CORRESPONDENCE COVER SHEET
WASTE PERMITS DIVISION
TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Date: 01/19/2022
Facility Name: J. Robert Welsh Power Plant
Permit or Registration No.: Pending

Nature of Correspondence:
☒ Initial/New
☐ Response/Revision*

*If Response/Revision, please provide previous TCEQ Tracking No.:
(Previous TCEQ Tracking No. can be found in the Subject line of the TCEQ's response letter to your original submittal.)

This cover sheet should accompany all correspondences submitted to the Waste Permits Division and should be affixed to the front of your submittal as a cover page. Please check the appropriate box for the type of correspondence being submitted. For questions regarding this form, please contact the Waste Permits Division at (512) 239-2335.

Table 1 - Municipal Solid Waste

APPLICATIONS	REPORTS and RESPONSES
☐ New Notification	☐ Closure Report
☐ New Permit (including Subchapter T)	☐ Groundwater Alternate SRC Demonstration
☐ New Registration (including Subchapter T)	☐ Groundwater Corrective Action
☐ Major Amendment	☐ Groundwater Monitoring Report
☐ Minor Amendment	☐ Groundwater Statistical Evaluation
☐ Limited Scope Major Amendment	☐ Landfill Gas Corrective Action
☐ Notice Modification	☐ Landfill Gas Monitoring
☐ Non-Notice Modification	☐ Liner Evaluation Report
☐ Transfer/Name Change Modification	☐ Soil Boring Plan
☐ Temporary Authorization	☐ Special Waste Request
☐ Voluntary Revocation	☐ Other:
☐ Subchapter T Workplan	
☐ Other:	

Table 2 - Industrial & Hazardous Waste

APPLICATIONS	REPORTS and RESPONSES
☒ New	☐ Annual/Biennial Site Activity Report
☐ Renewal	☐ CfPT Plan/Result
☐ Post-Closure Order	☐ Closure Certification/Report
☐ Major Amendment	☐ Construction Certification/Report
☐ Minor Amendment	☐ CPT Plan/Result
☐ Class 3 Modification	☐ Extension Request
☐ Class 2 Modification	☐ Groundwater Monitoring Report
☐ Class 1 ED Modification	☐ Interim Status Change
☐ Class 1 Modification	☐ Interim Status Closure Plan
☐ Endorsement	☐ Soil Core Monitoring Report
☐ Temporary Authorization	☐ Treatability Study
☐ Voluntary Revocation	☐ Trial Burn Plan/Result
☐ 335.6 Notification	☐ Unsaturated Zone Monitoring Report
☒ Other: CCR Unit Registration	☐ Waste Minimization Report
	☐ Other:

Volume 1

- TCEQ Application
- Section 2 Supplement – TCEQ ePay
- Section 13 Supplement – Property and Legal Description
- Section 17 Supplement – Legal Authority
- Maps and Drawings
- Attachment 1 – Location Restrictions and Geology Reports
- Attachment 2 – Design Criteria for CCR Landfills and Surface

TCEQ Application

`Texas Commission on Environmental Quality

Registration Application for Coal Combustion Residuals (CCR) Waste Management

I. General Information

1. Reason for Submittal

Type of Registration Application

☒ New ☐ Major Amendment ☐ Minor Amendment

☐ Notice of Deficiency (NOD) Response ☐ Transfer ☐ Name Change

☐ Other

2. Application Fees (See Section 2 Supplement)

☒ $150 Application Fee

Payment Method

☐ Check ☒ Online through ePay portal <www3.tceq.texas.gov/epay/>

If paid online, enter ePay Trace Number: 582EA000467908

3. Facility Information

Facility information must match regulated entity information on the Core Data Form.

Applicant: ☐ Owner ☐ Operator ☒ Owner/Operator

Facility TCEQ Solid Waste Registration No: 31086

Facility EPA ID: TXD00072614

Regulated Entity Reference No. (if issued): RN 100213370

Facility Name: Welsh Power Plant

Facility (Area Code) Telephone Number: 903 855 5410

Facility physical street address (city, state, zip code, county):

State HWY 11 and FM 1735, Pittsburg, Tx 75686 Titus

Facility mailing address (city, state, zip code, county):

State HWY 11 and FM 1735, Pittsburg, Tx 75686 Titus

Latitude (Degrees, Minutes Seconds): 32°59'49" North

Longitude (Degrees, Minutes Seconds): 94°58'5" West

4. Publicly Accessible Website

Provide the URL address of a publicly accessible website where the owner or operator of a CCR unit will post information.
http://www.aep.com/environment/ccr/Welsh

5. Facility Landowner(s) Information

Facility landowner(s) name: American Electric Power/Southwestern Electric Power Company

Facility landowner mailing address: 1187 County Road 4865, 01

City: Pittsburg State: Tx Zip Code: 75686

(Area Code) Telephone Number: 903 855 5410

Email Address (optional):

6. CCR Waste Management Unit(s)

☒ Landfill Unit(s) ☒ Surface Impoundment(s)

For each existing landfill, new landfill and lateral expansion, existing surface impoundment, and new surface impoundment and lateral expansion(s) provide information on type of waste, the registered unit(s) in which they are managed, and sampling and analytical methods.

Submit the following tables:

Table I.6. – CCR Waste Management Units;

Table I.6.A. – Waste Management Information;

Table I.6.B. – Waste Managed in Registered Units; and

Table I.6.C. – Sampling and Analytical Methods.

7. Description of Proposed Activities or Changes to Existing Facility

Provide a brief description of the proposed activities if application is for a new facility, or the proposed changes to an existing facility or registration conditions, if the application is for an amendment.

Welsh Power Plant is an electric generation facility which utilizes fossil fuel fired boilers. The CCR units are needed to manage CCR and non-CCR waste steams on-site.

8. Primary Contact Information

Contact Name: Jill Parker-Witt Title: Senior Engineer

Contact mailing address: 502 North Allen Ave
City: Shreveport County: Caddo State: La Zip Code: 71102
(Area Code) Telephone Number: 318 673 3816

Email Address (optional): jcparker-witt@aep.com

9. Notice Publishing

Party responsible for publishing notice:
☒ Applicant ☐ Consultant ☐ Agent in Service

Contact Name: Jill Parker-Witt Title: Sr. Engineer

Contact mailing address: 502 N Allen Ave
City: Shreveport County: Caddo State: La Zip Code: 71102
(Area Code) Telephone Number: 318 673 3816

10. Alternative Language Notice

Is an alternative language notice required for this application? For determination, refer to Alternative Language Checklist on the Public Notice Verification Form (TCEQ-20244-Waste-NORI).

☐ Yes ☒ No

11. Public Place Location of Application

Name of the Public Place: **Mount Pleasant Public Library**
Physical Address: **601 North Madison (across from City Hall)**
City: **Mt. Pleasant** County: **Titus** State: **Tx** Zip Code: **75455**
(Area code) Telephone Number: **903 575 4180**

12. Ownership Status of the Facility

☒ Corporation ☐ Limited Partnership

☐ Sole Proprietorship ☐ General Partnership ☐ Other (specify):

Does the Site Owner (Permittee/Registrant) own all the CCR units and all the facility property?

☒ Yes ☐ No

13. Property / Legal Description Information

Provide a legal description and supporting documents of the property where the management of CCR waste will occur; including a survey plat and a boundary metes and bounds description (30 TAC §352.231(g)).

Submit the following documents:

a. Property Legal Description
b. Property Metes and Bounds Description
c. Metes and Bounds Drawings
d. On-Site Easements Drawings

14. Operator Information

Identify the entity who will conduct facility operations, if the owner and operator are not the same.

Operator Name: Same as Facility Landowner

mailing address:

City: State: Zip Code:

(Area Code) Telephone Number:

Email Address (optional):

15. Confidential Documents

Does the application contain confidential documents?

☐ Yes ☒ No

If "Yes", cross-reference the confidential documents throughout the application and submit as a separate attachment in a binder clearly marked "CONFIDENTIAL."

16. Permits and Construction Approvals

Permit or Approval	Received	Pending	Not Applicable
Hazardous Waste Management Program under the Texas Solid Waste Disposal Act	☒	☐	☐
Underground Injection Control Program under the Texas Injection Well Act	☐	☐	☒
National Pollutant Discharge Elimination System Program under the Clean Water Act and Waste Discharge Program under Texas Water Code, Chapter 26	☒	☐	☐
Prevention of Significant Deterioration Program under the Federal Clean Air Act (FCAA). Nonattainment Program under the FCAA	☐	☐	☐
National Emission Standards for Hazardous Air Pollutants Preconstruction Approval under the FCAA	☒	☐	☐
Other (describe)	☐	☐	☐
Other (describe)	☐	☐	☐
Other (describe)	☐	☐	☐

17. Legal Authority (See Section 17 Supplement)

The owner and operator of the facility shall submit verification of their legal status with the application. This shall be a one-page certificate of incorporation issued by the secretary of state. The owner or operator shall list all persons having over a 20% ownership in the facility.

18. TCEQ Core Data Form: CN 600126767 RN100213370

The TCEQ requires that a Core Data Form (TCEQ-10400) be submitted on all incoming applications, unless a Regulated Entity and Customer Reference Number has been issued by the TCEQ and no core data information has changed. For more information regarding the Core Data Form, call (512) 239-5175 or visit the TCEQ Website.

19. Other Governmental Entities Information

Coastal Management Program

Is the facility within the Coastal Management Program boundary?

☐ Yes ☒ No

Local Government Jurisdiction (If Applicable)
Within City Limits of:
Within Extraterritorial Jurisdiction of:

Is the facility located in an area in which the governing body of the municipality or county has prohibited the storage, processing or disposal of municipal or industrial solid waste?

☐ Yes ☒ No If “Yes”, provide a copy of the ordinance or order as an attachment.

20. Attachments (See Maps and Drawings)

Does the application include the following?

General Maps	• Yes	☐ No
General Topographic Map	• Yes	☐ No
Facility Layout Map	• Yes	☐ No
Surrounding Features Map	• Yes	☐ No
Process Flow Diagram	• Yes	☐ No
Land Ownership Map	• Yes	☐ No
Land Ownership List	• Yes	☐ No
Pre-printed Mailing Labels	• Yes	☐ No

Maps and drawings shall be legible and easily readable by eye without magnification. Scales and paper size shall be chosen based on the type of map submitted, the land area covered, and the amount of detail to be shown. See instructions for details regarding maps and drawings to be submitted in application.

21. Verification of Compliance

Does the owner and operator verify that the design, construction, and operation of CCR landfill(s) and surface impoundment(s) meets the requirements of 30 TAC §352.231(f) (30 TAC §352.2; 40 CFR §257.52, and 40 CFR §§257.3-1 – 257.3-3).

☒ Yes ☐ No

II. Location Restrictions and Geology

See Instructions and Technical Guidance

22. Location Restrictions (See Attachment 1 – 1.1 to 1.3)

Submit certifications and technical reports demonstrating compliance of CCR unit(s) with applicable location restrictions (30 TAC 352, Subchapter E) and comply with 30 TAC §352.231(d) and 30 TAC §352.4 for submission of engineering and geoscientific information.

A. **Placement above the uppermost aquifer** (30 TAC §352.601) (40 CFR §257.60). For those CCR units whose base is less than five feet above the upper limit of the uppermost aquifer, please submit a copy of the demonstration showing evidence of compliance with 40 CFR §257.60(a) – (c).

B. **Wetlands** (30 TAC §352.611) (40 CFR §257.61). For CCR units located in wetlands, please submit a copy of the demonstration showing evidence of compliance with 40 CFR §257.61(a) – (c).

C. **Fault areas** (30 TAC §352.621) (40 CFR §257.62). For CCR units located within 200 feet of the outermost damage zone of a fault, please submit a copy of the demonstration showing evidence of compliance with 40 CFR §257.62(a) – (c).

D. **Seismic impact zones** (30 TAC §352.631) (40 CFR §257.63). For CCR units located in a seismic impact zone, please submit a copy of the demonstration showing evidence of compliance with 40 CFR §257.63(a) – (c).

E. **Unstable areas** (30 TAC §352.641) (40 CFR §257.64). For CCR units located in unstable areas, please submit a copy of the demonstration showing evidence of compliance with 40 CFR §257.64(a) – (d).

23. Geology Summary Report (See Attachment 1 – 1.1 to 1.3, Section 2.4 of each Location Restriction Report

Submit a summary of the geologic conditions at the facility, including the relation of the geologic condition to each CCR unit. The summary must include enough information and data and include sources and references for the information. Include all groundwater monitoring data required by 40 CFR Part 257, Subpart D, (30 TAC §352.241, §352.601, §352.621, §352.631, and §352.641) and submitted in accordance of 30 TAC §352.4.

Note: Previously prepared documents may be submitted but must be supplemented or updated as necessary to provide the requested information (30 TAC §352.241(b)).

III. Fugitive Dust Control Plan

24. Fugitive Dust Control Plan (See Attachment 3 – 3.1 and 3.2)

A. **Submit a copy of the CCR Fugitive Dust Control Plan** (30 TAC §352.801) (40 CFR §257.80(b)), or the most recently amended plan. The initial plan or subsequent amended plan must be certified by a qualified Texas licensed professional engineer (Texas P.E.) that the plan meets the requirements of 30 TAC Chapter 352.

B. **Submit the most recent Annual CCR Fugitive Dust Control Report** (30 TAC §352.801) (40 CFR §257.80(c)) and include the report information.

IV. Landfill Criteria

See Instructions and Technical Guidance – No. 30 Coal Combustion Residuals Landfill

25. Landfill(s) for CCR Waste (See Attachment 1 and 3, more detail below)

Provide the following information below if there is a landfill; if there is more than one landfill, separate information is required for each landfill.

A. Landfill Characteristics (Attachment 1 – 1.3, Section 2.2 of Location Restriction Report)

Describe the design, installation, construction, and operation of the landfill and submit a completed Table IV.A. – Landfill Characteristics.

B. Liner Design (not applicable for existing landfill prior to Oct 14, 2015)

1. For existing landfills, provide attachments describing how the facility will comply with 30 TAC 352, Subchapter F (Design Criteria).
2. For new landfills or lateral expansions of existing landfills, submit pages describing how the facility will comply with 30 TAC §352.261 and 30 TAC §352.701.
3. Complete Table IV.B. - Landfill Liner System and specify the type of liner used for the landfill.
4. Provide attachments describing the design, installation, and operation of the liner and leak detection system. The description must demonstrate that the liner and leak detection system will prevent discharge to the land, groundwater, and surface water. Submit a quality assurance project plan (QAPP) to ensure that each analysis is performed appropriately.

C. Leachate Collection and Removal (not applicable for existing landfill prior to Oct 14, 2015)

Submit design information and description of leachate collection and removal system in accordance with 30 TAC §352.701.

Complete Table IV.C. - Landfill Leachate Collection System

D. Design of Liner and Leachate Collection and Removal System. (not applicable for existing landfill prior to Oct 14, 2015)

For a new landfill or lateral expansion of a CCR landfill, provide a qualified Texas P.E. certification and technical report that the design of the liner and the leachate collection and removal system meets the requirements of 30 TAC §352.711.

E. Run-on and Run-off Controls (Attachment 3 – 3.3)

At time of application, attach pages describing how the facility will comply with the run-on and run-off system plan for an existing, new, or lateral expansion of a CCR landfill information. Provide a qualified Texas P.E. certification and technical report that the run-on and run-off control system plans meet the requirements of 30 TAC §352.811.

F. **Inspection for Landfills (Attachment 3 – 3.8 and 3.9)**

At time of application, attach pages describing how the facility will comply 30 TAC §352.841 and complete Table IV.D. – Inspection Schedule for Landfills. For existing CCR landfills, provide the most recent inspection report. All CCR landfills and any lateral expansions of a CCR landfill must be inspected for any structural weakness, malfunction, deterioration conditions which are disrupting or have the potential to disrupt the operation or safety of the CCR unit, or any other conditions which may cause harm to human health and environment at a frequency specified in 40 CFR §257.84(a) and (b).

V. Surface Impoundment Criteria

See Instructions and Technical Guidance – No. 31 Coal Combustion Residuals Surface Impoundment

26. Surface Impoundment(s) for CCR Waste (See Attachments 2 and 3, more detail below)

Provide the following information below if there is a surface impoundment; if there is more than one surface impoundment, separate information is required for each surface impoundment.

A. **General Surface Impoundment(s) Characteristics (Attachment 2 – 2.4 and 2.8)**

Provide information about the characteristics of the surface impoundment(s): incised, surface area (acres), storage volume (acres-feet), and depth (feet).

For all surface impoundment(s), include the following information:

1. Complete Table V.A. - Surface Impoundments Characteristics. List the surface impoundment(s) to be registered as a CCR unit(s), the wastes managed in each unit, and the rated capacity or size of each unit.
2. Describe the surface impoundment(s) and provide a plan view drawing with cross-sections, if available.
3. Specify the minimum freeboard to be maintained and the basis of the design to prevent overtopping resulting from normal or abnormal operation; overfilling; wind and wave action; rainfall; run-on; malfunctions of level controllers, alarms, and other equipment; and human error. Show that adequate freeboard will be available to prevent overtopping from a 100-year, 24-hour storm.
4. Waste Flow
   Describe the means that will be used to immediately shut off the flow of waste to the impoundment in the event of liner failure or to prevent overtopping.
5. Dike Construction ☒ Yes ☐ No

   If Yes, submit the dike certification (located at the end of the application).

   The structural integrity of the dike system must be certified by a qualified Texas P.E. before the registration is issued. If the impoundment is not being used, the dike system must be certified before it can be put into use. The certification must be sealed by a qualified Texas P.E., along with the engineering firm's name and registration number (30 TAC §352.4).

A report shall accompany the dike certification which summarizes the activities, calculations, and laboratory and field analyses performed in support of the dike certification. Describe the design basis used in construction of the dikes. A QAPP should be included in the report to ensure that each analysis is performed appropriately and include:

(1) Slope Stability Analysis

(2) Hydrostatic and Hydrodynamic Analysis

(3) Storm Loading

(4) Rapid Drawdown

Earthen dikes should have a protective cover to minimize wind and water erosion and to preserve the structural integrity of the dike. Describe the protective cover used and describe its installation and maintenance procedures.

B. Liner Design (Attachment 2 – 2.1 and 2.2)

For surface impoundment(s), provide information about how the facility will comply with 30 TAC §352.711 for existing CCR surface impoundments. For new and lateral expansion of CCR surface impoundments provide information on how the facility will comply with 30 TAC §352.261, and 30 TAC §352.721, see Instructions and Technical Guidance No. 31 Coal Combustion Residuals Surface Impoundment. The qualified Texas P.E. must certify that the design of the liner complies with the requirements of 30 TAC Chapter 352 and 40 CFR Part 257, Subpart D, where required.

Is the CCR surface impoundment unlined? ☒ Yes ☐ No

If "Yes", the CCR unit is subject to the closure requirements under 30 TAC Chapter 352 and 40 CFR §257.101(a) to retrofit or close. A notification must be prepared stating that an assessment of corrective measures has been initiated.

1. Complete Table V.B. - Surface Impoundment Liner System for each surface impoundment to be registered.
2. Describe the design, installation and operation of liner and leak detection components. The description must demonstrate that the liner and leak detection system will prevent discharge to the land and surface water. Submit a QAPP report to ensure that each analysis is performed appropriately.
3. For new or laterally expansions of existing surface impoundments, provide a subsurface soil investigation report that must include:
    a. A description of all borings drilled, at the unit location, to test soils and characterize groundwater;
    b. A unit map drawn to scale showing the surveyed locations and elevations of the borings, including location of permanent identification markers ((30 TAC §352.731) and (40 CFR §257.73(a)(1));
    c. Cross-sections prepared from the borings depicting the generalized strata at the unit;
    d. Boring logs, including a description of materials encountered, and any discontinuities such as fractures, fissures, slickensides, lenses or seams;
    e. A description of the geotechnical data and the geotechnical properties of the subsurface soil materials, including the suitability of the soils and strata for the intended uses; and

f. A demonstration that all geotechnical tests were performed in accordance with industry practices and recognized procedures.

C. **Hazard Potential Classification (Attachment 2 – 2.3 and 2.7)**

Provide the current hazard potential classification assessment and associated documentation, as required by 30 TAC §352.731 or §352.741 and 40 CFR §257.73(a)(2) or §257.74(a)(2). The qualified Texas P.E. must certify that the initial hazard potential classification and any subsequent periodic classification was conducted in accordance with the requirements of 30 TAC Chapter 352, where required.

Hazard Potential Classification: **Both the PBAP and the BASP are Low Hazard Potential**

D. **Emergency Action Plan for High or Significantly High Hazard Potential (not applicable)**

Provide the current Emergency Action Plan that has been certified by a qualified Texas P.E. and includes the following requirements from 30 TAC 352, Subchapter F and 40 CFR §257.73(a)(3)(i)(A) - (E) or 40 CFR §257.74 (a)(3)(i)(A) - (E). The qualified Texas P.E. must certify that the written Emergency Action Plan and any subsequent amendment of the plan complies with the requirements of 30 TAC 352, Subchapter F, where required.

Complete Table V.J. - Inspection of Surface Impoundments

E. **Inflow Design Flood Control System Plan (Attachment 3 – 3.4 and 3.5)**

Describe how the surface impoundment(s) system will manage stormwater run-on away from the surface impoundment(s) (30 TAC §352.821 and 40 CFR §257.82(a) and (c)). Stormwater run-on must be diverted away from a surface impoundment, based on the hazard potential. Where dikes are used to divert run-on, they must be protected from erosion. Include all analyses used to calculate run-on volumes. Provide the inflow design flood control system plan. Provide qualified Texas P.E. certification that the initial and periodic inflow design flood control system plans meet the requirements of 30 TAC §352.821, where required.

F. **History of Construction for Existing CCR Surface Impoundment(s), or the Design and Construction Plans for New and Lateral Expansions (Attachment 2 – 2.4 and 2.8)**

Provide information on the history of construction for each existing CCR surface impoundment (30 TAC §352.731 and 40 CFR §257.73(c)) or the design and construction plans for new and lateral expansions of each CCR surface impoundment (30 TAC §352.741) and (40 CFR §257.74(c)).

G. **Structural Stability Assessment (Attachment 2 – 2.5 and 2.9)**

Provide the most recent structural stability assessment of the surface impoundments. Include the combined capacity of all surface impoundment spillways with calculations; the peak discharge the unit must meet for all combined spillways; probable maximum flood-high hazard, 1,000-yr-significant high hazard, 100-yr-low hazard; identify if there were any structural stability deficiencies in last assessment; identify how these deficiencies were managed and corrected; and qualified Texas P.E. certification. The structural stability assessment must include all information required in 30 TAC §352.731 for existing surface impoundments or 30 TAC §352.741 for new or laterally expanding surface impoundments.

H. **Safety Factor Assessment (Attachment 2 – 2.6 and 2.10)**

The current safety factor assessment must be submitted with the application. It must include documentation that demonstrates whether the calculated factors of safety for each CCR surface impoundment achieve the minimum safety factors specified in 30 TAC 352, Subchapter F and 40 CFR §257.73(e)(1)(i) - (iv) and 40 CFR §257.74(e)(1)(i) - (iv) for the critical cross-section of the embankment. The critical cross-section is the cross-section anticipated to be the most susceptible to structural failure based on appropriate engineering considerations, including loading conditions. The safety factor assessments must be supported by appropriate engineering calculations and certified by a qualified Texas P.E.

VI. Groundwater Monitoring and Corrective Action (30 TAC 352, Subchapter H)

See Instructions and Technical Guidance – No. 32 Coal Combustion Residuals Groundwater Monitoring and Corrective Action

27. Groundwater Monitoring System (See Attachment 4 – 4.1 to 4.3)

A. Complete Table VI.A. - Unit Groundwater Detection Monitoring System.

B. Provide a map showing location of wells, groundwater elevations, and groundwater flow direction.

C. Provide attachments describing how the facility will comply with the requirements in 30 TAC §352.911 and provide a certification by a qualified Texas P.E or qualified Texas P.G. that the groundwater monitoring system design and construction meet the requirements of 30 TAC Chapter 352.

D. Provide a figure showing the geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities.

E. For a multiunit groundwater monitoring system, demonstrate that the groundwater monitoring system will be equally as capable of detecting monitored constituents at the waste boundary of the CCR unit as the individual groundwater monitoring system for each CCR unit by providing at minimum the following information:

   1. Number, spacing, and orientation of each CCR unit;
   2. Hydrogeologic setting; and
   3. Site history.

F. Has there been any sampling concentrations of one or more constituents listed in Appendix IV detected at statistically significant levels above the groundwater protection standard (GWPS)? ☒ Yes only at ☐the primary bottom ash pond.

G. Provide information on how monitoring wells have been constructed and cased in a manner that maintains the integrity of the monitoring well borehole and to prevent contamination of samples and the groundwater.

28. Groundwater Monitoring Sampling and Analysis Program (See Attachment 4 – 4.4)

Provide a sampling and analysis plan that includes procedures and techniques; sampling and analytical methods that are appropriate for groundwater sampling; and that address the requirements of 30 TAC §352.931 and 40 CFR §257.93. Provide a P.E or P.G. certification that describes the statistical method selected to evaluate the groundwater monitoring data and certifies that the selected statistical method is appropriate for evaluating the groundwater monitoring data for the CCR management area. Refer to TG-32 for information and guidance.

29. CCR Unit(s) in a Detection Monitoring Program (See Attachment 4 – 4.5 to 4.10)

Does the facility have CCR unit(s) in a Detection Monitoring Program?

☒ Yes ☐ No

If "Yes", Submit the following information:

A. Submit Table VI.C. – Facility CCR Units Under Detection Monitoring.

B. Provide a Background Evaluation Report.

C. Provide a report with the results of semiannual monitoring events.

1. Has a statistically significant increase (SSI) been detected for one or more of the constituents listed in Appendix III at any monitoring well?

   ☒ Yes ☐ No

2. Has a notification to the executive director been sent within 14 days?

   ☒ Yes ☐ No

3. Date assessment monitoring program will start: **NA**

4. Do you plan to provide an alternative source demonstration (ASD)?

   ☒ Yes ☐ No

30. CCR Unit(s) in an Assessment Monitoring Program

Does the facility have CCR unit(s) in an Assessment Monitoring Program?

☒ Yes ☐ No

If "Yes", Submit information related for units.

A. Complete Table VI.D. – CCR Units Under Assessment Monitoring.

B. Provide, for each well in assessment monitoring status, the recorded concentrations lab sheets and results in a tabulated form.

C. Have the concentrations of all constituents listed in Appendices III and IV been at or below background values, using the statistical procedures in 30 TAC §352.931 and 40 CFR §257.93(g), for two consecutive sampling events for the CCR unit(s)? ☐ Yes ☒ No

If answer to above is yes, detection monitoring may resume. The owner or operator must prepare a notification stating that detection monitoring is resuming for the CCR unit and obtain written approval from the executive director.

D. Are there any concentrations of any constituent in Appendices III and IV above background values? ☒ Yes ☐ No

1. Has a notification to the executive director been sent within 14 days?

   ☒ Yes ☐ No

E. Date assessment of corrective measures will be initiated (must be within **90 days** of finding a statistically significant level above the GWPS) for the CCR unit(s): **NA**

F. Will you provide an ASD (see TG-32 for an acceptable submittal)? ☒ Yes ☐ No

G. Date assessment of corrective measures will be initiated if ASD is not accepted? **Assessment of corrective measures will be initiated within 90 days of receiving TCEQ's denial of the submitted ASD.**

H. Complete Table VI.D-2. - Groundwater Detection Monitoring Parameters

Note: Refer to TG-32 regarding establishing a GWPS for each constituent in Appendix IV detected in the groundwater and attach as table.

I. Have you completed the assessment of corrective measures? ☐ Yes ☐ No
If "Yes", date assessment of corrective measures was completed:
If "No", date assessment of corrective measures will be completed:
Expected date of submittal of amendment (see note below):
Provide completed assessment of corrected measures materials.

Note: Within **30 days** of completing the assessment of corrective measures, and before remedy implementation, the owner or operator shall submit an application for amendment to the registration. In some circumstances, the assessment of corrective measures and selected remedy may be approved as part of the initial application for the CCR unit registration.

J. Have you selected a remedy? ☐ Yes ☐ No

Provide public meeting documentation under 30 TAC §352.961 and a report under 30 TAC §352.971 and 40 CFR §257.97.

VII. Closure and Post-Closure Care

See Instructions and Technical Guidance

Submit a full closure plan and post-closure plan and all information describing how the owner or operator will comply with 30 TAC 352, Subchapter J and 40 CFR §§257.100 - 257.104. The owner of property on which an existing disposal facility is located, following the closure of a unit, must also submit documentation that a notation has been placed in the deed to the facility that will in perpetuity notify any potential purchasers of the property that the land has been used to manage CCR wastes and its use is restricted (30 TAC §352.1221 and 40 CFR §257.102(i)). For CCR units, closed after October 19, 2015, that were closed before submission of the application, the applicant should submit documentation to show that notices required under 30 TAC 352, Subchapter K and 40 CFR §257.105 or §257.106 have been filed.

31. Closure Plan (See Attachment 5 – 5.1 to 5.6)

This section applies to the owners and operators of all CCR units required to be registered. The applicant must close the facility in a manner that minimizes need for further maintenance and controls, or eliminates, to the extent necessary to protect human health and the environment, the post-closure release of CCR waste, chemical constituents of concern, leachate, contaminated rainfall, or waste decomposition products to the groundwater, surface waters, or to the atmosphere.

The type of unit to be closed can determine the level of detail sufficient for a closure plan. CCR units which have been certified closed after October 19, 2015, must provide documentation to demonstrate compliance with state and federal regulations.

For each unit to be registered, complete Table VII.A.1. - Unit Closure and list the CCR Unit components to be decontaminated, possible methods of decontamination, and possible methods of disposal of wastes and waste residues generated during unit closure. All ancillary components must be decontaminated, and the generated waste disposed of appropriately.

Information about CCR units closed or to be closed under alternative closure requirements must be provided in Table VII.A.2. - CCR Units Under Alternative Closure Notification.

Guidance on design of a closure cap and final cover for non-hazardous industrial solid wastes landfills is provided in EPA publication 530-SW-85-014, TCEQ Technical Guidance No. 3 and TCEQ publication, RG-534, “Guidance for Liner Construction and Testing for a Municipal Solid Waste Landfill”.

32. Post-Closure Care Plan (See Attachment 6 – 6.1 to 6.3)

Provide a post-closure care plan that complies with the requirements of 30 TAC §352.1241. Post-closure care of each CCR unit must continue for at least 30 years after the date of completing closure of the unit and must consist of monitoring and reporting of the groundwater monitoring systems, in addition to the maintenance and monitoring of CCR unit. Continuation of certain security requirements may be necessary after the date of closure. Post-closure use of property on or in which waste remains after closure must never be allowed to disrupt the integrity of the containment system. In addition, submit the following information:

- The name, address, and phone number of the person or office to contact about the CCR unit during the post-closure period; and
- A discussion of the future use of the land associated with each unit.

Landfills and surface impoundments which have been certified closed after October 19, 2015, must be included in post-closure care plans, unless they have been determined to have been closed by waste removal equivalent to the closure standards in 30 TAC §352.1221 and 40 CFR §257.102 or 30 TAC §352.1231 and 40 CFR §257.103. If such a demonstration has been made pursuant to 40 CFR §257.102 or §257.103, but an equivalency determination has not been made, please submit a copy of the demonstration documentation. If an equivalency determination has been made, applicant should submit a copy of this determination.

VIII. Financial Assurance

33. Post-Closure Care Cost Estimate (See Attachment 7)

Financial assurance for post-closure care (30 TAC §352.1101) applies to owners or operators of all CCR units, except CCR units from which the owner or operator intends to remove wastes and perform clean closure. Provide a written cost estimate in current dollars of the total cost of the 30-year (or longer, if applicable under 30 TAC §352.1101(d)) post-closure care period to perform post-closure care requirements as prescribed in 30 TAC §352.1241. The cost estimate must be based on the costs of hiring a third party to conduct post-closure care maintenance.

Complete Table VIII.A.1 – Post-Closure Cost Summary for Existing Registered Units

Complete Table VIII.A.2. - Post-Closure Cost Summary for Proposed Registered Units

34. Financial Assurance Mechanism

The financial assurance for post-closure care is required in accordance with 30 TAC §352.1101. The applicant shall demonstrate the financial assurance within 90 days after approval of the registration with a financial mechanism acceptable to TCEQ in compliance with 30 TAC §352.1101(c) and 30 TAC §37, Subchapters A through D, except as indicated in 30 TAC §352.1111, in an amount no less than the amount specified in the approved Post-Closure Care Cost Summary. Provide a description of the proposed financial assurance mechanism.

Complete Table VIII.B. - Post-Closure Period, for the authorized post-closure period, to meet the requirements of 30 TAC §352.1241(a) through (c).

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Welsh_TCEQ Registration App_Combined 1 18.pdf

DocVerify ID:	3ACABB05-BB07-44DC-8E5D-DC61A79FA8B9
Created:	January 18, 2022 14:06:28 -8:00
Pages:	1
Remote Notary:	Yes / State: OH

E-Signature Summary

E-Signature 1: Gary O. Spitznogle (GOS)
January 19, 2022 11:09:03 -8:00 [19A7F1940BA2] [65.27.154.195]
gospitznogle@aep.com (Principal) (Personally Known)

E-Signature Notary: S. Smithhisler (SRS)
January 19, 2022 11:09:03 -8:00 [2D473F74AF86] [161.235.221.103]
srsmithhisler@aep.com
I, S. Smithhisler, did witness the participants named above electronically sign this document.

Signature Page

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Applicant Signature:______________________________ Date: _____________

Name and Official Title (type or print): ____________________________________

Owner or Operator Signature: Gary O. Spitznogle Date: 01/19/2022

Name and Official Title (type or print): Gary O. Spitznogle, VP Environmental Services

To be completed by the owner or operator if the application is signed by an authorized representative for the operator

I,________________________hereby designate ____________________________
(operator) (authorized representative)

as my representative and hereby authorize said representative to sign any application, submit additional information as may be requested by the Commission; and/or appear for me at any hearing or before the Texas Commission on Environmental Quality in conjunction with this request for a CCR waste management registration. I further understand that I am responsible for the contents of this application, for oral statements given by my authorized representative in support of the application, and for compliance with the terms and conditions of any registration which might be issued based upon this application.

____
Printed or Typed Name of Applicant or Principal Executive Officer

____
Signature

(Note: Application Must Bear Signature & Seal of Notary Public)

Subscribed and sworn to before me by the said Gary O. Spitznogle on this 19th day of January, 2022.

My commission expires on the 29th day of April, 2024.

Sarah Smithhisler
Commission # 2019-RE-775042
Electronic Notary Public
State of Ohio
My Comm Exp. Apr 29, 2024

Notary Public in and for Franklin County, Ohio

Notarial act performed by audio-visual communication

(Seal)

Registration Application for Coal Combustion Residuals Waste Management

(See instructions for P.E/P.G. seal requirements.)

Attachments and Tables	**Attachment No.**
General Information	NA
Attachments	Maps and Drawings
Technical Report and Certification	NA
Location Restrictions Certifications	1
Placement above the uppermost aquifer	1
Wetlands	1
Fault Areas	1
Seismic impact zones	1
Unstable areas	1
Geology Summary	1
CCR Fugitive Dust Control Plan	3
Annual CCR Fugitive Dust Control Report	3
Landfill Design and Operating Criteria	NA
Landfill Characteristics	1
Liner Design	NA
Leachate Collection and Removal	NA
Run-on and Run-off Controls	3
Inspection for Landfills	3
Surface Impoundment Design and Operating Criteria	2
General Surface Impoundment Characteristics	2
Liner Design	2
Hazard Potential Classification	2
Emergency Action Plan	NA
Inflow Design Flood Control System Plan	3
Construction History/Design Plans	2
Structural Stability Assessment	2
Safety Factor Assessment	2
Groundwater Monitoring and Corrective Action	4
Groundwater Monitoring System	4
Groundwater Monitoring Sampling and Analysis Program	4
Detection Monitoring Program	4
Assessment Monitoring Program	4
Assessment of Corrective Measures	NA
Remedy Report	NA
Closure and Post-Closure Care	5
Closure Plan	6
Post-Closure Care	7
Financial Assurance	NA

Tables

Tables	Submitted	Not Applicable
Table I.6. - CCR Waste Management Units	☒	☐
Table I.6.A. - Waste Management Information	☒	☐
Table I.6.B. - Wastes Managed in Registered Units	☒	☐
Table I.6.C. - Sampling and Analytical Methods	☒	☐
Table IV.A. - Landfill Characteristics	☒	☐
Table IV.B. - Landfill Liner System	☐	☒
Table IV.C. - Landfill Leachate Collection System	☐	☒
Table IV.D. - Inspection Schedule of Landfills	☒	☐
Table V.A. - Surface Impoundments Characteristics	☒	☐
Table V.B. - Surface Impoundment Liner System	☐	☒
Table V.J. - Inspection of Surface Impoundments	☒	☐
Table VI.A. - Unit Groundwater Detection Monitoring System	☒	☐
Table VI.C. - CCR Units Under Detection Monitoring	☒	☐
Table VI.D. - CCR Units Under Assessment Monitoring	☒	☐
Table VI.D-2. - Groundwater Detection Monitoring Parameters	☒	☐
Table VII.A.1. - Unit Closure	☒	☐
Table VII.A.2. - CCR Units Under Alternative Closure Notification	☒	☐
Table VIII.A.1. - Post-Closure Cost Summary for Existing Registered Units	☒	☐
Table VIII.A.2. - Post-Closure Cost Summary for Proposed Registered Units	☐	☒
Table VIII.B. - Post-Closure Period	☒	☐
Engineering Certification(s) - Dike Construction	☒	☐

Additional Attachments as Applicable - Select all those apply and add as necessary

☐ TCEQ Core Data Form(s)
☐ Signatory Authority Delegation
☒ Fee Payment Receipt
☐ Confidential Documents
☐ Certificate of Fact (Certificate of Incorporation)
☐ Assumed Name Certificate

Table I.6. – CCR Waste Management Units

CCR Unit No.[1]	Unit Name	N.O.R. No.[1]	Unit Description[3]	Capacity	Unit Status[2]
	Bottom Ash Storage Pond(BASP)	014	Surface impoundment for CCR and non_CCR materials	555,000 CY	Inactive
	Primary Bottom Ash Pond (PBAP)	004	Surface impoundment for CCR and non_CCR materials	715,000 CY	Active
	Landfill(LF)	001	Landfill for CCR and non-CCR materials	1.687MM CY	Active

1 Registered Unit No. and N.O.R. No. cannot be reassigned to new units or used more than once.
2 Unit Status options: Active, Closed, Inactive (built but not managing waste), Proposed (not yet built), Never Built, Transferred, Post-Closure.
3 If a unit has been transferred, the applicant should indicate which facility/permit it has been transferred to in the Unit Description column.

Table I.6.A. – Waste Management Information

Waste No.[1]	Waste Type(s)	Source	Volume (tons/year)
1	Combined Wastewater	Generated on-site from a product process or service activity	262,810
2	Fly ash/removal of fine particulates from flue gas	Generated on-site from a product process or service activity	19791
3	Bottom ash	Generated on-site from a product process or service activity	203,677
4	Ash transport water	Generated on-site from a product process or service activity	203,677
5	Coal pile runoff	Generated on-site from a product process or service activity	341,654
6	Spent blasting grit	Generated on-site from a product process or service activity	0.1
7	Ecology pit sediment-dewatered	Generated on-site from a product process or service activity	0.5
8	Aqueduct sediment-cleanout of water supply pipeline	Generated on-site from a product process or service activity	0.05
9	Spent sand filter media from sewage treatment plant	Generated on-site from a product process or service activity	0.01
10	Stoney and metallic rejects from grinding coal	Generated on-site from a product process or service activity	5
11	Cooler washwaters-non-chemical cleaning	Generated on-site from a product process or service activity	8
12	Spent sand media filter from demineralizer	Generated on-site from a product process or service activity	0.01
13	Low volume wastewater	Generated on-site from a product process or service activity	1,385,011
14	Un-neutralized acidic regeneration waste	Generated on-site from a product process or service activity	3255
15	Un-neutralized caustic regeneration waste	Generated on-site from a product process or service activity	8202
16	Acidic lab waste generated from testing	Generated on-site from a product process or service activity	0.01
17	Lab waste generated from testing	Generated on-site from a product process or service activity	1
18	Collection of wastewater from air heater and stack washings	Generated on-site from a product process or service activity	8
19	Acid pond sludge	Generated on-site from a product process or service activity	0.05
20	Coal ash composite	Generated on-site from a product process or service activity	20829

[1] Assign waste number sequentially. Do not remove waste number wastes which are no longer generated.

Table I.6.B. – Wastes Managed in Registered Units

Waste No.[1]	Waste	TCEQ Waste Form Codes and Classification Codes
1	Combined Wastewater	00141142 – Class II
2	Fly ash/removal of fine particulates from flue gas	00153042 – Class II
3	Bottom ash	00163042 – Class II
4	Ash transport water	00191142 – Class II
5	Coal pile runoff	00211142 – Class II
6	Spent blasting grit	00713892 – Class II
7	Ecology pit sediment-dewatered	00813912 – Class II
8	Aqueduct sediment-cleanout of water supply pipeline	00825192 – Class II
9	Spent sand filter media from sewage treatment plant	00833102 – Class II
10	Stoney and metallic rejects from grinding coal	00853192 – Class II
11	Cooler washwaters-non-chemical cleaning	00891142 – Class II
12	Spent sand media filter from demineralizer	00973102 – Class II
13	Low volume wastewater	02121142 – Class II
14	Un-neutralized acidic regeneration waste	02131052 – Class II
15	Un-neutralized caustic regeneration waste	02141102 – Class II
16	Acidic lab waste generated from testing	02181052 – Class II
17	Lab waste generated from testing	02191142 – Class II
18	Collection of wastewater from air heater and stack washings	02251141 – Class II
19	Acid pond sludge	02263912 – Class II
20	Coal ash composite	90063042 – Class II

1 from Table I.6.A., first column

Table I.6.C – Sampling and Analytical Methods

Waste No.[1]	Sampling Location	Sampling Method	Frequency	Parameter	Test Method	Desired Accuracy Level
1	Various	Grab/composite	Once upon waste determination	TCLP Metals, pH, semi-volatiles, total copper, total iron, volatiles	1311/6010B, pH meter, 1311/8270, 6010B, 1311/8260	
2	Fly ash silo	Grab	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH	1311/6010B, 1:1 9045 C	
3	Inlet to bottom ash pond	Grab	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH	Atomic absorption spectroscopy, 1:1 slurry	
4	Ash piping prior to bottom ash pond	Grab	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH, TCLP volatiles/Semi-volatiles	1311/6010B, pH meter, 1311/8270, 6010B, 1311/8260	
5	Coal pile storage and processing area prior to pond entry	Grab	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH, TCLP volatiles/Semi-volatiles	1311/6010B, pH meter, 1311/8270, 6010B, 1311/8260	
6	Collected from stockpile of material	Grab	Each time newly generated before disposal	TCLP RCRA 8 metals, TCLP TX Table 1 metals	1311/6010B	
7	Drums of dewatered ecology pit sludge	Grab/composite	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, PCB, TPH	1311/6010B, 8082, 1664	
8	Pipeline before entering ash pond	Grab	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals	1311/6010B	
9	Sand filter beds	Core sampler	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, PCB, TPH	1311/6010B, 8082, 1664	
10	Waste pile from pulverizers	Grab	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH	1311/6010B, 150.1	
11	Drums collecting washwater after washed	Grab/Composite	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH, TPH Total Copper, Total Fe, TCLP volatiles/Semi-volatiles	1311/6010B, pH meter, 1311/8270, 6010B, 1311/8260	

Waste No.[1]	Sampling Location	Sampling Method	Frequency	Parameter	Test Method	Desired Accuracy Level
12	Pile of media stored for analysis	Grab/Composite	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH, TPH, TCLP volatiles/semi-volatiles	1311/6010B, 9045C, 1005, 1311/8270, 6010B, 1311/8260	
13	Various	Grab	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH, TCLP volatiles/semi-volatiles	1311/8270, 1311/6010B, 1311/8260, pH meter	
14	Discharge line of demineralized prior to entering sump	Grab	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH, TCLP volatiles/semi-volatiles	1311/8270, 1311/6010B, 1311/8260, pH meter	
15	Discharge line of demineralized prior to entering sump	Grab	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH, TCLP volatiles/semi-volatiles	1311/8270, 1311/6010B, 1311/8260, pH meter	
16	Laboratory	Grab	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH, TCLP volatiles/semi-volatiles	1311/8270, 1311/6010B, 1311/8260, pH meter	
17	Laboratory	Grab	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH, TCLP volatiles/semivolatiles	1311/8270, 1311/6010B, 1311/8260, pH meter	
18	Frac tanks collecting wash waters	Horizontal sampler	Each time generated	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH	1311/6010B, pH meter	
19	Metal cleaning pond	Grab/Composite	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH, TPH, TCLP volatiles/semivolatiles	1311/6010B, 9045C, 1005, 1311/8270, 6010B, 1311/8260, SW 846 7.0	
20	Bottom ash storage pond	Grab	Once upon waste determination	TCLP RCRA 8 metals, TCLP TX Table 1 metals, pH	1311/6010B, pH meter	

1 from Table I.6.A., first column

Table IV.A. – Landfills Characteristics

Registered Unit No.	Landfill	N.O.R. No.	Waste Nos.[1]	Rated Capacity	Dimensions[2]	Distance from lowest liner to groundwater	Action Leakage Rate (if required)	Unit will manage CCR Waste and non-CCR Waste (state all that apply)
		001	2, 3, 6, 7, 9, 10, 12, 19, 20	1.687MM CY	39.13 acres L=2069.95 ft W=850.00 ft D=24 ft	NA – landfill is not lined	NA – landfill is not lined	Both CCR Waste and non-CCR Waste

1 From Table I.6.A., first column
2 Dimensions should be provided as average length, width and depth, also include the surface acreage for the unit.

Table IV.B. – Landfill Liner System - NA

Registered Unit No.*	Landfill	Geomembrane Liner Material	Geomembrane Liner Permeability (cm/sec)	Geomembrane Liner Thickness	Soil Liner Material	Soil Liner Permeability (cm/sec)	Soil Liner Thickness
	Landfill	NA	NA	NA	NA	NA	NA

* This number should match the Registration Unit No. given on Table IV.A.

Table IV.C. – Landfill Leachate Collection System

NA

Registered Unit No.	Landfill Name	Drainage Media	Collection Pipes (including risers)	Filter Fabric	Geofabric	Sump Material
	Landfill	NA	NA	NA	NA	NA

Table IV.D. – Inspection Schedule of Landfills

Facility Unit(s) and Basic Elements	Possible Error, Malfunction, or Deterioration	Frequency of Inspection
Landfill	Discolored Discharge	7 Days
Landfill	Unexplained Increase or Decrease in Discharge	7 Days
Landfill	Uncontrolled Seepage/Leachate Outbreak	7 Days
Landfill	Unintended Ponded Water at Toe of Slope	7 Days
Landfill	Wet Surface on Slope (Indication of Potential Seepage)	7 Days
Embankment	Ruts, Depressions, Settlement, or Misalignment	7 Days
Embankment	Cracks, Bulges, or Slope Failure	7 Days
Control Features	Damage or Blockage to Drainage Feature	7 Days
Control Features	Malfunctioning Gate, Valve, Stop Log, Pump, or Related Structures	7 Days
Control Features	Unintended Ponded Water Along Ditch or Channel	7 Days
Surface	Minor or Major Erosion	7 Days
Surface	Displaced Riprap or Stone	7 Days
Surface	Visible Fugitive Dust	7 Days
Surface	Animal Activity	7 Days
Surface	Excessive Vegetation	7 Days
Surface	Bare or Missing Vegetation	7 Days
Surface	Damage to Stairs, Walkways, Ramps, Platforms, or Liners	7 Days

Table V.A. – Surface Impoundment Characteristics

Registered Unit No.	Surface Impoundment Name	N.O.R. No.	Waste Nos.[1]	Rated Capacity	Dimensions[2]	Distance from lowest liner to groundwater	Action Leakage Rate (if required)	Unit will manage CCR Waste and non-CCR Waste (state all that apply)
	Primary Bottom Ash Pond (PBAP)	004	1, 2, 3, 4, 5, 7, 8, 11, 13, 14, 15, 16, 17, 18	715,000 Cubic yards	65 acres D=5 feet L= 1035 feet W= 2850 feet	NA- No liner	NA- No liner	Both CCR Waste and non-CCR Waste
	Bottom Ash Storage Pond(BASP)	014	2, 3, 7, 8	555,000 cubic yards	22 acres D=20 feet L= 985 feet W= 925 feet	NA- No liner	NA- No liner	Both CCR Waste and non-CCR Waste

1 From Table I.6.A., first column
2 Dimensions should be provided as average length, width and depth, also include the surface acreage for the unit.

Table V.B. – Surface Impoundment Liner System – NA

Registered Unit No.*	Surface Impoundment Name	Geomembrane Liner Material	Geomembrane Liner Permeability (cm/sec)	Geomembrane Liner Thickness	Soil Liner Material	Soil Liner Permeability (cm/sec)	Soil Liner Thickness
	PBAP	NA	NA	NA	NA	NA	NA
	BASP	NA	NA	NA	NA	NA	NA

* This number should match the Registration Unit No. given on Table V.A.

Table V.J. – Inspection Schedule of Surface Impoundments

Facility Unit(s) and Basic Elements	Possible Error, Malfunction, or Deterioration	Frequency of Inspection
BASP/PBAP	Discolored Discharge	7 Days
BASP/PBAP	Unexplained Increase or Decrease in Discharge	7 Days
BASP/PBAP	Uncontrolled Seepage/Leachate Outbreak	7 Days
BASP/PBAP	Unintended Ponded Water at Toe of Slope	7 Days
BASP/PBAP	Wet Surface on Slope (Indication of Potential Seepage)	7 Days
Embankment	Ruts, Depressions, Settlement, or Misalignment	7 Days
Embankment	Cracks, Bulges, or Slope Failure	7 Days
Control Features	Damage or Blockage to Drainage Feature	7 Days
Control Features	Malfunctioning Gate, Valve, Stop Log, Pump, or Related Structures	7 Days
Control Features	Unintended Ponded Water Along Ditch or Channel	7 Days
Surface	Minor or Major Erosion	7 Days
Surface	Displaced Riprap or Stone	7 Days
Surface	Visible Fugitive Dust	7 Days
Surface	Animal Activity	7 Days
Surface	Excessive Vegetation	7 Days
Surface	Bare or Missing Vegetation	7 Days
Surface	Damage to Stairs, Walkways, Ramps, Platforms, or Liners	7 Days

Table VI.A. – Unit Groundwater Detection Monitoring Systems

Waste Management Unit/Area Name[1]

Landfill

Well Number(s):	AD-1	AD-5	AD-17	AD-11	AD-12	AD-13	AD-14	AD-22	AD-23
Hydrogeologic Unit Monitored	Uppermost Fine to med grained clayey and silty sand								
Type (e.g., point of compliance, background, observation, etc.)	Background	Background	Background	POC	Ob	POC	POC	Ob	Ob
Up or Down Gradient	UP	UP	UP	Down	UP	Down	Down	UP	UP
Casing Diameter and Material	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC
Screen Diameter and Material	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC
Screen Slot Size (in.)	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’
Top of Casing Elevation (Ft, Mean Sea Level *[MSL]*)	357.57	351	357.1	342.18	369.33	347	345.43	360.33	368.82
Grade or Surface Elevation (Ft, MSL)	355.57	349.00	353.99	339.61	366.27	344.12	342.32	360.94	369.37
Well Depth (Ft, Below Grade Surface *[BGS]*)	25	30	40	20	30	20	19	20	20
Well Depth (Ft, Below Top of Casing *[BTOC]*)	28	33	43	23	33	23	22	20	20
Screen Interval From (Ft, BGS) To (Ft, BGS)	15-25	20-30	24-39	10-20	20-30	6-16	8-18	5-20	5-20
Screen Interval From (Ft, BTOC) To (Ft, BTOC)	18-28	23-33	27-42	13-20	23-33	9-19	11-21	5-20	5-20

1 From Tables in Section I.; *MSL*: Mean Sea Level; *BGS*: Below Grade Surface; *BTOC*: Below Top of Casing

Table VI.A. – Unit Groundwater Detection Monitoring Systems

Waste Management Unit/Area Name[1] BASP										
Well Number(s):	AD-1	AD-5	AD-17	AD-12	AD-2	AD-3	AD-4C	AD16R	AD-22	AD-23
Hydrogeologic Unit Monitored	Uppermost Fine to med grained clayey and silty sand									
Type (e.g., point of compliance, background, observation, etc.)	Background	Background	Background	Ob	Ob	POC	POC	POC	Ob	Ob
Up or Down Gradient	UP	UP	UP	UP	Up	Down	Down	Down	UP	UP
Casing Diameter and Material	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC
Screen Diameter and Material	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC
Screen Slot Size (in.)	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’
Top of Casing Elevation (Ft, Mean Sea Level *[MSL]*)	357.57	351	357.1	369.33	346.16	333.10	333.28	353.55	360.33	368.82
Grade or Surface Elevation (Ft, MSL)	355.57	349.00	353.99	366.27	344.16	331.10	329.15	350.55	360.94	369.37
Well Depth (Ft, Below Grade Surface *[BGS]*)	25	30	40	30	25	17	15	27	20	20
Well Depth (Ft, Below Top of Casing *[BTOC]*)	28	33	43	33	28	20	18	30	20	20
Screen Interval From (Ft, BGS) To (Ft, BGS)	15-25	20-30	24-39	20-30	15-25	7-17	5-15	12-27	5-20	5-20
Screen Interval From (Ft, BTOC) To (Ft, BTOC)	18-28	23-33	27-42	23-33	18-28	10-20	8-18	15-30	5-20	5-20

Table VI.A. – Unit Groundwater Detection Monitoring Systems

Waste Management Unit/Area Name[1] PBAP											
Well Number(s):	AD-1	AD-5	AD-17	AD-12	AD-6	AD-7	AD-8	AD-9	AD-15	AD-22	AD-23
Hydrogeologic Unit Monitored	Uppermost Fine to med grained clayey and silty sand										
Type (e.g., point of compliance, background, observation, etc.)	Background	Background	Background	Ob	Ob	Ob	POC	POC	POC	Ob	Ob
Up or Down Gradient	UP	UP	UP	UP	UP	UP	Down	Down	Down	UP	UP
Casing Diameter and Material	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC
Screen Diameter and Material	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC	2” Sch 40 PVC
Screen Slot Size (in.)	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’	0.01’
Top of Casing Elevation (Ft, Mean Sea Level *[MSL]*)	357.57	351	357.1	369.33	46.33	350.82	340.01	343.09	322.81	360.33	368.82
Grade or Surface Elevation (Ft, MSL)	355.57	349.00	353.99	366.27	343.31	34.86	337.53	340.32	343.29	360.94	369.37
Well Depth (Ft, Below Grade Surface *[BGS]*)	25	30	40	30	33	38	29	35	46	20	20
Well Depth (Ft, Below Top of Casing *[BTOC]*)	28	33	43	33	36	41	31	38	49	20	20
Screen Interval From (Ft, BGS) To (Ft, BGS)	15-25	20-30	24-39	20-30	23-33	28-38	16-26	20-35	25.5-45.5	5-20	5-20
Screen Interval From (Ft, BTOC) To (Ft, BTOC)	18-28	23-33	27-42	23-33	26-36	31-41	19-26	23-38	28.5-48.8	5-20	5-20

Table VI.C. – CCR Units Under Detection Monitoring

N.O.R. Unit No.	Unit Description[1,2]	Well(s)	Constituent(s)	Date of SSI Determination	Date of Assessment Monitoring Notification[3]
014	BASP	AD-16R	pH	01/18/2018	NA-ASD
014	BASP	AD-16R, AD-4C	Sulfate(AD-16R) Chloride(AD-4)	08/14/2018	NA-ASD
014	BASP	AD-4C	Sulfate	01/11/2019	NA-ASD
014	BASP	AD-3	Chloride	04/30/2019	NA-ASD
014	BASP	AD-16R, AD-4C	TDS(AD-4, 16R), Sulfate (AD-4)	07/22/2020	NA-ASD
NOTE: BASP initiated closure April 6, 2021					

1 Indicates a unit for which a 30 TAC Chapter 352/40 CFR Part 257, Subpart D alternative closure determination has been requested pursuant to 40 CFR §257.103.

2 Indicates a unit for which a 30 TAC Chapter 352/40 CFR Part 257, Subpart D alternative closure determination has been made pursuant to 40 CFR §257.103.

3 Enter month, day, and year.

Table VI.D. – CCR Units Under Assessment Monitoring

N.O.R. Unit No.	Unit Description[1,2]	Well(s)	Constituent(s)	Date of SSL Determination	Date of Assessment of corrective measures Notification[3]
004	PBAP[1]	AD-9	Lithium	08/15/2018	NA - ASD
004	PBAP[1]	AD-9	Lithium	02/21/2019	NA - ASD
004	PBAP[1]	AD-9	Lithium	07/23/2019	NA - ASD
004	PBAP[1]	AD-9	Lithium	05/19/2020	NA - ASD
004	PBAP[1]	AD-9	Lithium	02/11/2021	NA - ASD
001	LF	NA	NA	NA	NA

1 Indicates a unit for which a 30 TAC Chapter 352/40 CFR Part 257, Subpart D alternative closure determination has been requested pursuant to 40 CFR §257.103.

2 Indicates a unit for which a 30 TAC Chapter 352/40 CFR Part 257, Subpart D alternative closure determination has been made pursuant to 40 CFR §257.103.

3 Enter month, day, and year

Table VI.D-2. – Groundwater Detection Monitoring Parameters

Parameter	Sampling Frequency	Analytical Method	Practical Quantification Limit (units)	Concentration Limit[1]
Boron	Semi annual	EPA 200.8-1994, Rev. 5.4	0.05 ppb	0.052-BASP
Calcium	Semi annual	EPA 200.7-1994, Rev. 4.4	0.3 ppb	0.9-BASP
Chloride	Semi annual	EPA 300.1-1997 Rev 1.0	0.04 ppb	8.02-BASP
Fluoride	Semi annual	EPA 300.1-1997 Rev 1.0	0.06 ppb	1-BASP
Sulfate	Semi annual	EPA 300.1-1997 Rev 1.0	0.4 ppb	10.6-BASP
TDS	Semi annual	EPA 300.1-1997 Rev 1.0	100 ppb	140-BASP
pH	Semi annual	Field test		5.0 to 2.6-BASP
Antimony	Semi annual	EPA 200.8-1994, Rev. 5.4	0.1 ppb	0.006 ppm - LF&PBAP
Arsenic	Semi annual	EPA 200.8-1994, Rev. 5.4	0.1 ppb	0.01 ppm - LF&PBAP
Barium	Semi annual	EPA 200.8-1994, Rev. 5.4	0.2 ppb	2 ppm- LF&PBAP
Beryllium	Semi annual	EPA 200.8-1994, Rev. 5.4	0.1 ppb	0.004 ppm- LF&PBAP
Cadmium	Semi annual	EPA 200.8-1994, Rev. 5.4	0.05 ppb	0.0065 ppm- LF&PBAP
Chromium	Semi annual	EPA 200.8-1994, Rev. 5.4	0.2 ppb	0.1 ppm- LF&PBAP
Cobalt	Semi annual	EPA 200.8-1994, Rev. 5.4	0.05 ppb	0.075 ppm- LF&PBAP
Fluoride	Semi annual	EPA 300.1-1997 Rev 1.0	0.06 ppb	4 ppm- LF&PBAP
Lead	Semi annual	EPA 200.8-1994, Rev. 5.4	0.004 ppm	0.004 ppm- LF&PBAP
Lithium	Semi annual	EPA 200.8-1994, Rev. 5.4	0.0002 ppm	0.39 ppm- LF&PBAP
Mercury	Semi annual	EPA 245.7-2005, Rev. 2.0	0.005 ppb	0.002 ppm- LF&PBAP
Molybdenum	Semi annual	EPA 200.8-1994, Rev. 5.4	0.002 ppm	0.002 ppm- LF&PBAP
Selenium	Semi annual	EPA 200.8-1994, Rev. 5.4	0.2 ppb	0.05 ppm- LF&PBAP
Thallium	Semi annual	EPA 200.8-1994, Rev. 5.4	0.5 ppb	0.002 ppm- LF&PBAP
Radium 226+228	Semi annual	SW-846 9320-2014,Rev. 1.0/SW-846 9315-1986,Rev. 0	0.5 pCi/L	5pCi/L- LF&PBAP

1 The concentration limit is the basis for determining whether a release has occurred from the CCR unit/area.

Table VII.A.1. – Unit Closure

For each unit to be registered, list the unit components to be decontaminated, the possible methods of decontamination, and the possible methods of disposal of wastes and waste residues generated during unit closure.

Equipment or CCR Unit	Possible Methods of Decontamination[1]	Possible Methods of Disposal[1]
BASP	Closure by removal	Place CCR into on-site landfill
PBAP	Closure by removal	Place CCR waste into on-site landfill
LF	Closure in place	Cap and cover at final grade

1 Applicants may list more than one appropriate method.

Table VII.A.2. – CCR Units Under Alternative Closure Notification

Registered Unit No.	N.O.R. Unit No.	Unit Description[1,2]	Date of Receipt of Last Waste[3]	Date of Closure Notification[3]
	004	PBAP- Cessation of operation	02/2027	10-23-2020-TCEQ 11-30-2020- EPA

1 Indicates a unit for which a 30 TAC Chapter 352/40 CFR Part 257, Subpart D alternative closure determination has been requested pursuant to 40 CFR §257.103.

2 Indicates a unit for which a 30 TAC Chapter 352/40 CFR Part 257, Subpart D alternative closure determination has been made pursuant to 40 CFR §257.103.

3 Enter month, day, and year.

Table VIII.A.1. – Post-Closure Cost Summary for Existing Registered Units

Unit	Cost
Landfill 001 (see attached worksheets for details)	$76,350 (annually)
Total Existing Unit Post-Closure Cost Estimate	$2,398,500 (in 2018 Dollar)[1]

Table VIII.A.2. - Post-Closure Cost Summary for Proposed Registered Units

Unit	Cost

1 As units are added or deleted from these tables through future registration amendments, the remaining itemized unit costs should be updated for inflation when re-calculating the revised total cost in current dollars.

Table VIII.B. – Post-Closure Period

Unit Name	Date Certified Closed	Authorized Post-Closure Period (Yrs.)	Earliest Date Post-Closure Ends (See Note 1)
Landfill 001		30 years	
[Unit Example 2]	**[1/1/1990]**	30 years	**[1/1/2020]**
[Unit Example 3]	**[1/1/1984]**	30 years	**[1/1/2014]**

Note 1 – Post-Closure Care shall continue beyond the specified date until the Executive Director has approved the applicant's request to reduce or terminate the post-closure period, consistent with 30 TAC §352.1241 – Post-Closure Care Requirements.

Welsh Power Plant
Southwest Electric Power Company
Primary Bottom Ash Pond

"I, Gary F. Zych (licensed Professional Engineer), Texas P.E. License Number #127152, of Registered Firm American Electric Power Service Corporation, Registered Firm No. F-3341, certify under penalty of law that I have personally examined and am familiar with the design and construction of the dikes that are a portion of the Primary Bottom Ash Pond based on the available documents related to this surface impoundment.

I further certify that I have evaluated the dike design and materials of construction using accepted engineering procedures, and have determined that the dike, including the portion of the dike providing freeboard, has structural integrity, and is constructed in accordance with applicable surface impoundment criteria per the following:

Existing Diked Surface Impoundment – 40 CFR 257.73 and 30 TAC Section 352.731.

Gary F. Zych
Gary F. Zych
Manager – Geotechnical Engineering Section
American Electric Power Service Corporation

Date: 1/3/2022

GARY F. ZYCH
127152

Welsh Power Plant
Southwestern Electric Power Company
Bottom Ash Storage Pond

"I, Gary F. Zych (licensed Professional Engineer), Texas P.E. License Number #127152, of Registered Firm American Electric Power Service Corporation, Registered Firm No. F-3341, certify under penalty of law that I have personally examined and am familiar with the design and construction of the dikes that are a portion of the Bottom Ash Storage Pond based on the available documents related to this surface impoundment.

I further certify that I have evaluated the dike design and materials of construction using accepted engineering procedures, and have determined that the dike, including the portion of the dike providing freeboard, has structural integrity, and is constructed in accordance with applicable surface impoundment criteria per the following:

Existing Diked Surface Impoundment – 40 CFR 257.73 and 30 TAC Section 352.731.

Gary F Zych
Gary F. Zych
Manager – Geotechnical Engineering Section
American Electric Power Service Corporation

Date: 1/3/2022

GARY F. ZYCH
127152

SECTIONS 2, 13, AND 17 SUPPLEMENTS

Section 2 Supplement

TCEQ ePay Receipt

Section 13 Supplement

Property Legal Description
Property Metes and Bounds Description, Primary Bottom Ash Pond
Property Metes and Bounds Description, Bottom Ash Storage Pond
Property Metes and Bounds Description, Landfill
Survey Plat
Metes and Bounds Drawing

Section 17 Supplement

Verification of Legal Status

Section 2 Supplement

TCEQ ePay Receipt

Questions or Comments >>

Shopping Cart | Select Fee | Search Transactions | Sign Out

Your transaction is complete. Thank you for using TCEQ ePay.

Note: It may take up to 3 working days for this electronic payment to be processed and be reflected in the TCEQ ePay system. Print this receipt and the vouchers for your records. An email receipt has also been sent.

Transaction Information

Trace Number: 582EA000467908
Date: 01/06/2022 04:43 PM
Payment Method: CC - Authorization 0000004805
ePay Actor: JILL PARKER-WITT
Actor Email: jcparker-witt@aep.com
IP: 167.239.221.102
TCEQ Amount: $150.00
Texas.gov Price: $153.64*

* This service is provided by Texas.gov, the official website of Texas. The price of this service includes funds that support the ongoing operations and enhancements of Texas.gov, which is provided by a third party in partnership with the State.

Payment Contact Information

Name: JILL PARKER-WITT
Company: AEP
Address: 225 EAGLE BEND WAY, SHREVEPORT, LA 71115
Phone: 318-673-3816

Cart Items

Click on the voucher number to see the voucher details.

Voucher	Fee Description	AR Number	Amount
551592	COAL COMBUSTION RESIDUALS-NEW OR AMENDMENT		$100.00
551593	30 TAC 305.53B CCR NOTIFICATION FEE		$50.00
		TCEQ Amount:	$150.00

ePay Again | Exit ePay

Note: It may take up to 3 working days for this electronic payment to be processed and be reflected in the TCEQ ePay system. Print this receipt for your records.

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Section 13 Supplement

Property and Legal Description

Property Legal Description

docVerify

36A43800

Welsh_TCEQ Registration App_Combined 1 50.pdf

DocVerify ID:	36A43800-4546-4073-8065-8B09EF0CF6F6
Created:	January 18, 2022 14:06:28 -8:00
Pages:	1
Remote Notary:	Yes / State: OH

E-Signature Summary

E-Signature 1: Gary O. Spitznogle (GOS)
January 19, 2022 11:09:04 -8:00 [9A19BC43308C] [65.27.154.195]
gospitznogle@aep.com (Principal) (Personally Known)

E-Signature Notary: S. Smithhisler (SRS)
January 19, 2022 11:09:04 -8:00 [E3149C8BD7C9] [161.235.221.103]
srsmithhisler@aep.com
I, S. Smithhisler, did witness the participants named above electronically sign this document.

13. Property / Legal Description Information

Provide a legal description and supporting documents of the property where the management of CCR waste will occur; including a survey plat and a boundary metes and bounds description (30 TAC §352.231(g) – property owner information shall be provided in the application in accordance with 330.59(d) of this title, except 330.59(d)(2)(B) of this title.)

SECTION 330.59. Contents of Part I of the Application

(d) Property owner information. Property owner information shall include the following:

(1) the legal description of the facility;

(A) the legal description of the property and the county, book, and page number or other generally accepted identifying reference of the current ownership record;

(B) for property that is platted, the county, book, and page number or other generally accepted identifying reference of the final plat record that includes the acreage encompassed in the application and a copy of the final plat, in addition to a written legal description;

(C) a boundary metes and bounds description of the facility signed and sealed by a registered professional land surveyor (D) drawings of the boundary metes and bounds description; and

(2) a property owner affidavit signed by the owner that includes the following:

(A) acknowledgment that the State of Texas may hold the property owner of record either jointly or severally responsible for the operation, maintenance, and closure and post-closure care of the facility; and

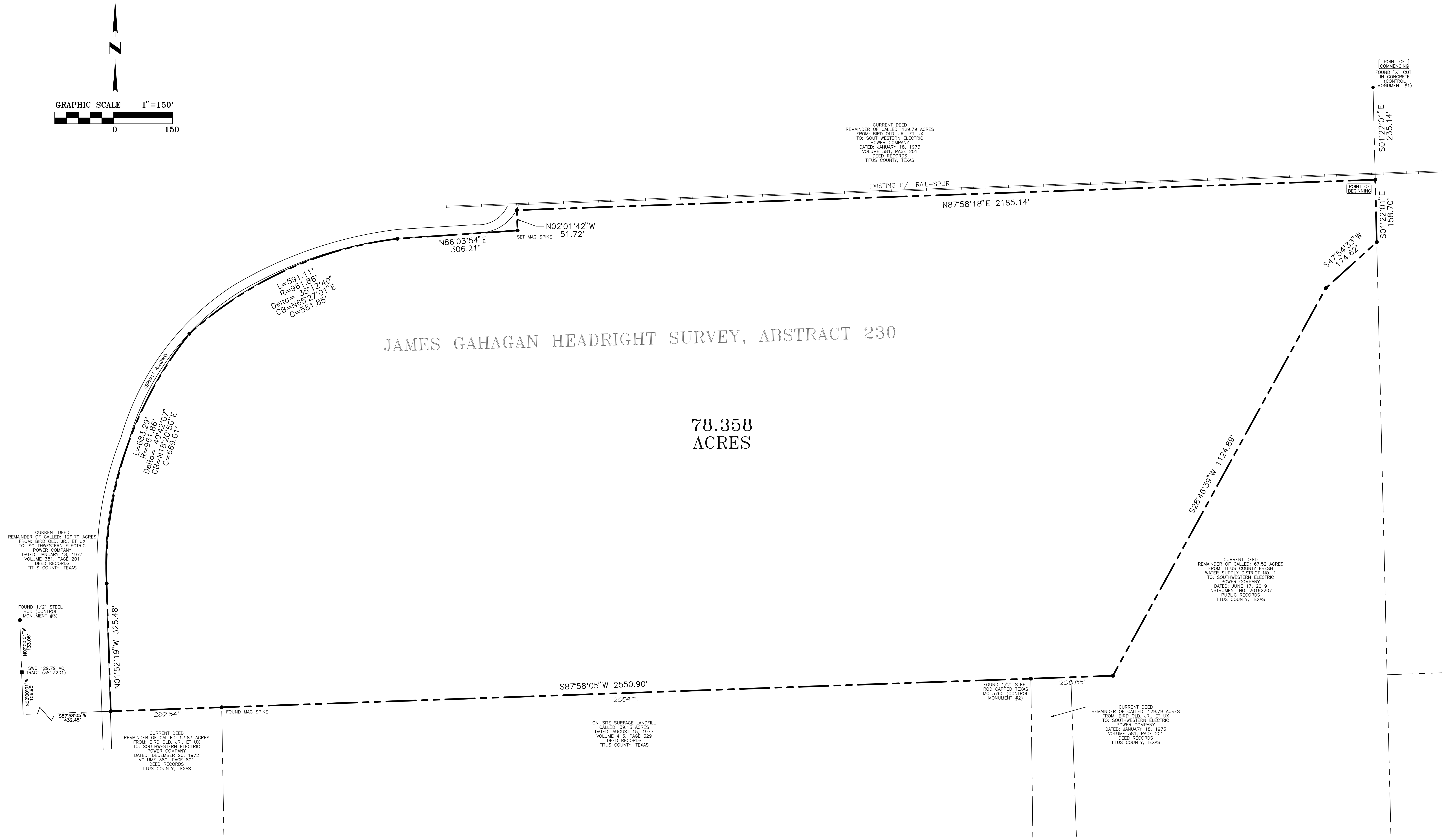
(C) acknowledgment that the facility owner or operator and the State of Texas shall have access to the property during the active life and post-closure care period, if required, after closure for the purpose of inspection and maintenance:

"I Gary O. Spitznogle as Vice President of Environmental Services
(print Signatory Name) (Signatory Capacity)

as authorized signatory for **Welsh Power Plant**, acknowledge that the State of Texas may hold me either jointly or severally responsible for the operation, maintenance and closure and post-closure care of the facility. For the facility where waste will remain after closure, I acknowledge that I have a responsibility to file with the county deed records an affidavit to the public advertising that the land will be used for a solid waste facility prior to the time that the facility actually begins operating and to file a final recording upon completion of disposal operations and closure of the landfill unit(s) in accordance with **Title 30 Texas Administrative Code 352.1221**, **Criteria for Conducting the Closure or Retrofit of Coal Combustion Residual Units**. I further acknowledge that I or the operator at the State of Texas shall have access to the property during the active life and post-closure care period."

Gary O. Spitznogle 01/19/2022
(Property Owner's Signature) (Date)

Property Metes and Bounds Description, Primary Bottom Ash Pond



Property Description
78.358 Acres
Titus County, Texas

All that certain lot, tract or parcel of land lying and situated in the James Gahagan Headright Survey, Abstract 230, Titus County, Texas, being a part of that certain tract of land described as 129.79 acres in the deed from Bird Old, Jr., and wife, Louise Old to Southwestern Electric Power Company, dated January 18, 1973, recorded in Volume 381, Page 201 of the Deed Records of Titus County, Texas, a part of that certain tract of land described as 53.83 acres in the deed from Bird Old, Jr., et ux, to Southwestern Electric Power Company, dated December 20, 1972, recorded in Volume 380, Page 801 of the Deed Records of Titus County, Texas, a part of that certain tract of land described as 67.52 acres in the deed from Titus County Fresh Water Supply District No. 1 to Southwestern Electric Power Company, dated June 17, 2019, recorded in Instrument No. 20192207 of the Public Records of Titus County, Texas, and being more particularly described by metes and bounds as follows:

COMMENCING at an "X" cut in concrete found for a corner, the Northeast corner of the said 129.79 acre tract, an inside ell corner of that certain tract of land described as 353.29 acres in the deed from Terrell W. Connor, Jr., Sarah Connor Arnett, George Connor, Lev Old Connor, and Margaret Anne Youngblood to Southwestern Electric Power Company, dated November 24, 1972, recorded in Volume 380, Page 597 of the Deed Records of Titus County, Texas;

THENCE South 01 degrees 22 minutes 01 seconds East a distance of 235.14 feet along the East line of the said 129.79 acre tract, the East line of the said 67.52 acre tract, and the West line of the said 353.29 acre tract to a 1/2 inch steel rod set for a corner, capped MTG 101011–00, the POINT OF BEGINNING of the herein described tract of land;

THENCE South 01 degrees 22 minutes 01 seconds East a distance of 158.70 feet along the East line of the said 129.79 acre tract, the East line of the said 67.52 acre tract, and the West line of the said 353.29 acre tract to a 1/2 inch steel rod set for a corner, capped MTG 101011–00;

THENCE South 47 degrees 54 minutes 33 seconds West a distance of 174.62 feet across the said 67.52 acre tract, same being across the said 129.79 acre tract to a 1/2 inch steel rod set for a corner, capped MTG 101011–00, at an angle point;

THENCE South 28 degrees 46 minutes 39 seconds West a distance of 1124.89 feet across the said 67.52 acre tract, same being across the said 129.79 acre tract to a 1/2 inch steel rod set for a corner, capped MTG 101011–00, at an angle point;

THENCE South 87 degrees 58 minutes 05 seconds West, at a distance of 208.85 feet passing the Northeast corner of that certain 39.13 acre tract of land designated as an on-site Surface Landfill for the purpose of disposal of fly ash, dated August 15, 1977, recorded in Volume 413, Page 329 of the Deed Records of Titus County, Texas, at a distance of 2268.56 feet passing a mag-spike found for a corner, the Northwest corner of the said 39.13 acre tract, continuing in all a distance of 2550.90 feet to a 1/2 inch steel rod set for a corner, capped MTG 101011–00, lying on the Eastern edge of an interior plant road, said corner bears South 87 degrees 58 minutes 05 seconds West a distance of 432.45 feet and North 02 degrees 00 minutes 01 seconds West, at a distance of 106.95 feet passing the Southwest corner of the said 129.79 acre tract, continuing in all a distance of 240.01 feet to a 1/2 inch steel rod found for a corner, an angle point in the West line of the said 129.79 acre tract;

THENCE North 01 degrees 52 minutes 19 seconds West a distance of 325.48 feet along the Eastern edge of the said road to a 1/2 inch steel rod set for a corner, capped MTG 101011–00, at the beginning of a circular curve to the right;

THENCE in a Northeasterly direction along the arc of the said circular curve a distance of 683.29 feet, with a delta angle of 40 degrees 42 minutes 07 seconds, a radius of 961.86 feet, a chord bearing of North 18 degrees 20 minutes 50 seconds East, and a chord distance of 669.01 feet to a 1/2 inch steel rod set for a corner, capped MTG 101011–00, at the beginning of a compound curve to the right;

THENCE in a Northeasterly direction along the arc of the said curve a distance of 591.11 feet, with a delta angle of 35 degrees 12 minutes 40 seconds, a radius of 961.86 feet, a chord bearing of North 65 degrees 27 minutes 01 seconds East, and a chord distance of 581.85 feet to a 1/2 inch steel rod set for a corner, capped MTG 101011–00, at the end of the said circular curve;

THENCE North 86 degrees 03 minutes 54 seconds East a distance of 306.21 feet along the Southern edge of the said road to a mag-spike set for a corner;

THENCE North 02 degrees 01 minutes 42 seconds West a distance of 51.72 feet to a 1/2 inch steel rod set for a corner, capped MTG 101011–00, lying 12.5 feet South of the Southern rail of a rail-spur;

THENCE North 87 degrees 58 minutes 18 seconds East a distance of 2185.14 feet 12.5 feet South of, and parallel to the said South rail to the point of beginning and containing 78.358 acres of land, at the time of this survey.

THE BEARINGS ARE BASED ON GRID NORTH WITHIN THE "TEXAS COORDINATE SYSTEM OF 1983, NORTH CENTRAL ZONE", NAD83 (CORS96, EPOCH 2002.0), AT THE SURFACE. THE COMBINED SCALE FACTOR TO GO FROM SURFACE TO GRID IS 0.999880014398. THE FOLLOWING CONTROL MONUMENTS WERE USED TO ESTABLISH THE BASIS OF BEARINGS:

CONTROL MONUMENT #1	CONTROL MONUMENT #2	CONTROL MONUMENT #2
N=7084255.5411	N=7084165.6335	N=7084314.5475
E=3091996.2066	E=3088798.4561	E=3086226.4878

NOTE:
In providing this boundary survey, no attempt has been made to obtain or show data concerning existence, size, depth, condition, capacity or location of any utility existing on the site, whether private, municipal or public owned. Subsurface and environmental conditions were not surveyed or examined or statement is made concerning the existence of underground or overhead conditions, containers or facilities that may affect the use or development of this property. Easement research was not done for this property by the surveyor, nor was a current title policy provided prior to this survey.

SURVEYOR CERTIFICATE:

THIS IS TO CERTIFY THAT THIS SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON DECEMBER 17, 2021. THAT THIS PLAT (MAP OR DRAWING) SUBSTANTIALLY COMPLIES WITH THE CURRENT PROFESSIONAL AND TECHNICAL STANDARDS OF THE TEXAS BOARD OF PROFESSIONAL LAND SURVEYING, AND REPRESENTS THE FACTS FOUND AT THE TIME OF THE SURVEY, THERE ARE NO VISIBLE IMPROVEMENTS EXCEPT AS SHOWN ON THE SURVEY PLAT.

THIS PLAT IS FOR THE INTENDED USE OF AMERICAN ELECTRIC POWER AS RELATES TO OWNERSHIP OR TRANSFER OF OWNERSHIP. THIS SURVEY IS NOT ASSIGNABLE OR TRANSFERABLE, MAY NOT BE REISSUED WITHOUT RE-SURVEY AND MAY BE VOID/INVALID SUBJECT TO CHANGES IN GOVERNANCE OR INTERPRETATIONS ISSUED BY THE TEXAS BOARD OF PROFESSIONAL LAND SURVEYING, AND MAY NOT BE COPIED OR PROVIDED TO OTHER PARTIES WITHOUT THE EXPRESSED WRITTEN PERMISSION OF THE UNDERSIGNED.

Jeffrey Wood

JEFFREY A. WOOD
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 6220, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: JANUARY 7, 2022

JEFFREY A. WOOD
#6220

BOUNDARY SURVEY

78.358 ACRES IN THE JAMES GAHAGAN
HEADRIGHT SURVEY, ABSTRACT 230
TITUS COUNTY, TEXAS

Date	Revision/Description

Drawn By	Checked By	Project No.	Dwg. Date
CW	JW	217008	1/7/2022

MTG engineers & surveyors

5930 SUMMERHILL RD.
TEXARKANA TEXAS 75503
P 903.838.8533 | F 903.832.4700
www.mtgengineers.com

TBPE NO. 354

File No.	Sheet No.

Property Metes and Bounds Description, Bottom Ash Storage Pond

014

Central and South West Services, Inc.

ENVIRONMENTAL SERVICES
502 N. Allen Avenue • Shreveport, Louisiana 71101
(318) 673-3802 • Fax (318) 673-3960

FEB 2000

January 31, 2000

CERTIFIED MAIL

Mr. Jeff Saitis
Executive Director
Texas Natural Resource Conservation Commission
P.O. Box 13087
Austin, TX 78711-3087

RE: SWEPCO – Welsh Power Plant (Solid Waste Reg. No. 31086)
New Ash Surface Impoundment - Welsh Bottom Ash Storage Pond

Dear Mr.Saitis:

Southwestern Electric Power Company respectfully notifies the TNRCC that the Welsh Power Plant (Solid Waste Registration No. 31086) will be constructing the aforementioned surface impoundment for the on-site storage of fly ash (waste code 00153042), bottom ash (waste code 00163042), and aqueduct sediment (waste code 00825192). This structure will be deed recorded and designated as Waste Management Unit No. 014.

Enclosed is Drawing No. WEPX-335 which shows the expected location, size, and cross section of this structure. SWEPCO plans to line the structure with a 60 mm HDPE synthetic liner.

If you have any further questions about this notification, please feel free to contact me at (318) 673-3852. Thank you for your assistance.

Sincerely,

Kelly G. Spencer, CPSSc
Sr. Environmental Specialist

enclosure

cc: Winston Holley – Plant Support
Jim Trimble - Welsh
File

014

THE STATE OF LOUISIANA }
KNOW ALL MEN BY THESE PRESENTS:
PARISH OF CADDO }

That I, Kelly G. Spencer, Senior Environmental Specialist, hereby certify that the hereinafter described tract of land located in Titus County, Texas, will be used by the said Southwestern Electric Power Company as a surface impoundment for the purpose of disposal of Class 2 wastes including fly ash, bottom ash, and aqueduct sediment under Texas Natural Resource Conservation Commission Solid Waste Registration No. 31086, Facility Unit No. 014, Class 2 Wastes, (Waste Codes 00153042, 00163042, and 00825192) said land being described as follows:

DESCRIPTION OF 25.69 ACRES OF LAND

Being 25.69 acres of land located in the JAMES GAHAGAN SURVEY, A-230, Titus County, Texas, said 25.69 acre tract being part of a 85 acre tract described as TRACT 2 according to the deed of record in Volume 399, Page 123 of the Deed Records of Titus County, said 25.69 acre tract being more particularly described as follows by using the recorded bearing of the west boundary line of said 85 acre tract:

BEGINNING at a 2" x 2" angle iron found at a ell corner of said 85 acre tract and being the northeast corner of a 25 acre tract described by deed recorded in Volume 162, Page 589 of said Deed Records, said point being the POINT OF BEGINNING of the herein described tract;

THENCE across 85 acre tract the following bearings and distances: N00°42'00" E 553.65 feet to a ½" iron rod set for corner, S88°25'28" E 256.61 feet to a ½" iron rod set for corner, S88°39'01" E 385.07 feet to a ½" iron rod set for corner, S88°39'01" E 164.80 feet to a ½" iron rod set for corner, said corner being on the east boundary line of said 85 acre tract and the west boundary line of a 176.20 acre tract conveyed to SOUTHWESTERN ELECTRIC POWER COMPANY according to the deed of record in Volume 384, Page 404 of said Deed Records;

THENCE along the common boundary line of said 85 acre tract and the 176.20 acre tract the following bearings and distances: S00°09'00" W 558.69 feet to a point for corner, S17°09'53" E 226.85 feet to a point for corner, S06°17'00" 502.80 feet to a point for corner, and S69°43'00" 410.96 feet to a point for corner;

THENCE N89°40'00" W, 448.24 feet across said 85 acre tract to a point of corner, said point being on the west boundary line of said 85 acre tract and the east boundary line of a 44 acre tract conveyed to V. J. Jenkins;

THENCE N00°42'00" E, 828.66 feet along the west boundary line of 85 acre tract and the east boundary lines of said 44 acre tract and said 25 acre tract to the POINT OF BEGINNING and containing 25.69 acres of land.

I, Lee W. Newman, Registered Professional Land Surveyor No. 3444, do hereby certify that this plat and field notes correctly represent the results of a survey made on the ground during the month of November 1999. There are no encroachments on said tract of land by buildings on the adjoining tracts. There are no visible highlines, pipelines, or other utility lines on said tract of land other than those serving same and those shown on the plat.

WITNESS MY HAND this 31st day of January, 2000.

Kelly G. Spencer
~~Senior~~ Environmental Specialist
Central and South West Services, Inc.
P.O. Box 21106
Shreveport, LA 71156

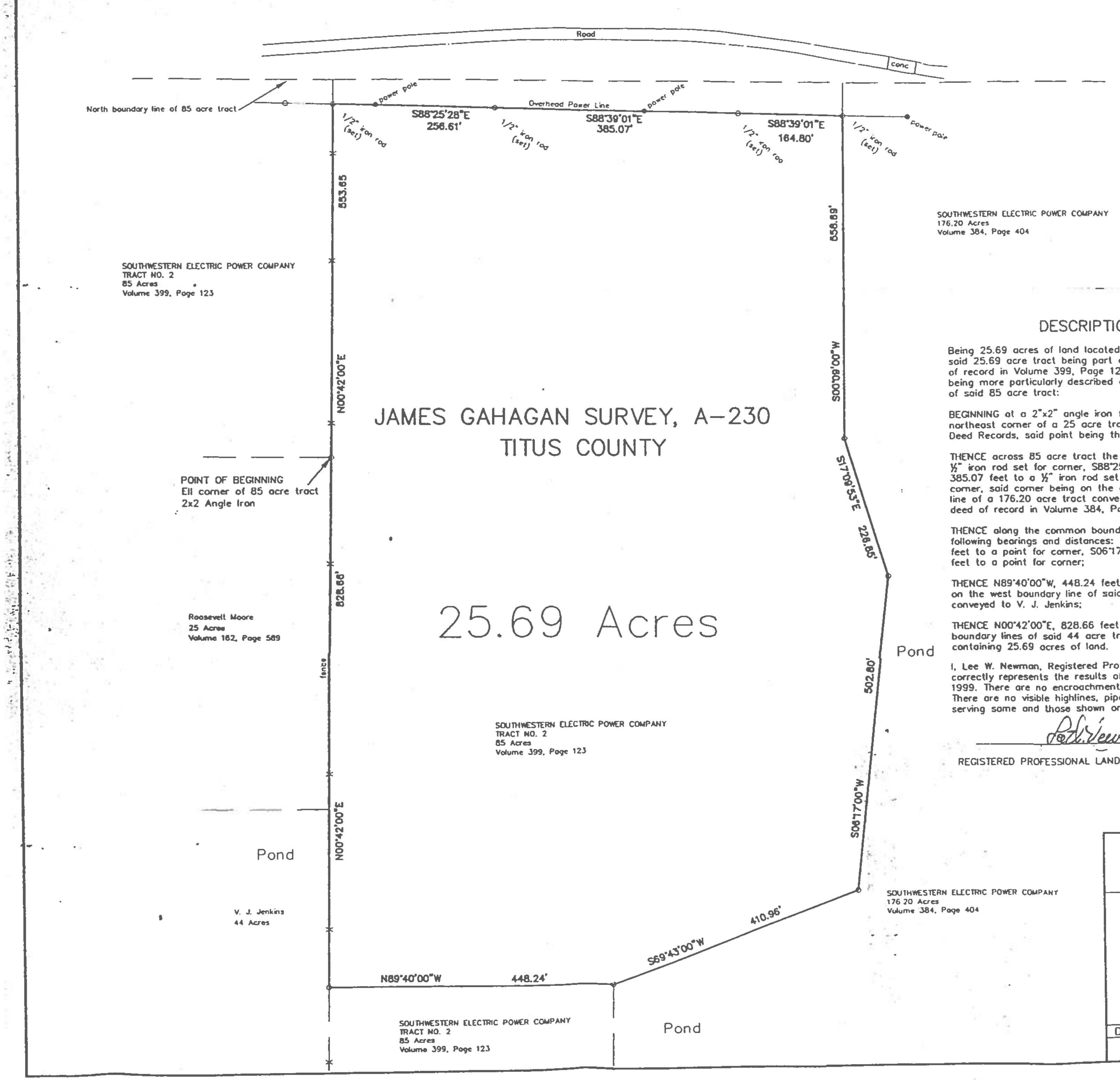
THE STATE OF LOUISIANA
PARISH OF CADDO

Before me, the undersigned authority, in and for said Parish and State, on this day personally appeared KELLY G. SPENCER, known to me to be the person whose name is subscribed to the foregoing instrument and acknowledged to me that he executed the same before me, the undersigned authority, for the purposes and consideration therein expressed, and in the capacity therein stated.

GIVEN UNDER MY HAND AND SEAL OF OFFICE, the 31ST day of JANUARY, 2000.

NOTARY PUBLIC

Jerry G. Branner
Notary Public, State of Louisiana,
Parish of Caddo. My Commission is for life.



Scale. 1" = 100'
Job No. 13,177

DESCRIPTION OF 25.69 ACRE TRACT

Being 25.69 acres of land located in the JAMES GAHAGAN SURVEY, A-230, Titus County, Texas, said 25.69 acre tract being part of a 85 acre tract described as TRACT 2 according to the deed of record in Volume 399, Page 123 of the Deed Records of Titus County, said 25.69 acre tract being more particularly described as follows by using the recorded bearing of the west boundary line of said 85 acre tract:

BEGINNING at a 2"x2" angle iron found at a ell corner of said 85 acre tract and being the northeast corner of a 25 acre tract described by deed recorded in Volume 162, Page 589 of said Deed Records, said point being the POINT OF BEGINNING of the herein described tract;

THENCE across 85 acre tract the following bearings and distances: N00°42'00"E 553.65 feet to a ½" iron rod set for corner, S88°25'28"E 256.61 feet to a ½" iron rod set for corner, S88°39'01"E 385.07 feet to a ½" iron rod set for corner, S88°39'01"E 164.80 feet to a ½" iron rod set for corner, said corner being on the east boundary line of said 85 acre tract and the west boundary line of a 176.20 acre tract conveyed to SOUTHWESTERN ELECTRIC POWER COMPANY according to the deed of record in Volume 384, Page 404 of said Deed Records;

THENCE along the common boundary line of said 85 acre tract and the 176.20 acre tract the following bearings and distances: S00°09'00"W 558.69 feet to a point for corner, S17°09'53"E 226.85 feet to a point for corner, S06°17'00"W 502.80 feet to a point for corner, and S69°43'00"W 410.96 feet to a point for corner;

THENCE N89°40'00"W, 448.24 feet across said 85 acre tract to a point for corner, said point being on the west boundary line of said 85 acre tract and the east boundary line of a 44 acre tract conveyed to V. J. Jenkins;

THENCE N00°42'00"E, 828.66 feet along the west boundary line of 85 acre tract and the east boundary lines of said 44 acre tract and said 25 acre tract to the POINT OF BEGINNING and containing 25.69 acres of land.

I, Lee W. Newman, Registered Professional Land Surveyor, certify that this plat and field notes correctly represents the results of a survey made on the ground during the month of November, 1999. There are no encroachments on said tract of land by buildings on the adjoining tracts. There are no visible highlines, pipelines, or other utility lines on said tract of land other than those serving same and those shown on the plat.

L.W. Newman 1-11-2000

REGISTERED PROFESSIONAL LAND SURVEYOR NO. 3444 DATE

LEE W. NEWMAN
3444

PLAT OF SURVEY

SWEPCO
25.69 ACRES
JAMES GAHAGAN SURVEY, A-230
TITUS COUNTY, TEXAS

PREPARED BY
Established 1934
HART Engineering Company

P.O. Box 2804
415 N. CENTER ST.
LONGVIEW, TX 75606
903-758-0166
FAX/758-2402
DATE: 1-12-00

DRAWN BY	SCALE	JOB NO.	DWG NAME
GSR	1" = 100'	13,177	BNDRY

VOL. 1227 PAGE 246

ADDENDUM to DEED RECORD
TITUS COUNTY
Vol. 1227, Page 245

001522

THE STATE OF TEXAS }
KNOW ALL MEN BY THESE PRESENTS:
COUNTY OF TITUS }

Pursuant to 30 TAC §335.5, I, Jennifer K. Meyer, Sr. Plant Environmental Coordinator for American Electric Power Company, hereby certify that the waste management unit described in Volume 1227, Page 245, of the Deed Records of Titus County, Texas, has received the following Class 2 waste(s) in addition to those waste(s) previously deed recorded:

Ecology Pit Sediment (00813912)
Fly Ash (00153042)
Bottom Ash (00163042)
Aqueduct Sediment (00825192)

Subsequent to this filing, waste disposal activities effecting this management unit can be found at Central Records Department, Texas Natural Resource Conservation Commission, 12100 Park 35 Circle, Austin, Texas, 78753, by asking for the file on Solid Waste Registration No. 31086, (see Waste Management Unit No. 014).

WITNESS MY HAND this 20 day of MARCH, 2002.

Jennifer K. Meyer

Jennifer K. Meyer
Sr. Environmental Coordinator
AEP/SWEPCO – Welsh Power Plant
Rt. 4, Box 221
Pittsburg, TX 75686

THE STATE OF TEXAS }
COUNTY OF TITUS }

Before me, the undersigned authority, in and for said County and State, on this day personally appeared Jennifer Meyer, know to me to be the person whose name is subscribed to the foregoing instrument and acknowledged to me that he executed the same before me, the undersigned authority, for the purposes and consideration therein expressed, and in the capacity therein stated.

GIVEN UNDER MY HAND AND SEAL OF OFFICE, this 20 day of March, 2002.

STACI COOK
Notary Public
STATE OF TEXAS
My Comm. Exp. 11-24-2005

Staci Cook

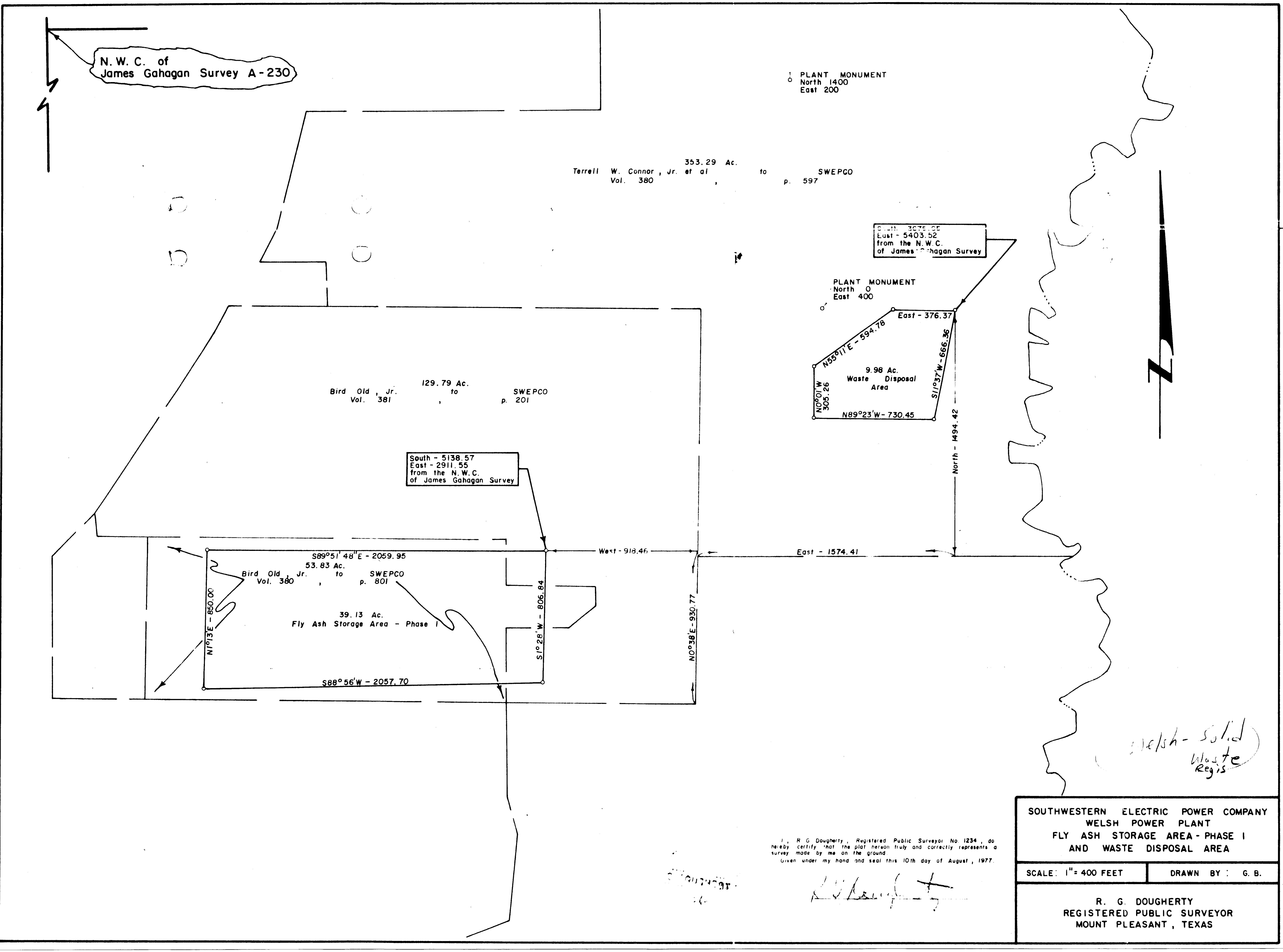
Notary Public, Titus County, State of Texas

My Commission Expires 11-24-2005

03/20/2002

Property Metes and Bounds Description, Landfill

THE BEARINGS ARE BASED ON GRID NORTH WITHIN THE "TEXAS COORDINATE SYSTEM OF 1983, NORTH CENTRAL ZONE", NAD83 (CORS96, EPOCH 2002.0), WITH A CONVERGENCE ANGLE OF -02 DEGREES 10 MINUTES 08 SECONDS. THE COMBINED SCALE FACTOR TO GO FROM GRID TO SURFACE IS 1.00012.



Welsh - Solid Waste Regis

SOUTHWESTERN ELECTRIC POWER COMPANY
WELSH POWER PLANT
FLY ASH STORAGE AREA - PHASE I
AND WASTE DISPOSAL AREA

SCALE: 1" = 400 FEET

DRAWN BY: G. B.

R. G. DOUGHERTY
REGISTERED PUBLIC SURVEYOR
MOUNT PLEASANT, TEXAS

I, R G Dougherty, Registered Public Surveyor No. 1234, do hereby certify that the plat hereon truly and correctly represents a survey made by me on the ground.

Given under my hand and seal this 10th day of August, 1977.

Welsh - Solid Waste
Disposal

R. G. DOUGHERTY
REGISTERED PUBLIC SURVEYOR
P. O BOX 604
MT. PLEASANT, TEXAS 75455

TELEPHONE
OFFICE 572-2076
MT. PLEASANT

SOUTHWESTERN ELECTRIC POWER COMPANY

Fly Ash Storage Area - Phase I

All that certain tract or parcel of land situated in the County of Titus, State of Texas, being a portion of the James Gahagan Survey, Abst. No. 230 and also being parts of the 129.79 acre tract conveyed by Bird Old, Jr. to SWEPCO, Volume 381, Page 201 and the 53.83 acre tract conveyed by Bird Old, Jr. to SWEPCO Volume 380, Page 801 all of the Deed Records of said County and bounded as follows:
BEGINNING at an iron stake for corner, said stake being situated South 5138.57 feet and East 2911.55 feet from the northwest corner of the said Gahagan Survey and being further described as being N 0° 38' E, 930.77 feet and W, 918.46 feet from the southeast corner of the said 129.79 acre tract;
THENCE S 1° 28' W, 806.84 feet to an iron stake for corner;
THENCE S 88° 56' W, 2057.70 feet to an iron stake for corner;
THENCE N 1° 13' E, 850.00 feet to an iron stake for corner;
THENCE S 89° 51' 48" E, 2059.95 feet to the place of beginning and containing 39.13 acres of land.

Waste Disposal Area

All that certain tract orparcel of land situated in the County of Titus, State of Texas, being a portion of the James Gahagan Survey, Abst. No. 230 and also being a part of the 353.29 acre tract conveyed by Terrell W. Connor, Jr. et al to SWEPCO by deed recorded in Volume 380, Page 597 of the Deed Records of said County and bounded as follows:
BEGINNING at an iron stake for corner, said stake being situated South, 3675.05 feet and East 5403.52 feet from the northwest corner of the said Gahagan Survey and being further described as being East, 1574.41 feet and North 1494.42 feet from the lower southwest corner of the said 353.29 acre tract;
THENCE S 11° 37' W, 666.36 feet to an iron stake for corner;
THENCE N 89° 23' W, 730.45 feet to an iron stake for corner;
THENCE N 0° 01' W, 305.26 feet to an iron stake for corner;
THENCE N 55° 11' E, 594.78 feet to an iron stake for corner;
THENCE East 376.37 feet to the place of beginning and containing 9.98 acres of land.

I, R. G. Dougherty, Registered Public Surveyor No. 1234, do hereby certify that the field notes hereon were prepared from an actual survey on the ground.

Given under my hand and seal this 11th day of August, 1977.

R. G. Dougherty
REGISTERED PUBLIC SURVEYOR

R. G. DOUGHERTY
1234

[illegible] Register

THE STATE OF TEXAS)(
KNOW ALL MEN BY THESE PRESENTS:
COUNTY OF TITUS)(

2707

That I, Tully R. Florey III, Attorney for Southwestern Electric Power Company, hereby certify that the hereinafter described tract of land located in Titus County, Texas, will be used by the said Southwestern Electric Power Company as an on-site Surface Landfill for the purpose of disposal of fly ash from power plant boiler, under Texas Water Quality Board Registration No. 31086, Class I, Code 171380, said land being described as follows:

All that certain tract or parcel of land situated in Titus County, Texas, being a portion of the James Gahagan Survey, Abst. No. 230 and also being parts of the 129.79 acre tract conveyed by Bird Old, Jr. to SWEPCO, Vol. 381, page 201 and the 53.83 acre tract conveyed by Bird Old, Jr. to SWEPCO recorded in Vol. 380, page 801 all of the Deed Records of said County and bounded as follows:

BEGINNING at an iron stake for corner, said stake being situated South 5138.57 feet and East 2911.55 feet from the northwest corner of the said Gahagan Survey and being further described as being N. 0° 38' E., 930.77 feet and W., 918.46 feet from the Southeast corner of the said 129.79 acre tract;
THENCE SOUTH 1° 28' W., 806.84 feet to an iron stake for corner;
THENCE SOUTH 88° 56' W., 2057.70 feet to an iron stake for corner;
THENCE NORTH 1° 13' E., 850.00 feet to an iron stake for corner;
THENCE SOUTH 89° 51' 48" E., 2059.95 feet to the place of beginning and containing 39.13 acres of land;

WITNESS MY HAND this 15th day of August, 1977.

Tully R. Florey III
Tully R. Florey III
P. O. Box 107
Mt. Pleasant, Texas 75455

ATTORNEY FOR SOUTHWESTERN ELECTRIC POWER COMPANY

SWORN TO AND SUBSCRIBED BEFORE me this 15th day of August, 1977.

Notary Public, Titus County, Texas.

THE STATE OF

The State of Texas
COUNTY OF TITUS

I, ALLEN LaPRADE. Clerk of the Court of said County, do certify that the foregoing instrument of writing, dated on the 15 day of Aug. A. D., 1977, with its Certificate of Authentication, was filed for record in my office, the 15 day of Aug. A. D., 1977, at 3:30 o'clock P M., and duly recorded the 16 day of Aug. A. D., 1977, in the Deed Records of said County, in Vol. 413 Page 329.

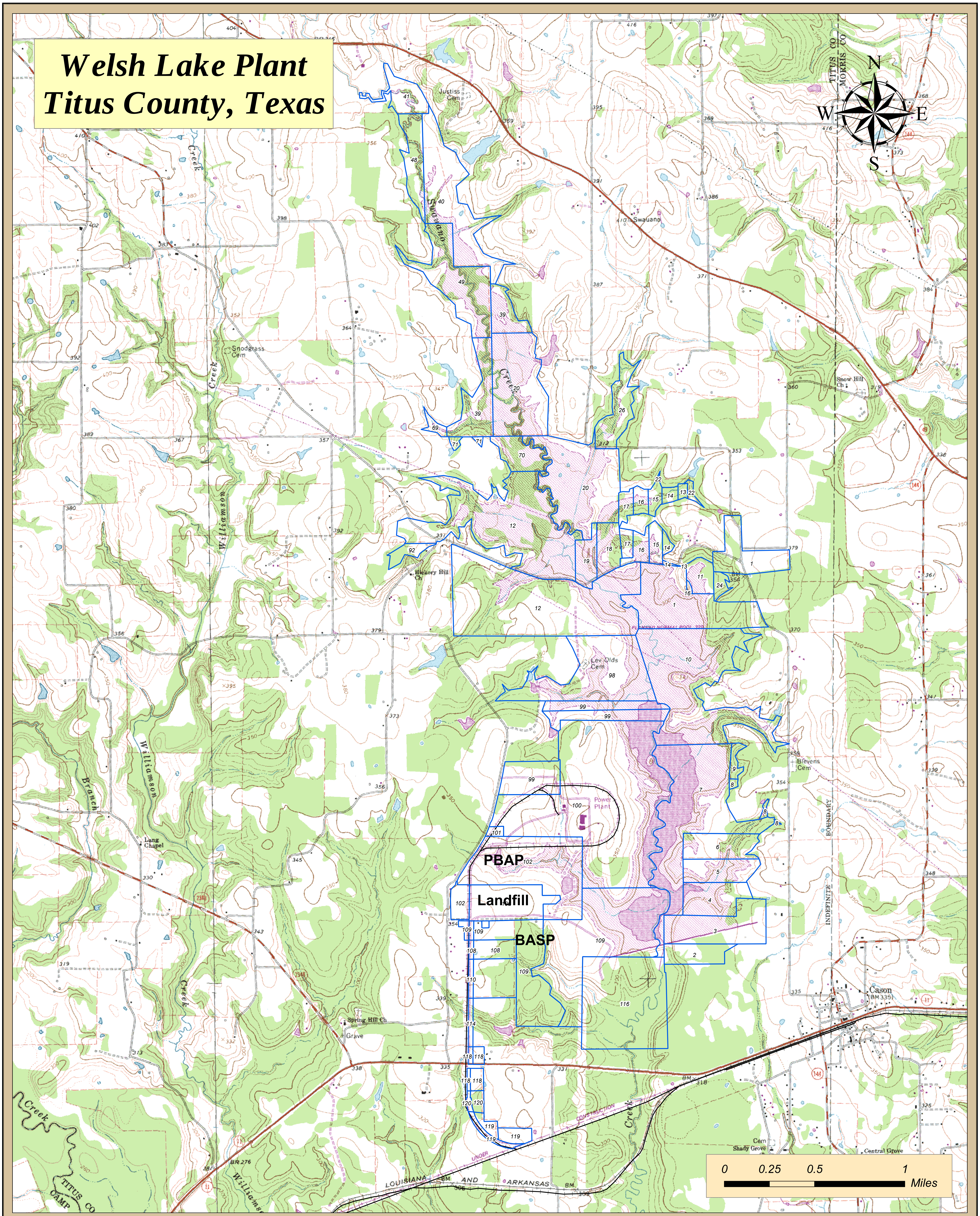
WITNESS my hand and seal of the Court of said County, at my office in Mt. Pleasant, Texas, this the date last above written.

ALLEN LaPRADE
County Clerk, Titus County, Texas
By Eugenia Roach, Deputy

SERVICE PRESS CO.

Survey Plat

Welsh Lake Plant
Titus County, Texas

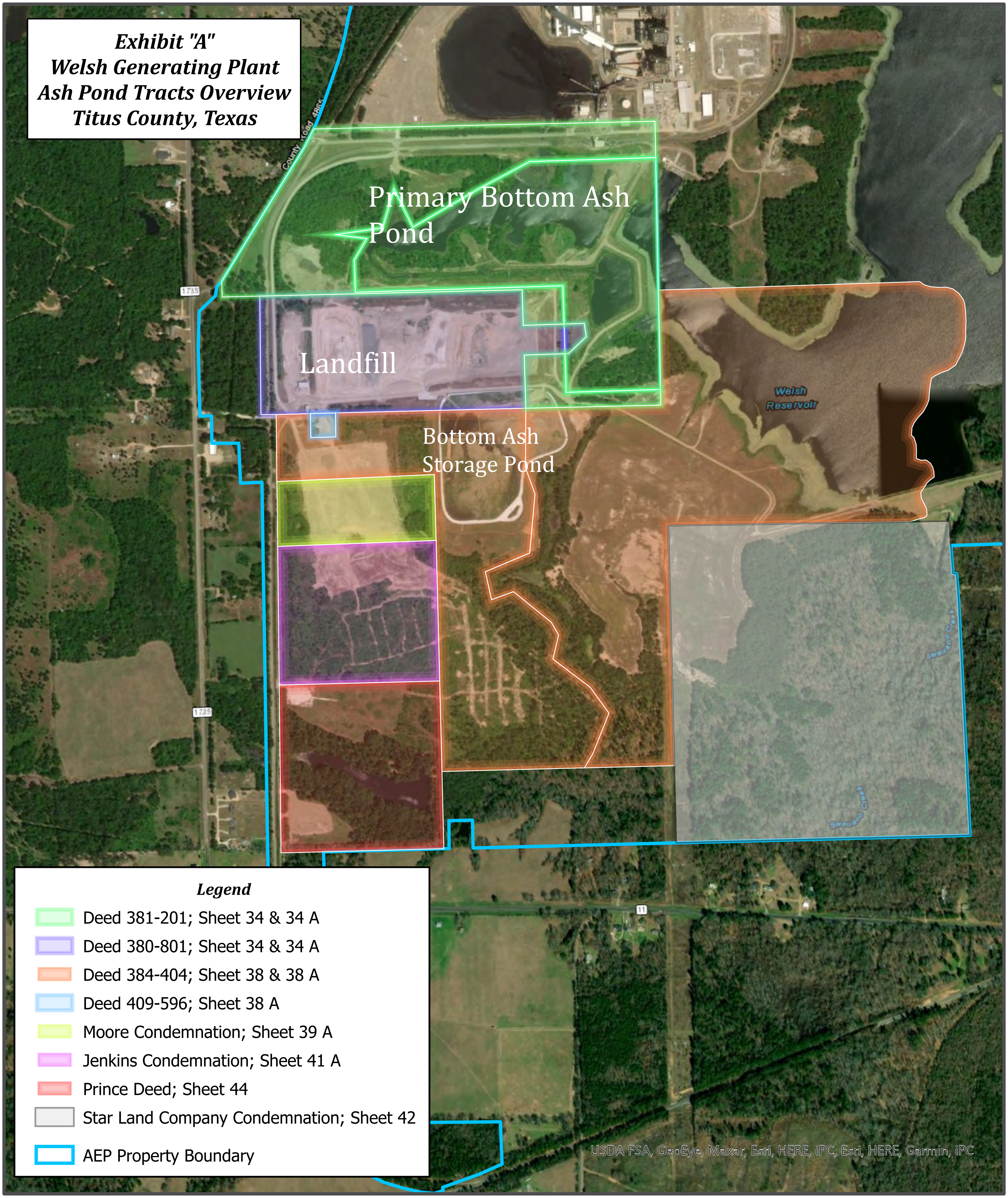


Section #13 survey plat

Cartography By AEP Land Management Department

Metes and Bounds Drawing

Exhibit "A"
Welsh Generating Plant Ash Pond Tracts Overview Titus County, Texas



Legend

- 🟩 Deed 381-201; Sheet 34 & 34 A
- 🟪 Deed 380-801; Sheet 34 & 34 A
- 🟧 Deed 384-404; Sheet 38 & 38 A
- 🟦 Deed 409-596; Sheet 38 A
- 🟨 Moore Condemnation; Sheet 39 A
- 🟪 Jenkins Condemnation; Sheet 41 A
- 🟥 Prince Deed; Sheet 44
- ⬜ Star Land Company Condemnation; Sheet 42
- 🟦 AEP Property Boundary

Data Current As Of: October 20, 2020

Feet
0 1,000 2,000

Cartography Provided By: AEP Real Estate Asset Management GIS Dept.

Disclaimer: This drawing is not an actual survey, and is for general information purposes only.

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

N
W E
S

Section 17 Supplement

Legal Authority

Verification of Legal Status

Corporations Section
P.O.Box 13697
Austin, Texas 78711-3697

Ruth R. Hughs
Secretary of State

Office of the Secretary of State

Certificate of Fact

The undersigned, as Secretary of State of Texas, does hereby certify that the document, Application for Certificate of Authority for SOUTHWESTERN ELECTRIC POWER COMPANY (file number 1211806), a DELAWARE, USA, Foreign For-Profit Corporation, was filed in this office on June 04, 1947.

It is further certified that the entity status in Texas is in existence.

In testimony whereof, I have hereunto signed my name officially and caused to be impressed hereon the Seal of State at my office in Austin, Texas on March 09, 2021.

Ruth R. Hughs
Secretary of State

MAPS and DRAWINGS

General Maps: (30 TAC 352.231(e)) General location map in accordance with 305.45(a)(6) and 30 TAC 330.59(c)

Topographic Map – show regional surface water flow direction to area streams, rivers, ponds and lakes.

Facility Layout Map: show property boundary; all CCR unit outlines with name and location.

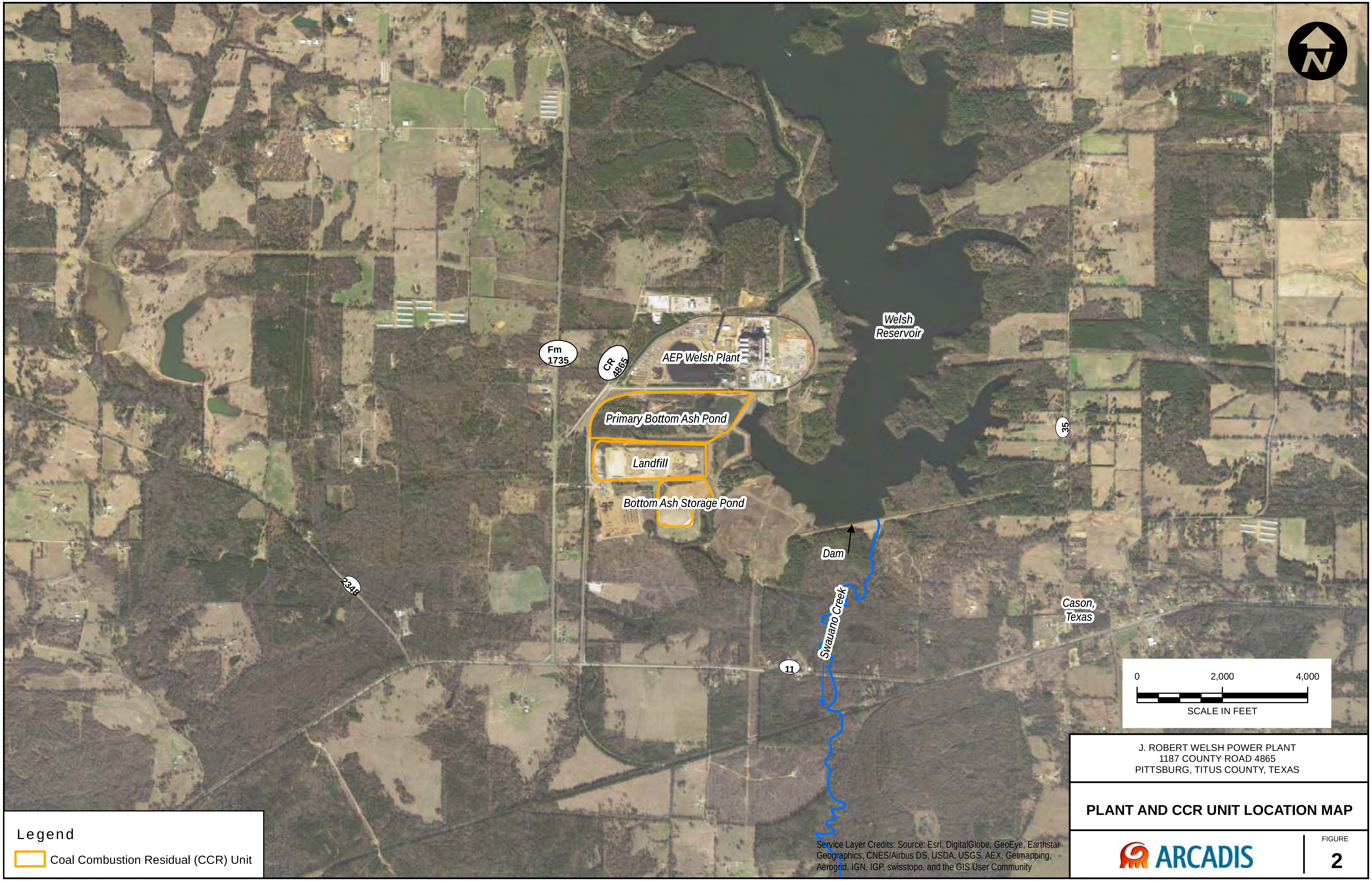
NA- Surrounding Features Map: show area streams, rivers, ponds, lakes and area at least 1000 feet beyond property. – (<u>This is displayed on the TOPO MAP therefore there is no additional map</u>)

Process Flow Diagram: provide word descriptions of the CCR process flow, depicting the handling, collection, storage and disposal of all CCR material within the facility from the boiler to the CCR units and other locations.

¼ mile Surrounding Land Ownership Map

Land Ownership List

General Map



Legend

☐ Coal Combustion Residual (CCR) Unit

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

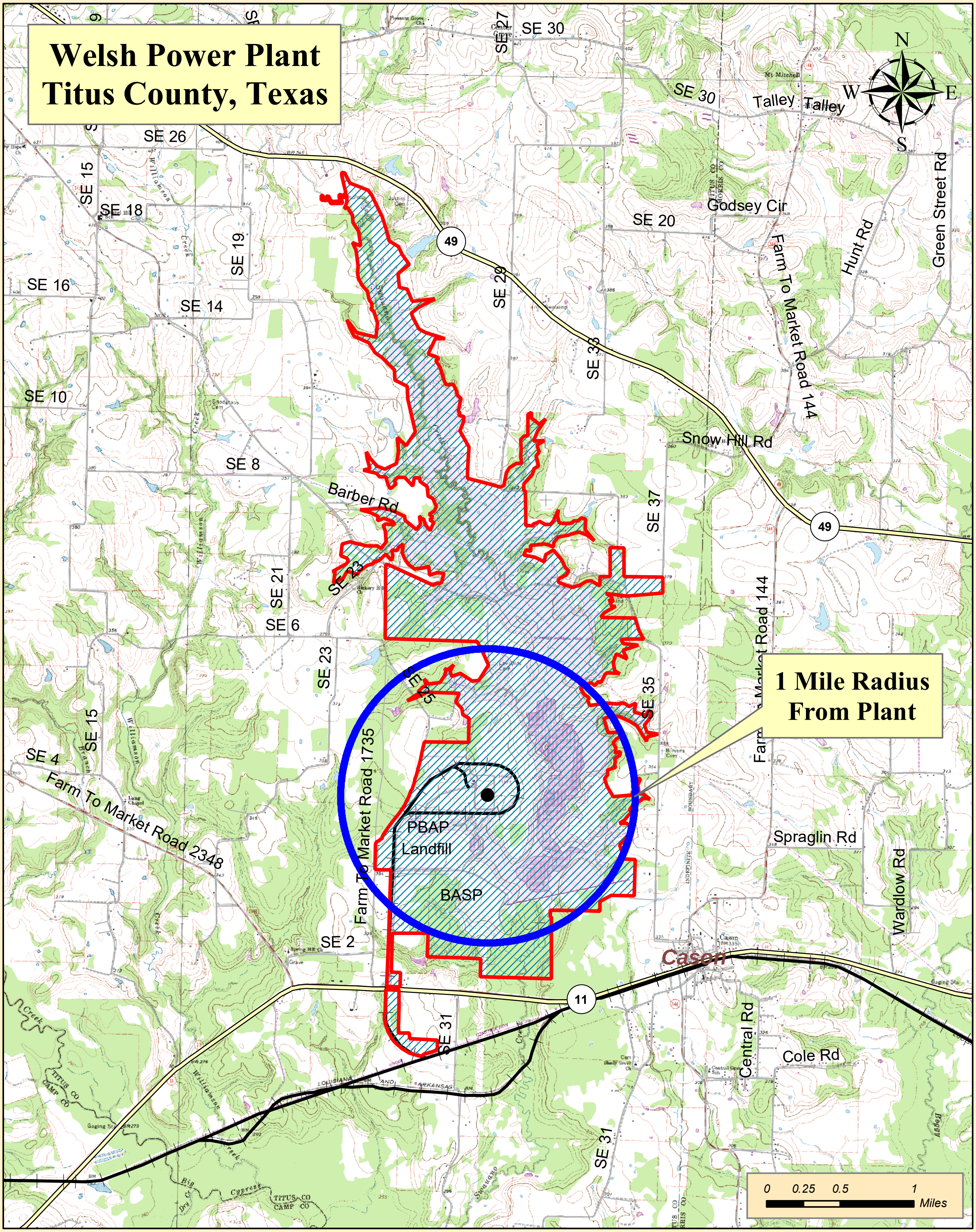
PLANT AND CCR UNIT LOCATION MAP

ARCADIS

FIGURE
2

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 2 - CCR location.mxd

General Topographic Map



Facility Layout Map

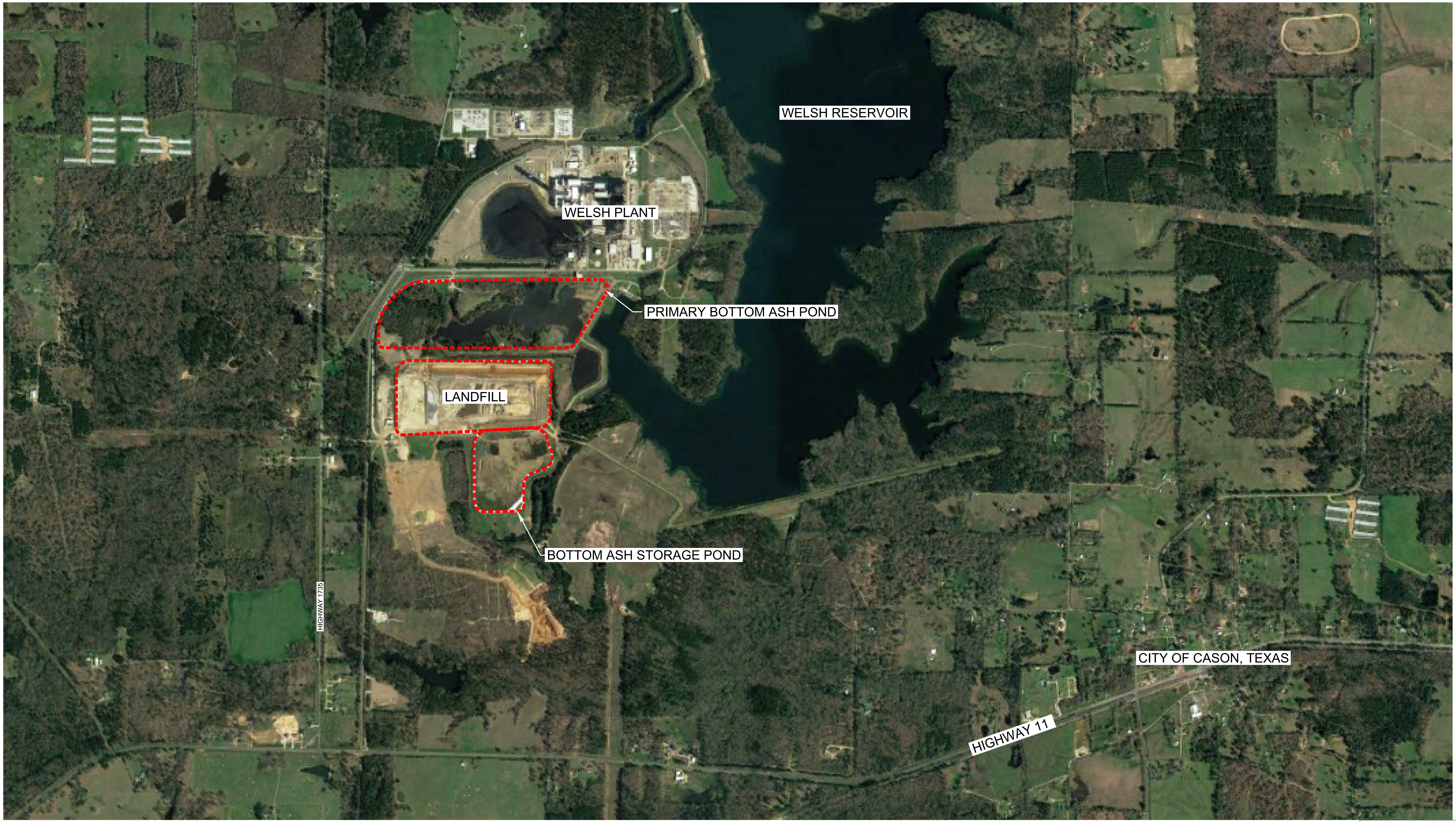


Figure 2

PRELIMINARY - NOT FOR CONSTRUCTION

🟥 LIMITS OF CCR UNIT

no.	date	by	ckd	description
A	06/22/20	KTM	RNO	ISSUED FOR EXTENSION REQUEST

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Company, Inc.
Firm Reg. No. F-845

designed R. OWENS
detailed J. RIDDER

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY™

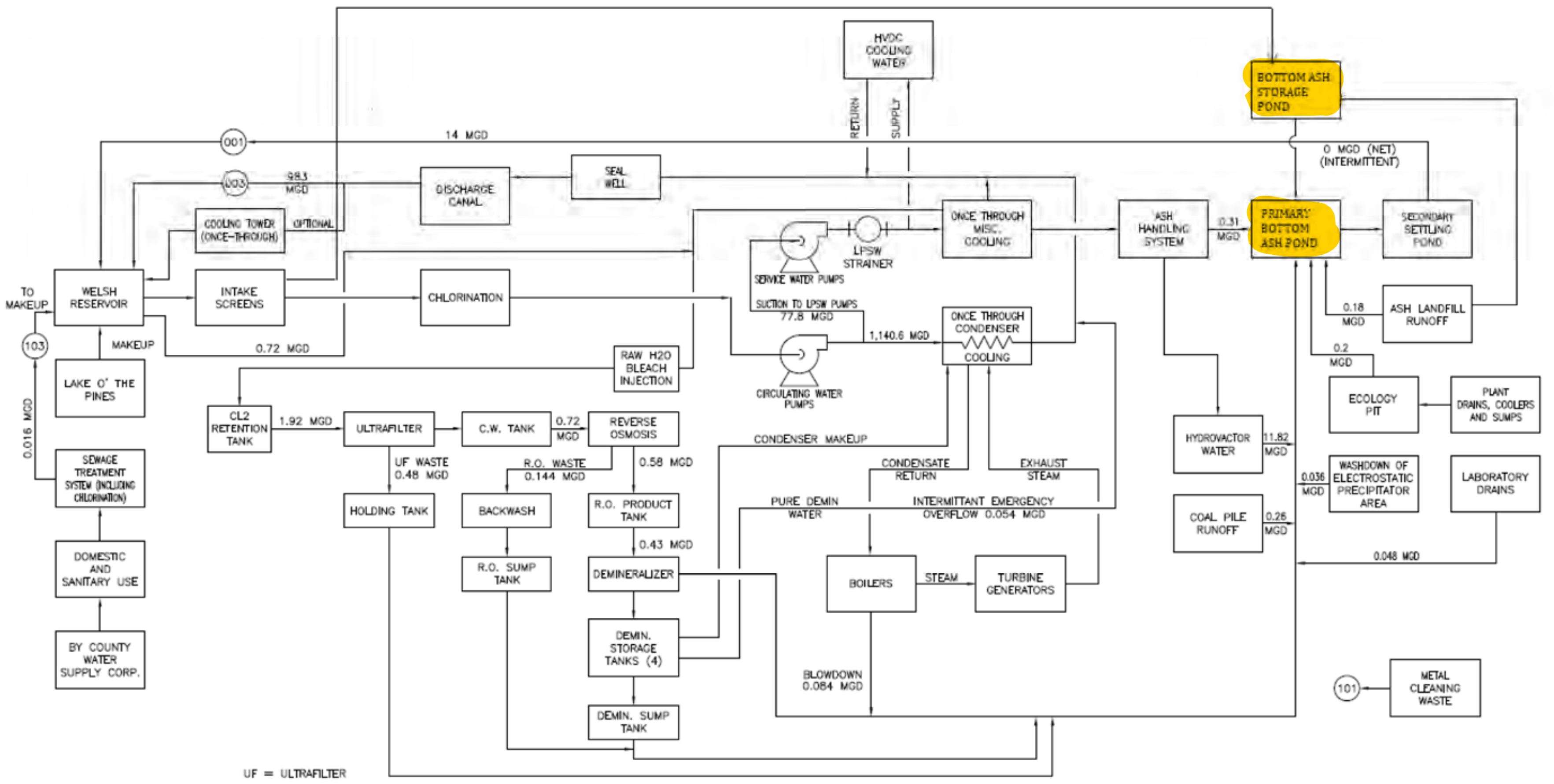
CCR / ELG COMPLIANCE PROJECT
WELSH POWER PLANT
TITUS COUNTY, TEXAS

CCR UNIT LOCATION MAP
project 120798
contract
drawing SK - C502
rev. A
sheet of sheets
file 120798SK-C502.DGN

C:\Users\rowens\Desktop\AEP\WELSH\120798SK-C502.dgn

6/29/2020

Process Flow Diagram



UF = ULTRAFILTER

DATE	NO.	DESCRIPTION	APPD.
	11	ISSUED FOR PERMIT RENEWAL PROCESS. PRELIMINARY - REFERENCE ONLY TDA	EM BV

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

AEP CONFIDENTIAL

REFERENCE AEP's CORPORATE INFORMATION SECURITY POLICY

"THIS DRAWING IS THE PROPERTY OF THE **AMERICAN ELECTRIC POWER SERVICE CORP.**, AND IS LOANED UPON CONDITION THAT IT IS NOT TO BE REPRODUCED OR COPIED, IN WHOLE OR IN PART, OR USED FOR FURNISHING INFORMATION TO ANY PERSON WITHOUT THE WRITTEN CONSENT OF THE **AEP SERVICE CORP.**, OR FOR ANY PURPOSE DETRIMENTAL TO THEIR INTEREST, AND IS TO BE RETURNED UPON REQUEST"

SOUTHWESTERN ELECTRIC POWER COMPANY

WELSH PLANT

CASON TEXAS

ENVIRONMENTAL

WATER FLOW DIAGRAM

UNIT: 123

DRAWING NUMBER: WSH7

REV: 11

SCALE: -
DR: -
CH: -
SUP: -
ENG: -
DATE: SEE REV 0

CIVIL ENGINEERING

APPROVED BY

AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

Process Flow Description

Welsh Power Plant
Water Balance Narrative (refer to Water Balance Diagram)
<u>CCR Wastestreams:</u>

The PBAP receives approximately 0.63 million gallons a day (MGD) of sluiced flows containing economizer and bottom ash.

AEP evaluated each CCR wastestream placed in the PBAP at Welsh Plant. For the reasons discussed below and in Table 1, the following CCR wastestreams must continue to be placed in the PBAP due to lack of alternative capacity both on and off-site.

Table 1. Welsh Plant CCR Wastestreams

CCR Wastestream	Average Flow (gpd)	Current Configuration	Alternative Capacity Currently Available? Yes/No	AEP Notes
Bottom Ash	630,000	Bottom ash is currently sluiced to the PBAP.	No	There are currently no alternative CCR compliant ponds onsite and extensive modifications would be required to manage the bottom ash so that it could be disposed in the onsite landfill. These alternatives are not practicable for generating units that will cease combusting coal in 2028.
Economizer Ash	Included with Bottom Ash flows	Sluiced to the existing PBAP with bottom ash	No	There are currently no alternative CCR compliant ponds onsite and extensive modifications would be required to manage the economizer ash so that it could be disposed in the onsite landfill. These alternatives are not practicable for generating units that will cease combusting coal in 2028.
Pyrites (non-CCR but handled with CCR wastestreams)	Included with Bottom Ash flows	Sluiced to the existing PBAP using the existing bottom ash pumps and piping.	No	No alternate system is available for collection of pyrites which are comingled with bottom and economizer ash. Extensive modifications would be required to manage the pyrites so that it could be disposed in the onsite landfill. These alternatives are not practicable for generating units that will cease combusting coal in 2028.

Welsh Plant does not have an existing alternate impoundment on-site that meets the liner or aquifer separation requirements of EPA's CCR regulation, and considerable modifications to plant equipment, facilities, and processes will be necessary before Welsh Plant can cease sluicing CCR and placing non-CCR wastestreams into the PBAP. A new CCR compliant impoundment approximately 10 acres in size would be required to treat the CCR and non-CCR wastestreams, with the exception of the coal pile runoff flow, in order to meet the TPDES permit limits. A new non-CCR impoundment approximately 5 acres in size with chemical treatment would be required to treat the coal pile runoff flow. Since Welsh Plant has elected to pursue the option to permanently cease the use of the coal fired boilers by a date certain, developing alternative disposal capacity is "illogical" as stated by EPA, and also counterproductive to the work to retire the boilers and close the CCR surface impoundments. As EPA explained in the preamble of the 2015 rule, it is not possible for sites that sluice CCR material to an impoundment to eliminate the impoundment and dispose of the material offsite. See 80 Fed. Reg. 21,301, 21,423 (Apr. 17, 2015) ("[W]hile it is possible to transport dry ash off-site to [an] alternate disposal facility that is simply not feasible for wet-generated CCR. Nor can facilities immediately convert to dry handling systems."). A new CCR compliant impoundment would be required to treat the CCR flows as noted above.

If temporary frac tanks were used for treatment of the CCR sluice water and if 24 hours would provide sufficient residence time for the settling of the fine solids in the CCR wastestreams, approximately 75 frac tanks would be required to store and treat the bottom ash transport water. The number of tanks required was estimated by taking the total sluice flow (630,000 gallons) divided by the frac tank capacity (21,000 gallons) and doubling it to account for the 24 hours settling time requirement which resulted in 60 frac tanks. Because approximately 10 of these frac tanks would need to be rotated out of service each day for solids removal and disposal in the Welsh landfill, an allowance, or emergency margin, of 15 frac tanks was added to this value, which resulted in a total of 75 tanks being required. These tanks would require significant amounts of interconnecting piping which could create an unacceptable potential for significant leaks or spills.

For off-site disposal, 630,000gpd on average would require approximately 84 trucks per day based on 7,500 gallons per truck to haul off and dispose of the water collected. This operation would need to take place 24 hours a day and 7 days a week and poses significant safety risks both on and off-site due to the truck traffic and is not feasible to achieve.

The most likely facility type capable of managing industrial wastewaters are publicly-owned or private treatment works, underground injection wells, or publicly available waste management facilities capable of solidifying liquid wastes for disposal in a landfill. Given the volume and characteristics of the CCR wastestreams, increases in permitted capacity or other modifications to the permitted pretreatment programs of a public or private wastewater treatment facility would likely be required to manage this flow, if one were available. Off-site disposal is not an option for Welsh Plant CCR material.

As a result, the conditions at Welsh Plant satisfy the demonstration requirement in 40 CFR § 257.103(f)(2)(i) and in the interim period (prior to permanent cessation of the coal-fired boilers) Welsh Plant must continue to use the PBAP due to the absence of alternative disposal capacity both on and off-site of the facility.

Non-CCR Wastestreams:

Approximately 12 MGD of various non-CCR wastestreams are sent to the PBAP. These wastewater streams include coal pile runoff, wash down of the electrostatic precipitator area, hydrovactor vacuum system discharges, boiler blowdown, water treatment waste (ultrafiltration, reverse osmosis, demineralizer), plant drains and sumps, contact and non-contact storm water runoff as well as contact storm water runoff from and through the ash landfill.

AEP evaluated each non-CCR wastestream placed in the PBAP at Welsh Plant. For the reasons discussed below and in Table 2, each of the following non-CCR wastestreams must continue to be placed in the PBAP due to lack of alternative capacity both on and off-site.

Table 2. Welsh Plant non-CCR Wastestreams

Non-CCR Wastestream	Average Flow (gpd)	Current Configuration	Alternative Capacity Currently Available? Yes/No	AEP Notes
Hydrovactor Flows	11,800,000	Pumped to the existing PBAP, using the existing bottom ash pumps and piping	No	The PBAP provides treatment for these non-CCR wastestreams (primarily solids settling) to allow them to meet the TPDES discharge limits and no on-site alternative capacity exists for treatment. Significant physical alterations would be required to treat the flows as noted in the discussion above. Off-site disposal of these flows is not practical as noted in the discussion below.
Coal Pile Runoff	260,000	Gravity flows to the existing PBAP	No	
Ecology Pit flows	668,000	Collects flow from multiple sources including plant drains, coolers and sumps pumped to the PBAP	No	
Washdowns of Electrostatic Precipitator Area	36,000	Flows to the existing PBAP through sump and exiting plumbing	No	
Water Treatment Waste	692,000	Wastewater from demineralizer regenerant, reverse osmosis and ultrafilter. Flows to the existing PBAP through sump and exiting plumbing	No	
Lab Drains & Boiler Blowdown	132,000	Flow to the existing PBAP	No	

Non-CCR Wastestream	Average Flow (gpd)	Current Configuration	Alternative Capacity Currently Available? Yes/No	AEP Notes
Ash Landfill Stormwater Runoff	180,000	Flow is directed to the existing PBAP through a system of ditches	No	
Non-contact stormwater runoff	Intermittent	Flow is directed to the existing PBAP through a system of ditches	No	

Welsh Plant does not have an existing alternate impoundment on-site that can be utilized for the non-CCR wastestreams as discussed above.

Relative to off-site disposal capacity for the non-CCR streams; the sheer volume which would need to be handled on a daily basis makes this impractical. 12 MGD on average would require approximately 1600 trucks per day based on 7,500 gallons per truck to haul off and dispose of the water collected. This operation would need to take place 24 hours a day and 7 days a week and poses significant safety risks both on and off-site due to the truck traffic. Collection of the flows would require the installation of significant infrastructure (sumps, piping, loading facilities) that currently does not exist at the plant for most of the non-CCR wastrestreams. Furthermore, the 12 MGD flow rate is an average flow rate. Several of the non-CCR wastestreams (coal pile runoff, landfill runoff, etc) are mostly a result of rain events which are not predictable and could result in daily flows that significantly exceeds the 12 MGD average flowrate. The most likely facility type capable of managing industrial wastewaters are publicly-owned or private treatment works, underground injection wells, or publicly available waste management facilities capable of solidifying liquid wastes for disposal in a landfill. Given the volume and characteristics of the non-CCR wastestreams, increases in permitted capacity or other modifications to the permitted pretreatment programs of a public or private wastewater treatment facility would likely be required to manage this flow, if one were available.

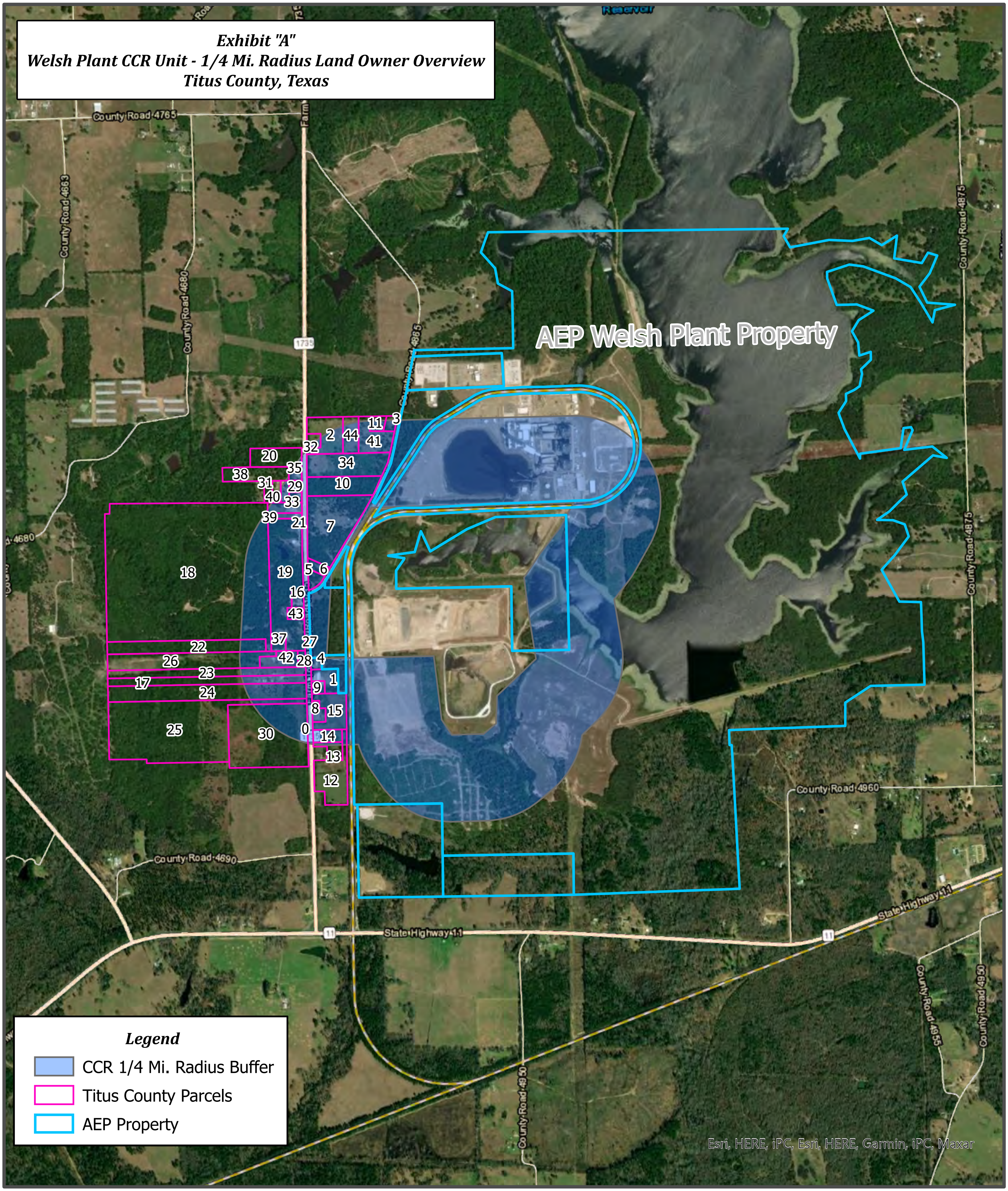
Consequently, there are no feasible offsite-disposal options for the non-CCR wastestreams at Welsh Plant. As stated previously, since AEP has elected to pursue the option to permanently cease the use of the coal fired boilers by a certain date, developing alternative disposal capacity is “illogical,” to use EPA’s words, and also counterproductive to the work to retire the boilers and close the impoundments. There is currently no existing installed infrastructure at the plant to support reroute of these flows. For the reasons discussed above, each of the remaining non-CCR wastestreams must continue to be placed in the PBAP due to lack of alternative capacity both on and off-site. Consequently, in order to continue to operate and generate electricity, Welsh Plant must continue to use the PBAP to manage the non-CCR wastestreams discussed above.

Based on the evaluation of alternative disposal options, AEP selected the following options for compliance at Welsh Plant:

- Cessation of the coal burning boilers
- Closure of the PBAP by CCR material removal.

Land Ownership Map

Exhibit "A"
Welsh Plant CCR Unit - 1/4 Mi. Radius Land Owner Overview
Titus County, Texas



Disclaimer: This drawing is not an actual survey, and is for general information purposes only.

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Land Ownership List

Map ID	OWN1_LAST	OWN1_FRST	OWN2_LAST	OWN2_FRST	MAIL_NBR	MAIL_STR	MAIL_MODE	MAIL_QDRT	MAIL_UNIT	MAIL_CITY	MAIL_STATE	MAIL_ZIP
0	WEST	DONALD	WEST	ANNIE	7661	FM 1735				PITTSBURG	TX	756868556
1	WEST	HERMAN	WEST	TABATHA	2720	STATE HIGHWAY 11				PITTSBURG	TX	756868543
2	ELLIS	RAYMOND			6851	FM 1735				PITTSBURG	TX	756868599
3	YEPEZ	LITZI DANIELA			3830	TEXAS HIGHWAY 49				MOUNT PLEASANT	TX	754558819
4	WEST	HERMAN	WEST	TABATHA	2720	STATE HIGHWAY 11				PITTSBURG	TX	756868543
5	EVANS	V A			1406	COUNTY ROAD 4865				PITTSBURG	TX	756868562
6	EVANS	V A			1406	COUNTY ROAD 4865				PITTSBURG	TX	756868562
7	CRAIG	HATTIE RUTH				PO BOX 896				PITTSBURG	TX	756860896
8	ADAMS	JUDY ANN			302	LAKE LAMOND	RD		20	LONGVIEW	TX	756045820
9	WEST	EDDIE			7501	FM 1735				PITTSBURG	TX	756868555
10	TEXAS BONARRICO HOMES LLC				8023	FM 1735				PITTSBURG	TX	756868606
11	YEPEZ	DANIEL			3830	TEXAS HIGHWAY 49				MOUNT PLEASANT	TX	754558819
12	JENKINS	V J			875	COUNTY ROAD 4950				PITTSBURG	TX	756865514
13	REVERSE MORTGAGE FUNDING LLC				3900	CAPITOL CITY	BLVD			LANSING	MI	489062147
14	PLAYBOY RIDING CLUB					PO BOX 67				CASON	TX	756360067
15	ADAMS	JUDY ANN			302	LAKE LAMOND	RD		20	LONGVIEW	TX	756045820
16	EVANS	ARTHUR LEE			7324	FM 1735				PITTSBURG	TX	756868553
17	GONZALEZ	FELIPE			7502	FM 1735				PITTSBURG	TX	756868560
18	TIPPIT	RONALD			4679	TEXAS HIGHWAY 37		S		CLARKSVILLE	TX	754267804
19	ROCKWELL	BRENDA			7060	FM 1735				PITTSBURG	TX	756868586
20	HUERTA	VICTOR LIERA	PAULA	VILLEGAS BARRIENTO	1311	HOUSTON	AVE			MOUNT PLEASANT	TX	754552837
21	CHURCH OAK GROVE CHURCH OF CHRIST					PO BOX 249				CASON	TX	756360249
22	EVANS	BUSH			458	COUNTY ROAD 1326				QUITMAN	TX	757834098
23	GONZALEZ	FELIPE			7502	FM 1735				PITTSBURG	TX	756868560
24	DUNN	GREGORY L	DUNN	TERRI J	3209	SAWGRASS	RD			EDMOND	OK	730348335
25	KEITH	JOHN F			235	MANSFIELD	BLVD			SUNNYVALE	TX	751829550
26	LAWRENCE	MARK			1495	COUNTY ROAD 4680				PITTSBURG	TX	756868514
27	WILLIS	GEORGE O			939	INDIAN CREEK	TRL			DALLAS	TX	752411928
28	SIMMONS	JAMES F			67	COUNTY ROAD 1264				PITTSBURG	TX	756865797
29	SALAS	MARCELINO			1305	MCMINN	AVE			MOUNT PLEASANT	TX	754555734
30	KEITH	JOHN F			235	MANSFIELD	BLVD			SUNNYVALE	TX	751829550
31	STEVENSON	TONDRA			2000	CHOCTAW	ST		58	MOUNT PLEASANT	TX	754555150
32	ELLIS	RAYMOND			6851	FM 1735				PITTSBURG	TX	756868599
33	GARRETT	BRENDA ROCKWELL				PO BOX 1424				MOUNT PLEASANT	TX	754561424
34	PORTER	DAMIEN DONTE			465	COUNTY ROAD 1346				PITTSBURG	TX	756866420
35	MORROW	TONY			6878	FM 1735				PITTSBURG	TX	756868551
36	TORRES	RAMON	TORRES	GRICELDA	6855	FM 1735				PITTSBURG	TX	756868599
37	TRAYLOR	MARENDA ROCKWELL				PO BOX 1424				MOUNT PLEASANT	TX	754561424
38	PAIXAO	LUIS	BARBOSA	CELINA	6890	FM 1735				PITTSBURG	TX	756868551
39	CHURCH OAK GROVE CHURCH OF CHRIST					PO BOX 249				CASON	TX	756360249
40	LINWOOD	TONYA			6928	FM 1735				PITTSBURG	TX	756868552
41	YEPEZ	DANIEL	YEPEZ	MARIA L	3830	TEXAS HIGHWAY 49				MOUNT PLEASANT	TX	754558819
42	RAGSDALE	JOEY	RAGSDALE	AMANDA	1808	COUNTY ROAD 4840				MOUNT PLEASANT	TX	754558244
43	ROCKWELL	LIONEL				PO BOX 1282				MOUNT PLEASANT	TX	754561282
44	YEPEZ	DANIEL	YEPEZ	MARIA L	3830	TEXAS HIGHWAY 49				MOUNT PLEASANT	TX	754558819

ATTACHMENT 1

Location Restrictions and Geology Reports

30 TAC §352.241- Geology

Location Restriction Reports containing a summary of the geologic conditions at the facility and were prepared and signed in accordance with 30 TAC §352.4. All groundwater monitoring data is located in the annual Groundwater Monitoring and Corrective Action Reports (see, Attachment 4b).

30 TAC §352.251 - Location Restriction Application Submission

These Location Restriction reports contain documentation demonstrating compliance with applicable location restrictions in Subchapter E of 30 TAC §352 and information required by Placement above the uppermost aquifer (30 TAC §352.601/40 CFR §257.60), Wetlands (30 TAC §352.611/40 CFR §257.61), Fault Areas (30 TAC §352.621/40 CFR §257.62), Seismic impact zones (30 TAC §352.631/40 CFR §257.63), and Unstable areas (30 TAC §352.641/40 CFR §257.64) were applicable.

Terms used in these reports comport with 30 TAC §352.3/40 CFR §257.53

Geology Summary Report – See Section 2.4 in the Location Restriction Report

Submit a summary of the geologic conditions at the facility, including the relation of the geologic condition to each CCR unit. The summary must include enough information and data and include sources and references for the information. Include all groundwater monitoring data required by 40 CFR Part 257, Subpart D, (30 TAC §352.241, §352.601, §352.621, §352.631, and §352.641) and submitted in accordance of 30 TAC §352.4.

1.1 – Primary Bottom Ash Pond – CCR Location Restriction Evaluation, October 3, 2018

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American Electric Power Service Corporation

Primary Bottom Ash Pond - CCR Location Restriction Evaluation

J. Robert Welsh Power Plant
1187 County Road 4865
Titus County
Pittsburg, Texas

October 3, 2018

ARCADIS

STATE OF TEXAS
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Primary Bottom Ash Pond – CCR Location Restriction Evaluation

J. Robert Welsh Plant
1187 County Road 4865
Titus County
Pittsburg, Texas

Prepared for:

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Our Ref.:

OH015976.0011

Date:

October 3, 2018

Tables

Figures

Appendices

Acronyms and Abbreviation

AEP	American Electric Power Service Cooperation
amsl	above mean sea level
ARCADIS	ARCADIS U.S., Inc.
PBAP	primary bottom ash pond
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
FAP	fly ash pond
FGD	flue gas desulfurization
ft	feet
PTI	Permit to Install
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality

1. Objective

This report was prepared by ARCADIS U.S., Inc. (ARCADIS) for American Electric Power Service Corporation (AEP) to assess the location of the Primary Bottom Ash Pond relative to the location restrictions included in the Coal Combustion Residual (CCR) requirements, as specified in the Code of Federal Regulations (CFR) 40 CFR 257.60 to 257.64, at the AEP Generating Plant (Plant) located at 1187 County Road 4865 in Pittsburg, Titus County, Texas (**Figure 1**). The CCR requirements include an evaluation of the adequacy of the groundwater monitoring well network to characterize groundwater quality up and down gradient of the CCR unit and an evaluation of whether the CCR unit meets up to 5 location restrictions, which include: the base of the CCR unit is 5 feet (ft) above the uppermost aquifer, the CCR unit may not be located in a wetland, within 200 ft of the damage zone of a fault that has displacement during the Holocene, within a seismic impact zones, or in an unstable area.

Three regulated CCR units associated with the Plant were identified for review, which include the Primary Bottom Ash Pond, landfill, and bottom ash storage pond (**Figure 2**). This report summarizes the evaluation of the location restriction criteria at the Primary Bottom Ash Pond (Site). The evaluation of the groundwater monitoring well network in the uppermost aquifer is not included in this report and will be completed under separate cover.

This evaluation included a review of AEP-provided data associated with previously completed subsurface investigation activities in the vicinity of the Primary Bottom Ash Pond CCR unit, as well as publically-available geologic and hydrogeologic data. The following report also presents the current Conceptual Site Model based on documents reviewed and will further describe the uppermost aquifer.

2. Background Information

The following section provides background information for the AEP J. Robert Welsh Generating Plant Primary Bottom Ash Pond.

2.1 Facility Location Description

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The Primary Bottom Ash Pond CCR unit is located southwest of the Plant and directly west of the Welsh Reservoir (**Figures 1** and **2**).

2.2 Description of Primary Bottom Ash Pond CCR Unit

The following section will discuss the embankment configuration, area, volume, construction and operational history, and surface water control associated with the Primary Bottom Ash Pond.

2.2.1 Embankment Configuration

The Primary Bottom Ash Pond was placed into operation in approximately 1977, and is located in a topographically low area that had been an unnamed intermittent tributary of Swauano Creek prior to development of the Site. The Primary Bottom Ash Pond is bounded by natural ground surface (topographically higher areas) to the north and west, and embankment dikes to the south and east. These dikes are constructed of compacted sandy clay and clayey sand. The embankment dike south of the Primary Bottom Ash Pond includes a drainage canal that receives overflow (clear) water from the Primary Bottom Ash Pond. The water level in the Primary Bottom Ash Pond is controlled by a weir box which discharges into the drainage canal. The clear water in the drainage canal flows east and discharges into the clear water pond.

The Primary Bottom Ash Pond embankment is up to approximately 40 ft in height. Discussions of embankment configuration and timeline, including cross sections through the dikes, was provided in a previous report prepared by ETTL Engineers & Consultants Inc. in 2010 (ETTL, 2010).

2.2.2 Area/Volume

Per the *Hydraulic Analysis of Welsh Power Plant Ash Ponds Report,* dated December 2010 (Freese and Nichols, 2010), the bottom elevation of the Primary Bottom Ash Pond is 300 feet above mean sea level (amsl), the high level overflow weir box bottom elevation is 325 feet amsl, and the storage capacity of the Primary Bottom Ash Pond at elevation 325 feet amsl is 304.2 acre-ft (**Figure 3**).

2.2.3 Construction and Operational History

The AEP J. Robert Welsh Plant began operations in 1977 with three coal-fired generating units (Units 1, 2, and 3). Throughout the life of the generating plant, CCR materials (fly ash, bottom ash, economizer ash) have been generated. All of these byproducts were stored in either the Primary Bottom Ash Pond or in the adjacent landfill that was constructed in approximately 1977. In 2000, the 22-acre bottom ash storage pond was installed south of the landfill. The bottom ash storage pond was constructed with a 60-mil high-density polyethylene (HDPE) liner, and receives bottom ash and economizer ash dredged and sluiced from the Primary Bottom Ash Pond (**Figure 3**).

Presently bottom ash and economizer ash from the generating plant are sluiced to the Primary Bottom Ash Pond. Solids settle as the clear liquids flow through a drainage canal into the clear water pond (a non-CCR unit). Water in the clear water pond discharges through a weir box into a 36-inch-diameter pipe, and then into the Welsh Reservoir under Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ00018111000 (**Figure 3**).

2.2.4 Surface Water Control

Surface water flow within the Primary Bottom Ash Pond complex is controlled by a weir and emergency spillway located on the south side of the pond below the embankments. The pond elevation is maintained so that surface water flows through the weir box which has a bottom elevation of 325 feet amsl. The emergency spillway is 90 feet wide with a crest elevation of 334 feet amsl. Clear water flows through the weir (and occasionally the emergency spillway during heavy precipitation events) into a drainage canal along the south side of the pond. The drainage canal discharges into the clear water pond located directly southeast of the Primary Bottom Ash Pond (**Figure 3**).

The perimeter embankments on the south and east sides of the Primary Bottom Ash Pond are located at an approximate elevation of 340 feet amsl. Therefore the perimeter embankments have approximately six feet of freeboard above the emergency spillway.

2.3 Previous Investigations

The initial soils investigation for the site was provided in a 1973 report prepared by McClelland Engineers, Inc. entitled "*Soils Investigation, Welsh Power Plant, Cason, Texas*". This investigation included advancement of soil borings in the Primary Bottom Ash Pond area, and geotechnical soil testing to characterize the area encompassed by the Primary Bottom Ash Pond.

In 2001, five monitoring wells (AD-1 through AD-5) were installed in the area of the Primary Bottom Ash Pond and bottom ash storage pond to obtain hydrologic data for the uppermost water-bearing unit. Twelve additional monitoring wells (AD-4a, AD-4b, AD-4c, AD-6 through AD-14) were installed in the area of the Primary Bottom Ash Pond, bottom ash storage pond, and landfill by Eagle Environmental Services in 2009 to obtain more detailed hydrologic data for the uppermost water-bearing unit.

In 2010, ETTL prepared a report entitled "*Geotechnical Investigation, Welsh Power Station, Existing Ash Storage Ponds Embankment Investigation, Pittsburg, Texas*". The objective of this report was to evaluate the stability of the earthen embankments for the Primary Bottom Ash Pond and non-CCR clear water pond (aka "Secondary Ash Pond"). The principal finding of this investigation was that slope stability would be acceptable following a proposed repair to the embankment of the clear water pond. The repair of the embankment of the clear water pond was completed during September 2010.

In 2010, Freese and Nichols performed a *Hydraulic Analysis of the Welsh Power Plant Ash Ponds* (Freese and Nichols, 2010). The report concluded the spillways for the Primary Bottom Ash Pond, clear water pond, and bottom ash storage pond are hydraulically adequate for the full range of storm events from the 10-year to the 100-year storm events.

In December 2015, Auckland Consulting further expanded the groundwater monitoring well system at the Plant by installation of monitoring wells AD-15 through AD-18 (Auckland Consulting, 2016). Monitoring well completion diagrams are provided in **Appendix A.**

2.4 Hydrogeologic Setting

The site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently southeast. The Site is located on the outcrop of the Eocene-age

Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966).

These features are further illustrated on five lines of cross section that were prepared through the Primary Bottom Ash Pond area, with three lines trending from west to east (A-A'; B-B'; C-C'), and the other two lines trending from north to south (D-D'; E-E'). The cross section location map is included as **Figure 3** and the lines of cross section are included as **Figure** 4 (A-A') through **Figure 8** (E-E').

2.4.1 Climate and Water Budget

The climate of Titus County, Texas is moist sub-humid. Average temperatures range from 45˚ Fahrenheit (F) in January to 82.9˚F in July. The mean annual growing season is 228 days (Broom, 1965). Average annual precipitation (including liquid water equivalent from snowfall) is approximately 47 inches according to weatherdb.com.

2.4.2 Regional and Local Geologic Setting

The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966). The Recklaw Formation attains a thickness of approximately 110 feet in Titus County, and is underlain by the Eocene-age Carrizo Sand which consists of fine to coarse sand, silt, and clay (Broom, 1965). In the topographically low areas underlying the Welsh Reservoir to the east of the Primary Bottom Ash Pond, Quarternary alluvial sediments associated with the Swauano Creek are present (Flawn, 1966).

Detailed regional geologic characterization can be found in several published reports including Texas Water Commission Bulletin 6517 "*Ground-Water Resources of Camp, Franklin, Morris and Titus Counties, Texas*" (Broom, 1965), and The University of Texas at Austin Bureau of Economic Geology "*Geologic Atlas of Texas – Texarkana Sheet*" (Flawn, 1966).

Detailed regional and site geologic characterization can be found in the 2010 ETTL report entitled "*Geotechnical Investigation, Welsh Power Station, Existing Ash Storage Ponds Embankment Investigation, Pittsburg, Texas*" (ETTL, 2010).

2.4.3 Surface Water and Surface Water Groundwater Interactions

The Site is generally less than one-half mile from Swauano Creek, which was dammed near the southern end of the site during plant development to form the Welsh Reservoir. Groundwater flow direction at the Site is generally from west to east, following surface topography towards the Welsh Reservoir. The Welsh Reservoir is likely a gaining surface water feature, and groundwater elevations on site are higher than the normal stage elevation of the Welsh Reservoir (320 feet amsl).

The Primary Bottom Ash Pond normal operating level is set by the weir box which has a bottom elevation of 325 feet amsl. **Figure 9** is a potentiometric surface map based on March 2016 water level data for the uppermost water bearing unit at the Site, and water level elevations in the Site monitoring wells are summarized on **Table 1**. As shown on Figure 9, shallow groundwater flow direction in the area of the Primary Bottom Ash Pond is easterly toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.01 foot per foot.

2.4.4 Water Users

A water well inventory conducted by Banks Information Solutions showed one water well within a ½-mile radius of the Site (Banks, 2013). The water well is located on-site to the southwest (side gradient) of the Primary Bottom Ash Pond, and was installed for Southwestern Electric Company in 1974 with a screened interval from 515 to 535 ft below ground surface, and plugged at a later date.

3. Isolation from the Uppermost Aquifer

CCR Rule 40 CFR Part 257.60 requires that the base of new and existing CCR surface impoundments be constructed such that the base of the unit is no less than 5 ft above the top of the uppermost aquifer, or that if the base is within 5 ft of the uppermost aquifer, that there will not be hydraulic connection between the base of the unit and the uppermost aquifer.

3.1 Uppermost Aquifer and Piezometric Analysis

3.1.1 Piezometric Analysis

3.1.1.1 Horizontal and Vertical Position Relative to CCR Unit

Geologic data from soil borings and monitoring wells installed at the site show the uppermost water bearing unit in the area of the Primary Bottom Ash Pond is a fine to medium grained clayey and silty sand stratum with an average thickness of approximately 10 feet that is located between an elevation of approximately 310 and 320 feet amsl (**Appendix A**). The base of the Primary Bottom Ash Pond ranges in elevation from approximately 330 feet amsl on the west to 300 feet amsl on the east. Therefore the uppermost water-bearing unit appears to be in contact with the Primary Bottom Ash Pond and is further illustrated on cross section A-A' (**Figure 4)** and cross section D-D' (**Figure 7)**.

3.1.1.2 Overall Flow Conditions

Groundwater is recharged from regional precipitation infiltration and locally from ash pond use. The uppermost water bearing unit (clayey and silty sand) is expected to have a hydraulic conductivity of approximately 10^{-4} centimeters per second (Fetter, 1980). Based on the hydraulic conductivity and saturated thickness (approximately 10 feet), the yield of the uppermost water-bearing unit is anticipated to exceed the TCEQ non-useable (Class 3) limit of 150 gallons per day (TCEQ, 2010).

Groundwater elevations are summarized on **Table 1** for 2011 through 2017. The comprehensive groundwater data set from March 2016 is depicted on **Figure 9**. The groundwater flow is generally easterly towards the Welsh Reservoir.

3.1.2 Uppermost Aquifer

3.1.2.1 CCR Rule Definition

The CCR rule definitions for an aquifer and the uppermost aquifer as specified in 40 CFR 257.53 indicates an aquifer is a geologic formation capable of yielding usable quantities of groundwater to wells or springs while an uppermost aquifer is defined as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers, that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural groundwater surface to which the aquifer rises during the wet season.

3.1.2.2 Common definitions

An aquifer is commonly defined as a geologic unit that stores and transmits water (readily or at sufficient flow rates) to supply wells and springs (USGS, 2015; Fetter, 2001). The uppermost aquifer is considered the first encountered aquifer nearest to the CCR unit.

3.1.2.3 State regulatory definition

According to Title 30, Texas Administrative Code (TAC) Rule 350, a useable aquifer is capable of yielding 150 gallons per day (approximately 0.1 gallons per minute) or more with a total dissolved solids concentration of 10,000 milligrams per liter (mg/L) or lower (TCEQ, 2010).

3.1.3 Identified onsite hydrostratigraphic unit

The identified on-Site hydrostratigraphic unit in the area of the Primary Bottom Ash Pond is the fine to medium grained clayey and silty sand stratum that is located between an elevation of approximately 310 and 320 feet amsl. This unit is not used locally for groundwater supply or industrial water use, but meets the TCEQ definition of a useable aquifer.

3.2 Compliance with Isolation Distance

The uppermost water-bearing unit underlying the Primary Bottom Ash Pond meets the regulatory definition of an aquifer. As shown on the cross-sections presented on **Figures 4** and **7**, the base of the Primary Bottom Ash Pond is in contact with this aquifer. Therefore, this CCR Unit does not meet the location restriction for separation from the uppermost aquifer.

4. Wetlands

CCR Rule 40 CFR Part 257.61 requires that existing and new CCR surface impoundments must not be located in wetlands.

4.1 Local Wetlands

Based on the August 20, 2015 site visit and review of available published information, a portion of the Primary Bottom Ash Pond is located within an area that exhibited wetland characteristics that might be classified as a regulated wetland. A potential wetlands location map is provided on **Figure 10**, and photos of these areas are included in **Appendix B**.

4.2 Compliance with Wetland Restrictions

Based on the August 20, 2015 site visit and review of available information, a portion of the Primary Bottom Ash Pond may be located within wetlands. Therefore, this CCR Unit may not meet the location restriction regarding wetlands. Further investigation is recommended.

5. Fault Areas

CCR Rule 40 CFR Part 257.62 requires that existing and new CCR surface impoundments must not be located within 200 ft of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates that the and alternate setback will prevent damage to the structural integrity of the CCR unit.

5.1 Description of Regional Geologic Structural Features

Regional geologic publications were reviewed to determine structural features for the Site. A regional fault map is provided on **Figure 11**. The U.S. Geological Survey Open File Report 88-450K shows the Site is located within the East Texas Basin, with faulting north of the basin (Talco Fault Zone) and south of the basin (Elkhart-Mt. Enterprise Fault Zone). No faulting was identified in the Site area (USGS, 1988). Texas Water Commission Bulletin 6517 and the University of Texas at Austin Bureau of Economic Geology Geologic Atlas of Texas – Texarkana Sheet show no faulting at the Site (Broom, 1965; Flawn, 1966).

A previous evaluation of geologic structural features at the Site was conducted by ETTL, and no evidence of faulting was identified (ETTL, 2010).

5.2 Compliance with Fault Area Restrictions

A review of available geologic reports and maps has indicated that the site is not located near any faults with displacement in the Holocene. Therefore, the CCR units at this site meet the location restriction for faults.

6. Seismic Impact Zone

CCR Rule 40 CFR Part 257.63 requires that existing and new CCR surface impoundments must not be located within a seismic impact zone unless the owner or operator demonstrates that all structural components of the CCR unit are designed to withstand the maximum horizontal acceleration in lithified earth material for the site.

6.1 Definition of Seismic Impact Zone

CCR Rule 40 CFR Part 257.53 defines a seismic impact zone as an area having a 2% or greater probability that the maximum horizontal acceleration expressed as a percentage of the earth's gravitational pull (g) will exceed 0.10 g in 50 years.

6.2 Compliance with Seismic Impact Zone Restriction

Figure 12 presents the seismic hazard map for Texas, as published by the USGS. As shown on **Figure 12**, the site falls within the zone having a maximum horizontal acceleration of 0.04 to 0.06 g. Therefore, the CCR unit meets the location restriction for seismic impact zone.

7. Unstable Areas

CCR Rule 40 CFR Part 257.64 requires that existing and new CCR surface impoundments must not be located within an unstable area unless the owner or operator demonstrates that the design of the unit will ensure the integrity of the structural components of the unit.

7.1 Definition of Unstable Area and local Conditions

7.1.1 CCR Rule Definition

CCR Rule 40 CFR Part 257.53 defines an unstable area as a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of the CCR unit. These may include poor foundation conditions, areas susceptible to mass movements (landslides), and karst terrains.

7.1.2 Poor Foundation Soils

A soil stability report has been prepared for the Primary Bottom Ash Pond by ETTL in 2010. This report concluded that the Primary Bottom Ash Pond embankments exhibit acceptable factors of safety and that the underlying foundation soils are not susceptible to liquefaction.

7.1.3 Mass Movements

The Primary Bottom Ash Pond is located within the valley floor of an unnamed intermittent tributary of Swauano Creek, and is therefore not an area subject to mass movements. This conclusion is supported by the ETTL soil stability report (ETTL, 2010).

7.1.4 Karst

The site area is located on the outcrop of unconsolidated Cretaceous Formations consisting predominantly of sand and clay (Broom, 1965; Flawn, 1966). The Primary Bottom Ash Pond is not located in a karst area.

7.1.5 Subsurface Mining

No subsurface mines are known to exist below the CCR units at the Site.

7.2 Compliance with Unstable Areas Restriction

Based on our site visit and review of available information, the Primary Bottom Ash Pond is not located within unstable areas. Therefore, this CCR unit meets the location restriction requirements for unstable areas.

8. Summary, Conclusions, and PE Certification

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, as well as the evaluations discussed within this report, the J. Robert Welsh Power Plant Primary Bottom Ash Pond meets the CCR surface impoundment location restrictions of 40 CFR Part 257 for fault areas, seismic impact zones, and unstable areas. However, the Primary Bottom Ash Pond does NOT meet the location restrictions for separation from the uppermost aquifer and possibly wetlands.

Kenneth J. Brandner
Printed Name of Registered Professional Engineer

Kenneth J Brandner
Signature

KENNETH J. BRANDNER
69586

69586
Registration No.

Texas
Registration State

10-3-18
Date

9. References

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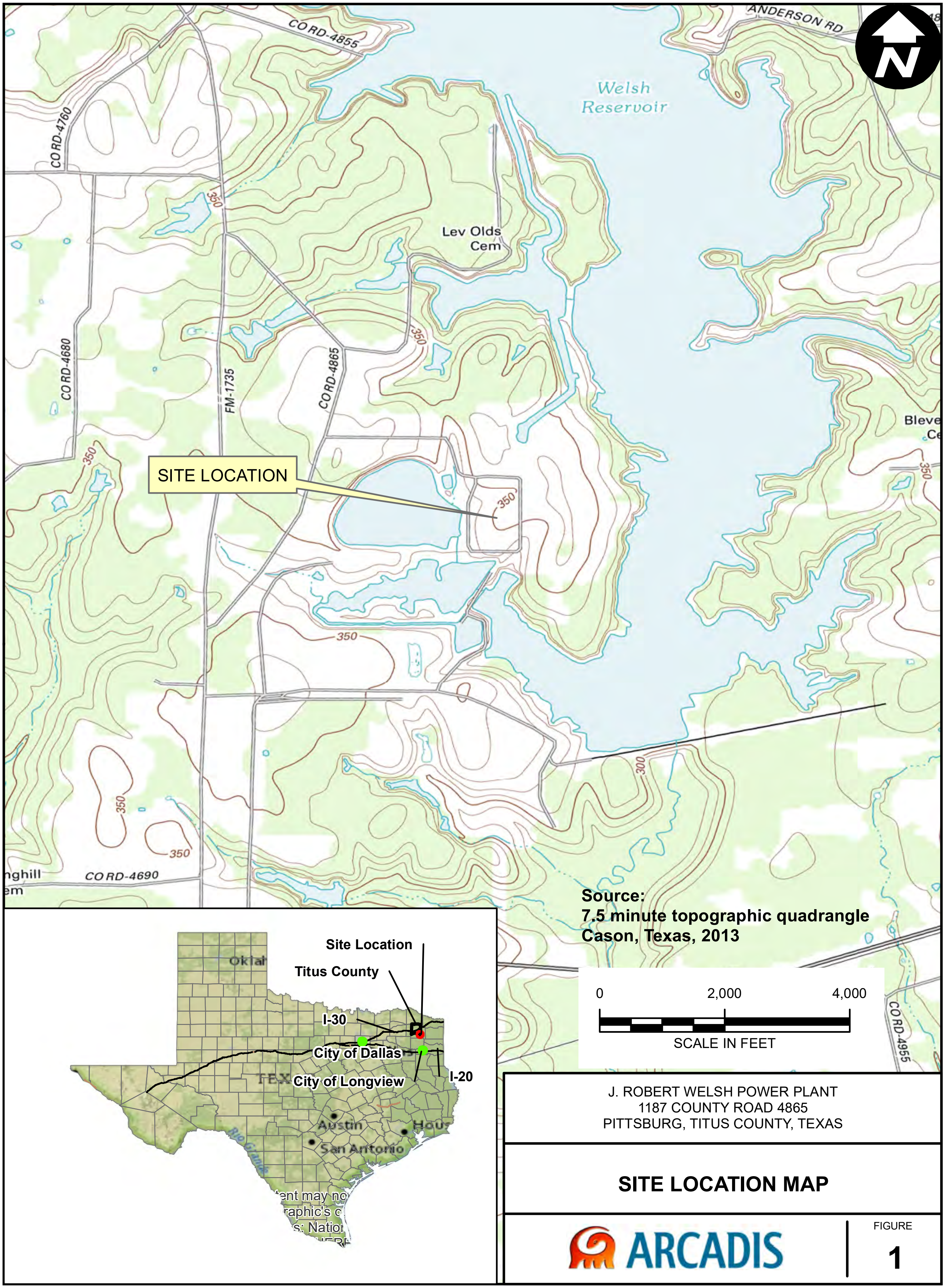
Table 1
Water Level Data
AEP J. Robert Welsh Power Plant - CCR Storage Areas
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Screen		Bottom of Screen		6/7/2011	12/6/2011	5/2/2012	11/1/2012	5/14/2013	11/19/2013	5/12/2014	11/16/2014	5/12/2015	3/4/2016	5/26/2016	7/27/2016	10/19/2016	12/12/2016	1/17/2017	2/23/2017
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																												
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57	338.46	334.92	337.88	337.18	337.43	336.73	338.03	337.64	340.82	342.83	344.89	342.89	341.23	340.58	341.18	339.74
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16	330.16	329.07	330.00	329.26	329.83	329.70	330.09	329.69	332.56	332.32	332.32	332.32	332.32	332.32	332.32	332.32
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10	323.81	323.19	323.99	323.29	323.77	323.98	324.12	323.28	325.58	325.12	325.12	325.12	325.12	325.12	325.12	325.12
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61	324.81	324.84	324.62	324.40	324.74	325.52	325.44	325.13	327.00	326.90	326.90	326.90	326.90	326.90	326.90	326.90
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19	325.01	324.19	325.24	322.90	324.86	324.68	325.64	325.34	327.19	327.12	327.12	327.12	327.12	327.12	327.12	327.12
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55	324.35	324.32	324.50	324.30	324.30	325.21	325.22	324.90	326.58	326.67	326.67	326.67	326.67	326.67	326.67	326.67
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15	324.18	324.50	324.64	324.37	324.11	325.06	325.01	324.71	326.50	326.19	326.19	326.19	326.19	326.19	326.19	326.19
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00	336.34	336.58	336.82	336.99	336.78	336.47	336.80	336.01	339.07	338.04	338.04	338.04	338.04	338.04	338.04	338.04
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31	333.04	333.02	332.83	333.02	333.11	332.81	333.11	332.81	333.38	334.00	334.00	334.00	334.00	334.00	334.00	334.00
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86	334.32	334.12	334.19	334.20	334.13	334.58	333.77	333.98	334.09	333.61	333.61	333.61	333.61	333.61	333.61	333.61
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53	325.41	324.09	325.69	325.15	325.79	325.75	325.98	325.77	326.05	325.70	325.70	325.70	325.70	325.70	325.70	325.70
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32	328.46	328.53	328.63	328.44	328.74	329.38	NM	330.18	329.98	329.74	329.74	329.74	329.74	329.74	329.74	329.74
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23	323.44	322.55	323.27	323.35	323.51	323.76	323.57	323.88	323.95	323.55	323.55	323.55	323.55	323.55	323.55	323.55
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61	327.99	328.37	327.82	327.93	327.94	328.13	328.20	327.97	328.96	328.13	328.13	328.13	328.13	328.13	328.13	328.13
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27	348.30	348.29	349.86	349.56	349.99	349.65	349.89	350.01	350.65	350.39	350.39	350.39	350.39	350.39	350.39	350.39
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12	332.36	332.24	333.09	332.26	332.68	333.25	333.35	332.01	337.58	334.76	334.76	334.76	334.76	334.76	334.76	334.76
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32	330.40	329.80	331.67	330.34	330.94	331.69	332.12	330.17	336.63	334.83	334.83	334.83	334.83	334.83	334.83	334.83
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71	---	---	---	---	---	---	---	---	---	322.14	322.14	322.14	322.14	322.14	322.14	322.14
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86	---	---	---	---	---	---	---	---	---	337.09	337.09	337.09	337.09	337.09	337.09	337.09
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99	---	---	---	---	---	---	---	---	---	334.64	334.64	334.64	334.64	334.64	334.64	334.64
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17	---	---	---	---	---	---	---	---	---	343.66	343.66	343.66	343.66	343.66	343.66	343.66
Piezometers																												
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

NM - Not measured.
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through March 2016.



Source:
7.5 minute topographic quadrangle
Cason, Texas, 2013

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LOCATION MAP

ARCADIS

FIGURE
1

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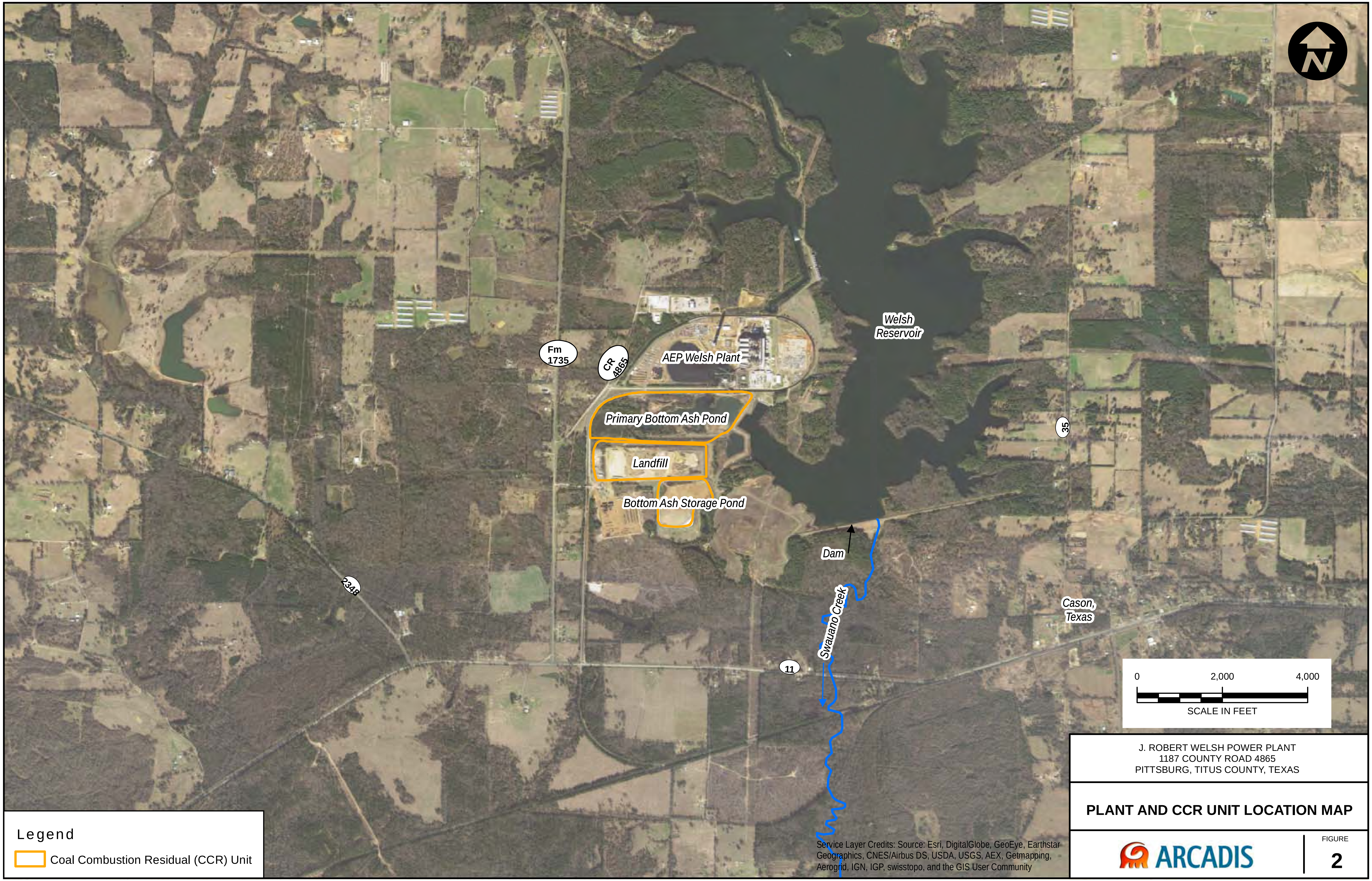

Legend

▭ Coal Combustion Residual (CCR) Unit

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PLANT AND CCR UNIT LOCATION MAP

ARCADIS

FIGURE
2

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 2 - CCR location.mxd

Legend

- ✦ Monitoring Well Location
- ● Piezometer Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◐ Soil Boring
- A ⊢⊣ A' Line of Geologic Cross Section
- ▭ Site Features

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LAYOUT AND WELL LOCATIONS

ARCADIS

FIGURE
3

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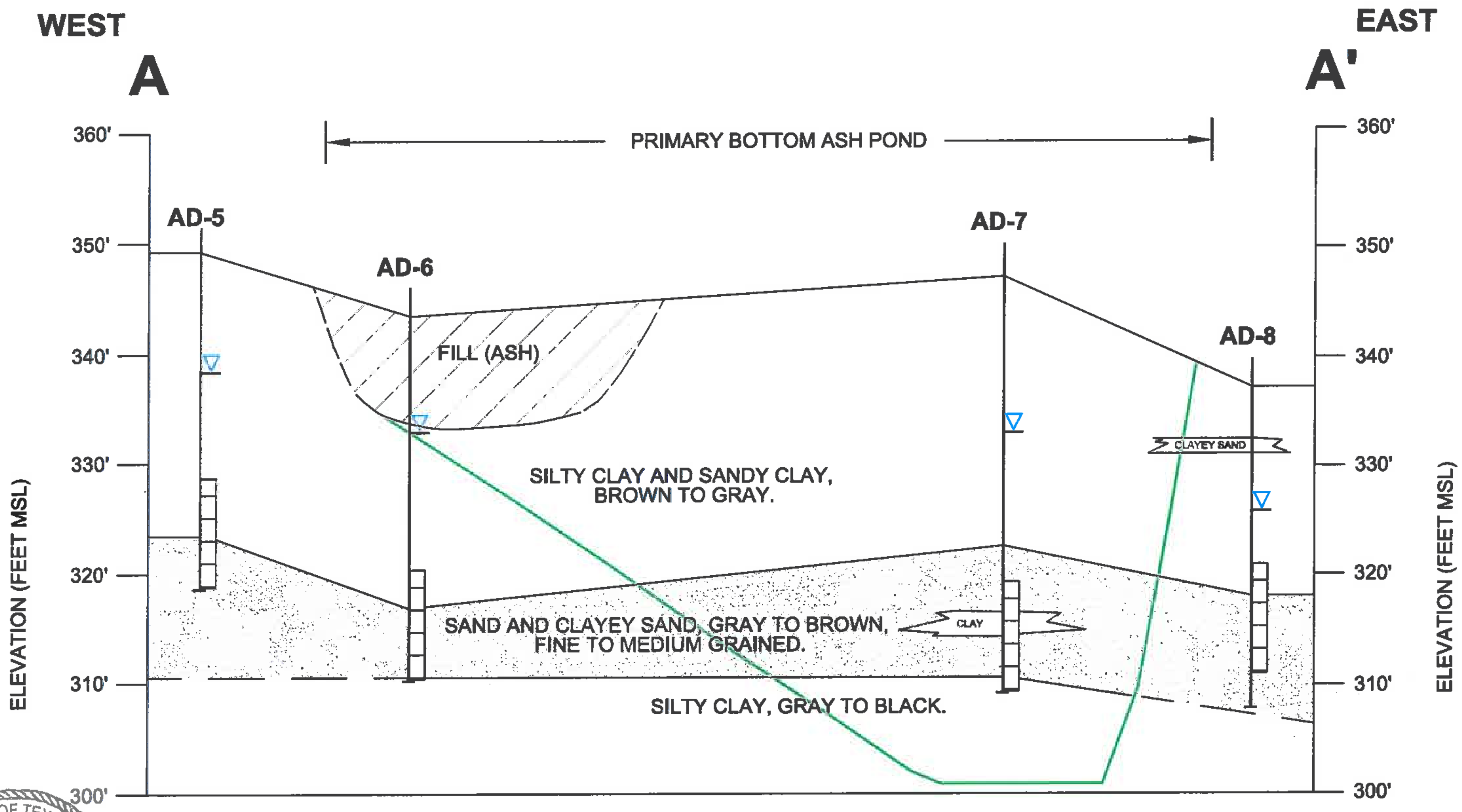

Kenneth J. Brandner
Geology
1787

10-3-18

0 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (5/12/15)
—	PROJECTED BASE OF ASH POND (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
A - A'

ARCADIS

FIGURE
4

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH016970 - CCR Plant Assessments\Welsh Power Plant\2018 Final Reports\Primary Ash Pond WELL Network Evaluation\Figures-Maps\Figure 4 Cross Section A-A'.dwg LAYOUT: MODEL SAVED: 8/28/2018 9:53 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE:
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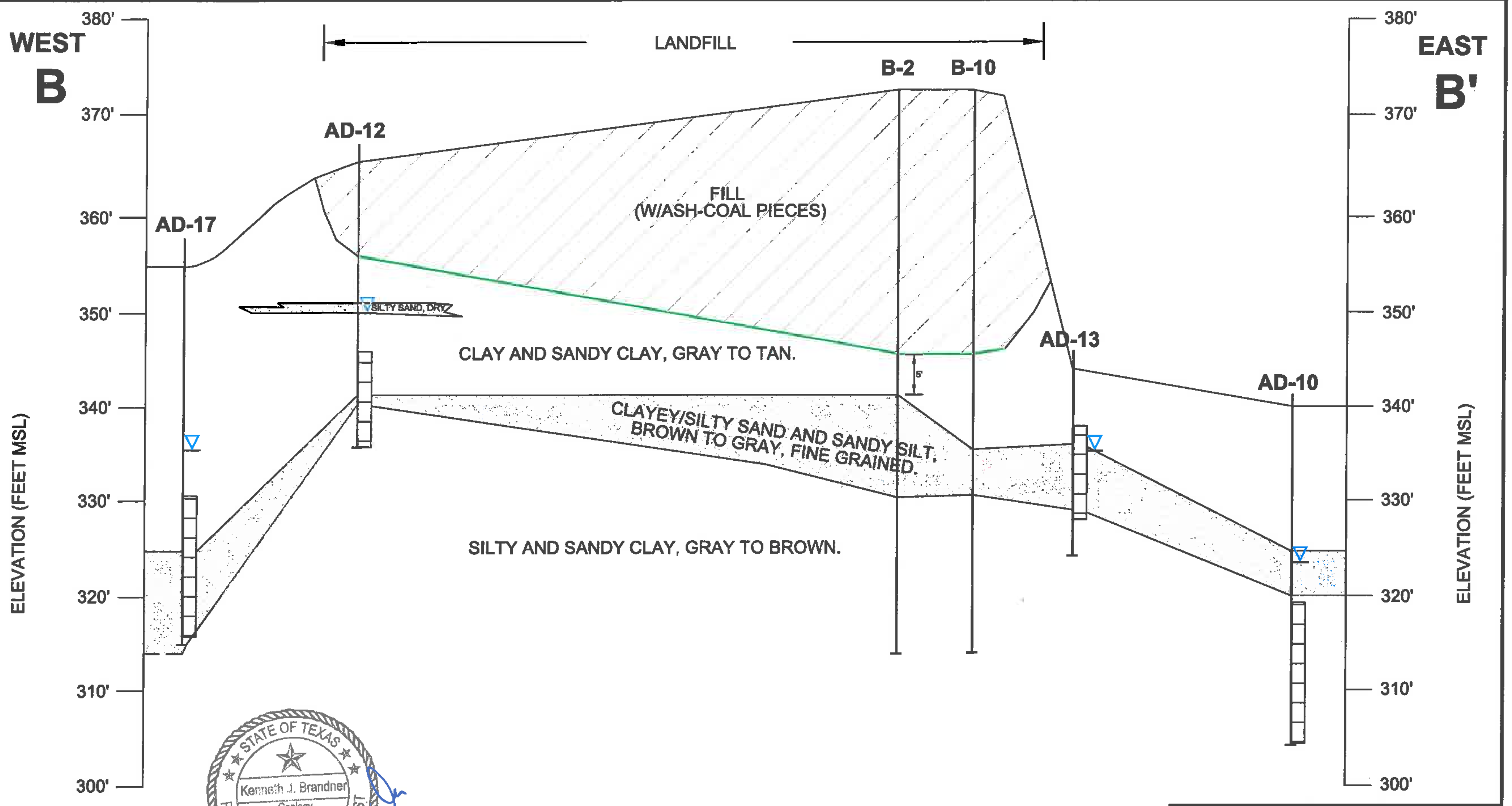

Kenneth J. Brandner
Geology
1787

10-3-18

0 300'
HORIZONTAL SCALE

NOTE: BASE OF LANDFILL ELEVATION TAKEN FROM "WELSH POWER PLANT- UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12/3/76.

LEGEND

☐	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
🟩	BASE OF LANDFILL (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
B - B'

ARCADIS

FIGURE
5

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH018978 - CCR Plant Assessment\Welsh Power Plant\2018 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 5 Cross Section B-B'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:41 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE:
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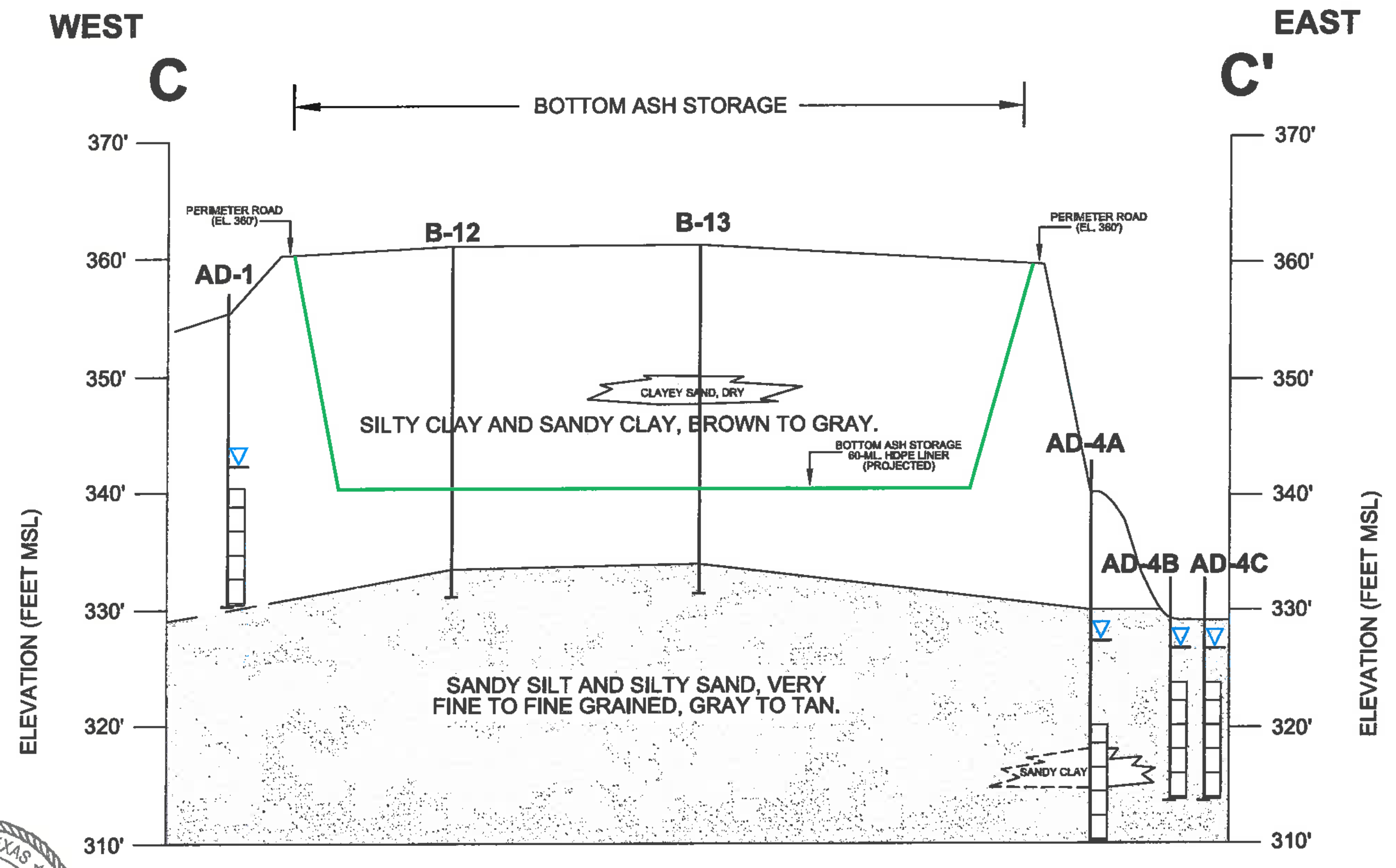


STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOLOGIST

10-3-18

0 200'
HORIZONTAL SCALE

NOTE: BASE OF BOTTOM ASH STORAGE HAS A 60-MIL. HDPE LINER AT ELEVATION 340.0', TAKEN FROM FREESE AND NICHOLS "HYDRAULIC ANALYSIS OF WELSH POWER PLANT ASH PONDS, AMERICAN ELECTRIC POWER COMPANY", DATED DECEMBER 2010.

LEGEND

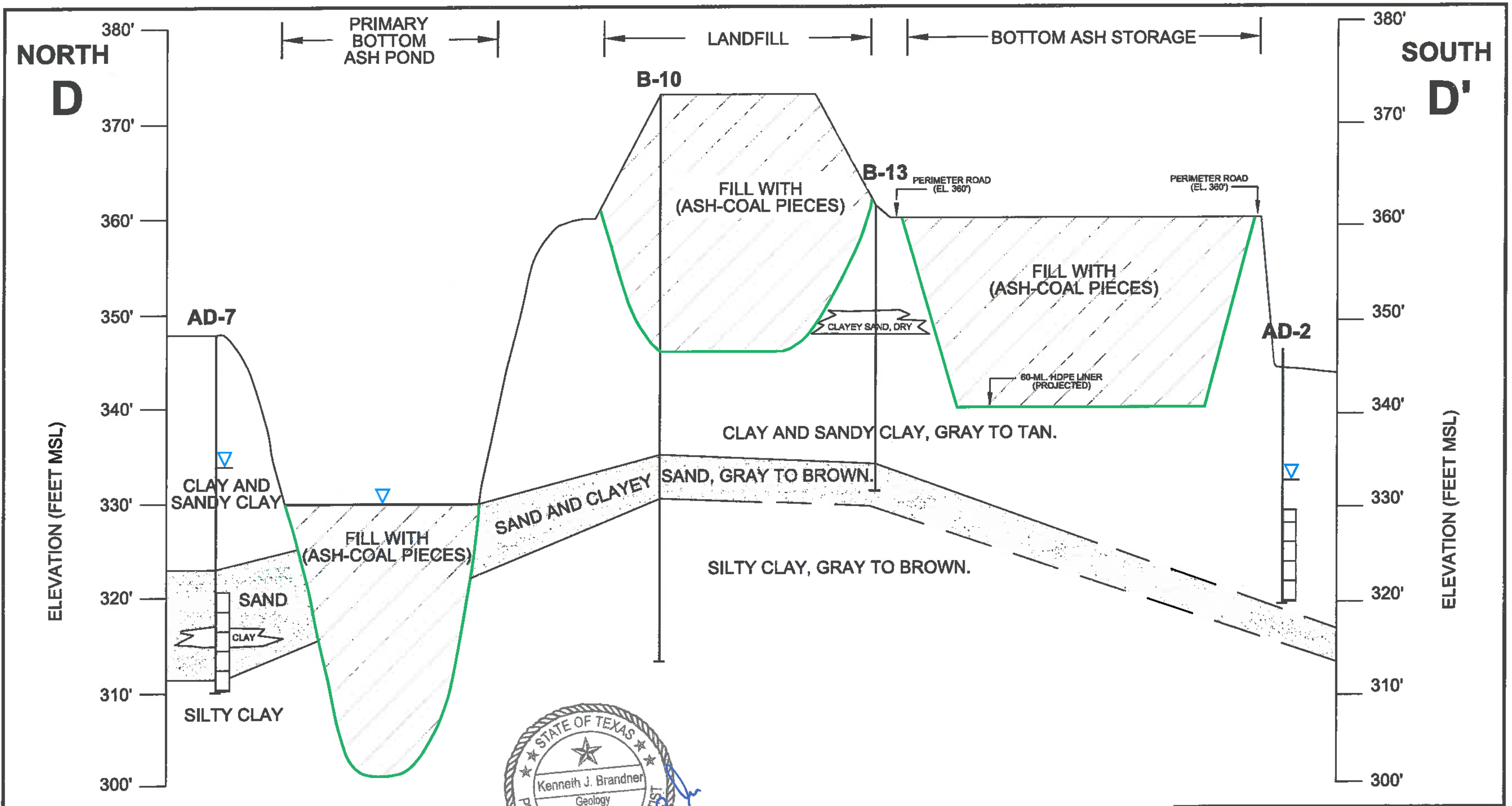
⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
🟩	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION C - C'

ARCADIS

FIGURE
6



Kenneth J. Brandner
Geology
1787

Kenneth J. Brandner
10-3-18

0 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

▤	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (5/12/15)
🟩	BASE OF CCR UNIT

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
D - D'

ARCADIS

FIGURE
7

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond WELL Network Evaluation\Figures-Maps\Figure 7 Cross Section D-D'.dwg LAYOUT: MODEL SAVED: 5/26/2015 10:07 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE:
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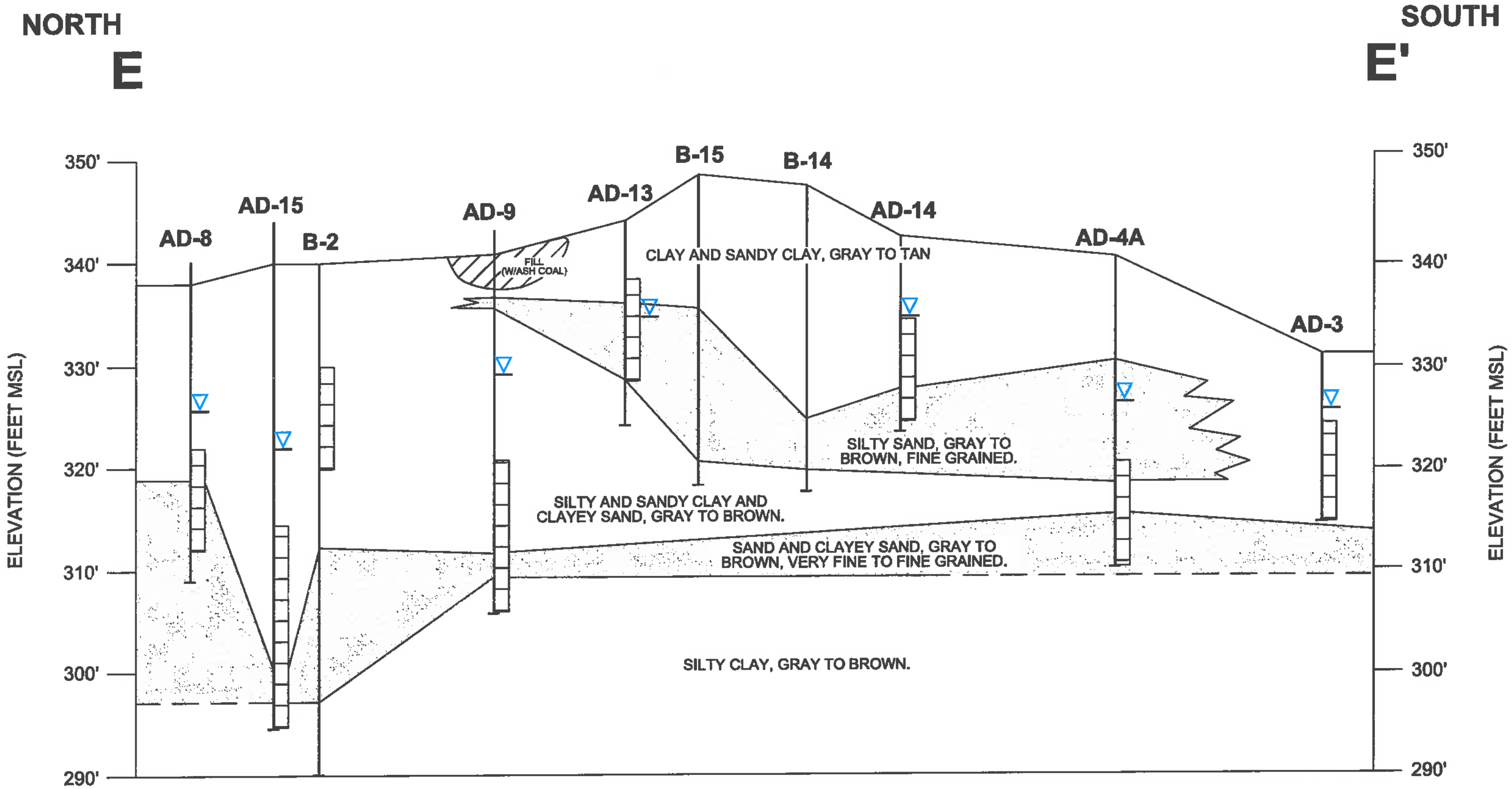


Kenneth J. Brandner
Geology
1787

10-3-18

0 ▬▬▬ 300'
HORIZONTAL SCALE

LEGEND

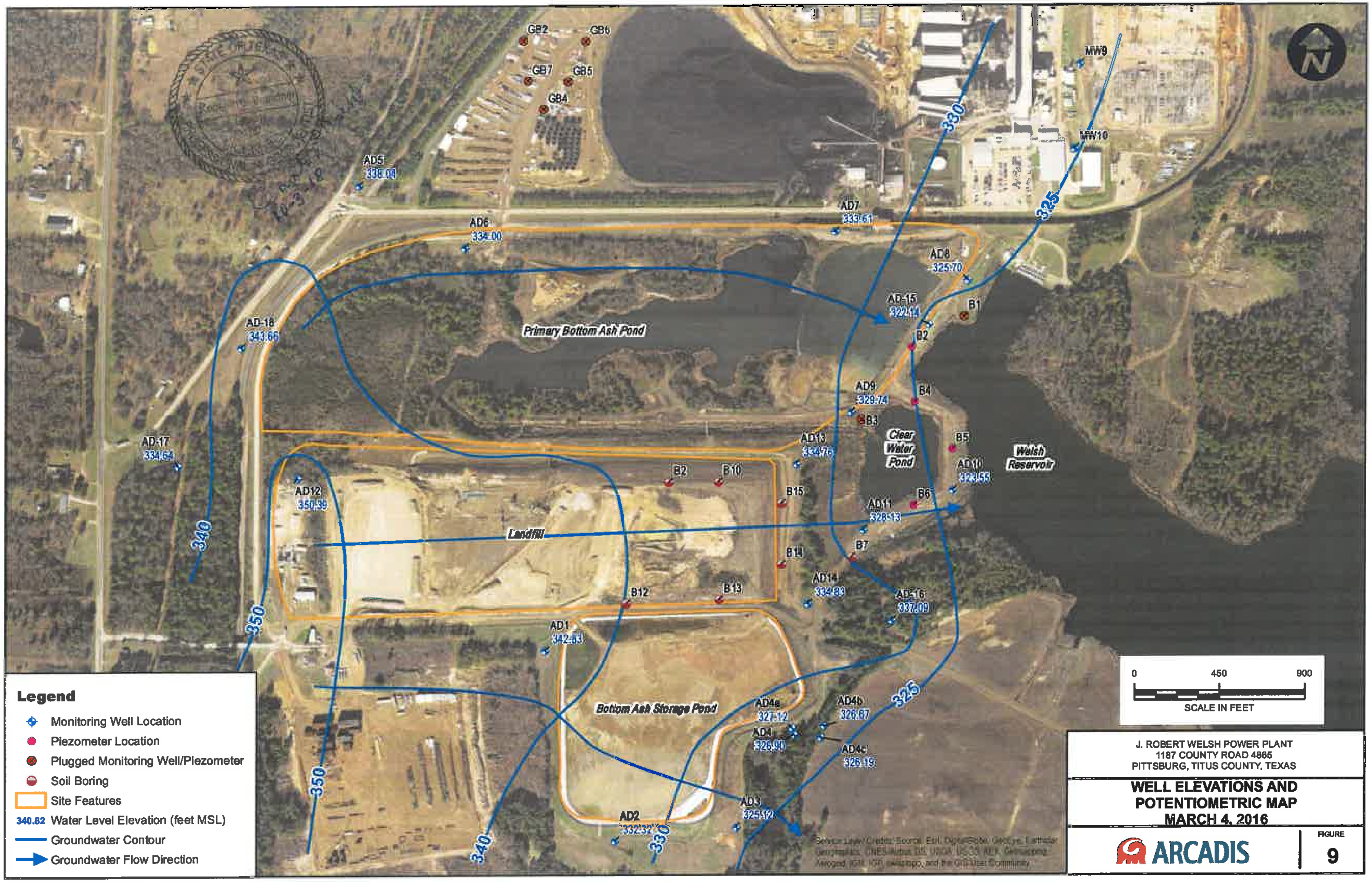
▯	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION E - E'

ARCADIS

FIGURE
8



Legend

- ◆ Monitoring Well Location
- ● Piezometer Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◒ Soil Boring
- ▭ Site Features
- 340.82 Water Level Elevation (feet MSL)
- — Groundwater Contour
- → Groundwater Flow Direction

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

WELL ELEVATIONS AND POTENTIOMETRIC MAP MARCH 4, 2016

ARCADIS

FIGURE
9

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 9 - Mar2016_POT.mxd

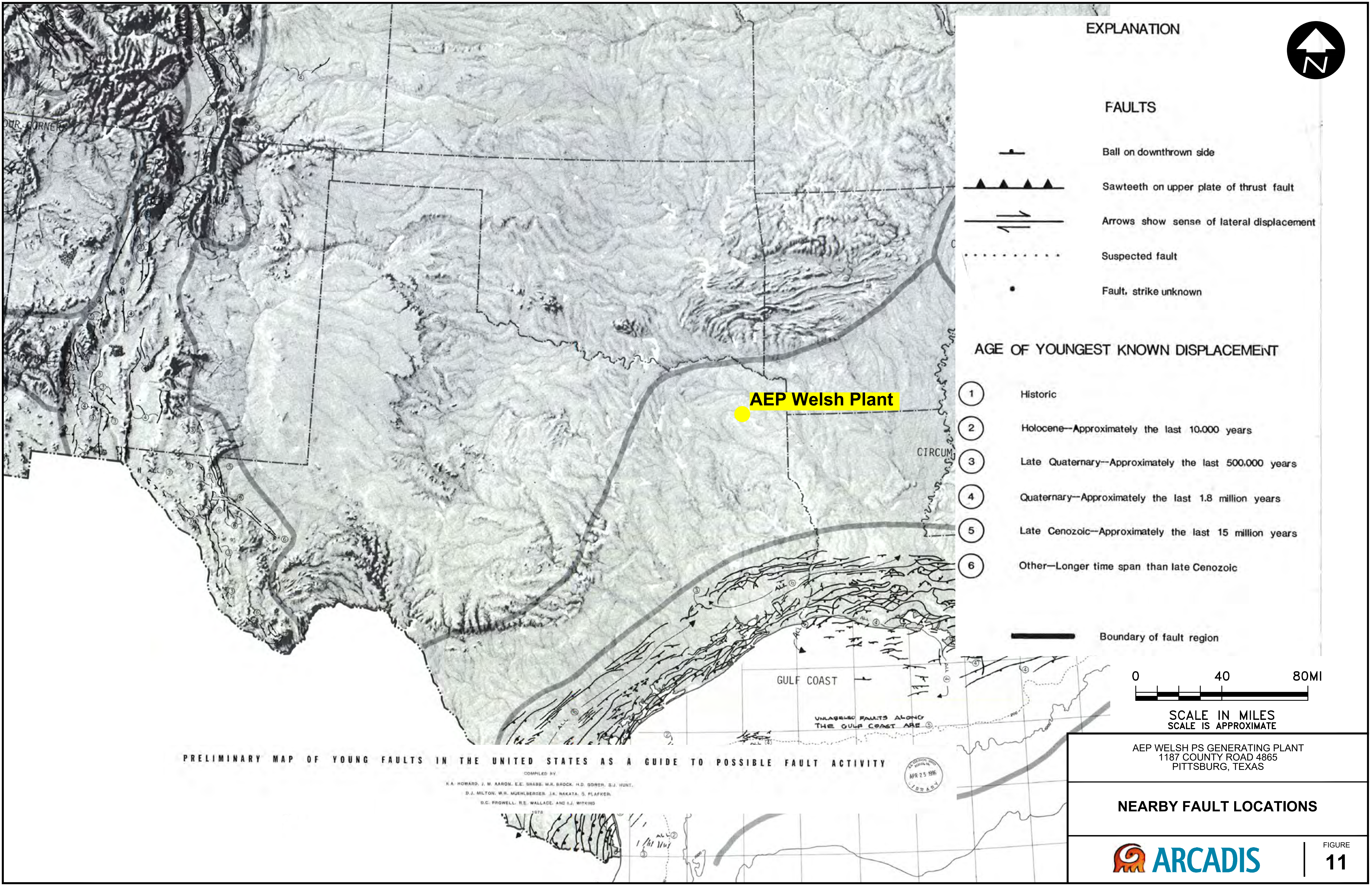
Source: Esri, DigitalGlobe, GeoEye, i-cu
swisstopo, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

POTENTIAL WETLAND LOCATIONS

ARCADIS

FIGURE
10



PRELIMINARY MAP OF YOUNG FAULTS IN THE UNITED STATES AS A GUIDE TO POSSIBLE FAULT ACTIVITY

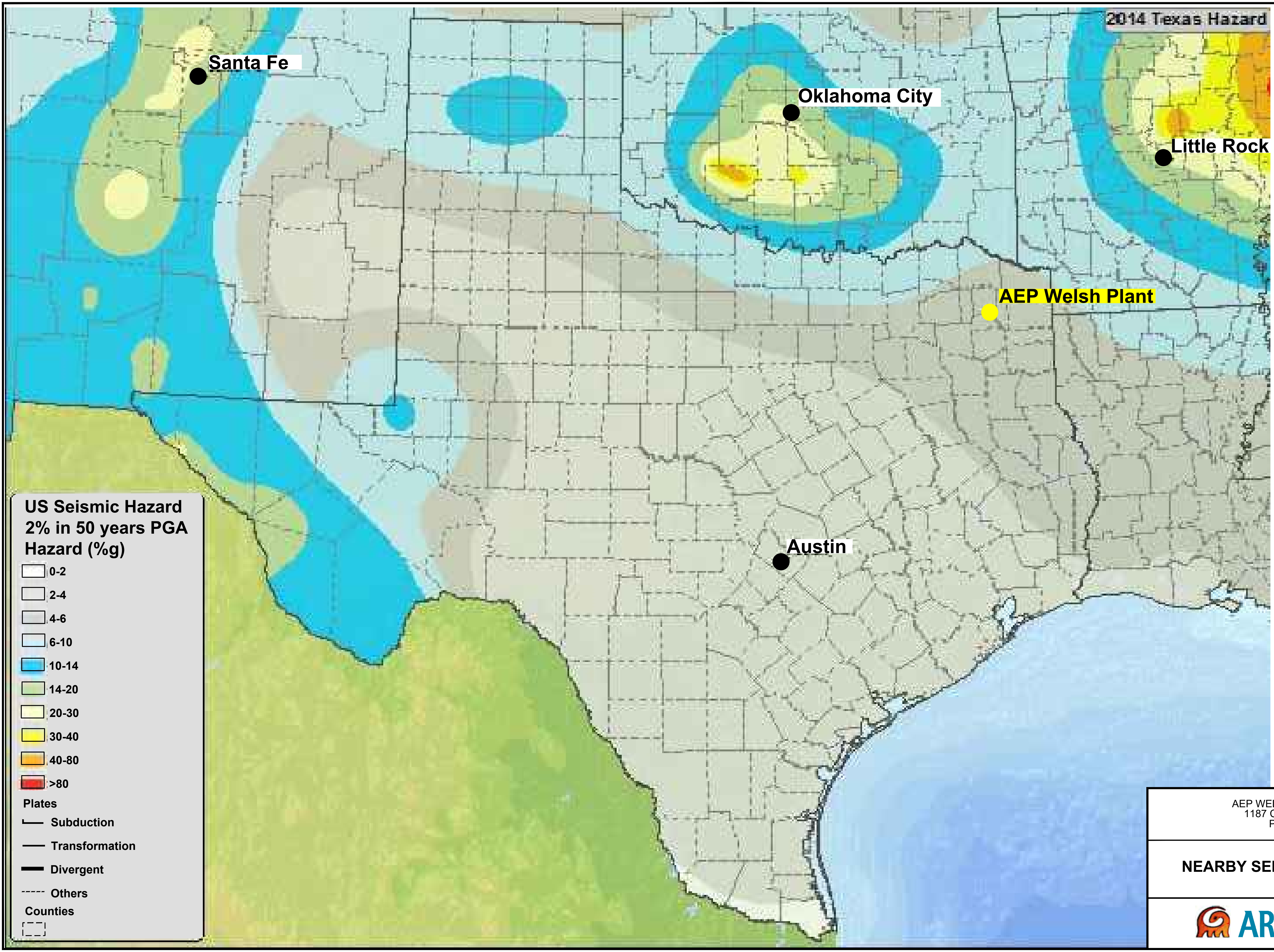
COMPILED BY
K.A. HOWARD, J. M. AARON, E.E. BRABB, M.R. BROCK, H.D. GOWER, S.J. HUNT,
D.J. MILTON, W.R. MUEHLBERGER, J.K. NAKATA, G. PLAFKER,
D.C. PROWELL, R.E. WALLACE, AND I.J. WITKIND
1978

AEP WELSH PS GENERATING PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TEXAS

NEARBY FAULT LOCATIONS

ARCADIS

FIGURE
11



SOURCE:
USGS Earthquake Hazards Program,
Texas: 2014 Seismic Hazard Map

0 60 120

SCALE IN MILES
SCALE IS APPROXIMATE

AEP WELSH PLANT ASH POND
1187 COUNTY ROAD 4865
PITTSBURG, TX

NEARBY SEISMIC IMPACT ZONES

ARCADIS

FIGURE
12

G:\LFR\Projects\Non Cinci\AEP_Location Restriction Demonstration_OH015976\AEP_Seismic Figures.dwg LAYOUT: PITTSBURG TX POND SAVED: 9/15/2015 6:41 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ACAD.CTB PLOTTED: 9/15/2015 6:43 PM BY: CALDWELL, MILES

ARCADIS

Appendix A

Boring/Well Construction Logs

AD-1

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt. 4, Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

County ~~Camp~~ Titus

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS 33°02'48"N 94°50'47"W N

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	25	gray silty clay with some hard red streaks

AP-1

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 13 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	Sch 40
2	N	#10 slot screen	15	25	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 13 ft. to 0 ft. No. of sacks used 6-50#
ft. to ft. No. of sacks used
Method used bentonite
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 12'8" ft. below land surface Date 1-11-01
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-2

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) **OWNER** Southwestern Electric (Name) **ADDRESS** Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) **ADDRESS OF WELL:** County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) **GRID #** 16-58-4

3) **TYPE OF WORK (Check):**
☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) **PROPOSED USE (Check):** ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic
☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'37"N
94°50'44"W
N↑

6) **WELL LOG:**
Date Drilling:
Started 4/26 19 2001
Completed 4/26 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) **DRILLING METHOD (Check):** ☐ Driven
☐ Air Rotary ☐ Mud Rotary ☒ Bored
☐ Air Hammer ☐ Cable Tool ☐ Jetted
☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	2	top soil
2	5	red & gray clay w/ silt
5	10	red & gray clay w/ silt
10	25	gray silty clay w/ tan streaks
		AP-2

(Use reverse side if necessary)

8) **Borehole Completion (Check):** ☐ Open Hole ☐ Straight Wall
☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 12 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	Sch 40
2	N	#10 slot screen	15	25	Sch 40

9) **CEMENTING DATA** [Rule 338.44(1)]
Cemented from 12 ft. to 2 ft. No. of sacks used 5-50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance

10) **SURFACE COMPLETION**
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) **WATER LEVEL:**
Static level ____ ft. below land surface Date ____
Artesian flow ____ gpm. Date ____

12) **PACKERS:** NA Type Depth

13) **TYPE PUMP:** NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ____ ft.

14) **WELL TESTS:** NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

15) **WATER QUALITY:**
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ____ (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS ____ (Street or RFD) (City) (State) (Zip)

(Signed) Gilbert M (Licensed Well Driller) (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-3

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

County ~~Camp~~ Titus

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'38"N
94°50'37"W
N↑

6) WELL LOG:
Date Drilling:
Started 4/26 ~~19~~ 2001
Completed 4/26 ~~19~~ 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	17

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ______

From (ft.)	To (ft.)	Description and color of formation material
0	12	gray silty clay w/ tan streaks
12	15	very stiff gray/blood red clay
15	17	very stiff gray clay w/ red nodules and tan streaks

AP-3

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other ______

If Gravel Packed give interval ... from 5 ft. to 17 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Casting Screen
			From	To	
2	N	riser	+2	7	Sch 40
2	N	#10 slot screen	7	17	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 2 ft. to 5 ft. No. of sacks used 2 1/2 - 50#
______ ft. to ______ ft. No. of sacks used ______
Method used bentonite pellets
Cemented by ______
Distance to septic system field lines or other concentrated contamination ______ ft.
Method of verification of above distance ______

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ______ ft. below land surface Date ______
Artesian flow ______ gpm. Date ______

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc., ______ ft.

14) WELL TESTS: NA
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ______ (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS ______ (Street or RFD) (City) (State) (Zip)

(Signed) Gilbert (Licensed Well Driller) (Signed) ______ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-4

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic
☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'43"N
94°50'33"W
N↑

6) WELL LOG:
Date Drilling:
Started 4/26 19 2001
Completed 4/26 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	30

7) DRILLING METHOD (Check): ☐ Driven
☐ Air Rotary ☐ Mud Rotary ☒ Bored
☐ Air Hammer ☐ Cable Tool ☐ Jetted
☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	5	red silty clay with gray streaks
5 -	30	gray silty clay with red streaks
		AD-4

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall
☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	19	Sch 40
2	N	#10 Slot Screen	19	29	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 2 ft. No. of sacks used 8-50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other NA
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

SOIL BORING LOG

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

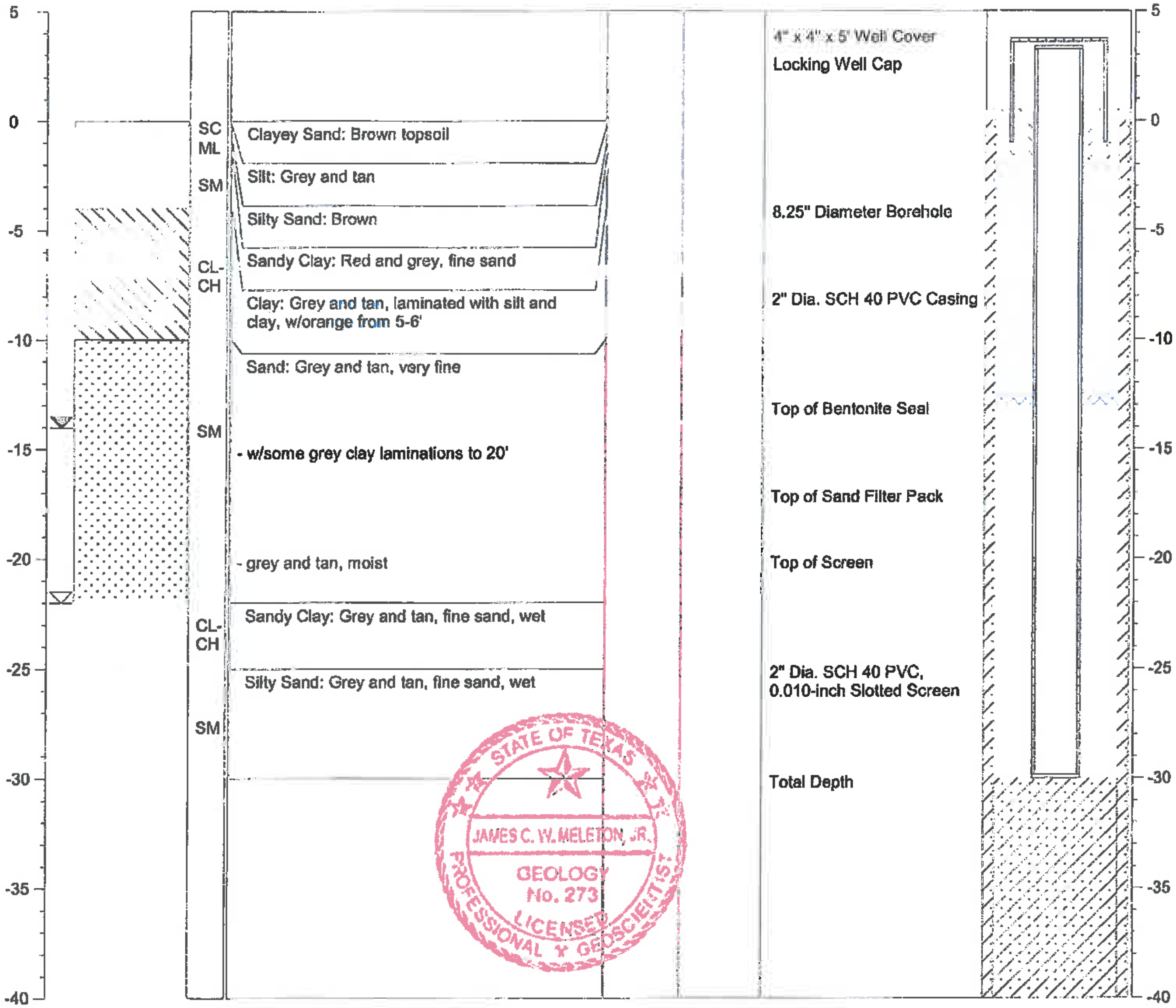
BORING/WELL NO.:	**AD-4A**
TOTAL DEPTH:	**30'**
TOP OF CASING ELEV.:	**342.85 ft. NGVD**
GROUND SURFACE ELEV.:	**340.19 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04527**
Longitude: 94.84258

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown topsoil
ML	Silt: Grey and tan
SM	Silty Sand: Brown
CL-CH	Sandy Clay: Red and grey, fine sand
	Clay: Grey and tan, laminated with silt and clay, w/orange from 5-6'
SM	Sand: Grey and tan, very fine - w/some grey clay laminations to 20' - grey and tan, moist
CL-CH	Sandy Clay: Grey and tan, fine sand, wet
SM	Silty Sand: Grey and tan, fine sand, wet

WELL DESCRIPTION:
- 4" x 4" x 5' Well Cover
- Locking Well Cap
- 8.25" Diameter Borehole
- 2" Dia. SCH 40 PVC Casing
- Top of Bentonite Seal
- Top of Sand Filter Pack
- Top of Screen
- 2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
- Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4B**
TOTAL DEPTH:	**15'**
TOP OF CASING ELEV.:	**333.23 ft. NGVD**
GROUND SURFACE ELEV.:	**329.55 ft. NGVD**

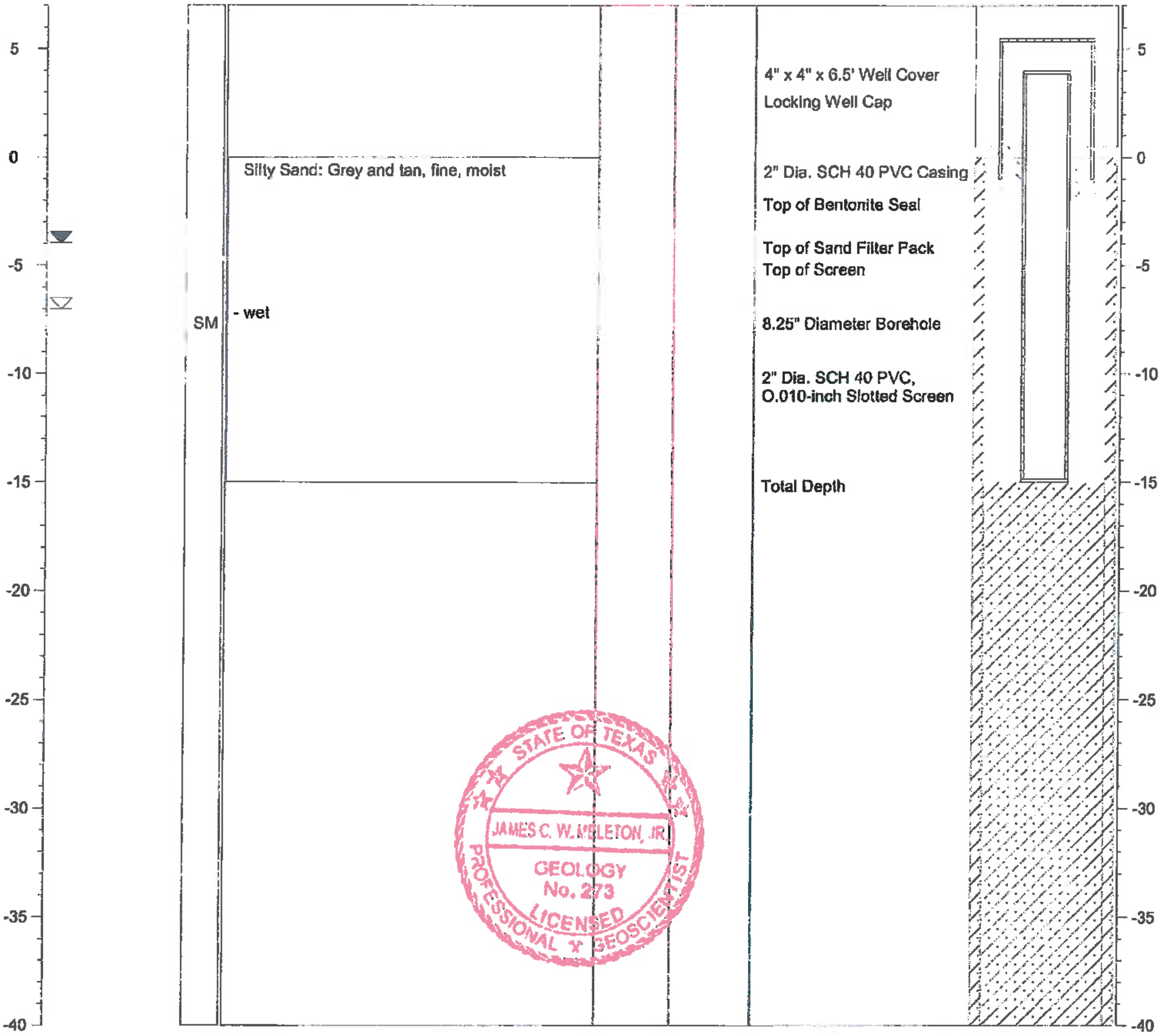
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.04531**
Longitude: 94.84230

▼ Water level during drilling
▽ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Silty Sand: Grey and tan, fine, moist
- wet

4" x 4" x 6.5' Well Cover
Locking Well Cap
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
8.25" Diameter Borehole
2" Dia. SCH 40 PVC,
0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	AD-4C
TOTAL DEPTH:	15'
TOP OF CASING ELEV.:	333.28 ft. NGVD
GROUND SURFACE ELEV.:	329.15 ft. NGVD

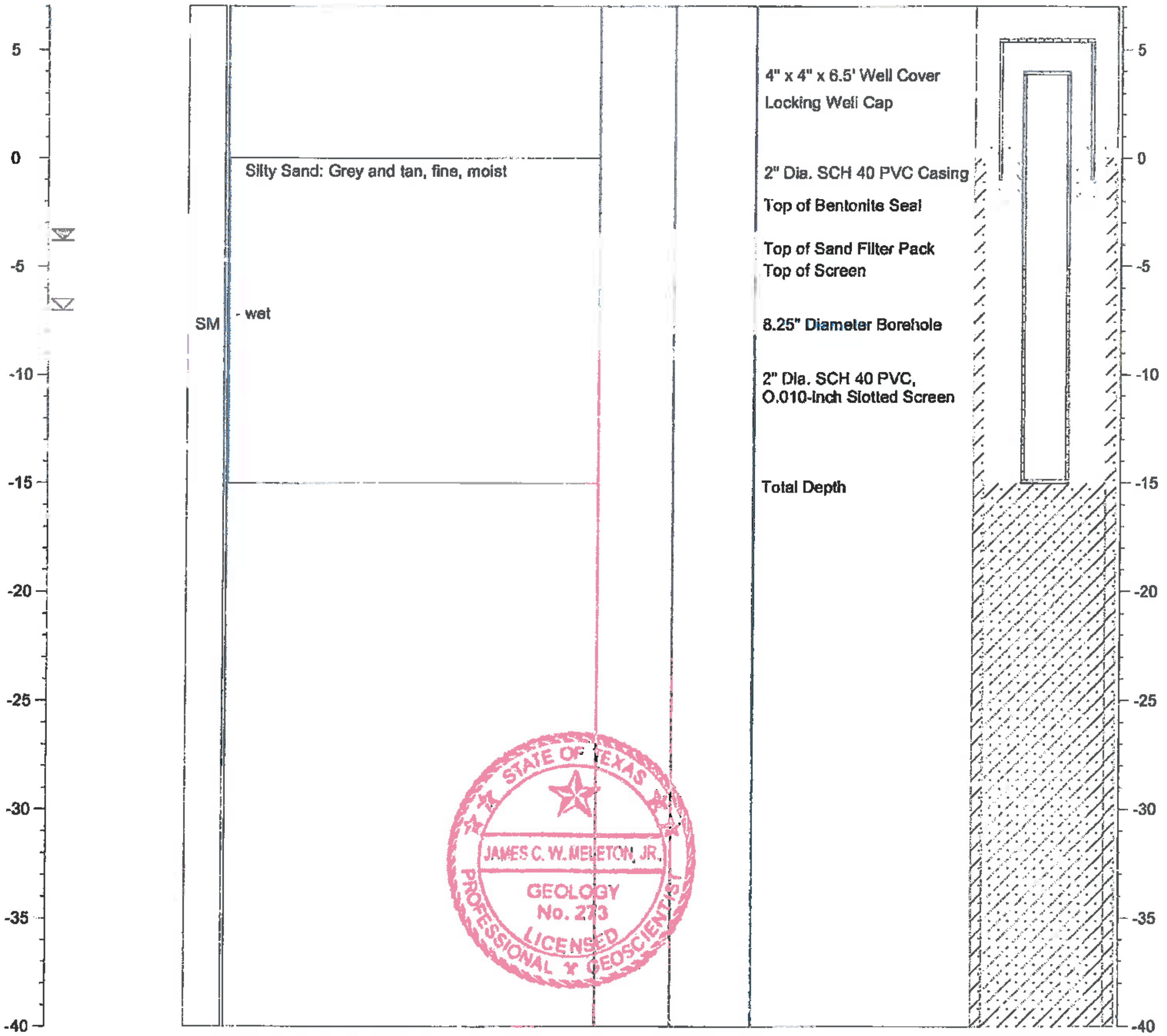
CLIENT:	AEP	DRILLING CO.:	WEST Drilling
PROJECT:	Ash Disposal Area	DRILLER:	Tom McCullough
SITE LOCATION:	Welsh Power Plant	METHOD OF DRILLING:	Hollow-stem Auger
PROJECT NO.:	S-08-0109	SAMPLING METHODS:	Split-spoon
LOGGED BY:	James Meleton, Jr.	DATE DRILLED:	9/23/09

NOTES: **Latitude: 33.04507**
Longitude: 94.84244

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

AD-5

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt.4, Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) 33°03'13"N 94°51'00"W N↑

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	10	red & gray clay with orange streaks
10	20	gray/black clay with tan clay
20	25	stiff clay with lignite streak
25	30	fine gray sand

AP-5

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	20	Sch 40
2	N	#10 slot screen	20	30	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 0 ft. No. of sacks used ____
____ ft. to ____ ft. No. of sacks used ____
Method used bentonite
Cemented by ____
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance ____

✓10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 11' 9" ft. below land surface Date 1-11-01
Artesian flow ____ gpm. Date ____

12) PACKERS: NA Type Depth

13) TYPE PUMP: ☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other ____
Depth to pump bowls, cylinder, jet, etc., ____ ft.

14) WELL TESTS: Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

✓15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ____ (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS ____ (Street or RFD) (City) (State) (Zip)

(Signed) ____ (Licensed Well Driller) (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.: **AD-6**
TOTAL DEPTH: **33'**
TOP OF CASING ELEV.: **346.33 ft. NGVD**
GROUND SURFACE ELEV.: **343.31 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

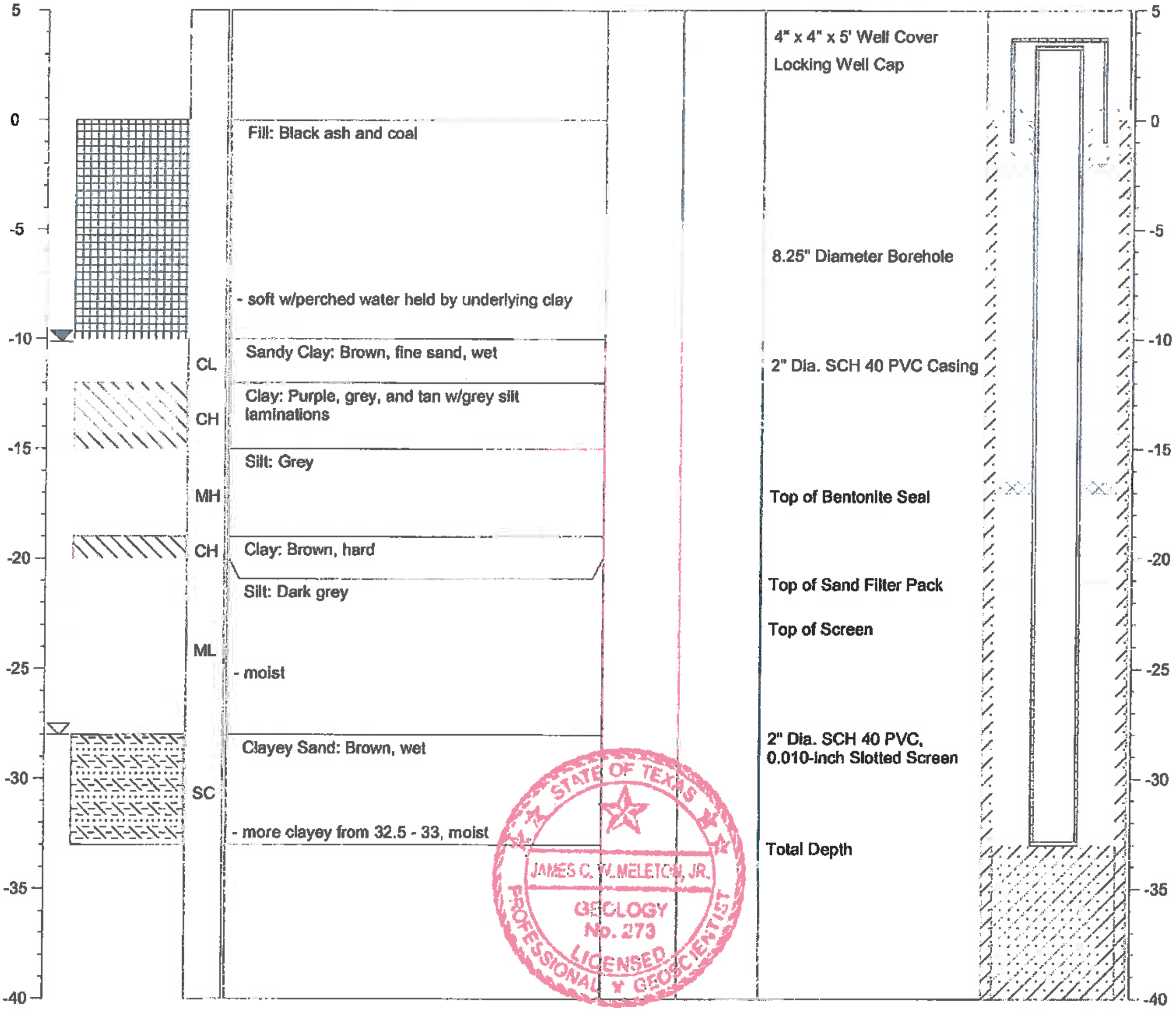
DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/23/09**

NOTES: **Latitude: 33.05235**
Longitude: 94.84757

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Fill: Black ash and coal
- soft w/perched water held by underlying clay
Sandy Clay: Brown, fine sand, wet
Clay: Purple, grey, and tan w/grey silt laminations
Silt: Grey
Clay: Brown, hard
Silt: Dark grey
- moist
Clayey Sand: Brown, wet
- more clayey from 32.5 - 33, moist

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

JAMES C. W. MELETON, JR.
GEOLOGY
No. 273

SOIL BORING LOG

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC

BORING/WELL NO.:	**AD-7**
TOTAL DEPTH:	**38'**
TOP OF CASING ELEV.:	**350.82 ft. NGVD**
GROUND SURFACE ELEV.:	**347.86 ft. NGVD**

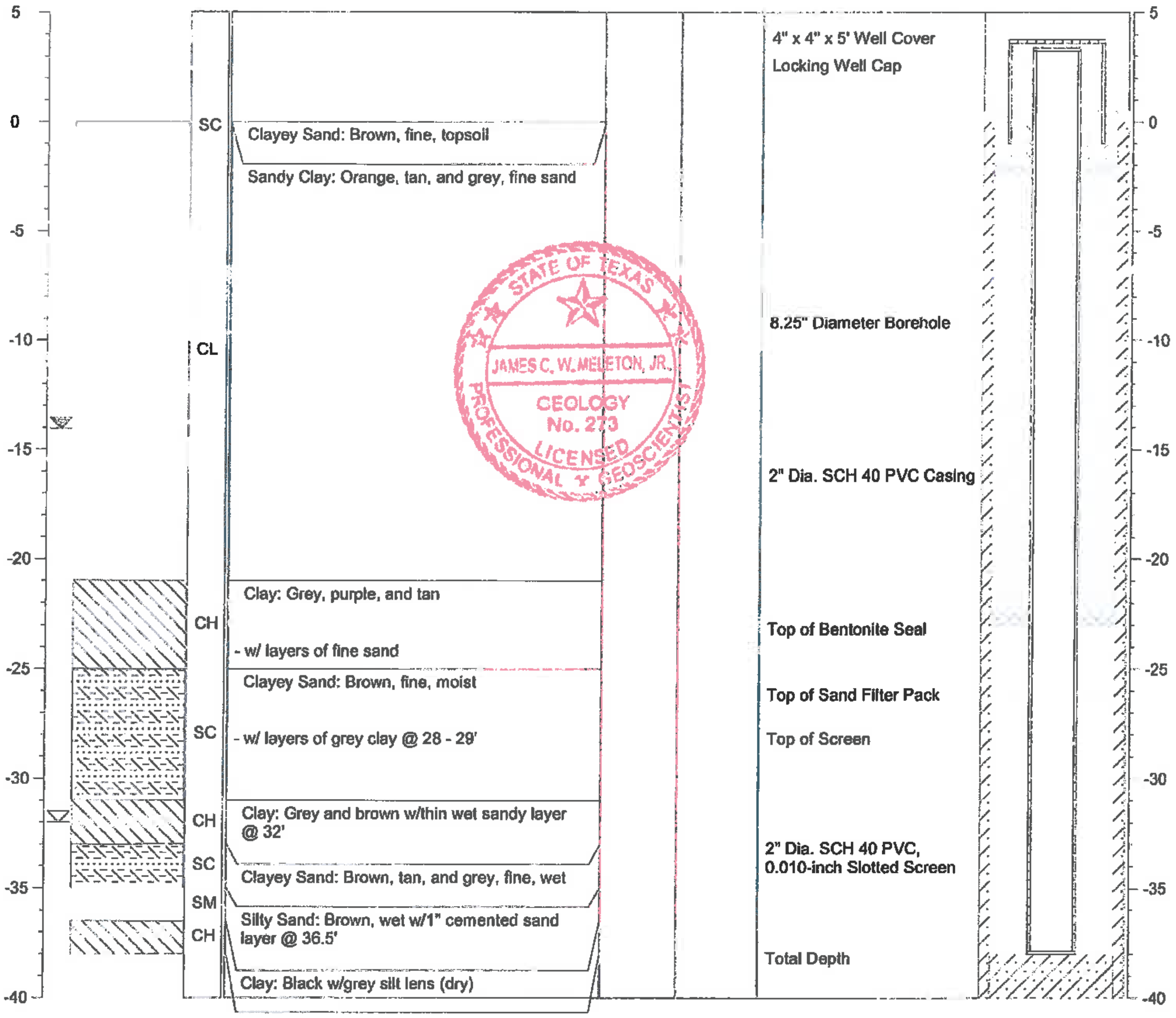
CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/24/09**

NOTES: **Latitude: 33.05257**
Longitude: 94.84219

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, fine, topsoil
CL	Sandy Clay: Orange, tan, and grey, fine sand
CH	Clay: Grey, purple, and tan - w/ layers of fine sand
SC	Clayey Sand: Brown, fine, moist - w/ layers of grey clay @ 28 - 29'
CH	Clay: Grey and brown w/thin wet sandy layer @ 32'
SC	Clayey Sand: Brown, tan, and grey, fine, wet
SM	Silty Sand: Brown, wet w/1" cemented sand layer @ 36.5'
CH	Clay: Black w/grey silt lens (dry)

WELL DESCRIPTION

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

JAMES C. W. MELETON, JR.
GEOLOGY No. 273

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT INC

SOIL BORING LOG

BORING/WELL NO.:	**AD-8**
TOTAL DEPTH:	**29'**
TOP OF CASING ELEV.:	**340.01 ft. NGVD**
GROUND SURFACE ELEV.:	**337.53 ft. NGVD**

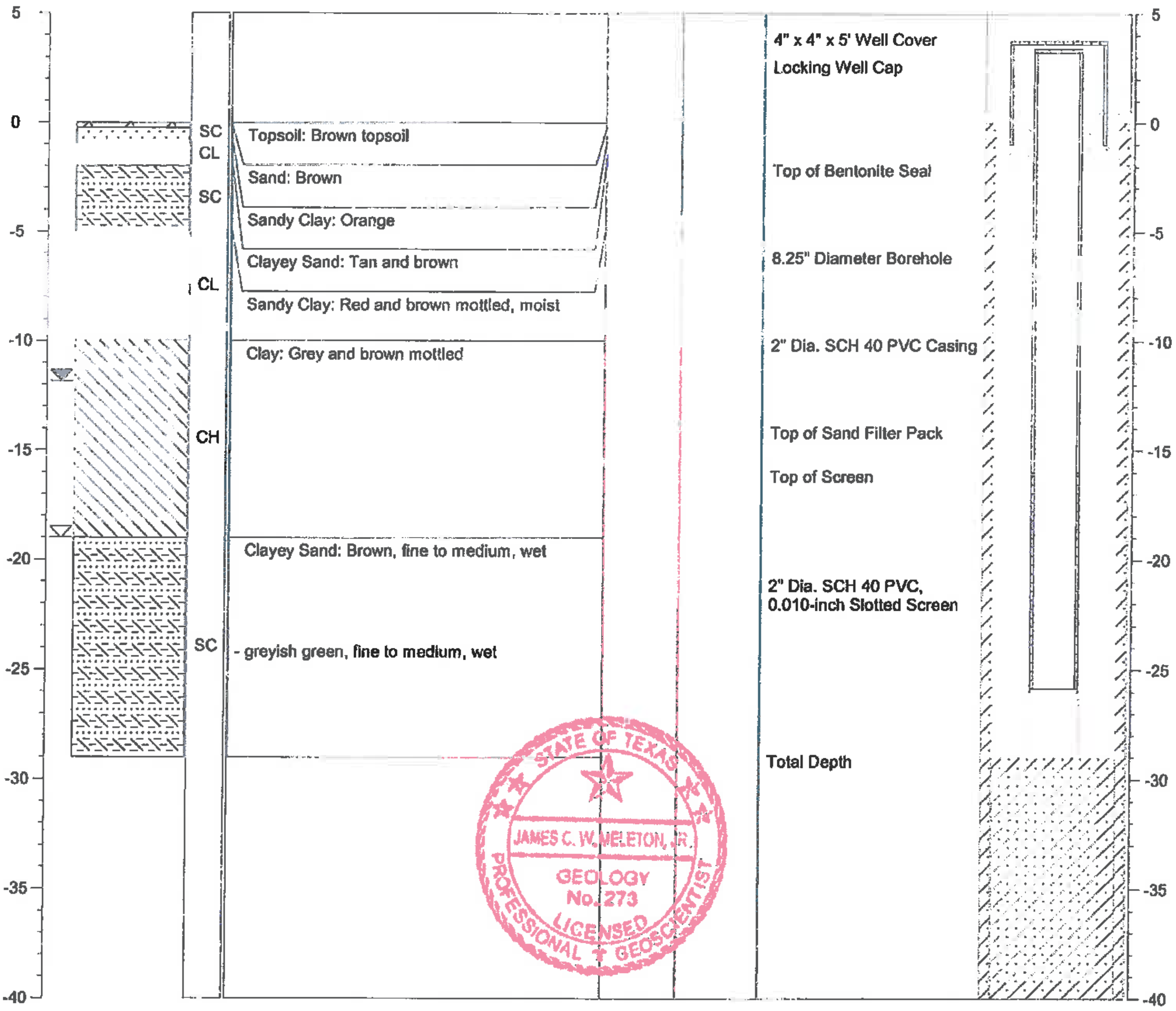
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/21/09**

NOTES: **Latitude: 33.05187**
Longitude: 94.84026

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Topsoil: Brown topsoil

Sand: Brown

Sandy Clay: Orange

Clayey Sand: Tan and brown

Sandy Clay: Red and brown mottled, moist

Clay: Grey and brown mottled

Clayey Sand: Brown, fine to medium, wet

- greyish green, fine to medium, wet

4" x 4" x 5' Well Cover

Locking Well Cap

Top of Bentonite Seal

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC,
0.010-inch Slotted Screen

Total Depth

JAMES C. W. MELETON, JR.
GEOLOGY
No. 273

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.:	**AD-9**
TOTAL DEPTH:	**35'**
TOP OF CASING ELEV.:	**343.09 ft. NGVD**
GROUND SURFACE ELEV.:	**340.32 ft. NGVD**

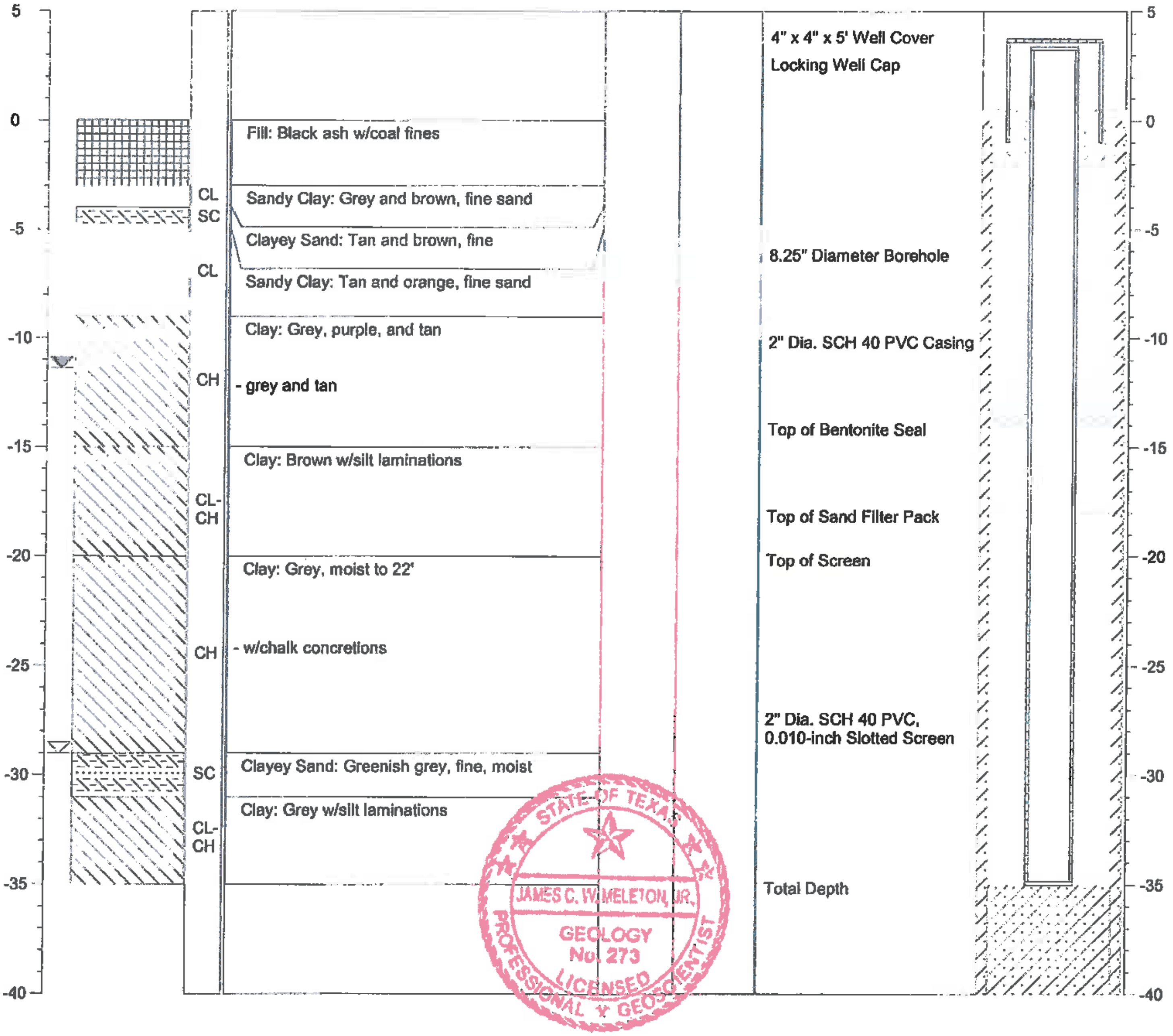
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/21/09**

NOTES: **Latitude: 33.04995**
Longitude: 94.84196

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
	Fill: Black ash w/coal fines
CL	Sandy Clay: Grey and brown, fine sand
SC	Clayey Sand: Tan and brown, fine
CL	Sandy Clay: Tan and orange, fine sand
CH	Clay: Grey, purple, and tan - grey and tan
CL-CH	Clay: Brown w/silt laminations
CH	Clay: Grey, moist to 22' - w/chalk concretions
SC	Clayey Sand: Greenish grey, fine, moist
CL-CH	Clay: Grey w/silt laminations

WELL DESCRIPTION:
- 4" x 4" x 5' Well Cover
- Locking Well Cap
- 8.25" Diameter Borehole
- 2" Dia. SCH 40 PVC Casing
- Top of Bentonite Seal
- Top of Sand Filter Pack
- Top of Screen
- 2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
- Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
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No. 273
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PROFESSIONAL GEOSCIENTIST

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SOIL BORING LOG

BORING/WELL NO.: **AD-10**
TOTAL DEPTH: **35'**
TOP OF CASING ELEV.: **343.01 ft. NGVD**
GROUND SURFACE ELEV.: **340.23 ft. NGVD**

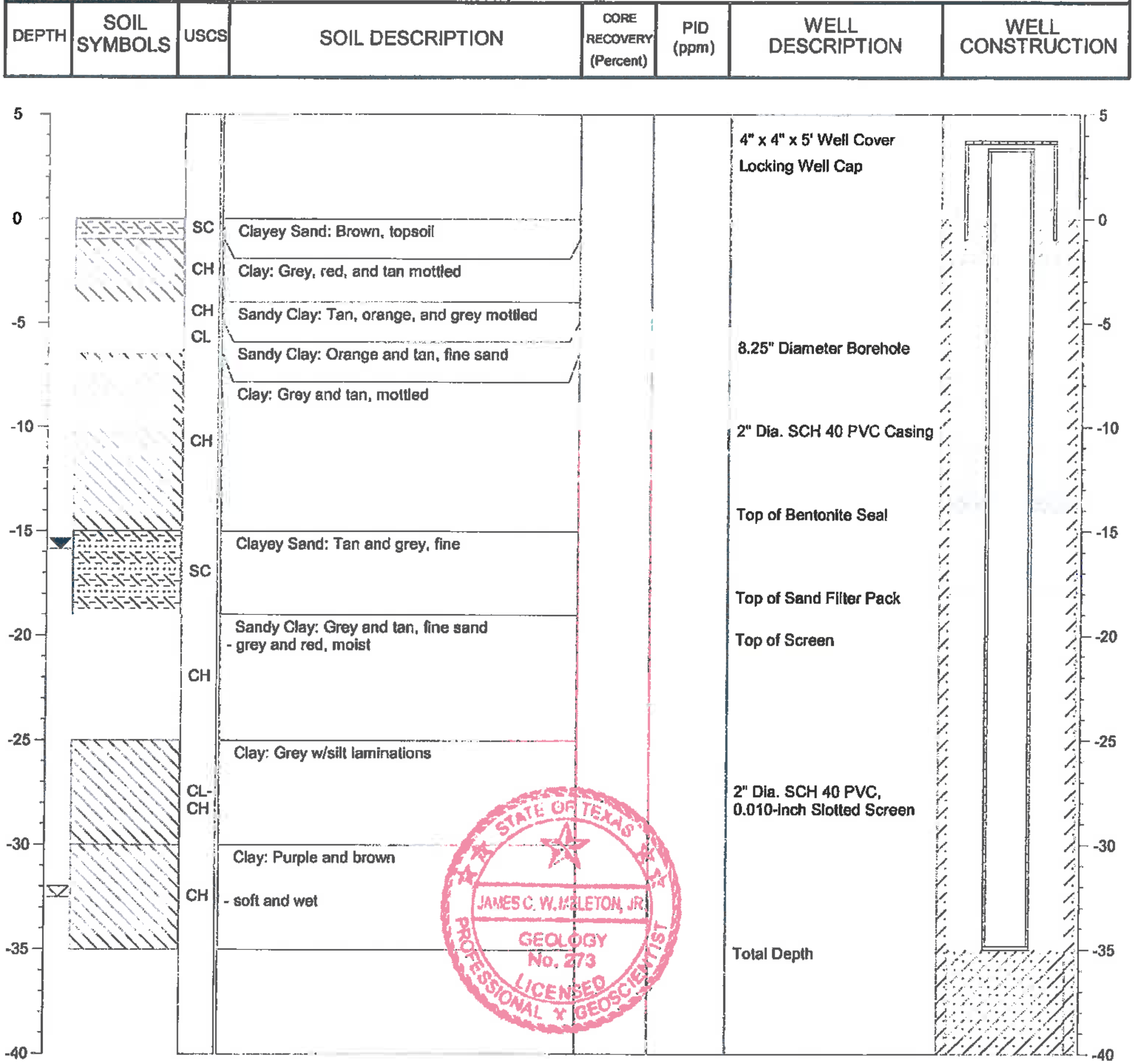
CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/22/09**

NOTES: **Latitude: 33.04881**
Longitude: 94.84047

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, topsoil
CH	Clay: Grey, red, and tan mottled
CH	Sandy Clay: Tan, orange, and grey mottled
CL	Sandy Clay: Orange and tan, fine sand
CH	Clay: Grey and tan, mottled
SC	Clayey Sand: Tan and grey, fine
CH	Sandy Clay: Grey and tan, fine sand - grey and red, moist
CL-CH	Clay: Grey w/silt laminations
CH	Clay: Purple and brown - soft and wet

WELL DESCRIPTION

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY No. 273
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ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.:	**AD-11**
TOTAL DEPTH:	**20'**
TOP OF CASING ELEV.:	**342.18 ft. NGVD**
GROUND SURFACE ELEV.:	**339.61 ft. NGVD**

CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

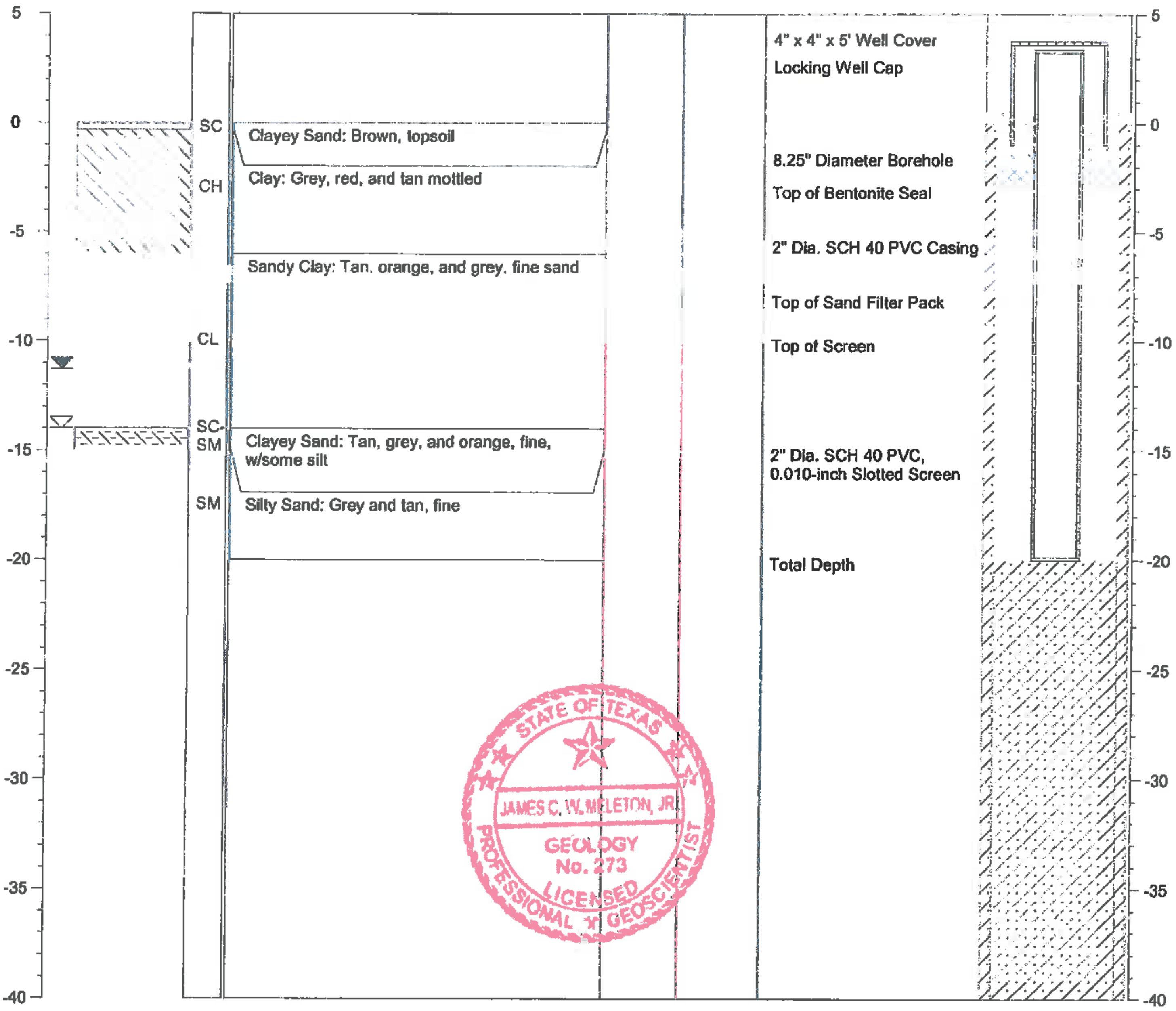
DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04824**
Longitude: 94.84177

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, topsoil
CH	Clay: Grey, red, and tan mottled
CL	Sandy Clay: Tan, orange, and grey, fine sand
SC-SM	Clayey Sand: Tan, grey, and orange, fine, w/some silt
SM	Silty Sand: Grey and tan, fine

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
Top of Bentonite Seal
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
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ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-12**
TOTAL DEPTH:	**30'**
TOP OF CASING ELEV.:	**369.33 ft. NGVD**
GROUND SURFACE ELEV.:	**366.27 ft. NGVD**

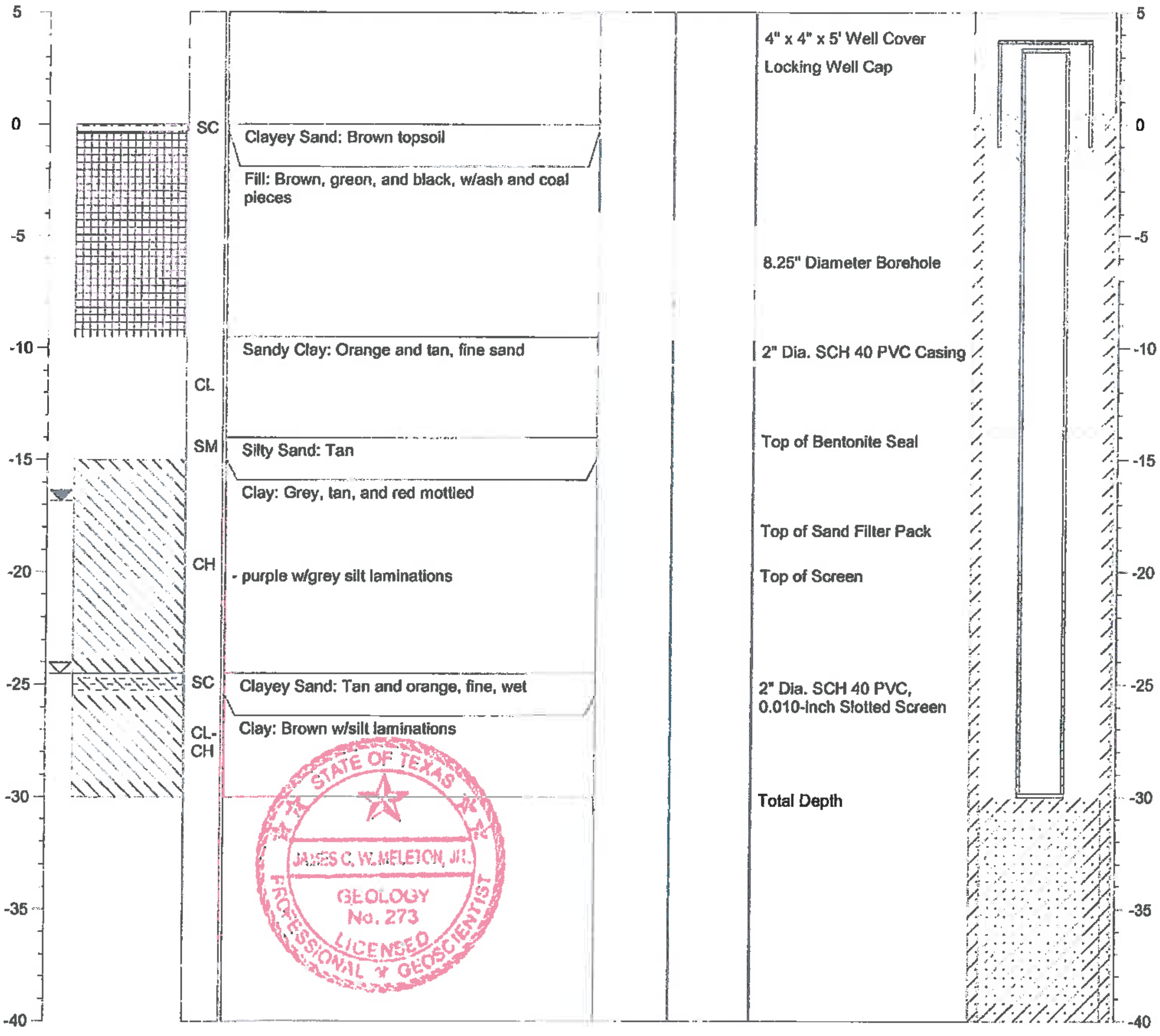
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/24/09**

NOTES: **Latitude: 33.04901**
Longitude: 94.84977

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Clayey Sand: Brown topsoil

Fill: Brown, green, and black, w/ash and coal pieces

Sandy Clay: Orange and tan, fine sand

Silty Sand: Tan

Clay: Grey, tan, and red mottled

- purple w/grey silt laminations

Clayey Sand: Tan and orange, fine, wet

Clay: Brown w/silt laminations

4" x 4" x 5' Well Cover
Locking Well Cap

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Bentonite Seal

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC,
0.010-inch Slotted Screen

Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

SOIL BORING LOG

BORING/WELL NO.:	**AD-13**
TOTAL DEPTH:	**20'**
TOP OF CASING ELEV.:	**347.00 ft. NGVD**
GROUND SURFACE ELEV.:	**344.12 ft. NGVD**

E·A·G·L·E ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

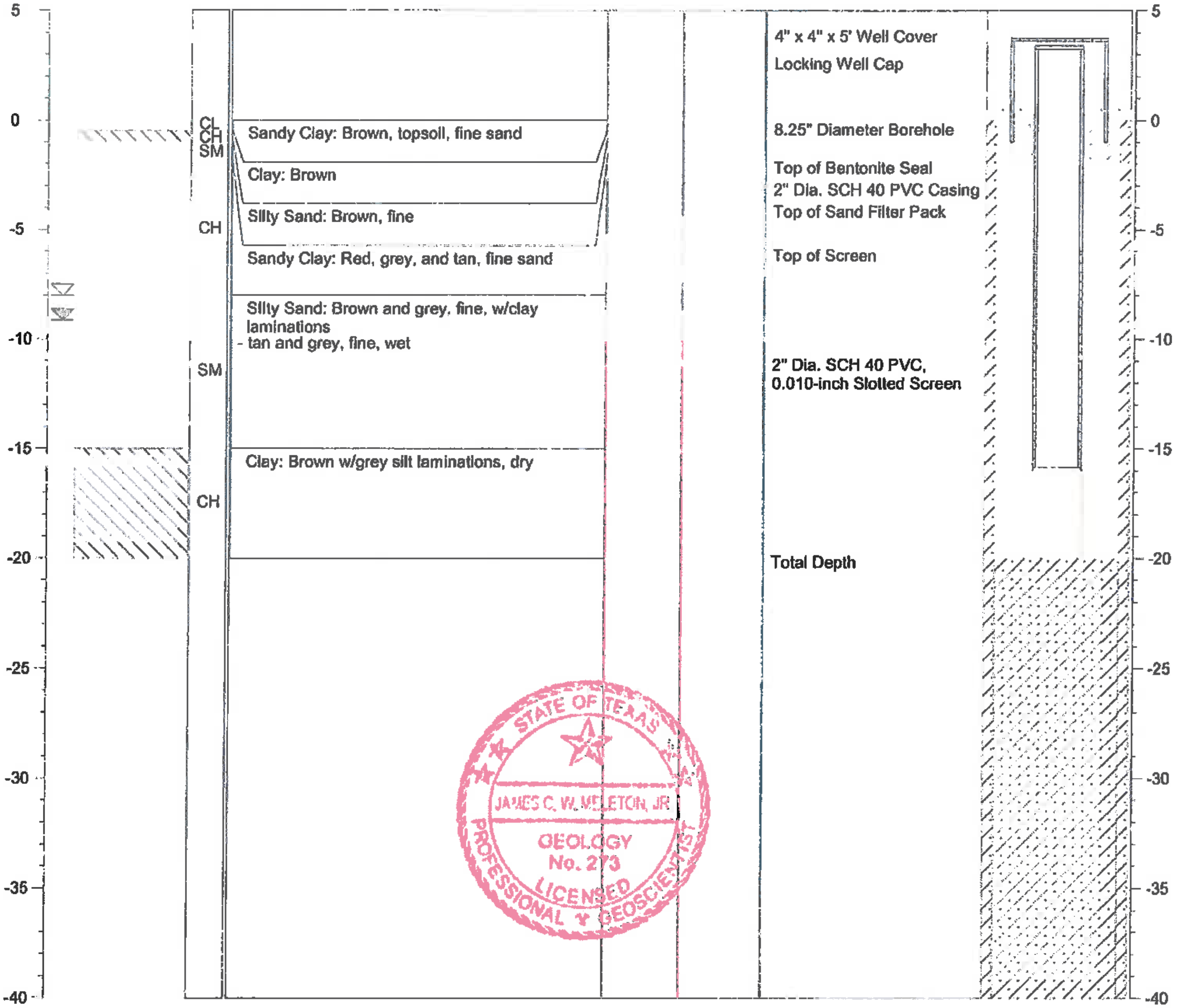
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04918**
Longitude: 94.84275

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
CL	Sandy Clay: Brown, topsoil, fine sand
CH	Clay: Brown
SM	Silty Sand: Brown, fine
CH	Sandy Clay: Red, grey, and tan, fine sand
SM	Silty Sand: Brown and grey, fine, w/clay laminations - tan and grey, fine, wet
CH	Clay: Brown w/grey silt laminations, dry

WELL DESCRIPTION

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
Top of Bentonite Seal
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
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No. 273
LICENSED
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ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-14**
TOTAL DEPTH:	**18.5'**
TOP OF CASING ELEV.:	**345.43 ft. NGVD**
GROUND SURFACE ELEV.:	**342.32 ft. NGVD**

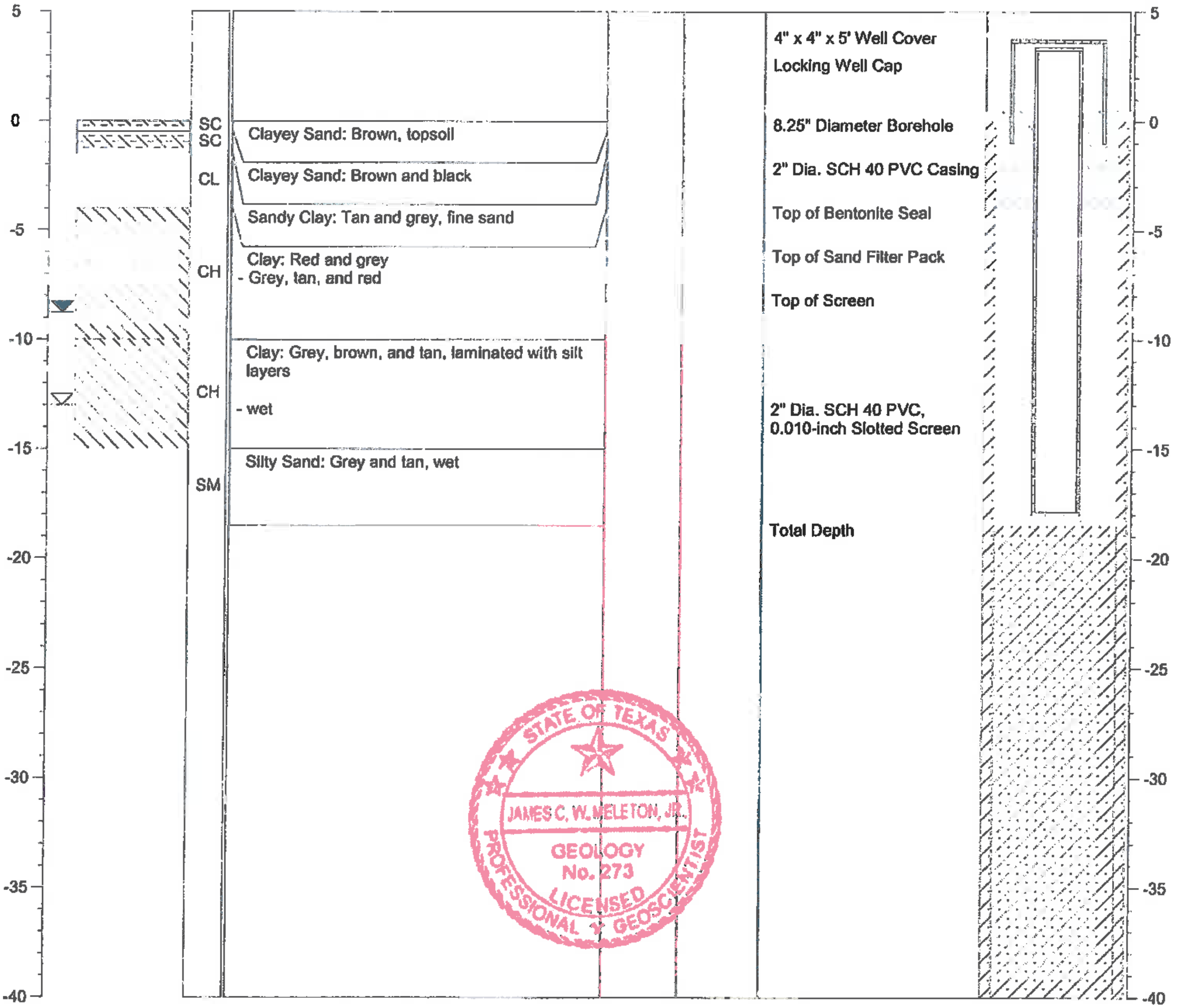
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04715**
Longitude: 94.84256

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



STATE OF TEXAS
JAMES C. W. MELETON, JR.
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No. 273
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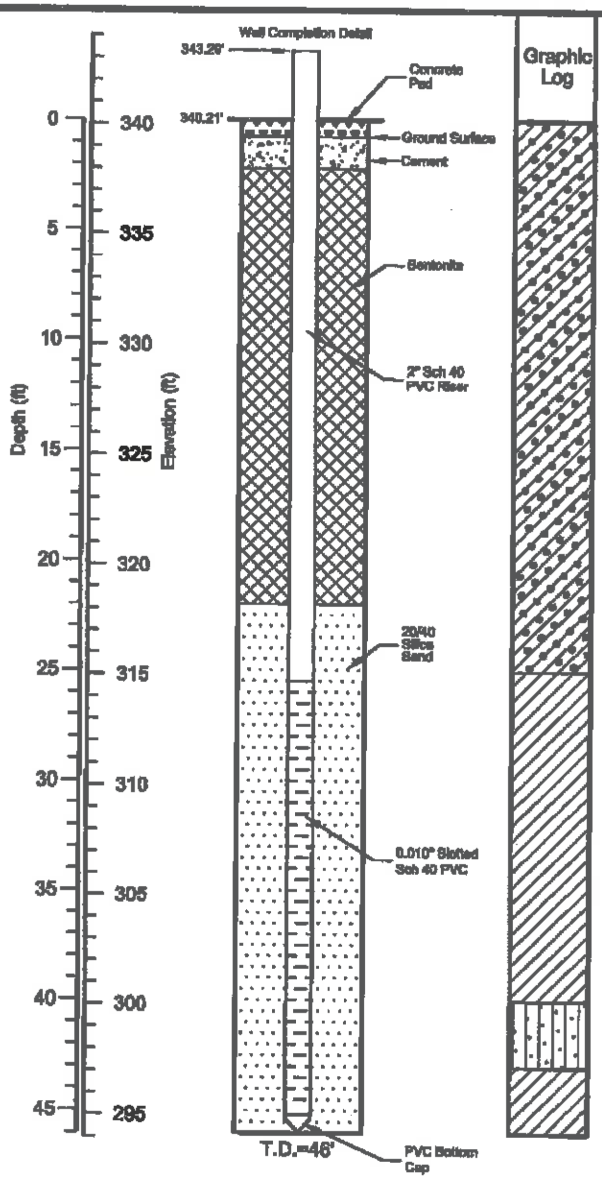


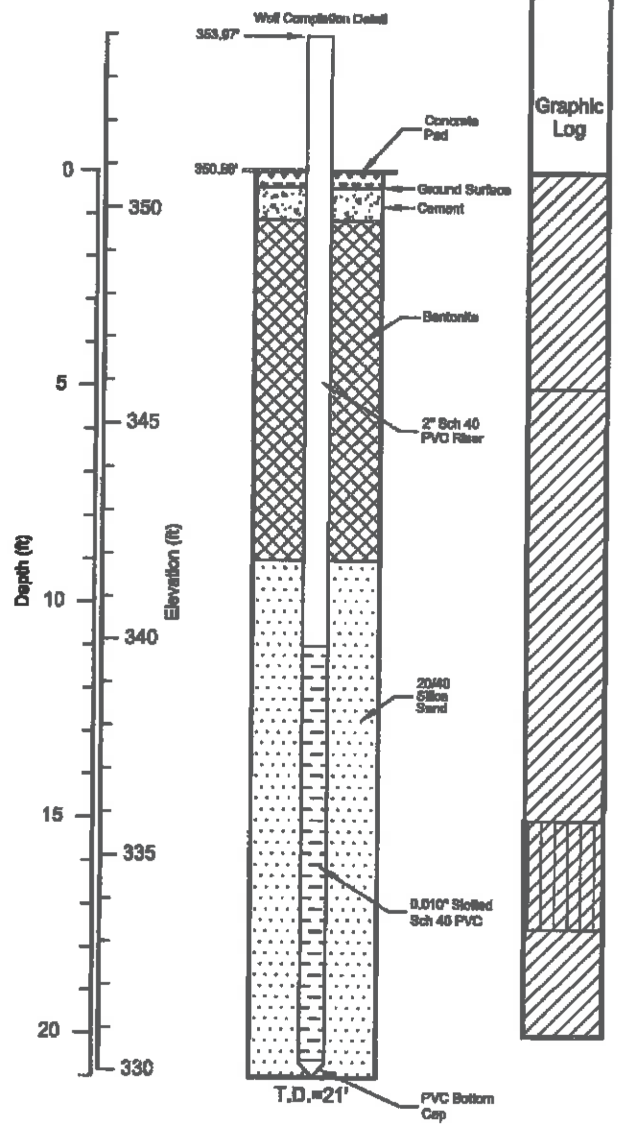
PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		SC	Clayey SAND: reddish brown	16	48	37	18	19
				- 2" lense of brown sand					
				- 3" lense of brown sand					
	Direct Push		CL	Sandy Lean CLAY: reddish brown, very moist					
				- less moisture	22	51	36	19	17
			SM	Silty SAND: light brown & light gray, wet.	27	24	28	NP	-
			CL	Lean CLAY: orangish brown & light gray, mottled, with sand	28	94	45	21	24

STEVEN R. WEMPLE
2176
1-22-16

west DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahatchie, Texas 75165

DATE: 12/12/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-15
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/12/15	DRAWN BY: HDS	PROJECT NO.: — SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	Description Interva (feet bgs)	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0–5		Direct Push		CL	Lean CLAY w/ Sand: light brown & light gray - orangish brown, with silt	16	82	26	16	10
5–15				CL	Lean CLAY w/ Sand: orangish-brown & light gray	22	88	31	19	12
15–17.5				CL-ML	Silty CLAY: orange w/ brown, wet	30	89	27	20	7
17.5–21				CL	Sandy, Lean CLAY: brown w/ orange, stiff	26	66	46	26	20

STEVEN R. WEMPLE
SOIL SCIENCE
LICENSE NUMBER 2176

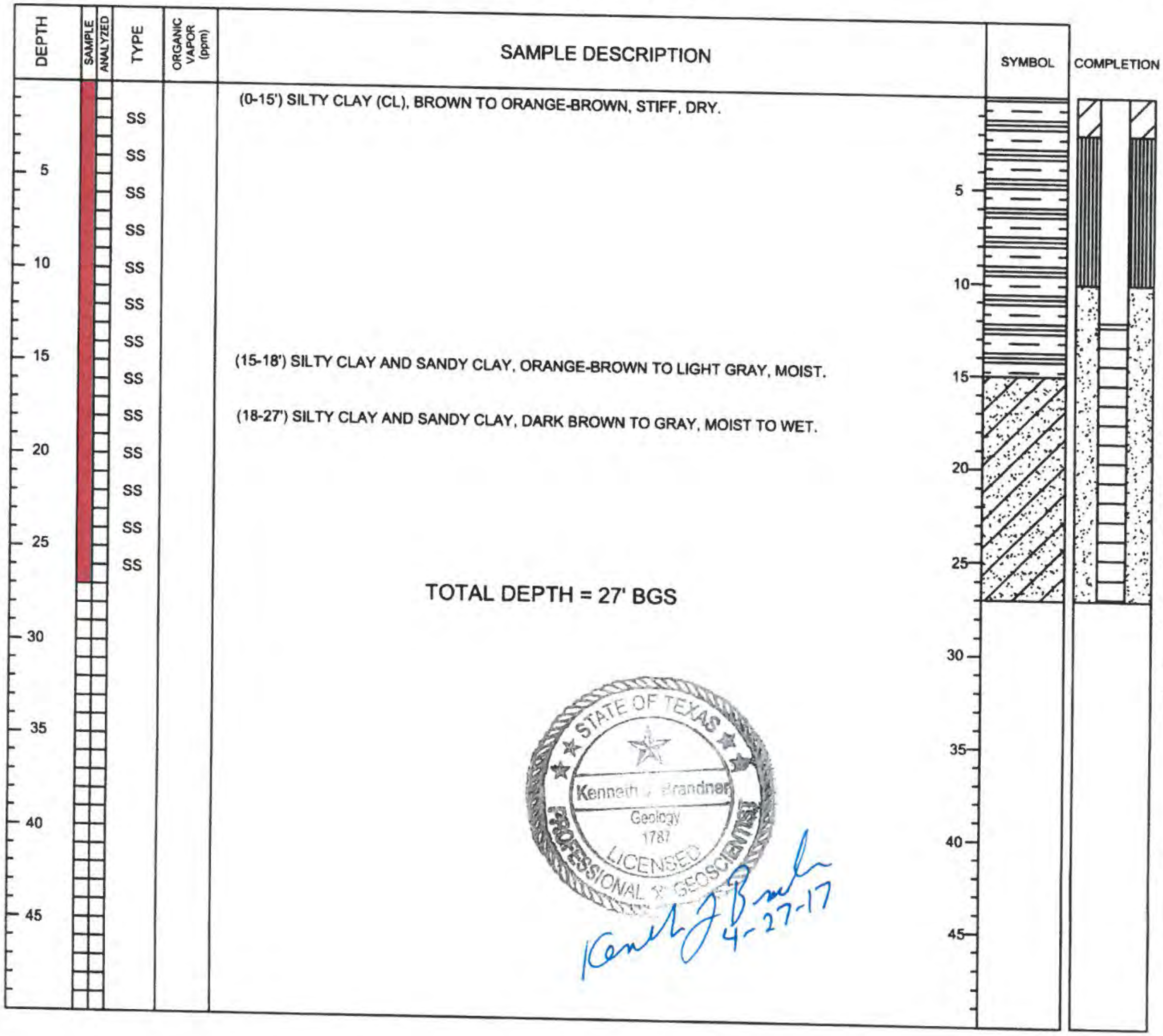
1-22-16

West DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/10/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-16
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/10/15	DRAWN BY: HDS	PROJECT NO.: —
Depth to Water: –	Depth to Product: NA	CHECKED BY: SRW	SCALE: AS SHOWN
			FILE NAME: JR Welsh Power Plant LOGS.dwg

WELL LOG



(0-15') SILTY CLAY (CL), BROWN TO ORANGE-BROWN, STIFF, DRY.

(15-18') SILTY CLAY AND SANDY CLAY, ORANGE-BROWN TO LIGHT GRAY, MOIST.

(18-27') SILTY CLAY AND SANDY CLAY, DARK BROWN TO GRAY, MOIST TO WET.

TOTAL DEPTH = 27' BGS

Kenneth J. Brandner
Geology
1787

Kenneth J Brandner
4-27-17

AD-16R
WELL

AEP
CLIENT

BOTTOM ASH STORAGE POND
PROJECT

WELSH POWER PLANT
LOCATION

4/12/17
DATE

HSA
DRILLING METHOD

2" PVC, 2' AGL-12' BGL
CASING

2" PVC, 12'-27' BGS
SCREEN

0-2' BGS
CEMENT

2-10' BGS
BENTONITE

10-27' BGS
SAND PACK

350.55' / 353.49'
GROUND ELEV. / TOP OF CASING ELEV.

CT - CUTTINGS
SB - SPLIT BARREL(5')
SS - SPLIT SPOON(2')

▽ HC LEVEL
▼ WATER LEVEL

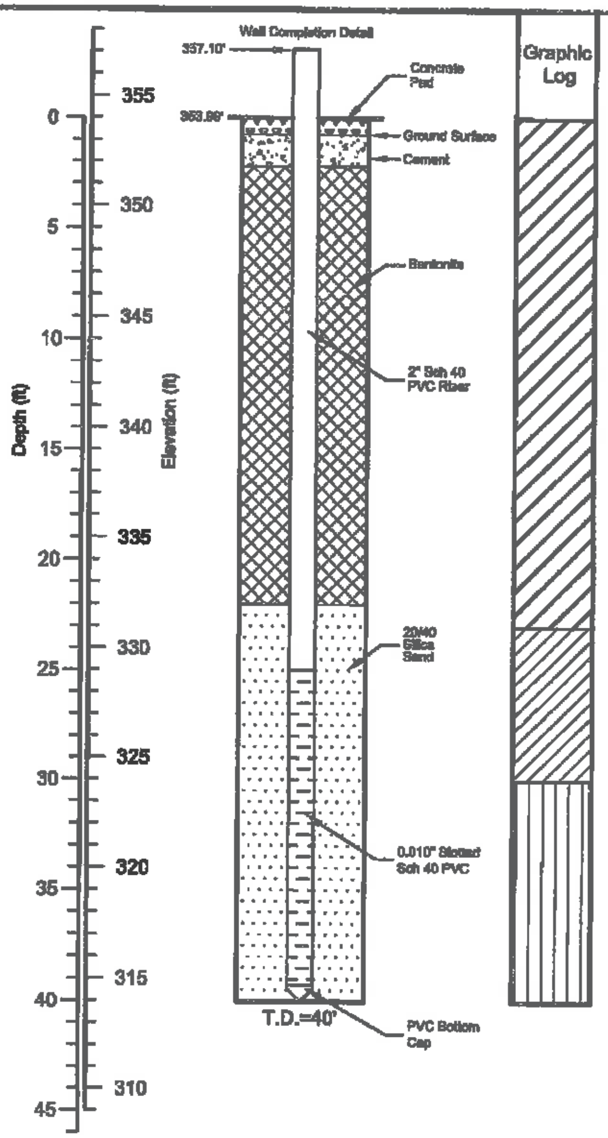
▒ SAND	▨ FILL/CONCRETE
▤ SILT	▥ BENTONITE
▤ CLAY	⁘ GRAVEL

START: FINISH:

PAGE 1 OF 1

ARCADIS Design & Consultancy for natural and built assets

711 N. CARANCAHUA, #1080
CORPUS CHRISTI, TEXAS 78401
TEL: (361) 883-1353 FAX: (361) 883-7565



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0		Direct Push		CH	Fat CLAY: reddish-brown					
5					- light gray to light brown, reddish brown w/ Sand and gravel lenses	24	97	83	30	53
10					- light brown					
15					- brown Sand lenses, wet					
20					- gray, w/ some Silt	18	90	53	25	28
25		Direct Push		CL	Lean CLAY with Sand: gray	22	81	43	22	21
30				ML	Sandy SILT: gray	23	63	26	NP	-
35										
40										

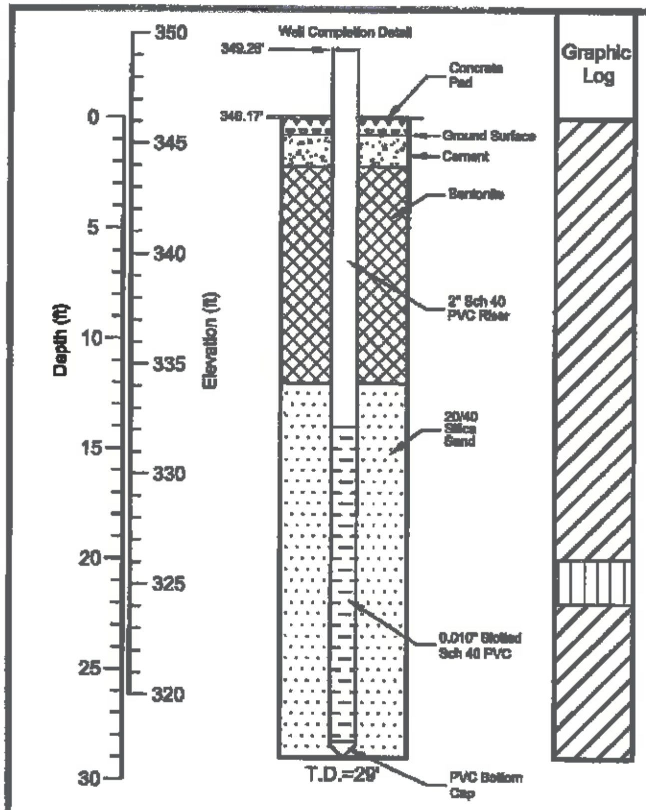
STEVEN R. WEMPLE
2176

1/22/16

west DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/10/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-17
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: — SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0		Direct Push		CH	Fat CLAY: light brown & light gray, sandy					
5					- reddish brown and light gray, with Sand					
10						19	88	50	24	26
15					- gray with silt					
					- gray, stiff					
20				ML	SILT: gray, with Clay and Sand, wet	29	86	26	NP	-
				CH	Fat CLAY: light gray, silty w/ Sand, very stiff					
25						20	85	50	23	27
30										

STEVEN R. WEMPLE
2176
1-22-21

west
DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/11/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-18
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: — / SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg

Project: AEP Welsh Power Plant **Project Location: Cason, TX** **Project Number: TXL0064**	# Log of Boring GB-1 Sheet 1 of 2

Date(s) Drilled **July 23, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **37 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **367 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Bentonite Chips**	Location **On the Northern edge of proposed chemical pond along the screening berm.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
367	0					Other		Black COAL, a few fine roots and organics.						
			ST											Shelby tube pulled black COAL
			SS	10										SPT 4, 5, 5, 5. 24" recovered
362	5													
			SS	11	Soft to Firm	SC		Reddish Brown fine SAND, little clay, trace silt, Dry. Natural Ground.						SPT 4, 5, 6, 7. 24" recovered
					Soft	SM		Reddish brown fine SAND with silt, trace clay. Vertical sand seams in sample, Dry.						SPT 3, 5, 6, 8. 24" recovered.
			SS	11										
357	10		ST						23.6	22	48.9	5.4E-07		Shelby tube sample, 18" recovered.
					Soft	SC		Reddish brown well graded fine SAND, trace silt and clay. Damp.						SPT 5, 6, 6, 9. 24" recovered
			SS	12	Firm	CL		Greyish red CLAY, little sand, horizontal sand seams, Dry.						
					Soft	SC		Brownish red fine SAND, little clay, Damp.						SPT 7, 6, 7, 9. 24" recovered.
			SS	13	Firm	SC-CL		⟩ Four-inch CLAY seam, little fine sand.						
					Firm	CL		Reddish grey CLAY, little sand, oxidized iron ore. Dry						
352	15				Soft	SM		Brownish red fine SAND, trace clay, thin clay seams. Moist.						SPT 8, 9, 9, 9. 24" recovered.
			SS	16					17.74	14	40.1			
			ST						16.25	NP	28.9	3.6E-05		Shelby tube samples look like SC. 17" recovered.
														SPT 9, 8, 9, 11. 24 inches recovered.
347	20		SS	17	Soft	Other		⟩ Iron oxidized material						
					Soft	SC		Brownish red fine SAND, little clay. Moist.						SPT 5, 7, 8, 50/2. 21" recovered
			SS	15										
			SS	50	Soft	CL		Dark grey CLAY, little fine sand, Wet.						SPT 50/3".
					Very Hard	SP		Dark grey-black cemented SAND, little clay. Wet. Driller comments that cemented sand terminates at 25.5 feet.						
342	25													SPT 11, 13, 14, 16. 24" recovered.
			SS	27	Soft to Firm	SC		Dark grey fine SAND, little clay. Moist. Soft sand with lenses of firm clay.						
					Hard	CL		ǀ Dark grey CLAY, little sand, Dry.						
					Soft	SC		Dark grey-black fine SAND, little clay, Wet. Encountered water but water rose to 19 feet after 15 min break.						SPT 11, 16, 30, 14. 24" recovered.
			SS	46										
			SS	37										SPT 11, 15, 22, 25. 24" recovered.
337	30				Hard	CL								

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
337	30	▨	SS	37	Hard	CL	▨	Dark grey CLAY, little fine sand, occansional horizontal sand seams. Wet. (cont.)						SPT 11, 15, 22, 25. 24" recovered.
		▨			Soft	ML	▥	Dark grey-black fine SAND, with clay, frequent hard clay lenses (1-3"), Wet.						SPT 6, 11, 18, 24. 24 recovered.
		▨	SS	29			▥		26.37	NP	57.5			
332	35				Hard	CL	▨	Black CLAY, trace to little fine sand, trace silt. Dry						SPT 9, 16, 18, 23. 24" recovered.
			SS	34			▨							
								Bottom of Boring at 37 feet bgs						
327	40													
322	45													
317	50													
312	55													
307	60													
302	65													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-02

Sheet 1 of 1

Date(s) Drilled **August 14, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **364.56 feet MSL**
Groundwater Level and Date Measured **21.53 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Western edge of proposed chemical pond near perimeter fence.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
364.6	0				Soft	Other		Coal						
					Soft	CL		Greyish brown CLAY, with little silt, little sand, damp.						
			SS	4										SPT 2, 2, 2. 12" recovered.
			SS	13										SPT 4, 7, 6, 12.
359.6	5		ST											Shelby Tube Sample
					Firm	CH		Brownish tan CLAY with silt, little sand, Damp. Occasional sand and iron ore.						SPT 8, 12, 17, 21
			SS	29					23.71	38	77.3			
			SS	80										SPT 20, 30, 50/5. 17" recovered
354.6	10				Soft	SC		Red-orange fine SAND, little clay, damp. Occasional iron ore.						SPT 15, 20, 24, 31. 18" recovered.
					Soft	CL		Brownish tan CLAY, little silt, little sand, Damp.						
			SS	44	Soft	SM		Red-orange fine SAND, little clay, Damp.						
														SPT 11, 12, 9, 32.
			SS	21					20.35	NP	33.5			
														SPT 6, 6, 12, 6.
349.6	15		SS	18										
					Soft	SM-SC		Light brown fine SAND, with little silt, little sand, Damp.						
														SPT 12, 25, 50/5.
					Firm	CL		Black CLAY, with fine sand, Wet.						
			SS	75	Soft	SM-SC		Dark red fine SAND, little clay, little silt, Wet.						
														SPT 9, 16, 12, 15.
					Soft-Firm	SC		Dark grey fine SAND, little clay, Wet. Occasional clay seams.						
			SS	28										
344.6	20													SPT 9, 17, 21, 27.
			SS	38	Firm	SC		Frequent clay lenses.	22.55	13	36.6			
								8/11/09 ▼						
														SPT 22, 35, 50/4".
			SS	65										
														SPT 10, 15, 18, 26.
339.6	25		SS	33										
					Soft	SC		Less clay lenses, Wet.						SPT 12, 27, 37, 50/5".
			SS	64										
														SPT 19, 24, 21, 50/5".
			SS	44										
					Hard	CL		Dark grey CLAY, little to trace silt, Wet.						
334.6	30													

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

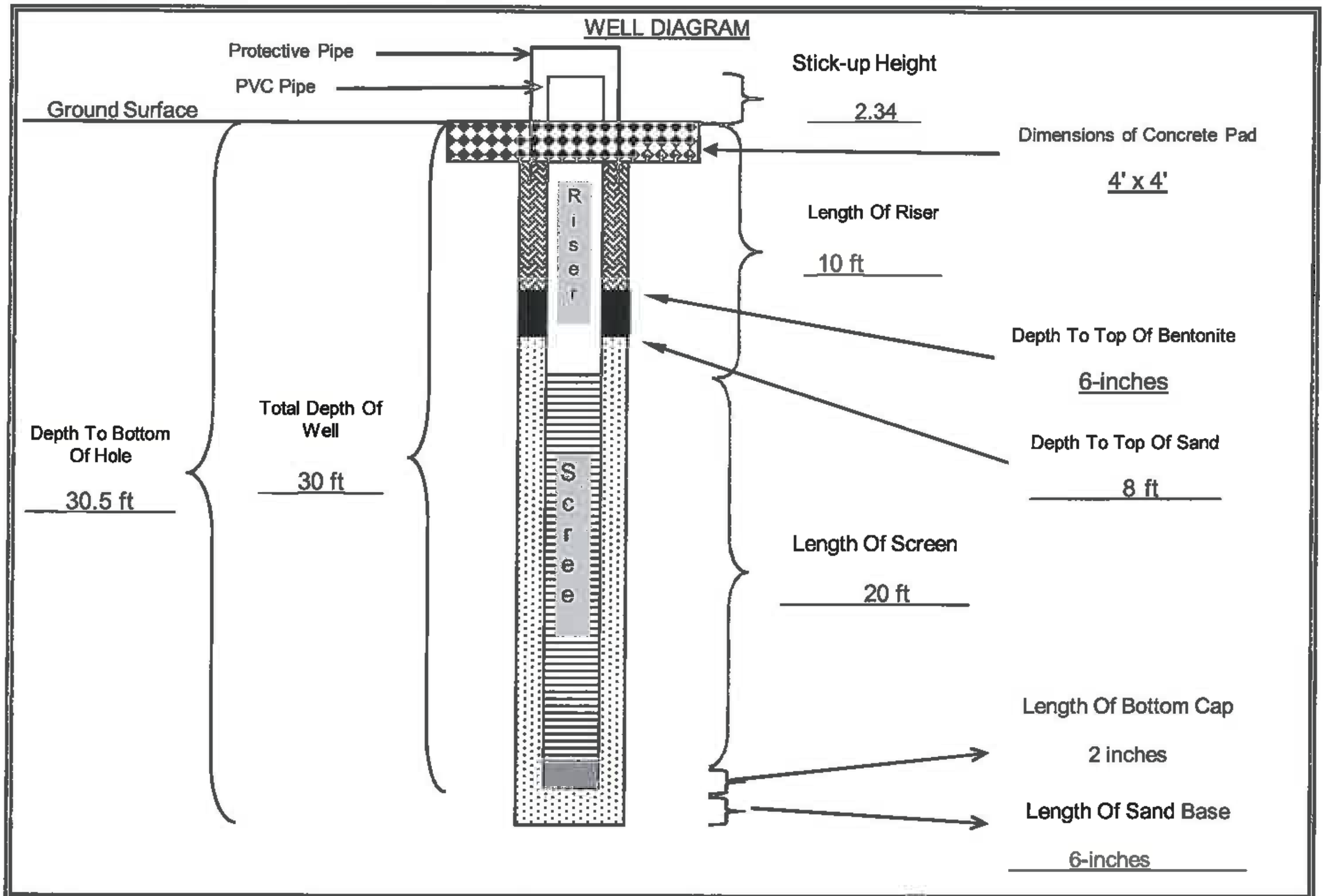
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL NO.: GB-02
WELL LOCATION:
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 364.56 (ft, msl)
TOP OF SCREEN ELEVATION: 354.56 (ft, msl)
BOTTOM OF WELL ELEVATION: 334.06 (ft, msl)
NORTHING: 747.0223 EASTING: -2442.888
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 8 (in)
DRILLING TECHNIQUE: Hollow stem Size: (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE: Not used-sealed with bentonite chips
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 4 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 13 bags lbs
STATIC WATER: 21.53 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height 2.34

Dimensions of Concrete Pad 4' x 4'

Length Of Riser 10 ft

Depth To Top Of Bentonite 6-inches

Depth To Top Of Sand 8 ft

Depth To Bottom Of Hole 30.5 ft

Total Depth Of Well 30 ft

Length Of Screen 20 ft

Length Of Bottom Cap 2 inches

Length Of Sand Base 6-inches

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services OBSERVED BY: Kush Chohan
DATE: August 7th, 2009 CHECKED BY: DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 1 of 2

Date(s) Drilled **August 7, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **31 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **359.91 feet MSL**
Groundwater Level and Date Measured **21.89 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Southwest corner of proposed chemical pond near screening pile.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
359.9	0				Soft	Other		Coal						
354.9	5		ST		Soft	CH		Shelby Tube		43	96.1			Shelby tube sample.
			SS	41	Firm	CH		Light brown-grey CLAY, little silt, occasional sand seams (fine), Damp.	24.04	29	90.4			SPT 29, 22, 19, 21.
349.9	10		SS	27	Soft	CH		Brownish dark grey CLAY, trace sand, trace silt, Wet.						SPT 6, 12, 15, 20.
			SS	53	Soft	SC		Dark orange red SAND, little clay, trace silt, Wet. Occasional clay seam (dark grey).						SPT 17, 29, 24, 25.
			SS	32	Soft	SC		Clay lenses.						SPT 7, 15, 17, 40.
344.9	15													SPT 9, 17, 30, 20.
			SS	47	Soft	SC		Clay lense						
					Soft	SC		Dark grey fine SAND with clay, occasional clay lense, Wet.						SPT 11, 50/4".
			SS	50	Firm	CL		Dark grey CLAY, little fine sand, Wet.						
					Soft	SC		Dark grey fine SAND, little clay, occasional clay seam, iron ore, Wet.						SPT 11, 27, 17, 21.
339.9	20		SS	44										
								8/11/09 ▼						
334.9	25													SPT 27, 40, 50/4".
			SS	90										
					Firm	SC		Dark grey clay lense						SPT 11, 15, 40, 50/3".
			SS	55										
			SS	55										SPT 17, 50/5.5".
329.9	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
329.9	30	▨	SS	65	Hard	CL	▨	Dark grey CLAY, trace silt, trace fine sand.					▨	SPT 17, 50/5.5".
								Bottom of Boring at 31 feet bgs						
324.9	35													
319.9	40													
314.9	45													
309.9	50													
304.9	55													
299.9	60													
294.9	65													

Figure

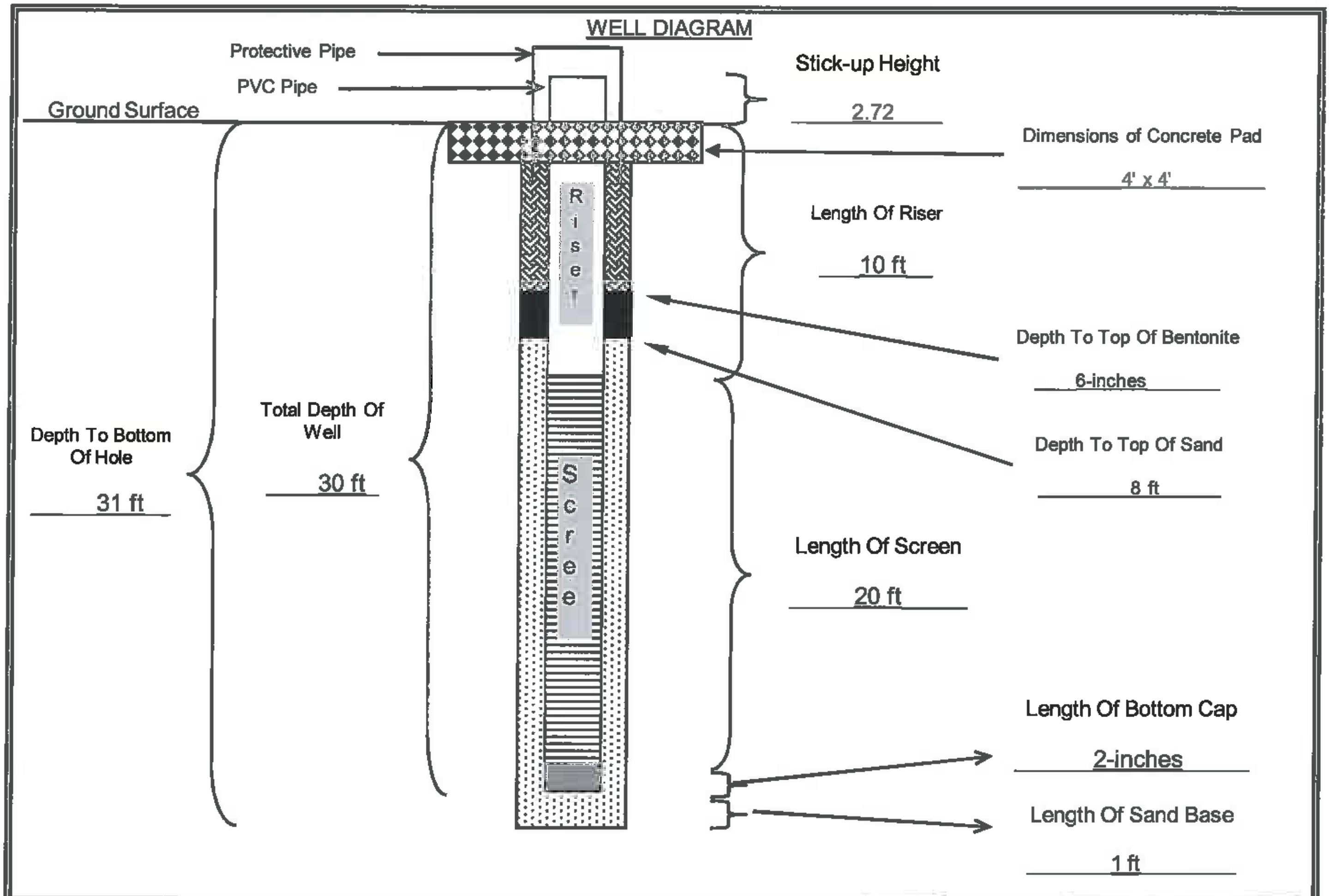
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL LOCATION:
WELL NO.: **GB-03**
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION:	359.57 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	349.57 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	328.57 (ft, msl)	CEMENT TYPE:	None used-sealed with bentonite chips
NORTHING: 460.5803	EASTING: -2507.6332	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	4 bags lbs
RISER DIAMETER:	2 (in) Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 20 (ft)	AMOUNT SAND USED:	12 bags lbs
BOREHOLE DIAMETER:	8 (in)	STATIC WATER:	21.89 depth from TOC
DRILLING TECHNIQUE:	Hollow Stem Size: 8 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height
2.72

Dimensions of Concrete Pad
4' x 4'

Length Of Riser
10 ft

Depth To Top Of Bentonite
6-inches

Depth To Top Of Sand
8 ft

Length Of Screen
20 ft

Length Of Bottom Cap
2-inches

Length Of Sand Base
1 ft

Depth To Bottom Of Hole
31 ft

Total Depth Of Well
30 ft

▨	Cement/Bentonite Grout	░	Sand Pack	▦	Neat Concrete	■	Bentonite	▩	Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: 7-Aug-09
OBSERVED BY: Kush S. Chohan
CHECKED BY:
DATE:

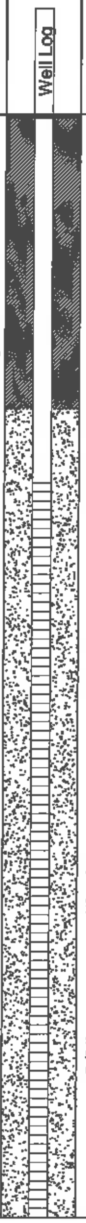
Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **34 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.22 feet MSL**
Groundwater Level and Date Measured **20.54 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Southeast corner of proposed chemical evaportation pond. Located in a grassy field.**	

Elevation, feet	Depth, feet	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
357.2	0			Soft	SM-SC	Reddish brown fine SAND, little silt, trace clay, damp.					SPT 1, 3, 6, 6. 24" recovered.
		SS	9								
				Soft	Other	COAL					
				Firm	SC	Brownish red SAND, little clay, trace silt. Damp.					
				Firm	CL	Reddish pink CLAY, some fine sand, Dry.					SPT 4, 4, 4, 4. 24" recovered.
		SS	8				24.49	47	90.2		
											SPT 5, 6, 8, 4. 18" recovered.
				Soft	Other	Oxidized SAND and clay with iron ore.					
352.2	5	SS	14	Soft	CH	Light reddish brown CLAY and sand mixture, Dry.					
				Soft	SC	Reddish brown SAND, little clay, Dry.					
		ST					28.4	36	61.1	7.7E-09	12" Shelby tube. 9" recovered.
		SS	17	Firm	CH	Light brownish tan CLAY, little sand, occasional sand seams, Dry.					SPT 3, 4, 13, 15. 27" recovered.
347.2	10										
342.2	15			Soft	SC	Red/yellowish brown SAND, some clay, Wet.					SPT 3, 7, 3, 15. 24" recovered.
		SS	10				6.95	14	47		
				Firm	SC	Occasional clay lenses.					
337.2	20	ST				8/11/09					Shelby tube. 12" driven 0" pulled. Gravel material encountered.
				Soft to Firm	SM	Black to dark grey fine/med SAND, little clay, occasional clay lenses, Wet.					SPT 7, 10, 9, 13. 24" recovered.
		SS	19								
332.2	25			Soft	SM	Well graded light grey fine/med SAND, trace silt, Wet.					SPT 17, 24, 50/5.5". 19" recovered.
		SS	74				22.29	NP	13.5		
				Firm	CL	Dark grey clay lense, Wet.					
				Firm	SM-SC	Well graded light grey fine/med SAND, trace silt, Wet.					
327.2	30										



Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.2	30	☒	ST		Hard	ML	▥	Dark grey CLAY, little sand, Wet.						12" Shelby tube. Bent shelby tube.
		☒	ST						21.3	NP	84.2	2.0E-08		12" Shelby tube.
		▨	SS	38	Hard	CL	▨	Dark grey CLAY, trace sand, Wet.	25.44	18	92.5			SPT 15, 19, 19, 25. 24" recovered.
								Bottom of Boring at 34 feet bgs						
322.2	35													
317.2	40													
312.2	45													
307.2	50													
302.2	55													
297.2	60													
292.2	65													

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

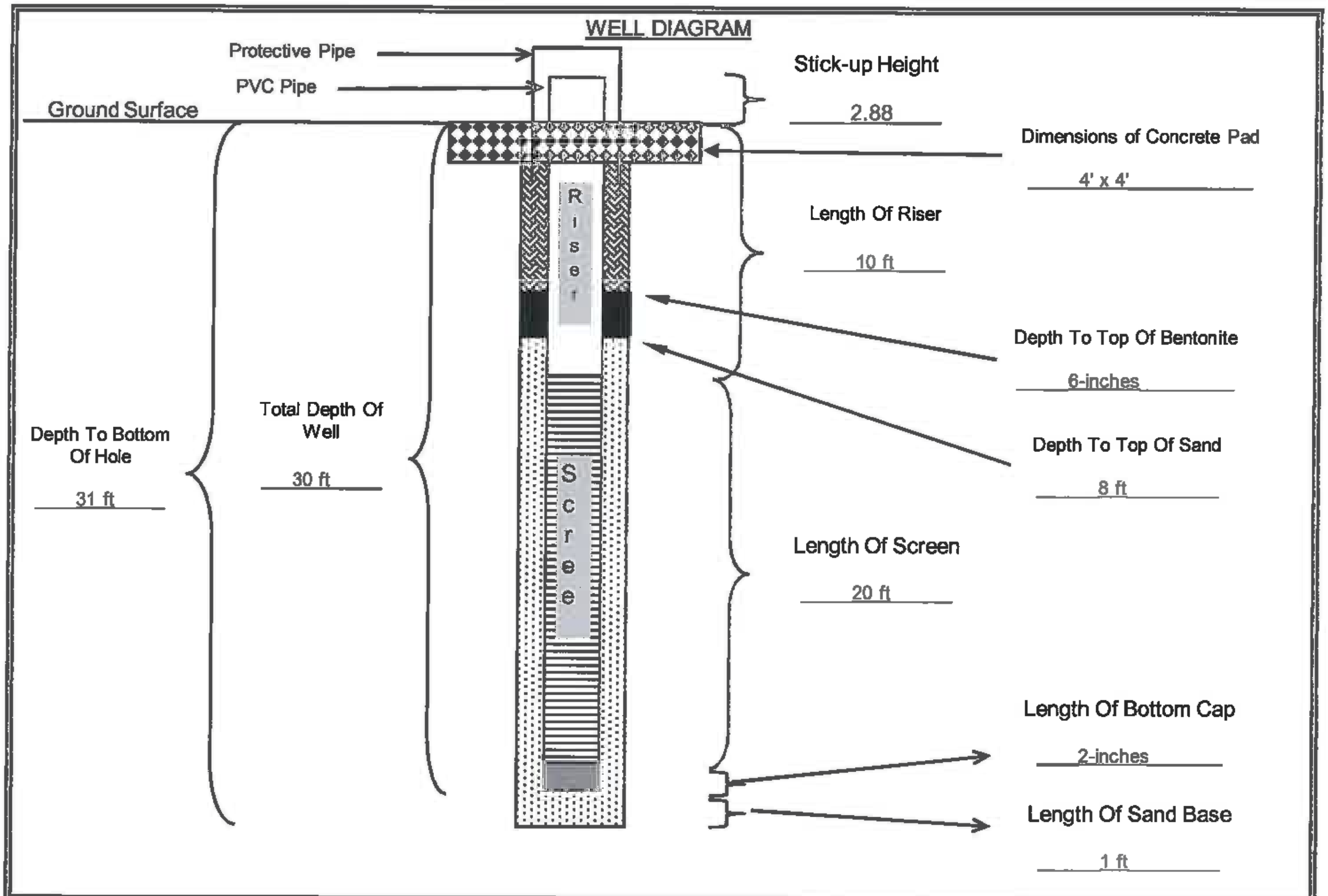
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 24-Jul-09
WELL LOCATION:
WELL NO.: GB-04
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.22 (ft, msl)
TOP OF SCREEN ELEVATION: 347.22 (ft, msl)
BOTTOM OF WELL ELEVATION: 326.22 (ft, msl)
NORTHING: -384.9666 EASTING: -2353.7375
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 6.75 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 6.75 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 3 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 20.54 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.88
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 1 ft
Total Depth Of Well: 30 ft
Depth To Bottom Of Hole: 31 ft

▨ Cement/Bentonite Grout ⛆ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: 24-Jul-09
OBSERVED BY: Kush S. Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30.5 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.49 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8-11-09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Eastern edge of proposed chemical evaporation pond.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
357.5	0				Soft	SW-SM		Dark fine SAND with brown organic material and roots.						SPT 2, 2, 5, 5. 24" recovered
			SS	7	Firm	CH		Dark red/grey CLAY, trace silt. Dry.	23.37	44	68.6			
														SPT 4, 4, 7, 9. 24" recovered.
			SS	11								7E-07		
														SPT 5, 6, 8, 13. 24 recovered
352.5	5		SS	14										
						CH		Trace of sand						
			ST		Soft	CH		Dark red fine SAND, trace clay, Damp.	16.5	41	73.8	3.2E-08		Shelby tube. Pushed 12 recovered 9".
														SPT 5, 7, 11, 11. 24" recovered.
					Firm	CH		Light tan CLAY, trace sand, Dry.						
			SS	18	Soft	SC		Dark red SAND, trace of CLAY, Damp.						
					Firm	CL		Light tan CLAY, trace fine sand, Dry.						
					Soft	SC		Dark red SAND, little clay, frequent clay seams, Damp						SPT 6, 7, 11, 14. 24" recovered.
347.5	10		SS	16										
						SC		Frequent clay seams						SPT 11, 22, 13, 14. 24" recovered.
			SS	35	Soft	SC		Red/orange fine SAND, trace clay, trace coarse sand, poorly sorted, Moist.						
														SPT 17, 27, 50/5". 17" recovered.
			SS	77	Firm	CL		Brownish grey CLAY, trace sand, Moist.						
					Soft	SC		Tanish grey fine SAND, some clay, Wet.						
342.5	15		ST					8-11-09 ▼	19.9	13	35.7	6.6E-07		Shelby tube. Pushed 12" recovered 9".
														SPT 11, 13, 10, 14. 24" recovered.
			SS	23					27.98	NP	32.3			
					Soft	SM		Dark grey coarse SAND/GRAVEL mix, some fine sand, trace clay, Wet.						
					Soft	SM-SC		Red fine SAND, trace clay, Moist. cemented. Moist.						SPT 7, 8, 11, 13. 24" recovered.
			SS	19										
					Firm	SC		Black fine SAND, occasional clay, Wet.						
337.5	20													
					Firm	CL		Dark grey CLAY, little sand, Wet.						SPT 8, 10, 12, 15. 24" recovered.
					Firm	SM		Black fine SAND, some medium sand, some clay, Wet.						
			SS	22					32.23	NP	35.5			
					Firm	CL		Dark grey CLAY, little sand, Wet.						
					Firm	SM		Black fine SAND, some medium sand, some clay, Wet.						
														SPT 6, 11, 17, 21. 24" recovered.
					Firm	SM		Frequent clay seams						
			SS	28										
					Firm	SM		Frequent clay seams.						
			ST											Shelby tube. 12" driven 0 recovered.
332.5	25													SPT 15, 19, 21, 27. 24" recovered.
			SS	40	Hard	CL		Dark grey CLAY, trace of sand, Dry.						
														SPT 10, 11, 11, 50/5". 23" recovered.
			SS	22										
					Very Hard	CL		Dark grey CLAY, frequent iron stone/ore. Rig chatter driller comments						
			ST						24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
327.5	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.5	30	☒	ST		Hard	CL	▨	Dark grey CLAY, trace of sand, Dry. (cont.)	24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
								Bottom of Boring at 30.5 feet bgs						
322.5	35													
317.5	40													
312.5	45													
307.5	50													
302.5	55													
297.5	60													
292.5	65													

Figure

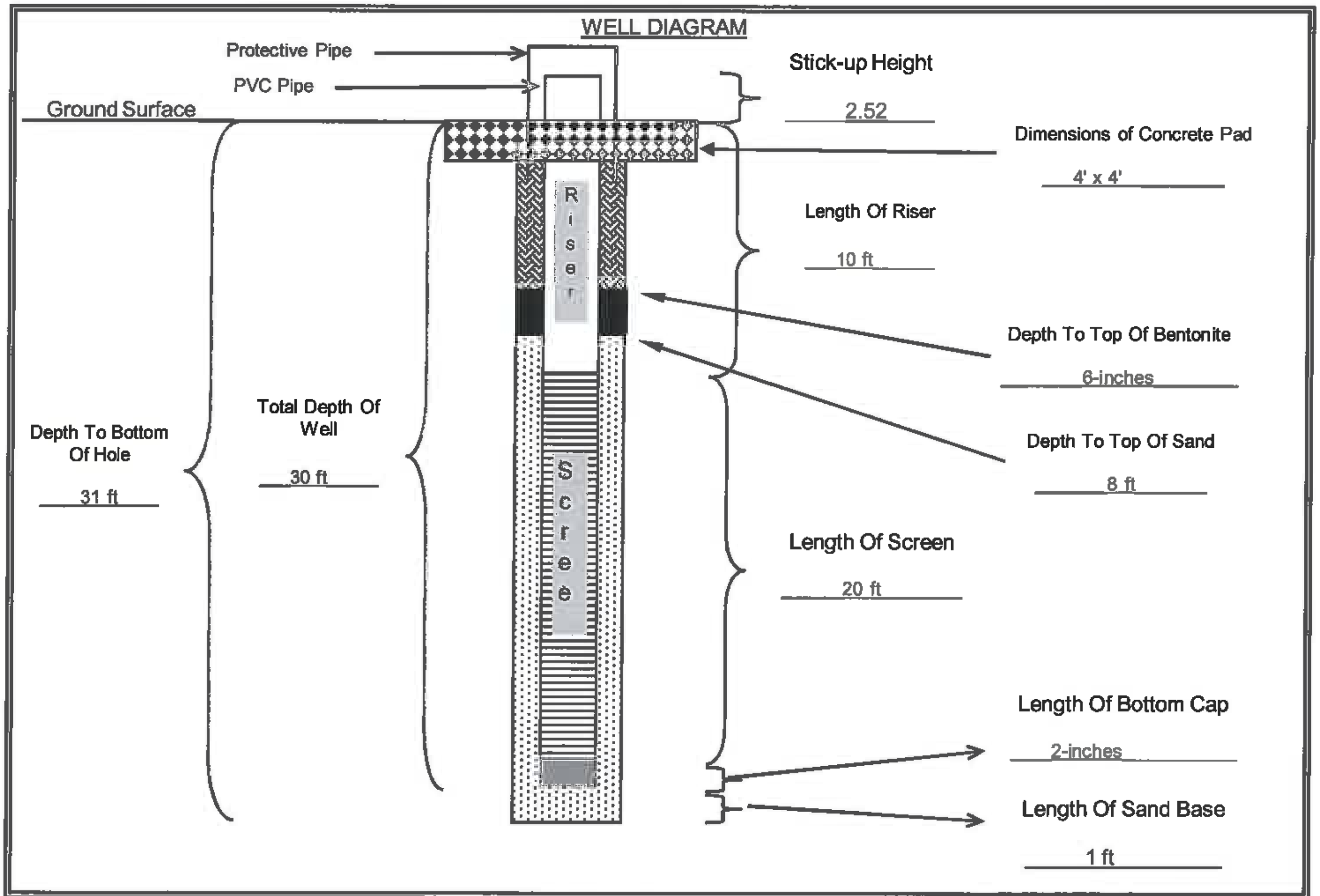
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: August 6 2009
WELL NO.: GB-05
WELL LOCATION:
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION:	357.49 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	347.49 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	326.49 (ft, msl)	CEMENT TYPE:	
NORTHING: 529.1865	EASTING: -2243.9973	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	3 bags lbs
RISER DIAMETER:	2 (in) Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 20 (ft)	AMOUNT SAND USED:	7 bags lbs
BOREHOLE DIAMETER:	8 (in)	STATIC WATER:	17.33 depth from TOC
DRILLING TECHNIQUE:	Hollow Stem Size: 8 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.52

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 10 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 8 ft

Depth To Bottom Of Hole: 31 ft

Total Depth Of Well: 30 ft

Length Of Screen: 20 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 1 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC	INSTALLED BY:	Total Support Services	OBSERVED BY:	Kush Chohan	
	DATE:	6-Aug-09	CHECKED BY:		DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-06

Sheet 1 of 1

Date(s) Drilled **7/23/2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.41 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube, Other**	Hammer Data **140 lb, 30 in drop, auto hammer**
Borehole Backfill **Well Completion**	Location **Northeast corner of proposed chemical pond in the middle of open grass field.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
357.4	0				Soft	SP		Greyish brown fine SAND with trace fines. Organic material (roots).						Hand Auger
			HA		Soft	SP-SM		Greyish red fine SAND, little silt. Poorly sorted, less organic material.						
					Soft	SM		Greyish red fine SAND, with little silt and clay. Dry.						
					Soft			Tanish grey fine SAND, trace silt and clay, frequent iron oxide, frequent discoloration.						
			SS	14					12.74	34	67.9			SPT 4, 7, 7. 16" recovered
					Firm	CL		Red light brown CLAY, little sand, trace silt, Dry.						
352.4	5													SPT 3, 5, 6, 8. 20" recovered
			SS	11	Soft	SC		Dark reddish brown fine SAND, little clay.						
					Soft	CL		Light grey CLAY, little sand, trace silt. Dry.						
					Soft	SC		Reddish brown fine SAND, trace clay, trace silt. Occasional clay seams. Damp.						SPT 3, 5, 7, 7. 24" recovered
			SS	12					17.65	NP	43.2			
					Soft	CL		Light grey CLAY, little fine sand						
			SS		Soft to Firm	SC		Brownish red fine SAND, little to some clay, some cementation, Damp.						24" driven, 15" recovered.
347.4	10													SPT 8, 9, 10, 10. 24" recovered.
			SS	19										
					Soft to Firm	CL		Brown CLAY, little fine sand, frequent brown sand-clay mixture with iron ore oxide.						Shelby Tube. 24" driven/16" recovered
			ST						22.9	21	43.2	6.0e-07		
342.4	15				Firm	CL		Dark redish brown CLAY, little fine sand, Damp. 8/11/09						SPT 15, 10, 22, 30. 24" recovered
			SS	40	Firm	SC		Dark reddish brown SAND, little to some clay, Moist.						
					Firm	CL		Black CLAY, little fine sand, Wet.						SPT 2, 8, 14, 10. 24" recovered
			SS	22	Firm	SW		Black fine SAND, trace clay, trace med sand, Wet.						
					Firm	CL		Black CLAY, trace fine sand, trace silt, Wet.						SPT 5, 8, 22, 50/4". 22 recovered.
						SC		Black fine SAND, little clay, Wet.						
337.4	20		SS	30	Firm	CL		Black CLAY, trace sand, trace silt. Wet.						
					Firm	SC		Black fine SAND, trace to little clay, Wet. Occasional black clay seams.						SPT 10, 11, 23, 33. 24" recovered
			SS	34	Firm	SP-SC		Black fine SAND, with little clay, trace med sand, Wet.						
						SW-SC		Grading to med SAND, Wet.						SPT 11, 16, 16, 24. 24" recovered.
			SS	36										
332.4	25													SPT 9, 11, 12, 22. 24" recovered.
			SS	23	Firm	SW-SC		Occasional CLAY lenses, Wet.						
					Firm	SC		Black fine SAND, little med sand and clay, Wet.						SPT 7, 15, 25, 50/3". 21 recovered.
			SS	40	Hard	CL		Dark grey CLAY, little sand, little silt, Dry.						
			ST							19	45.1			Shelby tube. 12" driven-8" recovered.
327.4	30							Bottom of Boring at 30 feet bgs						

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

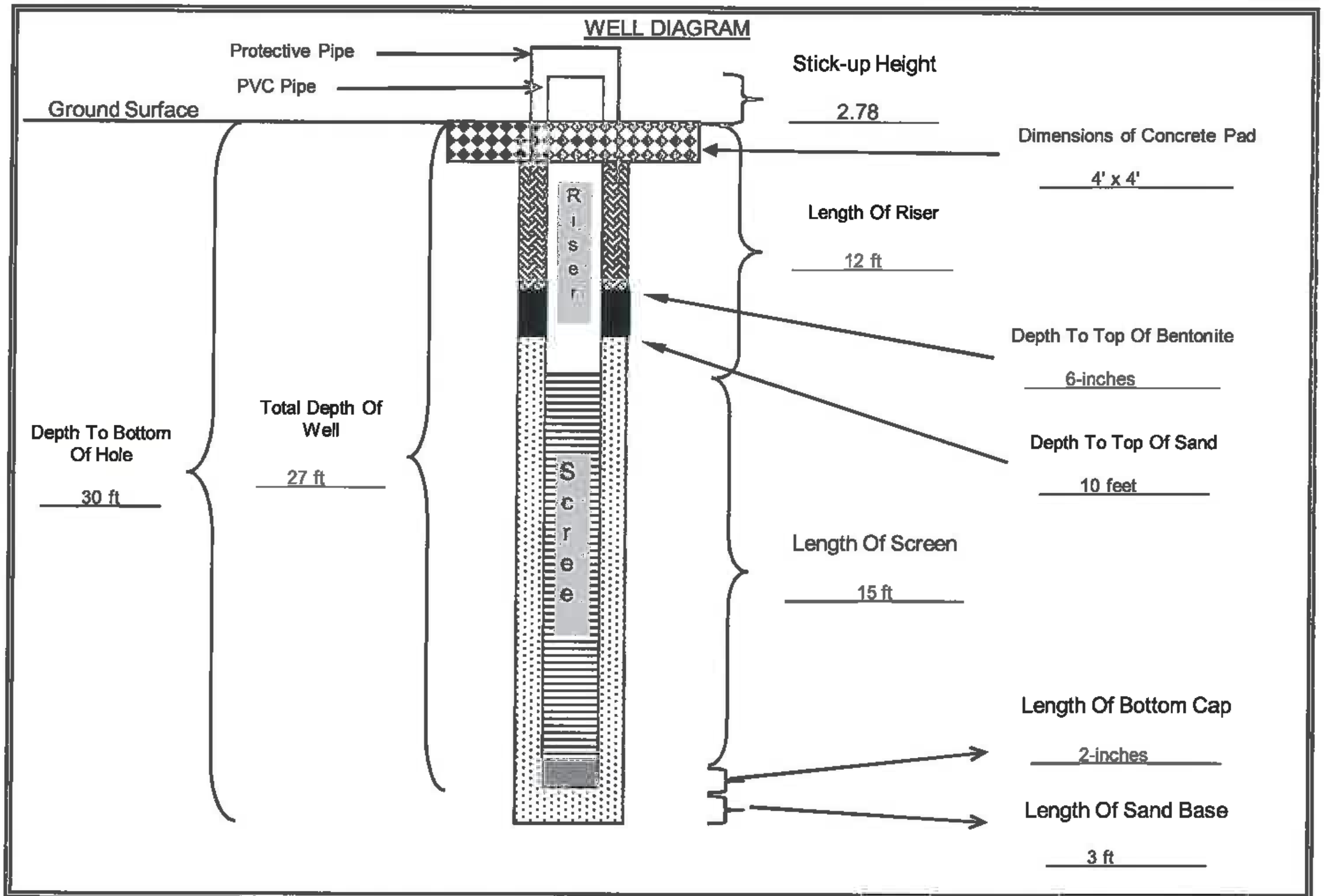
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 23-Jul-09
WELL LOCATION:
WELL NO.: GB-06
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.41 (ft, msl)
TOP OF SCREEN ELEVATION: 345.41 (ft, msl)
BOTTOM OF WELL ELEVATION: 327.41 (ft, msl)
NORTHING: 740.4893 EASTING: -2166.134
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 12 (ft)
SCREEN DIAMETER: 2 (in) Length: 15 (ft)
BOREHOLE DIAMETER: 6.75 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 6.75 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 2.5 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 15.3 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height 2.78
Dimensions of Concrete Pad 4' x 4'
Length Of Riser 12 ft
Depth To Top Of Bentonite 6-inches
Depth To Top Of Sand 10 feet
Length Of Screen 15 ft
Length Of Bottom Cap 2-inches
Length Of Sand Base 3 ft
Depth To Bottom Of Hole 30 ft
Total Depth Of Well 27 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▩ Neat Concrete ■ Bentonite ▒ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: 23-Jul-09
OBSERVED BY: Kush Chohan
CHECKED BY:
DATE:

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

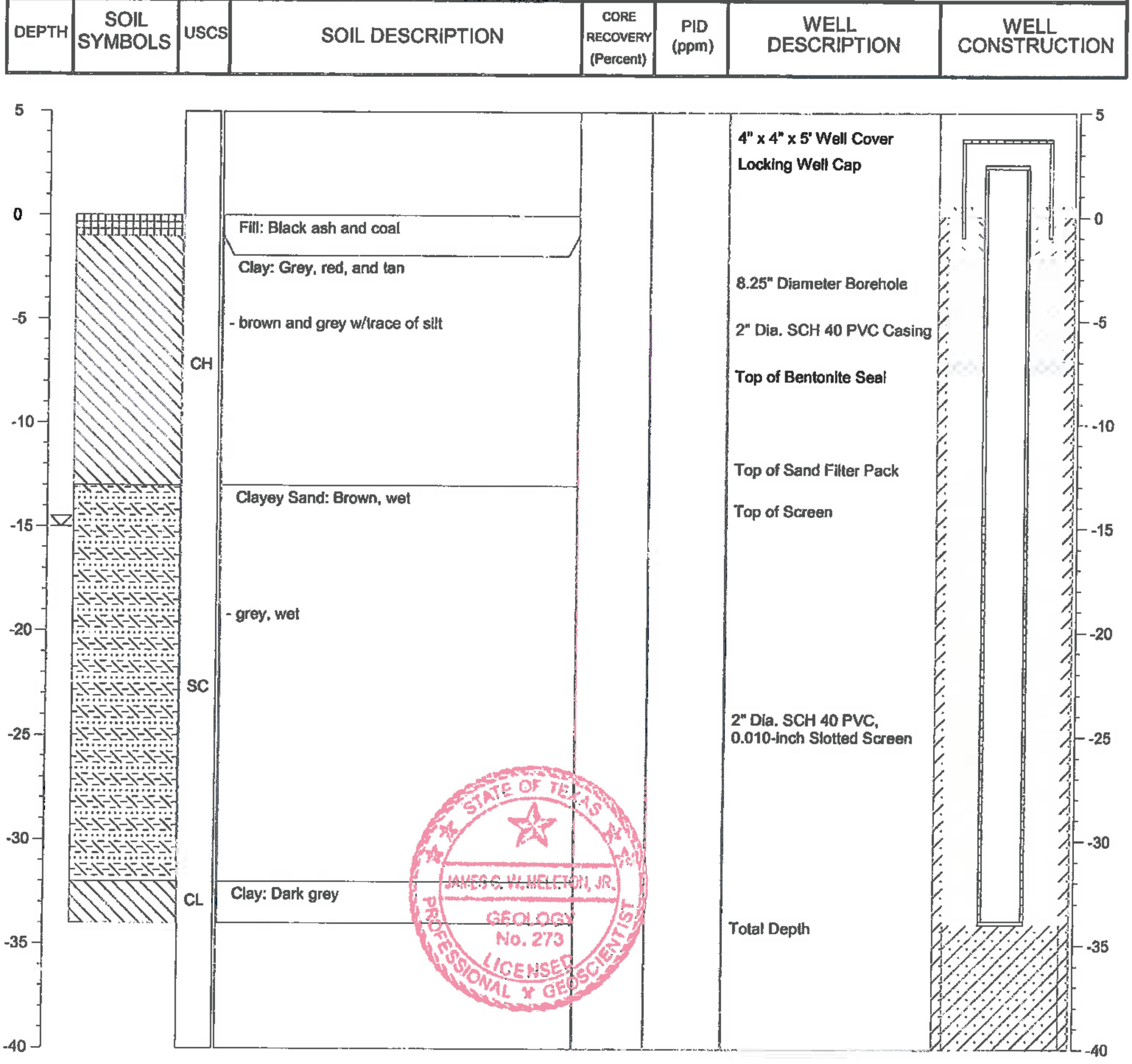
BORING/WELL NO.:	**GB-07/MW-7**
TOTAL DEPTH:	**34'**
TOP OF CASING ELEV.:	**362.75 ft. NGVD**
GROUND SURFACE ELEV.:	**360.20 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Metal Cleaning Waste Pond**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0120**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**12/1/09**

NOTES: **Latitude: 33.05455**
Longitude: 94.84674

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



USCS	SOIL DESCRIPTION	WELL DESCRIPTION
		4" x 4" x 5' Well Cover
		Locking Well Cap
	Fill: Black ash and coal	
	Clay: Grey, red, and tan	
		8.25" Diameter Borehole
	- brown and grey w/trace of silt	2" Dia. SCH 40 PVC Casing
CH		Top of Bentonite Seal
		Top of Sand Filter Pack
	Clayey Sand: Brown, wet	
		Top of Screen
	- grey, wet	
SC		
		2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
CL	Clay: Dark grey	
		Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-1

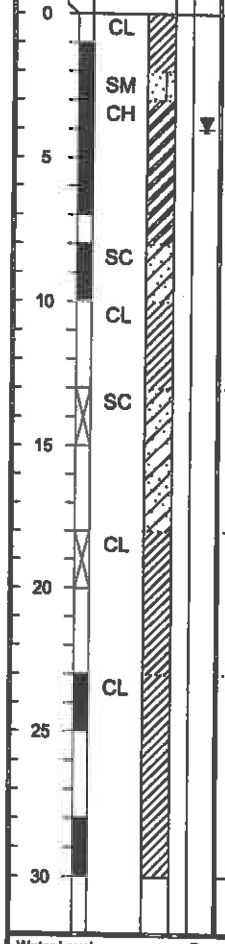
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

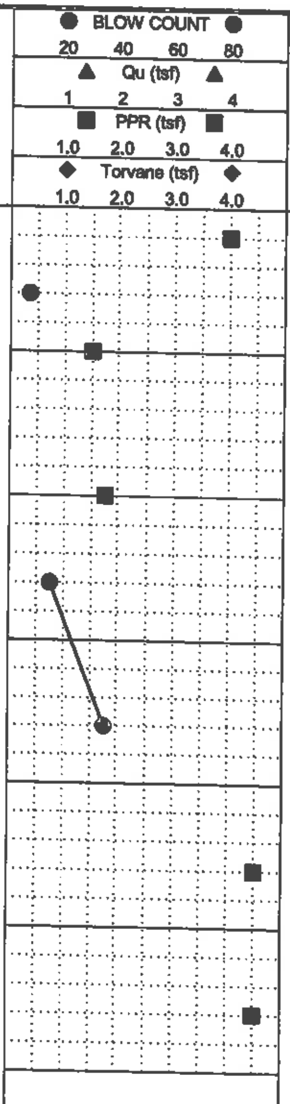
BORING TYPE: Flight Auger

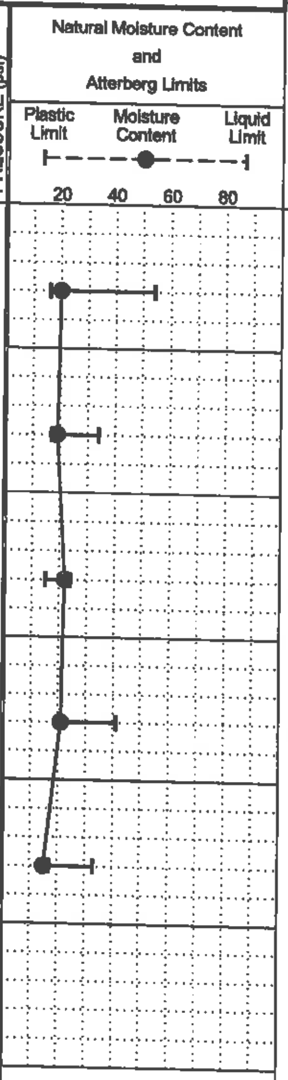
DATE 10/27/09

SURFACE ELEVATION 324.1



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; brownish orange	P=4.0 SF										
SM	SILTY SAND(SM) tannish orange	N=7										
CH	SANDY FAT CLAY(CH) medium stiff; tannish orange						20	54	16	38	63	+40Sieve=10%, +4 Sieve=1%
	–stiff	P=1.5										
SC	CLAYEY SAND(SC) medium dense; tannish orange; with clay seams	P=1.75					19	34	17	17	32	+40 Sieve=7%, +4 Sieve=3%
CL	SANDY LEAN CLAY(CL) stiff; orange											
SC	CLAYEY SAND(SC) medium dense; orange; saturated; with iron oxide cemented sandstone rock	N=15					22	24	15	9	19	+40Sieve=35%, +4 Sieve=22%
CL	LEAN CLAY WITH SAND(CL) hard; dark gray; with clay seams	N=35					21	41	21	20	75	+40 Sieve=2%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; dark brown	P=4.5+					15	33	17	16	52	+40 Sieve=1%, +4 Sieve=0%
	–grayish brown; laminated with silt	P=4.5+										
	Bottom of Boring @ 30'											





Water Level Est.: ∇ Measured: ▼ Perched: ∇

Water Observations: Seepage @ 5' while drilling. Water level @ 4' and open to 30' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.090', W 94°50.417'

Piezometer B-2

LOG OF BORING B-2

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

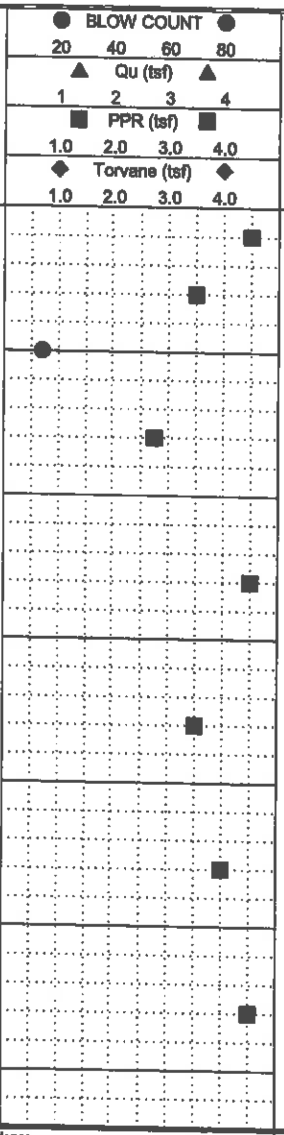
PROJECT NO.: G3242-09

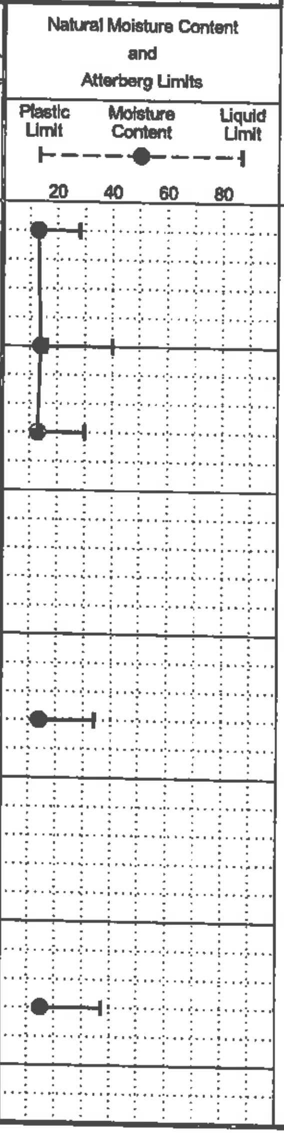
BORING TYPE: Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7

USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL		SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+					13	28	14	14	61	+40 Sieve=3%, +4 Sieve=0%
		--very stiff	P=3.5										
		--stiff	N=14					14	40	16	24	65	+40 Sieve=0%, +4 Sieve=0%
		--very stiff; reddish brown	P=2.75					13	30	14	16	58	+40 Sieve=0%, +4 Sieve=0%
CL		SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+										
	▼	--very stiff	P=3.5					14	34	15	19	54	+40 Sieve=0%, +4 Sieve=0%
			P=4.0										
SC		CLAYEY SAND(SC) medium dense; tan, red, and gray	P=4.5					15	37	16	21	47	+40 Sieve=5%, +4 Sieve=3%





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

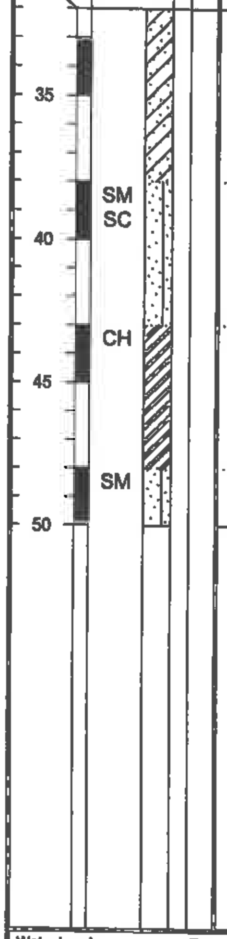
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

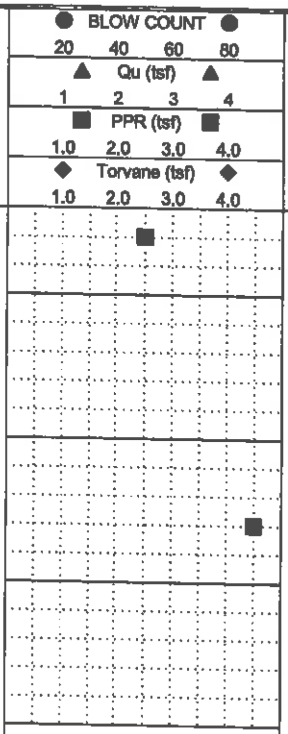
BORING TYPE: Flight Auger

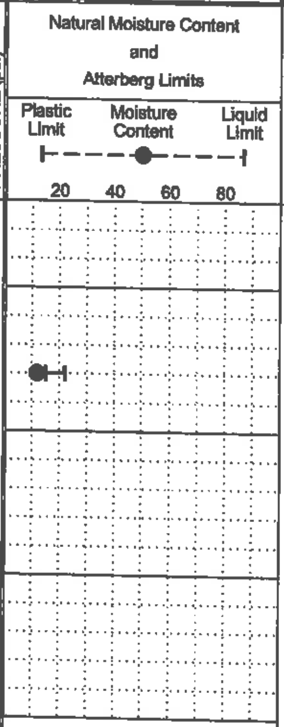
DATE 10/28/09

SURFACE ELEVATION 339.7



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	--red and tan	P=2.5										
SM SC	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated	SF					12	22	15	7	48	+40 Sieve=0%, +4 Sieve=0%
CH	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams	P=4.5+										
SM	SILTY SAND(SM) black and gray	SF										
	Bottom of Boring @ 50'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:

N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

Piezometer B-2

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-2

Location Pittsburg, Texas

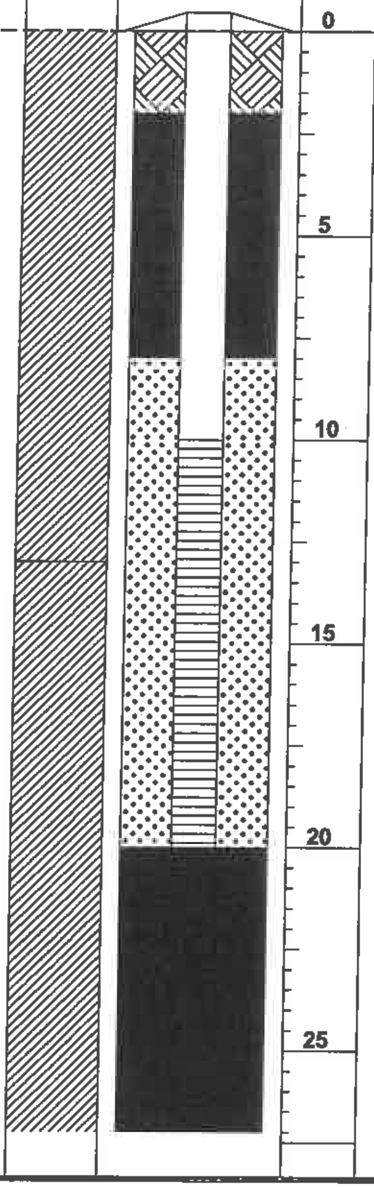
Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description
0		Ground Surface
		SANDY LEAN CLAY(CL) hard; red and tan
		--very stiff
5		--stiff
		--very stiff; reddish brown
10		
		SANDY LEAN CLAY(CL) hard; red and tan
15		
		--very stiff
20		
25		

Field Strength Data | **Graphic Log** | **Well Construction Graphics** | **Depth Feet** | **Well Construction Details**

T.O.C. Elev.



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/28/09

Drilling Completed 10/28/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-8' & 20-50'

Filter Pack Qty. 8-20'

Filter Pack Type 20/40 Sand

Static Water Level

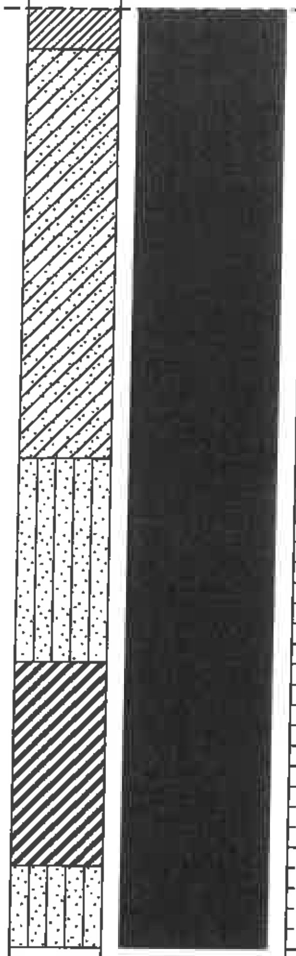
Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**

Well No. B-2
Location Pittsburg, Texas
Surface Elev.
Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		CLAYEY SAND(SC) medium dense; tan, red, and gray					
30						30	
		--red and tan					
35						35	
		SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated					
40						40	
		FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams					
45						45	
		SILTY SAND(SM) black and gray					
50						50	
		Bottom of Boring @ 50'					
55							
60							



LOG OF BORING B-3

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

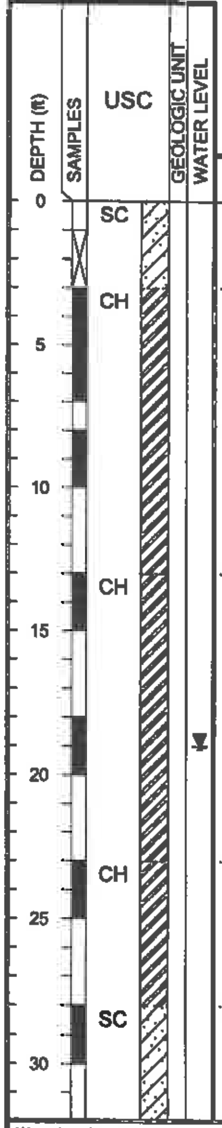
PROJECT NO.: G3242-09

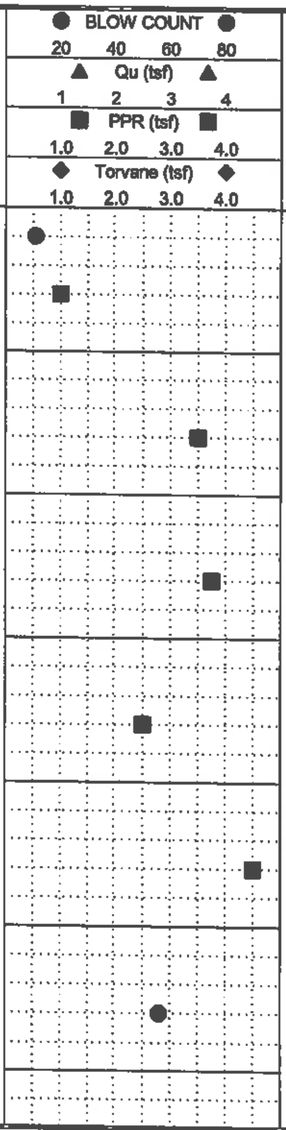
BORING TYPE: Flight Auger

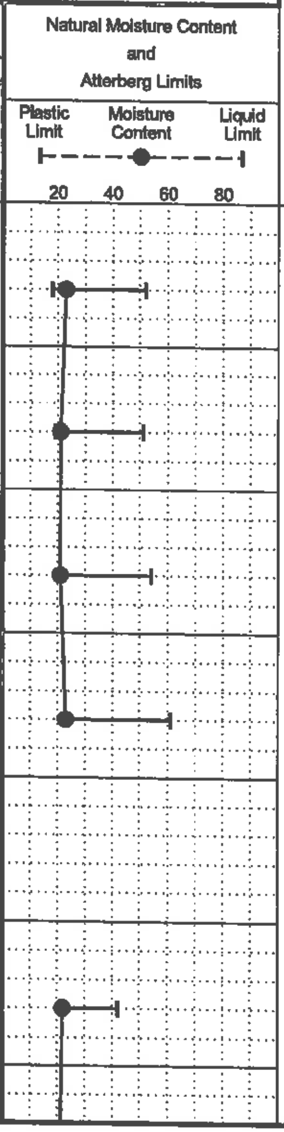
DATE 10/27/09

SURFACE ELEVATION 339.6

USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC		CLAYEY SAND(SC) medium dense; gray and red	N=11										
CH		FAT CLAY(CH) stiff; red and tan; with sand seams	P=1.0					23	52	18	34	87	+40 Sieve=3%, +4 Sieve=0%
		--very stiff	P=3.5					21	51	19	32	86	+40 Sieve=3%, +4 Sieve=0%
CH		FAT CLAY WITH SAND(CH) very stiff; brown; with ferric joints	P=3.75					21	54	20	34	85	+40Sieve=10%, +4 Sieve=1%
	▼	--red and tan; layered; with ferric seams	P=2.5					23	61	24	37	81	+40Sieve=11%, +4 Sieve=0%
CH		FAT CLAY(CH) hard; gray; with sand seams	P=4.5+										
SC		CLAYEY SAND(SC) very dense; gray; with sand seams	N=56					22	42	22	20	35	+40 Sieve=1%, +4 Sieve=0%







Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

PROJECT: Welsh Power Plant
Pittsburgh, Texas

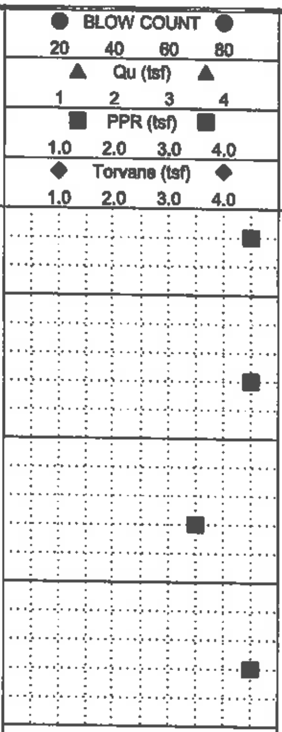
PROJECT NO.: G3242-09

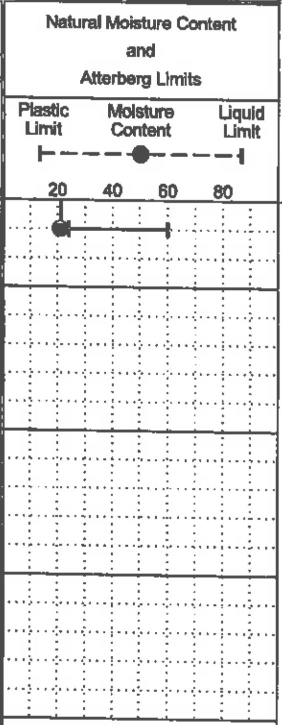
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6

DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35		CH			FAT CLAY(CH) hard; brown; layered and with sand seams	P=4.5+					21	60	24	36	95	+40 Sieve=1%, +4 Sieve=0%
40					--gray and green	P=4.5+										
45		CL			SANDY LEAN CLAY(CL) very stiff; gray and dark green; layered; with sand seams	P=3.5										
50		CH			FAT CLAY(CH) hard; gray and dark green; layered; with silt seams	P=4.5+										
					Bottom of Boring @ 50'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

Piezometer B-4

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

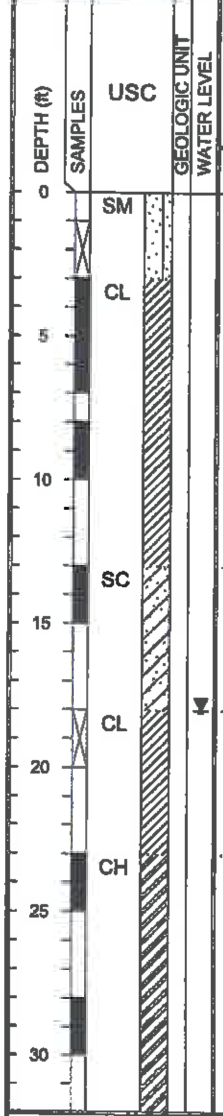
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

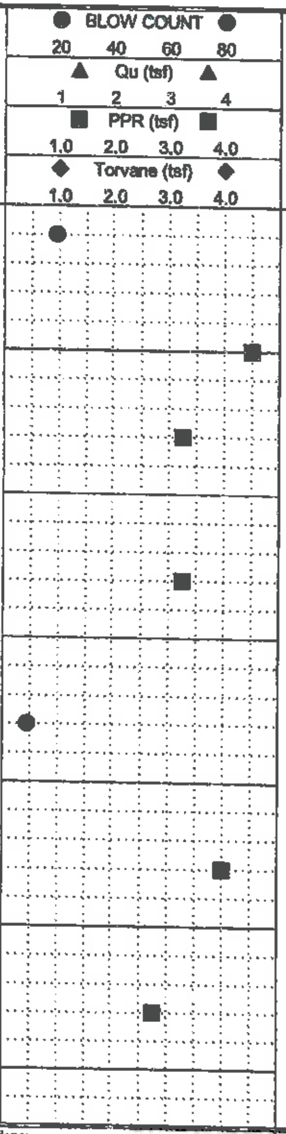
BORING TYPE: Flight Auger

DATE 10/27/09

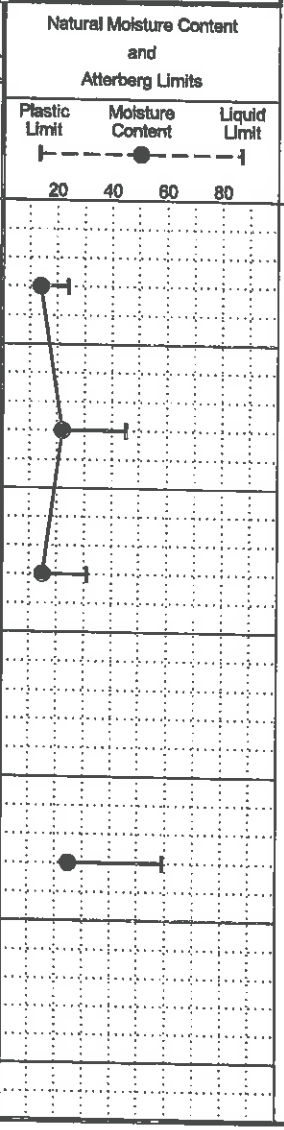
SURFACE ELEVATION 340.6



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SILTY SAND(SM) medium dense; tan; with gravel	N=19						
SANDY LEAN CLAY(CL) dark brown	SF						
–tannish orange		14	24	15	9	59	+40 Sieve=1%, +4 Sieve=0%
–hard; orangish tan	P=4.5						
	P=3.25	22	45	21	24	94	+40 Sieve=2%, +4 Sieve=0%
–very stiff; white							
CLAYEY SAND(SC) medium dense; tan –orangish gray; with sand seams	P=3.25	15	31	15	16	40	+40 Sieve=1%, +4 Sieve=0%
SANDY LEAN CLAY(CL) stiff; orangish tan	N=9						
FAT CLAY(CH) very stiff; orangish tan; with ferric seams	P=4.0	25	59	24	35	88	+40 Sieve=4%, +4 Sieve=0%
–tannish brown; with iron ore seams	P=2.75						



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

ETTL
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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

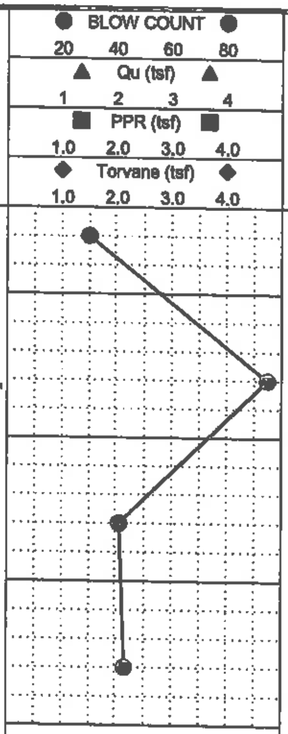
PROJECT NO.: G3242-09

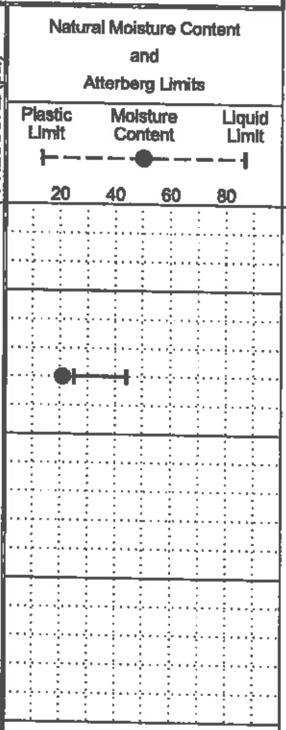
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	SAMPLES	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	☒		–hard; light gray; layered and with silt seams	N=30										
40	☒	CL	LEAN CLAY(CL) hard; light gray; layered and with silt seams	N=50/5.75"					21	44	25	19	93	+40 Sieve=1%, +4 Sieve=0%
45	☒		–light gray	N=41										
50	☒		–layered and with sand seams; with lignite	N=43										
			Bottom of Boring @ 50'											





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

Piezometer B-4

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-4

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description
0		Ground Surface
		SILTY SAND(SM) medium dense; tan; with gravel
		SANDY LEAN CLAY(CL) dark brown
		–tannish orange
5		–hard; orangish tan
10		–very stiff; white
		CLAYEY SAND(SC) medium dense; tan
15		–orangish gray; with sand seams
		SANDY LEAN CLAY(CL) stiff; orangish tan
20		
		FAT CLAY(CH) very stiff; orangish tan; with ferric seams
25		

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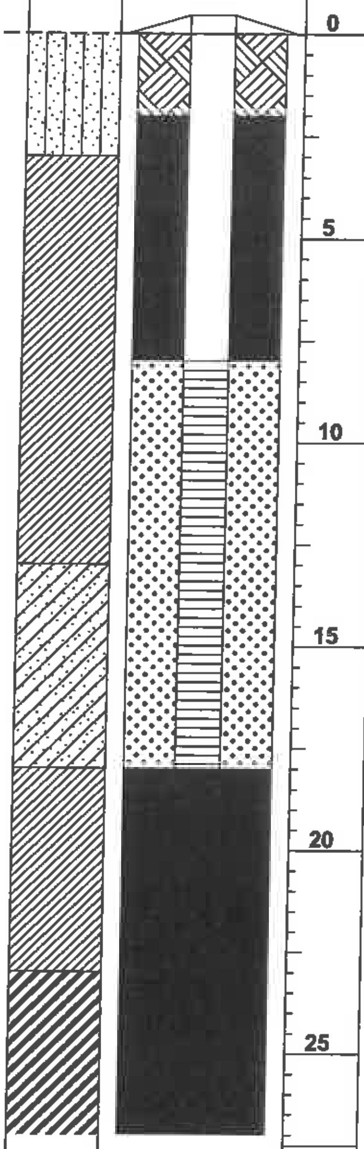


Well Construction Details

T.O.C. Elev.

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 8.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 8.0' **to** 18.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-8' & 18-50'

Filter Pack Qty. 6-18'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ETTL Engineers & Consultants Inc.

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-4

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
	--tannish brown; with iron ore seams					
30					30	
	--hard; light gray; layered and with silt seams					
35					35	
	LEAN CLAY(CL) hard; light gray; layered and with silt seams					
40					40	
	--light gray					
45					45	
	--layered and with sand seams; with lignite					
50	Bottom of Boring @ 50'				50	
55						
60						

Piezometer B-5

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

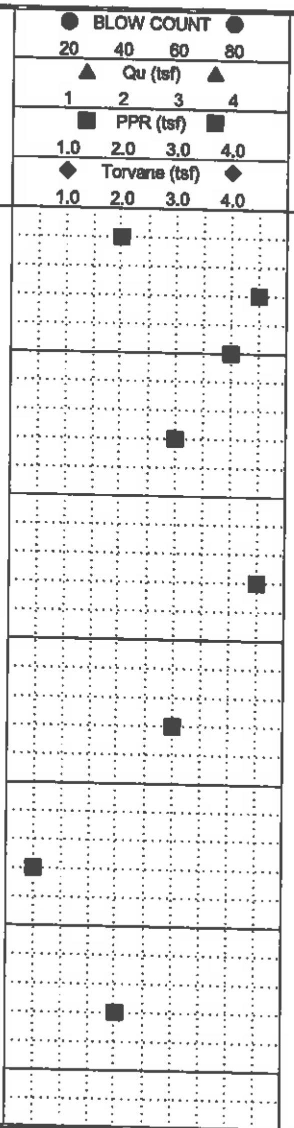
PROJECT NO.: G3242-09

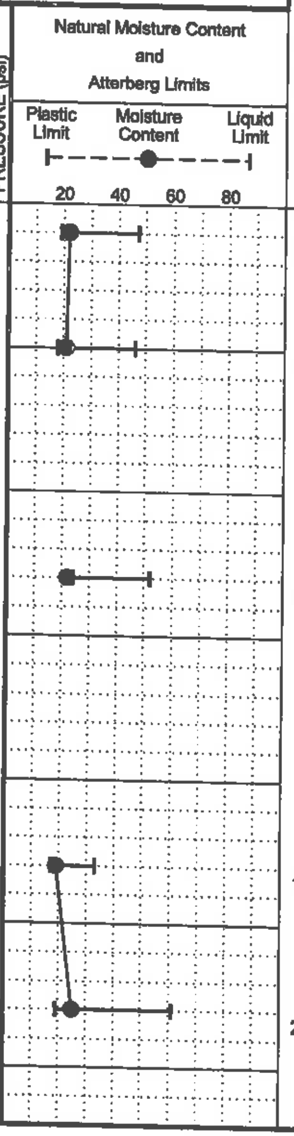
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) stiff; red and tan	P=2.0					22	47	19	28	81	+40 Sieve=9%, +4 Sieve=3%
CL	LEAN CLAY(CL) hard; red and tan	P=4.5+										
	–very stiff	P=4.0					21	46	18	28	94	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY(CL) very stiff; brown and tan	P=3.0										
CH	FAT CLAY WITH SAND(CH) hard; red and tan	P=4.5+					22	52	24	28	88	+40 Sieve=3%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams	P=3.0										
SC	CLAYEY SAND(SC) very loose; tan, red, and gray	P=0.5					19	33	17	16	44	+40 Sieve=1%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) stiff; red and gray	P=2.0					25	61	19	42	83	+40 Sieve=5%, +4 Sieve=3%





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

LOG OF BORING B-5

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	SC	SILTY CLAYEY SAND(SC) gray and red; saturated	SF						
35									
	CH	FAT CLAY(CH) hard; red and gray; with sand seams	P=4.5+	25	51	31	20	87	+40 Sieve=6%, +4 Sieve=0%
40									
45		–gray, tan, and red; with sand seams	P=4.5+						
	SM SC	SILTY SAND(SM-SC) red and gray	SF						
50		Bottom of Boring @ 50'							

BLOW COUNT: 20 40 60 80
Qu (tsf): 1 2 3 4
PPR (tsf): 1.0 2.0 3.0 4.0
Torvane (tsf): 1.0 2.0 3.0 4.0

DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)

Natural Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
20 40 60 80

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

Rezoneker B-5

ENVIRONMENTAL LOG

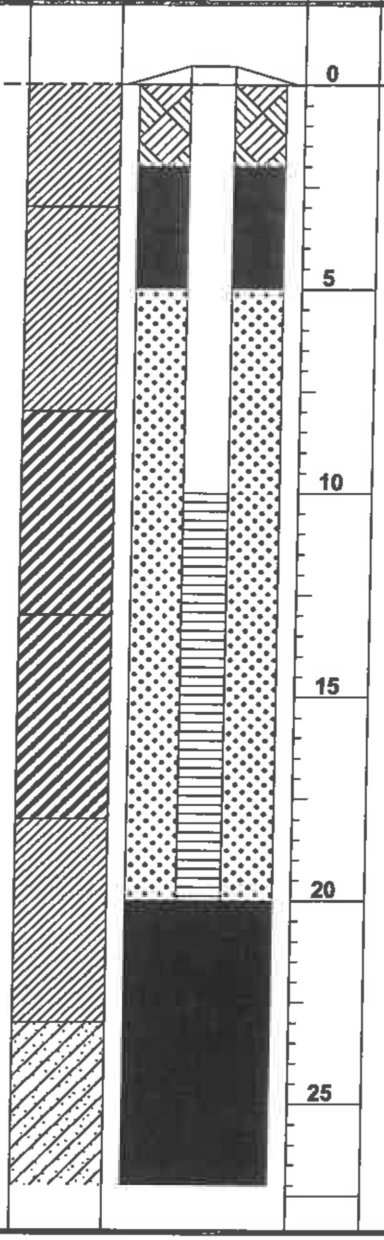
Client: Welsh Power Plant	**Well No.** B-5
Project No: G3242-095 **Phase** **Task**	**Location** Pittsburg, Texas
	Surface Elev. **Page** 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description
0		Ground Surface
		LEAN CLAY WITH SAND(CL) stiff; red and tan
		LEAN CLAY(CL) hard; red and tan
5		--very stiff
		FAT CLAY(CL) very stiff; brown and tan
10		
		FAT CLAY WITH SAND(CH) hard; red and tan
15		
		SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams
20		
		CLAYEY SAND(SC) very loose; tan, red, and gray
25		

Continued Next Page

Field Strength Data | **Graphic Log** | **Well Construction Graphics** | **Depth Feet** | **Well Construction Details**

T.O.C. Elev.



Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed ____

Development Completed ____

Type of Well ____

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-5' & 20-50'

Filter Pack Qty. 5-20'

Filter Pack Type 20/40 Sand

Static Water Level ____

Notes: ____

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

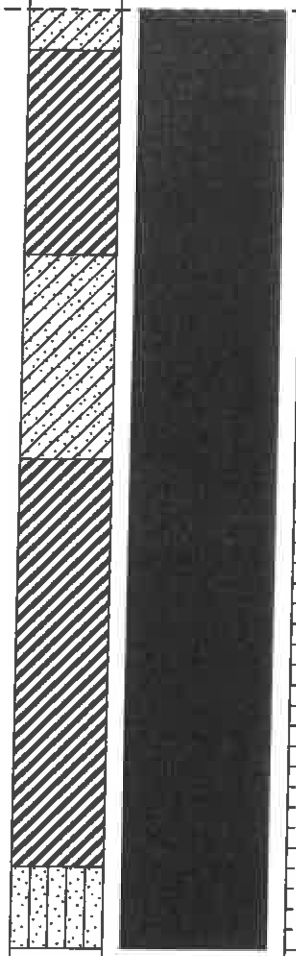
Well No. B-5

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
	FAT CLAY WITH SAND(CH) stiff; red and gray					
30					30	
	SILTY CLAYEY SAND(SC) gray and red; saturated					
35					35	
	FAT CLAY(CH) hard; red and gray; with sand seams					
40					40	
	–gray, tan, and red; with sand seams					
45					45	
	SILTY SAND(SM-SC) red and gray					
50	Bottom of Boring @ 50'				50	
55						
60						



ETTL Engineers & Consultants Inc.

Piezometer B-6

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

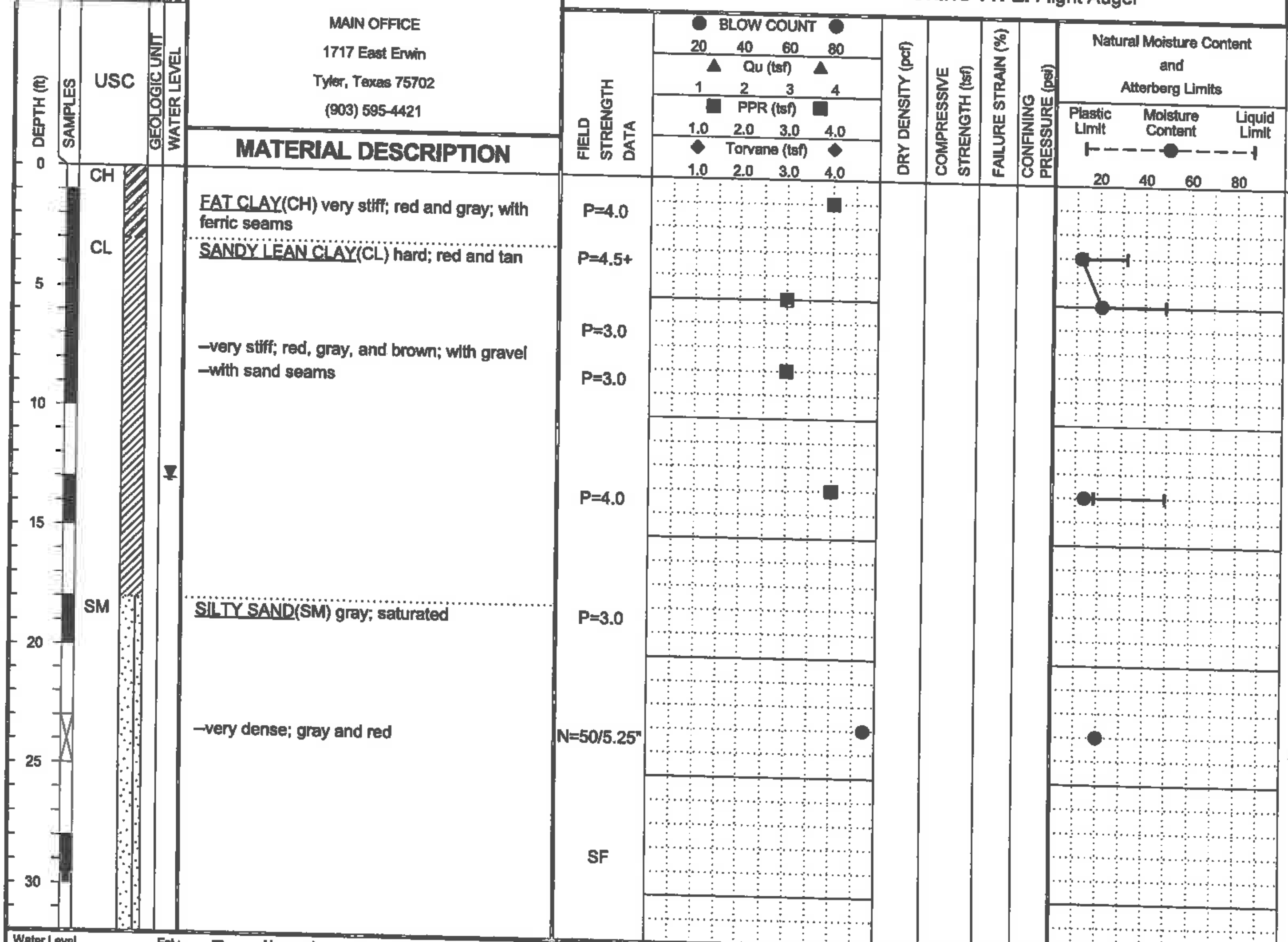
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY(CH) very stiff; red and gray; with ferric seams	P=4.0						
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+	12	32	14	18	60	+40 Sieve=0%, +4 Sieve=0%
		P=3.0	21	49	20	29	93	+40 Sieve=2%, +4 Sieve=0%
	–very stiff; red, gray, and brown; with gravel –with sand seams	P=3.0						
		P=4.0	14	49	18	31	65	+40 Sieve=0%, +4 Sieve=0%
SM	SILTY SAND(SM) gray; saturated	P=3.0						
	–very dense; gray and red	N=50/5.25"	20				18	+40 Sieve=0%, +4 Sieve=0%
		SF						

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

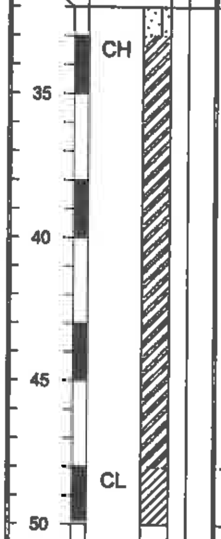
PROJECT: Welsh Power Plant
Pittsburgh, Texas

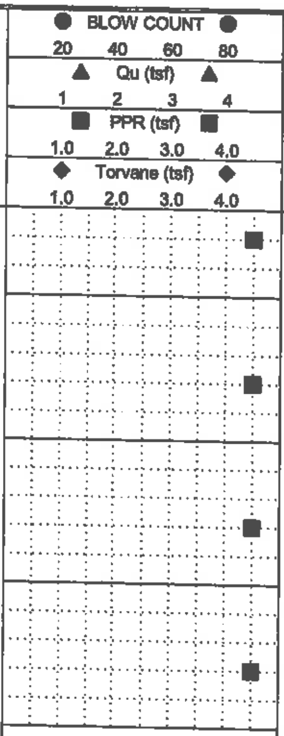
PROJECT NO.: G3242-09

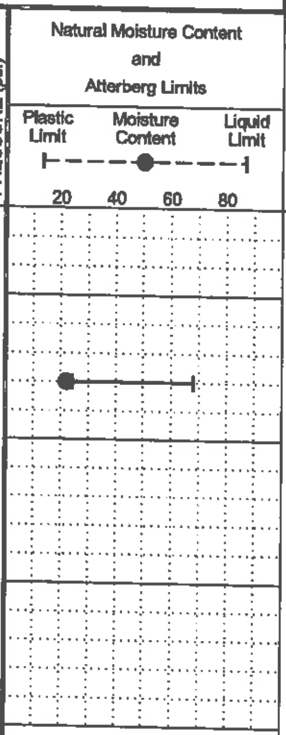
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1







DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35		CH			FAT CLAY(CH) hard; brown; with sand seams	P=4.5+										
40						P=4.5+					22	68	24	44	95	+40 Sieve=0%, +4 Sieve=0%
45					--dark green	P=4.5+										
50		CL			LEAN CLAY(CL) hard; dark green; laminated with lignite	P=4.5+										
					Bottom of Boring @ 50'											

Water Level Est.: ∇ Measured: ▼ Perched: ∇

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

Piezometer B-6

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

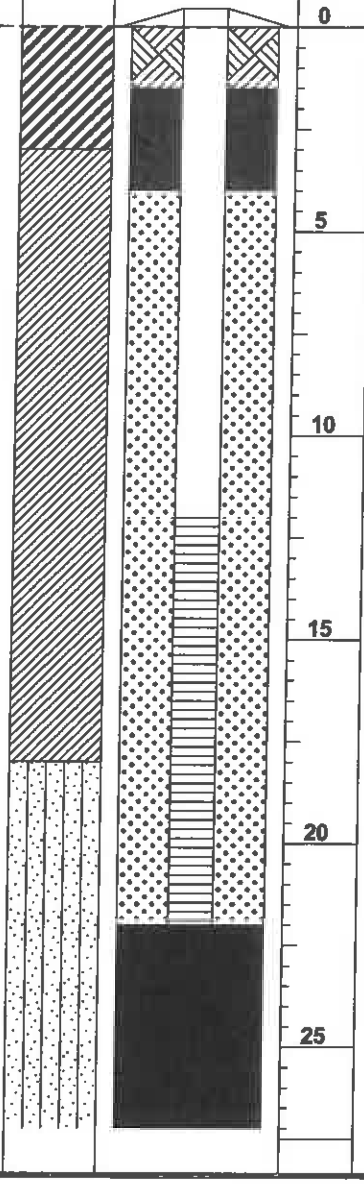
Well No. B-6

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
						T.O.C. Elev.
0	Ground Surface				0	
	FAT CLAY(CH) very stiff; red and gray; with ferric seams					
	SANDY LEAN CLAY(CL) hard; red and tan					
5					5	
	–very stiff; red, gray, and brown; with gravel					
	–with sand seams					
10					10	
15					15	
	SILTY SAND(SM) gray; saturated					
20					20	
	–very dense; gray and red					
25					25	



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/28/09

Drilling Completed 10/28/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 12.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 12.0' **to** 22.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 1.5-4' & 22-50'

Filter Pack Qty. 4-22'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

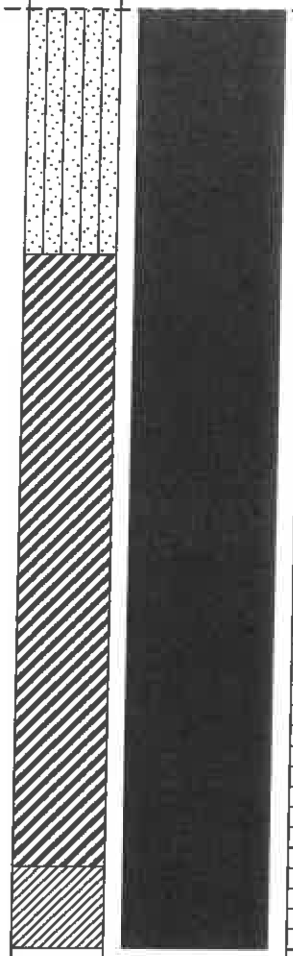
Well No. B-6

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
30						30	
		FAT CLAY(CH) hard; brown; with sand seams					
35						35	
40						40	
		–dark green					
45						45	
		LEAN CLAY(CL) hard; dark green; laminated with lignite					
50						50	
		Bottom of Boring @ 50'					
55							
60							



ETTL Engineers & Consultants Inc.

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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-7

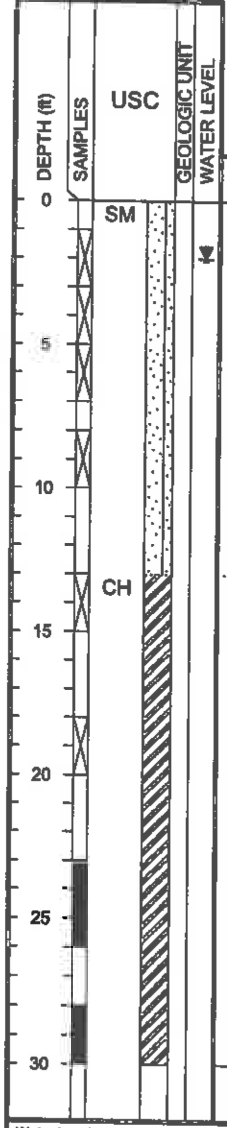
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

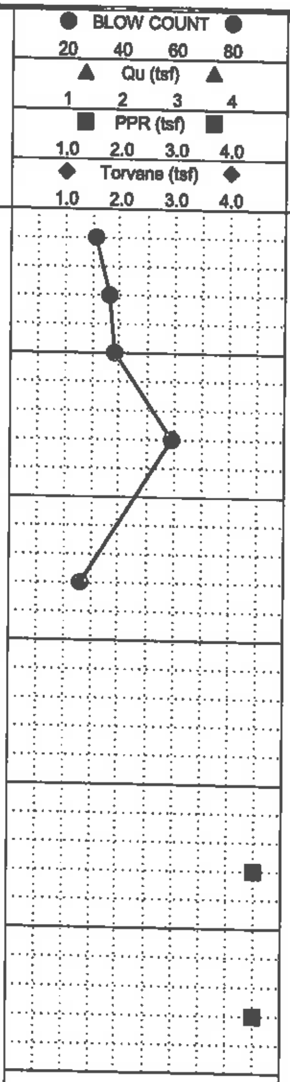
BORING TYPE: Flight Auger

DATE 10/27/09

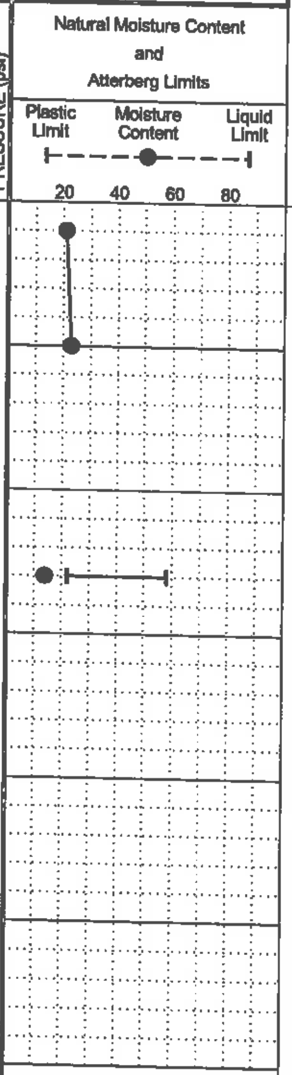
SURFACE ELEVATION 340.4



USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SM	▼	SILTY SAND(SM) dense; tan	N=31	21				21	+40 Sieve=0%, +4 Sieve=0%
			N=36						
		--gray; saturated	N=38	23				15	+40 Sieve=0%, +4 Sieve=0%
		--very dense	N=59						
CH		FAT CLAY(CH) very stiff; dark gray; with silt and ferric seams	N=26	14	58	22	36	98	+40 Sieve=0%, +4 Sieve=0%
		--hard; gray and black; with trace of lignite	P=4.5+						
		--gray							
			P=4.5+						
		Bottom of Boring @ 30'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 4' while drilling. Water level @ 2' and open to 7' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.898', W 94°50.519'

Landfill Boring B-2

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

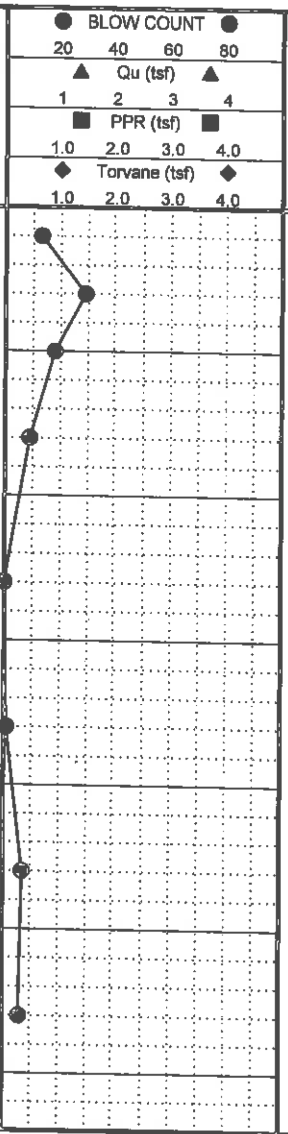
BORING TYPE: Rotary Wash/Flight Auger

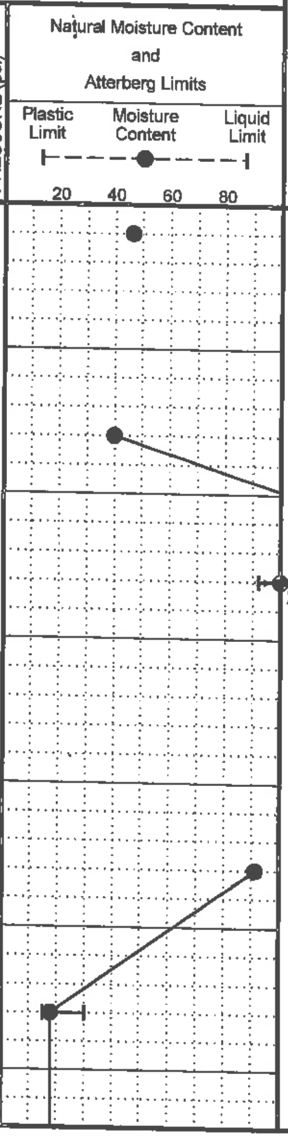
DATE 10/8/14

SURFACE ELEVATION 373.8

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
ML SM	ASH (SILT WITH GRAVEL(ML)) medium dense; light grayish brown; with coarse-grained sand and lightly cemented gravel pieces; dry	N=13					46				59	+40 Sieve=27% +4 Sieve=16%
		N=29										
	ASH (SILTY SAND(SM)) medium dense; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces	N=18										
	--loose; moist	N=9					40				40	+40 Sieve=19% +4 Sieve=2%
MH	ASH (ELASTIC SILT(MH)) very loose; black; with fine-grained sand and lightly cemented gravel pieces; saturated	N=0					200	134	92	42	100	+40 Sieve=0% +4 Sieve=0%
SM	ASH (SILTY SAND(SM)) very loose; dark brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=1										
	--loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7					91				61	+40 Sieve=11% +4 Sieve=1%
CL	SANDY LEAN CLAY(CL) medium stiff; dark brown and black; with fine-grained sand and cemented gravel pieces; saturated	N=6					18	30	15	15	63	+40 Sieve=1% +4 Sieve=0%

DEPTH (ft) 0 5 10 15 20 25 30 | SAMPLES | GEOLOGIC UNIT: Epc @ 28-43' & Er @ 43-60' | WATER LEVEL ▼





Water Level Est.: ∇ Measured: ▼ Perched: ⊻

Water Observations: Water level @ 13'.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

LOG OF BORING B-2 (cont.)

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

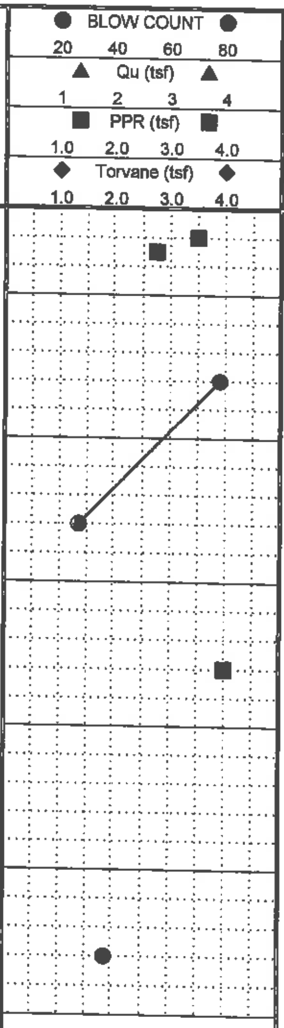
PROJECT NO.: G4207-146

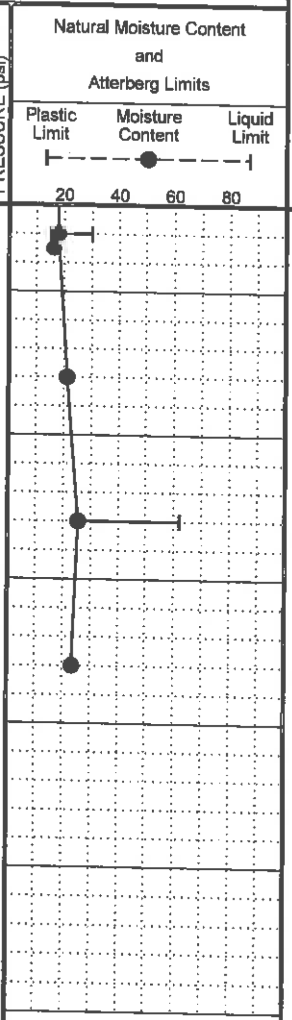
DRILL RIG: B-61 HDX

BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14

SURFACE ELEVATION 373.8





DEPTH (ft)	USC	GEOLOGIC UNIT	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	SC	Eqc @ 28-43' & Er @ 43-60'	CLAYEY SAND(SC) dense; light brown, light gray and reddish brown; moist; with fine-grained sand; mottled	P=3.5 P=2.75	110	1.39	4.3	21	18 16	30	15	15	39	+40 Sieve=0% +4 Sieve=0%
40	SM		SILTY SAND(SM) very dense; light brown, yellowish brown and light gray; moist; mottled; with fine-grained sand	N=78					21				24	+40 Sieve=0% +4 Sieve=0%
45	CH		FAT CLAY(CH) very stiff; dark brown and light brown; moist; with sand seams; laminated	N=27					25	62	26	36	96	+40 Sieve=2% +4 Sieve=0%
50			--dark brown with light gray; moist; with silt seams	P=4.0	98				24					
55														
60			--hard; dark brown; moist	N=37										
			Bottom of Boring @ 60'											

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill boring B-10

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

BORING TYPE: Rotary Wash/Flight Auger

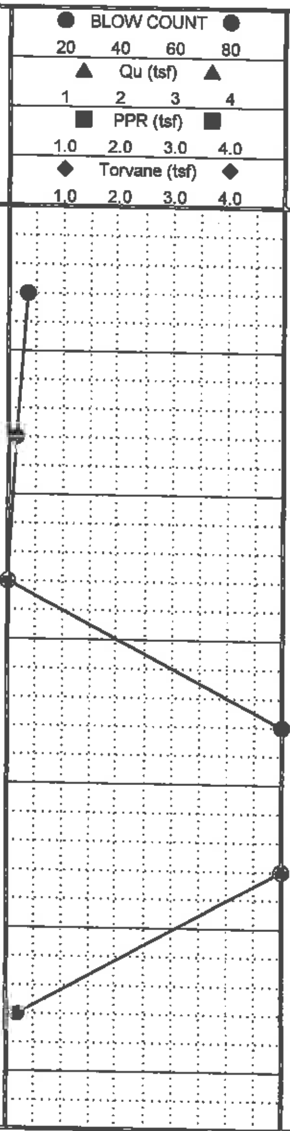
DATE 10/8/14

SURFACE ELEVATION 373.2

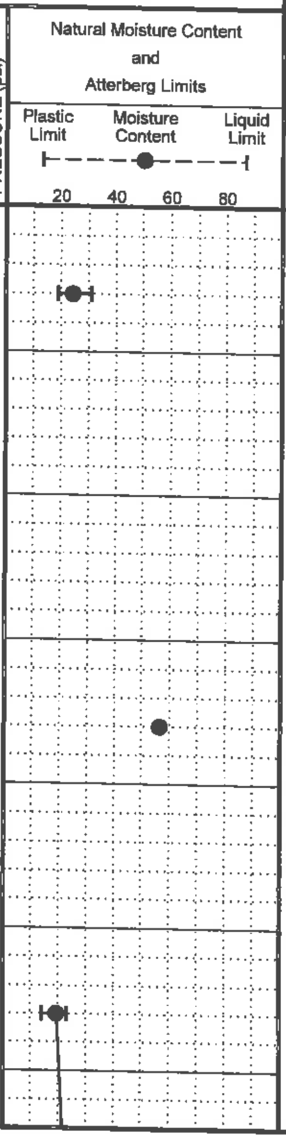
DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0–9	SC	ASH (CLAYEY SAND(SC)) loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7	24	31	19	12	41	+40 Sieve=21% +4 Sieve=11%
9–17.5	MH	ASH (ELASTIC SILT(MH)) very loose; black; moist	N=3						
		--wet	N=0						
17.5–27	SM	ASH (SILTY SAND WITH GRAVEL(SM)) very dense; light brown and dark brown; with lightly cemented gravel pieces and coarse-grained sand; moist; cemented layer from 17.5' to 21'	N=50/1"	56				14	+40 Sieve=71% +4 Sieve=28%
		--cemented layer from 23' to 27'	N=50/4"						
27–	CL	SANDY LEAN CLAY(CL) medium stiff; grayish brown and yellowish brown; saturated; mottled	N=4	19	23	14	9	57	+40 Sieve=1% +4 Sieve=0%

Geologic Unit: Egc @ 27-43' & Er @ 43-60'

Water Level: ▽ at 13'



Columns without data: DRY DENSITY (pcf); COMPRESSIVE STRENGTH (tsf); FAILURE STRAIN (%); CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

LOG OF BORING B-10 (cont.)

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1717 East Erwin
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PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

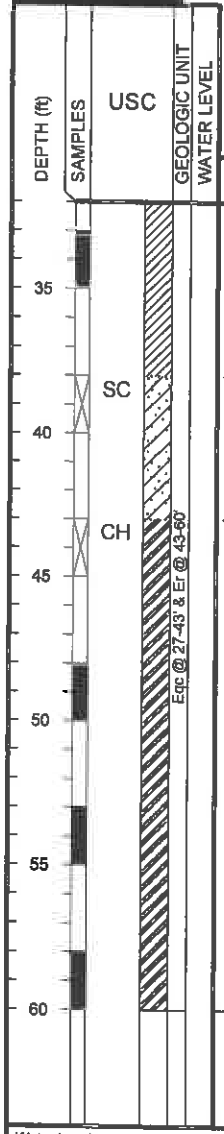
PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

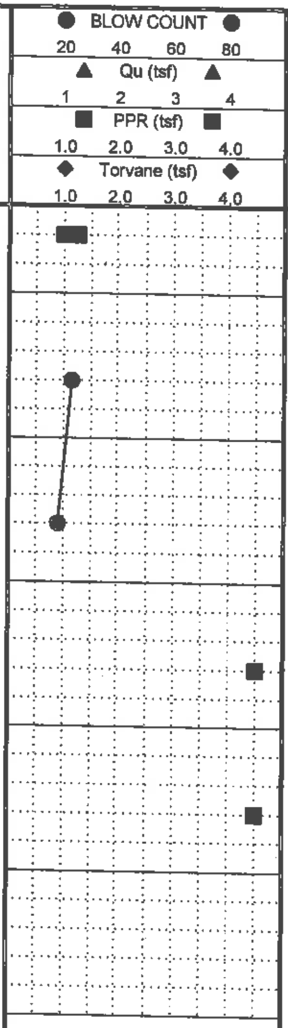
BORING TYPE: Rotary Wash/Flight Auger

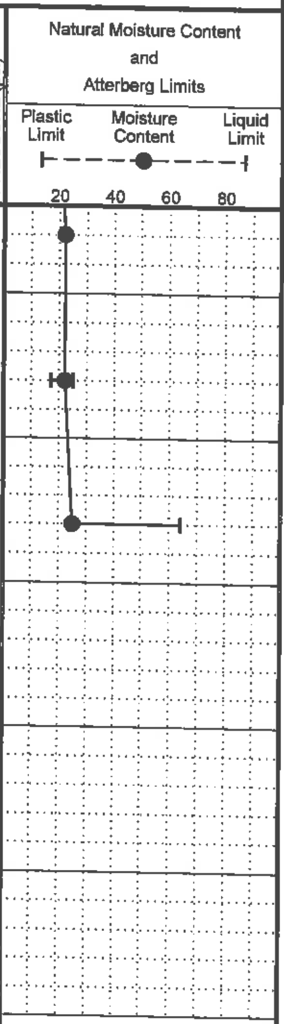
DATE 10/8/14

SURFACE ELEVATION 373.2



DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
			P=1.25 P=1.0	107	2.10	6.1	21	22					
	SC	CLAYEY SAND(SC) medium dense; reddish brown and grayish brown; moist; mottled	N=23					22	25	17	8	27	+40 Sieve=3% +4 Sieve=0%
	CH	FAT CLAY(CH) very stiff; dark brown with light gray; with silt seams; moist	N=18					25	64	24	40	90	+40 Sieve=7% +4 Sieve=0%
		--hard	P=4.5+										
			P=4.5+										
60		Bottom of Boring @ 60'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill Boring B-12

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-12

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

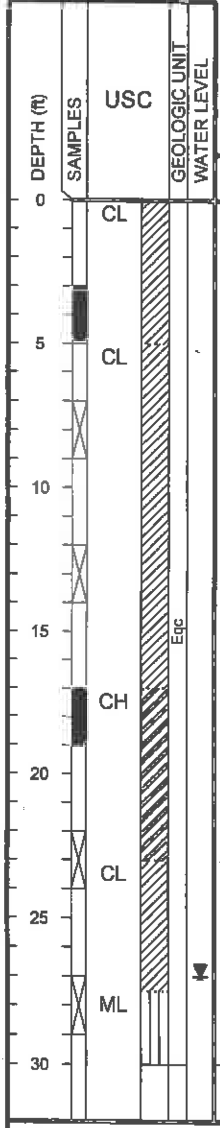
PROJECT NO.: G4207-146

DRILL RIG:

BORING TYPE: Flight Auger

DATE 10/15/14

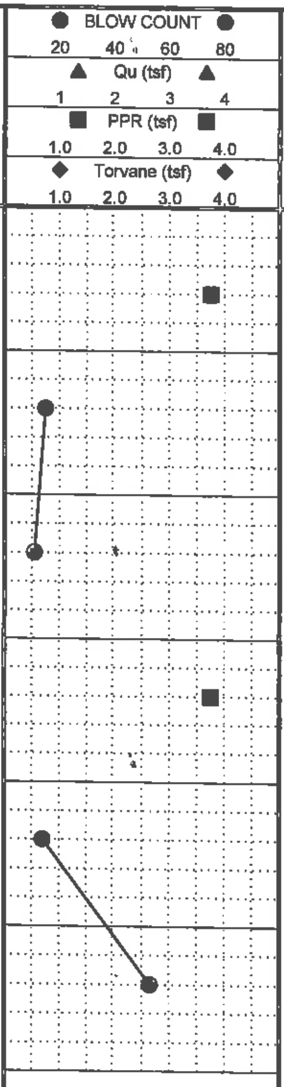
SURFACE ELEVATION 361.7



MATERIAL DESCRIPTION

Material Description	Field Strength Data
LEAN CLAY WITH SAND(CL) stiff; light gray and reddish brown; moist; mottled	P=3.75
SANDY LEAN CLAY(CL) stiff; light brown, light gray and reddish brown; moist; mottled	N=15
--grayish brown and brown; moist	N=11
FAT CLAY WITH SAND(CH) stiff; light gray and reddish brown; moist; mottled; with ferric seams	P=3.75
LEAN CLAY(CL) stiff; light gray and brownish gray; moist; layered with silt	N=14
SILT WITH SAND(ML) very dense; light brown and yellowish brown; moist; with clay seams	N=53

Bottom of Boring @ 30'

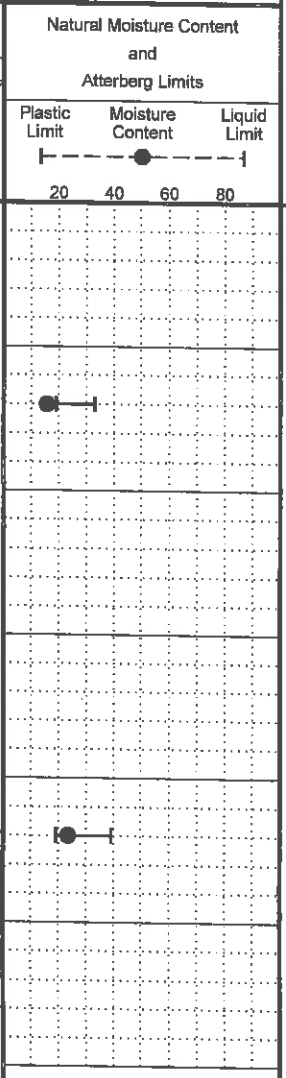


DRY DENSITY (pcf)

COMPRESSIVE STRENGTH (tsf)

FAILURE STRAIN (%)

CONFINING PRESSURE (psi)



Moisture Content (%)	Liquid Limit LL	Plastic Limit PL	Plasticity Index PI	Minus #200 Sieve (%)	Other Tests Performed (Page Ref. #)
16	33	19	14	58	+40 Sieve=1% +4 Sieve=0%
24	39	19	20	93	+40 Sieve=1% +4 Sieve=0%

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 27' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04713°, W94.84486°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-13

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-13

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

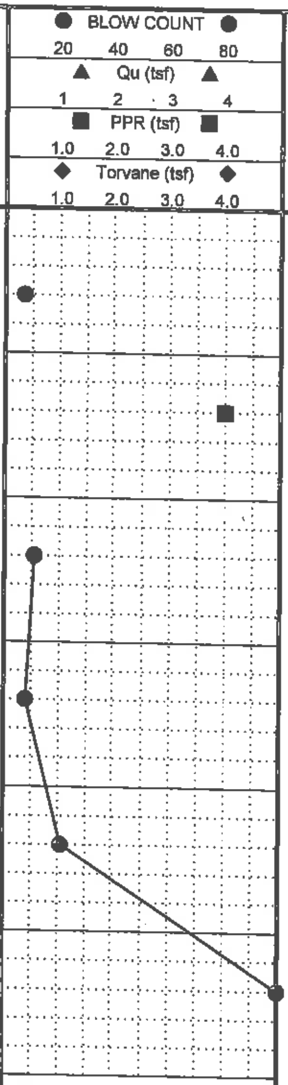
DRILL RIG:

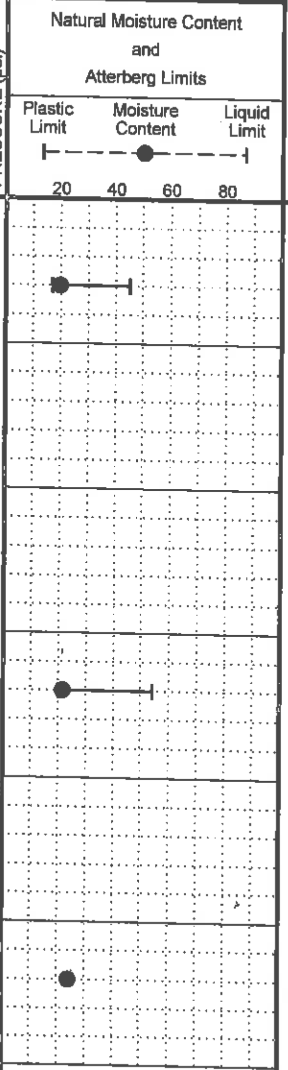
BORING TYPE: Flight Auger

DATE 10/15/14

SURFACE ELEVATION 361.4

DEPTH (ft)	USC	GEOLOGIC UNIT	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	Eqc	LEAN CLAY WITH SAND(CL) medium stiff; reddish brown with light gray; moist	N=7					20	45	17	28	76	+40 Sieve=1% +4 Sieve=0%
5	CL		SANDY LEAN CLAY(CL) very stiff; light brown, gray and reddish brown; moist; mottled	P=4.0										
10	SC		CLAYEY SAND(SC) medium dense; grayish brown; moist											
	CH		FAT CLAY WITH SAND(CH) medium stiff; reddish brown and light gray; moist; mottled	N=11										
15				N=8					22	54	20	34	79	+40 Sieve=1% +4 Sieve=0%
20	CL		LEAN CLAY(CL) very stiff; light gray and grayish brown; moist; layered with silt	N=21										
25	ML		SILT WITH SAND(ML) very dense; light gray and yellowish brown; wet; with clay seams	N=50/5"					24				80	+40 Sieve=0% +4 Sieve=0%
30			Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 28' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.047160°, W94.84384°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-14

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-14

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

DRILL RIG:

BORING TYPE: Flight Auger

DATE 10/14/14

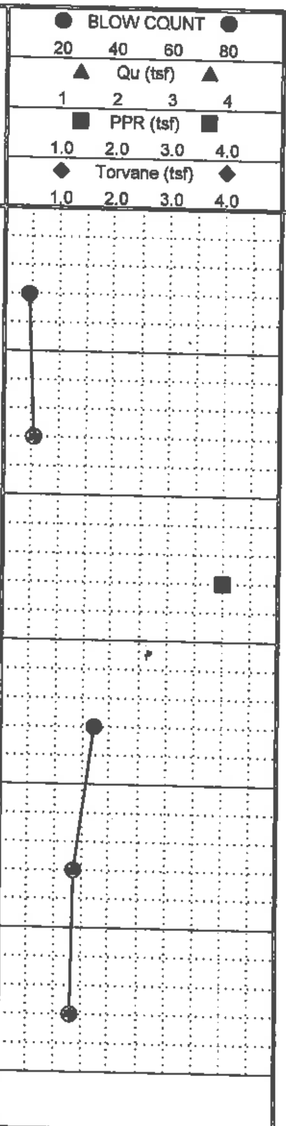
SURFACE ELEVATION 347.2

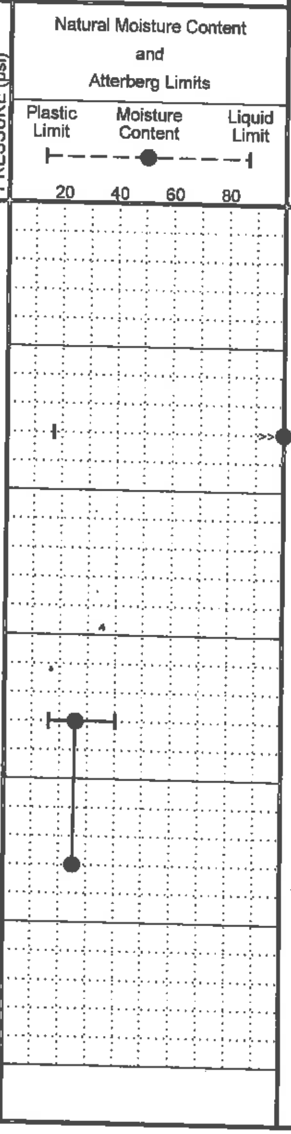
DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	SANDY LEAN CLAY(CL) medium stiff; yellowish brown with reddish brown; dry; with clay seams	N=9						
	ML	SANDY SILT(ML) medium dense; grayish brown; moist; with clay seams	N=11	108	17	17	NP	68	+40 Sieve=1% +4 Sieve=1%
	CL	SANDY LEAN CLAY(CL) very stiff; light gray and gray; moist	P=4.0						
		--light gray and grayish brown; moist; layered with silt	N=34	26	40	16	24	67	+40 Sieve=1% +4 Sieve=0%
	SP SM	POORLY GRADED SAND WITH SILT(SP-SM) medium dense; yellowish brown, light gray and reddish brown; wet	N=27	25				10	+40 Sieve=0% +4 Sieve=0%
	CL	LEAN CLAY(CL) very stiff; dark brown; moist; with silt partings	N=26						
30		Bottom of Boring @ 30'							

GEOLOGIC UNIT: Eqc @ 0-28' & Er @ 28-30'

WATER LEVEL: ▼

DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 23' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04774°, W94.84290°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-15

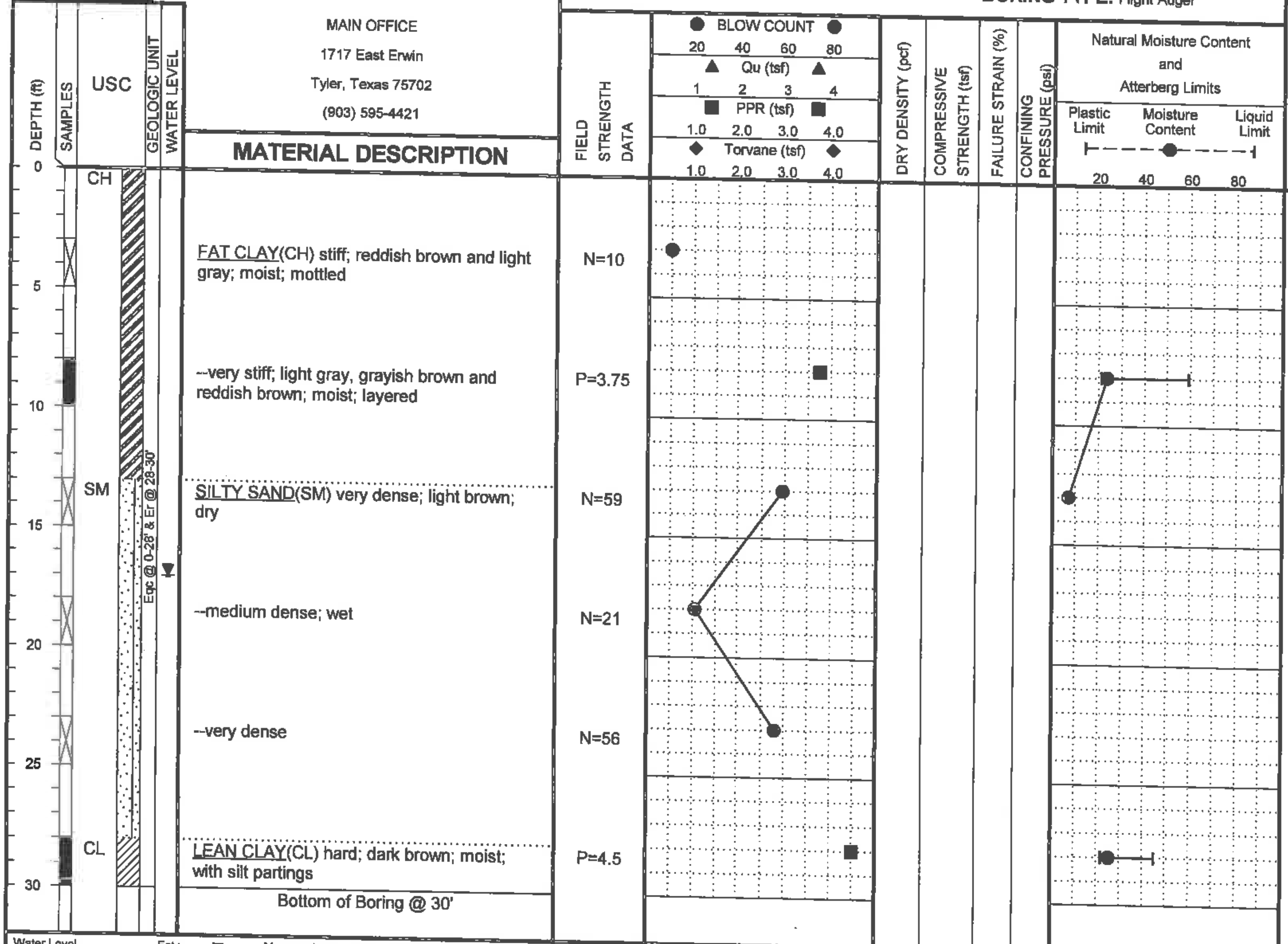
ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-15

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas
DRILL RIG:
PROJECT NO.: G4207-146
BORING TYPE: Flight Auger

DATE 10/14/14
SURFACE ELEVATION 348.2



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY(CH) stiff; reddish brown and light gray; moist; mottled	N=10										
	--very stiff; light gray, grayish brown and reddish brown; moist; layered	P=3.75					24	59	21	38	85	+40 Sieve=0% +4 Sieve=0%
SM	SILTY SAND(SM) very dense; light brown; dry	N=59					7				12	+40 Sieve=0% +4 Sieve=0%
	--medium dense; wet	N=21										
	--very dense	N=56										
CL	LEAN CLAY(CL) hard; dark brown; moist; with silt partings	P=4.5					25	45	22	23	92	+40 Sieve=0% +4 Sieve=0%
	Bottom of Boring @ 30'											

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 19' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04857°, W94.84286°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

ARCADIS

Appendix B

Photographic Log

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **1**	**Date:** 8/20/2015

Direction Photo Taken:

North

Description:
Staging area west of landfill.

P8200493

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **2**	**Date:** 8/20/2015

Direction Photo Taken:

South Southeast

Description:

Potential wetland on the top (west) end of the Primary Ash Pond.

P8200495

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No.	**Date:**
3	8/20/2015

Direction Photo Taken:

West Northwest

Description:

Ditch between road and railway west of landfill, this ditch would be non-jurisdictional.

P8200497

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No.	**Date:**
4	8/20/2015

Direction Photo Taken:

Northeast

Description:

Ground Water Monitoring Well AD-12 near northwest end of landfill.

P8200501

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **5**	**Date:** 8/20/2015

Direction Photo Taken:

East Northeast

Description:

View of plant from top of landfill. Primary ash pond is within the wooded area on left.

P8200506

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **6**	**Date:** 8/20/2015

Direction Photo Taken:

East Northeast

Description:

Drainage canal that drains from primary ash pond to clear water pond.

P8200510

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 7

Date: 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Vegetated strip between landfill and road. This would be isolated due to lack of connectivity.

P8200521

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 8

Date: 8/20/2015

Direction Photo Taken:

North

Description:

Dike between landfill and primary ash pond. Facility in the background.

P8200522

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 9

Date: 8/20/2015

Direction Photo Taken:

West

Description:

Vegetated strip between landfill and road. This area would be isolated due to lack of connectivity.

P8200527

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 10

Date: 8/20/2015

Direction Photo Taken:

North Northeast

Description:

Road east of landfill running toward facility and clear water pond.

P8200530

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **11**	**Date:** 8/20/2015

Direction Photo Taken:

South

Description:

Top of landfill.

P8200534

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **12**	**Date:** 8/20/2015

Direction Photo Taken:

Southeast

Description:

View of lined bottom ash storage pond.

P8200538

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 13

Date: 8/20/2015

Direction Photo Taken:

Southeast

Description:

Lined bottom ash storage pond.

P8200545

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 14

Date: 8/20/2015

Direction Photo Taken:

South

Description:

Southside of lined bottom ash storage pond.

P8200547

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No.	**Date:**
15	8/20/2015

Direction Photo Taken:

West

Description:

East side of lined bottom ash storage pond.

P8200560

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No.	**Date:**
16	8/20/2015

Direction Photo Taken:

North

Description:

Upland with pine and ground water monitoring well AD-2 south of lined bottom ash storage pond.

P8200563

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No.	**Date:**
17	8/20/2015

Direction Photo Taken:

Description:

Outflow of water from plant into the northeast portion of the Primary Ash Pond.

P8200577

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No.	**Date:**
18	8/20/2015

Direction Photo Taken:

South Southwest

Description:

Northeast portion of primary ash pond, view facing south-southwest.

P8200578

1.2 – Bottom Ash Storage Pond – CCR Location Restriction Evaluation, May 2, 2016

American Electric Power Service Corporation

Bottom Ash Storage Pond - CCR Location Restriction Evaluation

J. Robert Welsh Power Plant
1187 County Road 4865
Titus County
Pittsburg, Texas

May 2, 2016

ARCADIS

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

Kenneth J. Brandner

Kenneth Brandner, P.E., P.G.
Senior Project Engineer

Matthew J. Lamb

Matthew J. Lamb
Project Manager

John Holm, P.E.
Principal Engineer

Bottom Ash Storage Pond – CCR Location Restriction Evaluation

J. Robert Welsh Plant
1187 County Road 4865
Titus County
Pittsburg, Texas

Prepared for:
AEP

Prepared by:
ARCADIS U.S., Inc.
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Ohio 43235-1447
Tel 614 985 9100
Fax 614 985 9170

Our Ref.:
OH015976.0011

Date:
May 2, 2016

Tables

Figures

Appendices

Acronyms and Abbreviation

AEP	American Electric Power Service Cooperation
amsl	above mean sea level
ARCADIS	ARCADIS U.S., Inc.
BAP	bottom ash pond
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
FAP	fly ash pond
FGD	flue gas desulfurization
ft	feet
PTI	Permit to Install
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality

1. Objective

This report was prepared by ARCADIS U.S., Inc. (ARCADIS) for American Electric Power Service Corporation (AEP) to assess the location of the Bottom Ash Storage Pond relative to the location restrictions included in the Coal Combustion Residual (CCR) requirements, as specified in the Code of Federal Regulations (CFR) 40 CFR 257.60 to 257.64, at the AEP Generating Plant (Plant) located at 1187 County Road 4865 in Pittsburg, Titus County, Texas (**Figure 1**). The CCR requirements include an evaluation of whether the CCR unit meets up to 5 location restrictions, which include: the base of the CCR unit is 5 feet (ft) above the uppermost aquifer, the CCR unit may not be located in a wetland, within 200 ft of the damage zone of a fault that has displacement during the Holocene, within a seismic impact zones, or in an unstable area.

Three regulated CCR units associated with the Plant were identified for review, which include the primary ash pond, landfill, and Bottom Ash Storage Pond (**Figure 2**). This report summarizes the evaluation of the location restriction criteria at the Bottom Ash Storage Pond (Site).

This evaluation included a review of AEP-provided data associated with previously completed subsurface investigation activities in the vicinity of the Bottom Ash Storage Pond CCR unit, as well as publically-available geologic and hydrogeologic data. The following report also presents the current Conceptual Site Model based on documents reviewed and will further describe the uppermost aquifer.

2. Background Information

The following section provides background information for the AEP J. Robert Welsh Generating Plant Bottom Ash Storage Pond.

2.1 Facility Location Description

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The Bottom Ash Storage Pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir (**Figures 1** and **2**).

2.2 Description of Bottom Ash Storage Pond CCR Unit

The following section will discuss the embankment configuration, area, volume, construction and operational history, and surface water control associated with the Bottom Ash Storage Pond.

2.2.1 Embankment Configuration

The Bottom Ash Storage Pond was placed into operation in 2000, and is located in a topographically high area of the Plant. The Bottom Ash Storage Pond embankments are approximately 20 feet in height and are constructed of compacted clay on a 3:1 slope (3 feet horizontal, 1 foot vertical). The elevation at the base of the embankment is approximately 340 feet amsl, and the elevation at the top of the embankment around the perimeter of the Bottom Ash Storage Pond is approximately 360 feet amsl (Southwestern Electric Power Company, 2000).

2.2.2 Area/Volume

The Bottom Ash Storage Pond is 22 acres in size. Per the *Hydraulic Analysis of Welsh Power Plant Ash Ponds Report,* dated December 2010 (Freese and Nichols, 2010), the principal spillway for the Bottom Ash Storage Pond is located near the southeast corner of the pond and consists primarily of an 18 inch drain at elevation 350.5 feet amsl and also of a 40-foot-long broad-crested weir with a crest elevation of 355 feet amsl. The emergency spillway is an 8-foot-wide weir with a rock rip-rap discharge chute located along the southern embankment at an elevation of 358 feet amsl. The storage capacity of the Bottom Ash Storage Pond at elevation 358 feet amsl is 86.50 acre-ft (Freese and Nichols, 2010).

2.2.3 Construction and Operational History

The AEP J. Robert Welsh Plant began operations in 1977 with three coal-fired generating units (Units 1, 2, and 3). Throughout the life of the generating plant, CCR materials (fly ash, bottom ash, economizer ash) have been generated. All of these byproducts were stored either in the primary ash pond or in the adjacent landfill that was constructed in the late 1970's. In 2000, the 22-acre Bottom Ash Storage Pond was installed south of the landfill. The Bottom Ash Storage Pond receives bottom ash and economizer ash dredged and sluiced from the primary ash pond (**Figure 3**).

The Bottom Ash Storage Pond contains a 60-mil high-density polyethylene (HDPE) liner. The liner is located at the base of the Bottom Ash Storage Pond at an elevation of 340 feet amsl. The liner also extends along the base of the Bottom Ash Storage Pond sidewalls and is keyed into the top of the Bottom Ash Storage Pond earthen embankment at an elevation of 360 feet amsl (Southwestern Electric Power Company, 2000).

The southeast corner of the Bottom Ash Storage Pond contains an approximate ¼-acre clear water pond with a base elevation of 347 feet amsl (**Figure 3**). The clear water pond receives clear water primarily through at 18 inch drain and then through an overflow structure from the main part of the Bottom Ash Storage Pond through the 40-foot-long broad-crested weir discussed above in Section 2.2.2. Water in the ¼-acre clear water pond at the southeast corner of the Bottom Ash Storage Pond discharges through a 30-inch-diameter pipe into the primary ash pond system.

2.2.4 Surface Water Control

Surface water flow within the Bottom Ash Storage Pond is primarily controlled by an 18 inch drain and then by a weir located on the southeast side of the pond below the embankments. The pond elevation is maintained so that surface water flows through the drain pipe at invert elevation 350.5 feet amsl or weir which has a crest elevation of 355 feet amsl. Clear water flows through the weir into the ¼-acre clear water pond at the southeast corner of the Bottom Ash Storage Pond, then discharges through a 30-inch-diameter pipe into the primary ash pond (**Figure 3**).

The emergency spillway for the Bottom Ash Storage Pond is located along the southern embankment, and is 8 feet wide with a crest elevation of 358 feet amsl. The perimeter embankments of the Bottom Ash Storage Pond are located at an elevation of 360 feet amsl. Therefore the perimeter embankments have approximately five feet of freeboard above the clear water discharge weir, and approximately two feet of freeboard above the emergency spillway.

2.3 Previous Investigations

The initial soils investigation for the site was provided in a 1973 report prepared by McClelland Engineers, Inc. entitled "*Soils Investigation, Welsh Power Plant, Cason, Texas*". This investigation included advancement of soil borings in the primary ash pond area, and geotechnical soil testing to characterize the area encompassed by the primary ash pond.

In 2000, Maxim Technologies prepared a report entitled "*Subsurface Exploration for Ash Storage Area, Phase II, Welsh Power Plant, Cason, Texas*". This report evaluated the geotechnical properties of the soils below the Bottom Ash Storage Pond.

In 2000, an HDPE liner installation report was prepared by Alliance Incorporated. This report provided details regarding installation of the 60-mil HDPE liner on the bottom of the Bottom Ash Storage Pond.

In 2001, five monitoring wells (AD-1 through AD-5) were installed in the area of the primary ash pond and Bottom Ash Storage Pond to obtain hydrologic data for the uppermost water-bearing unit. Twelve additional monitoring wells (AD-4a, AD-4b, AD-4c, AD-6 through AD-14) were installed in the area of the primary ash pond, Bottom Ash Storage Pond, and landfill by Eagle Environmental Services in 2009 to obtain more detailed hydrologic data for the uppermost water-bearing unit.

In 2010, Freese and Nichols performed a *Hydraulic Analysis of the Welsh Power Plant Ash Ponds* (Freese and Nichols, 2010). The report concluded the spillways for the primary ash pond, clear water pond, and Bottom Ash Storage Pond are hydraulically adequate for the full range of storm events from the 10-year to the 100-year storm events.

In December 2015, Auckland Consulting further expanded the groundwater monitoring well system at the Plant by installation of monitoring wells AD-15 through AD-18 (Auckland Consulting, 2016). Monitoring well completion diagrams are provided in **Appendix A.**

2.4 Hydrogeologic Setting

The site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently southeast. The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966).

These features are further illustrated on five lines of cross section that were prepared through the Bottom Ash Storage Pond area, with three lines trending from west to east (A-A'; B-B'; C-C'), and the other two lines trending from north to south (D-D'; E-E'). The cross section location map is included as **Figure 3** and the lines of cross section are included as **Figure 4** (A-A') through **Figure 8** (E-E').

2.4.1 Climate and Water Budget

The climate of Titus County, Texas is moist sub-humid. Average temperatures range from 45° Fahrenheit (F) in January to 82.9°F in July. The mean annual growing season is 228 days (Broom, 1965). Average annual precipitation (including liquid water equivalent from snowfall) is approximately 47 inches according to weatherdb.com.

2.4.2 Regional and Local Geologic Setting

The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966). The Recklaw Formation attains a thickness of approximately 110 feet in Titus County, and is underlain by the Eocene-age Carrizo Sand which consists of fine to coarse sand, silt, and clay (Broom, 1965). In the topographically low areas underlying the Welsh Reservoir to the east of the Bottom Ash Storage Pond, Quarternary alluvial sediments associated with the Swauano Creek are present Flawn, 1966).

Detailed regional geologic characterization can be found in several published reports including Texas Water Commission Bulletin 6517 "*Ground-Water Resources of Camp, Franklin, Morris and Titus Counties, Texas*" (Broom, 1965), and The University of Texas at Austin Bureau of Economic Geology "*Geologic Atlas of Texas – Texarkana Sheet*" (Flawn, 1966).

Detailed regional and site geologic characterization can be found in the 2010 ETTL report entitled "*Geotechnical Investigation, Welsh Power Station, Existing Ash Storage Ponds Embankment Investigation, Pittsburg, Texas*" (ETTL, 2010).

2.4.3 Surface Water and Surface Water Groundwater Interactions

The Site is generally less than one-half mile from Swauano Creek, which was dammed near the southern end of the site during plant development to form the Welsh Reservoir. Groundwater flow direction at the Site is generally from west to east, following surface topography towards the Welsh Reservoir. The Welsh Reservoir is likely a gaining surface water feature, and groundwater elevations on site are higher than the normal stage elevation of the Welsh Reservoir (approximately 320 feet amsl).

The Bottom Ash Storage Pond normal operating level is near the clear water overflow weir which has a crest elevation of 355 feet amsl. **Figure 9** is a potentiometric surface map based on March 2016 water level data for the uppermost water bearing unit at the Site, and water level elevations in the Site monitoring wells are summarized on **Table 1**. As shown on **Figure 9**, shallow groundwater flow direction in the area of the Bottom Ash Storage Pond is east-southeasterly toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.01 foot per foot.

2.4.4 Water Users

A water well inventory conducted by Banks Information Solutions showed one water well within a ½-mile radius of the Site (Banks, 2013). The water well is located on-site to the west (up gradient) of the Bottom Ash Storage Pond, and was installed for Southwestern Electric Company in 1974 with a screened interval from 515 to 535 ft below ground surface, and plugged at a later date.

3. Isolation from the Uppermost Aquifer

CCR Rule 40 CFR Part 257.60 requires that the base of new and existing CCR surface impoundments be constructed such that the base of the unit is no less than 5 ft above the top of the uppermost aquifer, or that if the base is within 5 ft of the uppermost aquifer, that there will not be hydraulic connection between the base of the unit and the uppermost aquifer.

3.1 Uppermost Aquifer and Piezometric Analysis

3.1.1 Piezometric Analysis

3.1.1.1 Horizontal and Vertical Position Relative to CCR Unit

Geologic data from soil borings and monitoring wells installed at the site show the uppermost water bearing unit in the area of the Bottom Ash Storage Pond is a very fine to fine grained silty sand and sandy silt stratum with an average thickness of approximately 12 feet that is located between an elevation of approximately 320 and 332 feet amsl (**Appendix A**). The base of the Bottom Ash Storage Pond is at an elevation of 340 feet feet amsl. Therefore the separation distance between the uppermost water-bearing unit and the base of the Bottom Ash Storage Pond is approximately 8 feet. This separation distance is further illustrated on cross section C-C' (**Figure 6)** and cross section D-D' (**Figure 7)**.

3.1.1.2 Overall Flow Conditions

Groundwater is recharged from regional precipitation infiltration. The uppermost water bearing unit (silty sand) is expected to have a hydraulic conductivity of approximately 10^{-4} centimeters per second (Fetter, 1980). Based on the hydraulic conductivity and saturated thickness (approximately 12 feet), the yield of the uppermost water-bearing unit is anticipated to exceed the TCEQ non-useable (Class 3) limit of 150 gallons per day (TCEQ, 2010).

Available groundwater elevations are summarized on **Table 1** for 2011 through 2016. The most recent comprehensive groundwater data set from March 2016 is depicted on **Figure 9**. The groundwater flow is generally easterly towards the Welsh Reservoir.

3.1.2 Uppermost Aquifer

3.1.2.1 CCR Rule Definition

The CCR rule definitions for an aquifer and the uppermost aquifer as specified in 40 CFR 257.53 indicates an aquifer is a geologic formation capable of yielding usable quantities of groundwater to wells or springs while an uppermost aquifer is defined as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers, that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural groundwater surface to which the aquifer rises during the wet season.

3.1.2.2 Common definitions

An aquifer is commonly defined as a geologic unit that stores and transmits water (readily or at sufficient flow rates) to supply wells and springs (USGS, 2015; Fetter, 2001). The uppermost aquifer is considered the first encountered aquifer nearest to the CCR unit.

3.1.2.3 State regulatory definition

According to Title 30, Texas Administrative Code (TAC) Rule 350, a useable aquifer is capable of yielding 150 gallons per day (approximately 0.1 gallons per minute) or more with a total dissolved solids concentration of 10,000 milligrams per liter (mg/L) or lower (TCEQ, 2010).

3.1.3 Identified onsite hydrostratigraphic unit

The identified on-Site hydrostratigraphic unit in the area of the Bottom Ash Storage Pond is the very fine to fine grained silty sand and sandy silt stratum that is located between an elevation of approximately 320 and 332 feet amsl. This unit is not used locally for groundwater supply or industrial water use, but meets the TCEQ definition of a useable aquifer.

3.2 Compliance with Isolation Distance

The uppermost water-bearing unit underlying the Bottom Ash Storage Pond meets the regulatory definition of an aquifer. As shown on the cross-sections presented on **Figures 6** and **7**, the base of the Bottom Ash Storage Pond is approximately eight feet above this aquifer. Therefore, this CCR Unit meets the location restriction for separation from the uppermost aquifer. Also, the base of the Bottom Ash Storage Pond contains a 60-mil HDPE liner which also provides isolation from the uppermost water-bearing unit.

4. Wetlands

CCR Rule 40 CFR Part 257.61 requires that existing and new CCR surface impoundments must not be located in wetlands.

4.1 Local Wetlands

Based on the August 20, 2015 site visit and review of available published information, the Bottom Ash Storage Pond is not located within an area that exhibited wetland characteristics that might be classified as a regulated wetland. Photos of the Bottom Ash Storage Pond area are included in **Appendix B**, and **Figure 10** is a map showing wetlands locations in the CCR unit area.

4.2 Compliance with Wetland Restrictions

Based on the August 20, 2015 site visit and review of available information, the Bottom Ash Storage Pond does not contain wetlands. Therefore, this CCR Unit meets the location restriction regarding wetlands.

5. Fault Areas

CCR Rule 40 CFR Part 257.62 requires that existing and new CCR surface impoundments must not be located within 200 ft of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates that the and alternate setback will prevent damage to the structural integrity of the CCR unit.

5.1 Description of Regional Geologic Structural Features

Regional geologic publications were reviewed to determine structural features for the Site. A regional fault map is provided on **Figure 11**. The U.S. Geological Survey Open File Report 88-450K shows the Site is located within the East Texas Basin, with faulting north of the basin (Talco Fault Zone) and south of the basin (Elkhart-Mt. Enterprise Fault Zone). No faulting was identified in the Site area (USGS, 1988). Texas Water Commission Bulletin 6517 and the University of Texas at Austin Bureau of Economic Geology Geologic Atlas of Texas – Texarkana Sheet show no faulting at the Site (Broom, 1965; Flawn, 1966).

A previous evaluation of geologic structural features at the Site was conducted by ETTL, and no evidence of faulting was identified (ETTL, 2010).

5.2 Compliance with Fault Area Restrictions

A review of available geologic reports and maps has indicated that the site is not located near any faults with displacement in the Holocene. Therefore, the CCR units at this site meet the location restriction for faults.

6. Seismic Impact Zone

CCR Rule 40 CFR Part 257.63 requires that existing and new CCR surface impoundments must not be located within a seismic impact zone unless the owner or operator demonstrates that all structural components of the CCR unit are designed to withstand the maximum horizontal acceleration in lithified earth material for the site.

6.1 Definition of Seismic Impact Zone

CCR Rule 40 CFR Part 257.53 defines a seismic impact zone as an area having a 2% or greater probability that the maximum horizontal acceleration expressed as a percentage of the earth's gravitational pull (g) will exceed 0.10 g in 50 years.

6.2 Compliance with Seismic Impact Zone Restriction

Figure 12 presents the seismic hazard map for Texas, as published by the USGS. As shown on **Figure 12**, the site falls within the zone having a maximum horizontal acceleration of 0.04 to 0.06 g. Therefore, the CCR unit meets the location restriction for seismic impact zone.

7. Unstable Areas

CCR Rule 40 CFR Part 257.64 requires that existing and new CCR surface impoundments must not be located within an unstable area unless the owner or operator demonstrates that the design of the unit will ensure the integrity of the structural components of the unit.

7.1 Definition of Unstable Area and local Conditions

7.1.1 CCR Rule Definition

CCR Rule 40 CFR Part 257.53 defines an unstable area as a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of the CCR unit. These may include poor foundation conditions, areas susceptible to mass movements (landslides), and karst terrains.

7.1.2 Poor Foundation Soils

A soil geotechnical report was prepared for the Bottom Ash Storage Pond by Maxim Technologies in 2000 (Maxim Technologies, April 2000). The Bottom Ash Storage Pond was constructed during 2000 using compacted clay in accordance with specifications prepared by Southwestern Electric Power Company (Southwestern Electric Power Company, 2000). The specifications included compaction of the Bottom Ash Storage Pond embankments in loose lifts not exceeding eight inches (8"), and compaction of each lift to 90% modified proctor density at optimum moisture content.

Maxim Technologies conducted inspections and soil geotechnical testing during construction of the Bottom Ash Storage Pond embankments to confirm the compaction specifications had been met (Maxim Technologies, July 2000). Alliance Incorporated conducted inspections and testing during installation of the 60-mil HDPE liner at the base of the Bottom Ash Storage Pond. Alliance Incorporated concluded the HDPE liner was installed in accordance with the specifications (Alliance Incorporated, 2000). Also, the ETTL Geotechnical Investigation Report (ETTL, 2010) concluded the native soil types and relative low maximum ground acceleration at the site indicate a negligible risk of liquefaction.

7.1.3 Mass Movements

The Bottom Ash Storage Pond is not located within an area subject to mass movements. This conclusion is supported by the ETTL soil stability report (ETTL, 2010).

7.1.4 Karst

The site area is located on the outcrop of unconsolidated Cretaceous Formations consisting predominantly of sand and clay (Broom, 1965; Flawn, 1966). The Bottom Ash Storage Pond is not located in a karst area.

7.1.5 Subsurface Mining

No subsurface mines are known to exist below the CCR units at the Site.

7.2 Compliance with Unstable Areas Restriction

Based on our site visit and review of available information, the Bottom Ash Storage Pond is not located within unstable areas. Therefore, this CCR unit meets the location restriction requirements for unstable areas.

8. Summary, Conclusions, and PE Certification

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, as well as the evaluations discussed within this report, the J. Robert Welsh Power Plant Bottom Ash Storage Pond meets the CCR surface impoundment location restrictions of 40 CFR Part 257 for separation from the uppermost aquifer, wetlands, fault areas, seismic impact zones, and unstable areas.

Kenneth J. Brandner

Printed Name of Registered Professional Engineer

Kenneth J Brandner

Signature

KENNETH J. BRANDNER
69586

69586
Registration No.

Texas
Registration State

5-2-16
Date

9. References

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Tables

Table 1
Water Level Data
AEP J. Robert Welsh Power Plant - CCR Storage Areas
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Screen		Bottom of Screen		6/7/2011	12/6/2011	5/2/2012	11/1/2012	5/14/2013	11/19/2013	5/12/2014	11/16/2014	5/12/2015	3/4/2016
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																						
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57	338.46	334.92	337.88	337.18	337.43	336.73	338.03	337.64	340.82	342.83
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16	330.16	329.07	330.00	329.26	329.83	329.70	330.09	329.69	332.56	332.32
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10	323.81	323.19	323.99	323.29	323.77	323.98	324.12	323.28	325.58	325.12
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61	324.81	324.84	324.62	324.40	324.74	325.52	325.44	325.13	327.00	326.90
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19	325.01	324.19	325.24	322.90	324.86	324.68	325.64	325.34	327.19	327.12
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55	324.35	324.32	324.50	324.30	324.30	325.21	325.22	324.90	326.58	326.67
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15	324.18	324.50	324.64	324.37	324.11	325.06	325.01	324.71	326.50	326.19
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00	336.34	336.58	336.82	336.99	336.78	336.47	336.80	336.01	339.07	338.04
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31	333.04	333.02	332.83	333.02	333.11	332.81	333.11	332.81	333.38	334.00
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86	334.32	334.12	334.19	334.20	334.13	334.58	333.77	333.98	334.09	333.61
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53	325.41	324.09	325.69	325.15	325.79	325.75	325.98	325.77	326.05	325.70
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32	328.46	328.53	328.63	328.44	328.74	329.38	NM	330.18	329.98	329.74
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23	323.44	322.55	323.27	323.35	323.51	323.76	323.57	323.88	323.95	323.55
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61	327.99	328.37	327.82	327.93	327.94	328.13	328.20	327.97	328.96	328.13
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27	348.30	348.29	349.86	349.56	349.99	349.65	349.89	350.01	350.65	350.39
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12	332.36	332.24	333.09	332.26	332.68	333.25	333.35	332.01	337.58	334.76
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32	330.40	329.80	331.67	330.34	330.94	331.69	332.12	330.17	336.63	334.83
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71	---	---	---	---	---	---	---	---	---	322.14
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86	---	---	---	---	---	---	---	---	---	337.09
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99	---	---	---	---	---	---	---	---	---	334.64
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17	---	---	---	---	---	---	---	---	---	343.66
Piezometers																						
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

NM - Not measured.
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through March 2016.

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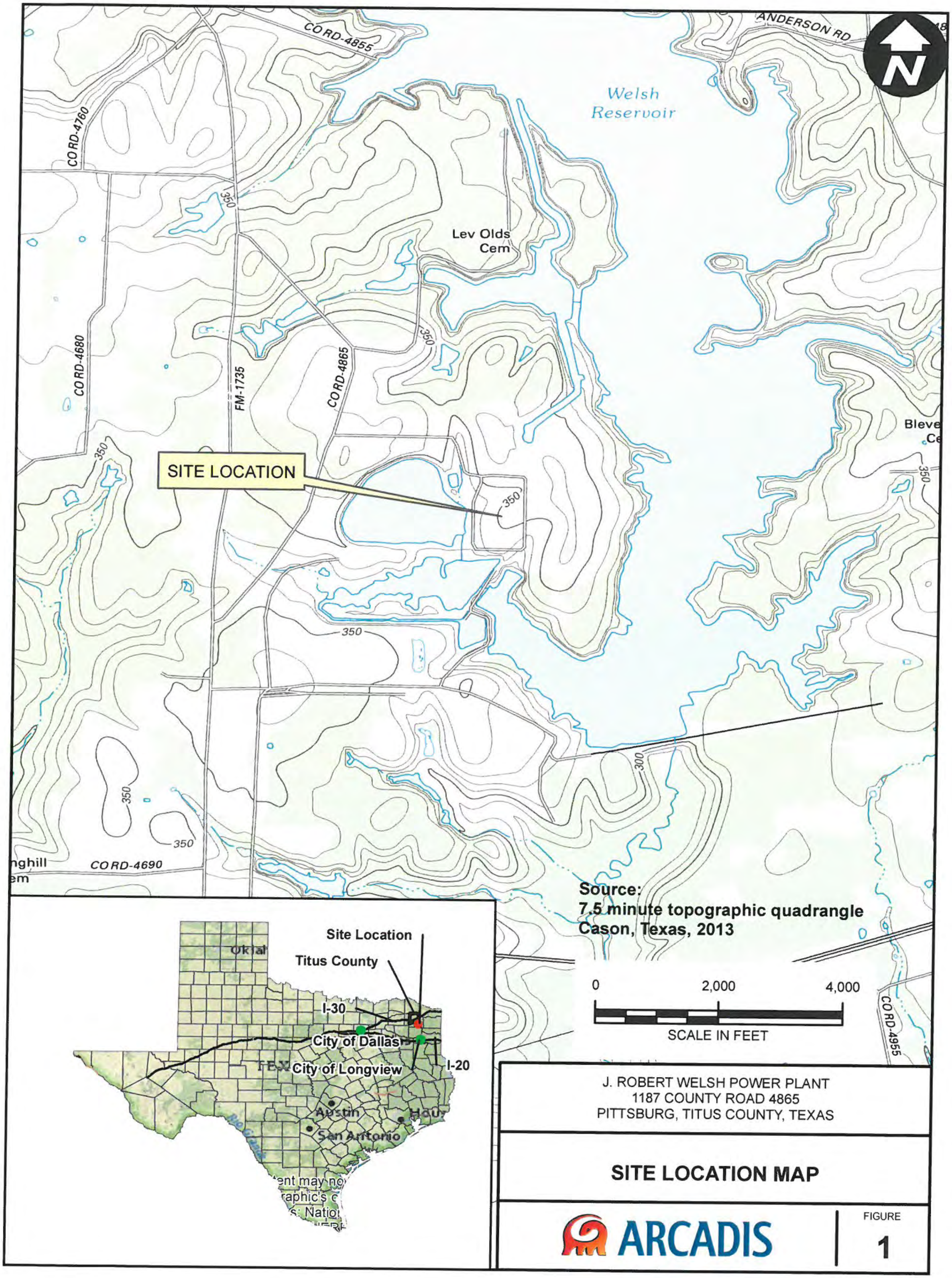
Figures



Source:
7.5 minute topographic quadrangle
Cason, Texas, 2013

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LOCATION MAP

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FIGURE
1

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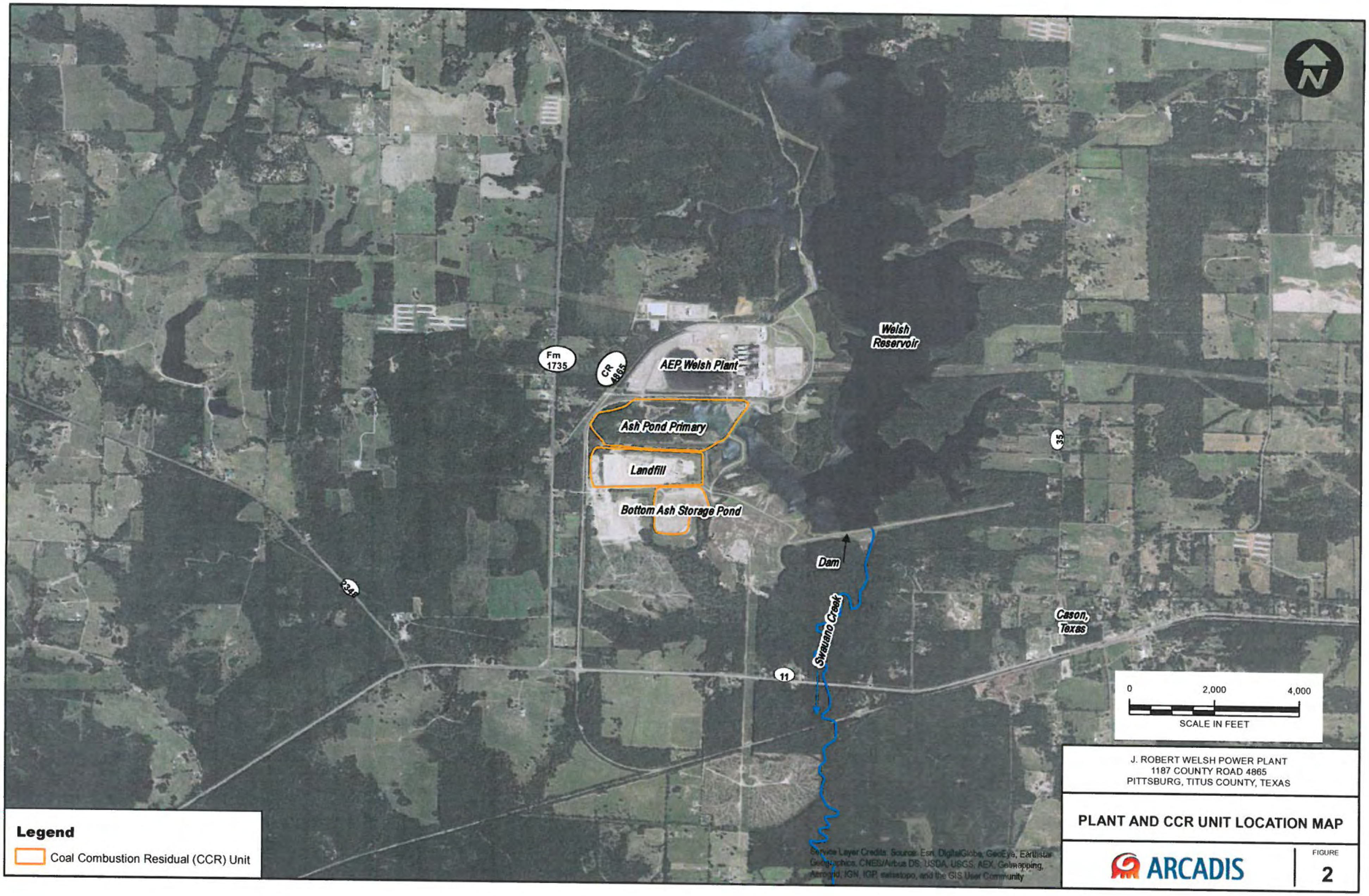

Legend

🟧 Coal Combustion Residual (CCR) Unit

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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PLANT AND CCR UNIT LOCATION MAP

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FIGURE
2

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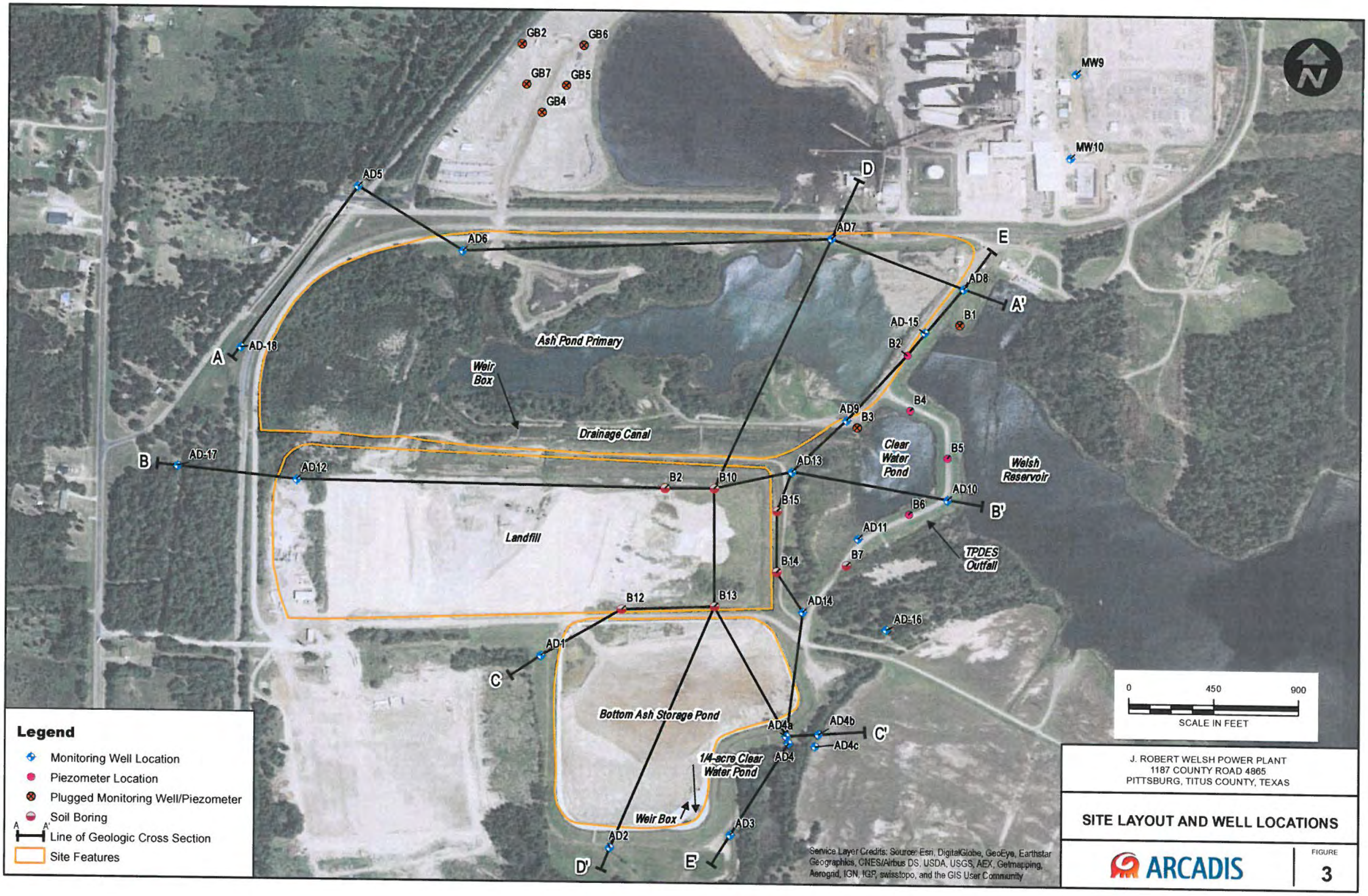

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SITE LAYOUT AND WELL LOCATIONS

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FIGURE
3

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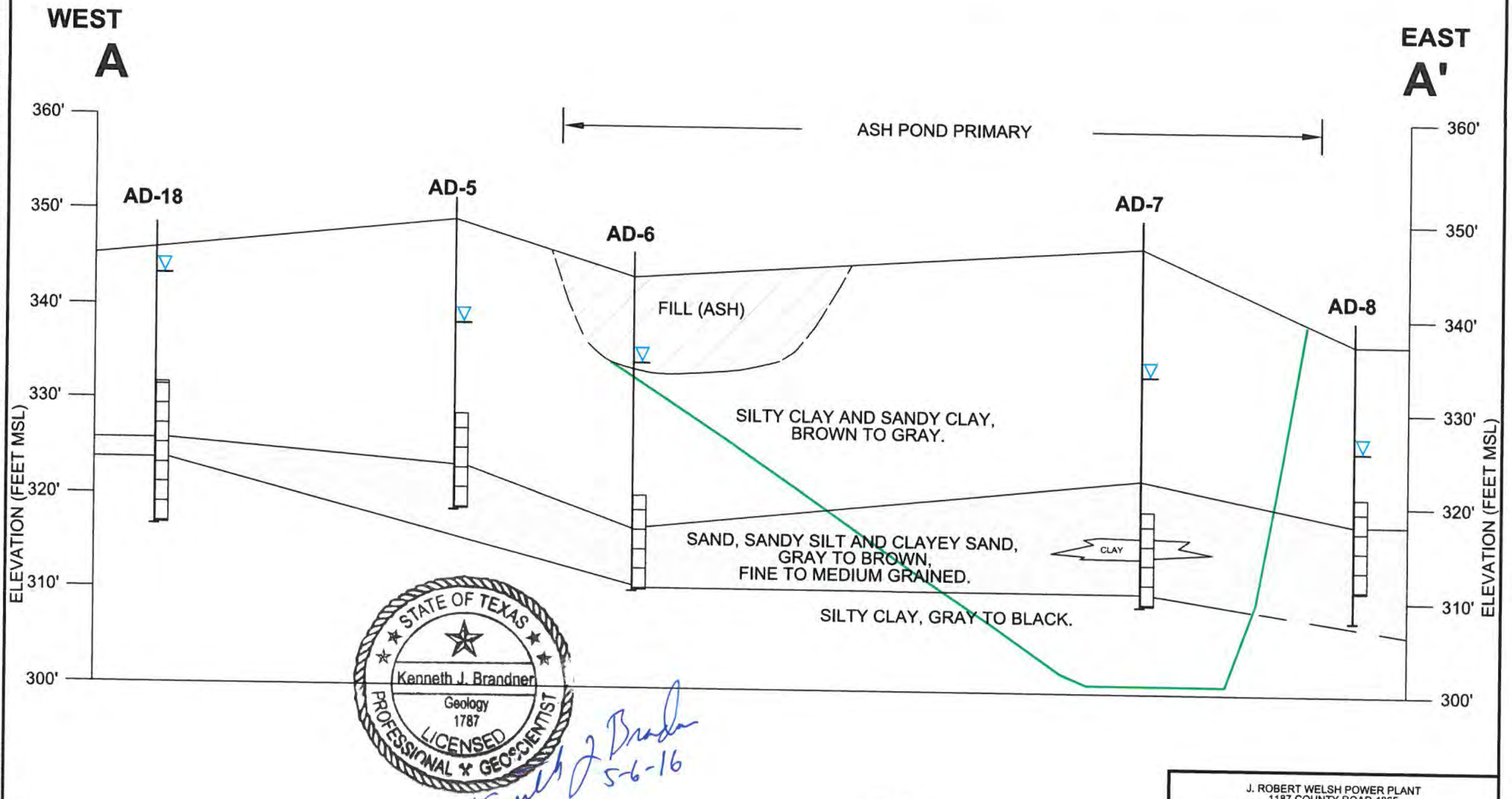

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Kenneth J Brandner
5-6-16

NOTE: BASE OF ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

⊟	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	PROJECTED BASE OF ASH POND (SEE NOTE)

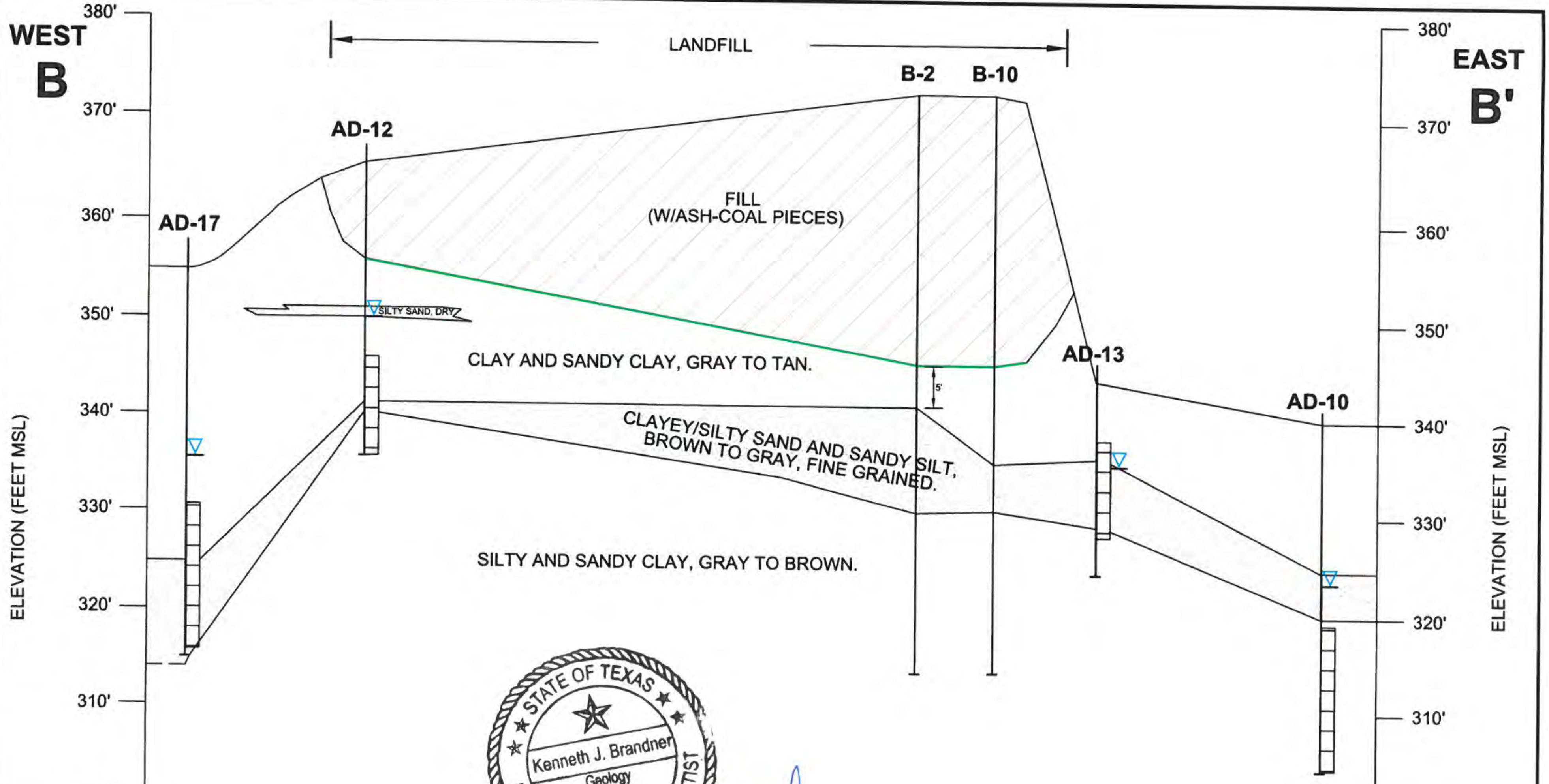
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
A - A'

ARCADIS

FIGURE
4

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF* G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 4 Cross Section A-A'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:48 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE: — PLOTTED: 3/16/2016 9:08 AM BY: LEASE, DIANA



0 300'
HORIZONTAL SCALE

NOTE: BASE OF LANDFILL ELEVATION TAKEN FROM "WELSH POWER PLANT- UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12/3/76.

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

Kenneth J Brandner
5-6-16

LEGEND

⊟	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
🟩	BASE OF LANDFILL (SEE NOTE)

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CROSS SECTION
B - B'

ARCADIS

FIGURE
5

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 5 Cross Section B-B'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:41 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE:
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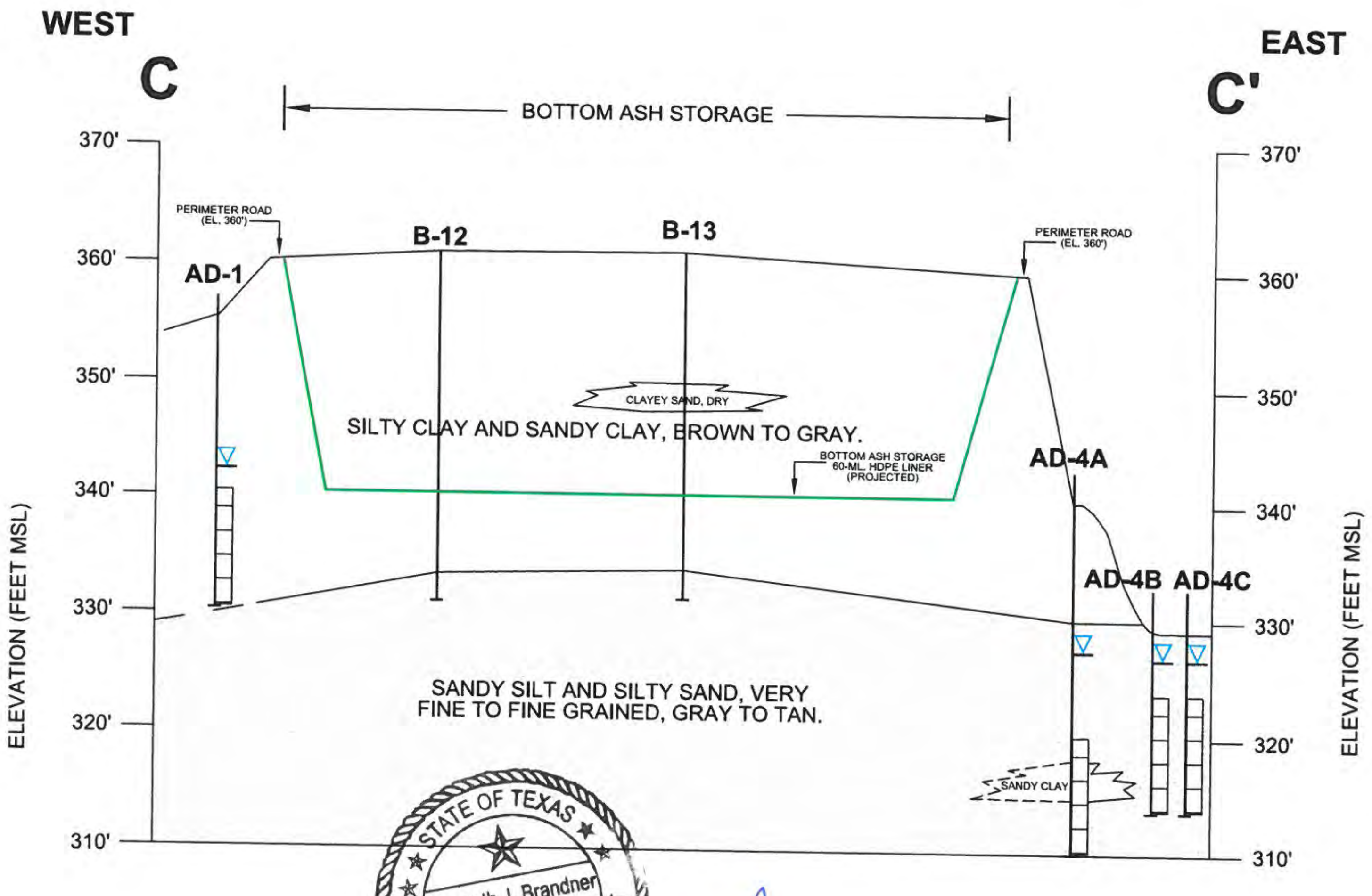

Kenneth J. Brandner
Geology
1787

Kenneth J Brandner
5-6-16

0 200'
HORIZONTAL SCALE

NOTE: BASE OF BOTTOM ASH STORAGE HAS A 60-ML. HDPE LINER AT ELEVATION 340.0', TAKEN FROM FREESE AND NICHOLS "HYDRAULIC ANALYSIS OF WELSH POWER PLANT ASH PONDS, AMERICAN ELECTRIC POWER COMPANY", DATED DECEMBER 2010.

LEGEND

⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION C - C'

ARCADIS

FIGURE
6

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 6 Cross Section C-C'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:54 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: —
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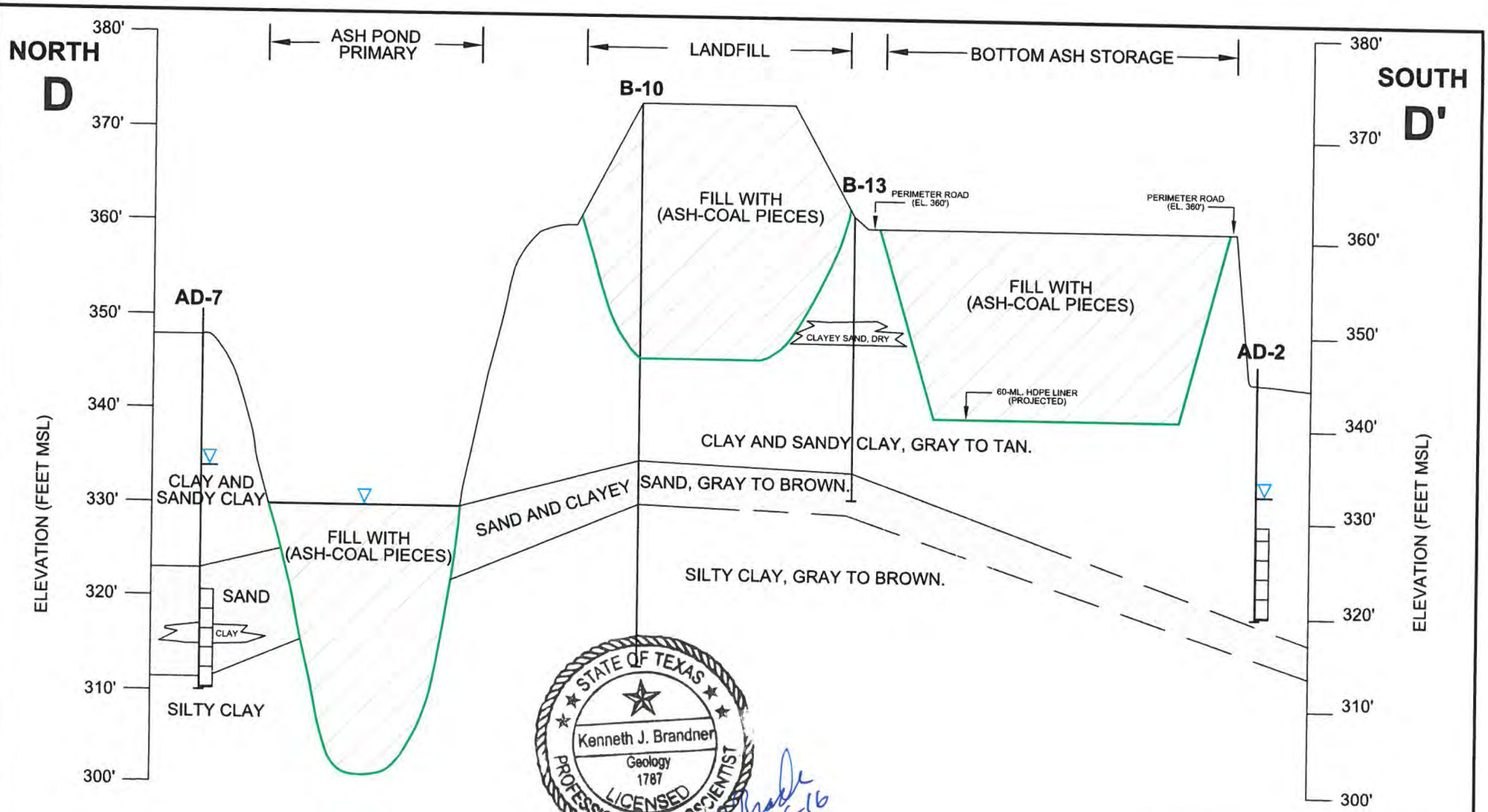

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Geology
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Ken J Brandner
5-6-16

0 300'
HORIZONTAL SCALE

NOTE: BASE OF ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	BASE OF CCR UNIT

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION D - D'

ARCADIS

FIGURE
7

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 7 Cross Section D-D'.dwg LAYOUT: MODEL SAVED: 8/26/2015 9:07 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE:
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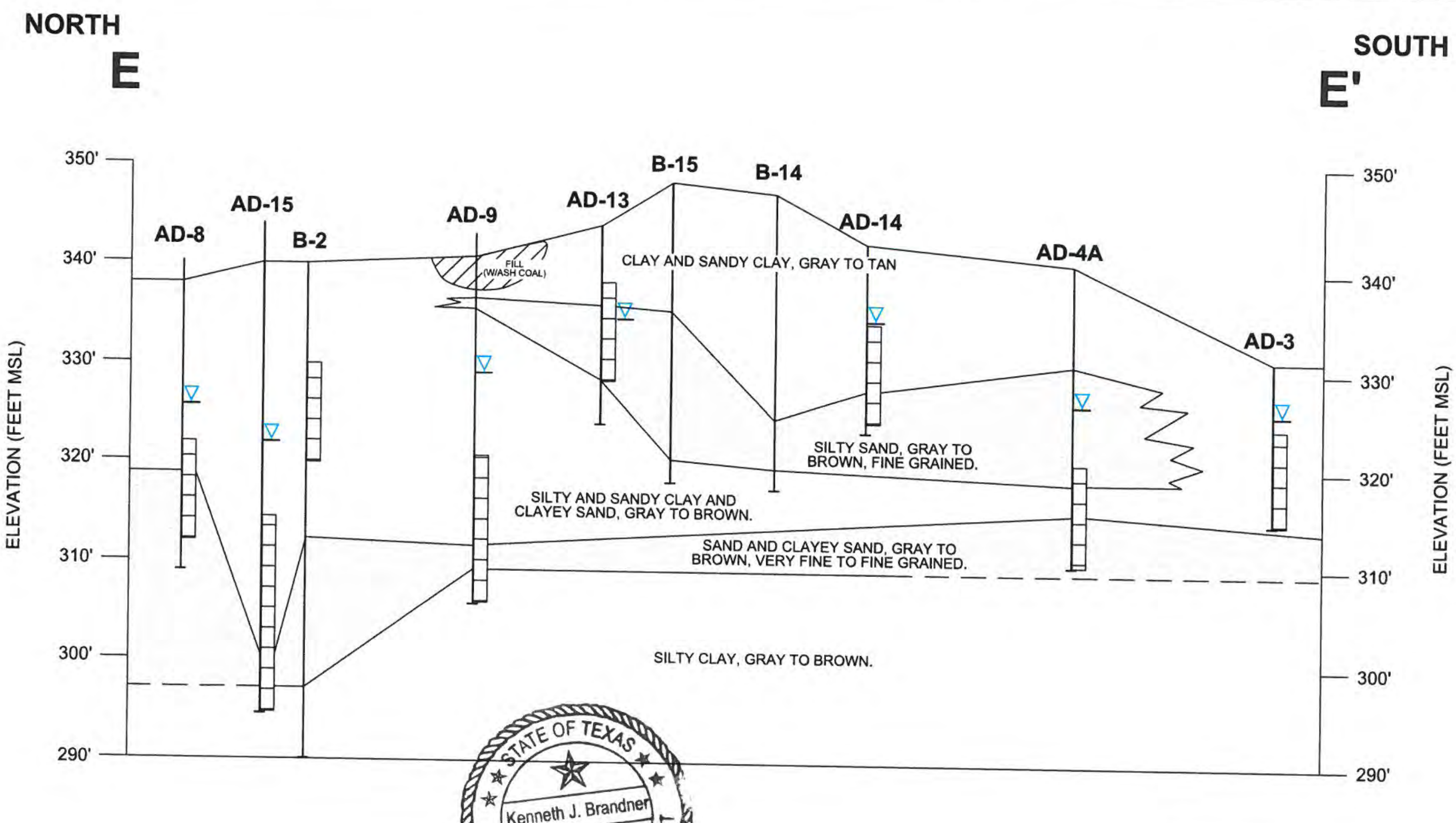


0 300'
HORIZONTAL SCALE

Kenneth J. Brandner
Geology
1787

Kenneth J. Brandner 5-6-16

LEGEND

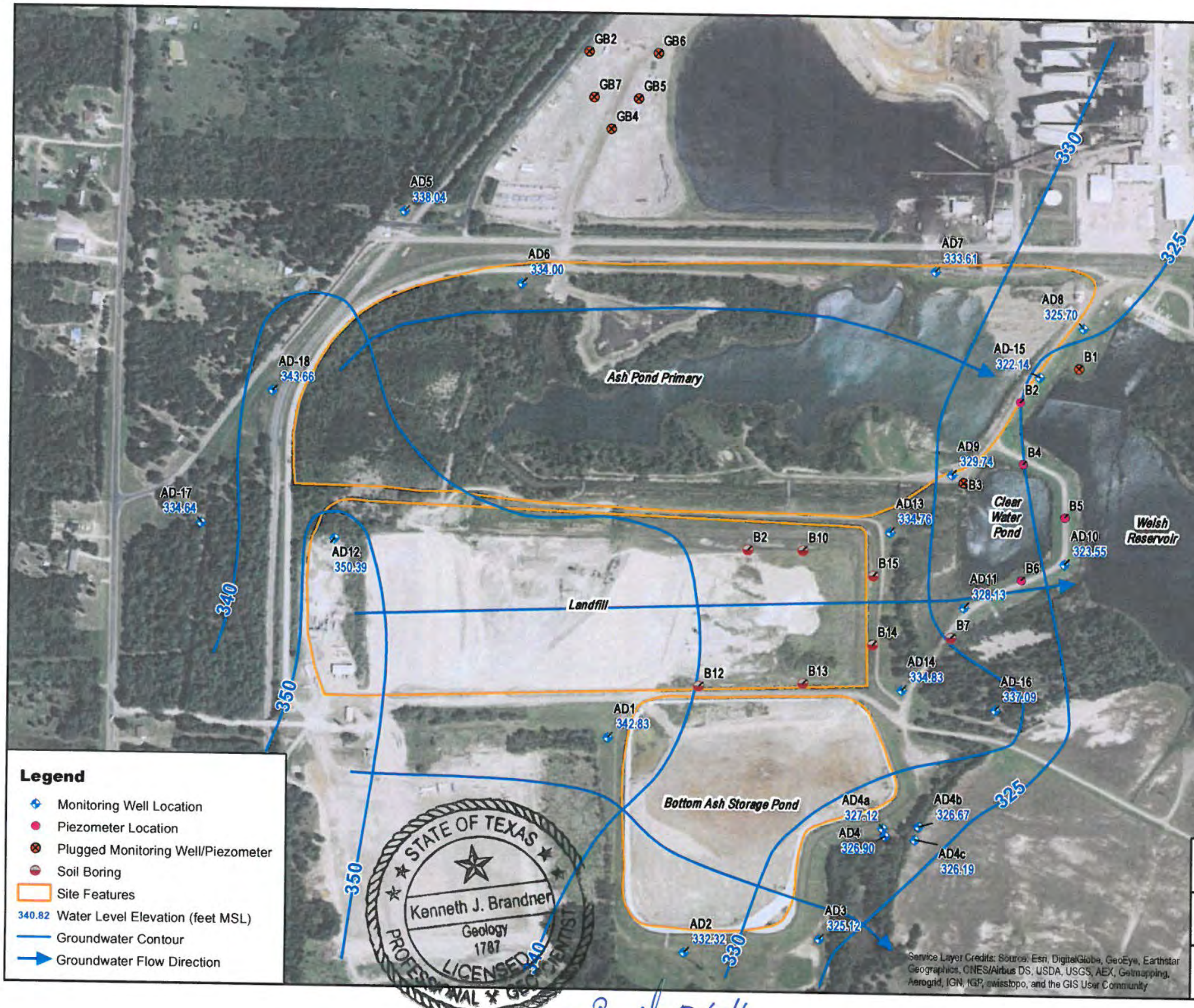
⊟	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION E - E'

ARCADIS

FIGURE
8



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

WELL ELEVATIONS AND POTENTIOMETRIC MAP
MARCH 4, 2016

ARCADIS

FIGURE
9

Kenneth J. Brandner
Geology
1787

5-6-16

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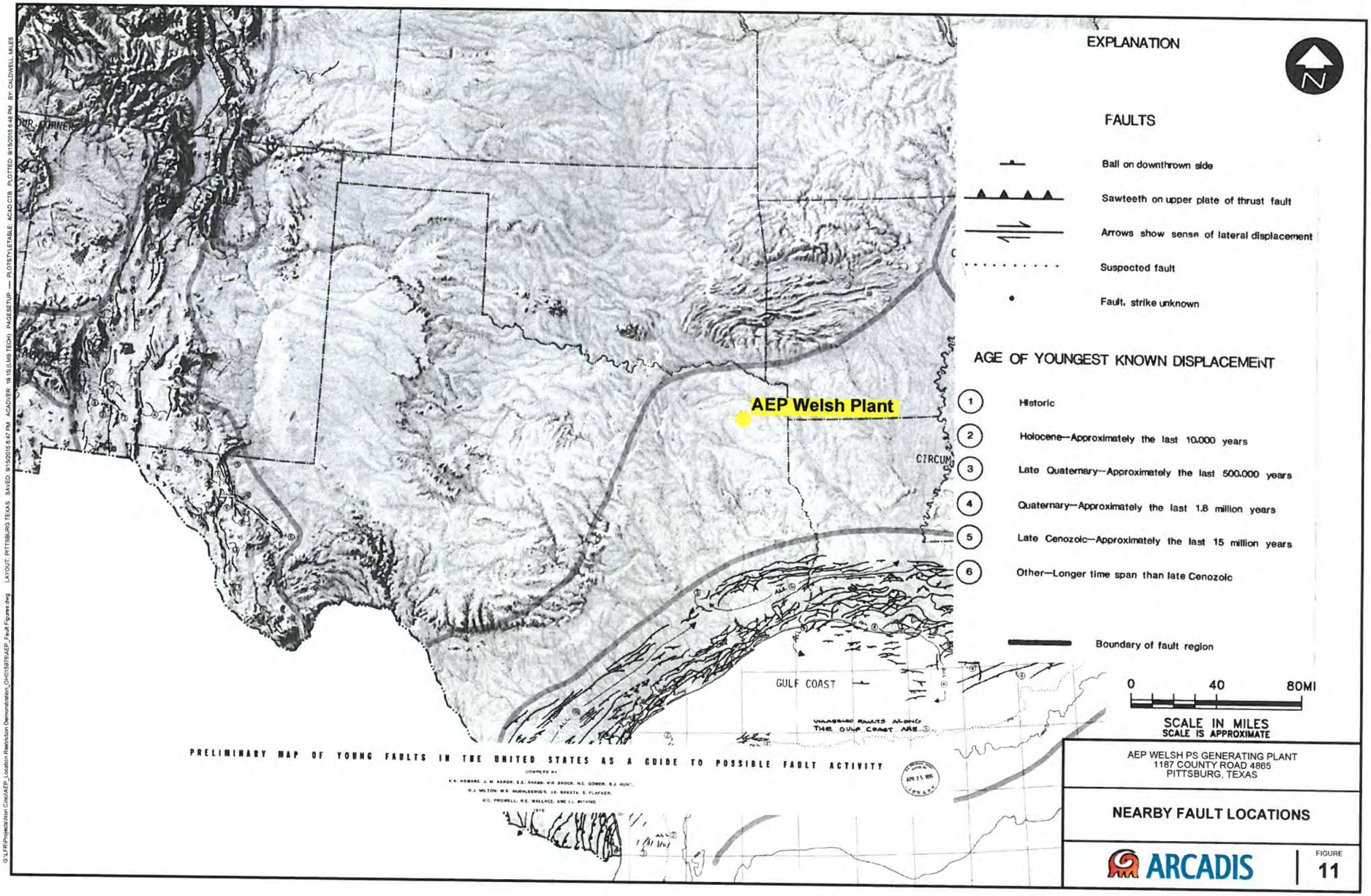
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

POTENTIAL WETLAND LOCATIONS

ARCADIS

FIGURE
10



PRELIMINARY MAP OF YOUNG FAULTS IN THE UNITED STATES AS A GUIDE TO POSSIBLE FAULT ACTIVITY

COMPILED BY

K.A. HOWARD, J.M. AARON, E.E. BRABB, M.R. BROCK, H.D. GOWER, S.J. HUNT,
D.J. MILTON, W.R. MUEHLBERGER, J.K. NAKATA, G. PLAFKER,
D.C. PROWELL, R.E. WALLACE, AND I.J. WITKIND
1978

AEP WELSH PS GENERATING PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TEXAS

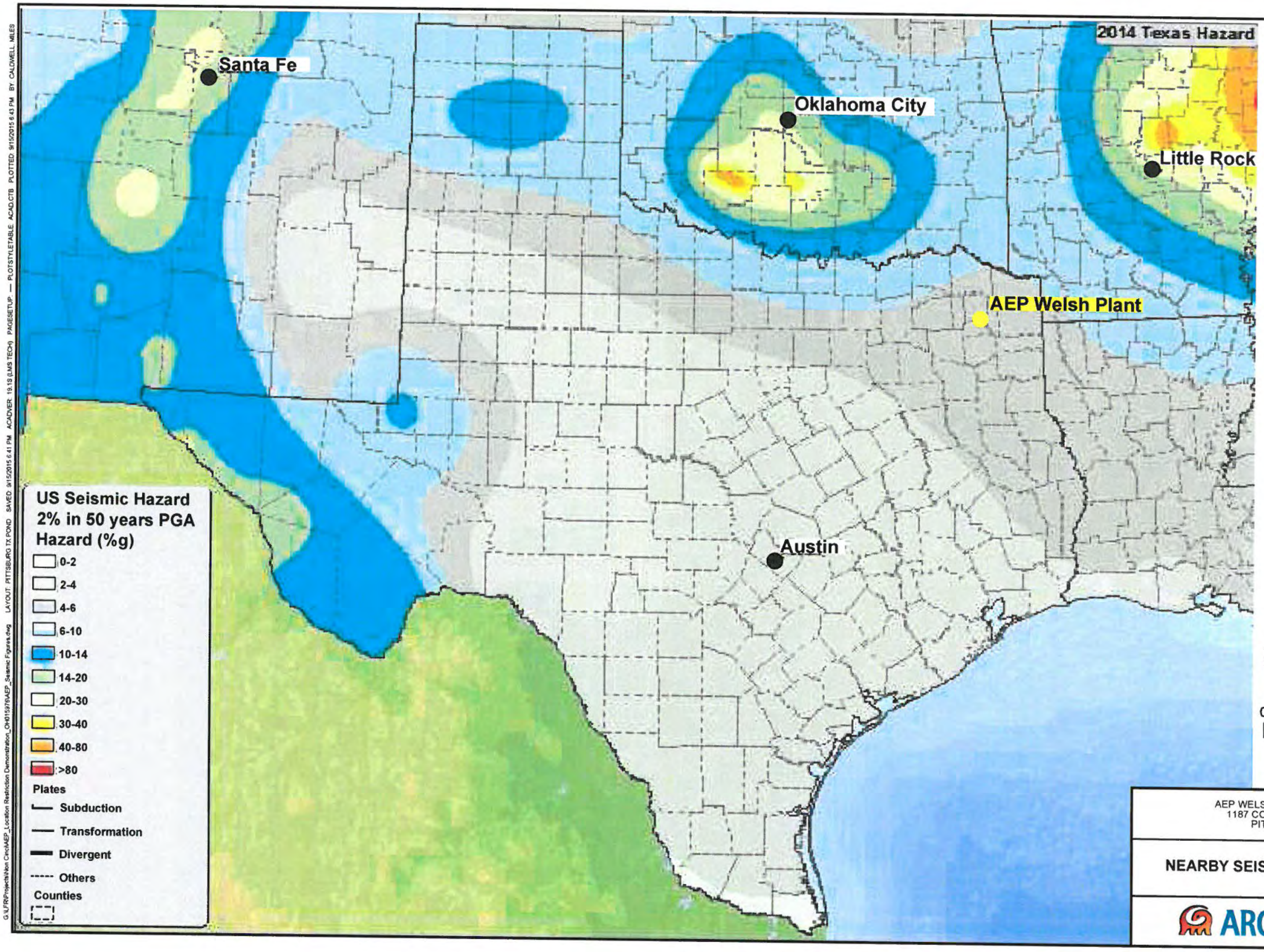
NEARBY FAULT LOCATIONS

ARCADIS

FIGURE
11

G:\LFR\Projects\Non Cinci\AEP_Location Restriction Demonstration_OH015976\AEP_Fault Figures.dwg LAYOUT: PITTSBURG TEXAS SAVED: 9/15/2015 6:47 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: ACAD.CTB PLOTTED: 9/15/2015 6:48 PM BY: CALDWELL, MILES

G:\LFR\Projects\Non Cinci\AEP_Location Restriction Demonstration_OH015976\AEP_Seismic Figures.dwg LAYOUT: PITTSBURG TX POND SAVED: 9/15/2015 6:41 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE: ACAD.CTB PLOTTED: 9/15/2015 6:43 PM BY: CALDWELL, MILES



SOURCE:
USGS Earthquake Hazards Program,
Texas: 2014 Seismic Hazard Map

AEP WELSH PLANT ASH POND
1187 COUNTY ROAD 4865
PITTSBURG, TX

NEARBY SEISMIC IMPACT ZONES

ARCADIS

FIGURE
12

ARCADIS

Appendix A

Boring/Well Construction Logs

AD-1

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt.4, Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS 33°02'48"N 94°50'47"W

N

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	25	gray silty clay with some hard red streaks

AP-1

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other

If Gravel Packed give interval ... from 13 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	Sch 40
2	N	#10 slot screen	15	25	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 13 ft. to 0 ft. No. of sacks used 6-50#
ft. to ft. No. of sacks used
Method used bentonite
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 12'8" ft. below land surface Date 1-11-01
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-2

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

County ~~Camp~~ Titus

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic
☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'37"N
94°50'44"W
N

6) WELL LOG:
Date Drilling:
Started 4/26 2001
Completed 4/26 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven
☐ Air Rotary ☐ Mud Rotary ☒ Bored
☐ Air Hammer ☐ Cable Tool ☐ Jetted
☐ Other ______

From (ft.)	To (ft.)	Description and color of formation material
0	2	top Soil
2	5	red & gray clay w/ silt
5	10	red & gray clay w/ silt
10	25	gray silty clay w/ tan streaks

AP-2

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall
☐ Underreamed ☒ Gravel Packed ☐ Other ______
If Gravel Packed give interval ... from 12 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	Sch 40
2	N	#10 slot screen	15	25	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 12 ft. to 2 ft. No. of sacks used 5-50#
______ ft. to ______ ft. No. of sacks used ______
Method used bentonite pellets
Cemented by ______
Distance to septic system field lines or other concentrated contamination ______ ft.
Method of verification of above distance ______

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ______ ft. below land surface Date ______
Artesian flow ______ gpm. Date ______

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc., ______ ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete Items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ______ (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS ______ (Street or RFD) (City) (State) (Zip)

(Signed) ______ (Licensed Well Driller) (Signed) ______ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-3

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'38"N
94°50'37"W
N

6) WELL LOG:
Date Drilling:
Started 4/26 2001
Completed 4/26 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	17

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ____

From (ft.)	To (ft.)	Description and color of formation material
0	12	gray silty clay w/ tan streaks
12	15	very stiff gray/blood red clay
15	17	Very stiff gray clay w/ red nodules and tan streaks

AP-3

(*Use reverse side if necessary*)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other ____

If Gravel Packed give interval ... from 5 ft. to 17 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., If commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	7	Sch 40
2	N	#10 slot screen	7	17	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 2 ft. to 5 ft. No. of sacks used 2 1/2 - 50#
____ ft. to ____ ft. No. of sacks used ____
Method used bentonite pellets
Cemented by ____
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance ____

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ____ ft. below land surface Date ____
Artesian flow ____ gpm. Date ____

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ____
Depth to pump bowls, cylinder, jet, etc., ____ ft.

14) WELL TESTS: NA
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ____ (Type or print) WELL DRILLER'S LICENSE NO. TX 52694 M

ADDRESS ____ (Street or RFD) (City) (State) (Zip)

(Signed) Gilbert M. (Licensed Well Driller) (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-4

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'43"N
94°50'33"W
N↑

6) WELL LOG:
Date Drilling:
Started 4/26 19 2001
Completed 4/26 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ____

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other ____

If Gravel Packed give interval ... from 16 ft. to 30 ft.

From (ft.)	To (ft.)	Description and color of formation material
0	5	red silty clay with gray streaks
5 -	30	gray silty clay with red streaks

AP-4

(Use reverse side if necessary)

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	19	Sch 40
2	N	#10 Slot Screen	19	29	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 2 ft. No. of sacks used 8-50#
____ ft. to ____ ft. No. of sacks used ____
Method used bentonite pellets
Cemented by ____
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance ____

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ____ ft. below land surface Date ____
Artesian flow ____ gpm. Date ____

12) PACKERS: N/A Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other NA
Depth to pump bowls, cylinder, jet, etc., ____ ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ____ (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS ____ (Street or RFD) (City) (State) (Zip)

(Signed) ____ (Licensed Well Driller) (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

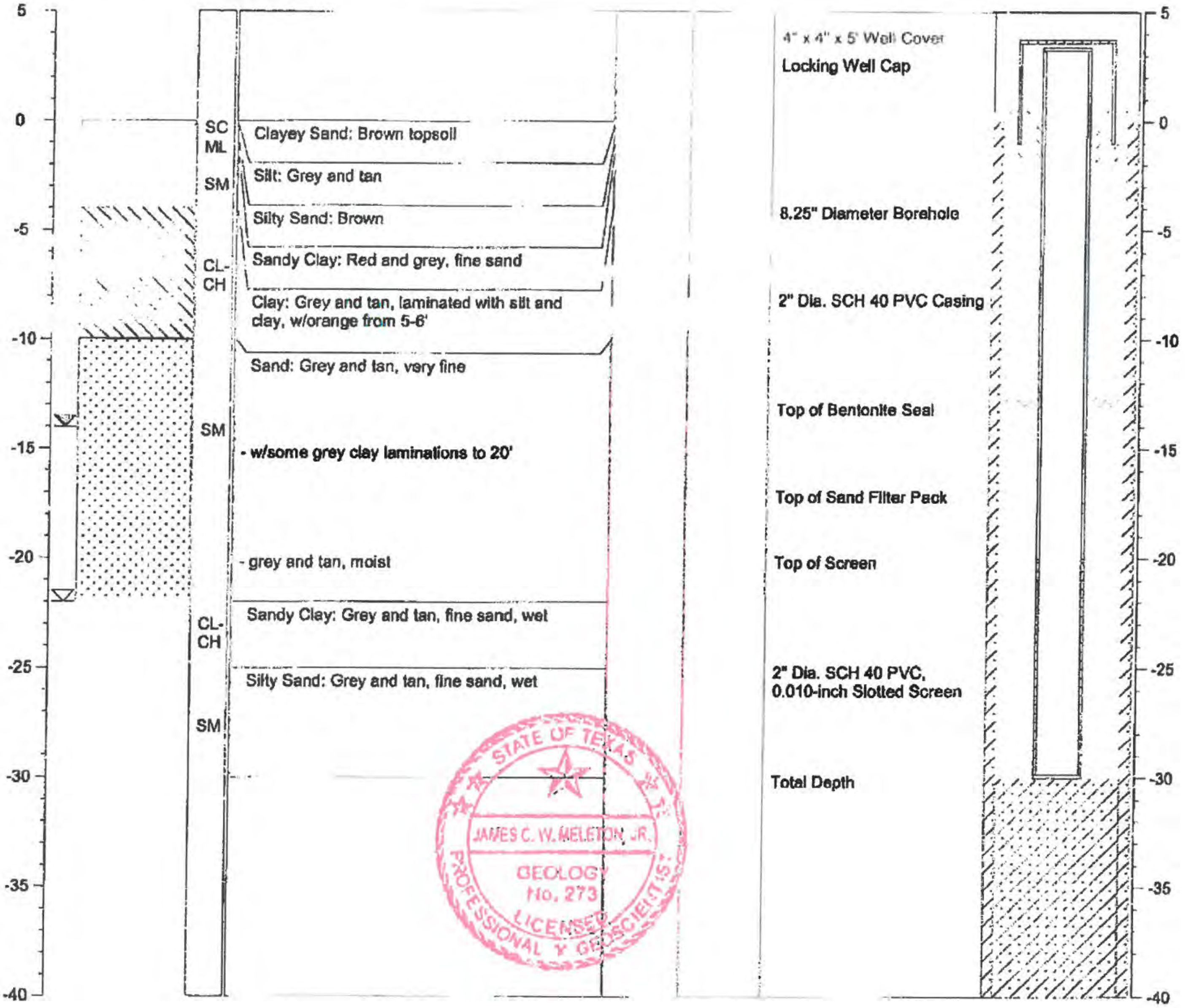
BORING/WELL NO.:	**AD-4A**
TOTAL DEPTH:	**30'**
TOP OF CASING ELEV.:	**342.85 ft. NGVD**
GROUND SURFACE ELEV.:	**340.19 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04527**
Longitude: 94.84258

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION
				4" x 4" x 5' Well Cover Locking Well Cap
SC	Clayey Sand: Brown topsoil			
ML	Silt: Grey and tan			
SM	Silty Sand: Brown			8.25" Diameter Borehole
CL-CH	Sandy Clay: Red and grey, fine sand			
	Clay: Grey and tan, laminated with silt and clay, w/orange from 5-6'			2" Dia. SCH 40 PVC Casing
SM	Sand: Grey and tan, very fine - w/some grey clay laminations to 20' - grey and tan, moist			Top of Bentonite Seal Top of Sand Filter Pack Top of Screen
CL-CH	Sandy Clay: Grey and tan, fine sand, wet			
SM	Silty Sand: Grey and tan, fine sand, wet			2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
				Total Depth

JAMES C. W. MELETON, JR.
GEOLOGY
No. 273

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4B**
TOTAL DEPTH:	**15'**
TOP OF CASING ELEV.:	**333.23 ft. NGVD**
GROUND SURFACE ELEV.:	**329.55 ft. NGVD**

CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

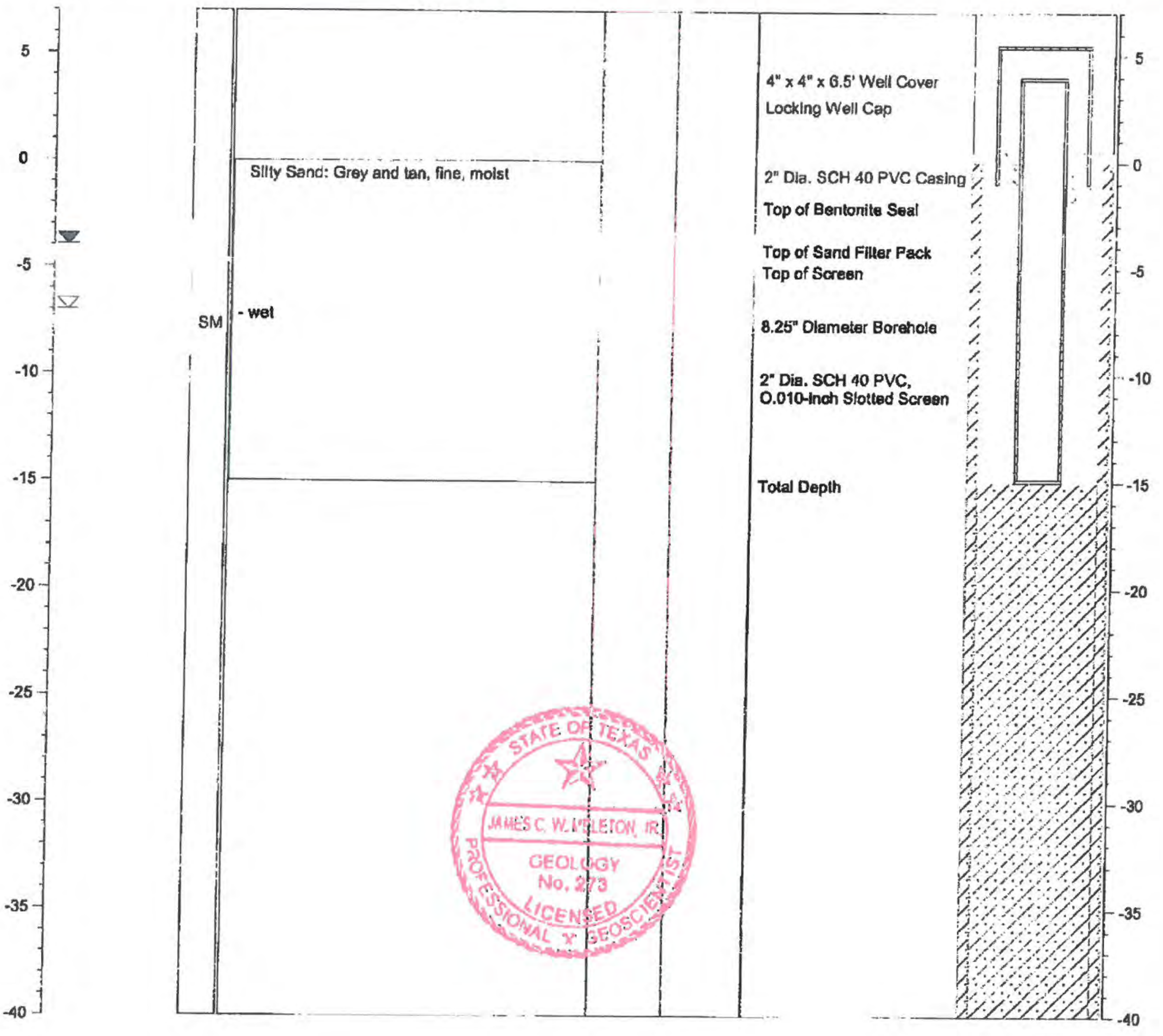
DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.04531**
Longitude: 94.84230

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4C**
TOTAL DEPTH:	**15'**
TOP OF CASING ELEV.:	**333.28 ft. NGVD**
GROUND SURFACE ELEV.:	**329.15 ft. NGVD**

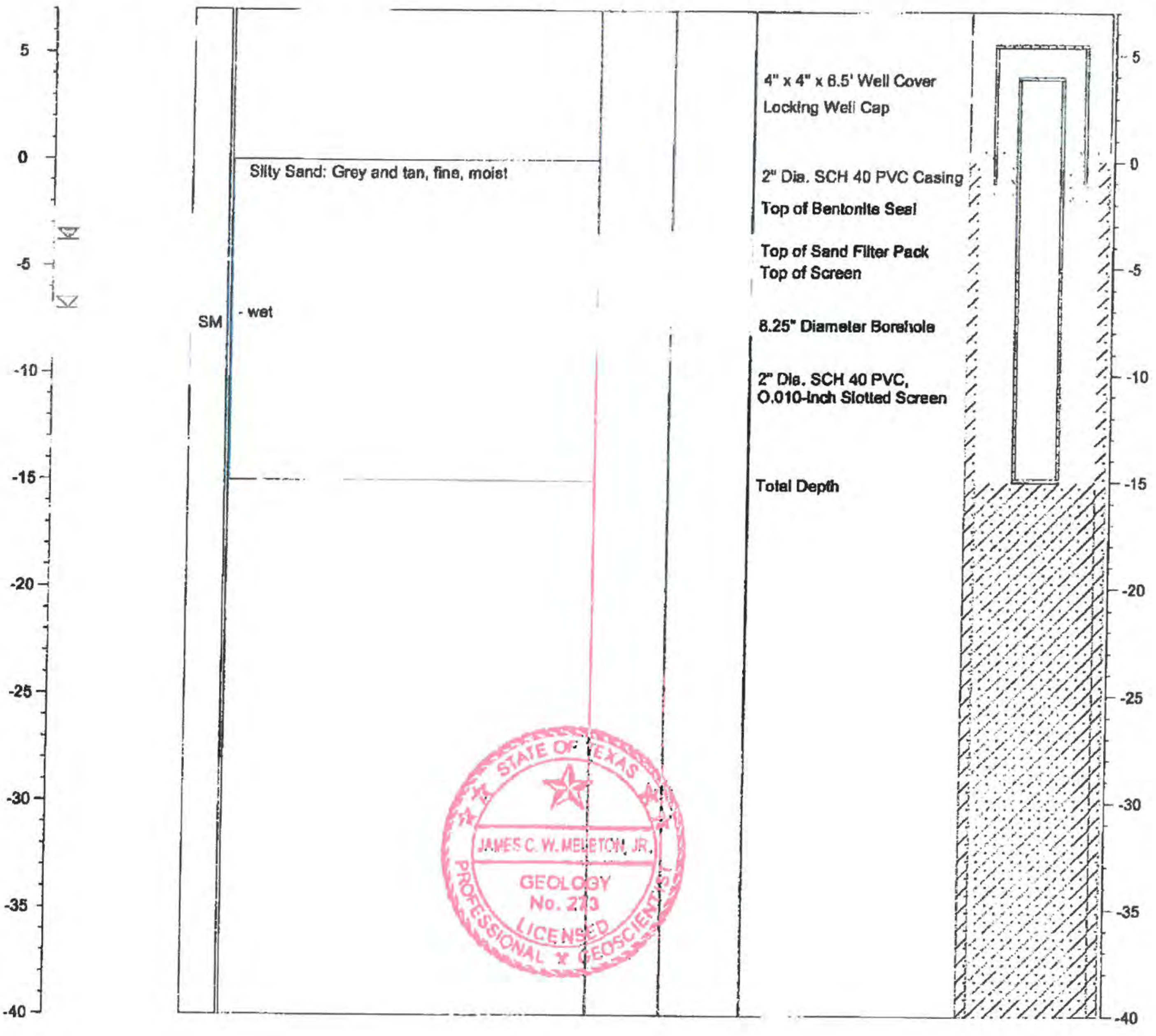
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.04507**
Longitude: 94.84244

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



JAMES C. W. MELETON, JR.
GEOLOGY
No. 273

AD-5

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt.4, Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic
☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) 33°03'13"N
94°51'00"W
N↑

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8¼	Surface	30

7) DRILLING METHOD (Check): ☐ Driven
☐ Air Rotary ☐ Mud Rotary ☒ Bored
☐ Air Hammer ☐ Cable Tool ☐ Jetted
☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	10	red & gray clay with orange streaks
10	20	gray/black clay with tan clay
20	25	stiff clay with lignite streak
25	30	fine gray sand

AP-5

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall
☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	risor	+2	20	Sch 40
2	N	#10 slot screen	20	30	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 0 ft. No. of sacks used ____
____ ft. to ____ ft. No. of sacks used ____
Method used bentonite
Cemented by ____
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance ____

✓ 10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 11'9" ft. below land surface Date 1-11-01
Artesian flow ____ gpm. Date ____

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ____
Depth to pump bowls, cylinder, jet, etc., ____ ft.

14) WELL TESTS:
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

✓ 15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ____ (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS ____ (Street or RFD) (City) (State) (Zip)

(Signed) ____ (Licensed Well Driller) (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

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SOIL BORING LOG

BORING/WELL NO.:	**AD-6**
TOTAL DEPTH:	**33'**
TOP OF CASING ELEV.:	**346.33 ft. NGVD**
GROUND SURFACE ELEV.:	**343.31 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.05235**
Longitude: 94.84757

▽ Water level during drilling
▼ Water level in completed well

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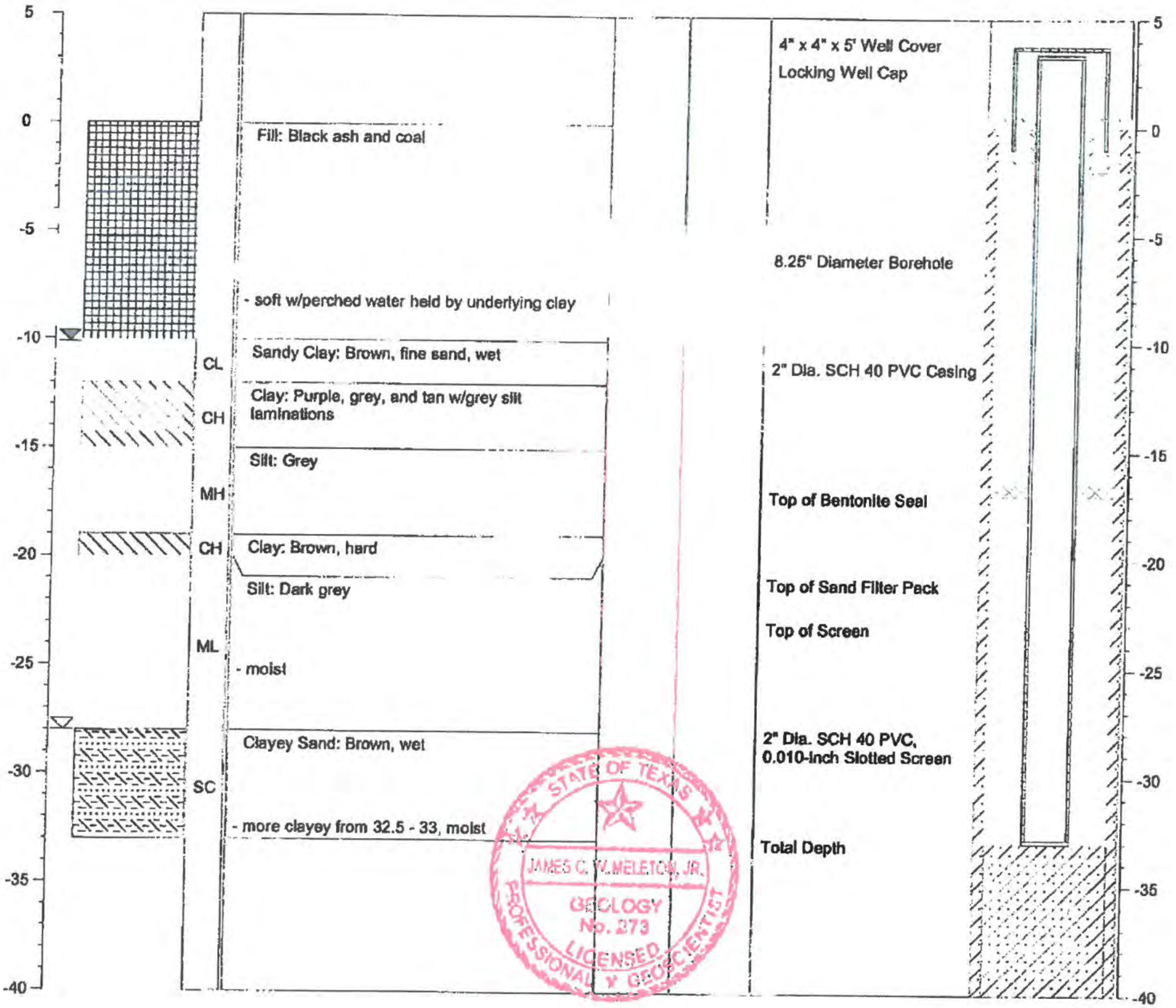

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION
5						4" x 4" x 5' Well Cover Locking Well Cap	
0			Fill: Black ash and coal				
-5						8.25" Diameter Borehole	
			- soft w/perched water held by underlying clay				
-10		CL	Sandy Clay: Brown, fine sand, wet			2" Dia. SCH 40 PVC Casing	
		CH	Clay: Purple, grey, and tan w/grey silt laminations				
-15		MH	Silt: Grey			Top of Bentonite Seal	
-20		CH	Clay: Brown, hard				
		ML	Silt: Dark grey			Top of Sand Filter Pack Top of Screen	
-25			- moist				
-30		SC	Clayey Sand: Brown, wet			2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen	
			- more clayey from 32.5 - 33, moist			Total Depth	
-35							
-40							

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
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SOIL BORING LOG

BORING/WELL NO.:	**AD-7**
TOTAL DEPTH:	**38'**
TOP OF CASING ELEV.:	**350.82 ft. NGVD**
GROUND SURFACE ELEV.:	**347.86 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/24/09**

NOTES: **Latitude: 33.05257**
Longitude: 94.84219

▽ Water level during drilling
▼ Water level in completed well

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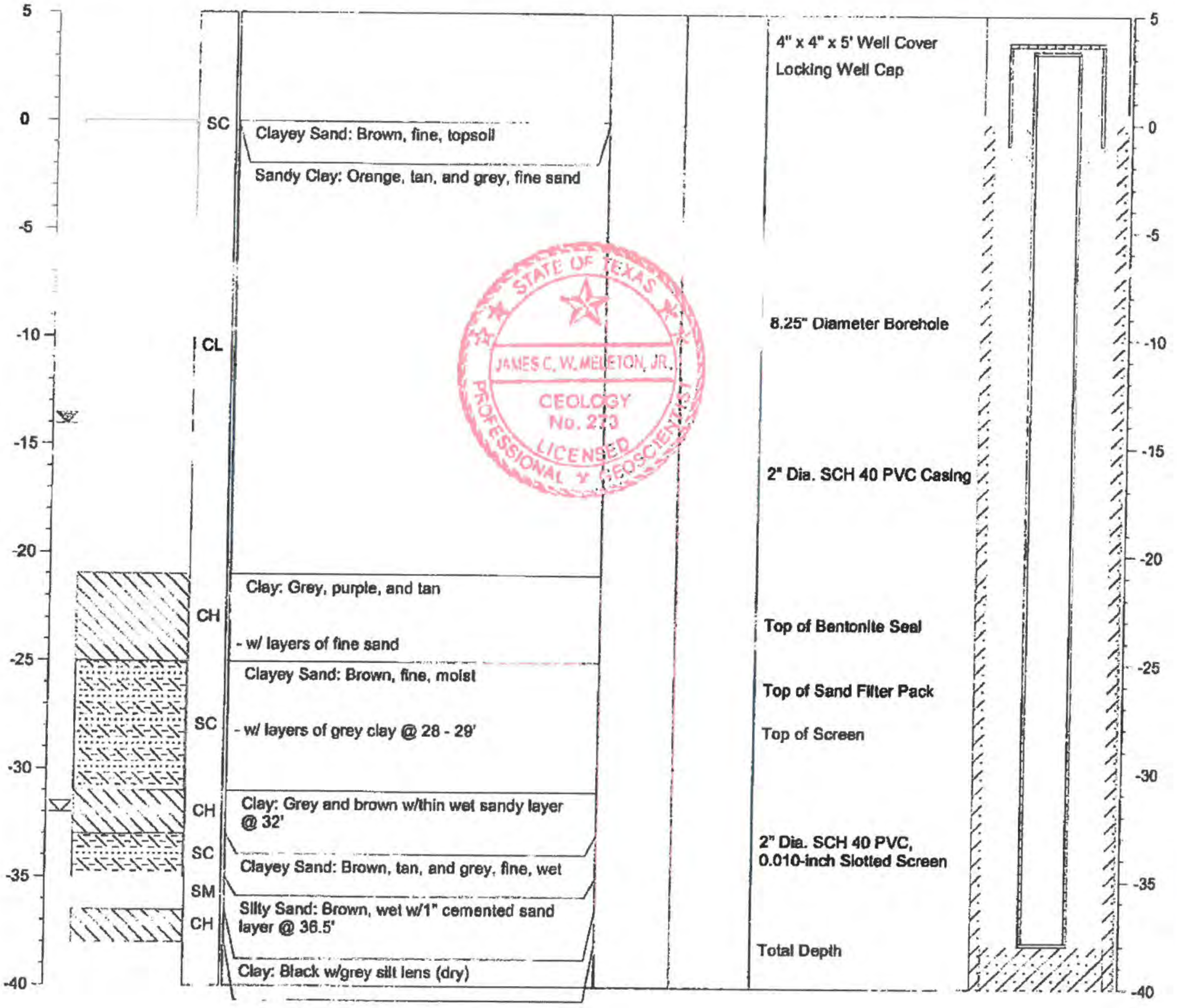
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Clayey Sand: Brown, fine, topsoil

Sandy Clay: Orange, tan, and grey, fine sand

Clay: Grey, purple, and tan

- w/ layers of fine sand

Clayey Sand: Brown, fine, moist

- w/ layers of grey clay @ 28 - 29'

Clay: Grey and brown w/thin wet sandy layer @ 32'

Clayey Sand: Brown, tan, and grey, fine, wet

Silty Sand: Brown, wet w/1" cemented sand layer @ 36.5'

Clay: Black w/grey silt lens (dry)

4" x 4" x 5' Well Cover
Locking Well Cap

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Bentonite Seal

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen

Total Depth

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SOIL BORING LOG

BORING/WELL NO.: **AD-8**
TOTAL DEPTH: **29'**
TOP OF CASING ELEV.: **340.01 ft. NGVD**
GROUND SURFACE ELEV.: **337.53 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/21/09**

NOTES: **Latitude: 33.05187**
Longitude: 94.84026

▽ Water level during drilling
▼ Water level in completed well

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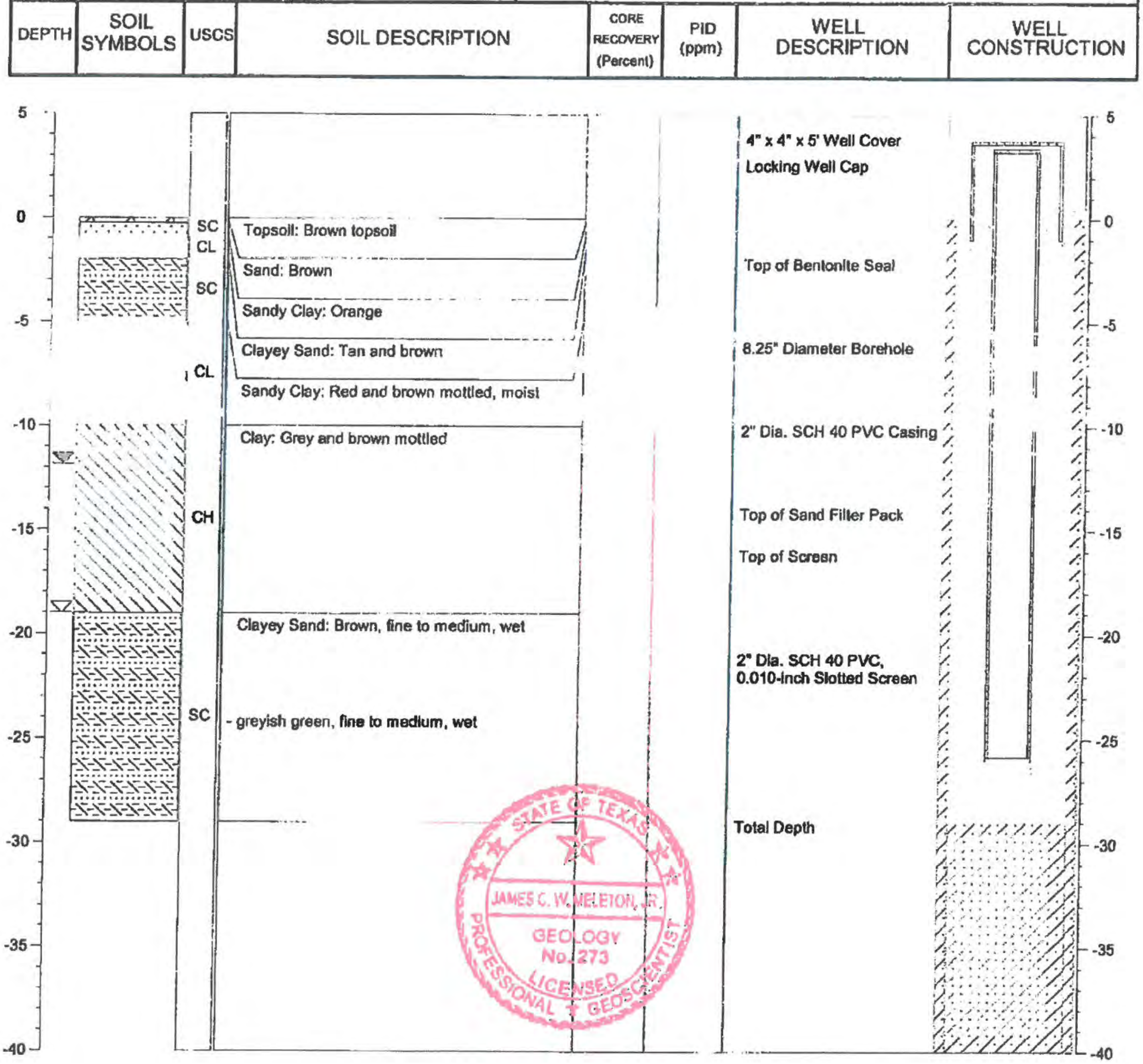

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SOIL BORING LOG

BORING/WELL NO.: **AD-9**
TOTAL DEPTH: **35'**
TOP OF CASING ELEV.: **343.09 ft. NGVD**
GROUND SURFACE ELEV.: **340.32 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/21/09**

NOTES: **Latitude: 33.04995**
Longitude: 94.84196

▽ Water level during drilling
▼ Water level in completed well

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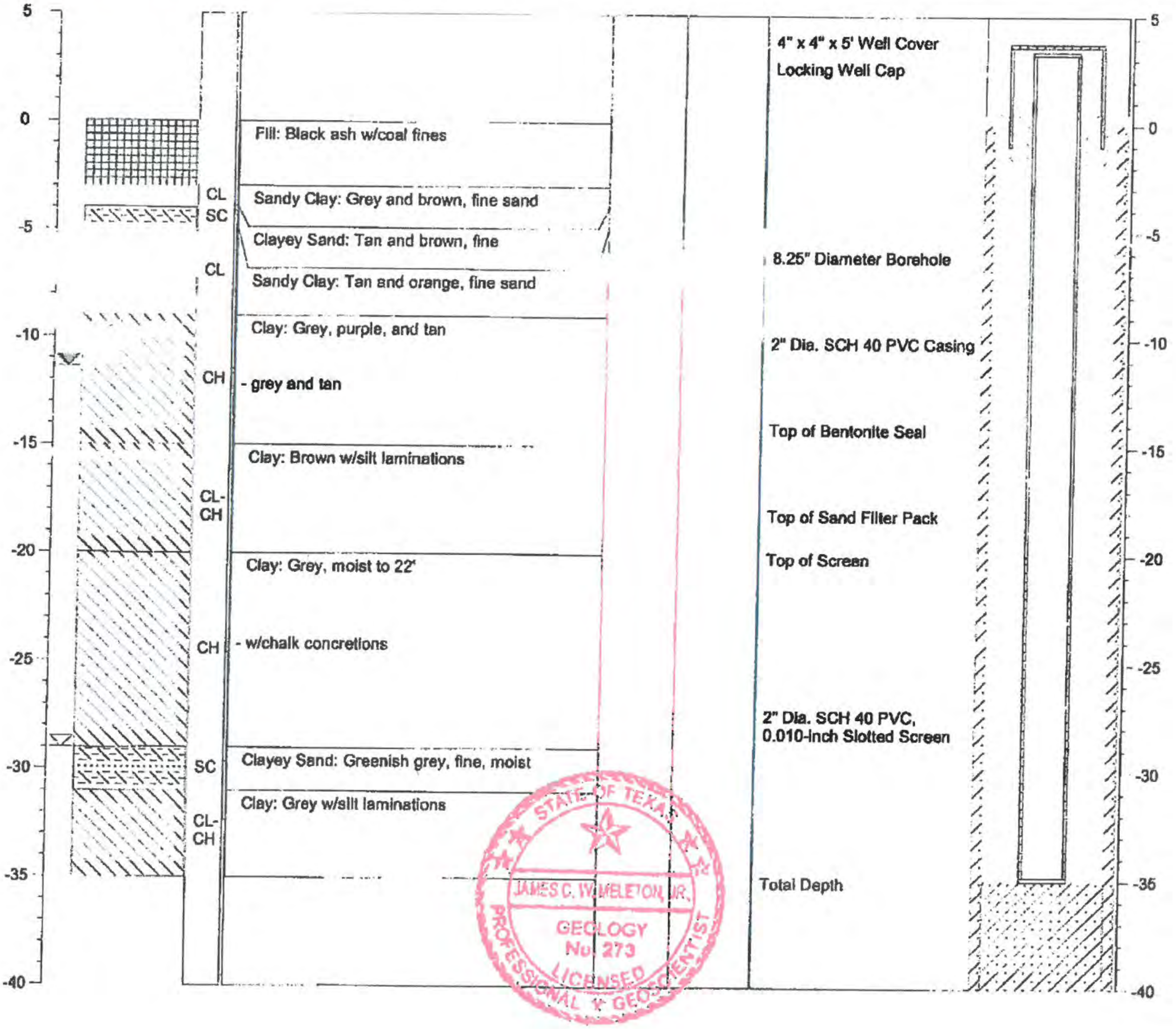

DEPTH	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION
5					4" x 4" x 5' Well Cover Locking Well Cap
0		Fill: Black ash w/coal fines			
	CL	Sandy Clay: Grey and brown, fine sand			
-5	SC	Clayey Sand: Tan and brown, fine			8.25" Diameter Borehole
	CL	Sandy Clay: Tan and orange, fine sand			
-10	CH	Clay: Grey, purple, and tan - grey and tan			2" Dia. SCH 40 PVC Casing
-15	CL-CH	Clay: Brown w/silt laminations			Top of Bentonite Seal Top of Sand Filter Pack
-20	CH	Clay: Grey, moist to 22' - w/chalk concretions			Top of Screen 2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
-30	SC	Clayey Sand: Greenish grey, fine, moist			
	CL-CH	Clay: Grey w/silt laminations			
-35					Total Depth

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SOIL BORING LOG

BORING/WELL NO.:	**AD-10**
TOTAL DEPTH:	**35'**
TOP OF CASING ELEV.:	**343.01 ft. NGVD**
GROUND SURFACE ELEV.:	**340.23 ft. NGVD**

CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04881**
Longitude: 94.84047

▽ Water level during drilling
▼ Water level in completed well

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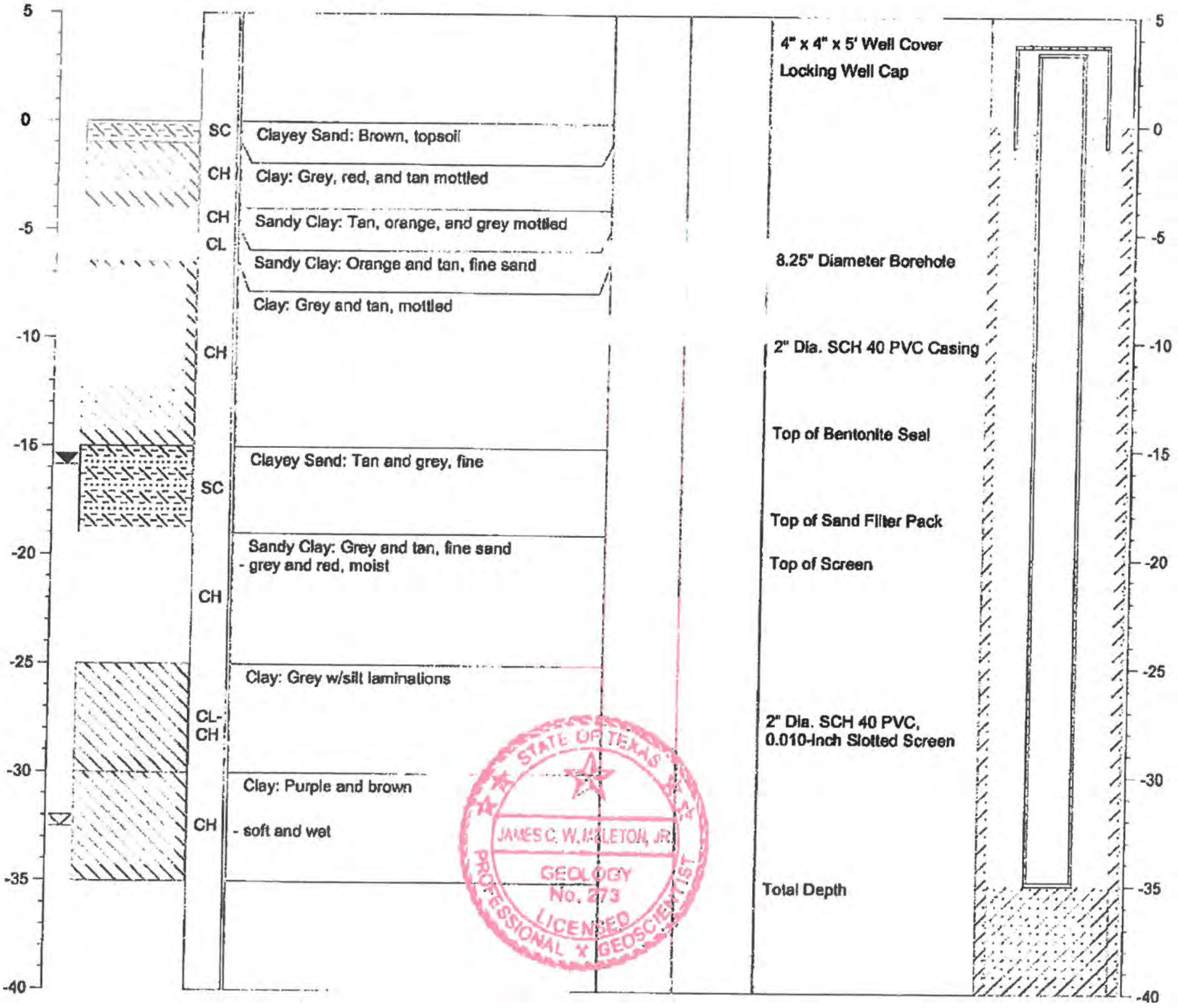
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



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SOIL BORING LOG

BORING/WELL NO.:	**AD-11**
TOTAL DEPTH:	**20'**
TOP OF CASING ELEV.:	**342.18 ft. NGVD**
GROUND SURFACE ELEV.:	**339.61 ft. NGVD**

CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04824**
Longitude: 94.84177

▽ Water level during drilling
▼ Water level in completed well

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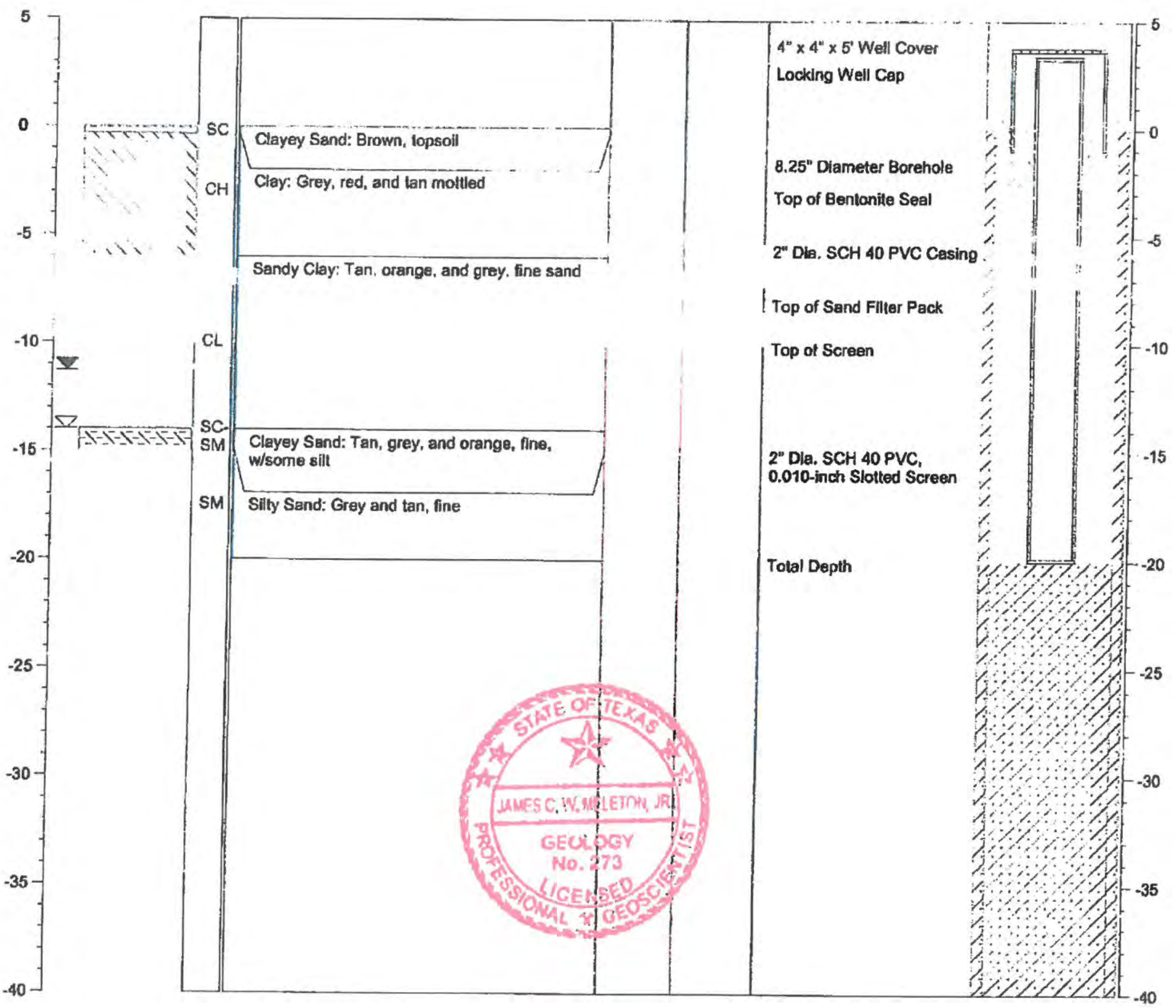

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION
		SC	Clayey Sand: Brown, topsoil				
		CH	Clay: Grey, red, and tan mottled				
		CL	Sandy Clay: Tan, orange, and grey, fine sand				
		SC-SM	Clayey Sand: Tan, grey, and orange, fine, w/some silt				
		SM	Silty Sand: Grey and tan, fine				

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
Top of Bentonite Seal
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.: **AD-12**
TOTAL DEPTH: **30'**
TOP OF CASING ELEV.: **369.33 ft. NGVD**
GROUND SURFACE ELEV.: **366.27 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/24/09**

NOTES: **Latitude: 33.04901**
Longitude: 94.84977

▽ Water level during drilling
▼ Water level in completed well

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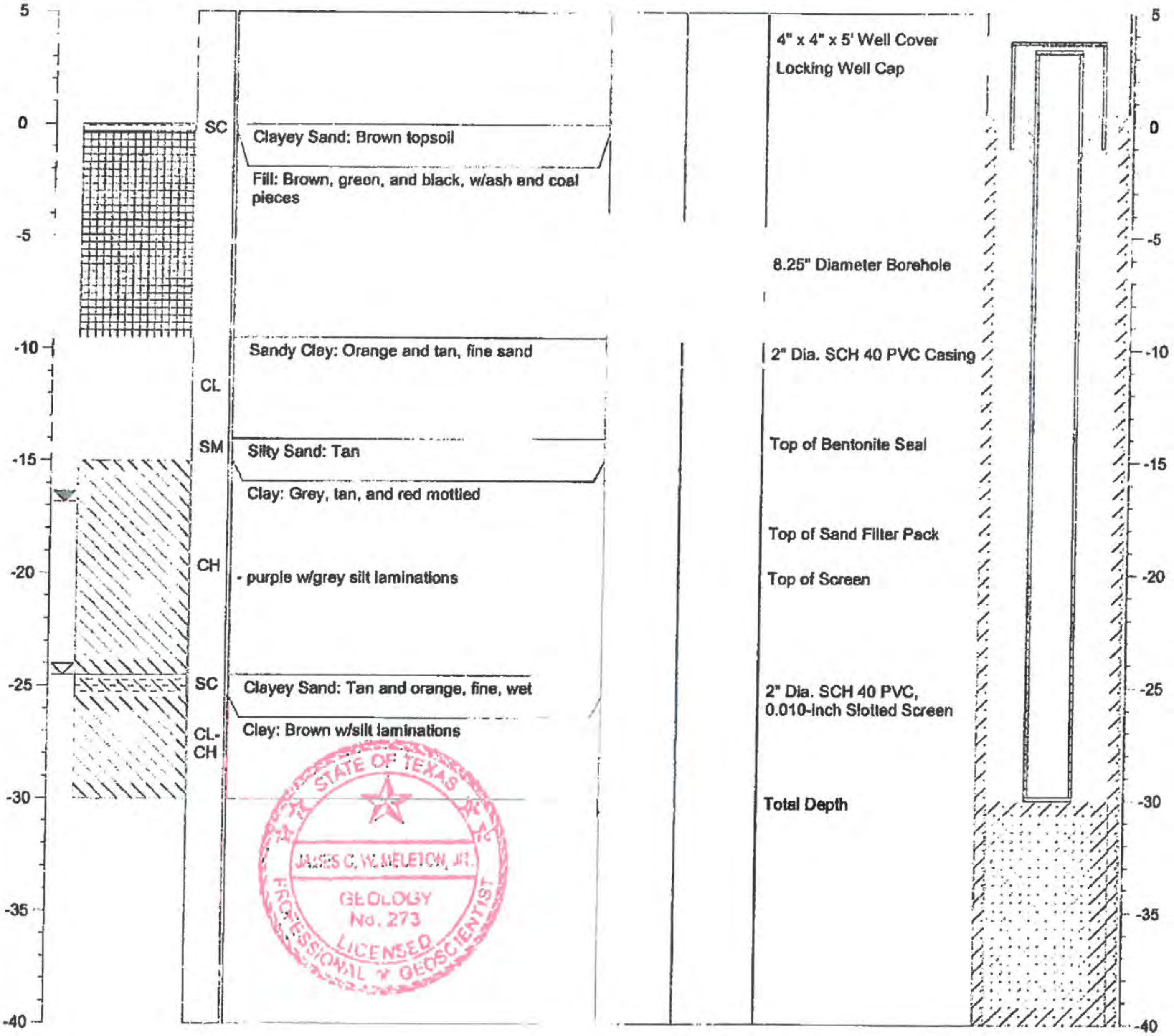
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



DEPTH	USCS	SOIL DESCRIPTION	WELL DESCRIPTION
5			4" x 4" x 5' Well Cover Locking Well Cap
0	SC	Clayey Sand: Brown topsoil	
		Fill: Brown, green, and black, w/ash and coal pieces	
-5			8.25" Diameter Borehole
-10	CL	Sandy Clay: Orange and tan, fine sand	2" Dia. SCH 40 PVC Casing
-15	SM	Silty Sand: Tan	Top of Bentonite Seal
	CH	Clay: Grey, tan, and red mottled	Top of Sand Filter Pack
-20		- purple w/grey silt laminations	Top of Screen
-25	SC	Clayey Sand: Tan and orange, fine, wet	2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
	CL-CH	Clay: Brown w/silt laminations	
-30			Total Depth

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SOIL BORING LOG

BORING/WELL NO.: **AD-13**
TOTAL DEPTH: **20'**
TOP OF CASING ELEV.: **347.00 ft. NGVD**
GROUND SURFACE ELEV.: **344.12 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

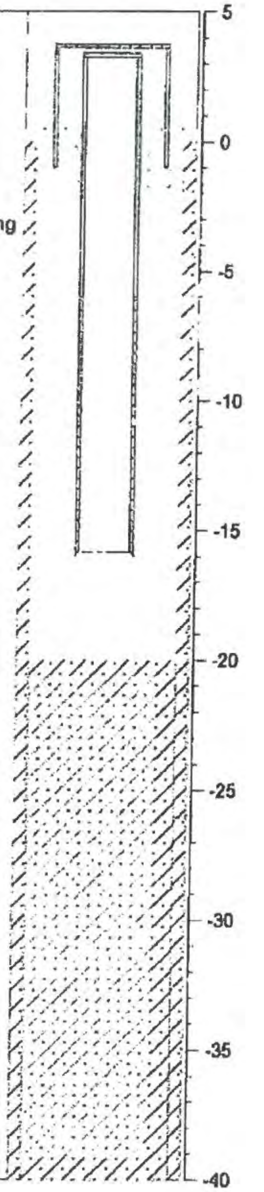
DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/22/09**

NOTES: **Latitude: 33.04918**
Longitude: 94.84275

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION
5						4" x 4" x 5' Well Cover Locking Well Cap	
0		CL CH SM	Sandy Clay: Brown, topsoil, fine sand			8.25" Diameter Borehole	
			Clay: Brown			Top of Bentonite Seal 2" Dia. SCH 40 PVC Casing	
-5		CH	Silty Sand: Brown, fine			Top of Sand Filter Pack	
			Sandy Clay: Red, grey, and tan, fine sand			Top of Screen	
-10		SM	Silty Sand: Brown and grey, fine, w/clay laminations - tan and grey, fine, wet			2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen	
-15		CH	Clay: Brown w/grey silt laminations, dry				
-20						Total Depth	
-25							
-30							
-35							
-40							



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OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.:	**AD-14**
TOTAL DEPTH:	**18.5'**
TOP OF CASING ELEV.:	**345.43 ft. NGVD**
GROUND SURFACE ELEV.:	**342.32 ft. NGVD**

CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04715**
Longitude: 94.84256

▽ Water level during drilling
▼ Water level in completed well

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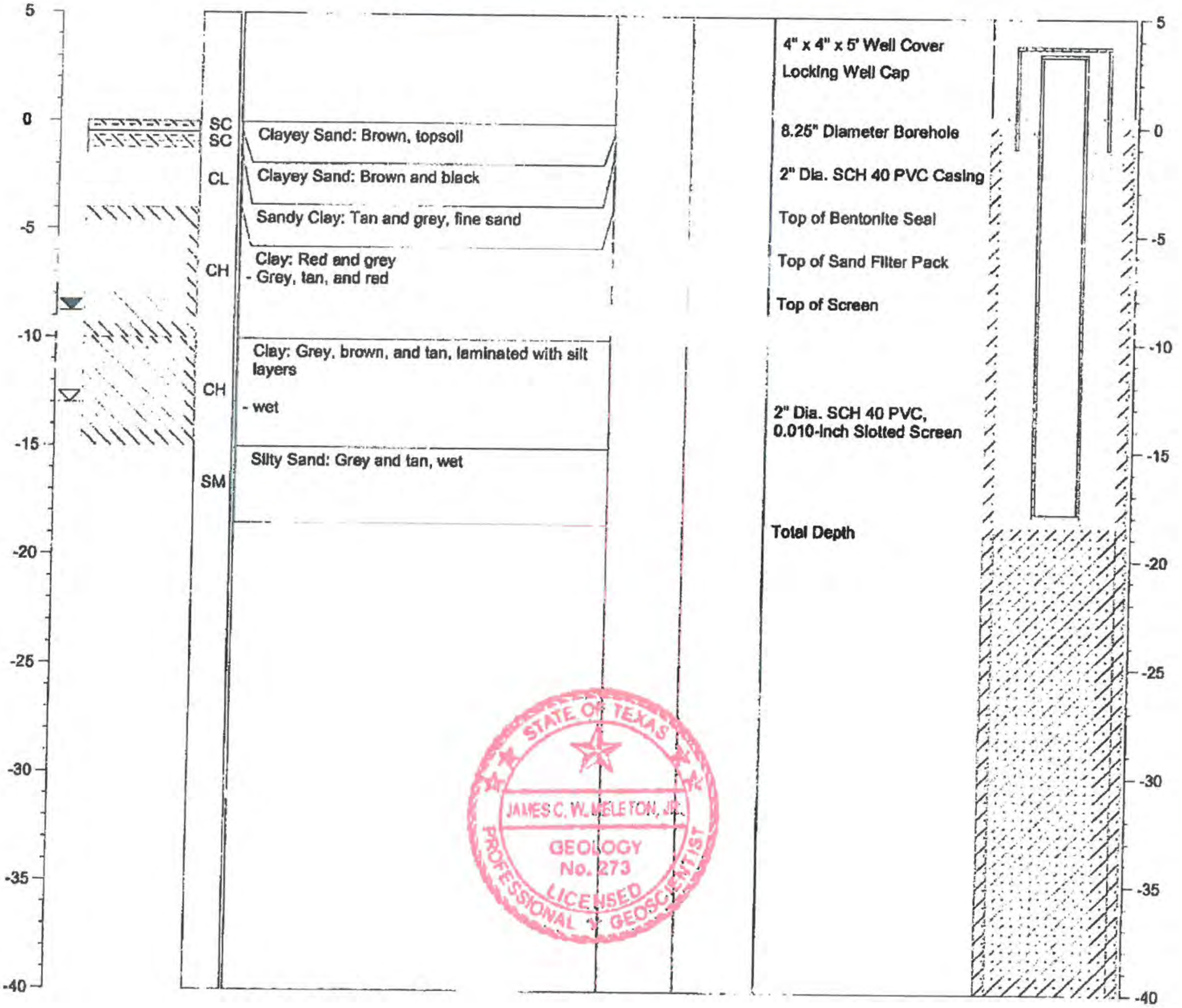
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, topsoil
SC	Clayey Sand: Brown and black
CL	Sandy Clay: Tan and grey, fine sand
CH	Clay: Red and grey - Grey, tan, and red
CH	Clay: Grey, brown, and tan, laminated with silt layers - wet
SM	Silty Sand: Grey and tan, wet

WELL DESCRIPTION
4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-Inch Slotted Screen
Total Depth

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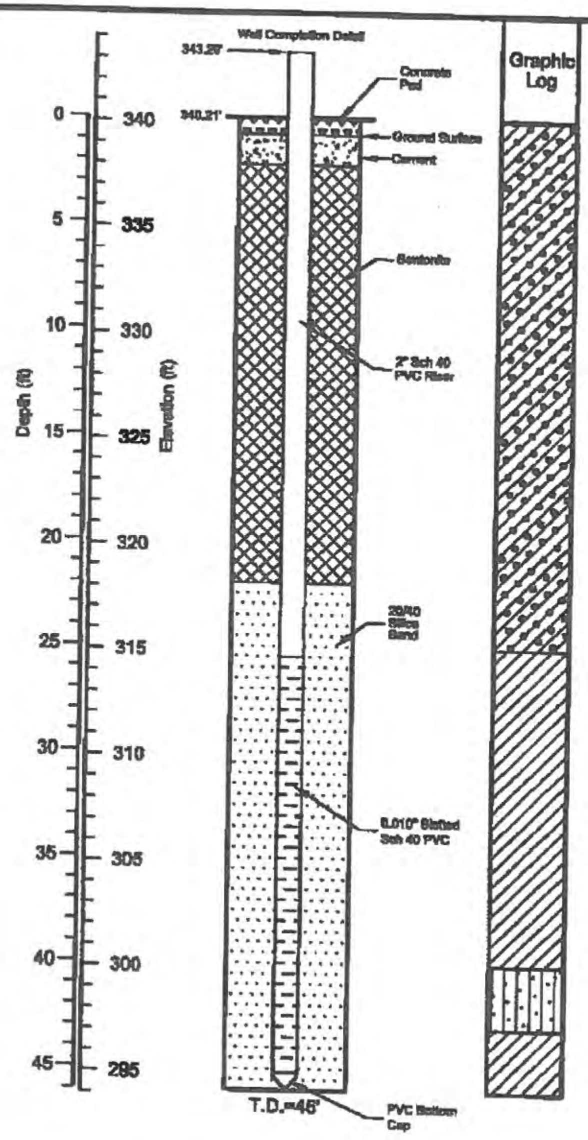


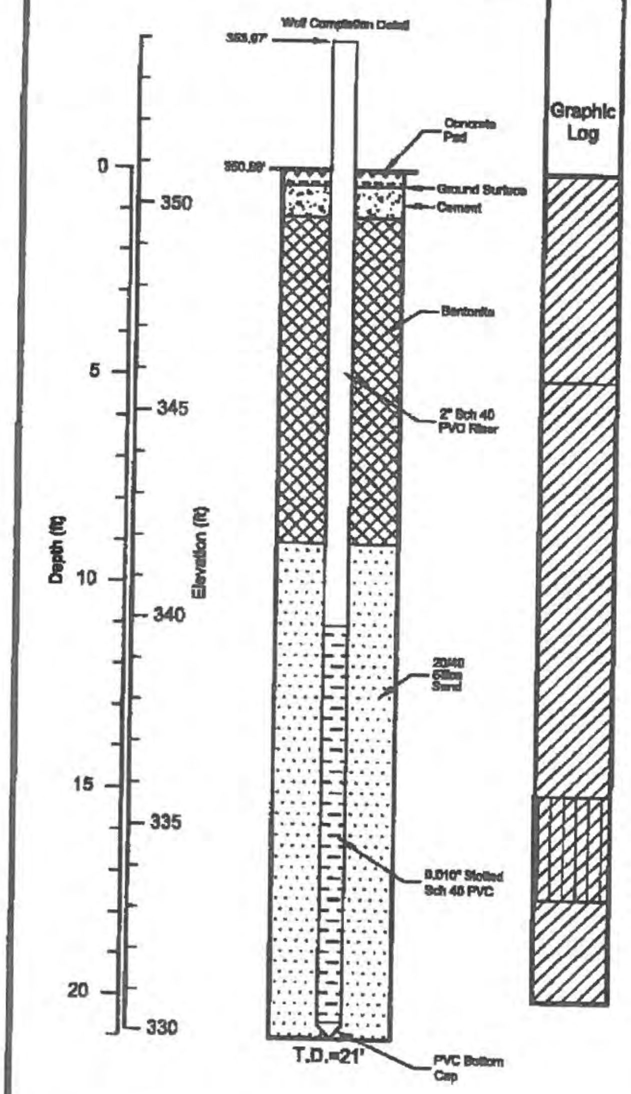
Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0		Direct Push		SC	Clayey SAND: reddish brown					
15						16	48	37	18	19
					- 2" lense of brown sand					
20					- 3" lense of brown sand					
25		Direct Push		CL	Sandy Lean CLAY: reddish brown, very moist					
30					- less moisture					
35						22	51	36	19	17
40				SM	Silty SAND: light brown & light gray, wet.	27	24	28	NP	-
45				CL	Lean CLAY: orangish brown & light gray, mottled, with sand	28	94	45	21	24

STEVEN R. WEMPLE
SOIL SCIENCE
2176
1-22-16

west
DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahatchie, Texas 75165

DATE: 12/12/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-15
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/12/15	DRAWN BY: HDS	PROJECT NO.: —
			SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	Description Interva (feet bgs)	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0		Direct Push		CL	Lean CLAY w/ Sand: light brown & light gray - orangish brown, with silt	16	82	26	16	10
5				CL	Lean CLAY w/ Sand: orangish-brown & light gray	22	88	31	19	12
15				CL-ML	Silty CLAY: orange w/ brown, wet	30	69	27	20	7
				CL	Sandy, Lean CLAY: brown w/ orange, stiff	28	66	46	26	20
20										

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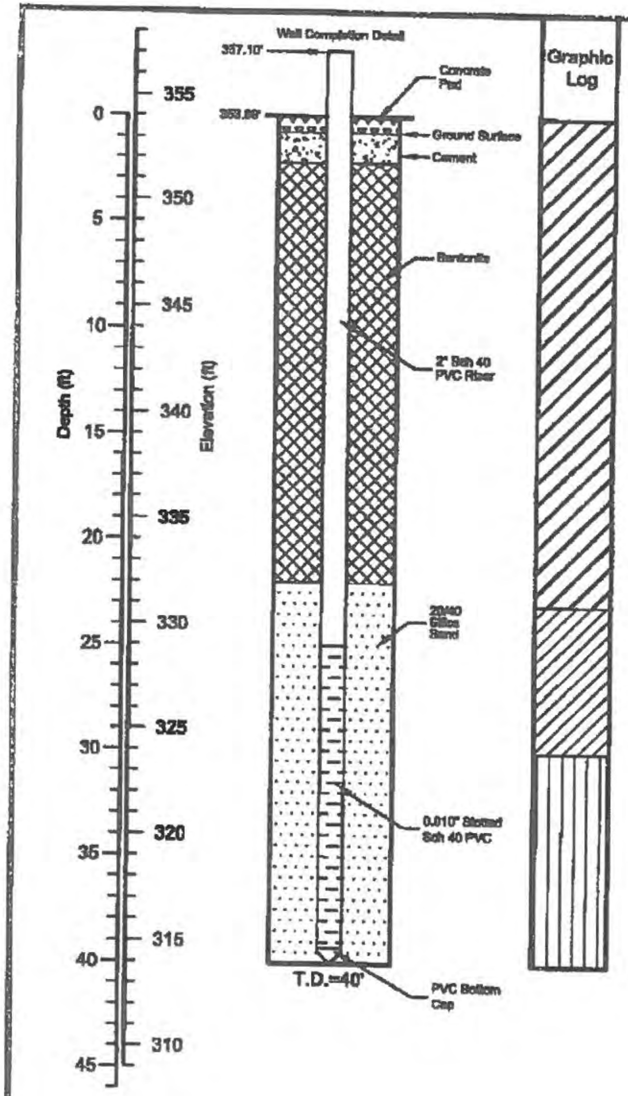
SOIL SCIENCE
LICENSE NUMBER 2176

1-22-16

West DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/10/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-16
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/10/15	DRAWN BY: HDS	PROJECT NO.: —
Depth to Water: –	Depth to Product: NA	CHECKED BY: SRW	SCALE: AS SHOWN
			FILE NAME: JR Welsh Power Plant LOGS.dwg



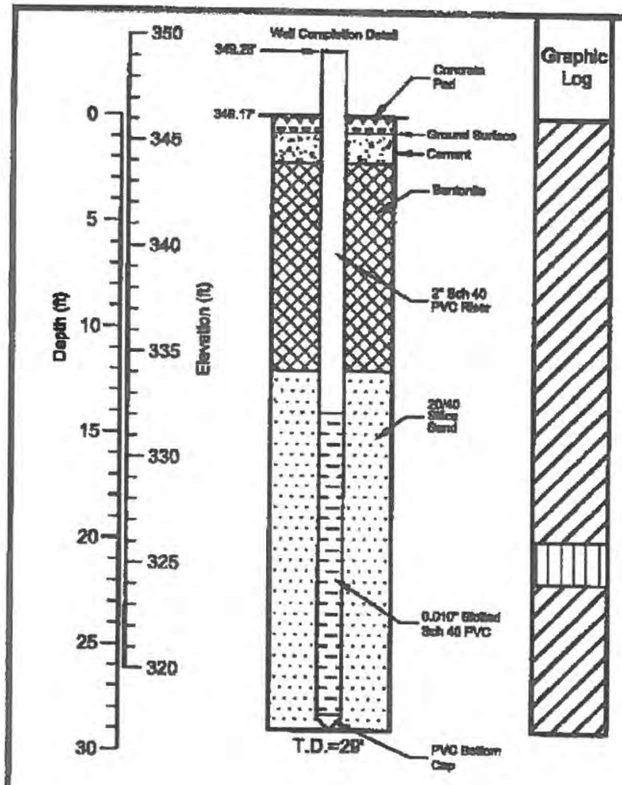
PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		CH	Fat CLAY: reddish-brown					
				- light gray to light brown, reddish brown w/ Sand and gravel lenses	24	97	83	30	53
				- light brown					
				- brown Sand lenses, wet					
				- gray, w/ some Silt	18	90	53	25	28
			CL	Lean CLAY with Sand: gray	22	81	43	22	21
	Direct Push		ML	Sandy SILT: gray	23	63	28	NP	-

STEVEN L. WEMPLE
2178
1/22/16

west
DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/10/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-17
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: — / SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		CH	Fat CLAY: light brown & light gray, sandy - reddish brown and light gray, with Sand - gray with silt - gray, stiff	19	88	50	24	26
			ML	SILT: gray, with Clay and Sand, wet	29	86	26	NP	-
			CH	Fat CLAY: light gray, silty w/ Sand, very stiff	20	85	50	23	27

STEVEN R. WEMPLE
LICENSE NUMBER 2176

1-22-16

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WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/11/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-18
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: —
			SCALE: AS SHOWN
Depth to Water: –	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 1 of 2

Date(s) Drilled **July 23, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **37 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **367 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Bentonite Chips**	Location **On the Northern edge of proposed chemical pond along the screening berm.**	

Elevation, feet	Depth, feet	Sample Type	Sample Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
367	0				Other		Black COAL, a few fine roots and organics.						
		ST											Shelby tube pulled black COAL
		SS	10										SPT 4, 5, 5, 5. 24" recovered
362	5	SS	11	Soft to Firm	SC		Reddish Brown fine SAND, little clay, trace silt, Dry. Natural Ground.						SPT 4, 5, 6, 7. 24" recovered
		SS	11	Soft	SM		Reddish brown fine SAND with silt, trace clay. Vertical sand seams in sample, Dry.						SPT 3, 5, 6, 6. 24" recovered.
357	10	ST						23.6	[illegible]	48.9	5.4E-07		Shelby tube sample, 18" recovered.
				Soft	SC		Reddish brown well graded fine SAND, trace silt and clay. Damp.						
		SS	12	Firm	CL		Greyish red CLAY, little sand, horizontal sand seams, Dry.						SPT 5, 6, 8, 9. 24" recovered
				Soft	SC		Brownish red fine SAND, little clay, Damp.						
		SS	13	Firm	SC-CL		Four-inch CLAY seam, little fine sand.						SPT 7, 6, 7, 9. 24" recovered.
				Firm	CL		Reddish grey CLAY, little sand, oxidized iron ore. Dry						
352	15			Soft	SM		Brownish red fine SAND, trace clay, thin clay seams. Moist.						
		SS	16					17.74	14	40.1			SPT 8, 9, 9, 8. 24" recovered.
		ST						16.25	NP	26.9	3.6E-05		Shelby tube samples look like SC. 17" recovered.
347	20	SS	17	Soft	Other		Iron oxidized material						SPT 9, 8, 9, 11. 24 Inches recovered.
				Soft	SC		Brownish red fine SAND, little clay. Moist.						
		SS	15										SPT 5, 7, 8, 50/2. 21" recovered
		SS	50	Soft	CL		Dark grey CLAY, little fine sand, Wet.						SPT 50/3".
				Very Hard	SP		Dark grey-black cemented SAND, little clay. Wet. Driller comments that cemented sand terminates at 25.5 feet.						
342	25	SS	27	Soft to Firm	SC		Dark grey fine SAND, little clay. Moist. Soft sand with lenses of firm clay.						SPT 11, 13, 14, 16. 24" recovered.
				Hard	CL		Dark grey CLAY, little sand, Dry.						
		SS	46	Soft	SC		Dark grey-black fine SAND, little clay, Wet. Encountered water but water rose to 19 feet after 15 min break.						SPT 11, 16, 30, 14. 24" recovered
		SS	37										SPT 11, 15, 22, 25. 24" recovered.
337	30			Hard	CL								

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
337	30	▨	SS	37	Hard	CL		Dark grey CLAY, little fine sand, occasional horizontal sand seams. Wet. (cont.)						SPT 11, 15, 22, 25. 24" recovered.
		▨	SS	29	Soft	ML		Dark grey-black fine SAND, with clay, frequent hard clay lenses (1-3"), Wet.	26.37	NP	57.5			SPT 6, 11, 18, 24. 24 recovered.
332	35		SS	34	Hard	CL		Black CLAY, trace to little fine sand, trace silt. Dry						SPT 9, 16, 18, 23. 24" recovered.
								Bottom of Boring at 37 feet bgs						
327	40													
322	45													
317	50													
312	55													
307	60													
302	65													

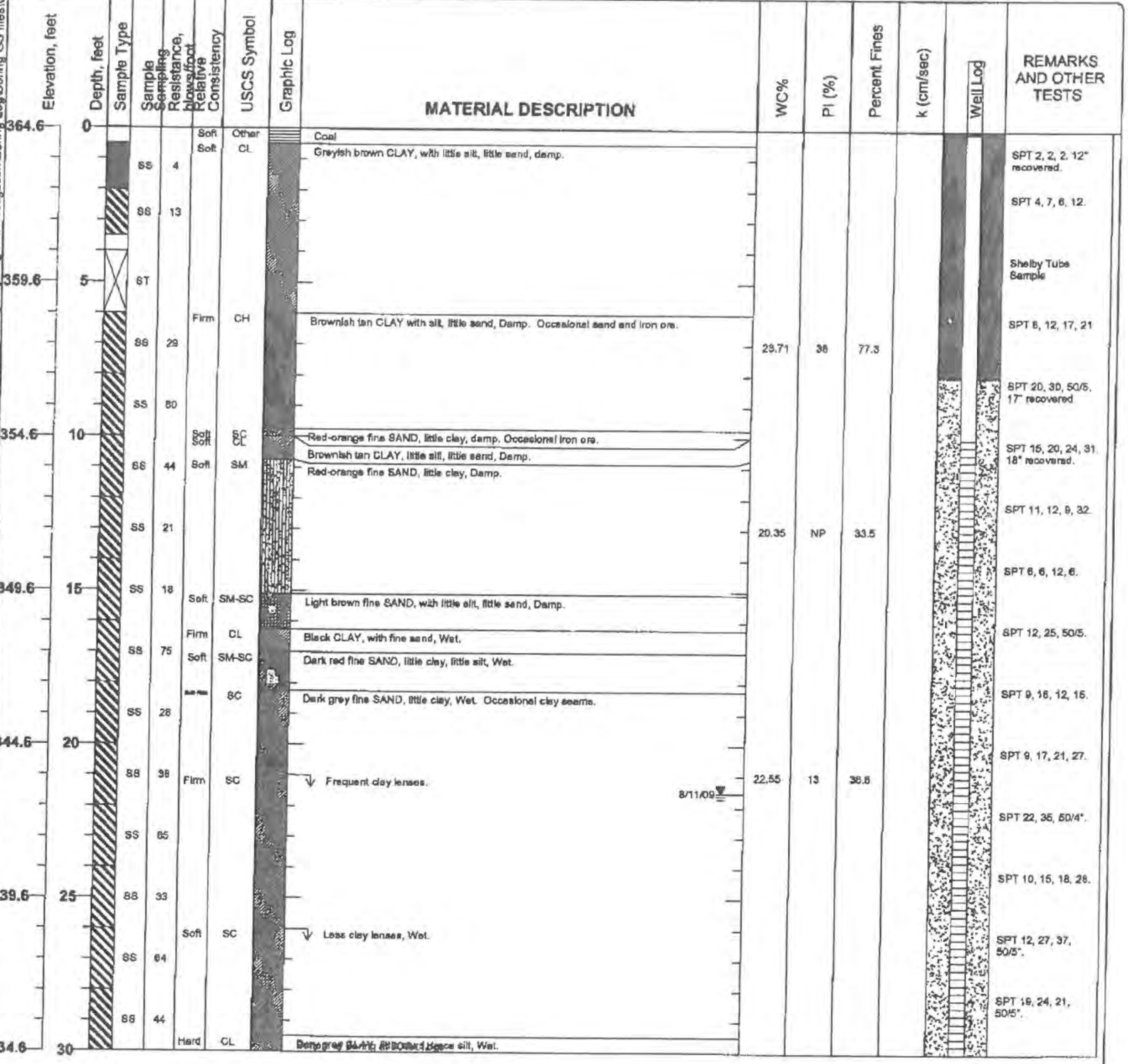
Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-02

Sheet 1 of 1

Date(s) Drilled **August 14, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **364.56 feet MSL**
Groundwater Level and Date Measured **21.53 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Western edge of proposed chemical pond near perimeter fence.**	



Elevation, feet	Depth, feet	Sample Type	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
364.6	0			Soft	Other	Coal					
				Soft	CL	Greyish brown CLAY, with little silt, little sand, damp.					
		SS	4								SPT 2, 2, 2. 12" recovered.
		SS	13								SPT 4, 7, 6, 12.
359.6	5	ST									Shelby Tube Sample
				Firm	CH	Brownish tan CLAY with silt, little sand, Damp. Occasional sand and iron ore.					
		SS	29				23.71	38	77.3		SPT 6, 12, 17, 21
		SS	80								SPT 20, 30, 50/5. 17" recovered
354.6	10			Soft	SC	Red-orange fine SAND, little clay, damp. Occasional iron ore.					
				Soft	CL	Brownish tan CLAY, little silt, little sand, Damp.					
		SS	44	Soft	SM	Red-orange fine SAND, little clay, Damp.					SPT 15, 20, 24, 31. 18" recovered.
		SS	21				20.35	NP	33.5		SPT 11, 12, 9, 32.
349.6	15	SS	18								SPT 6, 6, 12, 6.
				Soft	SM-SC	Light brown fine SAND, with little silt, little sand, Damp.					
				Firm	CL	Black CLAY, with fine sand, Wet.					
		SS	75	Soft	SM-SC	Dark red fine SAND, little clay, little silt, Wet.					SPT 12, 25, 50/5.
				[illegible]	SC	Dark grey fine SAND, little clay, Wet. Occasional clay seams.					
		SS	28								SPT 9, 16, 12, 15.
344.6	20										
		SS	38	Firm	SC	↓ Frequent clay lenses.	22.55	13	36.6		SPT 9, 17, 21, 27.
						8/11/09 ▼					
		SS	65								SPT 22, 35, 50/4".
339.6	25	SS	33								SPT 10, 15, 18, 28.
				Soft	SC	↓ Less clay lenses, Wet.					
		SS	64								SPT 12, 27, 37, 50/5".
		SS	44								SPT 19, 24, 21, 50/5".
334.6	30			Hard	CL	[illegible] silt, Wet.					

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

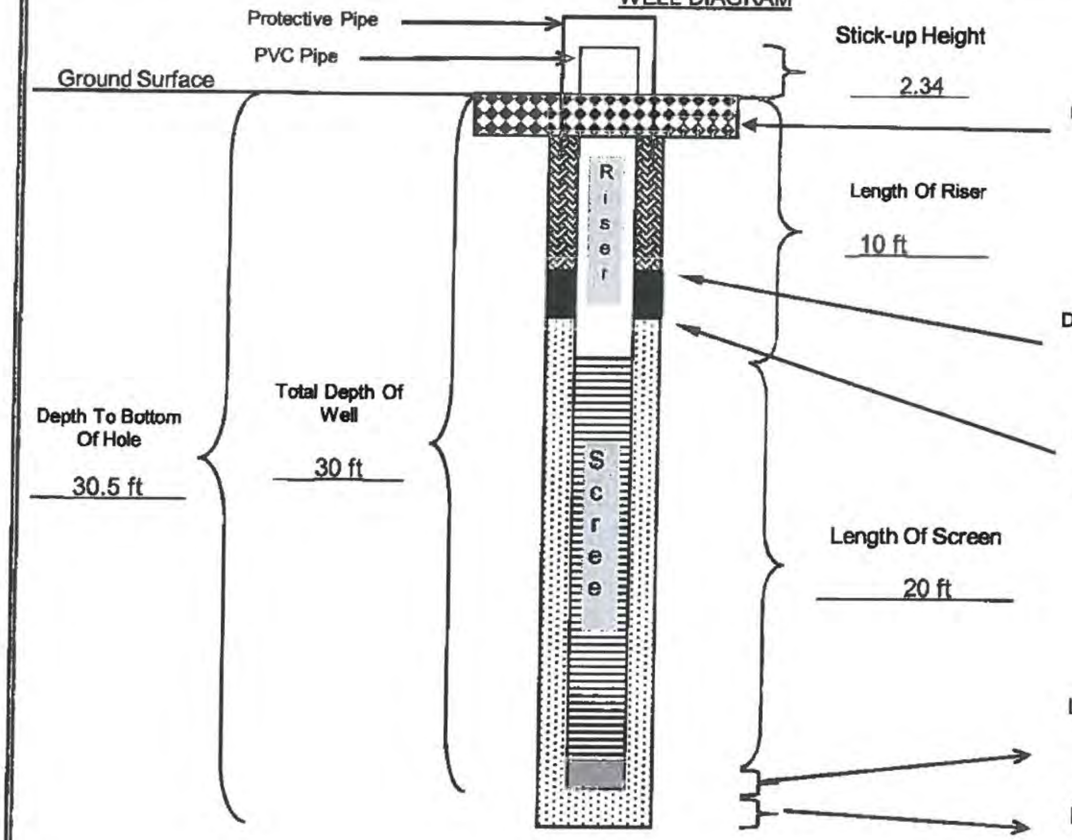
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL LOCATION:
WELL NO.: GB-02
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 364.56 (ft, msl)
TOP OF SCREEN ELEVATION: 354.56 (ft, msl)
BOTTOM OF WELL ELEVATION: 334.06 (ft, msl)
NORTHING: 747.0223 EASTING: -2442.888
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 8 (in)
DRILLING TECHNIQUE: Hollow stem Size: (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE: Not used-sealed with bentonite chips
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 4 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 13 bags lbs
STATIC WATER: 21.53 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.34
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2 inches
Length Of Sand Base: 6-inches
Depth To Bottom Of Hole: 30.5 ft
Total Depth Of Well: 30 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▒ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: August 7th, 2009
OBSERVED BY: Kush Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 1 of 2

Date(s) Drilled **August 7, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **31 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **359.91 feet MSL**
Groundwater Level and Date Measured **21.89 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Southwest corner of proposed chemical pond near screening pile.**	

Elevation, feet	Depth, feet	Sample Type	Sample Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
359.9	0			Soft	Other	Coal					
354.9	5	ST		Soft	CH	Shelby Tube		43	96.1		Shelby tube sample.
		SS	41	Firm	CH	Light brown-grey CLAY, little silt, occasional sand seams (fine), Damp.	24.04	29	90.4		SPT 29, 22, 19, 21.
				Soft	CH	Brownish dark grey CLAY, trace sand, trace silt, Wet.					SPT 6, 12, 15, 20.
349.9	10	SS	27								
		SS	53	Soft	SC	Dark orange red SAND, little clay, trace silt, Wet. Occasional clay seam (dark grey).					SPT 17, 29, 24, 25.
				Soft	SC	**Clay lenses.**					SPT 7, 15, 17, 40.
		SS	32								
344.9	15										SPT 9, 17, 30, 20.
		SS	47	Soft	SC	Clay lense					
				Soft	SC	Dark grey fine SAND with clay, occasional clay lense, Wet.					SPT 11, 50/4".
		SS	50	Firm	CL	Dark grey CLAY, little fine sand, Wet.					
				Soft	SC	Dark grey fine SAND, little clay, occasional clay seam, iron ore, Wet.					SPT 11, 27, 17, 21.
339.9	20	SS	44								
						8/11/09 ▽					
334.9	25										
		SS	90								SPT 27, 40, 50/4".
				Firm	SC	Dark grey clay lense					
		SS	55								SPT 11, 15, 40, 50/3".
		SS	55								SPT 17, 50/5.5".
329.9	30										

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
329.9	30	▨	SS	55	Hard	CL	▨	Dark grey CLAY, trace silt, trace fine sand.					▨	SPT 17, 50/5.5".
								Bottom of Boring at 31 feet bgs						
324.9	35													
319.9	40													
314.9	45													
309.9	50													
304.9	55													
299.9	60													
294.9	65													

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

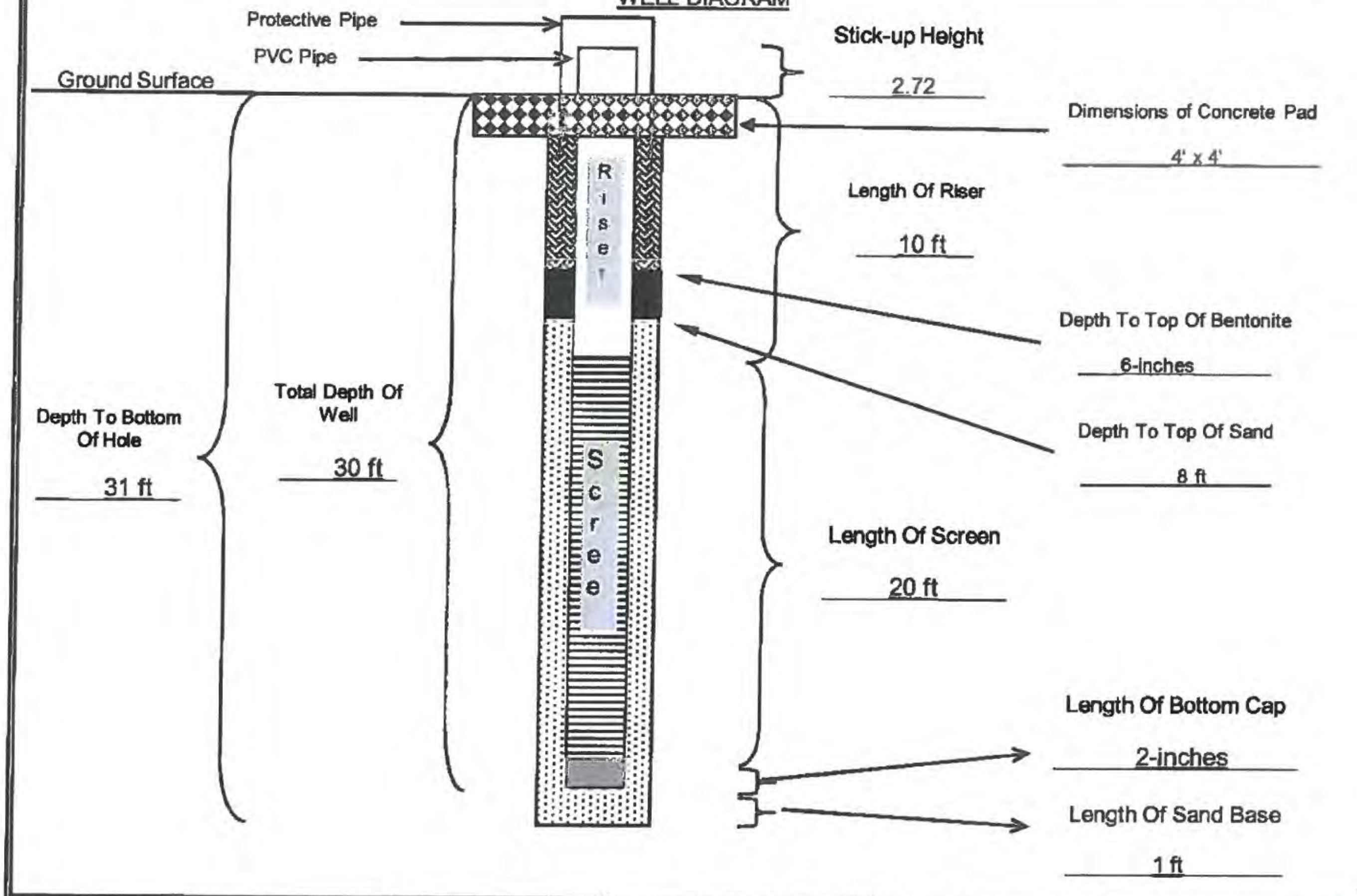
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL LOCATION:
WELL NO.: **GB-03**
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 359.57 (ft, msl)
TOP OF SCREEN ELEVATION: 349.57 (ft, msl)
BOTTOM OF WELL ELEVATION: 328.57 (ft, msl)
NORTHING: 460.5803 EASTING: -2507.6332
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 8 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 8 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE: None used-sealed with bentonite chips
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 4 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 12 bags lbs
STATIC WATER: 21.89 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.72
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 1 ft
Total Depth Of Well: 30 ft
Depth To Bottom Of Hole: 31 ft

▨	Cement/Bentonite Grout	░	Sand Pack	◆	Neat Concrete	■	Bentonite	▒	Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: 7-Aug-09
OBSERVED BY: Kush S. Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **34 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.22 feet MSL**
Groundwater Level and Date Measured **20.54 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Southeast corner of proposed chemical evaportation pond. Located in a grassy field.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
357.2	0		SS	9	Soft	SM-SC	Reddish brown fine SAND, little silt, trace clay, damp.					SPT 1, 3, 6, 6. 24" recovered.
					Soft	Other	COAL					
					Firm	SC	Brownish red SAND, little clay, trace silt. Damp.					
			SS	8	Firm	CL	Reddish pink CLAY, some fine sand, Dry.	24.49	47	90.2		SPT 4, 4, 4, 4. 24" recovered.
352.2	5		SS	14	Soft	Other	Oxidized SAND and clay with iron ore.					SPT 5, 6, 5, 4. 18" recovered.
					Soft	CH	Light reddish brown CLAY and sand mixture, Dry.					
			ST		Soft	SC	Reddish brown SAND, little clay, Dry.	26.4	38	61.1	7.7E-09	12" Shelby tube. 9" recovered.
			SS	17	Firm	CH	Light brownish tan CLAY, little sand, occasional sand seams, Dry.					SPT 3, 4, 13, 16. 27" recovered.
347.2	10											
342.2	15		SS	10	Soft	SC	Red/yellowish brown SAND, some clay, Wet.					SPT 3, 7, 8, 15. 24" recovered.
					Firm	SC	Occasional clay lenses.	8.95	14	47		
337.2	20		ST				8/11/09 ▼					Shelby tube. 12" driven 0" pulled. Gravel material encountered. SPT 7, 10, 8, 13. 24" recovered.
			SS	19	Soft to Firm	SM	Black to dark grey fine/med SAND, little clay, occasional clay lenses, Wet.					
332.2	25		SS	74	Soft	SM	Well graded light grey fine/med SAND, trace silt, Wet.	22.29	NP	13.5		SPT 17, 24, 50/5.5". 19" recovered.
					Firm	CL	Dark grey clay lense, Wet.					
					Firm	SM-SC	Well graded light grey fine/med SAND, trace silt, Wet.					
327.2	30											

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.2	30	☒	ST		Hard	ML		Dark grey CLAY, little sand, Wet.						12" Shelby tube. Bent shelby tube.
		☒	ST						21.3	NP	84.2	2.0E-08		12" Shelby tube.
		▨	SS	38	Hard	CL		Dark grey CLAY, trace sand, Wet.	25.44	18	92.5			SPT 15, 18, 19, 25. 24" recovered.
								Bottom of Boring at 34 feet bgs						
322.2	35													
317.2	40													
312.2	45													
307.2	50													
302.2	55													
297.2	60													
292.2	65													

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

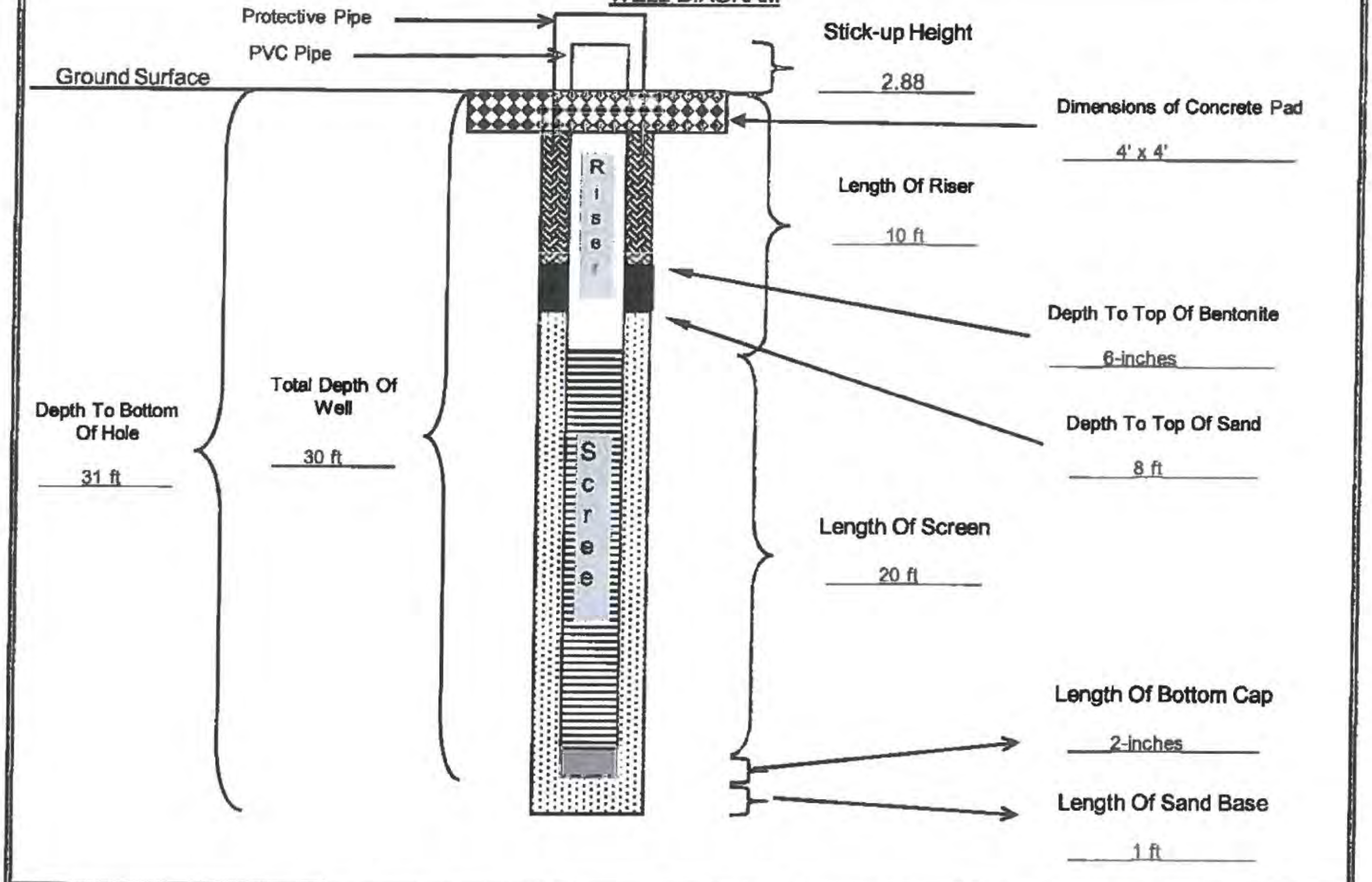
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 24-Jul-09
WELL LOCATION:
WELL NO.: GB-04
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.22 (ft, msl)
TOP OF SCREEN ELEVATION: 347.22 (ft, msl)
BOTTOM OF WELL ELEVATION: 326.22 (ft, msl)
NORTHING: -384.9666 EASTING: -2353.7375
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 6.75 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 6.75 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 3 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 20.54 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.88
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 1 ft
Total Depth Of Well: 30 ft
Depth To Bottom Of Hole: 31 ft

▨ Cement/Bentonite Grout ⬚ Sand Pack ▩ Neat Concrete ■ Bentonite ▒ Bottom Cap

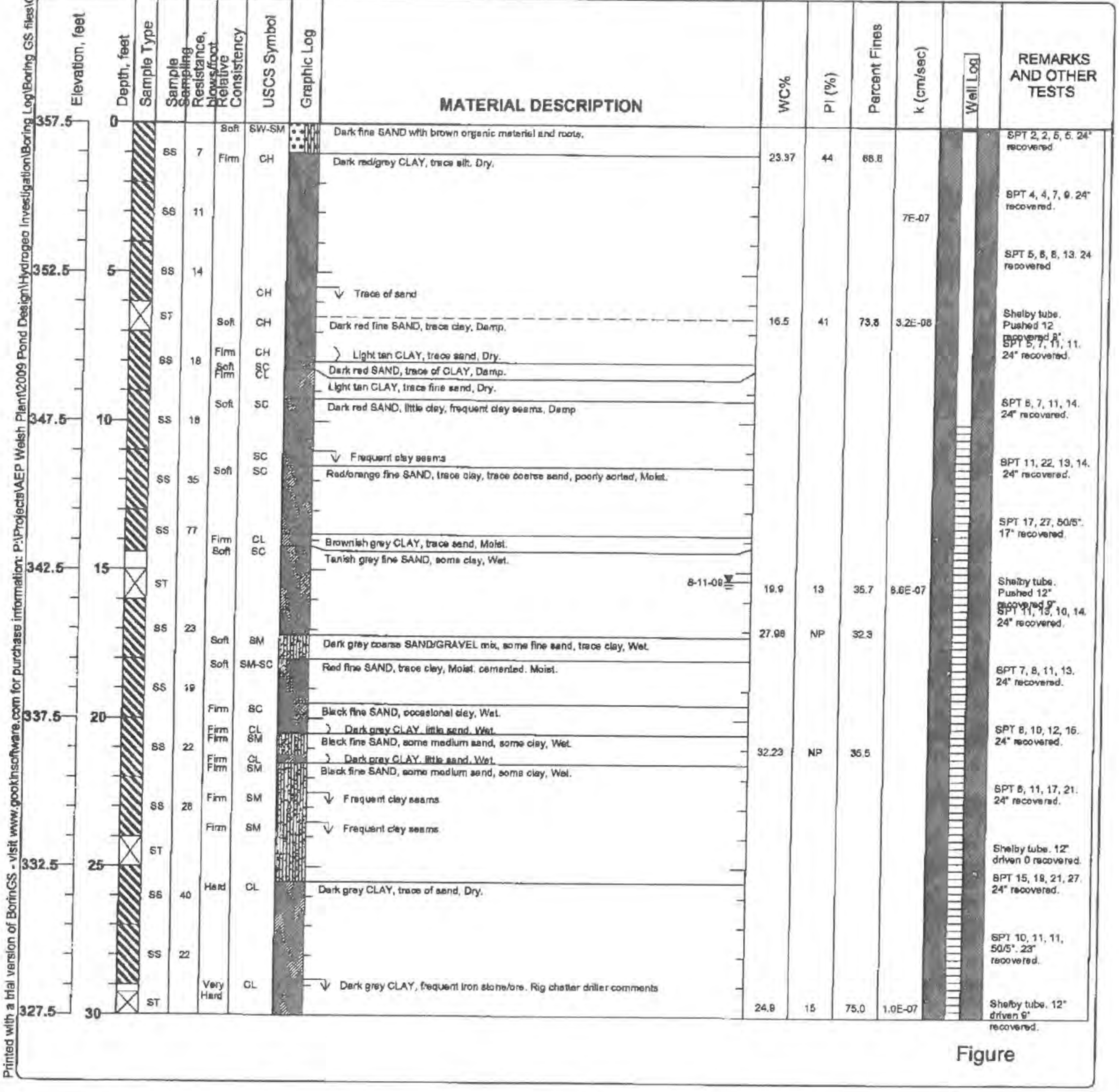
QA/QC
INSTALLED BY: Total Support Services
DATE: 24-Jul-09
OBSERVED BY: Kush S. Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30.5 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.49 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8-11-09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Eastern edge of proposed chemical evaporation pond.**	



Elevation, feet	Depth, feet	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
357.5	0			Soft	SW-SM	Dark fine SAND with brown organic material and roots.					SPT 2, 2, 5, 6. 24" recovered
		SS	7	Firm	CH	Dark red/grey CLAY, trace silt. Dry.	23.37	44	66.8		
		SS	11							7E-07	SPT 4, 4, 7, 9. 24" recovered.
352.5	5	SS	14								SPT 5, 6, 8, 13. 24 recovered
					CH	Trace of sand					
		ST		Soft	CH	Dark red fine SAND, trace clay, Damp.	16.5	41	73.8	3.2E-08	Shelby tube. Pushed 12 recovered 8".
		SS	18	Firm	CH	Light tan CLAY, trace sand, Dry.					SPT 5, 7, 11, 11. 24" recovered.
				Soft	SC	Dark red SAND, trace of CLAY, Damp.					
				Firm	CL	Light tan CLAY, trace fine sand, Dry.					
				Soft	SC	Dark red SAND, little clay, frequent clay seams, Damp					
347.5	10	SS	18								SPT 6, 7, 11, 14. 24" recovered.
					SC	Frequent clay seams					
		SS	35	Soft	SC	Red/orange fine SAND, trace clay, trace coarse sand, poorly sorted, Moist.					SPT 11, 22, 13, 14. 24" recovered.
		SS	77								SPT 17, 27, 50/5". 17" recovered.
				Firm	CL	Brownish grey CLAY, trace sand, Moist.					
				Soft	SC	Tanish grey fine SAND, some clay, Wet.					
342.5	15	ST				8-11-09 ▼	19.9	13	35.7	8.6E-07	Shelby tube. Pushed 12" recovered 9".
		SS	23				27.98	NP	32.3		SPT 11, 13, 10, 14. 24" recovered.
				Soft	SM	Dark grey coarse SAND/GRAVEL mix, some fine sand, trace clay, Wet.					
				Soft	SM-SC	Red fine SAND, trace clay, Moist. cemented. Moist.					
		SS	19								SPT 7, 8, 11, 13. 24" recovered.
				Firm	SC	Black fine SAND, occasional clay, Wet.					
337.5	20			Firm	CL	Dark grey CLAY, little sand, Wet.					
		SS	22	Firm	SM	Black fine SAND, some medium sand, some clay, Wet.	32.23	NP	35.5		SPT 6, 10, 12, 15. 24" recovered.
				Firm	CL	Dark grey CLAY, little sand, Wet.					
				Firm	SM	Black fine SAND, some medium sand, some clay, Wet.					
		SS	28	Firm	SM	Frequent clay seams					SPT 6, 11, 17, 21. 24" recovered.
				Firm	SM	Frequent clay seams					
		ST									Shelby tube. 12" driven 0 recovered.
332.5	25										
		SS	40	Hard	CL	Dark grey CLAY, trace of sand, Dry.					SPT 15, 19, 21, 27. 24" recovered.
		SS	22								SPT 10, 11, 11, 50/5". 23" recovered.
				Very Hard	CL	Dark grey CLAY, frequent iron stone/ore. Rig chatter driller comments					
		ST					24.9	15	75.0	1.0E-07	Shelby tube. 12" driven 9" recovered.
327.5	30										

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.5	30	⊠	ST	Hard	CL	▨	Dark grey CLAY, trace of sand, Dry. (cont.)	24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
							Bottom of Boring at 30.5 feet bgs						
322.5	35												
317.5	40												
312.5	45												
307.5	50												
302.5	55												
297.5	60												
292.5	65												

Figure

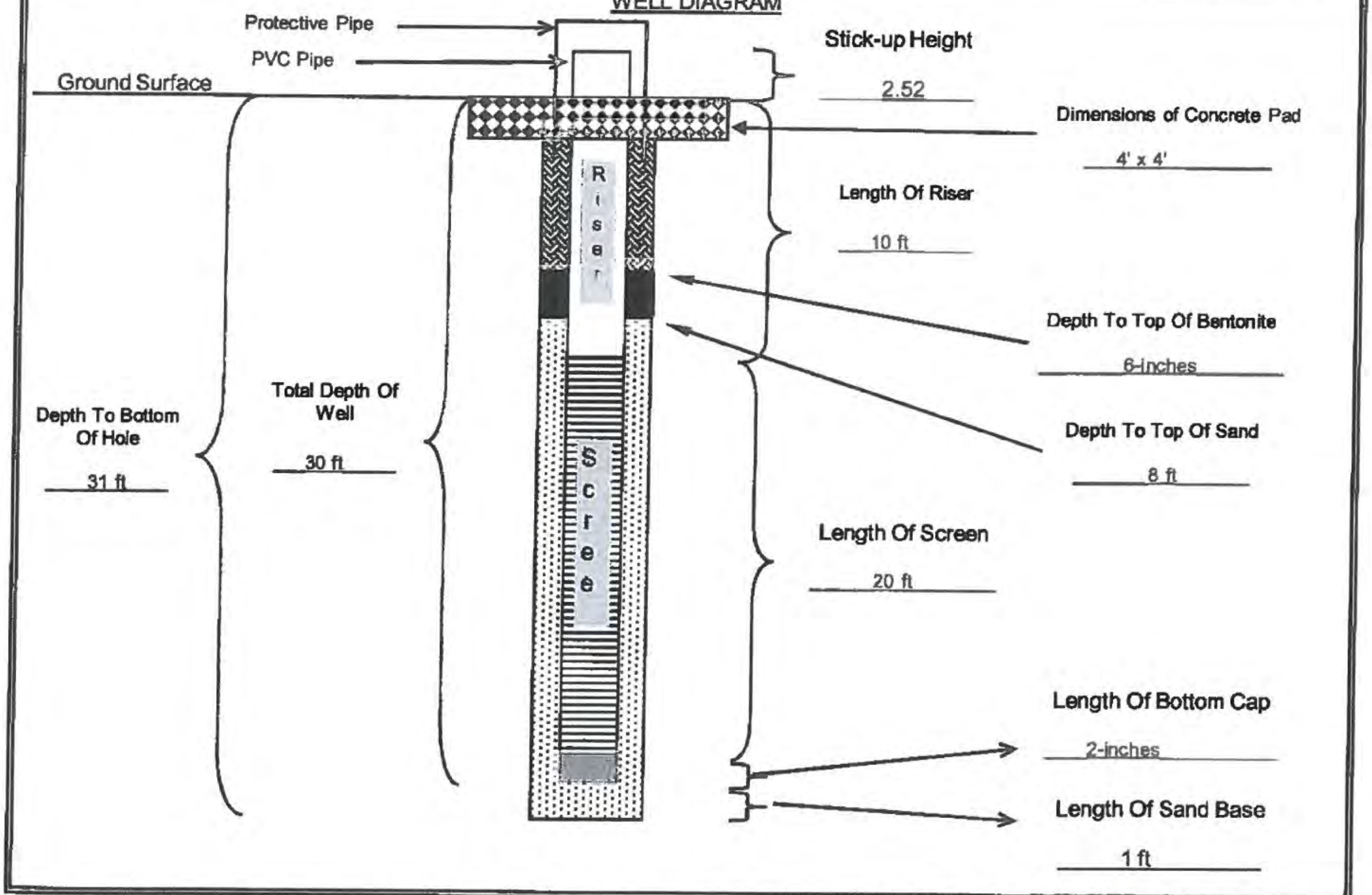
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: August 6 2009
WELL LOCATION:
WELL NO.: **GB-05**
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION:	357.49 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	347.49 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	326.49 (ft, msl)	CEMENT TYPE:	
NORTHING: 529.1865	EASTING: -2243.9973	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	3 bags lbs
RISER DIAMETER: 2 (in)	Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER: 2 (in)	Length: 20 (ft)	AMOUNT SAND USED:	7 bags lbs
BOREHOLE DIAMETER:	8 (in)	STATIC WATER:	17.33 depth from TOC
DRILLING TECHNIQUE: Hollow Stem	Size: 8 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.52

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 10 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 8 ft

Depth To Bottom Of Hole: 31 ft

Total Depth Of Well: 30 ft

Length Of Screen: 20 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 1 ft

▨ Cement/Bentonite Grout	░ Sand Pack	◆ Neat Concrete	■ Bentonite	▒ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
OBSERVED BY: Kush Chohan
DATE: 6-Aug-09
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

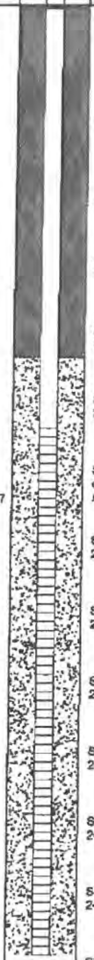
Log of Boring GB-06

Sheet 1 of 1

Date(s) Drilled **7/23/2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.41 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube, Other**	Hammer Data **140 lb, 30 in drop, auto hammer**
Borehole Backfill **Well Completion**	Location **Northeast corner of proposed chemical pond in the middle of open grass field.**	

Elevation, feet	Depth, feet	Sample Type	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
357.4	0			Soft	SP	Greyish brown fine SAND with trace fines. Organic material (roots).					Hand Auger
		HA		Soft	SP-SM	Greyish red fine SAND, little silt. Poorly sorted, less organic material.					
				Soft	SM	Greyish red fine SAND, with little silt and clay. Dry.					
		SS	14	Soft		Tanish grey fine SAND, trace silt and clay, frequent iron oxide, frequent discoloration.	12.74	34	67.9		SPT 4, 7, 7. 16" recovered
				Firm	CL	Red light brown CLAY, little sand, trace silt, Dry.					
352.4	5										
		SS	11	Soft	SC	Dark reddish brown fine SAND, little clay.					SPT 3, 5, 6, 8. 20" recovered
				Soft	CL	Light grey CLAY, little sand, trace silt. Dry.					
		SS	12	Soft	SC	Reddish brown fine SAND, trace clay, trace silt. Occasional clay seams. Damp.	17.65	NP	43.2		SPT 3, 5, 7, 7. 24" recovered
				Soft	CL	Light grey CLAY, little fine sand					
		SS		Soft to Firm	SC	Brownish red fine SAND, little to some clay, some cementation, Damp.					24" driven, 15" recovered.
347.4	10										
		SS	19								SPT 8, 9, 10, 10. 24" recovered.
		ST		Soft to Firm	CL	Brown CLAY, little fine sand, frequent brown sand-clay mixture with iron ore oxide.	22.9	21	43.2	6.0e-07	Shelby Tube. 24" driven/16" recovered
342.4	15			Firm	CL	Dark redish brown CLAY, little fine sand, Damp. 8/11/09 ▼					
		SS	40	Firm	SC	Dark reddish brown SAND, little to some clay, Moist.					SPT 15, 10, 22, 30. 24" recovered
				Firm	CL	Black CLAY, little fine sand, Wet.					
		SS	22	Firm	SW	Black fine SAND, trace clay, trace med sand, Wet.					SPT 2, 8, 14, 10. 24" recovered
				Firm	CL	Black CLAY, trace fine sand, trace silt, Wet.					
		SS	30		SC	Black fine SAND, little clay, Wet.					SPT 5, 8, 22, 50/4". 22 recovered.
337.4	20			Firm	CL	Black CLAY, trace sand, trace silt. Wet.					
				Firm	SC	Black fine SAND, trace to little clay, Wet. Occasional black clay seams.					SPT 10, 11, 23, 33. 24" recovered
		SS	34	Firm	SP-SC	Black fine SAND, with little clay, trace med sand, Wet.					
		SS	36		SW-SC	Grading to med SAND, Wet.					SPT 11, 16, 16, 24. 24" recovered.
332.4	25										SPT 9, 11, 12, 22. 24" recovered.
		SS	23	Firm	SW-SC	Occasional CLAY lenses, Wet.					
				Firm	SC	Black fine SAND, little med sand and clay, Wet.					SPT 7, 15, 25, 50/3". 21 recovered.
		SS	40	Hard	CL	Dark grey CLAY, little sand, little silt, Dry.					
		ST						19	45.1		Shelby tube. 12" driven-8" recovered.
327.4	30					Bottom of Boring at 30 feet bgs					

Well Log



Figure

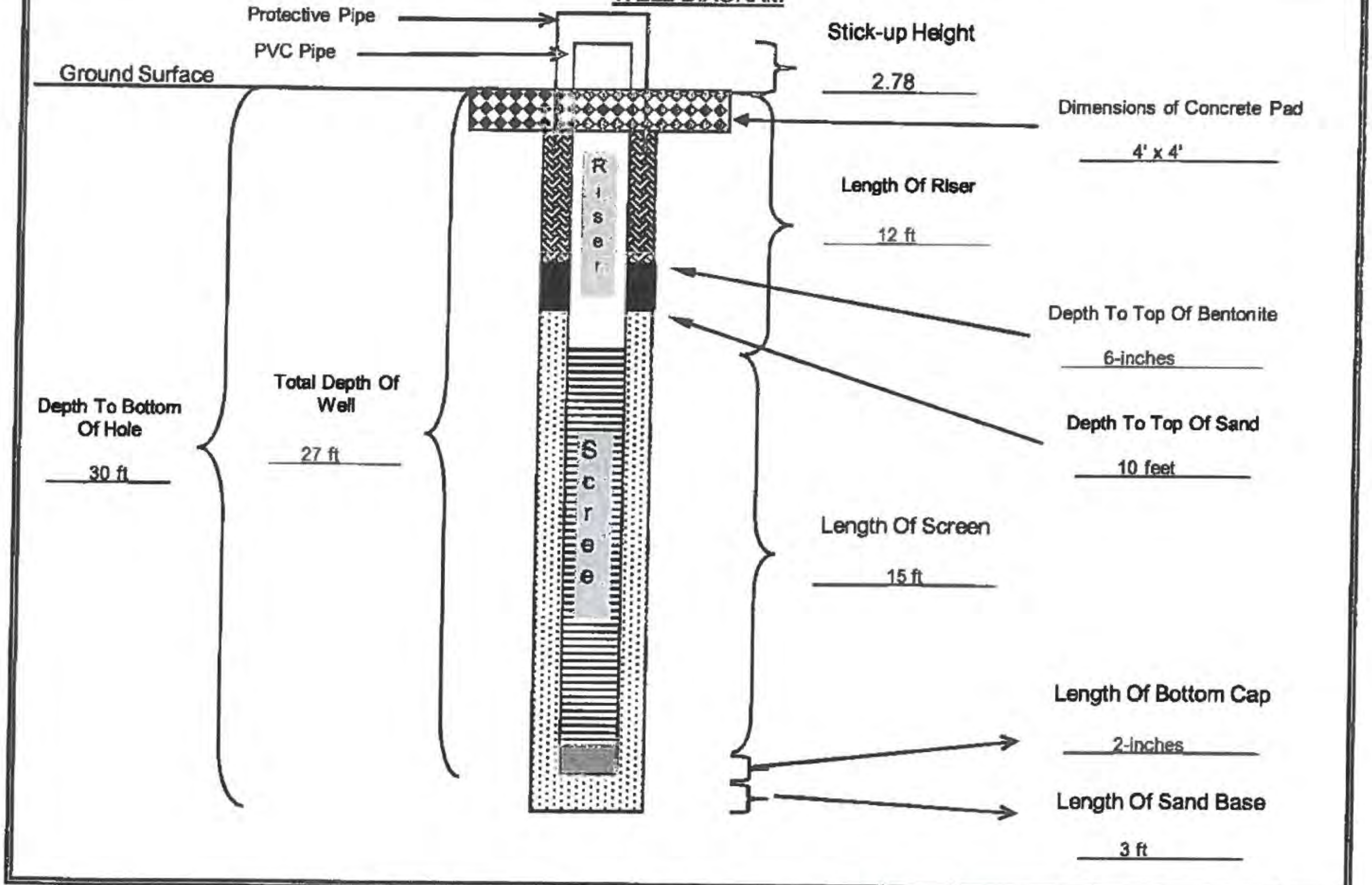
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 23-Jul-09
WELL LOCATION:
WELL NO.: **GB-06**
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION:	357.41	(ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	345.41	(ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	327.41	(ft, msl)	CEMENT TYPE:	
NORTHING: 740.4893	EASTING: -2166.134		CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC		SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:			SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC		DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:			AMOUNT BENTONITE USED:	2.5 bags lbs
RISER DIAMETER:	2 (in) Length: 12	(ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 15	(ft)	AMOUNT SAND USED:	7 bags lbs
BOREHOLE DIAMETER:	6.75	(in)	STATIC WATER:	15.3 depth from TOC
DRILLING TECHNIQUE:	Hollow Stem Size: 6.75	(in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.78

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 12 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 10 feet

Total Depth Of Well: 27 ft

Depth To Bottom Of Hole: 30 ft

Length Of Screen: 15 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 3 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC INSTALLED BY:	Total Support Services	OBSERVED BY:	Kush Chohan
DATE:	23-Jul-09	CHECKED BY:	DATE:

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**GB-07/MW-7**
TOTAL DEPTH:	**34'**
TOP OF CASING ELEV.:	**362.75 ft. NGVD**
GROUND SURFACE ELEV.:	**360.20 ft. NGVD**

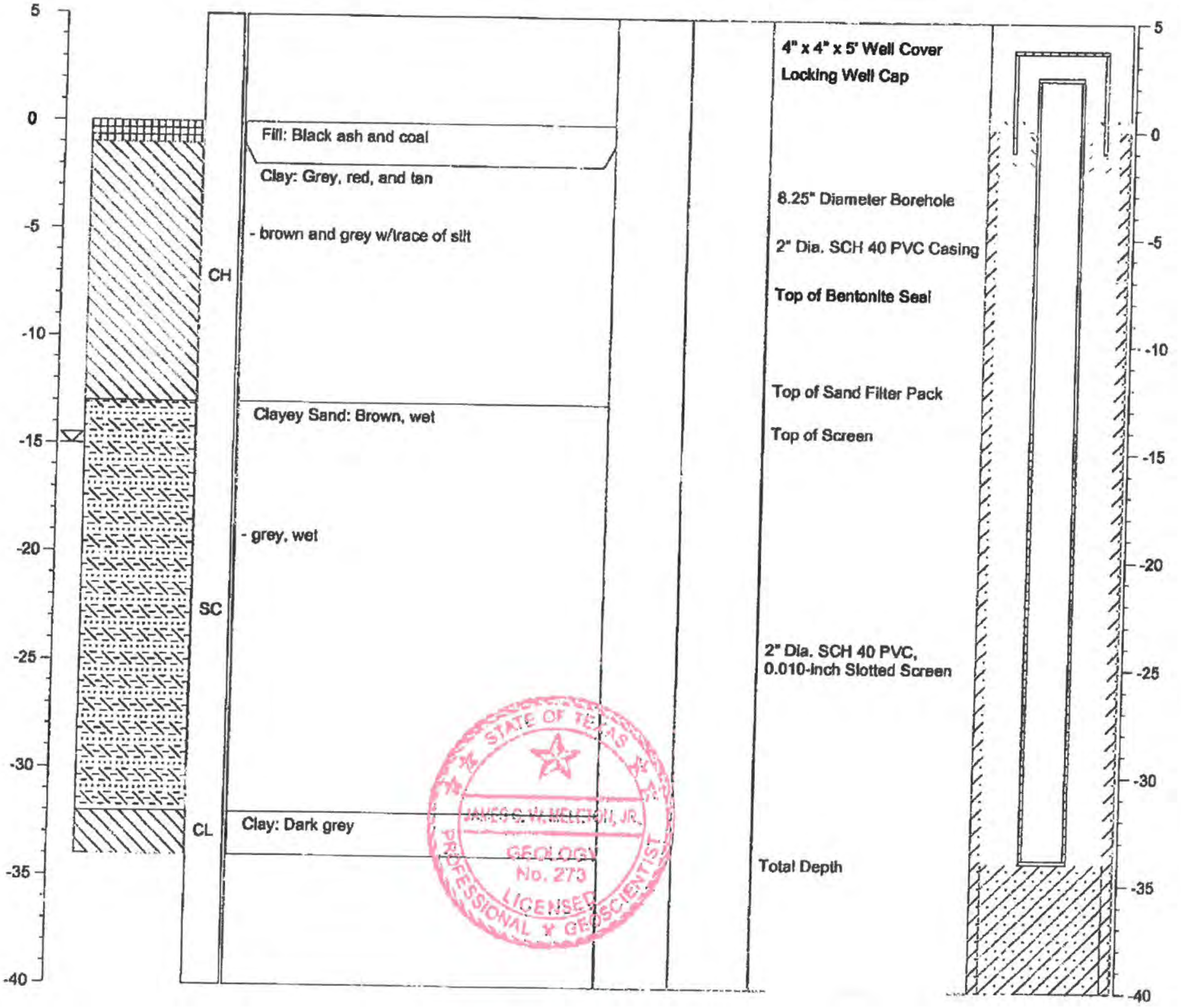
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Metal Cleaning Waste Pond**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0120**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**12/1/09**

NOTES: **Latitude: 33.05455**
Longitude: 94.84674

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



JAMES C. W. MELETON, JR.
GEOLOGY
No. 273

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-1

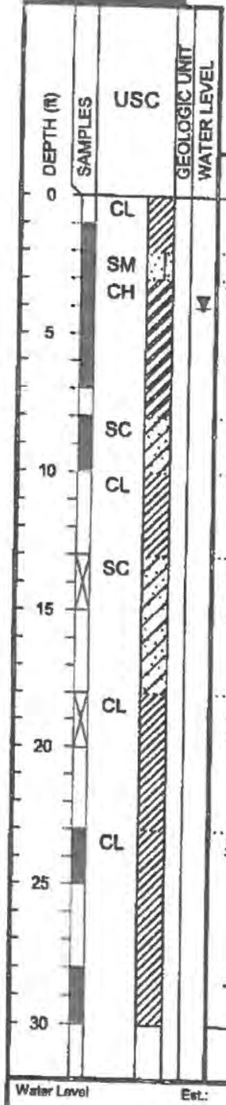
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

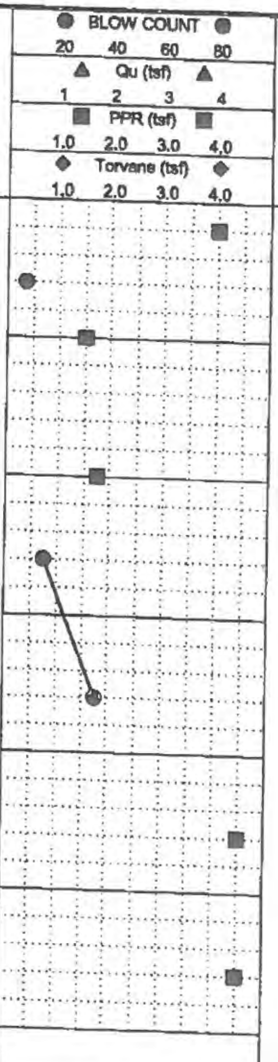
BORING TYPE: Flight Auger

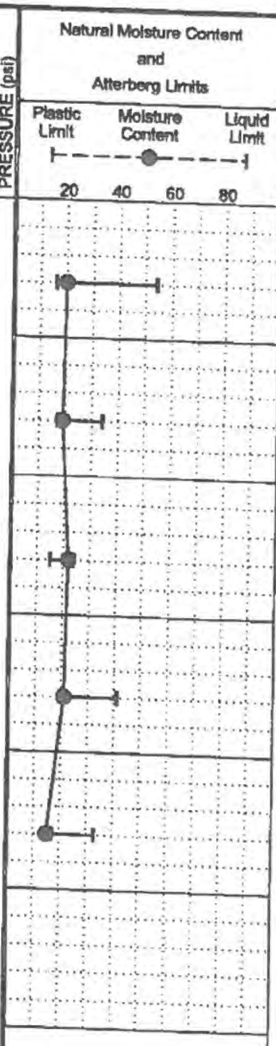
DATE 10/27/09

SURFACE ELEVATION 324.1



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; brownish orange	P=4.0 SF										
SM	SILTY SAND(SM) tannish orange	N=7										
CH	SANDY FAT CLAY(CH) medium stiff; tannish orange --stiff	P=1.5					20	54	16	38	63	+40Sieve=10%, +4 Sieve=1%
SC	CLAYEY SAND(SC) medium dense; tannish orange; with clay seams	P=1.75					19	34	17	17	32	+40 Sieve=7%, +4 Sieve=3%
CL	SANDY LEAN CLAY(CL) stiff; orange											
SC	CLAYEY SAND(SC) medium dense; orange; saturated; with iron oxide cemented sandstone rock	N=15					22	24	15	9	19	+40Sieve=35%, +4 Sieve=22%
CL	LEAN CLAY WITH SAND(CL) hard; dark gray; with clay seams	N=35					21	41	21	20	75	+40 Sieve=2%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; dark brown	P=4.5+					15	33	17	16	52	+40 Sieve=1%, +4 Sieve=0%
	--grayish brown; laminated with silt	P=4.5+										
	Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 5' while drilling. Water level @ 4' and open to 30' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.090', W 94°50.417'

Piezometer B-2

ETTL
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CONSULTANTS

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

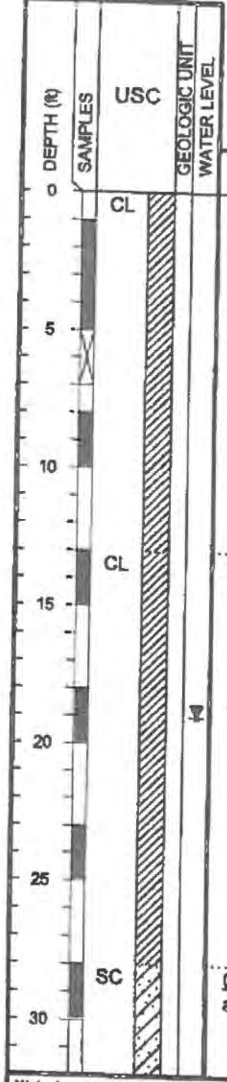
PROJECT: Welsh Power Plant
Pittsburgh, Texas

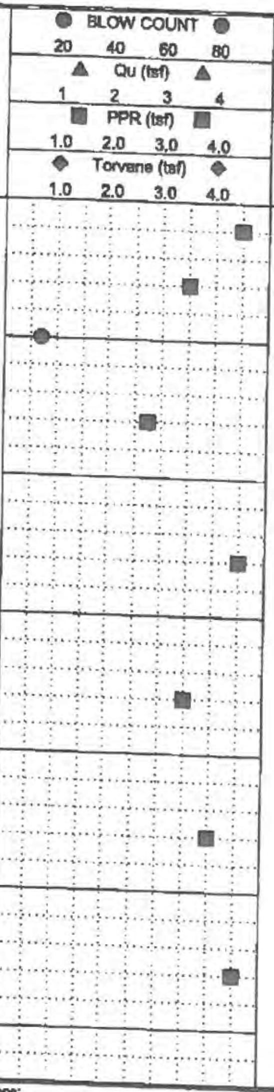
PROJECT NO.: G3242-09

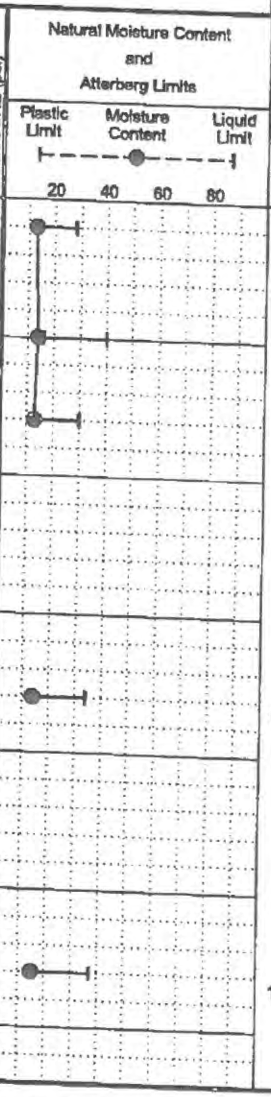
BORING TYPE: Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+					13	28	14	14	61	+40 Sieve=3%, +4 Sieve=0%
	—very stiff	P=3.5										
	—stiff	N=14					14	40	16	24	65	+40 Sieve=0%, +4 Sieve=0%
	—very stiff; reddish brown	P=2.75					13	30	14	16	58	+40 Sieve=0%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+										
	—very stiff	P=3.5					14	34	15	19	54	+40 Sieve=0%, +4 Sieve=0%
		P=4.0										
SC	CLAYEY SAND(SC) medium dense; tan, red, and gray	P=4.5					15	37	16	21	47	+40 Sieve=5%, +4 Sieve=3%

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

LOG OF BORING B-2

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	BLOW COUNT 20 40 60 80 / Qu (tsf) 1 2 3 4 / PPR (tsf) 1.0 2.0 3.0 4.0 / Torvane (tsf) 1.0 2.0 3.0 4.0	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 20 40 60 80	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35		--red and tan	P=2.5												
40	SM SC	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated	SF							12	22	15	7	48	+40 Sieve=0%, +4 Sieve=0%
45	CH	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams	P=4.5+												
50	SM	SILTY SAND(SM) black and gray	SF												
		Bottom of Boring @ 50'													

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

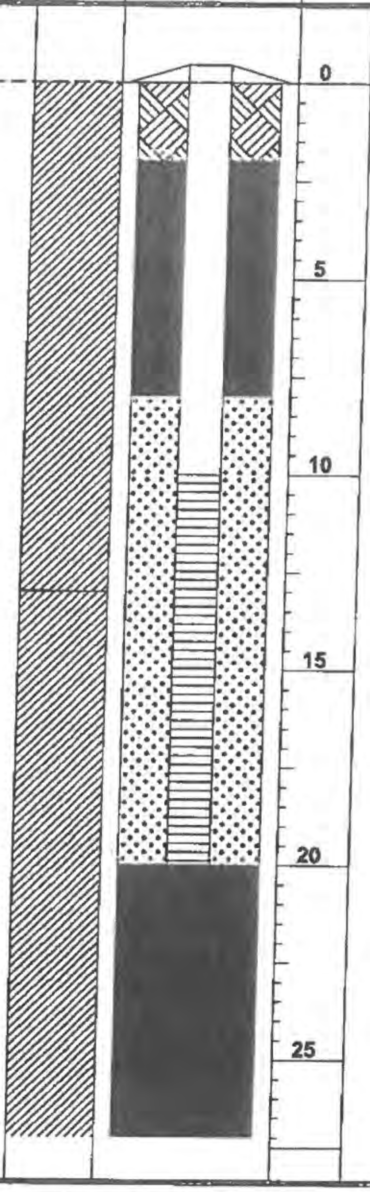
Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

Piezometer B-2

ENVIRONMENTAL LOG
Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**

Well No. B-2
Location Pittsburg, Texas
Surface Elev.
Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		SANDY LEAN CLAY(CL) hard; red and tan					
		–very stiff					
5		–stiff				5	
		–very stiff; reddish brown					
10						10	
		SANDY LEAN CLAY(CL) hard; red and tan					
15						15	
		–very stiff					
20						20	
25						25	



Continued Next Page

Driller Doug Hinds
Logged By James Griffith
Drilling Started 10/28/09
Drilling Completed 10/28/09
Construction Completed
Development Completed
Type of Well

Drilling Method Solid Stem Auger
Borehole Diameter 6.5"
Well Casing 2.0" **Dia.** 0.0' **to** 10.0'
Casing Type PVC
Well Screen 2.0" **Dia.** 10.0' **to** 20.0'
Screen Type Slotted
Slot Size 0.010"
Grout Type Bentonite

Bentonite Seal 2-8' & 20-50'
Filter Pack Qty. 8-20'
Filter Pack Type 20/40 Sand
Static Water Level
Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

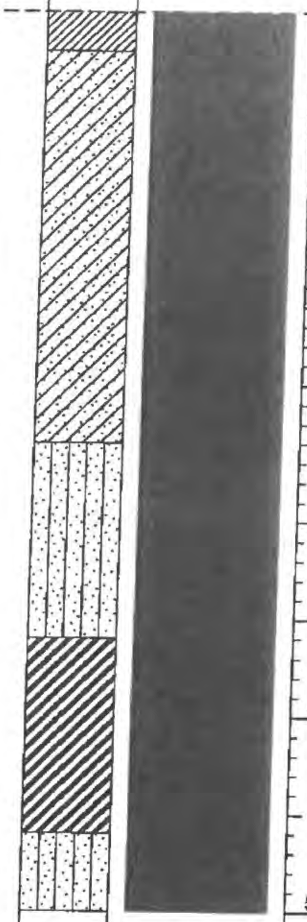
Well No. B-2

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		CLAYEY SAND(SC) medium dense; tan, red, and gray					
30						30	
		--red and tan					
35						35	
		SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated					
40						40	
		FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams					
45						45	
		SILTY SAND(SM) black and gray					
50						50	
		Bottom of Boring @ 50'					
55							
60							



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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

PROJECT: Welsh Power Plant
Pittsburgh, Texas

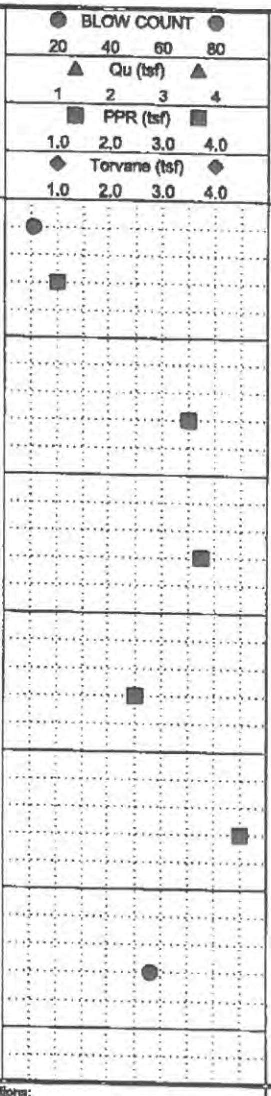
PROJECT NO.: G3242-09

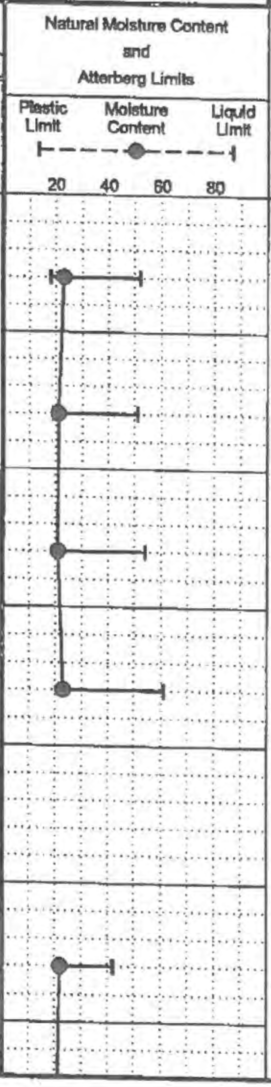
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6

USC	Water Level	MATERIAL DESCRIPTION	Field Strength Data	Dry Density (pcf)	Compressive Strength (tsf)	Failure Strain (%)	Confining Pressure (psi)	Moisture Content (%)	Liquid Limit LL	Plastic Limit PL	Plasticity Index PI	Minus #200 Sieve (%)	Other Tests Performed (Page Ref. #)
SC		CLAYEY SAND(SC) medium dense; gray and red	N=11										
CH		FAT CLAY(CH) stiff; red and tan; with sand seams	P=1.0					23	52	18	34	87	+40 Sieve=3%, +4 Sieve=0%
		–very stiff	P=3.5					21	51	19	32	86	+40 Sieve=3%, +4 Sieve=0%
CH		FAT CLAY WITH SAND(CH) very stiff; brown; with ferric joints	P=3.75					21	54	20	34	85	+40Sieve=10%, +4 Sieve=1%
	▼	–red and tan; layered; with ferric seams	P=2.5					23	61	24	37	81	+40Sieve=11%, +4 Sieve=0%
CH		FAT CLAY(CH) hard; gray; with sand seams	P=4.5+										
SC		CLAYEY SAND(SC) very dense; gray; with sand seams	N=56					22	42	22	20	35	+40 Sieve=1%, +4 Sieve=0%





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

PROJECT: Welsh Power Plant
Pittsburgh, Texas

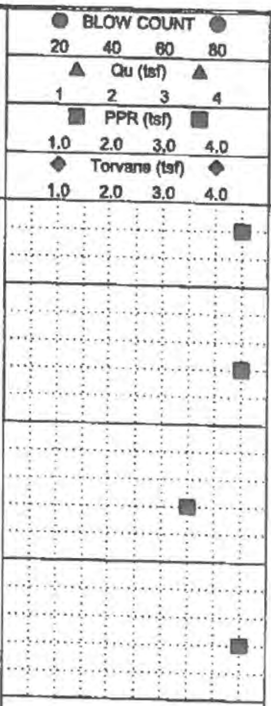
PROJECT NO.: G3242-09

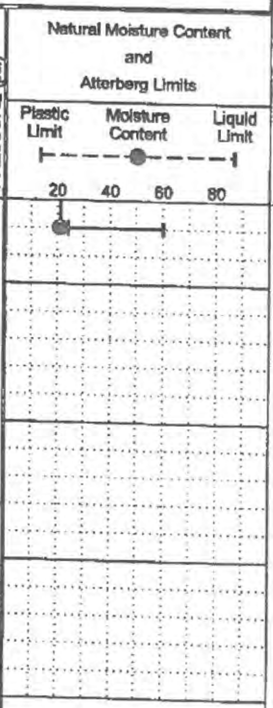
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6

DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	▨	CH			FAT CLAY(CH) hard; brown; layered and with sand seams	P=4.5+					21	60	24	36	95	+40 Sieve=1%, +4 Sieve=0%
40	▨				–gray and green	P=4.5+										
45	▨	CL			SANDY LEAN CLAY(CL) very stiff; gray and dark green; layered; with sand seams	P=3.5										
50	▨	CH			FAT CLAY(CH) hard; gray and dark green; layered; with silt seams	P=4.5+										
					Bottom of Boring @ 50'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

Piezometer B-4

ETTL ENGINEERS & CONSULTANTS

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	SM	SILTY SAND(SM) medium dense; tan; with gravel	N=19						
	CL	SANDY LEAN CLAY(CL) dark brown	SF						
5		—tannish orange		14	24	15	9	59	+40 Sieve=1%, +4 Sieve=0%
		—hard; orangish tan	P=4.5						
10			P=3.25	22	45	21	24	94	+40 Sieve=2%, +4 Sieve=0%
		—very stiff; white							
	SC	CLAYEY SAND(SC) medium dense; tan	P=3.25						
15		—orangish gray; with sand seams		15	31	15	16	40	+40 Sieve=1%, +4 Sieve=0%
	CL	SANDY LEAN CLAY(CL) stiff; orangish tan	N=9						
20									
	CH	FAT CLAY(CH) very stiff; orangish tan; with ferric seams	P=4.0						
25				25	59	24	35	88	+40 Sieve=4%, +4 Sieve=0%
		—tannish brown; with iron ore seams	P=2.75						
30									

Field strength scales: ● BLOW COUNT ● 20 40 60 80; ▲ Qu (tsf) ▲ 1 2 3 4; ■ PPR (tsf) ■ 1.0 2.0 3.0 4.0; ◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0

DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)

Natural Moisture Content and Atterberg Limits: Plastic Limit ├ - - - ● - - - ┤ Liquid Limit, Moisture Content; 20 40 60 80

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

LOG OF BORING B-4

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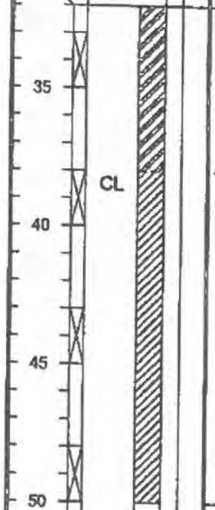
(903) 595-4421

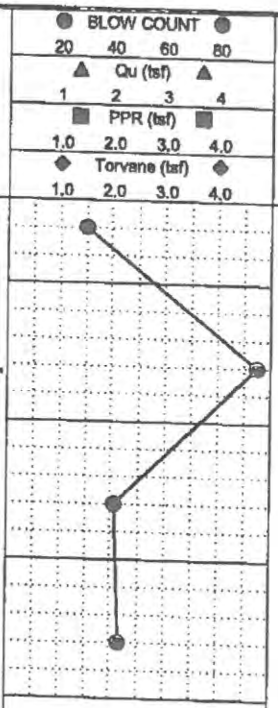
PROJECT: Welsh Power Plant
Pittsburgh, Texas
PROJECT NO.: G3242-09
BORING TYPE: Flight Auger

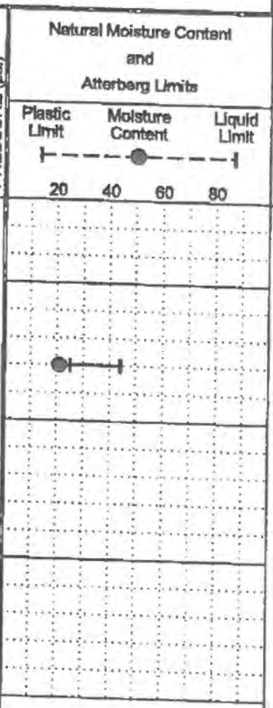
DATE 10/27/09
SURFACE ELEVATION 340.6

DEPTH (ft) | SAMPLES | USC | GEOLOGIC UNIT | WATER LEVEL



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
–hard; light gray; layered and with silt seams	N=30										
LEAN CLAY(CL) hard; light gray; layered and with silt seams	N=50/5.75"					21	44	25	19	93	+40 Sieve=1%, +4 Sieve=0%
–light gray	N=41										
–layered and with sand seams; with lignite	N=43										
Bottom of Boring @ 50'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

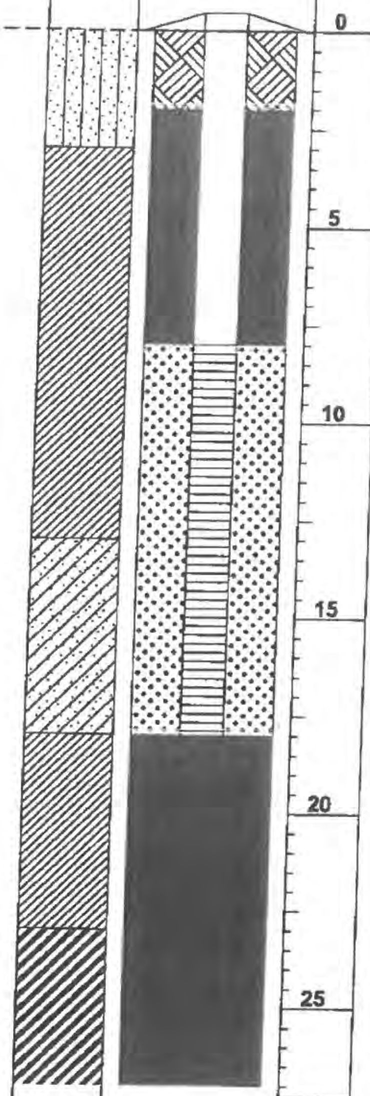
Piezometer B-4

ENVIRONMENTAL LOG

Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**

Well No. B-4
Location Pittsburg, Texas
Surface Elev.
Page 1 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
						T.O.C. Elev.
0	Ground Surface				0	
	SILTY SAND(SM) medium dense; tan; with gravel					
	SANDY LEAN CLAY(CL) dark brown					
	–tannish orange					
5	–hard; orangish tan				5	
10	–very stiff; white				10	
	CLAYEY SAND(SC) medium dense; tan					
15	–orangish gray; with sand seams				15	
	SANDY LEAN CLAY(CL) stiff; orangish tan					
20					20	
	FAT CLAY(CH) very stiff; orangish tan; with ferric seams					
25					25	



Continued Next Page

Driller Doug Hinds
Logged By James Griffith
Drilling Started 10/27/09
Drilling Completed 10/27/09
Construction Completed
Development Completed
Type of Well

Drilling Method Solid Stem Auger
Borehole Diameter 6.5"
Well Casing 2.0" **Dia.** 0.0' **to** 8.0'
Casing Type PVC
Well Screen 2.0" **Dia.** 8.0' **to** 18.0'
Screen Type Slotted
Slot Size 0.010"
Grout Type Bentonite

Bentonite Seal 2-8' & 18-50'
Filter Pack Qty. 6-18'
Filter Pack Type 20/40 Sand
Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

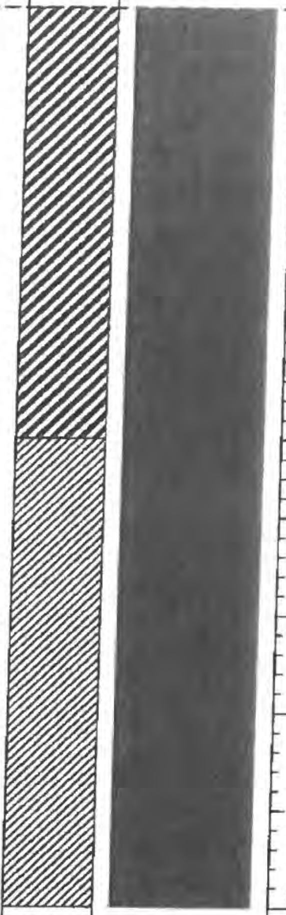
Well No. B-4

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		–tannish brown; with iron ore seams					
30						30	
		–hard; light gray; layered and with silt seams					
35						35	
		LEAN CLAY(CL) hard; light gray; layered and with silt seams					
40						40	
		–light gray					
45						45	
		–layered and with sand seams; with lignite					
50						50	
		Bottom of Boring @ 50'					
55							
60							



ETTL Engineers & Consultants Inc.

Piezometer B-5

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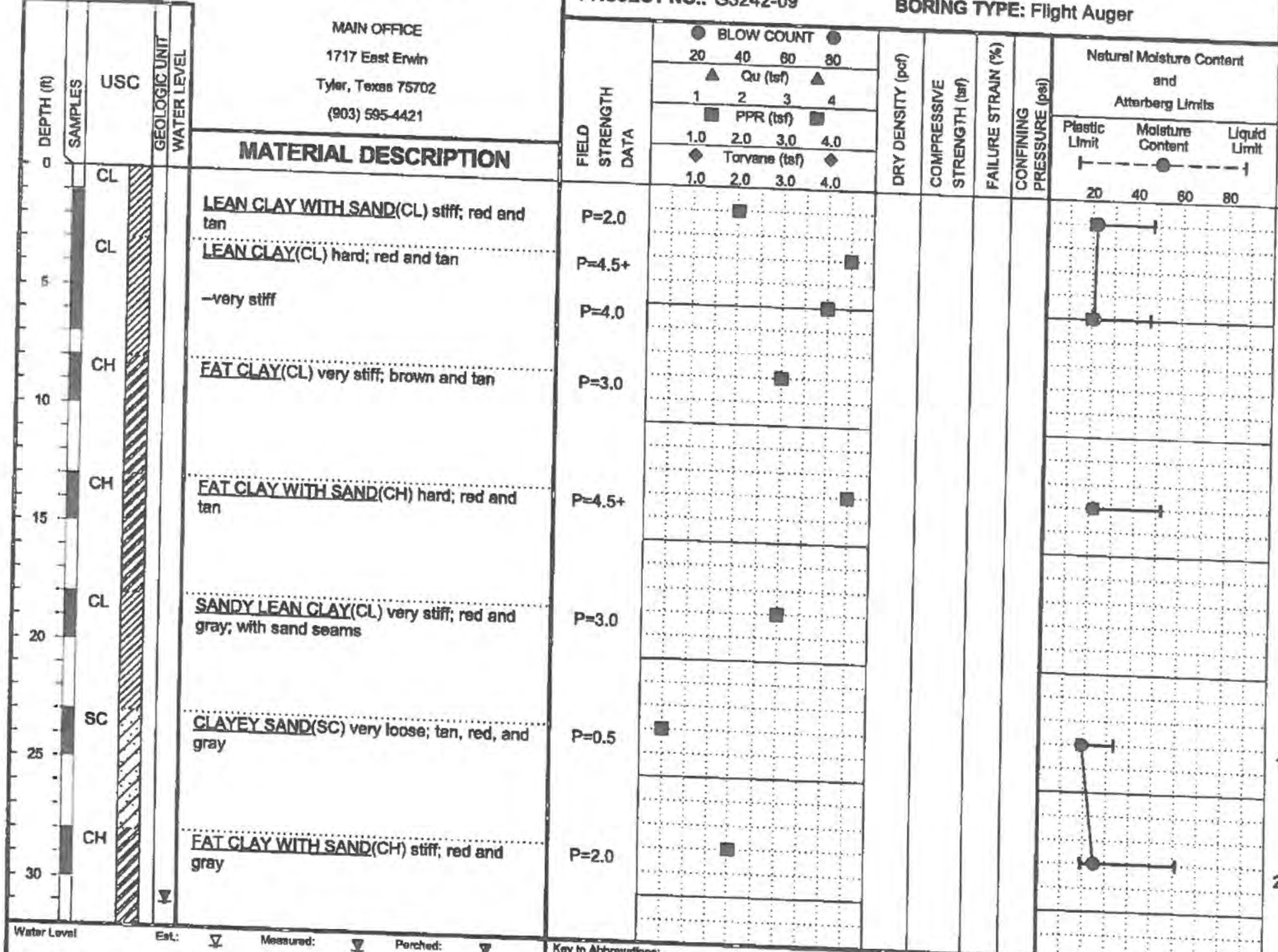
MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas
PROJECT NO.: G3242-09
BORING TYPE: Flight Auger

DATE 10/27/09
SURFACE ELEVATION 340.0

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) stiff; red and tan	P=2.0						
CL	LEAN CLAY(CL) hard; red and tan	P=4.5+	22	47	19	28	81	+40 Sieve=9%, +4 Sieve=3%
	–very stiff	P=4.0	21	46	18	28	94	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY(CL) very stiff; brown and tan	P=3.0						
CH	FAT CLAY WITH SAND(CH) hard; red and tan	P=4.5+	22	52	24	28	88	+40 Sieve=3%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams	P=3.0						
SC	CLAYEY SAND(SC) very loose; tan, red, and gray	P=0.5	19	33	17	16	44	+40 Sieve=1%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) stiff; red and gray	P=2.0	25	61	19	42	83	+40 Sieve=5%, +4 Sieve=3%



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	SC	SILTY CLAYEY SAND(SC) gray and red; saturated	SF										
40	CH	FAT CLAY(CH) hard; red and gray; with sand seams	P=4.5+					25	51	31	20	87	+40 Sieve=6%, +4 Sieve=0%
45		–gray, tan, and red; with sand seams	P=4.5+										
50	SM SC	SILTY SAND(SM-SC) red and gray	SF										
		Bottom of Boring @ 50'											

● BLOW COUNT ● 20 40 60 80
▲ Qu (tsf) ▲ 1 2 3 4
■ PPR (tsf) ■ 1.0 2.0 3.0 4.0
◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits
Plastic Limit ├- - - -●- - - -┤ Liquid Limit
Moisture Content
20 40 60 80

ATTERBERG LIMITS(%)

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

Piezometer P-5

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-5

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description
0	Ground Surface
	LEAN CLAY WITH SAND(CL) stiff; red and tan
	LEAN CLAY(CL) hard; red and tan
5	--very stiff
	FAT CLAY(CL) very stiff; brown and tan
10	
	FAT CLAY WITH SAND(CH) hard; red and tan
15	
	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams
20	
	CLAYEY SAND(SC) very loose; tan, red, and gray
25	

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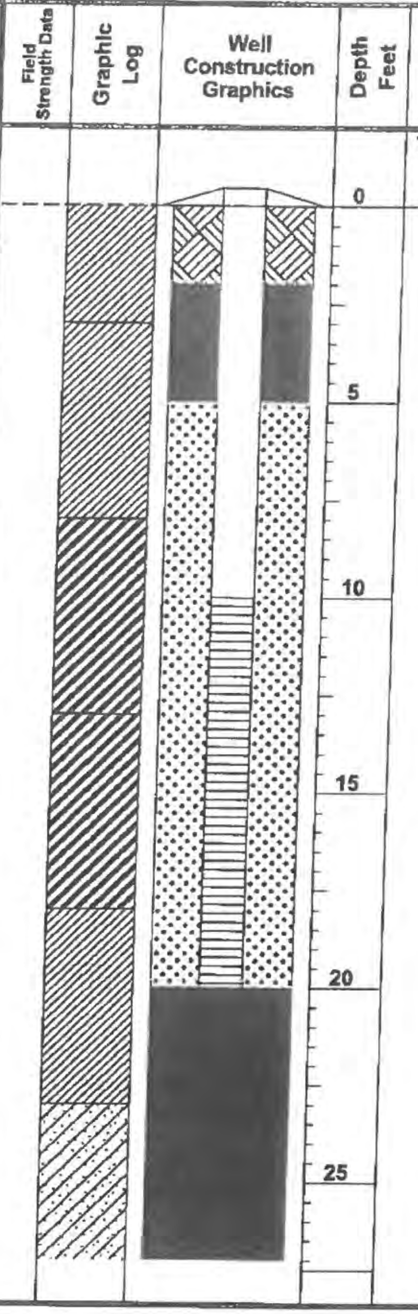


Well Construction Details

T.O.C. Elev.

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed

Development Completed

Type of Well

Drilling Method Solid Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-5' & 20-50'

Filter Pack Qty. 5-20'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

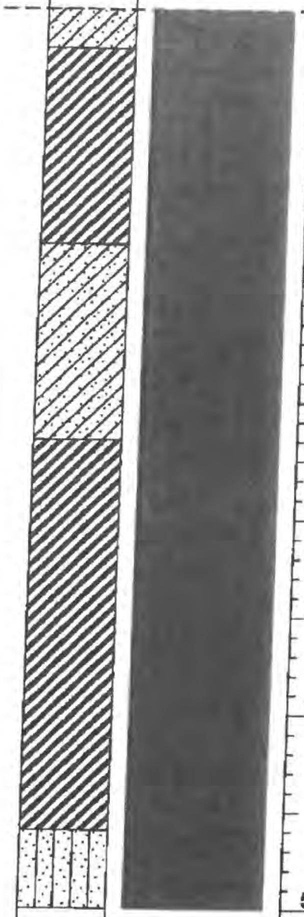
Well No. B-5

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
	FAT CLAY WITH SAND(CH) stiff; red and gray					
30					30	
	SILTY CLAYEY SAND(SC) gray and red; saturated					
35					35	
	FAT CLAY(CH) hard; red and gray; with sand seams					
40					40	
	–gray, tan, and red; with sand seams					
45					45	
	SILTY SAND(SM-SC) red and gray					
50	Bottom of Boring @ 50'				50	
55						
60						



ETTL Engineers & Consultants Inc.

Piezometer B-6

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

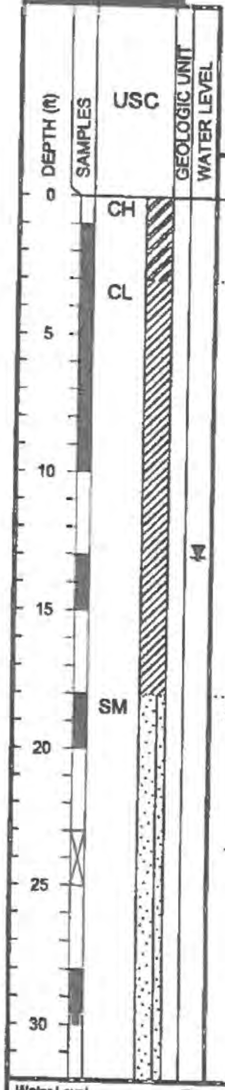
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

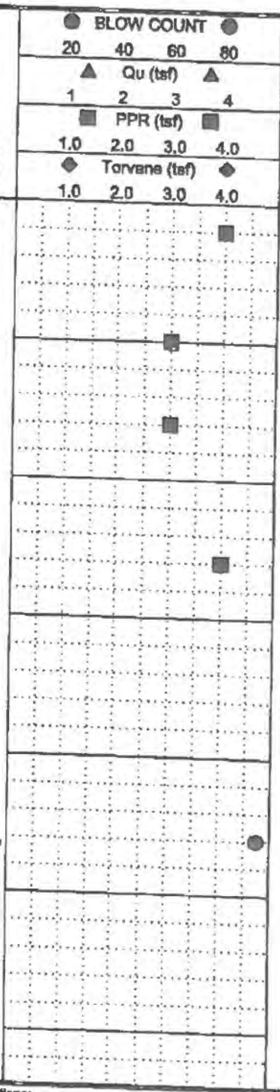
BORING TYPE: Flight Auger

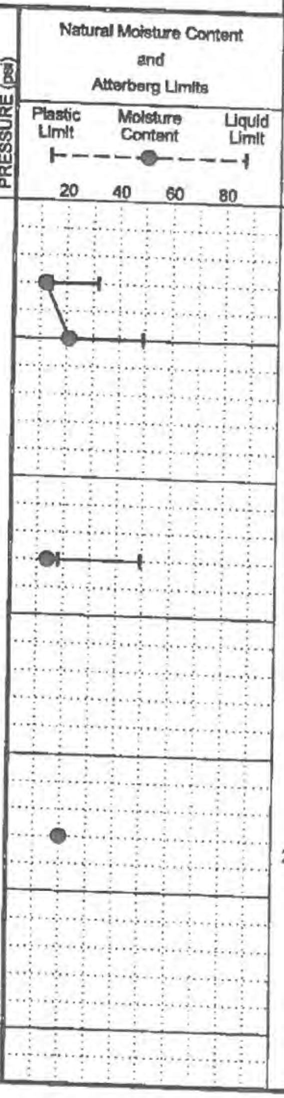
DATE 10/27/09

SURFACE ELEVATION 340.1



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY(CH) very stiff; red and gray; with ferric seams	P=4.0										
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+					12	32	14	18	60	+40 Sieve=0%, +4 Sieve=0%
	—very stiff; red, gray, and brown; with gravel	P=3.0					21	49	20	29	93	+40 Sieve=2%, +4 Sieve=0%
	—with sand seams	P=3.0										
		P=4.0					14	49	18	31	65	+40 Sieve=0%, +4 Sieve=0%
SM	SILTY SAND(SM) gray; saturated	P=3.0										
	—very dense; gray and red	N=50/5.25"					20				18	+40 Sieve=0%, +4 Sieve=0%
		SF										





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

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Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1

● BLOW COUNT ● 20 40 60 80
▲ Qu (tsf) ▲ 1 2 3 4
■ PPR (tsf) ■ 1.0 2.0 3.0 4.0
◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits: Plastic Limit ⊢ - - - ● - - - ⊣ Liquid Limit, Moisture Content; 20 40 60 80

DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	■	CH			FAT CLAY(CH) hard; brown; with sand seams	P=4.5+										
40	■					P=4.5+					22	68	24	44	95	+40 Sieve=0%, +4 Sieve=0%
45	■				-dark green	P=4.5+										
50	■	CL			LEAN CLAY(CL) hard; dark green; laminated with lignite	P=4.5+										
					Bottom of Boring @ 50'											

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

Piezometer B-6

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

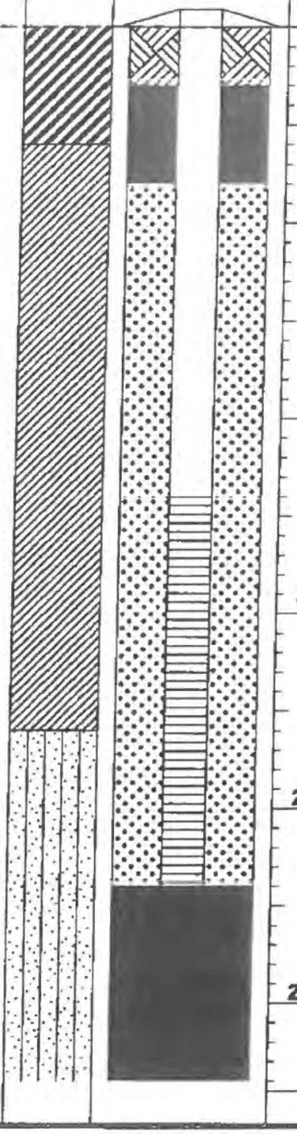
Well No. B-6

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		FAT CLAY(CH) very stiff; red and gray; with ferric seams					
		SANDY LEAN CLAY(CL) hard; red and tan					
5						5	
		–very stiff; red, gray, and brown; with gravel					
		–with sand seams					
10						10	
15						15	
		SILTY SAND(SM) gray; saturated					
20						20	
		–very dense; gray and red					
25						25	



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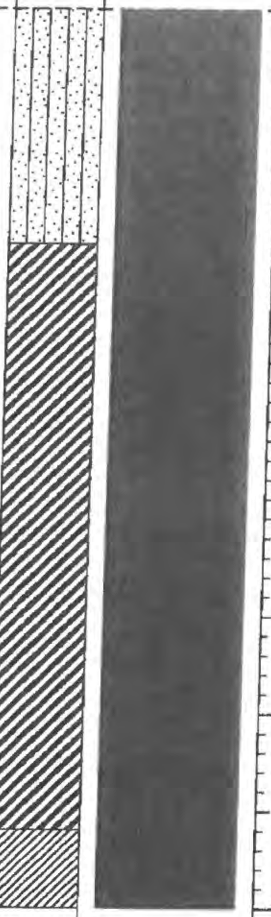
Driller Doug Hinds	**Drilling Method** Solid Stem Auger	**Bentonite Seal** 1.5-4' & 22-50'
Logged By James Griffith	**Borehole Diameter** 6.5"	**Filter Pack Qty.** 4-22'
Drilling Started 10/28/09	**Well Casing** 2.0" **Dia.** 0.0' **to** 12.0'	**Filter Pack Type** 20/40 Sand
Drilling Completed 10/28/09	**Casing Type** PVC	**Static Water Level**
Construction Completed	**Well Screen** 2.0" **Dia.** 12.0' **to** 22.0'	
Development Completed	**Screen Type** Slotted	**Notes:**
Type of Well	**Slot Size** 0.010"	
	Grout Type Bentonite	

ETTL Engineers & Consultants Inc.

ENVIRONMENTAL LOG
Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**

Well No. B-6
Location Pittsburg, Texas
Surface Elev.
Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
30						30	
35		FAT CLAY(CH) hard; brown; with sand seams				35	
40						40	
45		–dark green				45	
50		LEAN CLAY(CL) hard; dark green; laminated with lignite				50	
		Bottom of Boring @ 50'					
55							
60							



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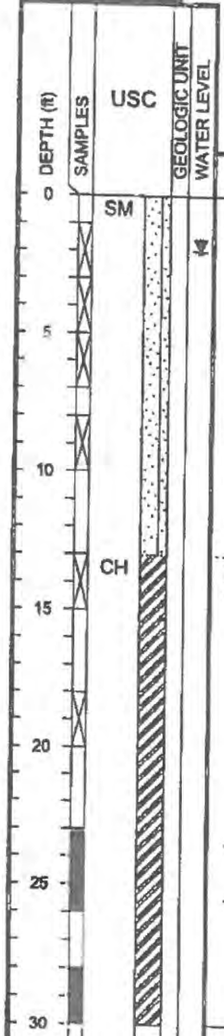
MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

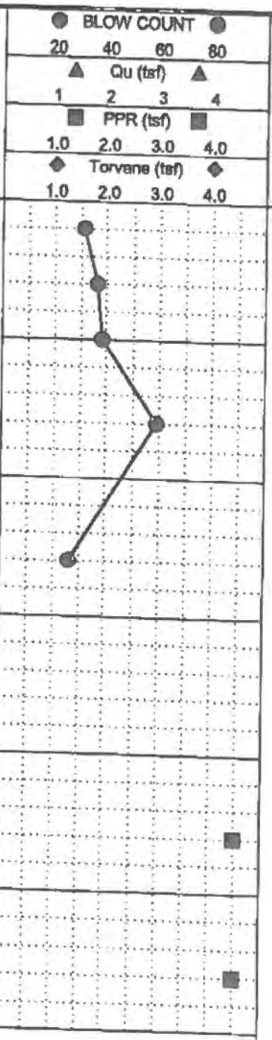
LOG OF BORING B-7

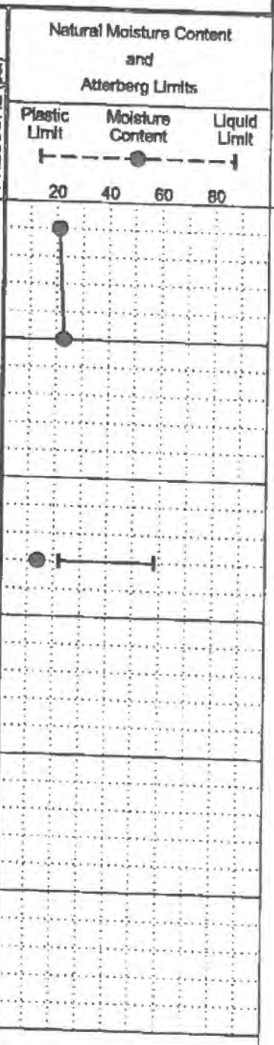
PROJECT: Welsh Power Plant
Pittsburgh, Texas
PROJECT NO.: G3242-09
BORING TYPE: Flight Auger

DATE 10/27/09
SURFACE ELEVATION 340.4



DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	SM	SILTY SAND(SM) dense; tan	N=31					21				21	+40 Sieve=0%, +4 Sieve=0%
			N=38										
5		~gray; saturated	N=38					23				15	+40 Sieve=0%, +4 Sieve=0%
		~very dense	N=59										
13	CH	FAT CLAY(CH) very stiff; dark gray; with silt and ferric seams	N=26					14	58	22	36	98	+40 Sieve=0%, +4 Sieve=0%
23		~hard; gray and black; with trace of lignite	P=4.5+										
		~gray	P=4.5+										
30		Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 4' while drilling. Water level @ 2' and open to 7' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.898', W 94°50.519'

Landfill Boring B-2

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LOG OF BORING B-2

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

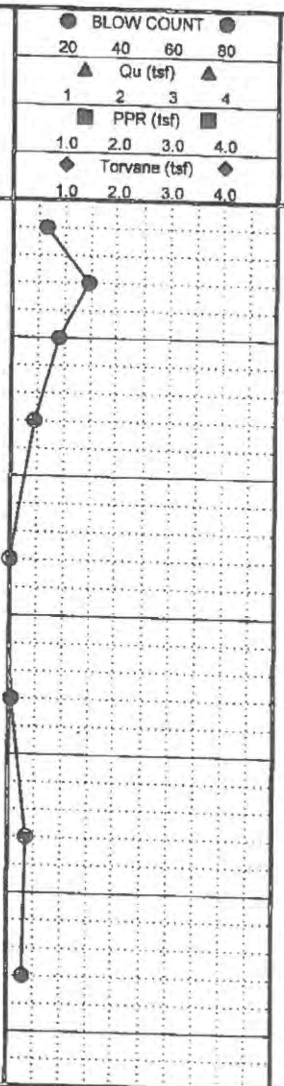
DRILL RIG: B-61 HDX

BORING TYPE: Rotary Wash/Flight Auger

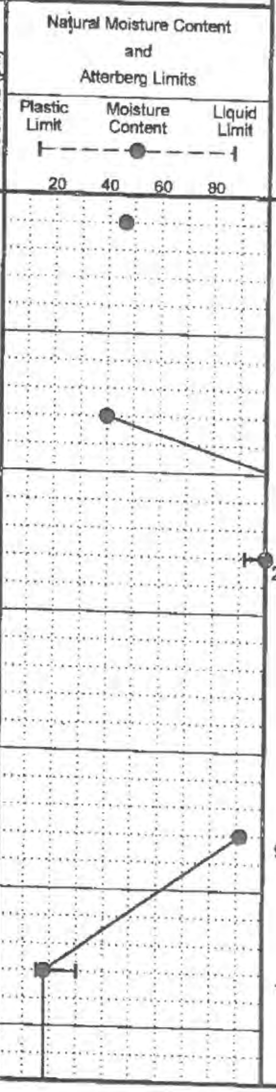
DATE 10/8/14

SURFACE ELEVATION 373.8

DEPTH (ft)	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	ML			ASH (SILT WITH GRAVEL(ML)) medium dense; light grayish brown; with coarse-grained sand and lightly cemented gravel pieces; dry	N=13	46				59	+40 Sieve=27% +4 Sieve=16%
	SM				N=29						
5				ASH (SILTY SAND(SM)) medium dense; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces	N=18						
				--loose; moist	N=9						
10						40				40	+40 Sieve=19% +4 Sieve=2%
	MH	Egc @ 28-43' & Er @ 43-60'	▼	ASH (ELASTIC SILT(MH)) very loose; black; with fine-grained sand and lightly cemented gravel pieces; saturated	N=0						
15						200	134	92	42	100	+40 Sieve=0% +4 Sieve=0%
	SM			ASH (SILTY SAND(SM)) very loose; dark brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=1						
20											
				--loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7						
25						91				61	+40 Sieve=11% +4 Sieve=1%
	CL			SANDY LEAN CLAY(CL) medium stiff; dark brown and black; with fine-grained sand and cemented gravel pieces; saturated	N=6						
30						18	30	15	15	63	+40 Sieve=1% +4 Sieve=0%



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

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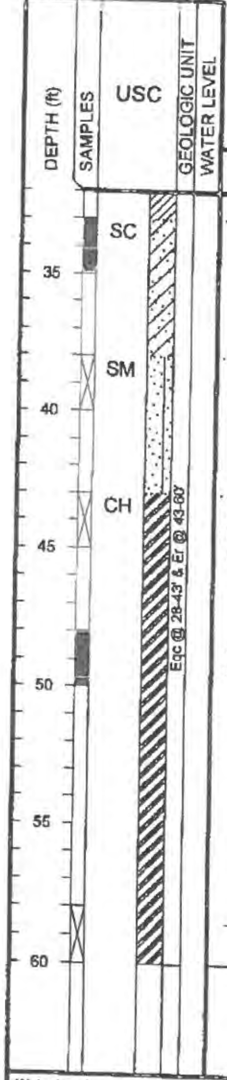
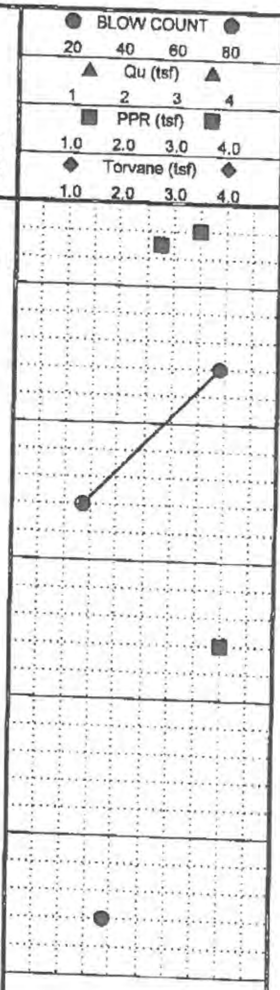
LOG OF BORING B-2 (cont.)

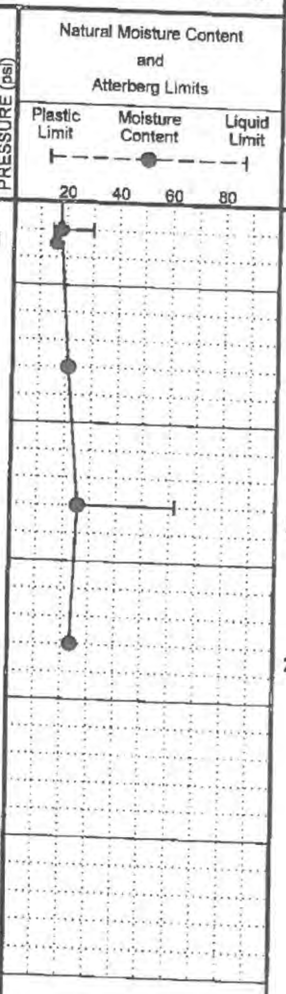
PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas
PROJECT NO.: G4207-146
DRILL RIG: B-61 HDX
BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14
SURFACE ELEVATION 373.8



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	CLAYEY SAND(SC) dense; light brown, light gray and reddish brown; moist; with fine-grained sand; mottled	P=3.5 P=2.75	110	1.39	4.3	21	18 16	30	15	15	39	+40 Sieve=0% +4 Sieve=0%
SM	SILTY SAND(SM) very dense; light brown, yellowish brown and light gray; moist; mottled; with fine-grained sand	N=78					21				24	+40 Sieve=0% +4 Sieve=0%
CH	FAT CLAY(CH) very stiff; dark brown and light brown; moist; with sand seams; laminated	N=27					25	62	26	36	96	+40 Sieve=2% +4 Sieve=0%
	--dark brown with light gray; moist; with silt seams	P=4.0	98				24					
	--hard; dark brown; moist	N=37										
	Bottom of Boring @ 60'											





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill boring B-10

LOG OF BORING B-10

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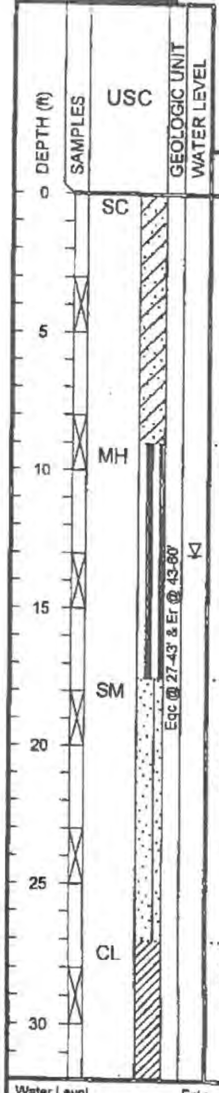
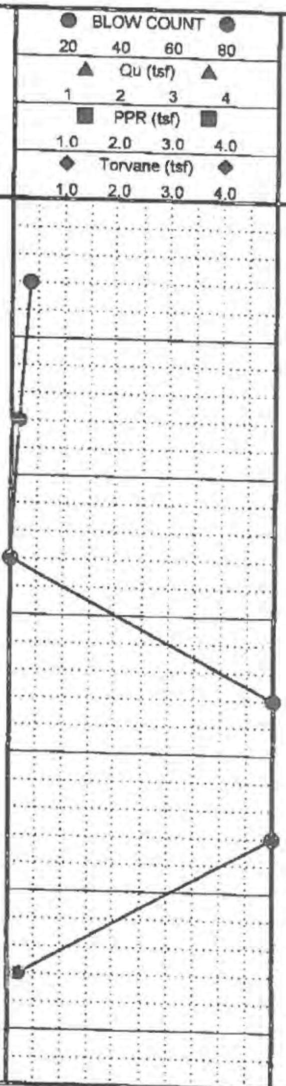
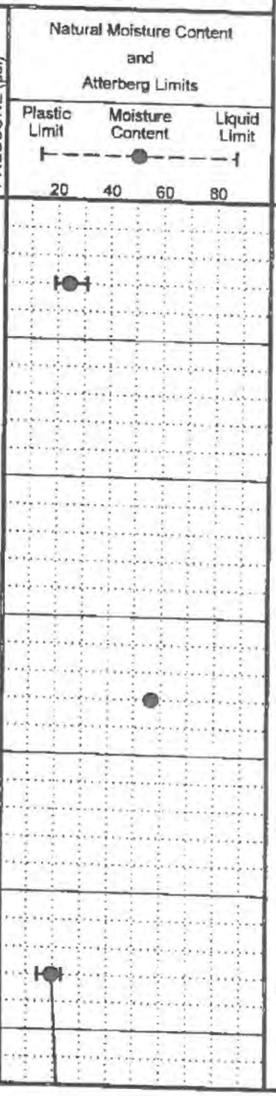
PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas
DRILL RIG: B-61 HDX
PROJECT NO.: G4207-146
BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14
SURFACE ELEVATION 373.2







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	ASH (CLAYEY SAND(SC)) loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7					24	31	19	12	41	+40 Sieve=21% +4 Sieve=11%
MH	ASH (ELASTIC SILT(MH)) very loose; black; moist	N=3										
	--wet	N=0										
SM	ASH (SILTY SAND WITH GRAVEL(SM)) very dense; light brown and dark brown; with lightly cemented gravel pieces and coarse-grained sand; moist; cemented layer from 17.5' to 21'	N=50/1"					56				14	+40 Sieve=71% +4 Sieve=28%
	--cemented layer from 23' to 27'	N=50/4"										
CL	SANDY LEAN CLAY(CL) medium stiff; grayish brown and yellowish brown; saturated; mottled	N=4					19	23	14	9	57	+40 Sieve=1% +4 Sieve=0%

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

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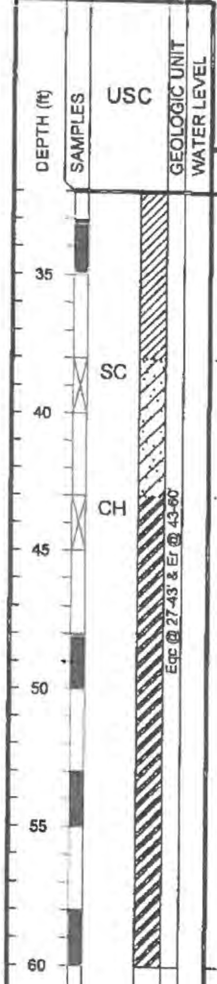
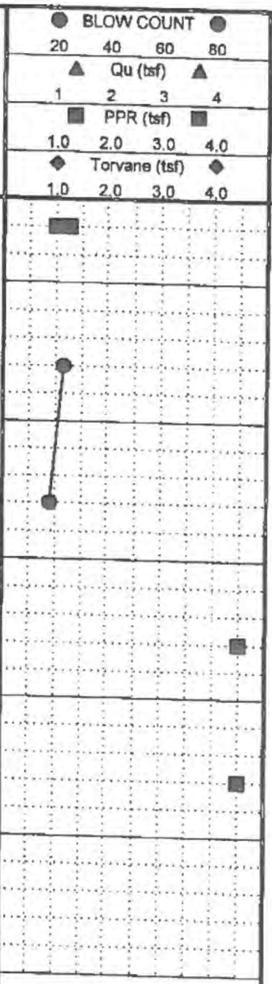
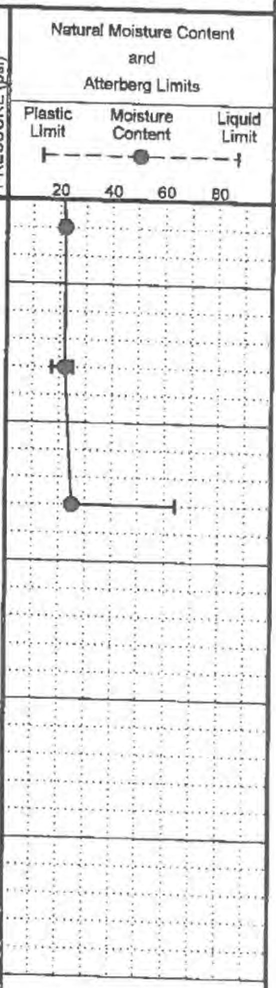
LOG OF BORING B-10 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas
PROJECT NO.: G4207-146
DRILL RIG: B-61 HDX
BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14
SURFACE ELEVATION 373.2







MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	P=1.25 P=1.0	107	2.10	6.1	21	22					
CLAYEY SAND(SC) medium dense; reddish brown and grayish brown; moist; mottled	N=23					22	25	17	8	27	+40 Sieve=3% +4 Sieve=0%
FAT CLAY(CH) very stiff; dark brown with light gray; with silt seams; moist	N=18					25	64	24	40	90	+40 Sieve=7% +4 Sieve=0%
--hard	P=4.5+										
	P=4.5+										
Bottom of Boring @ 60'											

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill Boring B-12

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-12

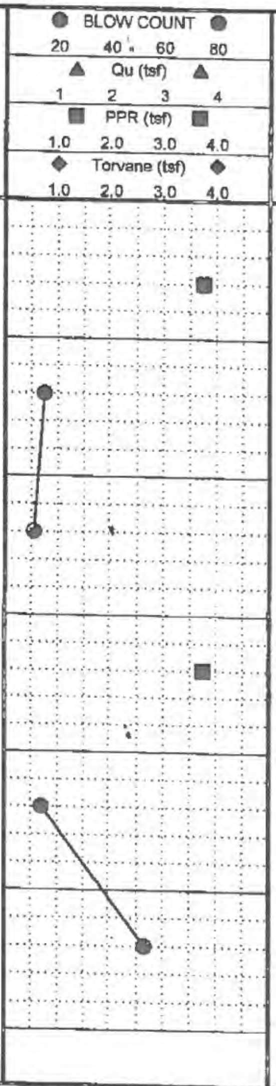
PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas
DRILL RIG:
PROJECT NO.: G4207-146
BORING TYPE: Flight Auger

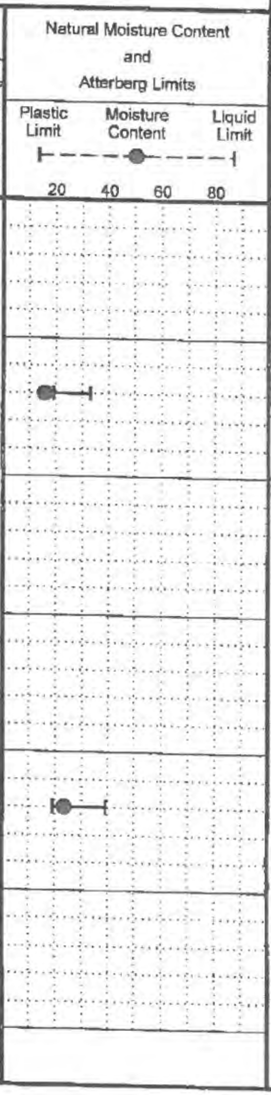
DATE 10/15/14
SURFACE ELEVATION 361.7

USC	GEOLOGIC UNIT	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	Eqc	LEAN CLAY WITH SAND(CL) stiff; light gray and reddish brown; moist; mottled	P=3.75						
CL		SANDY LEAN CLAY(CL) stiff; light brown, light gray and reddish brown; moist; mottled	N=15	16	33	19	14	58	+40 Sieve=1% +4 Sieve=0%
		--grayish brown and brown; moist	N=11						
CH		FAT CLAY WITH SAND(CH) stiff; light gray and reddish brown; moist; mottled; with ferric seams	P=3.75						
CL		LEAN CLAY(CL) stiff; light gray and brownish gray; moist; layered with silt	N=14	24	39	19	20	93	+40 Sieve=1% +4 Sieve=0%
ML		SILT WITH SAND(ML) very dense; light brown and yellowish brown; moist; with clay seams	N=53						
		Bottom of Boring @ 30'							

DEPTH (ft): 0, 5, 10, 15, 20, 25, 30

Columns: SAMPLES; WATER LEVEL; DRY DENSITY (pcf); COMPRESSIVE STRENGTH (tsf); FAILURE STRAIN (%); CONFINING PRESSURE (psi)





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 27' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04713°, W94.84486°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Land fill Boring B-13

LOG OF BORING B-13

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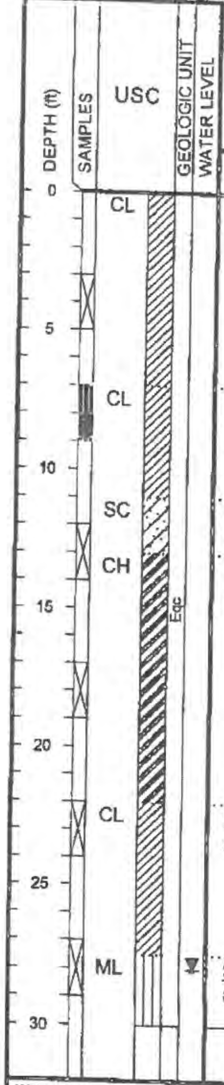
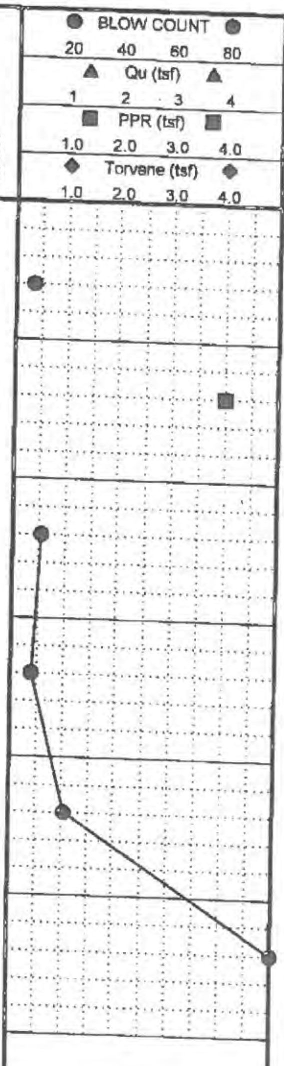
(903) 595-4421

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas
PROJECT NO.: G4207-146
DRILL RIG:
BORING TYPE: Flight Auger

DATE 10/15/14
SURFACE ELEVATION 361.4

DEPTH (ft)	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0–7	CL	Eqc		LEAN CLAY WITH SAND(CL) medium stiff; reddish brown with light gray; moist	N=7					20	45	17	28	76	+40 Sieve=1% +4 Sieve=0%
7–11	CL			SANDY LEAN CLAY(CL) very stiff; light brown, gray and reddish brown; moist; mottled	P=4.0										
11–13	SC			CLAYEY SAND(SC) medium dense; grayish brown; moist											
13–22	CH			FAT CLAY WITH SAND(CH) medium stiff; reddish brown and light gray; moist; mottled	N=11 N=8					22	54	20	34	79	+40 Sieve=1% +4 Sieve=0%
22–28	CL			LEAN CLAY(CL) very stiff; light gray and grayish brown; moist; layered with silt	N=21										
28–30	ML		▼	SILT WITH SAND(ML) very dense; light gray and yellowish brown; wet; with clay seams	N=50/5"					24				80	+40 Sieve=0% +4 Sieve=0%
30				Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 28' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.047160°, W94.84384°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-14

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(903) 595-4421

LOG OF BORING B-14

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

DRILL RIG:

BORING TYPE: Flight Auger

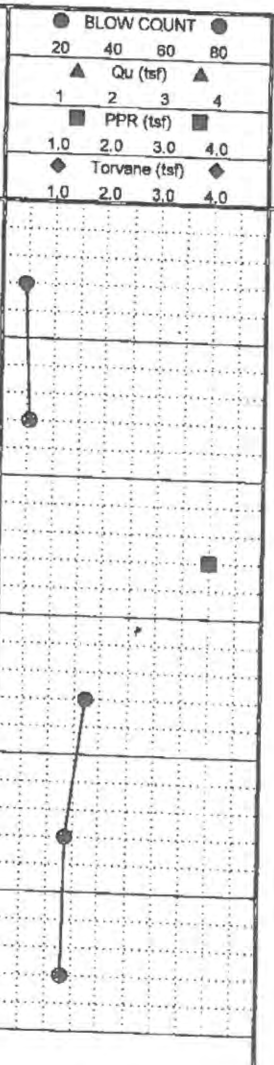
DATE 10/14/14

SURFACE ELEVATION 347.2

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0–8	CL	SANDY LEAN CLAY(CL) medium stiff; yellowish brown with reddish brown; dry; with clay seams	N=9						
8–13	ML	SANDY SILT(ML) medium dense; grayish brown; moist; with clay seams	N=11	108	17	17	NP	68	+40 Sieve=1% +4 Sieve=1%
13–23	CL	SANDY LEAN CLAY(CL) very stiff; light gray and gray; moist	P=4.0						
		-light gray and grayish brown; moist; layered with silt	N=34	26	40	16	24	67	+40 Sieve=1% +4 Sieve=0%
23–28	SP SM	POORLY GRADED SAND WITH SILT(SP-SM) medium dense; yellowish brown, light gray and reddish brown; wet	N=27	25				10	+40 Sieve=0% +4 Sieve=0%
28–30	CL	LEAN CLAY(CL) very stiff; dark brown; moist; with silt partings	N=26						
		Bottom of Boring @ 30'							

GEOLOGIC UNIT: Eqc @ 0-28' & Er @ 28-30'

WATER LEVEL: ▼ at 17'



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 23' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04774°, W94.84290°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-15

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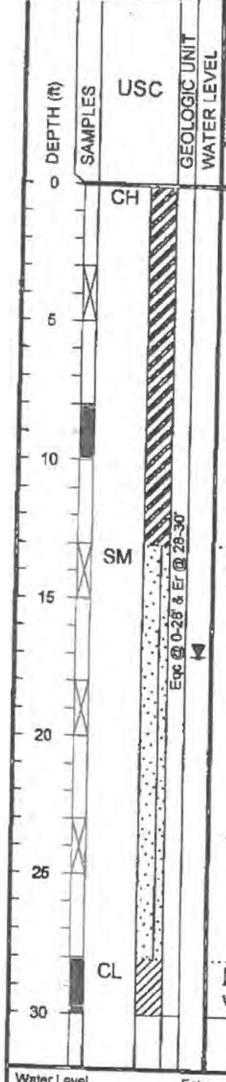
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-15

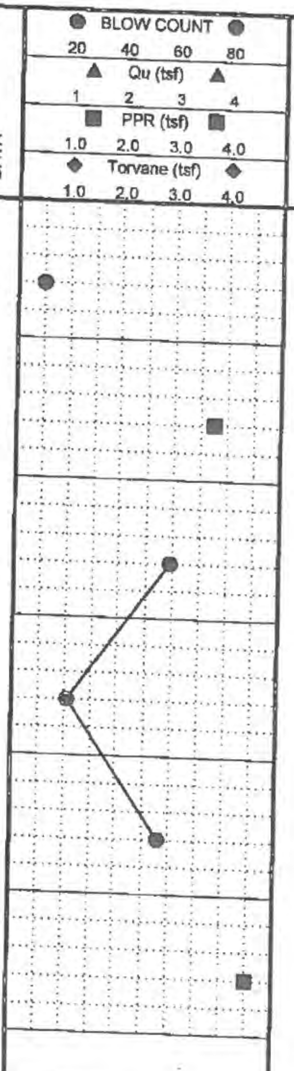
PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas
DRILL RIG:
PROJECT NO.: G4207-146
BORING TYPE: Flight Auger

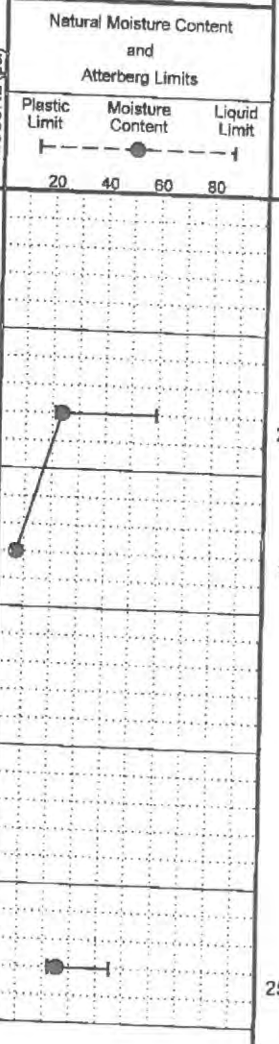
DATE 10/14/14
SURFACE ELEVATION 348.2



MATERIAL DESCRIPTION

MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
FAT CLAY(CH) stiff; reddish brown and light gray; moist; mottled	N=10										
--very stiff; light gray, grayish brown and reddish brown; moist; layered	P=3.75					24	59	21	38	85	+40 Sieve=0% +4 Sieve=0%
SILTY SAND(SM) very dense; light brown; dry	N=59					7				12	+40 Sieve=0% +4 Sieve=0%
--medium dense; wet	N=21										
--very dense	N=56										
LEAN CLAY(CL) hard; dark brown; moist; with silt partings	P=4.5					25	45	22	23	92	+40 Sieve=0% +4 Sieve=0%
Bottom of Boring @ 30'											





Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 19' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04857°, W94.84286°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

ARCADIS

Appendix B

Photographic Log

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 1

Date: 8/20/2015

Direction Photo Taken:

North

Description:
Staging area west of landfill.

P8200493

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 2

Date: 8/20/2015

Direction Photo Taken:

South Southeast

Description:

Potential wetland on the top (west) end of the Primary Ash Pond.

P8200495

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 3 **Date:** 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Ditch between road and railway west of landfill, this ditch would be non-jurisdictional.

P8200497

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 4 **Date:** 8/20/2015

Direction Photo Taken:

Northeast

Description:

Ground Water Monitoring Well AD-12 near northwest end of landfill.

P8200501

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 5

Date: 8/20/2015

Direction Photo Taken:

East Northeast

Description:

View of plant from top of landfill. Primary ash pond is within the wooded area on left.

P8200506

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 6

Date: 8/20/2015

Direction Photo Taken:

East Northeast

Description:

Drainage canal that drains from primary ash pond to clear water pond.

P8200510

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 7 **Date:** 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Vegetated strip between landfill and road. This would be isolated due to lack of connectivity.

P8200521

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 8 **Date:** 8/20/2015

Direction Photo Taken:

North

Description:

Dike between landfill and primary ash pond. Facility in the background.

P8200522

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 9

Date: 8/20/2015

Direction Photo Taken:

West

Description:

Vegetated strip between landfill and road. This area would be isolated due to lack of connectivity.

P8200527

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 10

Date: 8/20/2015

Direction Photo Taken:

North Northeast

Description:

Road east of landfill running toward facility and clear water pond.

P8200530

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 11

Date: 8/20/2015

Direction Photo Taken:

South

Description:

Top of landfill.

P8200534

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 12

Date: 8/20/2015

Direction Photo Taken:

Southeast

Description:

View of lined bottom ash storage pond.

P8200538

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 13 **Date:** 8/20/2015

Direction Photo Taken:

Southeast

Description:

Lined bottom ash storage pond.

P8200545

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 14 **Date:** 8/20/2015

Direction Photo Taken:

South

Description:

Southside of lined bottom ash storage pond.

P8200547

ARCADIS

PHOTOGRAPHIC LOG

Project Name:

AEP – J. ROBERT WELSH POWER PLANT

Location:

PITTSBURG, TITUS COUNTY, TEXAS

Project No.

OK001625.0001

Photo No. 15

Date: 8/20/2015

Direction Photo Taken:

West

Description:

East side of lined bottom ash storage pond.

P8200560

ARCADIS

PHOTOGRAPHIC LOG

Project Name:

AEP – J. ROBERT WELSH POWER PLANT

Location:

PITTSBURG, TITUS COUNTY, TEXAS

Project No.

OK001625.0001

Photo No. 16

Date: 8/20/2015

Direction Photo Taken:

North

Description:

Upland with pine and ground water monitoring well AD-2 south of lined bottom ash storage pond.

P8200563

ARCADIS

PHOTOGRAPHIC LOG

Project Name:

AEP – J. ROBERT WELSH POWER PLANT

Location:

PITTSBURG, TITUS COUNTY, TEXAS

Project No.

OK001625.0001

Photo No. 17

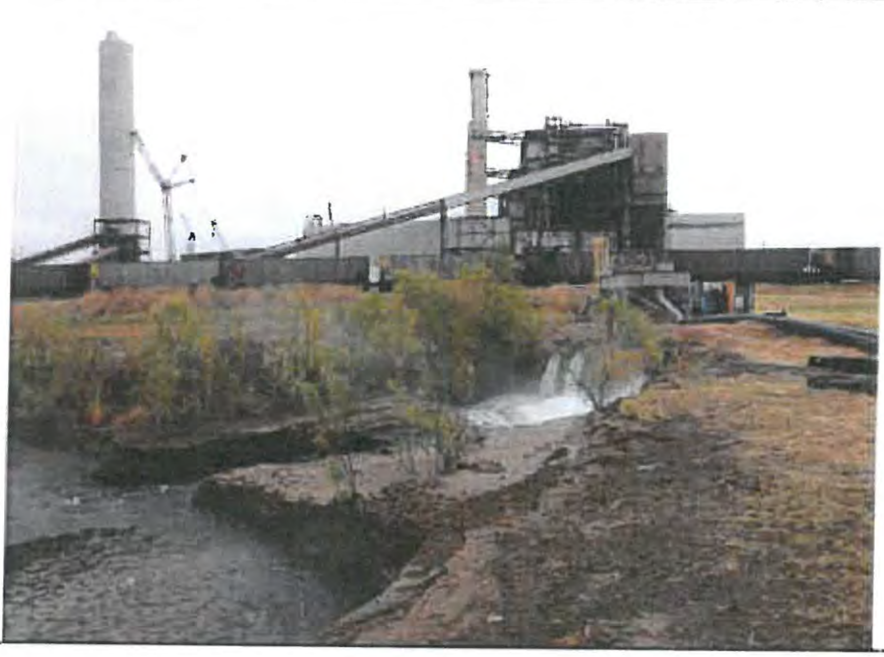
Date: 8/20/2015

Direction Photo Taken:

Description:

Outflow of water from plant into the northeast portion of the Primary Ash Pond.

P8200577



ARCADIS

PHOTOGRAPHIC LOG

Project Name:

AEP – J. ROBERT WELSH POWER PLANT

Location:

PITTSBURG, TITUS COUNTY, TEXAS

Project No.

OK001625.0001

Photo No. 18

Date: 8/20/2015

Direction Photo Taken:

South Southwest

Description:

Northeast portion of primary ash pond, view facing south-southwest.

P8200578

1.3 – Landfill – CCR Location Restriction Evaluation, May 2, 2016

American Electric Power Service Corporation

Landfill – CCR Location Restriction Evaluation

J. Robert Welsh Power Plant
1187 County Road 4865
Titus County
Pittsburg, Texas

May 2, 2016

ARCADIS

Landfill – CCR Location Restriction Evaluation

J. Robert Welsh Plant
1187 County Road 4865
Titus County
Pittsburg, Texas

Prepared for:
AEP

Prepared by:
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Fax 614 985 9170

Our Ref.:
OH015976.0011

Date:
May 2, 2016

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Geology
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LICENSED
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Kenneth J Brandner

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Senior Project Engineer

Matthew J Lamb

Matthew J. Lamb
Project Manager

John W Holm

John Holm, P.E.
Principal Engineer

Tables

Figures

Appendices

Acronyms and Abbreviation

AEP	American Electric Power Service Cooperation
amsl	above mean sea level
ARCADIS	ARCADIS U.S., Inc.
BAP	bottom ash pond
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
FAP	fly ash pond
FGD	flue gas desulfurization
ft	feet
PTI	Permit to Install
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality

1. Objective

This report was prepared by ARCADIS U.S., Inc. (ARCADIS) for American Electric Power Service Corporation (AEP) to assess the location of the existing landfill relative to the location restrictions included in the Coal Combustion Residual (CCR) requirements, as specified in the Code of Federal Regulations (CFR) 40 CFR 257.60 to 257.64, at the AEP Generating Plant (Plant) located at 1187 County Road 4865 in Pittsburg, Titus County, Texas (**Figure 1**). The CCR requirements include an evaluation of the adequacy of the groundwater monitoring well network to characterize groundwater quality up and down gradient of the CCR unit and an evaluation of whether the CCR unit meets up to 5 location restrictions, which for new landfills, existing and new CCR surface impoundments, and lateral expansions include: the base of the CCR unit is 5 feet (ft) above the uppermost aquifer, the CCR unit may not be located in a wetland, within 200 ft of the damage zone of a fault that has displacement during the Holocene, within a seismic impact zones, or in an unstable area. However, because the subject CCR unit for this report is an existing landfill with no lateral expansions, this CCR unit is subject to one location restriction: unstable area.

Three regulated CCR units associated with the Plant were identified for review, which include the primary ash pond, existing landfill, and bottom ash storage pond (**Figure 2**). This report summarizes the evaluation of the location restriction criteria for the existing landfill (landfill). The evaluation of the groundwater monitoring well network in the uppermost aquifer is not included in this report and will be completed under separate cover.

This evaluation included a review of AEP-provided data associated with previously completed subsurface investigation activities in the vicinity of the landfill CCR unit, as well as publically-available geologic and hydrogeologic data. The following report also presents the current Conceptual Site Model based on documents reviewed and will further describe the uppermost aquifer.

2. Background Information

The following section provides background information for the AEP J. Robert Welsh Generating Plant landfill.

2.1 Facility Location Description

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The landfill CCR unit is located approximately 2,000 feet southwest of the Plant generating units, directly south of the primary ash pond CCR unit, and approximately 800 feet west of the Welsh Reservoir (**Figures 1** and **2**).

2.2 Description of Landfill CCR Unit

The following section will discuss the embankment configuration, area, volume, construction and operational history, and surface water control associated with the landfill.

2.2.1 Embankment Configuration

The landfill was placed into operation in approximately 1977, and is located in a topographically high area south of the primary ash pond. The landfill is approximately 40 acres in size, and is located directly above native clayey soils. The base of the landfill ranges in elevation from approximately 355 feet amsl on the west side to 345 feet amsl on the east side. These landfill base elevations were confirmed by soil borings installed through the landfill in 2014 (ETTL, 2015).

The western two thirds of the landfill is used as a temporary storage and processing area for marketable ash material that is sold for beneficial reuse including road base material. The eastern third of the landfill is an approximate 13-acre active ash disposal area where ash is placed above the base of the landfill to a top surface elevation that currently ranges from approximately 364 to 380 feet amsl. In the future, the top planned elevation of the landfill will be approximately 430 feet amsl (ETTL, 2015).

Ash material had previously been placed into the landfill against an earthen embankment with 2:1 side slopes (2 feet horizontal, 1 foot vertical). However, to reduce the potential for slope failure, the side slopes of the landfill embankment were re-graded to 3:1 (3 feet horizontal, 1 foot vertical) in 2010. Horizontal benches approximately 25 feet wide are also planned to be emplaced into the side slopes at approximate elevations of 373 feet amsl (Level 1 bench) and 400 feet amsl (Level 2 bench) (ETTL, 2015).

2.2.2 Area/Volume

The landfill occupies an area of approximately 40 acres. A capacity analysis of the landfill was conducted by AEP in 2008 (AEP, 2008). The capacity analysis concluded the landfill has a maximum ash storage capacity of approximately 1,770,000 cubic yards beyond April 2008. Based on soil borings installed through the landfill (ETTL, 2015), the maximum ash thickness is approximately 33 feet, and the average ash thickness within the 40-acre landfill is approximately 20 feet. This corresponds to a current ash volume of approximately 800 acre-feet (1,290,000 cubic yards).

2.2.3 Construction and Operational History

The AEP J. Robert Welsh Plant began operations in 1977 with three coal-fired generating units (Units 1, 2, and 3). Throughout the life of the generating plant, CCR materials (fly ash, bottom ash, economizer ash) have been generated. All of these byproducts were stored in the primary ash pond or in the landfill that was constructed in the late 1970's. In 2000, the 22-acre bottom ash storage pond was installed south of the landfill (**Figure 3**).

The landfill received fly ash, bottom ash, and economizer ash from the generating plant. The ash was sluiced to the landfill between approximately 1982 and 2000. Now dry ash is trucked to the landfill. The landfill is also utilized for disposal of ash dredged from the Bottom Ash Storage Pond that was constructed in 2000. The ash is currently stored in the eastern third of the landfill, and the western two thirds of the landfill is currently used as a temporary storage and processing area for marketable ash material that is sold for beneficial reuse, loaded into trucks, and transported offsite for reuse (highway road base, etc.).

2.2.4 Surface Water Control

Surface water flow within the landfill is controlled by drainage ditches at the north and east toes of the landfill. Surface water in the drainage ditches flows to a culvert at the northeast corner of the landfill, then discharges into the primary ash pond directly north of the landfill.

2.3 Previous Investigations

The initial soils investigation for the site was provided in a 1973 report prepared by McClelland Engineers, Inc. entitled "*Soils Investigation, Welsh Power Plant, Cason, Texas*". This investigation included advancement of soil borings in the primary ash pond area, and geotechnical soil testing to characterize the area encompassed by the primary ash pond.

In 2001, five monitoring wells (AD-1 through AD-5) were installed in the area of the primary ash pond and bottom ash storage pond to obtain hydrologic data for the uppermost water-bearing unit. Twelve additional monitoring wells (AD-4a, AD-4b, AD-4c, AD-6 through AD-14) were installed in the area of the primary ash pond, bottom ash storage pond, and landfill by Eagle Environmental Services in 2009 to obtain more detailed hydrologic data for the uppermost water-bearing unit. In December 2015, Auckland Consulting further expanded the groundwater monitoring well system at the Plant by installation of monitoring wells AD-15 through AD-18 (Auckland Consulting, 2016). Monitoring well completion diagrams are provided in **Appendix A.**

In 2015, ETTL conducted a *Geotechnical Investigation* of the Landfill (ETTL, 2015). The report concluded the risk of slope failure due to liquefaction is very low, and recommended regrading of the top surface of the existing ash at the southeast corner of the landfill to eliminate ponding of surface water. The report also recommended dredged ash be spread out to drain water prior to placement in the landfill, emplacement of a 3-foot-thick clay cap on the existing side slopes in the eastern third of the landfill on a 3:1 slope (3 feet horizontal, 1 foot vertical), and improve drainage along the toe of the eastern third of the landfill using either horizontal drains at the toe of the slope or trenches containing perforated pipe with a geotextile cover.

2.4 Hydrogeologic Setting

The site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently southeast. The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966).

These features are further illustrated on five lines of cross section that were prepared through the landfill area, with three lines trending from west to east (A-A'; B-B'; C-C'), and the other two lines trending from north to south (D-D'; E-E'). The cross section location map is included as **Figure 3** and the lines of cross section are included as **Figure 4** (A-A') through **Figure 8** (E-E').

2.4.1 Climate and Water Budget

The climate of Titus County, Texas is moist sub-humid. Average temperatures range from 45° Fahrenheit (F) in January to 82.9°F in July. The mean annual growing season is 228 days (Broom, 1965). Average annual precipitation (including liquid water equivalent from snowfall) is approximately 47 inches according to weatherdb.com.

2.4.2 Regional and Local Geologic Setting

The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966). The Recklaw Formation attains a thickness of approximately 110 feet in Titus County, and is underlain by the Eocene-age Carrizo Sand which consists of fine to coarse sand, silt, and clay (Broom, 1965). In the topographically low areas underlying the Welsh Reservoir to the east of the CCR units, Quarternary alluvial sediments associated with the Swauano Creek are present Flawn, 1966).

Detailed regional geologic characterization can be found in several published reports including Texas Water Commission Bulletin 6517 "*Ground-Water Resources of Camp, Franklin, Morris and Titus Counties, Texas*" (Broom, 1965), and The University of Texas at Austin Bureau of Economic Geology "*Geologic Atlas of Texas – Texarkana Sheet*" (Flawn, 1966).

Detailed regional and site geologic characterization can be found in the 2015 ETTL report entitled "*Geotechnical Investigation, Phase 1 Landfill Seepage Evaluation and Vertical Expansion, Pittsburg, Texas"* (ETTL, 2015).

2.4.3 Surface Water and Surface Water Groundwater Interactions

The Site is generally less than one-half mile from Swauano Creek, which was dammed near the southern end of the site during plant development to form the Welsh Reservoir. Groundwater flow direction at the Site is generally from west to east, following surface topography towards the Welsh Reservoir. The Welsh Reservoir is likely a gaining surface water feature, and groundwater elevations on site are higher than the normal stage elevation of the Welsh Reservoir (approximately 320 feet amsl).

Figure 9 is a potentiometric surface map based on March 2016 water level data for the uppermost water bearing unit at the Site, and water level elevations in the Site monitoring wells are summarized on **Table 1**. As shown on **Figure 9**, shallow groundwater flow direction in the area of the landfill is easterly toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.01 foot per foot.

2.4.4 Water Users

A water well inventory conducted by Banks Information Solutions showed one water well within a ½-mile radius of the Site (Banks, 2013). The water well is located on-site to the northwest (up gradient) of the landfill, and was installed for Southwestern Electric Company in 1974 with a screened interval from 515 to 535 ft below ground surface, and plugged at a later date.

3. Unstable Areas

CCR Rule 40 CFR Part 257.64 requires that existing landfills must not be located within an unstable area unless the owner or operator demonstrates that the design of the unit will ensure the integrity of the structural components of the unit.

3.1 Definition of Unstable Area and local Conditions

3.1.1 CCR Rule Definition

CCR Rule 40 CFR Part 257.53 defines an unstable area as a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of the CCR unit. These may include poor foundation conditions, areas susceptible to mass movements (landslides), and karst terrains.

3.1.2 Poor Foundation Soils

A soil stability report has been prepared for the landfill by ETTL in 2015. This report stated the native soil profile beneath the landfill consists generally of 5 to 15 feet of clay, and report concluded the foundation soils are not susceptible to liquefaction, and seismicity in not generally a concern (ETTL, 2015).

3.1.3 Mass Movements

The eastern third of the landfill (approximate 13-acre area) currently contains ash up to 33 feet in height above the native clayey soils. The ETTL 2015 soil stability report indicated a potential for shallow surface slides up to about 5 feet deep in the eastern third of the landfill in areas where the side slopes are saturated by rainfall and where weak (loose granular uncemented) ash constituent is present. The report recommended re-grading the top surface of the existing ash at the southeast corner of the landfill to eliminate ponding of surface water. The report also recommended dredged ash be spread out to drain water prior to placement in the landfill, emplacement of a 3-foot-thick clay cap on the existing ash side slopes in the eastern third of the landfill on a 3:1 slope (3 feet horizontal, 1 foot vertical), and improve drainage along the toe of the eastern third of the landfill using either horizontal drains at the toe of the slope or trenches containing perforated pipe with a geotextile cover.

3.1.4 Karst

The site area is located on the outcrop of unconsolidated Cretaceous Formations consisting predominantly of sand and clay (Broom, 1965; Flawn, 1966). The landfill is not located in a karst area.

3.1.5 Subsurface Mining

No subsurface mines are known to exist below the CCR units at the Site.

3.2 Compliance with Unstable Areas Restriction

Based on our site visit and review of available information, the landfill is not currently located within unstable areas. Therefore, this CCR unit meets the location restriction requirements for unstable areas. However, future vertical expansion of the landfill is planned, and the ETTL 2015 soil stability report indicated a potential for shallow surface slides up to about 5 feet deep in the eastern third of the landfill in areas where the side slopes are saturated by rainfall and where weak (loose granular uncemented) ash constituent is present. The report recommended re-grading the top surface of the existing ash at the southeast corner of the landfill to eliminate ponding of surface water. The report also recommended dredged ash be spread out to drain water prior to placement in the landfill, emplacement of a 3-foot-thick clay cap on the existing ash side slopes in the eastern third of the landfill on a 3:1 slope (3 feet horizontal, 1 foot vertical), and improve drainage along the toe of the eastern third of the landfill using either horizontal drains at the toe of the slope or trenches containing perforated pipe with a geotextile cover.

4. Summary, Conclusions, and PE Certification

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, as well as the evaluations discussed within this report, the J. Robert Welsh Power Plant landfill meets the CCR existing landfill restrictions of 40 CFR Part 257 for unstable areas. However, prior to future vertical expansion of the landfill, the recommendations provided in the ETTL 2015 *Geotechnical Investigation* report should be implemented.

Kenneth J. Brandner
Printed Name of Registered Professional Engineer

Kenneth J Brandner
Signature

KENNETH J. BRANDNER
69586

69586
Registration No.

Texas
Registration State

5-2-16
Date

5. References

AEP. 2008. "Welsh Plant Existing Landfill Capacity Analysis", August 2008.

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Tables

Table 1
Water Level Data
AEP J. Robert Welsh Power Plant - CCR Storage Areas
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Screen		Bottom of Screen		6/7/2011	12/6/2011	5/2/2012	11/1/2012	5/14/2013	11/19/2013	5/12/2014	11/16/2014	5/12/2015	3/4/2016
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																						
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57	338.46	334.92	337.88	337.18	337.43	336.73	338.03	337.64	340.82	342.83
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16	330.16	329.07	330.00	329.26	329.83	329.70	330.09	329.69	332.56	332.32
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10	323.81	323.19	323.99	323.29	323.77	323.98	324.12	323.28	325.58	325.12
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61	324.81	324.84	324.62	324.40	324.74	325.52	325.44	325.13	327.00	326.90
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19	325.01	324.19	325.24	322.90	324.86	324.68	325.64	325.34	327.19	327.12
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55	324.35	324.32	324.50	324.30	324.30	325.21	325.22	324.90	326.58	326.67
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15	324.18	324.50	324.64	324.37	324.11	325.06	325.01	324.71	326.50	326.19
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00	336.34	336.58	336.82	336.99	336.78	336.47	336.80	336.01	339.07	338.04
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31	333.04	333.02	332.83	333.02	333.11	332.81	333.11	332.81	333.38	334.00
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86	334.32	334.12	334.19	334.20	334.13	334.58	333.77	333.98	334.09	333.61
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53	325.41	324.09	325.69	325.15	325.79	325.75	325.98	325.77	326.05	325.70
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32	328.46	328.53	328.63	328.44	328.74	329.38	NM	330.18	329.98	329.74
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23	323.44	322.55	323.27	323.35	323.51	323.76	323.57	323.88	323.95	323.55
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61	327.99	328.37	327.82	327.93	327.94	328.13	328.20	327.97	328.96	328.13
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27	348.30	348.29	349.86	349.56	349.99	349.65	349.89	350.01	350.65	350.39
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12	332.36	332.24	333.09	332.26	332.68	333.25	333.35	332.01	337.58	334.76
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32	330.40	329.80	331.67	330.34	330.94	331.69	332.12	330.17	336.63	334.83
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71	---	---	---	---	---	---	---	---	---	322.14
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86	---	---	---	---	---	---	---	---	---	337.09
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99	---	---	---	---	---	---	---	---	---	334.64
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17	---	---	---	---	---	---	---	---	---	343.66
Piezometers																						
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

NM - Not measured.

(a) Source: Eagle Environmental Services Well Logs (2009).

(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).

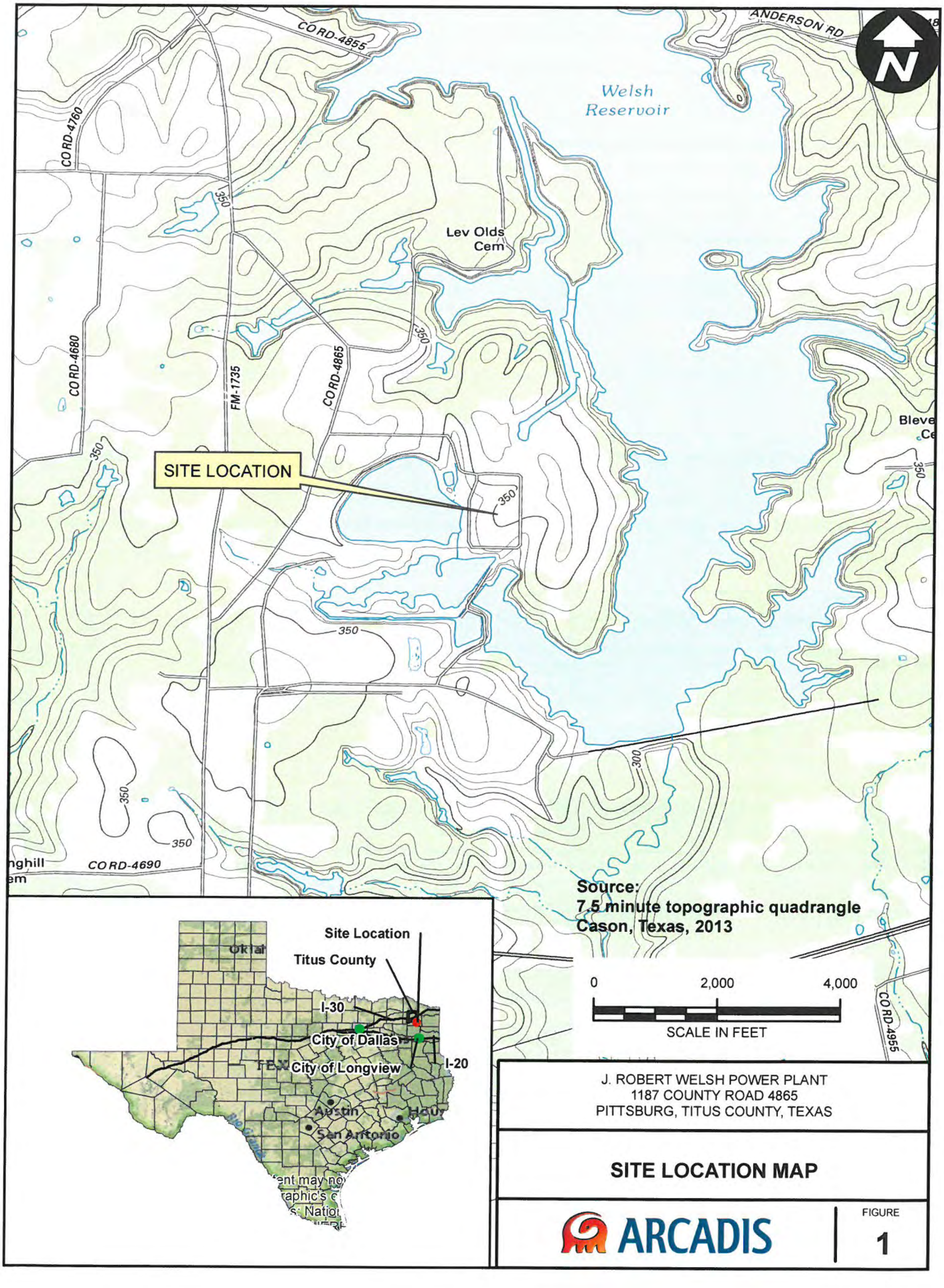
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).

(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.

Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through March 2016.

ARCADIS

Figures



Source:
7.5 minute topographic quadrangle
Cason, Texas, 2013

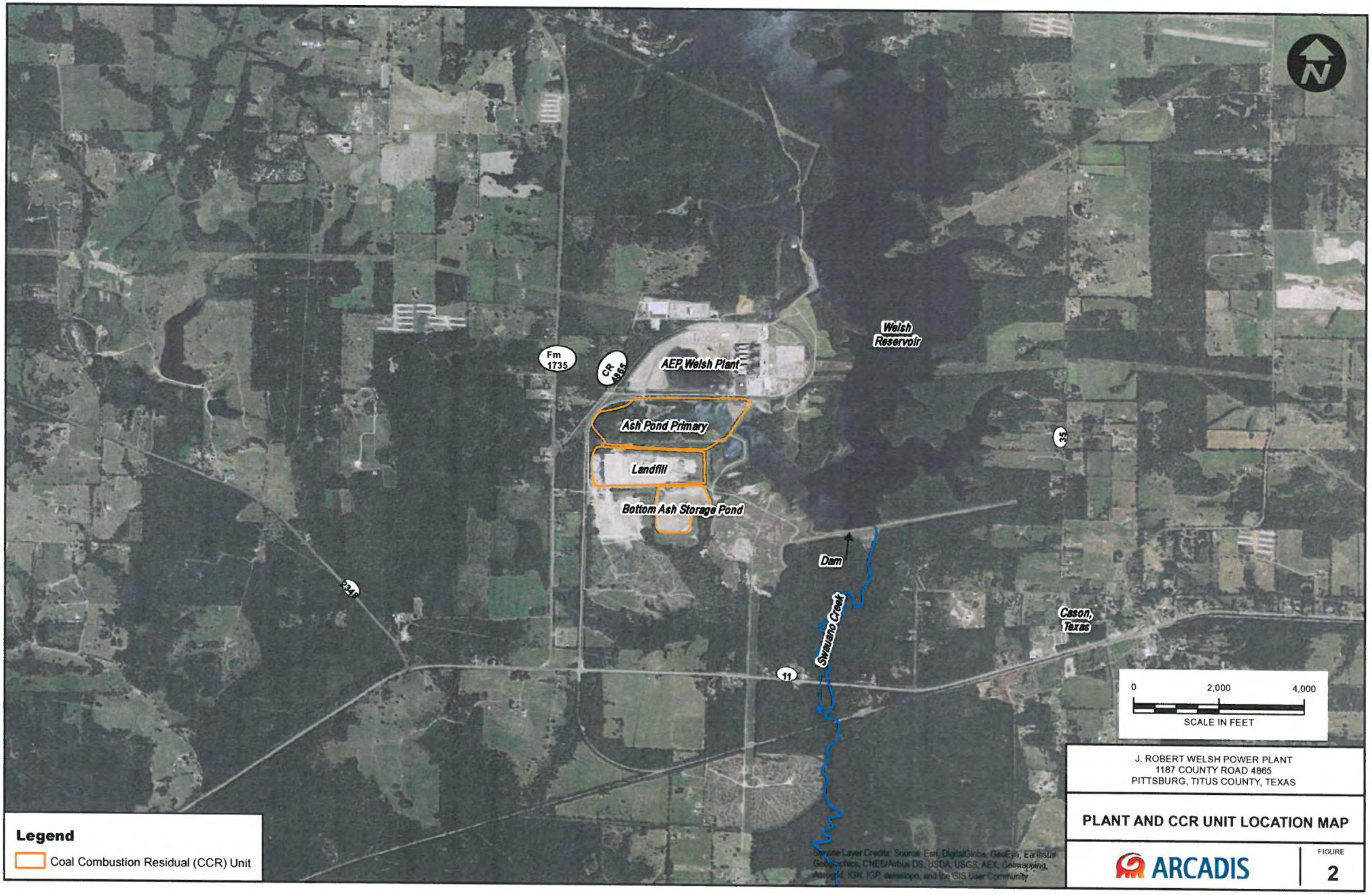
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LOCATION MAP

ARCADIS

FIGURE
1

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 1 - site map.mxd



Legend

🟧 Coal Combustion Residual (CCR) Unit

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

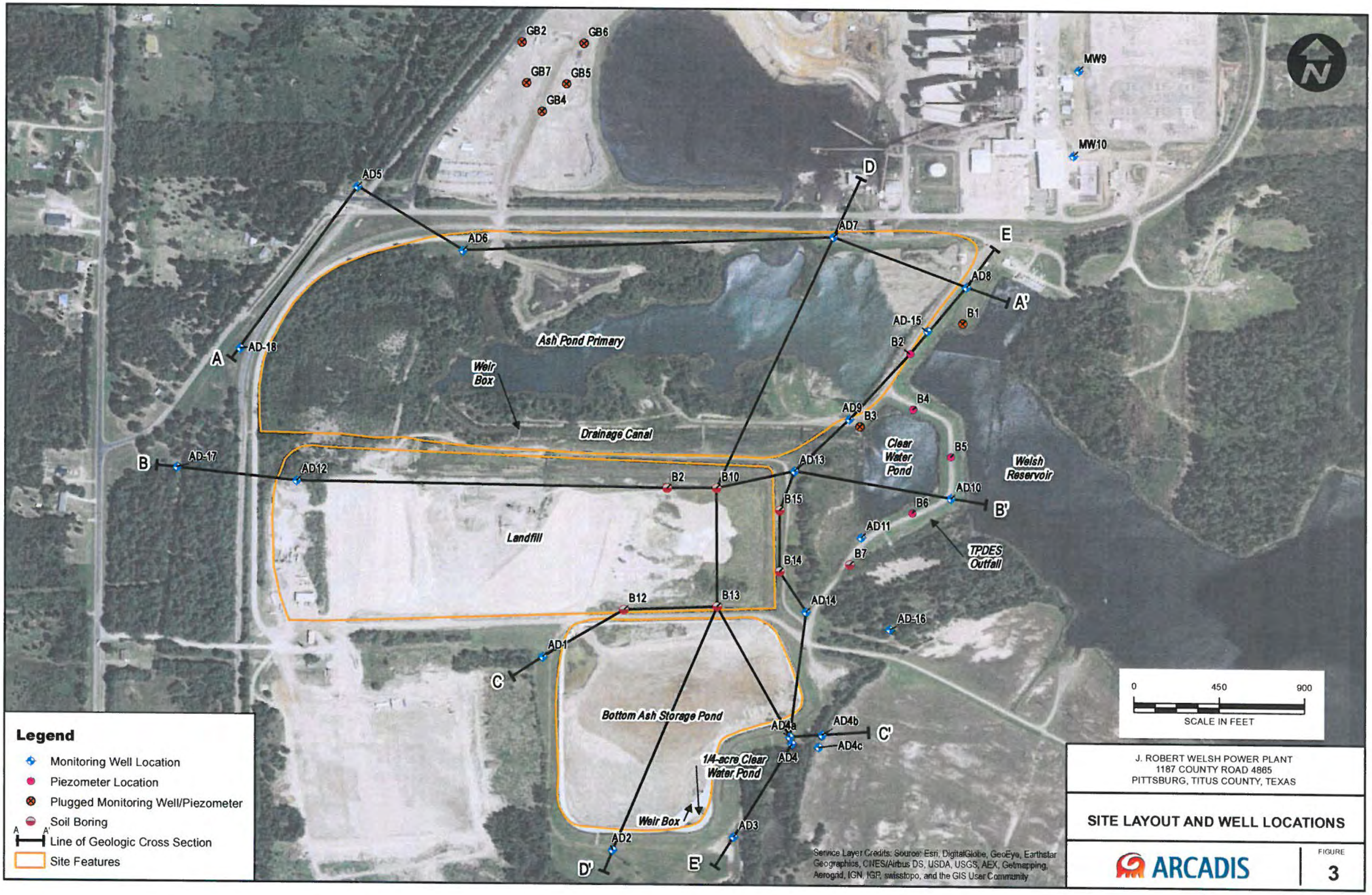
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PLANT AND CCR UNIT LOCATION MAP

ARCADIS

FIGURE
2

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 2 - CCR location.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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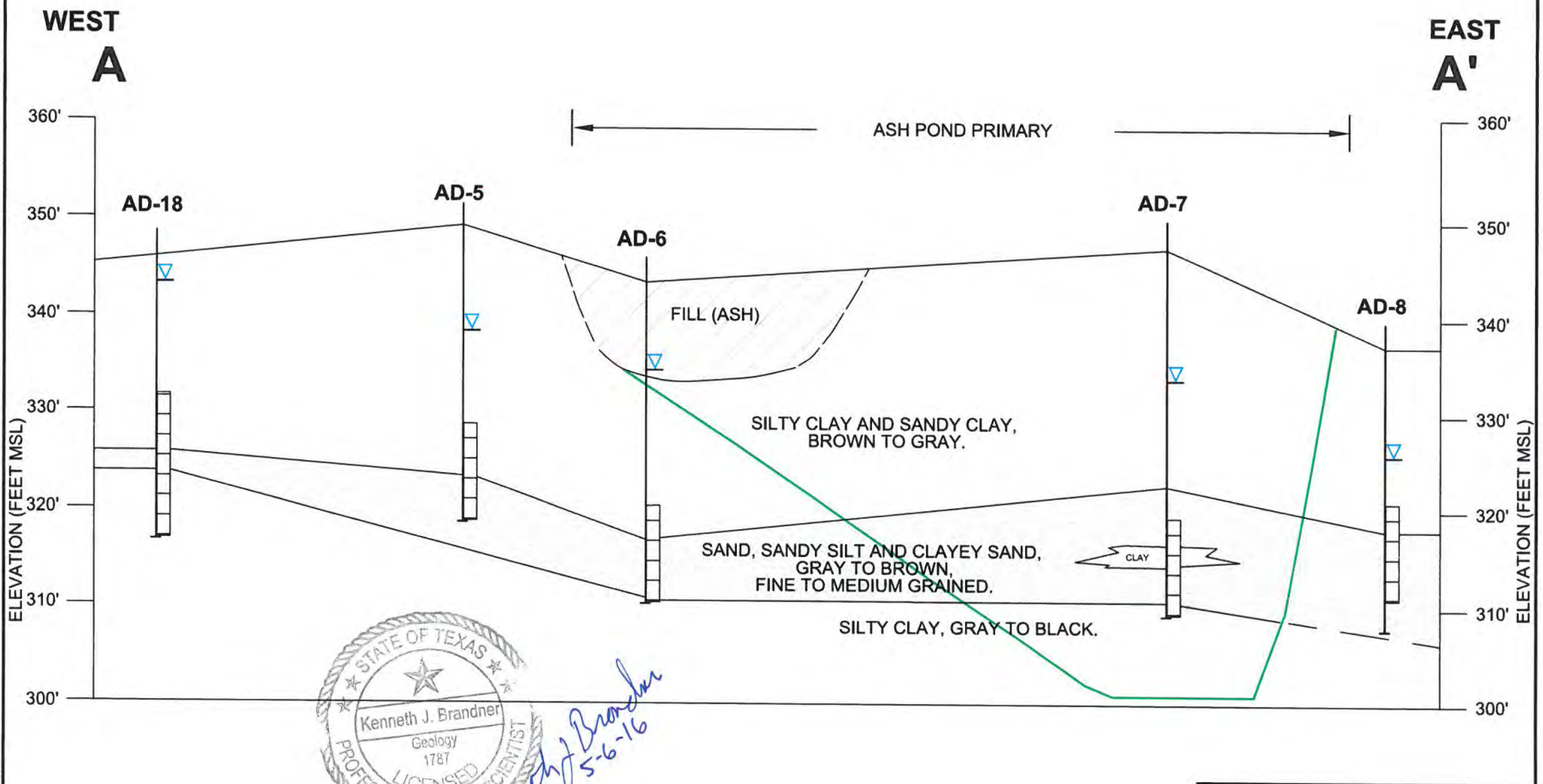
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LAYOUT AND WELL LOCATIONS

ARCADIS

FIGURE
3



Kenneth J. Brandner
Geology
1787

Kenneth J Brandner
5-6-16

0 300'
HORIZONTAL SCALE

NOTE: BASE OF ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

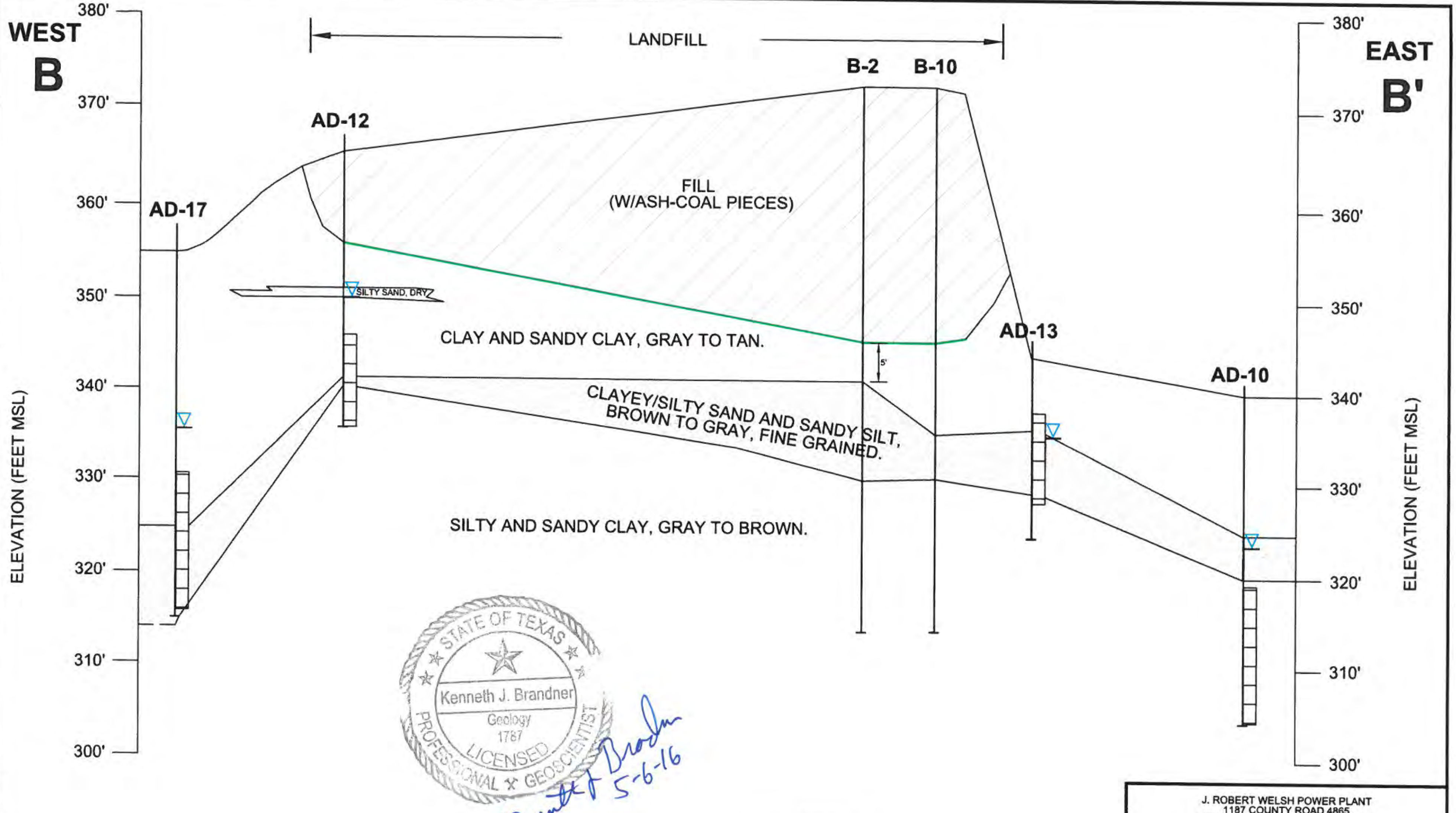
⊟	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	PROJECTED BASE OF ASH POND (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
A - A'

ARCADIS

FIGURE
4



Kenneth J. Brandner
Geology
1787

Kenneth J Brandner 5-6-16

0 300'
HORIZONTAL SCALE

NOTE: BASE OF LANDFILL ELEVATION TAKEN FROM "WELSH POWER PLANT- UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12/3/76.

LEGEND

⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	BASE OF LANDFILL (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
B - B'

ARCADIS

FIGURE
5

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 5 Cross Section B-B'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:41 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE:
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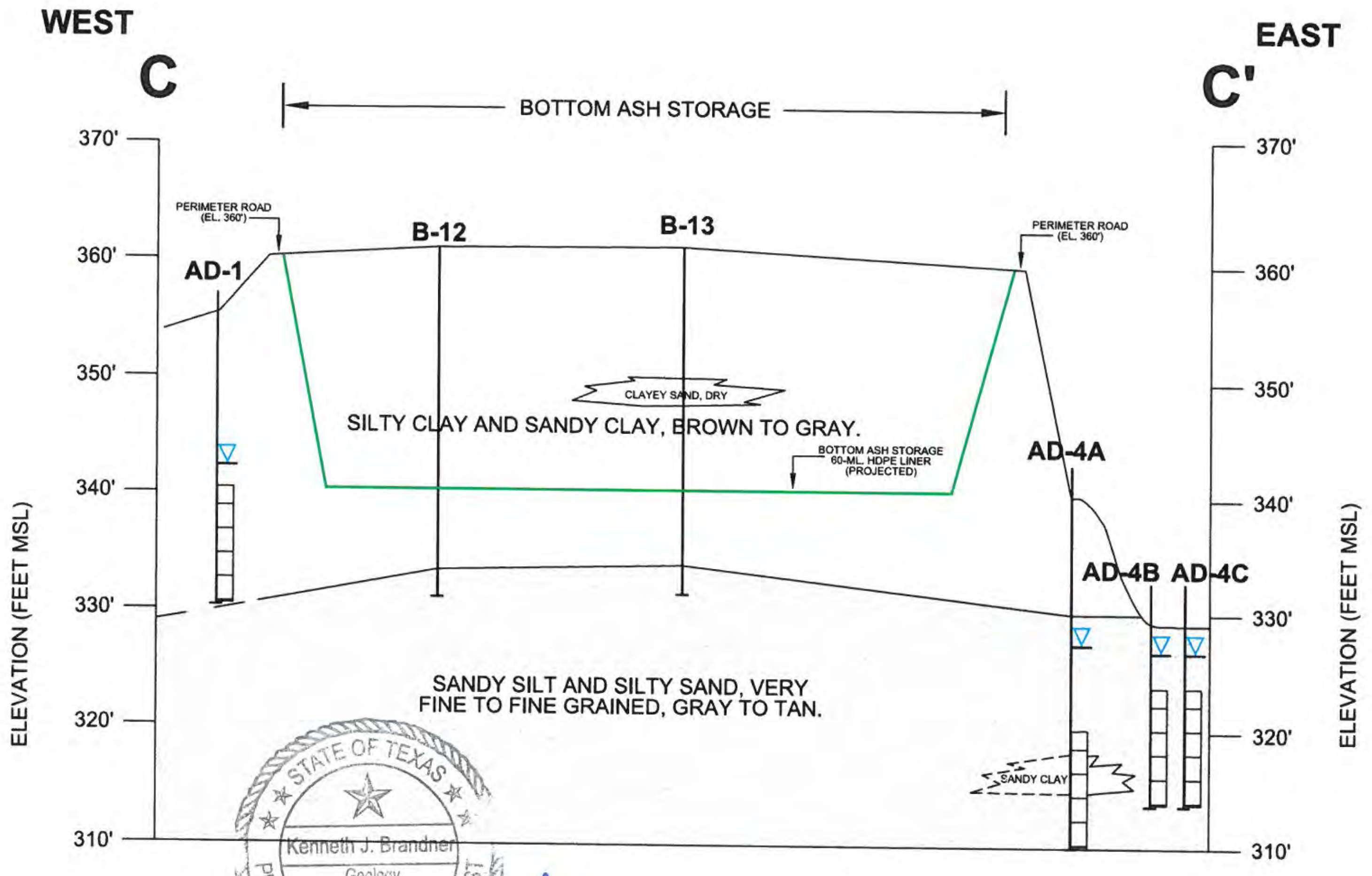

Kenneth J. Brandner
Geology
1787

Kenneth J Brandner
5-6-16

0 200'
HORIZONTAL SCALE

NOTE: BASE OF BOTTOM ASH STORAGE HAS A 60-ML. HDPE LINER AT ELEVATION 340.0', TAKEN FROM FREESE AND NICHOLS "HYDRAULIC ANALYSIS OF WELSH POWER PLANT ASH PONDS, AMERICAN ELECTRIC POWER COMPANY", DATED DECEMBER 2010.

LEGEND

⊟	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
C - C'

ARCADIS

FIGURE
6

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ONe*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 6 Cross Section C-C'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:54 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: —
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G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 7 Cross Section D-D'.dwg LAYOUT: MODEL SAVED: 8/26/2015 9:07 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE:
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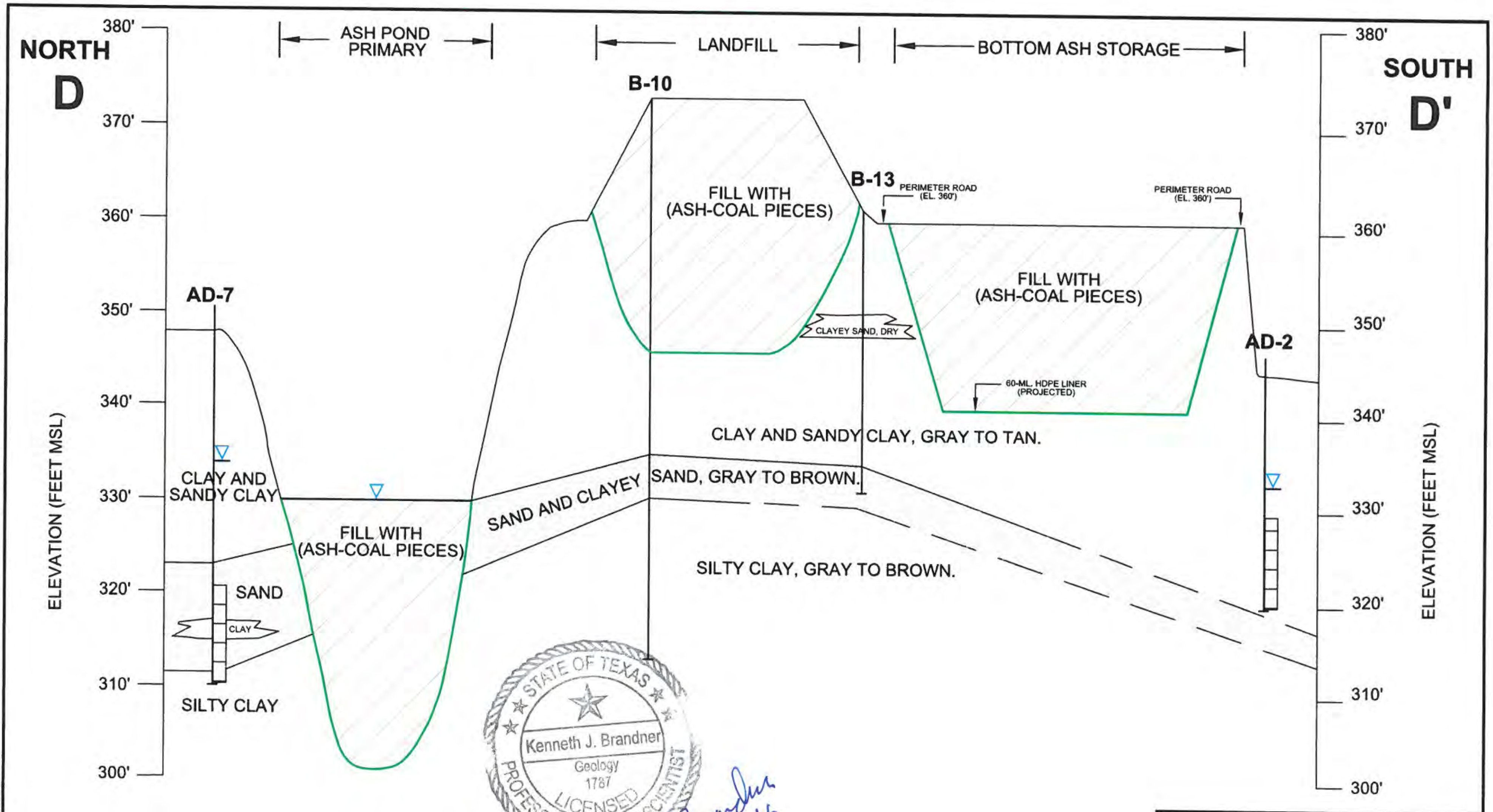


Kenneth J. Brandner
1787
5-6-16

0 300'
HORIZONTAL SCALE

NOTE: BASE OF ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

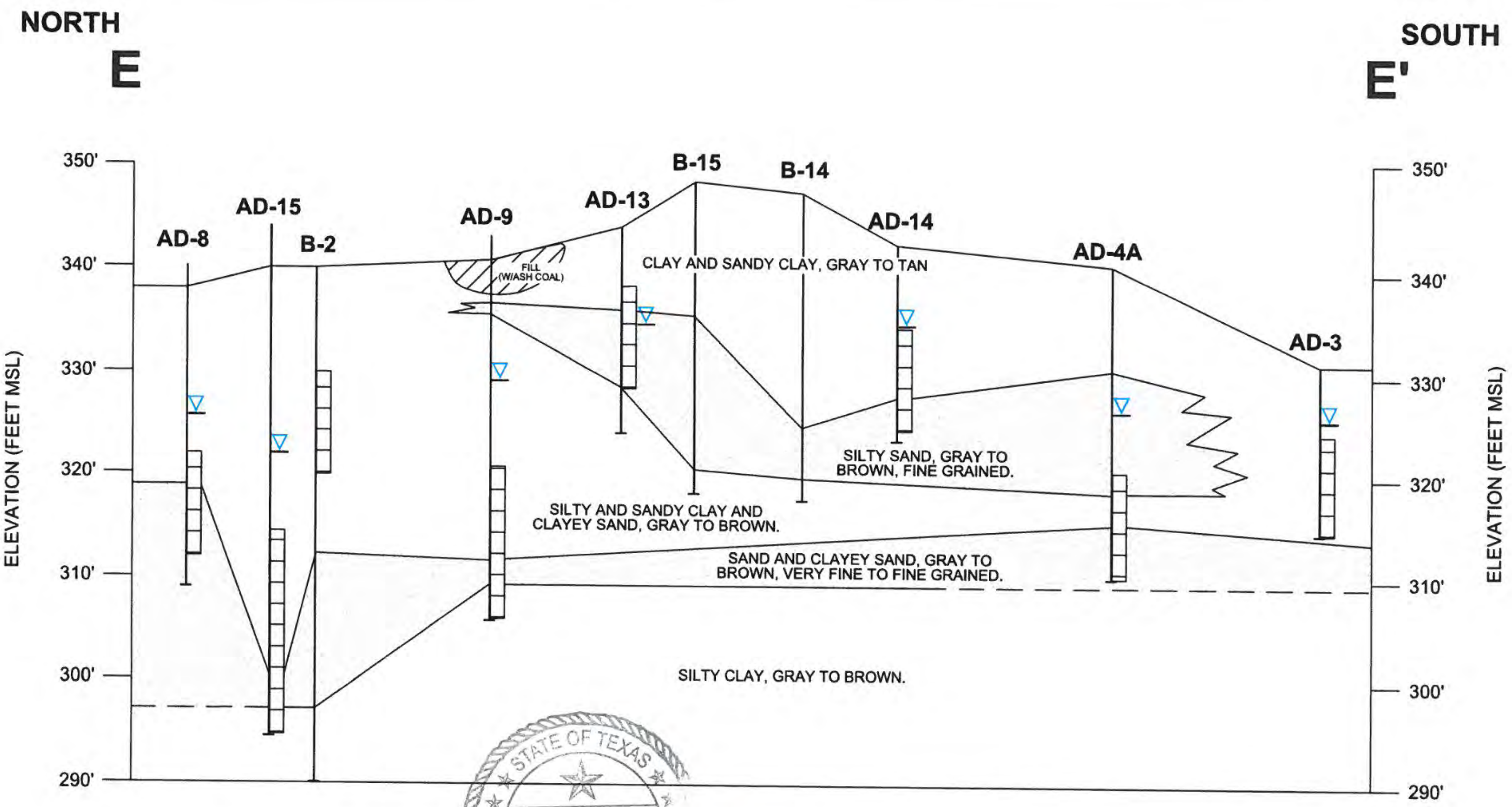
▤	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	BASE OF CCR UNIT

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
D - D'

ARCADIS

FIGURE
7



Kenneth J. Brandner
Geology
1787

Kenneth J. Brandner 5-6-16

0 300'
HORIZONTAL SCALE

LEGEND

⊟ MONITORING WELL SCREENED INTERVAL

▽ WATER LEVEL IN MONITORING WELL (3/4/16)

— PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
E - E'

ARCADIS

FIGURE
8

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 8 Cross Section E-E'.dwg LAYOUT: MODEL SAVED: 3/11/2016 12:06 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE:
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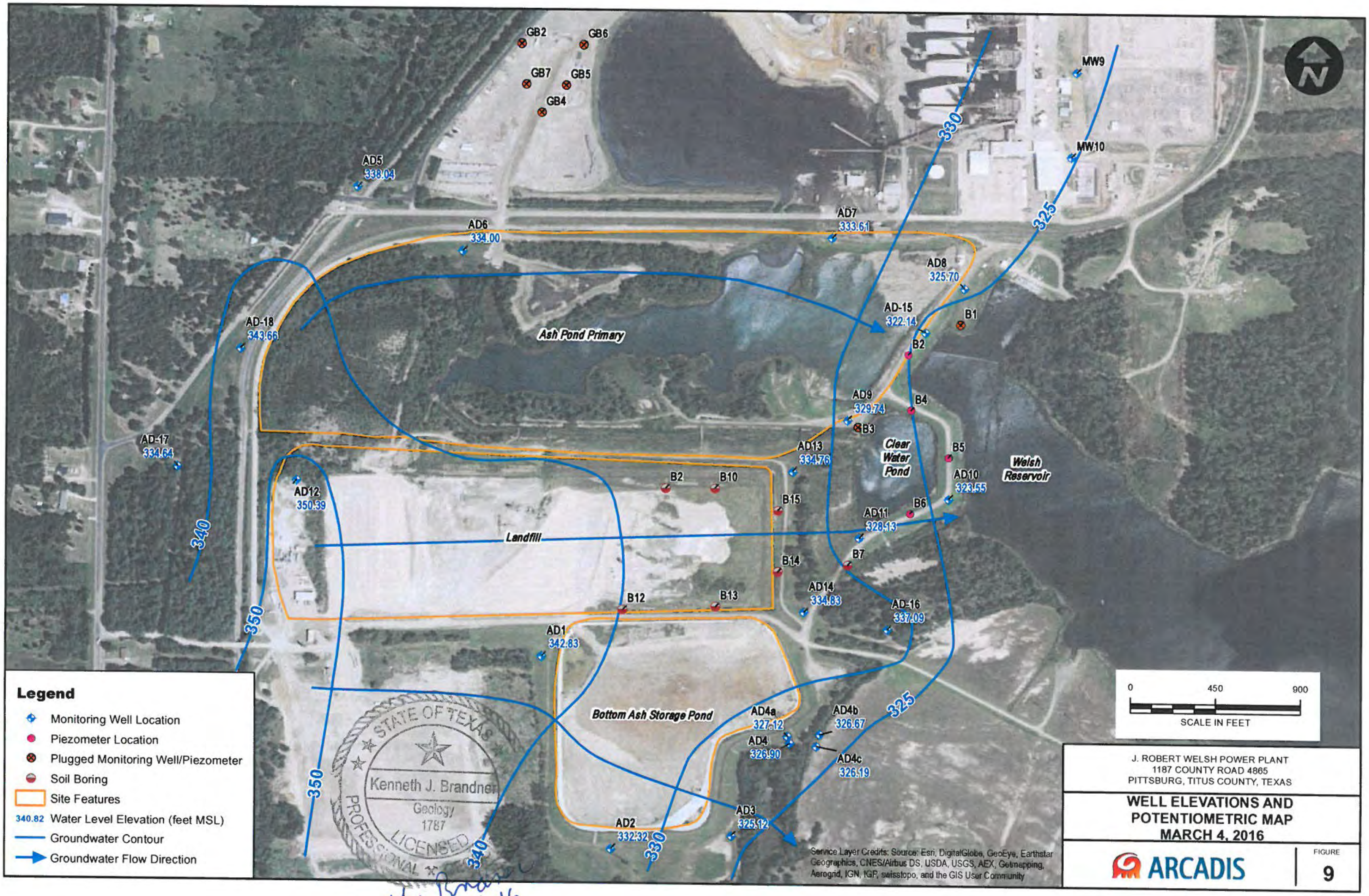


Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

WELL ELEVATIONS AND POTENTIOMETRIC MAP
MARCH 4, 2016

ARCADIS

FIGURE
9

Kenneth J. Brandner
Geology
1787

Kenneth J Brandner
5-6-16

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 9 - Mar2016_POT.mxd

ARCADIS

Appendix A

Boring/Well Construction Logs

AD-1

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4,Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt.4,Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

6) GPS
33°02'48"N
94°50'47"W

N

5) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other____

From (ft.)	To (ft.)	Description and color of formation material
0	25	gray silty clay with some hard red streaks

AP-1

(*Use reverse side if necessary*)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other____

If Gravel Packed give interval ... from 13 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	Sch 40
2	N	#10 slot screen	15	25	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 13 ft. to 0 ft. No. of sacks used 6-50#
____ ft. to ____ ft. No. of sacks used ____
Method used bentonite
Cemented by ____
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance ____

✓10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 12'8" ft. below land surface Date 1-11-01
Artesian flow ____ gpm. Date ____

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other____
Depth to pump bowls, cylinder, jet, etc., ____ ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

✓15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ____ (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS ____ (Street or RFD) (City) (State) (Zip)

(Signed) ____ (Licensed Well Driller) (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-2

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

County ~~Camp~~ Titus

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ PublicSupply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'37"N
94°50'44"W
N↑

6) WELL LOG:
Date Drilling:
Started 4/26 2001
Completed 4/26 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	2	top Soil
2	5	red & gray clay w/ silt
5	10	red & gray clay w/ silt
10	25	gray silty clay w/ tan streaks
		AP-2

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other

If Gravel Packed give interval ... from 12 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	Sch 40
2	N	#10 slot screen	15	25	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 12 ft. to +2 ft. No. of sacks used 5-50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) Gilbert M. R (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-3

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

1) OWNER Southwestern Electrie (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'38"N
94°50'37"W
N

6) WELL LOG:
Date Drilling:
Started 4/26 2001
Completed 4/26 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	17

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	12	gray silty clay w/ tan streaks
12	15	very stiff gray/blood red clay
15	17	Very stiff gray clay w/ red nodules and tan streaks

AP-3

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 5 ft. to 17 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	7	Sch 40
2	N	#10 slot screen	7	17	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 2 ft. to 5 ft. No. of sacks used 2 1/2 - 50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print)
WELL DRILLER'S LICENSE NO. TX 52694 M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller)
(Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-4

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

County ~~Camp~~ Titus

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'43"N
94°50'33"W
N

6) WELL LOG:
Date Drilling:
Started 4/26 19 2001
Completed 4/26 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ______

From (ft.)	To (ft.)	Description and color of formation material
0	5	red silty clay with gray streaks
5 -	30	gray silty clay with red streaks

AP-4

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other ______

If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	19	Sch 40
2	N	#10 slot screen	19	29	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 2 ft. No. of sacks used 8-50#
______ ft. to ______ ft. No. of sacks used ______
Method used bentonite pellets
Cemented by ______
Distance to septic system field lines or other concentrated contamination ______ ft.
Method of verification of above distance ______

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ______ ft. below land surface Date ______
Artesian flow ______ gpm. Date ______

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other NA
Depth to pump bowls, cylinder, jet, etc., ______ ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ______ (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS ______ (Street or RFD) (City) (State) (Zip)

(Signed) ______ (Licensed Well Driller) (Signed) ______ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.: **AD-4A**
TOTAL DEPTH: **30'**
TOP OF CASING ELEV.: **342.85 ft. NGVD**
GROUND SURFACE ELEV.: **340.19 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

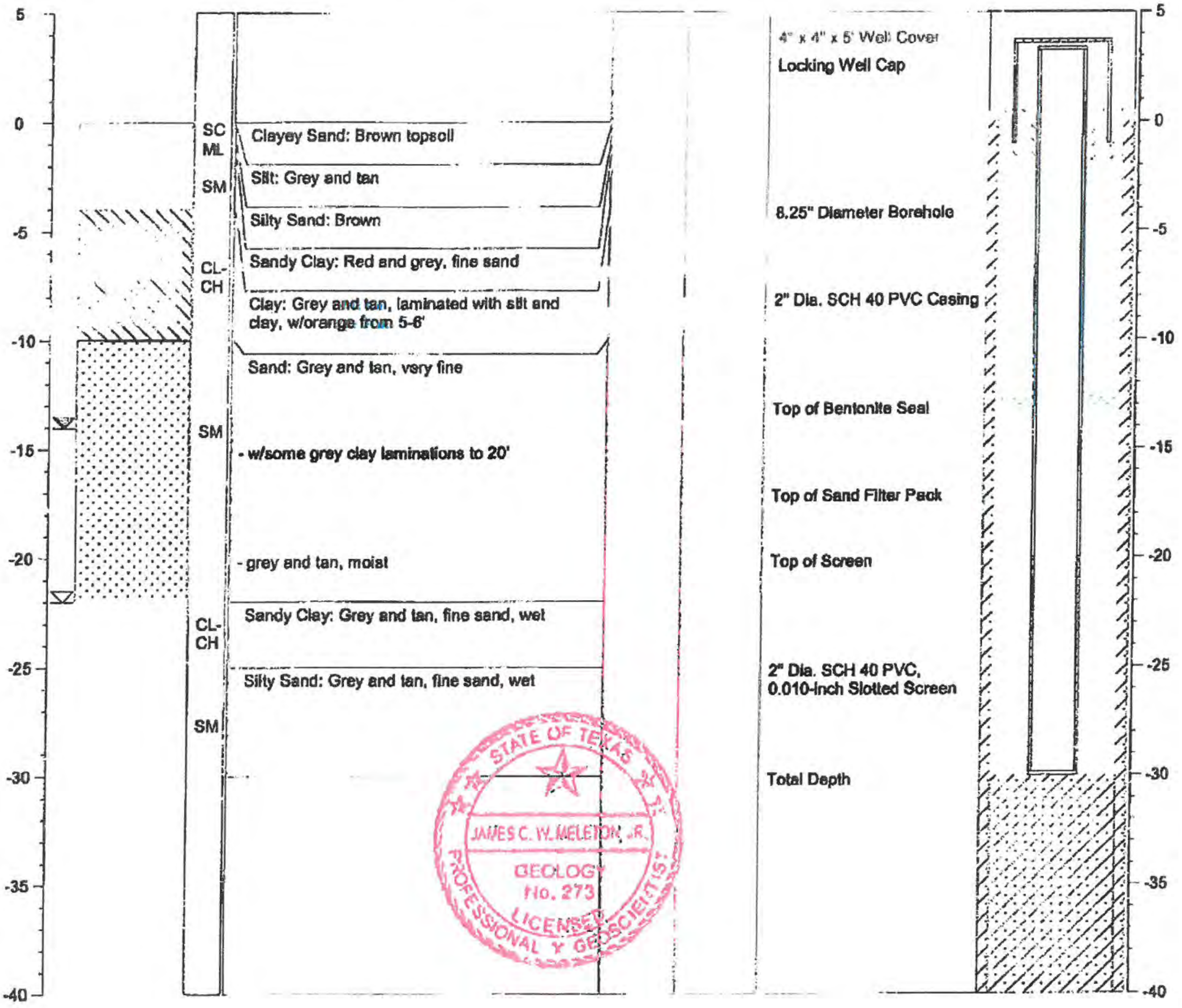
DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/22/09**

NOTES: **Latitude: 33.04527**
Longitude: 94.84258

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED PROFESSIONAL GEOSCIENTIST

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4B**
TOTAL DEPTH:	**15'**
TOP OF CASING ELEV.:	**333.23 ft. NGVD**
GROUND SURFACE ELEV.:	**329.55 ft. NGVD**

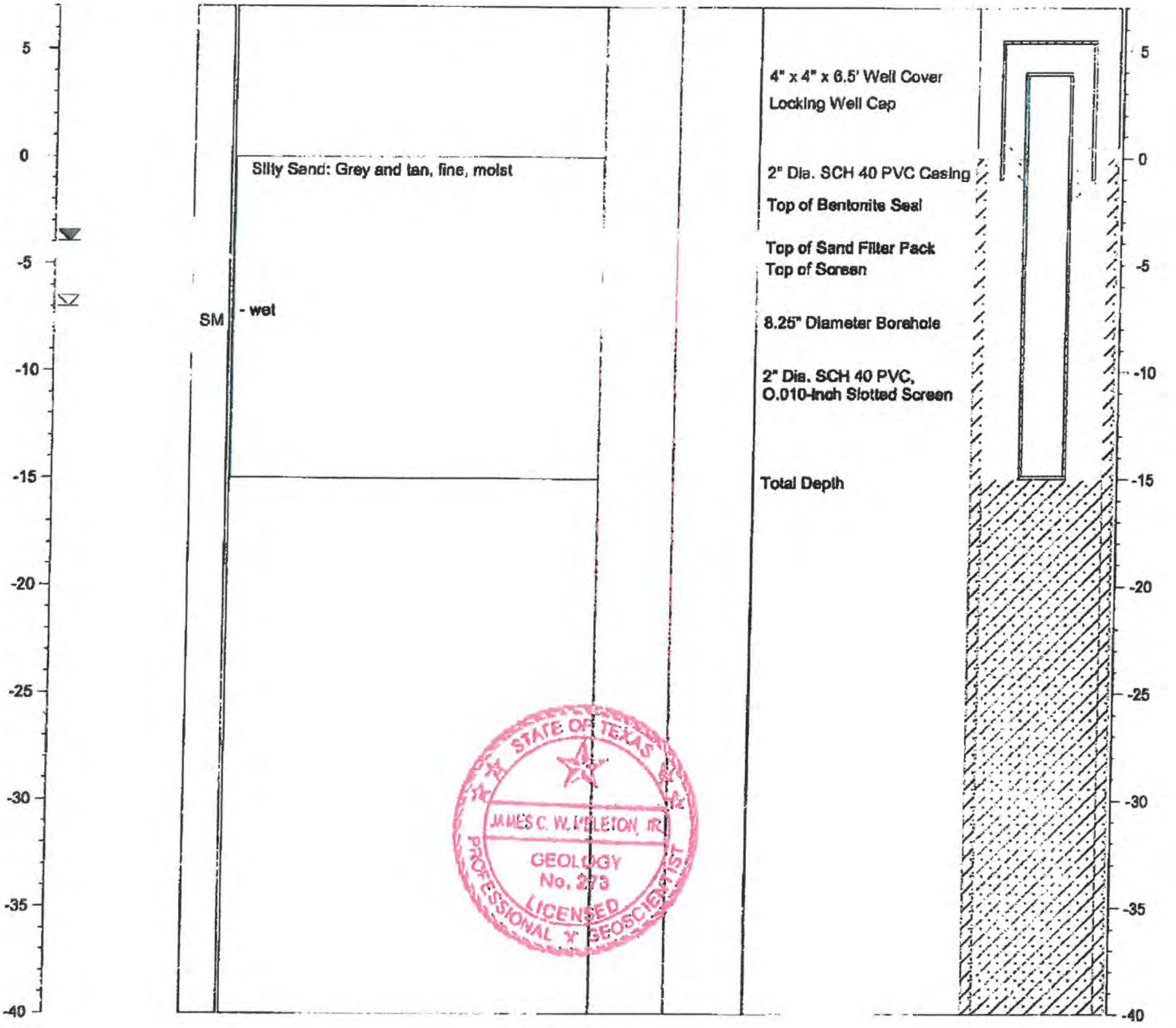
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.04531**
Longitude: 94.84230

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Silty Sand: Grey and tan, fine, moist

- wet

4" x 4" x 6.5' Well Cover
Locking Well Cap
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
8.25" Diameter Borehole
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

JAMES C. W. MELETON, JR.
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No. 273

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OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.: **AD-4C**
TOTAL DEPTH: **15'**
TOP OF CASING ELEV.: **333.28 ft. NGVD**
GROUND SURFACE ELEV.: **329.15 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

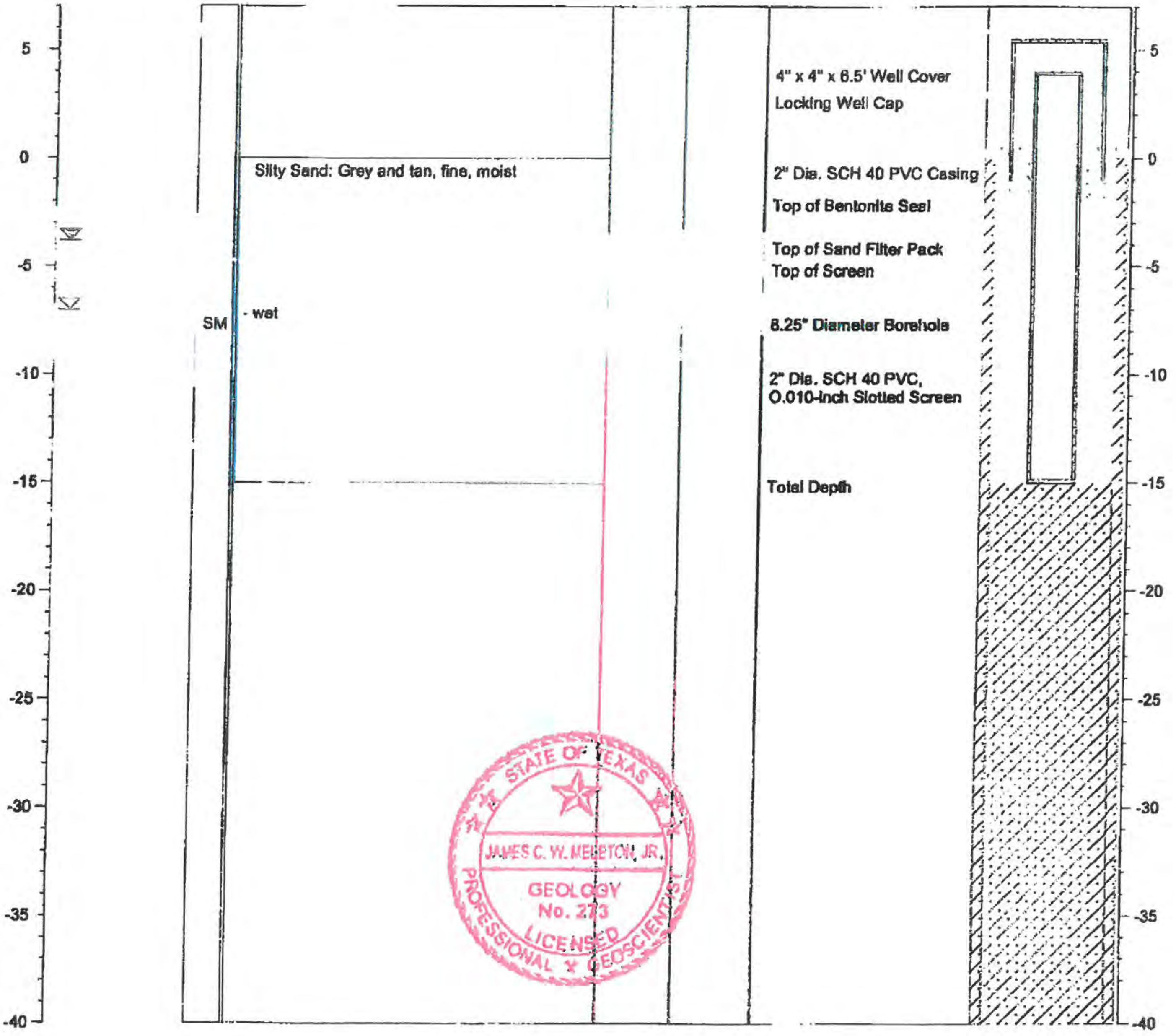
DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/23/09**

NOTES: **Latitude: 33.04507**
Longitude: 94.84244

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

AD-5

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt.4, Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) 33°03'13"N 94°51'00"W N↑

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8¼	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ______

From (ft.)	To (ft.)	Description and color of formation material
0	10	red & gray clay with orange streaks
10	20	gray/black clay with tan clay
20	25	stiff clay with lignite streak
25	30	fine gray sand

AP-5

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other ______
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	risor	+2	20	Sch 40
2	N	#10 slot screen	20	30	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 0 ft. No. of sacks used ______
______ ft. to ______ ft. No. of sacks used ______
Method used bentonite
Cemented by ______
Distance to septic system field lines or other concentrated contamination ______ ft.
Method of verification of above distance ______

✓ 10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 11' 9" ft. below land surface Date 1-11-01
Artesian flow ______ gpm. Date ______

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc., ______ ft.

14) WELL TESTS:
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.

✓ 15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ______ (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS ______ (Street or RFD) ______ (City) ______ (State) ______ (Zip)

(Signed) ______ (Licensed Well Driller) (Signed) ______ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

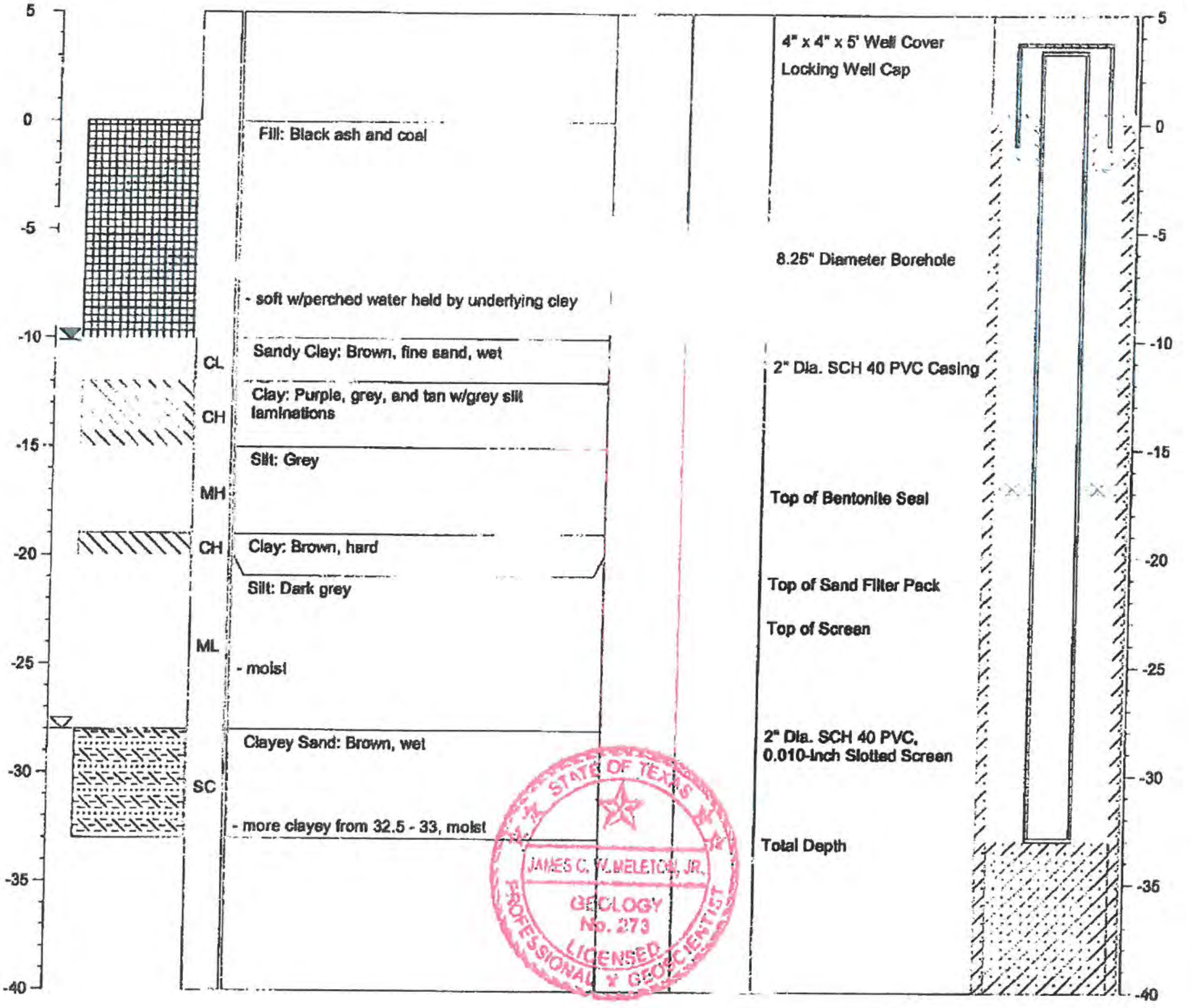
BORING/WELL NO.:	AD-6
TOTAL DEPTH:	33'
TOP OF CASING ELEV.:	346.33 ft. NGVD
GROUND SURFACE ELEV.:	343.31 ft. NGVD

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.05235**
Longitude: 94.84757

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION
			Fill: Black ash and coal			4" x 4" x 5' Well Cover Locking Well Cap	
			- soft w/perched water held by underlying clay			8.25" Diameter Borehole	
		CL	Sandy Clay: Brown, fine sand, wet			2" Dia. SCH 40 PVC Casing	
		CH	Clay: Purple, grey, and tan w/grey silt laminations				
		MH	Silt: Grey			Top of Bentonite Seal	
		CH	Clay: Brown, hard				
		ML	Silt: Dark grey			Top of Sand Filter Pack Top of Screen	
			- moist				
		SC	Clayey Sand: Brown, wet			2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen	
			- more clayey from 32.5 - 33, moist			Total Depth	

JAMES C. W. MELETON, JR.
GEOLOGY
No. 273

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ENVIRONMENTAL SERVICES OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.:	AD-7
TOTAL DEPTH:	38'
TOP OF CASING ELEV.:	350.82 ft. NGVD
GROUND SURFACE ELEV.:	347.86 ft. NGVD

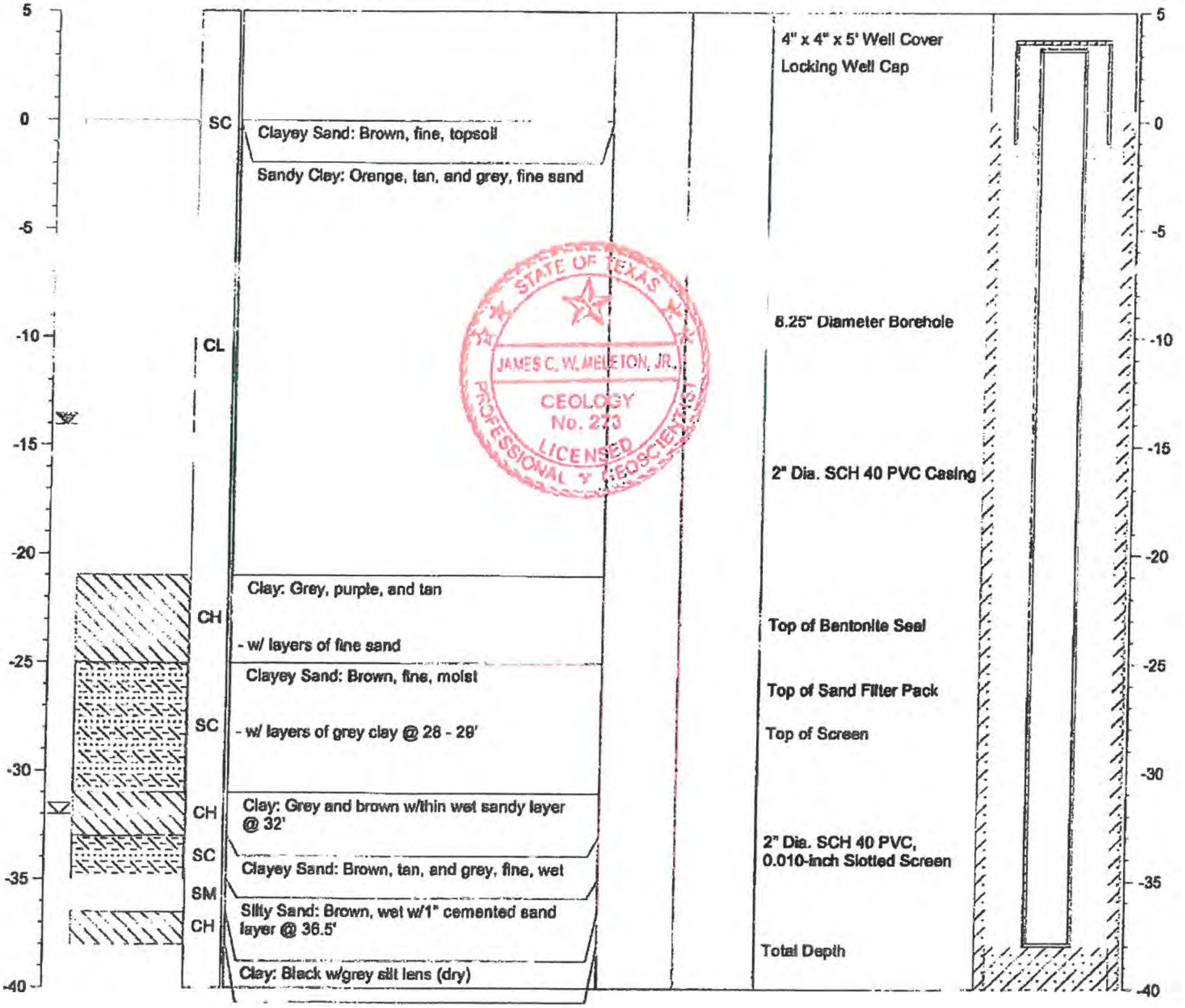
CLIENT:	AEP	DRILLING CO.:	WEST Drilling
PROJECT:	Ash Disposal Area	DRILLER:	Tom McCullough
SITE LOCATION:	Welsh Power Plant	METHOD OF DRILLING:	Hollow-stem Auger
PROJECT NO.:	S-08-0109	SAMPLING METHODS:	Split-spoon
LOGGED BY:	James Meleton, Jr.	DATE DRILLED:	9/24/09

NOTES: **Latitude: 33.05257**
Longitude: 94.84219

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, fine, topsoil
CL	Sandy Clay: Orange, tan, and grey, fine sand
CH	Clay: Grey, purple, and tan - w/ layers of fine sand
SC	Clayey Sand: Brown, fine, moist - w/ layers of grey clay @ 28 - 29'
CH	Clay: Grey and brown w/thin wet sandy layer @ 32'
SC	Clayey Sand: Brown, tan, and grey, fine, wet
SM	Silty Sand: Brown, wet w/1" cemented sand layer @ 36.5'
CH	Clay: Black w/grey silt lens (dry)

WELL DESCRIPTION:
4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

JAMES C. W. MELETON, JR.
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No. 273

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ENVIRONMENTAL SERVICES
OF SHREVEPORT INC

SOIL BORING LOG

BORING/WELL NO.:	**AD-8**
TOTAL DEPTH:	**29'**
TOP OF CASING ELEV.:	**340.01 ft. NGVD**
GROUND SURFACE ELEV.:	**337.53 ft. NGVD**

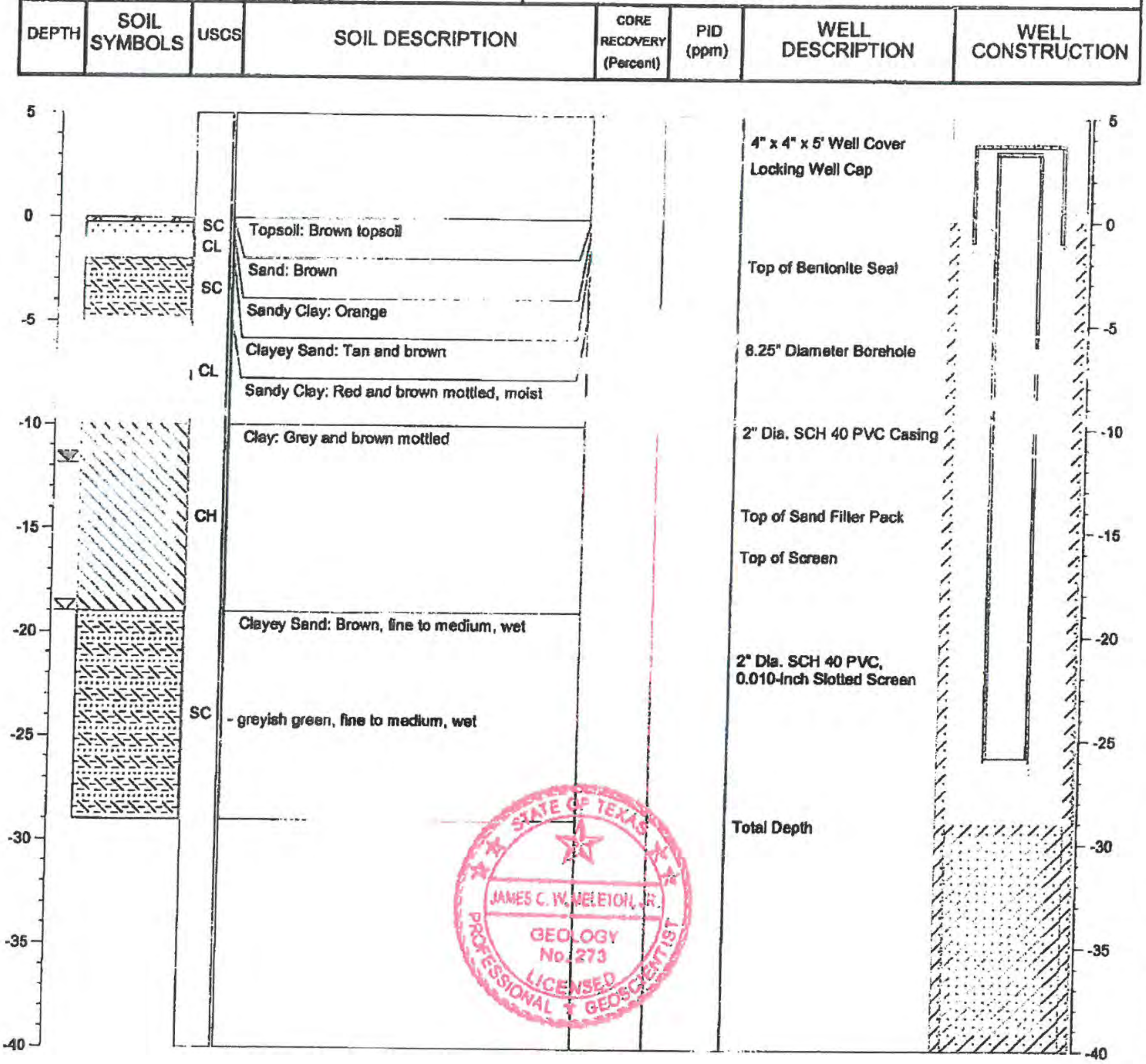
CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/21/09**

NOTES: **Latitude: 33.05187**
Longitude: 94.84026

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
PROFESSIONAL LICENSED GEOSCIENTIST

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ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.:	**AD-9**
TOTAL DEPTH:	**35'**
TOP OF CASING ELEV.:	**343.09 ft. NGVD**
GROUND SURFACE ELEV.:	**340.32 ft. NGVD**

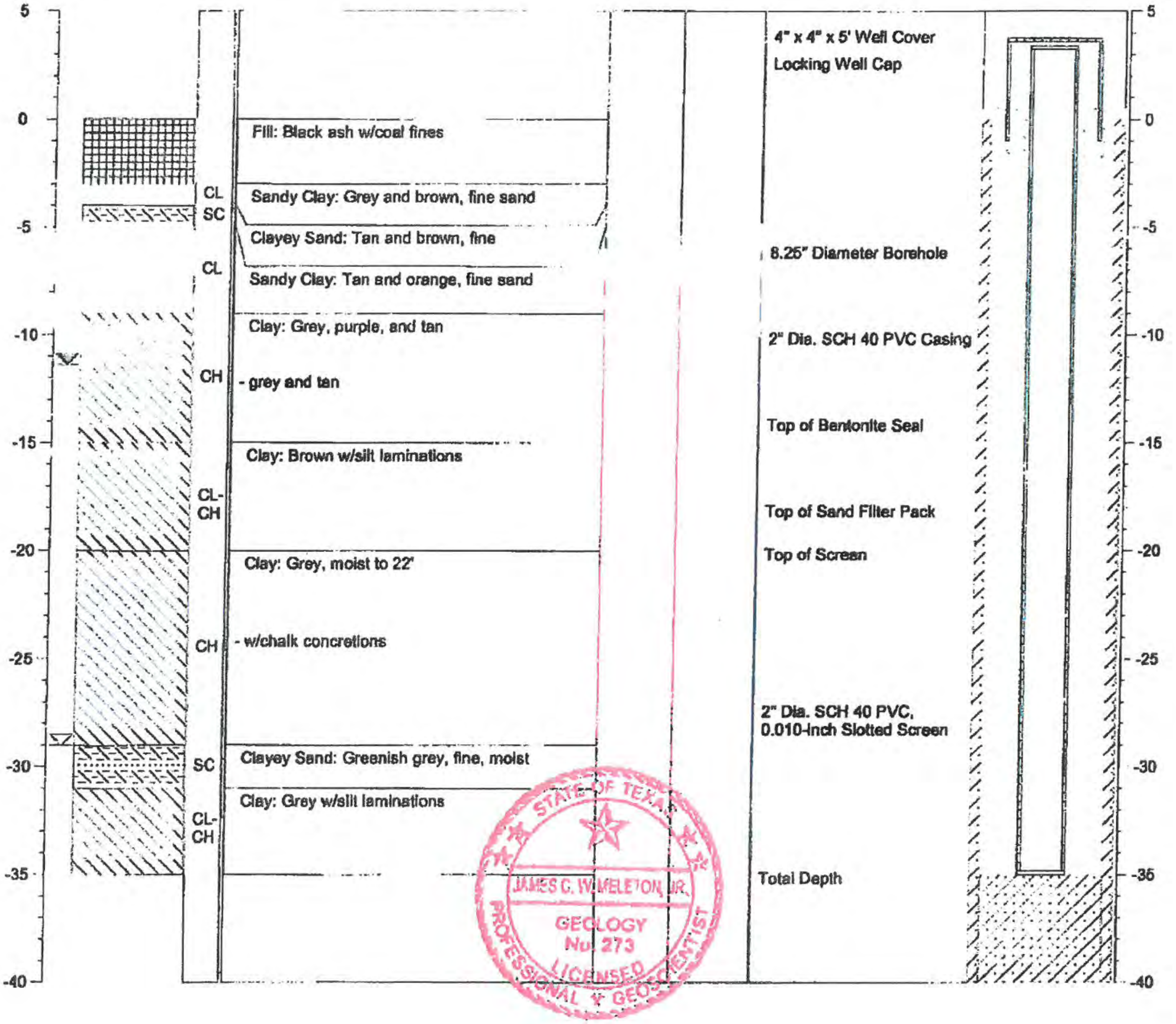
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/21/09**

NOTES: **Latitude: 33.04995**
Longitude: 94.84196

⩡ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Fill: Black ash w/coal fines

CL — Sandy Clay: Grey and brown, fine sand

SC — Clayey Sand: Tan and brown, fine

CL — Sandy Clay: Tan and orange, fine sand

Clay: Grey, purple, and tan

CH — - grey and tan

Clay: Brown w/silt laminations

CL-CH

Clay: Grey, moist to 22'

CH — - w/chalk concretions

SC — Clayey Sand: Greenish grey, fine, moist

CL-CH — Clay: Grey w/silt laminations

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
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OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.: **AD-10**
TOTAL DEPTH: **35'**
TOP OF CASING ELEV.: **343.01 ft. NGVD**
GROUND SURFACE ELEV.: **340.23 ft. NGVD**

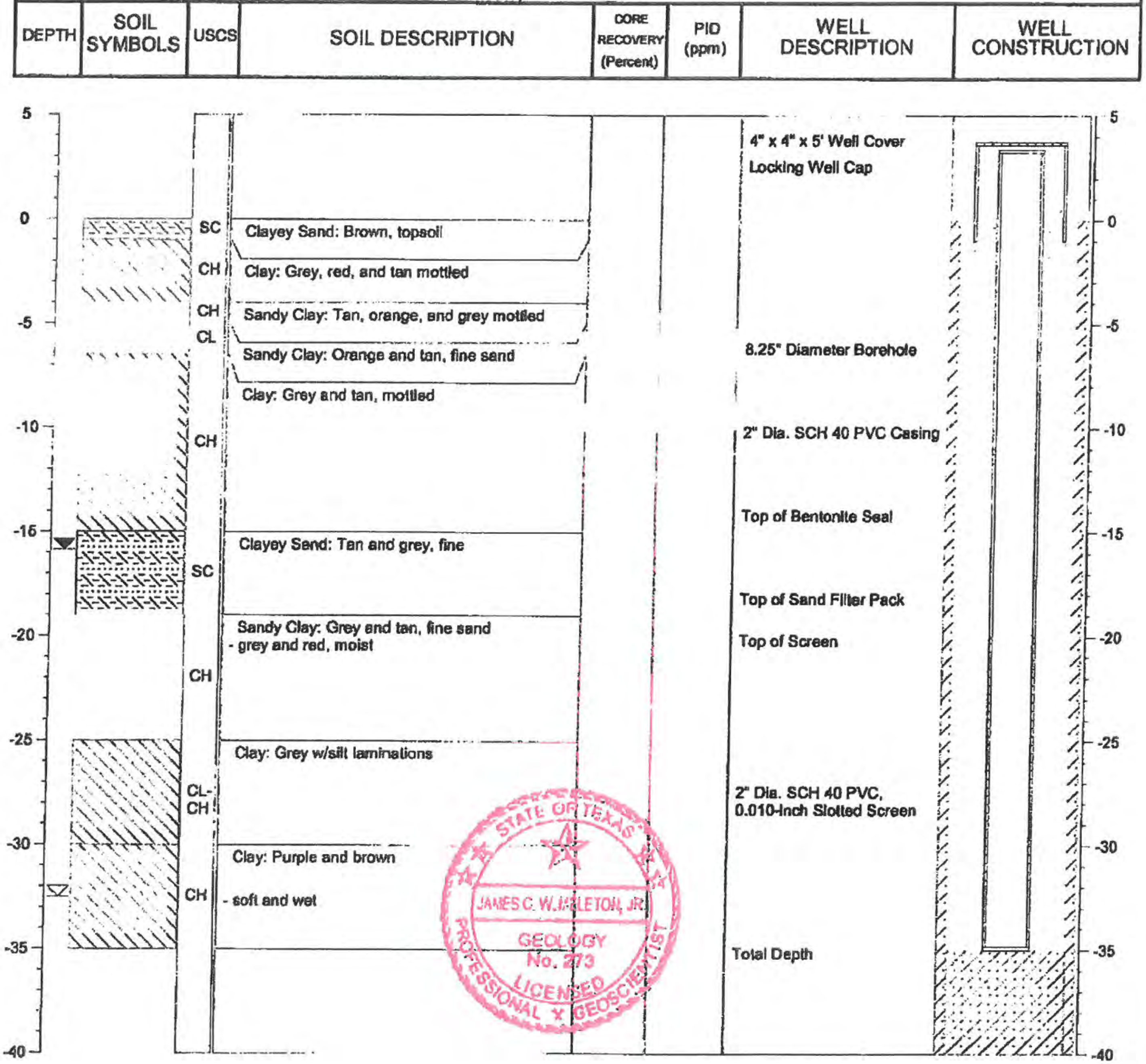
CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/22/09**

NOTES: **Latitude: 33.04881**
Longitude: 94.84047

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.:	**AD-11**
TOTAL DEPTH:	**20'**
TOP OF CASING ELEV.:	**342.18 ft. NGVD**
GROUND SURFACE ELEV.:	**339.61 ft. NGVD**

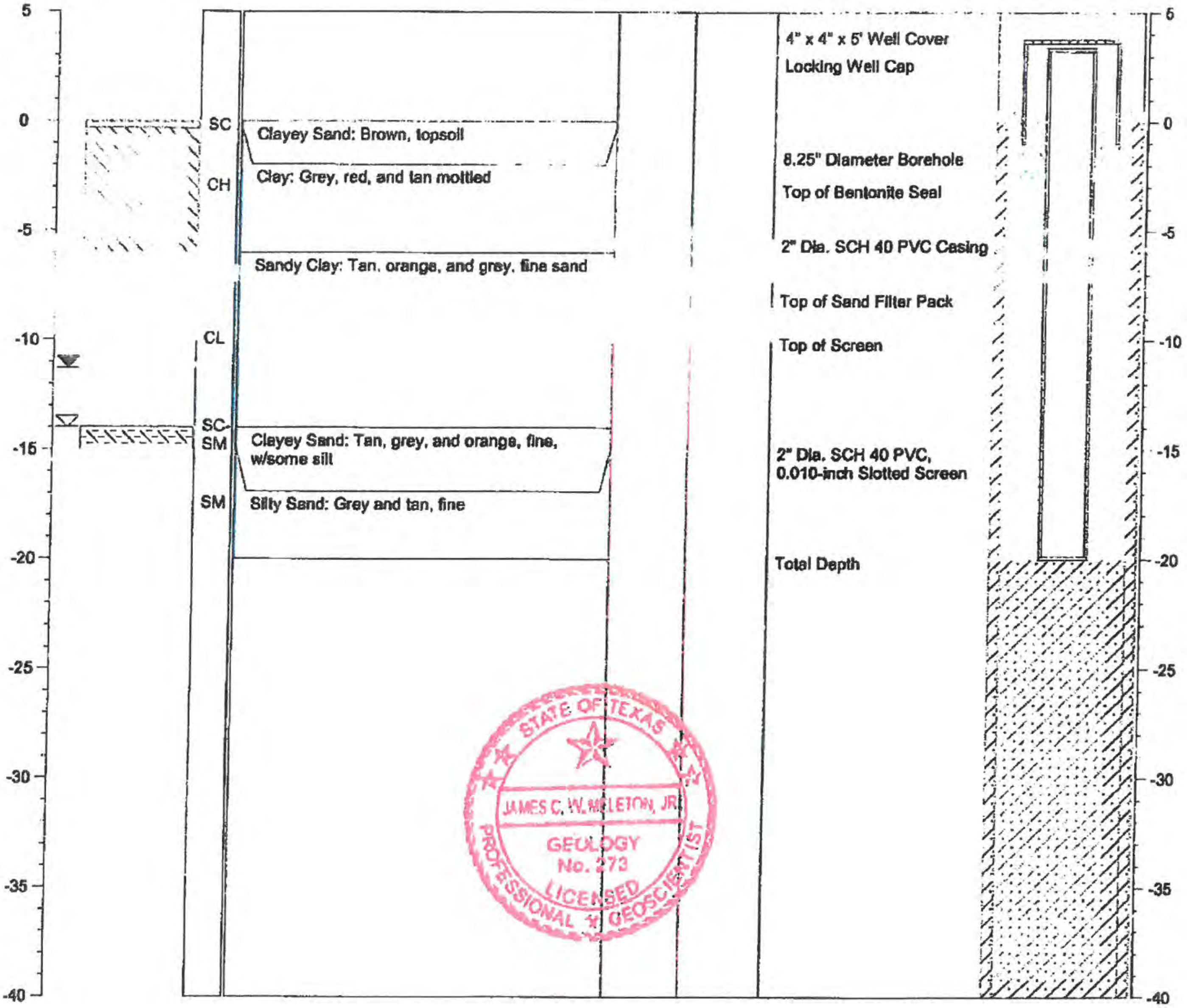
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04824**
Longitude: 94.84177

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Clayey Sand: Brown, topsoil

Clay: Grey, red, and tan mottled

Sandy Clay: Tan, orange, and grey, fine sand

Clayey Sand: Tan, grey, and orange, fine, w/some silt

Silty Sand: Grey and tan, fine

4" x 4" x 5' Well Cover

Locking Well Cap

8.25" Diameter Borehole

Top of Bentonite Seal

2" Dia. SCH 40 PVC Casing

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen

Total Depth

JAMES C. W. MELETON, JR
GEOLOGY No. 273

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OF SHREVEPORT, INC.

SOIL BORING LOG

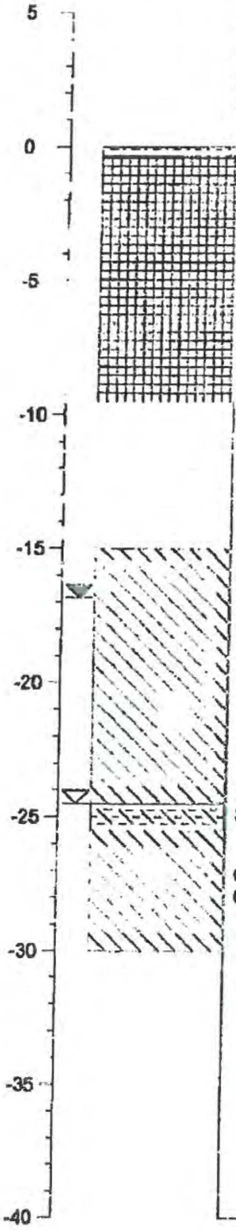
BORING/WELL NO.:	**AD-12**
TOTAL DEPTH:	**30'**
TOP OF CASING ELEV.:	**369.33 ft. NGVD**
GROUND SURFACE ELEV.:	**366.27 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/24/09**

NOTES: **Latitude: 33.04901**
Longitude: 94.84977

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



DEPTH	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION
5					4" x 4" x 5' Well Cover Locking Well Cap
0	SC	Clayey Sand: Brown topsoil			
		Fill: Brown, green, and black, w/ash and coal pieces			
-5					8.25" Diameter Borehole
-10	CL	Sandy Clay: Orange and tan, fine sand			2" Dia. SCH 40 PVC Casing
-15	SM	Silty Sand: Tan			Top of Bentonite Seal
		Clay: Grey, tan, and red mottled			Top of Sand Filter Pack
-20	CH	- purple w/grey silt laminations			Top of Screen
-25	SC	Clayey Sand: Tan and orange, fine, wet			2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
	CL-CH	Clay: Brown w/silt laminations			
-30					Total Depth
-35					
-40					

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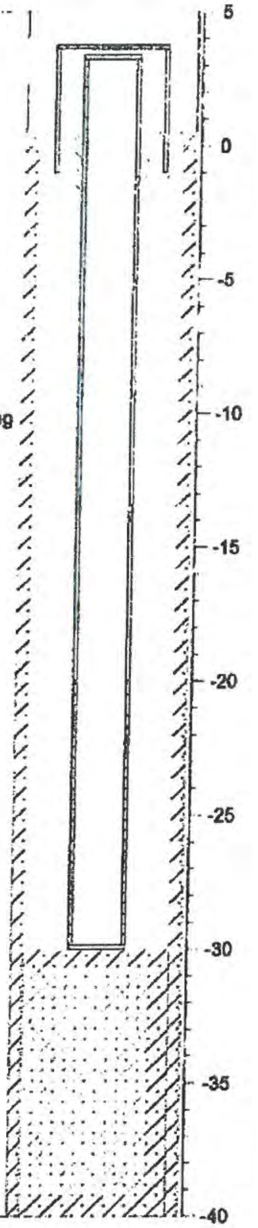


SOIL BORING LOG

BORING/WELL NO.:	**AD-13**
TOTAL DEPTH:	**20'**
TOP OF CASING ELEV.:	**347.00 ft. NGVD**
GROUND SURFACE ELEV.:	**344.12 ft. NGVD**

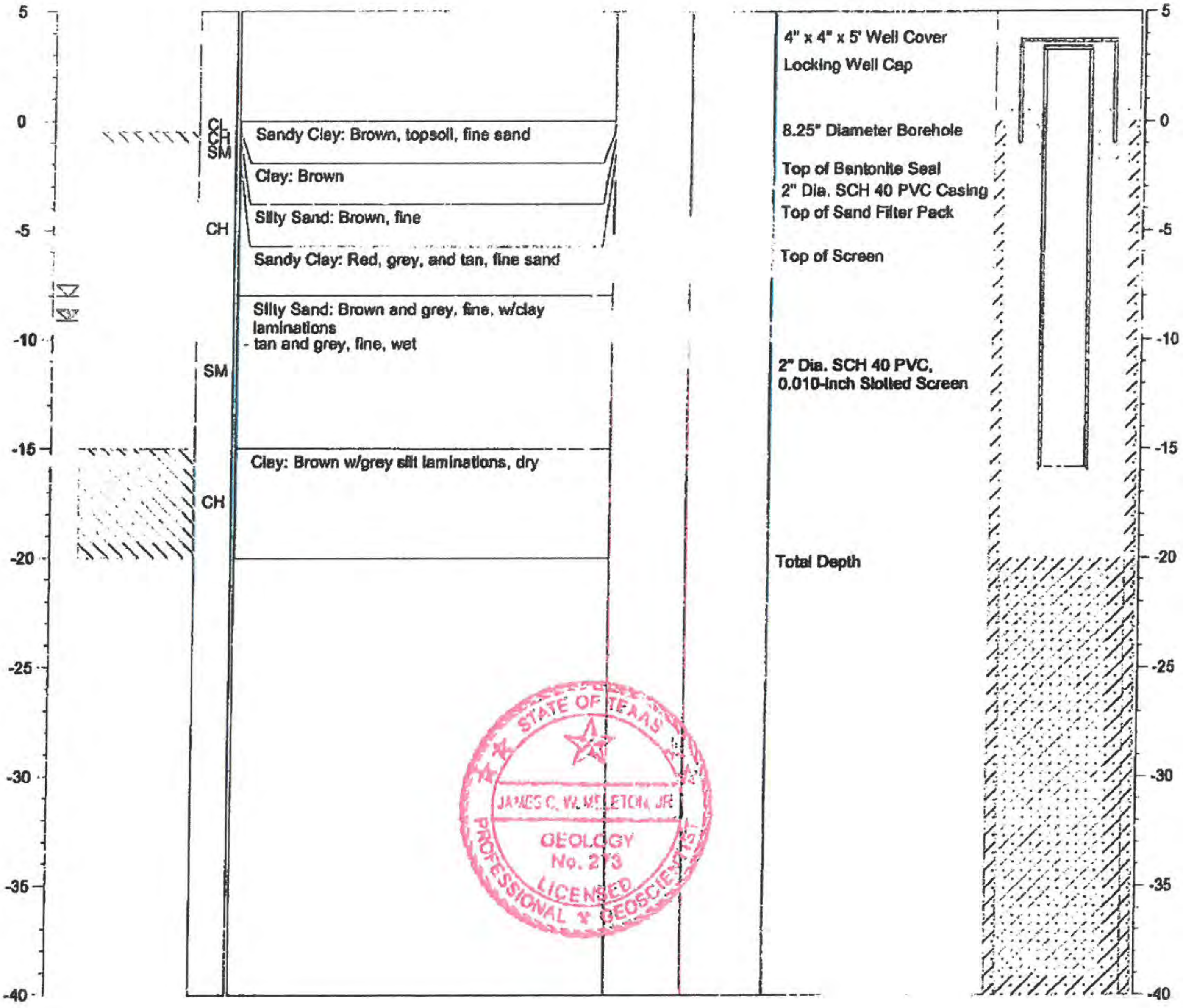
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04918**
Longitude: 94.84275

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Sandy Clay: Brown, topsoil, fine sand
Clay: Brown
Silty Sand: Brown, fine
Sandy Clay: Red, grey, and tan, fine sand
Silty Sand: Brown and grey, fine, w/clay laminations
- tan and grey, fine, wet
Clay: Brown w/grey silt laminations, dry

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
Top of Bentonite Seal
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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GEOLOGY
No. 273

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SOIL BORING LOG

BORING/WELL NO.:	AD-14
TOTAL DEPTH:	18.5'
TOP OF CASING ELEV.:	345.43 ft. NGVD
GROUND SURFACE ELEV.:	342.32 ft. NGVD

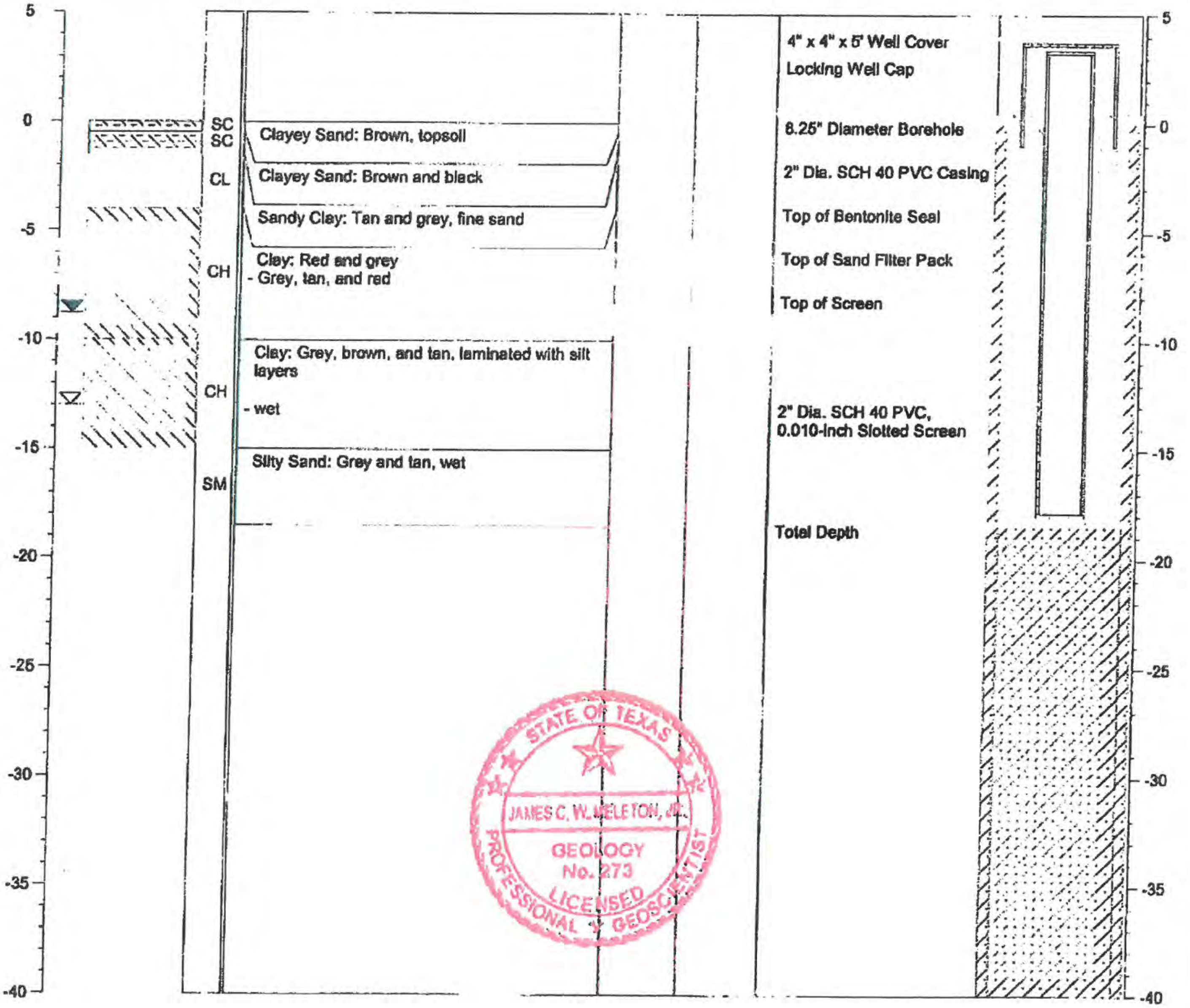
CLIENT:	AEP	DRILLING CO.:	WEST Drilling
PROJECT:	Ash Disposal Area	DRILLER:	Tom McCullough
SITE LOCATION:	Welsh Power Plant	METHOD OF DRILLING:	Hollow-stem Auger
PROJECT NO.:	S-08-0109	SAMPLING METHODS:	Split-spoon
LOGGED BY:	James Meleton, Jr.	DATE DRILLED:	9/22/09

NOTES: Latitude: 33.04715
Longitude: 94.84256

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, topsoil
SC	Clayey Sand: Brown and black
CL	Sandy Clay: Tan and grey, fine sand
CH	Clay: Red and grey - Grey, tan, and red
CH	Clay: Grey, brown, and tan, laminated with silt layers - wet
SM	Silty Sand: Grey and tan, wet

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
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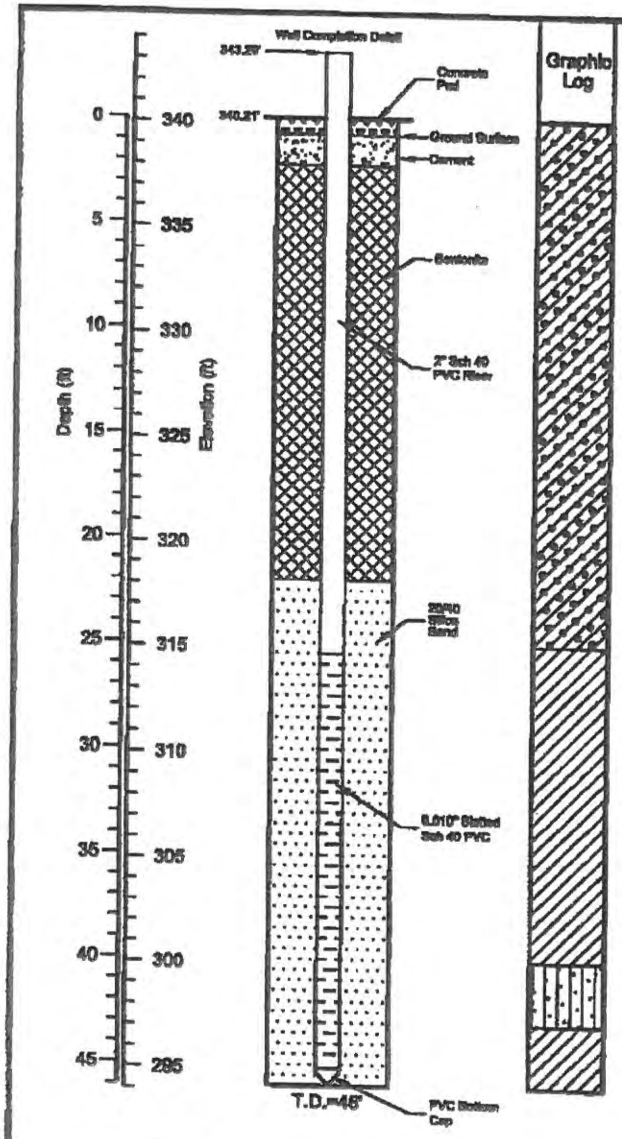


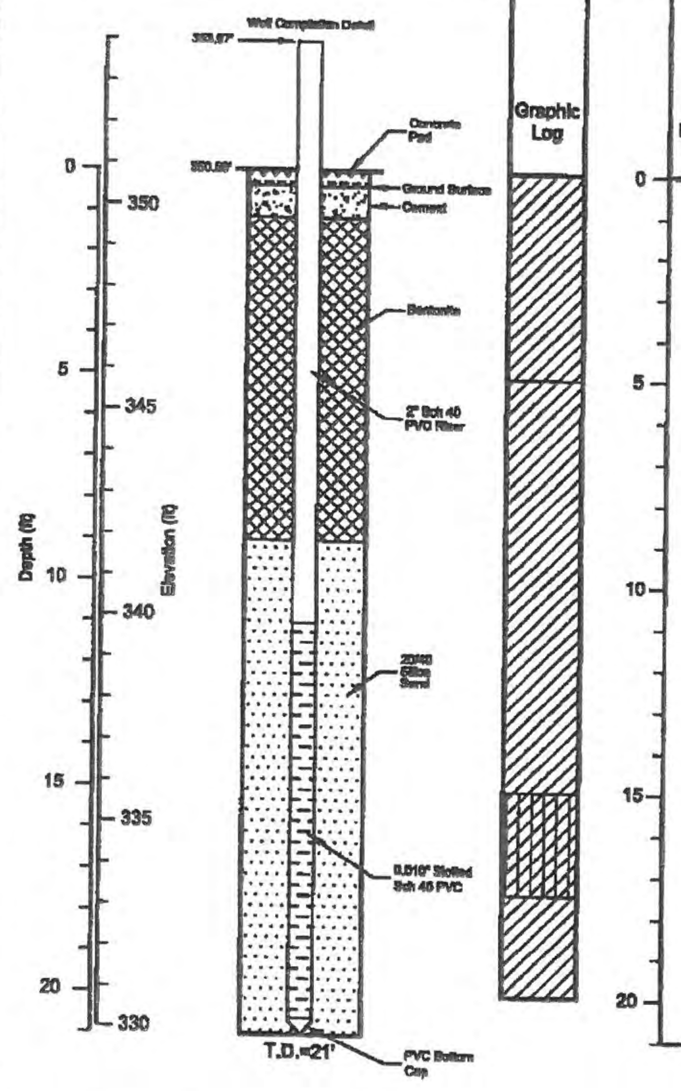
PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		SC	Clayey SAND: reddish brown	16	48	37	18	19
				- 2" lense of brown sand					
				- 3" lense of brown sand					
	Direct Push		CL	Sandy Lean CLAY: reddish brown, very moist					
				- less moisture	22	51	36	19	17
			SM	Silty SAND: light brown & light gray, wet.	27	24	28	NP	-
			CL	Lean CLAY: orangish brown & light gray, mottled, with sand	28	94	45	21	24

STEVEN R. WEMPLE
SOIL SCIENCE
2176
1-22-16

WEST DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahatchie, Texas 75165

DATE: 12/12/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-15
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/12/15	DRAWN BY: HDS	PROJECT NO.: — SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



PID Reading (ppm)	Sampling Device	Sample Interval	Description Interval (feet bgs)	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		CL	Lean CLAY w/ Sand: light brown & light gray - orangish brown, with silt	16	82	26	16	10
			CL	Lean CLAY w/ Sand: orangish-brown & light gray	22	88	31	19	12
			CL-ML	Silty CLAY: orange w/ brown, wet	30	69	27	20	7
			CL	Sandy, Lean CLAY: brown w/ orange, stiff	26	66	46	26	20

STEVEN R. WEMPLE
3178
1-22-16

West DRILLING environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

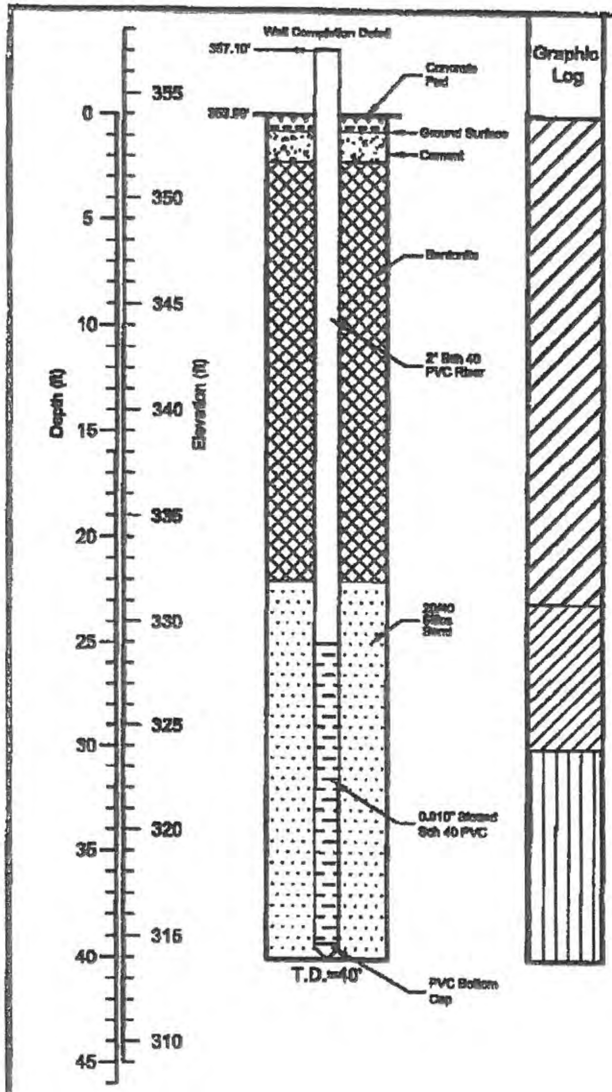
DATE: 12/10/15	Logged by: Robert Williams, PE
Drilling Method: H.S.A.	Driller: Robert Williams
Bit Diameter: 7.25"	Date Completed: 12/10/15
Depth to Water: –	Depth to Product: NA

Welsh Power Station
Pittsburg, Texas

DRAWN BY: HDS
CHECKED BY: SRW

Log of Boring
AD-16

PROJECT NO.: —
SCALE: AS SHOWN
FILE NAME: JR Welsh Power Plant LOGS.dwg



PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		CH	Fat CLAY: reddish-brown					
				- light gray to light brown, reddish brown w/ Sand and gravel lenses	24	87	83	30	53
				- light brown					
				- brown Sand lenses, wet					
				- gray, w/ some Silt					
					18	90	53	25	28
	Direct Push		CL	Lean CLAY with Sand: gray	22	51	43	22	21
			ML	Sandy SILT: gray	23	83	26	NP	-

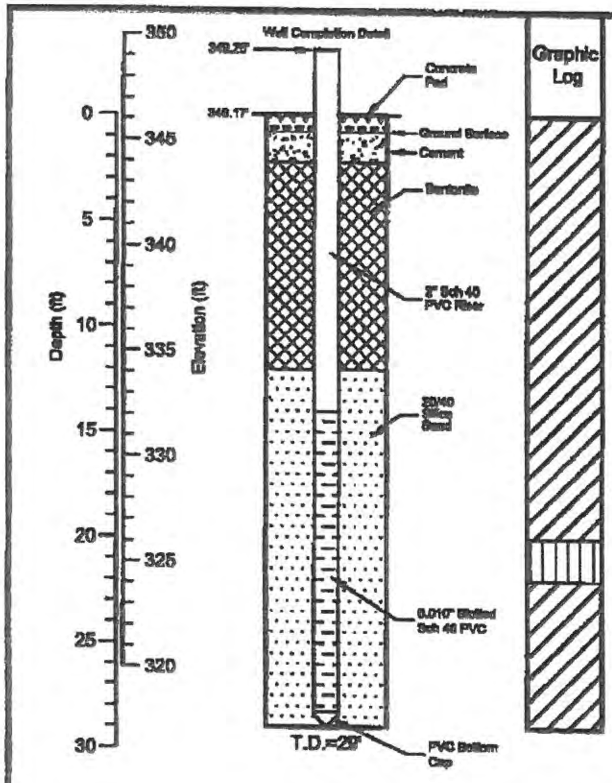
STEVEN R. WEMPLE
2178

1/22/16

west
DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/10/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-17
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: —
			SCALE: AS SHOWN
Depth to Water: –	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0–20		Direct Push		CH	Fat CLAY: light brown & light gray, sandy - reddish brown and light gray, with Sand - gray with silt - gray, stiff	19	88	50	24	26
20–22				ML	SILT: gray, with Clay and Sand, wet	29	86	26	NP	-
22–29				CH	Fat CLAY: light gray, silty w/ Sand, very stiff	20	85	50	23	27

STEVEN R. WEMPLE
LICENSE NUMBER 2176

1-22-16

west DRILLING enviromental & geotechnical WEST Drilling, Inc. 101 Industrial Drive Waxahachie, Texas 75165	DATE: 12/11/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-18
	Drilling Method: H.S.A.	Driller: Robert Williams		
	Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: — / SCALE: AS SHOWN
	Depth to Water: –	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 1 of 2

Date(s) Drilled **July 23, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **37 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **367 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Bentonite Chips**	Location **On the Northern edge of proposed chemical pond along the screening berm.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
367	0					Other		Black COAL, a few fine roots and organics.						
			ST											Shelby tube pulled black COAL
			SS	10										SPT 4, 5, 5, 5. 24" recovered
362	5		SS	11	Soft to Firm	SC		Reddish Brown fine SAND, little clay, trace silt, Dry. Natural Ground.						SPT 4, 5, 6, 7. 24" recovered
			SS	11	Soft	SM		Reddish brown fine SAND with silt, trace clay. Vertical sand seams in sample, Dry.						SPT 3, 5, 6, 6. 24" recovered.
357	10		ST						23.6	[illegible]	46.9	5.4E-07		Shelby tubs sample, 18" recovered.
					Soft	SC		Reddish brown well graded fine SAND, trace silt and clay. Damp.						
			SS	12	Firm	CL		Greyish red CLAY, little sand, horizontal sand seams, Dry.						SPT 5, 6, 8, 9. 24" recovered
					Soft	SC		Brownish red fine SAND, little clay, Damp.						
			SS	13	Firm	SC-CL		Four-inch CLAY seam, little fine sand.						SPT 7, 6, 7, 9. 24" recovered.
					Firm	CL		Reddish grey CLAY, little sand, oxidized iron ore. Dry						
352	15		SS	18	Soft	SM		Brownish red fine SAND, trace clay, thin clay seams. Moist.	17.74	14	40.1			SPT 8, 9, 9, 9. 24" recovered.
			ST						16.25	NP	26.9	3.6E-05		Shelby tube samples look like SC. 17" recovered.
347	20		SS	17	Soft	Other		Iron oxidized material						SPT 9, 8, 9, 11. 24 Inches recovered.
					Soft	SC		Brownish red fine SAND, little clay. Moist.						
			SS	15										SPT 5, 7, 8, 50/2. 21" recovered
			SS	[illegible]	Soft	CL		Dark grey CLAY, little fine sand, Wet.						SPT 50/3".
					Very Hard	SP		Dark grey-black cemented SAND, little clay. Wet. Driller comments that cemented sand terminates at 25.5 feet.						
342	25													
			SS	27	Soft to Firm	SC		Dark grey fine SAND, little clay. Moist. Soft sand with lenses of firm clay.						SPT 11, 13, 14, 16. 24" recovered.
					Hard	CL		Dark grey CLAY, little sand, Dry.						
			SS	46	Soft	SC		Dark grey-black fine SAND, little clay, Wet. Encountered water but water rose to 19 feet after 15 min break.						SPT 11, 16, 30, 14. 24" recovered.
			SS	37										SPT 11, 15, 22, 25. 24" recovered.
337	30				Hard	CL								

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
337	30	SS	37	Hard	CL		Dark grey CLAY, little fine sand, occasional horizontal sand seams. Wet. (cont.)						SPT 11, 15, 22, 25. 24" recovered.
		SS	29	Soft	ML		Dark grey-black fine SAND, with clay, frequent hard clay lenses (1-3"). Wet.	26.37	NP	57.5			SPT 6, 11, 18, 24. 24 recovered.
332	35	SS	34	Hard	CL		Black CLAY, trace to little fine sand, trace silt. Dry						SPT 9, 16, 18, 23. 24" recovered.
							Bottom of Boring at 37 feet bgs						
327	40												
322	45												
317	50												
312	55												
307	60												
302	65												

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-02

Sheet 1 of 1

Date(s) Drilled **August 14, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **364.56 feet MSL**
Groundwater Level and Date Measured **21.53 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Western edge of proposed chemical pond near perimeter fence.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
364.6	0				Soft	Other		Coal						
					Soft	CL		Greyish brown CLAY, with little silt, little sand, damp.						
			SS	4										SPT 2, 2, 2. 12" recovered.
			SS	13										SPT 4, 7, 6, 12.
359.6	5		ST											Shelby Tube Sample
					Firm	CH		Brownish tan CLAY with silt, little sand, Damp. Occasional sand and iron ore.						SPT 6, 12, 17, 21
			SS	29					23.71	38	77.3			
			SS	80										SPT 20, 30, 50/5. 17" recovered
354.6	10				Soft	SC		Red-orange fine SAND, little clay, damp. Occasional iron ore.						
					Soft	CL		Brownish tan CLAY, little silt, little sand, Damp.						SPT 15, 20, 24, 31. 18" recovered.
			SS	44	Soft	SM		Red-orange fine SAND, little clay, Damp.						
														SPT 11, 12, 9, 32.
			SS	21					20.35	NP	33.5			
														SPT 6, 6, 12, 6.
349.6	15		SS	18	Soft	SM-SC		Light brown fine SAND, with little silt, little sand, Damp.						
					Firm	CL		Black CLAY, with fine sand, Wet.						SPT 12, 25, 50/5.
			SS	75	Soft	SM-SC		Dark red fine SAND, little clay, little silt, Wet.						
					[illegible]	SC		Dark grey fine SAND, little clay, Wet. Occasional clay seams.						SPT 9, 18, 12, 15.
			SS	26										
344.6	20													SPT 9, 17, 21, 27.
			SS	38	Firm	SC		Frequent clay lenses. 8/11/09 ▼	22.55	13	36.6			
														SPT 22, 35, 50/4".
			SS	65										
														SPT 10, 15, 18, 26.
339.6	25		SS	33										
					Soft	SC		Less clay lenses, Wet.						SPT 12, 27, 37, 50/5".
			SS	64										
														SPT 19, 24, 21, 50/5".
			SS	44										
					Hard	CL		[illegible] grey CLAY, [illegible] silt, Wet.						
334.6	30													

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

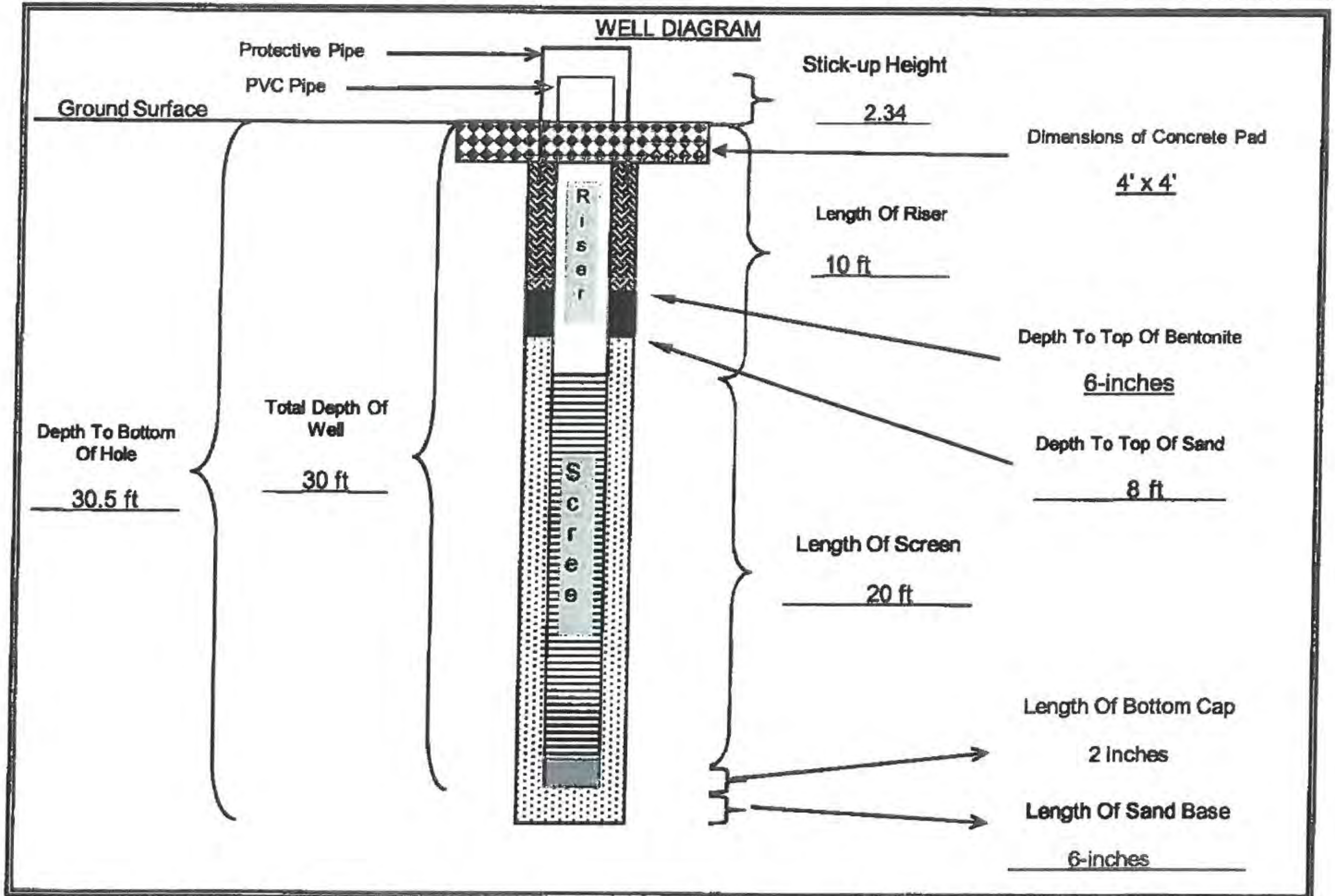
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL LOCATION:
WELL NO.: GB-02
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 364.56 (ft, msl)
TOP OF SCREEN ELEVATION: 354.56 (ft, msl)
BOTTOM OF WELL ELEVATION: 334.06 (ft, msl)
NORTHING: 747.0223 EASTING: -2442.888
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 8 (in)
DRILLING TECHNIQUE: Hollow stem Size: (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE: Not used-sealed with bentonite chips
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 4 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 13 bags lbs
STATIC WATER: 21.53 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height
2.34

Dimensions of Concrete Pad
4' x 4'

Length Of Riser
10 ft

Depth To Top Of Bentonite
6-inches

Depth To Top Of Sand
8 ft

Depth To Bottom Of Hole
30.5 ft

Total Depth Of Well
30 ft

Length Of Screen
20 ft

Length Of Bottom Cap
2 inches

Length Of Sand Base
6-inches

▨	Cement/Bentonite Grout	░	Sand Pack	▦	Neat Concrete	■	Bentonite	▩	Bottom Cap

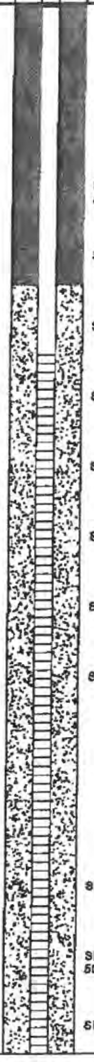
QA/QC
INSTALLED BY: Total Support Services
DATE: August 7th, 2009
OBSERVED BY: Kush Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 1 of 2

Date(s) Drilled **August 7, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **31 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **359.91 feet MSL**
Groundwater Level and Date Measured **21.89 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Southwest corner of proposed chemical pond near screening pile.**	



Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
359.9	0				Soft	Other	Coal					
354.9	5		ST		Soft	CH	Shelby Tube		43	98.1		Shelby tube sample.
			SS	41	Firm	CH	Light brown-grey CLAY, little silt, occasional sand seams (fine), Damp.	24.04	29	90.4		SPT 29, 22, 19, 21.
349.9	10		SS	27	Soft	CH	Brownish dark gray CLAY, trace sand, trace silt, Wet.					SPT 6, 12, 15, 20.
			SS	53	Soft	SC	Dark orange red SAND, little clay, trace silt, Wet. Occasional clay seam (dark grey).					SPT 17, 29, 24, 25.
			SS	32	Soft	SC	Clay lenses.					SPT 7, 15, 17, 40.
344.9	15		SS	47	Soft	SC	Clay lense					SPT 9, 17, 30, 20.
					Soft	SC	Dark grey fine SAND with clay, occasional clay lense, Wet.					SPT 11, 50/4".
			SS	50	Firm	CL	Dark grey CLAY, little fine sand, Wet.					
339.9	20		SS	44	Soft	SC	Dark grey fine SAND, little clay, occasional clay seam, iron ore, Wet.					SPT 11, 27, 17, 21.
							8/11/09 ▼					
334.9	25		SS	90								SPT 27, 40, 50/4".
			SS	65	Firm	SC	Dark grey clay lense					SPT 11, 15, 40, 50/3".
			SS	55								SPT 17, 50/5.5".
329.9	30											

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
329.9	30	▨	SS 55	Hard	CL	▨	Dark gray CLAY, trace silt, trace fine sand.						SPT 17, 50/5.5".
							Bottom of Boring at 31 feet bgs						
324.9	35												
319.9	40												
314.9	45												
309.9	50												
304.9	55												
299.9	60												
294.9	65												

Figure

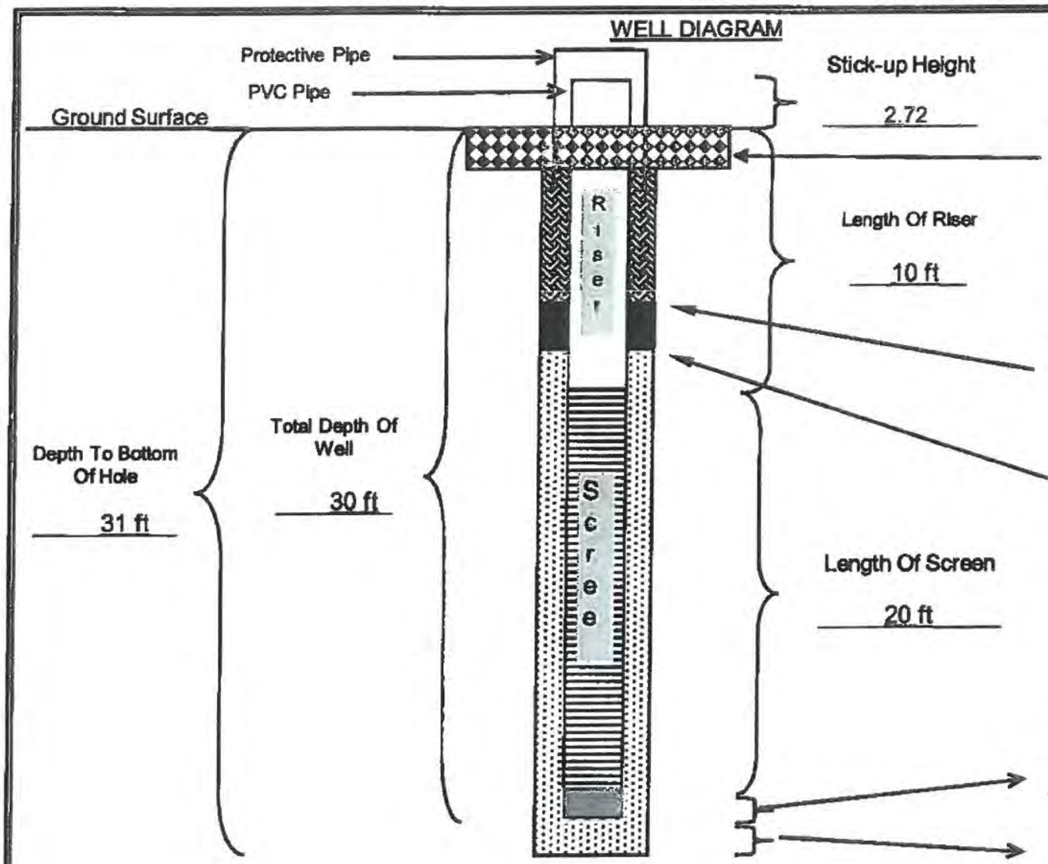
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL LOCATION:
WELL NO.: GB-03
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION:	359.57 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	349.57 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	328.57 (ft, msl)	CEMENT TYPE:	None used-sealed with bentonite chips
NORTHING: 460.5803	EASTING: -2507.6332	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	4 bags lbs
RISER DIAMETER:	2 (in) Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 20 (ft)	AMOUNT SAND USED:	12 bags lbs
BOREHOLE DIAMETER:	8 (in)	STATIC WATER:	21.89 depth from TOC
DRILLING TECHNIQUE: Hollow Stem	Size: 8 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.72

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 10 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 8 ft

Depth To Bottom Of Hole: 31 ft

Total Depth Of Well: 30 ft

Length Of Screen: 20 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 1 ft

▨ Cement/Bentonite Grout	░ Sand Pack	▦ Neat Concrete	■ Bentonite	▩ Bottom Cap

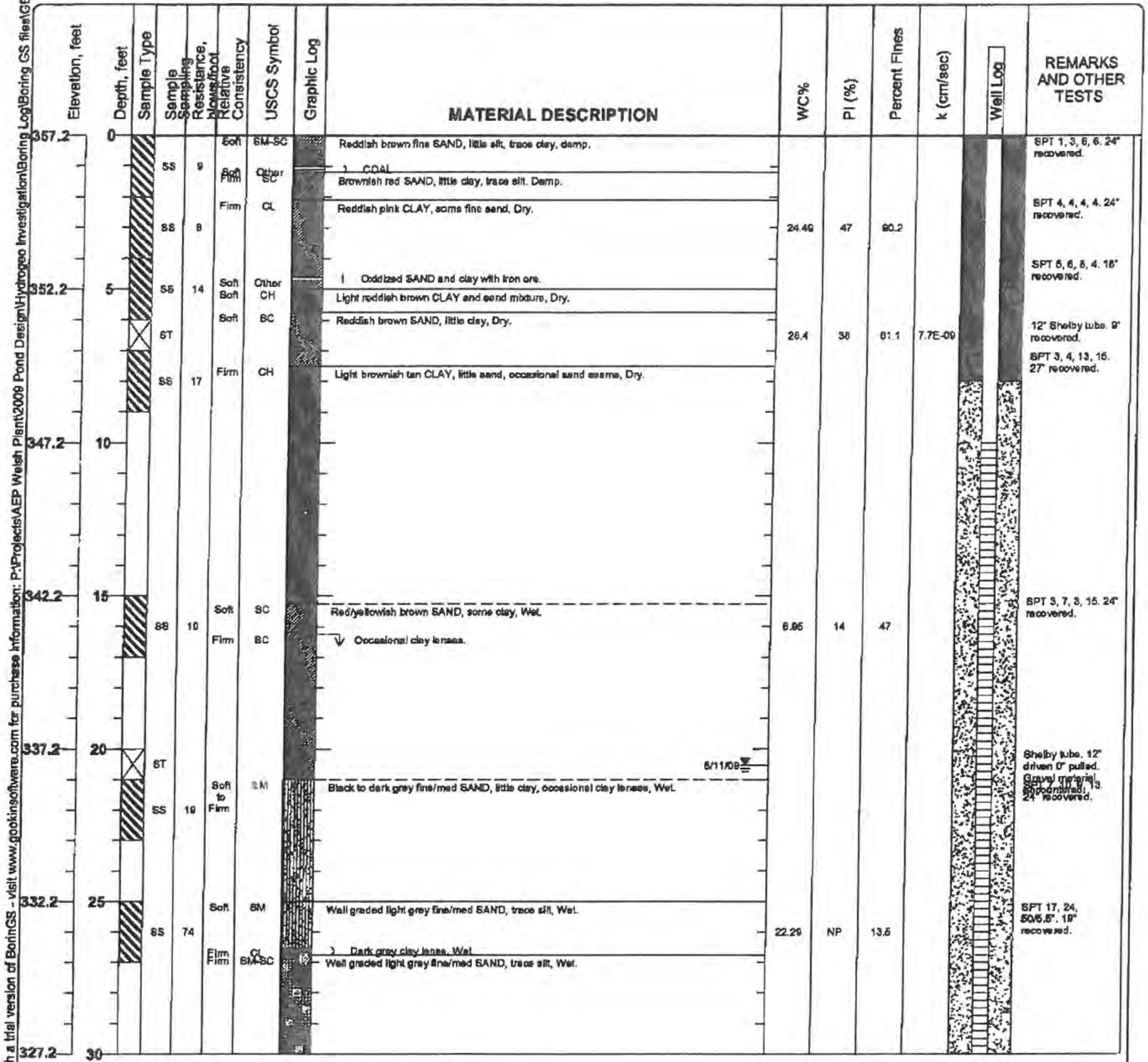
QA/QC INSTALLED BY:	Total Support Services	OBSERVED BY:	Kush S. Chohan
DATE:	7-Aug-09	CHECKED BY:	DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **34 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.22 feet MSL**
Groundwater Level and Date Measured **20.54 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Southeast corner of proposed chemical evaporation pond. Located in a grassy field.**	



Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
357.2	0				Soft	SM-SC	Reddish brown fine SAND, little silt, trace clay, damp.					SPT 1, 3, 6, 6. 24" recovered.
			SS	9	Soft Firm	Other SC	1 COAL Brownish red SAND, little clay, trace silt. Damp.					
					Firm	CL	Reddish pink CLAY, some fine sand, Dry.					SPT 4, 4, 4, 4. 24" recovered.
			SS	8				24.49	47	90.2		
							1 Oxidized SAND and clay with iron ore.					SPT 5, 6, 8, 4. 18" recovered.
352.2	5		SS	14	Soft Soft	Other CH	Light reddish brown CLAY and sand mixture, Dry.					
					Soft	SC	Reddish brown SAND, little clay, Dry.					
			ST					26.4	38	61.1	7.7E-09	12" Shelby tube. 9" recovered.
			SS	17	Firm	CH	Light brownish tan CLAY, little sand, occasional sand seams, Dry.					SPT 3, 4, 13, 15. 27" recovered.
347.2	10											
342.2	15				Soft	SC	Red/yellowish brown SAND, some clay, Wet.					SPT 3, 7, 3, 15. 24" recovered.
			SS	10				6.95	14	47		
					Firm	SC	Occasional clay lenses.					
337.2	20		ST				8/11/09					Shelby tube. 12" driven 0" pulled. Gravel material encountered. SPT 7, 11, 8, 13. 24" recovered.
			SS	19	Soft to Firm	SM	Black to dark grey fine/med SAND, little clay, occasional clay lenses, Wet.					
332.2	25				Soft	SM	Well graded light grey fine/med SAND, trace silt, Wet.					SPT 17, 24, 50/5.5". 19" recovered.
			SS	74				22.29	NP	13.5		
					Firm Firm	CL SM-SC	1 Dark grey clay lense, Wet Well graded light grey fine/med SAND, trace silt, Wet.					
327.2	30											

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.2	30	☒	ST		Hard	ML	▥	Dark grey CLAY, little sand, Wet.					▒	12" Shelby tube. Bent shelby tube.
		☒	ST						21.3	NP	84.2	2.0E-06		12" Shelby tube.
		▨	SS	38	Hard	CL	▩	Dark grey CLAY, trace sand, Wet.	25.44	18	92.5			SPT 15, 18, 19, 25. 24" recovered.
								Bottom of Boring at 34 feet bgs						
322.2	35													
317.2	40													
312.2	45													
307.2	50													
302.2	55													
297.2	60													
292.2	65													

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

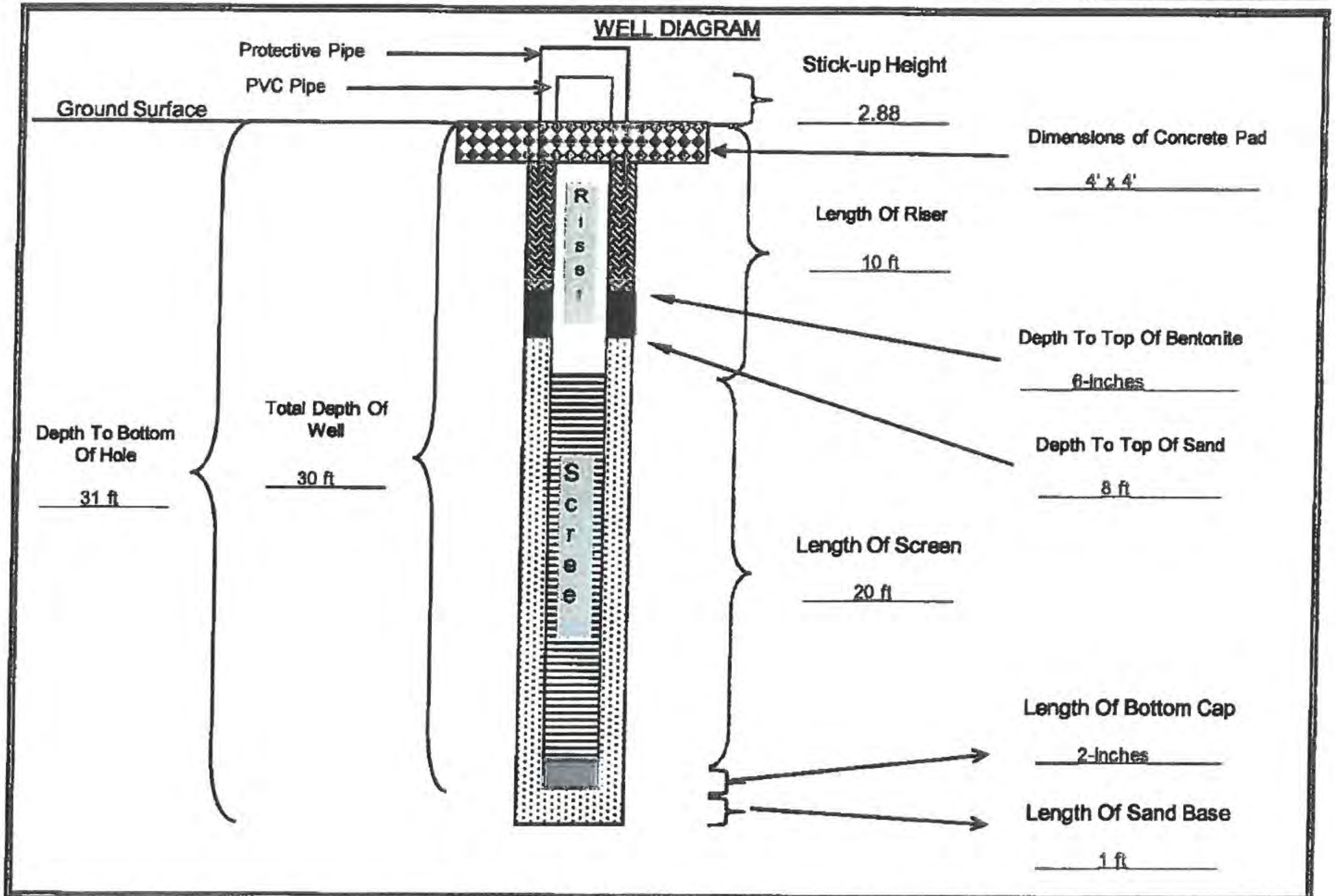
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 24-Jul-09
WELL LOCATION:
WELL NO.: GB-04
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.22 (ft, msl)
TOP OF SCREEN ELEVATION: 347.22 (ft, msl)
BOTTOM OF WELL ELEVATION: 326.22 (ft, msl)
NORTHING: -384.9666 EASTING: -2353.7375
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 6.75 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 6.75 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 3 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 20.54 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.88
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Depth To Bottom Of Hole: 31 ft
Total Depth Of Well: 30 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 1 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC INSTALLED BY: Total Support Services OBSERVED BY: Kush S. Chohan
DATE: 24-Jul-09 CHECKED BY: DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30.5 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.49 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8-11-09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Eastern edge of proposed chemical evaporation pond.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
357.5	0				Soft	SW-SM		Dark fine SAND with brown organic material and roots.						SPT 2, 2, 5, 5. 24" recovered
			SS	7	Firm	CH		Dark red/grey CLAY, trace silt, Dry.	23.37	44	65.6			
			SS	11								7E-07		SPT 4, 4, 7, 9. 24" recovered.
352.5	5		SS	14										SPT 5, 5, 8, 13. 24 recovered
						CH		Trace of sand						
			ST		Soft	CH		Dark red fine SAND, trace clay, Damp.	16.5	41	73.8	3.2E-08		Shelby tube. Pushed 12 recovered 9".
			SS	18	Firm	CH		Light tan CLAY, trace sand, Dry.						SPT 5, 7, 11, 11. 24" recovered.
					Soft	SC		Dark red SAND, trace of CLAY, Damp.						
					Firm	CL		Light tan CLAY, trace fine sand, Dry.						
					Soft	SC		Dark red SAND, little clay, frequent clay seams, Damp						SPT 6, 7, 11, 14. 24" recovered.
347.5	10		SS	18										
						SC		Frequent clay seams						
			SS	35	Soft	SC		Red/orange fine SAND, trace clay, trace coarse sand, poorly sorted, Moist.						SPT 11, 22, 13, 14. 24" recovered.
			SS	77										SPT 17, 27, 50/5". 17" recovered.
					Firm	CL		Brownish grey CLAY, trace sand, Moist.						
					Soft	SC		Tanish grey fine SAND, some clay, Wet.						
342.5	15													
			ST					8-11-09 ▼	19.9	13	35.7	8.6E-07		Shelby tube. Pushed 12" recovered 9".
			SS	23										SPT 11, 13, 10, 14. 24" recovered.
									27.96	NP	32.3			
					Soft	SM		Dark grey coarse SAND/GRAVEL mix, some fine sand, trace clay, Wet.						
					Soft	SM-SC		Red fine SAND, trace clay, Moist. cemented. Moist.						
			SS	19										SPT 7, 8, 11, 13. 24" recovered.
					Firm	SC		Black fine SAND, occasional clay, Wet.						
337.5	20													
					Firm	CL		Dark grey CLAY, little sand, Wet.						
			SS	22	Firm	SM		Black fine SAND, some medium sand, some clay, Wet.						SPT 8, 10, 12, 16. 24" recovered.
									32.23	NP	35.5			
					Firm	CL		Dark grey CLAY, little sand, Wet.						
					Firm	SM		Black fine SAND, some medium sand, some clay, Wet.						
			SS	26	Firm	SM		Frequent clay seams						SPT 8, 11, 17, 21. 24" recovered.
					Firm	SM		Frequent clay seams.						
			ST											Shelby tube. 12" driven 0 recovered.
332.5	25													SPT 15, 19, 21, 27. 24" recovered.
			SS	40	Hard	CL		Dark grey CLAY, trace of sand, Dry.						
			SS	22										SPT 10, 11, 11, 50/5". 23" recovered.
					Very Hard	CL		Dark grey CLAY, frequent iron stone/ore. Rig chatter driller comments						
			ST						24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
327.5	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.5	30	☒	ST	Hard	CL	▨	Dark grey CLAY, trace of sand, Dry. (cont.)	24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
							Bottom of Boring at 30.5 feet bgs						
322.5	35												
317.5	40												
312.5	45												
307.5	50												
302.5	55												
297.5	60												
292.5	65												

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

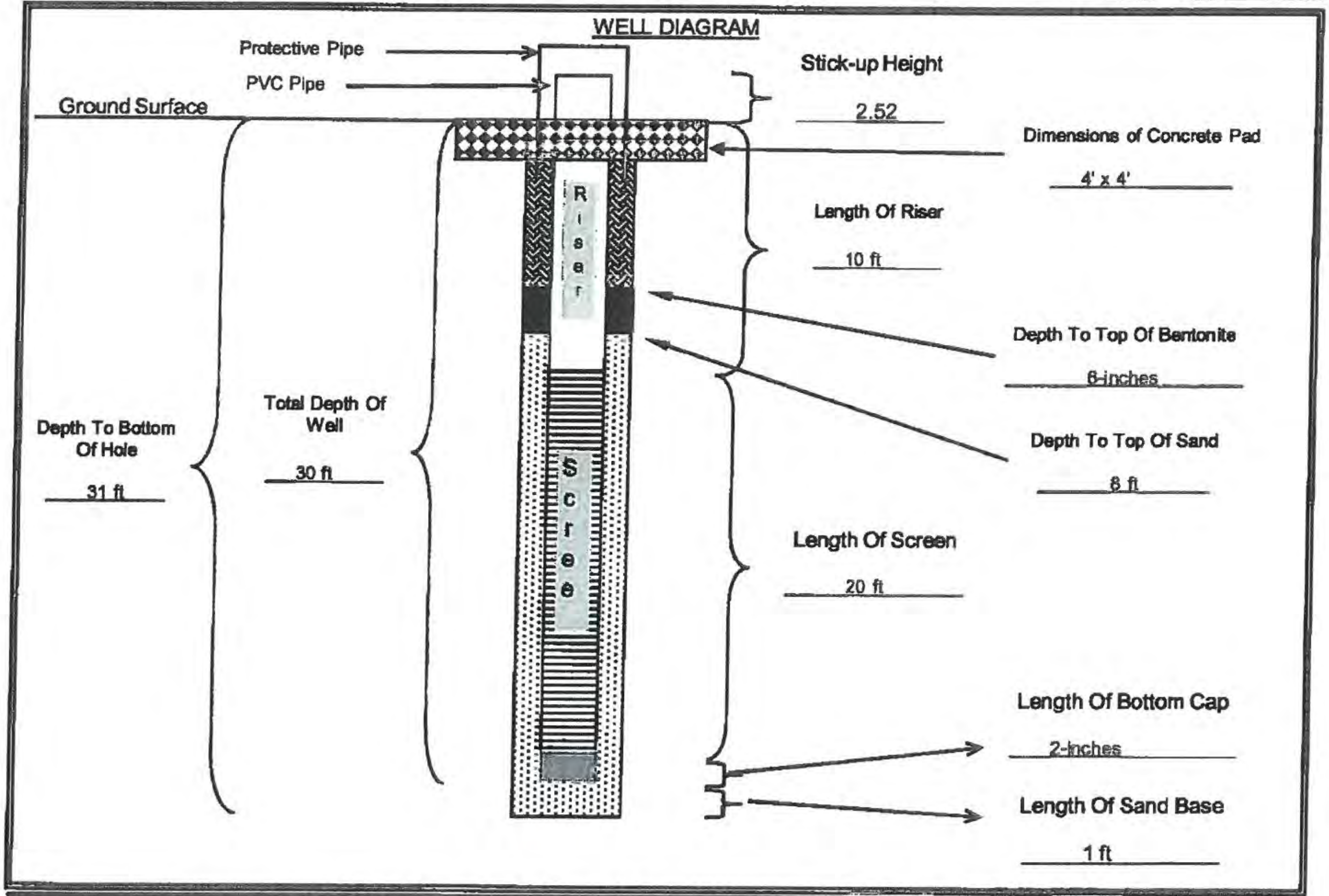
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: August 6 2009
WELL LOCATION:
WELL NO.: GB-05
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.49 (ft, msl)
TOP OF SCREEN ELEVATION: 347.49 (ft, msl)
BOTTOM OF WELL ELEVATION: 326.49 (ft, msl)
NORTHING: 529.1865 EASTING: -2243.9973
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 8 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 8 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 3 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 17.33 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.52
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Total Depth Of Well: 30 ft
Depth To Bottom Of Hole: 31 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 1 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
OBSERVED BY: Kush Chohan
DATE: 6-Aug-09
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-06

Sheet 1 of 1

Date(s) Drilled **7/23/2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.41 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube, Other**	Hammer Data **140 lb, 30 in drop, auto hammer**
Borehole Backfill **Well Completion**	Location **Northeast corner of proposed chemical pond in the middle of open grass field.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
357.4	0				Soft	SP		Greyish brown fine SAND with trace fines. Organic material (roots).						Hand Auger
			HA		Soft	SP-SM		Greyish red fine SAND, little silt. Poorly sorted, less organic material.						
					Soft	SM		Greyish red fine SAND, with little silt and clay. Dry.						
					Soft			Tanish grey fine SAND, trace silt and clay, frequent iron oxide, frequent discoloration.						SPT 4, 7, 7. 16" recovered
			SS	14					12.74	34	67.9			
					Firm	CL		Red light brown CLAY, little sand, trace silt, Dry.						
352.4	5													SPT 3, 5, 6, 8. 20" recovered
			SS	11	Soft	SC		Dark reddish brown fine SAND, little clay.						
					Soft	CL		Light grey CLAY, little sand, trace silt. Dry.						SPT 3, 5, 7, 7. 24" recovered
					Soft	SC		Reddish brown fine SAND, trace clay, trace silt. Occasional clay seams. Damp.						
			SS	12					17.65	NP	43.2			
					Soft	CL		Light grey CLAY, little fine sand						
			SS		Soft to Firm	SC		Brownish red fine SAND, little to some clay, some cementation, Damp.						24" driven, 15" recovered.
347.4	10													
														SPT 8, 9, 10, 10. 24" recovered.
			SS	19										
					Soft to Firm	CL		Brown CLAY, little fine sand, frequent brown sand-clay mixture with iron ore oxide.						Shelby Tube. 24" driven/16" recovered
			ST						22.9	21	43.2	6.0e-07		
342.4	15				Firm	CL		Dark reddish brown CLAY, little fine sand, Damp. 8/11/09 ▼						SPT 15, 10, 22, 30. 24" recovered
			SS	40	Firm	SC		Dark reddish brown SAND, little to some clay, Moist.						
					Firm	CL		Black CLAY, little fine sand, Wet.						SPT 2, 8, 14, 10. 24" recovered
			SS	22	Firm	SW		Black fine SAND, trace clay, trace med sand, Wet.						
					Firm	CL		Black CLAY, trace fine sand, trace silt, Wet.						SPT 5, 8, 22, 50/4". 22 recovered.
						SC		Black fine SAND, little clay, Wet.						
337.4	20		SS	30	Firm	CL		Black CLAY, trace sand, trace silt. Wet.						
					Firm	SC		Black fine SAND, trace to little clay, Wet. Occasional black clay seams.						SPT 10, 11, 23, 33. 24" recovered
			SS	34	Firm	SP-SC		Black fine SAND, with little clay, trace med sand, Wet.						
						SW-SC		Grading to med SAND, Wet.						SPT 11, 16, 16, 24. 24" recovered.
			SS	36										
332.4	25													SPT 9, 11, 12, 22. 24" recovered.
			SS	23	Firm	SW-SC		Occasional CLAY lenses, Wet.						
					Firm	SC		Black fine SAND, little med sand and clay, Wet.						SPT 7, 15, 25, 50/3". 21 recovered.
			SS	40	Hard	CL		Dark grey CLAY, little sand, little silt, Dry.						
			ST							19	45.1			Shelby tube, 12" driven-6" recovered.
327.4	30							Bottom of Boring at 30 feet bgs						

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

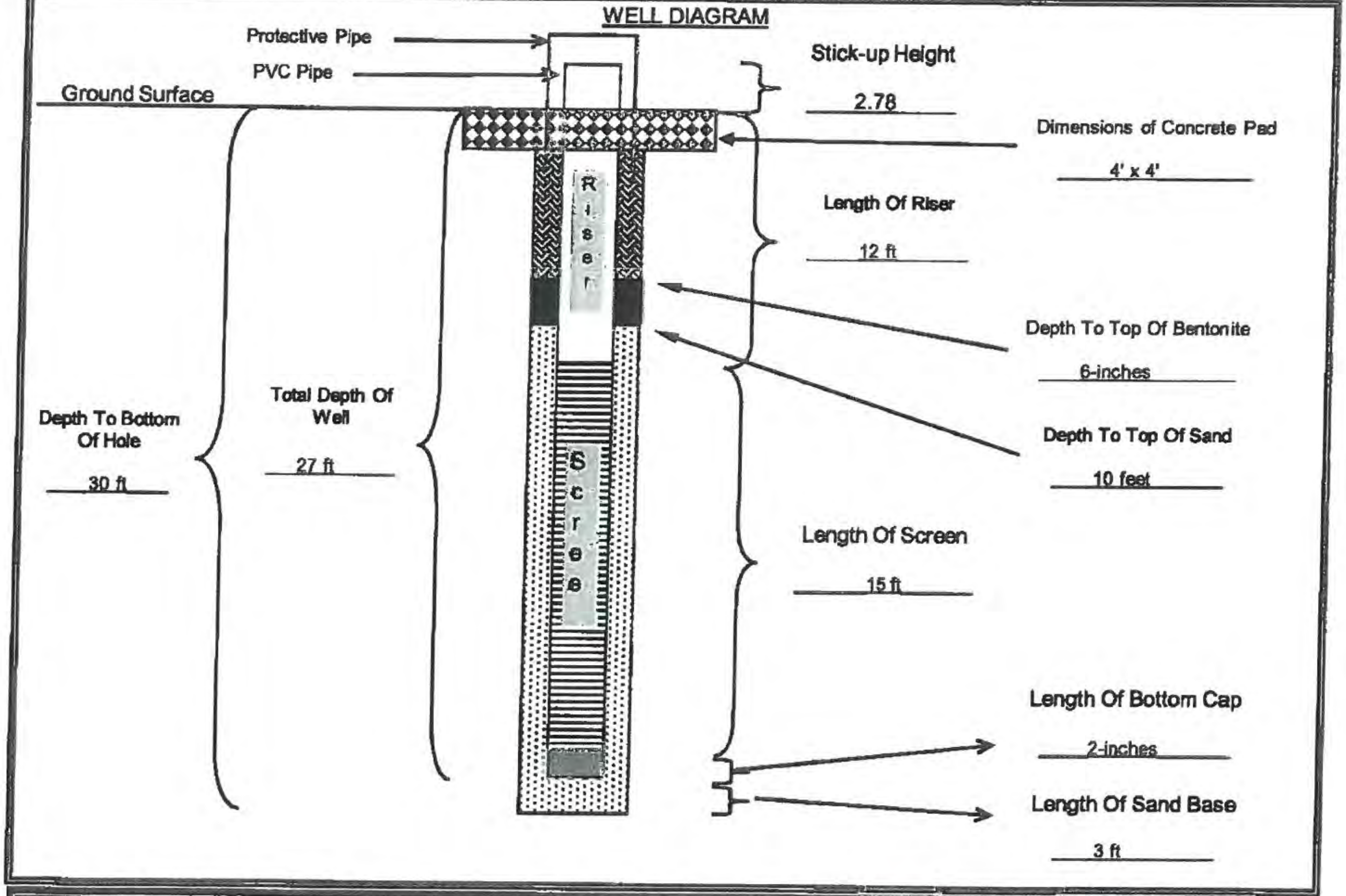
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0084
DATE/TIME: 23-Jul-09
WELL LOCATION:
WELL NO.: GB-06
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.41 (ft, msl)
TOP OF SCREEN ELEVATION: 345.41 (ft, msl)
BOTTOM OF WELL ELEVATION: 327.41 (ft, msl)
NORTHING: 740.4893 EASTING: -2166.134
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 12 (ft)
SCREEN DIAMETER: 2 (in) Length: 15 (ft)
BOREHOLE DIAMETER: 6.75 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 6.75 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 2.5 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 15.3 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.78
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 12 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 10 feet
Length Of Screen: 15 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 3 ft
Total Depth Of Well: 27 ft
Depth To Bottom Of Hole: 30 ft

▨ Cement/Bentonite Grout	░ Sand Pack	▦ Neat Concrete	■ Bentonite	▩ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: 23-Jul-09
OBSERVED BY: Kush Chohan
CHECKED BY:
DATE:

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	GB-07/MW-7
TOTAL DEPTH:	34'
TOP OF CASING ELEV.:	362.75 ft. NGVD
GROUND SURFACE ELEV.:	360.20 ft. NGVD

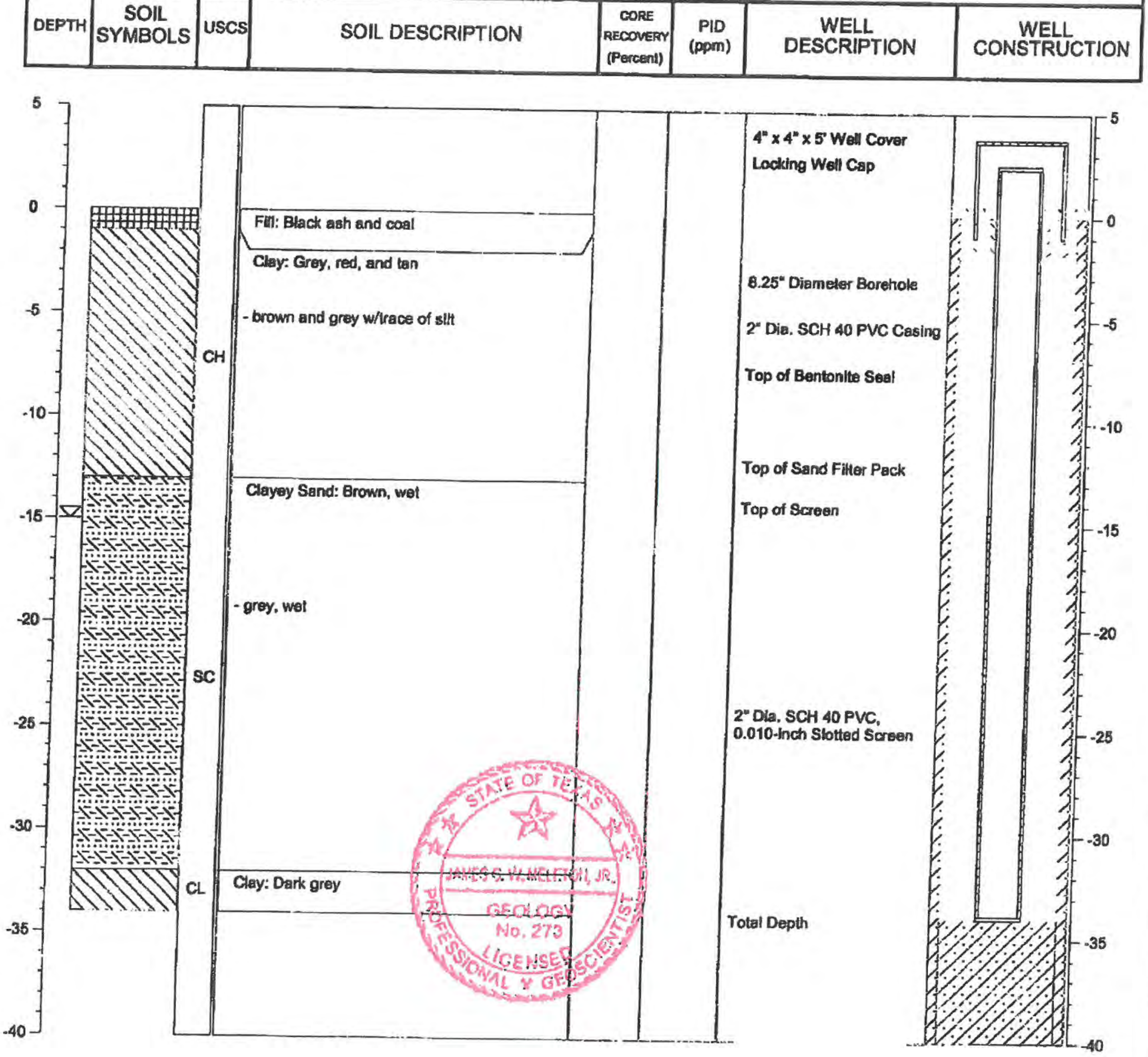
CLIENT:	AEP
PROJECT:	Metal Cleaning Waste Pond
SITE LOCATION:	Welsh Power Plant
PROJECT NO.:	S-08-0120
LOGGED BY:	James Meleton, Jr.

DRILLING CO.:	WEST Drilling
DRILLER:	Tom McCullough
METHOD OF DRILLING:	Hollow-stem Auger
SAMPLING METHODS:	Split-spoon
DATE DRILLED:	12/1/09

NOTES: Latitude: 33.05455
Longitude: 94.84674

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



JAMES G. W. MELETON, JR.
GEOLOGY
No. 273

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-1

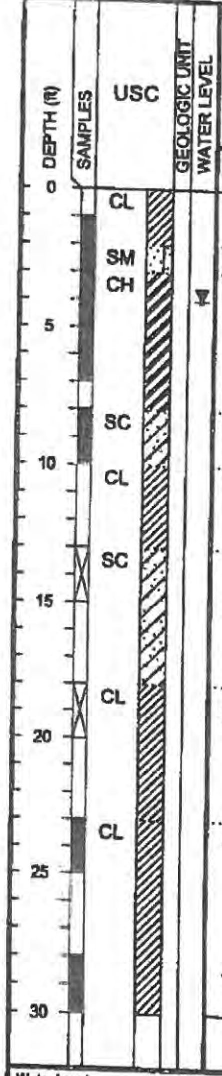
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

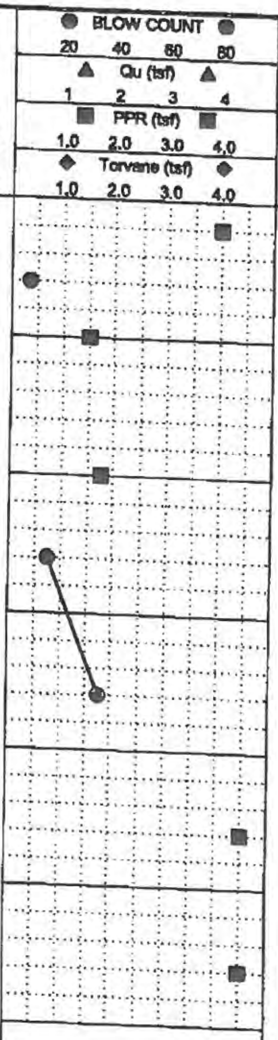
DATE 10/27/09

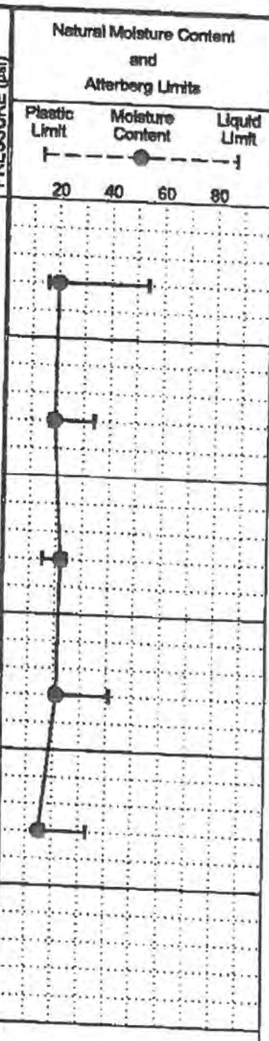
SURFACE ELEVATION 324.1



USC	Water Level	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL		SANDY LEAN CLAY(CL) very stiff; brownish orange	P=4.0 SF						
SM	▼	SILTY SAND(SM) tannish orange	N=7						
CH		SANDY FAT CLAY(CH) medium stiff; tannish orange –stiff	P=1.5	20	54	16	38	63	+40Sieve=10%, +4 Sieve=1%
SC		CLAYEY SAND(SC) medium dense; tannish orange; with clay seams	P=1.75						
CL		SANDY LEAN CLAY(CL) stiff; orange		19	34	17	17	32	+40 Sieve=7%, +4 Sieve=3%
SC		CLAYEY SAND(SC) medium dense; orange; saturated; with iron oxide cemented sandstone rock	N=15	22	24	15	9	19	+40Sieve=35%, +4 Sieve=22%
CL		LEAN CLAY WITH SAND(CL) hard; dark gray; with clay seams	N=35	21	41	21	20	75	+40 Sieve=2%, +4 Sieve=0%
CL		SANDY LEAN CLAY(CL) hard; dark brown	P=4.5+	15	33	17	16	52	+40 Sieve=1%, +4 Sieve=0%
		–grayish brown; laminated with silt	P=4.5+						
		Bottom of Boring @ 30'							

DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 5' while drilling. Water level @ 4' and open to 30' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.090', W 94°50.417'

Piezometer B-2

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

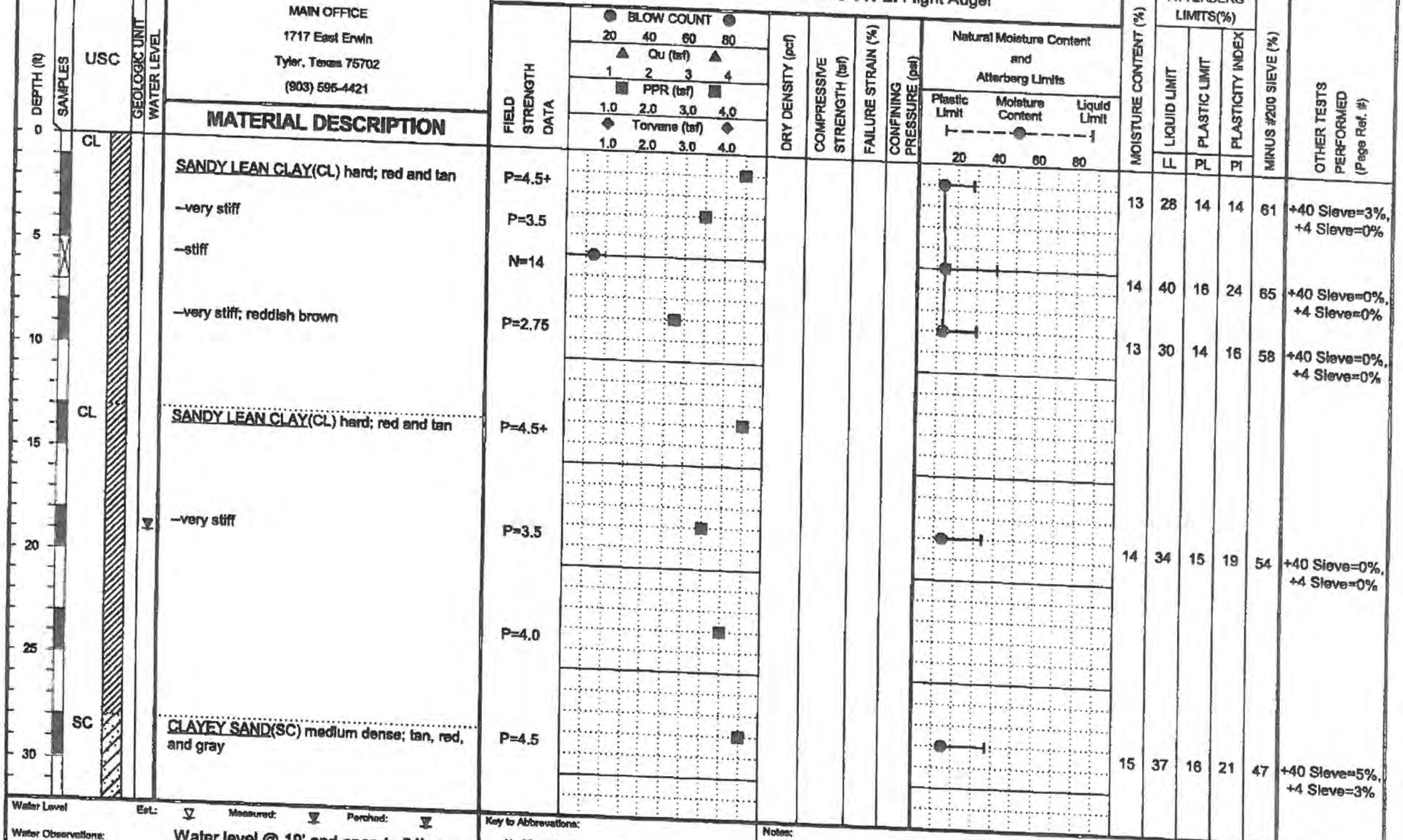
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+						
	–very stiff	P=3.5	13	28	14	14	61	+40 Sieve=3%, +4 Sieve=0%
	–stiff	N=14						
	–very stiff; reddish brown	P=2.75	14	40	16	24	65	+40 Sieve=0%, +4 Sieve=0%
			13	30	14	16	58	+40 Sieve=0%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+						
	–very stiff	P=3.5						
			14	34	15	19	54	+40 Sieve=0%, +4 Sieve=0%
		P=4.0						
SC	CLAYEY SAND(SC) medium dense; tan, red, and gray	P=4.5						
			15	37	16	21	47	+40 Sieve=5%, +4 Sieve=3%

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

LOG OF BORING B-2

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7

Legend: ● BLOW COUNT ● 20 40 60 80; ▲ Qu (tsf) ▲ 1 2 3 4; ■ PPR (tsf) ■ 1.0 2.0 3.0 4.0; ◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits: Plastic Limit ├ - - - ● - - - ┤ Liquid Limit, Moisture Content; 20 40 60 80

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35		–red and tan	P=2.5						
40	SM SC	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated	SF	12	22	15	7	48	+40 Sieve=0%, +4 Sieve=0%
45	CH	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams	P=4.5+						
50	SM	SILTY SAND(SM) black and gray	SF						
		Bottom of Boring @ 50'							

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

Piezometer B-2

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

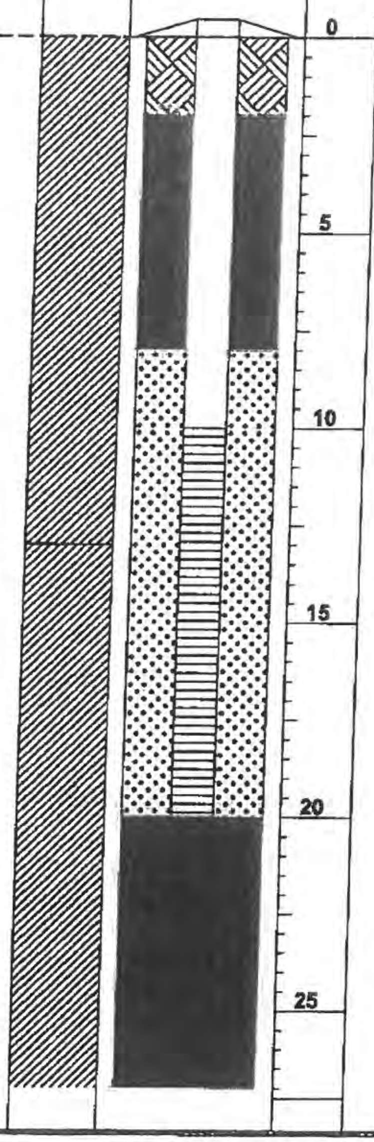
Well No. B-2

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
						T.O.C. Elev.
0	Ground Surface				0	
	SANDY LEAN CLAY(CL) hard; red and tan					
	–very stiff					
5	–stiff				5	
	–very stiff; reddish brown					
10					10	
	SANDY LEAN CLAY(CL) hard; red and tan					
15					15	
	–very stiff					
20					20	
25					25	



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/28/09

Drilling Completed 10/28/09

Construction Completed

Development Completed

Type of Well

Drilling Method Solid Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-8' & 20-50'

Filter Pack Qty. 8-20'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

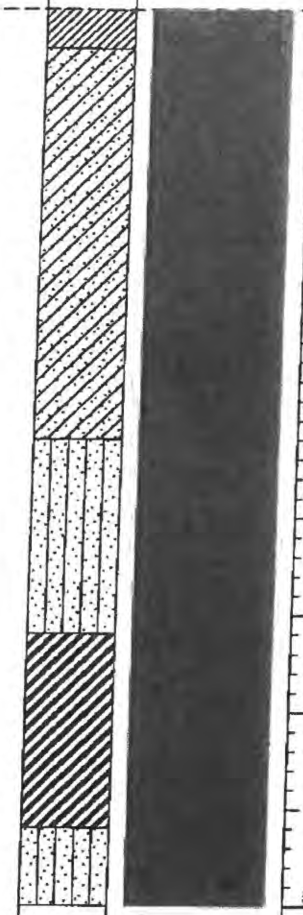
Well No. B-2

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
	CLAYEY SAND(SC) medium dense; tan, red, and gray					
30					30	
	--red and tan					
35					35	
	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated					
40					40	
	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams					
45					45	
	SILTY SAND(SM) black and gray					
50	Bottom of Boring @ 50'				50	
55						
60						



LOG OF BORING B-3

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

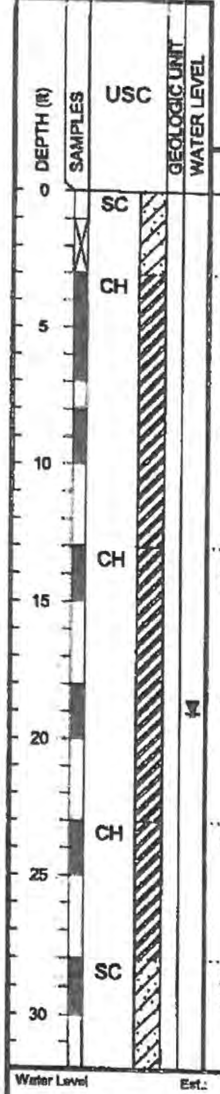
PROJECT NO.: G3242-09

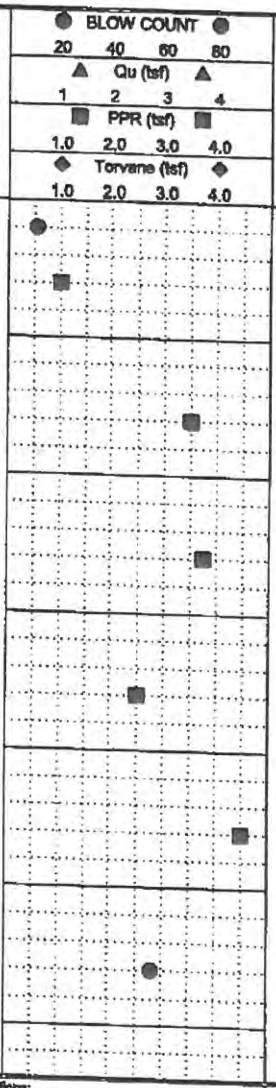
BORING TYPE: Flight Auger

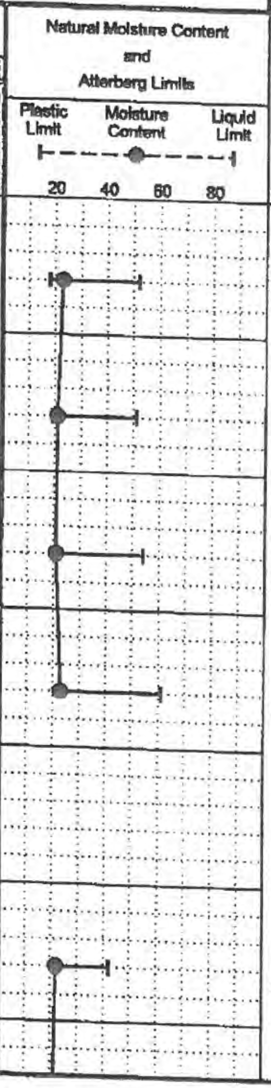
DATE 10/27/09

SURFACE ELEVATION 339.6

USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC		CLAYEY SAND(SC) medium dense; gray and red	N=11										
CH		FAT CLAY(CH) stiff; red and tan; with sand seams	P=1.0					23	52	18	34	87	+40 Sieve=3%, +4 Sieve=0%
		–very stiff	P=3.5					21	51	19	32	86	+40 Sieve=3%, +4 Sieve=0%
CH		FAT CLAY WITH SAND(CH) very stiff; brown; with ferric joints	P=3.75					21	54	20	34	85	+40Sieve=10%, +4 Sieve=1%
	▼	–red and tan; layered; with ferric seams	P=2.5					23	61	24	37	81	+40Sieve=11%, +4 Sieve=0%
CH		FAT CLAY(CH) hard; gray; with sand seams	P=4.5+										
SC		CLAYEY SAND(SC) very dense; gray; with sand seams	N=56					22	42	22	20	35	+40 Sieve=1%, +4 Sieve=0%







Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

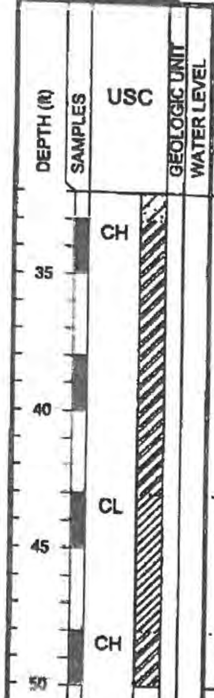
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

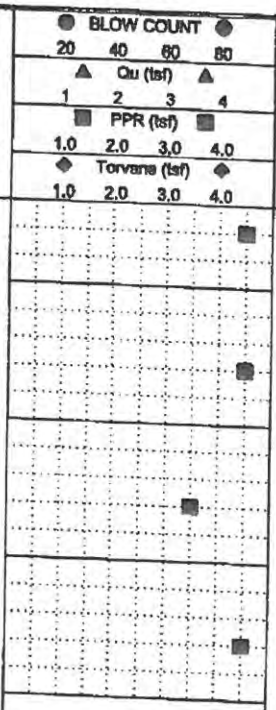
DATE 10/27/09

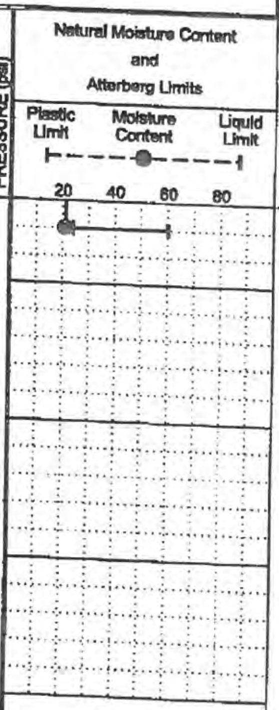
SURFACE ELEVATION 339.6



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY(CH) hard; brown; layered and with sand seams	P=4.5+	21	60	24	36	95	+40 Sieve=1%, +4 Sieve=0%
	–gray and green	P=4.5+						
CL	SANDY LEAN CLAY(CL) very stiff; gray and dark green; layered; with sand seams	P=3.5						
CH	FAT CLAY(CH) hard; gray and dark green; layered; with silt seams	P=4.5+						
	Bottom of Boring @ 50'							

DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)





Water Level — Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

Piezometer B-4

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ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

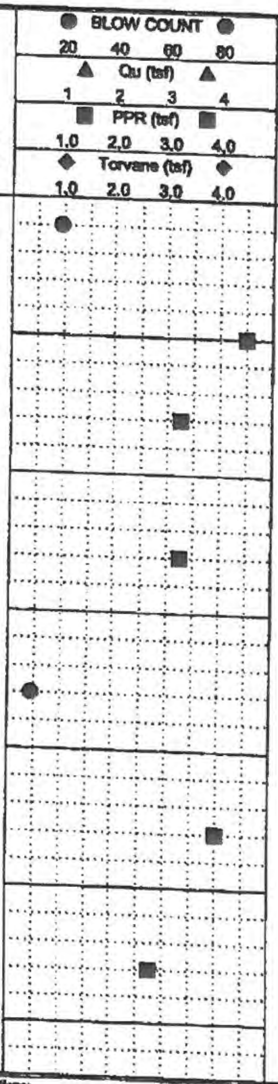
PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

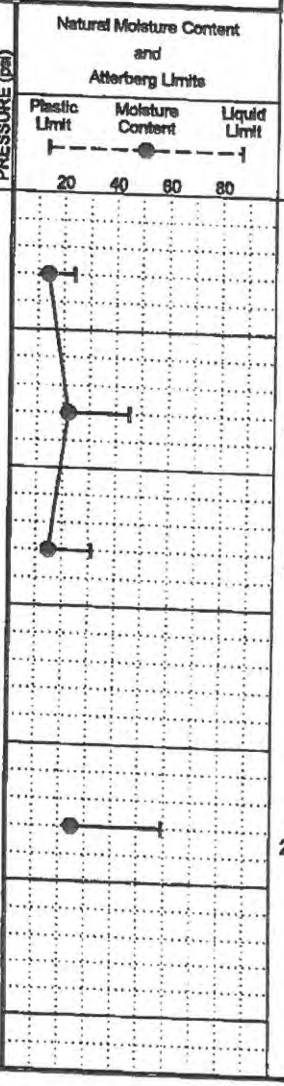
DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	SM	SILTY SAND(SM) medium dense; tan; with gravel	N=19						
	CL	SANDY LEAN CLAY(CL) dark brown --tannish orange	SF						
5		--hard; orangish tan	P=4.5	14	24	15	9	59	+40 Sieve=1%, +4 Sieve=0%
			P=3.25						
10		--very stiff; white		22	45	21	24	94	+40 Sieve=2%, +4 Sieve=0%
	SC	CLAYEY SAND(SC) medium dense; tan --orangish gray; with sand seams	P=3.25						
15				15	31	15	16	40	+40 Sieve=1%, +4 Sieve=0%
	CL	SANDY LEAN CLAY(CL) stiff; orangish tan	N=9						
20									
	CH	FAT CLAY(CH) very stiff; orangish tan; with ferric seams	P=4.0						
25				25	59	24	35	88	+40 Sieve=4%, +4 Sieve=0%
		--tannish brown; with iron ore seams	P=2.75						
30									



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

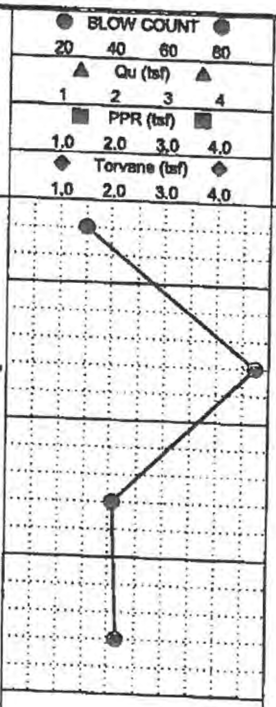
PROJECT NO.: G3242-09

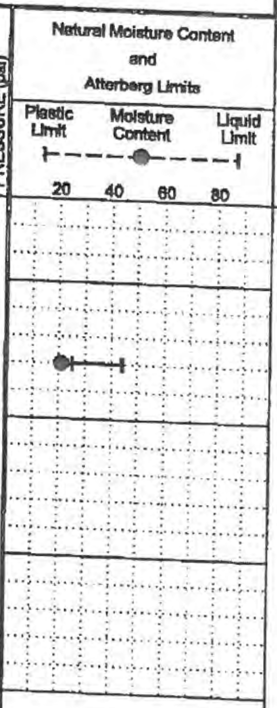
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35		–hard; light gray; layered and with silt seams	N=30										
40	CL	LEAN CLAY(CL) hard; light gray; layered and with silt seams	N=50/5.75"					21	44	25	19	93	+40 Sieve=1%, +4 Sieve=0%
45		–light gray	N=41										
50		–layered and with sand seams; with lignite	N=43										
		Bottom of Boring @ 50'											





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

Piezometer B-4

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

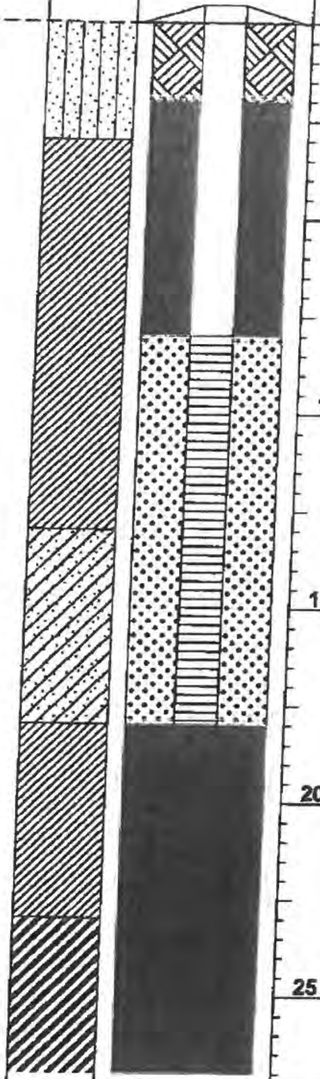
Well No. B-4

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
						T.O.C. Elev.
0	Ground Surface				0	
	SILTY SAND(SM) medium dense; tan; with gravel					
	SANDY LEAN CLAY(CL) dark brown					
	–tannish orange					
5	–hard; orangish tan				5	
10	–very stiff; white				10	
	CLAYEY SAND(SC) medium dense; tan					
15	–orangish gray; with sand seams				15	
	SANDY LEAN CLAY(CL) stiff; orangish tan					
20					20	
	FAT CLAY(CH) very stiff; orangish tan; with ferric seams					
25					25	



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed

Development Completed

Type of Well

Drilling Method Solid Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 8.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 8.0' **to** 18.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-8' & 18-50'

Filter Pack Qty. 6-18'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

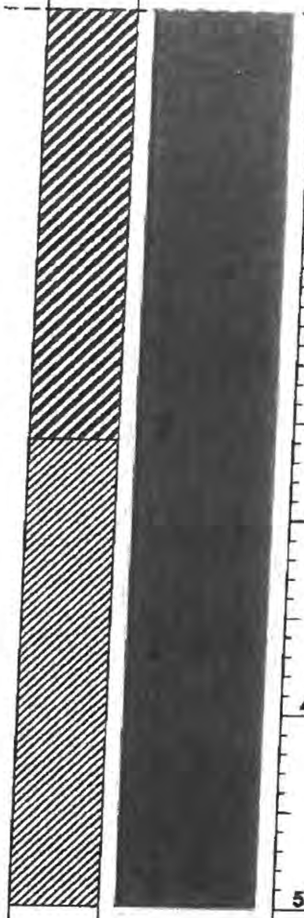
Well No. B-4

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
	–tannish brown; with iron ore seams					
30					30	
	–hard; light gray; layered and with silt seams					
35					35	
	LEAN CLAY(CL) hard; light gray; layered and with silt seams					
40					40	
	–light gray					
45					45	
	–layered and with sand seams; with lignite					
50	Bottom of Boring @ 50'				50	
55						
60						



ETTL Engineers & Consultants Inc.

Piezometer B-5

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

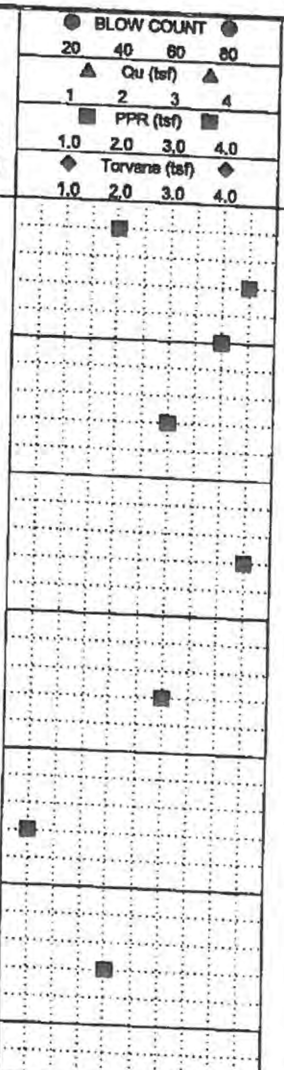
BORING TYPE: Flight Auger

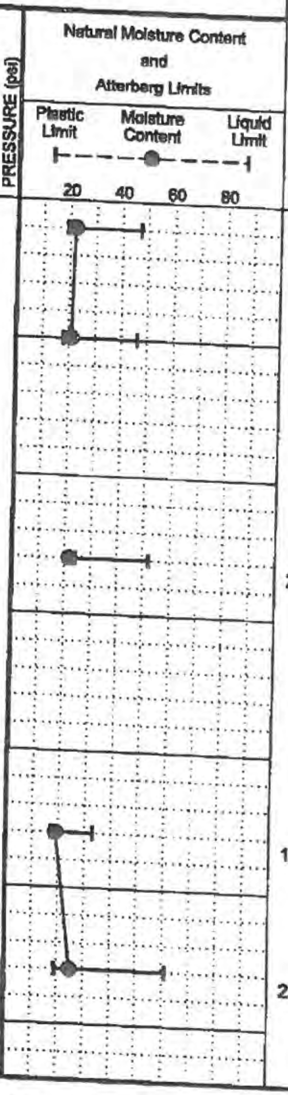
DATE 10/27/09

SURFACE ELEVATION 340.0

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	LEAN CLAY WITH SAND(CL) stiff; red and tan	P=2.0						
	CL	LEAN CLAY(CL) hard; red and tan	P=4.5+	22	47	19	28	81	+40 Sieve=8%, +4 Sieve=3%
5		–very stiff	P=4.0						
	CH	FAT CLAY(CL) very stiff; brown and tan	P=3.0	21	46	18	28	94	+40 Sieve=3%, +4 Sieve=0%
10									
	CH	FAT CLAY WITH SAND(CH) hard; red and tan	P=4.5+	22	52	24	28	88	+40 Sieve=3%, +4 Sieve=0%
15									
	CL	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams	P=3.0						
20									
	SC	CLAYEY SAND(SC) very loose; tan, red, and gray	P=0.5	19	33	17	16	44	+40 Sieve=1%, +4 Sieve=0%
25									
	CH	FAT CLAY WITH SAND(CH) stiff; red and gray	P=2.0	25	61	19	42	83	+40 Sieve=5%, +4 Sieve=3%
30									

DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)





Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	SC	SILTY CLAYEY SAND(SC) gray and red; saturated	SF										
40	CH	FAT CLAY(CH) hard; red and gray; with sand seams	P=4.5+					25	51	31	20	87	+40 Sieve=6%, +4 Sieve=0%
45		–gray, tan, and red; with sand seams	P=4.5+										
50	SM SC	SILTY SAND(SM-SC) red and gray	SF										
		Bottom of Boring @ 50'											

● BLOW COUNT ● 20 40 60 80
▲ Qu (tsf) ▲ 1 2 3 4
■ PPR (tsf) ■ 1.0 2.0 3.0 4.0
◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits
Plastic Limit ├ – – – ● – – – ┤ Moisture Content Liquid Limit
20 40 60 80

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

Repeater B-5

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-5

Location Pittsburg, Texas

Surface Elev.

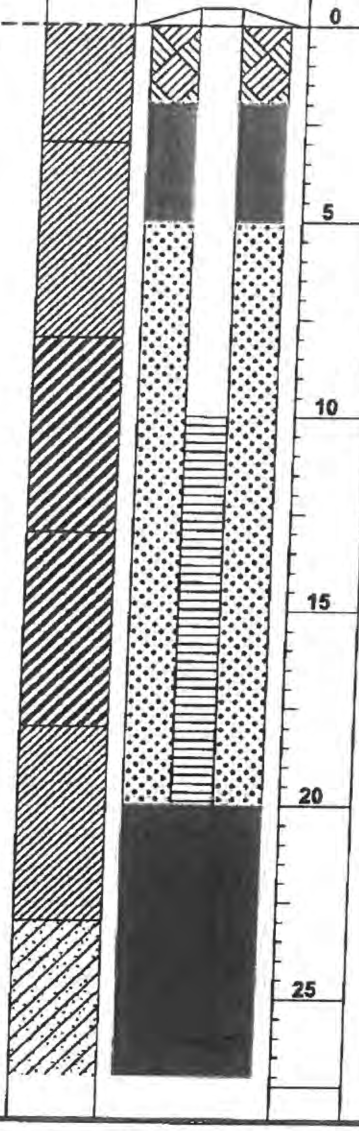
Page 1 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description
0	Ground Surface
	LEAN CLAY WITH SAND(CL) stiff; red and tan
	LEAN CLAY(CL) hard; red and tan
5	—very stiff
	FAT CLAY(CL) very stiff; brown and tan
10	
	FAT CLAY WITH SAND(CH) hard; red and tan
15	
	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams
20	
	CLAYEY SAND(SC) very loose; tan, red, and gray
25	

Continued Next Page

Field Strength Data | **Graphic Log** | **Well Construction Graphics** | **Depth Feet** | **Well Construction Details**

T.O.C. Elev.



Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed ______

Development Completed ______

Type of Well ______

Drilling Method Solid Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-5' & 20-50'

Filter Pack Qty. 5-20'

Filter Pack Type 20/40 Sand

Static Water Level ______

Notes: ______

ETTL Engineers & Consultants Inc.

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

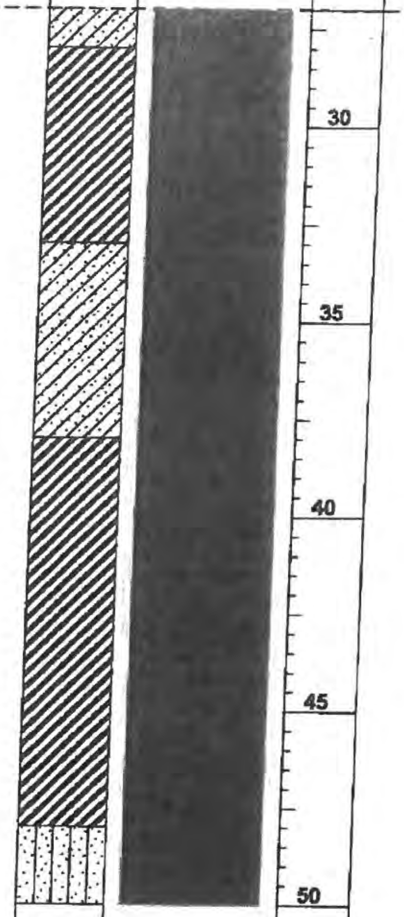
Well No. B-5

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
	FAT CLAY WITH SAND(CH) stiff; red and gray					
30					30	
	SILTY CLAYEY SAND(SC) gray and red; saturated					
35					35	
	FAT CLAY(CH) hard; red and gray; with sand seams					
40					40	
	–gray, tan, and red; with sand seams					
45					45	
	SILTY SAND(SM-SC) red and gray					
50	Bottom of Boring @ 50'				50	
55						
60						



ETTL Engineers & Consultants Inc.

Piezometer B-6

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

PROJECT: Welsh Power Plant
Pittsburgh, Texas

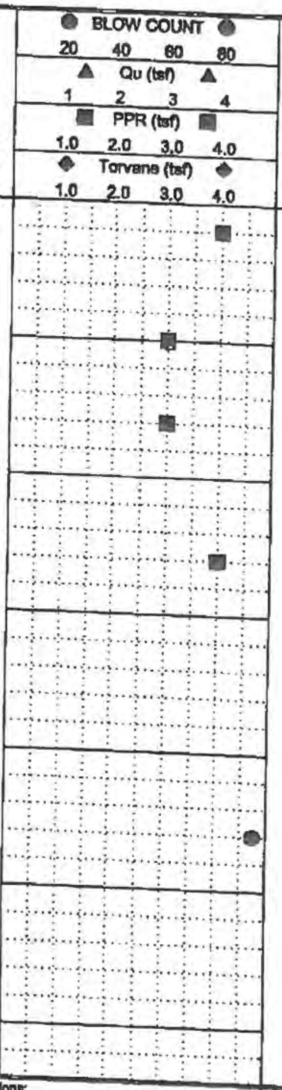
PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

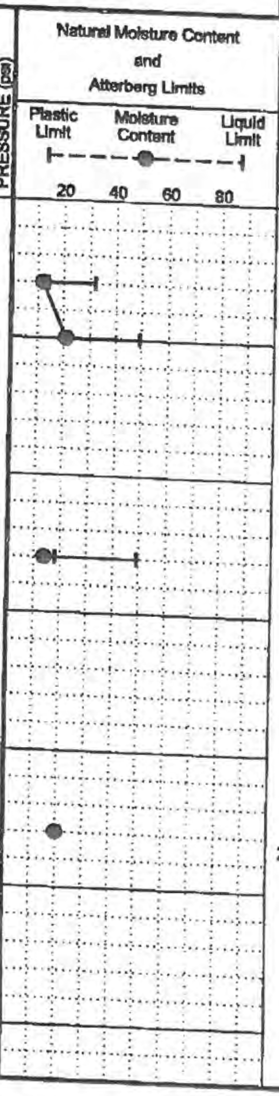
DATE 10/27/09

SURFACE ELEVATION 340.1

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY(CH) very stiff; red and gray; with ferric seams	P=4.0						
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+						
			12	32	14	18	60	+40 Sieve=0%, +4 Sieve=0%
	—very stiff; red, gray, and brown; with gravel	P=3.0	21	49	20	29	93	+40 Sieve=2%, +4 Sieve=0%
	—with sand seams	P=3.0						
		P=4.0	14	49	18	31	65	+40 Sieve=0%, +4 Sieve=0%
SM	SILTY SAND(SM) gray; saturated	P=3.0						
	—very dense; gray and red	N=50/5.25"	20				18	+40 Sieve=0%, +4 Sieve=0%
		SF						



DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

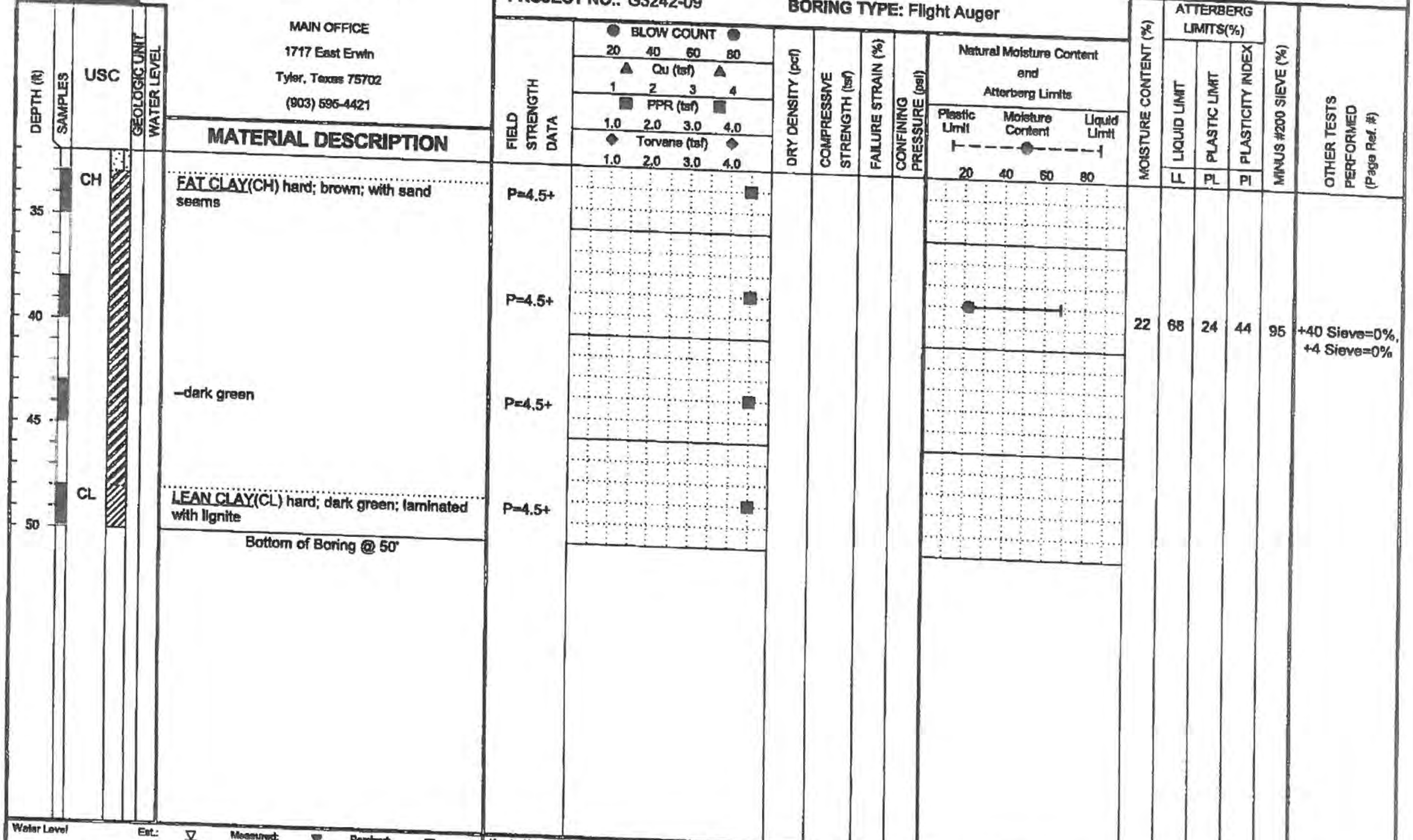
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1



DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	CH	FAT CLAY(CH) hard; brown; with sand seams	P=4.5+										
40			P=4.5+					22	68	24	44	95	+40 Sieve=0%, +4 Sieve=0%
45		–dark green	P=4.5+										
	CL	LEAN CLAY(CL) hard; dark green; laminated with lignite	P=4.5+										
50		Bottom of Boring @ 50'											

Water Level Est.: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

Piezometer B-6

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

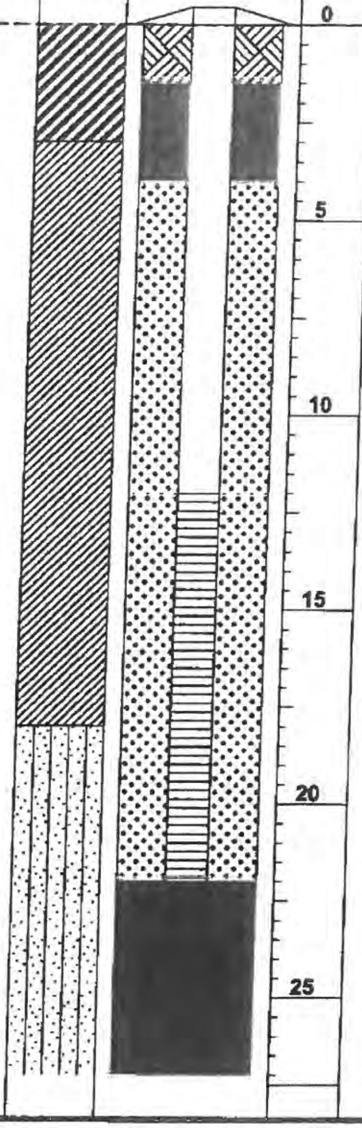
Well No. B-6

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet / Sampler	Overburden/Lithologic Description	Well Construction Details
		T.O.C. Elev.
0	Ground Surface	
	FAT CLAY(CH) very stiff; red and gray; with ferric seams	
	SANDY LEAN CLAY(CL) hard; red and tan	
5		
	—very stiff; red, gray, and brown; with gravel	
	—with sand seams	
10		
15		
	SILTY SAND(SM) gray; saturated	
20		
	—very dense; gray and red	
25		



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/28/09

Drilling Completed 10/28/09

Construction Completed

Development Completed

Type of Well

Drilling Method Solid Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 12.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 12.0' **to** 22.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 1.5-4' & 22-50'

Filter Pack Qty. 4-22'

Filter Pack Type 20/40 Sand

Static Water Level

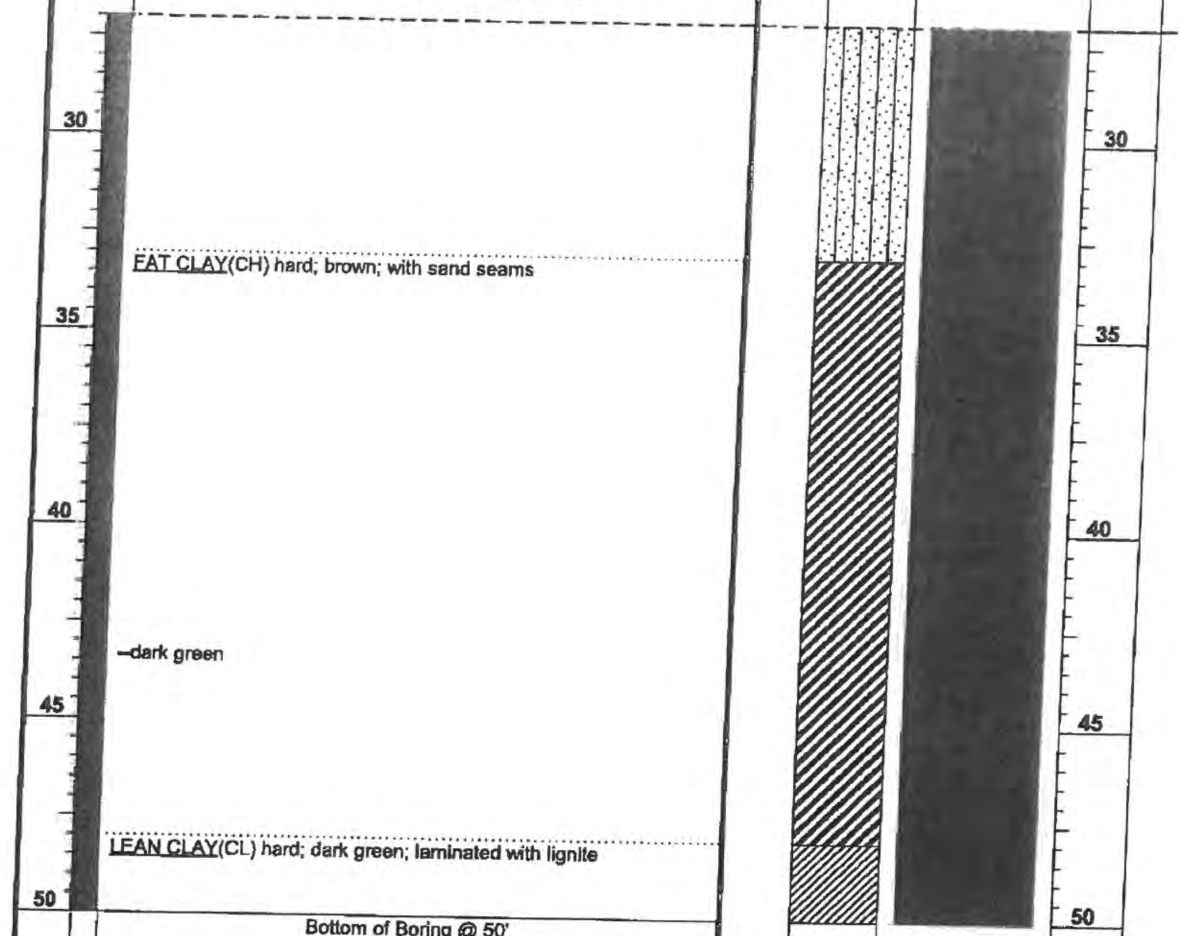
Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**

Well No. B-6
Location Pittsburg, Texas
Surface Elev.
Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
33	FAT CLAY(CH) hard; brown; with sand seams					
44	–dark green					
48	LEAN CLAY(CL) hard; dark green; laminated with lignite					
50	Bottom of Boring @ 50'					



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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-7

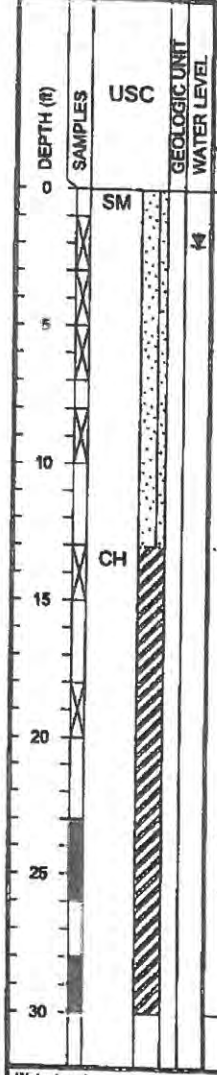
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

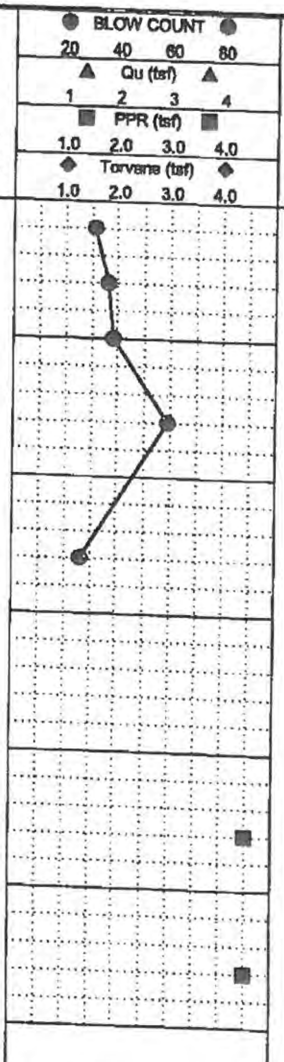
BORING TYPE: Flight Auger

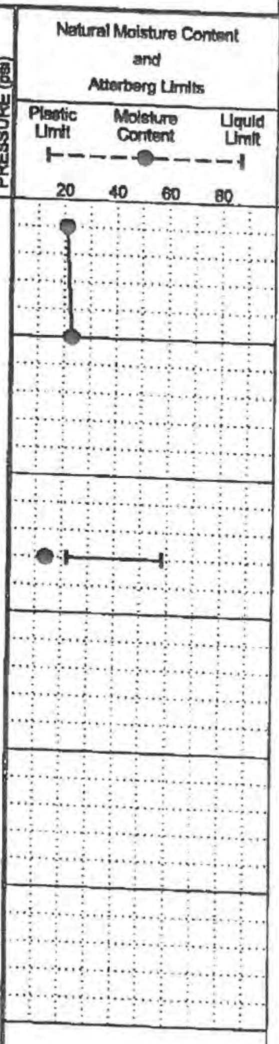
DATE 10/27/09

SURFACE ELEVATION 340.4



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SM	SILTY SAND(SM) dense; tan	N=31										
		N=36					21				21	+40 Sieve=0%, +4 Sieve=0%
	--gray; saturated	N=38										
							23				15	+40 Sieve=0%, +4 Sieve=0%
	--very dense	N=59										
CH	FAT CLAY(CH) very stiff; dark gray; with silt and ferric seams	N=26					14	58	22	36	98	+40 Sieve=0%, +4 Sieve=0%
	--hard; gray and black; with trace of lignite	P=4.5+										
	--gray											
		P=4.5+										
	Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 4' while drilling. Water level @ 2' and open to 7' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.898', W 94°50.519'

Landfill Boring B-2

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

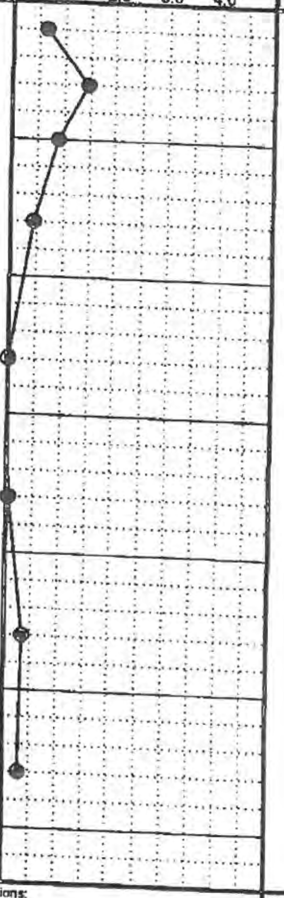
BORING TYPE: Rotary Wash/Flight Auger

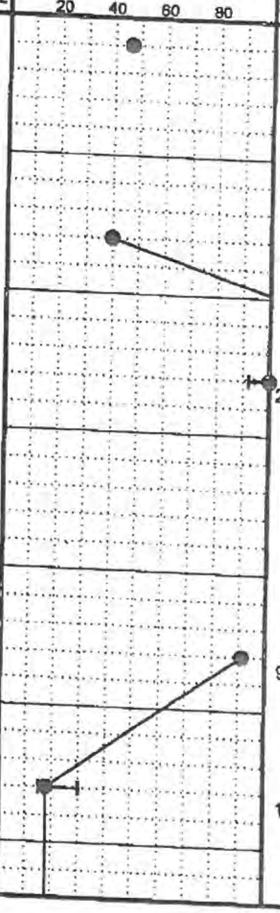
DATE 10/8/14

SURFACE ELEVATION 373.8

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA
ML	ASH (SILT WITH GRAVEL(ML)) medium dense; light grayish brown; with coarse-grained sand and lightly cemented gravel pieces; dry	N=13
SM	ASH (SILTY SAND(SM)) medium dense; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces	N=29 N=18
	--loose; moist	N=9
MH	ASH (ELASTIC SILT(MH)) very loose; black; with fine-grained sand and lightly cemented gravel pieces; saturated	N=0
SM	ASH (SILTY SAND(SM)) very loose; dark brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=1
	--loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7
CL	SANDY LEAN CLAY(CL) medium stiff; dark brown and black; with fine-grained sand and cemented gravel pieces; saturated	N=6

GEOLOGIC UNIT: Egc @ 28-43' & Er @ 43-60'





DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
				46				59	+40 Sieve=27% +4 Sieve=16%
				40				40	+40 Sieve=19% +4 Sieve=2%
				200	134	92	42	100	+40 Sieve=0% +4 Sieve=0%
				91				61	+40 Sieve=11% +4 Sieve=1%
				18	30	15	15	63	+40 Sieve=1% +4 Sieve=0%

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

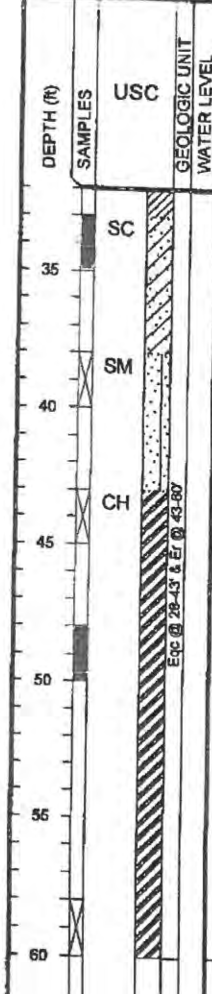
BORING TYPE: Rotary Wash/Flight Auger

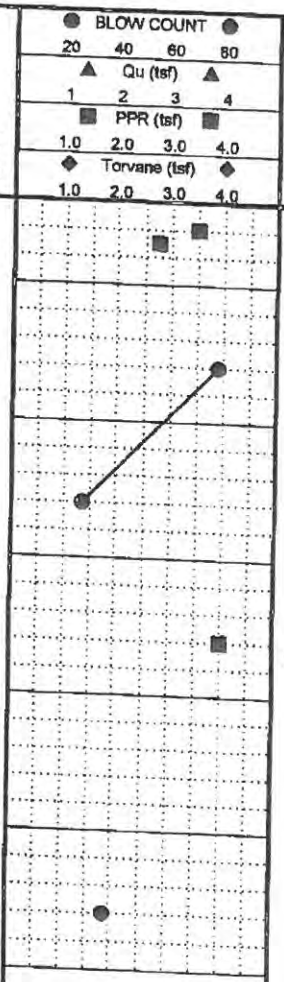
DATE 10/8/14

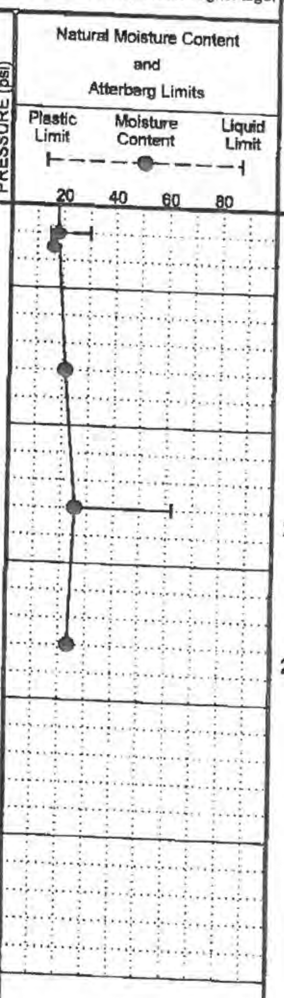
SURFACE ELEVATION 373.8

MATERIAL DESCRIPTION

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	CLAYEY SAND(SC) dense; light brown, light gray and reddish brown; moist; with fine-grained sand; mottled	P=3.5 P=2.75	110	1.39	4.3	21	18 16	30	15	15	39	+40 Sieve=0% +4 Sieve=0%
SM	SILTY SAND(SM) very dense; light brown, yellowish brown and light gray; moist; mottled; with fine-grained sand	N=78					21				24	+40 Sieve=0% +4 Sieve=0%
CH	FAT CLAY(CH) very stiff; dark brown and light brown; moist; with sand seams; laminated	N=27					25	62	26	36	96	+40 Sieve=2% +4 Sieve=0%
	--dark brown with light gray; moist; with silt seams	P=4.0	98				24					
	--hard; dark brown; moist	N=37										
	Bottom of Boring @ 60'											







Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill boring B-10

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ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

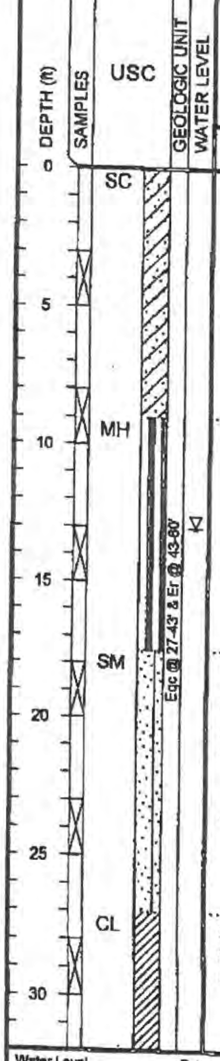
PROJECT NO.: G4207-146

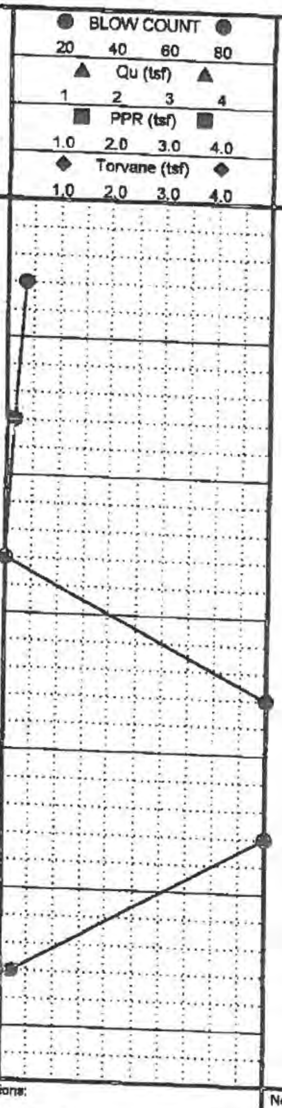
DRILL RIG: B-61 HDX

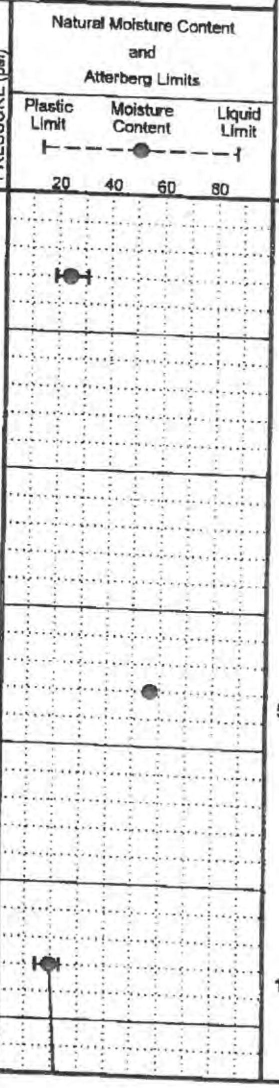
BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14

SURFACE ELEVATION 373.2







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	ASH (CLAYEY SAND(SC)) loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7					24	31	19	12	41	+40 Sieve=21% +4 Sieve=11%
MH	ASH (ELASTIC SILT(MH)) very loose; black; moist	N=3										
	--wet	N=0										
SM	ASH (SILTY SAND WITH GRAVEL(SM)) very dense; light brown and dark brown; with lightly cemented gravel pieces and coarse-grained sand; moist; cemented layer from 17.5' to 21'	N=50/1"					56				14	+40 Sieve=71% +4 Sieve=28%
	--cemented layer from 23' to 27'	N=50/4"										
CL	SANDY LEAN CLAY(CL) medium stiff; grayish brown and yellowish brown; saturated; mottled	N=4					19	23	14	9	57	+40 Sieve=1% +4 Sieve=0%

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

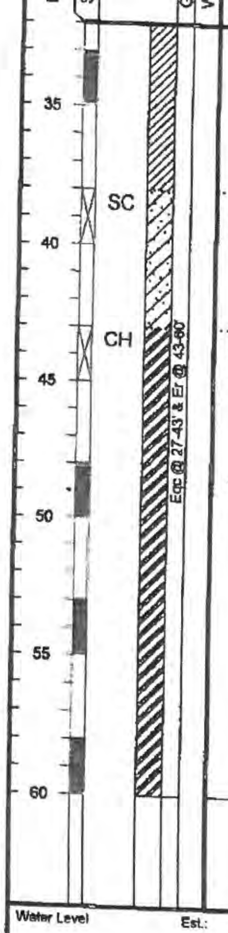
PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

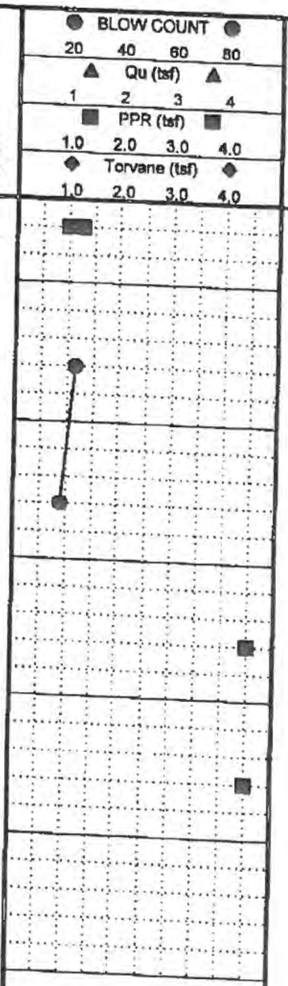
BORING TYPE: Rotary Wash/Flight Auger

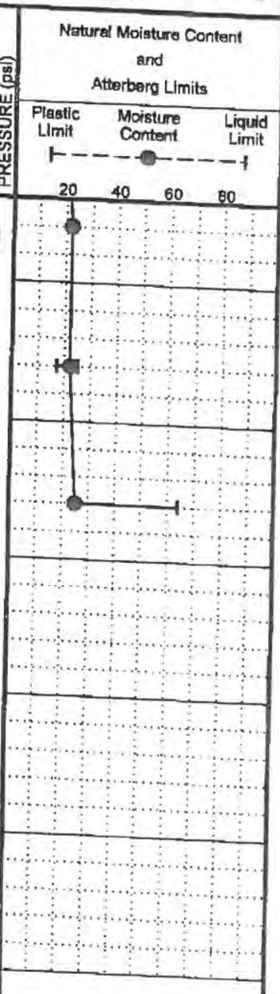
DATE 10/8/14

SURFACE ELEVATION 373.2



DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
34			P=1.25 P=1.0	107	2.10	6.1	21	22					
39	SC	CLAYEY SAND(SC) medium dense; reddish brown and grayish brown; moist; mottled	N=23					22	25	17	8	27	+40 Sieve=3% +4 Sieve=0%
44	CH	FAT CLAY(CH) very stiff; dark brown with light gray; with silt seams; moist	N=18					25	64	24	40	90	+40 Sieve=7% +4 Sieve=0%
49		–hard	P=4.5+										
54			P=4.5+										
60		Bottom of Boring @ 60'											





Water Level Est.: ∇ Measured: ▼ Parched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill Boring B-12

LOG OF BORING B-12

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

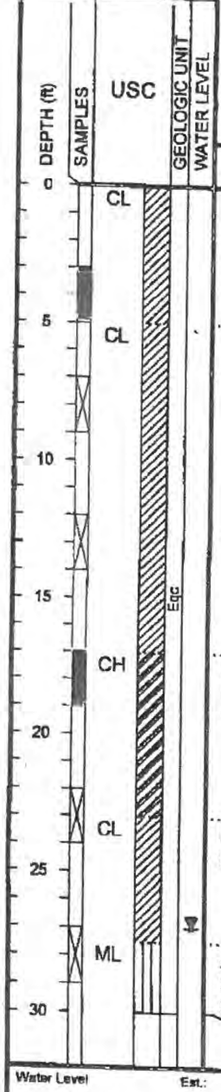
DRILL RIG:

PROJECT NO.: G4207-146

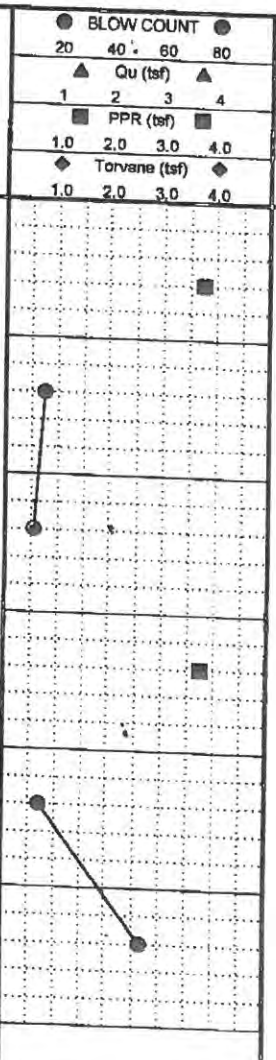
BORING TYPE: Flight Auger

DATE 10/15/14

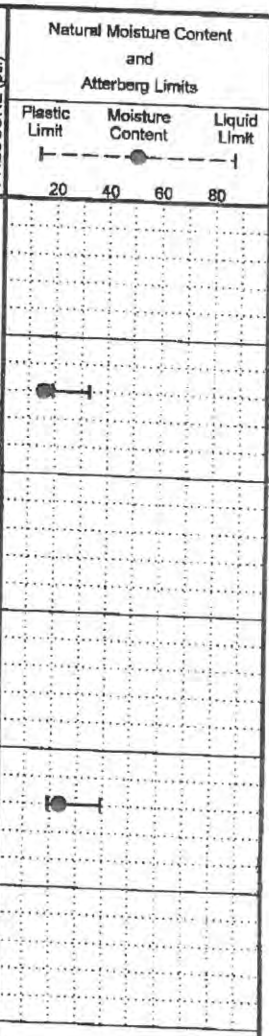
SURFACE ELEVATION 361.7



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) stiff; light gray and reddish brown; moist; mottled	P=3.75						
CL	SANDY LEAN CLAY(CL) stiff; light brown, light gray and reddish brown; moist; mottled	N=15	16	33	19	14	58	+40 Sieve=1% +4 Sieve=0%
	–grayish brown and brown; moist	N=11						
CH	FAT CLAY WITH SAND(CH) stiff; light gray and reddish brown; moist; mottled; with ferric seams	P=3.75						
CL	LEAN CLAY(CL) stiff; light gray and brownish gray; moist; layered with silt	N=14	24	39	19	20	93	+40 Sieve=1% +4 Sieve=0%
ML	SILT WITH SAND(ML) very dense; light brown and yellowish brown; moist; with clay seams	N=53						
	Bottom of Boring @ 30'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 27' and open upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04713°, W94.84486°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Land fill Boring B-13

ETTL
ENGINEERS &
CONSULTANTS

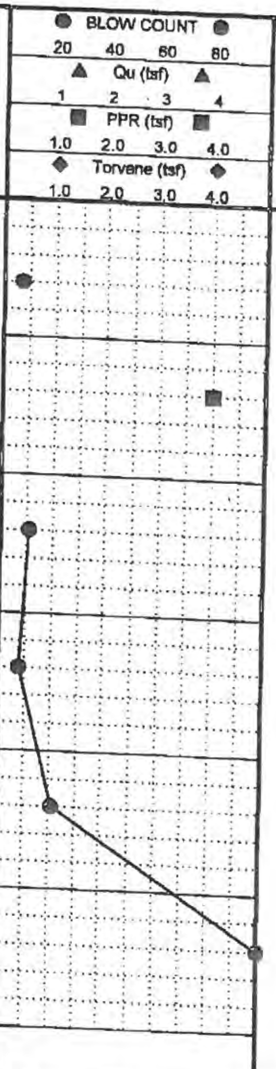
MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-13

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas
DRILL RIG:
PROJECT NO.: G4207-146
BORING TYPE: Flight Auger

DATE 10/15/14
SURFACE ELEVATION 361.4

DEPTH (ft)	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL			LEAN CLAY WITH SAND(CL) medium stiff; reddish brown with light gray; moist	N=7					20	45	17	28	76	+40 Sieve=1% +4 Sieve=0%
	CL			SANDY LEAN CLAY(CL) very stiff; light brown, gray and reddish brown; moist; mottled	P=4.0										
10	SC			CLAYEY SAND(SC) medium dense; grayish brown; moist											
	CH	Ecc		FAT CLAY WITH SAND(CH) medium stiff; reddish brown and light gray; moist; mottled	N=11										
20					N=8					22	54	20	34	79	+40 Sieve=1% +4 Sieve=0%
	CL			LEAN CLAY(CL) very stiff; light gray and grayish brown; moist; layered with silt	N=21										
	ML		▼	SILT WITH SAND(ML) very dense; light gray and yellowish brown; wet; with clay seams	N=50/5"					24				80	+40 Sieve=0% +4 Sieve=0%
30				Bottom of Boring @ 30'											



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 28' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.047160°, W94.84384°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-14

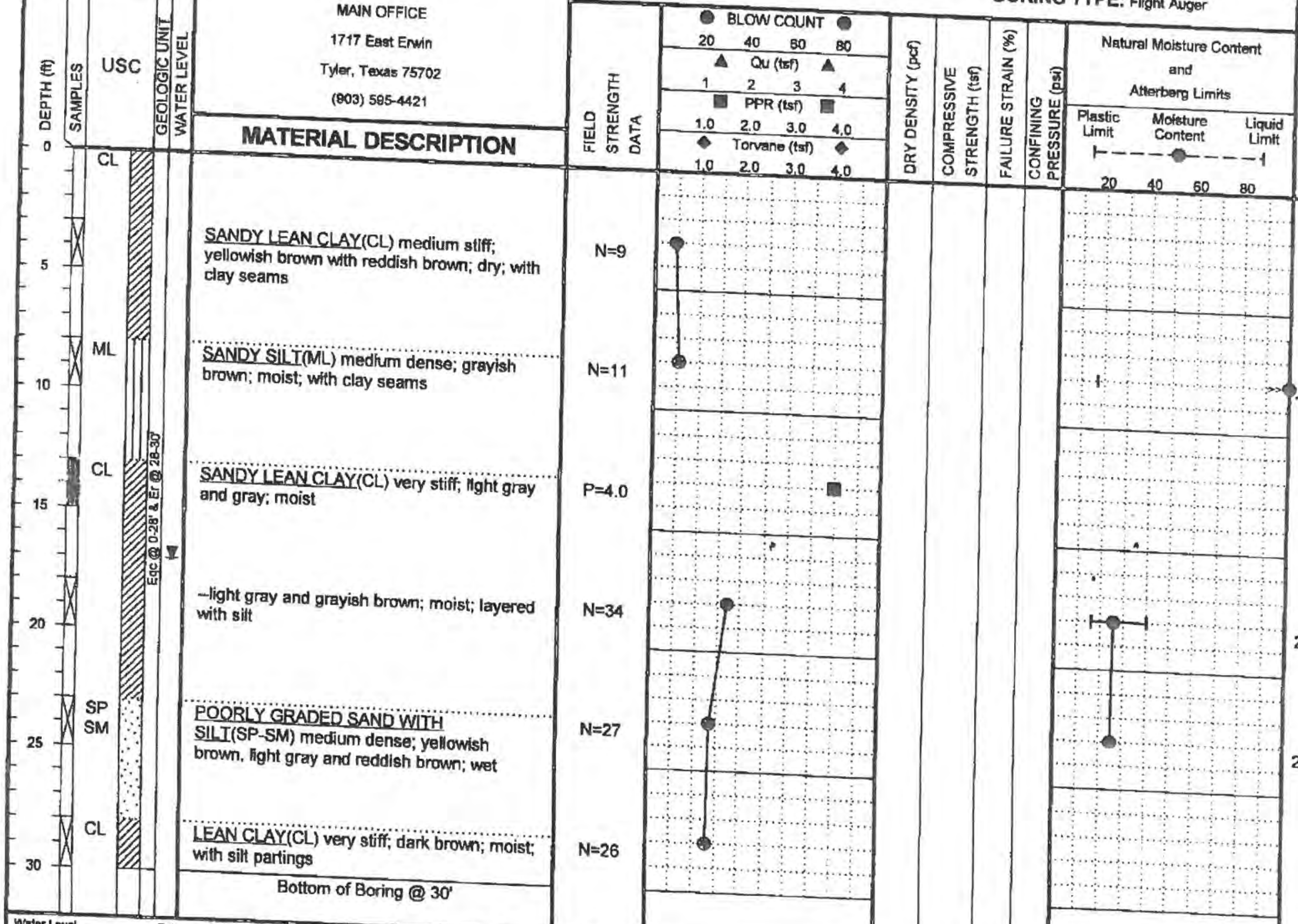
ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-14

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas
DRILL RIG:
PROJECT NO.: G4207-146
BORING TYPE: Flight Auger

DATE 10/14/14
SURFACE ELEVATION 347.2



DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	SANDY LEAN CLAY(CL) medium stiff; yellowish brown with reddish brown; dry; with clay seams	N=9										
	ML	SANDY SILT(ML) medium dense; grayish brown; moist; with clay seams	N=11					108	17	17	NP	68	+40 Sieve=1% +4 Sieve=1%
	CL	SANDY LEAN CLAY(CL) very stiff; light gray and gray; moist	P=4.0										
		--light gray and grayish brown; moist; layered with silt	N=34					26	40	16	24	67	+40 Sieve=1% +4 Sieve=0%
	SP SM	POORLY GRADED SAND WITH SILT(SP-SM) medium dense; yellowish brown, light gray and reddish brown; wet	N=27					25				10	+40 Sieve=0% +4 Sieve=0%
	CL	LEAN CLAY(CL) very stiff; dark brown; moist; with silt partings	N=26										
30		Bottom of Boring @ 30'											

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 23' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04774°, W94.84290°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-15

ETTL
ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-15

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

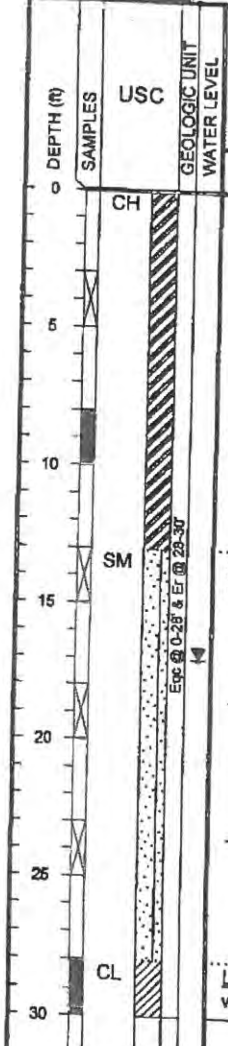
DRILL RIG:

PROJECT NO.: G4207-146

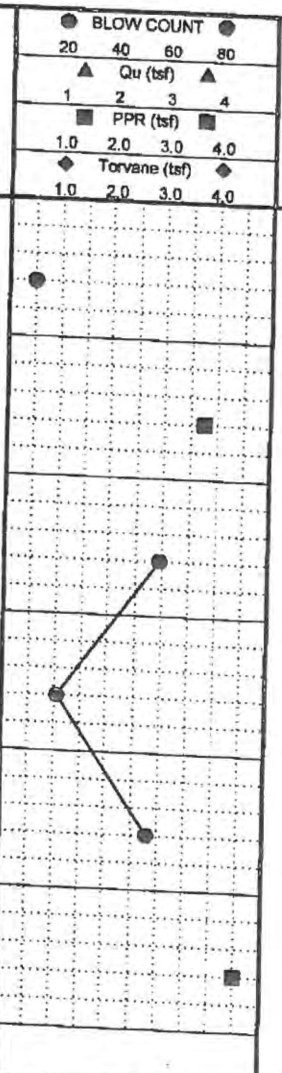
BORING TYPE: Flight Auger

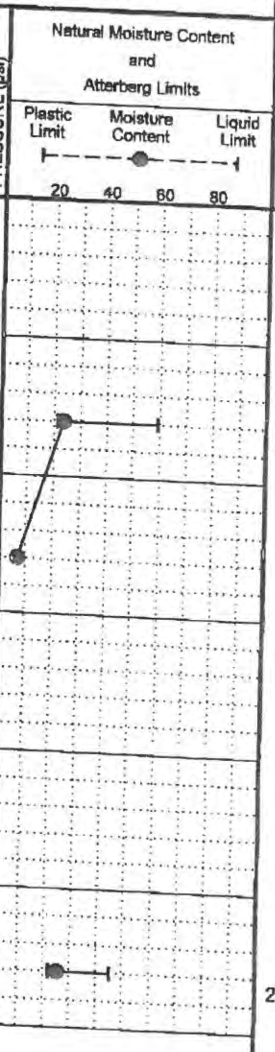
DATE 10/14/14

SURFACE ELEVATION 348.2



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
FAT CLAY(CH) stiff; reddish brown and light gray; moist; mottled	N=10										
--very stiff; light gray, grayish brown and reddish brown; moist; layered	P=3.75					24	59	21	38	85	+40 Sieve=0% +4 Sieve=0%
SILTY SAND(SM) very dense; light brown; dry	N=59					7				12	+40 Sieve=0% +4 Sieve=0%
--medium dense; wet	N=21										
--very dense	N=56										
LEAN CLAY(CL) hard; dark brown; moist; with silt partings	P=4.5					25	45	22	23	92	+40 Sieve=0% +4 Sieve=0%
Bottom of Boring @ 30'											





Water Level Est: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 19' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04857°, W94.84286°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

ARCADIS

Appendix B

Photographic Log

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 1	**Date:** 8/20/2015

Direction Photo Taken:

North

Description:
Staging area west of landfill.

P8200493

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 2	**Date:** 8/20/2015

Direction Photo Taken:

South Southeast

Description:

Potential wetland on the top (west) end of the Primary Ash Pond.

P8200495

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 3

Date: 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Ditch between road and railway west of landfill, this ditch would be non-jurisdictional.

P8200497

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 4

Date: 8/20/2015

Direction Photo Taken:

Northeast

Description:

Ground Water Monitoring Well AD-12 near northwest end of landfill.

P8200501

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 5

Date: 8/20/2015

Direction Photo Taken:

East Northeast

Description:

View of plant from top of landfill. Primary ash pond is within the wooded area on left.

P8200506

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 6

Date: 8/20/2015

Direction Photo Taken:

East Northeast

Description:

Drainage canal that drains from primary ash pond to clear water pond.

P8200510

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 7

Date: 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Vegetated strip between landfill and road. This would be isolated due to lack of connectivity.

P8200521

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 8

Date: 8/20/2015

Direction Photo Taken:

North

Description:

Dike between landfill and primary ash pond. Facility in the background.

P8200522

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT

Location: PITTSBURG, TITUS COUNTY, TEXAS

Project No. OK001625.0001

Photo No. 9

Date: 8/20/2015

Direction Photo Taken:

West

Description:

Vegetated strip between landfill and road. This area would be isolated due to lack of connectivity.

P8200527

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT

Location: PITTSBURG, TITUS COUNTY, TEXAS

Project No. OK001625.0001

Photo No. 10

Date: 8/20/2015

Direction Photo Taken:

North Northeast

Description:

Road east of landfill running toward facility and clear water pond.

P8200530

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 11

Date: 8/20/2015

Direction Photo Taken:

South

Description:

Top of landfill.

P8200534

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 12

Date: 8/20/2015

Direction Photo Taken:

Southeast

Description:

View of lined bottom ash storage pond.

P8200538

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **13**	**Date:** 8/20/2015

Direction Photo Taken:

Southeast

Description:

Lined bottom ash storage pond.

P8200545

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **14**	**Date:** 8/20/2015

Direction Photo Taken:

South

Description:

Southside of lined bottom ash storage pond.

P8200547

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 15 **Date:** 8/20/2015

Direction Photo Taken:

West

Description:

East side of lined bottom ash storage pond.

P8200560

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 16 **Date:** 8/20/2015

Direction Photo Taken:

North

Description:

Upland with pine and ground water monitoring well AD-2 south of lined bottom ash storage pond.

P8200563

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 17

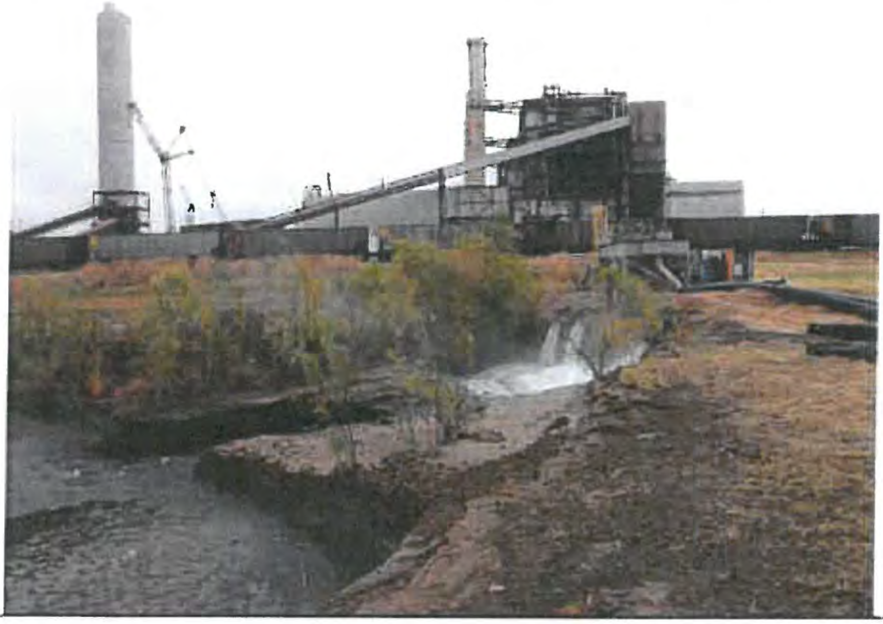
Date: 8/20/2015

Direction Photo Taken:

Description:

Outflow of water from plant into the northeast portion of the Primary Ash Pond.

P8200577



ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 18

Date: 8/20/2015

Direction Photo Taken:

South Southwest

Description:

Northeast portion of primary ash pond, view facing south-southwest.

P8200578

1.4 – Arcadis Texas Engineering Services and Geoscientist Firm Registration Numbers

Jill Parker-Witt
AEP Land Environmental and Remediation Services
502 N. Allen Avenue
Shreveport, LA 71101-2669

Arcadis U.S., Inc.
711 North Carancahua
Suite 904
Corpus Christi
Texas 78401
Phone: 361 883 1353
Fax: 361 883 7565
www.arcadis.com

TX Engineering License # F-533
TX Geoscientist License # 50158

Date: December 28, 2021
Our Ref: 30109967
Subject: J. Robert Welsh Power Plant
1187 County Road 4865
Titus County, Texas

Dear Ms. Parker-Witt,

Please see the below supplementary information regarding the Arcadis U.S. Inc. Texas engineering license information including the engineering firm's name and registration number in accordance with 30 TAC §352.4:

- Arcadis U.S. Inc.
- Engineering Services firm registration number F-533
- Professional Geoscientist firm registration number 50158

Please contact Ken Brandner at 361.533.2780 or Matt Lamb at 614.985.9134 if you have any questions.

Sincerely,
Arcadis U.S., Inc.

KENNETH J. BRANDNER
69586

12-28-21

Kenneth J. Brandner, P.E. #69586, Exp. 03.31.22
Geological Engineer

Kenneth J. Brandner
Geology
1787

12-28-21

Kenneth J. Brandner, P.G. #1787, Exp. 03.31.22
Geological Engineer

Email: Ken.Bradner@arcadis.com
Direct Line: 361 533 2780

ATTACHMENT 2

Design Criteria for CCR Landfills and Surface Impoundments

Landfill(s) For CCR Waste

NA - 30 TAC §352.261 – Design Criteria Application Submission
Submit documentation demonstrating compliance with applicable design criteria in Subchapter F: Design Criteria (30 TAC §352.701-741)

NA - 30 TAC §352.701/40 §CFR 257.70 – Design Criteria for Coal Combustion Residuals Landfill – (only for new and lateral expansions)

Surface Impoundment(s) For CCR Waste

30 TAC §352.711/40 §CFR 257.71 – Liner Design Criteria for Existing CCR Surface Impoundments.

PBAP - Certification of liner system
BASP - Certification of liner system

NA- 30 TAC §352.721/40 §CFR 257.72 – Liner Design Criteria for New and Lateral expansion of CCR Surface Impoundments

30 TAC §352.731/40 §CFR 257.73 – Structural Integrity Criteria for Existing CCR Surface Impoundments.

PBAP - Periodic Hazard Potential
- **NA** - Emergency Action Plan
- Construction History/Design Plans
- Structural Stability Assessment
- Safety Factor Assessment

BASP - Periodic Hazard Potential
- **NA** - Emergency Action Plan
- Construction History/Design Plans
- Structural Stability Assessment
- Safety Factor Assessment

NA - 30 TAC §352.741/40 §CFR 257.74 – Structural Integrity Criteria for New and Lateral Expansions CCR Surface Impoundments

2.1 – Primary Bottom Ash Pond Liner Certification, September 2016

Professional Engineer's Certification:

I certify that I have reviewed the design/construction records related to the CCR unit noted below or discussed the construction of such unit with personnel to attest that it was not constructed with a liner meeting the requirements of section 40 CFR 257.71 (a).

Southwestern Electric Power Company
Welsh Power Plant, Pittsburg, Texas
Primary Ash Pond

Shah Baig

Shahriyar S. Baig, P.E.
American Electric Power Service Corporation
Engineering Services

09-23-2016

SHAHRIYAR S. BAIG
92172

American Electric Power
Service Corporation
Texas Registered Engineering
Firm No. F-3341

2.2 – Bottom Ash Storage Pond Liner Certification, September 2016

Professional Engineer's Certification:

I certify that I have reviewed the design/construction records related to the CCR unit noted below or discussed the construction of such unit with personnel to attest that it was not constructed with a liner meeting the requirements of section 40 CFR 257.71 (a).

Southwestern Electric Power Company
Welsh Power Plant, Pittsburg, Texas
Bottom Ash Storage Pond

Shah Baig

Shahriyar S. Baig, P.E.
American Electric Power Service Corporation
Engineering Services

09-23-2016

SHAHRIYAR S. BAIG
92172

American Electric Power
Service Corporation
Texas Registered Engineering
Firm No. F-3341

2.3 – Primary Bottom Ash Pond Hazard Potential Classification Assessment, July 2021

Southwestern Electric Power Company
Welsh Power Station
Primary Bottom Ash Pond

Hazard Potential Classification Assessment

AEP has performed an evaluation to classify the above CCR Surface Impoundment in accordance with FEMA's Hazard Potential Classification System for Dams. These guidelines evaluate the consequences of a potential failure not the likelihood of a failure. Guidelines that were developed and utilized are included below.

<u>Hazard Potential Classification Systems</u> (from FEMA 333, April 2004)

1. **Low Hazard Potential**
   Dams assigned the low hazard potential classification are those where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.
2. **Significant Hazard Potential**
   Dams assigned the significant hazard potential classification are those dams where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.
3. **High Hazard Potential**
   Dams assigned the high hazard potential classification are those where failure or mis-operation will probably cause loss of human life.

The AEP J. Robert Welsh Power Station is located at 1187 County Road 4865, Pittsburg, TX 75686. The plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas.

The Primary Bottom Ash Pond is located southwest of the Plant and directly west of the Welsh Reservoir. The dam is situated upstream of the Welsh Reservoir. The impact of the failure or mis-operation of the dam will be contained within the Welsh Creek Reservoir with minimal off property impact and no potential for human life loss, and no potential economic and infrastructure lifeline losses. The US EPA CCR Impoundment Assessment Report has listed this ash pond as Low Hazard.

There has been no changes in classification by the State Dam Safety nor has there been any other physical changes that would warrant a change in the classification.

Based on the FEMA Hazard Potential Classification Systems for Dams and on the above discussion, Welsh Primary Bottom Ash Pond Dam is classified as a **<u>Low Hazard Potential Dam</u>**.

Professional Engineer's Certification:

I certify that this Hazard Potential Classification Assessment is in accordance with the requirements of section 30 TAC 352.731.

Gary F. Zych, P.E.

Gary F. Zych
7/29/2021

GARY F. ZYCH
127152

American Electric Power
Service Corporation
Texas Registered Engineering
Firm No. F-3341

2.4 – History of Construction, Primary Bottom Ash Pond, October 2016

HISTORY OF CONSTRUCTION

CFR 257.73(c)(1)

Primary Bottom Ash Pond

Welsh Plant
Pittsburg, Texas

October, 2016
(Corrected)

Prepared for: AEP/SWEPCO - Welsh Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

GERS – 16 – 129

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Attachments

Attachment A – Location Map
Attachment B – Design Reports
Attachment C – Design Drawings
Attachment D – Instrumentation Location Map
Attachment E – Hydrology and Hydraulic Report

1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CCR 257.73(c)(1) with an evaluation of the facility.

2.0 DESCRIPTION OF CCR THE IMPOUNDMENT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash pond and the Bottom Ash Storage pond. The Primary Bottom Ash pond CCR unit is located southwest of the Plant and directly west of the Welsh Reservoir.

The Primary Bottom Ash pond is bounded by natural ground surface (topographically higher areas) to the north and west, and embankment dikes to the south and east. The elevation at the top of embankment along the crest area is approximately 340.0 feet above msl. Presently, economizer ash from the generating plant is sluiced to the Primary Bottom Ash pond. On occasion, bottom ash is sluiced to the Primary Bottom Ash pond.

3.0 SUMMARY OF OWNERSHIP 275.73(c)(1)(i)

[The name and address of the person(s) owning or operating the CCR unit: the name associated with the CCR unit: and the identification number of the CCR unit if one has been assigned by the state.]

The AEP J. Robert Welsh Plant is located at 1187 County Road 4865, Pittsburg, TX, 75686, in southern Titus County. The plant is approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The primary ash pond CCR unit is located southwest of the Plant and directly west of the Welsh Reservoir. It is owned and operated by Southwestern Electric Power Company (SWEPCO). The facilities Ash Pond Complex operates two surface impoundments for storing CCR and a clear water pond for decant water.

4.0 LOCATION OF THE CCR UNIT 275.73 (c)(1)(ii)

[The location of the CCR unit identified on the most recent U.S. Geological Survey (USGS) 7 ½ minute or 15 minute topographic quadrangle map, or a topographic map of equivalent scale if a USGS map is not available.]

A location map is included in Attachment A.

5.0 STATEMENT OF PURPOSE 275.73 (c)(1)(iii)

[A statement of the purpose for which the CCR unit is being used.]

The Primary Bottom Ash Pond is a surface impoundment for storing CCR. Presently, economizer ash from the generating plant is sluiced to the primary ash pond. On occasion, bottom ash is sluiced to the primary ash pond. The Primary Bottom Ash Pond also receives storm water run-off from the main plant area and the coal yard area. All of the water from the primary bottom ash pond flows into a secondary pond that provides storage of decant water. Additional facility wastewaters (non-ash) are also discharged to the primary bottom ash pond.

6.0 NAME AND SIZE OF WATERSHED THE CCR UNIT IS LOCATED

275.73 (c)(1)(iv)

[The name and size in acres of the watershed within which the CCR unit is located.]

The Welsh Primary Bottom Ash Pond is comprised of a diked embankments constructed across a natural draw area which separates it from the main body of the adjacent cooling lake. The primary ash pond is bounded by natural ground surface (topographically higher areas) to the north and west, and embankment dikes to the south and east. Therefore, there are areas surrounding the impoundment that contributes to the run-off. The watershed for the ponds is equal to approximately 349 acres.

The Primary Bottom Ash Pond is located within the Region 11 – Arkansas –White –Red Region Watershed and are part of the sub group HUC = 11140305 Lake O' the Pines watershed area. The area is approximately 571,731.2 acres.

7.0 DESCRIPTION OF THE FOUNDATION AND ABUTMENT MATERIALS

275.73(c)(1)(v)

[A description of the physical and engineering properties of the foundation and abutment materials on which the CCR unit is located.]

The foundaion materials for the Primary Bottom Ash Pond embankment consist primarily of stiff to hard lean clay (CL) and fat clay (CH) with intermittent layers of medium dense to very dense clayey sand (SC) and silty sand (SM). A thick layer of very dense silty sand (SM) which is apparently the native surficial soils is present near the previous creek bed. Atterberg Plasticity Indices of the tested soils ranged between a low of 9 to a high of 44. The engineering properties of foundation soils had a cohesion that ranged between 300 psf and 320 psf and a friction angle that ranged between 15 degrees and 30 degrees. Additioanl details on the engineering properties of the foundaiton soils is in the design reports presented in Attachment B.

8.0 DESCRIPTION OF EACH CONSTRUCTED ZONE OR STAGE OF THE CCR UNIT

275.73 (c)(1)(vi)

[A statement of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR unit; and the approximate dates of construction of each successive stage of construction of the CCR unit.]

The Primary Bottom Ash Pond embankment was constructed in 1974 and is constructed of compacted earth fill. The source and type of soils used for earth fill is unknown. However, AEP contracted with

ETTL Engineers & Consultants Inc. of Tyler, Texas to perform a Geotechnical Investigation of Existing Ash Storage Ponds Embankments on June 21, 2010 (copy of this report is provided in Attachment C). The evaluation of the existing earthen embankments consisted of slope stability and seepage analyses for the embankments. The soil properties provided are based on the information obtained from soil borings located along the crest area of the primary bottom ash pond. Three borings were drilled to a depth of 50 feet below the existing crest of the embankment (Appendix C). Based on the soil borings, the fill material in the embankment consists primarily of stiff to hard lean clay (CL), fat clay (CH) and medium dense clayey sand (SC) overlying the native soils which consist primarily of stiff to hard lean clay (CL) and fat clay (CH) with intermittent layers of medium dense to very dense clayey sand (SC) and silty sand (SM). Atterberg Plasticity Indices of the tested soils ranged between a low of 9 to a high of 44. The engineering properties of embankment soils had a cohesion of 310 psf and a friction angle of 23 degrees. Additioanl details on the engineering properties of the foundaiton soils is in the design reports presented in Attachment B.

9.0 ENGINEERING STRUCTURES AND APPURTENANCES, 275.73 (c)(1)(vii)

[At a scale that details engineering structures and appurtenances relevant to the design, construction, operation, and maintenance of the CCR unit, detailed dimensional drawings of the CCR unit, including a plan view and cross sections of the length and width of the CCR unit, showing all zones, foundation improvements, drainage provisions, spillways, diversion ditches, outlets, instrument locations, and slope protection…]

The Primary Bottom Ash Pond receives effluent from the ash sluice lines that discharge the ash slurry on the east side of the pond. The ash settles, and the decant water flows through a 48-inch wide concrete weir box and into the Secondary Pond via an approximate 1,950-foot long discharge canal which originates at the southwest corner of the Primary bottom Ash Pond. The weir box has a minimum crest elevation of 325.0 feet, and flows through the weir box are controlled by installing 12-inch stop logs that are 55 inches long. Flows are conveyed through the weir box by sheet piling installed across the discharge canal, on either side of the weir box. The Primary Bottom Ash Pond has a 90-foot wide earthen emergency spillway on the south side of the pond; the spillway crest elevation is 334.0 feet. The emergency spillway overflows from the Primary Bottom Ash Pond directly into the discharge canal at the approximate midpoint of the discharge canal. A copy of the design drawings are presented in Attachment C.

10.0 SUMMARY OF POOL SURFACE ELEVATIONS, AND MAXIMUM DEPTH OF CCR, 275.73 (c)(1)(vii)

[…in addition to the normal operating pool surface elevation and the maximum pool elevation following peak discharge from the inflow design flood, the expected maximum depth of CCR within the CCR surface impoundment.]

The table below describes the normal pool elevations and maximum pool elevations as well as maximum depth of CCR within the impoundment. The Inflow Design Flood is the 100-year storm event.

	Primary Bottom Ash Pond
Normal Pool Elevation	333.0 ft.
Maximum Pool Elevation following peak discharge from inflow design flood	337.46 ft.
Expected Maximum depth of CCR within impoundment	33.0 ft.

11.0 FEATURES THAT COULD ADVERSELY AFFECT OPERATION DUE TO MALFUNCTION OR MIS-OPERATION (275.73 (c)(1)(vii))

[…and any identifiable natural or manmade features that could adversely affect operations of the CCR unit due to malfunction or mis-operation]

In the event of malfunction or mis-operation of any of the pond's appurtenances the ponds operations could be adversely affected. These structures include weir structures, effluent return piping and pump structures and influent sluicing piping and structures. See design drawings in Attachment C for location and details of all appurtenances.

12.0 DESCRIPTION OF THE TYPE, PURPOSE AND LOCATION OF EXISTING INSTRUMENTATION 275.73 (c)(1)(VIII)

[A description of the type, purpose, and location of existing instrumentation.]

The Primary Bottom Ash Pond has 2 piezometers located within the structure of the dam. These piezometers are read on a minimum of every 30 days for the purpose of determining the phreatic water level within the dike. A location map is provided in Attachment D.

13.0 AREA – CAPACITY CURVES FOR THE CCR UNIT 275.73 (c)(1)(IX)

[Area-capacity curves for the CCR unit.]

The area capacity curves for the Primary Bottom Ash Pond is included in the Hydrology and Hydraulic Analysis Report by Freese and Nichols, Inc., dated 2010 located in Attachment E.

14.0 275.73 (c)(1)(x) DESCRIPTION OF EACH SPILLWAY AND DIVERSION

[A description of each spillway and diversion design features and capacities and calculations used in their determination.]

Complete details of each spillway structure are included with the design drawings in Attachment C. Hydrology and Hydraulic Analysis which include calculations for each spillway structure are included in Attachment E.

The principal spillway for the Primary Bottom Ash Pond is located in the canal connecting the Primary and Secondary Ash Ponds. It consists of a weir box with bottom elevation of 325.0 ft amsl and a 4-foot wide by 2-foot tall opening. During normal operations pf the pond stop logs are not used. However, stop logs are placed in this opening according to regular dredging operation records by AEP. This structure also consists of sheet piling to each side of the weir box, which functions as a sharp-crested weir when water levels reach the top elevation of 336.0 ft amsl. Additionally, the Primary Bottom Ash Pond has a 90-foot wide emergency spillway with a crest elevation of 334.0 ft-msl. Both the orifice and weir equations were utilized in calculating the discharge rating curves the discharge rating curve for both spillways is shown in Attachment E.

15.0 SUMMARY CONSTRUCTION SPECIFICATIONS AND PROVISIONS FOR SURVEILLANCE, MAINTENANCE AND REPAIR 275.73 (C)(1)(XI)

[The construction specifications and provisions for surveillance, maintenance, and repair of the CCR unit.]

As required by the CCR rules the Primary Ash Pond is inspected at least every 7 days by a qualified person. Instrumentation data is collected at least every 30 days and reviewed by AEP Engineering Services. Also as a requirement of the CCR rules the impoundment is inspected annually by a professional engineer.

If repairs are found to be necessary during any inspection they will be completed as needed.

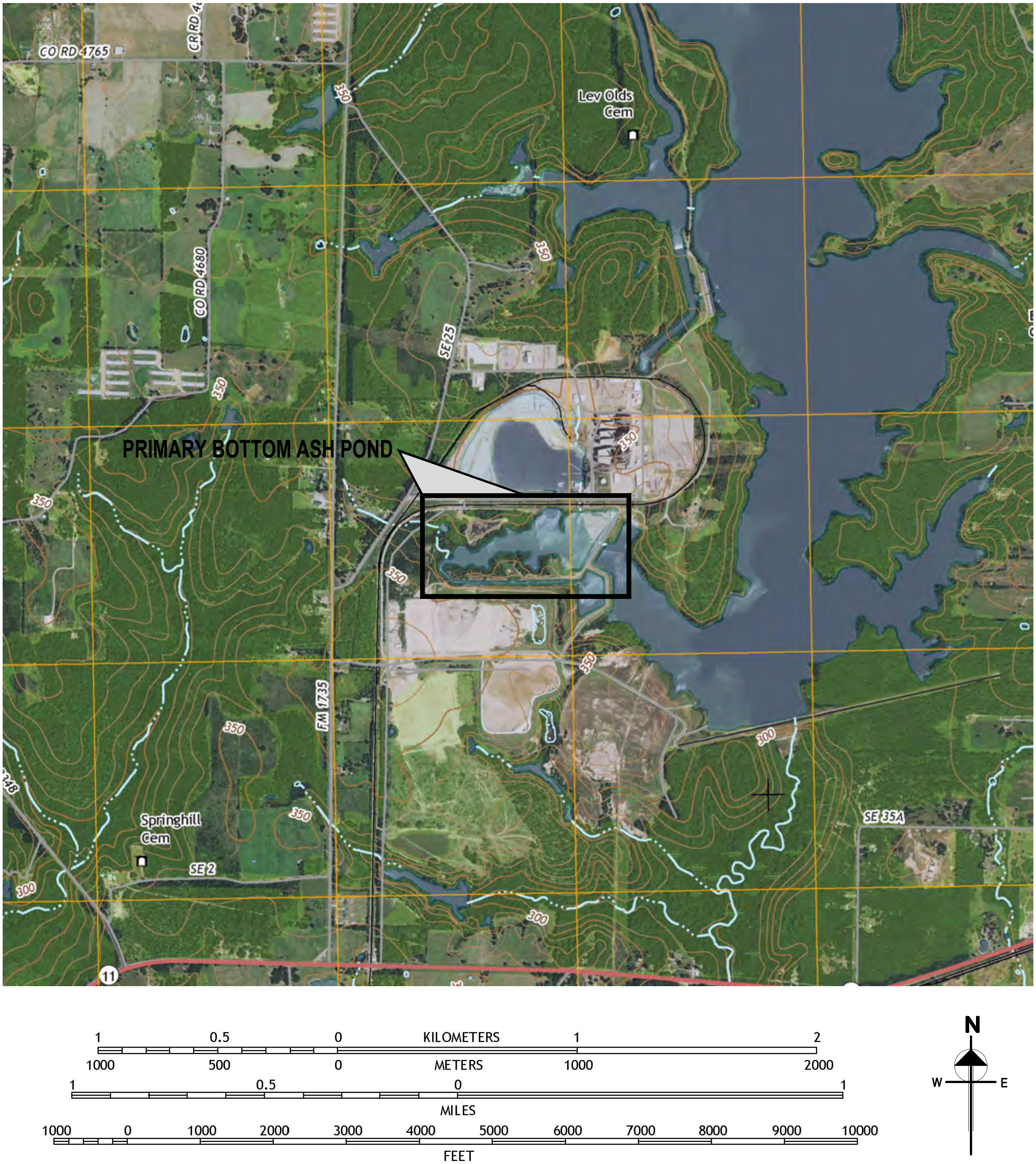
16.0 RECORD OR KNOWLEDGE OF STRUCTURAL INSTABILITY 275.73 (C)(1)(XII)

[Any record or knowledge of the structural instability of the CCR unit.]

To date there has been no known record of knowledge of structural instability of the CCR unit.

ATTACHMENT A

LOCATION MAP



THIS DRAWING IS CLASSIFIED AS:

AEP PUBLIC

REFERENCE AEP's CORPORATE INFORMATION SECURITY POLICY

SOUTHWESTERN ELECTRIC POWER COMPANY

WELSH PLANT

CASON TEXAS

UNIT: 13

DRAWING NUMBER: LOCATION MAP

REV: 1

SCALE: 1"=2000'

CIVIL ENGINEERING

DR:

CH:

SUP:

ENG:

DATE: 10/4/16

"THIS DRAWING IS THE PROPERTY OF THE **AMERICAN ELECTRIC POWER SERVICE CORP.** AND IS LOANED UPON CONDITION THAT IT IS NOT TO BE REPRODUCED OR COPIED, IN WHOLE OR IN PART, OR USED FOR FURNISHING INFORMATION TO ANY PERSON WITHOUT THE WRITTEN CONSENT OF THE **AEP SERVICE CORP.** ,OR FOR ANY PURPOSE DETRIMENTAL TO THEIR INTEREST, AND IS TO BE RETURNED UPON REQUEST"

PRIMARY BOTTOM ASH POND

USGS TOPO MAP

7.5-MINUTE SERIES

AEP AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

ATTACHMENT B

DESIGN REPORTS

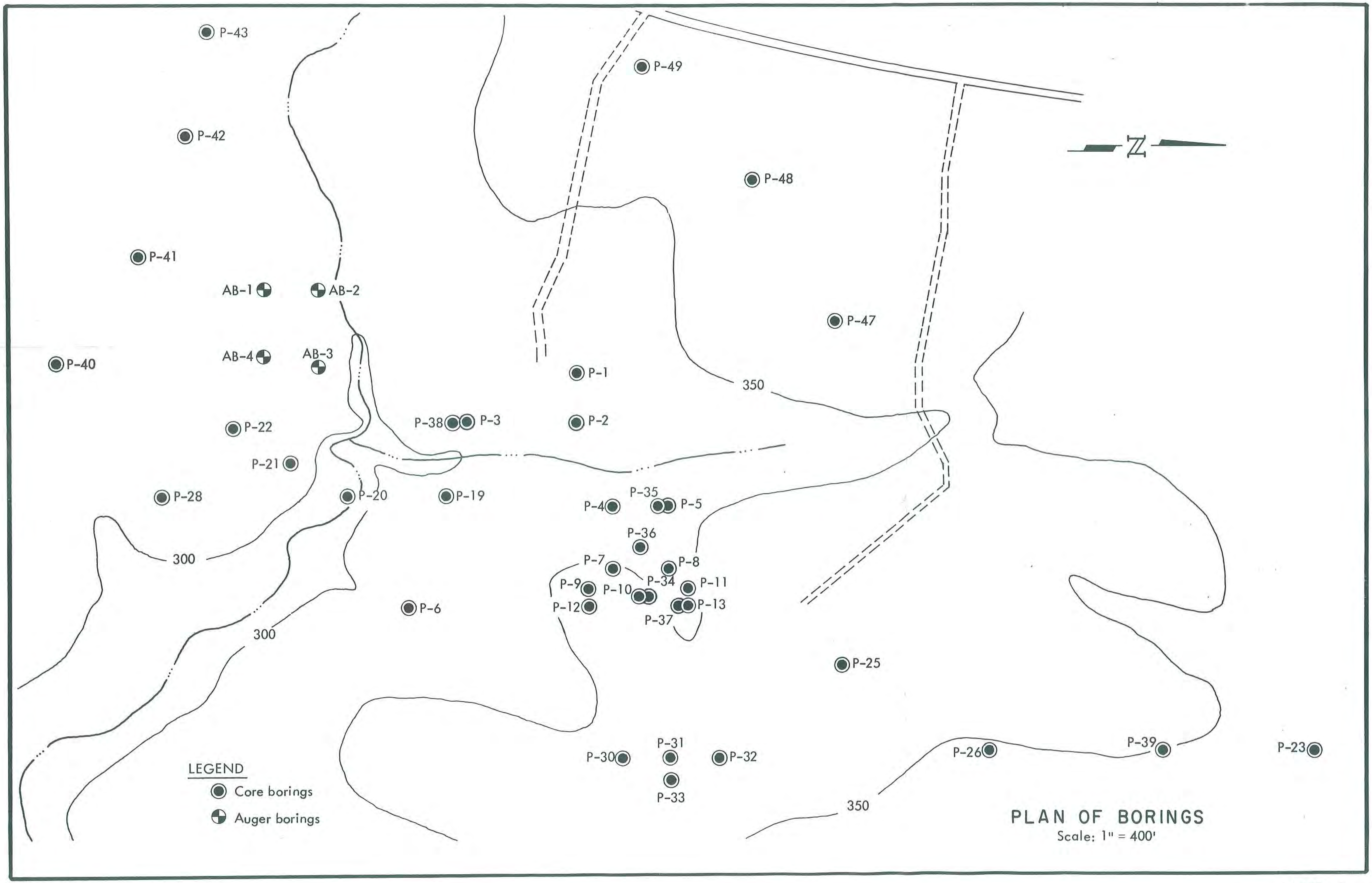
PRELIMINARY REPORT

SOILS INVESTIGATION
WELSH POWER PLANT
CASON, TEXAS

Report to

SOUTHWESTERN ELECTRIC POWER COMPANY
Shreveport, Louisiana

McClelland
engineers, inc.
geotechnical
consultants



PLAN OF BORINGS

Scale: 1" = 400'

McClelland engineers, inc. / geotechnical consultants

6100 HILLCROFT / HOUSTON, TEXAS 77036
TEL. 713 / 772-3701 / TELEX 762-447

August 31, 1973
Job No. 73-085

Southwestern Electric Power Company
P. O. box 1106
Shreveport, Louisiana 71156

Attention: Mr. W. H. Holley

Preliminary Report
Soils Investigation
Welsh Power Plant
Cason, Texas

Gentlemen:

Presented here are the logs of borings and the results of laboratory soil tests made to investigate soil conditions at the proposed Welsh Power Plant near Cason, Texas. This study was authorized by your Purchase Order No. Y-14567 dated March 27, 1973 and was performed in accordance with our letters of February 20, March 20, and April 30, 1973.

Soil conditions at the site were investigated by 38 undisturbed-sample or core borings and 4 disturbed-sample or auger borings drilled at the locations shown on Plate 1. The core borings were drilled to depths ranging from 25 to 198.5 ft, and the auger borings were drilled to depths ranging from 12.5 to 20 ft. Samples of the foundation materials were obtained in general accordance with specifications issued by Sargent & Lundy. Samples were generally obtained at about 5-ft intervals in the core borings using 3-in. thin-wall-tube, 2-in. split-barrel and Denison barrel samplers. Samples were obtained continuously in the auger borings using a 4-in. auger.

Detailed descriptions of the soils encountered in the borings are given on the logs of borings presented on Plates 2 through 43. The logs of borings presented on Plates 31 through 43 are presented in preliminary form and will be resubmitted in final form when laboratory testing on samples from these borings is complete. Most of the terms and symbols appearing on the logs are identified on Plate 44.

RECEIVED
SEP 4 - 1973
OFFICE OF
W. H. HOLLEY

The following tabulation gives the types of soil tests performed and the symbols used in plotting test results on the logs of borings.

Type of Test	Symbol
Shear Strength	
Unconfined Compression	○
Unconsolidated-undrained Triaxial	△
Hand Penetrometer	⊗
Water Content	●
Plastic and Liquid Limits	+------+
Consolidation	(see Plates 45 thru 57)
Specific Gravity	(recorded with consolidation test results)
Sieve Analysis	(see Plates 58 thru 60)
Percent finer than No. 200 Sieve	(listed under -#200,% on logs)

Blow counts from standard penetration tests are shown in the "Blows Per Foot" column on the boring logs. The results of water level observations in the boreholes are recorded at the bottom of most boring logs.

We appreciate the opportunity to work with you on this project. If you have any questions, please call us.

Very truly yours,

McCLELLAND ENGINEERS, INC.

Clarence J. Ehlers

Clarence J. Ehlers, P.E.
Project Manager

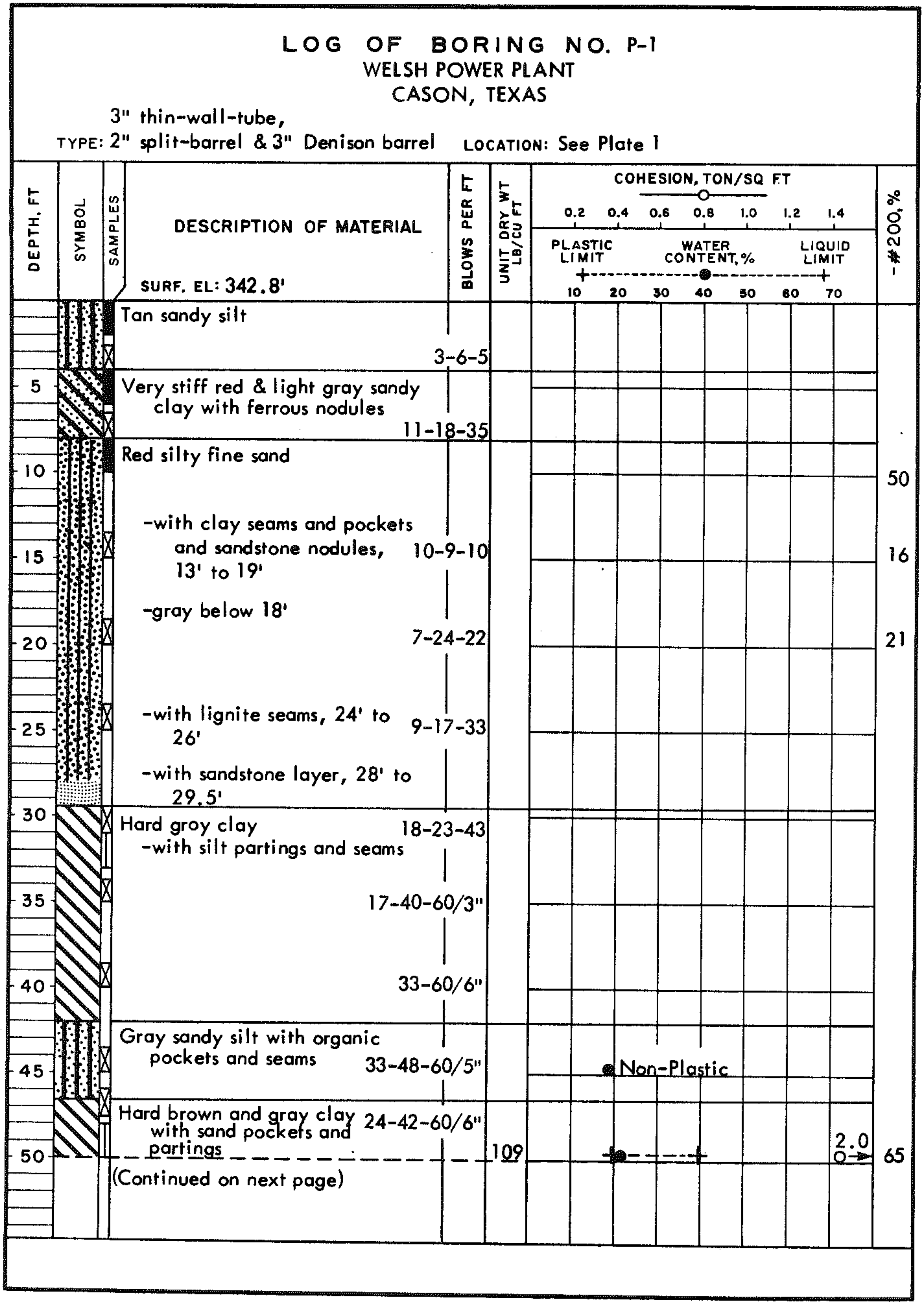
CJE/mmf
Copies Submitted:
Southwestern Electric Power Company: (6)
Sargent & Lundy: (6)

Form 108-1 (57) Job No. 78-085

LOG OF BORING NO. P-1

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube, 2" split-barrel & 3" Denison barrel LOCATION: See Plate 1



SURF. EL: 342.8'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT; PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT	-#200, %
0	Tan sandy silt	3-6-5			
5	Very stiff red & light gray sandy clay with ferrous nodules	11-18-35			
10	Red silty fine sand				50
15	-with clay seams and pockets and sandstone nodules, 13' to 19'	10-9-10			16
20	-gray below 18'	7-24-22			21
25	-with lignite seams, 24' to 26'	9-17-33			
	-with sandstone layer, 28' to 29.5'				
30	Hard gray clay -with silt partings and seams	18-23-43			
35		17-40-60/3"			
40		33-60/6"			
45	Gray sandy silt with organic pockets and seams	33-48-60/5"		Non-Plastic	
50	Hard brown and gray clay with sand pockets and partings	24-42-60/6"	109	2.0	65

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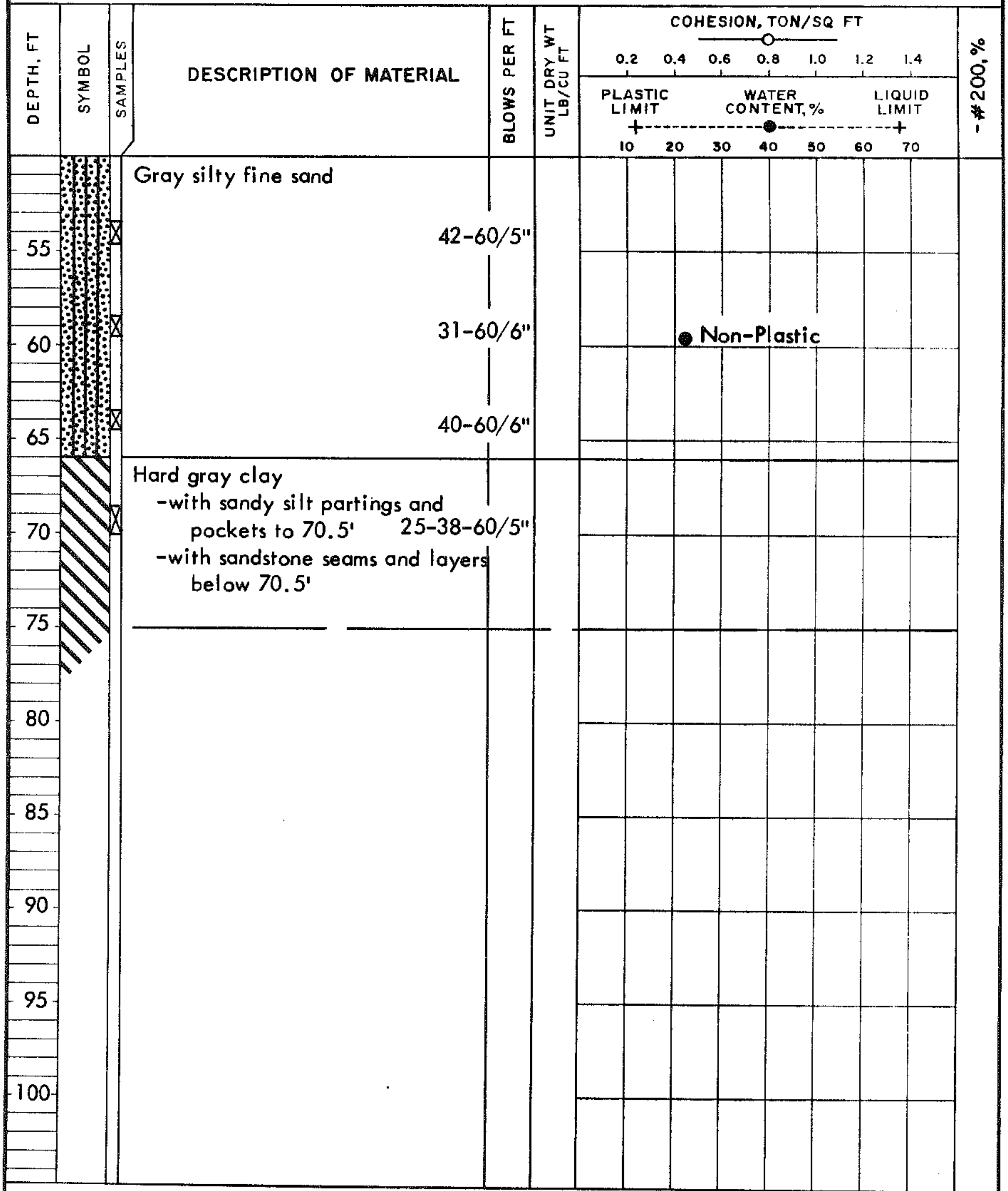
McCLELLAND ENGINEERS

75-085

LOG OF BORING NO. P-1 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS



DESCRIPTION OF MATERIAL	BLOWS PER FT
Gray silty fine sand	42-60/5" 31-60/6" 40-60/6"
Hard gray clay -with sandy silt partings and pockets to 70.5' -with sandstone seams and layers below 70.5'	25-38-60/5"

COMPLETION DEPTH: 75'
DATE: April 26, 1973

DEPTH TO WATER IN BORING: 8.0'

DATE: May 3, 1973

McCLELLAND ENGINEERS

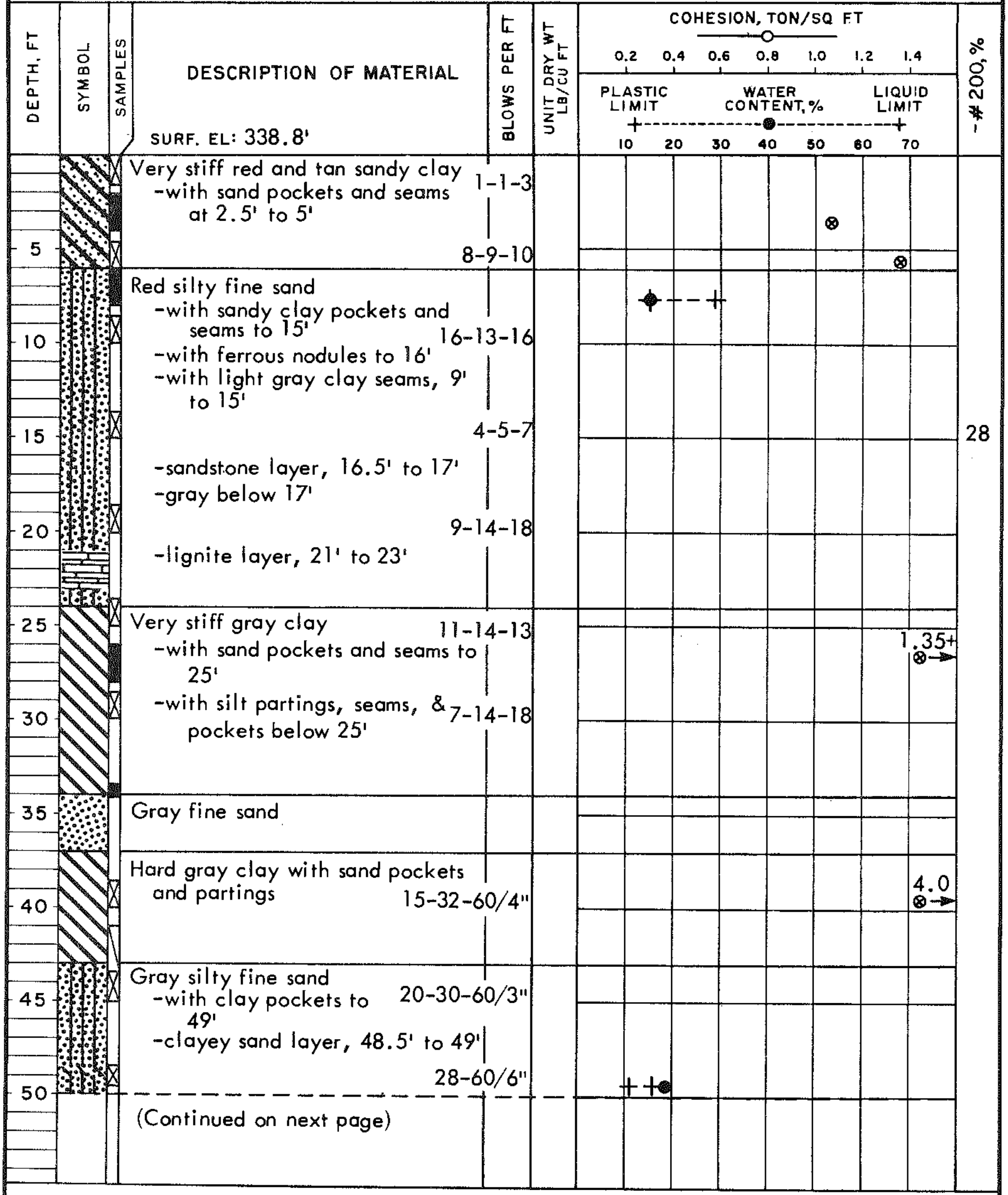
Form 106-1 (57) Job No. 75-085

LOG OF BORING NO. P-2

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube, 2" split-barrel & 3" Denison barrel LOCATION: See Plate 1

SURF. EL: 338.8'



DESCRIPTION OF MATERIAL	BLOWS PER FT	-#200, %
Very stiff red and tan sandy clay -with sand pockets and seams at 2.5' to 5'	1-1-3 8-9-10	
Red silty fine sand -with sandy clay pockets and seams to 15' -with ferrous nodules to 16' -with light gray clay seams, 9' to 15' -sandstone layer, 16.5' to 17' -gray below 17' -lignite layer, 21' to 23'	16-13-16 4-5-7 9-14-18	28
Very stiff gray clay -with sand pockets and seams to 25' -with silt partings, seams, & pockets below 25'	11-14-13 7-14-18	
Gray fine sand		
Hard gray clay with sand pockets and partings	15-32-60/4"	
Gray silty fine sand -with clay pockets to 49' -clayey sand layer, 48.5' to 49'	20-30-60/3" 28-60/6"	

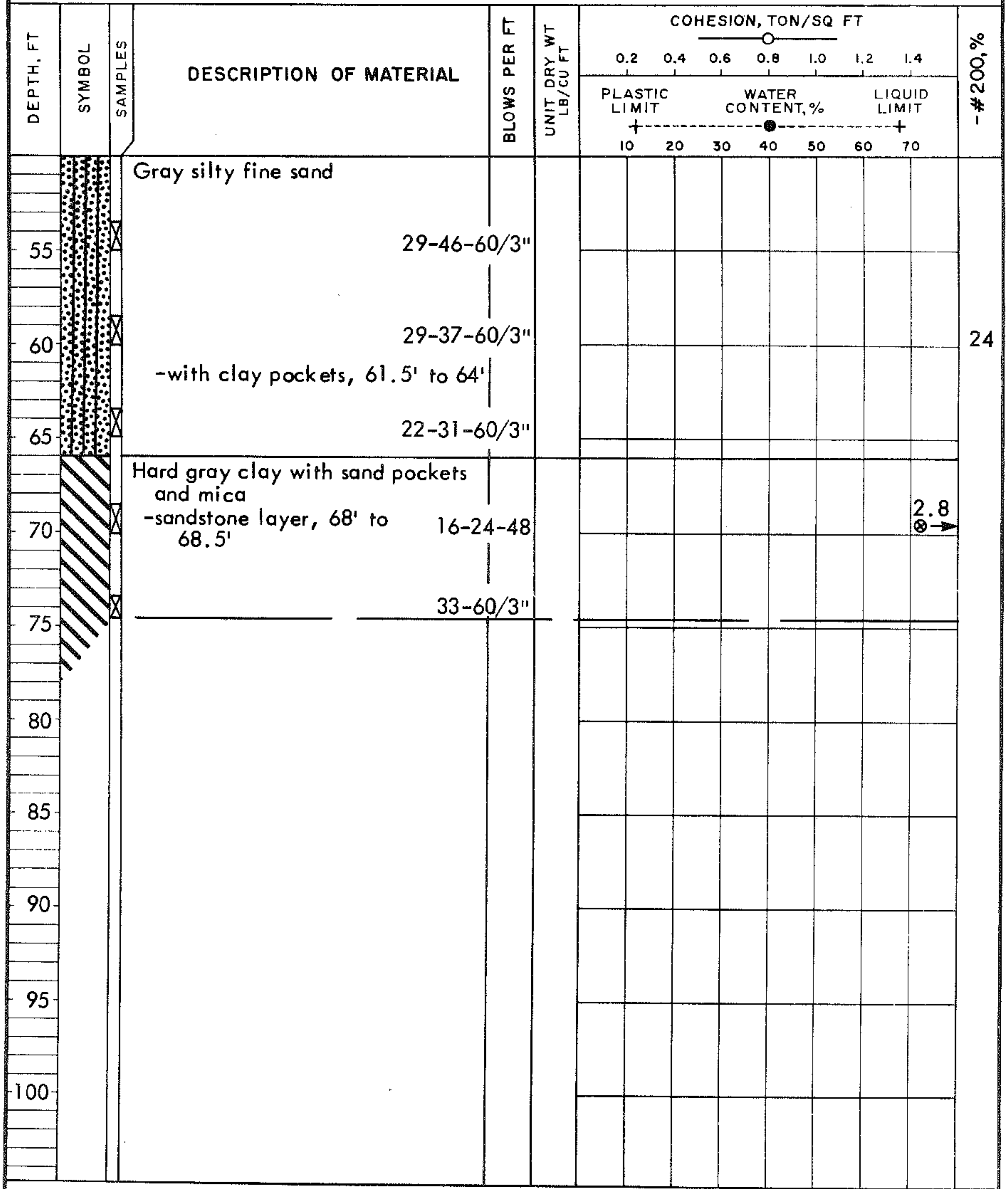
(Continued on next page)

McCLELLAND ENGINEERS

PLATE 3

Form 106-3 (57) Job No. 73-085

LOG OF BORING NO. P-2 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



Depth, ft	Description of Material	Blows per ft	Cohesion, ton/sq ft	-#200, %
52–66	Gray silty fine sand			
55		29-46-60/3"		
60		29-37-60/3"		24
61.5–64	-with clay pockets, 61.5' to 64'			
65		22-31-60/3"		
66–74.5	Hard gray clay with sand pockets and mica			
68–68.5	-sandstone layer, 68' to 68.5'			
70		16-24-48	2.8 ⊗→	
74		33-60/3"		

COMPLETION DEPTH: 74.5'
DATE: April 28, 1973

DEPTH TO WATER IN BORING: 13.3'
DATE: May 3, 1973

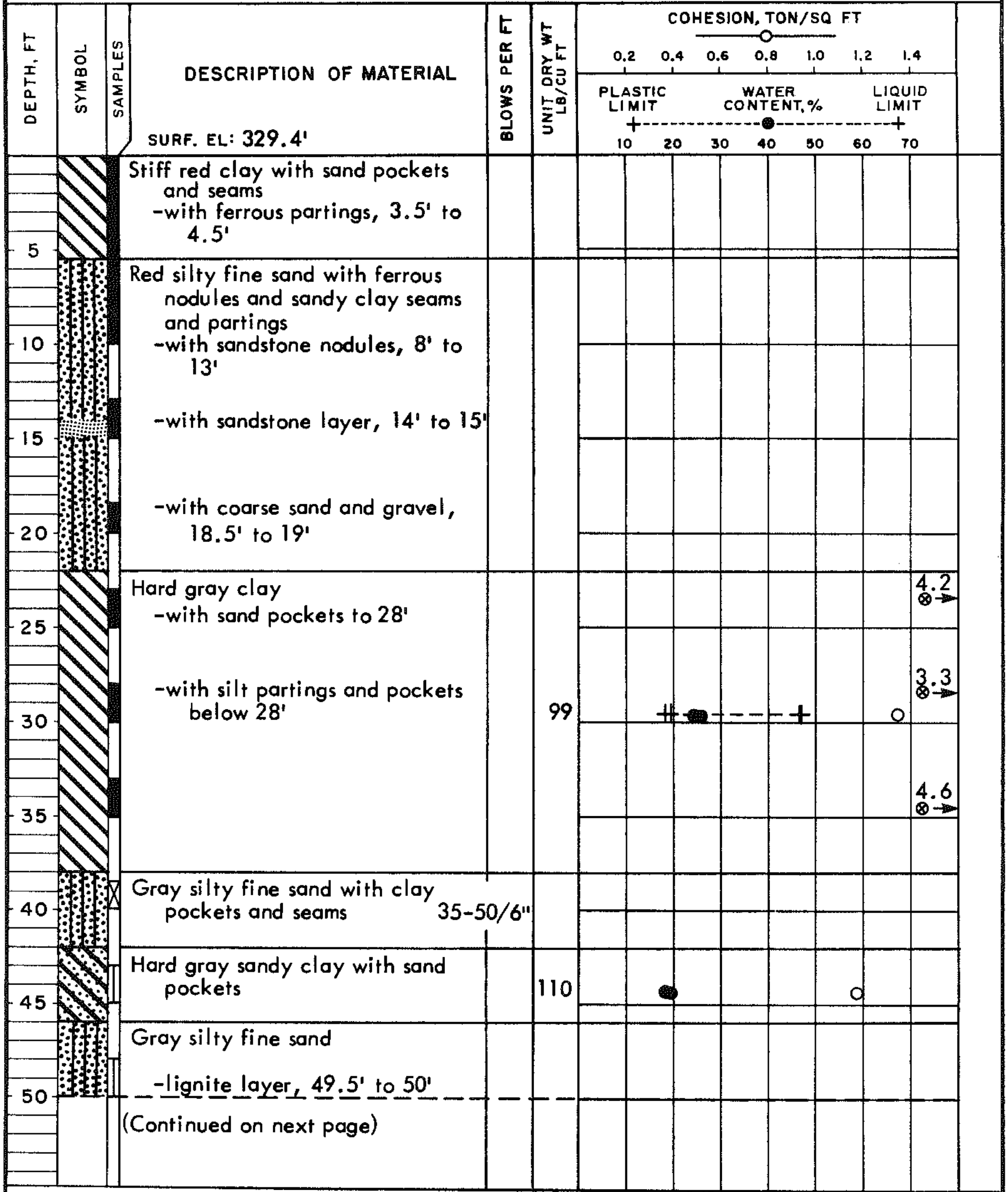
McCLELLAND ENGINEERS

PLATE 3a

Form 108 Job No. 73-085

LOG OF BORING NO. P-3
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube
2" split-barrel & 3" Denison barrel
LOCATION: See Plate 1



SURF. EL: 329.4'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Stiff red clay with sand pockets and seams -with ferrous partings, 3.5' to 4.5'		
Red silty fine sand with ferrous nodules and sandy clay seams and partings -with sandstone nodules, 8' to 13' -with sandstone layer, 14' to 15' -with coarse sand and gravel, 18.5' to 19'		
Hard gray clay -with sand pockets to 28' -with silt partings and pockets below 28'		99
Gray silty fine sand with clay pockets and seams	35-50/6"	
Hard gray sandy clay with sand pockets		110
Gray silty fine sand -lignite layer, 49.5' to 50'		

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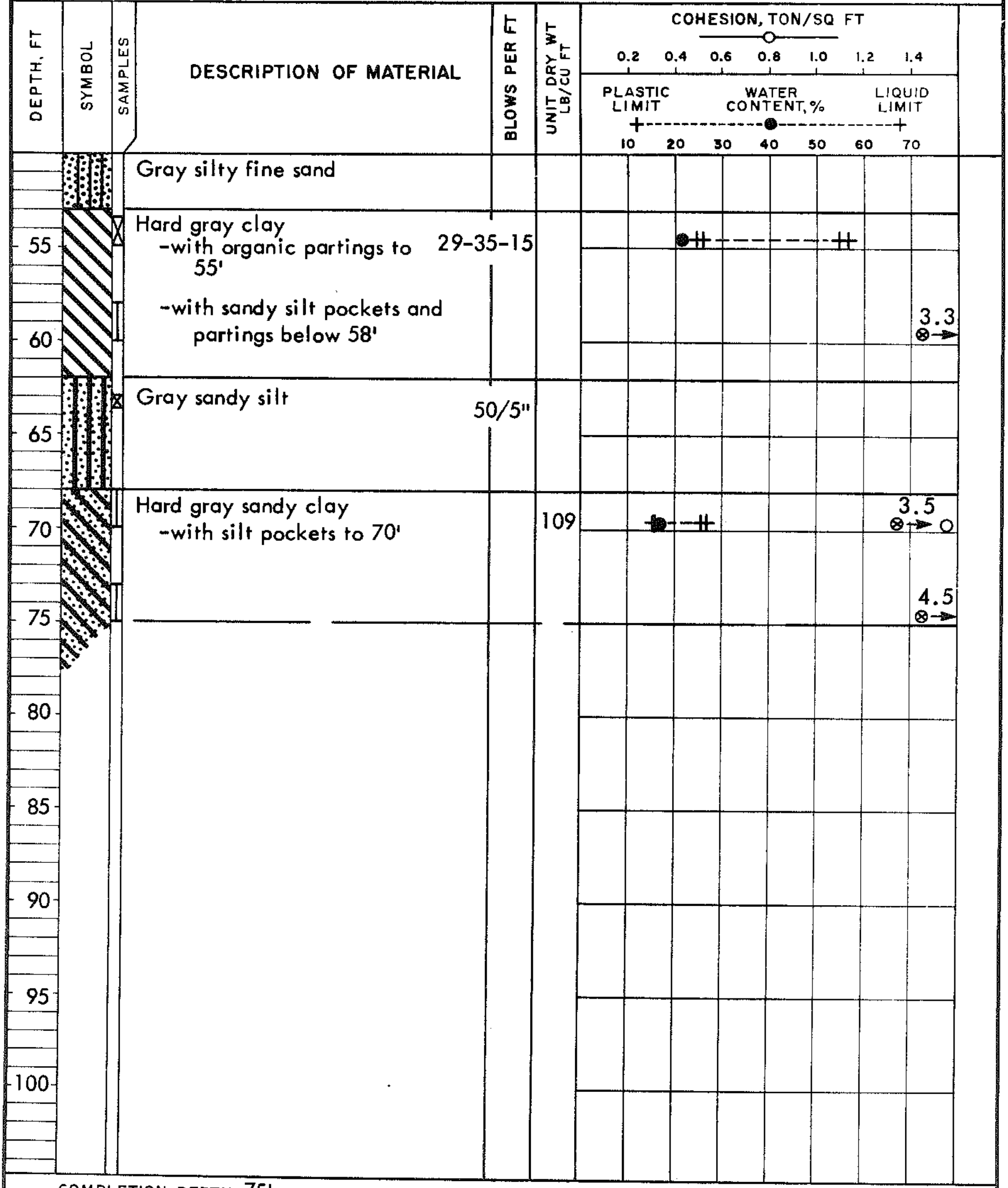
Form 108-3 (57) Job No 73-085

LOG OF BORING NO. P-3 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Gray silty fine sand		
Hard gray clay -with organic partings to 55' -with sandy silt pockets and partings below 58'	29-35-15	
Gray sandy silt	50/5"	
Hard gray sandy clay -with silt pockets to 70'		109

COMPLETION DEPTH: 75'
DATE: April 17, 1973

DEPTH TO WATER IN BORING: 10.4'

DATE: May 3, 1973

McCLELLAND ENGINEERS

Form 08-1-(57) Job No 79-085

LOG OF BORING NO. P-4
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel
LOCATION: See Plate 1

SURF. EL: 343.7'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200, %
Tan silty fine sand			
Very stiff red and tan very silty clay -with sand pockets to 4'			
Stiff red and tan very sandy clay -with sandstone seams and nodules, 6' to 8.5'		112	
Tan and light gray silty fine sand with clay seams and pockets and scattered gravel			48 70
Stiff tan and light gray sandy clay with sand and ferrous seams -gray below 23.5'	13-6-10		
Gray silty fine sand with sandstone nodules	18-50/9"		
Very stiff gray clay -with sandy silt pockets, partings, and seams to 43'	11-14-25 17-50/8"		
Gray silty fine sand -clayey fine sand, 46' to 53'	43-50/5"	110	

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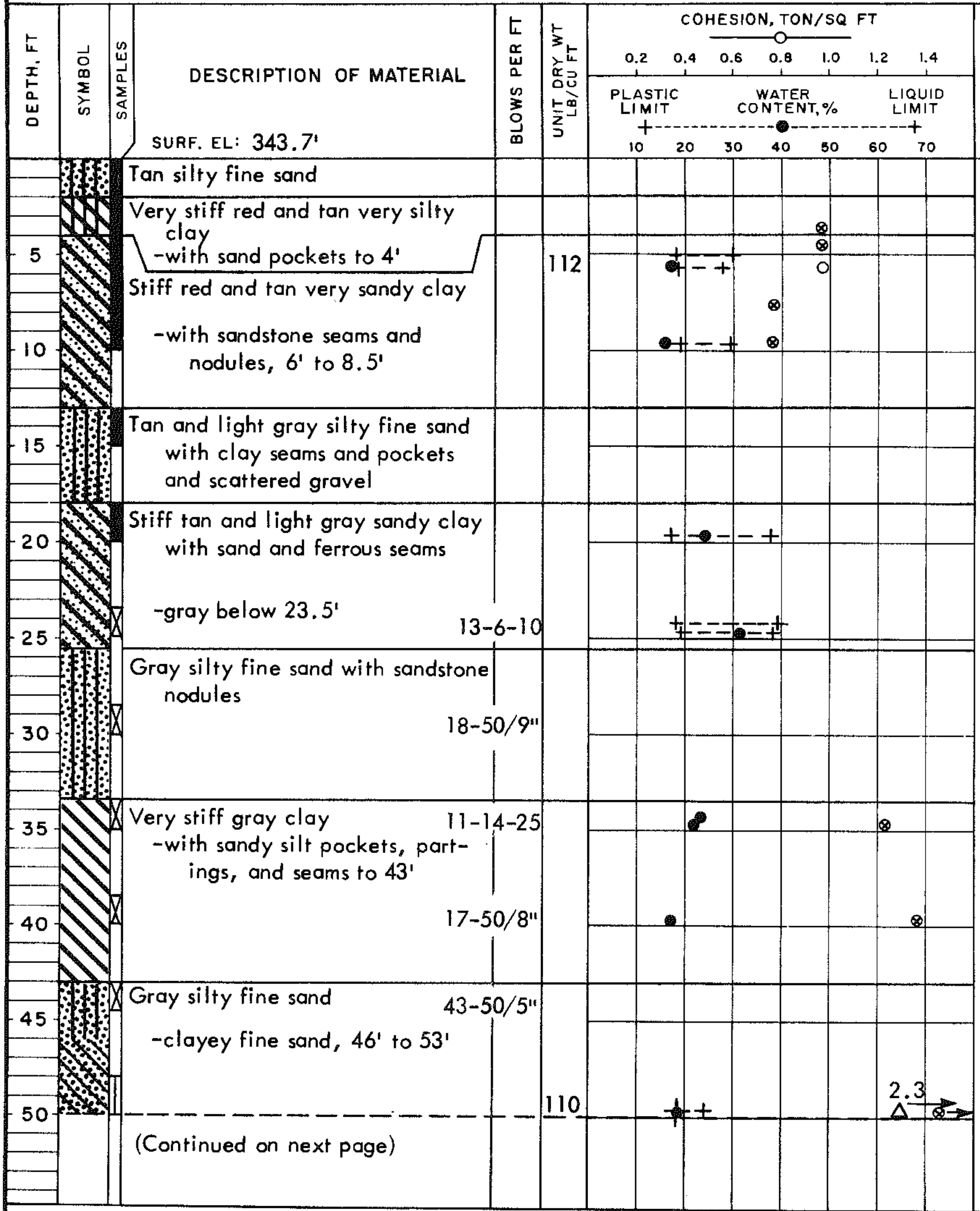
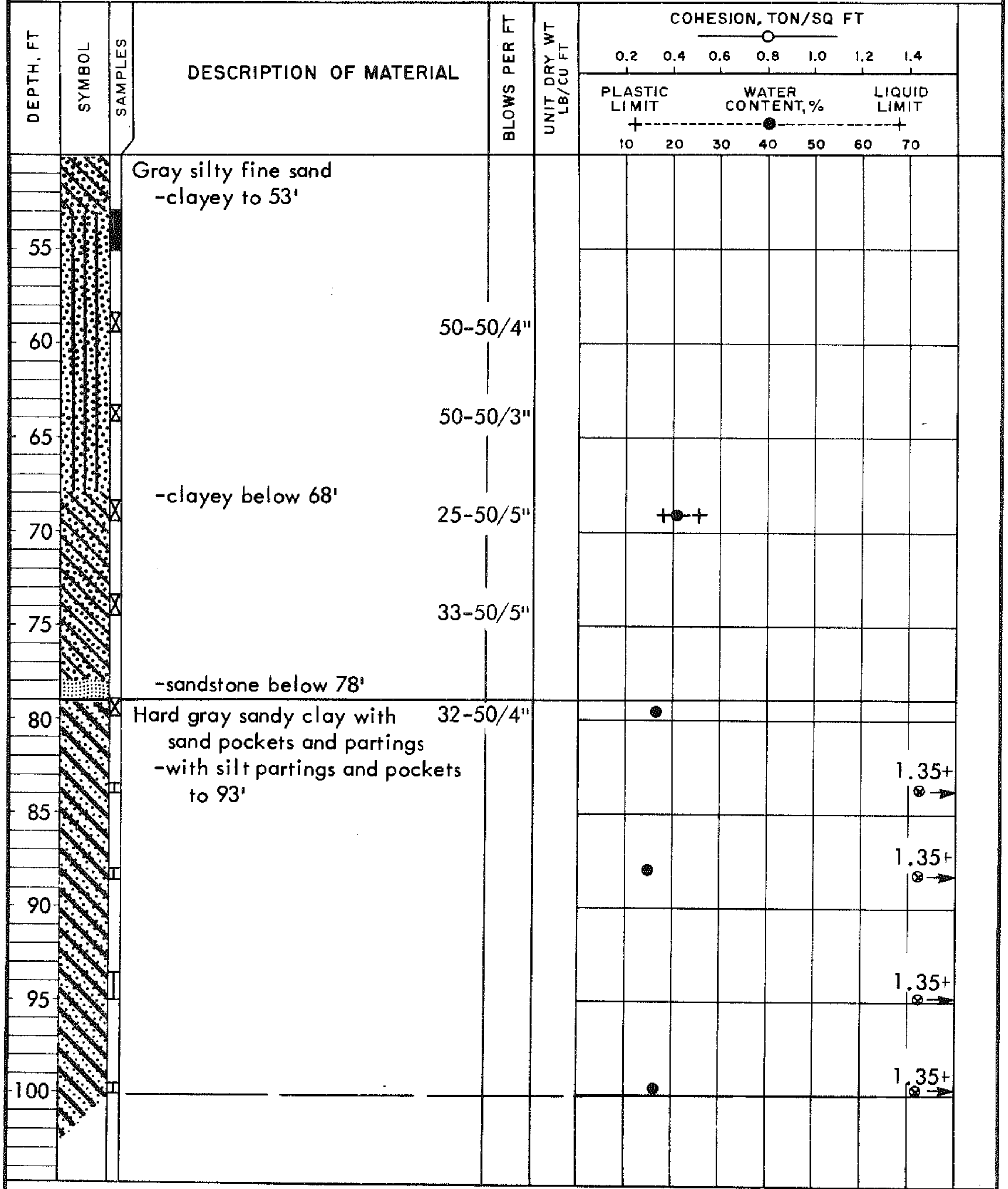


McCLELLAND ENGINEERS

Form 100-3 (57) Job No. 73-085

LOG OF BORING NO. P-4 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT
	Gray silty fine sand -clayey to 53'	
		50-50/4"
		50-50/3"
	-clayey below 68'	25-50/5"
		33-50/5"
	-sandstone below 78'	
	Hard gray sandy clay with sand pockets and partings -with silt partings and pockets to 93'	32-50/4"

COMPLETION DEPTH: 100'
DATE: March 28, 1973

DEPTH TO WATER IN BORING: 17.3' Caved at: 34' DATE: May 3, 1973

McCLELLAND ENGINEERS

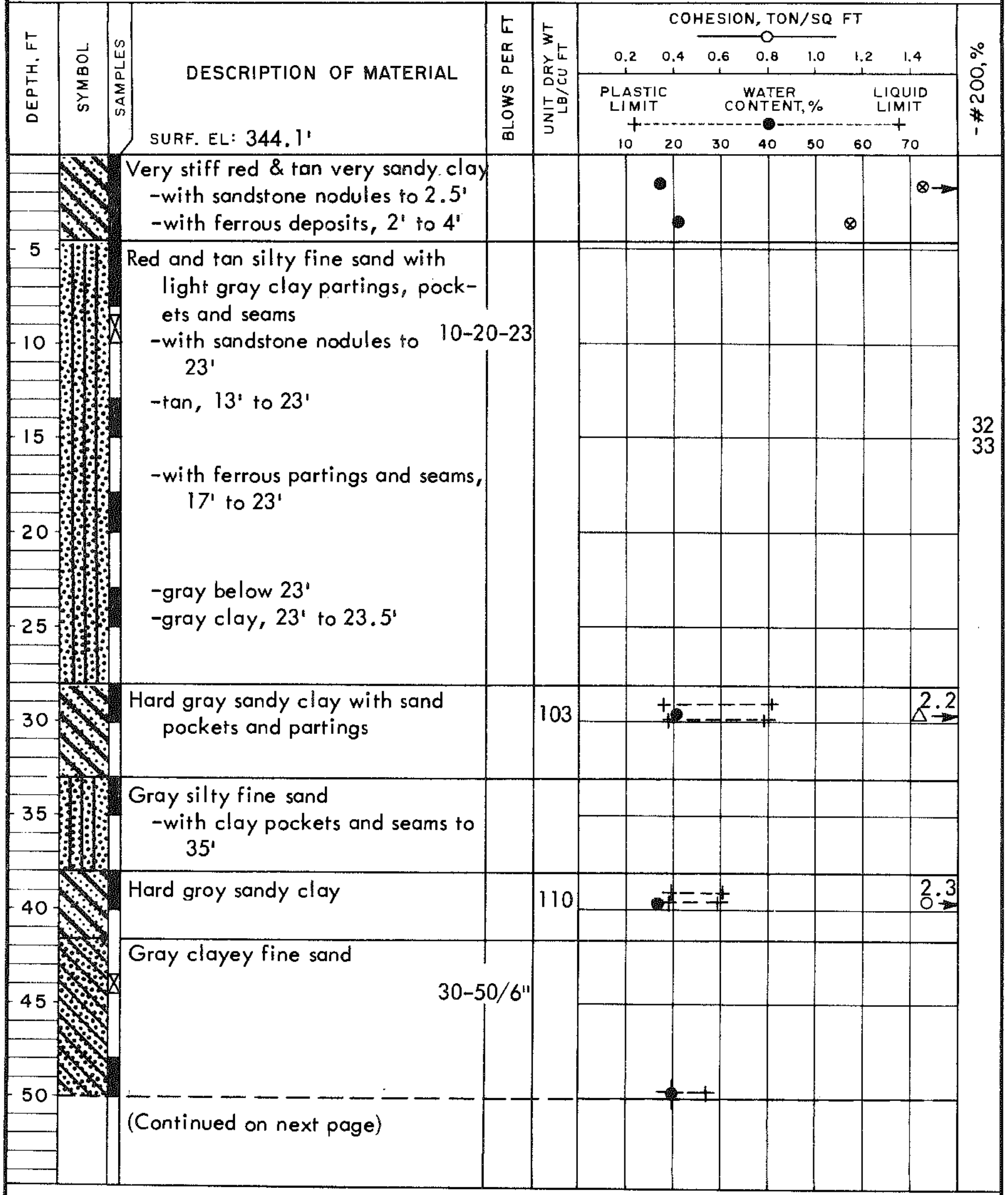
PLATE 5a

Form OB-1 (57) Job No 73-085

LOG OF BORING NO. P-5
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel   LOCATION: See Plate 1

SURF. EL: 344.1'



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
Very stiff red & tan very sandy clay -with sandstone nodules to 2.5' -with ferrous deposits, 2' to 4'			
Red and tan silty fine sand with light gray clay partings, pockets and seams -with sandstone nodules to 23' -tan, 13' to 23' -with ferrous partings and seams, 17' to 23' -gray below 23' -gray clay, 23' to 23.5'	10-20-23		32 33
Hard gray sandy clay with sand pockets and partings		103	
Gray silty fine sand -with clay pockets and seams to 35'			
Hard groy sandy clay		110	
Gray clayey fine sand	30-50/6"		

(Continued on next page)

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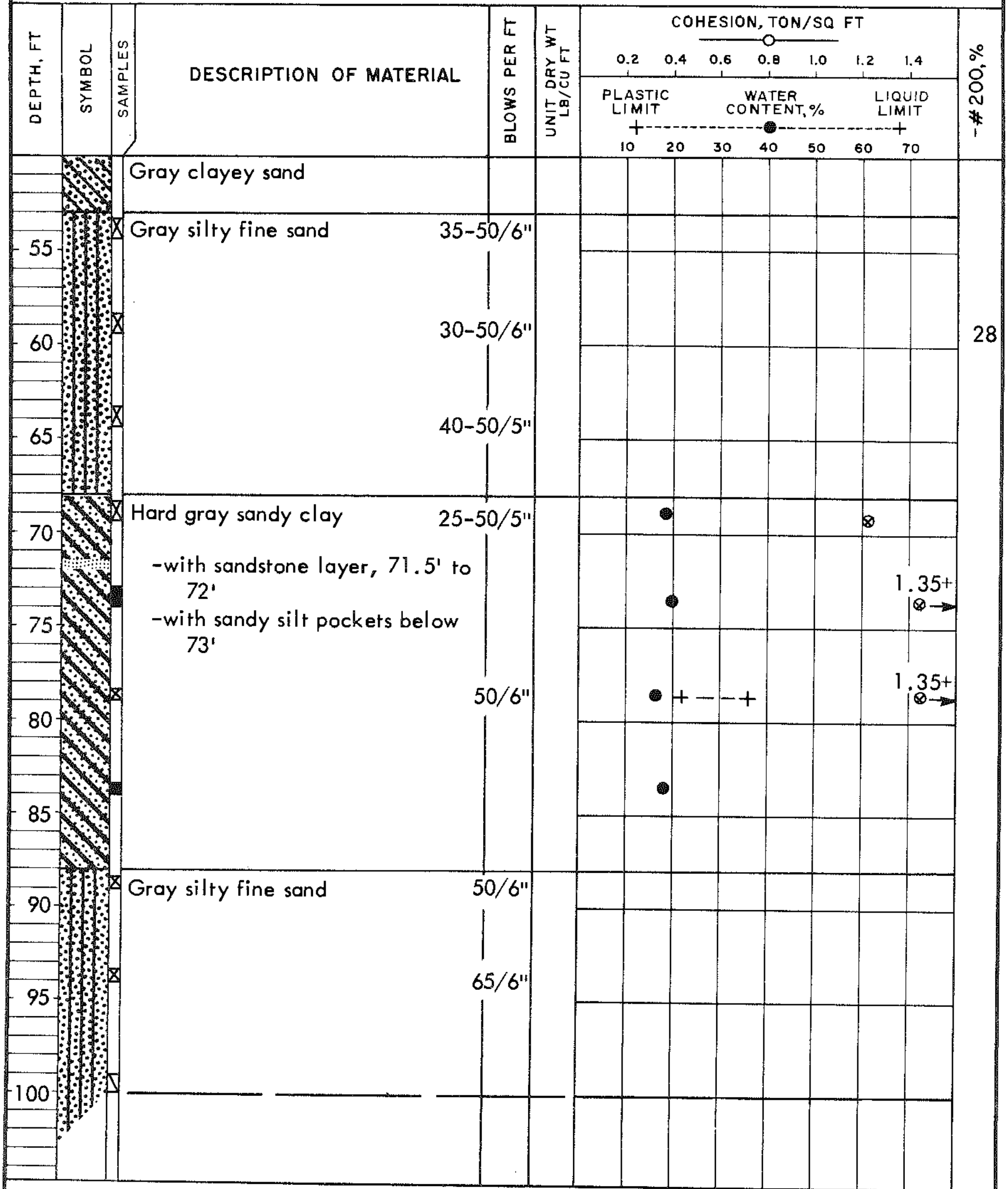
Form 10 Job No. 73-285

LOG OF BORING NO. P-5 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200, %
Gray clayey sand			
Gray silty fine sand	35-50/6"		
	30-50/6"		28
	40-50/5"		
Hard gray sandy clay -with sandstone layer, 71.5' to 72' -with sandy silt pockets below 73'	25-50/5"		
	50/6"		
Gray silty fine sand	50/6"		
	65/6"		

COMPLETION DEPTH: 100'
DATE: March 22, 1973

DEPTH TO WATER IN BORING: 12.5' Caved at: 24'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 6a

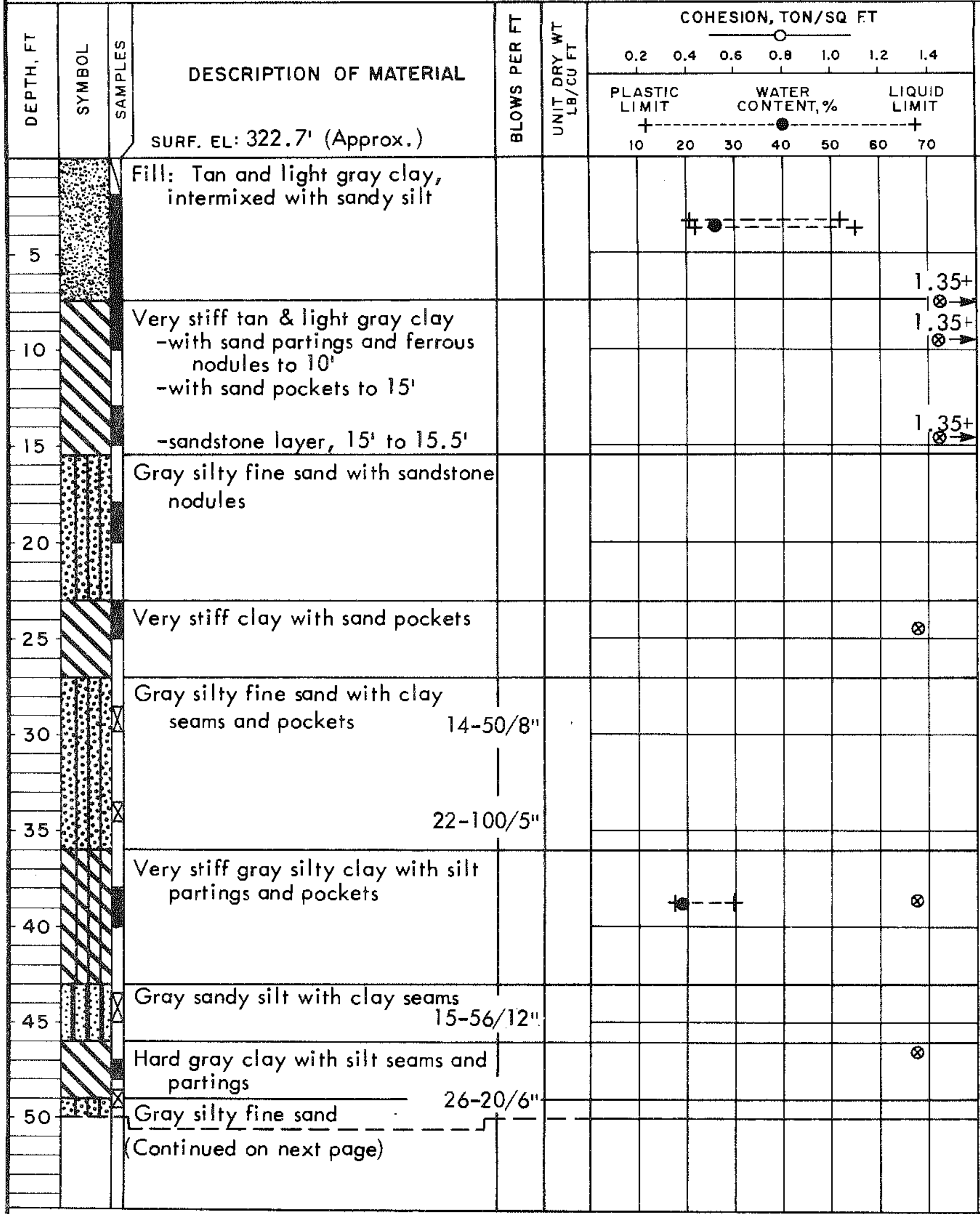
Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-6

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel
LOCATION: See Plate 1; Offset 29' NNW of staked location

SURF. EL: 322.7' (Approx.)



Fill: Tan and light gray clay, intermixed with sandy silt

Very stiff tan & light gray clay
-with sand partings and ferrous nodules to 10'
-with sand pockets to 15'
-sandstone layer, 15' to 15.5'

Gray silty fine sand with sandstone nodules

Very stiff clay with sand pockets

Gray silty fine sand with clay seams and pockets — 14-50/8"; 22-100/5"

Very stiff gray silty clay with silt partings and pockets

Gray sandy silt with clay seams — 15-56/12"

Hard gray clay with silt seams and partings — 26-20/6"

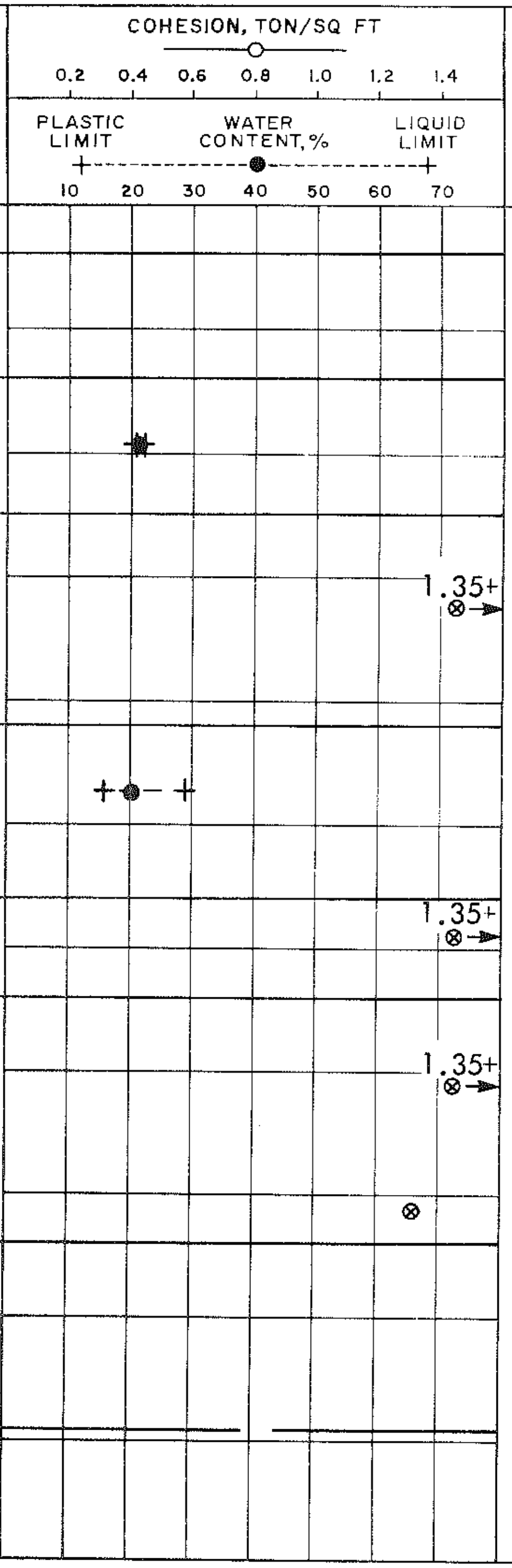
Gray silty fine sand

(Continued on next page)

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. P-6 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Gray silty fine sand		
Hard gray sandy clay with mica & sand pockets and seams	22-58/6"	
Gray sandy silt with clay seams and pockets	39-56/6"	
Hard gray clay -with lignite partings and seams to 66.5' -with silty sand partings & pockets below 66.5'	30-53/6" 36-58/6"	
Gray silty sand with sandy clay seams		
Gray cemented sand -with sandstone seams and layers to 78.5'	31-100/7"	
Hard gray sandy clay with sand pockets and mica	53-87/6" 100/9"	
Gray sandy silt with mica	40-60/3" 42-100/5"	



DEPTH, FT: 55, 60, 65, 70, 75, 80, 85, 90, 95, 100

COMPLETION DEPTH: 99.5'
DATE: April 12, 1973

DEPTH TO WATER IN BORING: 6.4'

DATE: April 23, 1973

McCLELLAND ENGINEERS

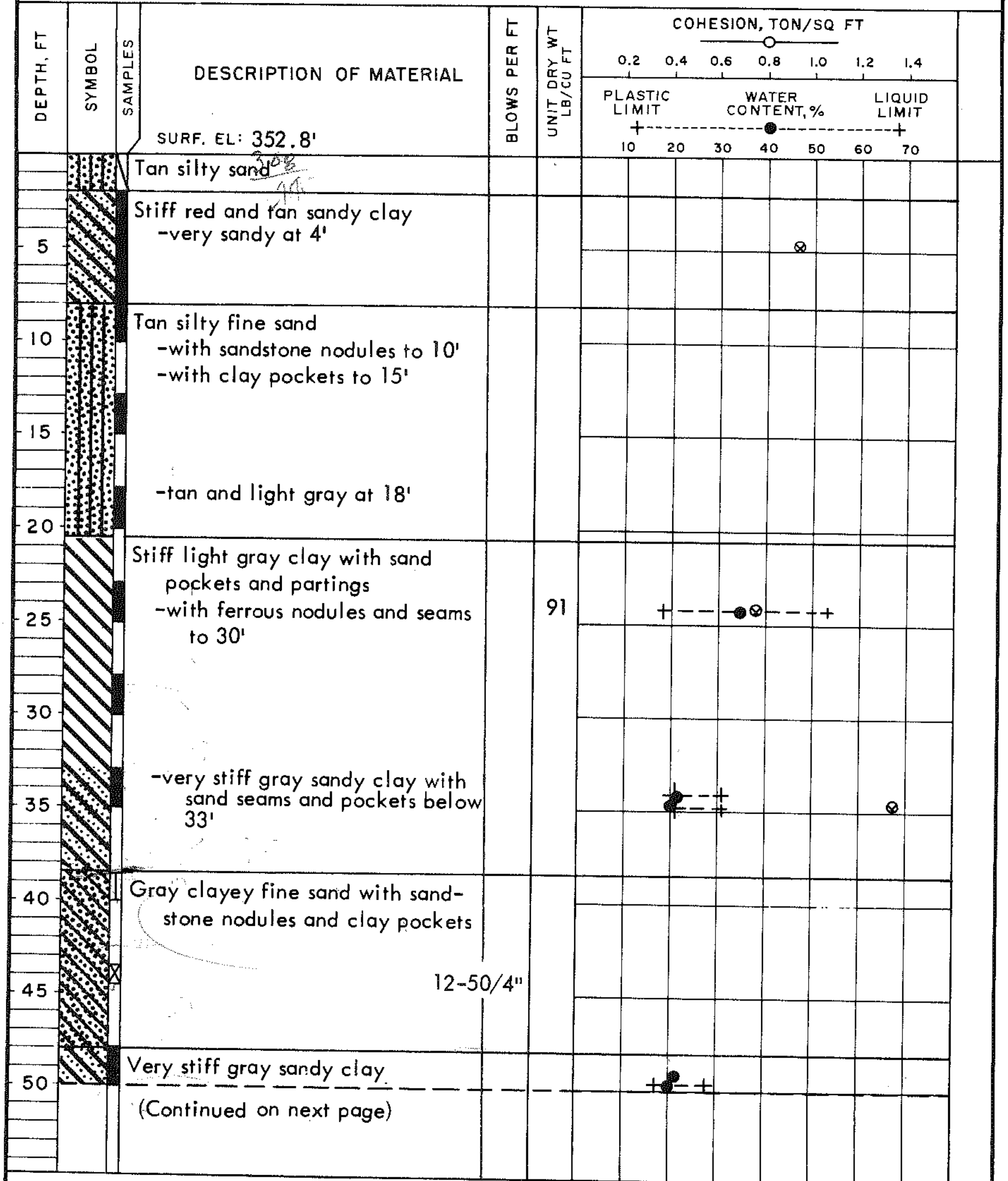
PLATE 7a

Form 06-1 (57) Job No 73-085

LOG OF BORING NO. P-7

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel
LOCATION: See Plate 1



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
SURF. EL: 352.8'		
Tan silty sand		
Stiff red and tan sandy clay -very sandy at 4'		
Tan silty fine sand -with sandstone nodules to 10' -with clay pockets to 15' -tan and light gray at 18'		
Stiff light gray clay with sand pockets and partings -with ferrous nodules and seams to 30' -very stiff gray sandy clay with sand seams and pockets below 33'		91
Gray clayey fine sand with sandstone nodules and clay pockets	12-50/4"	
Very stiff gray sandy clay		

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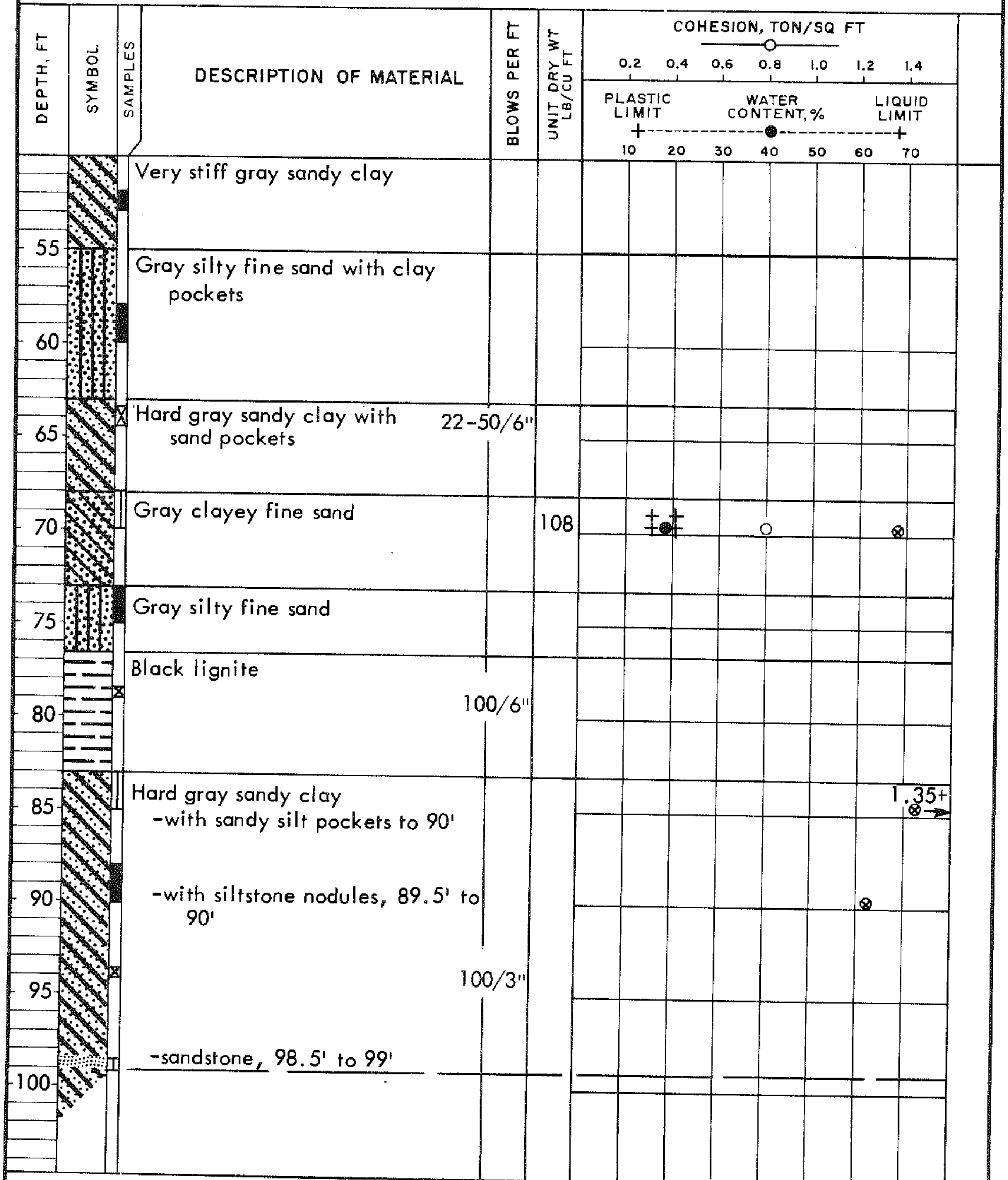
ENGINEERS

Form 108-A 1971 Job No 73-085

LOG OF BORING NO. P-7 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Very stiff gray sandy clay		
Gray silty fine sand with clay pockets		
Hard gray sandy clay with sand pockets	22-50/6"	
Gray clayey fine sand		108
Gray silty fine sand		
Black lignite	100/6"	
Hard gray sandy clay -with sandy silt pockets to 90' -with siltstone nodules, 89.5' to 90' -sandstone, 98.5' to 99'	100/3"	

COMPLETION DEPTH: 99'
DATE: March 29, 1973

DEPTH TO WATER IN BORING: 25.0' Caved at: 74'
DATE: April 23, 1973

McCLELLAND ENGINEERS

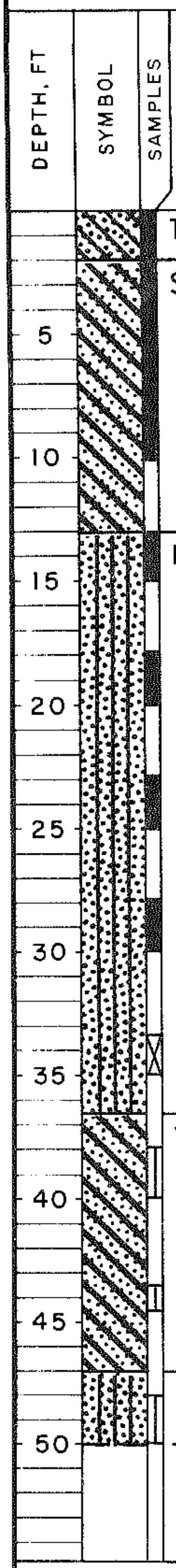
PLATE 8a

Form OB-1 (57) Job No 73-085

LOG OF BORING NO. P-8
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel

LOCATION: See Plate 1



SURF. EL: 346.5'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
Tan & light gray clayey fine sand			
Stiff tan sandy clay -with ferrous nodules and sand pockets to 8' -red and tan at 6'			
Light gray silty fine sand with clay seams -with ferrous nodules to 20.5' -red, 29' to 33.5'	11-21-22		32 20 31
Very stiff gray sandy clay with silt partings and pockets -with sandstone seams, 39' to 42'			
Gray silty fine sand			

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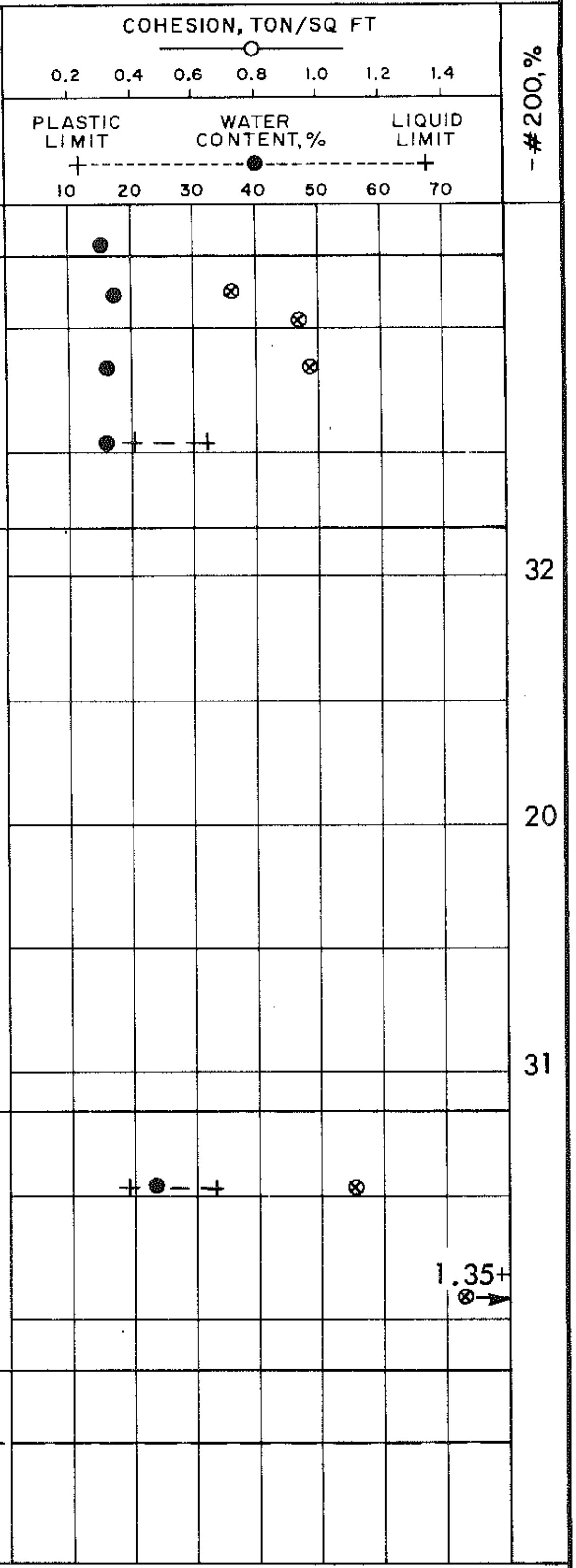

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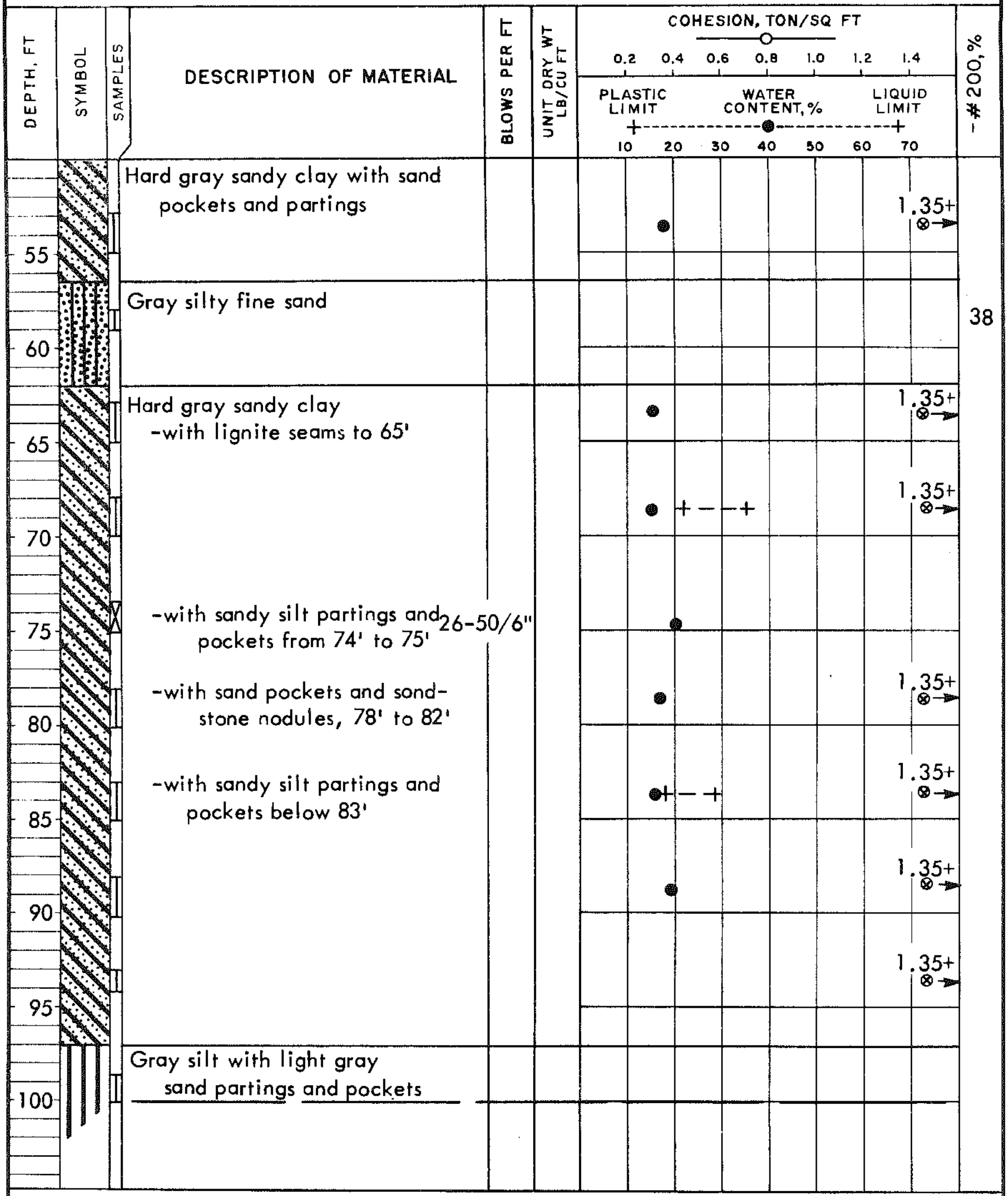
Form 108-3 (57) Job No 73-085

LOG OF BORING NO. P-8 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



Hard gray sandy clay with sand pockets and partings

Gray silty fine sand

Hard gray sandy clay
-with lignite seams to 65'

-with sandy silt partings and pockets from 74' to 75'

-with sand pockets and sandstone nodules, 78' to 82'

-with sandy silt partings and pockets below 83'

Gray silt with light gray sand partings and pockets

COMPLETION DEPTH: 100'
DATE: April 8, 1973

DEPTH TO WATER IN BORING: 16.8'
Caved at: 44'
DATE: April 23, 1973

McCLELLAND ENGINEERS

PLATE 9a

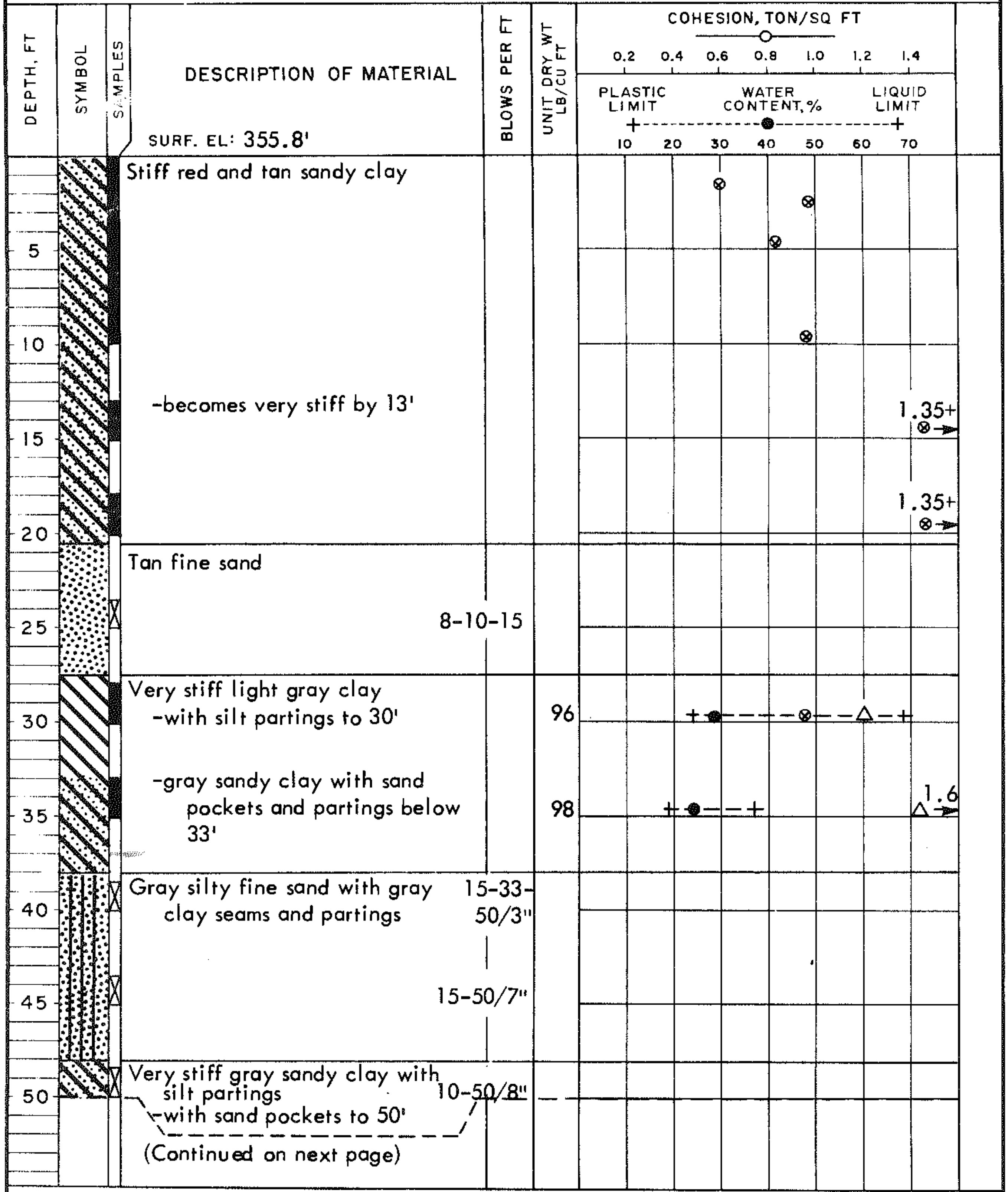
Form 38-1 (57) Job No 73-085

LOG OF BORING NO. P-9

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel
LOCATION: See Plate 1

SURF. EL: 355.8'



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Stiff red and tan sandy clay -becomes very stiff by 13'		
Tan fine sand	8-10-15	
Very stiff light gray clay -with silt partings to 30'		96
-gray sandy clay with sand pockets and partings below 33'		98
Gray silty fine sand with gray clay seams and partings	15-33-50/3"	
	15-50/7"	
Very stiff gray sandy clay with silt partings -with sand pockets to 50'	10-50/8"	

(Continued on next page)

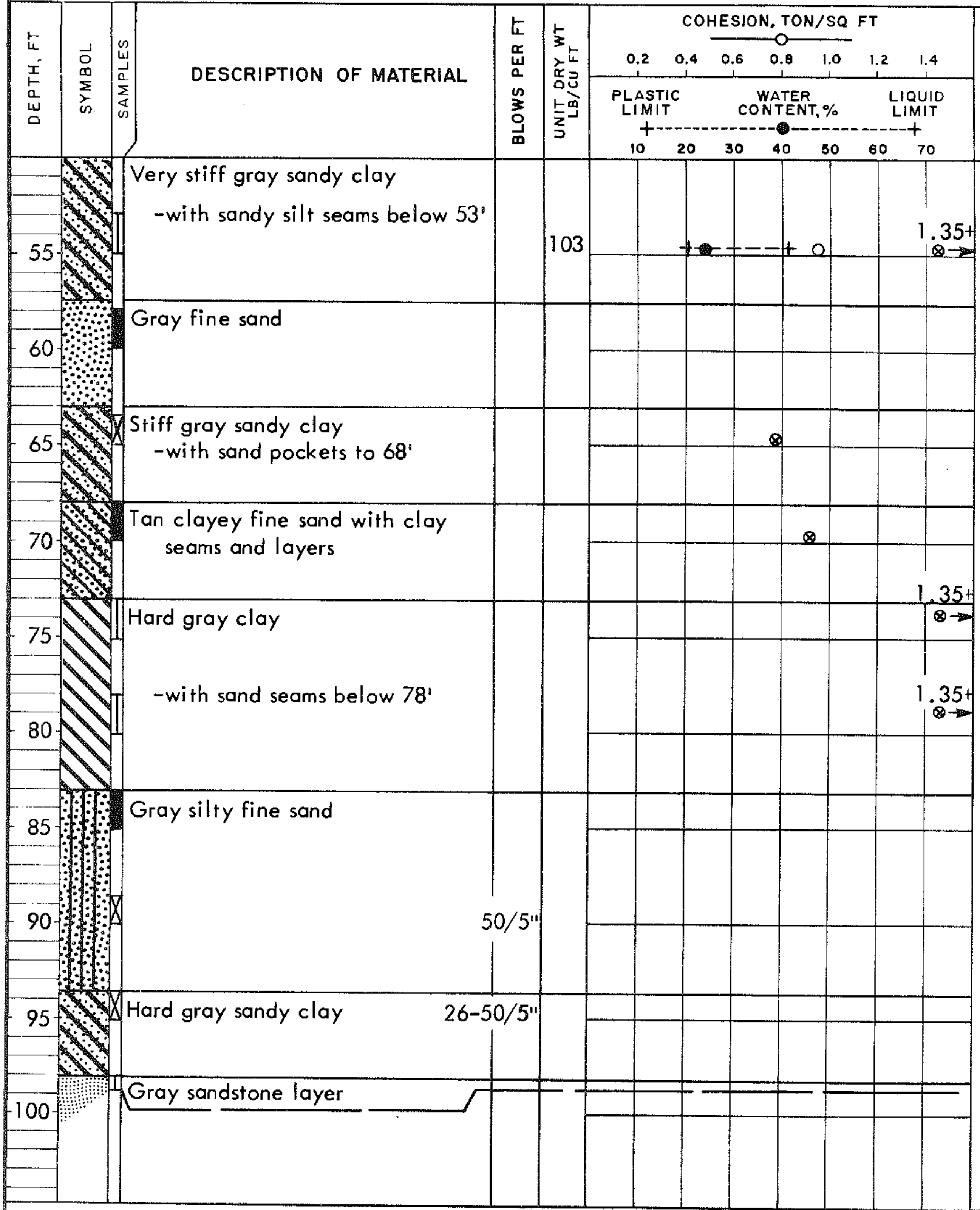
McCLELLAND ENGINEERS

Form 108-3 (57) Job No 72-085

LOG OF BORING NO. P-9 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
55	Very stiff gray sandy clay -with sandy silt seams below 53'		103
60	Gray fine sand		
65	Stiff gray sandy clay -with sand pockets to 68'		
70	Tan clayey fine sand with clay seams and layers		
75, 80	Hard gray clay -with sand seams below 78'		
85, 90	Gray silty fine sand	50/5"	
95	Hard gray sandy clay	26-50/5"	
100	Gray sandstone layer		



COMPLETION DEPTH: 98.5'
DATE: April 3, 1973

DEPTH TO WATER IN BORING: 24.3' Caved at: 41' DATE: May 3, 1973

McCLELLAND ENGINEERS

Form 38-1 (57) Job No 72-085

LOG OF BORING NO. P-10

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel
LOCATION: See Plate 1

SURF. EL: 352.7'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–8	Very stiff red and tan clay with sand pockets		
8–23	Red and tan fine sand -slightly clayey to 13' -with sandstone nodules, 14' to 15' -with ferrous deposits, 19' to 20'		
23–27.5	Light gray sandy silt -with sand pockets and seams	3-5-5	
27.5–41	Tan silty fine sand -with ferrous seams at 34' -gray with clay seams below 36.5'	6-3-5 10-16-26	
41–50	Very stiff gray sandy clay with silt partings and seams		102 105

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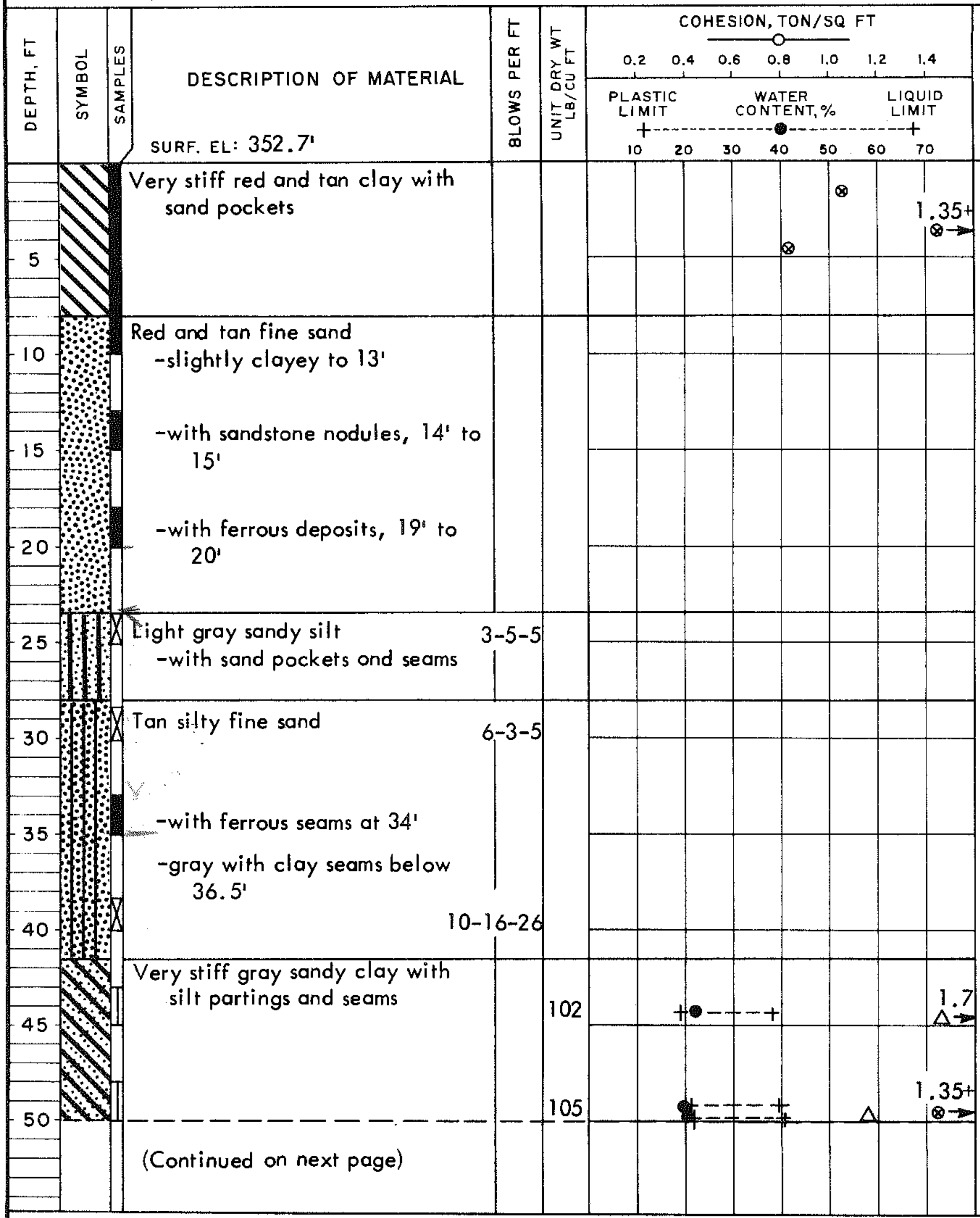

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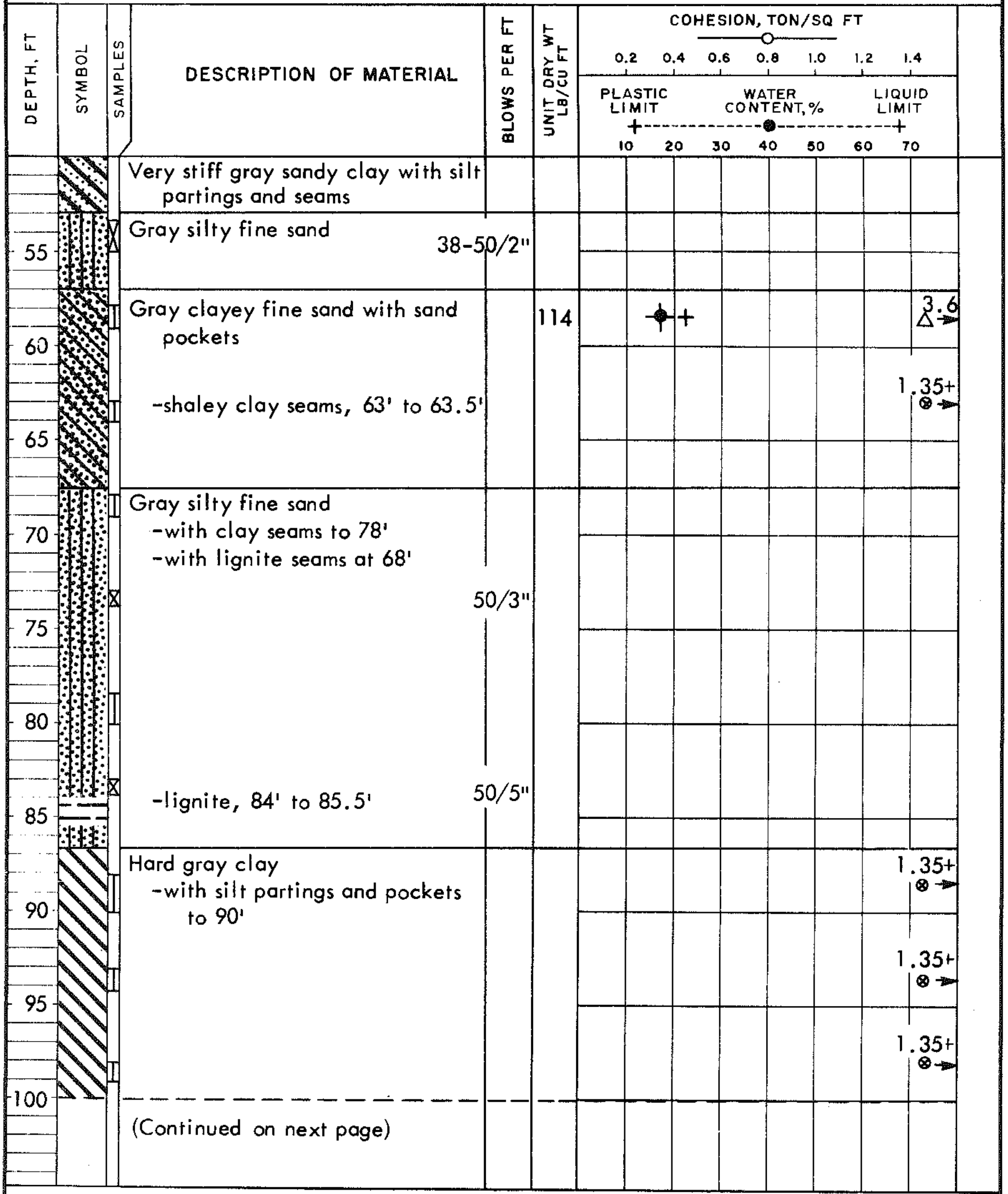
PLATE 11

Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-10 (Cont'd)
WELSH POWER PLANT
CASON TEXAS



DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
	Very stiff gray sandy clay with silt partings and seams			
55	Gray silty fine sand	38-50/2"		
60	Gray clayey fine sand with sand pockets		114	3.6
	-shaley clay seams, 63' to 63.5'			1.35+
70	Gray silty fine sand -with clay seams to 78' -with lignite seams at 68'	50/3"		
85	-lignite, 84' to 85.5'	50/5"		
90	Hard gray clay -with silt partings and pockets to 90'			1.35+
95				1.35+
				1.35+
100	(Continued on next page)			

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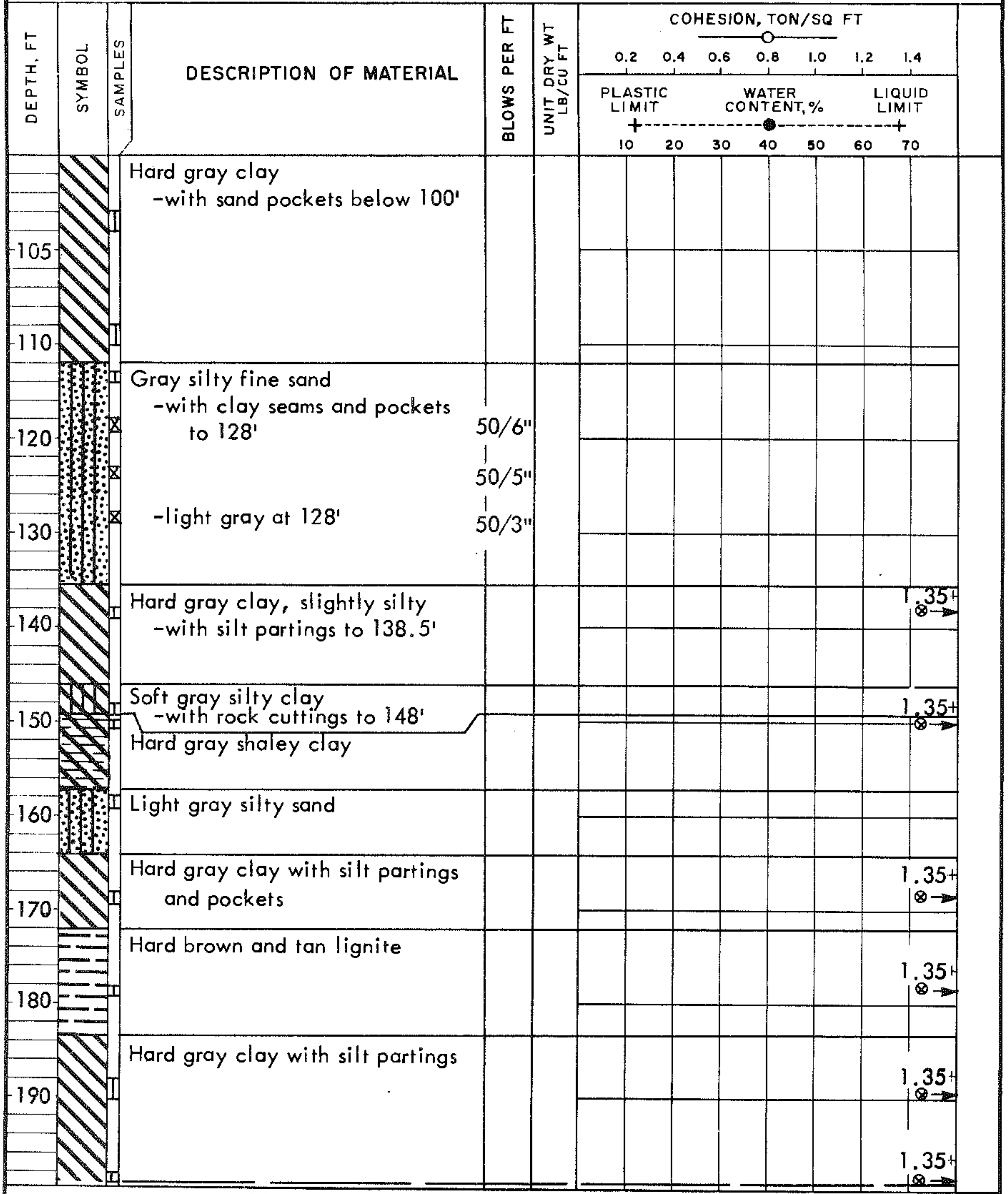
ENGINEERS

PLATE 11a

Form 108-3 (57) Job No Z3-085

Note Scale Change

LOG OF BORING NO. P-10 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



Hard gray clay
-with sand pockets below 100'

Gray silty fine sand
-with clay seams and pockets to 128'
-light gray at 128'

Hard gray clay, slightly silty
-with silt partings to 138.5'

Soft gray silty clay
-with rock cuttings to 148'

Hard gray shaley clay

Light gray silty sand

Hard gray clay with silt partings and pockets

Hard brown and tan lignite

Hard gray clay with silt partings

COMPLETION DEPTH: 198.5'
DATE: April 5, 1973

DEPTH TO WATER IN BORING: 27.2'
Caved at: 36'
DATE: April 11, 1973

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PLATE 11b

23-085

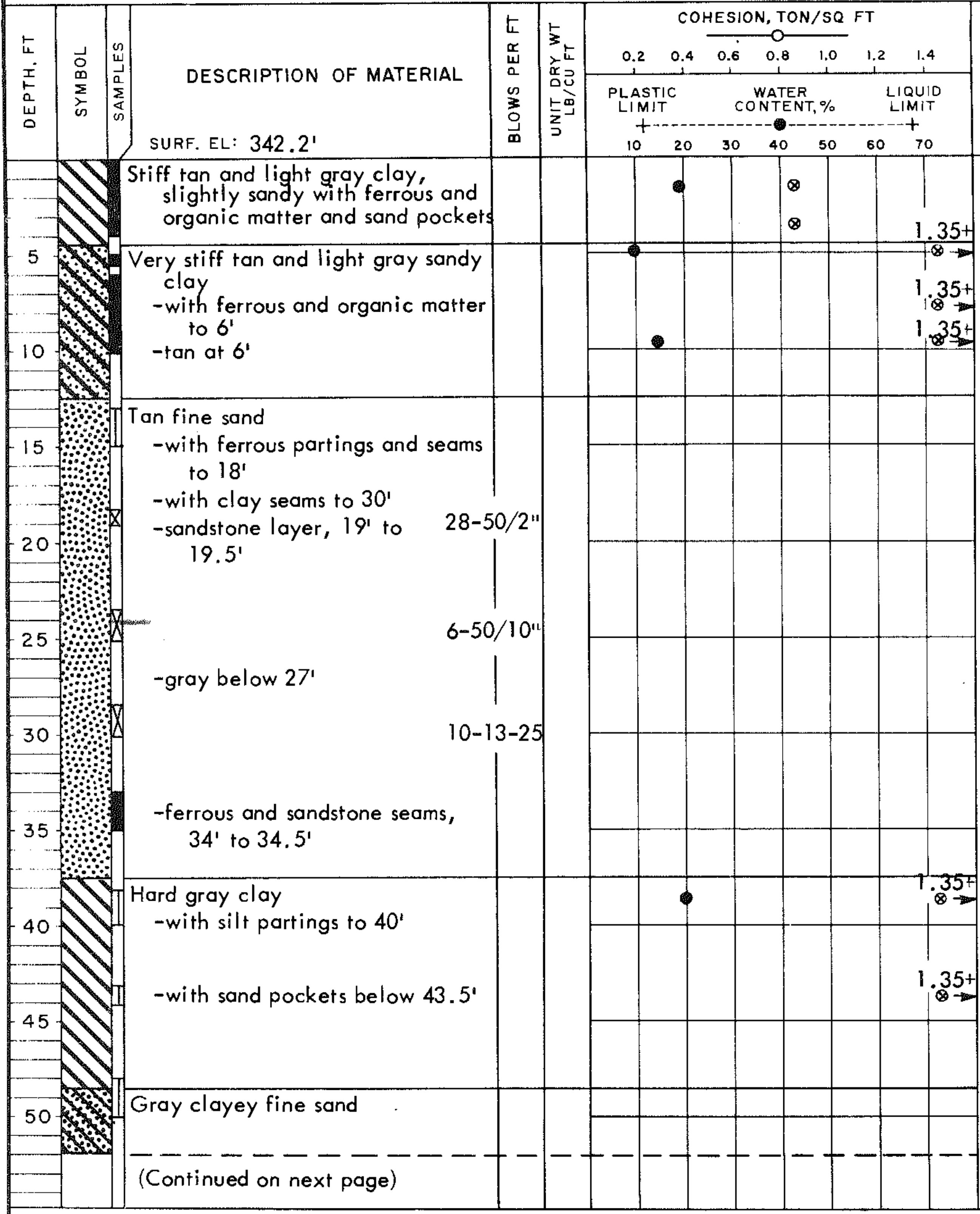
LOG OF BORING NO. P-11

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel LOCATION: See Plate 1

SURF. EL: 342.2'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
0	Stiff tan and light gray clay, slightly sandy with ferrous and organic matter and sand pockets		
4.5	Very stiff tan and light gray sandy clay -with ferrous and organic matter to 6' -tan at 6'		
12.5	Tan fine sand -with ferrous partings and seams to 18' -with clay seams to 30' -sandstone layer, 19' to 19.5'	28-50/2"	
		6-50/10"	
	-gray below 27'		
		10-13-25	
	-ferrous and sandstone seams, 34' to 34.5'		
37.5	Hard gray clay -with silt partings to 40' -with sand pockets below 43.5'		
48.5	Gray clayey fine sand		



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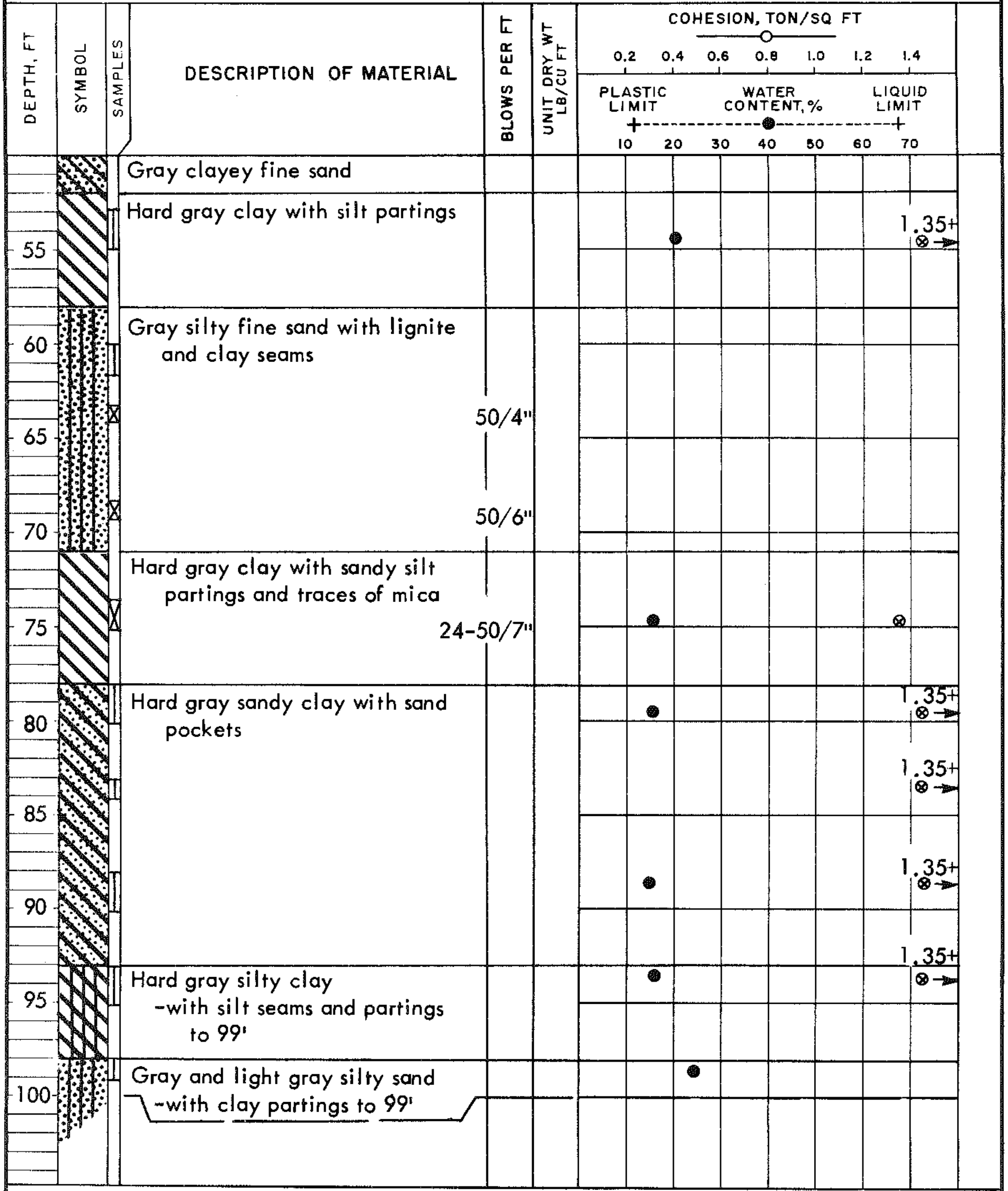
McCLELLAND ENGINEERS

Form 108-3 (57) Job No 73-085

LOG OF BORING NO. P-11 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



DESCRIPTION OF MATERIAL	BLOWS PER FT
Gray clayey fine sand	
Hard gray clay with silt partings	
Gray silty fine sand with lignite and clay seams	50/4" 50/6"
Hard gray clay with sandy silt partings and traces of mica	24-50/7"
Hard gray sandy clay with sand pockets	
Hard gray silty clay -with silt seams and partings to 99'	
Gray and light gray silty sand -with clay partings to 99'	

COMPLETION DEPTH: 100'
DATE: April 8, 1973

DEPTH TO WATER IN BORING: 14' Caved at: 39'
DATE: May 3, 1973

McCLELLAND ENGINEERS

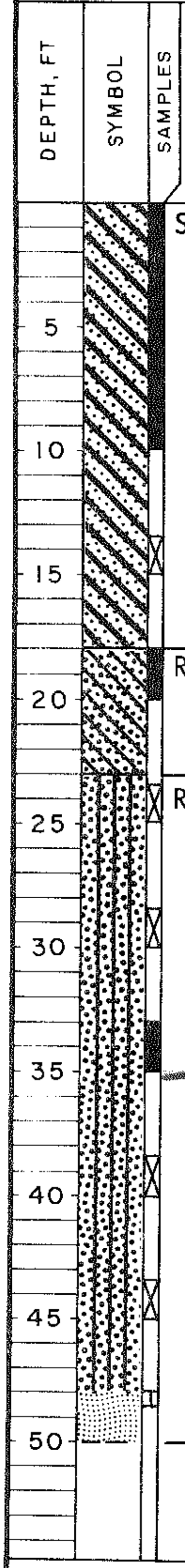
PLATE 12a

Form 98-1 (57) Job No. 73-085

LOG OF BORING NO. P-12
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel LOCATION: See Plate 1

SURF. EL: 353.4'



DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- #200, %
0	Stiff red and tan sandy clay			
	-with sand pockets and seams to 8'			
	-very stiff below 4'			
15		20-25-18		
18	Red and tan clayey fine sand with sand and clay pockets		114	
23	Red and tan silty fine sand	9-10-12		
30	-with ferrous seams and deposits, 29' to 33'	15-14-15		36
33	-tan, 33' to 38'			
38	-gray with clay seams below 38'			
40		36-42/6"		
45		20-42-50/4"		37
48	-sandstone, 48' to 50'			

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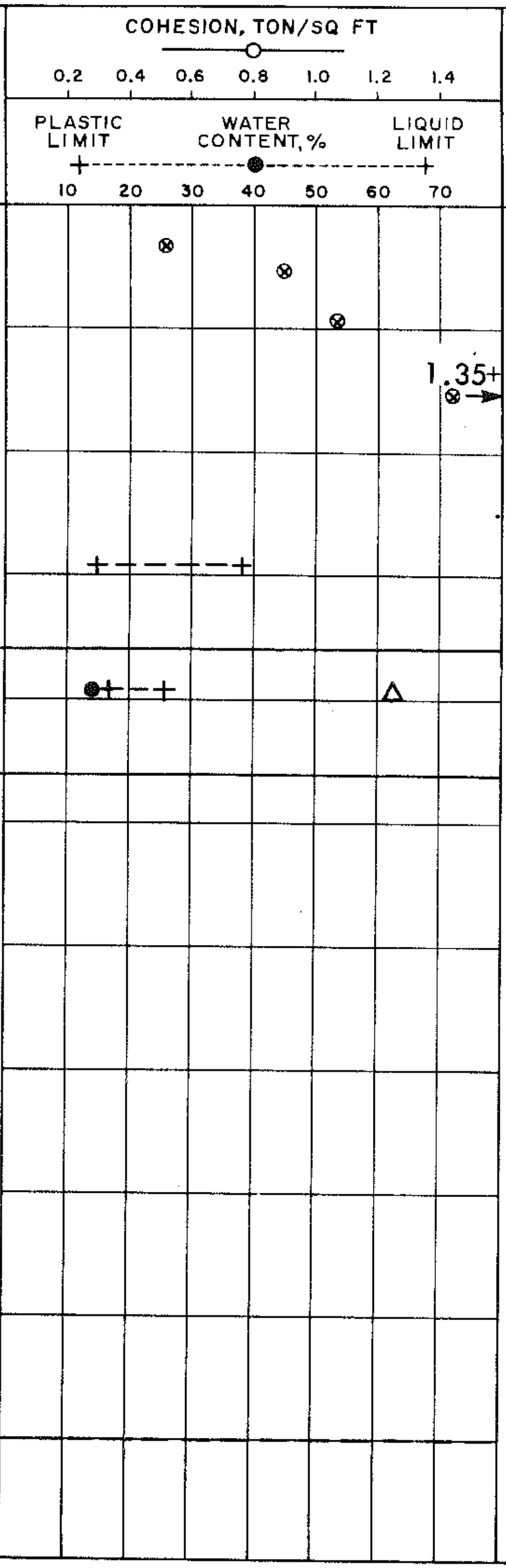

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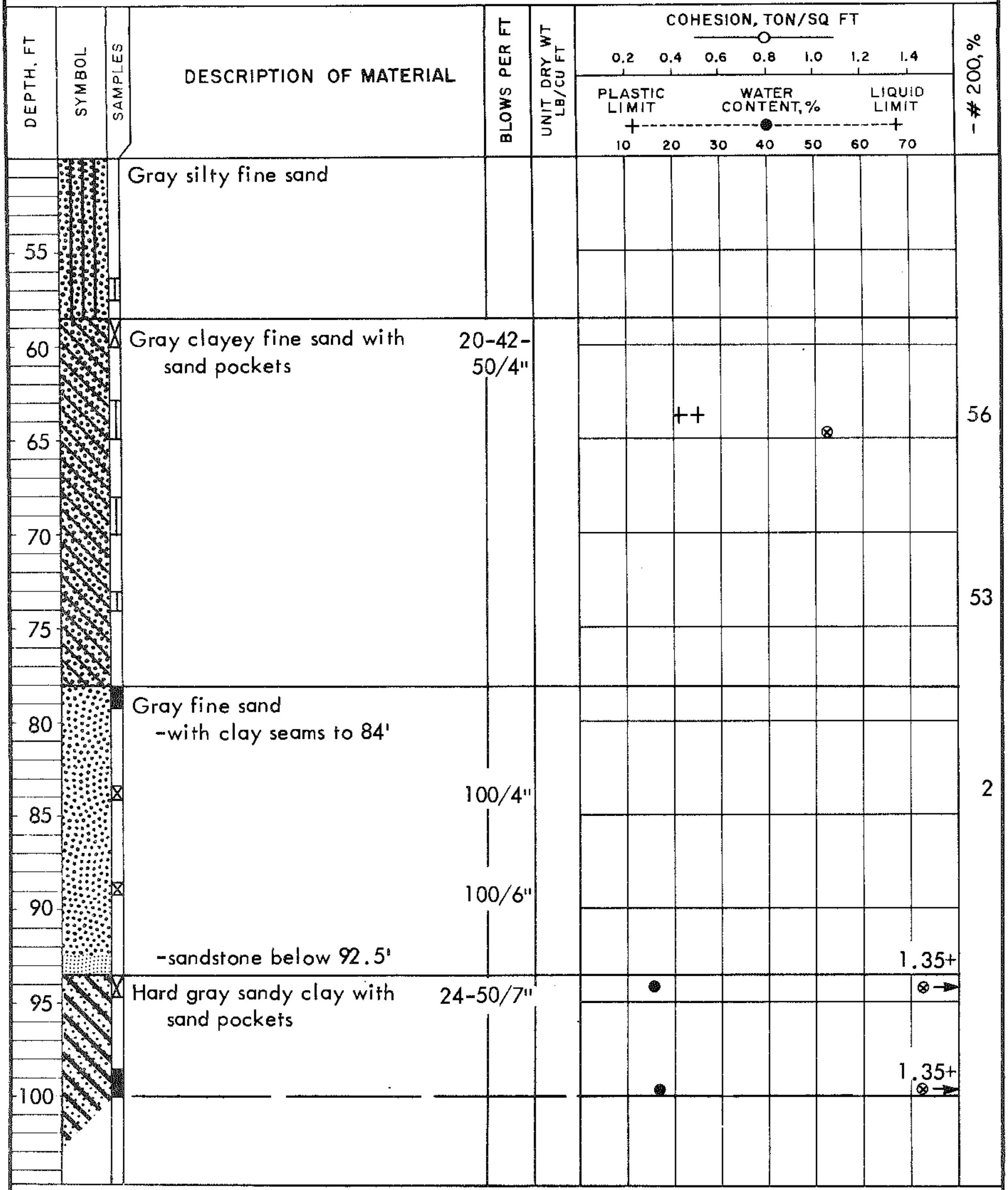
PLATE 13

Form 10 Job No. 73-785

LOG OF BORING NO. P-12 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	- # 200, %
	Gray silty fine sand		
60	Gray clayey fine sand with sand pockets	20-42-50/4"	
			56
			53
	Gray fine sand -with clay seams to 84'		
		100/4"	2
		100/6"	
	-sandstone below 92.5'		
95	Hard gray sandy clay with sand pockets	24-50/7"	

COMPLETION DEPTH: 100'
DATE: March 26, 1973

DEPTH TO WATER IN BORING: 24.8' Caved at: 44'
DATE: April 23, 1973

McCLELLAND ENGINEERS

PLATE 13a

Form 38-1 (57) Job No 73-085

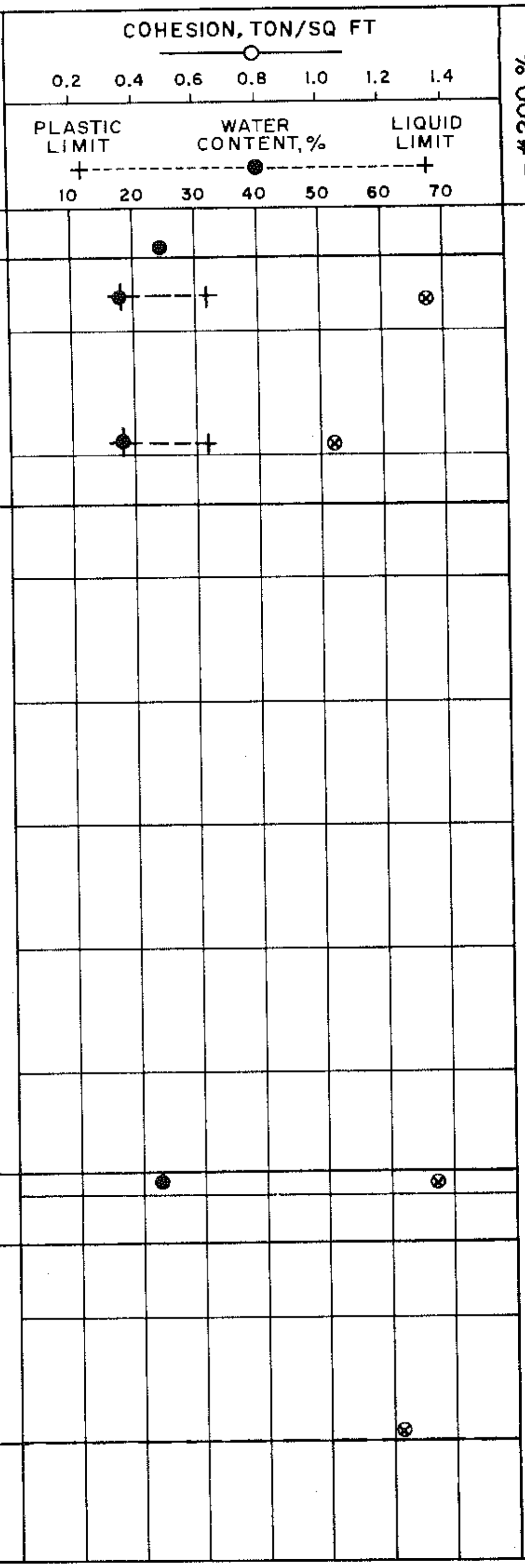
LOG OF BORING NO. P-13
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel

LOCATION: See Plate 1

SURF. EL: 348.1'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200, %
Firm tan and light gray clay			
Very stiff tan and light gray sandy clay			
-with silt pockets and partings below 8'			
Tan silty fine sand			21
			32
-with coarse sand layer at 23.5'	23-50/4"		
	2-6-11		21
-gray below 34'			
-with gravel layer at 35.5'			
	23-50/10"		
Hard gray clay			
Gray silty fine sand			20



DEPTH, FT: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

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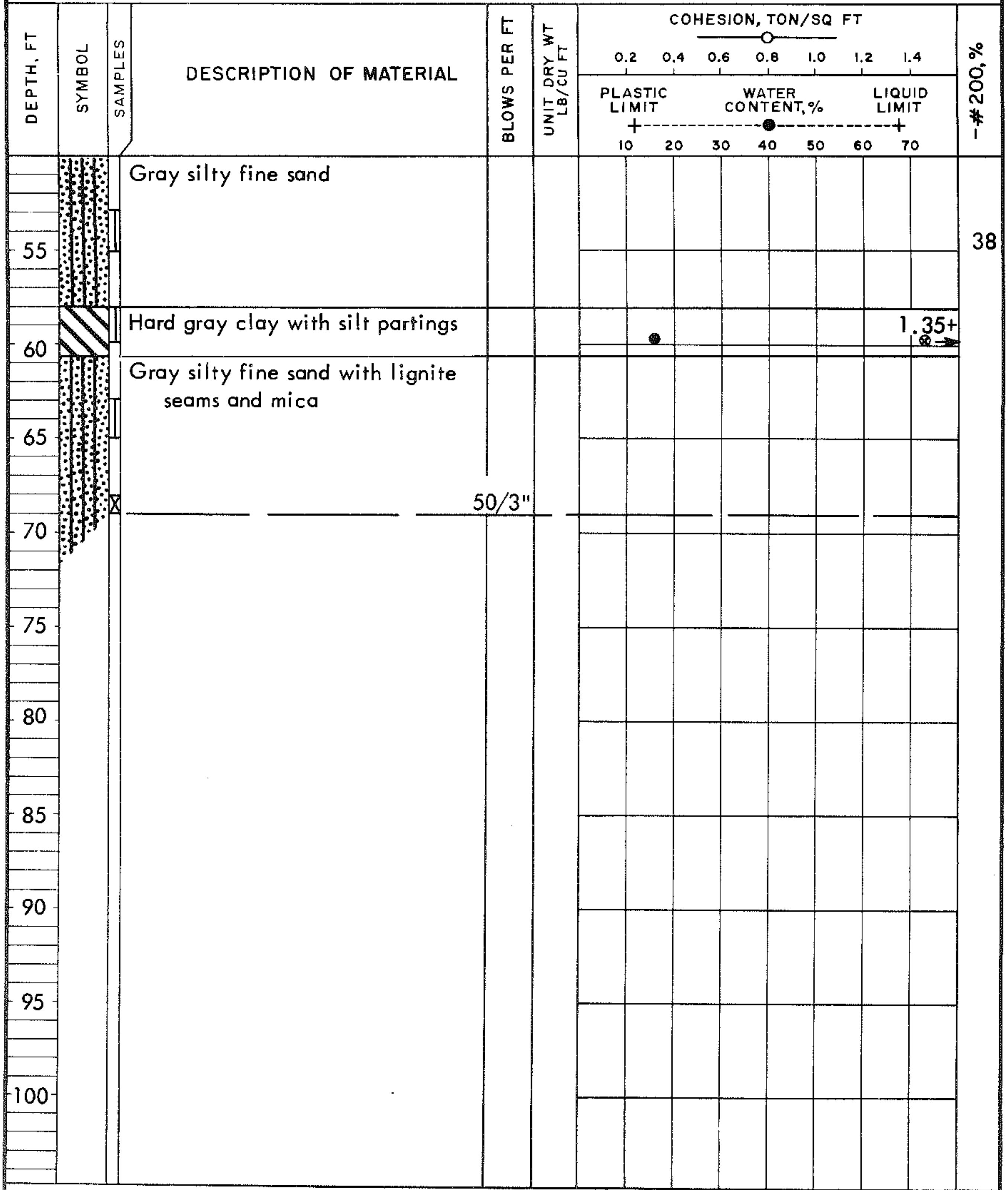
McCLELLAND ENGINEERS

LOG OF BORING NO. P-13 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



COMPLETION DEPTH: 69'
DATE: April 10, 1973

DEPTH TO WATER IN BORING: 15.8' Caved at: 60'

DATE: April 11, 1973

McCLELLAND ENGINEERS

PLATE 14a

Form 106-1 (57) Job No. 73-085

LOG OF BORING NO. P-19

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube, 2" split-barrel & 3" Denison barrel   LOCATION: See Plate 1

SURF. EL: 331.8'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
Gray & tan silty fine sand			
Stiff tan and light gray clay with sand pockets -red and light gray, 4' to 6' -light gray with ferrous partings below 6'		99	
Red silty fine sand -with ferrous deposits to 14' -with clay seams below 14' -gray below 17'	7-9-13 9-12-17 22-25-23		24 62
Hard gray clay with sand pockets			
Gray clayey silt with sandy silt pockets			
Hard gray clay with silt partings and pockets	22-50/9"		
Gray silty fine sand with clay pockets			
Hard gray clay with sand pockets and seams and mica	47-50/5"		

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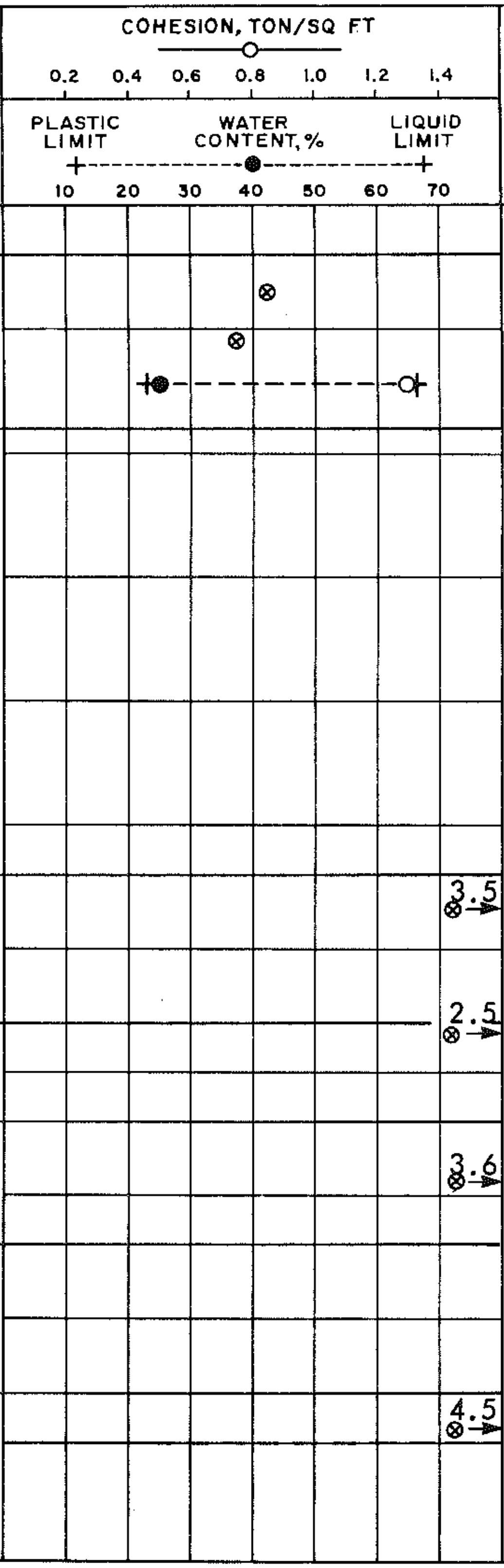
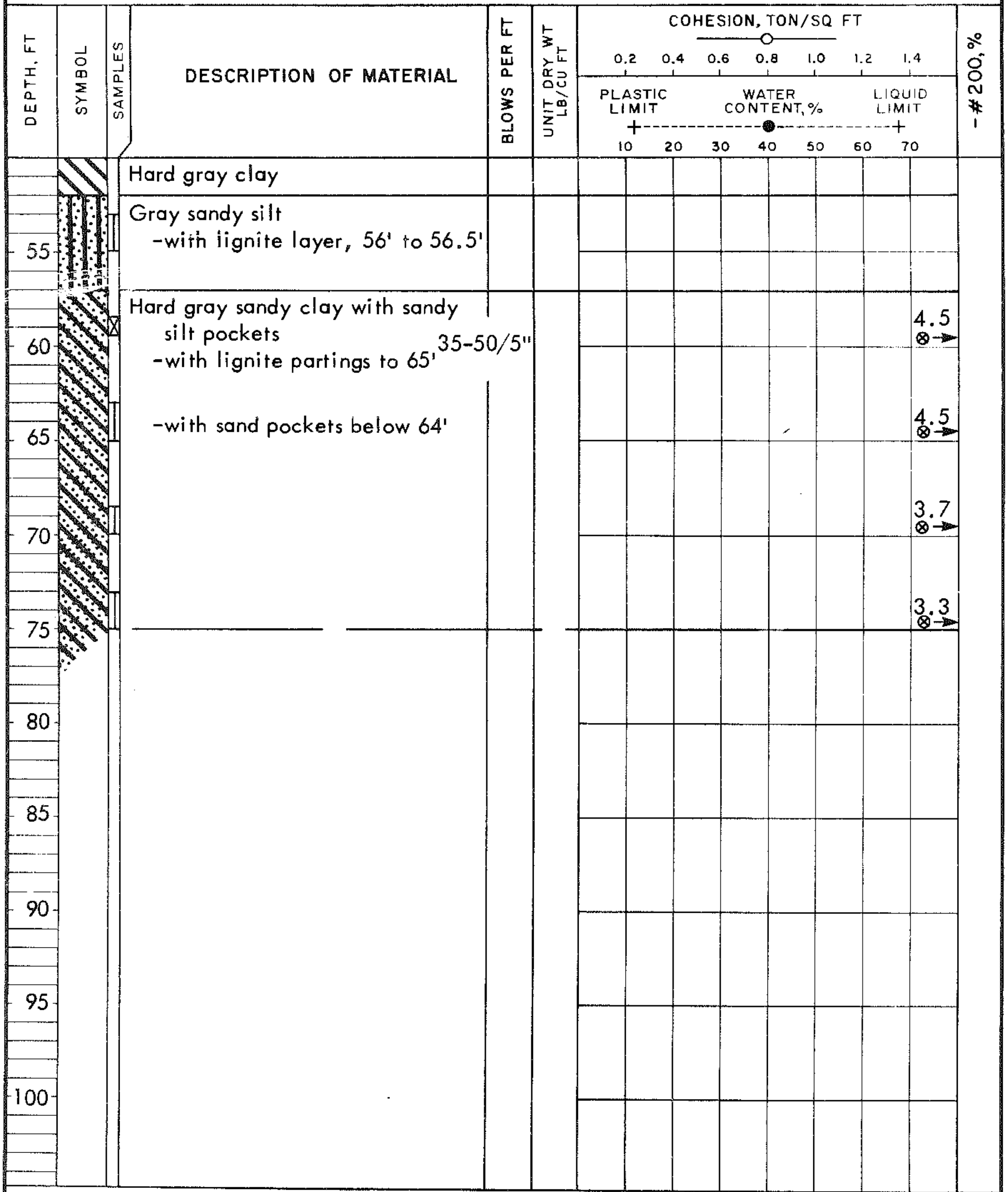


McCLELLAND ENGINEERS

PLATE 15

73-085

LOG OF BORING NO. P-19 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



Hard gray clay

Gray sandy silt
-with lignite layer, 56' to 56.5'

Hard gray sandy clay with sandy silt pockets
-with lignite partings to 65'
-with sand pockets below 64'

COMPLETION DEPTH: 75'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 6.8'

DATE: May 3, 1973

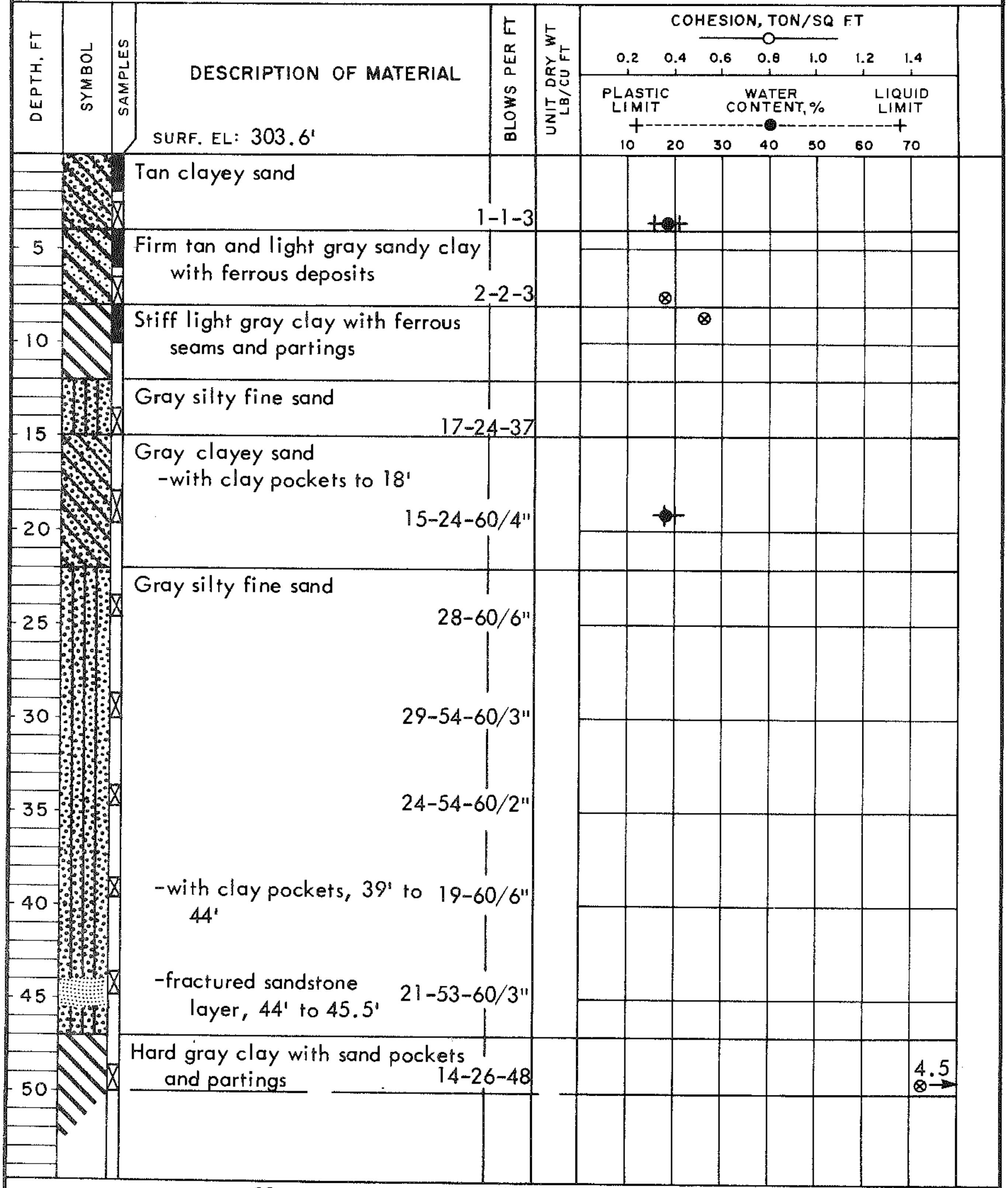
McCLELLAND ENGINEERS

PLATE 15a

Form 108-1 (57) Job No. 73-085

LOG OF BORING NO. P-20
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



DESCRIPTION OF MATERIAL	BLOWS PER FT
Tan clayey sand	1-1-3
Firm tan and light gray sandy clay with ferrous deposits	2-2-3
Stiff light gray clay with ferrous seams and partings	
Gray silty fine sand	17-24-37
Gray clayey sand -with clay pockets to 18'	15-24-60/4"
Gray silty fine sand	28-60/6"
	29-54-60/3"
	24-54-60/2"
-with clay pockets, 39' to 44'	19-60/6"
-fractured sandstone layer, 44' to 45.5'	21-53-60/3"
Hard gray clay with sand pockets and partings	14-26-48

COMPLETION DEPTH: 50'
DATE: April 28, 1973

DEPTH TO WATER IN BORING: 2.7'

DATE: May 3, 1973

McCLELLAND ENGINEERS

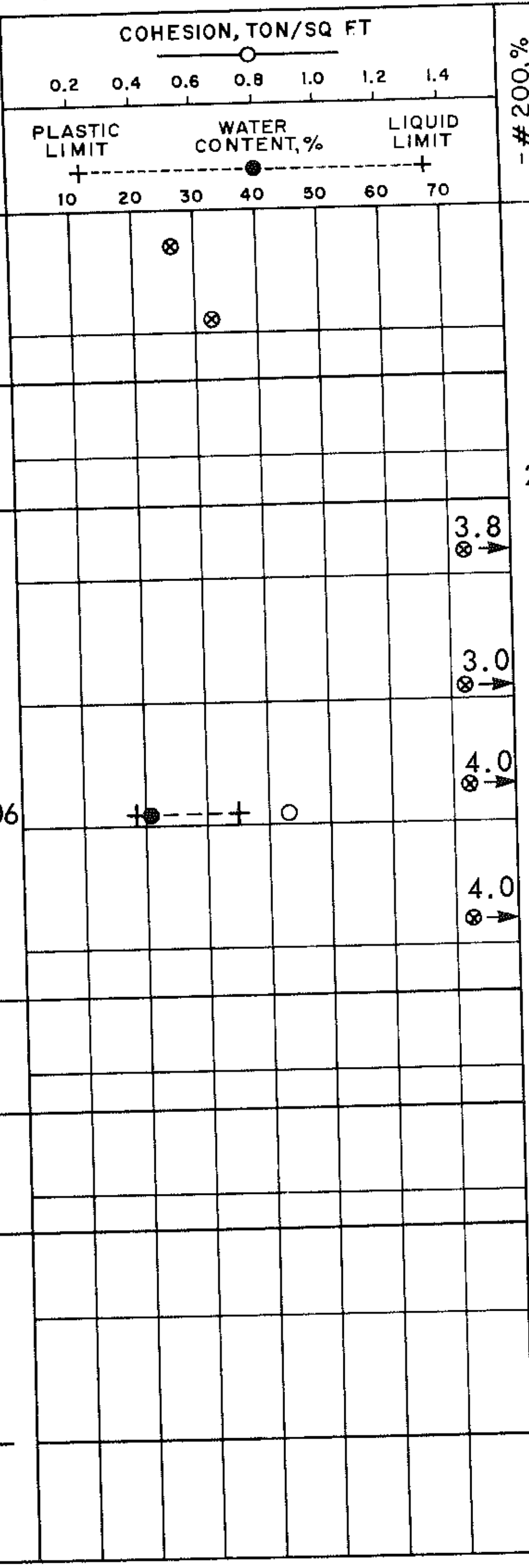
LOG OF BORING NO. P-21
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 323.6'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
	Stiff red and light gray clay with sand partings and pockets -with ferrous nodules, 2' to 6'	3-3-6		
5				
	Tan silty fine sand with light gray clay seams and pockets	12-16-27		
10				28
	Hard gray clay -with silt partings to 20'			
15				
	-brown, 18.5' to 19'	14-25-33		
20				
	-with sand pockets & partings, 23' to 25'		106	
25				
	-with silt partings & pockets, 28' to 30'	12-19-23		
30				
	Gray silty fine sand	31-36-60/3"		
35				
	Hard gray sandy clay with sand pockets	10-21-60/5"		
40				
	Gray silty fine sand	21-60/6"		30
		26-60/5"		
50		32-60/5"		21
	-sandstone layer, 57' to 57.5'	21-46-60/3"		
60				

← Note Scale Change



COMPLETION DEPTH: 60'
DATE: April 29, 1973

DEPTH TO WATER IN BORING: 11.6'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 17

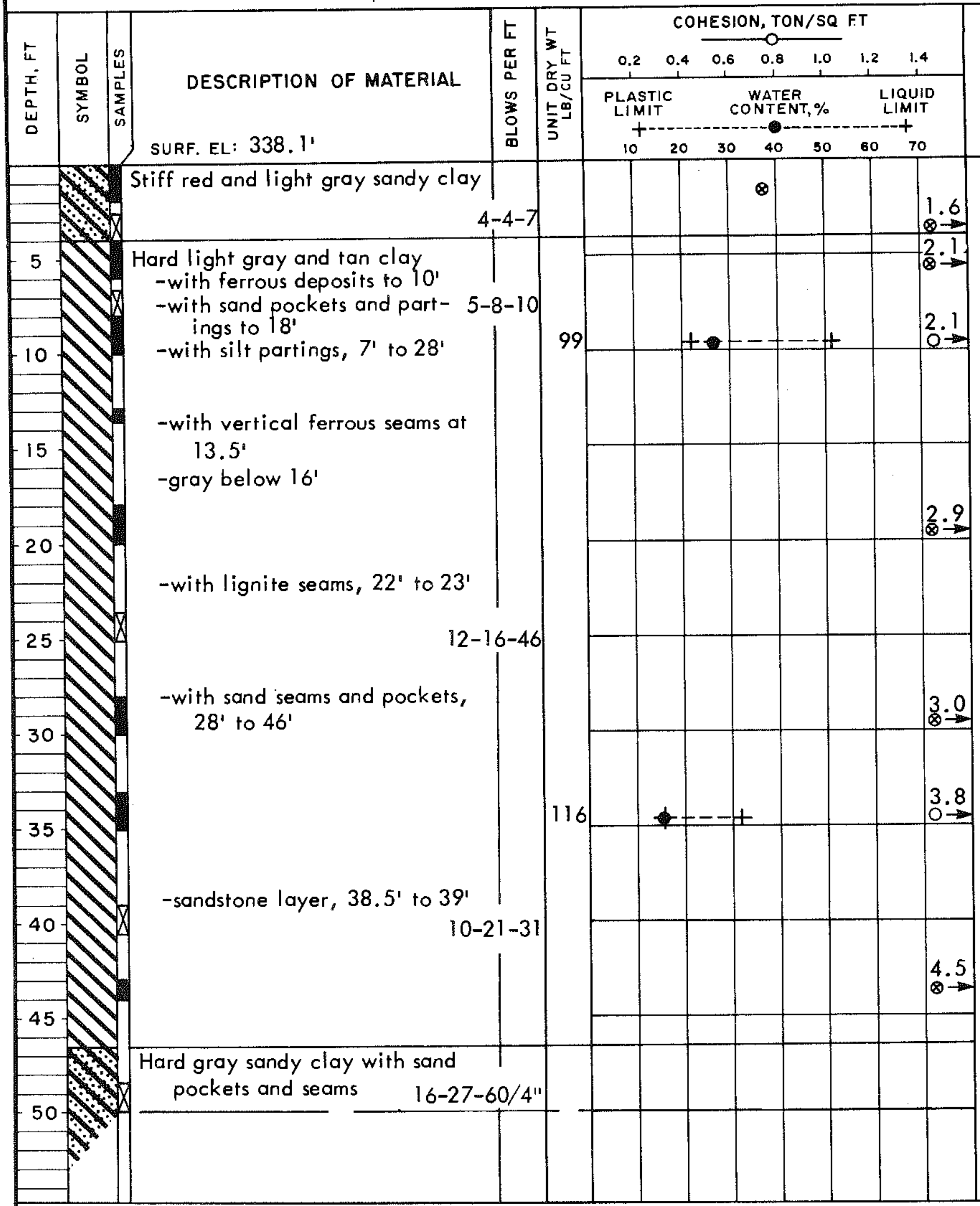
Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-22

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 338.1'



Stiff red and light gray sandy clay

Hard light gray and tan clay
- -with ferrous deposits to 10'
- -with sand pockets and partings to 18'
- -with silt partings, 7' to 28'
- -with vertical ferrous seams at 13.5'
- -gray below 16'
- -with lignite seams, 22' to 23'
- -with sand seams and pockets, 28' to 46'
- -sandstone layer, 38.5' to 39'

Hard gray sandy clay with sand pockets and seams

COMPLETION DEPTH: 50'
DATE: April 30, 1973

DEPTH TO WATER IN BORING: 1.2'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 18

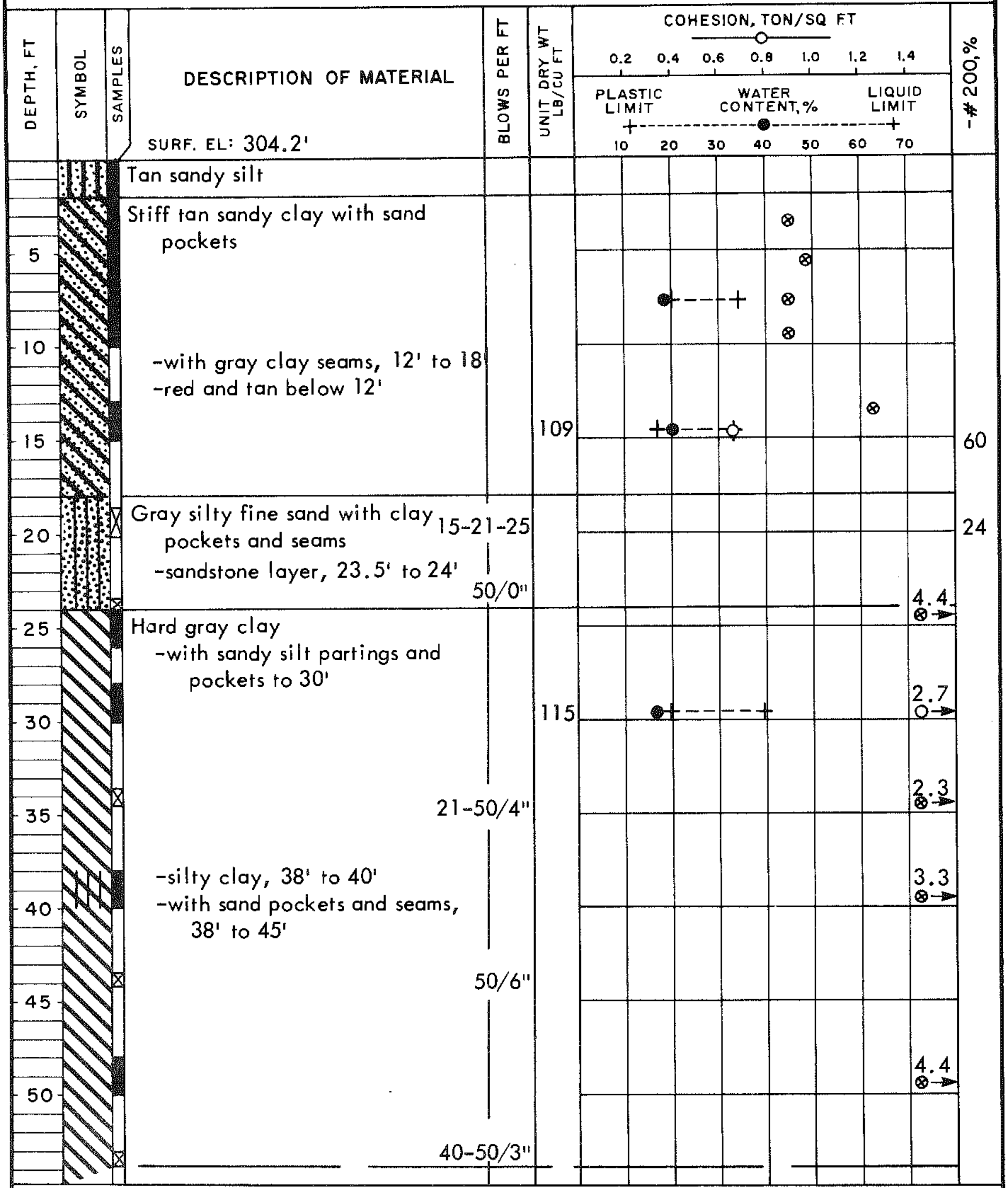
Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-23

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 304.2'



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
Tan sandy silt			
Stiff tan sandy clay with sand pockets -with gray clay seams, 12' to 18' -red and tan below 12'		109	60
Gray silty fine sand with clay pockets and seams -sandstone layer, 23.5' to 24'	15-21-25 50/0"		24
Hard gray clay -with sandy silt partings and pockets to 30' -silty clay, 38' to 40' -with sand pockets and seams, 38' to 45'	21-50/4" 50/6" 40-50/3"	115	

COMPLETION DEPTH: 53.75'
DATE: April 22, 1973

DEPTH TO WATER IN BORING: 6.6'

DATE: May 3, 1973

McCLELLAND ENGINEERS

Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-25
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 357.8'

COHESION, TON/SQ FT ○ : 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
PLASTIC LIMIT + WATER CONTENT, % ● LIQUID LIMIT + : 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT, %	-#200,%
0	Tan sandy silt				60 64
5	Stiff gray and red sandy clay with sand pockets -with gray clay seams to 8' -very stiff red and tan below 7'			⊗ (30) 2.7 ⊗→ 4.1 ⊗→	
10	-with red fine sand seams and layers below 13'	8-17-16		1.2 ⊗→	
20	Tan silty fine sand				
25	-with ferrous nodules, 24' to 24.5'	11-10-10			32
30		18-23-18			
35	-with ferrous partings, 34' to 35'	21-50/9"			16
40		28-50/8"			
45	-with organic partings, 43' to 45.5' -gray below 43'	8-14-20			
50	-with clay seams, 49' to 54'	14-50/6"			
	(Continued on next page)				

McCLELLAND ENGINEERS

Form 108-3 (57) Job No 73-085

LOG OF BORING NO. P-25 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200, %
	Tan silty fine sand			
		50/6"		
55				
	-sandstone layer, 58' to 59'			
60		50/6"		14
	-with clay seams and sandstone nodules below 64'	32-50/6"		
65				
70		50/4"		
		24-50/7"		
75				
80				
85				
90				
95				
100				

COMPLETION DEPTH: 74.5'
DATE: April 21, 1973

DEPTH TO WATER IN BORING: 5.3'

DATE: May 3, 1973

McCLELLAND ENGINEERS

Form OB-1 1571 Job No. 73-085

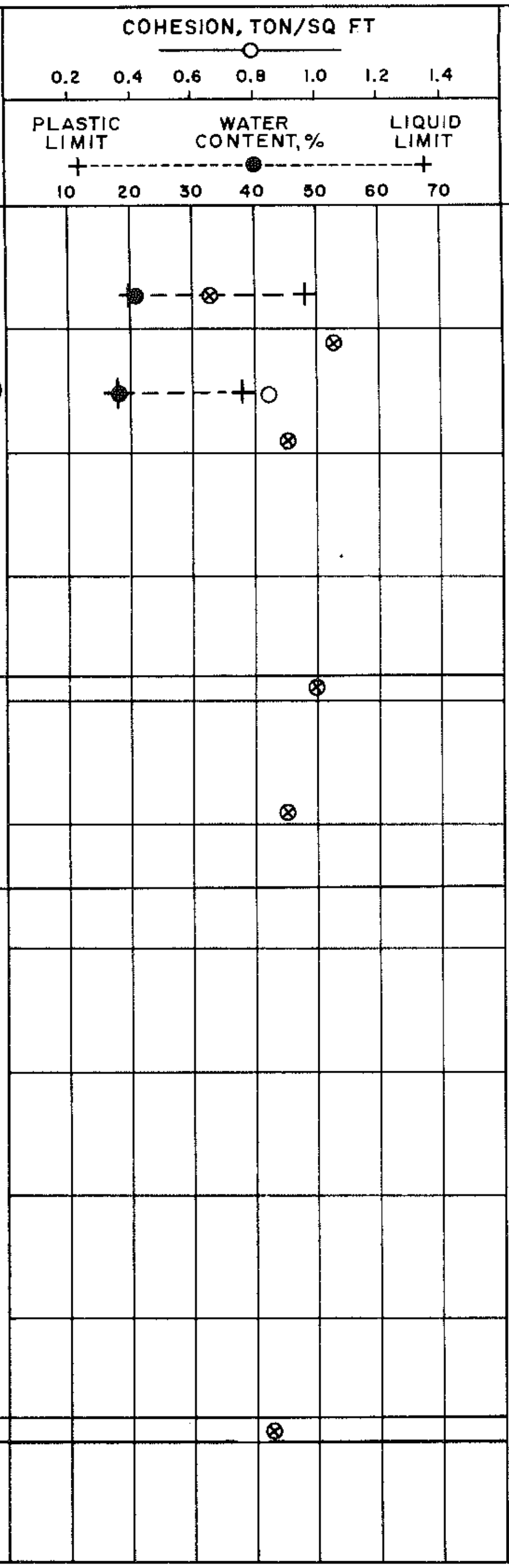
LOG OF BORING NO. P-26

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
	SURF. EL: 346.2'			
	Stiff tan sandy clay with sand pockets and seams			
	-with ferrous deposits, 4' to 10'			
5	-red and tan below 6'			
			110	66
10				
	-red fine sand layer, 13.5' to 14'	15-29-20		
15	-with ferrous nodules below 14'			
20	Very stiff light gray and brown clay with ferrous partings and sand partings, seams and pockets			
25	-gray below 24'	10-13-17		
	Tan fine sand with clay seams and pockets			
30		4-13-25		6
35		28-35-15		
40		6-4-7		27
		16-19-26		
50		10-31-22		4
		10-10-25		
60	Stiff gray clay			

Note Scale Change



COMPLETION DEPTH: 60'
DATE: April 21, 1973

DEPTH TO WATER IN BORING: 19.7'

DATE: May 3, 1973

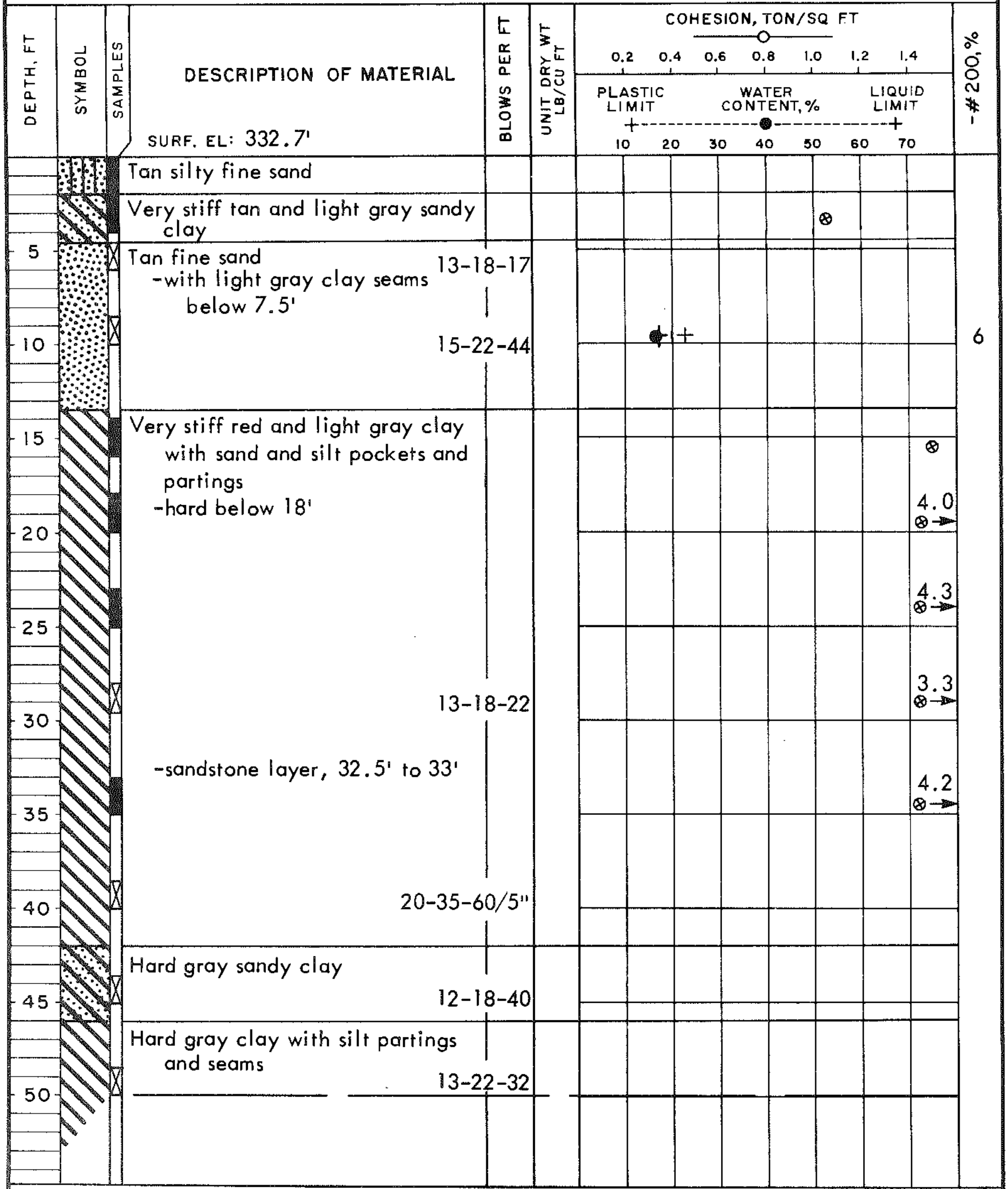
McCLELLAND ENGINEERS

Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-28

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



DESCRIPTION OF MATERIAL	BLOWS PER FT	COHESION, TON/SQ FT	-#200, %
Tan silty fine sand			
Very stiff tan and light gray sandy clay			
Tan fine sand -with light gray clay seams below 7.5'	13-18-17 15-22-44		6
Very stiff red and light gray clay with sand and silt pockets and partings -hard below 18' -sandstone layer, 32.5' to 33'	13-18-22 20-35-60/5"	4.0 4.3 3.3 4.2	
Hard gray sandy clay	12-18-40		
Hard gray clay with silt partings and seams	13-22-32		

COMPLETION DEPTH: 50'
DATE: April 30, 1973

DEPTH TO WATER IN BORING: 5.0'

DATE: May 3, 1973

McCLELLAND ENGINEERS

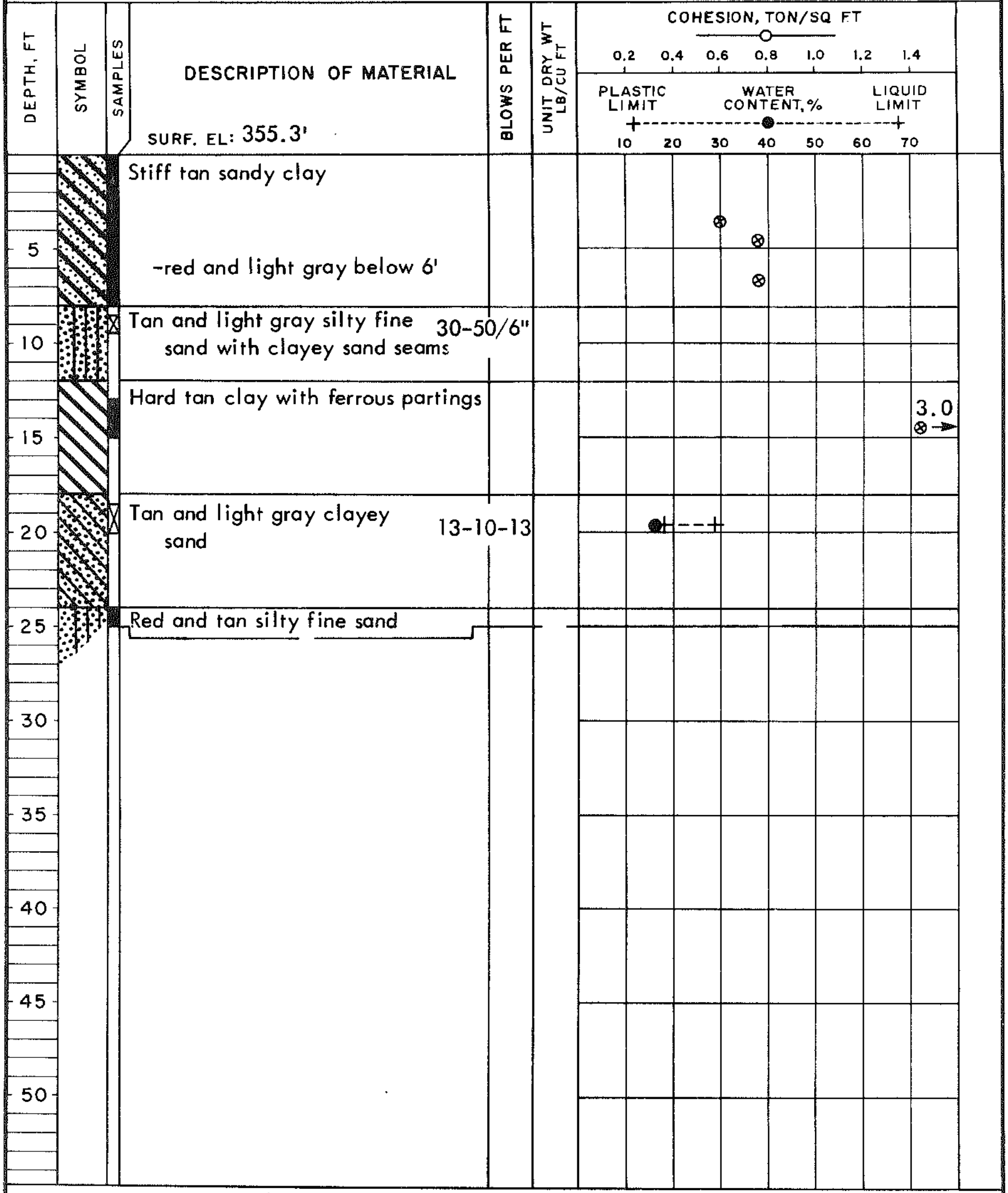
Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-30
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 355.3'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Stiff tan sandy clay -red and light gray below 6'		
Tan and light gray silty fine sand with clayey sand seams	30-50/6"	
Hard tan clay with ferrous partings		
Tan and light gray clayey sand	13-10-13	
Red and tan silty fine sand		



COMPLETION DEPTH: 25'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 19.0'

DATE: May 3, 1973

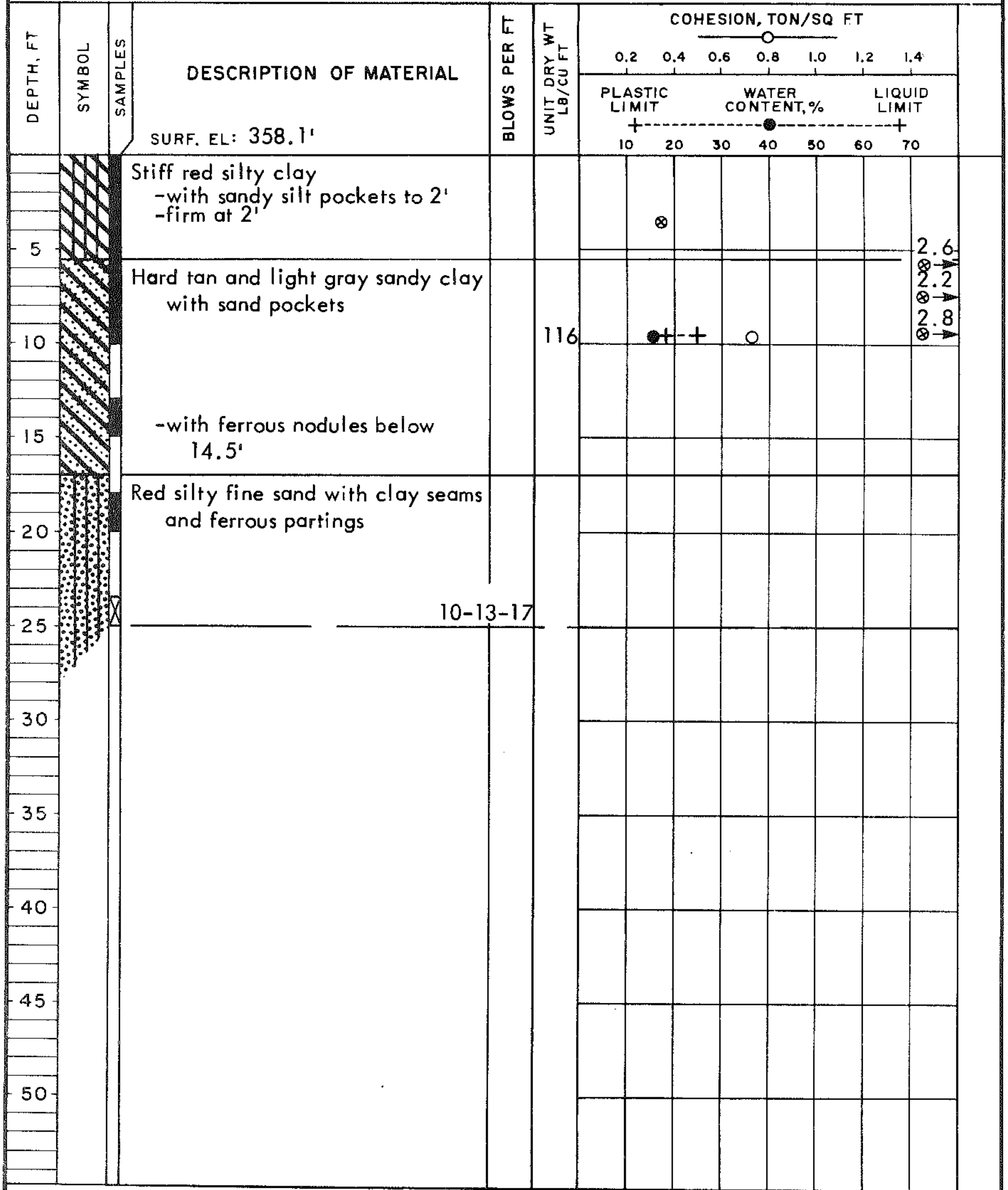
McCLELLAND ENGINEERS

Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-31

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



Stiff red silty clay
-with sandy silt pockets to 2'
-firm at 2'

Hard tan and light gray sandy clay with sand pockets

-with ferrous nodules below 14.5'

Red silty fine sand with clay seams and ferrous partings

COMPLETION DEPTH: 25'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 16.0'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 24

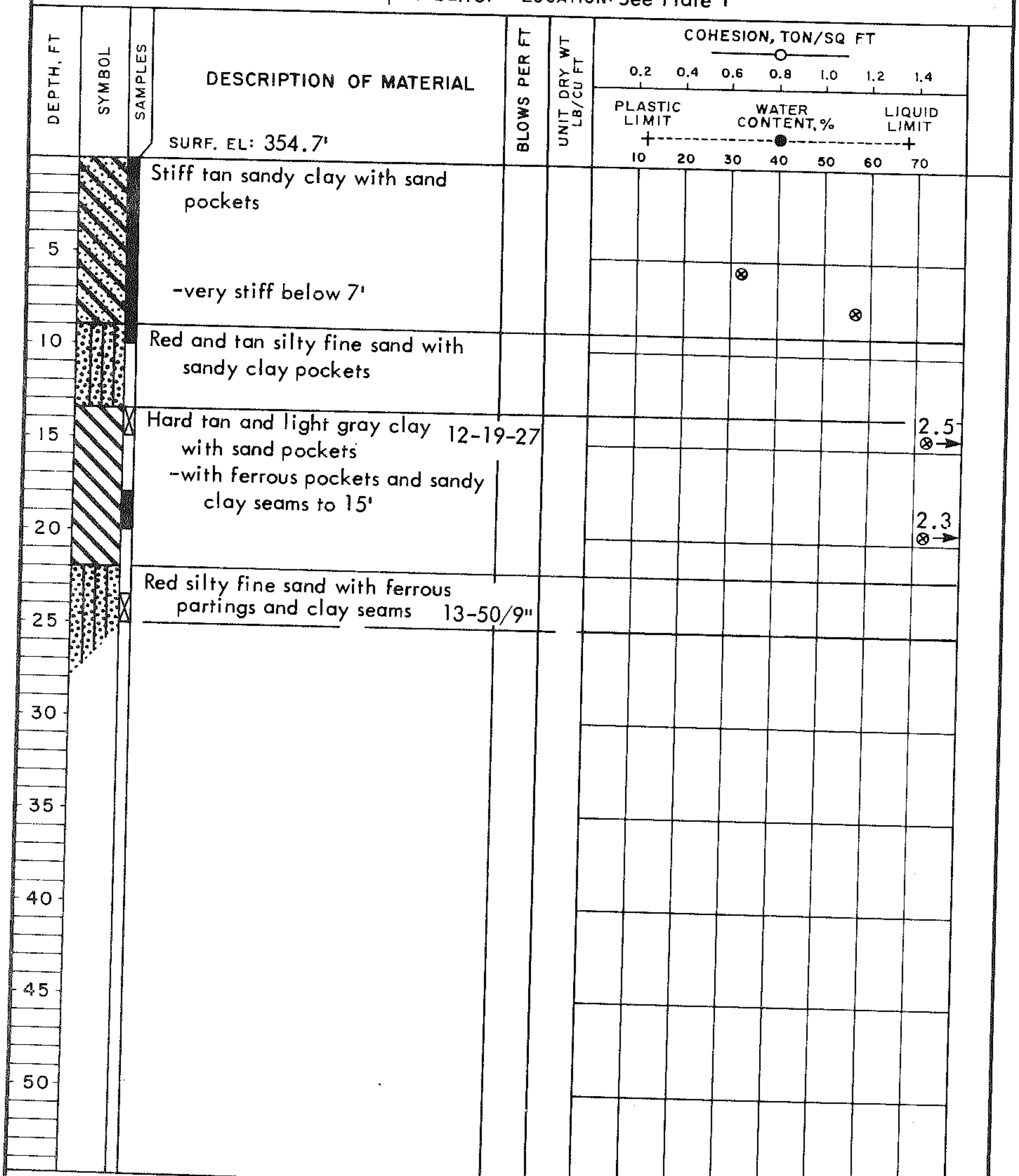
Form ... Job No. 73-085

LOG OF BORING NO. P-32

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel   LOCATION: See Plate 1

SURF. EL: 354.7'



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Stiff tan sandy clay with sand pockets -very stiff below 7'		
Red and tan silty fine sand with sandy clay pockets		
Hard tan and light gray clay with sand pockets -with ferrous pockets and sandy clay seams to 15'	12-19-27	
Red silty fine sand with ferrous partings and clay seams	13-50/9"	

COMPLETION DEPTH: 25'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 14.7'

DATE: May 3, 1973

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PLATE 25

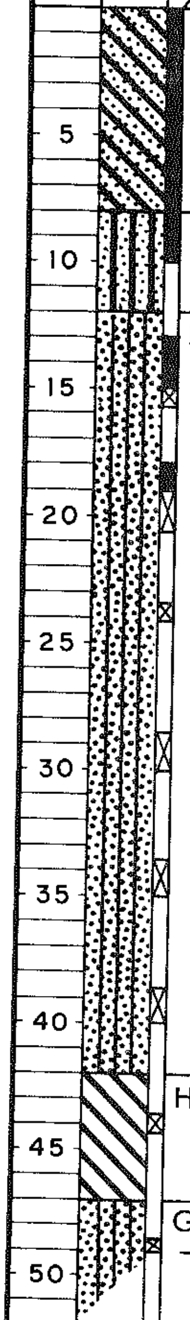
Form -08-1 (57) Job No. 73-085

LOG OF BORING NO. P-33

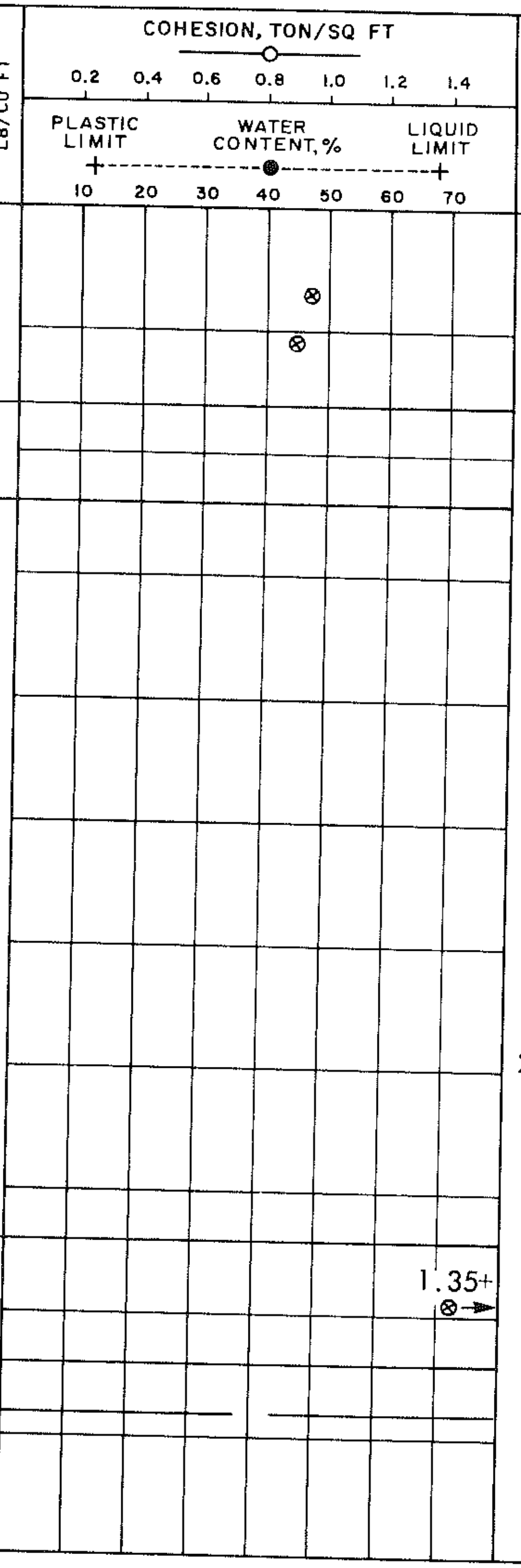
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 355.0'



DESCRIPTION OF MATERIAL	BLOWS PER FT	-#200,%
Stiff red and tan sandy clay with sand pockets and ferrous pockets		
Red and tan sandy silt with sand pockets		64
Red silty fine sand with ferrous nodules and pockets		
-with sandy clay seams and pockets to 30'	7-15-27	11
-tan and light gray, 19' to 38'	16-17-30	14
	28-28-50	
	11-14-22	
-with ferrous layer, 34.5' to 35'	14-77/12"	28
-gray with clay seams below 38'	12-40-48	
Hard gray clay	22-50/2"	
Gray silty fine sand	50/4"	



COMPLETION DEPTH: 49'
DATE: April 13, 1973

DEPTH TO WATER IN BORING: 15.4'

DATE: May 3, 1973

McCLELLAND ENGINEERS

Form 108-1 (57) Job No 73-085

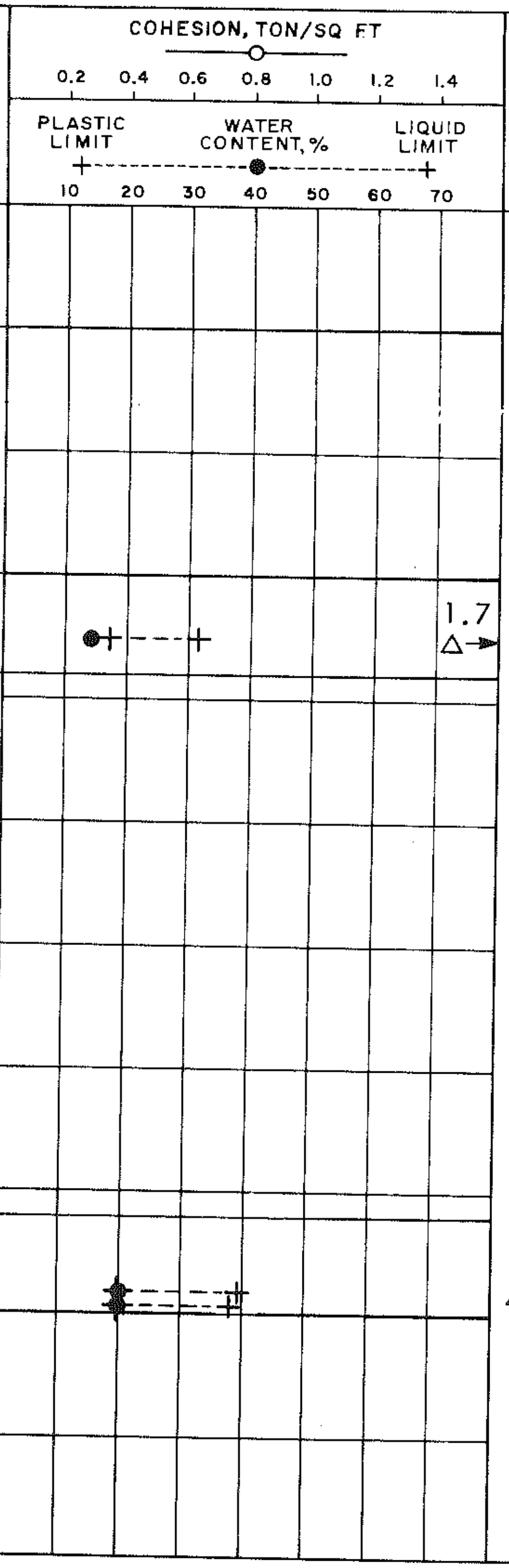
LOG OF BORING NO. P-34

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 352.2'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200, %
0–5	Very stiff red and tan clay			
5–15	Red and tan silty fine sand -with sandstone and red and light gray sandy clay below 8'	4-11-15 13-22-24		
15–19	Very stiff light gray clay with sand pockets and seams		105	
19–41	Light gray silty fine sand -tan, 24' to 36' -with clay seams and pockets below 24' -with sandstone nodules, 26' to 38' -gray below 36'	4-6-13 3-5-7 8-5-4 9-14-21		32
41–45	Hard gray sandy clay with silt seams and partings			49



COMPLETION DEPTH: 45'
DATE: May 1, 1973

DEPTH TO WATER IN BORING: 21.4'
DATE: May 3, 1973

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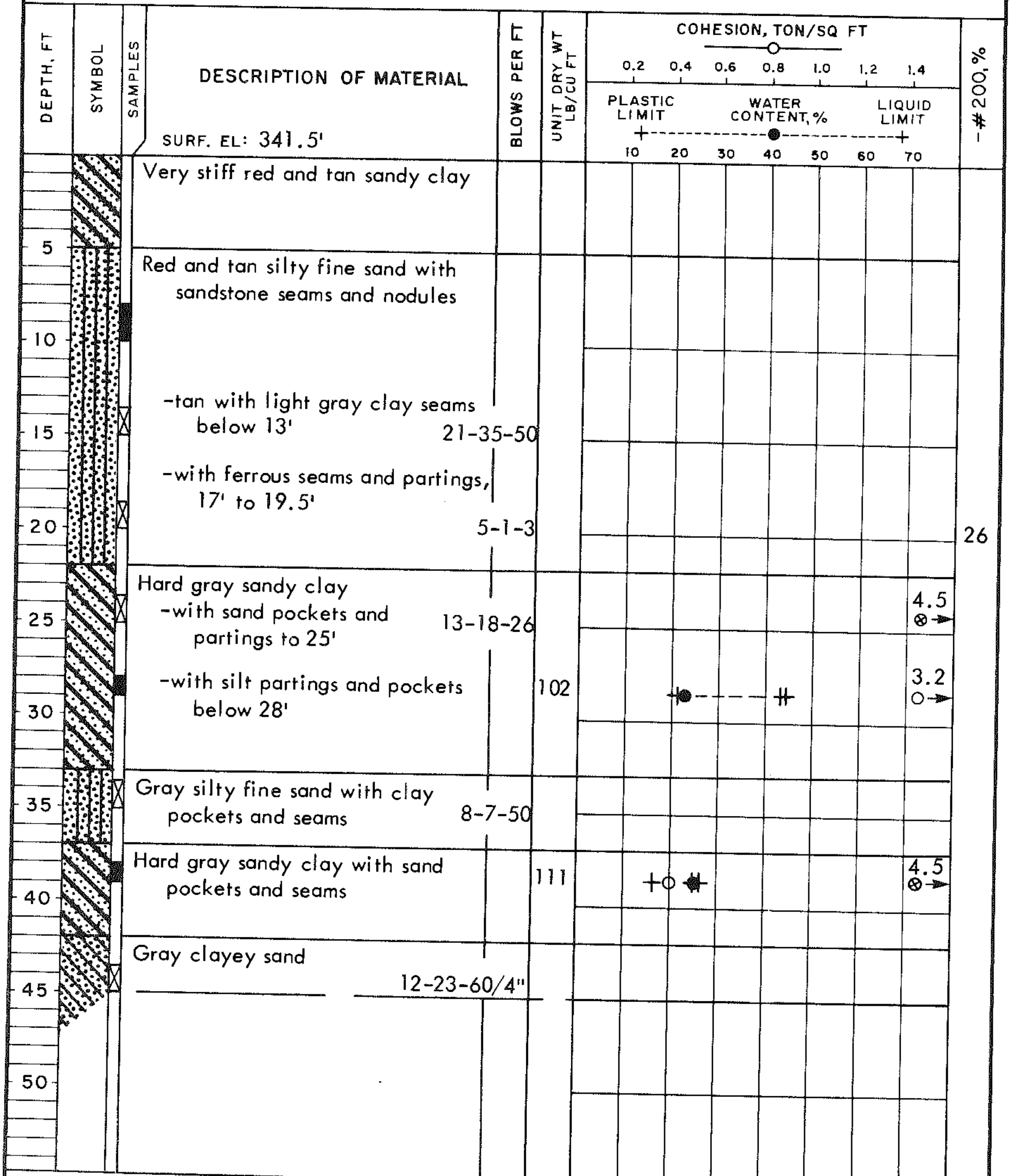
73-085

LOG OF BORING NO. P-35

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



SURF. EL: 341.5'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#200, %
0–5	Very stiff red and tan sandy clay				
5	Red and tan silty fine sand with sandstone seams and nodules				
13	-tan with light gray clay seams below 13'	21-35-50			
17	-with ferrous seams and partings, 17' to 19.5'	5-1-3			26
21.5	Hard gray sandy clay -with sand pockets and partings to 25'	13-18-26		4.5	
28	-with silt partings and pockets below 28'		102	3.2	
33	Gray silty fine sand with clay pockets and seams	8-7-50			
37	Hard gray sandy clay with sand pockets and seams		111	4.5	
42	Gray clayey sand	12-23-60/4"			

COMPLETION DEPTH: 45'
DATE: May 2, 1973

DEPTH TO WATER IN BORING: 10.9'

DATE: May 3, 1973

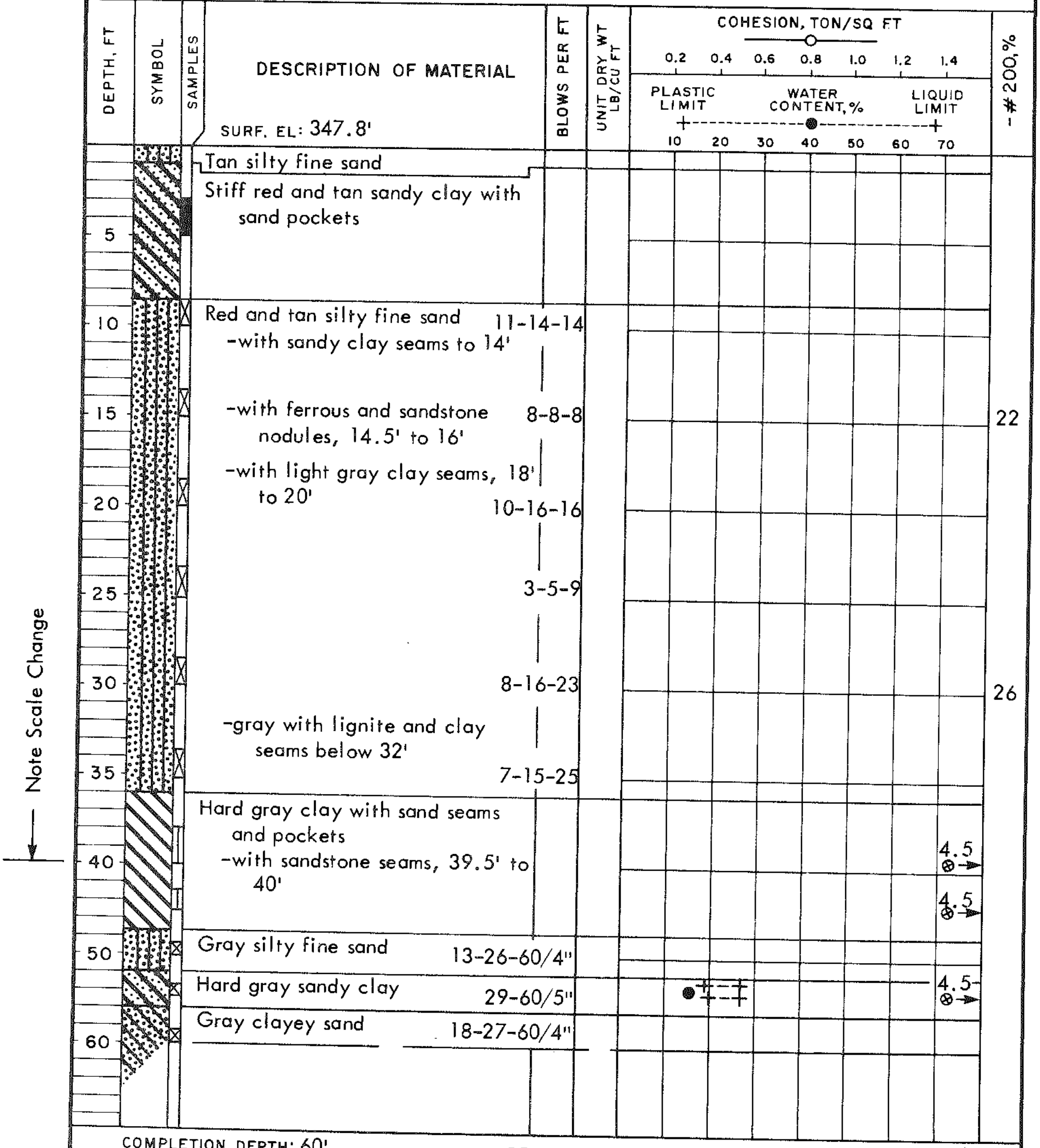
McCLELLAND ENGINEERS

Form 108-1 (57) Job No 23-085

LOG OF BORING NO. P-36
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube, 2" split-barrel & 3" Denison barrel
LOCATION: See Plate 1

SURF. EL: 347.8'



Description of Material	Blows per ft	- #200, %
Tan silty fine sand		
Stiff red and tan sandy clay with sand pockets		
Red and tan silty fine sand	11-14-14	
-with sandy clay seams to 14'		
-with ferrous and sandstone nodules, 14.5' to 16'	8-8-8	22
-with light gray clay seams, 18' to 20'	10-16-16	
	3-5-9	
	8-16-23	26
-gray with lignite and clay seams below 32'	7-15-25	
Hard gray clay with sand seams and pockets		
-with sandstone seams, 39.5' to 40'		
Gray silty fine sand	13-26-60/4"	
Hard gray sandy clay	29-60/5"	
Gray clayey sand	18-27-60/4"	

COMPLETION DEPTH: 60'
DATE: May 2, 1973

DEPTH TO WATER IN BORING: 18.0'
DATE: May 3, 1973

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Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-37
WELSH POWER PLANT
CASON, TEXAS

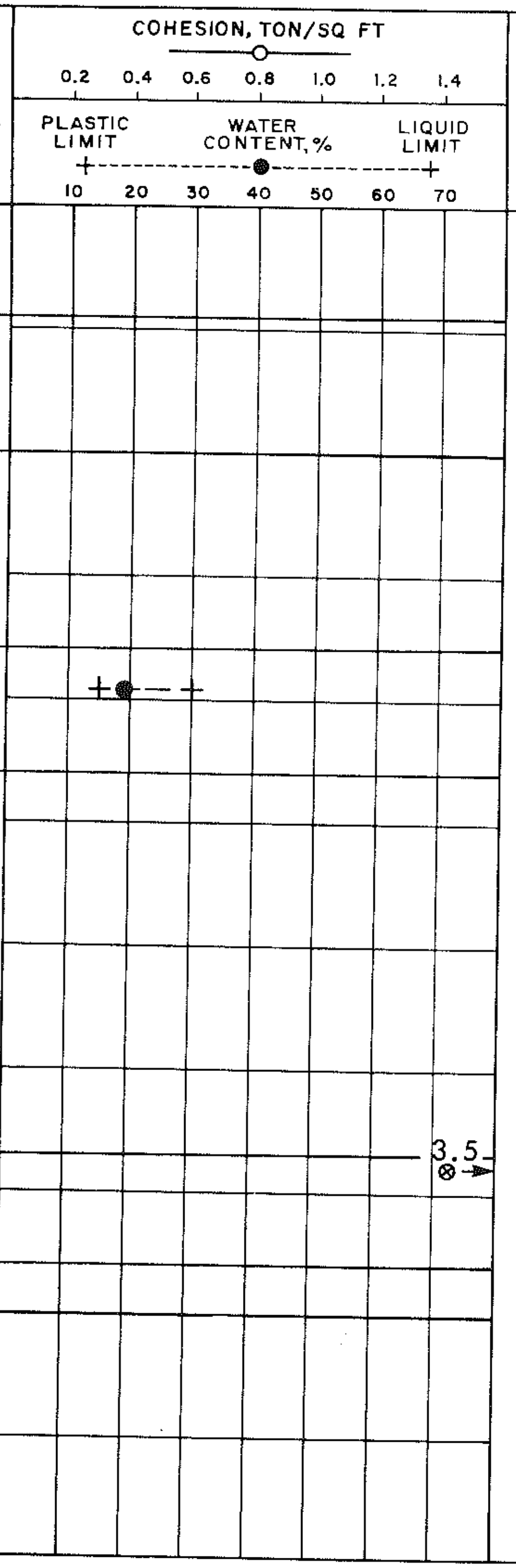
TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 348.1'

DESCRIPTION OF MATERIAL	BLOWS PER FT
Stiff tan silty clay with sand pockets and seams	2-3-5 4-8-9
Stiff tan and light gray sandy clay with sand seams and pockets and sandstone nodules	3-4-6 6-8-13 4-6-11
Tan silty fine sand -with sandy clay seams and pockets to 13'	8-14-15 8-17-16
Stiff tan and light gray sandy clay	4-3-5
Tan silty fine sand -gray below 32'	9-25-42 10-5-3 9-11-19
Hard gray clay with sand seams and pockets	
Gray silty fine sand	8-14-38

DEPTH, FT: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

UNIT DRY WT LB/CU FT



COMPLETION DEPTH: 45'
DATE: May 1, 1973

DEPTH TO WATER IN BORING: 16.5'

DATE: May 3, 1973

McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 23-080

.LOG OF BORING NO. P-38
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin Wall-Tube
2" Split-Spoon

LOCATION: See Plate 1

SURF. EL: 328.7'

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	J1 a1	stiff Red & TAN Sandy Clay w/ferrous deposits @ 1.5		
5	J2	Red & TAN Sandy Silt - w/clay seams 4.5 - 9.5	9/16/14	
	J3	- w/ferrous deposits @ 5	27/30/28	
10	J4	- w/ferrous Layer @ 8' (3")	9/15/27	
		- w/ferrous Layer 12.5 - 13.5		
15	J5	Gray Silty Fine Sand - w/Lignite seam @ 14.5 (3") - w/sandstone Layer 16'-17.5'	6/10/12	
20	J6 UP1	Stiff Gray Clay - laminated with silt below 20'	18/15/22	
25	J7 J8	- Light Gray sandy silt seam @ 26	8/10/15	
30	J9 UP2		10/14/17	
35	J10	Gray silty Fine Sand	29/37/60-2"	
40	J11		24/34/60-2"	
		Hard gray sandy clay - with mica and sand pockets		
45	J12		29/60-6"	
		- lignite layer, 46'-47'		
50	J13		60-6"	

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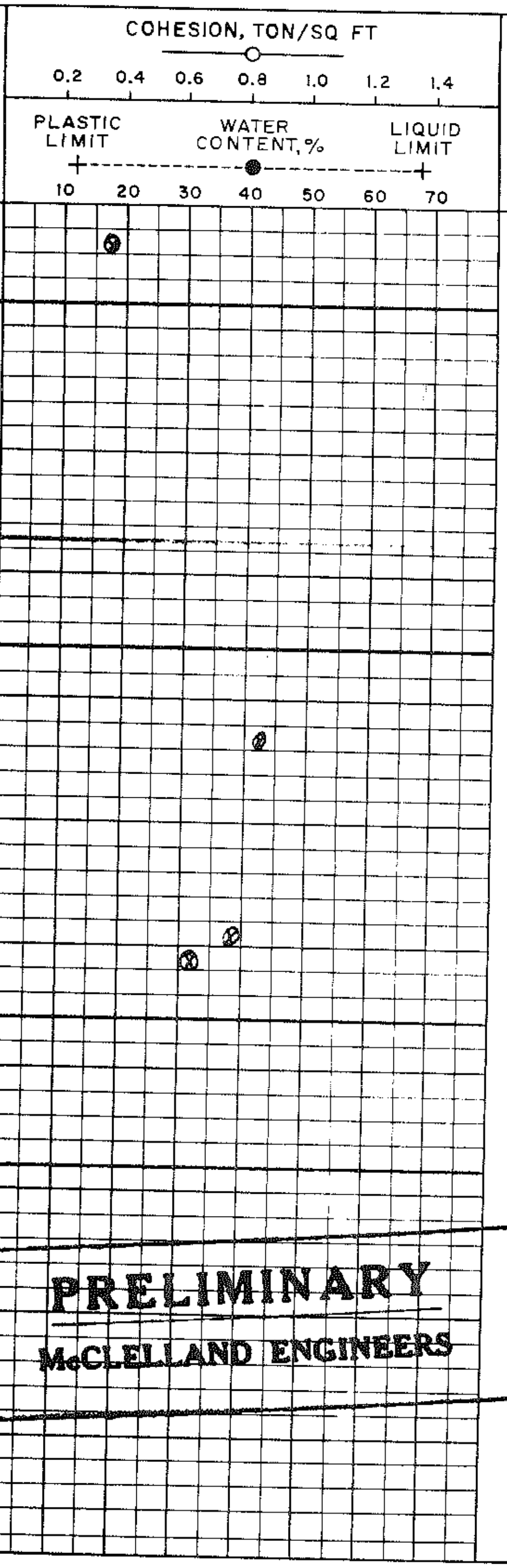

PRELIMINARY
McCLELLAND ENGINEERS

Form 108-5 (97) Job No. 73-086

LOG OF BORING NO. P-38 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 — PLASTIC LIMIT + WATER CONTENT, % ● LIQUID LIMIT + 10 20 30 40 50 60 70	ELEVATION, FT
			Hard Gray Sandy Clay				
55				27/39/63-3"			
60				30/45/60-5"			
			-w/lignite layer 63.5'-64.5'				
65			-w/scattered lignite seams, 64.5-67'				
70				27/40-3"			
75				40-6"			
80			-w/clay and sand seams below 79'	40-6"			
				40-4"			
85			Gray Sandy Silt -w/clay seams below 84'				
90				40-5"			
95				40-3"			
100				50/5"			

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 100'
DATE: July 30, 1973

DEPTH TO WATER IN BORING: 9.6' Caved at: 49.6' DATE: July 31, 1973

McCLELLAND ENGINEERS

PLATE 3/9

Form 105-5 (57) Job No. [illegible]

LOG OF BORING NO. P-39
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin-Wall-Tube
2" Split-Spoon
Denison-barrel

LOCATION: See Plate 1

SURF. EL: 348.6'

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	ELEVATION, FT
	UP1	Stiff Red & Tan Sandy Clay			
5	J1	Red Sandy Silt w/clay pockets, 5' to 8'	22/24/39		
	J2		22/24/55		
10	J3		19/31/31		
		- Tan below 13'			
15	J4	- w/gravel, 17'-17.5'	30/37/30		
20	J5	- w/ Brown clay seams below 20'	7/14/20		
		Stiff Brown & Light Gray clay w/sandy silt seams			
25	J6				
	UP2	Tan & Light Gray Silty Fine Sand	7/8/14		
30	J7	- Tan 28.5'-33.5'	48/60-5"		
		- w/sandstone nodules below 28.5			
	J8	- Tan & Red 33.5-45	30/60-6"		
35		w/Lignite layer, 36' to 36.5'			
40	J9		14/19/30		
45	J10	- Light Gray below 45	18/21/24		
		Hard Gray Clay			
50	J11	w/sand streaks @50	25/29/60		

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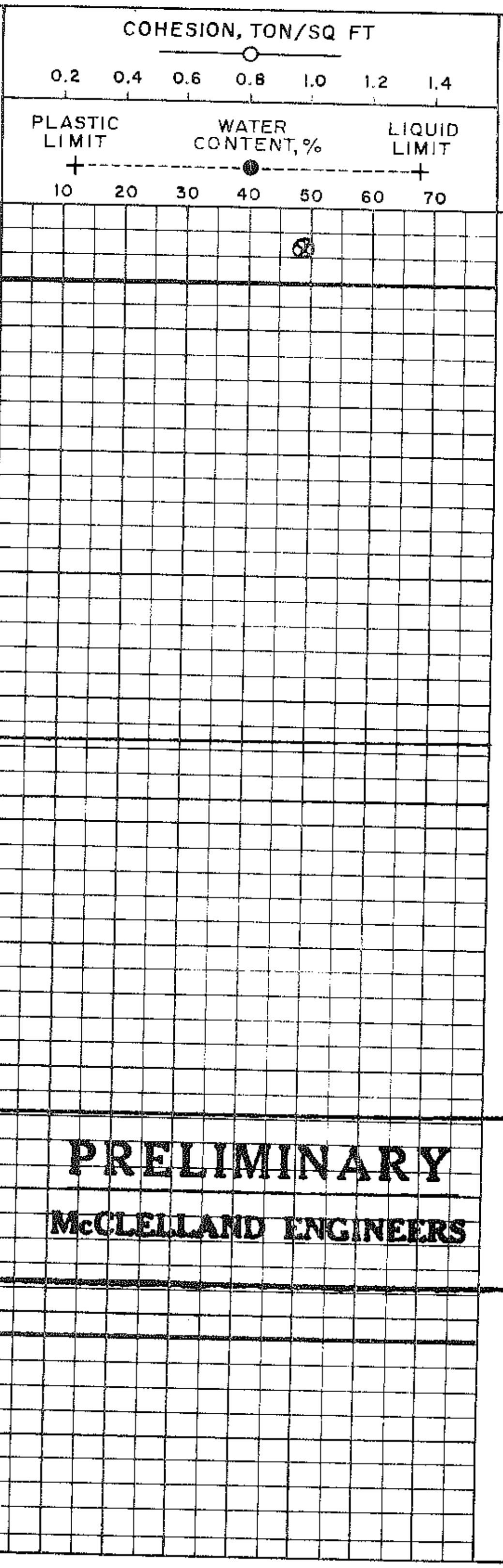


PRELIMINARY
McCLELLAND ENGINEERS

McCLELLAND ENGINEERS

Form 108-5 (67) Job No. 085

LOG OF BORING NO. P-39 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4 / PLASTIC LIMIT + WATER CONTENT, % ● LIQUID LIMIT + 10 20 30 40 50 60 70	ELEVATION, FT
	J12		Hard gray Clay			⊗	
55	J13		- laminated w/silt, 55' to 70'	30/34/60			
	J14B		-w/siltstone Nodules, 54.5-56				
60	J14A					1.35+	
	J14					⊗→	
	J15						
65				27/40-3			
	J16			24/40-6"			
70							
75				45-5"			
80							
85							
90							
95							
100							

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 75'
DATE: July 27, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND
ENGINEERS

Form 108-5 (57) Job No. 73-085

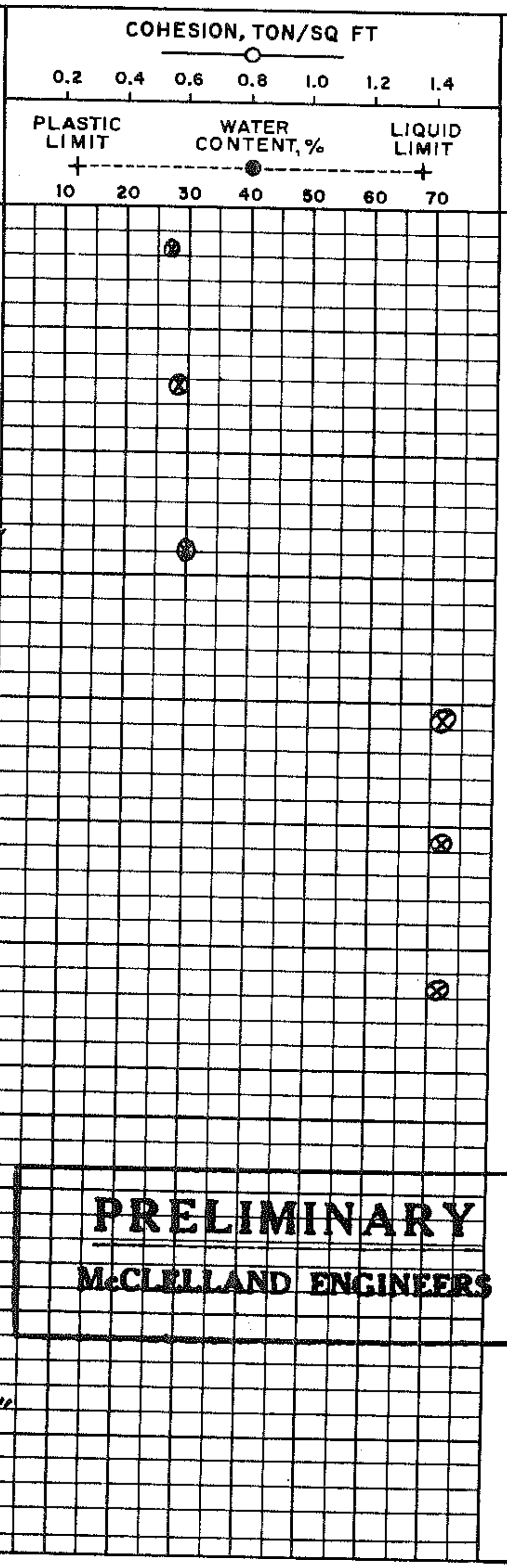
LOG OF BORING NO. P-40
Welsh Power Plant
Cason, Texas

TYPE: 3" Thin-Wall-Tube
2" Split-barrel

LOCATION: See Plate 1

SURF. EL: 341.9'

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	ELEVATION, FT
	UP1	Stiff Light Gray & Red Sandy Clay -w/ferrous deposits 2'-3.5'			
5	J1	-w/ferrous seams 5'-14' - light gray & tan 6.5'-20'	4/6/8		
	UP2				
10	J2	-w/sand seams and pockets below 10'	9/9/11		
15	J3	-w/sand layer, 16'-16.5'	23/28/60-4"		
20	J4 UP3	- Dark Gray below 20' - w/organic matter 20.5'-22' - Very Stiff below 21'	5/9/14		
25	J5 UP4		11/16/19		
30	J6 UP5		22/26/30		
35			42/60		
40	J7	Gray Silty Fine Sand w/organic matter 39'-40'	27/60-5"		
45	J8		27/26/60-5"		
50	J9		28/26/60-5"		



PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 50'
DATE: Aug. 2, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 73-085

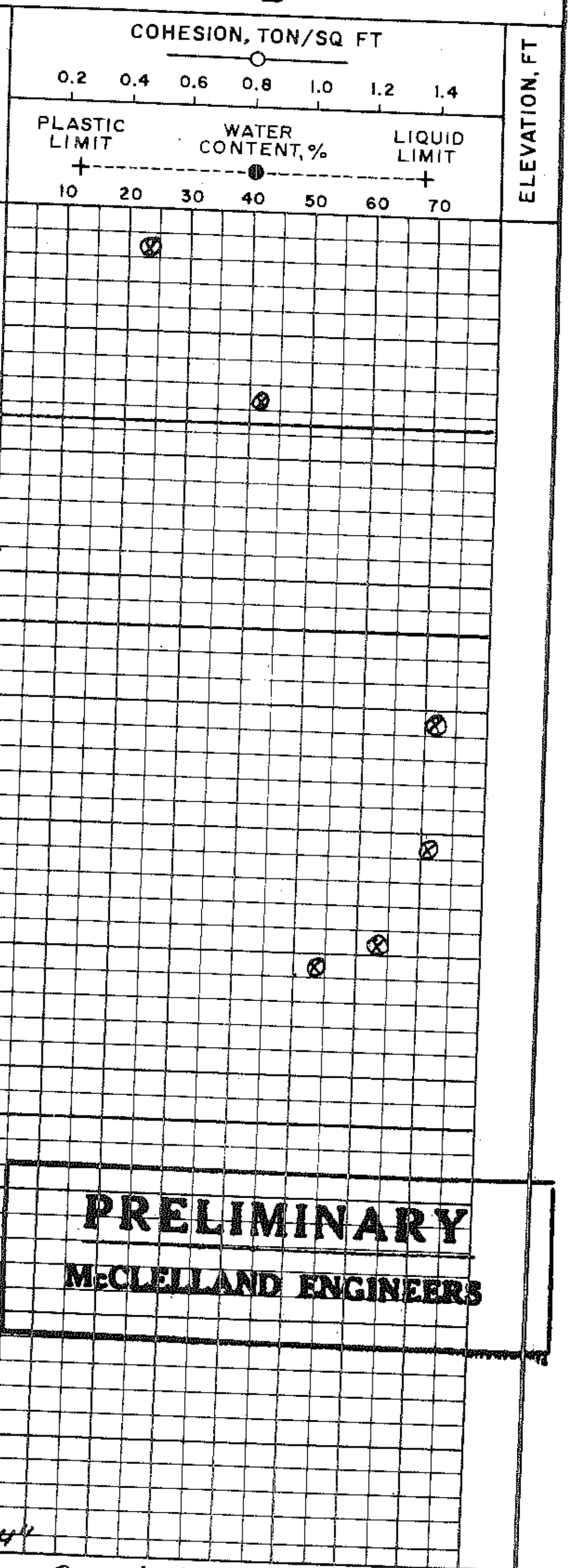
LOG OF BORING NO. P-41
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin-Wall-Tube
2" Split-Spoon

LOCATION: See Plate 1

SURF. EL: 347.7'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	UP1		Stiff Red & TAN Sandy Clay		
5	J1		- w/fervous deposits, 5'-7'	4/7/10	
	UP2				
10	J2		TAN & Light Gray Silty Fine Sand	16/20/24	
15	J3		- Light Gray & TAN below 15'	13/23/25	
	J4		Very stiff brown & light gray clay		
20	UP4		- w/silt streaks, 17'-20' - w/fervous deposits, 20'-21.5'	7/10/13	
25	J5 UP5		- Dark Gray below 25'	10/12/12	
30	J6 UP6			6/12/26	
35	J7			22/60-4"	
40	J8		Gray Silty Fine Sand w/organic matter 39' 43'	37/60-3	
45	J9			37/60-6"	
50	J10			37/60-3"	
55'	J11			36/32/60-4"	



PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 55'
DATE: AUG. 1, 1973

DEPTH TO WATER IN BORING: 7.3'
Caved at: 43.6'
DATE:

McCLELLAND ENGINEERS

PLATE 34

Form 108-5 (57) Job No.

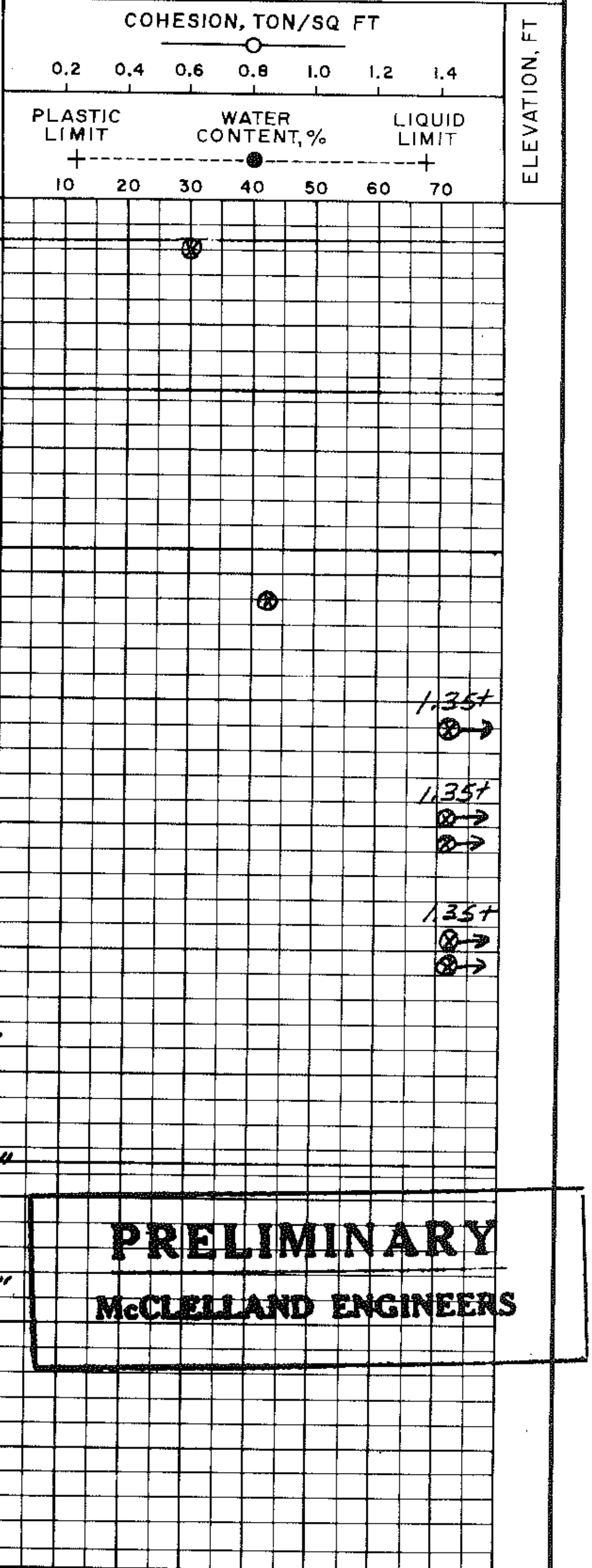
LOG OF BORING NO. P-42
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin-Wall-Tube
2" Split-Spoon

LOCATION: See Plate 1

SURF. EL: 349.3'

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	J1	TAN SANDY Silt		
		Stiff Light Gray, Red & TAN SANDY CLAY		
5	J2	- w/SAND pockets	4/5/7	
	UP1			
10	J3	TAN Silty Fine Sand	15/30/60-4	
	J4		5/8/9	
15	UP2	Very stiff Brown & Light Clay - laminated with silty fine sand to 34'		
	J5	- with ferrous deposit, 20'-21'	8/13/23	
20	UP3	- Brown, 20'-34'		
	J6	- w/SAND pockets below 25'	10/15/21	
25	UP4			
	J7		12/14/17	
30	UP5			
35	J8	- dark gray, w/ mica below 34'	23/40/60-5"	
40	J9	DArk Gray Clayey SAND to Very SANDy ClAY	25/35/60-4"	
45	J10	- w/ organic matter and mica	45/48/60-3"	
50	J11		35/60-5"	
	J12		15/40-5"	



PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 55'
DATE: July 30, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. P-43

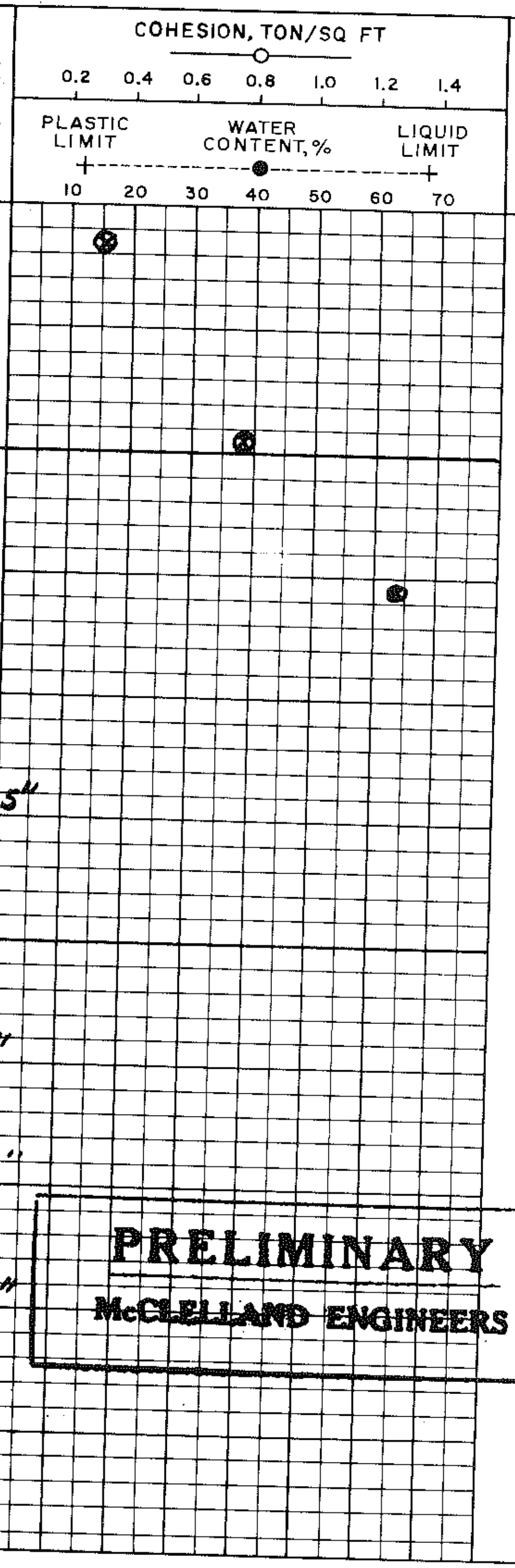
TYPE: 3" Thin Wall-Tube
2" Split-Spoon

LOCATION: See Plate 1

SURF. EL: 351.8'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT
	Firm Red & Light Sand Clay	
	-stiff below 3'	
5		3/3/9
	-with ferrous deposits below 7.5'	
10		4/5/7
	Very stiff tan & light gray Clay	
15	- Brown & Light Gray, 13'- 20'	9/11/15
	-w/silt seams, 15'-19'	
	-w/ferrous deposit, 15'-20'	
20		11/16/23
	- dark gray below 20'	
25	-w/sand pockets below 20'	15/24/60-5"
30		13/13/24
	Light Gray Sandy Silt, w/silty clay seams, 30'-36'	
35	-Dark Gray below 34'	18/35/60-4"
40		24/42/60-4"
45		36/41/60-4"
50		43/60-4"

(Continued on next page)



UNIT DRY WT LB/CU FT

ELEVATION, FT

PRELIMINARY
McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. P-43 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	ELEVATION, FT
			Dark gray sandy silt			
55		☒		38/40-4"		
60		☒		40-6"		
65		◺		27/40		
70		☒	-w/sand stone layer, 70'-71'	32/40-5"		
			-w/sand stone seams 71'-73.5'			
75		☒		31/40		
80						
85						
90						
95						
100						

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 75'
DATE: July 31, 1973

DEPTH TO WATER IN BORING:
DATE:

McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. P-47

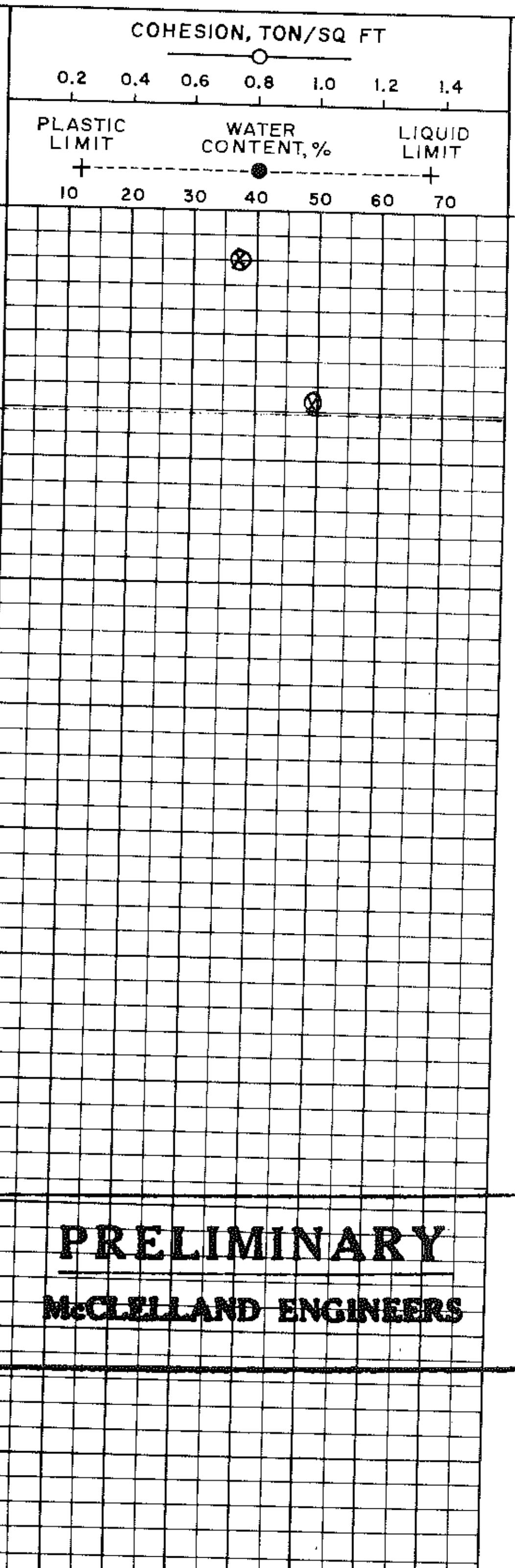
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin Wall Tube
2" Split-Spoon

LOCATION: See Plate 1

SURF. EL: 361.5'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	ELEVATION, FT
			Stiff Tan & Red Sandy Clay			
5			- w/sand streaks 4'-8'	8/11/16		
			- w/light Gray below 7'			
10			TAN, Red & Light Gray Sandy Silt - w/clay pockets 10-17	11/11/19		
15			- w/ferrous deposits, 14'-16'	19/33/20		
20			- w/clay partings below 20' - w/ferrous Nodules below 20	9/10/14		
25				11/23/39		
30						
35						
40						
45						
50						



PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 25'
DATE: July 26, 1973

DEPTH TO WATER IN BORING: 9.2' Caved at: 21.8'
DATE: July 30, 1973

McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 73085

LOG OF BORING NO. P-48

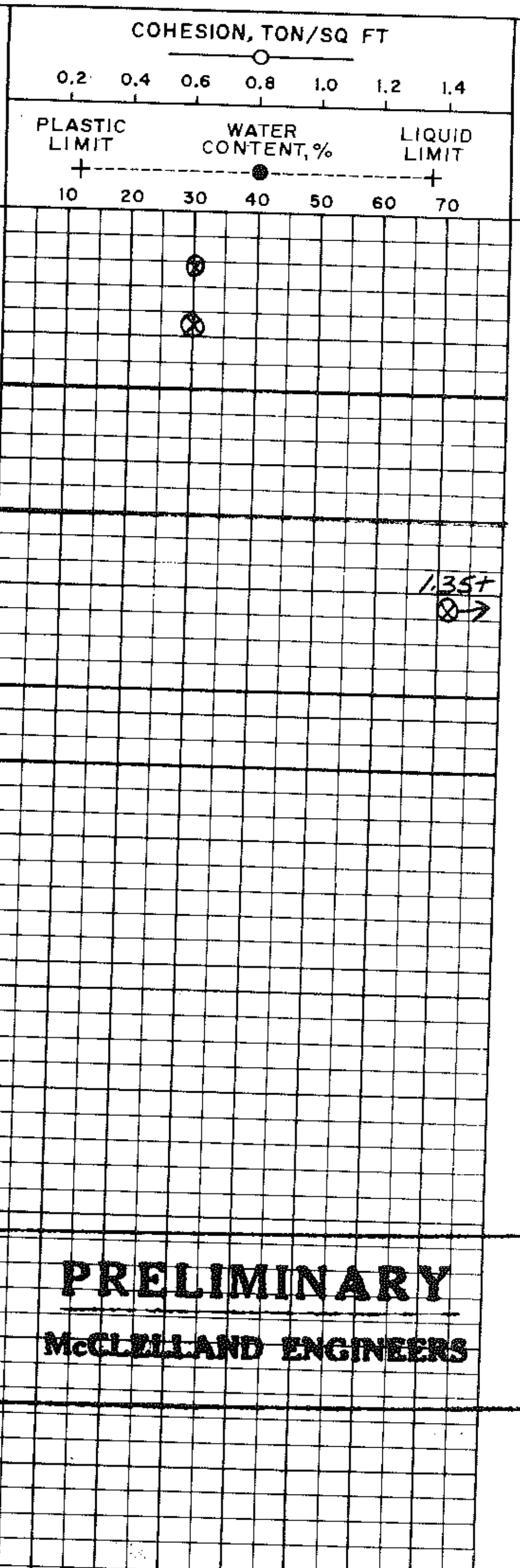
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin-Wall-Tube
2" Split-Spoon

LOCATION: See Plate 1

SURF. EL:

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	ELEVATION, FT
	UP1	■	Stiff red & light gray clay w/ sand pockets			
5	J1	☒		5/7/9		
	UP2	■				
10	J2	☒	Red Silty fine Sand -w/clay pockets	14/15/20		
	J3	☒	Very stiff Light gray clay -w/ferrous nodules, 14'-18'	5/8/10		
15	UP3	■	-shale layer, 16-16.5			
	J4	☒		2/8/2		
20			Firm Gray Clay w/silty fine sand seam @ 19			
25	J5	☒	Gray Silty Fine Sand -w/shale seam at 24.5' -w/scatterd sand stone seams, 26'-30.5'	10/14/40		
30	J6	☒		13/60=9"		
35	J7	☒	Very stiff Gray clay w/sandy silt partings w/sand stone below 32	18/24/39		
40						
45						
50						



PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 35'
DATE: July 26, 1973

DEPTH TO WATER IN BORING: 6.8' Caved at: 27.5' DATE: July 30, 1973

McCLELLAND ENGINEERS

PLATE 38

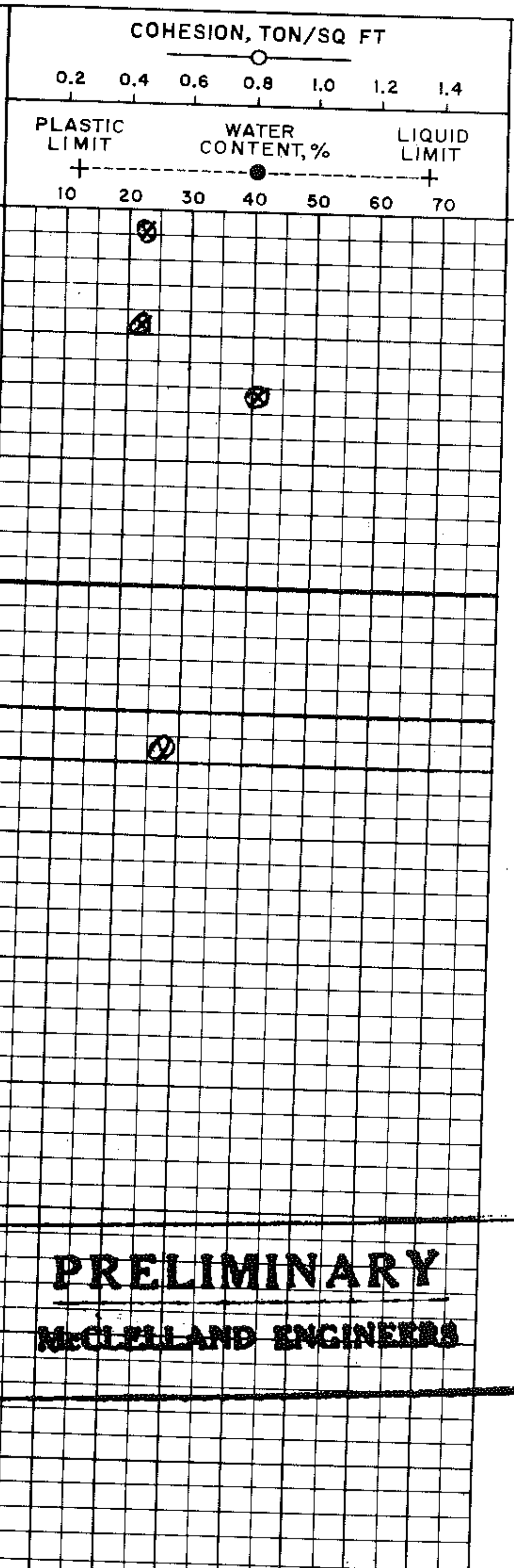
LOG OF BORING NO. P-49
WELSH POWER PLANT
CASON, TEXAS

TYPE: 2" Split-Spoon
3" Thin-Wall-Tube

LOCATION: See Plate 1

SURF. EL:

DEPTH, FT	SYMBOL / SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	UP1	Stiff Red & Light Gray clay		
5	J1	- w/ferrous nodules below 1.5	4/5/9	
	UP2			
10	J2		11/12/13	
15	J3		13/19/20	
	UP3	Tan & Red silty fine Sand w/clay pockets		
20	J4	w/sandstone seam @ 20'	5/7/9	
	UP4	Stiff Brown Clay w/organic matter @ 22'		
		Dark gray silty fine sand		
25	J5		20/60-6"	
30				
35				
40				
45				
50				



ELEVATION, FT

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 25'
DATE: July 25, 1973

DEPTH TO WATER IN BORING: 19.6' Caved at: 24.3' DATE: July 30, 1973

McCLELLAND ENGINEERS

Job No 73-785

Form No

LOG OF BORING NO. AB-1

WELSH POWER PLANT
CASON, TEXAS

TYPE: 4" Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL:	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT + WATER CONTENT, % ● LIQUID LIMIT + 10 20 30 40 50 60 70	ELEVATION, FT
			TAN & Red Sandy Clay			
5			- Light Gray & Red w/sand streaks below 5			
10			TAN & Red & Light Gray Clay w/silt & sand streak below 10' - Brown & TAN below 13'			
15			TAN Silty fine sand			
20						
25						
30						
35						
40						
45						
50						

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 15'
DATE: July 31, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

PLATE 40

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. AB-2

WELSH POWER PLANT
CASON, TEXAS

TYPE: 4" Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL:	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT: 10 20 30 40 50 60 70	ELEVATION, FT
			Tan Silty Fine Sand			
			Ferrous Deposits			
5			w/clay SEAMS & parting below 3'			
10						
15			- w/ Dark Gray Clay Seam @ 14			
20						
25						
30						
35						
40						
45						
50						

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 20'
DATE: AUG. 1, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

PLATE 41

Form 108-5 (57) Job No. 23-085

LOG OF BORING NO. AB-3
WELSH POWER PLANT
CASON, TEXAS

TYPE: 4" Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 331.9'	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) PLASTIC LIMIT + --- WATER CONTENT, % ● --- LIQUID LIMIT + (10 20 30 40 50 60 70)	ELEVATION, FT
			Tan & Red Silty Fine Sandy			
			Light Gray Clay w/Red streaks - below 2.5'			
5						
			-w/ferrous deposits 8'-11'			
10			- Brown Light & Tan below 11'			
			Tan Silty Fine Sand			
15						
20						
25						
30						
35						
40						
45						
50						

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 12.5'
DATE: 8-1-73

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. AB-4

WELSH POWER PLANT
CASON, TEXAS

TYPE: 4" Auger

LOCATION: See Plate 1

SURF. EL: 337.5'

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIT DRY WT LB/CU FT	ELEVATION, FT
			TAN Silty FINE SAND		
5			Red & Light Gray Sandy Clay		
10			TAN & Red & Light Gray Clay w/Ferrous deposits w/si SEAMS 10-16		
15			- Brown & Light Gray 11'-14' - Gray below 14'		
20			TAN Silty FINE SAND		
25					
30					
35					
40					
45					
50					

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 20'
DATE: Aug 1, 1973

DEPTH TO WATER IN BORING:

DATE:

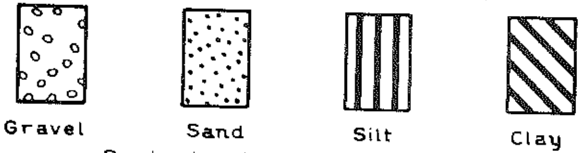
McCLELLAND ENGINEERS

PLATE 43

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

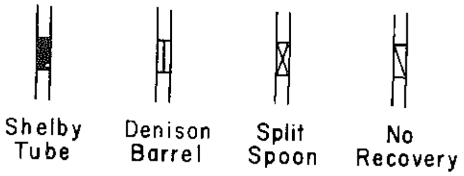
(SHOWN IN SYMBOL COLUMN)



Predominant type shown heavy

SAMPLER TYPES

(SHOWN IN SAMPLES COLUMN)



TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	RELATIVE DENSITY
Loose	0 to 40%
Medium dense	40 to 70%
Dense	70 to 100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ FT
Very soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very stiff	2.00 to 4.00
Hard	4.00 and higher

Note: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

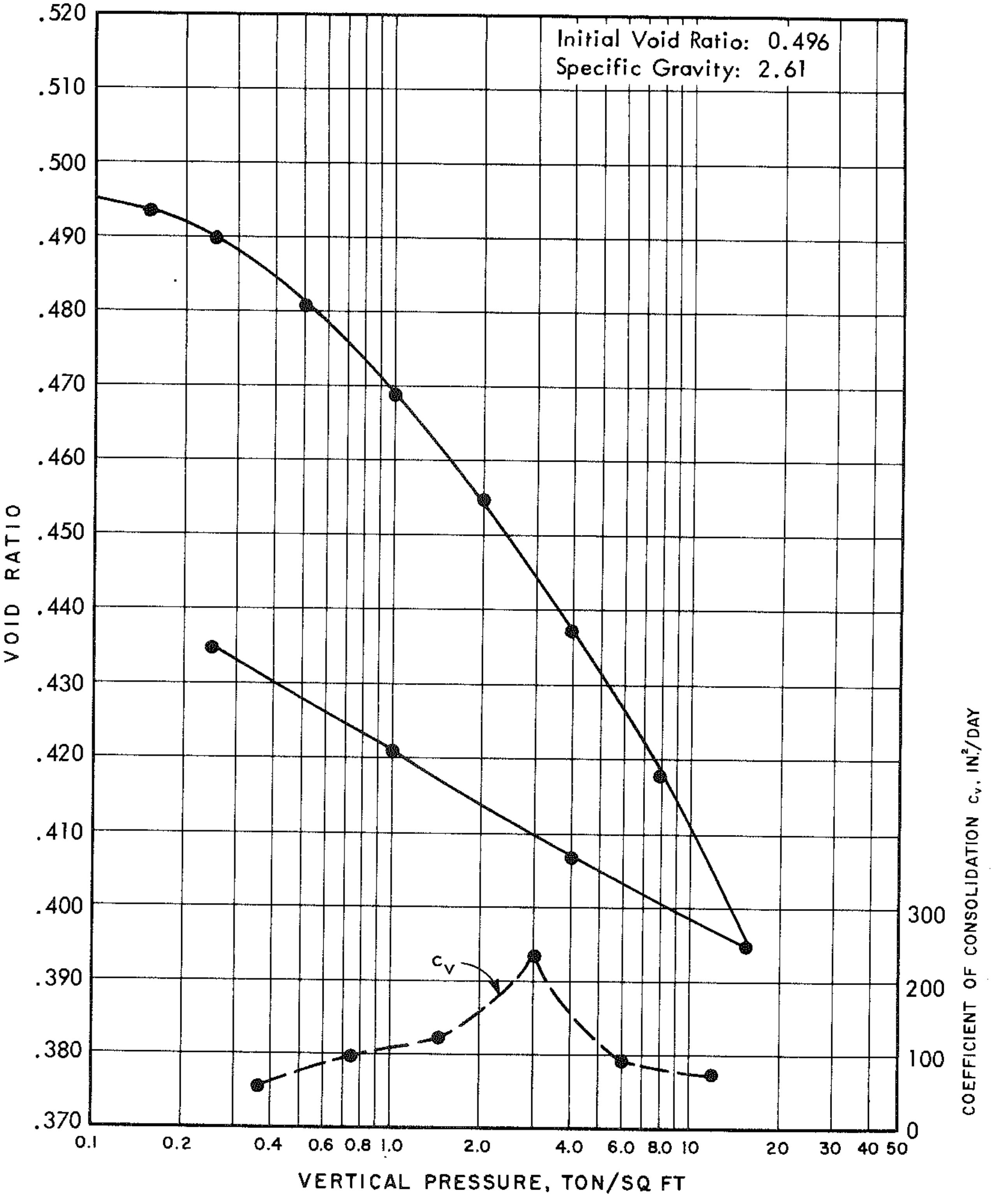
TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided	– having inclined planes of weakness that are slick and glossy in appearance.
Fissured	– containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated	– composed of thin layers of varying color and texture.
Interbedded	– composed of alternate layers of different soil types.
Calcareous	– containing appreciable quantities of calcium carbonate.
Well graded	– having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly graded	– predominantly of one grain size, or having a range of sizes with some intermediate size missing.

Terms used in this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

BORING: P-1 **DEPTH:** 50'
MATERIAL: Hard brown and gray clay with sand pockets

UNIT DRY WEIGHT: 109 LB/CU FT
WATER CONTENT: 14 %
LIQUID LIMIT: 40
PLASTIC LIMIT: 20

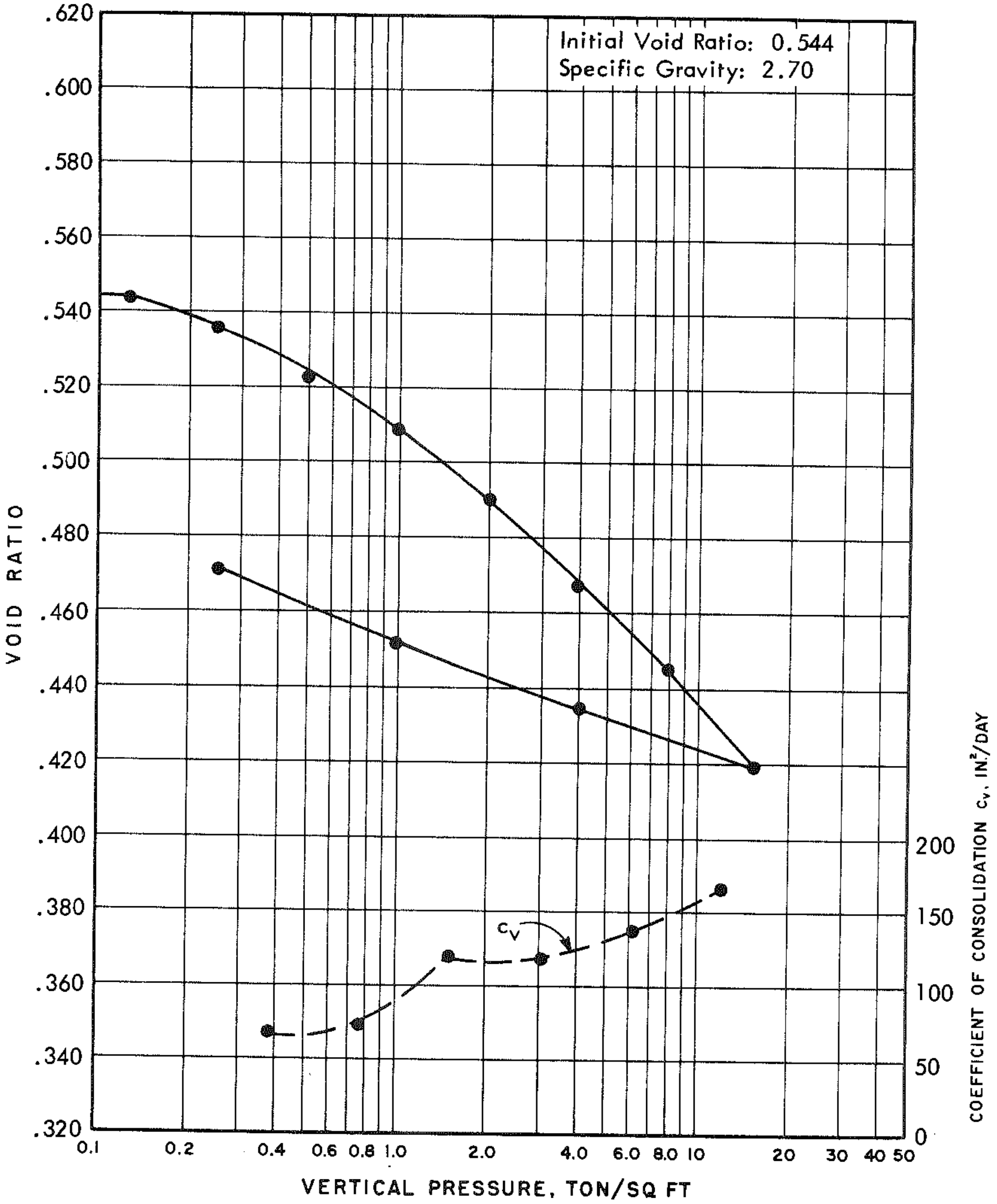


CONSOLIDATION TEST RESULTS

Form 06-3 57 JOB No 23-086

BORING: P-3 **DEPTH:** 70'
MATERIAL: Hard gray sandy clay

UNIT DRY WEIGHT: 109 LB/CU FT
WATER CONTENT: 18 %
LIQUID LIMIT: 27
PLASTIC LIMIT: 16

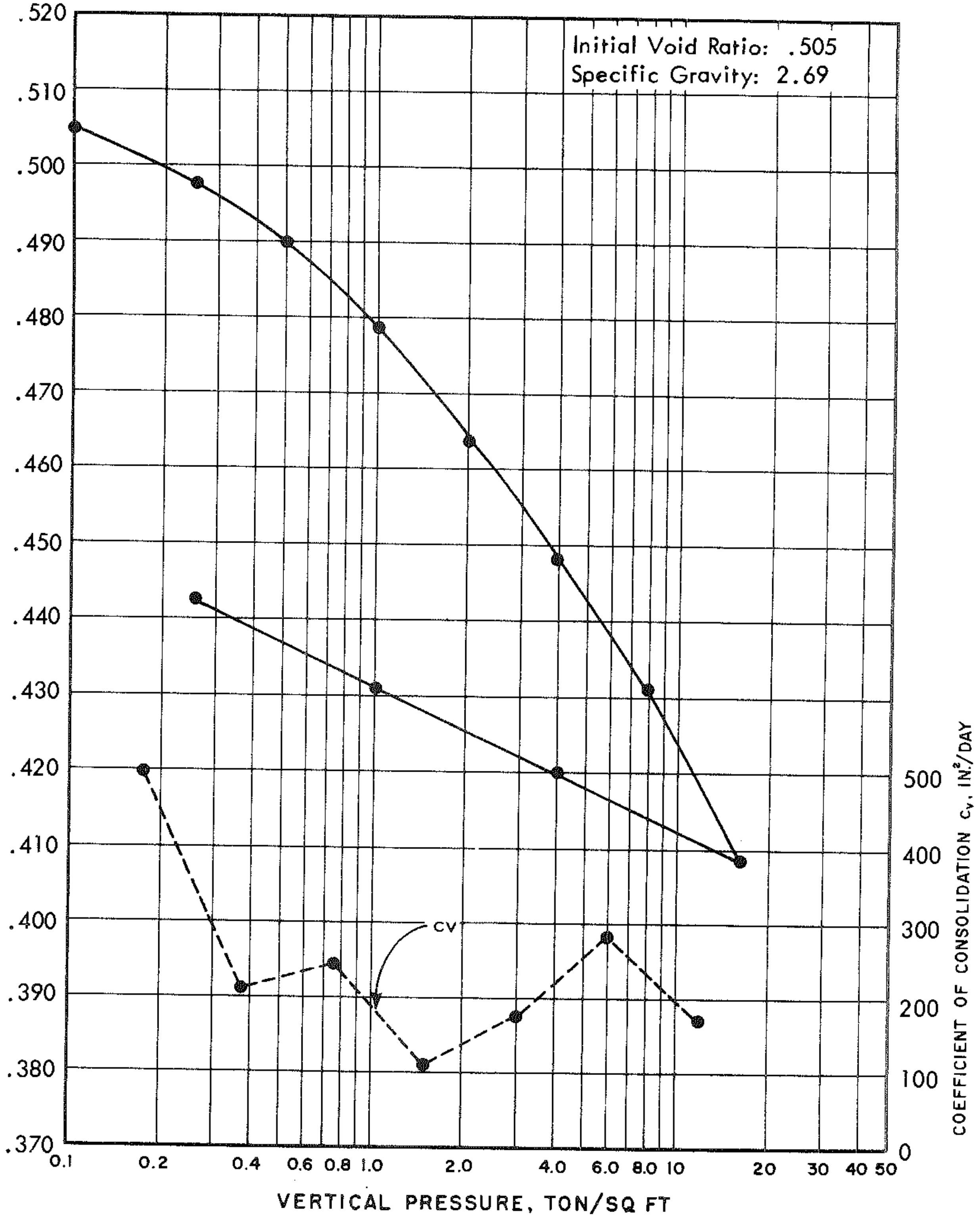


CONSOLIDATION TEST RESULTS

Form 063 57 Job No 73-085

BORING: P-4 **DEPTH:** 6'
MATERIAL: Stiff red and tan very sandy clay

UNIT DRY WEIGHT:	112	LB/CU FT
WATER CONTENT:	17	%
LIQUID LIMIT:	29	
PLASTIC LIMIT:	18	



Initial Void Ratio: .505
Specific Gravity: 2.69

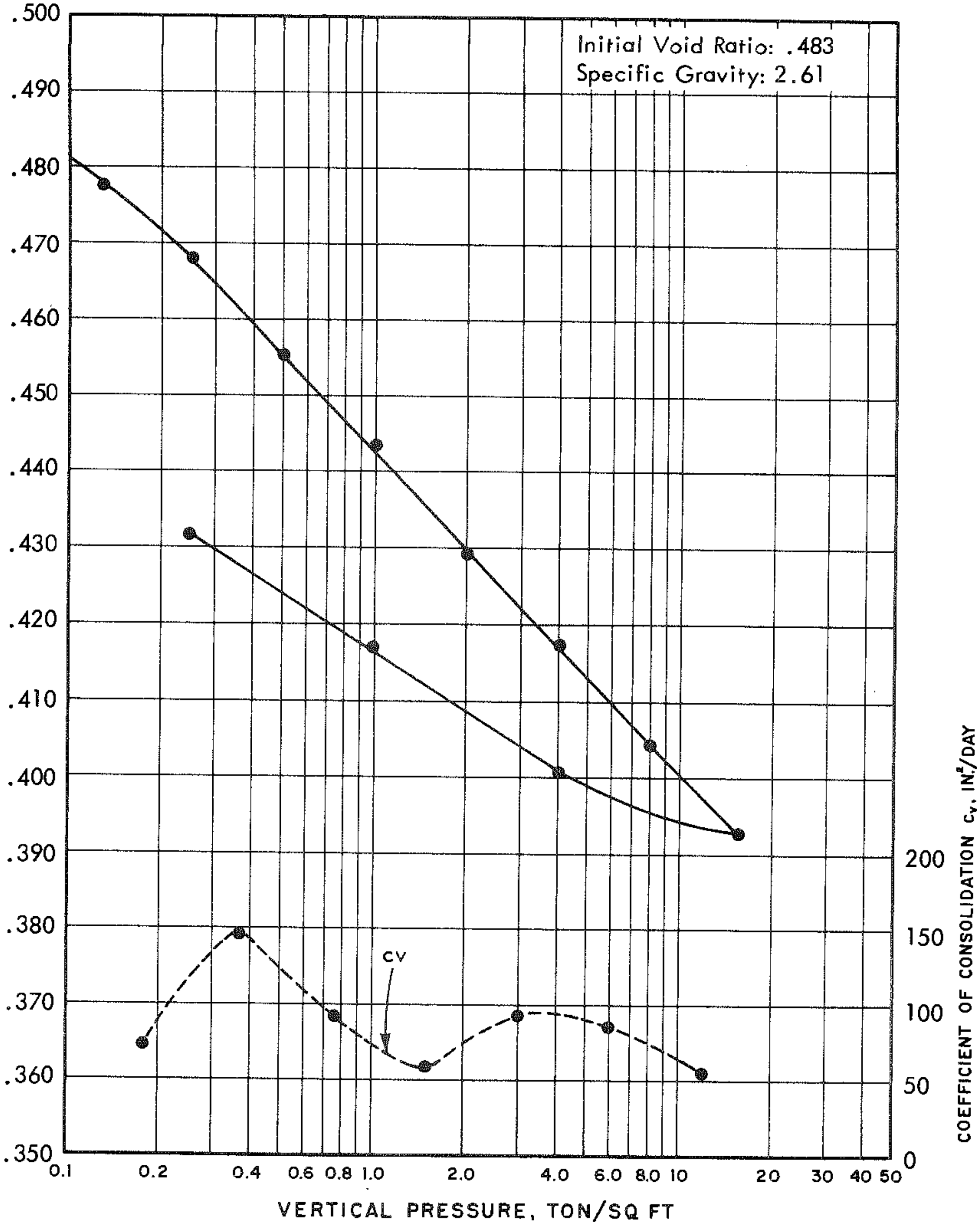
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

Form 06-3 57 Job No 73-085

BORING: P-4 **DEPTH:** 50'
MATERIAL: Gray clayey fine sand

UNIT DRY WEIGHT: 110 LB/CU FT
WATER CONTENT: 17 %
LIQUID LIMIT: 24
PLASTIC LIMIT: 18


Initial Void Ratio: .483
Specific Gravity: 2.61

CONSOLIDATION TEST RESULTS

BORING: P-5 **DEPTH:** 30'

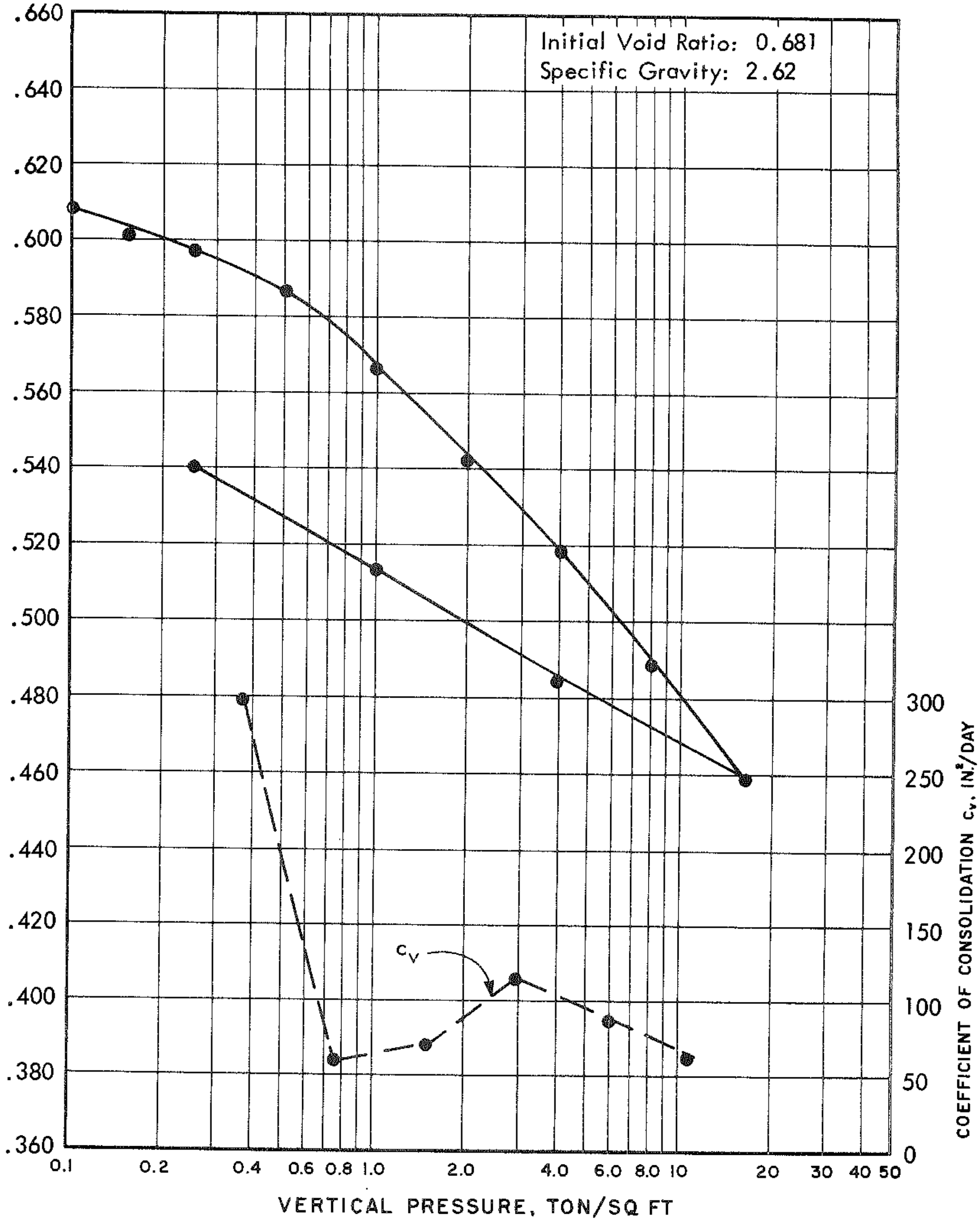
MATERIAL: Hard gray sandy clay with sand pockets and partings

UNIT DRY WEIGHT: 102 LB/CU FT

WATER CONTENT: 21 %

LIQUID LIMIT: 40

PLASTIC LIMIT: 19



Initial Void Ratio: 0.681

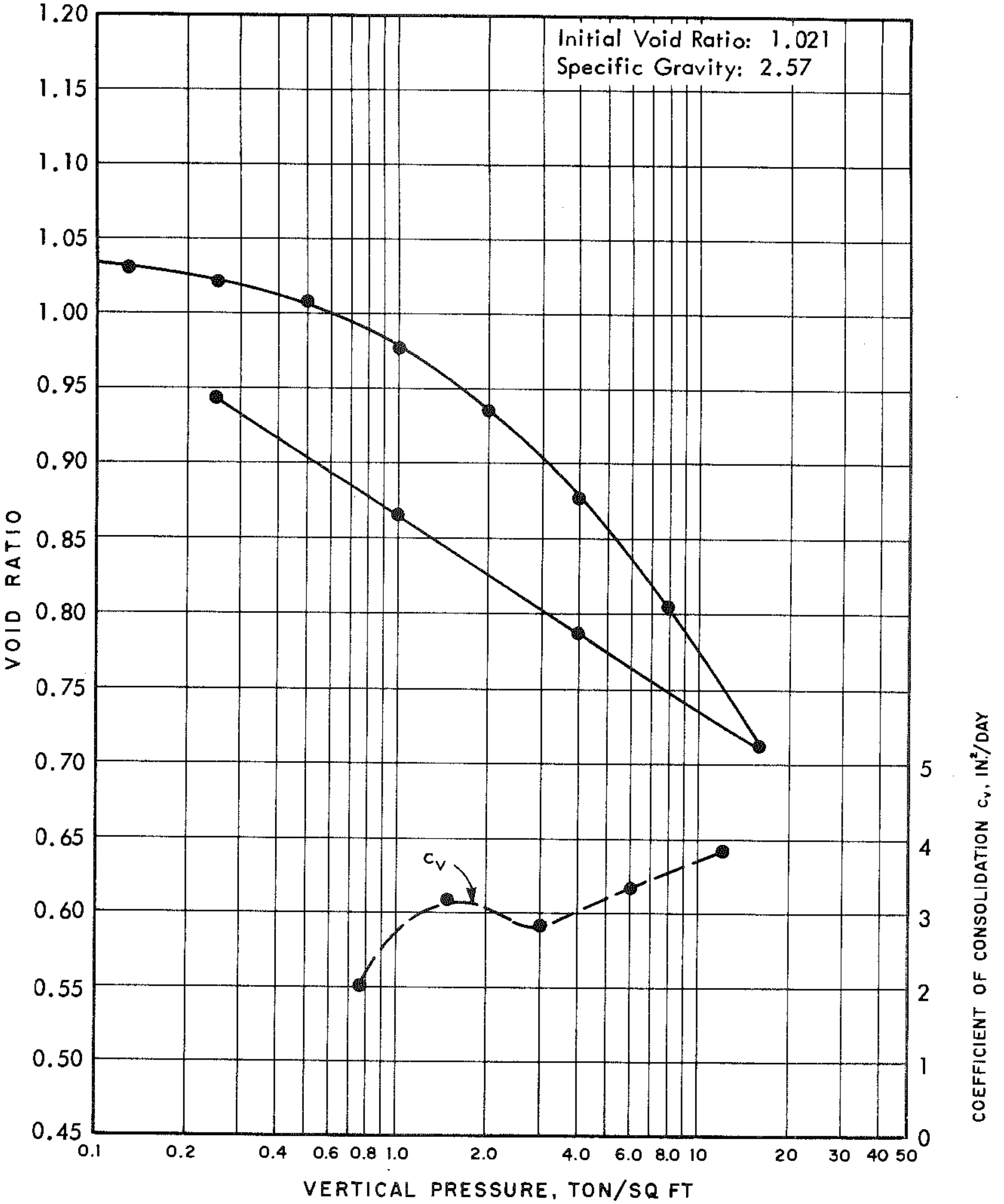
Specific Gravity: 2.62

CONSOLIDATION TEST RESULTS

Form 263 5 57 100 No 73.085

BORING: P-7 **DEPTH:** 24.5'
MATERIAL: Stiff light gray clay with sand pockets and ferrous nodules

UNIT DRY WEIGHT: 91 LB/CU FT
WATER CONTENT: 34 %
LIQUID LIMIT: 52
PLASTIC LIMIT: 18



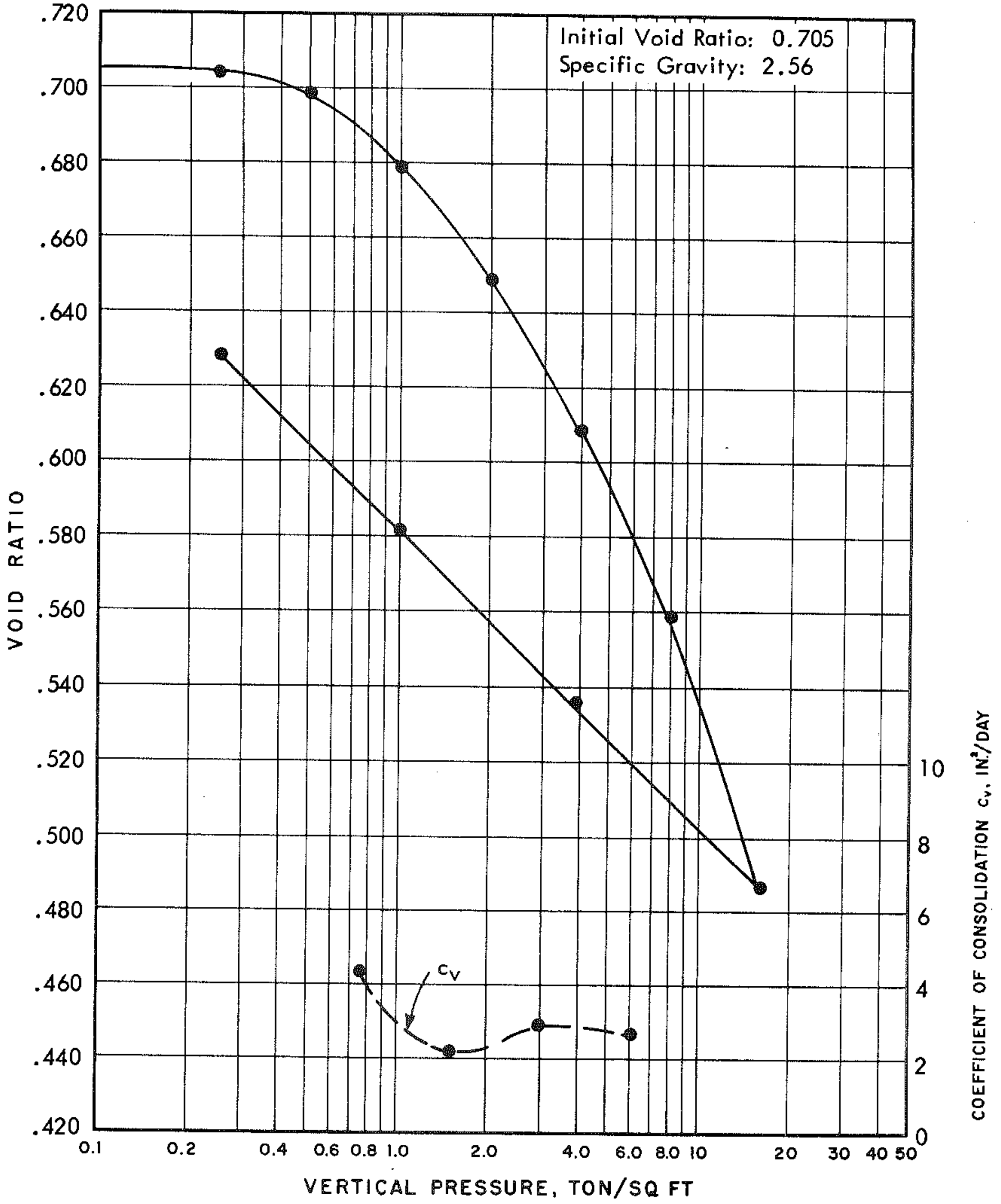
CONSOLIDATION TEST RESULTS

McCLELLAND
ENGINEERS

Form 06-3 57 JOB No 23-085

BORING: P-9 **DEPTH:** 29.5'
MATERIAL: Very stiff light gray clay with silt partings

UNIT DRY WEIGHT:	94 LB/CU FT
WATER CONTENT:	30 %
LIQUID LIMIT:	69
PLASTIC LIMIT:	23

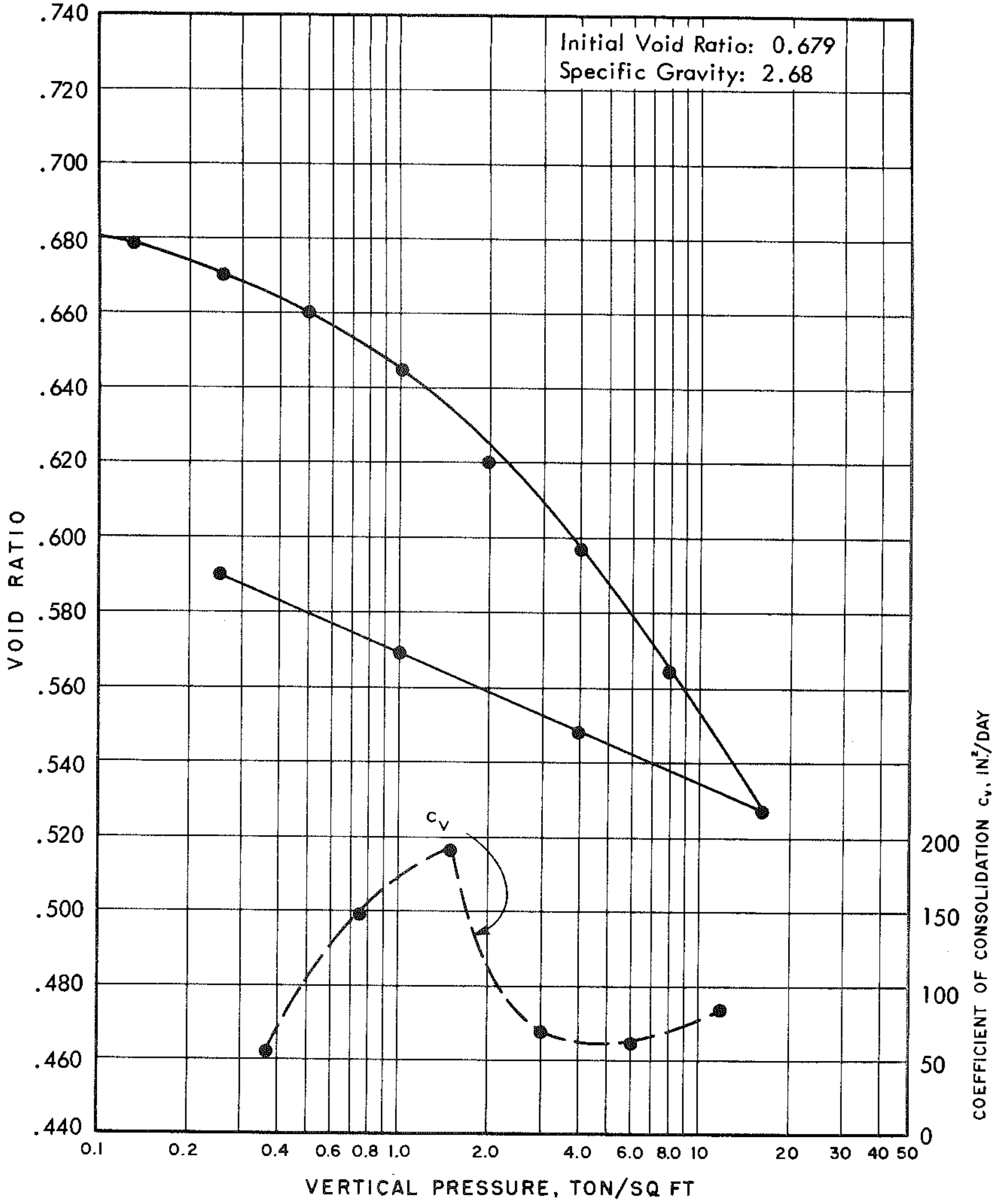


CONSOLIDATION TEST RESULTS

23085

BORING: P-9 DEPTH: 35'
MATERIAL: Very stiff gray sandy clay with sand partings

UNIT DRY WEIGHT: 100 LB/CU FT
WATER CONTENT: 22 %
LIQUID LIMIT: 37
PLASTIC LIMIT: 19

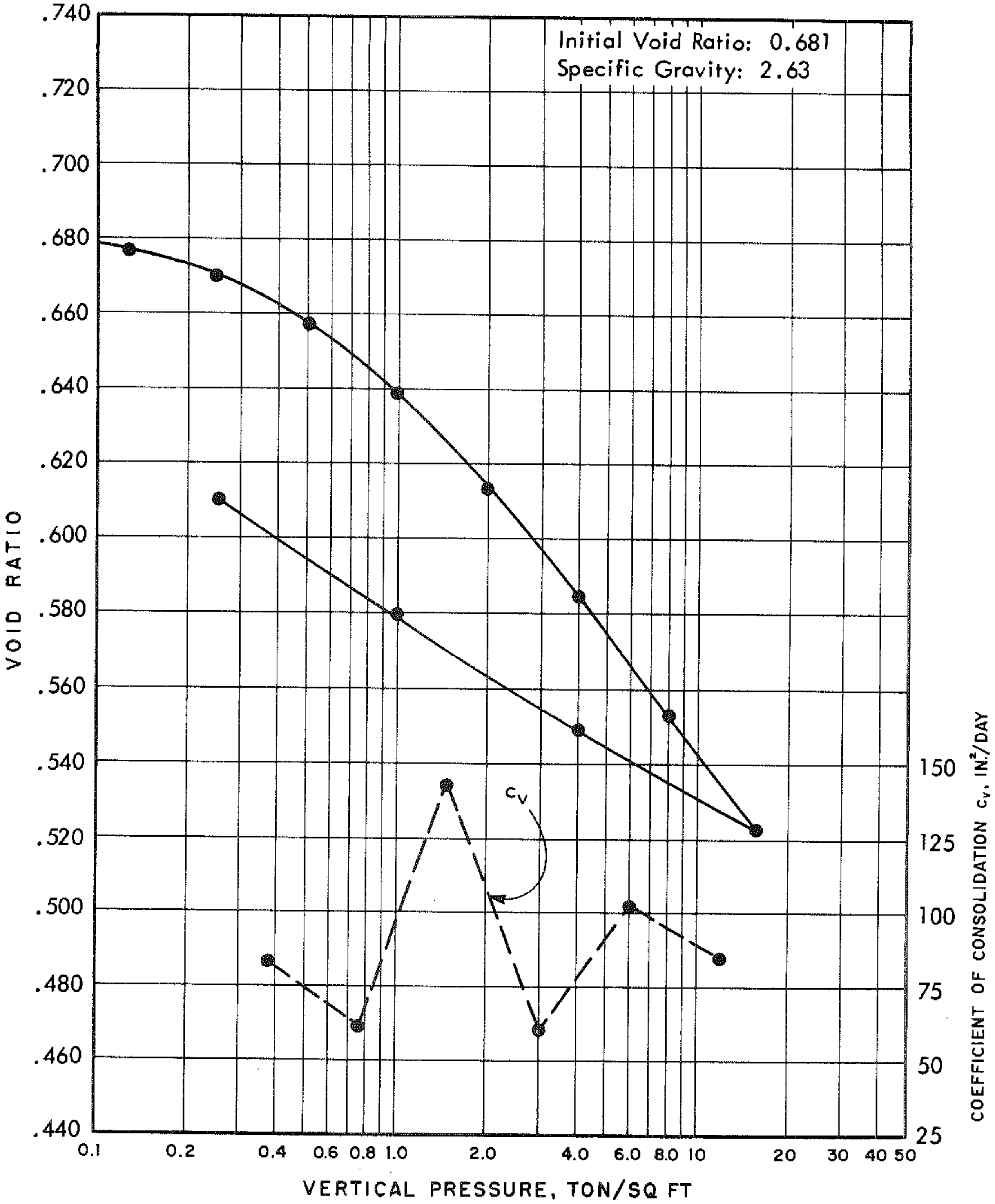


CONSOLIDATION TEST RESULTS

Form 06-3 '57 Job No 73-085

BORING: P-10 **DEPTH:** 45'
MATERIAL: Very stiff gray sandy clay with silt pockets

UNIT DRY WEIGHT:	98	LB/CU FT
WATER CONTENT:	22	%
LIQUID LIMIT:	38	
PLASTIC LIMIT:	19	



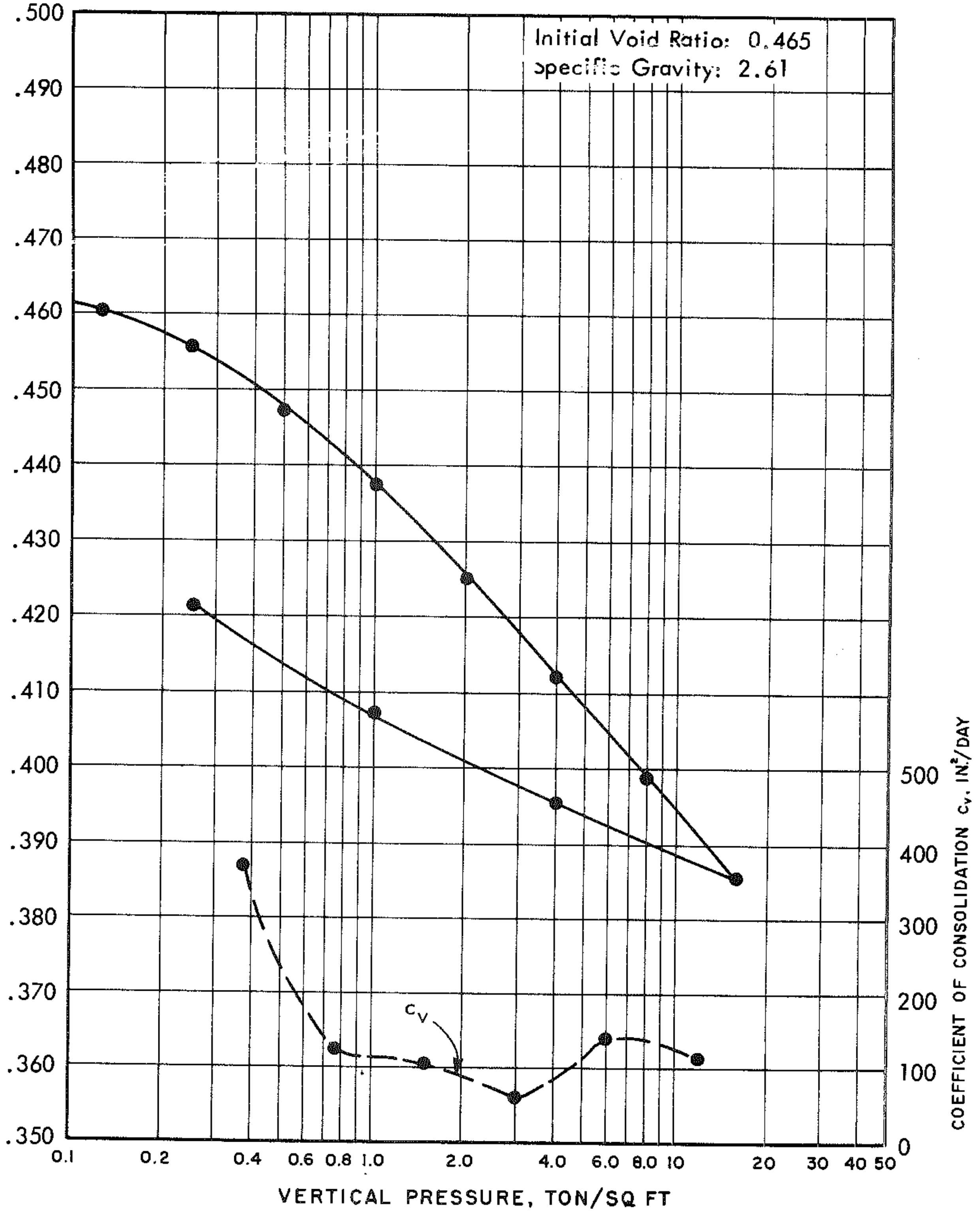
CONSOLIDATION TEST RESULTS

MCCLELLAND
ENGINEERS

23-085

BORING: P-10 **DEPTH:** 59'
MATERIAL: Gray clayey fine sand

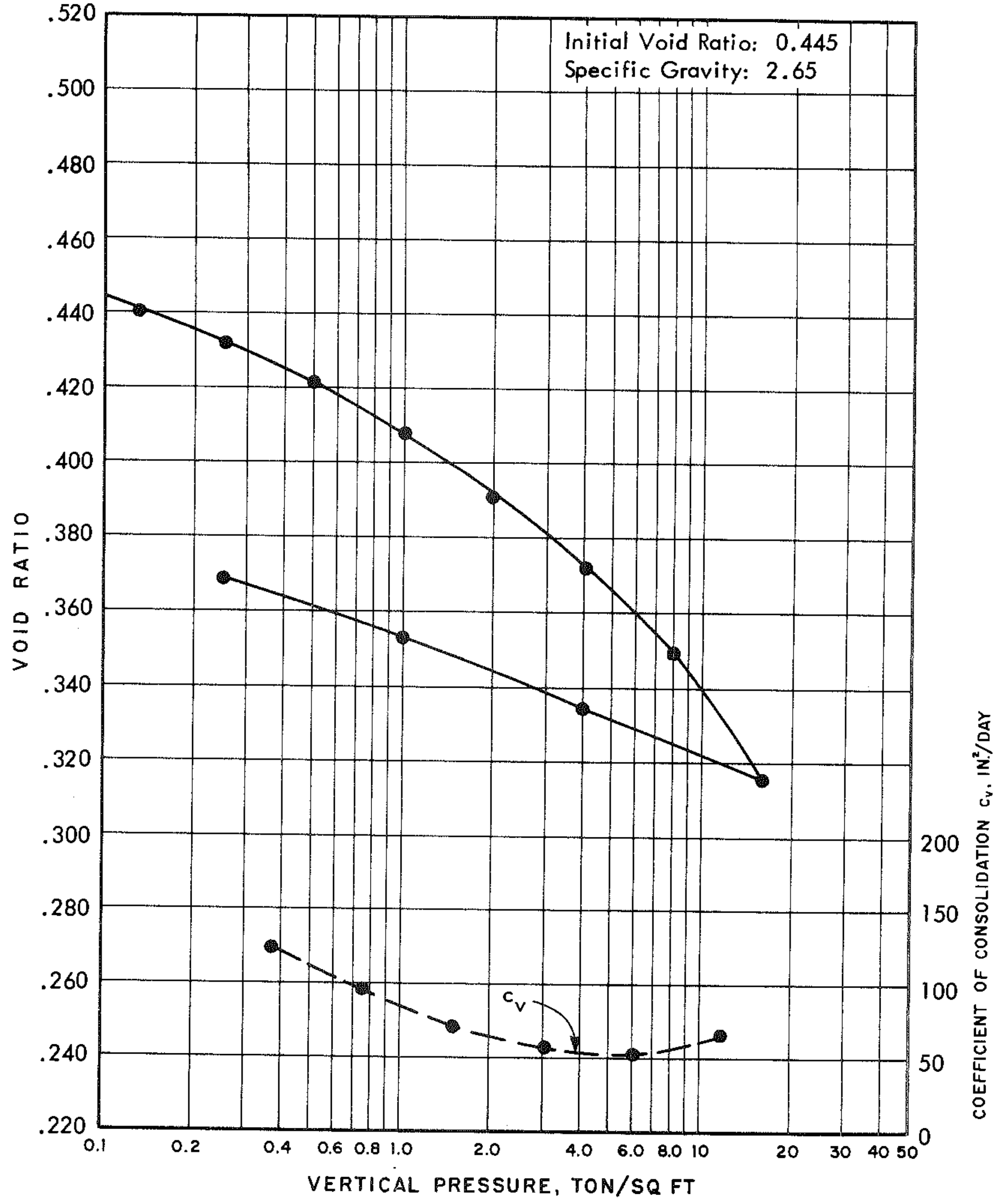
UNIT DRY WEIGHT:	111	LB/CU FT
WATER CONTENT:	17	%
LIQUID LIMIT:	22	
PLASTIC LIMIT:	17	


Initial Void Ratio: 0.465
Specific Gravity: 2.61

CONSOLIDATION TEST RESULTS

BORING: P-12 DEPTH: 20'
MATERIAL: Red and tan clayey fine sand
with clay pockets

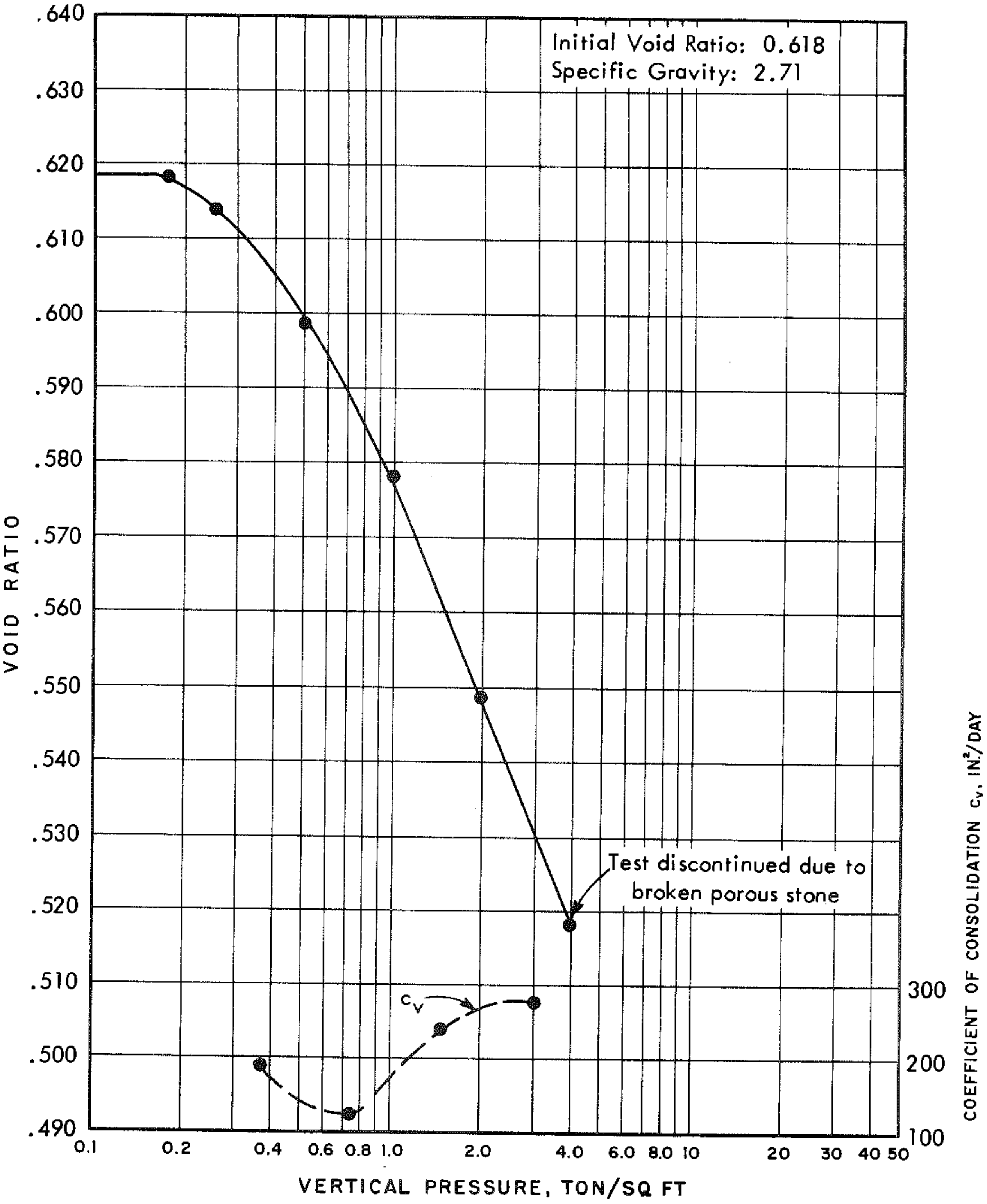
UNIT DRY WEIGHT:	115	LB/CU FT
WATER CONTENT:	16	%
LIQUID LIMIT:	26	
PLASTIC LIMIT:	17	



CONSOLIDATION TEST RESULTS

BORING: P-34 **DEPTH:** 18'
MATERIAL: Very stiff light gray clay with sand pockets and seams

UNIT DRY WEIGHT: 104.5 LB/CU FT
WATER CONTENT: 13 %
LIQUID LIMIT: 31
PLASTIC LIMIT: 17

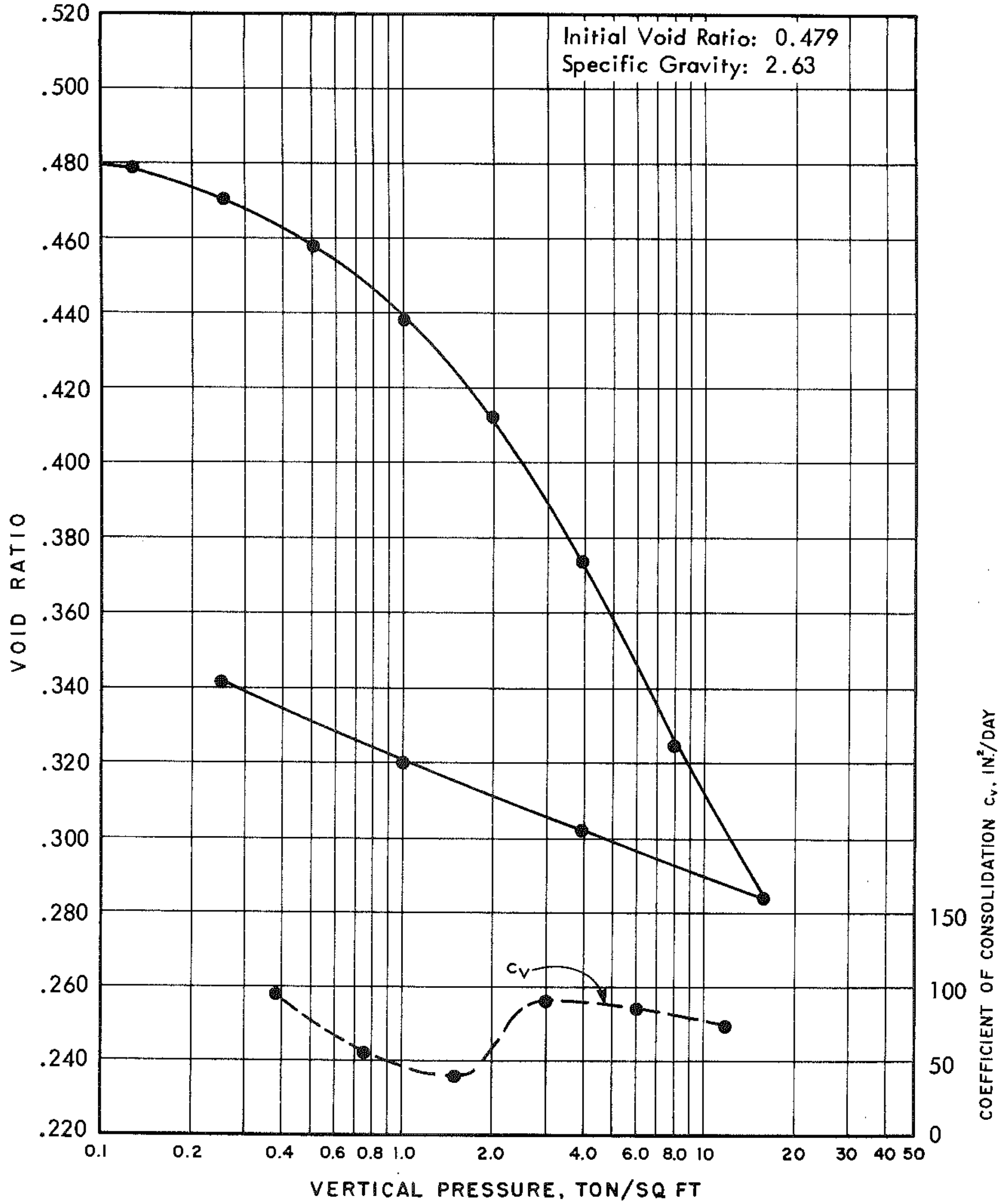


CONSOLIDATION TEST RESULTS

Form 36-3 57 Job No 73.085

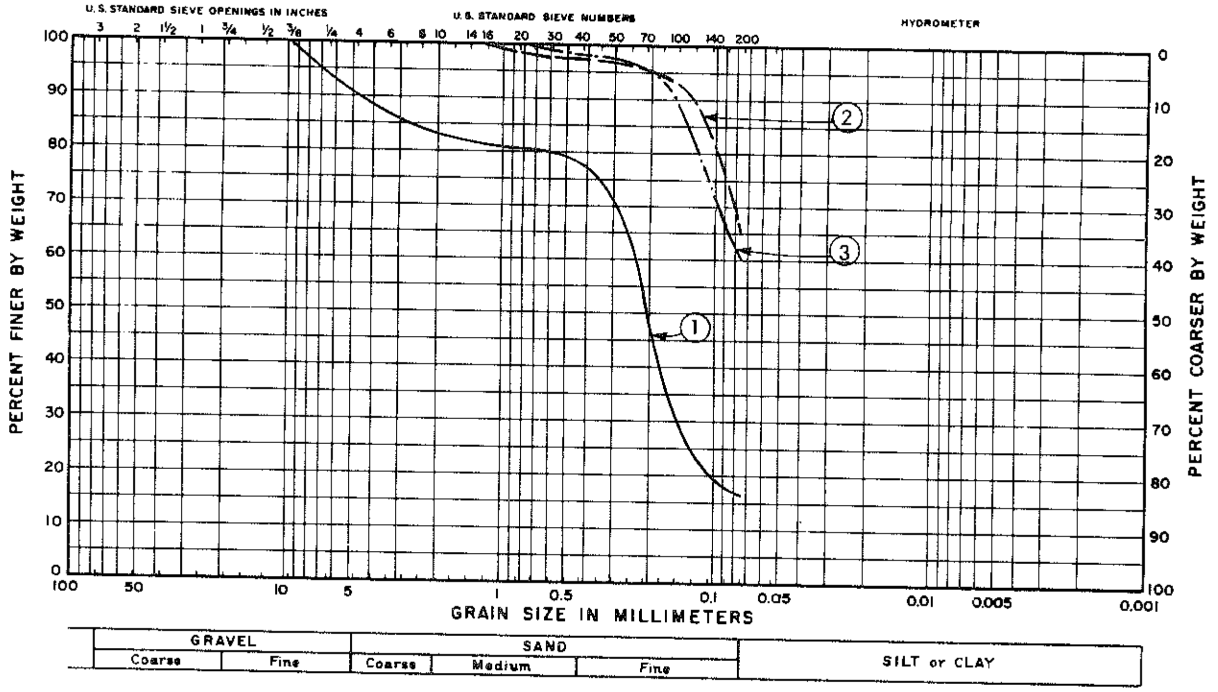
BORING: P-35 **DEPTH:** 39'
MATERIAL: Hard gray sandy clay with sand pockets

UNIT DRY WEIGHT: 111 LB/CU FT
WATER CONTENT: 18 %
LIQUID LIMIT: 25
PLASTIC LIMIT: 16



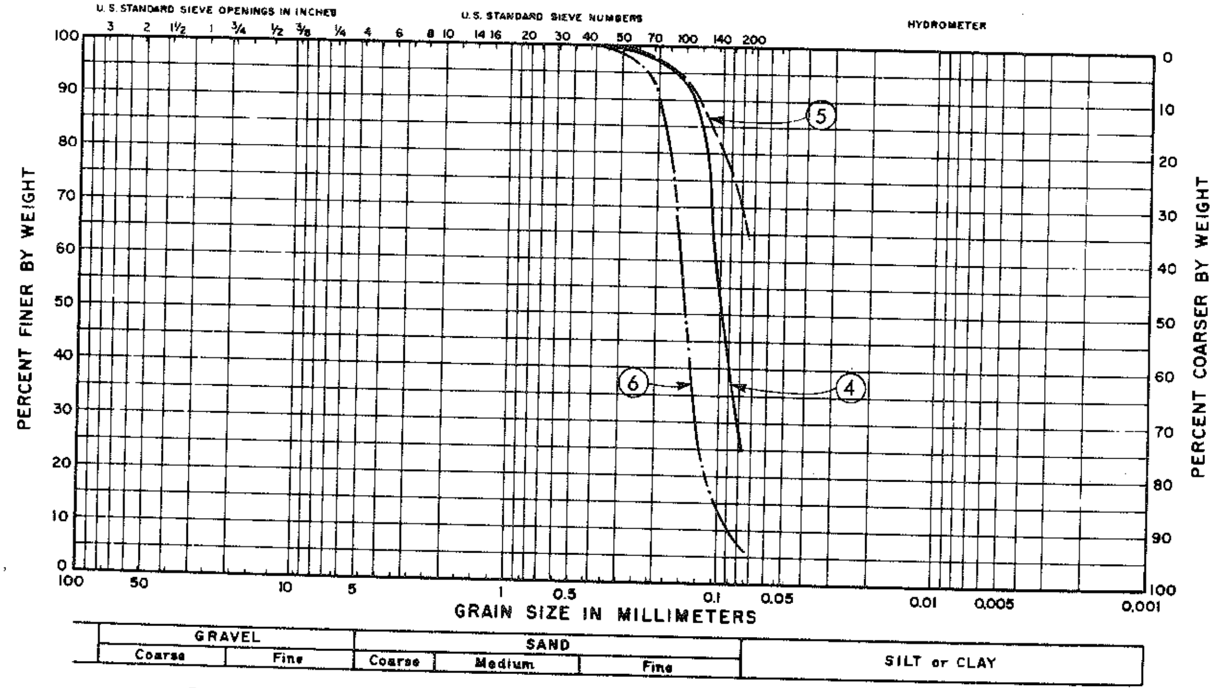
CONSOLIDATION TEST RESULTS

GRAIN SIZE CURVES



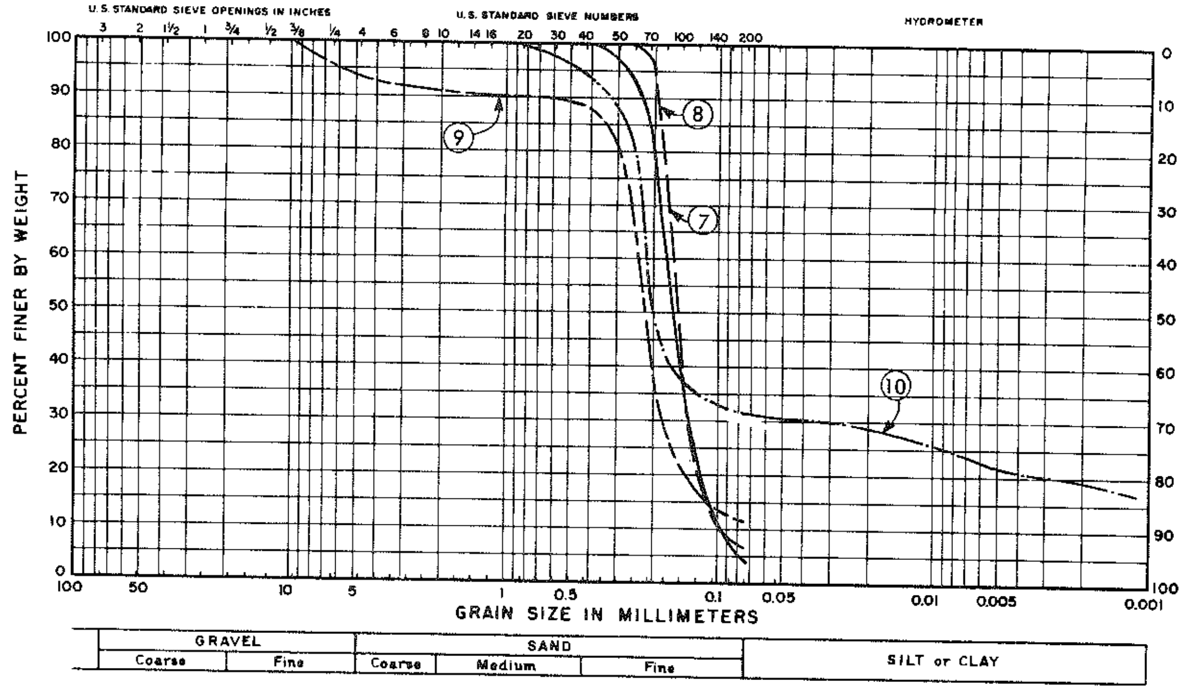
Curve No.	Boring No.	Depth, Ft.	Material
1	P- 1	15	Red silty fine sand with sandstone nodules
2	P- 1	50	Hard brown and gray clay with sand pockets
3	P-23	15	Red and tan sandy clay

GRAIN SIZE CURVES



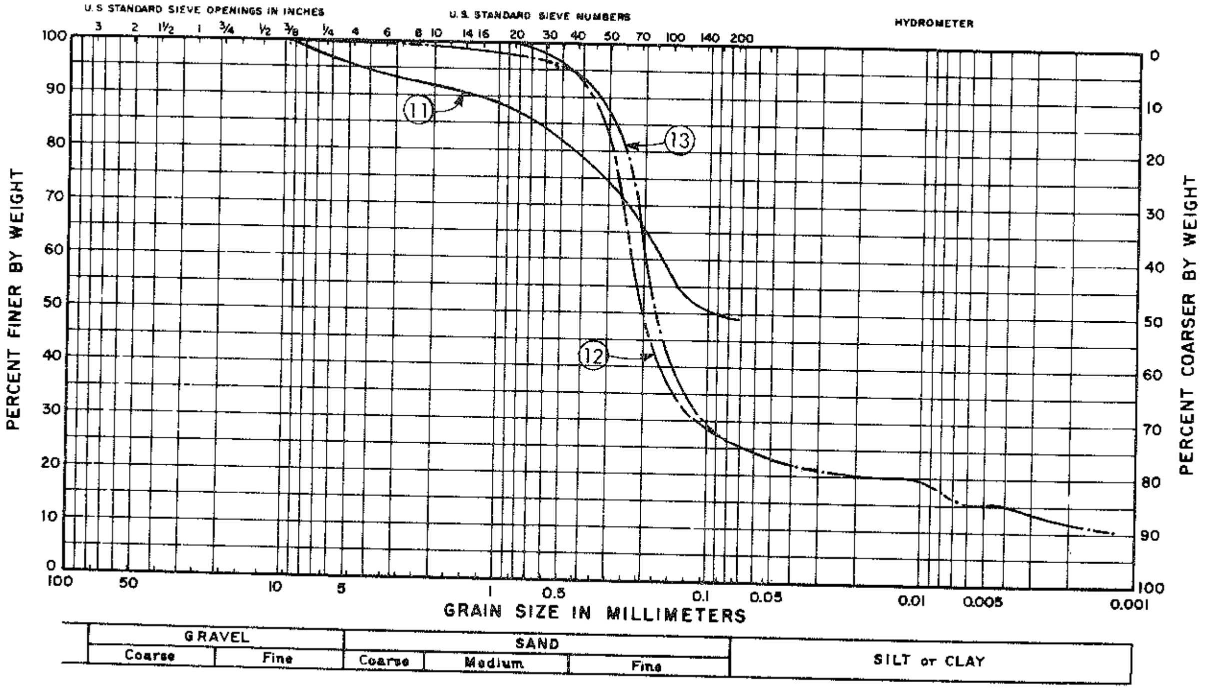
Curve No.	Boring No.	Depth, Ft.	Material
4	P-23	20	Gray silty fine sand
5	P-26	8	Red and tan sandy clay
6	P-26	30	Tan fine sand

GRAIN SIZE CURVES

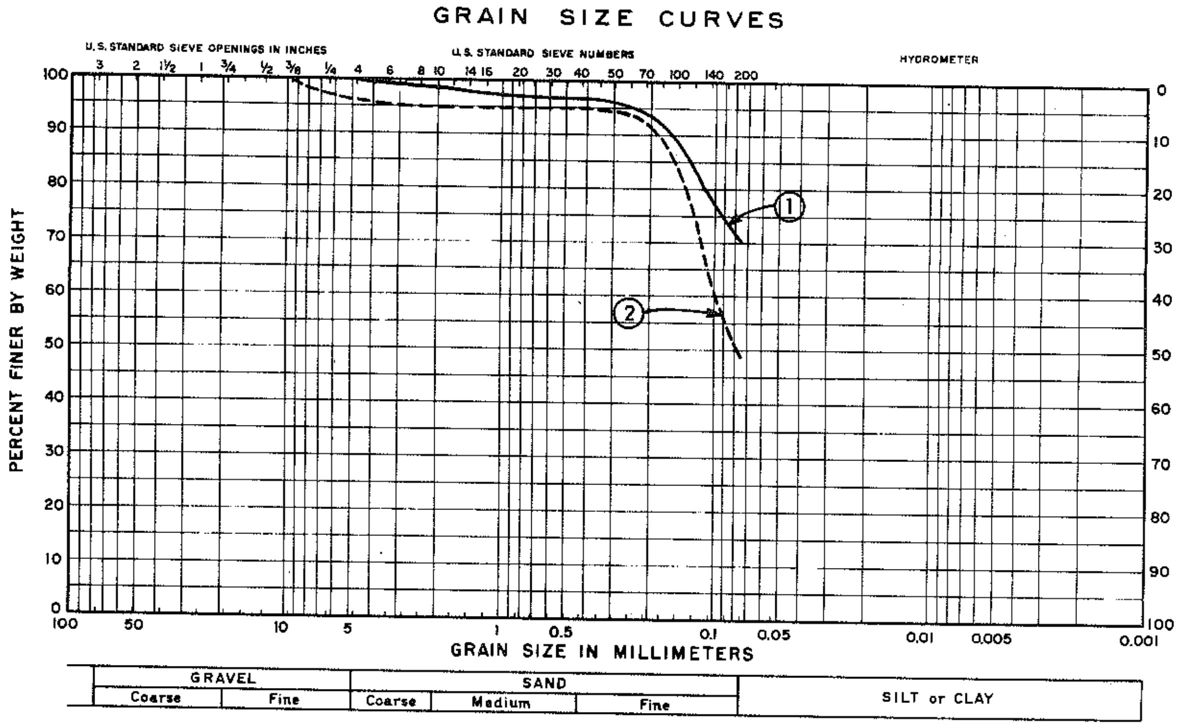


Curve No.	Boring No.	Depth, Ft.	Material
7	P-26	50	Tan fine sand
8	P-28	10	Tan fine sand
9	P-33	15.5	Red silty fine sand with ferrous nodules
10	P-34	30	Tan silty fine sand

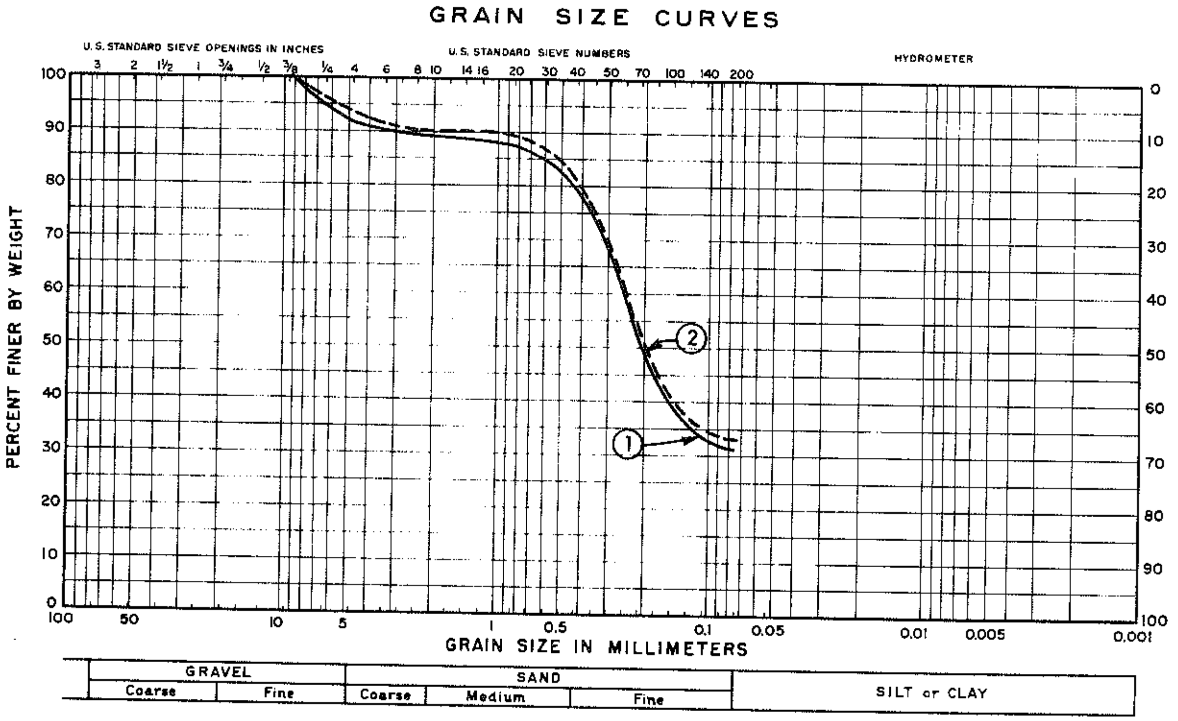
GRAIN SIZE CURVES



Curve No.	Boring No.	Depth, Ft.	Material
11	P-34	45	Gray sandy clay
12	P-35	20	Tan silty fine sand
13	P-36	30	Red and tan silty fine sand

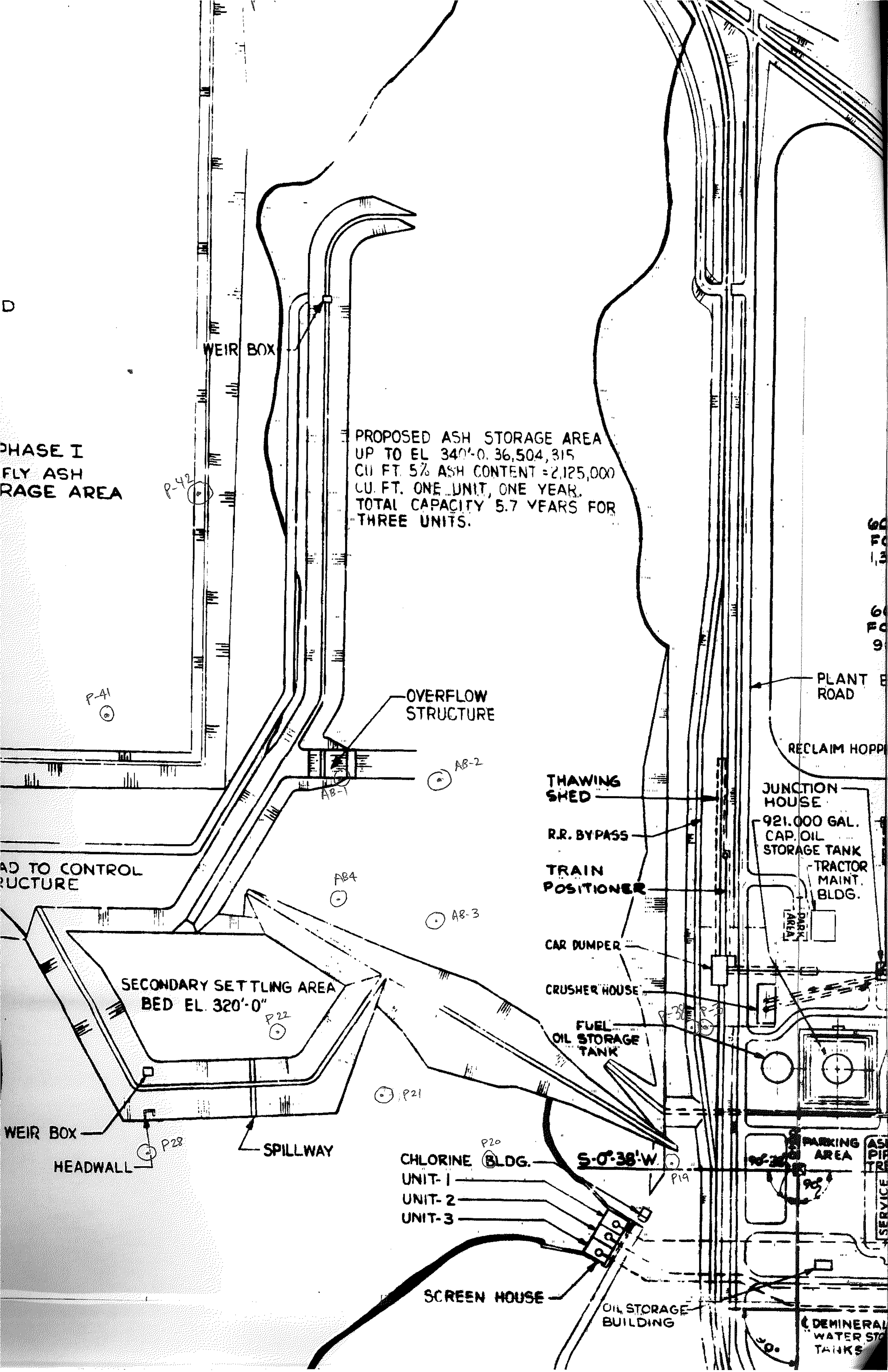


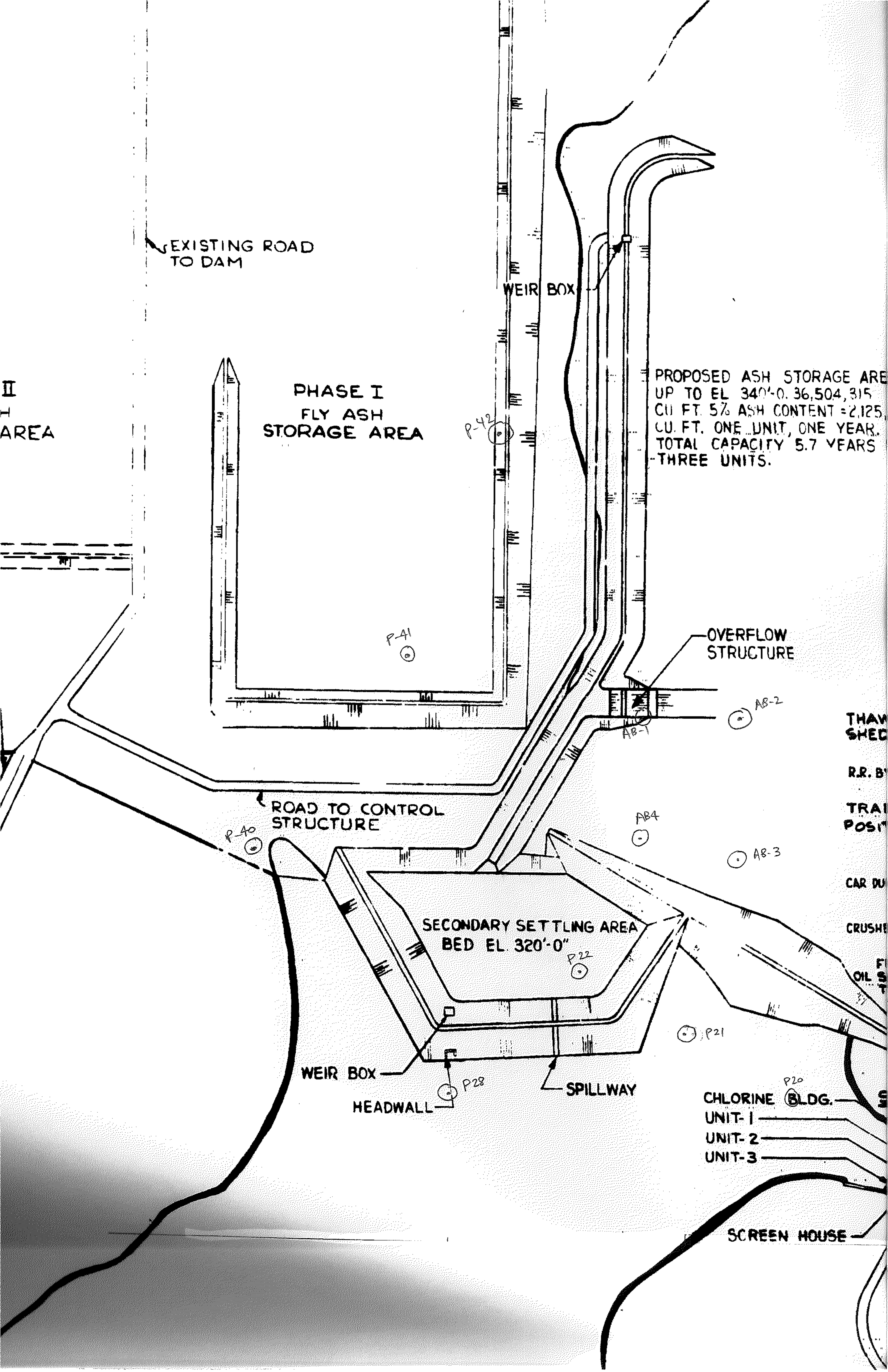
Curve No.	Boring No.	Depth, Ft.	Material
14	P-4	15	Tan silty fine sand with clay seams and gravel
15	P-4	15	Tan silty fine sand with clay seams and gravel



Curve No.	Boring No.	Depth, Ft.	Material
16	P-5	15	Tan silty fine sand with sandstone nodules
17	P-5	15	Tan silty fine sand with sandstone nodules

McCLELLAND
ENGINEERS


D
PHASE I
FLY ASH
RAGE AREA
WEIR BOX
P-42
P-41
PROPOSED ASH STORAGE AREA
UP TO EL 340'-0. 36,504,315
CU FT. 5% ASH CONTENT =2,125,000
CU. FT. ONE UNIT, ONE YEAR.
TOTAL CAPACITY 5.7 YEARS FOR
THREE UNITS.
OVERFLOW
STRUCTURE
AB-1
AB-2
AD TO CONTROL
RUCTURE
AB4
AB-3
SECONDARY SETTLING AREA
BED EL. 320'-0"
P22
P21
WEIR BOX
HEADWALL
P28
SPILLWAY
P20
CHLORINE BLDG.
UNIT-1
UNIT-2
UNIT-3
S-0°-38'-W
P19
SCREEN HOUSE
OIL STORAGE
BUILDING
THAWING
SHED
R.R. BYPASS
TRAIN
POSITIONER
CAR DUMPER
CRUSHER HOUSE
FUEL
OIL STORAGE
TANK
P-38
P-37
PLANT E
ROAD
RECLAIM HOPP
JUNCTION
HOUSE
921,000 GAL.
CAP. OIL
STORAGE TANK
TRACTOR
MAINT.
BLDG.
PARK
AREA
PARKING
AREA
90°-2
90°
ASI
PIP
TRE
SERVICE
℄ DEMINERAL
WATER STO
TANKS
90°
6C
FC
1,3
6
FC
9


EXISTING ROAD
TO DAM
II
AREA
PHASE I
FLY ASH
STORAGE AREA
P-42
WEIR BOX
PROPOSED ASH STORAGE ARE
UP TO EL 340'-0. 36,504,315
CU FT. 5% ASH CONTENT = 2,125,
CU. FT. ONE UNIT, ONE YEAR.
TOTAL CAPACITY 5.7 YEARS
THREE UNITS.
P-41
OVERFLOW
STRUCTURE
AB-2
AB-1
THAW
SHE
R.R. B
TRA
POS
ROAD TO CONTROL
STRUCTURE
P-40
AB4
AB-3
CAR DU
CRUSH
F
OIL S
T
SECONDARY SETTLING AREA
BED EL 320'-0"
P22
P21
WEIR BOX
P28
HEADWALL
SPILLWAY
P20
CHLORINE BLDG.
UNIT-1
UNIT-2
UNIT-3
SCREEN HOUSE

SARGENT & LUNDY
ENGINEERS
CHICAGO

ASH PIT DIKES
WELSH POWER PLANT - UNIT 1
SOUTHWESTERN ELECTRIC POWER COMPANY

DIVISION 2 - TECHNICAL REQUIREMENTS

SECTION 2-1: EARTHWORK

2-1.1 SECTION SCOPE

2-1.1.1 This section of the Specification includes requirements for the following, as indicated on the drawings, as hereinafter specified (under the Article numbers indicated), or as required to properly complete the WORK:

2-1.2	Services of Testing Laboratory
2-1.3	Soil Data and Topography
2-1.4	Removal of Sod and Topsoil
2-1.5	Excavation
2-1.6	Compacted Fill
2-1.7	Equipment
2-1.8	Fill Placement
2-1.9	Backfill
2-1.10	Excavation & Fill for Corrugated Metal Drainage Piping
2-1.11	Drainage Ditches
2-1.12	Bedding Course for Riprap
2-1.13	Riprap
2-1.14	Grading
2-1.15	Seeding

2-1.2 SERVICES OF TESTING LABORATORY

Will be furnished by Purchaser for use in connection with controlled compacted fill, as specified in Article 6.2 of Form 1714.

2-1.3 SOIL DATA AND TOPOGRAPHY

As specified in Article 2 of Form 1714. Drawings are included, and borings will be available for inspection at SWEPCo or McClelland Engineers at Houston, Texas.

2-1.4 REMOVAL OF SOD AND TOPSOIL

As specified in Article 4.6 of Form 1714. Stockpile topsoil on site, where and as requested by Purchaser's representative, for later reuse. Dispose of sod on site as requested by Purchaser's representative.

2-1.5 EXCAVATION

2-1.5.1 As specified in Article 5 of Form 1714. Dispose of all excavated materials on site, either as fill material or in stockpile area, as requested by Purchaser's representative. The Contractor's unit price fo
required to haul dirt in excess of the 2000 foot free haul distance he shall be paid at the unit pr
bid for overhaul per yard - quarter. Item 140 (Overhaul) of the 1972 Texas Highway Standard Spe
ification is hereby referenced as the governing specification. The 2000 foot free haul distance is
substituted for the 600 foot free haul distance specification in Item 140. Approval and authorizatio
in writing from the Engineer must be obtained before payment will be made for overhaul.

2-1.5.2 Area of stockpile shall be cleaned of vegetation and disposed of as specified in Article 4.5 of Form 1714.

2-1.5.3 Dewatering: As specified in Article 5.3 of Form 1714 and as indicated on the design drawings. During course of the WORK, Contractor shall maintain sufficient slope in excavation and on fill area to permit drainage of surface water and maintaining a dry working condition.

2-1.6 COMPACTED FILL

2-1.6.1 Conform to the applicable requirements of Article 6 of Form 1714 and requirements hereinafter specified.

2-1.6.2 Class and Type: One of the following as indicated on the drawings:

a. Class 1, Regular Compacted Fill, Type RCF1, Granular Material.

b. Class 1, Regular Compacted Fill, Type RCF2, Cohesive Material.

c. Class 2, Controlled Compacted Fill, Type CCF1, Granular Material.

d. Class 2, Controlled Compacted Fill, Type CCF2, Cohesive Material.

2-1.6.3 Material: Shall be impervious fill material obtained from excavation and borrow areas on site as indicated on the drawings, or from other approved stockpiles or borrow areas off site. All sources of dike fill shall be designated and approved by the Purchaser's representative. The fill material shall not contain any cobbles or broken rock larger than nine (9) inches maximum dimension at time of placement and compaction.

2-1.6.4 Compaction Densities: Dike fill shall be loosely placed in layers not exceeding ten (10) inches. Each layer of fill shall be thoroughly compacted by means of a sheepsfoot roller or pneumatic tired rollers of adequate capacity and through sufficient coverages to obtain not less than 95 percent of the maximum Modified Proctor density in accordance with ASTM Test D1557, latest edition. Compaction shall be performedwithin 2-1/2 percent of the optimum moisture content.

2-1.6.5 Disposal of Organic Materials: Vegetation, organic material, and other foreign materials removed in preparation of subgrade, as specified in Articles 6.3.3 and 6.4.3.2 of Form 1714, shall be disposed of on the site as requested by Purchaser's representative.

2-1.6.6 Preparation of Subgrade: Prior to placement of fill material and after stripping, the subgrade shall be compacted (proofrolled) through sufficient passes of an approved sheepsfoot roller capable of densifying the present surface to not less than 90 percent of the maximum Modified Proctor density in accordance with ASTM Test D1557.

2-1.7 EQUIPMENT

2-1.7.1 Compaction Equipment: Equipment to be used for constructing fill may consist of any type normally considered suitable to construct embankments for dams or highways. Main compaction equipment, including heavy pneumatic tired rollers, sheepsfoot rollers, vibratory compactors, shall be subject to approval of Purchaser's representative.

a. In addition to the foregoing equipment, Contractor shall have the following equipment available at the WORK:

a.1 Power tampers to be used for compaction of material in areas where it is impractical to use a roller or tractor.

a.2 A plain cylindrical roller, weighing not less than 1,000 pounds per lineal foot for rolling the surface of fill smooth for drainage in case of heavy precipitation.

a.3 Discs, harrows, and motor graders for drying and maintaining fill.

2-1.8 FILL PLACEMENT

2-1.8.1 As specified in Paragraph 6.4.5 of Form 1714, and as follows:

a. Distribution and gradation of materials throughout rolled fill shall be such that fill will be free from lenses, pockets, streaks or layers of material differing materially in texture or gradation from surrounding material. Combined excavation and placing operations shall be such that materials when compacted in the fill will be blended sufficiently to secure the best practicable degree of compaction, and stability. Travel on the fill shall be satisfactorily controlled to prevent tracking or cutting fill.

b. Successive loads of material shall be dumped so as to produce the best practicable distribution of material, and for this purpose locations in earth fill where individual loads shall be deposited may be designated. If the surface of any layer of material to be placed thereon has formed a hard over-compacted crust from traffic, it shall be moistened or both moistened and scarified as required before the succeeding layer of material is placed.

c. When rain is expected, and at the end of each working day, fill shall be rolled with a plain cylindrical roller to form a smooth surface with sufficient slope to cause rapid runoff of rainwater. Before resuming placement, this surface shall be scarified and moistened, as required. If Purchaser's representative determines that the rolled surface of any layer of earth fill in place is too wet for proper compaction of fill thereon, it shall be removed, allowed to dry, or shall be worked with a harrow, scarifier or other suitable equipment, to reduce water content to the required amount, and then shall be recompacted. Do not place the next succeeding layer of fill until approval to proceed is given by Purchaser's representative and the Consulting Engineers.

d. All openings through embankments required for construction and temporary drainage purposes shall be subject to approval. Approach or construction ramps for dikes and embankments shall be removed and those on the outside face shall be removed and/or trimmed, as requested.

2-1.9 BACKFILL

2-1.9.1 As specified in Article 7 of Form 1714.

2-1.9.2 Material shall be same as indicated in Article 2-1.6.3 for Compacted Fill.

2-1.10 EXCAVATION AND FILL FOR CORRUGATED METAL DRAIN PIPING

As specified in Article 9 of Form 1746.

2-1.11 DRAINAGE DITCHES

Cut and/or fill drainage ditches (if required) to cross sections and profiles indicated on the drawings. All surfaces shall be well compacted.

2-1.12 BEDDING COURSE FOR RIPRAP

2-1.12.1 Material: Bedding shall consist of a clean, well graded mixture of sand and gravel, crushed stone or crushed gravel conforming to the following gradation limits:

Sieve Size	% Passing by Weight
3"	100
1½"	65-85
#4	40-60
#40	20-35
#50	15-25
#100	0-15
#200	0-5

2-1.12.2 Placing: Place by approved means to the minimum thickness indicated on the drawings.

2-1.13 RIPRAP

2-1.13.1 Material:

a. Riprap shall consist of quarried stone, or other stone, free from structural defects and of approved quality. Stone containing shale, unsound sandstone or any other material which will readily disintegrate under handling and placing or weathering, shall not be used. Any stone which is free from incipient fractures and seams and has given evidence of ability to withstand weathering after long exposure to the elements shall be considered suitable for this purpose. Upon presentation of satisfactory evidence of ability to withstand weathering, such stone may be used without laboratory testing.

b. In case newly quarried stone or stone of questionable weathering quality is proposed, it shall be subjected to the sodium sulphate soundness test and shall show a loss, after cycles, of not more than 25 percent. Materials failing this test may be approved if, when subjected to fifty cycles of freezing and thawing, it has a loss not greater than 25 percent. Soundness method AASHO T104 (ASTM C88), "Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate" or T103, "Method of Test for Soundness of Aggregates by Freezing and Thawing" shall be used.

c. The moist unit weight of riprap shall not be less than 164 pounds per cubic foot.

2-1.13.2 Size and Gradation

a. Riprap shall be reasonably well graded and quarried stone shall have a gradation conforming to the following weight limits:

a.1 Maximum size....................................450 lbs.

a.2 At least 25 percent greater than..............200 lbs.

a.3 45 percent - 75 percent from - to.............80-120 lbs.

a.4 Not more than 25 percent less than............50 lbs.

a.5 Sand and rock dust not more than..............5 percent

b. The shortest dimension of any stone shall be not less than 1/3 of the longest dimension for at least 60 percent of the riprap. For the balance, the shortest dimension shall be not less than 1/5 of the longest dimension.

c. Alternate sizes and gradations will be considered for the WORK if they will achieve the desired performance at less cost. If an alternate is proposed, size and gradation of alternate shall be stated in the Bid Proposal, together with the price saving.

2-1.13.3 Placing:

a. Riprap shall be placed by dragline, clamshell or similar equipment which shall be operated so as to place each load of material in approximately its final position without further reworking, and without excessive height of drop.

b. Placement operations, including handling, stockpiling and transporting, shall be accomplished in such manner so as to produce a reasonably well graded mass of rock with minimum percentage of voids, free from objectionable pockets of small stones and clusters of large stones and having a reasonably regular finished surface.

c. Riprap shall be placed on the face of the dikes to the lines and grades and to the minimum thickness indicated on the drawings. The riprap shall be placed to this full minimum thickness in one operation. Thickness shall not be less than the minimum at any point. Hand placing to a limited extent may be required, but only to the extent necessary to secure results specified foregoing.

d. In no case shall a bulldozer be used in shaping the riprap slopes.

2-1.14 GRADING

As specified in Article 8 of Form 1714, and as indicated on the drawings.

2-1.15 SEEDING

2-1.15.1 All slopes and surfaces, as indicated on the drawings, shall be seeded as hereinafter specified.

2-1.15.2 Topsoil:

a. Material: Approved topsoil from topsoil previously excavated and stockpiled on the site or approved topsoil from sources off the property or both.

b. Placing:

b.1 Spread topsoil evenly to a depth which, after settlement and compaction, shall be 4 inches. Do not spread when ground or topsoil is excessively wet or otherwise in any condition detrimental to the work; if existing surface has become hardened or crusted, rake or otherwise break up to provide bond with layer of topsoil.

b.2 After spreading has been completed, rake up and remove large clods, stones larger than 2 inches in any dimension, roots, stumps, and other litter or deleterious material.

b.3 Completed finish grading shall provide a smooth grade, true to indicated elevations, cross sections and profiles, properly drained and free from pockets or high spots, and as approved for subsequent fertilizing and seeding operations as hereinafter specified.

2-1.15.3 Fertilizing:

a. Material: Ready-mixed material having an analysis of 16-8-8 nitrogen, available phosphoric acid and water soluble potash. Deliver to job in sealed containers with weight, analysis, and name of manufacturer clearly indicated on each container.

b. Storage: Store in such a manner as will not impair fertilizer's effectiveness.

c. Coverage: 300 lbs. per acre.

2-1.15.4 Seeding:

a. Seeding Time: Do fertilizing and seeding as soon as possible after completion of finish topsoil work. However, do no fertilizing or seeding during windy weather or when ground is wet or in an otherwise untillable condition.

b. Seed:

b1. Seed shall be un-Hulled Bermuda and Rye grass with purity and germination of 95 and 90, respectively.

b2. Coverage: Bermuda 5 lbs. per 1000 SY - Rye grass 21 lbs. per 1000SY

b3. All seed shall comply with all applicable laws and regulations of the State of Texas and of U.S. Department of Agriculture.

c. Have seed delivered to job in sealed containers.

d. Furnish to Purchaser duplicate signed copies of statement by seed vendor that each lot of seed has been tested by a recognized laboratory for seed testing within six months of date of delivery, and complies with all requirements for the specified seed.

e. Protection: Immediately after seeding, cover seeded areas with two (2) tons per acre of straw mulch and anchor this by spraying with cutback asphalt (RC-3) at the rate of .10 gallon per sq. yd.

f. Sowing and Maintaining, Etc.: Methods of preparation of seed beds, fertilizing, seeding, sprinkling, maintaining, repair, and reseeding as required will be at option of Contractor. Work shall not be considered complete until after a uniform and dense stand of healthy grass has been produced in accordance with these specifications, free from bare spots and gullies formed by erosion, and when accepted in writing by Purchaser.

Ash Pit Dikes

2-1.15.5

Estimated Quantities:

7,000 cubic yards excavation (common)

97,000 cubic yards excavation (core trench)

100,000 cubic yards excavation (discharge flume)

160,000 cubic yards embankment (density control)

19,000 square yards rip-rap (rock)
(Layered rock 12" thick on 6" depth gravel base and 4" thick sand base)

(Alternate:) 19,000 square yards rip-rap (Conc. Cl. B) - Same ba

10,000 square yards topsoil (4" thick layer)

10,000 square yards fertilizing, seeding, mulching, and watering

Basis for Payment:

Price per cubic yard excavation (common)
Price per cubic yard excavation (core trench)
Price per cubic yard excavation (discharge flume)
Price per cubic yard embankment (density control)
Price per yard - quarter - overhaul
Price per square yard rip-rap (rock)
(Alternate:) Price per square yard rip-rap (Conc. Cl. B)
Price per square yard 4" layer of topsoil
Price per square yard fertilizing, seeding, mulching, and watering.

ASH PIT DIKES
WELSH POWER PLANT - UNIT #1
SOUTHWESTERN ELECTRIC POWER COMPANY

DIVISION 2 - TECHNICAL REQUIREMENTS

SECTION 2-2: CLEARING AND GRUBBING

2-2.1 SECTION SCOPE

2-2.1.1 This Section of the Specification includes requirements for the following, as indicated on the drawings, as hereinafter specified (under the Article numbers indicated, or as required to properly complete the WORK:

2-2.1.2 Requirements of Division 1, General Requirements, also apply to the WORK under this Section 2-2.

2-2.2 TREE REMOVAL AND CLEARING

2-2.2.1 Conform to applicable requirements of Article 4 of Form 1714, and to requirements hereinafter specified.

2-2.2.2 Tree Removal:

a. Clear and grub all trees in the following areas.

   1. Dike borrow areas.

   2. Within the toes (the entire base) of lake and ash pond dikes.

b. All other trees within the lake and ash pond dikes shall be shear dozed at ground level.

c. Remove and dispose of off the site all partially buried logs, down timber, snags, brush, hedges, bushes and all other vegetation or organic material, all rubbish, debris and other foreign or objectionable material above ground surface.

d. Remove all floating debris in swampy areas and dispose of off site. Cut all trees in swampy areas as directed by Owner's Engineer.

2-2.2.3 CLEARING

a. Contractor shall have full property rights to all timber cut by him, and may sell, off the site only, all merchantable timber which he cuts. Merchantable timber may be processed either on the site or off the site, as agreed to with Purchaser, but shall all be removed from the site before completion of the WORK.

2-2.2.4 **ESTIMATED QUANTITY:** 32 acres clearing
20 acres clearing and grubbing

2-2.2.5 **BASIS FOR PAYMENT:** Price per acre clearing
Price per acre clearing and grubbing

ASH PIT DIKES
WELSH POWER PLANT - UNIT #1
SOUTHWESTERN ELECTRIC POWER COMPANY

DIVISION 2 - TECHNICAL REQUIREMENTS

SECTION 2-4: CONCRETE WORK

2-4.1 SECTION SCOPE

2-4.1.1 This Section of the Specification includes requirements for the following, as indicated on the drawings, as hereinafter specified (under the Article numbers indicated), or as required to properly complete the WORK:

2-4.2 Services of Testing Laboratory
2-4.3 Class of Concrete
2-4.4 Cement
2-4.5 Fly Ash
2-4.6 Water-Reducing Admixtures
2-4.7 Reinforcing Steel
2-4.8 Formwork
2-4.9 Cold Weather Placing of Concrete
2-4.10 Hot Weather Placing of Concrete
2-4.11 Concrete Finishes

2-4.1.2 Requirements of Division 1, General Requirements, also apply to the WORK under this Section 2-4.

2-4.2 SERVICES OF TESTING LABORATORY
These services will be furnished by Purchaser, as specified in Article 9 of Form 1715.

2-4.3 CLASS OF CONCRETE
Class AA (air-entrained), as specified in Article 8 of Form 1715 for all WORK, unless otherwise indicated.

2-4.4 CEMENT

2-4.4.1 Type: As specified in Item 15-1A, Table 15-1 of Form 1715.

2-4.4.2 Brand and Source: Only one brand and source of cement shall be used for all concrete WORK.

2-4.5 FLY ASH

2-4.5.1 Material: As specified in Item 15-B, Table 15-1 of Form 1715, except that the ASTM Standard Specification Designation shall be revised to ASTM C618, "Fly Ash and Raw or Calcined Natural Pozzolans for Use in Portland Cement Concrete" and the Pozzolan Class shall be Type F.

2-4.5.2 After source of fly ash has been initially approved, changing of source of fly ash will not be permitted without approval of the Consulting Engineers.

2-4.6 <u>WATER-REDUCING ADMIXTURES</u>

Use of <u>any</u> water-reducing admixtures will <u>NOT BE PERMITTED</u>.

2-4.7 <u>REINFORCING STEEL</u>

2-4.7.1 <u>Reinforcing</u>: Domestic steel. Conform to requirements specified in Item 15-1E, Table 15-1 of Form 1715, except steel shall conform to the applicable requirements of ASTM A615, Grade 60.

2-4.2 <u>Splice Requirements</u>: In place of splice requirements specified in Item (2), Table 15-29, Page 15-6 of Form 1715, splice requirements indicated in the "Reinforcement Lap Splice Schedule" on the drawings shall govern. Reinforcing shop drawing setting plans for the work shall also clearly indicate length of lap for each bar.

2-4.7.3 <u>Heating of Reinforcing</u>: Heating of reinforcing for bending or for any other purposes <u>will not be permitted</u>.

2-4.8 <u>FORMWORK</u>

In addition to requirements of Article 5 of Form 1715, also conform to applicable requirements of ACI 347, "Recommended Practice for Concrete Formwork".

2-4.9 <u>COLD WEATHER PLACING OF CONCRETE</u>

2-4.9.1 In place of requirements specified in Paragraph 10.5 Article 10 of Form 1715, the requirements of ACI 306, "Recommended Practice for Cold Weather Concreting" shall govern cold weather placing of concrete, unless otherwise indicated.

2-4.9.2 Attention is especially directed to Table 1.4.1 of ACI 306 for minimum and maximum temperatures of material and of concrete.

2-4.9.3 The use of salts or other chemicals as an accelerating admixture to concrete to prevent freezing and develop strength of concrete in a shorter period of time as specified in Chapter 6 of ACI 306 <u>will not be permitted</u>.

2-4.10 <u>HOT WEATHER PLACING OF CONCRETE</u>

Conform to applicable requirements specified in Article 10.6 of Form 1715 for hot weather placing of concrete.

2-4.11 <u>CONCRETE FINISHES</u>

As specified in Article 11 of Form 1715 and as indicated on the drawings.

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DIVISION 2 - TECHNICAL REQUIREMENTS

SECTION 2-5: GROUT WORK

2-5.1 SECTION SCOPE

2-5.1.1 This Section of the Specification includes requirements for the following, as indicated on the drawings, as hereinafter specified (under the Article numbers indicated), or as required to properly complete the WORK:

2-5.2 General
2-5.3 Antifreeze Solution for Anchor Bolt Sleeves (If Required)
2-5.4 Cold Weather Grouting
2-5.5 Hot Weather Grouting
2-5.6 Curing

2-5.1.2 Requirements of Division 1, General Requirements, also apply to the WORK under this Section 2-5.

2-5.2 GENERAL

2-5.2.1 Provide all grout required for the WORK, including, but not limited to grout for the following:

a. Anchor bolt sleeves.

b. Base plates.

2-5.2.2 Furnish, install and strip all formwork required for grout work.

2-5.3 ANTIFREEZE SOLUTION FOR ANCHOR BOLT SLEEVES (IF REQUIRED)

Place antifreeze solution for anchor bolt sleeves, as specified in Form 1737 and Article 11.1.4 of Form 1742, in all anchor bolt sleeves.

2-5.4 COLD WEATHER GROUTING

Conform to same requirements specified for cold weather placing of concrete in Article 2-4.9 of Section 2-4.

2-5.5 HOT WEATHER GROUTING

Conform to same requirements specified for hot weather placing of concrete in Article 2-4.10 of Section 2-4.

2-5.6 CURING

Use membrane curing, as specified for concrete work in Article 12 of Form 1715, in place of water curing as specified in Form 1741.

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DIVISION 2 - TECHNICAL REQUIREMENTS

SECTION 2-6: MISCELLANEOUS METALWORK AND EMBEDDED WORK

2-6.1 SECTION SCOPE

2-6.1.1 This Section of the Specification includes requirements for the following, as indicated on the drawings, as hereinafter specified (under the Article numbers indicated), or as required to properly complete the WORK:

- 2-6.2 General
- 2-6.3 Services of Testing Laboratory
- 2-6.4 Welding
- 2-6.5 Materials and Fabrication
- 2-6.6 Galvanizing
- 2-6.7 Prime Coat Cleaning and Painting

2-6.1.2 Requirements of Division 1, General Requirements, also apply to the WORK under this Section 2-6.

2-6.2 GENERAL

2-6.2.1 Work Included: Provide all applicable work included under Article 4 of Form 1742 and all similar work herein specified or indicated on the drawings.

2-6.2.2 Extent of Galvanizing: Galvanize all miscellaneous steelwork (except cast iron). For galvanizing requirements see Article 2-6.6.

2-6.3 SERVICES OF TESTING LABORATORY

Will be furnished by Purchaser for inspection of the following:

2-6.3.1 Materials: As specified in Article 7 of Form 1742.

2-6.3.2 Welding: As specified in Article 10 of Form 1701.

2-6.4 WELDING

Conform to applicable requirements of Form 1701.

2-6.5 MATERIALS AND FABRICATION

2-6.5.1 Material: ASTM A36 unless otherwise indicated; however, the use of Bessemer steel not permitted.

2-6.5.2 Anchor Bolts:

a. Contractor shall provide all anchor bolts required for the WORK, as specified in Article 11.1.2 of Form 1742, except that material shall be ASTM A36 for threaded rods and ASTM A307 for headed bolts and for all nuts for ASTM A36 threaded rods and ASTM A307 headed bolts.

b. Plugs: In place of hardwood plugs indicated in Form 1737, or on drawings, provide plastic plugs at top of sleeves with center opening 1/8 in. smaller in diameter than bolt size to insure tight weather-tight fit; shop or field punch or drill openings. Type and make of plastic plugs shall be as specified in Item 3, Table 07-4 of Form 1707.

c. Heating and Welding: Heating of <u>any</u> anchor bolt <u>in the field</u> for bending or other purposes will <u>not be permitted</u>, except that nuts for threaded rods or heads of headed bolts may be tack welded to the plate washers used for embedment in concrete.

2-6.5.3 <u>Expansion Anchors</u> Self-drilling type as specified in Item 8, Table 07-4 of Form 1707.

2-6.5.4 <u>Embedded Steel Plates</u>: Provide 4 nailing holes in each plate to permit ready attachment to formwork.

2-6.5.5 <u>Sluice Gates</u>: As indicated on the drawings.

2-6.5.6 <u>Stop Log Guides</u>: Conform to the applicable requirements of Form 1743..

2-6.5.7 <u>Stop Logs</u>: As specified in Article 8 of Form 1743 and as indicated on the drawings.

2-6.5.8 <u>Guardrails</u>: As specified in Paragraph 20.9 of Form 1742 and as indicated on the drawings.

2-6.6 <u>GALVANIZING</u>
As specified in Article 24 of Form 1742.

2-6.7 <u>PRIME COAT CLEANING AND PAINTING</u>

2-6.7.1 <u>Intent</u>: Clean and paint all ferrous metals, as specified in Article 3 of Form 1790, except the following:

a. Cast iron.

b. Galvanized steel (except for field touch-up).

2-6.7.2 <u>Shop Work</u>: As specified in Article 25 of Form 1742.

2-6.7.3 <u>Field Work for Ferrous Metals</u>: As specified in Articles 11, 12, 13 and 15 of Form 1790, as applicable.

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DIVISION 2 - TECHNICAL REQUIREMENTS

SECTION 2-7: DRAINAGE WORK

2-7.1 SECTION SCOPE

2-7.1.1 This Section of the Specification includes requirements for the following, as indicated on the drawings, as hereinafter specified (under the Article numbers indicated), or as required to properly complete the WORK:

- 2-7.2 General
- 2-7.3 Galvanized Corrugated Metal Drainage Piping
- 2-7.4 Manholes

2-7.1.2 Requirements of Division 1, General Requirements, also apply to the WORK under this Section 2-7.

2-7.2 GENERAL

All drainage work shall conform to applicable requirements of "The American Association of State Highway Officials", as indicated on the drawings and as hereinafter specified.

2-7.3 GALVANIZED CORRUGATED METAL DRAINAGE PIPING

2-7.3.1 Type: Riveted galvanized corrugated metal pipe (CMP), conforming to applicable requirements of AASHO M36, or helically corrugated galvanized metal culvert pipe, conforming to applicable requirements of AASHO M36 and to requirements hereinafter specified.

2-7.3.2 Manufacturers: Provide one of the following types and makes:

a. Standard Armco............	Armco Metal Products Division of Armco Steel Corporation
b. Corrugated................	Republic Steel Corporation
c. Corrugated...............	Wheeling Corrugating Company

2-7.3.3 Shape and Material: Round pipe or pipe-arch, sizes and gauges, as indicated on the drawings. Base metal copper bearing steel with copper content 0.20% minimum.

2-7.3.4 Fabrication:

a. Riveted Pipe: As specified in AASHO M36.

b. Helically Corrugated Pipe:

b1. As specified in AASHO M36.

b2. Corrugation pitch 2-3/4 in.; corrugation depth not less than 7/16 in. Seams continuous lock or weld type extending from end to end of pipe. Fabricate seams in such manner as not to affect shape or nominal diameter of pipe nor to create an element of weakness in pipe.

2-7.3.5 <u>Fittings</u>: Provide standard fabricated fittings as indicated or as required.

2-7.3.6 <u>Accessories</u>: Provide standard bolted coupling bands, bolts and all other accessories required for a complete installation.

2-7.3.7 <u>Installation</u>: In strict accordance with manufacturer's instructions, as approved, in accordance with applicable requirements of National Corrugated Metal Pipe Association Installation Manual and in accordance with the following requirements:

a. <u>Excavation and Fill</u>:

a1. Normally excavate trenches to match curve of pipe. Flat beds may also be used if as economical as curved beds.

a2. <u>Curved Beds</u>: Bed pipe evenly and firmly for width of 100% of pipe breadth.

a3. Flat Beds:

a3.1 After pipe in place on flat bed, provide well compacted granular fill under haunches. Use clean crushed stone, gravel or coarse sand, or other approved material, with 1½ in. maximum size.

a3.2 Provide same granular fill up to center line of pipe. Place in layers not exceeding 12 in. in depth before compaction.

a4. Fill above center line and up to grade with select, granular material, as approved and thoroughly compact. Place in layers as specified foregoing.

a5. Use fill material free of rocks, hard lumps, or clods larger than 3 in. Do not use sod, cinders or frozen fill.

a6. Use extreme care in placing all compacted fill to maintain fill at approximately the same level (not to exceed one foot differential) on both sides of pipes throughout entire placing of compacted fill.

b. <u>Joints</u>: Securely bolt all joints.

c. Provide beveled end section where indicated.

2-7.4 <u>MANHOLES</u>

2-7.4.1 Construct manholes of precast concrete, complete with cast iron frames and covers, steps, etc., as indicated on the drawings and as hereinafter specified.

2-7.4.2 <u>Precast Concrete Manholes</u>:

a. <u>Type</u>: Precast reinforced concrete ring type with precast reinforced concrete base and with rubber "O-Ring" or flat type rubber compression joints, conforming to applicable requirements of ASTM C478, "Specifications for Precast Reinforced Concrete Manhole Risers and Tops" and to requirements hereinafter specified.

b. <u>Manufacturers</u>: Provide precast elements and joint material as made by one of the following manufacturers:

b1. Continental Concrete Pipe Corporation.

b2. International Pipe & Ceramics Corporation (Lock-Joint Pipe Products).

b3. Concrete Pipe Division of Vulcan Materials Company.

b4. Material Service Division of General Dynamics Corporation.

c. Loading: Design manholes and catch basins for H-20 truck loading.

d. Precast Elements:

d1. Base: Closed-end pipe type with bell end.

d2. Ring Sections for Walls: Provide in multiples of 8 in. in height, with tongue and groove joints as required by depth of each manhole. Wall thickness for rings shall be 4 in. for 36 in. diameter manholes and 5 in. for 48 in. diameter manholes.

d3. Top section shall be eccentric cone type with minimum wall thickness of 4 in. for 36 in. diameter manholes and 5 in. for 48 in. diameter manholes, or shall be flat slab type not less than 8 in. thick, as indicated on drawings or as required by manhole depth. Arrange both types for taking cast iron manhole frame and cover.

d4. Rings and top cone shall have precast openings for field installation of cast iron steps and for all required drain pipes entering manholes.

e. Joints: Rubber "O-Ring" or flat type rubber compression type, with manufacturer's standard rubber ring. Mortar joints may be used if specifically approved.

2-7.4.3 Frames, Covers and Steps:

a. Cast iron, as made by one of the following:

a1. Neenah Foundry Company.

a2. James B. Clow & Sons.

b. Coating: Coat uniformly with coal tar pitch varnish.

c. Type: As indicated on the drawings.

2-7.4.4 Installation of Manholes:

a. Subgrade shall be level and free of projecting stones, rocks, etc.

b. Place a layer of sand, not less than 4 in. thick, over subgrade before installing precast base. Exercise care to install base dead level and with full bearing throughout on sand cushion, to insure that completed catch basins are plumb.

c. Installation of sections, using rubber rings, in strict accordance with manufacturer's instructions, as approved.

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JOB SPECIFICATIONS
FOR
EXCAVATION & EMBANKMENT FOR GENERATING PLANT AREA

GENERAL DESCRIPTION

The Generating Plant Area is a part of the plant site. As stated in the Technical Specifications TS-1 covering plant site grading, and shown by the drawings, grubbing, removing and stockpiling of topsoil, and general grading for the plant area under discussion have been performed. These items are included in the pay item quantities outlined under TS-1.

The Contractor shall be required to accomplish the excavation and embankment in the Generating Plant Area to line and grades as shown by drawings, S-148 and S-149, and in accordance with the following specification and Sargent & Lundy's Standard Specification for Earthwork (Form 1714).

EXCAVATION & EMBANKMENT FOR GENERATING PLANT AREA- CONT'D

I. EARTHWORK

A. The excavation and embankment shall be formed to the sections, slopes and dimensions as shown by Drawings S-148 and S-149.

B. Sections, slopes and dimensions may be changed by the Engineer at his discretion.

C. The Contractor shall be especially careful to slope the excavation in the generating plant area in such a manner to maintain the backslopes with a minimum difficulty. It shall be the responsibility of the Contractor to determine the backslope necessary for the particular soils encountered. However, the slope shall not be steeper than 2:1 (2 horizontal to 1 vertical).

D. The fill material to construct the embankment for the Generating Plant Area shall be excavated from sources designated by the Engineer. A select material as outlined under Form 1714 of these specifications is required. If possible, the select material will be designated in such a manner that it may be obtained in conjunction with the grading of the Plant Site. Prior to starting the embankment for the area under discussion, the Contractor shall consult with the Engineer to determine the source of the fill material. Any fill placed without prior approval of the Engineer shall be removed and replaced as directed by the Engineer at the Contractor's expense.

E. The embankments required under this section shall start from a firm compacted surface from which muck vegetation and other unsuitable material shall have been removed. It shall be compacted to the density required for the embankment.

F. Any unsuitable material excavated in the process of obtaining the select material required shall be placed as directed by the Engineer.

EXCAVATION & EMBANKMENT FOR GENERATING PLANT AREA - CONT'D

G. The embankment shall be loosely placed in layers not exceeding ten (10) inches. Each layer of fill shall be thoroughly compacted obtaining not less than 95% of the maximum Modified Procter density inaccordance with ASTM test D1557, latest addition. Compaction shall be performed within 2½% of the optimum moisture content.

H. The Contractor shall be required to excavate the area as shown by the referenced drawings in such a manner that will permit drainage of surface water and maintaining a dry area. Article 5. 3 of Form 1714 shall apply.

I. When material varies from optimum moisture content, it shall be treated as follows: When wet, it shall be drained or worked until optimum moisture content is attained. When dry it shall be sprinkled with water and mixed until optimum moisture content is attained.

J. The Contractor's unit price for excavation shall be based on a free haul distance of 2000 feet. In the event that the Contractor is required to haul dirt in excess of the 2000 foot free haul distance he shall be paid at the unit price bid for overhaul per yard - quarter. Item 140 (Overhaul) of the 1972 Texas Highway Standard Specification is hereby referenced as the governing specification. The 2000 foot free haul distance is substituted for the 600 foot free haul distance specification in Item 140. Approval and authorization in writing from the Engineer must be obtained before payment will be made for overhaul.

K. Estimated Quantities:

105,000 cubic yards - excavation
86,000 cubic yards - embankment

L. Basis for Payment:

Price per cubic yard excavation
Price per cubic yard embankment
Price per yard-quarter overhaul

QUANTITIES SUMMARY SHEET
(For Contractor's Information)

Item No.	Description	Unit	Plant Site Area	RR Bed Const.	Ash Pit and Dikes	Excav. & Emb. -Gen. Plan	Total Estimat Quanti
1.	Clearing	Acre	---	---	32	---	32
2.	Clearing & Grubbing	Acre	21	10	20	---	51
3.	Re-Grubbing	LS	180 Ac.	---	---	---	180 Ac.
4.	Excav. (Comm. Unclassified)	CY	543,000	126,000	1,000	105,000	775,000
5.	Excavation(Core Trench)	CY	---	---	97,000	---	97,000
6.	Excavation (Discharge Flume)	CY	---	---	100,000	---	100,000
7.	Stockpile Topsoil	CY	30,000	15,000	2,000	---	47,000
8.	Embankment (Density Control)	CY	335,000	104,000	160,000	86,000	685,000
9.	Overhaul	YQ	40,500	20,500	12,500	43,000	116,500
10.	Placing 96" dia. Steel Conduit	LF	220	---	---	---	220
11.	Structural Excavation (Culverts)	CY	1,550	450	---	---	2,000
12.	Concrete (C.I.A.) (Headwalls)	CY	35	20	---	---	55
13.	CMP (8 gauge)(Bitum. Coated)(72" dia.)	LF	---	270	---	---	270
14.	CMP (8 gauge)(Bitum. Coated)(60" dia)	LF	304	---	---	---	304
15.	CMP (10 gauge)(Bitum. Coated)(48" dia.)	LF	72	---	---	---	72
16.	CMP (12 gauge)(Bitum. Coated)(36" dia.)	LF	328	---	---	---	328
17.	CMP (12 gauge)(Bitum. Coated)(30" dia.)	LF	120	---	---	---	120
18.	CMP (14 gauge)(Bitum. Coated)(24" dia.)	LF	116	---	124	---	240
19.	CMP (Arch)(36"x22")(14 gauge)(Bitum. Coated)	LF	84	36	---	---	120
20.	CMP (Arch)(22"x13")(14 gauge)(Bitum. Coated)	LF	70	---	---	---	70
21.	Rip-Rap (Rock)	SY	---	---	19,000	---	19,000
22.	Placing Topsoil (4" Compact.)	SY	---	130,000	10,000	---	140,000
23.	Erosion Control (Seeding, Fertilizing, mulching, and watering)	SY	---	130,000	10,000	---	140,000
21-Alt.	Rip-Rap (Con. Cl. B)(4")	SY	---	---	19,000	---	19,000

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STANDARD SPECIFICATION FOR EARTHWORK

(Form 1714)

1. GENERAL

1.1 Earthwork shall conform to the requirements of this Standard Specification, the Job Specification, and the design drawings. In the event of variance between this Standard Specification and the Job Specification or design drawings, the Job Specification and the design drawings shall take precedence.

1.2 Where the terms "as indicated" or "indicated" are used in this Standard Specification, they shall mean "as shown, noted, called for or specified".

1.3 All references to the following publications are to the latest issue of each, together with the latest additions and/or amendments thereto, as of the date of Contract, unless otherwise indicated; references to the sponsoring agencies will be made in accordance with the abbreviations indicated:

1.3.1 ASTM	American Society for Testing and Materials Standard Specifications.
1.3.2 ASA	American Standards Association Standard Specifications.
1.3.3 AASHO	American Association of State Highway Officials Standard Specifications.

2. SOIL DATA AND TOPOGRAPHY

2.1 Soil Data: Drawings show borings made at site, and logs given thereon indicate character of soil. This information furnished for Contractor's convenience; in using it Contractor assumes the risk, as Purchaser and the Consulting Engineers assume no responsibility for accuracy of information shown thereon. Contractor will be permitted to make his own soil investigations, but same shall be made at no cost to Purchaser.

2.2 Topography: Drawings indicate elevations, dimensions and/or cross sections, profiles and contour lines of existing ground. This information furnished for Contractor's convenience; in using it Contractor assumes the risk, as Purchaser and the Consulting Engineers assume no responsibility for accuracy of information shown thereon. Contractor will be permitted to make his own investigation of topography during bid period, but same shall be made at no cost to Purchaser.

3. LINES AND GRADES

3.1 Contractor shall lay out lines and grades from existing base lines and bench marks on property and be fully responsible for correctness of such lines and grades and for proper execution of WORK to such lines and grades.

3.2 Purchaser reserves right to verify correctness of lines and grades during progress of WORK. Such verification by Purchaser will not relieve Contractor of responsibility as specified foregoing.

3.3 Contractor shall notify Consulting Engineers of any differences in location of existing work from that indicated, wherever such differences may affect new work.

3.4 Contractor shall preserve and maintain all bench marks and reference points established by Purchaser. Should Contractor, during prosecution of WORK, destroy or remove any bench marks and/or reference points established by Purchaser, the cost to Purchaser of re-establishing these bench marks and/or reference points will be charged to Contractor.

4. CLEARING

4.1 Prior to performing excavation or fill work, areas in which such work is to be done shall be cleared, grubbed and the top soil and sod removed. No clearing, grubbing or removal of top soil and sod shall be done outside designated areas without specific approval.

4.2 If extensive clearing, grubbing and removal of top soil and sod is required, the Job Specification or drawings will specifically so indicate. If such work is incidental, then it will not be specifically indicated and shall be performed prior to, but as part of, excavation work.

4.3 Clearing:

4.3.1 Clearing is defined as removal and disposal of all trees, down timber, snags, brush, hedges, bushes and all other vegetation or organic materials, and also all rubbish, debris or other foreign or objectionable materials above ground surface, except removal of sod and top soil.

4.3.2 Removal of structures, such as buildings, roadways, fences, etc., is classified as demolition and not as clearing, and will be indicated in the Job Specification (under Demolition Work) or on drawings.

4.3.3 Trees shall be filled in such manner as not to damage other trees or other vegetation which are to remain in place nor damage existing structures and facilities nor constitute a hazard to traffic or life.

4.4 Grubbing: Grubbing is defined as removal and disposal of all stumps, large roots, buried logs and all other objectionable material from below ground surface. Explosives may be used only if specifically approved and their use shall conform to all applicable laws and safety regulations.

4.5 Disposal:

4.5.1 All materials from clearing and grubbing operations shall be Contractor's property and shall be promptly disposed of off the site unless otherwise indicated in the Job Specification or on drawings; accumulation of such materials on premises not permitted.

4.5.2 Burning of Debris on Premises: If burning of debris on premises is permitted by the Job Specification, drawings or Purchaser, conform to following requirements:

4.5.2.1 Burn debris only in areas specifically designated by Purchaser.

4.5.2.2 Prior to burning any material, secure approval and permits from, and comply with all regulations of all authorities and all public bodies having jurisdiction in area of WORK.

4.5.2.3 Neatly pile all combustible material and burn when in suitable condition. Do piling in such manner and in such locations as to cause least fire risk.

4.5.2.4 Burn material thoroughly and completely so that materials are reduced to ashes, with no charred pieces, such as charred logs, remaining. Ashes and charcoal residue need not be removed. Combustible materials difficult to burn, such as tree stumps and root clumps, may be buried below grade, with not less than 1'-0" of cover over them and level with surrounding grade, if grubbing is not required for the WORK; if grubbing is required, then all such unburnable materials shall be disposed of off the premises.

4.5.2.5 Fire Protection: Provide fire fighting facilities, satisfactory to authorities having jurisdiction and to Purchaser and maintain such facilities in first class operating condition during course of burning operations.

4.6 Removal of Top Soil and Sod:

4.6.1 Top soil and sod shall be removed as part of excavation work, unless the Job Specification or drawings indicate that top soil and/or sod shall be removed and stored for reuse by Contractor or by others.

4.6.2 If top soil is indicated to be removed for reuse, it shall be carefully stripped off, stored in separate stockpiles and kept clean and free of all foreign material. Sod and other vegetation shall be removed from the top soil before it is stockpiled.

4.6.3 If sod is indicated to be removed for reuse, it shall be carefully removed, rolled up, and stored in a suitable and well protected manner, as approved.

4.6.4 If top soil and/or sod is indicated to be reused by Contractor, any and all excess stockpiles remaining on completion of WORK shall be removed and disposed of off the premises unless otherwise requested.

5. <u>EXCAVATION</u>

5.1 Excavation is defined to include all incidental clearing, all excavation and disposal of excavated materials, all protection, sheeting, shoring, bracing and cofferdams, all dewatering, and preparation of bearing areas as required to properly install and complete the WORK, regardless of portions of WORK for which required, and regardless of nature of materials encountered in excavating. Dredging shall be performed only if specified in the Job Specification or on the drawings.

5.2 Classification: Excavation shall be classified as earth or rock excavation, as follows:

5.2.1 Earth excavation is all material not classified as rock excavation.

5.2.2 Rock Excavation:

5.2.2.1 Rock excavation is defined as any material that requires the continuous use of drilling and blasting, or drilling, channeling, etc., and shall include granite, trap, quartzite, chert, limestone, hard sandstone, hard shale or slate or other similarly hard materials, as well as rocks and boulders measuring 1/2 cubic yard or more.

5.2.2.2 The Job Specification or drawings will indicate whether blasting is permitted. Blasting, if permitted, shall conform to requirements of 5.11, following.

5.3 Dewatering: Contractor shall provide and operate all dewatering equipment required for areas excavated by Contractor, and be responsible for maintaining a dry site satisfactory to Purchaser and Consulting Engineers.

5.4 Protection and Support:

5.4.1 Contractor shall provide all protection and support as required to properly install the WORK, as required for protection and support, of the WORK and of adjacent structures and improvements, and as required for safety of traffic and life.

5.4.2 Protection and support shall include temporary sheeting, bracing, shoring and cofferdams, and also, where indicated, permanent sheeting, bracing and shoring. All temporary sheeting, bracing, shoring and cofferdams shall be as approved, and all such temporary work shall be removed by Contractor when its use is no longer required, unless otherwise requested or approved.

5.4.3 Banks at excavations shall be protected and supported, where necessary or where requested, so that the banks and bottoms will be maintained and adjacent structures or other construction will be protected from damage caused by any earth or rock movement.

5.4.4 Protection and support shall be arranged for minimum interference with pipe laying, electrical ductwork installation and similar work.

5.4.5 Temporary Cofferdams: Contractor shall design temporary cofferdams required by him to perform his work and shall submit drawings thereof for approval. These drawings shall show all data on which the design is based. No such work shall be installed until such approval is received, and the work shall be done only in accordance with these approved drawings.

5.5 Earth excavations shall be of sufficient size to allow for placing of formwork for concrete, for inspection of formwork and surfaces of completed concrete, and for dampproofing, waterproofing, pipework, electrical ductwork, etc. Rock excavations shall be to neat lines unless otherwise indicated; where overbreak of rock occurs behind a vertical face of concrete placed against rock, overbreak shall be filled with the same concrete as required for the vertical face, and no payment will be made for concrete fill.

5.6 Excavations shall be carried to elevations indicated on drawings, and as follows:

5.6.1 Earth Excavation: Foundation excavations carried below the indicated level shall be filled with the same concrete as required for the foundation; other earth excavations carried below the indicated level shall be brought up to the proper level with compacted fill, sand, crushed stone, gravel or concrete, as determined most suitable by the Consulting Engineers.

5.6.2 Rock Excavation: When designated or approved elevations have been reached, rock surfaces shall be leveled off and all loose rock removed. Where overbreak of rock results in dropping elevations of rock surfaces below designated or approved elevations, overbreak shall be filled with the same concrete as required for the foundations.

5.6.3 No payment will be made for any of the foregoing specified fill required to remedy over-excavation in earth or overbreak in rock.

5.7 Hand excavation shall be used, if requested, for trenching or other excavation adjacent to structures or equipment where use of mechanical excavating equipment is not considered advisable by Purchaser or the Consulting Engineers.

5.8 Bearing Areas:

5.8.1 Bearing areas for all foundations shall be inspected and approved by Purchaser or the Consulting Engineers before any concrete is placed. If bearing areas are not suitable, as determined by the Consulting Engineers, Contractor may be requested to carry the excavations deeper to more suitable bearing material; such additional excavation will be paid for on the unit price basis set forth for the WORK. Contractor may also be requested by the Consulting Engineers to make auger borings or other tests at bearing areas to determine thickness of bearing stratum; these tests will be paid for on a unit price or cost plus basis, whichever is set forth for this item.

5.8.2 All foundations shall be placed on undisturbed soil unless otherwise indicated or approved.

5.8.3 Before placing any concrete for berms or slabs on fill, the soil shall be well tamped.

5.8.4 Before placing any concrete on soil that will absorb water, the surface of the soil shall be thoroughly wet with clean water immediately before the concrete is placed.

5.9 Excavation for Pipework and Electrical Ductwork:

5.9.1 Make excavation for this work true to grade, profile and alignment, and so as to provide full, even and continuous bedding. For pipework, normally excavate trenches to match curve of pipe; however, flat beds may be used if as economical as curved beds, or shall be used if indicated.

5.9.2 Where granular bedding under pipework or ductwork is indicated in the Job Specification or on drawings, excavate the additional amount required to place the indicated depth of bedding material.

5.10 Disposal of Excavated Materials:

5.10.1 Deposit and spread, or stockpile, excavation materials suitable (in opinion of Consulting Engineers) for fill or backfill, in quantities required and approved, on premises where requested.

5.10.2 For excavated materials not suitable for fill or backfill, the Job Specification or drawings will indicate whether such material is to be disposed of on or off premises, and disposal shall accordingly be as follows:

5.10.2.1 For such material to be disposed of on premises, deposit or spread on premises where approved or requested.

5.10.2.2 For such material to be disposed of off premises, promptly remove this material as excavated; stockpiling of such material will not be permitted.

5.10.3 After completion of fill and backfill work, or when approved or requested, dispose of any and all excess stockpiles or excess excavated materials either on or off the premises as specified in 5.10.2 foregoing.

5.11 Requirements for Blasting: If use of blasting is approved by Purchaser or Consulting Engineers, blasting shall conform to following requirements:

5.11.1 Blasting shall be performed only when proper precautions are taken for protection of persons, the work, private property, etc. Caps or other exploders or fuses shall in no case be stored or transported in same place in which dynamite or other explosives are transported. Location of storage magazines, methods of transportation and, in general, precautions taken to prevent accidents shall, at all times, be subject to approval of Purchaser or Consulting Engineers, but Contractor shall at all times be liable for any injuries to persons or property caused by explosives.

5.11.2 Every possible precaution shall be taken in blasting operations to preserve rock outside lines of excavation in soundest possible condition. Blasting shall be done only to lines and grades indicated on drawings or as approved by Consulting Engineers.

5.11.3 Explosives shall be of such quantity and power and shall be used in such locations as will not tend to open seams, or to crack or damage rock outside prescribed limits of excavation. If needed, firing of blast shall be controlled by use of delayed explosives. Whenever, in the opinion of Consulting Engineers, continuation of blasting may injure rock on which or against which concrete is to be placed, use of explosives shall be discontinued and excavation shall be completed by wedging, boring, channeling or other suitable means.

5.11.4 Contractor shall submit plans and methods of operation for rock excavation work before work is started. Approval of method of blasting or of strength and amount of explosives used will not relieve Contractor of responsibility for blasting operations.

5.11.5 For blasting, Contractor shall employ a supervisor thoroughly experienced in this type of work and shall at all times maintain rigid inspection to see that intent of these requirements are fully complied with.

5.11.6 Contractor shall maintain a complete and detailed record of blasting operations, in a form approved by Purchaser, and shall submit copies of such records to Purchaser as requested.

5.12 Dredging:

5.12.1 Before submittal of bid, Contractor shall obtain a sweeping map from The U. S. Army Corps of Engineers, and shall also determine from them the full extent of their requirements as it will affect the WORK.

5.12.2 Contractor shall furnish, establish and maintain in good order all range marks, stakes, gauges and buoys required for proper execution of this work, and furnish, on request, the use of such boats, boatmen, laborers and materials forming a part of the ordinary and usual equipment and crew used for this work as may be necessary for Purchaser, Consulting Engineers and Corps of Engineers to inspect work.

5.12.3 Contractor shall provide sounding and sweeping equipment and labor to sound and sweep dredged areas to establish that indicated grade, profile and alignment are met.

5.12.4 As soon as possible after completion of dredging work, Contractor shall thoroughly examine dredged area by sounding and sweeping to determine that completed work meets all requirements indicated on drawings and all requirements specified by Corps of Engineers. Arrange with Purchaser for representatives of Purchaser, Consulting Engineers and Corps of Engineers to be present when sounding and sweeping is performed. However, the presence of these representatives shall in no way relieve Contractor of responsibility for accuracy and proper completion of the work.

5.12.5 Any shoals, lumps or other lack of Contract dimensions disclosed by the foregoing examination shall be remedied by Contractor, and shall again be sounded, and swept if required, until the entire dredged area is satisfactory in every respect to Purchaser, Consulting Engineers and Corps of Engineers.

5.12.6 Contractor shall maintain a complete record of soundings, in a form approved by Consulting Engineers, and shall submit copies of such records to Consulting Engineers as requested.

6. <u>FILL</u>

6.1 Fill includes the following two classes, with two types under each class; the use of each shall be as indicated in the Job Specification or on the drawings:

6.1.1 Class 1: Regular compacted fill, Types RCF1 and RCF2.

6.1.2 Class 2: Controlled compacted fill, Types CCF1 and CCF2.

6.2 Services of Testing Laboratory: Where controlled compacted fill is specified, Purchaser will furnish services of a Testing Laboratory to determine suitability of fill material, to set optimum moisture contents, and to perform field tests to check on compliance with moisture and density requirements. Contractor shall furnish the Testing Laboratory with all required quantities of fill material, from the same source as will be used for the WORK, as required for test purposes.

6.3 Class 1, Regular Compacted Fill:

6.3.1 The two types are based on the materials specified for use as fill, as follows:

6.3.1.1 Type RCF1: Granular material (sand, crushed stone, gravel, etc).

6.3.1.2 Type RCF2: Cohesive material (clay, sandy loam, silty loam, etc).

6.3.2 Material: The Job Specification or drawings will indicate the source of materials to be used, such as material from excavation at the site, or from borrow pits, or from off site sources, etc. All material used shall be as approved by Purchaser and/or the Consulting Engineers.

6.3.3 Preparation of Subgrade: Prior to placing regular compacted fill, strip areas to be covered of all vegetation or other organic material or other foreign or deleterious material.

6.3.4 Compaction Densities: Build up fill to grade elevations indicated or required, with suitable moisture control and compaction throughout placing, as specified in 6.3.5 following, to produce a completed fill capable of supporting trucks and other heavy construction equipment.

6.3.5 Placing of Fill: Place as follows, unless otherwise approved or requested:

6.3.5.1 Place fill, with suitable moisture content, in uniform horizontal layers not over 9" deep before compaction.

6.3.5.2 For Type RCF1 granular fill, compact by successive high speed passage of heavy tractors (with treads covering 100% of area), or with other <u>vibratory type</u> equipment, as approved.

6.3.5.3 For Type RCF2 cohesive fill, compact by use of sheeps foot roller or with other <u>camming type</u> equipment, as approved.

6.3.5.4 In places inaccessible to large equipment, obtain required compaction with mechanical vibrators for Type RCF1 granular fill, and with mechanical rammers for Type RCF2 cohesive fill.

6.4 Class 2, Controlled Compacted Fill:

6.4.1 The two types are based on the materials specified for use as fill, as follows:

6.4.1.1 Type CCF1: Granular material (sand, crushed stone, gravel, etc.)

6.4.1.2 Type CCF2: Cohesive material (clay, sandy loam, silty loam, etc.)

6.4.2 Material: Conform to same requirements specified in 6.3.2 for granular fill.

6.4.3 Preparation of Subgrade:

6.4.3.1 Subgrade to receive controlled compacted fill shall be inspected by Purchaser or the Consulting Engineers to determine if it is suitable and has sufficient bearing capacity for the fill material and loads to be placed over it. If subgrade is not suitable, as determined by the Consulting Engineers, Contractor may be requested to perform additional excavation as specified in 5.8 for Bearing Areas, with compensation as specified therein.

6.4.3.2 Prior to placing controlled compacted fill, strip areas to be covered of all vegetation, top soil and all organic material or other foreign or deleterious materials.

6.4.3.3 Thoroughly break and turn soil underlying the filled area to depth of 6" before deposition of fill material. No breaking of ground as more than 200 feet in advance of placing fill.

6.4.4 Compaction Densities: Build up fill to grade elevations indicated or required, with suitable moisture control and compaction throughout placing, as specified in 6.4.5 following, to produce following densities:

6.4.4.1 Decidedly granular fill material: 90% of its maximum density.

6.4.4.2 All other fill material: 95% of its maximum density.

6.4.5 Placing of Fill: Place as follows, unless otherwise approved or requested:

6.4.5.1 Place fill, with optimum moisture content, in uniform horizontal layers not over 6" deep before compaction. Add water, or dry out fill, to maintain optimum moisture content throughout placing and compaction.

6.4.5.2 For Type CCF1 granular fill, compact by successive high speed passage of heavy tractors (with treads covering 100% of area), or with other <u>vibratory type</u> equipment, as approved.

6.4.5.3 For Type CCF2 cohesive fill, compact by use of sheeps foot roller or with other <u>ramming type</u> equipment, as approved.

6.4.5.4 In places inaccessible to large equipment, obtain required compaction with mechanical vibrators for Type CCF1 granular fill, and with mechanical rammers for Type CCF2 cohesive fill.

7. BACKFILL

7.1 Backfill includes general backfilling around all work excavated for by Contractor, and also all other backfill indicated on drawings as by Contractor.

7.2 Backfill shall be approved materials previously excavated at the site or materials obtained from approved borrow pits and shall be free of sod or other deleterious or foreign matter.

7.3 Backfill shall be built up to the grade elevations indicated or required, with suitable moisture control and compaction throughout placing, in the same manner as specified in 6.3 for Regular Compacted Fill, Types RCF1 and RCF2.

7.4 Backfill against foundation walls shall be placed only when directed.

7.5 Backfill Around Underground Piping: Place backfill around underground piping, drain lines, etc., only after piping, drain lines, etc., have been tested and/or inspected and approved. Use special care in backfilling to see that backfill is free of cinders or other materials which may be injurious, in opinion of Consulting Engineers, to such piping, drain lines, etc. Provide backfill free from rocks, hard lumps or clods larger than 3 inches. Do not use sod. Place backfill below top of piping, drain lines, etc., in alternate layers on each side of piping, drain lines, etc. Backfill around corrugated metal drainage pipe, corrugated structural plate pipe or welded steel plate pipe shall also conform to requirements specified in 7.6, following.

7.6 Backfill For Corrugated and Welded Steel Pipe:

7.6.1 Where flat beds for this piping is indicated in Job Specification or on drawings, provide flat granular bedding fill under pipe, with depth of bedding as indicated on drawings. Provide greater depth bedding fill if required by unsuitable soil conditions, as determined by the Consulting Engineers.

7.6.2 Granular Bedding: Use clean crushed stone or gravel, or other approved material, with 1-1/2" maximum size.

7.6.3 After pipe is in place on flat bed, provide controlled compacted granular fill under haunches. Use clean crushed stone, gravel or coarse sand, or other approved material, with 1-1/2" maximum size.

7.6.4 Also provide same controlled compacted granular fill up to center line of pipe.

7.6.5 Fill above center line of pipe and up to grade with select material, as approved, with controlled compaction.

7.6.6 Controlled compaction shall conform to requirements specified in 6.4 for Controlleo Compacted Fill, Types CCF1 and CCF2. Services of Testing Laboratory will also be furnished for this work as specified in 6.2 foregoing.

7.6.7 Use extreme care in placing all compacted fill to maintain fill at approximately the same level (not to exceed one foot differential) on both sides of pipes throughout entire placing of compacted fill.

7.7 Backfill for Electrical Ductruns:

7.7.1 Requirement of Standard Specification STD-EF-103 that clay or loam backfill shall be used for ductruns shall not apply. Any approved previously excavated material may be used for backfill over ductruns that are cast in place, provided that maximum size of material shall not exceed two inches (2").

7.7.2 For precast concrete ductruns, provide a layer of clean, washed sand not less than 2" thick on SIDES AND TOP, with balance of backfill approved previously excavated material not exceeding 2" maximum size. Provide sand cushion for precast ductruns as specified in Job Specification under Concrete Work, or as indicated on drawings.

7.8 Backfill in Roadways: Where existing roadways are cut to install new work, backfill such areas as quickly as possible after completion (including testing, if required) of new work. Bring backfill to within 10" of road surface ready for installation of new roadway by Contractor or by others as indicated in Job Specification or on drawings.

8. <u>GRADING</u>: Consists of rough grading and finish grading, as follows:

8.1 Rough Grading: Cut, fill, spread and level during course of WORK to elevations indicated.

8.2 Finish Grading: Fine grade and level to provide a smooth finish grade free of debris, foreign matter, objectionable stones, clods, lumps, pockets or high spots, properly drained and true to indicated elevations. Do finish grading only near completion of WORK or when requested.

RKANA

'd. 4-8-74

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SOUTHWESTERN LABORATORIES

CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

TEXARKANA

Texarkana Texas April 12,1974 File No.

Report of tests on Soil

To Murray,Link,Thomas & Griffin

Received from Same Date Rec'd. 4-8-74

Identification Marks SWEPCO's Welsh Power Plant

The following samples were taken in order to depict the material available to construct the Ash Pit Dike. Based on the information we have received, it is believed that the higher clay content soils should be used in the core of the dike. We have located some moderate to high plasticity index material lying adjacent to the Ash Pit Dike. The following results were obtained on these materials.

Sieve Sizes % Passing	Gray Clay	Red & Gray Clay
No. 40	100.0	100.0
80	98.9	98.8
100	97.7	98.0
200	97.0	95.2
Liquid Limit	49	48
Plasticity Index	25	24

cc: 2: Murray,Link,Thomas & Griffin
1: Mr. Bill Millard
1: Mr. Emil Rizzio
1: Mr. Ed Bargainear

Lab. No. 14475

SOUTHWESTERN LABORATORIES

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Date Rec'd. 6-3-74

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SOUTHWESTERN LABORATORIES

CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas June 4,1974 File No.

Report of tests on Soil

To Murray,Link,Thomas & Griffin

Received from Same Date Rec'd 5-31-

Identification Marks SWEPCO Welsh Power Plant, Cason,Texas

FIELD DENSITY TESTS

No	Location	Percent Moisture	Dry Density Lbs. Cu Ft	Perce Proct
463	Sta. 7+00 Right of Centerline Primary dike 3' above natural ground	21.0	105.2	96.
464	Sta. 5+75 Right of Centerline Primary dike 2½' above natural ground	22.0	104.3	15.
465	Sta. 4+80 Centerline of primary dike 3' below natural ground	20.1	105.2	96.

Maximum Dry Density at Optimum Moisture 109.4 Lbs. Cu Ft

Optimum Moisture 19.0

cc: 3: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Bargainer

Lab No 14730

SOUTHWESTERN LABORATORIES

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UMONT TEXARKANA
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Date Rec'd. 6-4-74

Dry Density Lbs./Cu.Ft.	Percent Proctor
115.7	96.6
115.1	96.1
114.2	95.3

bs./Cu. Ft.

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CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas June 4,1974 File No.

Report of tests on Soil

To Murray,Link,Thomas & Griffin

Received from Same Date Rec'd 5-30-74

Identification Marks SWEPCO Welsh ower Plant,Cason,Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs. Cu Ft	Percent Proctor
460	Sta. 5+70 Centerline of primary dike 5½' above natural ground	19.6	106.3	97.2
461	Sta. 6+00 3½' above natural ground left of primary dike	20.1	105.9	96.8
462	Sta. 7+00 Left of Centerline, primary dike 3' above natural ground	19.2	106.6	97.4

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture 109.4 Lbs. Cu Ft

Optimum Moisture 19.0 %

cc: 3: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Burgmineer

Lab No 14729

SOUTHWESTERN LABORATORIES

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W. H. HOLLEY

SOUTHWESTERN LABORATORIES
FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA
CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas June 6,1974 File No

Report of tests on: Soil
To: Murray,Thomas & Griffin
Received from: Same
Date Rec'd 6-1-74
Identification Marks: SWEPCO Walsh Power Plant-Cason,Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft	Percent Proctor
466	Sta. 5+50 Rt. Primary Dike 3' Above Natural Ground	22.0	106.1	97.0
467	Sta. 8+00 Lt. Primary Dike 3½ Ft. Above Natural Ground	21.3	105.9	96.8
468	Sta. 7+00 Lt. Primary Dike 3½ Ft. above	20.7	105.1	96.0
469	Sta. 6+00 Rt. Primary Dike 3' above natural ground	20.4	106.4	97.2
470	Sta. 8+00 Rt. Primary Dike 2' Above Natural Ground	20.6	105.6	97.4

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture	109.4	Lbs Cu Ft
Optimum Moisture	19.0	%

cc: 3: Murray,Thomas & Griffin
1: Mr. Emil Rismio
1: Mr. Ed Burgainoer
1: Mr. Bill Millard

Lab. No. 14731

SOUTHWESTERN LABORATORIES

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File No.

Date Rec'd. 5-20-74

Dry Density Lbs./Cu.Ft.	Percent Proctor
105.5	96.4
106.2	97.1
106.0	96.9
107.4	98.2
106.5	97.4
105.3	96.3

Lbs./Cu. Ft.

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FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA
CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana Texas May 23,1974 File No

Report of tests on Soil

To Murray,Link,Thomas & Griffin

Received from Same

Identification Marks SWEPCO Welsh Power Plant, Cason,Texas

Date Rec'd 5-21-74

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs. Cu.Ft	Percent Proctor
437	Sta. 6+80 Left of Centerline, primary dike 4' above natural ground	19.8	106.3	97.2
438	Sta. 5+20 Centerline of primary dike 4' above natural ground	20.4	106.1	97.0
439	Sta. 7+00 Center of primary dike 4' above natural ground	20.2	105.9	96.8
440	Sta. 8+10 Core of primary dike 4' below natural ground	22.1	104.9	95.9

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture 109.4 Lbs. Cu. Ft.

Optimum Moisture 19.0

cc: 2: Murray,Link, Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Burgaineer

Lab No 14666

SOUTHWESTERN LABORATORIES

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RATORIES
BEAUMONT TEXARKANA
MISTS

File No.

Date Rec'd. 5-18-74

Dry Density Lbs./Cu.Ft.	Percent Proctor
106.2	97.1
104.6	95.6
105.9	96.8

Lbs./Cu. Ft.

%

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SOUTHWESTERN LABORATORIES
FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA
CONSULTING, ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas May 21, 1974 File No.

Report of tests on Soil

To Murray, Link, Thomas & Griffin

Received from Same

Identification Marks SWEPCO Welsh Power Plant, Cason, Texas

Date Rec'd. 5-20-74

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft.	Percent Proctor
431	Sta. 2+00 Core of primary dike 4' below natural ground	21.1	105.5	96.4
432	Sta. 3+00 Core of primary dike 4' below natural ground	19.8	106.2	97.1
433	Sta. 4+20 core of primary dike 3' below natural ground	20.2	106.0	96.9
434	Sta. 5+50 Centerline of primary 3' above natural ground	19.3	107.4	98.2
435	Sta. 6+00 right of centerline, primary dike 3' above natural ground	20.7	106.5	97.4
436	Sta. 6+10 left of centerline, primary dike natural gound elevation	19.9	105.3	96.3

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture 109.4 Lbs./Cu. Ft

Optimum Moisture 19.0 %

cc: 2: Murray, Link, Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Bargaineer

Lab No. 14659

SOUTHWESTERN LABORATORIES

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— File No.

Date Rec'd. 5-17-74

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	Dry Density Lbs./Cu.Ft.	Percent Proctor
	105.5	96.4
	106.3	97.2
	106.0	96.9
	105.9	96.8

4 Lbs./Cu. Ft.
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SOUTHWESTERN LABORATORIES

FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA
CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana Texas May 21,1974 File No

Report of tests on Soil

To Murray,Link,Thomas &Griffin

Received from Same Date Rec'd. 5-18-7

Identification Marks SWEPCO, Welsh Power Plant-Cason,Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft.	Percent Proctor
428	Sta. 7+00 Core of primary dike 2' above natural ground			
429	Sta. 6+80 natural ground core of primary dike	20.7	106.2	97.
430	Sta. 6+80 2' above natural ground right side of primary dike	21.0	104.6	95.
		19.8	105.9	96.

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture 109.4 Lbs Cu Ft
Optimum Moisture 19.0 %

cc: 2: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Burgaineer

Lab No 14658

SOUTHWESTERN LABORATORIES

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Rec'd. 5-16-74

ty Ft.	Percent Proctor
l	92.4
	95.9
	97.1

SOUTHWESTERN LABORATORIES
FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA
CONSULTING, ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas May 21,1974 File No. ____

Report of tests on	Soil		
To	Murray,Link,Thomas & Griffin		
Received from	Same	Date Rec'd.	5-17-74
Identification Marks	SWEPCO Welsh Power Plant, Cason,Texas		

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft.	Percent Proctor
424	Sta. 7+00 Natural Ground Elev. Core of Primary Dike			
425	Sta. 6+25 1' below natural ground core of primary dike	21.4	105.5	96.4
426	Sta. 7+10 Below natural ground core of primary dike	20.7	106.3	97.2
427	Sta. 6+75 Right side of primary dike 1' above natural ground	21.3	106.0	96.9
		20.9	105.9	96.8

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture	109.4	Lbs. Cu. Ft.
Optimum Moisture	19.0	%

cc: 2: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Bargainer

Lab No 16657

SOUTHWESTERN LABORATORIES

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FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA
CONSULTING, ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas May 21,1974 File No.

Report of tests on Soil

To Murray,Link,Thomas & Griffin

Received from Same Date Rec'd. 5-16-74

Identification Marks SWEPCO, Walsh Power Plant, Carson, Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft.	Percent Proctor
421	Sta. 6+50 Core of Dike 3' below natural ground primary dike	21.0	101.1	92.4
422	Sta. 7+00 Core of Dike 3' Below natural ground primary Dike	22.4	104.9	95.9
423	Sta. 6+50 Retest	20.8	106.2	97.1

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture 109.4 Lbs. Cu. Ft.

Optimum Moisture 19.0 %

cc: 2: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Al Burgaineer

Lab No 14656

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FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA
CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas April 22, 1974 File No.

Report of tests on Soil

To Murray, Link, Thomas & Griffin

Received from Same

Identification Marks SWEPCO Welsh Power Plant, Cason, Texas

Date Rec'd. 4-19-74

Sample # 1 Centerline of Dike-Sta. 7+00
Orange Sandy Clay With Iron Ore

% Passing # 40	89.9
% Passing # 60	84.9
% Passing # 100	66.5
% Passing # 200	49

Atterberg Limits

Liquid Limit	28.0
Plasticity Index	12

Sample # 2-Sta. 0+00 N, Sta. ~~0+00~~ 3+50W West
Red Sandy Clay

% Passing # 40	99.4
% Passing # 60	98.6
% Passing # 100	90.0
% Passing # 200	71.2

Atterberg Limits

Liquid Limit	36
Plasticity Index	18

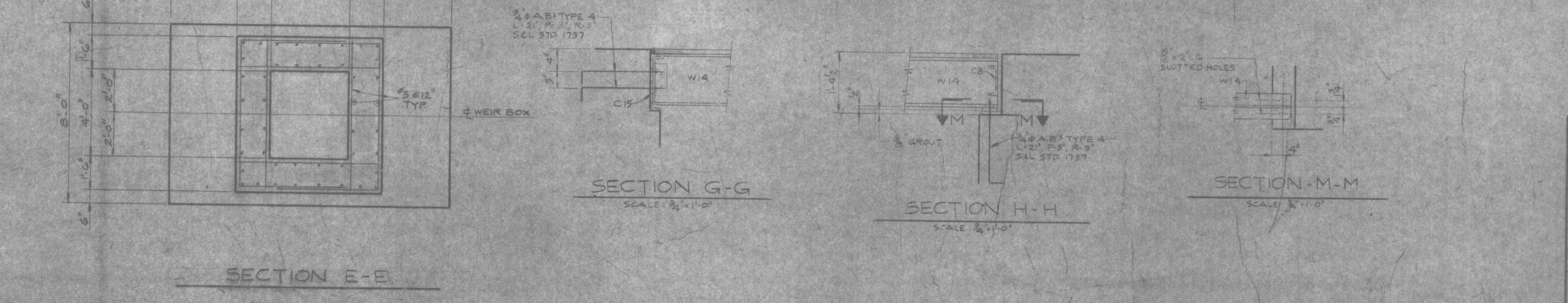
RECEIVED
1974
W. R. HOLLEY

cc: 2: Murray, Link, Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Ed Bargaineer
1: Mr. Bill Millard

Lab No 14525

SOUTHWESTERN LABORATORIES


OLD
6
5
200'
100'
1000'
20+00 S
350'
200'
BOTTOM ELL 325.0'
"B"
CREST ELL 334
345
350
"C"
ASH POND AREA
340
330
310
℄ TRACK
℄ ROAD 1+55
00+35 S
159'
EMERGENCY SPILLWAY
100'
3:1
EL 325
PASSING TRACK SEE S-40
FOR GRADING DETAILS IN DUMPER AREA SEE DWG S-43
24" Ø CMP
SECONDARY SETTLING AREA
ELEV 320
300
T/DIKE ELEV 340
16+33 S
5+47 W
SCREEN HOUSE UNIT #1
SCREEN HOUSE UNIT #2
DUMPER



S13

Released For Const. 3-3-77
E.P.B. 6 copies
D.E.W. 4 copies

NOTES

1. FOR GENERAL NOTES SEE DWG. S-102.

REFERENCE DRAWINGS

S-11 SITE DEVELOPMENT PLAN.
S-12 ASH POND & SECONDARY SETTLING AREA

Drawing Release Record

Rev.	Date	Init.	Description
A	6-10-74	MSM	RELEASED FOR CONST.
B	7-24-74	MSM	LOCATE & W...
C	3-3-77	BIP	ADDED INST. PIPE

WEIR BOX
PLAN & SECTIONS
WELSH POWER PLANT UNIT 1
SOUTHWESTERN ELECTRIC POWER CO.
CASON, TEXAS

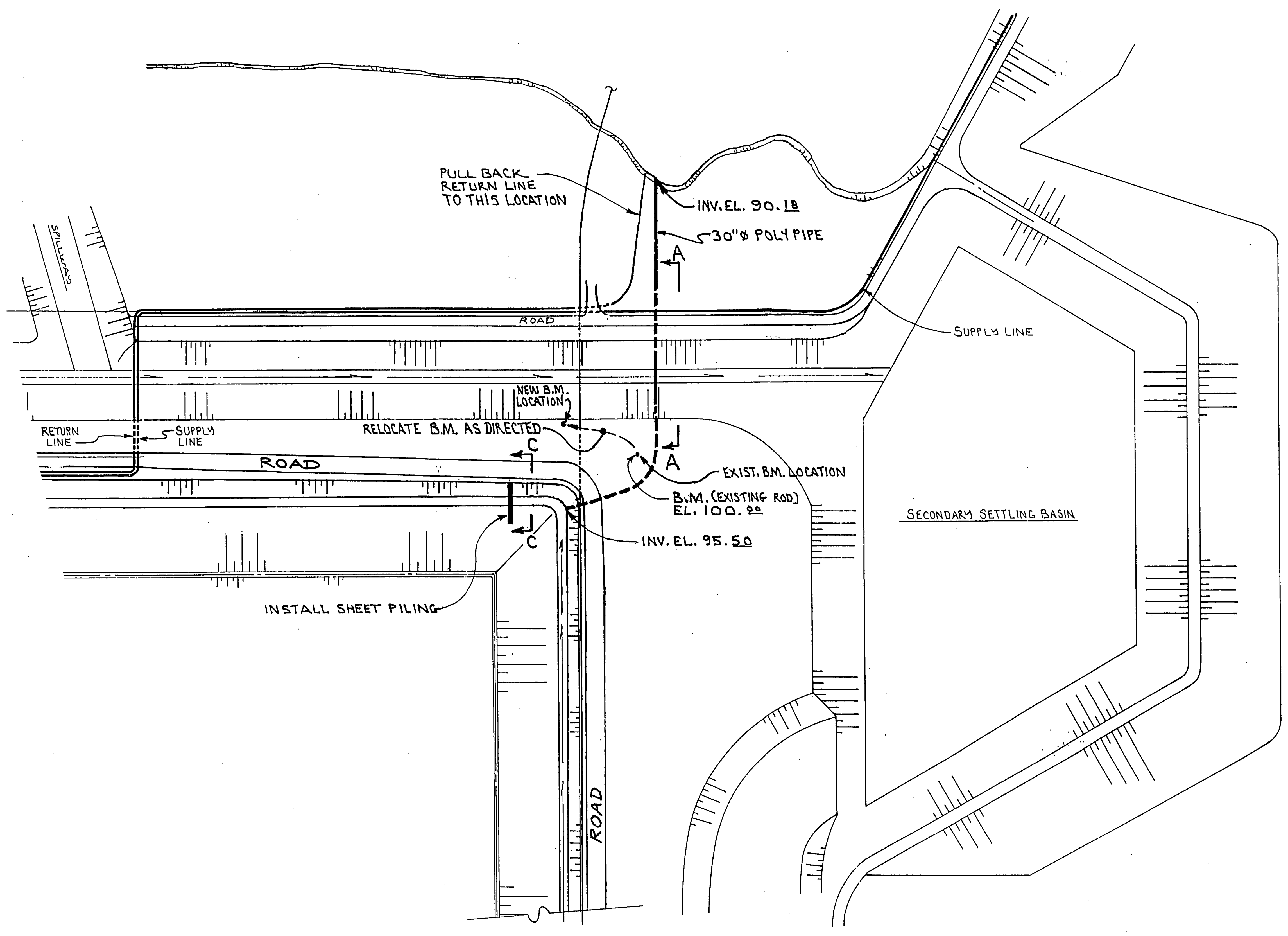
SCALE ⅜"=1'-0" UNLESS NOTED
DRAWN TOWNSEND 8-1-73
CHECKED
ENGINEER
APPROVED
JOB NO.

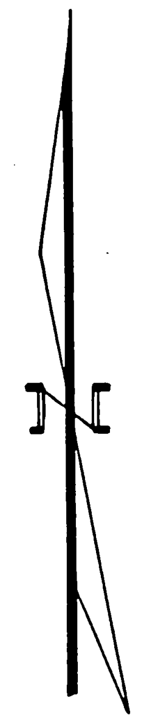
SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO.
S-13

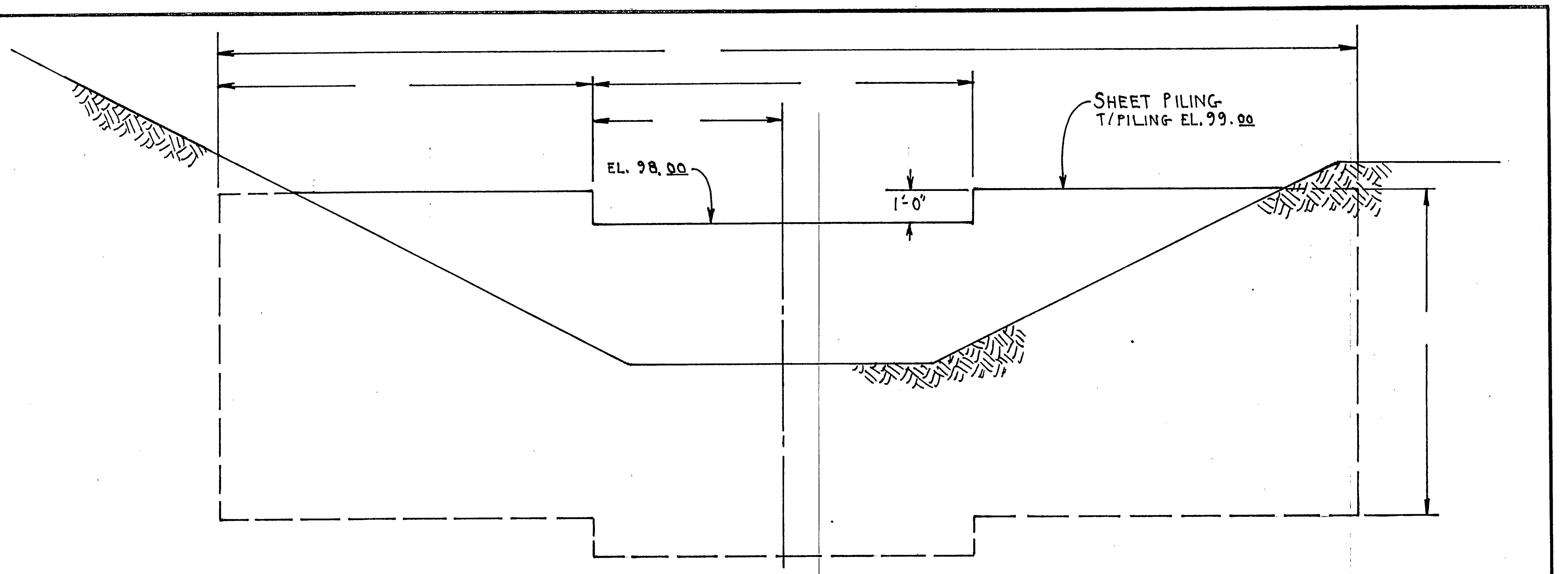
ATTACHMENT C

DESIGN DRAWINGS

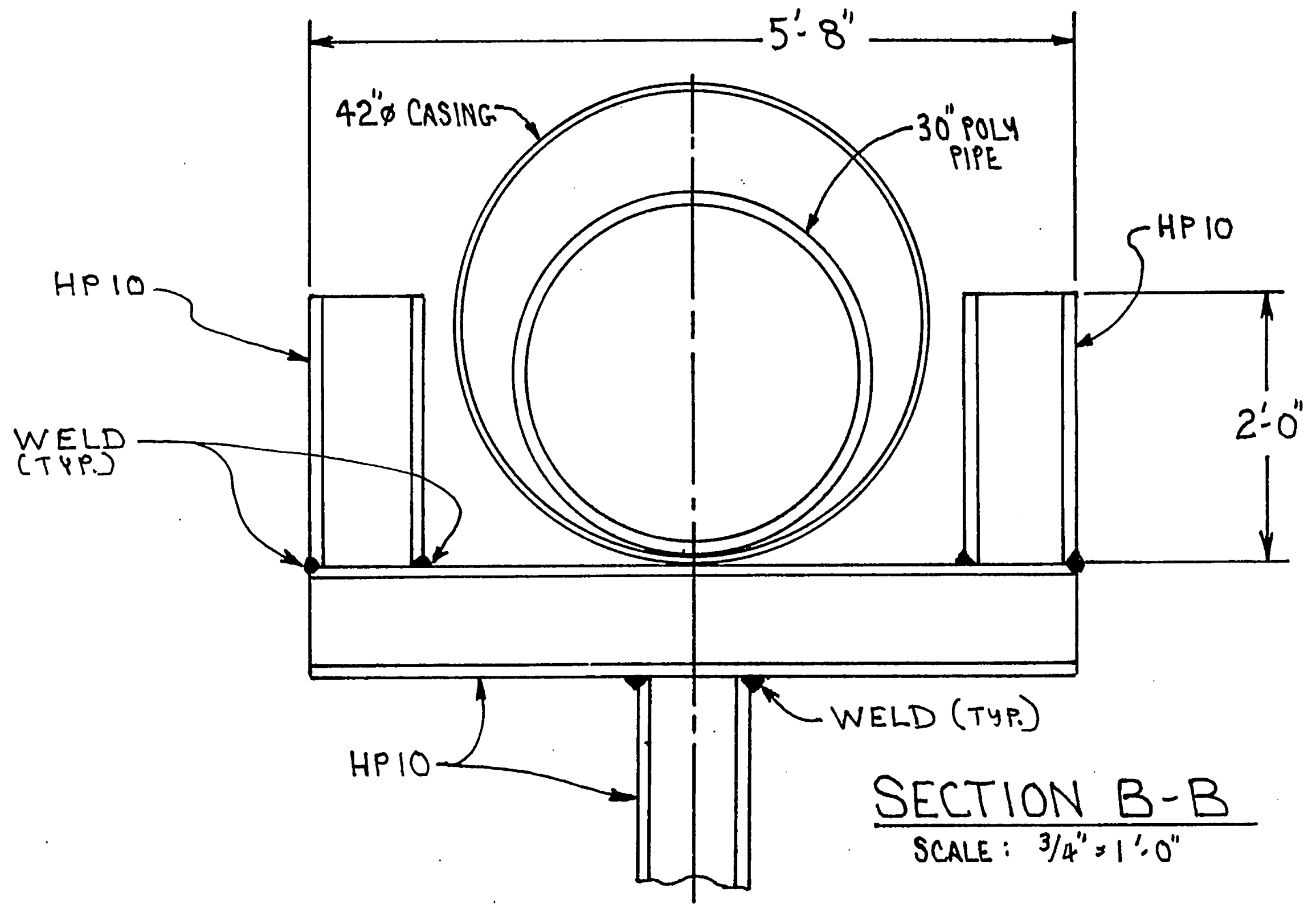




PLAN VIEW
SCALE: 1" = 100'



SECTION C-C
SCALE: 3/8" = 1'-0"



SECTION B-B
SCALE: 3/4" = 1'-0"

SECTION A-A
SCALE: 3/16" = 1'-0"

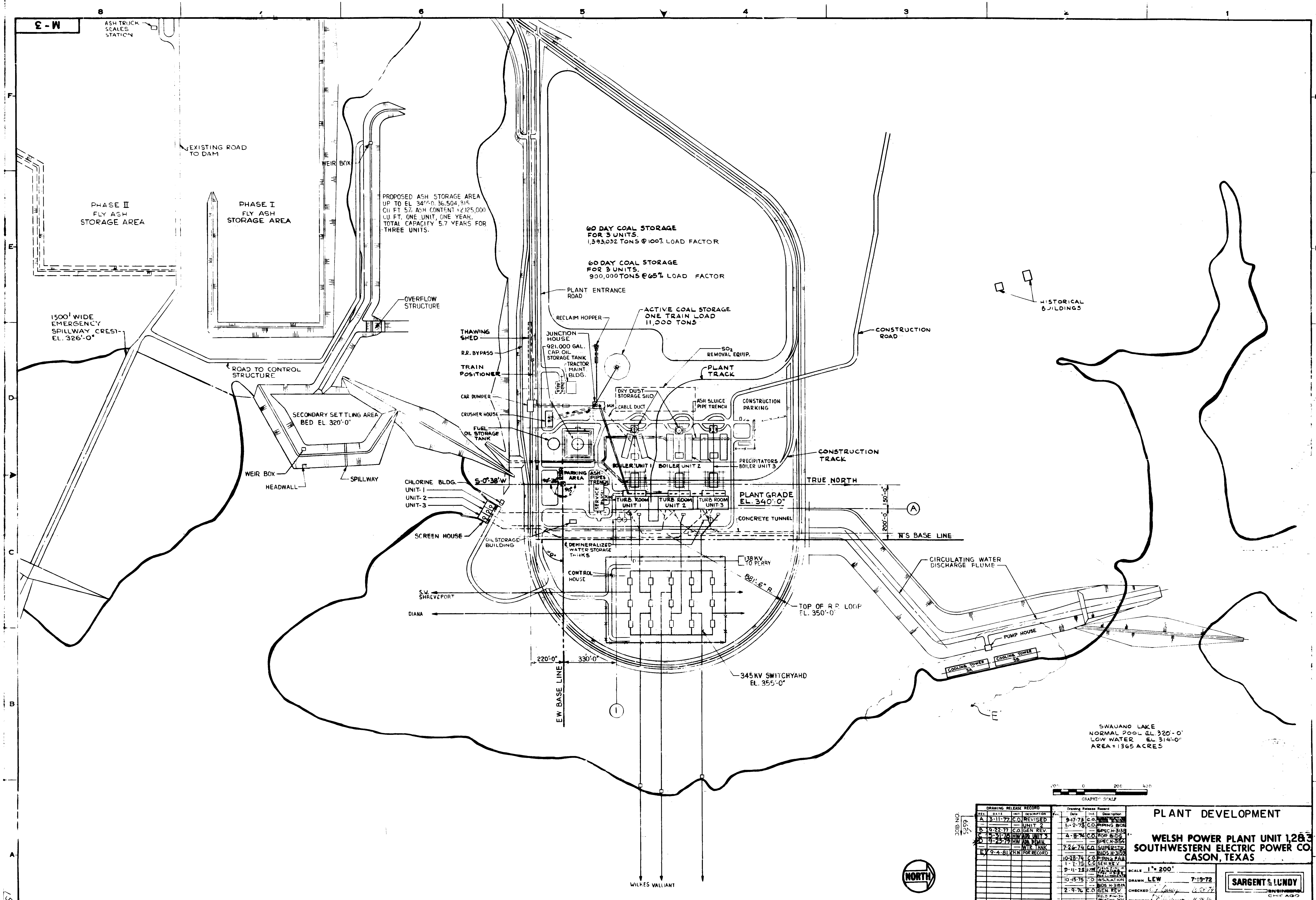
* ACTUAL LENGTH OF HP BEAM DRIVEN INTO GROUND TO BE SHOWN ON DRAWING AFTER COMPLETION

REV	W.O.	BY	DATE	SUBJECT	APPROVED

AREA DRAINAGE
PLAN
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

A E P

DEPT.
DIV.
APPROVED
DRWN. BY: B Potter
DATE: 12-5-00
SCALE: AS NOTED
W.O.
SH. 1
DRWG. NO. WEPX-343



JOB NO. 5259

DRAWING RELEASE RECORD

REV.	DATE	INIT.	DESCRIPTION
A	3-11-77	C.O.	REVISED
—	—	—	UNIT 2
B	9-22-77	C.O.	GEN. REV.
C	5-31-78	HW	ADD UNIT 3
D	9-25-79	HW	ADD DEMIN.
—	—	—	WTR. TANK
E	9-4-81	H.W.	FOR RECORD

Drawing Release Record

Rev.	Date	Init.	Description
	9-17-73	C.O.	[illegible]
	1-2-73	C.O.	PIPING BIDS
	—	—	SPEC. H-3138
	4-8-74	C.O.	FOR BIDS
	—	—	SPEC. H-3154
	7-26-74	C.O.	SUPERSTR.
	—	—	BIDS H-3159
	10-28-74	C.O.	PIPING FAB
	1-7-75	C.O.	GEN. REV.
	9-11-75	[illegible]	FIELD FINISH PAINTING SPEC H 3185 FOR COMMENTS
	10-15-75	C.O.	INSULATION
	—	—	BIDS H-3187A
	2-9-76	C.O.	GEN. REV.
	3-16-76		FIELD FINISH PAINTING SPEC H 3183 FOR BIDS
	4-5-78	C.O.	GEN. REV.

PLANT DEVELOPMENT

WELSH POWER PLANT UNIT 1,2&3
SOUTHWESTERN ELECTRIC POWER CO.
CASON, TEXAS

SCALE 1" = 200'
DRAWN LEW 7-19-72
CHECKED 10-28-74
ENGINEER 10-28-74
APPROVED 10-28-74

JOB NO.	JOB NO.	JOB NO.
4812	5259	5464

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO.
M-3

NOTES

REFERENCE DRAWINGS

SITE DEVELOPMENT PLAN
ASH POND SITE PLAN & CROSS SECTIONS SHEET 1
ASH POND LAKE & CROSS SECTIONS SHEET 2
SECONDARY SETTLING AREA SPILLWAY
PLAN, SECTION & PROFILE DISCHARGE FLUME
SECONDARY SETTLING AREA WEIR BOX STRUCTURE

Rev.	Date	Init.	Description
B	10-25-73	MJJ	GEN REV
C	12-6-73	MJJ	ADDED NOTE
D	5-30-74	MJS	REVISE DRAWING
E	7-24-74	JSM	RELOCATE SECONDARY DIKE
F	8-12-74	JSM	[illegible]

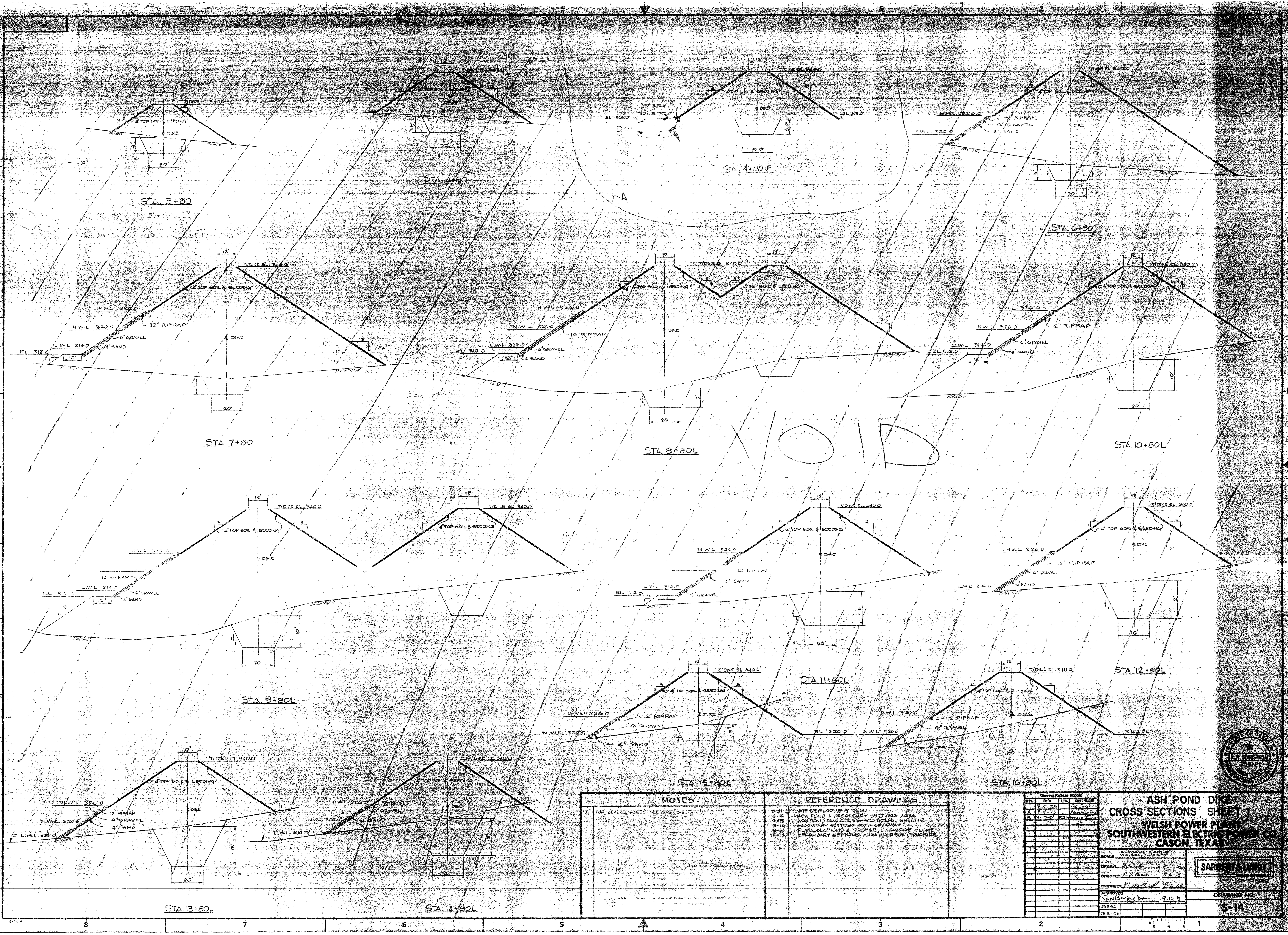
ASH POND & SECONDARY SETTLING AREA
WELSH POWER PLANT
SOUTHWESTERN ELECTRIC POWER CO.
CASON, TEXAS

SCALE
DRAWN
CHECKED
ENGINEER
APPROVED

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO.
S-12

#4



NOTES
1. FOR GENERAL NOTES SEE DWG. S-11

REFERENCE DRAWINGS	
S-11	SITE DEVELOPMENT PLAN
S-12	ASH POND & SECONDARY SETTLING AREA
S-15	ASH POND DIKE CROSS-SECTIONS, SHEET-2
S-16	SECONDARY SETTLING AREA SPILLWAY
S-18	PLAN, SECTIONS & PROFILE DISCHARGE FLUME
S-13	SECONDARY SETTLING AREA WEIR BOX STRUCTURE

Drawing Release Record

Rev.	Date	Init.	Description
	9-11-73		For Const.
A	9-18-73		Relocated Dike
B	9-17-74	MJM	Remove Sand Gravel

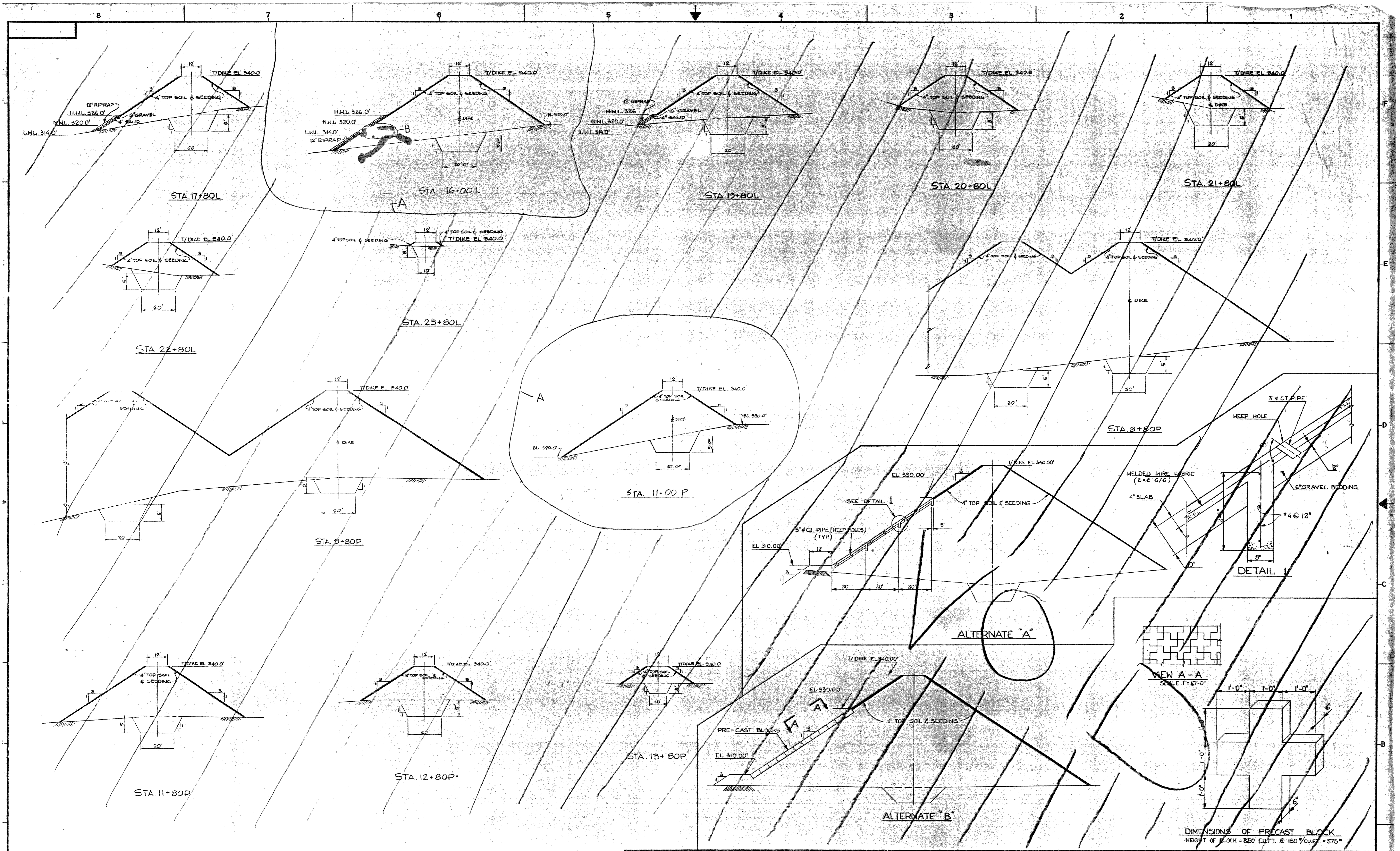
ASH POND DIKE
CROSS SECTIONS SHEET 1
WELSH POWER PLANT
SOUTHWESTERN ELECTRIC POWER CO.
CASON, TEXAS

SCALE HORIZONTAL 1" = 20'-0" VERTICAL 1" = 10'-0"
DRAWN D. Cecel 6-17-73
CHECKED R. P. Panati 9-6-73
ENGINEER W. Millard 9-7-73
APPROVED R N Bergstrom 9-10-73
JOB NO. 4512-03

SARGENT & LUNDY
CHICAGO

DRAWING NO.
S-14

R. N. BERGSTROM 25972



NOTES

1. FOR GENERAL NOTES SEE DWG. S-11

REFERENCE DRAWINGS

S-11	SITE DEVELOPMENT PLAN
S-12	ASH POND & SECONDARY SETTLING AREA
S-14	ASH POND DIKE CROSS-SECTIONS, SHEET-1
S-16	SECONDARY SETTLING AREA SPILLWAY
S-18	PLAN, SECTIONS & PROFILE, DISCHARGE FLUME
S-19	SECONDARY SETTLING AREA, WEIR BOX STRUCTURE

Drawing Release Record

Rev.	Date	Init.	Description
	9-11-73		FOR CONST.
A	9-18-73		RELOCATED DIKES

ASH POND DIKE CROSS SECTIONS
SHEET 2
WELSH POWER PLANT
SOUTHWESTERN ELECTRIC POWER CO.
CASON, TEXAS

SCALE HORIZONTAL: 1"=20'-0" VERTICAL: 1"=10'-0"
DRAWN D. Cecal 6-8-73
CHECKED R.P. Pahati 9-6-73
ENGINEER W. Millard 9-7-73
APPROVED R.N. Bergstrom 9-10-73
JOB NO. 4512-03

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO.
S-15

R. N. BERGSTROM
25972

BORING SCHEDULE

BORING	DEPTH
P1, P2, P-3, P-19, P25, P-39, P-43	75'
P-4, P5, P6, P7, P8, P-9, P11. P-12, P-13, P-38	100'
P-30, P-31, P-32, P-47 P-49	25'
P-10	TO ROCK
P-20, P-22, P-28, P-33 P-40, P-44	50'
P-21, P23, P-26, P-36, P-45, P-46	60'
P-34, P-35, P-37	45'
P-48	35'
P-41, P-42	55'
AB-1, AB-2, AB-3, AB-4	20'

PROPOSED BORINGS (UNIT #3)

BORING NO.	BASELINE COORDINATES		BORING DEPTH
P-101	9+20.00N	6+50.00W	75 FT.
P-102	9+10.00N	3+90.00W	75 FT.
P-103	9+80.00N	2+80.00W	75 FT.
✳ P-104	5+12.00S	1+50.00W	60 FT.
P-105	19+00.00N	3+00.00E	50 FT.
P-106	26+00.00N	8+00.00E	50 FT.

✳ SEE NOTE 4

NOTES

1. THE FOLLOWING BORINGS HAVE NOT BEEN TAKEN AND THEIR REFERENCE IS ELIMINATED FROM THE SEQUENCE SHOWN IN THE BORING SCHEDULE. BORINGS P-14, P-15, P-16 P-17, P-18, P-24, P-27.
2. BORINGS AB-1 THRU AB-4 ARE AUGER BORINGS.
3. LEGEND: ◕ BORINGS ALREADY DRILLED
   ⊕ BORINGS TO BE TAKEN
4. BORING P-104 HAS SPECIAL SAMPLING REQUIREMENTS. SEE SPECIFICATION FOR GEOTECHNICAL INVESTIGATION OF UNIT #3.

REFERENCE DRAWINGS

S-2 SOIL BORING LOGS, SHEET-1
S-3 SOIL BORING LOGS, SHEET-2

UNITS #1&2
UNIT #3

NORTH

Drawing Release Record

Rev.	Date	Init.	Description
	1-9-73		FOR BORINGS
A	4-30-73		REV. ENTIRE ARRANGEMENT ADD BORINGS P34 THRU 37
B	6-26-73	J.S	ADD BORINGS P38 THRU 49 & AB-1 THRU AB-4
	10-15-73	J.S	ADDENDUM #1 SPEC. H-3130
C	03-14-78		ADD. BORINGS P-101 THRU P-106
			FOR UNIT 3 SCREEN HOUSE BID &
~~C~~	08-01-78		SPEC. NO. H-4397

SOIL BORING LOCATION PLAN

WELSH POWER PLANT UNIT 1, 2&3
SOUTHWESTERN ELECTRIC POWER CO.
CASON, TEXAS

SCALE 1" = 200'
DRAWN W. MILLER 12-26-72
CHECKED
ENGINEER
APPROVED
JOB NO. 4512 5464-05

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO. S-1

REV.	DATE	BY	SUBJECT
B	3/17/75	MJM	ADDED SIDEWALK, REMOVED HOLD
A	10/18/74	MJM	WIDEN CANAL TO 15' ADD PILING
	8/2/74		REL FOR CONST

ASH SETTLING BASIN
DISCHARGE CONTROL STRUCT.
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.
G.O. CONSTRUCTION DEPARTMENT
DIVISION

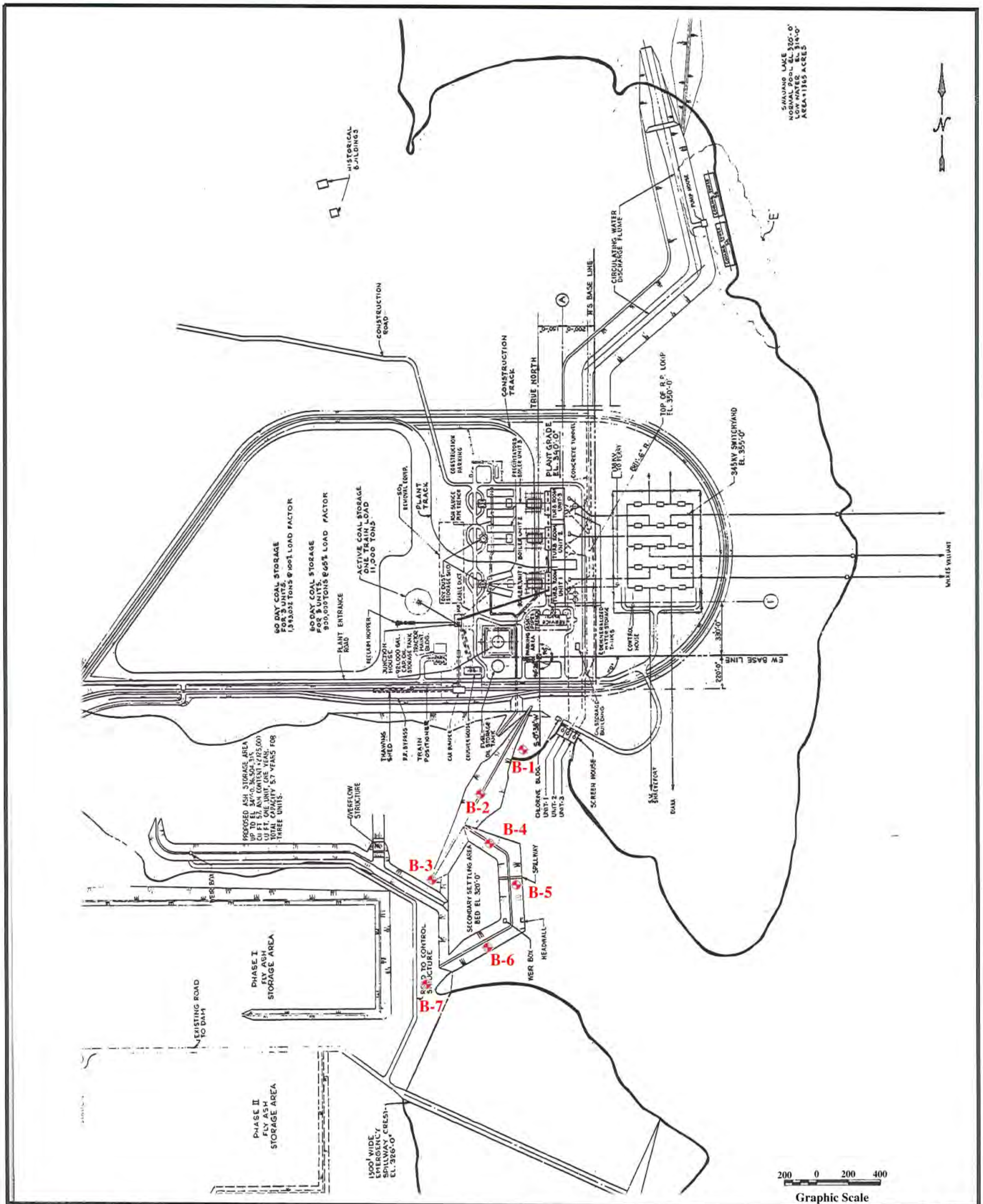
APPROVED ENGR. IN CHARGE
APPROVED DIV. SUPT.
APPROVED CHIEF ENGR.

SHEET
DRWN. BY MJM
TRAC. BY
DATE: 7-11-74
SCALE: 3/8"=1'-0"
WORK ORDER
DRWG. NO. WEPX-31

FILE

ATTACHMENT D

INSTRUMENTATION LOCATION MAP



ETTL ENGINEERS & CONSULTANTS
MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

WELSH POWER PLANT
PITTSBURGH, TEXAS

PLATE 1 - PLAN OF BORINGS

APPROVED BY:

JOB NO.: G3242-095

DRAWN BY: K.C.R.

DATE: JAN. 2010

SCALE: AS SHOWN

LEGEND

——— E ———	OVERHEAD ELECTRIC LINE
——— · · · ———	EDGE OF WATER
— — — — — —	EDGE OF GRAVEL
- - - - - - - -	STORM DRAIN
⌒⌒⌒⌒⌒⌒	WOODLINE
- - - - - - - -	TOP OF BANK/SLOPE
——— · · · ———	TOE OF DITCH/SLOPE
- - - - - - - -	1.0' CONTOUR INTERVAL
- - - - - - - -	5.0' CONTOUR INTERVAL
⊠	SOIL BORING LOCATION
⊕	MONITOR WELL/PIEZOMETER LOCATION
○	POWER POLE
↓	GUY WIRE
⧗	VALVE
▣	MISCELLANEOUS (LABELED)

Monitor Well Coordinate Table

Northing	Easting	TOC Elev	TOS Elev	NG Elev	Descriptor
7082649.9588	3088986.5724	333.28	Not Shot	Not Shot	AD-4
7082723.4133	3088944.5928	342.85	340.01	340.19	AD-4A
7082736.7044	3089027.6153	333.23	329.60	329.55	AD-4B
7085241.9050	3087322.4546	346.33	343.42	329.31	AD-6
7085379.0300	3088971.0772	350.82	347.90	347.86	AD-7
7085141.5536	3089572.1473	340.01	337.20	337.53	AD-8
7084426.2753	3089076.0299	343.09	340.51	340.32	AD-9
7084028.9574	3089541.4918	343.01	340.24	340.23	AD-10
7083806.9737	3089153.7064	342.18	339.55	339.61	AD-11
7083999.2913	3086633.7159	369.33	366.58	366.27	AD-12
7084143.6675	3088844.9078	347.00	344.15	344.12	AD-13
7083404.2266	3088923.7792	345.43	342.72	342.32	AD-14
7084922.5293	3089410.4800	339.67	339.95	339.87	B-2
7084518.8188	3089354.9016	340.63	340.89	340.74	B-4
7084252.5216	3089539.8565	339.98	340.29	340.22	B-5
7083922.5883	3089368.3732	340.10	340.42	340.44	B-6

NOTES:

1.) TOC ELEV DENOTES TOP OF CASING ELEVATION
2.) TOS ELEV DENOTES TOP OF CONCRETE SLAB ELEVATION
3.) NG ELEV DENOTES NATURAL GROUND ELEVATION

Soil Boring Coordinate Table

Northing	Easting	Elevation	Descriptor
7084415.3941	3089091.0855	339.63	B-3
7084981.0444	3089557.3777	324.07	B-1
7083836.1327	3089087.7883	330.38	B-7
7082299.4144	3090110.6561	325.90	NEW BORE NO. 1
7081836.9586	3089425.7638	323.63	NEW BORE NO. 2
7081271.2131	3089970.5504	320.85	NEW BORE NO. 3

THE BEARINGS ARE BASED ON GRID NORTH WITHIN THE "TEXAS COORDINATE SYSTEM OF 1983, NORTH CENTRAL ZONE", NAD83 (CORS96, EPOCH 2002.0), WITH A BEARING OF NORTH 87 DEGREES 57 MINUTES 35 SECONDS EAST. THE COMBINED SCALE FACTOR TO GO FROM GRID TO SURFACE IS 1.00012. THE FOLLOWING CONTROL MONUMENTS WERE USED TO ESTABLISH THE BASIS OF BEARINGS:

CONTROL MONUMENT NO. 30001	CONTROL MONUMENT NO. 30010
N-7085417.3416	N-7085452.9367
E-3087023.3084	E-3088022.5268

MIKE GARDNER
#5760

SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON NOVEMBER 6, 2009 AND NOVEMBER 17, 2009, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: NOVEMBER 11, 2009
REVISED: NOVEMBER 18, 2009
REVISED: JUNE 22, 2010

MONITOR WELL & PIEZOMETER WELL LOCATIONS

WELSH POWER PLANT
CASON, TEXAS
FOR: AEP

Date		Revision/Description
11/18/09	1	ADDED ADDITIONAL PIPE LOCATION
11/18/09	2	ADDED ADDITIONAL BORING LOCATION
11/18/09	3	CHANGED NEW BORING LOCATION
11/18/09	4	MODIFIED BORING DESCRIPTOR

Drawn By	Checked By	Project No.	Dwg. Date
J.B.D.	M.G.	094026	11/11/09

MTG engineers & surveyors
5930 SUMMERHILL RD. | P.O. BOX 3786
TEXARKANA TEXAS 75501
P 903.838.8533 | F 903.832.4700
www.mtgengineers.com

TBPE NO. 354

File No.

Sheet No. 2 OF 2

X:\2009 Projects\094026 TOPO AT WELSH POWER PLANT - GREG CARTER\094026 Grid_elev REVISED 6-22-10.pro
Tue Jun 22, 2010 11:42AM

ATTACHMENT E

HYDROLOGY AND HYDROLOGIC REPORT

Innovative approaches
Practical results
Outstanding service

`

Hydraulic Analysis of Welsh Power Plant Ash Ponds

American Electric Power Company

Prepared by:

FREESE AND NICHOLS, INC.
4055 International Plaza, Suite 200
Fort Worth, Texas 76109
817-735-7300

AEP10412

FREESE AND NICHOLS

Innovative approaches
Practical results
Outstanding service

Hydraulic Analysis of Welsh Power Plant Ash Ponds

American Electric Power Company

TRAVIS N. ATTANASIO
98433

Freese and Nichols, Inc.
Texas Registered Engineering Firm F-2144

The seal appearing on this document was authorized by Travis N. Attanasio on December 29, 2010

Prepared by:

FREESE AND NICHOLS, INC.
4055 International Plaza, Suite 200
Fort Worth, Texas 76109
817-735-7300

AEP10412

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

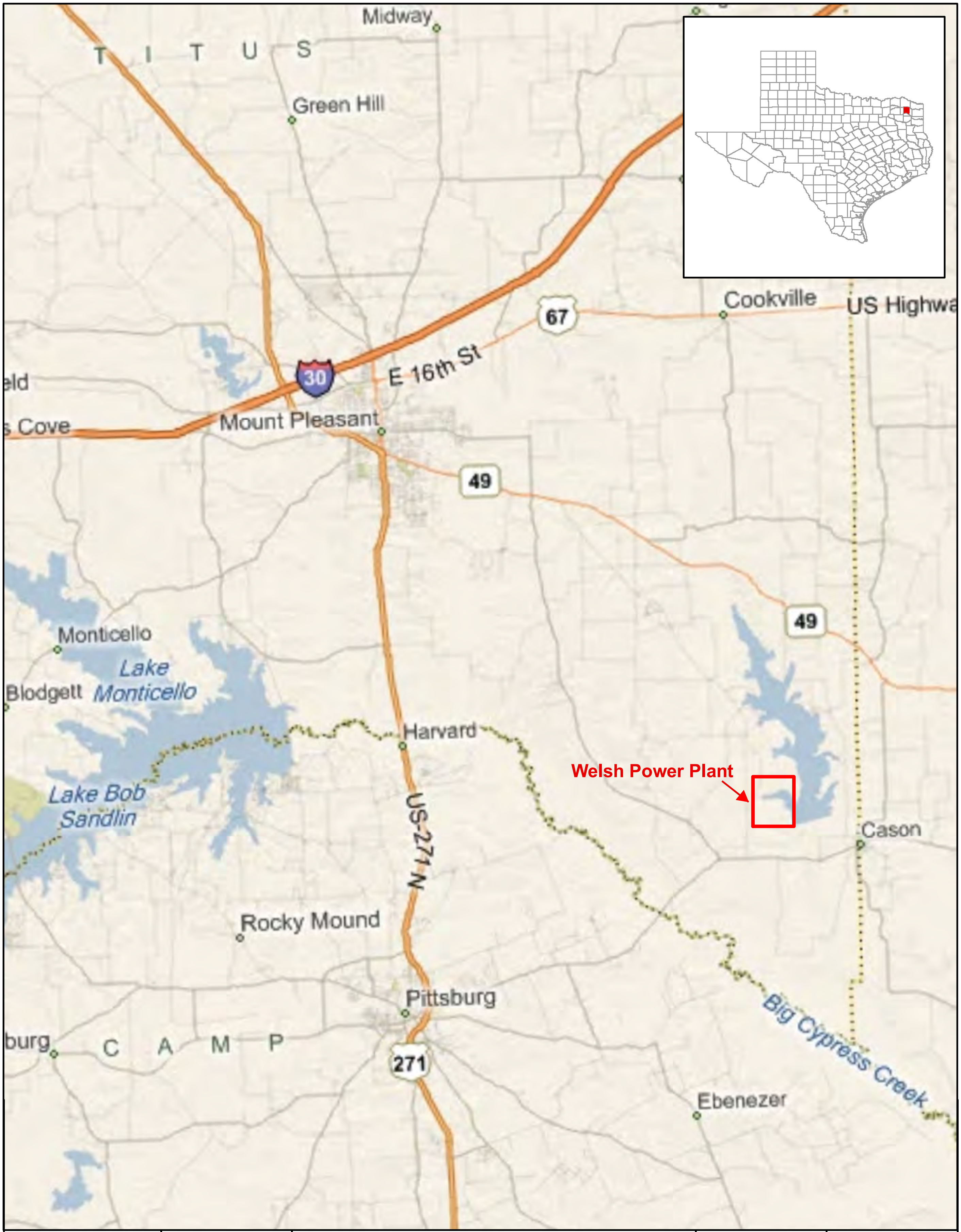
APPENDICES

Appendix A References
Appendix B Discharge Rating Curve Calculations
Appendix C Pertinent Drawings

1.0 INTRODUCTION

In November of 2010, Freese and Nichols, Inc., (FNI) was retained by American Electric Power (AEP) to perform various hydrologic and hydraulic calculations to determine the hydraulic adequacy of the Primary Ash, Secondary Ash, and Bottom Ash Ponds for the Welsh Power Plant located near Pittsburg, TX. This report summarizes the results of the analysis for the 10-year, 25-year, 100-year, 25% PMF, 50% PMF, and 100% PMF events.

The three Ash Ponds are situated immediately south of the Welsh Power Plant on the west side of Welsh Reservoir. The general location of the power plant and associated reservoirs is shown in Figure 1.



FN PROJECT NO.
AEP10412

FILE NAME
H:\WR_DESIGN\FIGURES\Figure1_LocationMap.mxd

DATUM & COORDINATE SYSTEM
NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)

DATE CREATED
DECEMBER 2010

PREPARED BY
JPM

FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 1.25 2.5 5
Miles

WELSH POWER PLANT ASH PONDS

LOCATION MAP

N

FIGURE

1

2.0 HYDROLOGIC MODEL DEVELOPMENT

2.1 BASIN DELINEATION & CONNECTIVITY

The hydrologic model for the Welsh Power Plant Ash Ponds was created in HEC-HMS[1] and consisted of seven total drainage basins, as shown in Figure 2. The total drainage area modeled is approximately 0.695 square miles, or 445 acres. Two basins, labeled *Primary* and *Power Plant*, drain directly into the Primary Ash Pond. The Ash Storage Area was divided into two drainage basins – *Ash Storage Area A* and *Ash Storage Area B* – based on a December 2009 survey of the area. A small portion of the Ash Storage Area, along with a small wooded area, drains into the Bottom Ash Pond and is shown as *to Bottom Ash* in Figure 2. Additionally, the area inside the embankment for the Bottom Ash Pond is labeled *Bottom Ash* and drains directly into the reservoir area. Finally, the basin labeled *Secondary* represents the area draining to the Secondary Ash Pond.

Each of the seven basins and three reservoir areas are connected in some way and form an intricate system of connectivity. The only discharges from the Primary Ash Pond flow through a drainage canal to the Secondary Ash Pond. This canal flows from west to east and is controlled by a weir box control structure. Discharges from the Primary Ash Pond emergency spillway also flow into this drainage canal; however, these flows enter the canal downstream of the weir box control structure. Runoff from the Ash Storage Area also enters the Primary Ash Pond via a small sump area with a 24-inch culvert. Rainfall is routed through a small ditch around the perimeter of the Ash Storage Area to this culvert. The principal spillway for the Bottom Ash Pond discharges into a 30-inch pipe which transports the outflows to the Ash Storage Area ditch. These outflows eventually discharge into the Primary Ash Pond. The emergency spillway for the Bottom Ash Pond discharges freely into the area downstream of the Welsh Reservoir emergency spillway. Finally, the combined flows from the drainage canal enter the Secondary Ash Pond, which has both a principal and emergency spillway. All discharges from the Secondary Ash Pond flow into Welsh Reservoir. Spillway capacities are discussed in further detail in Section 2.4.

FN PROJECT NO.
AEP10412

FILE NAME
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DATUM & COORDINATE SYSTEM
NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)

DATE CREATED
DECEMBER 2010

PREPARED BY
JPM

FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 500 1,000 2,000
Feet

WELSH POWER PLANT ASH PONDS

DRAINAGE BASIN MAP

N

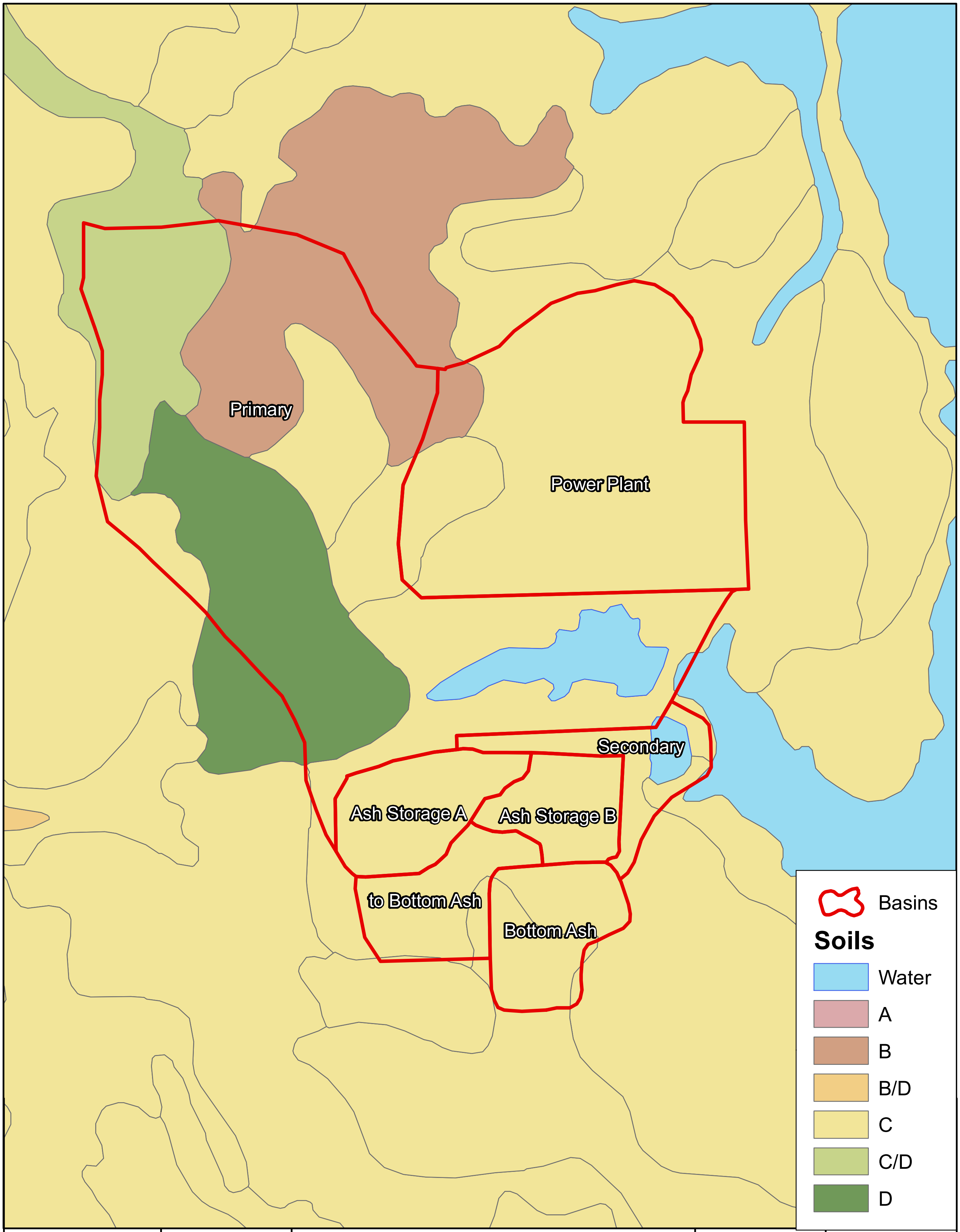
FIGURE
2

2.2 HYDROLOGIC PARAMETERS

The HEC-HMS model incorporates the NRCS Curve Number and Unit Hydrograph methods for each basin. In this model, the curve numbers were based on hydrologic soil classifications and land cover. The instantaneous runoff effect of open water surfaces was accounted for in the development of the curve numbers. The soils dataset was obtained from the NRCS Soil Survey Geographic Database[2] (SSURGO), and land use dataset was obtained from the USGS Seamless Data Warehouse[3] in the form of the National Land Cover Dataset (NLCD) for 2001. Spatial information about soil types and land use classifications is presented in Figures 3 and 4, respectively. Table 1 provides the matrix used in determining the curve number for each basin. The curve numbers shown in Table 1 are for Antecedent Moisture Condition (AMC) II. These values were incorporated in the model for the frequency storm events, such as the 100-year storm event. In accordance with TCEQ recommendations, AMC III was applied to the model for PMF events. This represents a worst-case scenario with the ground fully saturated prior to the PMF event.

Table 1 – Curve Number Calculation Matrix

NLCD Classification		Curve Number (AMC II)					
#	**Description**	**A**	**B**	**B/C**	**C**	**C/D**	**D**
11	Open Water	100	100	100	100	100	100
21	Developed, Open Space	68	79	83	86	88	89
22	Developed, Low Intensity	51	68	74	79	82	84
23	Developed, Medium Intensity	77	85	88	90	91	92
24	Developed, High Intensity	89	92	93	94	95	95
31	Barren Land	77	86	89	91	93	94
41	Deciduous Forest	36	60	67	73	76	79
42	Evergreen Forest	36	60	67	73	76	79
43	Mixed Forest	36	60	67	73	76	79
52	Scrub/Shrub	35	56	63	70	74	77
71	Grassland/Herbaceous	39	61	68	74	77	80
81	Pasture/Hay	39	61	68	74	77	80
82	Cultivated Crops	67	78	82	85	87	89
90	Woody Wetlands	45	66	72	77	80	83



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DATUM & COORDINATE SYSTEM NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)

DATE CREATED DECEMBER 2010

PREPARED BY JPM

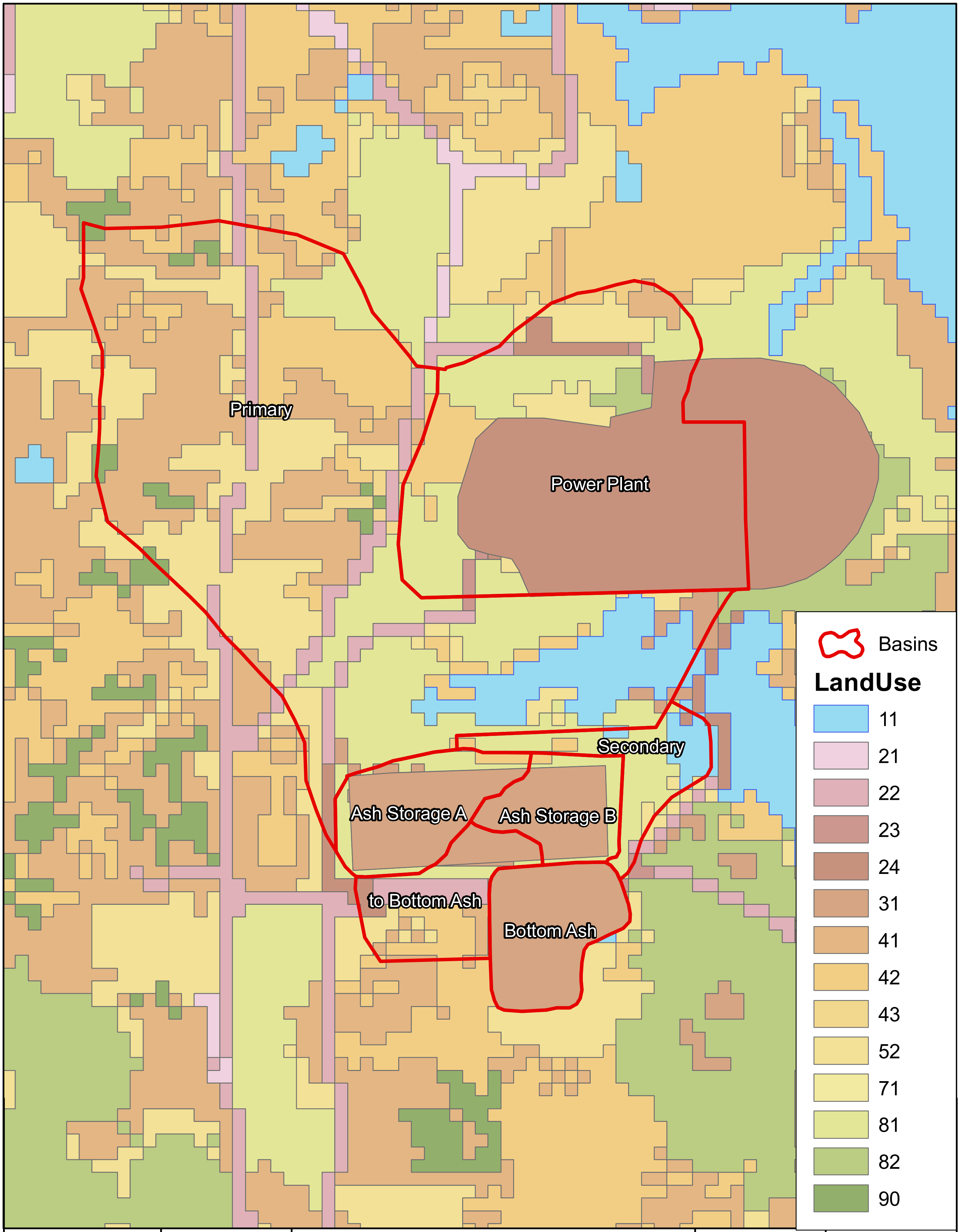
FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

WELSH POWER PLANT ASH PONDS

HYDROLOGIC SOIL CLASSIFICATIONS

FIGURE

3



FN PROJECT NO. AEP10412

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DATUM & COORDINATE SYSTEM NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)

DATE CREATED DECEMBER 2010

PREPARED BY JPM

FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 500 1,000 2,000 Feet

N

WELSH POWER PLANT ASH PONDS

LAND COVER DATA

FIGURE

4

The only input into HEC-HMS for the NRCS Dimensionless Unit Hydrograph is a lag time, which is calculated based on basin conditions, such as hydraulic length and average slope, according to the NRCS TR-55 Method. Table 2 provides a summary of the hydrologic parameters for each basin. Note that AMC II corresponds with the curve numbers used in the frequency model and that AMC III corresponds with the weighted curve numbers used in the PMP model.

Table 2 – Basin Parameters

Basin	Area (mi^2)	Lag Time (min)	Curve Number (AMC II)	Curve Number (AMC III)
Ash Storage A	0.034	5.28	87.1	93.9
Ash Storage B	0.025	7.51	87.1	93.9
Bottom Ash	0.034	4.78	91.0	95.9
Power Plant	0.180	18.77	85.3	93.0
Primary	0.366	36.14	76.0	88.0
Secondary	0.026	2.31	82.7	91.7
to Bottom Ash	0.031	16.51	77.8	89.0

2.3 ELEVATION-STORAGE DATA

Elevation-storage data for each reservoir was obtained from a combination of data sources. The elevation-storage relationship for the Primary Ash Pond was calculated from USGS 10-foot contours for the area and compared to calculations made by AEP. The Secondary Ash Pond used the AEP Calculations for elevation 320.0 ft-msl to elevation 330.0 ft-msl and a combination of USGS 10-foot contours and surveyed 2-foot contours. The Bottom Ash Pond used volume calculations from an April 2010 survey from elevation 346.13 ft-msl to elevation 355.92 ft-msl. The volume was then extrapolated to the top of dam elevation of 360.0 ft-msl by the average-end-area method and the assumption of 3:1 side slopes. These relationships were used in the hydrologic model for routing both frequency storm events and the PMF and are shown in Table 3 below.

Table 3 – Elevation-Storage Data

Primary	
Elevation (ft-msl)	Storage (acre-ft)
300	0.00
305	22.37
310	54.66
315	110.48
320	186.47
325	304.20
330	461.77
335	676.03
340	934.21

Secondary	
Elevation (ft-msl)	Storage (acre-ft)
320	0.00
330	36.87
331	41.31
332	46.30
333	51.82
334	57.67
335	63.77
336	70.09
337	76.59
338	83.26
339	90.22
340	97.45
341	105.06
342	112.68

Bottom Ash	
Elevation (ft-msl)	Storage (acre-ft)
346.13	0.00
347	0.22
348	1.31
349	3.17
350	5.51
351	8.33
352	11.94
353	16.77
354	23.57
355	33.04
356	45.07
357	65.66
358	86.50
359	107.61
360	128.98

2.4 DISCHARGE RATING CURVES

Each of the three dams has both a principal spillway and an emergency spillway. Information regarding the dimensions and elevations of each of these spillways was taken from a combination of original construction drawings, recent survey, and detailed descriptions from AEP personnel. Detailed calculations for the discharge rating curves of each spillway are included in Appendix B.

The principal spillway for the Primary Ash Pond is located in the canal connecting the Primary and Secondary Ash Ponds. It consists of a weir box with bottom elevation of 325.0 ft-msl and a 4-foot wide by 2-foot tall opening. Stop logs are placed in this opening according to regular dredging operations by AEP; however, normal conditions dictate that no stop logs are in place. This structure also consists of sheet piling to each side of the weir box, which will operate as a sharp-crested weir when flows reach the top elevation of 336.0 ft-msl. Additionally, the Primary Ash Pond has a 90-foot wide emergency spillway with a crest elevation of 334.0 ft-msl. Both the orifice and weir equations were utilized in calculating the discharge rating curves. The discharge rating curve for both spillways is shown in Table 4.

The principal spillway for the Secondary Ash Pond consists of a weir box with a 4-foot long weir discharging through a 36-inch conduit. The weir equation used for this weir box was obtained from Greg Carter of AEP from calculations he had performed in the design of a new weir plate, which is currently in place. Additionally, the Secondary Ash Pond has an approximately 45-foot wide earthen emergency spillway. The discharge rating curve for the emergency spillway was calculated with a simple HEC-RAS model with cross-sections cut through the spillway. The discharge rating curve for both spillways is shown in Table 4.

The principal spillway for the Bottom Ash Pond is a 40-foot long broad-crested weir with 6:1 side slopes and crest at elevation 355.0 ft-msl. It discharges into a small sump area connected to the 30-inch pipe directing flow back toward the Ash Storage Area. The emergency spillway is an 8-foot wide weir at elevation 358.0 ft-msl with a rock riprap discharge chute. The discharge rating curve for both spillways is shown in Table 4.

Table 4 – Discharge Rating Curves

Primary			
Elevation (ft-msl)	**Principal Spillway (cfs)**	**Emergency Spillway (cfs)**	**Total Discharge (cfs)**
325	0	---	0
326	39	---	39
327	54	---	54
328	67	---	67
329	77	---	77
330	86	---	86
331	94	---	94
332	102	---	102
333	109	---	109
334	116	0	116
335	122	285	407
336	128	849	976
337	340	1,637	1,977
338	723	2,640	3,363
339	1,217	3,857	5,074
340	1,801	5,291	7,092

Secondary			
Elevation (ft-msl)	**Principal Spillway (cfs)**	**Emergency Spillway (cfs)**	**Total Discharge (cfs)**
328.3	0	---	0
329	5	---	5
330	17	---	17
331	33	---	33
332	50	0	50
333	58	91	149
334	64	345	409
335	70	777	847
336	75	1,386	1,461
337	80	2,191	2,271
338	85	3,163	3,248
339	90	4,256	4,346
340	94	5,280	5,374

Bottom Ash			
Elevation (ft-msl)	**Principal Spillway (cfs)**	**Emergency Spillway (cfs)**	**Total Discharge (cfs)**
355.0	0	---	0
355.5	50	---	50
356.0	161	---	161
356.5	330	---	330
357.0	561	---	561
357.5	858	---	858
358.0	1,224	0	1,224
358.5	1,664	11	1,676
359.0	2,182	39	2,221
359.5	2,782	85	2,867
360.0	3,466	153	3,619

2.5 FREQUENCY MODEL RESULTS

Three frequency storm events were analyzed for the Welsh Ash Pond system – the 10-year, 25-year, and 100-year storm events. The hydrologic model described in the preceding sections was implemented in analyzing these events. Curve numbers were set to Antecedent Moisture Condition II, and initial abstractions were calculated automatically by HEC-HMS. These assumptions represent normal conditions, as would be expected prior to one of these storm events. The precipitation data was obtained from the National Oceanic and Atmospheric Administration's Technical Memorandum NWS HYDRO-35[4] and Technical Paper 40.[5] These values are presented in Table 5. Each storm event was assumed to have a duration of 24 hours.

Table 5 – Frequency Precipitation Depths

Frequency (yrs)	Precipitation (in)							
	5 min	15 min	60 min	2 hr	3 hr	6 hr	12 hr	24hr
1	0.42	0.89	1.69	1.99	2.20	2.64	3.12	3.58
2	0.51	1.08	1.97	2.45	2.68	3.19	3.78	4.41
5	0.58	1.25	2.54	3.14	3.40	4.15	4.92	5.81
10	0.64	1.38	2.91	3.64	3.95	4.90	5.90	6.82
25	0.72	1.57	3.36	4.22	4.62	5.73	6.76	7.90
50	0.79	1.72	3.75	4.75	5.18	6.41	7.74	8.83
100	0.86	1.88	4.13	5.23	5.78	7.09	8.62	9.85
500	1.12	2.45	5.39	6.83	7.54	9.26	11.26	12.86

These precipitation depths serve as input data into the hydrologic model, and were routed through the model as described previously. According to TCEQ recommendations and standard engineering practice, flood routings were started at the lowest spillway crest elevation for each dam. This corresponds to elevation 325.0 ft-msl, 328.3 ft-msl, and 355.0 ft-msl for the Primary, Secondary, and Bottom Ash Ponds, respectively. The results of the 10-year, 25-year, and 100-year storm events are shown in Tables 6, 7, and 8, respectively.

Table 6 – 10-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	328.50	874.71	71.92
Secondary	332.37	112.41	72.35
Bottom Ash	355.53	157.81	55.99

Table 7 – 25-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	329.35	1079.37	80.24
Secondary	332.51	137.68	81.67
Bottom Ash	355.62	187.44	76.21

Table 8 – 100-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	330.80	1415.75	92.68
Secondary	332.62	177.95	95.96
Bottom Ash	355.76	234.22	108.10

2.6 PMF MODEL RESULTS

The Probable Maximum Flood (PMF) is defined as the greatest flood to be expected, and the Probable Maximum Precipitation (PMP) is theoretically the greatest depth of rainfall for a given duration that is physically possible over a given size storm area at a particular geographic location. Generally, the rainfall depth is calculated for the ten square miles of the watershed which receive the highest intensity rainfall.

Hydrometeorological Report No. 52 (HMR-52),[6] developed by the U.S. Army Corps of Engineers, was used to determine the rainfall for each basin. PMP estimates were taken from Hydrometeorological Report No. 51[7] and distributed according to HMR-52 to obtain average rainfall depths over the various drainage areas.

HMR-52 calculates rainfall depths for storm durations ranging from five minutes to seventy-two hours. Table 9 lists the point rainfall depths calculated by HMR-52 for storm durations from one hour to 72 hours. Because the total drainage area is less than ten square miles, these point rainfall depths were applied to each of the 7 basins. Additionally, the total rainfall depth was distributed according to the temporal distribution described by the TCEQ guidelines.

Table 9 – HMR-52 Point Rainfall Depths

Storm Duration (hr)	Depth (in)
1	16.62
2	20.86
3	24.18
6	30.47
12	36.82
24	42.10
48	46.98
72	49.74

Each PMF duration was modeled as described previously, with flood routing started at the lowest spillway crest elevation. The 12-hour event was critical for both the Primary and Secondary Ash Ponds, and the 1-hour event was critical for the Bottom Ash Pond. Additionally, the 25% and 50% PMF were calculated for the critical duration. Tables 10, 11, and 12 contain the results of these PMF model runs – the 25% PMF, 50% PMF, and 100% PMF, respectively.

Table 10 – 25% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	331.83	690.29	100.59
Secondary	332.68	110.63	105.57
Bottom Ash	355.70	171.14	94.27

Table 11 – 50% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	335.16	1385.23	122.79
Secondary	334.23	511.60	501.07
Bottom Ash	356.15	342.28	211.11

Table 12 – 100% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	337.46	2770.78	517.89
Secondary	337.39	2664.30	2637.73
Bottom Ash	356.78	684.55	458.48

3.0 SUMMARY AND CONCLUSIONS

Based on the results of the hydraulic analysis, each of the three dams is hydraulically adequate for the full range of storm events from the 10-year to the 100% PMF event. Table 13 lists the pertinent elevation data for each dam, including the top of dam elevation and principal and emergency spillway crest elevations. Comparing these elevations to the maximum water surface elevations shown in Table 14 indicates that, even during the 100% PMF event, each of the three dams would have almost 3 feet of freeboard. Additionally, the emergency spillway for the Primary Ash Pond is not engaged during a storm event less than the 50% PMF, and the emergency spillway for the Bottom Ash Pond is not engaged, even during the 100% PMF event. The emergency spillway for the Secondary Ash Pond is, however, engaged much more frequently, even during a storm event as low as the 10-year storm. This should have no adverse affects on this area though, as it appears to have been designed to withstand frequent engaging.

Table 13 – Pertinent Dam Information

	Top of Dam (ft-msl)	Principal Spillway (ft-msl)	Emergency Spillway (ft-msl)
Primary	340.0	325.0	334.0
Secondary	340.0	328.3	332.0
Bottom Ash	360.0	355.0	358.0

Table 14 – Summary of Results

	10-year	25-year	100-year	25% PMF	50% PMF	100% PMF
Primary	328.50	329.35	330.80	331.83	335.16	337.46
Secondary	332.37	332.51	332.62	332.68	334.23	337.39
Bottom Ash	355.53	355.62	355.76	355.70	356.15	356.78

It should be noted that these results reflect the best understanding of existing conditions and could be significantly affected by major changes to any of the three reservoirs. Specifically, major fluctuations in the available storage in each reservoir, as could be caused by the regular dredging and movement of bottom ash in and out of the pond areas, would greatly impact the results of this analysis. However, in their current conditions, the Primary Ash, Secondary Ash, and Bottom Ash Ponds associated with the Welsh Power Plant are deemed to

be hydraulically adequate for any storm event up to the 100% PMF. Pertinent drawings for existing conditions are included in Appendix C.

Appendix A
References

References

1. U.S. Army Corps of Engineers, Hydrologic Engineering Center: *Hydrologic Modeling System HEC-HMS - User's Manual Version 3.4*, Davis, California, August 2009.

2. "Soil Data Mart." *NRCS Soil Survey Geographic (SSURGO) Database*. <http://soildatamart.nrcs.usda.gov>.

3. "National Land Cover Dataset 2001." *USGS Seamless Data Warehouse*. August 30, 2010. <http://seamless.usgs.gov/nlcd.php>.

4. U.S. Department of Commerce, National Oceanic and Atmospheric Administration: *Technical Memorandum NWS HYDRO-35, Five- to 60-Minute Precipitation Frequency for the Eastern and Central United States*, Silver Spring, MD, June 1977.

5. U.S. Department of Commerce, Weather Bureau: *Technical Paper No. 40, Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years*, Washington, D.C., May 1961.

6. U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Department of the Army, Corps of Engineers: *Hydrometeorological Report No. 52, Application of Probable Maximum Precipitation Estimates, United States East of the 105th Meridian*, Washington, D.C., 1982.

7. U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Department of the Army, Corps of Engineers: *Hydrometeorological Report No. 51, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian*, Washington, D.C., 1978.

Appendix B
Calculations

Discharge Rating Curve
Primary Ash Pond

Elevation [ft-msl]	Orifice [cfs]	Sheet Pile [cfs]	Main [cfs]	Emerg [cfs]	Total [cfs]
325.00	0.00	0.00	0.00	0.00	0.00
326.00	38.52	0.00	38.52	0.00	38.52
327.00	54.48	0.00	54.48	0.00	54.48
328.00	66.72	0.00	66.72	0.00	66.72
329.00	77.04	0.00	77.04	0.00	77.04
330.00	86.13	0.00	86.13	0.00	86.13
331.00	94.35	0.00	94.35	0.00	94.35
332.00	101.91	0.00	101.91	0.00	101.91
333.00	108.95	0.00	108.95	0.00	108.95
334.00	115.56	0.00	115.56	0.00	115.56
335.00	121.81	0.00	121.81	285.00	406.81
336.00	127.76	0.00	127.76	848.53	976.28
337.00	133.44	206.46	339.90	1636.79	1976.68
338.00	138.89	583.96	722.84	2640.00	3362.84
339.00	144.13	1072.80	1216.93	3857.22	5074.14
340.00	149.19	1651.68	1800.87	5290.90	7091.76

Main Spillway		
Sill Crest	325	ft-msl
Height	2	ft
Sill Width	4	ft
Orifice C	0.6	

$Q = C*A*\sqrt{(2*g*H)}$

Sheet Pile	336	ft-msl
Top Width	62	ft
Weir C	3.33	

$Q = C*L*H^{3/2}$

Emergency Spillway		
Crest	334	ft-msl
Length	90	ft
SS	2.5	:1
Weir C	3	

$Q = C*(L+2*SS*H)*H^{3/2}$

Discharge Rating Curve
Secondary Ash Pond

Elevation [ft-msl]	Weir [cfs]	Conduit [cfs]	Main [cfs]	Emerg [cfs]	Total [cfs]
328.30	0.00	12.77	0.00		0.00
328.50	0.75	15.39	0.75		0.75
329.00	4.85	22.36	4.85		4.85
329.50	10.62	29.44	10.62		10.62
330.00	17.43	35.94	17.43		17.43
330.50	24.97	40.33	24.97		24.97
331.00	33.01	44.34	33.01		33.01
331.50	41.36	48.10	41.36		41.36
332.00	49.90	51.65	49.90	0.00	49.90
332.50	58.50	55.03	55.03	25.00	80.03
333.00	67.07	58.27	58.27	90.91	149.18
333.50	75.51	61.37	61.37	193.62	254.99
334.00	83.73	64.36	64.36	344.83	409.19
334.50	91.67	67.24	67.24	537.74	604.98
335.00	99.25	70.03	70.03	777.17	847.20
335.50	106.41	72.72	72.72	1056.25	1128.97
336.00	113.09	75.34	75.34	1385.71	1461.05
336.50	119.24	77.87	77.87	1769.84	1847.71
337.00	124.79	80.34	80.34	2190.91	2271.25
337.50	129.70	82.74	82.74	2656.86	2739.60
338.00	133.91	85.08	85.08	3163.04	3248.12
338.50	137.39	87.36	87.36	3697.92	3785.28
339.00	140.09	89.59	89.59	4256.10	4345.69
339.50	141.96	91.76	91.76	4767.86	4859.62
340.00	142.96	93.89	93.89	5279.62	5373.51

Main Spillway

Weir Box

Crest	328.30	ft-msl
Length	4	ft
Weir C	2.152	

$Q = C*(L-0.2H)*H^{1/2}$

Weir Equation from AEP

Conduit

Diameter	36	in
Length	350	ft
U/S Invert	326.5	ft-msl
D/S Invert	326	ft-msl

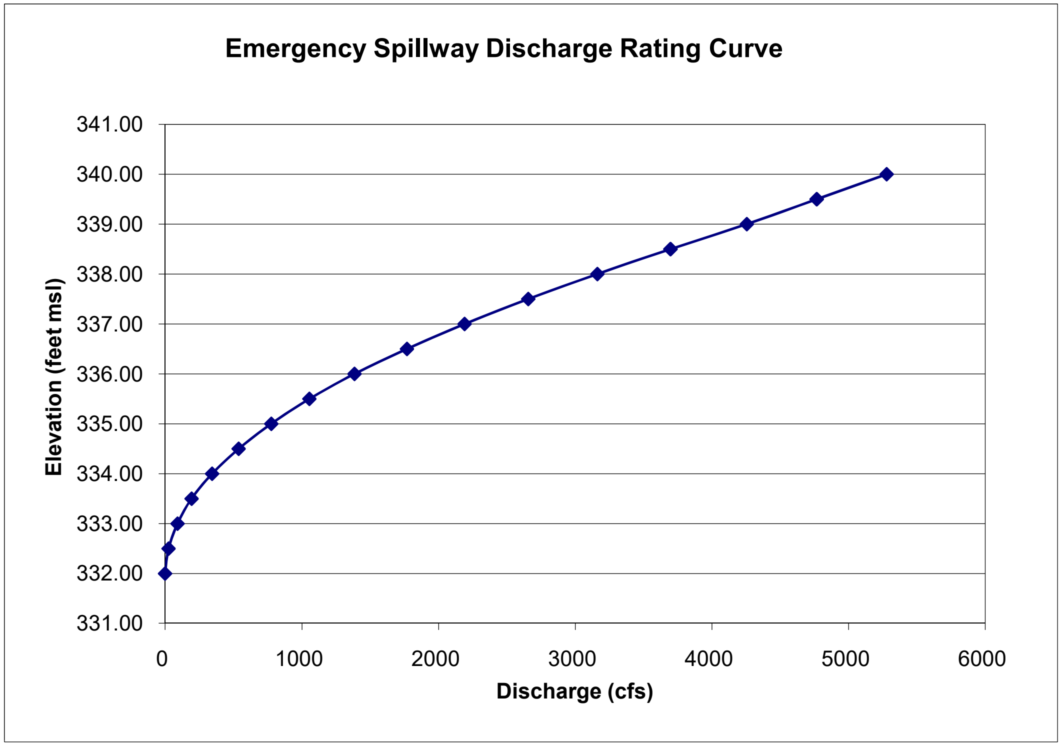
Calculated in FlowMaster

Emergency Spillway

Calculated in HEC-RAS; refer to following sheets for details.

Invert	332	Feet msl
Increment	0.5	Feet

Lake Level (feet msl)	**Discharge (cfs)**
332.00	0
332.50	25
333.00	91
333.50	194
334.00	345
334.50	538
335.00	777
335.50	1,056
336.00	1,386
336.50	1,770
337.00	2,191
337.50	2,657
338.00	3,163
338.50	3,698
339.00	4,256
339.50	4,768
340.00	5,280



HEC-RAS Results for most upstream cross section

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
SecondaryPon	EmergSpwy	871	PF 1	1	330	332.07		332.07	0	0	380.1	195.63	0
SecondaryPon	EmergSpwy	871	PF 2	10	330	332.29		332.29	0	0.02	423.67	197.71	0
SecondaryPon	EmergSpwy	871	PF 3	25	330	332.5		332.5	0.000002	0.06	465.34	200.66	0.01
SecondaryPon	EmergSpwy	871	PF 4	50	330	332.73		332.73	0.000005	0.1	511.65	204.53	0.01
SecondaryPon	EmergSpwy	871	PF 5	100	330	333.06		333.06	0.000012	0.18	579.79	208.93	0.02
SecondaryPon	EmergSpwy	871	PF 6	200	330	333.52		333.53	0.000031	0.32	677.95	215.13	0.03
SecondaryPon	EmergSpwy	871	PF 7	300	330	333.87		333.87	0.000051	0.43	752.96	221.16	0.04
SecondaryPon	EmergSpwy	871	PF 8	400	330	334.16		334.16	0.000071	0.54	818.24	228.29	0.05
SecondaryPon	EmergSpwy	871	PF 9	500	330	334.41		334.42	0.000091	0.64	876.57	234.47	0.05
SecondaryPon	EmergSpwy	871	PF 10	750	330	334.94		334.95	0.00014	0.85	1005.18	248.81	0.07
SecondaryPon	EmergSpwy	871	PF 11	1000	330	335.4		335.41	0.000184	1.03	1120.39	261.11	0.08
SecondaryPon	EmergSpwy	871	PF 12	1250	330	335.79		335.81	0.000224	1.19	1225.76	271.83	0.09
SecondaryPon	EmergSpwy	871	PF 13	1500	330	336.14		336.16	0.000261	1.34	1322.88	281.28	0.1
SecondaryPon	EmergSpwy	871	PF 14	2000	330	336.77		336.79	0.000326	1.6	1503.25	297.77	0.11
SecondaryPon	EmergSpwy	871	PF 15	2500	330	337.31		337.34	0.000381	1.82	1668.85	312.15	0.12
SecondaryPon	EmergSpwy	871	PF 16	3000	330	337.81		337.85	0.000427	2.01	1827.39	325.32	0.13
SecondaryPon	EmergSpwy	871	PF 17	3500	330	338.26		338.31	0.000468	2.19	1978.88	337.7	0.13
SecondaryPon	EmergSpwy	871	PF 18	4000	330	338.73		338.79	0.000495	2.34	2139.91	350.57	0.14
SecondaryPon	EmergSpwy	871	PF 19	4500	330	339.13		339.2	0.000525	2.48	2282.96	361.62	0.14
SecondaryPon	EmergSpwy	871	PF 20	5000	330	339.69		339.76	0.000513	2.55	2489.43	376.54	0.14

Discharge Rating Curve

Bottom Ash Pond

Elevation [ft-msl]	Main [cfs]	Emerg [cfs]	Total [cfs]
355.00	0.00	0.00	0.00
355.50	50.42	0.00	50.42
356.00	161.20	0.00	161.20
356.50	330.31	0.00	330.31
357.00	561.16	0.00	561.16
358.00	1224.21	0.00	1224.21
359.00	2182.40	39.00	2221.40
360.00	3465.91	152.74	3618.64
361.00	5102.78	358.53	5461.31
362.00	7119.19	672.00	7791.19
363.00	9539.72	1106.85	10646.57

Main Spillway		
Crest	355	ft-msl
Length	40	ft
SS	6	:1
Weir C	3.1	

$Q = C*(L+2*SS*H)*H^{3/2}$

Emergency Spillway		
Crest	358	ft-msl
Length	8	ft
SS	2.5	:1
Weir C	3	

$Q = C*(L+2*SS*H)*H^{3/2}$

Name	GRIDCODE	HSG	Area_ft^2	Area_acre	CN	Inc. CN
Ash Storage	31	C	1324276.445	30.401	91	70.06793
Ash Storage	42	C	53818.662	1.236	73	2.28431
Ash Storage	81	C	341795.137	7.847	74	14.70608
Bottom Ash	31	C	948778.856	21.781	91	91
Power Plant	41	B	1095.992	0.025	60	0.013099
Power Plant	42	B	101918.155	2.340	60	1.218085
Power Plant	81	B	99556.094	2.285	61	1.209685
Power Plant	22	C	15964.935	0.367	79	0.251229
Power Plant	23	C	70296.650	1.614	90	1.260236
Power Plant	24	C	2954103.082	67.817	94	55.31313
Power Plant	41	C	90963.024	2.088	73	1.322703
Power Plant	42	C	239129.961	5.490	73	3.477215
Power Plant	52	C	407500.071	9.355	70	5.68199
Power Plant	81	C	944143.815	21.675	74	13.91697
Power Plant	82	C	95577.482	2.194	85	1.618263
Primary	11	W	458394.580	10.523	100	4.490426
Primary	31	W	14036.955	0.322	100	0.137506
Primary	42	W	104596.947	2.401	100	1.02463
Primary	52	W	11325.853	0.260	100	0.110948
Primary	81	W	69931.187	1.605	100	0.685045
Primary	22	B	242034.352	5.556	68	1.612256
Primary	41	B	564582.710	12.961	60	3.318386
Primary	42	B	631114.853	14.488	60	3.709435
Primary	52	B	220919.125	5.072	56	1.211907
Primary	81	B	286358.868	6.574	61	1.711152
Primary	11	C	480754.464	11.037	100	4.709463
Primary	22	C	209907.569	4.819	79	1.624438
Primary	23	C	10746.609	0.247	90	0.094746
Primary	24	C	67309.636	1.545	94	0.619802
Primary	31	C	150242.962	3.449	91	1.339318
Primary	41	C	540228.652	12.402	73	3.863212
Primary	42	C	316050.970	7.256	73	2.260102
Primary	43	C	93028.069	2.136	73	0.66525
Primary	52	C	572546.147	13.144	70	3.926057
Primary	81	C	1192671.364	27.380	74	8.645709
Primary	82	C	10291.113	0.236	85	0.08569
Primary	90	C	82404.904	1.892	77	0.621573
Primary	41	C/D	916028.058	21.029	76	6.819781
Primary	42	C/D	135572.435	3.112	76	1.00933
Primary	52	C/D	331086.513	7.601	74	2.383839
Primary	90	C/D	101862.212	2.338	80	0.798273
Primary	22	D	301628.331	6.924	84	2.481987
Primary	31	D	13591.654	0.312	94	0.125155
Primary	41	D	558509.208	12.822	79	4.322207
Primary	42	D	58185.234	1.336	79	0.450286
Primary	43	D	21907.998	0.503	79	0.169542
Primary	52	D	973523.140	22.349	77	7.343195
Primary	81	D	435789.772	10.004	80	3.415192
Primary	90	D	31102.113	0.714	83	0.252881
Secondary	11	W	61159.403	1.404	100	8.574385
Secondary	22	W	0.178	0.000	100	2.49E-05
Secondary	24	W	284.987	0.007	100	0.039954
Secondary	52	W	3328.994	0.076	100	0.466716
Secondary	81	W	66883.300	1.535	100	9.37686
Secondary	11	C	100304.658	2.303	100	14.06244
Secondary	22	C	7813.937	0.179	79	0.865439
Secondary	23	C	5348.021	0.123	90	0.6748
Secondary	24	C	9873.918	0.227	94	1.301239
Secondary	31	C	300.129	0.007	91	0.03829
Secondary	42	C	37168.223	0.853	73	3.803946
Secondary	52	C	28941.171	0.664	70	2.840232
Secondary	81	C	391873.463	8.996	74	40.65531
to Bottom Ash	22	C	173034.687	3.972	79	17.29527

Basin	Area_acre
Ash Storage	39.48
Bottom Ash	21.78
Power Plant	115.25
Primary	234.35
Secondary	16.37
to Bottom Ash	18.14

Name	GRIDCODE	HSG	Area_ft^2	Area_acre	CN	Inc. CN
to Bottom Ash	23	C	2352.284	0.054	90	0.267855
to Bottom Ash	24	C	44395.328	1.019	94	5.279978
to Bottom Ash	31	C	108930.225	2.501	91	12.54171
to Bottom Ash	41	C	104222.261	2.393	73	9.626099
to Bottom Ash	42	C	197025.981	4.523	73	18.19757
to Bottom Ash	52	C	82351.521	1.891	70	7.293511
to Bottom Ash	81	C	78062.412	1.792	74	7.308709

Basin	Area_acre

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Ash Storage A	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.010	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	919.70	**FT**
SLOPE	0.021	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	2.319	

$$T_2 = \frac{L}{60 \times V}$$

PIPE FLOW - SOLVE FOR FULL FLOW VELOCITY

DIAMETER =	36	**IN.**
XSECT AREA =	7.07	**SQ FT**
WETTED PERIMETER	9.42	**FT**
SLOPE	0.002	**FT/FT**
MANNINGS N	0.024	
COMPUTED VELOCITY	2.39	**FT/S**
LENGTH	60	**FT**

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_4 = \frac{L}{60 \times V}$$

	Conditions	**Adjusted**	**NRCS Method**	**Selected**
WATERSHED NUMBER	**Ash Storage A**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	1.77	1.77
SHALLOW CONCENTRATED FLOW			6.61	6.61
SHALLOW CONCENTRATED FLOW			0.00	0.00
SHALLOW CHANNEL FLOW				0.00
PIPE FLOW			0.42	0.42
CHANNEL FLOW				0.00
TOTAL			8.79	8.79
			Lag (Hrs) =	**0.09**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) = **5.28**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Ash Storage B	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.025	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	796.31	**FT**
SLOPE	0.020	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	2.287	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	50
XSECT AREA=	112.000	**SQ FT**	**BOTTOM**	6
			DEPTH	4
WETTED PERIMETER	50.721	**FT**		
SLOPE	0.008	**FT/FT**		
MANNINGS N	0.08			
COMPUTED VELOCITY	2.768	**FT/S**		
LENGTH	911.59	**FT**		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	**Adjusted Tc (Min)**	**NRCS Method Tc (Min)**	**Selected Tc (Min)**
WATERSHED NUMBER	**Ash Storage B**			
SHEET FLOW	**Max 30 Min**	30.0	1.22	1.22
SHALLOW CONCENTRATED FLOW			5.80	5.80
CHANNEL FLOW			5.49	5.49
TOTAL			12.52	12.52
			Lag (Hrs) =	**0.13**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) = **7.51**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Bottom Ash	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.020	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	627.21	**FT**
SLOPE	0.010	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	1.578	

$$T_2 = \frac{L}{60 \times V}$$

984.648438

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**Bottom Ash**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	1.34	1.34
SHALLOW CONCENTRATED FLOW			6.62	6.62
TOTAL			7.96	7.96
			Lag (Hrs) =	**0.08**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**4.78**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Power Plant	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	FT.	MAX 100'
2 YR. 24 HOUR PRECIP	4.31	IN.	
SLOPE	0.020	FT/FT	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	558.86	FT
SLOPE	0.036	FT/FT
COMPUTED VELOCITY FROM FIGURE 3.1=	3.052	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	7
XSECT AREA=	8.000	SQ FT	BOTTOM	1
			DEPTH	2
WETTED PERIMETER	8.211	FT		
SLOPE	0.016	FT/FT		
MANNINGS N	0.05			
COMPUTED VELOCITY	3.720	FT/S		
LENGTH	2169.79	FT		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted Tc (Min)	NRCS Method Tc (Min)	Selected Tc (Min)
WATERSHED NUMBER	Power Plant			
SHEET FLOW	Max 30 Min	30.0	18.50	18.50
SHALLOW CONCENTRATED FLOW			3.05	3.05
CHANNEL FLOW			9.72	9.72
TOTAL			31.28	31.28
			Lag (Hrs) =	0.31

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	18.77

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Primary	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.020	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	2757.28	**FT**
SLOPE	0.009	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	1.536	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	10
XSECT AREA=	18.000	**SQ FT**	**BOTTOM**	2
			DEPTH	3
WETTED PERIMETER	12.000	**FT**		
SLOPE	0.010	**FT/FT**		
MANNINGS N	0.07			
COMPUTED VELOCITY	2.800	**FT/S**		
LENGTH	1984.65	**FT**		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**Primary**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	18.50	18.50
SHALLOW CONCENTRATED FLOW			29.91	29.91
CHANNEL FLOW			11.81	11.81
TOTAL			60.23	60.23
			Lag (Hrs) =	**0.60**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**36.14**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Secondary	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.150	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	599.56	**FT**
SLOPE	0.036	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	3.070	

$$T_2 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**Secondary**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	0.60	0.60
SHALLOW CONCENTRATED FLOW			3.26	3.26
TOTAL			3.85	3.85
			Lag (Hrs) =	**0.04**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**2.31**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	to Bottom Ash	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.050	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	763.95	**FT**
SLOPE	0.004	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	1.011	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	16
XSECT AREA=	20.000	**SQ FT**	**BOTTOM**	4
			DEPTH	2
WETTED PERIMETER	16.649	**FT**		
SLOPE	0.008	**FT/FT**		
MANNINGS N	0.05			
COMPUTED VELOCITY	3.001	**FT/S**		
LENGTH	377.81	**FT**		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

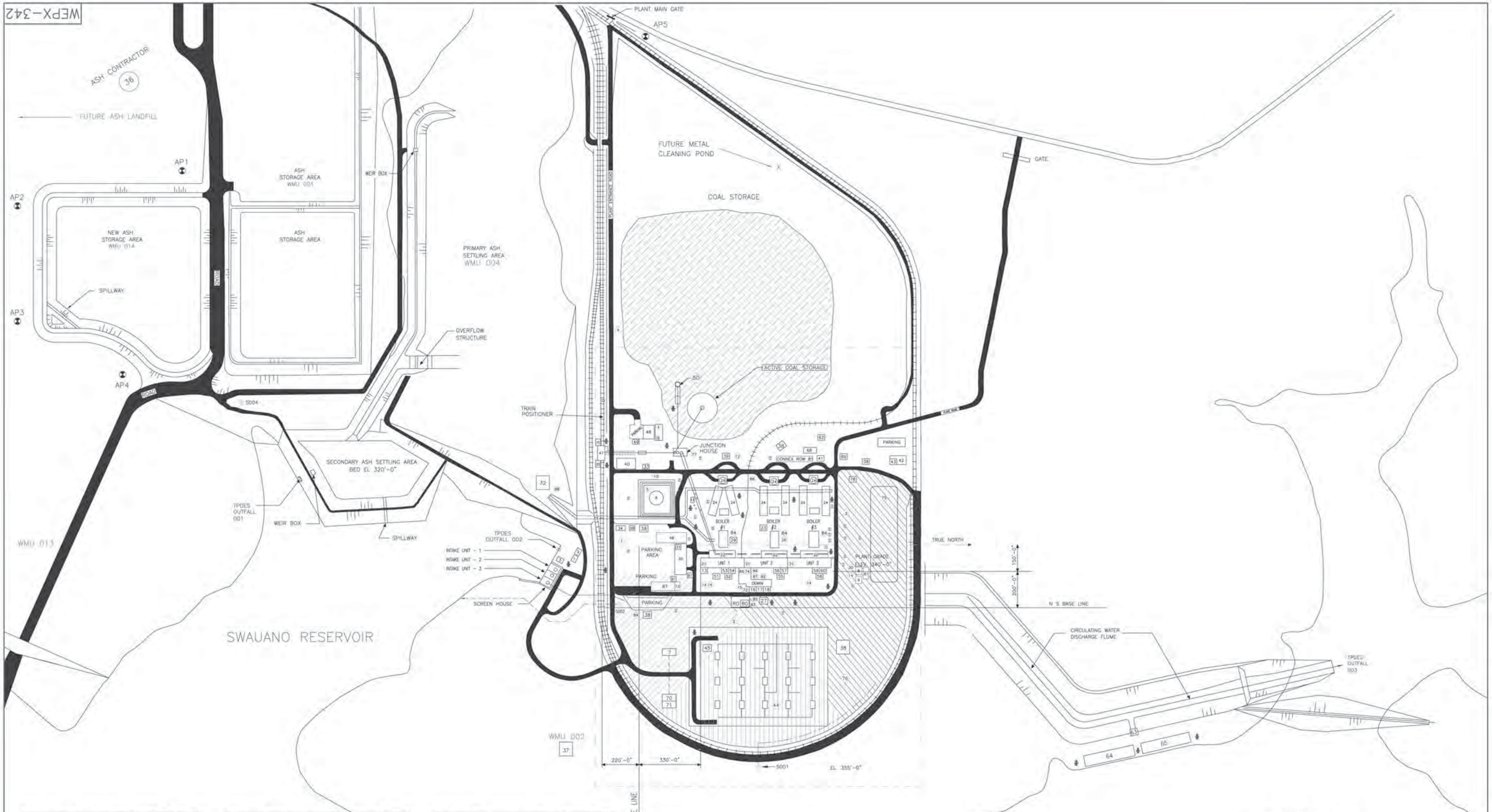
$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**to Bottom Ash**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	12.83	12.83
SHALLOW CONCENTRATED FLOW			12.59	12.59
CHANNEL FLOW			2.10	2.10
TOTAL			27.52	27.52
			Lag (Hrs) =	**0.28**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**16.51**

Appendix C
Pertinent Drawings



ID	Description	Location	Size (Gallons)	SECONDARY CONTAINMENT (GALLONS)
1	Sewage Plant	Intake	N/A	N/A
2	Chlorine Building	W. of Intake	8 - 1 ton cylinders	N/A
3	Emergency Fire Pump	Plant Intake	500	500
4	Transfer Shop Diesel Tanks	NW corner transfer shop	1,500 1,000	[illegible]
5	Used Oil Tank	Inside containment area of fuel oil tank	1,000	1,108,400*
6	#2 Fuel Oil Storage Tank	S of Unit #1 Precipitator	[illegible]	1,108,400*
7	Spare Transformer Runoff Containment	W. of Spare Transformer	NA	NA
8	Oil House	N. E. of Unit #2	Varies	Inside Bldg
9				
10	Fuel Oil Unloading Area	W of Fuel Oil Tank	NA	8,000
11	Ignitor Fuel Oil Pump Station	N. of Fuel Oil Tank	NA	[illegible]
12	Blasting Material storage	Varies	Varies	NA
13	Diesel & Dirty Oil Tanks	E. of Unit #1	2 @ 11,500 1 @ 2,000	[illegible]
14	Demineralized Water Storage Tanks	NE Turbine Bldg E. of Unit #1 and #3	Varies	NA
15	Filtered Water Tank	E. of Unit #1	[illegible]	NA
16	Caustic - Sodium Hydroxide	E. of Unit #2	15,000	[illegible]**
17	Sulfuric Acid	E. of Unit #2	15,000	3,000**
18	Caustic - Sodium Hydroxide	E. of Unit #3	5,000	[illegible]**
19	[illegible]	[illegible]	[illegible]	[illegible]
20				
21	Turbine Oil Tanks	Inside Unit 1, 2 & 3 Turbine Buildings	Unit 1 - 7,000 Unit 2 - 7,000 Unit 3 - 7,000	Unit 1 - 1,750 Unit 2 - 1,750 Unit 3 - 1,750
22	[illegible]	Pulverizer Bays each unit	[illegible]	NA
23	Sodium Hypochlorite	Various Demin/RO	[illegible]	NA
24	Precipitators & Fly Ash Silos	W. of Boilers #1, #2 & #3	[illegible]	NA
25	Car Dumper Hydraulic System	E. side of Dumper House	210	[illegible]

* The fuel oil and used oil tanks are located in a common diked area.

** Acid & Caustic tanks have small separate containments that join one large containment ([illegible] gal)

ID	Description	Location	Size (Gallons)	SECONDARY CONTAINMENT (GALLONS)
26	CO2 Tank	Unit #2 Boiler Elevator	14 Tons	NA
27	Chlorine Raw Water Disinfection	S. of Unit #2	8 - 1 ton cylinders	NA
28	CO2 Tank	W side of Main Parking Area	13 Tons	NA
29	CO2 Tank	Unit #1 Boiler Elevator	1 - 6 ton 1 - 4 ton	NA
30	Hydrogen Cylinders (H2)	NE Unit #3	[illegible]	NA
31	Maintenance Shop	1st Floor Service Bldg	NA	NA
32	Ash Recovery System	NE corner of Primary Ash Pond	NA	NA
33	Unleaded Gasoline	N of #2 Warehouse	1,000	[illegible]
34	WMU Ecology Pit - 017	SW Corner of Main Parking Area	[illegible]	NA
35	Service Building	N of Main Parking Area	NA	NA
36	Ash Contractor			
37	WMU Landfill - 002	S of Service Building	NA	NA
38	Material Storage Area	Various	NA	NA
39	Wash Rack for Ash Trucks	W of Unit #1 Ash Silo	NA	NA
40	#2 Warehouse (WMU 003)	E. of Tractor Shop	NA	NA
41	#3 Warehouse	W. of Unit #3	NA	NA
42	WMU Quonset Hut - 009	NW of Unit #3	NA	NA
43	Hazardous Storage Area in Quonset Hut	Quonset Hut	Variable	NA
44	Switchyard 345 kV	S. of Unit #1	NA	NA
45	Switchyard Control House	S side Switchyard	NA	NA
46	Maintenance Building	W. of Service Building	NA	NA
47	Car Dumper	S of Tractor Shop	NA	NA
48	Tractor Maintenance Building	SE of Coal Pile	NA	NA
49	Coal Yard Lube Oil Drum Storage	SE of Tractor Maint Bldg	approx. 12-55 gal drums	Inside Bldg
50	Reclaim Hopper	NW of Tractor Maint Bldg	NA	NA
51	Reserve Auxiliary Transformer	East of Unit #1	[illegible]	Moat/Chat
52	Main Power Transformer Unit #1	East of Unit #1	[illegible]	Moat/Chat
53	Auxiliary A Transformer Unit #1	East of Unit #1	[illegible]	Moat/Chat
54	Auxiliary B Transformer Unit #1	East of Unit #1	[illegible]	Moat/Chat
55	Main Power Transformer Unit #2	East of Unit #2	[illegible]	Moat/Chat
56	Auxiliary A Transformer Unit #2	East of Unit #2	5,772	Moat/Chat

ID	Description	Location	Size (Gallons)	SECONDARY CONTAINMENT (GALLONS)
57	Auxiliary B Transformer Unit #2	East of Unit #2	5,772	Moat/Chat
58	Main Power Transformer Unit #3	East of Unit #3	[illegible]	Moat/Chat
59	Auxiliary A Transformer Unit #3	East of Unit #3	[illegible]	Moat/Chat
60	Auxiliary B Transformer Unit #3	East of Unit #3	[illegible]	Moat/Chat
61	Material Storage Warehouse	N. of Oil House		
62	WMU - Acid Pond [illegible]	[illegible]	Varies	NA
63	Cooling Tower Pump House	W. of Cooling Towers at discharge canal	NA	NA
64	Cooling Tower A	Discharge Canal	NA	NA
65	Cooling Tower B	Discharge Canal	NA	NA
66	Raw water tank	E of Unit #2	[illegible]	NA
67	Clearwell Tank	E of Unit #2	[illegible]	NA
68	[illegible] Offices	W. of Unit #3	NA	NA
69	RSO Shop	NA	NA	NA
70	Spare Main Power Transformer	S. of Switchyard	[illegible]	Containment Runoff Pond
71	Spare Auxiliary Transformer	S. of Switchyard	[illegible]	Containment Runoff Pond
72	Bleach Tank	E. of Demin	[illegible] gal	[illegible]
73	Laboratory	N. of Warehouse	NA	NA
74	HTH Powder	Inside Demineralizer	[illegible] lbs	NA
75	Positioner Truck Lock Hydraulic System	W. of Dumper House	NA	NA
76	WMU [illegible]	N. of Switchyard	NA	NA
77	Dust Suppression	Coal yard	[illegible]	NA
78	RSO Office	N of #3 Silo	NA	NA
79	Material Storage	N of Turbine Bldg	NA	NA
80	RO Bldg. & Chemical Storage	E. of Unit #2	[illegible]	NA
81	Connex Row	S. of #3 Warehouse		
82	WMU - RO Reject Tank [illegible]	N. of RO Bldg	[illegible]	NA
83	Sulfuric Acid Tote	E. Wall RO Outside	330 gal	330
84	Drain Reservoir	U #1 U #2 U #3 [illegible]	[illegible] gal [illegible] gal [illegible] gal [illegible] gal	DWT DWT DWT DWT
85	Demineralizer	E. of Unit #2	NA	NA
86	Mill Reject Box WMU [illegible]			
87	Warehouse			
88	WMU [illegible]			
89	WMU [illegible]			
90	1500 KVA Transformer	NE of Service Building	[illegible]	[illegible]
91	1500 KVA Transformer	W of Warehouse	[illegible]	[illegible]
92	[illegible] Tank (WMU [illegible])	S. of Unit #2	[illegible]	NA

MWO 007 Temporary Storage Frac Tanks
MWO 018 RCRA Exempt
MWO 019 Temporary Tank

STORM WATER OUTFALLS
S001
S002
S004

▬	PLANT ROAD
▲	FIRE HYDRANT
①	EVACUATION AREA
②	EVACUATION AREA
③	EVACUATION AREA
④	EVACUATION AREA
●	MONITORING WELLS
●	ASH POND MONITORING WELLS

SWAUANO LAKE RESERVOIR
NORMAL POOL AL. 320'-0
LOW WATER EL. 314'-0
AREA = 1,365 ACRES

200' 0 200' 400'
GRAPHIC SCALE

SWAUANO RESERVOIR

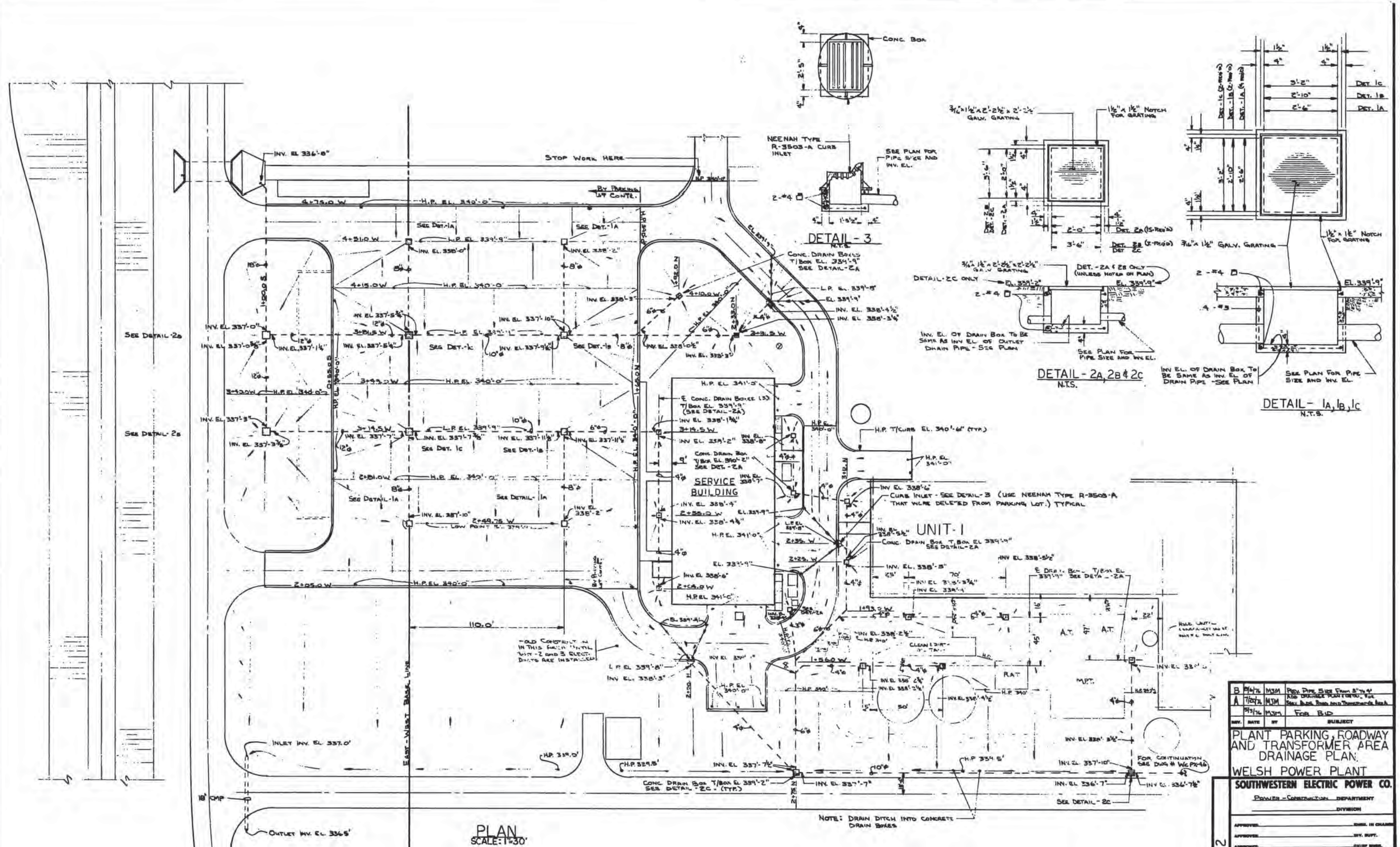
REV	DESCRIPTION	DATE	DR	BY	APP
8	CONFORMS TO CONSTRUCTION RECORDS	5/2/07	ML		JM
10	FUTURE SITE AREAS	6/2/10	ML		MD
9	CONFORMS TO CONSTRUCTION RECORDS	9/25/08	ML		JM

SPCC & STORM WATER SITE PLAN
WELSH POWER PLANT
PITTSBURG, TEXAS

SOUTHWESTERN ELECTRIC POWER

DRAFTING/ENGINEERING DATE SCALE 1"=
DFT. M. LONG 9/19/00
ENG.
APP. J. MEYER 9/19/00
AEP
DWG. NO. WEPX-342
SHT.
REV. No. 10

J:\CAD\Region V - SWEPCO\WELSH\Internal Drawings\Common\WEPX Drawings\WEPX-342.dwg 09/25/08 12:[illegible]



REV.	DATE	BY	SUBJECT
B	9/6/76	MJM	REV. PIPE SIZE FROM 3" TO 4"
A	7/20/76	MJM	ADD DRAINAGE PLAN & DETAIL FOR SERV. BLDG. ROAD AND TRANSFORMER AREA
	5/3/76	MJM	FOR BID

PLANT PARKING, ROADWAY AND TRANSFORMER AREA DRAINAGE PLAN.

WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

POWER - CONSTRUCTION DEPARTMENT

DIVISION

APPROVED ________ ENGR. IN CHARGE

APPROVED ________ DIV. SUPT.

APPROVED ________ CHIEF ENGR.

SHEET 2

DRWN. BY MJM

TRAC. BY

DATE: 2-9-76

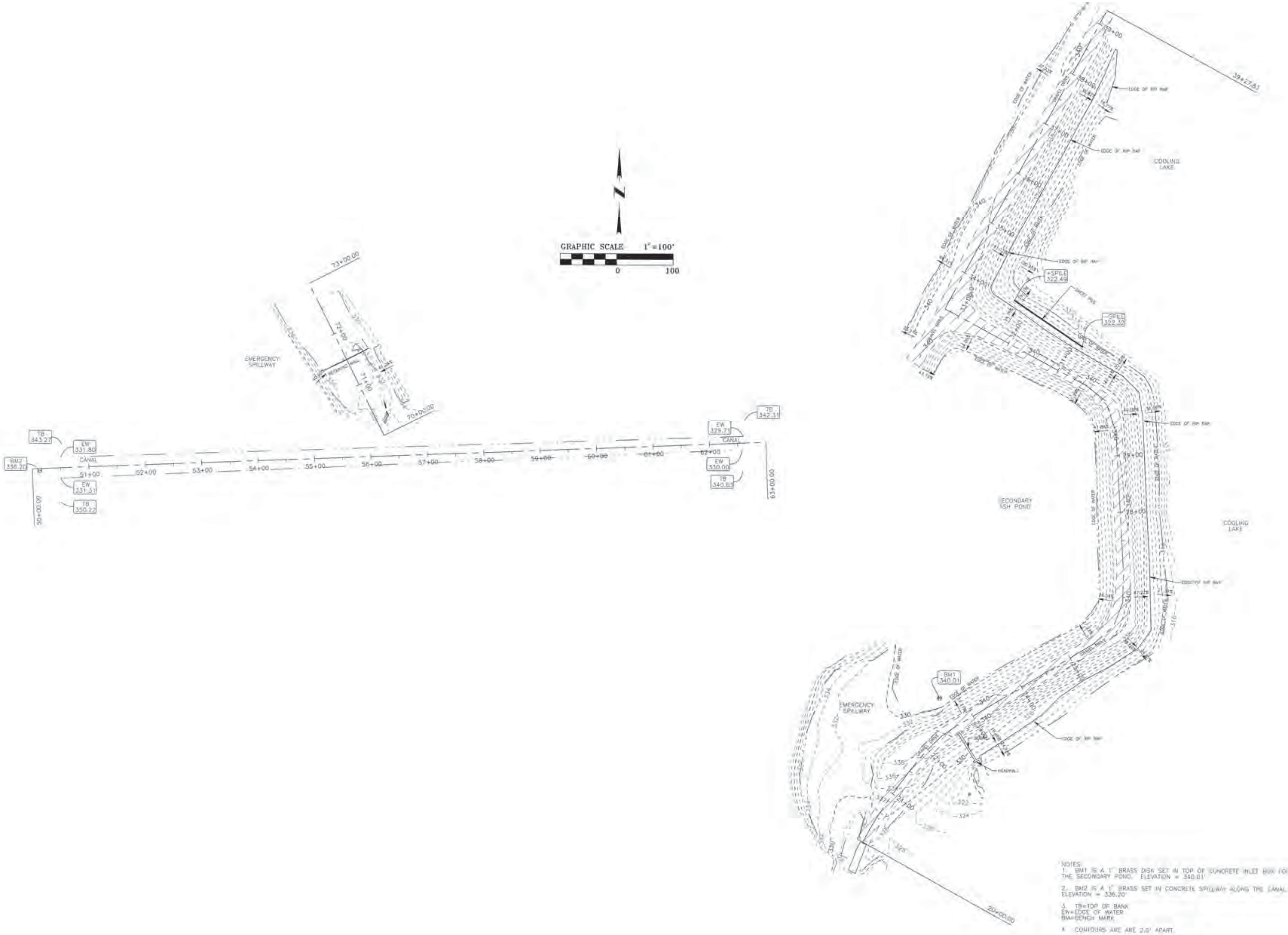
SCALE: AS NOTED

WORK ORDER

DWG. NO. WePX-68

SH. 2 OF 2

FILE



NOTES:
1. BM1 IS A 1" BRASS DISK SET IN TOP OF CONCRETE INLET BOX FOR THE SECONDARY POND. ELEVATION = 340.01'

2. BM2 IS A 1" BRASS SET IN CONCRETE SPILLWAY ALONG THE CANAL. ELEVATION = 336.20'

3. TB=TOP OF BANK
EW=EDGE OF WATER
BM=BENCH MARK

4. CONTOURS ARE ARE 2.0' APART.

5. LAKE ELEVATION PER WELSH POWER PLANT ON NOVEMBER 18, 2010 WAS 317.57 FEET MSL.

SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON NOVEMBER 18, 2010, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: NOVEMBER 23, 2010
REVISED: DECEMBER 6, 2010

MIKE GARDNER
#5760

TOPOGRAPHIC SURVEY

DIKE'S AT WELSH POWER PLANT
FOR: GREG CARTER

Date	Revision/Description
12/6/10	ADDED LAKE LEVEL NOTE
12/6/10	ADDED CROSS SECTION SHEETS

MTG engineers & surveyors
5930 SUMMERHILL RD. P.O. BOX 3786
TEXARKANA TEXAS 75501
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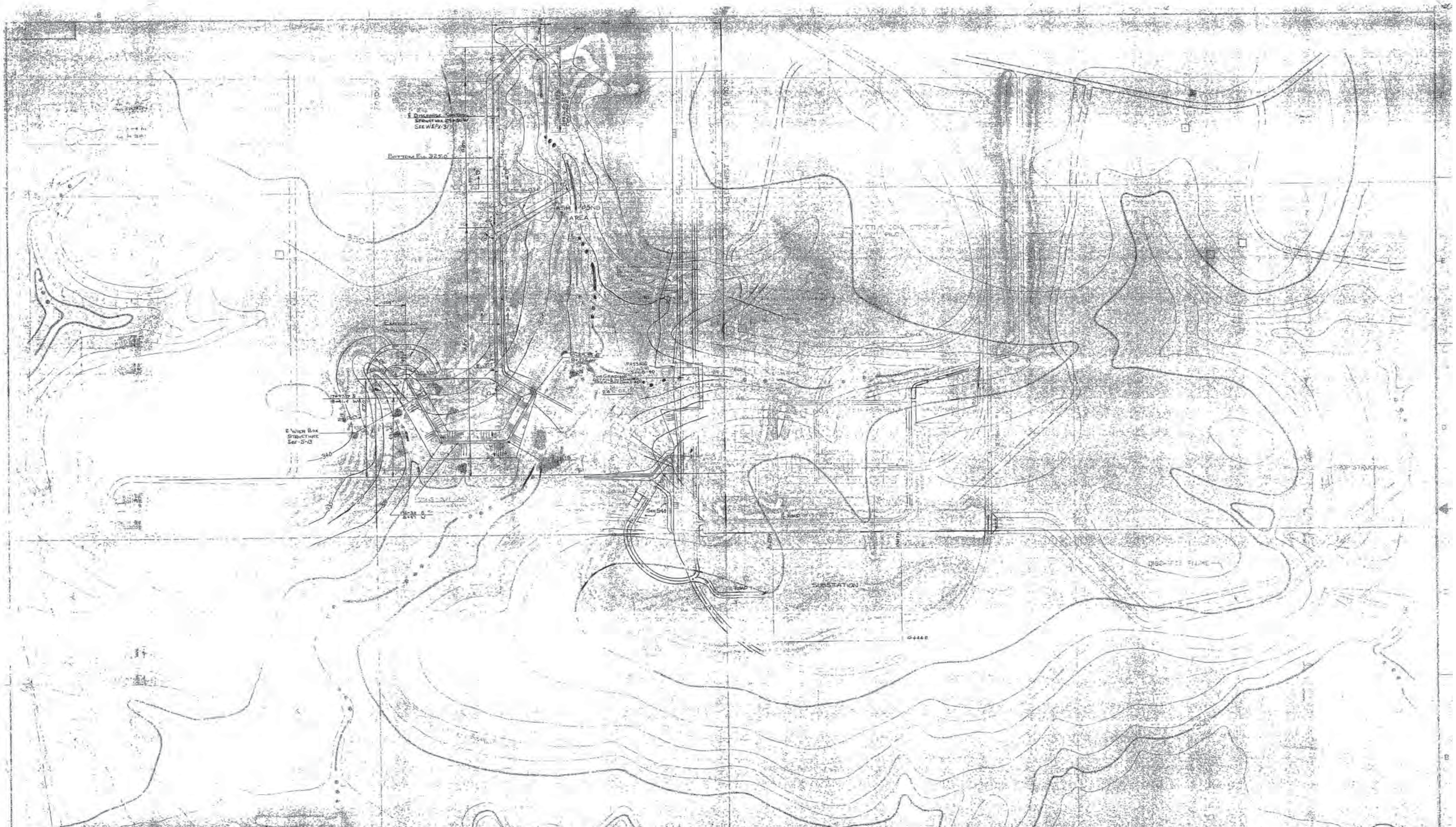
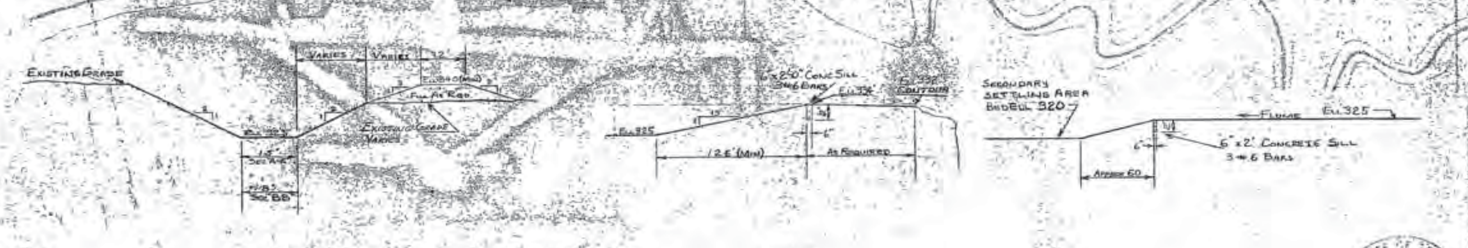
Drawn By	Checked By	Project No.	Dwg. Date	File No.	Sheet No.
MG	DW	104021	11/19/10		1





Sec "A-A" & "B-B"
As Noted
Scale 1" = 20'

Section "C-C"
No Scale

Section "D-D"
No Scale

NOTES

1. For general notes see dwg S-1

REFERENCE DRAWINGS

Site Development Plan
Ash Pond Dike Cross Sections - Sheet 1
Ash Pond Dike Cross Sections - Sheet 2
Secondary Settling Area Spillway
W.R. Section & Profile Discharge Flume
Secondary Settling Area Weir Box Structure

Drawing Revision Record

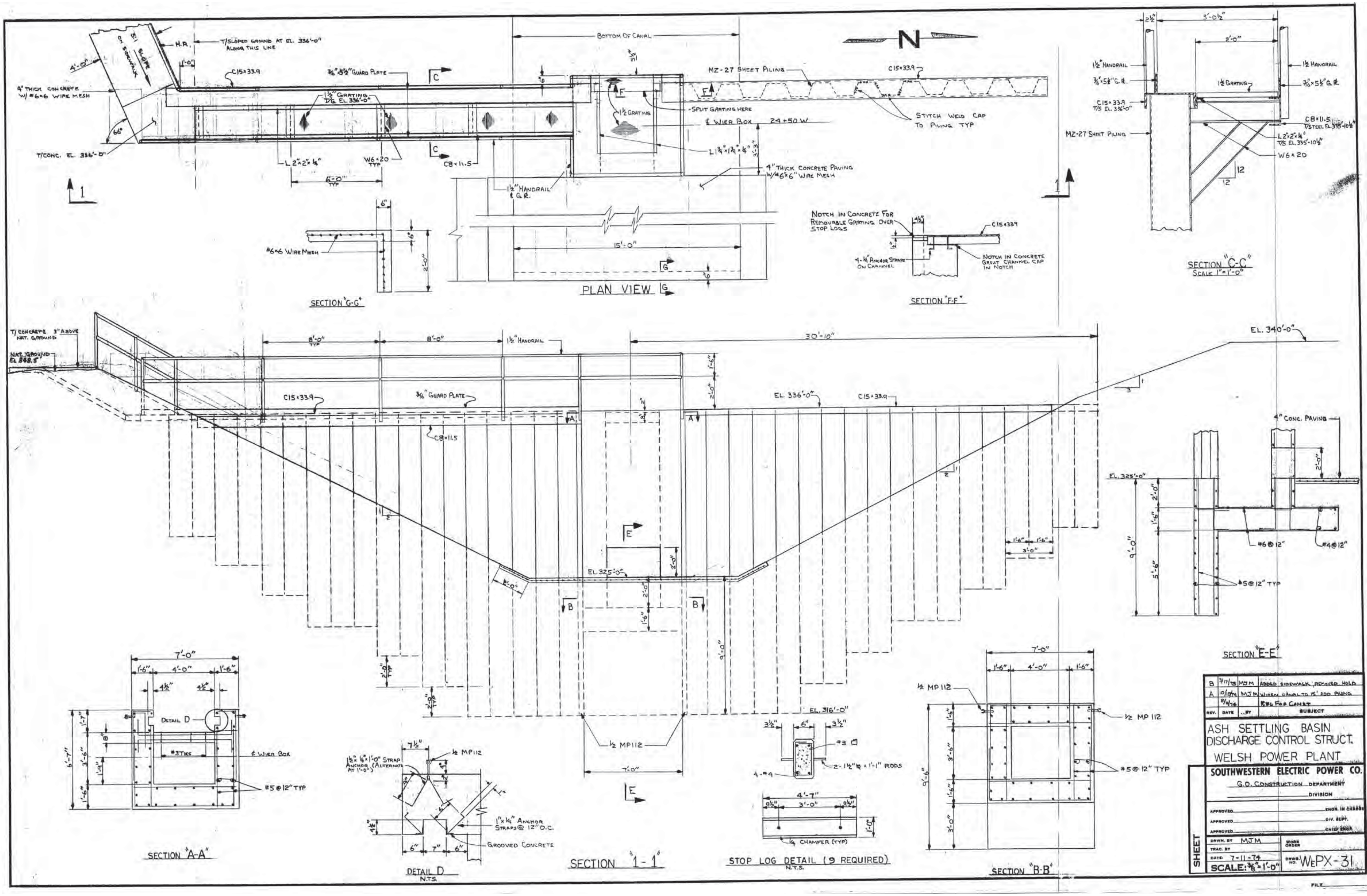
Rev.	Date	Init.	Issued For
B	10-25-73	MEO	Gen. Rev.
C	12-6-73		
D	5-30-74		
E	7-24-75		
F	10-12-79		

ASH POND & SECONDARY SETTLING AREA
WELSH POWER PLANT
SOUTHWESTERN ELECTRIC POWER CO.
CASON, TEXAS

SCALE
DRAWN
CHECKED
ENGINEER
APPROVED
JOB NO.

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO.
S-12



SECTION "G-G"

PLAN VIEW

SECTION "F-F"

SECTION "C-C"
SCALE 1"=1'-0"

SECTION "1-1"

SECTION "E-E"

SECTION "A-A"

DETAIL D
N.T.S.

STOP LOG DETAIL (9 REQUIRED)
N.T.S.

SECTION "B-B"

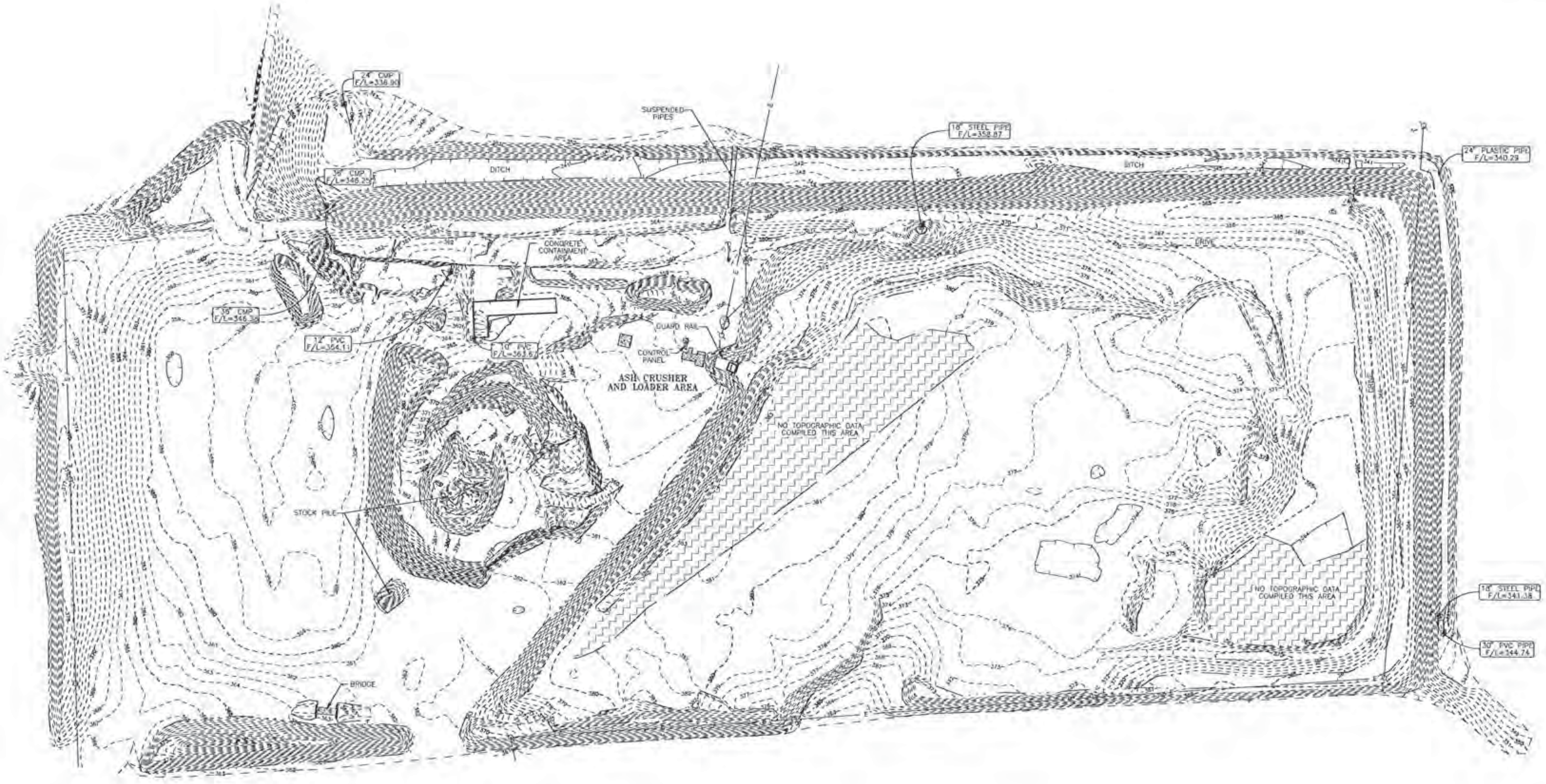
REV.	DATE	BY	SUBJECT
B	3/17/75	MJM	ADDED SIDEWALK, REMOVED HOLD
A	10/18/74	MJM	WIDEN CANAL TO 15' ADD PILING
	8/2/74		REL FOR CONST

ASH SETTLING BASIN
DISCHARGE CONTROL STRUCT.
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.
G.O. CONSTRUCTION DEPARTMENT
DIVISION

APPROVED ENGR. IN CHARGE
APPROVED DIV. SUPT.
APPROVED CHIEF ENGR.

DRWN. BY MJM
TRAC. BY
DATE: 7-11-74
SCALE: 3/8"=1'-0"
WORK ORDER
DRWG. NO. WEPX-31
SHEET
FILE

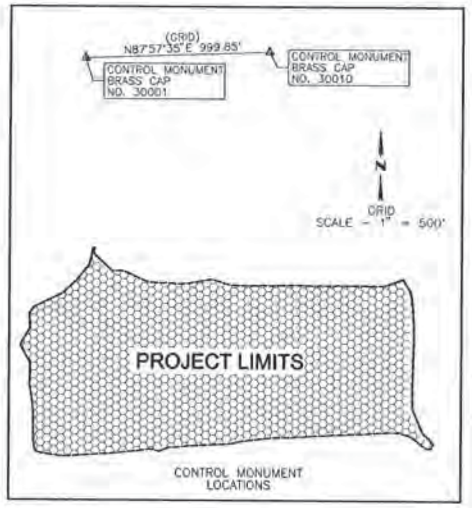


N

GRID
GRAPHIC SCALE 1"=100'
0 100

LEGEND

——— E ———	OVERHEAD ELECTRIC LINE
- - - - - - -	TOP OF BANK / SLOPE
——— - - - ———	TOE OF SLOPE / BANK
- - - - - - -	PIPING
- - - - - - -	EDGE OF DRIVE
— — — — —	EDGE OF GRAVEL
- - - 369 - - -	1.0' CONTOUR INTERVAL
- - - 370 - - -	5.0' CONTOUR INTERVAL
☐	POWER POLE
▣	PIPE LOCATION
⊥	GUY WIRE
△	CONTROL MONUMENT
⊕	LIGHT POLE
▩	CONCRETE SURFACE
▨	AREA NOT SURVEYED



CONTROL MONUMENT LOCATIONS

THE BEARINGS ARE BASED ON GRID NORTH WITHIN THE "TEXAS COORDINATE SYSTEM OF 1983, NORTH CENTRAL ZONE", NAD83 (CORS96, EPOCH 2002.0), WITH A BEARING OF NORTH 87 DEGREES 57 MINUTES 35 SECONDS EAST. THE COMBINED SCALE FACTOR TO GO FROM GRID TO SURFACE IS 1.00012. THE FOLLOWING CONTROL MONUMENTS WERE USED TO ESTABLISH THE BASIS OF BEARINGS:

CONTROL MONUMENT NO. 30001	CONTROL MONUMENT NO. 30010
N-7085417.3416 E-3087023.3084	N-7085452.9387 E-3088022.5268

MIKE GARDNER
#5760

SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON DECEMBER 14, 2009, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: DECEMBER 17, 2009

TOPOGRAPHIC SURVEY

ASH STORAGE AREA
WELSH POWER PLANT
FOR: AEP

Date	Revision/Description

Drawn By	Checked By	Project No.	Dwg. Date	File No.	Sheet No.
J.B.D.	M.G.	094027	12-17-09		

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TBPE NO. 354

X:\2009 Projects\094027 TOPO AT WELSH POWER PLANT - GREG CARTER\MERGE TOPO G.dwg
Thu Dec 17, 2009 10:13AM

2.5 – Structural Stability Assessment Periodic 5-Year Review, Primary Bottom Ash Pond, October 2021

STRUCTURAL STABILITY ASSESSMENT PERIODIC 5-YR REVIEW

30 TAC 352.731 (40 CFR 257.73(d))

Primary Bottom Ash Pond

Welsh Plant
Pittsburg, Texas

October, 2021

Prepared for: Southwest Electric Power Company (SWEPCO) – Welsh Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

BOUNDLESS ENERGY℠

Document No. GERS-21-034

Structural Stability Assessment
Periodic 5-Yr Review
CFR 257.73(d)
Welsh Plant
Primary Bottom Ash Pond

PREPARED BY Brett A. Dreger DATE 9/29/2021
Brett A. Dreger, P.E.

REVIEWED BY DATE 09-29-2021
Shah S. Baig, P.E.

APPROVED BY Gary Zych DATE 10/1/2021
Gary Zych, P.E.
Manager – AEP Geotechnical Engineering

Gary F. Zych
GARY F. ZYCH
127152
10/1/2021

American Electric Power Service Corporation
Texas Registered Engineering Firm No. F-3341

I certify to the best of my knowledge, information and belief that the information contained in this structural stability assessment meets the requirements of 40 CFR 257.73(d)

Table of CONTENTS

1.0 OBJECTIVE 257.73(d)

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of 30 TAC 352.731 (40 CFR 257.73(d)) and document whether the design, construction, operations, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices. This is the first periodic 5-year review of the initial assessment as per the Rule.

Note: There has not been any changes to the embankment structure, emergency spillway or the discharge weir structure since the initial assessment.

2.0 NAME AND DESCRIPTION OF CCR SURFACE IMPOUNDMENT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash Pond and the Bottom Ash Storage Pond. This report addresses the Primary Bottom Ash Pond. The Primary Bottom Ash Pond CCR unit is located southwest of the Plant and directly west of the Welsh Reservoir.

The Primary Bottom Ash Pond is bounded by natural ground surface (topographically higher areas) to the north and west, and embankment dikes to the south and east. The elevation at the top of embankment along the crest area is approximately 340.0 feet above msl. Presently, economizer ash and bottom ash from the generating plant is sluiced to the Primary Bottom Ash Pond.

3.0 STABLE FOUNDATION AND ABUTMENTS 257.73(d)(1)(i)

[Was the facility designed for and constructed on stable foundations and abutments? Describe any foundation improvements required as part of construction.]

The foundaion materials for the Primary Bottom Ash Pond embankment consist primarily of stiff to hard lean clay (CL) and fat clay (CH) with intermittent layers of medium dense to very dense clayey sand (SC) and silty sand (SM). There is a thick layer of very dense silty sand (SM) which is apparently the native surficial soils near the previous creek bed. Atterberg Plasticity Indices of the tested soils ranged between a low of 9 to a high of 44. Based on the subsurface investigation and engineering properties of the subsurface soils, it is concluded that the Primary Bottom Ash Pond dikes are supported on a stable foundation base.

Operation of the impoundment is performed so as to not adversely affect the foundation and abutments. As required by the CCR rules the Primary Bottom Ash Pond is inspected at least every 7 days by a qualified person. Also as a requirement of the CCR rules, the impoundment is also inspected annually by a professional engineer. Maintenance items are addressed as they are discovered as a part of those inspections.

4.0 SLOPE PROTECTION 257.73(d)(1)(ii)

[Describe the slope protection measures on the upstream and downstream slopes.]

Over the years the Primary Bottom Ash Pond unit has developed a thick layer of economizer and bottom ash on the interior slopes that provide a layer of protection from erosion and wave action and also support a set of ash sluice lines that are no longer in use. The exterior slopes consist of vegetative cover on the upper half of the slope while the lower half of the slope is protected by large rip rap for armor protection. Any erosion that may occur is repaired within a timely period.

5.0 EMBANKMENT CONSTRUCTION 257.73 (d)(1)(iii)

[Describe the specifications for compaction and/or recent boring to give a relative comparison of density.]

The Primary Bottom Ash Pond embankment is constructed of compacted earth fill. The source and type of soils used for earth fill is unknown. However, AEP contracted with ETTL Engineers & Consultants Inc. of Tyler, Texas to perform a Geotechnical Investigation of Existing Ash Storage Ponds Embankments on June 21, 2010. The evaluation of the existing earthen embankments consisted of slope stability and seepage analyses for the embankments. The evaluation was performed using information obtained from soil borings located on the crest and outside toe of the embankments. The embankment for the Primary Bottom Ash Pond was investigated. Three borings were drilled to 50 feet depth at the crest of the embankment. The fill material in the containment berm consists primarily of stiff to hard lean clay (CL), fat clay (CH) and medium dense clayey sand (SC) overlying the native soils which consist primarily of stiff to hard lean clay (CL) and fat clay (CH) with intermittent layers of medium dense to very dense clayey sand (SC) and silty sand (SM). Atterberg Plasticity Indices of the tested soils ranged between a low of 9 to a high 44. Based on the slope stability evaluation and the engineering properties of the subsurface soils, it is concluded that the Primary Bottom Ash Pond embankments are adequately constructed.

6.0 VEGETATION CONTROL 257.73 (d)(1)(iv)

[Describe the maintenance plan for vegetative cover.]

The vegetative slopes/areas are mowed to facilitate inspections and maintain the growth of the vegetative layer and prevent the growth of woody vegetation.

<u>7.0</u> SPILLWAY SYSTEM 257.73(d)(1)(v)

[Describe the spillway system and its capacity to pass the Inflow Design Flood as per its Hazard Classification.]

Hydrology and Hydraulic Analysis which includes calculations for each spillway structure are included in Inflow Design Flood Control Plan. The Inflow Design Flood for the Primary Bottom Ash Pond (PBAP) is the 100-year storm event.

The principal spillway weir box for the PBAP is located in the canal connecting the PBAP and the Clear Water Pond. The PBAP receives effluent from the ash sluice lines that transport the ash slurry on the east side of the pond. The ash settles, and the decant water flows to a 48-inch wide concrete weir box and into the Clear Water Pond via an approximate 1,950-foot long discharge canal which originates at the southwest corner of the PBAP. The weir box has a minimum crest elevation of 325.0 feet, and flows through the weir box are controlled by installing 12-inch stop logs that are 55 inches long. Flows are conveyed through the weir box by a sheet piling wall installed across the discharge canal, on either side of the weir box. The PBAP has a 90-foot wide earthen emergency spillway on the south side of the pond; the spillway crest elevation is 334.0 feet. The emergency spillway overflows from the PBAP directly into the discharge canal at approximate midpoint of the discharge canal. Based on the Hydrology and Hydraulic analysis the PBAP spillway system can handle the 100-year storm event.

<u>8.0</u> BURIED HYDRAULIC STRUCTURES 257.73 (d)(1)(vi)

[Describe the condition of the sections of any hydraulic structure that in buried beneath and/or in the embankment.]

There are no pipes that are part of the spillway system that are buried within or beneath the embankment structure.

9.0 SUDDEN DRAWDOWN 257.73 (d)(1)(vii)

[If the downstream slope is susceptible to inundation, discuss the stability due to a sudden drawdown.]

The downslope is partially inundated by the Swauano Creek reservoir. The reservoir is used to supply the power plant with a source of water for operations. The service spillway is a concrete morning glory drop inlet with a concrete conduit through the dam. It has a low level drain pipe (18-inch diameter) located at the bottom of the drop inlet and discharges into the concrete conduit. The emergency spillway is a broad-crested earthen spillway located in the right abutment of the dam. The service spillway overflow section is only activated during large precipitation events and the emergency spillway section has never been activated since the construction of the dam. The water level of the lake is also maintained via a make-up water line from a nearby reservoir that keeps the reservoir near normal pool levels. The water intake for the plant operations is maintained via pumps. In general, the reservoir area and volume is large compared to the intake pump capacity of the plant. Therefore, since the water level in the lake cannot increase or decrease significantly in a rapid manner, the condition for a sudden drawdown of the reservoir is not feasible.

2.6 – Safety Factor Assessment Periodic 5-Year Review, Primary Bottom Ash Pond, October 2021

SAFETY FACTOR ASSESSMENT
PERIODIC 5-YEAR REVIEW

30 TAC 352.731 (40 CFR 257.73e)

Primary Bottom Ash Pond

Welsh Plant
Pittsburg, Texas

October, 2021

Prepared for: Southwest Electric Power Company (SWEPCO) – Welsh Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

GERS-21-047

SAFETY FACTOR ASSESSMENT
PERIODIC 5-YEAR REVIEW
CFR 257.73(e)
WELSH PLANT
PRIMARY BOTTOM ASH POND

PREPARED BY Brett A. Dreger DATE 10/01/2021
Brett A. Dreger, P.E.

REVIEWED BY DATE 10/01/2021
Mohammad A. Ajlouni, P.E.

APPROVED BY Gary F. Zych DATE 10/4/2021
Gary F. Zych, P.E.
Section Manager – AEP Geotechnical Engineering

American Electric Power
Service Corporation
Texas Registered Engineering
Firm No. F-3341

Gary F. Zych
GARY F. ZYCH
127152
10/4/2021

I certify to the best of my knowledge, information, and belief that the information contained in this safety factor assessment meets the requirements of 40 CFR § 257.73(e)

Table of CONTENTS

1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of 30 TAC 352.731 (40 CFR 257.73(e)) for the safety factor assessment of CCR surface impoundments. This is the first periodic 5-year review of the safety factor assessment.

2.0 DESCRIPTION OF THE CCR UNIT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash Pond and the Bottom Ash Storage Pond. This report addresses the Primary Bottom Ash Pond. The Primary Bottom Ash Pond CCR unit is located southwest of the Plant and directly west of the Welsh Reservoir.

The Primary Bottom Ash pond is bounded by natural ground surface (topographically higher areas) to the north and west, and embankment dikes to the south and east. The elevation at the top of embankment along the crest area is approximately 340.0 feet above msl. Presently, economizer ash and bottom ash is sluiced to the Primary Bottom Ash Pond.

3.0 SAFETY FACTOR ASSESSMENT 257.73(e)

The periodic 5-year review was conducted to evaluate if any physical changes have been made to the earthen dike and/or operating changes that could impact the loading on the structure. The assumptions, material properties and operating pools defined in the initial assessment were reviewed. The review concluded that there have been no changes that would impact the stability analyses that were previously conducted. Therefore, the previous report and analyses are still applicable to the current conditions of the facility. The results indicate that the calculated factors of safety meet or exceed the minimum values defined in Section 257.73(e).

ATTACHMENT A

Initial Safety Factor Assessment – Primary Ash Pond

Initial Safety Factor Assessment – Primary Ash Pond
Welsh Power Generating Station
Pittsburgh, Texas

Auckland Project No. 2015-008A (Revision No. 2)
January 14, 2016

Prepared For:

American Electric Power Company
1 Riverside Plaza
Columbus, Ohio 43215

Prepared By:

Auckland Consulting, LLC
Jacksonville, Texas

TBPE Firm Registration No. F-16721
Expires 2/29/2016

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1.0 Introduction and Embankment Information

1.1 Introduction

The following report and evaluation provides the Initial Safety Factor Assessment of the Primary Ash Pond, an existing CCR impoundment (as defined by 40 CFR §257.2) located at the Welsh Power Station near Pittsburgh, Texas. In accordance with 40 CFR §257.73(e)(1)(i) through (iv) this initial assessment provides field and laboratory data, model outputs (detailing multiple stability conditions) and summary of safety factors for the Primary Ash Pond. In accordance with 40 CFR §257.73(e)(2) this report provides the Initial Safety Factor Assessment certification for the Primary Ash Pond.

1.2 Referenced Information and Data

Soils data, comprised of field and laboratory testing, utilized in the preparation of this assessment were completed by ETTL Engineers and Consultants, Inc. and documented in the report *Welsh Power Station, Existing Ash Storage Pond Embankment Investigation, Pittsburg, Texas* dated June 21, 2010. Based on a review of the provided field and laboratory data, it appears to be accurate and appropriate for use in the initial structural stability assessment of the Primary Ash Pond [40 CFR §257.73(e)(1)]. Furthermore, based on a recent site visit (October 2015), no modifications or elevation alterations have been made to the embankment since the referenced investigation. No additional field or laboratory activities were conducted. Soil data utilized in this evaluation is provided in the Appendix of this report.

The impoundment pool elevation data cited herein were provided in a separate hydrology and hydraulic (H&H) analysis report completed by Freese and Nichols titled *Hydraulic Analysis of Welsh Power Plant Ash Ponds* dated December 29, 2010 (not included herein). The referenced report generally meets the demonstration requirements of 40 CFR §257.82(a).

Embankment profile dimensions and elevations were determined by using existing information provided by the client. This information is also included in the Appendix of this report.

1.3 Embankment Evaluation Criteria

Based on information provided by the client, the existing embankment is constructed of lean clay (CL) and fat clay (CH) with existing side slopes (both up- and downstream) of approximately 2.5:1 (H:V), maximum embankment height of 35 feet (downstream) and top of dam elevation of 340.0 feet MSL. The crest width of the embankment is approximately 50 feet. An embankment cutoff key (key trench) extends below the core structure approximately five (5) feet and has an approximate bottom width of 20 feet.

The downstream toe of the Primary Ash Pond extends below the impounded water level of the adjacent Welsh Reservoir. Based on information provided by the client, the normal pool elevation for the Welsh Reservoir is approximately 320.0 feet (MSL). Reservoir levels are monitored and adjusted as needed to maintain a constant pool elevation of approximately 320.0 feet (MSL). Based on the active management and control of the Welsh Reservoir pool elevation, the downstream toe of the Primary Ash Pond should not be subject to sudden or rapid drawdown conditions, notwithstanding a catastrophic failure of or uncontrolled release from the Welsh Reservoir. Regardless, the sudden drawdown of the Welsh Reservoir along the downstream slope of the Primary Ash Pond is modeled herein (40 CFR §257.73(d)(1)(A)(3)(vii).

In accordance with 40 CFR §257.73(e)(1)(i) and (ii), the maximum storage pool elevation for the Primary Ash Pond as determined by the 25-year, 24-hour storm event is 329.35 feet (MSL). For the purposes of this evaluation, the maximum storage pool elevation of 330.0 feet (MSL) was utilized. Likewise the maximum (or flood) surcharge loading elevation as determined by the 100-year, 24-hour event is 330.80 feet (MSL), for this evaluation a maximum surcharge loading elevation of 331.0 feet (MSL) was utilized. Storage pool elevations were determined in accordance with 40 CFR §257.82(a).

2.0 Slope Stability Analyses

2.1 General

Soil parameters used for stability analyses of the existing embankment are based on findings of previous laboratory and field testing programs. The probable failure planes were analyzed using the analytical slope stability software, SLIDE by Rocscience, Inc. Methods of evaluation used in SLIDE are considered to be limited equilibrium methods of analysis, where each individual shear plane is evaluated to determine the resulting shear stress at the point of failure. For the purposes of this evaluation the Bishop Method of analysis, which analyzes circular failure planes through the slope was utilized.

Per 40 CFR §257.73(e)(1)(i) through (iii), four (4) modeled scenarios (presented below) were utilized to evaluate the stability of the existing embankment: steady state seepage (long term) condition under maximum storage pool, steady state seepage (long term) condition under maximum surcharge pool, steady state seepage condition with seismic loading under maximum storage pool conditions, and rapid drawdown (of the inundated downstream slope). The following minimum factors of safety (FS) and soil stress parameters were utilized in modeling. Minimum factors of safety are based on demonstration requirements provided in 40 CFR §257.73(e)(1) and guidance provided by the United States Army Corps of Engineers (USACE).

Summary of Embankment Condition and Factor of Safety		
Embankment Condition	**Soil Parameters**	**Minimum Factor of Safety**
Steady State Seepage – Maximum Pool	Effective Stress	1.50
Steady State Seepage – Surcharge Pool	Effective Stress	1.40
Steady State Seepage (Seismic) – Maximum Pool	Total Stress	1.00
Rapid Drawdown – Downstream Slope	Effective and Total Stress	1.20
NOTE: Minimum factors of safety based on demonstration requirements provided in 40 CFR §257.82 (e)(1). Minimum factor of safety for Rapid Drawdown based on guidance provided by the United States Army Corps of Engineers (USACE).		

For evaluation of steady state seepage (long term) conditions with seismic, peak ground acceleration for this location was obtained from the USGS National Seismic Hazard Mapping Project (http://earthquake.usgs.gov/hazards). Based on the seismic survey data, the anticipated site specific peak ground acceleration (PGA) of 0.06g (acceleration at rock sites) for two (2) percent probability of exceedance in 50 years (40 CFR Part 257, Preamble page 21384). Correcting for acceleration at soft soil sites (Seismic Site Classification D) yields an estimated PGA of 0.13g. The seismic coefficient (k) used for pseudo static analysis is determined by reducing the estimated PGA by 50% yielding a seismic coefficient of 0.065g.

2.2 Liquefaction Assessment

Liquefaction of soils occurs when horizontal shearing stresses exceed the strength of existing loose, saturated sand. This sudden loss of shear strength and subsequent soil structure is typically associated with earthquake-induced horizontal movement. Recent engineering publications[1] provide criteria to assess liquefaction potential of sands (little to no fines) and clayey soils of low plasticity (e.g. clayey sands, silts). These criteria indicate that water content of fine-grained or cohesive soils needs to be high (≥ 0.85 *Liquid Limit [LL]), a clay fine content (defined as grains smaller than 0.002 mm) of less than 10 percent (< 10%), and relatively low soil density (assessed in terms of SPT blow counts). In addition, the accepted minimum seismic threshold acceleration to cause liquefaction in loose sands is 0.10g, the anticipated site specific PGA for this site is 0.06g.

Native fine grained (or cohesive) material underlying the Primary Ash Pond generally consist of medium stiff to hard lean clay and fat clay (CL and CH) soils and coarse grained (or sandy) material consist of medium dense to very dense clayey sand (SC), silty sand (SM) and silty clayey sand (SC-SM) soils. Based on these soil characteristics and that the Primary Ash Pond is located in a zone of low peak ground acceleration (PGA), the risk of

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[1] Seed, R.B., et al, Recent Advances in Soil Liquefaction Engineering: A Unified and Consistent Framework, 26th Annual ASCE Los Angeles Spring Seminar, April 2003

either embankment or underlying soils liquefying are negligible [40 CFR §257.73(e)(1)(iv)].

2.3 Embankment and Foundation Stratigraphy

The models developed for this evaluation are based on the existing embankment geometry, results of field and laboratory testing and hydrologic site information provided by the client. Selection of the critical slope section was based on both height and subsurface sensitivity to loading. The following tables provide a summary of soil parameters used for these analyses. Specific soil parameters used for each model are presented in the Appendix.

Summary of Long Term, Total Stress Soil Parameters:

Material Type	Unit Weight (pcf)	Consolidated-Undrained Cohesion (psf)	Consolidated-Undrained Angle of Internal Friction (degrees)
Embankment Fill	125	570	12
Clayey Sand (SC)	130	360	10
Silty Sand (SM)	125	0	30
Fat Clay (CH)	130	320	19

NOTE: Properties used for Steady State Seepage with Seismic and Rapid Drawdown analyses.

Summary of Long Term, Effective Stress Soil Parameters

Material Type	Unit Weight (pcf)	Consolidated-Drained Cohesion (psf)	Consolidated-Drained Angle of Internal Friction (degrees)
Embankment Fill	125	310	23
Clayey Sand (SC)	130	320	15
Silty Sand (SM)	125	0	30
Fat Clay (CH)	130	300	28

NOTE: Properties used for Steady State Seepage and Rapid Drawdown analyses. Consolidated-drained conditions determined based on pore pressure measurements made during Consolidated-Undrained (CU) triaxial testing.

2.4 Seepage Analysis Parameters

The analysis of embankment seepage is based on laboratory results and estimated values for permeability for various embankment and native foundation soils. These soil parameters were utilized in the models to establish a long term steady state condition and corresponding phreatic surface in the embankment. Hydraulic conductivity test results are provided in the Appendix. Hydraulic conductivity properties utilized in the seepage analysis are provided in the below table.

Hydraulic Conductivity of Embankment Soils

Material Type	Permeability (ft/sec)
Embankment Fill	1×10^{-9}
Clayey Sand (SC)	1×10^{-7}
Silty Sand (SM)	1×10^{-5}
Fat Clay (CH)	1×10^{-8}

2.5 Stability Analysis Results

The following table provides the results of the stability analysis for each of the conditions cited herein, as required by 40 CFR §257.73(e)(1)(i) through (iii). The graphical representations of each analysis are included in the Appendix.

Summary of Stability Analyses – Safety Factors

Modeled Condition	Factor of Safety	
	Actual	Minimum
Steady State Seepage – Maximum Pool	1.51	1.50
Steady State Seepage – Surcharge Pool	1.51	1.40
Steady State Seepage with Seismic – Maximum Pool	1.07	1.00
Rapid Drawdown – Downstream Slope	1.21	1.20

Based on the findings of this analysis, the evaluated embankment appears to be stable under the modeled conditions and demonstrate the minimum safety factors, as required by 40 CFR §257.73(e)(1)(i) through (iii).

3.0 Report Limitations

This report has been prepared for the exclusive use of our client for the specific application to the project discussed and has been prepared in accordance with the generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. The analyses contained in the report are based on the data obtained from the referenced soil borings performed within the project site. This report does not reflect variations that may occur between borings or across the site. Soil borings do not necessarily reflect strata variations that may exist at other locations within the project site.

4.0 Initial Structural Stability Assessment Certification

By means of this certification, (i) I have reviewed the requirements of 40 CFR §257.73(e)(1) – *Periodic Safety Factor Assessments*, (ii) I or my agent has visited and examined the facility, (iii) the referenced data used in this evaluation to the best of my knowledge appears correct and appropriate for use, (iv) and this Initial Safety Factor Assessment for the Primary Ash Pond (Welsh Power Station) has been prepared to the best of my knowledge in accordance with §257.73(e)(1).

By: ______________________

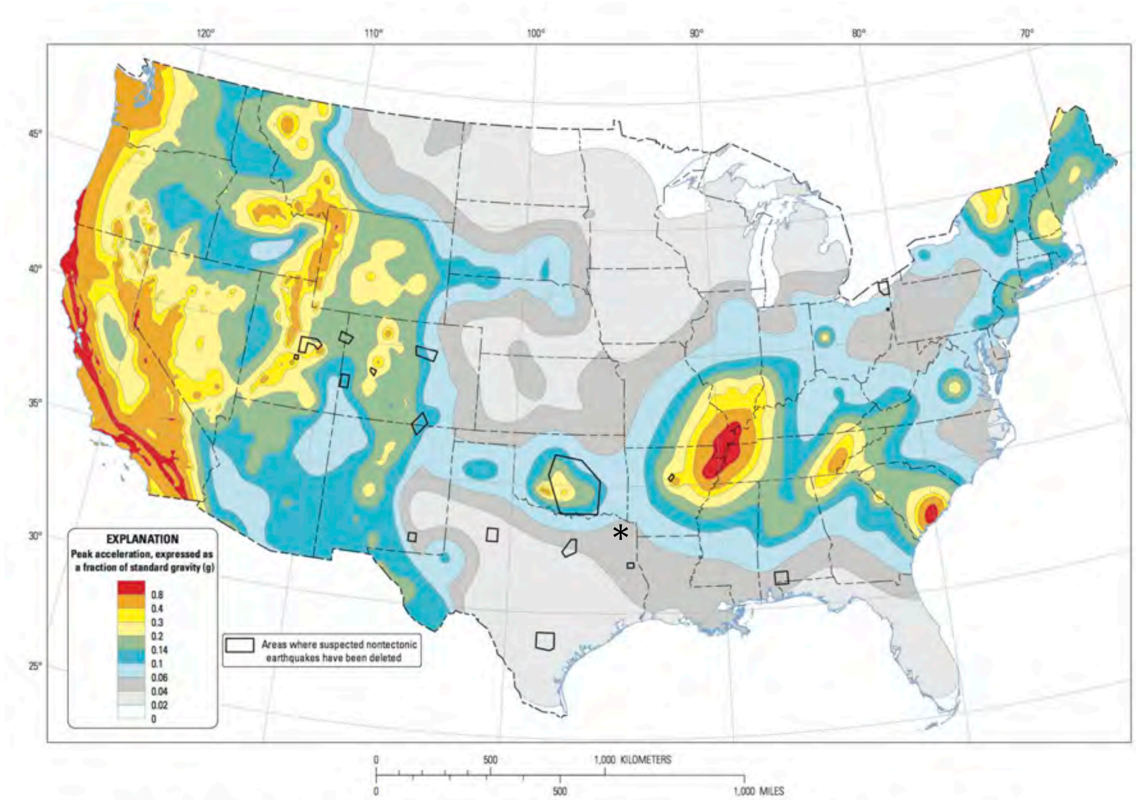
Dated: January 14, 2016

JOHN J. TAYNTOR
99202

TBPE Firm Registration No. F-16721
Expires 2/29/2016

Appendix

Stability Analyses
Reference Data



Two-percent probability of exceedance in 50 years map of peak ground acceleration

* Approximate location of Welsh Power Generating Station

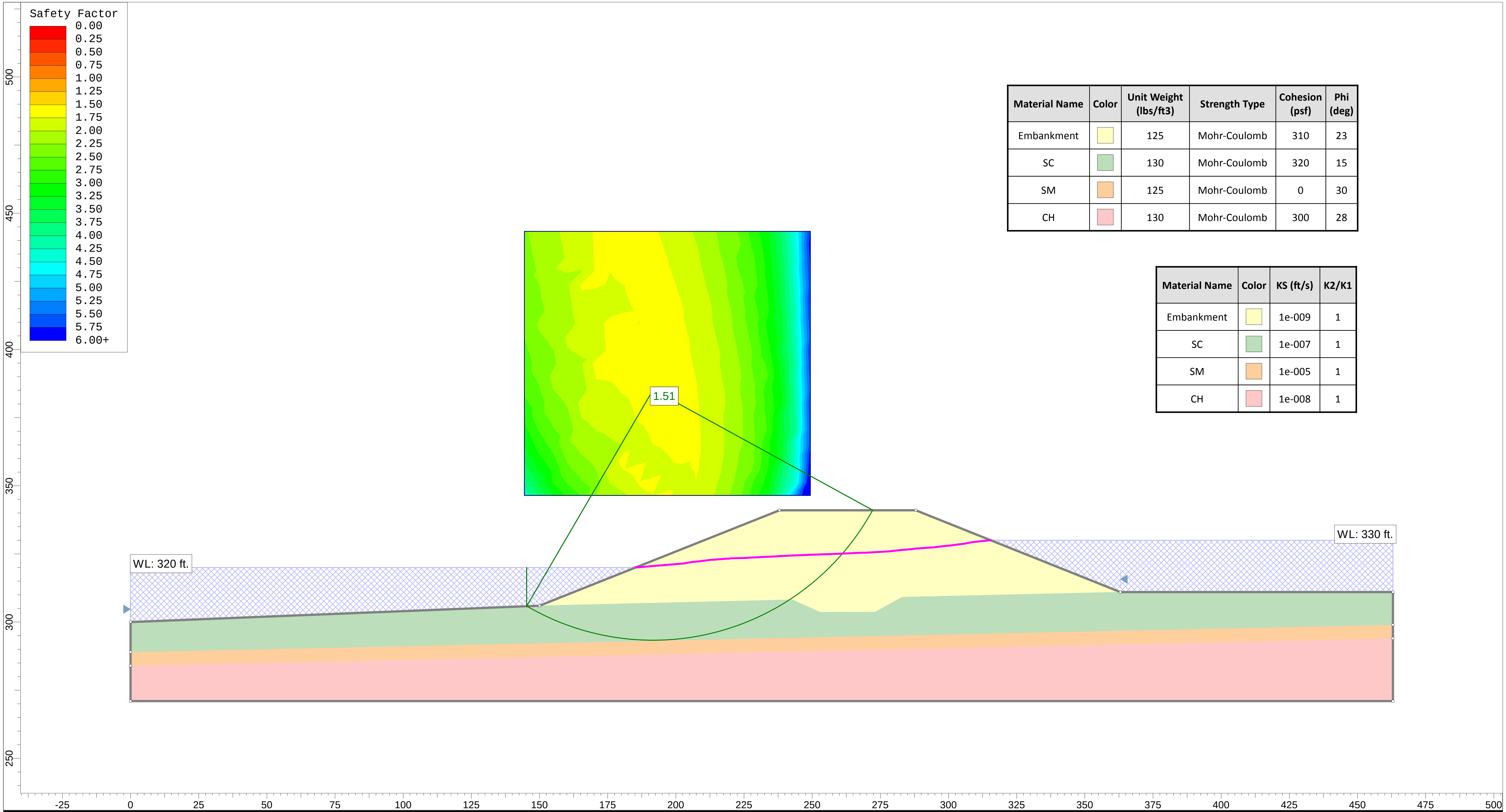
Provided by USGS National Seismic Hazard Mapping Project.

Seismic Probability Map

Scale: N/A

Auckland Project No. 2015-008A

Welsh Power Generating Station
Initial Safety Factor Assessment - Primary Ash Pond
Pittsburgh, Texas



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	Mohr-Coulomb	310	23
SC	🟩	130	Mohr-Coulomb	320	15
SM	🟧	125	Mohr-Coulomb	0	30
CH	🟥	130	Mohr-Coulomb	300	28

Material Name	Color	KS (ft/s)	K2/K1
Embankment	🟨	1e-009	1
SC	🟩	1e-007	1
SM	🟧	1e-005	1
CH	🟥	1e-008	1

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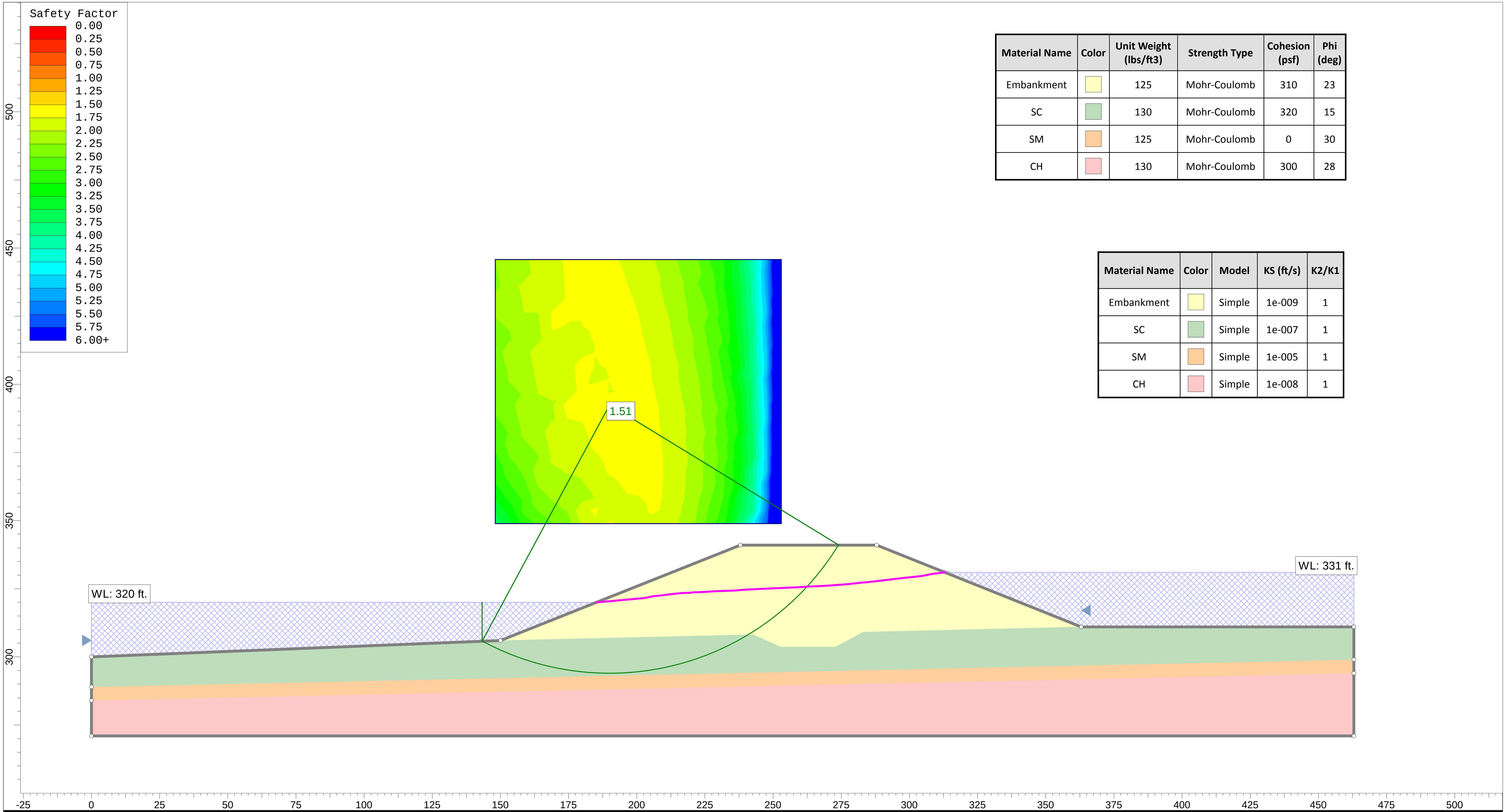
Jacksonville, Texas 75766

SLIDEINTERPRET 6.036

Project	Welsh Power Station - Primary Ash Pond
Analysis Description	Maximum Storage Pool at Normal Reservoir Pool
Drawn By	JJT
Company	
Date	12/2/2015
File Name	Primary_SSS_normal_25yr pool_Rev1.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	Mohr-Coulomb	310	23
SC	🟩	130	Mohr-Coulomb	320	15
SM	🟧	125	Mohr-Coulomb	0	30
CH	🟥	130	Mohr-Coulomb	300	28

Material Name	Color	Model	KS (ft/s)	K2/K1
Embankment	🟨	Simple	1e-009	1
SC	🟩	Simple	1e-007	1
SM	🟧	Simple	1e-005	1
CH	🟥	Simple	1e-008	1

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SLIDEINTERPRET 6.036

Project Welsh Power Station - Primary Ash Pond

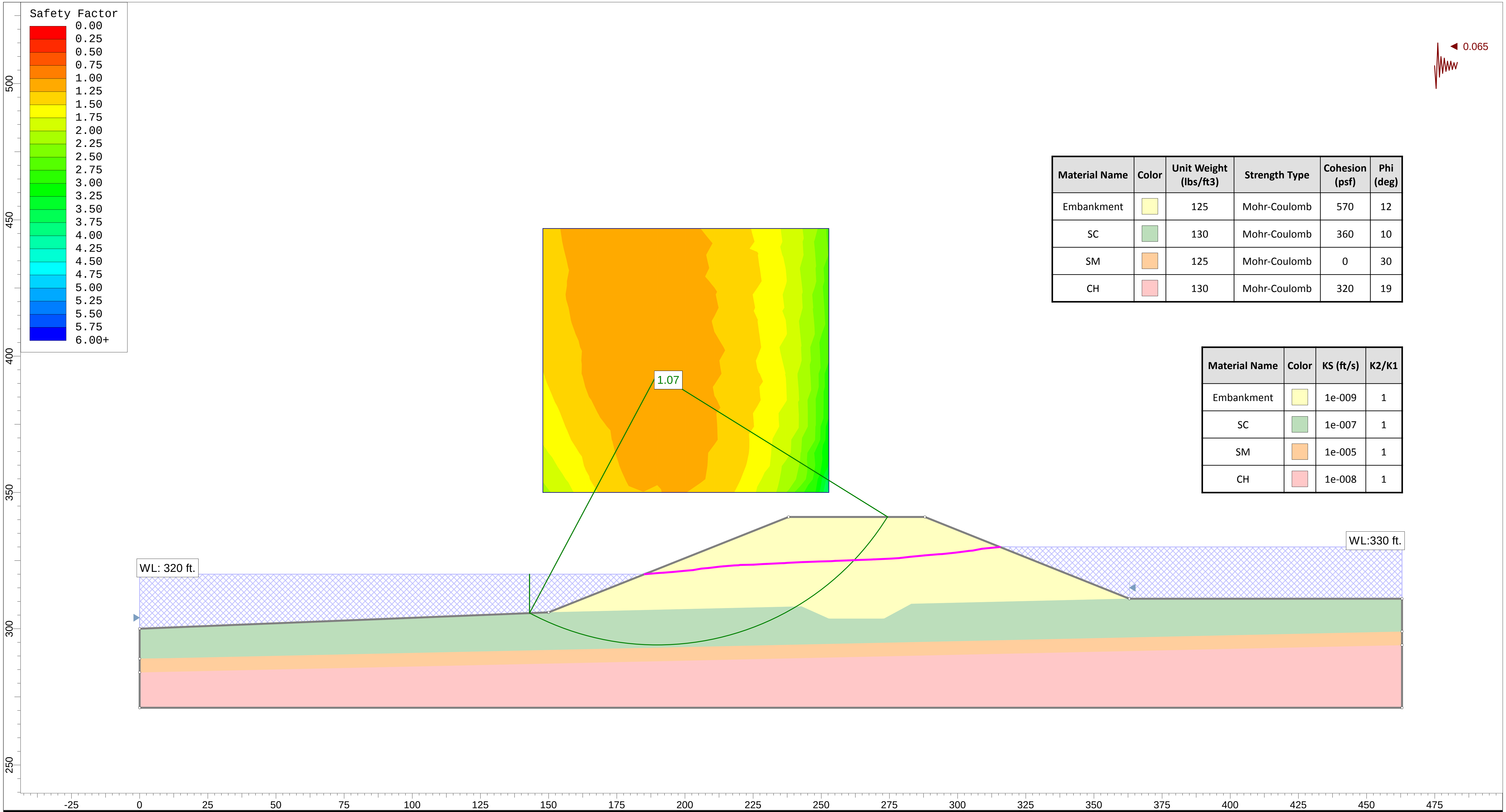
Analysis Description Maximum Surcharge Pool at Normal Reservior Pool

Drawn By JJT

Company

Date 12/2/2015

File Name Primary_SSS_normal_100 yr pool_Rev1.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	Mohr-Coulomb	570	12
SC	🟩	130	Mohr-Coulomb	360	10
SM	🟧	125	Mohr-Coulomb	0	30
CH	🟥	130	Mohr-Coulomb	320	19

Material Name	Color	KS (ft/s)	K2/K1
Embankment	🟨	1e-009	1
SC	🟩	1e-007	1
SM	🟧	1e-005	1
CH	🟥	1e-008	1

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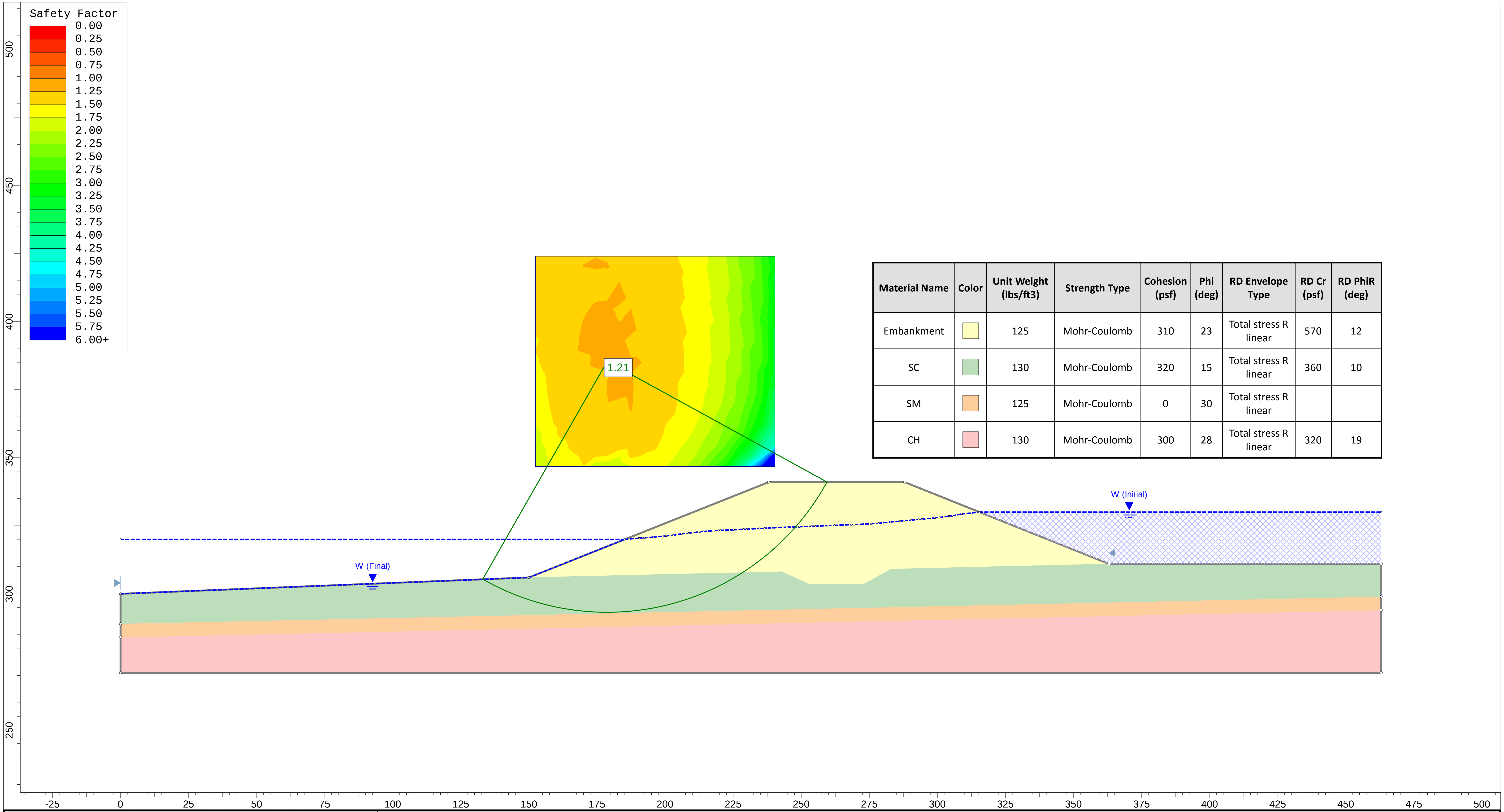
SLIDEINTERPRET 6.036

Project	Welsh Power Station - Primary Ash Pond
Analysis Description	Maximum Storage Pool at Normal Reservior Pool, Seismic Analysis

Drawn By	JJT	*Company*	
Date	12/23/2015	*File Name*	Primary_SSS_seismic_25yr pool.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	RD Envelope Type	RD Cr (psf)	RD PhiR (deg)
Embankment	🟨	125	Mohr-Coulomb	310	23	Total stress R linear	570	12
SC	🟩	130	Mohr-Coulomb	320	15	Total stress R linear	360	10
SM	🟧	125	Mohr-Coulomb	0	30	Total stress R linear		
CH	🟥	130	Mohr-Coulomb	300	28	Total stress R linear	320	19

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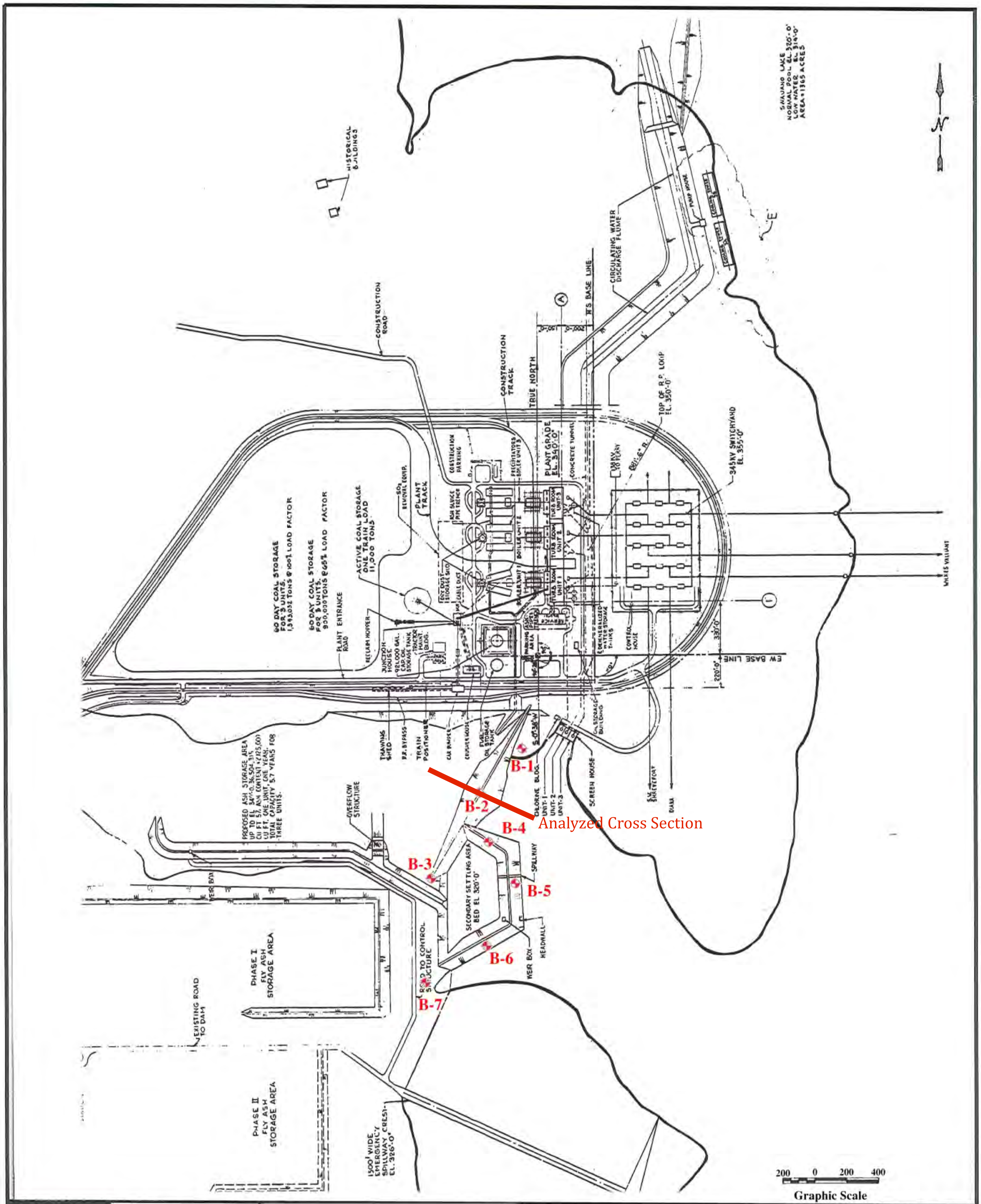
Project	Welsh Power Station - Primary Ash Pond
Analysis Description	Maximum Storage Pool with Rapid Drawdown of Reservior Pool
Drawn By	JJT
Company	
Date	12/2/2015
File Name	Primary_RD Res_normal_25yr pool.slim

SLIDEINTERPRET 6.036



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WELSH POWER PLANT
PITTSBURGH, TEXAS

PLATE 1 - PLAN OF BORINGS

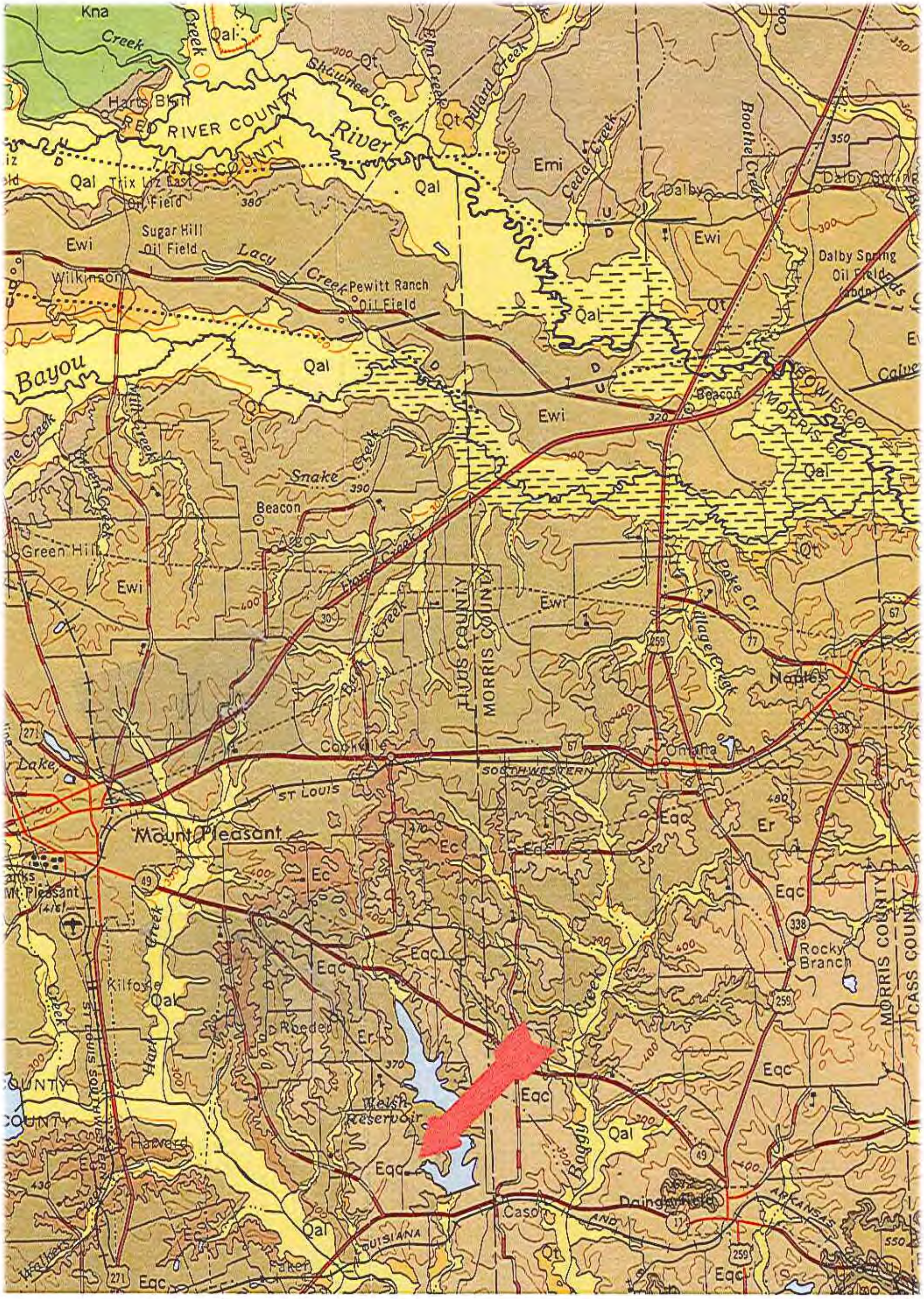
JOB NO.: G3242-095

DATE: JAN. 2010

SCALE: AS SHOWN

APPROVED BY:

DRAWN BY: K.C.R.



EXPLANATION

SEDIMENTARY ROCKS

Pleistocene Recent

QUATERNARY

Qal

Alluvium

Flood-plain deposits

Qt

Fluviatile terrace deposits undivided

Eocene

TERTIARY

Es / Etg

Sparta Sand

Quartz sand, fine to medium grained, light gray to brownish gray, slightly cohesive from silt and clay matrix, massive, locally cross-bedded, interbeds of sandy clay more abundant upward, locally carbonaceous; weathers various shades of light gray, at base hard, brown, ferruginous sandstone; lower part 170± feet thick, upper part absent. Locally includes Tyler Greensand Member, Etg, quartz-glauconite greensand, grayish green, massive, locally cross-bedded; weathers dark reddish brown, abundant ironstone concretions

Ew

Weches Formation

Glauconite and quartz sand, grayish green to grayish olive green, thin bedded, locally cross-bedded to lenticular, clay interbeds light brown to moderate light gray, silty, muscovitic, thin bedded; weathers moderate to dark reddish brown, locally forms limonitic and sideritic iron ore and clay ironstone concretions; marine megafossils in southern part; 35± feet thick, range 0–70 feet

Eqc

Queen City Sand

Quartz sand, fine grained to locally medium grained, light gray to brownish gray, locally carbonaceous, and clay, gray to brown, silty, slightly lignitic, sand most abundant to west; weathers red and white mottled, ironstone concretions and ledges common; local beds of glauconite-quartz greensand, cross-bedded, weathers to ferruginous ledges and rubble; 100–400 feet thick, thins southeastward

Er

Reklaw Formation

Upper 100± feet, clay, brownish black to brownish gray, silty, muscovitic, carbonaceous, laminated, interbeds of moderate reddish-brown clay; weathers light brown, ironstone concretions common; a few marine fossils. Lower 15± feet, quartz sand, fine to very fine grained, grayish green, glauconitic, argillaceous, massive, locally cross-bedded; weathers moderate brown to dark yellowish orange with clay ironstone ledges and rubble; fossils, clay ironstone, and clay decrease northward

Ec

Carrizo Sand

Upper part, very fine sand, silt, clayey silt, silty clay, medium to dark gray, carbonaceous; weathers moderate yellowish brown to dark reddish brown, indurated ledges of dark brownish-gray ironstone common. Lower part, quartz sand, fine to medium grained, light brownish gray, weakly cohesive, massive, locally cross-bedded; weathers light gray to various shades of red. Thickness 20–100 feet

Ewi

Wilcox Group undivided

Mostly silty and sandy clay, various shades of gray, local beds of clay, lignite, silt, and quartz sand, in part carbonaceous, laminated to massive, locally cross-bedded, weathers to various shades of gray, brown, yellow, and red. Calcareous siltstone and ironstone concretions common; abundant plant fossils, a few marine fossils in southeastern part; 500–1,000 feet thick.

E

Eocene rocks undivided

Reklaw Formation, Carrizo Sand, Wilcox Group, and Midway Group on Brooks dome, not separately shown

Ewp

Wills Point Formation

Clay, medium bluish gray, greenish gray, grayish green, brownish gray, silt increases upward, laminated to locally massive, glauconitic near base, rough calcareous siltstone concretions common in upper part, locally lignitic in upper part, thin bed of fossilic limestone near middle; weathers medium gray to yellowish gray; fossiliferous; 300± feet thick

Ek

Kincaid Formation

Clay, medium gray to dark gray, greenish gray, brownish gray, glauconitic, calcareous, selenitic, locally silty or sandy, locally phosphatic near base, thin beds of limestone in upper part, gray, hard, detrital; weathers medium gray; fossiliferous; 180± feet thick

Upper Cretaceous

CRETACEOUS

Kke

Kemp Clay

Clay, dark gray to bluish gray, calcareous, silty, glauconitic, calcareous concretions common; weathers dark greenish gray and black; upper part only crops out

Ku

Upper Cretaceous rocks undivided

Navarro Group, Taylor Group, and Austin Chalk on Brooks dome not separately shown

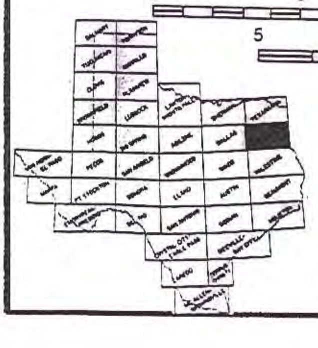
Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 Nautical Miles

CONTOUR INTERVAL 100 FEET
WITH SUPPLEMENTARY CONTOURS AT 50 FOOT INTERVALS



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SITE SURFACE GEOLOGY

JOB No.: G3242-09	
DATE: 1975	
SCALE: 1:250,000	

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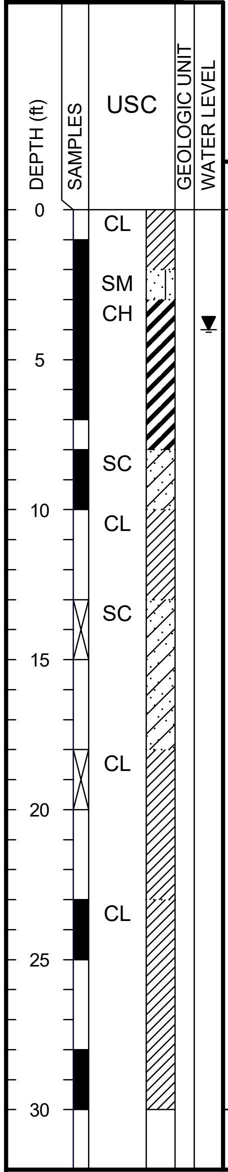
LOG OF BORING B-1

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

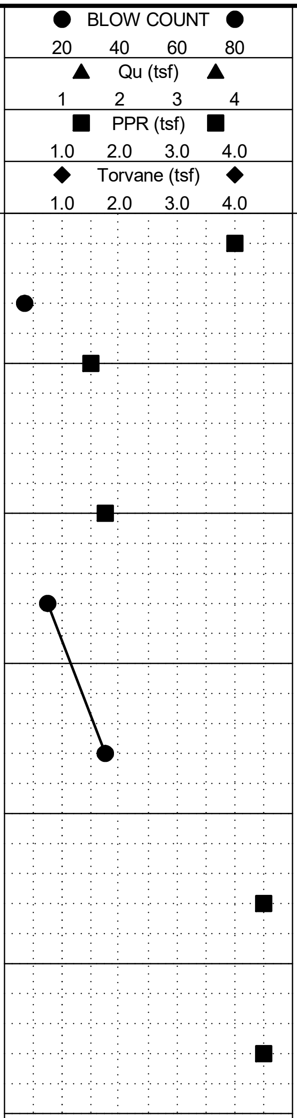
DATE 10/27/09

SURFACE ELEVATION 324.1

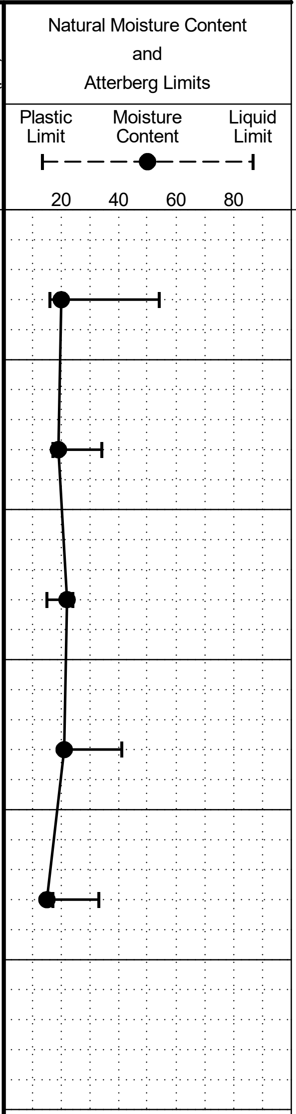


USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; brownish orange	P=4.0						
SM	SILTY SAND(SM) tannish orange	SF						
CH	SANDY FAT CLAY(CH) medium stiff; tannish orange	N=7	20	54	16	38	63	+40Sieve=10%, +4 Sieve=1%
	--stiff	P=1.5						
SC	CLAYEY SAND(SC) medium dense; tannish orange; with clay seams	P=1.75	19	34	17	17	32	+40 Sieve=7%, +4 Sieve=3%
CL	SANDY LEAN CLAY(CL) stiff; orange							
SC	CLAYEY SAND(SC) medium dense; orange; saturated; with iron oxide cemented sandstone rock	N=15	22	24	15	9	19	+40Sieve=35%, +4 Sieve=22%
CL	LEAN CLAY WITH SAND(CL) hard; dark gray; with clay seams	N=35	21	41	21	20	75	+40 Sieve=2%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; dark brown	P=4.5+	15	33	17	16	52	+40 Sieve=1%, +4 Sieve=0%
	--grayish brown; laminated with silt	P=4.5+						
	Bottom of Boring @ 30'							

ATTERBERG LIMITS(%)



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 5' while drilling. Water level @ 4' and open to 30' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.090', W 94°50.417'

ETTL
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LOG OF BORING B-2

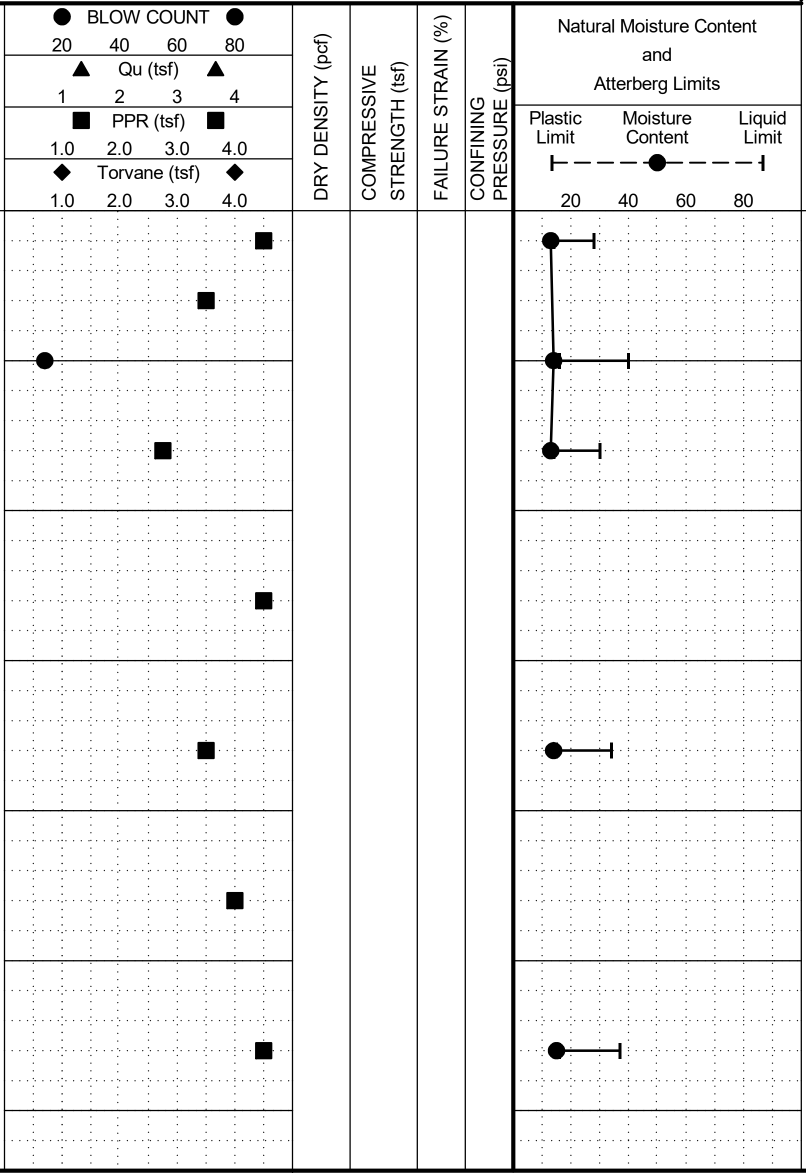
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+	13	28	14	14	61	+40 Sieve=3%, +4 Sieve=0%
	--very stiff	P=3.5						
	--stiff	N=14	14	40	16	24	65	+40 Sieve=0%, +4 Sieve=0%
	--very stiff; reddish brown	P=2.75	13	30	14	16	58	+40 Sieve=0%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+						
	--very stiff ▼	P=3.5	14	34	15	19	54	+40 Sieve=0%, +4 Sieve=0%
		P=4.0						
SC	CLAYEY SAND(SC) medium dense; tan, red, and gray	P=4.5	15	37	16	21	47	+40 Sieve=5%, +4 Sieve=3%

DEPTH (ft): 0, 5, 10, 15, 20, 25, 30

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

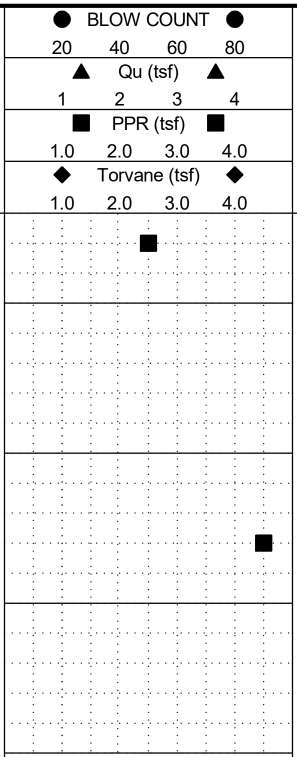
DATE 10/28/09

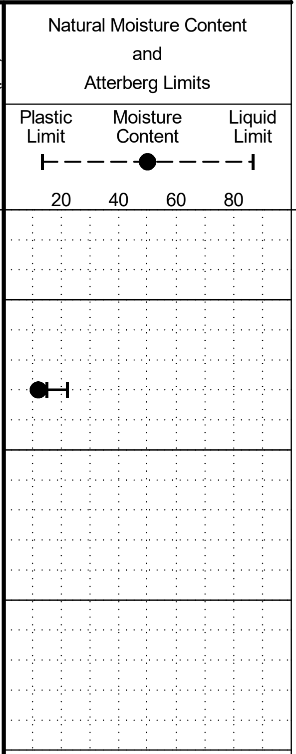
SURFACE ELEVATION 339.7

MATERIAL DESCRIPTION

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
33–35		--red and tan	P=2.5						
38–40	SM SC	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated	SF	12	22	15	7	48	+40 Sieve=0%, +4 Sieve=0%
43–45	CH	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams	P=4.5+						
48–50	SM	SILTY SAND(SM) black and gray	SF						

Bottom of Boring @ 50'





DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

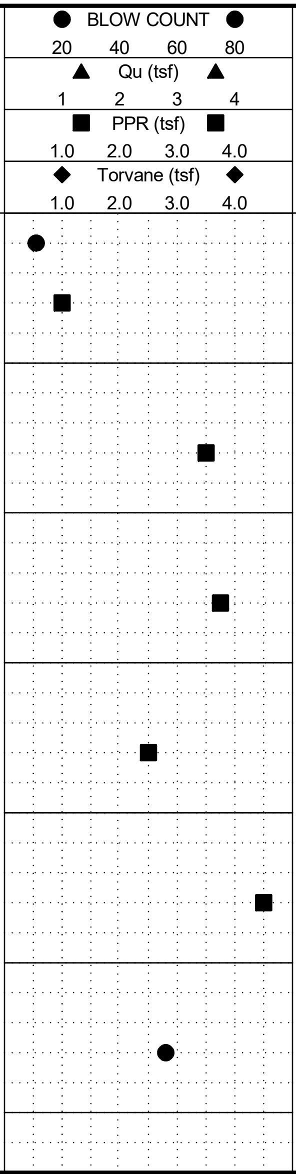
SURFACE ELEVATION 339.6

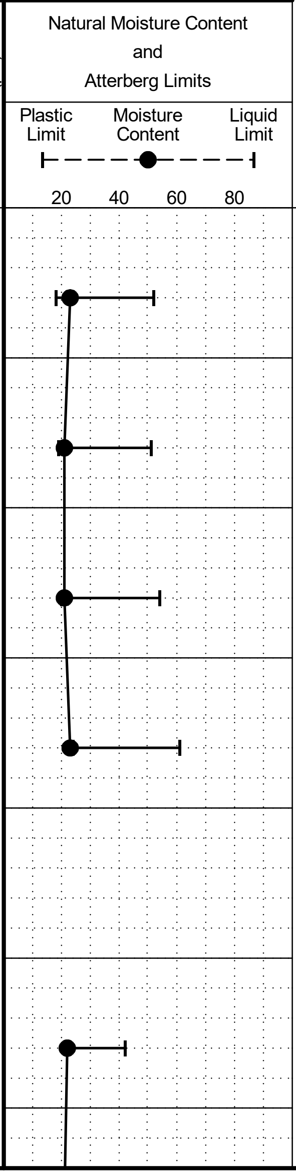
MATERIAL DESCRIPTION

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	CLAYEY SAND(SC) medium dense; gray and red	N=11						
CH	FAT CLAY(CH) stiff; red and tan; with sand seams	P=1.0	23	52	18	34	87	+40 Sieve=3%, +4 Sieve=0%
	--very stiff	P=3.5	21	51	19	32	86	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) very stiff; brown; with ferric joints	P=3.75	21	54	20	34	85	+40Sieve=10%, +4 Sieve=1%
	--red and tan; layered; with ferric seams	P=2.5	23	61	24	37	81	+40Sieve=11%, +4 Sieve=0%
CH	FAT CLAY(CH) hard; gray; with sand seams	P=4.5+						
SC	CLAYEY SAND(SC) very dense; gray; with sand seams	N=56	22	42	22	20	35	+40 Sieve=1%, +4 Sieve=0%

DEPTH (ft): 0, 5, 10, 15, 20, 25, 30

Columns: DEPTH (ft) | SAMPLES | USC | GEOLOGIC UNIT | WATER LEVEL ▼ | DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi) | ATTERBERG LIMITS(%)





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

LOG OF BORING B-3

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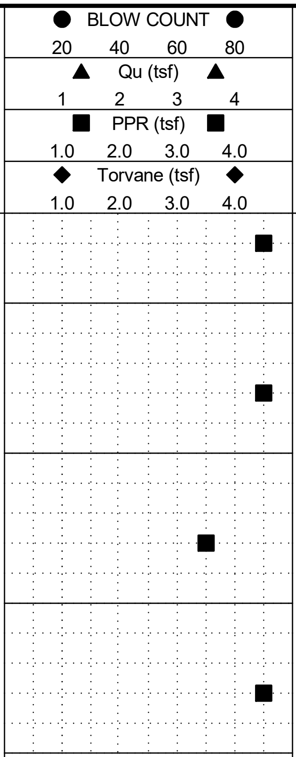
DATE 10/27/09

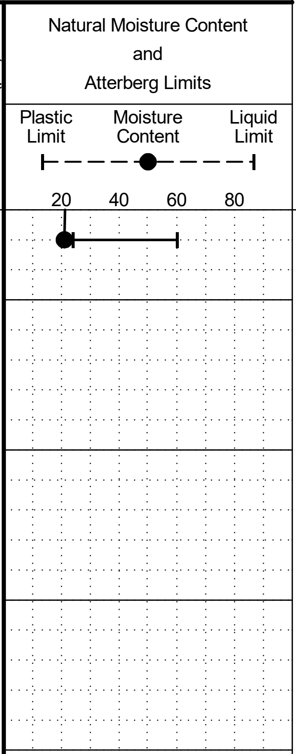
SURFACE ELEVATION 339.6

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger





DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	CH	FAT CLAY(CH) hard; brown; layered and with sand seams	P=4.5+	21	60	24	36	95	+40 Sieve=1%, +4 Sieve=0%
35									
		--gray and green	P=4.5+						
40									
	CL	SANDY LEAN CLAY(CL) very stiff; gray and dark green; layered; with sand seams	P=3.5						
45									
	CH	FAT CLAY(CH) hard; gray and dark green; layered; with silt seams	P=4.5+						
50		Bottom of Boring @ 50'							

Water Level Est.: ∇ Measured: ▼ Perched: ⊻

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

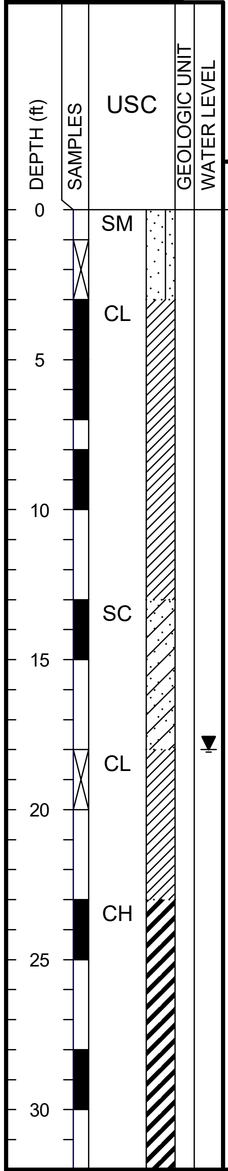
LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

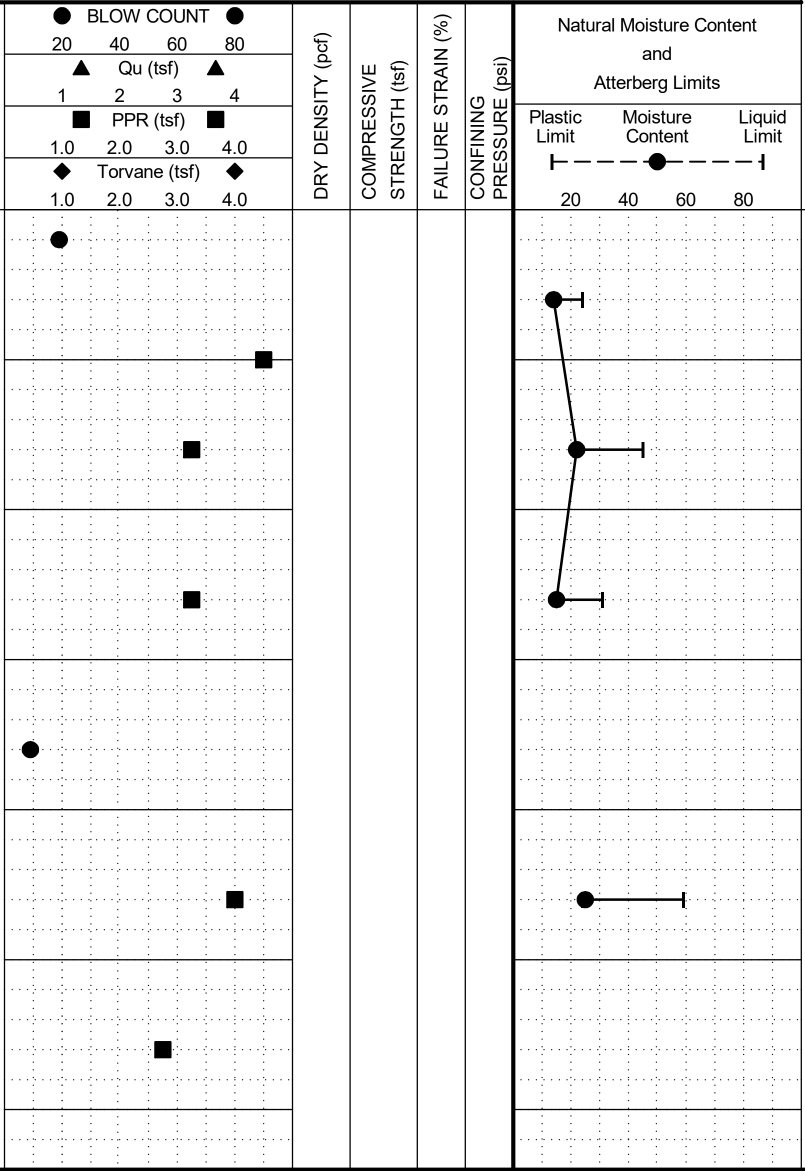
PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SM	SILTY SAND(SM) medium dense; tan; with gravel	N=19						
CL	SANDY LEAN CLAY(CL) dark brown	SF	14	24	15	9	59	+40 Sieve=1%, +4 Sieve=0%
	--tannish orange							
	--hard; orangish tan	P=4.5						
		P=3.25	22	45	21	24	94	+40 Sieve=2%, +4 Sieve=0%
	--very stiff; white							
SC	CLAYEY SAND(SC) medium dense; tan	P=3.25	15	31	15	16	40	+40 Sieve=1%, +4 Sieve=0%
	--orangish gray; with sand seams							
CL	SANDY LEAN CLAY(CL) stiff; orangish tan	N=9						
CH	FAT CLAY(CH) very stiff; orangish tan; with ferric seams	P=4.0	25	59	24	35	88	+40 Sieve=4%, +4 Sieve=0%
	--tannish brown; with iron ore seams	P=2.75						



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

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LOG OF BORING B-4

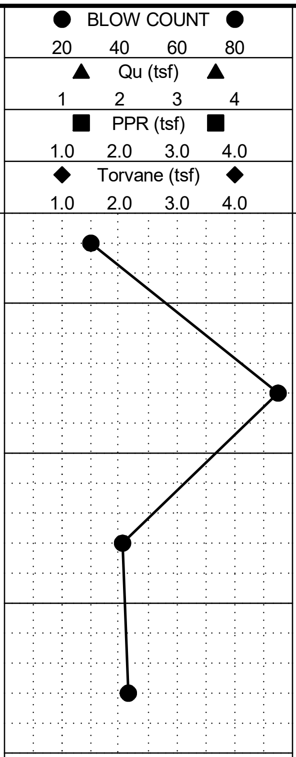
PROJECT: Welsh Power Plant
Pittsburgh, Texas

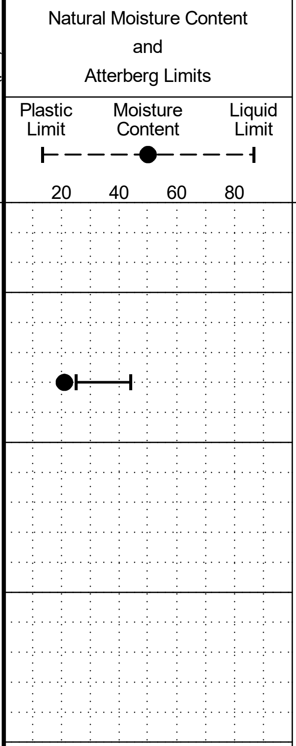
PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
					--hard; light gray; layered and with silt seams	N=30										
35																
		CL			LEAN CLAY(CL) hard; light gray; layered and with silt seams	N=50/5.75"					21	44	25	19	93	+40 Sieve=1%, +4 Sieve=0%
40																
					--light gray	N=41										
45																
					--layered and with sand seams; with lignite	N=43										
50					Bottom of Boring @ 50'											





Water Level Est.: ∇ Measured: ▼ Perched: ⊻

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

LOG OF BORING B-5

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Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

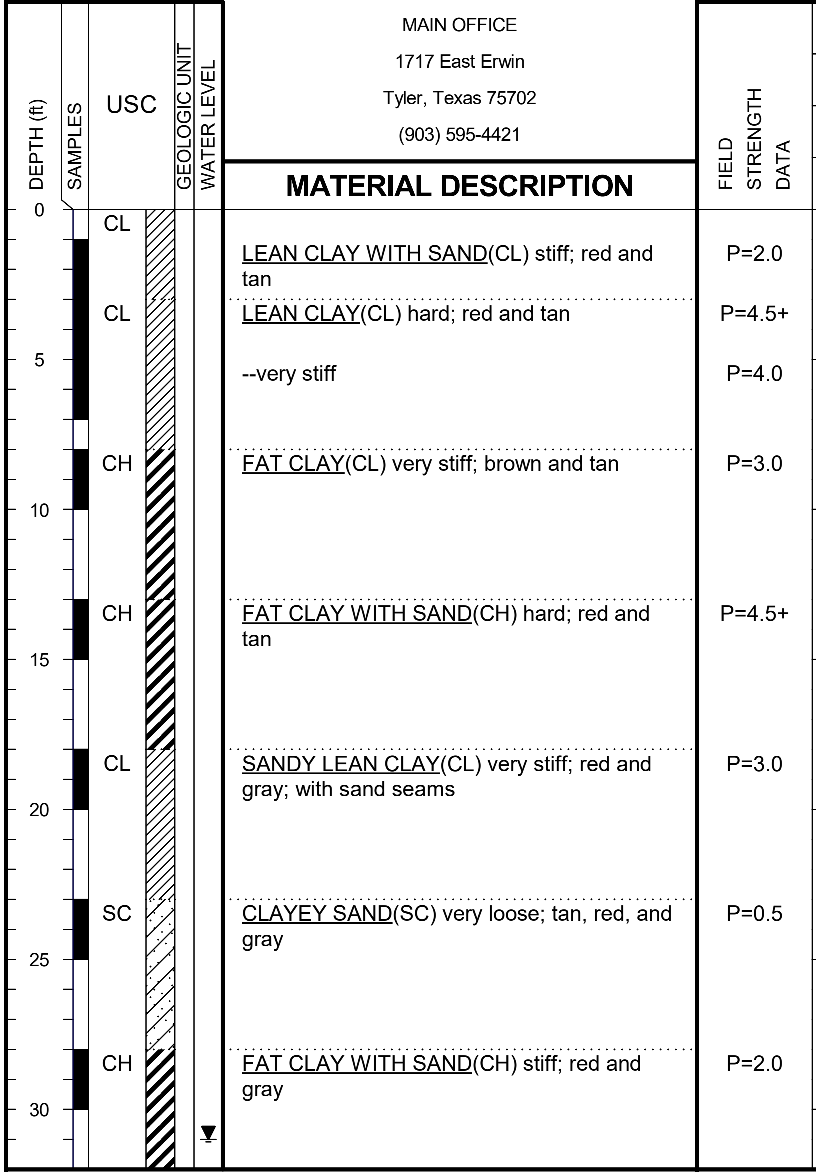
PROJECT NO.: G3242-09

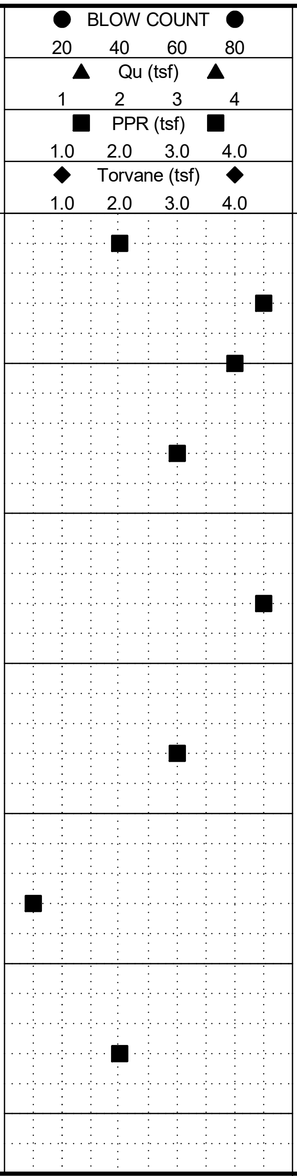
BORING TYPE: Flight Auger

DATE 10/27/09

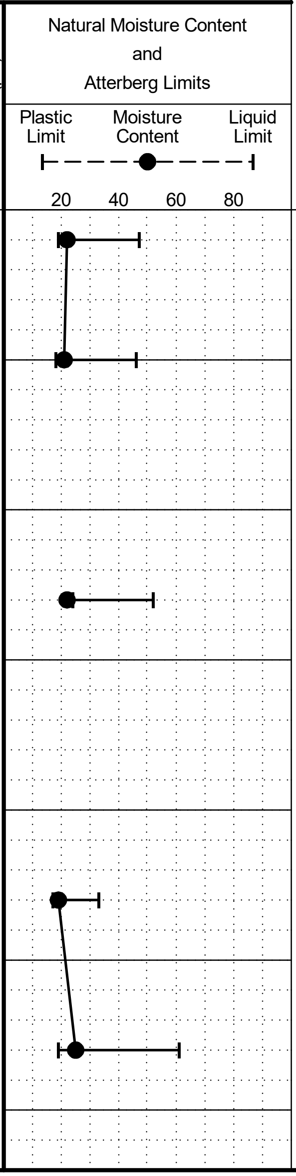
SURFACE ELEVATION 340.0

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) stiff; red and tan	P=2.0	22	47	19	28	81	+40 Sieve=9%, +4 Sieve=3%
CL	LEAN CLAY(CL) hard; red and tan	P=4.5+						
	--very stiff	P=4.0	21	46	18	28	94	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY(CL) very stiff; brown and tan	P=3.0						
CH	FAT CLAY WITH SAND(CH) hard; red and tan	P=4.5+	22	52	24	28	88	+40 Sieve=3%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams	P=3.0						
SC	CLAYEY SAND(SC) very loose; tan, red, and gray	P=0.5	19	33	17	16	44	+40 Sieve=1%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) stiff; red and gray	P=2.0	25	61	19	42	83	+40 Sieve=5%, +4 Sieve=3%





DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
33–35	SC	SILTY CLAYEY SAND(SC) gray and red; saturated	SF						
38–40	CH	FAT CLAY(CH) hard; red and gray; with sand seams	P=4.5+	25	51	31	20	87	+40 Sieve=6%, +4 Sieve=0%
43–45		--gray, tan, and red; with sand seams	P=4.5+						
48–50	SM SC	SILTY SAND(SM-SC) red and gray	SF						
50		Bottom of Boring @ 50'							

Column headings: DEPTH (ft); SAMPLES; USC; GEOLOGIC UNIT; WATER LEVEL; MATERIAL DESCRIPTION; FIELD STRENGTH DATA; ● BLOW COUNT ● 20 40 60 80; ▲ Qu (tsf) ▲ 1 2 3 4; ■ PPR (tsf) ■ 1.0 2.0 3.0 4.0; ◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0; DRY DENSITY (pcf); COMPRESSIVE STRENGTH (tsf); FAILURE STRAIN (%); CONFINING PRESSURE (psi); Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit ├ – – – ● – – – ┤ 20 40 60 80; MOISTURE CONTENT (%); ATTERBERG LIMITS(%) LL PL PI; MINUS #200 SIEVE (%); OTHER TESTS PERFORMED (Page Ref. #)

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
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LOG OF BORING B-6

PROJECT: Welsh Power Plant
Pittsburgh, Texas

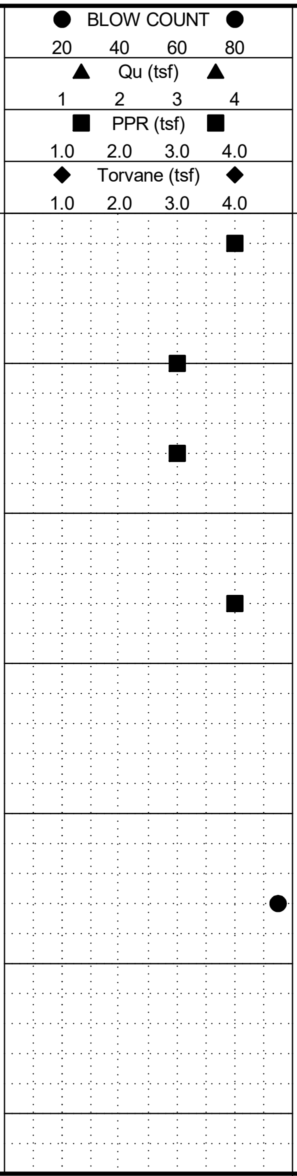
PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

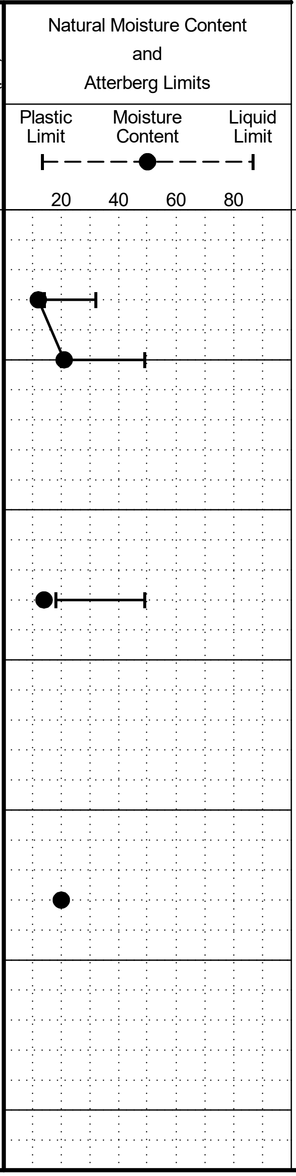
SURFACE ELEVATION 340.1

MATERIAL DESCRIPTION

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CH	FAT CLAY(CH) very stiff; red and gray; with ferric seams	P=4.0						
3	CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+	12	32	14	18	60	+40 Sieve=0%, +4 Sieve=0%
5				21	49	20	29	93	+40 Sieve=2%, +4 Sieve=0%
			P=3.0						
		--very stiff; red, gray, and brown; with gravel --with sand seams	P=3.0						
10									
			P=4.0	14	49	18	31	65	+40 Sieve=0%, +4 Sieve=0%
15									
18	SM	SILTY SAND(SM) gray; saturated	P=3.0						
20									
		--very dense; gray and red	N=50/5.25"	20				18	+40 Sieve=0%, +4 Sieve=0%
25									
			SF						
30									



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

LOG OF BORING B-6

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PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1

● BLOW COUNT ● 20 40 60 80
▲ Qu (tsf) ▲ 1 2 3 4
■ PPR (tsf) ■ 1.0 2.0 3.0 4.0
◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit — 20 40 60 80

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
33–35	CH	FAT CLAY(CH) hard; brown; with sand seams	P=4.5+										
38–40			P=4.5+					22	68	24	44	95	+40 Sieve=0%, +4 Sieve=0%
43–45		--dark green	P=4.5+										
48–50	CL	LEAN CLAY(CL) hard; dark green; laminated with lignite	P=4.5+										
50		Bottom of Boring @ 50'											

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
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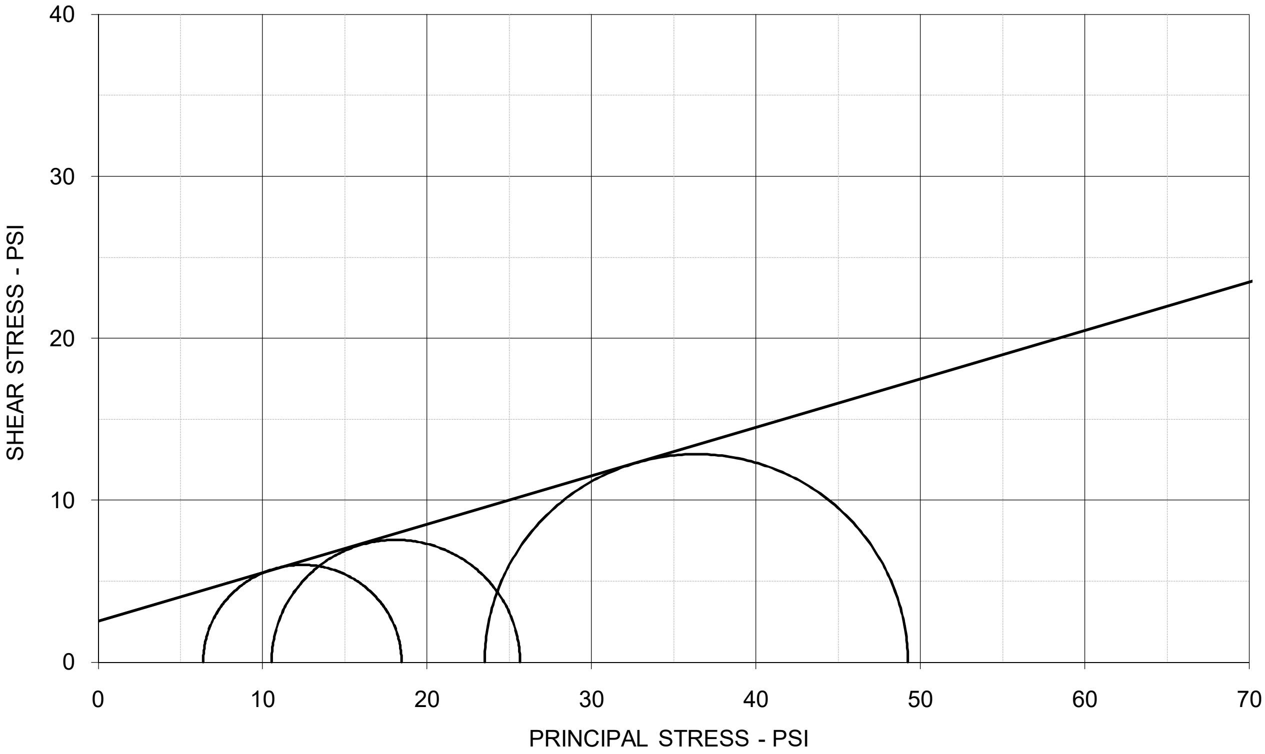
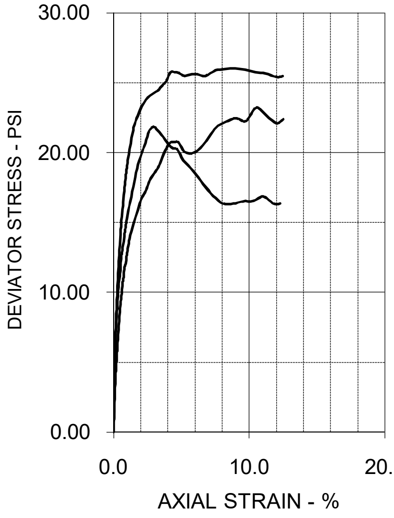
Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ ' =	16.7 deg	c' =	2.5 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	23.9	24.1	26.5	
Dry Density - pcf	102.5	100.6	99.0	
Diameter - inches	2.01	2.00	2.01	
Height - inches	4.00	3.92	3.98	
AT TEST				
Final Moisture - %	25.4	24.3	25.0	
Dry Density - pcf	102.7	102.4	101.9	
Calculated Diameter (in.)	2.01	1.98	1.99	
Height - inches	4.02	3.87	3.92	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.03	15.08	25.71	
Total Pore Pressure - psi	53.6	59.4	66.5	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.9	0.9	4.8	
σ_1' Failure - psi	18.43	25.64	49.23	
σ_3' Failure - psi	6.40	10.56	23.52	

TEST DESCRIPTION

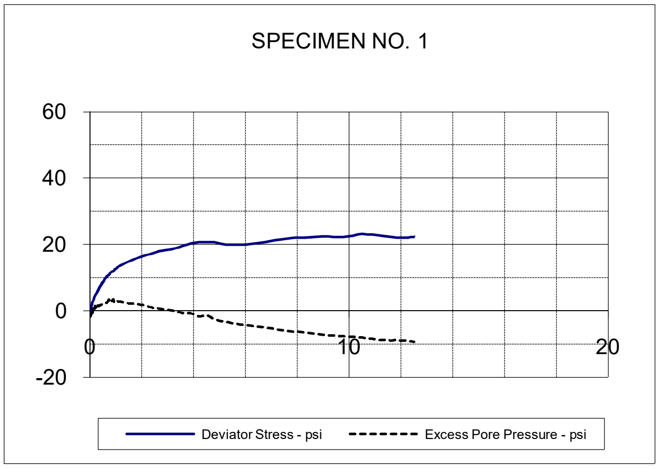
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Tan & Gray Clay & w/ some Ferric Joints
Sampled on Site, B-1 5' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

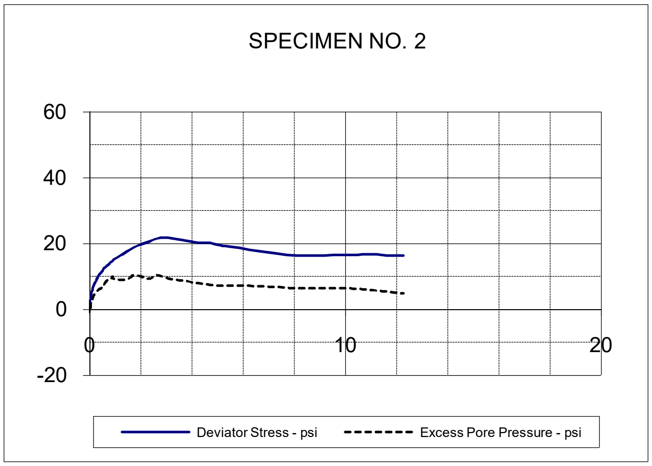
PROJECT INFORMATION

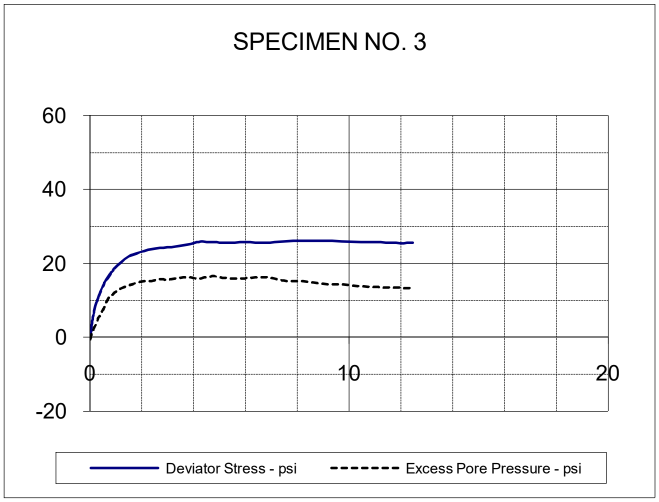
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

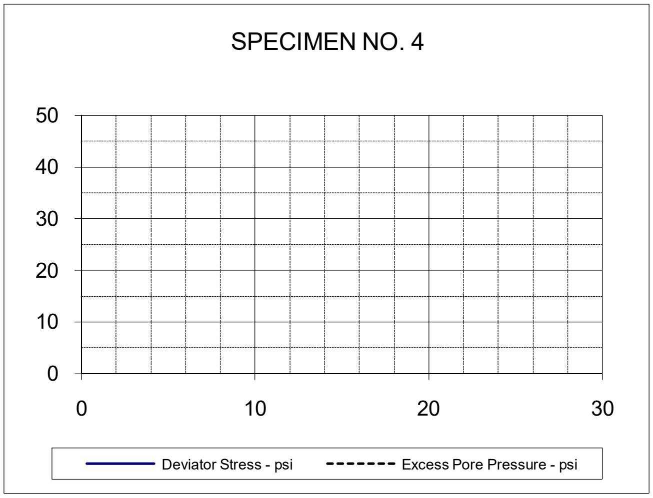
ETTL ENGINEERS & CONSULTANTS

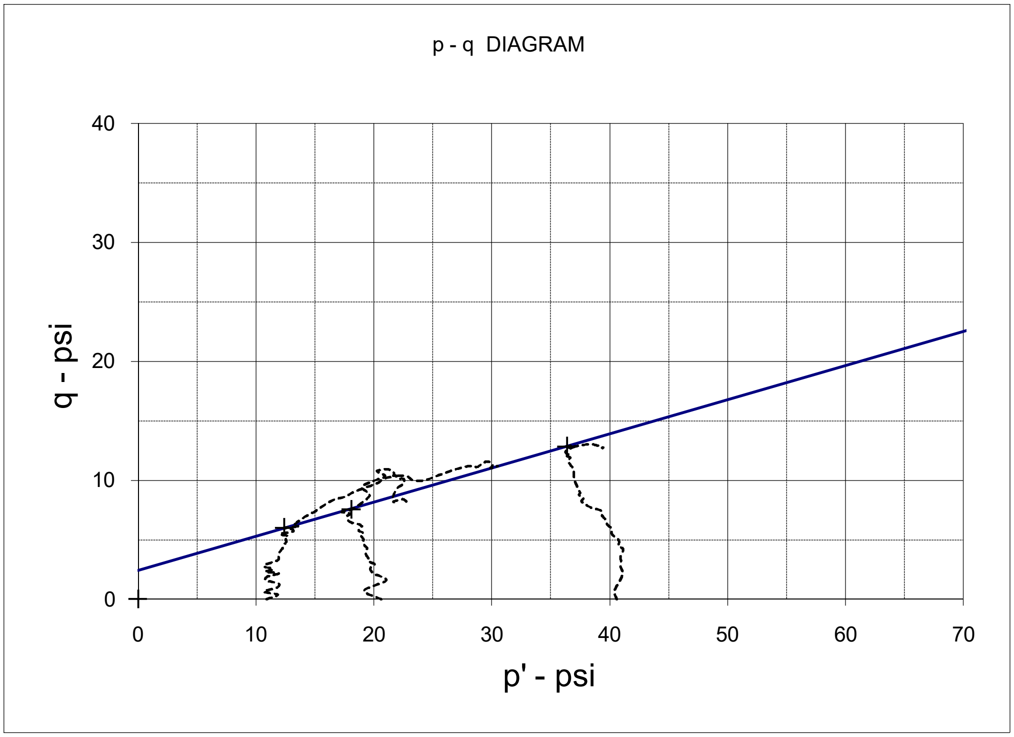
PLATE: B.1







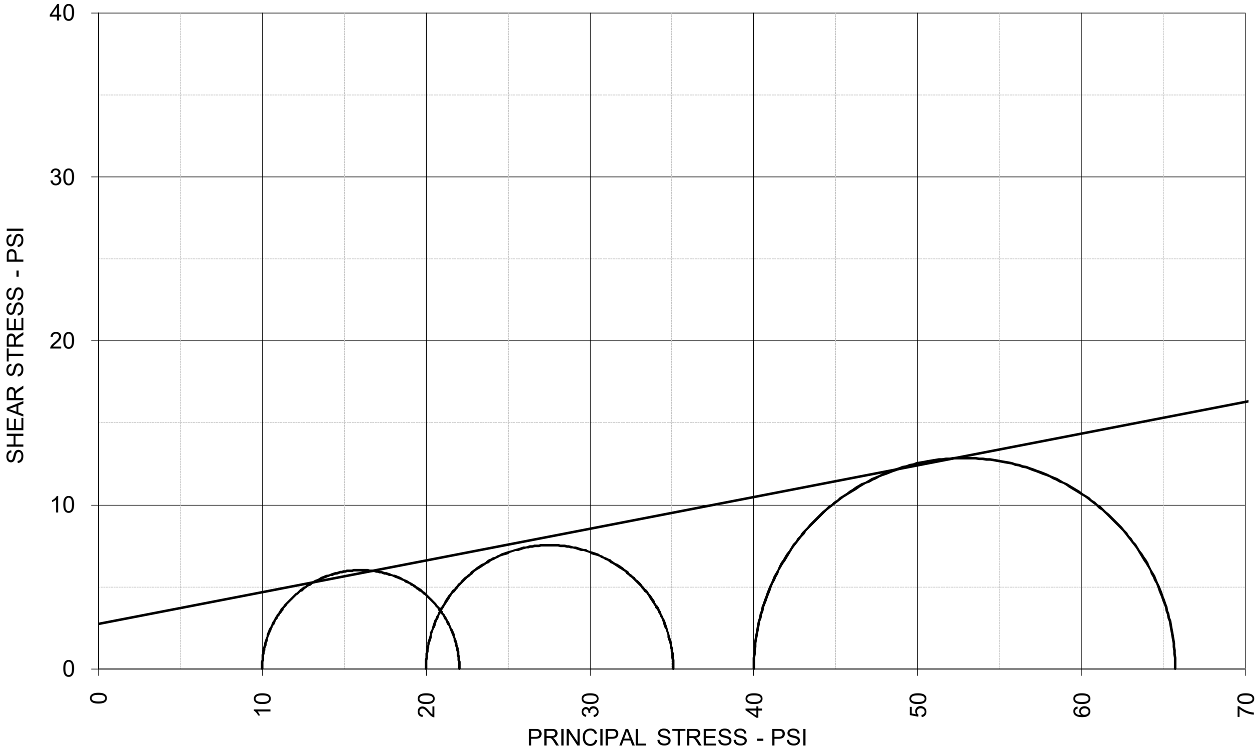




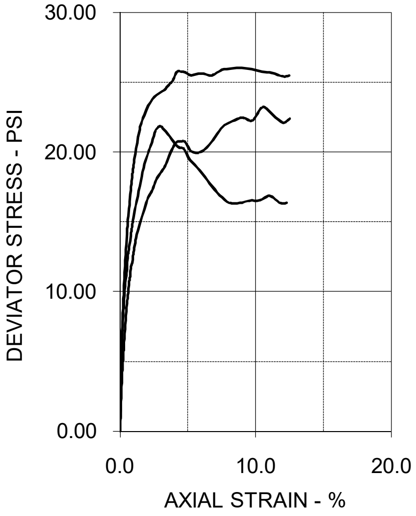
EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	α (deg) = 16.0	a (psi) = 2.4
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3242 - 095		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Tan & Gray Clay & w/ some Ferric Joints			

G 3242-095, B-1 5'-10' Welsh

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 10.9 deg	c = 2.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	23.9	24.1	26.5	
Dry Density - pcf	102.5	100.6	99.0	
Diameter - inches	2.01	2.00	2.01	
Height - inches	4.00	3.92	3.98	
AT TEST				
Final Moisture - %	25.4	24.3	25.0	
Dry Density - pcf	102.7	102.4	101.9	
Calculated Diameter (in.)	2.01	1.98	1.99	
Height - inches	4.02	3.87	3.92	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.03	15.08	25.71	
Total Pore Pressure - psi	53.6	59.4	66.5	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.9	0.9	4.8	
σ_1 Failure - psi	22.03	35.08	65.71	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

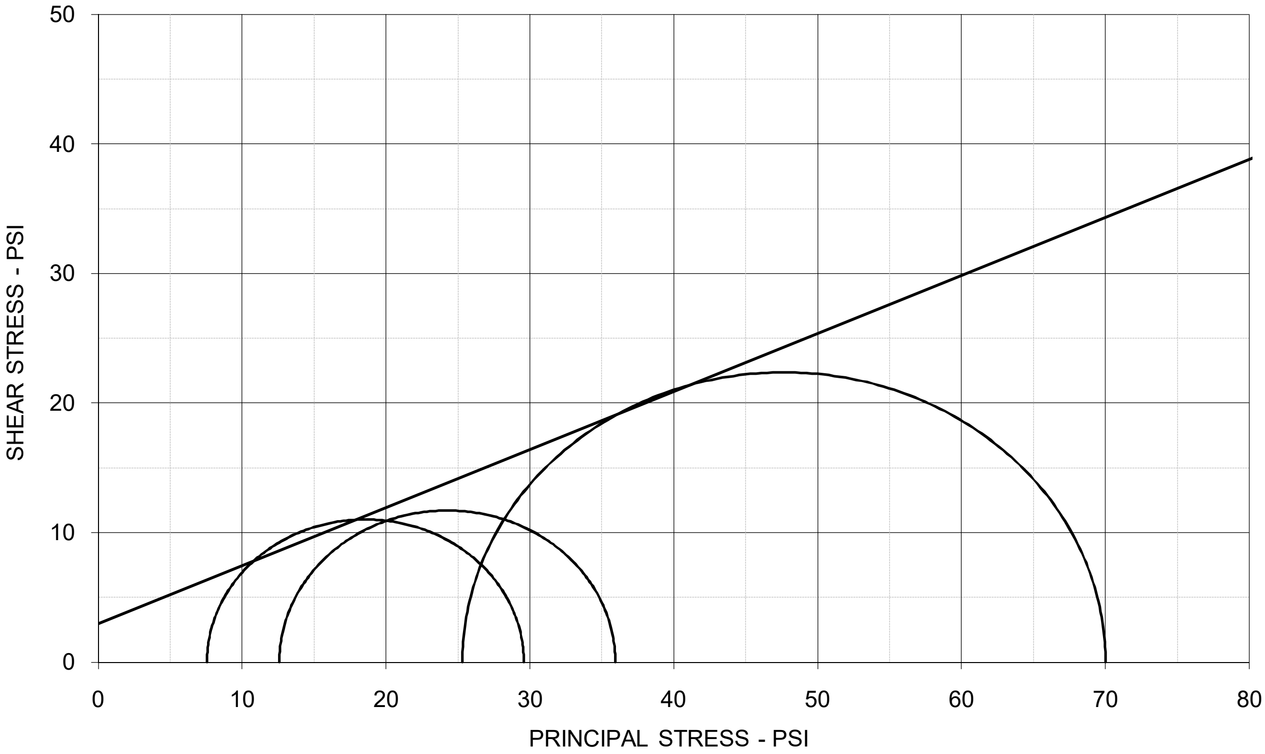
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Tan & Gray Clay & w/ some Ferric Joints
Sampled on Site, B-1 5' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

PROJECT INFORMATION

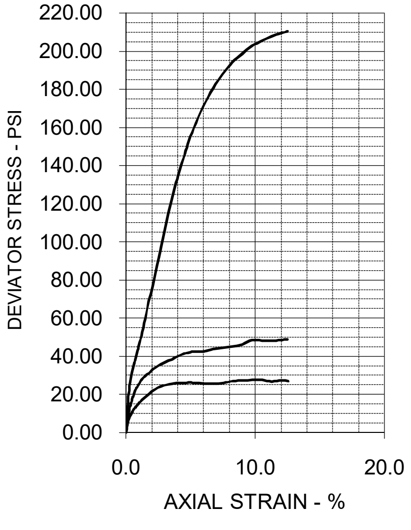
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

ETTL ENGINEERS & CONSULTANTS PLATE: B.3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ ' = 24.1 deg	c' = 2.9 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	14.4	23.6	13.0	
Dry Density - pcf	114.9	100.1	122.2	
Diameter - inches	2.01	2.02	2.00	
Height - inches	4.00	4.00	4.02	
AT TEST				
Final Moisture - %	18.7	24.4	13.2	
Dry Density - pcf	115.2	101.7	123.3	
Calculated Diameter (in.)	2.00	2.01	1.99	
Height - inches	3.99	3.97	3.98	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	22.03	23.38	44.72	
Total Pore Pressure - psi	52.5	57.4	64.7	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.7	2.4	1.0	
σ_1' Failure - psi	29.58	35.95	70.02	
σ_3' Failure - psi	7.55	12.57	25.30	

TEST DESCRIPTION

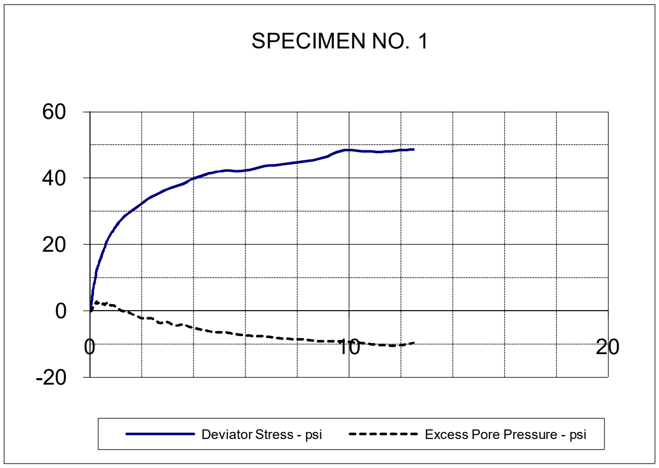
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Reddish Brown Sandy Lean Clay
Sampled on Site, B-2 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

ETTL ENGINEERS & CONSULTANTS

PLATE: B.1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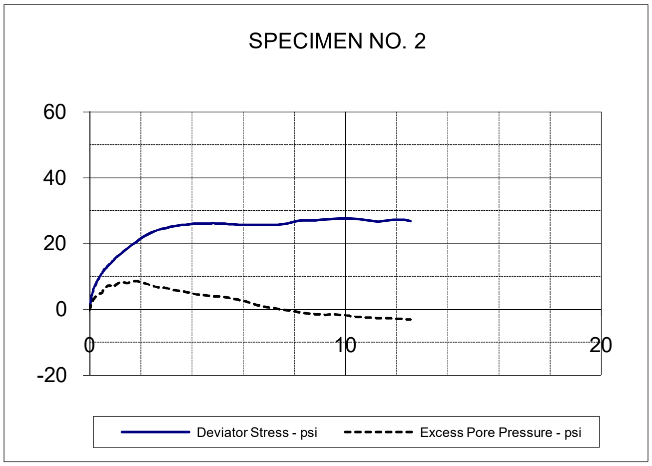
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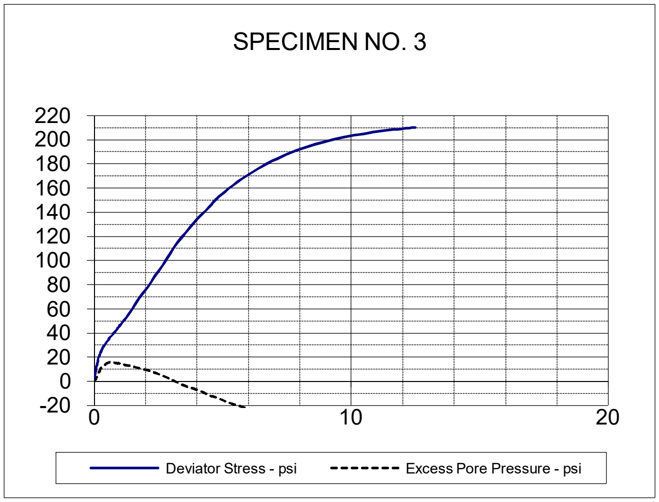
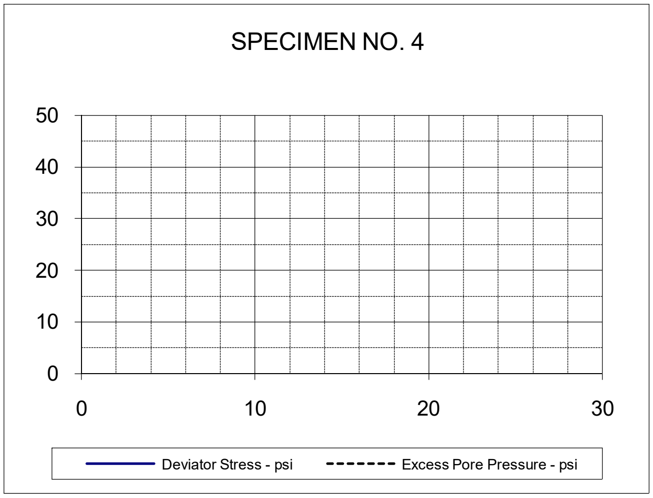
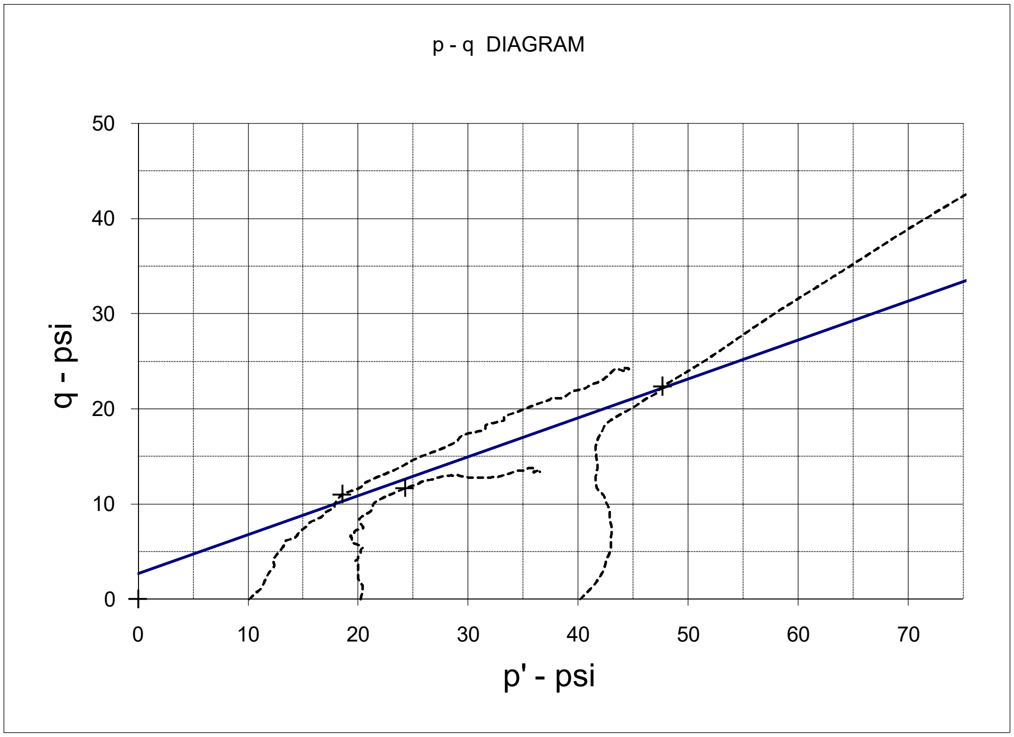

SPECIMEN NO. 3

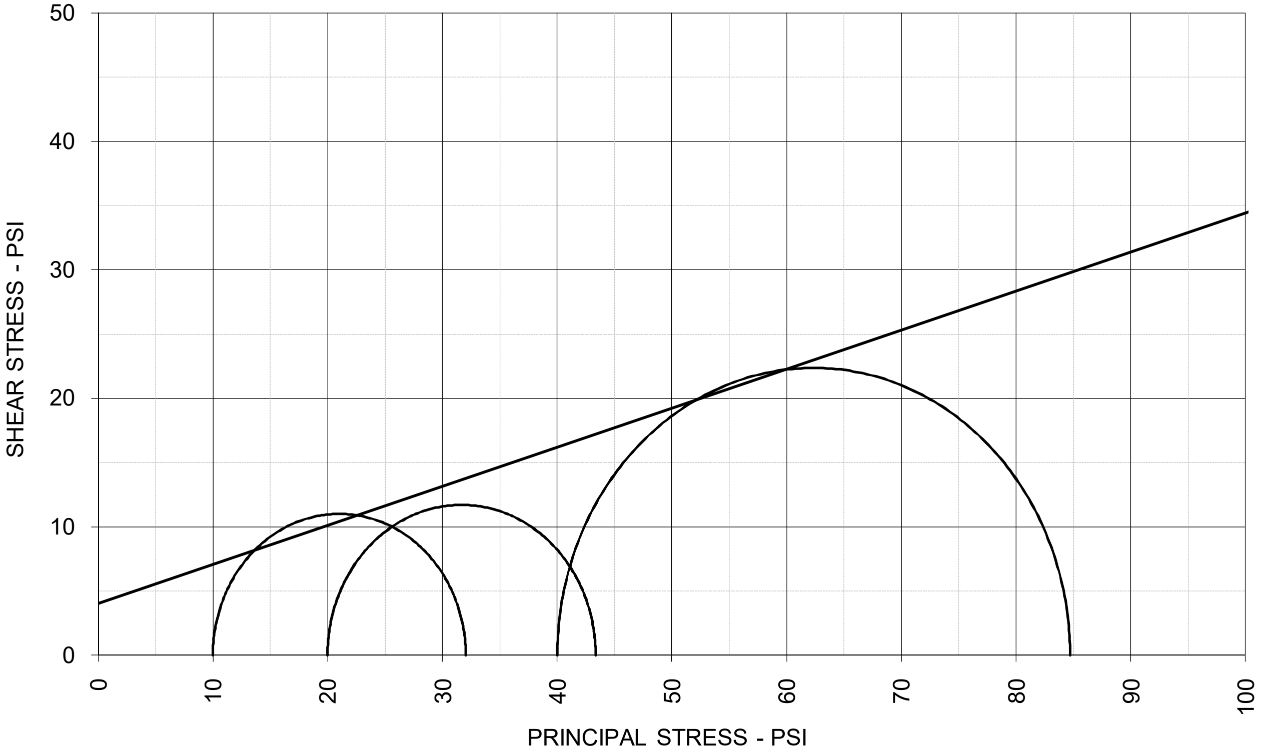

SPECIMEN NO. 4


p - q DIAGRAM

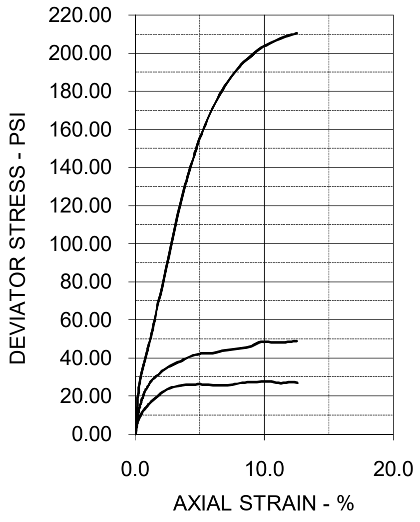
EFFECTIVE STRESS PARAMETERS	R^2 = 0.98	α (deg) = 22.3	a (psi) = 2.7
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3242 - 095		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Reddish Brown Sandy Lean Clay			

G 3242-095, B-2 8'-10' Welsh

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	φ = 16.9 deg	c = 4.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	14.4	23.6	13.0	
Dry Density - pcf	114.9	100.1	122.2	
Diameter - inches	2.01	2.02	2.00	
Height - inches	4.00	4.00	4.02	
AT TEST				
Final Moisture - %	18.7	24.4	13.2	
Dry Density - pcf	115.2	101.7	123.3	
Calculated Diameter (in.)	2.00	2.01	1.99	
Height - inches	3.99	3.97	3.98	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	22.03	23.38	44.72	
Total Pore Pressure - psi	52.5	57.4	64.7	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.7	2.4	1.0	
σ_1 Failure - psi	32.03	43.38	84.72	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Reddish Brown Sandy Lean Clay
Sampled on Site, B-2 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

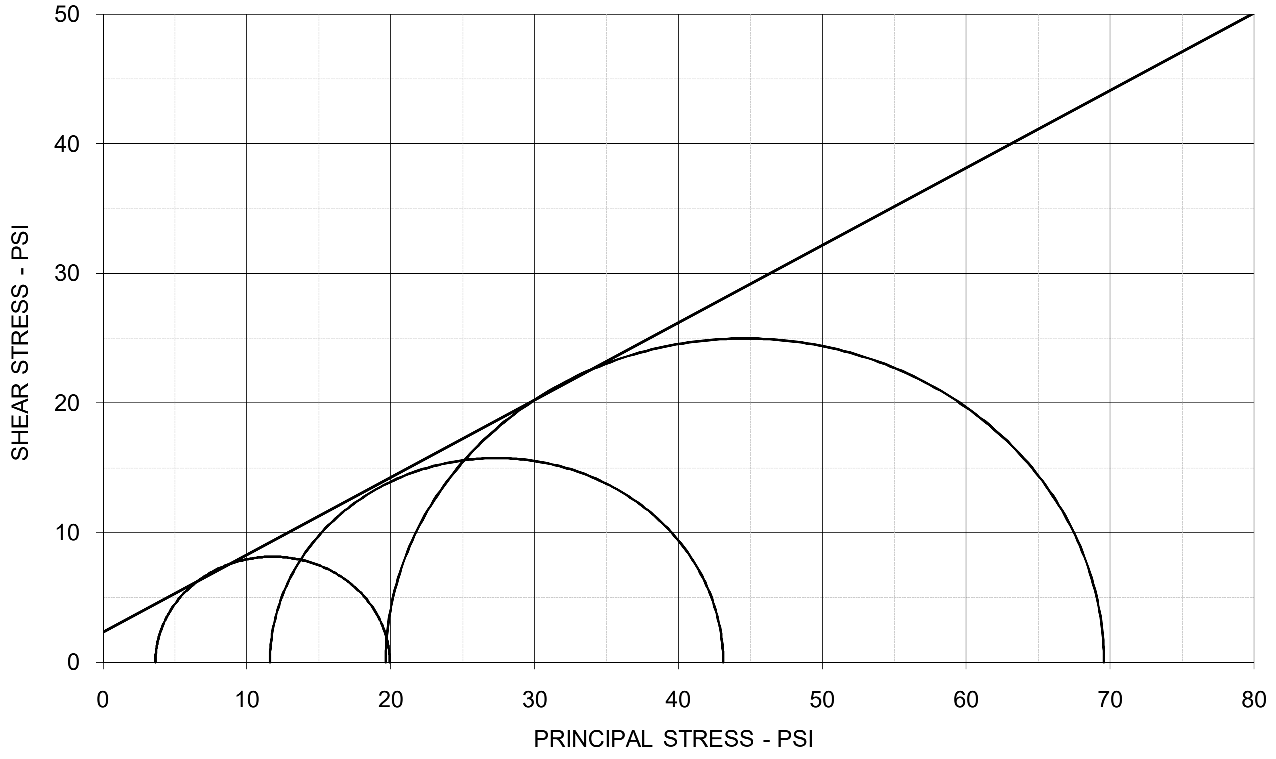
PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

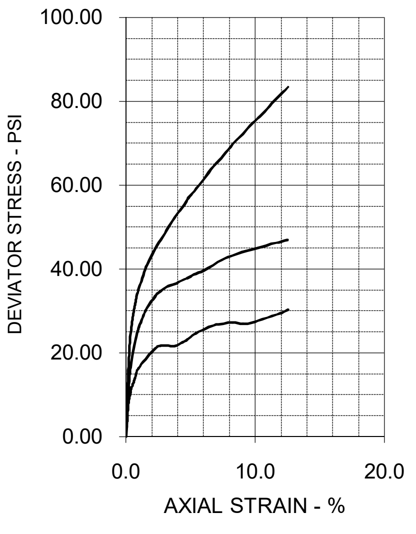
ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ ' =	30.8 deg	c' =	2.3 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	20.5	17.7	16.0	
Dry Density - pcf	106.7	111.3	117.2	
Diameter - inches	2.00	1.99	1.98	
Height - inches	3.99	3.98	4.00	
AT TEST				
Final Moisture - %	27.8	18.6	16.3	
Dry Density - pcf	106.8	112.4	118.7	
Calculated Diameter (in.)	2.00	1.99	1.97	
Height - inches	3.98	3.97	3.96	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	16.30	31.51	49.94	
Total Pore Pressure - psi	56.4	58.4	70.4	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.0	1.8	3.3	
σ_1' Failure - psi	19.94	43.12	69.59	
σ_3' Failure - psi	3.64	11.61	19.65	

TEST DESCRIPTION

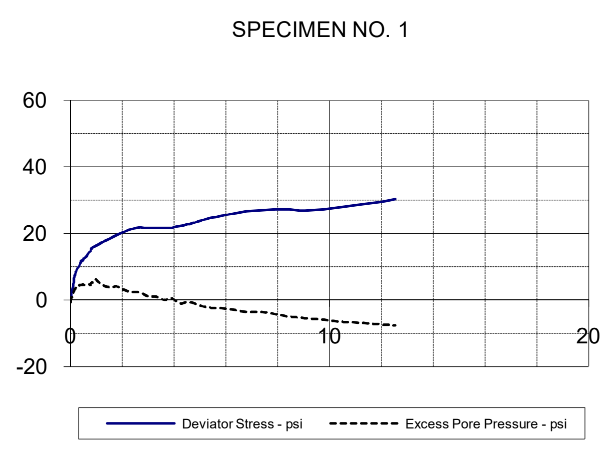
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Tan, Brown, Gray & Red Clayey Sand
Sampled on Site, B-2 28' to 30' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

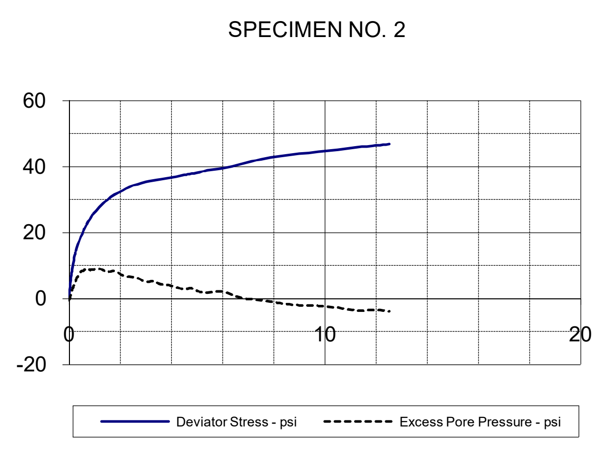
PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

ETTL ENGINEERS & CONSULTANTS

PLATE: B.1


SPECIMEN NO. 1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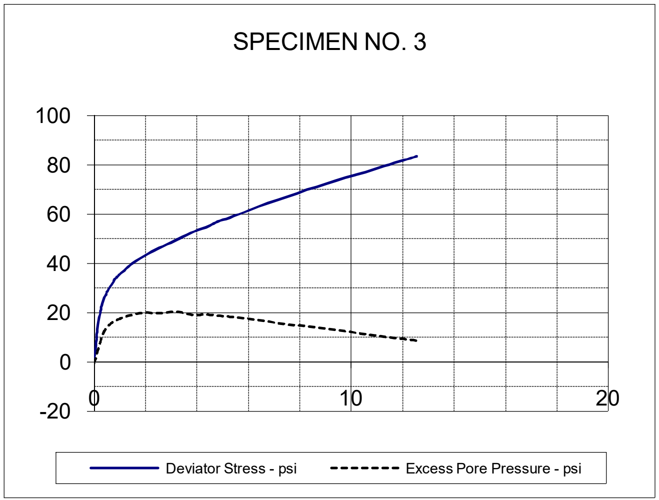
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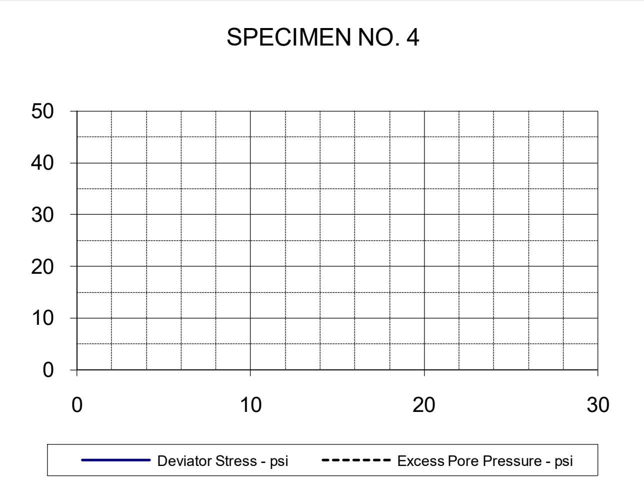
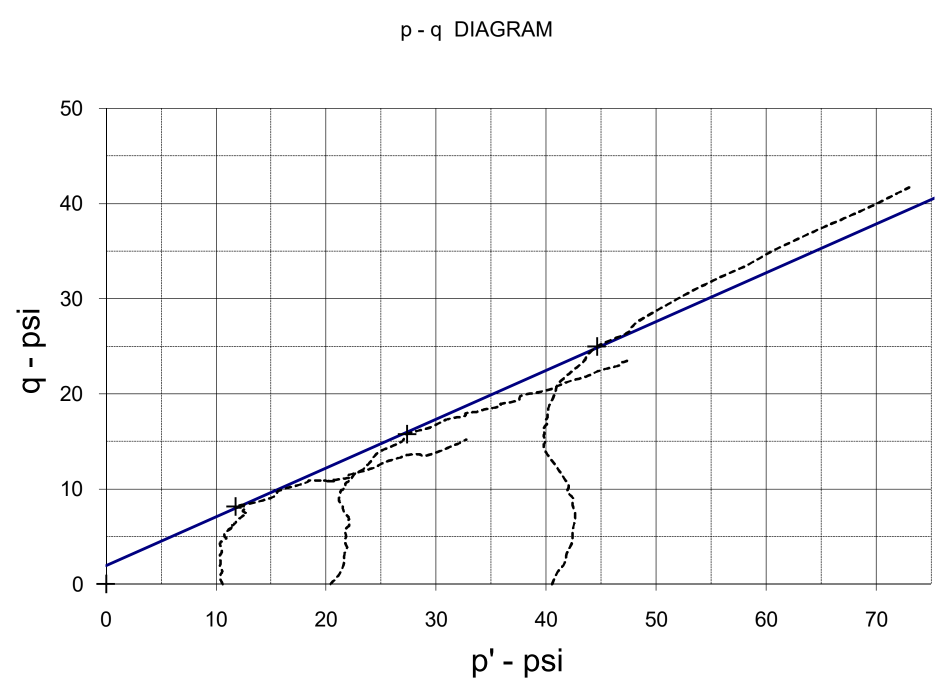
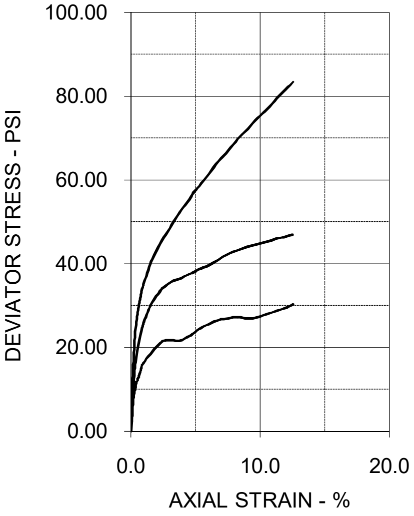

SPECIMEN NO. 4


p - q DIAGRAM

EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	α (deg) = 27.1	a (psi) = 2.0
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3242 - 095		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Tan, Brown, Gray & Red Clayey Sand			

TRIAXIAL SHEAR TEST REPORT

TOTAL STRESS PARAMETERS	φ = 20.8 deg	c = 2.4 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	20.5	17.7	16.0	
Dry Density - pcf	106.7	111.3	117.2	
Diameter - inches	2.00	1.99	1.98	
Height - inches	3.99	3.98	4.00	
AT TEST				
Final Moisture - %	27.8	18.6	16.3	
Dry Density - pcf	106.8	112.4	118.7	
Calculated Diameter (in.)	2.00	1.99	1.97	
Height - inches	3.98	3.97	3.96	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	16.30	31.51	49.94	
Total Pore Pressure - psi	56.4	58.4	70.4	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.0	1.8	3.3	
σ_1 Failure - psi	26.30	51.51	89.94	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Tan, Brown, Gray & Red Clayey Sand
Sampled on Site, B-2 28' to 30' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

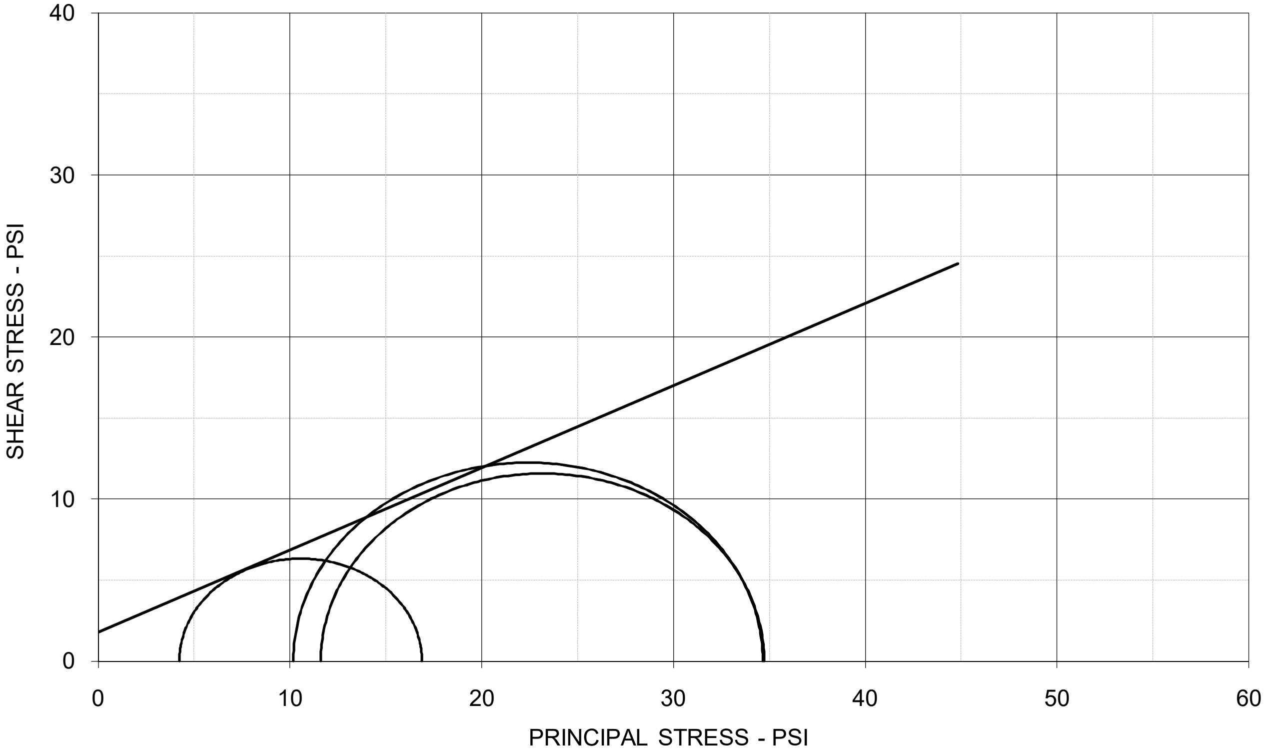
PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

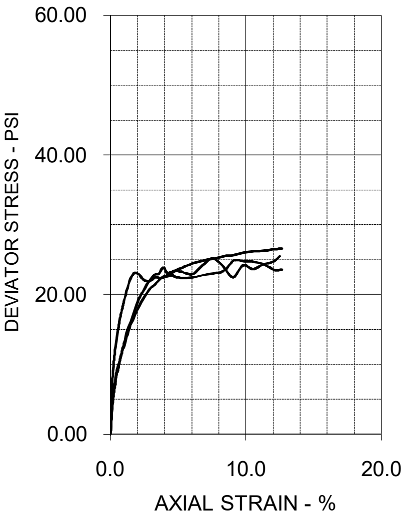
ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ ' = 26.9 deg	c' = 1.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	24.0	23.2	20.1	
Dry Density - pcf	98.6	102.2	104.5	
Diameter - inches	2.01	2.02	2.00	
Height - inches	3.97	4.01	4.01	
AT TEST				
Final Moisture - %	26.5	24.8	24.2	
Dry Density - pcf	99.5	103.0	105.7	
Calculated Diameter (in.)	2.01	2.02	2.00	
Height - inches	3.99	4.01	4.03	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.64	23.13	24.50	
Total Pore Pressure - psi	55.7	58.4	79.8	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.0	1.8	6.1	
σ_1' Failure - psi	16.87	34.74	34.66	
σ_3' Failure - psi	4.23	11.61	10.16	

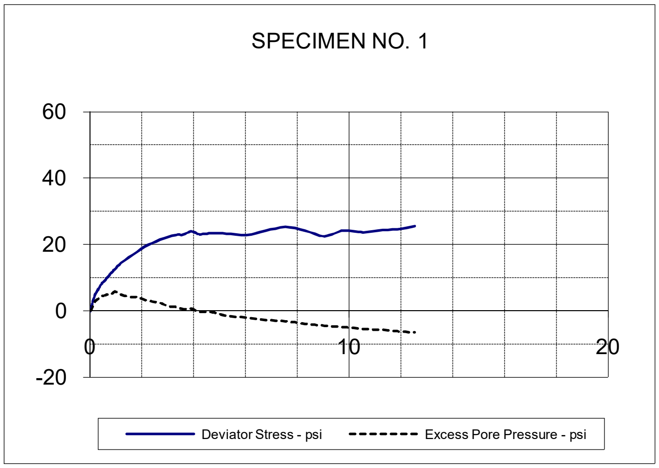
TEST DESCRIPTION

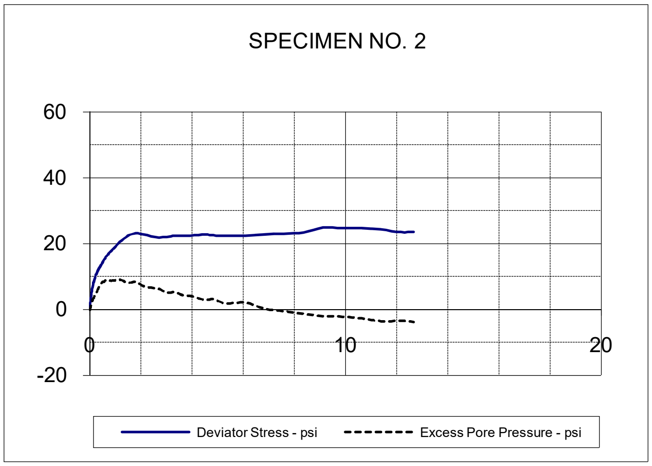
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Gray, Brown & Tan Fat Clay w/ Ferric Seams
Sampled on Site, B-5 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

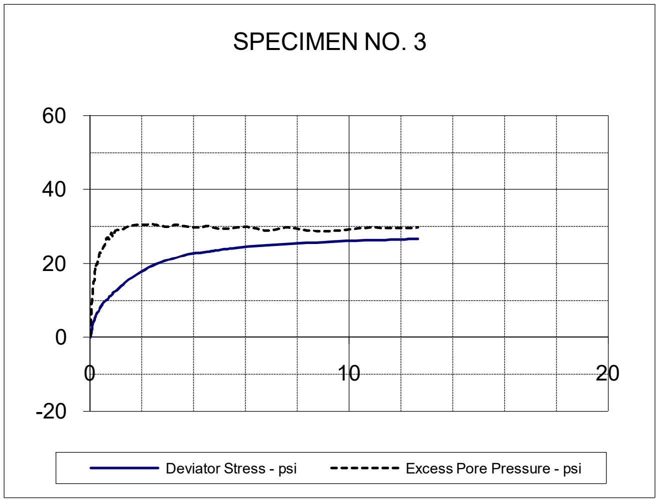
PROJECT INFORMATION

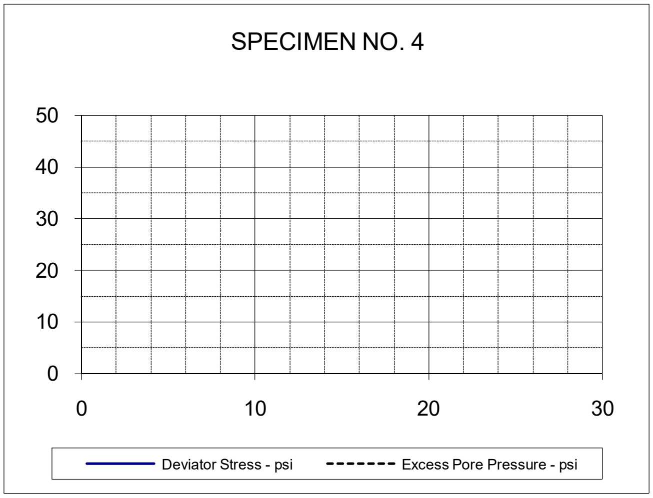
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

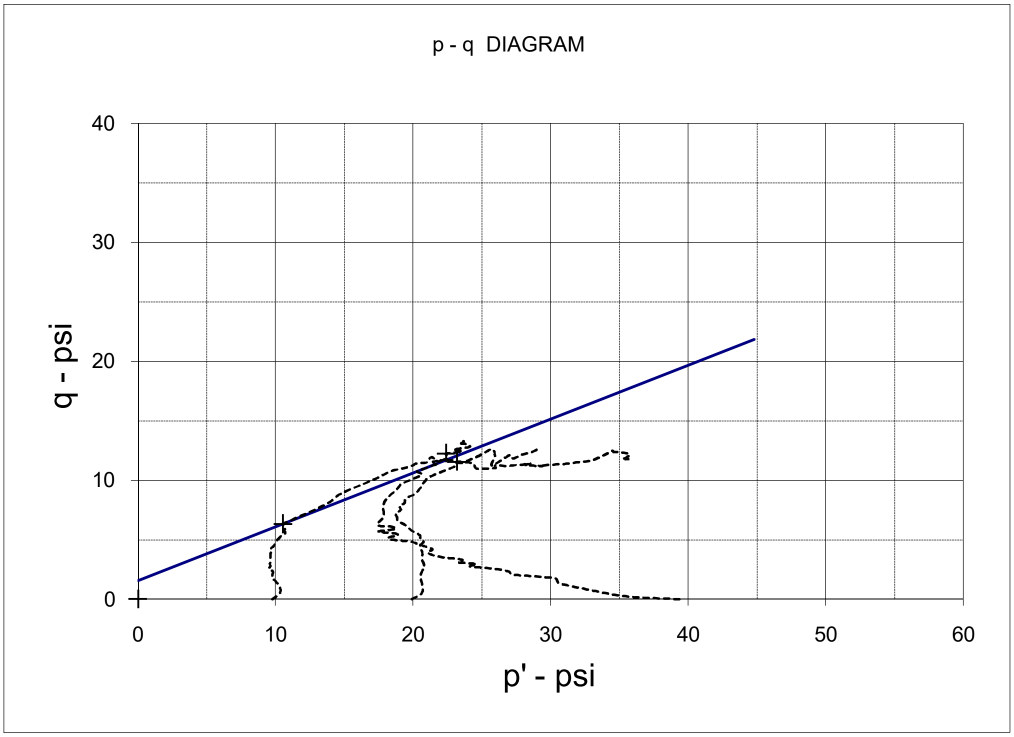
ETTL ENGINEERS & CONSULTANTS PLATE: B.1







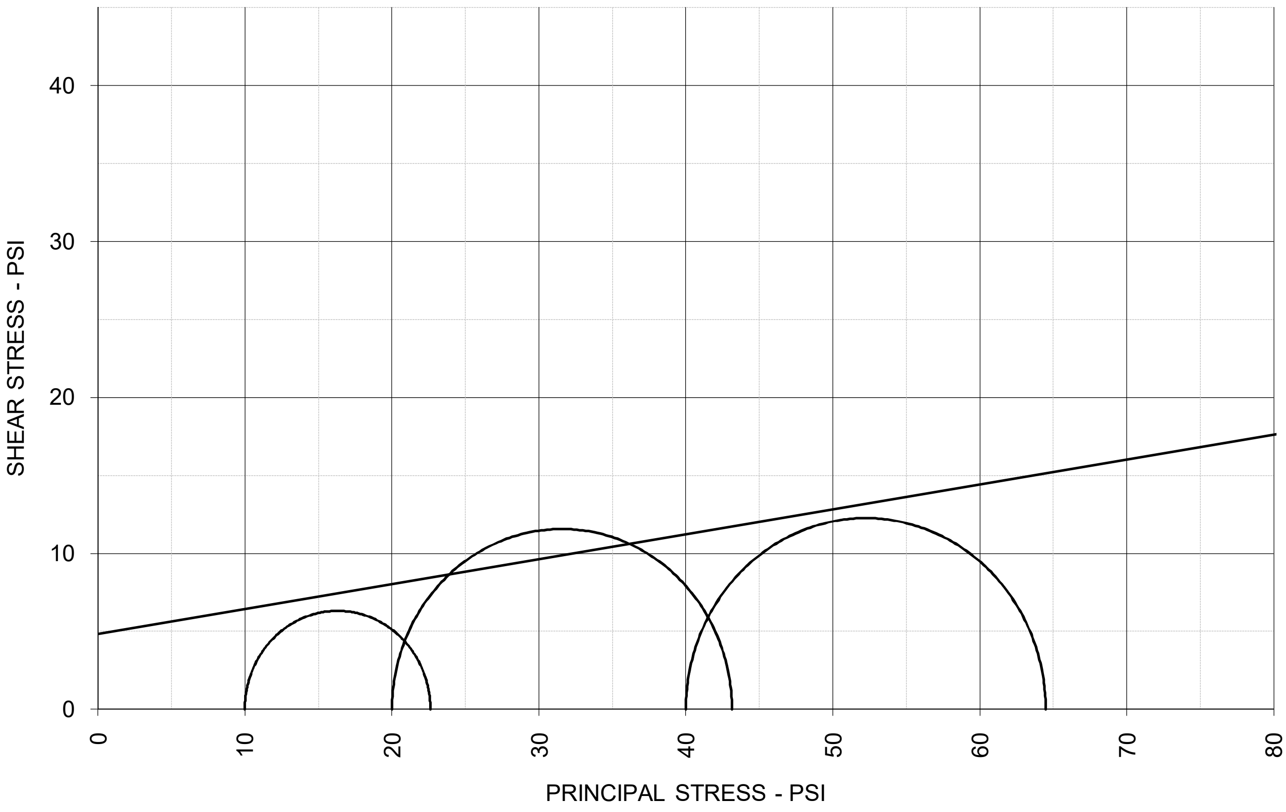




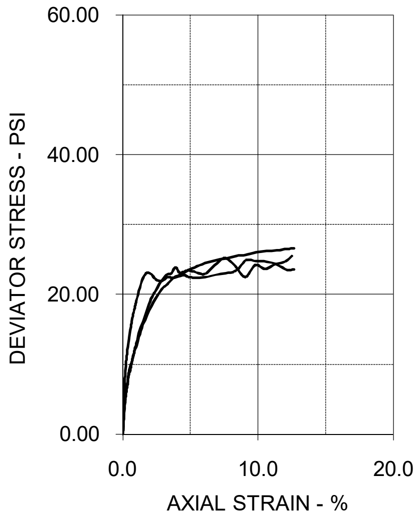
EFFECTIVE STRESS PARAMETERS	R^2 = 0.97	α (deg) = 24.3	a (psi) = 1.6
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3242 - 095		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Gray, Brown & Tan Fat Clay w/ Ferric Seams			

G 3242-095, B-5 8'-10' Welsh

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 9.1 deg	c = 4.9 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	24.0	23.2	20.1	
Dry Density - pcf	98.6	102.2	104.5	
Diameter - inches	2.01	2.02	2.00	
Height - inches	3.97	4.01	4.01	
AT TEST				
Final Moisture - %	26.5	24.8	24.2	
Dry Density - pcf	99.5	103.0	105.7	
Calculated Diameter (in.)	2.01	2.02	2.00	
Height - inches	3.99	4.01	4.03	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.64	23.13	24.50	
Total Pore Pressure - psi	55.7	58.4	79.8	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.0	1.8	6.1	
σ_1 Failure - psi	22.64	43.13	64.50	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Gray, Brown & Tan Fat Clay w/ Ferric Seams
Sampled on Site, B-5 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

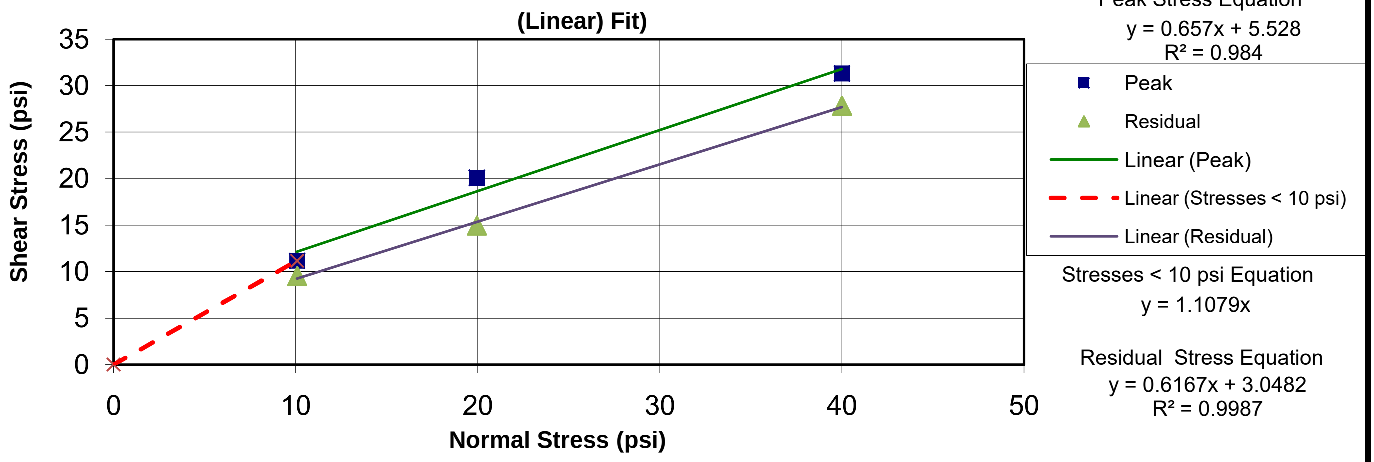
ETTL ENGINEERS & CONSULTANTS

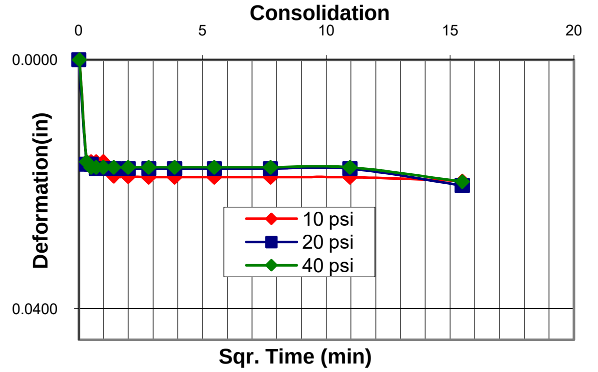
PLATE: B.3

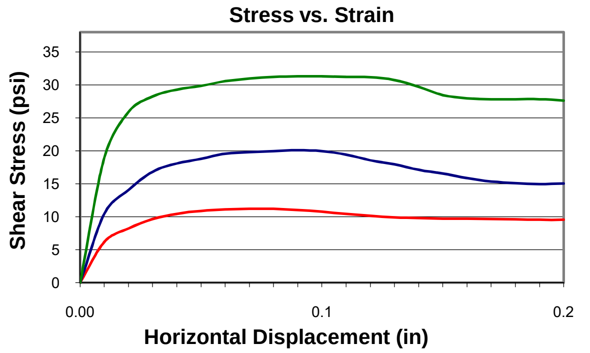
ETTL Engineers & Consultants Inc.

GEOTECHNICAL ✶ MATERIALS ✶ ENVIRONMENTAL ✶ DRILLING ✶ LANDFILLS

ASTM 3080 Direct Shear Test Report







Peak Strength Parameters

	Peak		Residual	
Friction Angle	33.3 (deg)		31.63 (deg)	
Cohesion	5.53 (psi)	796.0 (psf)	3.05 (psi)	438.9 (psf)
Friction Angle Stresses < 10psi			47.91	(deg)

Specimen Number	1	2	3
Initial			
Moisture Content - %	22.5%	23.5%	23.2%
Dry Density- lb/ft^3	103.8	100.3	101.8
Height-inches	1.008	1.008	1.008
Diameter- inches	2.50	2.50	2.50
Final			
Moisture Content - %	23.1%	25.4%	23.5%
Dry Density- lb/ft^3	103.8	100.9	102.0
Height after shear-(inches)	1.009	1.006	1.006
Height after consolidation (inches)	0.989	0.988	0.988
Normal Stress-(psi)	10	20	40
Peak Failure Stress-(psi)	11.17	20.09	31.31
Residual Failure Stress-(psi)	9.52	14.96	27.84
Strain Rate - (inches/min)	0.0033	0.0033	0.0033

Project Information

Project : Welsh power Plant Embankments
Client: AEP
Material Origin: , TX
Material Description: Dark Red Silty Sand

LL	PL	PI
-	-	NP
-200%	18	

Job No: G 3241-095
Boring No: B-6
Depth: 28'-31'
Date: November 24, 2009

Technician: Owen Sanderson
Sample Type: Shelby Tube
Sampling method: Shelby Tube
Testing Device: Soiltest B-124BY 2.5 in. round

Remarks

When Calculating stresses < 10 psi: use appropriate Equation above (assuming no Cohesion)

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas
Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084
Project No. : G 3242-095

Permometer Data

Boring No.:	B-2	a_p =	0.031416 cm^2			Set Mercury to Pipet Rp at beginning	Equilibrium	1.7	cm^3
Sample:		a_a =	0.767120 cm^2				Pipet **Rp**	**6.7**	cm^3
Depth (ft):	13'-15'	M_1 =	0.030180	C =	0.000444308		Annulus **Ra**	1.5	cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671				

Material Description : Red & Tan Sandy Lean Clay

SAMPLE DATA

Wet Wt. sample + ring or tare : 602.32 g
Tare or ring Wt. : 0.0 g
Wet Wt: of Sample : 602.32 g

						Before Test		After Test
					Tare No.:	T-16	Tare No.:	T-1
Diameter :	2.73	in	6.94	cm^2	Wet Wt.+tare:	292.51	Wet Wt.+tare:	746.56
Length :	2.76	in	7.02	cm	Dry Wt.+tare:	276.22	Dry Wt.+tare:	683.49
Area:	5.87	in^2	37.85	cm^2	Tare Wt:	151.95	Tare Wt:	217.27
Volume :	16.21	in^3	265.71	cm^3	Dry Wt.:	124.27	Dry Wt.:	466.22
Unit Wt.(wet):	**141.45**	pcf	**2.27**	g/cm^3	Water Wt.:	16.29	Water Wt.:	63.07
Unit Wt.(dry):	**125.06**	pcf	**2.00**	g/cm^3	% moist.:	**13.1**	% moist.:	**13.5**

Assumed Specific Gravity: **2.65** Max Dry Density(pcf) = 125.1105 OMC = 13.108554
% of max = 100.0 +/- OMC = 0.00
Calculated % saturation: 111.02 Void ratio (e) = **0.32** Porosity (n)= **0.24**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.26

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	1680	6	0.6588251	23.5	0.920	3.47E-08	9.84E-05	
12/28/2009	2280	5.9	0.7588251	23.5	0.920	2.98E-08	8.44E-05	
12/28/2009	3180	5.7	0.9588251	23.5	0.920	2.76E-08	7.83E-05	
12/28/2009	4140	5.55	1.1088251	23.5	0.920	2.50E-08	7.09E-05	

SUMMARY

ka = 2.93E-08 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	3.47E-08	cm/sec	18.5	%
k2 =	2.98E-08	cm/sec	1.7	%
k3 =	2.76E-08	cm/sec	5.6	%
k4 =	2.50E-08	cm/sec	14.6	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**2.93E-08**	cm/sec	**8.30E-05**	ft/day
Void Ratio	e =	**0.32**			
Porosity	n =	**0.24**			
Bulk Density	γ =	**2.27**	g/cm^3	**141.5**	pcf
Water Content	W =	**0.26**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**3.00E-13**	cm^2	(at 20 deg C)	

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas
Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084
Project No. : G 3242-095 Permometer Data

Boring No.:	B-2	a_p =	0.031416 cm^2		**Set Mercury to Pipet Rp at beginning**	Equilibrium	1.7	cm^3
Sample:		a_a =	0.767120 cm^2			Pipet **Rp**	**6.7**	cm^3
Depth (ft):	33'-35'	M_1 =	0.030180	C =	0.000433922	Annulus **Ra**	1.5	cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671			

Material Description : Red & Tan Clayey Sand

SAMPLE DATA

Wet Wt. sample + ring or tare :			553.04	g
Tare or ring Wt. :			0.0	g
Wet Wt: of Sample :			553.04	g
Diameter :	2.76	in	7.01	cm^2
Length :	2.75	in	6.98	cm
Area:	5.97	in^2	38.54	cm^2
Volume :	16.42	in^3	269.13	cm^3
Unit Wt.(wet):	**128.23**	pcf	**2.05**	g/cm^3
Unit Wt.(dry):	**107.70**	pcf	**1.73**	g/cm^3

	Before Test		After Test
Tare No.:	T-21	Tare No.:	T-13
Wet Wt.+tare:	553.04	Wet Wt.+tare:	784.01
Dry Wt.+tare:	464.50	Dry Wt.+tare:	684.19
Tare Wt:	0.00	Tare Wt:	219.69
Dry Wt.:	464.5	Dry Wt.:	464.5
Water Wt.:	88.54	Water Wt.:	99.82
% moist.:	**19.1**	% moist.:	**21.5**

Assumed Specific Gravity: **2.73** Max Dry Density(pcf) = 107.7462 OMC = 19.0613563
% of max = 100.0 +/- OMC = 0.00
Calculated % saturation: 100.72 Void ratio (e) = **0.58** Porosity (n)= **0.37**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.31

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	1580	5.4	1.2588251	23.5	0.920	7.40E-08	2.10E-04	
12/28/2009	2310	5	1.6588251	23.5	0.920	7.04E-08	2.00E-04	
12/28/2009	2535	4.9	1.7588251	23.5	0.920	6.90E-08	1.96E-04	
12/28/2009	2775	4.8	1.8588251	23.5	0.920	6.76E-08	1.92E-04	

SUMMARY

ka = 7.03E-08 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	7.40E-08	cm/sec	5.3	%
k2 =	7.04E-08	cm/sec	0.2	%
k3 =	6.90E-08	cm/sec	1.8	%
k4 =	6.76E-08	cm/sec	3.8	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**7.03E-08**	cm/sec	**1.99E-04**	ft/day
Void Ratio	e =	**0.58**			
Porosity	n =	**0.37**			
Bulk Density	γ =	**2.05**	g/cm^3	**128.2**	pcf
Water Content	W =	**0.33**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**7.20E-13**	cm^2	(at 20 deg C)	

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas
Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084
Project No. : G 3242-095

Permometer Data

Boring No.:	B-3	a_p =	0.031416 cm^2	**Set Mercury to Pipet Rp at beginning**	Equilibrium	1.7 cm^3
Sample:		a_a =	0.767120 cm^2		Pipet **Rp**	**6.7** cm^3
Depth (ft):	8'-10'	M_1 =	0.030180	C = 0.000431052	Annulus **Ra**	1.5 cm^3
Other Location:		M_2 =	1.040953	T = 0.201660671		

Material Description : Red & Tan Fat Clay

SAMPLE DATA

Wet Wt. sample + ring or tare :			559.11	g
Tare or ring Wt. :			0.0	g
Wet Wt: of Sample :			559.11	g
Diameter :	2.75	in	6.99	cm^2
Length :	2.72	in	6.90	cm
Area:	5.94	in^2	38.32	cm^2
Volume :	16.13	in^3	264.26	cm^3
Unit Wt.(wet):	**132.02**	pcf	**2.12**	g/cm^3
Unit Wt.(dry):	**114.62**	pcf	**1.84**	g/cm^3

Before Test		After Test	
Tare No.:	T-23	Tare No.:	T-3
Wet Wt.+tare:	166.09	Wet Wt.+tare:	783.53
Dry Wt.+tare:	162.69	Dry Wt.+tare:	700.67
Tare Wt:	140.30	Tare Wt:	220.71
Dry Wt.:	22.39	Dry Wt.:	479.96
Water Wt.:	3.4	Water Wt.:	82.86
% moist.:	**15.2**	% moist.:	**17.3**

Assumed Specific Gravity: **2.68** Max Dry Density(pcf) = 114.6685 OMC = 15.1853506
% of max = 100.0 +/- OMC = 0.00
Calculated % saturation: 100.64 Void ratio (e) = **0.46** Porosity (n)= **0.31**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.43

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	1476	5.4	1.258825	23.5	0.920	7.87E-08	2.23E-04	
12/28/2009	2205	5	1.658825	23.5	0.920	7.33E-08	2.08E-04	
12/28/2009	2370	4.9	1.758825	23.5	0.920	7.33E-08	2.08E-04	
12/28/2009	2580	4.8	1.858825	23.5	0.920	7.22E-08	2.05E-04	

SUMMARY

ka = 7.44E-08 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	7.87E-08	cm/sec	5.8	%
k2 =	7.33E-08	cm/sec	1.5	%
k3 =	7.33E-08	cm/sec	1.4	%
k4 =	7.22E-08	cm/sec	2.9	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**7.44E-08**	cm/sec	**2.11E-04**	ft/day
Void Ratio	e =	**0.46**			
Porosity	n =	**0.31**			
Bulk Density	γ =	**2.12**	g/cm^3	**132.0**	pcf
Water Content	W =	**0.28**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**7.62E-13**	cm^2	(at 20 deg C)	

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas
Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084
Project No. : G 3242-095

Permometer Data

Boring No.:	B-4	a_p =	0.031416 cm^2		Set Mercury to Pipet Rp at beginning	Equilibrium	1.7 cm^3
Sample:		a_a =	0.767120 cm^2			**Pipet Rp**	**6.7** cm^3
Depth (ft):	8'-10'	M_1 =	0.030180	C =	0.000429664	Annulus **Ra**	1.5 cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671		

Material Description : Dark Brown Sandy Lean Clay

SAMPLE DATA

Wet Wt. sample + ring or tare : 531.96 g
Tare or ring Wt. : 0.0 g
Wet Wt: of Sample : 531.96 g

Diameter :	2.76	in	7.01	cm^2
Length :	2.72	in	6.92	cm
Area:	5.98	in^2	38.57	cm^2
Volume :	16.29	in^3	266.87	cm^3
Unit Wt.(wet):	**124.38**	pcf	**1.99**	g/cm^3
Unit Wt.(dry):	**100.61**	pcf	**1.61**	g/cm^3

Before Test		After Test	
Tare No.:	T-24	Tare No.:	T-6
Wet Wt.+tare:	230.01	Wet Wt.+tare:	759.40
Dry Wt.+tare:	207.52	Dry Wt.+tare:	648.84
Tare Wt:	112.35	Tare Wt:	217.34
Dry Wt.:	95.17	Dry Wt.:	431.5
Water Wt.:	22.49	Water Wt.:	110.56
% moist.:	**23.6**	% moist.:	**25.6**

Assumed Specific Gravity: **2.72** Max Dry Density(pcf) = 100.6512 OMC = 23.6313964
% of max = 100.0 +/- OMC = 0.00
Calculated % saturation: 101.32 Void ratio (e) = **0.69** Porosity (n)= **0.41**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.40

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	2280	6.1	0.558825	23.5	0.920	2.07E-08	5.88E-05	
12/28/2009	2940	6	0.658825	23.5	0.920	1.92E-08	5.44E-05	
12/28/2009	3660	5.9	0.758825	23.5	0.920	1.79E-08	5.09E-05	
12/28/2009	4200	5.84	0.818825	23.5	0.920	1.70E-08	4.82E-05	

SUMMARY

ka = 1.87E-08 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	2.07E-08	cm/sec	10.8	%
k2 =	1.92E-08	cm/sec	2.5	%
k3 =	1.79E-08	cm/sec	4.1	%
k4 =	1.70E-08	cm/sec	9.2	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**1.87E-08**	cm/sec	**5.30E-05**	ft/day
Void Ratio	e =	**0.69**			
Porosity	n =	**0.41**			
Bulk Density	γ =	**1.99**	g/cm^3	**124.4**	pcf
Water Content	W =	**0.38**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**1.92E-13**	cm^2	(at 20 deg C)	

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas

Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084

Project No. : G 3242-095

Permometer Data

Boring No.:	B-5	a_p =	0.031416 cm^2		Set Mercury to Pipet Rp at beginning	Equilibrium	1.7	cm^3
Sample:		a_a =	0.767120 cm^2			**Pipet Rp**	**6.7**	cm^3
Depth (ft):	23'-25'	M_1 =	0.030180	C =	0.00043565	Annulus **Ra**	1.5	cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671			

Material Description : Orangish Tan Fat Clay

SAMPLE DATA

Wet Wt. sample + ring or tare :			532.37	g					
Tare or ring Wt. :			0.0	g		Before Test		After Test	
Wet Wt: of Sample :			532.37	g	Tare No.:	T-25	Tare No.:	T-9
Diameter :	2.74	in	6.97	cm^2	Wet Wt.+tare:	532.37	Wet Wt.+tare:	765.78
Length :	2.73	in	6.94	cm	Dry Wt.+tare:	441.00	Dry Wt.+tare:	661.51
Area:	5.91	in^2	38.15	cm^2	Tare Wt:	0.00	Tare Wt:	220.51
Volume :	16.16	in^3	264.75	cm^3	Dry Wt.:	441	Dry Wt.:	441
Unit Wt.(wet):	**125.48**	pcf	**2.01**	g/cm^3	Water Wt.:	91.37	Water Wt.:	104.27
Unit Wt.(dry):	**103.94**	pcf	**1.67**	g/cm^3	% moist.:	**20.7**	% moist.:	**23.6**

Assumed Specific Gravity: **2.72** Max Dry Density(pcf) = 103.9846 OMC = 20.7188209

% of max = 100.0 +/- OMC = 0.00

Calculated % saturation: 101.48 Void ratio (e) = **0.63** Porosity (n)= **0.39**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.37

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	212	5.5	1.158825	23.5	0.920	5.03E-07	1.43E-03	
12/28/2009	237	5.4	1.258825	23.5	0.920	4.95E-07	1.40E-03	
12/28/2009	259	5.3	1.358825	23.5	0.920	4.96E-07	1.41E-03	
12/28/2009	289	5.2	1.458825	23.5	0.920	4.83E-07	1.37E-03	

SUMMARY

ka = 4.95E-07 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	5.03E-07	cm/sec	1.8	%
k2 =	4.95E-07	cm/sec	0.2	%
k3 =	4.96E-07	cm/sec	0.3	%
k4 =	4.83E-07	cm/sec	2.2	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**4.95E-07**	cm/sec	**1.40E-03**	ft/day
Void Ratio	e =	**0.63**			
Porosity	n =	**0.39**			
Bulk Density	γ =	**2.01**	g/cm^3	**125.5**	pcf
Water Content	W =	**0.35**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**5.07E-12**	cm^2	(at 20 deg C)	

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas
Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084
Project No. : G 3242-095

Permometer Data

Boring No.:	B-6	a_p =	0.031416 cm^2			Set Mercury to Pipet Rp at beginning	Equilibrium	1.7	cm^3
Sample:		a_a =	0.767120 cm^2				Pipet **Rp**	**6.7**	cm^3
Depth (ft):	28'-30'	M_1 =	0.030180	C =	0.000408156		Annulus **Ra**	1.5	cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671				

Material Description : Gray Silty Sand

SAMPLE DATA

Wet Wt. sample + ring or tare :			457.40	g					
Tare or ring Wt. :			0.0	g		Before Test		After Test	
Wet Wt: of Sample :			457.40	g	Tare No.:	T-5	Tare No.:	T-10
Diameter :	2.69	in	6.83	cm^2	Wet Wt.+tare:	355.86	Wet Wt.+tare:	661.49
Length :	2.46	in	6.24	cm	Dry Wt.+tare:	328.36	Dry Wt.+tare:	581.76
Area:	5.68	in^2	36.64	cm^2	Tare Wt:	218.80	Tare Wt:	221.13
Volume :	13.96	in^3	228.75	cm^3	Dry Wt.:	109.56	Dry Wt.:	360.63
Unit Wt.(wet):	**124.77**	pcf	**2.00**	g/cm^3	Water Wt.:	27.5	Water Wt.:	79.73
Unit Wt.(dry):	**99.74**	pcf	**1.60**	g/cm^3	% moist.:	**25.1**	% moist.:	**22.1**

Assumed Specific Gravity: **2.55** Max Dry Density(pcf) = 99.78226 OMC = 25.1004016
% of max = 100.0 +/- OMC = 0.00
Calculated % saturation: 94.57 Void ratio (e) = **0.60** Porosity (n)= **0.37**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 10.42

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	7	4	2.658825	23.5	0.920	4.12E-05	1.17E-01	
12/28/2009	9	3.5	3.158825	23.5	0.920	4.23E-05	1.20E-01	
12/28/2009	11	3	3.658825	23.5	0.920	4.57E-05	1.30E-01	
12/28/2009	16	2.5	4.158825	23.5	0.920	4.28E-05	1.21E-01	

SUMMARY

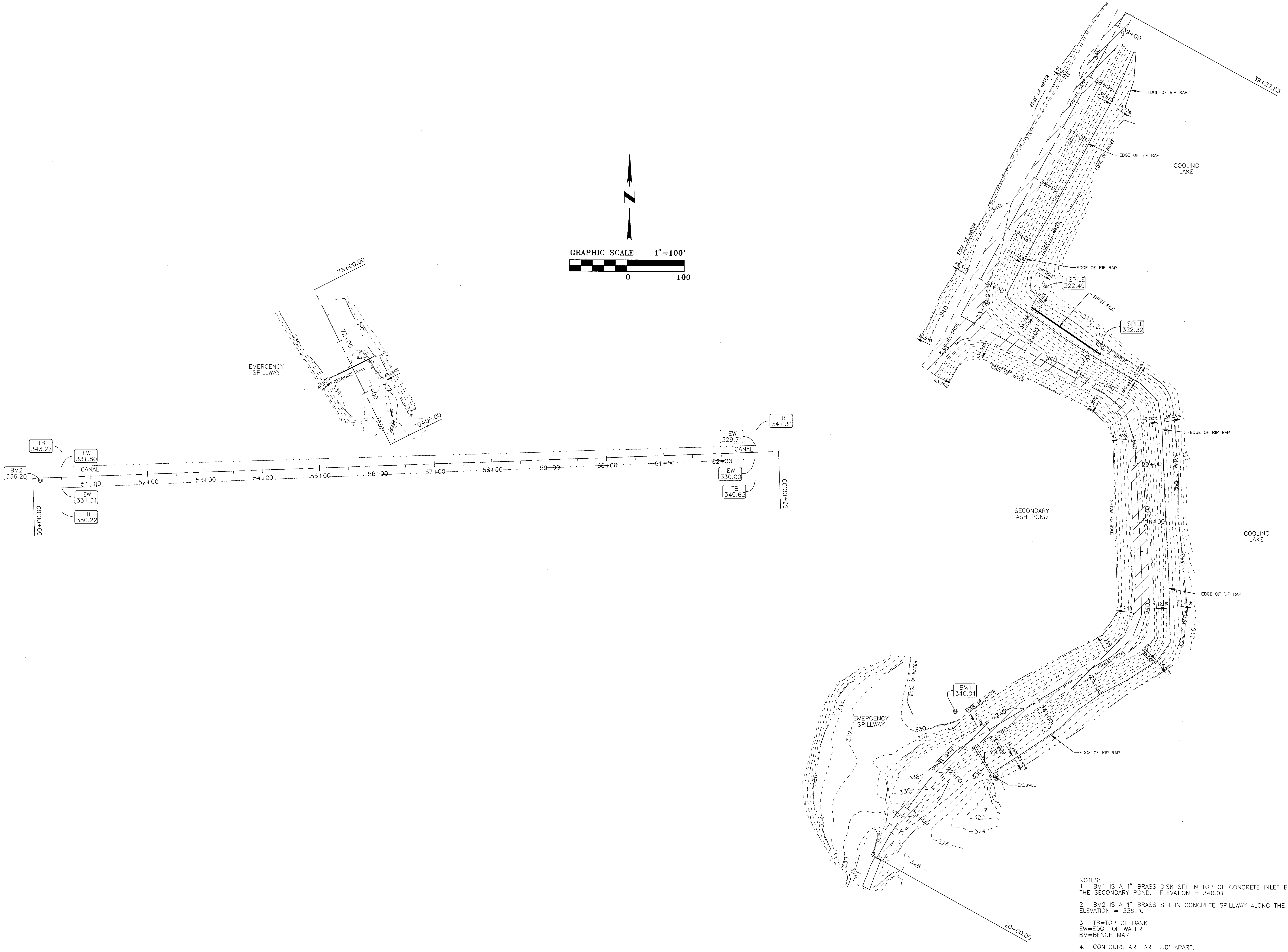
ka = 4.30E-05 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	4.12E-05	cm/sec	4.2	%
k2 =	4.23E-05	cm/sec	1.7	%
k3 =	4.57E-05	cm/sec	6.3	%
k4 =	4.28E-05	cm/sec	0.4	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**4.30E-05**	cm/sec	**1.22E-01**	ft/day
Void Ratio	e =	**0.60**			
Porosity	n =	**0.37**			
Bulk Density	γ =	**2.00**	g/cm^3	**124.8**	pcf
Water Content	W =	**0.40**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**4.41E-10**	cm^2	(at 20 deg C)	

Robert Duke, P.E.



NOTES:

1. BM1 IS A 1" BRASS DISK SET IN TOP OF CONCRETE INLET BOX FOR THE SECONDARY POND. ELEVATION = 340.01'.

2. BM2 IS A 1" BRASS SET IN CONCRETE SPILLWAY ALONG THE CANAL. ELEVATION = 336.20'

3. TB=TOP OF BANK
EW=EDGE OF WATER
BM=BENCH MARK

4. CONTOURS ARE ARE 2.0' APART.

5. LAKE ELEVATION PER WELSH POWER PLANT ON NOVEMBER 18, 2010 WAS 317.57 FEET MSL.

SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON NOVEMBER 18, 2010, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: NOVEMBER 23, 2010
REVISED: DECEMBER 6, 2010

MIKE GARDNER
#5760

TOPOGRAPHIC SURVEY

DIKE'S AT WELSH POWER PLANT
FOR: GREG CARTER

Date	Revision/Description
12/6/10	ADDED LAKE LEVEL NOTE
12/6/10	ADDED CROSS SECTION SHEETS

Drawn By	Checked By	Project No.	Dwg. Date
MG	DW	104021	11/19/10

MTG engineers & surveyors
5930 SUMMERHILL RD. | P.O. BOX 3786
TEXARKANA TEXAS 75501
P 903.838.8533 | F 903.832.4700
www.mtgengineers.com

TBPE NO. 354

File No.	Sheet No.
	1

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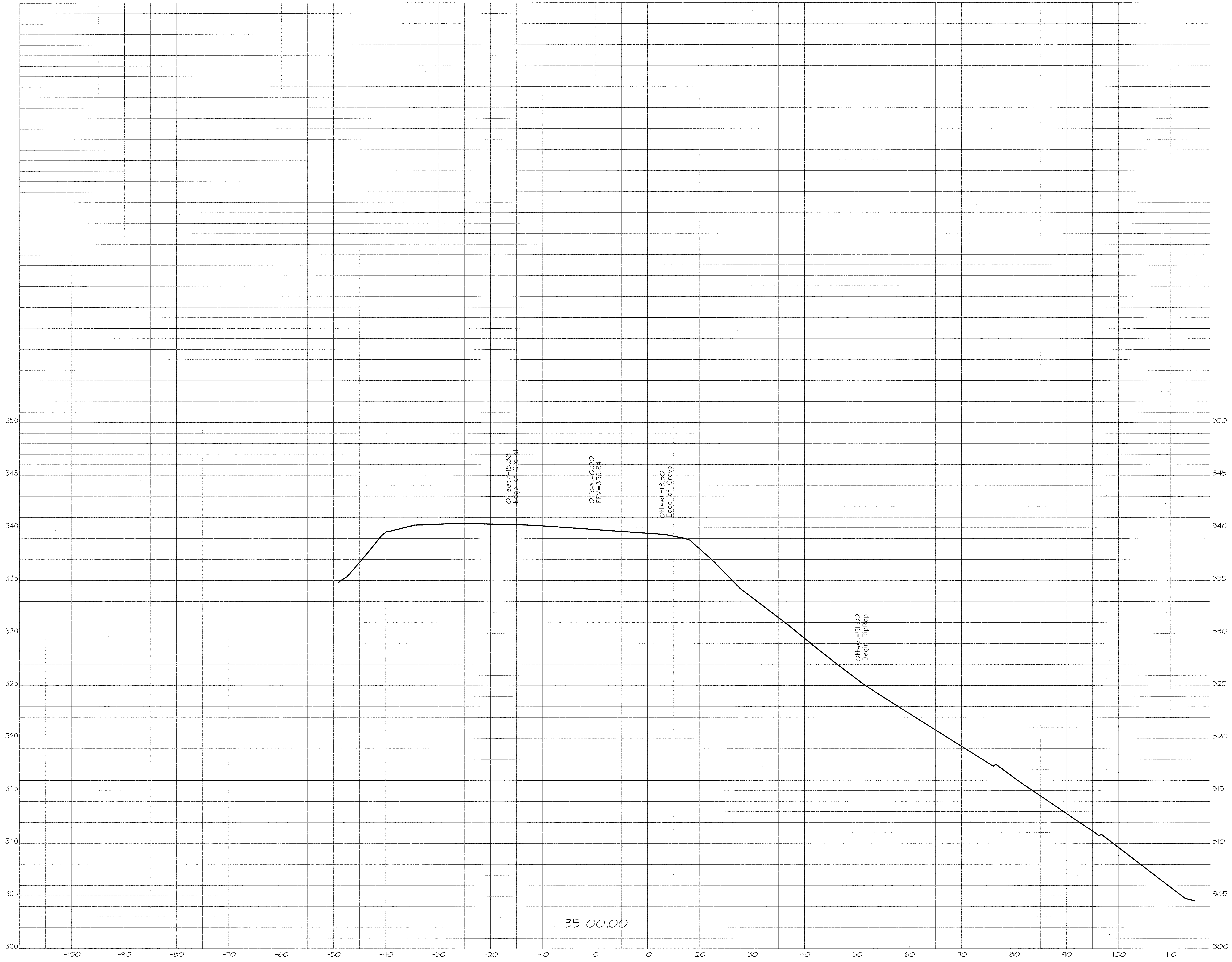
Mon Dec 6, 2010 11:13AM

HORIZONTAL SCALE - 1"=10'
VERTICAL SCALE - 1"=5'



SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON NOVEMBER 18, 2010, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: NOVEMBER 23, 2010
REVISED: DECEMBER 6, 2010

MIKE GARDNER
#5760

CROSS SECTIONS
ASH POND BERM

DIKE'S AT WELSH POWER PLANT
FOR: GREG CARTER

Date	Revision/Description

Drawn By	Checked By	Project No.	Dwg. Date
J.B.D.	M.G.	104021	12/6/2010

MTG engineers & surveyors

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TBPE NO. 354

File No.

Sheet No. 5

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2.7 – Bottom Ash Storage Pond Hazard Potential Classification Assessment, July 2021

Southwestern Electric Power Company
Welsh Power Station
Bottom Ash Storage Pond

Hazard Potential Classification Assessment

AEP has performed an evaluation to classify the above CCR Surface Impoundment in accordance with FEMA's Hazard Potential Classification System for Dams. These guidelines evaluate the consequences of a potential failure not the likelihood of a failure. Guidelines that were developed and utilized are included below.

Hazard Potential Classification Systems (from FEMA 333, April 2004)

1. **Low Hazard Potential**
   Dams assigned the low hazard potential classification are those where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.
2. **Significant Hazard Potential**
   Dams assigned the significant hazard potential classification are those dams where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.
3. **High Hazard Potential**
   Dams assigned the high hazard potential classification are those where failure or mis-operation will probably cause loss of human life.

The AEP J. Robert Welsh Power Station is located at 1187 County Road 4865, Pittsburg, TX 75686. The plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas.

The Bottom Ash Storage Pond is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir. Loss of human life is not probable in the event of a catastrophic failure of the embankment and a failure of the embankment is expected to have a low economic and environmental impact. The US EPA CCR Impoundment Assessment Report has listed this ash pond as Low Hazard.

There has been no changes in classification by the State Dam Safety nor has there been any other physical changes that would warrant a change in the classification.

Based on the FEMA Hazard Potential Classification Systems for Dams and on the above discussion, Welsh Bottom Ash Storage Pond Dam is classified as a **Low Hazard Potential Dam**.

Professional Engineer's Certification:

I certify that this Hazard Potential Classification Assessment is in accordance with the requirements of section 30 TAC 352.731.

Gary F. Zych, P.E.

Gary F. Zych
7/29/2021

GARY F. ZYCH
127152

2.8 – History of Construction, Bottom Ash Storage Pond, October 2016

HISTORY OF CONSTRUCTION

CFR 257.73(c)(1)

Bottom Ash Storage Pond

Welsh Plant
Pittsburg, Texas

October, 2016

Prepared for: AEP/SWEPCO - Welsh Plant

Pirkey, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

GERS – 16 – 130

Table of CONTENTS

Attachments

Attachment A – Location Map
Attachment B – Design Reports
Attachment C – Design Drawings
Attachment D – Hydrology and Hydraulic Report

1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CCR 257.73(c)(1) with an evaluation of the facility.

2.0 DESCRIPTION OF CCR THE IMPOUNDMENT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash Pond and the Bottom Ash Storage pond. The Bottom Ash Storage Pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir.

The Bottom Ash Storage Pond embankments are approximately 20 feet in height and are constructed on a 3:1 slope (3 feet horizontal, 1 foot vertical). The elevation at the base of the embankment is approximately 340 feet above msl, and the elevation at the top of the embankment around the perimeter of the Bottom Ash Storage Pond is approximately 360 feet above msl. Presently a combination of economizer ash, bottom ash and some fly ash is sluiced to the bottom ash storage pond from the primary bottom ash pond.

3.0 SUMMARY OF OWNERSHIP 275.73(c)(1)(i)

[The name and address of the person(s) owning or operating the CCR unit: the name associated with the CCR unit: and the identification number of the CCR unit if one has been assigned by the state.]

The AEP J. Robert Welsh Plant is located at 1187 County Road 4865, Pittsburg, TX, 75686, in southern Titus County. The plant is approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The Bottom Ash Storage Pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir. It is owned and operated by Southwestern Electric Power Company (SWEPCO). The facilities Ash Pond Complex operates two surface impoundments for storing CCR and a clear water pond for decant water.

4.0 LOCATION OF THE CCR UNIT 275.73 (c)(1)(ii)

[The location of the CCR unit identified on the most recent U.S. Geological Survey (USGS) 7 ½ minute or 15 minute topographic quadrangle map, or a topographic map of equivalent scale if a USGS map is not available.]

A location map is included in Attachment A.

5.0 STATEMENT OF PURPOSE 275.73 (c)(1)(iii)

[A statement of the purpose for which the CCR unit is being used.]

The Bottom Ash Storage Pond is a surface impoundment for storing CCR. Presently, economizer ash and occasionally bottom ash and fly ash from the primary bottom ash pond is dredged and sluiced to the bottom ash storage pond. The Bottom Ash Storage Pond area also receives storm water run-off from a small water shed area of the plant property and an adjacent ash storage area. All of the decant water from the Bottom Ash Storage Pond flows back into the primary bottom ash pond.

6.0 NAME AND SIZE OF WATERSHED THE CCR UNIT IS LOCATED

275.73 (c)(1)(iv)

[The name and size in acres of the watershed within which the CCR unit is located.]

The Welsh Bottom Ash Pond is comprised of a diked embankments constructed of compacted earth materials. The Bottom Ash Storage Pond is bounded by natural ground surface (topographically higher areas) to the north and embankment dikes to the south, east and west. Therefore, there are areas surrounding the impoundment that contributes to the run-off. The watershed for the ponds is equal to approximately 42 acres.

The Bottom Ash Storage Pond is located within the Region 11 – Arkansas –White –Red Region Watershed and are part of the sub group HUC = 11140305 Lake O' the Pines watershed area. The area is approximately 571,731.2 acres.

7.0 DESCRIPTION OF THE FOUNDATION AND ABUTMENT MATERIALS

275.73(c)(1)(v)

[A description of the physical and engineering properties of the foundation and abutment materials on which the CCR unit is located.]

Native coarse grained (or sandy) material underlying the Bottom Ash Pond generally Consist of medium dense to very dense silty sand (SM), clayey sand (SC) and silt (ML) and Fine grained (or clayey) material consist of medium stiff to hard lean clay and fat clay (CL and CH) soils. The engineering properties of foundation soils had a cohesion that ranged between 0 psf and 300 psf and a friction angle that ranged between 22 degrees and 36 degrees. Additioanl details on the engineering properties of the foundaiton soils is in the design reports presented in Attachment B.

8.0 DESCRIPTION OF EACH CONSTRUCTED ZONE OR STAGE OF THE CCR UNIT

275.73 (c)(1)(vi)

[A statement of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR unit; and the approximate dates of construction of each successive stage of construction of the CCR unit.]

The Bottom Ash Storage Pond embankment was constructed in 2000 and is constructed of compacted earth fill. The source and type of soils used for earth fill is unknown. However, AEP contracted with Auckland Consulting, Inc. of Tyler, Texas to perform a Geotechnical Investigation of Existing Bottom Ash Storage Pond Embankments in 2016 (copy provided in Attachment B). The evaluation of the existing earthen embankments consisted of slope stability and seepage analyses for the embankments. The evaluation was performed using information obtained from soil borings located on the crest and outside toe of the embankments. The embankments for the Bottom Ash Storage were investigated. The subsurface exploration of the embankment consisted of advancing a total of seven (7) borings located in potentially critical areas of the embankment. Four (4) borings (Boring Nos. 2 through 5) were completed along the embankment crest with termination depths ranging from approximately 40 to 50 feet. Three

(3) borings (Boring Nos. 6 through 8) were completed along the embankment toe and were advanced to termination depths of approximately 40 feet.

Based on soil borings and field testing information, the existing soil embankment consist of lean clay (CL) with existing side slopes (both up- and downstream) of approximately 3:1 (H:V), Maximum embankment height of approximately 34 feet (downstream) and top of dam elevation of 360.0 feet MSL. The engineering properties of embankment soils had a cohesion of 150 psf and a friction angle of 32 degrees. Additioanl details on the engineering properties of the foundaiton soils is in the design reports presented in Attachment C. The downstream slope of the embankment is constructed with an intermediate 12-foot wide bench that supports a 30-inch HDPE decant pipe. To account for the potential loading of the decant pipe, a surcharge load of 150 psf was applied to the bench. The crest width of the embankment is approximately 12 feet. The impoundment's storage area (side slopes and bottom) is lined with a 60 mil HDPE liner.

<u>9.0</u> ENGINEERING STRUCTURES AND APPURTENANCES, 275.73 (c)(1)(vii)

[At a scale that details engineering structures and appurtenances relevant to the design, construction, operation, and maintenance of the CCR unit, detailed dimensional drawings of the CCR unit, including a plan view and cross sections of the length and width of the CCR unit, showing all zones, foundation improvements, drainage provisions, spillways, diversion ditches, outlets, instrument locations, and slope protection…]

Ash materials are dredged from the Primary bottom Ash Pond and sluiced to the Bottom Ash Storage Pond, where the ash materials are then managed. The southeast corner of the Bottom Ash Storage Pond has an interior dike which separates the main body of the pond from a small sump area. This interior dike has a 40-foot wide interior spillway section with a crest elevation of 355.0 feet, however this spillway does not act as the hydraulic control for the Bottom Ash Storage Pond. Discharges from the Bottom Ash Storage Pond are initially controlled by an 18-inch HDPE pipe with an invert elevation of 350.5 feet penetrating the 40 foot wide interior spillway, and then by a 30-inch HDPE pipe with an invert elevation of 350.0 feet located in the sump area; flows through this pipe are directed back to Primary Pond. The Bottom Ash Storage Pond has an 8-foot wide emergency spillway with a crest elevation of 358.0 feet. The emergency spillway channel is lined with riprap and discharges into an unnamed tributary of Swauano Creek just upstream of the south end of the Welsh Reservoir emergency spillway. The design drawings are presented in Attachment C.

<u>10.0</u> SUMMARY OF POOL SURFACE ELEVATIONS, AND MAXIMUM DEPTH OF CCR, 275.73 (c)(1)(vii)

[…in addition to the normal operating pool surface elevation and the maximum pool elevation following peak discharge from the inflow design flood, the expected maximum depth of CCR within the CCR surface impoundment.]

The table below describes the normal pool elevations and maximum pool elevations as well as maximum depth of CCR within the impoundment. The Inflow Design Flood is the 100-year storm event.

	Primary Bottom Ash Pond
Normal Pool Elevation	350.5
Maximum Pool Elevation following peak discharge from inflow design flood	355.046
Expected Maximum depth of CCR within impoundment	20 ft

11.0 FEATURES THAT COULD ADVERSELY AFFECT OPERATION DUE TO MALFUNCTION OR MIS-OPERATION (275.73 (c)(1)(vii))

[…and any identifiable natural or manmade features that could adversely affect operations of the CCR unit due to malfunction or mis-operation]

In the event of malfunction or mis-operation of any of the pond's appurtenances the ponds operations could be adversely affected. These structures include weir structures, low water discharge gated structures, effluent return piping and pump structures and influent sluicing piping and structures. See design drawings in Attachment C for location and details of all appurtenances.

12.0 DESCRIPTION OF THE TYPE, PURPOSE AND LOCATION OF EXISTING INSTRUMENTATION 275.73 (c)(1)(viii)

[A description of the type, purpose, and location of existing instrumentation.]

This is no instrumentation for this facility.

13.0 AREA – CAPACITY CURVES FOR THE CCR UNIT 275.73 (c)(1)(ix)

[Area-capacity curves for the CCR unit.]

The area capacity curves for the Primary Bottom Ash Pond is included in the Hydrology and Hydraulic Analysis Report by Freese and Nichols, Inc., dated 2010 in Attachment D.

14.0 275.73 (c)(1)(x) DESCRIPTION OF EACH SPILLWAY AND DIVERSION

[A description of each spillway and diversion design features and capacities and calculations used in their determination.]

Complete details of each spillway structure are included with the design drawings in Attachment C. Hydrology and Hydraulic Analysis which include calculations for each spillway structure are included in Inflow Design Flood Control Plan.

The principal spillway for the Bottom Ash Pond is a 40-foot long broad-crested weir with 6:1 side slopes and crest at elevation 355.0 ft-msl. However, this spillway does not act as the hydraulic control for the Bottom Ash Storage Pond. Discharges from the Bottom Ash Storage Pond are initially controlled by an

18-inch HDPE pipe with an invert elevation of 350.5 feet penetrating the 40 foot wide interior spillway, and then by a 30-inch HDPE pipe with an invert elevation of 350.0 feet located in the sump area; flows through this pipe are directed back to Primary Pond. The Bottom Ash Storage Pond has an 8-foot wide emergency spillway with a crest elevation of 358.0 feet. The emergency spillway channel is lined with rock riprap and discharges into an unnamed tributary of Swauano Creek just upstream of the south end of the Welsh Reservoir emergency spillway.

<u>15.0</u> SUMMARY CONSTRUCTION SPECIFICATIONS AND PROVISIONS FOR SURVEILLANCE, MAINTENANCE AND REPAIR 275.73 (C)(1)(XI)

[The construction specifications and provisions for surveillance, maintenance, and repair of the CCR unit.]

Readily available portions of the original construction specifications are included in Appendix B.

As required by the CCR rules the Primary Ash Pond is inspected at least every 7 days by a qualified person. Instrumentation data is collected at least every 30 days and reviewed by AEP Engineering Services. Also as a requirement of the CCR rules the impoundment is also inspected annual by a professional engineer.

If repairs are found to be necessary during any inspection they will be completed as needed.

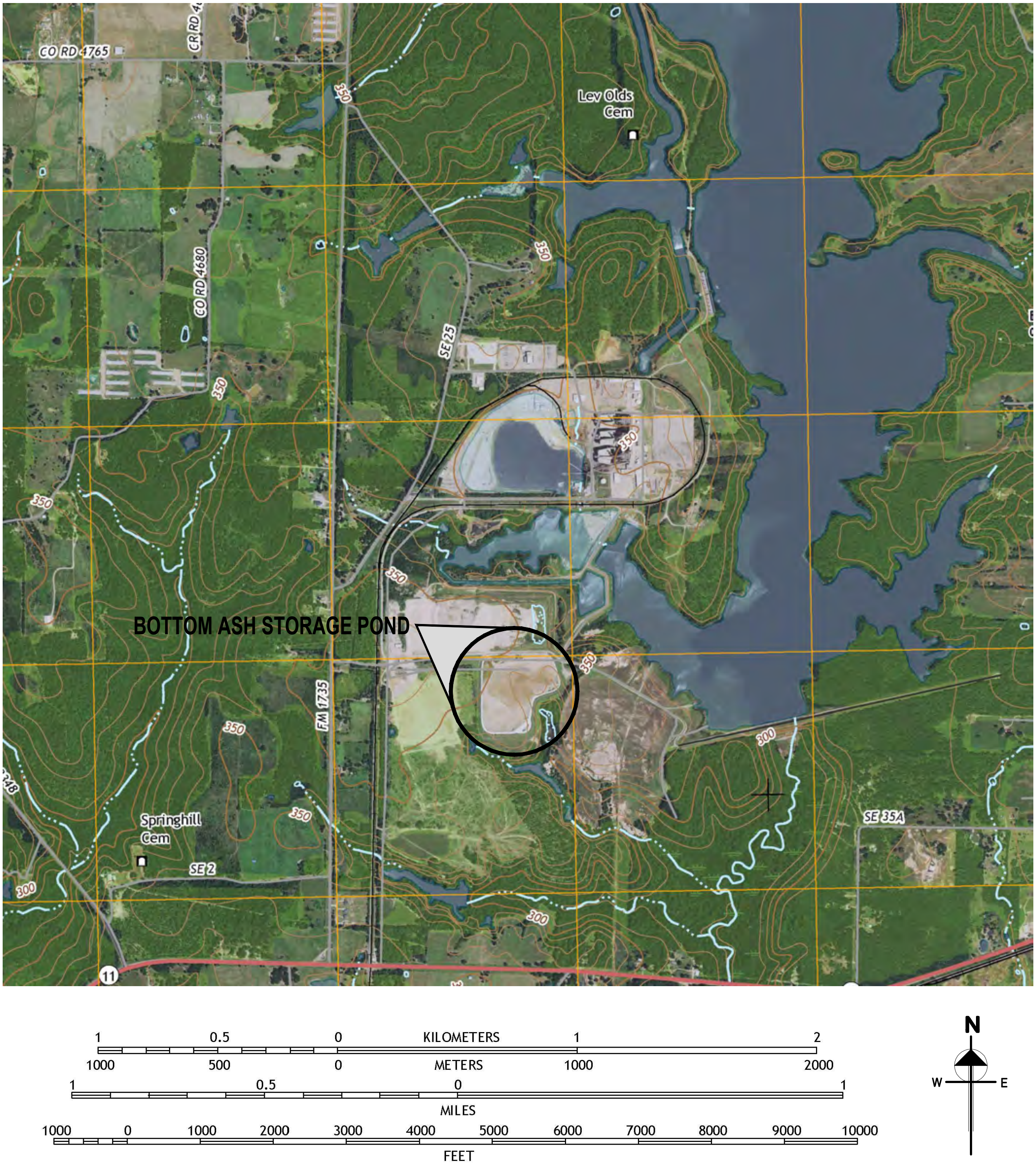
<u>16.0</u> RECORD OR KNOWLEDGE OF STRUCTURAL INSTABILITY 275.73 (C)(1)(XII)

[Any record or knowledge of the structural instability of the CCR unit.]

To date there has been no known record of knowledge of the structural instability of the CCR unit.

ATTACHMENT A

LOCATION MAP



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REFERENCE AEP's CORPORATE INFORMATION SECURITY POLICY

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SOUTHWESTERN ELECTRIC POWER COMPANY

WELSH PLANT

CASON TEXAS

BOTTOM ASH STORAGE POND

USGS TOPO MAP

7.5-MINUTE SERIES

UNIT: 13

DRAWING NUMBER: LOCATION MAP

REV: 1

SCALE: 1"=2000'

CIVIL ENGINEERING

DR:

CH:

SUP:

ENG:

DATE: 10/4/16

AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

ATTACHMENT B

DESIGN REPORTS

Initial Safety Factor Assessment – Bottom Ash Pond

Welsh Power Plant
Pittsburg, Texas

Auckland Project No. 2016-007
August 30, 2016

Prepared For:

American Electric Power Company
1 Riverside Plaza
Columbus, Ohio 43215

Prepared By:

Auckland Consulting, LLC
Jacksonville, Texas

TBPE Firm Registration No. F-16721
Expires 2/29/2017

Table of Contents

Appendix

1.0 Introduction and Embankment Information

1.1 Introduction

The following report and evaluation provides the Initial Safety Factor Assessment of the Bottom Ash Pond, an existing CCR impoundment (as defined by 40 CFR §257.2) located at the Welsh Power Plant near Pittsburg, Texas. In accordance with 40 CFR §257.73(e)(1)(i) through (iv) this initial assessment provides field and laboratory data, model outputs (detailing multiple stability conditions) and summary of safety factors for the Bottom Ash Pond. In accordance with 40 CFR §257.73(e)(2) this report provides the Initial Safety Factor Assessment certification for the Bottom Ash Pond.

1.2 Referenced Information and Data

The impoundment pool elevation data cited herein were provided in a separate hydrology and hydraulic (H&H) analysis report completed by Freese and Nichols titled *Hydraulic Analysis of Welsh Power Plant Ash Ponds* dated December 29, 2010 (not included herein). The referenced report generally meets the demonstration requirements of 40 CFR §257.82(a).

Embankment profile dimensions and elevations were determined by using existing information provided by the client. This information is included in the Appendix of this report.

1.3 Embankment Evaluation Criteria

Based on information provided and collected, the existing embankment is primarily lean clay (CL) with existing side slopes (both up- and downstream) of approximately 3:1 (H:V), maximum embankment height of approximately 34 feet (downstream) and top of dam elevation of 360.0 feet MSL. The downstream slope of the embankment is constructed with a 12-foot wide bench (vertical position on the slope varies along the embankment) that supports a 30-inch HDPE decant pipe. To account for the potential loading of the decant pipe, a surcharge load of 150 psf was applied to the bench. The crest width of the embankment is approximately 12 feet. The impoundment's storage area (side slopes and bottom) is lined with a 60-mil HDPE liner. The critical section for the embankment was determined to occur in the vicinity of Boring No. 4, as depicted on the Plan of Borings.

It is our understanding that the maximum storage elevation of impounded CCR material is 355.0 feet (MSL); however, the facility is managed to maintain an ash level less than this maximum level. The downstream toe of the Bottom Ash Pond is not adjacent to other water bodies that may inundate the downstream slope (or toe) and therefore not subject to 40 CFR §257.73(d)(1)(A)(3)(vii).

In accordance with 40 CFR §257.73(e)(1)(i) and (ii), the maximum storage pool elevation for the Bottom Ash Pond as determined by the 25-year, 24-hour storm event is 355.62 feet (MSL). For the purposes of this evaluation, the maximum storage pool elevation of 356.0 feet (MSL) was utilized. Likewise, the maximum (or flood) surcharge loading elevation as determined by the 100-year, 24-hour event is 355.76 feet (MSL), for this evaluation a maximum surcharge loading elevation of 356.0 feet (MSL) was utilized. Storage pool elevations were determined in accordance with 40 CFR §257.82(a).

2.0 Field and Laboratory Testing

2.1 Field Activities

The subsurface exploration of the embankment consisted of advancing a total of seven (7) borings located in potentially critical areas of the embankment. Four (4) borings (Boring Nos. 2 through 5) were completed along the embankment crest with termination depths ranging from approximately 40 to 50 feet. Three (3) borings (Boring Nos. 6 through 8) were completed along the embankment toe and were advanced to termination depths of approximately 40 feet. Boring No. 1 was not accessible by drilling equipment and therefore not completed. Borings were located in the field as shown on the Plan of Borings included in the Appendix of this report.

Drilling Methods. Field operations were performed in general accordance with ASTM procedures or similar accepted practices. Soil borings were drilled using a track mounted Geoprobe drilling rig equipped with a rotary head and continuous augers. The use of mud rotary or rotary wash was not necessary.

Soil Sampling. Sample intervals were semi-continuous in the upper 10 feet of each boring and five (5) foot intervals thereafter, unless otherwise directed by the onsite engineer. Split-spoon (Standard Penetration Test, SPT) or disturbed samples were collected in general accordance with ASTM Standard Method D 1586. Relatively undisturbed soil samples were collected in general accordance with ASTM D 1587 and extruded in the field and sealed in plastic to protect against moisture loss. Soil shear strengths were determined by using a calibrated hand penetrometer on undisturbed samples.

The collected samples were subsequently examined and selected for laboratory testing by a geotechnical engineer.

Boring Logs. The general subsurface soil and groundwater conditions encountered during field activities are presented on boring logs attached in the Appendix of this report. Information on the boring logs includes groundwater levels, laboratory test data, penetration resistance and soil classifications based on the Unified Soil Classification System (USCS).

Groundwater Level Measurements. Groundwater level observations completed during field activities are noted on the boring logs attached in the Appendix of this report.

2.2 Laboratory Testing Program

Laboratory testing was conducted on selected samples to assist in the classification of the soils encountered and to evaluate the physical and engineering properties of subsurface soils. Laboratory test results are presented on the boring logs included in the Appendix. Laboratory tests were performed in general accordance with ASTM procedures cited in the table below.

Laboratory Test	Test Designation
Atterberg Liquid Limit and Plastic Limit Determination	ASTM D 4318
Percentage Soil Passing No. 200 Sieve	ASTM D 1140
Moisture Content Determination	ASTM D 2216
Particle Size Analysis of Soils	ASTM D 422
Unconsolidated Undrained (UU) Triaxial Compression	ASTM D 2850
Hydraulic Conductivity	ASTM D 5084
Consolidated Undrained (CU) Triaxial Compression	ASTM D 4767
Direct Shear of Soils Under Consolidated Drain Conditions	ASTM D 3080

Soil samples not utilized in laboratory testing will be retained for approximately 30 days from the report issuance date and then disposed, unless specifically requested in writing from the client.

3.0 Slope Stability Analyses

3.1 General

Soil parameters used for stability analyses of the existing embankment are based on findings of the completed laboratory and field testing programs and previous assessments completed as the Welsh Power Plant. The probable failure planes were analyzed using the analytical slope stability software, SLIDE by Rocscience, Inc. Methods of evaluation used in SLIDE are considered to be limited equilibrium methods of analysis, where each individual shear plane is evaluated to determine the resulting shear stress at the point of failure. For the purposes of this evaluation the Bishop Method of analysis, which analyzes circular failure planes through the slope was utilized.

Per 40 CFR §257.73(e)(1)(i) through (iii), three (3) modeled scenarios (presented below) were utilized to evaluate the stability of the existing embankment: steady state seepage (long term) condition under maximum storage pool, steady state seepage (long term) condition under maximum surcharge pool, and steady state seepage condition with seismic loading under maximum storage pool conditions. The following minimum factors of safety (FS) and soil stress parameters were utilized in modeling. Minimum factors of safety are based on demonstration requirements provided in 40 CFR §257.73(e)(1).

Summary of Embankment Condition and Factor of Safety		
Embankment Condition	**Soil Parameters**	**Minimum Factor of Safety**
Steady State Seepage – Maximum Pool	Effective Stress	1.50
Steady State Seepage – Surcharge Pool	Effective Stress	1.40
Steady State Seepage (Seismic) – Maximum Pool	Total Stress	1.00
NOTE: Minimum factors of safety based on demonstration requirements provided in 40 CFR §257.82 (e)(1).		

For evaluation of steady state seepage (long term) conditions with seismic, peak ground acceleration for this location was obtained from the USGS National Seismic Hazard Mapping Project (http://earthquake.usgs.gov/hazards). Based on the seismic survey data, the anticipated site specific peak ground acceleration (PGA) of 0.06g (acceleration at rock sites) for two (2) percent probability of exceedance in 50 years (40 CFR Part 257, Preamble page 21384). Correcting for acceleration at soft soil sites (Seismic Site Classification D) yields an estimated PGA of 0.13g. The seismic coefficient (k) used for pseudo static analysis is determined by reducing the estimated PGA by 50% yielding a seismic coefficient of 0.065g.

3.2 Liquefaction Assessment

Liquefaction of soils occurs when horizontal shearing stresses exceed the strength of existing loose, saturated sand. This sudden loss of shear strength and subsequent soil structure is typically associated with earthquake-induced horizontal movement. Recent engineering publications[1] provide criteria to assess liquefaction potential of sands (little to no fines) and clayey soils of low plasticity (e.g. clayey sands, silts). These criteria indicate that water content of fine-grained or cohesive soils needs to be high (≥ 0.85 *Liquid Limit [LL]), a clay fine content (defined as grains smaller than 0.002 mm) of less than 10 percent (< 10%), and relatively low soil density (assessed in terms of SPT blow counts). In addition, the accepted minimum seismic threshold acceleration to cause liquefaction in loose sands is 0.10g, the anticipated site specific PGA for this site is 0.06g.

Native coarse grained (or sandy) material underlying the Bottom Ash Pond generally consist of medium dense to very dense silty sand (SM), clayey sand (SC) and silt (ML) and fine grained (or clayey) material consist of medium stiff to hard lean clay and fat clay (CL and CH) soils. Based on these soil characteristics and that the Bottom Ash Pond is located in

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[1] Seed, R.B., et al, Recent Advances in Soil Liquefaction Engineering: A Unified and Consistent Framework, 26th Annual ASCE Los Angeles Spring Seminar, April 2003

a zone of low peak ground acceleration (PGA), the risk of either embankment or underlying soils liquefying are negligible [40 CFR §257.73(e)(1)(iv)].

3.3 Embankment and Foundation Stratigraphy

The models developed for this evaluation are based on the existing embankment geometry, results of field and laboratory testing and hydrologic site information provided by the client. Selection of the critical slope section was based on both height and subsurface sensitivity to loading. The following tables provide a summary of soil parameters used for these analyses. Specific soil parameters used for each model are presented in the Appendix.

Summary of Long Term, Total Stress Soil Parameters:

Material Type	Unit Weight (pcf)	Consolidated-Undrained Cohesion (psf)	Consolidated-Undrained Angle of Internal Friction (degrees)
Embankment Fill	125	250	28
Silty, Clayey Sand (SM_SC)	120	225	20
Silty Sand (SM)	120	0	30
Native Fat and Lean Clay (CH_CL)	125	450	14
Ash	100	0	30

NOTE: Properties used for Steady State Seepage with Seismic analyses.

Summary of Long Term, Effective Stress Soil Parameters

Material Type	Unit Weight (pcf)	Consolidated-Drained Cohesion (psf)	Consolidated-Drained Angle of Internal Friction (degrees)
Embankment Fill	125	150	32
Silty, Clayey Sand (SM_SC)	120	0	34
Silty Sand (SM)	120	0	36
Native Fat and Lean Clay (CH_CL)	125	300	22
Ash	100	0	30

NOTE: Properties used for Steady State Seepage analyses. Consolidated-drained conditions determined based on pore pressure measurements made during Consolidated-Undrained (CU) triaxial testing.

The HDPE liner was modeled at the interface of the slope and the ash pond, a nominal strength of 50 psf was assumed for the liner material.

3.4 Seepage Analysis Parameters

The observed groundwater levels while drilling through the embankment (approximate groundwater elevation of 30 to 34 feet, below the crest) correspond with those groundwater elevations encountered while drilling adjacent to the embankment toe (approximately groundwater elevation six [6] feet, below existing grade). No elevated groundwater seepage or groundwater levels were observed in boreholes completed in the embankment that would indicate a prolific and defined phreatic surface in the embankment.

Therefore, based on the available information it appears that the existing impermeable liner has precluded the development of a phreatic surface (internal groundwater elevation) within the embankment. Though the probability of a phreatic surface developing in the embankment is considered low, it is however possible, and therefore was modeled as part of the structural assessment.

The analysis of embankment seepage is based on laboratory results and estimated values for permeability for various embankment and native foundation soils. These soil parameters were utilized in the models to establish a long term steady state condition and corresponding phreatic surface in the embankment. Hydraulic conductivity test results are provided in the Appendix. Hydraulic conductivity properties utilized in the seepage analysis are provided in the below table.

Hydraulic Conductivity of Embankment Soils	
Material Type	**Permeability (ft/sec)**
Embankment Fill	1×10^{-8}
Silty, Clayey Sand (SM_SC)	1×10^{-5}
Silty Sand (SM)	1×10^{-5}
Native Fat and Lean Clay (CH_CL)	1×10^{-8}
Ash	1×10^{-4}

The HDPE liner is assumed to be impermeable; therefore a very low permeability value of 1×10^{-20} ft/sec was utilized.

3.5 Stability Analysis Results

The following table provides the results of the stability analysis for each of the conditions cited herein, as required by 40 CFR §257.73(e)(1)(i) through (iii). The graphical representations of each analysis are included in the Appendix.

Summary of Stability Analyses – Safety Factors

Modeled Condition	Factor of Safety	
	Actual	Minimum
Steady State Seepage – Maximum Pool	2.60	1.50
Steady State Seepage – Surcharge Pool	2.60	1.40
Steady State Seepage with Seismic – Maximum Pool	1.60	1.00

Summary of Stability Analyses– Safety Factors
(Potential Phreatic Surface)

Modeled Condition	Factor of Safety	
	Actual	Minimum
Steady State Seepage – Maximum Pool	1.78	1.50
Steady State Seepage – Surcharge Pool	1.78	1.40
Steady State Seepage with Seismic – Maximum Pool	1.31	1.00

Based on the findings of this analysis, the evaluated embankment appears to be stable under both modeled conditions (existing conditions and potential phreatic surface) and demonstrate the minimum safety factors, as required by 40 CFR §257.73(e)(1)(i) through (iii).

4.0 Report Limitations

This report has been prepared for the exclusive use of our client for the specific application to the project discussed and has been prepared in accordance with the generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. The analyses contained in the report are based on the data obtained from the soil

borings performed within the project site. This report does not reflect variations that may occur between borings or across the site. Soil borings do not necessarily reflect strata variations that may exist at other locations within the project site.

5.0 Initial Structural Stability Assessment Certification

By means of this certification, (i) I have reviewed the requirements of 40 CFR §257.73(e)(1) – *Periodic Safety Factor Assessments*, (ii) I or my agent has visited and examined the facility, (iii) the referenced data used in this evaluation to the best of my knowledge appears correct and appropriate for use, (iv) and this Initial Safety Factor Assessment for the Bottom Ash Pond (Welsh Power Plant) has been prepared to the best of my knowledge in accordance with §257.73(e)(1).

By:

Dated: August 30, 2016

JOHN J. TAYNTOR
99202

TBPE Firm Registration No. F-16721
Expires 2/28/2017

Appendix

Stability Analyses
Reference Data

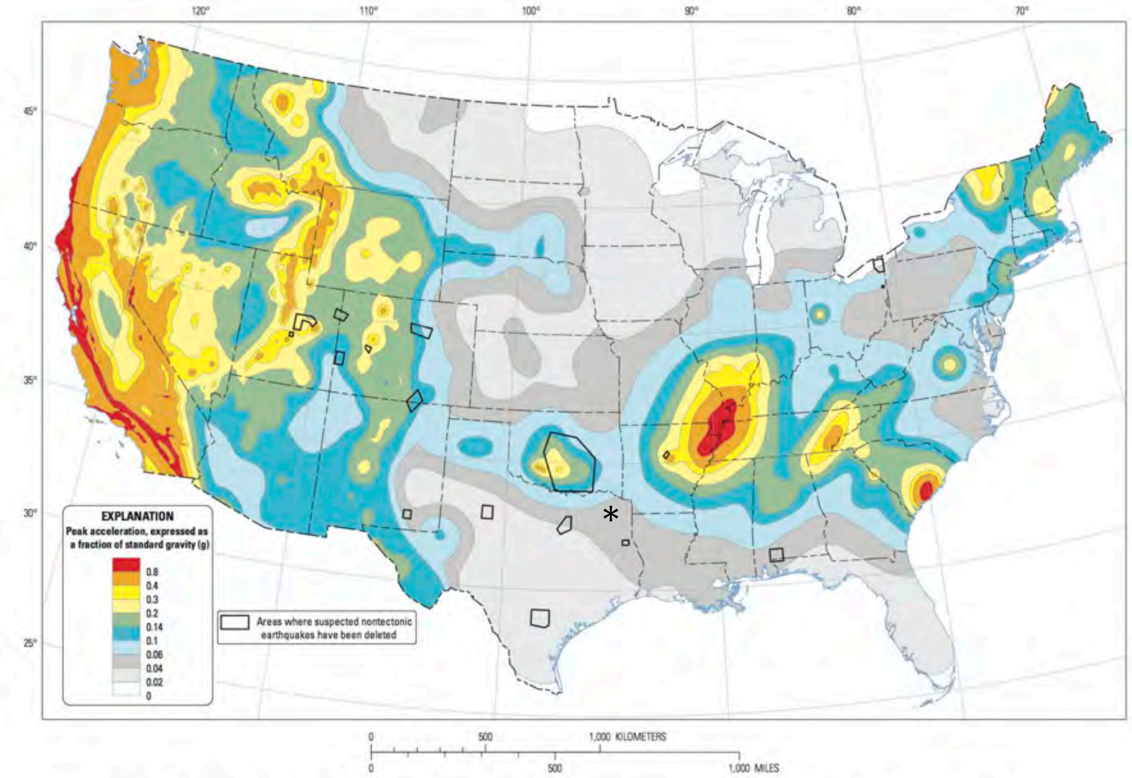
Aerial image provided by Google Earth.

Soil Boring Location Plan

Scale: N/A

Auckland Project No. 2016-007

Welsh Power Plant
Initial Safety Factor Assessment - Bottom Ash Pond
Pittsburg, Texas



Two-percent probability of exceedance in 50 years map of peak ground acceleration

* Approximate location of Welsh Power Plant

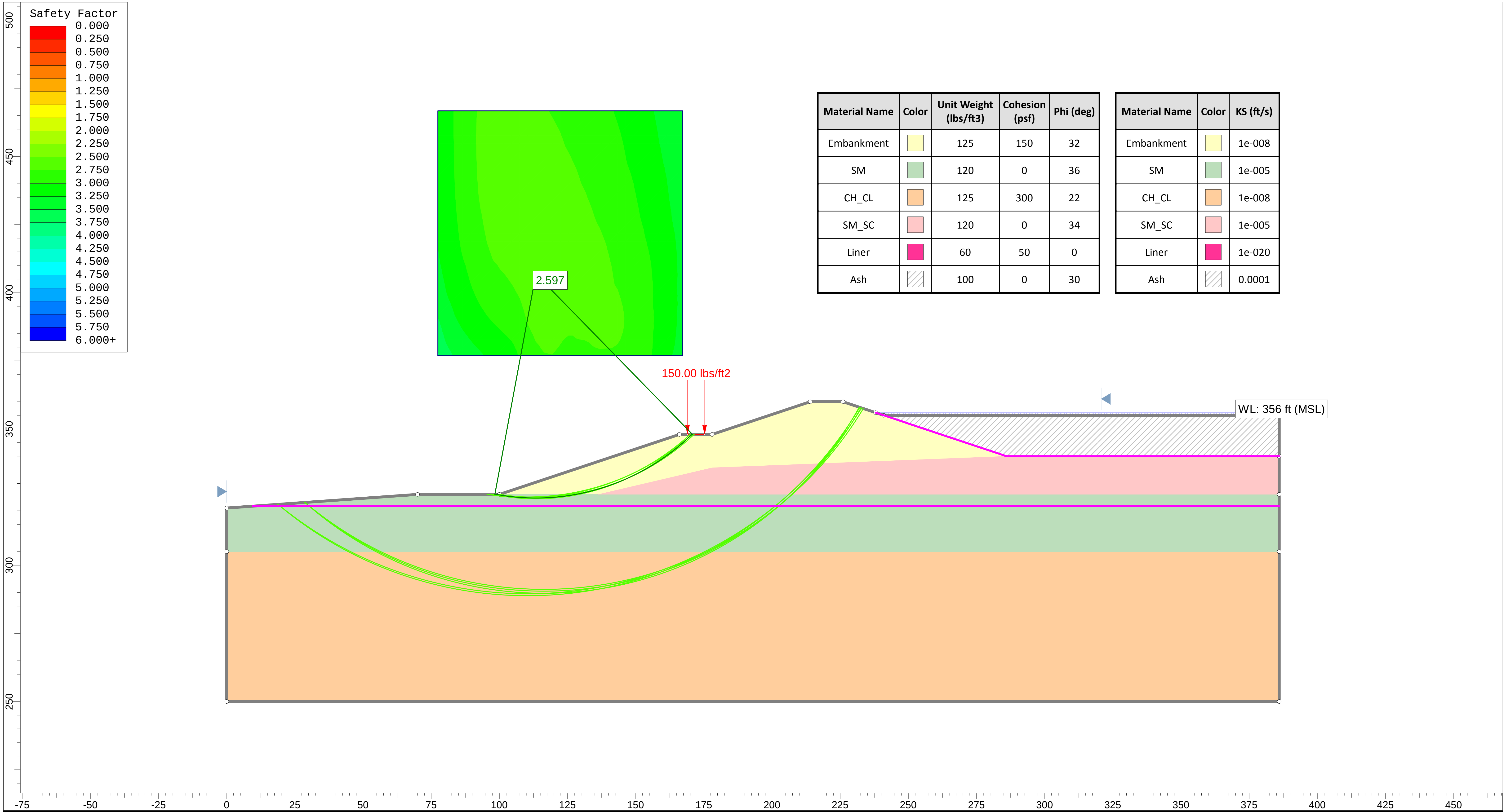
Provided by USGS National Seismic Hazard Mapping Project.

Seismic Probability Map

Scale: N/A

Auckland Project No. 2016-007

Welsh Power Plant
Initial Safety Factor Assessment - Bottom Ash Pond
Pittsburg, Texas



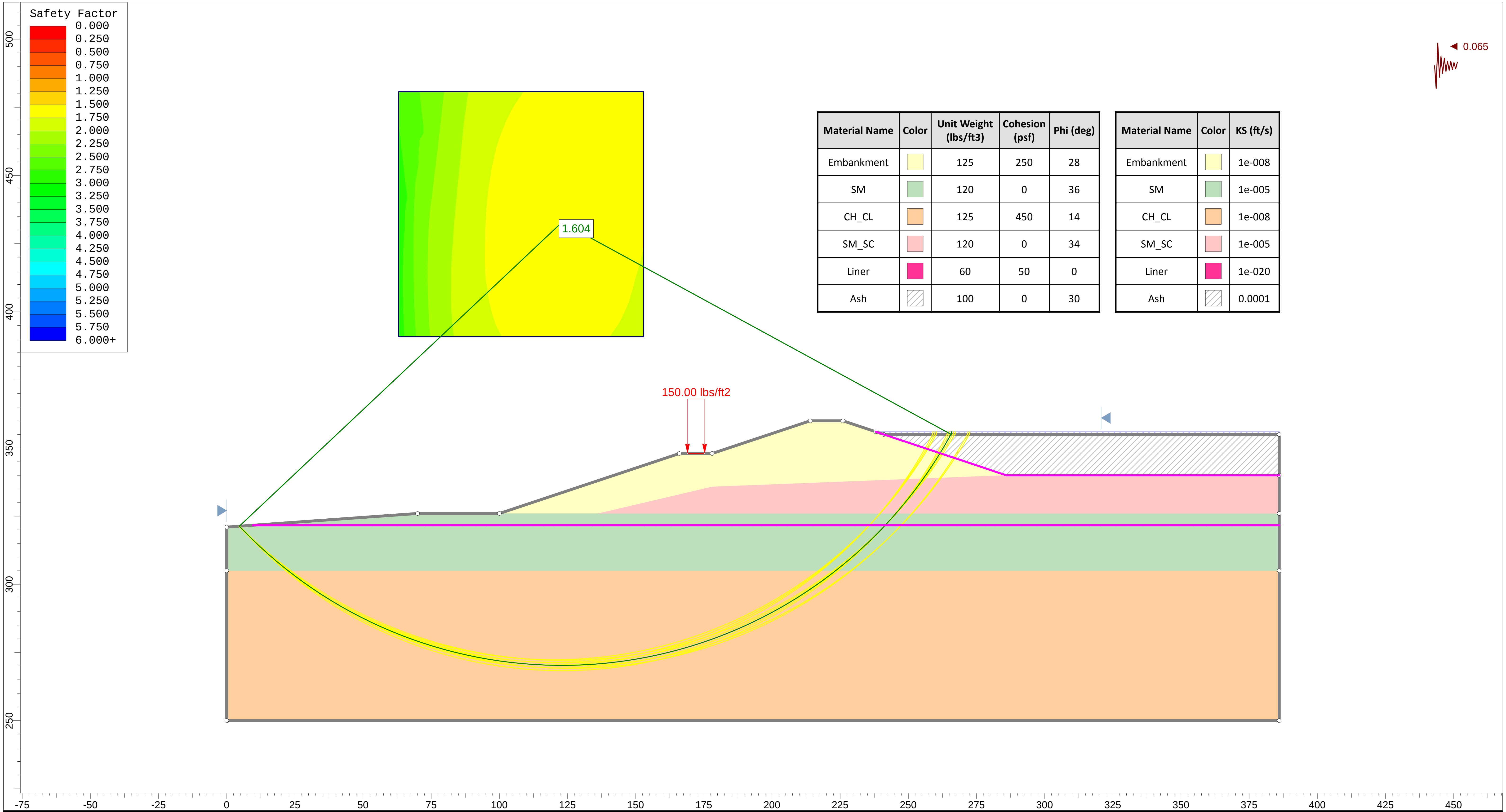
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	150	32
SM	🟩	120	0	36
CH_CL	🟧	125	300	22
SM_SC	🟥	120	0	34
Liner	🟪	60	50	0
Ash	▨	100	0	30

Material Name	Color	KS (ft/s)
Embankment	🟨	1e-008
SM	🟩	1e-005
CH_CL	🟧	1e-008
SM_SC	🟥	1e-005
Liner	🟪	1e-020
Ash	▨	0.0001

Auckland Consulting LLC

Project	Welsh Power Station - Bottom Ash Pond		
Analysis Description	Steady State Seepage at Maximum and Surcharge Pool		
Drawn By	JJT	*Company*	Auckland
Date	7/11/2016, 3:30:13 PM	*File Name*	Winston_SS.slim

SLIDEINTERPRET 6.036



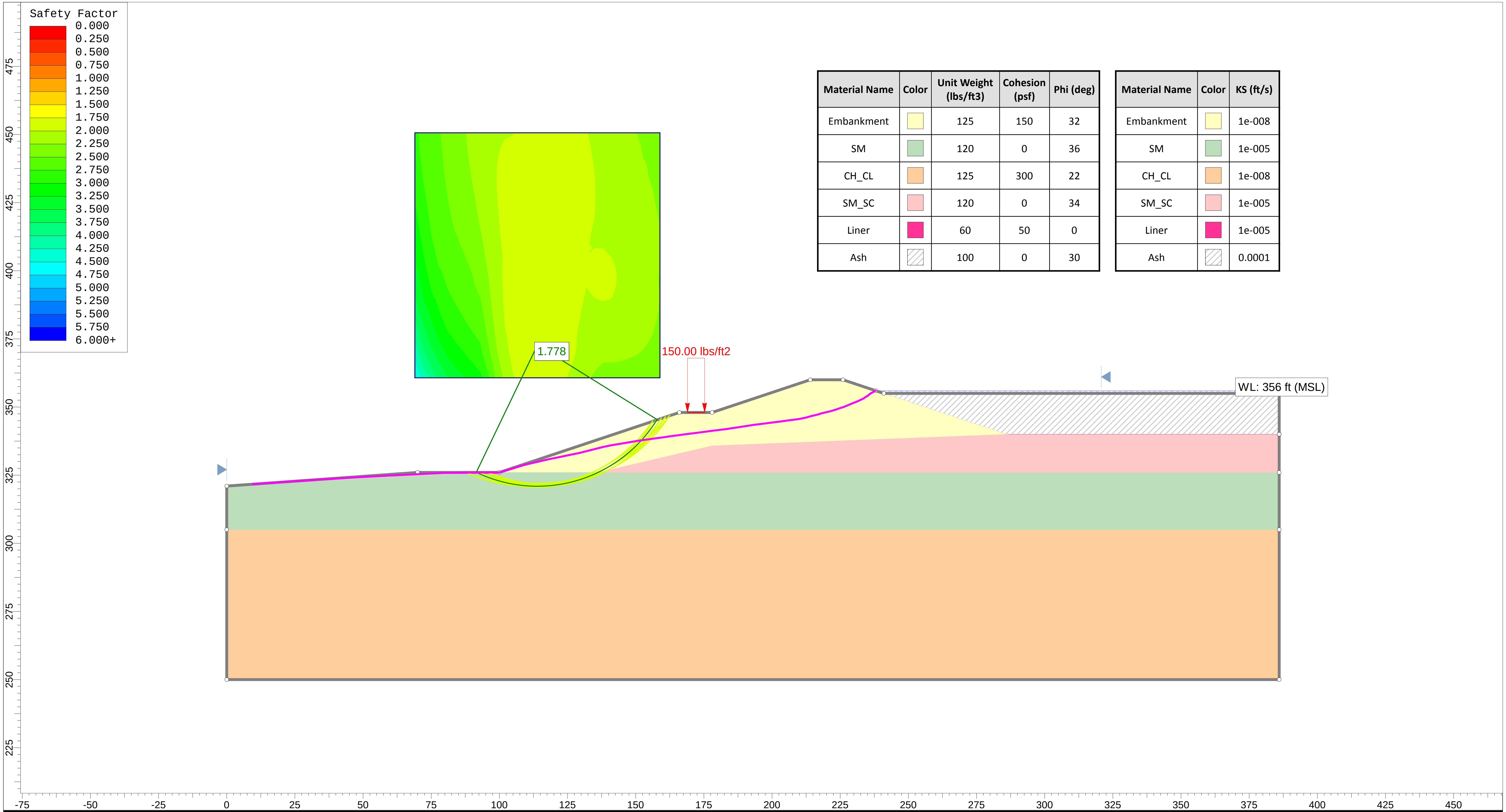
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	250	28
SM	🟩	120	0	36
CH_CL	🟧	125	450	14
SM_SC	🟥	120	0	34
Liner	🟪	60	50	0
Ash	▨	100	0	30

Material Name	Color	KS (ft/s)
Embankment	🟨	1e-008
SM	🟩	1e-005
CH_CL	🟧	1e-008
SM_SC	🟥	1e-005
Liner	🟪	1e-020
Ash	▨	0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project	Welsh Power Station - Bottom Ash Pond
Analysis Description	Steady State Seepage at Maximum and Surcharge Pool, Seismic Analysis
Drawn By	JJT
Company	Auckland
Date	7/11/2016, 3:30:13 PM
File Name	Winston_SSS.slim



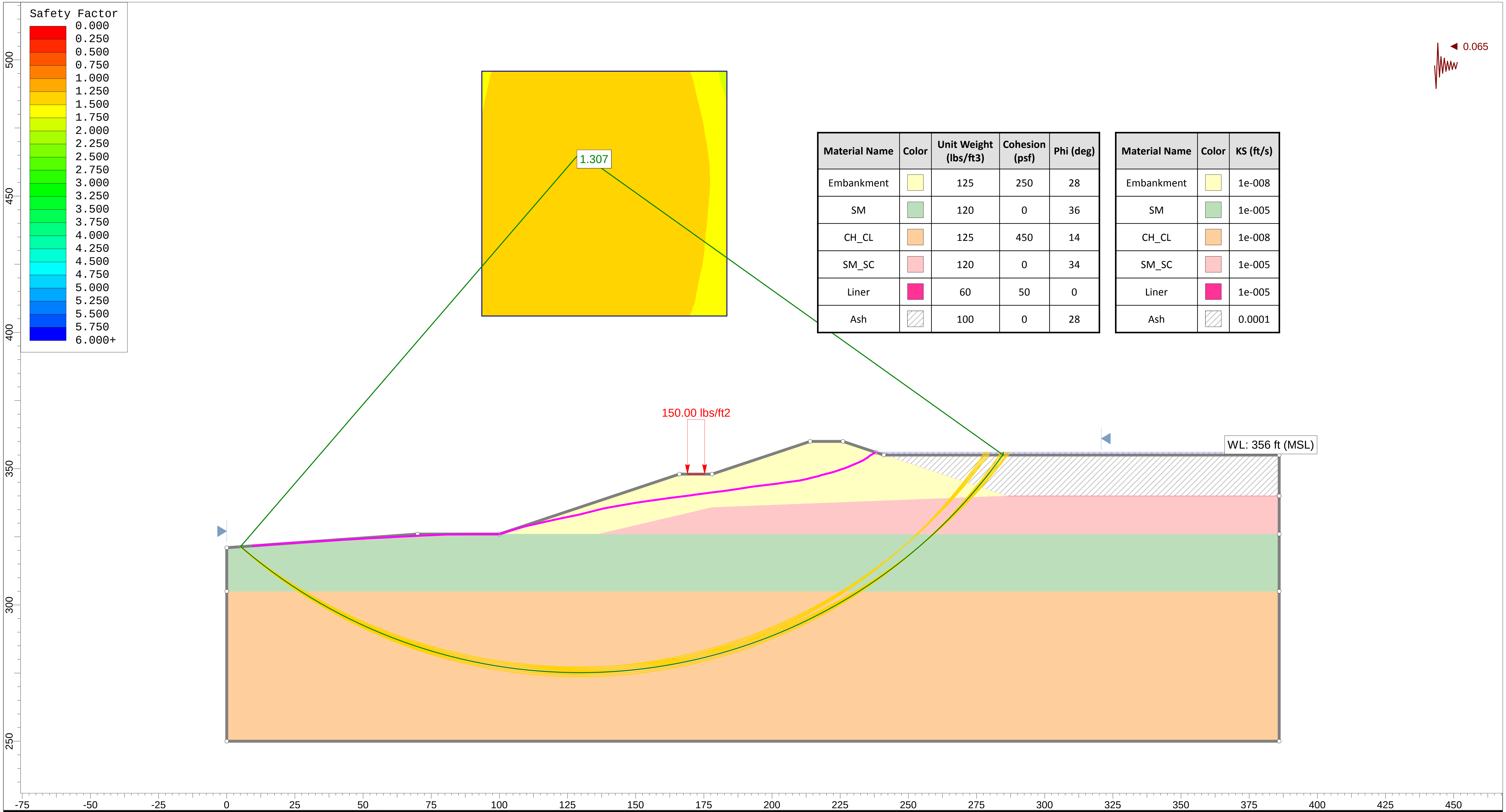
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	150	32
SM	🟩	120	0	36
CH_CL	🟧	125	300	22
SM_SC	🟥	120	0	34
Liner	🟪	60	50	0
Ash	▨	100	0	30

Material Name	Color	KS (ft/s)
Embankment	🟨	1e-008
SM	🟩	1e-005
CH_CL	🟧	1e-008
SM_SC	🟥	1e-005
Liner	🟪	1e-005
Ash	▨	0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project	Welsh Power Station - Bottom Ash Pond		
Analysis Description	Steady State Seepage at Maximum and Surcharge Pool (assumed phreatic surface)		
Drawn By	JJT	*Company*	Auckland
Date	7/11/2016, 3:30:13 PM	*File Name*	Winston_SS_L.slim



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	250	28
SM	🟩	120	0	36
CH_CL	🟧	125	450	14
SM_SC	🟥	120	0	34
Liner	🟪	60	50	0
Ash	▨	100	0	28

Material Name	Color	KS (ft/s)
Embankment	🟨	1e-008
SM	🟩	1e-005
CH_CL	🟧	1e-008
SM_SC	🟥	1e-005
Liner	🟪	1e-005
Ash	▨	0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project	Welsh Power Station - Bottom Ash Pond		
Analysis Description	Steady State Seepage at Maximum and Surcharge Pool, Seismic Analysis (assumed phreatic surface)		
Drawn By	JJT	*Company*	Auckland
Date	7/11/2016, 3:30:13 PM	*File Name*	Winston_SSS_L.slim

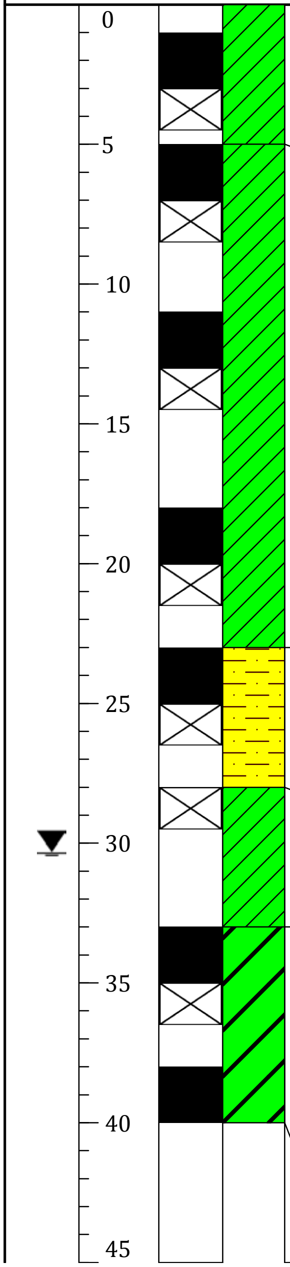
Auckland Consulting LLC

LOG OF BORING B2

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease

Project No.: 2016-007
Drill Date(s): 05/19/2016

GPS Coordinates: N33° 02' 38.1" W94° 50' 42.3"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Very Stiff, light gray, red and tan, Sandy Lean Clay (CL), mottled, interbedded sand seams		4.0		57	23	35	18	17	
- medium stiff, mottled	8								
Stiff, tan with gray and red, Sandy Lean Clay (CL), mottled	14	N/A		64	23	34	22	12	
- very stiff, between 11 to 18 ft	15	3.0	2.5	61	16	36	17	19	114
- hard, between 18 to 20 ft		4.5+							114
- stiff, below 20 ft	15			66	18	38	19	19	
Medium Dense, light gray with tan, Silt with Sand (ML), with few clay	19	N/A		73	17				
- medium stiff									
Hard, light gray with tan, Lean Clay (CL), interbedded sand seams	40								
Very Stiff, light gray with tan, Fat Clay (CH), interbedded sand seams	18	3.0		98	30	63	31	32	92
- dark gray, tan and red, with sand inclusions and ferrous partings below 38 ft		3.0							
Boring terminated at 40 feet.									

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 30 ft during drilling. Water level at 30 feet upon completion. Boring caved to 32 feet. N/A: Not Attempted

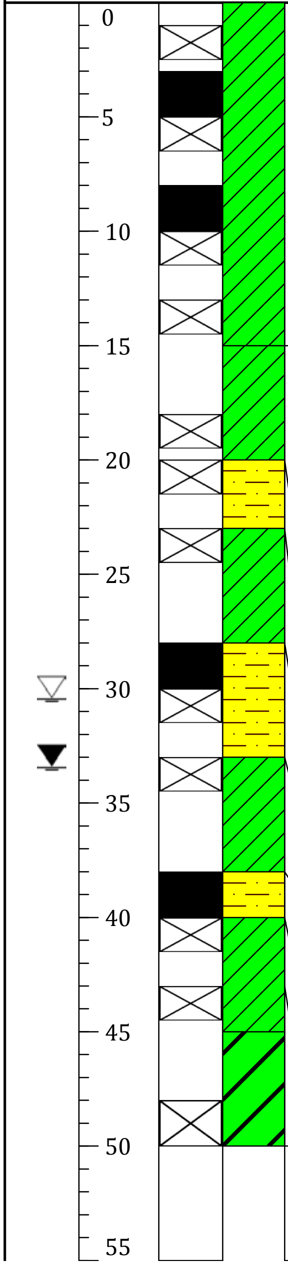
Auckland Consulting LLC

LOG OF BORING B3

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease

Project No.: 2016-007
Drill Date(s): 05/18/2016

GPS Coordinates: N33° 02' 39.2" W94° 50' 38.1"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Stiff, red, tan and gray, Sandy Lean Clay (CL), mottled	9								
		3.0		59	17	33	16	17	113
- with interbedded sand seams	13								
		1.5		67	18	39	21	18	111
- very stiff, tan, gray with red below 10 ft	18								
	16								
Very Stiff, red, brown, tan with gray, Lean Clay with Sand (CL), mottled, with interbedded sand seams		4.0	2.2	71	18	42	20	22	109
- clay with silt and organics (wood debris) at 18 ft	26			61	13				
	30			70	19				
Medium Dense, gray, Sandy Silt (ML), few organics (wood debris), few clay inclusions									
Very Stiff, tan, red and gray, Sandy Lean Clay (CL), mottled with silt		N/A		52	12	29	21	8	
	16								
Medium Dense, light gray and red, Sandy Silt (ML), mottled, few clay inclusions	19			91	29	36	24	12	
Very Stiff, tan, orange and red, Lean Clay (CL), mottled, laminated									
		N/A							
Light gray, tan and red, Sandy Silt (ML), mottled, few clay inclusions	35			70	24				
Hard, tan, gray with orange, Sandy Lean Clay (CL) with trace silt, mottled, laminated	34								
Very Stiff, gray, Fat Clay (CH), laminated	29			98	27	53	25	28	
Boring terminated at 50 feet.									

Additional Information/Comments:

Logger: R. Pierson

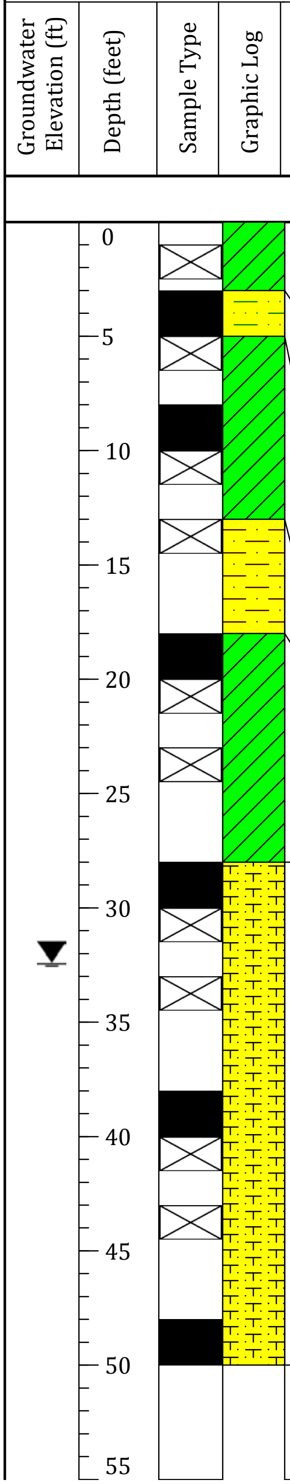
Notes/Comments: Seepage encountered at 30 ft during drilling. Water level at 33 feet upon completion. Boring caved to 40 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B4

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 06/08/2016

GPS Coordinates: N33° 02' 43.1" W94° 50' 37.1"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Stiff, red, brown with gray, Sandy Lean Clay (CL), mottled	9			63	14	38	18	20	
		3.5		44	19	42	25	17	109
Medium Dense, light gray, red and brown, Clayey Sand (SC), mottled, laminated	15								
Very Stiff, light gray, tan and brown, Sandy Lean Clay (CL), mottled, slickensided		3.5		66	16	33	20	13	
	12								
- stiff, light gray, red and tan, with silt and sand seams below 10 ft	13			62	18				
Medium Dense, light gray and brown, Sandy Silt (ML), mottled, few clay inclusions									
		3.0		55	17	38	20	18	
Very Stiff, brown, gray and red, Sandy Lean Clay (CL), mottled	18								
	10								
- stiff below 23 ft									
Dense, brown, light gray and red, Silty Sand (SM)		N/A		43	16	NP	NP	NP	
	37								
- brown with red, some clay between 30 to 33 ft	46			30	30	NP	NP	NP	
- very dense, light gray with tan below 33 ft									
		N/A							116
	48								
	48								
		N/A		26	19	NP	NP	NP	
Boring terminated at 50 feet.									

Additional Information/Comments:

Logger: R. Pierson

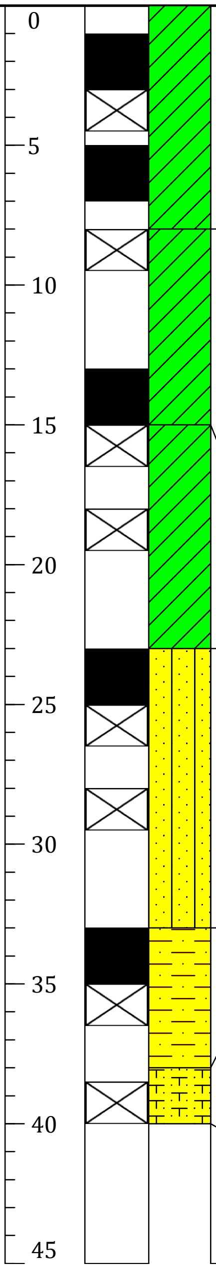
Notes/Comments: Seepage encountered at 32 ft during drilling. Water level at 32 feet upon completion. Boring caved to 40 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B5

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 06/08/2016

GPS Coordinates: N33° 02' 45.0" W94° 50' 33.4"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger



Groundwater Elevation (ft)	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	Stiff, red, gray and brown, Sandy Lean Clay (CL), mottled		2.0		54	20	40	18	22	
		11								
	- very stiff with sand lenses below 5 ft		2.5		60	17	44	20	24	119
	Very Stiff, light gray and brown, Lean Clay with Sand (CL), mottled	16								
	- stiff with sand and organics (root and wood debris) below 13 ft		2.0		79	18	35	17	18	110
		23			62	12	30	16	14	
	Very Stiff, light brown with gray, Sandy Lean Clay (CL), with few organics (root debris)	6								
	- medium stiff, silt with sand below 18 ft									
	Medium Dense, light brown, tan with gray, Silty Clayey Sand (SC-SM), mottled, with organics (root debris) between 23 to 25 ft		N/A		47	10	31	23	8	
		26								
	- very dense below 28 ft	34			44	20				
▼										
	Very Dense, light gray with tan, Silt (ML)		N/A		91	27	NP	NP	NP	96
	- sandy silt below 35 ft	68								
	Very Dense, light gray with tan, Silty Sand (SM)	96			21	28				
	Boring terminated at 40 feet.									

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 33 ft during drilling. Water level at 33 feet upon completion. Boring caved to 38 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B6

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 05/17/2016

GPS Coordinates: N33° 02' 43.0" W94° 50' 34.1"
Surface Elevation: 332 ft, MSL (approx)
Drilling Method: Dry Auger

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0	☒	Medium Dense, red, tan and brown, Silt with Sand (ML), mottled	16								
		☒	- with gray	23			73	19	NP	NP	NP	
▼	5	■	Medium Dense, tan, gray and brown, Silty Sand (SM), mottled		N/A							
▽		☒	- tan and gray below 8 ft	24			45	26	NP	NP	NP	
	10											
		☒	- very dense between 13 and 30 ft	57								
	15											
		☒		51			47	27				
	20											
		☒	- few clay inclusions below 23 ft	73								
	25											
		■			N/A		36	29	NP	NP	NP	122
	30	☒	- dense with few clay inclusions between 30 and 33 ft	34								
		☒	- very dense below 33 ft	79								
	35											
		☒	Medium Dense, dark gray, tan and red, Clayey Sand (SC), few silt, trace gypsum	27			39	25	47	21	26	
	40		Boring terminated at 40 feet.									
	45											

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 8 ft during drilling. Water level at 6 feet upon completion. Boring caved to 15 feet. N/A: Not Attempted

Auckland Consulting LLC

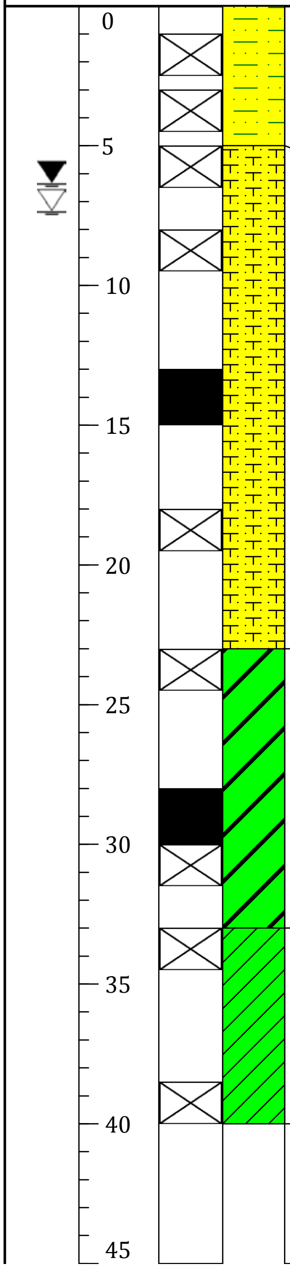
LOG OF BORING B7

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease

Project No.: 2016-007
Drill Date(s): 05/17/2016

GPS Coordinates: N33° 02' 40.8" W94° 50' 36.5"
Surface Elevation: 328 ft, MSL (approx)
Drilling Method: Dry Auger

Groundwater Elevation (ft) | Depth (feet) | Sample Type | Graphic Log



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Loose, red, brown and tan, Clayey Sand (SC), few organics	8								
- medium dense, gray and tan below 3 ft	26			40	22				
Dense, tan, gray and red, Silty Sand (SM)	32			31	24	NP	NP	NP	
	47								
- light gray with tan, with few clay inclusions between 13 and 18 ft		N/A		31	26	NP	NP	NP	100
- medium dense below 18 ft	30								
Medium Stiff, tan, orange and brown, Fat Clay (CH), laminated with gypsum	5			92	31	55	22	33	
		N/A							
- very stiff below 30 ft	29								
Hard, dark gray and gray, Lean Clay with Sand (CL), laminated with gypsum	57			73	23	33	18	15	
	36								
Boring terminated at 40 feet.									

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 7 ft during drilling. Water level at 6 feet upon completion. Boring caved to 35 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B8

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 05/18/2016

GPS Coordinates: N33° 02' 37.8" W94° 50' 38.0"
Surface Elevation: 338 ft, MSL (approx)
Drilling Method: Dry Auger

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0	☒	▨	Stiff, gray, red and tan, Sandy Lean Clay (CL), mottled	12								
		■	▨			4.5+	1.8	51	18	33	18	15	115
	5	☒	▨	- very stiff between 5 and 8 ft	22								
▽		☒	▨	- stiff, gray and light brown, mottled with interbedded sand seams below 8 ft	11			57	23				
	10		▨										
		☒	▨	Stiff, light brown and gray, Fat Clay (CH), laminated, few ferrous partings	13								
▼	15		▨										
		☒	▨	- very stiff, dark gray with brown, gypsum below 18 ft	28			60	25	58	32	26	
	20		▨										
		■	▨	- laminated with gypsum, interbedded sand seams below 23 ft		2.5							
	25	☒	▨		22								
		☒	▨		30			88	19	63	32	31	
	30		▨										
		☒	▨	- hard below 33 ft	38								
	35		▨										
		☒	▨		34			85	29				
	40			Boring terminated at 40 feet.									
	45												

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 8 ft during drilling. Water level at 16 feet upon completion. Boring caved to 26 feet. N/A: Not Attempted

Boring Log Terms and Symbols

Symbols and Sampler Types

■	Thin-walled Tube (Shelby Tube)
☒	Standard Penetration Test (SPT)
◩	Auger Sample
⧗	Texas Cone Penetration Test (TCP)
▼	Observed Static-Water Level
▽	Observed Free Water (Seepage)

Soil Consistency and Structure

Strength of Fine Grained Soils		
Consistency	**SPT (Blows/ft)**	**UCS (tsf)**
Very Soft	< 2	< 0.25
Soft	2 – 4	0.25 – 0.5
Medium Stiff	4 – 8	0.5 – 1.0
Stiff	8 – 15	1.0 – 2.0
Very Stiff	15 – 30	2.0 – 4.0
Hard	> 30	> 4.0

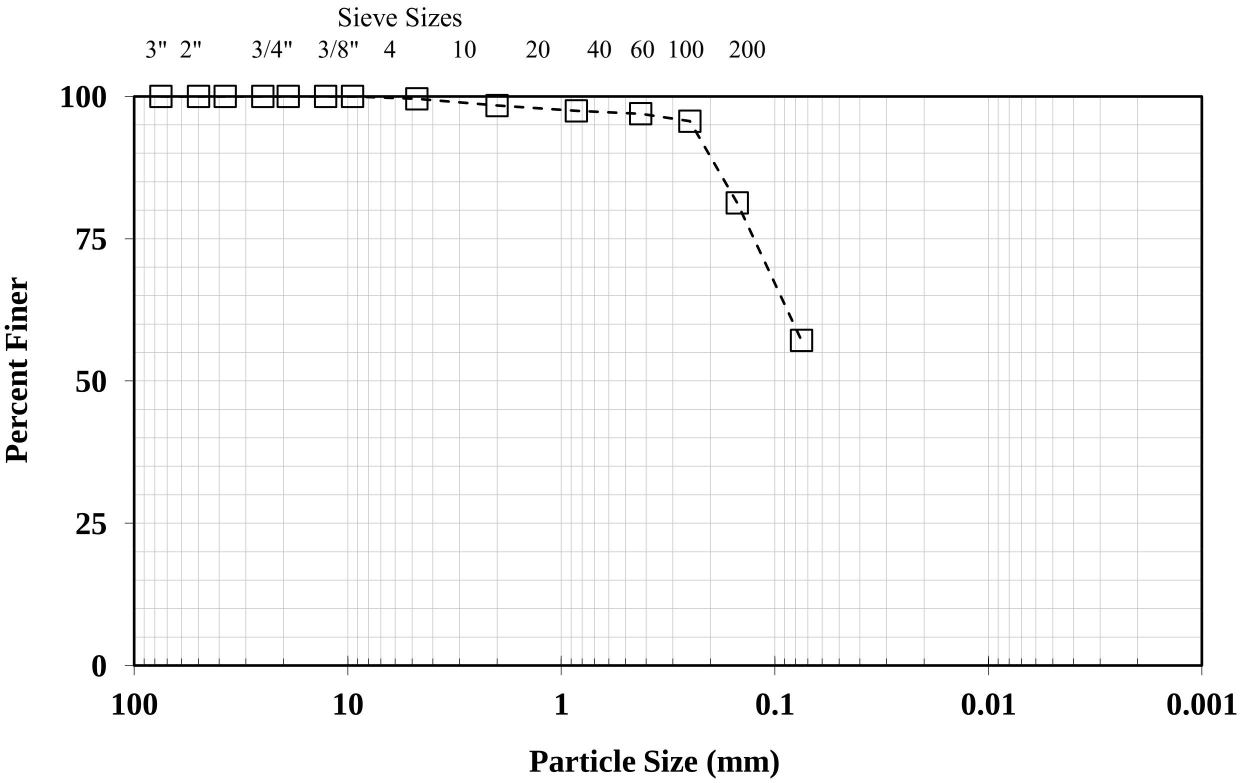
Density of Coarse Grained Soils		
Consistency	**SPT (Blows/ft)**	**TCP (Blows/ft)**
Very Loose	0 – 4	< 8
Loose	5 – 10	9 – 20
Medium Dense	11 – 30	21 – 60
Dense	31 – 50	61 -100
Very Dense	> 50	> 100

Soil Structure - Description	
Description	**Explanation**
Laminated	Alternating layers of varying material or color.
Slickensided	Fractured polished planes, little resistance to fracturing
Blocky	Cohesive soil that can be broken into small angular pieces.
Lensed	Inclusion of small pockets of different soils
Homogeneous	Same appearance and color throughout

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2 1-3

TRI Log#: 20888.1
Test Method: ASTM D422



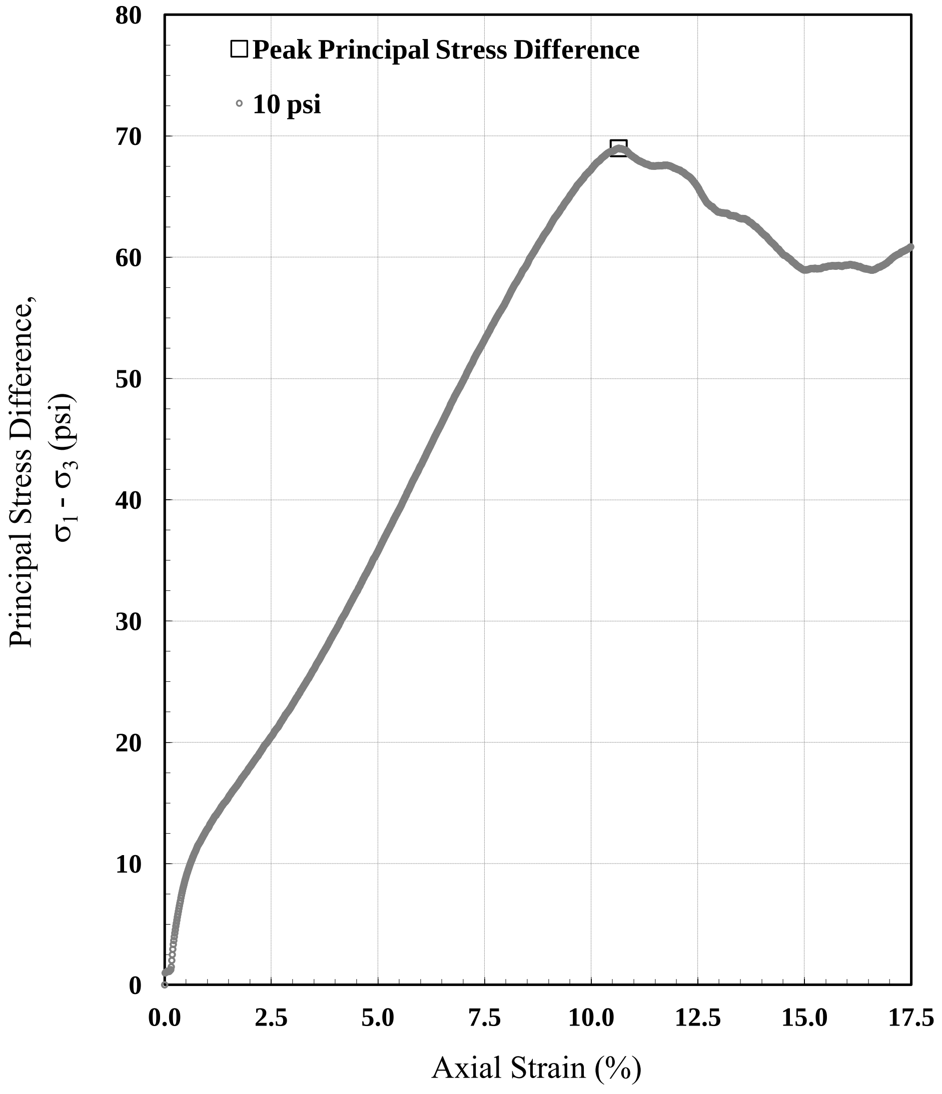
Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	99.6
No. 10 (2.00 mm)	98.4
No. 20 (0.841 mm)	97.5
No. 40 (0.420 mm)	97.0
No. 60 (0.250 mm)	95.6
No. 100 (0.149 mm)	81.3
No. 200 (0.074 mm)	57.1
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

USCS Classification (ASTM D2487)	Sandy lean clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	23.0
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	35
	Plastic Limit	18
	Plastic Index	17
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Unconsolidated-Undrained (Q) Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D2850
Sample:	B2: 11-13		



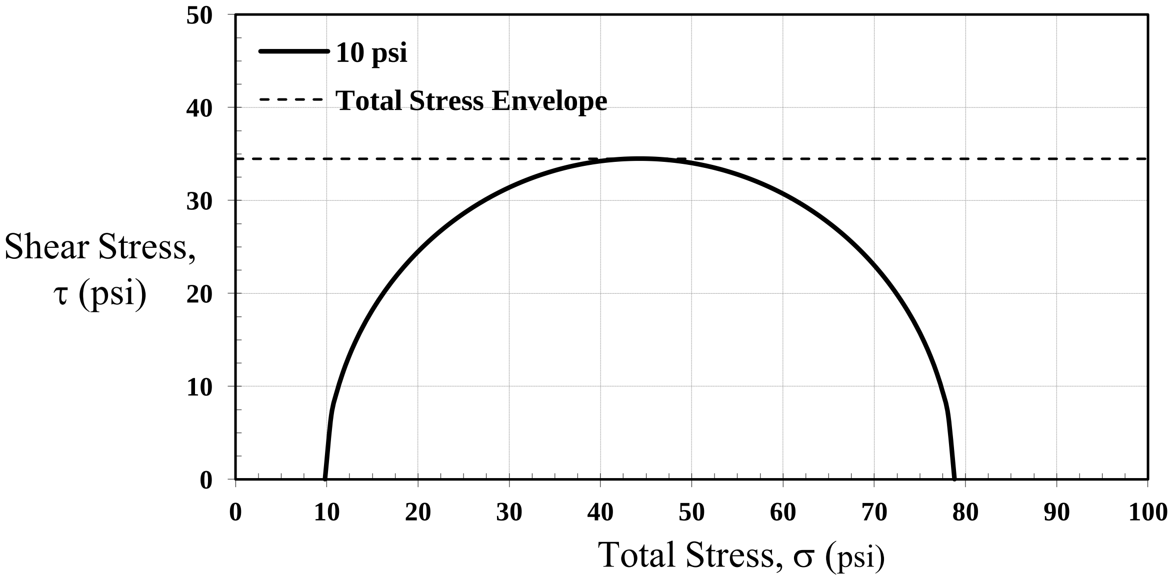
Test Parameters	
Minor Principal Stress (psi)	10.0
Rate of Strain (%/hr)	60

Initial Properties	
Avg. Diameter (in)	2.84
Avg. Height (in)	5.61
Avg. Water Content (%)	15.5
Bulk Density (pcf)	132.1
Dry Density (pcf)	114.4
Saturation (%)	92.0
Void Ratio	0.45
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	10.6
Minor Total Stress (psi)	10.0
Major Total Stress (psi)	79.0
Principal Stress Diff. (psi)	69.0

Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	34.5
S_u / σ_3	3.4

Note: The Mohr failure envelope was taken as a horizontal straight line. It should, however, be noted that the specimen was partially saturated.



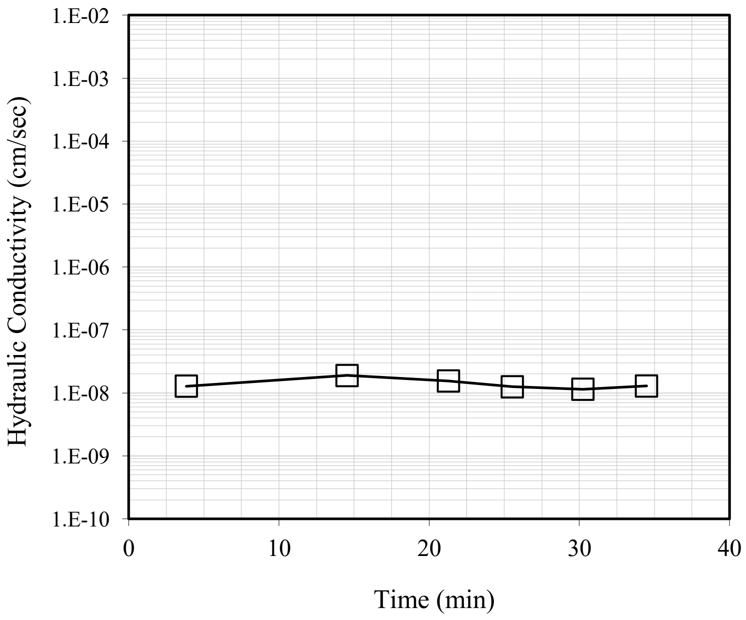
Jeffrey A. Kuhn , Ph.D., P.E., 6/30/2016
Analysis & Quality Review/Date
Laboratory Staff: LC

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

Hydraulic Conductivity

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D5084 Method F
Sample ID:	B2: 18-20		

Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.82
Height (in)	1.81
Initial Mass (g)	389.6
Sample Area (in^2)	6.25
Water Content (%)	15.5
Total Unit Weight (pcf)	131.4
Dry Unit Weight (pcf)	113.8
Specific Gravity (Assumed)	2.65
Degree of Saturation	90.4
Void Ratio	0.45
Porosity	0.31
1 Pore Volume (cc)	57.7
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.96



Specimen Image

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
21.3	1.5E-08
25.5	1.3E-08
30.2	1.1E-08
34.5	1.3E-08
Average, Last 2 Readings	**1.2E-08**

Note: Permeation measurements were made with a mercury U-tube.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016

Analysis & Quality Review/Date

Testing Performed By: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2: 33-35

TRI Log #: 20888
Test Method: ASTM D4767 Mod

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	14.2	28.3	42.5
Initial Specimen Properties			
Avg. Diameter (in)	2.05	2.05	2.05
Avg. Height (in)	4.33	4.33	4.33
Avg. Water Content (%)	30.8	-	-
Bulk Density (pcf)	119.7	119.7	119.7
Dry Density (pcf)	91.5	-	-
Saturation (%)	98.8	-	-
Void Ratio, n	0.84	0.84	0.84
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	79.7	80.0	80.2
B-Value, End of Saturation	0.96	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.82	0.82	0.82
Area (in^2)	3.28	3.28	3.28

Shear / Post-Shear			
Avg. Water Content (%)	-	-	29.7
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	1.0	1.5	1.9
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	5.6	11.9	20.5
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	15.8	25.5	34.0
Pore Water Pressure, Δu_f (psi)	-	-	-	9.8	17.2	22.6
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	21.4	37.4	54.5
Effective Friction Angle (degrees)	-			22.1		
Effective Cohesion (psi)	-			3.3		

R-Envelope, "Total" Stress		
Friction Angle (deg)	-	14.3
Cohesion (psi)	-	2.3

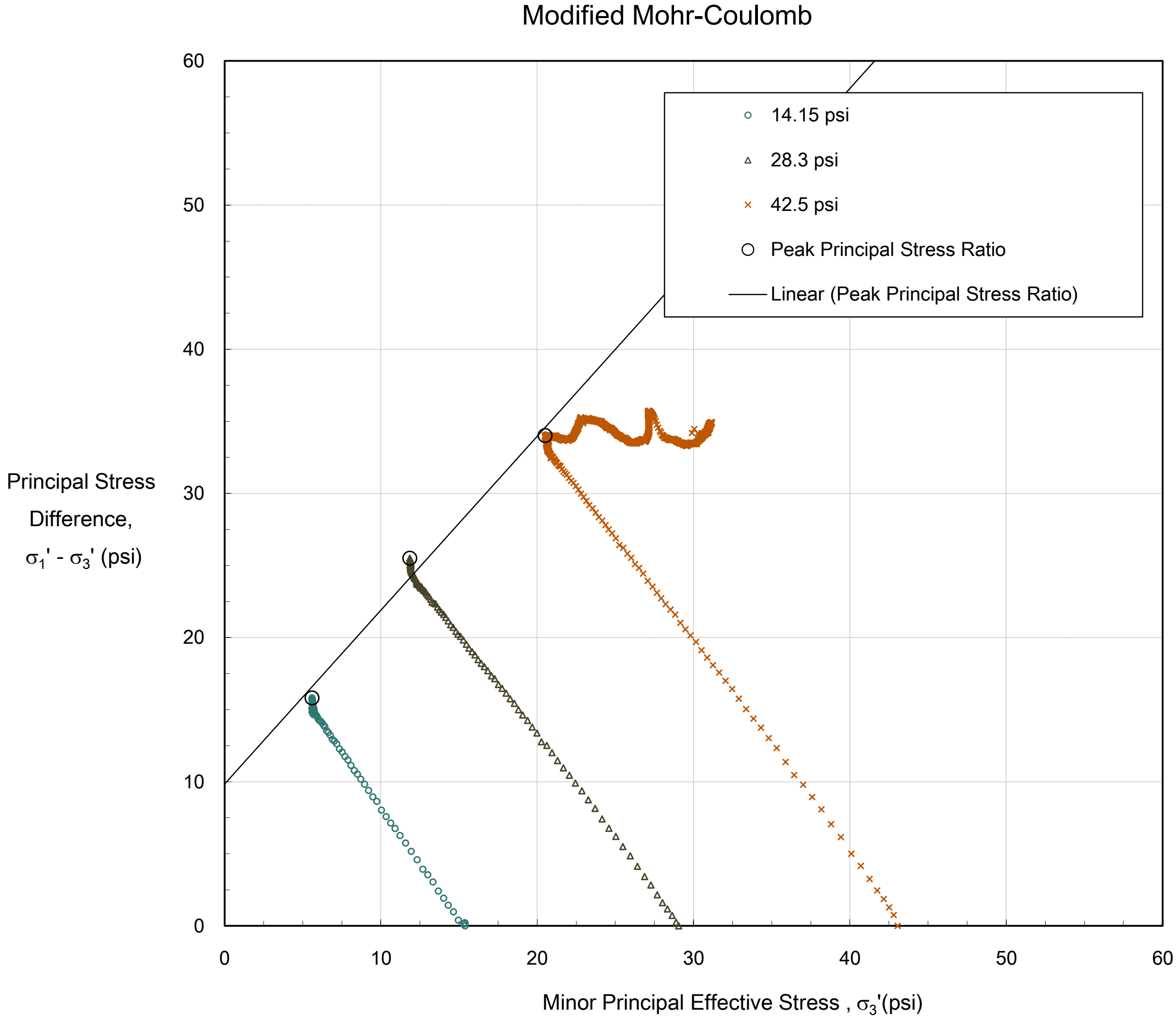
Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/12/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2: 33-35

TRI Log #: 20888
Test Method: ASTM D4767 Mod

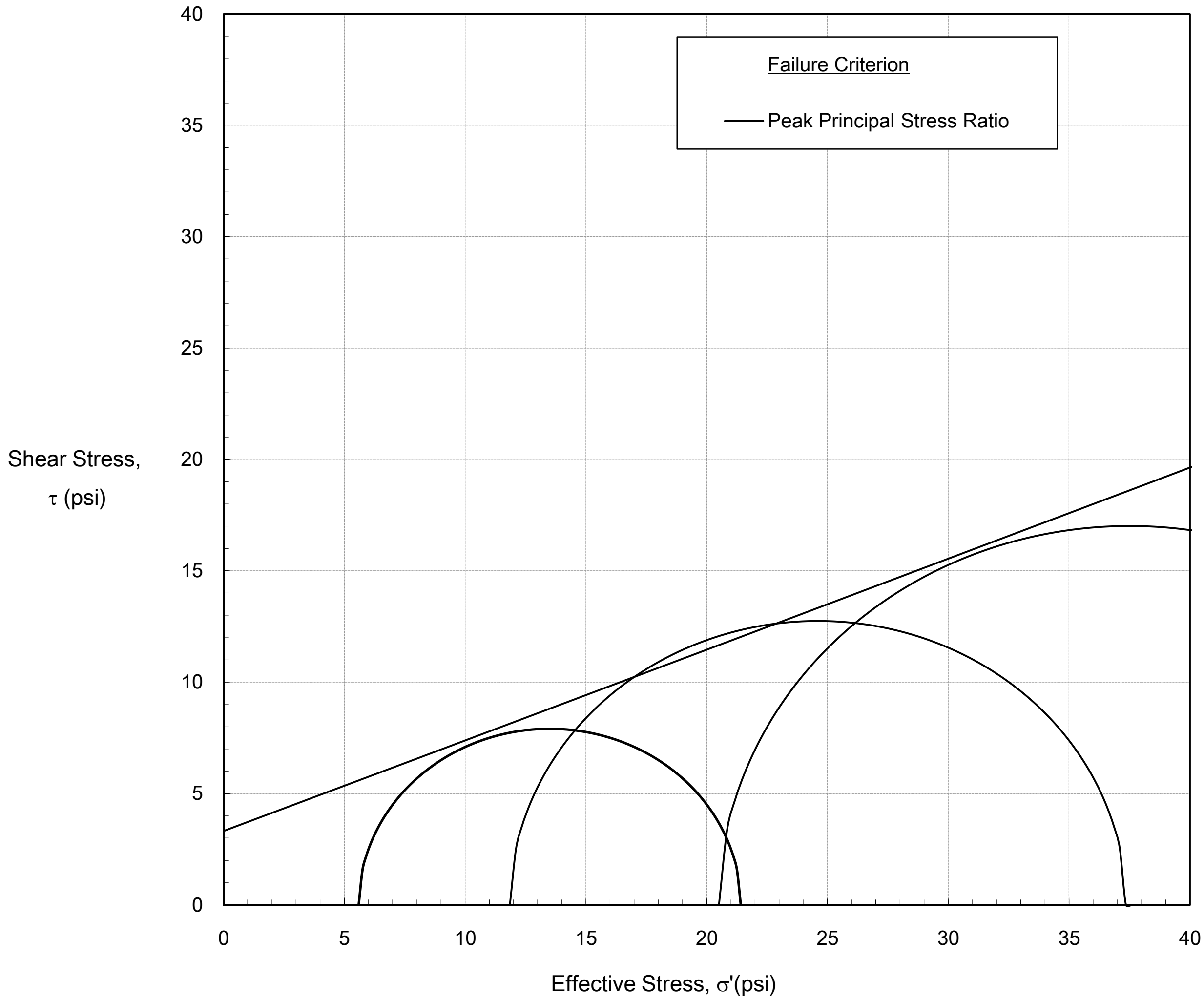


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	22.1
Effective Cohesion (psi)	-	3.3

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B2: 33-35		

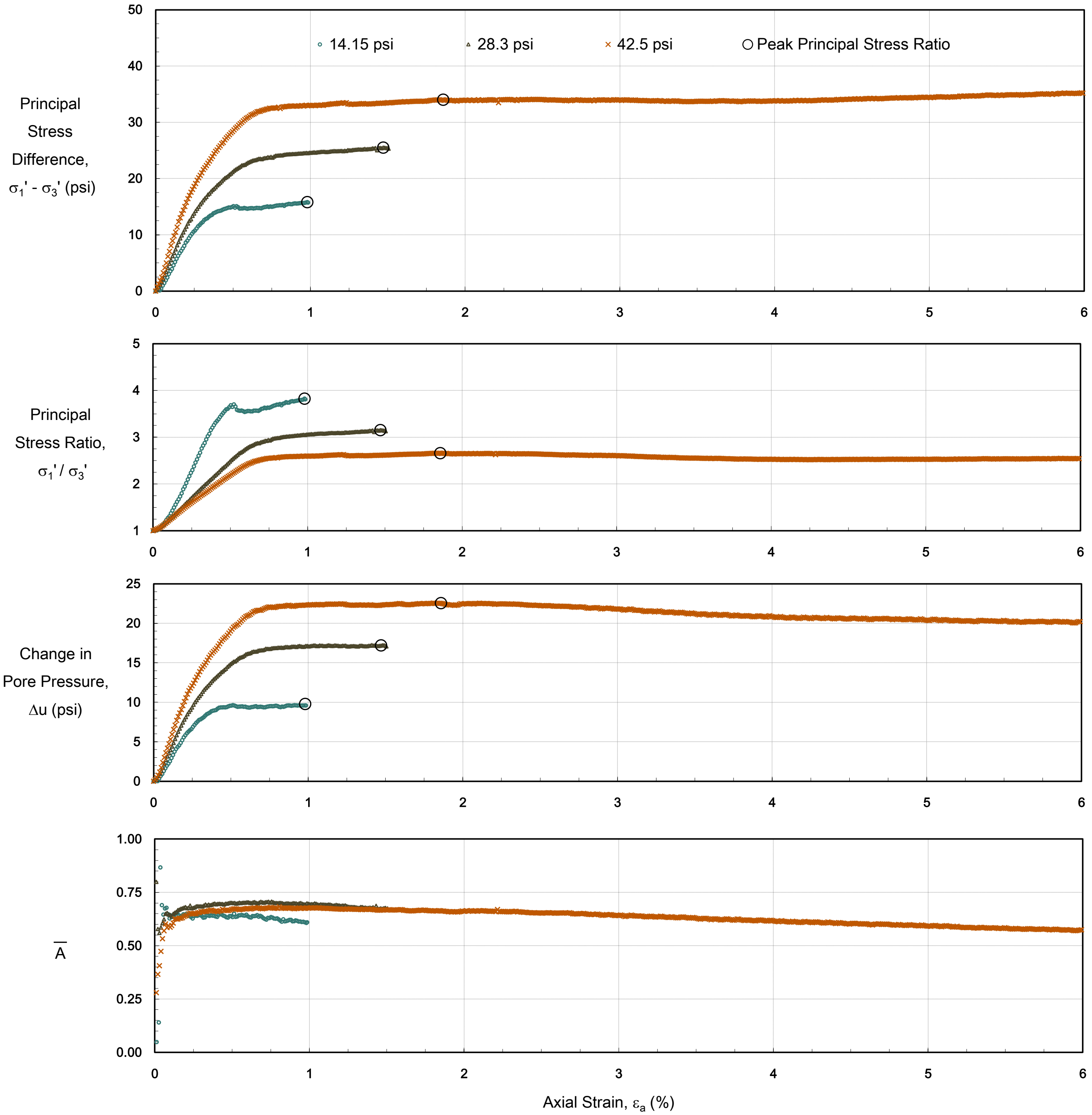
Mohr-Coulomb



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	22.1
Effective Cohesion (psi)	-	3.3

Multi-Stage Consolidated-Undrained Triaxial Compression

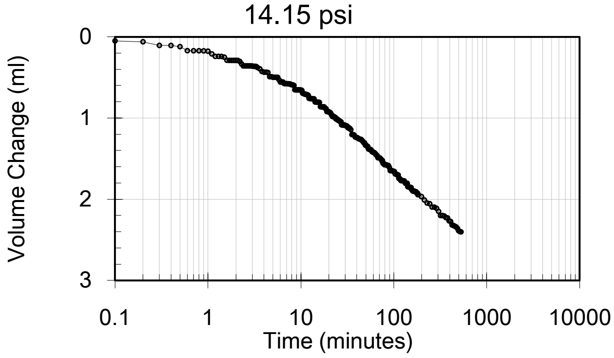
Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B2: 33-35		

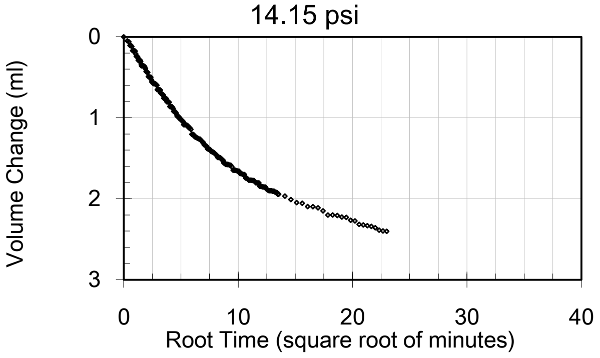


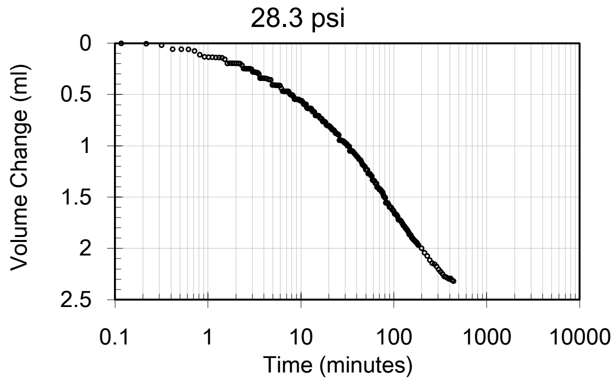
Multi-Stage Consolidated-Undrained Triaxial Compression

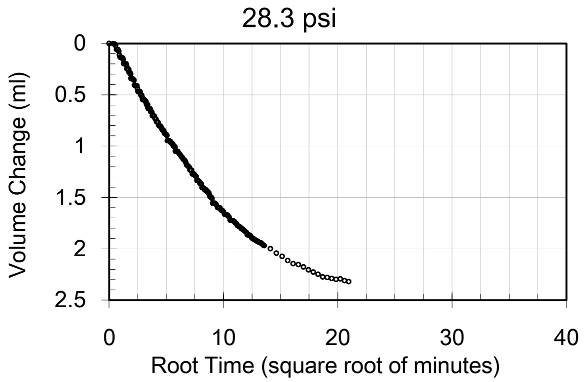
Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B2: 33-35		

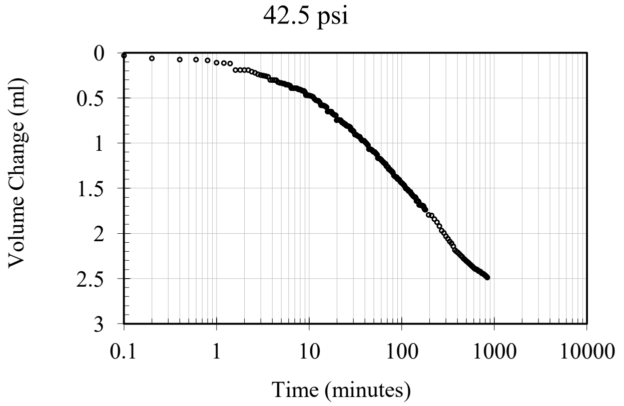
Consolidation

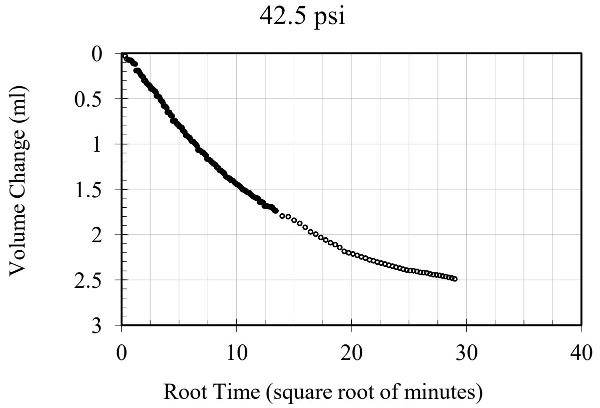












5 of 5

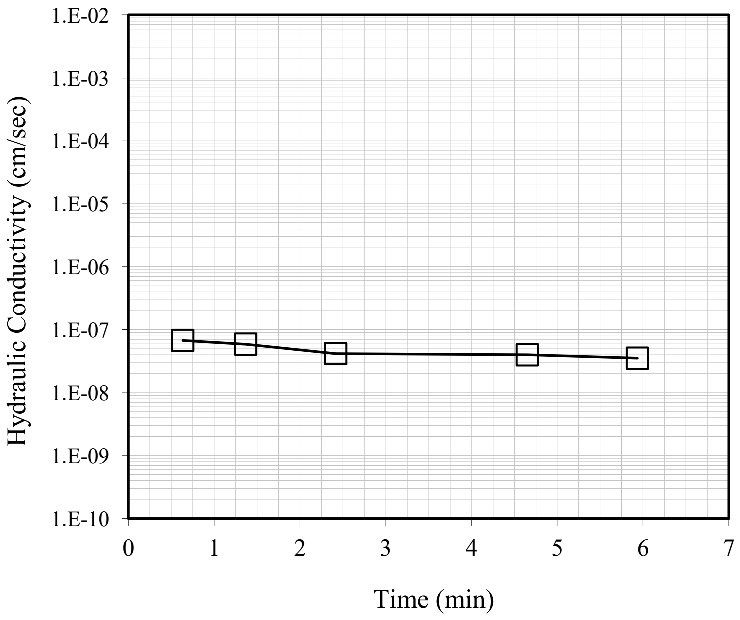
The testing herein is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Hydraulic Conductivity

Client: Auckland Consulting LLC
Project: Winston Pond
Sample ID: B3: 3-5

TRI Log #: 20888
Test Method: ASTM D5084 Method F



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.83
Height (in)	1.59
Initial Mass (g)	341.8
Sample Area (in^2)	6.28
Water Content (%)	15.9
Total Unit Weight (pcf)	130.4
Dry Unit Weight (pcf)	112.6
Specific Gravity (Assumed)	2.65
Degree of Saturation	89.6
Void Ratio	0.47
Porosity	0.32
1 Pore Volume (cc)	52.2
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.96

Specimen Image

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
1.4	5.9E-08
2.4	4.2E-08
4.6	4.0E-08
5.9	3.5E-08
Average, Last 2 Readings	**3.8E-08**

Note: Permeation measurements were made with a mercury U-tube.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Analysis & Quality Review/Date
Testing Performed By: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

TRI Log #: 20888
Test Method: ASTM D4767 Mod

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	3.8	7.5	15.0
Initial Specimen Properties			
Avg. Diameter (in)	2.05	2.05	2.05
Avg. Height (in)	4.46	4.46	4.46
Avg. Water Content (%)	17.8	-	-
Bulk Density (pcf)	130.1	130.1	130.1
Dry Density (pcf)	110.5	-	-
Saturation (%)	91.3	-	-
Void Ratio, n	0.53	0.53	0.53
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	81.1	81.1	81.1
B-Value, End of Saturation	1.00	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.51	0.51	0.51
Area (in^2)	3.27	3.27	3.26

Shear / Post-Shear			
Avg. Water Content (%)	-	-	19.9
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	1.0	0.8	2.7
Minor Effective Stress (psi), $\sigma_3'{}_f$	-	-	-	2.2	4.4	10.1
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	7.0	11.6	28.5
Pore Water Pressure, Δu_f (psi)	-	-	-	1.6	3.1	4.9
Major Effective Stress (psi), $\sigma_1'{}_f$	-	-	-	9.2	16.0	38.6
Effective Friction Angle (degrees)	-			35.1		
Effective Cohesion (psi)	-			0.1		

R-Envelope, "Total" Stress		
Friction Angle (deg)	-	28.5
Cohesion (psi)	-	0 (Forced)

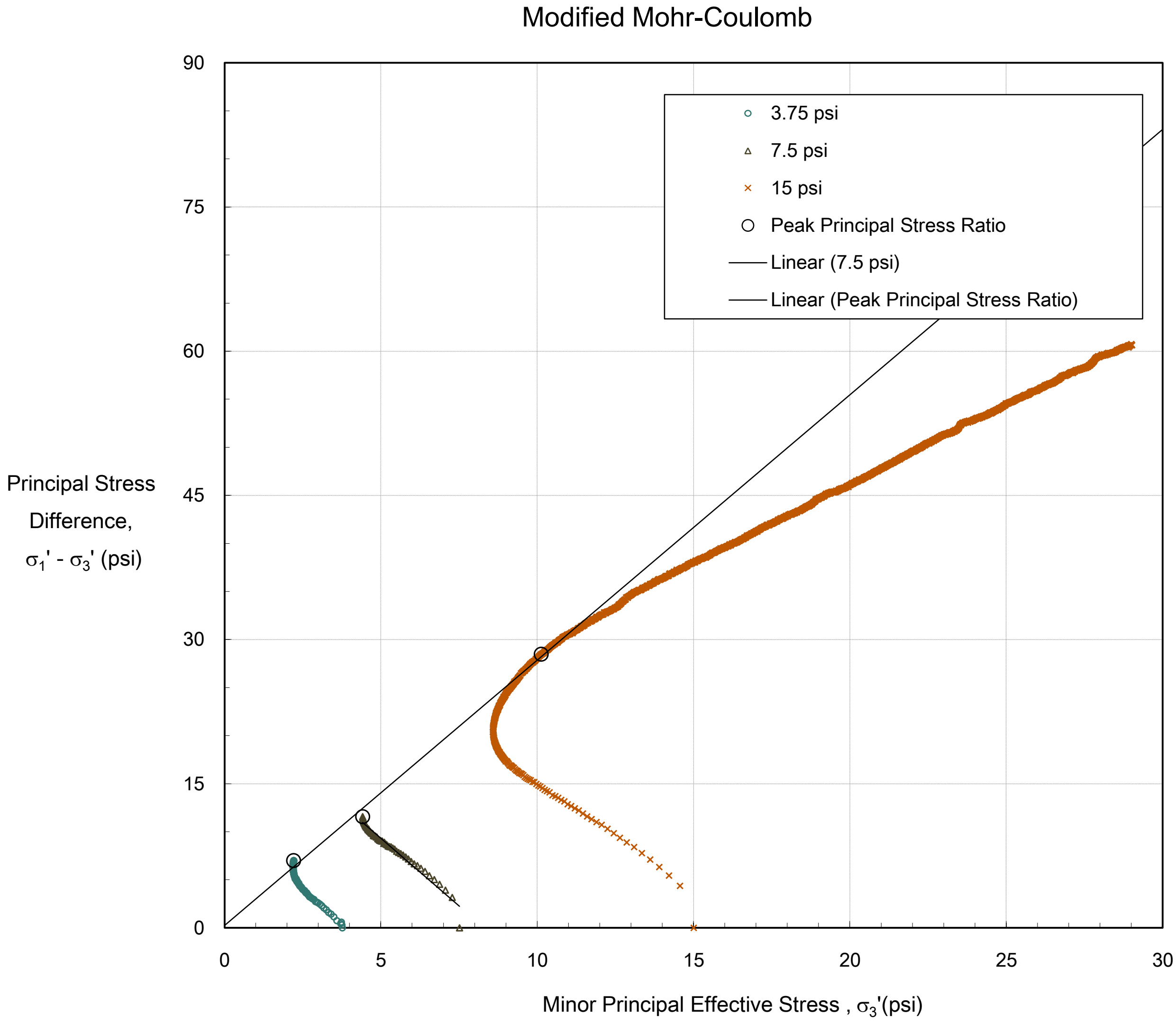
Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/13/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

TRI Log #: 20888
Test Method: ASTM D4767 Mod



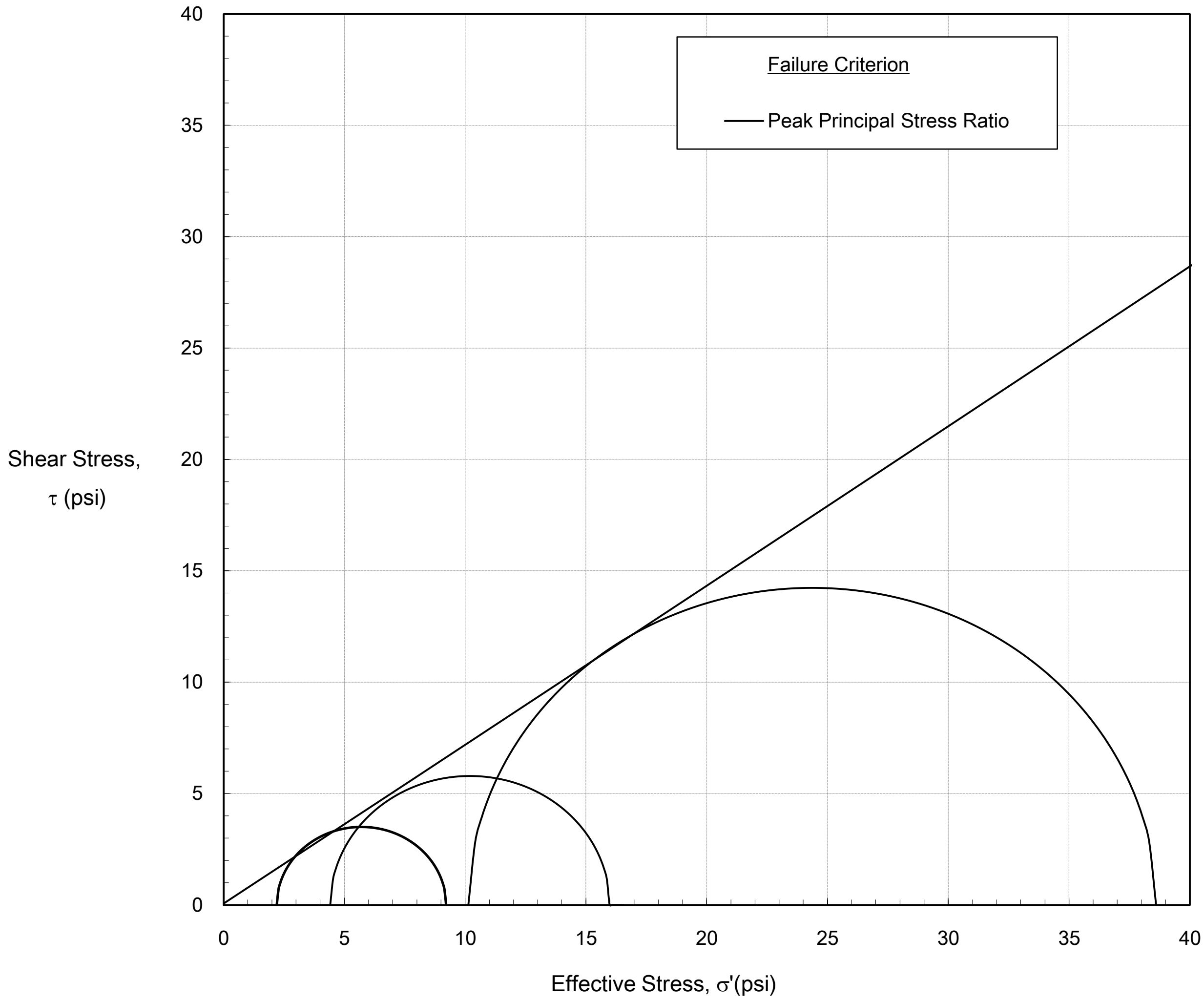
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	35.1
Effective Cohesion (psi)	-	0.1

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

TRI Log #: 20888
Test Method: ASTM D4767 Mod

Mohr-Coulomb

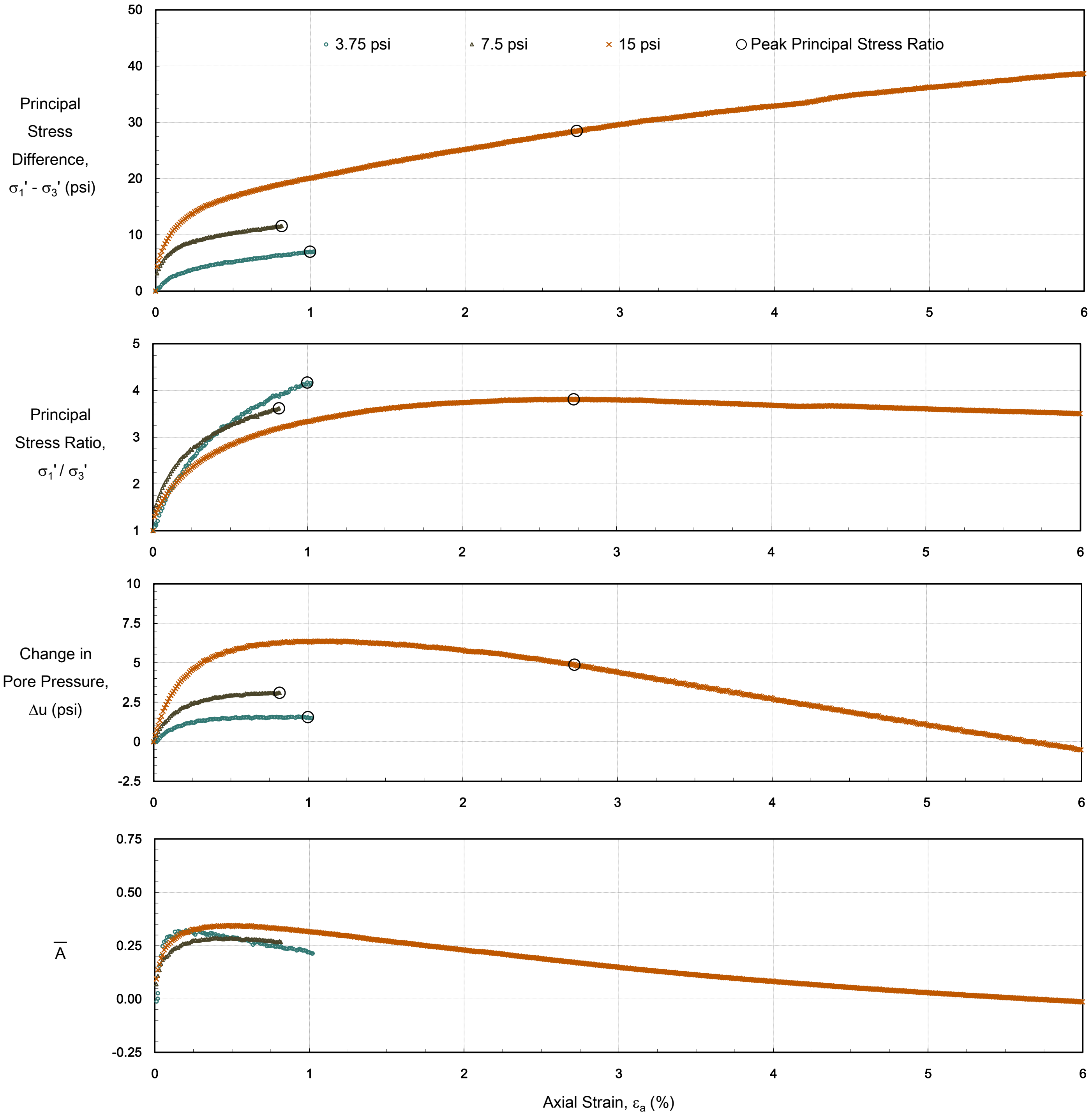


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	35.1
Effective Cohesion (psi)	-	0.1

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

TRI Log #: 20888
Test Method: ASTM D4767 Mod

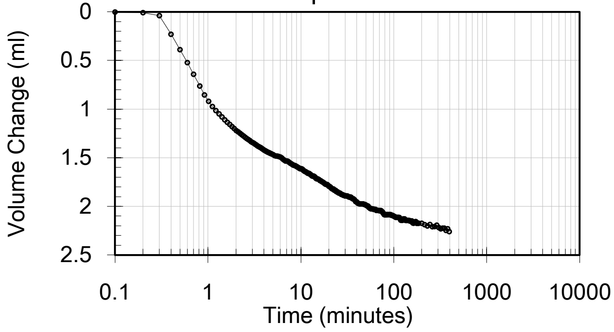


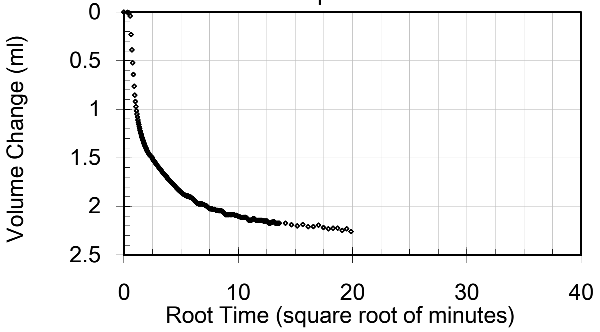
Multi-Stage Consolidated-Undrained Triaxial Compression

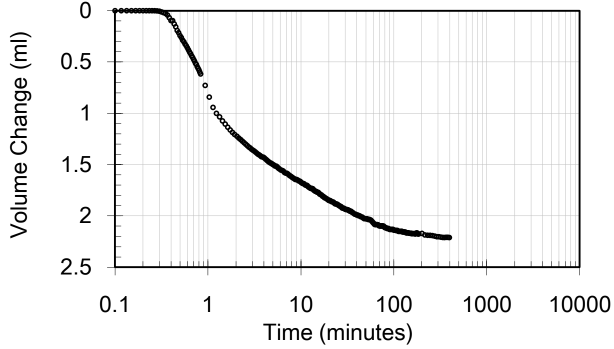
Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

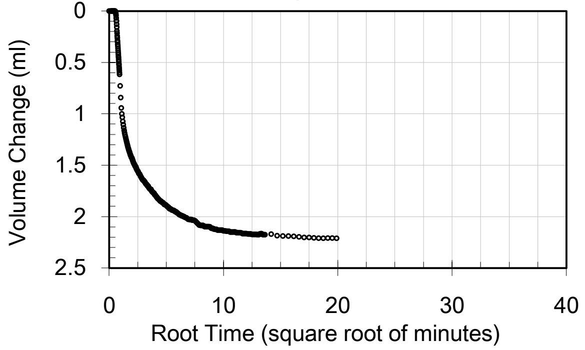
TRI Log #: 20888
Test Method: ASTM D4767 Mod

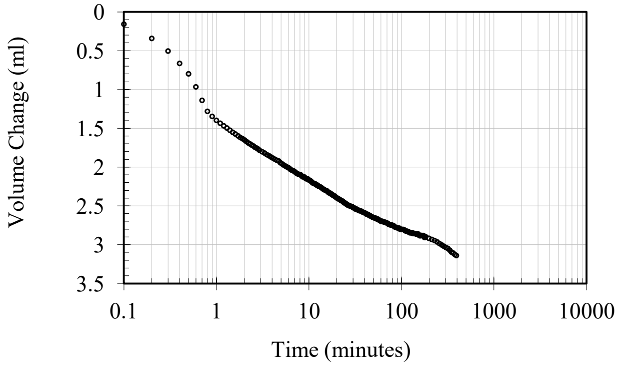
Consolidation

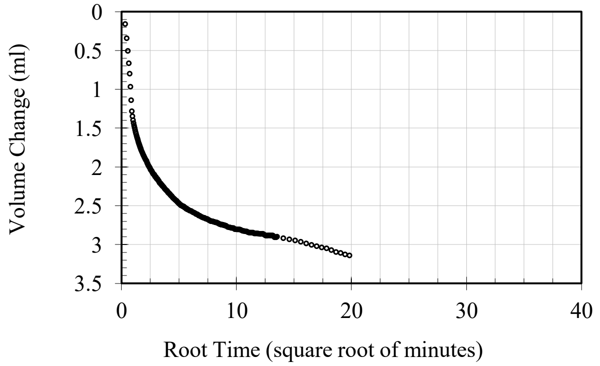

3.75 psi


3.75 psi


7.5 psi

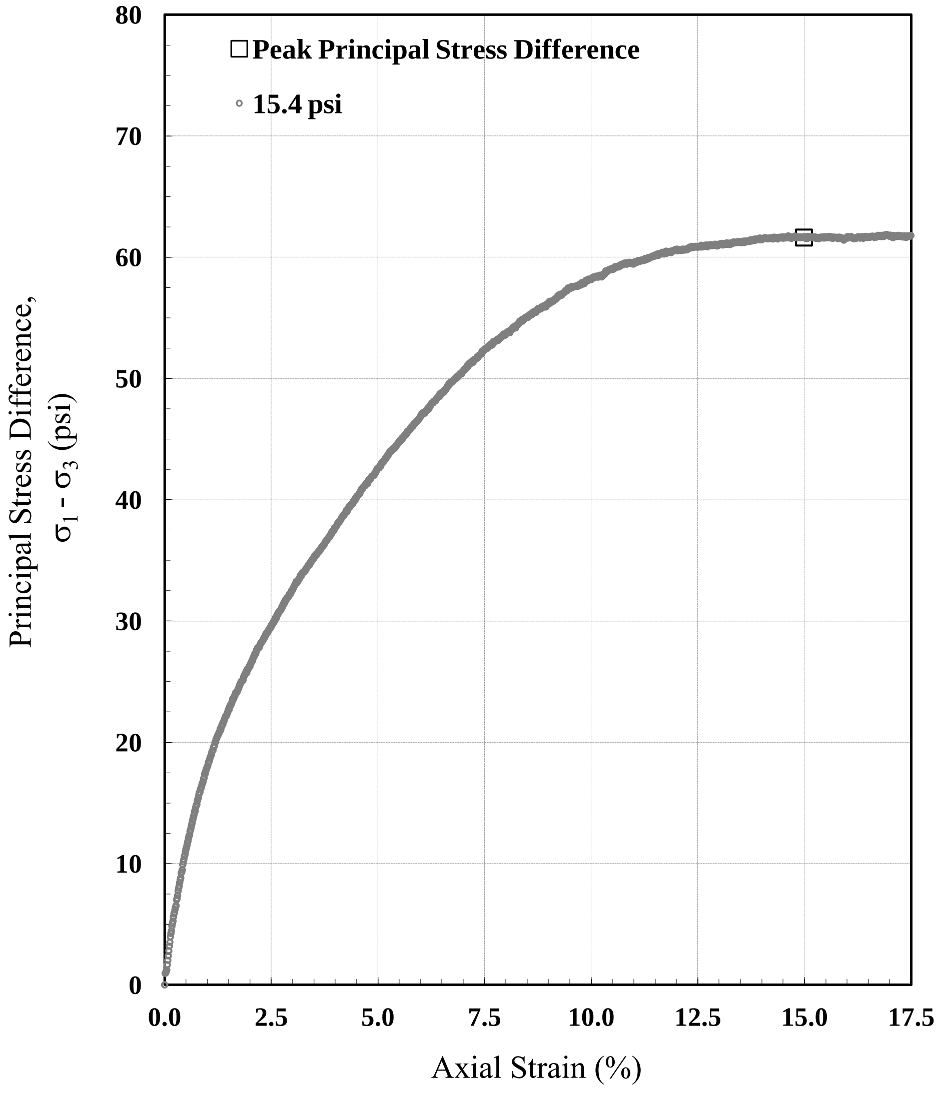

7.5 psi


15 psi


15 psi

Unconsolidated-Undrained (Q) Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D2850
Sample:	B3: 18-19		



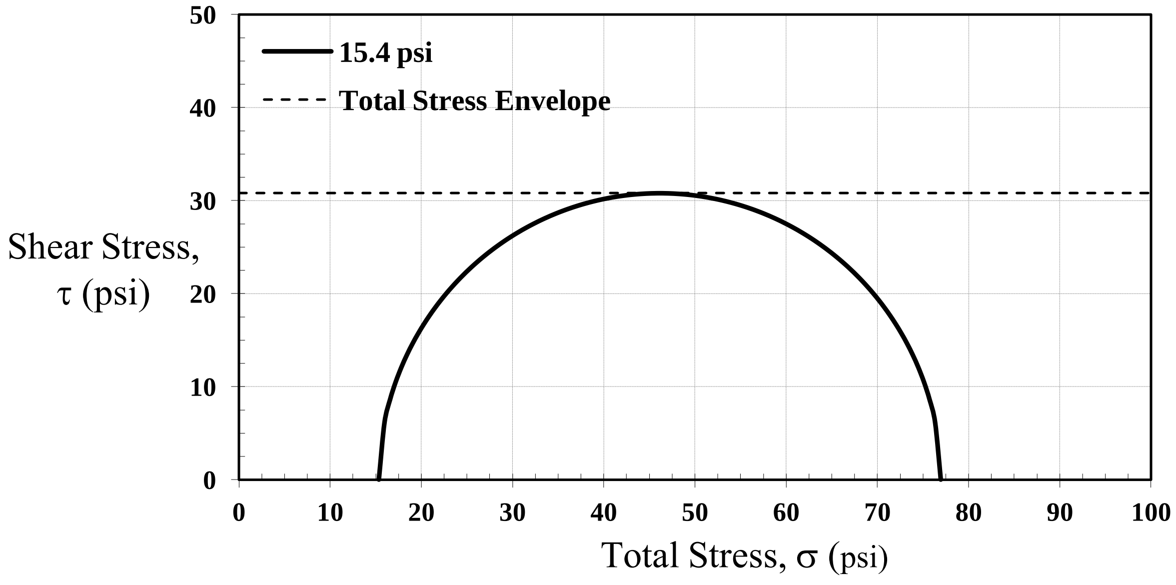
Test Parameters	
Minor Principal Stress (psi)	15.4
Rate of Strain (%/hr)	60

Initial Properties	
Avg. Diameter (in)	1.31
Avg. Height (in)	2.55
Avg. Water Content (%)	18.6
Bulk Density (pcf)	129.6
Dry Density (pcf)	109.2
Saturation (%)	95.9
Void Ratio	0.51
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	15.0
Minor Total Stress (psi)	15.4
Major Total Stress (psi)	77.0
Principal Stress Diff. (psi)	61.6

Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	30.8
S_u / σ_3	2.0

Note: The Mohr failure envelope was taken as a horizontal straight line. It should, however, be noted that the specimen was partially saturated.



Jeffrey A. Kuhn , Ph.D., P.E., 6/30/2016

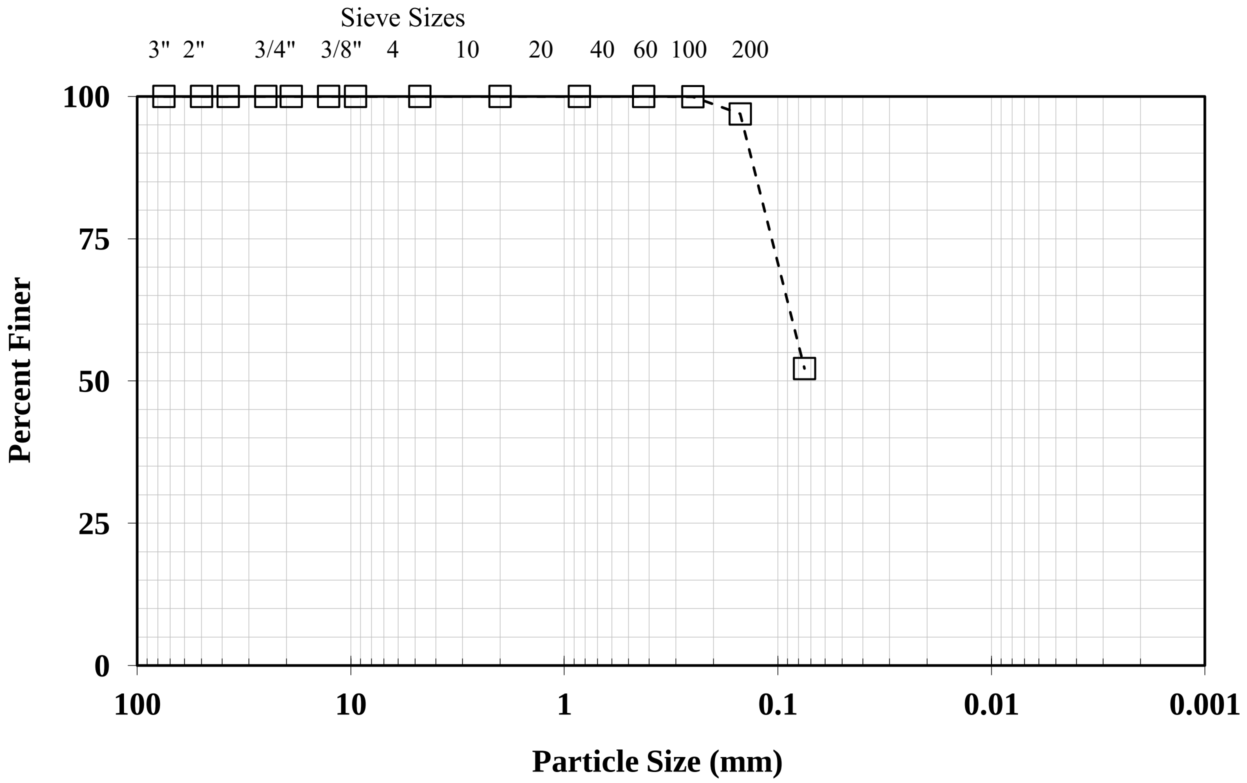
Analysis & Quality Review/Date

Laboratory Staff: LC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3 28-30

TRI Log#: 20888.13
Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (0.841 mm)	100.0
No. 40 (0.420 mm)	100.0
No. 60 (0.250 mm)	99.9
No. 100 (0.149 mm)	96.9
No. 200 (0.074 mm)	52.2
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

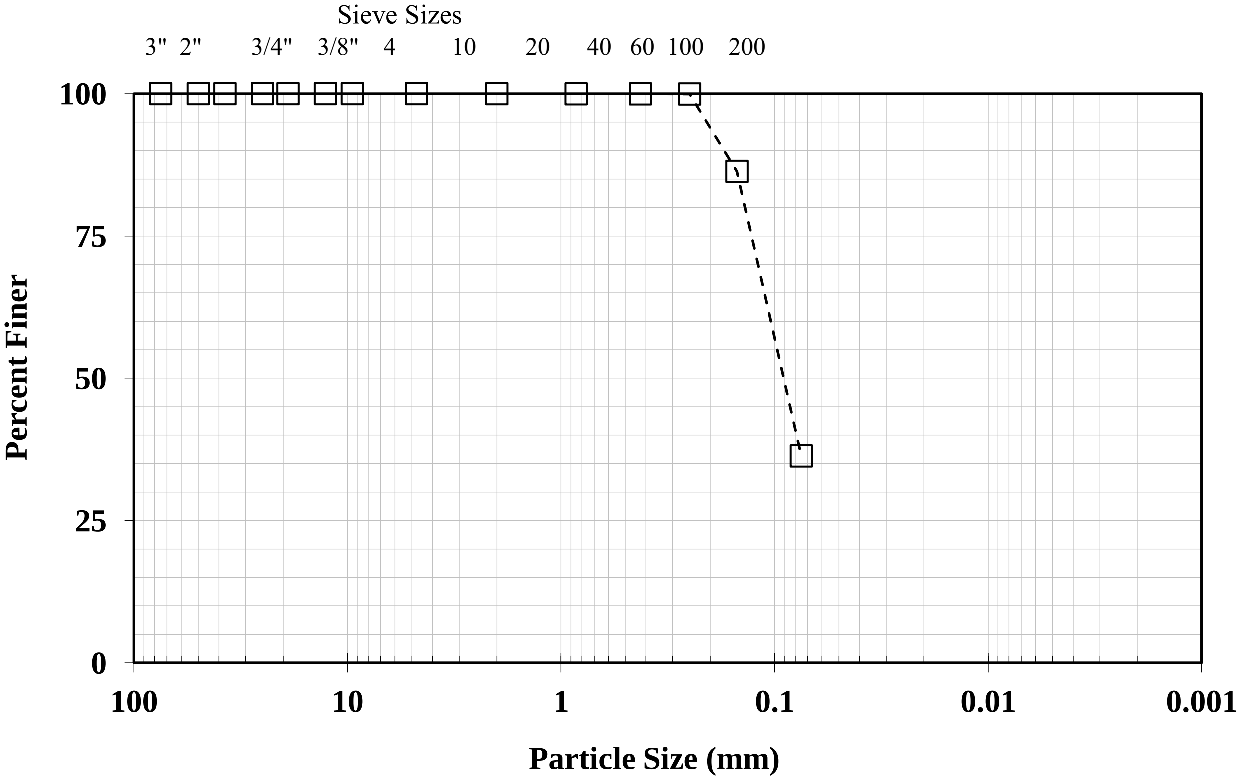
USCS Classification (ASTM D2487)	Sandy lean clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	11.9
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	29
	Plastic Limit	21
	Plastic Index	8
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B6: 28-30

TRI Log#: 20888.20
Test Method: ASTM D422



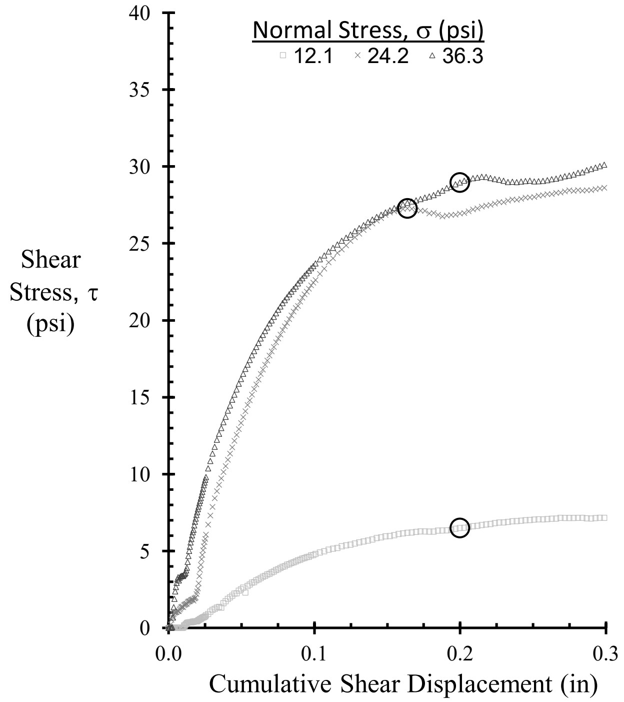
Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (0.841 mm)	100.0
No. 40 (0.420 mm)	100.0
No. 60 (0.250 mm)	99.9
No. 100 (0.149 mm)	86.3
No. 200 (0.074 mm)	36.3
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

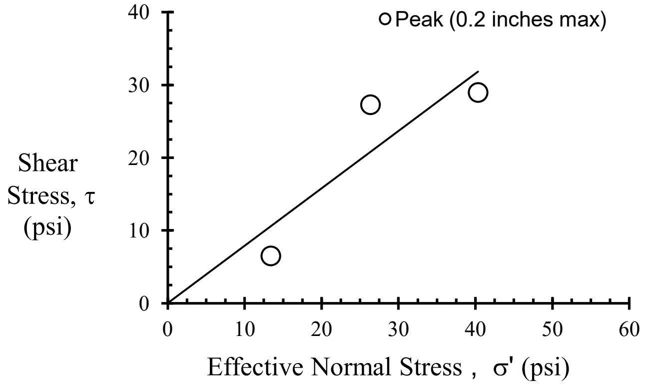
USCS Classification (ASTM D2487)	Silty sand (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	28.9
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	25
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

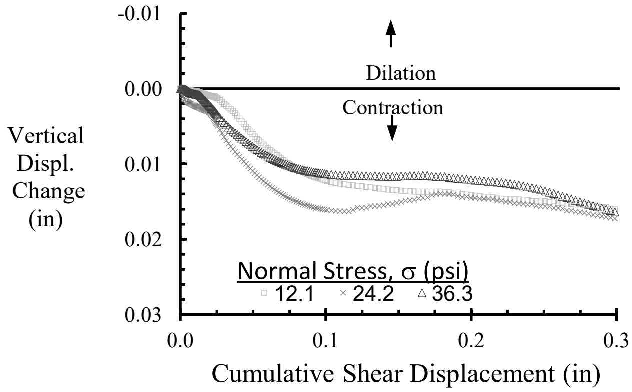
Direct Shear of Soil Under Consolidated-Drained Conditions

Client:	Auckland Consulting LLC	TRI Log#:	20888
Project:	Winston Pond	Test Method:	ASTM D 3080
Sample:	B6: 28-30		





Note: Area Correction Has Been Applied



Sample Number		1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	29.9	27.7	28.8
	Saturation, %	225.9	223.9	225.0
	Dry Density, pcf	122.4	124.5	123.4
	Void Ratio	0.35	0.33	0.34
Post Consol	Height, in (prior to shear)	0.94	0.96	0.97
	Final Water Content, %	25.5	21.5	21.9
	Dry Density, pcf	130.9	129.3	126.6
	Void Ratio	0.26	0.28	0.31
Displacement rate (in/min)		2.0E-03	2.0E-03	2.0E-03
Peak (0.2 inches)	Normal Stress, σ' (psi)	13.40	26.36	40.34
	Shear Stress, τ (psi)	6.50	27.28	28.96
	Displacement (in)	0.20	0.16	0.20
	ϕ'_d, degrees	38.3		
	c'_d, psi	0 (Forced)		

Note: The loose sample was tamped in place. A specific gravity of 2.65 was assumed for weight-volume calculations.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/16

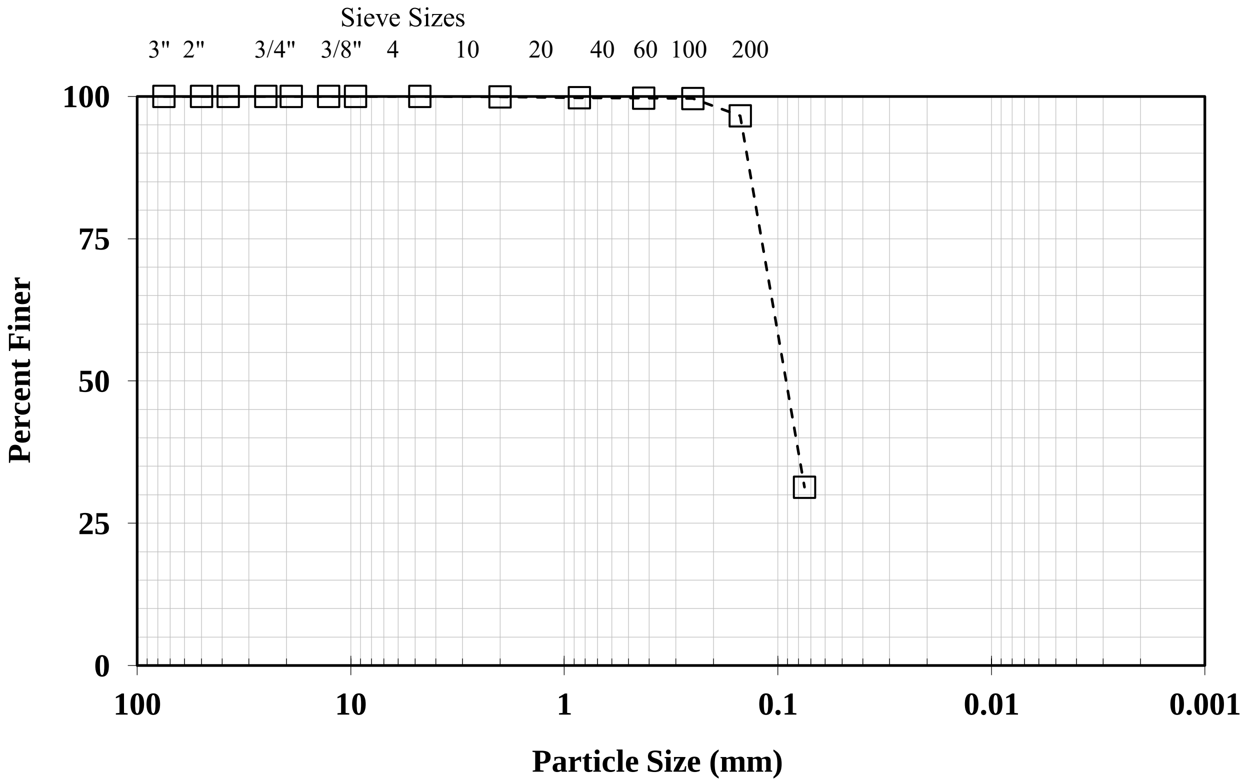
Analysis & Quality Review/Date

Test Performed By: LC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B7 13-15

TRI Log#: 20888.24
Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	99.9
No. 20 (0.841 mm)	99.8
No. 40 (0.420 mm)	99.7
No. 60 (0.250 mm)	99.6
No. 100 (0.149 mm)	96.6
No. 200 (0.074 mm)	31.3
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

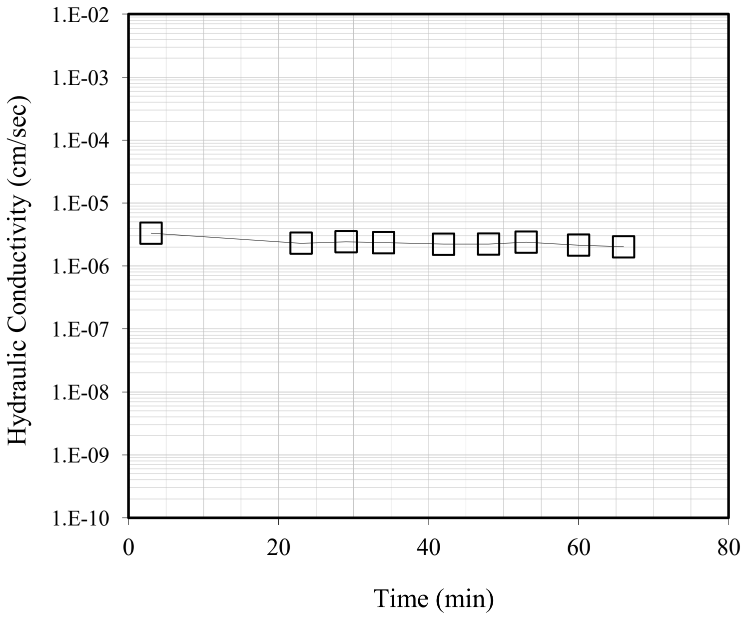
USCS Classification (ASTM D2487)	Silty sand (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	25.6
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	24
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

Hydraulic Conductivity

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D5084 Method C
Sample ID:	B7: 13-15		



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.80
Height (in)	2.21
Initial Mass (g)	444.2
Sample Area (in^2)	6.16
Water Content (%)	24.5
Total Unit Weight (pcf)	124.3
Dry Unit Weight (pcf)	99.9
Specific Gravity (Assumed)	2.65
Degree of Saturation	99.0
Void Ratio	0.66
Porosity	0.40
1 Pore Volume (cc)	88.3
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.99

Specimen Image

Note: Permeation measurements were made with a mercury U-tube.

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
48.0	2.2E-06
53.0	2.4E-06
60.0	2.2E-06
66.0	2.0E-06
Average, Last 4 Readings	**2.2E-06**

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016

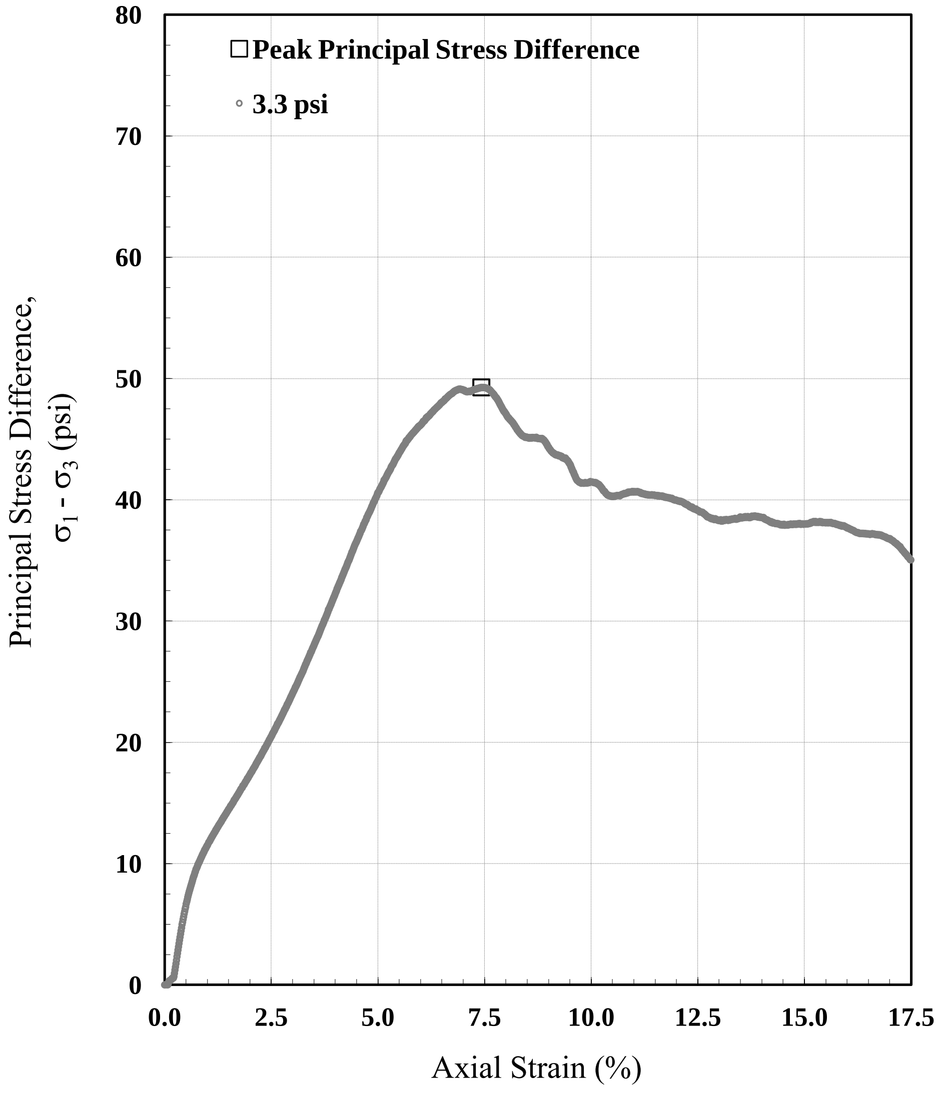
Analysis & Quality Review/Date

Testing Performed By: SOC & LC

Unconsolidated-Undrained (Q) Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B8: 3-5

TRI Log #: 20888
Test Method: ASTM D2850



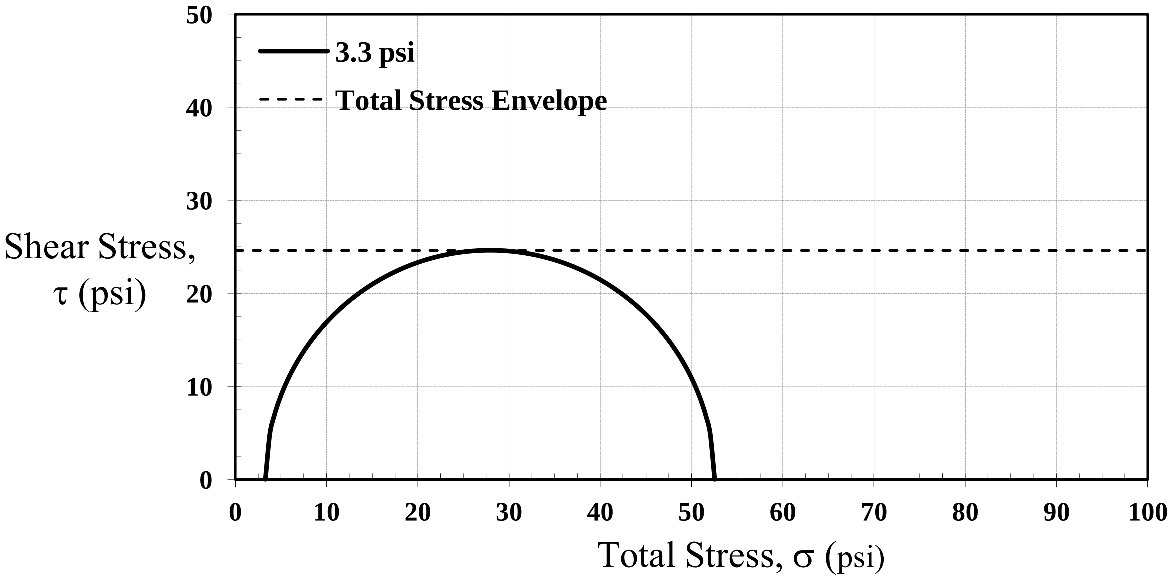
Test Parameters	
Minor Principal Stress (psi)	3.3
Rate of Strain (%/hr)	60

Initial Properties	
Avg. Diameter (in)	2.80
Avg. Height (in)	5.60
Avg. Water Content (%)	15.2
Bulk Density (pcf)	132.9
Dry Density (pcf)	115.4
Saturation (%)	92.8
Void Ratio	0.43
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	7.4
Minor Total Stress (psi)	3.3
Major Total Stress (psi)	52.6
Principal Stress Diff. (psi)	49.3

Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	24.6
S_u / σ_3	7.5

Note: The Mohr failure envelope was taken as a horizontal straight line. It should, however, be noted that the specimen was partially saturated.



Jeffrey A. Kuhn , Ph.D., P.E., 6/30/2016

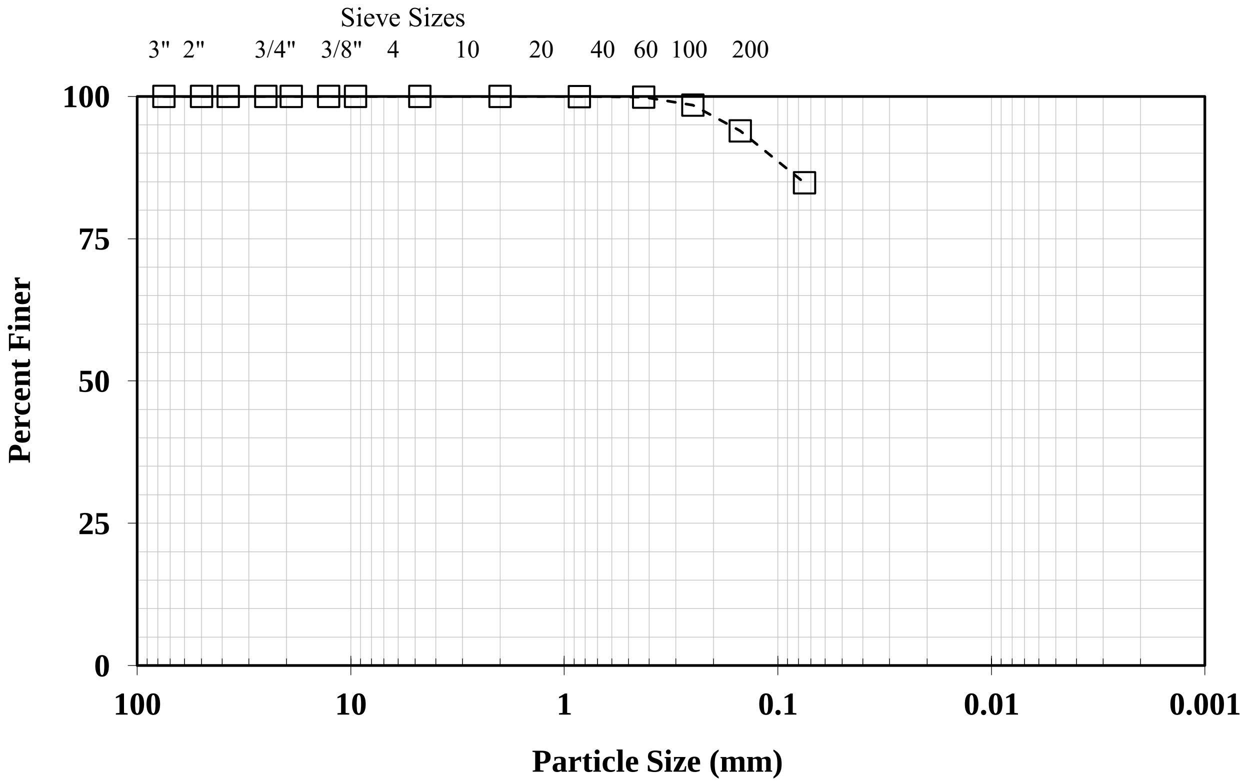
Analysis & Quality Review/Date

Laboratory Staff: LC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B8 38-40

TRI Log#: 20888.32
Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (0.841 mm)	100.0
No. 40 (0.420 mm)	99.9
No. 60 (0.250 mm)	98.5
No. 100 (0.149 mm)	93.9
No. 200 (0.074 mm)	84.8
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

USCS Classification (ASTM D2487)	- -	
As-Received Moisture Content (%)	(ASTM D2216)	28.8
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	- -
	Plastic Limit	- -
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (3-5)

TRI Log #: 21381
Test Method: ASTM D4767 Mod

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	5.0	10.0	15.0
Initial Specimen Properties			
Avg. Diameter (in)	1.95	1.96	1.97
Avg. Height (in)	4.39	4.33	4.24
Avg. Water Content (%)	18.1	-	-
Bulk Density (pcf)	128.7	129.5	130.6
Dry Density (pcf)	109.0	-	-
Saturation (%)	89.4	-	-
Void Ratio, n	0.55	0.54	0.52
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	81.0	80.9	80.9
B-Value, End of Saturation	0.97	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.54	0.52	0.51
Area (in^2)	2.98	3.00	3.04

Shear / Post-Shear			
Avg. Water Content (%)	-	-	20.6
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	0.8	1.3	1.6
Minor Effective Stress (psi), $\sigma_3'{}_f$	-	-	-	2.7	6.1	11.1
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	9.1	16.6	25.8
Pore Water Pressure, Δu_f (psi)	-	-	-	2.5	4.2	4.2
Major Effective Stress (psi), $\sigma_1'{}_f$	-	-	-	11.8	22.7	36.9
Effective Friction Angle (degrees)	-			29.9		
Effective Cohesion (psi)	-			1.2		

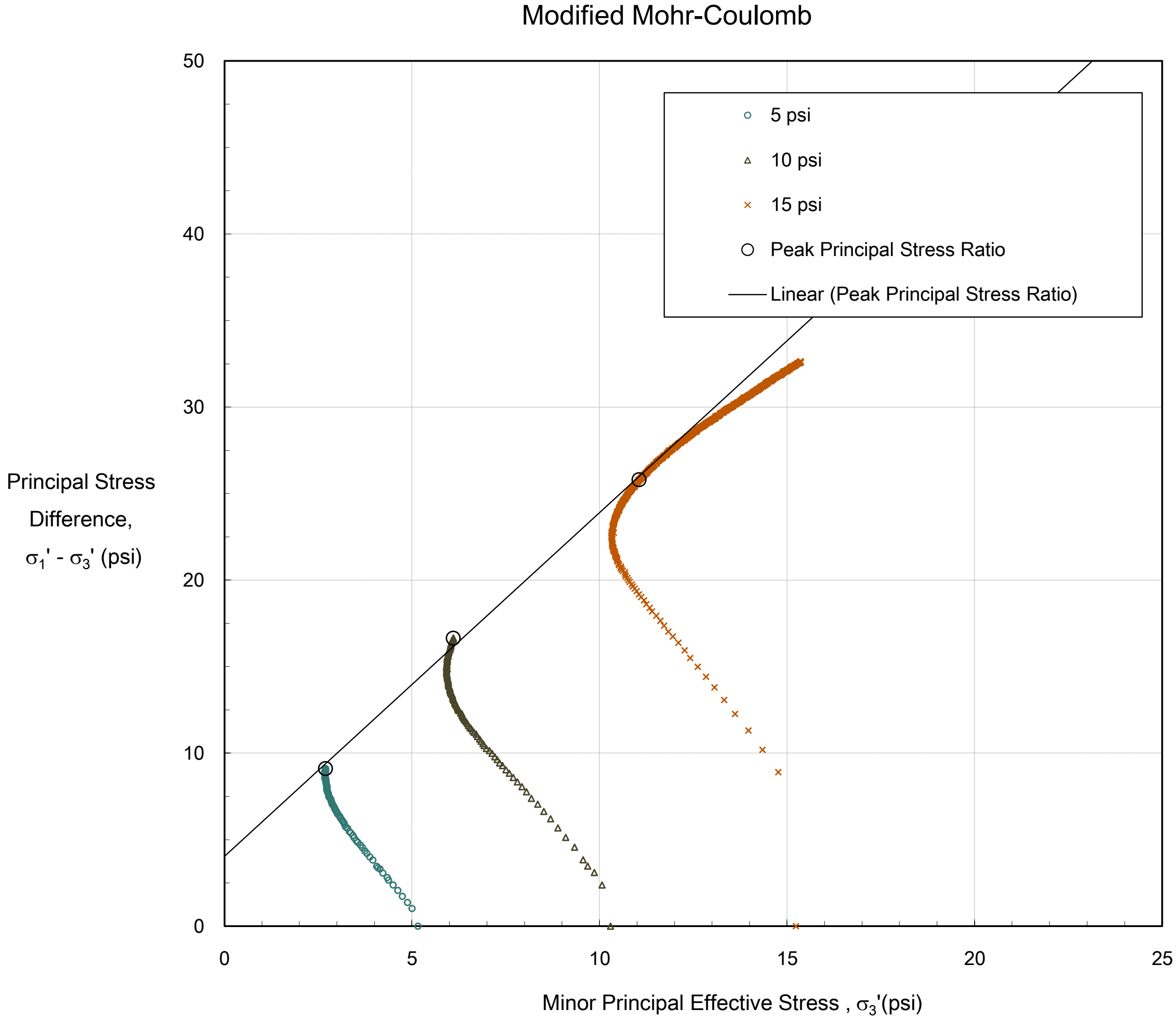
R-Envelope, "Total" Stress		
Friction Angle (deg)	-	26.9
Cohesion (psi)	-	0.1

Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/12/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-4 (3-5)		

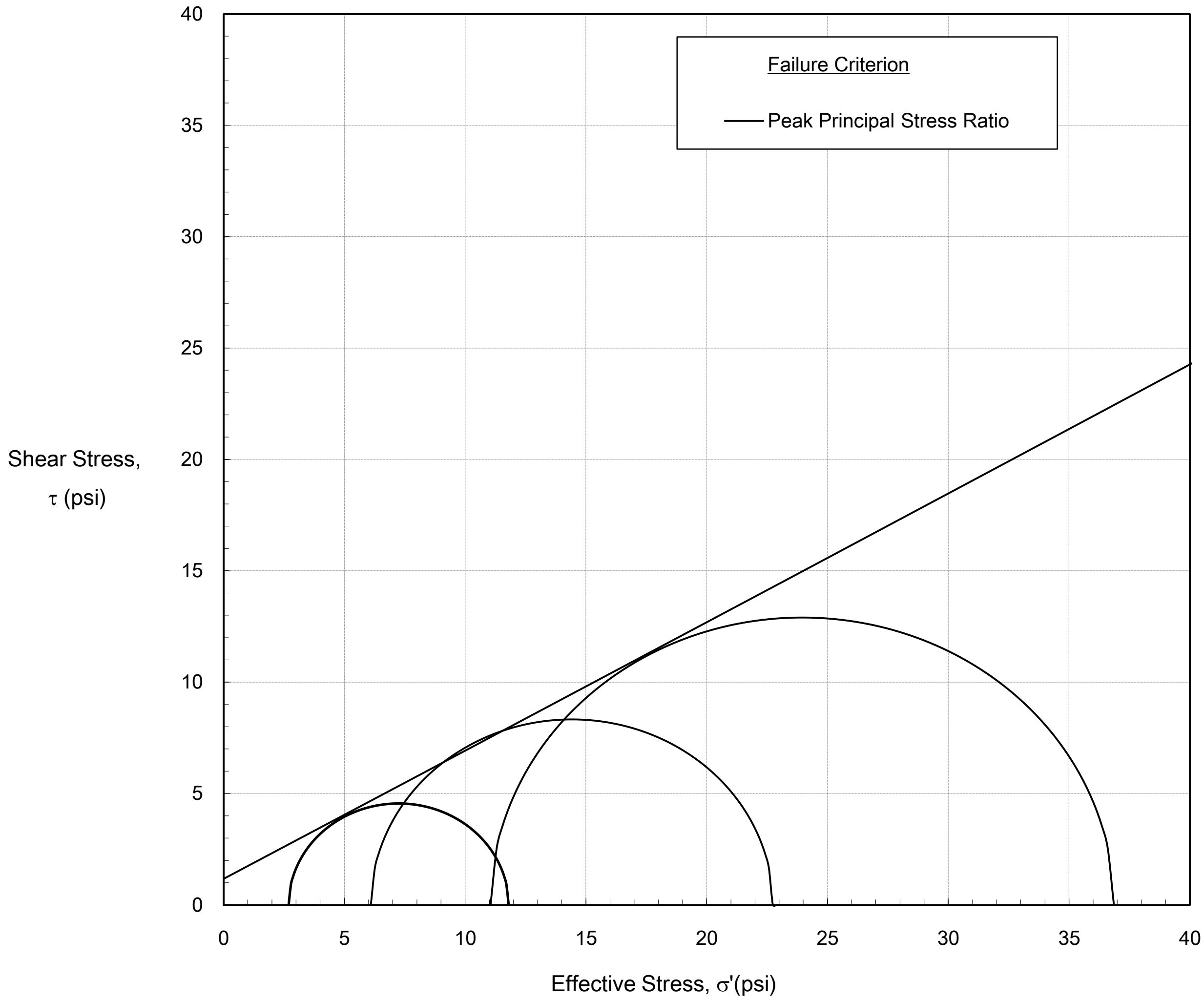


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	29.9
Effective Cohesion (psi)	-	1.2

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-4 (3-5)		

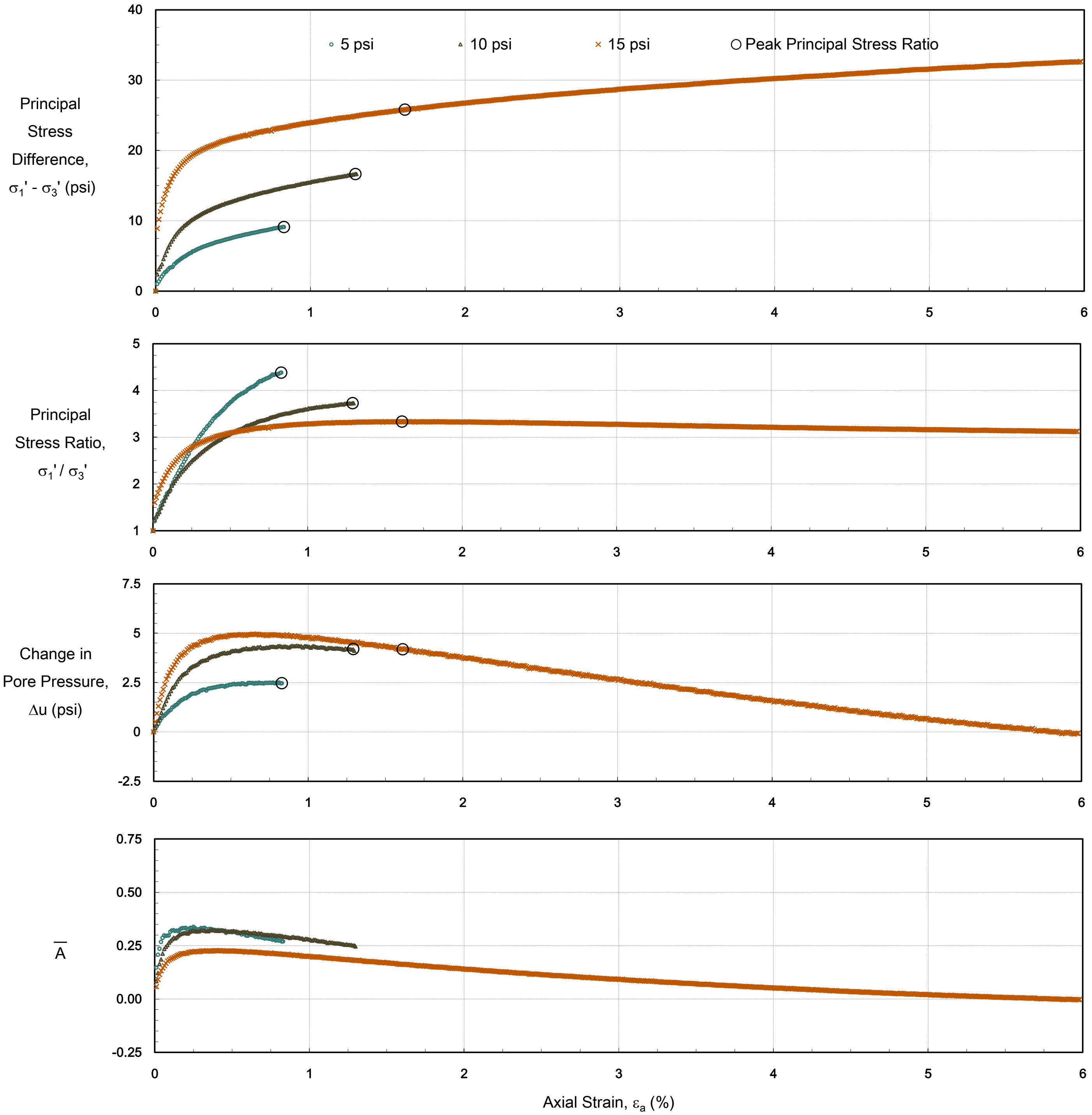
Mohr-Coulomb



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	29.9
Effective Cohesion (psi)	-	1.2

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-4 (3-5)		

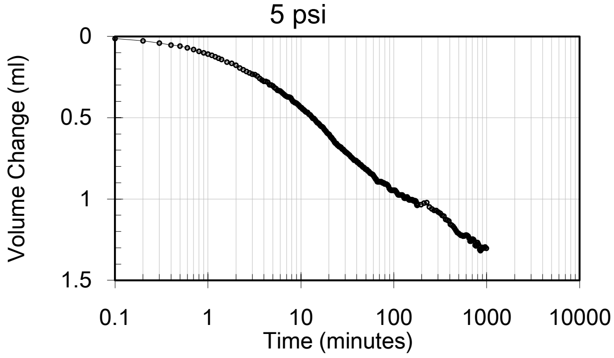


Multi-Stage Consolidated-Undrained Triaxial Compression

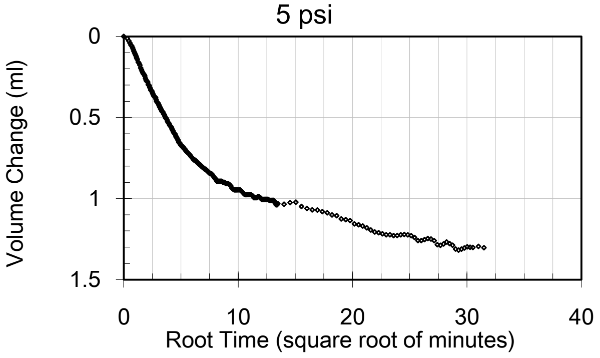
Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-4 (3-5)		

Consolidation

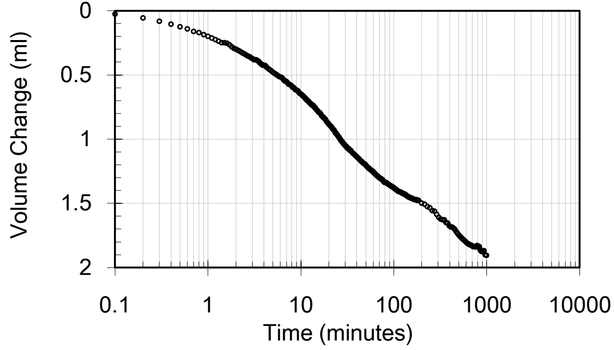
5 psi



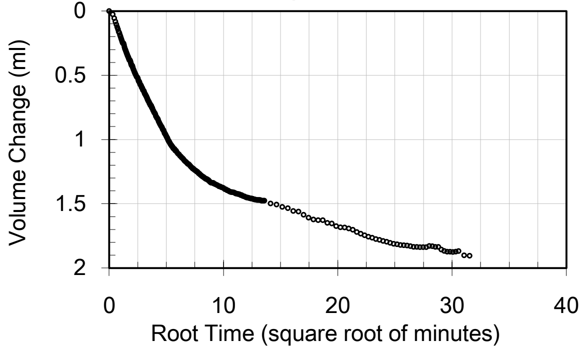
5 psi



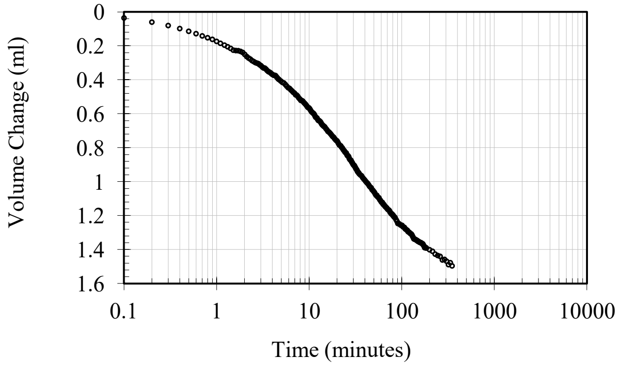
10 psi



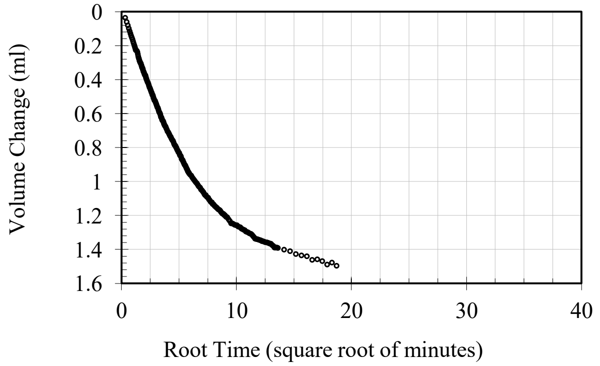
10 psi



15 psi

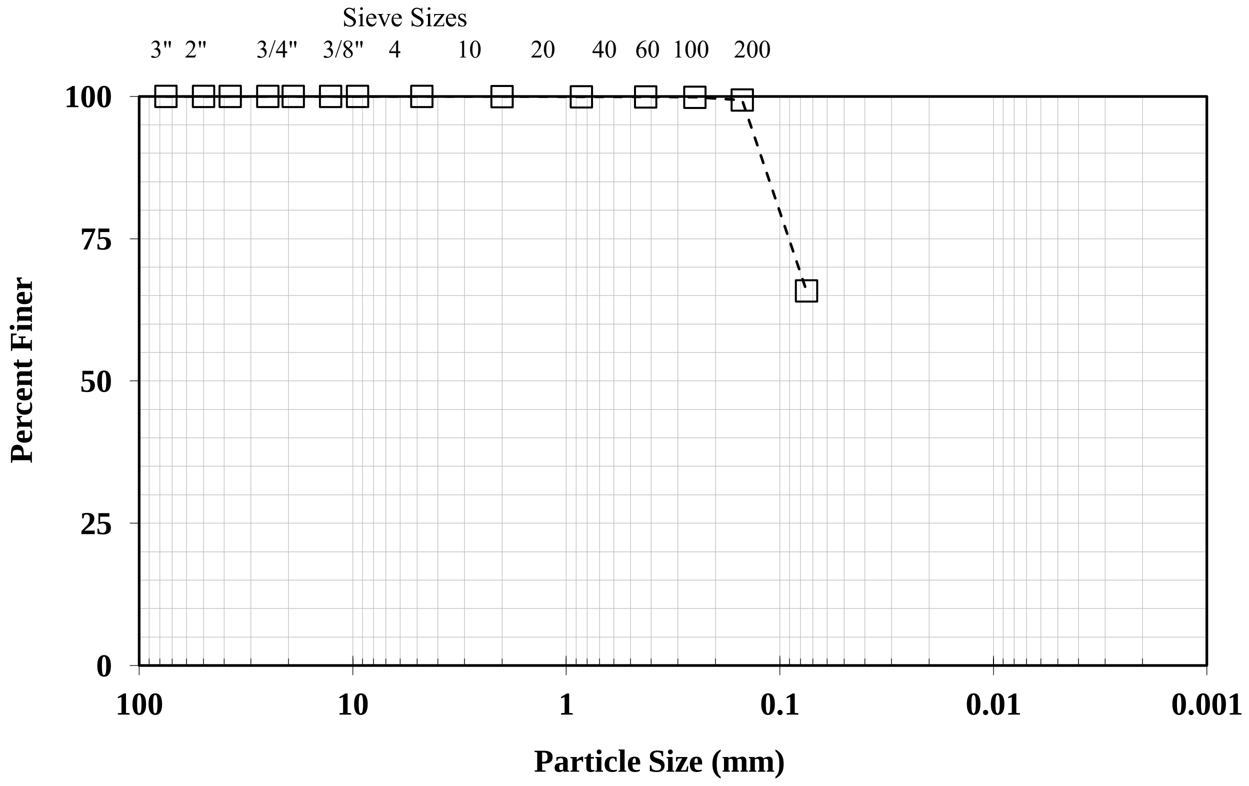


15 psi



Particle Size Analysis for Soils

Client:	Auckland Consulting LLC	TRI Log#: 21381.3
Project:	Winston Pond	Test Method: ASTM D422
Sample:	B-4 (8-10)	



Sieve Analysis		
Sieve Size		Percent Passing
3 in.	(76.2 mm)	100.0
2 in.	(50.8 mm)	100.0
1.5 in.	(38.1 mm)	100.0
1 in.	(25.4 mm)	100.0
3/4 in.	(19.0 mm)	100.0
1/2 in.	(12.7 mm)	100.0
3/8 in.	(9.51 mm)	100.0
No. 4	(4.76 mm)	100.0
No. 10	(2.00 mm)	100.0
No. 20	(0.841 mm)	99.9
No. 40	(0.420 mm)	99.9
No. 60	(0.250 mm)	99.8
No. 100	(0.149 mm)	99.4
No. 200	(0.074 mm)	65.8

Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

USCS Classification (ASTM D2487)	Sandy lean clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	16.3
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	33
	Plastic Limit	20
	Plastic Index	13
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

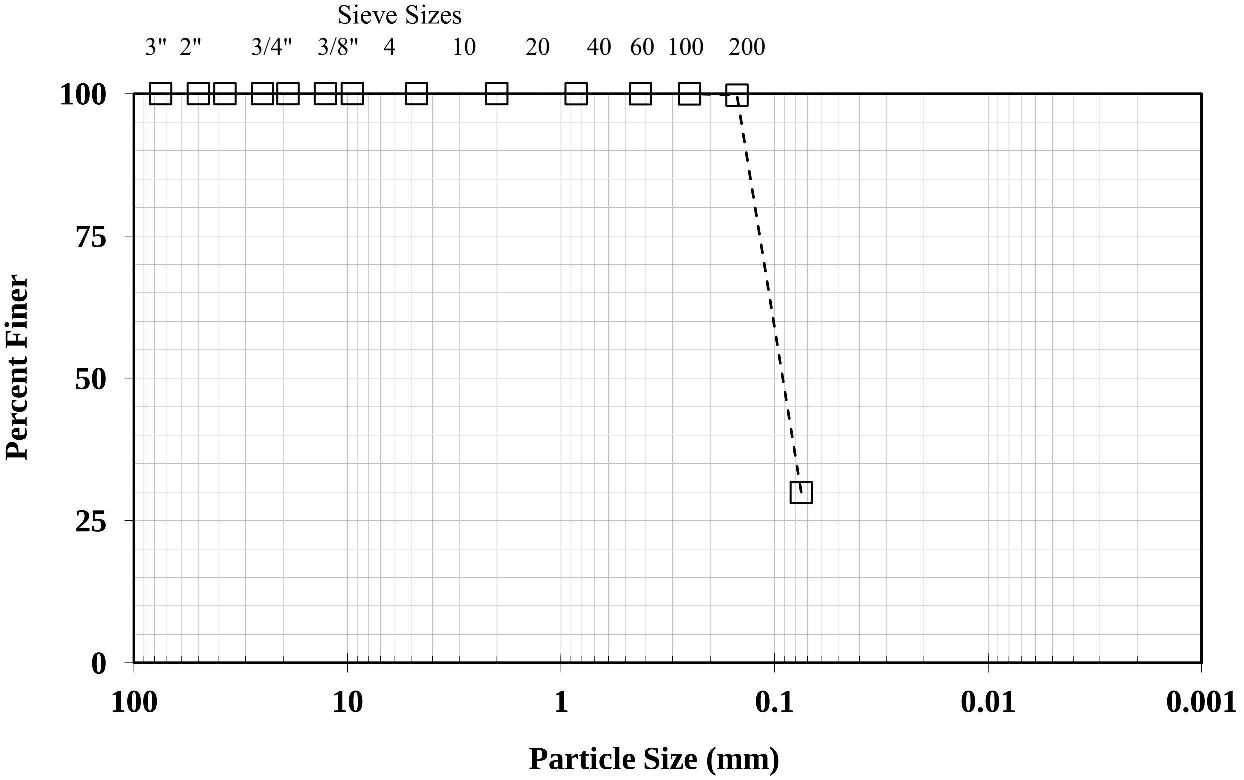
Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016

Quality Review/Date

Tested by: KH & PC

Particle Size Analysis for Soils

Client:	Auckland Consulting LLC	TRI Log#: 21381.7
Project:	Winston Pond	Test Method: ASTM D422
Sample:	B-4 (33-35)	



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (0.841 mm)	100.0
No. 40 (0.420 mm)	100.0
No. 60 (0.250 mm)	100.0
No. 100 (0.149 mm)	99.7
No. 200 (0.074 mm)	29.9
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

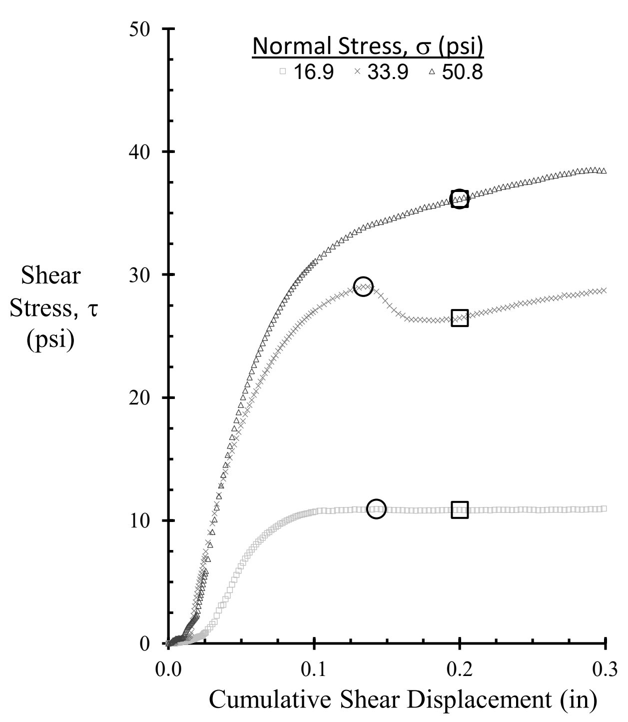
USCS Classification (ASTM D2487)	Silty sand (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	29.6
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	26
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

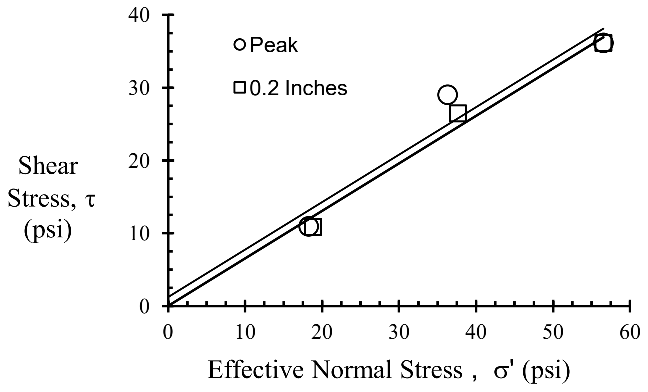
Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Direct Shear of Soil Under Consolidated-Drained Conditions

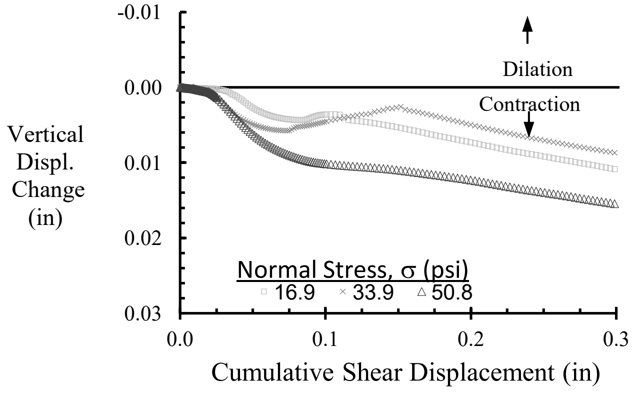
Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (38-40)

TRI Log#: 21381
Test Method: ASTM D 3080





Note: Area Correction Has Been Applied



	Sample Number	1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	24.7	24.9	24.9
	Saturation, %	155.9	156.2	156.2
	Dry Density, pcf	116.4	116.3	116.3
	Void Ratio	0.42	0.42	0.42
Post Consol	Height, in (prior to shear)	1.00	1.00	0.99
	Final Water Content, %	23.9	25.0	23.6
	Dry Density, pcf	116.9	116.5	117.2
	Void Ratio	0.41	0.42	0.41
Displacement rate (in/min)		2.0E-03	2.0E-03	2.0E-03
Peak	Normal Stress, σ' (psi)	18.26	36.30	56.54
	Shear Stress, τ (psi)	10.94	29.03	36.15
	Displacement (in)	0.14	0.13	0.20
	ϕ'_d, degrees	33.1		
	c'_d, psi	1.2		
Post-Peak	Normal Stress, σ' (psi)	18.83	37.66	56.54
	Shear Stress, τ (psi)	10.87	26.47	36.15
	Displacement (in)	0.20	0.20	0.20
	ϕ'_d, degrees	33.1		
	c'_d, psi	0 (Forced)		

Note: The loose sample was tamped in place. A specific gravity of 2.65 was assumed for weight-volume calculations.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/16
Analysis & Quality Review/Date
Test Performed By: LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (5-7)

TRI Log #: 21381
Test Method: ASTM D4767 Mod

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	5.0	10.0	15.0
Initial Specimen Properties			
Avg. Diameter (in)	1.85	1.85	1.87
Avg. Height (in)	4.51	4.44	4.35
Avg. Water Content (%)	17.6	-	-
Bulk Density (pcf)	139.6	141.0	142.1
Dry Density (pcf)	118.7	-	-
Saturation (%)	100.0	-	-
Void Ratio, n	0.42	0.41	0.40
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	80.7	80.8	81.5
B-Value, End of Saturation	0.94	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.41	0.40	0.38
Area (in^2)	2.67	2.68	2.72

Shear / Post-Shear			
Avg. Water Content (%)	-	-	19.1
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	0.6	1.3	1.4
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	4.3	5.6	9.9
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	9.2	11.7	23.4
Pore Water Pressure, Δu_f (psi)	-	-	-	0.7	2.8	3.4
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	13.5	17.3	33.3
Effective Friction Angle (degrees)	-			32.3		
Effective Cohesion (psi)	-			0 (Forced)		

R-Envelope, "Total" Stress		
Friction Angle (deg)	-	27.1
Cohesion (psi)	-	0 (Forced)

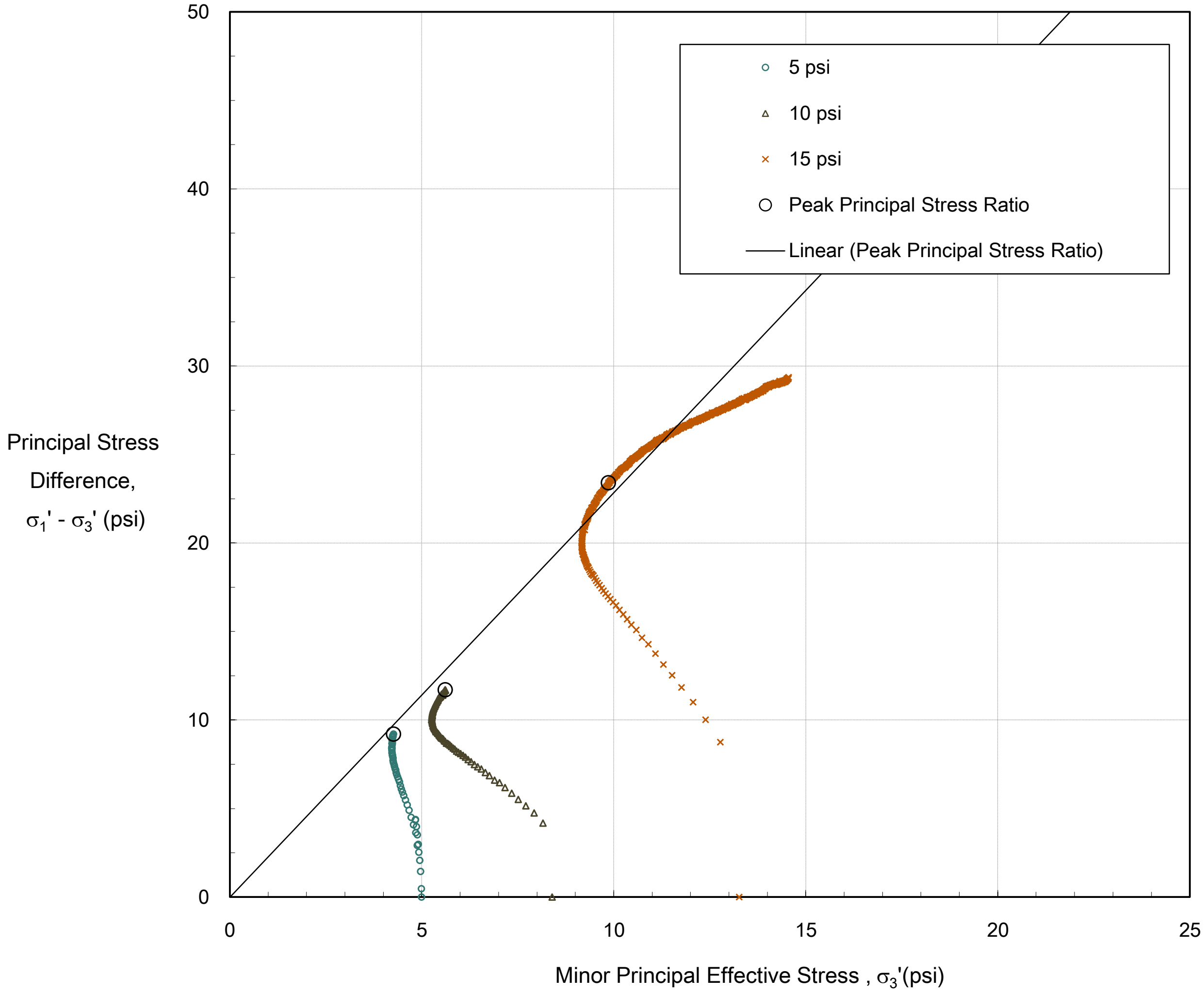
Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/12/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-5 (5-7)		

Modified Mohr-Coulomb

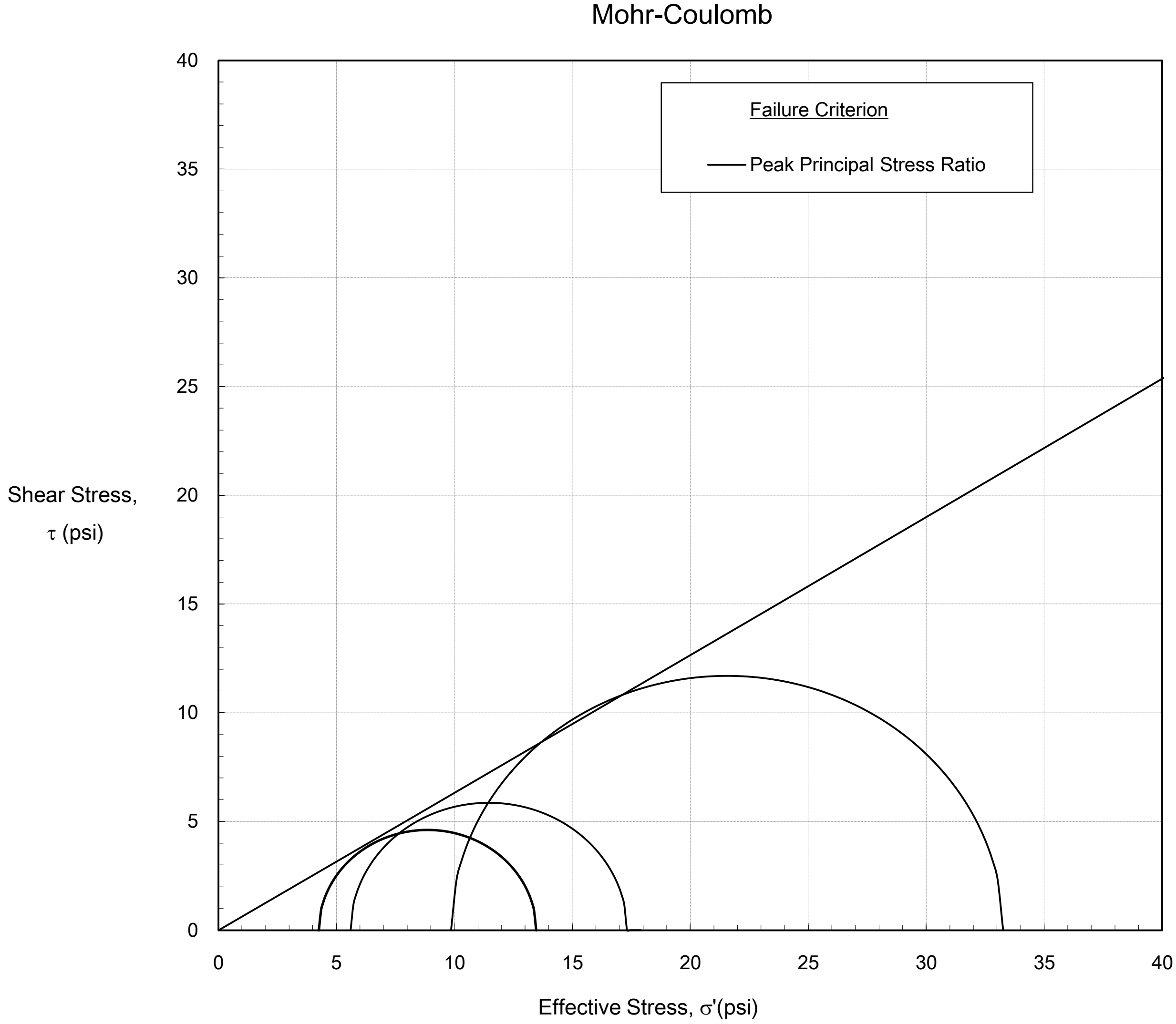


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	32.3
Effective Cohesion (psi)	-	0 (Forced)

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (5-7)

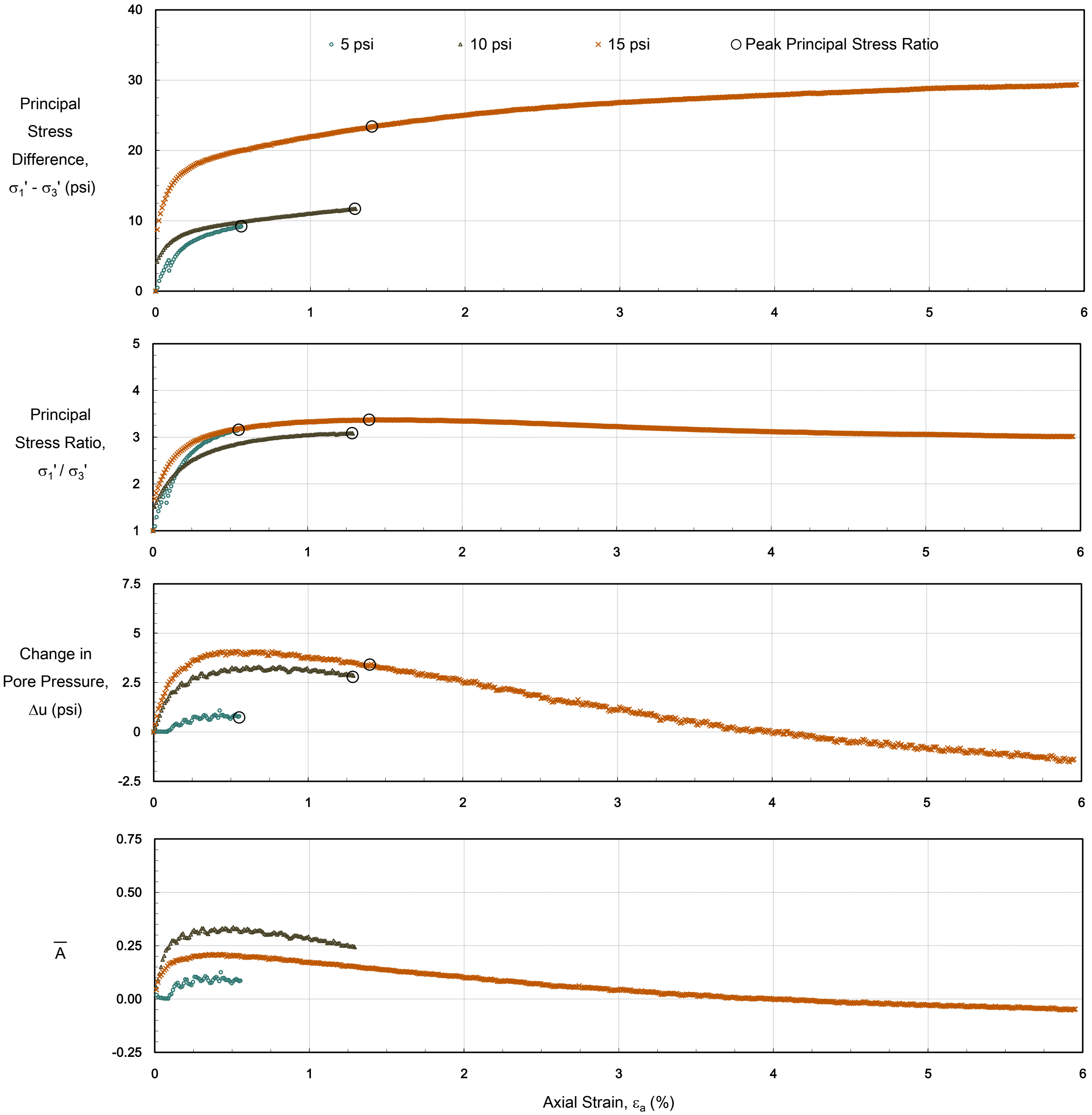
TRI Log #: 21381
Test Method: ASTM D4767 Mod



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	32.3
Effective Cohesion (psi)	-	0 (Forced)

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-5 (5-7)		

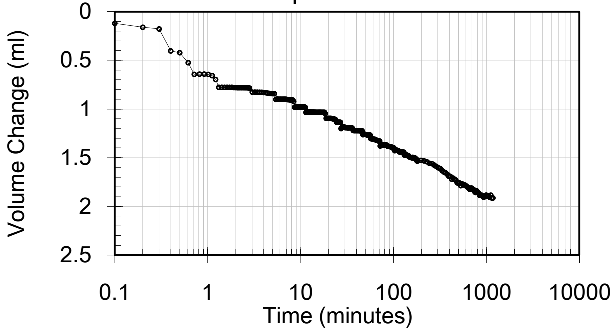


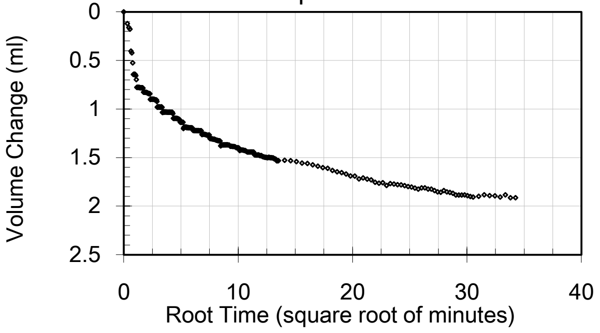
Multi-Stage Consolidated-Undrained Triaxial Compression

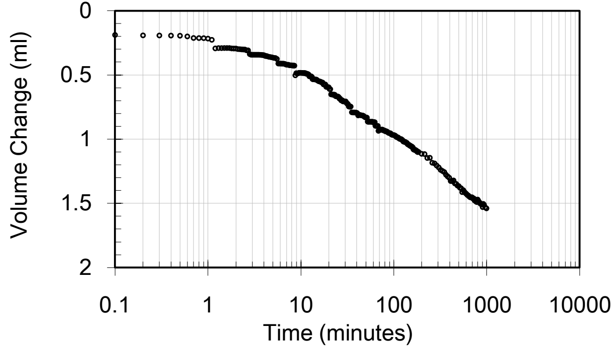
Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (5-7)

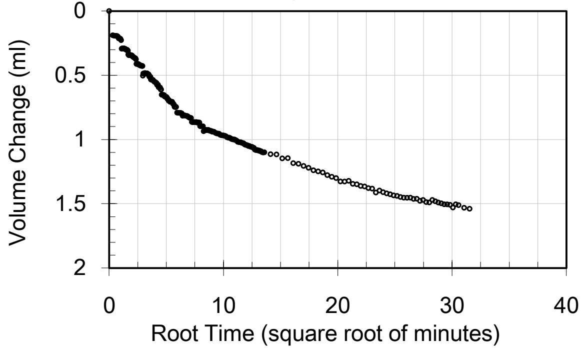
TRI Log #: 21381
Test Method: ASTM D4767 Mod

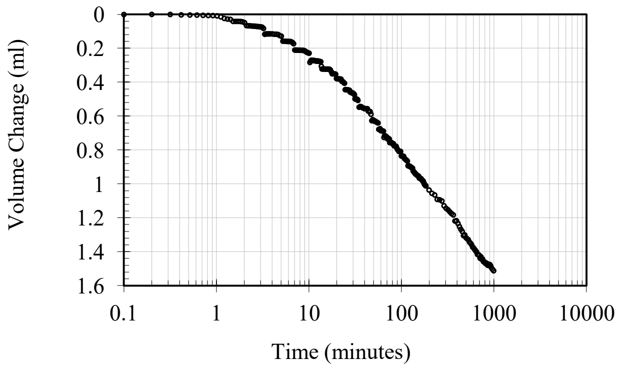
Consolidation

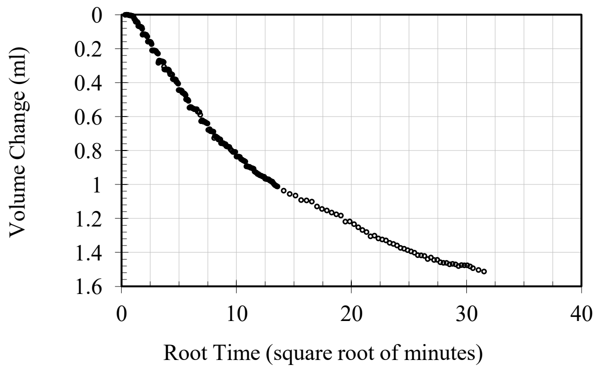

5 psi


5 psi


10 psi


10 psi

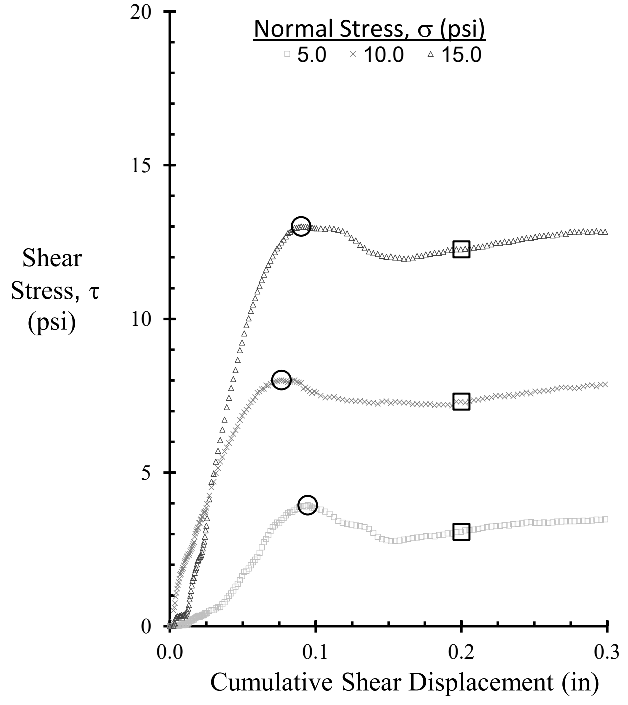

15 psi

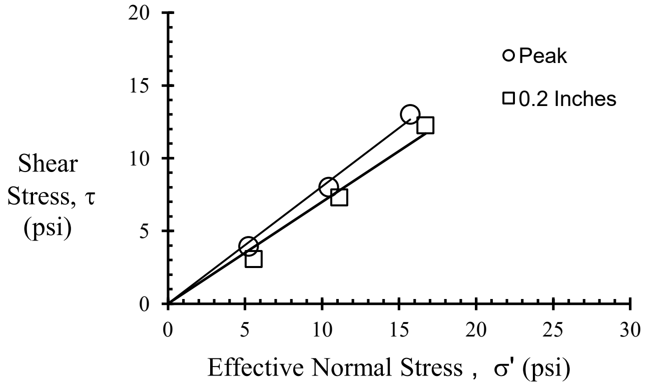

15 psi

Direct Shear of Soil Under Consolidated-Drained Conditions

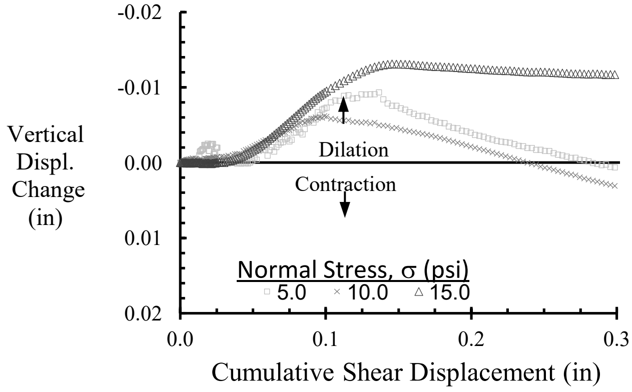
Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (13-15)

TRI Log#: 21381
Test Method: ASTM D 3080





Note: Area Correction Has Been Applied



	Sample Number	1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	16.9	16.0	15.6
	Saturation, %	83.9	83.6	89.1
	Dry Density, pcf	107.9	109.7	112.9
	Void Ratio	0.53	0.51	0.46
Post Consol	Height, in (prior to shear)	1.00	1.00	1.00
	Final Water Content, %	21.1	20.9	19.2
	Dry Density, pcf	108.0	109.9	113.3
	Void Ratio	0.53	0.50	0.46
Displacement rate (in/min)		6.0E-04	6.0E-04	6.0E-04
Peak	Normal Stress, σ' (psi)	5.23	10.43	15.72
	Shear Stress, τ (psi)	3.94	8.01	13.01
	Displacement (in)	0.09	0.08	0.09
	ϕ'_d, degrees	38.8		
	c'_d, psi	0 (Forced)		
Post-Peak	Normal Stress, σ' (psi)	5.56	11.12	16.70
	Shear Stress, τ (psi)	3.07	7.31	12.26
	Displacement (in)	0.20	0.20	0.20
	ϕ'_d, degrees	35.0		
	c'_d, psi	0 (Forced)		

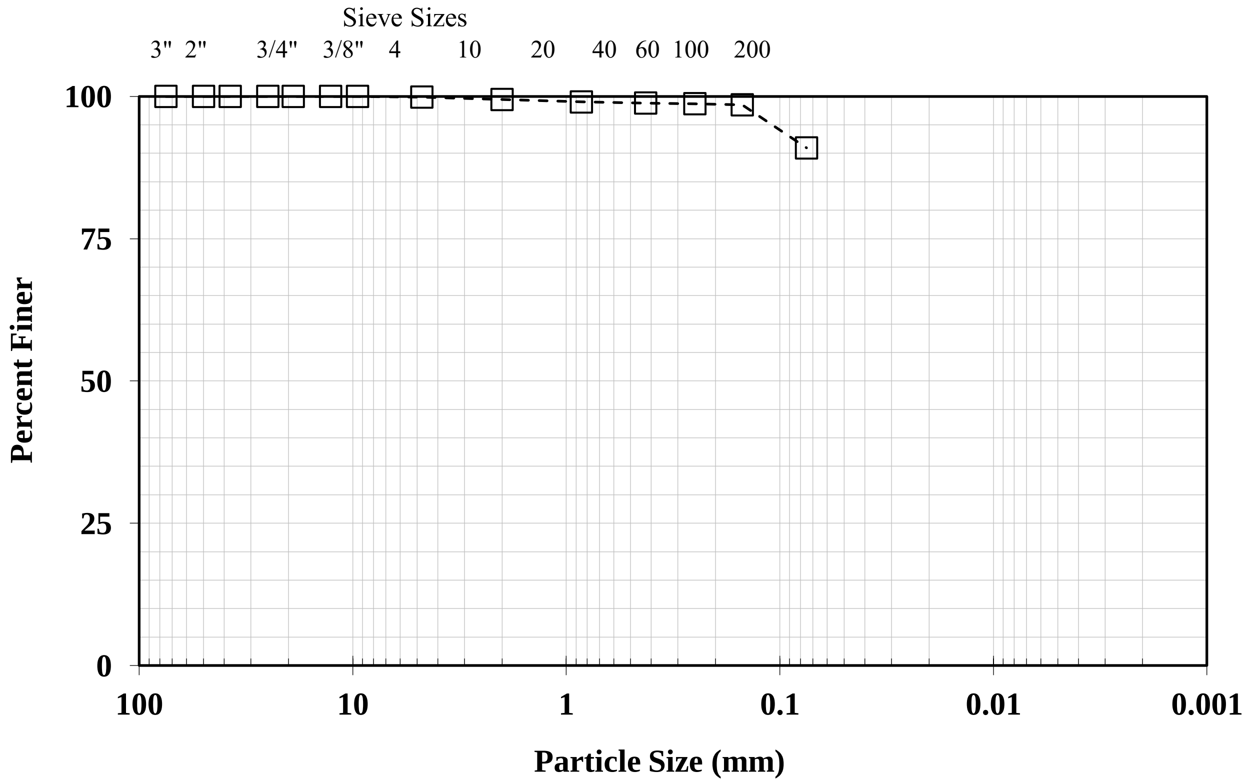
Note: The undisturbed soil samples were extruded and trimmed using a trimming turntable. A specific gravity of 2.65 was assumed for weight-volume calculations.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/16
Analysis & Quality Review/Date
Test Performed By: LC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (33-35)

TRI Log#: 21381.16
Test Method: ASTM D422



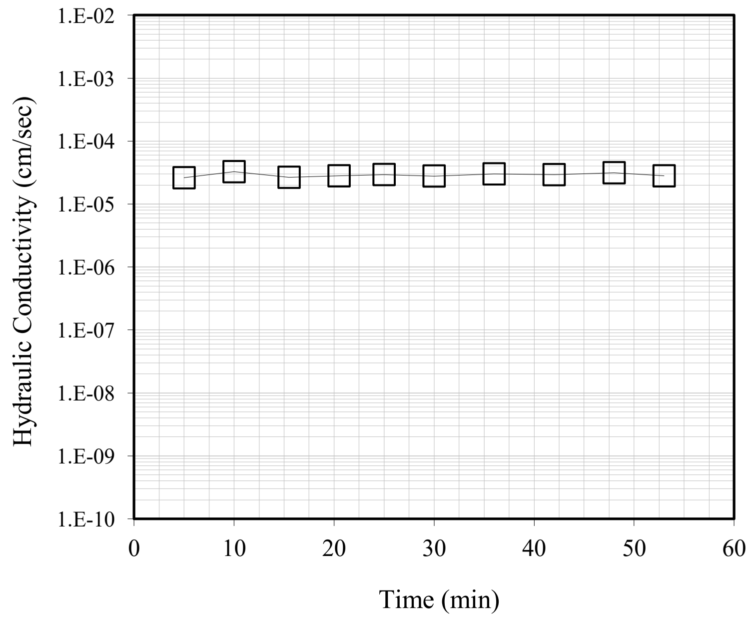
Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	99.9
No. 10 (2.00 mm)	99.5
No. 20 (0.841 mm)	99.0
No. 40 (0.420 mm)	98.8
No. 60 (0.250 mm)	98.7
No. 100 (0.149 mm)	98.5
No. 200 (0.074 mm)	90.9
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

USCS Classification (ASTM D2487)	Silt (ML)	
As-Received Moisture Content (%)	(ASTM D2216)	27.1
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	28
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Hydraulic Conductivity

Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D5084 Method C
Sample ID:	B-5: (33-35)		



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.80
Height (in)	2.55
Initial Mass (g)	500.5
Sample Area (in^2)	6.16
Water Content (%)	26.4
Total Unit Weight (pcf)	121.4
Dry Unit Weight (pcf)	96.1
Specific Gravity (Assumed)	2.65
Degree of Saturation	96.9
Void Ratio	0.72
Porosity	0.42
1 Pore Volume (cc)	107.8
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.99

Specimen Image

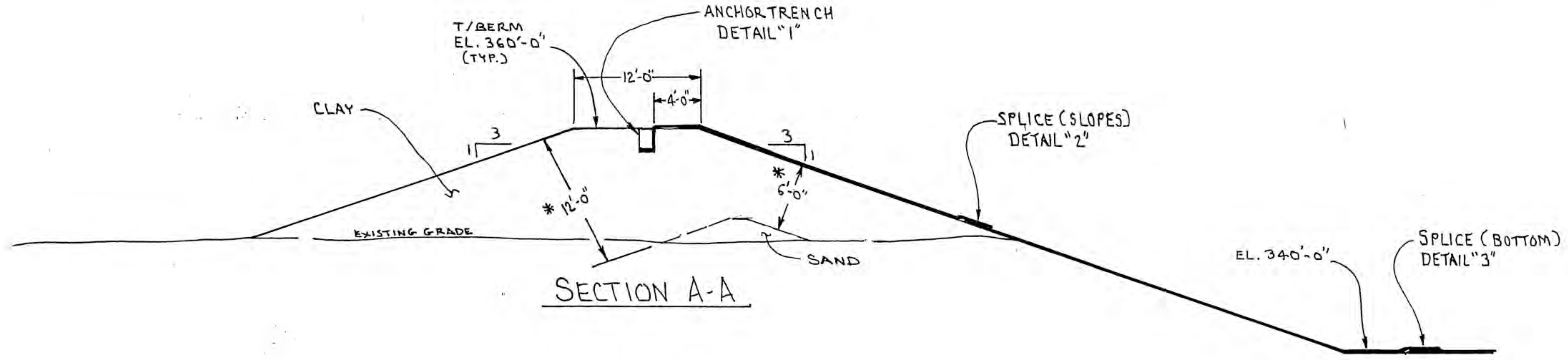
Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
36.0	3.0E-05
42.0	2.9E-05
48.0	3.1E-05
53.0	2.8E-05
Average, Last 4 Readings	**3.0E-05**

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016

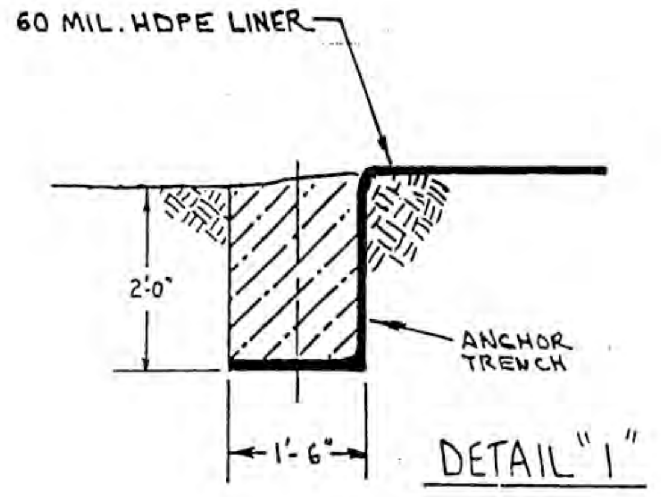
Analysis & Quality Review/Date

Testing Performed By: SOC & LC

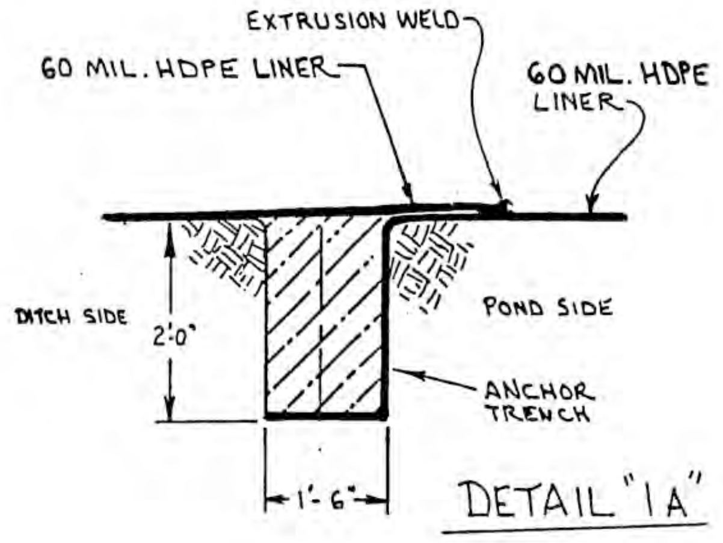
* - NOTE- THESE DIMENSIONS ARE SUBJECT TO ADJUSTMENT DEPENDING ON THE SAND / CLAY BALANCE VS. HAUL DISTANCE ON PROJECT.



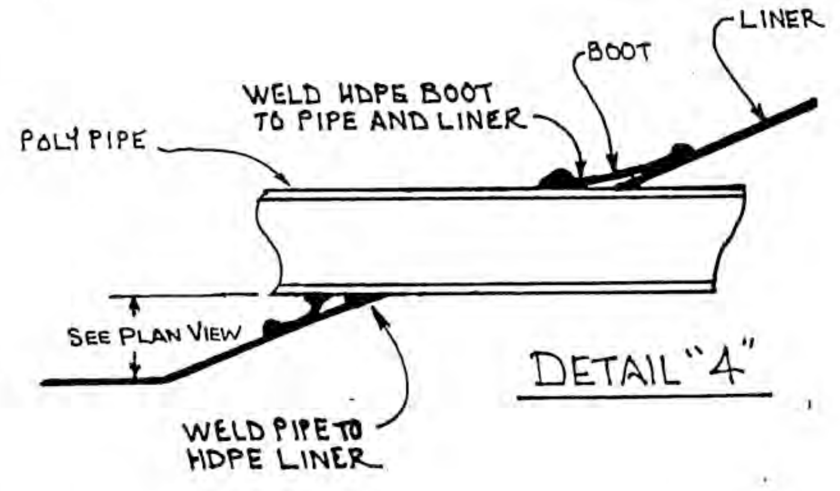
SECTION A-A



DETAIL "1"



DETAIL "1A"



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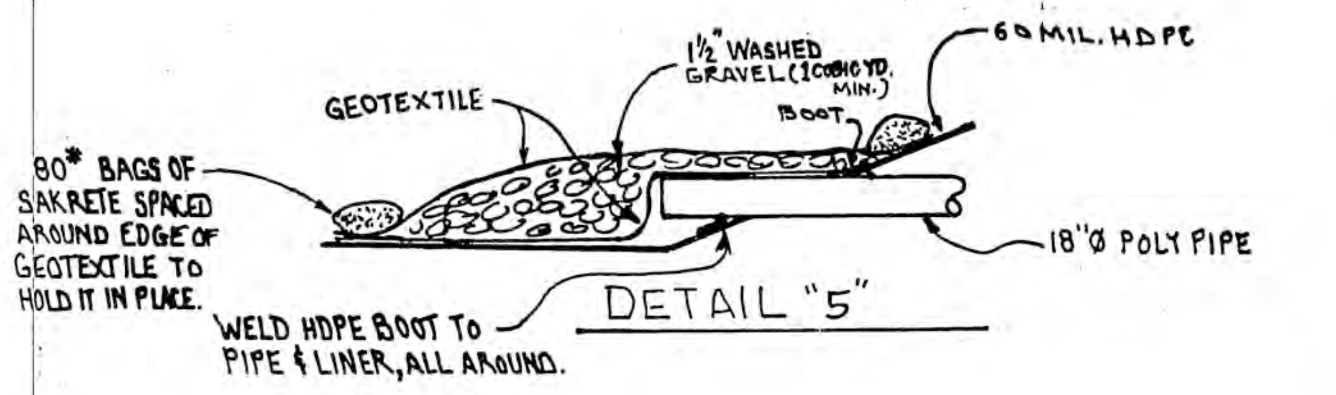
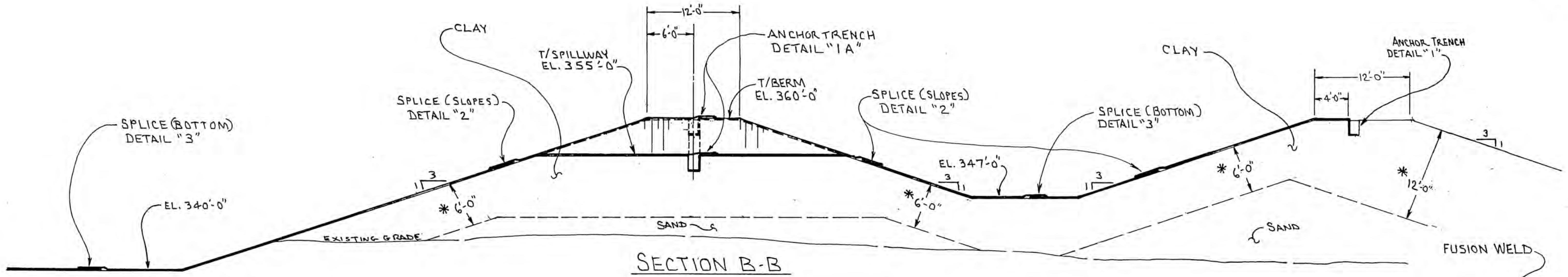
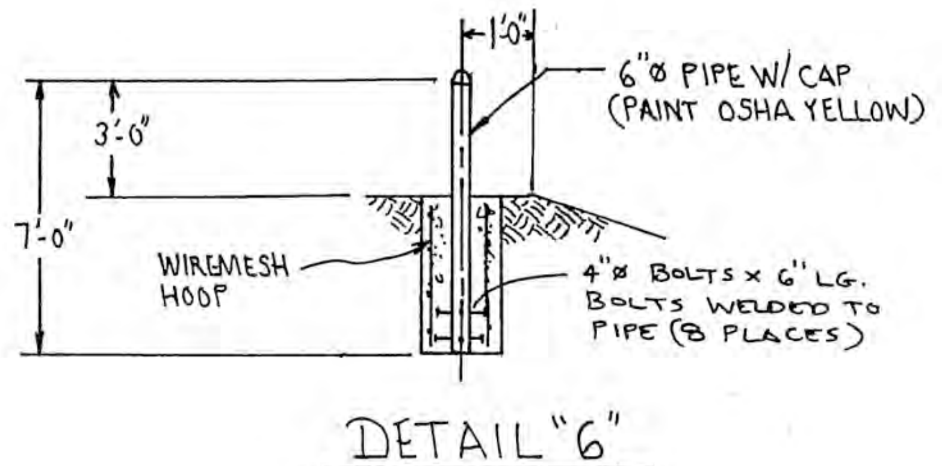


DETAIL "5"

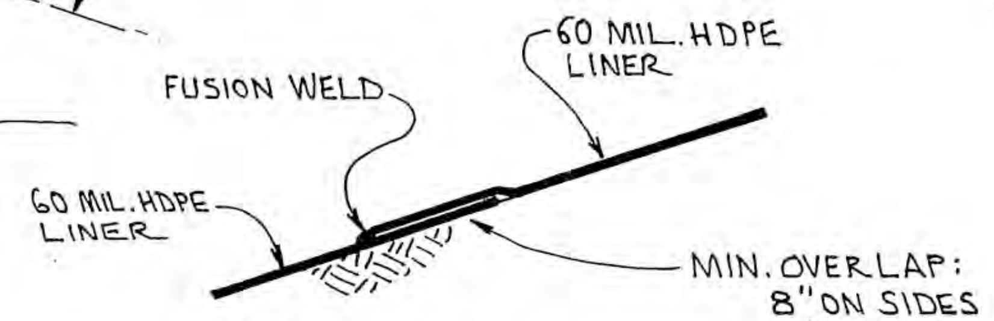


SECTION B-B



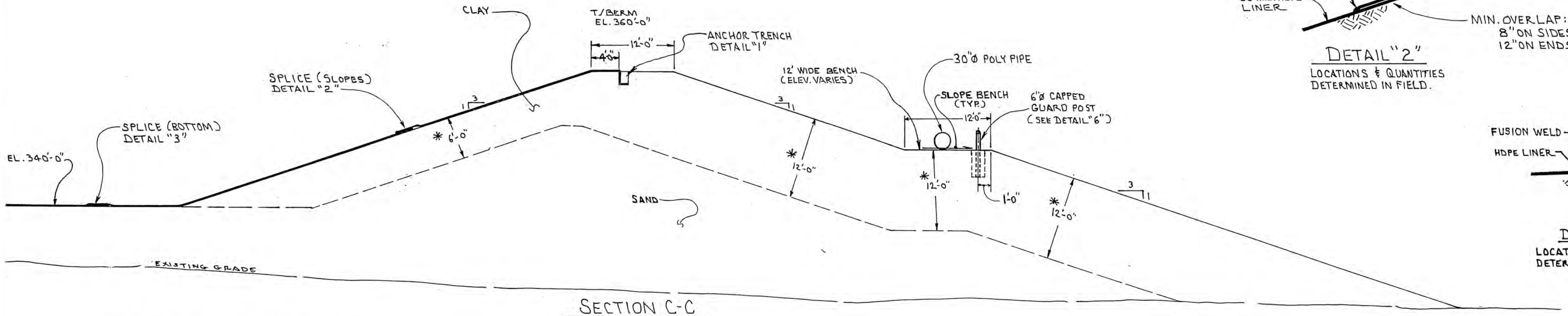
DETAIL "6"

50' ON CENTERS
(20 REQUIRED)

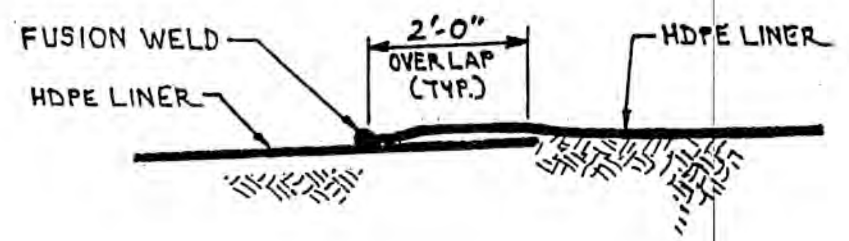


DETAIL "2"

LOCATIONS & QUANTITIES DETERMINED IN FIELD.

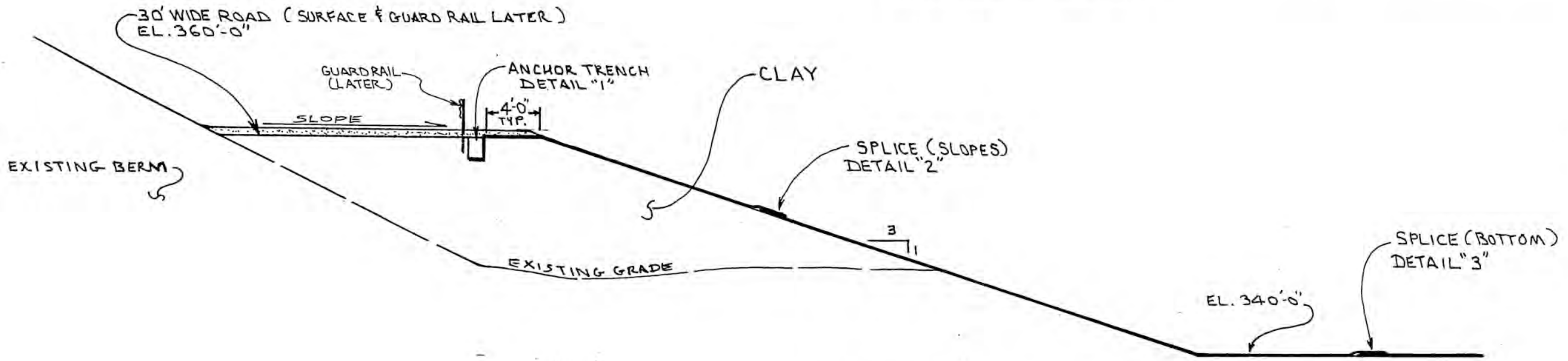


SECTION C-C

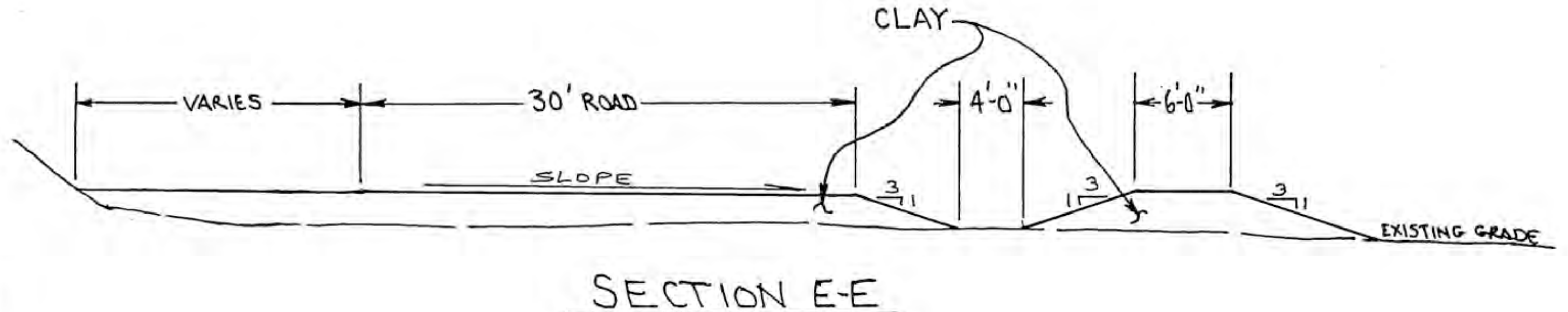


DETAIL "3"

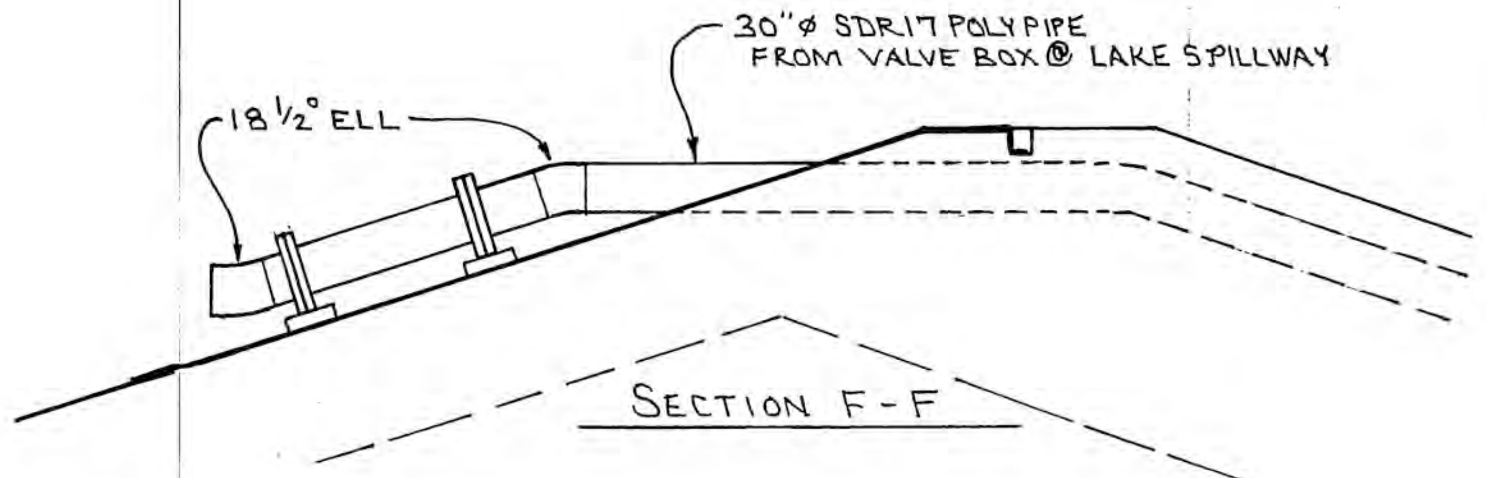
LOCATIONS & QUANTITIES DETERMINED IN FIELD



SECTION D-D



SECTION E-E



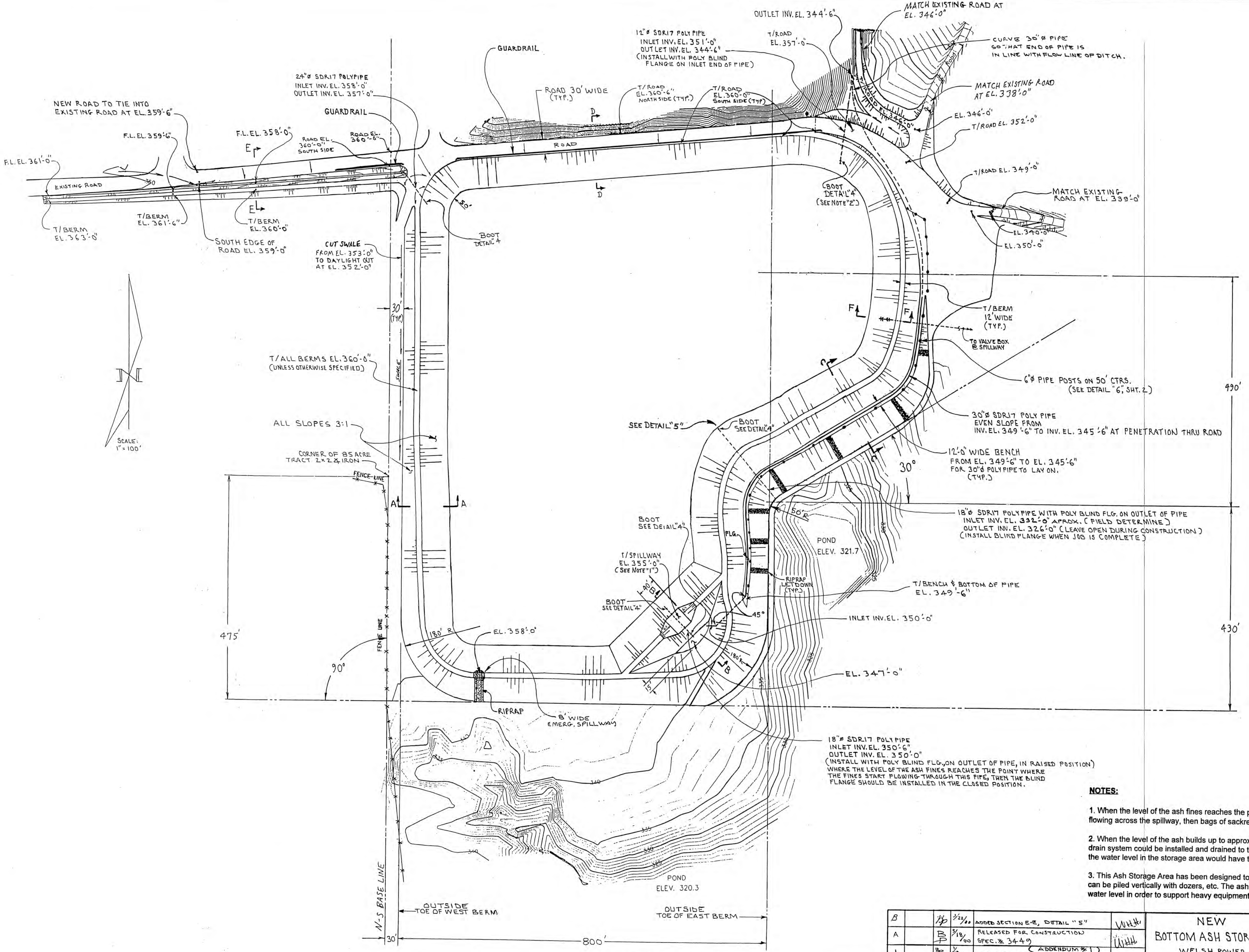
SECTION F-F

REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	10/29/00	AS BUILT	
A		BP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHK
1		BP	3/13/00	RELEASED FOR BIDS SPEC. # 3449 (ADDENDUM # 1)	
		BP	3/10/00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

DEPT.
DIV.
APPROVED
DRWN. BY: BP
DATE: 3-10-00
SCALE: AS SHOWN
W.O.
SH. 2 OF 2
DRWG. NO. WEPX- 335



NOTES:

1. When the level of the ash fines reaches the point where the fines start flowing across the spillway, then bags of sackrete can be installed to raise the spillway elevation.

2. When the level of the ash builds up to approx. elev. 355 along the north and east sides, a french drain system could be installed and drained to this outlet to help hold the water table down. Of course the water level in the storage area would have to be at elev. 351 or above for the french drain to function.

3. This Ash Storage Area has been designed to hold the water level as low as possible so the ash can be piled vertically with dozers, etc. The ash level needs to be approx. 4 ft. to 5 ft. above the water level in order to support heavy equipment.

REV.	W.O.	BY	DATE	SUBJECT	APPROVED
C		BP	10-29-00	AS BUILT	

REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	3/22/00	ADDED SECTION E-E, DETAIL "5"	WHH
A		BP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHH
1		BP	3/13/00	RELEASED FOR BIDS SPEC. #3449 (ADDENDUM #1)	
		BP	3-10-00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

DEPT.
DIV.
APPROVED
DRWN. BY: BP
DATE: 3-10-00
SCALE: 1" = 100'
W.O.
SH. 1 of 2
DRWG. NO. WEPX-335

MAXIM
TECHNOLOGIES INC

SUBSURFACE EXPLORATION

FOR

ASH STORAGE AREA, PHASE II
WELSH POWER PLANT
CASON, TEXAS

PREPARED FOR
SOUTHWESTERN ELECTRIC POWER COMPANY
ATTENTION: MR. WINSTON HOLLEY
P.O. BOX 21106
SHREVEPORT, LOUISIANA 71156

APRIL 27, 2000

MAXIM FILE #000444

MAXIM
TECHNOLOGIES INC

7222 Greenwood Road
P.O. Box 19220
Shreveport, LA 71149-0220
(318) 636-3673
Fax (318) 636-3723

April 27, 2000

Southwestern Electric Power Company
P.O. Box 21106
Shreveport, Louisiana 71156

Attention: Winston Holley

Reference: Subsurface Exploration
Ash Storage Area Phase II
Welsh Power Plant
Cason, Texas
Maxim File # 000444

Gentlemen:

Enclosed are a boring location diagram and boring logs with laboratory test results. The soil is comprised of silty sand (SM), clayey sandy silt (ML) and sandy silty clay (CL) materials.

We also enclose several soil profiles which provide soil categorization based upon elevation. Water was encountered at depths of thirteen (13) to eighteen (18) feet. The highest water elevation is 334.0 (along the west, north and center areas). Where the surface is lower (eastern and southern areas), the water levels are somewhat lower.

It has been a pleasure to perform this work for you. If we can be of any further assistance, please do not hesitate to call on us.

Very truly yours,

MAXIM TECHNOLOGIES, INC.

Gene Gardner

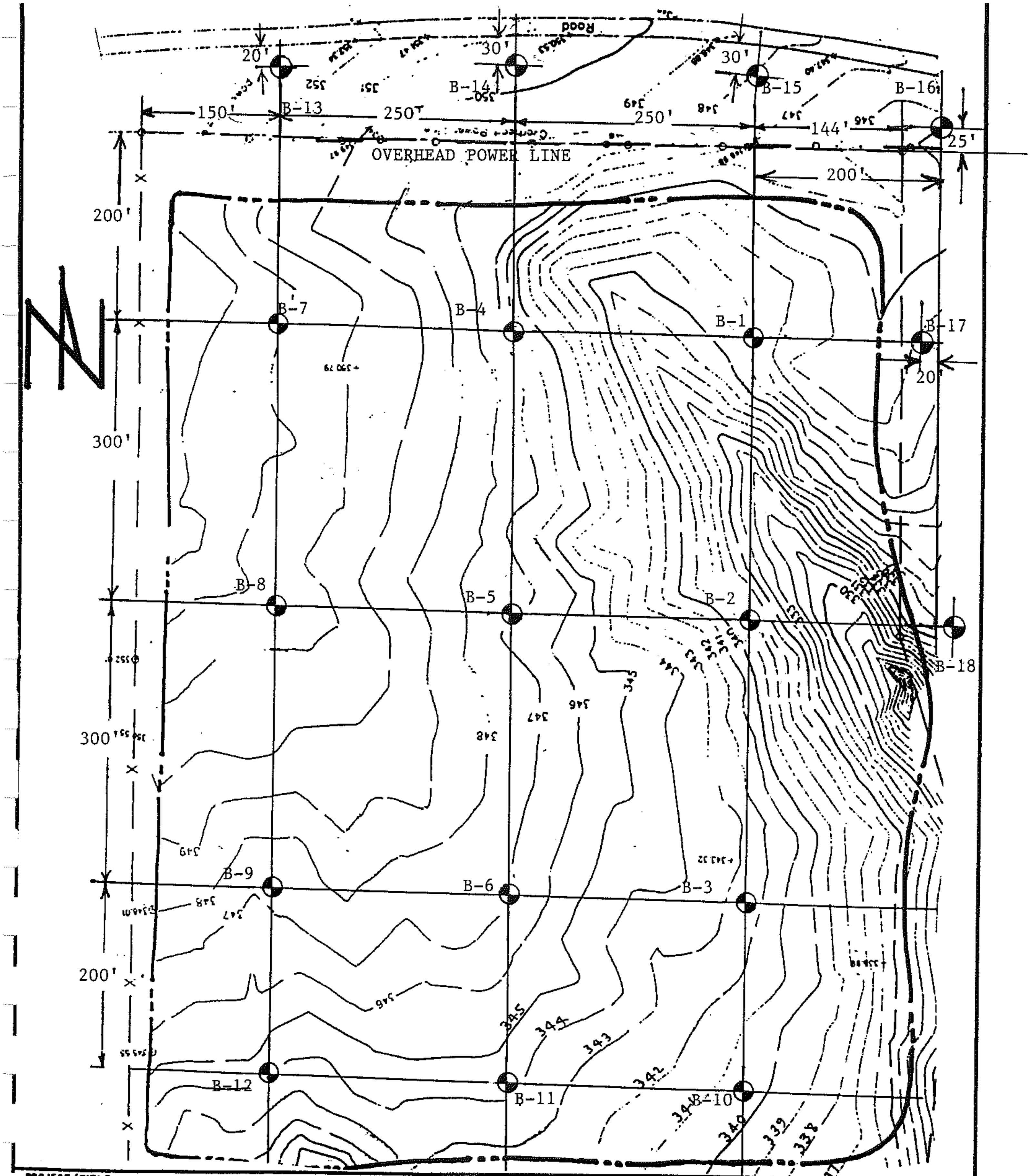
Gene Gardner, P.E.
Geotechnical Manager

STATE OF TEXAS
R. E. GARDNER
56016
REGISTERED PROFESSIONAL ENGINEER

Lloyd G. Hoover, P.E.
Louisiana District Manager

GG/LGH:mfh

cc: (3) client



PROJECT/TITLE

ASH STORAGE AREA - WELSH POWER PLANT

BORING LOCATION DIAGRAM

SITE LOCATION

CASON, TEXAS

SCALE: 3/4" = 100'

MAXIM FILE #000444

LOG OF BORING NO. B-1

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: ~~342.0~~ 341.86

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at thirteen (13) feet.

DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM	
												Six (6) inches of tan clayey sandy silt top soil	0.5
			20					55				Tan to red clayey sandy silt (ML)	
			18		25	18	7						
			14		21	17	4	57				-- Reddish tan	
5													
			10										8.0
			20					63				Tan to gray sandy silt (ML)	
10			26										
		▽											13.0
			30					30				Tan and gray silty sand (SM)	
15													15.0
												Bottom of boring	
20													
25													

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-2

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

CLIENT: Southwestern Electric Power Company

DATE: 4/6/00

SHEET 1 of 1

LOCATION: Cason, Texas

SURFACE ELEV: 341.5

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA										
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM	
		■		17									Six (6) inches of tan clayey sandy silt topsoil	0.5
		■		17		25	18	7	63				Tan clayey sandy silt (ML)	
	5	■		13		NP	NP	NP	61				Tan and tannish gray sandy silt (ML)	4.0
		■		11										
		■		16		20	17	3					Tan and gray clayey sandy silt (ML)	8.0
	10	■		22										
		■	▽	24									Gray sandy silt (ML)	12.0
	15												Bottom of boring	15.0
	20													
	25													

■	◧	☒	◫	◣	○
TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-3

PROJECT: Ash Storage Area Phase II-Welsh Power Plant
SHEET 1 of 1

CLIENT: Southwestern Electric Power Company
LOCATION: Cason, Texas

DATE: 4/6/00
SURFACE ELEV: 341.5

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA										
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM	
													Six (6) inches of tan clayey sandy silt topsoil	0.5
				16									Red to tan clayey sandy silt (ML)	
				18		23	18	5						4.0
	5			16		27	18	9					Red and light tan very sandy silty clay (CL)	
				17		31	19	12						8.0
				12									Tan and gray clayey silty sand (SC)	
	10			13					42					
			▽	19										15.0
	15			24					65				Gray and tan sandy silt (ML)	17.0
													Gray and tan silty sand (SM)	19.0
	20												Bottom of boring	
	25													

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

LOG OF BORING NO. B-4

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: 346.4

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA										
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM	
													Six (6) inches of tan clayey sandy silt topsoil	0.5
				19					50				Tan silty sand (SM)	2.0
				19		27	18	9					Reddish tan silty sandy clay (CL)	
	5			13					70					
				15										
				12										10.0
	10			20					51				Tan sandy silt (ML)	
			▽	26										15.0
	15												Bottom of boring	
	20													
	25													

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-5

PROJECT: Ash Storage Area Phase II-Welsh Power Plant
SHEET 1 of 1

CLIENT: Southwestern Electric Power Company
LOCATION: Cason, Texas

DATE: 4/6/00
SURFACE ELEV: 347.2

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: No waater was encountered

SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM	
	0												Six (6) inches of tan clayey sandy silt topsoil	0.5
▨		■		23									Reddish tan silty sandy clay (CL)	
▨		■		19		29	19	10						
▨	5	■		19		26	18	8						6.0
		■		14									Tan silty sand (SM)	
		■		15					49					
	10	■		18										
		☐												
		■		11					34				-- Light tan and gray	
	15												Bottom of boring	15.0
	20													
	25													

REMARKS:

■	▮	☒	☐	◣	○
TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

LOG OF BORING NO. B-6

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: 345.9

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt topsoil 0.5
				18									Tan to red silty sandy clay (CL)
				19		27	18	9					
				17									
	5												
				17		28	19	9					
				14									
	10			17		16	16	NP	53				10.0 Reddish tan sandy silt (ML)
													-- Tan
			▽	17									
	15												15.0 Bottom of boring
	20												
	25												

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

LOG OF BORING NO. B-7

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

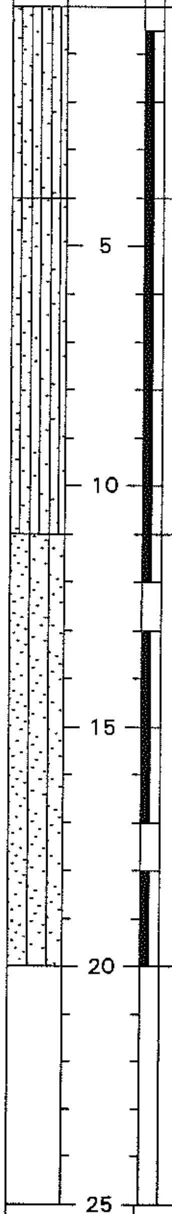
LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: 351.6

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at eighteen (1B) feet.



N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
	18		NP	NP	NP					Tan and gray sandy silt (ML)
	20		NP	NP	NP					
										4.0
	16									Reddish tan clayey sandy silt (ML)
	12		25	18	7					-- Red
	12									
	19		22	17	5					-- Red and tan
										11.0
										Tan to gray silty sand (SM)
	22					39				
	24									-- Tan
▽	25									
										20.0
										Bottom of boring

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-8

PROJECT: Ash Storage Area Phase II-Welsh Power Plant
SHEET 1 of 1

CLIENT: Southwestern Electric Power Company
LOCATION: Cason, Texas

DATE: 4/6/00
SURFACE ELEV: 350.7

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at seventeen (17) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt topsoil 0.5
				21									Red to reddish tan silty sandy clay (CLS)
				22		34	20	14					
				20									-- Gray and red
	5												
				17		34	20	14					-- Red to reddish tan
													8.0
				13									Reddish tan sandy silt (ML)
	10												
				13		NP	NP	NP					
													11.0
													Tan silty sand (SM)
				23									
	15												
				23									
			▽										
				26		NP	NP	NP	44				
	20												20.0
													Bottom of boring
	25												

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

LOG OF BORING NO. B-9

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: 346.8

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA										
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM	
													Six (6) inches of tan clayey sandy silt topsoil	0.5
				16									Tan clayey sandy silt (ML)	
				18										
				16		25	18	7						
	5													5.0
													Red and reddish tan silty sand (SM)	
				10										
				12		NP	NP	NP						9.0
													Tan silty sandy clay (CL)	
	10			16		35	20	15						12.0
													Tan silty sand (SM)	
				22										
			∇											
	15													15.0
													Bottom of boring	
	20													
	25													

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

LOG OF BORING NO. B-10

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

CLIENT: Southwestern Electric Power Company

DATE: 4/6/00

SHEET 1 of 1

LOCATION: Cason, Texas

SURFACE ELEV: ~~340.4~~ 337.64

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt topsoil 0.5
				17									Reddish tan silty sandy clay (CL)
				18		31	19	12					
				14		34	20	14					-- Reddish gray to tannish gray
	5												
				16									-- Tan
				15		28	19	9					-- Reddish tan
	10			17									-- Tannish gray
				20		30	19	11					14.0
			▽										Tan clayey sand (SC) 15.0
	15												Bottom of boring
	20												
	25												

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-11

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: ~~344.2~~ 342.01

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fifteen (15) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of clayey sandy silt topsoil 0.5
		TUBE SAMPLE		18									Tan to tan gray silty sandy clay (CL)
				17		29	19	10					4.0
				16		32	19	13					Gray and tan sandy silty clay (CL)
	5												
				14									
				14		29	19	10					
	10			16									13.0
		TUBE SAMPLE		19		17	16	1					Light tan clayey silty sand (SC)
	15		▽										15.0
													Bottom of boring
	20												
	25												

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

LOG OF BORING NO. B-12

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: ~~344.0~~ 342.84

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA										
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM	
													Six (6) inches of tan clayey sandy silt topsoil	0.5
				18									Reddish tan silty sandy clay (CL)	
				20		41	21	20						
				15		37	20	17						
	5													6.0
				14					47				Yellowish tan to tannish gray slightly clayey silty sand (SC)	8.0
				13		36	20	16					Tan and gray sandy silty clay (CL)	
	10			15										13.0
				15		17	16	1					Tan and gray slightly clayey silty sand (SC)	
			▽											15.0
	15												Bottom of boring	
	20													
	25													

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

LOG OF BORING NO. B-13

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/18/00

SURFACE ELEV: ~~353.0~~ 351.84

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: No water was encountered

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt topsoil (ML) 0.5
				21									Mottled red and tan sandy silty clay (CL)
				21		28	19	9					
				21					74				
	5												
				20		39	21	18					
				19									
	10			19		32	19	13					
				18		36	20	16					-- Tan and gray
	15			19									
				18									
	20												20.0 Bottom of boring
	25												

TUBE SAMPLE	AUGER SAMPLE	☒ SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-14

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/18/00

SURFACE ELEV: ~~350.5~~ 349.23

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encouhntered at eighteen (18) feet.

DEPTH (FT)	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
											Six (6) inches of tan clayey sandy silt topsoil (ML) 0.5
		16		25	18	7					Mottled red and tan clayey sandy silt (ML) 2.0
		18		27	18	9					Mottled red and gray sandy silty clay (CL)
		19									
5											
		19		36	20	16					
		20									
10		18									
		19		30	19	11					
15		21									18.0
	∇	64					70				Tan clayey sandy silt 20.0
20											Bottom of boring
25											

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-15

PROJECT: Ash Storage Area Phase II-Welsh Power Plant	**SHEET** 1 of 1
CLIENT: Southwestern Electric Power Company	**LOCATION:** Cason, Texas
DATE: 4/18/00	**SURFACE ELEV:** ~~348.0~~ 348.24

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at sixteen (16) feet.

DEPTH (FT)	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
											Six (6) inches of tan clayey sandy silt topsoil (ML) 0.5
		16									Reddish tan silty sandy clay (CL) -- with iron ore nodules -- red and gray mottled
		16		32	19	13					
		18		33	20	13					
5											
		14									
		12		32	19	13					
10											10.0
		12					18				Tan fine silty sand (SM)
											13.0
		18									Tan and gray very silty clay (CL)
15		21									
	▽										
		22		28	19	9					-- With gray silty clay stringers
20											20.0
											Bottom of boring
25											

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-16

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/18/00

SURFACE ELEV: ~~346.0~~ 345.44

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at nineteen (19) feet.

SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey silty sand topsoil (SC) 0.5
				13					61				Reddish tan and gray silty sandy clay (CL)
				16									
				16		32	19	13					
	5												
				15		25	18	7					6.0 Tan clayey sandy silt (ML)
				19									
	10			20									
				20					59				
	15			20									
													-- With thin clay stringers
				21									
			▽										
	20												20.0 Bottom of boring
	25												

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-17

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/18/00

SURFACE ELEV: ~~342.0~~ 342.72

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: No water encountered

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
				16					50				Six (6) inches of tan clayey silty sand topsoil (SC) 0.5
				16		25	18	7					Tan clayey silty sand (SC)
				12									
	5												
				10									
				10									
													9.0 Tan silty sand (SM)
	10												
				17					51				-- With clayey sand pockets
	15												15.0 Bottom of boring
	20												
	25												

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

REMARKS:

LOG OF BORING NO. B-18

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/18/00

SURFACE ELEV: ~~336.0~~ 338.72

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

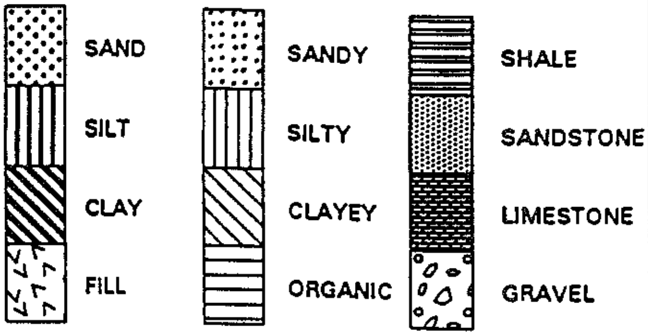
FIELD DATA				LABORATORY DATA										
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM	
													Six (6) inches of tan clayey silty sand topsoil (SC)	0.5
				15					35				Tan silty sand (SM) with red and gray clay lumps	
				15										
				11										
	5													
				10										8.0
				14					42				Gray silty sand (SM)	
	10													
				19										
				24					82					15.0
	15												Bottom of boring	
	20													
	25													

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

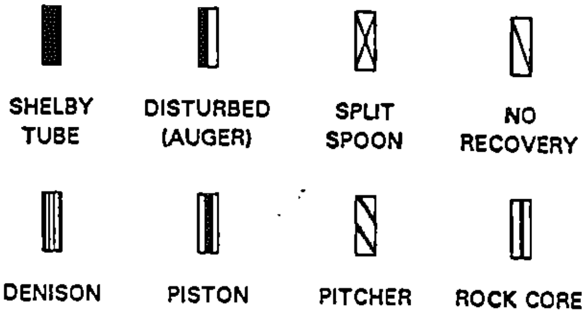
REMARKS:

KEY TO SOIL CLASSIFICATION TERMS AND SYMBOLS

SOIL OR ROCK TYPES



SAMPLER TYPES



CONSISTENCY OF COHESIVE SOILS (MAJOR PORTION PASSING NO. 200 SIEVE)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH, KIPS/SQ FT
VERY SOFT	LESS THAN 0.25
SOFT	0.25 TO 0.5
FIRM	0.5 TO 1.0
STIFF	1.0 TO 2.0
VERY STIFF	2.0 TO 4.0
HARD	GREATER THAN 4.0

RELATIVE DENSITY OF GRANULAR SOILS (MAJOR PORTION RETAINED ON NO. 200 SIEVE)

DESCRIPTIVE TERM	RELATIVE DENSITY,%
VERY LOOSE	LESS THAN 15
LOOSE	15 TO 35
MEDIUM DENSE	35 TO 65
DENSE	65 TO 85
VERY DENSE	GREATER THAN 85

WATER LEVELS

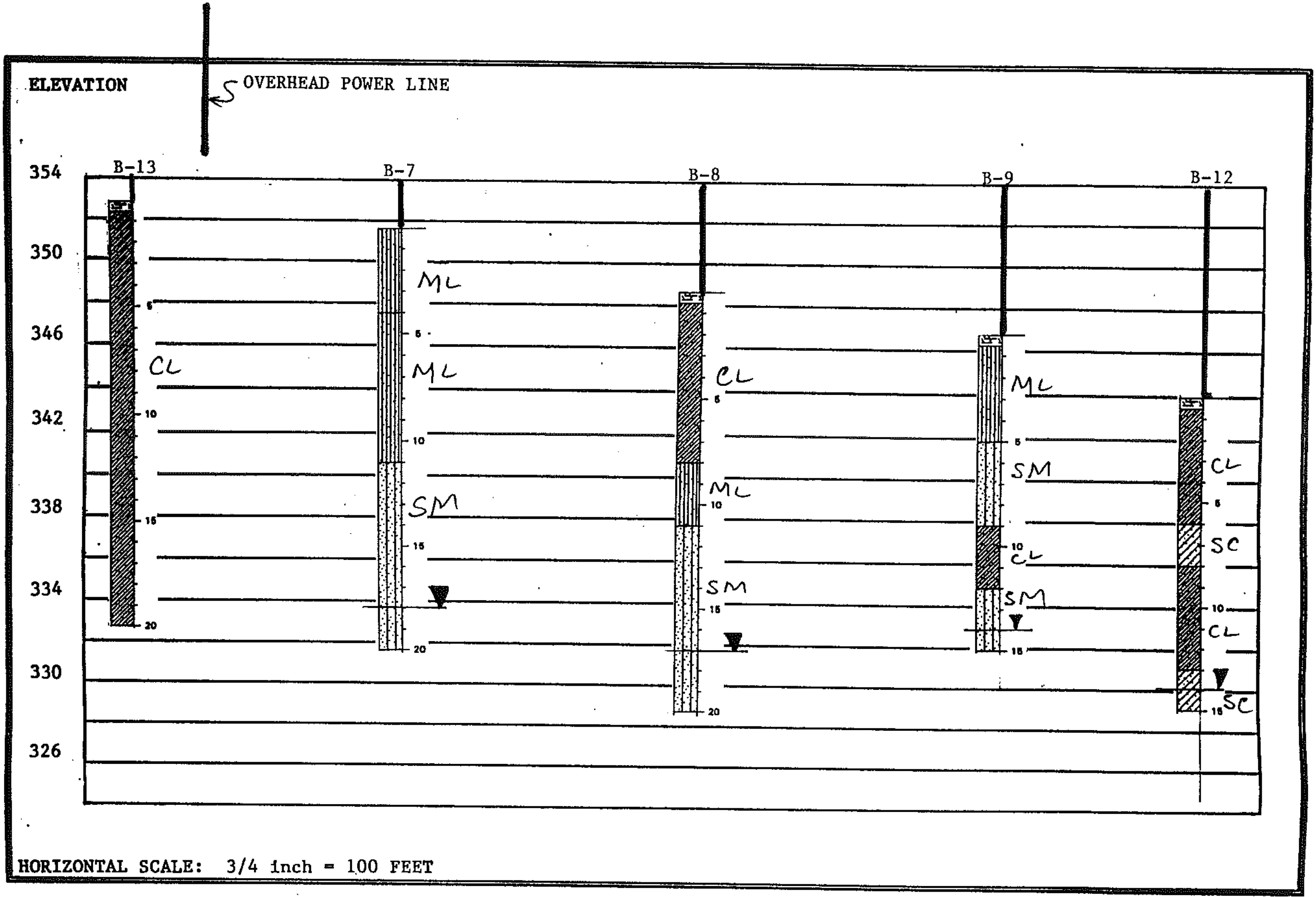
▼ - DEPTH GROUNDWATER FIRST ENCOUNTERED DURING DRILLING

▽ - GROUNDWATER LEVEL AFTER 24 HOURS (UNLESS OTHERWISE NOTED)

TERMS DESCRIBING SOIL STRUCTURE

Parting:	paper thin in thickness
Seam:	1/8" - 3" in thickness
Layer:	greater than 3" in thickness
Calcareous:	containing appreciable quanties of calcium carbonate
Ferrous:	containing appreciable quantities of iron
Well-graded:	having wide range in grain size & similar proportions of all intermediate sizes
Poorly graded:	predominately one grain size or having a range of sizes with few or no particles of some intermediate sizes
Fissured:	containing shrinkage cracks, frequently filled with fine sand or silt, usually more or less vertical
Interbedded:	composed of alternate layers of different soil types
Laminated:	composed of thin layers of varying color and texture
Slickensided:	having inclined planes of weakness that are slick & glossy in appearance

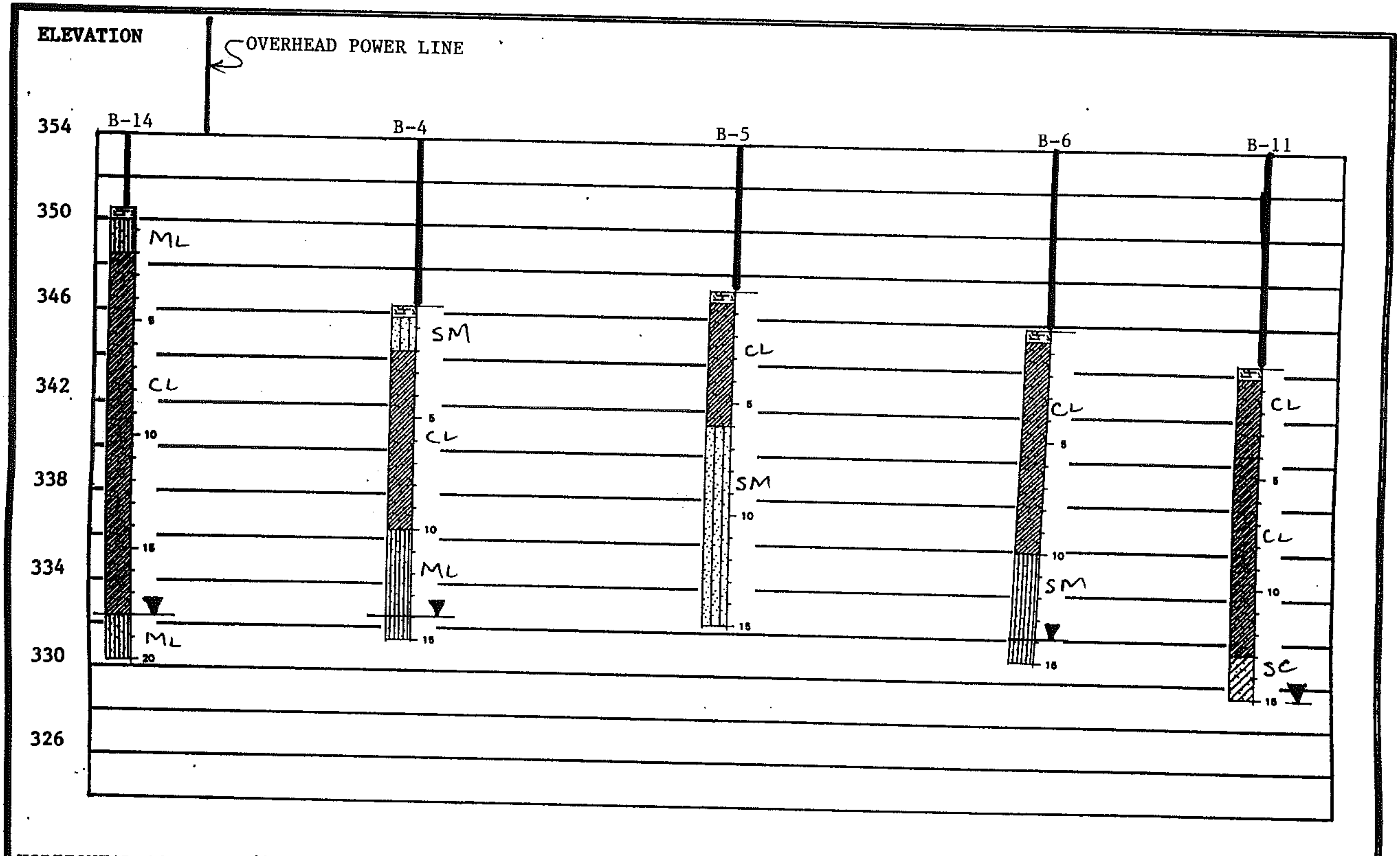
NOTE: Clays possessing slickensided or fissured structure may exhibit lower measured shear strength than indicated by the described consistency. The consistency of such soil is interprsted using the measured shear strength along with pocket penetrometer results.



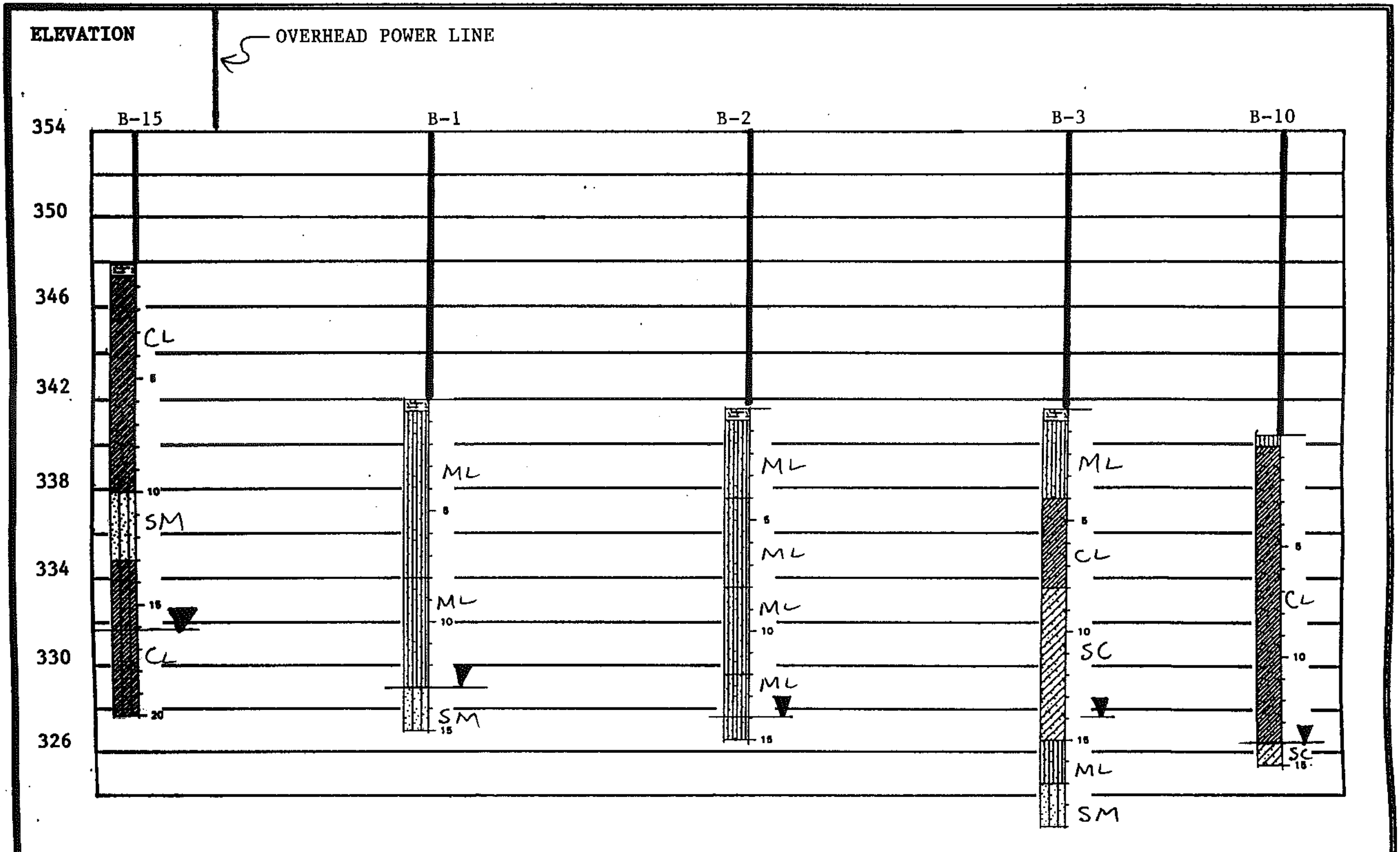
HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

MAXIM FILE #000444



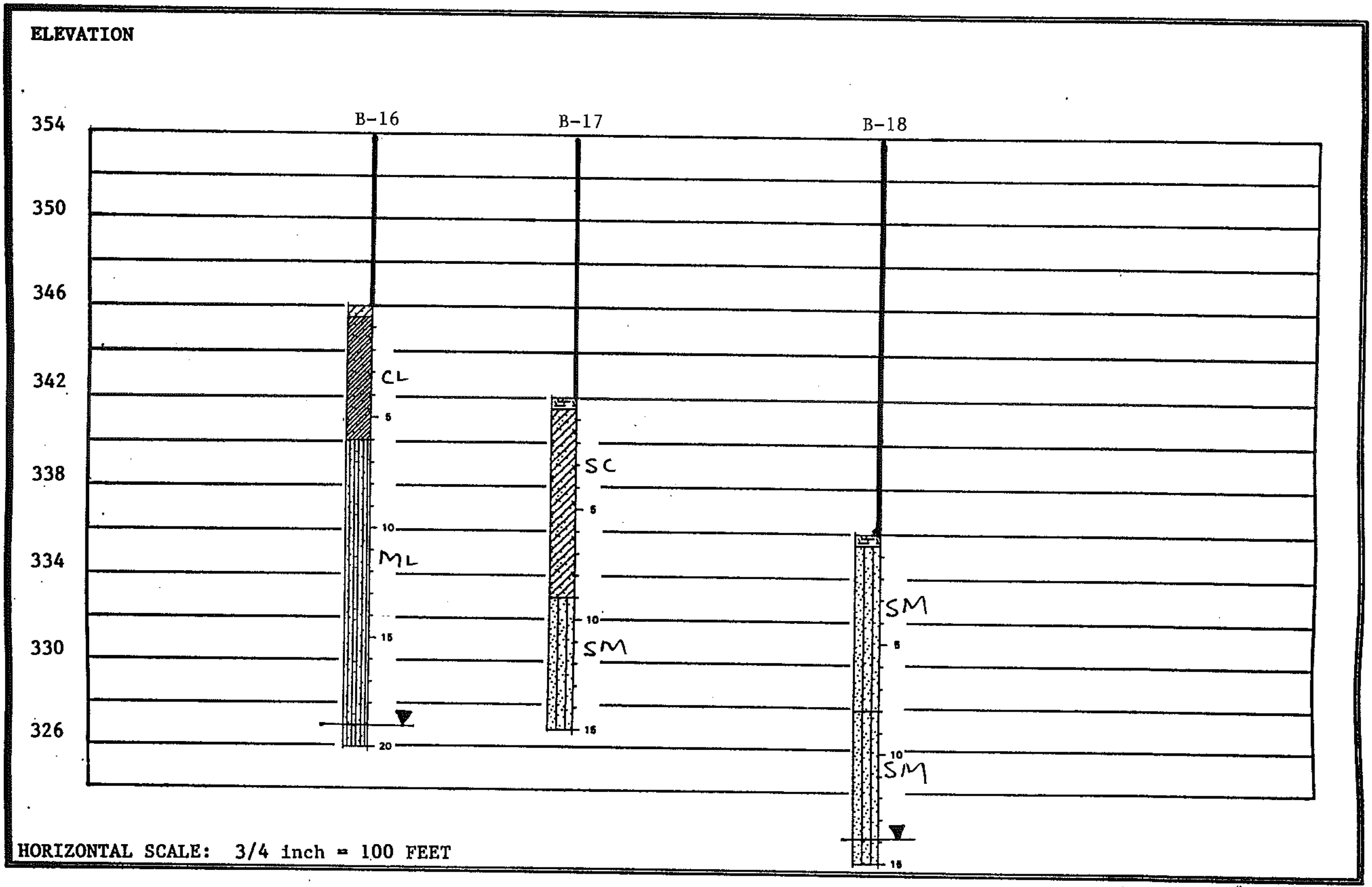
HORIZONTAL SCALE: 3/4 inch = 100 FEET



HORIZONTAL SCALE: 3/4 inch = 100 FEET

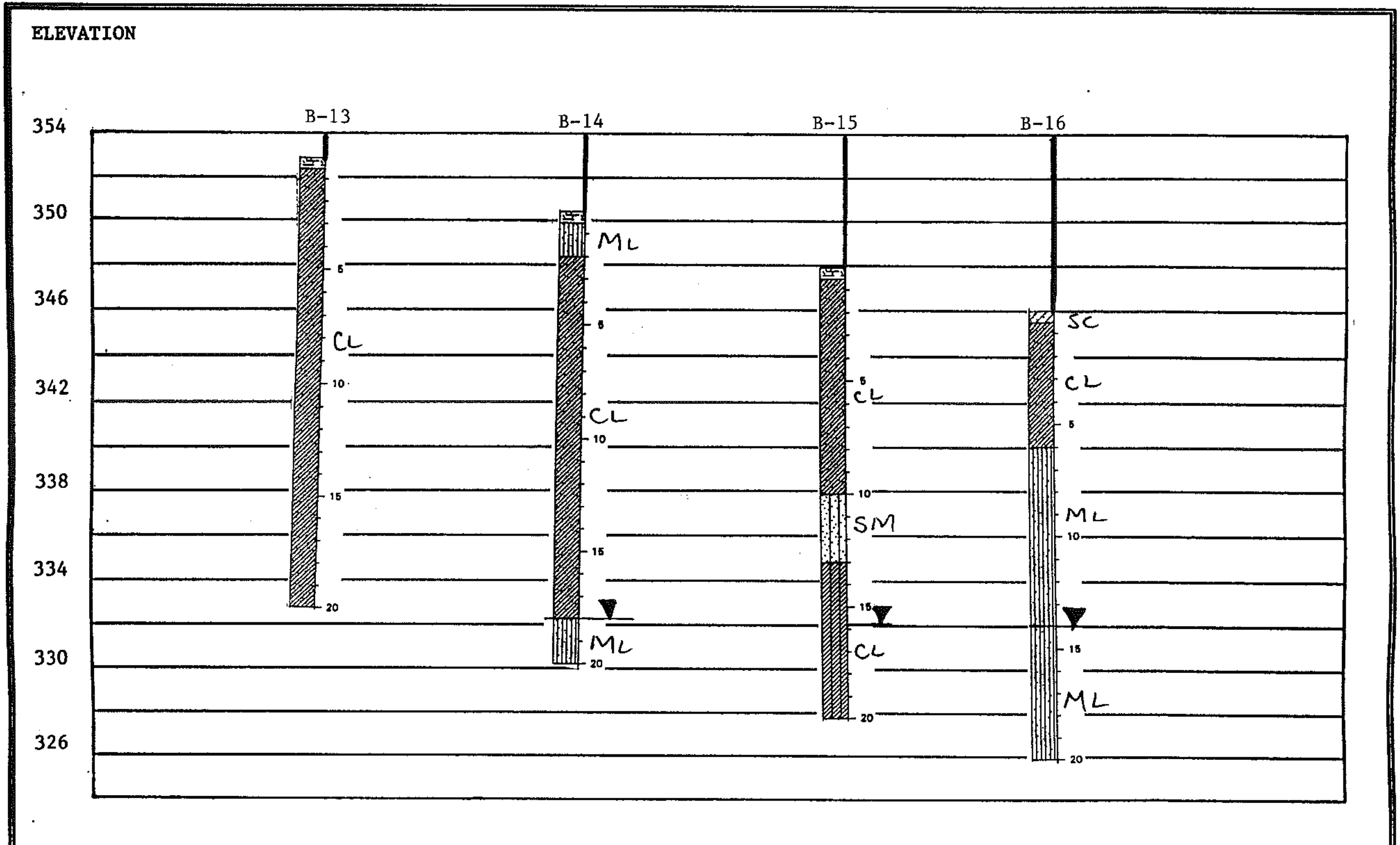
MAXIM TECHNOLOGIES, INC.

MAXIM FILE #000444



MAXIM TECHNOLOGIES, INC.

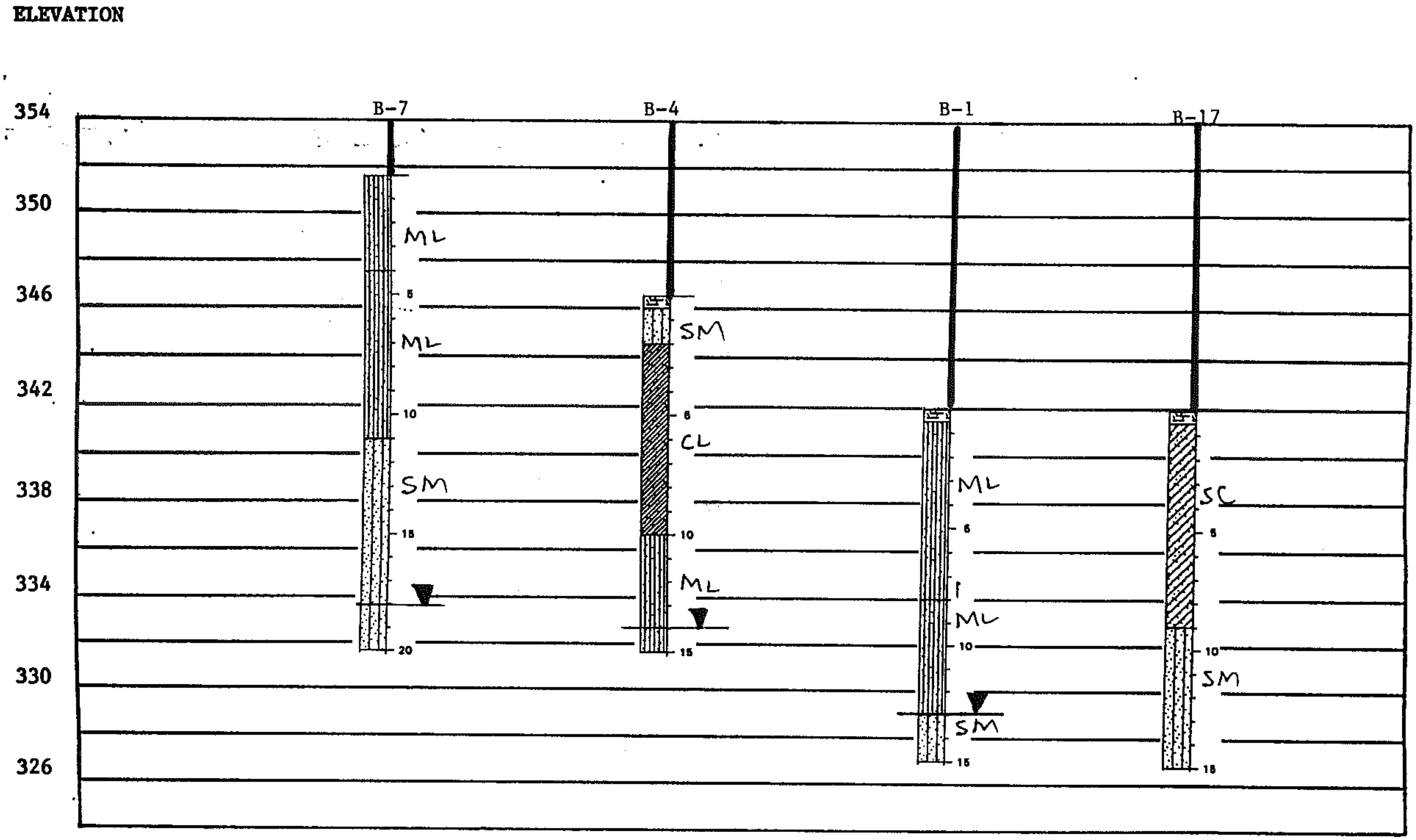
MAXIM FILE #000444



HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

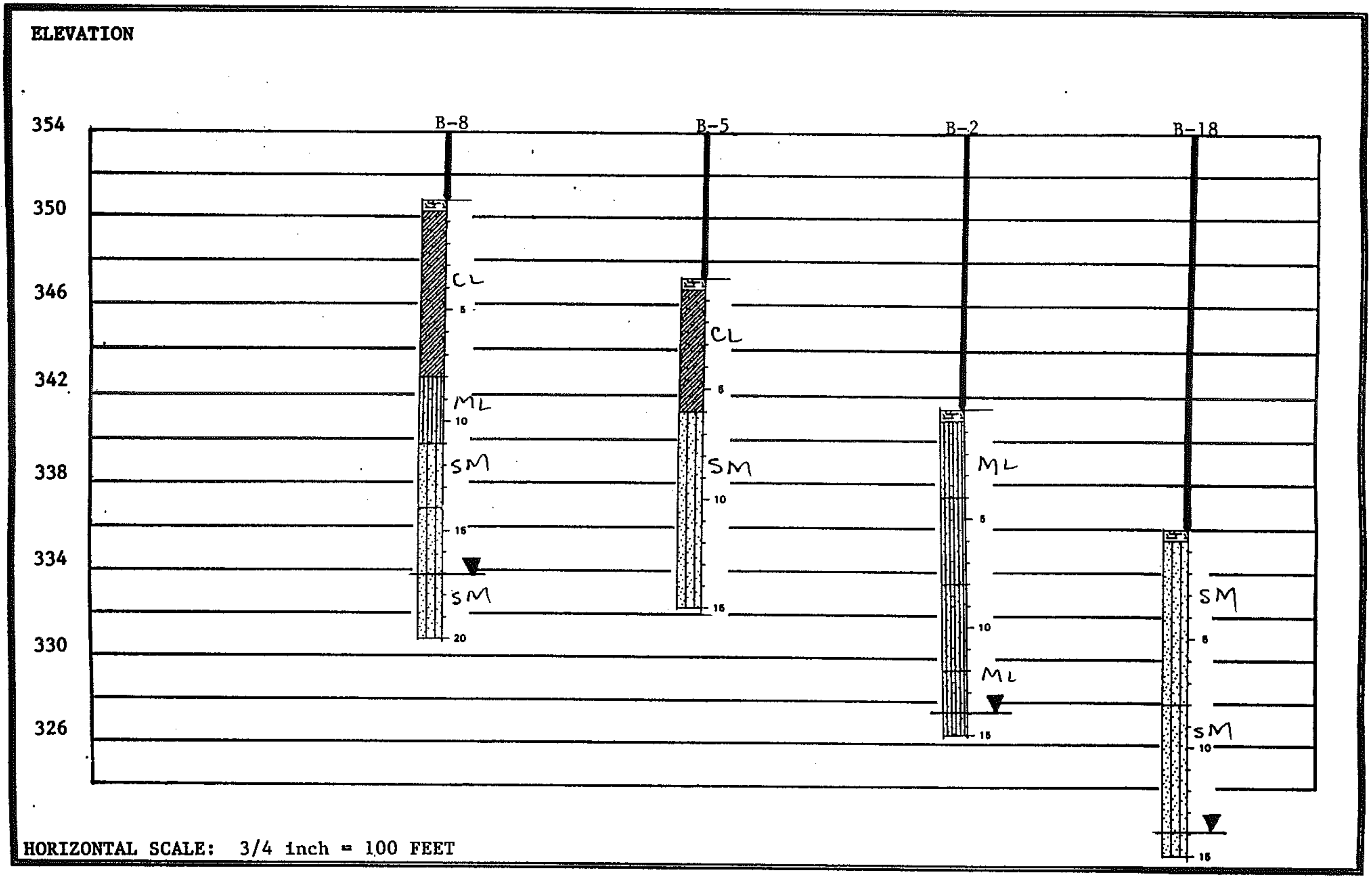
MAXIM FILE #000444



HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

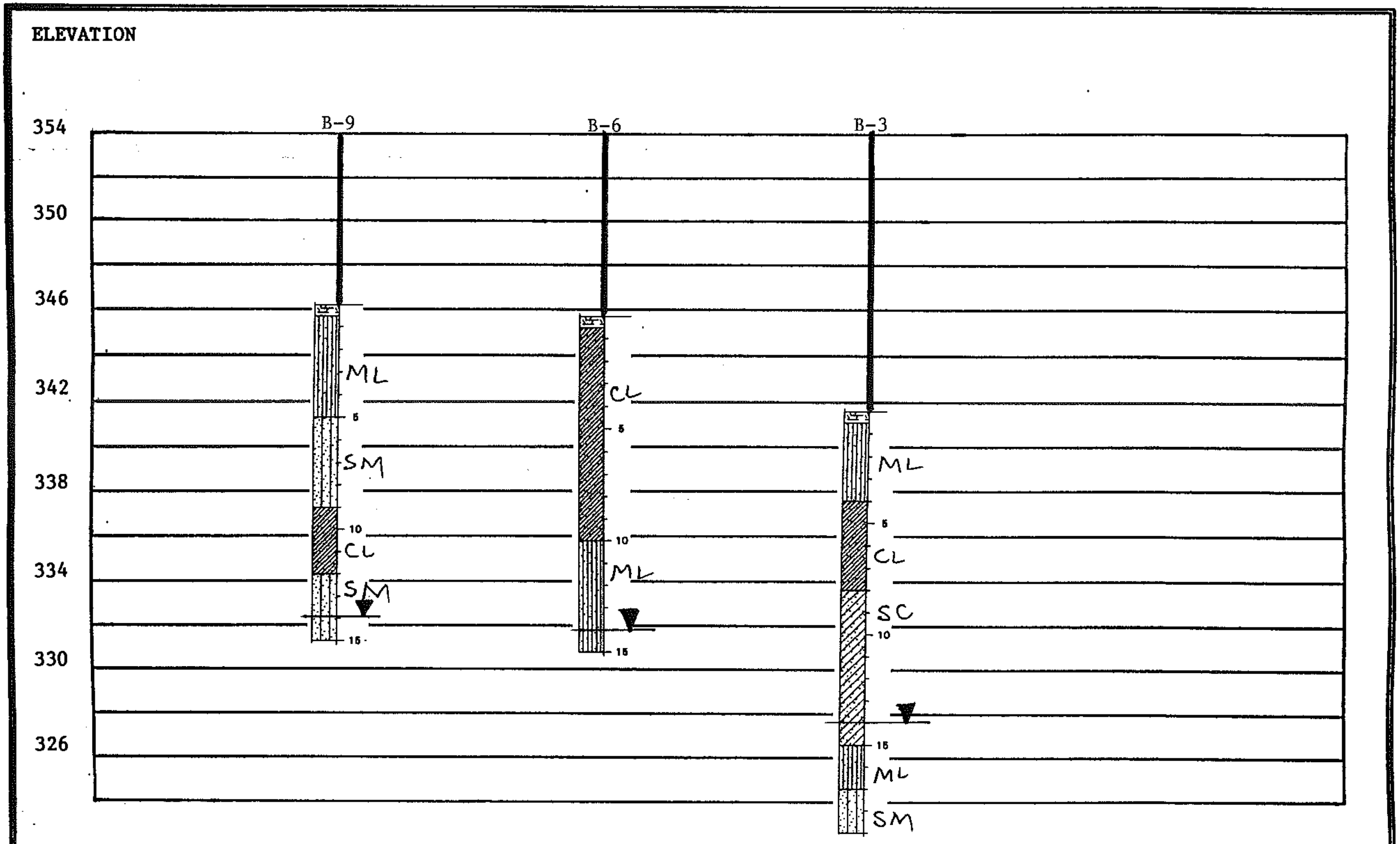
MAXIM FILE #000444



HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

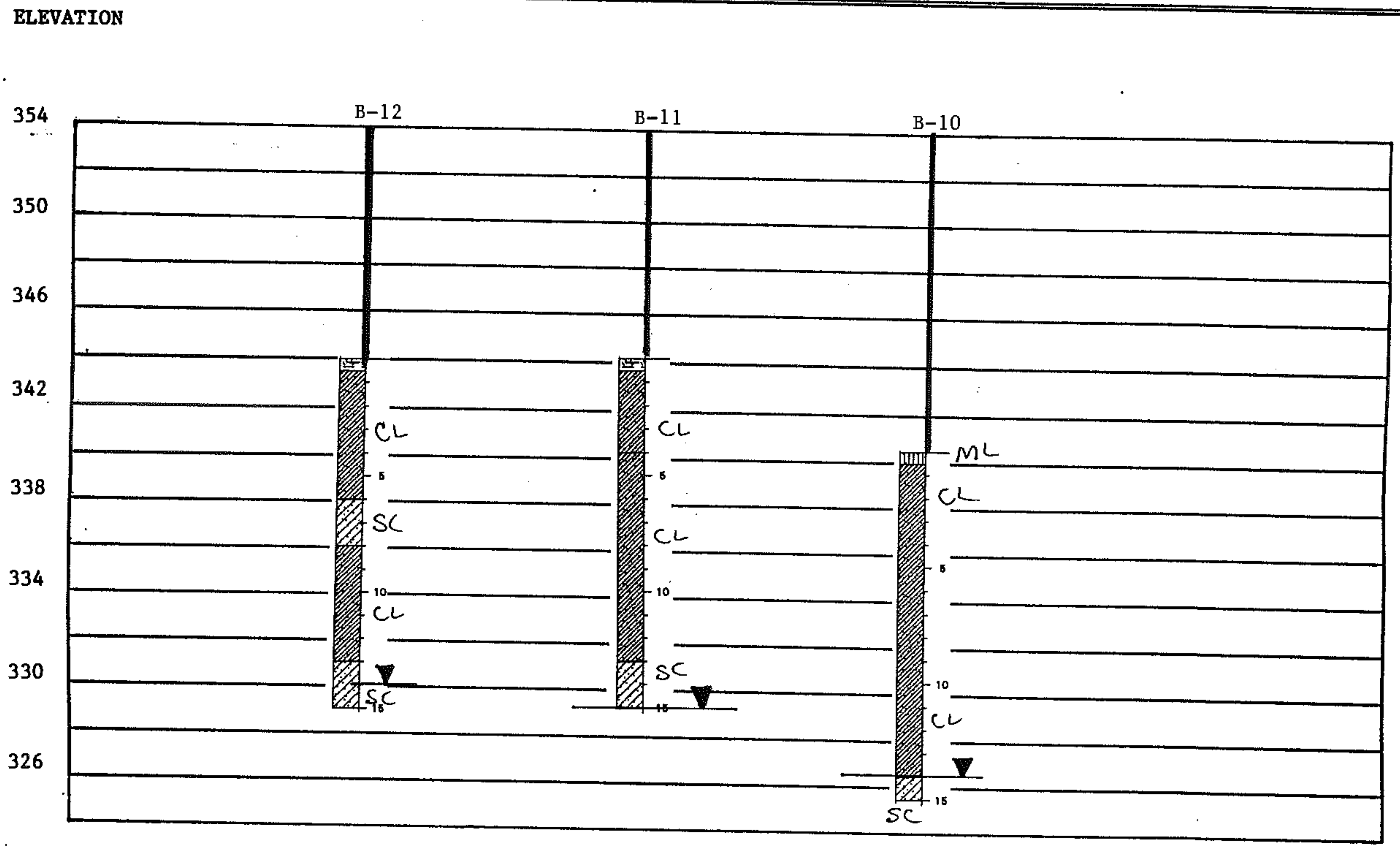
MAXIM FILE #000444



HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

MAXIM FILE #000444



HORIZONTAL SCALE: 3/4 inch = 100 FEET

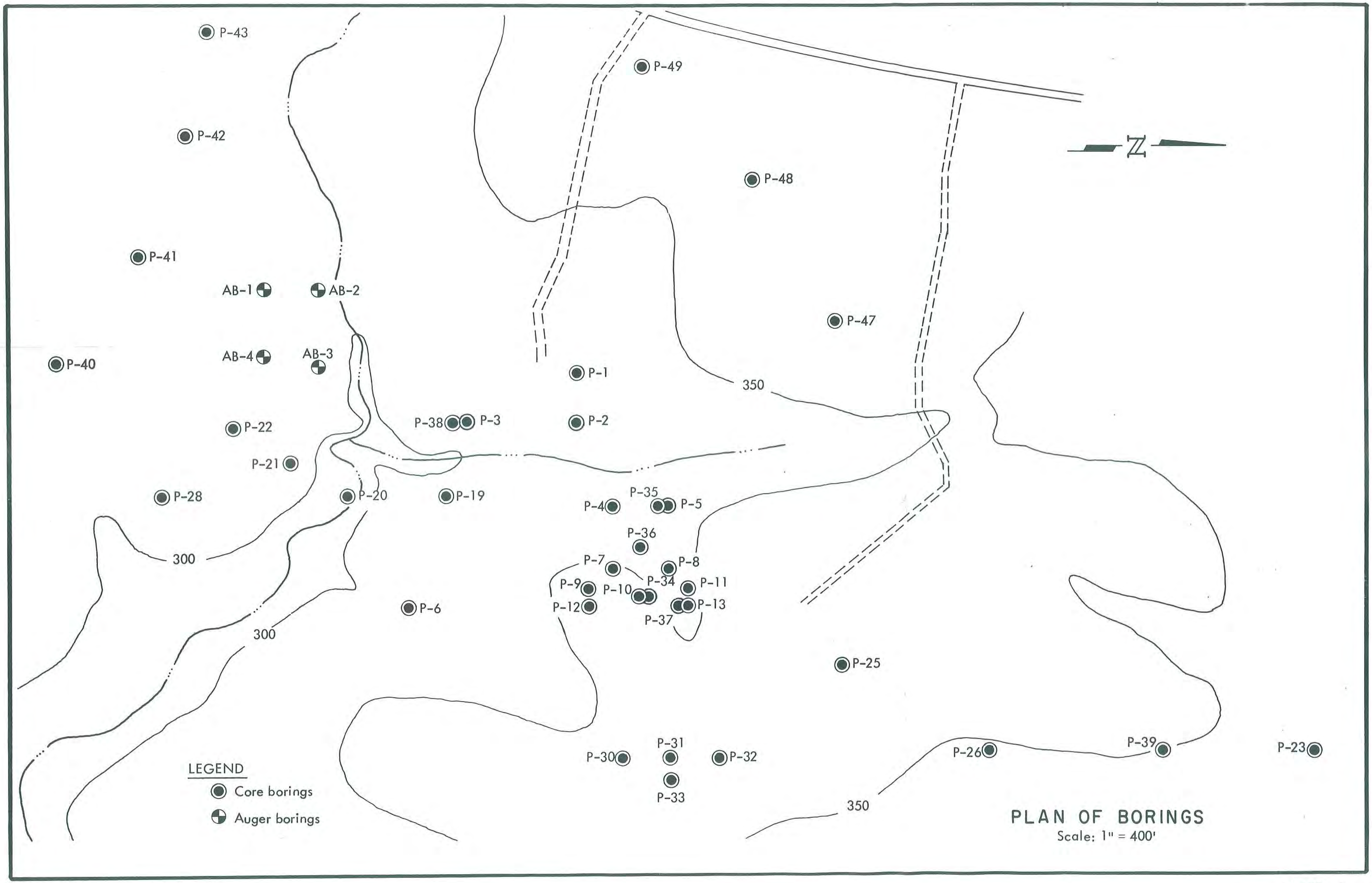
PRELIMINARY REPORT

SOILS INVESTIGATION
WELSH POWER PLANT
CASON, TEXAS

Report to

SOUTHWESTERN ELECTRIC POWER COMPANY
Shreveport, Louisiana

McClelland
engineers, inc.
geotechnical
consultants



PLAN OF BORINGS

Scale: 1" = 400'

McClelland engineers, inc. / geotechnical consultants

6100 HILLCROFT / HOUSTON, TEXAS 77036
TEL. 713 / 772-3701 / TELEX 762-447

August 31, 1973
Job No. 73-085

Southwestern Electric Power Company
P. O. box 1106
Shreveport, Louisiana 71156

Attention: Mr. W. H. Holley

Preliminary Report
Soils Investigation
Welsh Power Plant
Cason, Texas

Gentlemen:

Presented here are the logs of borings and the results of laboratory soil tests made to investigate soil conditions at the proposed Welsh Power Plant near Cason, Texas. This study was authorized by your Purchase Order No. Y-14567 dated March 27, 1973 and was performed in accordance with our letters of February 20, March 20, and April 30, 1973.

Soil conditions at the site were investigated by 38 undisturbed-sample or core borings and 4 disturbed-sample or auger borings drilled at the locations shown on Plate 1. The core borings were drilled to depths ranging from 25 to 198.5 ft, and the auger borings were drilled to depths ranging from 12.5 to 20 ft. Samples of the foundation materials were obtained in general accordance with specifications issued by Sargent & Lundy. Samples were generally obtained at about 5-ft intervals in the core borings using 3-in. thin-wall-tube, 2-in. split-barrel and Denison barrel samplers. Samples were obtained continuously in the auger borings using a 4-in. auger.

Detailed descriptions of the soils encountered in the borings are given on the logs of borings presented on Plates 2 through 43. The logs of borings presented on Plates 31 through 43 are presented in preliminary form and will be resubmitted in final form when laboratory testing on samples from these borings is complete. Most of the terms and symbols appearing on the logs are identified on Plate 44.

RECEIVED
SEP 4 - 1973
OFFICE OF
W. H. HOLLEY

The following tabulation gives the types of soil tests performed and the symbols used in plotting test results on the logs of borings.

Type of Test	Symbol
Shear Strength	
Unconfined Compression	○
Unconsolidated-undrained Triaxial	△
Hand Penetrometer	⊗
Water Content	●
Plastic and Liquid Limits	+------+
Consolidation	(see Plates 45 thru 57)
Specific Gravity	(recorded with consolidation test results)
Sieve Analysis	(see Plates 58 thru 60)
Percent finer than No. 200 Sieve	(listed under -#200,% on logs)

Blow counts from standard penetration tests are shown in the "Blows Per Foot" column on the boring logs. The results of water level observations in the boreholes are recorded at the bottom of most boring logs.

We appreciate the opportunity to work with you on this project. If you have any questions, please call us.

Very truly yours,

McCLELLAND ENGINEERS, INC.

Clarence J. Ehlers

Clarence J. Ehlers, P.E.
Project Manager

CJE/mmf
Copies Submitted:
Southwestern Electric Power Company: (6)
Sargent & Lundy: (6)

Form 108-1 (57) Job No. 73-085

LOG OF BORING NO. P-1

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube, 2" split-barrel & 3" Denison barrel
LOCATION: See Plate 1

SURF. EL: 342.8'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT; PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT	-#200, %
	Tan sandy silt	3-6-5			
5	Very stiff red & light gray sandy clay with ferrous nodules	11-18-35			
10	Red silty fine sand				50
15	-with clay seams and pockets and sandstone nodules, 13' to 19'	10-9-10			16
20	-gray below 18'	7-24-22			21
25	-with lignite seams, 24' to 26'	9-17-33			
	-with sandstone layer, 28' to 29.5'				
30	Hard gray clay -with silt partings and seams	18-23-43			
35		17-40-60/3"			
40		33-60/6"			
45	Gray sandy silt with organic pockets and seams	33-48-60/5"		Non-Plastic	
50	Hard brown and gray clay with sand pockets and partings	24-42-60/6"	109	2.0	65

(Continued on next page)

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PLATE 2

Form 106-3 (1971) Job No 75-085

LOG OF BORING NO. P-1 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
	▨		Gray silty fine sand				
55	▨	☒		42-60/5"			
60	▨	☒		31-60/6"		● Non-Plastic	
65	▨	☒		40-60/6"			
	▧		Hard gray clay -with sandy silt partings and pockets to 70.5'				
70	▧	☒		25-38-60/5"			
	▧		-with sandstone seams and layers below 70.5'				
75							
80							
85							
90							
95							
100							

COMPLETION DEPTH: 75'
DATE: April 26, 1973

DEPTH TO WATER IN BORING: 8.0'

DATE: May 3, 1973

McCLELLAND ENGINEERS

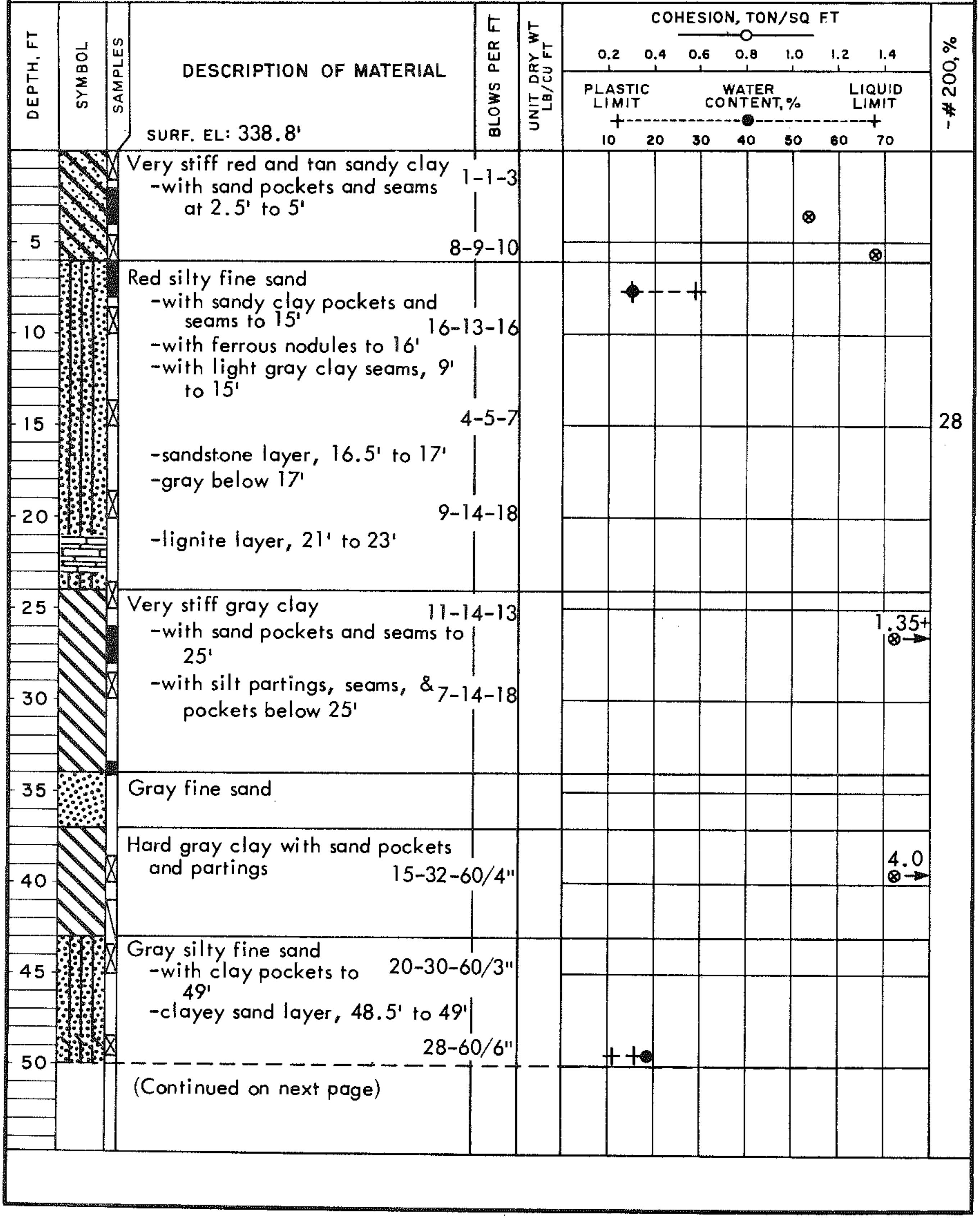
PLATE 2a

Form 106-1 (57) Job No. 73-085

LOG OF BORING NO. P-2
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube, 2" split-barrel & 3" Denison barrel LOCATION: See Plate 1

SURF. EL: 338.8'



DESCRIPTION OF MATERIAL	BLOWS PER FT	-#200, %
Very stiff red and tan sandy clay -with sand pockets and seams at 2.5' to 5'	1-1-3 8-9-10	
Red silty fine sand -with sandy clay pockets and seams to 15' -with ferrous nodules to 16' -with light gray clay seams, 9' to 15' -sandstone layer, 16.5' to 17' -gray below 17' -lignite layer, 21' to 23'	16-13-16 4-5-7 9-14-18	28
Very stiff gray clay -with sand pockets and seams to 25' -with silt partings, seams, & pockets below 25'	11-14-13 7-14-18	
Gray fine sand		
Hard gray clay with sand pockets and partings	15-32-60/4"	
Gray silty fine sand -with clay pockets to 49' -clayey sand layer, 48.5' to 49'	20-30-60/3" 28-60/6"	

(Continued on next page)

McCLELLAND ENGINEERS

Form 100-3 (57) Job No. 73-085

LOG OF BORING NO. P-2 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#200, %
	Gray silty fine sand				
55		29-46-60/3"			
60		29-37-60/3"			24
	-with clay pockets, 61.5' to 64'				
65		22-31-60/3"			
	Hard gray clay with sand pockets and mica				
70	-sandstone layer, 68' to 68.5'	16-24-48		2.8	
75		33-60/3"			

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4
PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10 20 30 40 50 60 70

COMPLETION DEPTH: 74.5'
DATE: April 28, 1973

DEPTH TO WATER IN BORING: 13.3'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 3a

Form 108 (7/71) Job No. 73-085

LOG OF BORING NO. P-3

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube
2" split-barrel & 3" Denison barrel
LOCATION: See Plate 1

SURF. EL: 329.4'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Stiff red clay with sand pockets and seams -with ferrous partings, 3.5' to 4.5'		
Red silty fine sand with ferrous nodules and sandy clay seams and partings -with sandstone nodules, 8' to 13' -with sandstone layer, 14' to 15' -with coarse sand and gravel, 18.5' to 19'		
Hard gray clay -with sand pockets to 28' -with silt partings and pockets below 28'		99
Gray silty fine sand with clay pockets and seams	35-50/6"	
Hard gray sandy clay with sand pockets		110
Gray silty fine sand -lignite layer, 49.5' to 50'		

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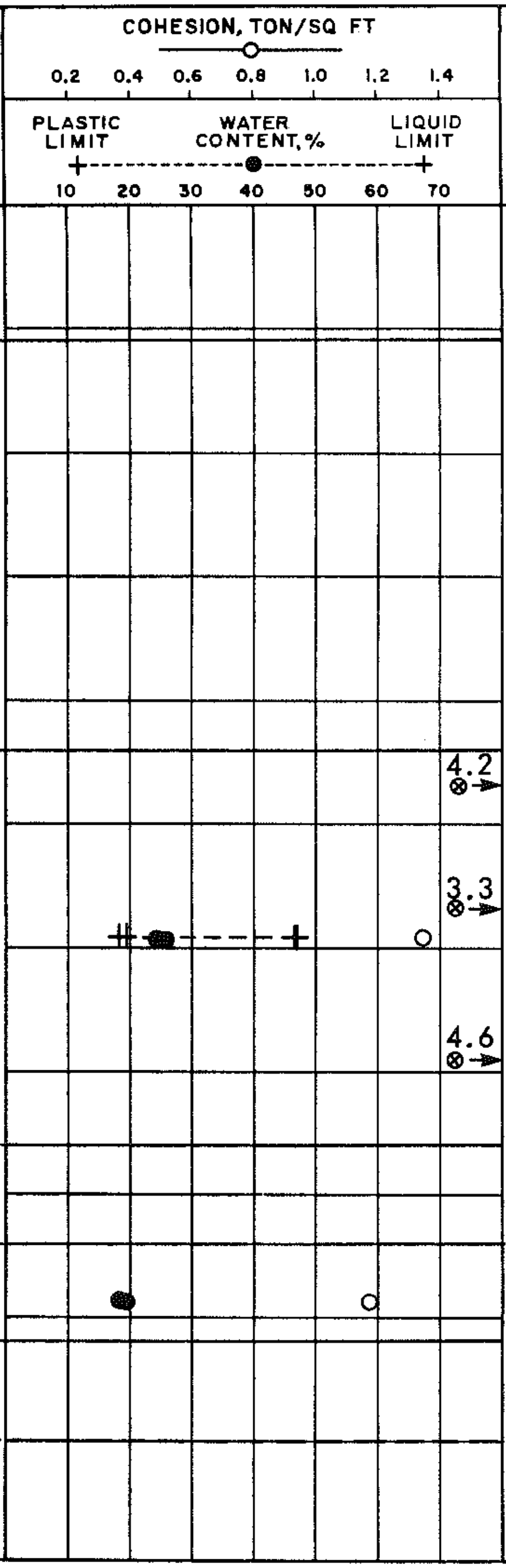


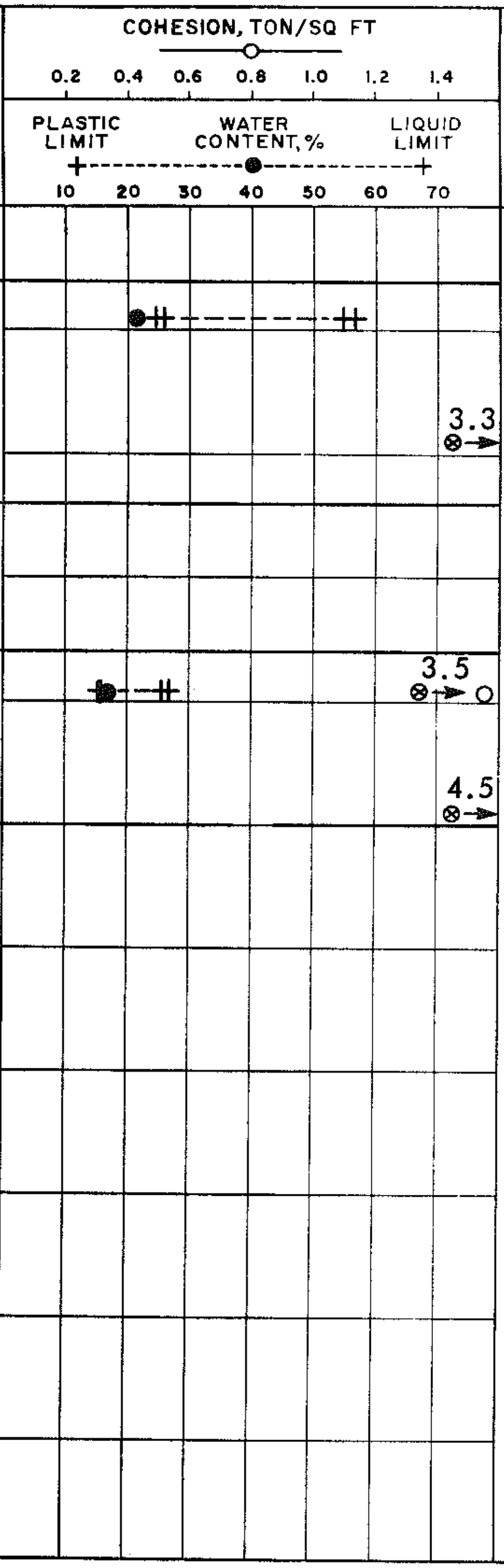
DEPTH, FT: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

McCLELLAND ENGINEERS

Form 108-3 (57) Job No 73-085

LOG OF BORING NO. P-3 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	Gray silty fine sand		
55	Hard gray clay -with organic partings to 55' -with sandy silt pockets and partings below 58'	29-35-15	
60			
	Gray sandy silt	50/5"	
65			
70	Hard gray sandy clay -with silt pockets to 70'		109
75			
80			
85			
90			
95			
100			



COMPLETION DEPTH: 75'
DATE: April 17, 1973

DEPTH TO WATER IN BORING: 10.4'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 4a

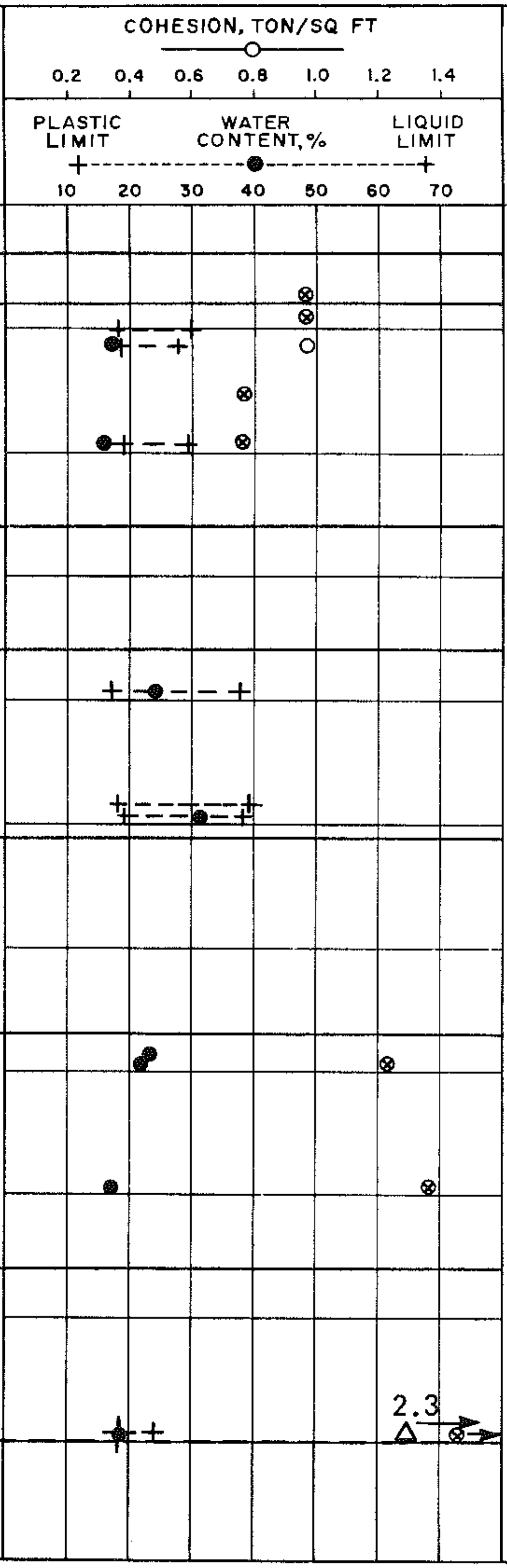
Form 08-1-(57) Job No. 79-085

LOG OF BORING NO. P-4
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel
LOCATION: See Plate 1

SURF. EL: 343.7'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200, %
Tan silty fine sand			
Very stiff red and tan very silty clay -with sand pockets to 4'			
Stiff red and tan very sandy clay -with sandstone seams and nodules, 6' to 8.5'		112	
Tan and light gray silty fine sand with clay seams and pockets and scattered gravel			48 70
Stiff tan and light gray sandy clay with sand and ferrous seams -gray below 23.5'	13-6-10		
Gray silty fine sand with sandstone nodules	18-50/9"		
Very stiff gray clay -with sandy silt pockets, partings, and seams to 43'	11-14-25 17-50/8"		
Gray silty fine sand -clayey fine sand, 46' to 53'	43-50/5"	110	



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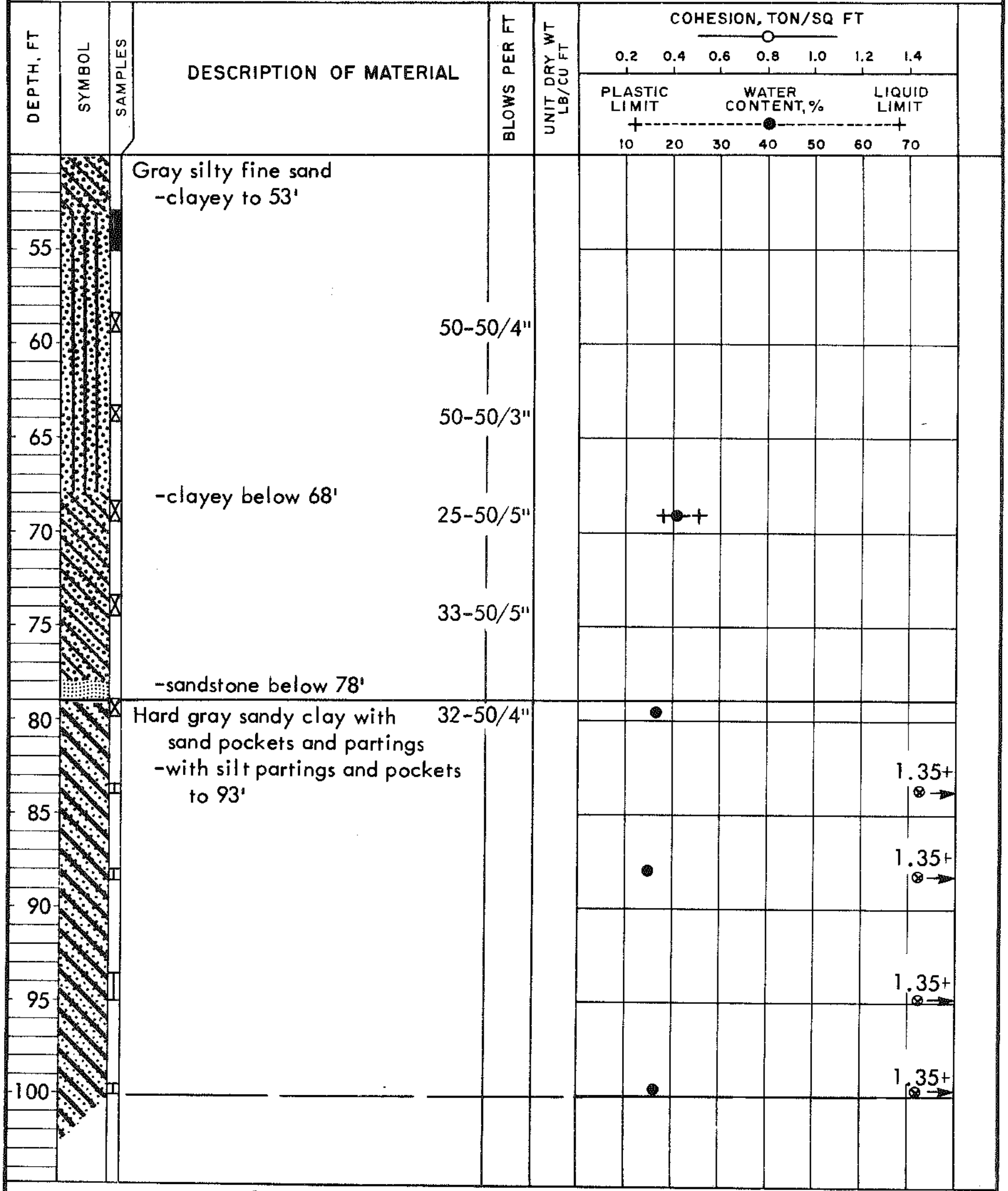
Form 100-3 (57) Job No. 78-085

LOG OF BORING NO. P-4 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



Gray silty fine sand
-clayey to 53'
-clayey below 68'
-sandstone below 78'

Hard gray sandy clay with sand pockets and partings
-with silt partings and pockets to 93'

COMPLETION DEPTH: 100'
DATE: March 28, 1973

DEPTH TO WATER IN BORING: 17.3'
Caved at: 34'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 5a

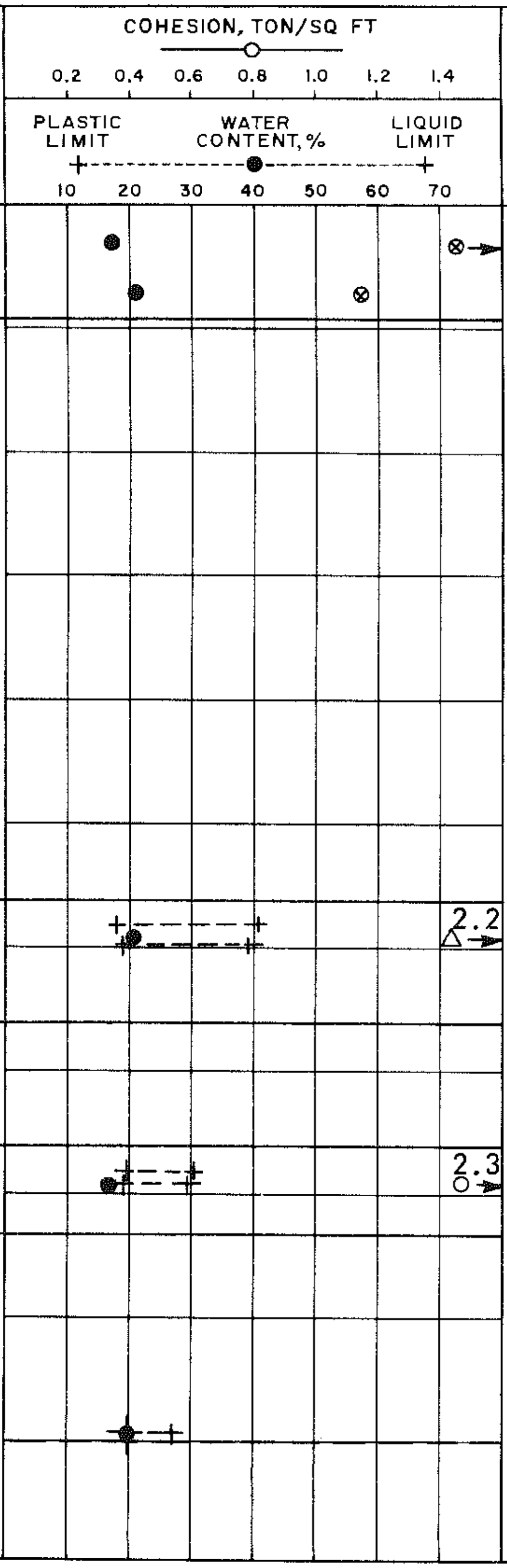
Form 08-1 (57) Job No 73-085

LOG OF BORING NO. P-5
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 344.1'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200, %
0	Very stiff red & tan very sandy clay -with sandstone nodules to 2.5' -with ferrous deposits, 2' to 4'			
5	Red and tan silty fine sand with light gray clay partings, pockets and seams -with sandstone nodules to 23' -tan, 13' to 23' -with ferrous partings and seams, 17' to 23' -gray below 23' -gray clay, 23' to 23.5'	10-20-23		32 33
30	Hard gray sandy clay with sand pockets and partings		103	
35	Gray silty fine sand -with clay pockets and seams to 35'			
40	Hard groy sandy clay		110	
45	Gray clayey fine sand	30-50/6"		
50	(Continued on next page)			



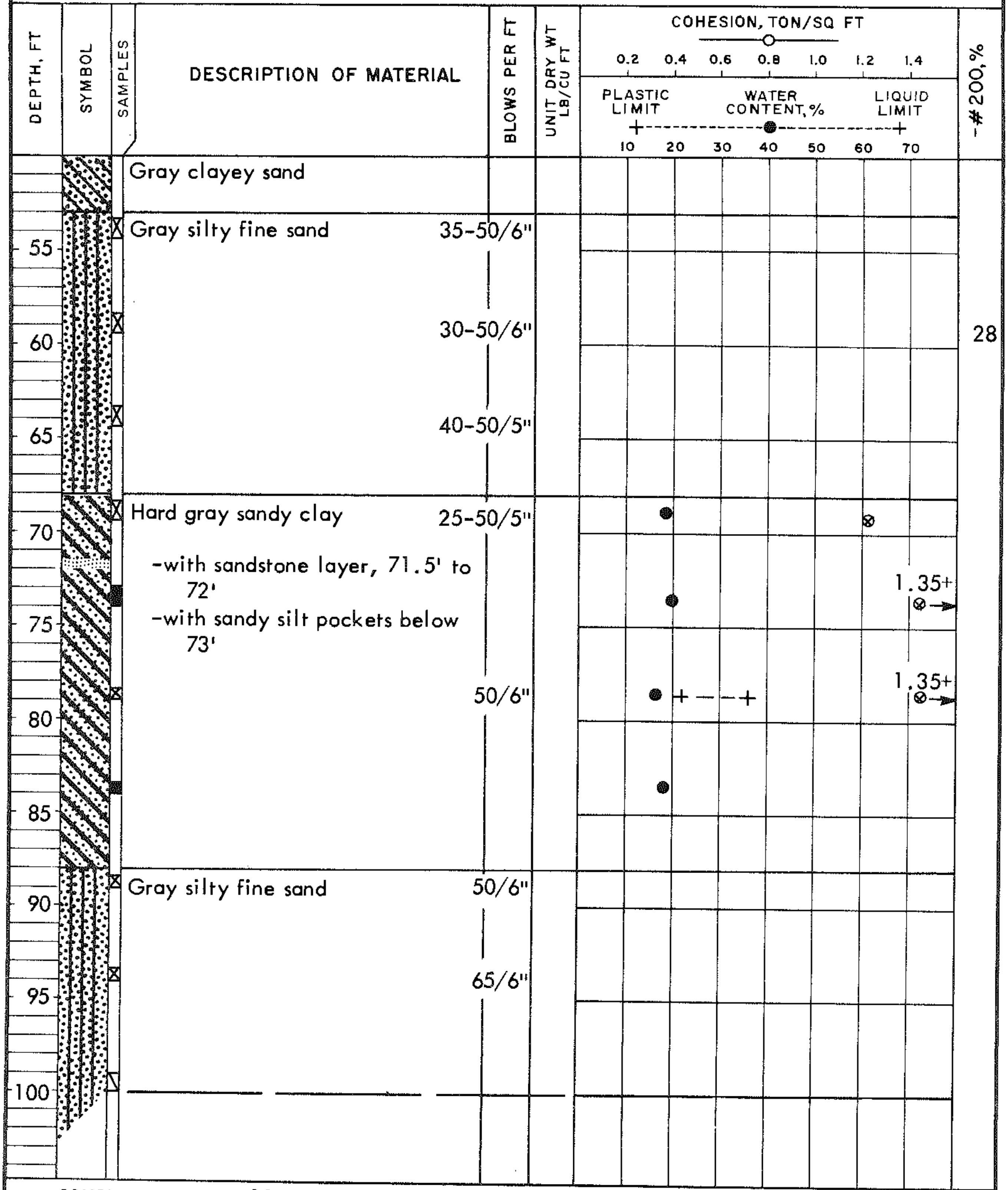
McCLELLAND ENGINEERS

PLATE 6

Form 10 Job No. 72-285

LOG OF BORING NO. P-5 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS



DESCRIPTION OF MATERIAL	BLOWS PER FT	-#200, %
Gray clayey sand		
Gray silty fine sand	35-50/6"	
	30-50/6"	28
	40-50/5"	
Hard gray sandy clay	25-50/5"	
-with sandstone layer, 71.5' to 72'		
-with sandy silt pockets below 73'		
	50/6"	
Gray silty fine sand	50/6"	
	65/6"	

COMPLETION DEPTH: 100'
DATE: March 22, 1973

DEPTH TO WATER IN BORING: 12.5' Caved at: 24'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 6a

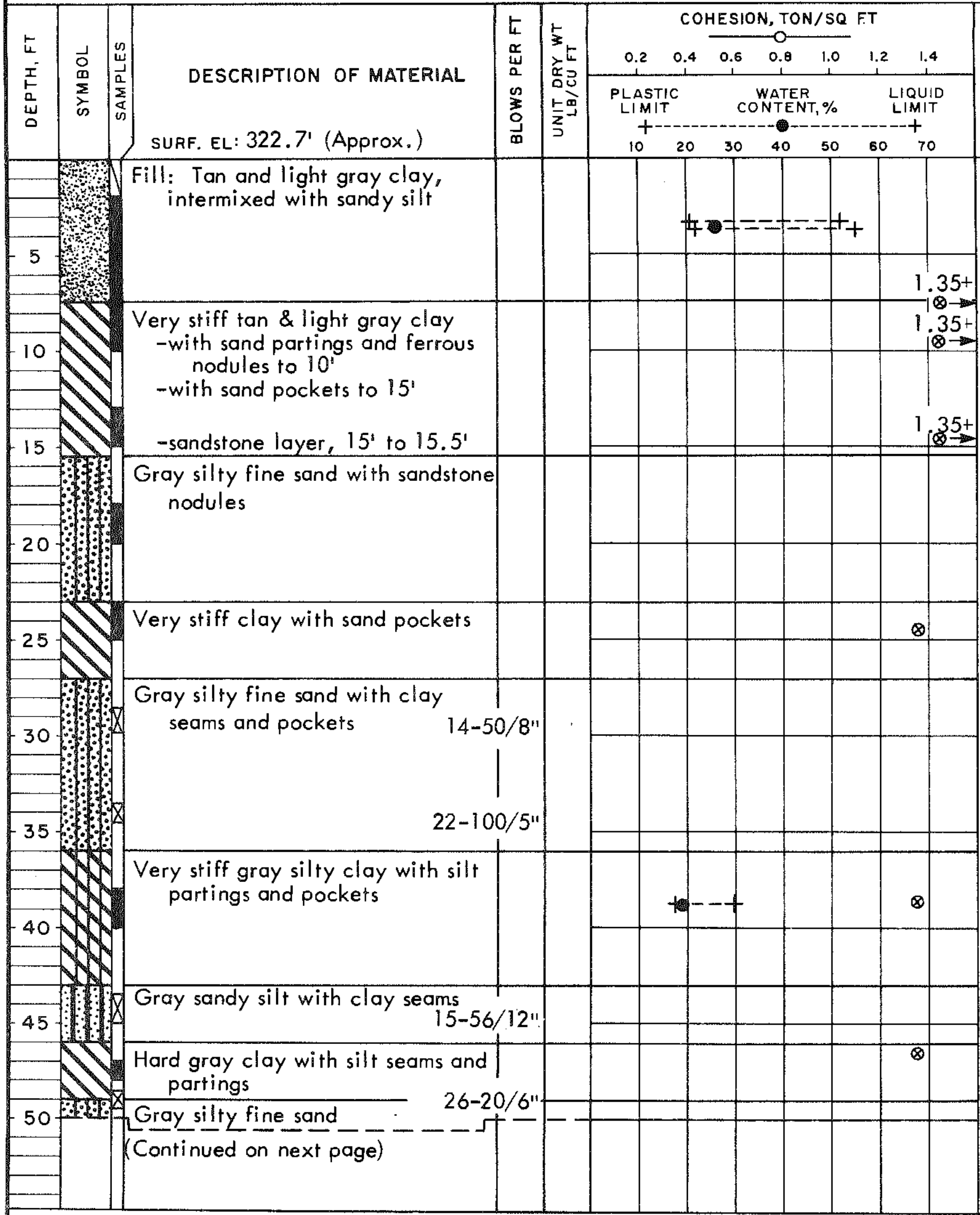
Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-6

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel
LOCATION: See Plate 1; Offset 29' NNW of staked location

SURF. EL: 322.7' (Approx.)



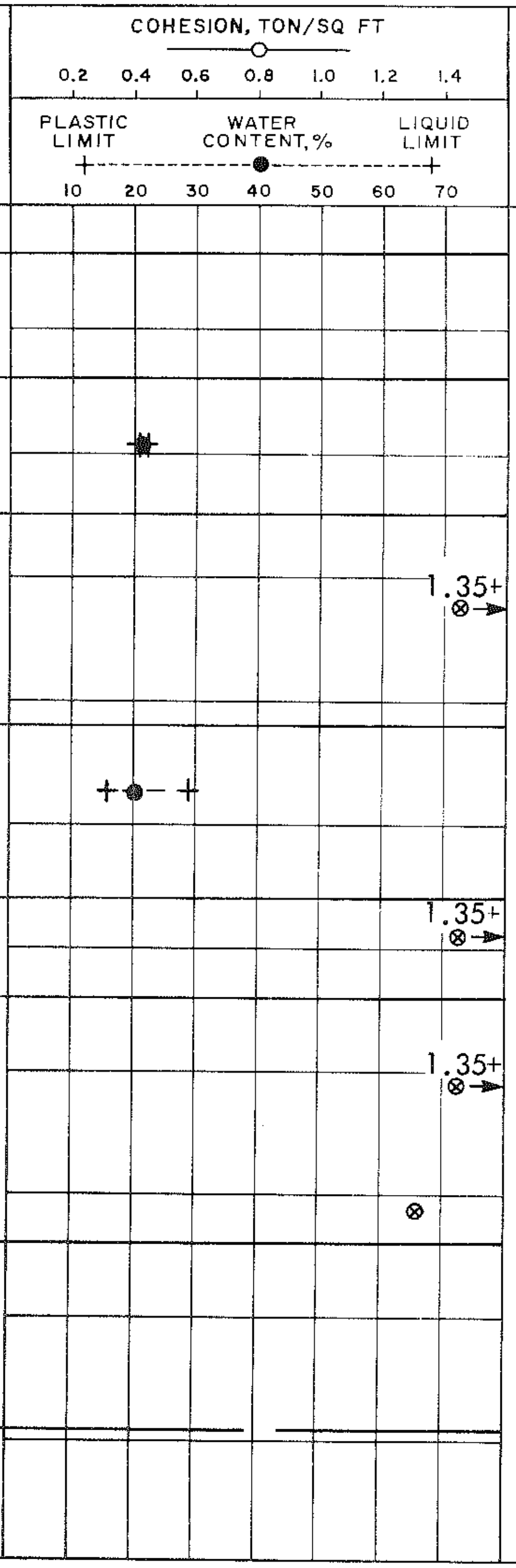
Depth, ft	Description of Material	Blows per ft
0 – 7.5	Fill: Tan and light gray clay, intermixed with sandy silt	
7.5 – 15.5	Very stiff tan & light gray clay -with sand partings and ferrous nodules to 10' -with sand pockets to 15' -sandstone layer, 15' to 15.5'	
15.5 – 23	Gray silty fine sand with sandstone nodules	
23 – 27	Very stiff clay with sand pockets	
27 – 36	Gray silty fine sand with clay seams and pockets	14-50/8" 22-100/5"
36 – 43	Very stiff gray silty clay with silt partings and pockets	
43 – 46	Gray sandy silt with clay seams	15-56/12"
46 – 49	Hard gray clay with silt seams and partings	26-20/6"
49 – 50	Gray silty fine sand	

(Continued on next page)

Form 105-5 (57) Job No. 73-085

LOG OF BORING NO. P-6 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Gray silty fine sand		
Hard gray sandy clay with mica & sand pockets and seams	22-58/6"	
Gray sandy silt with clay seams and pockets	39-56/6"	
Hard gray clay -with lignite partings and seams to 66.5' -with silty sand partings & pockets below 66.5'	30-53/6" 36-58/6"	
Gray silty sand with sandy clay seams		
Gray cemented sand -with sandstone seams and layers to 78.5'	31-100/7"	
Hard gray sandy clay with sand pockets and mica	53-87/6" 100/9"	
Gray sandy silt with mica	40-60/3" 42-100/5"	



COMPLETION DEPTH: 99.5'
DATE: April 12, 1973

DEPTH TO WATER IN BORING: 6.4'

DATE: April 23, 1973

McCLELLAND ENGINEERS

PLATE 7a

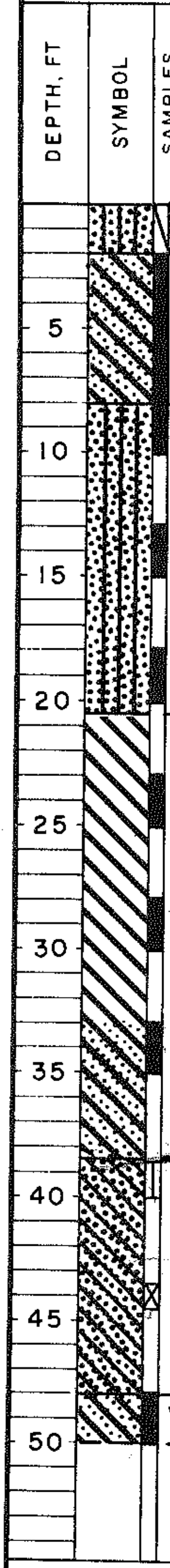
Form 06-1 (57) Job No 73-085

LOG OF BORING NO. P-7

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel LOCATION: See Plate 1

SURF. EL: 352.8'



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Tan silty sand 308 11		
Stiff red and tan sandy clay -very sandy at 4'		
Tan silty fine sand -with sandstone nodules to 10' -with clay pockets to 15' -tan and light gray at 18'		
Stiff light gray clay with sand pockets and partings -with ferrous nodules and seams to 30' -very stiff gray sandy clay with sand seams and pockets below 33'		91
Gray clayey fine sand with sandstone nodules and clay pockets	12-50/4"	
Very stiff gray sandy clay		

(Continued on next page)

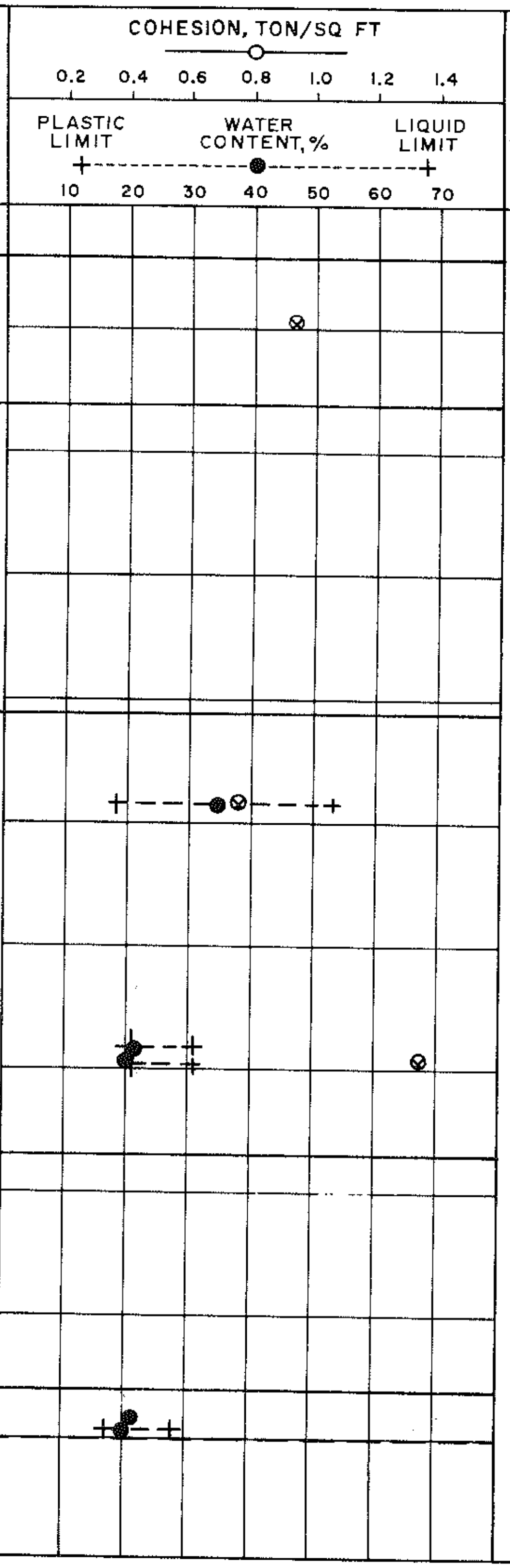


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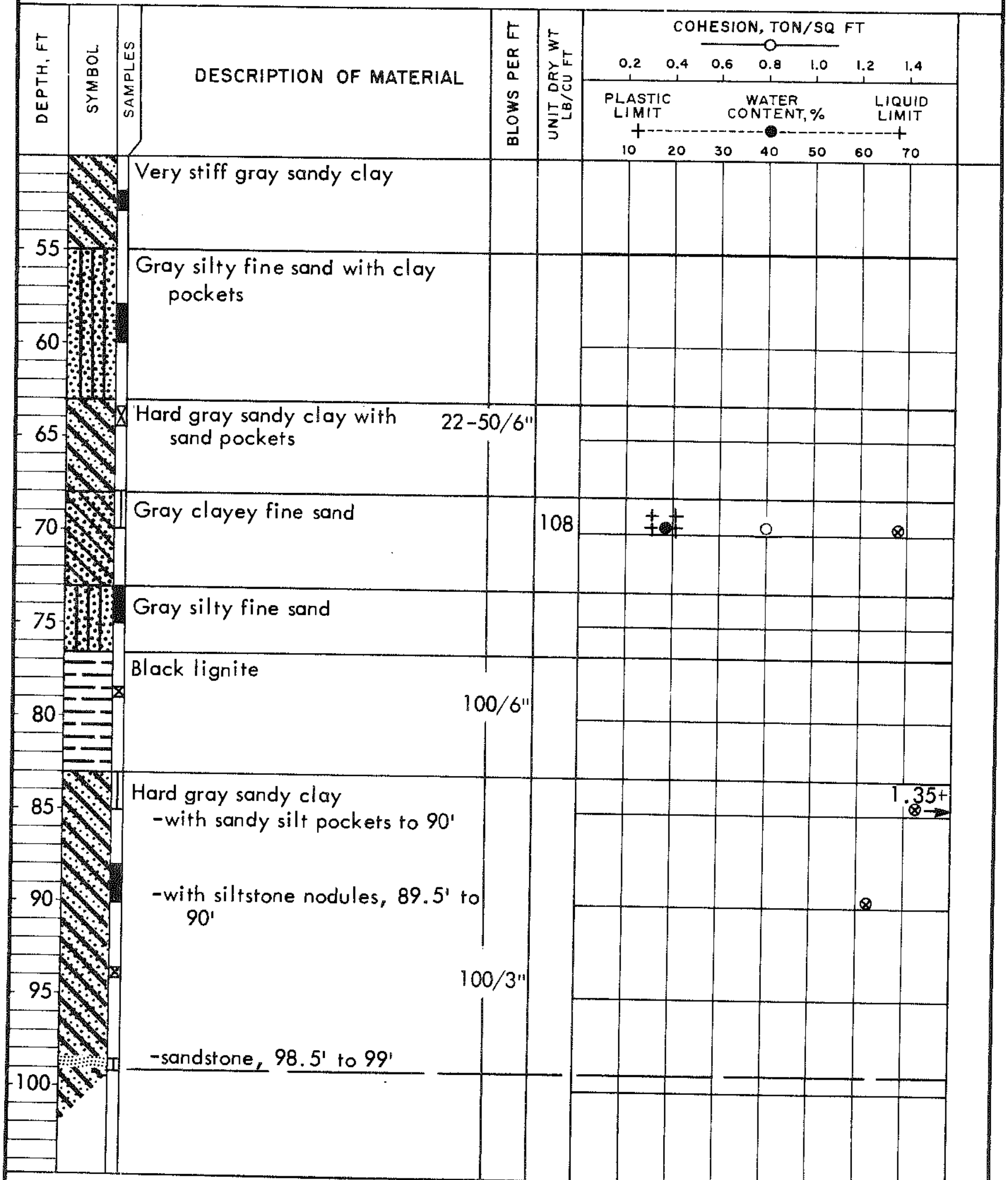
PLATE 8

Form 108-4 1971 Job No. 73-085

LOG OF BORING NO. P-7 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Very stiff gray sandy clay		
Gray silty fine sand with clay pockets		
Hard gray sandy clay with sand pockets	22-50/6"	
Gray clayey fine sand		108
Gray silty fine sand		
Black lignite	100/6"	
Hard gray sandy clay -with sandy silt pockets to 90' -with siltstone nodules, 89.5' to 90' -sandstone, 98.5' to 99'	100/3"	

COMPLETION DEPTH: 99'
DATE: March 29, 1973

DEPTH TO WATER IN BORING: 25.0' Caved at: 74'
DATE: April 23, 1973

McCLELLAND ENGINEERS

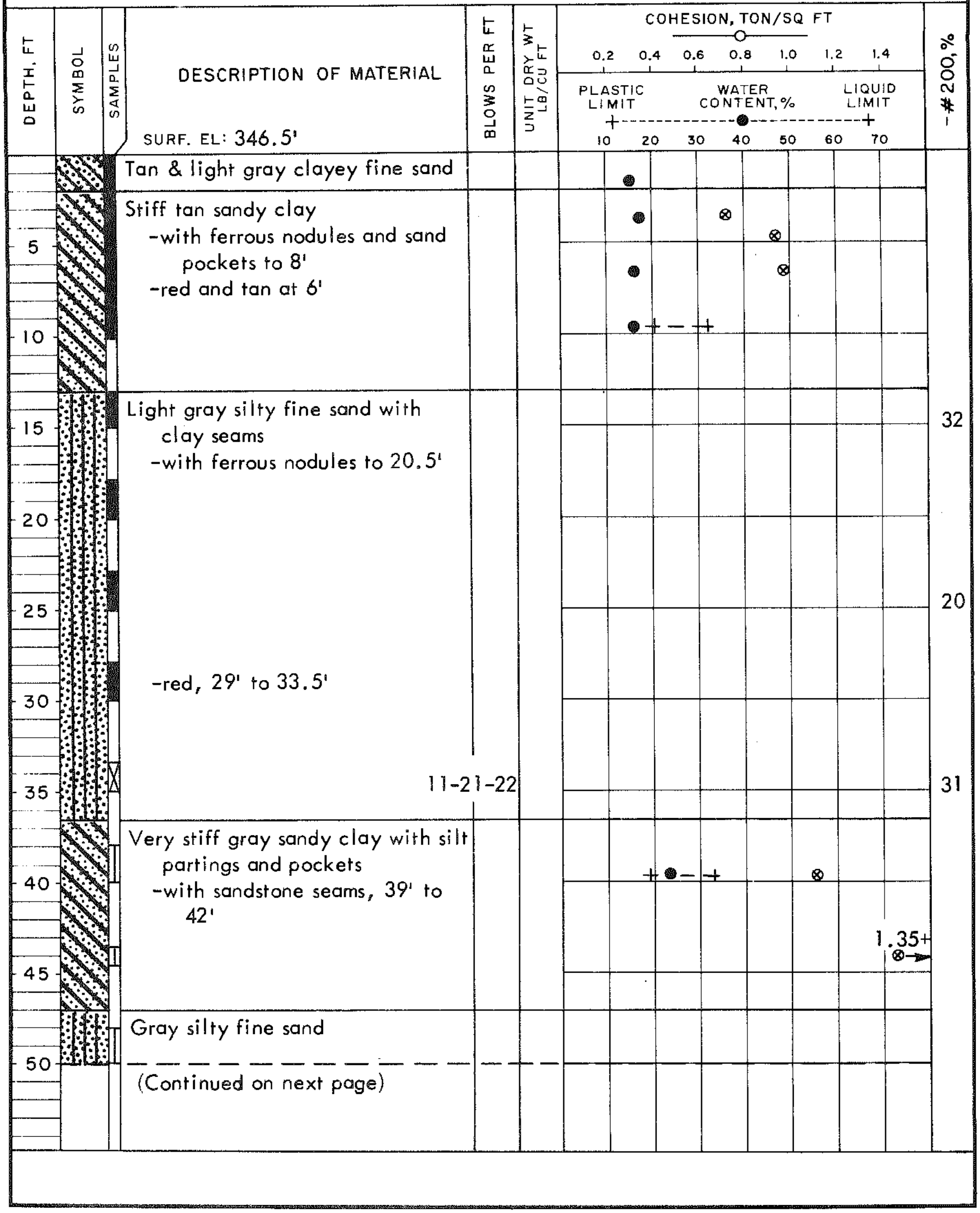
PLATE 8a

Form OB-1 (57) Job No 73-085

LOG OF BORING NO. P-8

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel
LOCATION: See Plate 1



SURF. EL: 346.5'

Tan & light gray clayey fine sand

Stiff tan sandy clay
-with ferrous nodules and sand pockets to 8'
-red and tan at 6'

Light gray silty fine sand with clay seams
-with ferrous nodules to 20.5'
-red, 29' to 33.5'

11-21-22

Very stiff gray sandy clay with silt partings and pockets
-with sandstone seams, 39' to 42'

Gray silty fine sand

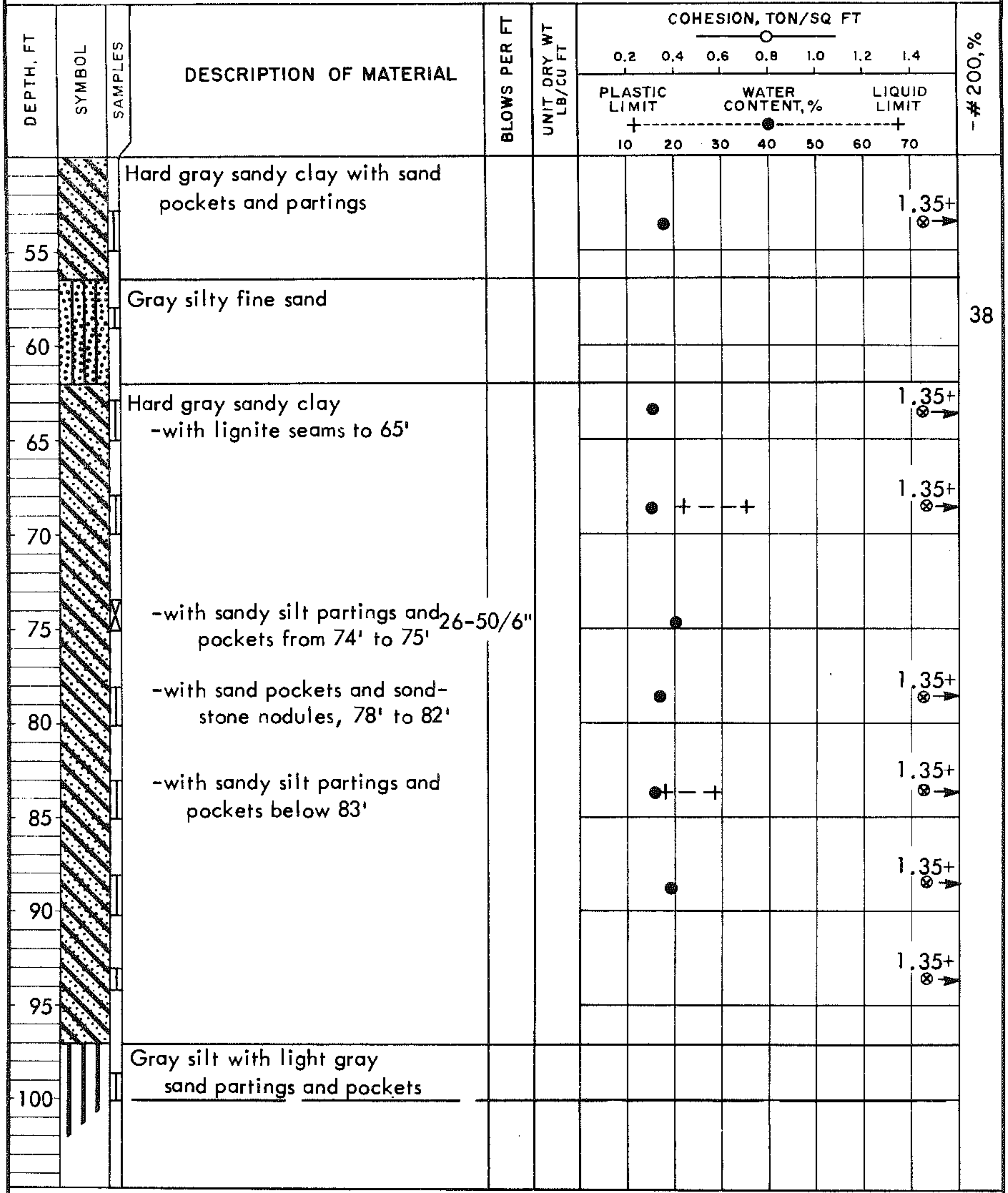
(Continued on next page)

McCLELLAND ENGINEERS

PLATE 9

Form 108-3 (57) Job No 73-085

LOG OF BORING NO. P-8 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



Hard gray sandy clay with sand pockets and partings

Gray silty fine sand

Hard gray sandy clay
-with lignite seams to 65'

-with sandy silt partings and pockets from 74' to 75'

-with sand pockets and sandstone nodules, 78' to 82'

-with sandy silt partings and pockets below 83'

Gray silt with light gray sand partings and pockets

COMPLETION DEPTH: 100'
DATE: April 8, 1973

DEPTH TO WATER IN BORING: 16.8'
Caved at: 44'
DATE: April 23, 1973

McCLELLAND ENGINEERS

PLATE 9a

Form 08-1 (57) Job No 73-085

LOG OF BORING NO. P-9
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel
LOCATION: See Plate 1

SURF. EL: 355.8'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	Stiff red and tan sandy clay		
	-becomes very stiff by 13'		
	Tan fine sand		
25		8-10-15	
	Very stiff light gray clay		
30	-with silt partings to 30'		96
35	-gray sandy clay with sand pockets and partings below 33'		98
40	Gray silty fine sand with gray clay seams and partings	15-33-50/3"	
45		15-50/7"	
50	Very stiff gray sandy clay with silt partings -with sand pockets to 50'	10-50/8"	

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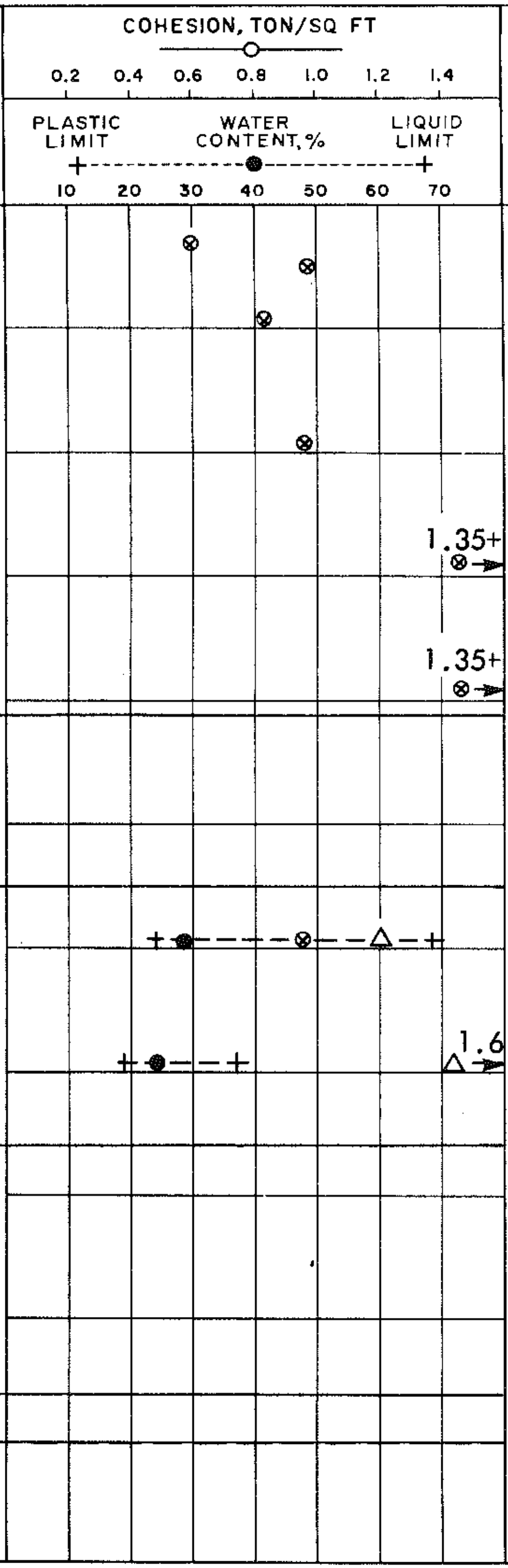
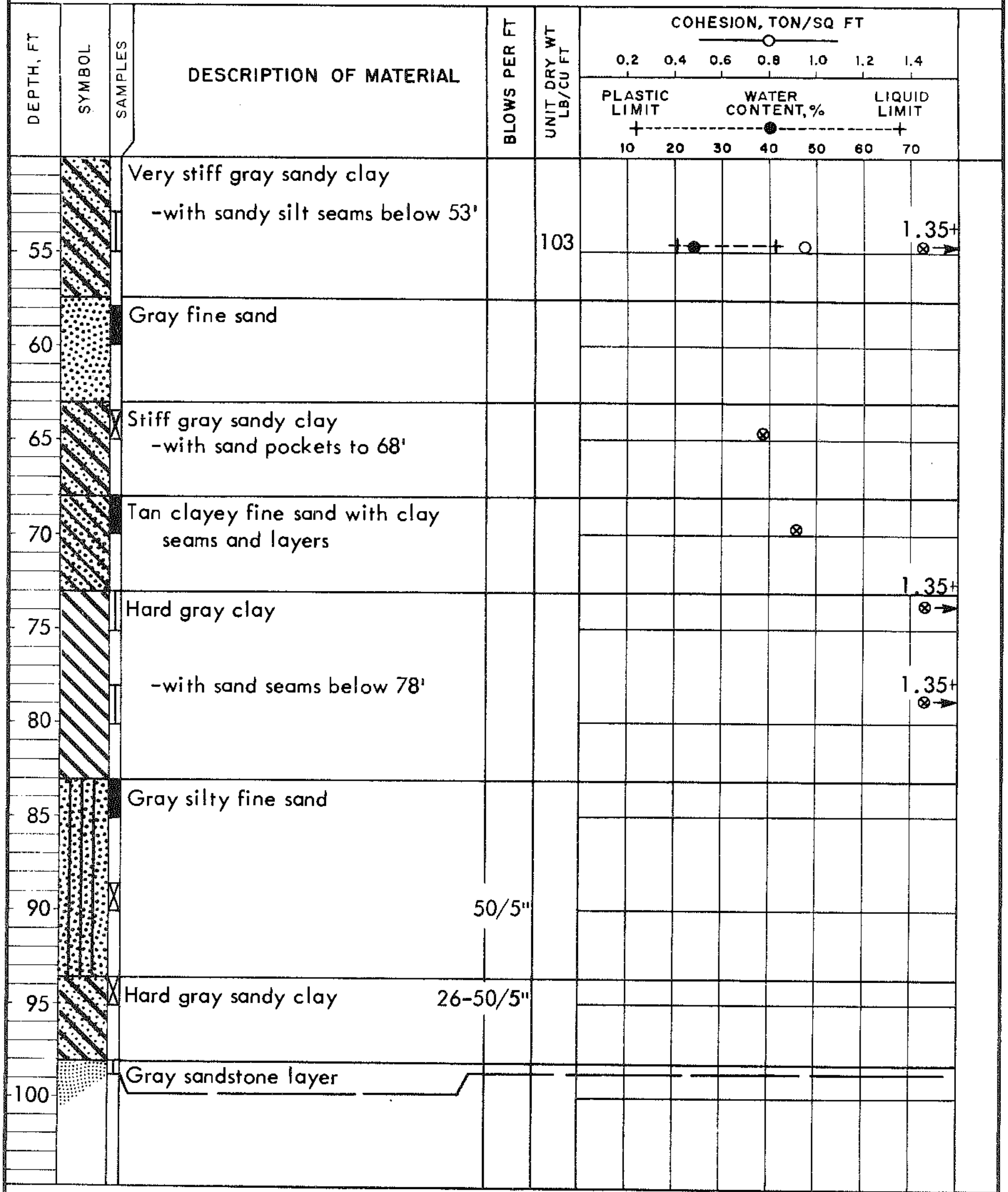


Form 108-3 (57) Job No 73-085

LOG OF BORING NO. P-9 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Very stiff gray sandy clay -with sandy silt seams below 53'		103
Gray fine sand		
Stiff gray sandy clay -with sand pockets to 68'		
Tan clayey fine sand with clay seams and layers		
Hard gray clay -with sand seams below 78'		
Gray silty fine sand	50/5"	
Hard gray sandy clay	26-50/5"	
Gray sandstone layer		

COMPLETION DEPTH: 98.5'
DATE: April 3, 1973

DEPTH TO WATER IN BORING: 24.3'
Caved at: 41'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 10a

Form 38-1 (57) Job No 72-085

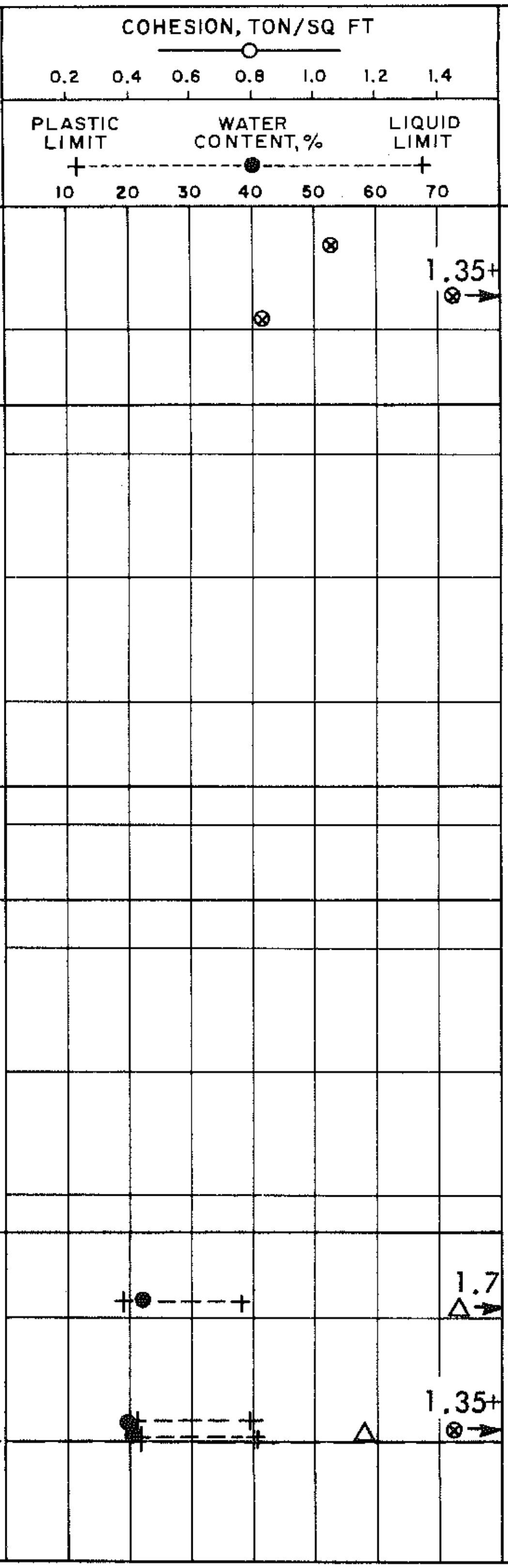
LOG OF BORING NO. P-10
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel

LOCATION: See Plate 1

SURF. EL: 352.7'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Very stiff red and tan clay with sand pockets		
Red and tan fine sand -slightly clayey to 13' -with sandstone nodules, 14' to 15' -with ferrous deposits, 19' to 20'		
Light gray sandy silt -with sand pockets and seams	3-5-5	
Tan silty fine sand -with ferrous seams at 34' -gray with clay seams below 36.5'	6-3-5 10-16-26	
Very stiff gray sandy clay with silt partings and seams		102 105
(Continued on next page)		



DEPTH, FT: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

McCLELLAND ENGINEERS

Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-10 (Cont'd)
WELSH POWER PLANT
CASON TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	Very stiff gray sandy clay with silt partings and seams		
55	Gray silty fine sand	38-50/2"	
60	Gray clayey fine sand with sand pockets		114
65	-shaley clay seams, 63' to 63.5'		
70	Gray silty fine sand -with clay seams to 78' -with lignite seams at 68'		
75		50/3"	
80			
85	-lignite, 84' to 85.5'	50/5"	
90	Hard gray clay -with silt partings and pockets to 90'		
95			
100	(Continued on next page)		

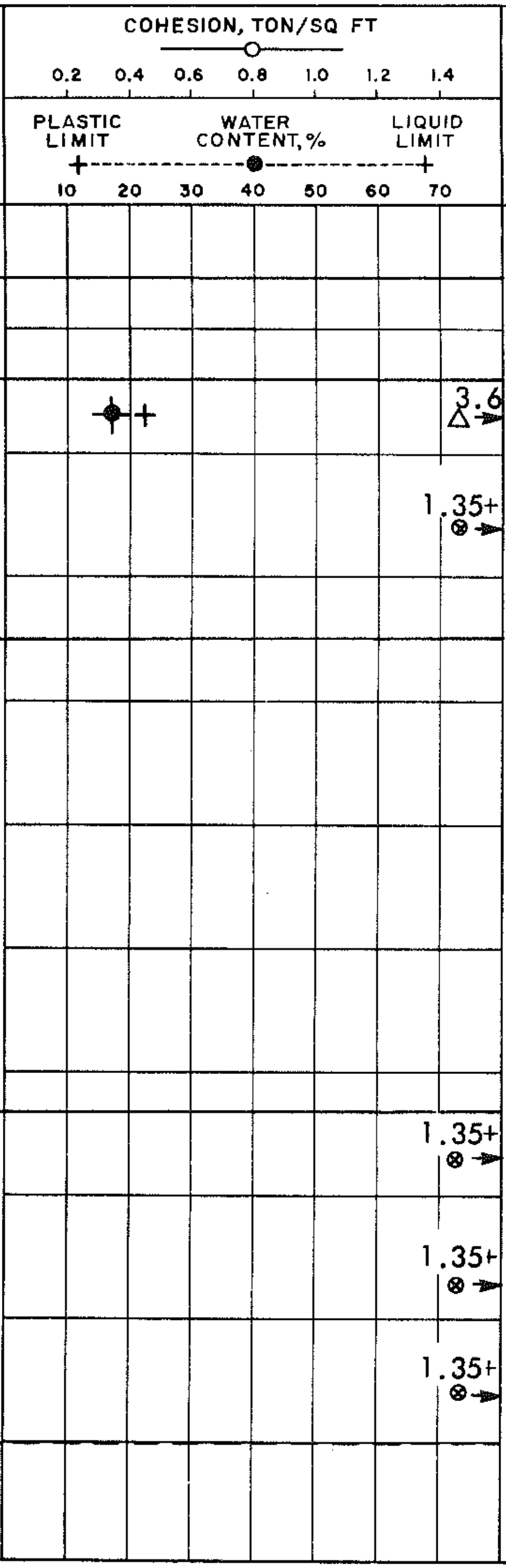


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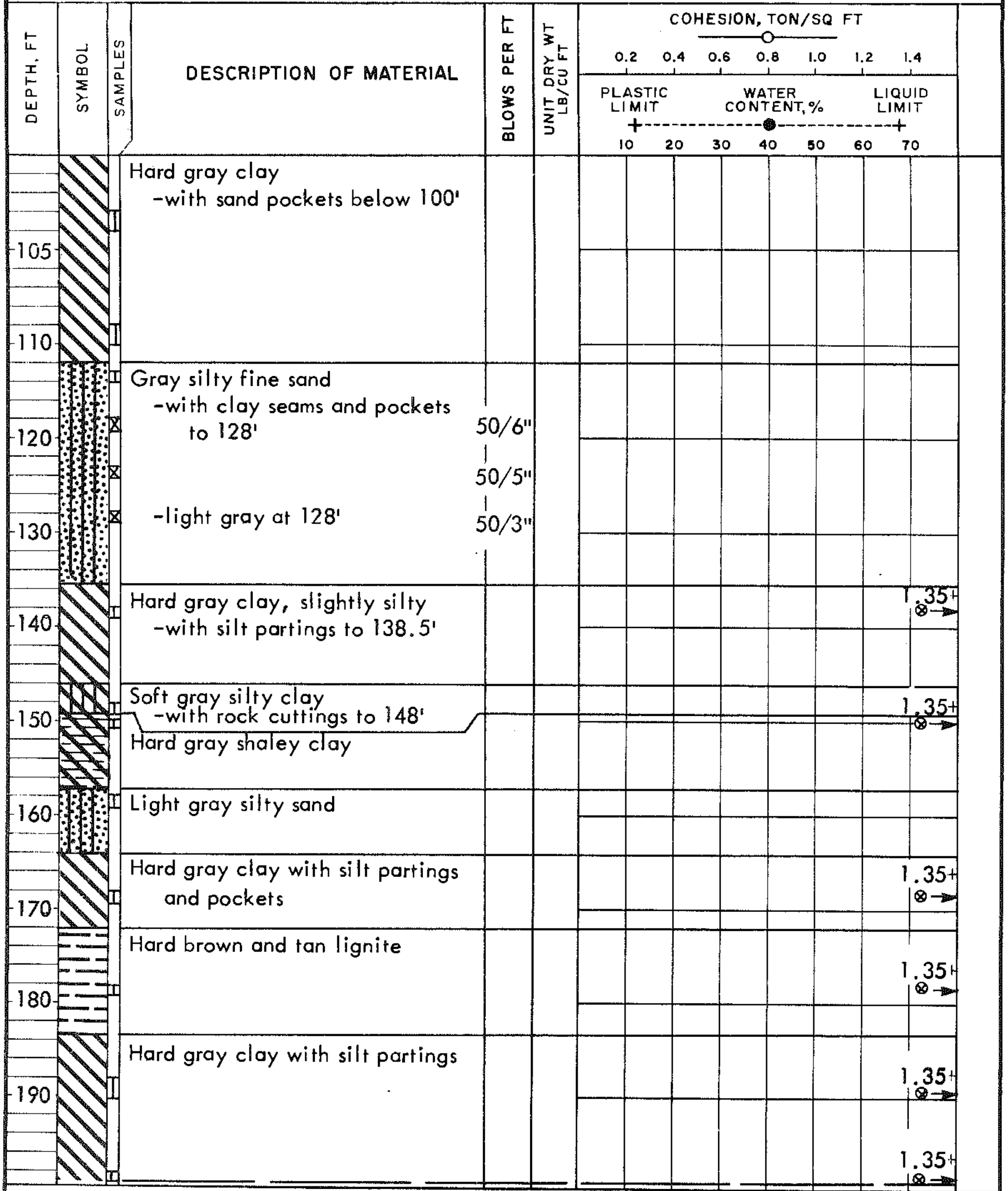
PLATE 11a

Form 108-3 (57) Job No Z3-085

Note Scale Change

LOG OF BORING NO. P-10 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



Hard gray clay
-with sand pockets below 100'

Gray silty fine sand
-with clay seams and pockets to 128'
-light gray at 128'

Hard gray clay, slightly silty
-with silt partings to 138.5'

Soft gray silty clay
-with rock cuttings to 148'

Hard gray shaley clay

Light gray silty sand

Hard gray clay with silt partings and pockets

Hard brown and tan lignite

Hard gray clay with silt partings

COMPLETION DEPTH: 198.5'
DATE: April 5, 1973

DEPTH TO WATER IN BORING: 27.2'
Caved at: 36'
DATE: April 11, 1973

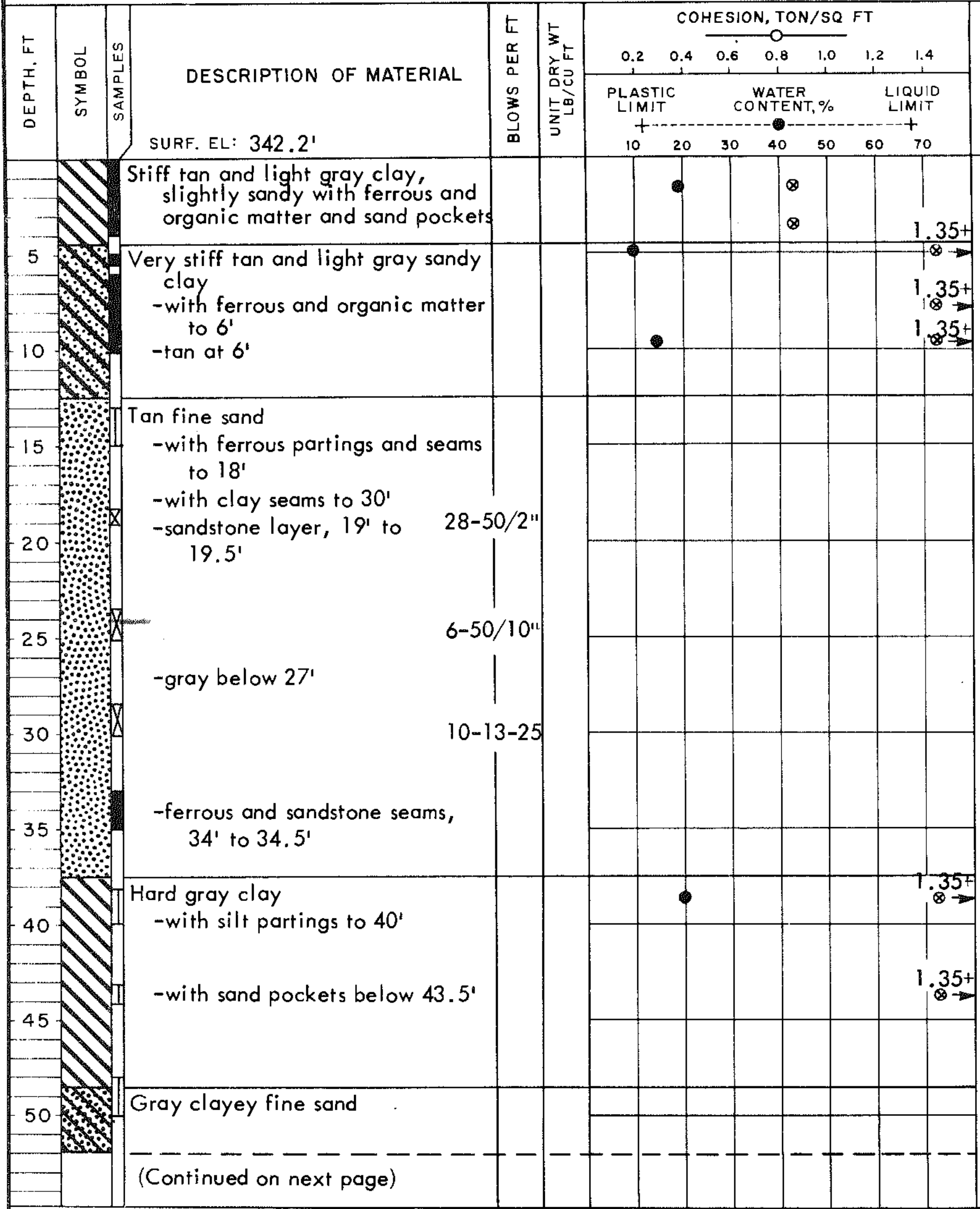
McCLELLAND ENGINEERS

PLATE 11b

Job No 23-085

LOG OF BORING NO. P-11
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel   LOCATION: See Plate 1



DESCRIPTION OF MATERIAL	BLOWS PER FT
SURF. EL: 342.2'	
Stiff tan and light gray clay, slightly sandy with ferrous and organic matter and sand pockets	
Very stiff tan and light gray sandy clay -with ferrous and organic matter to 6' -tan at 6'	
Tan fine sand -with ferrous partings and seams to 18' -with clay seams to 30' -sandstone layer, 19' to 19.5'	28-50/2"
	6-50/10"
-gray below 27'	10-13-25
-ferrous and sandstone seams, 34' to 34.5'	
Hard gray clay -with silt partings to 40' -with sand pockets below 43.5'	
Gray clayey fine sand	

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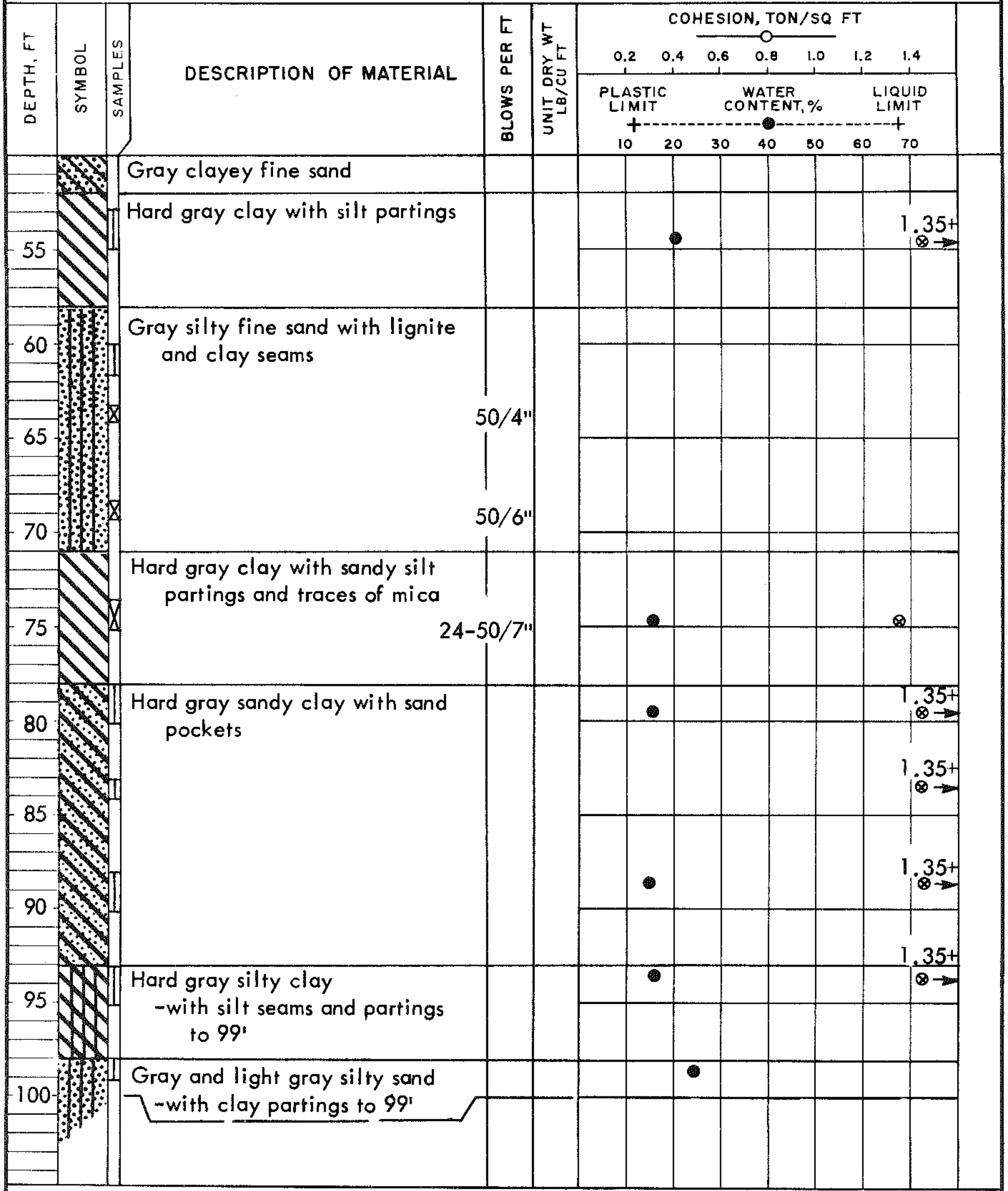
Form 108-3 (57) Job No 73-085

LOG OF BORING NO. P-11 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



Gray clayey fine sand

Hard gray clay with silt partings

Gray silty fine sand with lignite and clay seams

Hard gray clay with sandy silt partings and traces of mica

Hard gray sandy clay with sand pockets

Hard gray silty clay
-with silt seams and partings to 99'

Gray and light gray silty sand
-with clay partings to 99'

COMPLETION DEPTH: 100'
DATE: April 8, 1973

DEPTH TO WATER IN BORING: 14' Caved at: 39' DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 12a

Job No. 73-085

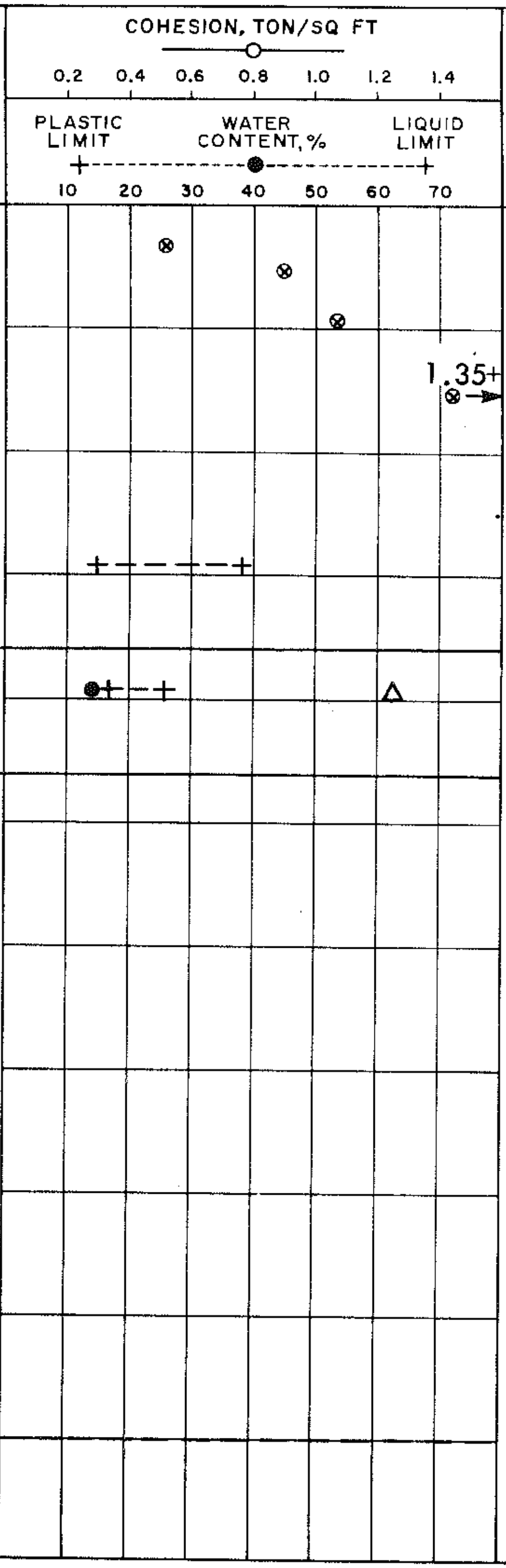
LOG OF BORING NO. P-12

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel LOCATION: See Plate 1

SURF. EL: 353.4'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- #200, %
	Stiff red and tan sandy clay -with sand pockets and seams to 8' -very stiff below 4'			
5				
10				
15		20-25-18		
20	Red and tan clayey fine sand with sand and clay pockets		114	
25	Red and tan silty fine sand	9-10-12		
30	-with ferrous seams and deposits, 29' to 33'	15-14-15		36
	-tan, 33' to 38'			
35				
	-gray with clay seams below 38'			
40		36-42/6"		
45		20-42-50/4"		37
	-sandstone, 48' to 50'			
50				



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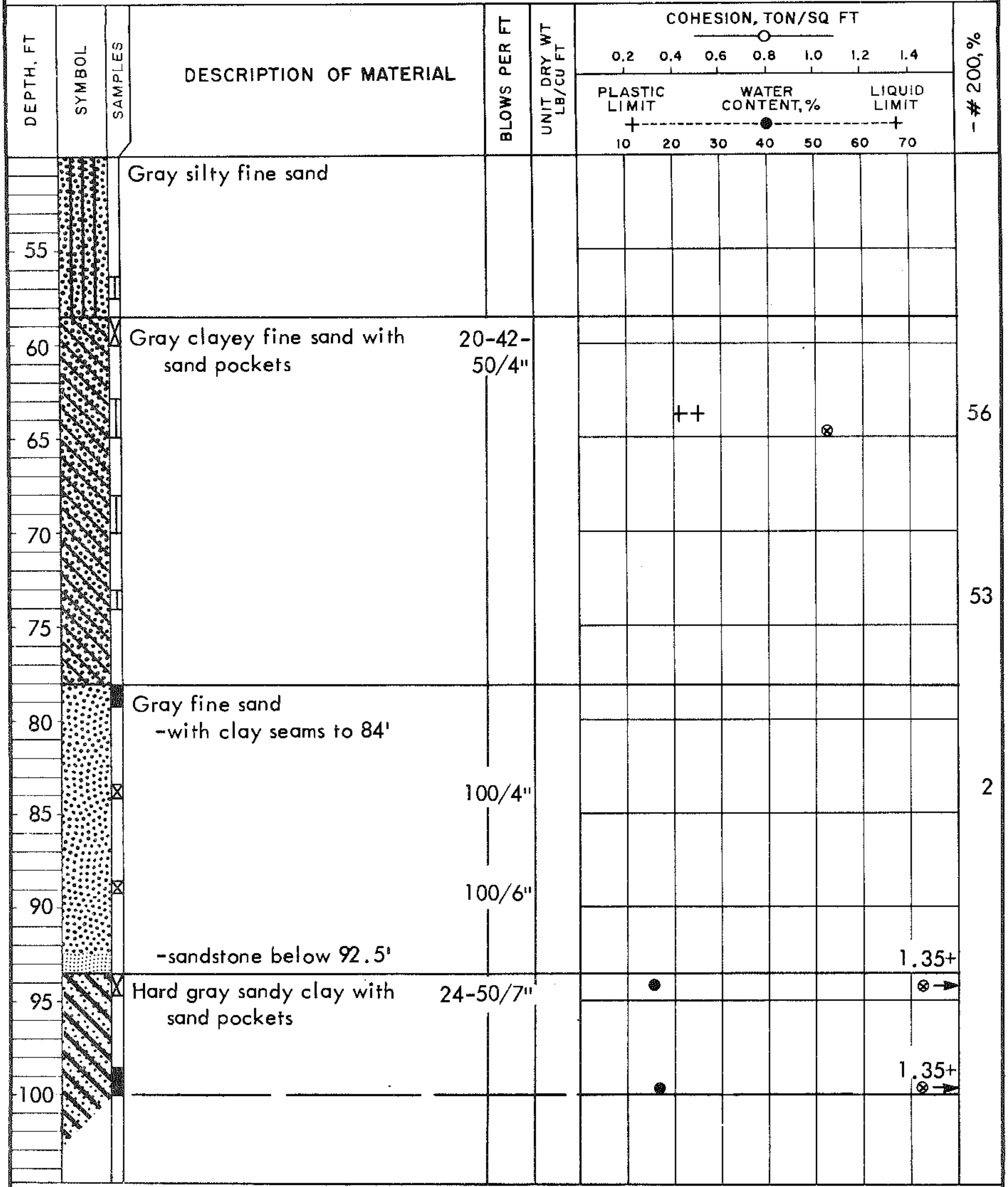
McCLELLAND ENGINEERS

Form 10 Job No. 73-785

LOG OF BORING NO. P-12 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS



DESCRIPTION OF MATERIAL	BLOWS PER FT	- # 200, %
Gray silty fine sand		
Gray clayey fine sand with sand pockets	20-42-50/4"	56 53
Gray fine sand -with clay seams to 84'	100/4" 100/6"	2
-sandstone below 92.5'		
Hard gray sandy clay with sand pockets	24-50/7"	

COMPLETION DEPTH: 100'
DATE: March 26, 1973

DEPTH TO WATER IN BORING: 24.8' Caved at: 44'
DATE: April 23, 1973

McCLELLAND ENGINEERS

PLATE 13a

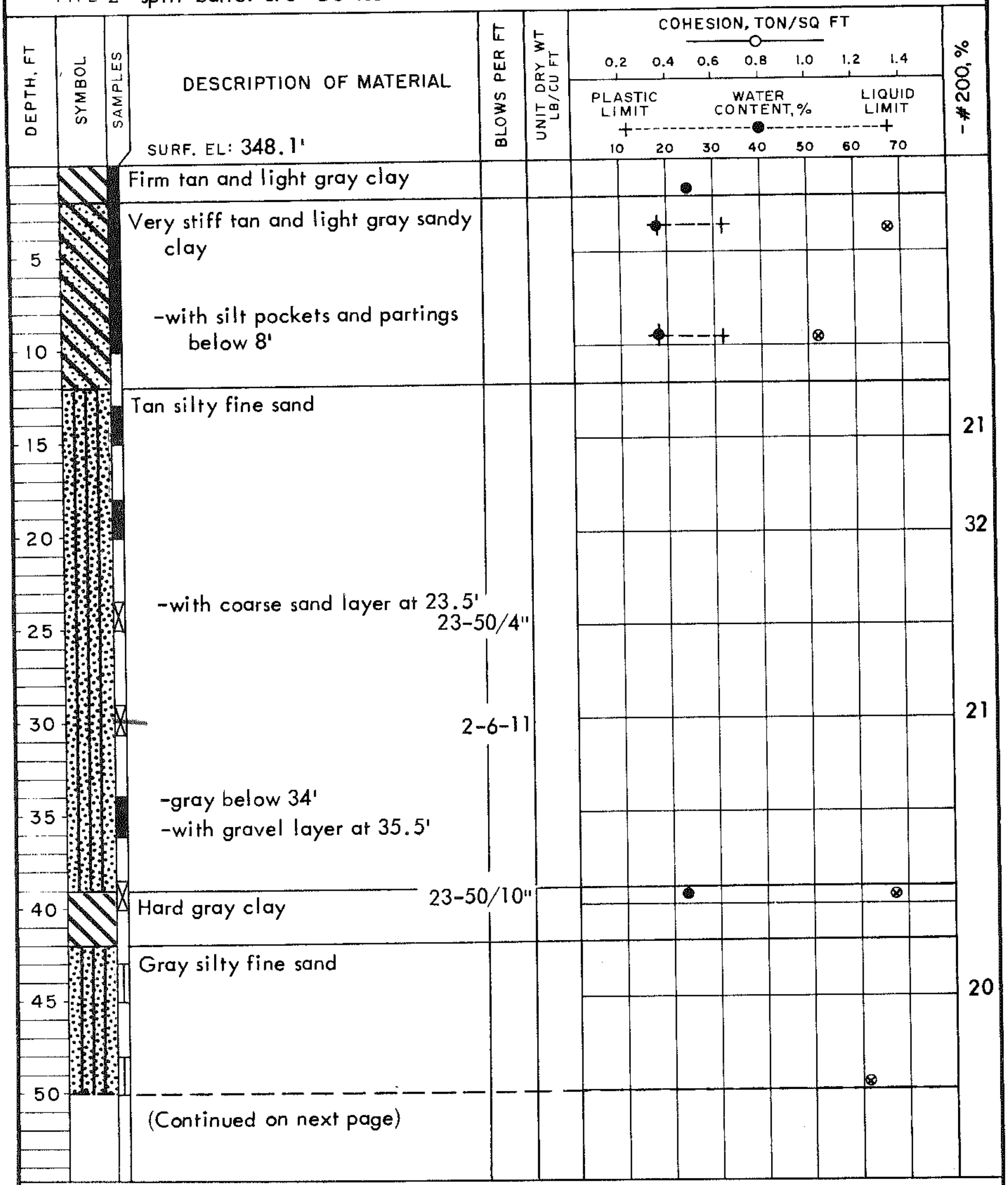
Form 38-1 (57) Job No 73-085

LOG OF BORING NO. P-13

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel

LOCATION: See Plate 1



Firm tan and light gray clay

Very stiff tan and light gray sandy clay
-with silt pockets and partings below 8'

Tan silty fine sand
-with coarse sand layer at 23.5'
-gray below 34'
-with gravel layer at 35.5'

Hard gray clay

Gray silty fine sand

(Continued on next page)

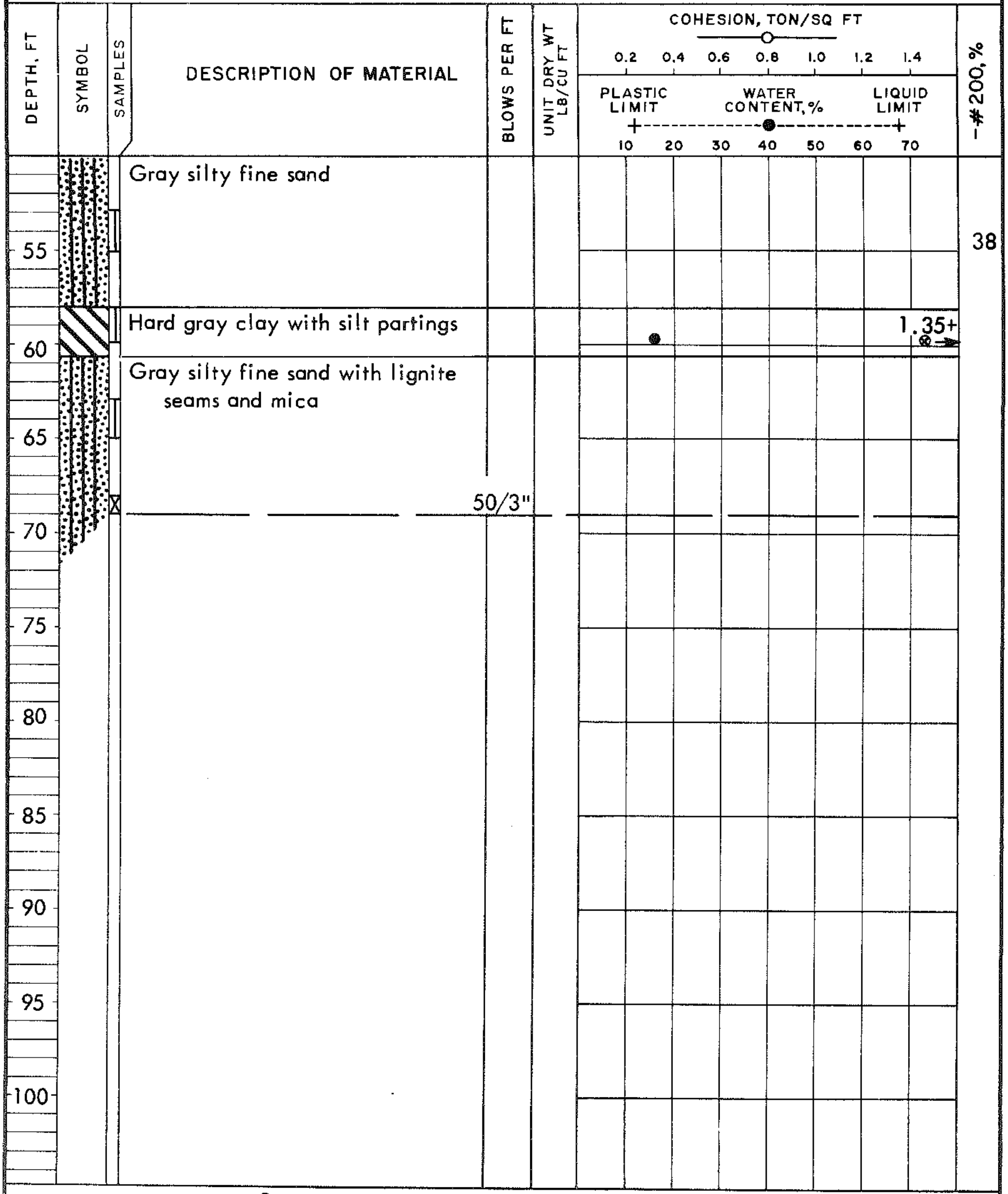
McCLELLAND ENGINEERS

PLATE 14

Form 108-[illegible] Job No 73-1985

LOG OF BORING NO. P-13 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS



Gray silty fine sand

Hard gray clay with silt partings

Gray silty fine sand with lignite seams and mica

COMPLETION DEPTH: 69'
DATE: April 10, 1973

DEPTH TO WATER IN BORING: 15.8'
Caved at: 60'

DATE: April 11, 1973

McCLELLAND ENGINEERS

PLATE 14a

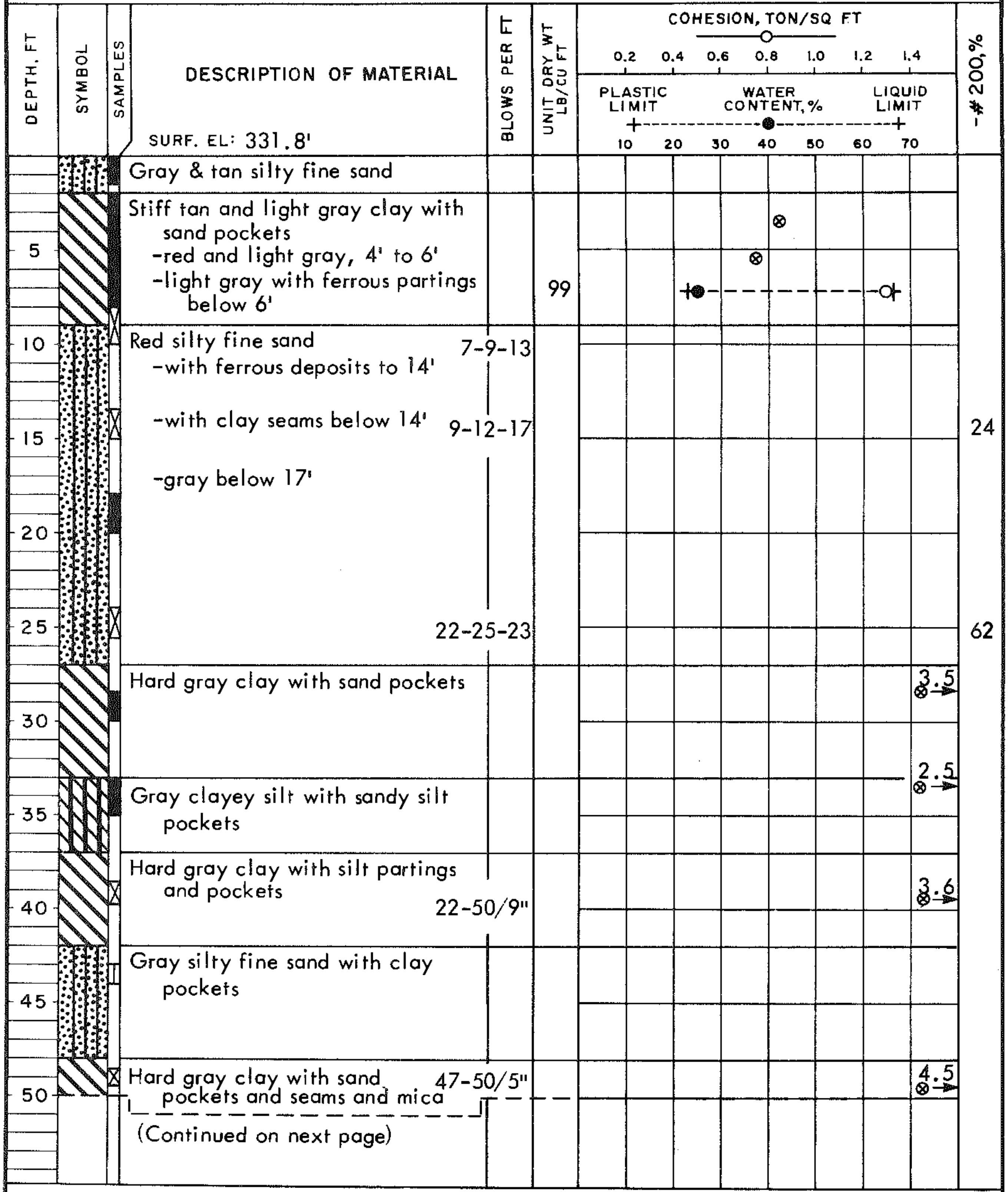
Form 106-1 (57) Job No. 73-085

LOG OF BORING NO. P-19

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube, 2" split-barrel & 3" Denison barrel
LOCATION: See Plate 1

SURF. EL: 331.8'



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
Gray & tan silty fine sand			
Stiff tan and light gray clay with sand pockets -red and light gray, 4' to 6' -light gray with ferrous partings below 6'		99	
Red silty fine sand -with ferrous deposits to 14'	7-9-13		
-with clay seams below 14'	9-12-17		24
-gray below 17'			
	22-25-23		62
Hard gray clay with sand pockets			
Gray clayey silt with sandy silt pockets			
Hard gray clay with silt partings and pockets	22-50/9"		
Gray silty fine sand with clay pockets			
Hard gray clay with sand pockets and seams and mica	47-50/5"		

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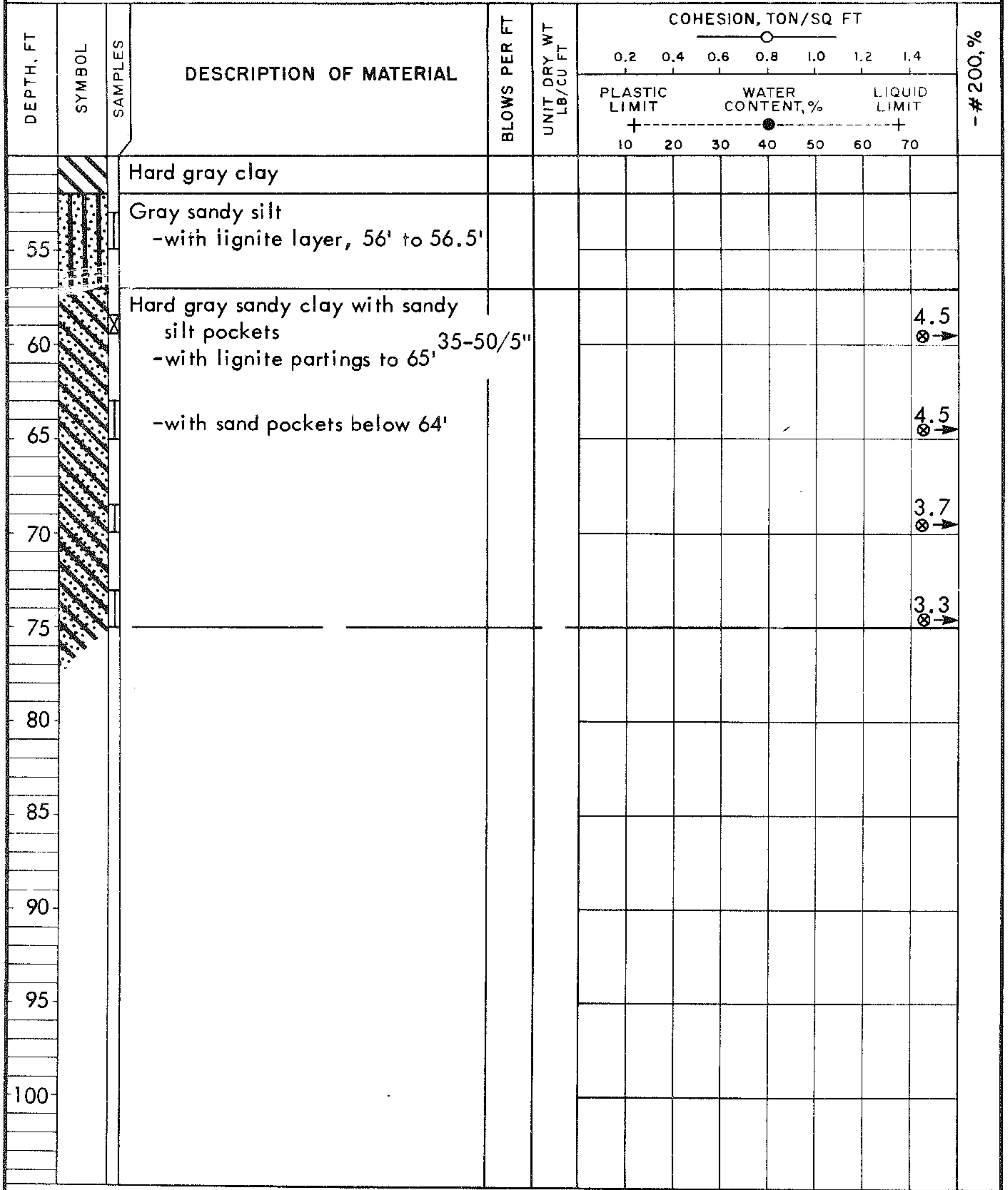
73-085

LOG OF BORING NO. P-19 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS



Hard gray clay

Gray sandy silt
-with lignite layer, 56' to 56.5'

Hard gray sandy clay with sandy silt pockets
-with lignite partings to 65'
-with sand pockets below 64'

COMPLETION DEPTH: 75'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 6.8'
DATE: May 3, 1973

McCLELLAND ENGINEERS

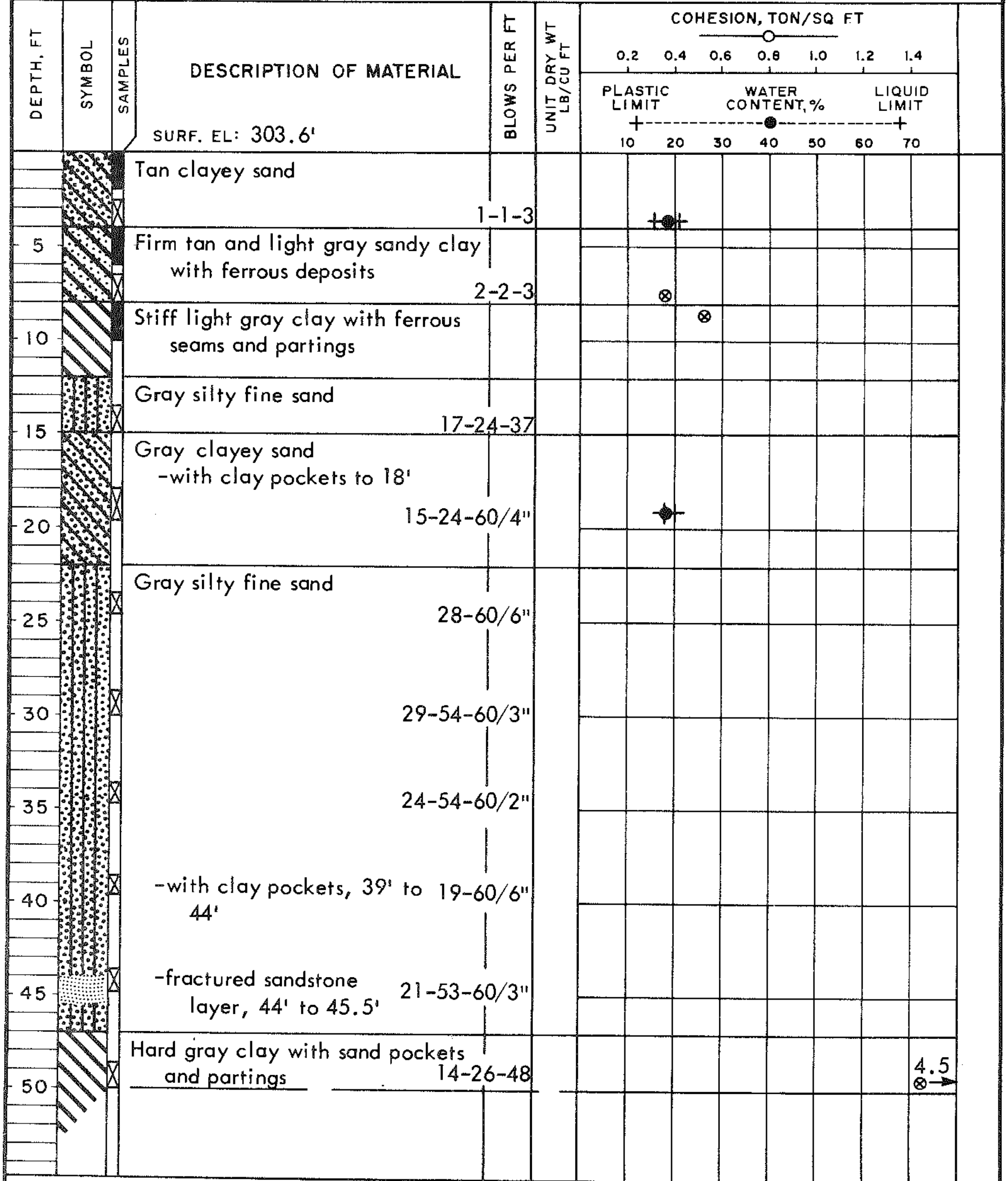
PLATE 15a

Form 108-1 (57) Job No. 73-085

LOG OF BORING NO. P-20

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



DESCRIPTION OF MATERIAL SURF. EL: 303.6'	BLOWS PER FT	UNIT DRY WT LB/CU FT
Tan clayey sand	1-1-3	
Firm tan and light gray sandy clay with ferrous deposits	2-2-3	
Stiff light gray clay with ferrous seams and partings		
Gray silty fine sand	17-24-37	
Gray clayey sand -with clay pockets to 18'	15-24-60/4"	
Gray silty fine sand	28-60/6"	
	29-54-60/3"	
	24-54-60/2"	
-with clay pockets, 39' to 44'	19-60/6"	
-fractured sandstone layer, 44' to 45.5'	21-53-60/3"	
Hard gray clay with sand pockets and partings	14-26-48	

COMPLETION DEPTH: 50'
DATE: April 28, 1973

DEPTH TO WATER IN BORING: 2.7'

DATE: May 3, 1973

McCLELLAND ENGINEERS

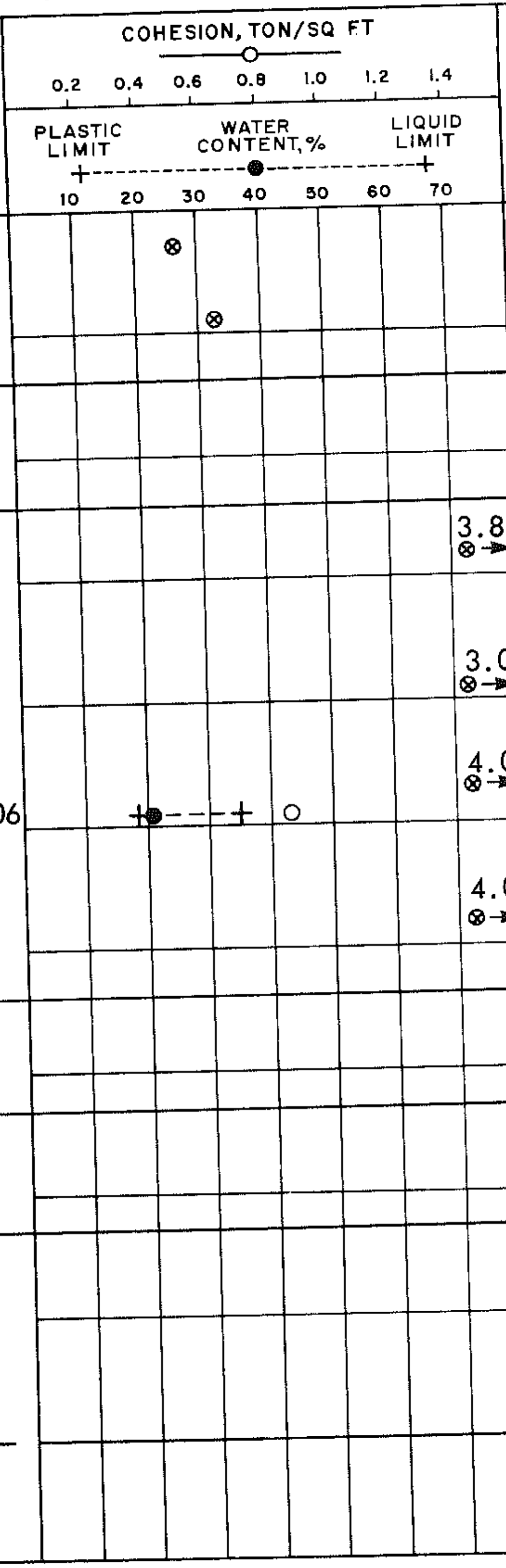
LOG OF BORING NO. P-21
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 323.6'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
Stiff red and light gray clay with sand partings and pockets -with ferrous nodules, 2' to 6'	3-3-6		
Tan silty fine sand with light gray clay seams and pockets	12-16-27		28
Hard gray clay -with silt partings to 20'			
-brown, 18.5' to 19'	14-25-33		
-with sand pockets & partings, 23' to 25'		106	
-with silt partings & pockets, 28' to 30'	12-19-23		
Gray silty fine sand	31-36-60/3"		
Hard gray sandy clay with sand pockets	10-21-60/5"		
Gray silty fine sand	21-60/6"		30
	26-60/5"		
	32-60/5"		21
-sandstone layer, 57' to 57.5'	21-46-60/3"		

Note Scale Change



COMPLETION DEPTH: 60'
DATE: April 29, 1973

DEPTH TO WATER IN BORING: 11.6'

DATE: May 3, 1973

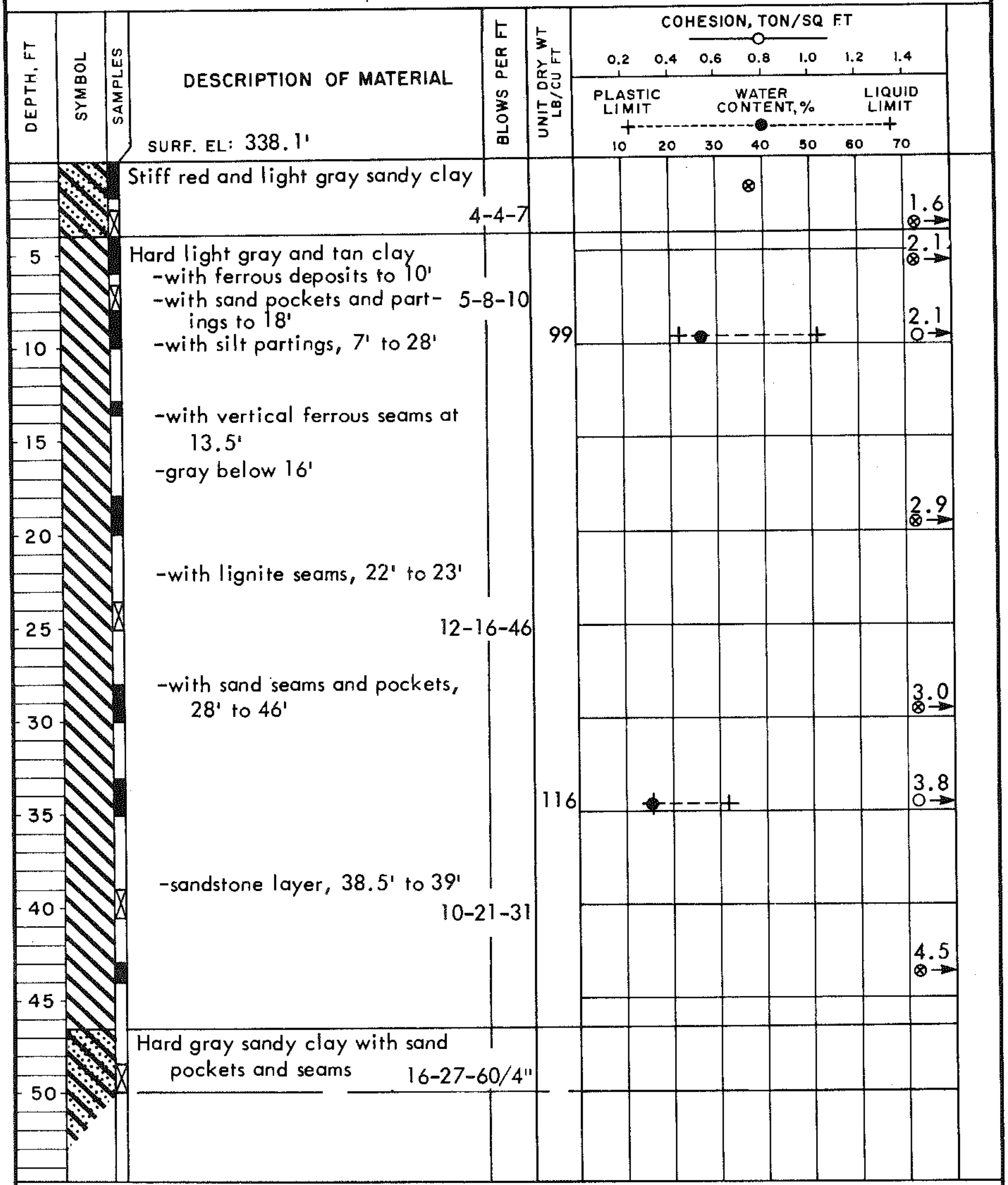
McCLELLAND ENGINEERS

Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-22
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 338.1'



Stiff red and light gray sandy clay

Hard light gray and tan clay
- -with ferrous deposits to 10'
- -with sand pockets and partings to 18'
- -with silt partings, 7' to 28'
- -with vertical ferrous seams at 13.5'
- -gray below 16'
- -with lignite seams, 22' to 23'
- -with sand seams and pockets, 28' to 46'
- -sandstone layer, 38.5' to 39'

Hard gray sandy clay with sand pockets and seams

COMPLETION DEPTH: 50'
DATE: April 30, 1973

DEPTH TO WATER IN BORING: 1.2'

DATE: May 3, 1973

McCLELLAND ENGINEERS

Form 108-1 (57) Job No 73-085

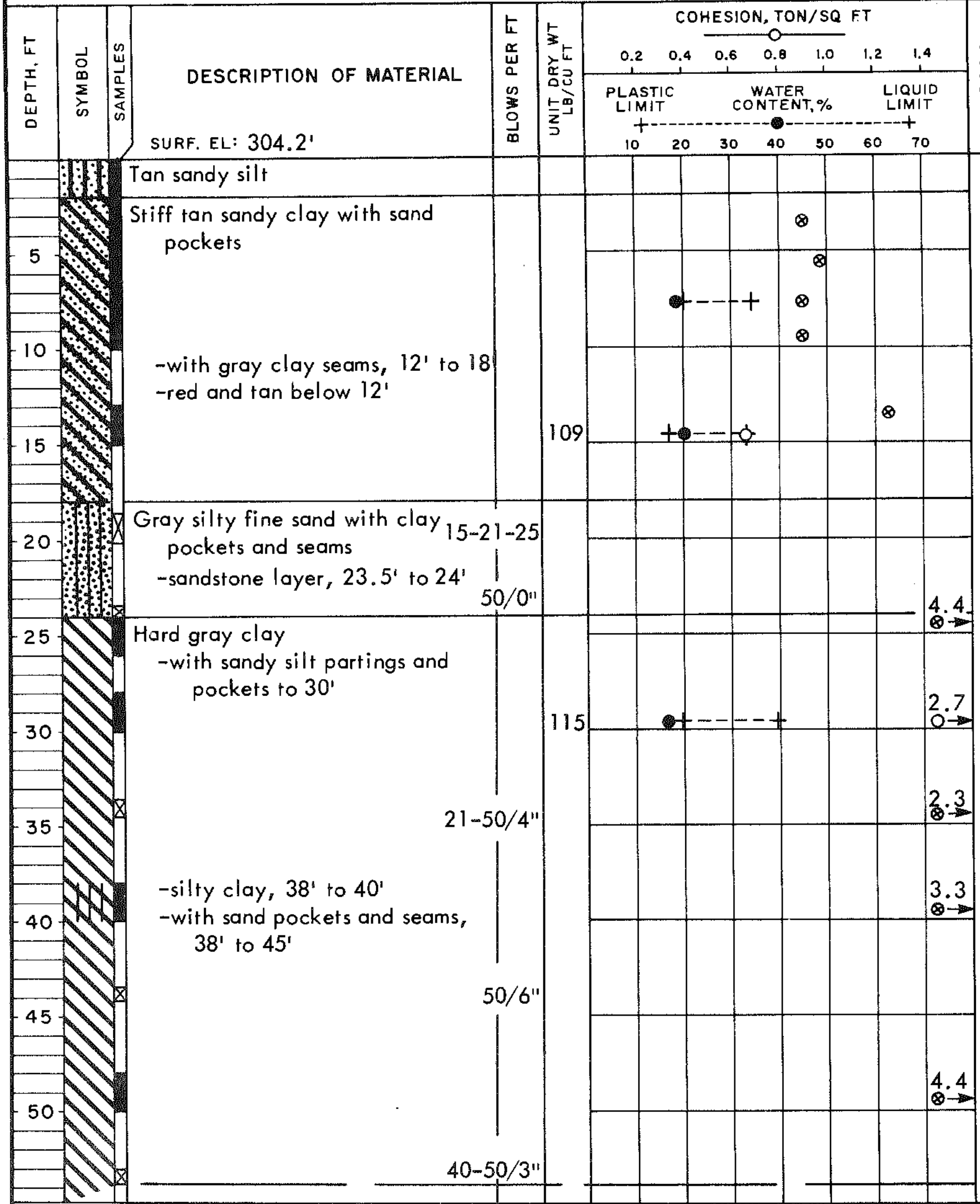
LOG OF BORING NO. P-23

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel   LOCATION: See Plate 1

SURF. EL: 304.2'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-# 200,%
Tan sandy silt			
Stiff tan sandy clay with sand pockets			
-with gray clay seams, 12' to 18' -red and tan below 12'		109	60
Gray silty fine sand with clay pockets and seams	15-21-25		24
-sandstone layer, 23.5' to 24'	50/0"		
Hard gray clay -with sandy silt partings and pockets to 30'		115	
	21-50/4"		
-silty clay, 38' to 40' -with sand pockets and seams, 38' to 45'			
	50/6"		
	40-50/3"		



COMPLETION DEPTH: 53.75'
DATE: April 22, 1973

DEPTH TO WATER IN BORING: 6.6'

DATE: May 3, 1973

McCLELLAND ENGINEERS

Form 108-1 (57) Job No 73-085

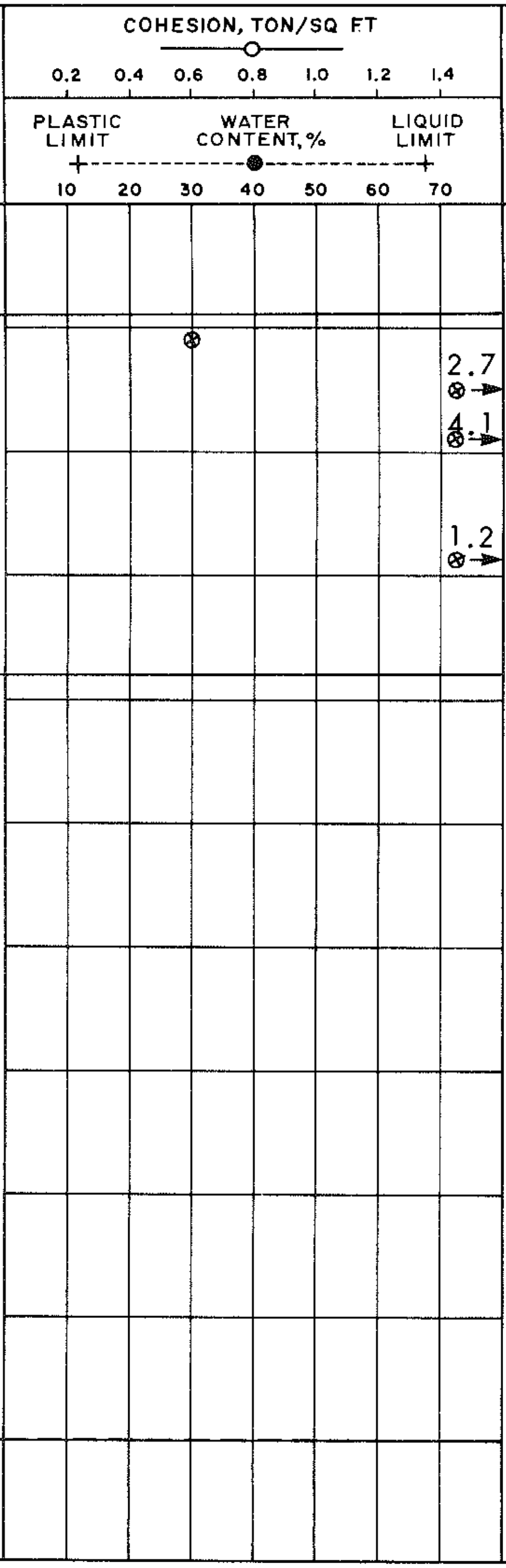
LOG OF BORING NO. P-25

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 357.8'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
0	Tan sandy silt			60 64
5	Stiff gray and red sandy clay with sand pockets -with gray clay seams to 8' -very stiff red and tan below 7'			
15	-with red fine sand seams and layers below 13'	8-17-16		
20	Tan silty fine sand			
25	-with ferrous nodules, 24' to 24.5'	11-10-10		32
30		18-23-18		
35	-with ferrous partings, 34' to 35'	21-50/9"		16
40		28-50/8"		
45	-with organic partings, 43' to 45.5' -gray below 43'	8-14-20		
50	-with clay seams, 49' to 54'	14-50/6"		



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McCLELLAND ENGINEERS

Form 108-3 (57) Job No 73-085

LOG OF BORING NO. P-25 (Cant'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) — PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
			Tan silty fine sand				
55		☒		50/6"			
			-sandstone layer, 58' to 59'				
60		☒		50/6"			14
65		☒	-with clay seams and sandstone nodules below 64'	32-50/6"			
70		☒		50/4"			
75		☒		24-50/7"			
80							
85							
90							
95							
100							

COMPLETION DEPTH: 74.5'
DATE: April 21, 1973

DEPTH TO WATER IN BORING: 5.3'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 20a

Form OB-1 1571 Job No 73-085

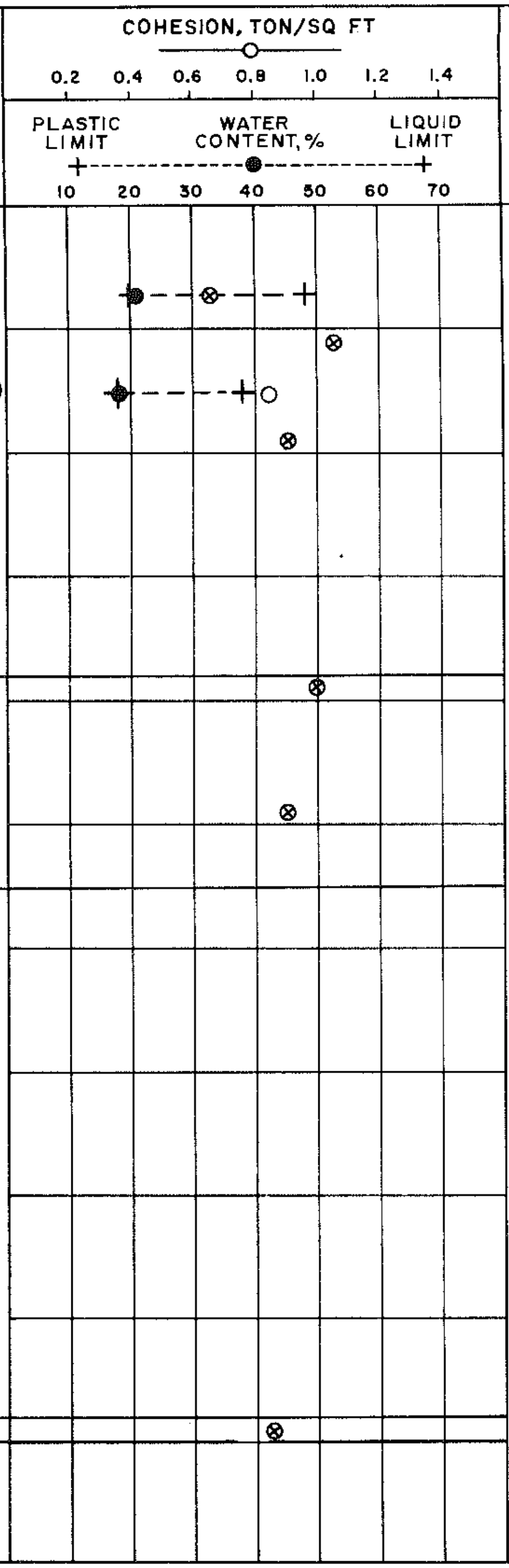
LOG OF BORING NO. P-26
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 346.2'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
	Stiff tan sandy clay with sand pockets and seams			
	-with ferrous deposits, 4' to 10'			
5				
	-red and tan below 6'			
			110	66
10				
	-red fine sand layer, 13.5' to 14'	15-29-20		
15	-with ferrous nodules below 14'			
20	Very stiff light gray and brown clay with ferrous partings and sand partings, seams and pockets			
25	-gray below 24'	10-13-17		
30	Tan fine sand with clay seams and pockets	4-13-25		6
35		28-35-15		
40		6-4-7		27
		16-19-26		
50		10-31-22		4
		10-10-25		
60	Stiff gray clay			

Note Scale Change



COMPLETION DEPTH: 60'
DATE: April 21, 1973

DEPTH TO WATER IN BORING: 19.7'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 21

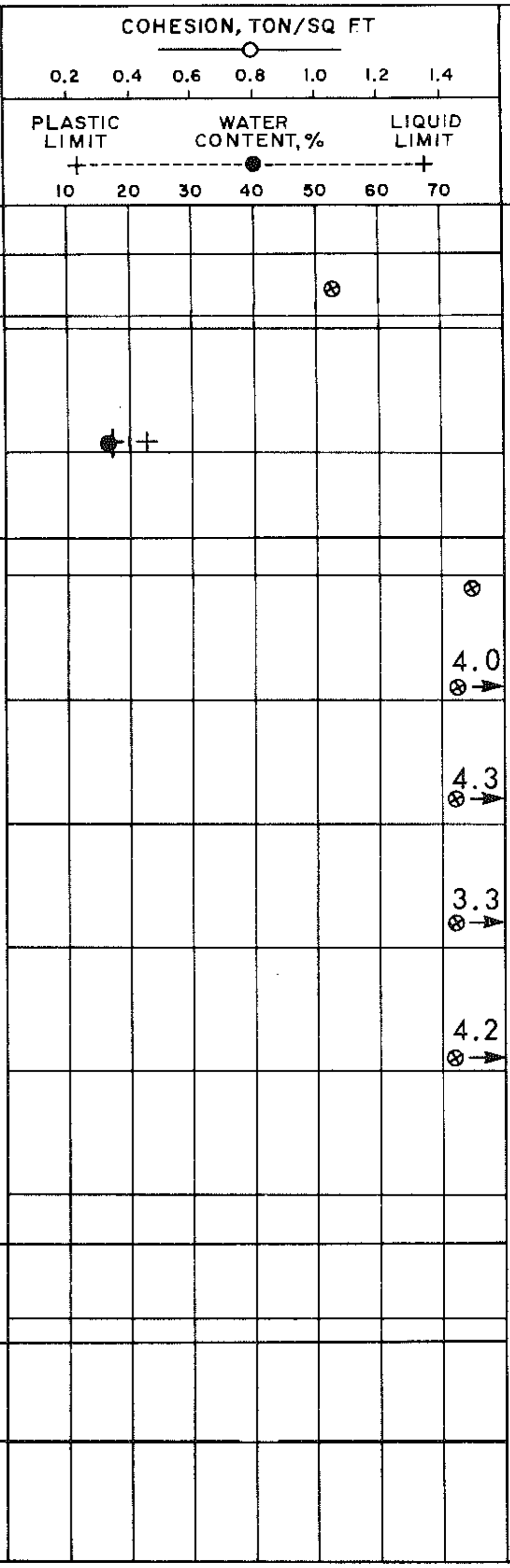
Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-28
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 332.7'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
0–2	Tan silty fine sand			
2–4.5	Very stiff tan and light gray sandy clay			
4.5–13	Tan fine sand -with light gray clay seams below 7.5'	13-18-17 15-22-44		6
13–42	Very stiff red and light gray clay with sand and silt pockets and partings -hard below 18' -sandstone layer, 32.5' to 33'	13-18-22 20-35-60/5"		
42–46	Hard gray sandy clay	12-18-40		
46–50	Hard gray clay with silt partings and seams	13-22-32		



COMPLETION DEPTH: 50'
DATE: April 30, 1973

DEPTH TO WATER IN BORING: 5.0'

DATE: May 3, 1973

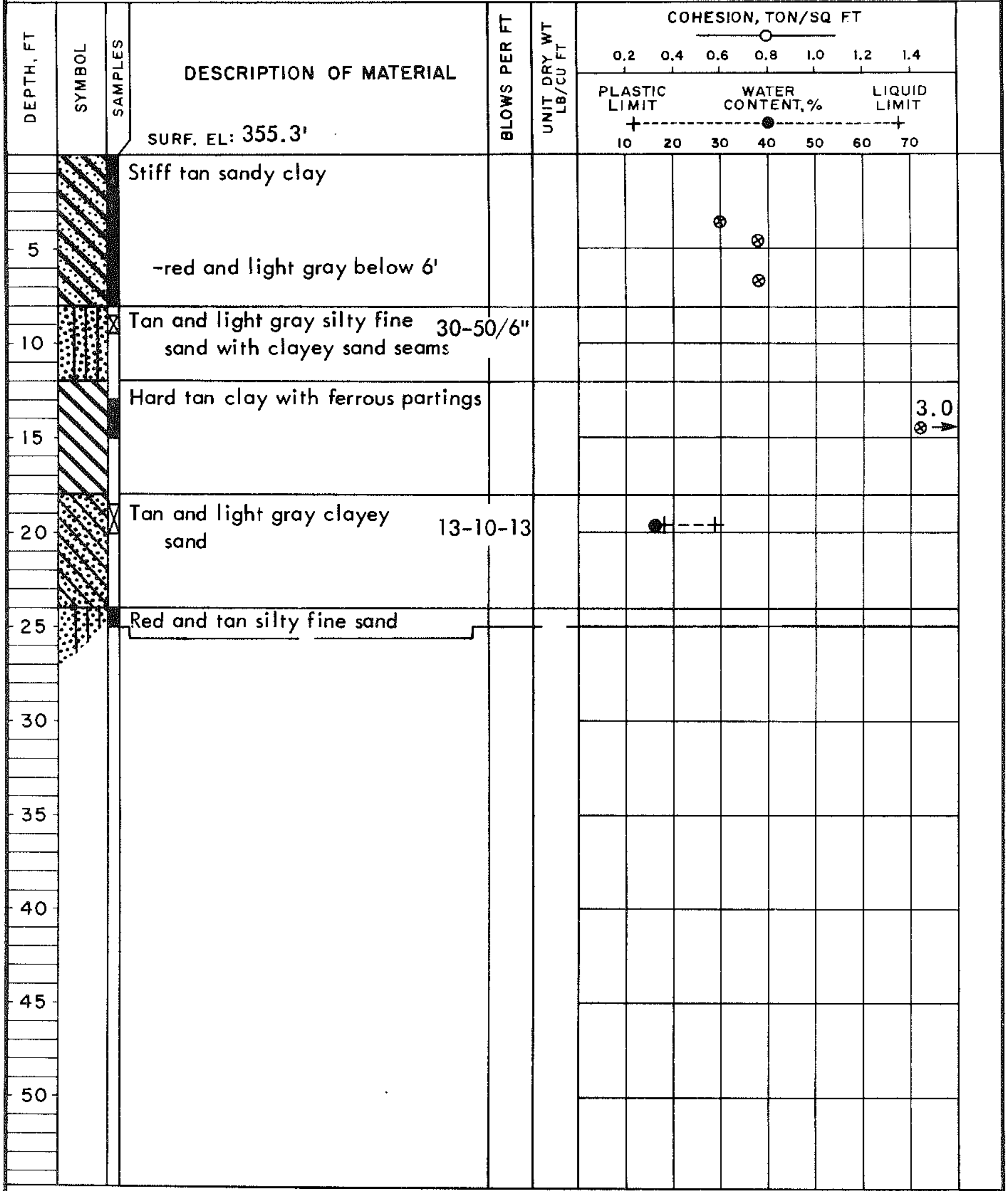
McCLELLAND ENGINEERS

Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-30

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



SURF. EL: 355.3'

DESCRIPTION OF MATERIAL	BLOWS PER FT
Stiff tan sandy clay -red and light gray below 6'	
Tan and light gray silty fine sand with clayey sand seams	30-50/6"
Hard tan clay with ferrous partings	
Tan and light gray clayey sand	13-10-13
Red and tan silty fine sand	

COMPLETION DEPTH: 25'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 19.0'

DATE: May 3, 1973

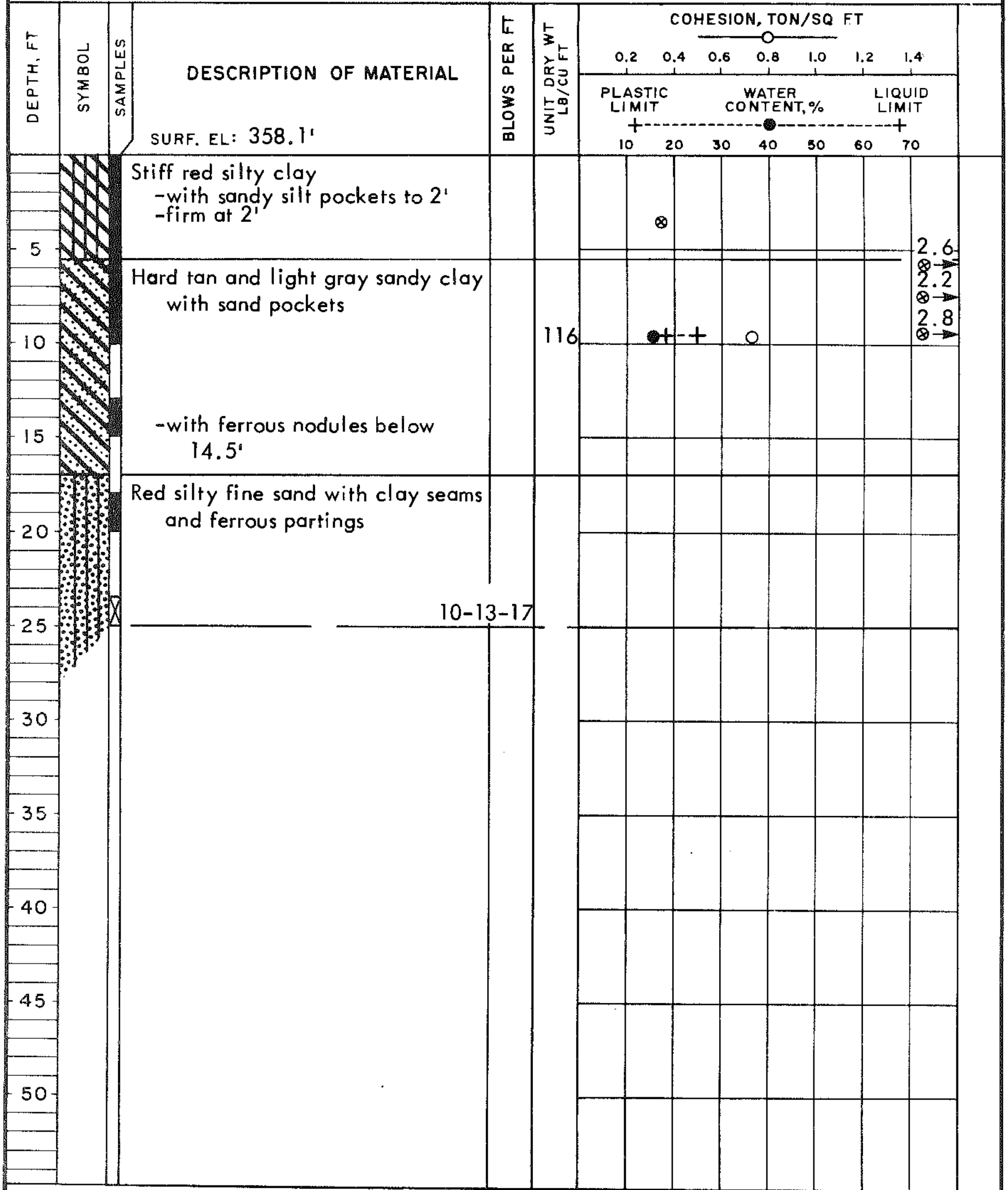
McCLELLAND ENGINEERS

PLATE 23

Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-31
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



SURF. EL: 358.1'

Stiff red silty clay
-with sandy silt pockets to 2'
-firm at 2'

Hard tan and light gray sandy clay with sand pockets

-with ferrous nodules below 14.5'

Red silty fine sand with clay seams and ferrous partings

COMPLETION DEPTH: 25'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 16.0'

DATE: May 3, 1973

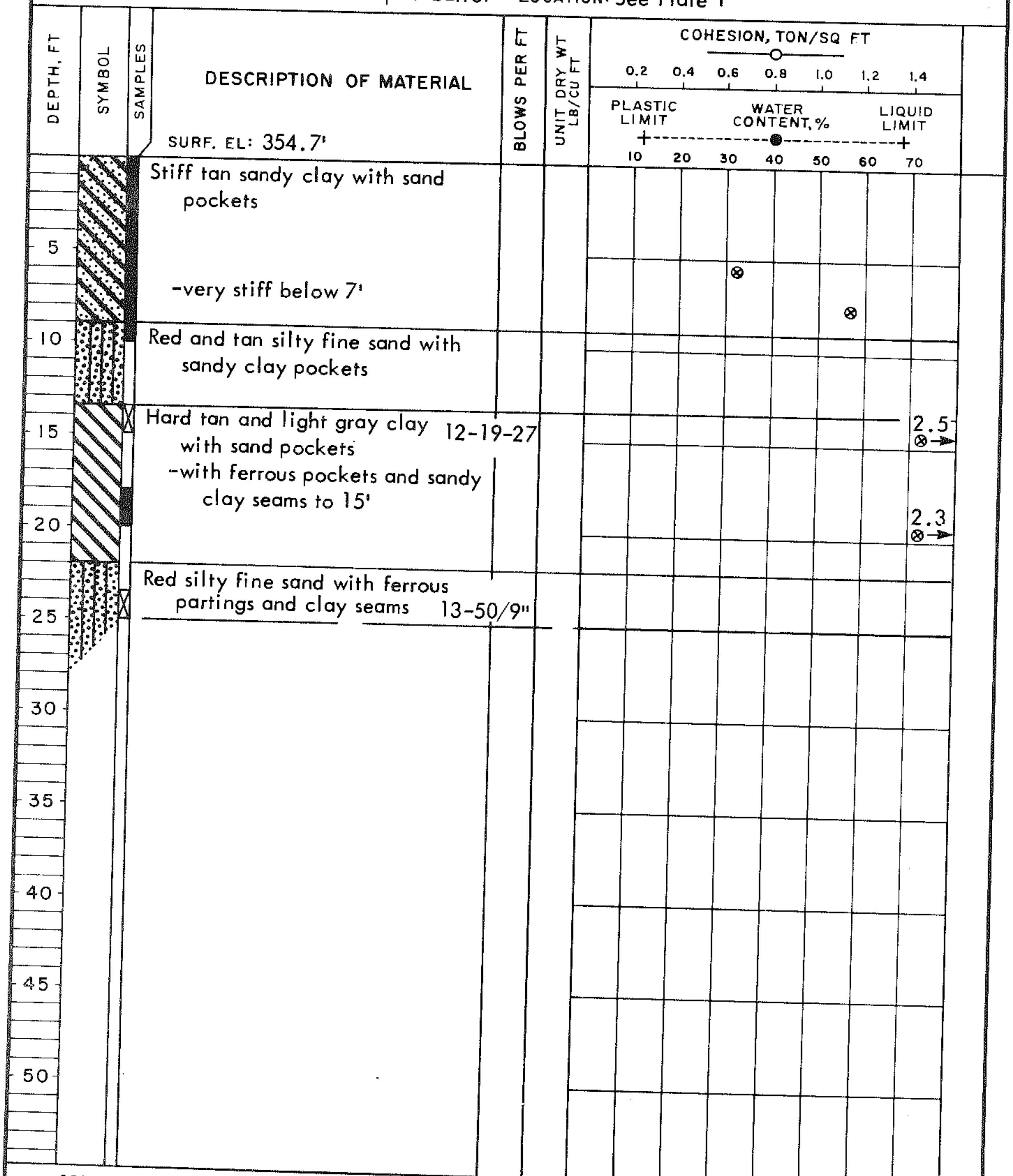
McCLELLAND ENGINEERS

Form ... Job No. 73-085

LOG OF BORING NO. P-32

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



SURF. EL: 354.7'

DESCRIPTION OF MATERIAL	BLOWS PER FT
Stiff tan sandy clay with sand pockets -very stiff below 7'	
Red and tan silty fine sand with sandy clay pockets	
Hard tan and light gray clay with sand pockets -with ferrous pockets and sandy clay seams to 15'	12-19-27
Red silty fine sand with ferrous partings and clay seams	13-50/9"

COMPLETION DEPTH: 25'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 14.7'

DATE: May 3, 1973

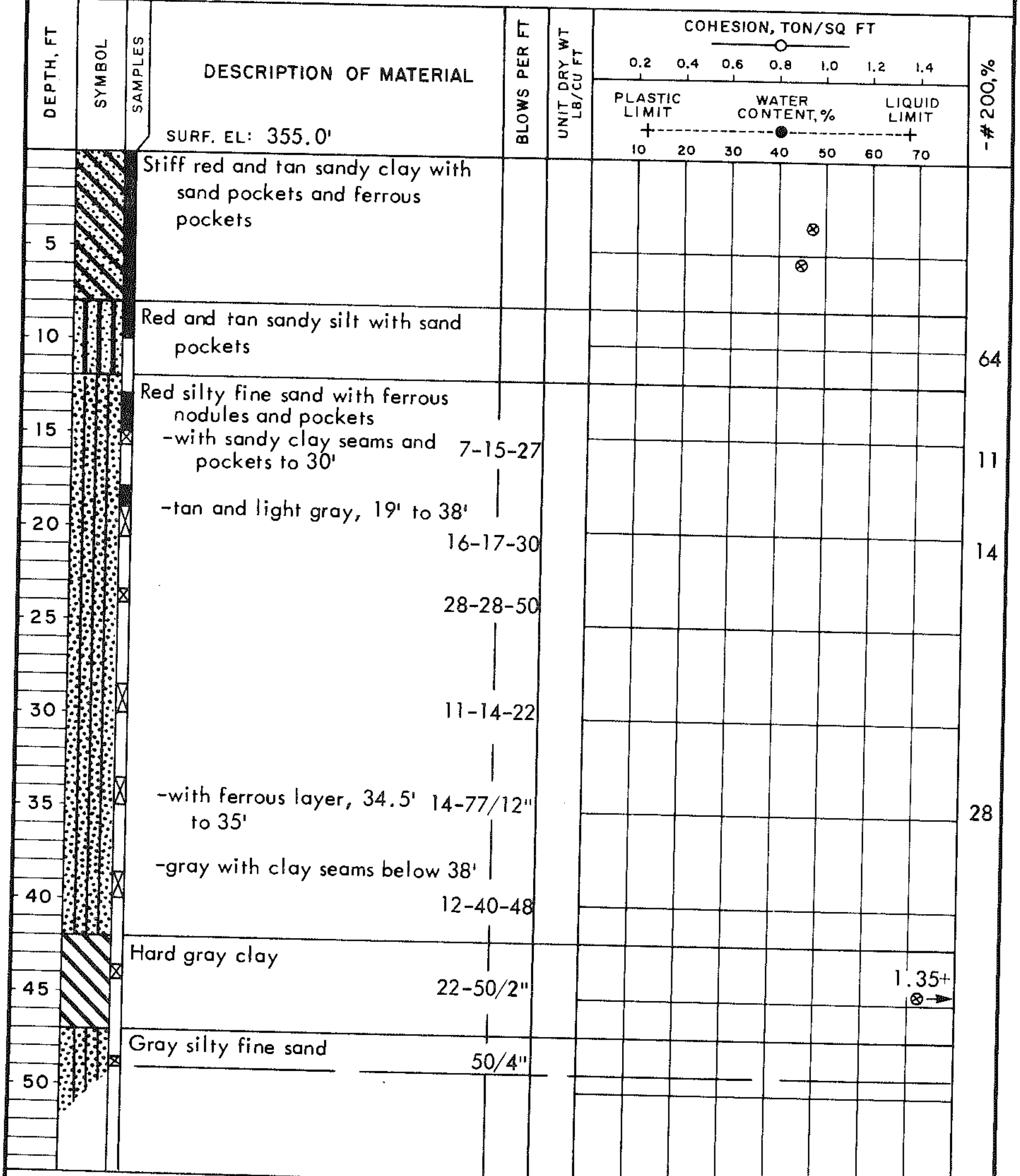
McCLELLAND ENGINEERS

Form -08-1 (57) Job No. 73-085

LOG OF BORING NO. P-33
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 355.0'



DESCRIPTION OF MATERIAL	BLOWS PER FT	-#200,%
Stiff red and tan sandy clay with sand pockets and ferrous pockets		
Red and tan sandy silt with sand pockets		64
Red silty fine sand with ferrous nodules and pockets		
-with sandy clay seams and pockets to 30'	7-15-27	11
-tan and light gray, 19' to 38'	16-17-30	14
	28-28-50	
	11-14-22	
-with ferrous layer, 34.5' to 35'	14-77/12"	28
-gray with clay seams below 38'	12-40-48	
Hard gray clay	22-50/2"	
Gray silty fine sand	50/4"	

COMPLETION DEPTH: 49'
DATE: April 13, 1973

DEPTH TO WATER IN BORING: 15.4'

DATE: May 3, 1973

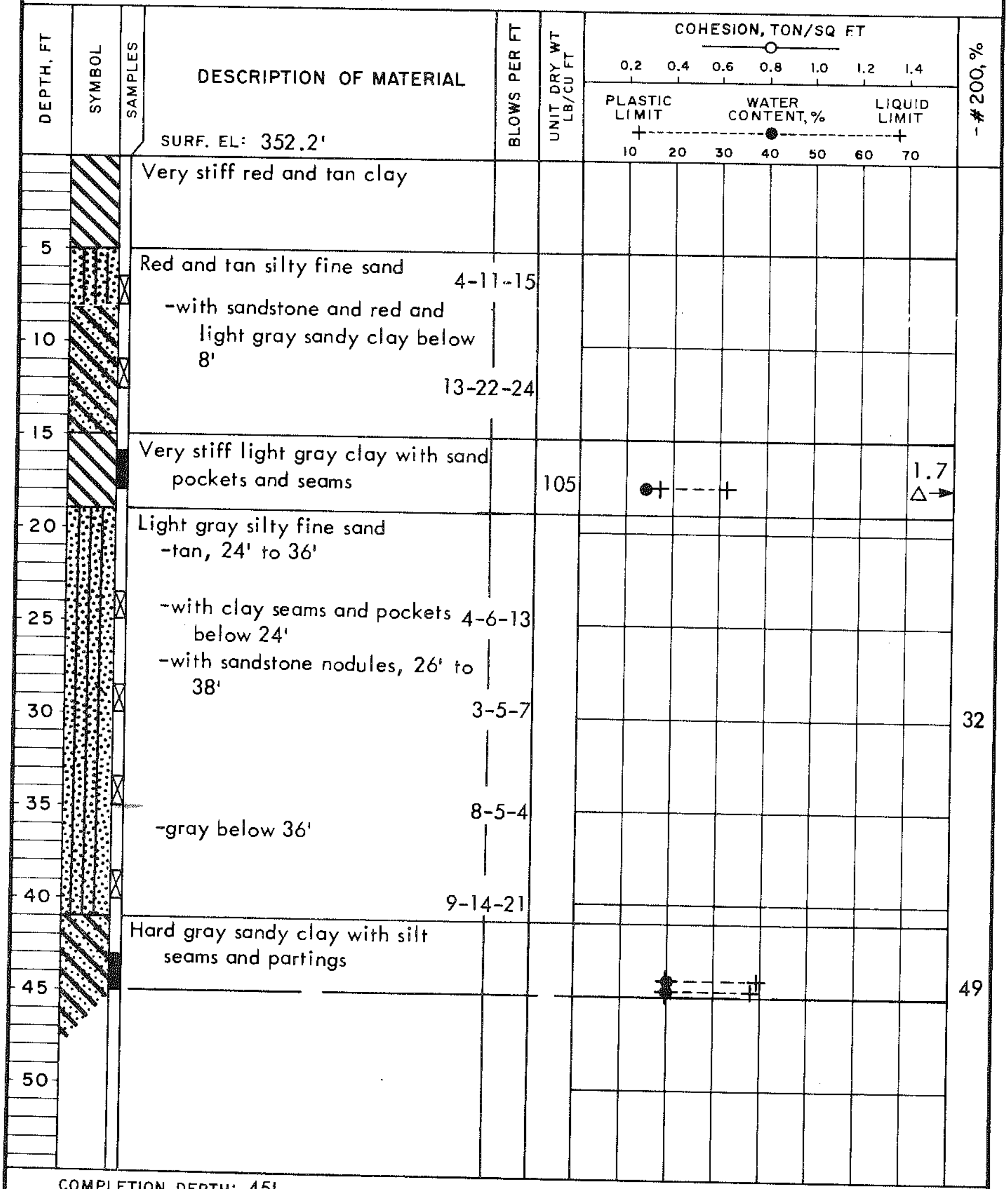
McCLELLAND ENGINEERS

Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-34
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 352.2'



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#200, %
Very stiff red and tan clay				
Red and tan silty fine sand -with sandstone and red and light gray sandy clay below 8'	4-11-15 13-22-24			
Very stiff light gray clay with sand pockets and seams		105	1.7 △→	
Light gray silty fine sand -tan, 24' to 36' -with clay seams and pockets below 24' -with sandstone nodules, 26' to 38' -gray below 36'	4-6-13 3-5-7 8-5-4 9-14-21			32
Hard gray sandy clay with silt seams and partings				49

COMPLETION DEPTH: 45'
DATE: May 1, 1973

DEPTH TO WATER IN BORING: 21.4'

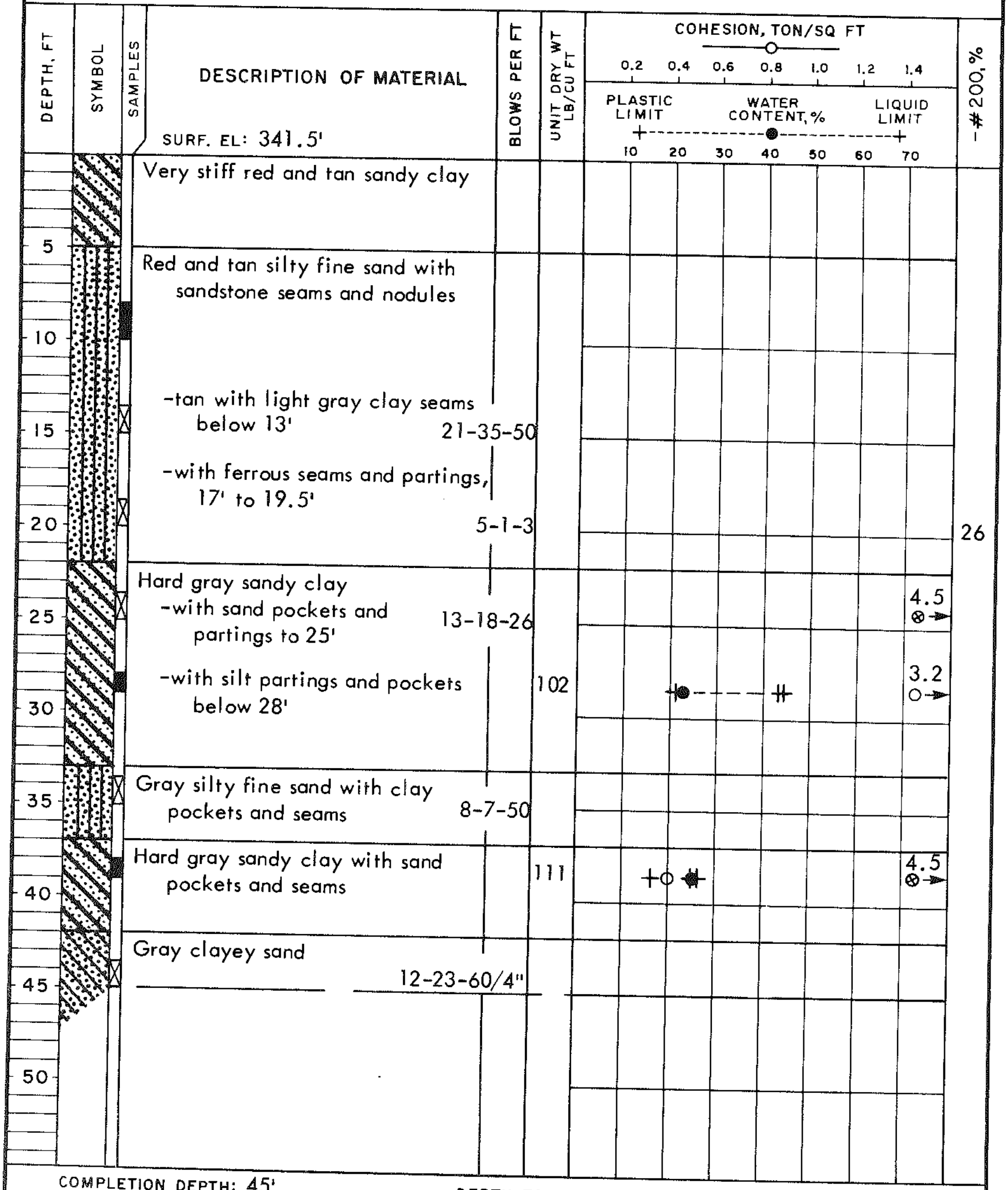
DATE: May 3, 1973

McCLELLAND ENGINEERS

73-085

LOG OF BORING NO. P-35
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#200, %
SURF. EL: 341.5'				
Very stiff red and tan sandy clay				
Red and tan silty fine sand with sandstone seams and nodules				
-tan with light gray clay seams below 13'	21-35-50			
-with ferrous seams and partings, 17' to 19.5'	5-1-3			26
Hard gray sandy clay				
-with sand pockets and partings to 25'	13-18-26		4.5	
-with silt partings and pockets below 28'		102	3.2	
Gray silty fine sand with clay pockets and seams	8-7-50			
Hard gray sandy clay with sand pockets and seams		111	4.5	
Gray clayey sand	12-23-60/4"			

COMPLETION DEPTH: 45'
DATE: May 2, 1973

DEPTH TO WATER IN BORING: 10.9'
DATE: May 3, 1973

McCLELLAND ENGINEERS

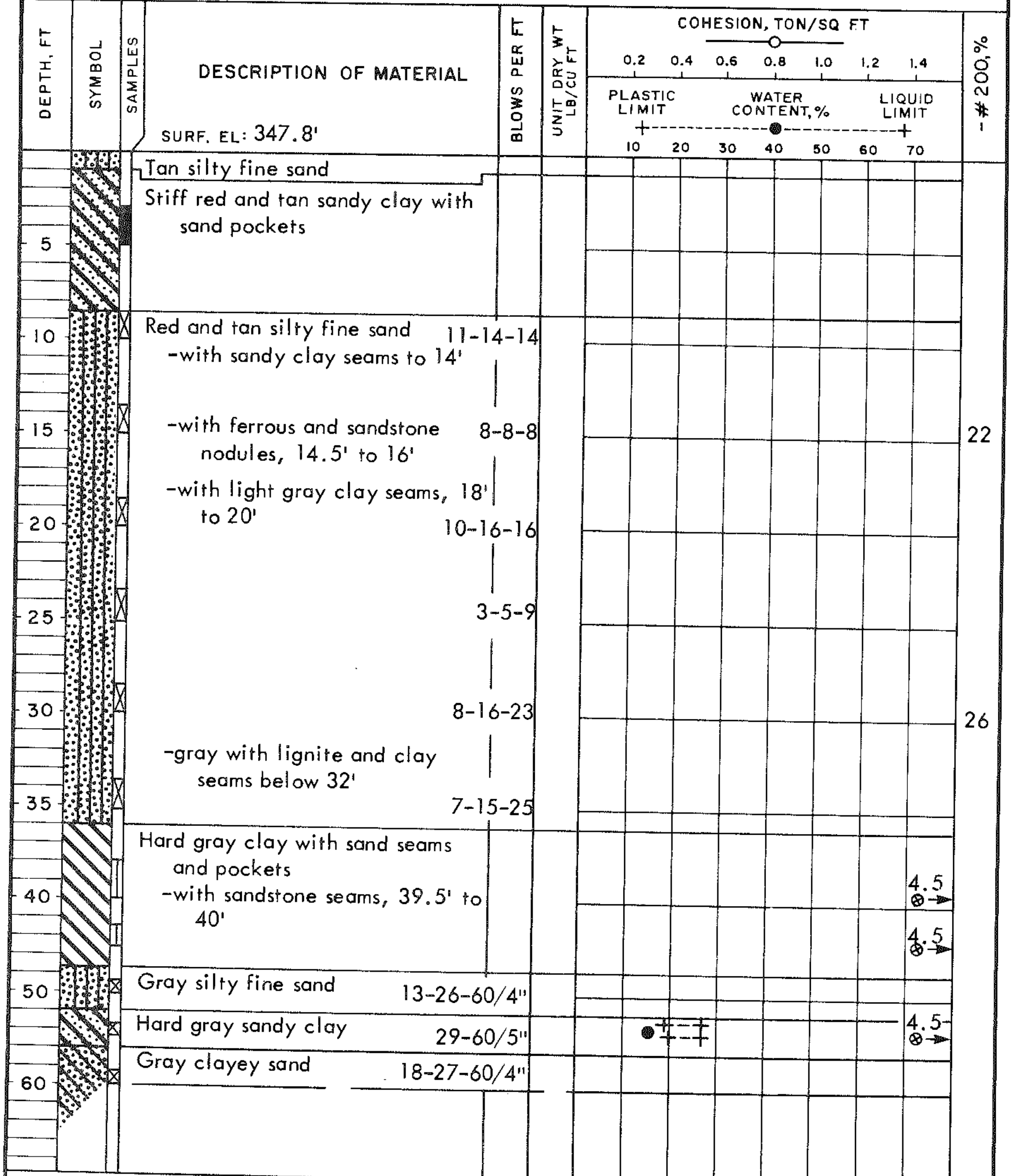
Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-36

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube, 2" split-barrel & 3" Denison barrel LOCATION: See Plate 1

SURF. EL: 347.8'



DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#200,%
	Tan silty fine sand				
5	Stiff red and tan sandy clay with sand pockets				
10	Red and tan silty fine sand -with sandy clay seams to 14'	11-14-14			
15	-with ferrous and sandstone nodules, 14.5' to 16' -with light gray clay seams, 18' to 20'	8-8-8			22
20		10-16-16			
25		3-5-9			
30	-gray with lignite and clay seams below 32'	8-16-23			26
35		7-15-25			
40	Hard gray clay with sand seams and pockets -with sandstone seams, 39.5' to 40'			4.5	
45				4.5	
50	Gray silty fine sand	13-26-60/4"			
55	Hard gray sandy clay	29-60/5"		4.5	
60	Gray clayey sand	18-27-60/4"			

COMPLETION DEPTH: 60'
DATE: May 2, 1973

DEPTH TO WATER IN BORING: 18.0'

DATE: May 3, 1973

McCLELLAND ENGINEERS

Form 108-1 (57) Job No 73-085

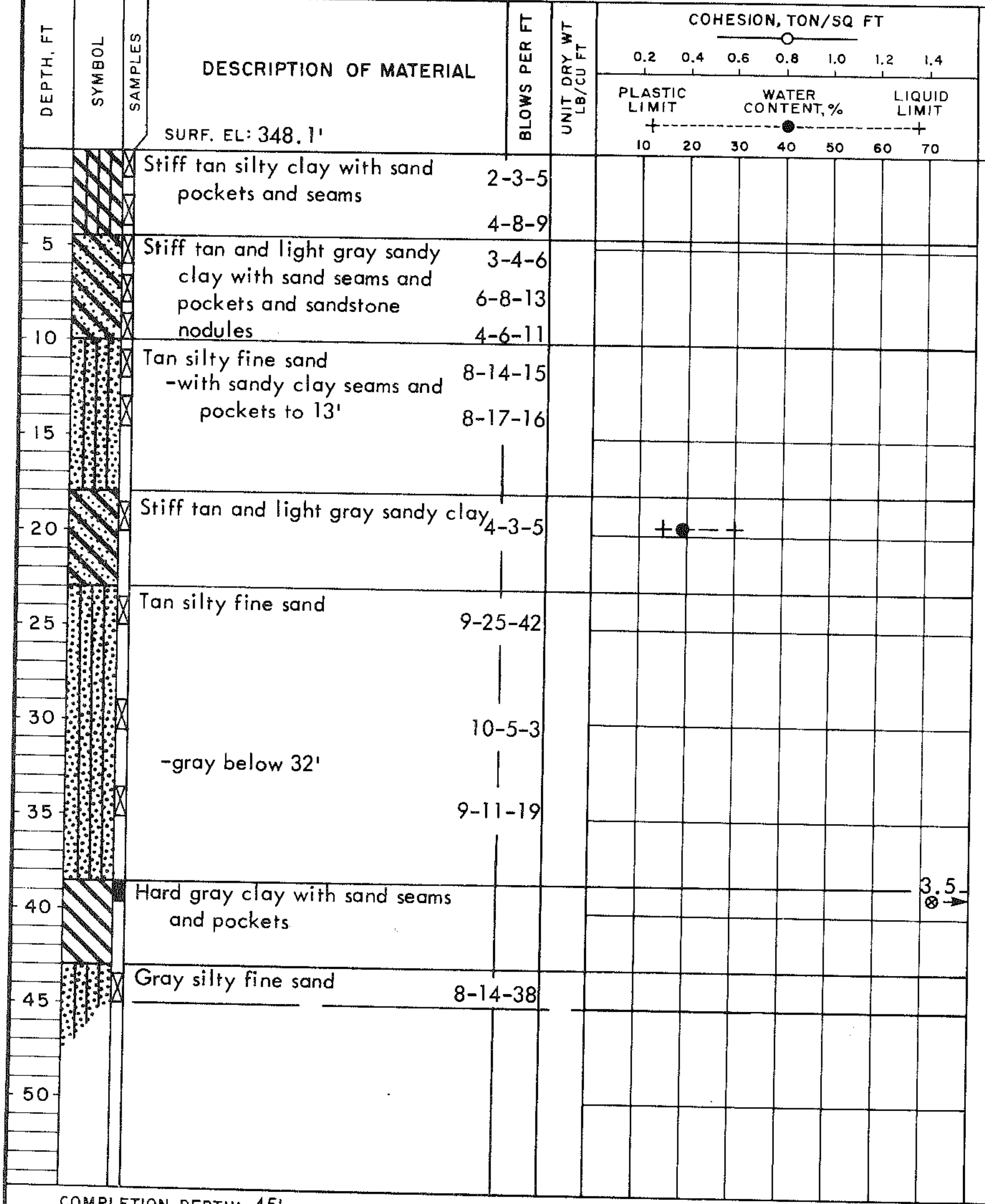
LOG OF BORING NO. P-37

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 348.1'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
Stiff tan silty clay with sand pockets and seams	2-3-5 4-8-9	
Stiff tan and light gray sandy clay with sand seams and pockets and sandstone nodules	3-4-6 6-8-13 4-6-11	
Tan silty fine sand -with sandy clay seams and pockets to 13'	8-14-15 8-17-16	
Stiff tan and light gray sandy clay	4-3-5	
Tan silty fine sand -gray below 32'	9-25-42 10-5-3 9-11-19	
Hard gray clay with sand seams and pockets		
Gray silty fine sand	8-14-38	



COMPLETION DEPTH: 45'
DATE: May 1, 1973

DEPTH TO WATER IN BORING: 16.5'

DATE: May 3, 1973

McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 73-080

LOG OF BORING NO. P-38
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin Wall-Tube
2" Split-Spoon

LOCATION: See Plat 1

SURF. EL: 328.7'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	ELEVATION, FT
	J1 a1	▨	stiff Red & TAN Sandy Clay w/ferrous deposits @ 1.5			
5	J2	☒	Red & TAN Sandy Silt - w/clay seams 4.5 - 9.5	9/16/14		
	J3	☒	- w/ferrous deposits @ 5	27/30/28		
10	J4	☒	- w/ferrous Layer @ 8' (3")	9/15/27		
			- w/ferrous Layer 12.5 - 13.5			
15	J5	☒	Gray Silty Fine Sand - w/Lignite seam @ 14.5 (3") - w/sandstone Layer 16' - 17.5'	6/10/12		
20	J6	☒	Stiff Gray Clay	18/15/22		
	UP1	▨	- laminated with silt below 20'			
25	J7 J8	☒ ▨	- Light Gray sandy silt seam @ 26	8/10/15		
30	J9 UP2	☒ ▨		10/14/17		
35	J10	☒	Gray silty Fine Sand	29/37/60-2"		
	J11	☒		24/34/60-2"		
40			Hard gray sandy clay - with mica and sand pockets			
45	J12	☒		29/60-6"		
			- lignite layer, 46' - 47'			
50	J13	☒		60-6"		

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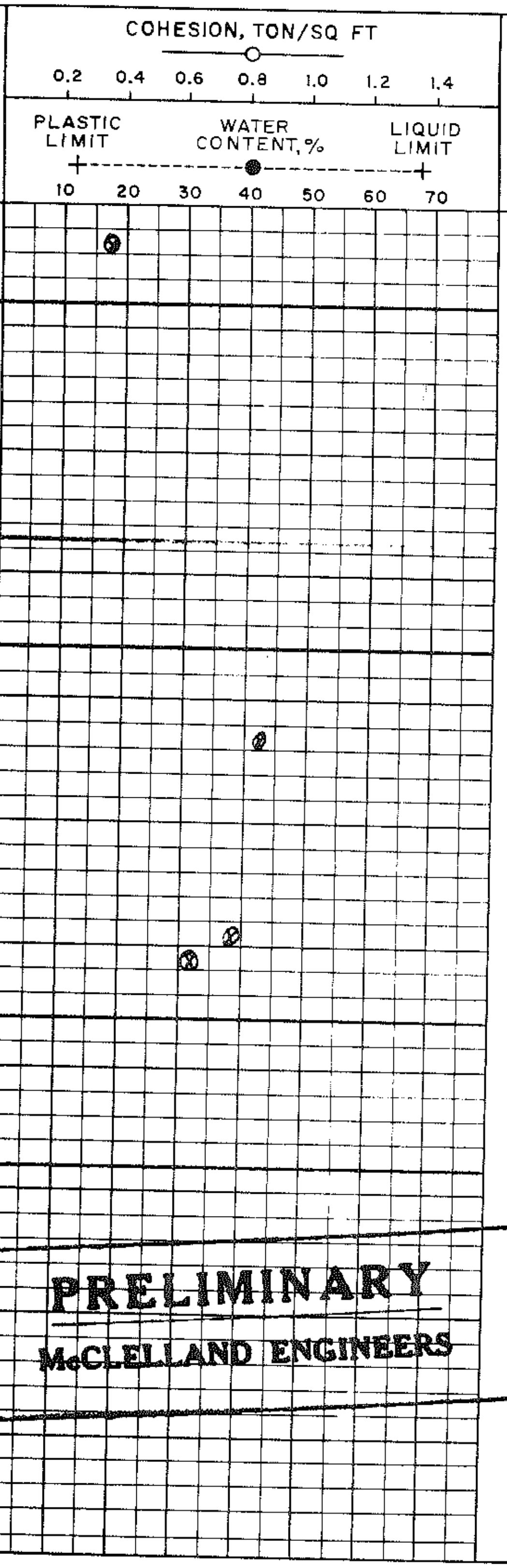


PRELIMINARY
McCLELLAND ENGINEERS

McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 73-086

LOG OF BORING NO. P38(Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) — PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10 20 30 40 50 60 70)	ELEVATION, FT
			Hard Gray Sandy Clay				
55				27/39/63-3"			
60				30/45/60-5"			
			-w/lignite layer 63.5'-64.5'				
65			-w/scattered lignite seams, 64.5-67'				
70				27/40-3"			
75				40-6"			
80			-w/clay and sand seams below 79'	40-6"			
				40-4"			
85			Gray Sandy Silt -w/clay seams below 84'				
90				40-5"			
95				40-3"			
100				50/5"			

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 100'
DATE: July 30, 1973

DEPTH TO WATER IN BORING: 9.6' Caved at: 49.6' DATE: July 31, 1973

McCLELLAND ENGINEERS

PLATE 3/9

LOG OF BORING NO. P-39

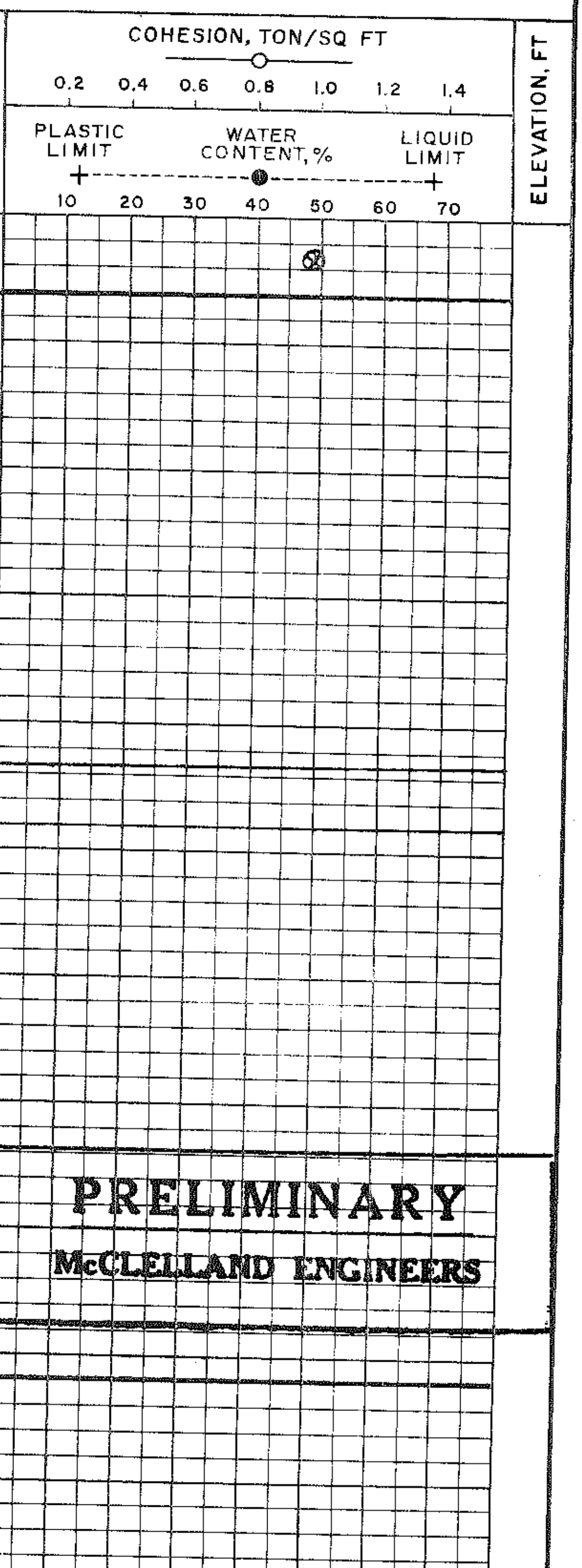
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin-Wall-Tube
2" Split-Spoon
Denison-barrel

LOCATION: See Plate 1

SURF. EL: 348.6'

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	UP1	Stiff Red & TAN Sandy Clay		
5	J1	Red Sandy Silt w/clay pockets, 5' to 8'	22/24/39	
	J2		22/24/55	
10	J3		19/31/31	
		-TAN below 13'		
15	J4	- w/gravel, 17'-17.5'	30/37/30	
20	J5	- w/ Brown clay seams below 20'	7/14/20	
		Stiff Brown & Light Gray clay w/sandy silt seams		
	J6			
25	UP2	TAN & Light Gray Silty Fine Sand	7/8/14	
	J7	- TAN 28.5'-33.5'	48/60-5"	
30		- w/sandstone nodules below 28.5		
	78	- TAN & Red 33.5-45	30/60-6"	
35		w/Lignite layer, 36' to 36.5'		
40	J9		14/19/30	
45	J10	- Light Gray below 45	18/21/24	
		Hard Gray Clay		
50	J11	w/sand streaks @50	25/29/60	
		(Continued on next page)		



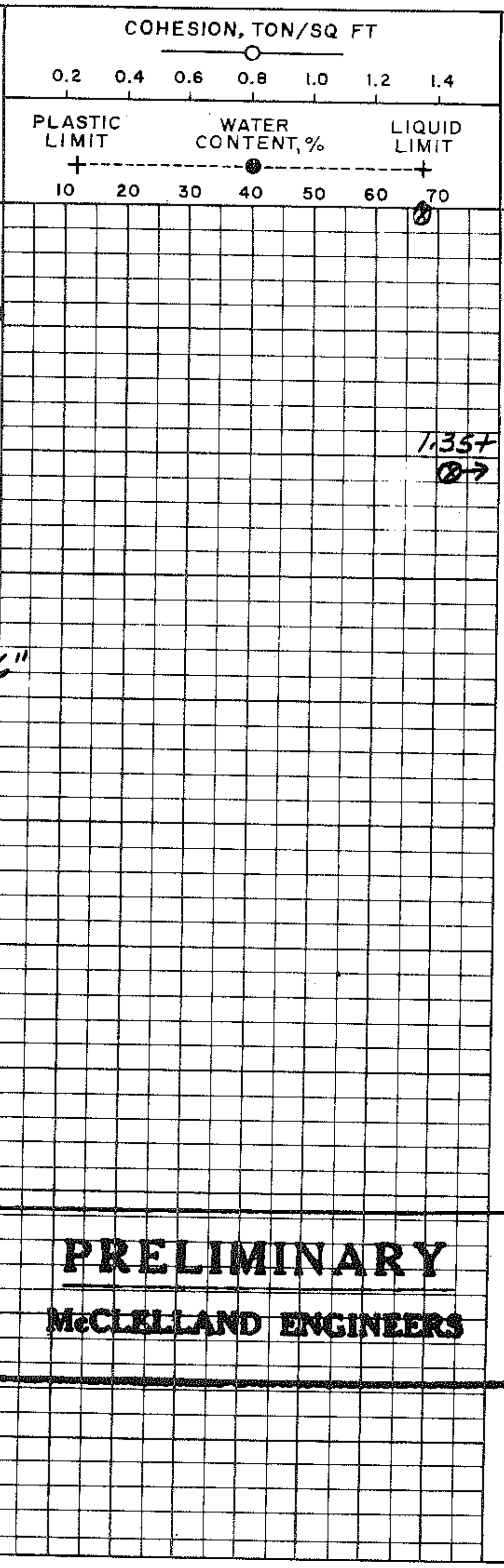
PRELIMINARY
McCLELLAND ENGINEERS

McCLELLAND
ENGINEERS

Form 108-5 (67) Job No. 73 085

LOG OF BORING NO. P-39 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	ELEVATION, FT
	J12		Hard gray Clay			
55	J13		- laminated w/silt, 55' to 70'	30/34/60		
	J14B		-w/siltstone Nodules, 54.5-56			
60	J14A					
	J14					
65	J15			27/40-3		
70	J16			24/40-6"		
75				45-5"		
80						
85						
90						
95						
100						



PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 75'
DATE: July 27, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND
ENGINEERS

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. P-40

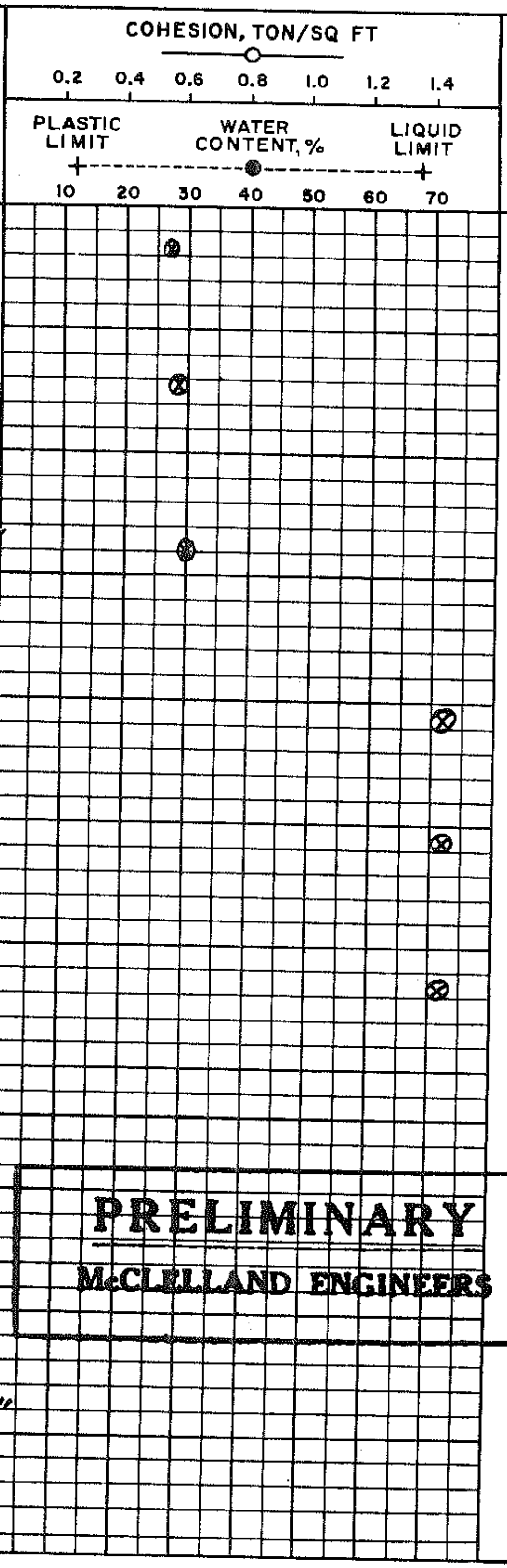
Welsh Power Plant
Cason, Texas

TYPE: 3" Thin-Wall-Tube
2" Split-barrel

LOCATION: See Plate 1

SURF. EL: 341.9'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	ELEVATION, FT
	UP1	■	Stiff Light Gray & Red Sandy Clay -w/ferrous deposits 2'-3.5'			
5	J1	☒	-w/ferrous seams 5'-14' - light gray & tan 6.5'-20'	4/6/8		
	UP2	■				
10	J2	☒	-w/sand seams and pockets below 10'	9/9/11		
	J3	☒		23/28/60-4"		
15			-w/sand layer, 16'-16.5'			
	J4	☒				
20	UP3	■	- Dark Gray below 20' - w/organic matter 20.5'-22' - Very Stiff below 21'	5/9/14		
25	J5	☒		11/16/19		
	UP4	■				
30	J6	☒		22/26/30		
	UP5	■				
35		☒		42/60		
40	J7	☒	Gray Silty Fine Sand w/organic matter 39'-40'	27/60-5"		
45	J8	☒		27/26/60-5"		
50	J9	☒		28/26/60-5"		



PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 50'
DATE: Aug. 2, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

PLATE 33

Form 108-5 (57) Job No. 73-085

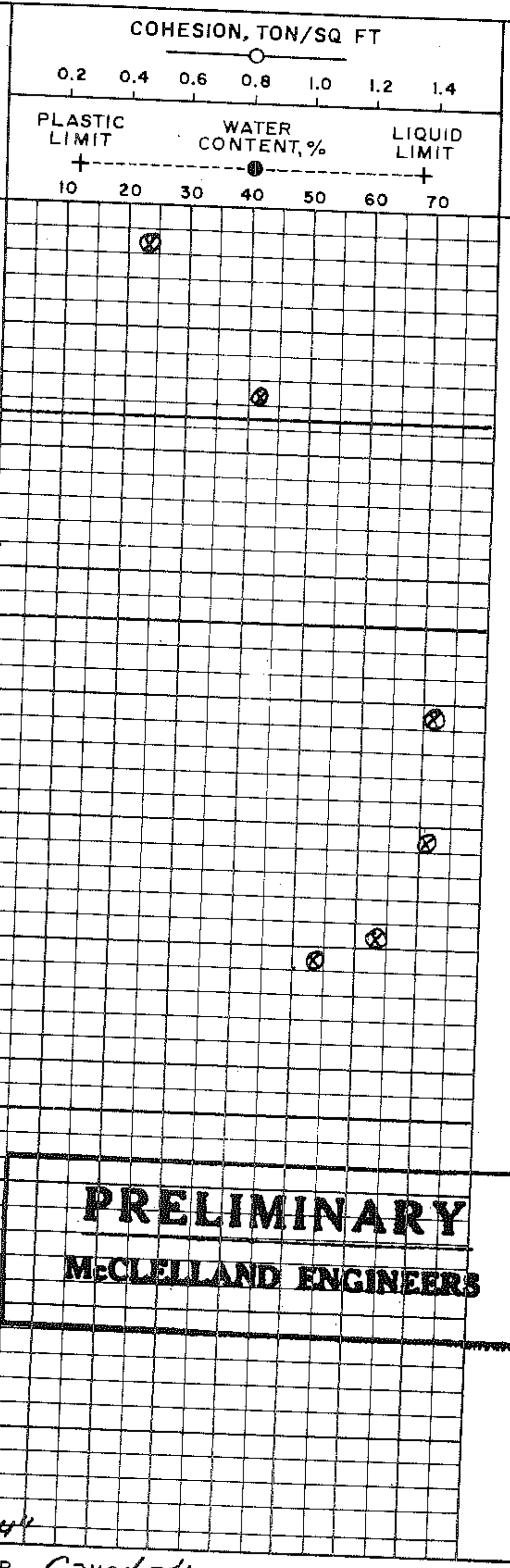
LOG OF BORING NO. P-41

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin-Wall-Tube
2" Split-Spoon

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 347.7'	BLOWS PER FT	UNIT DRY WT LB/CU FT	ELEVATION, FT
	UP1	■	Stiff Red & TAN Sandy Clay			
5	J1	⊠	-w/fervous deposits, 5'-7'	4/7/10		
	UP2	■				
10	J2	⊠	TAN & Light Gray Silty Fine Sand	16/20/24		
15	J3	⊠	-Light Gray & TAN below 15'	13/23/25		
	J4	⊠	Very stiff brown & light gray clay	7/10/13		
20	UP4	■	-w/silt streaks, 17'-20' -w/fervous deposits, 20'-21.5'			
25	J5	⊠		10/12/12		
	UP5	■	-Dark Gray below 25'			
30	J6	⊠		6/12/26		
	UP6	■				
35	J7	⊠		22/60-4"		
40	J8	⊠	Gray Silty Fine Sand w/organic matter 39' 43'	37/60-3		
45	J9	⊠		37/60-6"		
50	J10	⊠		37/60-3"		
55'	J11	⊠		36/32/60-4"		



PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 55'
DATE: AUG. 1, 1973

DEPTH TO WATER IN BORING: 7.3' Caved at: 43.6' DATE:

McCLELLAND ENGINEERS

PLATE 34

Form 108-5 (57) Job No.

LOG OF BORING NO. P-42

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin-Wall-Tube
2" Split-Spoon

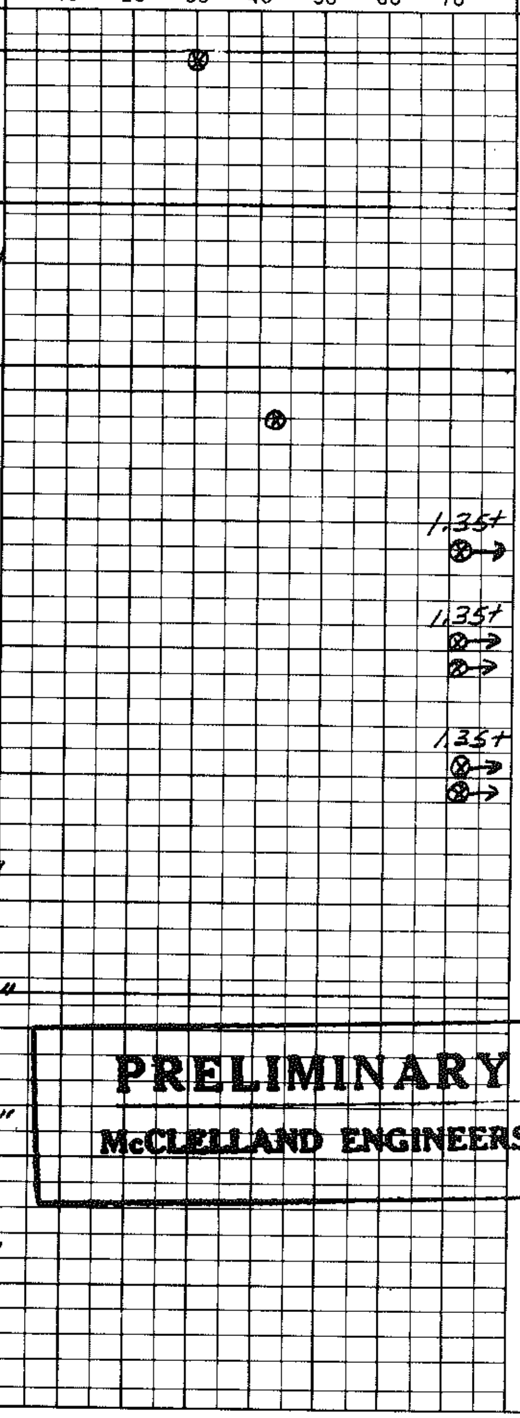
LOCATION: See Plate 1

SURF. EL: 349.3'

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	ELEVATION, FT
	J1	TAN SANDY Silt				
		Stiff Light Gray, Red & TAN SANDY CLAY				
5	J2	- w/SAND pockets	4/5/7			
	UP1					
10	J3	TAN Silty Fine Sand	15/30/60-4			
	J4		5/8/9			
15	UP2	Very stiff Brown & Light CLAY - laminated with silty fine sand to 34'				
20	J5	- with ferrous deposit, 20'-21'	8/13/23			
	UP3	- Brown, 20'-34'			1.35+	
25	J6	- w/SAND pockets below 25'	10/15/21		1.35+	
	UP4					
30	J7		12/14/17		1.35+	
	UP5					
35	J8	- dark gray w/ mica below 34'	23/40/60-5"			
40	J9	DarkGray Clayey SAND to Very Sandy Clay	25/35/60-4"			
45	J10	- w/ organic matter and mica	45/48/60-3"			
50	J11		35/60-5"			
	J12		15/40-5"			

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70



PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 55'
DATE: July 30, 1973

DEPTH TO WATER
IN BORING:

DATE:

McCLELLAND
ENGINEERS

Form 108-5 (57) Job No. 73-085

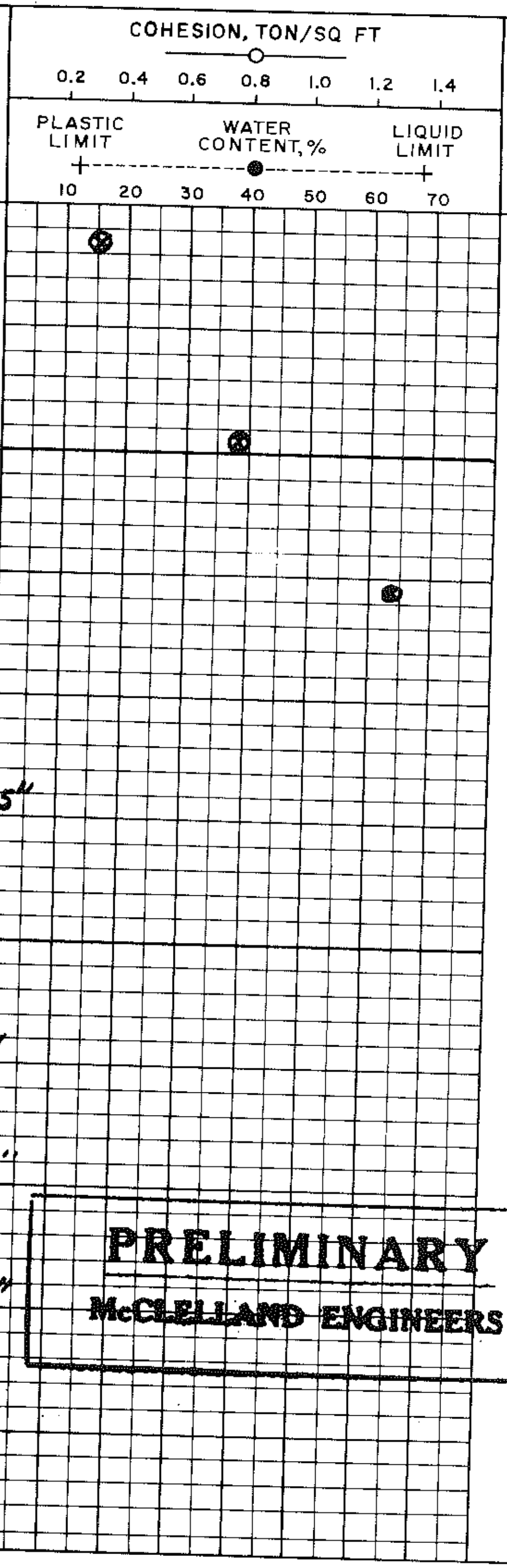
LOG OF BORING NO. P-43

TYPE: 3" Thin Wall-Tube
2" Split-Spoon

LOCATION: See Plate 1

SURF. EL: 351.8'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	ELEVATION, FT
			Firm Red & Light Sand Clay			
			-stiff below 3'	3/3/9		
5						
			-with ferrous deposits below 7.5'			
10				4/5/7		
			Very stiff tan & light gray Clay			
15			- Brown & Light Gray, 13'-20' -w/silt seams, 15'-19' -w/ferrous deposit, 15'-20'	9/11/15		
20				11/16/23		
			- dark gray below 20'			
25			- w/ sand pockets below 20'	15/26/60-5"		
30				13/13/24		
			Light Gray Sandy Silt, w/ silty clay seams, 30'-36'			
35			- Dark Gray below 34'	18/35/60-4"		
40				24/42/60-4"		
45				36/41/60-4"		
50				43/60-4"		
			(Continued on next page)			



PRELIMINARY
McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. P-43 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 / PLASTIC LIMIT + WATER CONTENT, % ● LIQUID LIMIT + 10 20 30 40 50 60 70	ELEVATION, FT
			Dark gray sandy silt				
55		☒		38/40-4"			
60		☒		40-6"			
65		☐		27/40			
70		☒	-w/sand stone layer, 70'-71'	32/40-5"			
			-w/sand stone seams 71'-73.5'				
75		☒		31/40			
80							
85							
90							
95							
100							

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 75'
DATE: July 31, 1973

DEPTH TO WATER
IN BORING:

DATE:

McCLELLAND
ENGINEERS

PLATE 36a

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. P-47

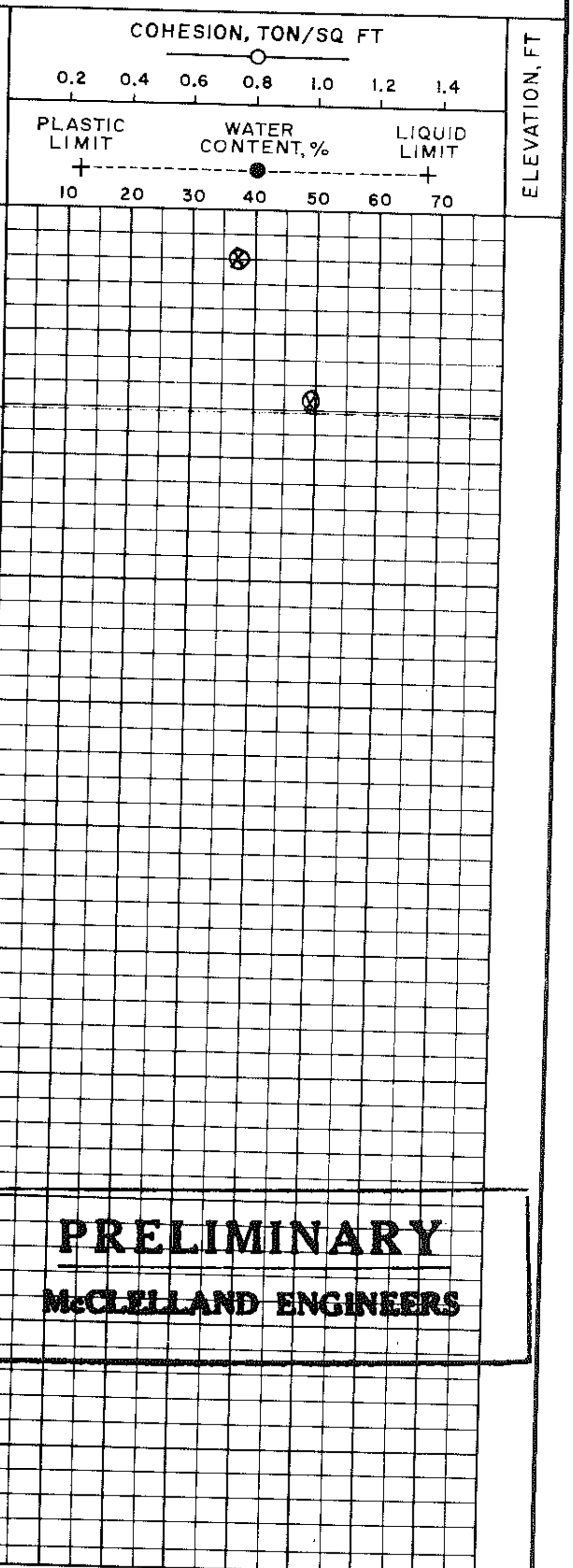
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin Wall Tube
2" Split-Spoon

LOCATION: See Plate 1

SURF. EL: 361.5'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
		■	Stiff Tan & Red Sandy Clay		
5		☒	-w/sand streaks 4'-8'	8/11/16	
		■	-w/light Gray below 7'		
10		☒	TAN, Red & Light Gray Sandy Silt -w/clay pockets 10-17	11/11/19	
15		☒	-w/ferrous deposits, 14'-16'	19/33/20	
20		☒	-w/clay partings below 20' -w/ferrous Nodules below 20	9/10/14	
25		☒		11/23/39	
30					
35					
40					
45					
50					



PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 25'
DATE: July 26, 1973

DEPTH TO WATER IN BORING: 9.2' Caved at: 21.8'
DATE: July 30, 1973

McCLELLAND ENGINEERS

Form 106-5 (57) Job No. 73085

LOG OF BORING NO. P-48
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin-Wall-Tube
2" Split-Spoon

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL:	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) ○ PLASTIC LIMIT + · WATER CONTENT, % ● · LIQUID LIMIT + (10 20 30 40 50 60 70)	ELEVATION, FT
	UP1	▆	Stiff red & light gray clay w/ Sand pockets			⊗ 30	
5	J1	☒		5/7/9		⊗ 30	
	UP2	▆					
10	J2	☒	Red Silty fine Sand -w/clay pockets	14/15/20			
	J3	☒	Very stiff Light gray clay -w/ ferrous nodules, 14'-18'	5/8/10			
15	UP3	▆	-shale layer, 16 - 16.5			1.35+ ⊗→	
	J4	☒		2/8/2			
20			Firm Gray Clay w/silty fine sand seam @ 19				
25	J5	☒	Gray Silty Fine Sand -w/shale seam at 24.5' - w/scatterd sand stone seams, 26' - 30.5'	10/14/40			
30	J6	☒		13/60=9"			
35	J7	☒	Very stiff Gray clay w/sandy silt partings w/sand stone below 32	18/24/39			
40							
45							
50							

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 35'
DATE: July 26, 1973

DEPTH TO WATER IN BOARING: 6.8'
Caved at: 27.5'
DATE: July 30, 1973

McCLELLAND ENGINEERS

PLATE 38

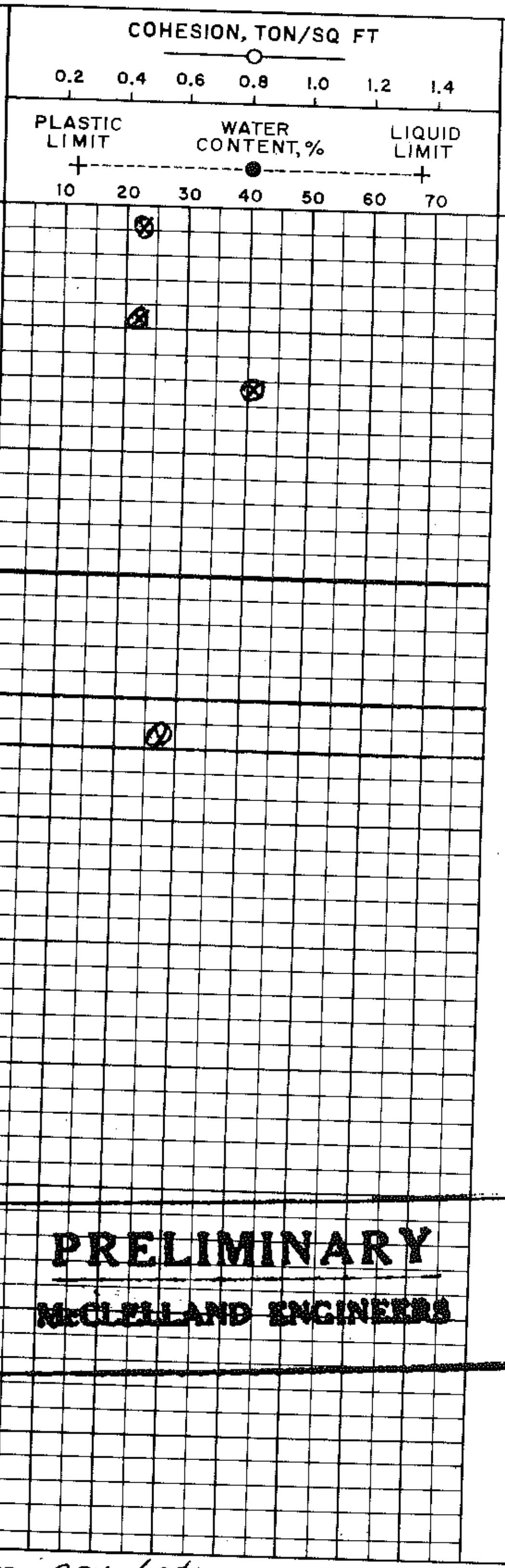
LOG OF BORING NO. P-49
WELSH POWER PLANT
CASON, TEXAS

TYPE: 2" Split-Spoon
3" Thin-Wall-Tube

LOCATION: See Plate 1

SURF. EL:

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	ELEVATION, FT
	UP1		Stiff Red & Light Gray clay			
5	J1		– w/terrous nodules below 1.5	4/5/9		
	UP2					
10	J2			11/12/13		
15	J3			13/19/20		
	UP3		TAN & Red silty fine Sand w/clay pockts			
20	J4		w/sandstone seam @ 20'	5/7/9		
	UP4		Stiff Brown Clay w/organic matter @ 22'			
			Dark gray silty fine sand			
25	J5			20/60-6"		
30						
35						
40						
45						
50						



PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 25'
DATE: July 25, 1973

DEPTH TO WATER IN BORING: 19.6' Caved at: 24.3' DATE: July 30, 1973

McCLELLAND ENGINEERS

Job No. 785

Form

LOG OF BORING NO. AB-1

WELSH POWER PLANT
CASON, TEXAS

TYPE: 4" Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL:	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT + WATER CONTENT, % ● LIQUID LIMIT + 10 20 30 40 50 60 70	ELEVATION, FT
			Tan & Red Sandy Clay - Light Gray & Red w/sand streaks below 5			
5						
10			Tan & Red & Light Gray Clay w/silt & sand streak below 10' - Brown & Tan below 13'			
15			Tan Silty Fine Sand			
20						
25						
30						
35						
40						
45						
50						

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 15'
DATE: July 31, 1973

DEPTH TO WATER IN BORING:
DATE:

McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. AB-2

WELSH POWER PLANT
CASON, TEXAS

TYPE: 4" Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL:	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT ○ 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT + - - - WATER CONTENT, % ● - - - LIQUID LIMIT + 10 20 30 40 50 60 70	ELEVATION, FT
			Tan Silty Fine Sand			
			Ferrous Deposits			
5			w/clay seams & parting below 3'			
10						
15			- w/Dark Gray Clay Seam@14			
20						
25						
30						
35						
40						
45						
50						

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 20'
DATE: AUG. 1, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

PLATE 41

Form 108-5 (57) Job No. 23-085

LOG OF BORING NO. AB-3
WELSH POWER PLANT
CASON, TEXAS

TYPE: 4" Auger

LOCATION: See Plate 1

SURF. EL: 331.9'

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIT DRY WT LB/CU FT	COHESION / WATER CONTENT	ELEVATION, FT
			TAN & Red Silty Fine SANDY			
			Light Gray Clay w/Red streaks below 2.5'			
5						
			-w/ferrous deposits 8'-11'			
10						
			- Brown Light & TAN below 11'			
			TAN Silty Fine Sand			
15						
20						
25						
30						
35						
40						
45						
50						

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 12.5'
DATE: 8-1-73

DEPTH TO WATER IN BORING:

DATE:

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. AB-4
WELSH POWER PLANT
CASON, TEXAS

TYPE: 4" Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 337.5'	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT 10 20 30 40 50 60 70	ELEVATION, FT
			TAN Silty Fine SAND			
5			Red & Light Gray Sandy Clay			
10 15			TAN & Red & Light Gray Clay w/Ferrous deposits w/si seams 10-16 - Brown & Light Gray 11'-14' - Gray below 14'			
20			TAN Silty Fine Sand			
25 30 35 40 45 50						

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 20'
DATE: Aug 1, 1973

DEPTH TO WATER IN BORING:

DATE:

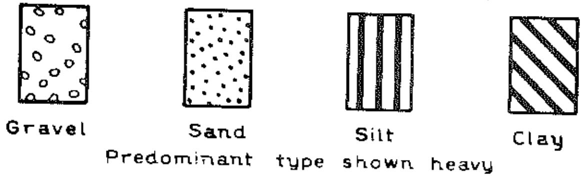
McCLELLAND ENGINEERS

PLATE 43

SYMBOLS AND TERMS USED ON BORING LOGS

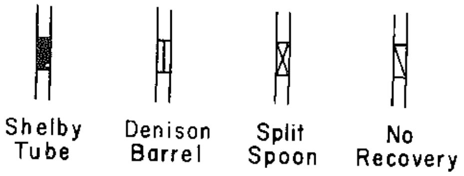
SOIL TYPES

(SHOWN IN SYMBOL COLUMN)



SAMPLER TYPES

(SHOWN IN SAMPLES COLUMN)



TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	RELATIVE DENSITY
Loose	0 to 40%
Medium dense	40 to 70%
Dense	70 to 100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ FT
Very soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very stiff	2.00 to 4.00
Hard	4.00 and higher

Note: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

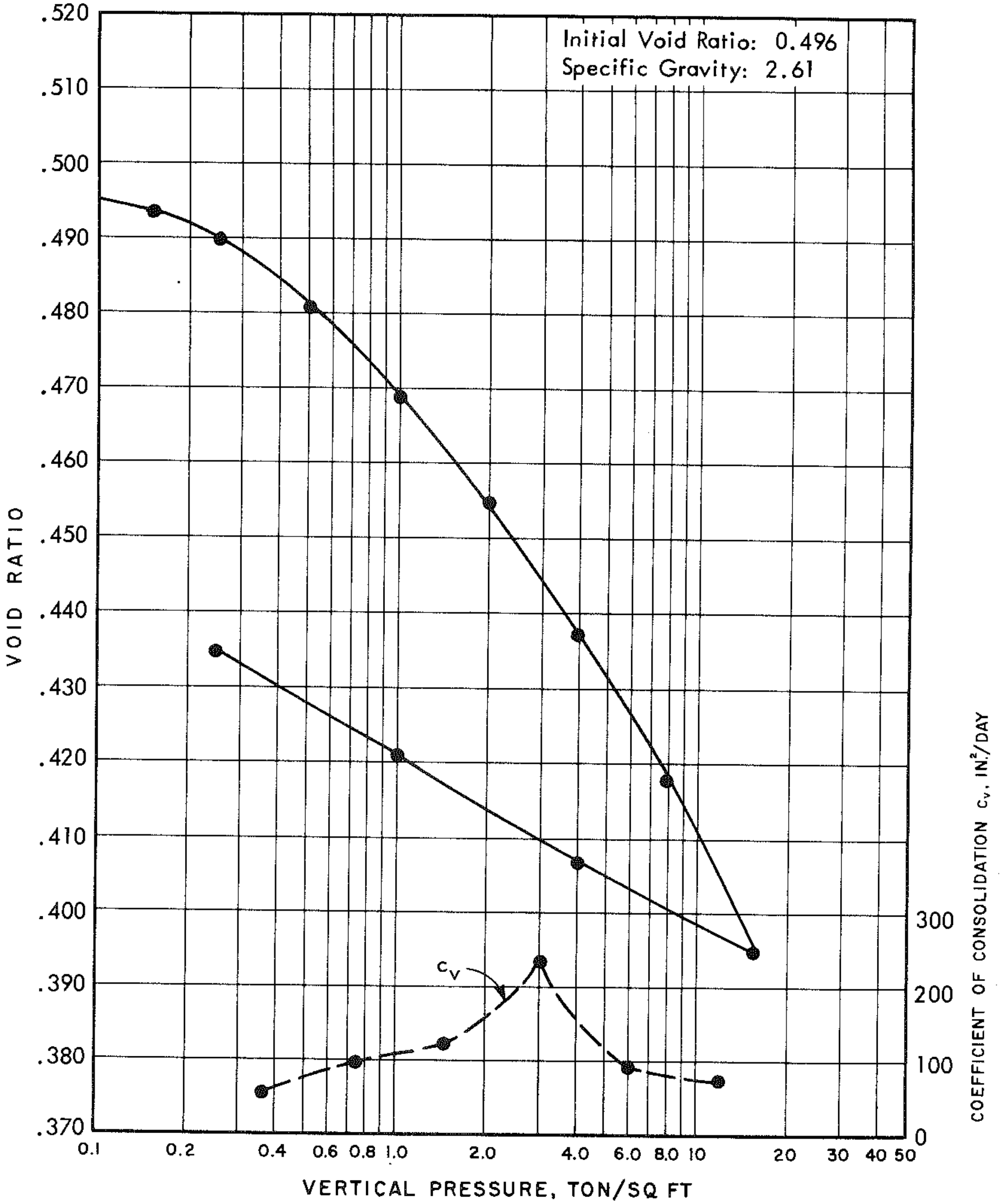
Slickensided	– having inclined planes of weakness that are slick and glossy in appearance.
Fissured	– containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated	– composed of thin layers of varying color and texture.
Interbedded	– composed of alternate layers of different soil types.
Calcareous	– containing appreciable quantities of calcium carbonate.
Well graded	– having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly graded	– predominantly of one grain size, or having a range of sizes with some intermediate size missing.

Terms used in this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

Form 593 57 Job No. 73-085

BORING: P-1 **DEPTH:** 50'
MATERIAL: Hard brown and gray clay with sand pockets

UNIT DRY WEIGHT: 109 LB/CU FT
WATER CONTENT: 14 %
LIQUID LIMIT: 40
PLASTIC LIMIT: 20



CONSOLIDATION TEST RESULTS

Form 06-3 57 JOB No 23-086

BORING: P-3 **DEPTH:** 70'

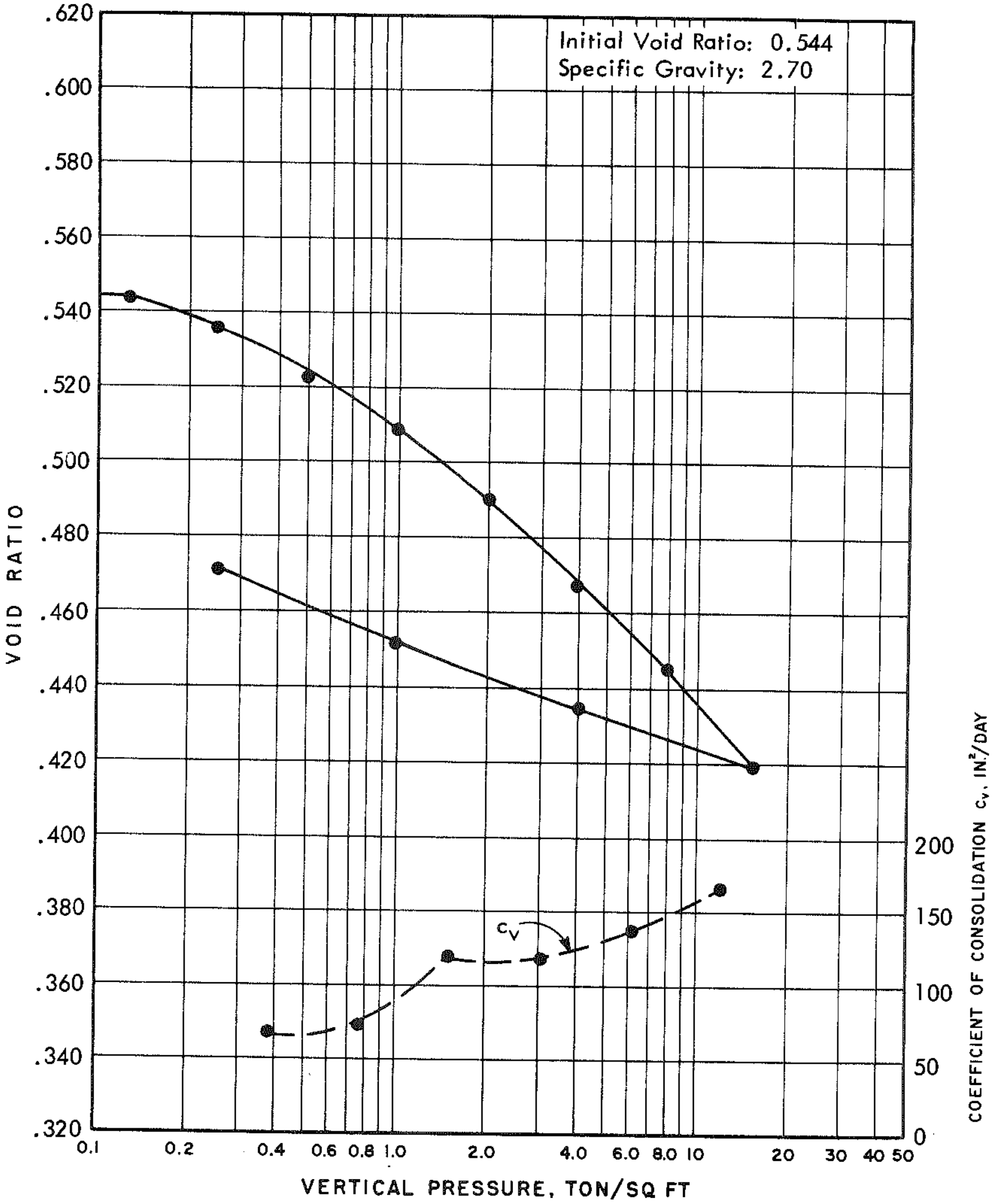
MATERIAL: Hard gray sandy clay

UNIT DRY WEIGHT: 109 LB/CU FT

WATER CONTENT: 18 %

LIQUID LIMIT: 27

PLASTIC LIMIT: 16

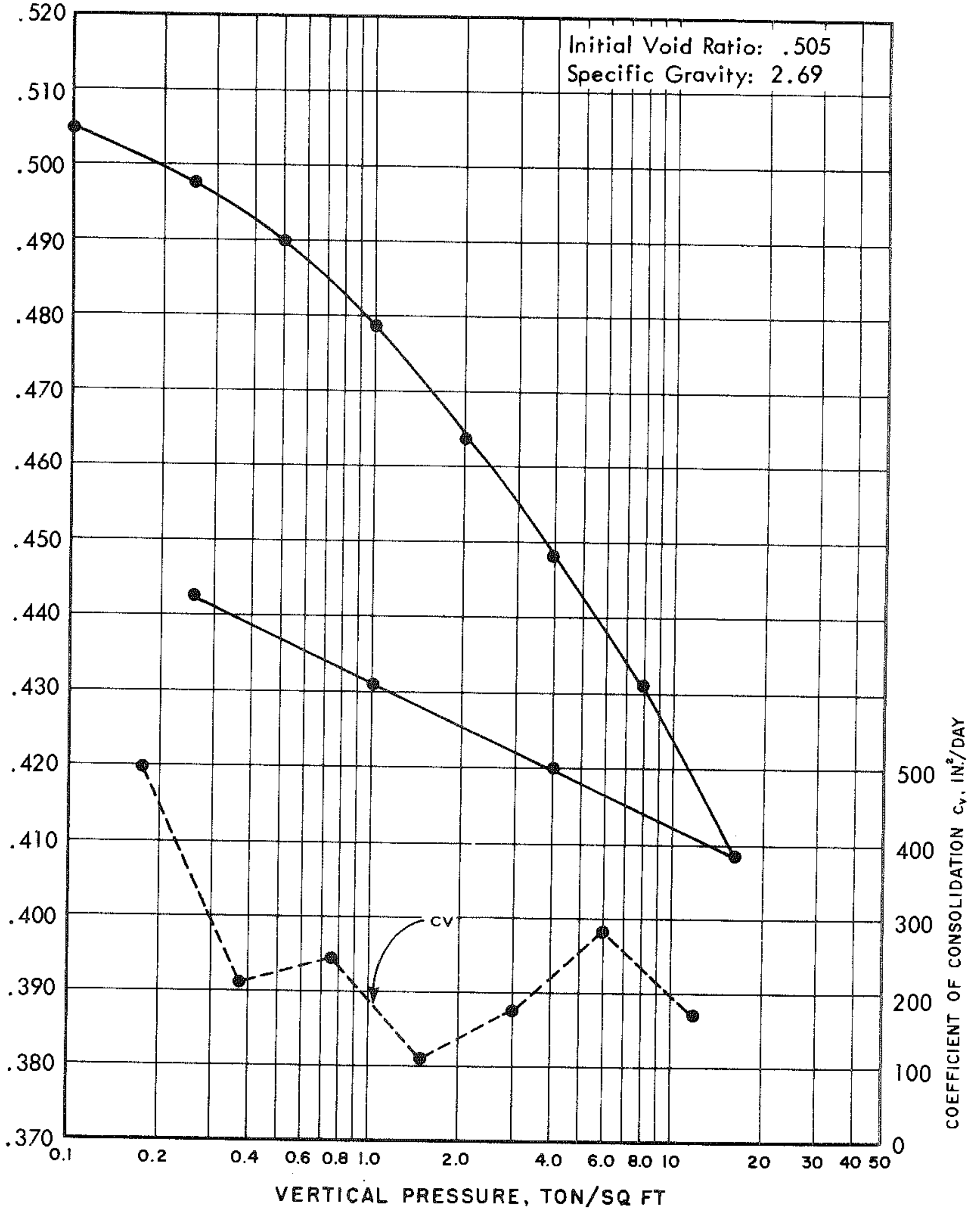


CONSOLIDATION TEST RESULTS

Form 363 57 Job No 73-085

BORING: P-4 **DEPTH:** 6'
MATERIAL: Stiff red and tan very sandy clay

UNIT DRY WEIGHT: 112 LB/CU FT
WATER CONTENT: 17 %
LIQUID LIMIT: 29
PLASTIC LIMIT: 18

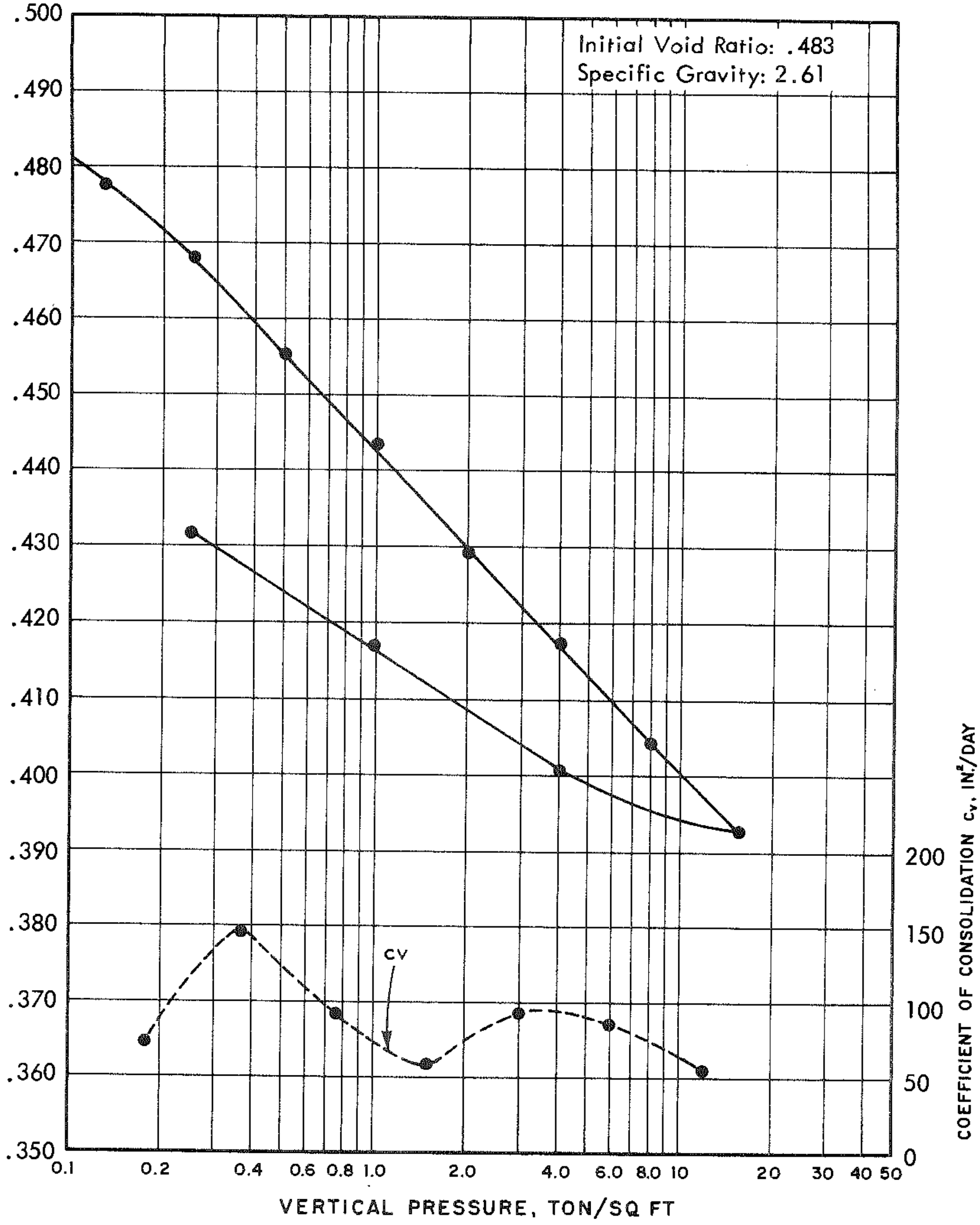


CONSOLIDATION TEST RESULTS

Form 36-3 57 Job No 73-085

BORING: P-4 DEPTH: 50'
MATERIAL: Gray clayey fine sand

UNIT DRY WEIGHT:	110	LB/CU FT
WATER CONTENT:	17	%
LIQUID LIMIT:	24	
PLASTIC LIMIT:	18	



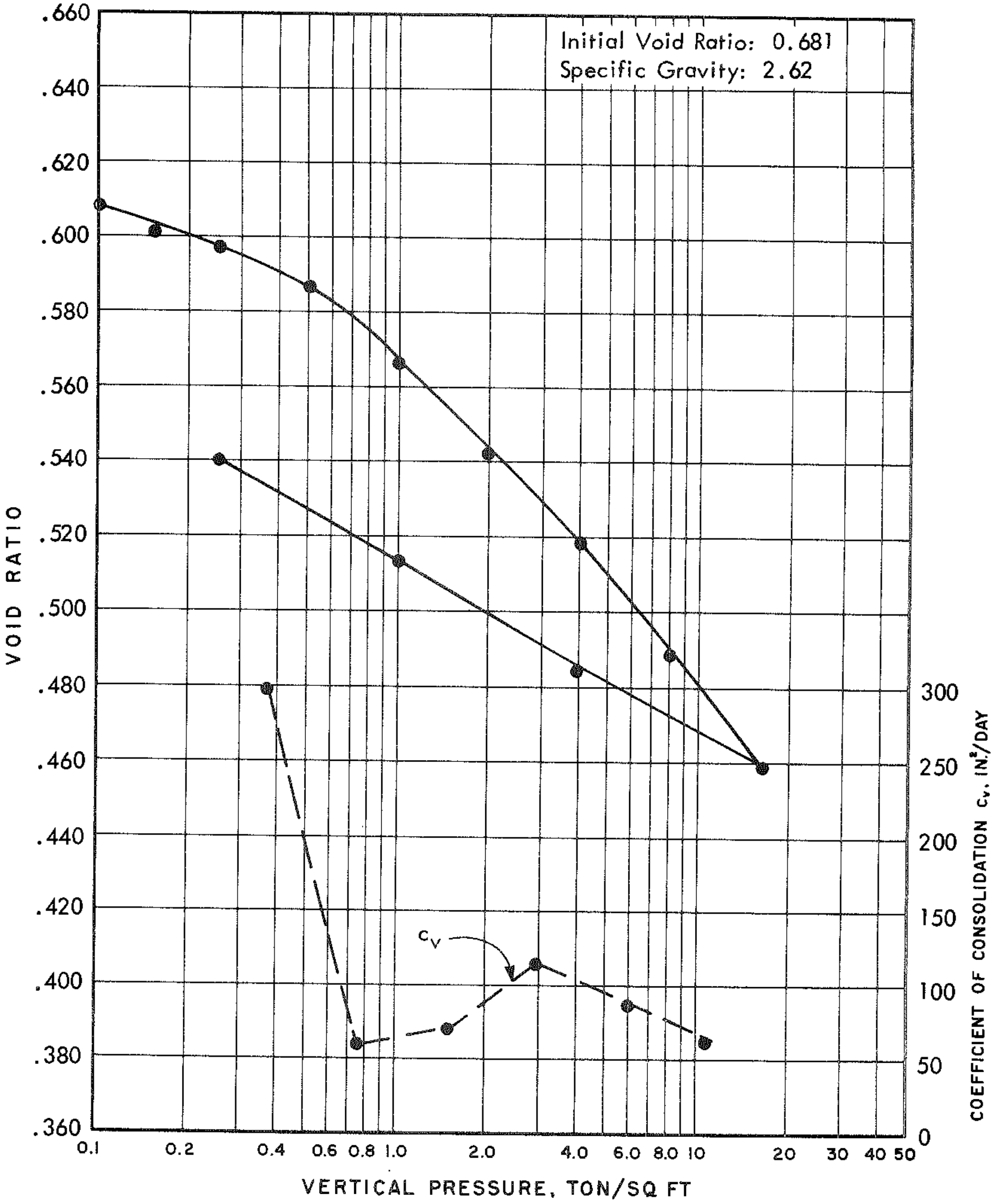
CONSOLIDATION TEST RESULTS

McCLELLAND
ENGINEERS

Form G6-3 '57 JOB No 73-7285 -

BORING: P-5 **DEPTH:** 30'
MATERIAL: Hard gray sandy clay with sand pockets and partings

UNIT DRY WEIGHT: 102 LB/CU FT
WATER CONTENT: 21 %
LIQUID LIMIT: 40
PLASTIC LIMIT: 19


Initial Void Ratio: 0.681
Specific Gravity: 2.62

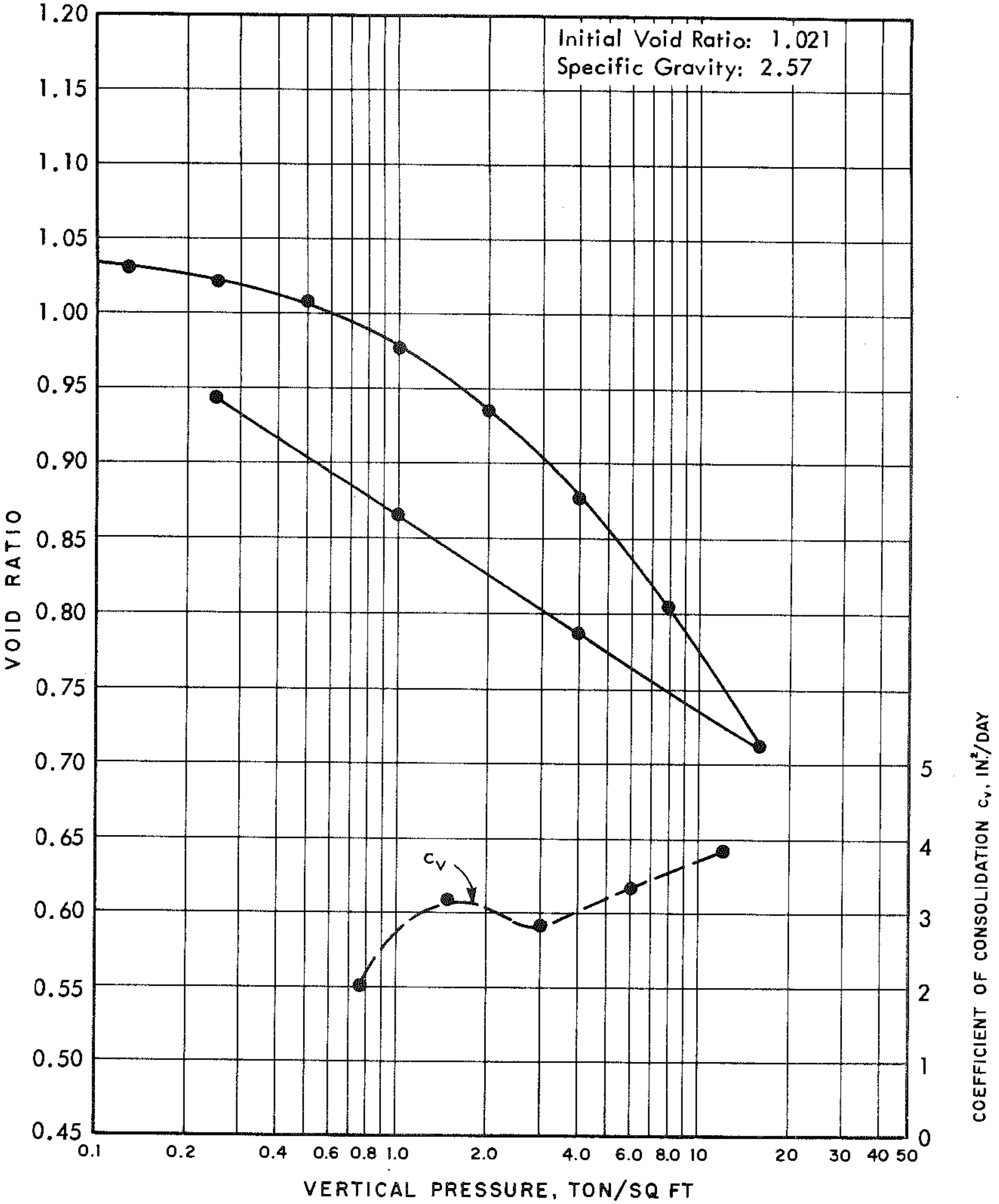
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

22.085

BORING: P-7 **DEPTH:** 24.5'
MATERIAL: Stiff light gray clay with sand pockets and ferrous nodules

UNIT DRY WEIGHT:	91	LB/CU FT
WATER CONTENT:	34	%
LIQUID LIMIT:	52	
PLASTIC LIMIT:	18	


Initial Void Ratio: 1.021
Specific Gravity: 2.57

CONSOLIDATION TEST RESULTS

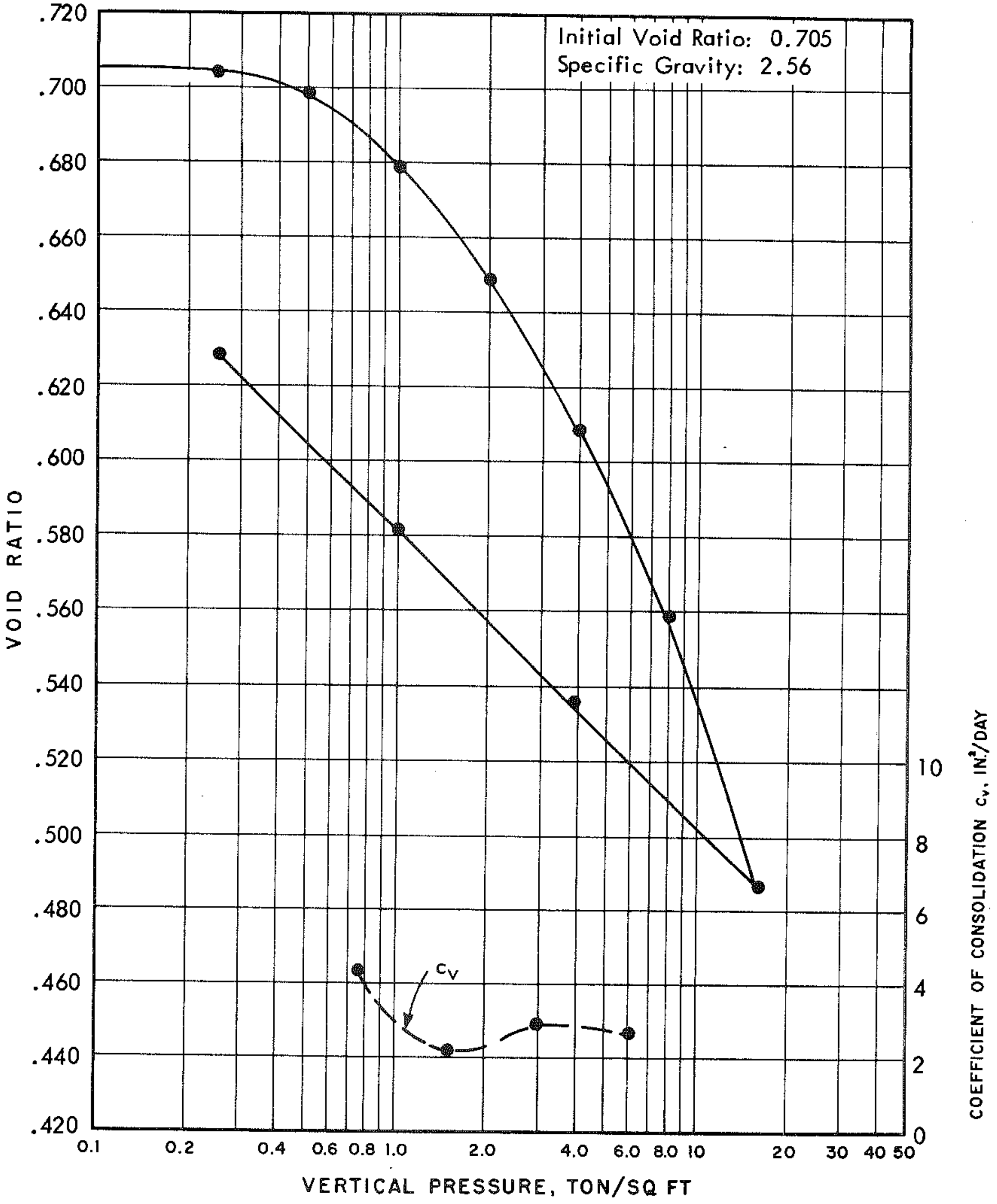
McCLELLAND
ENGINEERS

Form 06-3 57 JSD No 23-085

BORING: P-9 **DEPTH:** 29.5'

MATERIAL: Very stiff light gray clay with silt partings

UNIT DRY WEIGHT:	94 LB/CU FT
WATER CONTENT:	30 %
LIQUID LIMIT:	69
PLASTIC LIMIT:	23



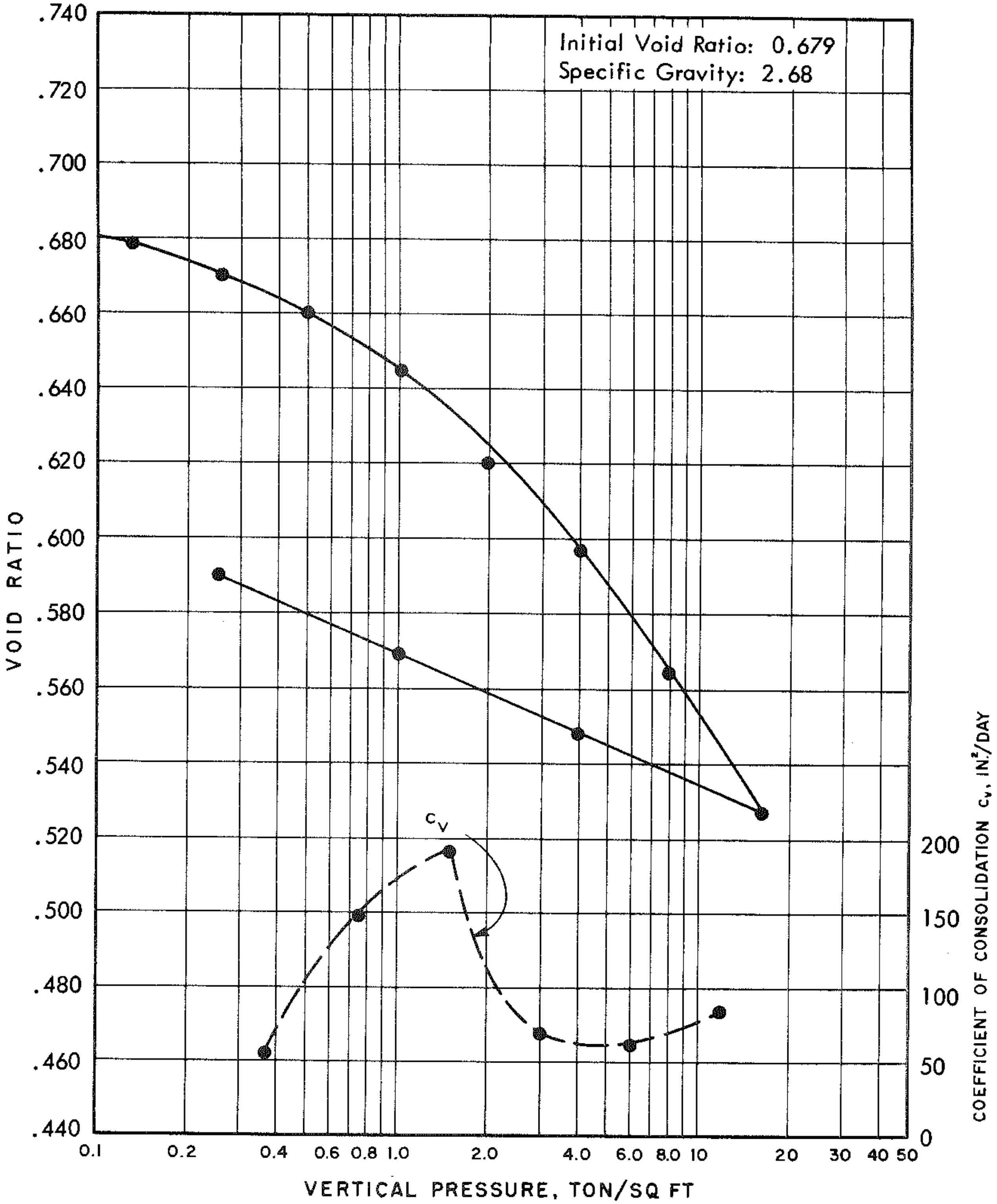
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

Form 56-3 57 Job No. 23085

BORING: P-9 **DEPTH:** 35'
MATERIAL: Very stiff gray sandy clay with sand partings

UNIT DRY WEIGHT: 100 LB/CU FT
WATER CONTENT: 22 %
LIQUID LIMIT: 37
PLASTIC LIMIT: 19



Initial Void Ratio: 0.679
Specific Gravity: 2.68

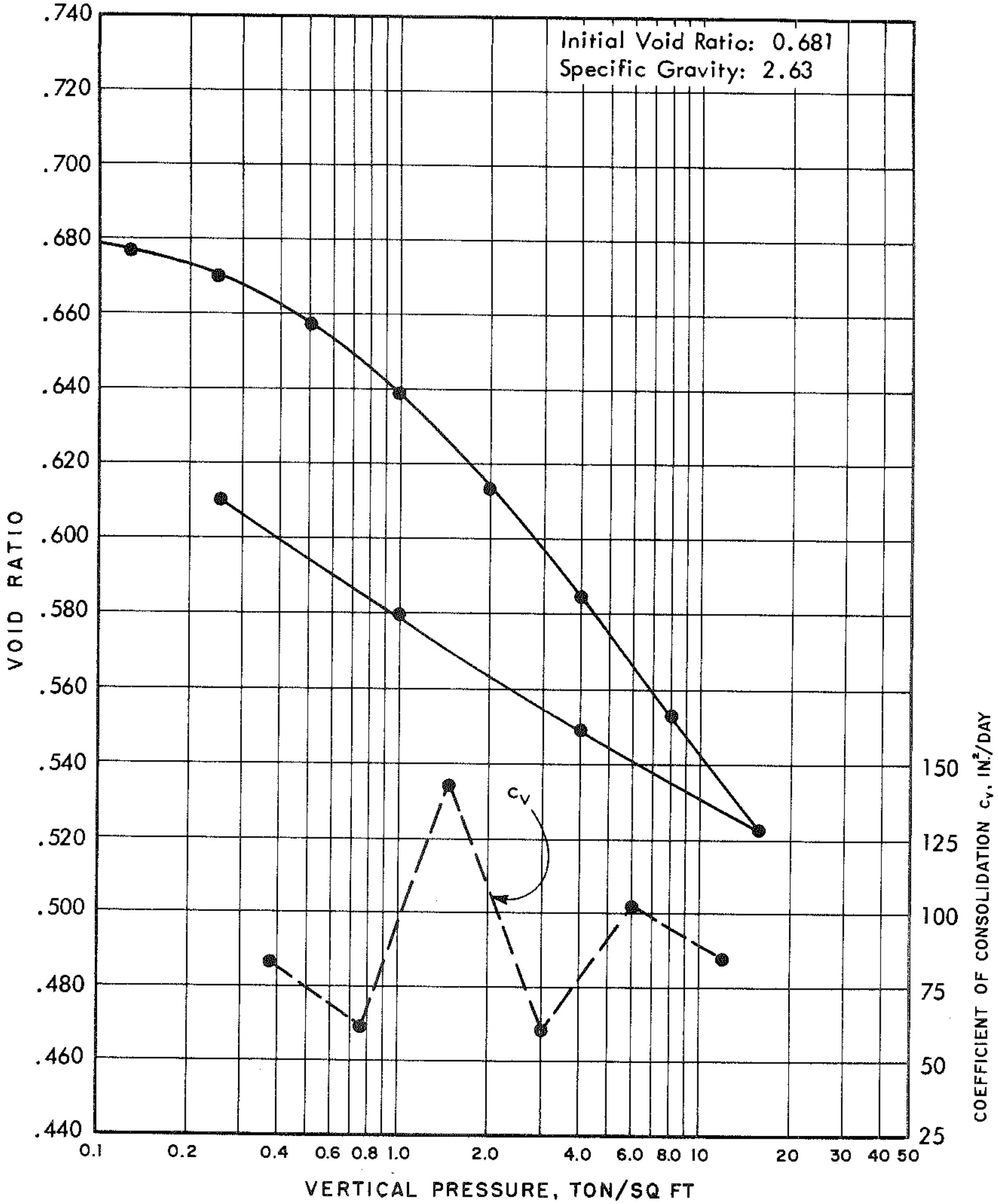
CONSOLIDATION TEST RESULTS

McCLELLAND
ENGINEERS

Form 36-3 '57 Job No 73085

BORING: P-10 DEPTH: 45'
MATERIAL: Very stiff gray sandy clay with silt pockets

UNIT DRY WEIGHT: 98 LB/CU FT
WATER CONTENT: 22 %
LIQUID LIMIT: 38
PLASTIC LIMIT: 19


Initial Void Ratio: 0.681
Specific Gravity: 2.63

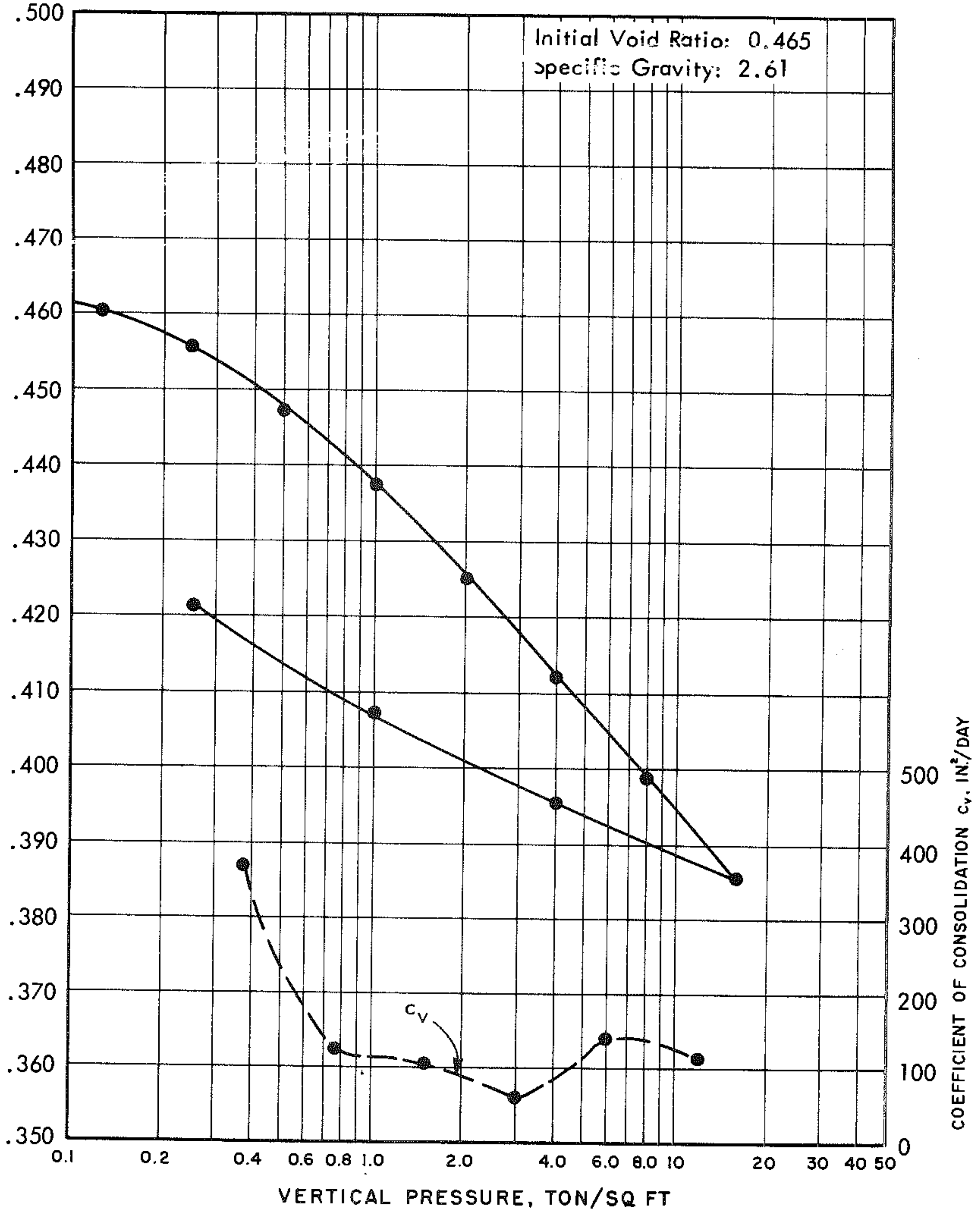
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

23-085

BORING: P-10 **DEPTH:** 59'
MATERIAL: Gray clayey fine sand

UNIT DRY WEIGHT: 111 LB/CU FT
WATER CONTENT: 17 %
LIQUID LIMIT: 22
PLASTIC LIMIT: 17



Initial Void Ratio: 0.465
Specific Gravity: 2.61

CONSOLIDATION TEST RESULTS

23-085

BORING: P-12 **DEPTH:** 20'

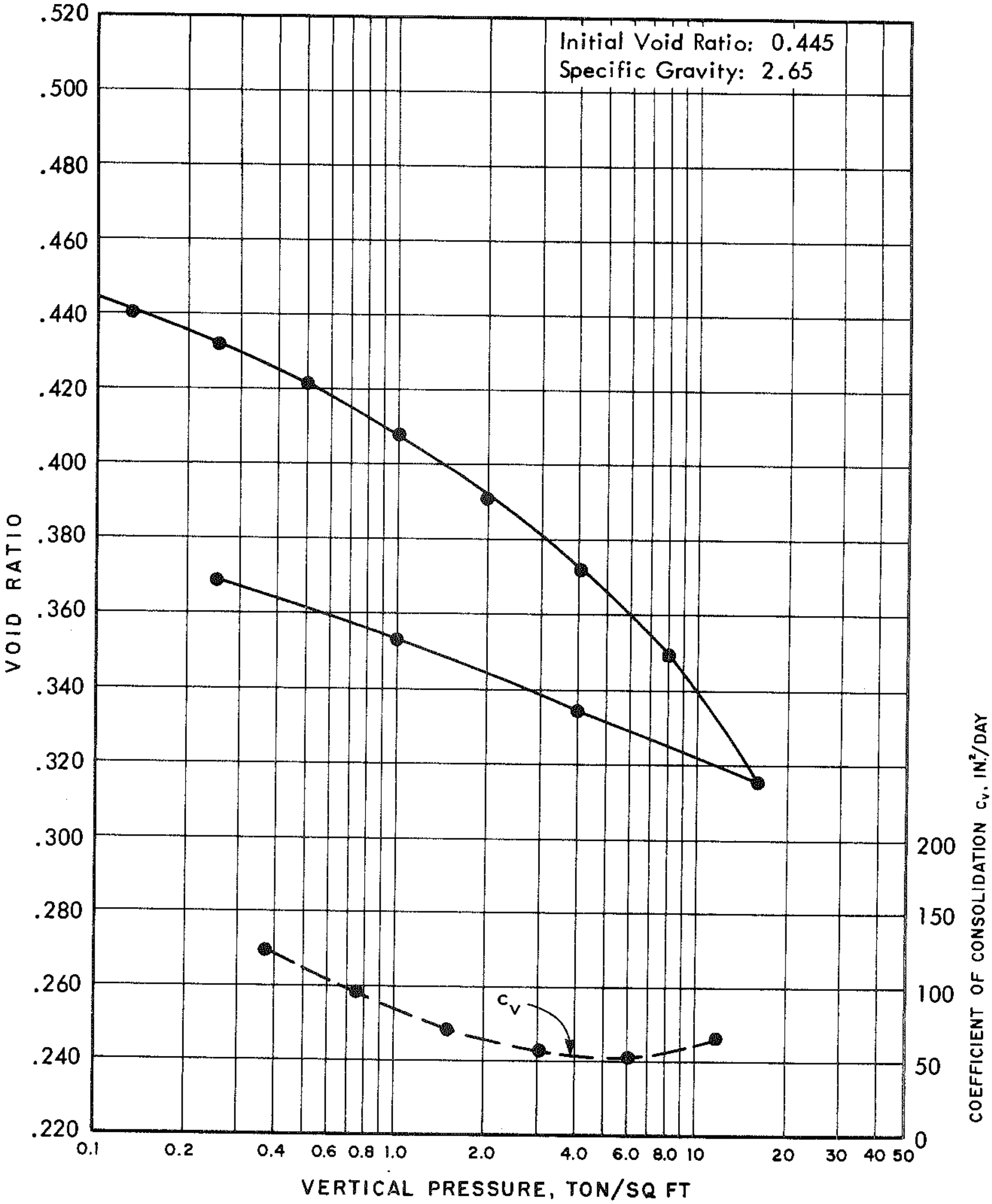
MATERIAL: Red and tan clayey fine sand with clay pockets

UNIT DRY WEIGHT: 115 LB/CU FT

WATER CONTENT: 16 %

LIQUID LIMIT: 26

PLASTIC LIMIT: 17



CONSOLIDATION TEST RESULTS

Job No. 73-085

BORING: P-34 **DEPTH:** 18'

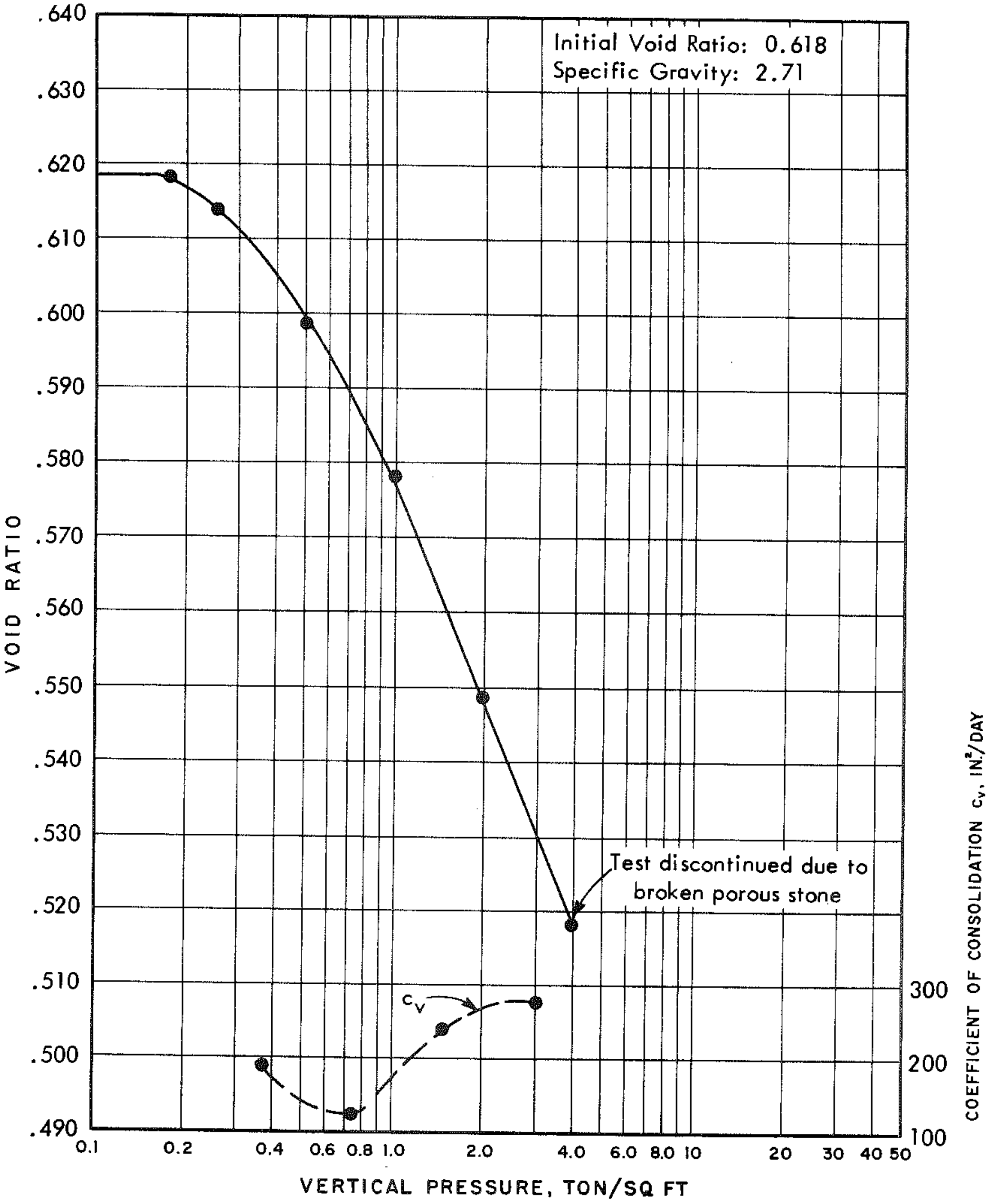
MATERIAL: Very stiff light gray clay with sand pockets and seams

UNIT DRY WEIGHT: 104.5 LB/CU FT

WATER CONTENT: 13 %

LIQUID LIMIT: 31

PLASTIC LIMIT: 17



CONSOLIDATION TEST RESULTS

McCLELLAND
ENGINEERS

Form 36-3 57 Job No 73-085

BORING: P-35 **DEPTH:** 39'

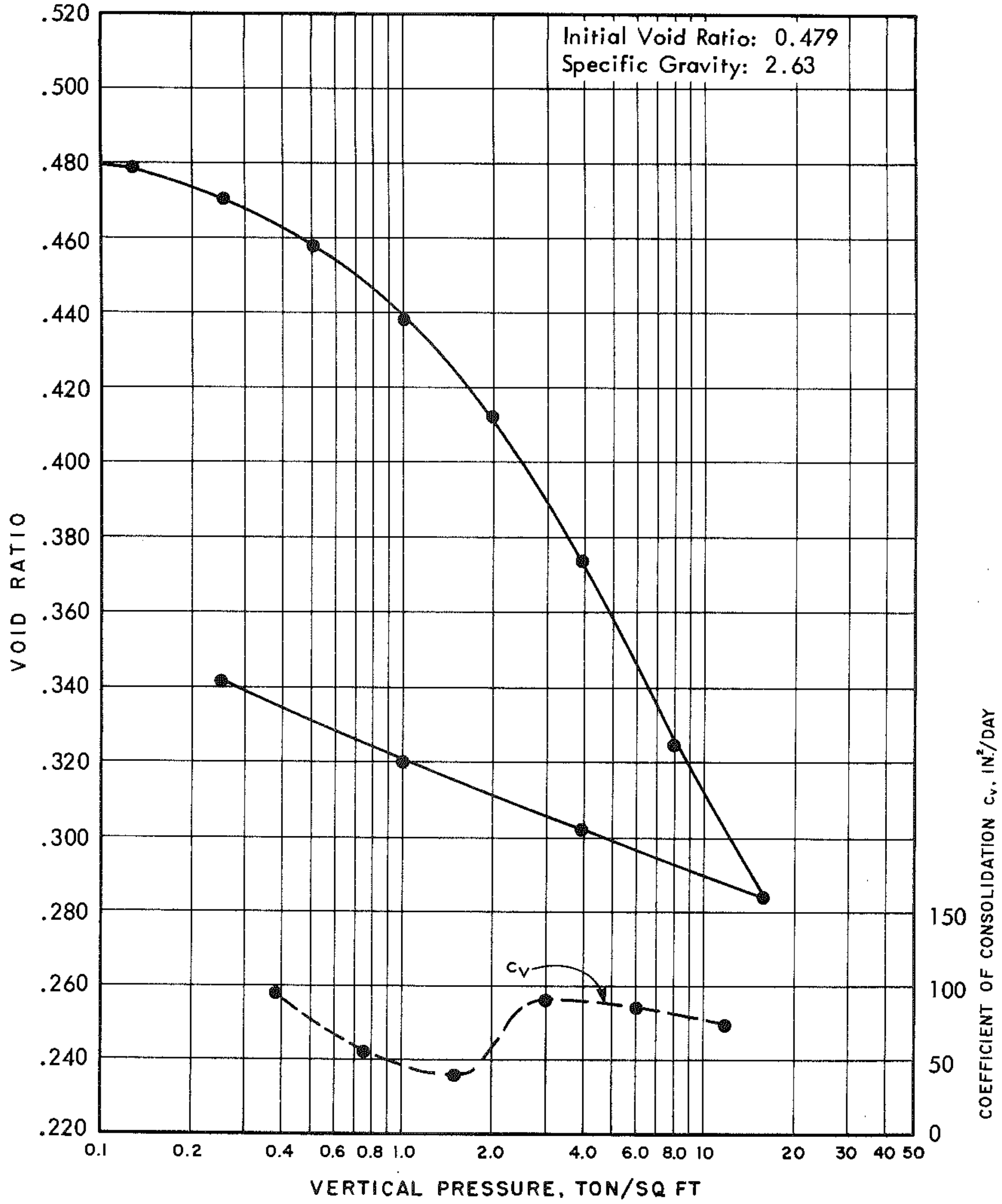
MATERIAL: Hard gray sandy clay with sand pockets

UNIT DRY WEIGHT: 111 LB/CU FT

WATER CONTENT: 18 %

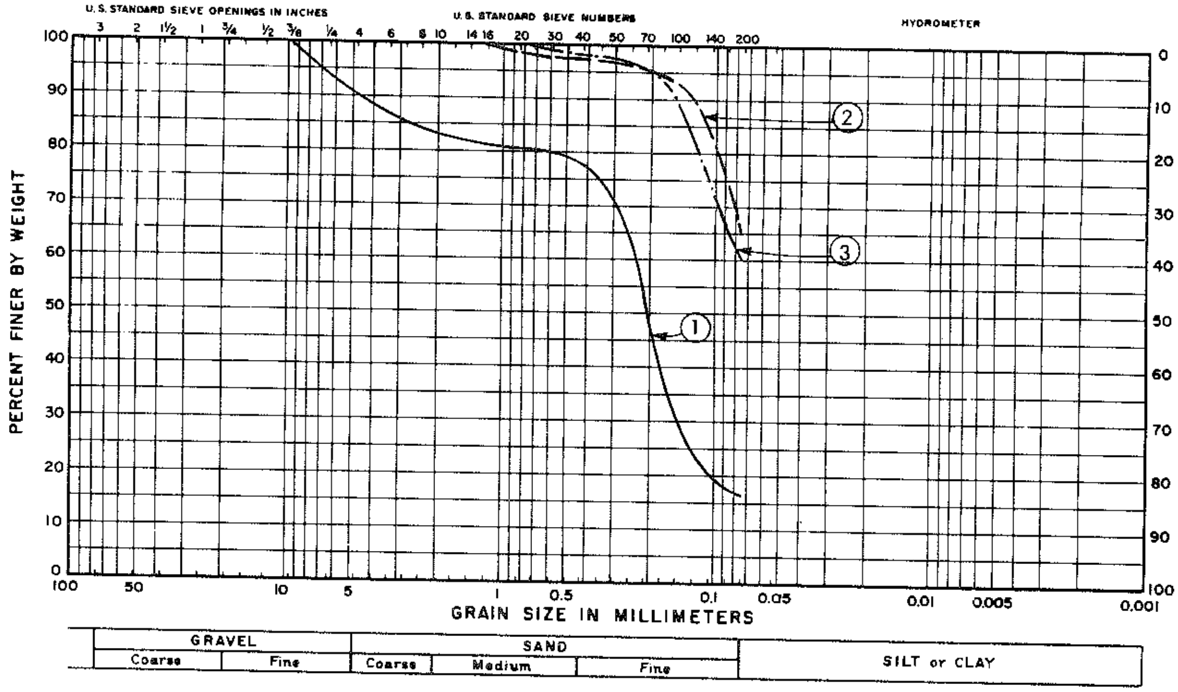
LIQUID LIMIT: 25

PLASTIC LIMIT: 16



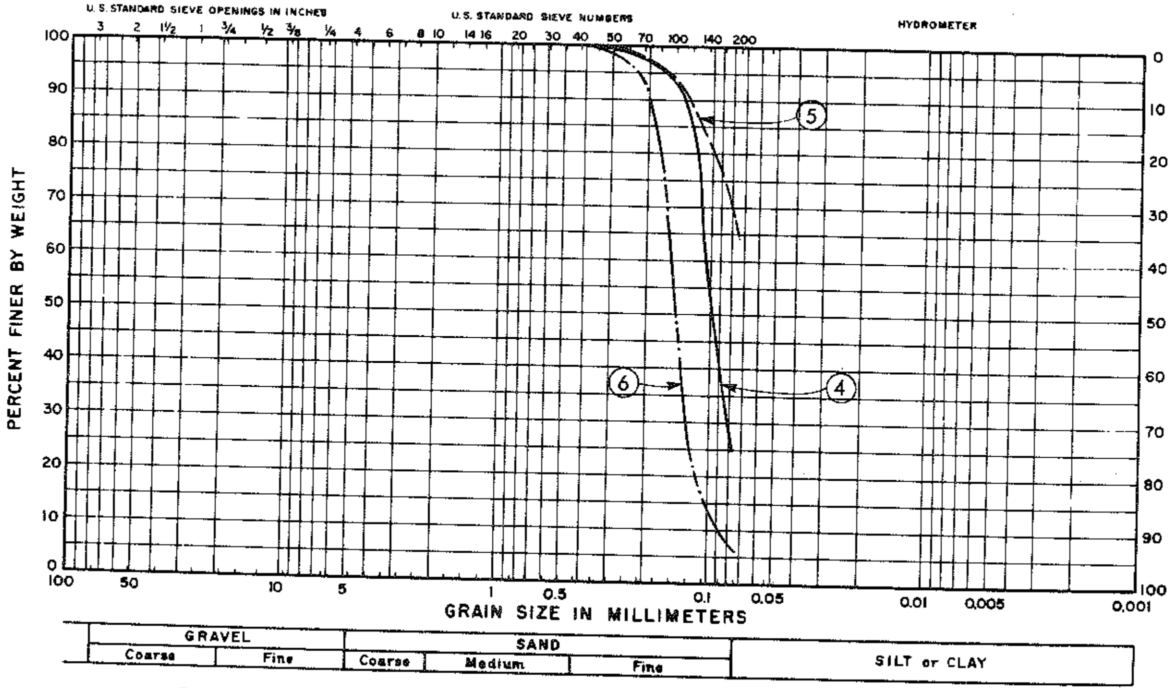
CONSOLIDATION TEST RESULTS

GRAIN SIZE CURVES



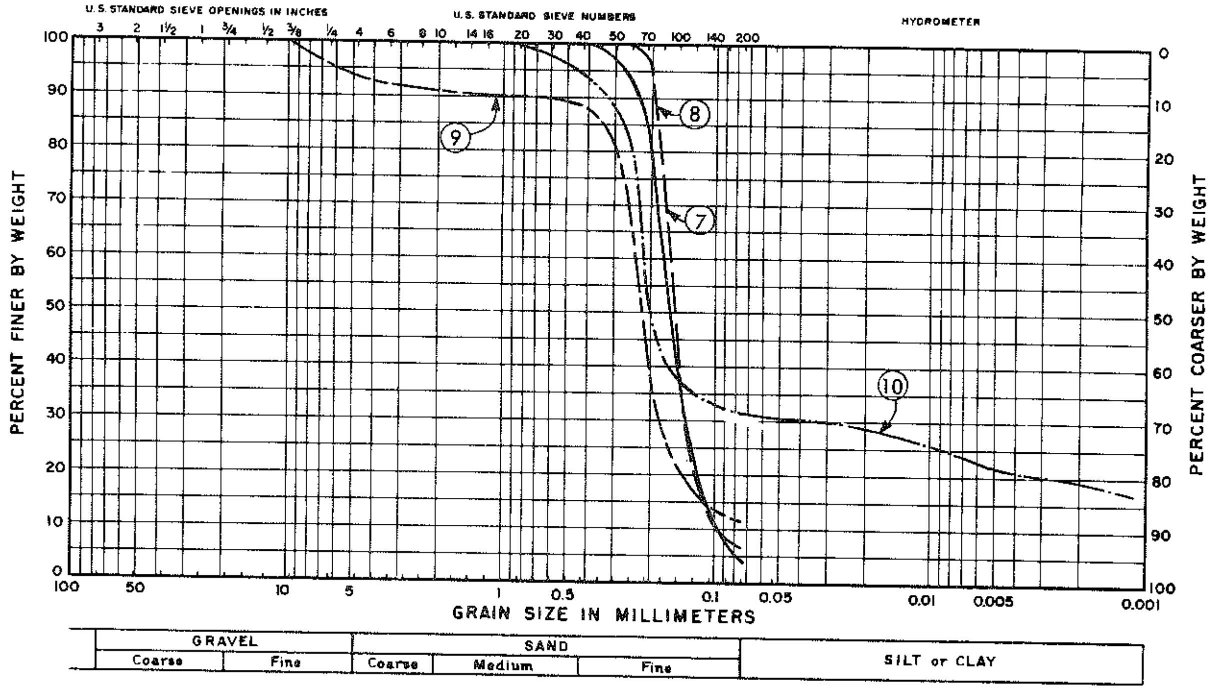
Curve No.	Boring No.	Depth, Ft.	Material
1	P- 1	15	Red silty fine sand with sandstone nodules
2	P- 1	50	Hard brown and gray clay with sand pockets
3	P-23	15	Red and tan sandy clay

GRAIN SIZE CURVES



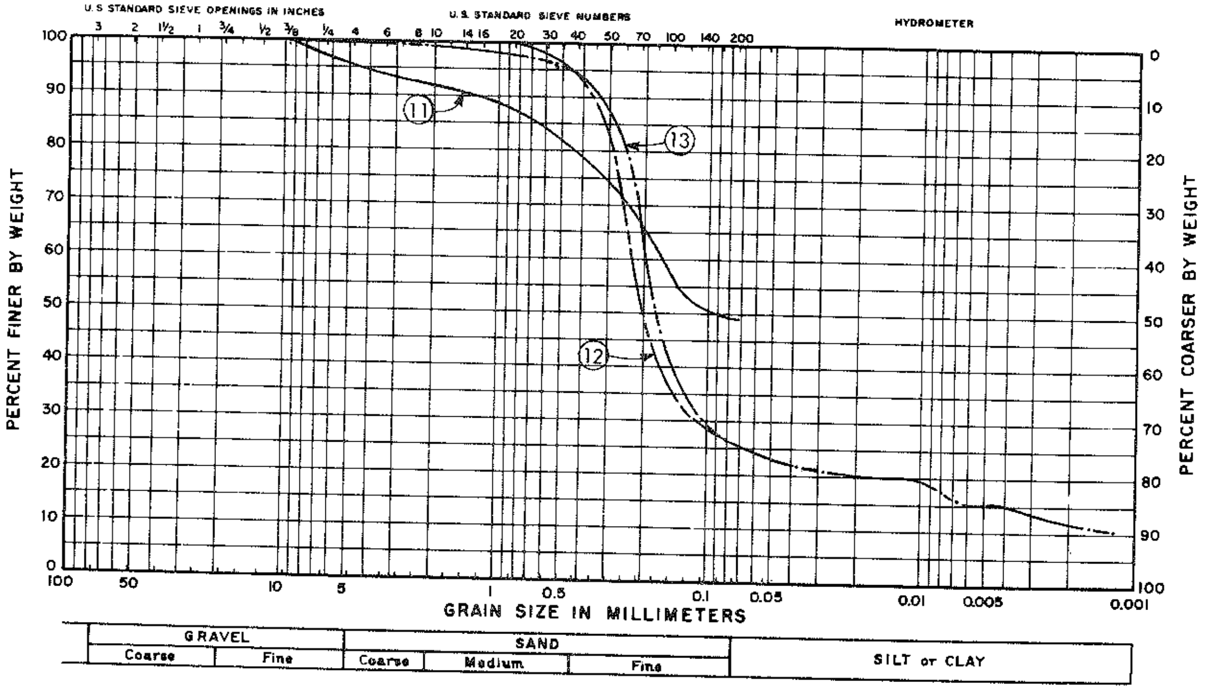
Curve No.	Boring No.	Depth, Ft.	Material
4	P-23	20	Gray silty fine sand
5	P-26	8	Red and tan sandy clay
6	P-26	30	Tan fine sand

GRAIN SIZE CURVES



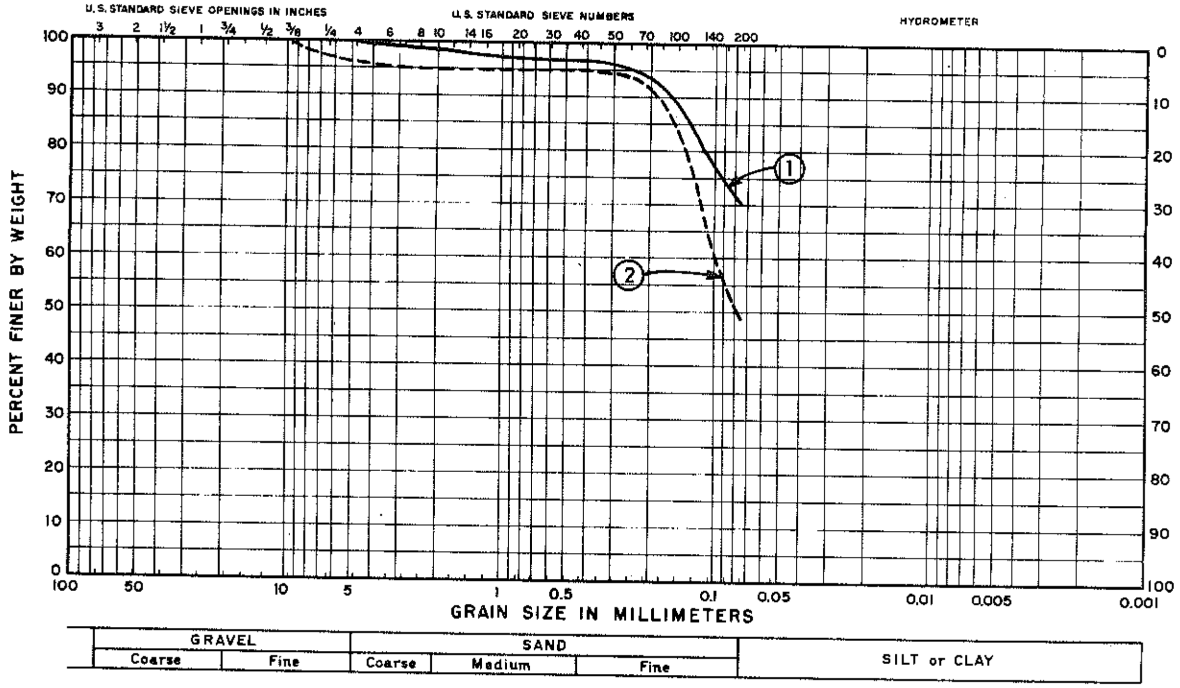
Curve No.	Boring No.	Depth, Ft.	Material
7	P-26	50	Tan fine sand
8	P-28	10	Tan fine sand
9	P-33	15.5	Red silty fine sand with ferrous nodules
10	P-34	30	Tan silty fine sand

GRAIN SIZE CURVES



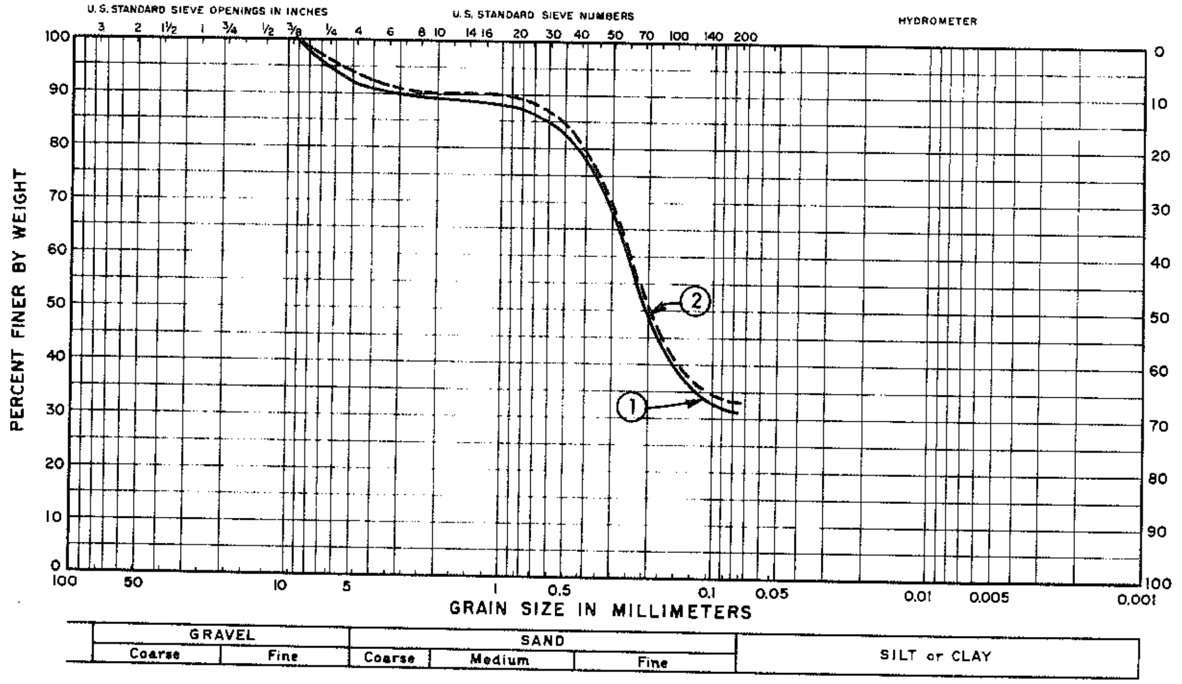
Curve No.	Boring No.	Depth, Ft.	Material
11	P-34	45	Gray sandy clay
12	P-35	20	Tan silty fine sand
13	P-36	30	Red and tan silty fine sand

GRAIN SIZE CURVES



Curve No.	Boring No.	Depth, Ft.	Material
14	P-4	15	Tan silty fine sand with clay seams and gravel
15	P-4	15	Tan silty fine sand with clay seams and gravel

GRAIN SIZE CURVES



Curve No.	Boring No.	Depth, Ft.	Material
16	P-5	15	Tan silty fine sand with sandstone nodules
17	P-5	15	Tan silty fine sand with sandstone nodules

SUMMARY OF PRICES
FOR
CONSTRUCTION OF NEW BOTTOM ASH STORAGE AREA
AT
WELSH POWER PLANT

The undersigned proposes to furnish all labor, materials, and equipment for the subject work in accordance with the attached specification and accompanying plans for the following prices to wit:

A. BID SCHEDULE

Item No.	Estimated Quantities	Unit	Description	Unit Price	Amount
1.	23	AC.	Clearing of designated work area.		
2.	23	AC.	Grubbing of designated work area.		
3.	20,000	C.Y.	Stripping topsoil from work area and stockpiling in shaped stockpiles as designated on drawings. (Measurement by cross-sections in stockpiles.)		
4.	150,000	C.Y.	Construction of berms using excavated materials from work area. (Measurement by cross-sections in place.)		
5.	100,000	S.Y.	Proofrolling area under berms and area to be lined.		
6.	6,000	L.F.	Excavate and backfill anchor trenches for HDPE liner.		
7A1.	90,000	S.Y.*	Furnish 60 mil. HDPE material.		
7A2.	5,000	S.Y.*	Furnish 100 mil. HDPE material.		
7B1.	90,000	S.Y.*	Install 60 mil. HDPE material.		
7B2.	5,000	S.Y.*	Install 100 mil. HDPE material.		

8.	5,000	C.Y.	Remove from stockpile and place and compact 6 in. topsoil on berms as indicated on dwgs. (Measurement in place.)	________	________
9A.	25,000	S.Y.	Seeding and fertilizing. (Disc, drag and drill seed.)	________	________
9B.	15,000	S.Y.	Seeding and fertilizing. (Spray w/ cellulose plaster mulch.)	________	________
10.	2	EA.	Drainage structures/systems.	________	________
11.	1 Lot	L.S.	Stormwater runoff control		________
12.	1 Lot	L.S.	Mobilization		________
13.	1 Lot	L.S.	Administration		________
			TOTAL ESTIMATED PRICE (Sum Items 1-13 above)	________	

NOTE: It should be understood that the above quantities are estimates only and that some could vary significantly up or down as job conditions dictate. OWNER reserves the right to add and/or delete bid items as job conditions dictate.

* Measurement based on area covered plus anchor trenches.

PROPOSAL DATA

1. Bidder shall list manufacturer of HDPE material. ________________
2. Bidder shall list installer of HDPE material. ________________
3. Bidder shall list all other sub-contractors. ________________

____

____

____

B. COST PLUS

As the work progresses, it may be necessary to do items of additional work (Extra Work) not covered by the specifications. The undersigned agrees to do such work on a "Cost

Plus" basis, if so authorized by purchaser. Purchaser will pay an amount equal to the net cost of such work, which shall include only the following items: *

1. Payroll cost of labor, including foremen.
2. Taxes and insurance on labor.
3. Percentage of Items 1 and 2 above for overhead and profit: ________________ % of 1 and 2.
4. Material.
5. Percentage of Item 4 above for overhead and profit: ________________ ______% of Item 4.

Note 2-1: The above percentages for overhead and profit shall cover:

2-1-1: Superintendents (except foremen).

2-1-2: Field office force,

2-1-3: Use of tools and supplies,

2-1-4: Use of construction equipment originally costing less than $1,000.00,

2-1-5: Any subcontractors' fees for over head and profit,

2-1-6: All overhead (including such taxes and insurance generally considered overhead).

2-1-7: Profit.

6. The undersigned shall list all equipment he plans to use on the WORK originally costing $1,000.00 or more and shall give an hourly rental rate for Cost Plus work. This rate shall apply to equipment located on the Project Site at the time the extra work is done. Said rate shall include insurance, fuel, oil, overheads and all other expenses for the equipment including operating personnel. (Bidder to attach separate rate sheet if necessary.)

Equipment (Include Type and Size)	Hourly Rental Rates

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* Based on mutual agreement, "Extra Work" may be performed by applying equipment and personnel hourly rates to hours worked as verified by daily time sheets and approved by OWNER/PURCHASER's Representative. Materials would be compensated for as in No. 5 above.

C. For Unit Price Contracts, the actual quantities may vary from the estimated quantities and the undersigned agrees that final payment will be adjusted to the actual quantities of work completed at the quoted unit prices listed.

D. The undersigned agrees that upon receipt of notification he will commence WORK on or about April 17, 2000 and will complete all WORK by October 31, 2000.

E. The undersigned estimates that it will take ________ working days to complete all WORK covered by this specification.

F. The undersigned hereby declares that he has visited the project site and has carefully examined the bid documents relative to the WORK covered by the proposal.

G. Bidder shall state any specific exceptions taken to this specification.

H. OWNER reserves the right to reject any and all bids.

I. The undersigned acknowledges by signature receipt of the following Addenda (if any have been received).

Addendum No. 1 ______________________________

Addendum No. 2 ______________________________

Addendum No. 3 ______________________________

Respectively submitted,

____
Signature of Bidder

____
Name of Company

(   )_________________________
Telephone Number of Bidder

(Seal if Bidder is a Corporation)

JOB SPECIFICATION

1. CLEARING

The work area was previously a pine plantation and was recently clear-cut. CONTRACTOR shall complete clearing the work area of all timber, snags, vegetation and other foreign material. All cleared material shall be disposed of by burning.

2. GRUBBING

The work area shall be grubbed by removing and disposing of all stumps, roots, logs and other foreign material from below existing grade. Stumps shall be buried only where designated by OWNER. All other grubbed materials shall be burned with any unburned materials being buried with the stumps.

3. STRIPPING TOPSOIL

The work area is covered by existing topsoil. The topsoil shall be removed and stockpiled in locations as designated on the design drawings. Completed stockpiles shall be neatly shaped. Any topsoil stockpile remaining after the work is completed shall be seeded and fertilized as per bid item No. 9A.

4. BERM CONSTRUCTION

After all topsoil has been removed, the subgrade under the berms shall be scarified/disked to a depth of 10 in., brought to optimum moisture, and compacted to 90% modified proctor (ASTM D-1557). The berms shall be constructed, as indicated on the design drawings, using excavated materials from within the bermed area.

All excavated materials shall be placed in lifts not exceeding eight inches (8") loose. Prior to compaction, the material shall be brought to optimum moisture. The material shall be processed and compacted to 90% modified proctor (ASTM D-1557) by utilizing suitable equipment that will achieve the blending and interparticle bonding required. Each completed lift shall be approved by the OWNER prior to placing of material for the next lift.

The boring logs indicate a layer of tan sand directly beneath the six (6) in. layer of topsoil. This layer of tan sand shall be excavated and placed in the internals of the berm as indicated on the berm cross-sections on the design drawings. The tan sand shall be placed and compacted as described in the preceding paragraph. The sandy clay and/or silty clay materials and the clayey sand materials shall be placed and compacted over the tan sand as described in the preceding paragraph. A full-time technician will be on site to verify the various material classifications.

5. PROOFROLLING

After the berm construction is completed and the bottom ash storage area shaped to the final grades indicated on the drawings, the entire area to be lined shall be proof rolled with equipment as approved by OWNER. Any area that pumps, ruts or shows signs of softness shall be repaired before proceeding with the installation of the liner.

6. ANCHOR TRENCHES

The anchor trenches shall be excavated to the line, grade, and width shown on the design drawing prior to liner system placement. The OWNER shall verify that the anchor trench has been constructed according to construction drawings.

No more than the amount of trench required for the geomembrane to be anchored in one day shall be excavated.

Slightly rounded corners shall be provided in the trench where the geomembrane adjoins the trench so as to avoid sharp bends in the geomembrane.

The anchor trench shall be backfilled and compacted by the CONTRACTOR as approved by the OWNER. Trench backfill material shall be placed in 8-inch thick loose lifts and compacted by wheel rolling with light, rubber-tired or other light compaction equipment.

Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane. At no time shall construction equipment come into direct contact with the geomembrane. If damage occurs, it shall be repaired by the CONTRACTOR prior to the completion of backfilling.

7. GEOMEMBRANE/LINER (FURNISH AND INSTALL)

A. Materials Furnished

<u>High Density Polyethylene Liner</u> (HDPE)

The Geomembrane supplied for this project must be suitable for the use intended. The CONTRACTOR shall obtain, and submit to OWNER, written evidence and assurance from the manufacturer that the product is acceptable for use as a pond liner in a pond to contain bottom ash and flyash from a coal fired electric generating facility. A typical chemical analysis of the component materials is as shown on Exhibit A included with the bid documents. The liner is to be placed on a prepared sandy clay subgrade and will be exposed to the environment under certain conditions.

CONTRACTOR submittals are required for OWNER's approval prior to installation of the membrane and are as follows:

1. Manufacturer's Certification that the proposed Geomembrane is suitable for purpose intended.

2. Material specifications containing the following test properties with results:

PROPERTY	**TEST METHOD**
Thickness, mils	ASTM D751/1593/374
Density (g/cc)	ASTM D792/1505
Melt Flow Index (g/10 minutes)	ASTM D1238-E
Tensile Properties Either Direction	ASTM D638 Type IV Dumbbell, 2 ipm
Tensile Strength at Break (lbs./in, width)	Gauge length per
Tensile Strength at Yield (lbs./in, width)	N.S.F. Std. 54
Elongation at Break (percent)	
Elongation at Yield (percent)	
Tear Resistance Initiation (lbs.)	ASTM D1004
Low Temperature Brittleness °F	ASTM D746 B
Dimensional Stability Each Direction (percent)	ASTM D1204 100°C 1 hr.
Volatile Loss (max. percent)	ASTM D1203 Meth. A
Ozone Resistance	ASTM D1149 7 days 100 ppm 104°F
Environmental Stress Crack Resistance (hrs)	ASTM D1693 Cond. B
Puncture Resistance (lbs.)	FTMS 101C Method 2065
Water Absorption (percent weight change)	ASTM D570
Coef. Linear Thermal Expansion 10^{-4}/°C	ASTM D696
Moisture Vaport Transmission (g/m^{2}day)	ASTM E96
Oxidative Induction Time (minutes)	ASTM D3895
Pure O_2 at 1 Atmosphere	200° C
Tensile Impact Strength (ft-lbs/in^2)	ASTM D1822
Carbon Black Content (percent)	ASTM D1603
Carbon Black Dispersion	ASTM D3015
Color (exposed side)	White

3. Installer's evidence of prior satisfactory experience in installation of HDPE liner with a list of at least five completed similar facilities with the name, address and phone number of a contact at the facility who can discuss the project.

4. Manufacturer's letter of approval of the installation at the facilities in No. 3 above.

Transportation

The geomembrane rolls or panels shall be packaged and shipped by appropriate means so that no damage is caused. Transportation shall be the responsibility of the CONTRACTOR.

Delivery

Off-loading and storage of the geomembrane is the responsibility of the CONTRACTOR. The CONTRACTOR shall be responsible for replacing any damaged or unacceptable material at no cost to the OWNER. All damaged rolls must be separated from the undamaged rolls. The OWNER will be the final authority on determination of damage.

On-Site Storage

The geomembrane shall be stored so as to be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage.

The rolls shall be stored on a prepared surface (not wooden pallets) and should not be stacked more than two rolls high.

Manufacturer

HDPE liner shall be as manufactured by GSE Lining Technology, Inc. or approved equal.

For the geomembrane materials furnished, the manufacturer will provide OWNER with a mutually agreeable twenty (20) year pro-rata warranty.

B. Installation

General

The surface upon which the HDPE Liner is to be installed is a prepared sandy clay subgrade.

Method of Placement

The CONTRACTOR shall be responsible for the following:

1. No equipment or tools shall damage the geomembrane by handling, trafficking, or other means.
2. No personnel working on the geomembrane shall smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane.

3. The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting geosynthetic clay liner.

4. The method used to place the panels shall minimize wrinkles. Wrinkles shall be identified as to proper location and compensation shall be identified on the CONTRACTOR's and OWNER's drawings. Ballast shall be used to prevent relocation of the compensating wrinkles by wind.

5. Adequate loading (e.g., sandbags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels). Ballast shall remain in place after the work is completed.

6. Direct contact with the geomembrane shall be minimized, i.e., the geomembrane in traffic areas is to be protected by extra geomembrane, or other suitable materials.

7. Completed liner installation shall be weighted down with 80 lb. bags of sackrete placed on 50 ft. centers both ways.

Weather Conditions

Geomembrane deployment shall proceed between ambient temperatures of 32°F to 105°F. Placement can proceed below 32° only after it has been verified by the OWNER that the material can be seamed according to the specification and is approved by the OWNER. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew) or in the presence of excessive winds, as determined by the CONTRACTOR.

Factory Seam Quality Verifications

The OWNER will require the CONTRACTOR to test and document up to as much as 20% of factory fusion welds (non-destructive air pressure test and/or vacuum test) in the field to verify factory test results. Additional testing at the CONTRACTOR's expense will be required if failed tests are obtained in the field.

Field Seaming

Seams shall be oriented parallel to the line of maximum slope, i.e., oriented down, not across the scope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized.

Seams shall be aligned with the least possible number of wrinkles and "fishmouths". If a fishmouth or wrinkle is found, it shall be relieved and capstripped.

Seam Overlap

Panels of geomembrane must have a finished overlap of a minimum of 4 inches for fusion welding and 3 inches for extrusion welding, but in any event sufficient overlap shall be provided to allow peel tests to be performed on the seam.

No solvent or adhesive may be used unless the product is approved by the OWNER. (Samples shall be submitted to the OWNER for testing and evaluation).

The procedure used to temporarily bond adjacent panels together shall not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any spot welding apparatus shall be controlled such that the geomembrane is not damaged.

Seaming Equipment and Accessories

The CONTRACTOR shall submit a list of equipment proposed for field seaming.

Test Seams

Field test seams shall be conducted on geomembrane liner to verify that seaming conditions are satisfactory. Test seams shall be conducted at the beginning of each seaming period, at the OWNER's discretion, and at least once each 4 hours, for each seaming apparatus used that day.

All test seams shall be made at a location selected by the OWNER in the area of the seaming and in contact with the subgrade. The test seam samples shall be 10 feet long for fusion welding and 3 feet long for extrusion welding with the seam centered lengthwise. Specimens 1 inch wide shall be cut from each opposite end of the test seam by the OWNER. The OWNER shall use a tensiometer to test these specimens for shear and peel. If a test seam fails to meet field seam specifications, the seaming apparatus and/or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved.

Non-Destructive Seam Testing

The CONTRACTOR shall non-destructively test all field seams over their full length. All test equipment, including but not limited to the following shall be furnished by the CONTRACTOR.

A. Vacuum Box testing

Equipment for testing single wedge fusion seams and extrusion seams shall be comprised of the following:

1. A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the bottom, port hole or valve assembly, and a vacuum gauge.
2. A steel vacuum tank and pump assembly equipped with a pressure controller and pipe connections.
3. A rubber pressure/vacuum hose with fittings and connections.
4. A plastic bucket and wide paint brush.
5. A soapy solution.

The following procedures shall be followed by the CONTRACTOR.

1. Excess sheet overlap shall be trimmed away.
2. Clean the window, gasket surfaces and check for leaks.
3. Energize the vacuum pump and reduce the tank pressure to approximately 3-5 psi.
4. Wet a strip of geomembrane approximately 12 inches by 48 inches (length of box) with the soapy solution.
5. Place the box over the wetted area and compress.
6. Close the bleed valve and open the vacuum valve.
7. Ensure that a leak tight seal is created.
8. For a period of approximately 15 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
9. If no bubbles appear after 15 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inches overlap and repeat the process.
10. All areas where soap bubbles appear shall be marked and repaired and then retested.

The following procedures shall apply to locations where seams cannot be non-destructively tested, as determined by the OWNER.

1. If the seam is accessible to testing equipment prior to final installation, the seam shall be non-destructively tested prior to final installation.

2. If the seam cannot be tested prior to final installation, the seaming operations shall be observed by the OWNER for uniformity and completeness.

B. Air Pressure Testing (For Double Fusion Seam Only)

The following procedures are applicable to those processes which produce a double seam with an enclosed space.

Equipment for testing double fusion seams shall be comprised of the following:

1. An air pump equipped with pressure gauge capable of generating and sustaining a pressure between 25 and 30 psi and mounted on a cushion to protect the geomembrane.

2. A manometer equipped with a sharp hollow needle, or other approved pressure feed device.

The following procedures shall be followed by the CONTRACTOR.

1. Seal one end of the seam to be tested.

2. Insert needle or other approved pressure feed device through the sealed end of the channel created by the double wedge fusion weld.

3. Energize the air pump to verify the unobstructed passage of air through the channel.

4. Seal the other end of the channel.

5. Energize the air pump to a pressure between 25 and 30 psi, close valve, and sustain pressure for approximately 5 minutes.

6. If loss of pressure exceeds 4 psi, or pressure does not stabilize, locate faulty area, repair and retest.

7. Remove needle or other approved pressure feed device and seal.

Destructive Seam Testing

The CONTRACTOR shall provide the OWNER with a minimum of one destructive test sample per 500 feet of seam length from a location specified by the OWNER. The CONTRACTOR shall not be informed in advance of the sample location.

A. Sampling Procedure

In order to obtain test results prior to completion of liner installation, samples shall be cut by the CONTRACTOR as the seaming progresses. Sampling times and locations shall be determined by the OWNER. The OWNER must witness the obtainment of all field test samples and the CONTRACTOR shall mark all samples with their location roll and seam number. The CONTRACTOR shall also record in written form the date, time, location, roll seam number, ambient temperatures, and pass or fail description. A copy of the information must be attached to each sample portion. All holes in the geomembrane resulting from obtaining the seam samples shall be immediately repaired. All patches shall be vacuum tested.

B. Size and Disposition of Samples

The samples shall be 12 inches wide by 24 inches long with the seam centered lengthwise. The sample shall be cut into two equal length pieces, half to be given to the OWNER and the other half to be given to the CONTRACTOR.

C. Field Laboratory Testing

The OWNER shall cut ten 1 inch wide replicate specimens from his sample and these shall be tested by the OWNER. The OWNER shall test five specimens for seam strength and five for peel strength. To be acceptable, four out of the five replicate test specimens must pass. Any specimen that fails through the weld or by adhesion at the weldsheet interface is a Non-FTB break and shall be considered a failure.

D. Independent Laboratory Testing

The OWNER will package and ship at least two seam samples received from the CONTRACTOR to a Laboratory for the determination of shear and peel strengths. The test method and procedures to be used by the Independent Laboratory shall be the same used in field testing, where seam samples are 1 inch wide, and the grip separation rate is 2 ipm. Four of five specimens per sample shall pass.

E. Procedures for Destructive Test Failure

The following procedures shall apply whenever a sample fails the field destructive test:

1. The CONTRACTOR shall cap strip the seam between the failed location and any passed test location.
2. The CONTRACTOR can retrace the welding path to an intermediate location (at a minimum of 10 feet from the location of the failed test), at the OWNER's direction, and take a small sample for an additional field test. If this test passes, then the seam shall be cap stripped between that location and the original failed location. If the test fails, then the process is repeated.
3. Over the length of seam failure, the CONTRACTOR shall either cut out the old seam, reposition the panel and reseam, or add a cap strip, as required by the OWNER.
4. After reseaming or placement of the cap strip, additional destructive field test(s) shall be taken within the reseamed area. The reseamed sample shall be found acceptable if test results are approved by the OWNER. If test results are not acceptable, this process shall be repeated until the reseamed length is judged satisfactory by the OWNER.

In the event that a sample fails a laboratory destructive test, then the above procedures shall be followed, considering laboratory tests exclusively.

The OWNER will document all actions taken in conjunction with destructive test failures.

Defects and Repairs

All seams and non-seam areas of the geomembrane shall be inspected by the OWNER for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be brushed, blown, or washed by the CONTRACTOR if the amount of dust or mud inhibits inspection. The OWNER shall decide if cleaning of the geomembrane is needed to facilitate inspection.

A. Evaluation

Each suspect location in seam and non-seam areas shall be non-destructively tested as appropriate in the presence of the OWNER. Each location that fails the non-destructive testing shall be marked by the OWNER, and repaired accordingly.

B. Repair Procedures

1. Defective seams shall be restarted/reseamed as described in the specifications.

2. Small holes shall be repaired by extrusion cap welding. If the hole is larger than 1/4 inch, it shall be patched.

3. Tears shall be repaired by patching. Where the tear is on a slope or an area of stress and has a sharp end it must be rounded prior to patching.

4. Blisters, large holes, undispersed raw materials, and contamination by foreign matter shall be repaired by patches.

5. Surfaces of HDPE which are to be patched shall be abraded and cleaned no more than 15 minutes prior to the repair. No more than 10% of the thickness shall be removed.

Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of 6 inches beyond the edge of defects. All patches shall be of the same compound and thickness as the geomembrane specified. All patches shall have their top edge beveled with an angle grinder prior to placement on the geomembrane. Patches shall be applied using approved methods only.

C. Restart/Reseaming Procedures

The welding process shall restart by grinding the existing seam and rewelding a new seam. Welding shall commence where the grinding started and must overlap the previous seam by at least 2 inches. Reseaming over an existing seam without regrinding shall not be permitted.

D. Verification of Repairs

Each repair shall be non-destructively tested, except when the OWNER requires a destructive seam sample obtained from a repaired seam. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved.

Recording of Results: Daily documentation of all non-destructive and destructive testing shall be provided to the OWNER by the

CONTRACTOR. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successfully retested.

Geomembrane Acceptance

The CONTRACTOR shall retain all ownership and responsibility for the geomembrane until acceptance by the OWNER. The geomembrane liner shall be accepted by the OWNER when all of the following conditions are met:

1. Installation is finished. (Partial Acceptance not allowed.)
2. Verification of the adequacy of all field seams and repairs, including associated testing, is complete.
3. Certification, including "as-built" drawing(s), is provided by the CONTRACTOR to the OWNER.

For the geomembrane materials installed, the installer will provide OWNER with a mutually agreeable five (5) year pro-rata warranty.

8. TOPSOIL SLOPES

A six inch (6") thick layer of topsoil shall be hauled and spread over the top and outside slope of the berms constructed in item No. 4 using topsoil previously stockpiled in item No. 3. The topsoil shall be placed and spread to such a depth so as to yield a six inch (6") thick layer when compacted to 85% of the modified proctor density (ASTM D-1557).

9. SEEDING AND FERTILIZING

A. Disc, Drag, and Drill Seed

This procedure shall be followed for topsoil stockpiles and basically flat areas as indicated on the drawings and/or as directed.

Fertilizer (13-13-13) @ 500 lbs/acre

Seed: Red Winter Wheat @ 35 lbs/acre
Oats @ 25 lbs/acre
Fescue @ 8 lbs/acre
Crimson Clover @ 15 lbs/acre

B. Cellulose/Plaster Mulch Seeding

This procedure shall be followed for all slopes and other areas as indicated on the drawings and/or as directed.

Fertilizer (13-13-13) @ 500 lbs/acre

Seed: Red Winter Wheat @ 35 lbs/acre
Oats @ 25 lbs/acre
Fescue @ 8 lbs/acre
Crimson Clover @ 25 lbs/acre
Rye Grass @ 25 lbs/acre

Water is available from OWNER's lake.

10. UNDER BERM DRAINAGE SYSTEM

See Design Drawings for details and specifications.

11. STORM WATER RUNOFF CONTROL

All work performed under this contract will be subject to complying with EPA Storm Water Discharge permit requirements (Federal Register Vol. 63, No. 128 dated July 6, 1998). CONTRACTOR shall be responsible for implementing storm water pollution prevention measures required to conform to such permit. Such measures may include erosion control mats, hay bale blocks, silt fences, sediment areas and other measures to appropriately control pollutants in the storm water discharges from all affected areas of construction.

CONTRACTOR shall immediately contain any spilled toxic or hazardous material (such as oil, grease, fuel, etc.) and dispose of appropriately.

Immediately after award, CONTRACTOR shall submit to OWNER information required for OWNER to submit a Notice Of Intent to EPA. CONTRACTOR shall prepare and submit to OWNER a NPDES pollution prevention plan. Such information shall include a sketch of the sites affected showing proposed locations and types of storm water control facilities. CONTRACTOR shall also submit a description of the planned method of maintaining such storm water control facilities.

The notice of intent for EPA storm water permit will be filed by OWNER. The pollution prevention plan will be maintained at the jobsite.

Periodic inspections will be made to assess the condition and adequacy of both the pollution prevention plan and procedures. Any deficiencies in the procedures shall be promptly corrected by CONTRACTOR.

The storm water pollution prevention plan must identify the CONTRACTOR and any subcontractors performing the work. In addition, the CONTRACTOR and any subcontractor must sign a copy of the following certification statement before commencement of the work. This signed statement will become a part of the storm water pollution prevention plan.

> "I certify under penalty of law that I understand the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit that authorizes the storm water discharges associated with construction activities identified as part of this certification."

CONTRACTOR shall effectively stabilize areas upon which work has been completed as soon as practical to do so.

Stabilization may involve topsoil, seeding and fertilization, or application of rip-rap or geotextiles subject approval by OWNER.

CONTRACTOR should note that the Storm Water Runoff permit requires that a sediment pond will be provided for runoff for areas that are greater than 10 acres.

No bid item is included for work or material required to conform to the storm water runoff provisions. Such payment will be considered subsidiary to the other bid items.

12. MOBILIZATION

This item is included so the CONTRACTOR can invoice a reasonable amount for mobilizing his equipment to and from the jobsite. It is not included for the CONTRACTOR to collect an unreasonable amount up front. Fifty (50) percent will be paid at the beginning of the job and Fifty (50) percent at the end of the job.

13. ADMINISTRATIVE

This item is provided for the CONTRACTOR to include his home and field office supervision and administrative expenses. This amount will be paid in equal monthly payments over the planned duration of the job.

14. SPECIAL NOTES

CONTRACTOR shall take necessary precautions to prevent damage to existing facilities such as underground pipelines, fences, gates, monitoring wells, power lines, etc.

15. DRAWINGS

The following drawings, exhibits, and other information are attached hereto and form a part hereof:

1. Boring logs B-1 thru B-9.
2. Site Topo prepared by Hart Engineering Co.
3. Exhibit A – Typical chemical analysis of the component materials to be placed in contact with geomembrane.'
4. Dwg. No. WEPX 335 (Sh. 1 & 2), "New Bottom Ash Storage Area".

GENERAL CONDITIONS

1. INGRESS AND EGRESS

The CONTRACTOR may use the roadways at the job site designated by the OWNER to the extent available and subject to the use of others. The CONTRACTOR shall endeavor to keep the roadways free from congestion at all times. In the event it becomes necessary for the CONTRACTOR to temporarily limit the use of the roadways or to block any portion thereof to facilitate construction, prior arrangements shall be worked out by the CONTRACTOR and the OWNER. The CONTRACTOR shall be responsible for any damage caused by him to roads. The CONTRACTOR shall be responsible for the handling of all equipment and materials which are furnished by the CONTRACTOR and are to be used in carrying out the work, as well as the materials furnished by the OWNER for erection by the CONTRACTOR. CONTRACTOR shall be responsible for the loss of or damage to OWNER furnished materials, while being handled by or in the possession of the CONTRACTOR.

2. GUARANTY BOND

The CONTRACTOR may be required to furnish a performance bond and payment bond in an amount equal to 100% of the contract price. The surety on the bond shall be a reputable corporation, legally qualified to carry on such business in the State in which this work is performed and shall be subject to the approval of the OWNER and shall comply with all applicable state laws. The cost of the bond shall be paid for by the OWNER.

3. SAFETY OF PERSONS AND PROPERTY

The CONTRACTOR shall take all reasonable precautions at all times to prevent injury to or death of any person at or near the site or engaged in the performance of the work and to prevent damage to or loss or destruction of any property located at or near the site. Such precautions shall include, but shall not be limited to, all safeguards and warnings necessary to protect workmen and others against any dangers or potentially dangerous conditions at or near the site of the work.

4. AUTHORITY OF THE OWNER

Work under this specification shall be subject to the approval of the OWNER, who shall determine acceptability, and who shall decide all questions which may arise as to the fulfillment of the requirements of the specifications, and to the order or precedence of the work.

5. TEMPORARY OFFICE BUILDING

Any temporary construction office building shall be furnished by and remains the property of the CONTRACTOR and shall be removed by him from the site when no longer needed. All temporary buildings shall have a presentable appearance at all times. All temporary buildings shall be arranged and located as approved by the OWNER and shall conform to the regulations established by local health authorities and shall be kept clean and orderly at all times.

6. WORK OUTSIDE REGULAR HOURS

If the CONTRACTOR, or any Subcontractor, desires to carry on work outside regular hours or holidays, he shall notify OWNER to make arrangements to inspect the work.

7. CLAIMS AND LIENS OF SUBCONTRACTORS

The CONTRACTOR specifically warrants and agrees that CONTRACTOR be solely and exclusively responsible for compensating any of CONTRACTOR's employees, subcontractors, material men and/or suppliers of any type or nature whatsoever and that no claims or liens of any type will be filed against any property owned by SWEPCO arising out of or incidental to the performance of any services performed pursuant to this contract. In the event a lien is filed, the CONTRACTOR agrees, upon written notice from SWEPCO to immediately obtain a bond at its expense so as to bond the property free and clear from the said lien and hold SWEPCO harmless from any losses that may result from the filing or enforcement of any said lien.

8. PROTECTION OF ADJOINING PROPERTY

The CONTRACTOR shall take proper means to protect the adjacent or adjoining property or properties in any way encountered, or which may be injured or seriously affected by any process of construction to be undertaken under this agreement from all damage or injury by reason of said process of construction; and he shall be liable for any and all claims for such damage on account of his failure to fully protect all adjoining property. The CONTRACTOR shall be responsible for the protection from damage by fire, falling trees or any other cause resulting from the contract work of the property, crops, timber, grass, livestock, fences, gaps, gates, cattle guards, buildings, or any other assets of adjoining landowners. The CONTRACTOR shall be responsible for the repair of such damaged property and shall make repairs without delay.

9. HEADINGS OF ARTICLES

The headings of articles, sections, paragraphs, and other parts of the contract are for convenience only and do not define, limit or construe the contents thereof.

10. PROTECTION OF BENCHMARKS

Benchmarks, stakes, marks, etc., shall be carefully preserved by the CONTRACTOR, and in case of careless destruction or removal by him or his employees, such benchmarks, stakes, marks, etc., shall be replaced by the OWNER at the CONTRACTOR's expense.

11. ENGINEER

Whenever the word Engineer is used in this Contract, it shall be understood as referring to the OWNER's authorized Engineer or Supervisor unless specifically noted otherwise. All field engineering required for the CONTRACTOR's work shall be furnished by the CONTRACTOR. If the final Contract price is based on a unit price application to actual final quantities, then the engineering (if required) to determine the actual quantities will be furnished by OWNER.

12. EQUAL EMPLOYMENT

CONTRACTOR covenants that as to SWEPCO, its affiliated companies or contractors that:

(a) All applicable provisions of Executive Order No. 11,246 dated September 24, 1965, the Rules and Regulations promulgated thereunder by the Office of Federal Contract Compliance of the United States Department of Labor, and all applicable requirements of the Equal Employment Opportunities Subchapter of the Civil Rights Act of 1964 and Section 402 of the Vietnam Era Veterans Readjustment Assistance Act of 1974 and Section 503 of the Rehabilitation Act of 1973 will be fully met and observed in respect to the performance of services covered by this contract.

(b) It has taken affirmative action to insure that applicants for employment by it and its employees are dealt with without regard to race, color, religion, sex or national origin.

13. ENVIRONMENTAL CLAIMS

In consideration of the benefits received herein, the CONTRACTOR agrees to fully and completely indemnify, hold harmless and defend at its expense SWEPCO, its successors and assigns, or any of its subsidiaries, directors, officers, employees, shareholders, contractors and/or agents, successors and/or assigns from and against any and all environmental claims of any type or nature whatsoever in any way arising out of or incidental to the performance of any work or services performed pursuant to this contract. For purposes of this indemnification agreement, environmental claims include but are not limited to any and all claims asserted pursuant to the Comprehensive Environmental

Response, Compensation and Liability Act (42 USC § 9601, et. seq.), the Resource Conservation Recovery Act (42 USC § 6901, et seq.), the Superfund Amendments and Re authorization Act of 1986, the Toxic Substance Control Act (15 USC § 2601, et seq.), including any amendments to any of said Acts, and any other present or future federal, state, or municipal laws, statutes, ordinances, regulations or policies in any manner governing or affecting the environment or hazardous substances or waste or any other environmental claims of any type or nature brought pursuant to common law. The CONTRACTOR shall assume the defense of any such claims immediately upon receipt of written notice from SWEPCO, or its successors or assigns. The CONTRACTOR specifically agrees to fully and completely comply with all statutes referred to in this paragraph, or any other present or future federal, state, or municipal laws, statutes, ordinances, regulations or policies in any manner governing or affecting the environment or any hazardous substances or wastes.

14. OUTDOOR BURNING

CONTRACTOR shall provide notice to OWNER and the appropriate agencies of its intent to engage in outdoor burning.

Should the CONTRACTOR engage in outdoor burning, such burning shall occur only between 9:00 a.m. and 5:00 p.m. And only on days where weather conditions are appropriate for undertaking such activities. Fires must be out and smoke ceased at 5:00 p.m. Burning operations must be managed so as not to create a nuisance to any area resident or residence. Fires cannot be started with anything other than diesel or gasoline and only in small quantities (particularly, no tires or asphalt materials are allowed for starting fires).

15. TRENCH EXCAVATION

Any trench excavation exceeding a depth of five feet shall be performed in accordance with OSHA standards for Trench Safety, #29 CFR Part 1926. Should trench excavation be performed in conjunction with the work, a separate price for trench excavation safety protection will be required.

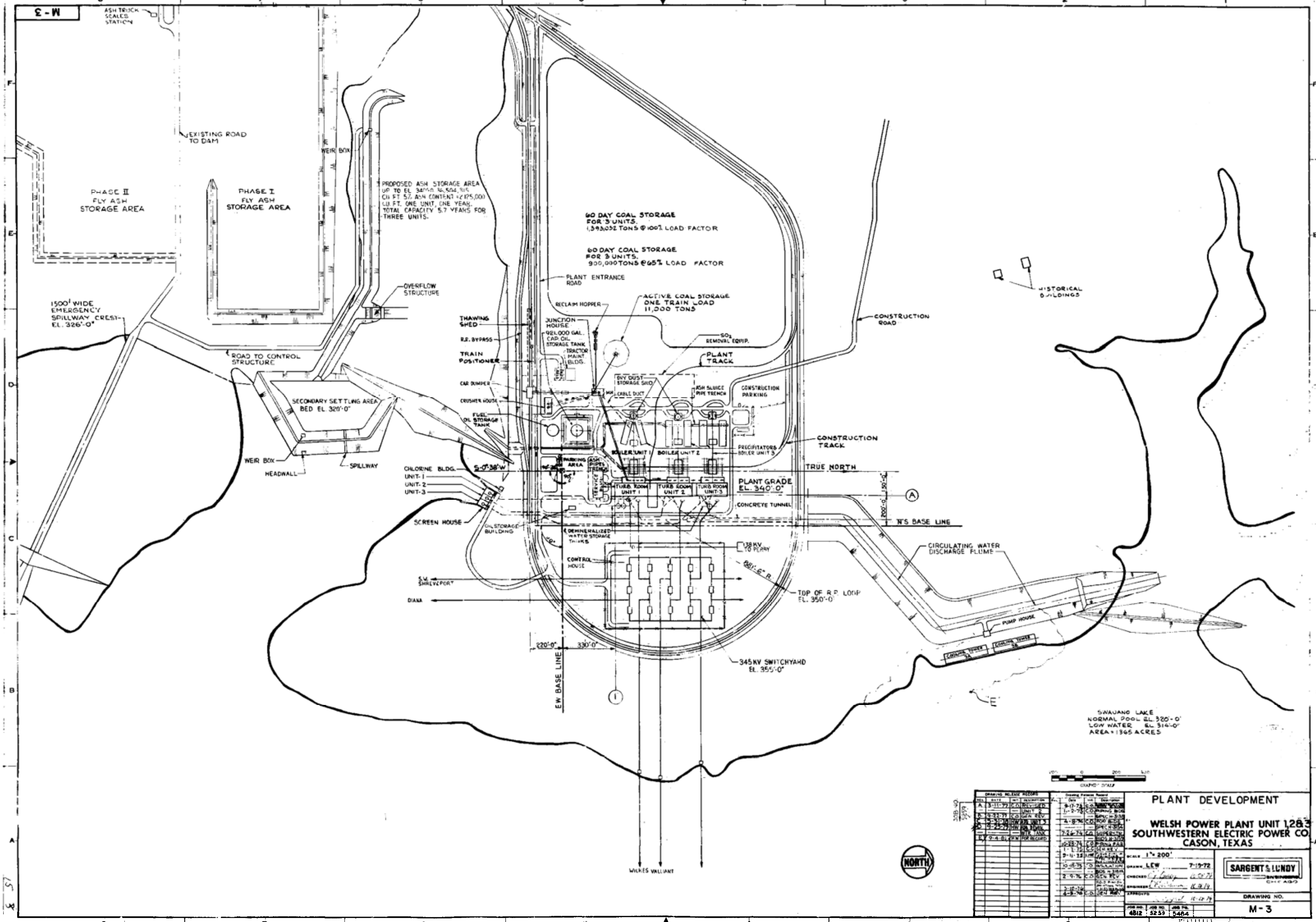
16. PAYMENT

A. SWEPCO agrees to pay the CONTRACTOR monthly as the work is completed, but the total of such payments on account shall at no time exceed ninety percent (90%) of the mutually agreed upon value of the work completed.

B. Ten percent (10%) upon completion of the work and acceptance by SWEPCO.

ATTACHMENT C

DESIGN DRAWINGS



DRAWING RELEASE RECORD

REV.	DATE	INIT.	DESCRIPTION
A	3-11-77	C.O.	REVISED
—	—	—	UNIT 2
B	9-22-77	C.O.	GEN. REV.
C	5-5-78	HW	ADD UNIT 3
D	9-25-79	HW	[illegible]
—	—	—	WTR. TANK
E	9-4-81	HW	FOR RECORD

308.40
5259

Drawing Release Record

Date	Init.	Description
9-17-73	C.O.	[illegible]
1-2-73	C.O.	PIPING BIDS
—	—	SPEC H-3130
4-8-74	C.O.	FOR BIDS
—	—	SPEC H-3154
7-26-74	C.O.	SUPERSTR.
—	—	BIDS H-3155
10-28-74	C.O.	PIPING FAB
1-7-75	C.O.	GEN. REV.
9-4-75	HW	[illegible]
10-15-75	C.O.	INSULATION
—	—	BIDS H-3184
2-9-76	C.O.	GEN. REV.
3-18-76		[illegible]
4-5-76	C.O.	GEN. REV.

PLANT DEVELOPMENT

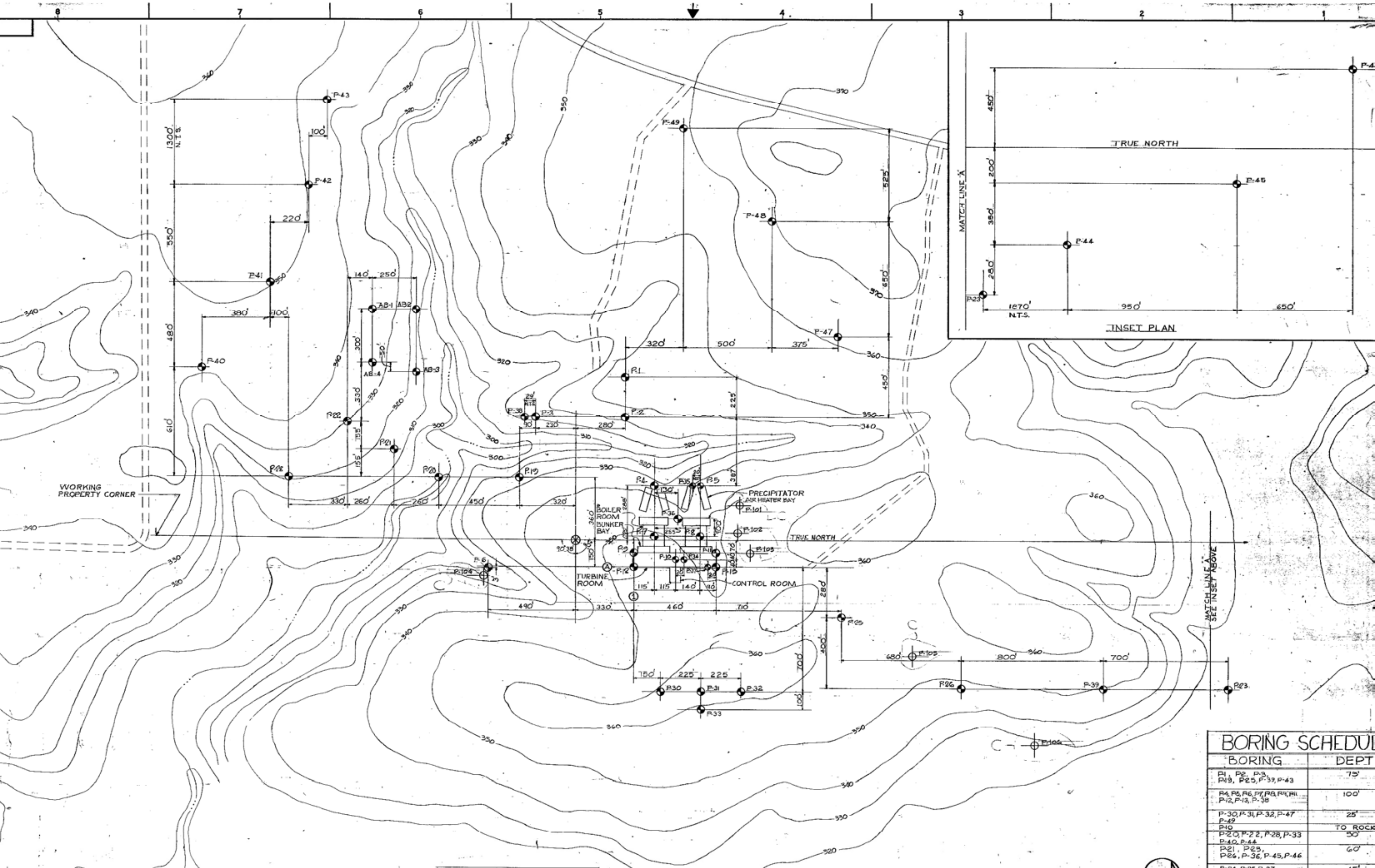
WELSH POWER PLANT UNIT 1,2&3
SOUTHWESTERN ELECTRIC POWER CO.
CASON, TEXAS

SCALE 1" = 200'
DRAWN LEW 7-19-72
CHECKED C. Lacey 10-31-74
ENGINEER [illegible] 10-31-74
APPROVED [illegible] 10-31-74

JOB NO.	JOB NO.	JOB NO.
4812	5259	5464

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO.
M-3



PROPOSED BORINGS (UNIT #3)

BORING NO.	BASELINE COORDINATES		BORING DEPTH
P-101	9+20.00N	6+50.00W	75 FT.
P-102	9+10.00N	3+90.00W	75 FT.
P-103	9+80.00N	2+80.00W	75 FT.
✱ P-104	5+12.00S	1+50.00W	60 FT.
P-105	19+00.00N	3+00.00E	50 FT.
P-106	26+00.00N	8+00.00E	50 FT.

✱ SEE NOTE 4

NOTES

1. THE FOLLOWING BORINGS HAVE NOT BEEN TAKEN AND THEIR REFERENCE IS ELIMINATED FROM THE SEQUENCE SHOWN IN THE BORING SCHEDULE. BORINGS P-14, P-15, P-16 P-17, P-18, P-24, P-27.
2. BORINGS AB-1 THRU AB-4 ARE AUGER BORINGS.
3. LEGEND: ● BORINGS ALREADY DRILLED
   ○ BORINGS TO BE TAKEN
4. BORING P-104 HAS SPECIAL SAMPLING REQUIREMENTS. SEE SPECIFICATION FOR GEOTECHNICAL INVESTIGATION OF UNIT #3.

REFERENCE DRAWINGS

S-2	SOIL BORING LOGS. SHEET-1
S-3	SOIL BORING LOGS. SHEET-2

BORING SCHEDUL

BORING	DEPT
P1, P2, P-3, P19, P25, P-39, P-43	75'
P4, P5, P6, P7, P8, P9, P11 P-12, P-13, P-38	100'
P-30, P-31, P-32, P-47 P-49	25'
P10	TO ROCK
P-20, P-22, P-28, P-33 P-40, P-44	50'
P21, P29, P26, P-36, P-45, P-46	60'
P-34, P-35, P-37	45'
P-48	35'
P-41, P-42	55'
AB-1, AB-2, AB-3, AB-4	20'

UNIT #3 UNITS #1&2

Drawing Release Record

Rev.	Date	Init.	Description
	1-9-73		[illegible]
A	4-?-73		[illegible]
B	6-26-73	L.S.	[illegible]
	10-15-73	J.S.	[illegible]
C	03-14-78		[illegible]
			[illegible]
[illegible]	08-01-78		[illegible]

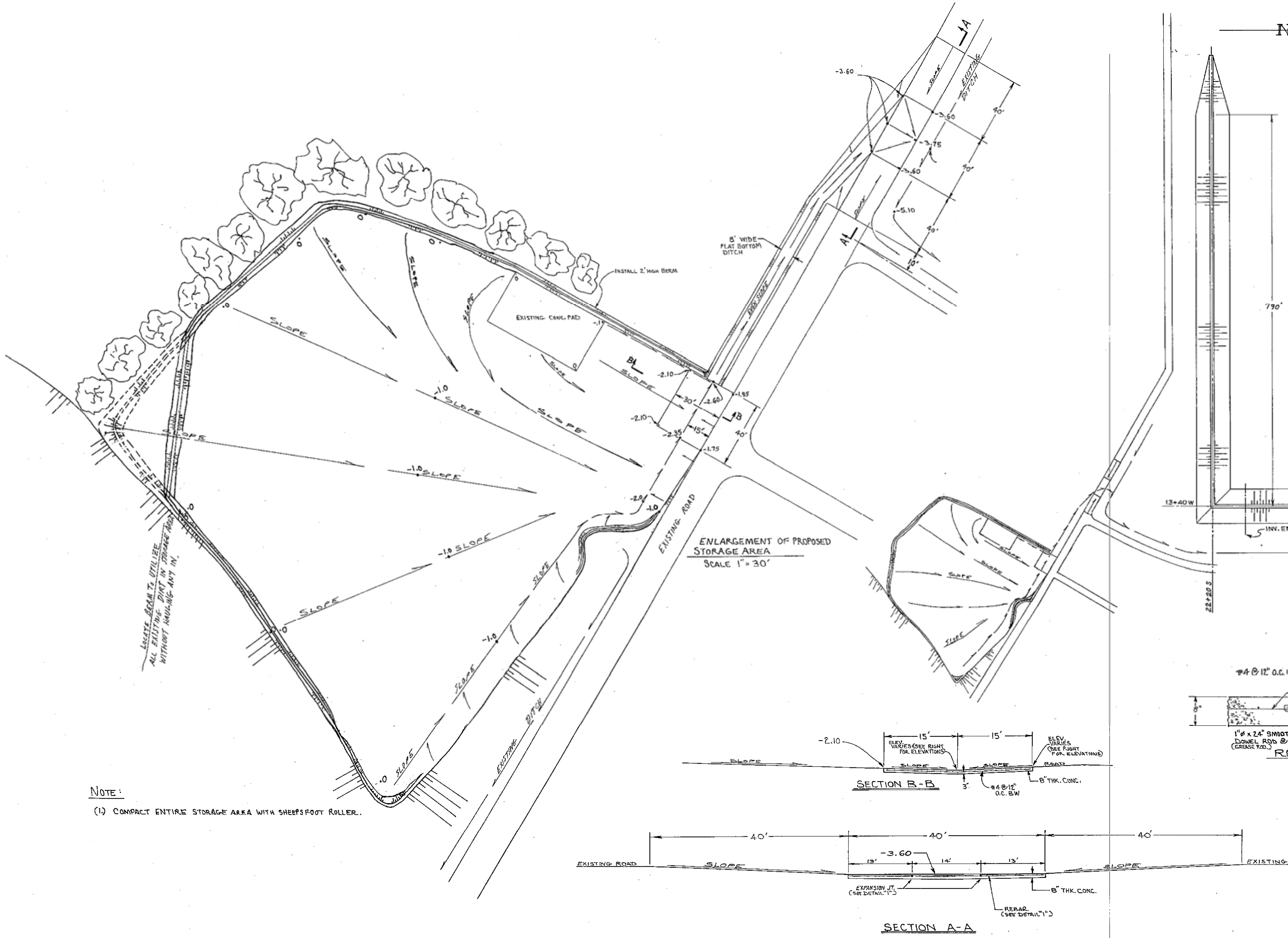
SOIL BORING LOCATION PL

WELSH POWER PLANT UNI
SOUTHWESTERN ELECTRIC POW
CASON, TEXAS

SCALE 1" = 200'
DRAWN W. MILLER 12-26-72
CHECKED
ENGINEER
APPROVED
JOB NO. 4312 5464-05

SARGENT &

DRAWING
S-1



NOTE:

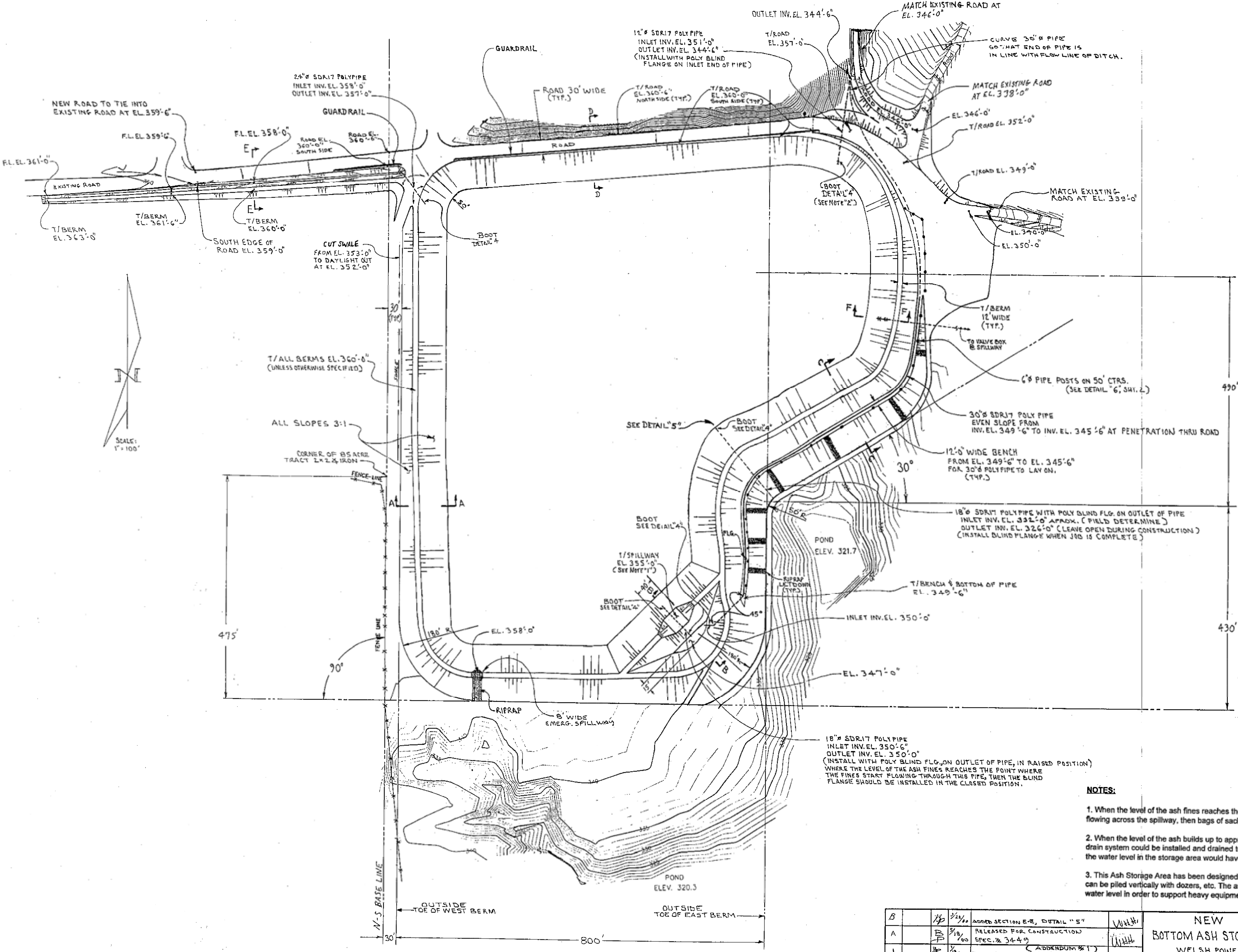
(1.) COMPACT ENTIRE STORAGE AREA WITH SHEEPSFOOT ROLLER.

		tjp		For Construction	
REV	W.O.	BY	DATE	SUBJECT	APPROVED

BOTTOM ASH TEMPORARY
STORAGE AREA

WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER



NOTES:

1. When the level of the ash fines reaches the point where the fines start flowing across the spillway, then bags of sackrete can be installed to raise

2. When the level of the ash builds up to approx. elev. 355 along the north drain system could be installed and drained to this outlet to help hold the w the water level in the storage area would have to be at elev. 351 or above f

3. This Ash Storage Area has been designed to hold the water level as low can be piled vertically with dozers, etc. The ash level needs to be approx. 4 water level in order to support heavy equipment.

REV.	W.O.	BY	DATE	SUBJECT	APPROVED
C		BP	10-29-00	AS BUILT	

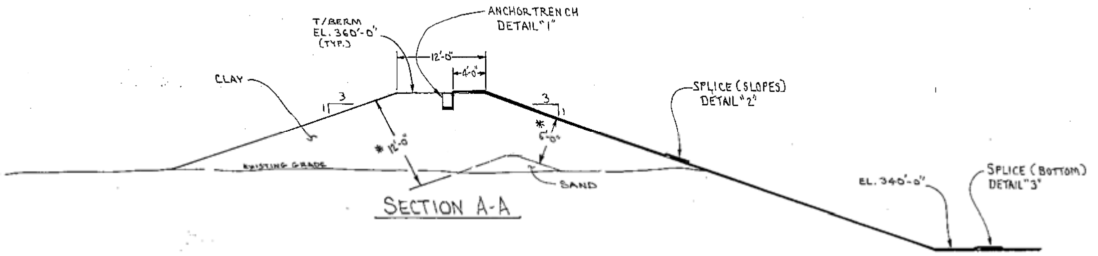
REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	9/22/00	ADDED SECTION E-E, DETAIL "5"	WHH
A		BP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHH
1		BP	3/13/00	RELEASED FOR BIDS SPEC. #3449 (ADDENDUM # 1)	
		BP	3-10-00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

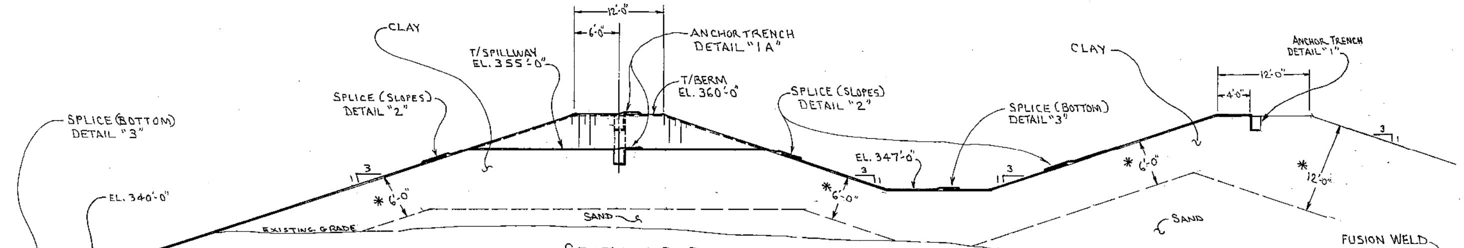
SOUTHWESTERN ELECTRIC POWER CO.

APP
DRW
SCA
SH.

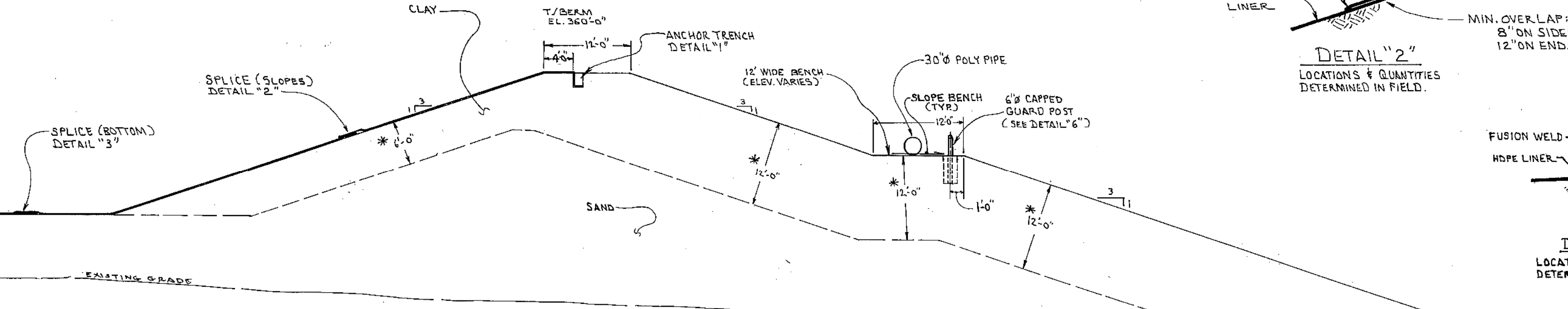
* - NOTE- THESE DIMENSIONS ARE SUBJECT TO ADJUSTMENT DEPENDING ON THE SAND / CLAY BALANCE VS. HAUL DISTANCE ON PROJECT.



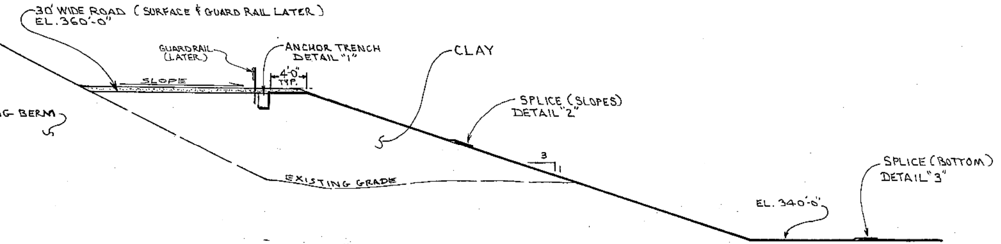
SECTION A-A



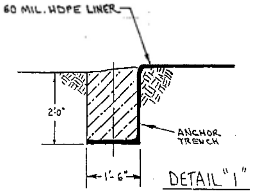
SECTION B-B



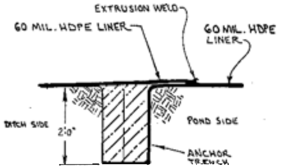
SECTION C-C



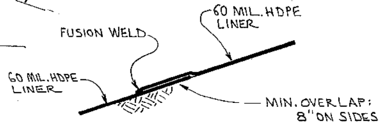
SECTION D-D



DETAIL "1"

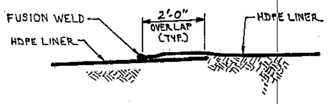


DETAIL "1A"



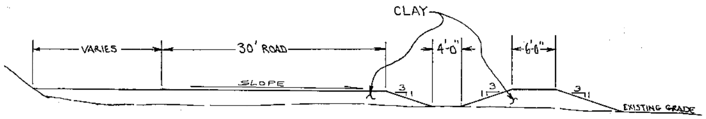
DETAIL "2"

LOCATIONS & QUANTITIES DETERMINED IN FIELD.

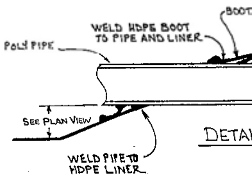


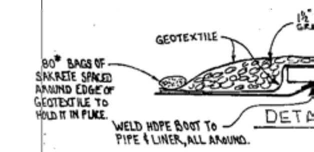
DETAIL "3"

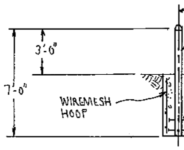
LOCATIONS & QUANTITIES DETERMINED IN FIELD



SECTION E-E



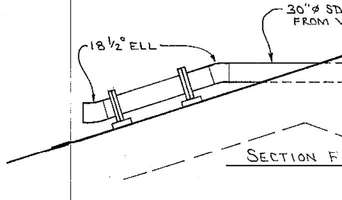




DETA

50' ON C

(2.0 RE



SECTION F

REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	10/20/00	AS BUILT	
A		BP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHA
1		BP	3/13/00	(ADDENDUM #1) RELEASED FOR BIDS SPEC. #3449	
		BP	3/10/00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER

ATTACHMENT D

HYDROLOGY AND HYDROLOGIC REPORT

Innovative approaches
Practical results
Outstanding service

Hydraulic Analysis of Welsh Power Plant Ash Ponds

American Electric Power Company

Prepared by:

FREESE AND NICHOLS, INC.
4055 International Plaza, Suite 200
Fort Worth, Texas 76109
817-735-7300

AEP10412

Innovative approaches
Practical results
Outstanding service

Hydraulic Analysis of Welsh Power Plant Ash Ponds

American Electric Power Company

TRAVIS N. ATTANASIO
98433

Freese and Nichols, Inc.
Texas Registered Engineering Firm F-2144

The seal appearing on this document was
authorized by Travis N. Attanasio on
December 29, 2010

Prepared by:

FREESE AND NICHOLS, INC.
4055 International Plaza, Suite 200
Fort Worth, Texas 76109
817-735-7300

AEP10412

TABLE OF CONTENTS

LIST OF TABLES

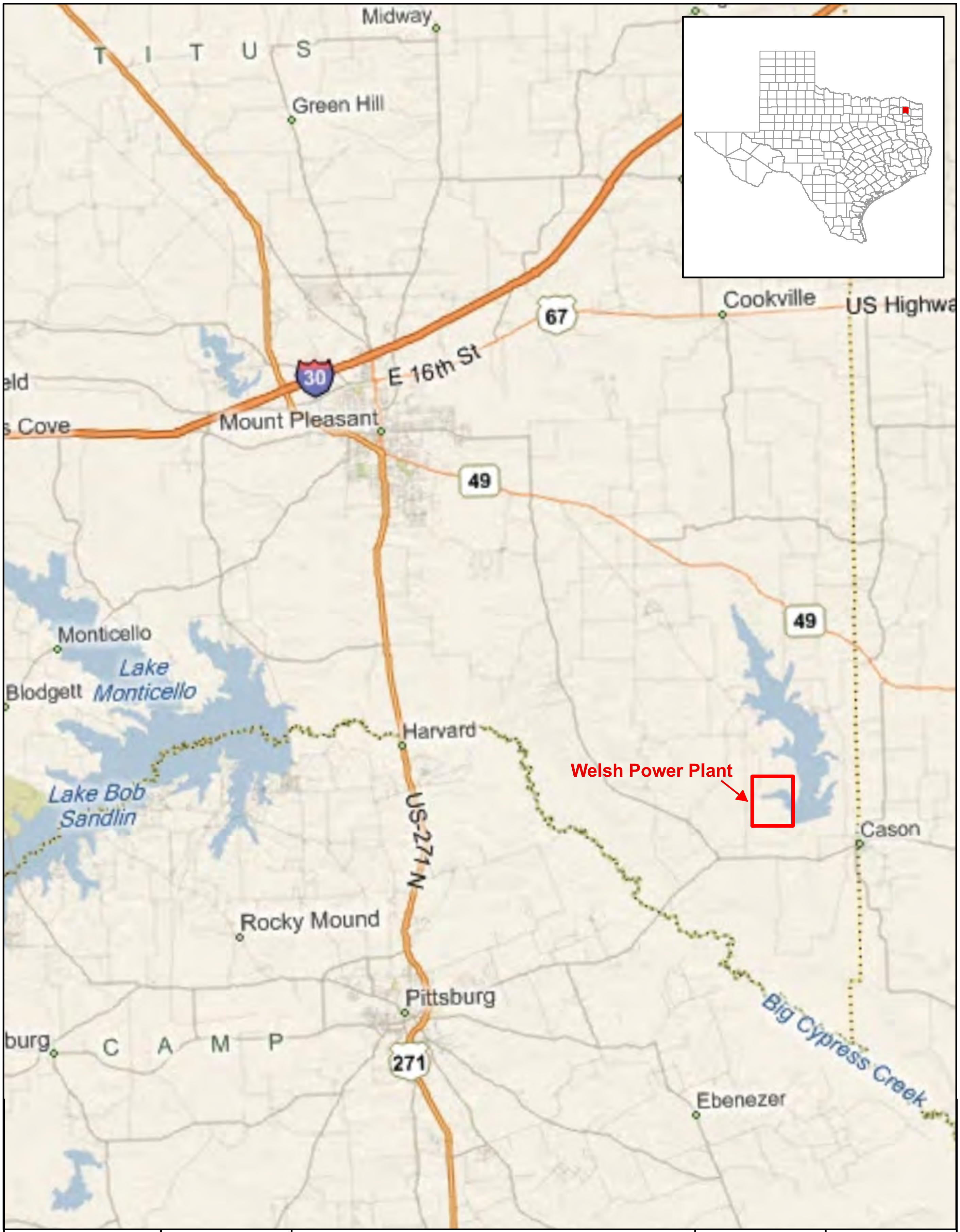
LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

In November of 2010, Freese and Nichols, Inc., (FNI) was retained by American Electric Power (AEP) to perform various hydrologic and hydraulic calculations to determine the hydraulic adequacy of the Primary Ash, Secondary Ash, and Bottom Ash Ponds for the Welsh Power Plant located near Pittsburg, TX. This report summarizes the results of the analysis for the 10-year, 25-year, 100-year, 25% PMF, 50% PMF, and 100% PMF events.

The three Ash Ponds are situated immediately south of the Welsh Power Plant on the west side of Welsh Reservoir. The general location of the power plant and associated reservoirs is shown in Figure 1.



FN PROJECT NO.
AEP10412

FILE NAME
H:\WR_DESIGN\FIGURES\Figure1_LocationMap.mxd

DATUM & COORDINATE SYSTEM
NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)

DATE CREATED
DECEMBER 2010

PREPARED BY
JPM

FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 1.25 2.5 5
Miles

WELSH POWER PLANT ASH PONDS

LOCATION MAP

N

FIGURE

1

2.0 HYDROLOGIC MODEL DEVELOPMENT

2.1 BASIN DELINEATION & CONNECTIVITY

The hydrologic model for the Welsh Power Plant Ash Ponds was created in HEC-HMS[1] and consisted of seven total drainage basins, as shown in Figure 2. The total drainage area modeled is approximately 0.695 square miles, or 445 acres. Two basins, labeled *Primary* and *Power Plant*, drain directly into the Primary Ash Pond. The Ash Storage Area was divided into two drainage basins – *Ash Storage Area A* and *Ash Storage Area B* – based on a December 2009 survey of the area. A small portion of the Ash Storage Area, along with a small wooded area, drains into the Bottom Ash Pond and is shown as *to Bottom Ash* in Figure 2. Additionally, the area inside the embankment for the Bottom Ash Pond is labeled *Bottom Ash* and drains directly into the reservoir area. Finally, the basin labeled *Secondary* represents the area draining to the Secondary Ash Pond.

Each of the seven basins and three reservoir areas are connected in some way and form an intricate system of connectivity. The only discharges from the Primary Ash Pond flow through a drainage canal to the Secondary Ash Pond. This canal flows from west to east and is controlled by a weir box control structure. Discharges from the Primary Ash Pond emergency spillway also flow into this drainage canal; however, these flows enter the canal downstream of the weir box control structure. Runoff from the Ash Storage Area also enters the Primary Ash Pond via a small sump area with a 24-inch culvert. Rainfall is routed through a small ditch around the perimeter of the Ash Storage Area to this culvert. The principal spillway for the Bottom Ash Pond discharges into a 30-inch pipe which transports the outflows to the Ash Storage Area ditch. These outflows eventually discharge into the Primary Ash Pond. The emergency spillway for the Bottom Ash Pond discharges freely into the area downstream of the Welsh Reservoir emergency spillway. Finally, the combined flows from the drainage canal enter the Secondary Ash Pond, which has both a principal and emergency spillway. All discharges from the Secondary Ash Pond flow into Welsh Reservoir. Spillway capacities are discussed in further detail in Section 2.4.

FN PROJECT NO.
AEP10412

FILE NAME
H:\WR_DESIGN\FIGURES\Figure2_Basins.mxd

DATUM & COORDINATE SYSTEM
NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)

DATE CREATED
DECEMBER 2010

PREPARED BY
JPM

FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 500 1,000 2,000
Feet

N

WELSH POWER PLANT ASH PONDS

DRAINAGE BASIN MAP

FIGURE

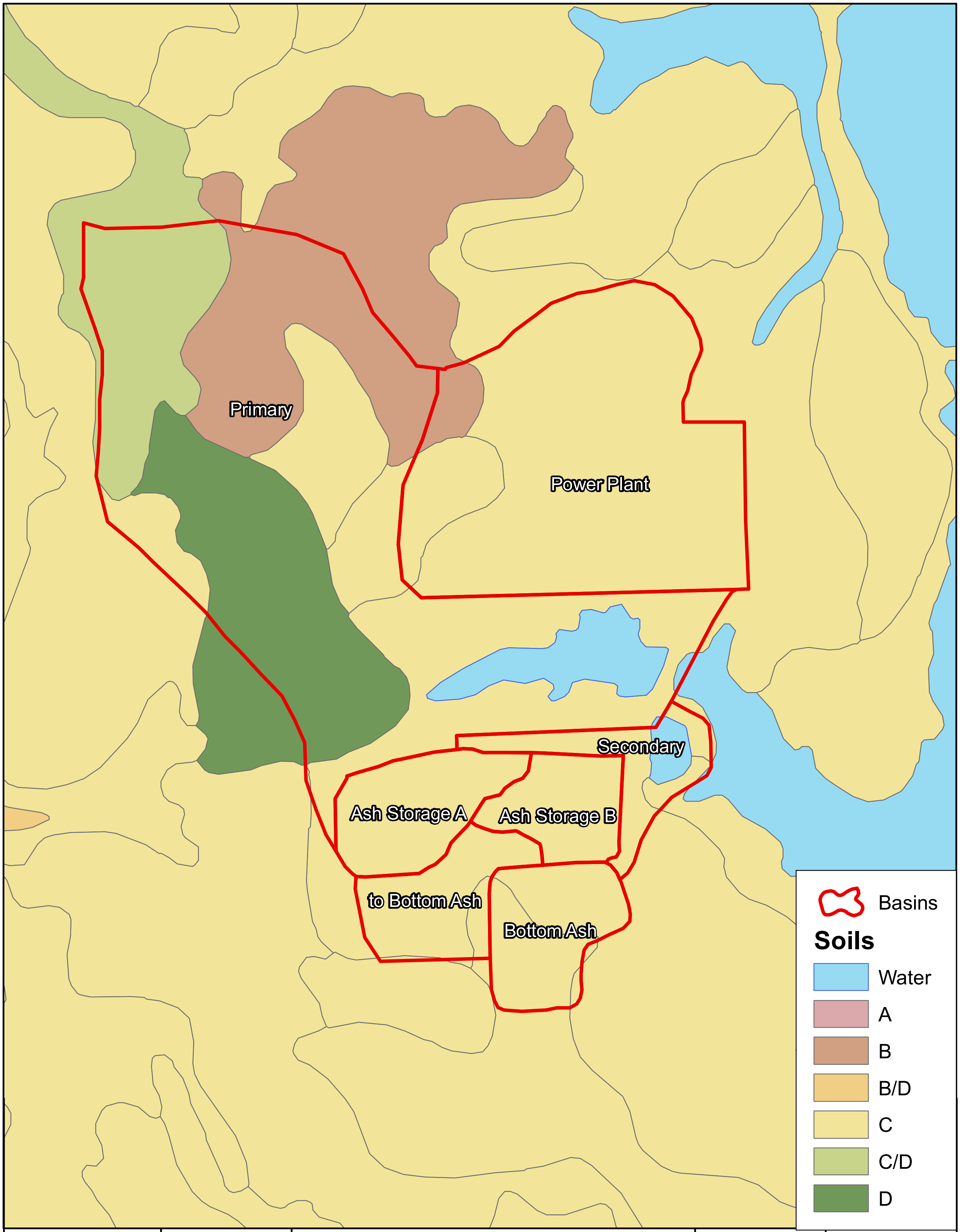
2

2.2 HYDROLOGIC PARAMETERS

The HEC-HMS model incorporates the NRCS Curve Number and Unit Hydrograph methods for each basin. In this model, the curve numbers were based on hydrologic soil classifications and land cover. The instantaneous runoff effect of open water surfaces was accounted for in the development of the curve numbers. The soils dataset was obtained from the NRCS Soil Survey Geographic Database[2] (SSURGO), and land use dataset was obtained from the USGS Seamless Data Warehouse[3] in the form of the National Land Cover Dataset (NLCD) for 2001. Spatial information about soil types and land use classifications is presented in Figures 3 and 4, respectively. Table 1 provides the matrix used in determining the curve number for each basin. The curve numbers shown in Table 1 are for Antecedent Moisture Condition (AMC) II. These values were incorporated in the model for the frequency storm events, such as the 100-year storm event. In accordance with TCEQ recommendations, AMC III was applied to the model for PMF events. This represents a worst-case scenario with the ground fully saturated prior to the PMF event.

Table 1 – Curve Number Calculation Matrix

NLCD Classification		Curve Number (AMC II)					
#	**Description**	**A**	**B**	**B/C**	**C**	**C/D**	**D**
11	Open Water	100	100	100	100	100	100
21	Developed, Open Space	68	79	83	86	88	89
22	Developed, Low Intensity	51	68	74	79	82	84
23	Developed, Medium Intensity	77	85	88	90	91	92
24	Developed, High Intensity	89	92	93	94	95	95
31	Barren Land	77	86	89	91	93	94
41	Deciduous Forest	36	60	67	73	76	79
42	Evergreen Forest	36	60	67	73	76	79
43	Mixed Forest	36	60	67	73	76	79
52	Scrub/Shrub	35	56	63	70	74	77
71	Grassland/Herbaceous	39	61	68	74	77	80
81	Pasture/Hay	39	61	68	74	77	80
82	Cultivated Crops	67	78	82	85	87	89
90	Woody Wetlands	45	66	72	77	80	83



FN PROJECT NO.
AEP10412

FILE NAME
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DATUM & COORDINATE SYSTEM
NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)

DATE CREATED
DECEMBER 2010

PREPARED BY
JPM

FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 500 1,000 2,000
Feet

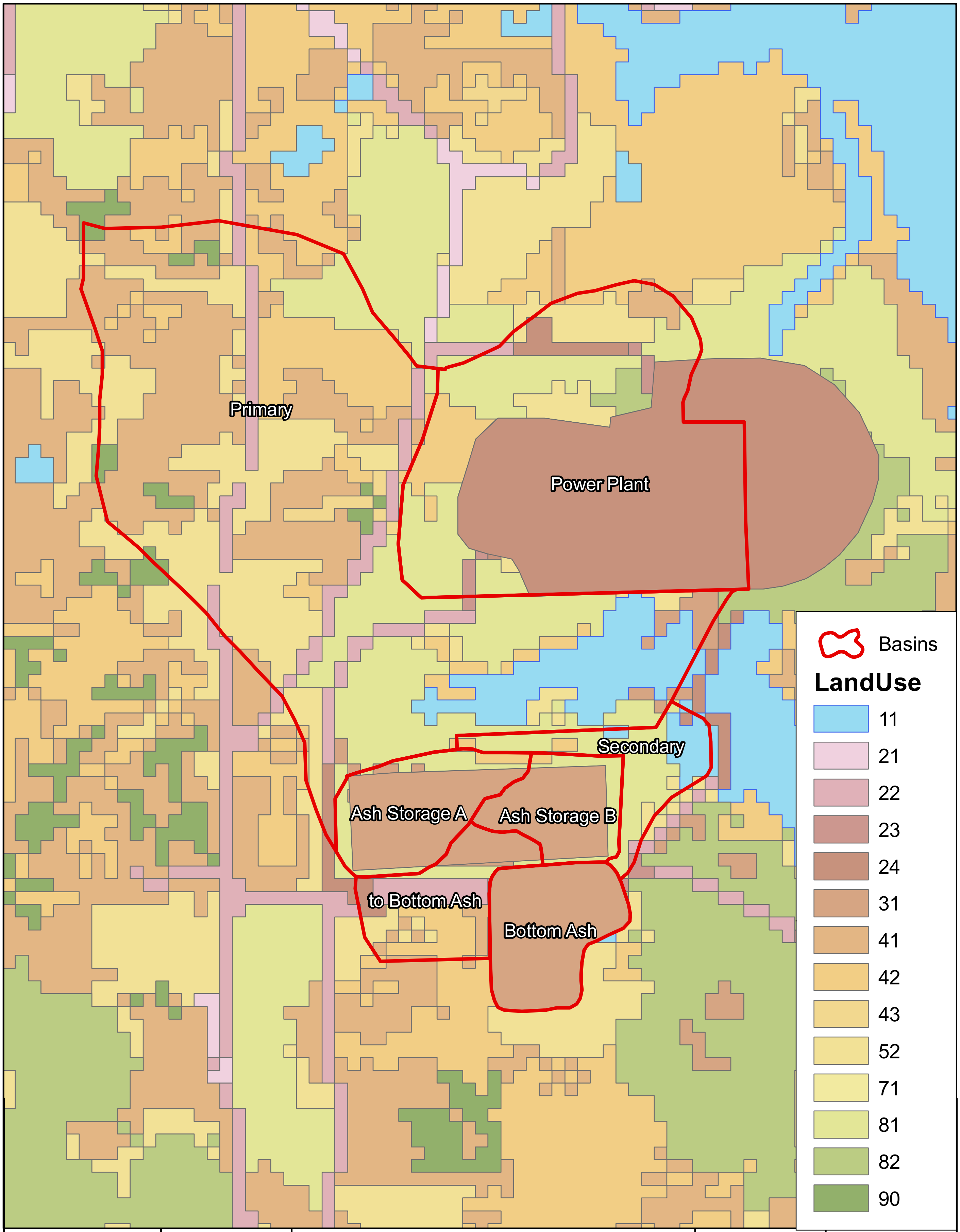
WELSH POWER PLANT ASH PONDS

HYDROLOGIC SOIL CLASSIFICATIONS

N

FIGURE

3



FN PROJECT NO.	AEP10412
FILE NAME	H:\WR_DESIGN\FIGURES\Figure4_LandCover.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)
DATE CREATED	DECEMBER 2010
PREPARED BY	JPM

FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 500 1,000 2,000
Feet

N

WELSH POWER PLANT ASH PONDS

LAND COVER DATA

FIGURE
4

The only input into HEC-HMS for the NRCS Dimensionless Unit Hydrograph is a lag time, which is calculated based on basin conditions, such as hydraulic length and average slope, according to the NRCS TR-55 Method. Table 2 provides a summary of the hydrologic parameters for each basin. Note that AMC II corresponds with the curve numbers used in the frequency model and that AMC III corresponds with the weighted curve numbers used in the PMP model.

Table 2 – Basin Parameters

Basin	Area (mi^2)	Lag Time (min)	Curve Number (AMC II)	Curve Number (AMC III)
Ash Storage A	0.034	5.28	87.1	93.9
Ash Storage B	0.025	7.51	87.1	93.9
Bottom Ash	0.034	4.78	91.0	95.9
Power Plant	0.180	18.77	85.3	93.0
Primary	0.366	36.14	76.0	88.0
Secondary	0.026	2.31	82.7	91.7
to Bottom Ash	0.031	16.51	77.8	89.0

2.3 ELEVATION-STORAGE DATA

Elevation-storage data for each reservoir was obtained from a combination of data sources. The elevation-storage relationship for the Primary Ash Pond was calculated from USGS 10-foot contours for the area and compared to calculations made by AEP. The Secondary Ash Pond used the AEP Calculations for elevation 320.0 ft-msl to elevation 330.0 ft-msl and a combination of USGS 10-foot contours and surveyed 2-foot contours. The Bottom Ash Pond used volume calculations from an April 2010 survey from elevation 346.13 ft-msl to elevation 355.92 ft-msl. The volume was then extrapolated to the top of dam elevation of 360.0 ft-msl by the average-end-area method and the assumption of 3:1 side slopes. These relationships were used in the hydrologic model for routing both frequency storm events and the PMF and are shown in Table 3 below.

Table 3 – Elevation-Storage Data

Primary	
Elevation (ft-msl)	Storage (acre-ft)
300	0.00
305	22.37
310	54.66
315	110.48
320	186.47
325	304.20
330	461.77
335	676.03
340	934.21

Secondary	
Elevation (ft-msl)	Storage (acre-ft)
320	0.00
330	36.87
331	41.31
332	46.30
333	51.82
334	57.67
335	63.77
336	70.09
337	76.59
338	83.26
339	90.22
340	97.45
341	105.06
342	112.68

Bottom Ash	
Elevation (ft-msl)	Storage (acre-ft)
346.13	0.00
347	0.22
348	1.31
349	3.17
350	5.51
351	8.33
352	11.94
353	16.77
354	23.57
355	33.04
356	45.07
357	65.66
358	86.50
359	107.61
360	128.98

2.4 DISCHARGE RATING CURVES

Each of the three dams has both a principal spillway and an emergency spillway. Information regarding the dimensions and elevations of each of these spillways was taken from a combination of original construction drawings, recent survey, and detailed descriptions from AEP personnel. Detailed calculations for the discharge rating curves of each spillway are included in Appendix B.

The principal spillway for the Primary Ash Pond is located in the canal connecting the Primary and Secondary Ash Ponds. It consists of a weir box with bottom elevation of 325.0 ft-msl and a 4-foot wide by 2-foot tall opening. Stop logs are placed in this opening according to regular dredging operations by AEP; however, normal conditions dictate that no stop logs are in place. This structure also consists of sheet piling to each side of the weir box, which will operate as a sharp-crested weir when flows reach the top elevation of 336.0 ft-msl. Additionally, the Primary Ash Pond has a 90-foot wide emergency spillway with a crest elevation of 334.0 ft-msl. Both the orifice and weir equations were utilized in calculating the discharge rating curves. The discharge rating curve for both spillways is shown in Table 4.

The principal spillway for the Secondary Ash Pond consists of a weir box with a 4-foot long weir discharging through a 36-inch conduit. The weir equation used for this weir box was obtained from Greg Carter of AEP from calculations he had performed in the design of a new weir plate, which is currently in place. Additionally, the Secondary Ash Pond has an approximately 45-foot wide earthen emergency spillway. The discharge rating curve for the emergency spillway was calculated with a simple HEC-RAS model with cross-sections cut through the spillway. The discharge rating curve for both spillways is shown in Table 4.

The principal spillway for the Bottom Ash Pond is a 40-foot long broad-crested weir with 6:1 side slopes and crest at elevation 355.0 ft-msl. It discharges into a small sump area connected to the 30-inch pipe directing flow back toward the Ash Storage Area. The emergency spillway is an 8-foot wide weir at elevation 358.0 ft-msl with a rock riprap discharge chute. The discharge rating curve for both spillways is shown in Table 4.

Table 4 – Discharge Rating Curves

Primary			
Elevation (ft-msl)	**Principal Spillway (cfs)**	**Emergency Spillway (cfs)**	**Total Discharge (cfs)**
325	0	---	0
326	39	---	39
327	54	---	54
328	67	---	67
329	77	---	77
330	86	---	86
331	94	---	94
332	102	---	102
333	109	---	109
334	116	0	116
335	122	285	407
336	128	849	976
337	340	1,637	1,977
338	723	2,640	3,363
339	1,217	3,857	5,074
340	1,801	5,291	7,092

Secondary			
Elevation (ft-msl)	**Principal Spillway (cfs)**	**Emergency Spillway (cfs)**	**Total Discharge (cfs)**
328.3	0	---	0
329	5	---	5
330	17	---	17
331	33	---	33
332	50	0	50
333	58	91	149
334	64	345	409
335	70	777	847
336	75	1,386	1,461
337	80	2,191	2,271
338	85	3,163	3,248
339	90	4,256	4,346
340	94	5,280	5,374

Bottom Ash			
Elevation (ft-msl)	**Principal Spillway (cfs)**	**Emergency Spillway (cfs)**	**Total Discharge (cfs)**
355.0	0	---	0
355.5	50	---	50
356.0	161	---	161
356.5	330	---	330
357.0	561	---	561
357.5	858	---	858
358.0	1,224	0	1,224
358.5	1,664	11	1,676
359.0	2,182	39	2,221
359.5	2,782	85	2,867
360.0	3,466	153	3,619

2.5 FREQUENCY MODEL RESULTS

Three frequency storm events were analyzed for the Welsh Ash Pond system – the 10-year, 25-year, and 100-year storm events. The hydrologic model described in the preceding sections was implemented in analyzing these events. Curve numbers were set to Antecedent Moisture Condition II, and initial abstractions were calculated automatically by HEC-HMS. These assumptions represent normal conditions, as would be expected prior to one of these storm events. The precipitation data was obtained from the National Oceanic and Atmospheric Administration's Technical Memorandum NWS HYDRO-35[4] and Technical Paper 40.[5] These values are presented in Table 5. Each storm event was assumed to have a duration of 24 hours.

Table 5 – Frequency Precipitation Depths

Frequency (yrs)	Precipitation (in)							
	5 min	15 min	60 min	2 hr	3 hr	6 hr	12 hr	24hr
1	0.42	0.89	1.69	1.99	2.20	2.64	3.12	3.58
2	0.51	1.08	1.97	2.45	2.68	3.19	3.78	4.41
5	0.58	1.25	2.54	3.14	3.40	4.15	4.92	5.81
10	0.64	1.38	2.91	3.64	3.95	4.90	5.90	6.82
25	0.72	1.57	3.36	4.22	4.62	5.73	6.76	7.90
50	0.79	1.72	3.75	4.75	5.18	6.41	7.74	8.83
100	0.86	1.88	4.13	5.23	5.78	7.09	8.62	9.85
500	1.12	2.45	5.39	6.83	7.54	9.26	11.26	12.86

These precipitation depths serve as input data into the hydrologic model, and were routed through the model as described previously. According to TCEQ recommendations and standard engineering practice, flood routings were started at the lowest spillway crest elevation for each dam. This corresponds to elevation 325.0 ft-msl, 328.3 ft-msl, and 355.0 ft-msl for the Primary, Secondary, and Bottom Ash Ponds, respectively. The results of the 10-year, 25-year, and 100-year storm events are shown in Tables 6, 7, and 8, respectively.

Table 6 – 10-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	328.50	874.71	71.92
Secondary	332.37	112.41	72.35
Bottom Ash	355.53	157.81	55.99

Table 7 – 25-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	329.35	1079.37	80.24
Secondary	332.51	137.68	81.67
Bottom Ash	355.62	187.44	76.21

Table 8 – 100-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	330.80	1415.75	92.68
Secondary	332.62	177.95	95.96
Bottom Ash	355.76	234.22	108.10

2.6 PMF MODEL RESULTS

The Probable Maximum Flood (PMF) is defined as the greatest flood to be expected, and the Probable Maximum Precipitation (PMP) is theoretically the greatest depth of rainfall for a given duration that is physically possible over a given size storm area at a particular geographic location. Generally, the rainfall depth is calculated for the ten square miles of the watershed which receive the highest intensity rainfall.

Hydrometeorological Report No. 52 (HMR-52),[6] developed by the U.S. Army Corps of Engineers, was used to determine the rainfall for each basin. PMP estimates were taken from Hydrometeorological Report No. 51[7] and distributed according to HMR-52 to obtain average rainfall depths over the various drainage areas.

HMR-52 calculates rainfall depths for storm durations ranging from five minutes to seventy-two hours. Table 9 lists the point rainfall depths calculated by HMR-52 for storm durations from one hour to 72 hours. Because the total drainage area is less than ten square miles, these point rainfall depths were applied to each of the 7 basins. Additionally, the total rainfall depth was distributed according to the temporal distribution described by the TCEQ guidelines.

Table 9 – HMR-52 Point Rainfall Depths

Storm Duration (hr)	Depth (in)
1	16.62
2	20.86
3	24.18
6	30.47
12	36.82
24	42.10
48	46.98
72	49.74

Each PMF duration was modeled as described previously, with flood routing started at the lowest spillway crest elevation. The 12-hour event was critical for both the Primary and Secondary Ash Ponds, and the 1-hour event was critical for the Bottom Ash Pond. Additionally, the 25% and 50% PMF were calculated for the critical duration. Tables 10, 11, and 12 contain the results of these PMF model runs – the 25% PMF, 50% PMF, and 100% PMF, respectively.

Table 10 – 25% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	331.83	690.29	100.59
Secondary	332.68	110.63	105.57
Bottom Ash	355.70	171.14	94.27

Table 11 – 50% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	335.16	1385.23	122.79
Secondary	334.23	511.60	501.07
Bottom Ash	356.15	342.28	211.11

Table 12 – 100% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	337.46	2770.78	517.89
Secondary	337.39	2664.30	2637.73
Bottom Ash	356.78	684.55	458.48

3.0 SUMMARY AND CONCLUSIONS

Based on the results of the hydraulic analysis, each of the three dams is hydraulically adequate for the full range of storm events from the 10-year to the 100% PMF event. Table 13 lists the pertinent elevation data for each dam, including the top of dam elevation and principal and emergency spillway crest elevations. Comparing these elevations to the maximum water surface elevations shown in Table 14 indicates that, even during the 100% PMF event, each of the three dams would have almost 3 feet of freeboard. Additionally, the emergency spillway for the Primary Ash Pond is not engaged during a storm event less than the 50% PMF, and the emergency spillway for the Bottom Ash Pond is not engaged, even during the 100% PMF event. The emergency spillway for the Secondary Ash Pond is, however, engaged much more frequently, even during a storm event as low as the 10-year storm. This should have no adverse affects on this area though, as it appears to have been designed to withstand frequent engaging.

Table 13 – Pertinent Dam Information

	Top of Dam (ft-msl)	Principal Spillway (ft-msl)	Emergency Spillway (ft-msl)
Primary	340.0	325.0	334.0
Secondary	340.0	328.3	332.0
Bottom Ash	360.0	355.0	358.0

Table 14 – Summary of Results

	10-year	25-year	100-year	25% PMF	50% PMF	100% PMF
Primary	328.50	329.35	330.80	331.83	335.16	337.46
Secondary	332.37	332.51	332.62	332.68	334.23	337.39
Bottom Ash	355.53	355.62	355.76	355.70	356.15	356.78

It should be noted that these results reflect the best understanding of existing conditions and could be significantly affected by major changes to any of the three reservoirs. Specifically, major fluctuations in the available storage in each reservoir, as could be caused by the regular dredging and movement of bottom ash in and out of the pond areas, would greatly impact the results of this analysis. However, in their current conditions, the Primary Ash, Secondary Ash, and Bottom Ash Ponds associated with the Welsh Power Plant are deemed to

be hydraulically adequate for any storm event up to the 100% PMF. Pertinent drawings for existing conditions are included in Appendix C.

Appendix A
References

References

1. U.S. Army Corps of Engineers, Hydrologic Engineering Center: *Hydrologic Modeling System HEC-HMS - User's Manual Version 3.4*, Davis, California, August 2009.

2. "Soil Data Mart." *NRCS Soil Survey Geographic (SSURGO) Database*. <http://soildatamart.nrcs.usda.gov>.

3. "National Land Cover Dataset 2001." *USGS Seamless Data Warehouse*. August 30, 2010. <http://seamless.usgs.gov/nlcd.php>.

4. U.S. Department of Commerce, National Oceanic and Atmospheric Administration: *Technical Memorandum NWS HYDRO-35, Five- to 60-Minute Precipitation Frequency for the Eastern and Central United States*, Silver Spring, MD, June 1977.

5. U.S. Department of Commerce, Weather Bureau: *Technical Paper No. 40, Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years*, Washington, D.C., May 1961.

6. U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Department of the Army, Corps of Engineers: *Hydrometeorological Report No. 52, Application of Probable Maximum Precipitation Estimates, United States East of the 105th Meridian*, Washington, D.C., 1982.

7. U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Department of the Army, Corps of Engineers: *Hydrometeorological Report No. 51, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian*, Washington, D.C., 1978.

Appendix B
Calculations

Discharge Rating Curve
Primary Ash Pond

Elevation [ft-msl]	Orifice [cfs]	Sheet Pile [cfs]	Main [cfs]	Emerg [cfs]	Total [cfs]
325.00	0.00	0.00	0.00	0.00	0.00
326.00	38.52	0.00	38.52	0.00	38.52
327.00	54.48	0.00	54.48	0.00	54.48
328.00	66.72	0.00	66.72	0.00	66.72
329.00	77.04	0.00	77.04	0.00	77.04
330.00	86.13	0.00	86.13	0.00	86.13
331.00	94.35	0.00	94.35	0.00	94.35
332.00	101.91	0.00	101.91	0.00	101.91
333.00	108.95	0.00	108.95	0.00	108.95
334.00	115.56	0.00	115.56	0.00	115.56
335.00	121.81	0.00	121.81	285.00	406.81
336.00	127.76	0.00	127.76	848.53	976.28
337.00	133.44	206.46	339.90	1636.79	1976.68
338.00	138.89	583.96	722.84	2640.00	3362.84
339.00	144.13	1072.80	1216.93	3857.22	5074.14
340.00	149.19	1651.68	1800.87	5290.90	7091.76

Main Spillway

Sill Crest	325	ft-msl
Height	2	ft
Sill Width	4	ft
Orifice C	0.6	

$$Q = C*A*\sqrt{(2*g*H)}$$

Sheet Pile	336	ft-msl
Top Width	62	ft
Weir C	3.33	

$$Q = C*L*H^{3/2}$$

Emergency Spillway

Crest	334	ft-msl
Length	90	ft
SS	2.5	:1
Weir C	3	

$$Q = C*(L+2*SS*H)*H^{3/2}$$

Discharge Rating Curve
Secondary Ash Pond

Elevation [ft-msl]	Weir [cfs]	Conduit [cfs]	Main [cfs]	Emerg [cfs]	Total [cfs]
328.30	0.00	12.77	0.00		0.00
328.50	0.75	15.39	0.75		0.75
329.00	4.85	22.36	4.85		4.85
329.50	10.62	29.44	10.62		10.62
330.00	17.43	35.94	17.43		17.43
330.50	24.97	40.33	24.97		24.97
331.00	33.01	44.34	33.01		33.01
331.50	41.36	48.10	41.36		41.36
332.00	49.90	51.65	49.90	0.00	49.90
332.50	58.50	55.03	55.03	25.00	80.03
333.00	67.07	58.27	58.27	90.91	149.18
333.50	75.51	61.37	61.37	193.62	254.99
334.00	83.73	64.36	64.36	344.83	409.19
334.50	91.67	67.24	67.24	537.74	604.98
335.00	99.25	70.03	70.03	777.17	847.20
335.50	106.41	72.72	72.72	1056.25	1128.97
336.00	113.09	75.34	75.34	1385.71	1461.05
336.50	119.24	77.87	77.87	1769.84	1847.71
337.00	124.79	80.34	80.34	2190.91	2271.25
337.50	129.70	82.74	82.74	2656.86	2739.60
338.00	133.91	85.08	85.08	3163.04	3248.12
338.50	137.39	87.36	87.36	3697.92	3785.28
339.00	140.09	89.59	89.59	4256.10	4345.69
339.50	141.96	91.76	91.76	4767.86	4859.62
340.00	142.96	93.89	93.89	5279.62	5373.51

Main Spillway

Weir Box

Crest	328.30	ft-msl
Length	4	ft
Weir C	2.152	

$Q = C*(L-0.2H)*H^{1/2}$

Weir Equation from AEP

Conduit

Diameter	36	in
Length	350	ft
U/S Invert	326.5	ft-msl
D/S Invert	326	ft-msl

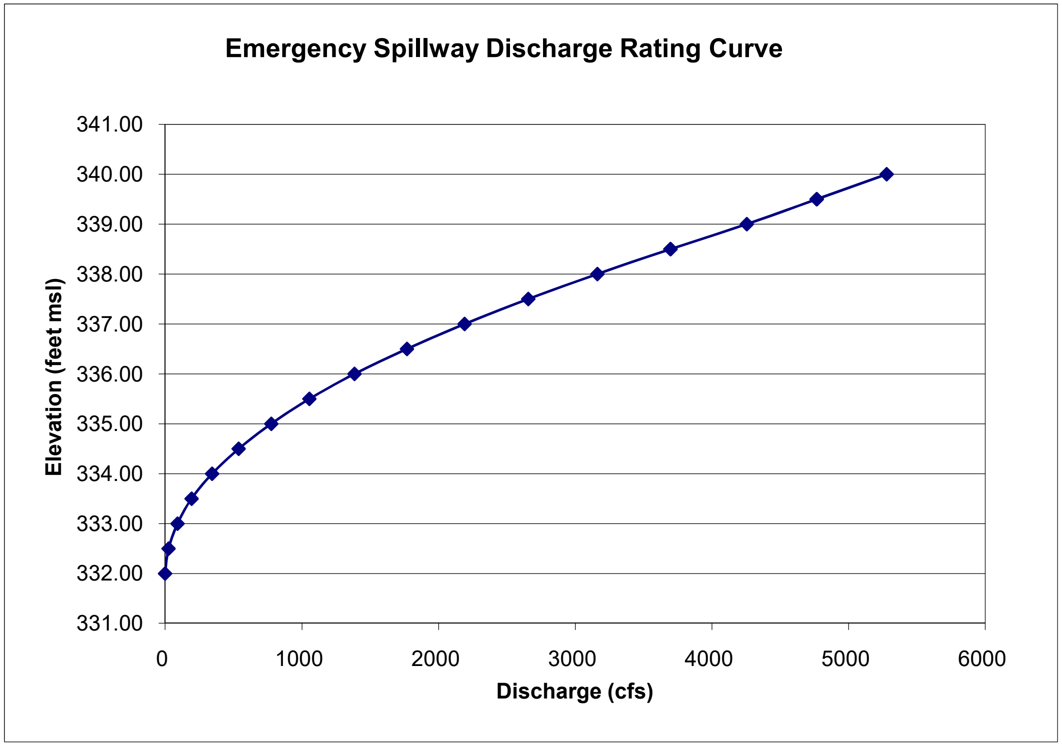
Calculated in FlowMaster

Emergency Spillway

Calculated in HEC-RAS; refer to following sheets for details.

Invert	332	Feet msl
Increment	0.5	Feet

Lake Level (feet msl)	**Discharge (cfs)**
332.00	0
332.50	25
333.00	91
333.50	194
334.00	345
334.50	538
335.00	777
335.50	1,056
336.00	1,386
336.50	1,770
337.00	2,191
337.50	2,657
338.00	3,163
338.50	3,698
339.00	4,256
339.50	4,768
340.00	5,280



HEC-RAS Results for most upstream cross section

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
SecondaryPon	EmergSpwy	871	PF 1	1	330	332.07		332.07	0	0	380.1	195.63	0
SecondaryPon	EmergSpwy	871	PF 2	10	330	332.29		332.29	0	0.02	423.67	197.71	0
SecondaryPon	EmergSpwy	871	PF 3	25	330	332.5		332.5	0.000002	0.06	465.34	200.66	0.01
SecondaryPon	EmergSpwy	871	PF 4	50	330	332.73		332.73	0.000005	0.1	511.65	204.53	0.01
SecondaryPon	EmergSpwy	871	PF 5	100	330	333.06		333.06	0.000012	0.18	579.79	208.93	0.02
SecondaryPon	EmergSpwy	871	PF 6	200	330	333.52		333.53	0.000031	0.32	677.95	215.13	0.03
SecondaryPon	EmergSpwy	871	PF 7	300	330	333.87		333.87	0.000051	0.43	752.96	221.16	0.04
SecondaryPon	EmergSpwy	871	PF 8	400	330	334.16		334.16	0.000071	0.54	818.24	228.29	0.05
SecondaryPon	EmergSpwy	871	PF 9	500	330	334.41		334.42	0.000091	0.64	876.57	234.47	0.05
SecondaryPon	EmergSpwy	871	PF 10	750	330	334.94		334.95	0.00014	0.85	1005.18	248.81	0.07
SecondaryPon	EmergSpwy	871	PF 11	1000	330	335.4		335.41	0.000184	1.03	1120.39	261.11	0.08
SecondaryPon	EmergSpwy	871	PF 12	1250	330	335.79		335.81	0.000224	1.19	1225.76	271.83	0.09
SecondaryPon	EmergSpwy	871	PF 13	1500	330	336.14		336.16	0.000261	1.34	1322.88	281.28	0.1
SecondaryPon	EmergSpwy	871	PF 14	2000	330	336.77		336.79	0.000326	1.6	1503.25	297.77	0.11
SecondaryPon	EmergSpwy	871	PF 15	2500	330	337.31		337.34	0.000381	1.82	1668.85	312.15	0.12
SecondaryPon	EmergSpwy	871	PF 16	3000	330	337.81		337.85	0.000427	2.01	1827.39	325.32	0.13
SecondaryPon	EmergSpwy	871	PF 17	3500	330	338.26		338.31	0.000468	2.19	1978.88	337.7	0.13
SecondaryPon	EmergSpwy	871	PF 18	4000	330	338.73		338.79	0.000495	2.34	2139.91	350.57	0.14
SecondaryPon	EmergSpwy	871	PF 19	4500	330	339.13		339.2	0.000525	2.48	2282.96	361.62	0.14
SecondaryPon	EmergSpwy	871	PF 20	5000	330	339.69		339.76	0.000513	2.55	2489.43	376.54	0.14

Discharge Rating Curve
Bottom Ash Pond

Elevation [ft-msl]	Main [cfs]	Emerg [cfs]	Total [cfs]
355.00	0.00	0.00	0.00
355.50	50.42	0.00	50.42
356.00	161.20	0.00	161.20
356.50	330.31	0.00	330.31
357.00	561.16	0.00	561.16
358.00	1224.21	0.00	1224.21
359.00	2182.40	39.00	2221.40
360.00	3465.91	152.74	3618.64
361.00	5102.78	358.53	5461.31
362.00	7119.19	672.00	7791.19
363.00	9539.72	1106.85	10646.57

Main Spillway		
Crest	355	ft-msl
Length	40	ft
SS	6	:1
Weir C	3.1	

$Q = C*(L+2*SS*H)*H^{3/2}$

Emergency Spillway		
Crest	358	ft-msl
Length	8	ft
SS	2.5	:1
Weir C	3	

$Q = C*(L+2*SS*H)*H^{3/2}$

Name	GRIDCODE	HSG	Area_ft^2	Area_acre	CN	Inc. CN
Ash Storage	31	C	1324276.445	30.401	91	70.06793
Ash Storage	42	C	53818.662	1.236	73	2.28431
Ash Storage	81	C	341795.137	7.847	74	14.70608
Bottom Ash	31	C	948778.856	21.781	91	91
Power Plant	41	B	1095.992	0.025	60	0.013099
Power Plant	42	B	101918.155	2.340	60	1.218085
Power Plant	81	B	99556.094	2.285	61	1.209685
Power Plant	22	C	15964.935	0.367	79	0.251229
Power Plant	23	C	70296.650	1.614	90	1.260236
Power Plant	24	C	2954103.082	67.817	94	55.31313
Power Plant	41	C	90963.024	2.088	73	1.322703
Power Plant	42	C	239129.961	5.490	73	3.477215
Power Plant	52	C	407500.071	9.355	70	5.68199
Power Plant	81	C	944143.815	21.675	74	13.91697
Power Plant	82	C	95577.482	2.194	85	1.618263
Primary	11	W	458394.580	10.523	100	4.490426
Primary	31	W	14036.955	0.322	100	0.137506
Primary	42	W	104596.947	2.401	100	1.02463
Primary	52	W	11325.853	0.260	100	0.110948
Primary	81	W	69931.187	1.605	100	0.685045
Primary	22	B	242034.352	5.556	68	1.612256
Primary	41	B	564582.710	12.961	60	3.318386
Primary	42	B	631114.853	14.488	60	3.709435
Primary	52	B	220919.125	5.072	56	1.211907
Primary	81	B	286358.868	6.574	61	1.711152
Primary	11	C	480754.464	11.037	100	4.709463
Primary	22	C	209907.569	4.819	79	1.624438
Primary	23	C	10746.609	0.247	90	0.094746
Primary	24	C	67309.636	1.545	94	0.619802
Primary	31	C	150242.962	3.449	91	1.339318
Primary	41	C	540228.652	12.402	73	3.863212
Primary	42	C	316050.970	7.256	73	2.260102
Primary	43	C	93028.069	2.136	73	0.66525
Primary	52	C	572546.147	13.144	70	3.926057
Primary	81	C	1192671.364	27.380	74	8.645709
Primary	82	C	10291.113	0.236	85	0.08569
Primary	90	C	82404.904	1.892	77	0.621573
Primary	41	C/D	916028.058	21.029	76	6.819781
Primary	42	C/D	135572.435	3.112	76	1.00933
Primary	52	C/D	331086.513	7.601	74	2.383839
Primary	90	C/D	101862.212	2.338	80	0.798273
Primary	22	D	301628.331	6.924	84	2.481987
Primary	31	D	13591.654	0.312	94	0.125155
Primary	41	D	558509.208	12.822	79	4.322207
Primary	42	D	58185.234	1.336	79	0.450286
Primary	43	D	21907.998	0.503	79	0.169542
Primary	52	D	973523.140	22.349	77	7.343195
Primary	81	D	435789.772	10.004	80	3.415192
Primary	90	D	31102.113	0.714	83	0.252881
Secondary	11	W	61159.403	1.404	100	8.574385
Secondary	22	W	0.178	0.000	100	2.49E-05
Secondary	24	W	284.987	0.007	100	0.039954
Secondary	52	W	3328.994	0.076	100	0.466716
Secondary	81	W	66883.300	1.535	100	9.37686
Secondary	11	C	100304.658	2.303	100	14.06244
Secondary	22	C	7813.937	0.179	79	0.865439
Secondary	23	C	5348.021	0.123	90	0.6748
Secondary	24	C	9873.918	0.227	94	1.301239
Secondary	31	C	300.129	0.007	91	0.03829
Secondary	42	C	37168.223	0.853	73	3.803946
Secondary	52	C	28941.171	0.664	70	2.840232
Secondary	81	C	391873.463	8.996	74	40.65531
to Bottom Ash	22	C	173034.687	3.972	79	17.29527

Basin	Area_acre
Ash Storage	39.48
Bottom Ash	21.78
Power Plant	115.25
Primary	234.35
Secondary	16.37
to Bottom Ash	18.14

Name	GRIDCODE	HSG	Area_ft^2	Area_acre	CN	Inc. CN
to Bottom Ash	23	C	2352.284	0.054	90	0.267855
to Bottom Ash	24	C	44395.328	1.019	94	5.279978
to Bottom Ash	31	C	108930.225	2.501	91	12.54171
to Bottom Ash	41	C	104222.261	2.393	73	9.626099
to Bottom Ash	42	C	197025.981	4.523	73	18.19757
to Bottom Ash	52	C	82351.521	1.891	70	7.293511
to Bottom Ash	81	C	78062.412	1.792	74	7.308709

Basin	Area_acre

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Ash Storage A	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.010	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	919.70	**FT**
SLOPE	0.021	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	2.319	

$$T_2 = \frac{L}{60 \times V}$$

PIPE FLOW - SOLVE FOR FULL FLOW VELOCITY

DIAMETER =	36	**IN.**
XSECT AREA =	7.07	**SQ FT**
WETTED PERIMETER	9.42	**FT**
SLOPE	0.002	**FT/FT**
MANNINGS N	0.024	
COMPUTED VELOCITY	2.39	**FT/S**
LENGTH	60	**FT**

$$V = \frac{1.49 \times \left(\frac{a}{P_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_4 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**Ash Storage A**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	1.77	1.77
SHALLOW CONCENTRATED FLOW			6.61	6.61
SHALLOW CONCENTRATED FLOW			0.00	0.00
SHALLOW CHANNEL FLOW				0.00
PIPE FLOW			0.42	0.42
CHANNEL FLOW				0.00
TOTAL			8.79	8.79
			Lag (Hrs) =	**0.09**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) = 5.28

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Ash Storage B	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.025	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	796.31	**FT**
SLOPE	0.020	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	2.287	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	50
XSECT AREA=	112.000	**SQ FT**	**BOTTOM**	6
			DEPTH	4
WETTED PERIMETER	50.721	**FT**		
SLOPE	0.008	**FT/FT**		
MANNINGS N	0.08			
COMPUTED VELOCITY	2.768	**FT/S**		
LENGTH	911.59	**FT**		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted Tc (Min)	NRCS Method Tc (Min)	Selected Tc (Min)
WATERSHED NUMBER	**Ash Storage B**			
SHEET FLOW	**Max 30 Min**	30.0	1.22	1.22
SHALLOW CONCENTRATED FLOW			5.80	5.80
CHANNEL FLOW			5.49	5.49
TOTAL			12.52	12.52
			Lag (Hrs) =	**0.13**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) = **7.51**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Bottom Ash	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.020	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	627.21	**FT**
SLOPE	0.010	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	1.578	

$$T_2 = \frac{L}{60 \times V}$$

984.648438

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**Bottom Ash**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	1.34	1.34
SHALLOW CONCENTRATED FLOW			6.62	6.62
TOTAL			7.96	7.96
			Lag (Hrs) =	**0.08**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) = 4.78

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Power Plant	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.020	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	558.86	**FT**
SLOPE	0.036	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	3.052	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	7
XSECT AREA=	8.000	**SQ FT**	**BOTTOM**	1
			DEPTH	2
WETTED PERIMETER	8.211	**FT**		
SLOPE	0.016	**FT/FT**		
MANNINGS N	0.05			
COMPUTED VELOCITY	3.720	**FT/S**		
LENGTH	2169.79	**FT**		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	**Adjusted**	**NRCS Method**	**Selected**
WATERSHED NUMBER	**Power Plant**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	18.50	18.50
SHALLOW CONCENTRATED FLOW			3.05	3.05
CHANNEL FLOW			9.72	9.72
TOTAL			31.28	31.28
			Lag (Hrs) =	**0.31**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**18.77**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Primary	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.020	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	2757.28	**FT**
SLOPE	0.009	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	1.536	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	10
XSECT AREA=	18.000	**SQ FT**	**BOTTOM**	2
			DEPTH	3
WETTED PERIMETER	12.000	**FT**		
SLOPE	0.010	**FT/FT**		
MANNINGS N	0.07			
COMPUTED VELOCITY	2.800	**FT/S**		
LENGTH	1984.65	**FT**		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**Primary**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	18.50	18.50
SHALLOW CONCENTRATED FLOW			29.91	29.91
CHANNEL FLOW			11.81	11.81
TOTAL			60.23	60.23
			Lag (Hrs) =	**0.60**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**36.14**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Secondary	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.150	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	599.56	**FT**
SLOPE	0.036	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	3.070	

$$T_2 = \frac{L}{60 \times V}$$

	Conditions	Adjusted Tc (Min)	NRCS Method Tc (Min)	Selected Tc (Min)
WATERSHED NUMBER	**Secondary**			
SHEET FLOW	**Max 30 Min**	30.0	0.60	0.60
SHALLOW CONCENTRATED FLOW			3.26	3.26
TOTAL			3.85	3.85
			Lag (Hrs) =	**0.04**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) = **2.31**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	to Bottom Ash	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.050	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	763.95	**FT**
SLOPE	0.004	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	1.011	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	16
XSECT AREA=	20.000	**SQ FT**	**BOTTOM**	4
			DEPTH	2
WETTED PERIMETER	16.649	**FT**		
SLOPE	0.008	**FT/FT**		
MANNINGS N	0.05			
COMPUTED VELOCITY	3.001	**FT/S**		
LENGTH	377.81	**FT**		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

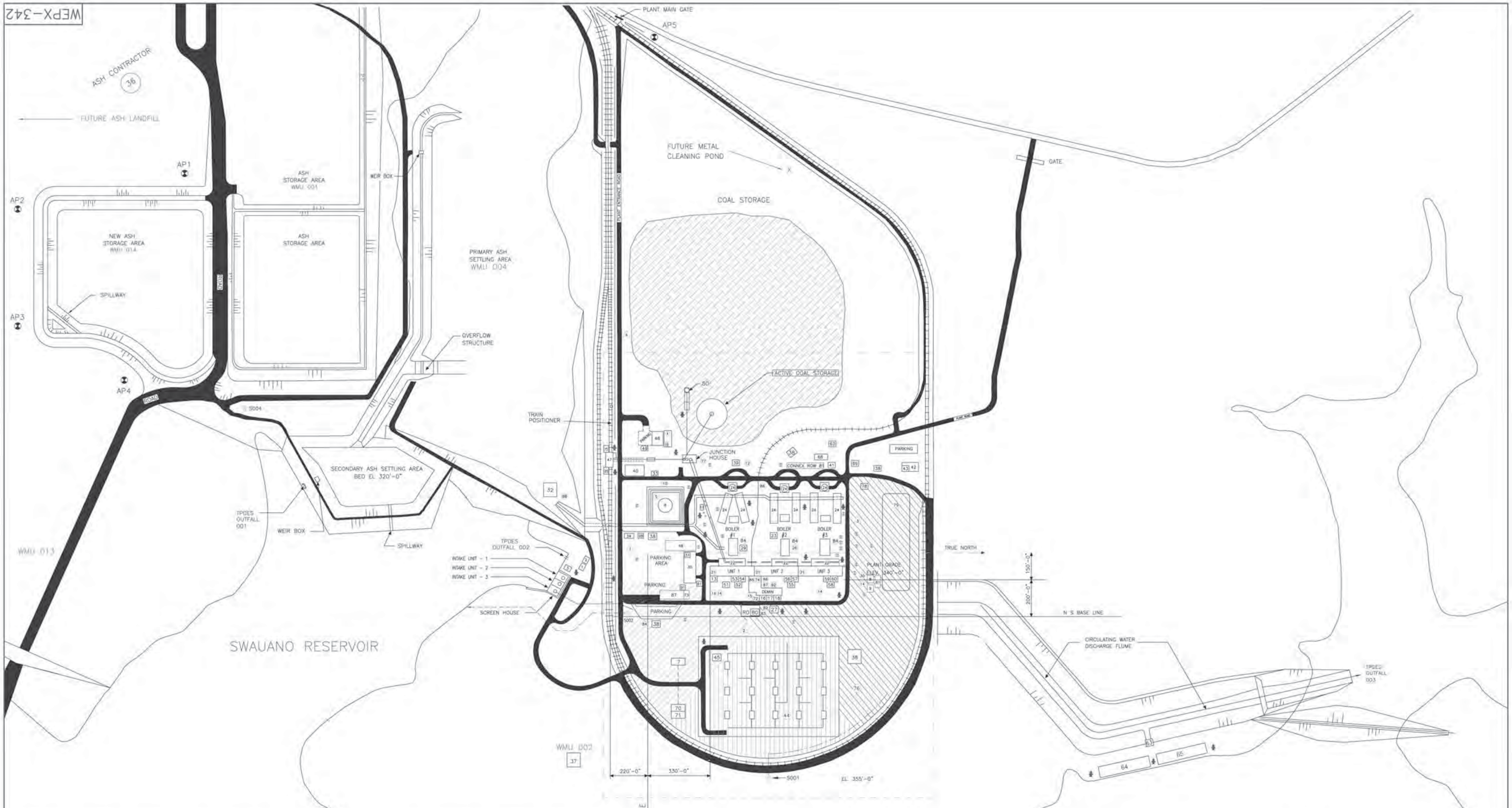
$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**to Bottom Ash**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	12.83	12.83
SHALLOW CONCENTRATED FLOW			12.59	12.59
CHANNEL FLOW			2.10	2.10
TOTAL			27.52	27.52
			Lag (Hrs) =	**0.28**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) = 16.51

Appendix C
Pertinent Drawings



ID	Description	Location	Size (Gallons)	SECONDARY CONTAINMENT (GALLONS)
1	Sewage Plant	Intake	N/A	N/A
2	Chlorine Building	W. of Intake	8 - 1 ton cylinders	N/A
3	Emergency Fire Pump	Plant Intake	500	500
4	Tractor Shop Diesel Tanks	NW corner tractor shop	1,500 1,000	4,275
5	Used Oil Tank	Inside containment area of fuel oil tank	5,000	1,106,400*
6	#2 Fuel Oil Storage Tank	S of Unit #1 Precipitator	672,000	1,106,400*
7	Spare Transfer Runoff Containment	W. of Spare Transformer	NA	NA
8	Oil House	N. E. of Unit #2	Varies	Inside Bldg.
9				
10	Fuel Oil Unloading Area	W of Fuel Oil Tank	NA	8,000
11	Ignitor Fuel Oil Pump Station	N. of Fuel Oil Tank	NA	2,800
12	Building Material storage	Various	Varies	NA
13	Diesel & Cmp. Oil Tanks	E. of Unit #1	3 @ 11,500 1 @ 2,000	7,300
14	Demineralized Water Storage Tanks	NE Turbine Bldg. E. of Unit #1 and #3	Varies	NA
15	Filtered Water Tank	E. of Unit #1	70,000	NA
16	Caustic - Sodium Hydroxide	E. of Unit #2	15,000	3,100**
17	Sulfuric Acid	E. of Unit #2	15,000	3,000**
18	Caustic - Sodium Hydroxide	E. of Unit #3	5,000	1,570**
19	Tractor Lube Oil	In tractor lube containment North of tractor shop	5,300	4,275
20				
21	Turbine Oil Tanks	Inside Unit 1, 2 & 3 Turbine Buildings	Unit 1 - 7,000 Unit 2 - 7,000 Unit 3 - 7,000	Unit 1 - 1,750 Unit 2 - 1,750 Unit 3 - 1,750
22	Mill Lube Oil Pulverizer Bays	Pulverizer Bay each Unit	3 - 350	NA
23	Sodium Hypochlorite	Various Demin/RO	Totes 330 gal	NA
24	Precipitators & Fly Ash Silos	W. of Boilers #1, #2 & #3	Steel 10,000 tons each	NA
25	Car Dumper Hydraulic System	E. side of Dumper House	210	530

* The fuel oil and used oil tanks are located in a common diked area.

** Acid & Caustic tanks have small separate containments that join on large containment (12,000 gal)

ID	Description	Location	Size (Gallons)	SECONDARY CONTAINMENT (GALLONS)
26	CO2 Tank	Unit #2 Boiler Elevator	14 Tons	NA
27	Chlorine-Raw Water (Domestic)	S. of Unit #2	5 - 1 ton cylinders	NA
28	CO2 Tank	W side of Main Parking Area	13 Tons	NA
29	CO2 Tank	Unit #1 Boiler Elevator	1 - 6 ton 1 - 4 ton	NA
30	Hydrogen Cylinders (H2)	NE Unit #3	16 - 197,838 ft3 4 - 3,497 ft3	NA
31	Maintenance Shop	1st Floor Service Bldg	NA	NA
32	Ash Recovery System	NE corner of Primary Ash Pond	NA	NA
33	Unleaded Gasoline	N of #2 Warehouse	1,000	1,143
34	WMU Ecology Pit - 017	SW Corner of Main Parking Area	5,700 ft3	NA
35	Service Building	N of Main Parking Area	NA	NA
36	Ash Contractor			
37	WMU Landfill - 002	S of Service Building	NA	NA
38	Material Storage Area	Various	NA	NA
39	Wash Rack for Ash Trucks	W of Unit #1 Ash Silo	NA	NA
40	#2 Warehouse (WMU 003)	E. of Tractor Shop	NA	NA
41	#3 Warehouse	W. of Unit #3	NA	NA
42	WMU Quonset Hut - 009	NW of Unit #3	NA	NA
43	Hazardous Storage Area in Quonset Hut	Quonset Hut	Variable	NA
44	Switchyard 345 kV	S. of Unit #1	NA	NA
45	Switchyard Control House	S side Switchyard	NA	NA
46	Maintenance Building	W of Service Building	NA	NA
47	Car Dumper	S of Tractor Shop	NA	NA
48	Tractor Maintenance Building	NE of Coal Pile	NA	NA
49	Coal Yard Lube Oil Drum Storage	SE of Tractor Maint Bldg	approx. 10 (55 gal drums)	Inside Bldg.
50	Reclaim Hopper	NW of Tractor Maint Bldg	NA	NA
51	Reserve Auxiliary Transformer	East of Unit #1	7,000	[illegible]
52	Main Power Transformer Unit #1	East of Unit #1	11,100	[illegible]
53	Auxiliary A Transformer Unit #1	East of Unit #1	3,500	[illegible]
54	Auxiliary B Transformer Unit #1	East of Unit #1	3,500	[illegible]
55	Main Power Transformer Unit #2	East of Unit #2	16,200	[illegible]
56	Auxiliary A Transformer Unit #2	East of Unit #2	5,772	[illegible]

ID	Description	Location	Size (Gallons)	SECONDARY CONTAINMENT (GALLONS)
57	Auxiliary B Transformer Unit #2	East of Unit #2	5,772	[illegible]
58	Main Power Transformer Unit #3	East of Unit #3	17,700	[illegible]
59	Auxiliary A Transformer Unit #3	East of Unit #3	6,080	[illegible]
60	Auxiliary B Transformer Unit #3	East of Unit #3	6,080	[illegible]
61	Material Storage Warehouse	N. of Oil House		
62	WMU - Acid Pond 020	W of Unit RSO Building	Varies	NA
63	Cooling Tower Pump House	W. of Cooling Towers at discharge canal	NA	NA
64	Cooling Tower A	Discharge Canal	NA	NA
65	Cooling Tower B	Discharge Canal	NA	NA
66	Raw water tank	E of Unit #2	16,000	NA
67	Clearwell Tank	E of Unit #2	70,000	NA
68	Visitor Offices	W. of Unit #3	NA	NA
69	RSO Shop	NA	NA	NA
70	Spare Main Power Transformer	S. of Switchyard	17,038	Containment Runoff Pond
71	Spare Auxiliary Transformer	S. of Switchyard	4,380	Containment Runoff Pond
72	Bleach Tank	E. of Demin	3,000 gal	6,100**
73	Laboratory	N. of Warehouse	NA	NA
74	HTH Powder	Inside Demineralizer	<125 lbs	NA
75	Positioner Truck Lock Hydraulic System	W. of Dumper House	NA	NA
76	WMU #022	N. of Switchyard	NA	NA
77	Dust Suppression	Coal yard	1,000	NA
78	RSO Office	N of #3 Silo	NA	NA
79	Material Storage	N of Turbine Bldg	NA	NA
80	RO Bldg. & Chemical Storage	E. of Unit #2	NA	NA
81	Conex Row	S. of #3 Warehouse		
82	WMU - RO Reject Tank 020	N. of RO Bldg	20,000	NA
83	Sulfuric Acid Tote	E. Wall RO Outside	330 gal	330
84	Drain Reservoir	U #1 U #2 U #3 Mobile	500 gal 500 gal 500 gal 500 gal	DWT DWT DWT DWT
85	Demineralizer	S. of Unit #2	NA	NA
86	RO Reject Box WMU 012			
87	Warehouse			
88	Nalco Polymer			
89	WMU 021			
90	1500 KVA Transformer	NE of Service Building	329	373
91	1500 KVA Transformer	W of Warehouse	330	373
92	HF Tank (WMU 031)	S. of unit #2	21,300	NA

MWO 007 Temporary Storage Frac Tanks
MWO 018 RCRA Exempt
MWO 019 Temporary Tank

STORM WATER OUTFALLS
S001
S002
S004

▬ PLANT ROAD
FIRE HYDRANT
① EVACUATION AREA
② EVACUATION AREA
③ EVACUATION AREA
④ EVACUATION AREA
MONITORING WELLS
ASH POND MONITORING WELLS

SWAUANO RESERVOIR

SWAUANO LAKE RESERVOIR
NORMAL POOL AL. 320'-0
LOW WATER EL. 314'-0
AREA = 1,365 ACRES

200' 0 200' 400'
GRAPHIC SCALE

REV	DESCRIPTION	DATE	DR	BY	APP
8	CONFORMS TO CONSTRUCTION RECORDS	5/2/07	ML		JM
10	FUTURE SITE AREAS	6/2/10	ML		MD
9	CONFORMS TO CONSTRUCTION RECORDS	9/25/08	ML		JM

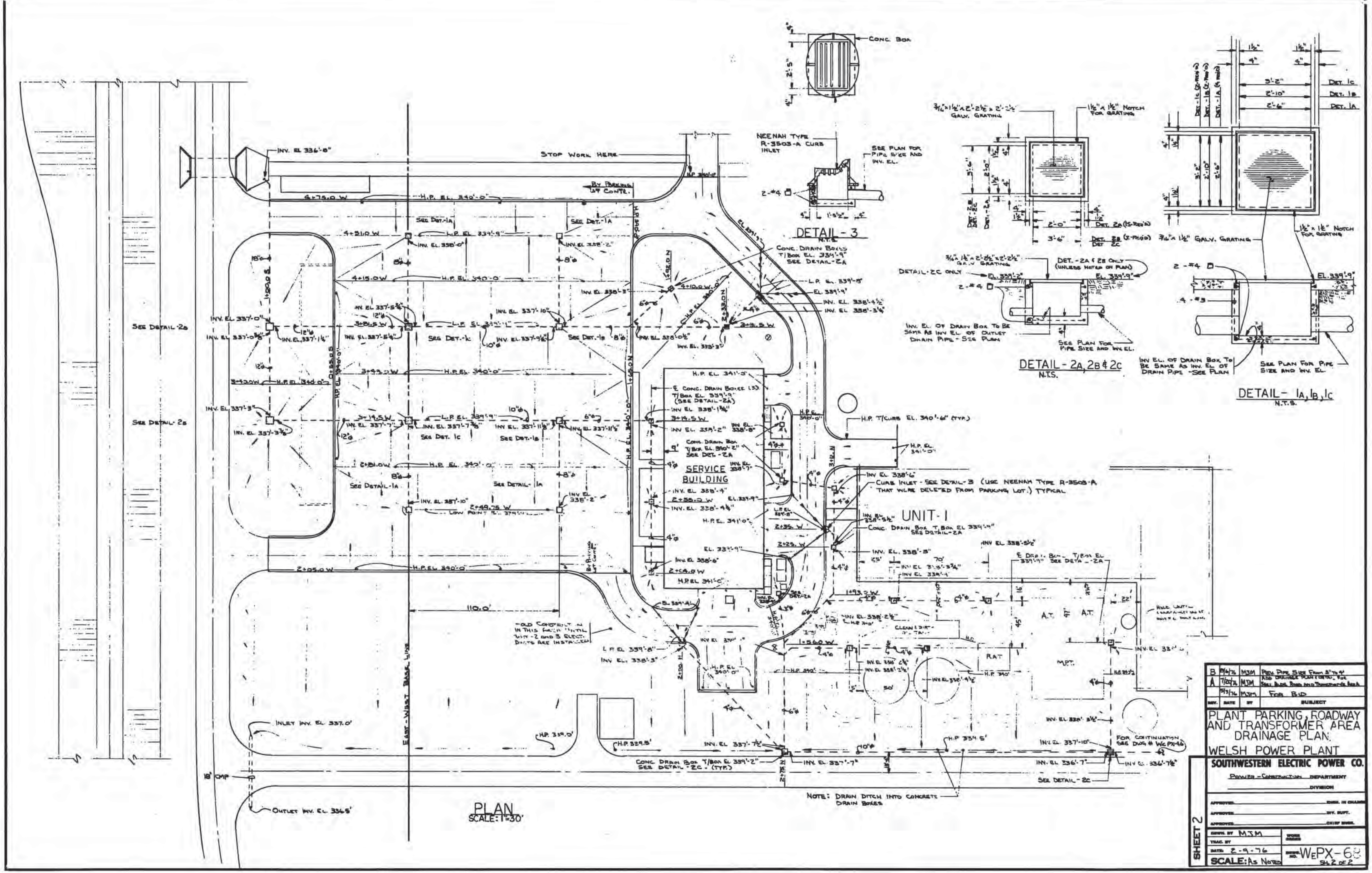
SPCC & STORM WATER SITE PLAN
WELSH POWER PLANT
PITTSBURG, TEXAS

SOUTHWESTERN ELECTRIC POWER

DRAFTING/ENGINEERING	DATE	SCALE: 1" =
DFT. M. LONG	9/19/00	
ENG.		
APP. J. MEYER	9/19/00	

DWG. NO. WEPX-342
REV. No. 10
SHT.

J:\CAD\Region V - SWEPCO\WELSH\Internal Drawings\Common\WEPX Drawings\WEPX-342.dwg 09/25/08 (2)



REV.	DATE	BY	SUBJECT
B	8/6/76	MJM	REV. PIPE SIZE FROM 5" TO 4"
A	7/20/76	MJM	ADD DRAINAGE PLAN & DETAIL FOR SERV. BLDG. ROAD AND TRANSFORMER AREA
	5/3/76	MJM	FOR BID

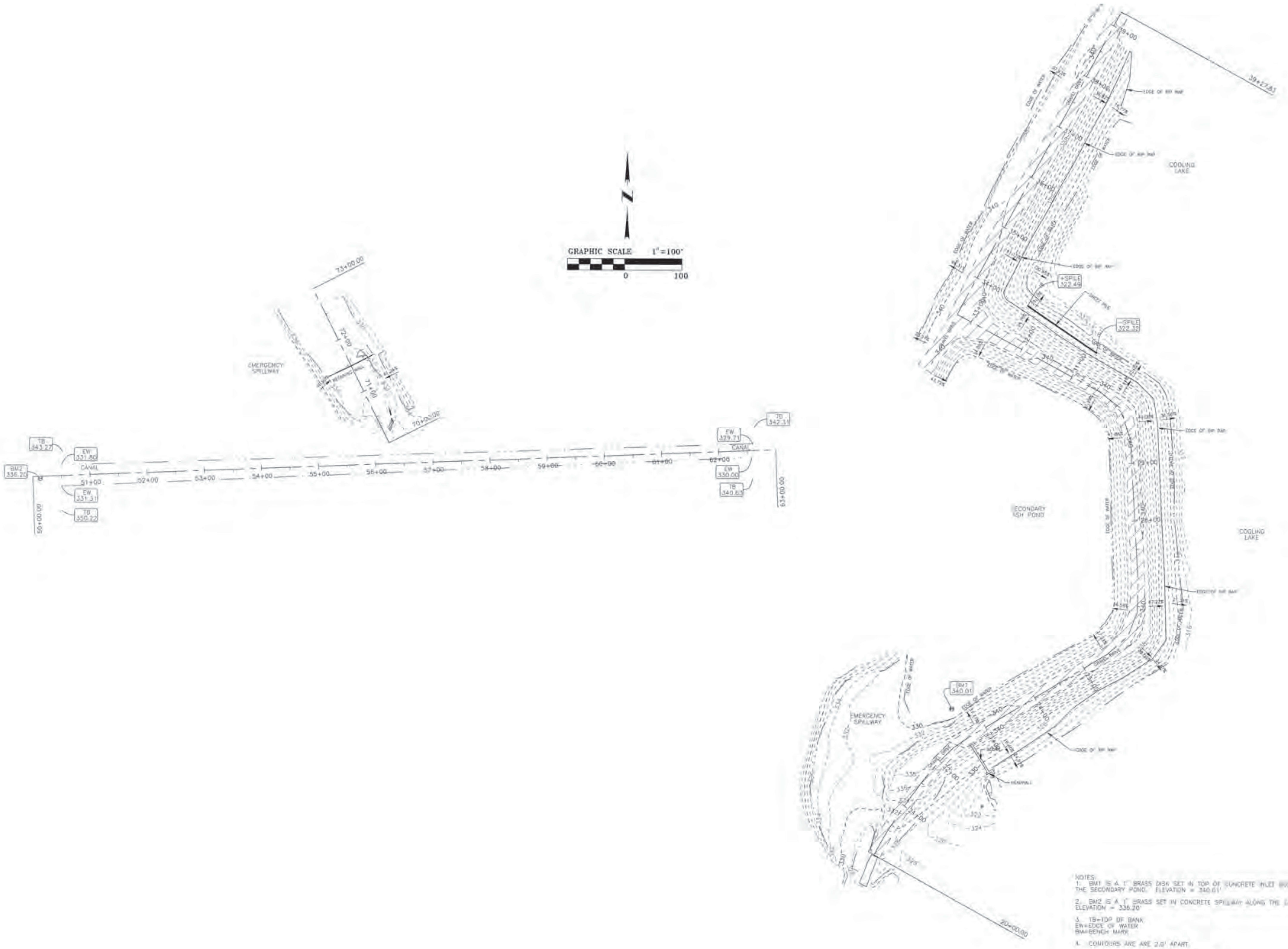
PLANT PARKING, ROADWAY AND TRANSFORMER AREA DRAINAGE PLAN
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.
POWER - CONSTRUCTION DEPARTMENT
DIVISION

APPROVED ______ ENGR. IN CHARGE
APPROVED ______ DIV. SUPT.
APPROVED ______ CHIEF ENGR.

DRWN. BY MJM
TRAC. BY
DATE 2-9-76
SCALE: AS NOTED
WORK ORDER
DRWG. NO. WePX-68 SH. 2 OF 2
SHEET 2

FILE



NOTES:
1. BM1 IS A 1" BRASS DISK SET IN TOP OF CONCRETE INLET BOX FOR THE SECONDARY POND. ELEVATION = 340.01'

2. BM2 IS A 1" BRASS SET IN CONCRETE SPILLWAY ALONG THE CANAL. ELEVATION = 336.20'

3. TB=TOP OF BANK
EW=EDGE OF WATER
BM=BENCH MARK

4. CONTOURS ARE ARE 2.0' APART.

5. LAKE ELEVATION PER WELSH POWER PLANT ON NOVEMBER 18, 2010 WAS 317.57 FEET MSL.

SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON NOVEMBER 18, 2010, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: NOVEMBER 23, 2010
REVISED: DECEMBER 6, 2010

MIKE CARDNER
#5760

TOPOGRAPHIC SURVEY

DIKE'S AT WELSH POWER PLANT
FOR: GREG CARTER

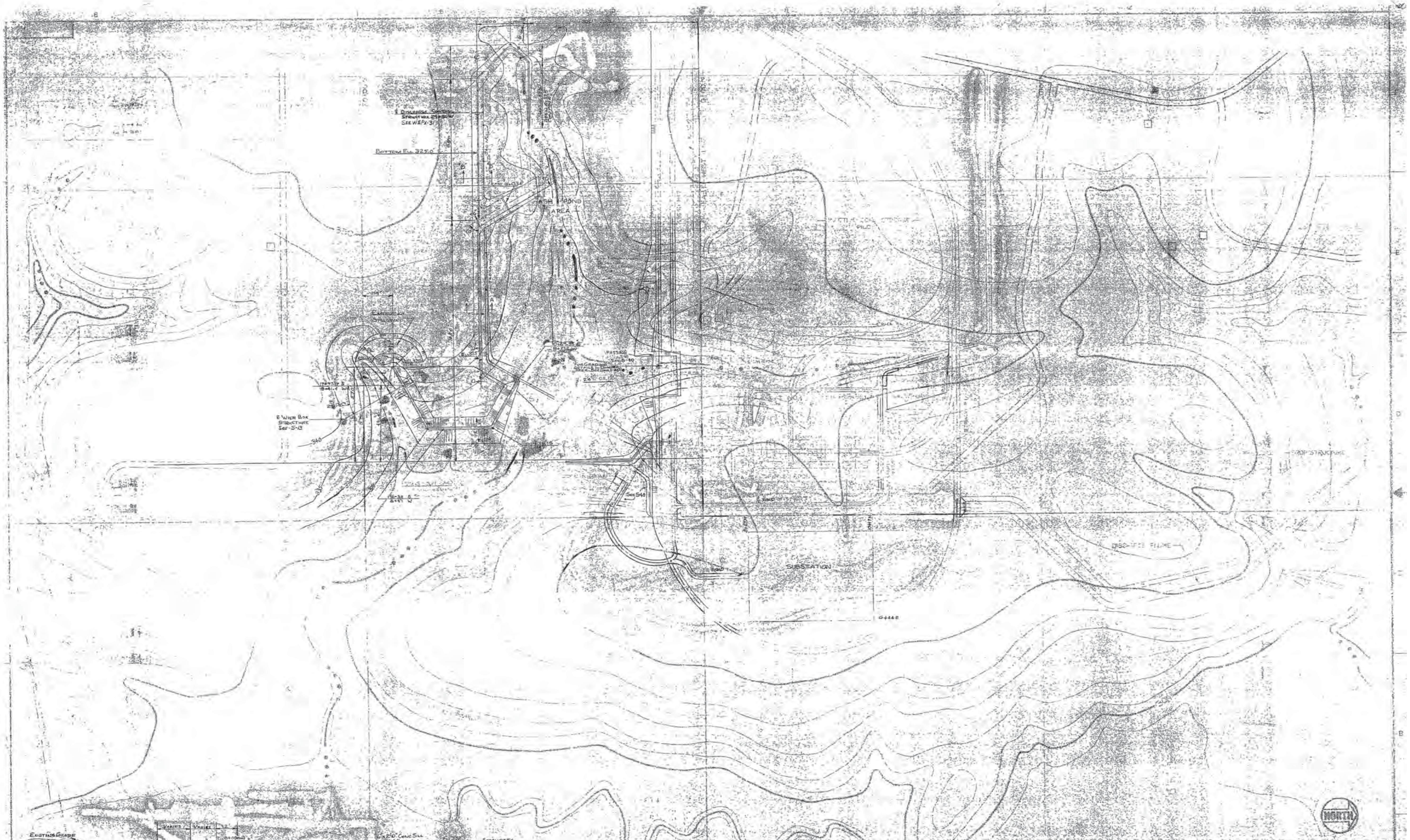
Date	Revision/Description
12/8/10	ADDED LAKE LEVEL NOTE
12/6/10	ADDED CROSS SECTION SHEETS

Drawn By	Checked By	Project No.	Dwg. Date
MG	DW	104021	11/18/10

MTG engineers & surveyors
5930 SUMMERHILL RD. P.O. BOX 3788
TEXARKANA TEXAS 75501
P 903.838.8533 | F 903.832.4700
www.mtgengineers.com

TBPE NO. 354

File No.	Sheet No.
	1



NOTES
1. For general notes see dwg. S-1

REFERENCE DRAWINGS
Site Development Plan
Ash Pond Dike Cross Sections — Sheet 1
Ash Pond Dike Cross Sections — Sheet 2
Secondary Settling Area Spillway
Section & Details Discharge Flume
Secondary Settling Area Weir Box Structure

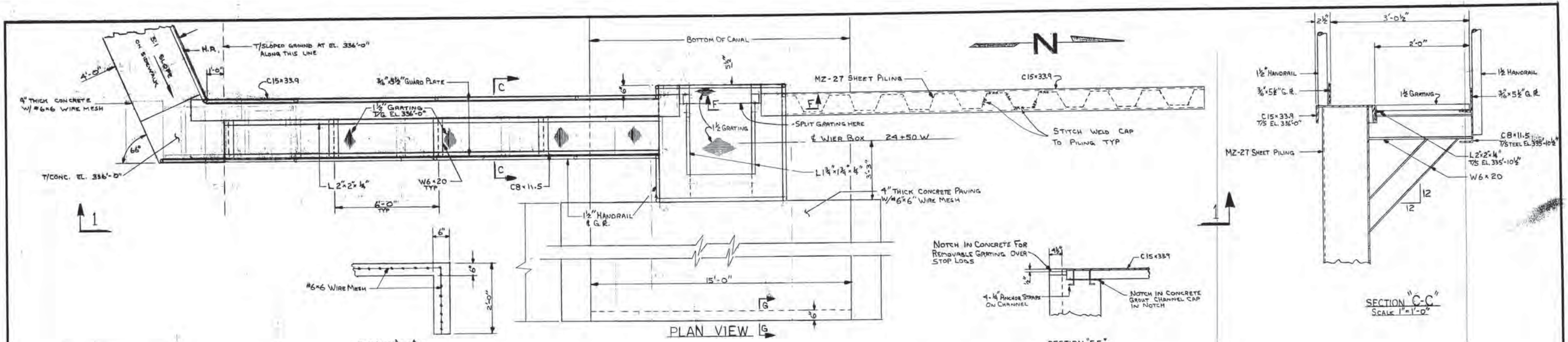
ASH POND & SECONDARY SETTLING AREA

WELSH POWER PLANT
SOUTHWESTERN ELECTRIC POWER CO.
CASON, TEXAS

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO.
S-12

#4

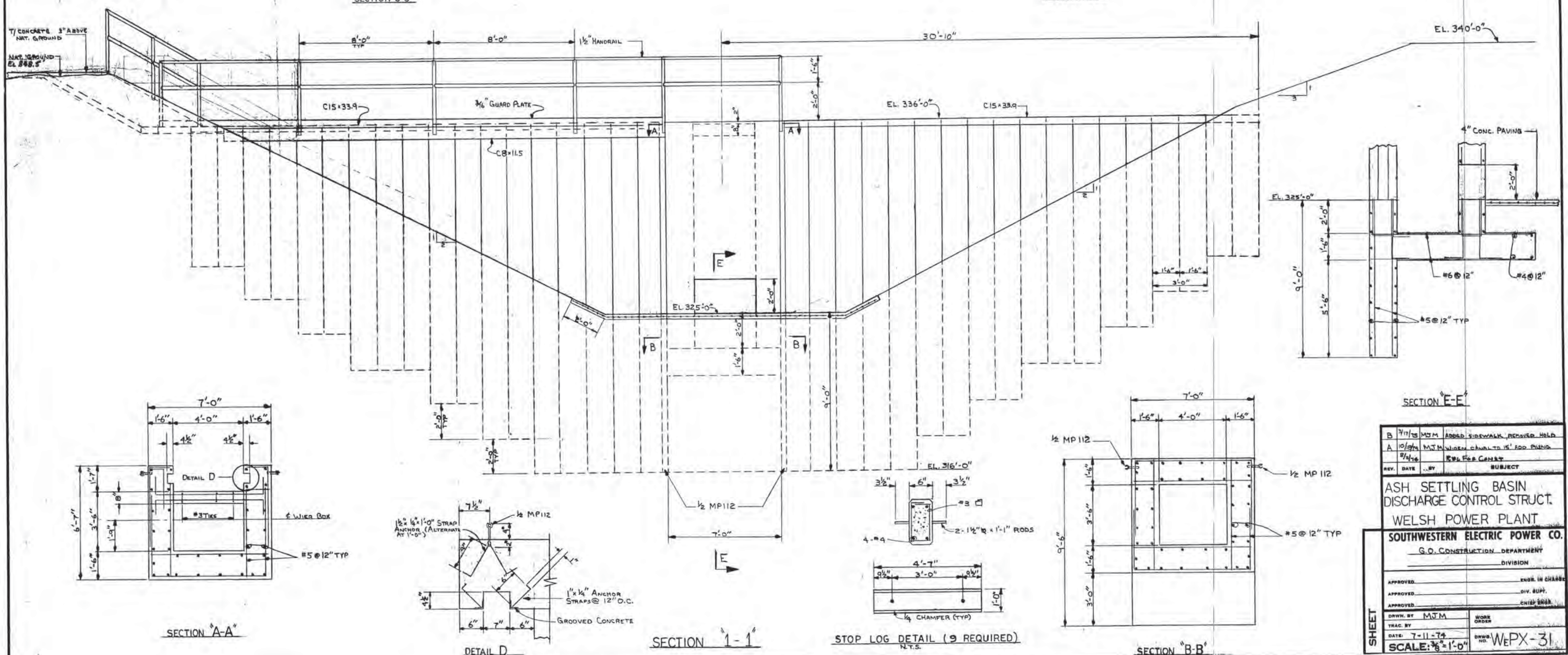


SECTION "G-G"

PLAN VIEW

SECTION "F-F"

SECTION "C-C"
SCALE 1"=1'-0"



SECTION "1-1"

SECTION "E-E"

SECTION "A-A"

DETAIL D
N.T.S.

STOP LOG DETAIL (9 REQUIRED)
N.T.S.

SECTION "B-B"

REV.	DATE	BY	SUBJECT
B	3/17/75	MJM	ADDED SIDEWALK, REMOVED HOLD
A	10/18/74	MJM	WIDEN CANAL TO 15' ADD PILING
	8/2/74		REL FOR CONST

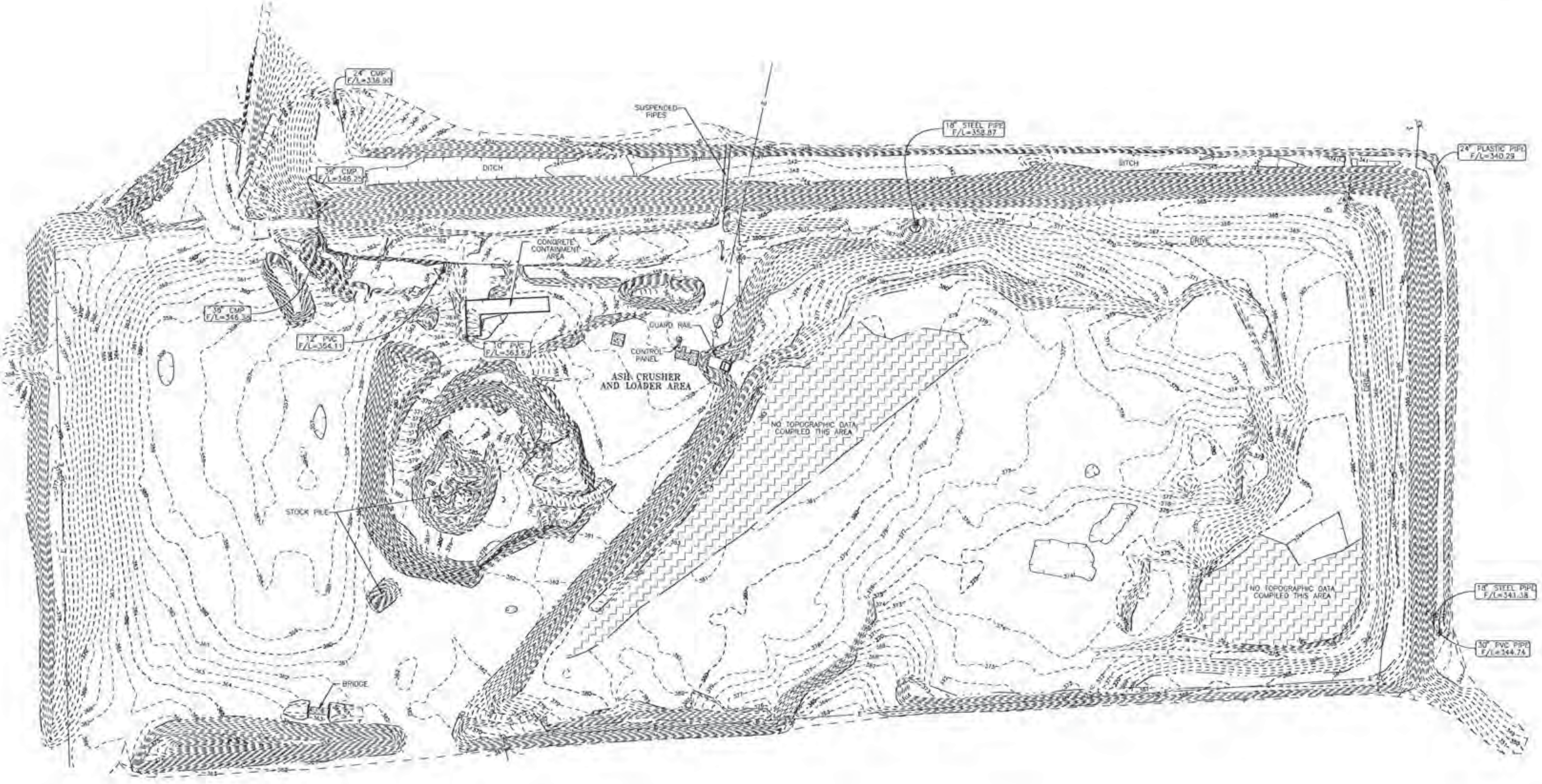
ASH SETTLING BASIN
DISCHARGE CONTROL STRUCT.
WELSH POWER PLANT

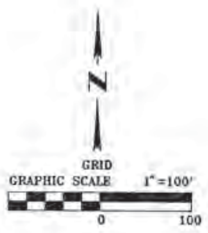
SOUTHWESTERN ELECTRIC POWER CO.
G.O. CONSTRUCTION DEPARTMENT
DIVISION

APPROVED ENGR. IN CHARGE
APPROVED DIV. SUPT.
APPROVED CHIEF ENGR.

SHEET
DRWN. BY MJM
TRAC. BY
DATE: 7-11-74
SCALE: 3/8"=1'-0"
WORK ORDER
DRWG. NO. WEPX-31

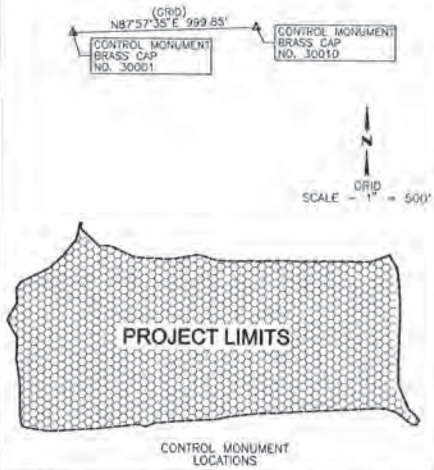
FILE





LEGEND

——— E ———	OVERHEAD ELECTRIC LINE
- - - - - - -	TOP OF BANK / SLOPE
——— - - - ———	TOE OF SLOPE / BANK
- - - - - - -	PIPING
- - - - - - -	EDGE OF DRIVE
— — — — —	EDGE OF GRAVEL
- - - - 369 - - - -	1.0' CONTOUR INTERVAL
- - - - 370 - - - -	5.0' CONTOUR INTERVAL
☐	POWER POLE
▣	PIPE LOCATION
⊥	GUY WIRE
△	CONTROL MONUMENT
⊕	LIGHT POLE
▩	CONCRETE SURFACE
▨	AREA NOT SURVEYED



CONTROL MONUMENT LOCATIONS

THE BEARINGS ARE BASED ON GRID NORTH WITHIN THE "TEXAS COORDINATE SYSTEM OF 1983, NORTH CENTRAL ZONE", NAD83 (CORS96, EPOCH 2002.0), WITH A BEARING OF NORTH 87 DEGREES 57 MINUTES 35 SECONDS EAST. THE COMBINED SCALE FACTOR TO GO FROM GRID TO SURFACE IS 1.00012. THE FOLLOWING CONTROL MONUMENTS WERE USED TO ESTABLISH THE BASIS OF BEARINGS:

CONTROL MONUMENT NO. 30001	CONTROL MONUMENT NO. 30010
N-7085417.3416	N-7085452.9387
E-3087023.3084	E-3088022.5268

MIKE GARDNER
#5760

SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON DECEMBER 14, 2009, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: DECEMBER 17, 2009

TOPOGRAPHIC SURVEY

ASH STORAGE AREA
WELSH POWER PLANT
FOR: AEP

Date	Revision/Description

Drawn By	Checked By	Project No.	Dwg. Date
J.B.O.	M.G.	094027	12-17-09

MTG engineers & surveyors

5930 SUMMERHILL RD. | P.O. BOX 3786
TEXARKANA TEXAS 75501
P 903.838.8533 | F 903.832.4700
www.mtgengineers.com

TBPE NO. 354

File No.	Sheet No.

X:\2009 Projects\094027 TOPO AT WELSH POWER PLANT – GREG CARTER\MERGE TOPO G.dwg
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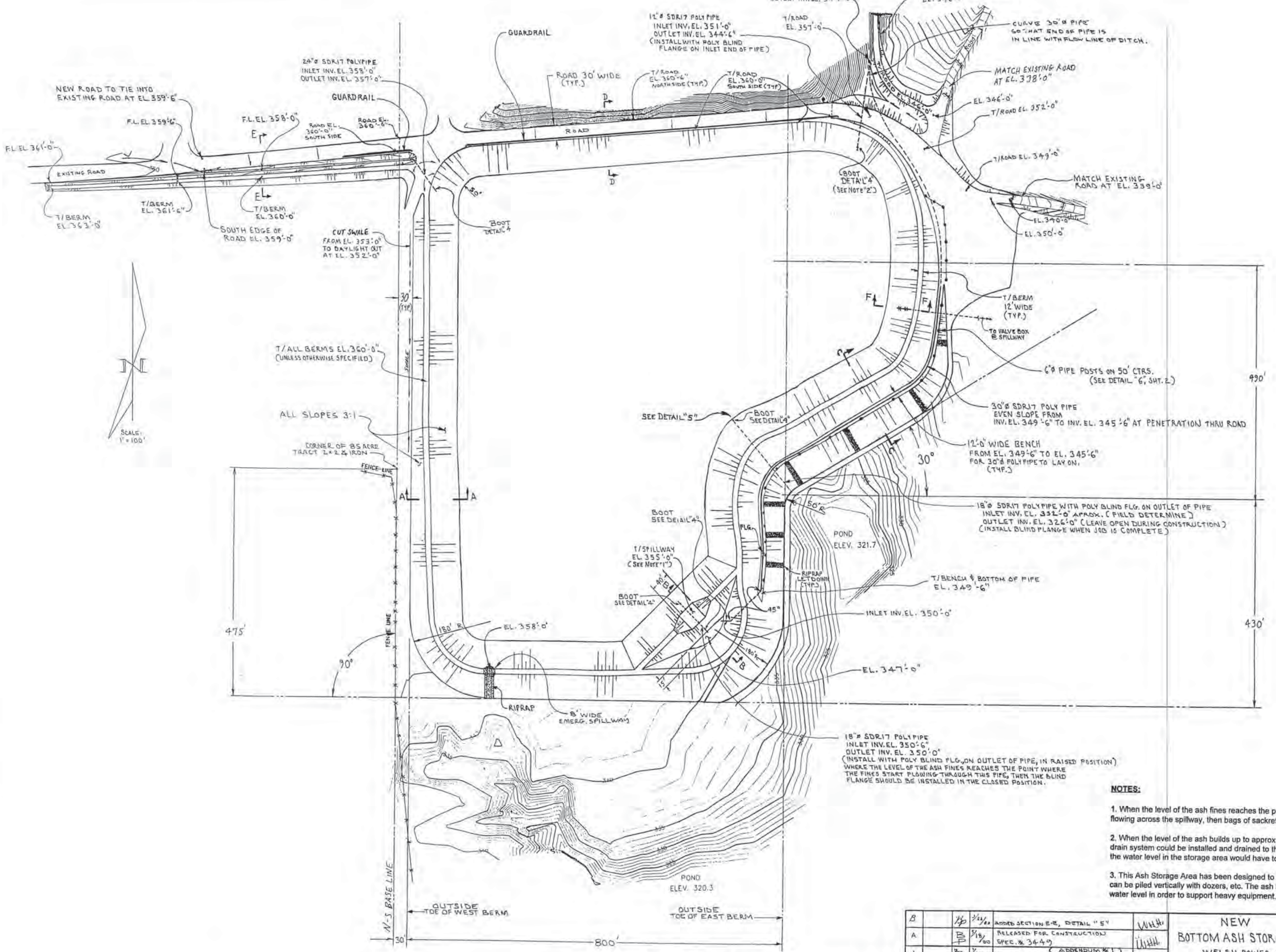


NOTES:

1. When the level of the ash fines reaches the point where the fines start flowing across the spillway, then bags of sackrete can be installed to raise the spillway elevation.

2. When the level of the ash builds up to approx. elev. 355 along the north and east sides, a french drain system could be installed and drained to this outlet to help hold the water table down. Of course the water level in the storage area would have to be at elev. 351 or above for the french drain to function.

3. This Ash Storage Area has been designed to hold the water level as low as possible so the ash can be piled vertically with dozers, etc. The ash level needs to be approx. 4 ft. to 5 ft. above the water level in order to support heavy equipment.

REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	7/21/00	ADDED SECTION E-E, DETAIL "5"	WHH
A		BP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHH
1		BP	3/13/00	RELEASED FOR BIDS SPEC. # 3449 (ADDENDUM # 1)	
		BP	3-10-00	RELEASED FOR BIDS	

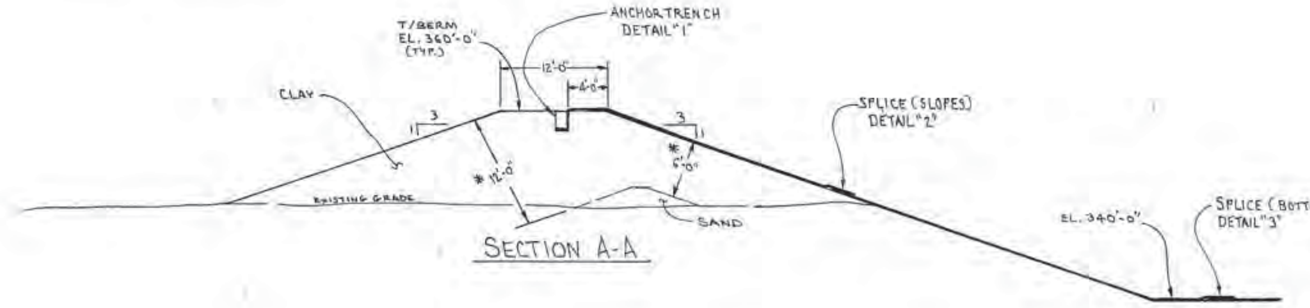
REV.	W.O.	BY	DATE	SUBJECT	APPROVED
C		BP	10-29-00	AS BUILT	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

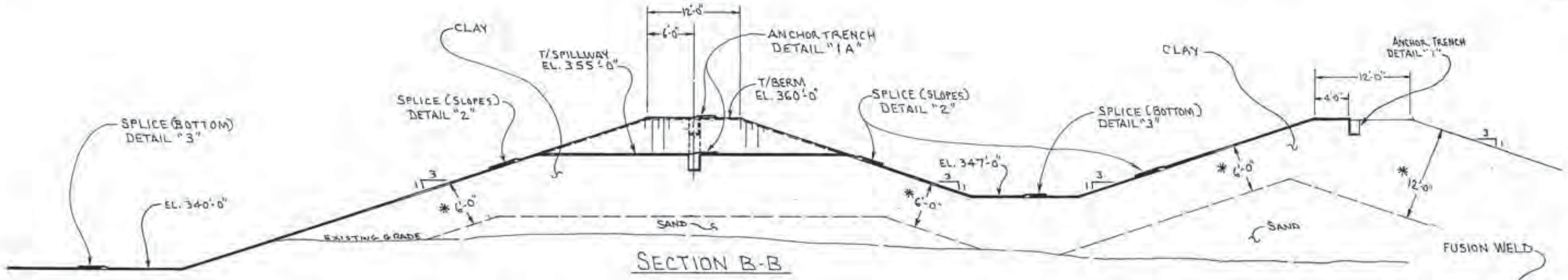
SOUTHWESTERN ELECTRIC POWER CO.

DEPT.
DIV.
APPROVED
DRWN. BY: BP
DATE: 3-10-00
SCALE: 1" = 100'
W.O.
SH. 1 of 2
DRWG. NO. WEPX-335

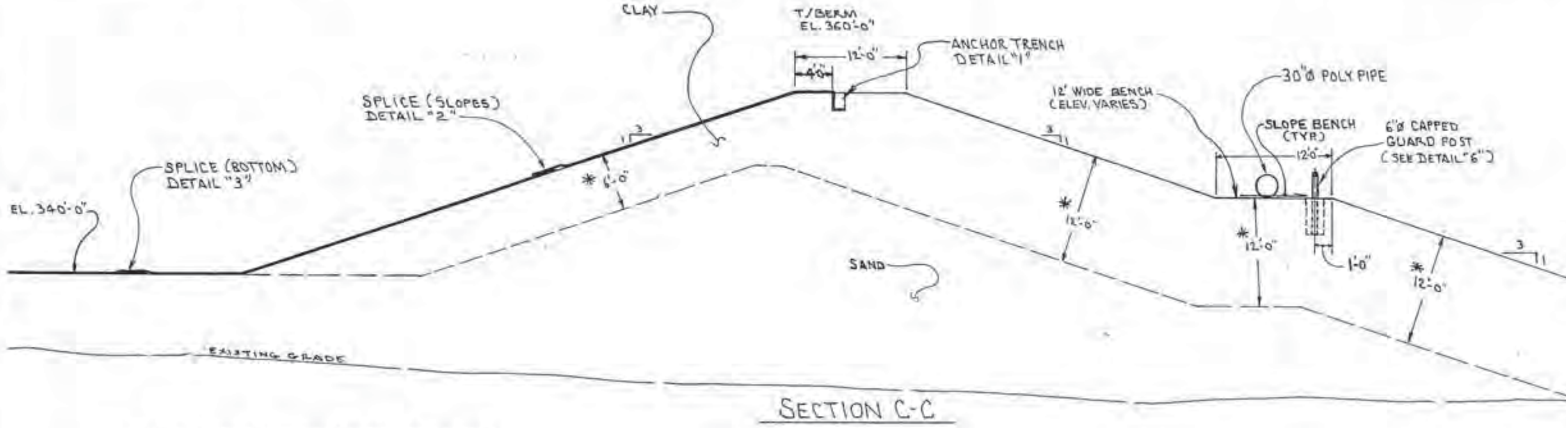
* - NOTE- THESE DIMENSIONS ARE SUBJECT TO ADJUSTMENT DEPENDING ON THE SAND / CLAY BALANCE VS. HAUL DISTANCE ON PROJECT.



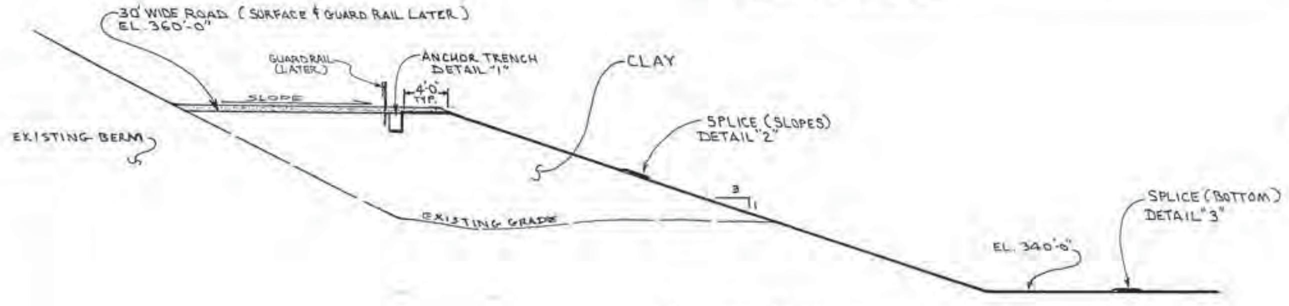
SECTION A-A



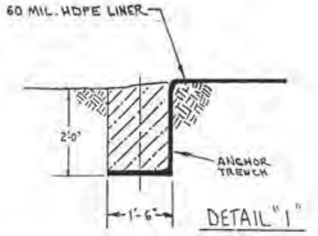
SECTION B-B



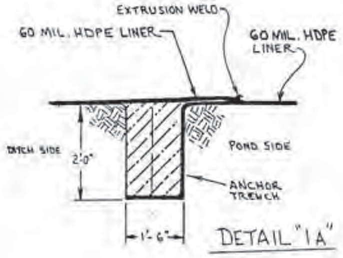
SECTION C-C



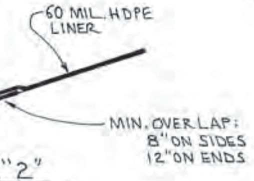
SECTION D-D



DETAIL "1"

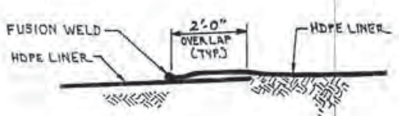


DETAIL "1A"



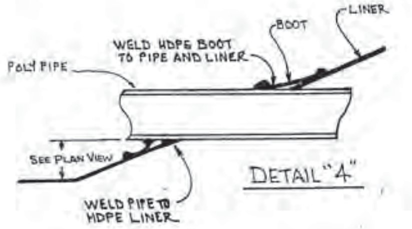
DETAIL "2"

LOCATIONS & QUANTITIES DETERMINED IN FIELD

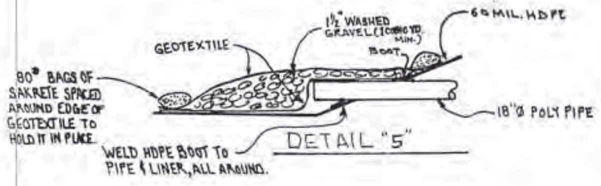


DETAIL "3"

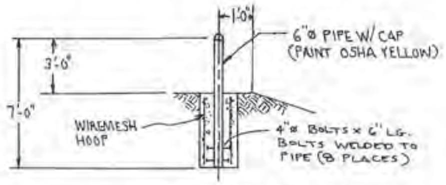
LOCATIONS & QUANTITIES DETERMINED IN FIELD



DETAIL "4"

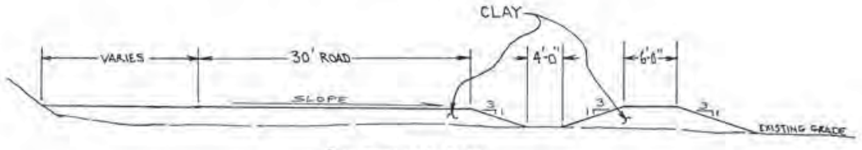


DETAIL "5"

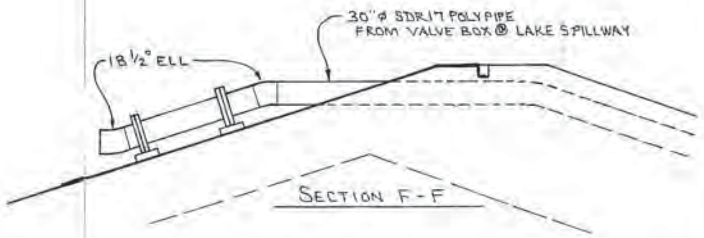


DETAIL "6"

50' ON CENTERS (20 REQUIRED)



SECTION E-E



SECTION F-F

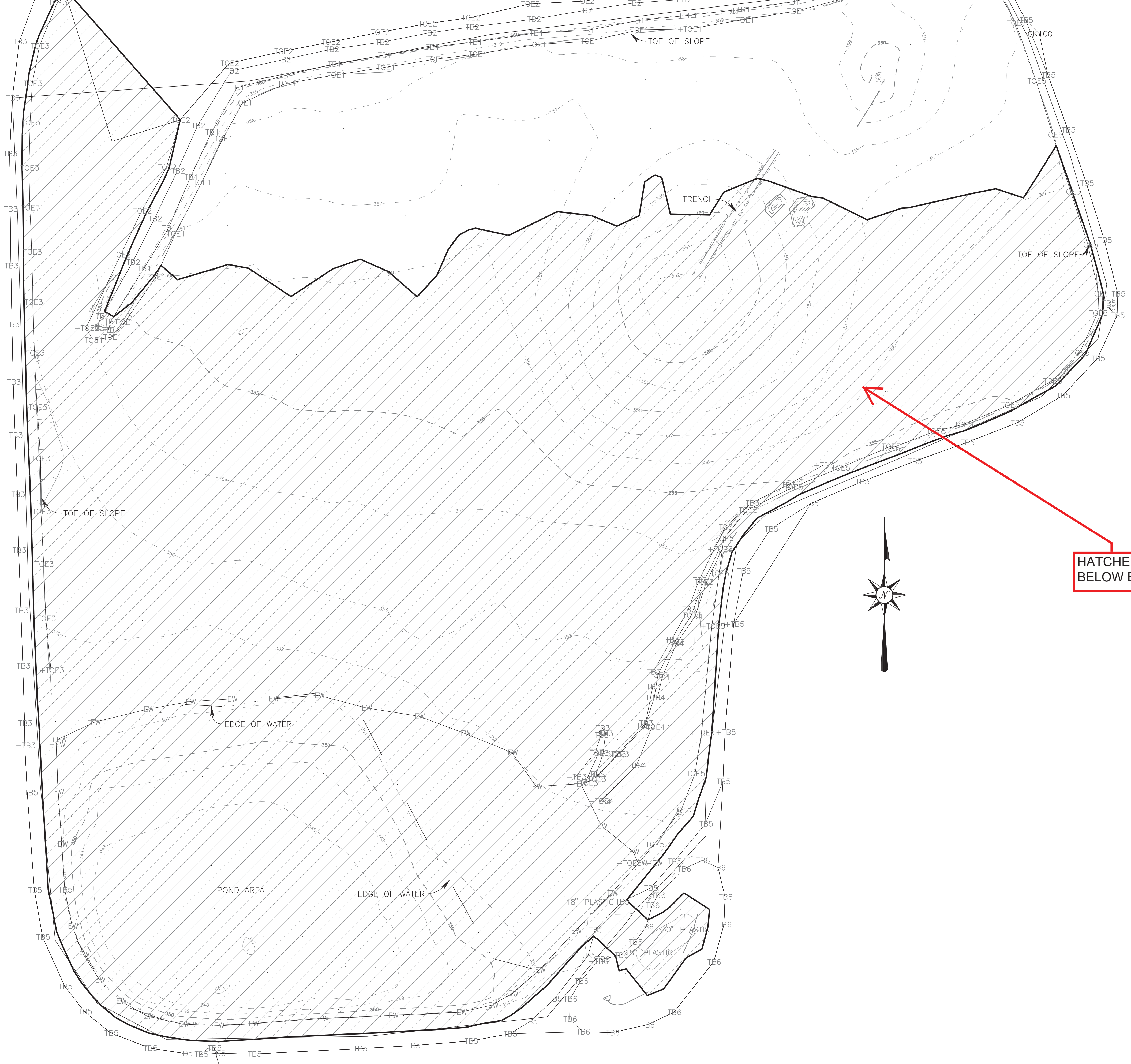
REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	10/29/00	AS BUILT	
A		AP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHH
1		BP	3/31/00	(ADDENDUM #1) RELEASED FOR BIDS SPEC. # 3449	
		BP	3/10/00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

DEPT.
DIV.
APPROVED
DRWN. BY: BP
DATE: 3-10-00
SCALE: AS SHOWN
W.O.
SH. 2 of 2
DRWG. NO. WEPX- 335

```
                         SURFACE TO DATUM VOLUME REPORT

Murray, Thomas & Griffin, Inc.
P.O. Box 3786
Texarkana, TX 75501
903-838-8533

Project:              X:\2009 Projects\094025 ASH POND TOPO WELSH - GREG CARTER\
                      VOLUME CALC 4-12-10.pro
Report Generated:                              Monday, April 12, 2010 9:22:04 AM
--------------------------------------------------------------------------------
Where the DTM surface is above the datum the volume is reported as fill.
Where the DTM surface is below the datum the volume is reported as excavation.
--------------------------------------------------------------------------------

Shrinkage/swell factors:     Excavation   1.0000             Fill   1.0000

DTM Surface                  Number        Datum
Layer Name                   of Points     Elevation
---------------------------  -----------   -----------
POINTS COMPOSITE                  632           355.92

Volume limited to that within the constraining boundary - Object  18228
Area within boundary: 600,437.78 SQ FT  (13.784 ACRES)
Total triangulated area: 594,973.58 SQ FT  (13.659 ACRES)

                          Elev Range         Cut Volume       Fill Volume
                                (ft)              (yd3)             (yd3)
      ------------------------------   ----------------  ----------------
                     346.13 > 346.92              213.3               0.0
                     346.92 > 347.92            1,674.4               0.0
                     347.92 > 348.92            2,922.6               0.0
                     348.92 > 349.92            3,724.2               0.0
                     349.92 > 350.92            4,444.3               0.0
                     350.92 > 351.92            5,674.4               0.0
                     351.92 > 352.92            7,552.1               0.0
                     352.92 > 353.92           10,632.0               0.0
                     353.92 > 354.92           14,916.3               0.0
                     354.92 > 355.92           19,411.2               0.0
                     355.92 > 355.94                0.0               0.0


Excavation Volume                          Fill Volume
Beneath Datum (yd3)                        Above Datum(yd3)
-----------------------------------        ---------------------------------
                  71,164.9                                      0.0

Net Difference: 71,164.9 yd3 excess volume beneath datum
```



HATCHED AREA IS THE PORTION
BELOW ELEVATION 355.92

357.92

LOW ELEVATION ON
EMERGENCY SPILLWAY

ASH POND VOLUME
BELOW ELEVATION 355.92

2.9 – Structural Stability Assessment Periodic 5-Year Review, Bottom Ash Storage Pond, October 2021

STRUCTURAL STABILITY ASSESSMENT
PERIODIC 5-YR REVIEW

30 TAC 352.731 (40 CFR 257.73(d))

Bottom Ash Storage Pond

Welsh Plant
Pittsburg, Texas

October, 2021

Prepared for: Southwest Electric Power Company (SWEPCO) – Welsh Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

Document No. GERS-21-035

Structural Stability Assessment
Periodic 5-Yr Review
CFR 257.73(d)
Welsh Plant
Bottom Ash Storage Pond

PREPARED BY Brett A. Dreger DATE 9/29/2021
Brett A. Dreger, P.E.

REVIEWED BY DATE 09-29-2021
Shah S. Baig, P.E.

APPROVED BY Gary Zych DATE 10/1/2021
Gary Zych, P.E.
Manager – AEP Geotechnical Engineering

American Electric Power
Service Corporation
Texas Registered Engineering
Firm No. F-3341

Gary F. Zych
GARY F. ZYCH
127152
10/1/2021

I certify to the best of my knowledge, information and belief that the information contained in this structural stability assessment meets the requirements of 40 CFR 257.73(d)

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1.0 OBJECTIVE 257.73(d)

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of 30 TAC 352.731 (40 CFR 257.73(d)) and document whether the design, construction, operations, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices. This is the first periodic 5-year review of the initial assessment as per the rule.

Note: There has not been any changes to the diking structure, emergency spillway, primary spillway or the primary discharge pipe through the dike system since the initial assessment.

2.0 NAME AND DESCRIPTION OF CCR SURFACE IMPOUNDMENT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash Pond and the Bottom Ash Storage pond. This report addresses the Bottom Ash Storage Pond. The Bottom Ash Storage Pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir.

The Bottom Ash Storage Pond embankments are approximately 20 feet in height and are constructed on a 3:1 slope (3 feet horizontal, 1 foot vertical). The elevation at the base of the embankment is approximately 340 feet above msl, and the elevation at the top of the embankment around the perimeter of the Bottom Ash Storage Pond is approximately 360 feet above msl. Presently a combination of economizer ash, bottom ash and some fly ash is sluiced to the bottom ash storage pond from the primary bottom ash pond.

3.0 STABLE FOUNDATION AND ABUTMENTS 257.73(d)(1)(i)

[Was the facility designed for and constructed on stable foundations and abutments? Describe any foundation improvements required as part of construction.]

Native coarse grained (or sandy) material underlying the Bottom Ash Storage Pond generally consists of medium dense to very dense silty sand (SM), clayey sand (SC) and silt (ML) and fine grained (clayey) material consist of medium stiff to hard lean clay and fat clay (CL and CH) soils. Based on the subsurface investigation and engineering properties of the subsurface soils, it is concluded that the Bottom Ash Storage Pond dikes are supported on a stable foundation base.

Operation of the impoundment is performed so as to not adversely affect the foundation and abutments. As required by the CCR rules the Bottom Ash Pond Complex is inspected at least every 7 days by a qualified person. Also as a requirement of the CCR rules, the impoundment is also inspected annually by a professional engineer. Maintenance items are addressed as they are discovered as a part of those inspections.

4.0 SLOPE PROTECTION 257.73(D)(1)(II)

[DESCRIBE THE SLOPE PROTECTION MEASURES ON THE UPSTREAM AND DOWNSTREAM SLOPES.]

The bottom ash storage pond interior has been constructed with a geomembrane liner. The impoundment’s storage area is lined with a 60 mil HDPE liner. The geomembrane extends all the way to the crest of the interior slope to protect areas that require protection from erosion and wave action. The exterior slopes consist of vegetative cover. Any erosion that may occur is repaired within a timely period.

5.0 EMBANKMENT CONSTRUCTION 257.73 (d)(1)(iii)

[Describe the specifications for compaction and/or recent boring to give a relative comparison of density.]

The Bottom Ash Storage Pond embankment is constructed of compacted earth fill. The source and type of soils used for earth fill is unknown. However, AEP contracted with Auckland Consulting, Inc. of Tyler, Texas to perform a Geotechnical Investigation of Existing Bottom Ash Storage Pond Embankments in 2016. The evaluation of the existing earthen embankments consisted of slope stability and seepage analyses for the embankments. The evaluation was performed using information obtained from soil borings drilled on the crest and outside toe of the embankments. The embankments for the Bottom Ash Storage Pond were investigated.
The subsurface exploration of the embankment consisted of advancing a total of seven (7) borings located in potentially critical areas of the embankment. Four (4) borings (Boring Nos. 2 through 5) were completed along the embankment crest with termination depths ranging from approximately 40 to 50 feet. Three (3) borings (Boring Nos. 6 through 8) were completed along the embankment toe and were advanced to termination depths of approximately 40 feet.

Based on subsurface soils and field sampling and testing, the existing embankment is primarily lean clay (CL) with existing side slopes (upstream and downstream) of approximately 3:1 (H:V). Based on the slope stability evaluation and the engineering properties of the subsurface soils, it is concluded that the Bottom Ash Storage Pond embankments are adequately constructed.

6.0 VEGETATION CONTROL 257.73 (d)(1)(iv)

[Describe the maintenance plan for vegetative cover.]

The vegetative slopes/areas are mowed to facilitate inspections and maintain the growth of the vegetative layer; and prevent the growth of woody vegetation.

7.0 SPILLWAY SYSTEM 257.73(d)(1)(v)

[Describe the spillway system and its capacity to pass the Inflow Design Flood as per its Hazard Classification.]

Hydrology and Hydraulic Analysis which includes calculations for each spillway structure are included in Inflow Design Flood Control Plan. As of April 11, 2021, the plant has ceased all sluicing operations and all surface water run-on to the Bottom Ash Storage Pond area. The only inflows to the Bottom Ash Storage Pond is direct rainfall within the pond's dikes. The Inflow Design Flood for the Bottom Ash Storage Pond is the 100-year storm event.

The principal spillway for the Bottom Ash Storage Pond is an 18-inch HDPE pipe with an invert elevation of 350.5 feet penetrating a 40 foot wide interior spillway that feeds into a sump area that is ultimately controlled by a 30-inch HDPE pipe with an invert elevation of 350.0 feet. Flows through the 30-inch HDPE pipe are directed back to Primary Bottom Ash Pond by gravity. The Bottom Ash Storage Pond has an 8-foot wide emergency spillway with a crest elevation of 358.0 feet. The emergency spillway channel is lined with rock riprap and discharges into an unnamed tributary of Swauano Creek just upstream of the south end of the Welsh Reservoir emergency spillway. Based on the Hydrology and Hydraulic analysis the bottom ash storage pond spillway system can handle the 100-year storm event.

8.0 BURIED HYDRAULIC STRUCTURES 257.73 (d)(1)(vi)

[Describe the condition of the sections of any hydraulic structure that in buried beneath and/or in the embankment.]

The 30-inch diameter HDPE discharge pipe for the principal spillway area extends through the top portion of the embankment of the bottom ash pond. The elevation of the pipe through the embankment is equal to the normal operating pool level of the pond. Once the pipe exits the embankment, it runs along the outside slope area until it reaches its discharge point. Based on examination of the exposed areas of the pipe along the outside slope area, the pipe appears to be in satisfactory condition.

There are no signs of settlement or sinkholes on the ground surface above the sections of pipe that are buried. The discharge pipe is a HDPE solid wall plastic pipe and no deterioration or shape changes have been observed on the visible sections of the pipe since the initial assessment.

9.0 SUDDEN DRAWDOWN 257.73 (d)(1)(vii)

[If the downstream slope is susceptible to inundation, discuss the stability due to a sudden drawdown.]

The downstream slope of the Bottom Ash dikes will not be inundated from any adjacent water bodies.

2.10 – Safety Factor Assessment Periodic 5-Year Review, Bottom Ash Storage Pond, October 2021

SAFETY FACTOR ASSESSMENT
PERIODIC 5-YEAR REVIEW

30 TAC 352.731 (40 CFR 257.73e)

Bottom Ash Storage Pond

Welsh Plant
Pittsburg, Texas

October, 2021

Prepared for: Southwest Electric Power Company (SWEPCO) – Welsh Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

GERS-21-048

SAFETY FACTOR ASSESSMENT
PERIODIC 5-YEAR REVIEW
CFR 257.73(e)
WELSH PLANT
BOTTOM ASH STORAGE POND

PREPARED BY Brett A. Dreger DATE 10/1/2021
Brett A. Dreger, P.E.

REVIEWED BY DATE 10/1/2021
Mohammad A. Ajlouni, P.E.

APPROVED BY Gary F. Zych DATE 10/4/2021
Gary F. Zych, P.E.
Section Manager – AEP Geotechnical Engineering

Gary F. Zych
GARY F. ZYCH
127152
10/4/2021

American Electric Power Service Corporation
Texas Registered Engineering
Firm No. F-3341

I certify to the best of my knowledge, information, and belief that the information contained in this safety factor assessment meets the requirements of 40 CFR § 257.73(e)

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1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of 30 TAC 352.731 (40 CFR 257.73(e)) for the safety factor assessment of CCR surface impoundments. This is the first periodic 5-year review of the safety factor assessment.

2.0 DESCRIPTION OF THE CCR UNIT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash Pond and the Bottom Ash Storage Pond. This report addresses the Bottom Ash Storage Pond. The Bottom Ash Storage Pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir.

The Bottom Ash Storage Pond embankments are approximately 20 feet in height and are constructed on a 3:1 slope (3 feet horizontal, 1 foot vertical). The elevation at the base of the embankment is approximately 340 feet above msl, and the elevation at the top of the embankment around the perimeter of the Bottom Ash Storage Pond is approximately 360 feet above msl. As of April 11, 2021, the plant has ceased all sluicing operations and all surface water run-on to the Bottom Ash Storage Pond area. Currently, the plant has initiated closure by removal for the Bottom Ash Storage Pond.

3.0 SAFETY FACTOR ASSESSMENT 257.73(e)

The periodic 5-year review was conducted to evaluate if any physical changes have been made to the earthen dike and/or operating changes that could impact the loading on the structure. The assumptions, material properties and operating pools defined in the initial assessment were reviewed. The review concluded that there have been no changes that would impact the stability analyses that were previously conducted. Therefore, the previous report and analyses are still applicable to the current conditions of the facility. The results indicate that the calculated factors of safety meet or exceed the minimum values defined in Section 257.73(e).

ATTACHMENT A

Initial Safety Factor Assessment – Bottom Ash Pond

Initial Safety Factor Assessment – Bottom Ash Pond
Welsh Power Plant
Pittsburg, Texas

Auckland Project No. 2016-007
August 30, 2016

Prepared For:

American Electric Power Company
1 Riverside Plaza
Columbus, Ohio 43215

Prepared By:

Auckland Consulting, LLC
Jacksonville, Texas

TBPE Firm Registration No. F-16721
Expires 2/29/2017

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Appendix

1.0 Introduction and Embankment Information

1.1 Introduction

The following report and evaluation provides the Initial Safety Factor Assessment of the Bottom Ash Pond, an existing CCR impoundment (as defined by 40 CFR §257.2) located at the Welsh Power Plant near Pittsburg, Texas. In accordance with 40 CFR §257.73(e)(1)(i) through (iv) this initial assessment provides field and laboratory data, model outputs (detailing multiple stability conditions) and summary of safety factors for the Bottom Ash Pond. In accordance with 40 CFR §257.73(e)(2) this report provides the Initial Safety Factor Assessment certification for the Bottom Ash Pond.

1.2 Referenced Information and Data

The impoundment pool elevation data cited herein were provided in a separate hydrology and hydraulic (H&H) analysis report completed by Freese and Nichols titled *Hydraulic Analysis of Welsh Power Plant Ash Ponds* dated December 29, 2010 (not included herein). The referenced report generally meets the demonstration requirements of 40 CFR §257.82(a).

Embankment profile dimensions and elevations were determined by using existing information provided by the client. This information is included in the Appendix of this report.

1.3 Embankment Evaluation Criteria

Based on information provided and collected, the existing embankment is primarily lean clay (CL) with existing side slopes (both up- and downstream) of approximately 3:1 (H:V), maximum embankment height of approximately 34 feet (downstream) and top of dam elevation of 360.0 feet MSL. The downstream slope of the embankment is constructed with a 12-foot wide bench (vertical position on the slope varies along the embankment) that supports a 30-inch HDPE decant pipe. To account for the potential loading of the decant pipe, a surcharge load of 150 psf was applied to the bench. The crest width of the embankment is approximately 12 feet. The impoundment's storage area (side slopes and bottom) is lined with a 60-mil HDPE liner. The critical section for the embankment was determined to occur in the vicinity of Boring No. 4, as depicted on the Plan of Borings.

It is our understanding that the maximum storage elevation of impounded CCR material is 355.0 feet (MSL); however, the facility is managed to maintain an ash level less than this maximum level. The downstream toe of the Bottom Ash Pond is not adjacent to other water bodies that may inundate the downstream slope (or toe) and therefore not subject to 40 CFR §257.73(d)(1)(A)(3)(vii).

In accordance with 40 CFR §257.73(e)(1)(i) and (ii), the maximum storage pool elevation for the Bottom Ash Pond as determined by the 25-year, 24-hour storm event is 355.62 feet (MSL). For the purposes of this evaluation, the maximum storage pool elevation of 356.0 feet (MSL) was utilized. Likewise, the maximum (or flood) surcharge loading elevation as determined by the 100-year, 24-hour event is 355.76 feet (MSL), for this evaluation a maximum surcharge loading elevation of 356.0 feet (MSL) was utilized. Storage pool elevations were determined in accordance with 40 CFR §257.82(a).

2.0 Field and Laboratory Testing

2.1 Field Activities

The subsurface exploration of the embankment consisted of advancing a total of seven (7) borings located in potentially critical areas of the embankment. Four (4) borings (Boring Nos. 2 through 5) were completed along the embankment crest with termination depths ranging from approximately 40 to 50 feet. Three (3) borings (Boring Nos. 6 through 8) were completed along the embankment toe and were advanced to termination depths of approximately 40 feet. Boring No. 1 was not accessible by drilling equipment and therefore not completed. Borings were located in the field as shown on the Plan of Borings included in the Appendix of this report.

Drilling Methods. Field operations were performed in general accordance with ASTM procedures or similar accepted practices. Soil borings were drilled using a track mounted Geoprobe drilling rig equipped with a rotary head and continuous augers. The use of mud rotary or rotary wash was not necessary.

Soil Sampling. Sample intervals were semi-continuous in the upper 10 feet of each boring and five (5) foot intervals thereafter, unless otherwise directed by the onsite engineer. Split-spoon (Standard Penetration Test, SPT) or disturbed samples were collected in general accordance with ASTM Standard Method D 1586. Relatively undisturbed soil samples were collected in general accordance with ASTM D 1587 and extruded in the field and sealed in plastic to protect against moisture loss. Soil shear strengths were determined by using a calibrated hand penetrometer on undisturbed samples.

The collected samples were subsequently examined and selected for laboratory testing by a geotechnical engineer.

Boring Logs. The general subsurface soil and groundwater conditions encountered during field activities are presented on boring logs attached in the Appendix of this report. Information on the boring logs includes groundwater levels, laboratory test data, penetration resistance and soil classifications based on the Unified Soil Classification System (USCS).

Groundwater Level Measurements. Groundwater level observations completed during field activities are noted on the boring logs attached in the Appendix of this report.

2.2 Laboratory Testing Program

Laboratory testing was conducted on selected samples to assist in the classification of the soils encountered and to evaluate the physical and engineering properties of subsurface soils. Laboratory test results are presented on the boring logs included in the Appendix. Laboratory tests were performed in general accordance with ASTM procedures cited in the table below.

Laboratory Test	Test Designation
Atterberg Liquid Limit and Plastic Limit Determination	ASTM D 4318
Percentage Soil Passing No. 200 Sieve	ASTM D 1140
Moisture Content Determination	ASTM D 2216
Particle Size Analysis of Soils	ASTM D 422
Unconsolidated Undrained (UU) Triaxial Compression	ASTM D 2850
Hydraulic Conductivity	ASTM D 5084
Consolidated Undrained (CU) Triaxial Compression	ASTM D 4767
Direct Shear of Soils Under Consolidated Drain Conditions	ASTM D 3080

Soil samples not utilized in laboratory testing will be retained for approximately 30 days from the report issuance date and then disposed, unless specifically requested in writing from the client.

3.0 Slope Stability Analyses

3.1 General

Soil parameters used for stability analyses of the existing embankment are based on findings of the completed laboratory and field testing programs and previous assessments completed as the Welsh Power Plant. The probable failure planes were analyzed using the analytical slope stability software, SLIDE by Rocscience, Inc. Methods of evaluation used in SLIDE are considered to be limited equilibrium methods of analysis, where each individual shear plane is evaluated to determine the resulting shear stress at the point of failure. For the purposes of this evaluation the Bishop Method of analysis, which analyzes circular failure planes through the slope was utilized.

Per 40 CFR §257.73(e)(1)(i) through (iii), three (3) modeled scenarios (presented below) were utilized to evaluate the stability of the existing embankment: steady state seepage (long term) condition under maximum storage pool, steady state seepage (long term) condition under maximum surcharge pool, and steady state seepage condition with seismic loading under maximum storage pool conditions. The following minimum factors of safety (FS) and soil stress parameters were utilized in modeling. Minimum factors of safety are based on demonstration requirements provided in 40 CFR §257.73(e)(1).

Summary of Embankment Condition and Factor of Safety		
Embankment Condition	**Soil Parameters**	**Minimum Factor of Safety**
Steady State Seepage – Maximum Pool	Effective Stress	1.50
Steady State Seepage – Surcharge Pool	Effective Stress	1.40
Steady State Seepage (Seismic) – Maximum Pool	Total Stress	1.00
NOTE: Minimum factors of safety based on demonstration requirements provided in 40 CFR §257.82 (e)(1).		

For evaluation of steady state seepage (long term) conditions with seismic, peak ground acceleration for this location was obtained from the USGS National Seismic Hazard Mapping Project (http://earthquake.usgs.gov/hazards). Based on the seismic survey data, the anticipated site specific peak ground acceleration (PGA) of 0.06g (acceleration at rock sites) for two (2) percent probability of exceedance in 50 years (40 CFR Part 257, Preamble page 21384). Correcting for acceleration at soft soil sites (Seismic Site Classification D) yields an estimated PGA of 0.13g. The seismic coefficient (k) used for pseudo static analysis is determined by reducing the estimated PGA by 50% yielding a seismic coefficient of 0.065g.

3.2 Liquefaction Assessment

Liquefaction of soils occurs when horizontal shearing stresses exceed the strength of existing loose, saturated sand. This sudden loss of shear strength and subsequent soil structure is typically associated with earthquake-induced horizontal movement. Recent engineering publications[1] provide criteria to assess liquefaction potential of sands (little to no fines) and clayey soils of low plasticity (e.g. clayey sands, silts). These criteria indicate that water content of fine-grained or cohesive soils needs to be high (≥ 0.85 *Liquid Limit [LL]), a clay fine content (defined as grains smaller than 0.002 mm) of less than 10 percent (< 10%), and relatively low soil density (assessed in terms of SPT blow counts). In addition, the accepted minimum seismic threshold acceleration to cause liquefaction in loose sands is 0.10g, the anticipated site specific PGA for this site is 0.06g.

Native coarse grained (or sandy) material underlying the Bottom Ash Pond generally consist of medium dense to very dense silty sand (SM), clayey sand (SC) and silt (ML) and fine grained (or clayey) material consist of medium stiff to hard lean clay and fat clay (CL and CH) soils. Based on these soil characteristics and that the Bottom Ash Pond is located in

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[1] Seed, R.B., et al, Recent Advances in Soil Liquefaction Engineering: A Unified and Consistent Framework, 26th Annual ASCE Los Angeles Spring Seminar, April 2003

a zone of low peak ground acceleration (PGA), the risk of either embankment or underlying soils liquefying are negligible [40 CFR §257.73(e)(1)(iv)].

3.3 Embankment and Foundation Stratigraphy

The models developed for this evaluation are based on the existing embankment geometry, results of field and laboratory testing and hydrologic site information provided by the client. Selection of the critical slope section was based on both height and subsurface sensitivity to loading. The following tables provide a summary of soil parameters used for these analyses. Specific soil parameters used for each model are presented in the Appendix.

Summary of Long Term, Total Stress Soil Parameters:

Material Type	Unit Weight (pcf)	Consolidated-Undrained Cohesion (psf)	Consolidated-Undrained Angle of Internal Friction (degrees)
Embankment Fill	125	250	28
Silty, Clayey Sand (SM_SC)	120	225	20
Silty Sand (SM)	120	0	30
Native Fat and Lean Clay (CH_CL)	125	450	14
Ash	100	0	30

NOTE: Properties used for Steady State Seepage with Seismic analyses.

Summary of Long Term, Effective Stress Soil Parameters

Material Type	Unit Weight (pcf)	Consolidated-Drained Cohesion (psf)	Consolidated-Drained Angle of Internal Friction (degrees)
Embankment Fill	125	150	32
Silty, Clayey Sand (SM_SC)	120	0	34
Silty Sand (SM)	120	0	36
Native Fat and Lean Clay (CH_CL)	125	300	22
Ash	100	0	30

NOTE: Properties used for Steady State Seepage analyses. Consolidated-drained conditions determined based on pore pressure measurements made during Consolidated-Undrained (CU) triaxial testing.

The HDPE liner was modeled at the interface of the slope and the ash pond, a nominal strength of 50 psf was assumed for the liner material.

3.4 Seepage Analysis Parameters

The observed groundwater levels while drilling through the embankment (approximate groundwater elevation of 30 to 34 feet, below the crest) correspond with those groundwater elevations encountered while drilling adjacent to the embankment toe (approximately groundwater elevation six [6] feet, below existing grade). No elevated groundwater seepage or groundwater levels were observed in boreholes completed in the embankment that would indicate a prolific and defined phreatic surface in the embankment.

Therefore, based on the available information it appears that the existing impermeable liner has precluded the development of a phreatic surface (internal groundwater elevation) within the embankment. Though the probability of a phreatic surface developing in the embankment is considered low, it is however possible, and therefore was modeled as part of the structural assessment.

The analysis of embankment seepage is based on laboratory results and estimated values for permeability for various embankment and native foundation soils. These soil parameters were utilized in the models to establish a long term steady state condition and corresponding phreatic surface in the embankment. Hydraulic conductivity test results are provided in the Appendix. Hydraulic conductivity properties utilized in the seepage analysis are provided in the below table.

Hydraulic Conductivity of Embankment Soils

Material Type	Permeability (ft/sec)
Embankment Fill	1×10^{-8}
Silty, Clayey Sand (SM_SC)	1×10^{-5}
Silty Sand (SM)	1×10^{-5}
Native Fat and Lean Clay (CH_CL)	1×10^{-8}
Ash	1×10^{-4}

The HDPE liner is assumed to be impermeable; therefore a very low permeability value of 1×10^{-20} ft/sec was utilized.

3.5 Stability Analysis Results

The following table provides the results of the stability analysis for each of the conditions cited herein, as required by 40 CFR §257.73(e)(1)(i) through (iii). The graphical representations of each analysis are included in the Appendix.

Summary of Stability Analyses – Safety Factors

Modeled Condition	Factor of Safety	
	Actual	Minimum
Steady State Seepage – Maximum Pool	2.60	1.50
Steady State Seepage – Surcharge Pool	2.60	1.40
Steady State Seepage with Seismic – Maximum Pool	1.60	1.00

Summary of Stability Analyses– Safety Factors
(Potential Phreatic Surface)

Modeled Condition	Factor of Safety	
	Actual	Minimum
Steady State Seepage – Maximum Pool	1.78	1.50
Steady State Seepage – Surcharge Pool	1.78	1.40
Steady State Seepage with Seismic – Maximum Pool	1.31	1.00

Based on the findings of this analysis, the evaluated embankment appears to be stable under both modeled conditions (existing conditions and potential phreatic surface) and demonstrate the minimum safety factors, as required by 40 CFR §257.73(e)(1)(i) through (iii).

4.0 Report Limitations

This report has been prepared for the exclusive use of our client for the specific application to the project discussed and has been prepared in accordance with the generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. The analyses contained in the report are based on the data obtained from the soil

borings performed within the project site. This report does not reflect variations that may occur between borings or across the site. Soil borings do not necessarily reflect strata variations that may exist at other locations within the project site.

5.0 Initial Structural Stability Assessment Certification

By means of this certification, (i) I have reviewed the requirements of 40 CFR §257.73(e)(1) – *Periodic Safety Factor Assessments*, (ii) I or my agent has visited and examined the facility, (iii) the referenced data used in this evaluation to the best of my knowledge appears correct and appropriate for use, (iv) and this Initial Safety Factor Assessment for the Bottom Ash Pond (Welsh Power Plant) has been prepared to the best of my knowledge in accordance with §257.73(e)(1).

By: ______________________________

Dated: August 30, 2016

JOHN J. TAYNTOR
99202

TBPE Firm Registration No. F-16721
Expires 2/28/2017

Appendix

Stability Analyses
Reference Data

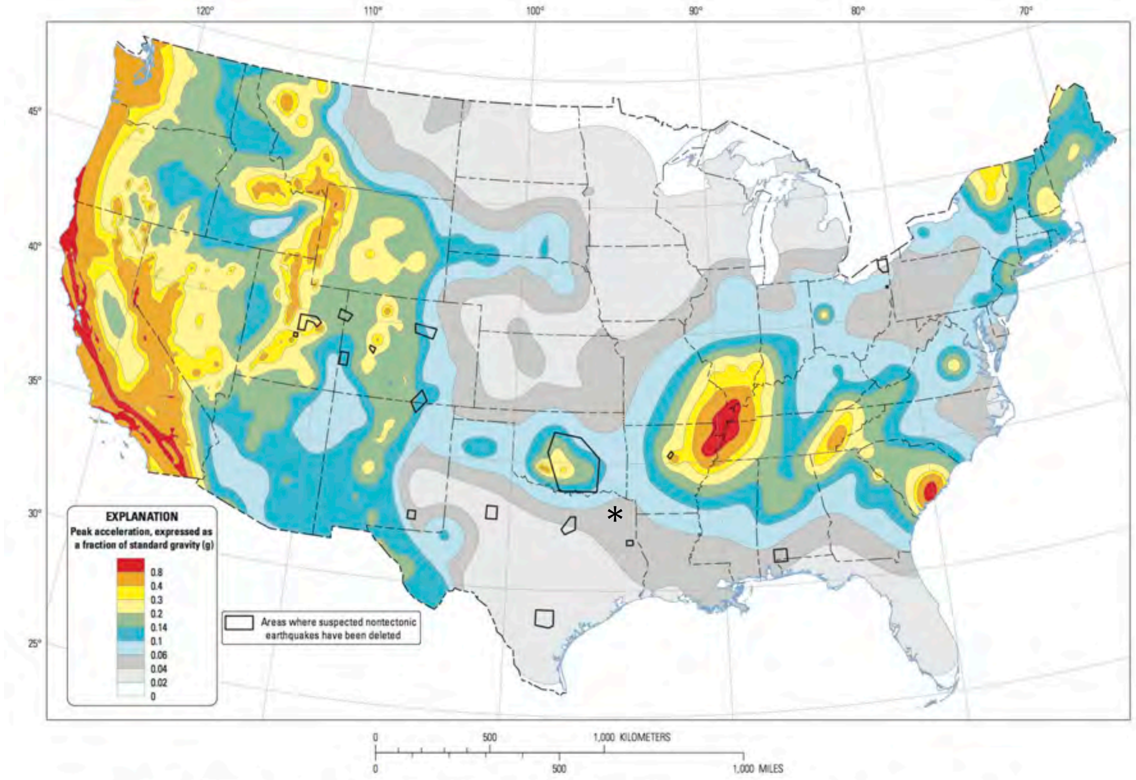
Aerial image provided by Google Earth.

Soil Boring Location Plan

Scale: N/A

Auckland Project No. 2016-007

Welsh Power Plant
Initial Safety Factor Assessment - Bottom Ash Pond
Pittsburg, Texas



Two-percent probability of exceedance in 50 years map of peak ground acceleration

* Approximate location of Welsh Power Plant

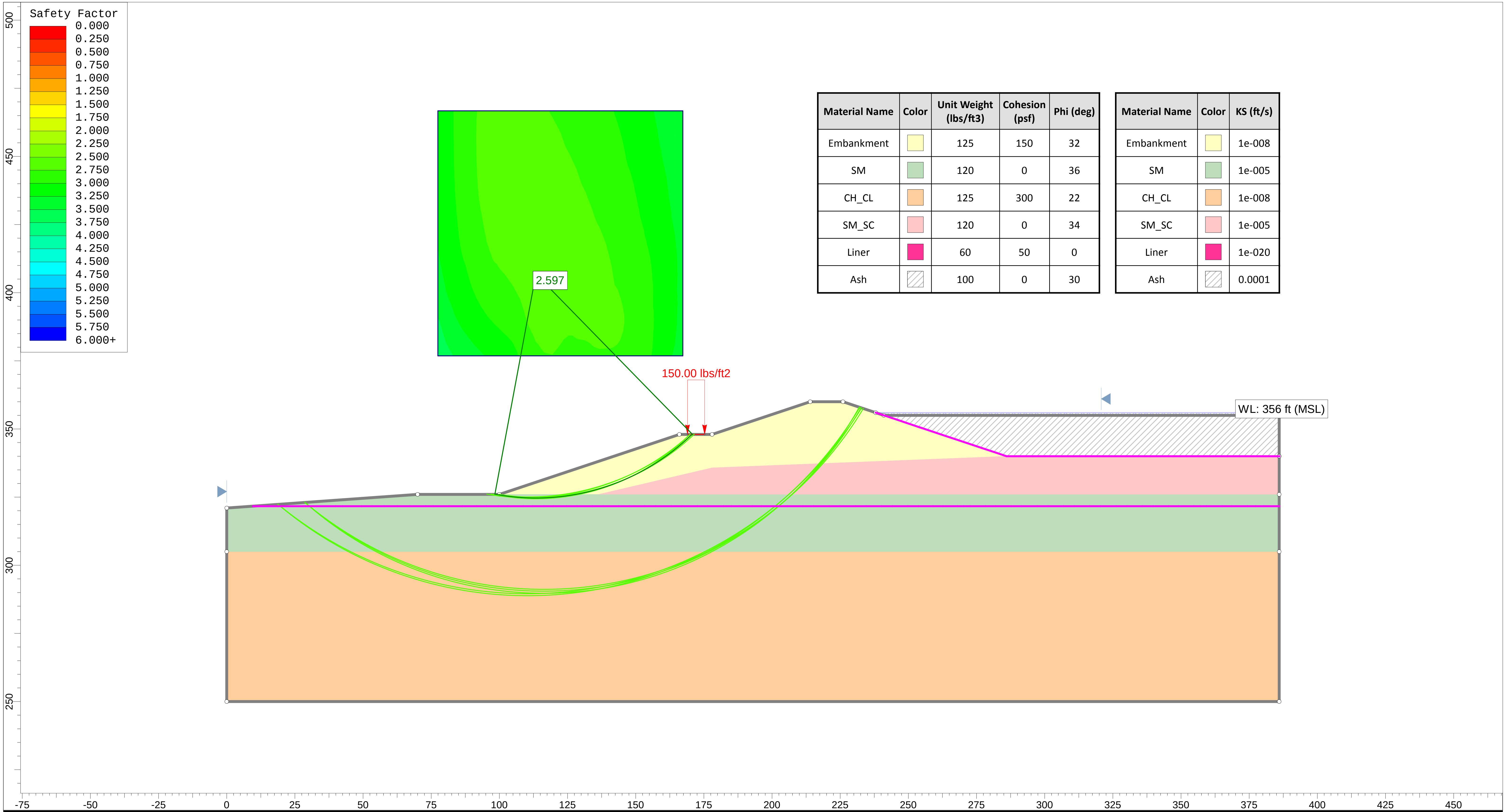
Provided by USGS National Seismic Hazard Mapping Project.

Seismic Probability Map

Scale: N/A

Auckland Project No. 2016-007

Welsh Power Plant
Initial Safety Factor Assessment - Bottom Ash Pond
Pittsburg, Texas



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	150	32
SM	🟩	120	0	36
CH_CL	🟧	125	300	22
SM_SC	🟥	120	0	34
Liner	🟪	60	50	0
Ash	▨	100	0	30

Material Name	Color	KS (ft/s)
Embankment	🟨	1e-008
SM	🟩	1e-005
CH_CL	🟧	1e-008
SM_SC	🟥	1e-005
Liner	🟪	1e-020
Ash	▨	0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project
Welsh Power Station - Bottom Ash Pond

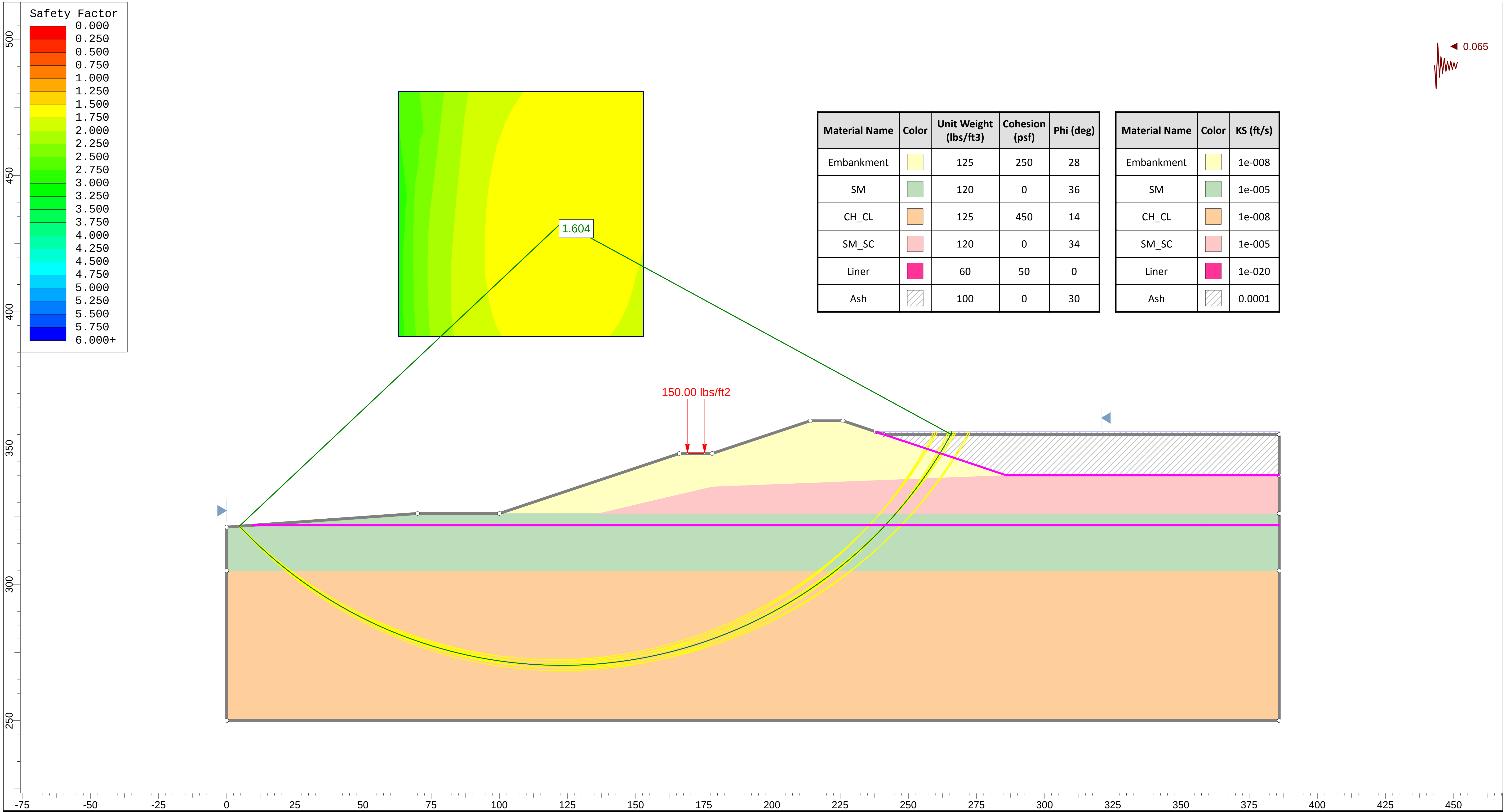
Analysis Description
Steady State Seepage at Maximum and Surcharge Pool

Drawn By
JJT

Company
Auckland

Date
7/11/2016, 3:30:13 PM

File Name
Winston_SS.slim



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	250	28
SM	🟩	120	0	36
CH_CL	🟧	125	450	14
SM_SC	🟥	120	0	34
Liner	🟥	60	50	0
Ash	▨	100	0	30

Material Name	Color	KS (ft/s)
Embankment	🟨	1e-008
SM	🟩	1e-005
CH_CL	🟧	1e-008
SM_SC	🟥	1e-005
Liner	🟥	1e-020
Ash	▨	0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project
Welsh Power Station - Bottom Ash Pond

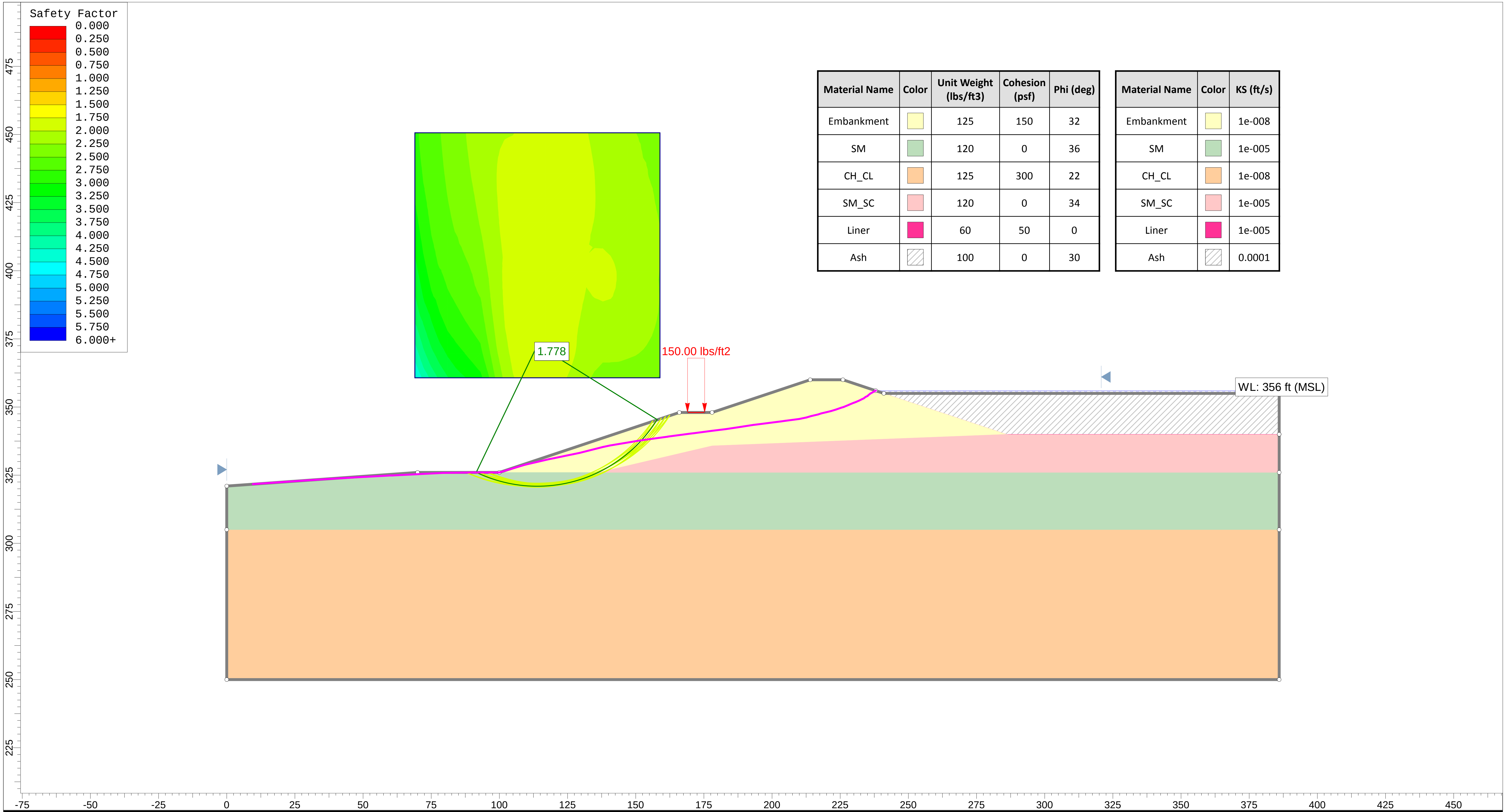
Analysis Description
Steady State Seepage at Maximum and Surcharge Pool, Seismic Analysis

Drawn By
JJT

Company
Auckland

Date
7/11/2016, 3:30:13 PM

File Name
Winston_SSS.slim



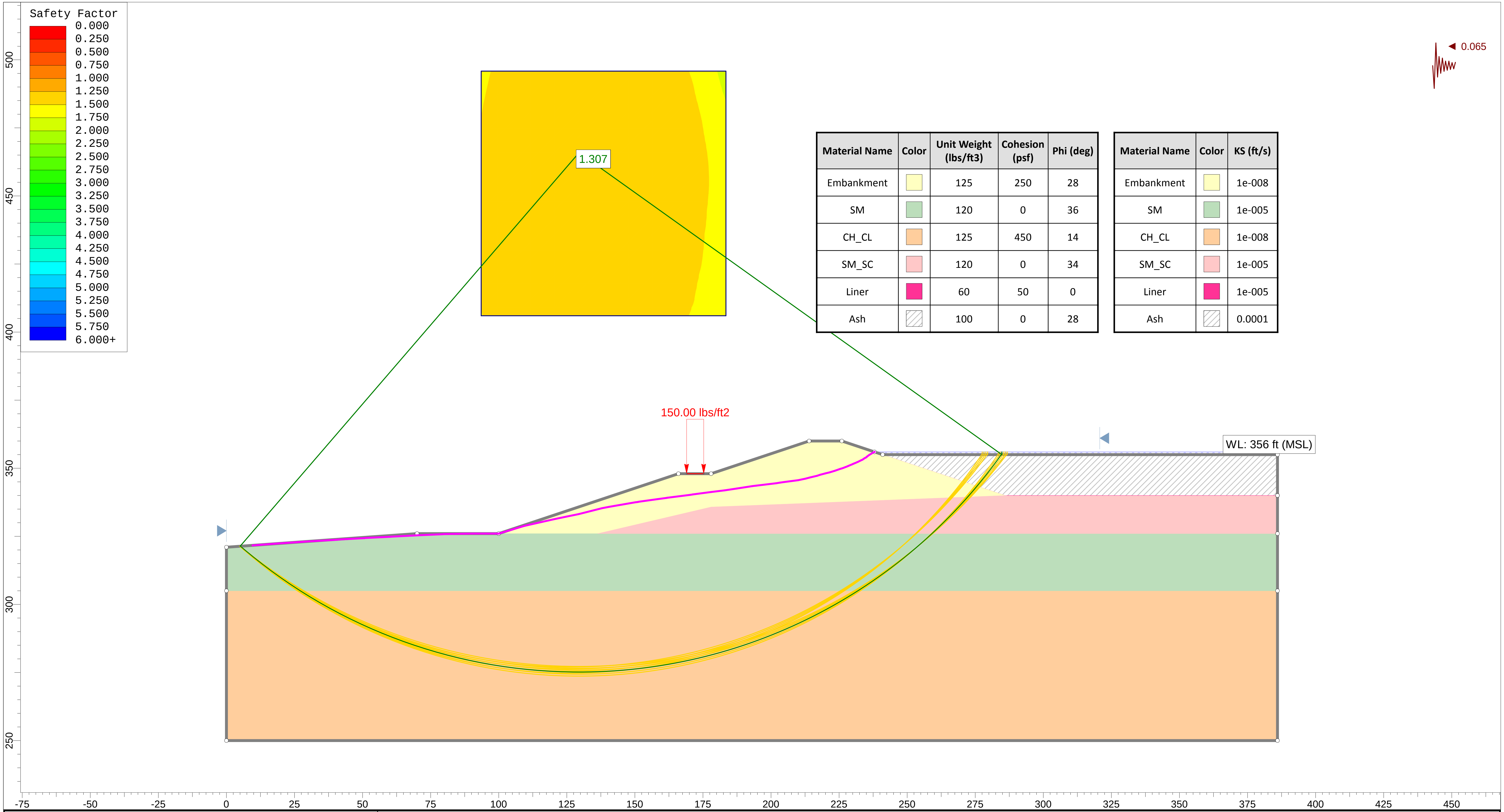
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	150	32
SM	🟩	120	0	36
CH_CL	🟧	125	300	22
SM_SC	🟥	120	0	34
Liner	🟪	60	50	0
Ash	▨	100	0	30

Material Name	Color	KS (ft/s)
Embankment	🟨	1e-008
SM	🟩	1e-005
CH_CL	🟧	1e-008
SM_SC	🟥	1e-005
Liner	🟪	1e-005
Ash	▨	0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project	Welsh Power Station - Bottom Ash Pond
Analysis Description	Steady State Seepage at Maximum and Surcharge Pool (assumed phreatic surface)
Drawn By JJT	*Company* Auckland
Date 7/11/2016, 3:30:13 PM	*File Name* Winston_SS_L.slim



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	250	28
SM	🟩	120	0	36
CH_CL	🟧	125	450	14
SM_SC	🟥	120	0	34
Liner	🟪	60	50	0
Ash	▨	100	0	28

Material Name	Color	KS (ft/s)
Embankment	🟨	1e-008
SM	🟩	1e-005
CH_CL	🟧	1e-008
SM_SC	🟥	1e-005
Liner	🟪	1e-005
Ash	▨	0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project	Welsh Power Station - Bottom Ash Pond		
Analysis Description	Steady State Seepage at Maximum and Surcharge Pool, Seismic Analysis (assumed phreatic surface)		
Drawn By	JJT	*Company*	Auckland
Date	7/11/2016, 3:30:13 PM	*File Name*	Winston_SSS_L.slim

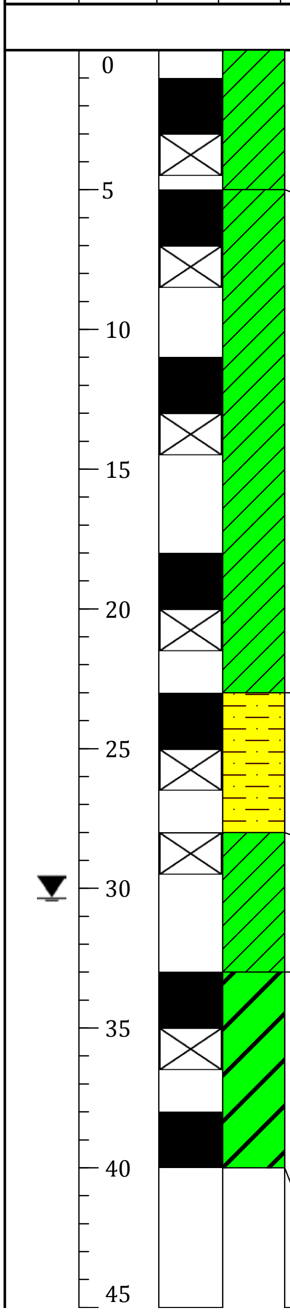
Auckland Consulting LLC

LOG OF BORING B2

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease

Project No.: 2016-007
Drill Date(s): 05/19/2016

GPS Coordinates: N33° 02' 38.1" W94° 50' 42.3"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Very Stiff, light gray, red and tan, Sandy Lean Clay (CL), mottled, interbedded sand seams		4.0		57	23	35	18	17	
- medium stiff, mottled	8								
Stiff, tan with gray and red, Sandy Lean Clay (CL), mottled		N/A							
	14			64	23	34	22	12	
- very stiff, between 11 to 18 ft		3.0	2.5	61	16	36	17	19	114
	15								
- hard, between 18 to 20 ft		4.5+							114
- stiff, below 20 ft	15			66	18	38	19	19	
Medium Dense, light gray with tan, Silt with Sand (ML), with few clay		N/A							
	19			73	17				
- medium stiff									
	40								
Hard, light gray with tan, Lean Clay (CL), interbedded sand seams									
Very Stiff, light gray with tan, Fat Clay (CH), interbedded sand seams		3.0		98	30	63	31	32	92
	18								
- dark gray, tan and red, with sand inclusions and ferrous partings below 38 ft		3.0							
Boring terminated at 40 feet.									

Additional Information/Comments:

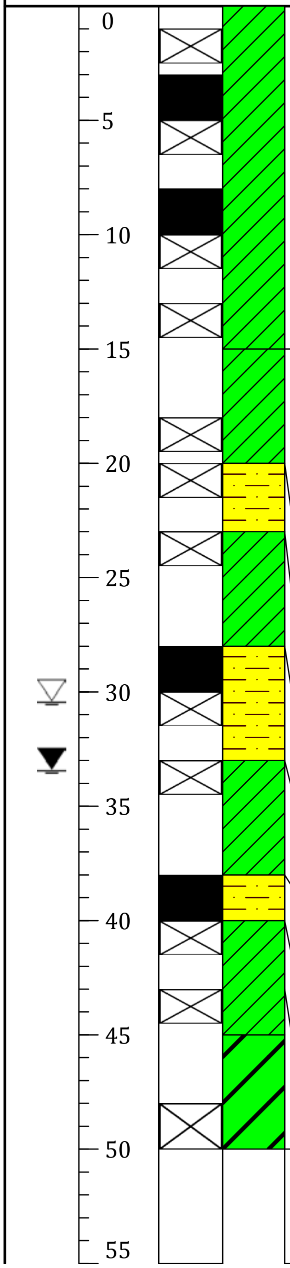
Logger: R. Pierson
Notes/Comments: Seepage encountered at 30 ft during drilling. Water level at 30 feet upon completion. Boring caved to 32 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B3

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 05/18/2016

GPS Coordinates: N33° 02' 39.2" W94° 50' 38.1"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Stiff, red, tan and gray, Sandy Lean Clay (CL), mottled	9								
		3.0		59	17	33	16	17	113
- with interbedded sand seams	13								
		1.5		67	18	39	21	18	111
- very stiff, tan, gray with red below 10 ft	18								
	16								
Very Stiff, red, brown, tan with gray, Lean Clay with Sand (CL), mottled, with interbedded sand seams		4.0	2.2	71	18	42	20	22	109
- clay with silt and organics (wood debris) at 18 ft	26			61	13				
	30			70	19				
Medium Dense, gray, Sandy Silt (ML), few organics (wood debris), few clay inclusions									
Very Stiff, tan, red and gray, Sandy Lean Clay (CL), mottled with silt		N/A		52	12	29	21	8	
	16								
Medium Dense, light gray and red, Sandy Silt (ML), mottled, few clay inclusions	19			91	29	36	24	12	
Very Stiff, tan, orange and red, Lean Clay (CL), mottled, laminated									
		N/A							
Light gray, tan and red, Sandy Silt (ML), mottled, few clay inclusions	35			70	24				
Hard, tan, gray with orange, Sandy Lean Clay (CL) with trace silt, mottled, laminated	34								
Very Stiff, gray, Fat Clay (CH), laminated	29			98	27	53	25	28	
Boring terminated at 50 feet.									

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 30 ft during drilling. Water level at 33 feet upon completion. Boring caved to 40 feet. N/A: Not Attempted

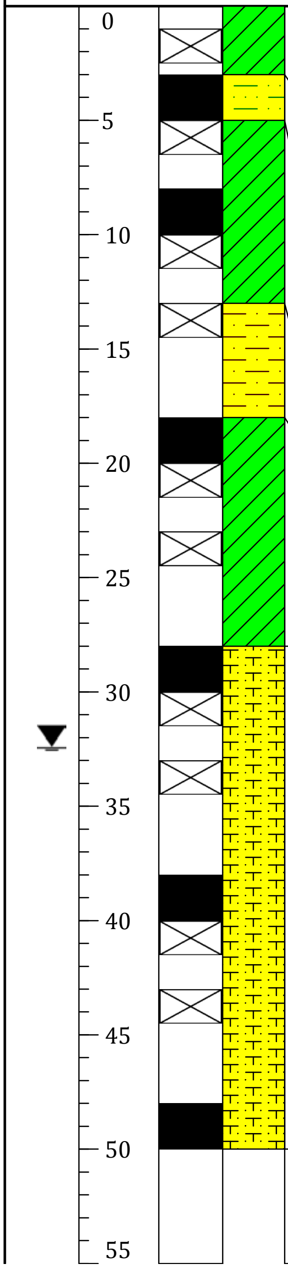
Auckland Consulting LLC

LOG OF BORING B4

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease

Project No.: 2016-007
Drill Date(s): 06/08/2016

GPS Coordinates: N33° 02' 43.1" W94° 50' 37.1"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Stiff, red, brown with gray, Sandy Lean Clay (CL), mottled	9			63	14	38	18	20	
		3.5		44	19	42	25	17	109
Medium Dense, light gray, red and brown, Clayey Sand (SC), mottled, laminated	15								
Very Stiff, light gray, tan and brown, Sandy Lean Clay (CL), mottled, slickensided		3.5		66	16	33	20	13	
	12								
- stiff, light gray, red and tan, with silt and sand seams below 10 ft	13			62	18				
Medium Dense, light gray and brown, Sandy Silt (ML), mottled, few clay inclusions									
		3.0		55	17	38	20	18	
Very Stiff, brown, gray and red, Sandy Lean Clay (CL), mottled	18								
	10								
- stiff below 23 ft									
Dense, brown, light gray and red, Silty Sand (SM)		N/A		43	16	NP	NP	NP	
	37								
- brown with red, some clay between 30 to 33 ft - very dense, light gray with tan below 33 ft	46			30	30	NP	NP	NP	
		N/A							116
	48								
	48								
		N/A		26	19	NP	NP	NP	
Boring terminated at 50 feet.									

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 32 ft during drilling. Water level at 32 feet upon completion. Boring caved to 40 feet. N/A: Not Attempted

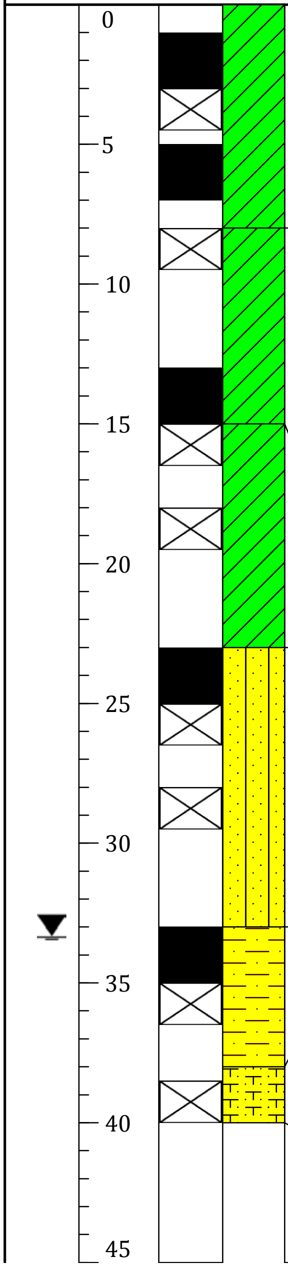
Auckland Consulting LLC

LOG OF BORING B5

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease

Project No.: 2016-007
Drill Date(s): 06/08/2016

GPS Coordinates: N33° 02' 45.0" W94° 50' 33.4"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Stiff, red, gray and brown, Sandy Lean Clay (CL), mottled		2.0		54	20	40	18	22	
	11								
- very stiff with sand lenses below 5 ft		2.5		60	17	44	20	24	119
	16								
Very Stiff, light gray and brown, Lean Clay with Sand (CL), mottled									
- stiff with sand and organics (root and wood debris) below 13 ft		2.0		79	18	35	17	18	110
	23			62	12	30	16	14	
Very Stiff, light brown with gray, Sandy Lean Clay (CL), with few organics (root debris)	6								
- medium stiff, silt with sand below 18 ft									
Medium Dense, light brown, tan with gray, Silty Clayey Sand (SC-SM), mottled, with organics (root debris) between 23 to 25 ft		N/A		47	10	31	23	8	
	26								
- very dense below 28 ft	34			44	20				
Very Dense, light gray with tan, Silt (ML)		N/A		91	27	NP	NP	NP	96
- sandy silt below 35 ft	68								
Very Dense, light gray with tan, Silty Sand (SM)	96			21	28				
Boring terminated at 40 feet.									

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 33 ft during drilling. Water level at 33 feet upon completion. Boring caved to 38 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B6

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 05/17/2016

GPS Coordinates: N33° 02' 43.0" W94° 50' 34.1"
Surface Elevation: 332 ft, MSL (approx)
Drilling Method: Dry Auger

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0												
		☒		Medium Dense, red, tan and brown, Silt with Sand (ML), mottled	16								
		☒		- with gray	23			73	19	NP	NP	NP	
	5												
▼		■		Medium Dense, tan, gray and brown, Silty Sand (SM), mottled		N/A							
▽													
		☒		- tan and gray below 8 ft	24			45	26	NP	NP	NP	
	10												
		☒		- very dense between 13 and 30 ft	57								
	15												
		☒			51			47	27				
	20												
		☒		- few clay inclusions below 23 ft	73								
	25												
		■				N/A		36	29	NP	NP	NP	122
	30												
		☒		- dense with few clay inclusions between 30 and 33 ft	34								
		☒		- very dense below 33 ft	79								
	35												
		☒		Medium Dense, dark gray, tan and red, Clayey Sand (SC), few silt, trace gypsum	27			39	25	47	21	26	
	40												
				Boring terminated at 40 feet.									
	45												

Additional Information/Comments:

Logger: R. Pierson

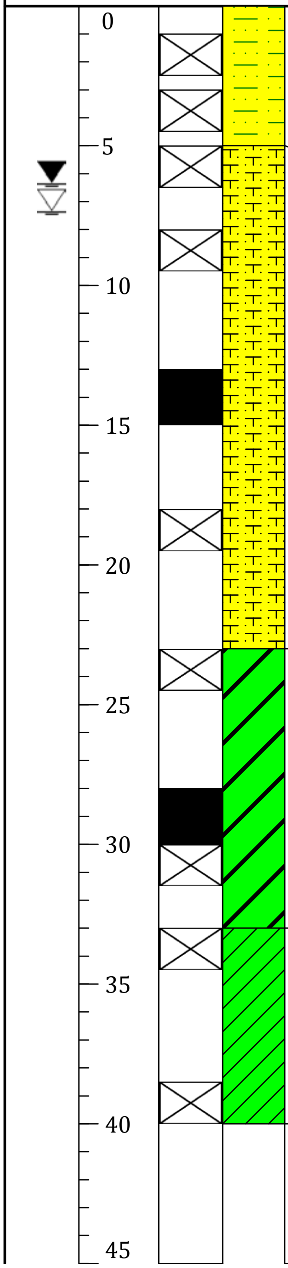
Notes/Comments: Seepage encountered at 8 ft during drilling. Water level at 6 feet upon completion.
Boring caved to 15 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B7

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 05/17/2016

GPS Coordinates: N33° 02' 40.8" W94° 50' 36.5"
Surface Elevation: 328 ft, MSL (approx)
Drilling Method: Dry Auger



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Loose, red, brown and tan, Clayey Sand (SC), few organics	8								
- medium dense, gray and tan below 3 ft	26			40	22				
Dense, tan, gray and red, Silty Sand (SM)	32			31	24	NP	NP	NP	
	47								
- light gray with tan, with few clay inclusions between 13 and 18 ft		N/A		31	26	NP	NP	NP	100
- medium dense below 18 ft	30								
Medium Stiff, tan, orange and brown, Fat Clay (CH), laminated with gypsum	5			92	31	55	22	33	
		N/A							
- very stiff below 30 ft	29								
Hard, dark gray and gray, Lean Clay with Sand (CL), laminated with gypsum	57			73	23	33	18	15	
	36								
Boring terminated at 40 feet.									

Additional Information/Comments:

Logger: R. Pierson

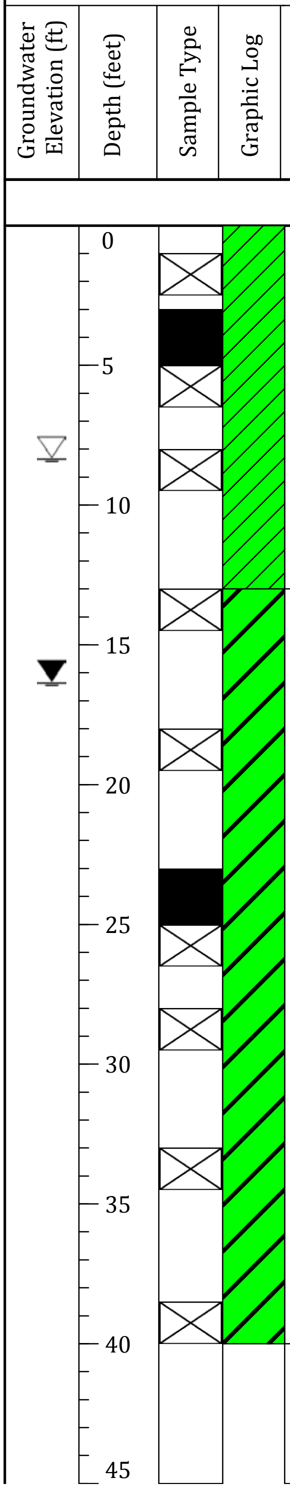
Notes/Comments: Seepage encountered at 7 ft during drilling. Water level at 6 feet upon completion. Boring caved to 35 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B8

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 05/18/2016

GPS Coordinates: N33° 02' 37.8" W94° 50' 38.0"
Surface Elevation: 338 ft, MSL (approx)
Drilling Method: Dry Auger



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Stiff, gray, red and tan, Sandy Lean Clay (CL), mottled	12								
		4.5+	1.8	51	18	33	18	15	115
- very stiff between 5 and 8 ft	22								
- stiff, gray and light brown, mottled with interbedded sand seams below 8 ft	11			57	23				
Stiff, light brown and gray, Fat Clay (CH), laminated, few ferrous partings	13								
- very stiff, dark gray with brown, gypsum below 18 ft	28			60	25	58	32	26	
- laminated with gypsum, interbedded sand seams below 23 ft		2.5							
	22								
	30			88	19	63	32	31	
- hard below 33 ft	38								
	34			85	29				
Boring terminated at 40 feet.									

Additional Information/Comments:

Logger: R. Pierson
Notes/Comments: Seepage encountered at 8 ft during drilling. Water level at 16 feet upon completion.
Boring caved to 26 feet. N/A: Not Attempted

Auckland Consulting LLC

Boring Log Terms and Symbols

Symbols and Sampler Types

■	Thin-walled Tube (Shelby Tube)
☒	Standard Penetration Test (SPT)
◩	Auger Sample
⧗	Texas Cone Penetration Test (TCP)
▼	Observed Static-Water Level
▽	Observed Free Water (Seepage)

Soil Consistency and Structure

Strength of Fine Grained Soils		
Consistency	**SPT (Blows/ft)**	**UCS (tsf)**
Very Soft	< 2	< 0.25
Soft	2 – 4	0.25 – 0.5
Medium Stiff	4 – 8	0.5 – 1.0
Stiff	8 – 15	1.0 – 2.0
Very Stiff	15 – 30	2.0 – 4.0
Hard	> 30	> 4.0

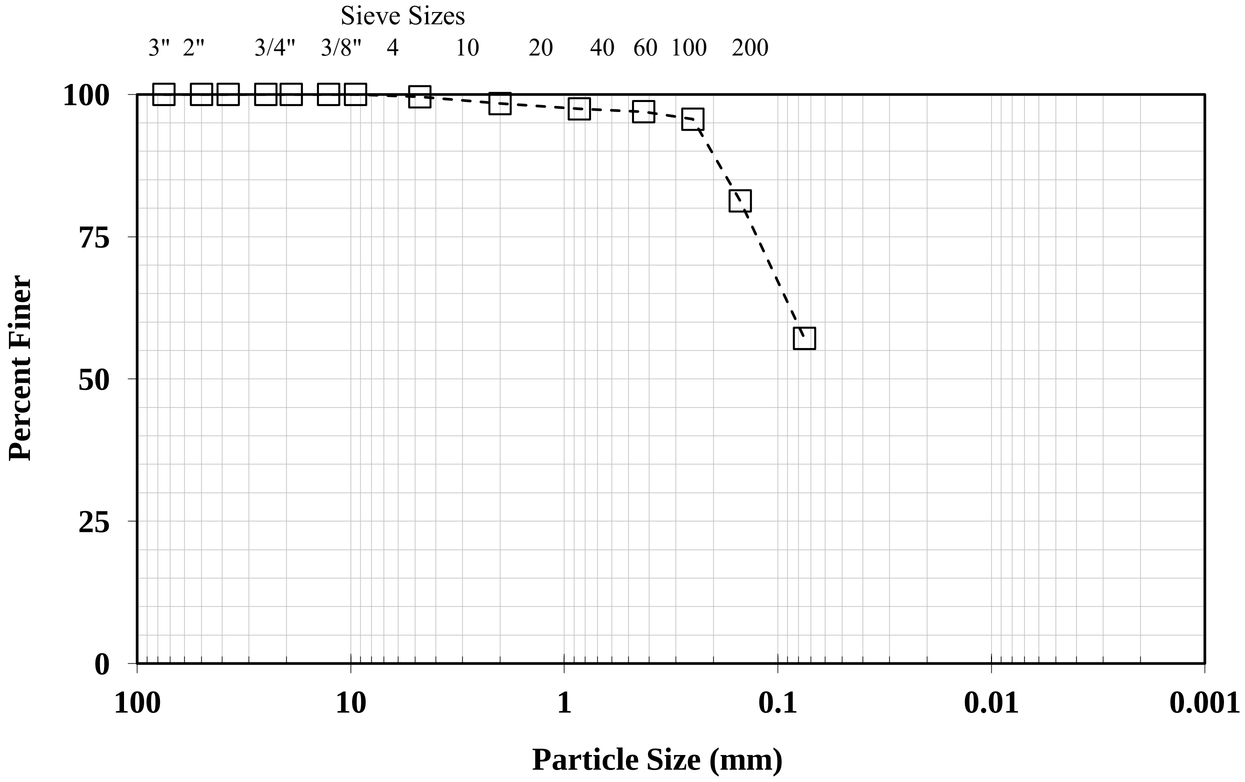
Density of Coarse Grained Soils		
Consistency	**SPT (Blows/ft)**	**TCP (Blows/ft)**
Very Loose	0 – 4	< 8
Loose	5 – 10	9 – 20
Medium Dense	11 – 30	21 – 60
Dense	31 – 50	61 -100
Very Dense	> 50	> 100

Soil Structure - Description	
Description	**Explanation**
Laminated	Alternating layers of varying material or color.
Slickensided	Fractured polished planes, little resistance to fracturing
Blocky	Cohesive soil that can be broken into small angular pieces.
Lensed	Inclusion of small pockets of different soils
Homogeneous	Same appearance and color throughout

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2 1-3

TRI Log#: 20888.1
Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	99.6
No. 10 (2.00 mm)	98.4
No. 20 (0.841 mm)	97.5
No. 40 (0.420 mm)	97.0
No. 60 (0.250 mm)	95.6
No. 100 (0.149 mm)	81.3
No. 200 (0.074 mm)	57.1
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

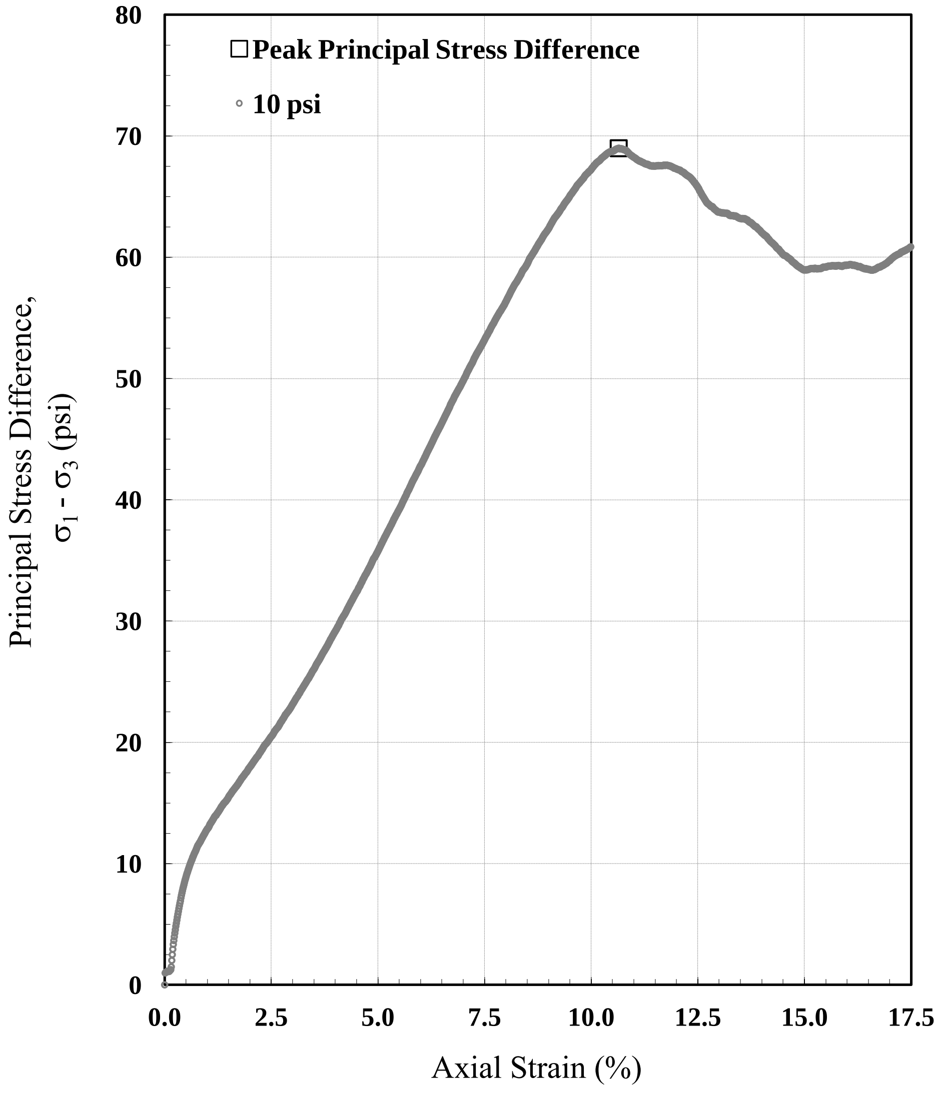
USCS Classification (ASTM D2487)	Sandy lean clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	23.0
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	35
	Plastic Limit	18
	Plastic Index	17
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

TRI
TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

Unconsolidated-Undrained (Q) Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D2850
Sample:	B2: 11-13		



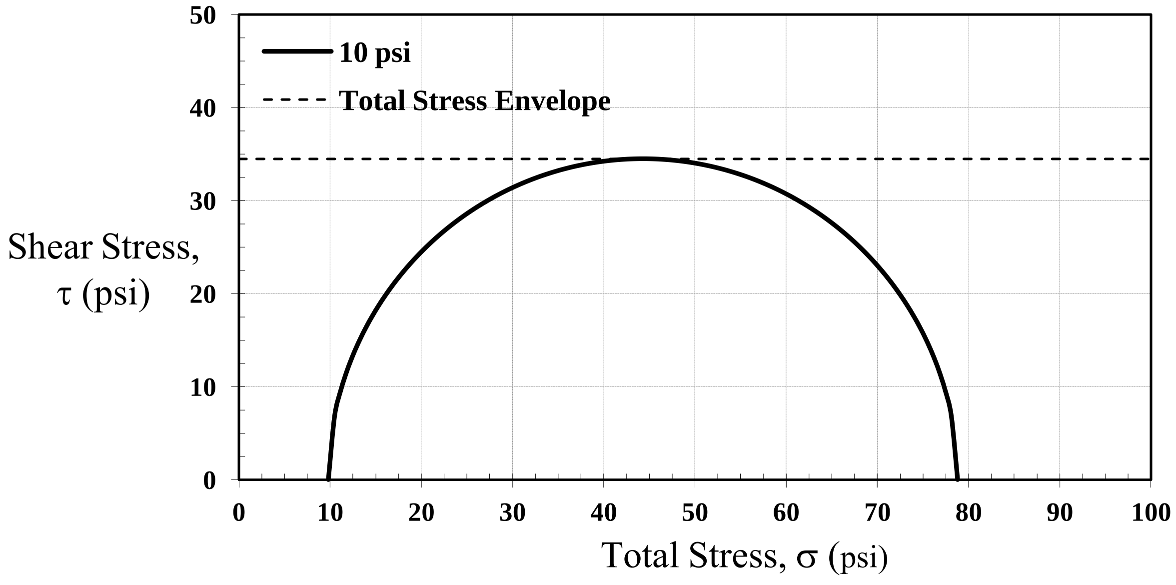
Test Parameters	
Minor Principal Stress (psi)	10.0
Rate of Strain (%/hr)	60

Initial Properties	
Avg. Diameter (in)	2.84
Avg. Height (in)	5.61
Avg. Water Content (%)	15.5
Bulk Density (pcf)	132.1
Dry Density (pcf)	114.4
Saturation (%)	92.0
Void Ratio	0.45
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	10.6
Minor Total Stress (psi)	10.0
Major Total Stress (psi)	79.0
Principal Stress Diff. (psi)	69.0

Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	34.5
S_u / σ_3	3.4

Note: The Mohr failure envelope was taken as a horizontal straight line. It should, however, be noted that the specimen was partially saturated.



Jeffrey A. Kuhn , Ph.D., P.E., 6/30/2016

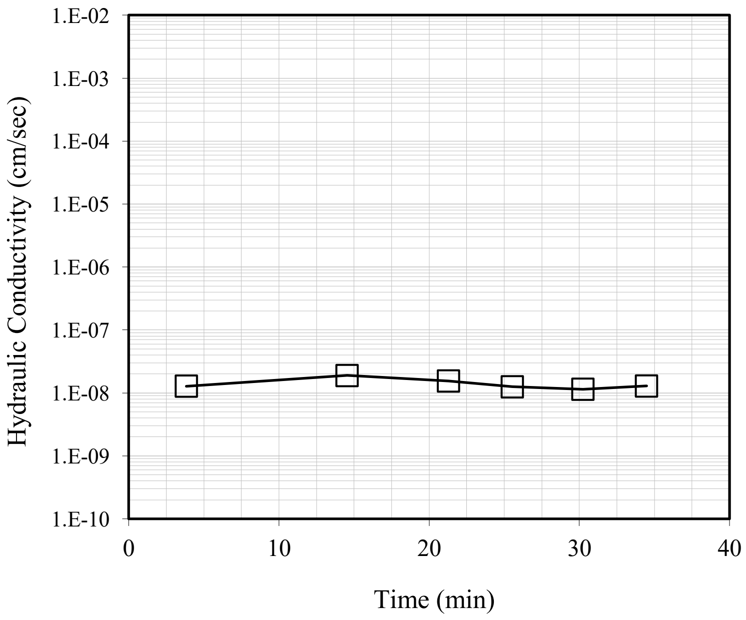
Analysis & Quality Review/Date

Laboratory Staff: LC

Hydraulic Conductivity

Client:	Auckland Consulting LLC
Project:	Winston Pond
Sample ID:	B2: 18-20

TRI Log #:	20888
Test Method:	ASTM D5084 Method F



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.82
Height (in)	1.81
Initial Mass (g)	389.6
Sample Area (in^2)	6.25
Water Content (%)	15.5
Total Unit Weight (pcf)	131.4
Dry Unit Weight (pcf)	113.8
Specific Gravity (Assumed)	2.65
Degree of Saturation	90.4
Void Ratio	0.45
Porosity	0.31
1 Pore Volume (cc)	57.7
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.96

Specimen Image

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
21.3	1.5E-08
25.5	1.3E-08
30.2	1.1E-08
34.5	1.3E-08
Average, Last 2 Readings	**1.2E-08**

Note: Permeation measurements were made with a mercury U-tube.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016

Analysis & Quality Review/Date

Testing Performed By: SOC & LC

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B2: 33-35		

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	14.2	28.3	42.5
Initial Specimen Properties			
Avg. Diameter (in)	2.05	2.05	2.05
Avg. Height (in)	4.33	4.33	4.33
Avg. Water Content (%)	30.8	-	-
Bulk Density (pcf)	119.7	119.7	119.7
Dry Density (pcf)	91.5	-	-
Saturation (%)	98.8	-	-
Void Ratio, n	0.84	0.84	0.84
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	79.7	80.0	80.2
B-Value, End of Saturation	0.96	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.82	0.82	0.82
Area (in^2)	3.28	3.28	3.28

Shear / Post-Shear			
Avg. Water Content (%)	-	-	29.7
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	1.0	1.5	1.9
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	5.6	11.9	20.5
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	15.8	25.5	34.0
Pore Water Pressure, Δu_f (psi)	-	-	-	9.8	17.2	22.6
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	21.4	37.4	54.5
Effective Friction Angle (degrees)	-			22.1		
Effective Cohesion (psi)	-			3.3		

R-Envelope, "Total" Stress		
Friction Angle (deg)	-	14.3
Cohesion (psi)	-	2.3

Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

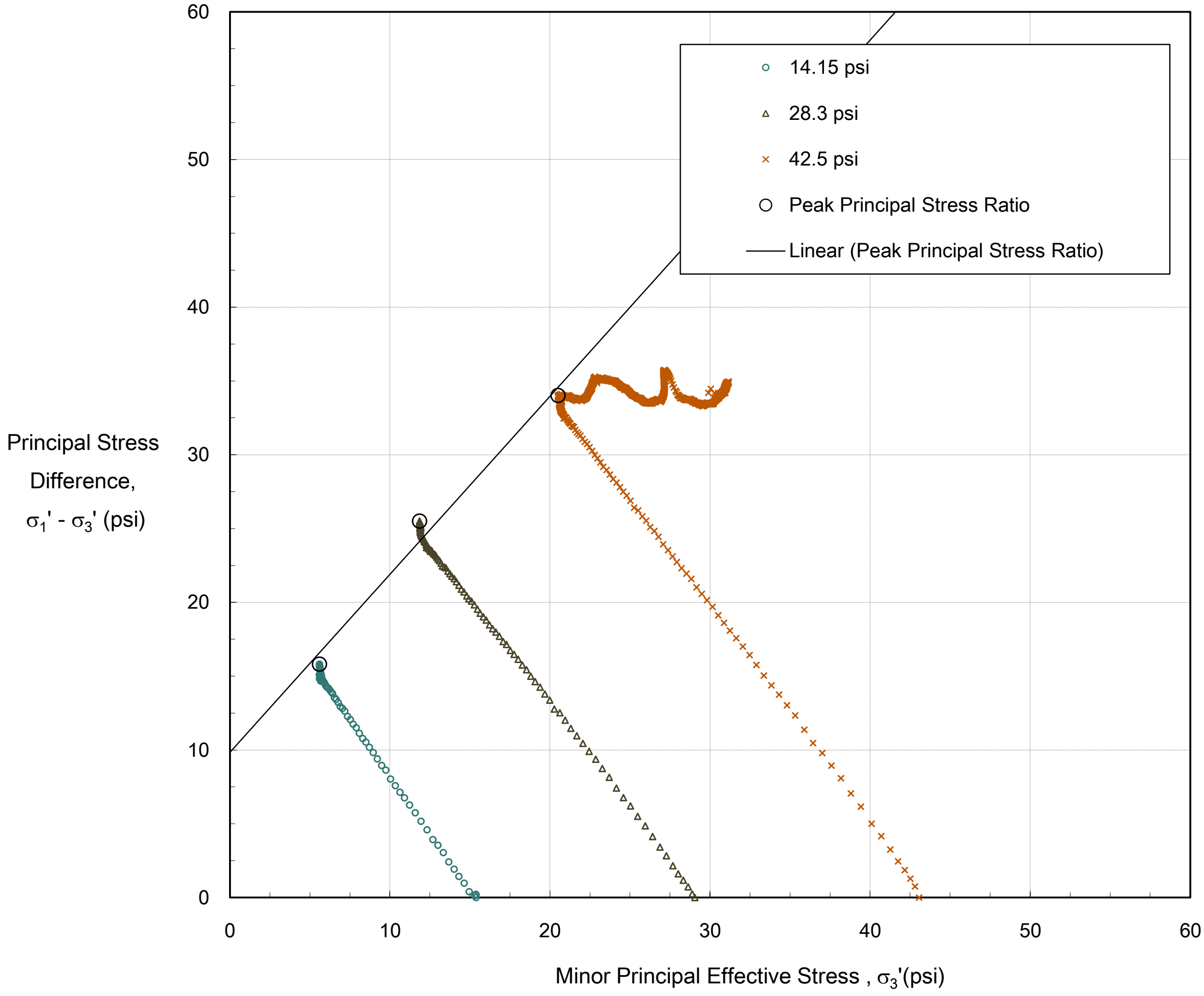
Jeffrey A. Kuhn , Ph.D., P.E., 7/12/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2: 33-35

TRI Log #: 20888
Test Method: ASTM D4767 Mod

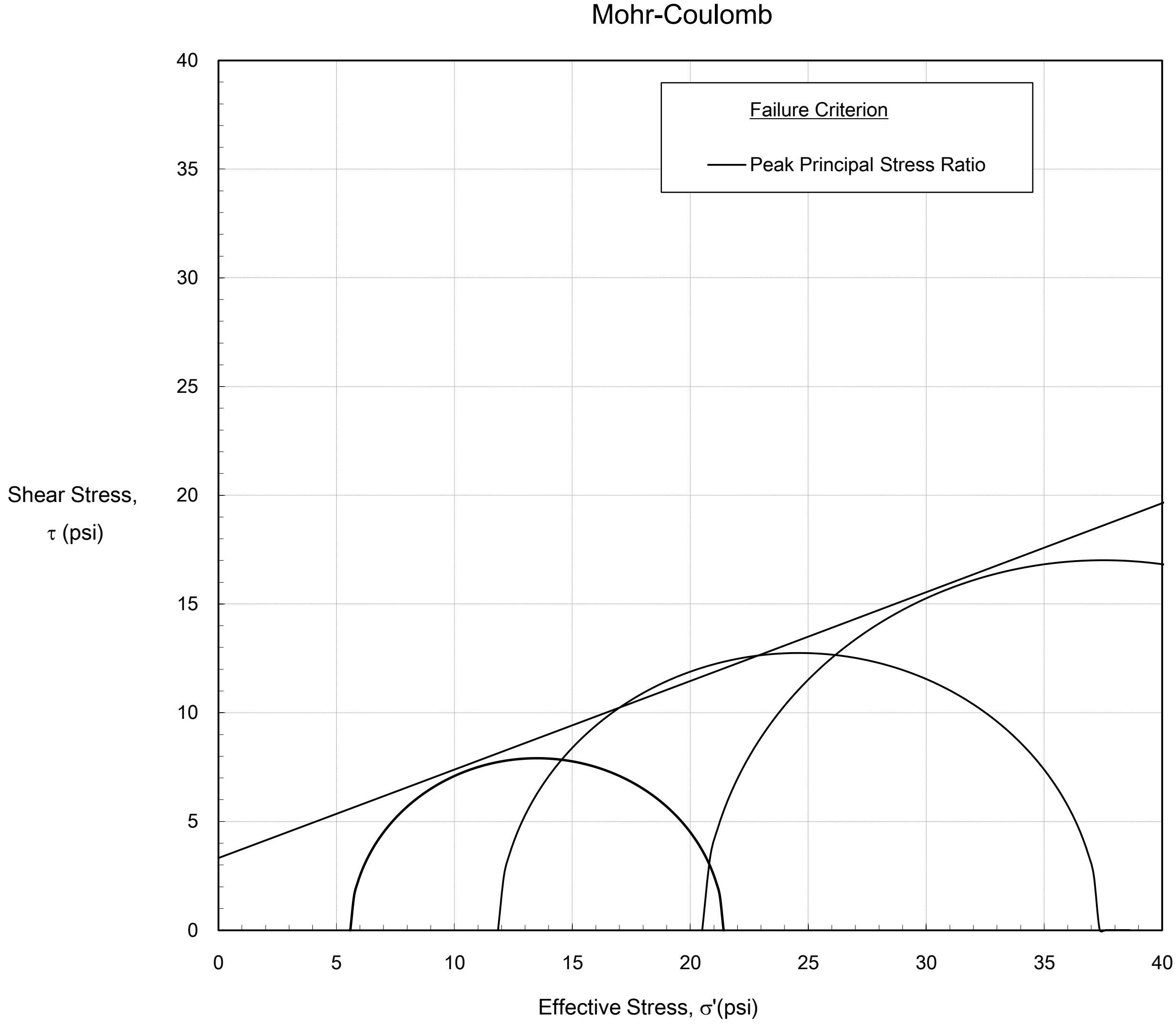
Modified Mohr-Coulomb



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	22.1
Effective Cohesion (psi)	-	3.3

Multi-Stage Consolidated-Undrained Triaxial Compression

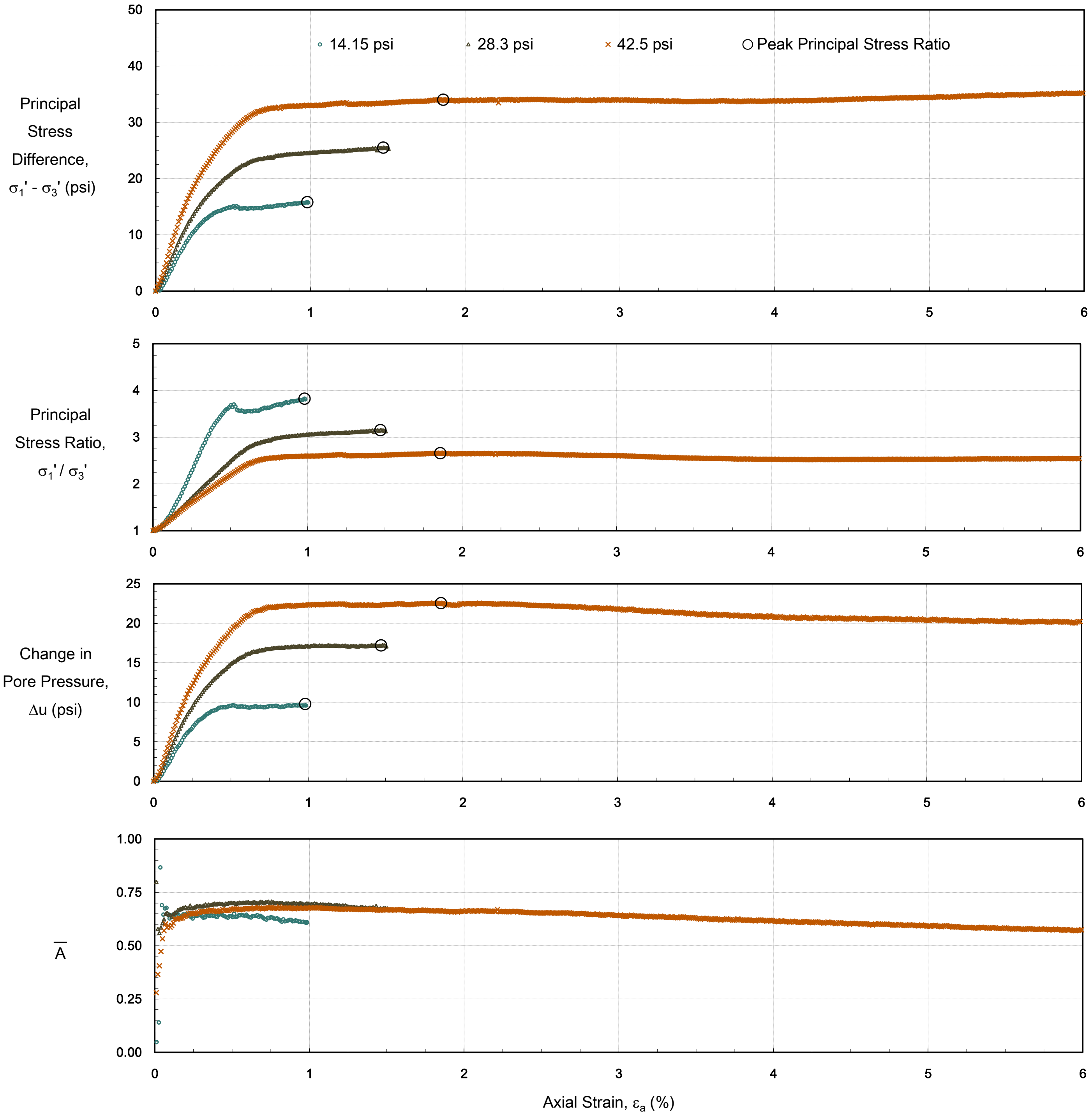
Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B2: 33-35		



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	22.1
Effective Cohesion (psi)	-	3.3

Multi-Stage Consolidated-Undrained Triaxial Compression

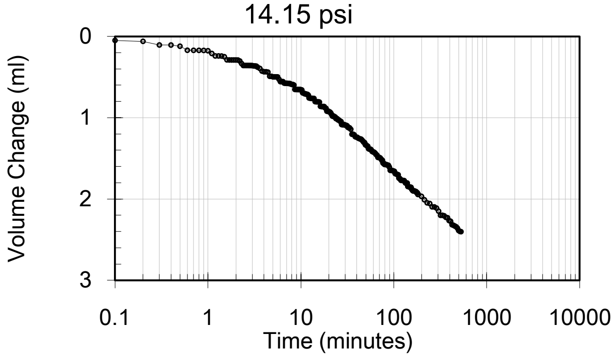
Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B2: 33-35		

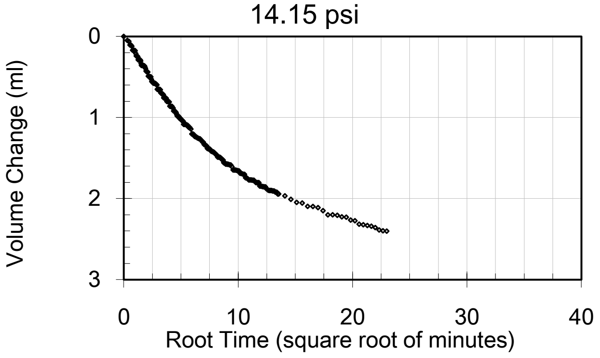


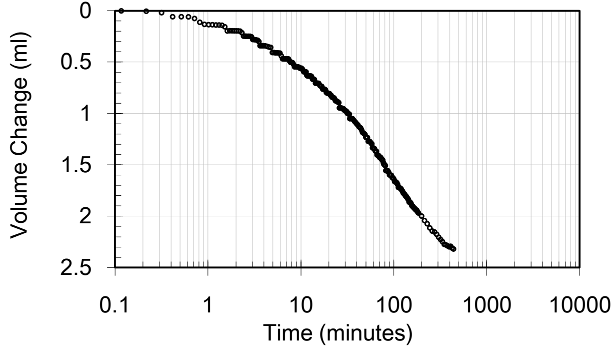
Multi-Stage Consolidated-Undrained Triaxial Compression

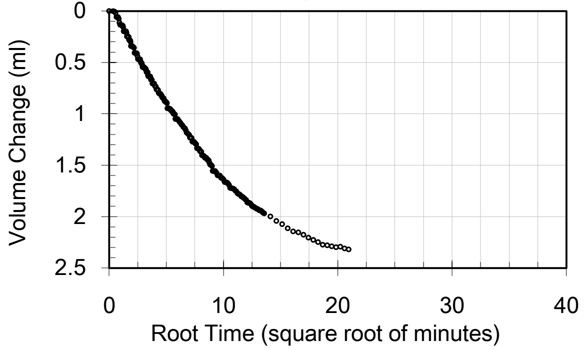
Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B2: 33-35		

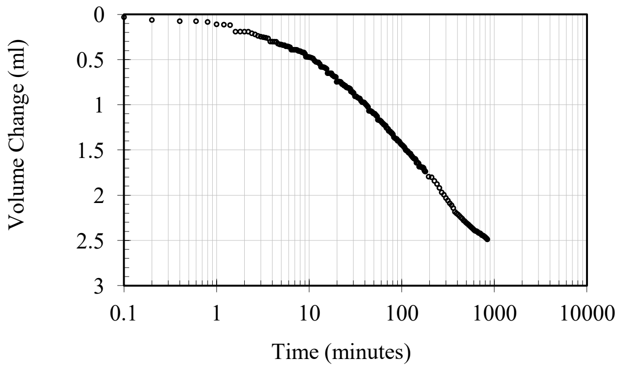
Consolidation

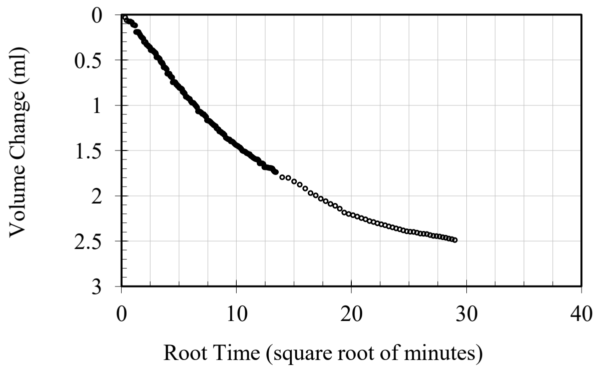

14.15 psi


14.15 psi


28.3 psi

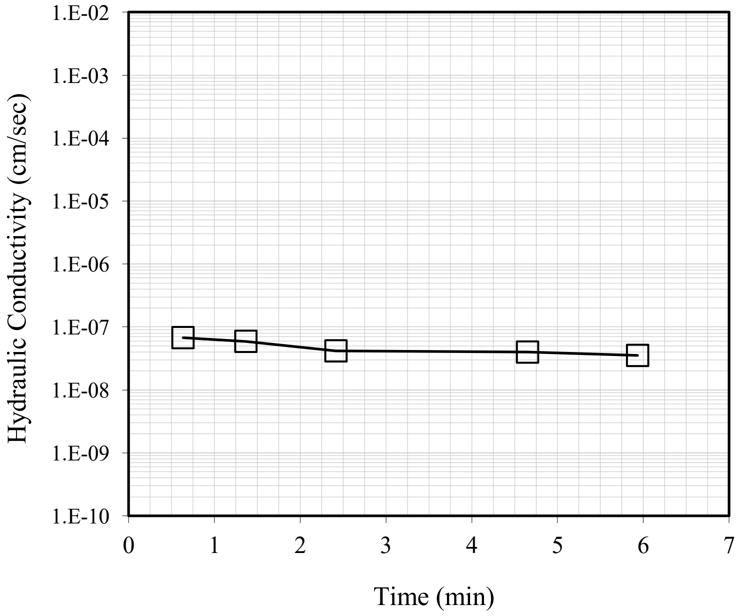

28.3 psi


42.5 psi


42.5 psi

Hydraulic Conductivity

Client:	Auckland Consulting LLC
Project:	Winston Pond
Sample ID:	B3: 3-5
TRI Log #:	20888
Test Method:	ASTM D5084 Method F



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.83
Height (in)	1.59
Initial Mass (g)	341.8
Sample Area (in^2)	6.28
Water Content (%)	15.9
Total Unit Weight (pcf)	130.4
Dry Unit Weight (pcf)	112.6
Specific Gravity (Assumed)	2.65
Degree of Saturation	89.6
Void Ratio	0.47
Porosity	0.32
1 Pore Volume (cc)	52.2
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.96

Specimen Image

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
1.4	5.9E-08
2.4	4.2E-08
4.6	4.0E-08
5.9	3.5E-08
Average, Last 2 Readings	**3.8E-08**

Note: Permeation measurements were made with a mercury U-tube.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016

Analysis & Quality Review/Date

Testing Performed By: SOC & LC

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

TRI Log #: 20888
Test Method: ASTM D4767 Mod

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	3.8	7.5	15.0
Initial Specimen Properties			
Avg. Diameter (in)	2.05	2.05	2.05
Avg. Height (in)	4.46	4.46	4.46
Avg. Water Content (%)	17.8	-	-
Bulk Density (pcf)	130.1	130.1	130.1
Dry Density (pcf)	110.5	-	-
Saturation (%)	91.3	-	-
Void Ratio, n	0.53	0.53	0.53
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	81.1	81.1	81.1
B-Value, End of Saturation	1.00	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.51	0.51	0.51
Area (in^2)	3.27	3.27	3.26

Shear / Post-Shear			
Avg. Water Content (%)	-	-	19.9
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	1.0	0.8	2.7
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	2.2	4.4	10.1
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	7.0	11.6	28.5
Pore Water Pressure, Δu_f (psi)	-	-	-	1.6	3.1	4.9
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	9.2	16.0	38.6
Effective Friction Angle (degrees)	-			35.1		
Effective Cohesion (psi)	-			0.1		

R-Envelope, "Total" Stress		
Friction Angle (deg)	-	28.5
Cohesion (psi)	-	0 (Forced)

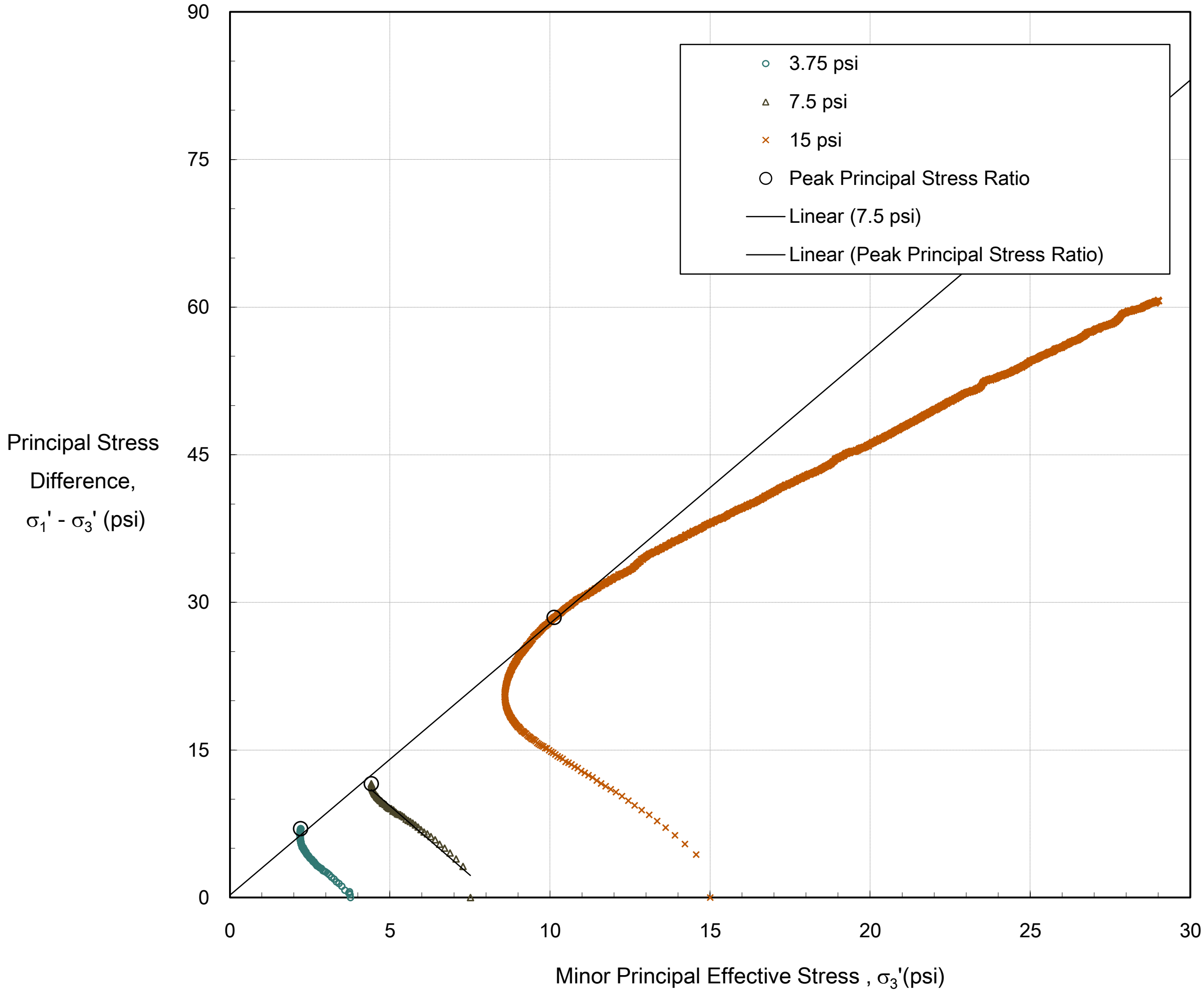
Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/13/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B3: 8-10		

Modified Mohr-Coulomb



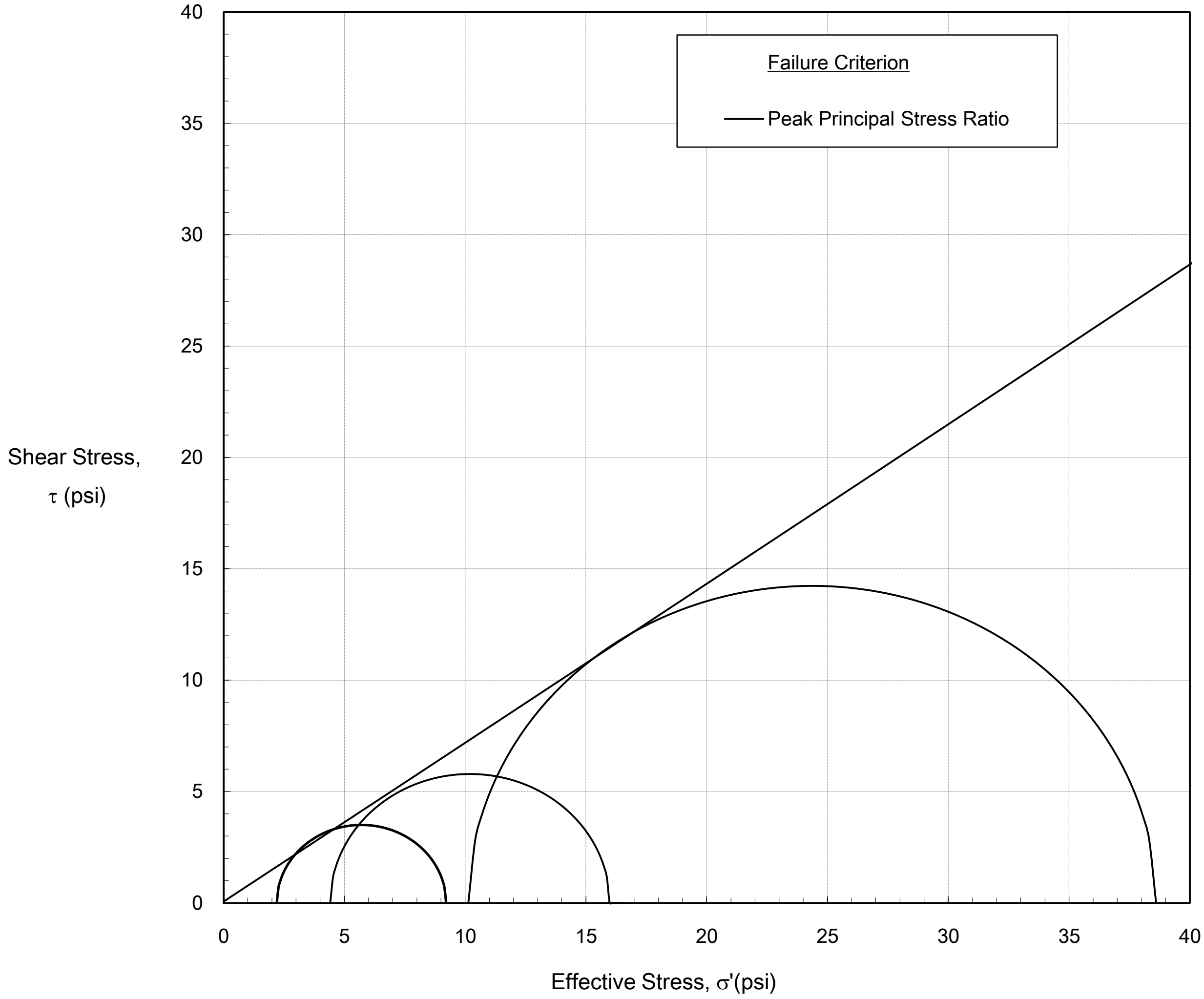
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	35.1
Effective Cohesion (psi)	-	0.1

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

TRI Log #: 20888
Test Method: ASTM D4767 Mod

Mohr-Coulomb

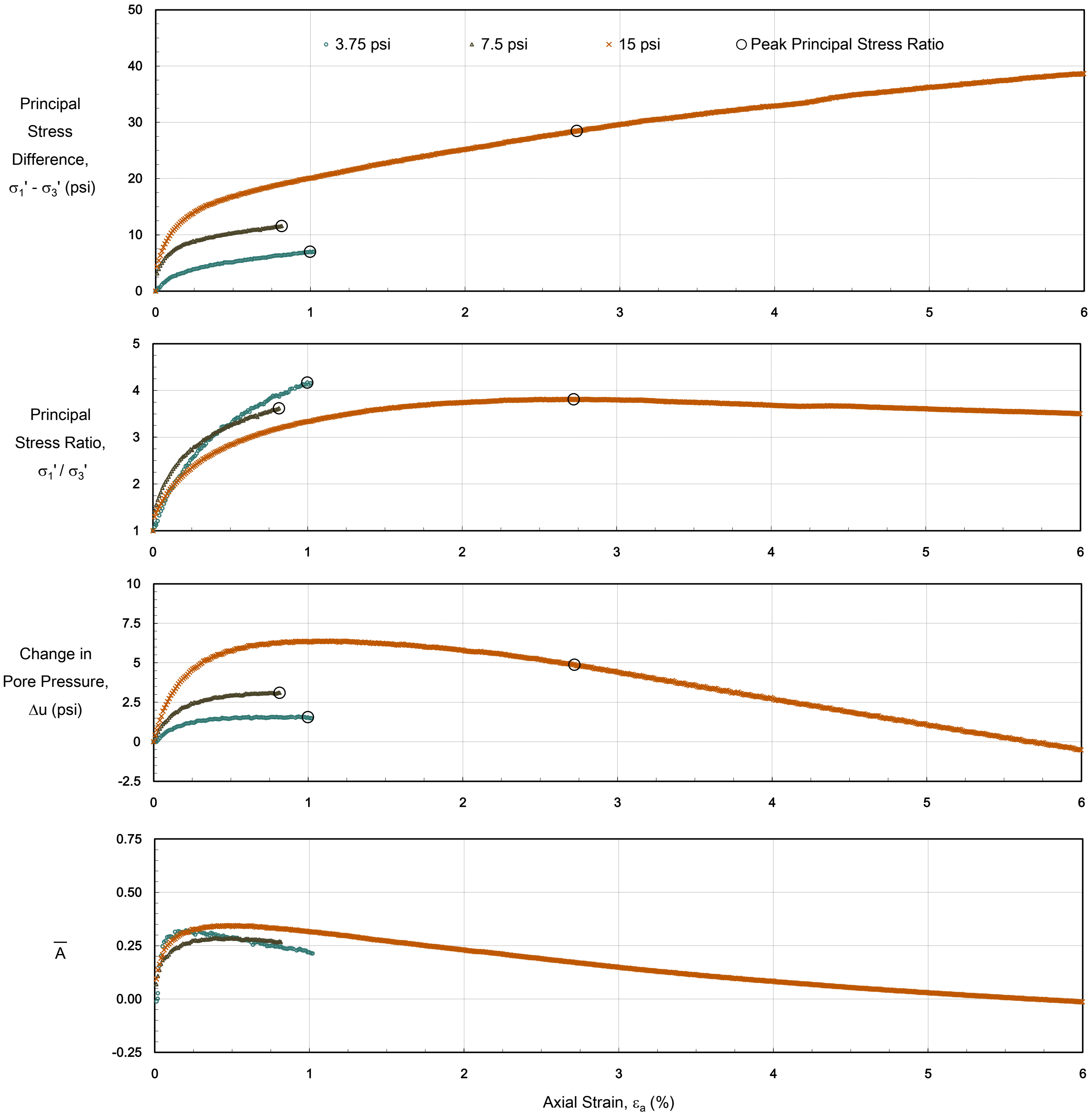


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	35.1
Effective Cohesion (psi)	-	0.1

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

TRI Log #: 20888
Test Method: ASTM D4767 Mod



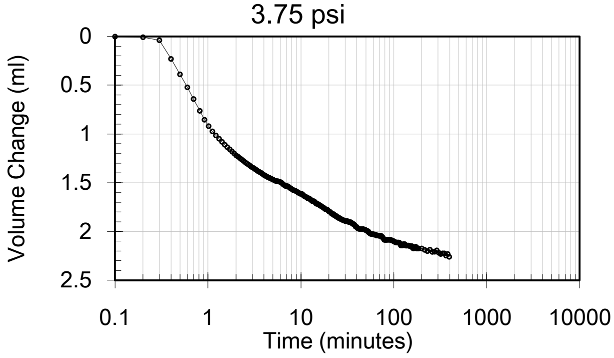
Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

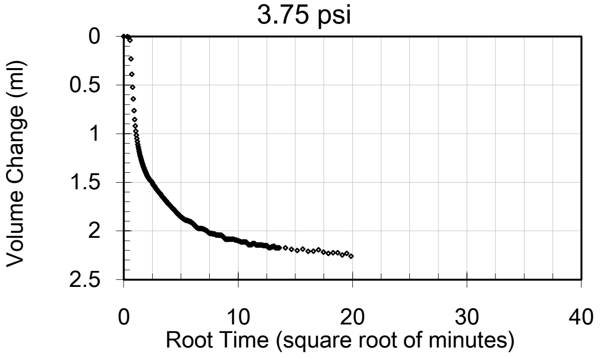
TRI Log #: 20888
Test Method: ASTM D4767 Mod

Consolidation

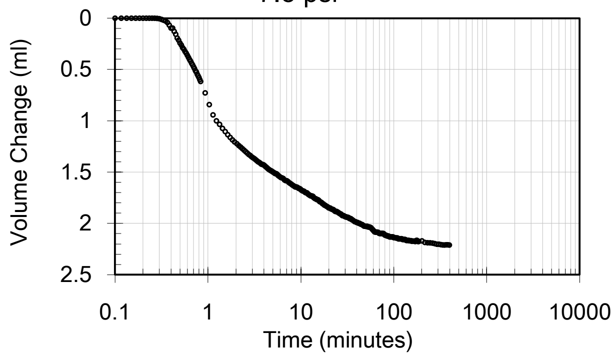
3.75 psi



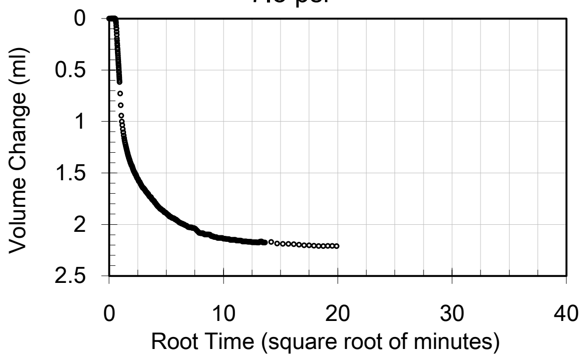
3.75 psi



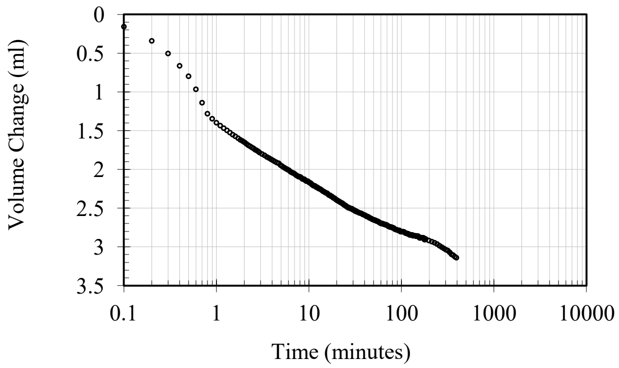
7.5 psi



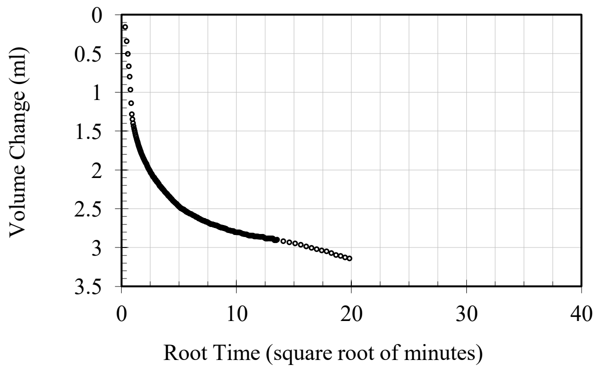
7.5 psi



15 psi



15 psi



Unconsolidated-Undrained (Q) Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 18-19

TRI Log #: 20888
Test Method: ASTM D2850

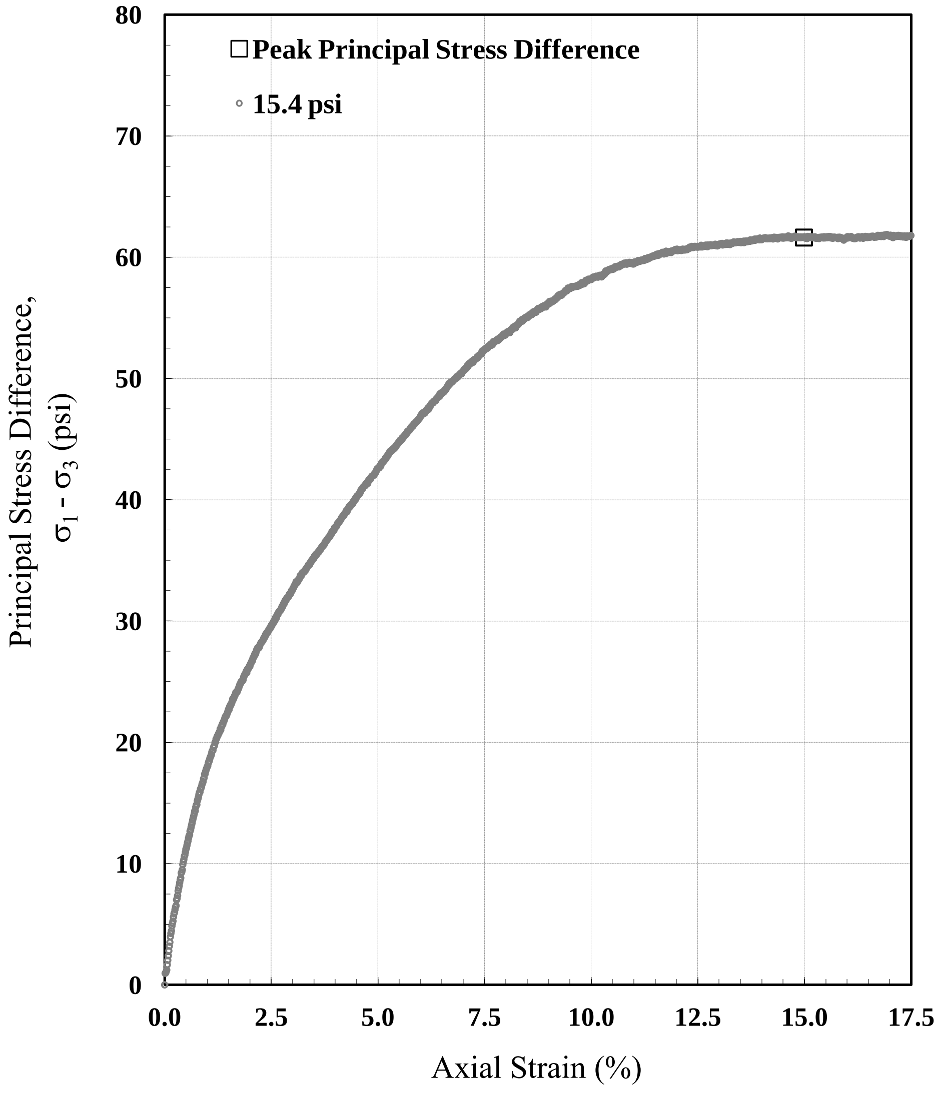
Test Parameters	
Minor Principal Stress (psi)	15.4
Rate of Strain (%/hr)	60

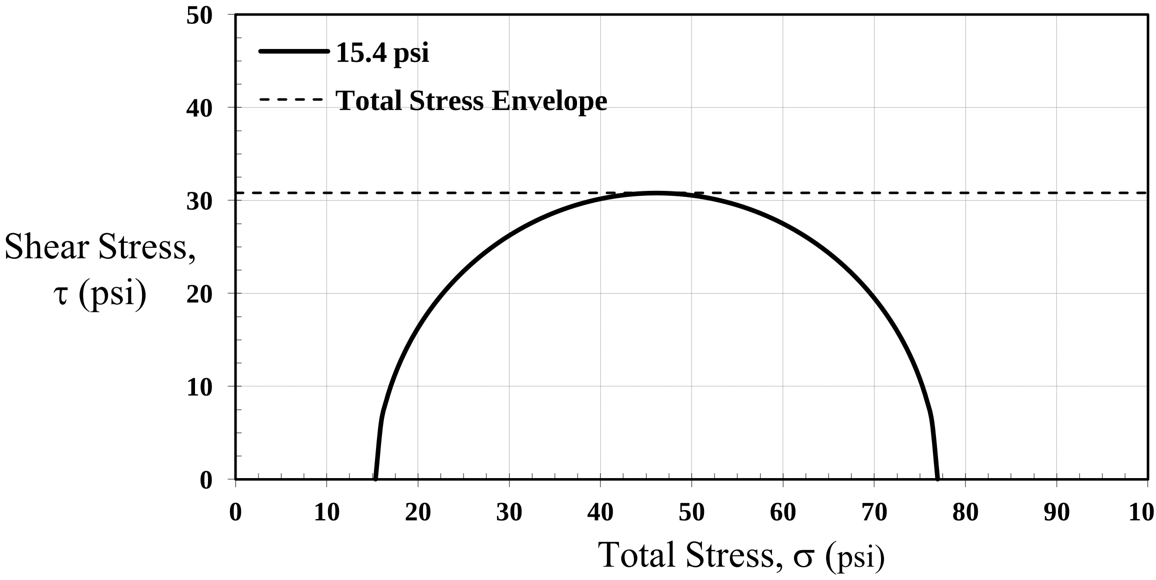
Initial Properties	
Avg. Diameter (in)	1.31
Avg. Height (in)	2.55
Avg. Water Content (%)	18.6
Bulk Density (pcf)	129.6
Dry Density (pcf)	109.2
Saturation (%)	95.9
Void Ratio	0.51
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	15.0
Minor Total Stress (psi)	15.4
Major Total Stress (psi)	77.0
Principal Stress Diff. (psi)	61.6

Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	30.8
S_u / σ_3	2.0

Note: The Mohr failure envelope was taken as a horizontal straight line. It should, however, be noted that the specimen was partially saturated.





Jeffrey A. Kuhn , Ph.D., P.E., 6/30/2016

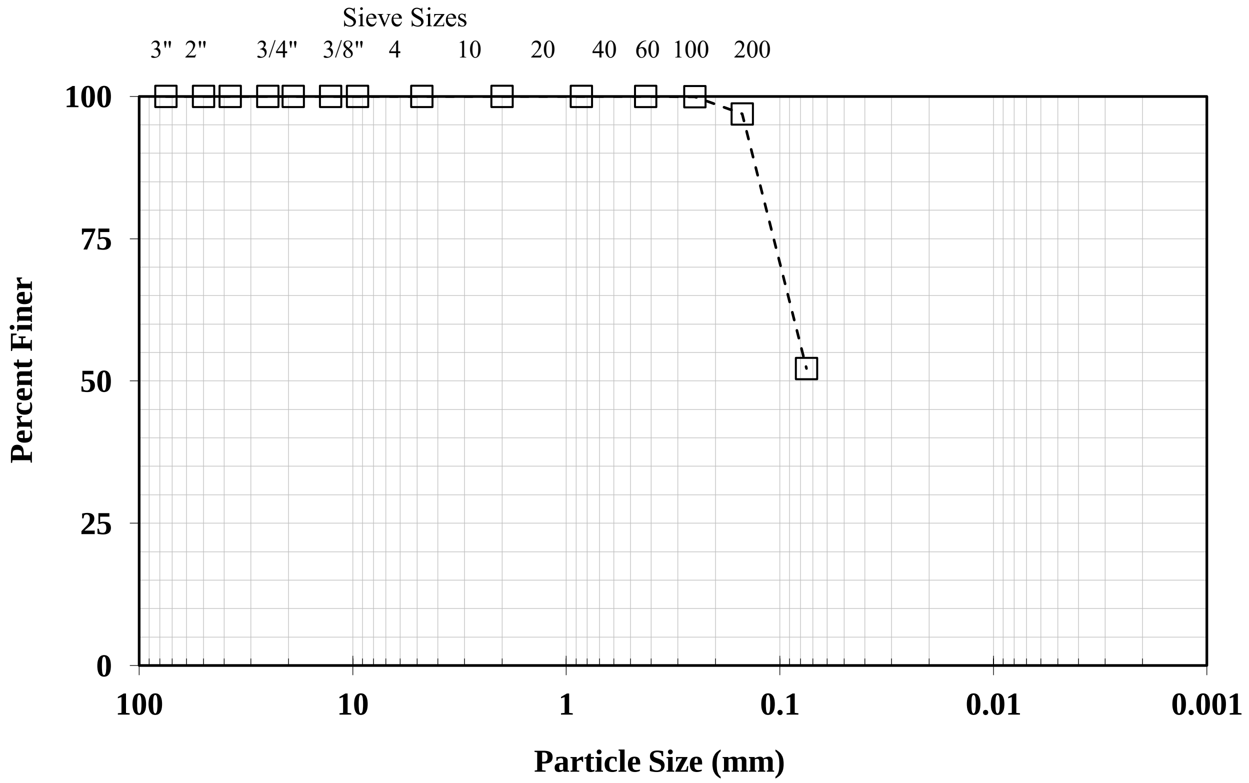
Analysis & Quality Review/Date

Laboratory Staff: LC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3 28-30

TRI Log#: 20888.13
Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (0.841 mm)	100.0
No. 40 (0.420 mm)	100.0
No. 60 (0.250 mm)	99.9
No. 100 (0.149 mm)	96.9
No. 200 (0.074 mm)	52.2
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

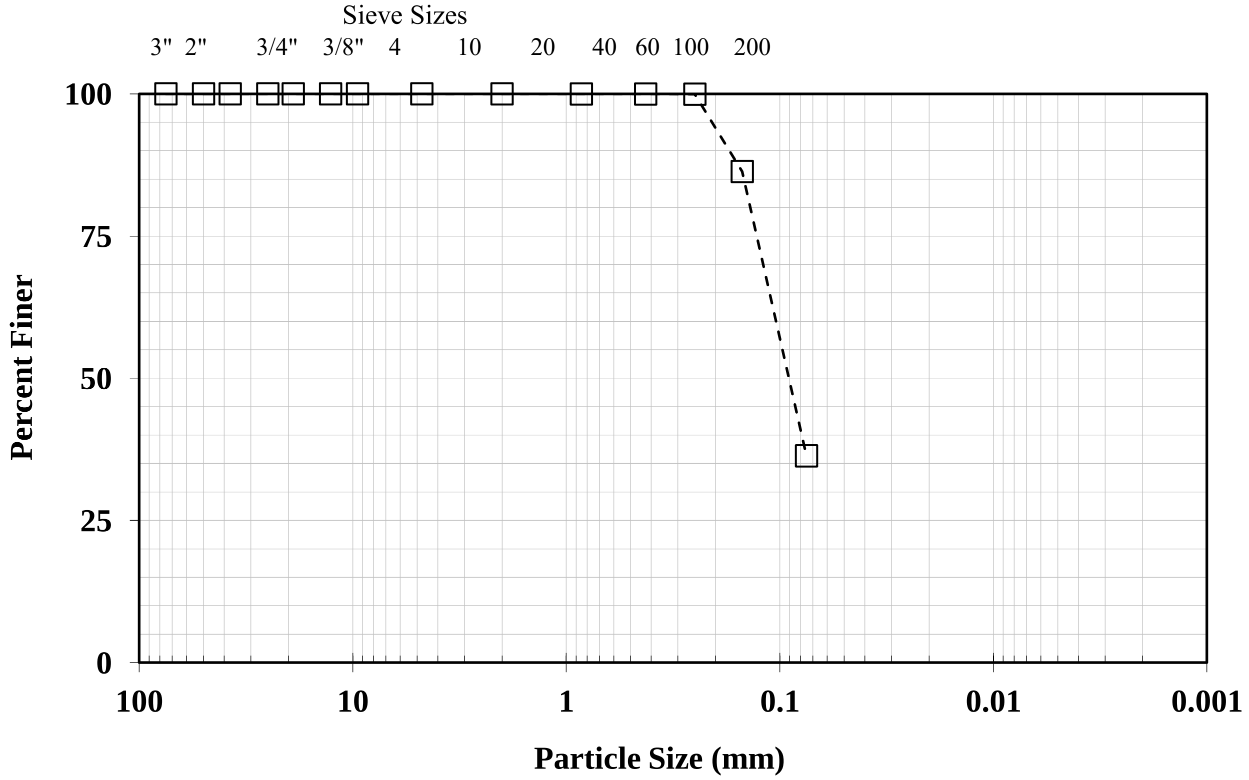
USCS Classification (ASTM D2487)	Sandy lean clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	11.9
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	29
	Plastic Limit	21
	Plastic Index	8
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B6: 28-30

TRI Log#: 20888.20
Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (0.841 mm)	100.0
No. 40 (0.420 mm)	100.0
No. 60 (0.250 mm)	99.9
No. 100 (0.149 mm)	86.3
No. 200 (0.074 mm)	36.3
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

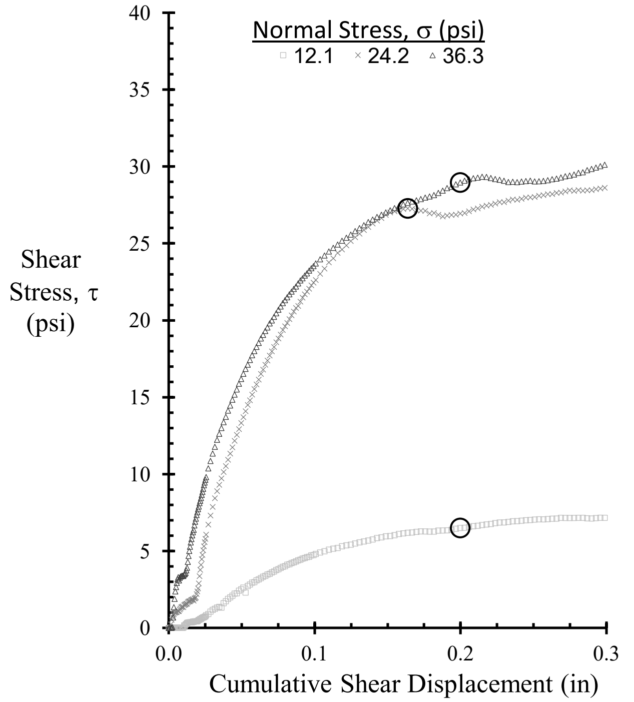
USCS Classification (ASTM D2487)	Silty sand (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	28.9
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	25
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

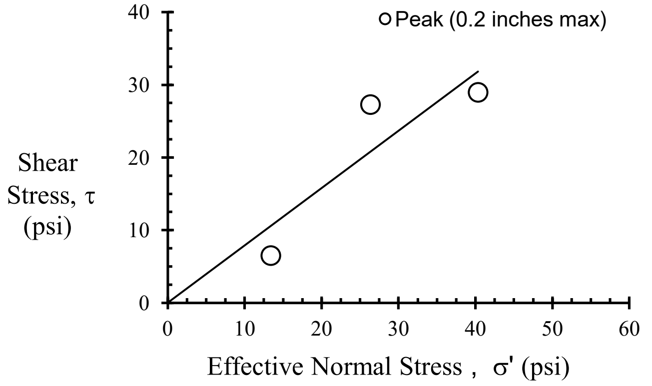
Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

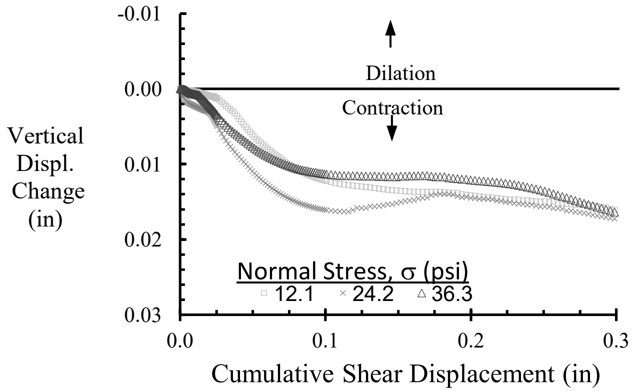
Direct Shear of Soil Under Consolidated-Drained Conditions

Client:	Auckland Consulting LLC	TRI Log#:	20888
Project:	Winston Pond	Test Method:	ASTM D 3080
Sample:	B6: 28-30		





Note: Area Correction Has Been Applied



	Sample Number	1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	29.9	27.7	28.8
	Saturation, %	225.9	223.9	225.0
	Dry Density, pcf	122.4	124.5	123.4
	Void Ratio	0.35	0.33	0.34
Post Consol	Height, in (prior to shear)	0.94	0.96	0.97
	Final Water Content, %	25.5	21.5	21.9
	Dry Density, pcf	130.9	129.3	126.6
	Void Ratio	0.26	0.28	0.31
Displacement rate (in/min)		2.0E-03	2.0E-03	2.0E-03
Peak (0.2 inches)	Normal Stress, σ' (psi)	13.40	26.36	40.34
	Shear Stress, τ (psi)	6.50	27.28	28.96
	Displacement (in)	0.20	0.16	0.20
	ϕ'_d, degrees	38.3		
	c'_d, psi	0 (Forced)		

Note: The loose sample was tamped in place. A specific gravity of 2.65 was assumed for weight-volume calculations.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/16

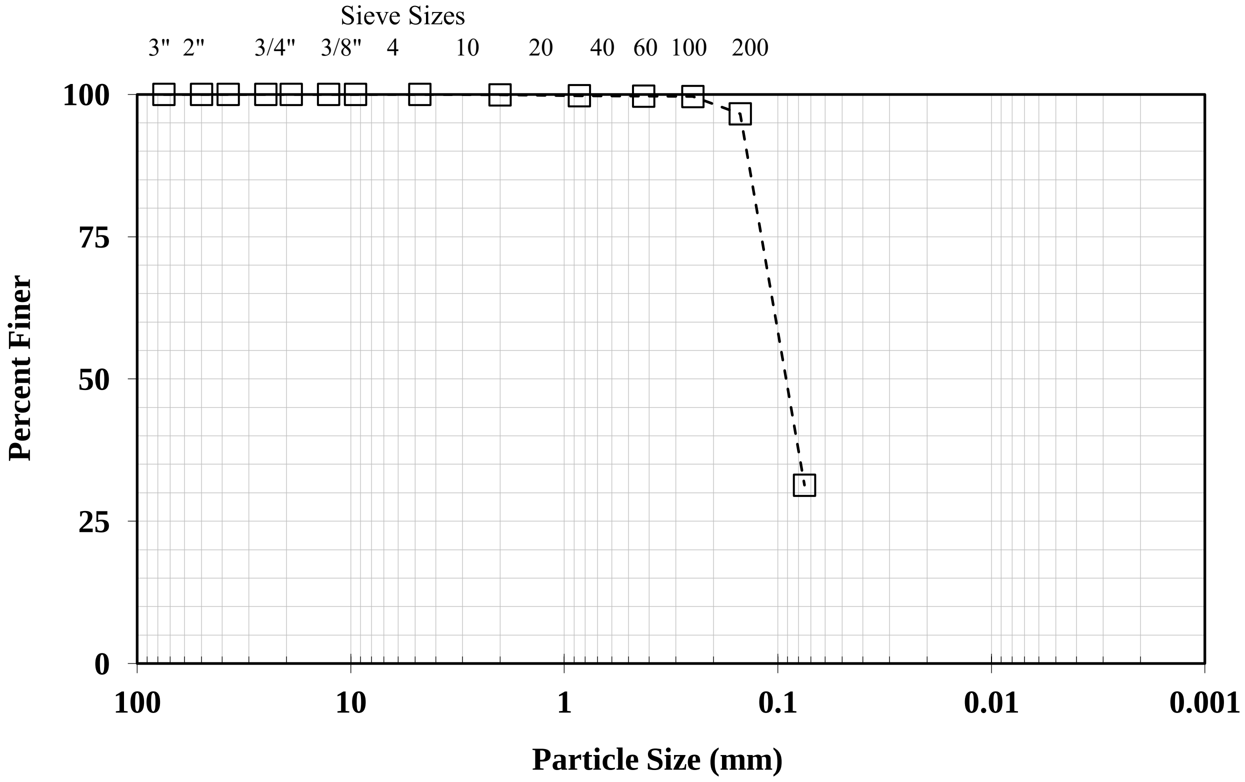
Analysis & Quality Review/Date

Test Performed By: LC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B7 13-15

TRI Log#: 20888.24
Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	99.9
No. 20 (0.841 mm)	99.8
No. 40 (0.420 mm)	99.7
No. 60 (0.250 mm)	99.6
No. 100 (0.149 mm)	96.6
No. 200 (0.074 mm)	31.3
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

USCS Classification (ASTM D2487)	Silty sand (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	25.6
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	24
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
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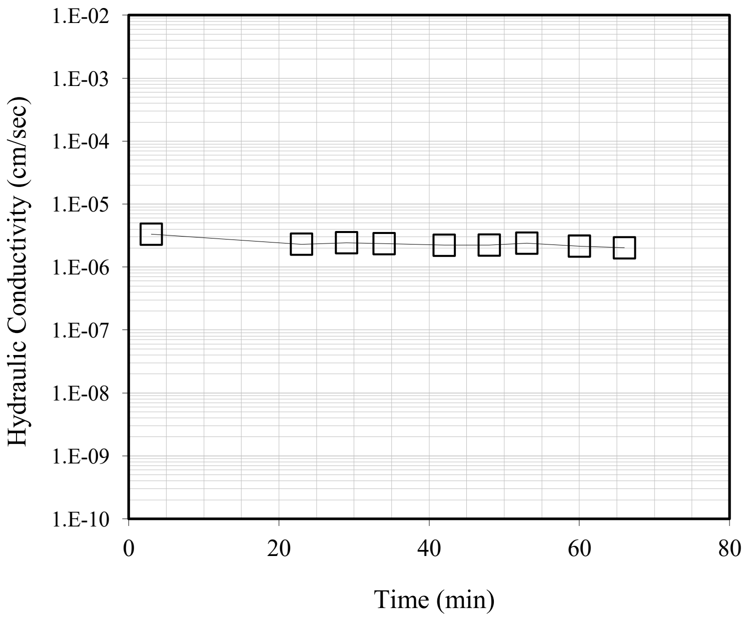
Hydraulic Conductivity

Client: Auckland Consulting LLC
Project: Winston Pond
Sample ID: B7: 13-15

TRI Log #: 20888
Test Method: ASTM D5084 Method C



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.80
Height (in)	2.21
Initial Mass (g)	444.2
Sample Area (in^2)	6.16
Water Content (%)	24.5
Total Unit Weight (pcf)	124.3
Dry Unit Weight (pcf)	99.9
Specific Gravity (Assumed)	2.65
Degree of Saturation	99.0
Void Ratio	0.66
Porosity	0.40
1 Pore Volume (cc)	88.3
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.99

Specimen Image

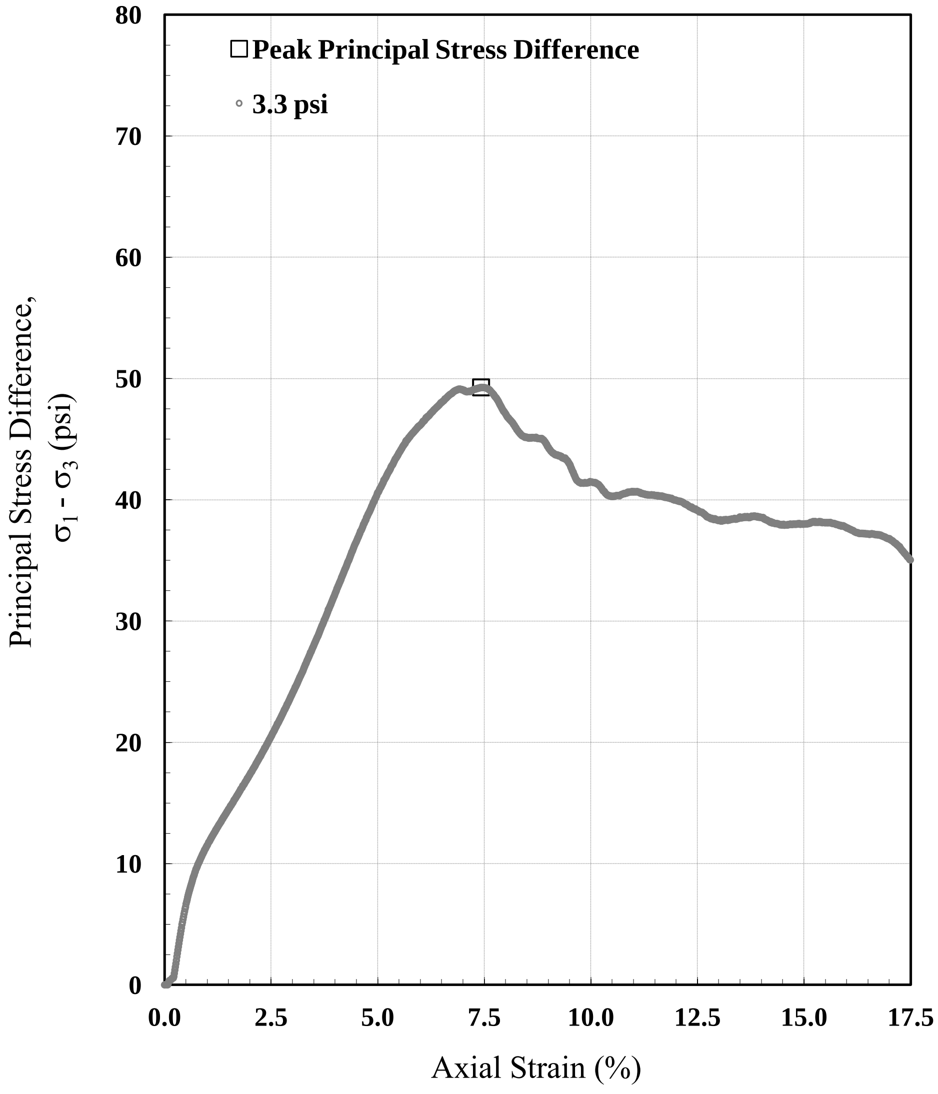
Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
48.0	2.2E-06
53.0	2.4E-06
60.0	2.2E-06
66.0	2.0E-06
Average, Last 4 Readings	**2.2E-06**

Note: Permeation measurements were made with a mercury U-tube.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Analysis & Quality Review/Date
Testing Performed By: SOC & LC

Unconsolidated-Undrained (Q) Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D2850
Sample:	B8: 3-5		



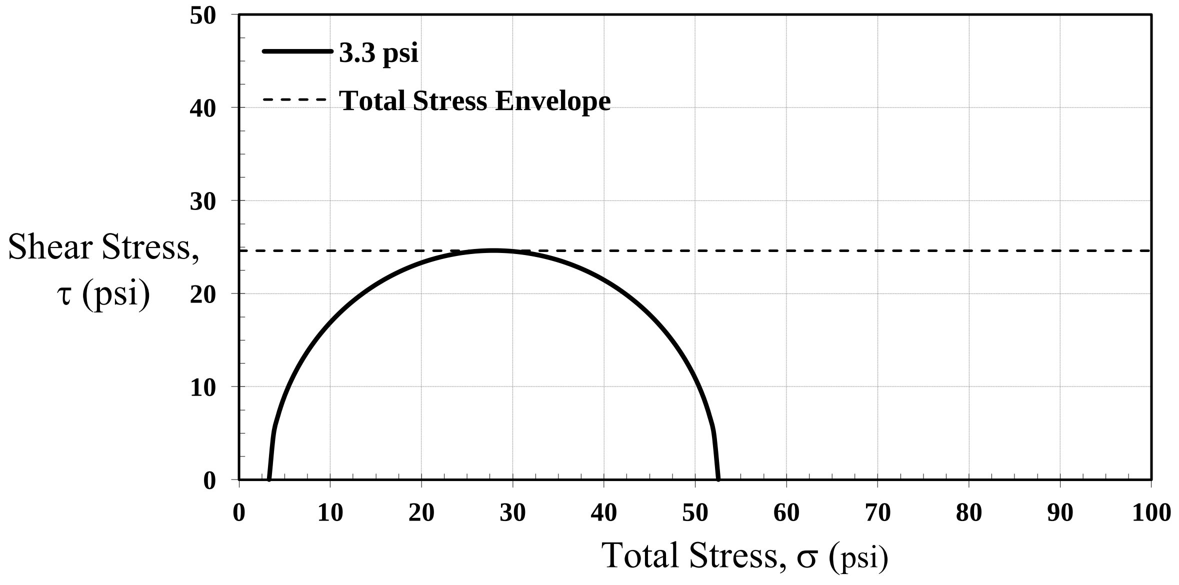
Test Parameters	
Minor Principal Stress (psi)	3.3
Rate of Strain (%/hr)	60

Initial Properties	
Avg. Diameter (in)	2.80
Avg. Height (in)	5.60
Avg. Water Content (%)	15.2
Bulk Density (pcf)	132.9
Dry Density (pcf)	115.4
Saturation (%)	92.8
Void Ratio	0.43
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	7.4
Minor Total Stress (psi)	3.3
Major Total Stress (psi)	52.6
Principal Stress Diff. (psi)	49.3

Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	24.6
S_u / σ_3	7.5

Note: The Mohr failure envelope was taken as a horizontal straight line. It should, however, be noted that the specimen was partially saturated.



Jeffrey A. Kuhn , Ph.D., P.E., 6/30/2016

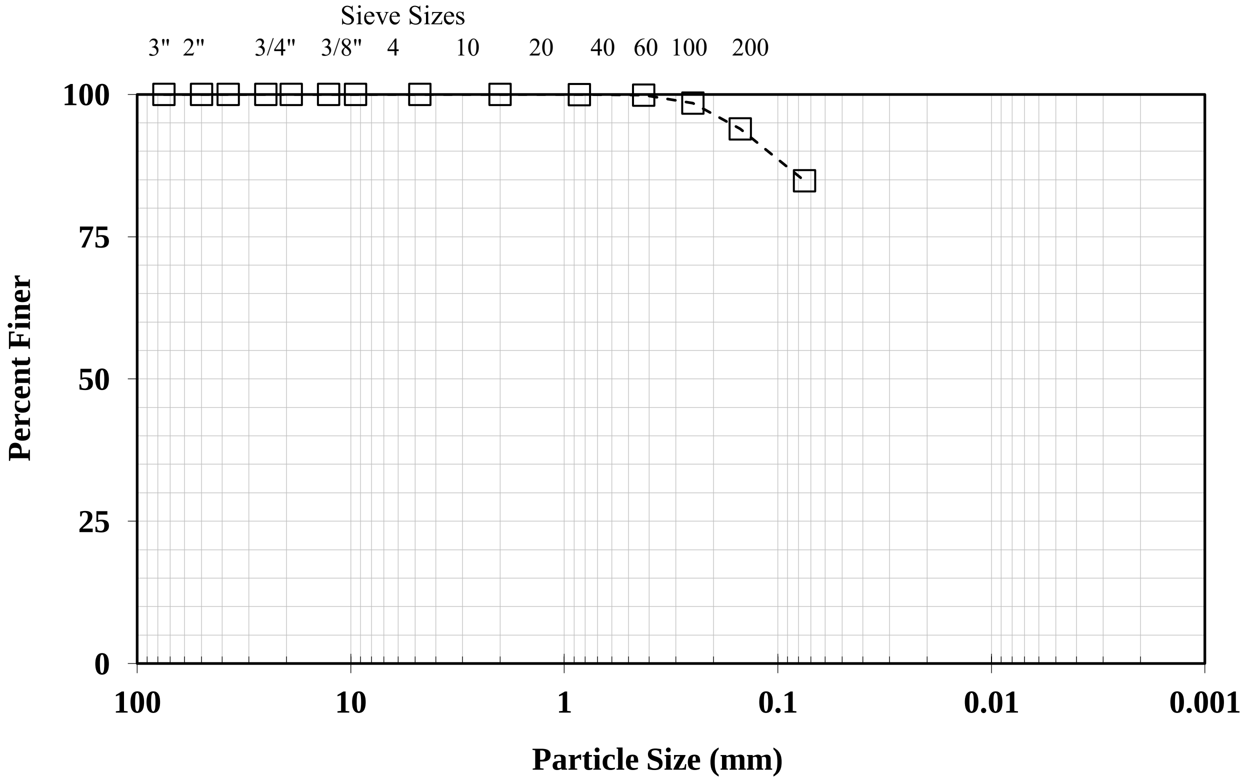
Analysis & Quality Review/Date

Laboratory Staff: LC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B8 38-40

TRI Log#: 20888.32
Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (0.841 mm)	100.0
No. 40 (0.420 mm)	99.9
No. 60 (0.250 mm)	98.5
No. 100 (0.149 mm)	93.9
No. 200 (0.074 mm)	84.8
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

USCS Classification (ASTM D2487)	- -	
As-Received Moisture Content (%)	(ASTM D2216)	28.8
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	- -
	Plastic Limit	- -
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (3-5)

TRI Log #: 21381
Test Method: ASTM D4767 Mod

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	5.0	10.0	15.0
Initial Specimen Properties			
Avg. Diameter (in)	1.95	1.96	1.97
Avg. Height (in)	4.39	4.33	4.24
Avg. Water Content (%)	18.1	-	-
Bulk Density (pcf)	128.7	129.5	130.6
Dry Density (pcf)	109.0	-	-
Saturation (%)	89.4	-	-
Void Ratio, n	0.55	0.54	0.52
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	81.0	80.9	80.9
B-Value, End of Saturation	0.97	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.54	0.52	0.51
Area (in^2)	2.98	3.00	3.04

Shear / Post-Shear			
Avg. Water Content (%)	-	-	20.6
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	0.8	1.3	1.6
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	2.7	6.1	11.1
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	9.1	16.6	25.8
Pore Water Pressure, Δu_f (psi)	-	-	-	2.5	4.2	4.2
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	11.8	22.7	36.9
Effective Friction Angle (degrees)	-			29.9		
Effective Cohesion (psi)	-			1.2		

R-Envelope, "Total" Stress		
Friction Angle (deg)	-	26.9
Cohesion (psi)	-	0.1

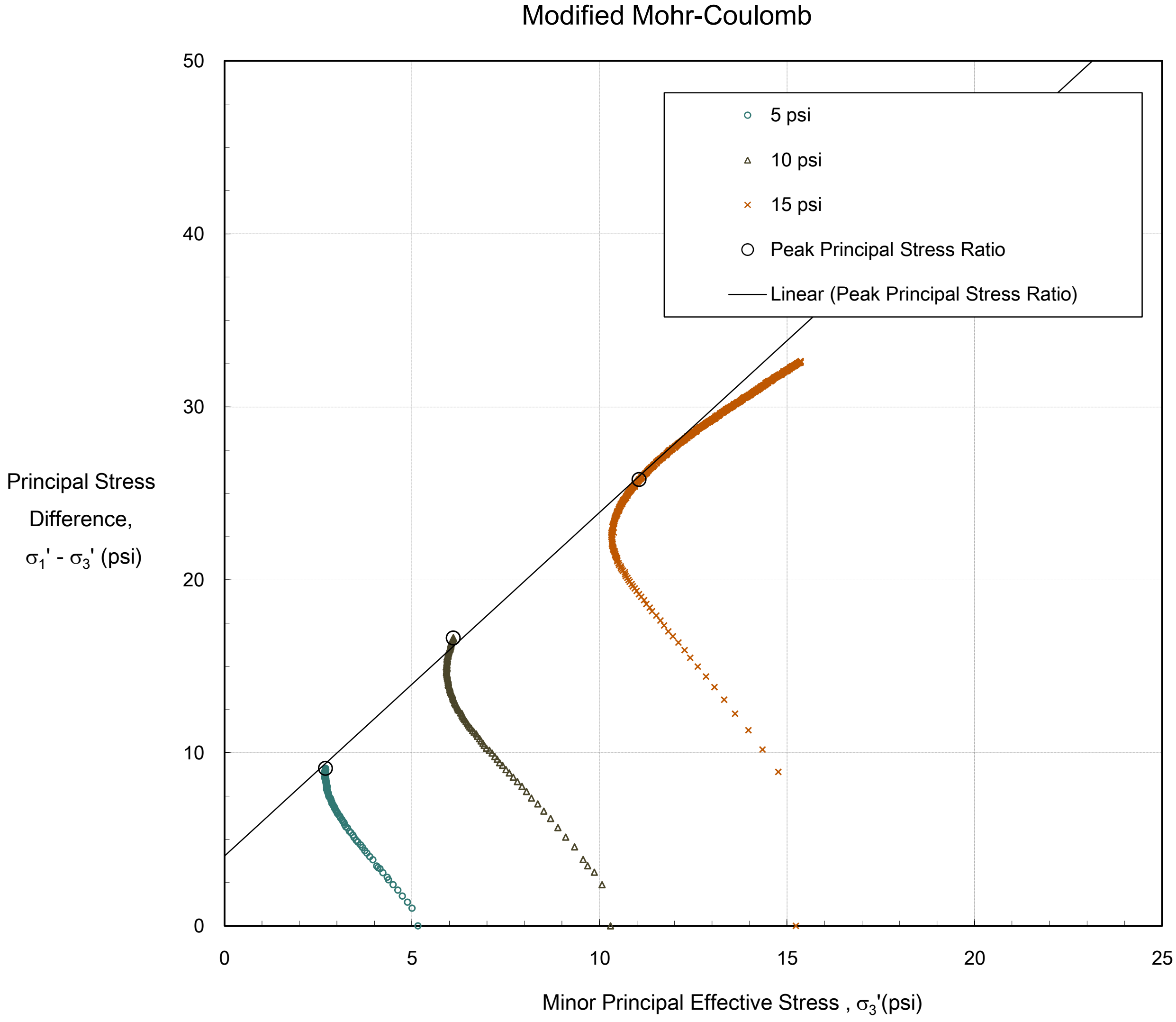
Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/12/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (3-5)

TRI Log #: 21381
Test Method: ASTM D4767 Mod

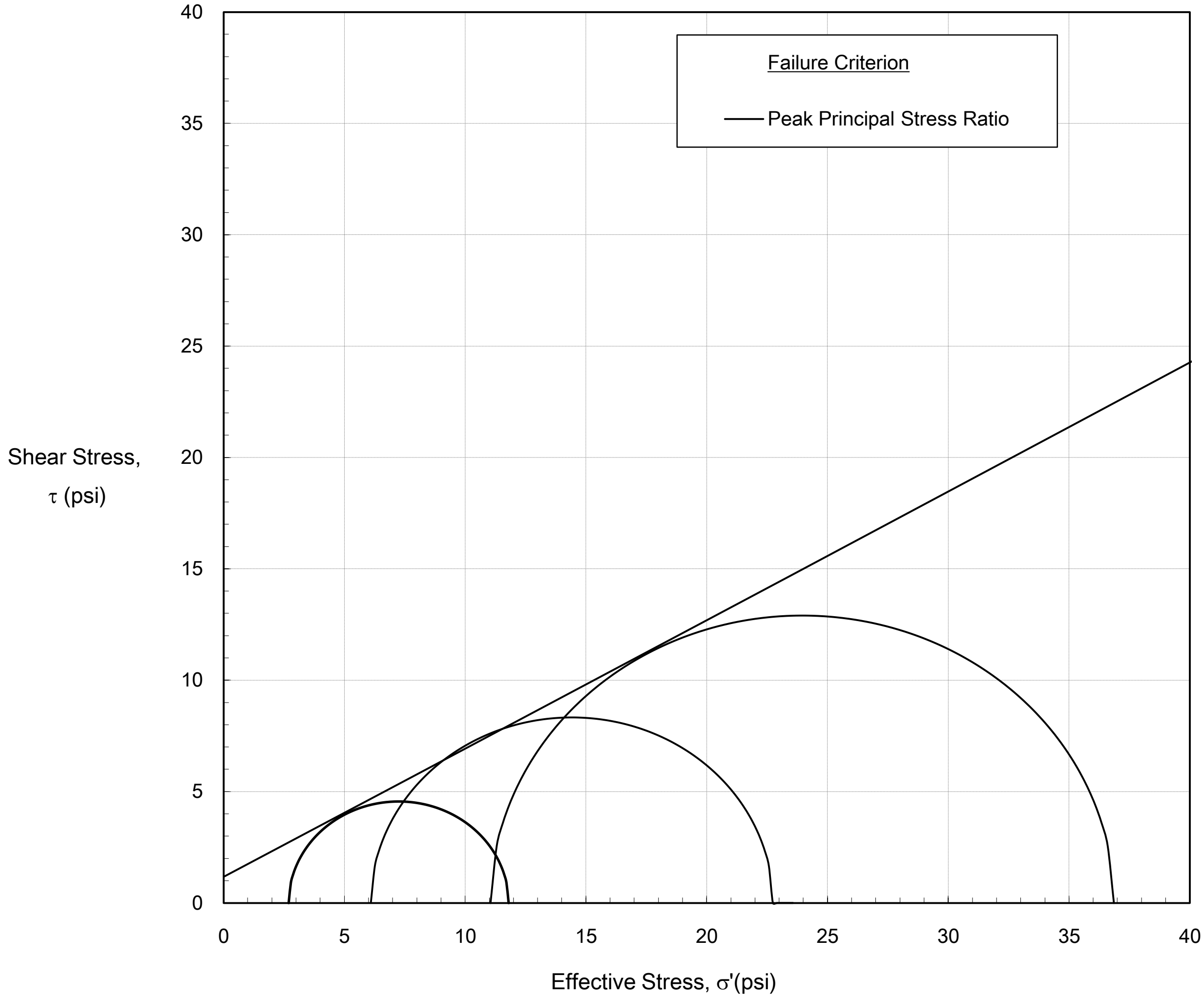


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	29.9
Effective Cohesion (psi)	-	1.2

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-4 (3-5)		

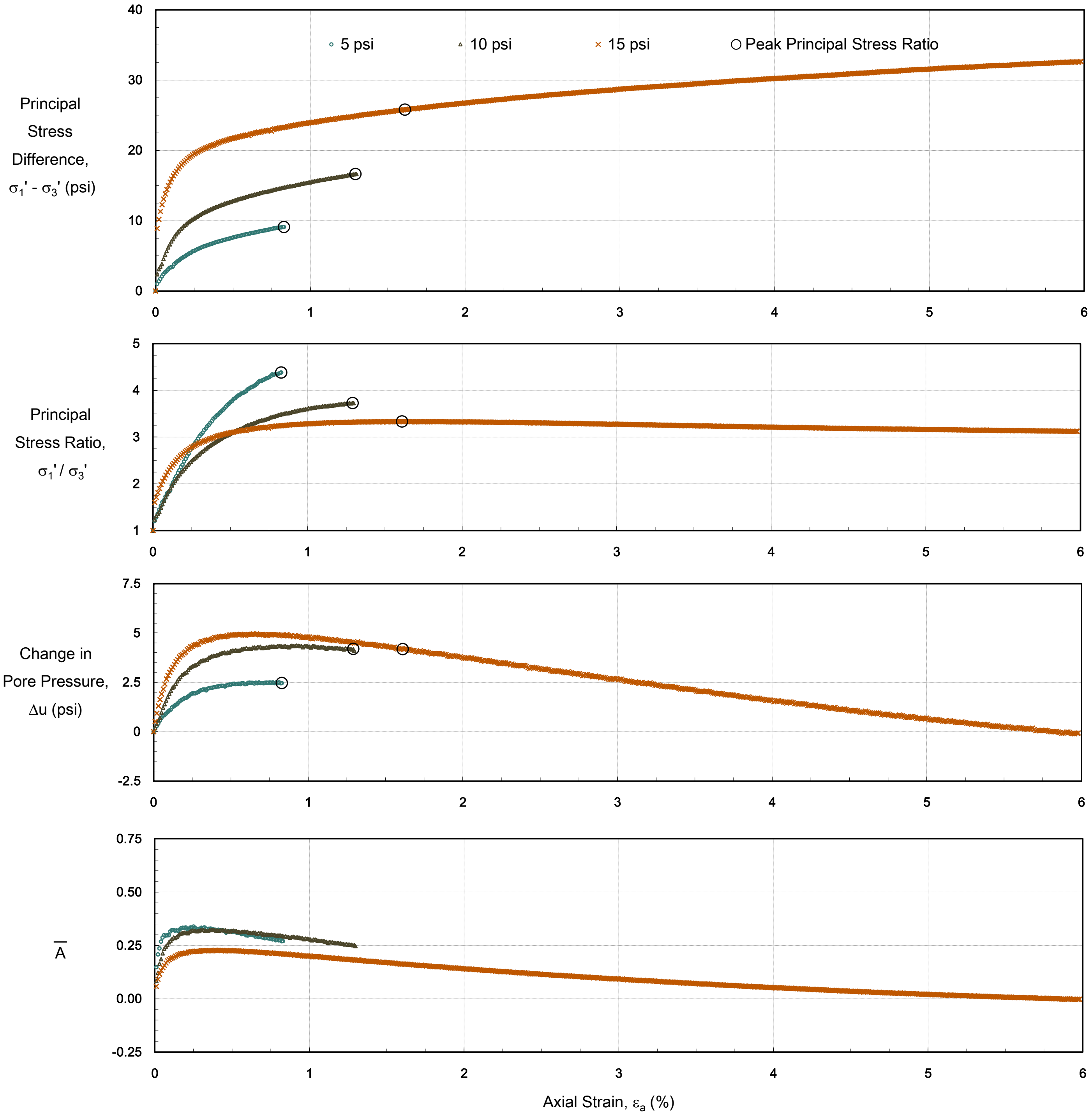
Mohr-Coulomb



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	29.9
Effective Cohesion (psi)	-	1.2

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-4 (3-5)		

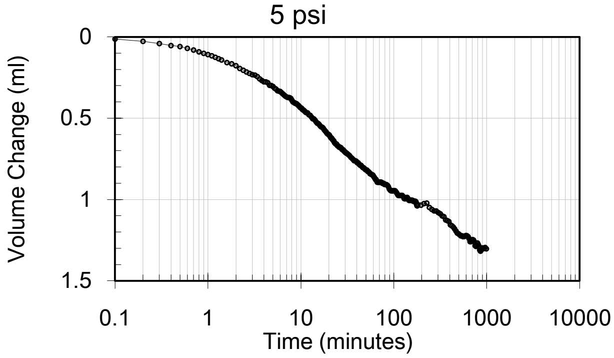


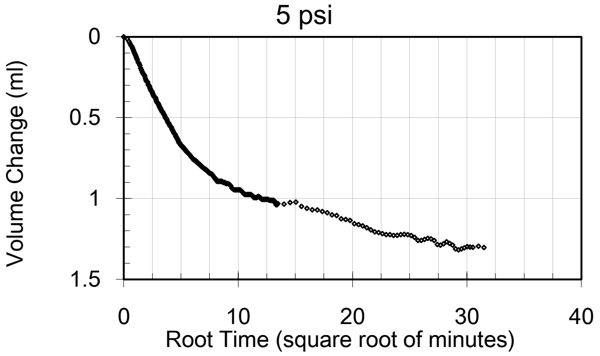
Multi-Stage Consolidated-Undrained Triaxial Compression

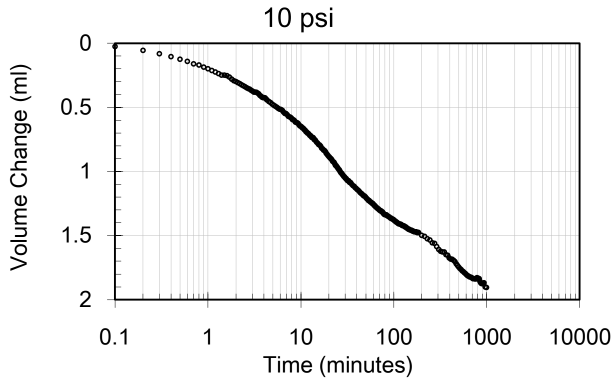
Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (3-5)

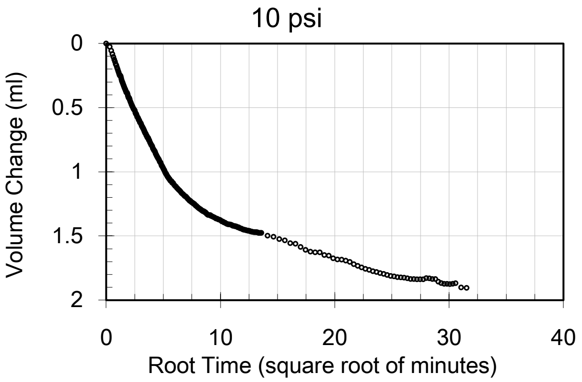
TRI Log #: 21381
Test Method: ASTM D4767 Mod

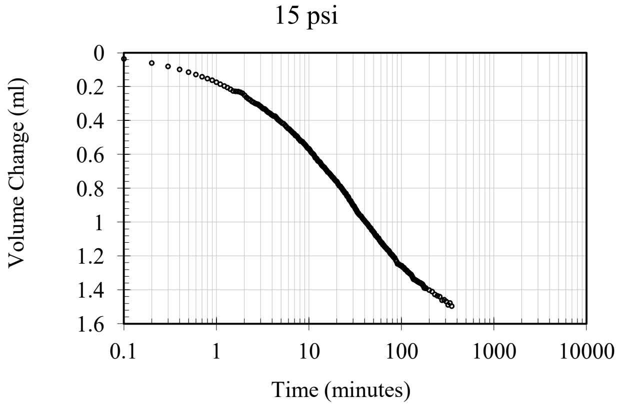
Consolidation

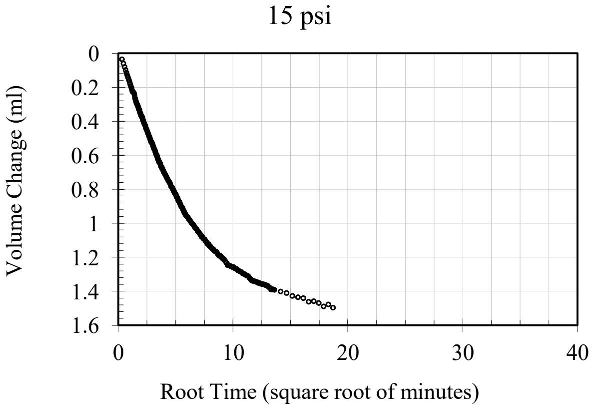








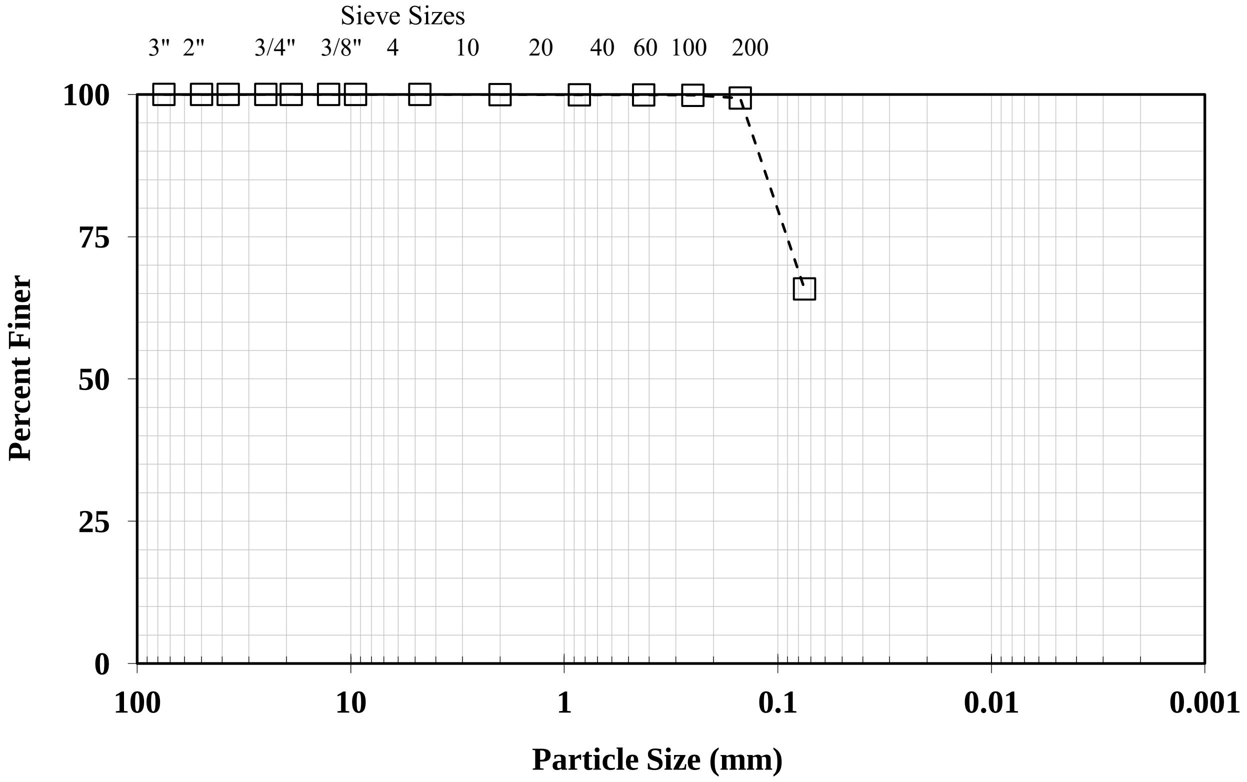




Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (8-10)

TRI Log#: 21381.3
Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (0.841 mm)	99.9
No. 40 (0.420 mm)	99.9
No. 60 (0.250 mm)	99.8
No. 100 (0.149 mm)	99.4
No. 200 (0.074 mm)	65.8
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

USCS Classification (ASTM D2487)	Sandy lean clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	16.3
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	33
	Plastic Limit	20
	Plastic Index	13
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

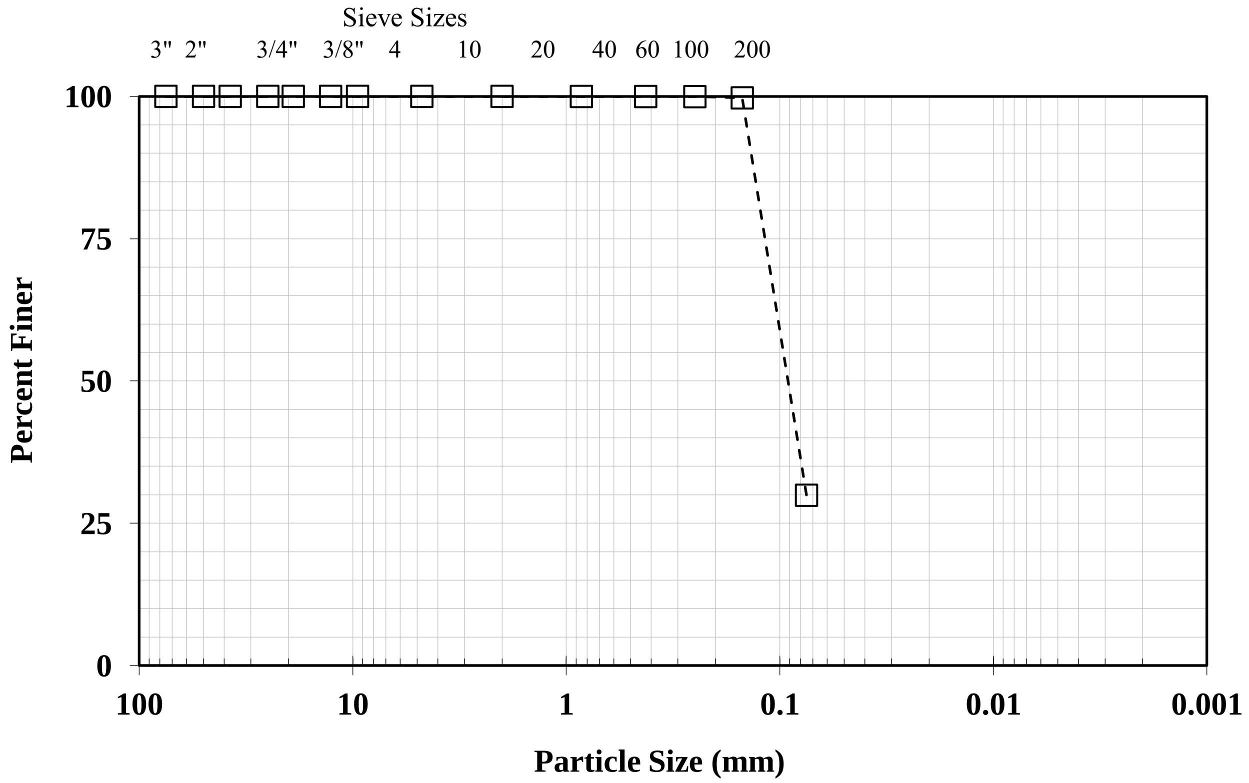
Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (33-35)

TRI Log#: 21381.7
Test Method: ASTM D422



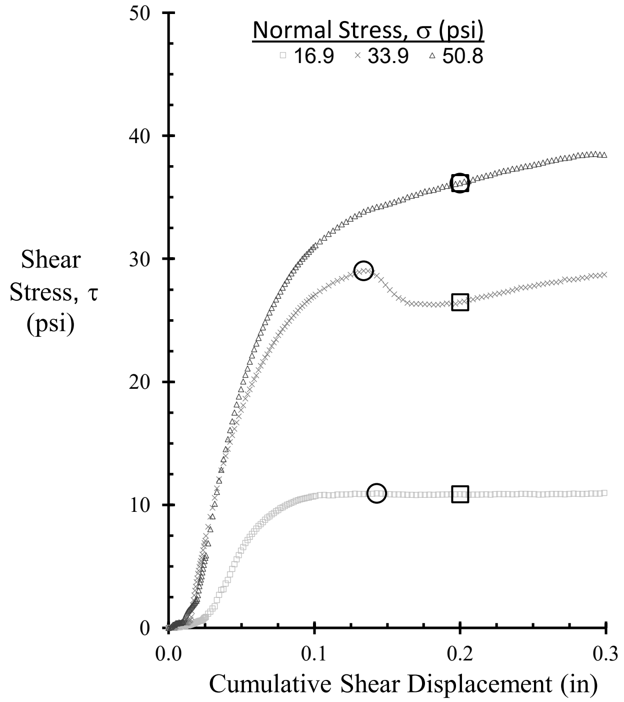
Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (0.841 mm)	100.0
No. 40 (0.420 mm)	100.0
No. 60 (0.250 mm)	100.0
No. 100 (0.149 mm)	99.7
No. 200 (0.074 mm)	29.9
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

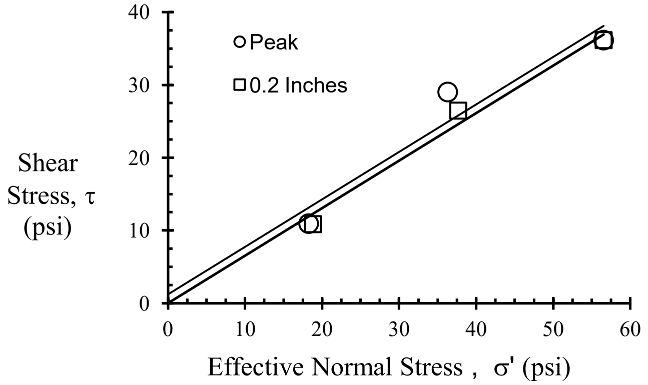
USCS Classification (ASTM D2487)	Silty sand (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	29.6
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	26
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

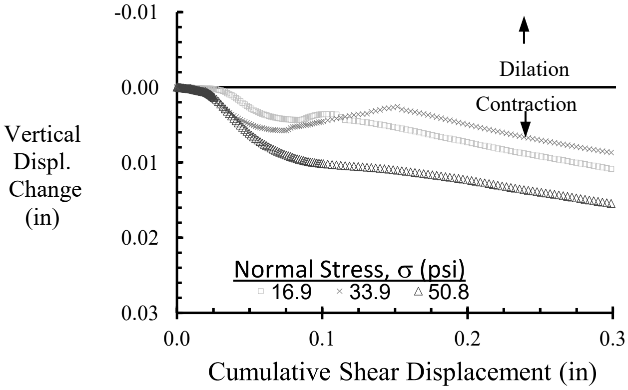
Direct Shear of Soil Under Consolidated-Drained Conditions

Client:	Auckland Consulting LLC	TRI Log#:	21381
Project:	Winston Pond	Test Method:	ASTM D 3080
Sample:	B-4 (38-40)		





Note: Area Correction Has Been Applied



	Sample Number	1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	24.7	24.9	24.9
	Saturation, %	155.9	156.2	156.2
	Dry Density, pcf	116.4	116.3	116.3
	Void Ratio	0.42	0.42	0.42
Post Consol	Height, in (prior to shear)	1.00	1.00	0.99
	Final Water Content, %	23.9	25.0	23.6
	Dry Density, pcf	116.9	116.5	117.2
	Void Ratio	0.41	0.42	0.41
Displacement rate (in/min)		2.0E-03	2.0E-03	2.0E-03
Peak	Normal Stress, σ' (psi)	18.26	36.30	56.54
	Shear Stress, τ (psi)	10.94	29.03	36.15
	Displacement (in)	0.14	0.13	0.20
	ϕ'_d, degrees	33.1		
	c'_d, psi	1.2		
Post-Peak	Normal Stress, σ' (psi)	18.83	37.66	56.54
	Shear Stress, τ (psi)	10.87	26.47	36.15
	Displacement (in)	0.20	0.20	0.20
	ϕ'_d, degrees	33.1		
	c'_d, psi	0 (Forced)		

Note: The loose sample was tamped in place. A specific gravity of 2.65 was assumed for weight-volume calculations.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/16

Analysis & Quality Review/Date

Test Performed By: LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-5 (5-7)		

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	5.0	10.0	15.0
Initial Specimen Properties			
Avg. Diameter (in)	1.85	1.85	1.87
Avg. Height (in)	4.51	4.44	4.35
Avg. Water Content (%)	17.6	-	-
Bulk Density (pcf)	139.6	141.0	142.1
Dry Density (pcf)	118.7	-	-
Saturation (%)	100.0	-	-
Void Ratio, n	0.42	0.41	0.40
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	80.7	80.8	81.5
B-Value, End of Saturation	0.94	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.41	0.40	0.38
Area (in^2)	2.67	2.68	2.72

Shear / Post-Shear			
Avg. Water Content (%)	-	-	19.1
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	0.6	1.3	1.4
Minor Effective Stress (psi), $\sigma_3'{}_f$	-	-	-	4.3	5.6	9.9
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	9.2	11.7	23.4
Pore Water Pressure, Δu_f (psi)	-	-	-	0.7	2.8	3.4
Major Effective Stress (psi), $\sigma_1'{}_f$	-	-	-	13.5	17.3	33.3
Effective Friction Angle (degrees)	-			32.3		
Effective Cohesion (psi)	-			0 (Forced)		

R-Envelope, "Total" Stress		
Friction Angle (deg)	-	27.1
Cohesion (psi)	-	0 (Forced)

Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/12/2016

Analysis & Quality Review/Date

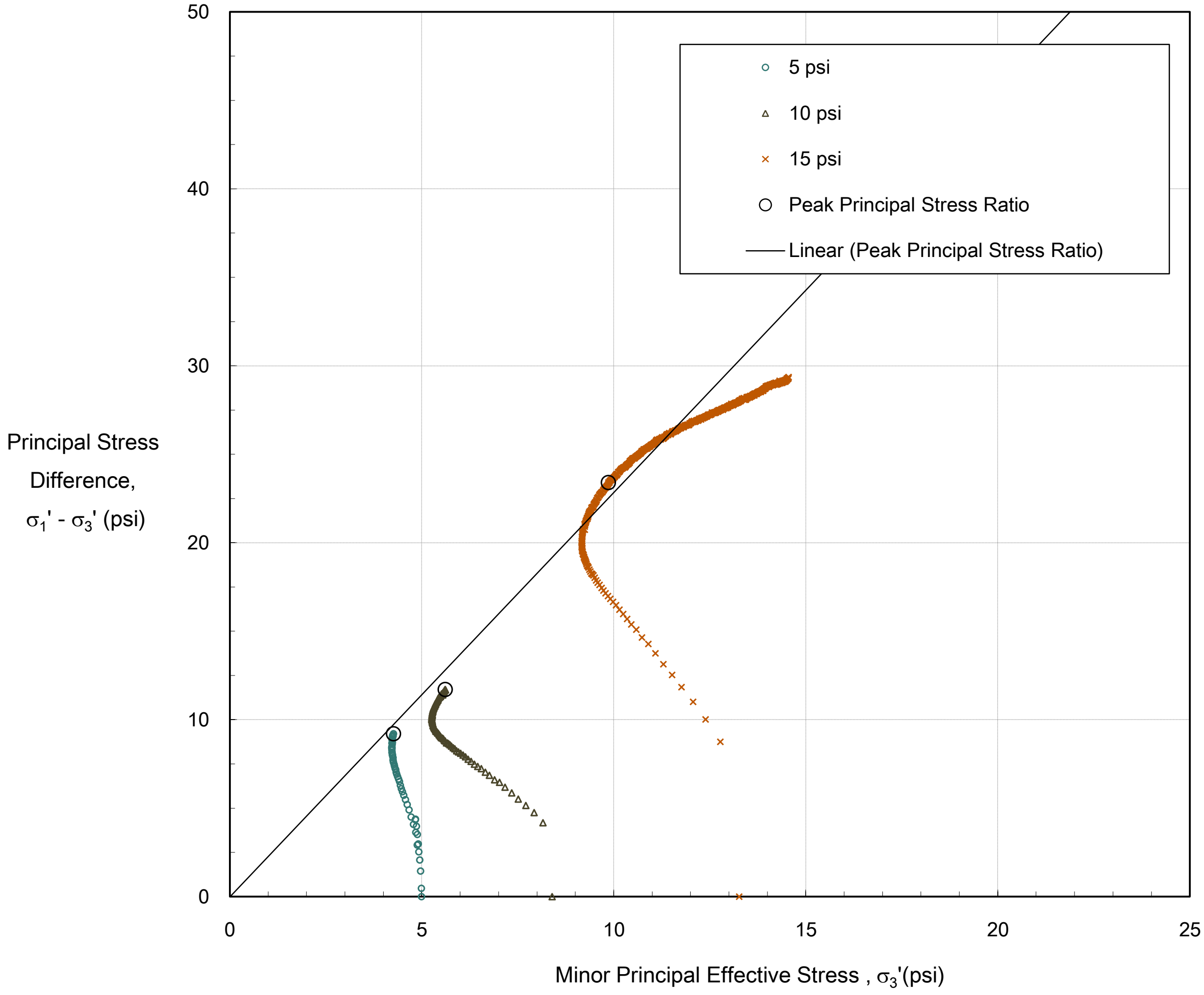
Laboratory Staff: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (5-7)

TRI Log #: 21381
Test Method: ASTM D4767 Mod

Modified Mohr-Coulomb



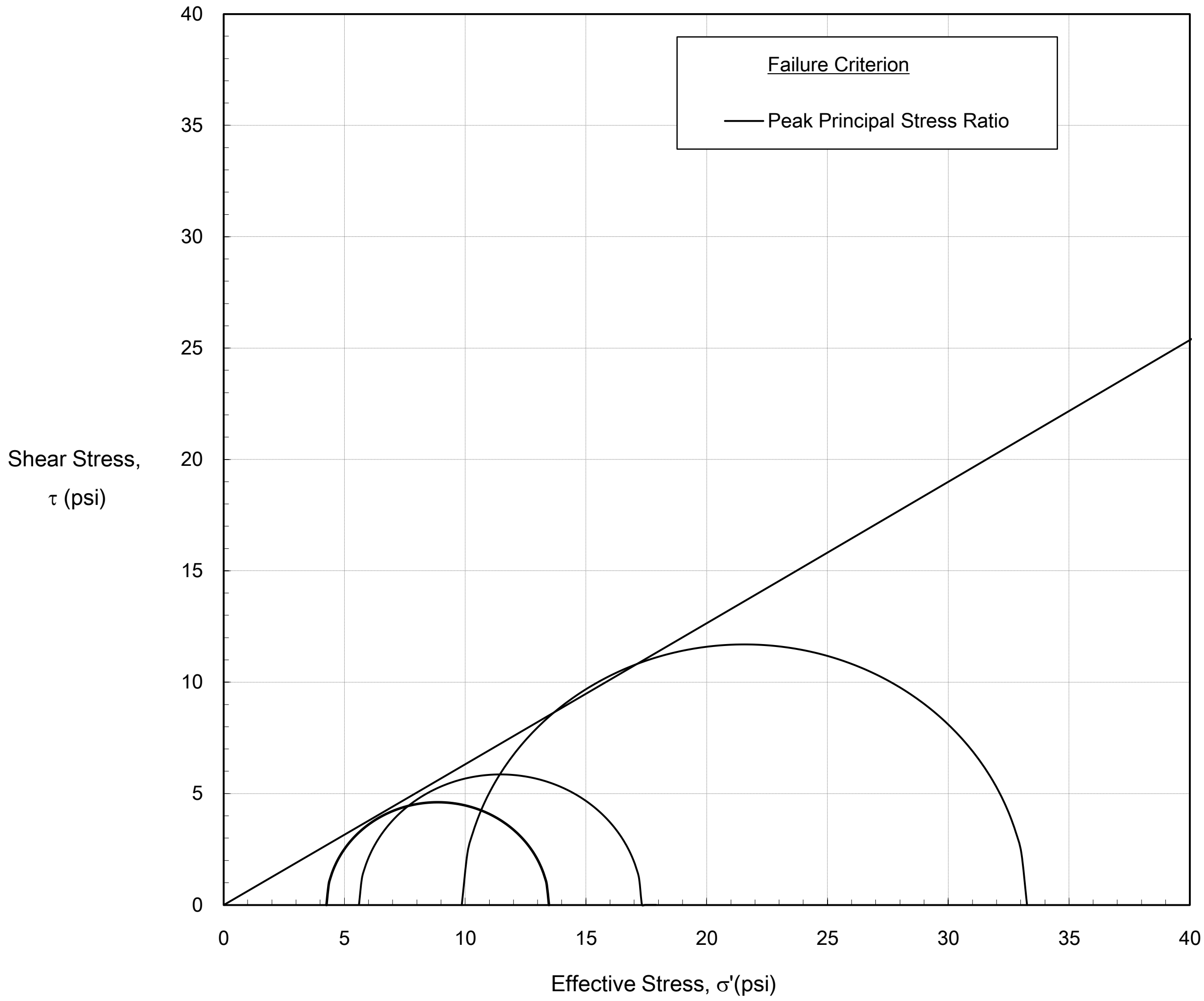
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	32.3
Effective Cohesion (psi)	-	0 (Forced)

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (5-7)

TRI Log #: 21381
Test Method: ASTM D4767 Mod

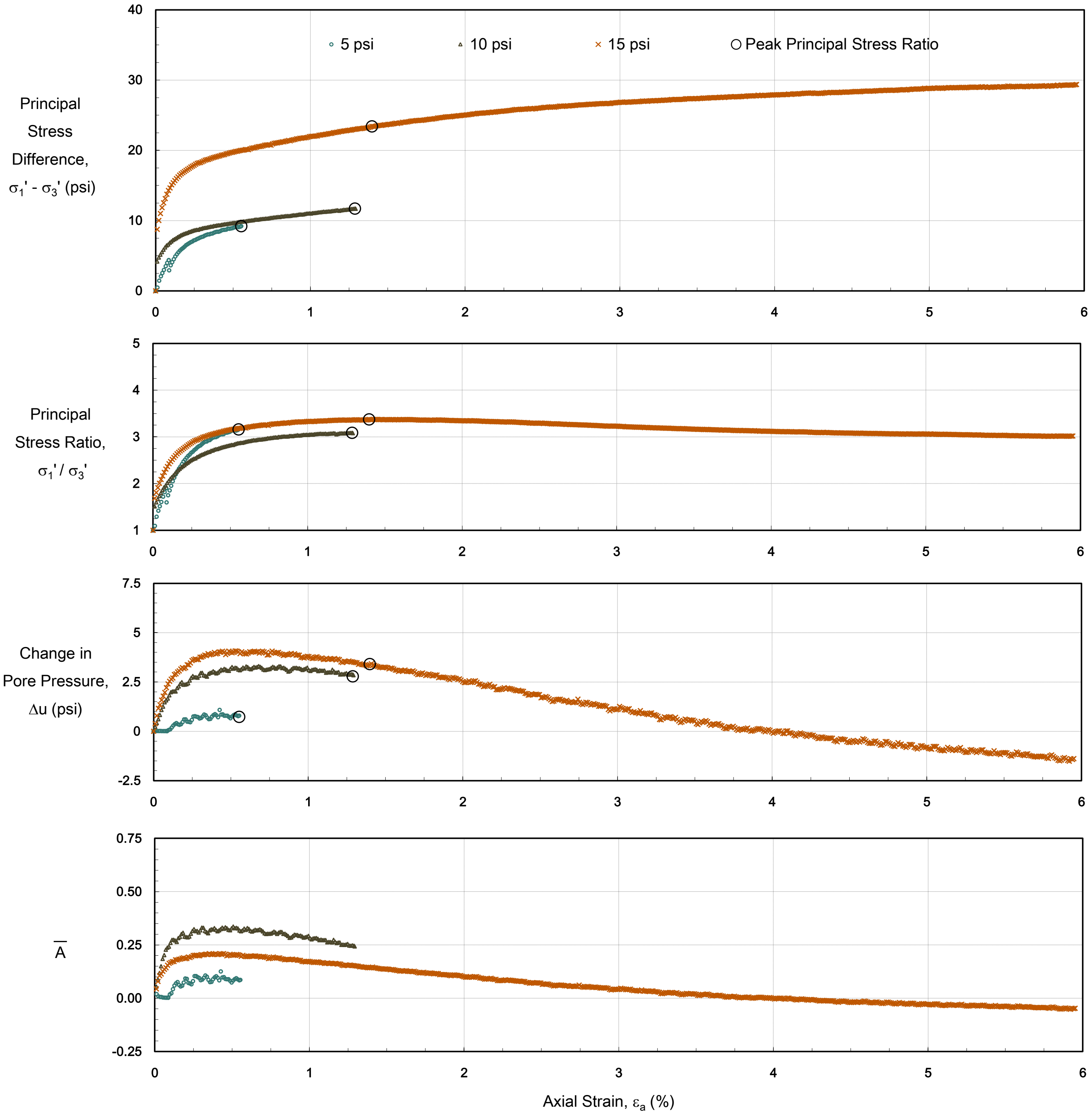
Mohr-Coulomb



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	32.3
Effective Cohesion (psi)	-	0 (Forced)

Multi-Stage Consolidated-Undrained Triaxial Compression

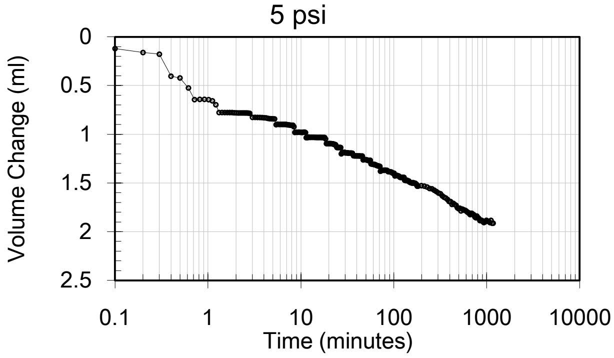
Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-5 (5-7)		

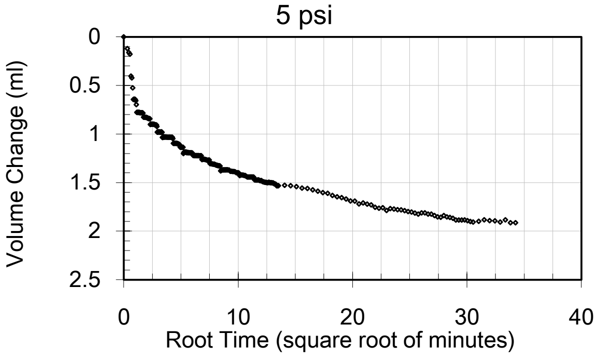


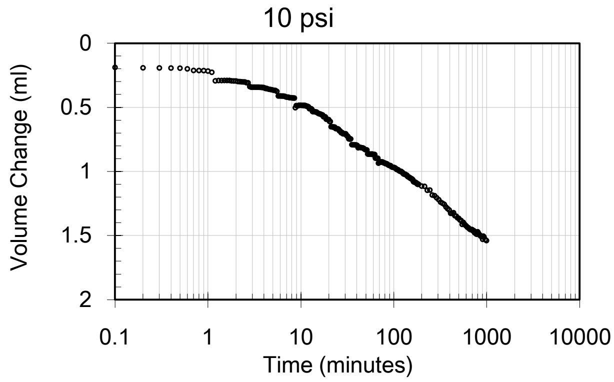
Multi-Stage Consolidated-Undrained Triaxial Compression

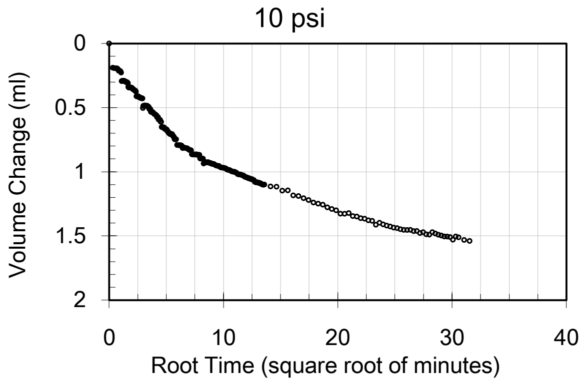
Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-5 (5-7)		

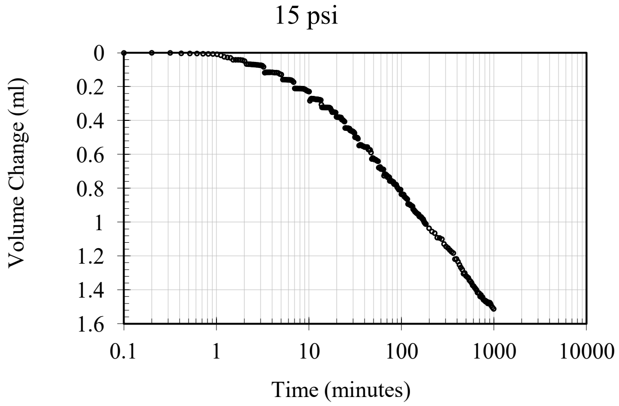
Consolidation

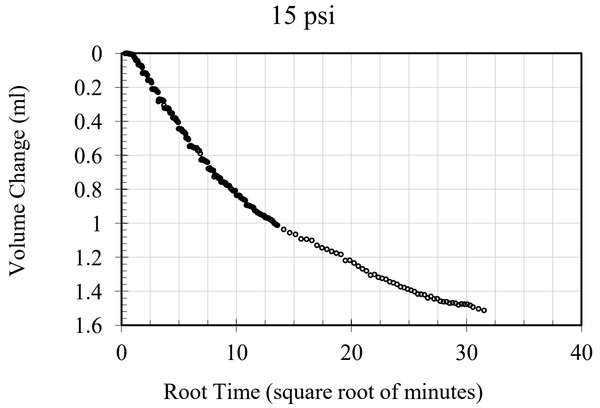






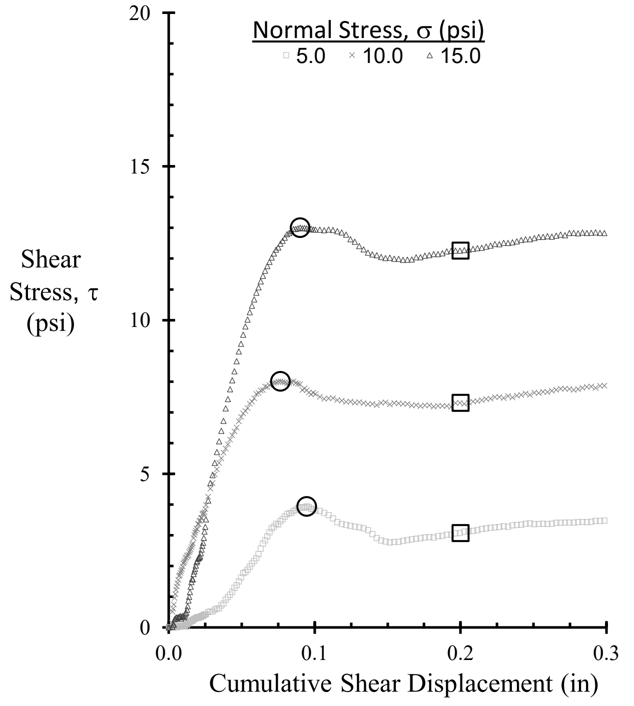


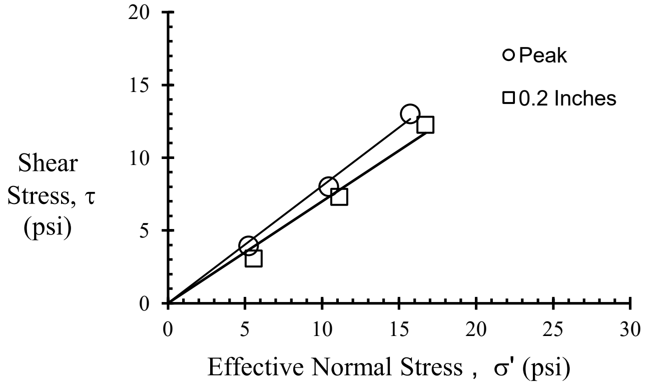




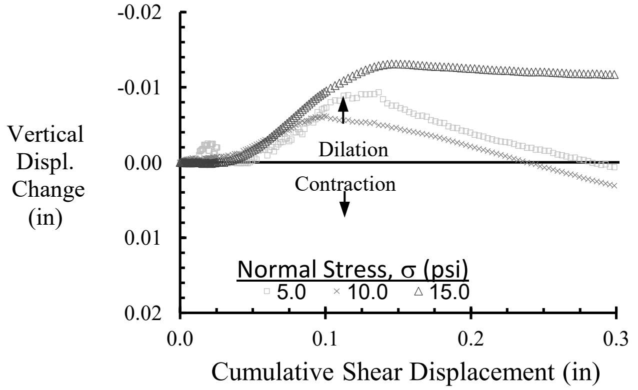
Direct Shear of Soil Under Consolidated-Drained Conditions

Client:	Auckland Consulting LLC	TRI Log#:	21381
Project:	Winston Pond	Test Method:	ASTM D 3080
Sample:	B-5 (13-15)		





Note: Area Correction Has Been Applied



	Sample Number	1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	16.9	16.0	15.6
	Saturation, %	83.9	83.6	89.1
	Dry Density, pcf	107.9	109.7	112.9
	Void Ratio	0.53	0.51	0.46
Post Consol	Height, in (prior to shear)	1.00	1.00	1.00
	Final Water Content, %	21.1	20.9	19.2
	Dry Density, pcf	108.0	109.9	113.3
	Void Ratio	0.53	0.50	0.46
Displacement rate (in/min)		6.0E-04	6.0E-04	6.0E-04
Peak	Normal Stress, σ' (psi)	5.23	10.43	15.72
	Shear Stress, τ (psi)	3.94	8.01	13.01
	Displacement (in)	0.09	0.08	0.09
	ϕ'_d, degrees	38.8		
	c'_d, psi	0 (Forced)		
Post-Peak	Normal Stress, σ' (psi)	5.56	11.12	16.70
	Shear Stress, τ (psi)	3.07	7.31	12.26
	Displacement (in)	0.20	0.20	0.20
	ϕ'_d, degrees	35.0		
	c'_d, psi	0 (Forced)		

Note: The undisturbed soil samples were extruded and trimmed using a trimming turntable. A specific gravity of 2.65 was assumed for weight-volume calculations.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/16

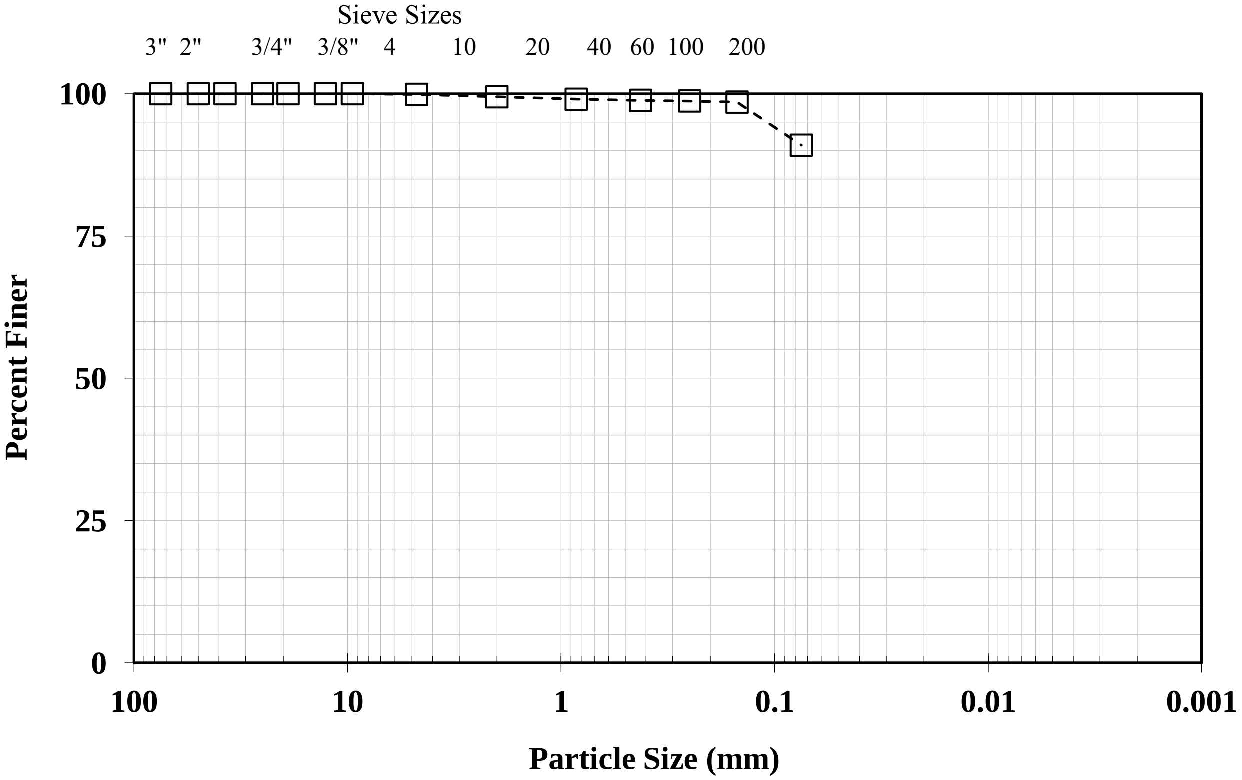
Analysis & Quality Review/Date

Test Performed By: LC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (33-35)

TRI Log#: 21381.16
Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	99.9
No. 10 (2.00 mm)	99.5
No. 20 (0.841 mm)	99.0
No. 40 (0.420 mm)	98.8
No. 60 (0.250 mm)	98.7
No. 100 (0.149 mm)	98.5
No. 200 (0.074 mm)	90.9
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

USCS Classification (ASTM D2487)	Silt (ML)	
As-Received Moisture Content (%)	(ASTM D2216)	27.1
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	28
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

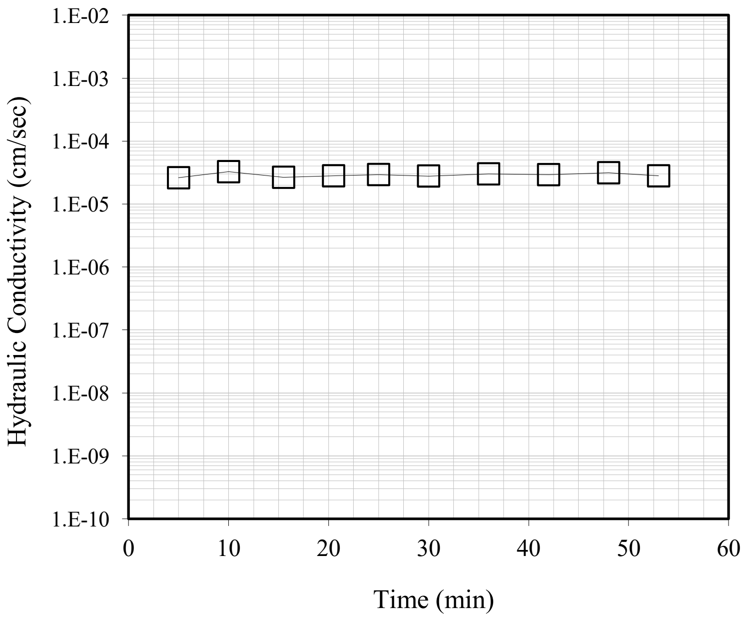
Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

Hydraulic Conductivity

Client:	Auckland Consulting LLC
Project:	Winston Pond
Sample ID:	B-5: (33-35)

TRI Log #:	21381
Test Method:	ASTM D5084 Method C



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.80
Height (in)	2.55
Initial Mass (g)	500.5
Sample Area (in^2)	6.16
Water Content (%)	26.4
Total Unit Weight (pcf)	121.4
Dry Unit Weight (pcf)	96.1
Specific Gravity (Assumed)	2.65
Degree of Saturation	96.9
Void Ratio	0.72
Porosity	0.42
1 Pore Volume (cc)	107.8
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.99

Specimen Image

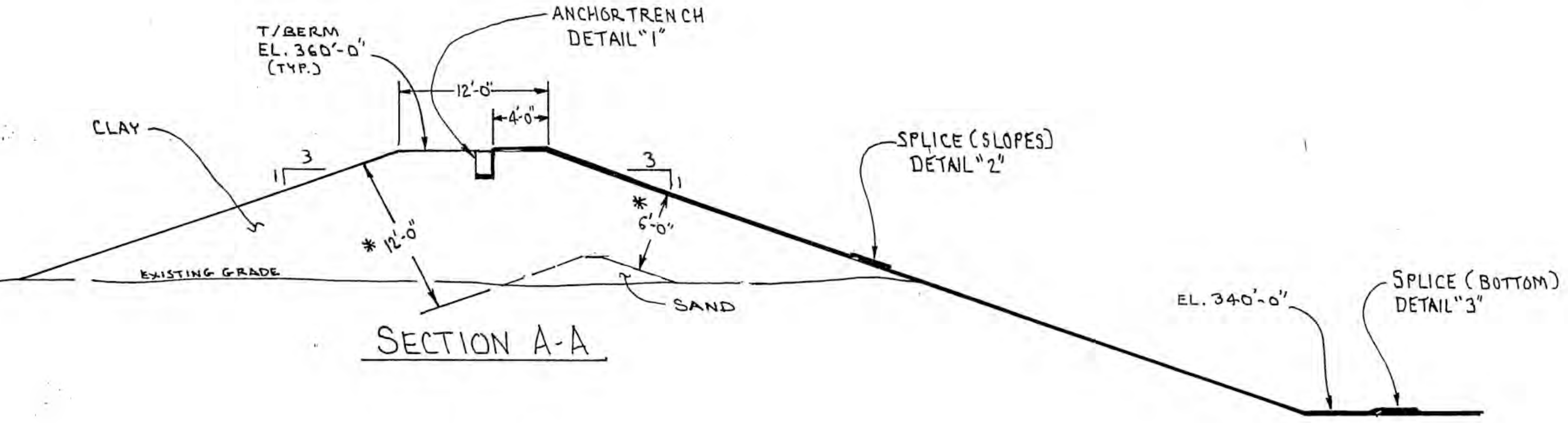
Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
36.0	3.0E-05
42.0	2.9E-05
48.0	3.1E-05
53.0	2.8E-05
Average, Last 4 Readings	**3.0E-05**

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016

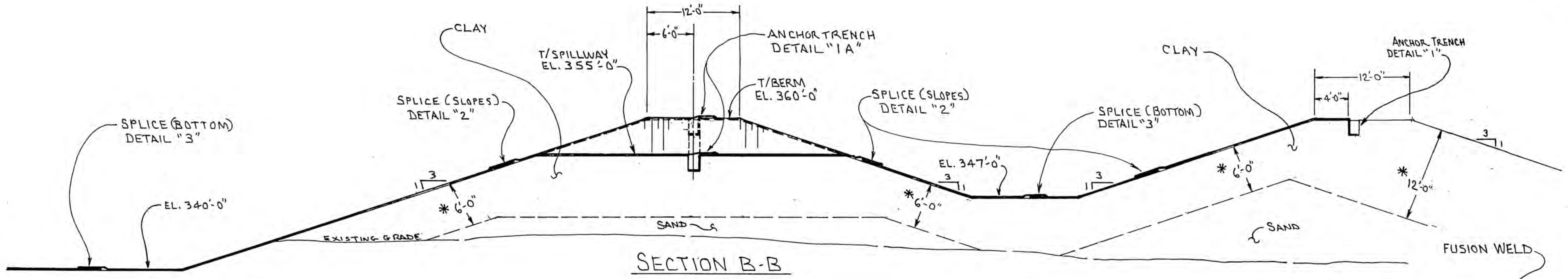
Analysis & Quality Review/Date

Testing Performed By: SOC & LC

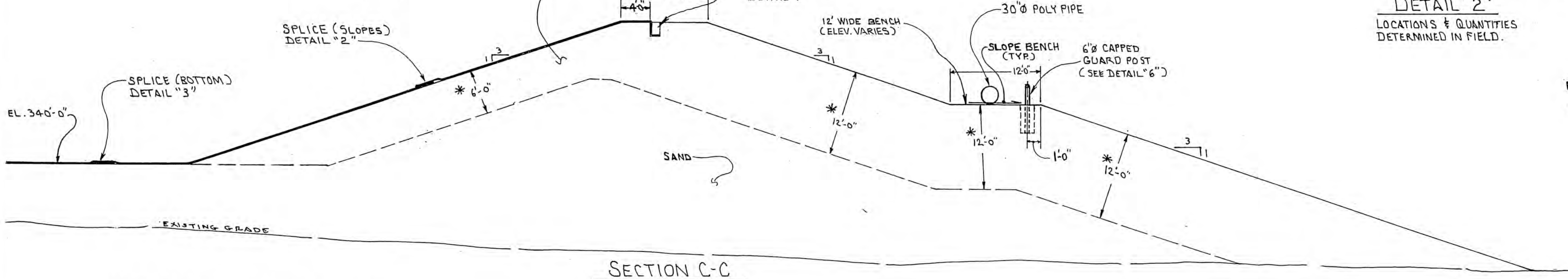
* - NOTE- THESE DIMENSIONS ARE SUBJECT TO ADJUSTMENT DEPENDING ON THE SAND / CLAY BALANCE VS. HAUL DISTANCE ON PROJECT.



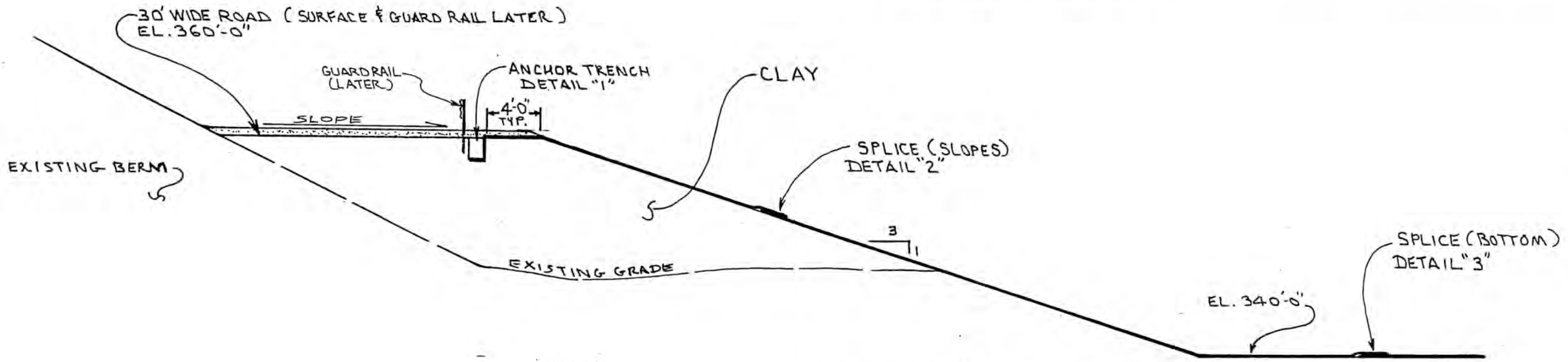
SECTION A-A



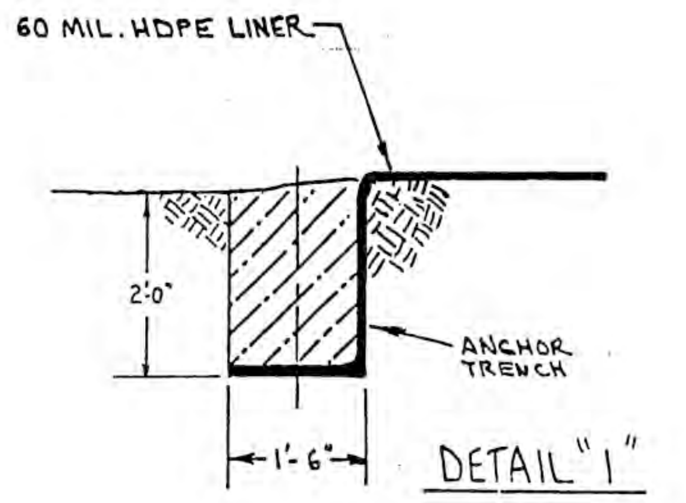
SECTION B-B



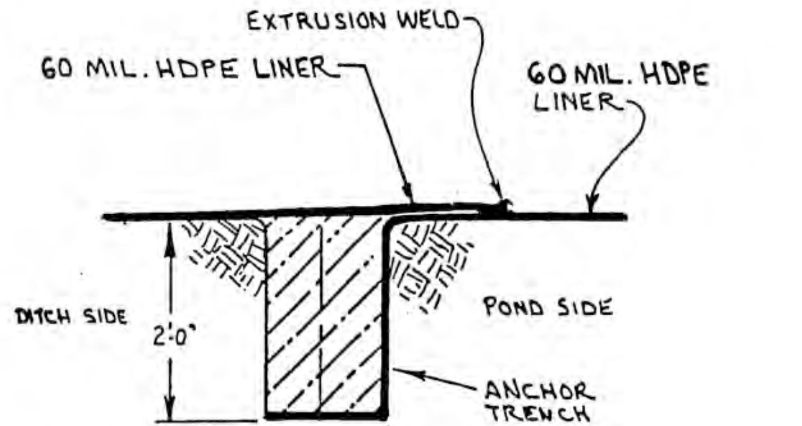
SECTION C-C



SECTION D-D



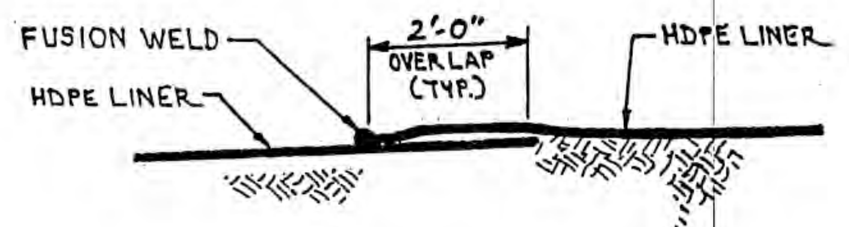
DETAIL "1"



DETAIL "1A"

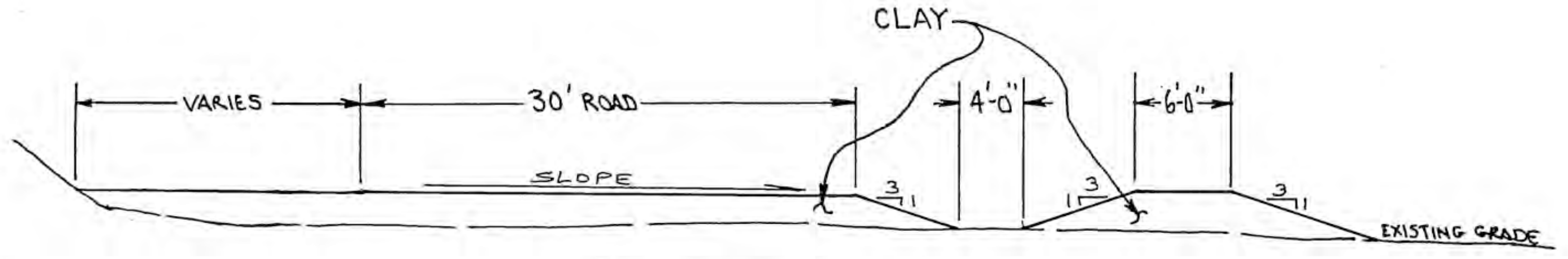
DETAIL "2"

LOCATIONS & QUANTITIES DETERMINED IN FIELD.

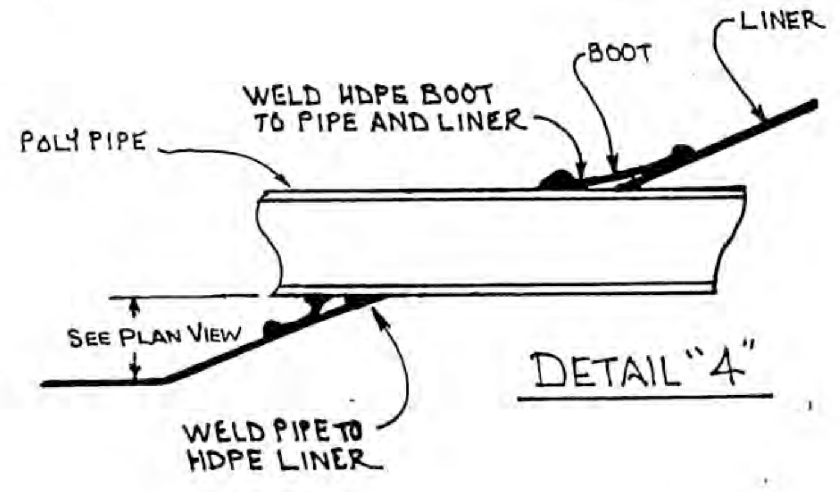


DETAIL "3"

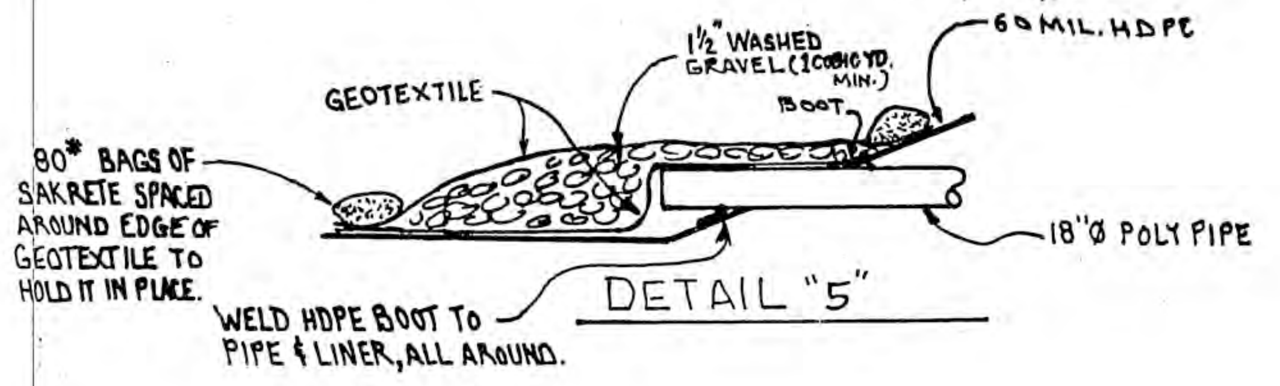
LOCATIONS & QUANTITIES DETERMINED IN FIELD



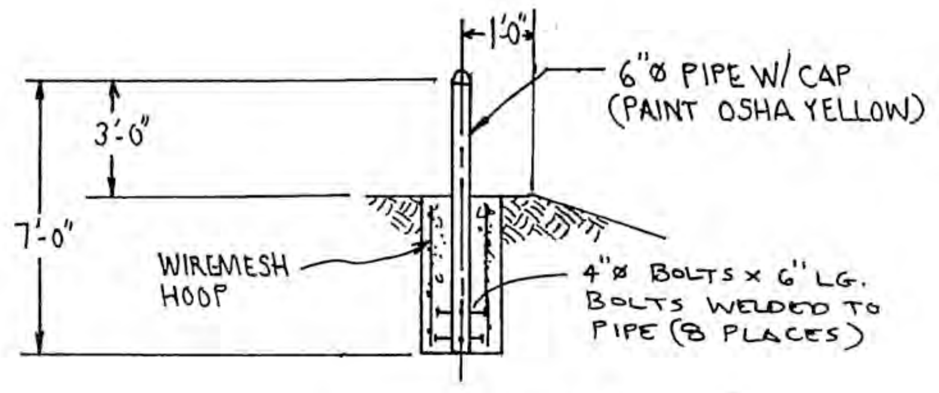
SECTION E-E



DETAIL "4"

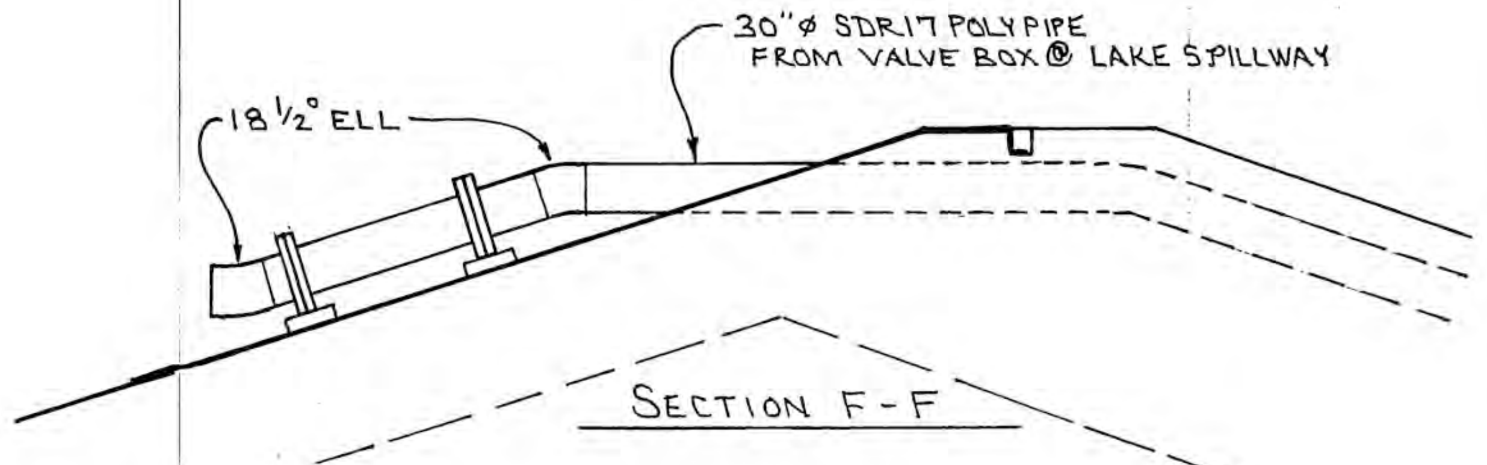


DETAIL "5"



DETAIL "6"

50' ON CENTERS
(20 REQUIRED)



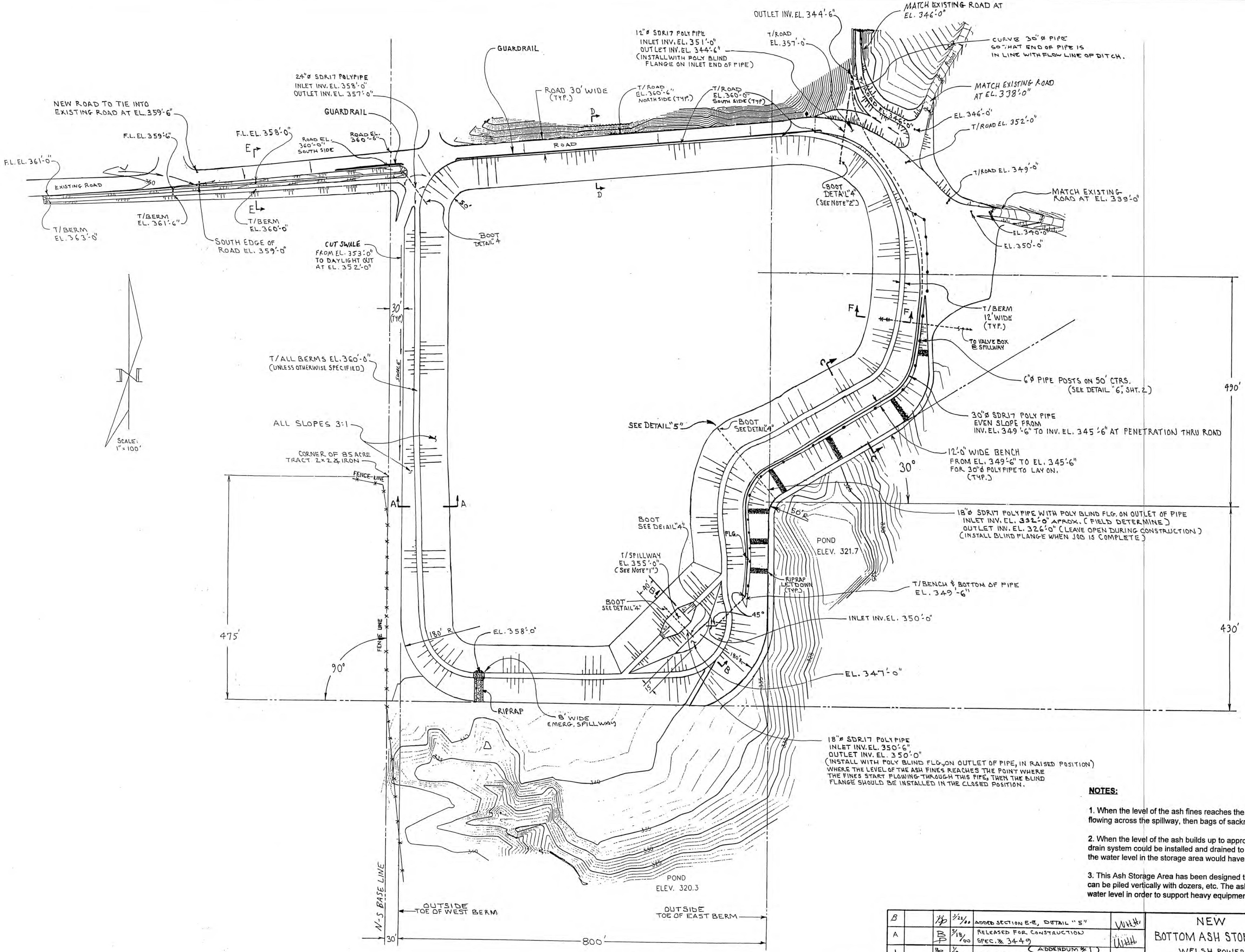
SECTION F-F

REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	10/29/00	AS BUILT	
A		BP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHH
1		BP	3/13/00	(ADDENDUM #1) RELEASED FOR BIDS SPEC. # 3449	
		BP	3/10/00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

DEPT.	
DIV.	
APPROVED	
DRWN. BY: BP	DATE: 3-10-00
SCALE: AS SHOWN	W.O.
SH. 2 OF 2	DRWG. NO. WEPX-335



NOTES:

1. When the level of the ash fines reaches the point where the fines start flowing across the spillway, then bags of sackrete can be installed to raise the spillway elevation.

2. When the level of the ash builds up to approx. elev. 355 along the north and east sides, a french drain system could be installed and drained to this outlet to help hold the water table down. Of course the water level in the storage area would have to be at elev. 351 or above for the french drain to function.

3. This Ash Storage Area has been designed to hold the water level as low as possible so the ash can be piled vertically with dozers, etc. The ash level needs to be approx. 4 ft. to 5 ft. above the water level in order to support heavy equipment.

REV.	W.O.	BY	DATE	SUBJECT	APPROVED
C		BP	10-29-00	AS BUILT	
B		BP	3/22/00	ADDED SECTION E-E, DETAIL "5"	WHH
A		BP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHH
1		BP	3/13/00	RELEASED FOR BIDS SPEC. # 3449 (ADDENDUM # 1)	
		BP	3-10-00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

DEPT.
DIV.
APPROVED
DRWN. BY: BP
DATE: 3-10-00
SCALE: 1" = 100'
W.O.
SH. 1 of 2
DRWG. NO. WEPX-335

Volume 2

- **Attachment 3 – Operating Criteria for CCR Landfills and Surface Impoundments**

ATTACHMENT 3

Operating Criteria for CCR Landfills and Surface Impoundments

30 TAC §352.271 – Operating Criteria Application Submission
Submit documentation demonstrating compliance with Subchapter G: Operating Criteria

30 TAC §352.801/40 CFR §257.80 – Air Criteria

- Submit Current Certified CCR Fugitive Dust Control Plan and Annual CCR Fugitive Dust Control Report

30 TAC §352.811/40 CFR §257.81 – Run-on and run-off controls for CCR landfills.

- Submit LF – Run-on and run-off control system plan

30 TAC §352.821/40 CFR §257.82 – Hydrologic and hydraulic capacity requirements of CCR Surface impoundments.

- Submit PBAP - Inflow Design Flood Control System Plan
- Submit BASP – Inflow Design Flood Control System Plan

30 TAC §352.831/40 CFR §257.83 – Inspection Requirements for CCR Surface Impoundments.

- Submit PBAP and BASP – Annual Inspection Report – WH 2021 Annual inspection report – CCR ash Ponds Final

30 TAC §352.841/40 CFR §257.84 – Inspection Requirements for CCR Landfills.

- Submit LF- Annual Inspection Report - WH 2021 LF inspection Report - Final

NA - 30 TAC §352.851 – Pre-Opening Inspection

3.1 – Fugitive Dust Control Plan, Landfill, Primary Bottom Ash Pond, Bottom Ash Storage Pond, November 2021

Southwestern Electric Power Company

WELSH PLANT

FUGITIVE DUST CONTROL PLAN

Landfill, Primary Bottom Ash Pond, Bottom Ash Storage Pond

Prepared By:
Southwestern Electric Power Company
Welsh Plant
1187 CR 4865
Pittsburg, Texas 75686

and

American Electric Power Service Corporation

Environmental Services - Floor 17

Columbus, OH 43215

October 2015 Revision 0
November 2021 Revision 3

Table of Contents

Appendices

Professional Engineer's Certification

By means of this certification, I certify that I have reviewed this CCR Fugitive Dust Control Plan and it meets the requirements of section 40 CFR 257.80(b).

DAVID ANTHONY MILLER

Printed Name of Registered Professional Engineer

DAVID ANTHONY MILLER
112498

David Anthony Miller

Signature

American Electric Power
Service Corporation
Texas Registered Engineering
Firm No. F-3341

112498	TEXAS	11.18.21
Registration No.	Registration State	Date

1.0 INTRODUCTION

This CCR Fugitive Dust Control Plan (Plan) has been prepared pursuant to the air criteria of 40 CFR part 257.80 (see Appendix A). The Plan has been prepared in accordance with the air criteria and following good engineering practices to include measures that will effectively minimize CCR from becoming airborne at the facility. The Plan and subsequent amendments will be placed in the operating record and retained in the office of the Welsh Plant Environmental Coordinator (PEC). The Plan and subsequent amendments will also be placed on Welsh Plant's publicly accessible internet website titled "CCR Rule Compliance Data and Information." The plan will be amended whenever there is a change in conditions that would substantially affect the written plan in effect, such as the construction and operation of a new CCR unit. Where appropriate, the Plan incorporates fugitive dust control requirements as contained in the Texas air permits issued for the plant.

There are two CCR surface impoundments and one CCR landfill located at Welsh that are subject to this Plan. The Plan addresses these CCR locations and the associated paved and unpaved roadways.

2.0 FACILITY DESCRIPTION AND CONTACT INFORMATION

2.1 Facility Information

Facility Information
Name of Facility: Southwestern Electric Power Company – Welsh Plant
Street: 1187 CR 4865
City: State: ZIP Code: Pittsburg, TX 75686
County: Titus
Latitude: 33° 3' 10.4" Longitude: - 94° 50' 57.0"

2.2 Contact Information

Facility Operator:
Name: Southwestern Electric Power Company – Welsh Plant
Attention: Donnie Duffee - Plant Manager
Address: 1187 CR 4865
City, State, Zip Code: Pittsburg, TX 75686

Facility Owner:
Name: Southwestern Electric Power Company
Attention: William Hildeson, Environmental Guru
Address: 1 Riverside Plaza - ES - Floor 17
City, State, Zip Code: Columbus, OH 43215

Plan Contact:
Name: Jasmine Gilbert – Welsh Plant Environmental Coordinator
Address: 1187 CR 4865
City, State, Zip Code: Pittsburg, TX 75686
Telephone number: 903-855-5444
Email address: jgilbert@aep.com

2.3 Activities at the Facility

Southwestern Electric Power Company (SWEPCO), a unit of American Electric Power (AEP), is operating a coal-fired electric power generating facility near Pittsburg, Texas, in Titus County. This facility is named the Welsh Power Plant. The plant consists of two units with boilers fueled by PRB coal.

2.4 Site Maps

A site location map for the Plant units is included as Figure 2-1 in Appendix C. Appendix B contains a site location map for the Landfill (Figure 1-1).

3.0 FUGITIVE DUST CONTROL SELECTION

3.1 Paved and Unpaved Roadways

3.1.1 Overview

Trucks are used to transport CCR to the Landfill from the plant site. The trucks travel over private roadways to the landfill entrance. From the ash silo, the trucks travel approximately 1.2 miles over landfill improved roadways to the disposal area. The applicable and adequate fugitive dust control measures were primarily selected in accordance with the measures contained in Texas Air Permits for the landfill roads and for the plant roads.

3.1.2 Landfill and Plant Roadways

The primary appropriate and applicable fugitive dust control measures for roadways are watering, tarping, and speed controls. Water trucks are used as needed based upon the daily inspections and other observations to minimize or eliminate fugitive dust. Chemical suppressants or stabilizers may also be used on unpaved roadways depending on specific site conditions. Posted speed limits are 15 mph for paved and unpaved roads. Implementation of control measures will not be necessary for roadways that are covered with snow and/or ice or if sufficient precipitation occurs to minimize or eliminate fugitive dust. Implementation of any control measures may be suspended if unsafe or hazardous driving conditions would be created by its use.

3.2 Landfill

3.2.1 Overview

The Welsh ash landfill receives fly ash and bottom ash. Both materials contain moisture (conditioned) but water or chemical suppressants are added at the landfill as necessary to minimize fugitive dust emissions. The landfill activities are subject to the Facility’s Air Permits. This permit specifies the applicable and appropriate fugitive dust control measures for the site to minimize or eliminate fugitive emissions. The permit also includes visible particulate emissions limits as well as monitoring, recordkeeping and reporting requirements. [**Note**: “conditioned” CCR means the material has sufficient moisture content to prevent wind dispersal but will not result in free liquids]

3.2.2 Unloading and Placement

Fly ash is unloaded from trucks in the active fill area of an open landfill cell, where a bulldozer or similar equipment will spread and compact the materials. A roller may also be used for compaction. After compaction, fly ash is often reclaimed and sold as road base material. The fugitive dust control measures for truck unloading ash includes maintaining moisture in the material and taking precautionary measures (minimize drop height). The measures for spreading and compacting include maintaining vehicle speed and watering materials.

3.2.3 Wind Erosion

Generally, landfill disposal areas can be classified as closed or open. Closed areas have received final cover and vegetation has been established. Open areas contain both the active fill area and areas that have been compacted but not yet received final cover. The open area fugitive dust control measures include: precautionary measures such as minimizing the amount of open area and pile height; compacting material as it is unloaded; watering; and application of chemical suppressants. The bottom ash storage pile fugitive dust emissions are minimized by watering, application of chemical suppressants and pile height control.

3.3 Primary Bottom Ash Pond

Welsh Plant bottom ash and economizer ash are sluiced to the Primary Ash Pond where the deposition of solid matter occurs. Due to the wet condition of the ash and location of the pond surface below the dam and valley wall elevations, the ponds typically have no fugitive emissions. Pond levels may be adjusted to inundate any exposed dry areas and minimize dusting. The applicable and appropriate fugitive dust control measure is to adjust the pond water level, when practicable.

3.4 Bottom Ash Storage Pond

The Welsh Bottom Ash Storage Pond is a poly-lined pond that contains mostly bottom ash and economizer ash that have been dredged from the Primary Bottom Ash Pond. Fly ash is also present at far lesser amounts. Ash is routinely reclaimed from the Bottom Ash Storage Pond for beneficial reuse. Water or chemical dust suppressants are applied to the pile to minimize fugitive emissions as needed. Two-foot freeboard is maintained around the pond to serve as a windbreak and minimize dusting.

4.0 PLAN ASSESSMENT

The Plan will be periodically assessed to verify its effectiveness, and if necessary, amended in accordance with Section 7.0 below. The Landfill and associated paved and unpaved roadways are inspected on a daily basis. The purpose of the inspections is to determine if the control measures for the CCR unit as described above are being implemented as necessary to minimize or eliminate fugitive emissions. Records of inspections and the control measures implemented as a result of the inspections will be maintained. The PEC will review the inspection records annually to assess the effectiveness of the Plan and determine if additional or modified measures are warranted. No inspection is necessary if the surface is covered with snow and/or ice or if precipitation has occurred that is sufficient to minimize or eliminate fugitive emissions. Implementation of any control measure may be suspended if unsafe or hazardous driving conditions would be created by its use.

5.0 CITIZEN COMPLAINT LOG

5.1 Plant Contacts

Generally, complaints made to the plant are by telephone and received by the PEC (Plan Contact). In the case of holiday, weekends, or other times when the PEC may not be onsite, the plant guard houses or plant general phone number may receive complaint information by telephone that is provided to the PEC at the earliest convenience. Complaints may also be made to TCEQ who in turn will contact the PEC.

5.2 Follow-up

All complaints will be entered into a record by the PEC with details noted such as the nature of the complaint, date, time, and other relevant details. All complaints will be followed up which may include: checking plant operations at the time of the event, reviewing inspection records, discussing with other plant personnel, reviewing weather data, collecting samples and contacting the person making the complaint to obtain additional information.

5.3 Corrective Action and Documentation

Corrective actions will be taken as needed and documented. If it is determined that the Plan needs to be amended as a result of the corrective actions, it will be amended in accordance with the Plan. If necessary, the PEC will follow-up with the complainant and/or TCEQ to explain the findings of the complaint investigation, corrective actions or sampling results. Citizen complaints will be recorded in the Annual Report.

6.0 ANNUAL REPORT

The Annual CCR Fugitive Dust Control Report (Annual Report) will be prepared which includes the following components: description of actions taken to control CCR fugitive dust; a record of all citizen complaints; and a summary of any corrective measures taken. The initial Annual Report will be completed no later than 14 months after placing the initial CCR fugitive dust control plan in the facility's operating record. The deadline for completing subsequent reports is one year after the date of completing the previous report. The Annual Report will be deemed complete when the plan has been placed in the facility's operating record as described in Section 8.0.

7.0 PLAN AMENDMENTS

This Plan is a "living" document and will be amended, as necessary, whenever there is a change in condition that would substantially affect the written plan in effect. The Plan will be amended in the case of construction and operation of a new CCR unit. Amendments made to the Plan will be documented in Appendix E. The amended Plan will be placed into the facility's operating record as described in Section 8.0.

8.0 RECORDKEEPING, NOTIFICATION and INTERNET REQUIREMENTS

8.1 Recordkeeping

The Plan and files of all related information will be maintained in a written operating record at the facility for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, record or study. Files may be maintained on a computer or storage system accessible by a computer. The Plan (and any subsequent amendment of the plan) and the Annual Report will be kept in the facility's operating record as they become available. Only the most recent Plan must be maintained in the record. [§ 257.105]

8.2 Notification

TCEQ will be notified within 30 days of when the Plan (or any subsequent amended Plan) or the Annual Report is placed in the operating record and on the publicly available internet site. This notification will be made before the close of business on the day the notification is required to be completed. "Before the close of business day" means the notification must be postmarked or sent by e-mail. If the notification deadline falls on a weekend or federal holiday, the notification is automatically extended to the next business day. [§ 257.106]

8.3 Internet Site Requirements

The most recent Plan and annual Report will be placed on the facility's CCR website titled "CCR Rule Compliance Data and Information" within 30 days of placing them in the operating record. [§ 257.107]

Appendix A

40 CFR Part 257.80 Operating Criteria

§ 257.80 Air criteria.

(a) The owner or operator of a CCR landfill, CCR surface impoundment, or any lateral expansion of a CCR unit must adopt measures that will effectively minimize CCR from becoming airborne at the facility, including CCR fugitive dust originating from CCR units, roads, and other CCR management and material handling activities.

(b) *CCR fugitive dust control plan.*
The owner or operator of the CCR unit must prepare and operate in accordance with a CCR fugitive dust control plan as specified in paragraphs (b)(1) through (7) of this section. This requirement applies in addition to, not in place of, any applicable standards under the Occupational Safety and Health Act.

(1) The CCR fugitive dust control plan must identify and describe the CCR fugitive dust control measures the owner or operator will use to minimize CCR from becoming airborne at the facility. The owner or operator must select, and include in the CCR fugitive dust control plan, the CCR fugitive dust control measures that are most appropriate for site conditions, along with an explanation of how the measures selected are applicable and appropriate for site conditions. Examples of control measures that may be appropriate include: Locating CCR inside an enclosure or partial enclosure; operating a water spray or fogging system; reducing fall distances at material drop points; using wind barriers, compaction, or vegetative covers; establishing and enforcing reduced vehicle speed limits; paving and sweeping roads; covering trucks transporting CCR; reducing or halting operations during high wind events; or applying a daily cover.

(2) If the owner or operator operates a CCR landfill or any lateral expansion of a CCR landfill, the CCR fugitive dust control plan must include procedures to emplace CCR as conditioned CCR. Conditioned CCR means wetting CCR with water to a moisture content that will prevent wind dispersal, but will not result in free liquids. In lieu of water, CCR conditioning may be accomplished with an appropriate chemical dust suppression agent.

(3) The CCR fugitive dust control plan must include procedures to log citizen complaints received by the owner or operator involving CCR fugitive dust events at the facility.

(4) The CCR fugitive dust control plan must include a description of the procedures the owner or operator will follow to periodically assess the effectiveness of the control plan.

(5) The owner or operator of a CCR unit must prepare an initial CCR fugitive dust control plan for the facility no later than October 19, 2015, or by initial receipt of CCR in any CCR unit at the facility if the owner or operator becomes subject to this subpart after October 19, 2015. The owner or operator has completed the initial CCR fugitive

dust control plan when the plan has been placed in the facility's operating record as required by § 257.105(g)(1).

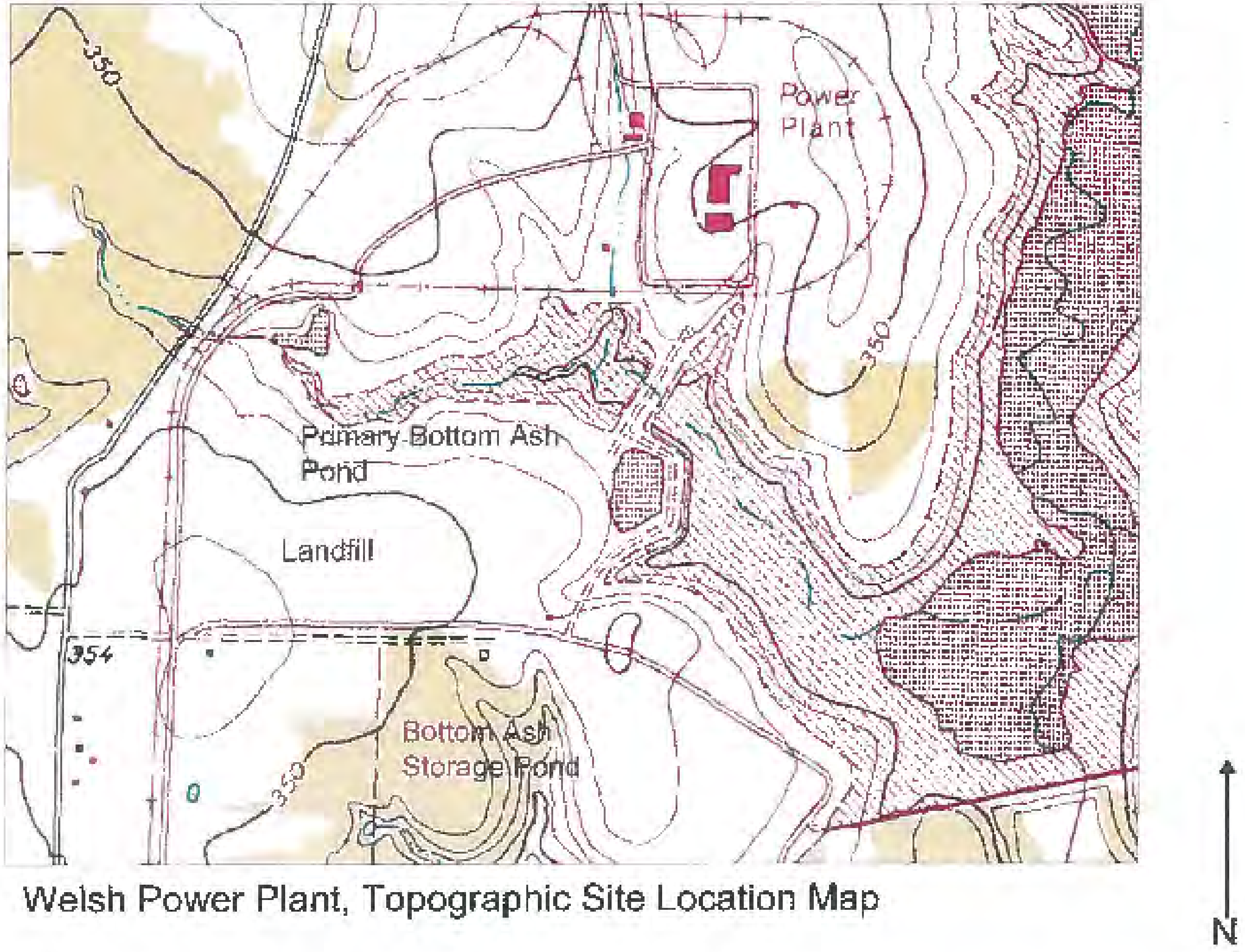
(6) *Amendment of the plan.* The owner or operator of a CCR unit subject to the requirements of this section may amend the written CCR fugitive dust control plan at any time provided the revised plan is placed in the facility's operating record as required by § 257.105(g)(1). The owner or operator must amend the written plan whenever there is a change in conditions that would substantially affect the written plan in effect, such as the construction and operation of a new CCR unit.

(7) The owner or operator must obtain a certification from a qualified professional engineer that the initial CCR fugitive dust control plan, or any subsequent amendment of it, meets the requirements of this section.

(c) *Annual CCR fugitive dust control report.* The owner or operator of a CCR unit must prepare an annual CCR fugitive dust control report that includes a description of the actions taken by the owner or operator to control CCR fugitive dust, a record of all citizen complaints, and a summary of any corrective measures taken. The initial annual report must be completed no later than 14 months after placing the initial CCR fugitive dust control plan in the facility's operating record. The deadline for completing a subsequent report is one year after the date of completing the previous report. For purposes of this paragraph (c), the owner or operator has completed the annual CCR fugitive dust control report when the plan has been placed in the facility's operating record as required by § 257.105(g)(2).

(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

Appendix B



Welsh Power Plant, Topographic Site Location Map

Appendix C


Welsh Power Plant
CCR Units
Legend
▫ American Electric Power Co
CCR Units
Welsh Power Plant
Primary bottom ash pond
Landfill
Bottom ash storage pond
SE-23
SE-25
SE-35C
SE-35B
4896
4875
SE-35A
4960
1222
1223
SE-3
1735
SE-2
Google Earth
©2018 Google
3000 ft
N

Appendix D

Record of Plan		
Revision Number	Date	Revision Description
0	10/12/2015	Initial
1	9/27/2016	Updated Plant Manager
2	7/5/2018	Updated Dallas Address, Removed Sentence in Section 3.2.2 about Bottom Ash, Added Bottom Ash information to Sections 3.3 and 3.4.
3	11/04/2021	Updated Plant Manager in Section 2.1, Updated Plan Contact and Address in Section 2.2.

3.2 – Annual CCR Fugitive Dust Control Report, September 2021

Southwestern Electric Power Company

J. Robert WELSH POWER PLANT

ANNUAL CCR FUGITIVE DUST CONTROL REPORT

Landfill, Primary Bottom Ash Pond, Bottom Ash Storage Pond

Prepared by:
Southwestern Electric Power Company
Welsh Plant
1187 CR 4865
Pittsburg, Texas 75686

and

American Electric Power Service Corporation
Environmental Services
1201 Elm St, Suite 4100
Dallas, Texas 75270

September 2021

Table of Contents

1.0 INTRODUCTION

This Annual CCR Fugitive Dust Control Report (Annual Report) has been prepared pursuant to the air criteria of 30 TAC 352.801 (40 CFR part 257.80).

The Annual Report summarizes activities described in the CCR fugitive dust control plan (Plan) and includes the following components: description of actions taken to control CCR fugitive dust; a record of all citizen complaints; and a summary of any corrective measures taken.

This initial Annual Report must be completed no later than 14 months after placing the initial Plan in the facility's operating record. The initial Welsh fugitive dust control plan was placed into the operating record on September 16, 2015. This Annual Report addresses the period from September 15, 2020 to September 16, 2021. The Annual Report is deemed complete when it is placed in the facility's operating record as described in Section 6.0. The deadline for completing subsequent Annual Reports is one year after the date of completing the previous report.

The Annual Report will be placed in the operating record. The Report will also be placed on Welsh Plant's publicly accessible internet website titled "CCR Rule Compliance Data and Information" as described in Section 6.0.

2.0 FACILITY DESCRIPTION AND CONTACT INFORMATION

Name of Facility: Southwestern Electric Power Company – Welsh Plant
Street: 1187 CR 4865
City: Pittsburg
State: TX
ZIP Code: 75686
County: Titus
Latitude: 33° 3' 10.4" Longitude: - 94° 50' 57.0"

2.2 Contact Information

Facility Operator:
Name: Southwestern Electric Power Company – Welsh Plant
Attention: Donnie Duffee - Plant Manager
Address: 1187 CR 4865
City, State, Zip Code: Pittsburg, TX 75686

Facility Owner:
Name: Southwestern Electric Power Company
Attention: William Hildeson - Environmental Specialist
Address: 1201 Elm St, Suite 4100
City, State, Zip Code: Dallas, TX 75270

Plan Contact:
Name: Jasmine Gilbert – Welsh Plant Environmental Coordinator (PEC)
Address: 1187 CR 4865
City, State, Zip Code: Pittsburg, TX 75686
Telephone number: 903-855-5444
Email address: jgilbert@aep.com

2.3 Facility Description

Southwestern Electric Power Company (SWEPCO), a unit of American Electric Power (AEP), is operating a coal-fired electric power generating facility near Pittsburg, Texas, in Titus County. This facility is named the J. Robert Welsh Power Plant. The plant consists of two 528 megawatt units with boilers fueled by Powder River Basin coal.

3.0 FUGITIVE DUST CONTROLS

The following fugitive dust control measures were implemented during the period addressed by this Annual Report:

Plant Activity	Fugitive Dust Control Measures
Plant roadways	Roadways were watered as needed and speed control measures were implemented.
Landfill – unloading and placement of material	Unloading emissions were controlled by maintaining moisture in the material, taking precautionary measures (minimizing drop height) and watering as needed; spreading and compacting emissions were controlled by maintaining vehicle speed, maintaining moisture in the material, and watering as needed.
Landfill – wind erosion	Wind erosion control measures for open areas included: minimizing the amount of open area and pile height; compacting material as it was unloaded; maintaining moisture content of the materials and watering as needed.
Primary Bottom Ash Pond	No controls are necessary as the pond level inhibits emissions.
Bottom Ash Storage Pond	Emissions were controlled by the inherent moisture of the material, timely loading of trucks and watering as needed.
Dry Fly Ash Handling	Emissions were controlled by using: full enclosures, bin vent filters, baghouses, water spray curtains and conditioning ash.

Note: *Implementation of control measures will not be necessary for roadways that are covered with snow and/or ice or if sufficient precipitation occurs to minimize or eliminate fugitive dust. Implementation of any control measures may be suspended if unsafe or hazardous driving conditions would be created by its use.*

4.0 CITIZEN COMPLAINT LOG

4.1 Plan Contacts

Generally, complaints made to the plant are by telephone and received by the PEC (Plan Contact). In the case of holiday, weekends, or other times when the PEC may not be onsite, the plant guard houses or plant general phone number may receive complaint information by telephone that is provided to the PEC at the earliest convenience. Complaints may also be made to Texas Commission on Environmental Quality (TCEQ) who in turn will contact the PEC. **No complaints were received by the Plant PEC during the period addressed by this Annual Report.**

4.2 Follow-up

All complaints will be entered into a log by the PEC with details noted such as the nature of the complaint, date, time, and other relevant details. All complaints will be followed up which may include: checking plant operations at the time of the event, reviewing inspection records, discussing with other plant personnel, reviewing weather data, collecting samples and contacting the person making the complaint to obtain additional information. **No complaint follow-up was necessary during the period addressed by this Annual Report.**

4.3 Corrective Action and Documentation

Corrective actions will be taken as needed and documented. If it is determined that the Plan needs to be amended as a result of the corrective actions, it will be amended in accordance with the Plan. If possible, the PEC will follow-up with the complainant and/or TCEQ to explain the findings of the complaint investigation, corrective actions or sampling results. Citizen complaints will be recorded in the annual Report. **No corrective actions due to complaints were necessary during the period addressed by this Annual Report.**

5.0 PLAN ASSESSMENT

The Plan will be periodically assessed to verify its effectiveness, and if necessary, amended. **The PEC reviewed the inspection records when preparing this Annual Report to assess the effectiveness of the Plan and determined that no additional or modified measures were warranted.**

6.0 RECORDKEEPING, NOTIFICATION and INTERNET REQUIREMENTS

6.1 Recordkeeping

The Annual Report and the Plan (and any subsequent amendment of the plan) will be kept in the facility's operating record as they become available. The Plan and files of all related information will be maintained in a written operating record at the facility for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, record or study. Only the most recent Plan must be maintained in the record. Files may be maintained on a computer or storage system accessible by a computer. One recordkeeping system may be used for the APS and Landfill if the system identifies each file by the name of each unit (i.e. APS or Landfill).

6.2 Notification

The Director of the Texas Commission on Environmental Quality will be notified within 30 days of when the Annual Report is placed in the operating record and on the publicly available internet site. This notification will be made before the close of business on the day the notification is required to be completed. "Before the close of business day" means the notification must be postmarked or sent by e-mail. If the notification deadline falls on a weekend or federal holiday, the notification is automatically extended to the next business day.

6.3 Internet Site Requirements

The most recent Annual Report will be placed on the facility's CCR website titled "CCR Rule Compliance Data and Information" within 30 days of placing it in the operating record.

3.3 – Run-on and Run-off Control System Plan Update and Reissue, Welsh Power Plant Ash Landfill, September 2021

AEP AMERICAN ELECTRIC POWER

SOUTHWESTERN ELECTRIC
POWER COMPANY

WELSH POWER PLANT
ASH LANDFILL

Run-on and Run-off
Control System Plan
Update & Reissue

September 17, 2021

PREPARED BY:

MTG
ENGINEERS
& SURVEYORS

5930 Summerhill Road 903.838.8533 telephone
Texarkana, TX 75503 903.832.4700 facsimile
TBPE No. 354

MTG TEXAS FIRM REGISTRATION NUMBER: 354
MTG PROJECT NUMBER: 217001

WELSH POWER PLANT - ASH LANDFILL
Run-on and Run-off Control System Plan

Table of Contents Page

1.0 Introduction

The Welsh Power Plant has a deed recorded ash landfill (Phase 1 Landfill) that currently receives ash materials from two 528 MW coal fired boilers. The plant annually produces fly ash, bottom ash and economizer ash. Typically, bottom and economizer ash are sluiced to the Primary Ash Pond, which has been periodically dredged and temporarily stored in the Bottom Ash Storage Pond.

Welsh Units 1 and 3 were retrofitted in 2016 to capture mercury in order to comply with EPA Mercury and Air Toxics Standard (MATS) emissions regulations. Activated Carbon Injection (ACI) captures the mercury and is mixed with fly ash to form an ACI byproduct, which is captured in a Pulse Jet Fabric Filter (PJFF).

The Ash Landfill has traditionally been operated in two sections, with a portion of the landfill being primarily composed of dredged bottom ash, economizer ash, and fly ash material sluiced to the ash landfill between approximately 1986 and 2000. The western portion of the Ash Landfill is used to reclaim ash materials for beneficial reuse. Ash sales to the construction industry have helped to extend the Ash Landfill life. A contract ash marketer utilizes the western two-thirds of the Ash Landfill as a temporary storage and processing area for fly ash. The ash marketer is contracted to sell all marketable ash material for beneficial reuse in order to extend the life of the Ash Landfill.

Modifications to the Ash Landfill cap, cover and dewatering systems were incorporated into a landfill site development plan and implemented in 2016 through 2019 (two separate contract efforts). These modifications were submitted to the Texas Commission on Environmental Quality (TCEQ) Industrial Solid Waste Permits Section and each were acknowledged by same. The modifications included provisions for a minimum 3-foot thickness compacted clay cap and a minimum 1.5-foot thickness erosion/vegetative cover, in accordance with TCEQ Technical Guideline No. 3. A project was also conducted in 2017, adding the Low Water Crossing.

30 TAC 352.811 (and by reference 40 CFR 257.81) requires the owner or operator of an existing or new landfill or any lateral expansion of a landfill used for Coal Combustion Residuals (CCR) must comply with the following:

- Design, construct, operate, and maintain:
    - A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.
    - A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.
- Run-off from the active portion of the CCR unit must be handled in accordance with the associated surface water requirements.

- Prepare initial and periodic run-on and run-off control system plans for the CCR unit according to the following timeframes:
    - For existing CCR landfills, the owner or operator of the CCR unit must have prepared the initial run-on and run-off control system plan no later than October 17, 2016.
    - The owner or operator of the CCR unit must prepare periodic run-on and run-off control system plans every five (5) years thereafter.
- Obtain a certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of this section.
- Comply with the recordkeeping requirements specified in 30 TAC 352.1301, the notification requirements specified in 30 TAC 352.1311, and the Publicly Accessible Website requirements specified in 30 TAC 352.1321.

This Run-on and Run-off Control System Plan presents the regulatory-required materials as noted above for the Welsh Ash Landfill. Though design of permanent run-on and run-off control measures were prepared for the Welsh Ash Landfill in the previously submitted/approved Design Modification, this Run-on and Run-off Control System Plan addresses a combination of both interim and permanent systems which are hereafter described.

As the Welsh Ash Landfill is subsequently filled and completed, periodic updates to this Run-on and Run-off Control System Plan may be required.

2.0 Run-on Control Systems

Run-on Controls are provided and accomplished for the interim condition of the Welsh Ash Landfill by a combination of perimeter grading conditions and interim/permanent perimeter drainage systems. The design and function of these systems are as follows:

2.1 Perimeter Grading Conditions

As shown in Figure 1 – Fly Ash Storage Area Phase I (WEPX-88), the Welsh Ash Landfill was constructed with a screen dike on the entire west, north and east sides with drainage culverts located on the north and the southeast areas. A berm of minimal length was constructed on the eastern side of the south boundary. The net effect of this original construction is a perimeter grading condition that is an average of fifteen feet above the surrounding area. As a result of this perimeter grading condition and the hydraulic and hydrological conditions demonstrated in perimeter drainage systems hereafter, a run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm has been in place from the outset.

2.2 Interim & Permanent Perimeter Drainage Systems

As shown in Figure 2 – Current TCEQ NOR Site Development Plan, the future condition of the Welsh Ash Landfill provides for a perimeter drainage system consisting of varying depth perimeter drainage systems (ditches). These perimeter drainage systems are designed as both a run-on and run-off control system to prevent flow onto or away from the active portion of the landfill during the peak discharge from a 24-hour, 25-year storm (Design Event).

In the interim condition, as shown in Figure 3 – Composite Existing Conditions (Merged Field & LiDAR Topography) and the associated Figure 4 – Existing & Proposed Conditions - Drainage Area Map, interim/permanent perimeter drainage systems have been provided. Currently the Run-on and Run-off Control System includes permanent components of the perimeter drainage systems along a portion of the east and northeast sides of the Welsh Ash Landfill. All other perimeter drainage systems are interim. These perimeter ditches are designed to likewise prevent flow onto the active portion of the landfill during the peak discharge from the Design Event.

2.3 Summary of Design Requirements & Justifications

Both Table 1 – Drainage Area Summaries and Table 2 – Q25 Run-on and Run-off Analysis Justifications (and supporting design calculations), as contained in Appendix 2, provide a summary of hydraulic and hydrologic capacity of the interim run-on/run-off control system. These analyses demonstrate that, in all instances, the currently implemented (and maintained) drainage system functions to control run-on for the peak discharge from a 24-hour, 25-year storm.

3.0 Run-off Control Systems

Run-off Controls are provided and accomplished for the interim condition of the Welsh Ash Landfill by a combination of perimeter grading conditions and interim/permanent perimeter drainage systems. The design, operation and maintenance of these perimeter drainage systems provide for conveyance of all 24-hour, 25-year storm run-off from within the Welsh Landfill to the Primary Bottom Ash Pond, a management unit designed to accommodate these flows and other process discharges from the Welsh Power Plant. The design and function of these systems are as summarized follows:

3.1 Perimeter Grading Conditions

As previously noted, the original construction resulted in a perimeter grading condition that is an average of fifteen feet above the surrounding area. As a result of this perimeter grading condition and the hydraulic and hydrological conditions demonstrated in perimeter drainage systems hereafter, an uncontrolled run-off control system is in place to prevent flow away from the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.

3.2 Interim Top Slope Diversion Berms and Swales

Due to proximity to interim perimeter drainage systems, Drainage Areas CDA 01, CDA 02, CDA 03, CDA 04, and CDA 05 currently require drainage swales in conjunction with berms, dikes or other top slope diversions to ensure contact runoff is managed within the landfill. As shown in Figure 3 – Composite Existing Conditions (Merged Field & LiDAR Topography) and the associated Figure 4 – Existing & Proposed Conditions - Drainage Area Map, these drainage features are configured with the purpose of preventing run-off from the adjacent perimeter drainage areas during a 24-hour, 25-year storm event.

3.3 Permanent Side Slope Terraces and Letdowns

Currently the Run-on and Run-off Control System includes earthen side slope terraces and letdowns along a portion of the east and northeast sides of the Welsh Ash Landfill. The future side slopes of the landfill will extend at a 3H:1V slope to a height of approximately 75-feet above the flowline of the permanent perimeter drainage systems (ditch). These systems or similar will be extended as the landfill continues to fill.

In accordance with Figure 2 – Current TCEQ NOR Site Development Plan and associated design, these terraces and letdowns are designed and implemented as run-off control systems to accommodate runoff from a 24-hour, 25-year storm (Design Event), when needed.

3.4 Interim and Permanent Perimeter Drainage Systems

As shown in Figure 2 – Current TCEQ NOR Site Development Plan, the future condition of the Welsh Ash Landfill provides for a perimeter drainage system consisting of varying depth perimeter drainage systems (ditches). These perimeter ditches are designed as both a run-on and run-off control system to prevent flow onto or away from the active portion of the landfill during the peak discharge from a 24-hour, 25-year storm (Design Event).

In the interim condition, as shown in Figure 3 – Composite Existing Conditions (Merged Field & LiDAR Topography) and the associated Figure 4 – Existing & Proposed Conditions - Drainage Area Map, some of these perimeter drainage systems (ditches) have been provided. Currently the Run-on and Run-off Control System includes permanent components of the perimeter drainage systems along a portion of the north and east sides of the Welsh Ash Landfill. All other perimeter drainage systems are interim. These perimeter ditches are designed to likewise prevent flow onto the active portion of the landfill during the peak discharge from the Design Event.

3.5 Interim and Permanent Culvert Systems

3.5.1 Interim. Driveway crossings are implemented around the perimeter drainage system on an as-needed basis. These crossings are considered interim; however, are sized for run-on and run-off control for the Design Event.

3.5.2 Permanent Culvert Systems, designed to control run-on and run-off equal to or greater than the 24-hour, 25-year design storm event and conveying same to the Primary Bottom Ash Pond, are currently in place as follows:

- Two HDPE culverts, one 30-inches in diameter and one 36-inches in diameter, in the perimeter ditch at the northeast corner of the Welsh Ash Landfill;
- Two 30-inch diameter HDPE culverts in the perimeter ditch at the northwest corner of the Welsh Ash Landfill; and
- A series of three 30-inch diameter HDPE culverts collecting and discharging stormwater runoff from within the landfill at the original “Culvert Number 2” (shown as 2a, 2b, and 2c) location (future landfill leachate collection sump).

3.6 Permanent Low Water Crossing System

The run-on and run-off designs provide for run-off to be routed south via a low water crossing. This low water crossing is comprised of a textured reinforced concrete trapezoidal broadcrest section, 10-feet wide by 2.76’ deep with 12H:1V side slopes and a -1.1% slope along the flowline. The crossing is sized and configured for in excess of the 24-hour, 25-year storm event for future landfill sideslope, terraces and letdowns.

At present, this low water crossing is blocked by perimeter berms to ensure that contact stormwater is routed to the Culvert Number 2 (shown as 2a, 2b, & 2c) location for discharge.

3.7 Summary of Design Requirements and Justifications

Both Table 1 – Drainage Area Summaries and Table 2 – Q25 Run-on and Run-off Analysis Justifications (and supporting design calculations), as contained in Appendix 2, provide a summary of hydraulic and hydrologic capacity of the interim run-on/run-off control system. These analyses demonstrate that, in all instances, the currently implemented (and maintained) drainage system function to control run-off for the peak discharge from a 24-hour, 25-year storm.

4.0 Summary of Requirements, Justifications and Conclusions

As previously stated,30 TAC 352.811 (and by reference Federal Regulation Title 40, Part 257.81) requires the owner or operator of an existing or new landfill or any lateral expansion of a landfill used for Coal Combustion Residuals (CCR) to comply with design, construction, operation, maintenance, certification and recordkeeping requirements that are summarized as follows:

- Design, construct, operate, and maintain:
    - A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.
    - A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.
- Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under 30 TAC 352.2.
- Prepare initial and periodic run-on and run-off control system plans for the CCR unit according to the following timeframes:
    - For existing CCR landfills, the owner or operator of the CCR unit must have prepared the initial run-on and run-off control system plan no later than October 17, 2016.
    - The owner or operator of the CCR unit must prepare periodic run-on and run-off control system plans every five (5) years thereafter.
- Obtain a certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of this section.
- Comply with the recordkeeping requirements specified in 30 TAC 352.1310, the notification requirements specified in 30 TAC 352.1311, and the Publicly Accessible Website requirements specified in 30 TAC 352.1321.

Both Table 1 – Drainage Area Summaries and Table 2 – Q25 Run-on and Run-off Analysis Justifications (and supporting design calculations), as contained in Appendix 2, provide a summary of hydraulic and hydrologic capacity of the interim run-on/run-off control system. These analyses demonstrate that, in all instances, the currently implemented (and maintained) drainage system functions to control both run-off and run-on for the peak discharge from a 24-hour, 25-year storm.

5.0 Plan Review and Changes in Welsh Ash Landfill Configuration

Landfill Owner and/or Operator will review and evaluate this Plan every five (5) years from initial plan preparation and when there are changes in the facility design, construction, operation, or maintenance that materially affect the facility's potential for run-on and run-off control. Amendments to the Plan made to address changes of this nature are referred to as technical or major amendments and must be certified by a Professional Engineer. Non-technical amendments can be performed by the Facility Owner and/or Operator. Non-technical amendments include the following:

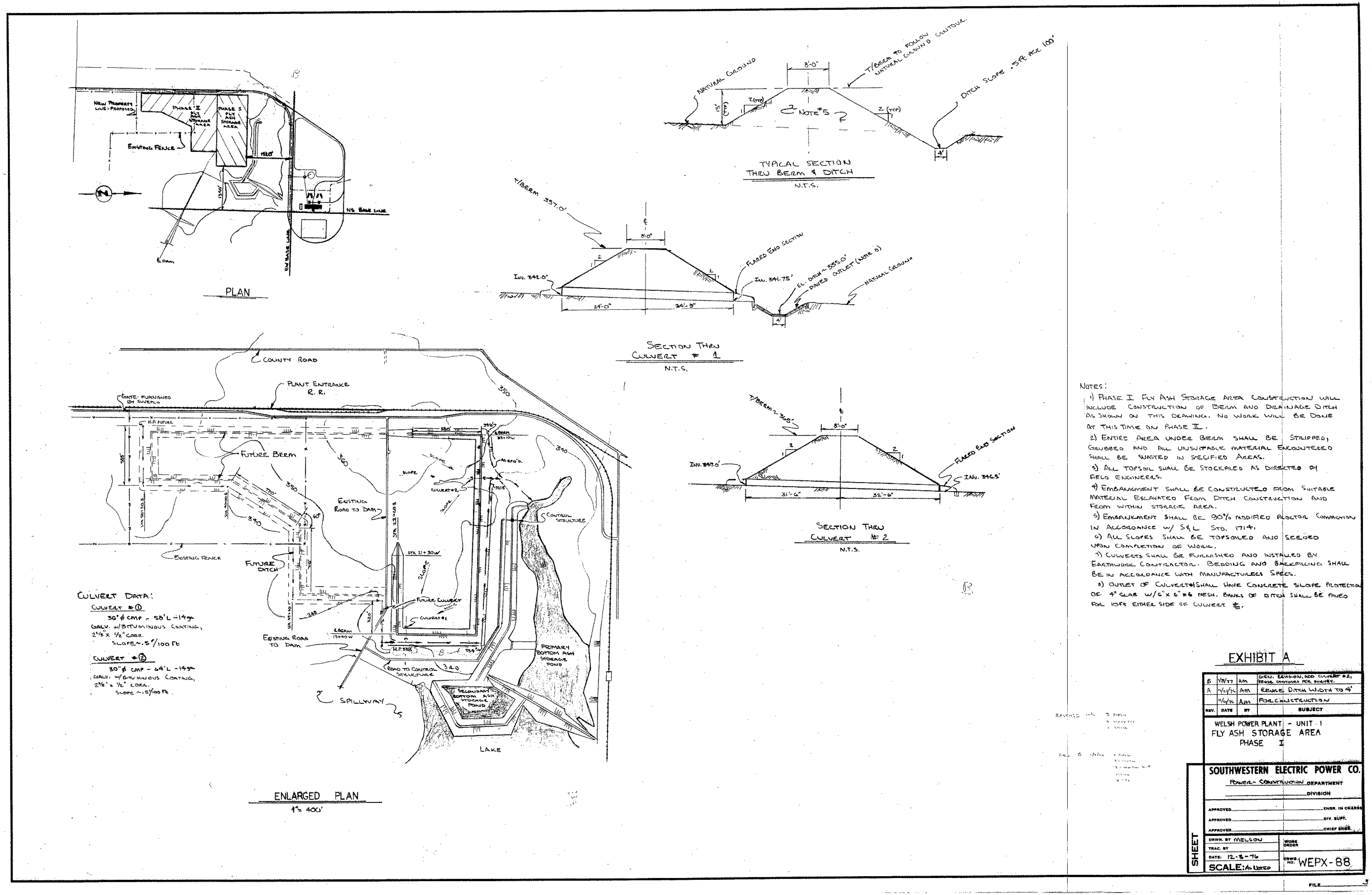
Technical and administrative amendments to the Plan will be documented on the Plan Review Log. Owner/Operator will make the necessary revisions to the Plan as soon as possible, but no later than six months after the change occurs. The Plan must be implemented as soon as possible following a technical amendment, but no later than six months from the date of the amendment. The Designated Person is responsible for initiating and coordinating revisions to the Spill Prevention, Control, and Countermeasure (SPCC) Plan.

Scheduled reviews and Plan amendments will be recorded in the Plan Review Log provided in Appendix 3. The log will be completed even if no amendment is made to the Plan as a result of the review.

6.0 Professional Engineer Certification

The original plan and all reviews and amended plans must obtain certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of TAC 352.811 (and by reference 40 CFR 257.81). This certification in no way relieves the owner or operator of the facility of his/her duty to fully implement this Plan. The Professional Engineer Certification page is provided in Appendix 4.

Appendix 1: Figures



CULVERT DATA:

CULVERT #①

30" ϕ CMP - 58'L - 14ga
GALV. W/BITUMINOUS COATING,
2⅔" x ½" CORR.
SLOPE ~ .5'/100 Ft

CULVERT #②

30" ϕ CMP - 64'L - 14ga
GALV. W/BITUMINOUS COATING,
2⅔" x ½" CORR.
SLOPE ~ .5'/100 Ft

NOTES:

1) PHASE I FLY ASH STORAGE AREA CONSTRUCTION WILL INCLUDE CONSTRUCTION OF BERM AND DRAINAGE DITCH AS SHOWN ON THIS DRAWING. NO WORK WILL BE DONE AT THIS TIME ON PHASE II.

2) ENTIRE AREA UNDER BERM SHALL BE STRIPPED, GRUBBED AND ALL UNSUITABLE MATERIAL ENCOUNTERED SHALL BE WASTED IN SPECIFIED AREAS.

3) ALL TOPSOIL SHALL BE STOCKPILED AS DIRECTED BY FIELD ENGINEERS.

4) EMBANKMENT SHALL BE CONSTRUCTED FROM SUITABLE MATERIAL EXCAVATED FROM DITCH CONSTRUCTION AND FROM WITHIN STORAGE AREA.

5) EMBANKMENT SHALL BE 90% MODIFIED PROCTOR COMPACTION IN ACCORDANCE W/ S&L STD. 1714.

6) ALL SLOPES SHALL BE TOPSOILED AND SEEDED UPON COMPLETION OF WORK.

7) CULVERTS SHALL BE FURNISHED AND INSTALLED BY EARTHWORK CONTRACTOR. BEDDING AND BACKFILLING SHALL BE IN ACCORDANCE WITH MANUFACTURERS SPECS.

8) OUTLET OF CULVERTS SHALL HAVE CONCRETE SLOPE PROTECTION OF 4" SLAB W/6" x 6" #6 MESH. BANKS OF DITCH SHALL BE PAVED FOR 10FT EITHER SIDE OF CULVERT ℄.

EXHIBIT A

REV.	DATE	BY	SUBJECT
B	1/3/77	AM	GEN. REVISION, ADD CULVERT #2, REVISE CONTOURS PER SURVEY.
A	7/21/76	AM	REVISE DITCH WIDTH TO 4'
	12/6/76	AM	FOR CONSTRUCTION

WELSH POWER PLANT - UNIT 1
FLY ASH STORAGE AREA
PHASE I

SOUTHWESTERN ELECTRIC POWER CO.
POWER - CONSTRUCTION DEPARTMENT
DIVISION

APPROVED ENGR. IN CHARGE
APPROVED DIV. SUPT.
APPROVED CHIEF ENGR.

DRWN. BY MELSON
TRAC. BY
DATE: 12-3-76
SCALE: AS NOTED
WORK ORDER
DRWG. NO. WEPX-88
SHEET
FILE 3

Figure 1- Fly Ash Storage Area Phase I (WEPX-88)

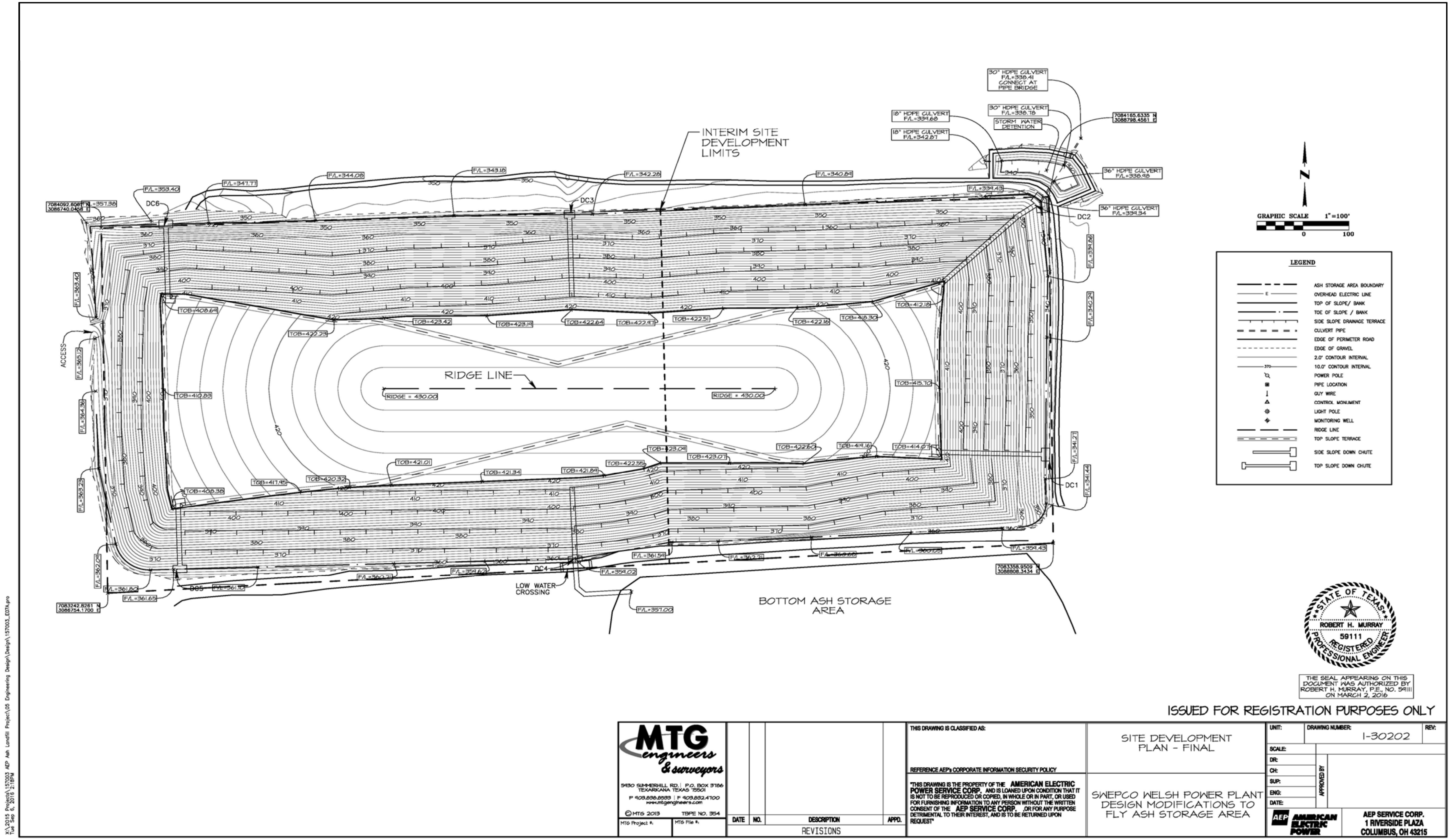


Figure 2 - Current TCEQ NOR Site Development Plan

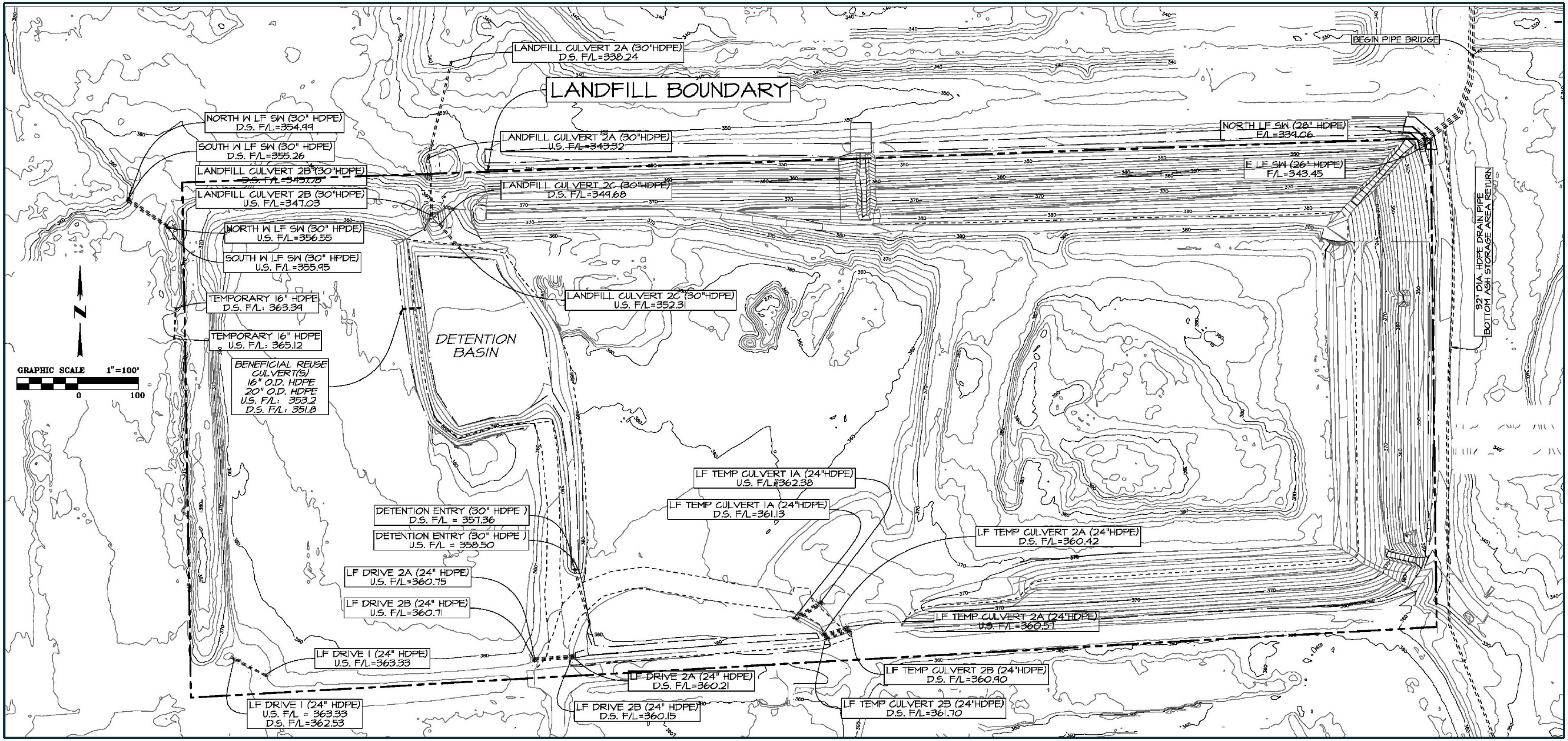


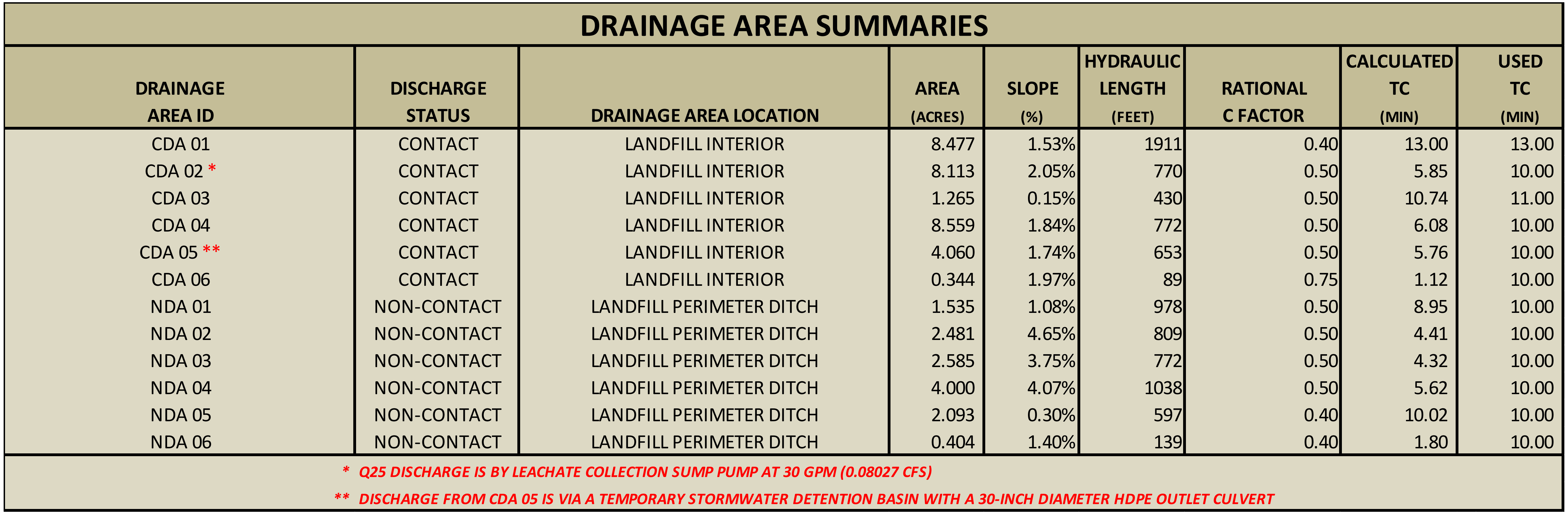
Figure 3 - Composite Existing Conditions (Merged Field & LiDAR Topography)

Figure 4 – Existing & Proposed Conditions - Drainage Area Map

Appendix 2: Tables

Table 1 – Drainage Area Summaries

Table 2 – Q25 Run-on and Run-off Analysis Justifications



DRAINAGE AREA SUMMARIES

DRAINAGE AREA ID	DISCHARGE STATUS	DRAINAGE AREA LOCATION	AREA (ACRES)	SLOPE (%)	HYDRAULIC LENGTH (FEET)	RATIONAL C FACTOR	CALCULATED TC (MIN)	USED TC (MIN)
CDA 01	CONTACT	LANDFILL INTERIOR	8.477	1.53%	1911	0.40	13.00	13.00
CDA 02 *	CONTACT	LANDFILL INTERIOR	8.113	2.05%	770	0.50	5.85	10.00
CDA 03	CONTACT	LANDFILL INTERIOR	1.265	0.15%	430	0.50	10.74	11.00
CDA 04	CONTACT	LANDFILL INTERIOR	8.559	1.84%	772	0.50	6.08	10.00
CDA 05 **	CONTACT	LANDFILL INTERIOR	4.060	1.74%	653	0.50	5.76	10.00
CDA 06	CONTACT	LANDFILL INTERIOR	0.344	1.97%	89	0.75	1.12	10.00
NDA 01	NON-CONTACT	LANDFILL PERIMETER DITCH	1.535	1.08%	978	0.50	8.95	10.00
NDA 02	NON-CONTACT	LANDFILL PERIMETER DITCH	2.481	4.65%	809	0.50	4.41	10.00
NDA 03	NON-CONTACT	LANDFILL PERIMETER DITCH	2.585	3.75%	772	0.50	4.32	10.00
NDA 04	NON-CONTACT	LANDFILL PERIMETER DITCH	4.000	4.07%	1038	0.50	5.62	10.00
NDA 05	NON-CONTACT	LANDFILL PERIMETER DITCH	2.093	0.30%	597	0.40	10.02	10.00
NDA 06	NON-CONTACT	LANDFILL PERIMETER DITCH	0.404	1.40%	139	0.40	1.80	10.00

** Q25 DISCHARGE IS BY LEACHATE COLLECTION SUMP PUMP AT 30 GPM (0.08027 CFS)*

*** DISCHARGE FROM CDA 05 IS VIA A TEMPORARY STORMWATER DETENTION BASIN WITH A 30-INCH DIAMETER HDPE OUTLET CULVERT*

Table 1 – Drainage Area Summaries

Q-25 RUN-ON/RUN-OFF ANALYSIS JUSTIFICATIONS

ANALYSIS ID	JUSTIFICATION ANALYSIS DRAINAGE AREAS INCLUDED	DRAINAGE STATUS	ANALYSIS TYPE	ANALYSIS AREA (ACRES)	ANALYSIS SLOPE (%)	BASIN SLOPE (%)	HYDRAULIC LENGTH (FEET)	ANALYSIS C FACTOR	ANALYSIS TC (MIN)	REQUIRED Q25 CAPACITY (CFS)	ANALYSIS JUSTIFICATION CONFIGURATION	AVAILABLE DEPTH (FT)	ANALYSIS DEPTH (FT)
INTERNAL CONTACT DRAINAGE AREAS													
I-01	CDA 01	CONTACT	TWO 24" HDPE CULVERTS	8.477	0.86%	1.53%	1911	0.40	13.00	27.09	TWO 52-FT LONG X 24" DIA HDPE CULVERTS	4.90	4.19
I-02	CDA 02 (LEACHATE COLLECTION AREA)	CONTACT	DRAINAGE CAPTURED & REMOVED	8.113	2.05%	2.05%	770	0.50	10.00	36.27	AREA RETAINS Q-25 RUNOFF VIA DETENTION	2.38	1.93
			BY SUMP PUMP								PEAK Q = 0.07 CFS		
I-03	CDA 01 & CDA 03	CONTACT	TRAPEZOIDAL CHANNEL, 3:1 SIDES	9.742	0.15%	1.35%	2341	0.41	23.74	23.32	0.15% 10-FT CHANNEL, 3:1 Sides, 1.5-FT DEEP	1.50	0.54
	CDA 01 & CDA 03	CONTACT	TWO 60'X24" HDPE CULVERTS	9.742	2.33%	1.35%	2341	0.41	23.74	23.32	70-FT LONG X 30" DIA HDPE CULVERT	8.80	2.51
I-04	CDA 04	CONTACT	TWO 32'X16" HDPE CULVERTS	8.559	4.37%	1.84%	772	0.50	10.00	38.26	TWO 32-FT LONG X 16" DIA HDPE CULVERTS *	6.22	6.92
I-05	DETENTION - AREAS CDA 1, 3, 4 & 5	CONTACT	DETENTION BASIN T0 SERIES OF HDPE PIPES	22.361	4.35%	1.26%	2994	0.57	20.00	82.21	SERIES - TWO 30" HDPE CULVERTS - PEAK Q = 34.74 CFS	8.00	3.29
I-06	DETENTION I-05 DISCHARGE	CONTACT	32'X32" HDPE CULVERT	22.705	0.40%	1.26%	3083	0.57	N/A	34.74	USE I-05 DETENTION PEAK DISCHARGE	8.00	3.27
PERIMETER NON-CONTACT DRAINAGE AREAS													
P-01	NDA 01	NON-CONTACT	V-DITCH, 3:1 SIDES	1.535	0.30%	1.97%	978	0.50	10.00	6.9	0.3% V-DITCH, 3:1 SIDES, 1.78-FEET DEPTH	1.80	1.13
P-02	NDA 01 & NDA 02	NON-CONTACT	5' CHANNEL, 3:1 SIDES	4.016	0.30%	3.29%	1787	0.50	10.00	17.97	0.3% - V-DITCH, 3:1 SIDES, 4-FEET DEPTH	4.00	1.63
P-03	NDA 03	NON-CONTACT	20' CHANNEL, 3:1 SIDES	2.585	0.30%	10.05%	772	0.50	10.00	11.56	0.3% - 20' CHANNEL, 3:1 SIDES, 7.5-FEET DEPTH	7.70	0.39
P-04	NDA 03 & NDA 04	NON-CONTACT	15' CHANNEL, 3:1 SIDES	6.585	0.30%	3.94%	1810	0.50	10.00	29.46	0.3% - 15' CHANNEL, 3:1 SIDES, 6.5-FEET DEPTH	6.50	0.80
P-02 & P04	DETENTION - AREAS NDA 01, 02,03 & 04	NON-CONTACT	426'X26" HDPE, U.S. 343.45, D.S. 335.48	10.601	1.87%	3.69%	1810	0.5	10.00	47.38	426'X26' HDPE @ 1.887% (COMBINED MAX Q = 38.49 CFS)	4.05	N/A
		NON-CONTACT	587'X28" HDPE, U.S. 339.06, D.S. 333.87		0.88%						587X28' HDPE @ 0.88%	8.44	2.42
P-05	NDA 05	NON-CONTACT	.3% V-DITCH, 3:1 L & 4:1R SIDES	2.093	3.46%	0.30%	597	0.4	10.00	7.49	.3% V-DITCH, 3:1 L & 4:1R SIDES	4.60	1.10
			50'X16" TEMP HDPE, U.S.365.12, D.S. 363.39								50'X16" TEMP HDPE @ 3.46%	6.72	1.92
P-06	NDA 05 & NDA 06	NON-CONTACT	.3% V-DITCH, 3:1 L & 3:1R SIDES	2.497	1.19%	1.19%	736	0.40	10.00	8.94	.3% V-DITCH, 3:1 L & 3:1R SIDES	1.92	1.73
			TWO 84'X30" HDPE, U.S.356.55, D.S. 355.26	2.497	1.54%	1.19%	736	0.40	10.00	8.94	TWO 84'X30" HDPE, U.S.356.55, D.S. 355.26	8.20	0.99

* ANALYSIS RUN FOR 15-INCH CULVERT OPTION AND AREA IS CONTAINED AND MERELY RUNS OVER THE TOP OF ROCK DETENTION BERM

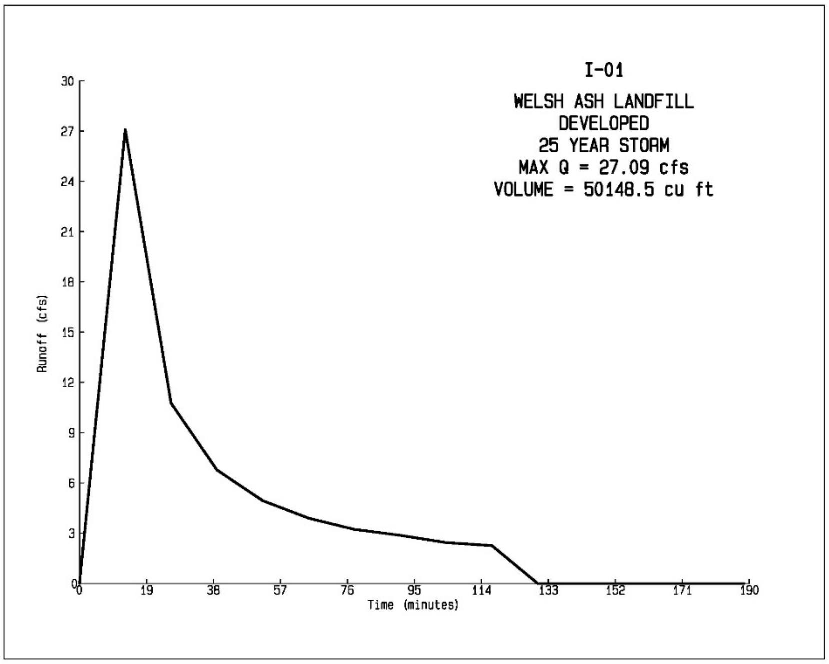
Table 2 - Q25 Run-on and Run-off Analysis Justifications

ANALYSIS JUSTIFICATION CALCULATIONS
INTERNAL CONTACT DRAINAGE AREAS

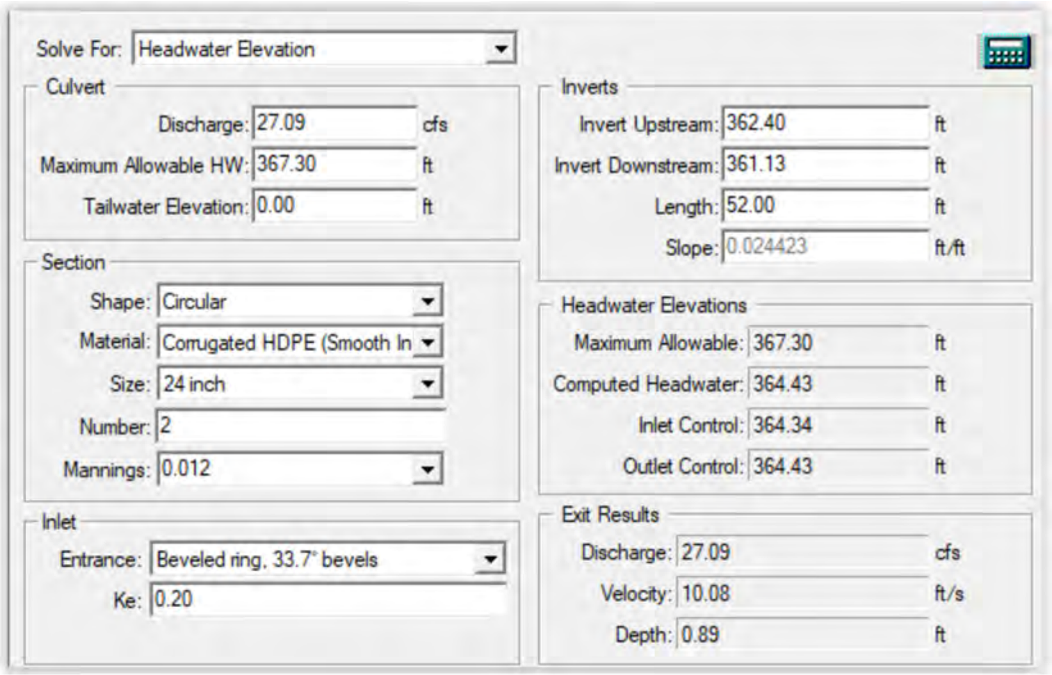
Note: "Contact Drainage Areas" refers to storm water runoff from these areas having come in contact with CCR materials.

ANALYSIS JUSTIFICATION - SECTION I-01

```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
--------------------------------------------------------------------------------
HYDROLOGIC REPORT
-----------------------------------------------------------------------
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER   SECTION I-01 (CDA 01)
DISCHARGES INTO    WELSH ASH LANDFILL
BASIN AREA     =      8.48  ACRES
RUNOFF COEFF. =      0.40
RAINFALL INT. =      7.99  IN/HR
TIME OF CONC. =     13.00  MINUTES
      TIME      RUNOFF
     (MIN)       (CFS)
    -------  ------------
       0.0        0.0
       6.5       13.5
      13.0       27.1
      19.5       18.9
      26.0       10.8
      32.5        8.8
      39.0        6.8
      45.5        5.9
      52.0        4.9
      58.5        4.4
      65.0        3.9
      71.5        3.6
      78.0        3.2
      84.5        3.1
      91.0        2.9
      97.5        2.7
     104.0        2.4
     110.5        2.4
     117.0        2.3
     123.5        1.1
     130.0        0.0
     136.5        0.0
     143.0        0.0
     149.5        0.0
     156.0        0.0
     162.5        0.0
     169.0        0.0
     175.5        0.0
     182.0        0.0
     188.5        0.0
     PEAK FLOW =        27.09  CFS
  TIME TO PEAK =        13.00  MIN
  TOTAL VOLUME =     50148.54  CU FT
```



I-01 CULVERTS: TWO 52’ X 24" DIA HDPE CULVERTS, 4.9’ MAX HW DEPTH
4.19’ CALCULATED HW DEPTH - MEETS Q-25 REQUIREMENT*



Solve For: Headwater Elevation

Culvert
Discharge: 27.09 cfs
Maximum Allowable HW: 367.30 ft
Tailwater Elevation: 0.00 ft

Section
Shape: Circular
Material: Corrugated HDPE (Smooth In
Size: 24 inch
Number: 2
Mannings: 0.012

Inlet
Entrance: Beveled ring, 33.7° bevels
Ke: 0.20

Inverts
Invert Upstream: 362.40 ft
Invert Downstream: 361.13 ft
Length: 52.00 ft
Slope: 0.024423 ft/ft

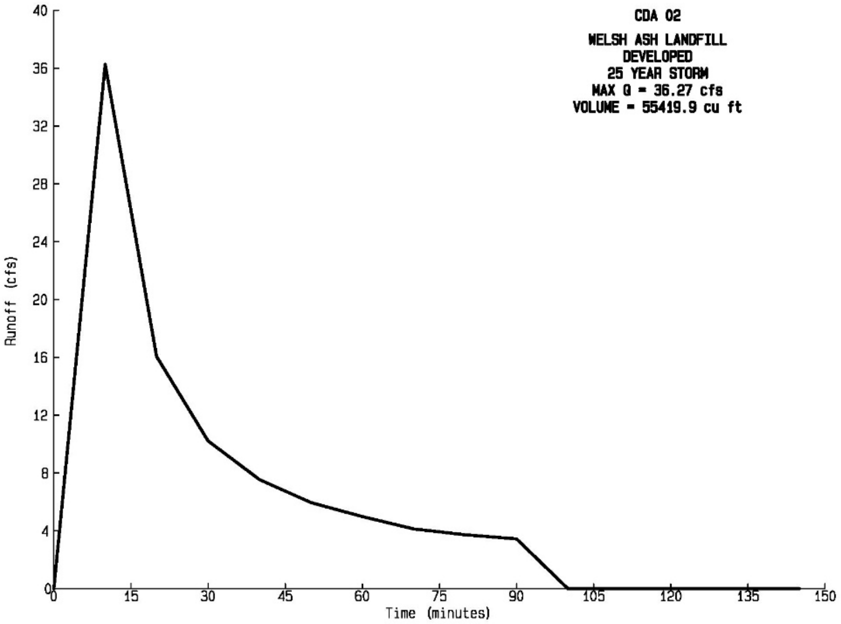
Headwater Elevations
Maximum Allowable: 367.30 ft
Computed Headwater: 364.43 ft
Inlet Control: 364.34 ft
Outlet Control: 364.43 ft

Exit Results
Discharge: 27.09 cfs
Velocity: 10.08 ft/s
Depth: 0.89 ft

* Bentley CulvertMaster – Culvert Analysis

ANALYSIS JUSTIFICATION - SECTION I-02

```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
--------------------------------------------------------------------------------
HYDROLOGIC REPORT
-----------------------------------------------------------------------
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER    CDA 02
DISCHARGES INTO     WELSH ASH LANDFILL
BASIN AREA     =      8.11  ACRES
RUNOFF COEFF. =      0.50
RAINFALL INT. =      8.94  IN/HR
TIME OF CONC. =     10.00  MINUTES
      TIME       RUNOFF
     (MIN)        (CFS)
    -------  ------------
       0.0         0.0
       5.0        18.1
      10.0        36.3
      15.0        26.2
      20.0        16.1
      25.0        13.1
      30.0        10.2
      35.0         8.9
      40.0         7.5
      45.0         6.8
      50.0         6.0
      55.0         5.5
      60.0         5.0
      65.0         4.6
      70.0         4.1
      75.0         3.9
      80.0         3.7
      85.0         3.6
      90.0         3.4
      95.0         1.7
     100.0         0.0
     105.0         0.0
     110.0         0.0
     115.0         0.0
     120.0         0.0
     125.0         0.0
     130.0         0.0
     135.0         0.0
     140.0         0.0
     145.0         0.0
     PEAK FLOW =         36.27   CFS
  TIME TO PEAK =         10.00   MIN
  TOTAL VOLUME =      55419.90   CU FT
```



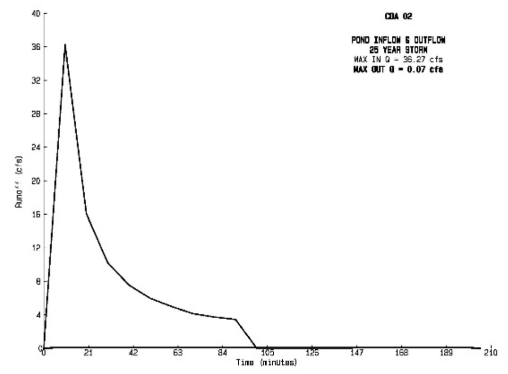
NOTE: Section I-02 is essentially a leachate collection cell which drains to the north side of the landfill where water is collected in a sump and pumped to the Primary Ash Pond return system. As a result, Section I-02 does not discharge to the stormwater run-on & run-off system and is treated as a detention pond with no Q25 impact to landfill drainage systems.

ANALYSIS JUSTIFICATION - SECTION I-02 (CONT)

```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
--------------------------------------------------------------------------------
HYDROLOGIC REPORT - STAGE, STORAGE, AND DISCHARGE
Pumped Detention Area - CDA 02
-----------------------------------------------------------------------
 1=USER DEFINED
      1)    356.620       Q   0.00
            Through
      7)    359.500       Q   0.07
ELEV          STORAGE       OUTFLOW       2S/T+O
              (CU.FT.)       (CFS)         (CFS)
-----------------------------------------------------------------------
   356.62          0.0           0.0           0.0
   356.67          0.0           0.0           0.0
   356.72          0.0           0.0           0.0
   356.76          0.0           0.0           0.0
   356.81          0.0           0.0           0.0
   356.86          0.0           0.0           0.0
   356.91          0.0           0.1           0.1
   356.95          0.0           0.1           0.1
   357.00          0.0           0.1           0.1
   357.06         68.5           0.1           0.5
   357.13        137.0           0.1           1.0
   357.19        205.5           0.1           1.4
   357.25        274.1           0.1           1.9
   357.31        342.6           0.1           2.4
   357.38        411.1           0.1           2.8
   357.44        479.6           0.1           3.3
   357.50        548.1           0.1           3.7
   357.56        915.3           0.1           6.2
   357.63       1282.5           0.1           8.6
   357.69       1649.7           0.1          11.1
   357.75       2016.9           0.1          13.5
   357.81       2384.1           0.1          16.0
   357.88       2751.3           0.1          18.4
   357.94       3118.5           0.1          20.9
   358.00       3485.7           0.1          23.3
   358.06       4524.5           0.1          30.2
   358.13       5563.4           0.1          37.2
   358.19       6602.2           0.1          44.1
   358.25       7641.0           0.1          51.0
   358.31       8679.8           0.1          57.9
   358.38       9718.7           0.1          64.9
   358.44      10757.5           0.1          71.8
   358.50      11796.3           0.1          78.7
   358.56      13968.8           0.1          93.2
   358.63      16141.3           0.1         107.7
   358.69      18313.8           0.1         122.2
   358.75      20486.3           0.1         136.6
   358.81      22658.7           0.1         151.1
   358.88      24831.2           0.1         165.6
   358.94      27003.7           0.1         180.1
   359.00      29176.2           0.1         194.6
```

ANALYSIS JUSTIFICATION - SECTION I-02 (CONT)

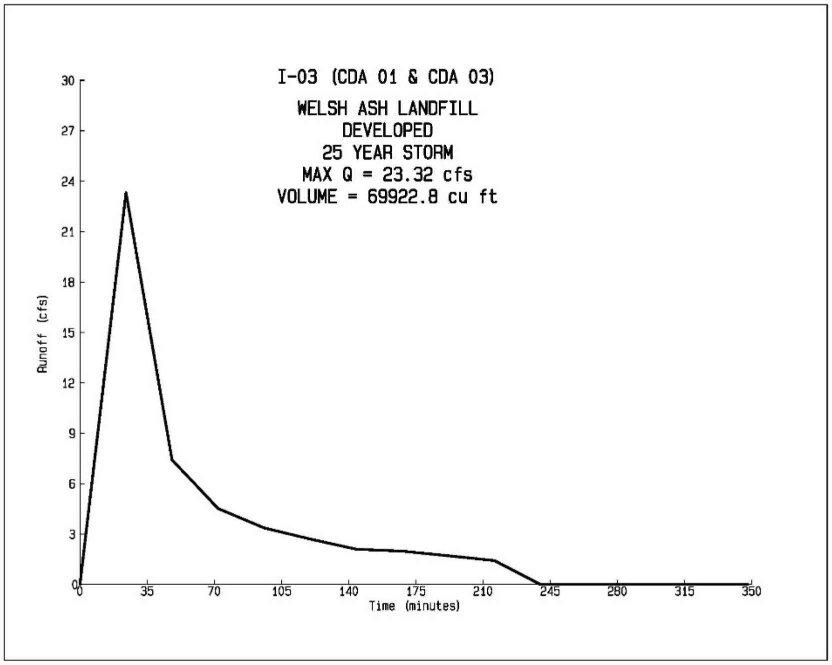
```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
-------------------------------------------------------------------------------
SECTION I-02 HYDROGRAPH ROUTING (Discharges via Forcemain to Primary Ash Pond)
PUMPED DETENTION AREA: CDA 02
    T        I1       I2      2S1/T        O1   2S2/T+O2        O2      2S2/T
-----------------------------------------------------------------------
25 YEAR STORM FREQUENCY
  5.00      0.0     18.1        0.0       0.0       18.1       0.1       18.1
 10.00     18.1     36.3       18.1       0.1       72.4       0.1       72.3
 15.00     36.3     26.2       72.3       0.1      134.7       0.1      134.6
 20.00     26.2     16.1      134.6       0.1      176.8       0.1      176.7
 25.00     16.1     13.1      176.7       0.1      205.9       0.1      205.8
 30.00     13.1     10.2      205.8       0.1      229.1       0.1      229.0
 35.00     10.2      8.9      229.0       0.1      248.1       0.1      248.0
 40.00      8.9      7.5      248.0       0.1      264.4       0.1      264.3
 45.00      7.5      6.8      264.3       0.1      278.5       0.1      278.5
 50.00      6.8      6.0      278.5       0.1      291.1       0.1      291.0
 55.00      6.0      5.5      291.0       0.1      302.4       0.1      302.3
 60.00      5.5      5.0      302.3       0.1      312.7       0.1      312.7
 65.00      5.0      4.6      312.7       0.1      322.2       0.1      322.1
 70.00      4.6      4.1      322.1       0.1      330.7       0.1      330.7
 75.00      4.1      3.9      330.7       0.1      338.7       0.1      338.6
 80.00      3.9      3.7      338.6       0.1      346.2       0.1      346.1
 85.00      3.7      3.6      346.1       0.1      353.4       0.1      353.3
 90.00      3.6      3.4      353.3       0.1      360.3       0.1      360.2
 95.00      3.4      1.7      360.2       0.1      365.3       0.1      365.3
100.00      1.7      0.0      365.3       0.1      366.9       0.1      366.9
105.00      0.0      0.0      366.9       0.1      366.8       0.1      366.7
110.00      0.0      0.0      366.7       0.1      366.7       0.1      366.6
115.00      0.0      0.0      366.6       0.1      366.5       0.1      366.5
120.00      0.0      0.0      366.5       0.1      366.4       0.1      366.3
125.00      0.0      0.0      366.3       0.1      366.2       0.1      366.2
130.00      0.0      0.0      366.2       0.1      366.1       0.1      366.0
135.00      0.0      0.0      366.0       0.1      366.0       0.1      365.9
140.00      0.0      0.0      365.9       0.1      365.8       0.1      365.8
145.00      0.0      0.0      365.8       0.1      365.7       0.1      365.6
150.00      0.0      0.0      365.6       0.1      365.6       0.1      365.5
155.00      0.0      0.0      365.5       0.1      365.4       0.1      365.4
160.00      0.0      0.0      365.4       0.1      365.3       0.1      365.2
165.00      0.0      0.0      365.2       0.1      365.2       0.1      365.1
170.00      0.0      0.0      365.1       0.1      365.0       0.1      365.0
175.00      0.0      0.0      365.0       0.1      364.9       0.1      364.8
180.00      0.0      0.0      364.8       0.1      364.8       0.1      364.7
185.00      0.0      0.0      364.7       0.1      364.6       0.1      364.6
190.00      0.0      0.0      364.6       0.1      364.5       0.1      364.4
195.00      0.0      0.0      364.4       0.1      364.4       0.1      364.3
200.00      0.0      0.0      364.3       0.1      364.2       0.1      364.2
            TIME TO PEAK =         0.08  HOURS
         MAXIMUM OUTFLOW =         0.07  CFS
         MAXIMUM STORAGE =        55028  CU FT
       MAXIMUM ELEVATION =        65.41  FT
           INFLOW VOLUME =        55420  CU FT
          OUTFLOW VOLUME =          804  CU FT
```



MEETS Q25 REQUIREMENT (empties over time)

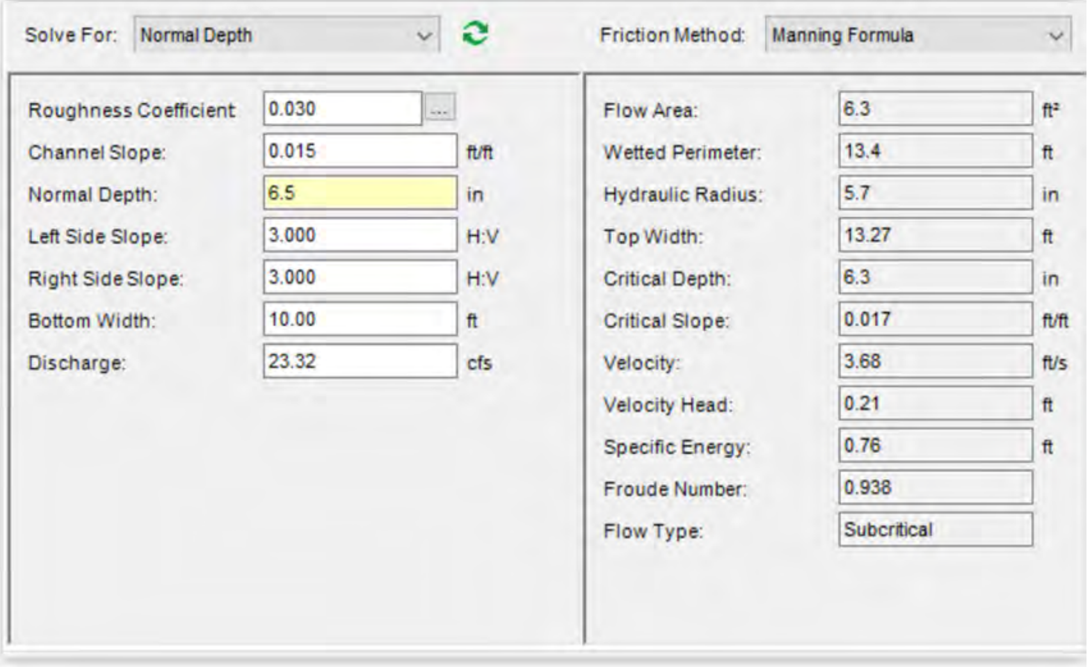
ANALYSIS JUSTIFICATION - SECTION I-03

```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
------------------------------------------------------------------------------
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER   I-03 (CDA 01 & CDA 03)
DISCHARGES INTO    WELSH ASH LANDFILL
BASIN AREA     =       9.74  ACRES
RUNOFF COEFF. =       0.41
RAINFALL INT. =       5.84  IN/HR
TIME OF CONC. =      24.00  MINUTES
      TIME      RUNOFF
     (MIN)       (CFS)
    -------  ------------
       0.0        0.0
      12.0       11.7
      24.0       23.3
      36.0       15.4
      48.0        7.4
      60.0        6.0
      72.0        4.5
      84.0        3.9
      96.0        3.4
     108.0        3.0
     120.0        2.7
     132.0        2.4
     144.0        2.1
     156.0        2.0
     168.0        2.0
     180.0        1.8
     192.0        1.7
     204.0        1.6
     216.0        1.4
     228.0        0.7
     240.0        0.0
     252.0        0.0
     264.0        0.0
     276.0        0.0
     288.0        0.0
     300.0        0.0
     312.0        0.0
     324.0        0.0
     336.0        0.0
     348.0        0.0
     PEAK FLOW =        23.32  CFS
  TIME TO PEAK =        24.00  MIN
  TOTAL VOLUME =     69922.80  CU FT
```



ANALYSIS JUSTIFICATION - SECTION I-03 (CONT)

I-03 CHANNEL: 0.15% V-DITCH, 10-FT TRAPEZOIDAL, 3:1 SIDES, 1.5-FT MIN. DEPTH
MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)
0.55'CALCULATED DEPTH, MEETS Q-25 REQUIREMENT*



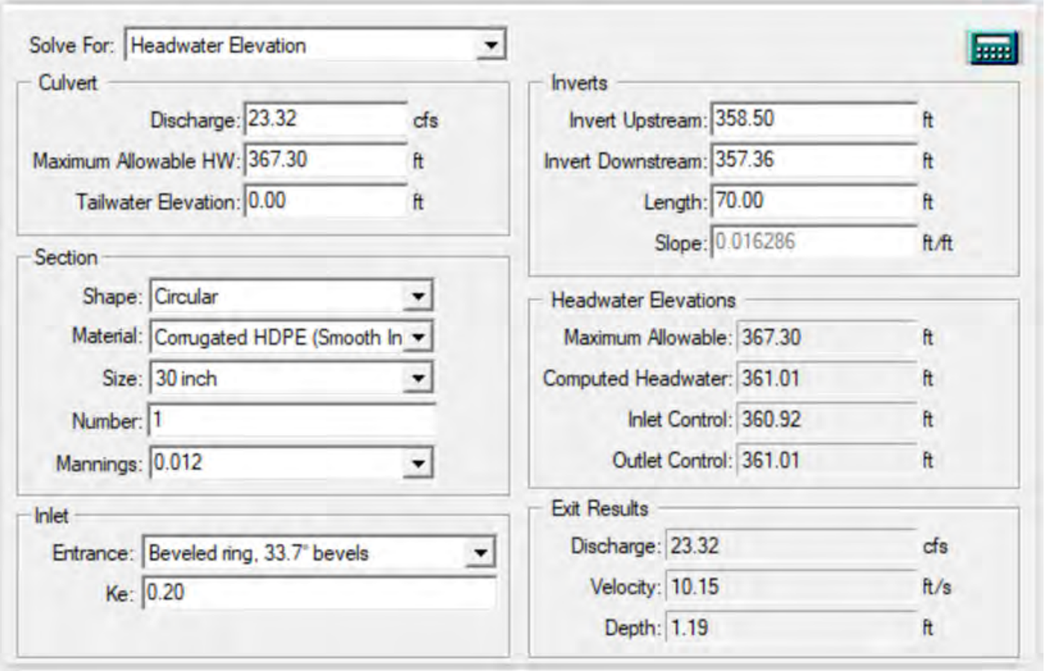
Solve For: Normal Depth
Friction Method: Manning Formula

Roughness Coefficient: 0.030
Channel Slope: 0.015 ft/ft
Normal Depth: 6.5 in
Left Side Slope: 3.000 H:V
Right Side Slope: 3.000 H:V
Bottom Width: 10.00 ft
Discharge: 23.32 cfs

Flow Area: 6.3 ft²
Wetted Perimeter: 13.4 ft
Hydraulic Radius: 5.7 in
Top Width: 13.27 ft
Critical Depth: 6.3 in
Critical Slope: 0.017 ft/ft
Velocity: 3.68 ft/s
Velocity Head: 0.21 ft
Specific Energy: 0.76 ft
Froude Number: 0.938
Flow Type: Subcritical

* Bentley FlowMaster V8i – Trapezoidal Channel Analysis

I-03 CULVERT: 70' X 30" DIA HDPE CULVERT, 8.8' MAX HW DEPTH
2.51' CALCULATED HW DEPTH - MEETS Q-25 REQUIREMENT*



Solve For: Headwater Elevation

Culvert
Discharge: 23.32 cfs
Maximum Allowable HW: 367.30 ft
Tailwater Elevation: 0.00 ft

Section
Shape: Circular
Material: Corrugated HDPE (Smooth In
Size: 30 inch
Number: 1
Mannings: 0.012

Inlet
Entrance: Beveled ring, 33.7° bevels
Ke: 0.20

Inverts
Invert Upstream: 358.50 ft
Invert Downstream: 357.36 ft
Length: 70.00 ft
Slope: 0.016286 ft/ft

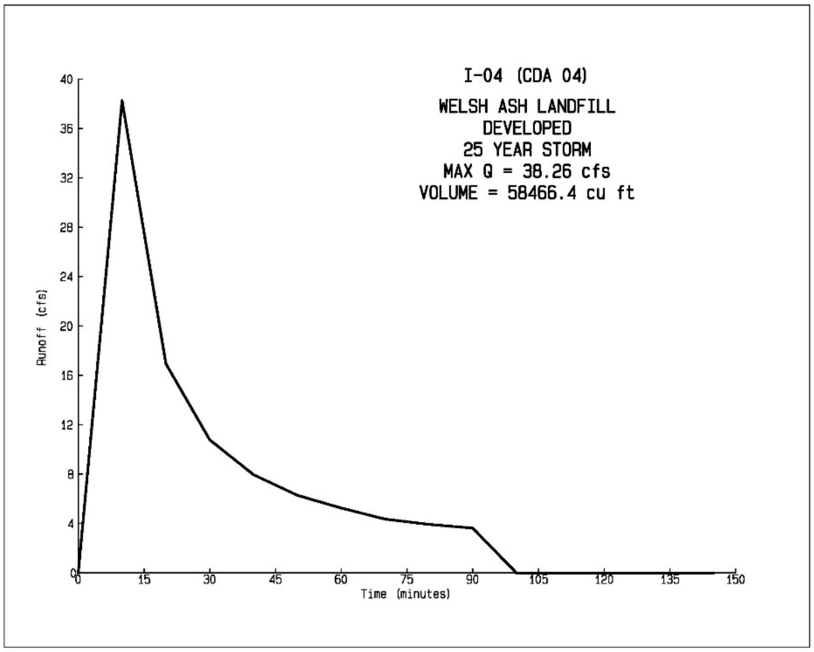
Headwater Elevations
Maximum Allowable: 367.30 ft
Computed Headwater: 361.01 ft
Inlet Control: 360.92 ft
Outlet Control: 361.01 ft

Exit Results
Discharge: 23.32 cfs
Velocity: 10.15 ft/s
Depth: 1.19 ft

* Bentley CulvertMaster – Culvert Analysis

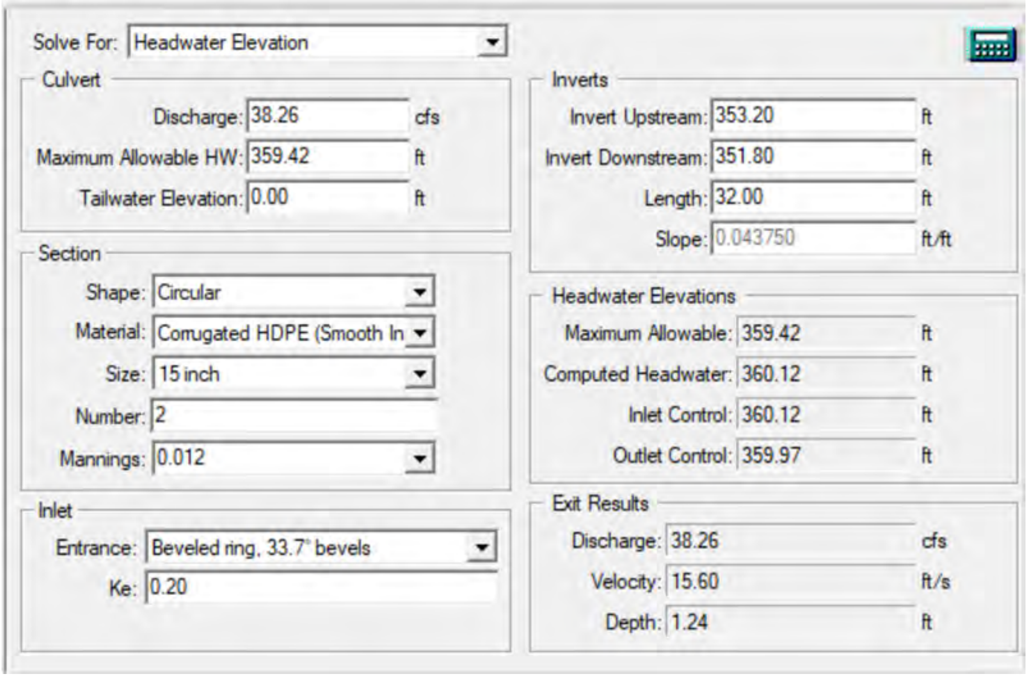
ANALYSIS JUSTIFICATION - SECTION I-05

```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
--------------------------------------------------------------------------------
HYDROLOGIC REPORT
-----------------------------------------------------------------------
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER   I-04 (CDA 04) – BENEFICIAL REUSE AREA
DISCHARGES INTO    WELSH ASH LANDFILL
BASIN AREA     =      8.56  ACRES
RUNOFF COEFF.  =      0.50
RAINFALL INT.  =      8.94  IN/HR
TIME OF CONC.  =     10.00  MINUTES
      TIME       RUNOFF
     (MIN)        (CFS)
    -------  ------------
       0.0         0.0
       5.0        19.1
      10.0        38.3
      15.0        27.6
      20.0        16.9
      25.0        13.9
      30.0        10.8
      35.0         9.4
      40.0         8.0
      45.0         7.1
      50.0         6.3
      55.0         5.8
      60.0         5.3
      65.0         4.8
      70.0         4.4
      75.0         4.2
      80.0         3.9
      85.0         3.8
      90.0         3.6
      95.0         1.8
     100.0         0.0
     105.0         0.0
     110.0         0.0
     115.0         0.0
     120.0         0.0
     125.0         0.0
     130.0         0.0
     135.0         0.0
     140.0         0.0
     145.0         0.0
     PEAK FLOW =        38.26  CFS
  TIME TO PEAK =        10.00  MIN
  TOTAL VOLUME =     58466.40  CU FT
```



ANALYSIS JUSTIFICATION - SECTION I-04 (CONT)

I-03 TEMPORARY CULVERTS: TWO 32'X16" HDPE CULVERTS, 6.22’ MAX HW DEPTH
6.92’ HW DEPTH (FOR 15” DIA CULVERTS) EXCEEDS (0.7’) TOP OF ROCK BERM OF THE DETENTION BASIN; HOWEVER, FLOWS ARE CONTAINED
MEETS Q-25 REQUIREMENT*



Solve For: Headwater Elevation

Culvert
Discharge: 38.26 cfs
Maximum Allowable HW: 359.42 ft
Tailwater Elevation: 0.00 ft

Section
Shape: Circular
Material: Corrugated HDPE (Smooth In
Size: 15 inch
Number: 2
Mannings: 0.012

Inlet
Entrance: Beveled ring, 33.7° bevels
Ke: 0.20

Inverts
Invert Upstream: 353.20 ft
Invert Downstream: 351.80 ft
Length: 32.00 ft
Slope: 0.043750 ft/ft

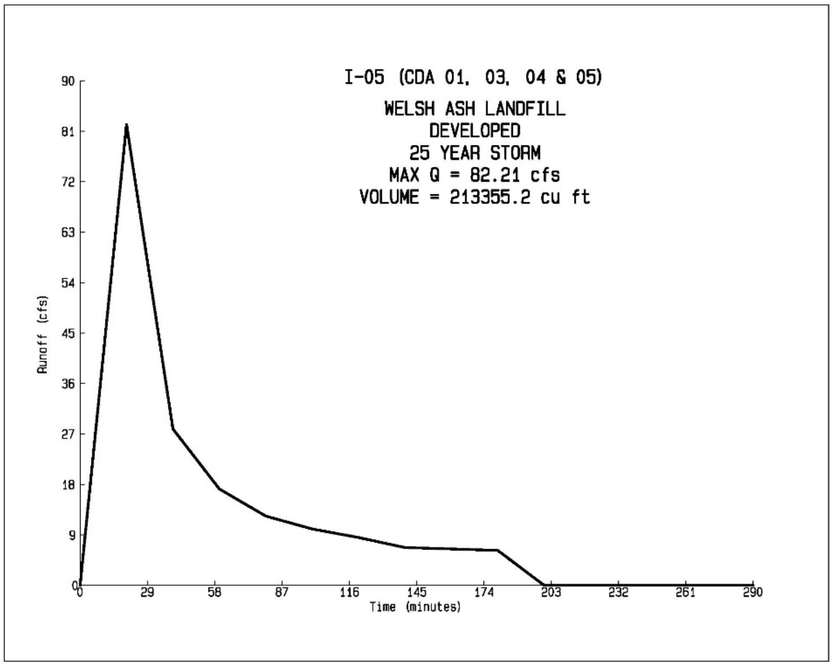
Headwater Elevations
Maximum Allowable: 359.42 ft
Computed Headwater: 360.12 ft
Inlet Control: 360.12 ft
Outlet Control: 359.97 ft

Exit Results
Discharge: 38.26 cfs
Velocity: 15.60 ft/s
Depth: 1.24 ft

* Bentley CulvertMaster – Culvert Analysis - (Calculated W/ 15” Dia Culverts)

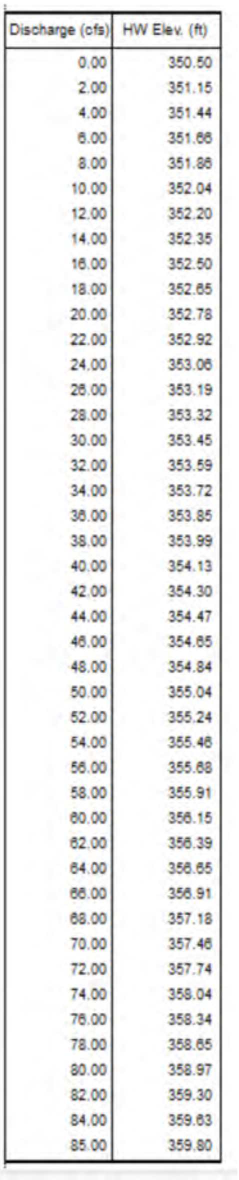
ANALYSIS JUSTIFICATION - SECTION I-05
SERIES OF TWO 30-IN DIA HDPE CULVERTS – DETENTION OUTLET

```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
---------------------------------------------------------------------------------
HYDROLOGIC REPORT
------------------------------------------------------------------------
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER   I-05 (DETENTION FOR CDA 01, 03, 04 & 05)
DISCHARGES INTO    WELSH ASH LANDFILL
BASIN AREA    =     22.36  ACRES
RUNOFF COEFF. =      0.57
RAINFALL INT. =      6.45  IN/HR
TIME OF CONC. =     20.00  MINUTES
      TIME      RUNOFF
     (MIN)       (CFS)
    -------  ------------
       0.0        0.0
      10.0       41.1
      20.0       82.2
      30.0       55.1
      40.0       27.9
      50.0       22.6
      60.0       17.2
      70.0       14.8
      80.0       12.4
      90.0       11.2
     100.0       10.1
     110.0        9.3
     120.0        8.5
     130.0        7.6
     140.0        6.8
     150.0        6.6
     160.0        6.5
     170.0        6.4
     180.0        6.2
     190.0        3.1
     200.0        0.0
     210.0        0.0
     220.0        0.0
     230.0        0.0
     240.0        0.0
     250.0        0.0
     260.0        0.0
     270.0        0.0
     280.0        0.0
     290.0        0.0
     PEAK FLOW =       82.21  CFS
  TIME TO PEAK =       20.00  MIN
  TOTAL VOLUME =   213355.20  CU FT
```



ANALYSIS JUSTIFICATION - SECTION I-05 (CONT)
SERIES OF 30-IN DIA HDPE – DETENTION OUTLET

```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
--------------------------------------------------------------------------------
HYDROLOGIC REPORT - STAGE, STORAGE, AND DISCHARGE
POND: I-05 (DETENTION FOR CDA 01, 03, 04 & 05)
------------------------------------------------------------------------
1=USER DEFINED *                                            10)    353.450       Q  30.00
       1)    350.500       Q   0.00                         11)    353.990       Q  38.00
       2)    351.150       Q   2.00                         12)    354.470       Q  44.00
       3)    351.440       Q   4.00                         13)    355.040       Q  50.00
       4)    351.660       Q   6.00                         14)    355.910       Q  58.00
       5)    351.860       Q   8.00                         15)    356.650       Q  64.00
       6)    352.040       Q  10.00                         16)    357.180       Q  68.00
       7)    352.500       Q  16.00                         17)    358.040       Q  74.00
       8)    352.920       Q  22.00                         18)    358.970       Q  80.00
       9)    353.060       Q  24.00
ELEV          STORAGE       OUTFLOW       2S/T+O
             (CU.FT.)        (CFS)        (CFS)
-----------------------------------------------------------------
   350.50          0.0           0.0          0.0
   350.75         12.8           0.8          0.8
   351.00         25.6           1.5          1.6
   351.25        615.8           2.7          4.7
   351.50       1205.9           4.5          8.6
   351.75       3435.9           6.9         18.4
   352.00       5665.9           9.6         28.4
   352.25      10391.0          12.7         47.4
   352.50      15116.1          16.0         66.4
   352.75      22732.0          19.6         95.3
   353.00      30347.8          23.1        124.3
   353.25      40426.1          26.9        161.7
   353.50      50504.3          30.7        199.1
   353.75      62132.0          34.4        241.6
   354.00      73759.7          38.1        284.0
   354.25      86213.7          41.2        328.6
   354.50      98667.6          44.3        373.2
   354.75     111596.0          46.9        418.9
   355.00     124524.3          49.6        464.7
   355.25     137942.5          51.9        511.7
   355.50     151360.8          54.2        558.8
   355.75     165355.4          56.5        607.7
   356.00     179350.0          58.7        656.6
   356.35     200039.7          61.6        728.4
   356.70     220729.4          64.4        800.1
   356.75     223797.2          64.8        810.7
   356.80     226865.0          65.1        821.3
   356.90     233083.1          65.9        842.8
   357.00     239301.2          66.6        864.3
   357.05     242453.6          67.0        875.2
   357.10     245605.9          67.4        886.1
   357.15     248789.3          67.8        897.1
   357.20     251972.8          68.1        908.0
   357.35     261714.3          69.2        941.6
   357.50     271455.7          70.2        975.1
   357.75     288481.5          72.0       1033.6
   358.00     305507.4          73.7       1092.1
   357.25     255220.0          68.5        919.2
   356.50     208906.7          62.8        759.1
   356.75     223797.2          64.8        810.7
   357.00     239301.2          66.6        864.3
   357.25     255220.0          68.5        919.2
   357.50     271455.7          70.2        975.1
   357.75     288481.5          72.0       1033.6
   358.00     305507.4          73.7       1092.1
   358.25     419039.7          75.4       1472.2
   358.50     436919.1          77.0       1533.4
```

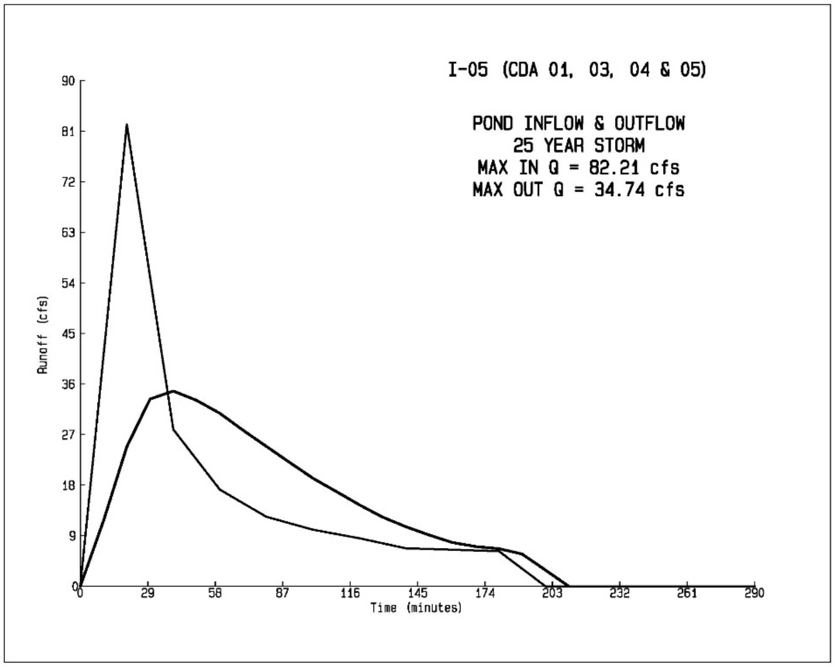


Discharge (cfs)	HW Elev. (ft)
0.00	350.50
2.00	351.15
4.00	351.44
6.00	351.66
8.00	351.86
10.00	352.04
12.00	352.20
14.00	352.35
16.00	352.50
18.00	352.65
20.00	352.78
22.00	352.92
24.00	353.06
26.00	353.19
28.00	353.32
30.00	353.45
32.00	353.59
34.00	353.72
36.00	353.85
38.00	353.99
40.00	354.13
42.00	354.30
44.00	354.47
46.00	354.65
48.00	354.84
50.00	355.04
52.00	355.24
54.00	355.46
56.00	355.68
58.00	355.91
60.00	356.15
62.00	356.39
64.00	356.65
66.00	356.91
68.00	357.18
70.00	357.46
72.00	357.74
74.00	358.04
76.00	358.34
78.00	358.65
80.00	358.97
82.00	359.30
84.00	359.63
85.00	359.80

* Discharge Rating Curve by Bentley CulvertMaster – Culvert Analysis

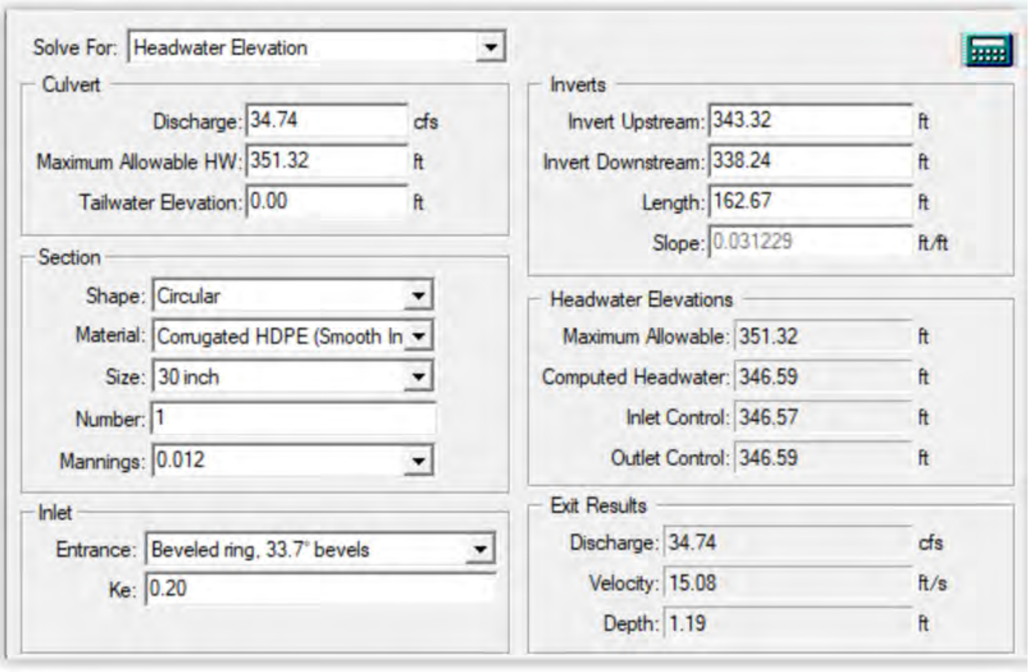
ANALYSIS JUSTIFICATION - SECTION I-05 (CONT)
SERIES OF 30-IN DIA HDPE – DETENTION OUTLET
MEETS Q-25 REQUIREMENT

```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
--------------------------------------------------------------------------------
HYDROLOGIC REPORT
------------------------------------------------------------------------
POND OUTFLOW HYDROGRAPH
POND IDENTIFIER   I-05 (DETENTION FOR CDA 01, 03, 04 & 05)
25 YEAR STORM FREQUENCY
      TIME      RUNOFF
     (MIN)       (CFS)
    -------   ------------
       0.0         0.0
      10.0        11.7
      20.0        24.8
      30.0        33.3
      40.0        34.7
      50.0        33.1
      60.0        30.8
      70.0        27.8
      80.0        24.9
      90.0        22.0
     100.0        19.2
     110.0        16.9
     120.0        14.5
     130.0        12.3
     140.0        10.6
     150.0         9.1
     160.0         7.8
     170.0         7.1
     180.0         6.7
     190.0         5.7
     200.0         2.9
     210.0         0.0
     PEAK FLOW =        34.74  CFS
  TIME TO PEAK =        40.00  MIN
  TOTAL VOLUME =    213542.40  CU FT
```



ANALYSIS JUSTIFICATION - SECTION I-05 (CONT)
I-05 CULVERT: 32’ X 30" DIA HDPE CULVERT, 8.8’ MAX HW DEPTH
3.27’ CALCULATED HW DEPTH - MEETS Q-25 REQUIREMENT*

```
USE I-05 DETENTION DISCHARGE HYDROGRAPH
25 YEAR STORM FREQUENCY
      TIME       RUNOFF
     (MIN)        (CFS)
    -------   ------------
      0.0         0.0
     10.0        11.7
     20.0        24.8
     30.0        33.3
     40.0        34.7
     50.0        33.1
     60.0        30.8
     70.0        27.8
     80.0        24.9
     90.0        22.0
    100.0        19.2
    110.0        16.9
    120.0        14.5
    130.0        12.3
    140.0        10.6
    150.0         9.1
    160.0         7.8
    170.0         7.1
    180.0         6.7
    190.0         5.7
    200.0         2.9
    210.0         0.0
```



Solve For: Headwater Elevation

Culvert
Discharge: 34.74 cfs
Maximum Allowable HW: 351.32 ft
Tailwater Elevation: 0.00 ft

Section
Shape: Circular
Material: Corrugated HDPE (Smooth In
Size: 30 inch
Number: 1
Mannings: 0.012

Inlet
Entrance: Beveled ring, 33.7° bevels
Ke: 0.20

Inverts
Invert Upstream: 343.32 ft
Invert Downstream: 338.24 ft
Length: 162.67 ft
Slope: 0.031229 ft/ft

Headwater Elevations
Maximum Allowable: 351.32 ft
Computed Headwater: 346.59 ft
Inlet Control: 346.57 ft
Outlet Control: 346.59 ft

Exit Results
Discharge: 34.74 cfs
Velocity: 15.08 ft/s
Depth: 1.19 ft

```
PEAK FLOW =        34.74   CFS
  TIME TO PEAK =       40.00   MIN
  TOTAL VOLUME =   213542.40   CU FT
```

ANALYSIS JUSTIFICATION CALCULATIONS
PERIMETER NON-CONTACT DRAINAGE AREAS

Note: “Perimeter Non-Contact Drainage Areas” refers to storm water runoff from these areas having not come in contact with CCR materials.

ANALYSIS JUSTIFICATION - SECTION P-01 DITCH

0.3% V-DITCH, 3:1 SIDES, 1.8-FT MIN. HW DEPTH

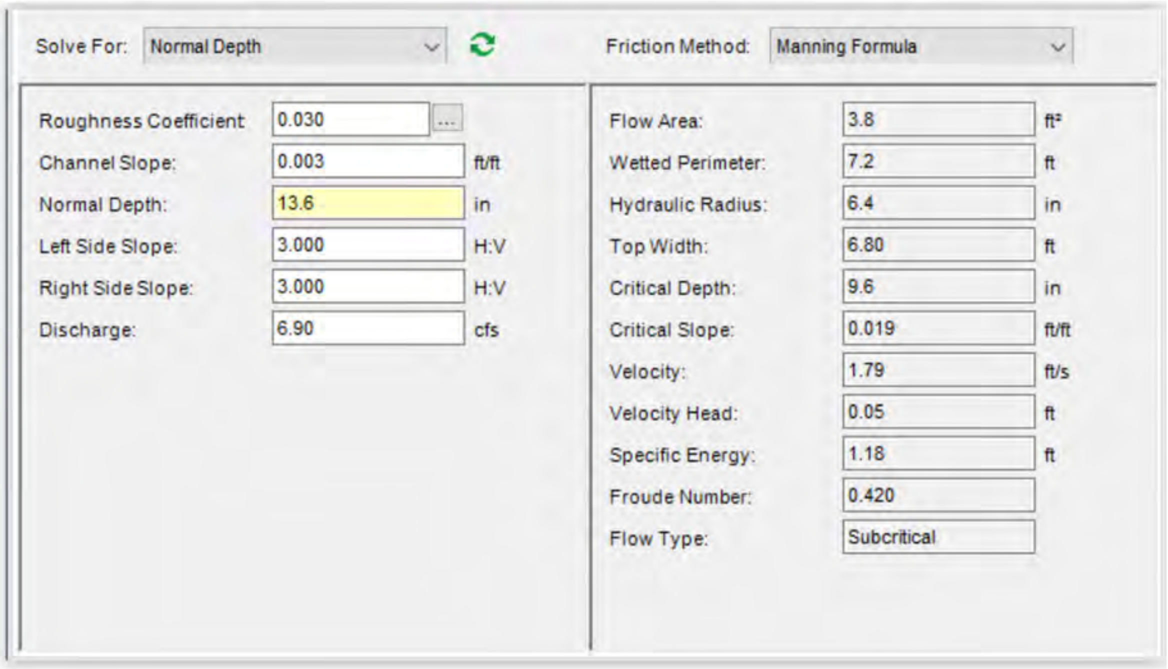
MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

```
HYDROLOGIC REPORT
-----------------------------------------------------------------------
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER   P-01
DISCHARGES INTO    WELSH ASH LANDFILL
BASIN AREA     =      1.53   ACRES
RUNOFF COEFF. =       0.50
RAINFALL INT. =       8.94   IN/HR
TIME OF CONC. =      10.00   MINUTES
      TIME      RUNOFF
     (MIN)       (CFS)
    -------  ------------
       0.0        0.0
       5.0        3.4
      10.0        6.9
      15.0        5.0
      20.0        3.0
      25.0        2.5
      30.0        1.9
      35.0        1.7
      40.0        1.4
      45.0        1.3
      50.0        1.1
      55.0        1.0
      60.0        0.9
      65.0        0.9
      70.0        0.8
      75.0        0.7
      80.0        0.7
      85.0        0.7
      90.0        0.7
      95.0        0.3
     100.0        0.0
     105.0        0.0
     110.0        0.0
     115.0        0.0
     120.0        0.0
     125.0        0.0
     130.0        0.0
     135.0        0.0
     140.0        0.0
     145.0        0.0
     PEAK FLOW =        6.86   CFS
  TIME TO PEAK =       10.00   MIN
  TOTAL VOLUME =    10485.00   CU FT
```

ANALYSIS JUSTIFICATION - SECTION P-01 DITCH (CONT)

0.3% V-DITCH, 3:1 SIDES, 1.5-FEET MIN. DEPTH AVAIL.
MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)
1.13’ CALCULATED HW DEPTH, MEETS Q-25 REQUIREMENT*

*



Solve For: Normal Depth
Friction Method: Manning Formula

Roughness Coefficient 0.030
Channel Slope: 0.003 ft/ft
Normal Depth: 13.6 in
Left Side Slope: 3.000 H:V
Right Side Slope: 3.000 H:V
Discharge: 6.90 cfs

Flow Area: 3.8 ft²
Wetted Perimeter: 7.2 ft
Hydraulic Radius: 6.4 in
Top Width: 6.80 ft
Critical Depth: 9.6 in
Critical Slope: 0.019 ft/ft
Velocity: 1.79 ft/s
Velocity Head: 0.05 ft
Specific Energy: 1.18 ft
Froude Number: 0.420
Flow Type: Subcritical

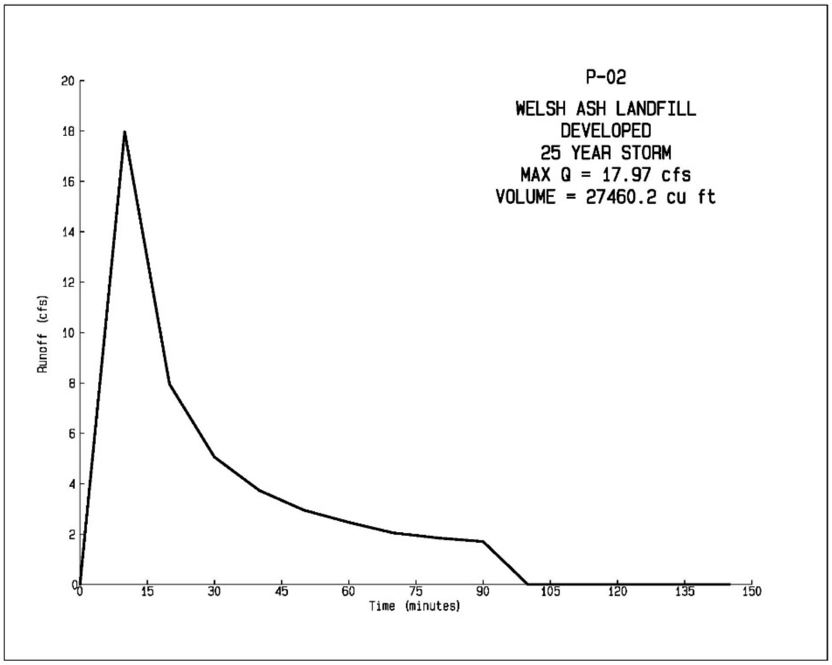
Bentley FlowMaster V8i – Triangular Channel Analysis

ANALYSIS JUSTIFICATION - SECTION P-02

0.3% V-DITCH, 3:1 SIDES, 4.0’ MIN. DEPTH

MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
--------------------------------------------------------------------------------
HYDROLOGIC REPORT
-----------------------------------------------------------------------
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER   P-02 (NDA 01 & NDA 02)
DISCHARGES INTO    WELSH ASH LANDFILL
BASIN AREA     =      4.02  ACRES
RUNOFF COEFF.  =      0.50
RAINFALL INT.  =      8.94  IN/HR
TIME OF CONC.  =     10.00  MINUTES
      TIME      RUNOFF
     (MIN)       (CFS)
    -------  ------------
       0.0        0.0
       5.0        9.0
      10.0       18.0
      15.0       13.0
      20.0        8.0
      25.0        6.5
      30.0        5.1
      35.0        4.4
      40.0        3.7
      45.0        3.3
      50.0        3.0
      55.0        2.7
      60.0        2.5
      65.0        2.3
      70.0        2.0
      75.0        2.0
      80.0        1.8
      85.0        1.8
      90.0        1.7
      95.0        0.9
     100.0        0.0
     105.0        0.0
     110.0        0.0
     115.0        0.0
     120.0        0.0
     125.0        0.0
     130.0        0.0
     135.0        0.0
     140.0        0.0
     145.0        0.0
     PEAK FLOW =        17.97  CFS
  TIME TO PEAK =        10.00  MIN
  TOTAL VOLUME =     27460.20  CU FT
```

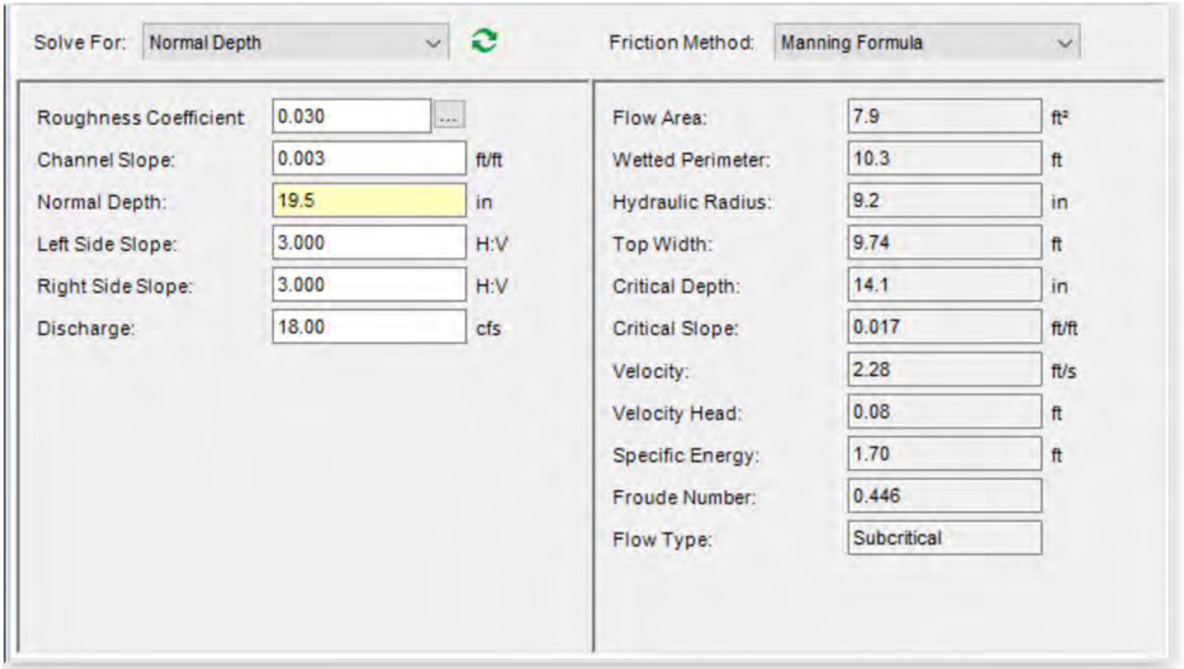


ANALYSIS JUSTIFICATION - SECTION P-02 (CONT)

1.1%,11.8L/12.6R:1, 10' CHANNEL, AVAIL. 4.0’ MIN. HW DEPTH

MANNING N VALUE: 0.02 (ROUGHENED CONCRETE)

1.63’ CALCULATED HW DEPTH -- MEETS Q-25 REQUIREMENT*



Solve For: Normal Depth

Friction Method: Manning Formula

Roughness Coefficient	0.030	
Channel Slope:	0.003	ft/ft
Normal Depth:	19.5	in
Left Side Slope:	3.000	H:V
Right Side Slope:	3.000	H:V
Discharge:	18.00	cfs

Flow Area:	7.9	ft²
Wetted Perimeter:	10.3	ft
Hydraulic Radius:	9.2	in
Top Width:	9.74	ft
Critical Depth:	14.1	in
Critical Slope:	0.017	ft/ft
Velocity:	2.28	ft/s
Velocity Head:	0.08	ft
Specific Energy:	1.70	ft
Froude Number:	0.446	
Flow Type:	Subcritical	

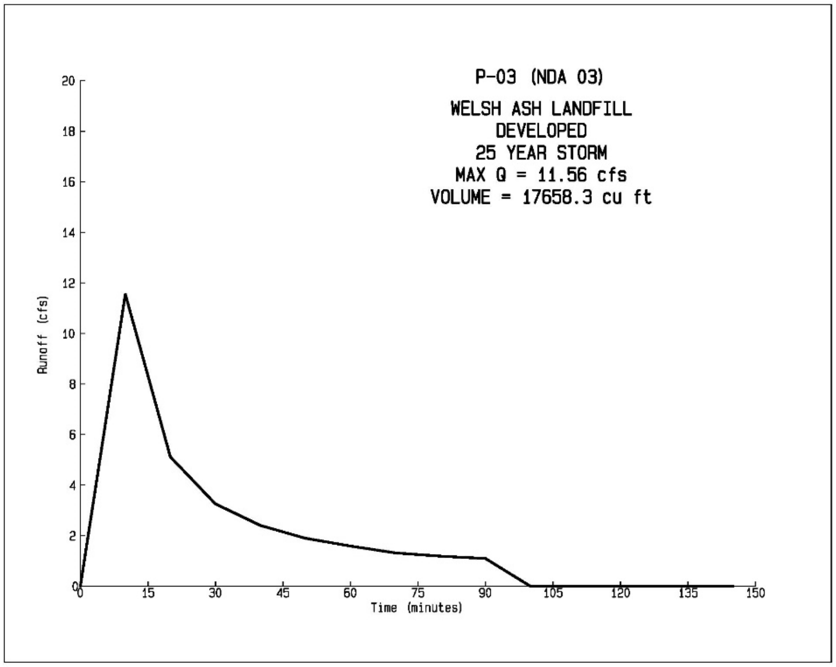
*	Bentley FlowMaster V8i – Triangular Channel Analysis

ANALYSIS JUSTIFICATION - SECTION P-03

20-FT WIDE, 0.3% CHANNEL, 3:1 SIDES, 7.7-FT MIN. DEPTH

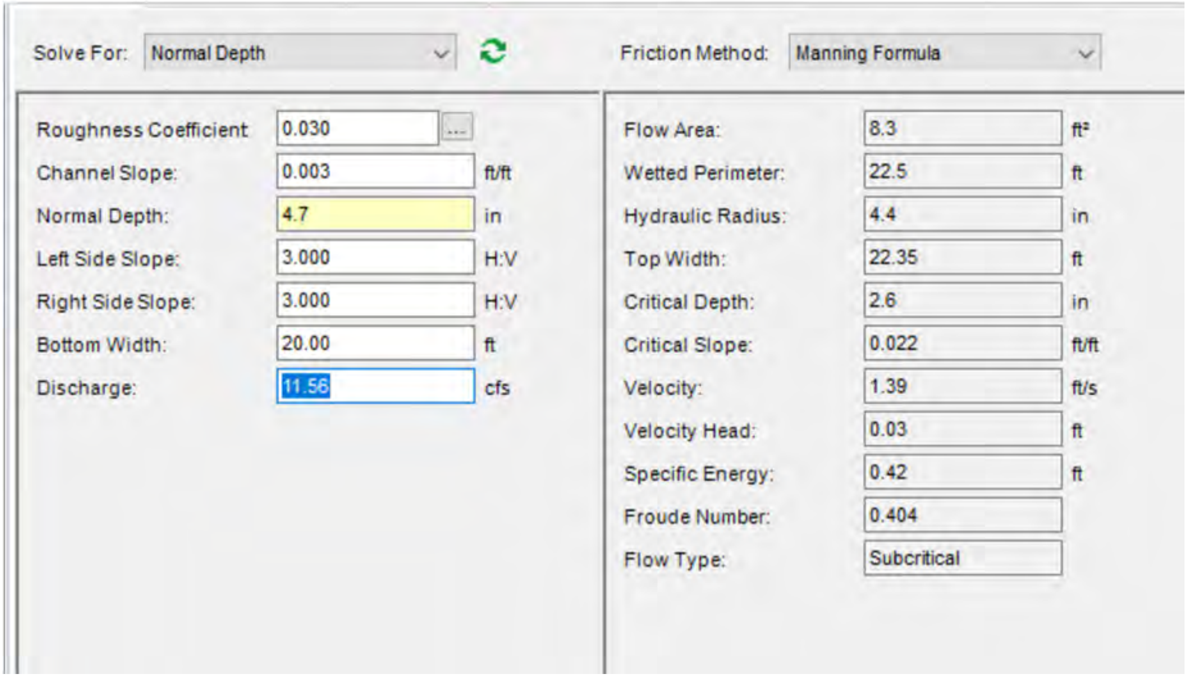
MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
--------------------------------------------------------------------------------
HYDROLOGIC REPORT
-----------------------------------------------------------------------
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER   P-03 (NDA 03)
DISCHARGES INTO    WELSH ASH LANDFILL
BASIN AREA     =      2.59  ACRES
RUNOFF COEFF. =      0.50
RAINFALL INT. =      8.94  IN/HR
TIME OF CONC. =     10.00  MINUTES
      TIME      RUNOFF
     (MIN)       (CFS)
    -------  ------------
       0.0        0.0
       5.0        5.8
      10.0       11.6
      15.0        8.3
      20.0        5.1
      25.0        4.2
      30.0        3.3
      35.0        2.8
      40.0        2.4
      45.0        2.2
      50.0        1.9
      55.0        1.7
      60.0        1.6
      65.0        1.5
      70.0        1.3
      75.0        1.3
      80.0        1.2
      85.0        1.1
      90.0        1.1
      95.0        0.5
     100.0        0.0
     105.0        0.0
     110.0        0.0
     115.0        0.0
     120.0        0.0
     125.0        0.0
     130.0        0.0
     135.0        0.0
     140.0        0.0
     145.0        0.0
     PEAK FLOW =        11.56  CFS
  TIME TO PEAK =        10.00  MIN
  TOTAL VOLUME =     17658.30  CU FT
```



ANALYSIS JUSTIFICATION - SECTION P-03 (CONT)

20-FT WIDE, 0.3% CHANNEL, 3:1 SIDES, 7.7’ MIN. HW DEPTH
MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)
0.39’ CALCULATED HW DEPTH, MEETS Q-25 REQUIREMENT*



Solve For: Normal Depth

Friction Method: Manning Formula

Roughness Coefficient	0.030	
Channel Slope:	0.003	ft/ft
Normal Depth:	4.7	in
Left Side Slope:	3.000	H:V
Right Side Slope:	3.000	H:V
Bottom Width:	20.00	ft
Discharge:	11.56	cfs

Flow Area:	8.3	ft²
Wetted Perimeter:	22.5	ft
Hydraulic Radius:	4.4	in
Top Width:	22.35	ft
Critical Depth:	2.6	in
Critical Slope:	0.022	ft/ft
Velocity:	1.39	ft/s
Velocity Head:	0.03	ft
Specific Energy:	0.42	ft
Froude Number:	0.404	
Flow Type:	Subcritical	

---

* Bentley FlowMaster V8i – Triangular Channel Analysis

ANALYSIS JUSTIFICATION - SECTION P-04

15-FT WIDE, 0.3% CHANNEL, 3:1 SIDES, 6.5-FT MIN. DEPTH

MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

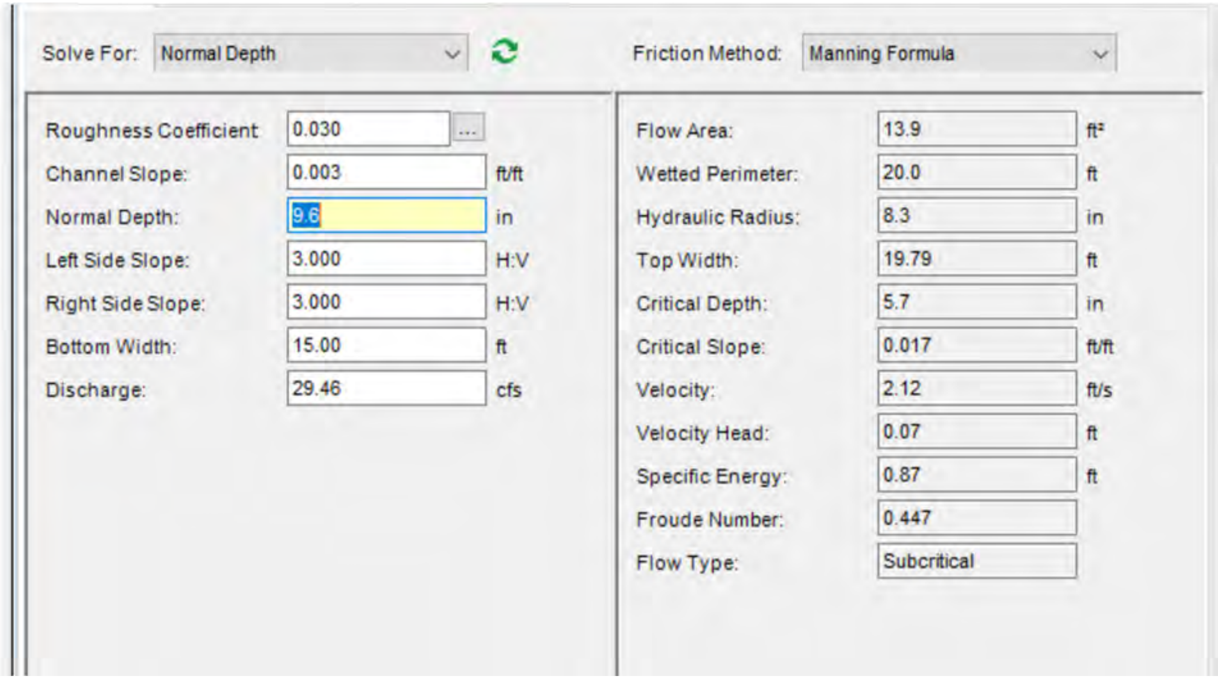
```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
--------------------------------------------------------------------------------
HYDROLOGIC REPORT
-----------------------------------------------------------------------
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER   P-04 (NDA 03 & NDA 04)
DISCHARGES INTO    WELSH ASH LANDFILL
BASIN AREA     =      6.59  ACRES
RUNOFF COEFF. =      0.50
RAINFALL INT. =      8.94  IN/HR
TIME OF CONC. =     10.00  MINUTES
      TIME      RUNOFF
     (MIN)       (CFS)
    -------  ------------
       0.0        0.0
       5.0       14.7
      10.0       29.5
      15.0       21.3
      20.0       13.0
      25.0       10.7
      30.0        8.3
      35.0        7.2
      40.0        6.1
      45.0        5.5
      50.0        4.8
      55.0        4.4
      60.0        4.1
      65.0        3.7
      70.0        3.4
      75.0        3.2
      80.0        3.0
      85.0        2.9
      90.0        2.8
      95.0        1.4
     100.0        0.0
     105.0        0.0
     110.0        0.0
     115.0        0.0
     120.0        0.0
     125.0        0.0
     130.0        0.0
     135.0        0.0
     140.0        0.0
     145.0        0.0
     PEAK FLOW =        29.46  CFS
  TIME TO PEAK =        10.00  MIN
  TOTAL VOLUME =     45016.20  CU FT
```

ANALYSIS JUSTIFICATION - SECTION P-04 (CONT)

15-FT WIDE, 0.3% CHANNEL, 3:1 SIDES, 6.5-FT MIN. HW DEPTH

MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

0.80' CALCULATED HW DEPTH, MEETS Q-25 REQUIREMENT*



Solve For: Normal Depth

Friction Method: Manning Formula

Roughness Coefficient 0.030
Channel Slope: 0.003 ft/ft
Normal Depth: 9.6 in
Left Side Slope: 3.000 H:V
Right Side Slope: 3.000 H:V
Bottom Width: 15.00 ft
Discharge: 29.46 cfs

Flow Area: 13.9 ft²
Wetted Perimeter: 20.0 ft
Hydraulic Radius: 8.3 in
Top Width: 19.79 ft
Critical Depth: 5.7 in
Critical Slope: 0.017 ft/ft
Velocity: 2.12 ft/s
Velocity Head: 0.07 ft
Specific Energy: 0.87 ft
Froude Number: 0.447
Flow Type: Subcritical

---

* Bentley FlowMaster V8i – Triangular Channel Analysis

ANALYSIS JUSTIFICATION - SECTION P-02 & P-04

P-04 & 02 CULVERTS: 28" & 26” DIA HDPE CULVERTS
SOLVE AS DETENTION

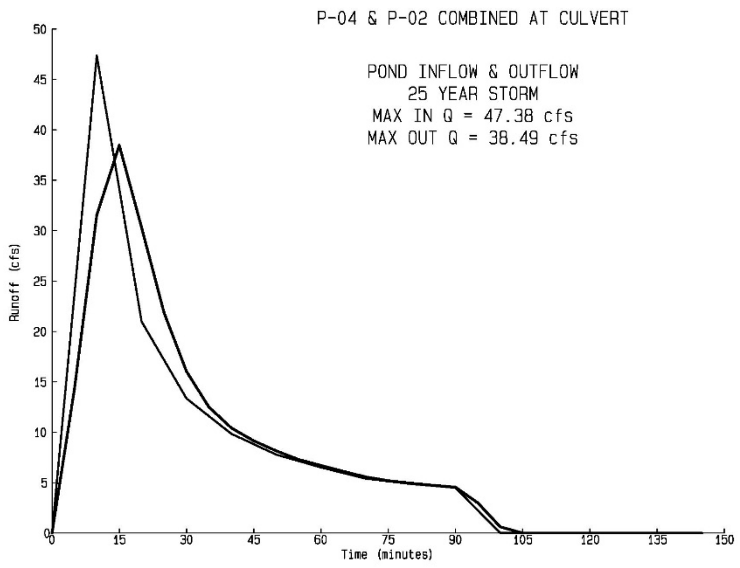
```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
--------------------------------------------------------------------------------
HYDROLOGIC REPORT
-----------------------------------------------------------------------
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER   P-04 & P-02 COMBINED AT CULVERT – CHANNEL DETENTION
DISCHARGES INTO    WELSH ASH LANDFILL
BASIN AREA    =     10.60  ACRES
RUNOFF COEFF. =      0.50
RAINFALL INT. =      8.94  IN/HR
TIME OF CONC. =     10.00  MINUTES
      TIME      RUNOFF
     (MIN)       (CFS)
    -------  ------------
       0.0        0.0
       5.0       23.7
      10.0       47.4
      15.0       34.2
      20.0       21.0
      25.0       17.2
      30.0       13.4
      35.0       11.6
      40.0        9.9
      45.0        8.8
      50.0        7.8
      55.0        7.2
      60.0        6.5
      65.0        6.0
      70.0        5.4
      75.0        5.1
      80.0        4.9
      85.0        4.7
      90.0        4.5
      95.0        2.3
     100.0        0.0
     105.0        0.0
     110.0        0.0
     115.0        0.0
     120.0        0.0
     125.0        0.0
     130.0        0.0
     135.0        0.0
     140.0        0.0
     145.0        0.0
     PEAK FLOW =        47.38  CFS
  TIME TO PEAK =        10.00  MIN
  TOTAL VOLUME =     72408.60  CU FT
```

ANALYSIS JUSTIFICATION - SECTION P-02 & P-04

P-04 & 02 CULVERTS: 28" & 26” DIA HDPE CULVERTS

2.42’ CALCULATED HW DEPTH AT 28” CULVERT - MEETS Q-25 REQUIREMENT*

```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
---------------------------------------------------------------------------------
HYDROGRAPH RESERVOIR ROUTING
POND: P-04 & P-02 COMBINED AT CULVERT
    T       I1      I2      2S1/T       O1  2S2/T+O2       O2      2S2/T
------------------------------------------------------------------------
25 YEAR STORM FREQUENCY
  5.00     0.0    23.7       0.0      0.0      23.7     14.3       9.4
 10.00    23.7    47.4       9.4     14.3      66.2     31.6      34.6
 15.00    47.4    34.2      34.6     31.6      84.6     38.5      46.1
 20.00    34.2    21.0      46.1     38.5      62.8     30.3      32.5
 25.00    21.0    17.2      32.5     30.3      40.3     21.9      18.5
 30.00    17.2    13.4      18.5     21.9      27.2     16.0      11.1
 35.00    13.4    11.6      11.1     16.0      20.0     12.5       7.5
 40.00    11.6     9.9       7.5     12.5      16.5     10.4       6.1
 45.00     9.9     8.8       6.1     10.4      14.3      9.2       5.2
 50.00     8.8     7.8       5.2      9.2      12.6      8.2       4.5
 55.00     7.8     7.2       4.5      8.2      11.2      7.3       3.9
 60.00     7.2     6.5       3.9      7.3      10.3      6.7       3.6
 65.00     6.5     6.0       3.6      6.7       9.4      6.1       3.2
 70.00     6.0     5.4       3.2      6.1       8.5      5.6       2.9
 75.00     5.4     5.1       2.9      5.6       7.9      5.2       2.7
 80.00     5.1     4.9       2.7      5.2       7.5      5.0       2.5
 85.00     4.9     4.7       2.5      5.0       7.1      4.7       2.4
 90.00     4.7     4.5       2.4      4.7       6.9      4.6       2.3
 95.00     4.5     2.3       2.3      4.6       4.5      3.0       1.5
           TIME TO PEAK =        0.25  HOURS
        MAXIMUM OUTFLOW =       38.49  CFS
        MAXIMUM STORAGE =        6920  CU FT
      MAXIMUM ELEVATION =      341.48  FT
          INFLOW VOLUME =       72409  CU FT
         OUTFLOW VOLUME =       72482  CU FT
```

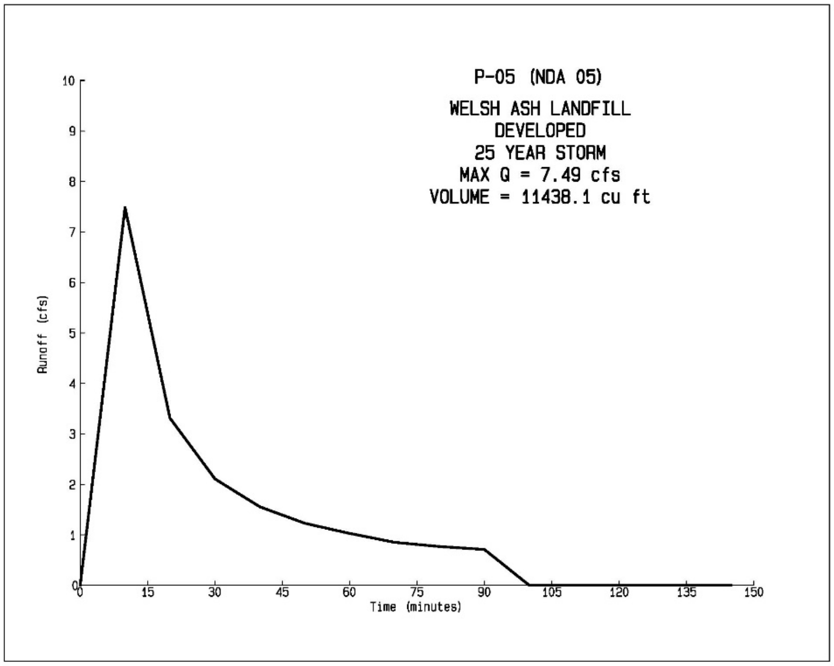


P-04 & P-02 COMBINED AT CULVERT

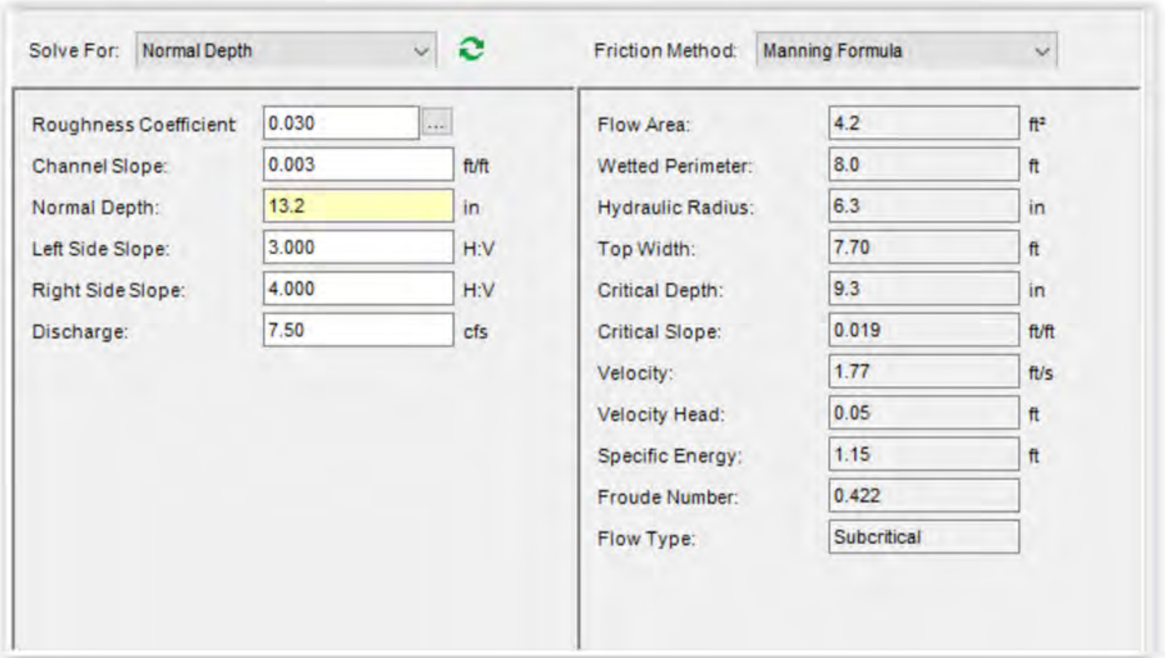
POND INFLOW & OUTFLOW
25 YEAR STORM
MAX IN Q = 47.38 cfs
MAX OUT Q = 38.49 cfs

ANALYSIS JUSTIFICATION - SECTION P-05
0.3% V-DITCH, 3:1 SIDES & 50'X16" DIA HDPE, MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)
50'X16" DIA HDPE CULVERT, 8.8' MAX HW DEPTH

```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
--------------------------------------------------------------------------------
HYDROLOGIC REPORT
-----------------------------------------------------------------------
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER   P-05 (NDA 05)
DISCHARGES INTO    WELSH ASH LANDFILL
BASIN AREA     =      2.09  ACRES
RUNOFF COEFF. =      0.40
RAINFALL INT. =      8.94  IN/HR
TIME OF CONC. =     10.00  MINUTES
      TIME       RUNOFF
     (MIN)        (CFS)
    -------   ------------
       0.0        0.0
       5.0        3.7
      10.0        7.5
      15.0        5.4
      20.0        3.3
      25.0        2.7
      30.0        2.1
      35.0        1.8
      40.0        1.6
      45.0        1.4
      50.0        1.2
      55.0        1.1
      60.0        1.0
      65.0        0.9
      70.0        0.9
      75.0        0.8
      80.0        0.8
      85.0        0.7
      90.0        0.7
      95.0        0.4
     100.0        0.0
     105.0        0.0
     110.0        0.0
     115.0        0.0
     120.0        0.0
     125.0        0.0
     130.0        0.0
     135.0        0.0
     140.0        0.0
     145.0        0.0
     PEAK FLOW =        7.49  CFS
  TIME TO PEAK =       10.00  MIN
  TOTAL VOLUME =    11438.10  CU FT
```



ANALYSIS JUSTIFICATION - SECTION P-05
0.3% V-DITCH, 3:1L X 4:1R SIDES, 6.72' MIN. HW DEPTH
MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)
1.10' CALCULATED HW DEPTH -- MEETS Q-25 REQUIREMENT*

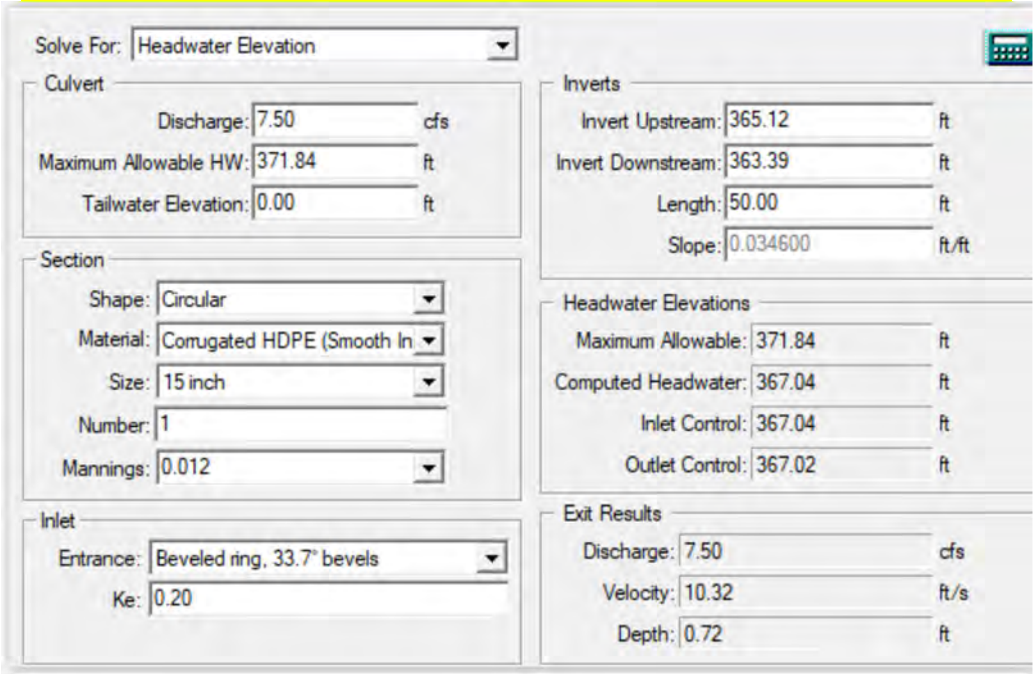

Solve For: Normal Depth
Friction Method: Manning Formula

Roughness Coefficient: 0.030
Channel Slope: 0.003 ft/ft
Normal Depth: 13.2 in
Left Side Slope: 3.000 H:V
Right Side Slope: 4.000 H:V
Discharge: 7.50 cfs

Flow Area: 4.2 ft²
Wetted Perimeter: 8.0 ft
Hydraulic Radius: 6.3 in
Top Width: 7.70 ft
Critical Depth: 9.3 in
Critical Slope: 0.019 ft/ft
Velocity: 1.77 ft/s
Velocity Head: 0.05 ft
Specific Energy: 1.15 ft
Froude Number: 0.422
Flow Type: Subcritical

* Bentley FlowMaster V8i – Trapezoidal Channel Analysis

ANALYSIS JUSTIFICATION - SECTION P-05
50'X16" DIA HDPE, 6.72 MIN. HW DEPTH
1.92-FT CALCULATED HW DEPTH – MEETS Q-25 REQUIREMENT


Solve For: Headwater Elevation

Culvert
Discharge: 7.50 cfs
Maximum Allowable HW: 371.84 ft
Tailwater Elevation: 0.00 ft

Section
Shape: Circular
Material: Corrugated HDPE (Smooth In
Size: 15 inch
Number: 1
Mannings: 0.012

Inlet
Entrance: Beveled ring, 33.7° bevels
Ke: 0.20

Inverts
Invert Upstream: 365.12 ft
Invert Downstream: 363.39 ft
Length: 50.00 ft
Slope: 0.034600 ft/ft

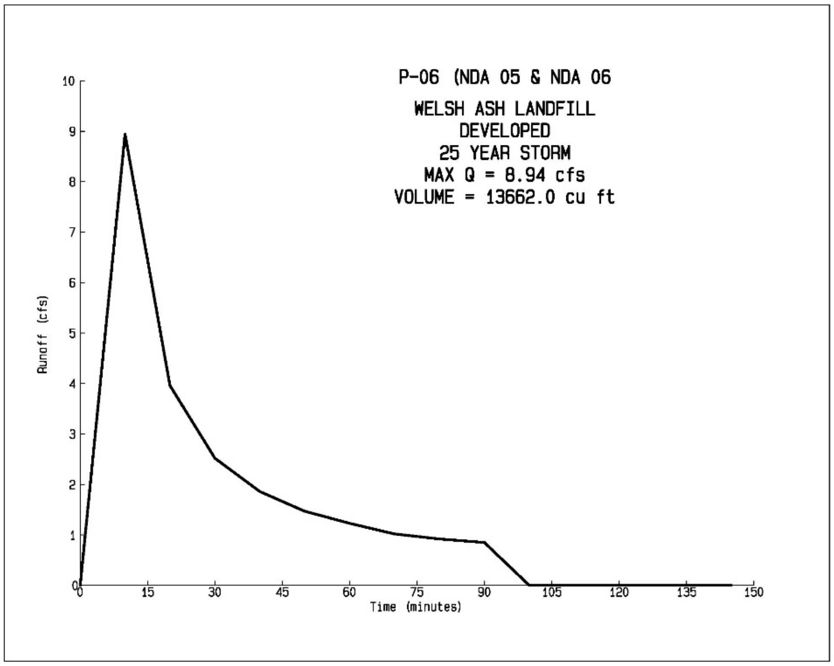
Headwater Elevations
Maximum Allowable: 371.84 ft
Computed Headwater: 367.04 ft
Inlet Control: 367.04 ft
Outlet Control: 367.02 ft

Exit Results
Discharge: 7.50 cfs
Velocity: 10.32 ft/s
Depth: 0.72 ft

* Bentley CulvertMaster – Culvert Analysis (Used 15" DIA HDPE, Conservative)

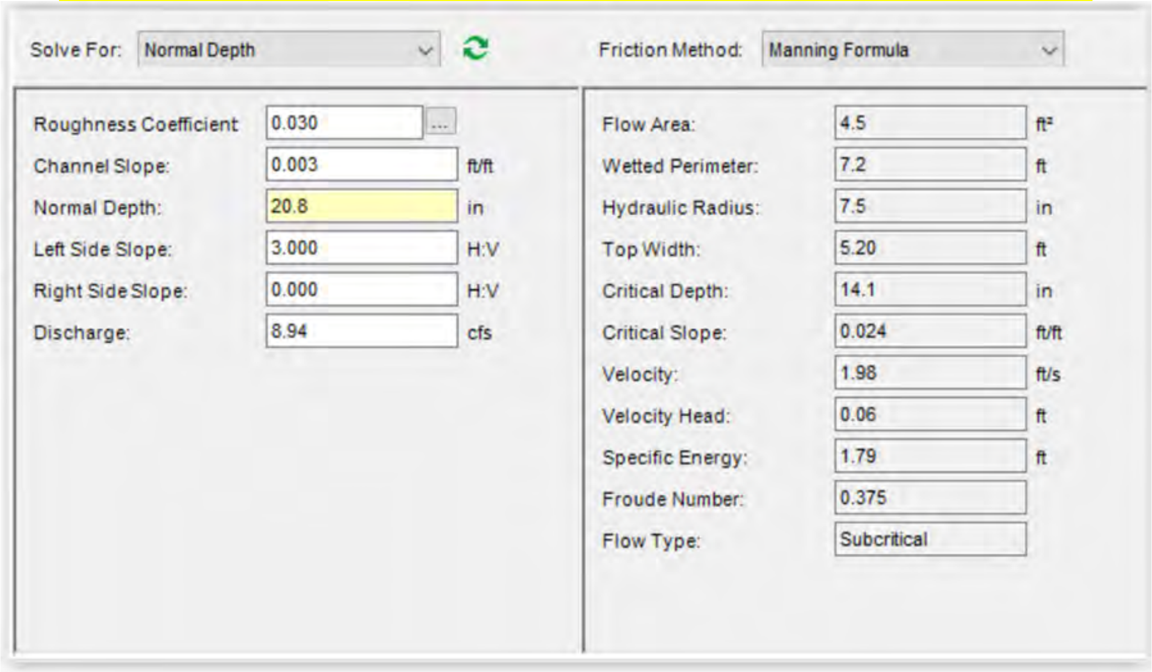
ANALYSIS JUSTIFICATION - SECTION P-06
0.3% V-DITCH, 3:1 SIDES & TWO 30-IN DIA HDPE
MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

```
PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
--------------------------------------------------------------------------------
HYDROLOGIC REPORT
-----------------------------------------------------------------------
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER   P-06 (NDA 05 & NDA 06
DISCHARGES INTO    WELSH ASH LANDFILL
BASIN AREA    =      2.50  ACRES
RUNOFF COEFF. =      0.40
RAINFALL INT. =      8.94  IN/HR
TIME OF CONC. =     10.00  MINUTES
      TIME      RUNOFF
     (MIN)       (CFS)
    -------  ------------
       0.0        0.0
       5.0        4.5
      10.0        8.9
      15.0        6.5
      20.0        4.0
      25.0        3.2
      30.0        2.5
      35.0        2.2
      40.0        1.9
      45.0        1.7
      50.0        1.5
      55.0        1.4
      60.0        1.2
      65.0        1.1
      70.0        1.0
      75.0        1.0
      80.0        0.9
      85.0        0.9
      90.0        0.8
      95.0        0.4
     100.0        0.0
     105.0        0.0
     110.0        0.0
     115.0        0.0
     120.0        0.0
     125.0        0.0
     130.0        0.0
     135.0        0.0
     140.0        0.0
     145.0        0.0
     PEAK FLOW =        8.94  CFS
  TIME TO PEAK =       10.00  MIN
  TOTAL VOLUME =    13662.00  CU FT
```



ANALYSIS JUSTIFICATION - SECTION P-06 (CONT)

0.3% V-DITCH, 3:1 SIDES & MIN 1.92’ HW DEPTH
MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)
1.73-FEET CALCULATED HW DEPTH – MEETS Q-25 REQUIREMENT



Solve For: Normal Depth
Friction Method: Manning Formula

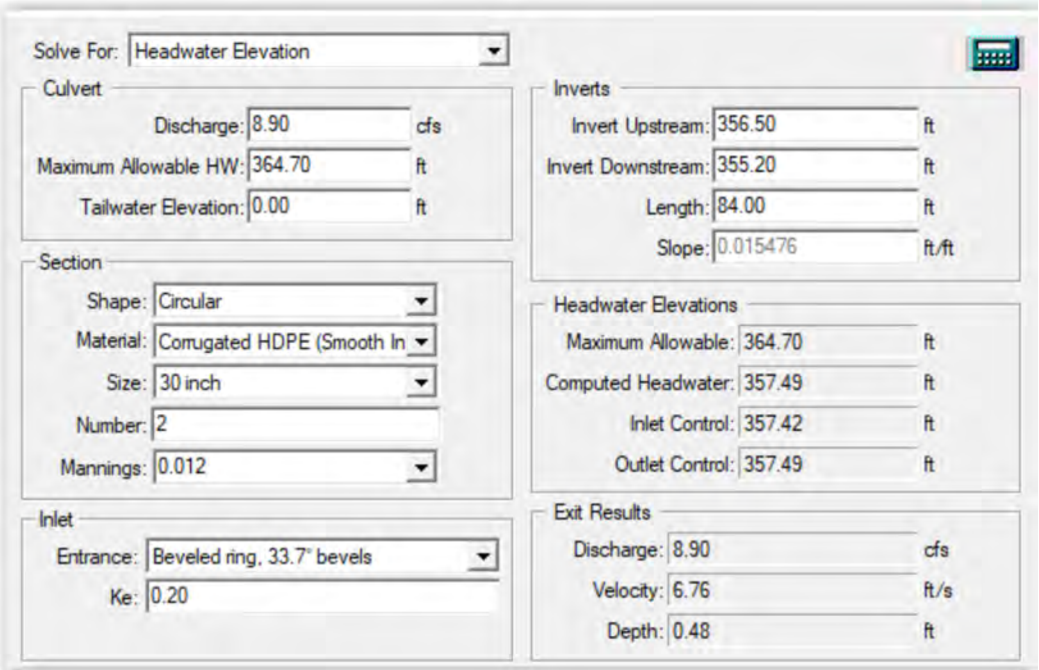
Roughness Coefficient	0.030	
Channel Slope:	0.003	ft/ft
Normal Depth:	20.8	in
Left Side Slope:	3.000	H:V
Right Side Slope:	0.000	H:V
Discharge:	8.94	cfs

Flow Area:	4.5	ft²
Wetted Perimeter:	7.2	ft
Hydraulic Radius:	7.5	in
Top Width:	5.20	ft
Critical Depth:	14.1	in
Critical Slope:	0.024	ft/ft
Velocity:	1.98	ft/s
Velocity Head:	0.06	ft
Specific Energy:	1.79	ft
Froude Number:	0.375	
Flow Type:	Subcritical	

* Bentley FlowMaster V8i – Triangular Channel Analysis

ANALYSIS JUSTIFICATION - SECTION P-06 (CONT)

TWO 84’X30” DIA HDPE, 8.2 MIN. HW DEPTH
0.99’ CALCULATED HW DEPTH – MEETS Q-25 REQUIREMENT



Solve For: Headwater Elevation

Culvert

Discharge:	8.90	cfs
Maximum Allowable HW:	364.70	ft
Tailwater Elevation:	0.00	ft

Section

Shape:	Circular
Material:	Corrugated HDPE (Smooth In
Size:	30 inch
Number:	2
Mannings:	0.012

Inlet

Entrance:	Beveled ring, 33.7° bevels
Ke:	0.20

Inverts

Invert Upstream:	356.50	ft
Invert Downstream:	355.20	ft
Length:	84.00	ft
Slope:	0.015476	ft/ft

Headwater Elevations

Maximum Allowable:	364.70	ft
Computed Headwater:	357.49	ft
Inlet Control:	357.42	ft
Outlet Control:	357.49	ft

Exit Results

Discharge:	8.90	cfs
Velocity:	6.76	ft/s
Depth:	0.48	ft

* Bentley CulvertMaster – Culvert Analysis

Appendix 3: Plan Review Log

Plan Review and Changes in Facility Configuration

Scheduled reviews and Plan amendments shall be recorded in the Plan Review Log below. This log must be completed even if no amendment is made to the Plan as a result of the review.

By	Date	Amendment Description	P.E. Certification Required?	P.E. Name	Licensing State Registration No.
RHM	9/13/2021	Complete Reissue *	Yes	Robert H. Murray	Texas 59111

** Significant drainage modifications resulted in major differences require a complete reissue of the Plan*

Appendix 4: Professional Engineer Certification

Professional Engineer Certification Page

The undersigned licensed Professional Engineer (P.E.) attests that this Run-on and Run-off Control Plan has been prepared, reviewed, and/or revised in accordance with good engineering practice, including consideration of applicable industry standards and the requirements of 40 CFR 257. This certification in no way relieves the Owner or Operator of the facility of his/her duty to fully implement this Plan.

Engineer: ______________________
Robert H. Murray, P.E.

Registration Number: _59111___________________

State: _Texas____________________

Date: September 17, 2021

ROBERT H. MURRAY
59111

MTG Engineers & Surveyors TBPE FIRM No. 354

P.E. certification is required for the Original Plan and Plan Reviews and Amendments.

3.4 – Inflow Design Flood Control Plan Periodic 5-Year Review, Primary Bottom Ash Pond, October 2021

INFLOW DESIGN FLOOD CONTROL PLAN
PERIODIC 5-YEAR REVIEW

30 TAC 352.821 (40 CFR 257.82)

Primary Bottom Ash Pond

Welsh Power Plant
Pittsburg, Texas

October, 2021

Prepared for: Southwest Electric Power Company – Welsh Power Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

DOCUMENT ID: GERS – 21 – 053

INFLOW DESIGN FLOOD CONTROL PLAN
PERIODIC 5-YEAR REVIEW
CFR 257.82
WELSH POWER PLANT
PRIMARY BOTTOM ASH POND

PREPARED BY Brett A. Dreger DATE 10/7/2021
Brett A. Dreger, P.E.

REVIEWED BY DATE 10/7/2021
Mohammad A. Ajlouni, Ph.D.,P.E.

APPROVED BY Gary F. Zych DATE 10/8/2021
Gary F. Zych, P.E.
Manager – AEP Geotechnical Engineering

American Electric Power
Service Corporation
Texas Registered Engineering
Firm No. F-3341

Gary F. Zych
GARY F. ZYCH
127152
10/8/2021

I certify to the best of my knowledge, information, and belief that the information contained in this Inflow Design Flood Control Plan meets the requirements of 40 CFR § 257.82

Table of CONTENTS

Attachment A: 2010 Hydraulic Analysis of Welsh Power Plant Ash Ponds

Attachment B: 2021 Hydraulic Analysis of Welsh Power Plant Ash Ponds

1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of 30 TAC 352.821 (40 CFR 257.82) for the hydrologic and hydraulic evaluation of CCR surface impoundments. This is the first periodic 5-year review of the inflow design flood control plan.

2.0 DESCRIPTION OF THE CCR UNIT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash pond and the Bottom Ash Storage pond. This report addresses the Primary Bottom Ash Pond. The Primary Bottom Ash pond CCR unit is located southwest of the Plant and directly west of the Welsh Reservoir.

The Primary Bottom Ash pond is bounded by natural ground surface (topographically higher areas) to the north and west, and embankment dikes to the south and east. The elevation at the top of embankment along the crest area is approximately 340.0 feet above msl. Presently, economizer ash and bottom ash from the generating plant is sluiced to the Primary Bottom Ash pond.

3.0 INFLOW DESIGN FLOOD 257.82(a)(3)

The facility is classified as a Low Hazard Potential Dam. This classification has not changed since the initial evaluation. The Inflow Design Flood is the 100-year storm event which is 9.85 inches in 24 hours.

4.0 FLOOD CONTROL PLAN 257.82(c)

All storm water runoff from the watershed drains into the reservoir created by the Primary Bottom Ash Pond Dam. The design to safely pass the inflow design flood without overtopping the crest of the dam is based on the normal pool being at maximum normal operating pool and utilizing the principal spillway and emergency spillway to handle the 100-year design storm without overtopping the crest of the dam.

The 2010 Hydraulic Analysis of Welsh Power Plant Ash Ponds report (Attachment A) provides the description of the drainage area, spillway system, flood storage capacity, inflow peak discharge and volume, peak discharge from the facility and maximum pool elevation at that time for the for the Primary Bottom Ash Pond.

The 2021 Hydraulic Analysis (Attachment B) was performed with the same 2010 model, except that the maximum normal operating poll level was revised to reflect current conditions. The maximum normal operating pool level was set at 333.0. Results of the analysis show that the maximum pool elevation from the 100-year storm is 335.5 which is less than the crest elevation of 340.0.

There has not been any changes to spillway system, flood storage capacity or rainfall estimates that would change the results presented in Attachment B. However, a new road crossing and culvert have been constructed in the discharge canal downstream of the primary bottom ash pond principal discharge weir structure. Results of the revised Hydraulic Analysis show that the peak discharge flow from principal discharge weir are less than the culvert capacity placed downstream. The attached calculations show that the facility has the capacity to manage the inflow design flood.

ATTACHMENT A

2010 Hydraulic Analysis

Of

Welsh Power Plant Ash Ponds

FREESE AND NICHOLS

Innovative approaches
Practical results
Outstanding service

Hydraulic Analysis of Welsh Power Plant Ash Ponds

American Electric Power Company

Prepared by:

FREESE AND NICHOLS, INC.
4055 International Plaza, Suite 200
Fort Worth, Texas 76109
817-735-7300

AEP10412

FREESE AND NICHOLS

Innovative approaches
Practical results
Outstanding service

Hydraulic Analysis of Welsh Power Plant Ash Ponds

American Electric Power Company

TRAVIS N. ATTANASIO
98433

Freese and Nichols, Inc.
Texas Registered Engineering Firm F-2144

The seal appearing on this document was
authorized by Travis N. Attanasio on
December 29, 2010

Prepared by:

FREESE AND NICHOLS, INC.
4055 International Plaza, Suite 200
Fort Worth, Texas 76109
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AEP10412

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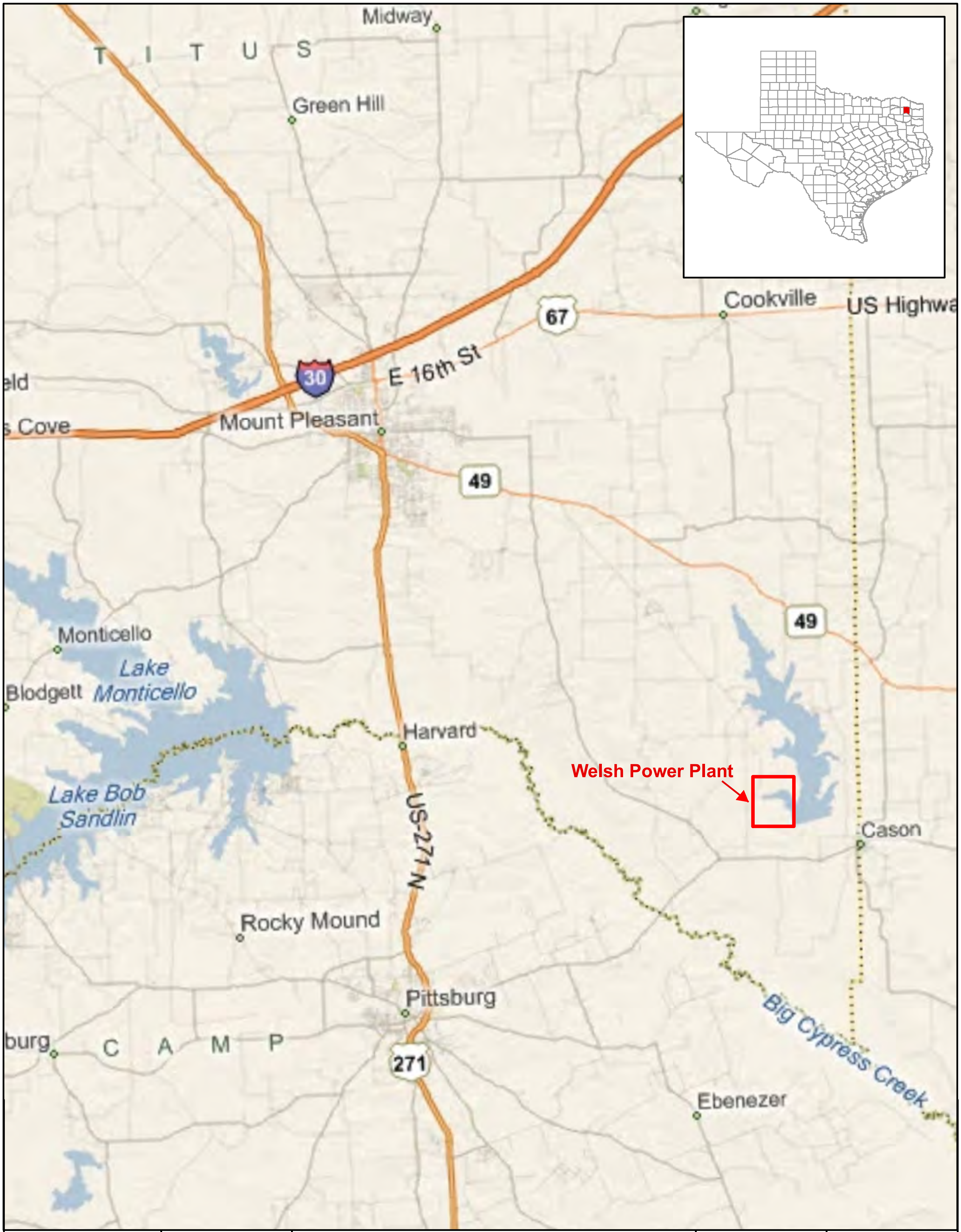
APPENDICES

1.0 INTRODUCTION

In November of 2010, Freese and Nichols, Inc., (FNI) was retained by American Electric Power (AEP) to perform various hydrologic and hydraulic calculations to determine the hydraulic adequacy of the Primary Ash, Secondary Ash, and Bottom Ash Ponds for the Welsh Power Plant located near Pittsburg, TX. This report summarizes the results of the analysis for the 10-year, 25-year, 100-year, 25% PMF, 50% PMF, and 100% PMF events.

The three Ash Ponds are situated immediately south of the Welsh Power Plant on the west side of Welsh Reservoir. The general location of the power plant and associated reservoirs is shown in Figure 1.



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DATUM & COORDINATE SYSTEM
NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)

DATE CREATED
DECEMBER 2010

PREPARED BY
JPM

FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 1.25 2.5 5 Miles

WELSH POWER PLANT ASH PONDS

LOCATION MAP

N

FIGURE

1

2.0 HYDROLOGIC MODEL DEVELOPMENT

2.1 BASIN DELINEATION & CONNECTIVITY

The hydrologic model for the Welsh Power Plant Ash Ponds was created in HEC-HMS[1] and consisted of seven total drainage basins, as shown in Figure 2. The total drainage area modeled is approximately 0.695 square miles, or 445 acres. Two basins, labeled *Primary* and *Power Plant*, drain directly into the Primary Ash Pond. The Ash Storage Area was divided into two drainage basins – *Ash Storage Area A* and *Ash Storage Area B* – based on a December 2009 survey of the area. A small portion of the Ash Storage Area, along with a small wooded area, drains into the Bottom Ash Pond and is shown as *to Bottom Ash* in Figure 2. Additionally, the area inside the embankment for the Bottom Ash Pond is labeled *Bottom Ash* and drains directly into the reservoir area. Finally, the basin labeled *Secondary* represents the area draining to the Secondary Ash Pond.

Each of the seven basins and three reservoir areas are connected in some way and form an intricate system of connectivity. The only discharges from the Primary Ash Pond flow through a drainage canal to the Secondary Ash Pond. This canal flows from west to east and is controlled by a weir box control structure. Discharges from the Primary Ash Pond emergency spillway also flow into this drainage canal; however, these flows enter the canal downstream of the weir box control structure. Runoff from the Ash Storage Area also enters the Primary Ash Pond via a small sump area with a 24-inch culvert. Rainfall is routed through a small ditch around the perimeter of the Ash Storage Area to this culvert. The principal spillway for the Bottom Ash Pond discharges into a 30-inch pipe which transports the outflows to the Ash Storage Area ditch. These outflows eventually discharge into the Primary Ash Pond. The emergency spillway for the Bottom Ash Pond discharges freely into the area downstream of the Welsh Reservoir emergency spillway. Finally, the combined flows from the drainage canal enter the Secondary Ash Pond, which has both a principal and emergency spillway. All discharges from the Secondary Ash Pond flow into Welsh Reservoir. Spillway capacities are discussed in further detail in Section 2.4.

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DATUM & COORDINATE SYSTEM
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0 500 1,000 2,000
Feet

WELSH POWER PLANT ASH PONDS

DRAINAGE BASIN MAP

N

FIGURE

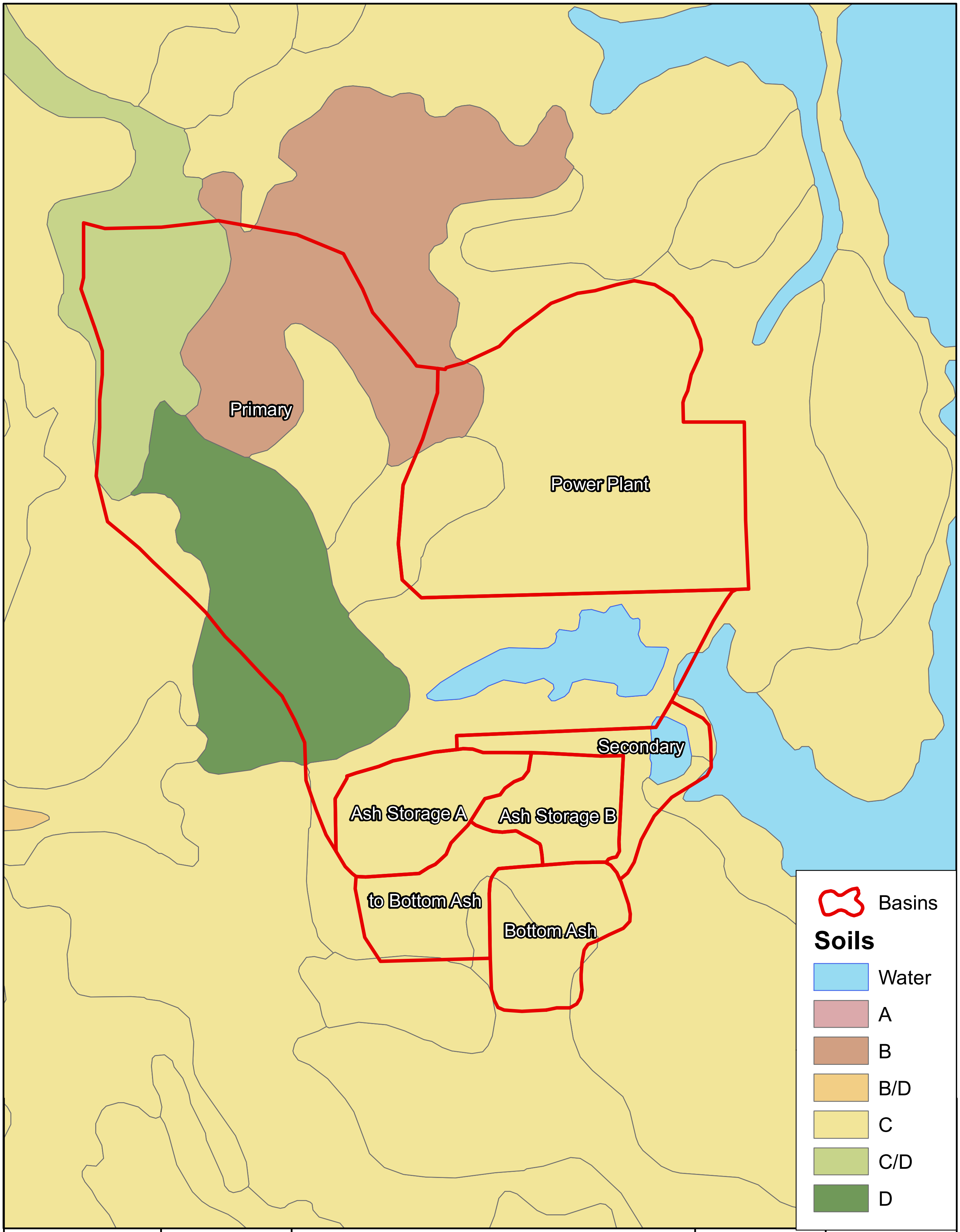
2

2.2 HYDROLOGIC PARAMETERS

The HEC-HMS model incorporates the NRCS Curve Number and Unit Hydrograph methods for each basin. In this model, the curve numbers were based on hydrologic soil classifications and land cover. The instantaneous runoff effect of open water surfaces was accounted for in the development of the curve numbers. The soils dataset was obtained from the NRCS Soil Survey Geographic Database[2] (SSURGO), and land use dataset was obtained from the USGS Seamless Data Warehouse[3] in the form of the National Land Cover Dataset (NLCD) for 2001. Spatial information about soil types and land use classifications is presented in Figures 3 and 4, respectively. Table 1 provides the matrix used in determining the curve number for each basin. The curve numbers shown in Table 1 are for Antecedent Moisture Condition (AMC) II. These values were incorporated in the model for the frequency storm events, such as the 100-year storm event. In accordance with TCEQ recommendations, AMC III was applied to the model for PMF events. This represents a worst-case scenario with the ground fully saturated prior to the PMF event.

Table 1 – Curve Number Calculation Matrix

NLCD Classification		Curve Number (AMC II)					
#	**Description**	**A**	**B**	**B/C**	**C**	**C/D**	**D**
11	Open Water	100	100	100	100	100	100
21	Developed, Open Space	68	79	83	86	88	89
22	Developed, Low Intensity	51	68	74	79	82	84
23	Developed, Medium Intensity	77	85	88	90	91	92
24	Developed, High Intensity	89	92	93	94	95	95
31	Barren Land	77	86	89	91	93	94
41	Deciduous Forest	36	60	67	73	76	79
42	Evergreen Forest	36	60	67	73	76	79
43	Mixed Forest	36	60	67	73	76	79
52	Scrub/Shrub	35	56	63	70	74	77
71	Grassland/Herbaceous	39	61	68	74	77	80
81	Pasture/Hay	39	61	68	74	77	80
82	Cultivated Crops	67	78	82	85	87	89
90	Woody Wetlands	45	66	72	77	80	83



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DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)
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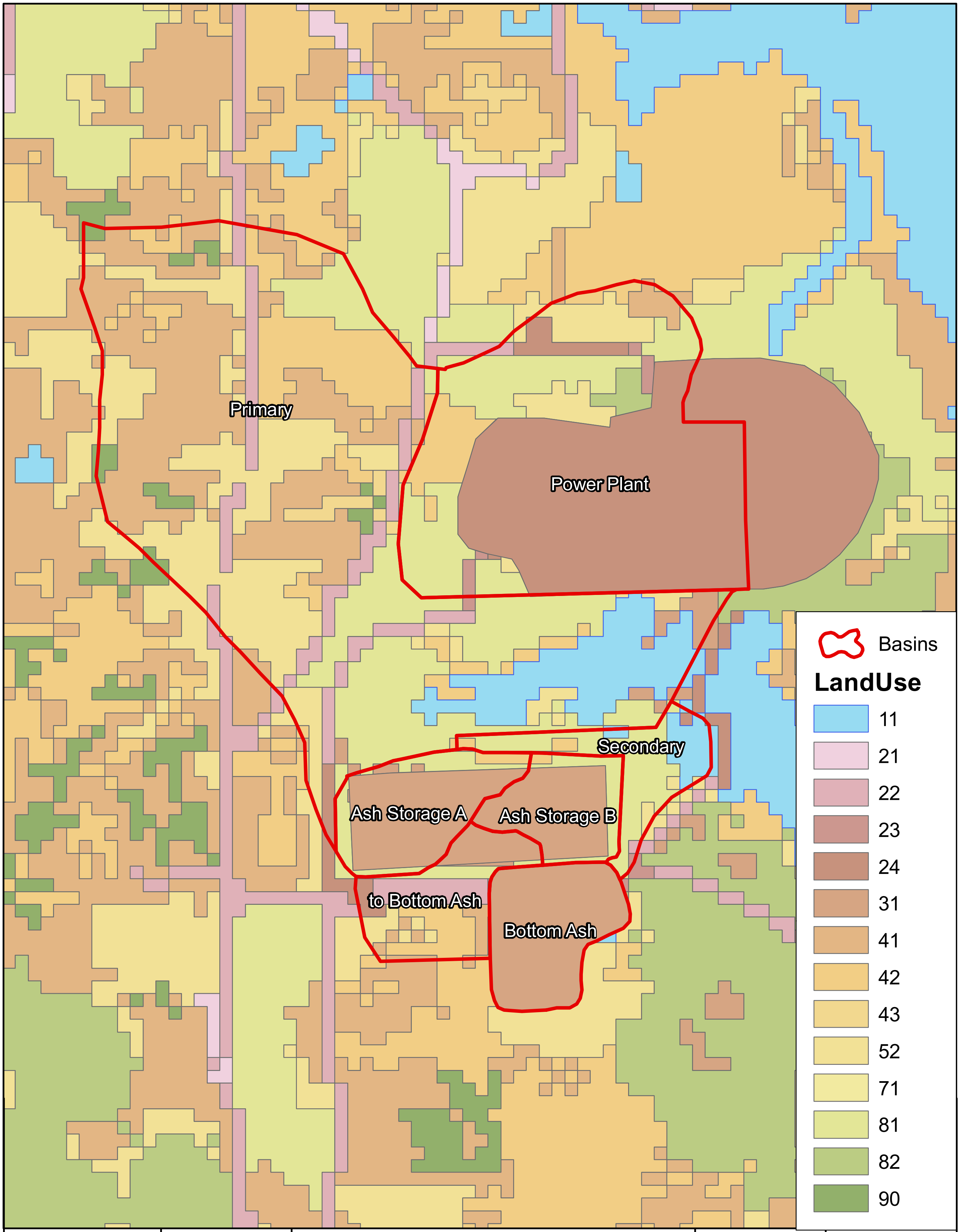
WELSH POWER PLANT ASH PONDS

HYDROLOGIC SOIL CLASSIFICATIONS

FIGURE

3



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DATUM & COORDINATE SYSTEM NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)

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0 500 1,000 2,000
Feet

WELSH POWER PLANT ASH PONDS

LAND COVER DATA

N

FIGURE

4

The only input into HEC-HMS for the NRCS Dimensionless Unit Hydrograph is a lag time, which is calculated based on basin conditions, such as hydraulic length and average slope, according to the NRCS TR-55 Method. Table 2 provides a summary of the hydrologic parameters for each basin. Note that AMC II corresponds with the curve numbers used in the frequency model and that AMC III corresponds with the weighted curve numbers used in the PMP model.

Table 2 – Basin Parameters

Basin	Area (mi^2)	Lag Time (min)	Curve Number (AMC II)	Curve Number (AMC III)
Ash Storage A	0.034	5.28	87.1	93.9
Ash Storage B	0.025	7.51	87.1	93.9
Bottom Ash	0.034	4.78	91.0	95.9
Power Plant	0.180	18.77	85.3	93.0
Primary	0.366	36.14	76.0	88.0
Secondary	0.026	2.31	82.7	91.7
to Bottom Ash	0.031	16.51	77.8	89.0

2.3 ELEVATION-STORAGE DATA

Elevation-storage data for each reservoir was obtained from a combination of data sources. The elevation-storage relationship for the Primary Ash Pond was calculated from USGS 10-foot contours for the area and compared to calculations made by AEP. The Secondary Ash Pond used the AEP Calculations for elevation 320.0 ft-msl to elevation 330.0 ft-msl and a combination of USGS 10-foot contours and surveyed 2-foot contours. The Bottom Ash Pond used volume calculations from an April 2010 survey from elevation 346.13 ft-msl to elevation 355.92 ft-msl. The volume was then extrapolated to the top of dam elevation of 360.0 ft-msl by the average-end-area method and the assumption of 3:1 side slopes. These relationships were used in the hydrologic model for routing both frequency storm events and the PMF and are shown in Table 3 below.

Table 3 – Elevation-Storage Data

Primary	
Elevation (ft-msl)	Storage (acre-ft)
300	0.00
305	22.37
310	54.66
315	110.48
320	186.47
325	304.20
330	461.77
335	676.03
340	934.21

Secondary	
Elevation (ft-msl)	Storage (acre-ft)
320	0.00
330	36.87
331	41.31
332	46.30
333	51.82
334	57.67
335	63.77
336	70.09
337	76.59
338	83.26
339	90.22
340	97.45
341	105.06
342	112.68

Bottom Ash	
Elevation (ft-msl)	Storage (acre-ft)
346.13	0.00
347	0.22
348	1.31
349	3.17
350	5.51
351	8.33
352	11.94
353	16.77
354	23.57
355	33.04
356	45.07
357	65.66
358	86.50
359	107.61
360	128.98

2.4 DISCHARGE RATING CURVES

Each of the three dams has both a principal spillway and an emergency spillway. Information regarding the dimensions and elevations of each of these spillways was taken from a combination of original construction drawings, recent survey, and detailed descriptions from AEP personnel. Detailed calculations for the discharge rating curves of each spillway are included in Appendix B.

The principal spillway for the Primary Ash Pond is located in the canal connecting the Primary and Secondary Ash Ponds. It consists of a weir box with bottom elevation of 325.0 ft-msl and a 4-foot wide by 2-foot tall opening. Stop logs are placed in this opening according to regular dredging operations by AEP; however, normal conditions dictate that no stop logs are in place. This structure also consists of sheet piling to each side of the weir box, which will operate as a sharp-crested weir when flows reach the top elevation of 336.0 ft-msl. Additionally, the Primary Ash Pond has a 90-foot wide emergency spillway with a crest elevation of 334.0 ft-msl. Both the orifice and weir equations were utilized in calculating the discharge rating curves. The discharge rating curve for both spillways is shown in Table 4.

The principal spillway for the Secondary Ash Pond consists of a weir box with a 4-foot long weir discharging through a 36-inch conduit. The weir equation used for this weir box was obtained from Greg Carter of AEP from calculations he had performed in the design of a new weir plate, which is currently in place. Additionally, the Secondary Ash Pond has an approximately 45-foot wide earthen emergency spillway. The discharge rating curve for the emergency spillway was calculated with a simple HEC-RAS model with cross-sections cut through the spillway. The discharge rating curve for both spillways is shown in Table 4.

The principal spillway for the Bottom Ash Pond is a 40-foot long broad-crested weir with 6:1 side slopes and crest at elevation 355.0 ft-msl. It discharges into a small sump area connected to the 30-inch pipe directing flow back toward the Ash Storage Area. The emergency spillway is an 8-foot wide weir at elevation 358.0 ft-msl with a rock riprap discharge chute. The discharge rating curve for both spillways is shown in Table 4.

Table 4 – Discharge Rating Curves

Primary			
Elevation (ft-msl)	**Principal Spillway (cfs)**	**Emergency Spillway (cfs)**	**Total Discharge (cfs)**
325	0	---	0
326	39	---	39
327	54	---	54
328	67	---	67
329	77	---	77
330	86	---	86
331	94	---	94
332	102	---	102
333	109	---	109
334	116	0	116
335	122	285	407
336	128	849	976
337	340	1,637	1,977
338	723	2,640	3,363
339	1,217	3,857	5,074
340	1,801	5,291	7,092

Secondary			
Elevation (ft-msl)	**Principal Spillway (cfs)**	**Emergency Spillway (cfs)**	**Total Discharge (cfs)**
328.3	0	---	0
329	5	---	5
330	17	---	17
331	33	---	33
332	50	0	50
333	58	91	149
334	64	345	409
335	70	777	847
336	75	1,386	1,461
337	80	2,191	2,271
338	85	3,163	3,248
339	90	4,256	4,346
340	94	5,280	5,374

Bottom Ash			
Elevation (ft-msl)	**Principal Spillway (cfs)**	**Emergency Spillway (cfs)**	**Total Discharge (cfs)**
355.0	0	---	0
355.5	50	---	50
356.0	161	---	161
356.5	330	---	330
357.0	561	---	561
357.5	858	---	858
358.0	1,224	0	1,224
358.5	1,664	11	1,676
359.0	2,182	39	2,221
359.5	2,782	85	2,867
360.0	3,466	153	3,619

2.5 FREQUENCY MODEL RESULTS

Three frequency storm events were analyzed for the Welsh Ash Pond system – the 10-year, 25-year, and 100-year storm events. The hydrologic model described in the preceding sections was implemented in analyzing these events. Curve numbers were set to Antecedent Moisture Condition II, and initial abstractions were calculated automatically by HEC-HMS. These assumptions represent normal conditions, as would be expected prior to one of these storm events. The precipitation data was obtained from the National Oceanic and Atmospheric Administration's Technical Memorandum NWS HYDRO-35[4] and Technical Paper 40.[5] These values are presented in Table 5. Each storm event was assumed to have a duration of 24 hours.

Table 5 – Frequency Precipitation Depths

Frequency (yrs)	Precipitation (in)							
	5 min	15 min	60 min	2 hr	3 hr	6 hr	12 hr	24hr
1	0.42	0.89	1.69	1.99	2.20	2.64	3.12	3.58
2	0.51	1.08	1.97	2.45	2.68	3.19	3.78	4.41
5	0.58	1.25	2.54	3.14	3.40	4.15	4.92	5.81
10	0.64	1.38	2.91	3.64	3.95	4.90	5.90	6.82
25	0.72	1.57	3.36	4.22	4.62	5.73	6.76	7.90
50	0.79	1.72	3.75	4.75	5.18	6.41	7.74	8.83
100	0.86	1.88	4.13	5.23	5.78	7.09	8.62	9.85
500	1.12	2.45	5.39	6.83	7.54	9.26	11.26	12.86

These precipitation depths serve as input data into the hydrologic model, and were routed through the model as described previously. According to TCEQ recommendations and standard engineering practice, flood routings were started at the lowest spillway crest elevation for each dam. This corresponds to elevation 325.0 ft-msl, 328.3 ft-msl, and 355.0 ft-msl for the Primary, Secondary, and Bottom Ash Ponds, respectively. The results of the 10-year, 25-year, and 100-year storm events are shown in Tables 6, 7, and 8, respectively.

Table 6 – 10-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	328.50	874.71	71.92
Secondary	332.37	112.41	72.35
Bottom Ash	355.53	157.81	55.99

Table 7 – 25-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	329.35	1079.37	80.24
Secondary	332.51	137.68	81.67
Bottom Ash	355.62	187.44	76.21

Table 8 – 100-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	330.80	1415.75	92.68
Secondary	332.62	177.95	95.96
Bottom Ash	355.76	234.22	108.10

2.6 PMF MODEL RESULTS

The Probable Maximum Flood (PMF) is defined as the greatest flood to be expected, and the Probable Maximum Precipitation (PMP) is theoretically the greatest depth of rainfall for a given duration that is physically possible over a given size storm area at a particular geographic location. Generally, the rainfall depth is calculated for the ten square miles of the watershed which receive the highest intensity rainfall.

Hydrometeorological Report No. 52 (HMR-52),[6] developed by the U.S. Army Corps of Engineers, was used to determine the rainfall for each basin. PMP estimates were taken from Hydrometeorological Report No. 51[7] and distributed according to HMR-52 to obtain average rainfall depths over the various drainage areas.

HMR-52 calculates rainfall depths for storm durations ranging from five minutes to seventy-two hours. Table 9 lists the point rainfall depths calculated by HMR-52 for storm durations from one hour to 72 hours. Because the total drainage area is less than ten square miles, these point rainfall depths were applied to each of the 7 basins. Additionally, the total rainfall depth was distributed according to the temporal distribution described by the TCEQ guidelines.

Table 9 – HMR-52 Point Rainfall Depths

Storm Duration (hr)	Depth (in)
1	16.62
2	20.86
3	24.18
6	30.47
12	36.82
24	42.10
48	46.98
72	49.74

Each PMF duration was modeled as described previously, with flood routing started at the lowest spillway crest elevation. The 12-hour event was critical for both the Primary and Secondary Ash Ponds, and the 1-hour event was critical for the Bottom Ash Pond. Additionally, the 25% and 50% PMF were calculated for the critical duration. Tables 10, 11, and 12 contain the results of these PMF model runs – the 25% PMF, 50% PMF, and 100% PMF, respectively.

Table 10 – 25% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	331.83	690.29	100.59
Secondary	332.68	110.63	105.57
Bottom Ash	355.70	171.14	94.27

Table 11 – 50% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	335.16	1385.23	122.79
Secondary	334.23	511.60	501.07
Bottom Ash	356.15	342.28	211.11

Table 12 – 100% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	337.46	2770.78	517.89
Secondary	337.39	2664.30	2637.73
Bottom Ash	356.78	684.55	458.48

3.0 SUMMARY AND CONCLUSIONS

Based on the results of the hydraulic analysis, each of the three dams is hydraulically adequate for the full range of storm events from the 10-year to the 100% PMF event. Table 13 lists the pertinent elevation data for each dam, including the top of dam elevation and principal and emergency spillway crest elevations. Comparing these elevations to the maximum water surface elevations shown in Table 14 indicates that, even during the 100% PMF event, each of the three dams would have almost 3 feet of freeboard. Additionally, the emergency spillway for the Primary Ash Pond is not engaged during a storm event less than the 50% PMF, and the emergency spillway for the Bottom Ash Pond is not engaged, even during the 100% PMF event. The emergency spillway for the Secondary Ash Pond is, however, engaged much more frequently, even during a storm event as low as the 10-year storm. This should have no adverse affects on this area though, as it appears to have been designed to withstand frequent engaging.

Table 13 – Pertinent Dam Information

	Top of Dam (ft-msl)	Principal Spillway (ft-msl)	Emergency Spillway (ft-msl)
Primary	340.0	325.0	334.0
Secondary	340.0	328.3	332.0
Bottom Ash	360.0	355.0	358.0

Table 14 – Summary of Results

	10-year	25-year	100-year	25% PMF	50% PMF	100% PMF
Primary	328.50	329.35	330.80	331.83	335.16	337.46
Secondary	332.37	332.51	332.62	332.68	334.23	337.39
Bottom Ash	355.53	355.62	355.76	355.70	356.15	356.78

It should be noted that these results reflect the best understanding of existing conditions and could be significantly affected by major changes to any of the three reservoirs. Specifically, major fluctuations in the available storage in each reservoir, as could be caused by the regular dredging and movement of bottom ash in and out of the pond areas, would greatly impact the results of this analysis. However, in their current conditions, the Primary Ash, Secondary Ash, and Bottom Ash Ponds associated with the Welsh Power Plant are deemed to

be hydraulically adequate for any storm event up to the 100% PMF. Pertinent drawings for existing conditions are included in Appendix C.

Appendix A
References

References

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6. U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Department of the Army, Corps of Engineers: *Hydrometeorological Report No. 52, Application of Probable Maximum Precipitation Estimates, United States East of the 105th Meridian*, Washington, D.C., 1982.

7. U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Department of the Army, Corps of Engineers: *Hydrometeorological Report No. 51, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian*, Washington, D.C., 1978.

Appendix B
Calculations

Discharge Rating Curve
Primary Ash Pond

Elevation [ft-msl]	Orifice [cfs]	Sheet Pile [cfs]	Main [cfs]	Emerg [cfs]	Total [cfs]
325.00	0.00	0.00	0.00	0.00	0.00
326.00	38.52	0.00	38.52	0.00	38.52
327.00	54.48	0.00	54.48	0.00	54.48
328.00	66.72	0.00	66.72	0.00	66.72
329.00	77.04	0.00	77.04	0.00	77.04
330.00	86.13	0.00	86.13	0.00	86.13
331.00	94.35	0.00	94.35	0.00	94.35
332.00	101.91	0.00	101.91	0.00	101.91
333.00	108.95	0.00	108.95	0.00	108.95
334.00	115.56	0.00	115.56	0.00	115.56
335.00	121.81	0.00	121.81	285.00	406.81
336.00	127.76	0.00	127.76	848.53	976.28
337.00	133.44	206.46	339.90	1636.79	1976.68
338.00	138.89	583.96	722.84	2640.00	3362.84
339.00	144.13	1072.80	1216.93	3857.22	5074.14
340.00	149.19	1651.68	1800.87	5290.90	7091.76

Main Spillway		
Sill Crest	325	ft-msl
Height	2	ft
Sill Width	4	ft
Orifice C	0.6	

$Q = C*A*\sqrt{(2*g*H)}$

Sheet Pile	336	ft-msl
Top Width	62	ft
Weir C	3.33	

$Q = C*L*H^{3/2}$

Emergency Spillway		
Crest	334	ft-msl
Length	90	ft
SS	2.5	:1
Weir C	3	

$Q = C*(L+2*SS*H)*H^{3/2}$

Discharge Rating Curve
Secondary Ash Pond

Elevation [ft-msl]	Weir [cfs]	Conduit [cfs]	Main [cfs]	Emerg [cfs]	Total [cfs]
328.30	0.00	12.77	0.00		0.00
328.50	0.75	15.39	0.75		0.75
329.00	4.85	22.36	4.85		4.85
329.50	10.62	29.44	10.62		10.62
330.00	17.43	35.94	17.43		17.43
330.50	24.97	40.33	24.97		24.97
331.00	33.01	44.34	33.01		33.01
331.50	41.36	48.10	41.36		41.36
332.00	49.90	51.65	49.90	0.00	49.90
332.50	58.50	55.03	55.03	25.00	80.03
333.00	67.07	58.27	58.27	90.91	149.18
333.50	75.51	61.37	61.37	193.62	254.99
334.00	83.73	64.36	64.36	344.83	409.19
334.50	91.67	67.24	67.24	537.74	604.98
335.00	99.25	70.03	70.03	777.17	847.20
335.50	106.41	72.72	72.72	1056.25	1128.97
336.00	113.09	75.34	75.34	1385.71	1461.05
336.50	119.24	77.87	77.87	1769.84	1847.71
337.00	124.79	80.34	80.34	2190.91	2271.25
337.50	129.70	82.74	82.74	2656.86	2739.60
338.00	133.91	85.08	85.08	3163.04	3248.12
338.50	137.39	87.36	87.36	3697.92	3785.28
339.00	140.09	89.59	89.59	4256.10	4345.69
339.50	141.96	91.76	91.76	4767.86	4859.62
340.00	142.96	93.89	93.89	5279.62	5373.51

Main Spillway

Weir Box

Crest	328.30	ft-msl
Length	4	ft
Weir C	2.152	

$Q = C*(L-0.2H)*H^{1/2}$

Weir Equation from AEP

Conduit

Diameter	36	in
Length	350	ft
U/S Invert	326.5	ft-msl
D/S Invert	326	ft-msl

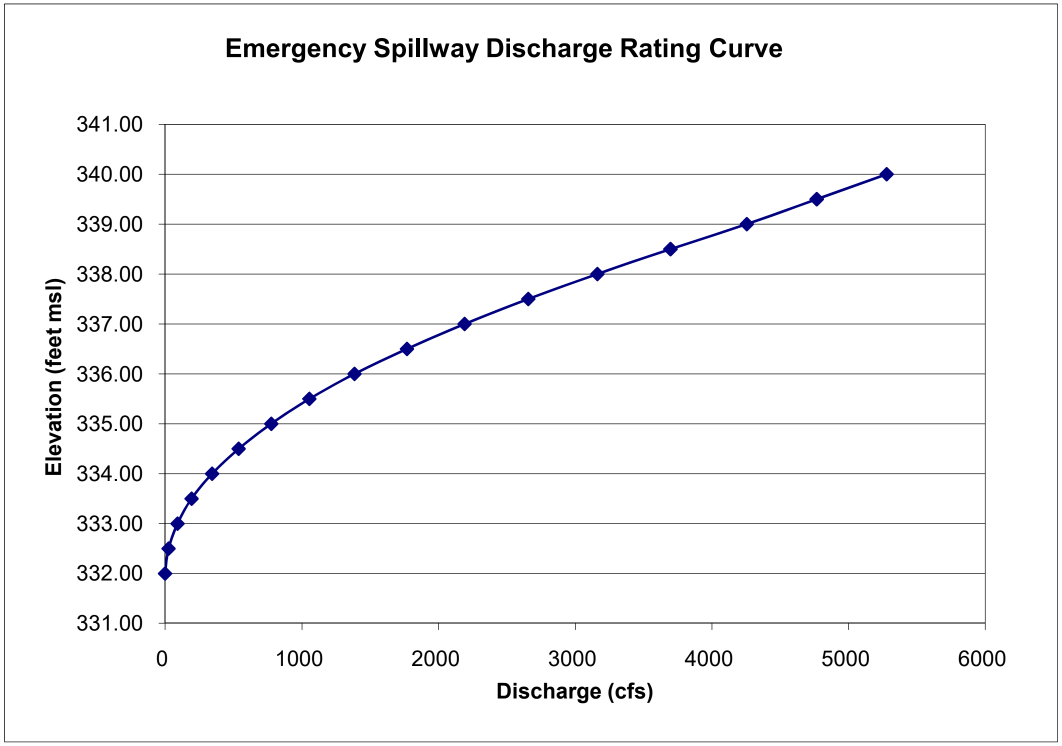
Calculated in FlowMaster

Emergency Spillway

Calculated in HEC-RAS; refer to following sheets for details.

Invert	332	Feet msl
Increment	0.5	Feet

Lake Level (feet msl)	Discharge (cfs)
332.00	0
332.50	25
333.00	91
333.50	194
334.00	345
334.50	538
335.00	777
335.50	1,056
336.00	1,386
336.50	1,770
337.00	2,191
337.50	2,657
338.00	3,163
338.50	3,698
339.00	4,256
339.50	4,768
340.00	5,280



HEC-RAS Results for most upstream cross section

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
SecondaryPon	EmergSpwy	871	PF 1	1	330	332.07		332.07	0	0	380.1	195.63	0
SecondaryPon	EmergSpwy	871	PF 2	10	330	332.29		332.29	0	0.02	423.67	197.71	0
SecondaryPon	EmergSpwy	871	PF 3	25	330	332.5		332.5	0.000002	0.06	465.34	200.66	0.01
SecondaryPon	EmergSpwy	871	PF 4	50	330	332.73		332.73	0.000005	0.1	511.65	204.53	0.01
SecondaryPon	EmergSpwy	871	PF 5	100	330	333.06		333.06	0.000012	0.18	579.79	208.93	0.02
SecondaryPon	EmergSpwy	871	PF 6	200	330	333.52		333.53	0.000031	0.32	677.95	215.13	0.03
SecondaryPon	EmergSpwy	871	PF 7	300	330	333.87		333.87	0.000051	0.43	752.96	221.16	0.04
SecondaryPon	EmergSpwy	871	PF 8	400	330	334.16		334.16	0.000071	0.54	818.24	228.29	0.05
SecondaryPon	EmergSpwy	871	PF 9	500	330	334.41		334.42	0.000091	0.64	876.57	234.47	0.05
SecondaryPon	EmergSpwy	871	PF 10	750	330	334.94		334.95	0.00014	0.85	1005.18	248.81	0.07
SecondaryPon	EmergSpwy	871	PF 11	1000	330	335.4		335.41	0.000184	1.03	1120.39	261.11	0.08
SecondaryPon	EmergSpwy	871	PF 12	1250	330	335.79		335.81	0.000224	1.19	1225.76	271.83	0.09
SecondaryPon	EmergSpwy	871	PF 13	1500	330	336.14		336.16	0.000261	1.34	1322.88	281.28	0.1
SecondaryPon	EmergSpwy	871	PF 14	2000	330	336.77		336.79	0.000326	1.6	1503.25	297.77	0.11
SecondaryPon	EmergSpwy	871	PF 15	2500	330	337.31		337.34	0.000381	1.82	1668.85	312.15	0.12
SecondaryPon	EmergSpwy	871	PF 16	3000	330	337.81		337.85	0.000427	2.01	1827.39	325.32	0.13
SecondaryPon	EmergSpwy	871	PF 17	3500	330	338.26		338.31	0.000468	2.19	1978.88	337.7	0.13
SecondaryPon	EmergSpwy	871	PF 18	4000	330	338.73		338.79	0.000495	2.34	2139.91	350.57	0.14
SecondaryPon	EmergSpwy	871	PF 19	4500	330	339.13		339.2	0.000525	2.48	2282.96	361.62	0.14
SecondaryPon	EmergSpwy	871	PF 20	5000	330	339.69		339.76	0.000513	2.55	2489.43	376.54	0.14

Discharge Rating Curve
Bottom Ash Pond

Elevation [ft-msl]	Main [cfs]	Emerg [cfs]	Total [cfs]
355.00	0.00	0.00	0.00
355.50	50.42	0.00	50.42
356.00	161.20	0.00	161.20
356.50	330.31	0.00	330.31
357.00	561.16	0.00	561.16
358.00	1224.21	0.00	1224.21
359.00	2182.40	39.00	2221.40
360.00	3465.91	152.74	3618.64
361.00	5102.78	358.53	5461.31
362.00	7119.19	672.00	7791.19
363.00	9539.72	1106.85	10646.57

Main Spillway		
Crest	355	ft-msl
Length	40	ft
SS	6	:1
Weir C	3.1	

$Q = C*(L+2*SS*H)*H^{3/2}$

Emergency Spillway		
Crest	358	ft-msl
Length	8	ft
SS	2.5	:1
Weir C	3	

$Q = C*(L+2*SS*H)*H^{3/2}$

Name	GRIDCODE	HSG	Area_ft^2	Area_acre	CN	Inc. CN
Ash Storage	31	C	1324276.445	30.401	91	70.06793
Ash Storage	42	C	53818.662	1.236	73	2.28431
Ash Storage	81	C	341795.137	7.847	74	14.70608
Bottom Ash	31	C	948778.856	21.781	91	91
Power Plant	41	B	1095.992	0.025	60	0.013099
Power Plant	42	B	101918.155	2.340	60	1.218085
Power Plant	81	B	99556.094	2.285	61	1.209685
Power Plant	22	C	15964.935	0.367	79	0.251229
Power Plant	23	C	70296.650	1.614	90	1.260236
Power Plant	24	C	2954103.082	67.817	94	55.31313
Power Plant	41	C	90963.024	2.088	73	1.322703
Power Plant	42	C	239129.961	5.490	73	3.477215
Power Plant	52	C	407500.071	9.355	70	5.68199
Power Plant	81	C	944143.815	21.675	74	13.91697
Power Plant	82	C	95577.482	2.194	85	1.618263
Primary	11	W	458394.580	10.523	100	4.490426
Primary	31	W	14036.955	0.322	100	0.137506
Primary	42	W	104596.947	2.401	100	1.02463
Primary	52	W	11325.853	0.260	100	0.110948
Primary	81	W	69931.187	1.605	100	0.685045
Primary	22	B	242034.352	5.556	68	1.612256
Primary	41	B	564582.710	12.961	60	3.318386
Primary	42	B	631114.853	14.488	60	3.709435
Primary	52	B	220919.125	5.072	56	1.211907
Primary	81	B	286358.868	6.574	61	1.711152
Primary	11	C	480754.464	11.037	100	4.709463
Primary	22	C	209907.569	4.819	79	1.624438
Primary	23	C	10746.609	0.247	90	0.094746
Primary	24	C	67309.636	1.545	94	0.619802
Primary	31	C	150242.962	3.449	91	1.339318
Primary	41	C	540228.652	12.402	73	3.863212
Primary	42	C	316050.970	7.256	73	2.260102
Primary	43	C	93028.069	2.136	73	0.66525
Primary	52	C	572546.147	13.144	70	3.926057
Primary	81	C	1192671.364	27.380	74	8.645709
Primary	82	C	10291.113	0.236	85	0.08569
Primary	90	C	82404.904	1.892	77	0.621573
Primary	41	C/D	916028.058	21.029	76	6.819781
Primary	42	C/D	135572.435	3.112	76	1.00933
Primary	52	C/D	331086.513	7.601	74	2.383839
Primary	90	C/D	101862.212	2.338	80	0.798273
Primary	22	D	301628.331	6.924	84	2.481987
Primary	31	D	13591.654	0.312	94	0.125155
Primary	41	D	558509.208	12.822	79	4.322207
Primary	42	D	58185.234	1.336	79	0.450286
Primary	43	D	21907.998	0.503	79	0.169542
Primary	52	D	973523.140	22.349	77	7.343195
Primary	81	D	435789.772	10.004	80	3.415192
Primary	90	D	31102.113	0.714	83	0.252881
Secondary	11	W	61159.403	1.404	100	8.574385
Secondary	22	W	0.178	0.000	100	2.49E-05
Secondary	24	W	284.987	0.007	100	0.039954
Secondary	52	W	3328.994	0.076	100	0.466716
Secondary	81	W	66883.300	1.535	100	9.37686
Secondary	11	C	100304.658	2.303	100	14.06244
Secondary	22	C	7813.937	0.179	79	0.865439
Secondary	23	C	5348.021	0.123	90	0.6748
Secondary	24	C	9873.918	0.227	94	1.301239
Secondary	31	C	300.129	0.007	91	0.03829
Secondary	42	C	37168.223	0.853	73	3.803946
Secondary	52	C	28941.171	0.664	70	2.840232
Secondary	81	C	391873.463	8.996	74	40.65531
to Bottom Ash	22	C	173034.687	3.972	79	17.29527

Basin	Area_acre
Ash Storage	39.48
Bottom Ash	21.78
Power Plant	115.25
Primary	234.35
Secondary	16.37
to Bottom Ash	18.14

Name	GRIDCODE	HSG	Area_ft^2	Area_acre	CN	Inc. CN
to Bottom Ash	23	C	2352.284	0.054	90	0.267855
to Bottom Ash	24	C	44395.328	1.019	94	5.279978
to Bottom Ash	31	C	108930.225	2.501	91	12.54171
to Bottom Ash	41	C	104222.261	2.393	73	9.626099
to Bottom Ash	42	C	197025.981	4.523	73	18.19757
to Bottom Ash	52	C	82351.521	1.891	70	7.293511
to Bottom Ash	81	C	78062.412	1.792	74	7.308709

Basin	Area_acre

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Ash Storage A	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.010	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	919.70	**FT**
SLOPE	0.021	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	2.319	

$$T_2 = \frac{L}{60 \times V}$$

PIPE FLOW - SOLVE FOR FULL FLOW VELOCITY

DIAMETER =	36	**IN.**
XSECT AREA =	7.07	**SQ FT**
WETTED PERIMETER	9.42	**FT**
SLOPE	0.002	**FT/FT**
MANNINGS N	0.024	
COMPUTED VELOCITY	2.39	**FT/S**
LENGTH	60	**FT**

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_4 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**Ash Storage A**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	1.77	1.77
SHALLOW CONCENTRATED FLOW			6.61	6.61
SHALLOW CONCENTRATED FLOW			0.00	0.00
SHALLOW CHANNEL FLOW				0.00
PIPE FLOW			0.42	0.42
CHANNEL FLOW				0.00
TOTAL			8.79	8.79
			Lag (Hrs) =	**0.09**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**5.28**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Ash Storage B	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.025	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	796.31	**FT**
SLOPE	0.020	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	2.287	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	50
XSECT AREA=	112.000	**SQ FT**	**BOTTOM**	6
			DEPTH	4
WETTED PERIMETER	50.721	**FT**		
SLOPE	0.008	**FT/FT**		
MANNINGS N	0.08			
COMPUTED VELOCITY	2.768	**FT/S**		
LENGTH	911.59	**FT**		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	**Adjusted**	**NRCS Method**	**Selected**
WATERSHED NUMBER	**Ash Storage B**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	1.22	1.22
SHALLOW CONCENTRATED FLOW			5.80	5.80
CHANNEL FLOW			5.49	5.49
TOTAL			12.52	12.52
			Lag (Hrs) =	**0.13**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**7.51**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Bottom Ash	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.020	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	627.21	**FT**
SLOPE	0.010	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	1.578	

$$T_2 = \frac{L}{60 \times V}$$

984.648438

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**Bottom Ash**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	1.34	1.34
SHALLOW CONCENTRATED FLOW			6.62	6.62
TOTAL			7.96	7.96
			Lag (Hrs) =	**0.08**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**4.78**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Power Plant	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	FT.	MAX 100'
2 YR. 24 HOUR PRECIP	4.31	IN.	
SLOPE	0.020	FT/FT	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	558.86	FT
SLOPE	0.036	FT/FT
COMPUTED VELOCITY FROM FIGURE 3.1=	3.052	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	7
XSECT AREA=	8.000	SQ FT	BOTTOM	1
			DEPTH	2
WETTED PERIMETER	8.211	FT		
SLOPE	0.016	FT/FT		
MANNINGS N	0.05			
COMPUTED VELOCITY	3.720	FT/S		
LENGTH	2169.79	FT		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted Tc (Min)	NRCS Method Tc (Min)	Selected Tc (Min)
WATERSHED NUMBER	Power Plant			
SHEET FLOW	Max 30 Min	30.0	18.50	18.50
SHALLOW CONCENTRATED FLOW			3.05	3.05
CHANNEL FLOW			9.72	9.72
TOTAL			31.28	31.28
			Lag (Hrs) =	0.31

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	18.77

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Primary	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.020	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	2757.28	**FT**
SLOPE	0.009	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	1.536	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	10
XSECT AREA=	18.000	**SQ FT**	**BOTTOM**	2
			DEPTH	3
WETTED PERIMETER	12.000	**FT**		
SLOPE	0.010	**FT/FT**		
MANNINGS N	0.07			
COMPUTED VELOCITY	2.800	**FT/S**		
LENGTH	1984.65	**FT**		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**Primary**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	18.50	18.50
SHALLOW CONCENTRATED FLOW			29.91	29.91
CHANNEL FLOW			11.81	11.81
TOTAL			60.23	60.23
			Lag (Hrs) =	**0.60**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**36.14**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Secondary	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.150	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	599.56	**FT**
SLOPE	0.036	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	3.070	

$$T_2 = \frac{L}{60 \times V}$$

	Conditions	Adjusted Tc (Min)	NRCS Method Tc (Min)	Selected Tc (Min)
WATERSHED NUMBER	**Secondary**			
SHEET FLOW	**Max 30 Min**	30.0	0.60	0.60
SHALLOW CONCENTRATED FLOW			3.26	3.26
TOTAL			3.85	3.85
			Lag (Hrs) =	**0.04**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**2.31**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	to Bottom Ash	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.050	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	763.95	**FT**
SLOPE	0.004	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	1.011	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	16
XSECT AREA=	20.000	**SQ FT**	**BOTTOM**	4
			DEPTH	2
WETTED PERIMETER	16.649	**FT**		
SLOPE	0.008	**FT/FT**		
MANNINGS N	0.05			
COMPUTED VELOCITY	3.001	**FT/S**		
LENGTH	377.81	**FT**		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

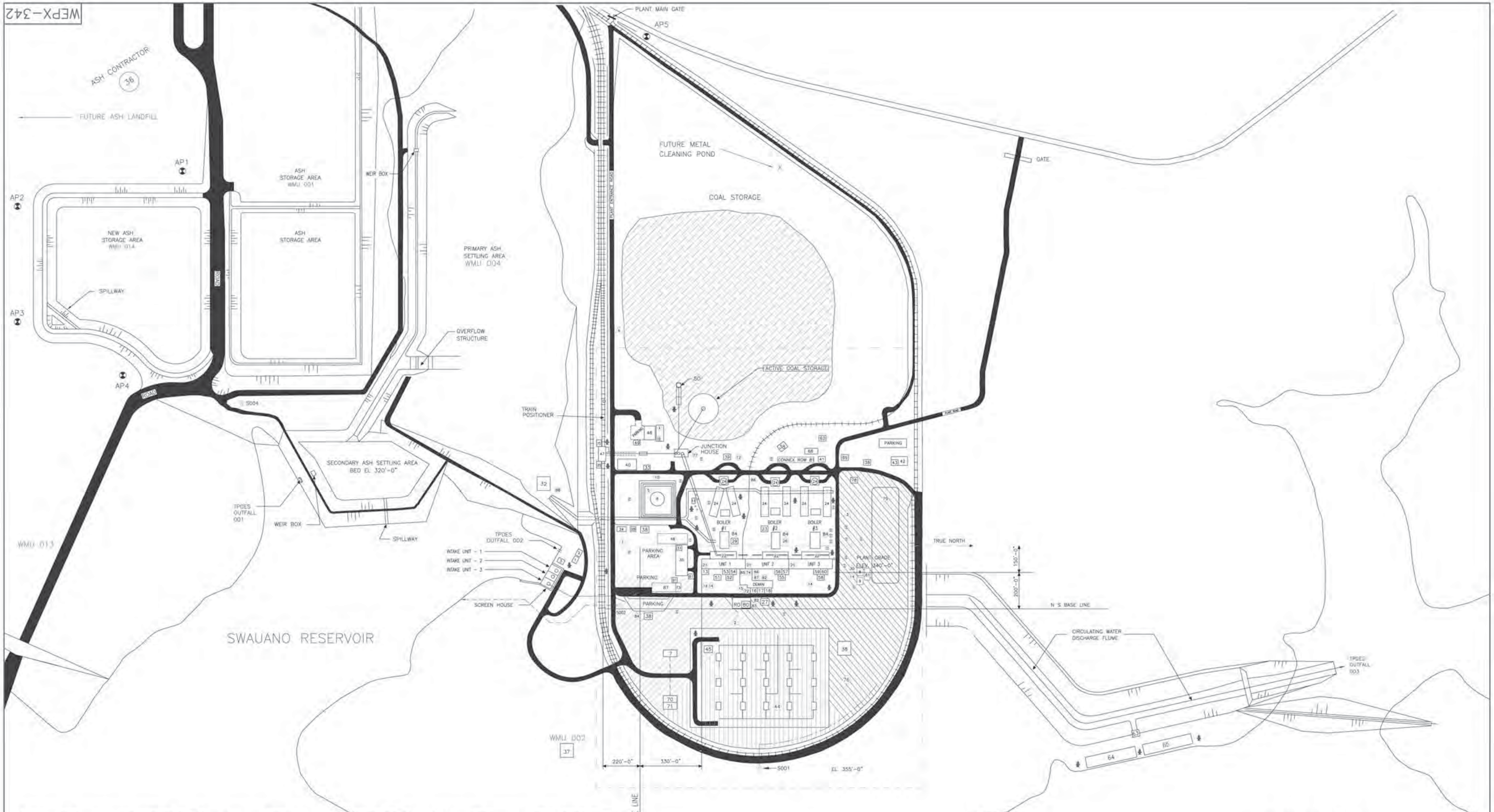
	Conditions	**Adjusted**	**NRCS Method**	**Selected**
WATERSHED NUMBER	**to Bottom Ash**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	12.83	12.83
SHALLOW CONCENTRATED FLOW			12.59	12.59
CHANNEL FLOW			2.10	2.10
TOTAL			27.52	27.52
			Lag (Hrs) =	**0.28**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**16.51**

Appendix C
Pertinent Drawings

WEPX-342



SWAUANO LAKE RESERVOIR
NORMAL POOL AL. 320'-0
LOW WATER EL. 314'-0
AREA = 1,365 ACRES

200' 0 200' 400'
GRAPHIC SCALE

ID	Description	Location	Size (Gallons)	SECONDARY CONTAINMENT (GALLONS)
1	Sewage Plant	Intake	N/A	N/A
2	Chlorine Building	W. of Intake	8 - 1 ton cylinders	NA
3	Emergency Fire Pump	Plant Intake	500	500
4	Tractor Shop Diesel Tanks	NW corner tractor shop	5,000 5,000	4,275
5	Used Oil Tank	Inside containment area of fuel oil tank	3,000	1,108,402*
6	#2 Fuel Oil Storage Tank	S of Unit #1 Precipitator	672,000	1,108,402*
7	Spare Transfo Runoff Containment	W. of Spare Transformer	NA	NA
8	Oil House	N. of Unit #2	Varies	Inside Bldg
9				
10	Fuel Oil Unloading Area	W of Fuel Oil Tank	NA	8,000
11	Ignitor Fuel Oil Pump Station	N. of Fuel Oil Tank	NA	2,000
12	Building Material storage	Varies	Varies	NA
13	Clean & Dirty Oil Tanks	E. of Unit #1	3 @ 11,500 1 @ 2,000	7,306
14	Demineralized Water Storage Tanks	NE Turbine Bldg. E. of Unit #1 and #3	Varies	NA
15	Filtered Water Tank	E. of Unit #1	70,000	NA
16	Caustic - Sodium Hydroxide	E. of Unit #2	15,000	3,100**
17	Sulfuric Acid	E. of Unit #2	15,000	3,000**
18	Caustic - Sodium Hydroxide	E. of Unit #3	5,000	1,575**
19	Tractor Lube Oil	In tractor tub containment North of tractor shop	5,300	4,275
20				
21	Turbine Oil Tanks	Inside Unit 1, 2 & 3 Turbine Buildings	Unit 1 - 7,050 Unit 2 - 7,050 Unit 3 - 7,000	Unit 1 - 1,750 Unit 2 - 1,750 Unit 3 - 1,750
22	Boiler Lube Oil Pulverizer Bays	Pulverizer Bay each unit	3 - 350	NA
23	Sodium Hypochlorite	Various Demin/RO	Totes 330 gal	NA
24	Precipitators & Fly Ash Silos	W. of Boilers #1, #2 & #3	Silos 10,000 tons each	NA
25	Car Dumper Hydraulic System	E. side of Dumper House	210	530

* The fuel oil and used oil tanks are located in a common diked area.

** Acid & Caustic tanks have small separate containments that join on large containment (12,000 gal)

ID	Description	Location	Size (Gallons)	SECONDARY CONTAINMENT (GALLONS)
26	CO2 Tank	Unit #2 Boiler Elevator	14 Tons	NA
27	Chlorine Raw Water (Domestic)	E of Unit #2	6 - 1 ton cylinders	NA
28	CO2 Tank	W side of Main Parking Area	13 Tons	NA
29	CO2 Tank	Unit #1 Boiler Elevator	1 - 6 ton 1 - 6 ton	NA
30	Hydrogen Cylinders (14)	NE Unit #3	10 - 197,936 ft3 4 - 3,187 ft3	NA
31	Maintenance Shop	1st Floor Service Bldg	NA	NA
32	Ash Recovery System	NE corner of Primary Ash Pond	NA	NA
33	Unleaded Gasoline	N of #2 Warehouse	1,000	1,143
34	WMU Ecology Pit - 017	SW Corner of Main Parking Area	5,700 ft3	NA
35	Service Building	N of Main Parking Area	NA	NA
36	Ash Contractor			
37	WMU Landfill - 002	S of Service Building	NA	NA
38	Material Storage Area	Various	NA	NA
39	Wash Rack for Ash Trucks	W of Unit #1 Ash Silo	NA	NA
40	#2 Warehouse (WMU 003)	E. of Tractor Shop	NA	NA
41	#3 Warehouse	W. of Unit #3	NA	NA
42	WMU Quonset Hut - 009	NW of Unit #3	NA	NA
43	Asbestos Storage Area in Quonset Hut	Quonset Hut	Variable	NA
44	Switchyard 345 kV	S. of Unit #1	NA	NA
45	Switchyard Control House	S side Switchyard	NA	NA
46	Maintenance Building	W of Service Building	NA	NA
47	Car Dumper	S of Tractor Shop	NA	NA
48	Tractor Maintenance Building	NE of Coal Pile	NA	NA
49	Coal Yard Lube Oil Drum Storage	SE of Tractor Maint Bldg.	approx. 10-55 gal drums	Inside Bldg.
50	Reclaim Hopper	NW of Tractor Maint Bldg.	NA	NA
51	Reserve Auxiliary Transformer	East of Unit #1	7,000	Moat/Char
52	Main Power Transformer Unit #1	East of Unit #1	11,100	Moat/Char
53	Auxiliary A Transformer Unit #1	East of Unit #1	3,500	Moat/Char
54	Auxiliary B Transformer Unit #1	East of Unit #1	3,500	Moat/Char
55	Main Power Transformer Unit #2	East of Unit #2	18,200	Moat/Char
56	Auxiliary A Transformer Unit #2	East of Unit #2	5,772	Moat/Char

ID	Description	Location	Size (Gallons)	SECONDARY CONTAINMENT (GALLONS)
57	Auxiliary B Transformer Unit #2	East of Unit #2	5,772	Moat/Char
58	Main Power Transformer Unit #3	East of Unit #3	17,700	Moat/Char
59	Auxiliary A Transformer Unit #3	East of Unit #3	8,980	Moat/Char
60	Auxiliary B Transformer Unit #3	East of Unit #3	8,980	Moat/Char
61	Material Storage Warehouse	N. of Oil House		
62	WMU - Acid Pond 007	W of Unit RSD Building	Varies	NA
63	Cooling Tower Pump House	W. of Cooling Towers at discharge canal	NA	NA
64	Cooling Tower A	Discharge Canal	NA	NA
65	Cooling Tower B	Discharge Canal	NA	NA
66	Raw water tank	E of Unit #2	16,000	NA
67	Clearwell Tank	E of Unit #2	70,000	NA
68	Visitor Offices	W. of Unit #3	NA	NA
69	RSG Shop	NA	NA	NA
70	Spare Main Power Transformer	S. of Switchyard	15,036	Containment Runoff Pond
71	Spare Auxiliary Transformer	S. of Switchyard	4,380	Containment Runoff Pond
72	Bleach Tank	E. of Demin	9,930 gal	6,335**
73	Laboratory	N. of Warehouse	NA	NA
74	HTH Powder	Inside Demineralizer	<125 lbs	NA
75	Positioner Truck Lock Hydraulic System	W. of Dumper House	NA	NA
76	WMU #022	N. of Switchyard	NA	NA
77	Dust Suppression	Coal yard	5,300	NA
78	RSG Office	N of #3 Silo	NA	NA
79	Material Storage	N of Turbine Bldg.	NA	NA
80	RO Bldg. & Chemical Storage	E. of Unit #2	NA	NA
81	Connex Row	S. of #3 Warehouse		
82	WMU - RO Reject Tank 020	N. of RO Bldg.	20,000	NA
83	Sulfuric Acid Tote	E. Wall RO Outside	330 gal	330
84	Drain Reservoir	U #1 U #2 U #3 Mobile	500 gal 500 gal 500 gal 500 gal	DWT DWT DWT DWT
85	Demineralizer	E. of Unit #2	NA	NA
86	RO Reject Box WMU 012			
87	Warehouse			
88	Nalco Petersen			
89	WMU 021			
90	1500 KVA Transformer	NE of Service Building	329	373
91	1500 KVA Transformer	W of Warehouse	330	373
92	FP Tank (WMU 011)	S of unit #2	21,300	NA

MWO 007 Temporary Storage Frac Tanks
MWO 018 RCRA Exempt
MWO 019 Temporary Tank

STORM WATER OUTFALLS
▨ S001
▨ S002
▨ S004

- ■ PLANT ROAD
- FIRE HYDRANT
- ① EVACUATION AREA
- ② EVACUATION AREA
- ③ EVACUATION AREA
- ④ EVACUATION AREA
- MONITORING WELLS
- ASH POND MONITORING WELLS

SWAUANO RESERVOIR

REV	DESCRIPTION	DATE	DR	BY	APP
8	CONFORMS TO CONSTRUCTION RECORDS	5/2/07	ML		JM
10	FUTURE SITE AREAS	6/2/10	ML		MD
9	CONFORMS TO CONSTRUCTION RECORDS	9/25/08	ML		JM

SPCC & STORM WATER SITE PLAN
WELSH POWER PLANT
PITTSBURG, TEXAS

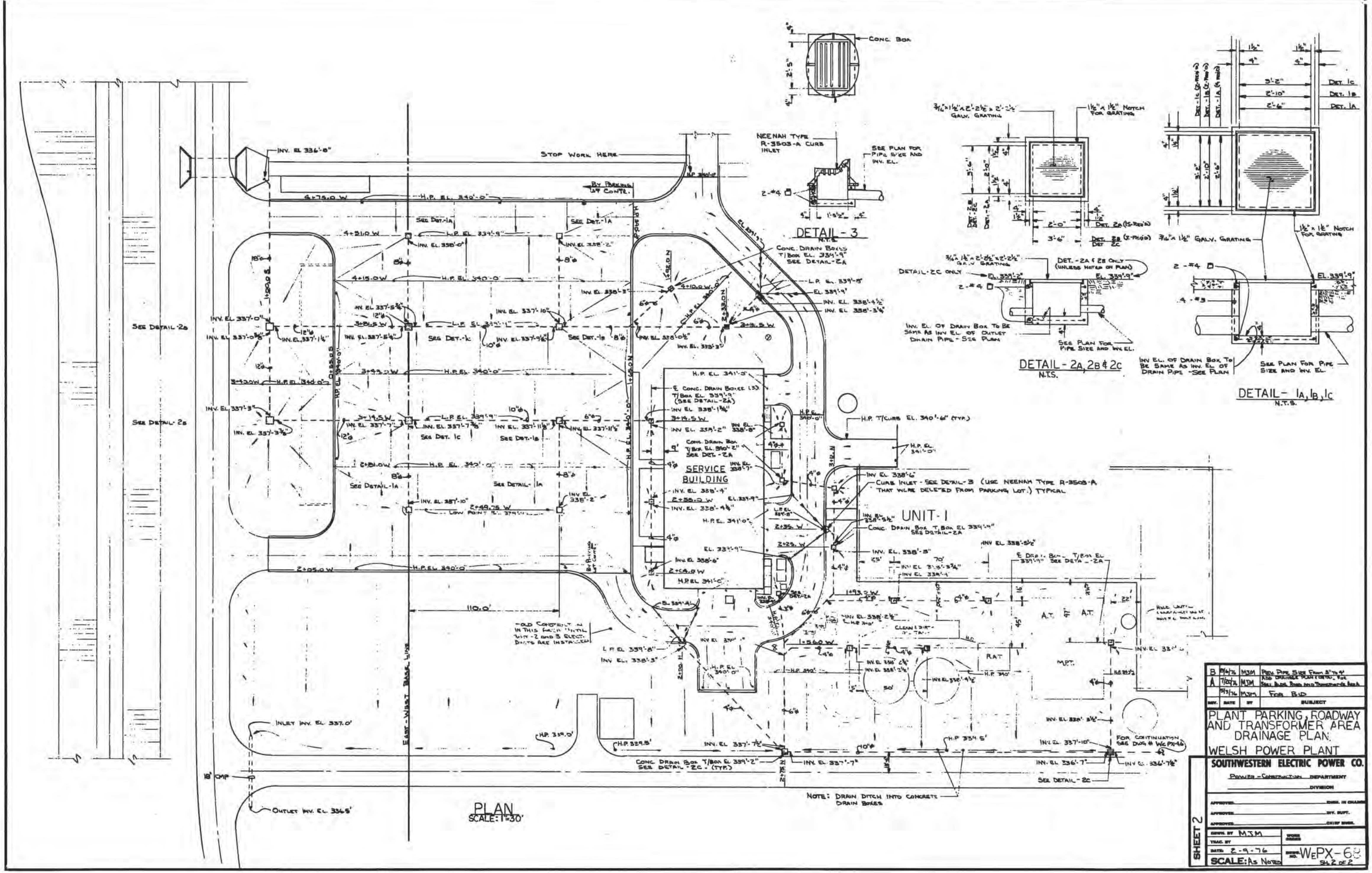
SOUTHWESTERN ELECTRIC POWER

DRAFTING/ENGINEERING	DATE	SCALE: 1
DFT. M. LONG	9/19/00	
ENG.		
APP. J. MEYER	9/19/00	

AEP

DWG. NO. WEPX-342
REV. No. 10
SHT.

J:\CAD\Region V - SWEPCO\WELSH\Internal Drawings\Common\WEPX Drawings\WEPX-342.dwg, 09/25/08 (2(4)



B	8/6/76	MJM	REV. PIPE SIZE FROM 5" TO 4"
A	7/20/76	MJM	ADD DRAINAGE PLAN & DETAIL FOR SERV. BLDG. ROAD AND TRANSFORMER AREA
	5/3/76	MJM	FOR BID
REV.	DATE	BY	SUBJECT

PLANT PARKING, ROADWAY AND TRANSFORMER AREA DRAINAGE PLAN:

WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

POWER - CONSTRUCTION DEPARTMENT

DIVISION

APPROVED ENGR. IN CHARGE

APPROVED DIV. SUPT.

APPROVED CHIEF ENGR.

SHEET 2

DRWN. BY MJM

TRAC. BY

DATE 2-9-76

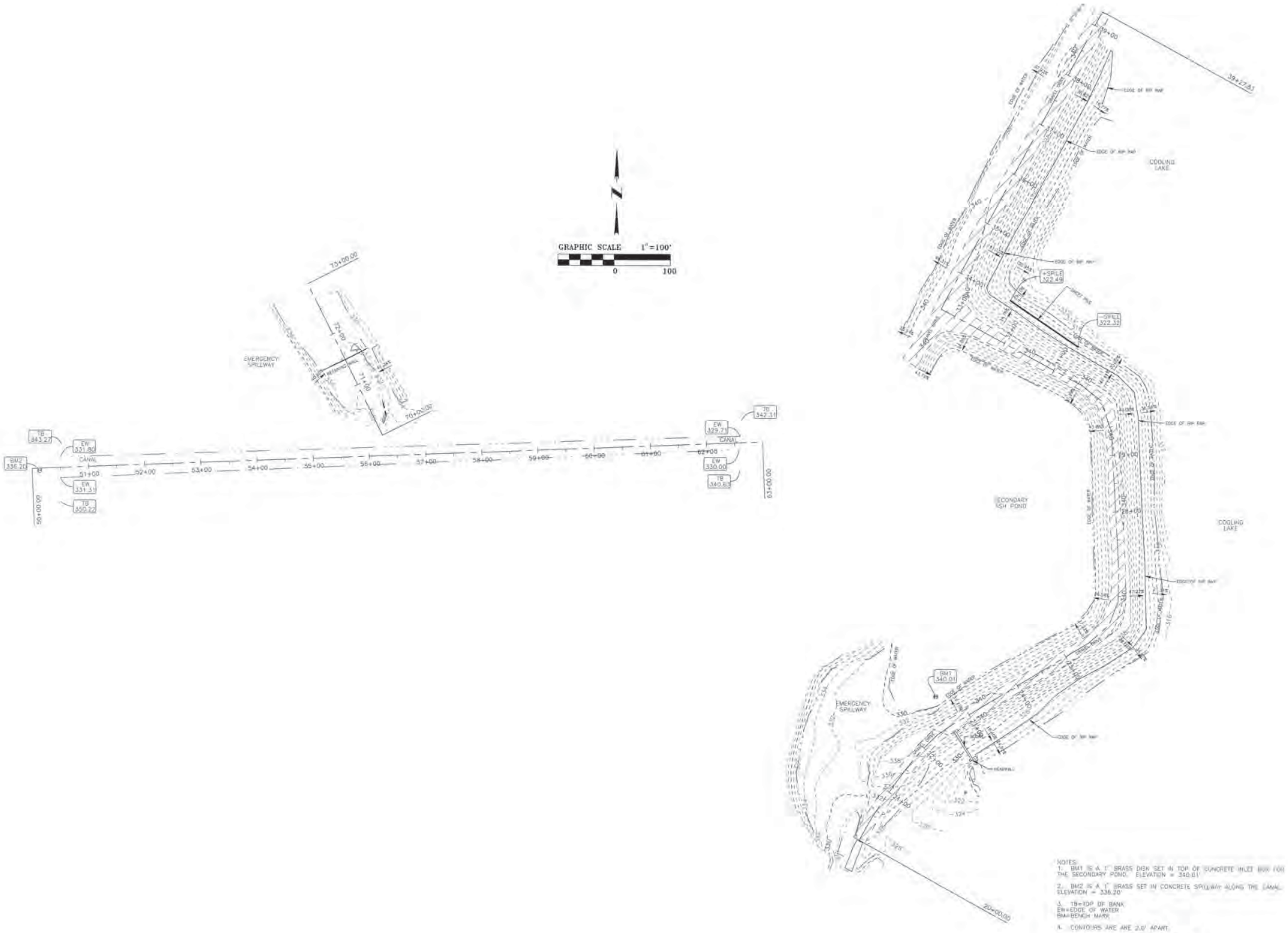
SCALE: As Noted

WORK ORDER

DRWG. NO. WEPX-68

SH. 2 OF 2

FILE



NOTES:
1. BM1 IS A 1" BRASS DISK SET IN TOP OF CONCRETE INLET BOX FOR THE SECONDARY POND. ELEVATION = 340.01'

2. BM2 IS A 1" BRASS SET IN CONCRETE SPILLWAY ALONG THE CANAL. ELEVATION = 336.20'

3. TB=TOP OF BANK
EW=EDGE OF WATER
BM=BENCH MARK

4. CONTOURS ARE ARE 2.0' APART.

5. LAKE ELEVATION PER WELSH POWER PLANT ON NOVEMBER 18, 2010 WAS 317.57 FEET MSL.

SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON NOVEMBER 18, 2010, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: NOVEMBER 23, 2010
REVISED: DECEMBER 6, 2010

MIKE GARDNER
#5760

TOPOGRAPHIC SURVEY

DIKE'S AT WELSH POWER PLANT
FOR: GREG CARTER

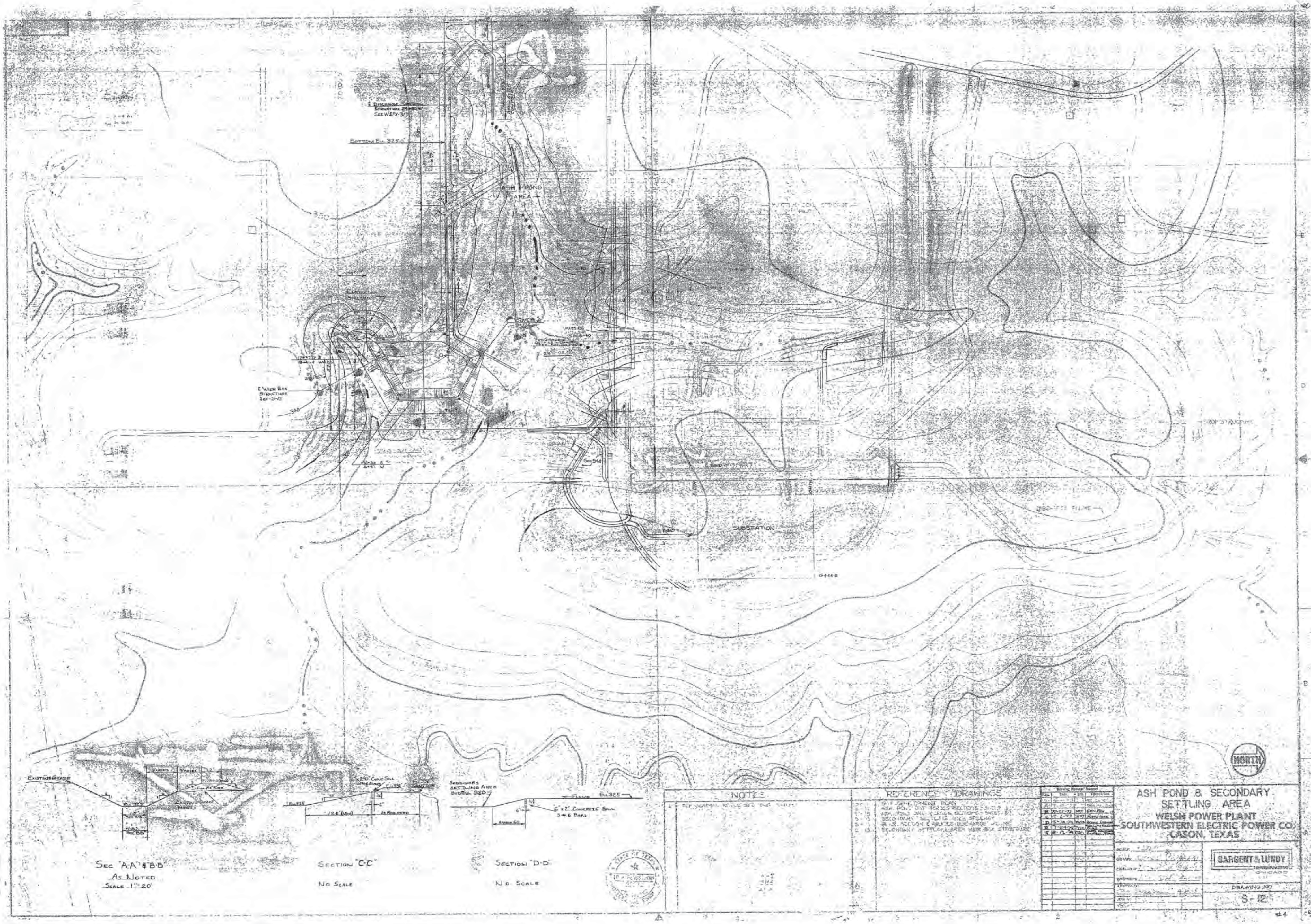
Date	Revision/Description
12/6/10	ADDED LAKE LEVEL NOTE
12/6/10	ADDED CROSS SECTION SHEETS

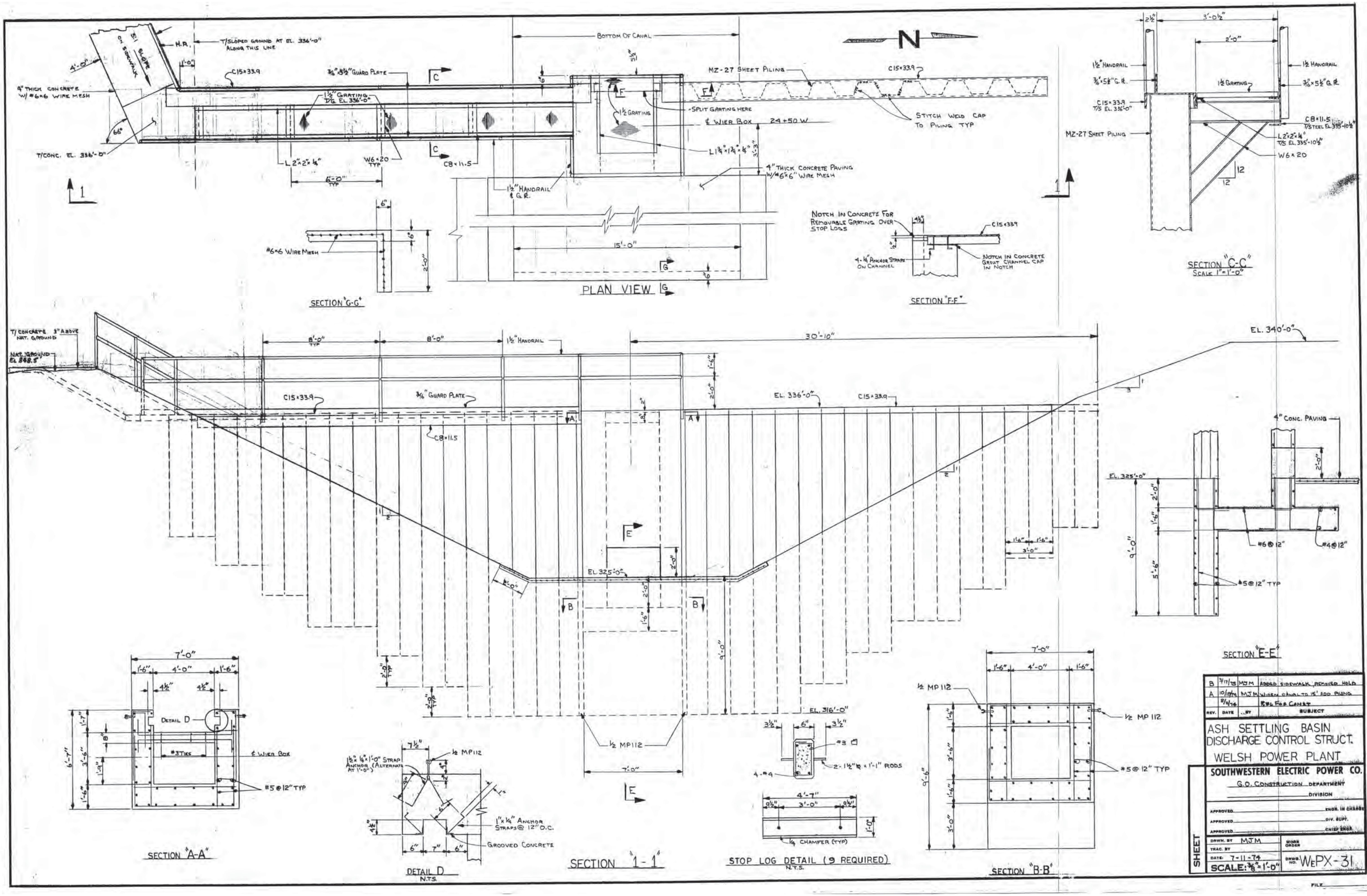
Drawn By	Checked By	Project No.	Dwg. Date
MG	DW	104021	11/19/10

MTG engineers & surveyors
5930 SUMMERHILL RD. P.O. BOX 3786
TEXARKANA TEXAS 75501
P 903.838.8533 | F 903.832.4700
www.mtgengineers.com

TBPE NO. 354

File No.
Sheet No. 1


ℰ DISCHARGE STRUCT.
SEE WEPX-31
BOTTOM EL. 325.0
ASH POND AREA
ℰ WEIR BOX STRUCTURE SEE S-13
340
SUBSTATION
DROP STRUCTURE
DISCHARGE FLUME
ROAD
EXISTING GRADE
VARIES
6"x2" CONC. SILL
SECONDARY SETTLING AREA BOTTOM EL. 320
FLUME EL. 325
6"x2" CONCRETE SILL 3-#6 BARS
As Required
Sec "A-A" & "B-B"
As Noted
Scale 1"=20'
Section "C-C"
No Scale
Section "D-D"
No Scale
NORTH
NOTES
REFERENCE DRAWINGS
SITE DEVELOPMENT PLAN
ASH POND DIKE CROSS SECTIONS - SHEET 1
ASH POND DIKE CROSS SECTIONS - SHEET 2
SECONDARY SETTLING AREA SPILLWAY
WEIR SECTION & SLUICE DISCHARGE FLUME
SECONDARY SETTLING AREA WEIR BOX STRUCTURE
ASH POND & SECONDARY SETTLING AREA
WELSH POWER PLANT
SOUTHWESTERN ELECTRIC POWER CO.
CASON, TEXAS
SARGENT & LUNDY
ENGINEERS
CHICAGO
DRAWING NO.
S-12



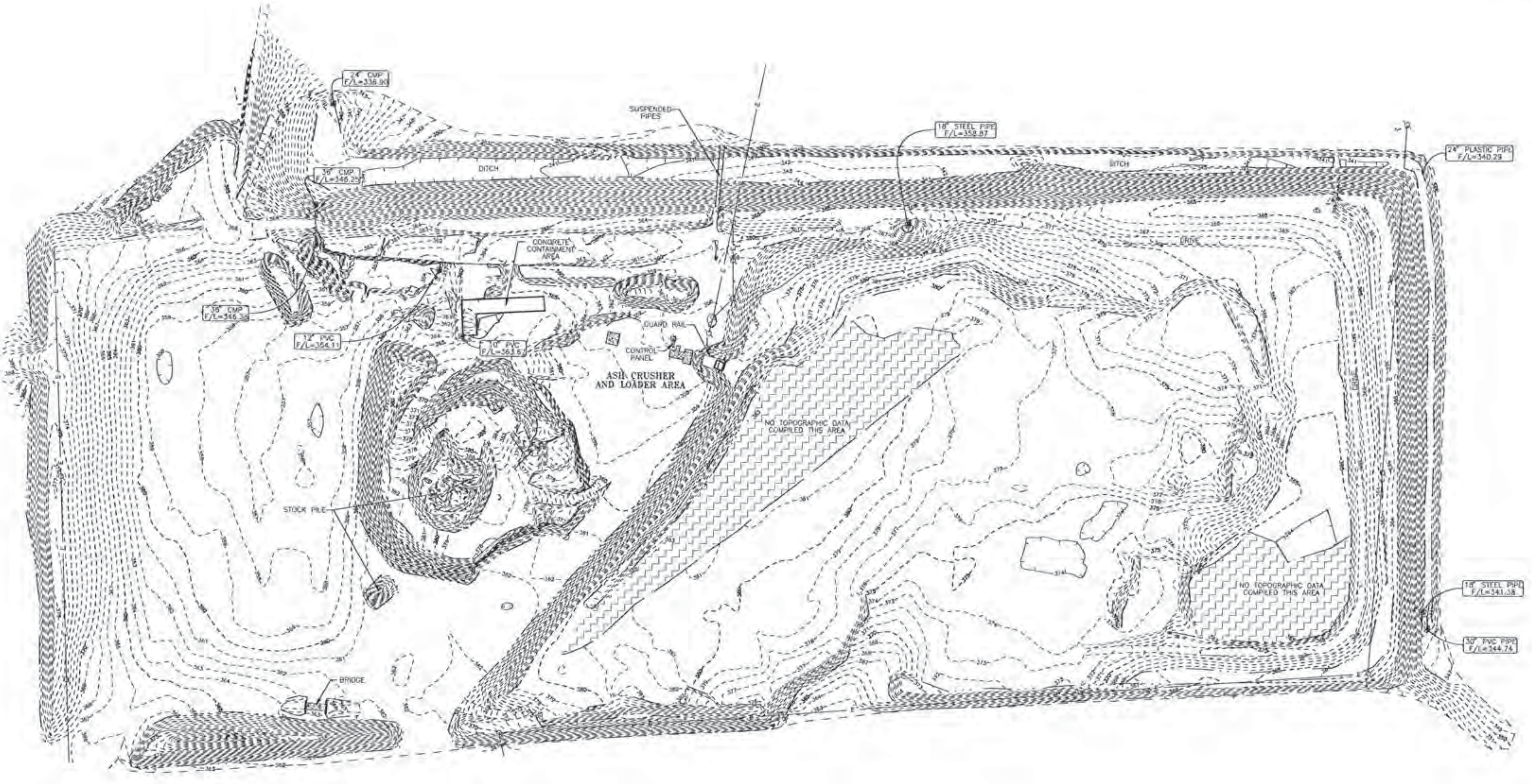
REV.	DATE	BY	SUBJECT
B	3/17/75	MJM	ADDED SIDEWALK, REMOVED HOLD
A	10/18/74	MJM	WIDEN CANAL TO 15' ADD PILING
	8/2/74		REL FOR CONST

ASH SETTLING BASIN
DISCHARGE CONTROL STRUCT.
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.
G.O. CONSTRUCTION DEPARTMENT
DIVISION

APPROVED ENGR. IN CHARGE
APPROVED DIV. SUPT.
APPROVED CHIEF ENGR.

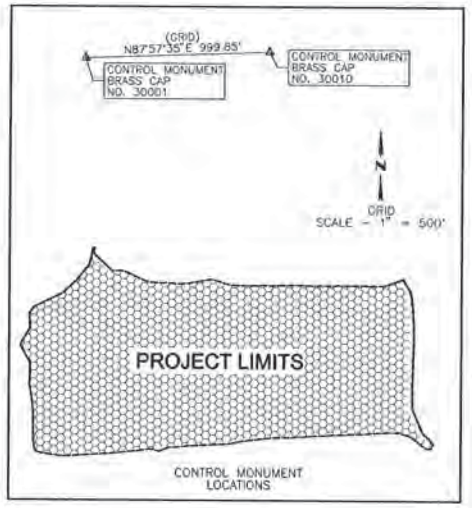
DRWN. BY MJM
TRAC. BY
DATE: 7-11-74
SCALE: 3/8"=1'-0"
WORK ORDER
DRWG. NO. WEPX-31
SHEET
FILE



N
GRID
GRAPHIC SCALE 1" =100'
0 100

LEGEND

—— E ——	OVERHEAD ELECTRIC LINE
- - - - - -	TOP OF BANK / SLOPE
—— - - - ——	TOE OF SLOPE / BANK
- - - - - - - -	PIPING
- - - - - - - -	EDGE OF DRIVE
— — — — —	EDGE OF GRAVEL
- - - 369 - - -	1.0' CONTOUR INTERVAL
- - - 370 - - -	5.0' CONTOUR INTERVAL
⌑	POWER POLE
▣	PIPE LOCATION
⊥	GUY WIRE
△	CONTROL MONUMENT
⊕	LIGHT POLE
▩	CONCRETE SURFACE
▨	AREA NOT SURVEYED



CONTROL MONUMENT LOCATIONS

THE BEARINGS ARE BASED ON GRID NORTH WITHIN THE "TEXAS COORDINATE SYSTEM OF 1983, NORTH CENTRAL ZONE", NAD83 (CORS96, EPOCH 2002.0), WITH A BEARING OF NORTH 87 DEGREES 57 MINUTES 35 SECONDS EAST. THE COMBINED SCALE FACTOR TO GO FROM GRID TO SURFACE IS 1.00012. THE FOLLOWING CONTROL MONUMENTS WERE USED TO ESTABLISH THE BASIS OF BEARINGS:

CONTROL MONUMENT NO. 30001	CONTROL MONUMENT NO. 30010
N-7085417.3416	N-7085452.9387
E-3087023.3084	E-3088022.5268

MIKE GARDNER
5760

SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON DECEMBER 14, 2009, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: DECEMBER 17, 2009

TOPOGRAPHIC SURVEY

ASH STORAGE AREA
WELSH POWER PLANT
FOR: AEP

Date	Revision/Description

Drawn By	Checked By	Project No.	Dwg. Date
J.B.O.	M.G.	094027	12-17-09

MTG engineers & surveyors
5930 SUMMERHILL RD. | P.O. BOX 3786
TEXARKANA TEXAS 75501
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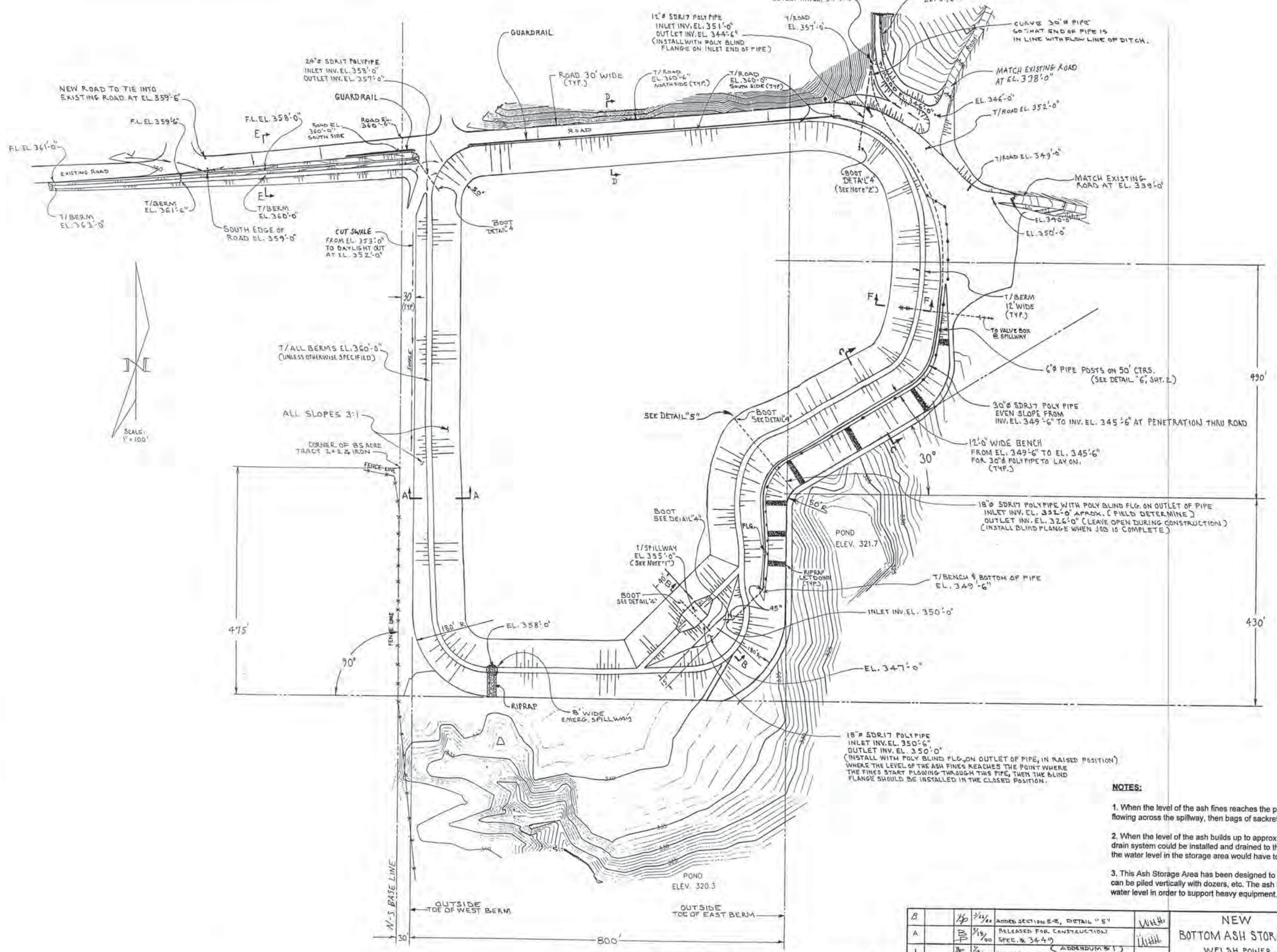
www.mtgengineers.com

TBPE NO. 354

File No.	Sheet No.

X:\2009 Projects\094027 TOPO AT WELSH POWER PLANT – GREG CARTER\MERGE TOPO G.dwg
Thu Dec 17, 2009 10:13AM



NOTES:

1. When the level of the ash fines reaches the point where the fines start flowing across the spillway, then bags of sackrete can be installed to raise the spillway elevation.

2. When the level of the ash builds up to approx. elev. 355 along the north and east sides, a french drain system could be installed and drained to this outlet to help hold the water table down. Of course the water level in the storage area would have to be at elev. 351 or above for the french drain to function.

3. This Ash Storage Area has been designed to hold the water level as low as possible so the ash can be piled vertically with dozers, etc. The ash level needs to be approx. 4 ft. to 5 ft. above the water level in order to support heavy equipment.

REV.	W.O.	BY	DATE	SUBJECT	APPROVED
C		BP	10-29-00	AS BUILT	

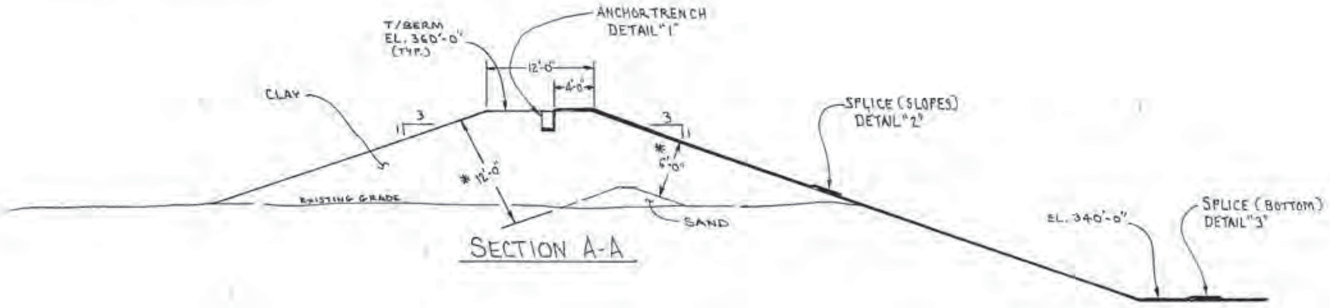
REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	7/21/00	ADDED SECTION E-E, DETAIL "5"	WHH
A		BP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHH
1		BP	4/13/00	RELEASED FOR BIDS SPEC. # 3449 (ADDENDUM # 1)	
		BP	3-10-00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

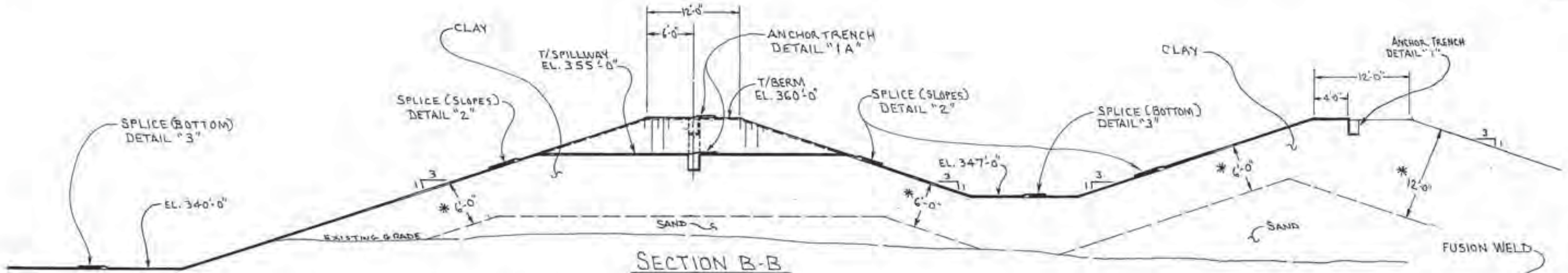
SOUTHWESTERN ELECTRIC POWER CO.

DEPT.	
DIV.	
APPROVED	
DRWN. BY: BP	DATE: 3-10-00
SCALE: 1"=100'	W.O.
SH. 1 of 2	DRWG. NO. WEPX-335

✱ - NOTE- THESE DIMENSIONS ARE SUBJECT TO ADJUSTMENT DEPENDING ON THE SAND / CLAY BALANCE VS. HAUL DISTANCE ON PROJECT.



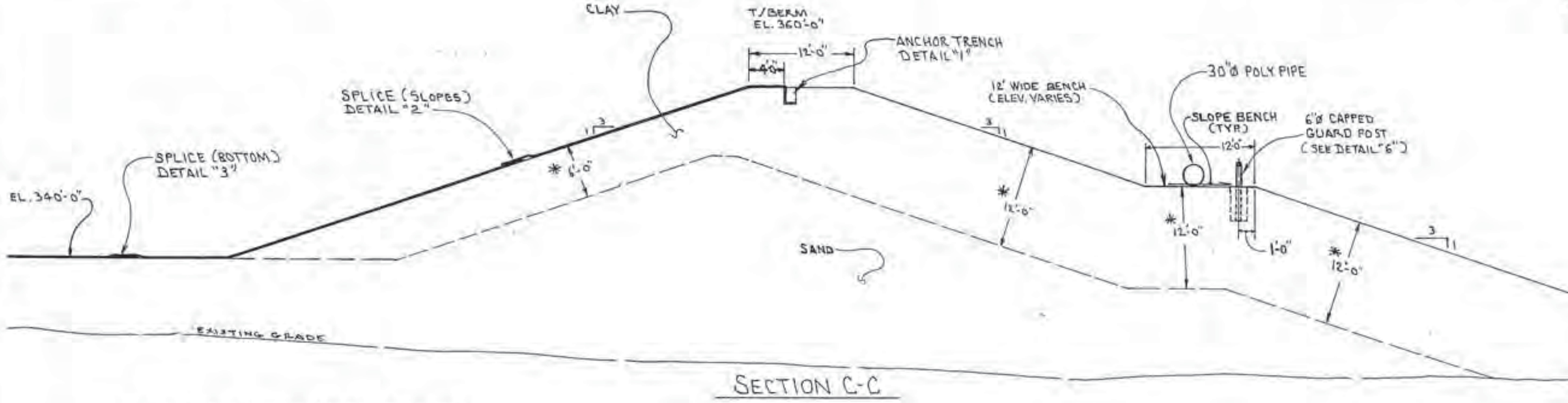
SECTION A-A



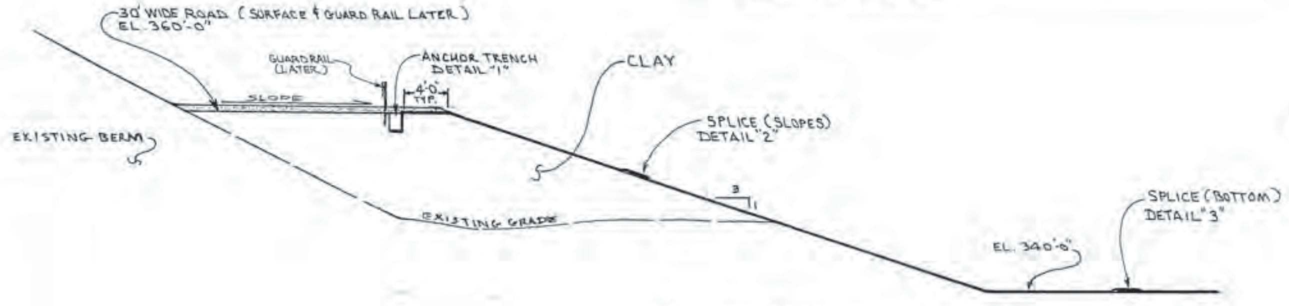
SECTION B-B

DETAIL "2"

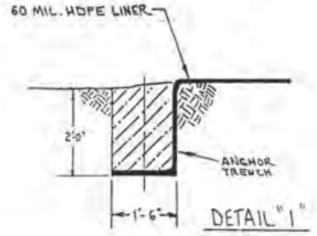
LOCATIONS & QUANTITIES DETERMINED IN FIELD



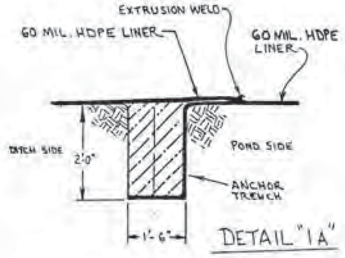
SECTION C-C



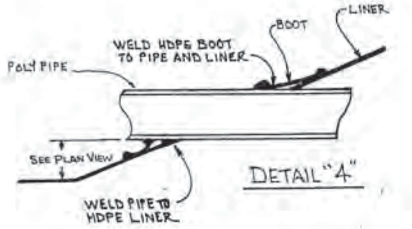
SECTION D-D



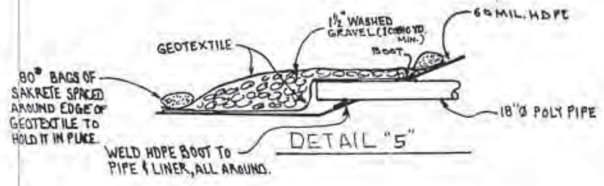
DETAIL "1"



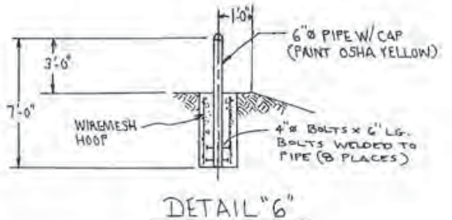
DETAIL "1A"



DETAIL "4"

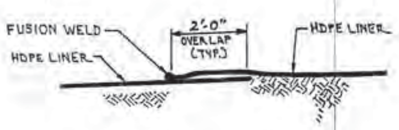


DETAIL "5"



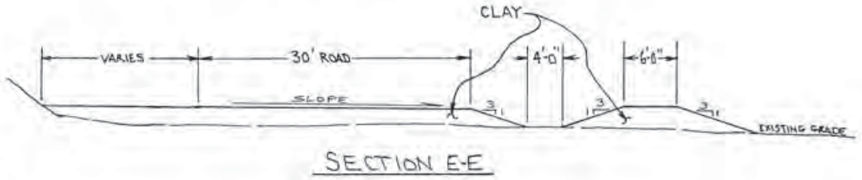
DETAIL "6"

50' ON CENTERS
(20 REQUIRED)

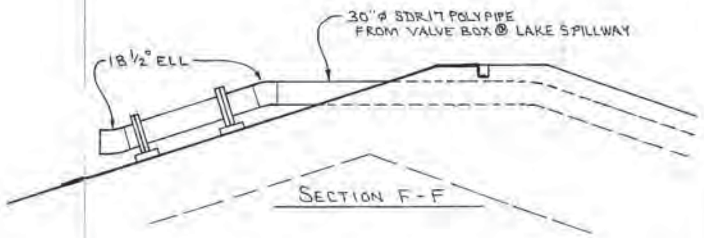


DETAIL "3"

LOCATIONS & QUANTITIES DETERMINED IN FIELD



SECTION E-E



SECTION F-F

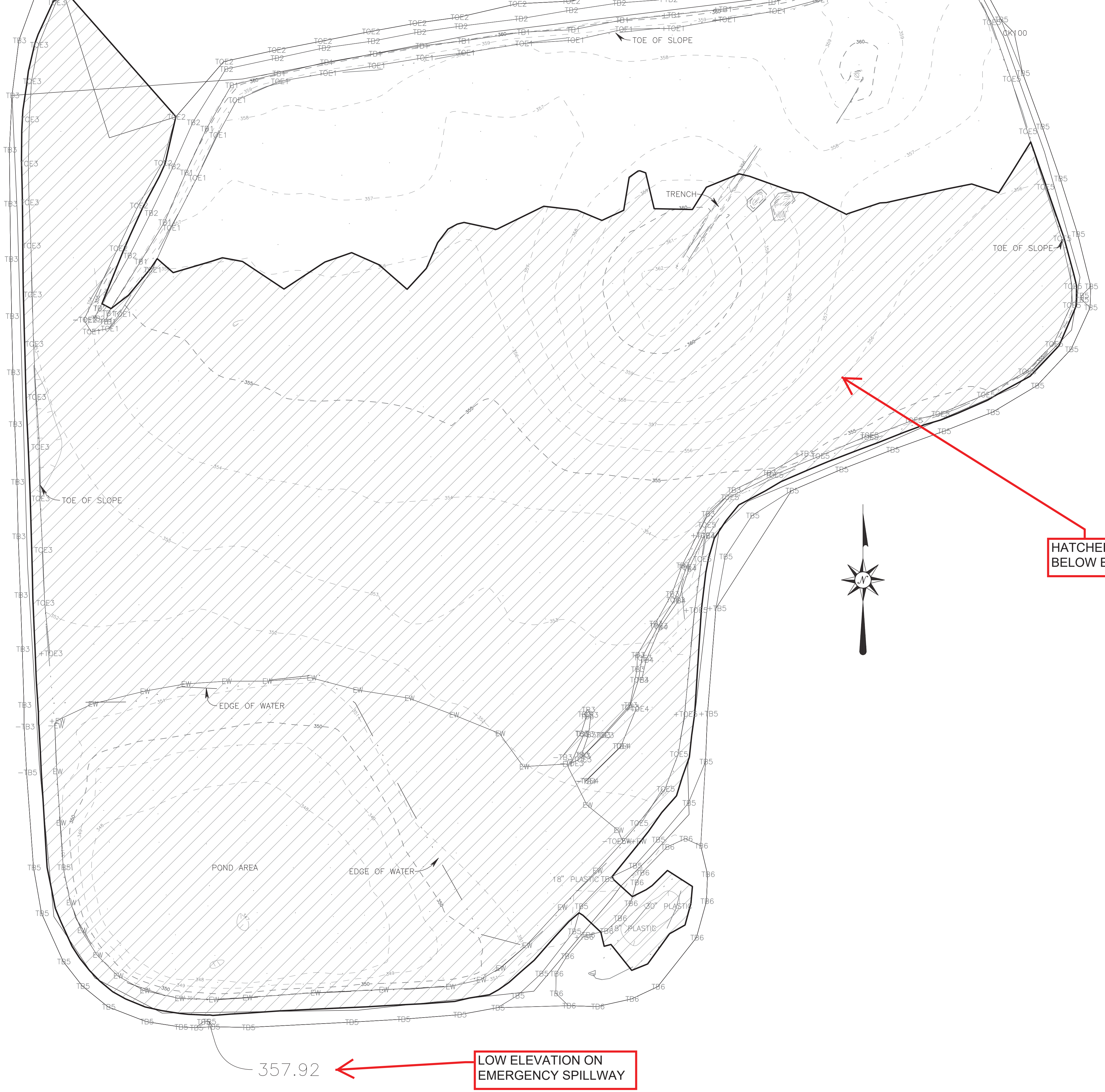
REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	10/29/00	AS BUILT	
A		AP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHA
1		BP	3/31/00	(ADDENDUM #1) RELEASED FOR BIDS SPEC. # 3449	
		BP	3/10/00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

DEPT.
DIV.
APPROVED
DRWN. BY: BP
DATE: 3-10-00
SCALE: AS SHOWN
W.O.
SH. 2 of 2
DRWG. NO. WEPX- 335

```
                         SURFACE TO DATUM VOLUME REPORT

Murray, Thomas & Griffin, Inc.
P.O. Box 3786
Texarkana, TX 75501
903-838-8533

Project:              X:\2009 Projects\094025 ASH POND TOPO WELSH - GREG CARTER\
                      VOLUME CALC 4-12-10.pro
Report Generated:                              Monday, April 12, 2010 9:22:04 AM
--------------------------------------------------------------------------------
Where the DTM surface is above the datum the volume is reported as fill.
Where the DTM surface is below the datum the volume is reported as excavation.
--------------------------------------------------------------------------------

Shrinkage/swell factors:     Excavation   1.0000             Fill   1.0000

DTM Surface                  Number        Datum
Layer Name                   of Points     Elevation
---------------------------  -----------   -----------
POINTS COMPOSITE                  632           355.92

Volume limited to that within the constraining boundary - Object  18228
Area within boundary: 600,437.78 SQ FT  (13.784 ACRES)
Total triangulated area: 594,973.58 SQ FT  (13.659 ACRES)

                          Elev Range         Cut Volume       Fill Volume
                                (ft)              (yd3)             (yd3)
      ------------------------------   ----------------  ----------------
                     346.13 > 346.92              213.3               0.0
                     346.92 > 347.92            1,674.4               0.0
                     347.92 > 348.92            2,922.6               0.0
                     348.92 > 349.92            3,724.2               0.0
                     349.92 > 350.92            4,444.3               0.0
                     350.92 > 351.92            5,674.4               0.0
                     351.92 > 352.92            7,552.1               0.0
                     352.92 > 353.92           10,632.0               0.0
                     353.92 > 354.92           14,916.3               0.0
                     354.92 > 355.92           19,411.2               0.0
                     355.92 > 355.94                0.0               0.0


Excavation Volume                          Fill Volume
Beneath Datum (yd3)                        Above Datum(yd3)
-----------------------------------        ---------------------------------
                  71,164.9                                      0.0

Net Difference: 71,164.9 yd3 excess volume beneath datum
```



HATCHED AREA IS THE PORTION BELOW ELEVATION 355.92

LOW ELEVATION ON EMERGENCY SPILLWAY

ASH POND VOLUME BELOW ELEVATION 355.92

ATTACHMENT B

2021 Hydraulic Analysis

Of

Welsh Power Plant Ash Ponds

Welsh Plant
2021 H&H Analysis for Ash Pond Systems
(Utilized F&N Model from the 2010 H&H Analysis)
(Performed on 9/28/2021)

HMS Version: 4.8
Executed: 28 September 2021, 16:27

Global Parameter Summary - Subbasin

Area (ft²)

Element Name	Area (ft²)
Primary	0.37
Power Plant	0.18
Bottom Ash	0.03
To Bottom Ash	0.03
Ash Storage B	0.02
Ash Storage A	0.03
Secondary	0.03

Downstream

Element Name	Downstream
Primary	Primary Pond
Power Plant	Primary Pond
Bottom Ash	Bottom Ash Pond
To Bottom Ash	Bottom Ash Pond
Ash Storage B	Reach - 2
Ash Storage A	Ash Culvert
Secondary	Secondary Pond

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number
Primary	0	76
Power Plant	0	85.3
Bottom Ash	0	91
To Bottom Ash	0	77.8
Ash Storage B	0	87.1
Ash Storage A	0	87.1
Secondary	0	82.7

Transform: Scs

Element Name	Lag	Unitgraph Type
Primary	36.14	Standard
Power Plant	18.77	Standard
Bottom Ash	4.78	Standard
To Bottom Ash	16.51	Standard
Ash Storage B	7.51	Standard
Ash Storage A	5.28	Standard
Secondary	2.31	Standard

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
Reach - 3	Reach - 2
Reach - 2	Ash Culvert
Reach - 1	Secondary Pond

Route: Muskingum Cunge

Element Name	Method	Channel	Length (ft)	Energy Slope	Mannings n	Bottom Width	Side Slope	Initial Variable	Space - Time Method	Index Parameter Type	Index Celerity	Invert Elevation	Maximum Depth Iterations	Maximum Route Step Iterations
Reach - 3	Muskingum Cunge	Circular	1460	0	0.01	Not Specified	Not Specified	Combined Inflow	Automatic DX and DT	Index Celerity	5	350	20	30
Reach - 2	Muskingum Cunge	Trapezoid	1430	0	0.08	26.46	2	Combined Inflow	Automatic DX and DT	Index Celerity	5	341	20	30
Reach - 1	Muskingum Cunge	Trapezoid	1210	0	0.08	15	2.5	Combined Inflow	Automatic DX and DT	Index Celerity	5	325	20	30

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Primary	0.37	776.77	01Jan2000, 12:40	6.86
Power Plant	0.18	585.58	01Jan2000, 12:20	8.04
Bottom Ash	0.03	168.05	01Jan2000, 12:05	8.75
To Bottom Ash	0.03	96.13	01Jan2000, 12:20	7.09
Bottom Ash Pond	0.06	107.92	01Jan2000, 12:35	7.97
Reach - 3	0.06	107.22	01Jan2000, 12:40	7.96
Ash Storage B	0.02	111.2	01Jan2000, 12:10	8.27
Reach - 2	0.09	118.43	01Jan2000, 12:30	7.9
Ash Storage A	0.03	157.92	01Jan2000, 12:05	8.27
Ash Culvert	0.12	253.9	01Jan2000, 12:10	7.97
Primary Pond	0.67	60.6	01Jan2000, 13:20	2.71
Reach - 1	0.67	60.16	01Jan2000, 13:35	2.71
Secondary	0.03	139.43	01Jan2000, 12:05	7.71
Secondary Pond	0.7	597.6	01Jan2000, 13:40	7.23
BottomAsh_ES	0	0	31Dec1999, 24:00	Not specified

Subbasin: Primary

Area (ft²) : 0.37
Downstream : Primary Pond

Loss Rate: Scs

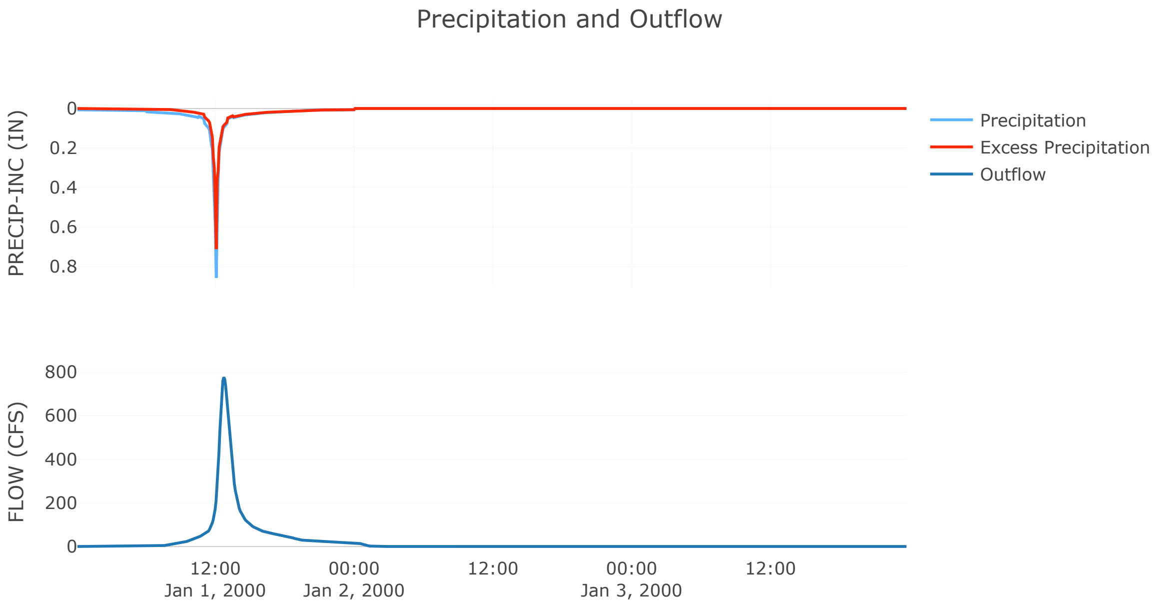
Percent Impervious Area	0
Curve Number	76

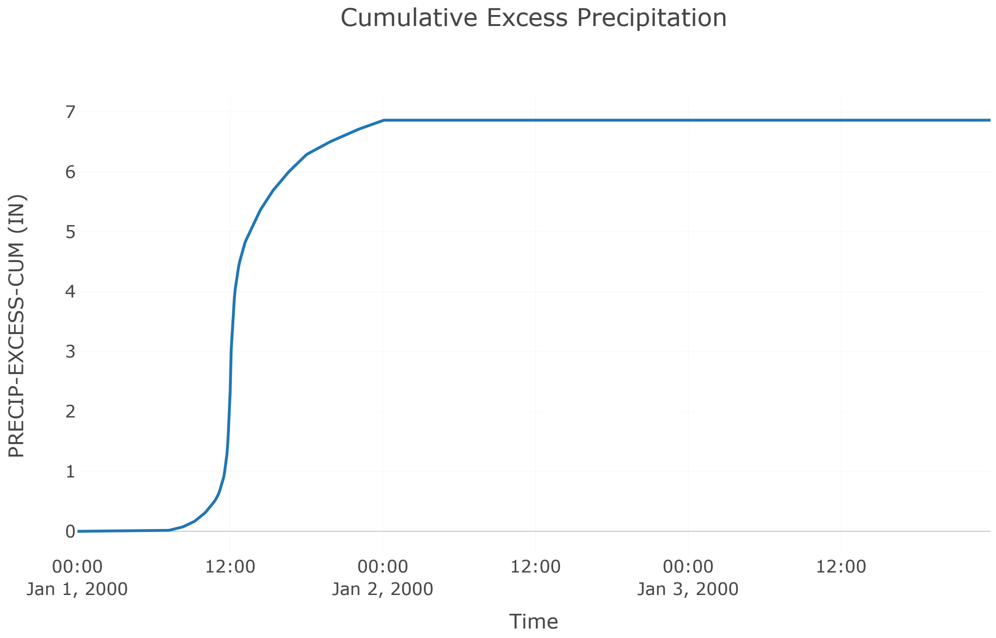
Transform: Scs

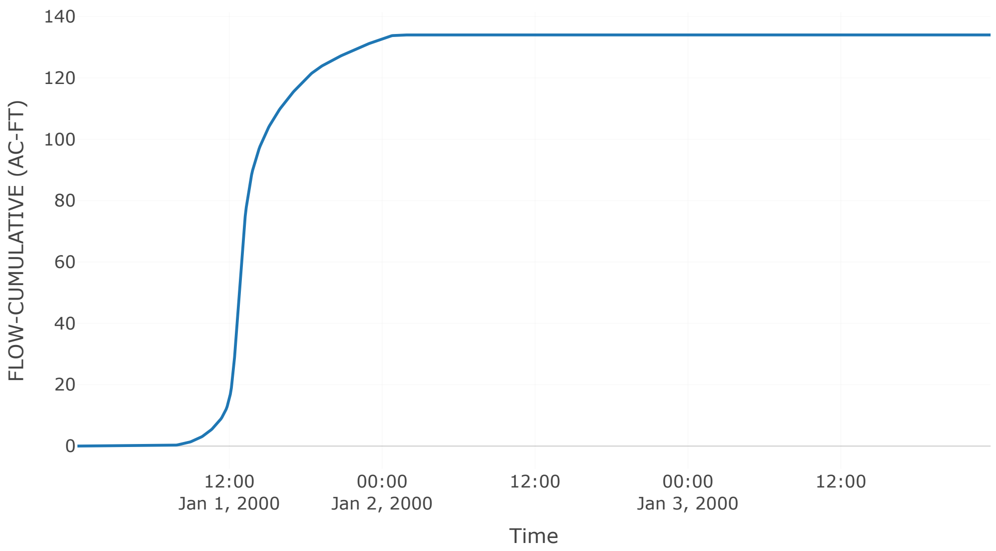
Lag	36.14
Unitgraph Type	Standard

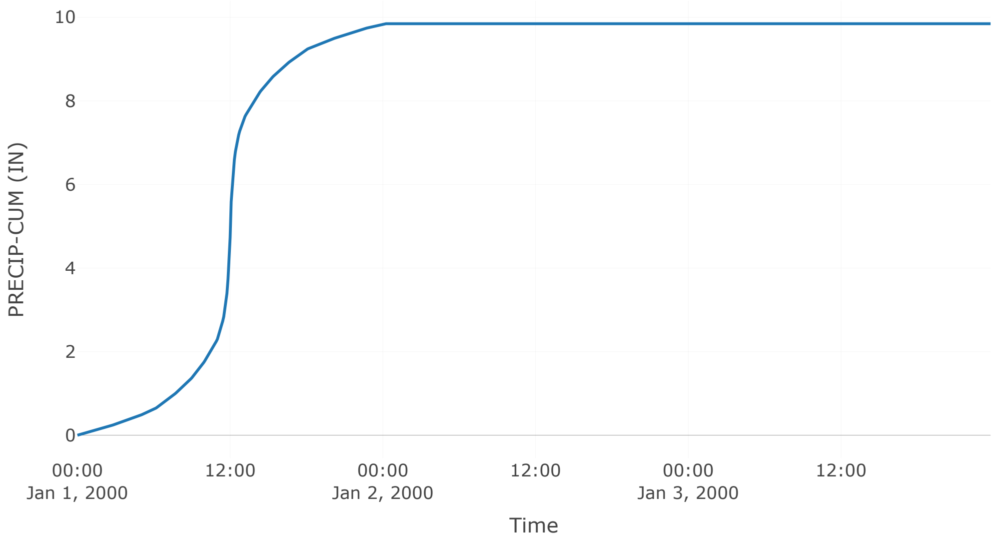
Results: Primary

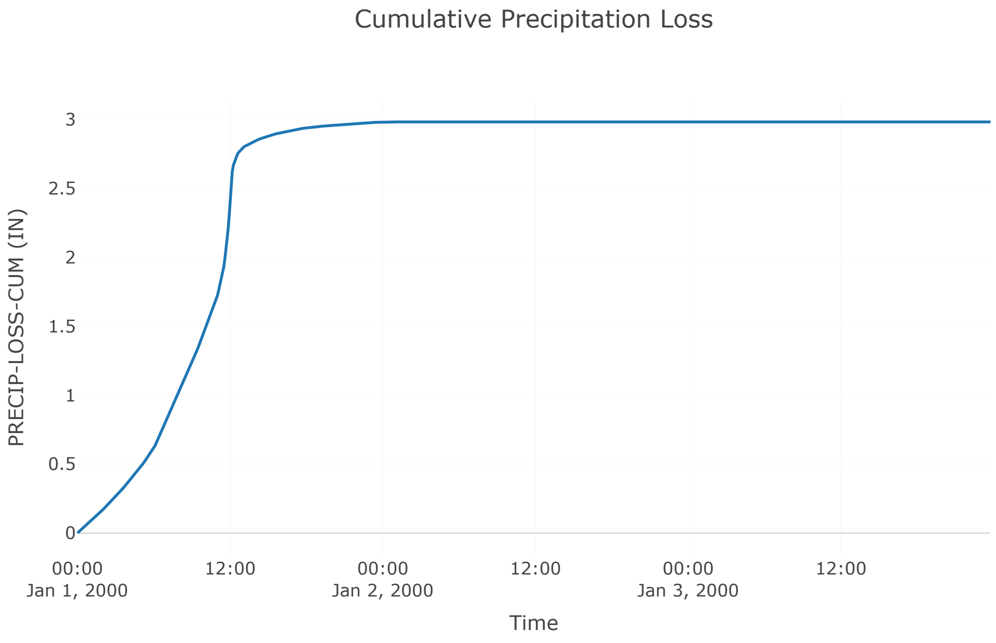
Peak Discharge (CFS)	776.77
Time of Peak Discharge	01Jan2000, 12:40
Volume (IN)	6.86
Precipitation Volume (AC - FT)	192.27
Loss Volume (AC - FT)	58.26
Excess Volume (AC - FT)	134
Direct Runoff Volume (AC - FT)	134
Baseflow Volume (AC - FT)	0

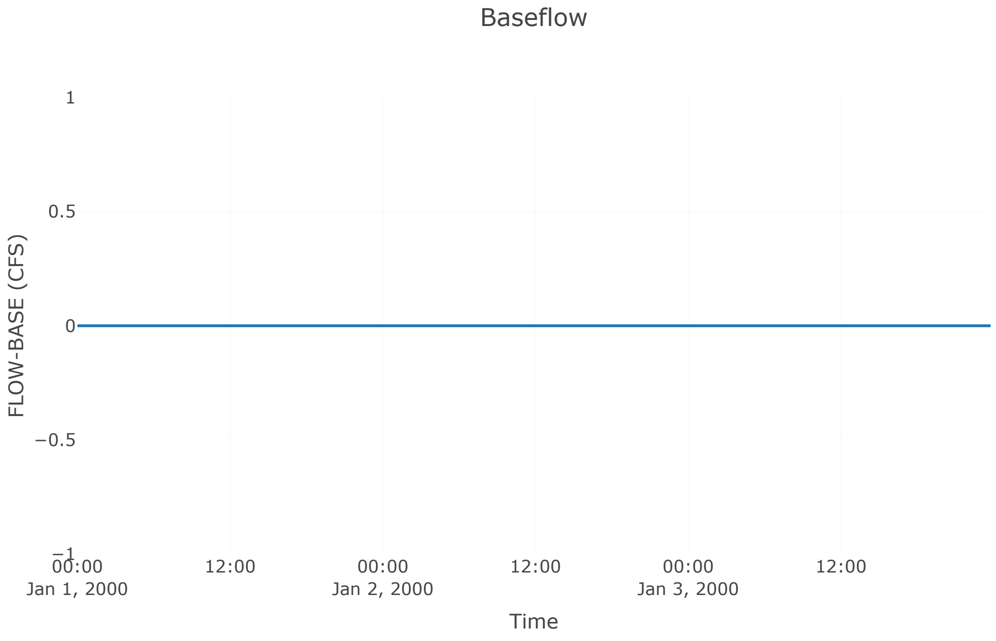

Precipitation and Outflow

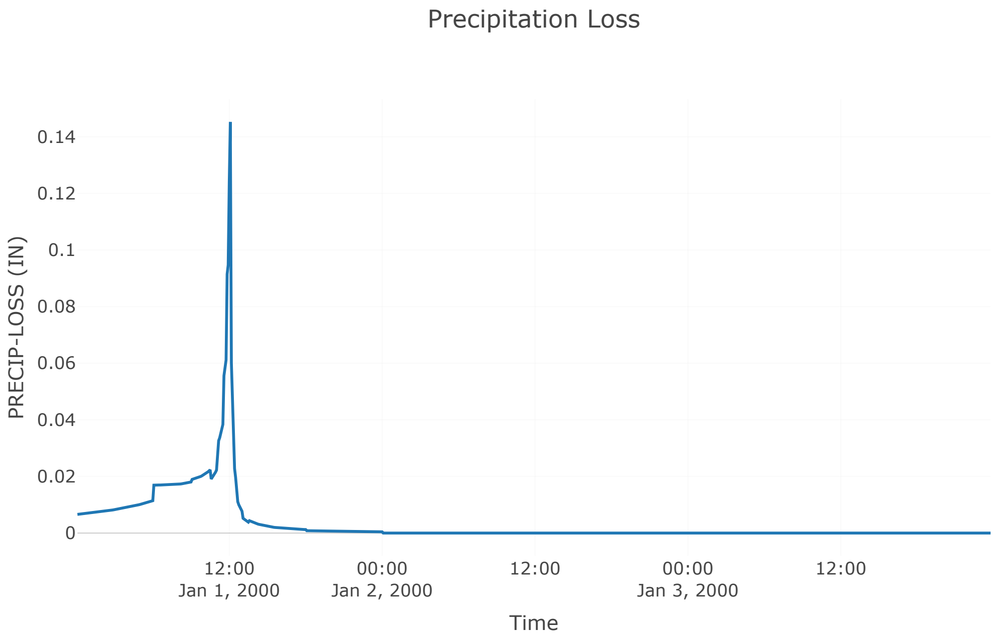

Cumulative Excess Precipitation

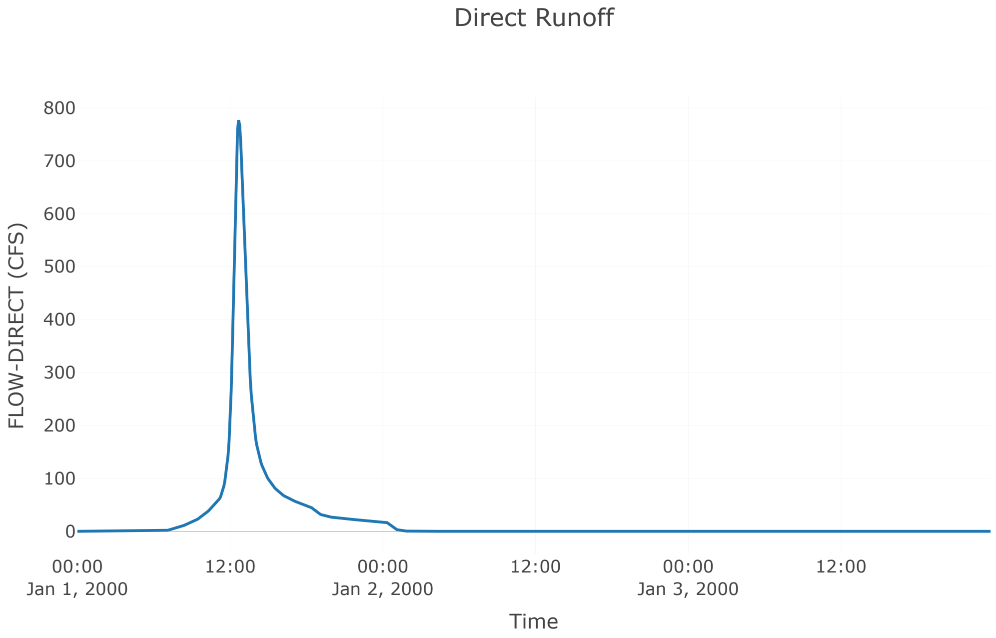

Cumulative Outflow

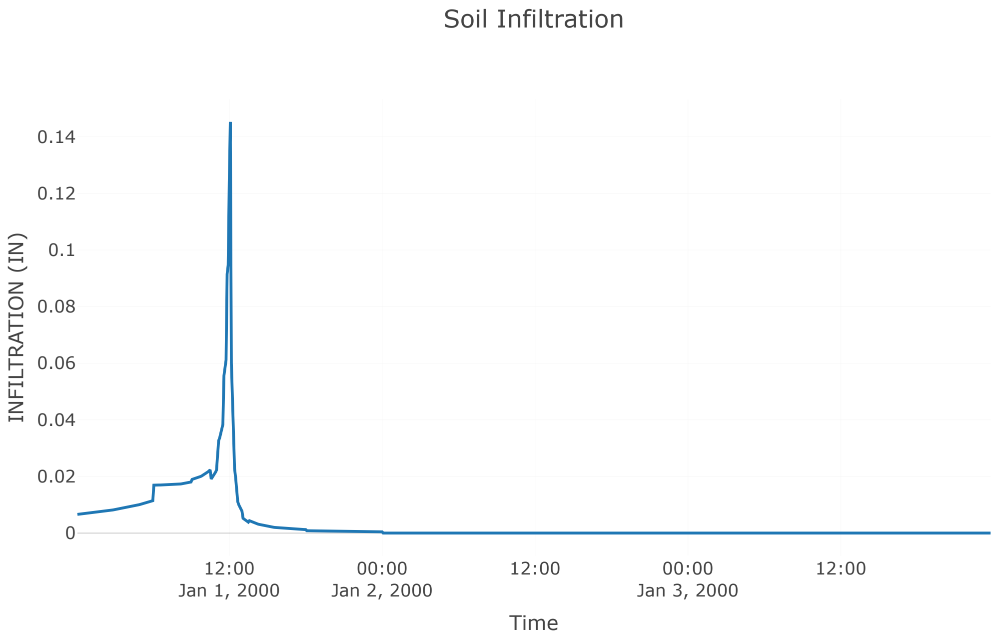

Cumulative Precipitation


Cumulative Precipitation Loss
PRECIP-LOSS-CUM (IN)
3
2.5
2
1.5
1
0.5
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Baseflow
FLOW-BASE (CFS)
1
0.5
0
−0.5
−1
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Precipitation Loss
PRECIP-LOSS (IN)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Direct Runoff
FLOW-DIRECT (CFS)
800
700
600
500
400
300
200
100
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Soil Infiltration
INFILTRATION (IN)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

Subbasin: Power Plant

Area (ft²) : 0.18
Downstream : Primary Pond

Loss Rate: Scs

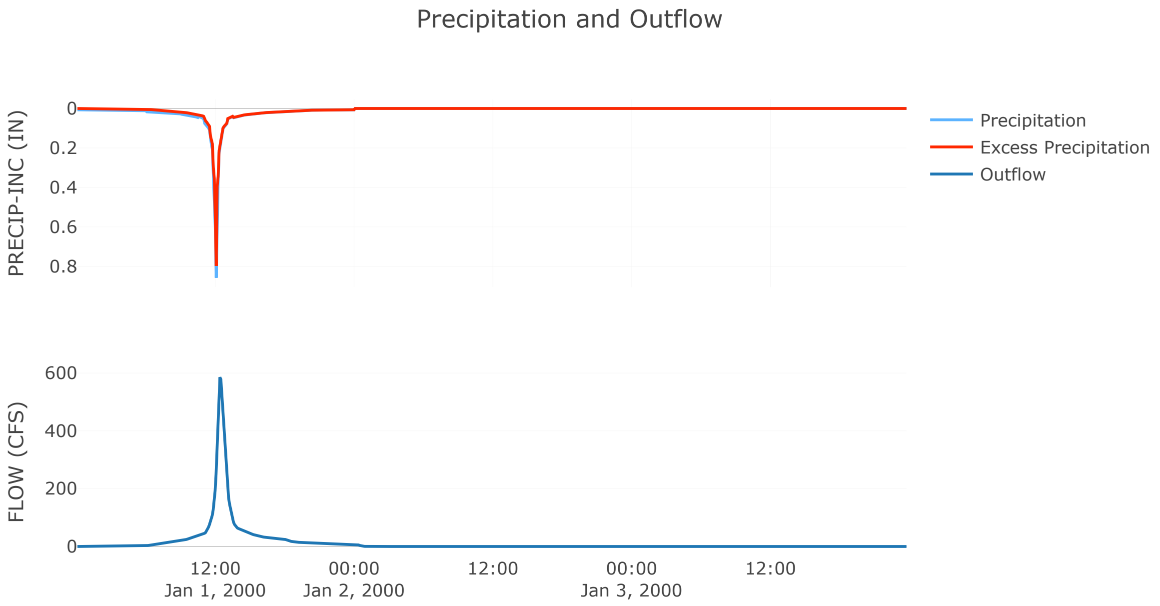
Percent Impervious Area	0
Curve Number	85.3

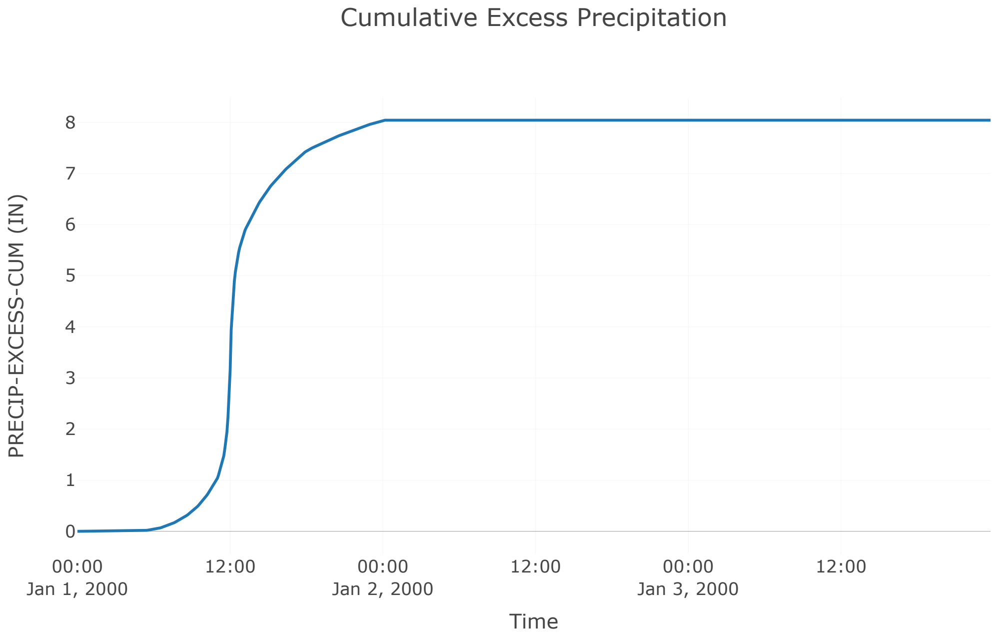
Transform: Scs

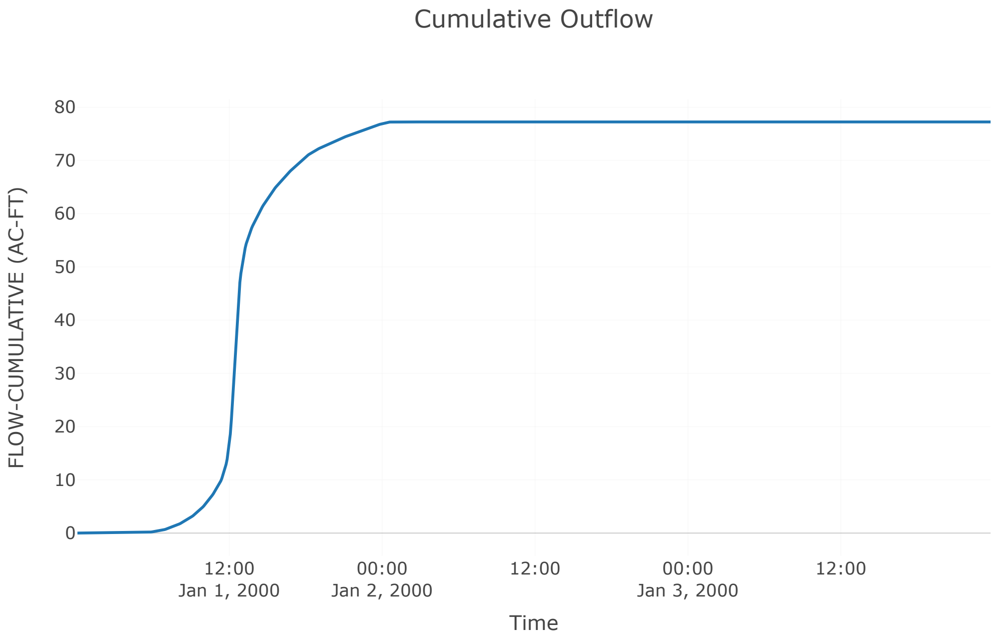
Lag	18.77
Unitgraph Type	Standard

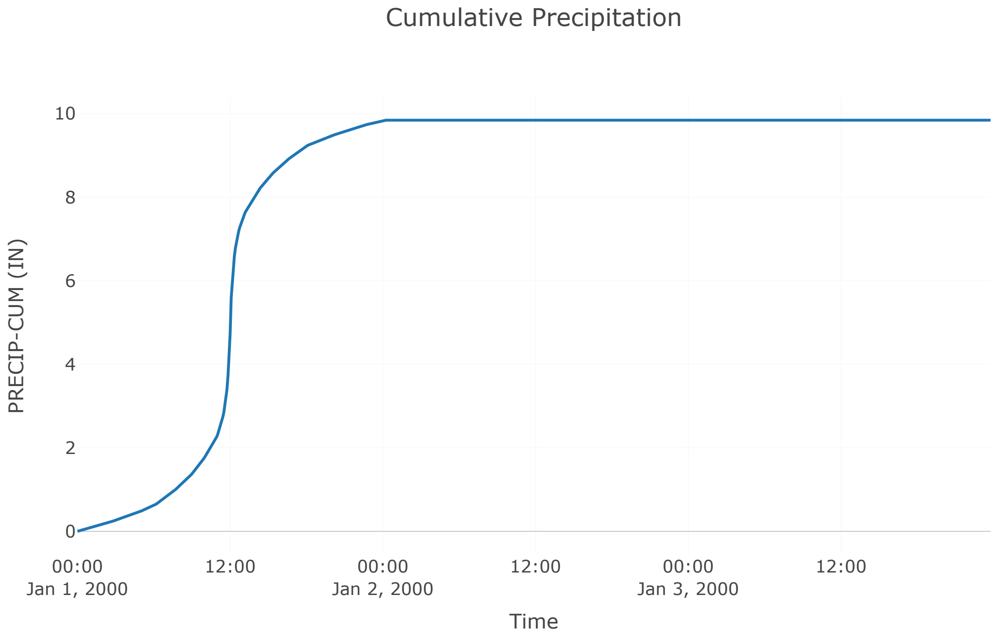
Results: Power Plant

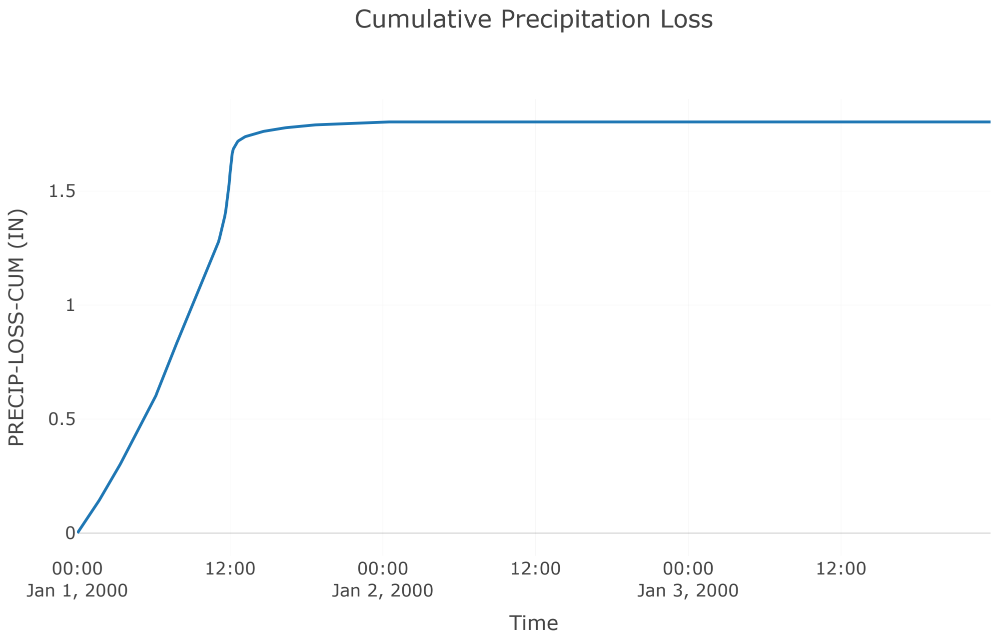
Peak Discharge (CFS)	585.58
Time of Peak Discharge	01Jan2000, 12:20
Volume (IN)	8.04
Precipitation Volume (AC - FT)	94.55
Loss Volume (AC - FT)	17.32
Excess Volume (AC - FT)	77.23
Direct Runoff Volume (AC - FT)	77.23
Baseflow Volume (AC - FT)	0

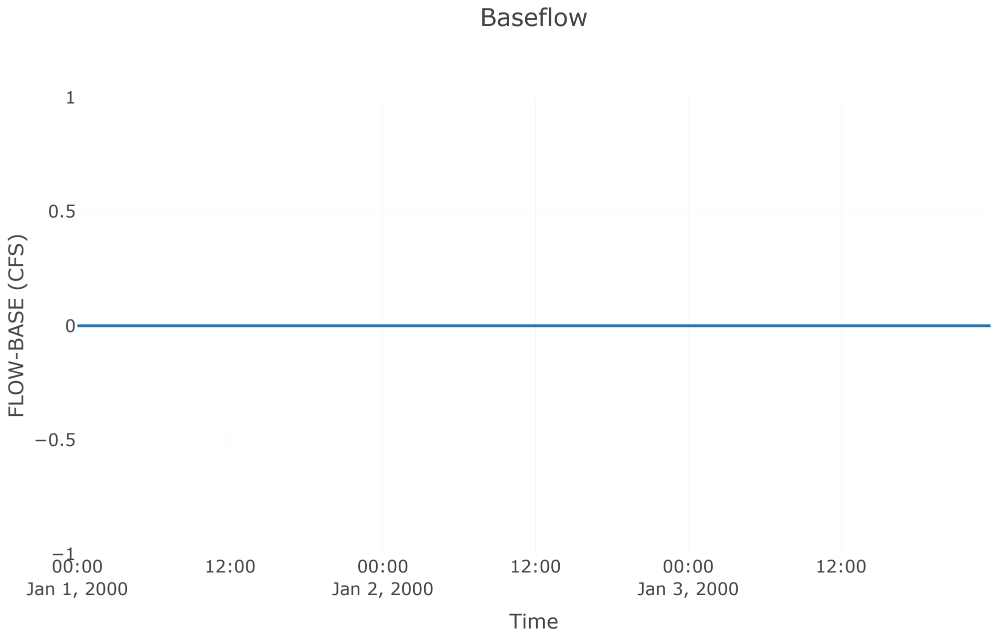

Precipitation and Outflow
PRECIP-INC (IN)
0
0.2
0.4
0.6
0.8
Precipitation
Excess Precipitation
Outflow
FLOW (CFS)
600
400
200
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00


Cumulative Excess Precipitation
PRECIP-EXCESS-CUM (IN)
8
7
6
5
4
3
2
1
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

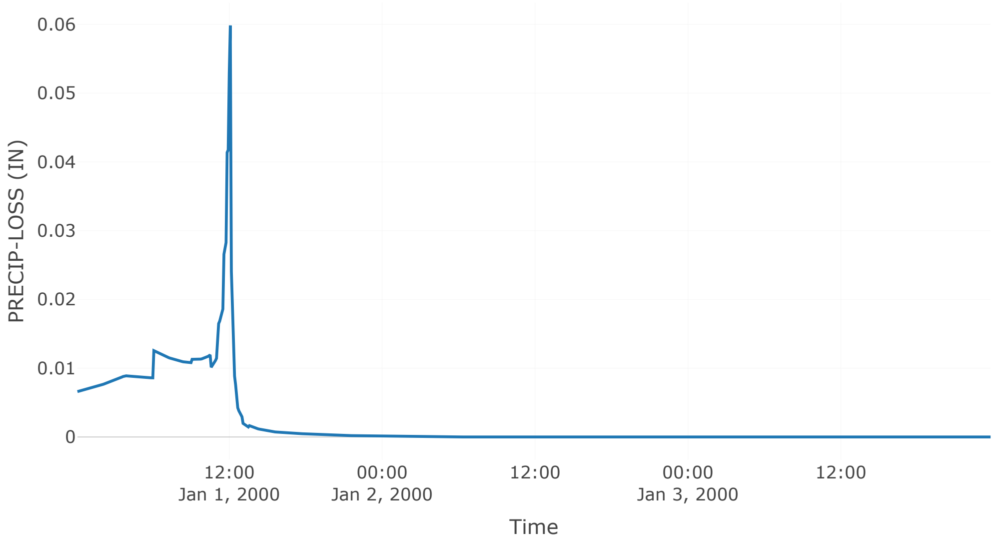

Cumulative Outflow
FLOW-CUMULATIVE (AC-FT)
80
70
60
50
40
30
20
10
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Cumulative Precipitation
PRECIP-CUM (IN)
10
8
6
4
2
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

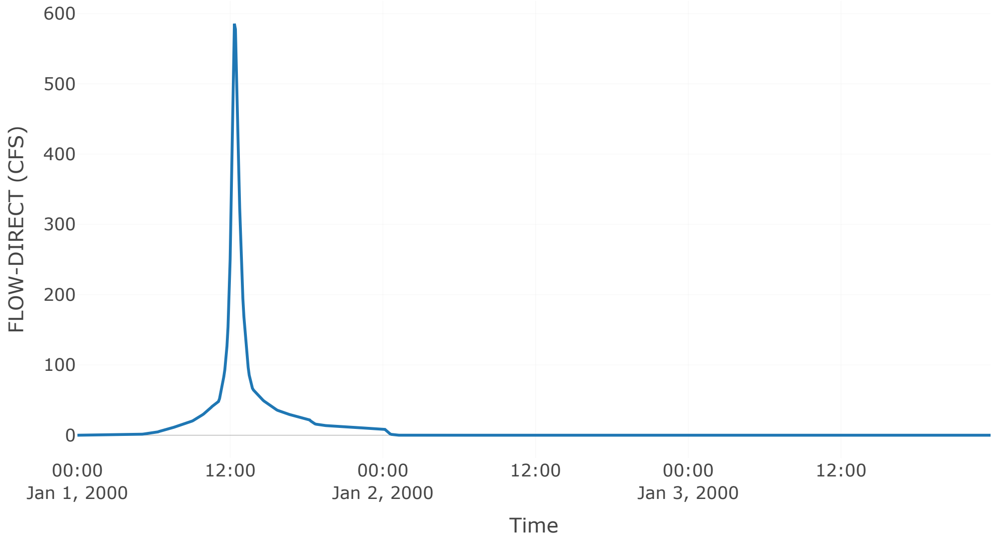

Cumulative Precipitation Loss
PRECIP-LOSS-CUM (IN)
0
0.5
1
1.5
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

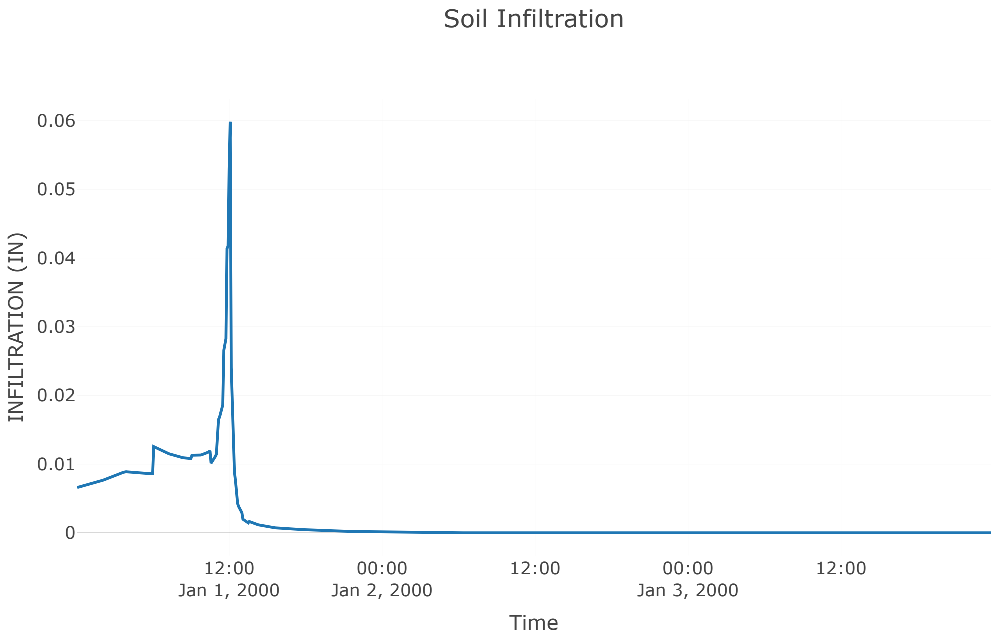

Baseflow
FLOW-BASE (CFS)
1
0.5
0
−0.5
−1
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

Precipitation Loss



Direct Runoff




Soil Infiltration
INFILTRATION (IN)
0.06
0.05
0.04
0.03
0.02
0.01
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

Subbasin: BottomAsh

Area (ft^2) : 0.03
Downstream : Bottom Ash Pond

Loss Rate: Scs

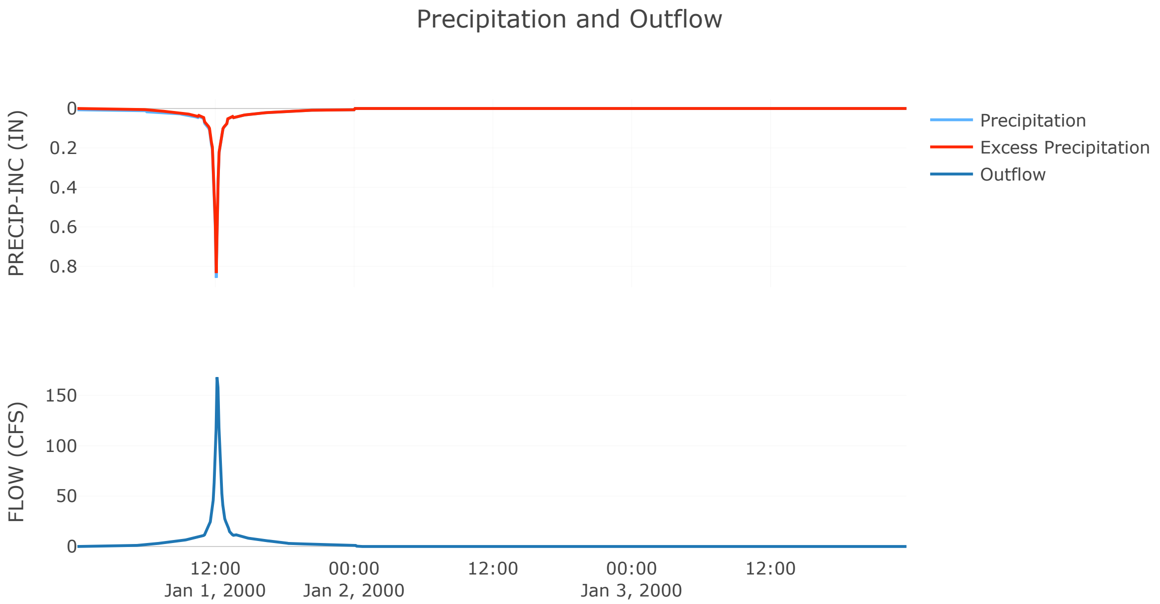
Percent Impervious Area	0
Curve Number	91

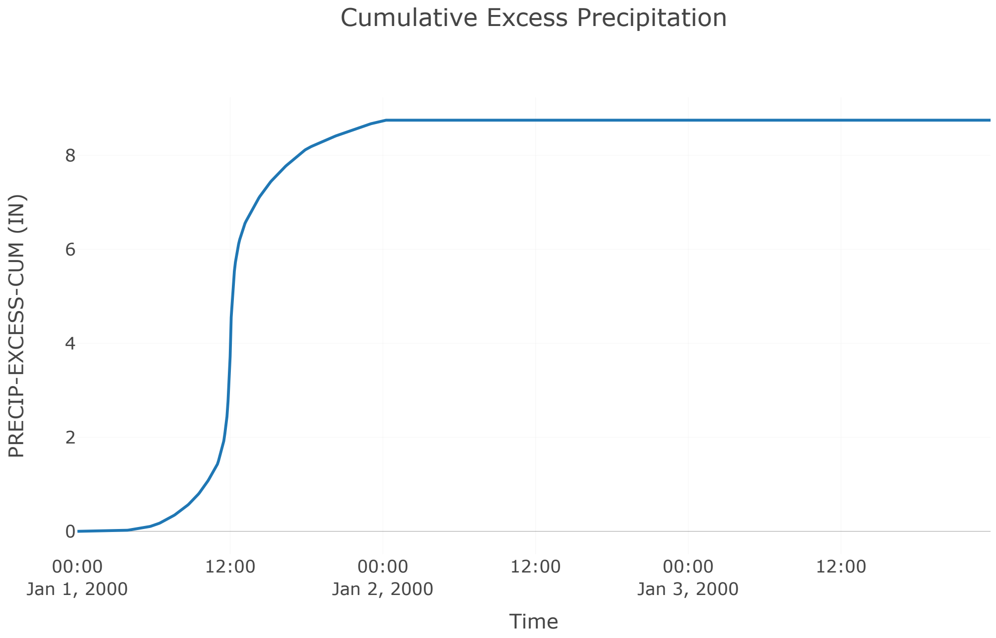
Transform: Scs

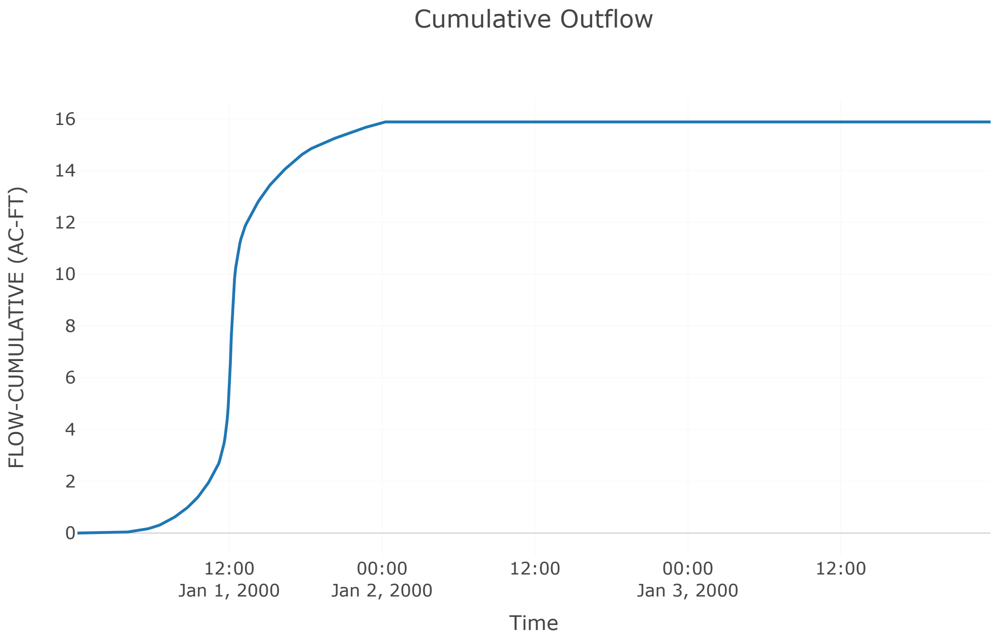
Lag	4.78
Unitgraph Type	Standard

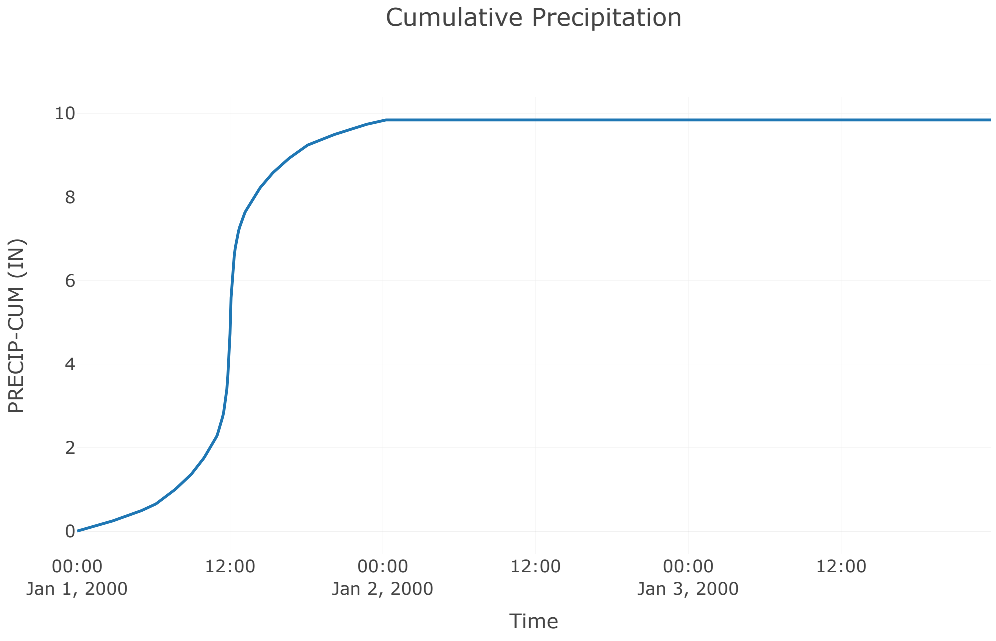
Results: BottomAsh

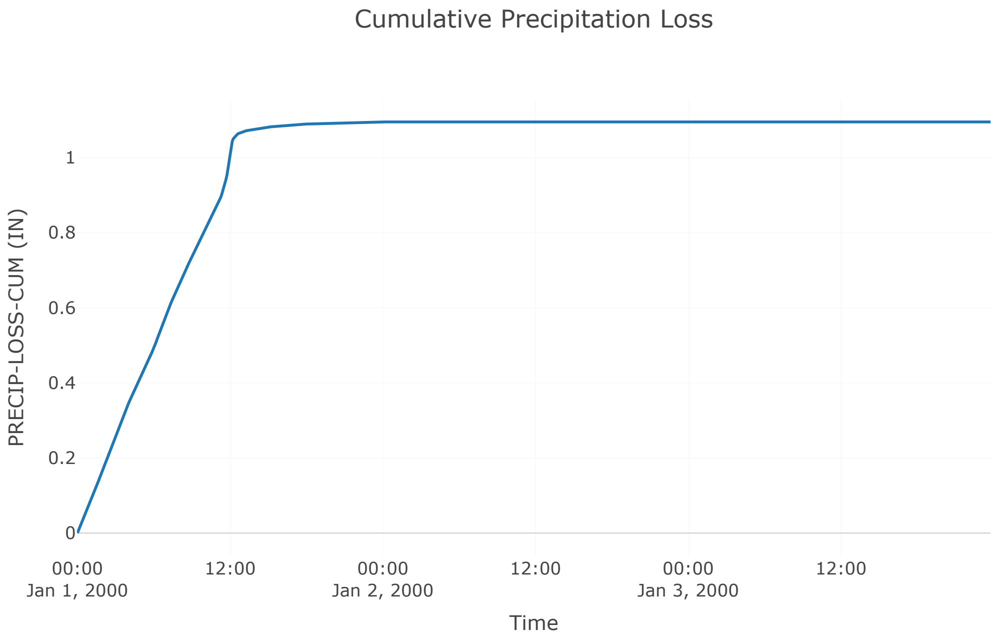
Peak Discharge (CFS)	168.05
Time of Peak Discharge	01Jan2000, 12:05
Volume (IN)	8.75
Precipitation Volume (AC - FT)	17.87
Loss Volume (AC - FT)	1.99
Excess Volume (AC - FT)	15.88
Direct Runoff Volume (AC - FT)	15.88
Baseflow Volume (AC - FT)	0

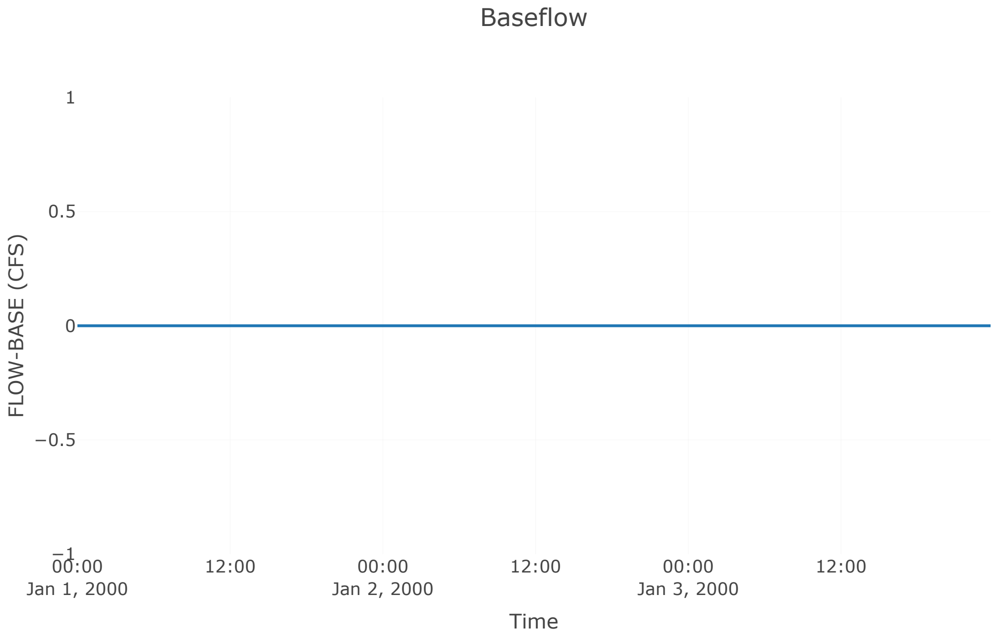

Precipitation and Outflow
PRECIP-INC (IN)
0
0.2
0.4
0.6
0.8
FLOW (CFS)
150
100
50
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Precipitation
Excess Precipitation
Outflow


Cumulative Excess Precipitation
PRECIP-EXCESS-CUM (IN)
8
6
4
2
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

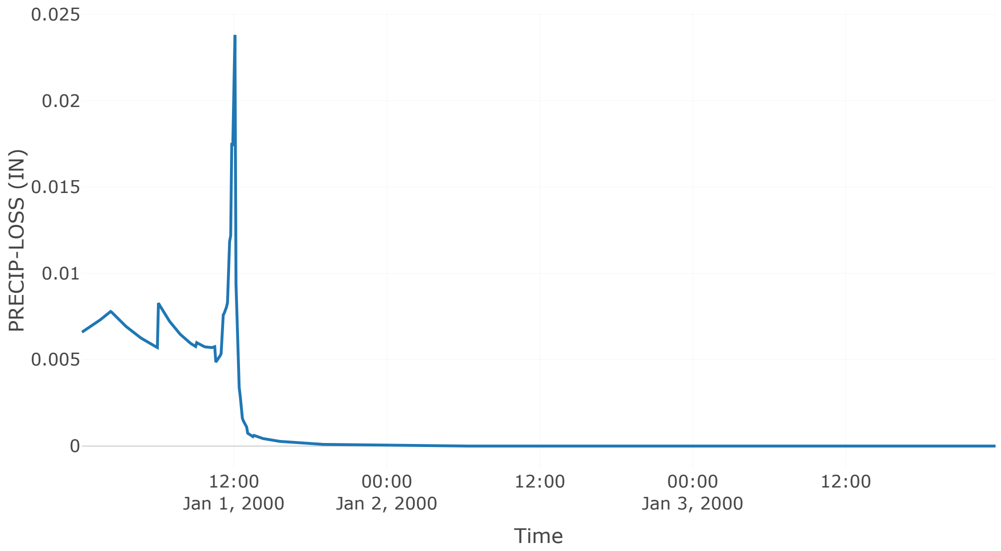

Cumulative Outflow
FLOW-CUMULATIVE (AC-FT)
16
14
12
10
8
6
4
2
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Cumulative Precipitation
PRECIP-CUM (IN)
10
8
6
4
2
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

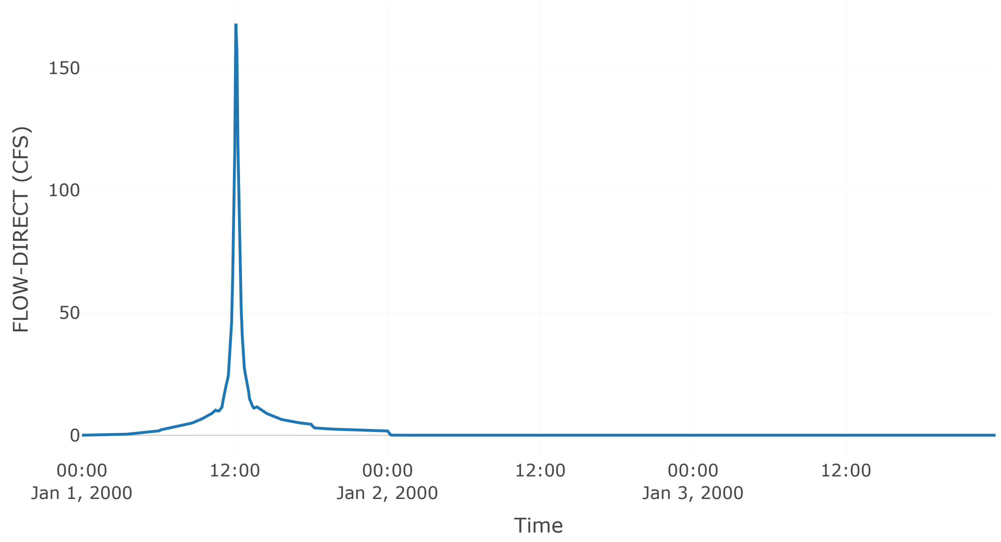

Cumulative Precipitation Loss
PRECIP-LOSS-CUM (IN)
1
0.8
0.6
0.4
0.2
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

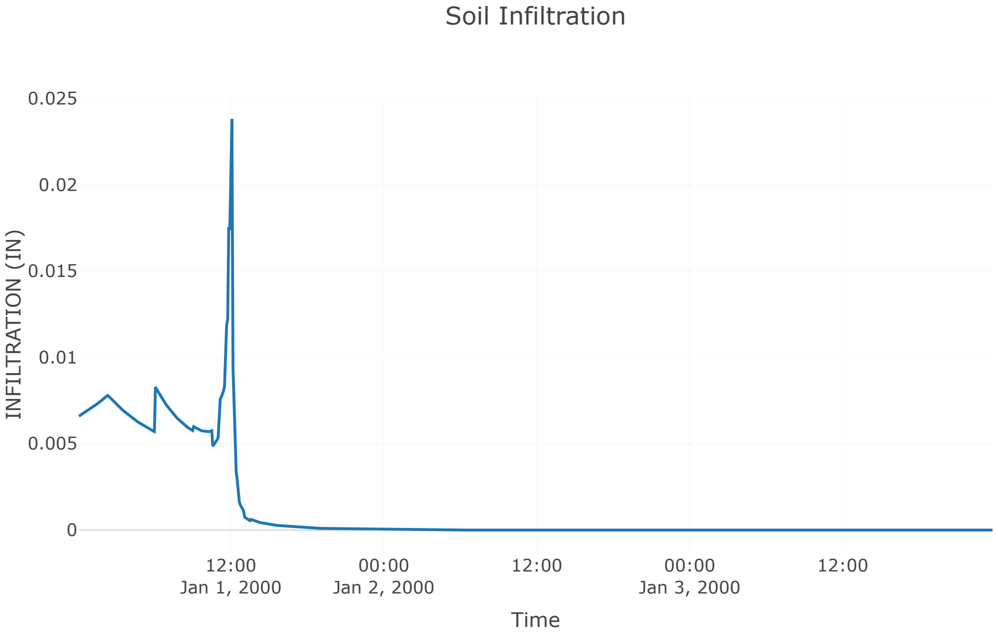

Baseflow
FLOW-BASE (CFS)
1
0.5
0
−0.5
−1
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

Precipitation Loss



Direct Runoff




Soil Infiltration
INFILTRATION (IN)
0.025
0.02
0.015
0.01
0.005
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

Subbasin: toBottomAsh

Area (ft²) : 0.03
Downstream : Bottom Ash Pond

Loss Rate: Scs

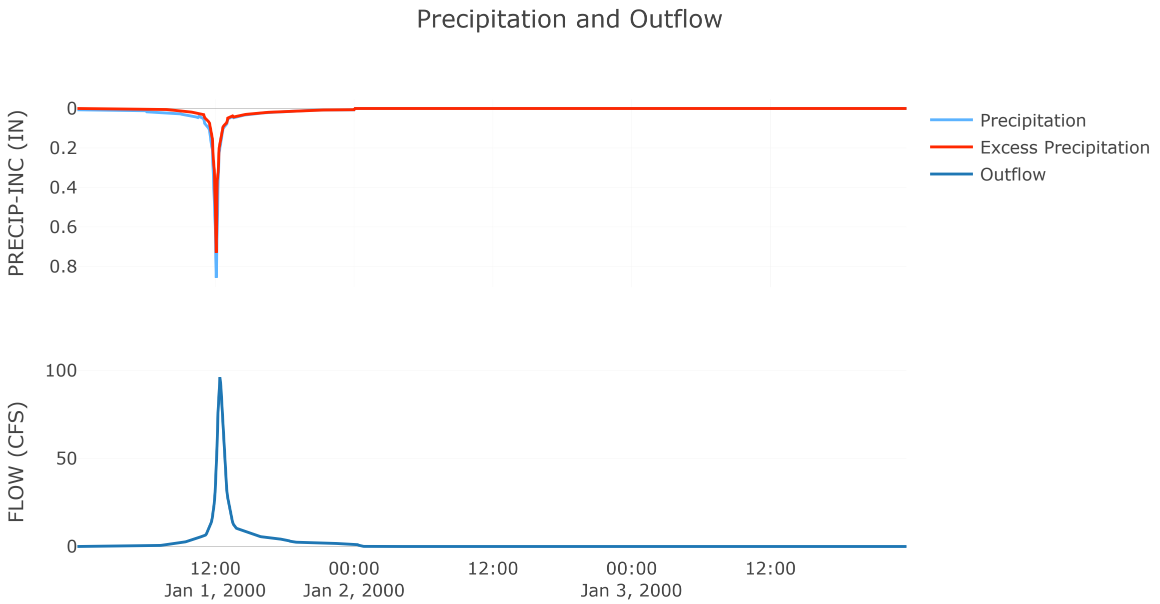
Percent Impervious Area	0
Curve Number	77.8

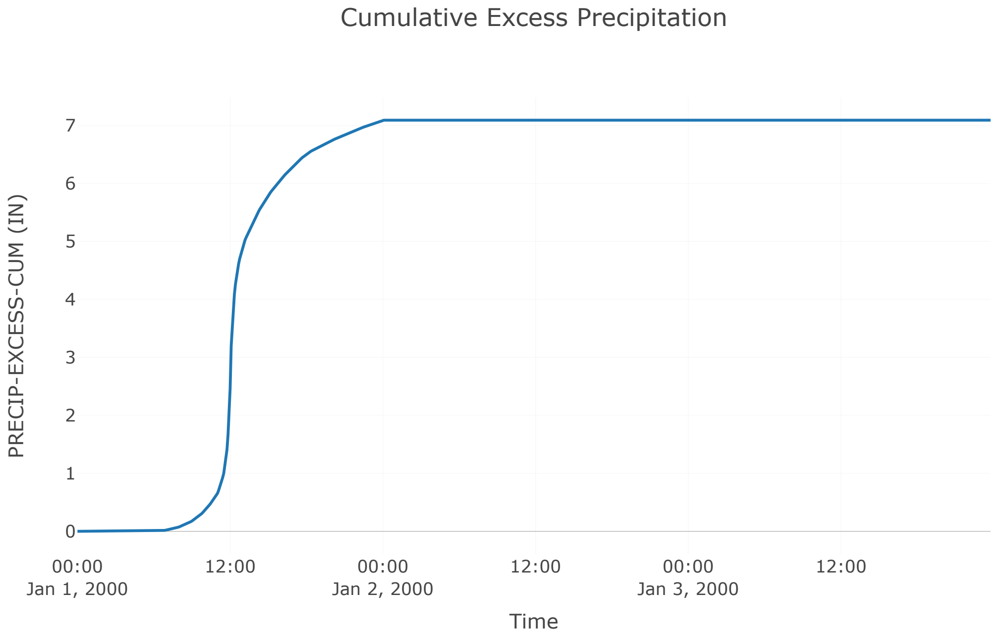
Transform: Scs

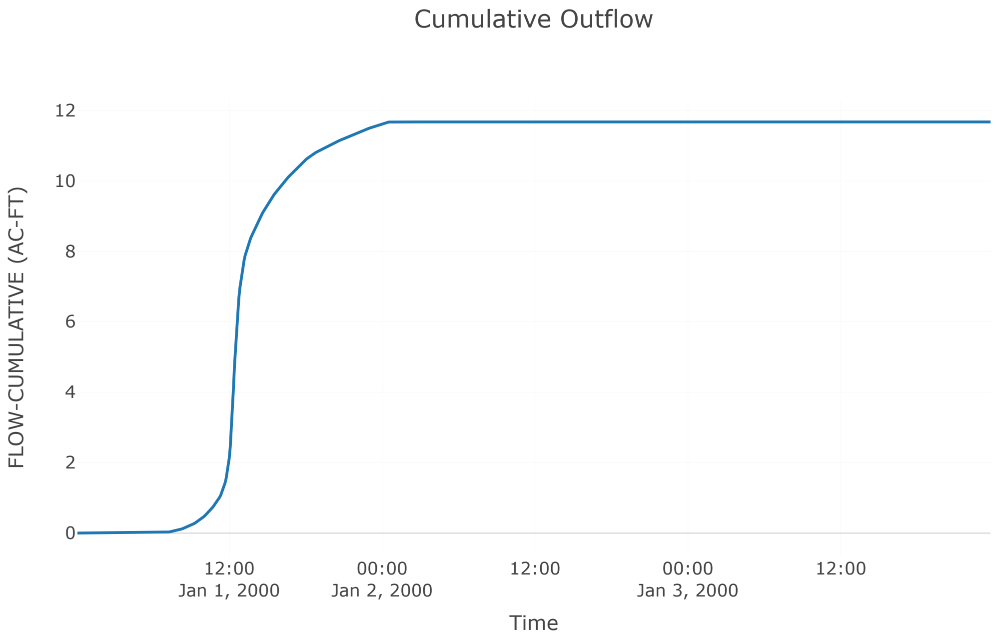
Lag	16.51
Unitgraph Type	Standard

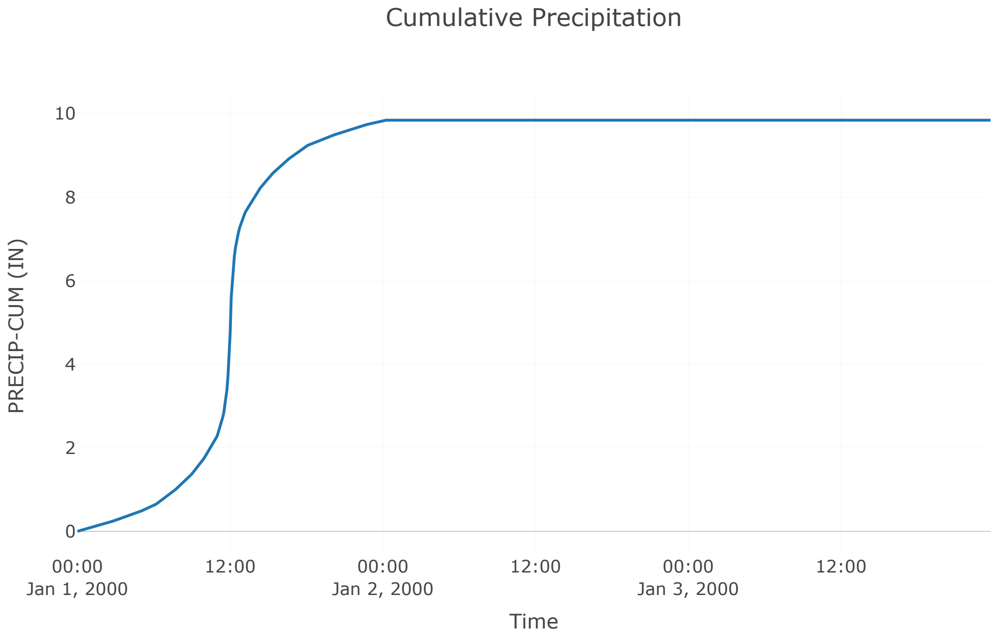
Results: toBottomAsh

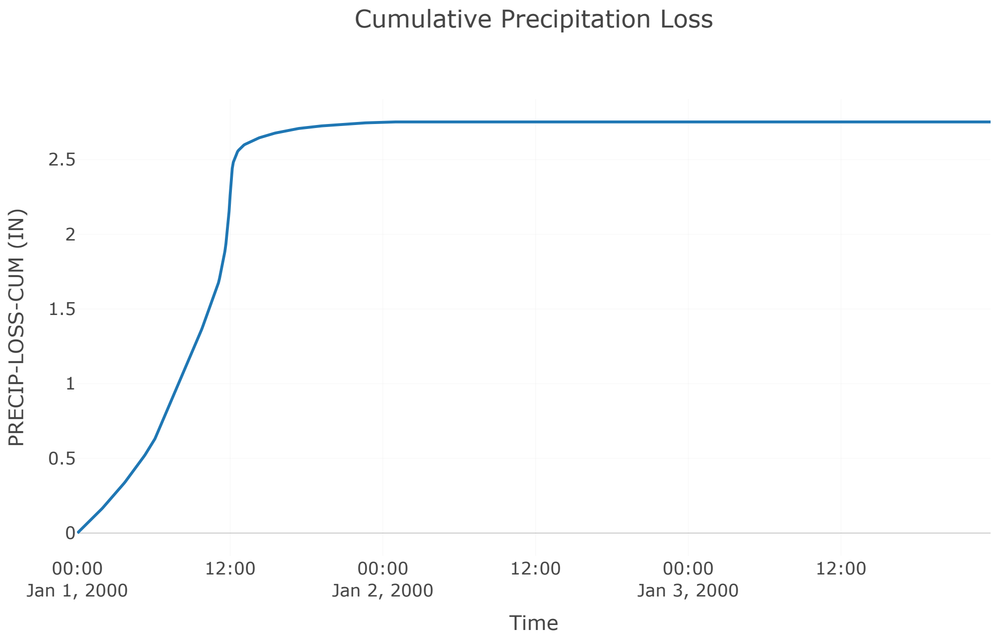
Peak Discharge (CFS)	96.13
Time of Peak Discharge	01Jan2000, 12:20
Volume (IN)	7.09
Precipitation Volume (AC - FT)	16.2
Loss Volume (AC - FT)	4.53
Excess Volume (AC - FT)	11.67
Direct Runoff Volume (AC - FT)	11.67
Baseflow Volume (AC - FT)	0

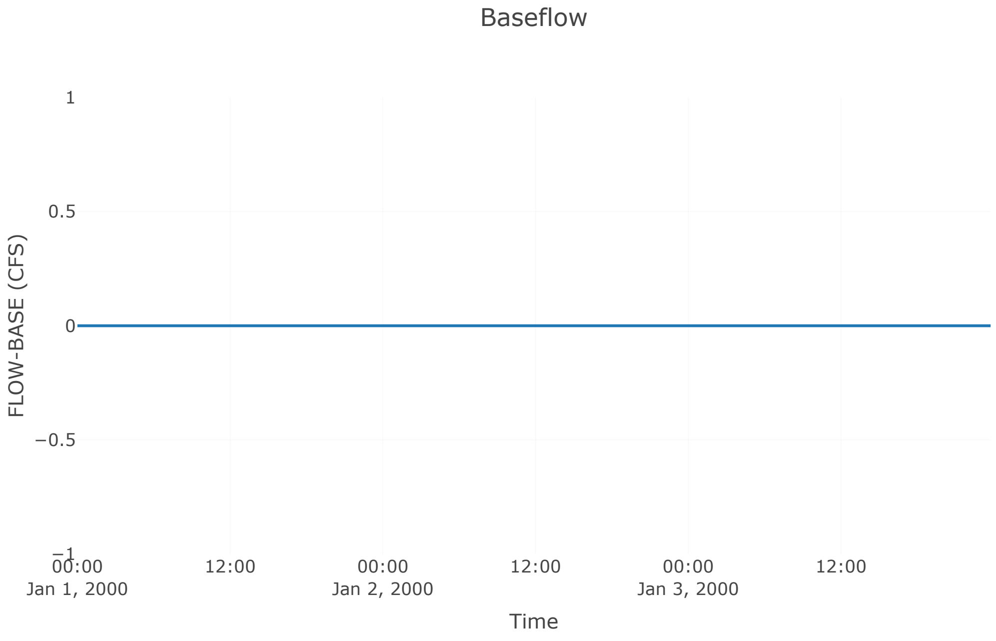

Precipitation and Outflow
PRECIP-INC (IN)
0
0.2
0.4
0.6
0.8
Precipitation
Excess Precipitation
Outflow
FLOW (CFS)
100
50
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00

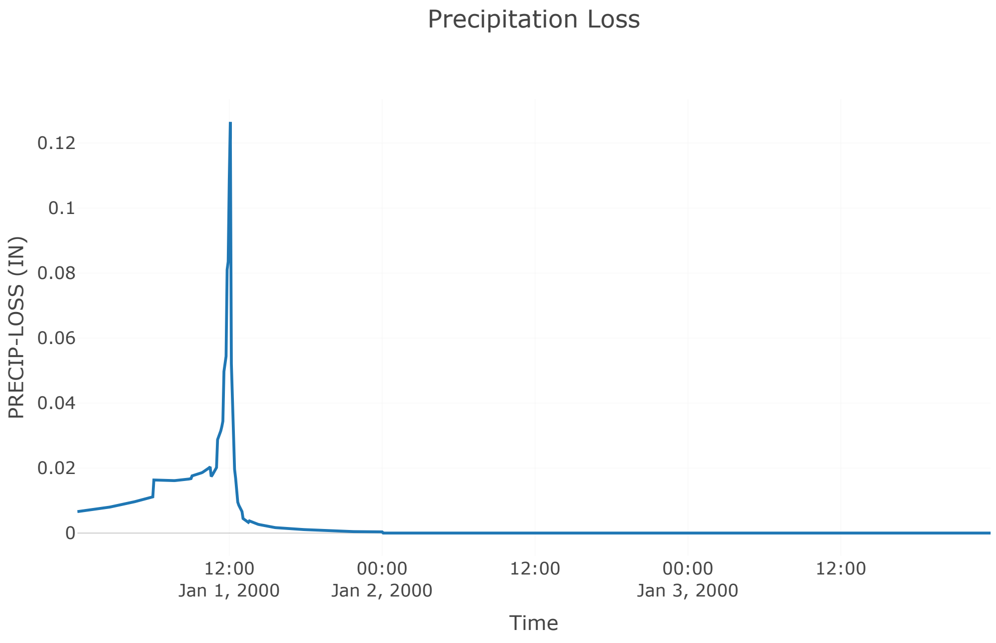

Cumulative Excess Precipitation
PRECIP-EXCESS-CUM (IN)
7
6
5
4
3
2
1
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

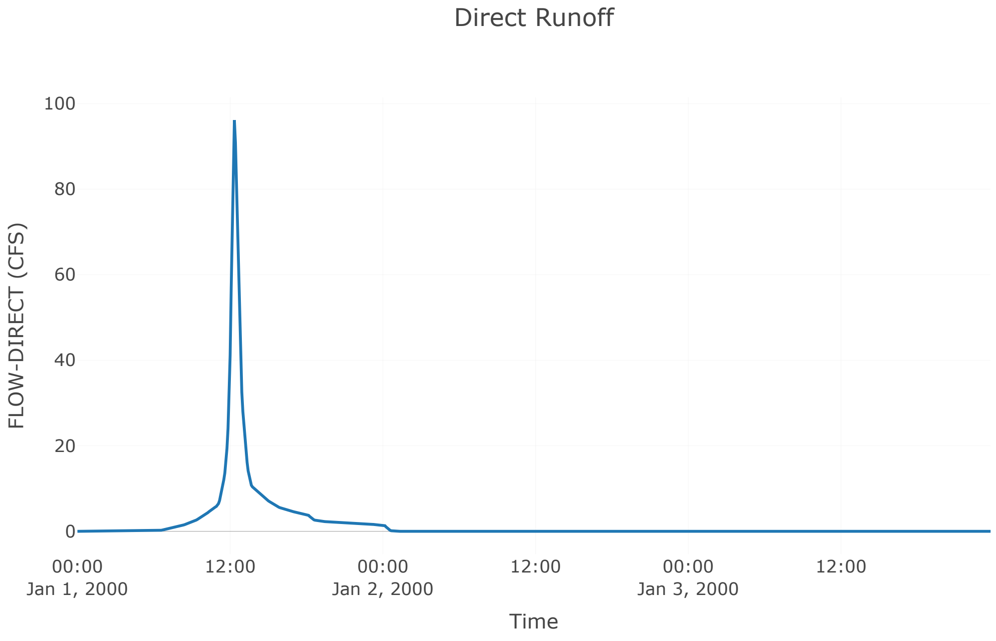

Cumulative Outflow
FLOW-CUMULATIVE (AC-FT)
12
10
8
6
4
2
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

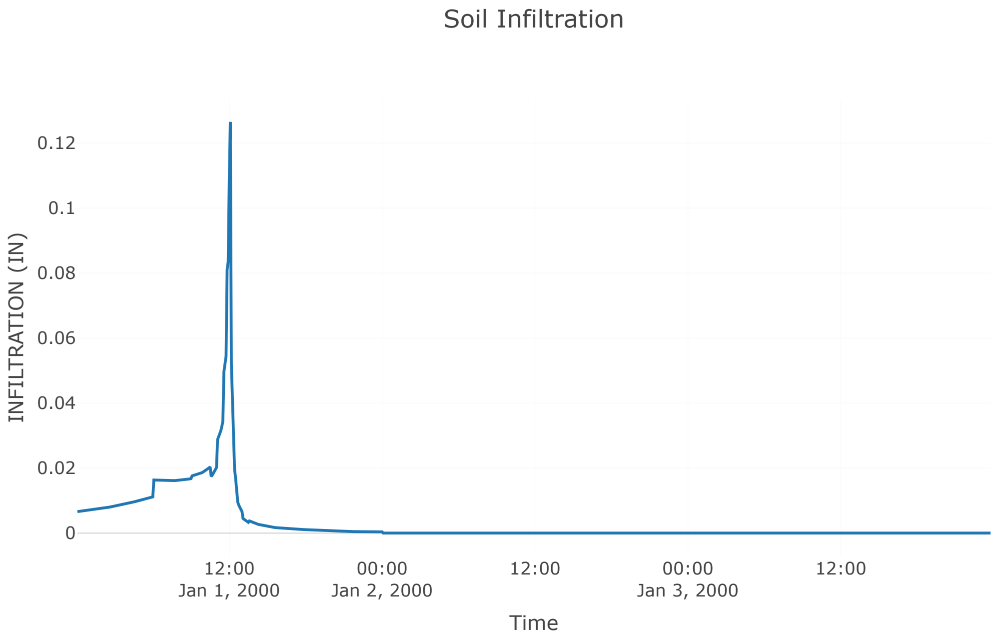

Cumulative Precipitation
PRECIP-CUM (IN)
10
8
6
4
2
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Cumulative Precipitation Loss
PRECIP-LOSS-CUM (IN)
2.5
2
1.5
1
0.5
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Baseflow
FLOW-BASE (CFS)
1
0.5
0
−0.5
−1
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Precipitation Loss
0.12
0.1
0.08
0.06
0.04
0.02
0
PRECIP-LOSS (IN)
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Direct Runoff
100
80
60
40
20
0
FLOW-DIRECT (CFS)
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Soil Infiltration
INFILTRATION (IN)
0.12
0.1
0.08
0.06
0.04
0.02
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

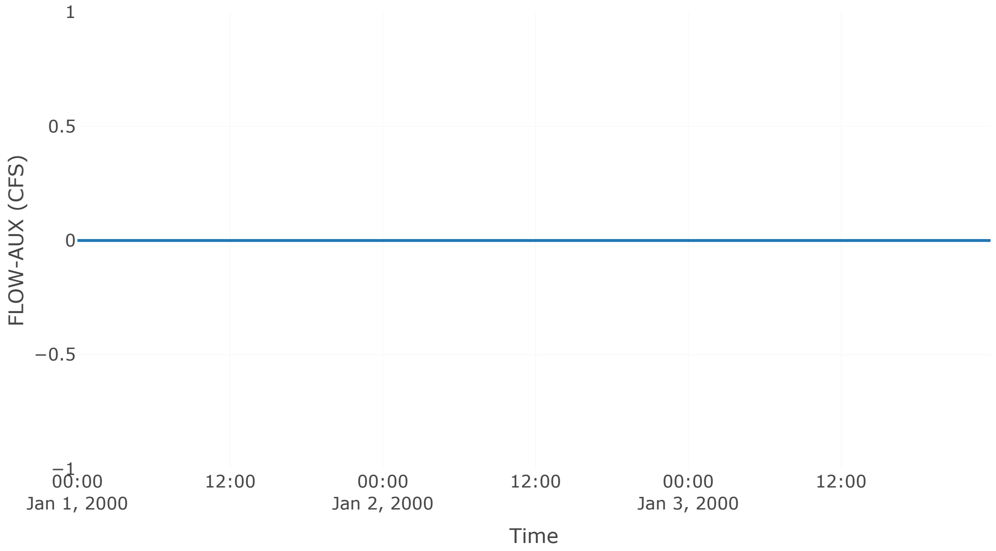
Reservoir: BottomAshPond

Downstream : Reach - 3

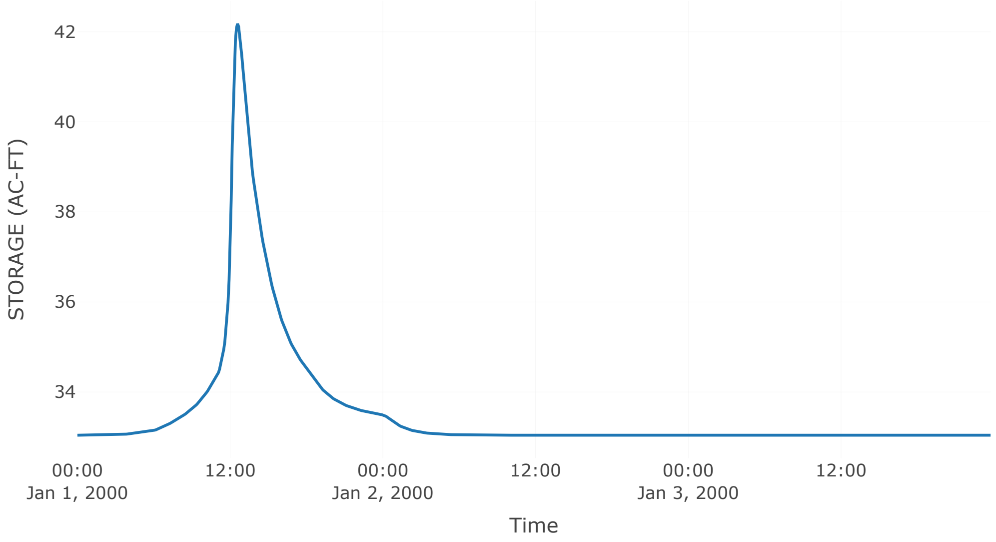
Results: BottomAshPond

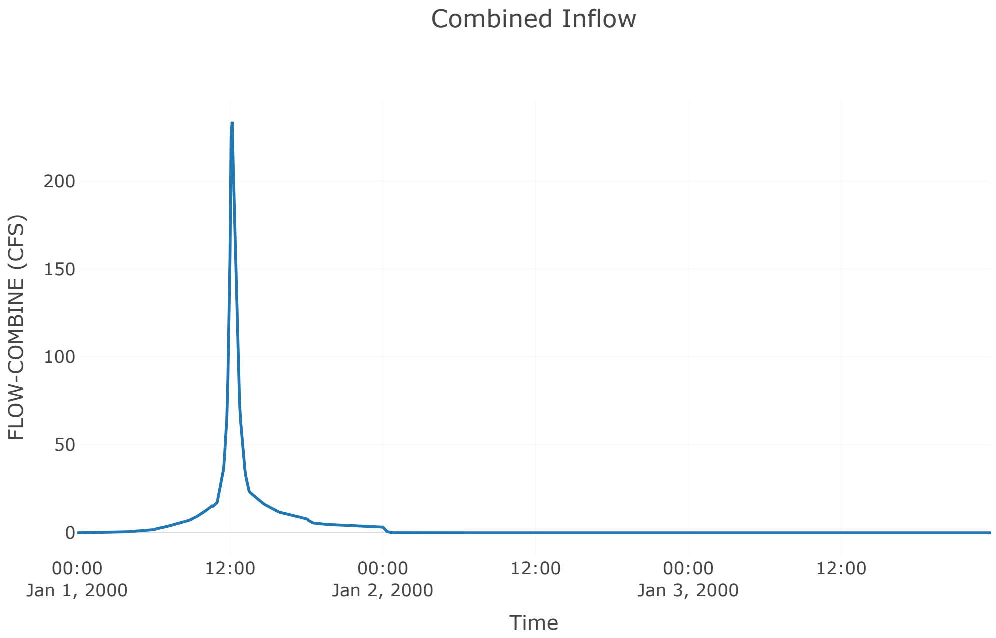
Peak Discharge (CFS)	107.92
Time of Peak Discharge	01Jan2000, 12:35
Volume (IN)	7.97
Peak Inflow (CFS)	233.78
Time of Peak Inflow	01Jan2000, 12:20
Inflow Volume (AC - FT)	27.56
Maximum Storage (AC - FT)	42.18
Peak Elevation (FT)	355.76
Discharge Volume (AC - FT)	27.57

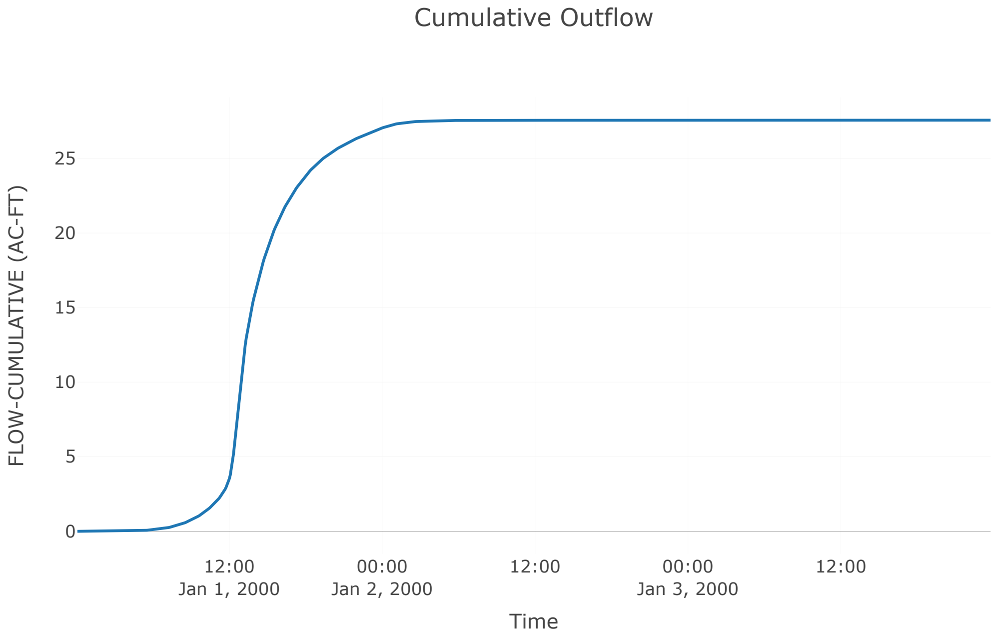
Auxiliary Outflow

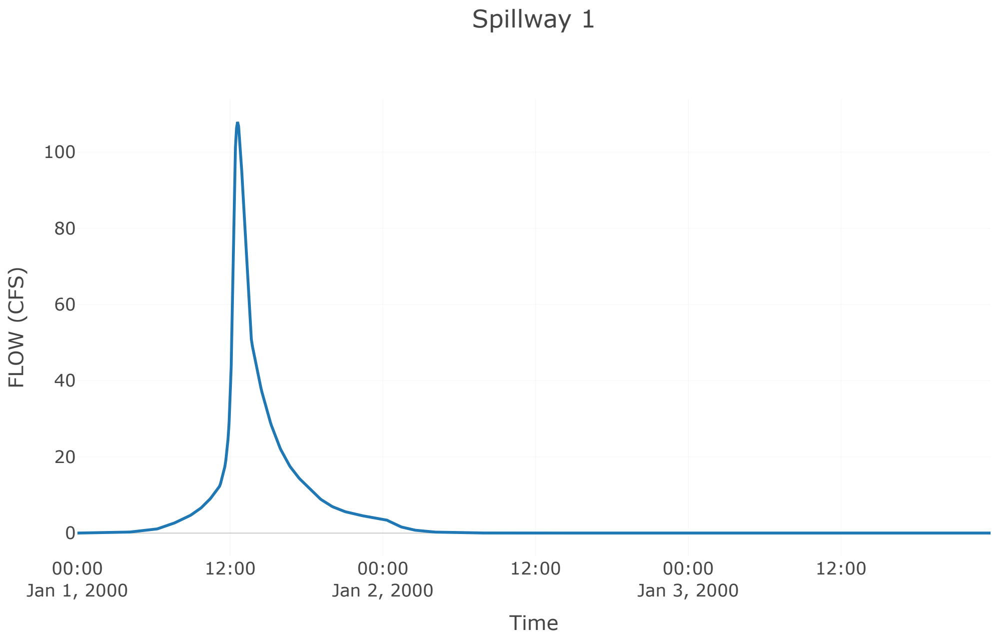


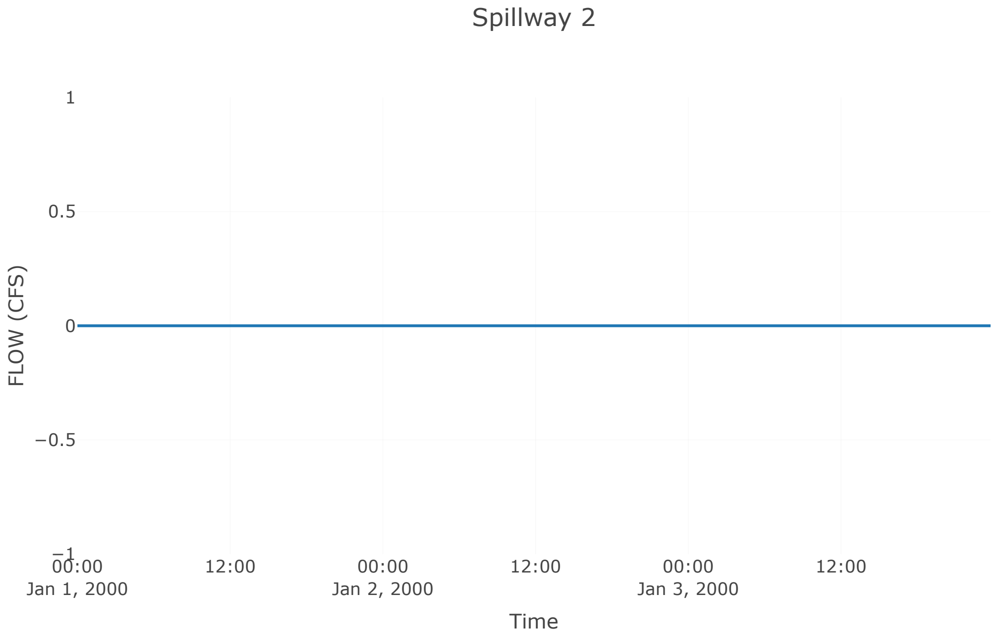
Storage

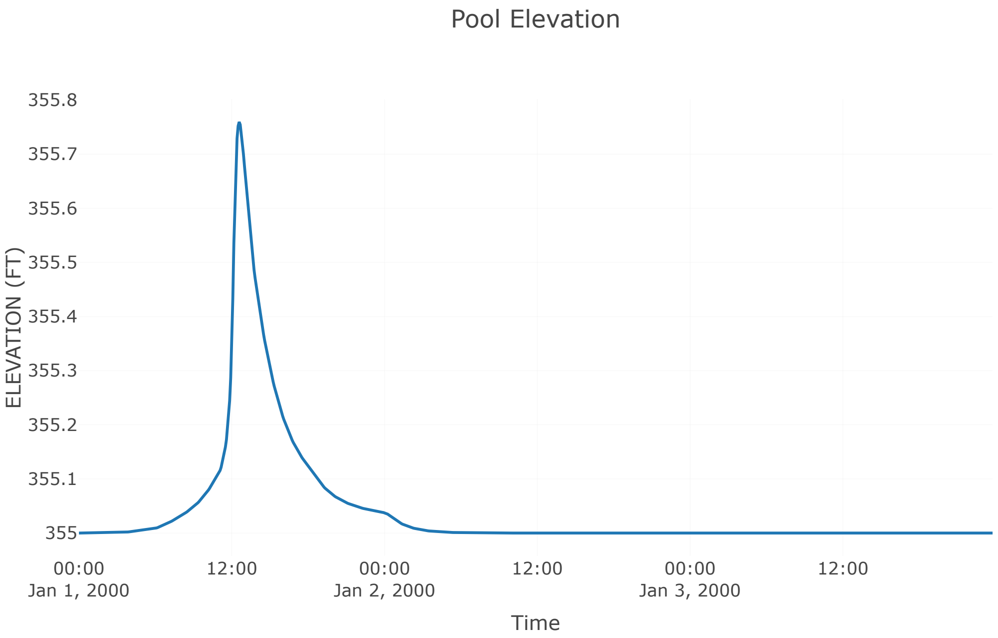


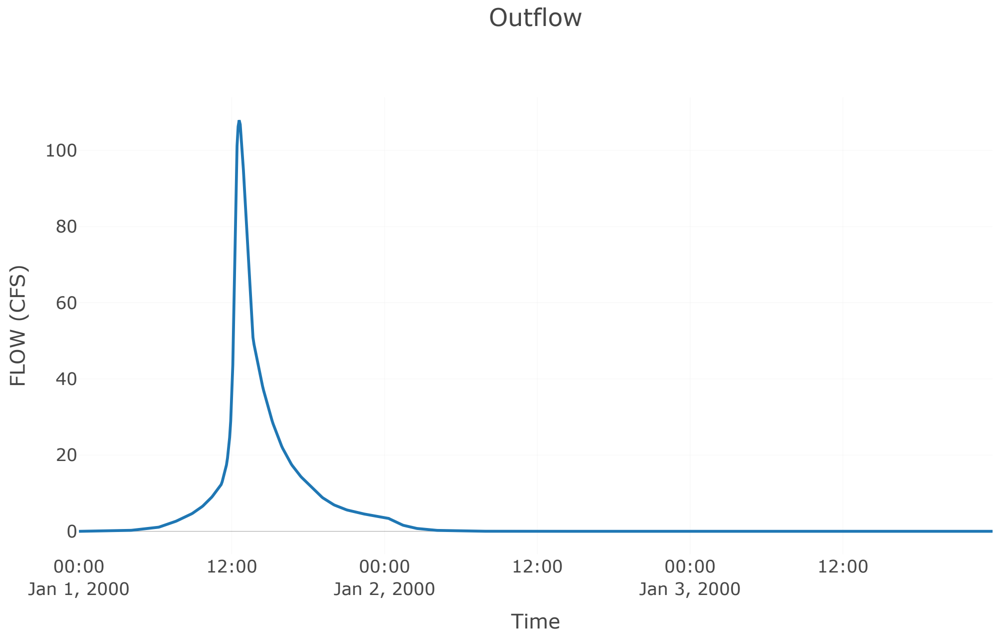

Combined Inflow
FLOW-COMBINE (CFS)
200
150
100
50
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Cumulative Outflow
FLOW-CUMULATIVE (AC-FT)
25
20
15
10
5
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Spillway 1
FLOW (CFS)
100
80
60
40
20
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Spillway 2
FLOW (CFS)
1
0.5
0
−0.5
−1
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Pool Elevation
ELEVATION (FT)
355.8
355.7
355.6
355.5
355.4
355.3
355.2
355.1
355
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Outflow
FLOW (CFS)
100
80
60
40
20
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

Reach: Reach-3

Downstream : Reach - 2

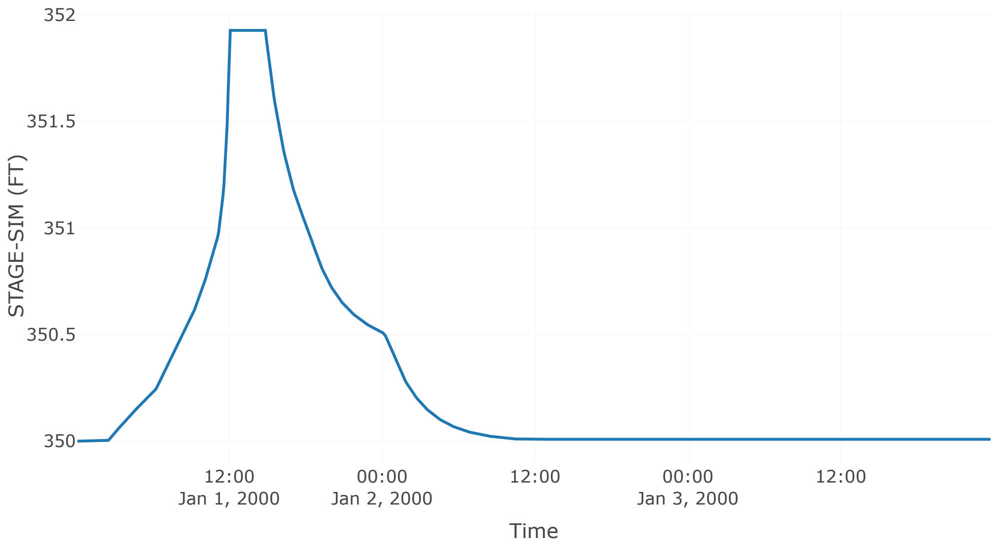
Route: Muskingum Cunge

Method	Muskingum Cunge
Channel	Circular
Length (ft)	1460
Energy Slope	0
Mannings n	0.01
Diameter	2.5
Initial Variable	Combined Inflow
Space - Time Method	Automatic DX and DT
Index Parameter Type	Index Celerity
Index Celerity	5
Invert Elevation	350
Maximum Depth Iterations	20
Maximum Route Step Iterations	30

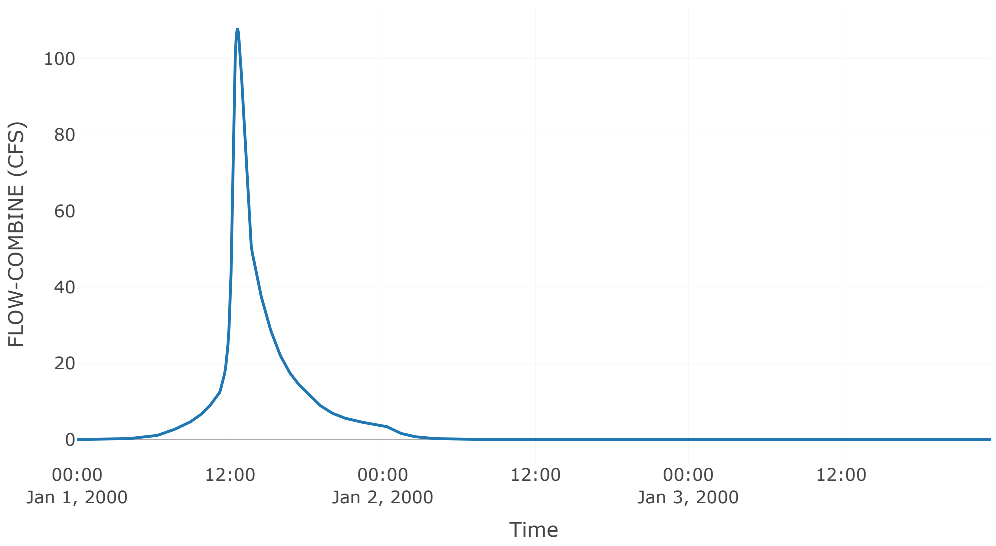
Results: Reach-3

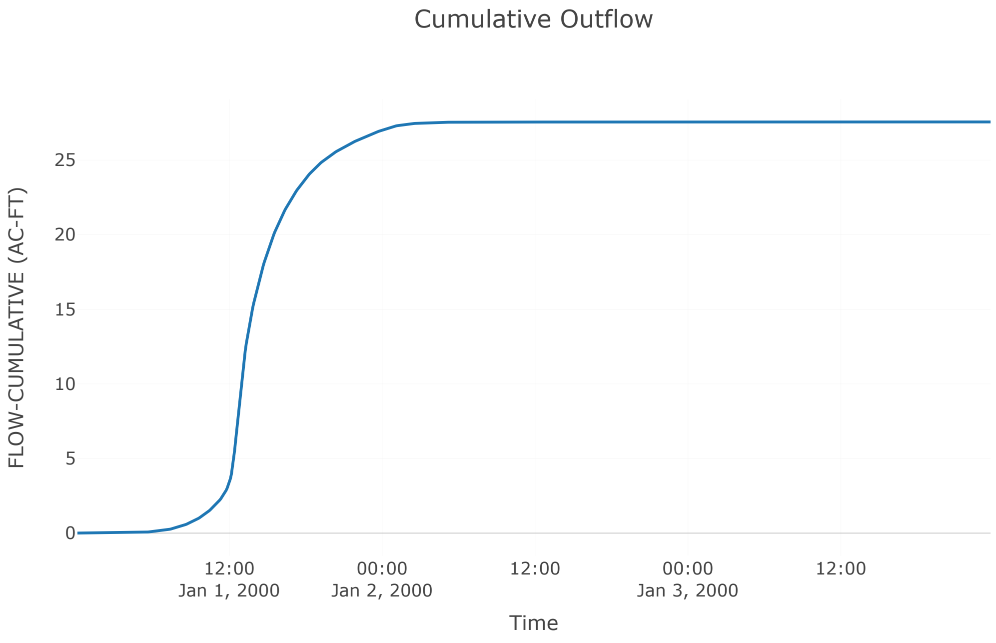
Peak Discharge (CFS)	107.22
Time of Peak Discharge	01Jan2000, 12:40
Volume (IN)	7.96
Peak Inflow (CFS)	107.92
Inflow Volume (AC - FT)	27.57

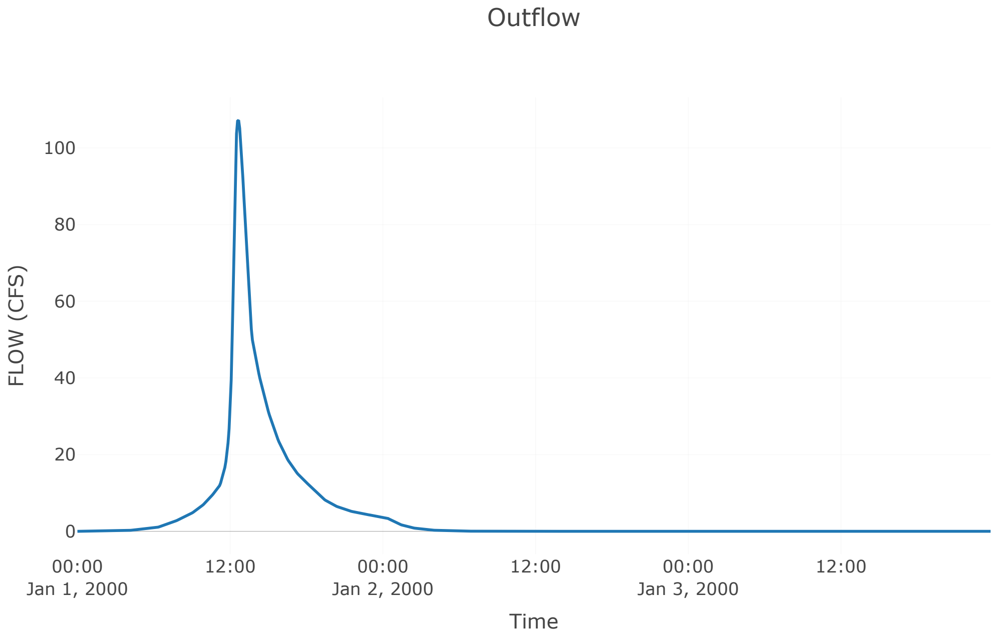
Computed Stage

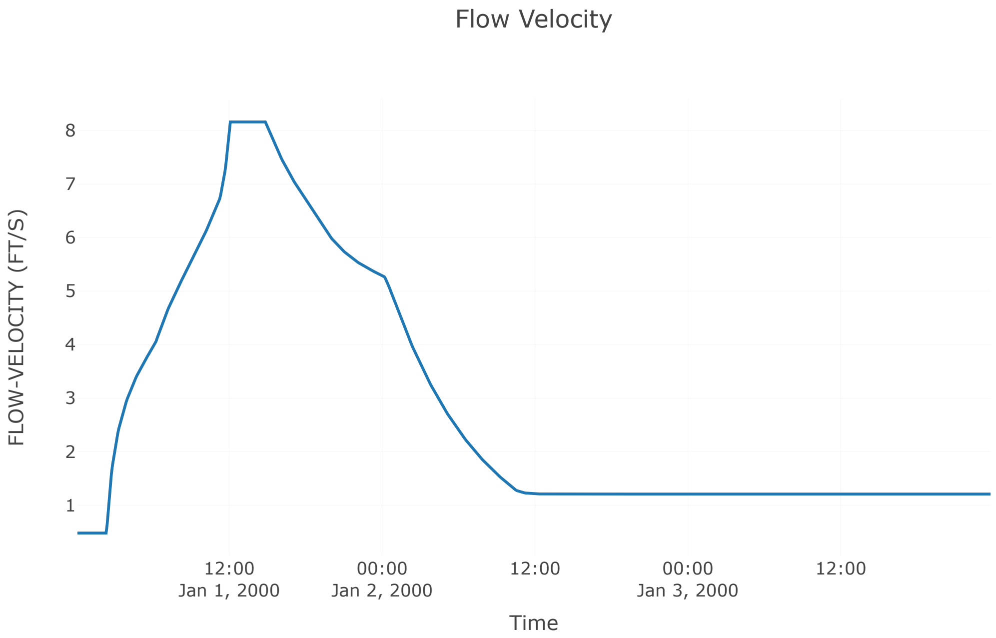


Combined Inflow




Cumulative Outflow
FLOW-CUMULATIVE (AC-FT)
25
20
15
10
5
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Outflow
FLOW (CFS)
100
80
60
40
20
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Flow Velocity
FLOW-VELOCITY (FT/S)
8
7
6
5
4
3
2
1
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

Subbasin: AshStorageB

Area (ft²) : 0.02
Downstream : Reach - 2

Loss Rate: Scs

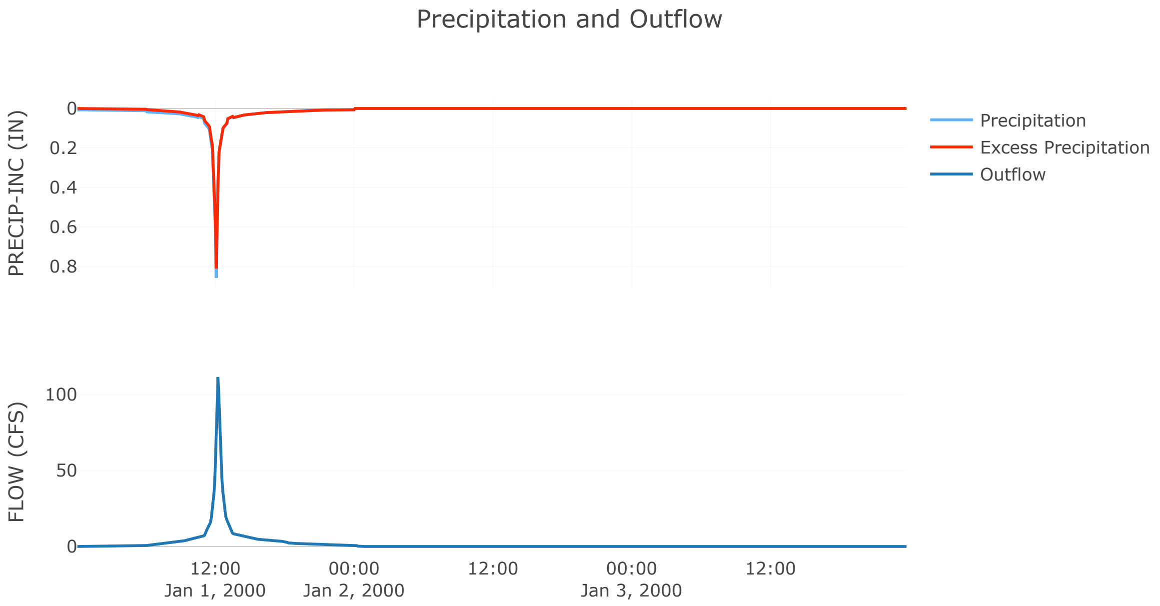
Percent Impervious Area	0
Curve Number	87.1

Transform: Scs

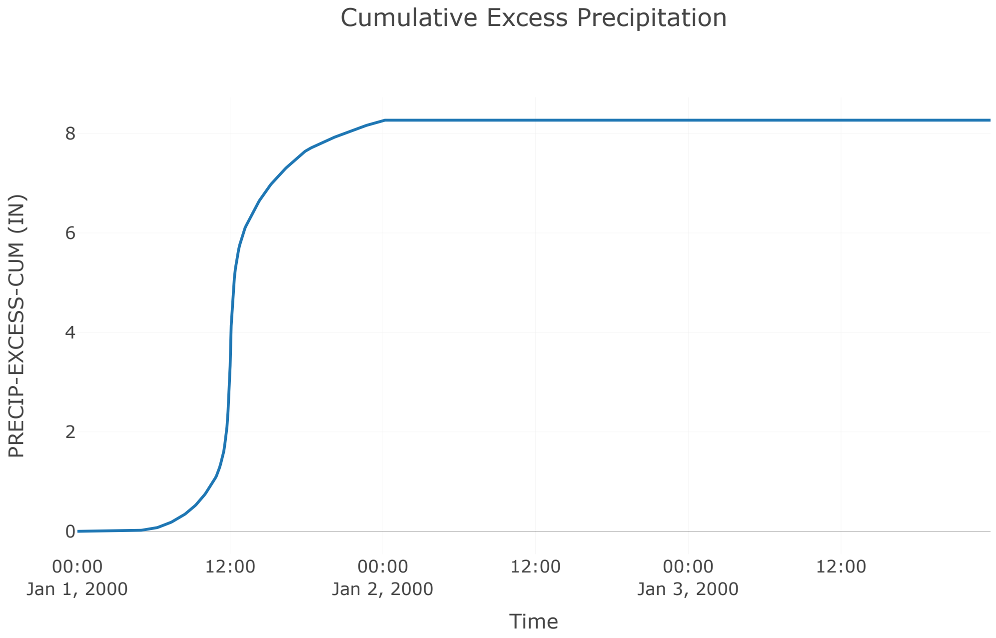
Lag	7.51
Unitgraph Type	Standard

Results: AshStorageB

Peak Discharge (CFS)	111.2
Time of Peak Discharge	01Jan2000, 12:10
Volume (IN)	8.27
Precipitation Volume (AC - FT)	13.03
Loss Volume (AC - FT)	2.09
Excess Volume (AC - FT)	10.94
Direct Runoff Volume (AC - FT)	10.94
Baseflow Volume (AC - FT)	0

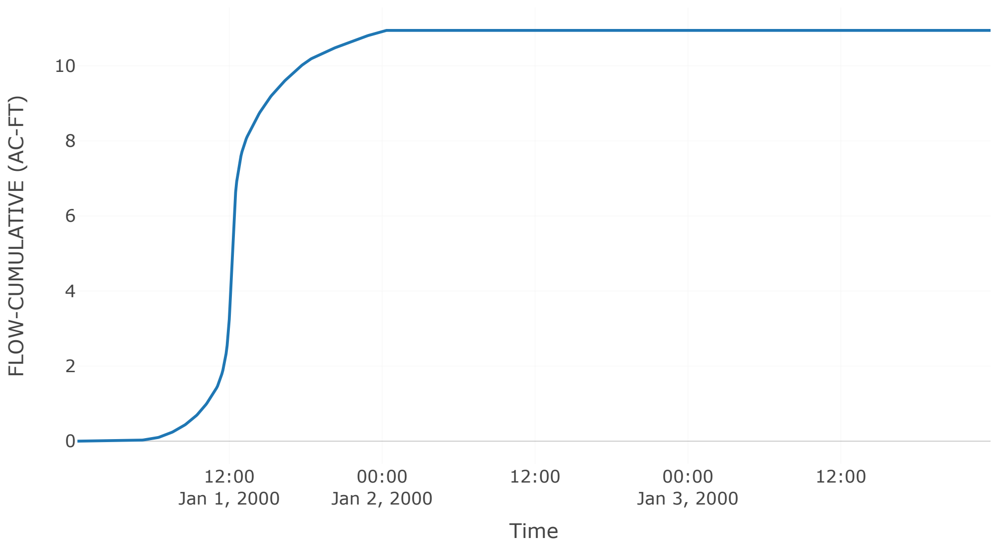


Precipitation and Outflow

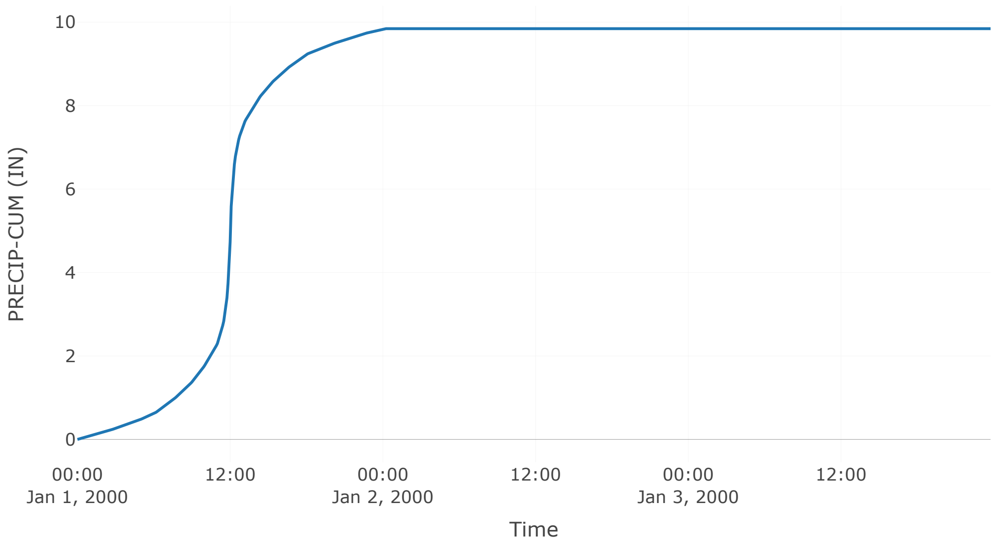


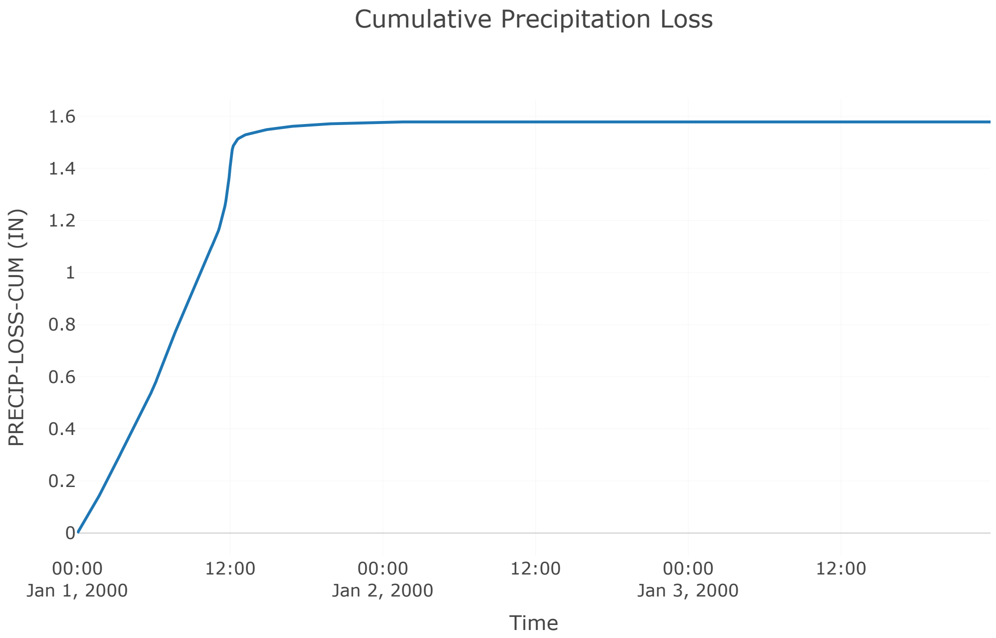
Cumulative Excess Precipitation

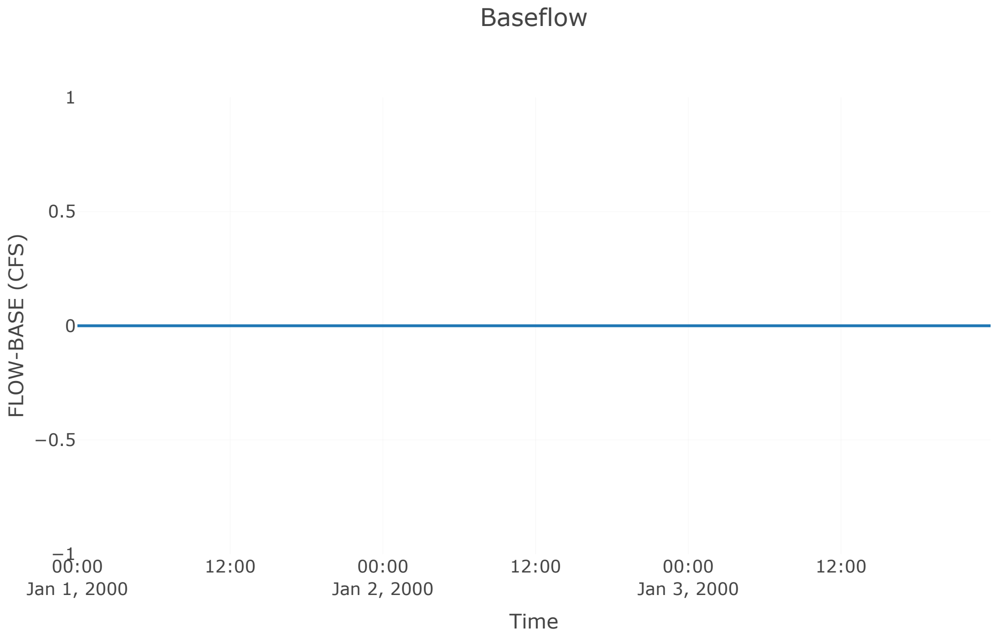
Cumulative Outflow

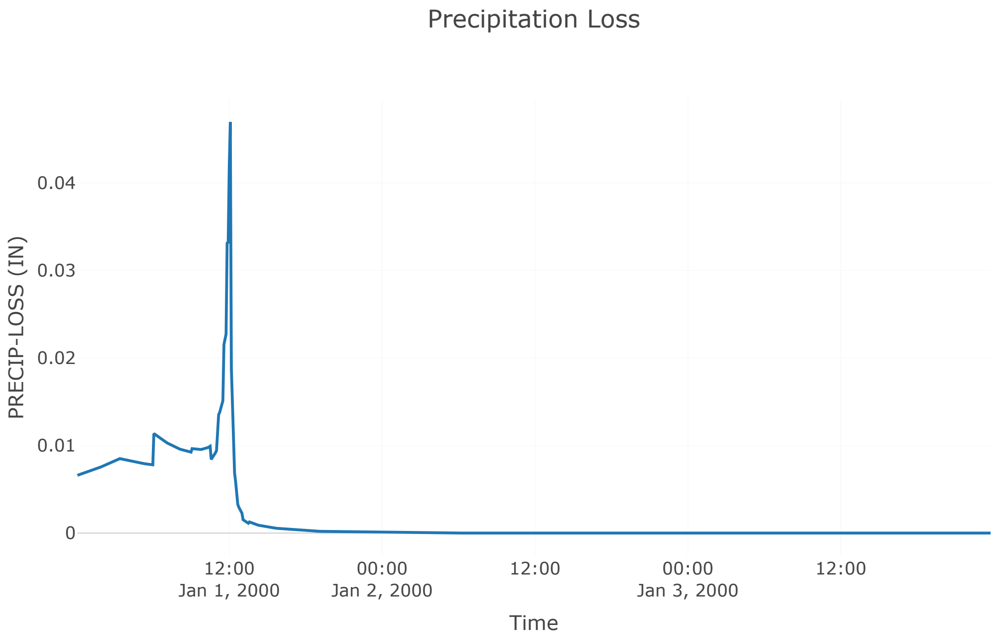


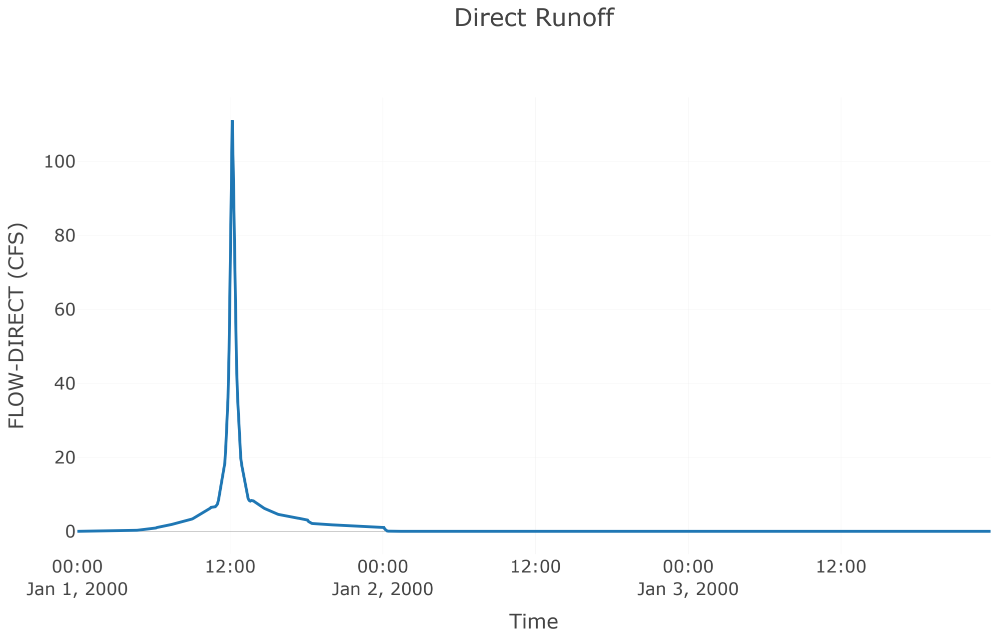
Cumulative Precipitation

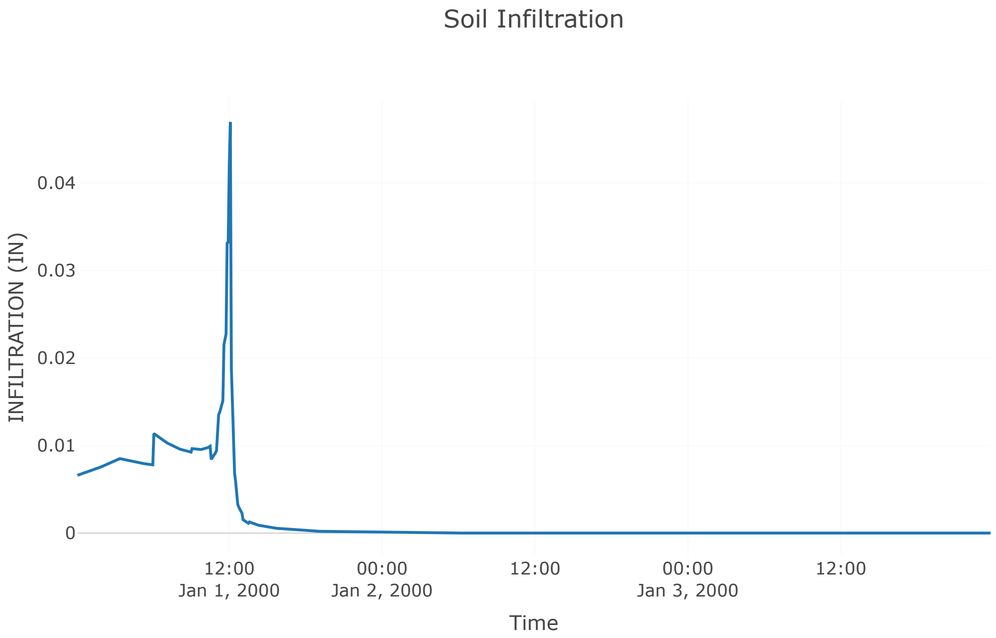



Cumulative Precipitation Loss
PRECIP-LOSS-CUM (IN)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Baseflow
FLOW-BASE (CFS)
1
0.5
0
−0.5
−1
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Precipitation Loss
PRECIP-LOSS (IN)
0.04
0.03
0.02
0.01
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Direct Runoff
FLOW-DIRECT (CFS)
100
80
60
40
20
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Soil Infiltration
INFILTRATION (IN)
0.04
0.03
0.02
0.01
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

Reach: Reach-2

Downstream : Ash Culvert

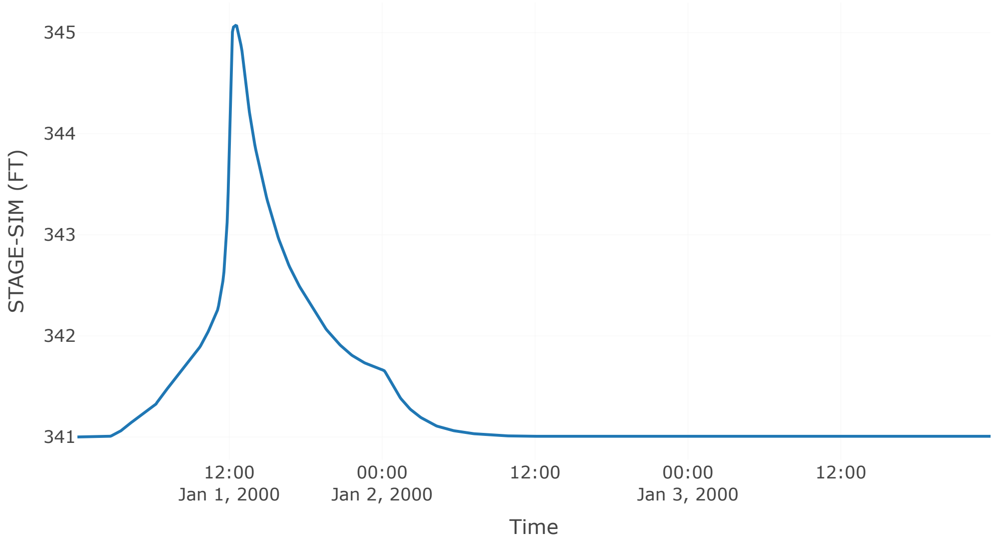
Route: Muskingum Cunge

Method	Muskingum Cunge
Channel	Trapezoid
Length (ft)	1430
Energy Slope	0
Mannings n	0.08
Bottom Width	26.46
Side Slope	2
Initial Variable	Combined Inflow
Space - Time Method	Automatic DX and DT
Index Parameter Type	Index Celerity
Index Celerity	5
Invert Elevation	341
Maximum Depth Iterations	20
Maximum Route Step Iterations	30

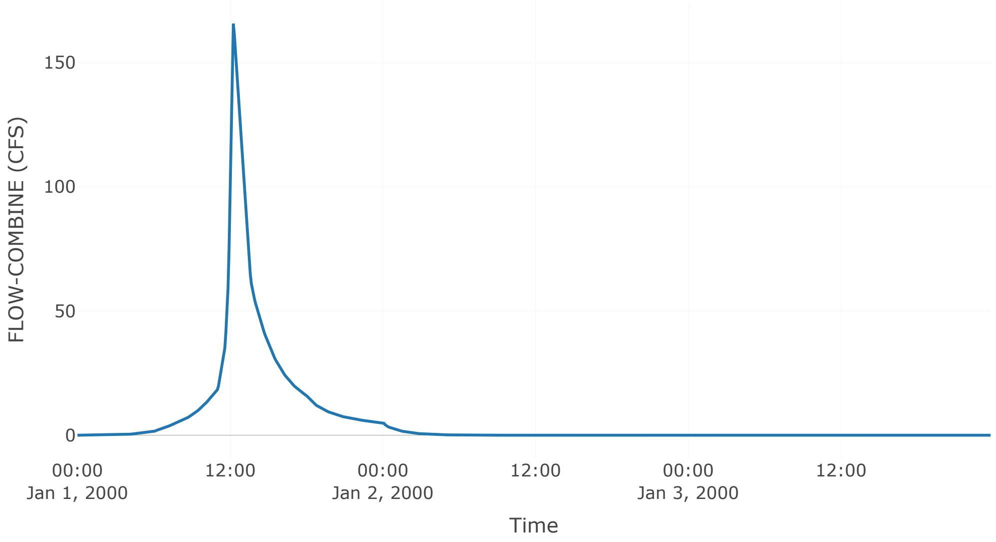
Results: Reach-2

Peak Discharge (CFS)	118.43
Time of Peak Discharge	01Jan2000, 12:30
Volume (IN)	7.9
Peak Inflow (CFS)	165.7
Inflow Volume (AC - FT)	38.5

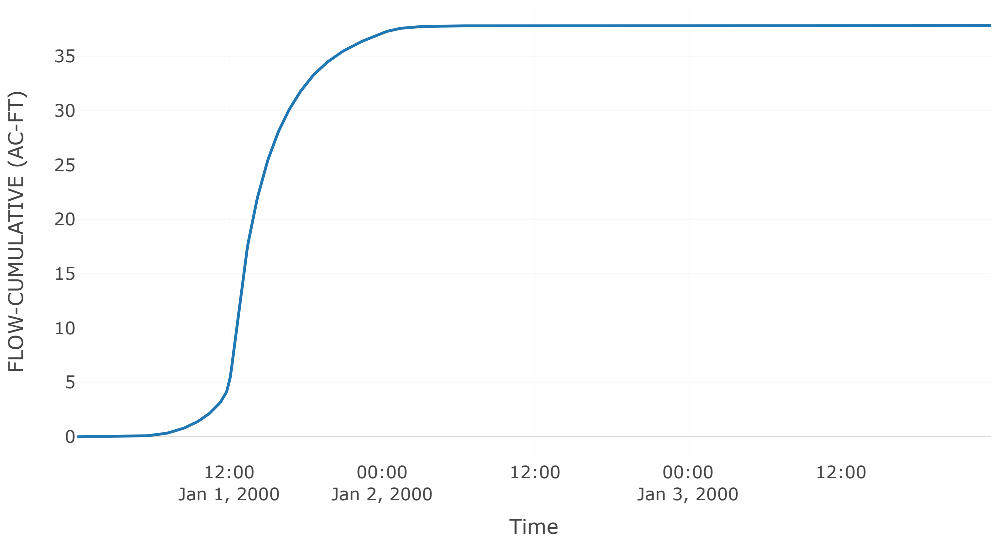
Computed Stage



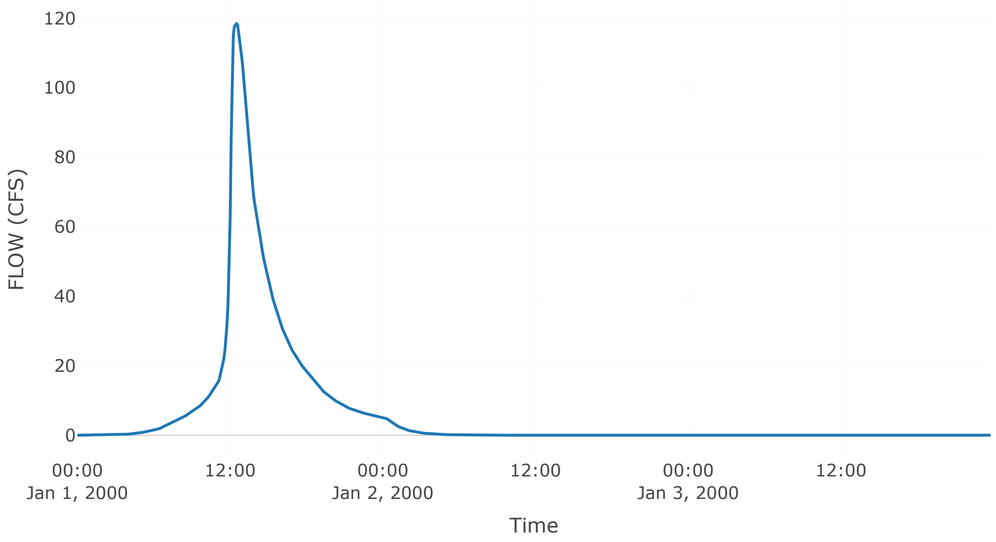
Combined Inflow

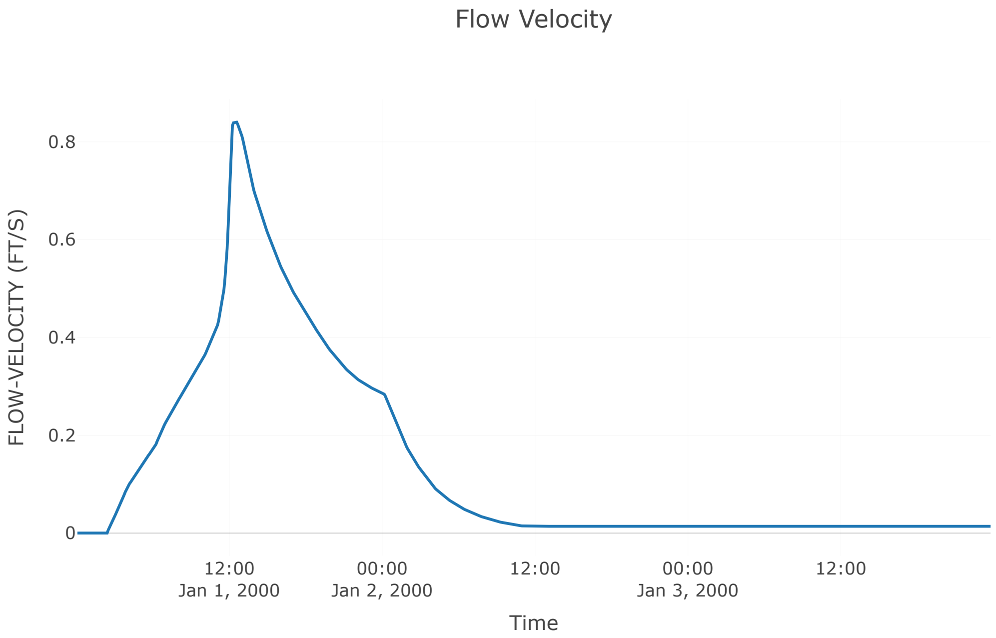


Cumulative Outflow



Outflow




Flow Velocity
FLOW-VELOCITY (FT/S)
0.8
0.6
0.4
0.2
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

Subbasin: AshStorageA

Area (ft²) : 0.03
Downstream : Ash Culvert

Loss Rate: Scs

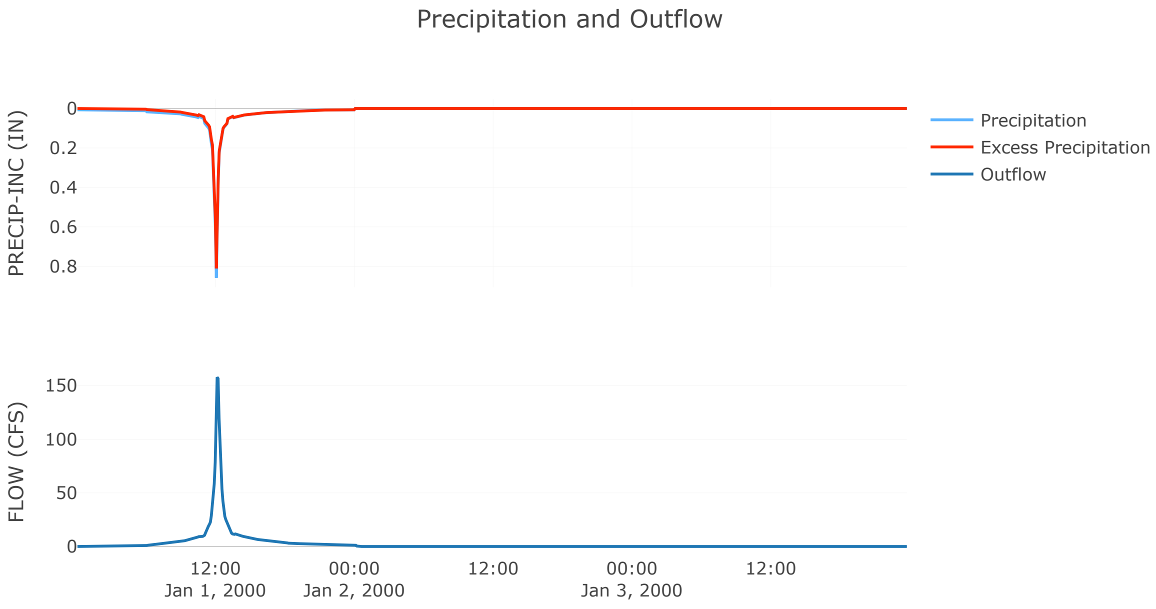
Percent Impervious Area	0
Curve Number	87.1

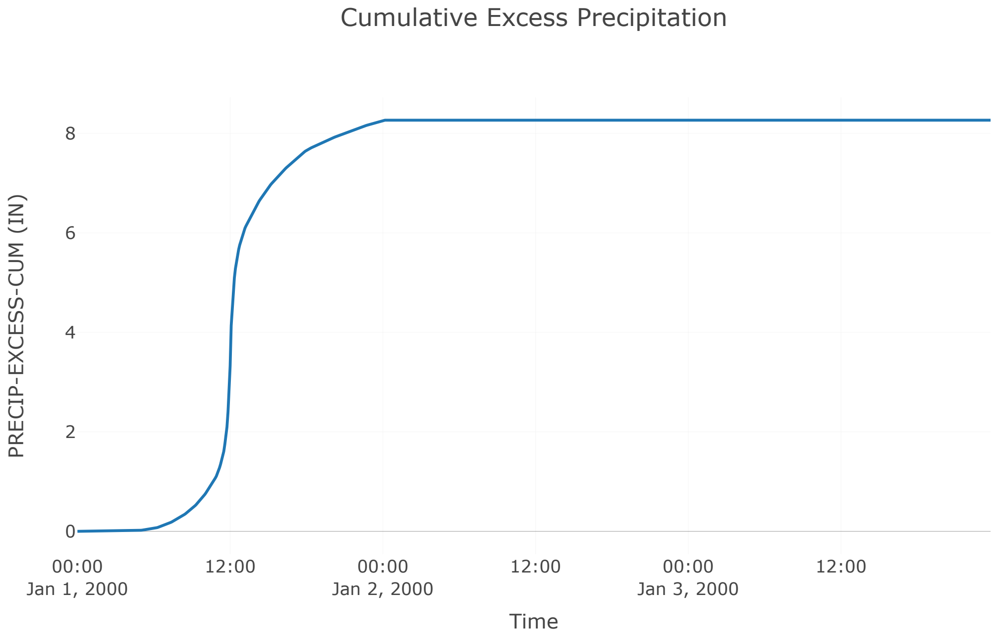
Transform: Scs

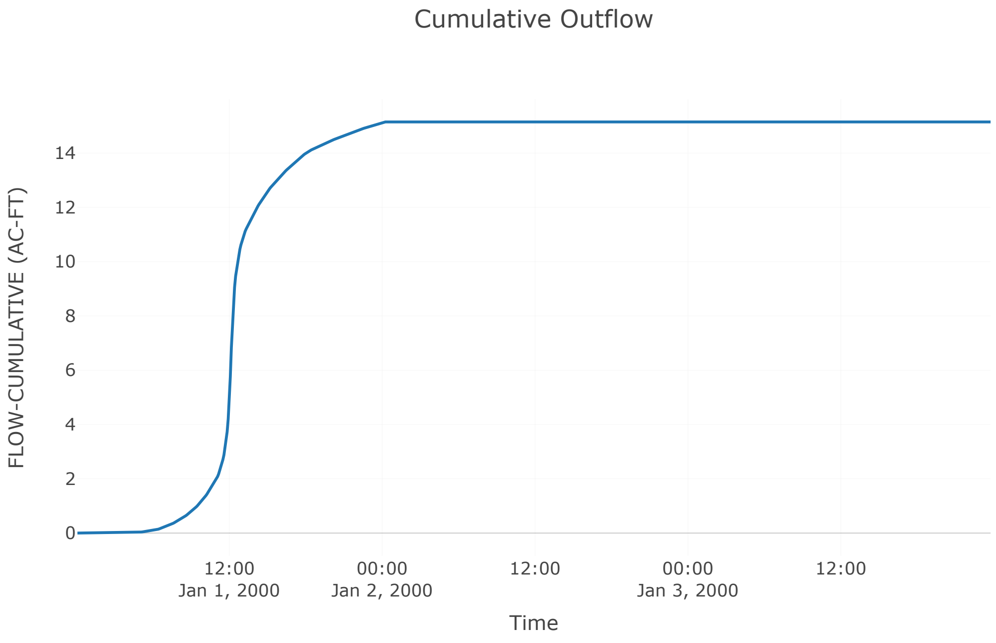
Lag	5.28
Unitgraph Type	Standard

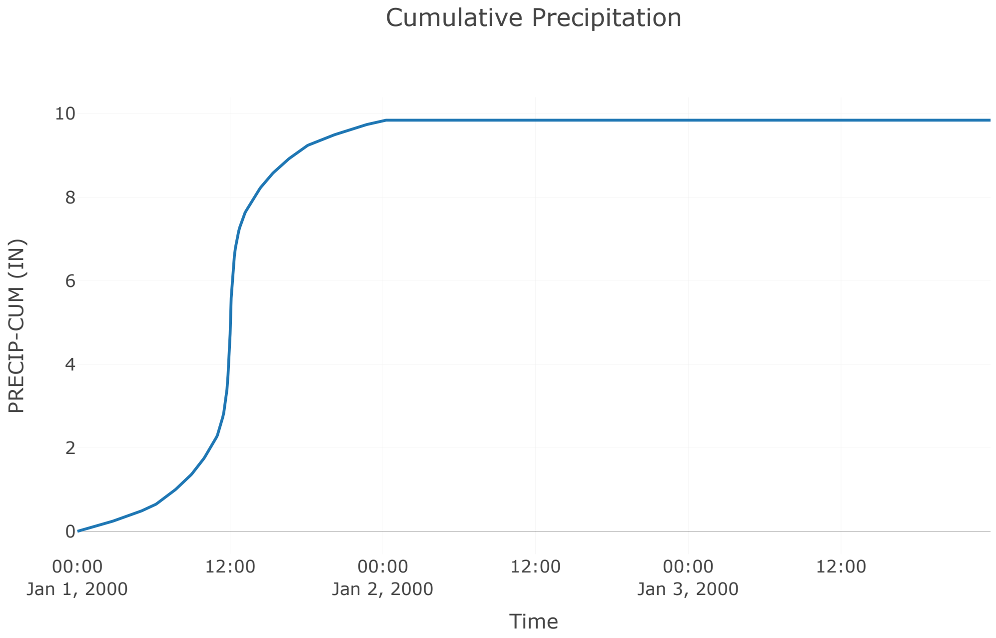
Results: AshStorageA

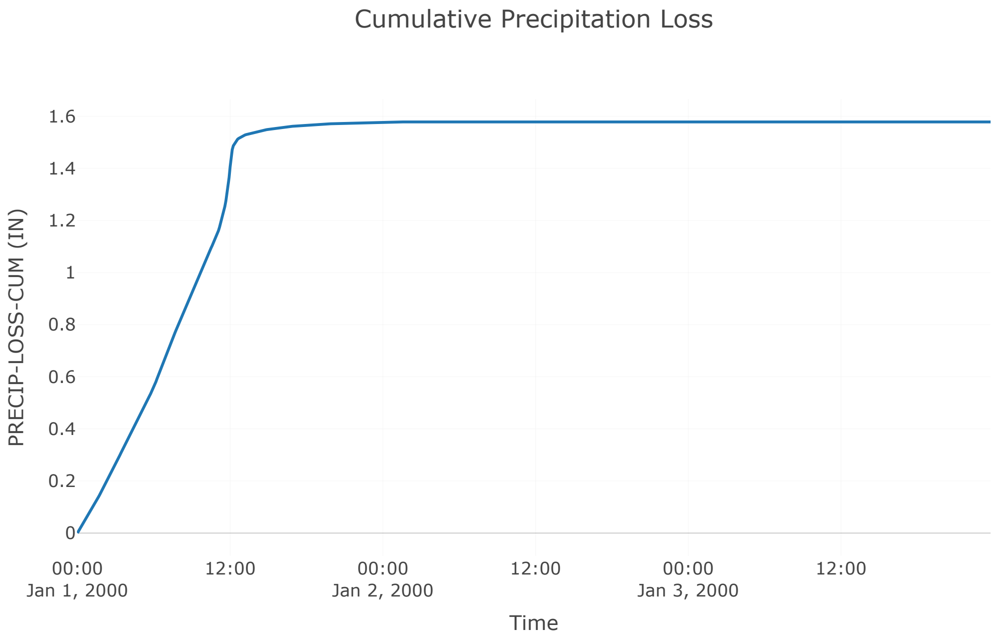
Peak Discharge (CFS)	157.92
Time of Peak Discharge	01Jan2000, 12:05
Volume (IN)	8.27
Precipitation Volume (AC - FT)	18.04
Loss Volume (AC - FT)	2.89
Excess Volume (AC - FT)	15.15
Direct Runoff Volume (AC - FT)	15.15
Baseflow Volume (AC - FT)	0

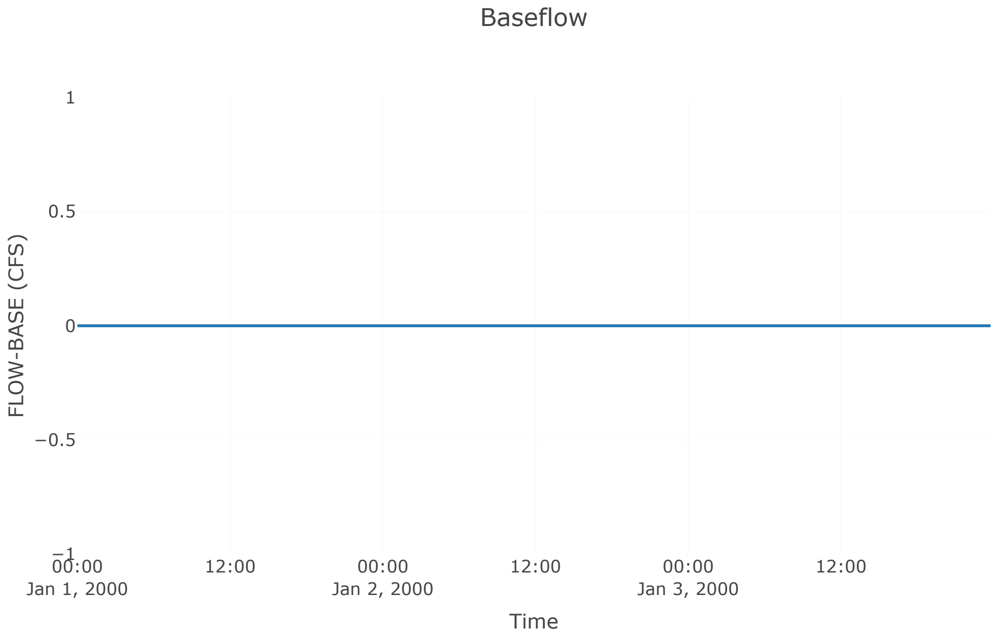

Precipitation and Outflow
PRECIP-INC (IN)
0
0.2
0.4
0.6
0.8
Precipitation
Excess Precipitation
Outflow
FLOW (CFS)
150
100
50
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00

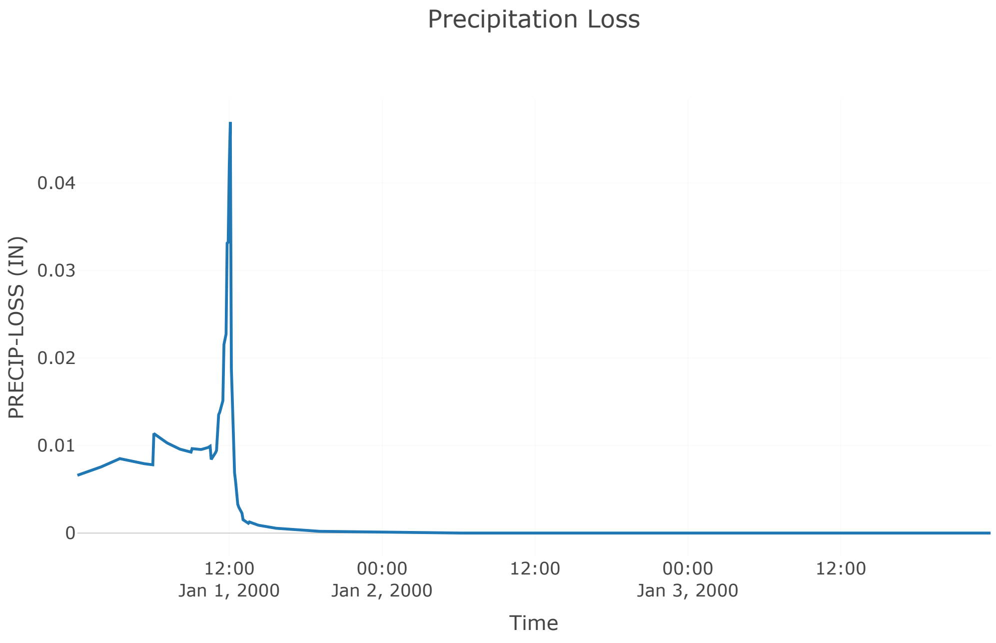

Cumulative Excess Precipitation
PRECIP-EXCESS-CUM (IN)
8
6
4
2
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

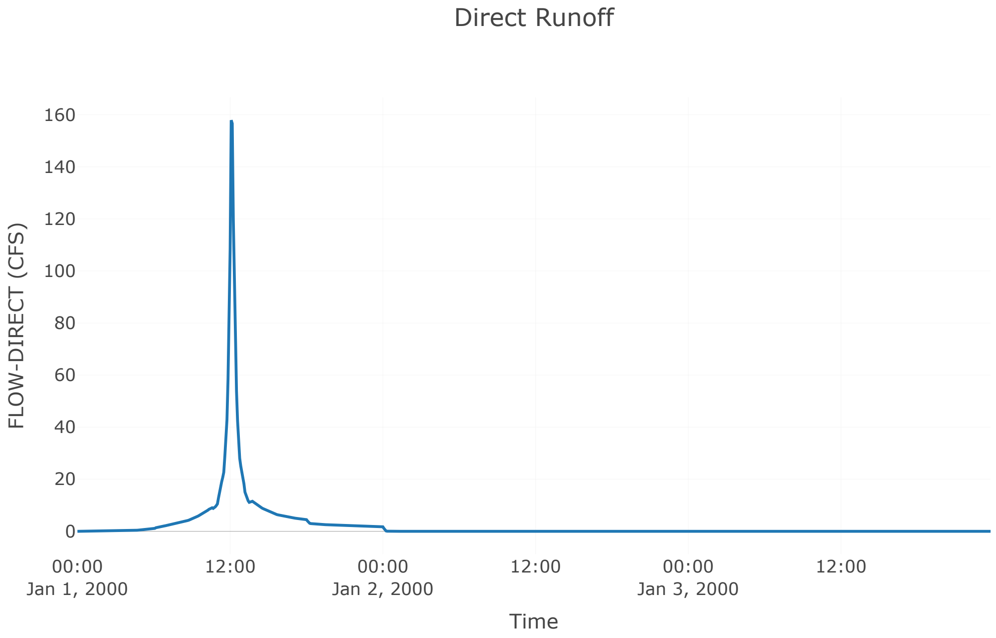

Cumulative Outflow
FLOW-CUMULATIVE (AC-FT)
0
2
4
6
8
10
12
14
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

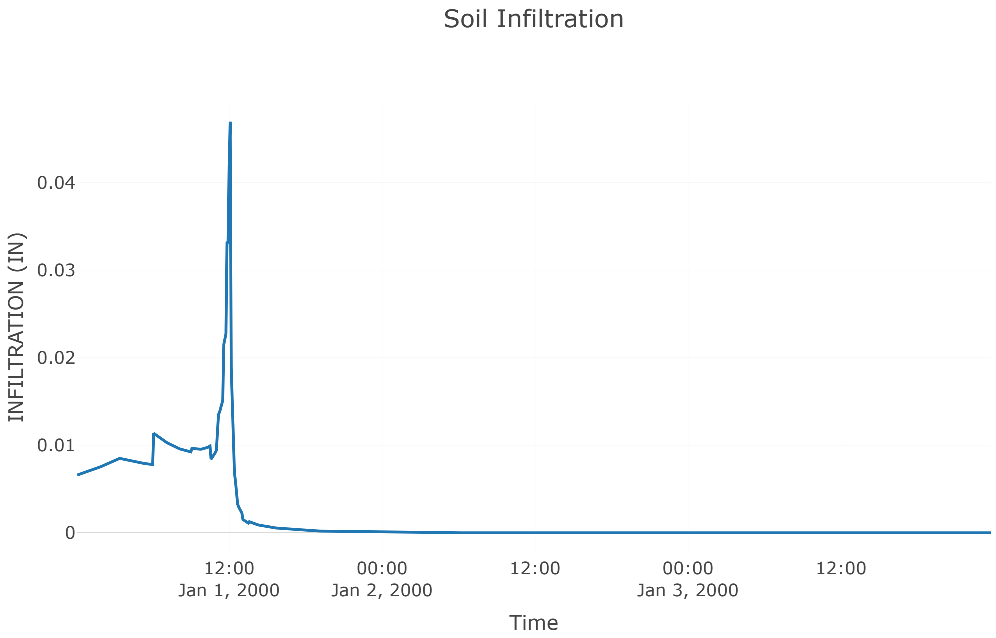

Cumulative Precipitation
PRECIP-CUM (IN)
0
2
4
6
8
10
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Cumulative Precipitation Loss
PRECIP-LOSS-CUM (IN)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Baseflow
FLOW-BASE (CFS)
1
0.5
0
−0.5
−1
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Precipitation Loss
PRECIP-LOSS (IN)
0.04
0.03
0.02
0.01
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Direct Runoff
FLOW-DIRECT (CFS)
160
140
120
100
80
60
40
20
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

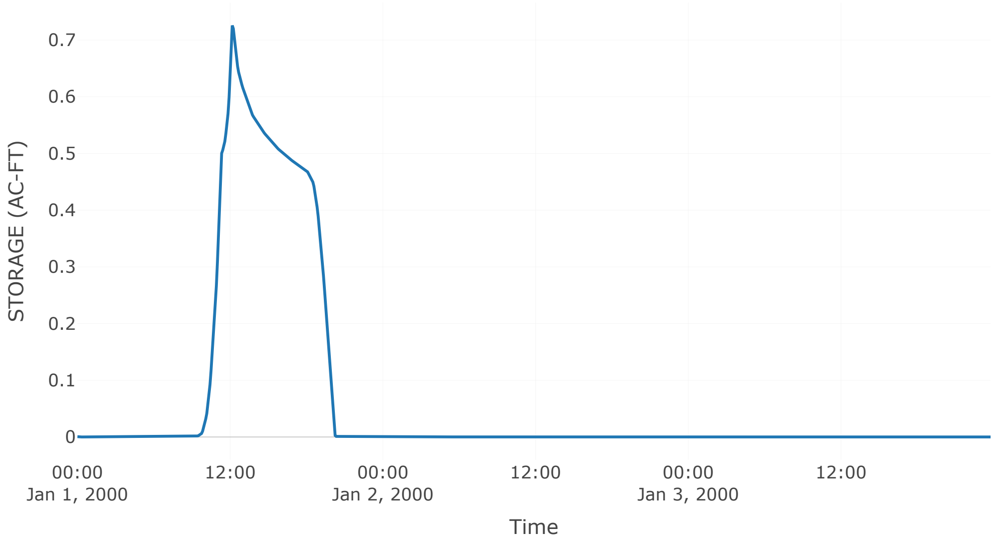

Soil Infiltration
INFILTRATION (IN)
0.04
0.03
0.02
0.01
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

Reservoir: AshCulvert

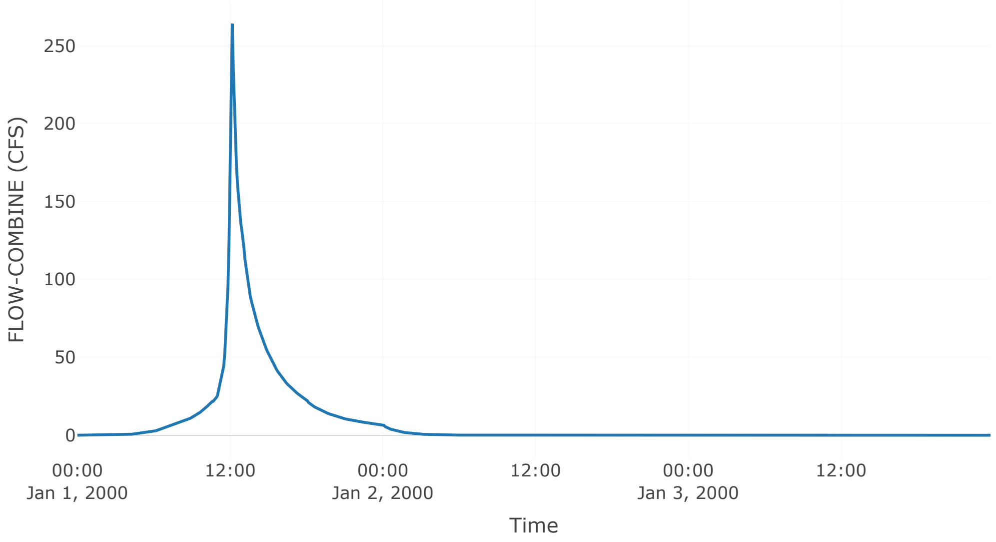
Downstream : Primary Pond

Results: AshCulvert	
Peak Discharge (CFS)	253.9
Time of Peak Discharge	01Jan2000, 12:10
Volume (IN)	7.97
Peak Inflow (CFS)	264.17
Time of Peak Inflow	01Jan2000, 12:15
Inflow Volume (AC - FT)	52.97
Maximum Storage (AC - FT)	0.73
Peak Elevation (FT)	343.91
Discharge Volume (AC - FT)	52.74

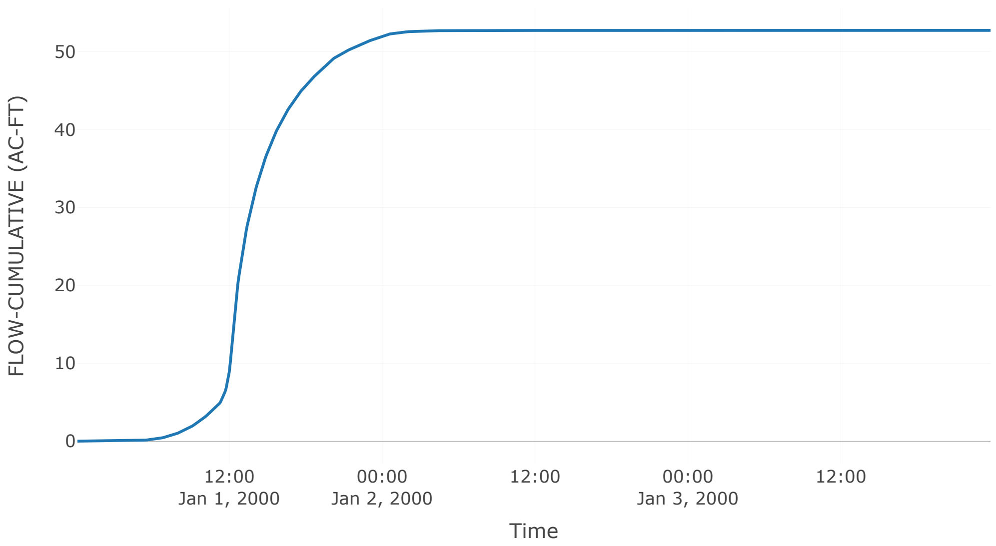
Storage



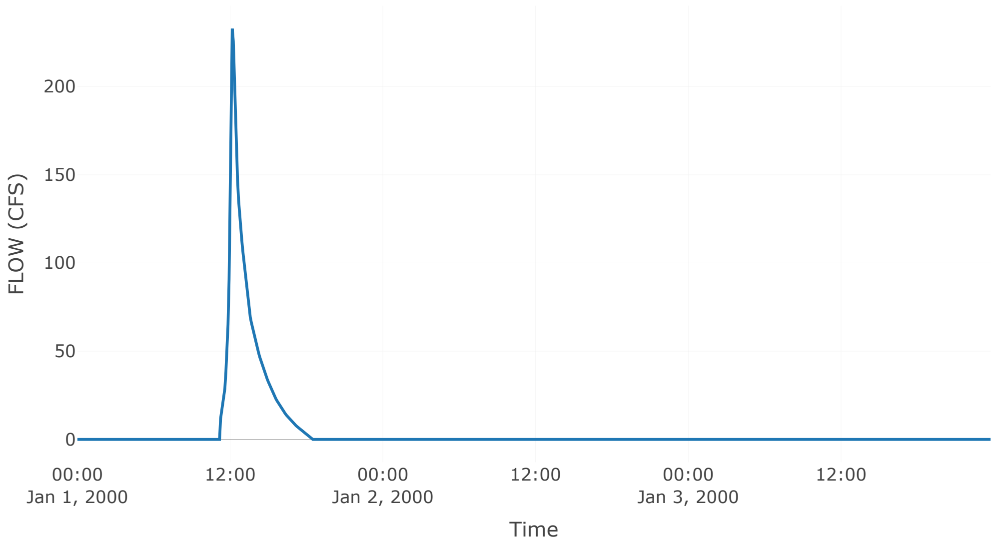
Combined Inflow

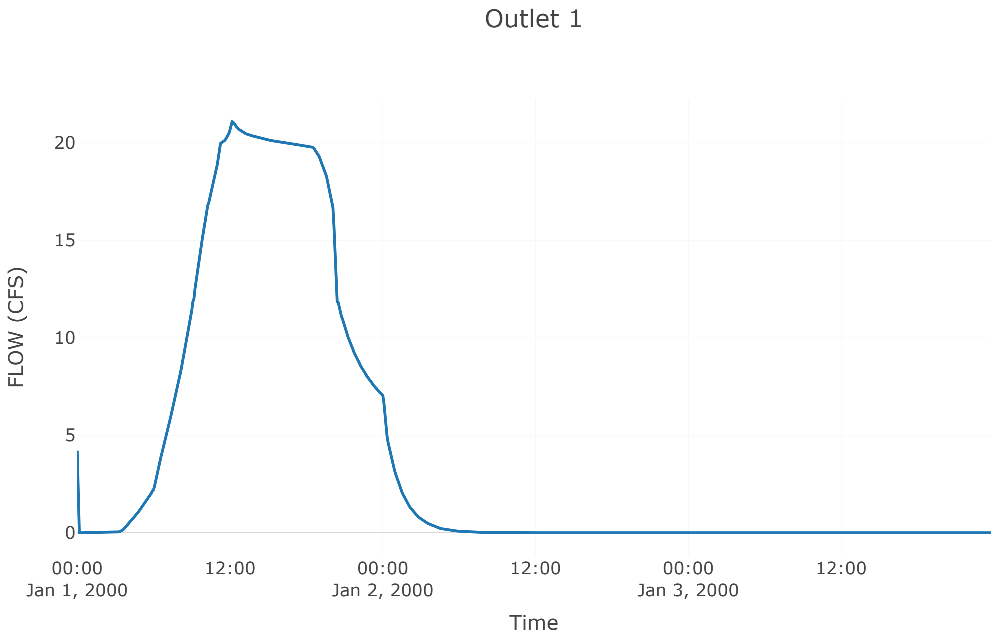


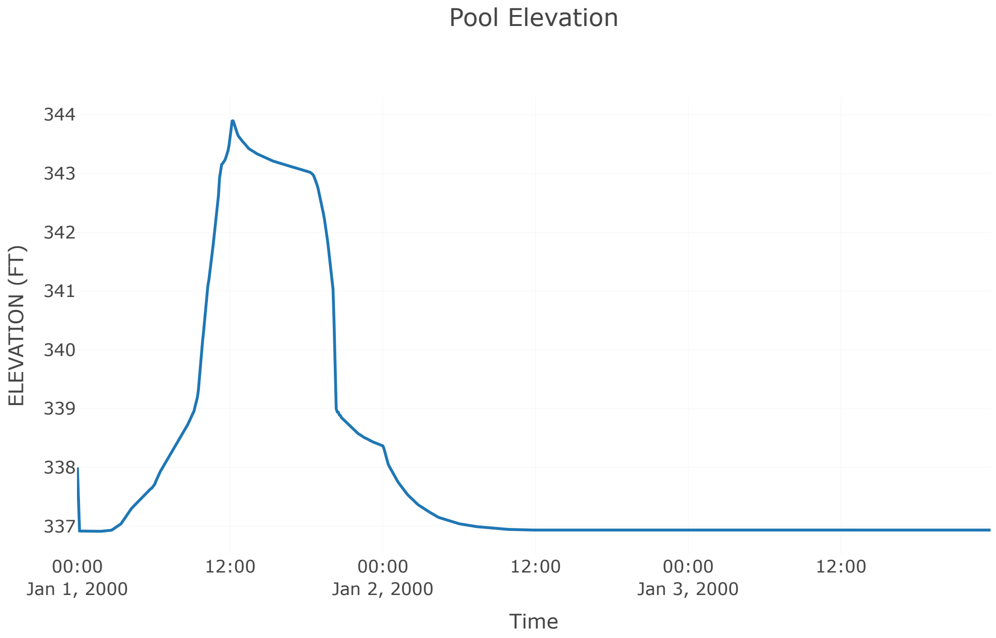
Cumulative Outflow

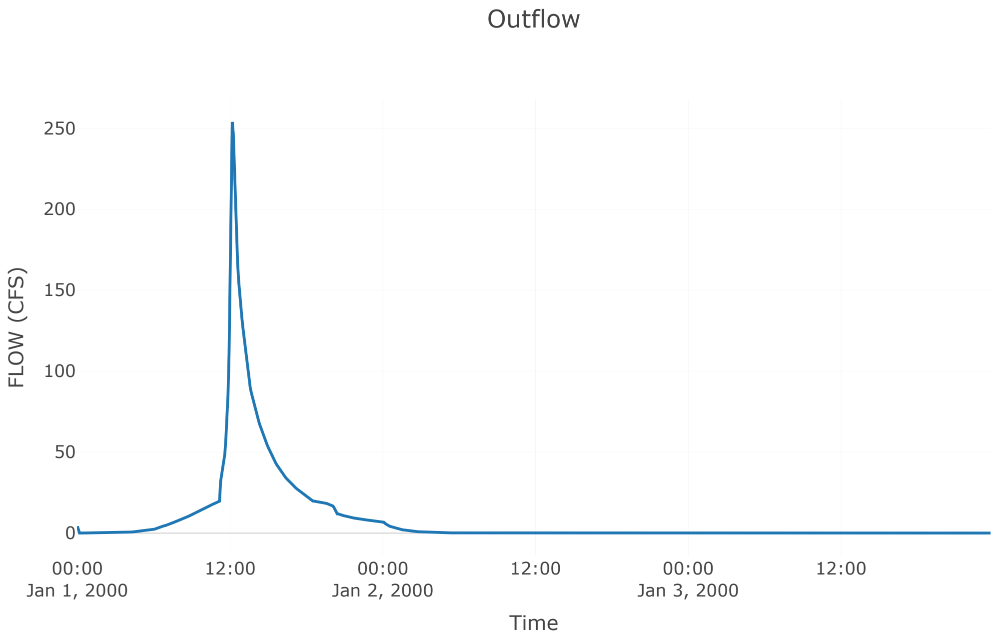


Spillway 1




Outlet 1
FLOW (CFS)
20
15
10
5
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Pool Elevation
ELEVATION (FT)
344
343
342
341
340
339
338
337
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

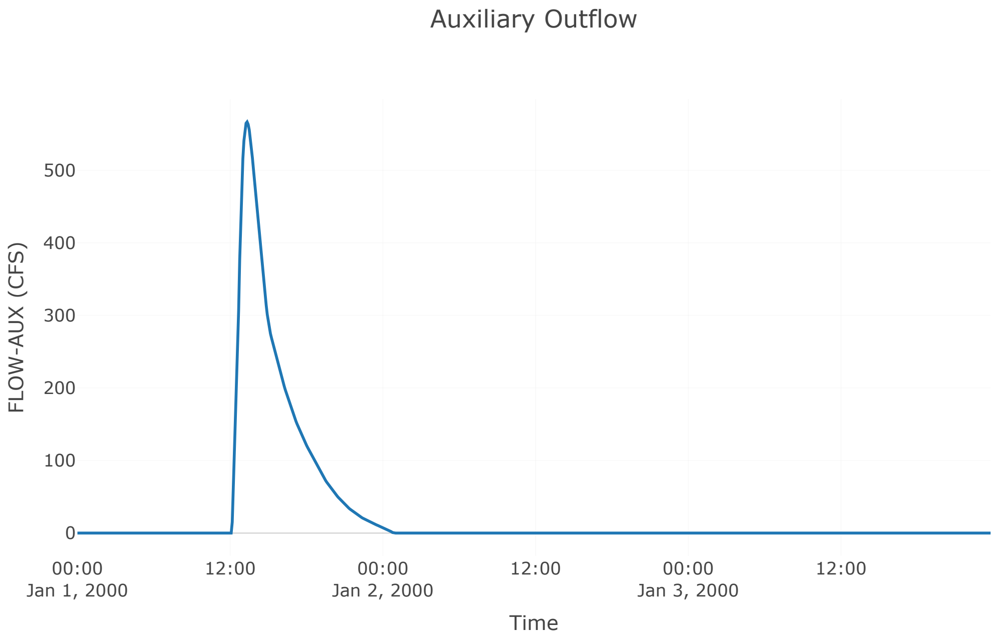

Outflow
FLOW (CFS)
250
200
150
100
50
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

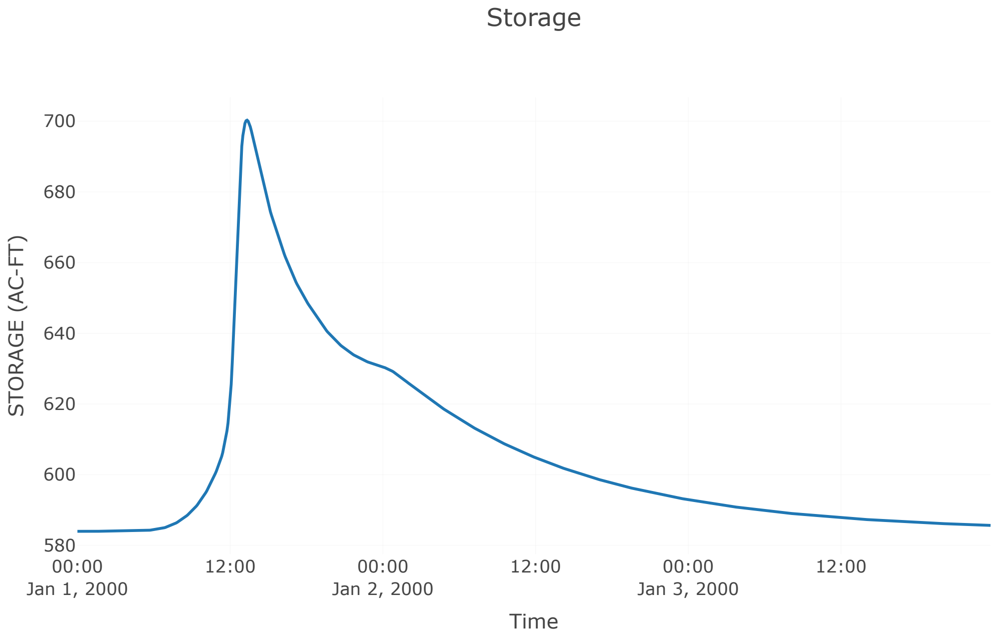
Reservoir: PrimaryPond

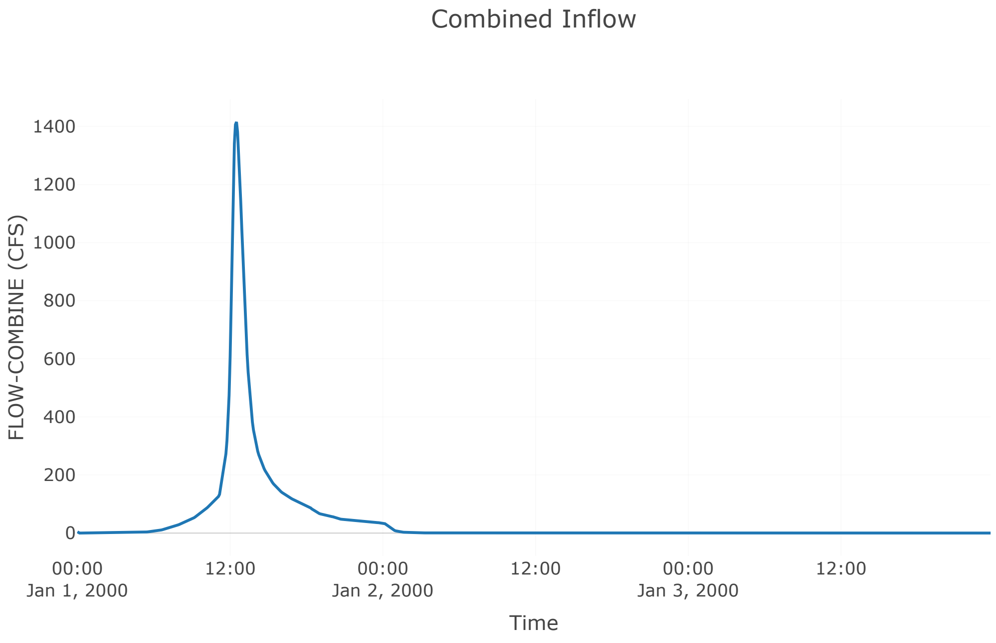
Downstream : Reach - 1

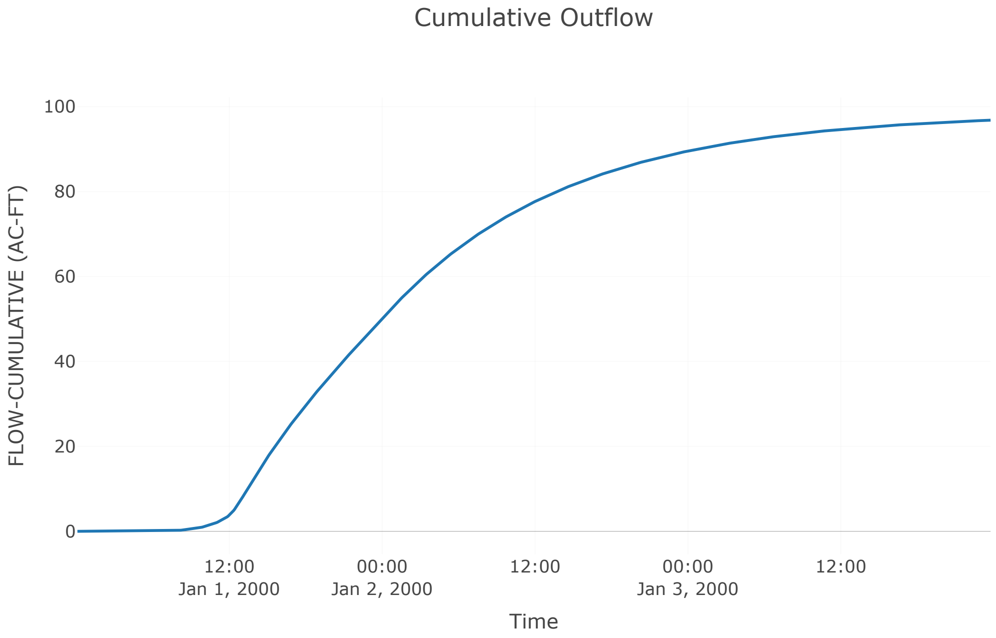
Results: PrimaryPond

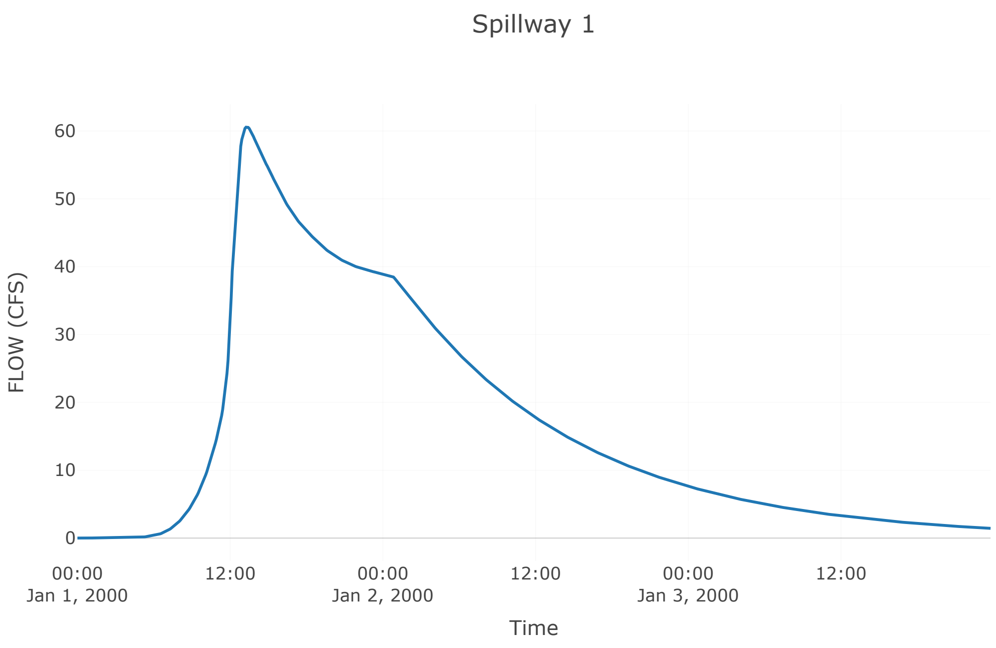
Peak Discharge (CFS)	60.6
Time of Peak Discharge	01Jan2000, 13:20
Volume (IN)	2.71
Peak Inflow (CFS)	1415.62
Time of Peak Inflow	01Jan2000, 12:35
Inflow Volume (AC - FT)	264
Maximum Storage (AC - FT)	700.28
Peak Elevation (FT)	335.5
Discharge Volume (AC - FT)	96.8

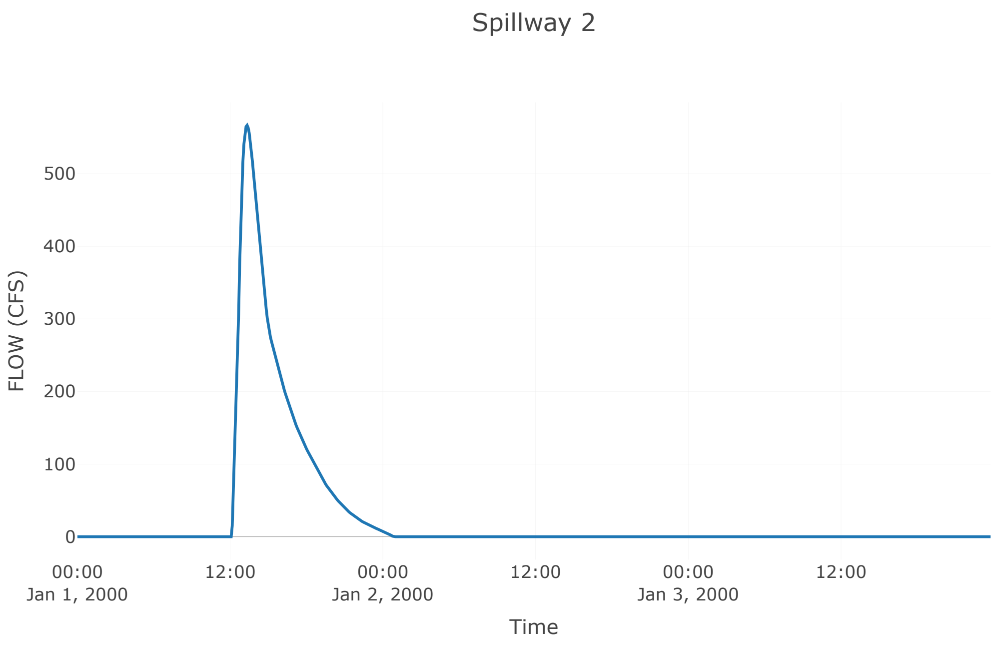

Auxiliary Outflow
FLOW-AUX (CFS)
500
400
300
200
100
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

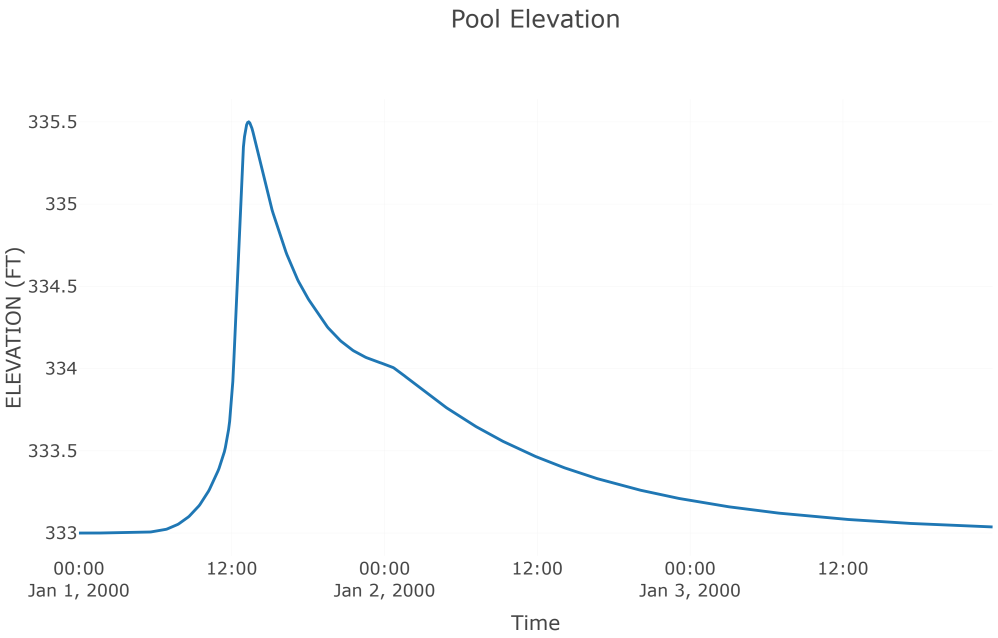

Storage
STORAGE (AC-FT)
700
680
660
640
620
600
580
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

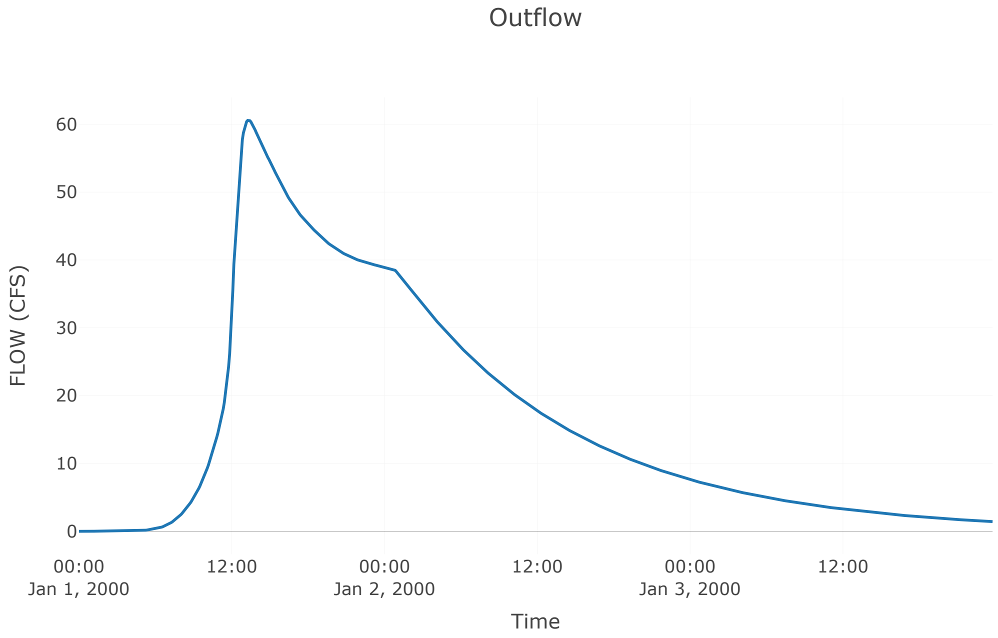

Combined Inflow
FLOW-COMBINE (CFS)
1400
1200
1000
800
600
400
200
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Cumulative Outflow
FLOW-CUMULATIVE (AC-FT)
100
80
60
40
20
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Spillway 1
FLOW (CFS)
60
50
40
30
20
10
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Spillway 2
FLOW (CFS)
500
400
300
200
100
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Pool Elevation
ELEVATION (FT)
335.5
335
334.5
334
333.5
333
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Outflow
FLOW (CFS)
60
50
40
30
20
10
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

Reach: Reach-1

Downstream : Secondary Pond

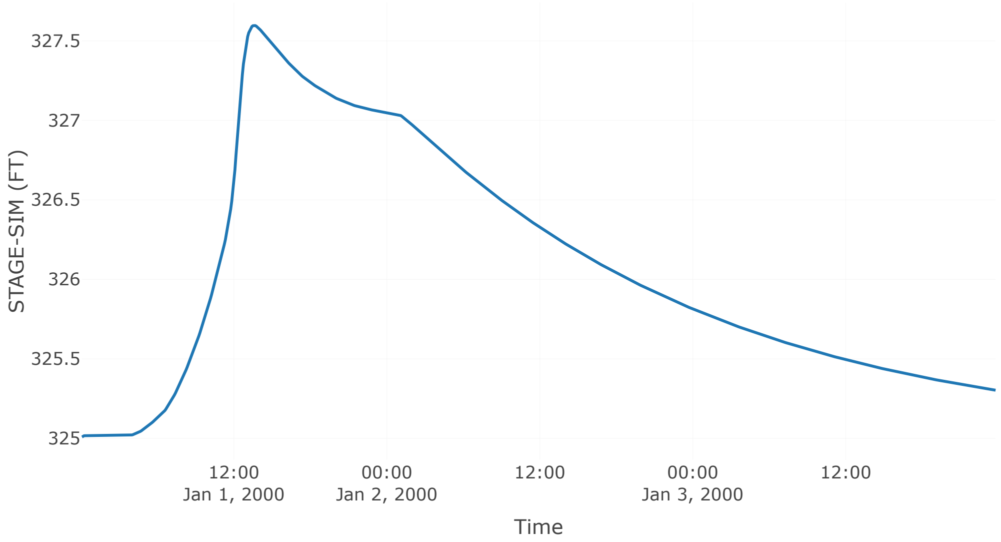
Route: Muskingum Cunge

Method	Muskingum Cunge
Channel	Trapezoid
Length (ft)	1210
Energy Slope	0
Mannings n	0.08
Bottom Width	15
Side Slope	2.5
Initial Variable	Combined Inflow
Space - Time Method	Automatic DX and DT
Index Parameter Type	Index Celerity
Index Celerity	5
Invert Elevation	325
Maximum Depth Iterations	20
Maximum Route Step Iterations	30

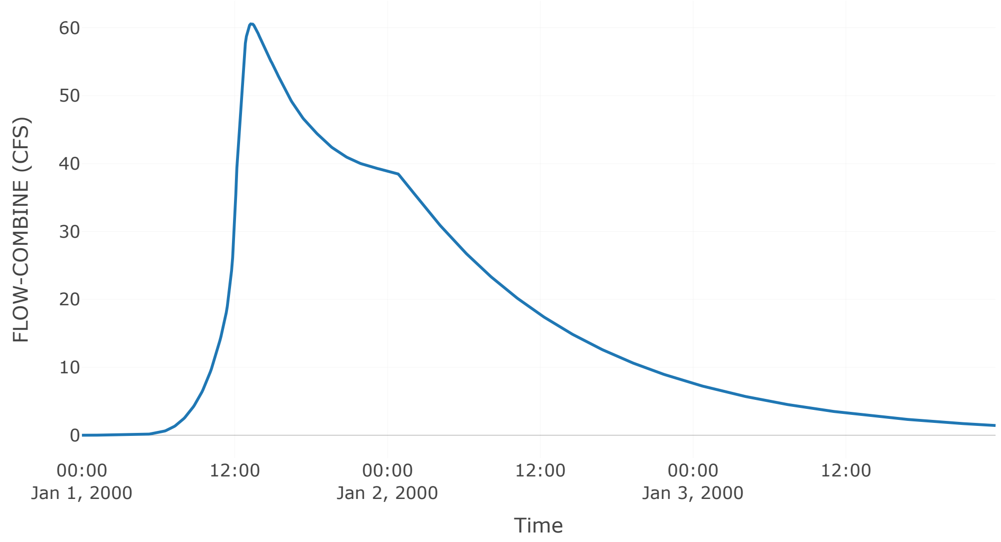
Results: Reach-1

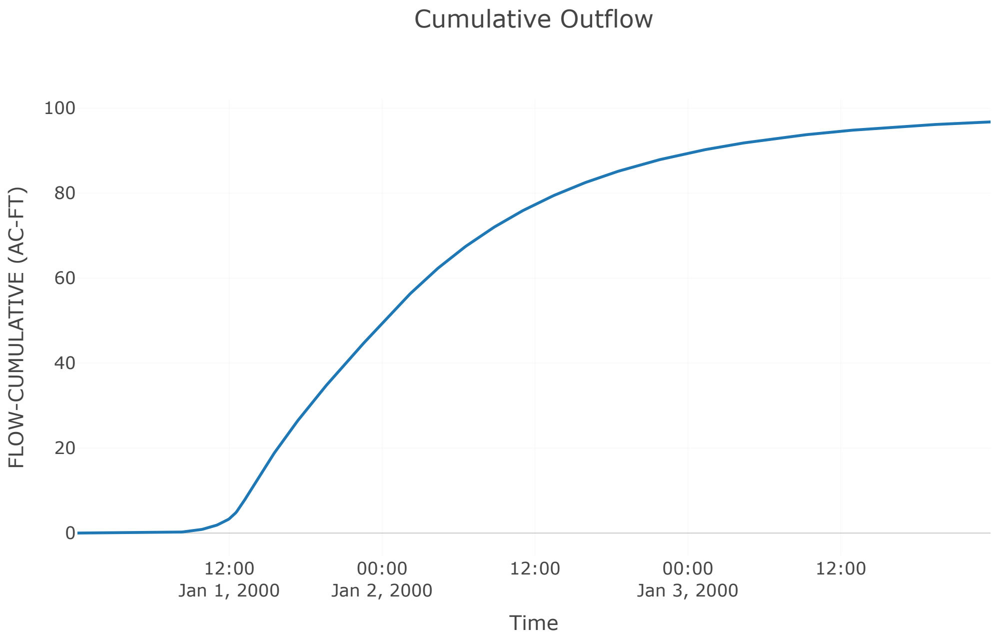
Peak Discharge (CFS)	60.16
Time of Peak Discharge	01Jan2000, 13:35
Volume (IN)	2.71
Peak Inflow (CFS)	60.6
Inflow Volume (AC - FT)	96.8

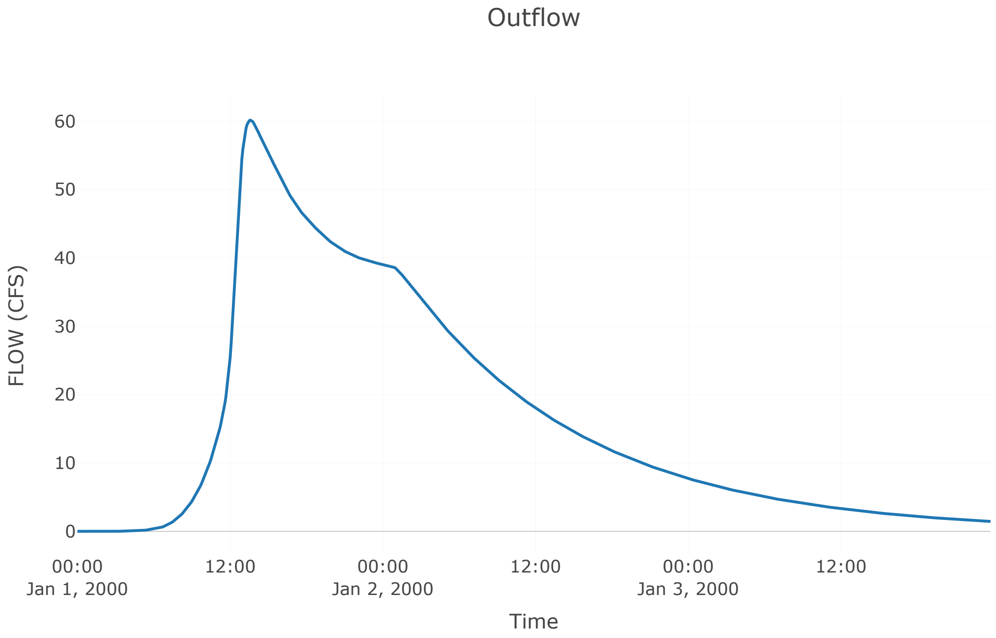
Computed Stage

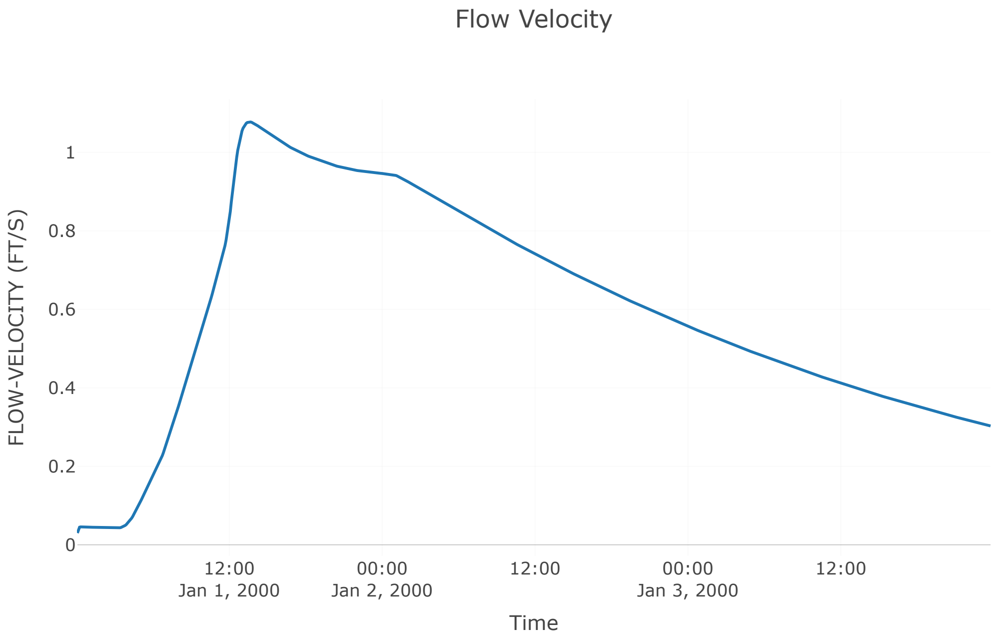


Combined Inflow




Cumulative Outflow
FLOW-CUMULATIVE (AC-FT)
100
80
60
40
20
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Outflow
FLOW (CFS)
60
50
40
30
20
10
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Flow Velocity
FLOW-VELOCITY (FT/S)
0
0.2
0.4
0.6
0.8
1
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

Subbasin: Secondary

Area (ft²) : 0.03
Downstream : Secondary Pond

Loss Rate: Scs

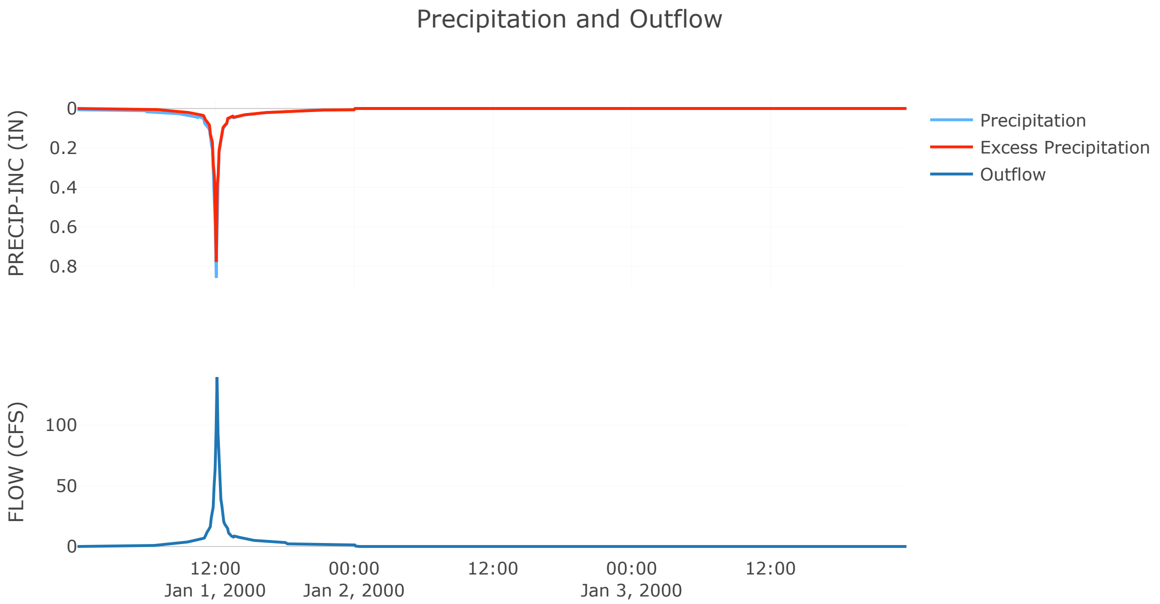
Percent Impervious Area	0
Curve Number	82.7

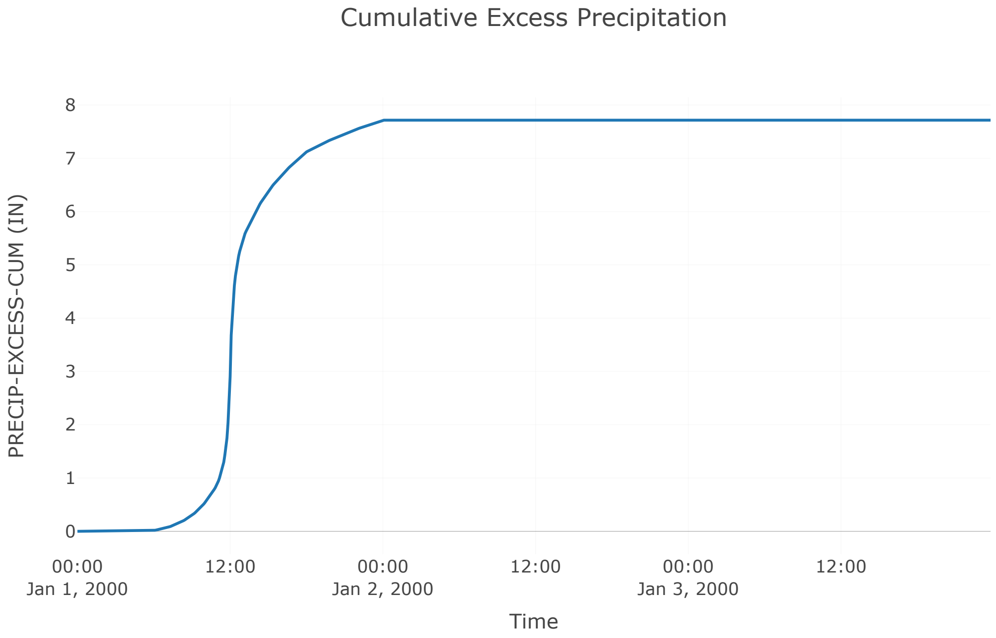
Transform: Scs

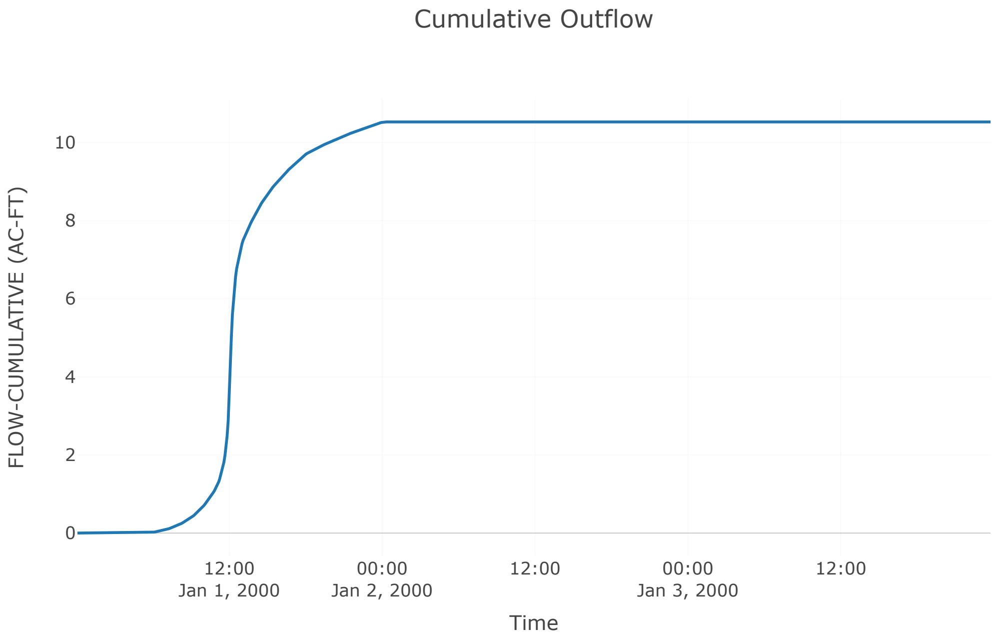
Lag	2.31
Unitgraph Type	Standard

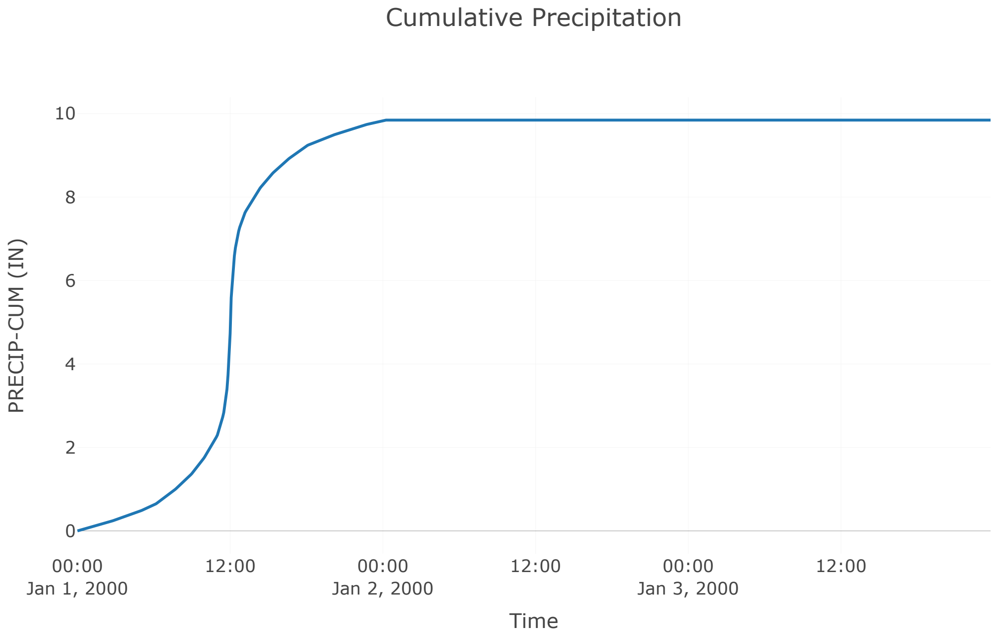
Results: Secondary

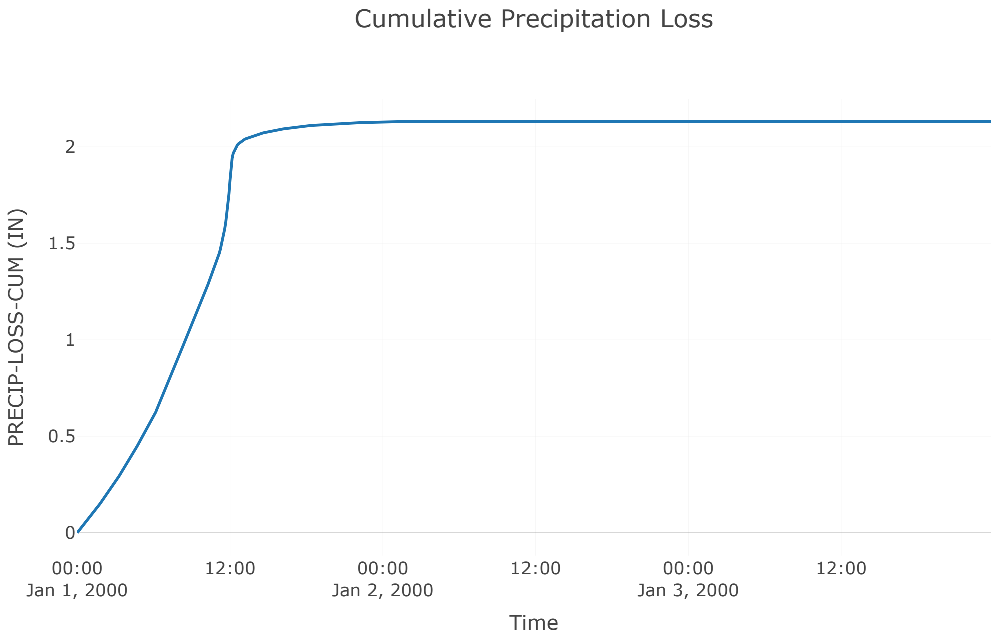
Peak Discharge (CFS)	139.43
Time of Peak Discharge	01Jan2000, 12:05
Volume (IN)	7.71
Precipitation Volume (AC - FT)	13.43
Loss Volume (AC - FT)	2.91
Excess Volume (AC - FT)	10.53
Direct Runoff Volume (AC - FT)	10.53
Baseflow Volume (AC - FT)	0

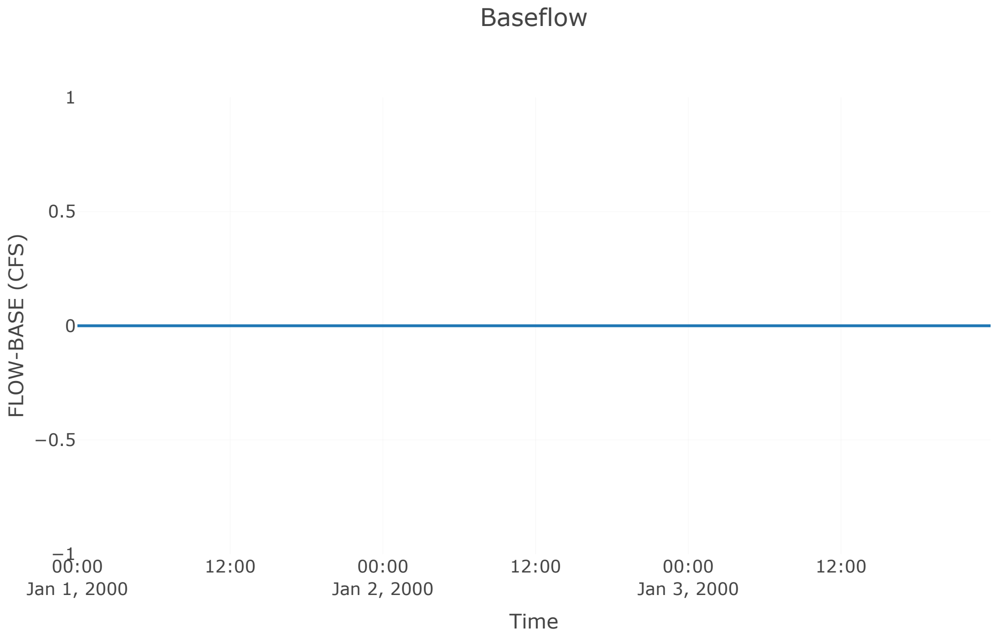

Precipitation and Outflow
PRECIP-INC (IN)
0
0.2
0.4
0.6
0.8
Precipitation
Excess Precipitation
Outflow
FLOW (CFS)
100
50
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00

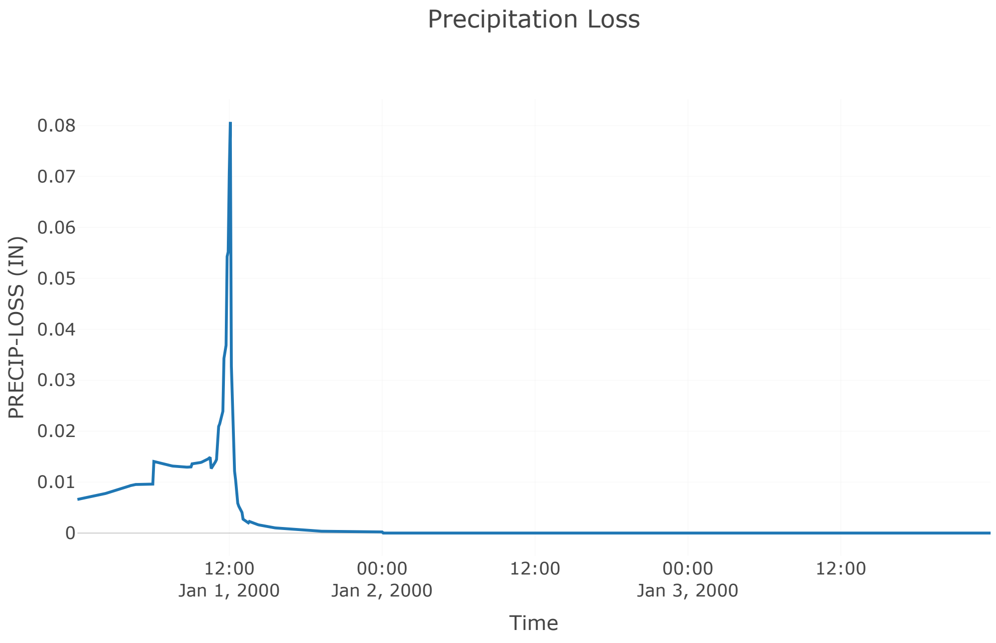

Cumulative Excess Precipitation
PRECIP-EXCESS-CUM (IN)
8
7
6
5
4
3
2
1
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

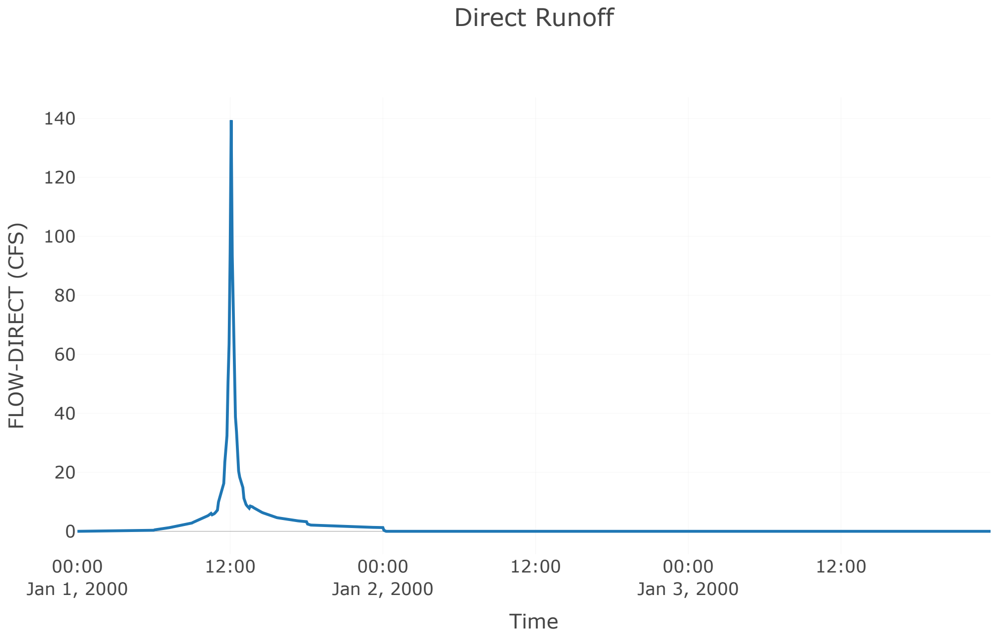

Cumulative Outflow
FLOW-CUMULATIVE (AC-FT)
0
2
4
6
8
10
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

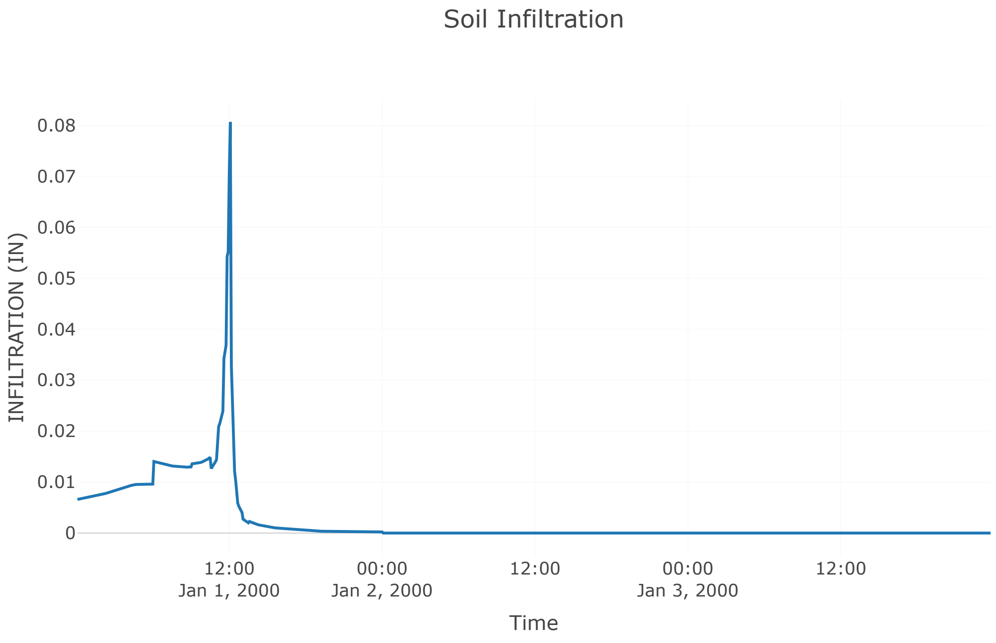

Cumulative Precipitation
PRECIP-CUM (IN)
0
2
4
6
8
10
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Cumulative Precipitation Loss
PRECIP-LOSS-CUM (IN)
2
1.5
1
0.5
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Baseflow
FLOW-BASE (CFS)
1
0.5
0
−0.5
−1
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Precipitation Loss
PRECIP-LOSS (IN)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

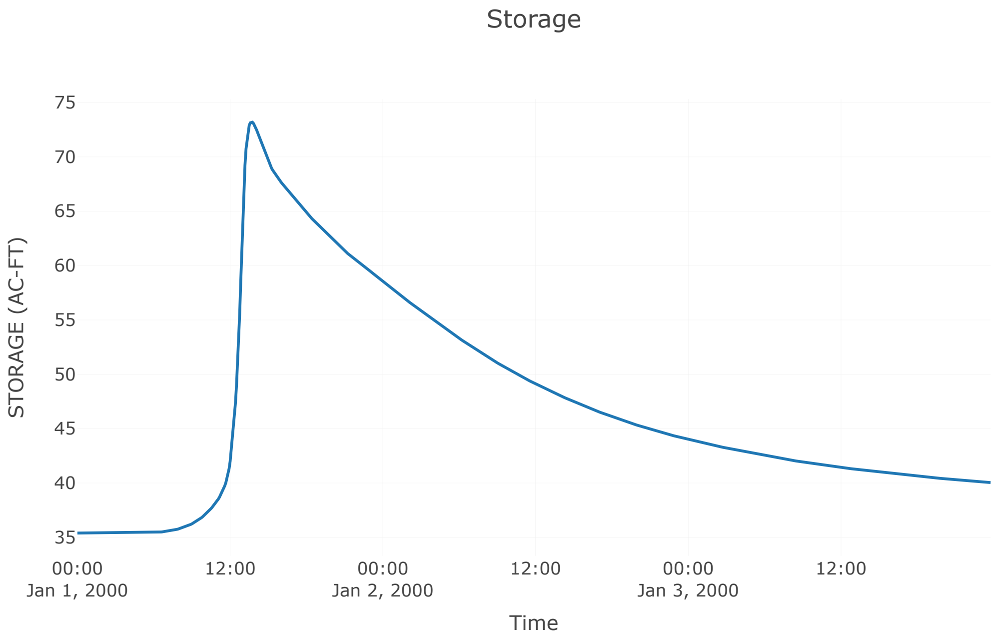

Direct Runoff
FLOW-DIRECT (CFS)
140
120
100
80
60
40
20
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

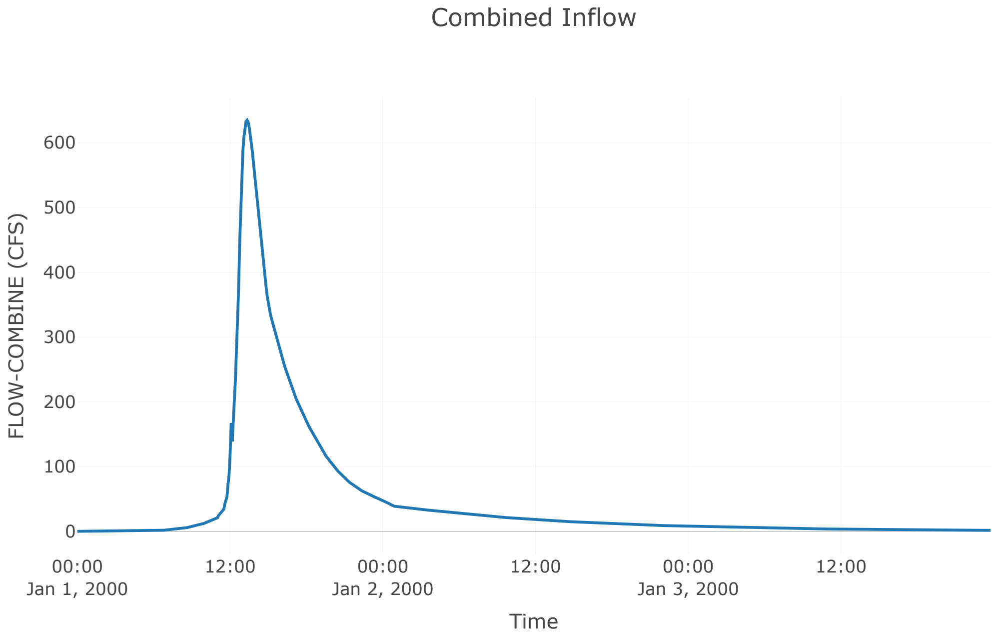

Soil Infiltration
INFILTRATION (IN)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

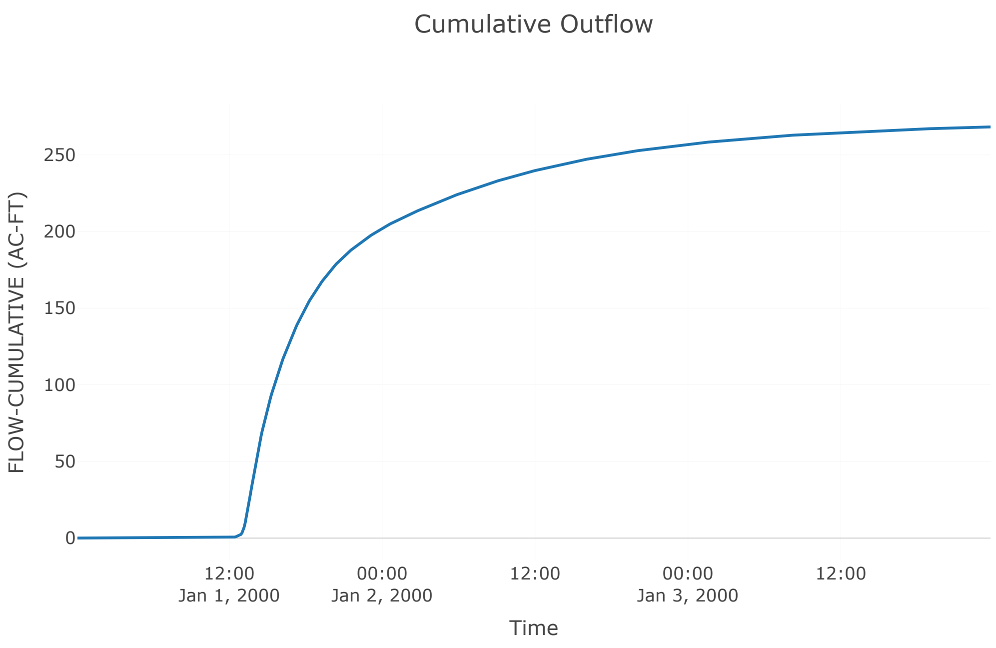
Reservoir: SecondaryPond

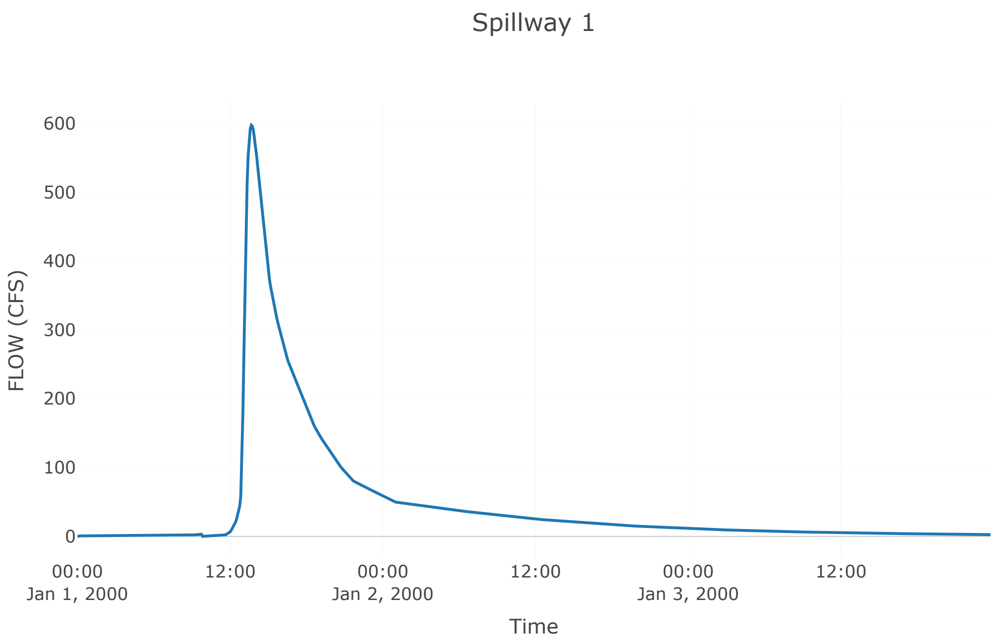
Results: SecondaryPond

Peak Discharge (CFS)	597.6
Time of Peak Discharge	01Jan2000, 13:40
Volume (IN)	7.23
Peak Inflow (CFS)	634.78
Time of Peak Inflow	01Jan2000, 13:20
Inflow Volume (AC - FT)	272.82
Maximum Storage (AC - FT)	73.22
Peak Elevation (FT)	336.48
Discharge Volume (AC - FT)	268.19

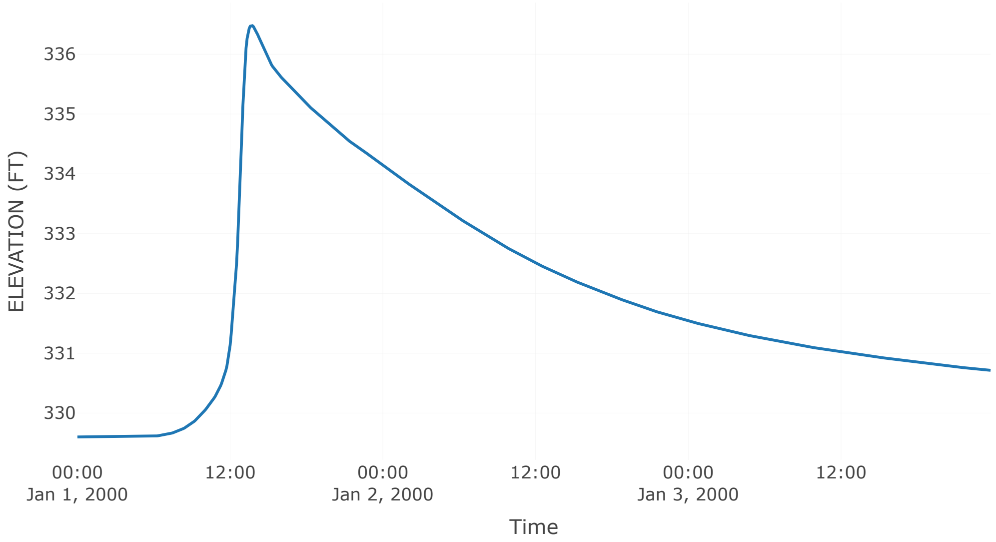

Storage
STORAGE (AC-FT)
75
70
65
60
55
50
45
40
35
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Combined Inflow
FLOW-COMBINE (CFS)
600
500
400
300
200
100
0
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

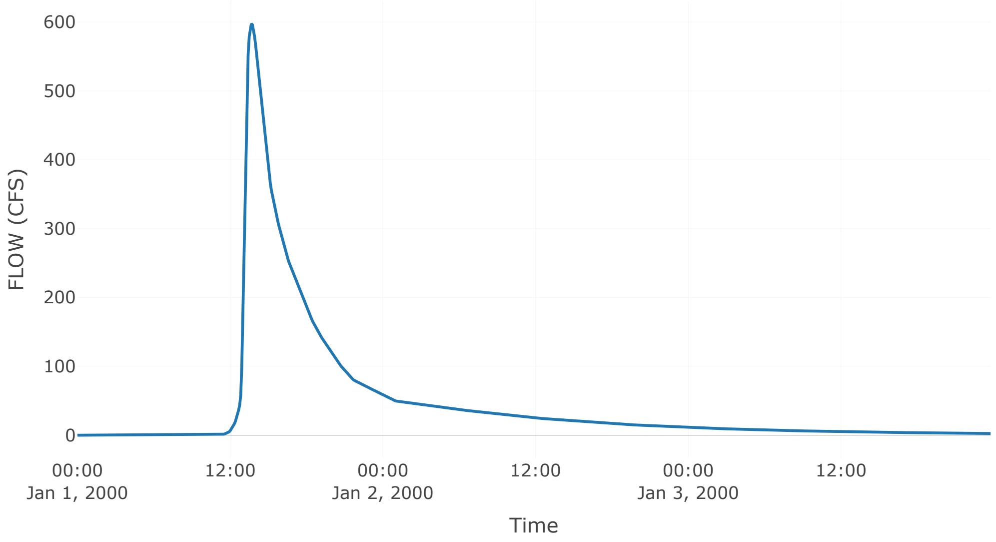

Cumulative Outflow
FLOW-CUMULATIVE (AC-FT)
0
50
100
150
200
250
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Spillway 1
FLOW (CFS)
0
100
200
300
400
500
600
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

Pool Elevation



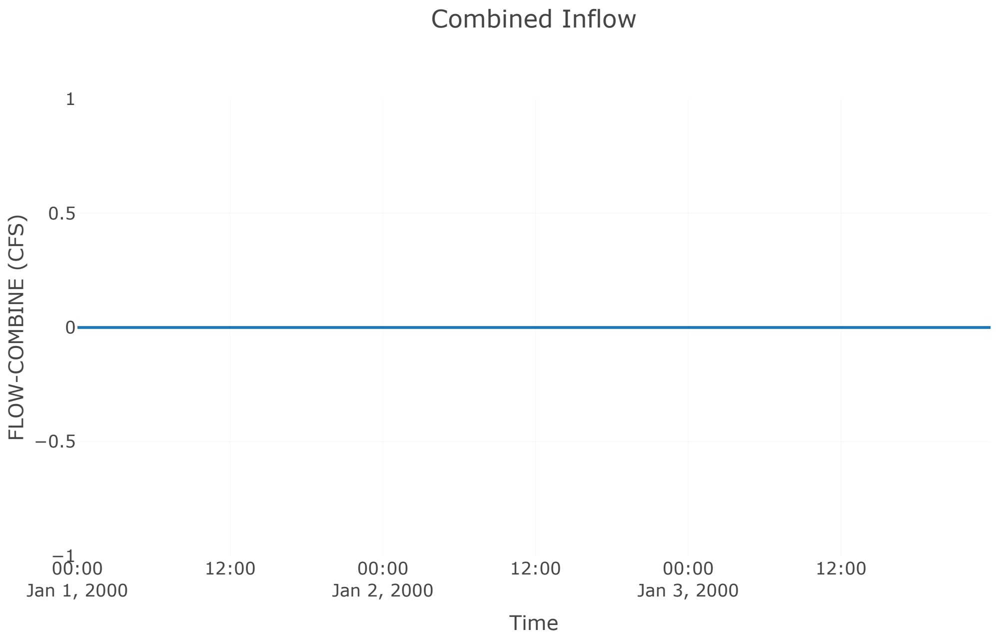
Outflow

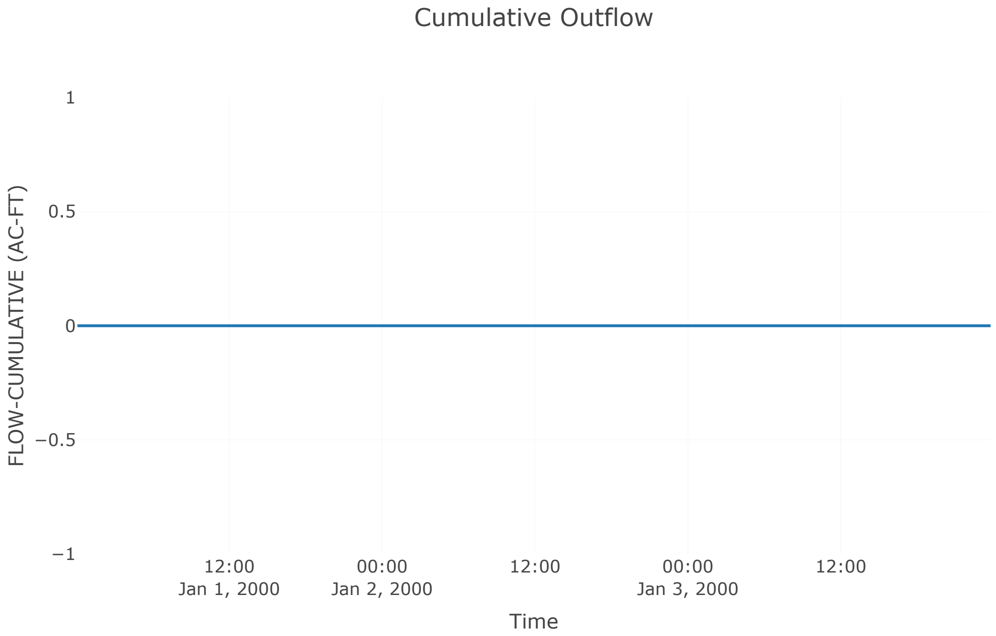


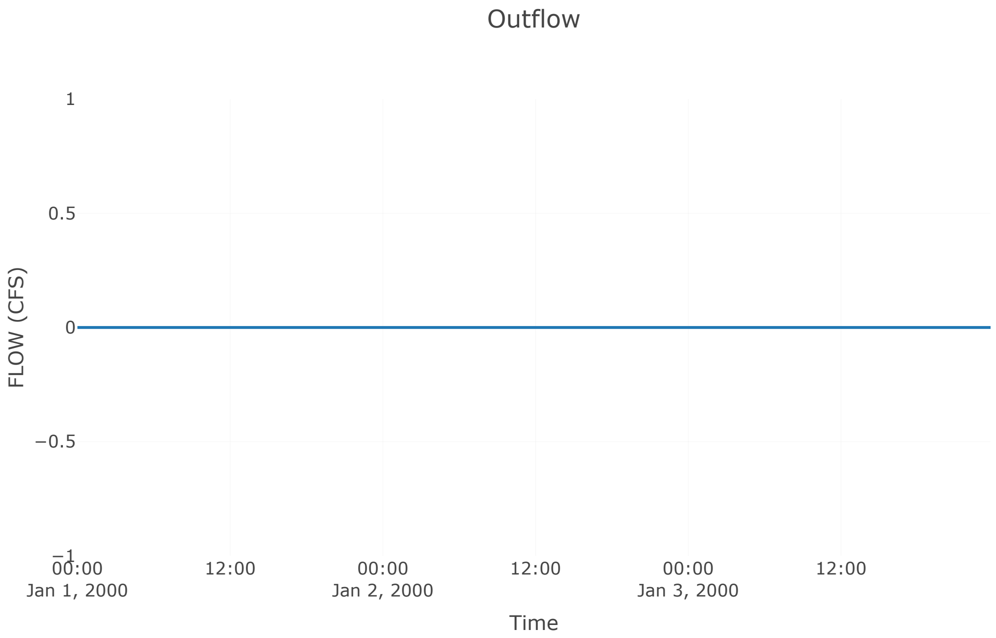
Sink: BottomAsh_ES

Results: BottomAsh_ES

Peak Discharge (CFS)	0
Time of Peak Discharge	31Dec1999, 24:00


Combined Inflow
1
0.5
0
−0.5
−1
FLOW-COMBINE (CFS)
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Cumulative Outflow
1
0.5
0
−0.5
−1
FLOW-CUMULATIVE (AC-FT)
12:00
Jan 1, 2000
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time


Outflow
FLOW (CFS)
1
0.5
0
−0.5
−1
00:00
Jan 1, 2000
12:00
00:00
Jan 2, 2000
12:00
00:00
Jan 3, 2000
12:00
Time

3.5 – Inflow Design Flood Control Plan Periodic 5-Year Review, Bottom Ash Storage Pond, October 2021

INFLOW DESIGN FLOOD CONTROL PLAN PERIODIC 5-YEAR REVIEW

30 TAC 352.821 (40 CFR 257.82)

Bottom Ash Storage Pond

Welsh Power Plant
Pittsburg, Texas

October, 2021

Prepared for: Southwest Electric Power Company – Welsh Power Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

DOCUMENT ID: GERS – 21 – 054

INFLOW DESIGN FLOOD CONTROL PLAN
PERIODIC 5-YEAR REVIEW
CFR 257.82
WELSH POWER PLANT
BOTTOM ASH STORAGE POND

PREPARED BY Brett A. Dreger DATE 10/4/2021
Brett A. Dreger, P.E.

REVIEWED BY DATE 10/5/2021
Mohammad A. Ajlouni, P.E.

APPROVED BY Gary F. Zych DATE 10/6/2021
Gary F. Zych, P.E.
Manager – AEP Geotechnical Engineering

American Electric Power
Service Corporation
Texas Registered Engineering
Firm No. F-3341

Gary F. Zych
GARY F. ZYCH
127152
10/6/2021

I certify to the best of my knowledge, information, and belief that the information contained in this Inflow Design Flood Control Plan meets the requirements of 40 CFR § 257.82

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Attachment A: Hydraulic Analysis of Welsh Power Plant Ash Ponds

1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of 30 TAC 352.821 (40 CFR 257.82) for the hydrologic and hydraulic evaluation of CCR surface impoundments. This is the first periodic 5-year review of the inflow design flood control plan.

2.0 DESCRIPTION OF THE CCR UNIT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash pond and the Bottom Ash Storage pond. This report addresses the Bottom Ash Storage Pond. The Bottom Ash Storage pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir.

In 2000, the 22-acre Bottom Ash Storage Pond was installed south of the landfill. The Bottom Ash Storage Pond receives economizer ash and bottom dredged and sluiced from the primary ash pond.

3.0 INFLOW DESIGN FLOOD 257.82(a)(3)

The facility is classified as a Low Hazard Potential Dam. This classification has not changed since the initial evaluation. The Inflow Design Flood is the 100-year storm event.

4.0 FLOOD CONTROL PLAN 257.82(c)

As of April 11, 2021, the plant has ceased all sluicing operations and all surface water run-on to the Bottom Ash Storage Pond area. The only inflows to the Bottom Ash Storage Pond is direct rainfall within the pond’s dikes. The design to safely pass the inflow design flood without overtopping the crest of the dam is based on the normal pool being at maximum normal operating pool and utilizing the principal spillway and emergency spillway to handle the 100-year design storm without overtopping the crest of the dam.

The 2010 Hydraulic Analysis of Welsh Power Plant Ash Ponds report (Attachment A) provides the description of the drainage area, spillway system, flood storage capacity, inflow peak discharge and volume, peak discharge from the facility and maximum pool elevation for the Bottom Ash Storage Pond.

There has not been any changes to spillway system, flood storage capacity or rainfall estimates that would change the results presented in Attachment A. The calculations show that the facility has the capacity to manage the inflow design flood, as well as large flood events.

ATTACHMENT A

Hydraulic Analysis

Of

Welsh Power Plant Ash Ponds

FREESE AND NICHOLS

Innovative approaches
Practical results
Outstanding service

Hydraulic Analysis of Welsh Power Plant Ash Ponds

American Electric Power Company

Prepared by:

FREESE AND NICHOLS, INC.
4055 International Plaza, Suite 200
Fort Worth, Texas 76109
817-735-7300

AEP10412

Innovative approaches
Practical results
Outstanding service

Hydraulic Analysis of Welsh Power Plant Ash Ponds

American Electric Power Company

TRAVIS N. ATTANASIO
98433

Freese and Nichols, Inc.
Texas Registered Engineering Firm F-2144

The seal appearing on this document was
authorized by Travis N. Attanasio on
December 29, 2010

Prepared by:

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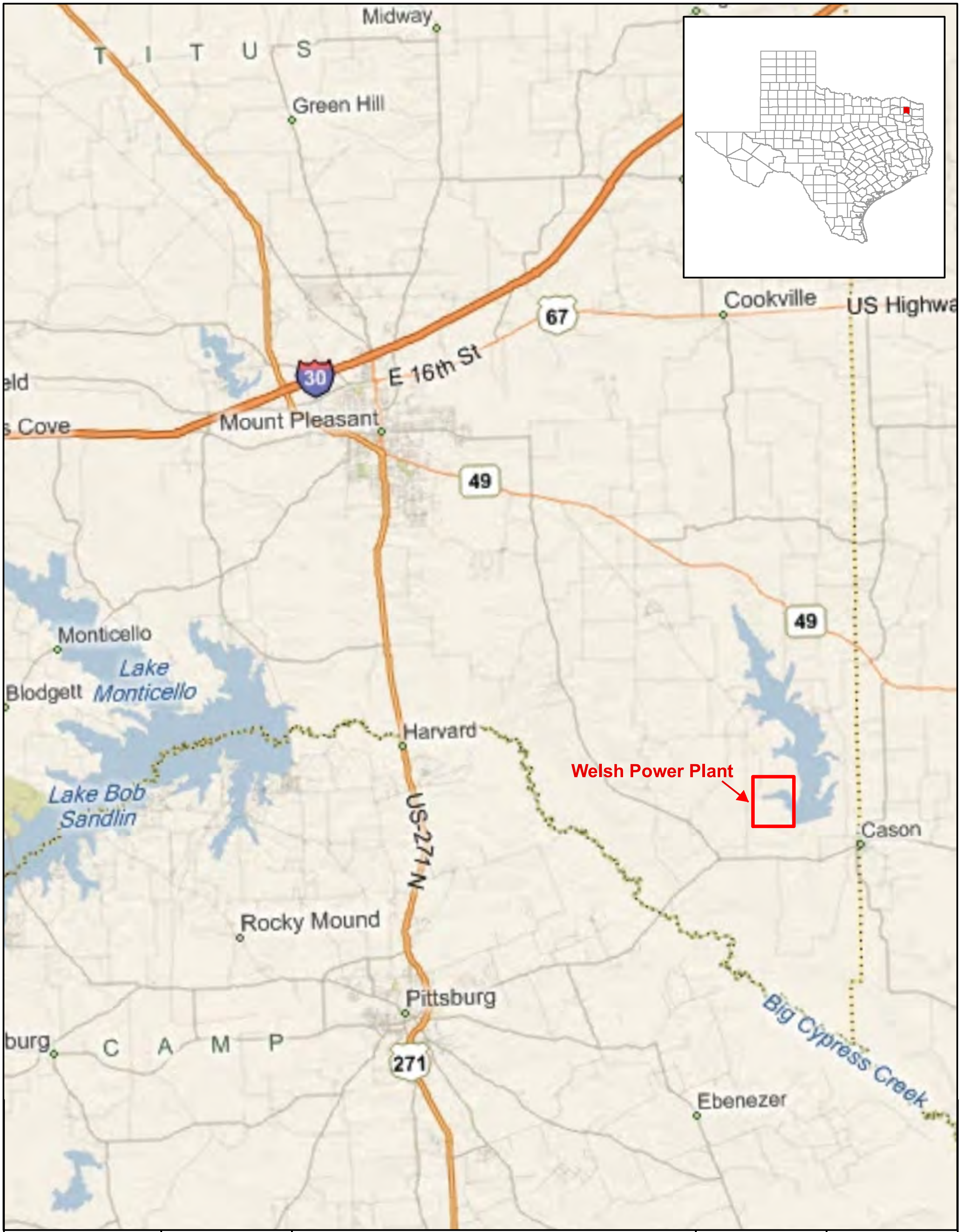
Appendix C Pertinent Drawings

1.0 INTRODUCTION

In November of 2010, Freese and Nichols, Inc., (FNI) was retained by American Electric Power (AEP) to perform various hydrologic and hydraulic calculations to determine the hydraulic adequacy of the Primary Ash, Secondary Ash, and Bottom Ash Ponds for the Welsh Power Plant located near Pittsburg, TX. This report summarizes the results of the analysis for the 10-year, 25-year, 100-year, 25% PMF, 50% PMF, and 100% PMF events.

The three Ash Ponds are situated immediately south of the Welsh Power Plant on the west side of Welsh Reservoir. The general location of the power plant and associated reservoirs is shown in Figure 1.



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DATUM & COORDINATE SYSTEM NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)

DATE CREATED DECEMBER 2010

PREPARED BY JPM

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4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 1.25 2.5 5 Miles

N

WELSH POWER PLANT ASH PONDS

LOCATION MAP

FIGURE 1

2.0 HYDROLOGIC MODEL DEVELOPMENT

2.1 BASIN DELINEATION & CONNECTIVITY

The hydrologic model for the Welsh Power Plant Ash Ponds was created in HEC-HMS[1] and consisted of seven total drainage basins, as shown in Figure 2. The total drainage area modeled is approximately 0.695 square miles, or 445 acres. Two basins, labeled *Primary* and *Power Plant*, drain directly into the Primary Ash Pond. The Ash Storage Area was divided into two drainage basins – *Ash Storage Area A* and *Ash Storage Area B* – based on a December 2009 survey of the area. A small portion of the Ash Storage Area, along with a small wooded area, drains into the Bottom Ash Pond and is shown as *to Bottom Ash* in Figure 2. Additionally, the area inside the embankment for the Bottom Ash Pond is labeled *Bottom Ash* and drains directly into the reservoir area. Finally, the basin labeled *Secondary* represents the area draining to the Secondary Ash Pond.

Each of the seven basins and three reservoir areas are connected in some way and form an intricate system of connectivity. The only discharges from the Primary Ash Pond flow through a drainage canal to the Secondary Ash Pond. This canal flows from west to east and is controlled by a weir box control structure. Discharges from the Primary Ash Pond emergency spillway also flow into this drainage canal; however, these flows enter the canal downstream of the weir box control structure. Runoff from the Ash Storage Area also enters the Primary Ash Pond via a small sump area with a 24-inch culvert. Rainfall is routed through a small ditch around the perimeter of the Ash Storage Area to this culvert. The principal spillway for the Bottom Ash Pond discharges into a 30-inch pipe which transports the outflows to the Ash Storage Area ditch. These outflows eventually discharge into the Primary Ash Pond. The emergency spillway for the Bottom Ash Pond discharges freely into the area downstream of the Welsh Reservoir emergency spillway. Finally, the combined flows from the drainage canal enter the Secondary Ash Pond, which has both a principal and emergency spillway. All discharges from the Secondary Ash Pond flow into Welsh Reservoir. Spillway capacities are discussed in further detail in Section 2.4.

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DATUM & COORDINATE SYSTEM
NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)

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0 500 1,000 2,000
Feet

WELSH POWER PLANT ASH PONDS

DRAINAGE BASIN MAP

N

FIGURE

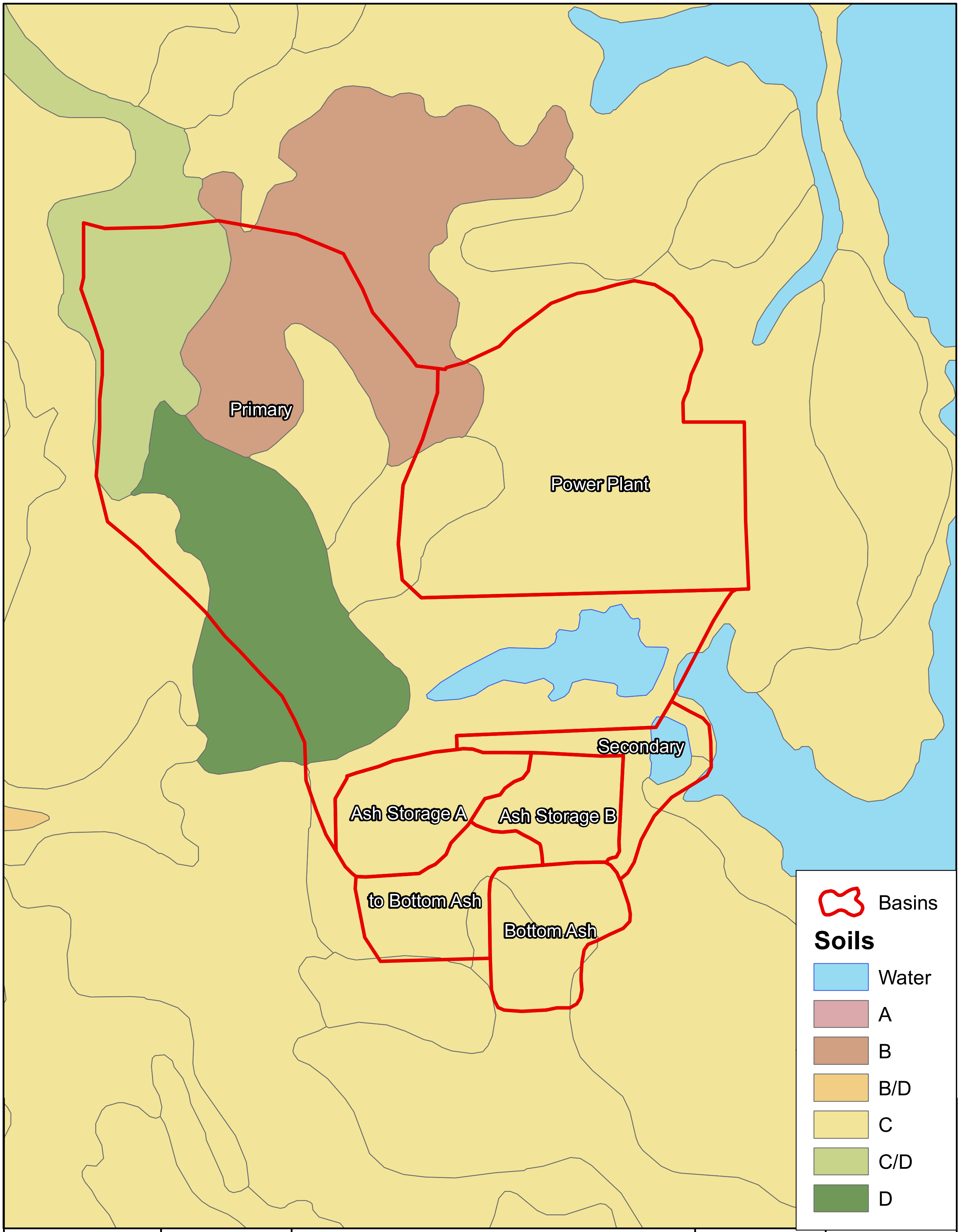
2

2.2 HYDROLOGIC PARAMETERS

The HEC-HMS model incorporates the NRCS Curve Number and Unit Hydrograph methods for each basin. In this model, the curve numbers were based on hydrologic soil classifications and land cover. The instantaneous runoff effect of open water surfaces was accounted for in the development of the curve numbers. The soils dataset was obtained from the NRCS Soil Survey Geographic Database[2] (SSURGO), and land use dataset was obtained from the USGS Seamless Data Warehouse[3] in the form of the National Land Cover Dataset (NLCD) for 2001. Spatial information about soil types and land use classifications is presented in Figures 3 and 4, respectively. Table 1 provides the matrix used in determining the curve number for each basin. The curve numbers shown in Table 1 are for Antecedent Moisture Condition (AMC) II. These values were incorporated in the model for the frequency storm events, such as the 100-year storm event. In accordance with TCEQ recommendations, AMC III was applied to the model for PMF events. This represents a worst-case scenario with the ground fully saturated prior to the PMF event.

Table 1 – Curve Number Calculation Matrix

NLCD Classification		Curve Number (AMC II)					
#	**Description**	**A**	**B**	**B/C**	**C**	**C/D**	**D**
11	Open Water	100	100	100	100	100	100
21	Developed, Open Space	68	79	83	86	88	89
22	Developed, Low Intensity	51	68	74	79	82	84
23	Developed, Medium Intensity	77	85	88	90	91	92
24	Developed, High Intensity	89	92	93	94	95	95
31	Barren Land	77	86	89	91	93	94
41	Deciduous Forest	36	60	67	73	76	79
42	Evergreen Forest	36	60	67	73	76	79
43	Mixed Forest	36	60	67	73	76	79
52	Scrub/Shrub	35	56	63	70	74	77
71	Grassland/Herbaceous	39	61	68	74	77	80
81	Pasture/Hay	39	61	68	74	77	80
82	Cultivated Crops	67	78	82	85	87	89
90	Woody Wetlands	45	66	72	77	80	83



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Feet

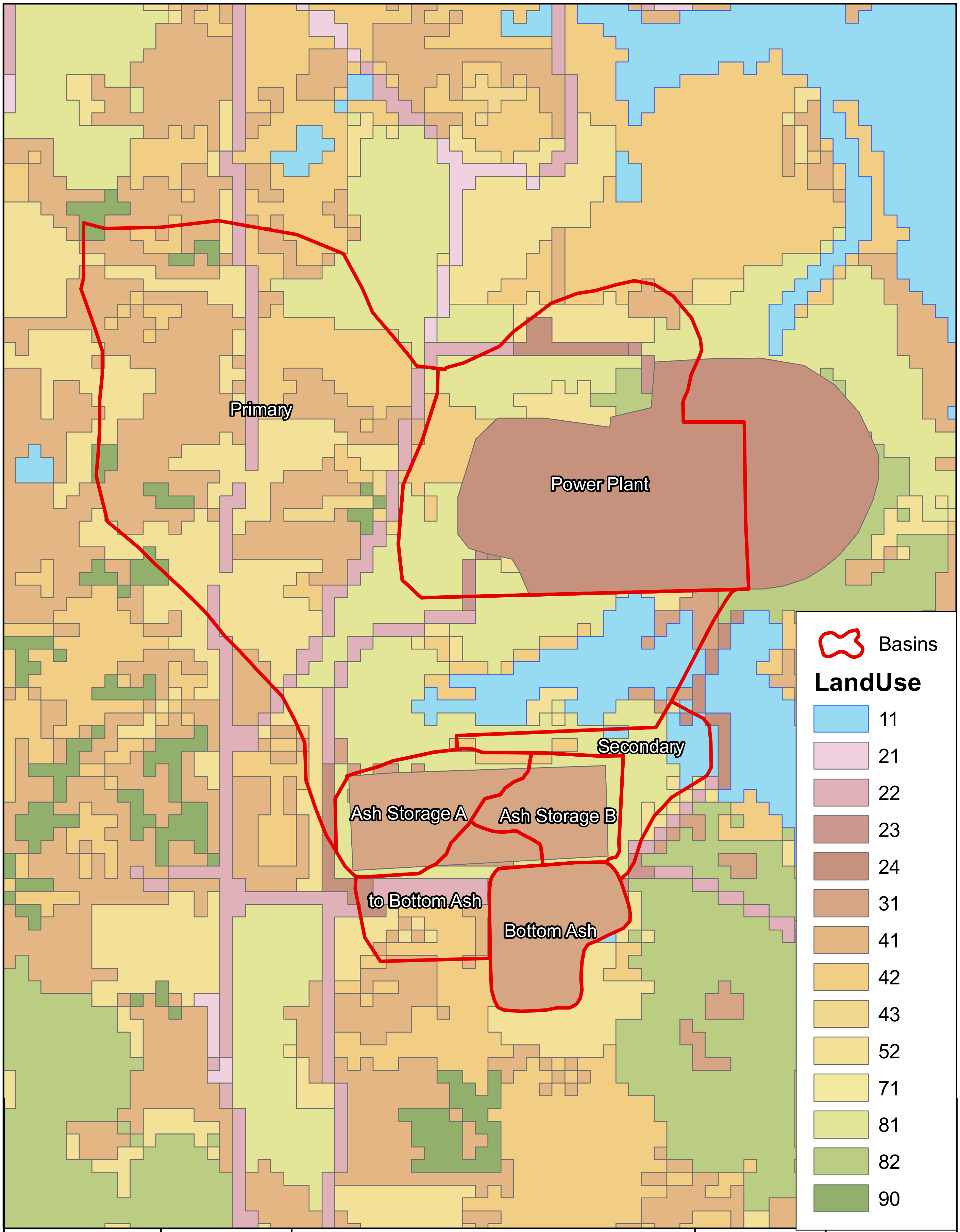
WELSH POWER PLANT ASH PONDS

HYDROLOGIC SOIL CLASSIFICATIONS

N

FIGURE

3



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DATE CREATED	DECEMBER 2010
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WELSH POWER PLANT ASH PONDS

LAND COVER DATA

FIGURE
4

The only input into HEC-HMS for the NRCS Dimensionless Unit Hydrograph is a lag time, which is calculated based on basin conditions, such as hydraulic length and average slope, according to the NRCS TR-55 Method. Table 2 provides a summary of the hydrologic parameters for each basin. Note that AMC II corresponds with the curve numbers used in the frequency model and that AMC III corresponds with the weighted curve numbers used in the PMP model.

Table 2 – Basin Parameters

Basin	Area (mi^2)	Lag Time (min)	Curve Number (AMC II)	Curve Number (AMC III)
Ash Storage A	0.034	5.28	87.1	93.9
Ash Storage B	0.025	7.51	87.1	93.9
Bottom Ash	0.034	4.78	91.0	95.9
Power Plant	0.180	18.77	85.3	93.0
Primary	0.366	36.14	76.0	88.0
Secondary	0.026	2.31	82.7	91.7
to Bottom Ash	0.031	16.51	77.8	89.0

2.3 ELEVATION-STORAGE DATA

Elevation-storage data for each reservoir was obtained from a combination of data sources. The elevation-storage relationship for the Primary Ash Pond was calculated from USGS 10-foot contours for the area and compared to calculations made by AEP. The Secondary Ash Pond used the AEP Calculations for elevation 320.0 ft-msl to elevation 330.0 ft-msl and a combination of USGS 10-foot contours and surveyed 2-foot contours. The Bottom Ash Pond used volume calculations from an April 2010 survey from elevation 346.13 ft-msl to elevation 355.92 ft-msl. The volume was then extrapolated to the top of dam elevation of 360.0 ft-msl by the average-end-area method and the assumption of 3:1 side slopes. These relationships were used in the hydrologic model for routing both frequency storm events and the PMF and are shown in Table 3 below.

Table 3 – Elevation-Storage Data

Primary	
Elevation (ft-msl)	Storage (acre-ft)
300	0.00
305	22.37
310	54.66
315	110.48
320	186.47
325	304.20
330	461.77
335	676.03
340	934.21

Secondary	
Elevation (ft-msl)	Storage (acre-ft)
320	0.00
330	36.87
331	41.31
332	46.30
333	51.82
334	57.67
335	63.77
336	70.09
337	76.59
338	83.26
339	90.22
340	97.45
341	105.06
342	112.68

Bottom Ash	
Elevation (ft-msl)	Storage (acre-ft)
346.13	0.00
347	0.22
348	1.31
349	3.17
350	5.51
351	8.33
352	11.94
353	16.77
354	23.57
355	33.04
356	45.07
357	65.66
358	86.50
359	107.61
360	128.98

2.4 DISCHARGE RATING CURVES

Each of the three dams has both a principal spillway and an emergency spillway. Information regarding the dimensions and elevations of each of these spillways was taken from a combination of original construction drawings, recent survey, and detailed descriptions from AEP personnel. Detailed calculations for the discharge rating curves of each spillway are included in Appendix B.

The principal spillway for the Primary Ash Pond is located in the canal connecting the Primary and Secondary Ash Ponds. It consists of a weir box with bottom elevation of 325.0 ft-msl and a 4-foot wide by 2-foot tall opening. Stop logs are placed in this opening according to regular dredging operations by AEP; however, normal conditions dictate that no stop logs are in place. This structure also consists of sheet piling to each side of the weir box, which will operate as a sharp-crested weir when flows reach the top elevation of 336.0 ft-msl. Additionally, the Primary Ash Pond has a 90-foot wide emergency spillway with a crest elevation of 334.0 ft-msl. Both the orifice and weir equations were utilized in calculating the discharge rating curves. The discharge rating curve for both spillways is shown in Table 4.

The principal spillway for the Secondary Ash Pond consists of a weir box with a 4-foot long weir discharging through a 36-inch conduit. The weir equation used for this weir box was obtained from Greg Carter of AEP from calculations he had performed in the design of a new weir plate, which is currently in place. Additionally, the Secondary Ash Pond has an approximately 45-foot wide earthen emergency spillway. The discharge rating curve for the emergency spillway was calculated with a simple HEC-RAS model with cross-sections cut through the spillway. The discharge rating curve for both spillways is shown in Table 4.

The principal spillway for the Bottom Ash Pond is a 40-foot long broad-crested weir with 6:1 side slopes and crest at elevation 355.0 ft-msl. It discharges into a small sump area connected to the 30-inch pipe directing flow back toward the Ash Storage Area. The emergency spillway is an 8-foot wide weir at elevation 358.0 ft-msl with a rock riprap discharge chute. The discharge rating curve for both spillways is shown in Table 4.

Table 4 – Discharge Rating Curves

Primary			
Elevation (ft-msl)	**Principal Spillway (cfs)**	**Emergency Spillway (cfs)**	**Total Discharge (cfs)**
325	0	---	0
326	39	---	39
327	54	---	54
328	67	---	67
329	77	---	77
330	86	---	86
331	94	---	94
332	102	---	102
333	109	---	109
334	116	0	116
335	122	285	407
336	128	849	976
337	340	1,637	1,977
338	723	2,640	3,363
339	1,217	3,857	5,074
340	1,801	5,291	7,092

Secondary			
Elevation (ft-msl)	**Principal Spillway (cfs)**	**Emergency Spillway (cfs)**	**Total Discharge (cfs)**
328.3	0	---	0
329	5	---	5
330	17	---	17
331	33	---	33
332	50	0	50
333	58	91	149
334	64	345	409
335	70	777	847
336	75	1,386	1,461
337	80	2,191	2,271
338	85	3,163	3,248
339	90	4,256	4,346
340	94	5,280	5,374

Bottom Ash			
Elevation (ft-msl)	**Principal Spillway (cfs)**	**Emergency Spillway (cfs)**	**Total Discharge (cfs)**
355.0	0	---	0
355.5	50	---	50
356.0	161	---	161
356.5	330	---	330
357.0	561	---	561
357.5	858	---	858
358.0	1,224	0	1,224
358.5	1,664	11	1,676
359.0	2,182	39	2,221
359.5	2,782	85	2,867
360.0	3,466	153	3,619

2.5 FREQUENCY MODEL RESULTS

Three frequency storm events were analyzed for the Welsh Ash Pond system – the 10-year, 25-year, and 100-year storm events. The hydrologic model described in the preceding sections was implemented in analyzing these events. Curve numbers were set to Antecedent Moisture Condition II, and initial abstractions were calculated automatically by HEC-HMS. These assumptions represent normal conditions, as would be expected prior to one of these storm events. The precipitation data was obtained from the National Oceanic and Atmospheric Administration's Technical Memorandum NWS HYDRO-35[4] and Technical Paper 40.[5] These values are presented in Table 5. Each storm event was assumed to have a duration of 24 hours.

Table 5 – Frequency Precipitation Depths

Frequency (yrs)	Precipitation (in)							
	5 min	15 min	60 min	2 hr	3 hr	6 hr	12 hr	24hr
1	0.42	0.89	1.69	1.99	2.20	2.64	3.12	3.58
2	0.51	1.08	1.97	2.45	2.68	3.19	3.78	4.41
5	0.58	1.25	2.54	3.14	3.40	4.15	4.92	5.81
10	0.64	1.38	2.91	3.64	3.95	4.90	5.90	6.82
25	0.72	1.57	3.36	4.22	4.62	5.73	6.76	7.90
50	0.79	1.72	3.75	4.75	5.18	6.41	7.74	8.83
100	0.86	1.88	4.13	5.23	5.78	7.09	8.62	9.85
500	1.12	2.45	5.39	6.83	7.54	9.26	11.26	12.86

These precipitation depths serve as input data into the hydrologic model, and were routed through the model as described previously. According to TCEQ recommendations and standard engineering practice, flood routings were started at the lowest spillway crest elevation for each dam. This corresponds to elevation 325.0 ft-msl, 328.3 ft-msl, and 355.0 ft-msl for the Primary, Secondary, and Bottom Ash Ponds, respectively. The results of the 10-year, 25-year, and 100-year storm events are shown in Tables 6, 7, and 8, respectively.

Table 6 – 10-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	328.50	874.71	71.92
Secondary	332.37	112.41	72.35
Bottom Ash	355.53	157.81	55.99

Table 7 – 25-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	329.35	1079.37	80.24
Secondary	332.51	137.68	81.67
Bottom Ash	355.62	187.44	76.21

Table 8 – 100-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	330.80	1415.75	92.68
Secondary	332.62	177.95	95.96
Bottom Ash	355.76	234.22	108.10

2.6 PMF MODEL RESULTS

The Probable Maximum Flood (PMF) is defined as the greatest flood to be expected, and the Probable Maximum Precipitation (PMP) is theoretically the greatest depth of rainfall for a given duration that is physically possible over a given size storm area at a particular geographic location. Generally, the rainfall depth is calculated for the ten square miles of the watershed which receive the highest intensity rainfall.

Hydrometeorological Report No. 52 (HMR-52),[6] developed by the U.S. Army Corps of Engineers, was used to determine the rainfall for each basin. PMP estimates were taken from Hydrometeorological Report No. 51[7] and distributed according to HMR-52 to obtain average rainfall depths over the various drainage areas.

HMR-52 calculates rainfall depths for storm durations ranging from five minutes to seventy-two hours. Table 9 lists the point rainfall depths calculated by HMR-52 for storm durations from one hour to 72 hours. Because the total drainage area is less than ten square miles, these point rainfall depths were applied to each of the 7 basins. Additionally, the total rainfall depth was distributed according to the temporal distribution described by the TCEQ guidelines.

Table 9 – HMR-52 Point Rainfall Depths

Storm Duration (hr)	Depth (in)
1	16.62
2	20.86
3	24.18
6	30.47
12	36.82
24	42.10
48	46.98
72	49.74

Each PMF duration was modeled as described previously, with flood routing started at the lowest spillway crest elevation. The 12-hour event was critical for both the Primary and Secondary Ash Ponds, and the 1-hour event was critical for the Bottom Ash Pond. Additionally, the 25% and 50% PMF were calculated for the critical duration. Tables 10, 11, and 12 contain the results of these PMF model runs – the 25% PMF, 50% PMF, and 100% PMF, respectively.

Table 10 – 25% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	331.83	690.29	100.59
Secondary	332.68	110.63	105.57
Bottom Ash	355.70	171.14	94.27

Table 11 – 50% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	335.16	1385.23	122.79
Secondary	334.23	511.60	501.07
Bottom Ash	356.15	342.28	211.11

Table 12 – 100% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	337.46	2770.78	517.89
Secondary	337.39	2664.30	2637.73
Bottom Ash	356.78	684.55	458.48

3.0 SUMMARY AND CONCLUSIONS

Based on the results of the hydraulic analysis, each of the three dams is hydraulically adequate for the full range of storm events from the 10-year to the 100% PMF event. Table 13 lists the pertinent elevation data for each dam, including the top of dam elevation and principal and emergency spillway crest elevations. Comparing these elevations to the maximum water surface elevations shown in Table 14 indicates that, even during the 100% PMF event, each of the three dams would have almost 3 feet of freeboard. Additionally, the emergency spillway for the Primary Ash Pond is not engaged during a storm event less than the 50% PMF, and the emergency spillway for the Bottom Ash Pond is not engaged, even during the 100% PMF event. The emergency spillway for the Secondary Ash Pond is, however, engaged much more frequently, even during a storm event as low as the 10-year storm. This should have no adverse affects on this area though, as it appears to have been designed to withstand frequent engaging.

Table 13 – Pertinent Dam Information

	Top of Dam (ft-msl)	Principal Spillway (ft-msl)	Emergency Spillway (ft-msl)
Primary	340.0	325.0	334.0
Secondary	340.0	328.3	332.0
Bottom Ash	360.0	355.0	358.0

Table 14 – Summary of Results

	10-year	25-year	100-year	25% PMF	50% PMF	100% PMF
Primary	328.50	329.35	330.80	331.83	335.16	337.46
Secondary	332.37	332.51	332.62	332.68	334.23	337.39
Bottom Ash	355.53	355.62	355.76	355.70	356.15	356.78

It should be noted that these results reflect the best understanding of existing conditions and could be significantly affected by major changes to any of the three reservoirs. Specifically, major fluctuations in the available storage in each reservoir, as could be caused by the regular dredging and movement of bottom ash in and out of the pond areas, would greatly impact the results of this analysis. However, in their current conditions, the Primary Ash, Secondary Ash, and Bottom Ash Ponds associated with the Welsh Power Plant are deemed to

be hydraulically adequate for any storm event up to the 100% PMF. Pertinent drawings for existing conditions are included in Appendix C.

Appendix A
References

References

1. U.S. Army Corps of Engineers, Hydrologic Engineering Center: *Hydrologic Modeling System HEC-HMS - User's Manual Version 3.4*, Davis, California, August 2009.

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5. U.S. Department of Commerce, Weather Bureau: *Technical Paper No. 40, Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years*, Washington, D.C., May 1961.

6. U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Department of the Army, Corps of Engineers: *Hydrometeorological Report No. 52, Application of Probable Maximum Precipitation Estimates, United States East of the 105th Meridian*, Washington, D.C., 1982.

7. U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Department of the Army, Corps of Engineers: *Hydrometeorological Report No. 51, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian*, Washington, D.C., 1978.

Appendix B
Calculations

Discharge Rating Curve
Primary Ash Pond

Elevation [ft-msl]	Orifice [cfs]	Sheet Pile [cfs]	Main [cfs]	Emerg [cfs]	Total [cfs]
325.00	0.00	0.00	0.00	0.00	0.00
326.00	38.52	0.00	38.52	0.00	38.52
327.00	54.48	0.00	54.48	0.00	54.48
328.00	66.72	0.00	66.72	0.00	66.72
329.00	77.04	0.00	77.04	0.00	77.04
330.00	86.13	0.00	86.13	0.00	86.13
331.00	94.35	0.00	94.35	0.00	94.35
332.00	101.91	0.00	101.91	0.00	101.91
333.00	108.95	0.00	108.95	0.00	108.95
334.00	115.56	0.00	115.56	0.00	115.56
335.00	121.81	0.00	121.81	285.00	406.81
336.00	127.76	0.00	127.76	848.53	976.28
337.00	133.44	206.46	339.90	1636.79	1976.68
338.00	138.89	583.96	722.84	2640.00	3362.84
339.00	144.13	1072.80	1216.93	3857.22	5074.14
340.00	149.19	1651.68	1800.87	5290.90	7091.76

Main Spillway		
Sill Crest	325	ft-msl
Height	2	ft
Sill Width	4	ft
Orifice C	0.6	

$Q = C*A*\sqrt{(2*g*H)}$

Sheet Pile	336	ft-msl
Top Width	62	ft
Weir C	3.33	

$Q = C*L*H^{3/2}$

Emergency Spillway		
Crest	334	ft-msl
Length	90	ft
SS	2.5	:1
Weir C	3	

$Q = C*(L+2*SS*H)*H^{3/2}$

Discharge Rating Curve
Secondary Ash Pond

Elevation [ft-msl]	Weir [cfs]	Conduit [cfs]	Main [cfs]	Emerg [cfs]	Total [cfs]
328.30	0.00	12.77	0.00		0.00
328.50	0.75	15.39	0.75		0.75
329.00	4.85	22.36	4.85		4.85
329.50	10.62	29.44	10.62		10.62
330.00	17.43	35.94	17.43		17.43
330.50	24.97	40.33	24.97		24.97
331.00	33.01	44.34	33.01		33.01
331.50	41.36	48.10	41.36		41.36
332.00	49.90	51.65	49.90	0.00	49.90
332.50	58.50	55.03	55.03	25.00	80.03
333.00	67.07	58.27	58.27	90.91	149.18
333.50	75.51	61.37	61.37	193.62	254.99
334.00	83.73	64.36	64.36	344.83	409.19
334.50	91.67	67.24	67.24	537.74	604.98
335.00	99.25	70.03	70.03	777.17	847.20
335.50	106.41	72.72	72.72	1056.25	1128.97
336.00	113.09	75.34	75.34	1385.71	1461.05
336.50	119.24	77.87	77.87	1769.84	1847.71
337.00	124.79	80.34	80.34	2190.91	2271.25
337.50	129.70	82.74	82.74	2656.86	2739.60
338.00	133.91	85.08	85.08	3163.04	3248.12
338.50	137.39	87.36	87.36	3697.92	3785.28
339.00	140.09	89.59	89.59	4256.10	4345.69
339.50	141.96	91.76	91.76	4767.86	4859.62
340.00	142.96	93.89	93.89	5279.62	5373.51

Main Spillway

Weir Box

Crest	328.30	ft-msl
Length	4	ft
Weir C	2.152	

$Q = C*(L-0.2H)*H^{1/2}$

Weir Equation from AEP

Conduit

Diameter	36	in
Length	350	ft
U/S Invert	326.5	ft-msl
D/S Invert	326	ft-msl

Calculated in FlowMaster

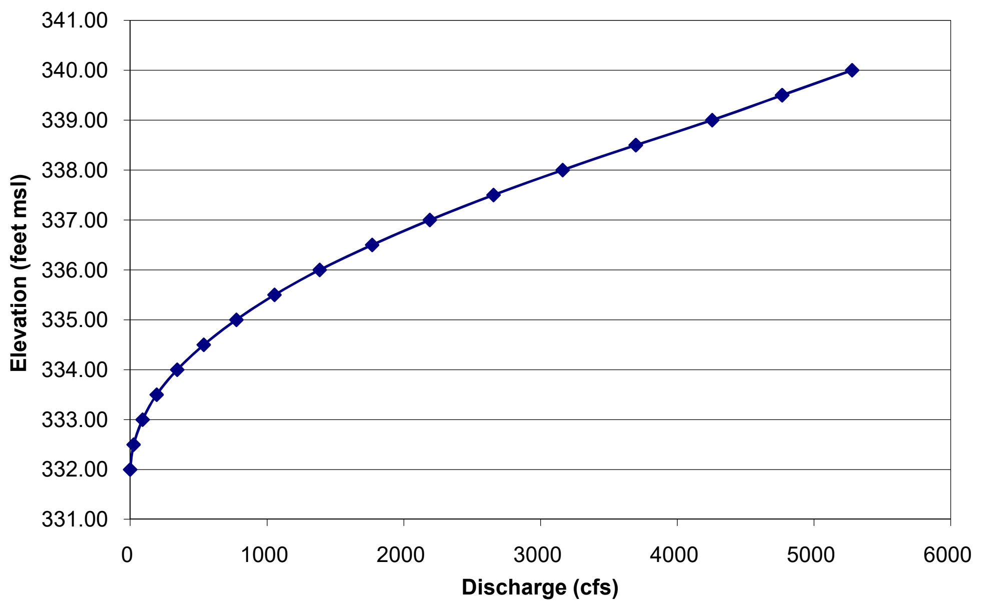
Emergency Spillway

Calculated in HEC-RAS; refer to following sheets for details.

Invert	332	Feet msl
Increment	0.5	Feet

Lake Level (feet msl)	**Discharge (cfs)**
332.00	0
332.50	25
333.00	91
333.50	194
334.00	345
334.50	538
335.00	777
335.50	1,056
336.00	1,386
336.50	1,770
337.00	2,191
337.50	2,657
338.00	3,163
338.50	3,698
339.00	4,256
339.50	4,768
340.00	5,280

Emergency Spillway Discharge Rating Curve



HEC-RAS Results for most upstream cross section

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
SecondaryPon	EmergSpwy	871	PF 1	1	330	332.07		332.07	0	0	380.1	195.63	0
SecondaryPon	EmergSpwy	871	PF 2	10	330	332.29		332.29	0	0.02	423.67	197.71	0
SecondaryPon	EmergSpwy	871	PF 3	25	330	332.5		332.5	0.000002	0.06	465.34	200.66	0.01
SecondaryPon	EmergSpwy	871	PF 4	50	330	332.73		332.73	0.000005	0.1	511.65	204.53	0.01
SecondaryPon	EmergSpwy	871	PF 5	100	330	333.06		333.06	0.000012	0.18	579.79	208.93	0.02
SecondaryPon	EmergSpwy	871	PF 6	200	330	333.52		333.53	0.000031	0.32	677.95	215.13	0.03
SecondaryPon	EmergSpwy	871	PF 7	300	330	333.87		333.87	0.000051	0.43	752.96	221.16	0.04
SecondaryPon	EmergSpwy	871	PF 8	400	330	334.16		334.16	0.000071	0.54	818.24	228.29	0.05
SecondaryPon	EmergSpwy	871	PF 9	500	330	334.41		334.42	0.000091	0.64	876.57	234.47	0.05
SecondaryPon	EmergSpwy	871	PF 10	750	330	334.94		334.95	0.00014	0.85	1005.18	248.81	0.07
SecondaryPon	EmergSpwy	871	PF 11	1000	330	335.4		335.41	0.000184	1.03	1120.39	261.11	0.08
SecondaryPon	EmergSpwy	871	PF 12	1250	330	335.79		335.81	0.000224	1.19	1225.76	271.83	0.09
SecondaryPon	EmergSpwy	871	PF 13	1500	330	336.14		336.16	0.000261	1.34	1322.88	281.28	0.1
SecondaryPon	EmergSpwy	871	PF 14	2000	330	336.77		336.79	0.000326	1.6	1503.25	297.77	0.11
SecondaryPon	EmergSpwy	871	PF 15	2500	330	337.31		337.34	0.000381	1.82	1668.85	312.15	0.12
SecondaryPon	EmergSpwy	871	PF 16	3000	330	337.81		337.85	0.000427	2.01	1827.39	325.32	0.13
SecondaryPon	EmergSpwy	871	PF 17	3500	330	338.26		338.31	0.000468	2.19	1978.88	337.7	0.13
SecondaryPon	EmergSpwy	871	PF 18	4000	330	338.73		338.79	0.000495	2.34	2139.91	350.57	0.14
SecondaryPon	EmergSpwy	871	PF 19	4500	330	339.13		339.2	0.000525	2.48	2282.96	361.62	0.14
SecondaryPon	EmergSpwy	871	PF 20	5000	330	339.69		339.76	0.000513	2.55	2489.43	376.54	0.14

Discharge Rating Curve
Bottom Ash Pond

Elevation [ft-msl]	Main [cfs]	Emerg [cfs]	Total [cfs]
355.00	0.00	0.00	0.00
355.50	50.42	0.00	50.42
356.00	161.20	0.00	161.20
356.50	330.31	0.00	330.31
357.00	561.16	0.00	561.16
358.00	1224.21	0.00	1224.21
359.00	2182.40	39.00	2221.40
360.00	3465.91	152.74	3618.64
361.00	5102.78	358.53	5461.31
362.00	7119.19	672.00	7791.19
363.00	9539.72	1106.85	10646.57

Main Spillway		
Crest	355	ft-msl
Length	40	ft
SS	6	:1
Weir C	3.1	

$Q = C*(L+2*SS*H)*H^{3/2}$

Emergency Spillway		
Crest	358	ft-msl
Length	8	ft
SS	2.5	:1
Weir C	3	

$Q = C*(L+2*SS*H)*H^{3/2}$

Name	GRIDCODE	HSG	Area_ft^2	Area_acre	CN	Inc. CN
Ash Storage	31	C	1324276.445	30.401	91	70.06793
Ash Storage	42	C	53818.662	1.236	73	2.28431
Ash Storage	81	C	341795.137	7.847	74	14.70608
Bottom Ash	31	C	948778.856	21.781	91	91
Power Plant	41	B	1095.992	0.025	60	0.013099
Power Plant	42	B	101918.155	2.340	60	1.218085
Power Plant	81	B	99556.094	2.285	61	1.209685
Power Plant	22	C	15964.935	0.367	79	0.251229
Power Plant	23	C	70296.650	1.614	90	1.260236
Power Plant	24	C	2954103.082	67.817	94	55.31313
Power Plant	41	C	90963.024	2.088	73	1.322703
Power Plant	42	C	239129.961	5.490	73	3.477215
Power Plant	52	C	407500.071	9.355	70	5.68199
Power Plant	81	C	944143.815	21.675	74	13.91697
Power Plant	82	C	95577.482	2.194	85	1.618263
Primary	11	W	458394.580	10.523	100	4.490426
Primary	31	W	14036.955	0.322	100	0.137506
Primary	42	W	104596.947	2.401	100	1.02463
Primary	52	W	11325.853	0.260	100	0.110948
Primary	81	W	69931.187	1.605	100	0.685045
Primary	22	B	242034.352	5.556	68	1.612256
Primary	41	B	564582.710	12.961	60	3.318386
Primary	42	B	631114.853	14.488	60	3.709435
Primary	52	B	220919.125	5.072	56	1.211907
Primary	81	B	286358.868	6.574	61	1.711152
Primary	11	C	480754.464	11.037	100	4.709463
Primary	22	C	209907.569	4.819	79	1.624438
Primary	23	C	10746.609	0.247	90	0.094746
Primary	24	C	67309.636	1.545	94	0.619802
Primary	31	C	150242.962	3.449	91	1.339318
Primary	41	C	540228.652	12.402	73	3.863212
Primary	42	C	316050.970	7.256	73	2.260102
Primary	43	C	93028.069	2.136	73	0.66525
Primary	52	C	572546.147	13.144	70	3.926057
Primary	81	C	1192671.364	27.380	74	8.645709
Primary	82	C	10291.113	0.236	85	0.08569
Primary	90	C	82404.904	1.892	77	0.621573
Primary	41	C/D	916028.058	21.029	76	6.819781
Primary	42	C/D	135572.435	3.112	76	1.00933
Primary	52	C/D	331086.513	7.601	74	2.383839
Primary	90	C/D	101862.212	2.338	80	0.798273
Primary	22	D	301628.331	6.924	84	2.481987
Primary	31	D	13591.654	0.312	94	0.125155
Primary	41	D	558509.208	12.822	79	4.322207
Primary	42	D	58185.234	1.336	79	0.450286
Primary	43	D	21907.998	0.503	79	0.169542
Primary	52	D	973523.140	22.349	77	7.343195
Primary	81	D	435789.772	10.004	80	3.415192
Primary	90	D	31102.113	0.714	83	0.252881
Secondary	11	W	61159.403	1.404	100	8.574385
Secondary	22	W	0.178	0.000	100	2.49E-05
Secondary	24	W	284.987	0.007	100	0.039954
Secondary	52	W	3328.994	0.076	100	0.466716
Secondary	81	W	66883.300	1.535	100	9.37686
Secondary	11	C	100304.658	2.303	100	14.06244
Secondary	22	C	7813.937	0.179	79	0.865439
Secondary	23	C	5348.021	0.123	90	0.6748
Secondary	24	C	9873.918	0.227	94	1.301239
Secondary	31	C	300.129	0.007	91	0.03829
Secondary	42	C	37168.223	0.853	73	3.803946
Secondary	52	C	28941.171	0.664	70	2.840232
Secondary	81	C	391873.463	8.996	74	40.65531
to Bottom Ash	22	C	173034.687	3.972	79	17.29527

Basin	Area_acre
Ash Storage	39.48
Bottom Ash	21.78
Power Plant	115.25
Primary	234.35
Secondary	16.37
to Bottom Ash	18.14

Name	GRIDCODE	HSG	Area_ft^2	Area_acre	CN	Inc. CN
to Bottom Ash	23	C	2352.284	0.054	90	0.267855
to Bottom Ash	24	C	44395.328	1.019	94	5.279978
to Bottom Ash	31	C	108930.225	2.501	91	12.54171
to Bottom Ash	41	C	104222.261	2.393	73	9.626099
to Bottom Ash	42	C	197025.981	4.523	73	18.19757
to Bottom Ash	52	C	82351.521	1.891	70	7.293511
to Bottom Ash	81	C	78062.412	1.792	74	7.308709

Basin	Area_acre

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Ash Storage A	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.010	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	919.70	**FT**
SLOPE	0.021	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	2.319	

$$T_2 = \frac{L}{60 \times V}$$

PIPE FLOW - SOLVE FOR FULL FLOW VELOCITY

DIAMETER =	36	**IN.**
XSECT AREA =	7.07	**SQ FT**
WETTED PERIMETER	9.42	**FT**
SLOPE	0.002	**FT/FT**
MANNINGS N	0.024	
COMPUTED VELOCITY	2.39	**FT/S**
LENGTH	60	**FT**

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_4 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**Ash Storage A**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	1.77	1.77
SHALLOW CONCENTRATED FLOW			6.61	6.61
SHALLOW CONCENTRATED FLOW			0.00	0.00
SHALLOW CHANNEL FLOW				0.00
PIPE FLOW			0.42	0.42
CHANNEL FLOW				0.00
TOTAL			8.79	8.79
			Lag (Hrs) =	**0.09**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) = 5.28

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Ash Storage B	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	**n value**	**% Land use**	**Inc n**
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.025	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	796.31	**FT**
SLOPE	0.020	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	2.287	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	50
XSECT AREA=	112.000	**SQ FT**	**BOTTOM**	6
			DEPTH	4
WETTED PERIMETER	50.721	**FT**		
SLOPE	0.008	**FT/FT**		
MANNINGS N	0.08			
COMPUTED VELOCITY	2.768	**FT/S**		
LENGTH	911.59	**FT**		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	**Adjusted**	**NRCS Method**	**Selected**
WATERSHED NUMBER	**Ash Storage B**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	1.22	1.22
SHALLOW CONCENTRATED FLOW			5.80	5.80
CHANNEL FLOW			5.49	5.49
TOTAL			12.52	12.52
			Lag (Hrs) =	**0.13**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) = **7.51**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Bottom Ash	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.020	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	627.21	**FT**
SLOPE	0.010	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	1.578	

$$T_2 = \frac{L}{60 \times V}$$

984.648438

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**Bottom Ash**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	1.34	1.34
SHALLOW CONCENTRATED FLOW			6.62	6.62
TOTAL			7.96	7.96
			Lag (Hrs) =	**0.08**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) = **4.78**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Power Plant	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	FT.	MAX 100'
2 YR. 24 HOUR PRECIP	4.31	IN.	
SLOPE	0.020	FT/FT	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	558.86	FT
SLOPE	0.036	FT/FT
COMPUTED VELOCITY FROM FIGURE 3.1=	3.052	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	7
XSECT AREA=	8.000	SQ FT	BOTTOM	1
			DEPTH	2
WETTED PERIMETER	8.211	FT		
SLOPE	0.016	FT/FT		
MANNINGS N	0.05			
COMPUTED VELOCITY	3.720	FT/S		
LENGTH	2169.79	FT		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	Power Plant	Tc (Min)	Tc (Min)	Tc (Min)
SHEET FLOW	Max 30 Min	30.0	18.50	18.50
SHALLOW CONCENTRATED FLOW			3.05	3.05
CHANNEL FLOW			9.72	9.72
TOTAL			31.28	31.28
			Lag (Hrs) =	0.31

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	18.77

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Primary	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	**n value**	**% Land use**	**Inc n**
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.020	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	2757.28	**FT**
SLOPE	0.009	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	1.536	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	10
XSECT AREA=	18.000	**SQ FT**	**BOTTOM**	2
			DEPTH	3
WETTED PERIMETER	12.000	**FT**		
SLOPE	0.010	**FT/FT**		
MANNINGS N	0.07			
COMPUTED VELOCITY	2.800	**FT/S**		
LENGTH	1984.65	**FT**		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	**Adjusted**	**NRCS Method**	**Selected**
WATERSHED NUMBER	**Primary**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	18.50	18.50
SHALLOW CONCENTRATED FLOW			29.91	29.91
CHANNEL FLOW			11.81	11.81
TOTAL			60.23	60.23
			Lag (Hrs) =	**0.60**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**36.14**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Secondary	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.150	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	599.56	**FT**
SLOPE	0.036	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	3.070	

$$T_2 = \frac{L}{60 \times V}$$

	Conditions	Adjusted Tc (Min)	NRCS Method Tc (Min)	Selected Tc (Min)
WATERSHED NUMBER	**Secondary**			
SHEET FLOW	**Max 30 Min**	30.0	0.60	0.60
SHALLOW CONCENTRATED FLOW			3.26	3.26
TOTAL			3.85	3.85
			Lag (Hrs) =	**0.04**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) = 2.31

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	to Bottom Ash	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	**FT.**	**MAX 100'**
2 YR. 24 HOUR PRECIP	4.31	**IN.**	
SLOPE	0.050	**FT/FT**	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2	
LENGTH	763.95	**FT**
SLOPE	0.004	**FT/FT**
COMPUTED VELOCITY FROM FIGURE 3.1=	1.011	

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	16
XSECT AREA=	20.000	**SQ FT**	**BOTTOM**	4
			DEPTH	2
WETTED PERIMETER	16.649	**FT**		
SLOPE	0.008	**FT/FT**		
MANNINGS N	0.05			
COMPUTED VELOCITY	3.001	**FT/S**		
LENGTH	377.81	**FT**		

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

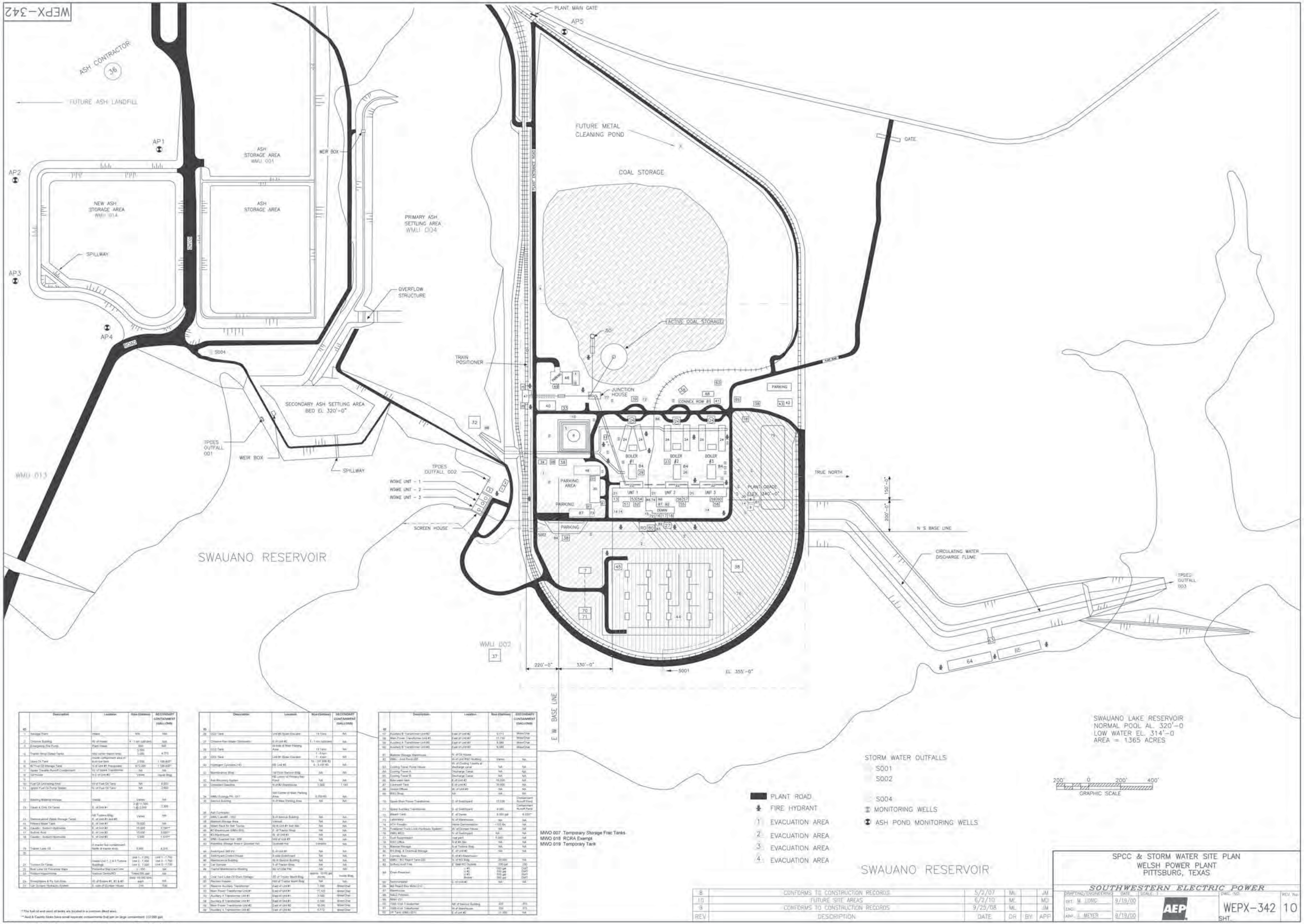
$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	**to Bottom Ash**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**
SHEET FLOW	**Max 30 Min**	30.0	12.83	12.83
SHALLOW CONCENTRATED FLOW			12.59	12.59
CHANNEL FLOW			2.10	2.10
TOTAL			27.52	27.52
			Lag (Hrs) =	**0.28**

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	**16.51**

Appendix C
Pertinent Drawings



MWO 007 Temporary Storage Frac Tanks
MWO 018 RCRA Exempt
MWO 019 Temporary Tank

SWAUANO LAKE RESERVOIR
NORMAL POOL AL. 320'-0
LOW WATER EL. 314'-0
AREA = 1,365 ACRES

200' 0 200' 400'
GRAPHIC SCALE

STORM WATER OUTFALLS
S001
S002
S004

▬	PLANT ROAD
↟	FIRE HYDRANT
1	EVACUATION AREA
2	EVACUATION AREA
3	EVACUATION AREA
4	EVACUATION AREA
⌶	MONITORING WELLS
●	ASH POND MONITORING WELLS

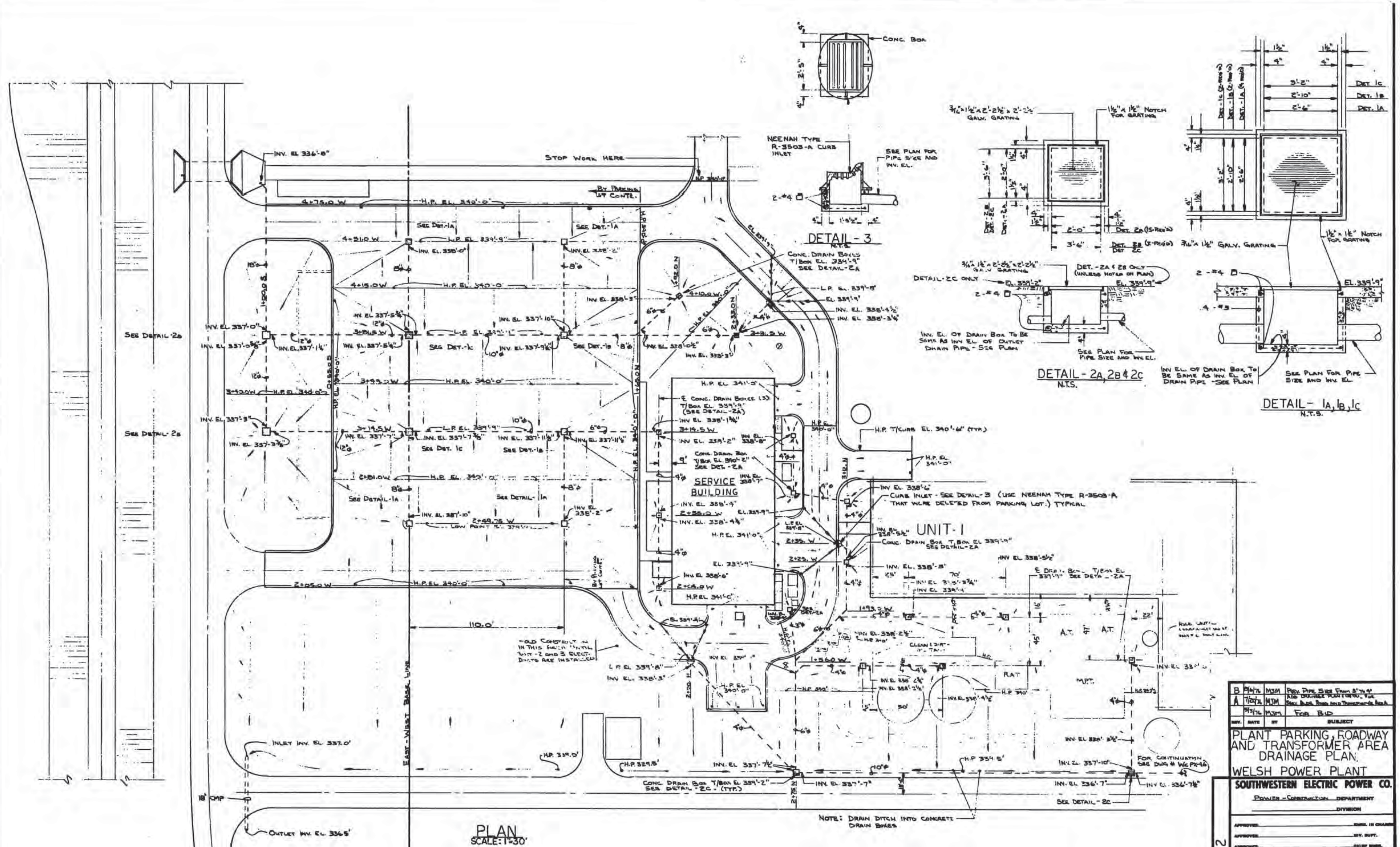
SWAUANO RESERVOIR

REV	DESCRIPTION	DATE	DR	BY	APP
8	CONFORMS TO CONSTRUCTION RECORDS	5/2/07	ML		JM
10	FUTURE SITE AREAS	6/2/10	ML		MD
9	CONFORMS TO CONSTRUCTION RECORDS	9/25/08	ML		JM

SPCC & STORM WATER SITE PLAN
WELSH POWER PLANT
PITTSBURG, TEXAS

SOUTHWESTERN ELECTRIC POWER

DRAFTING/ENGINEERING	DATE	SCALE: 1	DWG. NO.	REV. No.
DFT. M. LONG	9/19/00		WEPX-342	10
ENG.			SHT.	
APP. J. MEYER	9/19/00			



REV.	DATE	BY	SUBJECT
B	9/6/76	MJM	REV. PIPE SIZE FROM 3" TO 4"
A	7/20/76	MJM	ADD DRAINAGE PLAN & DETAIL FOR SERV. BLDG. ROAD AND TRANSFORMER AREA
	5/3/76	MJM	FOR BID

PLANT PARKING, ROADWAY
AND TRANSFORMER AREA
DRAINAGE PLAN.
WELSH POWER PLANT

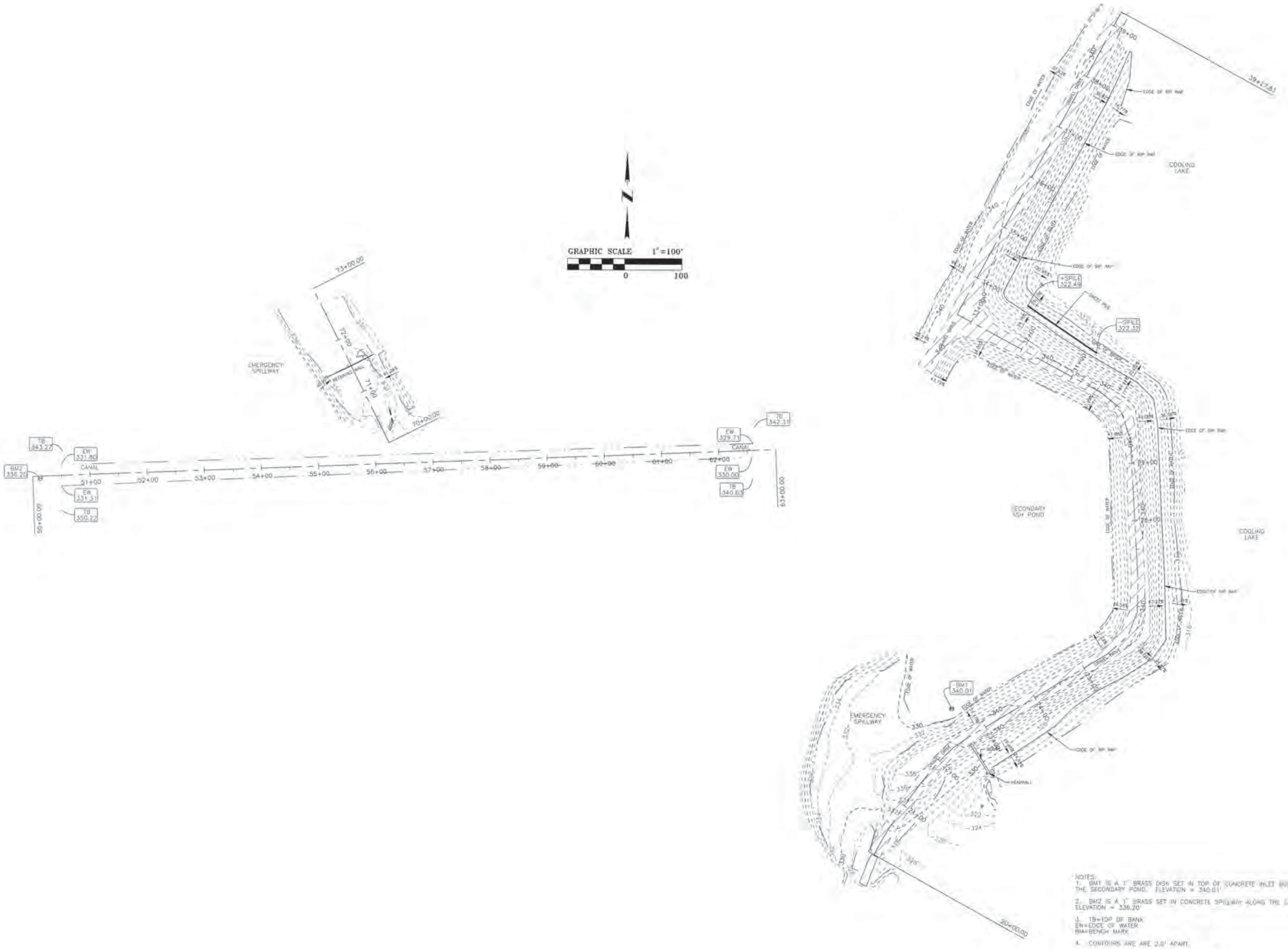
SOUTHWESTERN ELECTRIC POWER CO.

POWER - CONSTRUCTION DEPARTMENT
DIVISION

APPROVED ______ ENGR. IN CHARGE
APPROVED ______ DIV. SUPT.
APPROVED ______ CHIEF ENGR.

DRWN. BY MJM
TRAC. BY
DATE: 2-9-76
SCALE: As Noted
WORK ORDER
DWG. NO. WePX-68
Sh. 2 of 2
SHEET 2

FILE



NOTES:
1. BM1 IS A 1" BRASS DISK SET IN TOP OF CONCRETE INLET BOX FOR THE SECONDARY POND. ELEVATION = 340.01'

2. BM2 IS A 1" BRASS SET IN CONCRETE SPILLWAY ALONG THE CANAL. ELEVATION = 336.20'

3. TB=TOP OF BANK
EW=EDGE OF WATER
BM=BENCH MARK

4. CONTOURS ARE ARE 2.0' APART.

5. LAKE ELEVATION PER WELSH POWER PLANT ON NOVEMBER 18, 2010 WAS 317.57 FEET MSL.

SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON NOVEMBER 18, 2010, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: NOVEMBER 23, 2010
REVISED: DECEMBER 6, 2010

MIKE GARDNER
#5760

TOPOGRAPHIC SURVEY

DIKE'S AT WELSH POWER PLANT
FOR: GREG CARTER

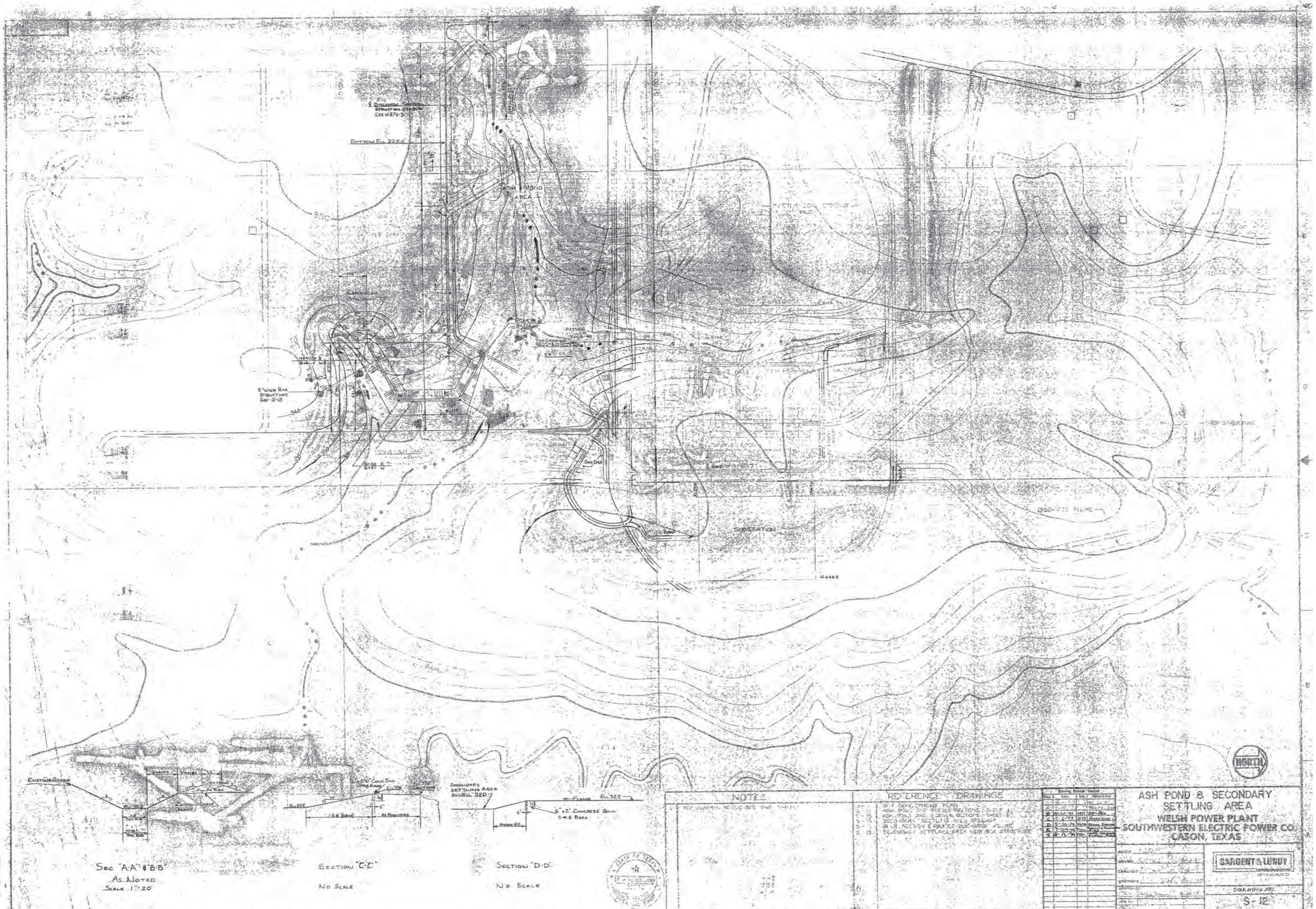
Date	Revision/Description
12/6/10	ADDED LAKE LEVEL NOTE
12/6/10	ADDED CROSS SECTION SHEETS

Drawn By	Checked By	Project No.	Dwg. Date
MG	DW	104021	11/19/10

MTG engineers & surveyors
5930 SUMMERHILL RD. P.O. BOX 3786
TEXARKANA TEXAS 75501
P 903.838.8533 | F 903.832.4700
www.mtgengineers.com

TBPE NO. 354

File No.	Sheet No.
	1



NOTES

1. FOR GENERAL NOTES SEE DWG S-1

REFERENCE DRAWINGS

SITE DEVELOPMENT PLAN
ASH POND DIKE CROSS SECTIONS - SHEET 1
ASH POND DIKE CROSS SECTIONS - SHEET 2
SECONDARY SETTLING AREA SPILLWAY
W.R. SECTION & DETAILS DISCHARGE FLUME
SECONDARY SETTLING AREA WEIR BOX STRUCTURE

Rev.	Date	By	Description
	5-..-73		
A	7-18-73		
B	10-25-73	MEC	Gen. Rev.
C	12-6-73		
D	5-30-74	WSN	
E	7-24-75		
F	10-12-79		

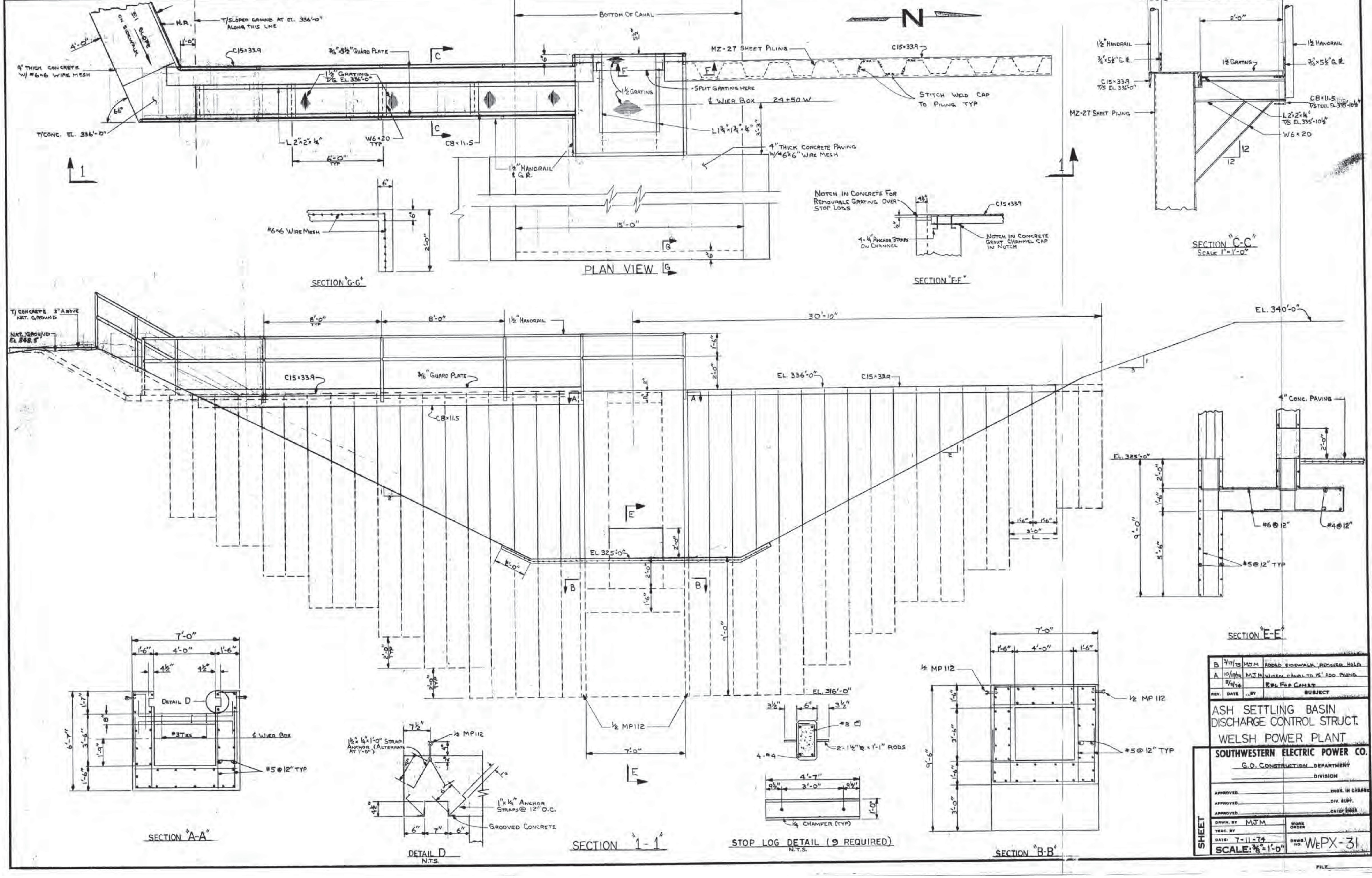
ASH POND & SECONDARY SETTLING AREA
WELSH POWER PLANT
SOUTHWESTERN ELECTRIC POWER CO.
CASON, TEXAS

SCALE
DRAWN
CHECKED
ENGINEER
APPROVED
JOB NO.

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO.
S-12

#4



REV.	DATE	BY	SUBJECT
B	3/17/75	MJM	ADDED SIDEWALK, REMOVED HOLD
A	10/18/74	MJM	WIDEN CANAL TO 15' ADD PILING
	8/2/74		REL FOR CONST

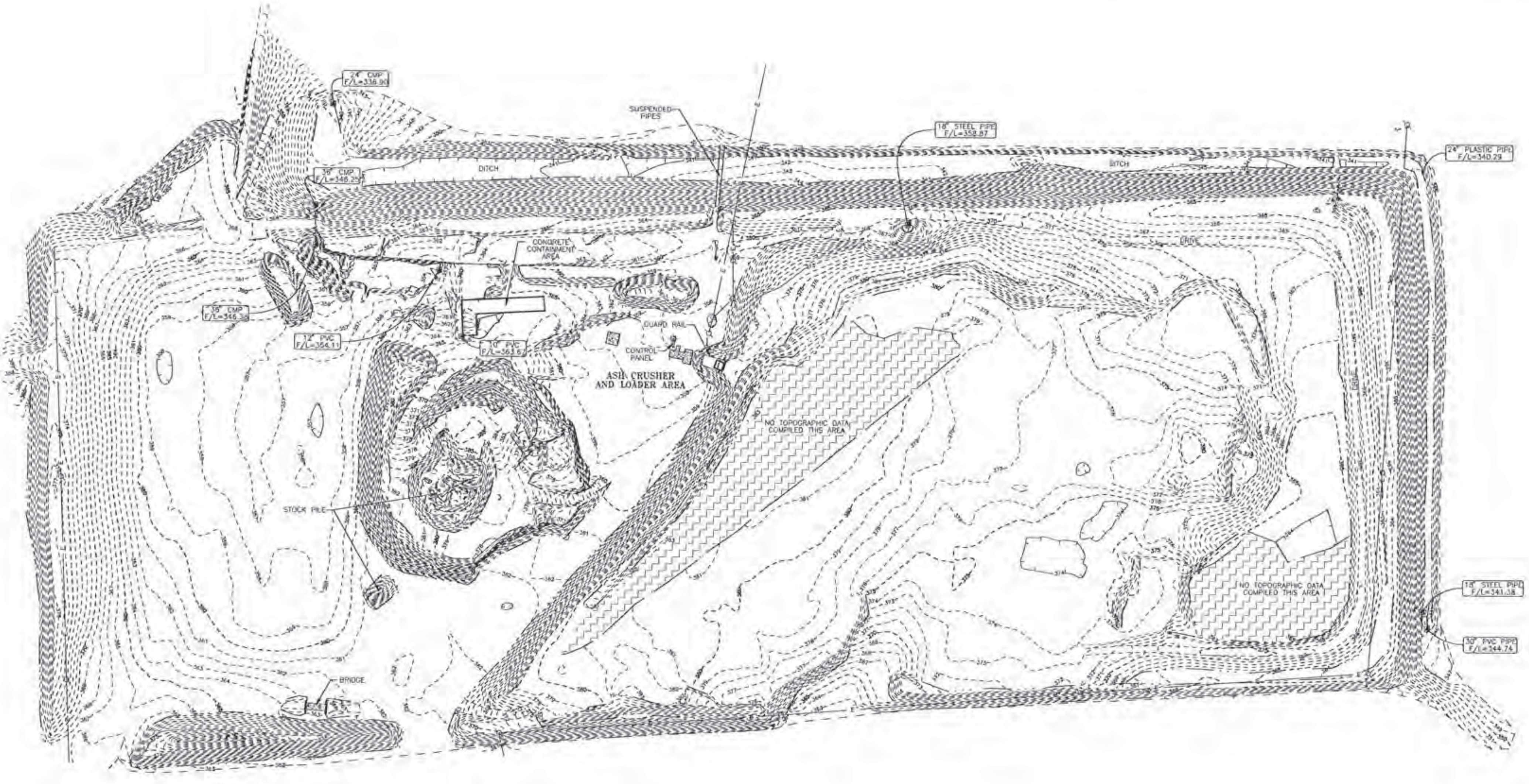
ASH SETTLING BASIN
DISCHARGE CONTROL STRUCT.
WELSH POWER PLANT

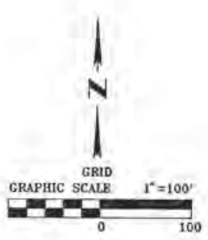
SOUTHWESTERN ELECTRIC POWER CO.
G.O. CONSTRUCTION DEPARTMENT
DIVISION

APPROVED ________ ENGR. IN CHARGE
APPROVED ________ DIV. SUPT.
APPROVED ________ CHIEF ENGR.

DRWN. BY MJM
TRAC. BY
DATE: 7-11-74
SCALE: 3/8"=1'-0"
WORK ORDER
DRWG. NO. WePX-31
SHEET

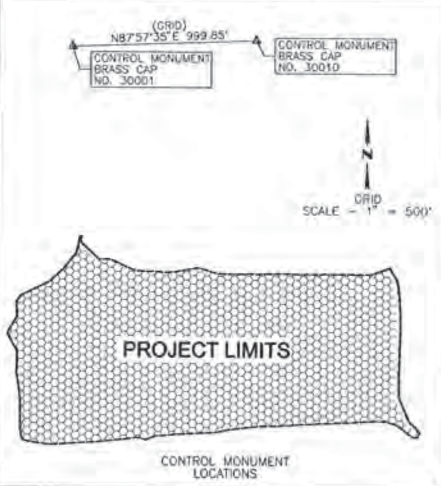
FILE ________





LEGEND

——— E ———	OVERHEAD ELECTRIC LINE
- - - - - - -	TOP OF BANK / SLOPE
——— - - - ———	TOE OF SLOPE / BANK
— - — - — - —	PIPING
— - - — - - —	EDGE OF DRIVE
— — — — —	EDGE OF GRAVEL
- - - - 369 - - - -	1.0' CONTOUR INTERVAL
- - - - 370 - - - -	5.0' CONTOUR INTERVAL
◻	POWER POLE
▣	PIPE LOCATION
⊥	GUY WIRE
△	CONTROL MONUMENT
⊕	LIGHT POLE
▩	CONCRETE SURFACE
▨	AREA NOT SURVEYED



CONTROL MONUMENT LOCATIONS

THE BEARINGS ARE BASED ON GRID NORTH WITHIN THE "TEXAS COORDINATE SYSTEM OF 1983, NORTH CENTRAL ZONE", NAD83 (CORS96, EPOCH 2002.0), WITH A BEARING OF NORTH 87 DEGREES 57 MINUTES 35 SECONDS EAST. THE COMBINED SCALE FACTOR TO GO FROM GRID TO SURFACE IS 1.00012. THE FOLLOWING CONTROL MONUMENTS WERE USED TO ESTABLISH THE BASIS OF BEARINGS:

CONTROL MONUMENT NO. 30001	CONTROL MONUMENT NO. 30010
N-7085417.3416	N-7085452.9387
E-3087023.3084	E-3088022.5268

MIKE GARDNER
#5760

SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON DECEMBER 14, 2009, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: DECEMBER 17, 2009

TOPOGRAPHIC SURVEY

ASH STORAGE AREA
WELSH POWER PLANT
FOR: AEP

Date	Revision/Description

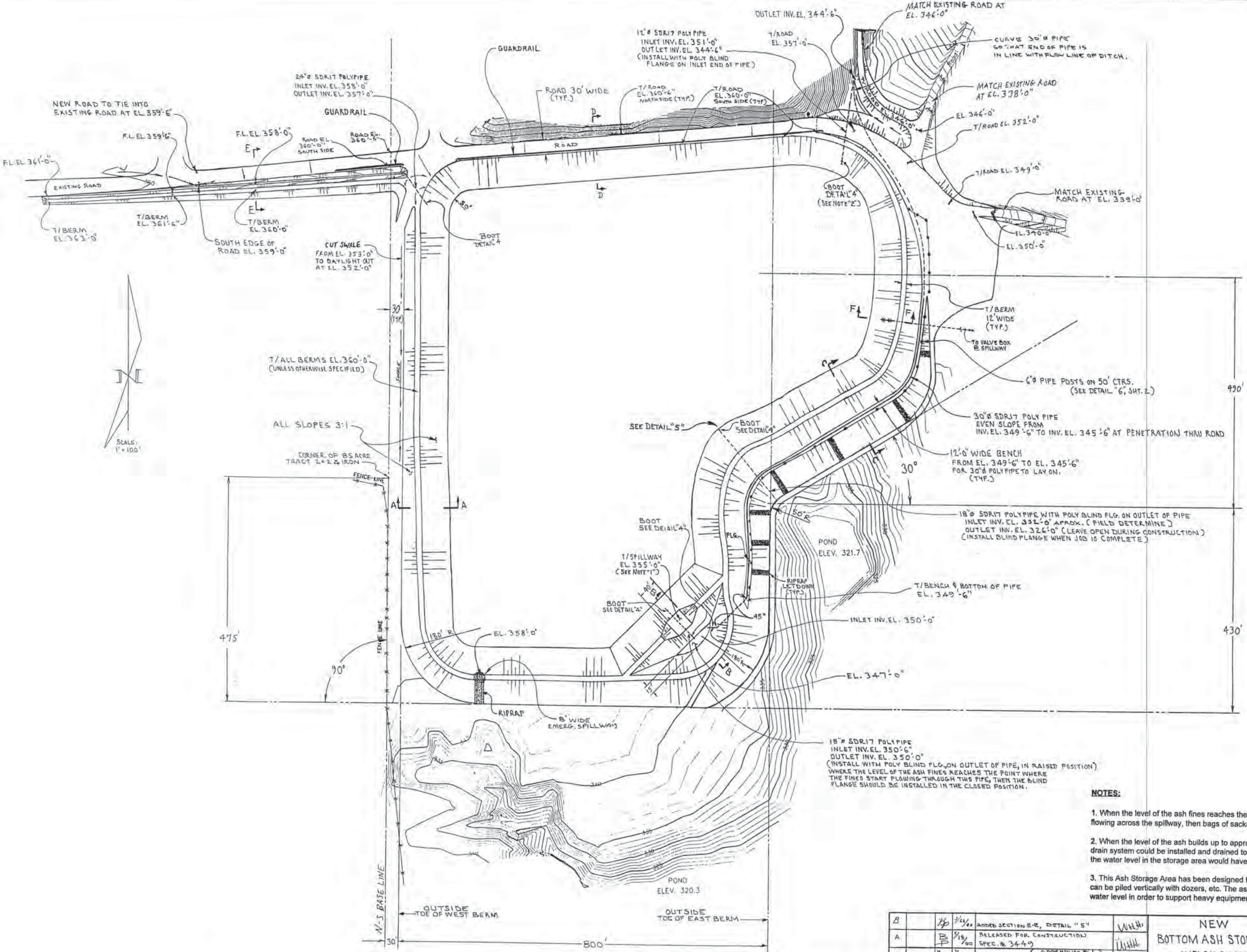
Drawn By	Checked By	Project No.	Dwg. Date	File No.	Sheet No.
J.B.O.	M.G.	094027	12-17-09		

MTG engineers & surveyors

5930 SUMMERHILL RD. | P.O. BOX 3786
TEXARKANA TEXAS 75501
P 903.838.8533 | F 903.832.4700
www.mtgengineers.com

TBPE NO. 354

X:\2009 Projects\094027 TOPO AT WELSH POWER PLANT - GREG CARTER\MERGE TOPO 6.dwg
Thu Dec 17, 2009 10:13AM



NOTES:

1. When the level of the ash fines reaches the point where the fines start flowing across the spillway, then bags of sackrete can be installed to raise the spillway elevation.

2. When the level of the ash builds up to approx. elev. 355 along the north and east sides, a french drain system could be installed and drained to this outlet to help hold the water table down. Of course the water level in the storage area would have to be at elev. 351 or above for the french drain to function.

3. This Ash Storage Area has been designed to hold the water level as low as possible so the ash can be piled vertically with dozers, etc. The ash level needs to be approx. 4 ft. to 5 ft. above the water level in order to support heavy equipment.

REV.	W.O.	BY	DATE	SUBJECT	APPROVED
C		BP	10-24-00	AS BUILT	

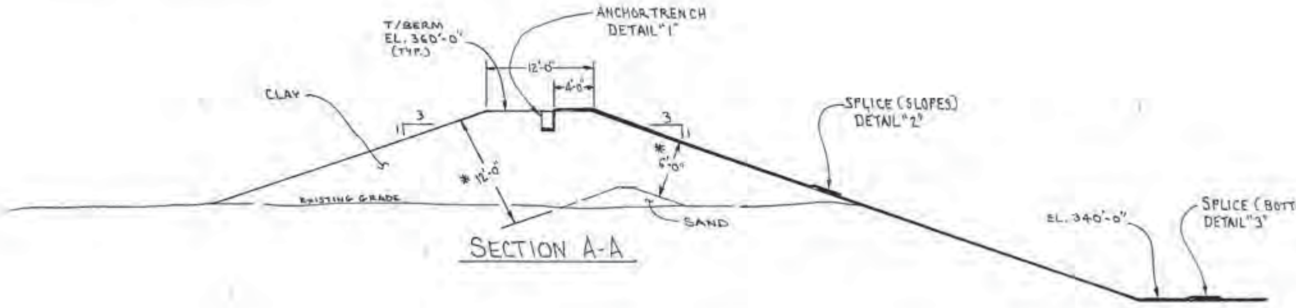
REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	7/24/00	ADDED SECTION E-E, DETAIL "5"	WHH
A		BP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHH
1		BP	4/13/00	RELEASED FOR BIDS SPEC. # 3449 (ADDENDUM # 1)	
		BP	3-10-00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

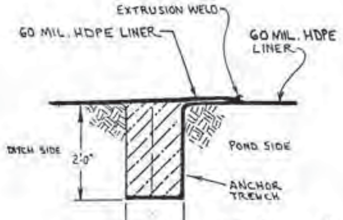
DEPT.
DIV.
APPROVED
DRWN. BY: BP
DATE: 3-10-00
SCALE: 1" = 100'
W.O.
SH. 1 of 2
DRWG. NO. WEPX-335

✻ - NOTE- THESE DIMENSIONS ARE SUBJECT TO ADJUSTMENT DEPENDING ON THE SAND / CLAY BALANCE VS. HAUL DISTANCE ON PROJECT.

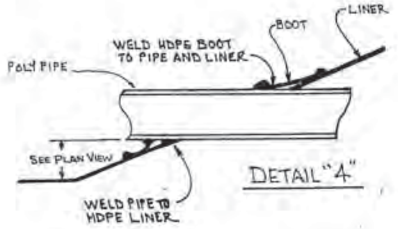


SECTION A-A

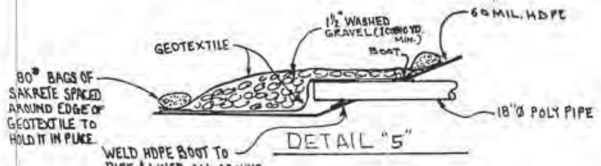
DETAIL "1"



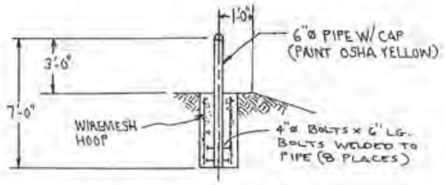
DETAIL "1A"



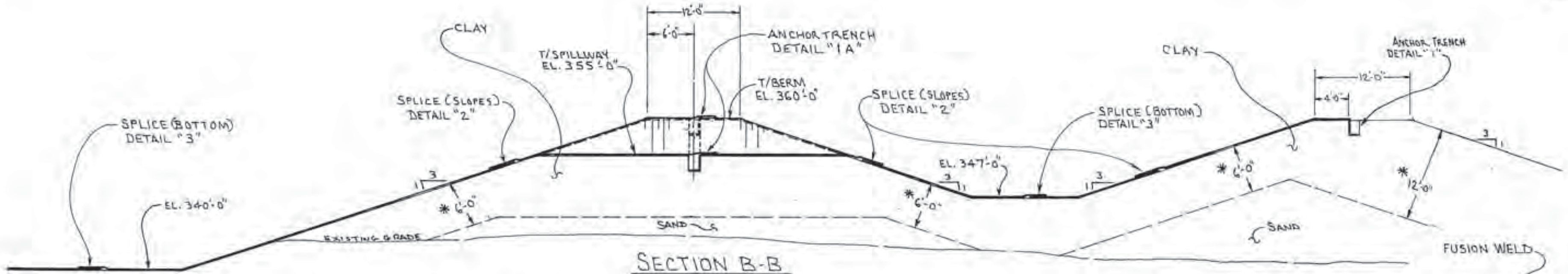
DETAIL "4"



DETAIL "5"

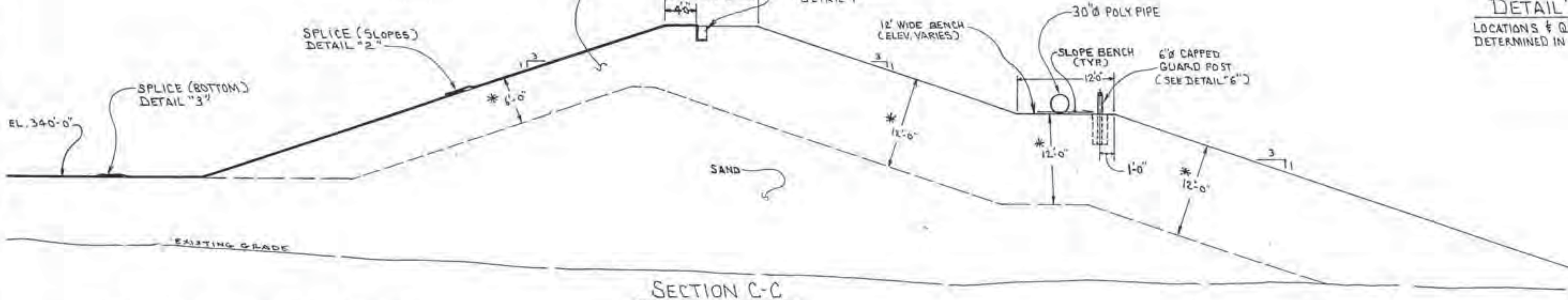


DETAIL "6"
50' ON CENTERS
(20 REQUIRED)

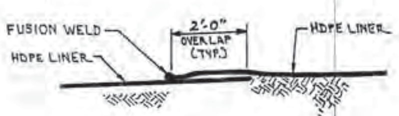


SECTION B-B

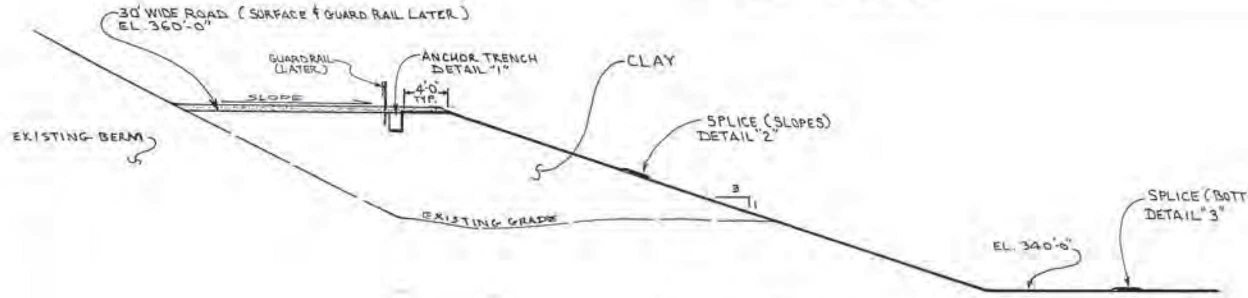
DETAIL "2"
LOCATIONS & QUANTITIES DETERMINED IN FIELD



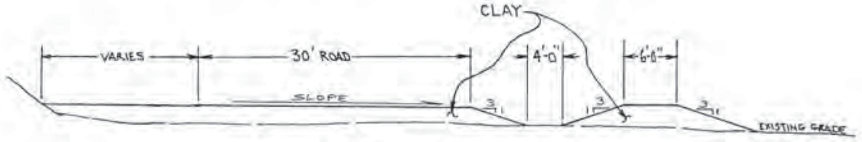
SECTION C-C



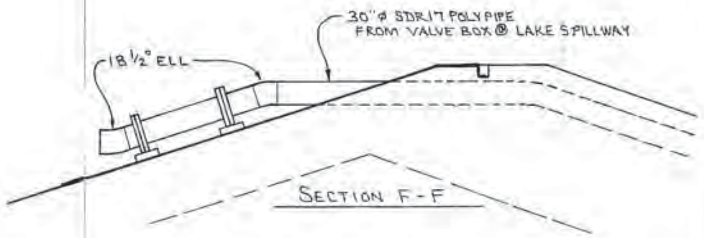
DETAIL "3"
LOCATIONS & QUANTITIES DETERMINED IN FIELD



SECTION D-D



SECTION E-E



SECTION F-F

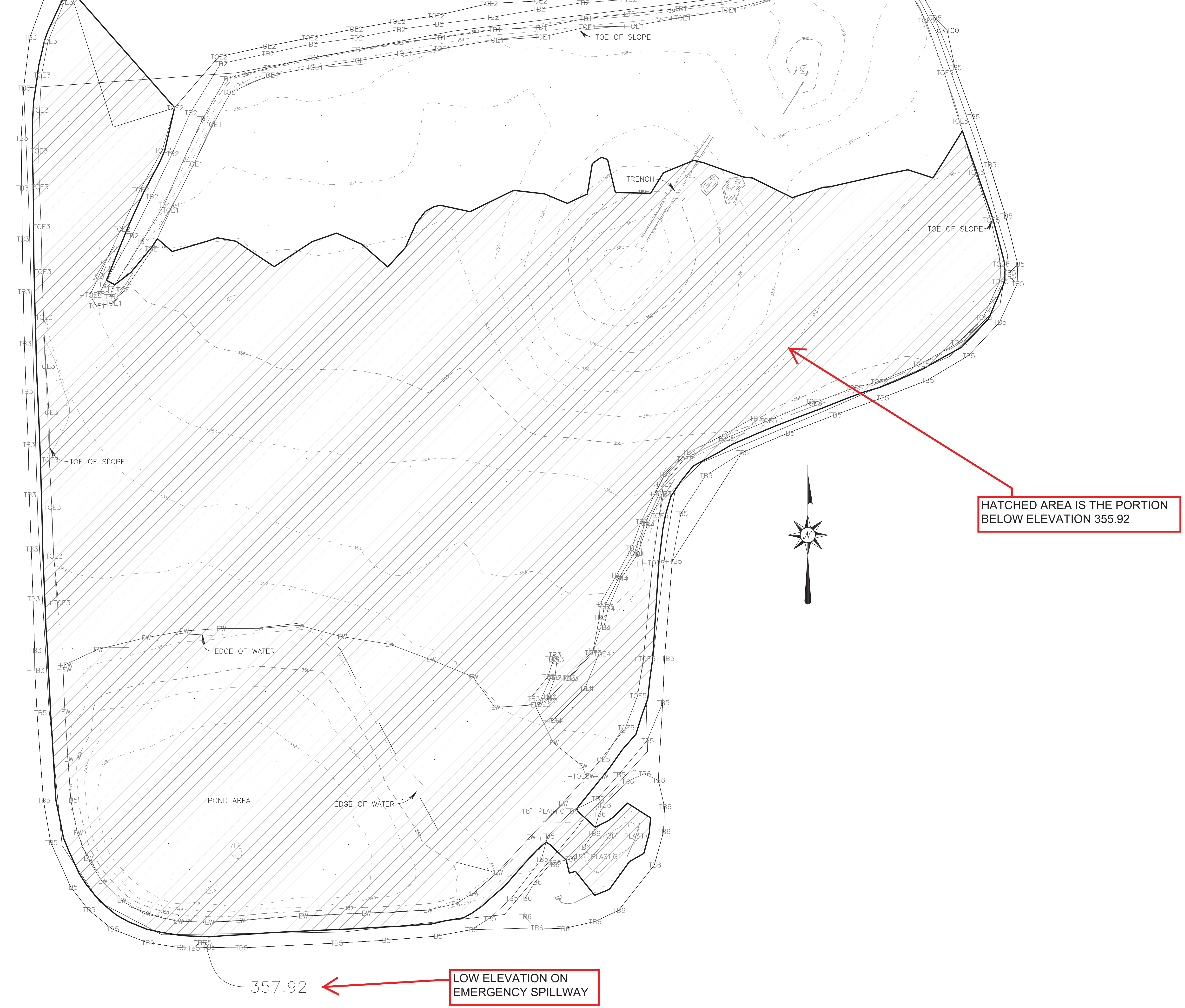
REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	10/29/00	AS BUILT	
A		BP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHH
1		BP	3/31/00	(ADDENDUM #1) RELEASED FOR BIDS SPEC. # 3449	
		BP	3/10/00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

	DEPT.
	DIV.
APPROVED	
DRWN. BY: BP	DATE: 3-10-00
SCALE: AS SHOWN	W.O.
SH. 2 of 2	DRWG. NO. WEPX- 335

```
                         SURFACE TO DATUM VOLUME REPORT

Murray, Thomas & Griffin, Inc.
P.O. Box 3786
Texarkana, TX 75501
903-838-8533

Project:              X:\2009 Projects\094025 ASH POND TOPO WELSH - GREG CARTER\
                      VOLUME CALC 4-12-10.pro
Report Generated:                              Monday, April 12, 2010 9:22:04 AM
--------------------------------------------------------------------------------
Where the DTM surface is above the datum the volume is reported as fill.
Where the DTM surface is below the datum the volume is reported as excavation.
--------------------------------------------------------------------------------

Shrinkage/swell factors:     Excavation   1.0000             Fill   1.0000

DTM Surface                  Number        Datum
Layer Name                   of Points     Elevation
---------------------------  -----------   -----------
POINTS COMPOSITE                  632           355.92

Volume limited to that within the constraining boundary - Object  18228
Area within boundary: 600,437.78 SQ FT  (13.784 ACRES)
Total triangulated area: 594,973.58 SQ FT  (13.659 ACRES)

                          Elev Range         Cut Volume       Fill Volume
                                (ft)              (yd3)             (yd3)
      ------------------------------   ----------------  ----------------
                     346.13 > 346.92              213.3               0.0
                     346.92 > 347.92            1,674.4               0.0
                     347.92 > 348.92            2,922.6               0.0
                     348.92 > 349.92            3,724.2               0.0
                     349.92 > 350.92            4,444.3               0.0
                     350.92 > 351.92            5,674.4               0.0
                     351.92 > 352.92            7,552.1               0.0
                     352.92 > 353.92           10,632.0               0.0
                     353.92 > 354.92           14,916.3               0.0
                     354.92 > 355.92           19,411.2               0.0
                     355.92 > 355.94                0.0               0.0


Excavation Volume                          Fill Volume
Beneath Datum (yd3)                        Above Datum(yd3)
-----------------------------------        ---------------------------------
                  71,164.9                                      0.0

Net Difference: 71,164.9 yd3 excess volume beneath datum
```



ASH POND VOLUME BELOW ELEVATION 355.92

3.6 – 2020 Dam and Dike Inspection Report, Welsh Power Plant CCR Ash Ponds, December 2020

Innovative approaches
Practical results
Outstanding service

2020 DAM AND DIKE INSPECTION REPORT
GEVR-20-014

WELSH POWER PLANT
CCR ASH PONDS

CASON, TEXAS

Prepared for:

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

Prepared by:

Freese and Nichols, Inc.
4055 International Plaza, Suite 200
Fort Worth, Texas 76109
(817) 735-7300
AEP20658

2020 DAM & DIKE INSPECTION REPORT

GEVR-20-014

WELSH POWER PLANT

CCR ASH PONDS

AMERICAN ELECTRIC POWER (SWEPCO)
CASON, TEXAS

INSPECTION DATE October 12, 2020

PREPARED BY Murphy Parks **DATE** 12-21-20
Murphy Parks, P.E.

REVIEWED BY **DATE** 12-21-20
Colin Young, P.E.

12-21-20
MURPHY H. PARKS
93756
Murphy Parks
FREESE AND NICHOLS, INC.
TEXAS REGISTERED
ENGINEERING FIRM
F-2144

I certify to the best of my knowledge, information and belief the information contained in this report meets the requirements of 40 CFR § 257.83(b).

TABLE OF CONTENTS

LIST OF TABLES

APPENDICES

1.0 INTRODUCTION

This report was prepared by Freese and Nichols, Inc., in part, to fulfill requirements of 40 CFR 257.83 and to provide South Western Electric Power Company (SWEPCO) and Welsh Power Plant with an evaluation of the facility.

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. Figure 1 shows the plant inspection vicinity map. The Ash Ponds at the Welsh Plant include the Primary Ash Pond and the Bottom Ash Storage Pond. The Primary Ash Pond CCR unit is located southwest of the Plant and directly west of the Welsh Reservoir. The Bottom Ash Storage Pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir. Figure 2 shows the two Ash Ponds general layout. Figure 1 and 2 are included in Appendix A.

American Electric Power Service Corporation’s Civil Engineering Division administers the Welsh Power Plant’s Dam Inspection and Maintenance Program (DIMP). As part of the DIMP, staff from Freese and Nichols, Inc. conducted the dam and dike inspections. This report contains the inspection findings, observations, photographic descriptions, conclusions, and maintenance recommendations. This inspection report addresses the Ash Ponds at the Welsh Power Plant. A separate inspection report has been prepared for the Clearwater Pond and the Swauano Dam (Non-CCR facilities).

Murphy Parks, P.E. and Cory Rauss, E.I.T. of Freese and Nichols, Inc., conducted the Ash Ponds Inspection. Mr. Greg Carter, P.E. of the AEP-Regional Engineering was present during the inspection. The inspection was performed on October 12, 2020. Weather conditions were sunny, clear skies, good visibility, and average temperature of 75° F.

This report has been prepared by Murphy Parks, P.E. and Cory Rauss E.I.T., and reviewed by Colin Young, P.E.. The report contains: (i) Description of the impoundments, (i) Summary of Visual Observations; (ii) Conclusions; and (iii) Recommendations. Photographs identifying typical conditions, problem areas, items that need correction or requiring additional monitoring, have been selected from the inspection field photographic file and provided in the Appendix B and C of the report.

2.0 DESCRIPTION OF IMPOUNDMENTS

2.1 PRIMARY ASH POND

The Primary Ash Pond was placed into operation in 1977 and is located in a topographically low area that had been an unnamed intermittent tributary of Swauano Creek prior to development of the Site. The Primary Ash Pond is bounded by natural ground (topographically higher areas) to the north and west, and embankment dikes to the south and east. The elevation at the top of embankment along the crest area is approximately 340.0 feet msl (mean sea level) and the toe elevation of the embankment is approximately 300.0 feet msl. The downstream slope of the Primary Ash Pond embankment is inundated by the cooling lake reservoir (Normal Pool lake level is 320.0 feet msl). These dikes are predominantly constructed of compacted sandy clay and clayey sand materials. The embankment dike south of the Primary Ash Pond includes a drainage canal that receives overflow (clear) water from the Primary Ash Pond. The water level in the Primary Ash Pond is controlled by a weir box which discharges into the drainage canal. The primary emergency spillway, which consists of a concrete weir set within an earthen channel that discharges into the drainage canal; the primary emergency spillway is approximately 950 feet to the west of the embankment. The clear water in the drainage canal flows east and discharges into the Clearwater Pond. The Primary Ash Pond embankment is approximately 40 feet in height. The secondary emergency spillway is located at the right end of the embankment and discharges directly into the Clearwater Pond. The storage capacity of the Primary Bottom Ash Pond at elevation 334 feet above msl is approximately 319 acre-ft.

2.2 BOTTOM ASH STORAGE POND

The Bottom Ash Storage Pond (Winston Pond) was placed into operation in 2000 and is located in a topographically high area of the Plant. The Bottom Ash Storage Pond embankments are approximately 20 feet in height and are constructed of compacted clay on a 3:1 slope (3 feet horizontal, 1 foot vertical). The elevation at the base of the embankment is approximately 340 feet msl, and the elevation at the top of the embankment around the perimeter of the Bottom Ash Storage Pond is approximately 360 feet msl.

The Bottom Ash Storage Pond is approximately 22 acres in size. The principal spillway for the Bottom Ash Storage Pond is located near the southeast corner of the pond and consists of an 18-inch drain at elevation 350.5 feet msl and a 40-foot-long broad-crested weir with a crest elevation of 355 feet msl. The emergency spillway is an 8-foot-wide weir with a rock riprap discharge chute located along the southern embankment at elevation of 358 feet msl. The storage capacity of the Bottom Ash Storage Pond at elevation 358 feet msl is approximately 344 acre-ft.

3.0 REVIEW OF AVAILABLE INFORMATION (257.83(b)(1)(i))

A review of available information regarding the status and condition of the CCR Ponds, which include files available in the CCR operating record, such as design and construction information, periodic structural stability assessments, previous 7-day inspection reports, previous quarterly inspection reports, 30-day instrumentation data, and previous annual inspections was conducted. Based on the review of the data it is concluded that there were no signs of actual or potential structural weakness or adverse conditions at the facilities.

4.0 CHANGES IN GEOMETRY SINCE LAST INSPECTION (257.83(b)(2)(i))

The Primary Ash Pond has been modified since the 2019 annual inspection by excavating the secondary emergency spillway through the crest of the embankment at the right end of the dam. Dimensions of the secondary emergency spillway are a 30-feet bottom width at crest elevation 337 feet msl with 10H:1V side slopes, for a total width of 90 feet and depth of 3 feet. Flows through the secondary emergency spillway would discharge directly into the Clearwater Pond. These modifications were constructed in concert with modifications to the drainage canal downstream of the weir box which included filling in the canal to construct a vehicle crossing. To convey drainage canal flows, a 36-inch diameter culvert and a 48-inch culvert were installed through the crossing.

With these hydraulic changes to the drainage canal, additional discharge capacity of the Primary Ash Pond was increased by constructing the secondary emergency spillway.

No modifications have been made to the geometry of the Bottom Ash Storage Pond since the 2019 annual inspection. The geometry of the impoundments have remained essentially unchanged.

5.0 CHANGES THAT EFFECT STABILITY OR OPERATION (257.83(b)(2)(vii))

The installation of the secondary emergency spillway in the Primary Ash Pond will change the operation of the pond during high flow conditions. These changes would not be expected to affect the stability of the impounding structure.

Based on interviews with plant personnel and field observations, there were no changes to the Bottom Ash Storage Pond since the last annual inspection that would affect the stability or operation of the impounding structure.

6.0 IMPOUNDMENT CHARACTERISTICS (257.83(b)(2)(iii, iv, v))

6.1 PRIMARY ASH POND

Table 1 is a summary of the minimum, maximum, and present depth and elevation of the impounded water since the previous annual inspection; the storage capacity of the impounding structure at the time of the inspection; and the approximate volume of the impounded water at the time of the inspection.

Table 1 - Summary of Relevant Storage Information for Primary Ash Pond

	Primary Ash Pond
Approximate **Minimum** depth of impounded water since last annual inspection	30.5 ft (330.5 ft msl)
Approximate **Maximum** depth of impounded water since last annual inspection	31.8 ft (331.8 ft msl)
Approximate **Present** depth of impounded water at the time of the inspection	31.5 ft (331.5 ft msl)
Approximate **Minimum** depth of CCR since last annual inspection	10.0 ft (310.0 ft msl)
Approximate **Maximum** depth of CCR since last annual inspection	32.5 ft (332.5 ft msl)
Approximate **Present** depth of CCR at the time of the inspection	32.5 ft (332.5 ft msl)
Storage Capacity of impounding structure at the time of the inspection	319.22 acre-ft
Approximate volume of impounded water at the time of the inspection	102.22 acre-ft
Approximate volume of CCR at the time of the inspection	217 acre-ft

Crest elevation of the dike = 340 ft msl, Bottom elevation of the pond = 300 ft msl

6.2 BOTTOM ASH STORAGE POND

Table 2 is a summary of the minimum, maximum, and present depth and elevation of the impounded water since the previous annual inspection; the storage capacity of the impounding structure at the time of the inspection; and the approximate volume of the impounded water at the time of the inspection.

Table 2 - Summary of Relevant Storage Information for Bottom Ash Storage Pond

	Bottom Ash Storage Pond
Approximate **Minimum** depth of impounded water since last annual inspection	9.6 ft (349.6 ft msl)
Approximate **Maximum** depth of impounded water since last annual inspection	10.8 ft (350.8 ft msl)
Approximate **Present** depth of impounded water at the time of the inspection	10.7 ft (350.7 ft msl)
Approximate **Minimum** depth of CCR since last annual inspection	10.5 ft (350.5 ft msl)
Approximate **Maximum** depth of CCR since last annual inspection	18.0 ft (358.0 ft msl)
Approximate **Present** depth of CCR at the time of the inspection	18.0 ft (358.0 ft msl)
Storage Capacity of impounding structure at the time of the inspection	344 acre-ft
Approximate volume of impounded water at the time of the inspection	39 acre-ft
Approximate volume of CCR at the time of the inspection	292 acre-ft

Crest elevation of the dike = 360 ft msl, Bottom elevation of the pond = 340 ft msl

7.0 INSPECTION (257.83(b)(1)(ii))

7.1 GENERAL

The summary of the visual observations uses terms to describe the general appearance or condition of an observed item, activity or structure. Their meaning is understood as follows:

Good: A condition or activity that is generally better than what is minimally expected or anticipated from a design or maintenance point of view.

Fair or Satisfactory:

A condition or activity that generally meets what is minimally expected or anticipated from a design or maintenance point of view.

Poor: A condition or activity that is generally below what is minimally expected or anticipated from a design or maintenance point of view.

Minor: A reference to an observed item (e.g., erosion, seepage, vegetation, etc.) where the current maintenance condition is below what is normal or desired, but which is not currently causing concern from a structure safety or stability point of view.

Significant: A reference to an observed item (e.g. erosion, seepage, vegetation, etc.) where the current maintenance program has neglected to improve the condition. Usually, conditions that have been previously identified in the inspections, but have not yet been corrected.

Excessive: A reference to an observed item (e.g., erosion, seepage, vegetation, cracks, concrete surface, etc.) where the current maintenance condition is worse than what is normal or desired and which may have affected the ability of the observer to properly evaluate the structures, or particular area being observed, or which may be a concern from a structure safety or stability point of view.

In addition, a "deficiency" is some evidence that a dam/dike has developed a problem that could impact the structural integrity of the dam/dike. There are four general categories of deficiencies. These four categories are described below:

1. Uncontrolled Seepage:

   Uncontrolled seepage is seepage that is not behaving as the design engineer has intended. An example of uncontrolled seepage is seepage that comes through or around the embankment and is not picked up and safely carried off by a drain. Seepage that is collected by a drain can still be uncontrolled if it is not safely collected and transported, such as seepage that is not clear. Seepage that is unable to be measured and/or observe it is considered uncontrolled seepage. Wet or soft areas are not considered as uncontrolled seepage, but can lead to this type of deficiency. These areas should be monitored frequently.

2. Displacement:

   Displacement of the embankment is large-scale movement of part of the dam/dike. Common signs of displacement are cracks, scraps, bulges, depressions, sinkholes and slides.

3. Blockage of Water Control Appurtenances:

   Blockage of Water Control Appurtenances is the restriction of the flow section at spillways, decant or pipe spillways, or drains.
4. Erosion:

   Erosion is the gradual movement of surface material by water, wind or ice. Erosion is considered a deficiency when it is more than a minor routine maintenance item.

7.2 VISUAL INSPECTION (257.83(b)(2)(i))

A visual inspection of the CCR Ponds was conducted to identify any signs of distress or malfunction of the impoundment and appurtenant structures. Specific items inspected included all structural elements of the dam such as upstream and downstream slopes, crest, and toe. Figure 3A (Photograph Location Map) and photographs of the Primary Ash Pond are included at Appendix B.

7.2.1 PRIMARY ASH POND

(i) (Photographs 1-4) The crest of the embankment appeared in good condition. The crest was level, and there were no obvious signs of settlement, cracking, or instabilities. The crest has effectively been widened and the upstream slope overbuilt through the placement of ash material over time. Delineation between the original crest and the overbuilt upstream slope is not readily apparent in the field. As a result of the overbuilt upstream slope, field observations are of the ash material and not of the original earthen embankment. Erosion gullies have formed at the upstream shoulder, however the gullies are not considered significant since they have developed in the overbuild material. Scrub vegetation has become established along the upstream shoulder of the overbuild. Geotechnical borings had recently been drilled in the crest in order to characterize embankment materials to support a slope stability study of future loading conditions when the pond will be excavated of ash material.

(ii) (Photographs 5-7) The downstream slope appeared in fair condition. There were no signs of slides, sloughs, or other slope instabilities. No seepage areas were observed. Vegetation coverage was heavy, and with the dam not having been mowed within the past 1 to 2 months, the vegetation precluded a complete visual inspection. Multiple animal burrows were observed at mid slope, just above the rock riprap armoring along the water line (Photograph 7). In this same area, the slope appeared to flatten to create a small horizontal bench approximately 8 feet wide, just above the rock riprap. The groin between where the downstream slope adjoins the downstream slope of the Clearwater Pond's north embankment was heavily vegetated and could not be inspected for erosion.

(iii) (Photographs 9-12) The primary emergency spillway appeared in fair to poor overall condition. The earthen channel had been mowed and was unobstructed. Rutting was noted in the channel, likely from mowing operations. The concrete weir is in poor condition. The weir has partially failed in several areas, with undermining of the weir occurring on the upstream and downstream sides (Photograph 11). In some areas the weir has tilted downstream. A maintenance roadway crosses the downstream end of the spillway before it discharges into the discharge channel (Photograph 12). The roadway has a small culvert to convey local runoff.

(iv) (Photograph 8) The secondary emergency spillway has been constructed since the 2019 inspection. The secondary emergency spillway is effectively a lowered section of the embankment crest at the right end of the dam. The spillway bottom width is 30 feet with 10H:1V side slopes and a crest elevation 3 feet lower than the crest of the embankment.

(v) The control weir box (i.e. overflow discharge structure) was not inspected. AEP staff reported this components was functioning as designed and no issues were reported.

7.2.2 BOTTOM ASH STORAGE POND

Figure 3B (Photograph Location Map) and photographs of the bottom ash storage pond are included at Appendix C.

(i) (Photographs 1-13) The crest of the embankment appeared in fair condition. The crest was level, and there were no obvious signs of settlement, cracking, or instabilities. The east embankment had been mowed, and therefore could be inspected. Multiple animal burrows were noted and flagged along the east embankment. The crest of the south, west, and north embankments was heavily overgrown with vegetation and had not been mowed, therefore these areas could not be inspected (Photographs 6, 11, 13). The crest fencing generally appeared straight, and was typically overgrown with vegetation. The distance between the fence and the geosynthetic liner is typically less than 10 feet, which may affect mowing operations.

(ii) (Photographs 1, 4, 5, 6, 8, 11, 13) The upstream slope was in good overall condition. There were no signs of slides, sloughs, or other slope instabilities. The upstream slope is mostly buttressed with ash material. The upstream slope is lined with a white geosynthetic liner throughout the pond. Several areas were noted where the liner had bubbled up, however these areas were stepped on to test the subgrade below and in all areas the subgrade was firm. No tears or separations at the liner joints were observed. Minor abrasion damage was noted on the later at the equipment access gate on the north side (Photograph 14). Woody vegetation is growing along the liner toe-in in multiple locations (Photograph 5). Ash management within the pond is good (Photograph 21).

(iii) (Photographs 15-20) The downstream slope was in good overall condition. There were no signs of slides, sloughs, or other slope instabilities. No seepage areas were observed. Vegetation coverage was fair to good, with the dam having been recently mowed. Vegetation coverage on the west embankment was fair to poor; this area of the embankment is shaded by trees and prevents good grass cover from establishing.

(iv) (Photograph 7) The principal spillway appeared in good overall condition. The inlet basin was dry at the time of the inspection and the floor of the inlet basin was mowed, and the staff gage was visible. The inlet weir and geosynthetic liner appeared level.

(v) (Photograph 9-10) The emergency spillway appeared in good overall condition. The geosynthetic liner on the upstream slope and control weir was bubbled. The outlet channel was stable and lined with rock riprap. It was noted the crest fencing would partially obstruct the spillway if it were engaged.

(vi) (Photograph 12) Pipe culverts are located at the northwest corner of the pond, which are part of the landfill storm water control system and discharge into the pond. The culverts appeared clear of obstructions and in good and functional condition.

7.3 INSTRUMENTATION (257.83(b)(2)(ii))

The monitoring instrumentation for the Primary Ash Pond consists of one (1) active piezometer (B-2) located through the main embankment area. There is no monitoring instrumentation for the Bottom Ash Storage Pond (Winston Pond). The location of the instrumentation is shown on Appendix D, Figure 4A. The maximum and minimum readings of Piezometer B-2 since the last annual inspection, a time period of September 2019 to September 2020, were 326.47 ft msl and 321.77 ft msl, respectively. Piezometer B-2 levels appeared consistent from month to month, and reacted to the fluctuation in tailwater levels (i.e. main lake). The results of the measurements of the piezometer is shown in Appendix D, Figure 4B.

8.0 SUMMARY OF FINDINGS

Primary Ash Pond:

Based on the visual observations during the inspection, the dam and appurtenances are generally in good condition. Specific conclusions related to this inspection are as follows.

- There is no evidence of distress that would indicate the possibility of immediate sliding, slope instability, settlement, misalignment or cracking of the ash pond embankments. As such, it is concluded that the dam and dikes are performing as designed.

- Excessive vegetation was noted on the downstream slope. The slope vegetation should be maintained at a manageable height.

- All animal burrows encountered should be eliminated by filling them with suitable materials and compacted as necessary.

Bottom Ash Storage Pond (Winston Pond):

Based on the visual observations during the inspection, the dam and appurtenances are generally in good condition. Specific conclusions related to this inspection are as follows

- There is no evidence of distress that would indicate the possibility of sliding, slope instability, settlement, misalignment or cracking of the Bottom Ash Storage Pond embankments. As such, it is concluded that the dikes are performing as designed.

- Vegetation management along the crest was poor. Vegetation management for the downstream slope and principal spillway outlet was satisfactory.

- Multiple animal burrows were noted throughout the crest of the east embankment.

9.0 RECOMMENDATIONS

Primary Ash Pond:

A summary of recommendations for general maintenance and continued monitoring, as well as any recommendations for remedial activities, is provided below:

1. Maintain vegetation on the downstream slope to a manageable height which allows inspection for irregularities and signs on distress.

2. Repair animal burrows by filling in with compatible material with proper compaction.

3. Construction of the secondary emergency spillway should be documented with as-built drawings. The stage-storage-discharge rating curve for the pond should be updated to reflect the changed hydraulic conditions.

4. The concrete weir inset in the primary emergency spillway channel should be repaired.

Bottom Ash Storage Pond (Winston Pond):

A summary of recommendations for general maintenance and continued monitoring, as well as any recommendations for remedial activities, is provided below:

1. Maintain vegetation throughout the embankment to a manageable height which allows inspection for irregularities and signs on distress. If the crest fence prohibits adequate

equipment access adjacent to the geosynthetic liner, consider removal or relocating the fence off the embankment.

2. Establish proper grass vegetation on the west embankment downstream slope. Reseeding, topsoil, and removal of trees at the toe to prevent shading may be required.

3. Repair animal burrows by filling in with compatible material with proper compaction.

9.1 MAINTENANCE ITEMS

Refer to Section 9.0 for Maintenance recommendations.

9.2 ITEMS TO MONITOR

- Monitor the Bottom Ash Storage Pond geosynthetic liner for excessive bubbling, warping, tears, or joint separation. If any of these conditions develop, perform repairs immediately.

9.3 DEFICIENCIES (257.83(b)(2)(vi))

There were no deficiencies or signs of structural weakness or disruptive conditions observed at the time of the inspection that would require additional investigation or remedial action. There were no deficiencies noted during any of the quarterly inspections. If any of these conditions develop before the next annual inspection, please contact AEP Geotechnical Engineering immediately.

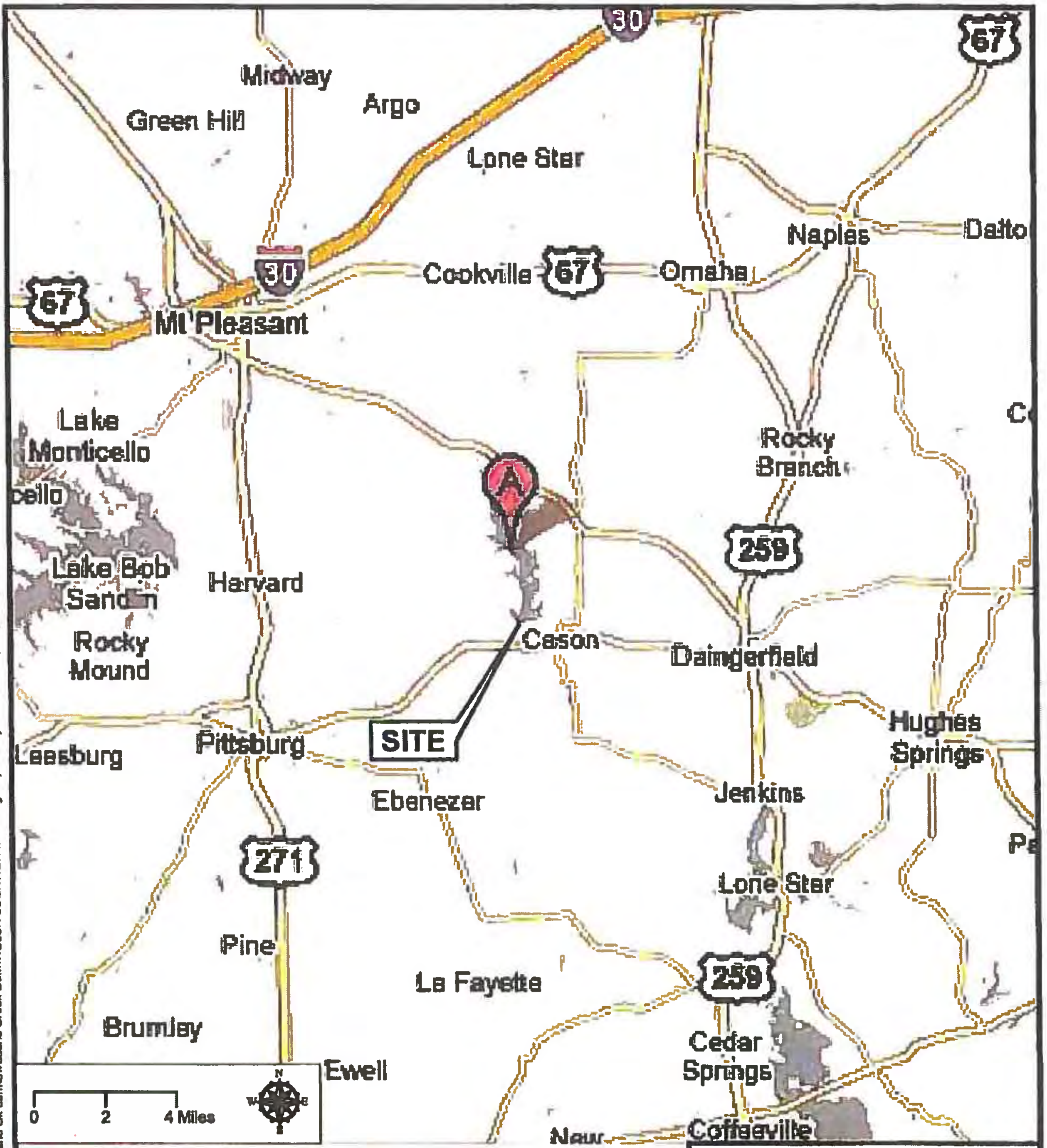
If you have any questions with regard to this report, please do not hesitate to contact Murphy Parks, P.E. at (817)-735-7439 or MHP@freese.com.

APPENDICES

Appendix A

Figure 1 - Vicinity Map

Figure 2 - CCR Pond Complex General Layout



Source: Google Maps

AEP WELSH POWER PLANT
SWAUANO CREEK DAM
TITUS COUNTY, TX

URS

URS Corporation
9400 Amberglen Blvd.
Austin, Texas 78729

DAM & DIKE INSPECTION
VICINITY MAP

DATE 4/14/2009	SCALE 1" = 4 MILES
URS JOB NUMBER 41009103	DRAWN BY SLC

Figure 1 Plant Inspection Vicinity Map

File Q:\AEP Dam Inspections\Welsh\Drawings Swauano Ck dam\Swauano Creek Dam\WELSH LOCATION MAP.dwg Layout: Layout1 Plotted Apr 14, 2009 - 2:45pm

FIGURE 2 - SITE LOCATION MAP

WELSH POWER PLANT, CASON, TX

Appendix B

Figure 3A – Photograph Location Map, Primary Ash Pond

Photographs of the Primary Ash Pond

FIGURE 3A - PHOTOGRAPH LOCATION MAP

PRIMARY ASH POND, WELSH POWER PLANT, CASON, TX

	Photograph 1: View along crest, looking left. Arrow points to location of recent boring locations.
	Photograph 2: View along upstream slope, looking right. Superimposed line approximates the original crest upstream shoulder, thus demonstrating the extent of overbuild which has occurred over the original upstream slope.
	Photograph 3: Close-up view of upstream edge of upstream slope overbuild. Note erosion gullies. Since gullies have formed in the overbuild material, they are not considered problematic.

Photograph 4: Overview of upstream slope and crest, looking left, as seen from the right end of the dam.

Photograph 5: Typical view of downstream slope, looking left.

Photograph 6: Typical view of downstream slope, looking right.

Photograph 7: Example of poor vegetation coverage on downstream slope, near the transition to the rock riprap slope protection. Multiple animal burrows were noted in this area.

Photograph 8: View along crest, looking right, towards the secondary emergency spillway which had been excavated in the crest/right abutment area. Flow direction is right to left. Clearwater Pond is at left.

Photograph 9: View of primary emergency spillway, looking upstream. Arrow points to overflow weir location. Note rutting at left side of photo.


Photograph 10: View of primary emergency spillway, looking downstream, from near the overflow weir location.


Photograph 11: Close-up view of primary emergency spillway overflow weir. Note undermining damage on upstream and downstream faces, and overall irregularity of the weir.


Photograph 12: View of roadway crossing at downstream end of primary emergency spillway.

Appendix C

Figure 3B – Photograph Location Map, Bottom Ash Storage Pond

Photographs of the Bottom Ash Storage Pond

FIGURE 3B - PHOTOGRAPH LOCATION MAP

ASH STORAGE POND, WELSH POWER PLANT, CASON, TX

Photograph 1: Typical view of upstream slope and crest along east embankment, looking south. Note the crest had been recently mowed in this section

Photograph 2: Example of animal burrowing activity on the crest. East embankment, looking south.

Photograph 3: Example of multiple animal burrows which were visible after the crest had been mowed.

	Photograph 4: Typical view of upstream slope and geosynthetic liner. East embankment, looking east.
	Photograph 5: Example woody vegetation growing at toe of geosynthetic liner toe-in on upstream slope.
	Photograph 6: View of crest where mowing operation had stopped. Beyond this point, the crest of the embankment was overgrown with vegetation and could not be thoroughly inspected. East embankment, near transition to south embankment.

	Photograph 7: View of principal spillway outlet pipe and control weir at southeast corner of pond.
	Photograph 8: View of upstream slope along south embankment, looking west.
	Photograph 9: View of emergency spillway weir. Note bubbling of geosynthetic liner.

Photograph 10: View of emergency spillway outlet channel, looking downstream. Note crest fence partially blocks the spillway weir.

Photograph 11: Typical view of crest and upstream slope on west embankment. Note crest is overgrown with vegetation.

Photograph 12: View of stormwater inlet pipes entering northwest corner of pond.

	Photograph 13: Typical view of crest and upstream slope on north embankment. Note crest is overgrown with vegetation.
	Photograph 14: View of minor abrasion damage of the geosynthetic liner where equipment enter pond through gate at left.
	Photograph 15: Typical view of downstream slope of east embankment, looking north

Photograph 16: Typical view of downstream slope and conveyance piping, along east embankment looking east. Note slope is well mowed.

Photograph 17: View of access ramp leading up to crest at southwest corner of pond.

Photograph 18: Typical view of downstream slope of south embankment, looking west.

	Photograph 19: View of vine vegetation growing in crest fence, as seen from downstream slope.
	Photograph 20: Typical view of downstream slope of west embankment, looking north.
	Photograph 21: View across pond, looking west from west embankment. Ash management operations appear good.

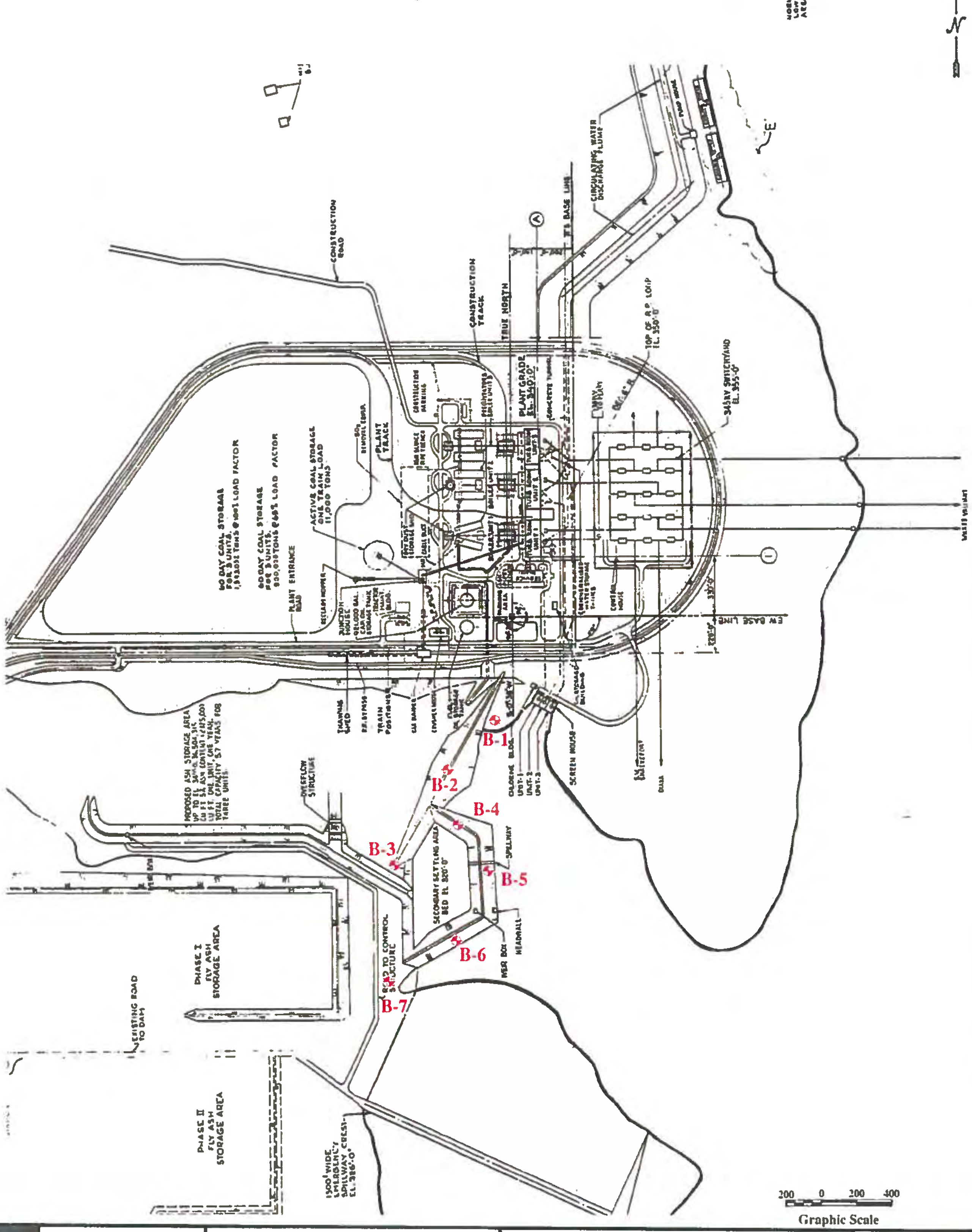
Appendix D

Figure 4A – Piezometer Location Map

Figure 4B – Primary Ash Pond Piezometer Data

FIGURE 4A - INSTRUMENT LOCATION MAP

Primary Ash Pond



ETTL ENGINEERS & CONSULTANTS
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1717 East Erwin
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WELSH POWER PLANT
PITTSBURGH, TEXAS

PLATE 1 - PLAN OF BORINGS	APPROVED BY:
JOB NO.: G3242-095	DRAWN BY: K.C.R.
DATE: JAN. 2010	SCALE: AS SHOWN

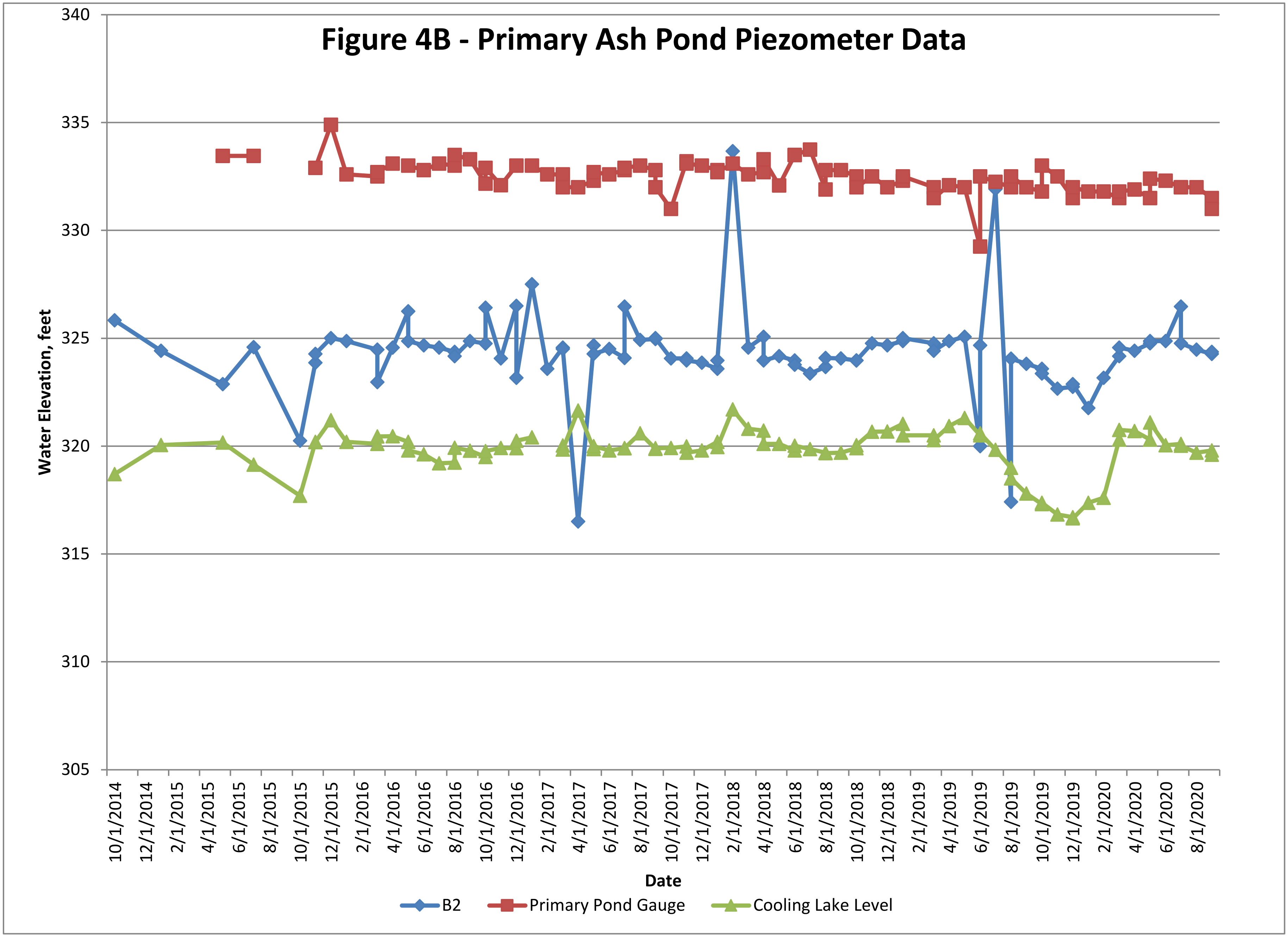
Figure 4B - Primary Ash Pond Piezometer Data
Water Elevation, feet
340
335
330
325
320
315
310
305
10/1/2014
12/1/2014
2/1/2015
4/1/2015
6/1/2015
8/1/2015
10/1/2015
12/1/2015
2/1/2016
4/1/2016
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12/1/2019
2/1/2020
4/1/2020
6/1/2020
8/1/2020
Date
B2
Primary Pond Gauge
Cooling Lake Level

3.7 – 2021 Annual Dam and Dike Inspection Report, Welsh Power Plant CCR Ash Ponds, December 2021

2021 ANNUAL DAM AND DIKE INSPECTION REPORT

CCR ASH PONDS

WELSH POWER PLANT
CASON, TEXAS

December, 2021

Prepared by: American Electric Power Service Corporation
1 Riverside Plaza
Columbus, OH 43215

GERS-21-078

2021 Dam & Dike Inspection Report

CCR Ash Ponds

DOCUMENT ID: GERS-21-078
Revision 0

WELSH POWER PLANT
CASON, TEXAS

INSPECTION DATE **October 19 and 20, 2021**

PREPARED BY: Brett A. Dreger **DATE** 12/8/2021
Brett A. Dreger, P.E.

REVIEWED BY: **DATE** 12-08-2021
Shah S. Baig, P.E.

APPROVED BY: Gary F. Zych **DATE** 12/15/2021
Gary F. Zych, P.E.
Manager - Geotechnical Engineering

American Electric Power
Service Corporation
Texas Registered Engineering
Firm No. F-3341

Gary F. Zych
GARY F. ZYCH
127152
12/15/2021

PROFESSIONAL ENGINEER
SEAL & SIGNATURE

I certify to the best of my knowledge, information and belief the information contained in this report meets the requirements of 40 CFR § 257.83(b).

TABLE OF CONTENTS

LIST OF TABLES

APPENDICES

1.0 INTRODUCTION

This report was prepared by AEP- Geotechnical Engineering Services (GES) section, in part, to fulfill requirements of 30 TAC 352.831 (40 CFR 257.83) and to provide Southwestern Electric Power Company (SWEPCO) and Welsh Power Plant with an evaluation of the facility.

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. Figure 1 shows the plant inspection vicinity map. The Ash ponds at the Welsh Plant include the Primary Bottom Ash Pond and the Bottom Ash Storage Pond. The Primary Bottom Ash Pond CCR unit is located southwest of the Plant and directly west of the Welsh Reservoir. The Bottom Ash Storage Pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir. Figure 2 shows the two Ash Ponds general layout.

Mr. Brett A. Dreger, P.E., from the Geotechnical Engineering Services Section, conducted the Ash Ponds Inspection. Mr. Greg Carter, P.E. Regional Engineering for Welsh Plant was the facility contact for the inspection and participated during the inspection. The inspection was performed on October 19 and 20, 2021. Weather conditions were mostly sunny, with temperatures ranging from 59° F in the morning to low 80's° F in the afternoon.

This report has been prepared by Mr. Brett A. Dreger, P.E., under the direct supervision of Mr. Gary Zych, P.E., AEP's Geotechnical section manager. The report presents: Description of the impoundments, Summary of Visual Observations; Conclusions; and Recommendations. Photographs identifying typical conditions of area findings, items that need correction or requiring additional monitoring, have been selected from the inspection field photographic file and provided in the Attachments B and C of this report.

2.0 DESCRIPTION OF IMPOUNDMENTS

2.1 PRIMARY BOTTOM ASH POND

The Primary Bottom Ash Pond was placed into operation in 1977, and is located in a topographically low area that had been an unnamed intermittent tributary of Swauano Creek prior to development of the Site. The Primary Bottom Ash Pond is bounded by natural ground surface (topographically higher areas) to the north and west, and embankment dikes to the south and east. The elevation at the top of embankment along the crest area is approximately 340.0 feet above msl and the toe elevation of the embankment is approximately 300.0 feet above msl. The downstream slope of the Primary Bottom Ash Pond embankment is inundated by the cooling lake reservoir (Normal Lake Level is 320.0 feet above msl). These dikes are predominantly constructed of compacted sandy clay and clayey sand. The embankment dike south of the Primary Bottom Ash Pond includes a drainage canal that receives overflow (clear) water from the Primary Bottom Ash Pond. The water level in the Primary Bottom Ash Pond is controlled by a weir box which discharges into the drainage canal. The clear water in the drainage canal flows east and discharges into the clear water pond. The Primary Bottom Ash Pond embankment is approximately 40 feet in height. The storage capacity of the Primary Bottom Ash Pond at elevation 334 feet above msl is approximately 319.22 acre-ft.

2.2 BOTTOM ASH STORAGE POND

The Bottom Ash Storage Pond (Winston Pond) was placed into operation in 2000, and is located in a topographically high area of the Plant. The Bottom Ash Storage Pond embankments are approximately 20 feet in height and are constructed of compacted clay on a 3:1 slope (3 feet horizontal, 1 foot vertical). The elevation at the base of the embankment is approximately 340 feet above msl, and the elevation at the top of the embankment around the perimeter of the Bottom Ash Storage Pond is approximately 360 feet above msl.

The Bottom Ash Storage Pond is approximately 22 acres in size. The principal spillway for the Bottom Ash Storage Pond is located near the southeast corner of the pond and consists primarily of an 18 inch pipe drain at elevation 350.5 feet above msl and also of a 40-foot-long broad-crested weir with a crest elevation of 355 feet above msl. The emergency spillway is an 8-foot-wide weir with a rock rip-rap discharge chute located along the southern embankment at an elevation of 358 feet above msl. The storage capacity of the Bottom Ash Storage Pond at elevation 358 feet above msl is approximately 344 acre-ft.

3.0 REVIEW OF AVAILABLE INFORMATION (257.83(b)(1)(i))

A review of available information regarding the status and condition of the CCR Ponds, which include files available in the CCR operating record, such as design and construction information, periodic structural stability assessments, previous 7 day inspection reports, 30-day instrumentation data, and previous annual inspections has been conducted. Based on the review of the data there were no signs of actual or potential structural weakness or adverse conditions.

4.0 CHANGES IN GEOMETRY SINCE LAST INSPECTION (257.83(b)(2)(i))

No modifications have been made to the geometry of the Primary Bottom Ash Pond and the Bottom Ash Storage Pond since the last annual inspection. The geometry of the impoundment has remained essentially unchanged.

5.0 CHANGES THAT EFFECT STABILITY OR OPERATION (257.83(b)(2)(vii))

Based on interviews with plant personnel and field observations there were no changes to the Primary Bottom Ash Pond since the last annual inspection that would affect the stability or operation of the impounding structure.

In April of 2021, the Bottom Ash Storage Pond ceased operations and no longer receives any CCR transport waters or CCR materials into the pond. Bottom Ash Storage Pond also stopped receiving all storm water runoff from the landfill and surrounding areas. These operational changes would not be expected to affect the stability of the impounding structure.

6.0 IMPOUNDMENT CHARACTERISTICS (257.83(b)(2)(iii, iv, v))

6.1 PRIMARY BOTTOM ASH POND

Table 1 is a summary of the minimum, maximum, and present depth and elevation of the impounded water since the previous annual inspection; the storage capacity of the impounding structure at the time of the inspection; and the approximate volume of the impounded water at the time of the inspection.

Table 1 - Summary of Relevant Storage Information for Primary Bottom Ash Pond

	Primary Bottom Ash Pond
Approximate **Minimum** depth of impounded water since last annual inspection	30.8 ft (330.8 ft)
Approximate **Maximum** depth of impounded water since last annual inspection	32.4 ft (332.40 ft)
Approximate **Present** depth of impounded water at the time of the inspection	31.7 ft (331.70 ft)
Approximate **Minimum** depth of CCR since last annual inspection	10.0 ft (310.0 ft)
Approximate **Maximum** depth of CCR since last annual inspection	32.5 ft (332.50 ft)
Approximate **Present** depth of CCR at the time of the inspection	32.5 ft (332.50 ft)
Storage Capacity of impounding structure at the time of the inspection	319.22 acre-ft
Approximate volume of impounded water at the time of the inspection	102.22 acre-ft
Approximate volume of CCR at the time of the inspection	217 acre-ft

6.2 BOTTOM ASH STORAGE POND

Table 2 is a summary of the minimum, maximum, and present depth and elevation of the impounded water since the previous annual inspection; the storage capacity of the impounding structure at the time of the inspection; and the approximate volume of the impounded water at the time of the inspection.

Table 2 - Summary of Relevant Storage Information for Bottom Ash Storage Pond

	Bottom Ash Storage Pond
Approximate **Minimum** depth of impounded water since last annual inspection	9.6 ft (349.6 ft)
Approximate **Maximum** depth of impounded water since last annual inspection	10.8 ft (350.8 ft)
Approximate **Present** depth of impounded water at the time of the inspection	10.7 ft (350.7 ft)
Approximate **Minimum** depth of CCR since last annual inspection	10.5ft (350.5 ft)
Approximate **Maximum** depth of CCR since last annual inspection	18.0ft (358.0 ft)
Approximate **Present** depth of CCR at the time of the inspection	18.0ft (358.0 ft)
Storage Capacity of impounding structure at the time of the inspection	344 acre-ft
Approximate volume of impounded water at the time of the inspection	39 acre-ft
Approximate volume of CCR at the time of the inspection	292 acre-ft

7.0 INSPECTION (257.83(b)(1)(ii))

7.1 GENERAL

The summary of the visual observations uses terms to describe the general appearance or condition of an observed item, activity or structure. Their meaning is understood as follows:

Good:	A condition or activity that is generally better or slightly better than what is minimally expected or anticipated from a design or maintenance point of view.
Fair or Satisfactory:	A condition or activity that generally meets what is minimally expected or anticipated from a design or maintenance point of view.
Poor:	A condition or activity that is generally below what is minimally expected or anticipated from a design or maintenance point of view.

Minor:	A reference to an observed item (e.g., erosion, seepage, vegetation, etc.) where the current maintenance condition is below what is normal or desired, but which is not currently causing concern from a structure safety or stability point of view.
Significant:	A reference to an observed item (e.g. erosion, seepage, vegetation, etc.) where the current maintenance program has neglected to improve the condition. Usually, conditions that have been previously identified in the previous inspections, but have not yet been corrected.
Excessive:	A reference to an observed item (e.g., erosion, seepage, vegetation, etc.) where the current maintenance condition is below or worse than what is normal or desired, and which may have affected the ability of the observer to properly evaluate the structure or particular area being observed or which may be a concern from a structure safety or stability point of view.

In addition, a “deficiency” is some evidence that a dam/dike has developed a problem that could impact the structural integrity of the dam/dike. There are four general categories of deficiencies. These four categories are described below:

1. Uncontrolled Seepage

   Uncontrolled seepage is seepage that is not behaving as the design engineer has intended. An example of uncontrolled seepage is seepage that comes through or around the embankment and is not picked up and safely carried off by a drain. Seepage that is collected by a drain can still be uncontrolled if it is not safely collected and transported, such as seepage that is not clear. Seepage that is unable to be measured and/or observe it is considered uncontrolled seepage.

   [Wet or soft areas are not considered as uncontrolled seepage, but can lead to this type of deficiency. These areas should be monitored frequently]

2. Displacement:

   Displacement of the embankment is large scale movement of part of the dam/dike. Common signs of displacement are cracks, scraps, bulges, depressions, sinkholes and slides.

3. Blockage of Control Features:

   Blockage of Control Features is the restriction of flow at spillways, decant or pipe spillways, or drains.

4. Erosion:

   Erosion is the gradual movement of surface material by water, wind or ice. Erosion is considered a deficiency when it is more than a minor routine maintenance item.

7.2 VISUAL INSPECTION (257.83(b)(2)(i))

A visual inspection of the CCR Ponds was conducted to identify any signs of distress or malfunction of the impoundment and appurtenant structures. Specific items inspected included all structural elements of the dam such as upstream and downstream slopes, crest, and toe. Photographs location map and inspection photographs are included in Appendices B and C.

7.2.1 PRIMARY BOTTOM ASH POND

(i) Typical condition of the upstream slope, crest, and downstream slope is illustrated in Photographs No. 1-4. The dike appeared in satisfactory and stable condition. There were no signs of settlement, misalignment, sloughing or erosion. Slightly overgrown vegetation was noticed along the upstream slope and on the downstream slope near the rock rip rap. There was some minor damage of the downstream slope near the crest from mowing activities (Photograph No. 3)

(ii) The two ash discharge pipes and ash sluice location are located at the northeast corner of the pond. Other effluent from the plant is discharge at the north dike. All the sluice pipes and base support did not indicate any sign of misalignment, settlement, or deterioration. Overall, the discharge pipes appeared in good functional condition.

(iii) Photograph No. 5 illustrates the emergency spillway located towards the southeast section of the south dike. The emergency spillway appeared to be functioning as needed but was covered with overgrown vegetation preventing a full inspection of the area.

(iv) A canal is located at the south end of the pond. A typical view of the discharge canal concrete weir box is illustrated in Photograph No. 6. The canal conveys water from southwest corner of the ash pond to the Clearwater pond located at the west southeast end. The canal indicated positive drainage condition. Excessive vegetation was noticed along the banks of the canal.

7.2.2 BOTTOM ASH STORAGE POND

(i) The east portion of the downstream slope is illustrated in Photographs No. 7 and 8. Slightly overgrown vegetation was noticed on these slopes. The slope appeared in satisfactory and stable condition with no signs of settlement, misalignment, sloughing or erosion.

(ii) Photographs No. 9 and 10 illustrate the south downstream slope areas. The slopes appeared in satisfactory and stable condition with some minor overgrown vegetation. There were no signs of settlement, misalignment, sloughing or erosion.

(iii) The northwest section of the west dike downstream slope is illustrated in Photograph No. 11. The slope appeared in satisfactory and stable condition with overgrown vegetation preventing a full inspection of the slopes. There were no signs of settlement, misalignment, sloughing or erosion.

(iv) Photograph No. 12 illustrates the emergency spillway location at the southwest section of the south dike. The spillway riprap was in satisfactory condition with some vegetation near the edges of the rock rip rap.

(v) Photographs No. 13 and 14 illustrate the interior conditions, upstream slope and crest areas of the pond. The upstream slope appeared to be in good and stable condition and mostly buttress with ash. The geosynthetic liner appeared intact and in good condition. The crest appeared in good and stable condition. Overgrown vegetation was noticed throughout the interior of the pond and on the crest area.

(vi) A small area within the pond is used as a control weir with a principal spillway inlet and outlet pipe located in southeast corner (Photograph No. 15). The principal spillway basin was dry at the time of inspection with no flow through the inlet or outlet pipes. The basin is silted up with ash sediment to the flow line of the inlet and outlet pipes and could possibly restrict flows when passing water from the main pond through the basin to the outlet pipe.

(vii) There are two pipe culverts located at the northwest corner of the pond that used to convey storm water from the landfill and surrounding areas into the pond. The storm water runoff channel and inlet pipes have been plugged to prevent storm water runoff from entering the pond (Photograph No. 16).

7.3 INSTRUMENTATION (257.83(b)(2)(ii))

The monitoring instrumentation for the Primary Bottom Ash Pond consists of the one (1) active piezometer (B-2) located through the main embankment area. There is no monitoring instrumentation for the Bottom Ash Storage Pond (Winston Pond). The location of the instrumentation is shown in Attachment D, Figure 4A. The maximum and minimum readings of Piezometer B-2 since the last annual inspection, a time period of October 2020 to October 2021, were 325.07 ft msl and 318.22 ft msl, respectively. Piezometer B-2 levels appeared consistent from month to month, and reacted to the fluctuation in tail water levels (i.e. main lake). There was a recent dip in one of the monthly readings which is most likely due to an error. The results of the measurements of the piezometer is shown in Appendix D, Figure 4B.

8.0 SUMMARY OF FINDINGS

Based on the visual observations and the inspection of the facilities, the dam and appurtenances are generally in satisfactory condition. Specific conclusions related to this inspection is included as follows.

Primary Bottom Ash Pond:

- There is no evidence of distress that would indicate the possibility of immediate sliding, slope instability, settlement, misalignment or cracking of the ash pond embankments. As such it is concluded that the dam and dikes are performing as designed.

- Overgrown vegetation was noticed throughout the pond areas and should be managed accordingly.

Bottom Ash Storage (Winston) Pond:

- There is no evidence of distress that would indicate the possibility of immediate sliding, slope instability, settlement, misalignment or cracking of the bottom ash pond embankments. As such it is concluded that the dam and dikes are performing as designed.
- Vegetation management for the facilities is considered satisfactory. However, some areas are overgrown and should be managed accordingly.
- The principal spillway basin is silted up with ash sediment to the flow line of the inlet and outlet pipes and could possibly restrict flows when passing water from the main pond through the basin to the outlet pipe.

9.0 RECOMMENDATIONS

A summary of our recommendations for general maintenance and continued monitoring, as well as any recommendations for remedial activities, is provided as follows:

- As noted all the excessive vegetation should be cut down and maintained consistently in order to control and properly manage it.
- The damaged slope area from mowing activities on the downstream slope of the primary ash storage pond should be repaired and seeded.
- The sediment buildup in the principal spillway basin area of the bottom ash storage pond should be cleaned out to promote un-obstructive flows through the basin area to the outlet pipe.

9.1 MAINTENANCE ITEMS

The following maintenance items were identified during the visual inspection:

- Vegetation management for the facilities is considered satisfactory. Some areas are overgrown and should be managed with controlled vegetation growth, however, there are a few areas that have sparse vegetation.

9.2 ITEMS TO MONITOR

- No items to monitor

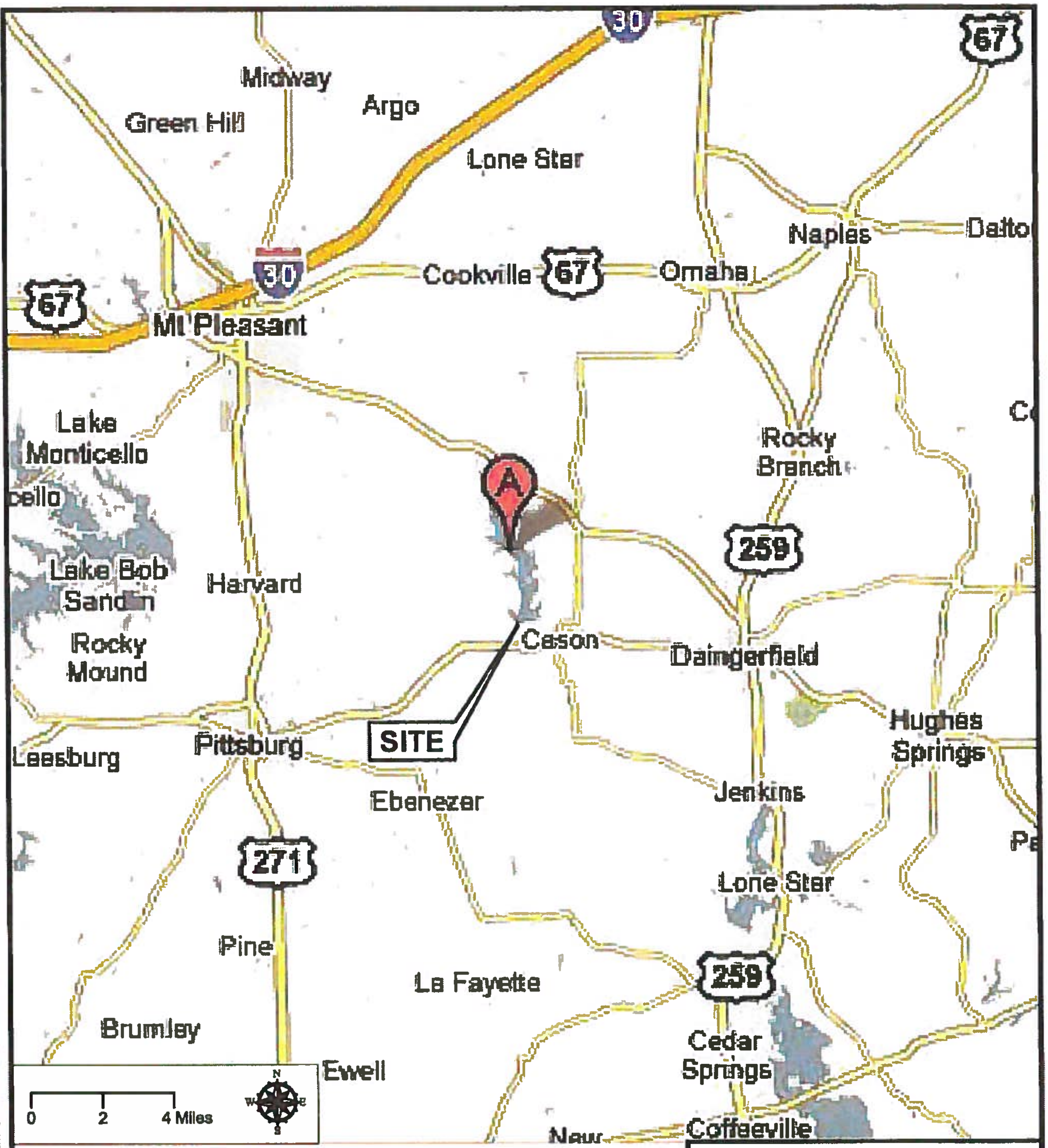
9.3 DEFICIENCIES (257.83(b)(2)(vi))

There were no deficiencies or signs of structural weakness or disruptive conditions that were observed at the time of the inspection that would require additional investigation or remedial action. There were no deficiencies noted during any of the quarterly inspections. If any of these conditions occur before the next annual inspection contact AEP Geotechnical Engineering immediately.

If you have any questions with regard to this report, please contact Brett Dreger at Audinet: 200-2258 or Gary Zych at Audinet: 200-2917.

Appendix A

Figure 1 - Vicinity Map
Figure 2 - CCR Pond Complex General Layout



Source: Google Maps

AEP WELSH POWER PLANT
SWAUANO CREEK DAM
TITUS COUNTY, TX

URS

URS Corporation
9400 Amberglen Blvd.
Austin, Texas 78729

DAM & DIKE INSPECTION
VICINITY MAP

DATE: 4/14/2009	SCALE: 1" = 4 MILES
URS JOB NUMBER: 41009103	DRAWN BY SLC

Figure 1 Plant Inspection Vicinity Map

File: Q:\AEP Dam Inspections\Walsh\Drawings Swauano Ck dam\Swauano Creek Dam\WELSH LOCATION MAP.dwg Layout: Layout1 Plotted Apr 14, 2009 - 2:45pm

FIGURE 2 - SITE LOCATION MAP

WELSH POWER PLANT, CASON, TX

Appendix B

Figure 3A – Photograph Location Map, Primary Bottom Ash Pond
Photographs of Primary Bottom Ash Pond

FIGURE 3A - PHOTOGRAPH LOCATION MAP

PRIMARY BOTTOM ASH POND, WELSH POWER PLANT, CASON, TX

Photo # 1 Typical view of Primary Bottom Ash Pond upstream slope and interior conditions.	
Photo # 2 Typical view of Primary Bottom Ash Pond downstream slope.	
Photo # 3 View of disturbed areas from mowing activities on downstream slope near the crest.	

Photo # 4 Typical crest area of Primary Bottom Ash Pond.	
Photo # 5 Emergency spillway channel of Primary Bottom Ash Pond.	
Photo # 6 View of the Primary Bottom Ash Pond discharge canal concrete weir box.	

Appendix C

Figure 3B – Photograph Location Map, Bottom Ash Storage Pond
Photographs of Bottom Ash Storage Pond

FIGURE 3B - PHOTOGRAPH LOCATION MAP

BOTTOM ASH STORAGE POND, WELSH POWER PLANT, CASON, TX

Photo # 7

Bottom Ash Storage Pond (Winston Pond) looking at downstream slope conditions on east side.

Photo # 8

Bottom Ash Storage Pond (Winston Pond) looking at downstream slope conditions on southeast side.

Photo # 9

Bottom Ash Storage Pond (Winston Pond) Looking at downstream slope conditions on south side.

Photo # 10

Bottom Ash Storage Pond (Winston Pond) Looking at downstream slope conditions on southwest side.

Photo # 11

Bottom Ash Storage Pond (Winston Pond) looking at downstream slope conditions on west side.

Photo # 12

Bottom Ash Storage Pond (Winston Pond) downstream slope looking at emergency spillway channel.

Photo # 13 Bottom Ash Storage Pond (Winston Pond) looking at typical interior conditions.	
Photo # 14 Bottom Ash Storage Pond (Winston Pond) looking at typical interior conditions.	
Photo # 15 Bottom Ash Storage Pond (Winston Pond) interior area looking at principal spillway outlet pipe and control weir at southeast corner.	

Photo # 16	
Bottom Ash Storage Pond (Winston Pond) storm water runoff channel and inlet pipes have been plugged to prevent storm water runoff from entering the pond.	
Photo # 17	
.	
Photo # 18	

Appendix D

Figure 4A - Piezometers Location Map
Figure 4B - Primary Bottom Ash Pond Piezometer Data

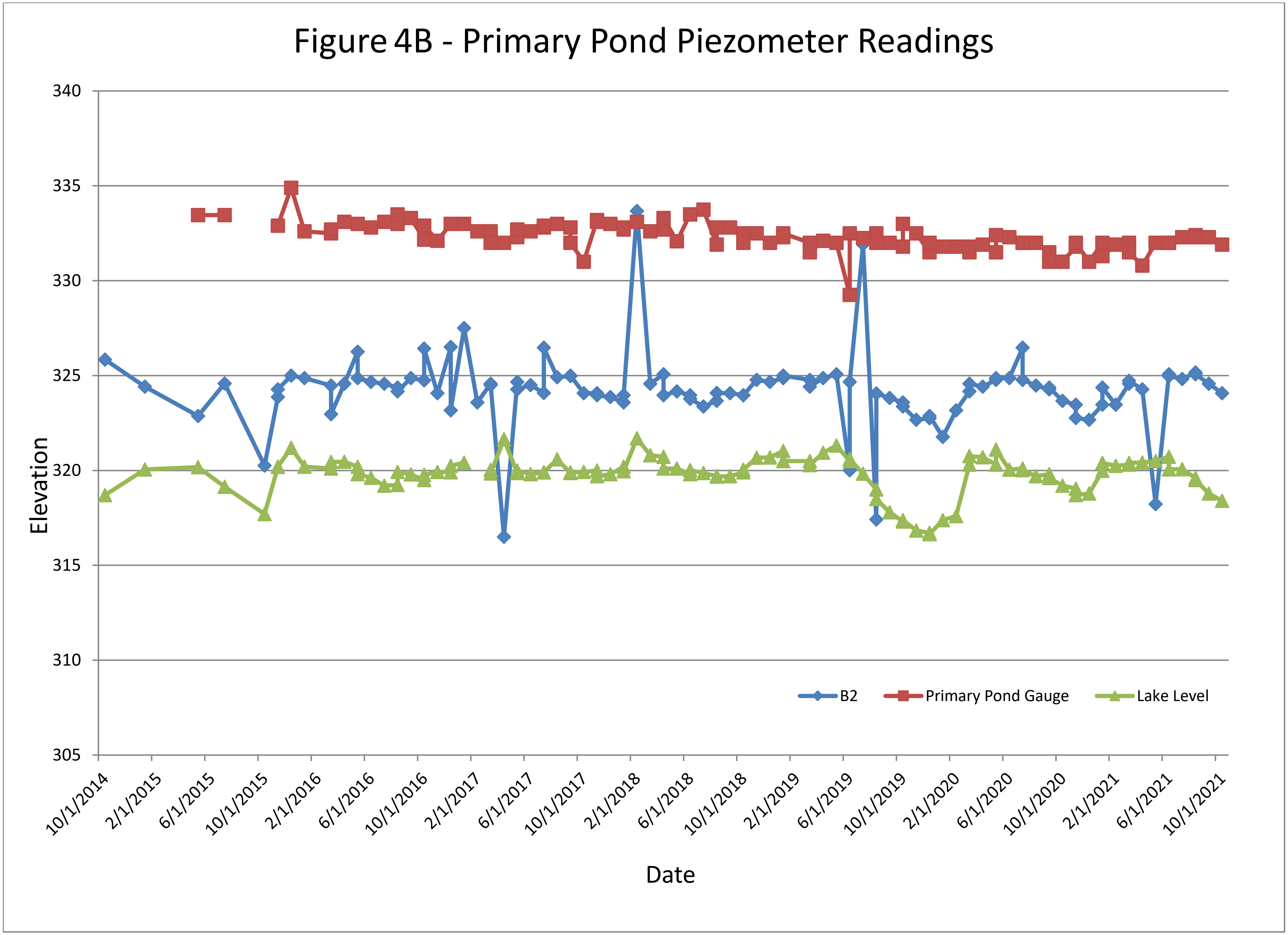


Figure 4B - Primary Pond Piezometer Readings
Elevation
340
335
330
325
320
315
310
305
Date
10/1/2014
2/1/2015
6/1/2015
10/1/2015
2/1/2016
6/1/2016
10/1/2016
2/1/2017
6/1/2017
10/1/2017
2/1/2018
6/1/2018
10/1/2018
2/1/2019
6/1/2019
10/1/2019
2/1/2020
6/1/2020
10/1/2020
2/1/2021
6/1/2021
10/1/2021
B2
Primary Pond Gauge
Lake Level

3.8 – 2020 Annual CCR Landfill Inspection Report, Ash Landfill, December 30, 2020

2020 Annual CCR Landfill Inspection Report

Ash Landfill

Welsh Power Plant
American Electric Power Service Company
(SWEPCO)
Cason, Texas

December 30, 2020

Prepared for:

Prepared by:

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2020 Annual CCR Landfill Inspection Report

Welsh Power Plant, Cason, Texas
Ash Landfill

Document Number: GEVR-20-025

Date of Inspection: November 2, 2020

PREPARED BY ____________ DATE 12-29-2020
Lane Roberts, P.E.

REVIEWED BY Cole Allen DATE 12-29-2020
Landon Cole Allen, P.E.

APPROVED BY ____________ DATE 12-30-2020
Lane Roberts, P.E.

LANE D. ROBERTS
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12-30-2020

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I certify to the best of my knowledge, information and belief that the information contained in this report meets the requirements of 40 CFR § 257.84(b).

2020 Annual CCR Landfill Inspection Report
Welsh Power Plant
Cason, Texas

Table of Contents

Attachments

Attachment A

Figure 1 – Vicinity Map
Figure 2 – Landfill Site Location Map

Attachment B

Figure 3 – Inspection Photograph Location Map
Inspection Photographs

1.0 INTRODUCTION

This report was prepared by Akron Consulting, LLC for the AEP - Geotechnical Engineering Services (GES) section, in part, to fulfill requirements of 40 CFR 257.84 and to provide the Welsh Power Plant an evaluation of the landfill facility.

Mr. Lane Roberts, P.E., performed the 2020 inspection of the Landfill at the Welsh Power Plant. This report is a summary of the inspection and an assessment of the general condition of the landfill facility. Mr. W. Greg Carter, P.E., Welsh Plant, was the facility contact during the inspection. The inspection was performed on November 2, 2020. Weather conditions were mild, sunny, light wind, and the average temperature was in the upper 50° Fahrenheit.

2.0 DESCRIPTION OF LANDFILL

The AEP J. Robert Welsh Power Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas (Figure 1, Vicinity Map). The CCR landfill is located south of the main plant. The CCR landfill is also located between the bottom ash storage pond to the south and primary bottom ash pond to the north. Figure 2 shows the exact location of the landfill. Figures 1 and 2 are included in Attachment A.

The AEP-SWEPCO Welsh Power Plant has a deed recorded Ash Landfill (also previously known as Fly Ash Storage Area and/or Phase 1) located in Titus County, Texas. The Welsh Ash Landfill is on record with the Texas Commission on Environmental Quality (TCEQ) as Industrial Solid Waste Facility (Registration Number 31086).

The Welsh Ash Landfill receives bottom ash, economizer ash, and fly ash from two (2) 528 MW coal fired boilers. Typically, the Welsh Power Plant annually produces approximately 150,000 cubic yards of fly ash and 37,000 cubic yards of bottom and economizer ash.

The Welsh Ash Landfill is generally operated in two sections. The eastern one-third of the landfill is primarily composed of dredged bottom ash, economizer ash, and fly ash material sluiced to the ash landfill between approximately 1986 and 2000. Since 2000, this area has been the primary disposal area for the landfill and is currently active. An ash marketer is contracted to sell all marketable ash material for beneficial reuse in order to extend the life of the landfill. They utilize the remaining western two-thirds of the landfill as a temporary storage and process area.

3.0 REVIEW OF AVAILABLE INFORMATION (257.84(b)(1)(i))

A review of available information regarding the status and condition of the landfill, which includes files available in the operating record, such as design and construction information, previous 7 day inspection reports, and previous annual inspections has been conducted. Based on the review of the data there were no signs of actual or potential structural weakness or adverse conditions.

4.0 INSPECTION (257.84(b)(1)(ii))

4.1 Changes In Geometry Since Last Inspection (257.84(b)(2)(i))

No modifications have been made to the geometry of the landfill since the 2019 annual inspection. According to previous annual inspections, the Eastern and Southern perimeter containment berms were re-constructed to address seepage and sloughing issues and to improve stability for long term disposal operations in 2016-2017. Clay cap and cover sections were also installed in these areas during this time. In 2018-2019, the north side clay cap and cover work was completed. However, there were no major construction activities in 2020 since the last report, and the overall geometry of the landfill has remained essentially unchanged.

4.2 Volume (257.84(b)(2)(ii))

In accordance with 257.84(b) the approximate volume of CCR added to or removed from the landfill for beneficial use between October 2019 and October 2020 was estimated by AEP as follows: Based on the CCR Tracking Spreadsheet, approximately 32,951 cubic yards of CCR material was removed from the landfill providing a net gain of air space.

From the 2019 CCR inspection report, the estimated volume was given as approximately 698,193 cubic-yards of the CCR material. Applying the net removal of approximately 32,951 cubic-yards this year, the total volume of CCR in the Welsh Landfill is estimated to be 665,242 cubic-yards.

698,193 – 32,951 = 665,242 cubic-yards

4.3 Definitions of Visual Observations and Deficiencies

This summary of the visual observations uses terms to describe the general appearance or condition of an observed item, activity or structure. The meaning of these terms is as follows:

Good:	A condition or activity that is generally better or slightly better than what is minimally expected or anticipated from a design or maintenance point of view.
Fair/Satisfactory:	A condition or activity that generally meets what is minimally expected or anticipated from a design or maintenance point of view.
Poor:	A condition or activity that is generally below what is minimally expected or anticipated from a design or maintenance point of view.
Minor:	A reference to an observed item (e.g., erosion, seepage, vegetation, etc.) where the current maintenance condition is below what is normal or desired, but which is not currently causing concern from a structure safety or stability point of view.
Significant:	A reference to an observed item (e.g. erosion, seepage, vegetation, etc.) where the current maintenance program has neglected to improve the condition. Usually, these are conditions that have been identified in the previous inspections, but have not been corrected.
Excessive:	A reference to an observed item (e.g., erosion, seepage, vegetation, etc.) where the current maintenance condition is above or worse than what is normal or desired, and which may have affected the ability of the observer to properly evaluate the structure or particular area being observed or which may be a concern from a structure safety or stability point of view.

This document also uses the definition of a "deficiency" as referenced in the CCR rule section §257.84(b)(5) Inspection Requirements for CCR Landfills. This definition has been assembled using the CCR rule preamble as well as guidance from MSHA, "Qualifications for Impoundment Inspection" CI-31, 2004. These guidance documents further elaborate on the definition of deficiency. Items not defined by deficiency are considered maintenance or items to be monitored.

A "deficiency" is some evidence that a landfill has developed a problem that could impact the structural integrity of the landfill. There are four general categories of deficiencies. These four categories are described below:

1. Uncontrolled Seepage (Leachate Outbreak)
   Leachate outbreak is the uncontrolled release of leachate from the landfill.
2. Displacement of the Embankment
   Displacement of the embankment is large scale movement of part of the landfill. Common signs of displacement are cracks, scarps, bulges, depressions, sinkholes and slides.
3. Blockage of Control Features
   Blockage of Control Features is the restriction of flow at spillways, decant or pipe spillways, or drains.
4. Erosion
   Erosion is the gradual movement of surface material by water, wind or ice. Erosion is considered a deficiency when it is more than a minor routine maintenance item.

4.4 Visual Inspection (257.84(b)(1)(ii))

A visual inspection of the Landfill was conducted to identify any signs of distress or malfunction of the landfill and appurtenant structures. Specific items inspected included all structural elements of the landfill perimeter berms, temporary and final covers, drainage features, disposal cells, and appurtenances such as leachate collection systems.

Overall the facility is in good condition. The landfill is functioning as intended with no signs of potential structural weakness or conditions which are disruptive to the safe operation of the landfill. An inspection location map and pertinent inspection photographs are included in Attachment B, but additional inspection pictures can be made available upon request.

Brief descriptions of the pertinent inspection photos have been included below:

1. Photographs No. 1 and 2 illustrate the general condition of the *south side* berm and outer slopes of the landfill. The landfill cover appeared to be in overall good condition with just a few small areas with hog rutting damage (Photograph No. 3).

2. Photograph No. 4 illustrates the southeast corner of the landfill where the rip-rap lined letdown channel is located, which appeared to be in good, functional condition. There was some minor erosion and overgrown vegetation present.

3. Photograph No. 5 illustrates the general condition of the *east side* berm and outer slopes of the landfill. The landfill cover appeared to be in overall good condition. An area of the toe ditch downstream of the northern access walkway had standing water, as shown in Photograph No. 6. There also was some minor erosion downstream of this area just upstream of the outlet in the northeast corner of the landfill. It appears that the ditch from the ponded water to the outlet could be re-graded to maintain a positive slope for the ditch, which would also mitigate the erosion.

4. Photograph No. 7 illustrates the HDPE-lined letdown in the northeast corner of the landfill. This system is functioning as designed. There was a very small tear in the liner, as shown in Photograph No. 8, which should be repaired before it expands. However, this liner is for storm water purposes only, so this is simply a maintenance item and not considered a deficiency.

5. Photograph No. 9 illustrates the general condition of the *north side* berm and outer slopes of the landfill. The landfill cover appeared to be in overall good condition. Only minor rills were observed along the toe of the slope in the perimeter ditch. Photograph No. 10 illustrates the HDPE-lined letdown in the middle of the north slope, which was recently repaired. There was some silt located in the bottom of the letdown from

previous erosion that is causing water to pond in the perimeter ditch, as shown in Photograph No. 11. This silt should be removed to maintain positive drainage.

6. Photograph No. 12 illustrates the main outlet of the processing area. The outlet seems to be free flowing, and the contractor should ensure that the processing area maintains positive drainage to this outlet.

7. According to previous annual inspections, the *western side* berm and outer slopes of the landfill are partially constructed of temporary soil cover and CCR material and sparse vegetation cover. Photographs No. 13 and 14 illustrate the condition of this exterior berm and slope. The outer slopes appeared to be very steep but in satisfactory and functioning condition with no signs of seepage, erosion or sloughing. Woody vegetation was noticed on the outer slopes and in the toe ditch. However, this berm is several feet above the processing area, so it is not confining any CCR material as a traditional landfill at this time. According to plant personnel, it is anticipated that this area will continue to operate as a processing area and will only store CCR material while being processed. Therefore, the CCR material should be marginal in height and not be stacked against or above the berm. If this area ever transitions from a processing area to a traditional active landfill, this berm would need to be re-evaluated by a professional engineer at that time.

8. Photograph No. 15 illustrates the overall landfill from a vantage point of the southwest corner looking northeast. As noted previously, the eastern one-third of the area is used for waste placement, and the western two-thirds of the area is used for processing waste materials. The landfill waste placement and material processing appeared to be performed properly and did not show any impact to the components of the landfill. A storm water management concrete structure is installed to collect and direct the runoff from the southern portion to the bottom ash storage pond to the southeast. This structure appeared to be in good, functional condition.

4.5 Changes That Effect Stability or Operation (257.84(b)(2)(iv))

Based on interviews with plant personnel and field observations, there were no major changes to the landfill since the last annual inspections that would affect the stability or the operation of the landfill.

5.0 SUMMARY OF FINDINGS

5.1 General Observations

In general the landfill is functioning as intended and the active area, interim cover, final cover, material processing area, runoff control system, and leachate collection sumps are in good condition. The plant is performing regular maintenance and inspections as required. Some maintenance items have been noted and are described in Section 5.2.

5.2 Maintenance Items

The following maintenance items were identified during the visual inspection. Contact GES for specific recommendations regarding repairs:

1 The small tear in the HDPE lined letdown in the northeast corner of the landfill should be repaired before it expands.

2 The hog rutting damage, minor erosion, and small rills discussed in detail in Section 4.4 should be repaired. Any bare areas should be re-seeded.

3 Ponding water was observed in two locations in the perimeter ditches due to minor sediment deposits. The sediment in the ditch needs to be cleaned out in these two areas and positive drainage needs to be established to prevent future significant ponding of water.

4 The ash contractor should maintain positive drainage over the processing area of the landfill.

5 Vegetation growth on the newly capped and covered slopes is generally good, but there were some areas that had excessive vegetation that needs to be cut down, especially around letdowns and intermediate slope benches. Any bare areas should be re-seeded.

5.3 Items To Monitor

The following items were identified during the visual inspection as items to be monitored (see inspection map for locations, if applicable):

- None identified as part of this inspection.

5.4 Deficiencies (257.84(b)(2)(iii))

There were no signs of structural weakness or disruptive conditions that were observed at the time of the inspection that would require additional investigation or remedial action. There were no deficiencies noted during this inspection or during any of the periodic 7-day inspections. A deficiency is defined as 1) uncontrolled seepage (leachate outbreak), 2) displacement of the embankment, 3) blockage of control features, or 4) erosion, more than minor maintenance. If any of these conditions occur before the next annual inspection, contact the Geotechnical Engineering Services (GES) section immediately.

ATTACHMENT A

Figure 1 – Vicinity Map
Figure 2 – Landfill Site Location Map

FIGURE 1 – VICINITY MAP

CCR LANDFILL, WELSH POWER PLANT, CASON, TX

Source: Google Maps

AEP WELSH POWER PLANT
SWAUANO CREEK DAM
TITUS COUNTY, TX

URS Corporation
9400 Amberglen Blvd
Austin, Texas 78729

DAM & DIKE INSPECTION
VICINITY MAP

DATE 4/14/2009	SCALE 1" = 4 MILES
URS JOB NUMBER 41009103	DRAWN BY SLC

File O:\AEP Dam Inspections\Welsh\Drawings Swauano Ck dam\Swauano Creek Dam\WELSH LOCATION MAP.dwg Layout: Layout1 Plotted: Apr 14, 2009 2:45pm

FIGURE 2 – LANDFILL SITE LOCATION MAP

WELSH POWER PLANT, CASON, TX

ATTACHMENT B

Figure 3 – Inspection Photograph Location Map
Inspection Photographs

FIGURE 3 - INSPECTION PHOTOGRAPH LOCATION MAP

CCR LANDFILL, WELSH POWER PLANT, CASON, TX

PHOTO #1 South berm, looking west	
PHOTO #2 South capped and covered berm and slopes, looking east	
PHOTO #3 Isolated minor hog rutting damage	

PHOTO #4 Rip-rap lined letdown in southeast corner, overgrown vegetation	
PHOTO #5 East capped and covered berm, looking north	
PHOTO #6 Ponding in eastern toe ditch	

PHOTO #7
HDPE-lined letdown in northeast corner

PHOTO #8
Small tear in letdown

PHOTO #9
North capped and covered berm, looking east

PHOTO #10 HDPE-lined letdown in center of north slope	
PHOTO #11 Silt in bottom of letdown causing minor ponding in upstream toe ditch	
PHOTO #12 Outlet for process area through north slope	

PHOTO #13 West berm, looking south	
PHOTO #14 West berm, looking north	
PHOTO #15 Overall landfill from southwest corner, looking northeast	

3.9 – 2021 Annual CCR Landfill Inspection Report, Ash Landfill, November 29, 2021

2021 ANNUAL CCR LANDFILL INSPECTION REPORT

Ash Landfill

Welsh Plant
American Electric Power Service Corporation
(SWEPCO)
Cason, Texas

November 29, 2021

Prepared for: SWEPCO.

Prepared by: American Electric Power Service Corporation

One Riverside Plaza

Columbus, OH 43215

GERS-21-075

2021 Annual CCR Landfill Inspection Report

Welsh Power Plant, Cason, Texas

Ash Landfill

Document Number: GERS-21-075

Inspection Date: October 19, 2021

PREPARED BY Brett A. Dreger **DATE** 12/1/2021
Brett A. Dreger, P.E.

REVIEWED BY ____________ **DATE** 12-2-2021
Shah S. Baig, P.E.

APPROVED BY Gary F. Zych **DATE** 12/2/2021
Gary F. Zych, P.E.
Manager – AEP Geotechnical Engineering

American Electric Power
Service Corporation
Texas Registered Engineering
Firm No. F-3341

Gary F. Zych
STATE OF TEXAS
GARY F. ZYCH
127152
LICENSED
PROFESSIONAL ENGINEER
12/2/2021

I certify to the best of my knowledge, information and belief the information contained in this report meets the requirements of 40 CFR § 257.84(b).

1.0 INTRODUCTION

This report was prepared by AEP- Geotechnical Engineering Services (GES) section, in part, to fulfill requirements of 30 TAC 352.841 (40 CFR 257.84) and to provide the Welsh Power Plant an evaluation of the facility.

Mr. Brett Dreger, P.E., performed the 2021 inspection of the Landfill at the Welsh Power Plant. This report is a summary of the inspection and an assessment of the general condition of the facility. Mr. Greg Carter, P.E., Regional Engineering for the Plant, was the facility contact. The inspection was performed on October 19, 2021. Weather conditions were mostly sunny, light wind, and the temperature was in the mid 70's° Fahrenheit.

2.0 DESCRIPTION OF LANDFILL

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas (Figure 1, Vicinity Map). The CCR landfill is located south of the main plant. The CCR landfill is also located between the bottom ash storage pond to the south and primary bottom ash pond to the north. Figure 2 shows the exact location of the landfill. Figure 1 and 2 are included in Attachment A.

The AEP-SWEPCO Welsh Power Plant has a deed recorded Ash Landfill (also previously known as Fly Ash Storage Area or Phase 1) located in Titus County, Texas. The Welsh Ash Landfill is on record with the Texas Commission on Environmental Quality (TCEQ) as Industrial Solid Waste Facility (Registration Number 31086).

The Welsh Ash Landfill receives bottom ash, economizer ash, and fly ash from two (2) 528 MW coal fired boilers. Typically, the Welsh Power Plant annually produces approximately 150,000 cubic yards of fly ash and 37,000 cubic yards of bottom and economizer ash.

The Welsh Ash Landfill is generally operated in two sections. The eastern one-third of the landfill is primarily composed of dredged bottom ash, economizer ash, and fly ash material sluiced to the ash landfill between approximately 1986 and 2000. Since 2000, this area has been the primary disposal area for the landfill and is currently active. An ash marketer is contracted to sell all marketable ash material for beneficial reuse in order to extend the life of the landfill. The ash marketer utilizes the remaining western two-thirds of the landfill as temporary storage and process area.

3.0 REVIEW OF AVAILABLE INFORMATION (257.84(b)(1)(i))

A review of available information regarding the status and condition of the Landfill which include files available in the operating record, such as design and construction information, previous 7 day inspection reports, and previous annual inspections has been conducted. Based on the review of the data there were no signs of actual or potential structural weakness or adverse conditions.

4.0 INSPECTION (257.84(b)(1)(ii))

4.1 Changes In Geometry Since Last Inspection (257.84(b)(2)(i))

No modifications have been made to the geometry of the Landfill since the last annual inspection. The overall geometry of the landfill has remained essentially unchanged, except for the change in topography of the active disposal and ash processing areas.

4.2 Volume (257.84(b)(2)(ii))

In accordance with 257.84(b) the approximate volume of CCR added to or removed from the landfill for beneficial use between November 2020 and October 2021 was estimated by AEP as follows. The CCR Tracking Spreadsheet provided by Landfill staff indicates that approximately 28,292 cubic yards (yd^3) of ash by product was added to the landfill while approximately 27,678 cubic yards (yd$^{3)}$ of ash by product (fly ash and flex base) were removed from the landfill. This estimate results in a net additional volume of approximately 614 yd^3 of CCR material in the Landfill.

From the 2020 CCR inspection report, the estimated volume was given as 665,242 cubic-yard of the CCR material. Applying estimated net addition of 614 cubic-yards, the total volume of CCR in the Welsh Landfill is estimated to be 665,856 cubic-yards.

665,242 + 614 = 665,856 cubic-yards

4.3 Definitions of Visual Observations and Deficiencies

This summary of the visual observations uses terms to describe the general appearance or condition of an observed item, activity or structure. The meaning of these terms is as follows:

Good:	A condition or activity that is generally better or slightly better than what is minimally expected or anticipated from a design or maintenance point of view.
Fair/Satisfactory:	A condition or activity that generally meets what is minimally expected or anticipated from a design or maintenance point of view.
Poor:	A condition or activity that is generally below what is minimally expected or anticipated from a design or maintenance point of view.
Minor:	A reference to an observed item (e.g., erosion, seepage, vegetation, etc.) where the current maintenance condition is below what is normal or desired, but which is not currently causing concern from a structure safety or stability point of view.
Significant:	A reference to an observed item (e.g. erosion, seepage, vegetation, etc.) where the current maintenance program has neglected to improve the condition. Usually conditions that have been identified in the previous inspections, but have not been corrected.
Excessive:	A reference to an observed item (e.g. erosion, seepage, vegetation, etc.) where the current maintenance condition is below or worse than what is normal or desired, and which may have affected the ability of the observer to properly evaluate the structure or particular area being observed or which may be a concern from a structure safety or stability point of view.

This document also uses the definition of a "deficiency" as referenced in the CCR rule section §257.84(b)(5) Inspection Requirements for CCR Landfills. This definition has been assembled using the CCR rule preamble as well as guidance from MSHA, "Qualifications for Impoundment Inspection" CI-31, 2004. These guidance documents further elaborate on the definition of deficiency. Items not defined by deficiency are considered maintenance or items to be monitored.

A "deficiency" is some evidence that a landfill has developed a problem that could impact the structural integrity of the landfill. There are four general categories of deficiencies. These four categories are described below:

1. Uncontrolled Seepage (Leachate Outbreak)
   Leachate outbreak is the uncontrolled release of leachate from the landfill.

2. Displacement of the Embankment
   Displacement of the embankment is large scale movement of part of the landfill. Common signs of displacement are cracks, scarps, bulges, depressions, sinkholes and slides.

3. Blockage of Control Features
   Blockage of Control Features is the restriction of flow at spillways, decant or pipe spillways, or drains.

4. Erosion
   Erosion is the gradual movement of surface material by water, wind or ice. Erosion is considered a deficiency when it is more than a minor routine maintenance item.

4.4 Visual Inspection (257.84(b)(1)(ii))

A visual inspection of the Landfill was conducted to identify any sign of distress or malfunction of the landfill and appurtenant structures. Specific items inspected included all structural elements of the landfill perimeter berms, temporary and final covers, drainage features, disposal cells and appurtenances such as leachate collection systems.

Overall, the facility is in satisfactory condition. The landfill is functioning as intended with no signs of potential structural weakness or conditions, which are disrupting to the safe operation of the landfill. An inspection photo location map and inspection photographs are included in Attachment B. Additional pictures were taken during the inspection could be made available upon request.

1. The south slope of the landfill and the toe ditch is illustrated in Photograph No. 1. The slope appeared in satisfactory condition with no signs of seepage, erosion, or sloughing. The toe ditch at the time of inspection appeared mostly dry. An area of the top of slope indicated hog rutting activity (Photograph No. 2).

2. Photograph No. 3 illustrates the southeast corner of the landfill where the riprap lined letdown channel is located. The channel appeared in satisfactory and functional condition. There was some overgrown brush and woody vegetation protruding through the rock lined channel.

3. The east slope of the landfill and the toe ditch is illustrated in Photographs No. 4 - 7. The slope appeared in satisfactory condition with no signs of seepage, erosion, or sloughing. The toe ditch at the time of inspection appeared mostly dry. The perimeter ditch below the access walkway on the northern end was bare from vegetation indicating that there had been standing water (Photograph No. 5) in this section of the ditch. Hog rutting activity was noticed on the mid slope near the access walkway on the northern end (Photograph No. 6). The perimeter ditch on the north end showed signs of head cutting activity from erosion (Photograph No. 7).

4. Photograph No. 8 illustrates the HDPE lined letdown channel in the northeast corner of the landfill. The channel appeared to be in satisfactory and functional condition, however there was a small tear in the liner near the anchor trench about midway up the slope (Photograph No. 10). The bottom section of the letdown channel is lined with concrete with energy dissipater blocks to slow water down before it enters the perimeter ditch. There is sediment buildup in the bottom of the ditch near the inlets to the 30 and 36 inch pipes (Photograph No. 9).

5. Photographs No. 11 – 16 illustrates the outer slopes, northern let down channel and perimeter ditch on the north side of the landfill. Most of the slopes appeared in satisfactory condition with no signs of seepage, erosion, or sloughing. Vegetation cover is satisfactory except for a few sparse areas located just west of the northern let down channel (Photograph No. 13 and 14). The west end of the northern berm is in poor condition with overgrown vegetation (Photograph No. 15). Photograph No. 17 shows the view of culvert #2 located in the northwest corner of the landfill. The culvert basin area is in satisfactory condition with some minor overgrown vegetation on the slopes.

6. The outer slopes of the western berm of the landfill are partially constructed of temporary soil cover and CCR material and have overgrown vegetation on the cover. Photographs No. 18 illustrates the condition of the exterior slope and toe ditch. The outer slopes appeared to be in poor, but functioning condition with no signs of seepage, erosion or sloughing. However, excessive vegetation and tree growth was noticed on the slope and in the toe ditch.

7. During the inspection the active disposal area (eastern 2/3 area) was being used for waste placement. The inside perimeter ditches and leachate collection sump drains were functioning as designed and there was no ponding of water in the disposal areas (Photographs No. 19 through 21). All of the storm water inside the landfill is directed to a diversion ditch which leads to a detention basin before it exits the landfill through Pipe Culvert #2 located in the ash processing area (Photographs No. 22 – 24). There is some overgrown vegetation near Pipe Culvert #2 that needs maintenance and clearing.

8. The western 1/3 of the landfill area is primarily utilized for the processing for beneficial use and sales of CCR materials. At the time of inspection the area was being used for ash processing. The areas are bound on the north and west sides by berms constructed out of soil and ash and have a temporary cover system. The area is bound on the south by a series of perimeter ditches, driveways and culverts to collect the storm water runoff

and direct it towards the low water crossing to exit the landfill (Photographs No. 25 – 28).

9. The low water crossing is constructed of reinforced concrete pavement and was in good and functional condition at the time of inspection (Photograph No. 29). Typically, storm water runoff from the active disposal areas used to be directed towards the western end of the disposal area where it is channeled into a low water crossing on the south side that flows into the Bottom Ash Storage Pond. However, since the notice of intent to close the Bottom Ash Storage Pond (April 6, 2021), a clay soil berm has been placed inside the landfill to prevent contact storm water from entering the low water crossing structure. In addition, the south side access road ditch has been plugged with a clay soil berm to prevent non-contact storm water from the access road, low water crossing and the access road ditch from entering the Bottom Ash Storage Pond (Photograph No. 30).

4.5 Changes That Effect Stability or Operation (257.84(b)(2)(iv))

Based on interview with plant personnel and field observations there were no changes to the landfill since the last annual inspection that would affect the stability or the operation of the landfill.

5.0 SUMMARY OF FINDINGS

5.1 General Observations

In general, the landfill is functioning as intended and the active area, interim cover, final cover, material processing area, runoff control system, and leachate collection sumps are in good condition. The Plant is performing regular maintenance and inspections as required. Some maintenance items have been noted and are described in Section 5.2.

5.2 Maintenance Items

The following maintenance items were identified during the visual inspection. Contact GES for specific recommendations regarding specific repair:

1 The outside slope areas damaged by hog activity on the southern and eastern slopes should be repaired.

2 Positive drainage shall be maintained over the landfill and in the perimeter ditches. The low spot in the east side perimeter ditch should be graded and fill in to maintain positive drainage.

3 The HDPE liner on the northeast corner let down channel should be repaired to prevent erosion and additional damage to the adjacent area.

4 The sediment build up in the northeast corner perimeter ditch near the 30 and 36 inch pipes needs to be cleared to prevent any pipe flow blockage from additional sediment build up.

5 Vegetation growth on the newly capped and covered slopes (South, East and North) is satisfactory, but some areas had either sparse vegetation that needs to be re-seeded or overgrown vegetation that needs to be maintained. There were a few areas of vegetation growth on the inside of the landfill needs to maintained as well (culvert #2).

6 The inner and outer slopes of the western berm are in poor, but functioning condition. Since this area is primarily an ash processing area, little ash is stacked up against the berm. The west berm will have to be re-built and the slope vegetation cleared and maintained before any active disposal operations can occur in the western end of the landfill.

5.3 Items To Monitor

- None identified as part of this inspection.

5.4 Deficiencies (257.84(b)(2)(iii))

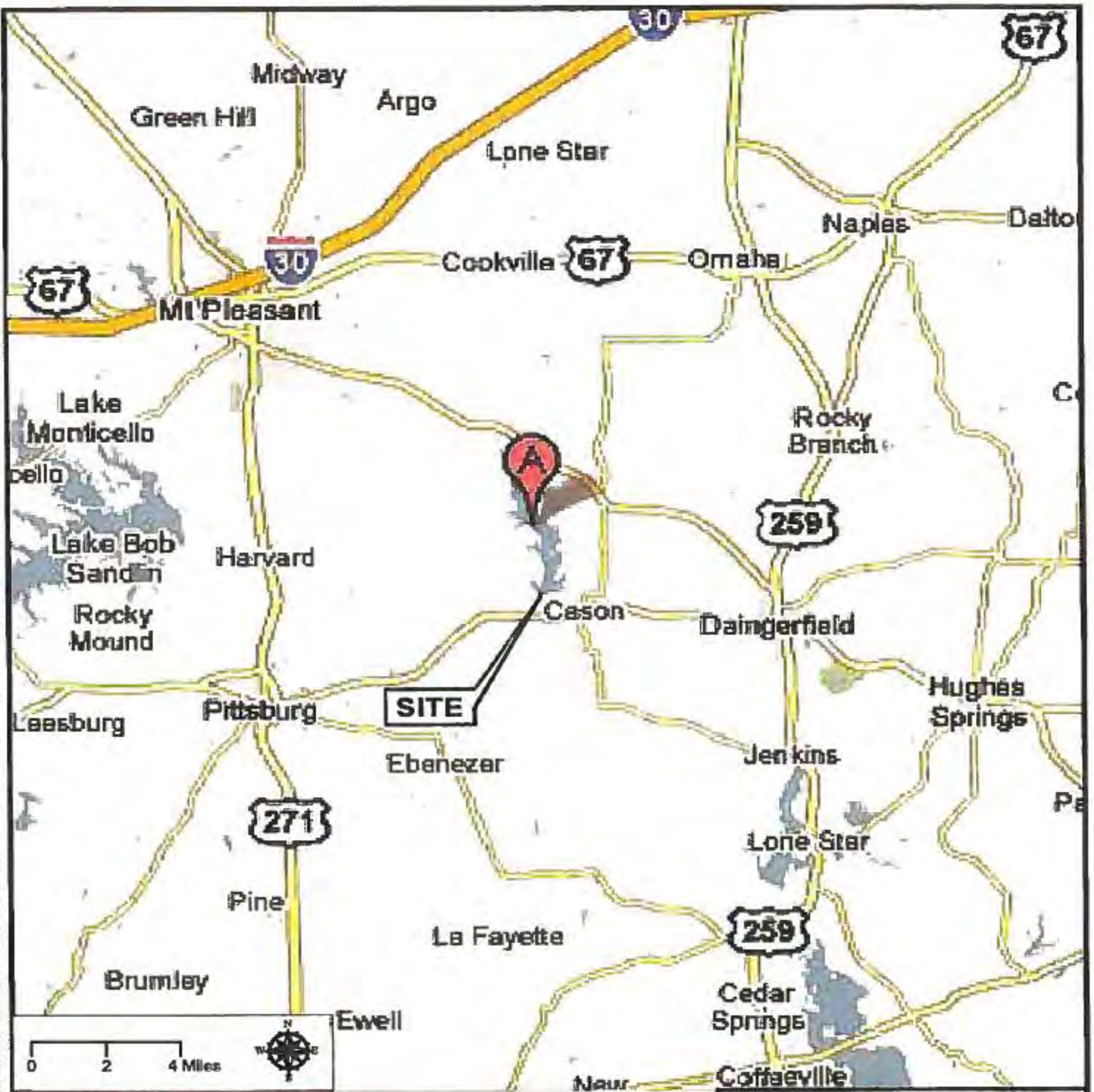
There were no signs of structural weakness or disruptive conditions that were observed at the time of the inspection that would require additional investigation or remedial action. There were no deficiencies noted during this inspection or during any of the periodic 7-day inspections. A deficiency is defined as 1) uncontrolled seepage (leachate outbreak), 2) displacement of the embankment, 3) blockage of control features, or 4) erosion, more than minor maintenance. If any of these conditions occur before the next annual inspection contact AEP Geotechnical Engineering immediately.

ATTACHMENT A

- FIGURE 1, VICINITY MAP
- FIGURE 2, LANDFILL SITE LOCATION MAP

FIGURE 1 – VICINITY MAP

CCR LANDFILL, WELSH POWER PLANT, CASON, TX



Source: Google Maps

AEP WELSH POWER PLANT
SWAUANO CREEK DAM
TITUS COUNTY, TX

URS Corporation
9400 Amberglen Blvd
Austin, Texas 78729

DAM & DIKE INSPECTION
VICINITY MAP

DATE 4/14/2009	SCALE 1" = 4 MILES
URS JOB NUMBER 41009103	DRAWN BY SLC

File: Q:\AEP Dam Inspections\Welsh\Drawings Swauano Ck dam\Swauano Creek Dam\WELSH LOCATION MAP.dwg Layout: Layout1 Plotted: Apr 14, 2009 - 2:45pm

FIGURE 2 – LANDFILL SITE LOCATION MAP

WELSH POWER PLANT, CASON, TX

ATTACHMENT B

- FIGURE 3, INSPECTION PHOTOGRAPH LOCATION MAP
- INSPECTION PHOTOGRAPHS

FIGURE 3 – INSPECTION PHOTOGRAPH LOCATION MAP

CCR LANDFILL, WELSH POWER PLANT, CASON, TX

Photo # 1 View of the Southern Berm Outside Slope Looking East.	
Photo # 2 View of the Southern Berm Top of Slope looking East. Notice Hog Rutting Activity.	
Photo # 3 View of the Southeast Berm Let Down Channel. Notice Some Overgrown Vegetation in Rocks.	

Photo # 4 View of the Eastern Berm Outside Slope Looking South.	
Photo # 5 View of the Eastern Berm Perimeter Ditch. This Section of Ditch is Flat and Holds Water After Storm Events.	
Photo # 6 View of the Eastern Berm Outside Slope Conditions. Notice Hog Rutting Activity.	

Photo # 7

View of the Eastern Berm Outside Slope and Perimeter Ditch. Notice Head Cutting in Center of Ditch From Flowing Water.

Photo # 8

View of the Northeast Corner Berm Let Down Ditch.

Photo # 9

View of the 30 and 36 inch Storm Water Pipes Located in Northeast Corner of Landfill Perimeter Ditch. Notice Sediment Buildup in Ditch and In Front of Pipe Inlets.

Photo # 10

View of the Northeast Corner Bern Let Down Ditch. Notice the Tear in the HDPE geoemembrane.

Photo # 11

View of the Northern Berm Outside Slope Conditions Looking West.

Photo # 12

View of the Northern Berm Central Let Down Channel.

Photo # 13

Typical View of the Northern Berm and Perimeter Ditch Slope Conditions Looking East. Notice the Areas of Sparse Vegetation.

Photo # 14

View of the Central Area of the Northern Berm Perimeter Ditch Conditions. Notice the Area of Sparse Vegetation.

Photo # 15

View of the West End of the Northern Berm. Notice Vegetation is Overgrown and Berm is in Poor Condition.

Photo # 16 Typical View of the West End Northern Berm Outside Slope Conditions Looking East.	
Photo # 17 View of Culvert #2 Outlet Pipe. Located on the Outside Slope in the Northwest corner of the Northern Berm.	
Photo # 18 View of the Western Berm Outside Slope Conditions. Notice the Overgrown Vegetation and Mature Tree on the Slope Areas.	

Photo # 19	
View of the South Interior Perimeter Ditch for the Active Disposal Area Located on the East Side of Landfill.	
Photo # 20	
View of the East Interior Perimeter Ditch for the Active Disposal Area Located on the East Side of Landfill.	
Photo # 21	
View of the North Interior Perimeter Ditch for the Active Disposal Area Located on the East Side of Landfill.	

Photo # 22

View of the Active Disposal Area Storm Water Diversion Ditch Located in the Middle Section of the Landfill.

Photo # 23

View of the Active Disposal Area Storm Water Detention Area Located in the Middle Section of Landfill.

Photo # 24

View of Culvert #2 Pipe From Inside the Landfill Ash Processing Area.

Photo # 25 View of the Interior Western Berm of the Ash Processing Area. Looking North.	
Photo # 26 View of the Ash Processing Area Typical Conditions. Looking East.	
Photo # 27 View of the South Interior Perimeter Ditch Located Along the Ash Processing Area.	

Photo # 28

View of the South Interior Perimeter Ditch Along the Mid-Section of the Landfill.

Photo # 29

View of the Low Water Crossing Located on South Side of Landfill Active Disposal Area. A Soil Berm has Been Placed Along the Interior of the Landfill to Divert Contact Storm Water Away from the Low Water Crossing.

Photo # 30

View of the South Side Low Water Crossing and Access Road Ditch Looking East. The Access Road Ditch Been Plugged with Soil to Prevent Non-Contact Storm Water From the Low Water Crossing and Access Road Ditch from Entering the Bottom Ash Storage Pond.

Volume 3

- **Attachment 4 – Groundwater Monitoring and Corrective Action**

ATTACHMENT 4

Groundwater Monitoring and Corrective Action

30 TAC §352.281 – Groundwater Monitoring and Corrective Action Application Submission.
Submit documentation demonstrating compliance with Subchapter H: Groundwater Monitoring and Corrective Action.

- Submit Groundwater Monitoring Well Network Evaluation Reports
- Submit a description of the groundwater sampling and analysis program that demonstrates compliance with the requirements of 30 TAC §352.931/40 CFR §257.93.

Detection Monitoring

- Submit most recent Groundwater Monitoring and Corrective Action Annual Report
- Submit a description of the groundwater monitoring well system that demonstrates compliance with the requirements of 30 TAC §352.911/40 CFR §257.91.
- Submit sufficient information, supporting data, analyses and most recent alternative source demonstrations to support a detection monitoring program meeting the requirements of 30 TAC §352.941/40 CFR §257.94. **See Annual Groundwater Monitoring and Corrective Action Report.**

CCR Unit(s) in a Detection Monitoring Program

BASP

Assessment Monitoring

- Submit sufficient information, supporting data, analyses and most recent alternative source demonstrations to support a detection monitoring program meeting the requirements of 30 TAC §352.941/40 CFR §257.94. **See Annual Groundwater Monitoring and Corrective Action Report.**
- Submit most recent Groundwater Monitoring and Corrective Action Annual Reports
- Submit a description of the groundwater monitoring well system that demonstrates compliance with the requirements of 30 TAC §352.911/40 CFR §257.91.

CCR Unit(s) in an Assessment Monitoring Program

PBAP, LF

4.1 – Primary Bottom Ash Pond – CCR Groundwater Monitoring Well Network Evaluation, June 29, 2016

ARCADIS
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American Electric Power Service Corporation

Primary Bottom Ash Pond - CCR Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187 County Road 4865
Titus County
Pittsburg, Texas

June 29, 2016

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

Kenneth Brandner

Kenneth Brandner, P.E., P.G.
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Project Manager

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Professional Engineer

Primary Bottom Ash Pond - CCR Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187County Road 4865
Titus County
Pittsburg, Texas

Prepared for:
AEP

Prepared by:
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Tel 614 985 9100
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Our Ref.:
OH015976.0011

Date:
June 29, 2016

Tables

Figures

Appendices

Acronyms and Abbreviation

AEP	American Electric Power Service Cooperation
amsl	above mean sea level
ARCADIS	ARCADIS U.S., Inc.
BAP	bottom ash pond
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
FAP	fly ash pond
FGD	flue gas desulfurization
ft	feet
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
PTI	Permit to Install
TDS	total dissolved solids

1. Objective

This report was prepared by ARCADIS U.S., Inc. (ARCADIS) for American Electric Power Service Corporation (AEP) to assess the adequacy of the groundwater monitoring well network included in the Coal Combustion Residual (CCR) requirements, as specified in Code of Federal Regulations (CFR) 40 CFR 257.91, for the Primary Bottom Ash Pond (CCR Unit) at the AEP Generating Plant (Plant) located at 1187 County Road 4865 in Pittsburg, Titus County, Texas (**Figure 1**). One of the CCR requirements includes an evaluation of the adequacy of the groundwater monitoring well network to characterize groundwater quality up and down gradient of the CCR unit.

Three regulated CCR units associated with the Plant were identified for review, which include the Primary Bottom Ash Pond, landfill, and bottom ash storage pond (**Figure 2**). This report summarizes the evaluation of the groundwater monitoring well network in the uppermost aquifer at the Primary Bottom Ash Pond (Site).

This evaluation included a review of AEP-provided data associated with previously completed subsurface investigation activities in the vicinity of the Primary Bottom Ash Pond CCR unit, as well as publically-available geologic and hydrogeologic data. The following report also presents the current Conceptual Site Model based on all documents reviewed and will further describe the uppermost aquifer, include an evaluation of the adequacy of the existing monitoring well network, and provide recommendations for monitoring well augmentation, as necessary.

2. Background Information

The following section provides background information for the AEP Welsh Generating Plant Primary Bottom Ash Pond.

2.1 Facility Location Description

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The Primary Bottom Ash Pond CCR unit is located southwest of the Plant and directly west of the Welsh Reservoir (**Figures 1** and **2**).

2.2 Description of Primary Bottom Ash Pond CCR Unit

The following section will discuss the embankment configuration, area, volume, construction and operational history, and surface water control associated with the Primary Bottom Ash Pond.

2.2.1 Embankment Configuration

The Primary Bottom Ash Pond was placed into operation in approximately 1977, and is located in a topographically low area that had been an unnamed intermittent tributary of Swauano Creek prior to development of the Site. The Primary Bottom Ash Pond is bounded by natural ground surface (topographically higher areas) to the north and west, and embankment dikes to the south and east. These dikes are constructed of compacted sandy clay and clayey sand. The embankment dike south of the Primary Bottom Ash Pond includes a drainage canal that receives overflow (clear) water from the Primary Bottom Ash Pond. The water level in the Primary Bottom Ash Pond is controlled by a weir box which discharges into the drainage canal. The clear water in the drainage canal flows east and discharges into the clear water pond.

The Primary Bottom Ash Pond embankment is up to approximately 40 ft in height. Discussions of embankment configuration and timeline, including cross sections through the dikes, was provided in a previous report prepared by ETTL Engineers & Consultants Inc. in 2010 (ETTL, 2010).

2.2.2 Area/Volume

Per the *Hydraulic Analysis of Welsh Power Plant Ash Ponds Report,* dated December 2010 (Freese and Nichols, 2010), the bottom elevation of the Primary Bottom Ash Pond is 300 feet above mean sea level (amsl), the high level overflow weir box bottom elevation is 325 feet MSL, and the storage capacity of the Primary Bottom Ash Pond at elevation 325 feet amsl is 304.2 acre-ft (**Figure 3**).

2.2.3 Construction and Operational History

The AEP J. Robert Welsh Plant began operations in 1977 with three coal-fired generating units (Units 1, 2, and 3). Throughout the life of the generating plant, CCR materials (fly ash, bottom ash, economizer ash) have been generated. All of these byproducts were stored in the Primary Bottom Ash Pond and in the adjacent landfill that was constructed in the late 1970's. In 2000, the 22-acre bottom ash storage pond was installed south of the landfill. The bottom ash storage pond was constructed with a 60-mil high-density polyethylene (HDPE) liner, and receives bottom ash and economizer ash dredged and sluiced from the Primary Bottom Ash Pond (**Figure 2**).

Presently bottom ash and economizer ash from the generating plant are sluiced to the Primary Bottom Ash Pond. Solids settle as the clear liquids flow through a drainage canal into the clear water pond (a non-CCR unit). Water in the clear water pond discharges through a weir box into a 36-inch-diameter pipe, and then into the Welsh Reservoir under Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ00018111000 (**Figure 3**).

2.2.4 Surface Water Control

Surface water flow within the Primary Bottom Ash Pond complex is controlled by a weir and emergency spillway located on the south side of the pond below the embankments. Pond elevation is maintained so that surface water flows through the weir box which has a bottom elevation of 325 feet amsl. The emergency spillway is 90 feet wide with a crest elevation of 334 feet amsl. Clear water flows through the weir (and occasionally the emergency spillway during heavy precipitation events) into a drainage canal along the south side of the pond. The drainage canal discharges into the clear water pond located directly southeast of the Primary Bottom Ash Pond (**Figure 3**).

The perimeter embankments on the south and east sides of the Primary Bottom Ash Pond are located at an approximate elevation of 340 feet amsl. Therefore the perimeter embankments have approximately six feet of freeboard above the emergency spillway.

2.3 Previous Investigations

The initial soils investigation for the site was provided in a 1973 report prepared by McClelland Engineers, Inc. entitled "*Soils Investigation, Welsh Power Plant, Cason, Texas*". This investigation included advancement of soil borings in the Primary Bottom Ash Pond area, and geotechnical soil testing to characterize the area encompassed by the Primary Bottom Ash Pond.

In 2001, five monitoring wells (AD-1 through AD-5) were installed in the area of the Primary Bottom Ash Pond and Bottom Ash Storage Pond to obtain hydrologic data for the uppermost water-bearing unit. Twelve additional monitoring wells (AD-4a, AD-4b, AD-4c, AD-6 through AD-14) were installed in the area of the Primary Bottom Ash Pond, Bottom Ash Storage Pond, and landfill by Eagle Environmental Services in 2009 to obtain more detailed hydrologic data for the uppermost water-bearing unit.

In 2010, ETTL prepared a report entitled "*Geotechnical Investigation, Welsh Power Station, Existing Ash Storage Ponds Embankment Investigation, Pittsburg, Texas*". The objective of this report was to evaluate the stability of the earthen embankments for the Primary Bottom Ash Pond and non-CCR clear water pond (aka "Secondary Ash Pond"). The principal finding of this investigation was that slope stability would be acceptable following a proposed repair to the embankment of the clear water pond. The repair of the embankment of the clear water pond was completed during September 2010.

In 2010, Freese and Nichols performed a *Hydraulic Analysis of the Welsh Power Plant Ash Ponds* (Freese and Nichols, 2010). The report concluded the spillways for the Primary Bottom Ash Pond, clear water pond, and are hydraulically adequate for the full range of storm events from the 10-year to the 100-year storm events.

In December 2015, Auckland Consulting further expanded the groundwater monitoring well system at the Plant by installation of monitoring wells AD-15 through AD-18 (Auckland Consulting, 2016). Monitoring well completion diagrams are provided in **Appendix A.**

2.4 Hydrogeologic Setting

The site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently southeast. The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966).

These features are further illustrated on five lines of cross section that were prepared through the Primary Bottom Ash Pond area, with three lines trending from west to east (A-A'; B-B'; C-C'), and the other two lines trending from north to south (D-D'; E-E'). The cross section location map is included as **Figure 3** and the lines of cross section are included as **Figure** 4 (A-A') through **Figure 8** (E-E').

2.4.1 Climate and Water Budget

The climate of Titus County, Texas is moist subhumid. The average January temperature is 45° Fahrenheit (F), and the average July temperature is 82.9°F. The mean annual growing season is 228 days (Broom, 1965). Average annual precipitation (including liquid water equivalent from snowfall) is approximately 47 inches according to weatherdb.com.

2.4.2 Regional and Local Geologic Setting

The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966). The Recklaw Formation attains a thickness of approximately 110 feet in Titus County, and is underlain by the Eocene-age Carrizo Sand which consists of fine to coarse sand, silt, and clay (Broom, 1965). In the topographically low areas underling the Welsh Reservoir to the east of the Primary Bottom Ash Pond, Quarternary alluvial sediments associated with Swauano Creek are present (Flawn, 1966).

Detailed regional geologic characterization can be found in several published reports including Texas Water Commission Bulletin 6517 "*Ground-Water Resources of Camp, Franklin, Morris and Titus Counties, Texas*" (Broom, 1965), and The University of Texas at Austin Bureau of Economic Geology "*Geologic Atlas of Texas – Texarkana Sheet*" (Flawn, 1966).

Detailed regional and site geologic characterization can be found in the 2010 ETTL report entitled "*Geotechnical Investigation, Welsh Power Station, Existing Ash Storage Ponds Embankment Investigation, Pittsburg, Texas*" (ETTL, 2010).

2.4.3 Surface Water and Surface Water Groundwater Interactions

The Site is generally less than one-half mile from Swauano Creek, which was dammed near the southern end of the Site during plant development to form the Welsh Reservoir. Groundwater flow direction at the Site is generally from west to east, following surface topography towards the Welsh Reservoir. The Welsh Reservoir is likely a gaining surface water feature, and groundwater elevations on site are higher than the normal stage elevation of the Welsh Reservoir (approximately 320 feet amsl).

The Primary Bottom Ash Pond normal operating level is near the weir box which has a bottom elevation of 325 feet amsl. **Figure 9** is a potentiometric surface map based on March 2016 water level data for the uppermost water bearing unit at the Site, and water level elevations in the Site monitoring wells are summarized on **Table 1**. As shown on **Figure 9**, shallow groundwater flow direction in the area of the Primary Bottom Ash Pond is easterly toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.01 foot per foot.

2.4.4 Water Users

A water well inventory conducted by Banks Information Solutions showed one water well within a ½-mile radius of the Site (Banks, 2013). The water well is located on-site to the southwest (side gradient) of the Primary Bottom Ash Pond, and was installed for Southwestern Electric Company in 1974 with screens from 515 to 535 feet below ground surface, and plugged at a later date.

3. Groundwater Monitoring Well Network Evaluation

The existing monitoring well network present at the Site was evaluated to determine if any of the wells were viable for continued use as part of the groundwater monitoring well network or also retained as part of a larger groundwater hydraulic monitoring well network. The hydrogeologic conditions were also evaluated to determine if the uppermost aquifer unit has an effective well network. The evaluation was completed in accordance with 40 CFR 257.91 to have an established monitoring well network that effectively monitors the uppermost aquifer up gradient and down gradient of the Site. The up gradient wells represent background groundwater quality and the down gradient wells are to be placed down gradient of the CCR unit boundary to monitor water quality.

3.1 Hydrostratigraphic Units

3.1.1 Horizontal and Vertical Position Relative to CCR Unit

Geologic data from soil borings and monitoring wells installed at the Site show the uppermost aquifer in the area of the Primary Bottom Ash Pond is a fine to medium grained clayey and silty sand stratum with an average thickness of approximately 10 feet that is located between an elevation of approximately 310 and 320 feet amsl (**Appendix A**). The base of the Primary Bottom Ash Pond ranges in elevation from approximately 330 feet amsl on the west to 300 feet amsl on the east. Therefore the uppermost aquifer appears to be in contact with the Primary Bottom Ash Pond and is further illustrated on cross section A-A' (**Figure 4**) and cross section D-D' (**Figure 7**).

3.1.2 Overall Flow Conditions

Groundwater is recharged from regional precipitation infiltration and locally from ash pond use. The uppermost aquifer (clayey and silty sand) is expected to have a hydraulic conductivity of approximately 10^{-4} centimeters per second (Fetter, 1980). Based on the hydraulic conductivity and saturated thickness (approximately 10 feet), the yield of the uppermost aquifer is anticipated to exceed the TCEQ non-useable (Class 3) limit of 150 gallons per day (TCEQ, 2010).

Available groundwater elevations are summarized on **Table 1** for 2011 through 2016. The most recent comprehensive groundwater data set from March 2016 is depicted on **Figure 9**. The groundwater flow is generally easterly towards the Welsh Reservoir.

3.2 Uppermost Aquifer

3.2.1 CCR Rule Definition

Per 40 CFR 257.60(a), new CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (five ft) above the upper limit of the uppermost aquifer, or must demonstrate there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high conditions).

The CCR rule definitions for an aquifer and the uppermost aquifer as specified in 40 CFR 257.53 indicates an aquifer is a geologic formation capable of yielding usable quantities of groundwater to wells or springs while an uppermost aquifer is defined as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers, that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural groundwater surface to which the aquifer rises during the wet season.

3.2.1.1 Common Definitions

An aquifer is commonly defined as a geologic unit that stores and transmits water (readily or at sufficient flow rates) to supply wells and springs (USGS, 2015; Fetter, 2001). The uppermost aquifer is considered the first encountered aquifer nearest to the CCR unit.

3.2.2 Identified Onsite Hydrostratigraphic Unit

The identified on-Site hydrostratigraphic unit in the area of the Primary Bottom Ash Pond is the fine to medium grained clayey and silty sand stratum that is located between an elevation of approximately 310 and 320 feet amsl. This unit is not used locally for groundwater supply or industrial water use, but meets the TCEQ definition of a useable aquifer.

3.3 Review of Existing Monitoring Well Network

3.3.1 Overview

The Site was visited by ARCADIS and AEP personnel on August 20, 2015 to review existing well network conditions and locations. A well construction table that summarizes the location, ground surface elevation, borehole depth, installation date, and associated well construction details of the monitoring well network is included as **Table 2**. Photo documentation of the located wells during the August 20, 2015 site visit is provided in **Appendix B**.

Monitoring wells AD-5 through AD-9 were previously installed at the Site to monitor the uppermost aquifer (fine to medium grained clayey and silty sand stratum) associated with the Primary Bottom Ash Pond. As discussed above in Section 3.1.1, the uppermost aquifer below the Primary Bottom Ash Pond is approximately 10 feet thick and is located between an elevation of approximately 310 and 320 feet amsl. In addition to these five monitoring wells, one piezometer (B-2) was installed directly down gradient (east) of the Primary Bottom Ash Pond in 2009 as part of the ETTL geotechnical investigation of the Primary Bottom Ash Pond embankments (ETTL, 2010).

3.3.2 Gaps in Monitoring Network

As shown on Geologic Cross Sections A-A' (**Figure 4**) and E-E' (**Figure 8**), existing monitoring well AD-5 is screened in the uppermost aquifer up gradient (northwest) of the Primary Bottom Ash Pond, and existing monitoring wells AD-8 and AD-9 are screened in the uppermost aquifer down gradient (east) of the Primary Bottom Ash Pond. These three monitoring wells will be utilized as part of the groundwater monitoring system for the Primary Bottom Ash Pond.

Monitoring well AD-18 was completed in the uppermost aquifer west of the Primary Bottom Ash Pond during December 2015. As shown on Geologic Cross Section A-A' (**Figure 4**) and the March 2016 potentiometric surface map (**Figure 9**), monitoring well AD-18 is located hydraulically up gradient of the Primary Bottom Ash Pond. Therefore monitoring well AD-18 will also be utilized as an up gradient monitoring well for the Primary Bottom Ash Pond.

As shown on the soil boring log in **Appendix A** and Geologic Cross Section E-E' (**Figure 8**), piezometer B-2 is located down gradient of the Primary Bottom Ash Pond, but is screened in a clay stratum above the top of the uppermost aquifer. Therefore piezometer B-2 will not be utilized as part of the groundwater monitoring system for the Primary Bottom Ash Pond. This data gap was addressed by installation of new down gradient monitoring well AD-15 adjacent to piezometer B-2 during December 2015 as shown on **Figure 9** and **Figure 10**. With the addition of monitoring wells AD-15 and AD-18 during December 2015, there are no gaps remaining in the groundwater monitoring network for the Primary Bottom Ash Pond.

4. Recommended Monitoring Network and PE Certification

The recommended modifications to the existing groundwater monitoring well network are intended to meet specifications stated in 40 CFR 257.91. Recommended wells are further discussed with respect to location to the Primary Bottom Ash Pond (up gradient or down gradient), well depth, and well construction. The recommended network would provide an improved understanding of groundwater quality, hydraulics, and groundwater flow at the Primary Bottom Ash Pond.

4.1 Recommended Monitoring Well Network Distribution

A total of three down gradient well locations (existing monitoring wells AD-8, AD-9, and AD-15) and two up gradient well locations (existing monitoring wells AD-5 and AD-18) are recommended to establish a groundwater quality monitoring well network for the Primary Bottom Ash Pond. In addition, existing monitoring wells AD-6 and AD-7 may be utilized as piezometers to obtain additional groundwater flow direction and gradient data for the Primary Bottom Ash Pond.

4.1.1 Location

The recommended monitoring well network for groundwater quality of the uppermost aquifer at the Primary Bottom Ash Pond is summarized on **Table 3** and illustrated on **Figure 10.**

4.1.2 Depth

The screen depths for the monitoring wells recommended for inclusion in the monitoring network are within the shallow saturated sand stratum (uppermost aquifer) that occurs between an elevation of approximately 310 and 320 feet amsl as shown on Geologic Cross Sections A-A' (**Figure 4**) and E-E' (**Figure 8**). The screen elevations are presented in **Table 3.**

4.1.3 Well Construction

As discussed above in Section 3.3.2, the gap in the monitoring well network for the uppermost aquifer at the Primary Bottom Ash Pond was addressed by installation of monitoring wells AD-15 and AD-18 during December 2015. Monitoring wells AD-15 and AD-18 were installed by a Texas Department of Licensing and Regulation (TDLR)-licensed water well driller. Well construction data for the monitoring well network are summarized on **Tables 2** and **3**, and the monitoring well completion diagrams are provided in **Appendix A**.

4.2 Professional Engineer's Certification

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the proposed groundwater monitoring system will be adequate to meet the requirements of 40 CFR Part 257.91.

Kenneth J. Brandner
Printed Name of Registered Professional Engineer

Kenth J Brandner
Signature

KENNETH J. BRANDNER
69586

69586
Registration No.

Texas
Registration State

6-29-16
Date

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ARCADIS

Tables

Table 1
Water Level Data
AEP J. Robert Welsh Power Plant - CCR Storage Areas
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Screen		Bottom of Screen		6/7/2011	12/6/2011	5/2/2012	11/1/2012	5/14/2013	11/19/2013	5/12/2014	11/16/2014	5/12/2015	3/4/2016
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																						
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57	338.46	334.92	337.88	337.18	337.43	336.73	338.03	337.64	340.82	342.83
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16	330.16	329.07	330.00	329.26	329.83	329.70	330.09	329.69	332.56	332.32
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10	323.81	323.19	323.99	323.29	323.77	323.98	324.12	323.28	325.58	325.12
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61	324.81	324.84	324.62	324.40	324.74	325.52	325.44	325.13	327.00	326.90
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19	325.01	324.19	325.24	322.90	324.86	324.68	325.64	325.34	327.19	327.12
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55	324.35	324.32	324.50	324.30	324.30	325.21	325.22	324.90	326.58	326.67
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15	324.18	324.50	324.64	324.37	324.11	325.06	325.01	324.71	326.50	326.19
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00	336.34	336.58	336.82	336.99	336.78	336.47	336.80	336.01	339.07	338.04
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31	333.04	333.02	332.83	333.02	333.11	332.81	333.11	332.81	333.38	334.00
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86	334.32	334.12	334.19	334.20	334.13	334.58	333.77	333.98	334.09	333.61
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53	325.41	324.09	325.69	325.15	325.79	325.75	325.98	325.77	326.05	325.70
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32	328.46	328.53	328.63	328.44	328.74	329.38	NM	330.18	329.98	329.74
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23	323.44	322.55	323.27	323.35	323.51	323.76	323.57	323.88	323.95	323.55
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61	327.99	328.37	327.82	327.93	327.94	328.13	328.20	327.97	328.96	328.13
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27	348.30	348.29	349.86	349.56	349.99	349.65	349.89	350.01	350.65	350.39
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12	332.36	332.24	333.09	332.26	332.68	333.25	333.35	332.01	337.58	334.76
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32	330.40	329.80	331.67	330.34	330.94	331.69	332.12	330.17	336.63	334.83
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71	---	---	---	---	---	---	---	---	---	322.14
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86	---	---	---	---	---	---	---	---	---	337.09
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99	---	---	---	---	---	---	---	---	---	334.64
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17	---	---	---	---	---	---	---	---	---	343.66
Piezometers																						
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

NM - Not measured.
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through March 2016.

Table 2
Well Construction Details
AEP J. Robert Welsh Power Plant - CCR Units
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Filter Pack		Bottom of Filter Pack		Top of Screen		Bottom of Screen	
								Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl
Monitoring Wells															
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	25.0	1/11/2001	PVC	2	13	343	25	331	15.0	340.57	25.0	330.57
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	25.0	4/26/2001	PVC	2	12	332	25	319	15.0	329.16	25.0	319.16
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	17.0	4/26/2001	PVC	2	5	326	17	314	7.0	324.10	17.0	314.10
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	30.0	4/26/2001	PVC	2	16	325	30	311	19.0	321.61	29.0	311.61
AD-4a (a)	33.04527	94.84258	340.19	30.0	9/22/2009	PVC	2	17	323	30	310	20.0	320.19	30.0	310.19
AD-4b (a)	33.04531	94.84230	329.55	15.0	9/23/2009	PVC	2	4	326	15	315	5.0	324.55	15.0	314.55
AD-4c (a)	33.04507	94.84244	329.15	15.0	9/23/2009	PVC	2	4	325	15	314	5.0	324.15	15.0	314.15
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	30.0	1/11/2001	PVC	2	16	333	30	319	20.0	329.00	30.0	319.00
AD-6 (a)	33.05235	94.84757	343.31	33.0	9/23/2009	PVC	2	21	322	33	310	23.0	320.31	33.0	310.31
AD-7 (a)	33.05257	94.84219	347.86	38.0	9/24/2009	PVC	2	26	322	38	310	28.0	319.86	38.0	309.86
AD-8 (a)	33.05187	94.84026	337.53	29.0	9/21/2009	PVC	2	14	324	29	309	16.0	321.53	26.0	311.53
AD-9 (a)	33.04995	94.84196	340.32	35.0	9/21/2009	PVC	2	18	322	35	305	20.0	320.32	35.0	305.32
AD-10 (a)	33.04881	94.84047	340.23	35.0	9/22/2009	PVC	2	18	322	35	305	20.0	320.23	35.0	305.23
AD-11 (a)	33.04824	94.84177	339.61	20.0	9/22/2009	PVC	2	8	332	20	320	10.0	329.61	20.0	319.61
AD-12 (a)	33.04901	94.84977	366.27	30.0	9/24/2009	PVC	2	18	348	30	336	20.0	346.27	30.0	336.27
AD-13 (a)	33.04918	94.84275	344.12	20.0	9/22/2009	PVC	2	4	340	20	324	6.0	338.12	16.0	328.12
AD-14 (a)	33.04715	94.84256	342.32	19.0	9/22/2009	PVC	2	6	336	18	324	8.0	334.32	18.0	324.32
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	46.0	12/12/15	PVC	2	22	318	45.5	295	25.5	314.71	45.5	294.71
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	21.0	12/10/15	PVC	2	9	342	21	330	11.0	339.86	21.0	329.86
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	40.0	12/10/15	PVC	2	22	332	39	315	24.0	329.99	39.0	314.99
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	29.0	12/11/15	PVC	2	12	334	29	317	14.0	332.17	29.0	317.17
Piezometers															
B-2 (b)	33° 03.078'	94° 50.449'	339.7	50.0	10/28/2009	PVC	2	8	332	20	320	10.0	329.70	20.0	319.70
B-4 (b)	33° 03.011'	94° 50.462'	340.6	50.0	10/27/2009	PVC	2	8	333	18	323	8.0	332.60	18.0	322.60
B-5 (b)	33° 02.964'	94° 50.428'	340.0	50.0	10/27/2009	PVC	2	5	335	20	320	10.0	330.00	20.0	320.00
B-6 (b)	33° 02.912'	94° 50.462'	340.1	50.0	10/28/2009	PVC	2	4	336	22	318	12.0	328.10	22.0	318.10

General Notes:
Elevation in feet above mean sea level.

Footnotes:
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
Acronyms and Abbreviations:
NA = Data not available
ft = feet
bls = below land surface
msl = mean sea level

Table 3
Proposed Well Network
AEP J. Robert Welsh Power Plant - Primary Bottom Ash Pond
Pittsburg, Titus County, Texas

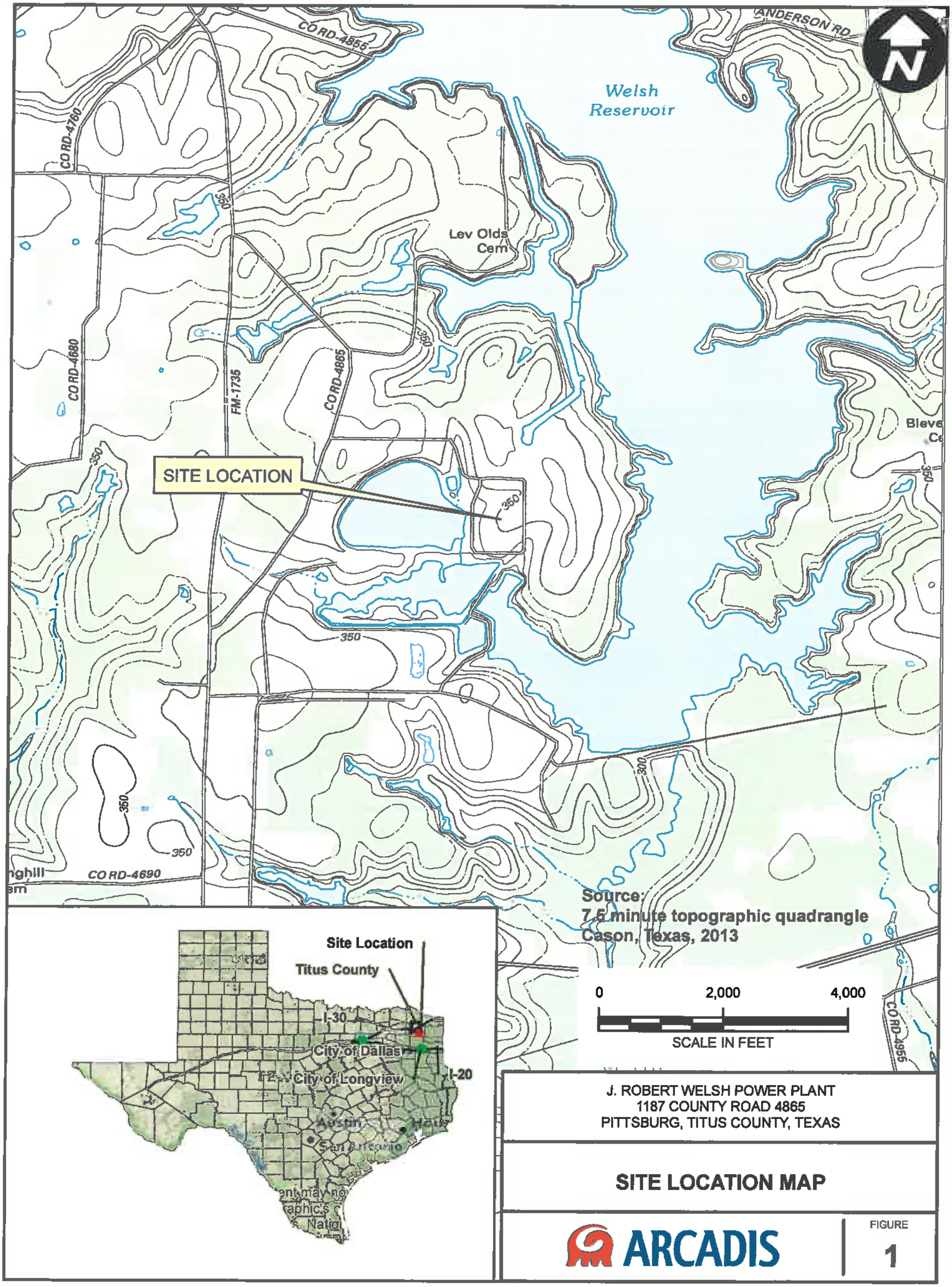
Well ID	Exisiting/ Proposed	Hydrostratigraphic Unit Target	Location Description		Screen Top Target Elevation[(a)] (ft amsl)	Screen Bottom Target Elevation[(a)] (ft amsl)	Screen Length (ft)	Comments
Upgradient								
AD-5	Existing	Uppermost Water-Bearing Unit	NW of Primary Bottom Ash Pond	Upgradient	329.0	319.0	10	Existing well installed in 2001; well will be utilitzed to establish backgroud water quality
AD-18	Existing	Uppermost Water-Bearing Unit	W of Primary Bottom Ash Pond	Upgradient	332.2	317.2	15	New monitoring well installed during December 2015 in uppermost shallow aquifer west of Primary Bottom Ash Pond - upgradient; well will be utilized to establish background water quality
Downgradient								
AD-8	Existing	Uppermost Water-Bearing Unit	E of Primary Bottom Ash Pond	Down gradient	321.5	311.5	10	Existing well installed in 2009; uppermost shallow aquifer adjacent to the Primary Bottom Ash Pond - downgradient
AD-9	Existing	Uppermost Water-Bearing Unit	E of Primary Bottom Ash Pond	Down gradient	320.3	305.3	15	Existing well installed in 2009; uppermost shallow aquifer adjacent to the Primary Bottom Ash Pond - downgradient
AD-15	Existing	Uppermost Water-Bearing Unit	E of Primary Bottom Ash Pond	Down gradient	314.7	294.7	20	New monitoring well installed during December 2015 in uppermost shallow aquifer adjacent to the Primary Bottom Ash Pond - downgradient
Piezometers								
AD-6	Existing	Uppermost Water-Bearing Unit	N of Primary Bottom Ash Pond	Side gradient	320.3	310.3	10	Existing well installed in 2009; and utilitzed to obtain water level data for uppermost water-bearing unit
AD-7	Existing	Uppermost Water-Bearing Unit	N of Primary Bottom Ash Pond	Side gradient	319.9	309.9	10	Existing well installed in 2009; and utilitzed to obtain water level data for uppermost water-bearing unit

Footnotes:
a. Target elevations are an estimated range.

Acronyms and Abbreviations:
U=Upgradient
D=Downgradient
ft = feet
amsl = above mean sea level

ARCADIS

Figures



Source:
7.5 minute topographic quadrangle
Cason, Texas, 2013

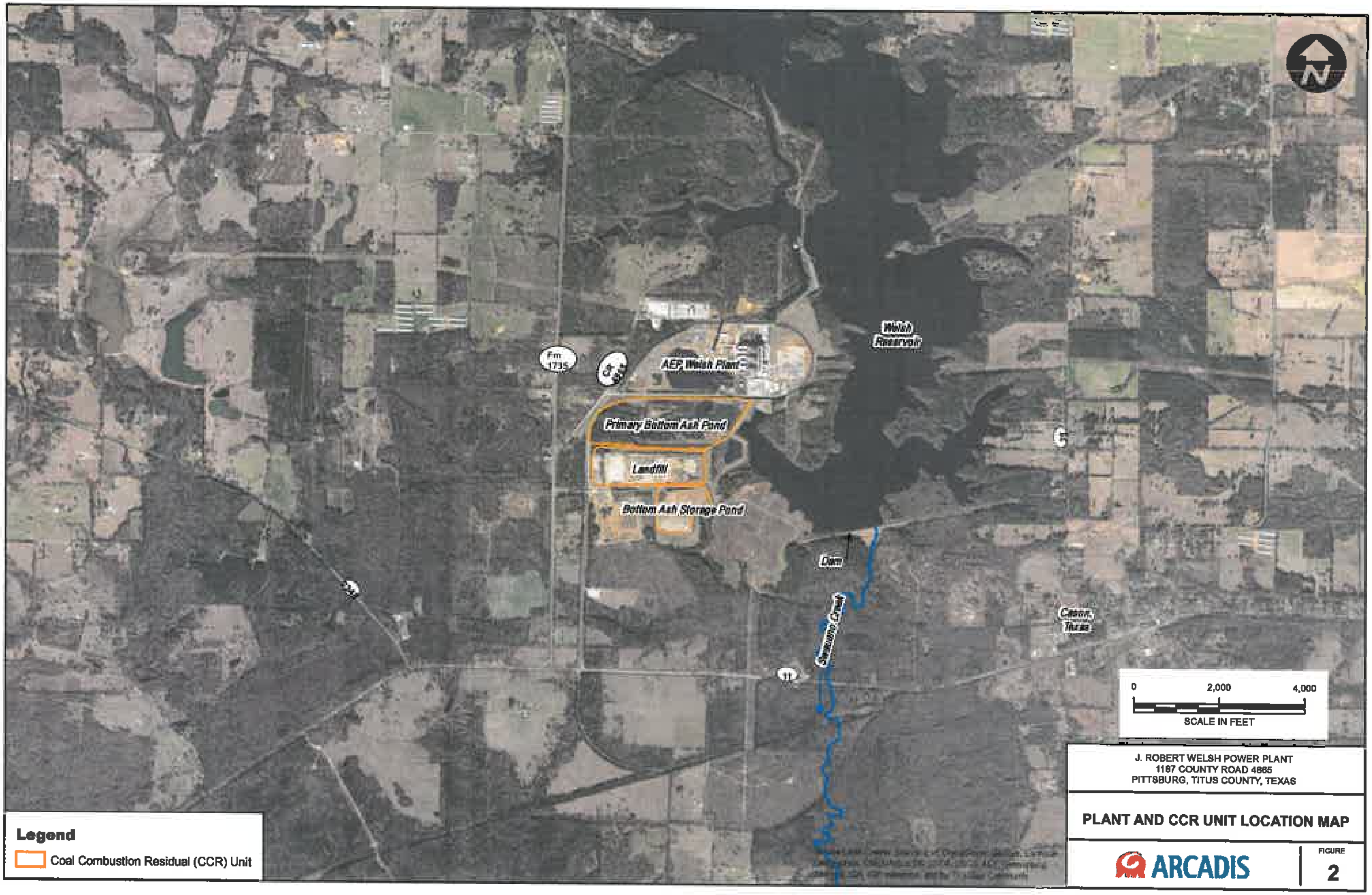
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LOCATION MAP

ARCADIS

FIGURE
1

Document Path: Z:\GISPROJECTS_ENVAEP\Welsh Plant\MXD\Landfill report\fig 1 - site map.mxd



Legend

🟧 Coal Combustion Residual (CCR) Unit

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PLANT AND CCR UNIT LOCATION MAP

ARCADIS

FIGURE
2

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill reporting\Fig 2 - CCR location.mxd

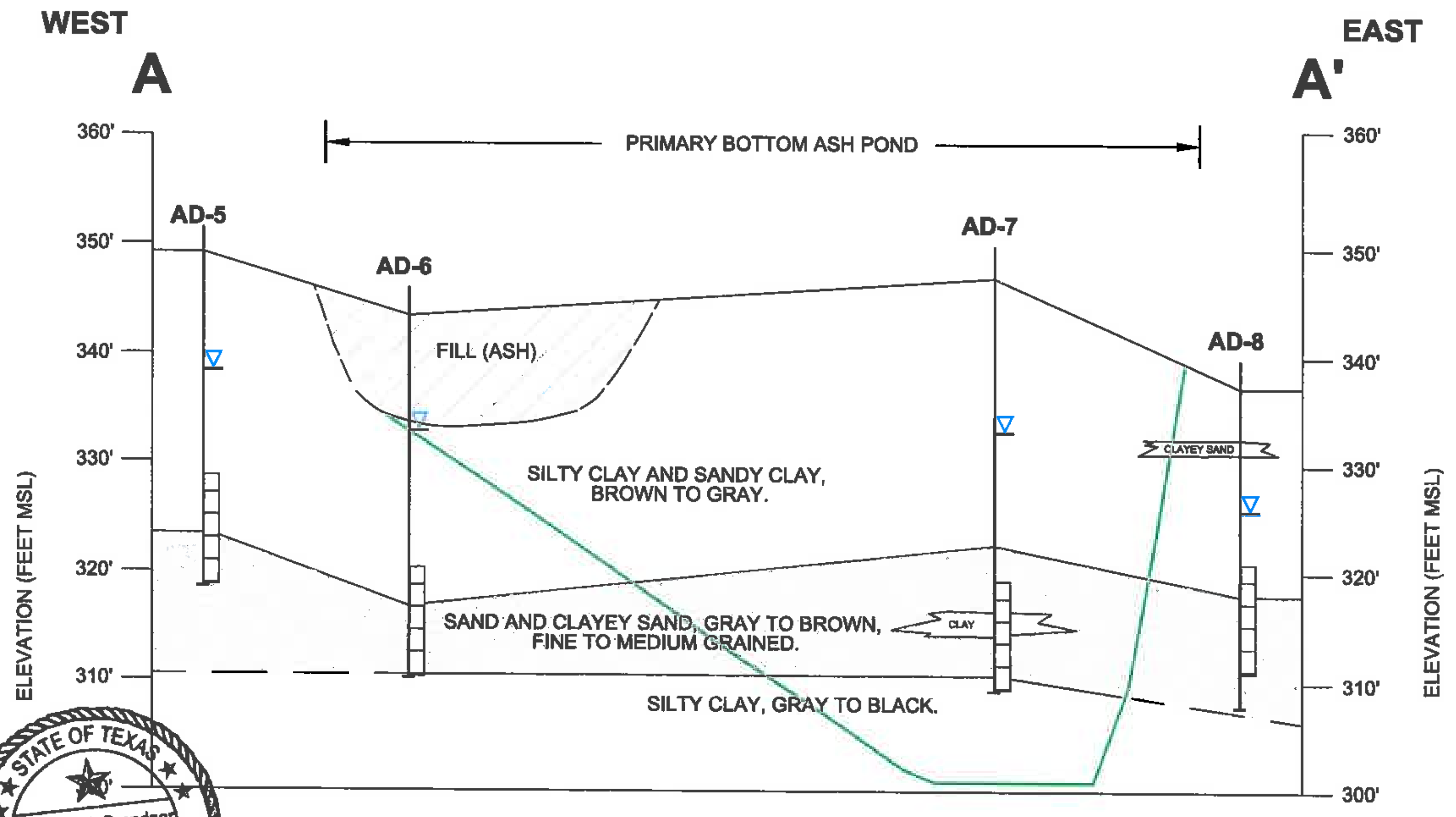
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LAYOUT AND WELL LOCATIONS

ARCADIS

FIGURE
3

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 3 - site layout.mxd



Kenneth J. Brandner
Geology
1787

Kenneth J. Brandner 6-29-16

0 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (5/12/15)
🟩	PROJECTED BASE OF ASH POND (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
A - A'

ARCADIS

FIGURE
4

CITY: DIV/GROUP: DB: LD: AM: PIC: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015078 - CCR Plant Assessment\Welsh Power Plant\2016 Final Reports\Primary Ash Pond WELL Network Evaluation\Figures-Maps\Figure 4 Cross Section A-A'.dwg LAYOUT: MODEL SAVED: 6/28/2016 8:53 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE:
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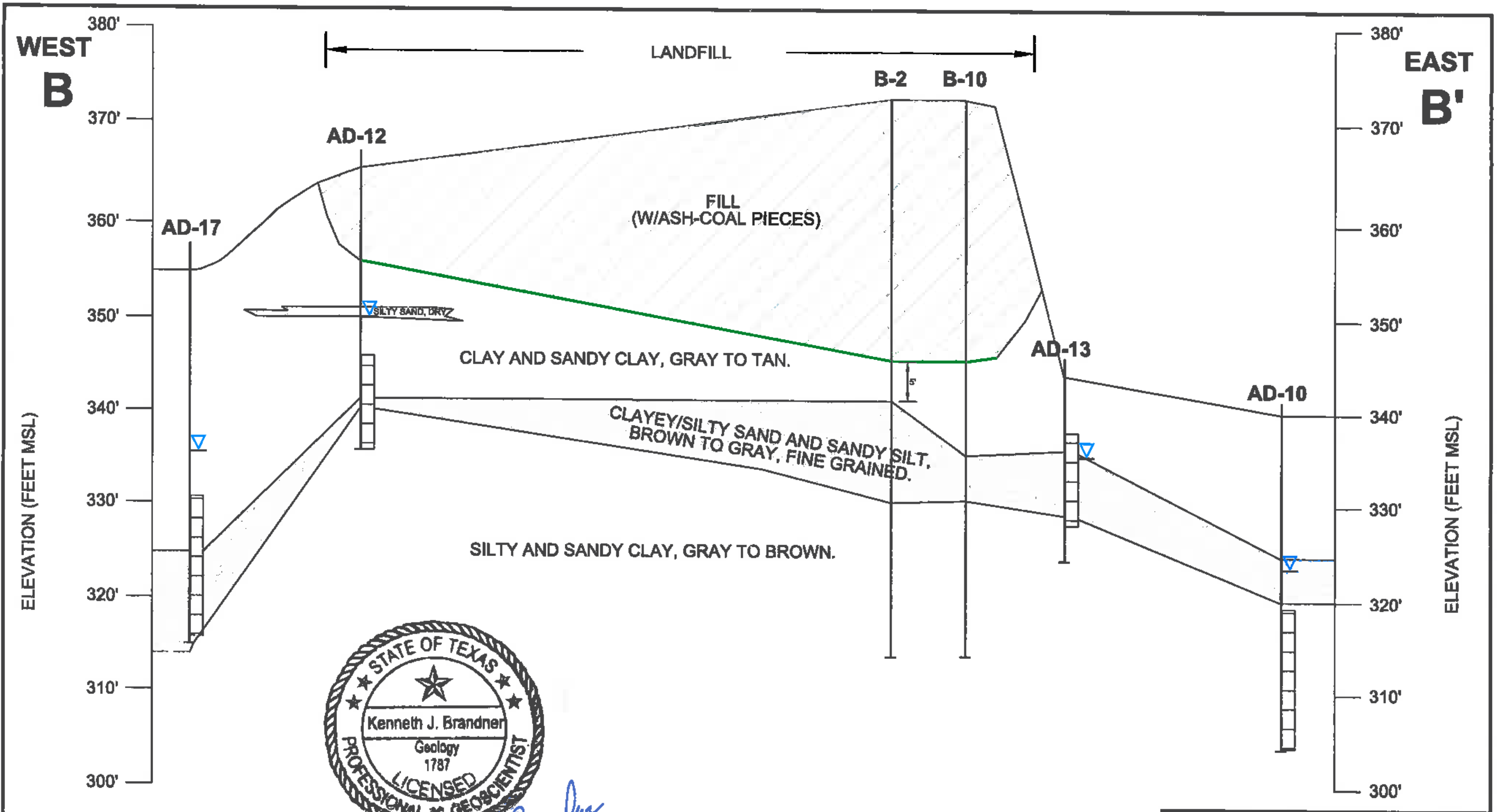


Kenneth J. Brandner
Geology
1787

Kenneth J. Brandner 6-29-16

0 300'
HORIZONTAL SCALE

NOTE: BASE OF LANDFILL ELEVATION TAKEN FROM "WELSH POWER PLANT- UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12/3/76.

LEGEND

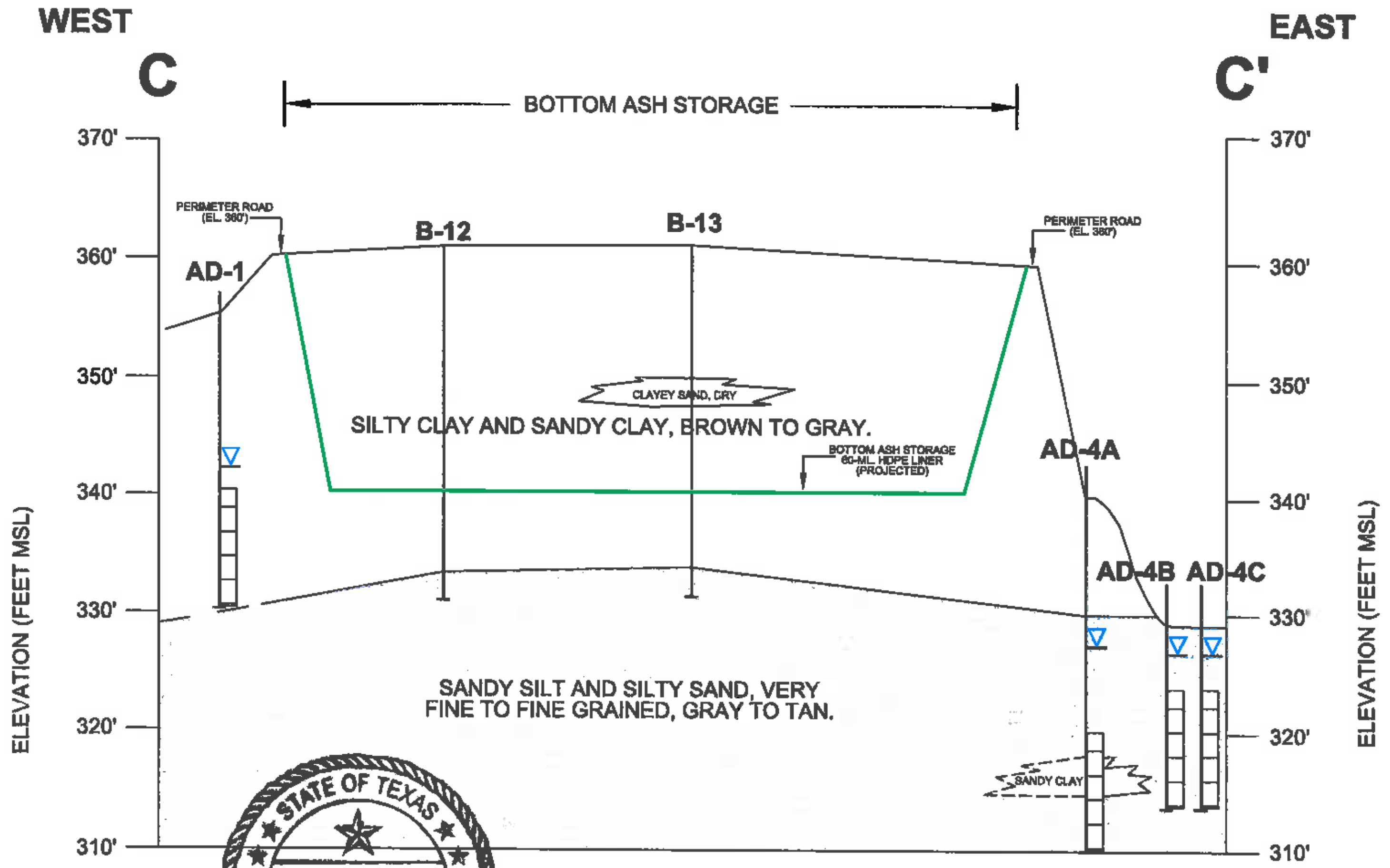
▥ MONITORING WELL SCREENED INTERVAL
▽ WATER LEVEL IN MONITORING WELL (3/4/16)
— BASE OF LANDFILL (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
B - B'

ARCADIS

FIGURE
5



Kenneth J. Brandner
Geology
1787

Kenneth J Brandner
6-29-16

0 200'
HORIZONTAL SCALE

NOTE: BASE OF BOTTOM ASH STORAGE HAS A 60-ML HDPE LINER AT ELEVATION 340.0', TAKEN FROM FREESE AND NICHOLS "HYDRAULIC ANALYSIS OF WELSH POWER PLANT ASH PONDS, AMERICAN ELECTRIC POWER COMPANY", DATED DECEMBER 2010.

LEGEND

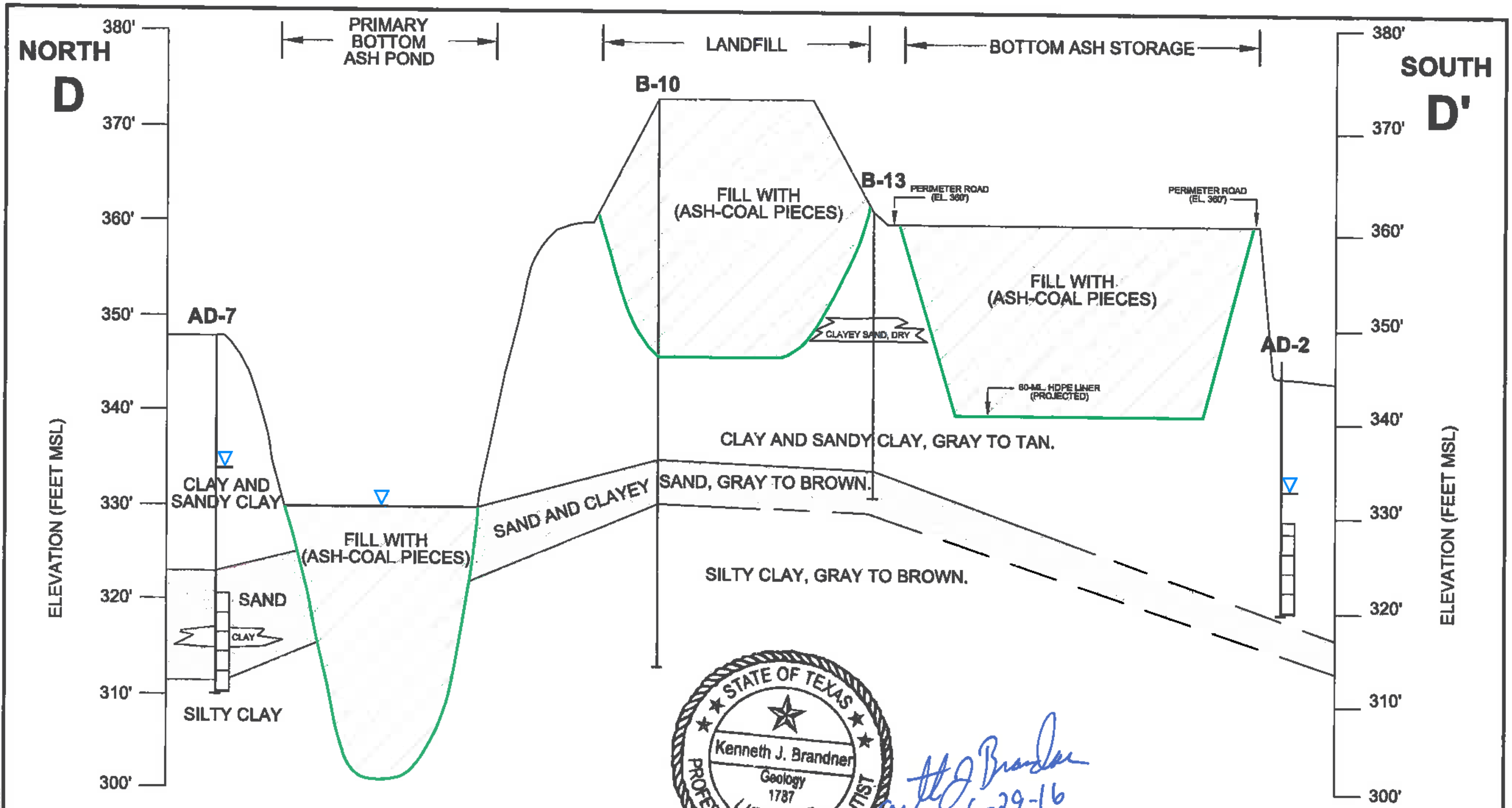
▤	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
🟩	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
C - C'

ARCADIS

FIGURE
6



Kenneth J. Brandner
Geology
1787

Kenneth J Brandner
6-29-16

0 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

☷	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (5/12/15)
🟩	BASE OF CCR UNIT

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
D - D'

ARCADIS

FIGURE
7

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015076 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond WELL Network Evaluation\Figures-Maps\Figure 7 Cross Section D-D'.dwg LAYOUT: MODEL SAVED: 6/28/2016 10:07 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE:
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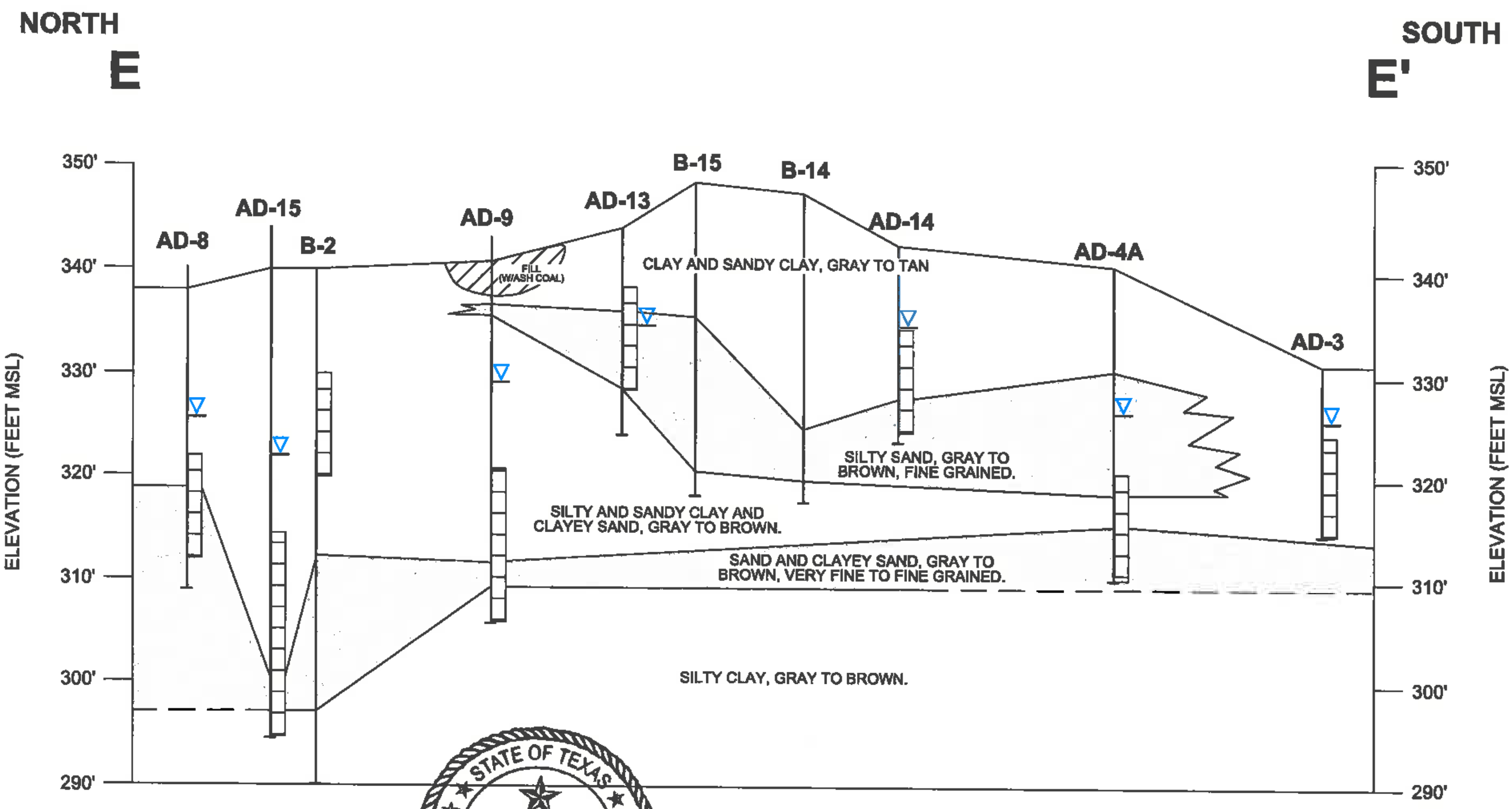

Kenneth J. Brandner
Geology
1737

Kenneth J Brandner
6-29-16

LEGEND

- ⌸ MONITORING WELL SCREENED INTERVAL
- ▽ WATER LEVEL IN MONITORING WELL (3/4/16)
- — PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
E - E'

ARCADIS

FIGURE
8

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OK015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 8 Cross Section E-E.dwg LAYOUT: MODEL SAVED: 3/11/2016 12:08 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE:
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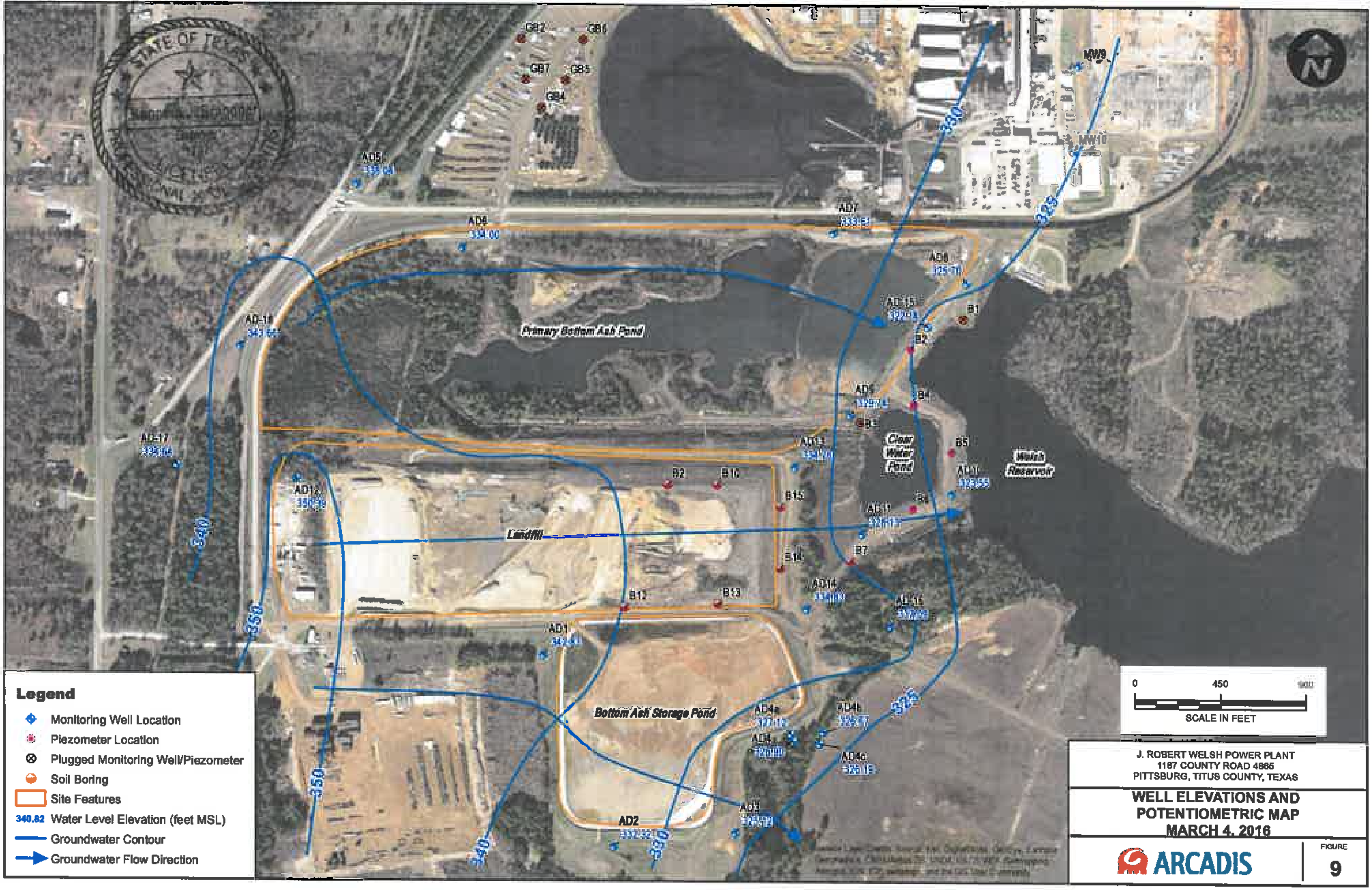
6-29-16



J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

WELL ELEVATIONS AND POTENTIOMETRIC MAP
MARCH 4, 2016

ARCADIS

FIGURE
9

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill reporting\Fig 9 - Mar2016_POT.mxd

Kenneth J. Brandner

6-29-16

Legend

- 🔷 Monitoring Well Location
- 🔶 Proposed Exiting CCR Unit Upgradient Monitoring Well
- ◆ Proposed Exiting CCR Unit Downgradient Monitoring Well
- ☐ Site Features

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PROPOSED MONITORING WELL NETWORK MAP - PRIMARY BOTTOM ASH POND

ARCADIS

FIGURE
10

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Ash Pond reportig 10 - proposed wells_v2.mxd

ARCADIS

Appendix A

Boring/Well Construction Logs

AD-1

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4, Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33° 02' 48" N
94° 50' 47" W

N

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ______

From (ft.)	To (ft.)	Description and color of formation material
0	25	gray silty clay with some hard red streaks
		AP-1

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other ______
If Gravel Packed give interval ... from 13 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	sch 40
2	N	#10 slot screen	15	25	sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 13 ft. to 0 ft. No. of sacks used 6-50#
______ ft. to ______ ft. No. of sacks used ______
Method used bentonite
Cemented by ______
Distance to septic system field lines or other concentrated contamination ______ ft.
Method of verification of above distance ______

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc. ______ ft.

✓ 10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.

11) WATER LEVEL:
Static level 12' 8" ft. below land surface Date 1-11-01
Artesian flow ______ gpm. Date ______

✓ 15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

12) PACKERS: NA Type Depth

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ______ (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS ______ (Street or RFD) (City) (State) (Zip)

(Signed) ______ (Licensed Well Driller) (Signed) ______ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-2

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

County ~~Camp~~ Titus

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'37"N
94°50'44"W
N

6) WELL LOG:
Date Drilling:
Started 4/26 19 2001
Completed 4/26 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ____

From (ft.)	To (ft.)	Description and color of formation material
0	2	top Soil
2	5	red & gray clay w/ silt
5	10	red & gray clay w/ silt
10	25	gray silty clay w/ tan streaks
		AP-2

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other ____

If Gravel Packed give interval ... from 12 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	Sch 40
2	N	#10 slot screen	15	25	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 12 ft. to 2 ft. No. of sacks used 5-50#
____ ft. to ____ ft. No. of sacks used ____
Method used bentonite pellets
Cemented by ____
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance ____

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ____ ft. below land surface Date ____
Artesian flow ____ gpm. Date ____

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ____
Depth to pump bowls, cylinder, jet, etc., ____ ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ____ (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS ____ (Street or RFD) (City) (State) (Zip)

(Signed) Gilbert M (Licensed Well Driller) (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-3

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'38"N
94°50'37"W
N

6) WELL LOG:
Date Drilling:
Started 4/26 19 2001
Completed 4/26 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	17

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	12	gray silt clay w/ tan streaks
12	15	very stiff gray/blood red clay
15	17	Very stiff gray clay w/ red nodules and tan streaks

AP-3

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 5 ft. to 17 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	7	Sch 40
2	N	#10 slot screen	7	17	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 2 ft. to 5 ft. No. of sacks used 2 1/2 - 50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX. 52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-4

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'43"N
94°50'33"W
N↑

6) WELL LOG:
Date Drilling:
Started 4/26 19 2001
Completed 4/26 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	5	red silty clay with gray streaks
5	30	gray silty clay with red streaks
		AP-4

(*Use reverse side if necessary*)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	19	Sch 40
2	N	#10 Slot Screen	19	29	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 2 ft. No. of sacks used 8-50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other NA
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4A**
TOTAL DEPTH:	**30'**
TOP OF CASING ELEV.:	**342.85 ft. NGVD**
GROUND SURFACE ELEV.:	**340.19 ft. NGVD**

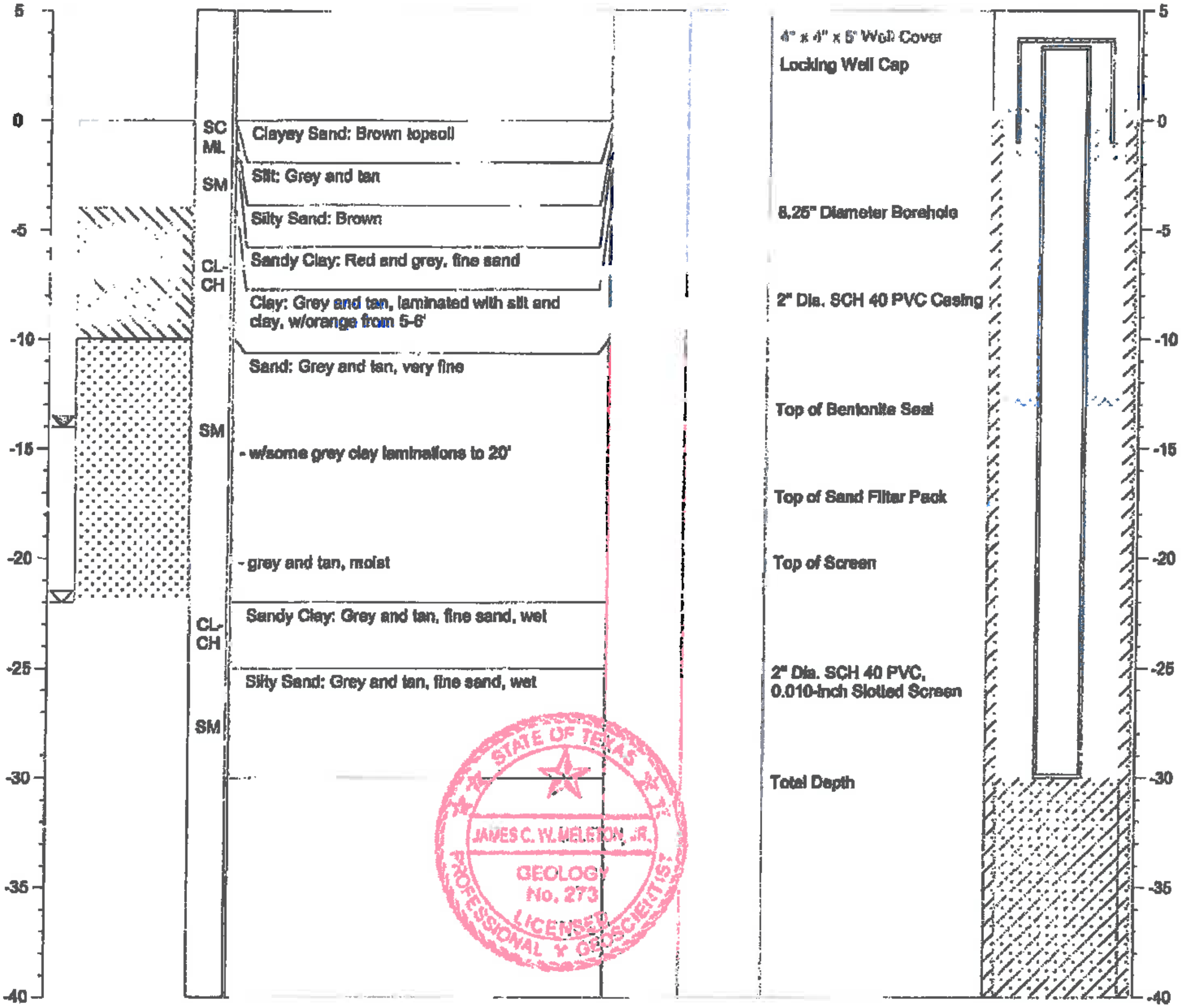
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04527**
Longitude: 94.84258

▽ Water level during drilling
▽ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



SC Clayey Sand: Brown topsoil

ML Silt: Grey and tan

SM Silty Sand: Brown

CL-CH Sandy Clay: Red and grey, fine sand

Clay: Grey and tan, laminated with silt and clay, w/orange from 5-6'

SM Sand: Grey and tan, very fine

- w/some grey clay laminations to 20'

- grey and tan, moist

CL-CH Sandy Clay: Grey and tan, fine sand, wet

SM Silty Sand: Grey and tan, fine sand, wet

4" x 4" x 5' Well Cover

Locking Well Cap

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Bentonite Seal

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen

Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	AD-4B
TOTAL DEPTH:	15'
TOP OF CASING ELEV.:	333.23 ft. NGVD
GROUND SURFACE ELEV.:	329.55 ft. NGVD

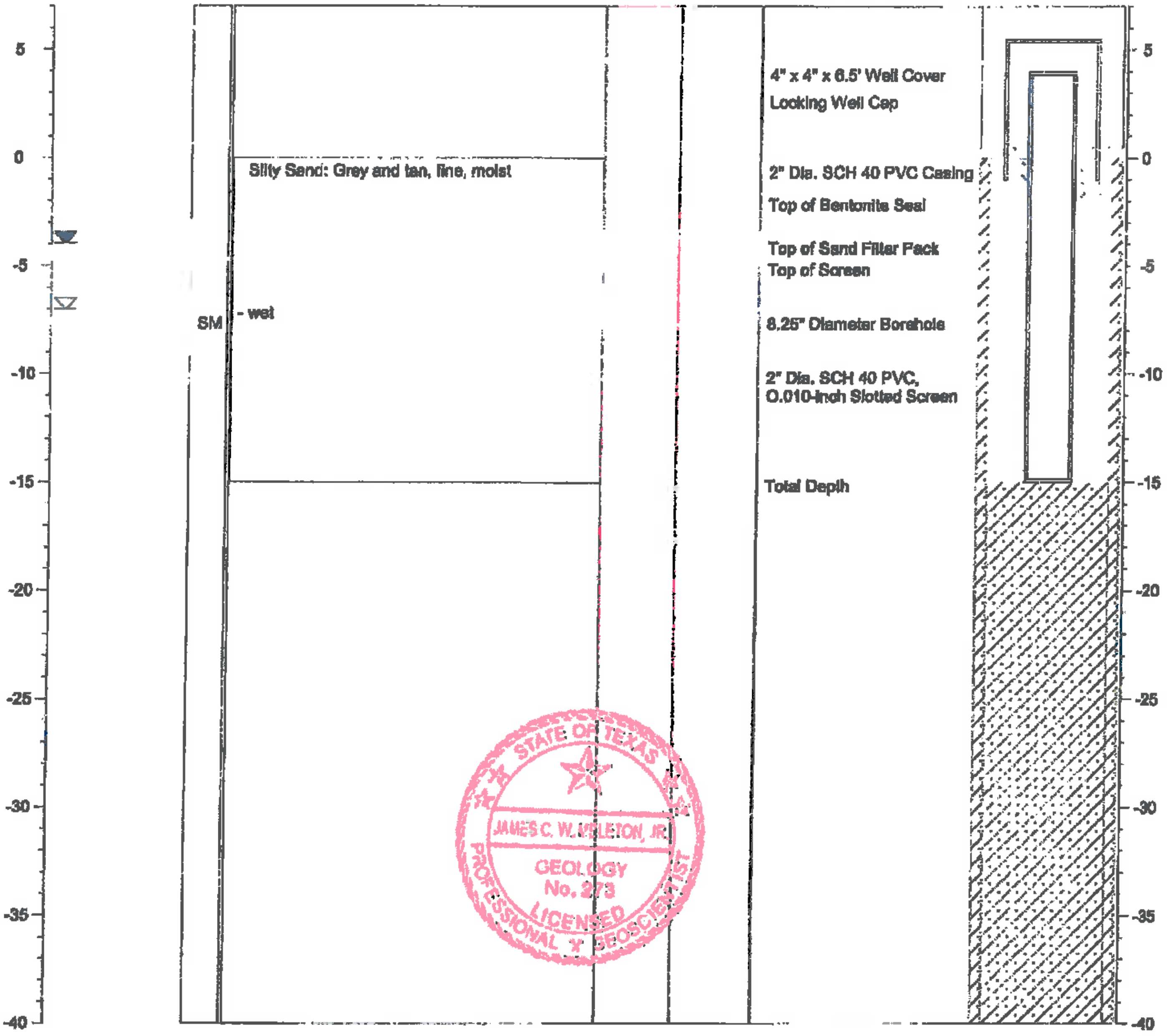
CLIENT:	AEP	DRILLING CO.:	WEST Drilling
PROJECT:	Ash Disposal Area	DRILLER:	Tom McCullough
SITE LOCATION:	Welsh Power Plant	METHOD OF DRILLING:	Hollow-stem Auger
PROJECT NO.:	S-08-0109	SAMPLING METHODS:	Split-spoon
LOGGED BY:	James Meleton, Jr.	DATE DRILLED:	9/23/09

NOTES: Latitude: 33.04531
Longitude: 94.84230

▼ Water level during drilling
▽ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



SM

Silty Sand: Grey and tan, fine, moist

- wet

4" x 4" x 6.5' Well Cover
Locking Well Cap
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
8.25" Diameter Borehole
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
PROFESSIONAL LICENSED GEOSCIENTIST

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OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	AD-4C
TOTAL DEPTH:	15'
TOP OF CASING ELEV.:	333.28 ft. NGVD
GROUND SURFACE ELEV.:	329.15 ft. NGVD

CLIENT:	AEP	DRILLING CO.:	WEST Drilling
PROJECT:	Ash Disposal Area	DRILLER:	Tom McCullough
SITE LOCATION:	Welsh Power Plant	METHOD OF DRILLING:	Hollow-stem Auger
PROJECT NO.:	S-08-0109	SAMPLING METHODS:	Split-spoon
LOGGED BY:	James Meleton, Jr.	DATE DRILLED:	9/23/09

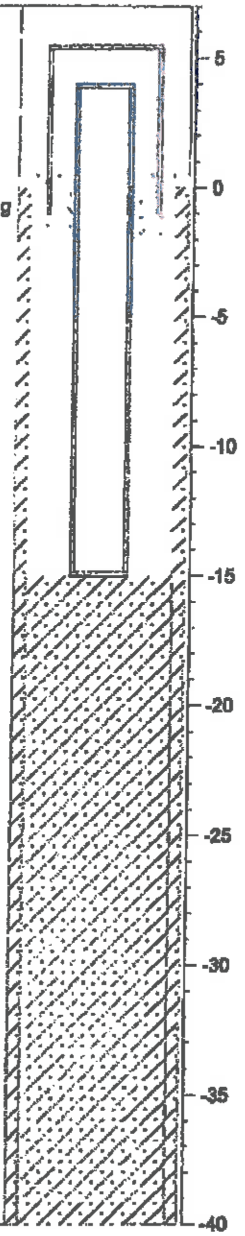
NOTES: Latitude: 33.04507
Longitude: 94.84244

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION
5						4" x 4" x 6.5' Well Cover Locking Well Cap
0			Silty Sand: Grey and tan, fine, moist			2" Dia. SCH 40 PVC Casing Top of Bentonite Seal
-5	▼ ▽	SM	- wet			Top of Sand Filter Pack Top of Screen 8.25" Diameter Borehole
-10						2" Dia. SCH 40 PVC, 0.010-Inch Slotted Screen
-15						Total Depth
-20						
-25						
-30						
-35						
-40						

WELL CONSTRUCTION



JAMES C. W. MELETON, JR.
GEOLOGY
No. 273

AD-5

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt.4, Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

County ~~Camp~~ Titus

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic
☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5)
33°03'13"N
94°51'00"W
N ↑

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8¼	Surface	30

7) DRILLING METHOD (Check): ☐ Driven
☐ Air Rotary ☐ Mud Rotary ☒ Bored
☐ Air Hammer ☐ Cable Tool ☐ Jetted
☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	10	red & gray clay with orange streaks
10	20	gray/black clay with tan clay
20	25	stiff clay with lignite streak
25	30	fine gray sand

AP-5

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall
☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	risor	+2	20	Sch 40
2	N	#10 slot screen	20	30	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 0 ft. No. of sacks used
ft. to ft. No. of sacks used
Method used bentonite
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

✓ 10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

14) WELL TESTS:
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

11) WATER LEVEL:
Static level 11'9" ft. below land surface Date 1-11-01
Artesian flow gpm. Date

✓ 15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

12) PACKERS: NA Type Depth

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX 52494-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) Gilbert M (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

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E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.: AD-6
TOTAL DEPTH: 33'
TOP OF CASING ELEV.: 346.33 ft. NGVD
GROUND SURFACE ELEV.: 343.31 ft. NGVD

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

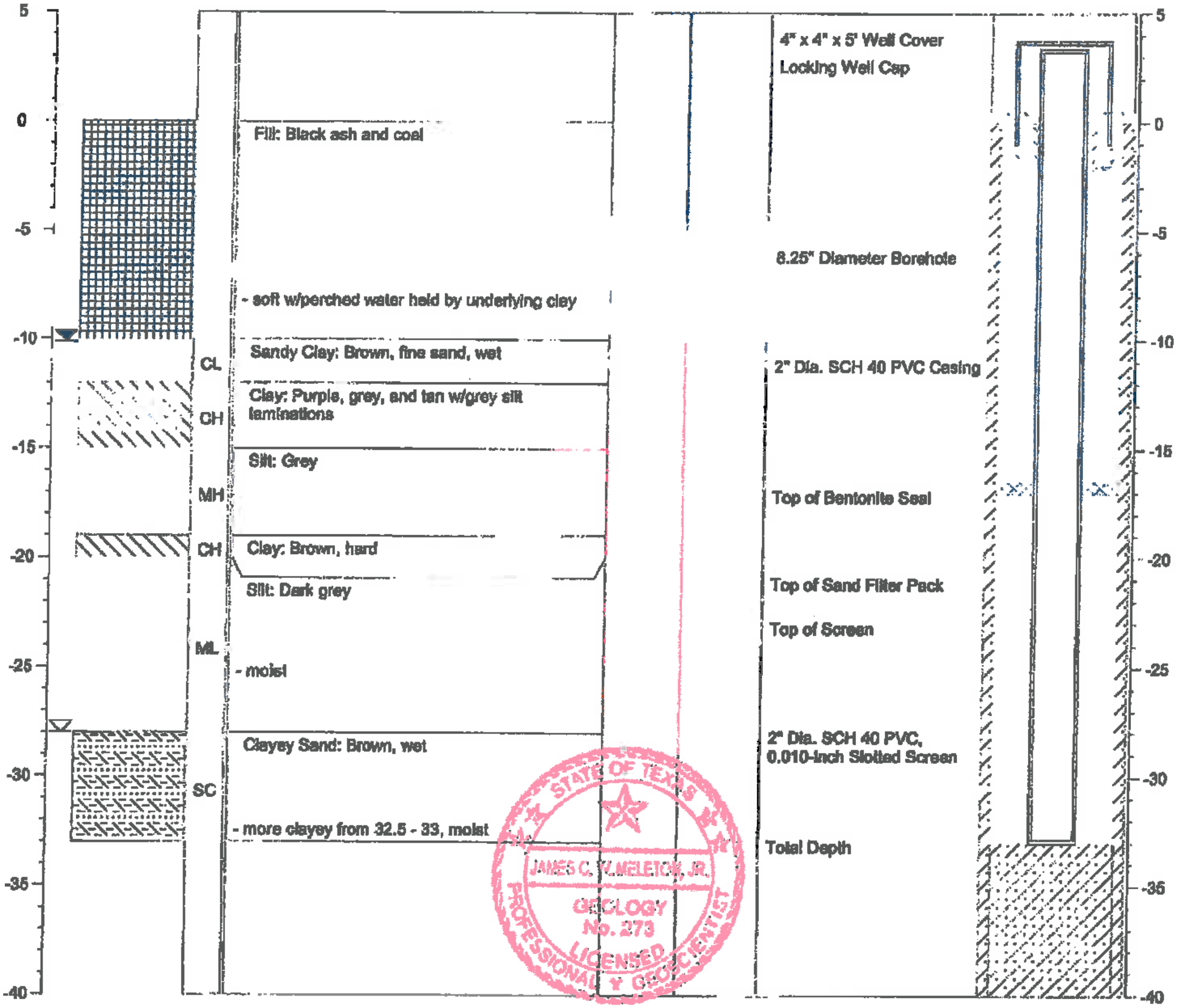
DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/23/09**

NOTES: **Latitude: 33.05235**
Longitude: 94.84757

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Fill: Black ash and coal

- soft w/perched water held by underlying clay

CL Sandy Clay: Brown, fine sand, wet

CH Clay: Purple, grey, and tan w/grey silt laminations

MH Silt: Grey

CH Clay: Brown, hard

ML Silt: Dark grey

- moist

SC Clayey Sand: Brown, wet

- more clayey from 32.5 - 33, moist

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED PROFESSIONAL GEOSCIENTIST

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-7**
TOTAL DEPTH:	**38'**
TOP OF CASING ELEV.:	**350.82 ft. NGVD**
GROUND SURFACE ELEV.:	**347.86 ft. NGVD**

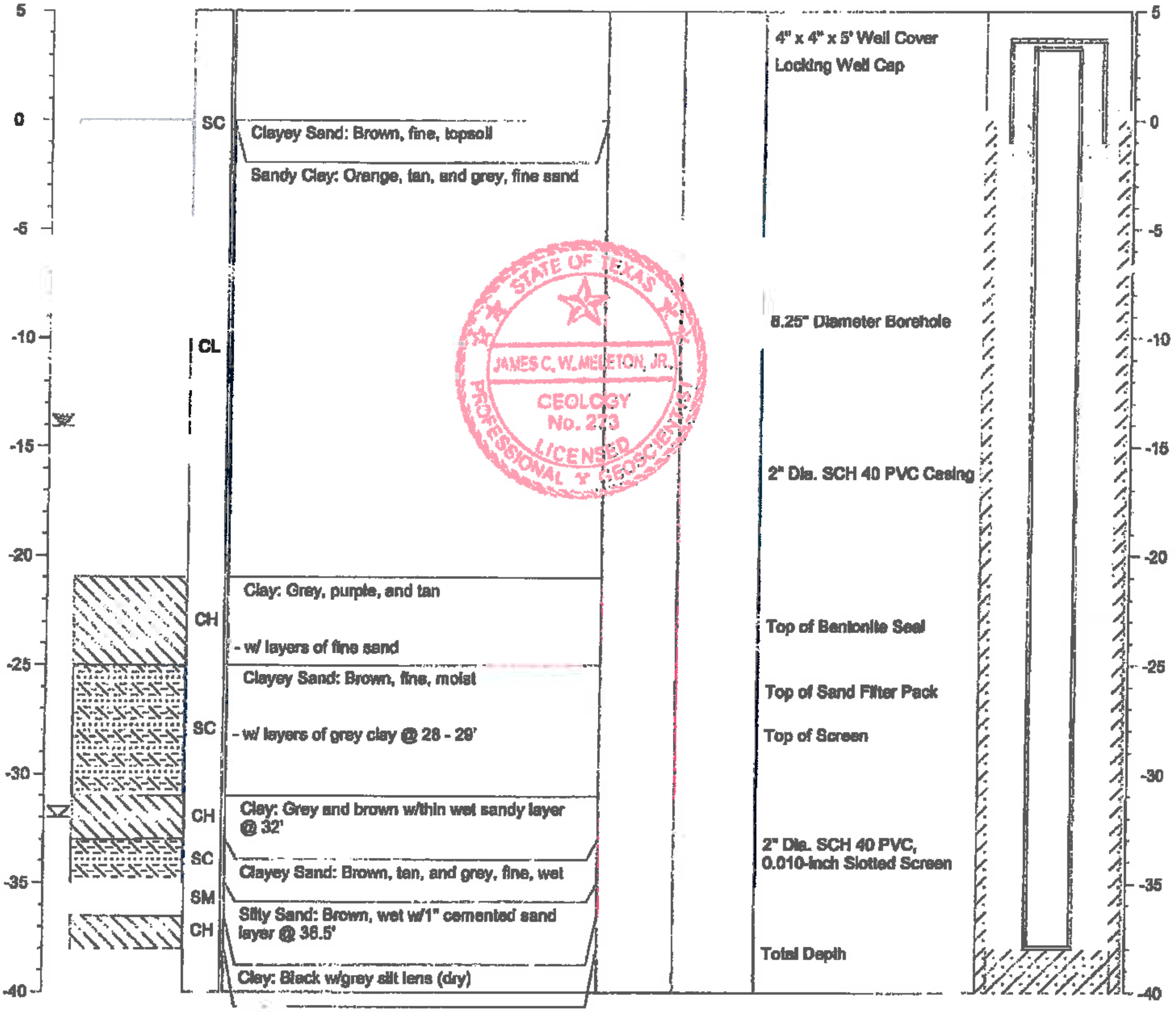
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/24/09**

NOTES: **Latitude: 33.05257**
Longitude: 94.84219

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



SC Clayey Sand: Brown, fine, topsoil

Sandy Clay: Orange, tan, and grey, fine sand

CL

CH Clay: Grey, purple, and tan
- w/ layers of fine sand

SC Clayey Sand: Brown, fine, moist
- w/ layers of grey clay @ 28 - 29'

CH Clay: Grey and brown w/thin wet sandy layer @ 32'

SC Clayey Sand: Brown, tan, and grey, fine, wet

SM Silty Sand: Brown, wet w/1" cemented sand layer @ 36.5'

CH Clay: Black w/grey silt lens (dry)

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

JAMES C. W. MELETON, JR.
GEOLOGY
No. 273

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ENVIRONMENTAL SERVICES OF SHREVEPORT INC

SOIL BORING LOG

BORING/WELL NO.:	AD-8
TOTAL DEPTH:	29'
TOP OF CASING ELEV.:	340.01 ft. NGVD
GROUND SURFACE ELEV.:	337.53 ft. NGVD

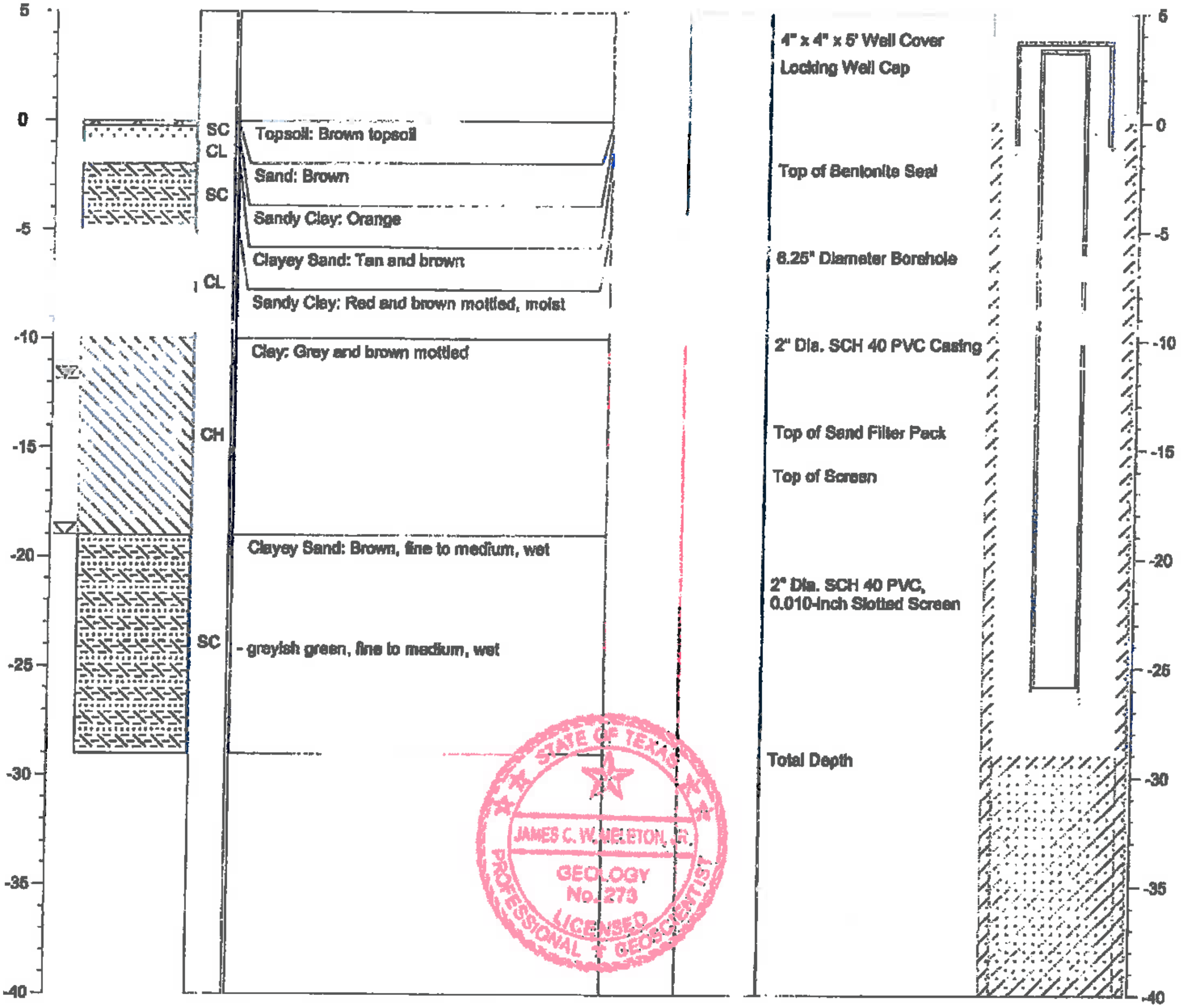
CLIENT:	AEP	DRILLING CO.:	WEST Drilling
PROJECT:	Ash Disposal Area	DRILLER:	Tom McCullough
SITE LOCATION:	Welsh Power Plant	METHOD OF DRILLING:	Hollow-stem Auger
PROJECT NO.:	S-08-0109	SAMPLING METHODS:	Split-spoon
LOGGED BY:	James Meleton, Jr.	DATE DRILLED:	9/21/09

NOTES: Latitude: 33.05187
Longitude: 94.84026

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Topsoil: Brown topsoil

Sand: Brown

Sandy Clay: Orange

Clayey Sand: Tan and brown

Sandy Clay: Red and brown mottled, moist

Clay: Grey and brown mottled

Clayey Sand: Brown, fine to medium, wet

- greyish green, fine to medium, wet

4" x 4" x 5' Well Cover

Locking Well Cap

Top of Bentonite Seal

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen

Total Depth

JAMES C. W. MELETON, JR.
GEOLOGY
No. 273

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.:	AD-9
TOTAL DEPTH:	35'
TOP OF CASING ELEV.:	343.09 ft. NGVD
GROUND SURFACE ELEV.:	340.32 ft. NGVD

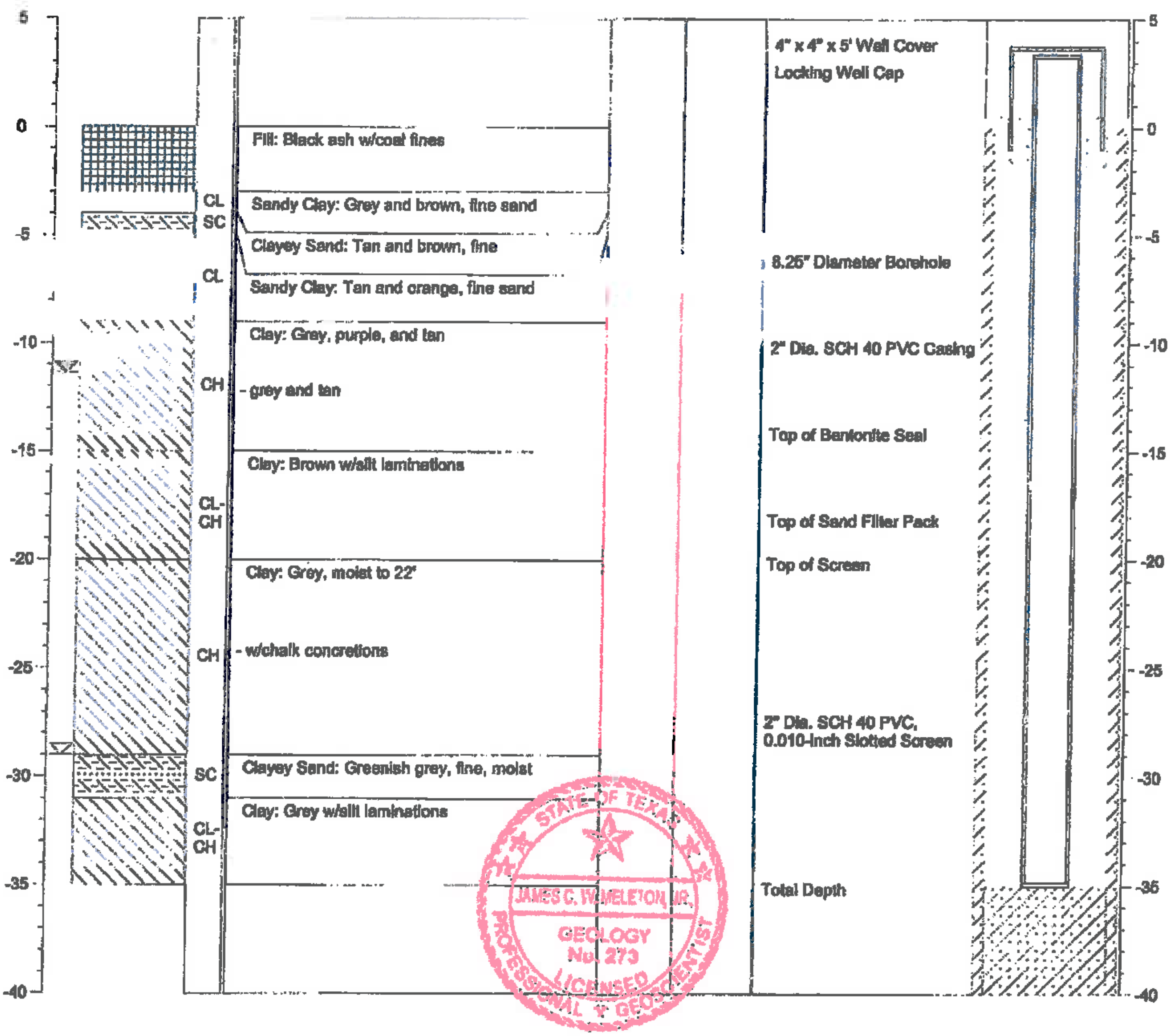
CLIENT:	AEP	DRILLING CO.:	WEST Drilling
PROJECT:	Ash Disposal Area	DRILLER:	Tom McCullough
SITE LOCATION:	Welsh Power Plant	METHOD OF DRILLING:	Hollow-stem Auger
PROJECT NO.:	S-08-0109	SAMPLING METHODS:	Split-spoon
LOGGED BY:	James Meleton, Jr.	DATE DRILLED:	9/21/09

NOTES: **Latitude: 33.04995**
Longitude: 94.84196

⊻ Water level during drilling
▽ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



JAMES C. W. MELETON, JR.
GEOLOGY No. 273

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	AD-10
TOTAL DEPTH:	35'
TOP OF CASING ELEV.:	343.01 ft. NGVD
GROUND SURFACE ELEV.:	340.23 ft. NGVD

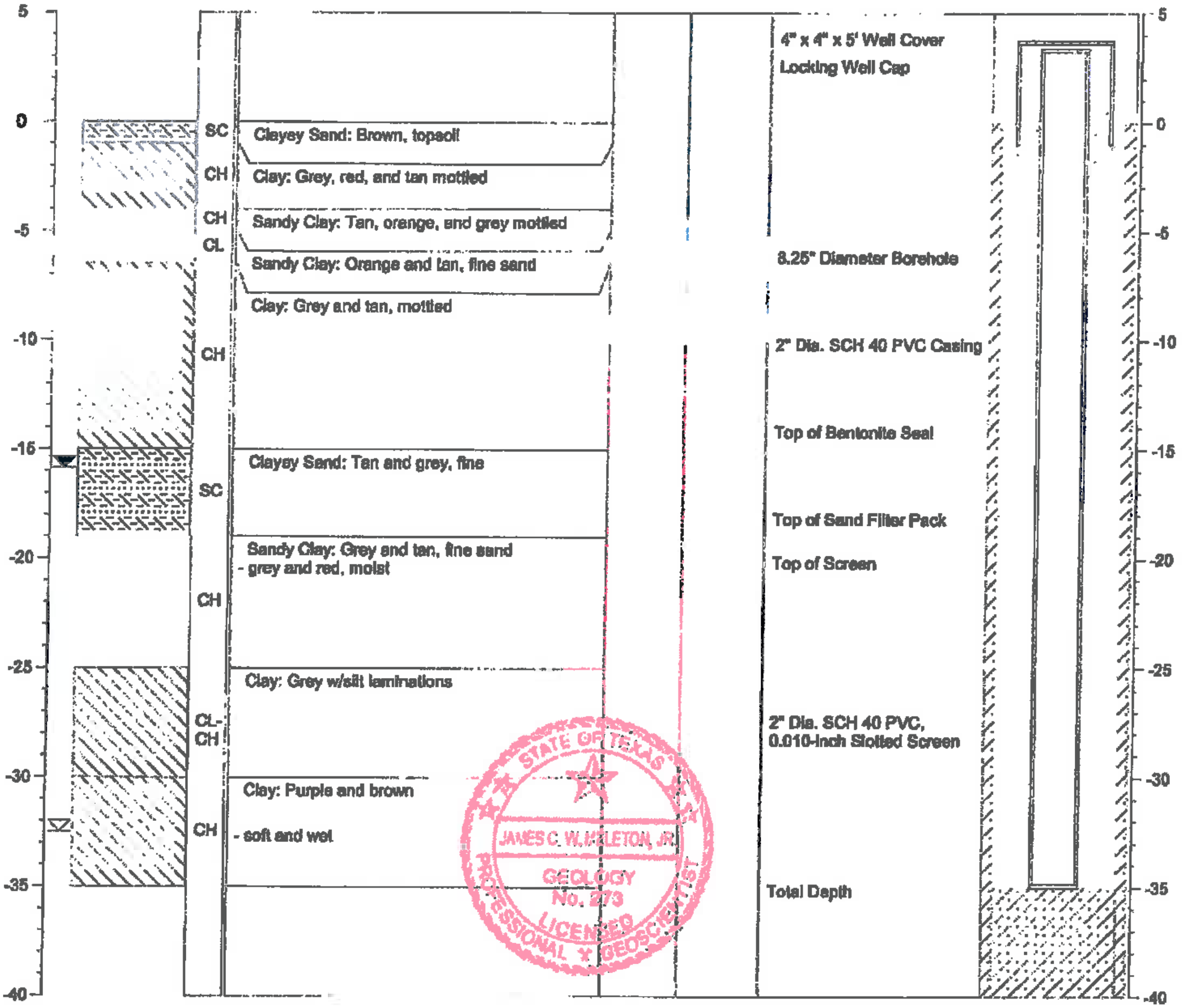
CLIENT:	AEP	DRILLING CO.:	WEST Drilling
PROJECT:	Ash Disposal Area	DRILLER:	Tom McCullough
SITE LOCATION:	Welsh Power Plant	METHOD OF DRILLING:	Hollow-stem Auger
PROJECT NO.:	S-08-0109	SAMPLING METHODS:	Split-spoon
LOGGED BY:	James Meleton, Jr.	DATE DRILLED:	9/22/09

NOTES: Latitude: 33.04881
Longitude: 94.84047

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Clayey Sand: Brown, topsoil
Clay: Grey, red, and tan mottled
Sandy Clay: Tan, orange, and grey mottled
Sandy Clay: Orange and tan, fine sand
Clay: Grey and tan, mottled
Clayey Sand: Tan and grey, fine
Sandy Clay: Grey and tan, fine sand
- grey and red, moist
Clay: Grey w/silt laminations
Clay: Purple and brown
- soft and wet

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.:	**AD-11**
TOTAL DEPTH:	**20'**
TOP OF CASING ELEV.:	**342.18 ft. NGVD**
GROUND SURFACE ELEV.:	**339.61 ft. NGVD**

CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

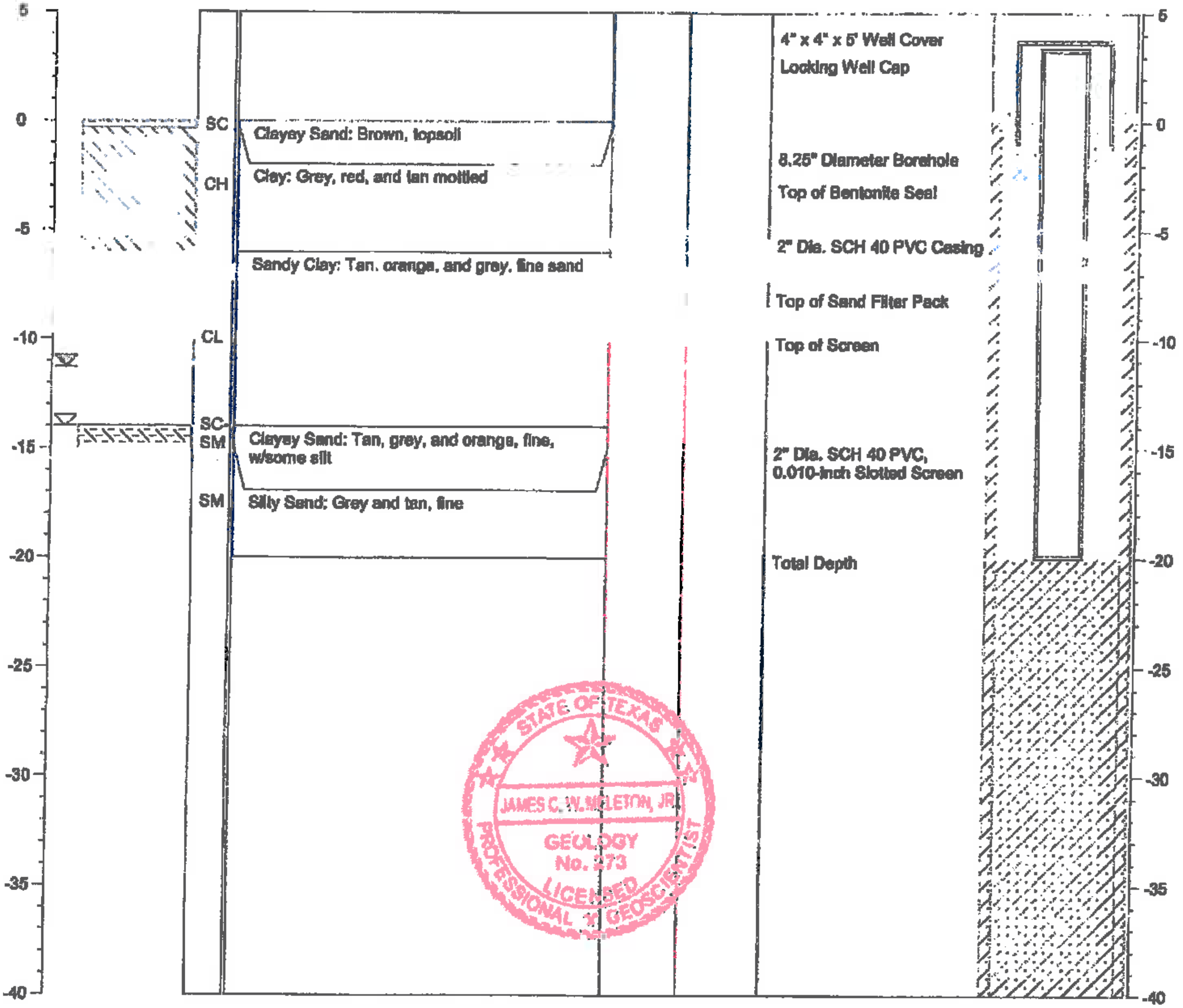
DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04824**
Longitude: 94.84177

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



SC Clayey Sand: Brown, topsoil

CH Clay: Grey, red, and tan mottled

Sandy Clay: Tan, orange, and grey, fine sand

CL

SC-SM Clayey Sand: Tan, grey, and orange, fine, w/some silt

SM Silty Sand: Grey and tan, fine

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
Top of Bentonite Seal
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED PROFESSIONAL GEOSCIENTIST

E·A·G·L·E ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.: **AD-12**
TOTAL DEPTH: **30'**
TOP OF CASING ELEV.: **369.33 ft. NGVD**
GROUND SURFACE ELEV.: **366.27 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

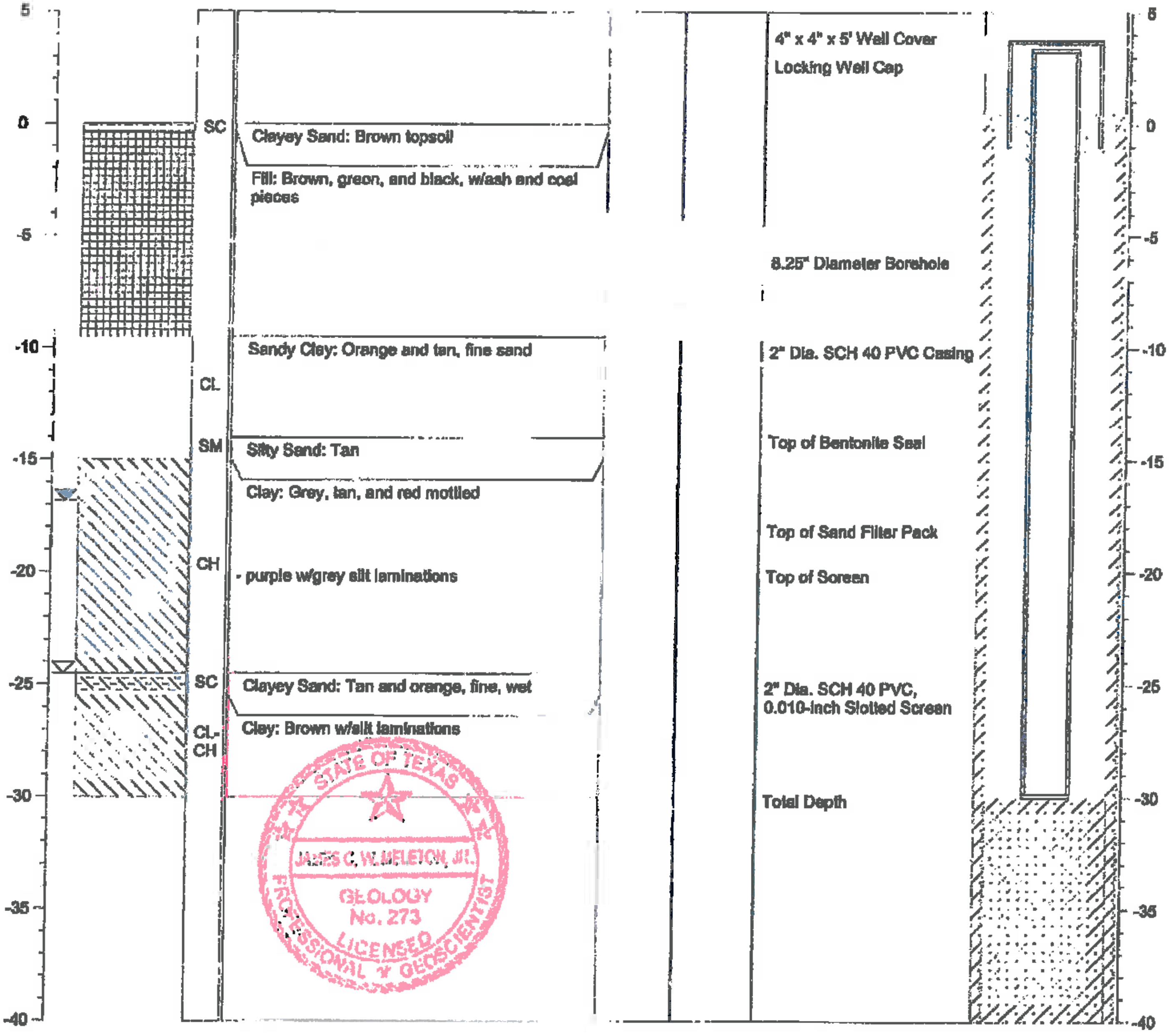
DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/24/09**

NOTES: **Latitude: 33.04901**
Longitude: 94.84977

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



JAMES C. W. MELETON, JR.
GEOLOGY
No. 273

EAGLE
ENVIRONMENTAL SERVICES OF SHREVEPORT INC

SOIL BORING LOG

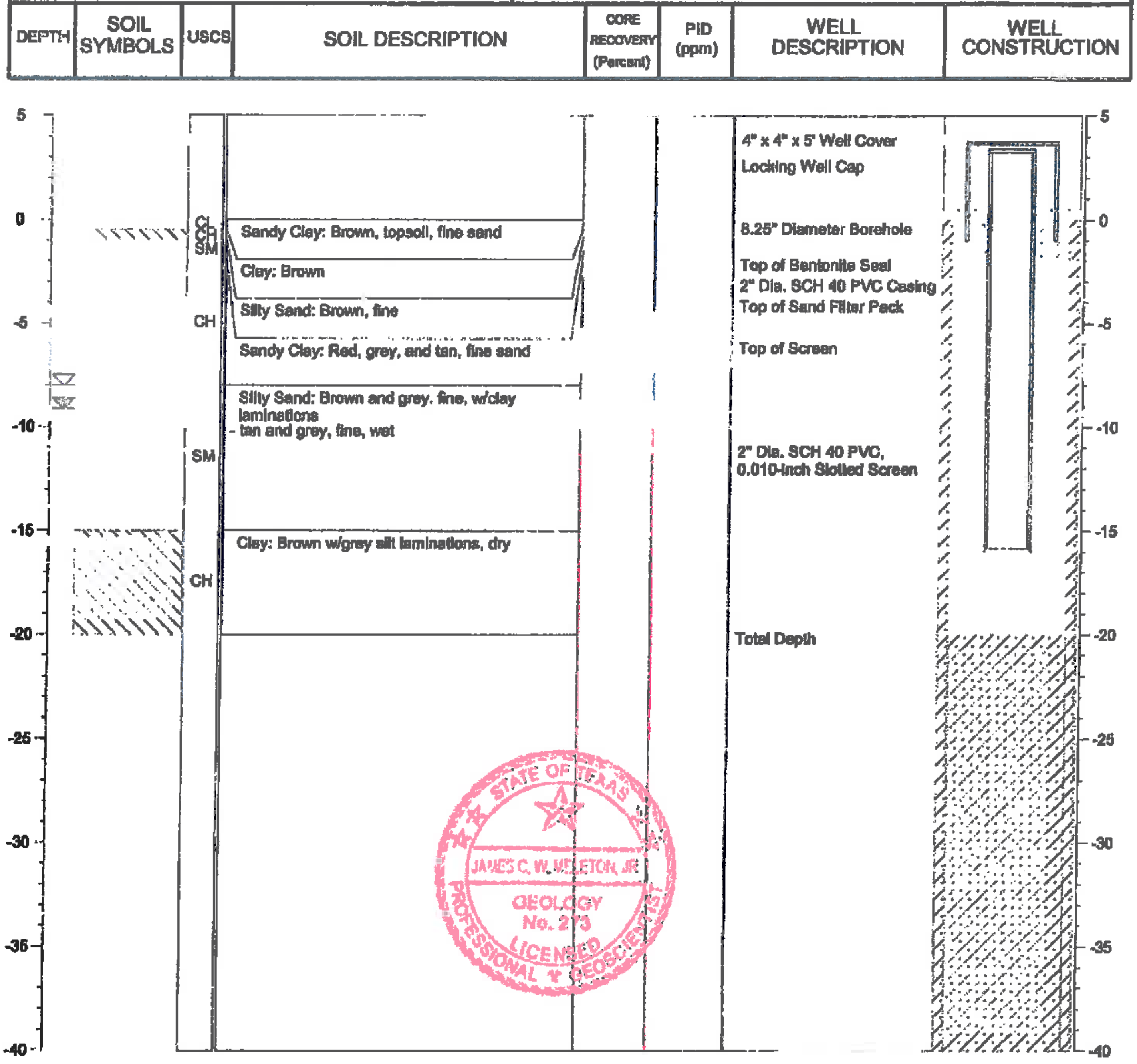
BORING/WELL NO.:	AD-13
TOTAL DEPTH:	20'
TOP OF CASING ELEV.:	347.00 ft. NGVD
GROUND SURFACE ELEV.:	344.12 ft. NGVD

CLIENT:	AEP	DRILLING CO.:	WEST Drilling
PROJECT:	Ash Disposal Area	DRILLER:	Tom McCullough
SITE LOCATION:	Welsh Power Plant	METHOD OF DRILLING:	Hollow-stem Auger
PROJECT NO.:	S-08-0109	SAMPLING METHODS:	Split-spoon
LOGGED BY:	James Meleton, Jr.	DATE DRILLED:	9/22/09

NOTES: Latitude: 33.04918
Longitude: 94.84275

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



Sandy Clay: Brown, topsoil, fine sand

Clay: Brown

Silty Sand: Brown, fine

Sandy Clay: Red, grey, and tan, fine sand

Silty Sand: Brown and grey, fine, w/clay laminations
- tan and grey, fine, wet

Clay: Brown w/grey silt laminations, dry

4" x 4" x 5' Well Cover

Locking Well Cap

8.25" Diameter Borehole

Top of Bentonite Seal

2" Dia. SCH 40 PVC Casing

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen

Total Depth

JAMES C. W. MELETON, JR.
GEOLOGY
No. 273

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ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	AD-14
TOTAL DEPTH:	18.5'
TOP OF CASING ELEV.:	345.43 ft. NGVD
GROUND SURFACE ELEV.:	342.32 ft. NGVD

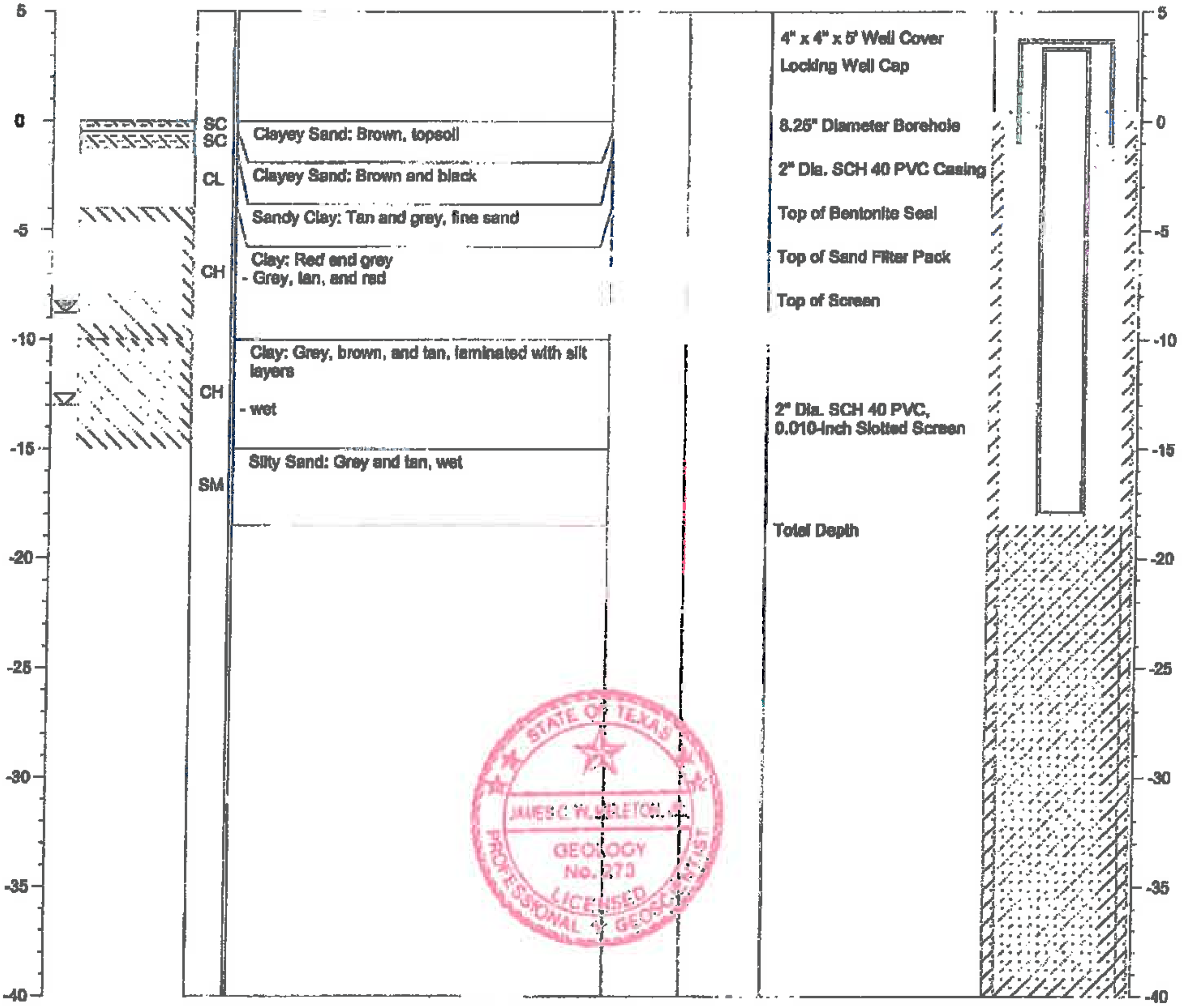
CLIENT:	AEP	DRILLING CO.:	WEST Drilling
PROJECT:	Ash Disposal Area	DRILLER:	Tom McCullough
SITE LOCATION:	Welsh Power Plant	METHOD OF DRILLING:	Hollow-stem Auger
PROJECT NO.:	S-08-0109	SAMPLING METHODS:	Split-spoon
LOGGED BY:	James Meleton, Jr.	DATE DRILLED:	9/22/09

NOTES: Latitude: 33.04715
Longitude: 94.84256

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Clayey Sand: Brown, topsoil

Clayey Sand: Brown and black

Sandy Clay: Tan and grey, fine sand

Clay: Red and grey
- Grey, tan, and red

Clay: Grey, brown, and tan, laminated with silt layers
- wet

Silty Sand: Grey and tan, wet

4" x 4" x 5' Well Cover
Locking Well Cap

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Bentonite Seal

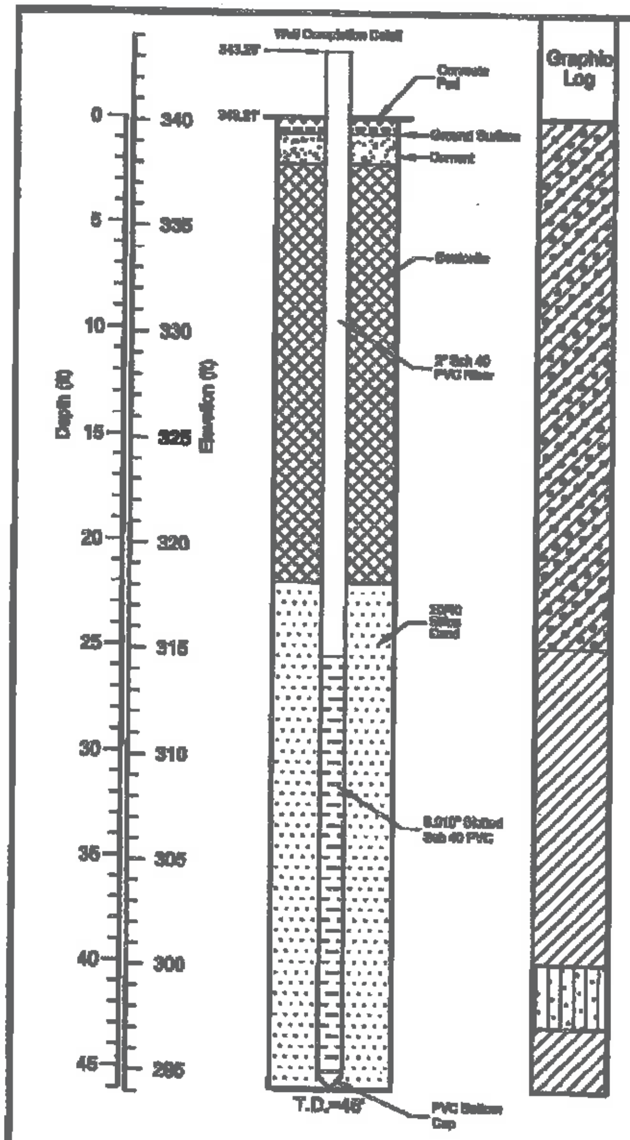
Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen

Total Depth

JAMES C. MELETON, JR.
GEOLOGY
No. 273



PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		SC	Clayey SAND: reddish brown					
					16	48	37	18	19
				- 2" lense of brown sand					
				- 3" lense of brown sand					
	Direct Push		CL	Sandy Lean CLAY: reddish brown, very moist					
				- less moisture					
					22	51	36	19	17
			SM	Silty SAND: light brown & light gray, wet.	27	24	26	NP	-
			CL	Lean CLAY: orangish brown & light gray, mottled, with sand	26	94	45	21	24

STEVEN R. WHIPPLE
SOIL SCIENCE
LICENSE NUMBER 2176

1-22-16

west
DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/12/15
Drilling Method: H.S.A.
Bit Diameter: 7.25"
Depth to Water: --

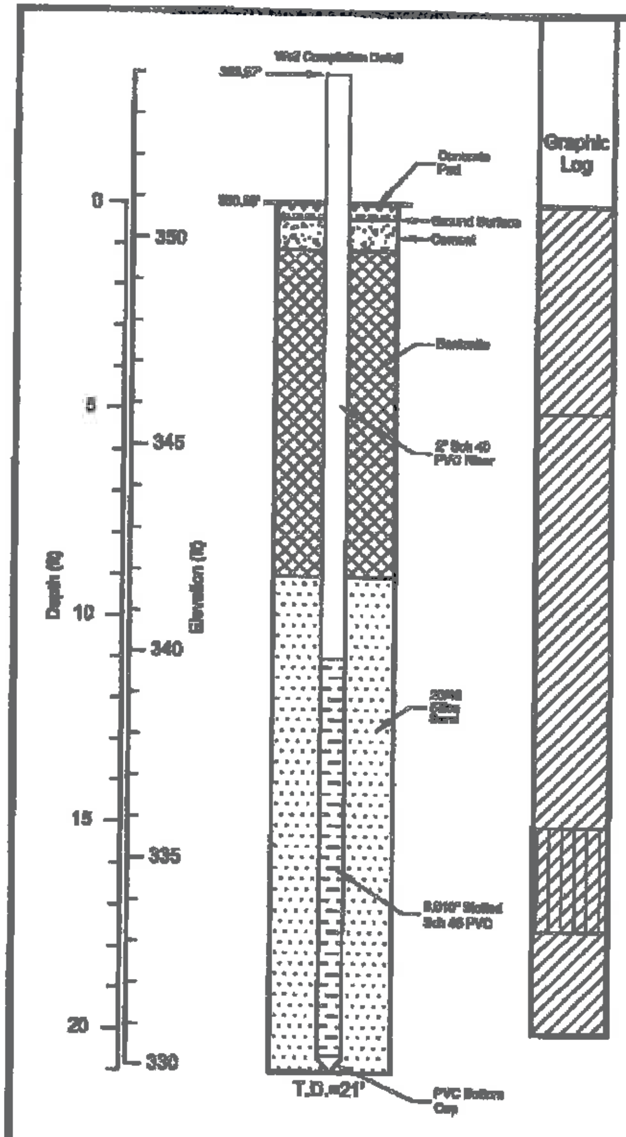
Logged by: Robert Williams, PE
Driller: Robert Williams
Date Completed: 12/12/15
Depth to Product: NA

Welsh Power Station
Pittsburg, Texas

DRAWN BY: HGS
CHECKED BY: SRW

Log of Boring
AD-15

PROJECT NO.: —
SCALE: AS SHOWN
FILE NAME: JR Welsh Power Plant LOGS.dwg



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	Description Interval (feet bgs)	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0–5		Direct Push		CL	Lean CLAY w/ Sand: light brown & light gray - orangish brown, with silt	16	82	26	16	10
5–15				CL	Lean CLAY w/ Sand: orangish-brown & light gray	22	88	31	19	12
15–17.5				CL-ML	Silty CLAY: orange w/ brown, wet	30	89	27	20	7
17.5–21				CL	Sandy, Lean CLAY: brown w/ orange, stiff	26	86	48	28	20

STEVEN R. WEMPLE

1-22-16

West DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

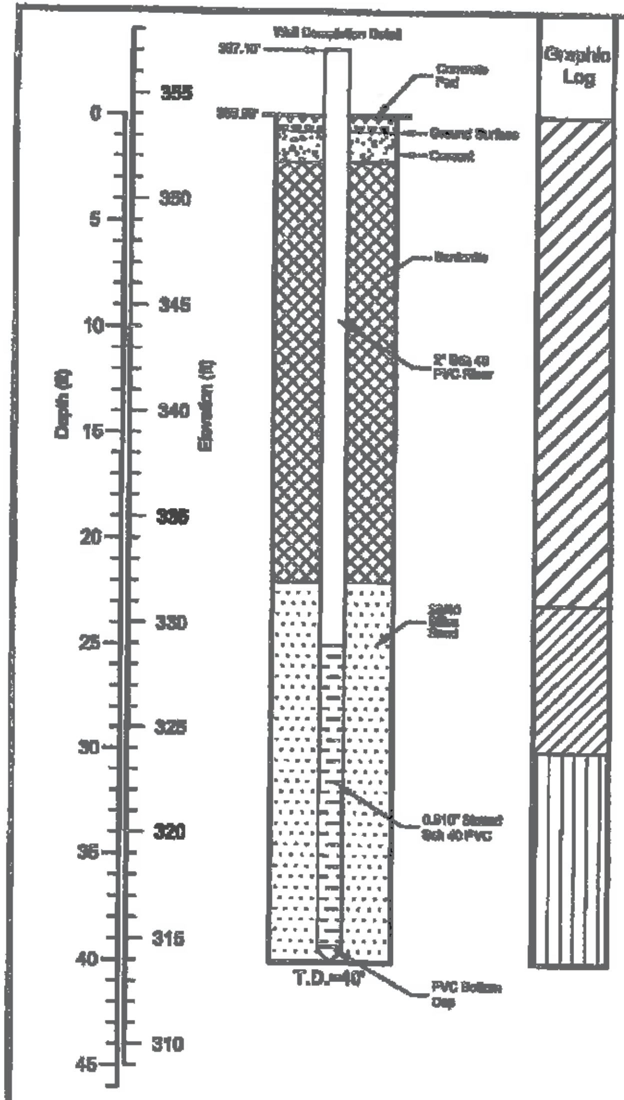
DATE: 12/10/15	Logged by: Robert Williams, PE
Drilling Method: H.S.A.	Driller: Robert Williams
Bit Diameter: 7.25"	Date Completed: 12/10/15
Depth to Water: --	Depth to Product: NA

Welsh Power Station
Pittsburg, Texas

DRAWN BY: HDS
CHECKED BY: SRW

Log of Boring AD-16

PROJECT NO.: ---
SCALE AS SHOWN
FILE NAME: JR Welsh Power Plant LOGS.dwg



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0		Direct Push		CH	Fat CLAY: reddish-brown					
5					- light gray to light brown, reddish brown w/ Sand and gravel lenses	24	97	83	30	53
10					- light brown					
15					- brown Sand lenses, wet					
20					- gray, w/ some Silt	16	90	53	25	28
25		Direct Push		CL	Lean CLAY with Sand: gray	22	81	43	22	21
30–40				ML	Sandy SILT: gray	23	83	26	NP	-

STATE OF TEXAS
STEVEN R. WHIPPLE
SOIL SCIENCE
2176
LICENSED

1/22/16

west DRILLING
environmental & geotechnical
WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

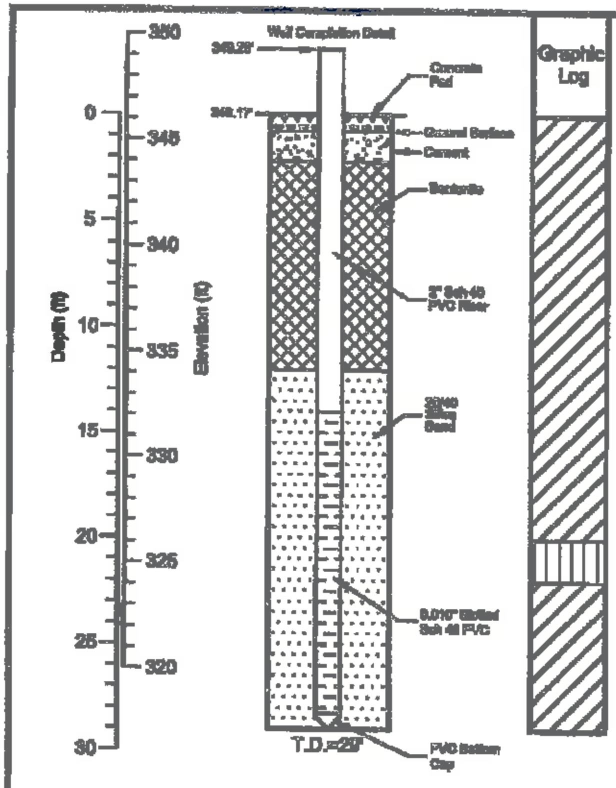
DATE: 12/10/15
Drilling Method: H.S.A.
Bit Diameter: 7.25"
Depth to Water: --

Logged by: Robert Williams, PE
Driller: Robert Williams
Date Completed: 12/11/15
Depth to Product: NA

Welsh Power Station
Pittsburg, Texas
DRAWN BY: HDS
CHECKED BY: SRW

Log of Boring
AD-17

PROJECT NO.: ---
SCALE: AS SHOWN
FILE NAME: JR Welsh Power Plant [illegible]



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0–20		Direct Push		CH	Fat CLAY: light brown & light gray, sandy - reddish brown and light gray, with Sand - gray with silt - gray, stiff	10	85	50	24	26
20–22				ML	SILT: gray, with Clay and Sand, wet	29	56	26	NP	-
22–29				CH	Fat CLAY: light gray, silty w/ Sand, very stiff	20	85	50	23	27

STEVEN R. WEMPLE
2176

1-22-16

West DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/11/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-18
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: —
			SCALE: AS SHOWN
Depth to Water: –	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: AR Welsh Power Plant LOGS.dwg

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 1 of 2

Date(s) Drilled **July 23, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **37 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **367 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Bentonite Chips**	Location **On the Northern edge of proposed chemical pond along the screening berm.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
367	0					Other		Black COAL, a few fine roots and organics.						
			ST											Shelby tube pulled black COAL
			SS	10										SPT 4, 5, 5, 5. 24" recovered
362	5		SS	11	Soft to Firm	SC		Reddish Brown fine SAND, little clay, trace silt, Dry. Natural Ground.						SPT 4, 5, 6, 7. 24" recovered
			SS	11	Soft	SM		Reddish brown fine SAND with silt, trace clay. Vertical sand seams in sample, Dry.						SPT 3, 5, 6, 6. 24" recovered.
357	10		ST						23.6	[illegible]	48.9	5.4E-07		Shelby tube sample, 18" recovered.
					Soft	SC		Reddish brown well graded fine SAND, trace silt and clay. Damp.						
			SS	12	Firm	CL		Greyish red CLAY, little sand, horizontal sand seams, Dry.						SPT 5, 6, 6, 9. 24" recovered
					Soft	SC		Brownish red fine SAND, little clay, Damp.						
			SS	13	Firm	SC-CL		Four-inch CLAY seam, little fine sand.						SPT 7, 6, 7, 9, 24" recovered.
					Firm	CL		Reddish grey CLAY, little sand, oxidized iron ore. Dry						
352	15				Soft	SM		Brownish red fine SAND, trace clay, thin clay seams. Moist.						
			SS	16					17.74	14	40.1			SPT 8, 9, 9, 9. 24" recovered.
			ST						16.25	NP	25.9	3.6E-05		Shelby tube samples look like SC. 17" recovered.
347	20		SS	17	Soft	Other		Iron oxidized material						SPT 6, 8, 9, 11. 24 inches recovered.
					Soft	SC		Brownish red fine SAND, little clay. Moist.						
			SS	15										SPT 5, 7, 8, 50/2. 21" recovered
			SS	[illegible]	Soft	CL		Dark grey CLAY, little fine sand, Wet.						SPT 50/3".
					Very Hard	SP		Dark grey-black cemented SAND, little clay. Wet. Driller comments that cemented sand terminates at 25.5 feet.						
342	25		SS	27	Soft to Firm	SC		Dark grey fine SAND, little clay. Moist. Soft sand with lenses of firm clay.						SPT 11, 13, 14, 16. 24" recovered.
					Hard	CL		Dark grey CLAY, little sand, Dry.						
			SS	46	Soft	SC		Dark grey-black fine SAND, little clay, Wet. Encountered water but water rose to 19 feet after 15 min break.						SPT 11, 16, 30, 14, 24" recovered.
			SS	37										SPT 11, 15, 22, 25. 24" recovered.
337	30				Hard	CL								

Figure

Printed with a trial version of BorinGS - visit www.gooknesoftware.com for purchase information: P:\Projects\AEP Welsh Plant\2009 Pond Design\Hydrogeo Investigation\Boring Log\Boring GS files\GB-1.bgs [KSC AEP.tpl]

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
337	30	▨	SS	37	Hard	CL		Dark grey CLAY, little fine sand, occasional horizontal sand seams. Wet. (cont.)						SPT 11, 15, 22, 25. 24" recovered.
		▨	SS	29	Soft	ML		Dark grey-black fine SAND, with clay, frequent hard clay lenses (1-3"). Wet.	26.37	NP	57.5			SPT 8, 11, 18, 24. 24 recovered.
332	35		SS	34	Hard	CL		Black CLAY, trace to little fine sand, trace silt. Dry						SPT 9, 18, 18, 23. 24" recovered.
								Bottom of Boring at 37 feet bgs						
327	40													
322	45													
317	50													
312	55													
307	60													
302	65													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-02

Sheet 1 of 1

Date(s) Drilled **August 14, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **364.56 feet MSL**
Groundwater Level and Date Measured **21.53 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Western edge of proposed chemical pond near perimeter fence.**	

Elevation, feet	Depth, feet	Sample Type	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
364.6	0			Soft	Other	Coal					
				Soft	CL	Greyish brown CLAY, with little silt, little sand, damp.					
		SS	4								SPT 2, 2, 2. 12" recovered.
		SS	13								SPT 4, 7, 6, 12.
359.6	5	ST									Shelby Tube Sample
				Firm	CH	Brownish tan CLAY with silt, little sand, Damp. Occasional sand and iron ore.					SPT 6, 12, 17, 21
		SS	29				23.71	36	77.3		
		SS	50								SPT 20, 30, 50/5. 17" recovered
354.6	10			Soft	SC	Red-orange fine SAND, little clay, damp. Occasional iron ore.					
				Soft	CL	Brownish tan CLAY, little silt, little sand, Damp.					SPT 15, 20, 24, 31. 18" recovered.
		SS	44	Soft	SM	Red-orange fine SAND, little clay, Damp.					
											SPT 11, 12, 9, 32.
		SS	21				20.35	NP	33.5		
349.6	15	SS	18								SPT 6, 6, 12, 6.
				Soft	SM-SC	Light brown fine SAND, with little silt, little sand, Damp.					
				Firm	CL	Black CLAY, with fine sand, Wet.					SPT 12, 25, 50/5.
		SS	75	Soft	SM-SC	Dark red fine SAND, little clay, little silt, Wet.					
				Soft-firm	SC	Dark grey fine SAND, little clay, Wet. Occasional clay seams.					SPT 9, 16, 12, 16.
		SS	28								
344.6	20										SPT 9, 17, 21, 27.
		SS	38	Firm	SC	Frequent clay lenses. 8/11/09 ▼	22.55	13	36.5		
											SPT 22, 35, 50/4".
		SS	65								
339.6	25	SS	33								SPT 10, 15, 18, 28.
				Soft	SC	Less clay lenses, Wet.					SPT 12, 27, 37, 50/5".
		SS	64								
											SPT 19, 24, 21, 50/5".
		SS	44								
				Hard	CL	Deep grey [illegible] silt, Wet.					
334.6	30										

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

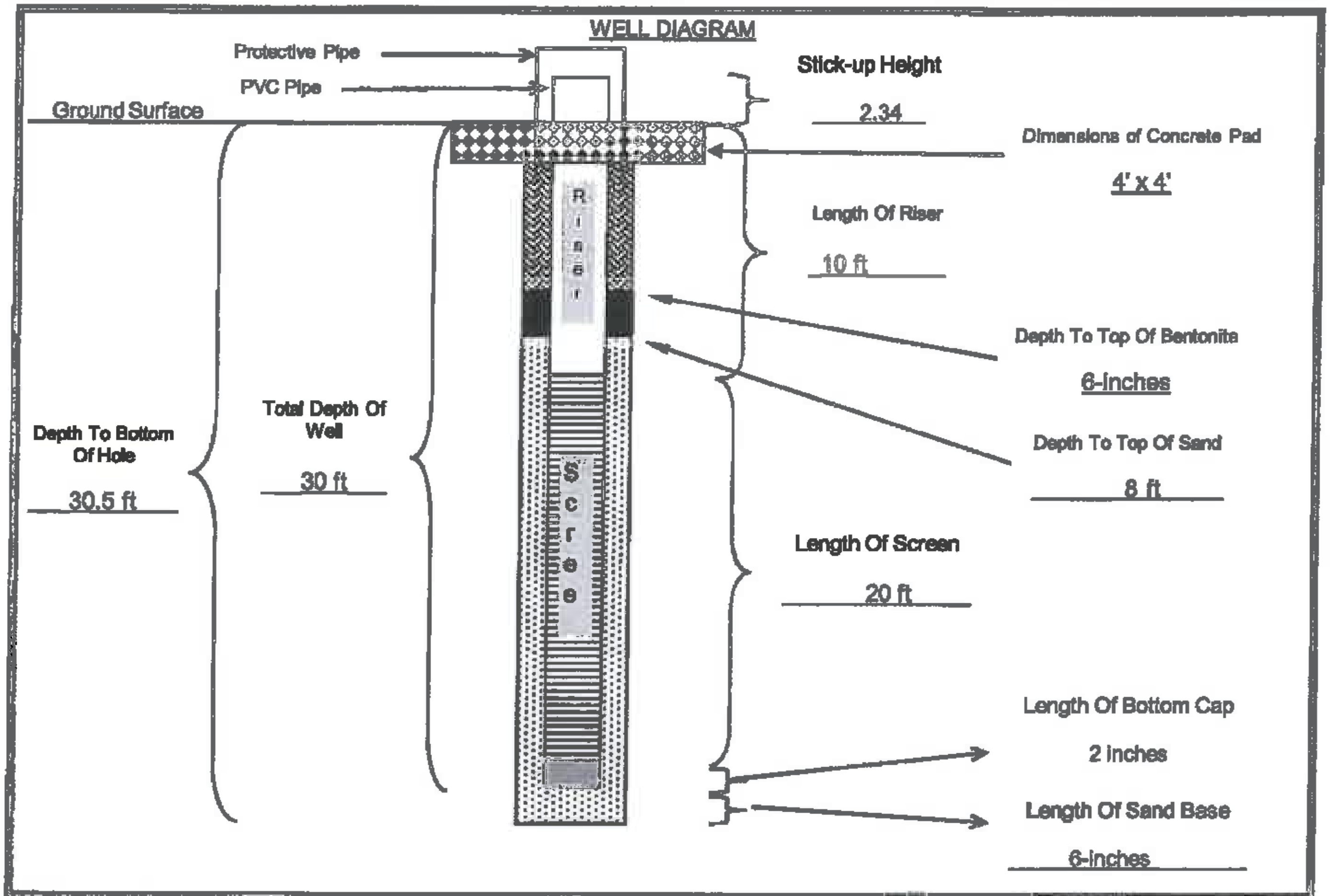
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL LOCATION:
WELL NO.: GB-02
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 364.56 (ft, msl)
TOP OF SCREEN ELEVATION: 354.56 (ft, msl)
BOTTOM OF WELL ELEVATION: 334.06 (ft, msl)
NORTHING: 747.0223 EASTING: -2442.888
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 8 (in)
DRILLING TECHNIQUE: Hollow stem Size: (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE: Not used-sealed with bentonite chips
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 4 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 13 bags lbs
STATIC WATER: 21.53 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.34
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2 inches
Length Of Sand Base: 6-inches
Depth To Bottom Of Hole: 30.5 ft
Total Depth Of Well: 30 ft

▨ Cement/Bentonite Grout ░ Sand Pack ◆ Neat Concrete ■ Bentonite ▒ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: August 7th, 2009
OBSERVED BY: Kush Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

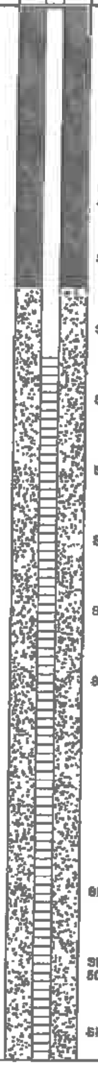
Sheet 1 of 2

Date(s) Drilled **August 7, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **31 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **359.91 feet MSL**
Groundwater Level and Date Measured **21.89 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Southwest corner of proposed chemical pond near screening pile.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
359.9	0				Soft	Other	Coal					
354.9	5	☒	ST		Soft	CH	Shelby Tube		43	98.1		Shelby tube sample.
		▨			Firm	CH	Light brown-grey CLAY, little silt, occasional sand seams (fine), Damp.					SPT 29, 22, 19, 21.
		▨	SS	41				24.04	29	90.4		
		▨			Soft	CH	Brownish dark grey CLAY, trace sand, trace silt, Wet.					SPT 6, 12, 15, 20.
349.9	10	▨	SS	27								
		▨	SS	53	Soft	SC	Dark orange red SAND, little clay, trace silt, Wet. Occasional clay seam (dark grey).					SPT 17, 29, 24, 25.
		▨			Soft	SC	Clay lenses.					SPT 7, 15, 17, 40.
		▨	SS	32								
344.9	15	▨										SPT 9, 17, 30, 20.
		▨	SS	47	Soft	SC	Clay lense					
		▨			Soft	SD	Dark grey fine SAND with clay, occasional clay lenes, Wet.					SPT 11, 50/4".
		▨	SS	50	Firm	CL	Dark grey CLAY, little fine sand, Wet.					
		▨			Soft	SC	Dark grey fine SAND, little clay, occasional clay seam, iron ore, Wet.					SPT 11, 27, 17, 21.
339.9	20	▨	SS	44								
							8/11/09 ▽					
334.9	25	▨										SPT 27, 40, 50/4".
		▨	SS	90								
		▨			Firm	SC	Dark grey clay lense					SPT 11, 15, 40, 50/3".
		▨	SS	55								
		▨	SS	55								SPT 17, 50/5.5".
329.9	30											

Graphic Log

Well Log



Figure

Printed with a trial version of BorinGS - visit www.gookinsoftware.com for purchase information: P:\Projects\AEP Welsh Plant\2009 Pond Design\Hydrogeo Investigation\Boring Log\Boring GS files\GB-03.bgs [KSC AEP.tpl]

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
329.9	30	▨	SS	65	Hard	CL	■	Dark grey CLAY, trace silt, trace fine sand.						SPT 17, 50/5.5".
								Bottom of Boring at 31 feet bgs						
324.9	35													
319.9	40													
314.9	45													
309.9	50													
304.9	55													
299.9	60													
294.9	65													

Figure

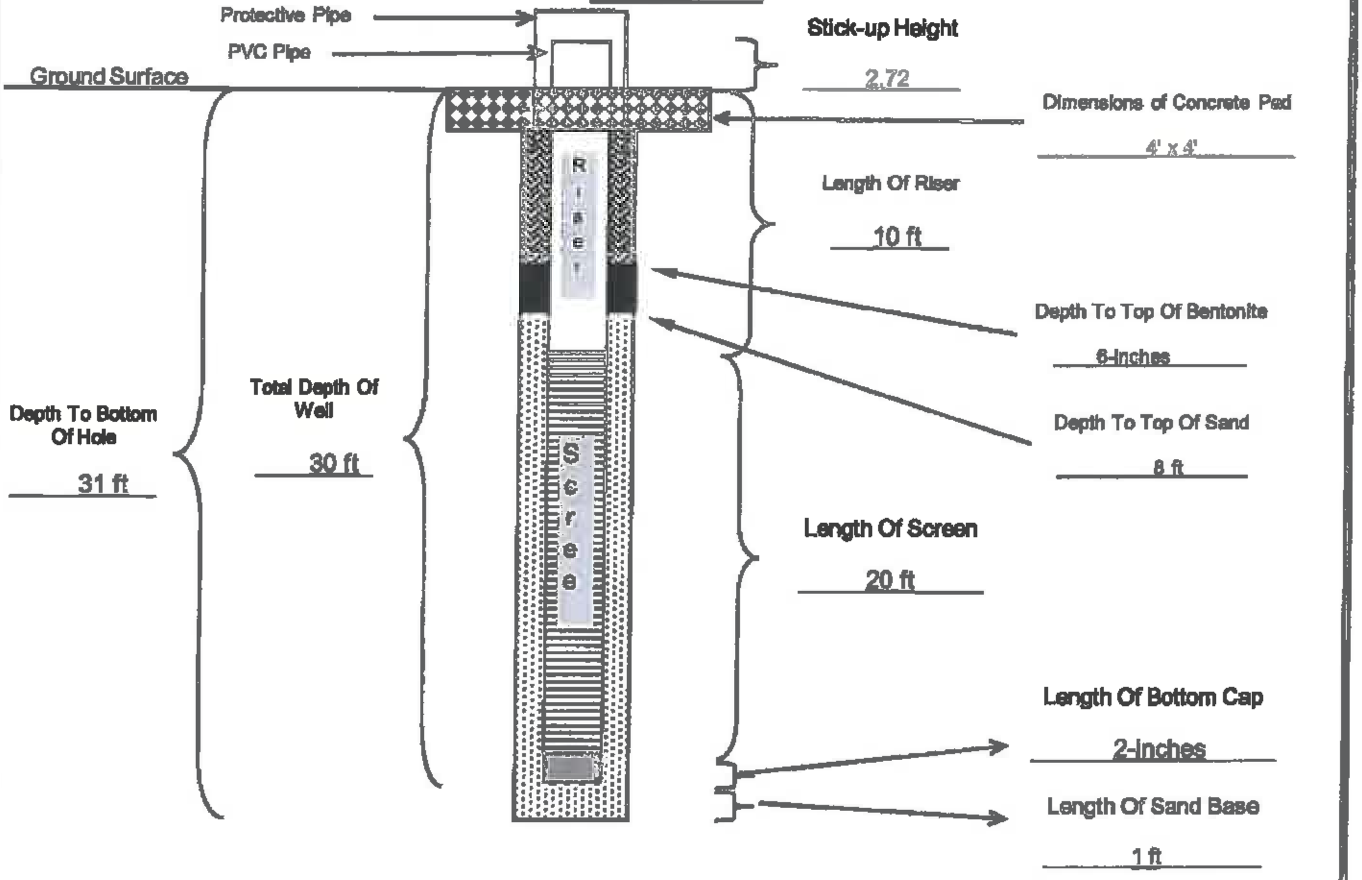
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME:	AEP Welsh Power Plant		GB-03
JOB NO.:	TXL0064		
DATE/TIME:	8/7/2009	WELL NO.:	
WELL LOCATION:		FIELD REP:	Kush Chohan

GROUND SURFACE ELEVATION:	359.57 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	349.57 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	328.57 (ft, msl)	CEMENT TYPE:	None used-sealed with bentonite chips
NORTHING: 460.5803	EASTING: -2507.6332	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	4 bags lbs
RISER DIAMETER:	2 (in) Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 20 (ft)	AMOUNT SAND USED:	12 bags lbs
BOREHOLE DIAMETER:	8 (in)	STATIC WATER:	21.89 depth from TOC
DRILLING TECHNIQUE:	Hollow Stem Size: 8 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.72

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 10 ft

Depth To Top Of Bentonite: 6-Inches

Depth To Top Of Sand: 8 ft

Depth To Bottom Of Hole: 31 ft

Total Depth Of Well: 30 ft

Length Of Screen: 20 ft

Length Of Bottom Cap: 2-Inches

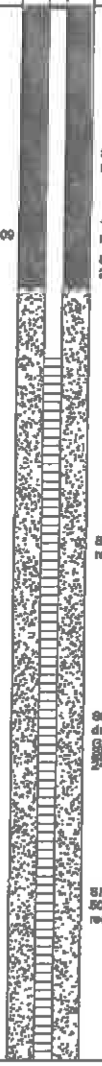
Length Of Sand Base: 1 ft

▨	Cement/Bentonite Grout	░	Sand Pack	▦	Neat Concrete	■	Bentonite	▒	Bottom Cap

QA/QC INSTALLED BY:	Total Support Services	OBSERVED BY:	Kush S. Chohan
DATE:	7-Aug-09	CHECKED BY:	DATE:

Project: AEP Welsh Power Plant **Project Location: Cason, Texas** **Project Number: TXL0064**	**Log of Boring GB-04** **Sheet 1 of 2**

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **34 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.22 feet MSL**
Groundwater Level and Date Measured **20.54 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Southeast corner of proposed chemical evaportation pond. Located in a grassy field.**	



Elevation, feet	Depth, feet	Sample Type	Sample Number	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
357.2	0				Soft	SM-SC	Reddish brown fine SAND, little silt, trace clay, damp.					SPT 1, 3, 5, 6. 24" recovered.
			SS	9	Soft	Other	1 COAL					
					Firm	SC	Brownish red SAND, little clay, trace silt. Damp.					
			SS	8	Firm	CL	Reddish pink CLAY, some fine sand, Dry.	24.49	47	90.2		SPT 4, 4, 4, 4. 24" recovered.
			SS	14	Soft	Other	1 Oxidized SAND and clay with iron ore.					SPT 5, 6, 5, 4. 15" recovered.
352.2	5				Soft	CH	Light reddish brown CLAY and sand mixture, Dry.					
			ST		Soft	SC	Reddish brown SAND, little clay, Dry.	28.4	35	61.1	7.7E-09	12" Shelby tube. 9" recovered.
			SS	17	Firm	CH	Light brownish tan CLAY, little sand, occasional sand seams, Dry.					SPT 3, 4, 13, 15. 27" recovered.
347.2	10											
342.2	15		SS	16	Soft	SC	Red/yellowish brown SAND, some clay, Wet.					SPT 3, 7, 8, 15. 24" recovered.
					Firm	SC	Occasional clay lenses.	6.95	14	47		
337.2	20		ST				8/11/09					Shelby tube. 12" driven 0" pulled. Gravel material encountered. SPT 7, 10, 9, 13. 24" recovered.
			SS	19	Soft to Firm	SM	Black to dark gray fine/med SAND, little clay, occasional clay lenses, Wet.					
332.2	25		SS	74	Soft	SM	Well graded light grey fine/med SAND, trace silt, Wet.	22.29	NP	13.5		SPT 17, 24, 50/5.5", 19" recovered.
					Firm	CL	Dark gray clay lense. Wet.					
					Firm	SM-SC	Well graded light grey fine/med SAND, trace silt, Wet.					
327.2	30											

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.2	30	☒	ST		Hard	ML		Dark grey CLAY, little sand, Wet.						12" Shelby tube. Bent shelby tube.
		☒	ST						21.3	NP	84.2	2.0E-06		12" Shelby tube.
		▨	SS	SS	Hard	CL		Dark grey CLAY, trace sand, Wet.	26.44	18	92.5			SPT 15, 18, 19, 26. 24" recovered.
								Bottom of Boring at 34 feet bgs						
322.2	35													
317.2	40													
312.2	45													
307.2	50													
302.2	55													
297.2	60													
292.2	65													

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

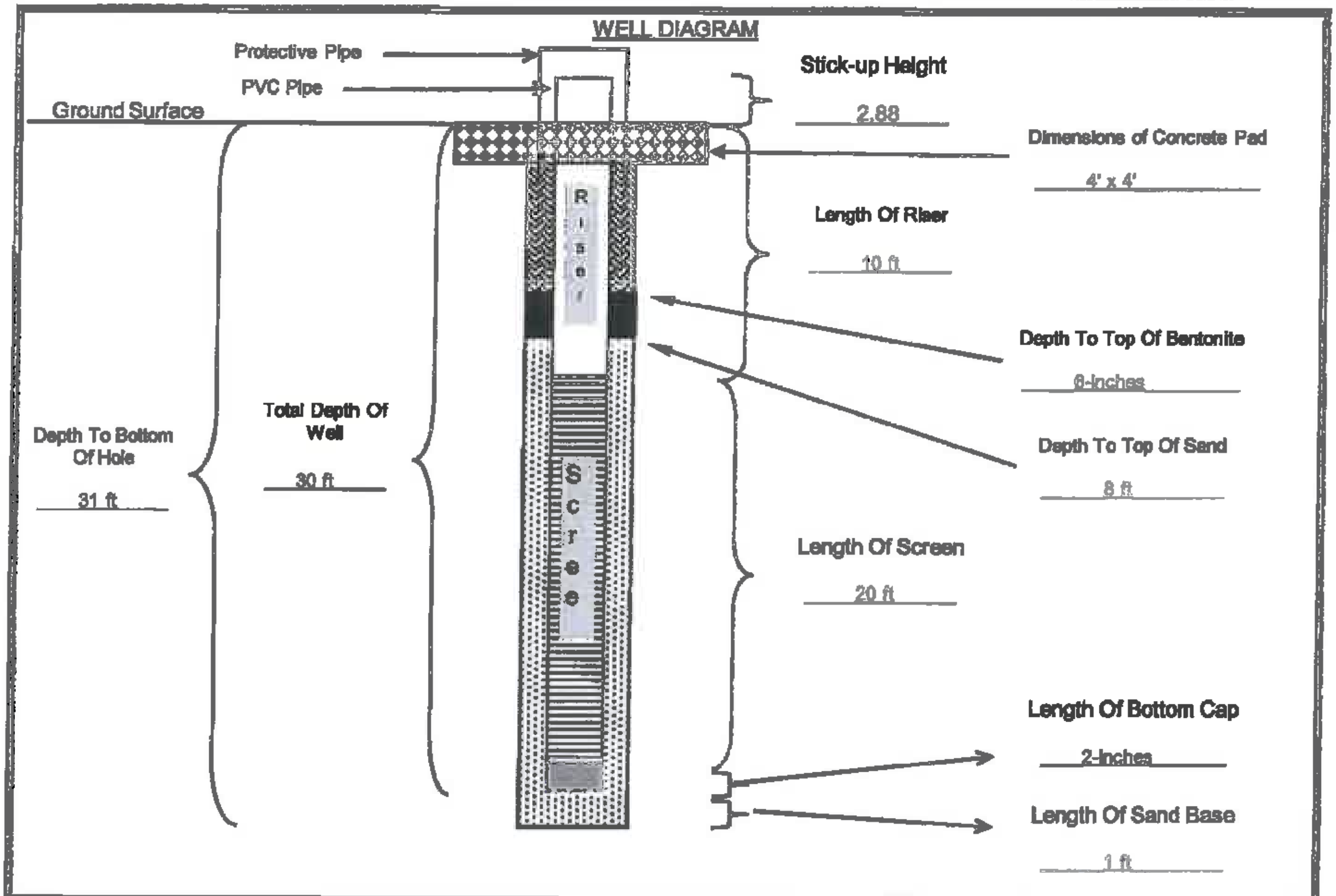
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 24-Jul-09
WELL NO.: GB-04
WELL LOCATION:
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.22 (ft, msl)
TOP OF SCREEN ELEVATION: 347.22 (ft, msl)
BOTTOM OF WELL ELEVATION: 326.22 (ft, msl)
NORTHING: -384.9668 EASTING: -2353.7375
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 6.75 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 6.75 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 3 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 20.54 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



▨	Cement/Bentonite Grout	▒	Sand Pack	▦	Neat Concrete	■	Bentonite	▩	Bottom Cap

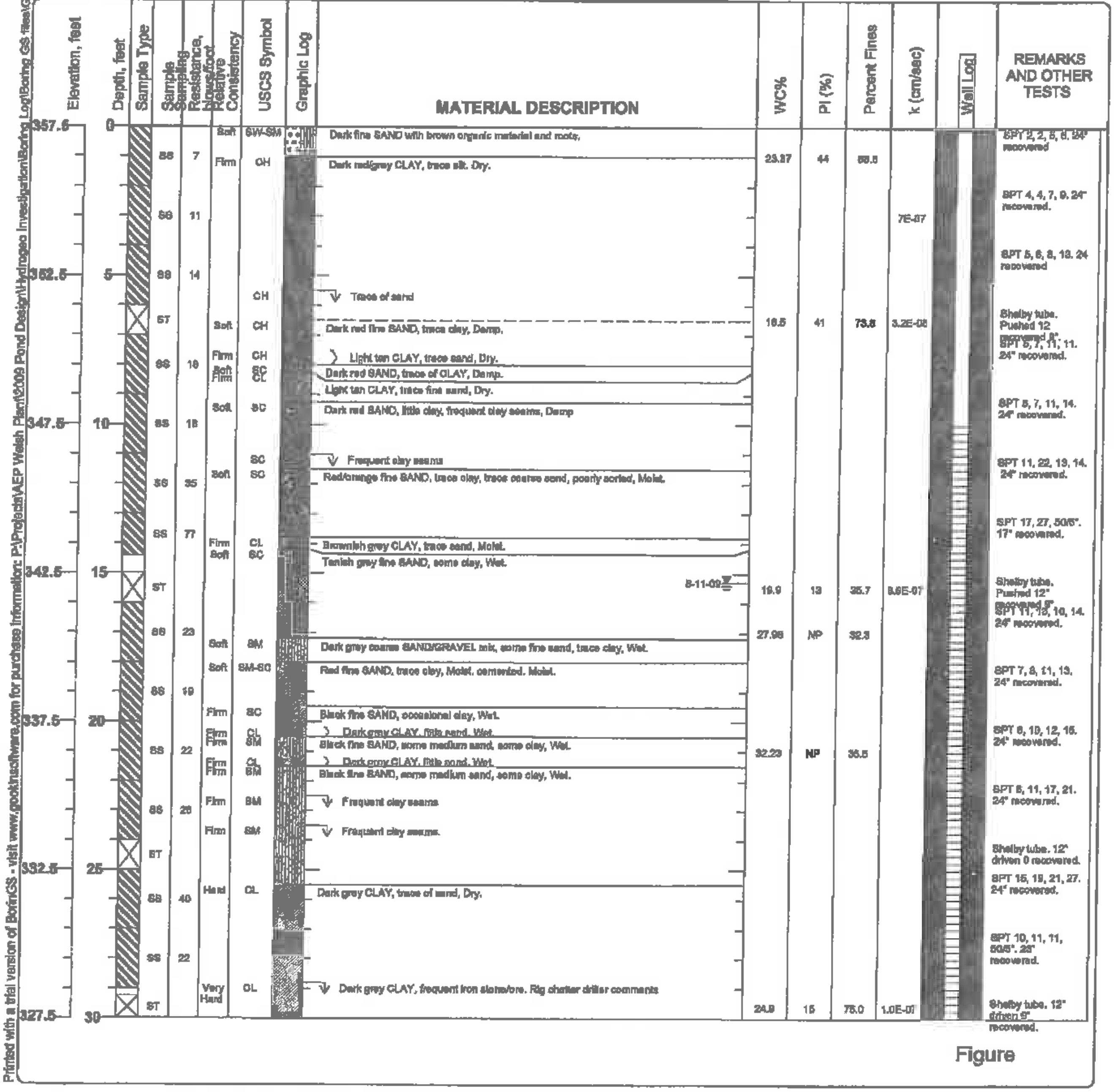
QA/QC
INSTALLED BY: Total Support Services
DATE: 24-Jul-09
OBSERVED BY: Kush S. Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30.5 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.49 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8-11-09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Eastern edge of proposed chemical evaporation pond.**	



Elevation, feet	Depth, feet	Sample Type	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
357.5	0			Soft	SW-SM	Dark fine SAND with brown organic material and roots,					SPT 2, 2, 5, 6. 24" recovered
		SS	7	Firm	CH	Dark red/grey CLAY, trace silt. Dry.	23.37	44	66.5		
		SS	11							7E-07	SPT 4, 4, 7, 9. 24" recovered.
352.5	5	SS	14								SPT 5, 6, 8, 13. 24 recovered
					CH	Trace of sand					
		ST		Soft	CH	Dark red fine SAND, trace clay, Damp.	16.5	41	73.8	3.2E-08	Shelby tube. Pushed 12 recovered 8".
		SS	16	Firm	CH	Light tan CLAY, trace sand, Dry.					SPT 5, 7, 11, 11. 24" recovered.
				Soft	SC	Dark red SAND, trace of CLAY, Damp.					
				Firm	CL	Light tan CLAY, trace fine sand, Dry.					
				Soft	SC	Dark red SAND, little clay, frequent clay seams, Damp					
347.5	10	SS	18								SPT 8, 7, 11, 14. 24" recovered.
					SC	Frequent clay seams					
		SS	35	Soft	SC	Red/orange fine SAND, trace clay, trace coarse sand, poorly sorted, Moist.					SPT 11, 22, 13, 14. 24" recovered.
		SS	77	Firm	CL	Brownish grey CLAY, trace sand, Moist.					SPT 17, 27, 50/5". 17" recovered.
				Soft	SC	Tanish grey fine SAND, some clay, Wet.					
342.5	15	ST				8-11-09	19.9	13	35.7	9.9E-07	Shelby tube. Pushed 12" recovered 8".
		SS	23				27.96	NP	32.3		SPT 11, 13, 10, 14. 24" recovered.
				Soft	SM	Dark grey coarse SAND/GRAVEL mix, some fine sand, trace clay, Wet.					
				Soft	SM-SC	Red fine SAND, trace clay, Moist. cemented. Moist.					
		SS	19								SPT 7, 8, 11, 13. 24" recovered.
				Firm	SC	Black fine SAND, occasional clay, Wet.					
337.5	20			Firm	CL	Dark grey CLAY, little sand, Wet.					SPT 6, 10, 12, 15. 24" recovered.
		SS	22	Firm	SM	Black fine SAND, some medium sand, some clay, Wet.	32.29	NP	36.5		
				Firm	CL	Dark grey CLAY, little sand, Wet					
				Firm	SM	Black fine SAND, some medium sand, some clay, Wet.					
		SS	26	Firm	SM	Frequent clay seams					SPT 8, 11, 17, 21. 24" recovered.
				Firm	SM	Frequent clay seams.					
		ST									Shelby tube. 12" driven 0 recovered.
332.5	25										
		SS	40	Hard	CL	Dark grey CLAY, trace of sand, Dry.					SPT 15, 19, 21, 27. 24" recovered.
		SS	22								SPT 10, 11, 11, 50/5". 23" recovered.
				Very Hard	CL	Dark grey CLAY, frequent iron stone/ore. Rig chatter driller comments					
327.5	30	ST					24.9	15	75.0	1.0E-07	Shelby tube. 12" driven 9" recovered.

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.5	30	⊠	ST		Hard	CL	■	Dark grey CLAY, trace of sand, Dry. (cont.)	24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
								Bottom of Boring at 30.5 feet bgs						
322.5	35													
317.5	40													
312.5	45													
307.5	50													
302.5	55													
297.5	60													
292.5	65													

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Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

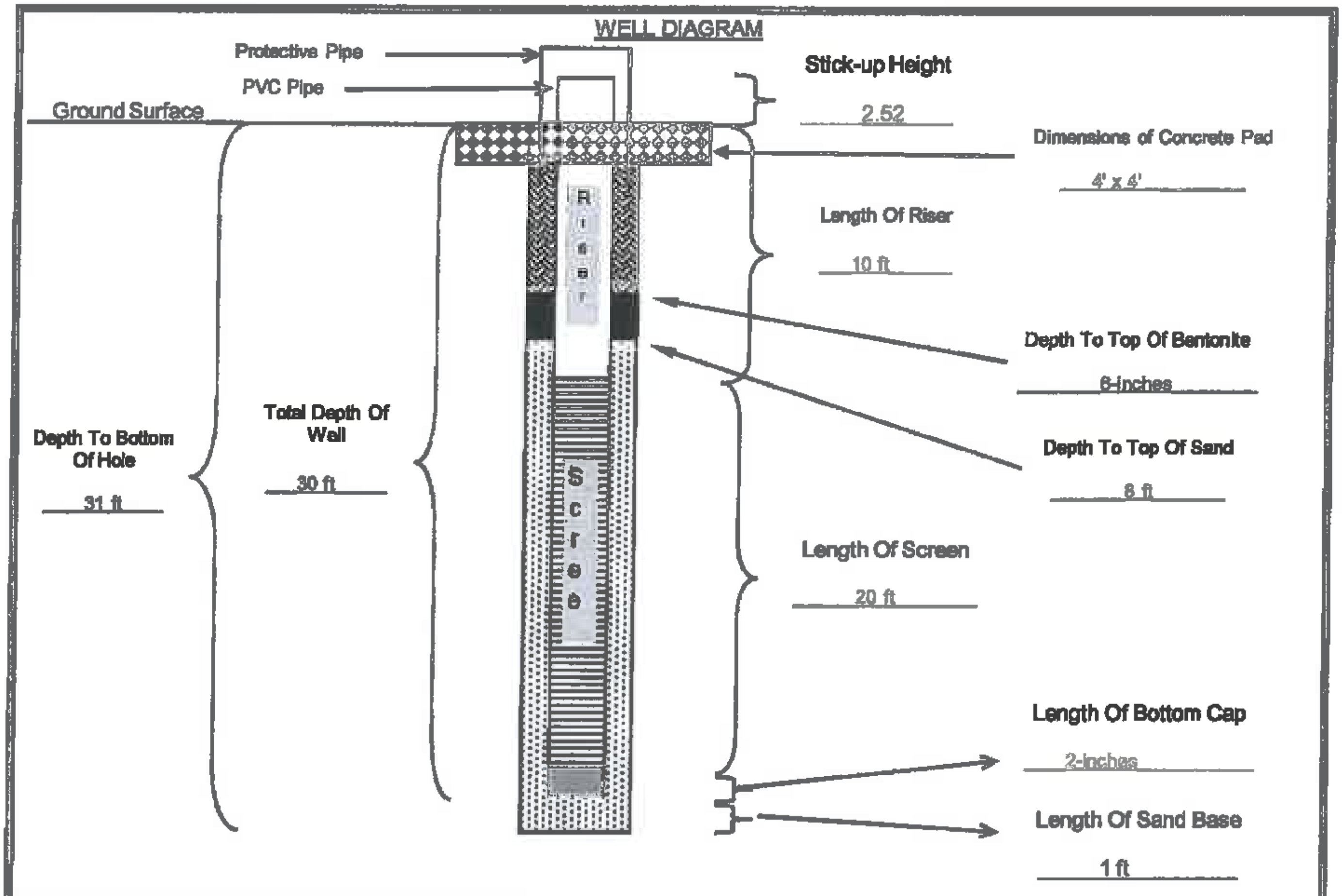
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: August 6 2009
WELL LOCATION:
WELL NO.: GB-05
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.49 (ft, msl)
TOP OF SCREEN ELEVATION: 347.49 (ft, msl)
BOTTOM OF WELL ELEVATION: 326.49 (ft, msl)
NORTHING: 529.1665 EASTING: -2243.9973
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 8 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 8 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 3 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 17.33 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.52
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-Inches
Depth To Top Of Sand: 8 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2-Inches
Length Of Sand Base: 1 ft
Depth To Bottom Of Hole: 31 ft
Total Depth Of Well: 30 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: 6-Aug-09
OBSERVED BY: Kush Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-06

Sheet 1 of 1

Date(s) Drilled **7/23/2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.41 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube, Other**	Hammer Data **140 lb, 30 in drop, auto hammer**
Borehole Backfill **Well Completion**	Location **Northeast corner of proposed chemical pond in the middle of open grass field.**	

Elevation, feet	Depth, feet	Sample Type	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	K (cm/sec)	REMARKS AND OTHER TESTS
357.4	0			Soft	SP	Greyish brown fine SAND with trace fines. Organic material (roots).					Hand Auger
		HA		Soft	SP-SM	Greyish red fine SAND, little silt. Poorly sorted, less organic material.					
				Soft	SM	Greyish red fine SAND, with little silt and clay, Dry.					
				Soft		Tanish gray fine SAND, trace silt and clay, frequent iron oxide, frequent discoloration.					SPT 4, 7, 7. 15" recovered
		SS	14				12.74	34	67.9		
				Firm	CL	Red light brown CLAY, little sand, trace silt, Dry.					
352.4	5										SPT 3, 5, 6, 8. 20" recovered
		SS	11	Soft	SC	Dark reddish brown fine SAND, little clay.					
				Soft	CL	Light gray CLAY, little sand, trace silt, Dry.					
				Soft	SC	Reddish brown fine SAND, trace clay, trace silt. Occasional clay seams. Damp.					SPT 3, 5, 7, 7. 24" recovered
		SS	12				17.65	NP	43.2		
				Soft	CL	Light gray CLAY, little fine sand					
		SS		Soft to Firm	SC	Brownish red fine SAND, little to some clay, some cementation, Damp.					24" driven, 15" recovered.
347.4	10										
											SPT 5, 9, 10, 10. 24" recovered.
		SS	19								
				Soft to Firm	CL	Brown CLAY, little fine sand, frequent brown sand-clay mixture with iron ore oxide.					Shelby Tube. 24" driven/16" recovered
		ST					22.9	21	43.2	6.0e-07	
342.4	15			Firm	CL	Dark redish brown CLAY, little fine sand, Damp.					
						8/11/09					
				Firm	SC	Dark reddish brown SAND, little to some clay, Moist.					SPT 15, 10, 22, 30. 24" recovered
		SS	40								
				Firm	CL	Black CLAY, little fine sand, Wet.					SPT 2, 8, 14, 10. 24" recovered
				Firm	SW	Black fine SAND, trace clay, trace med sand, Wet.					
		SS	22								
				Firm	CL	Black CLAY, trace fine sand, trace silt, Wet.					SPT 5, 8, 22, 50/4". 22 recovered.
					SC	Black fine SAND, little clay, Wet.					
337.4	20	SS	30	Firm	CL	Black CLAY, trace sand, trace silt. Wet.					
				Firm	SC	Black fine SAND, trace to little clay, Wet. Occasional black clay seams.					
											SPT 10, 11, 23, 33. 24" recovered
		SS	34	Firm	SP-SC	Black fine SAND, with little clay, trace med sand, Wet.					
					SW-SC	Grading to med SAND, Wet.					SPT 11, 16, 18, 24. 24" recovered.
		SS	36								
332.4	25										SPT 9, 11, 12, 22. 24" recovered.
		SS	23	Firm	SW-SC	Occasional CLAY lenses, Wet.					
				Firm	SC	Black fine SAND, little med sand and clay, Wet.					SPT 7, 15, 25, 50/5". 21 recovered.
		SS	40	Hard	CL	Dark gray CLAY, little sand, little silt, Dry.					
											Shelby tube. 12" driven-8" recovered.
		ST						19	45.1		
327.4	30					Bottom of Boring at 30 feet bgs					

Figure

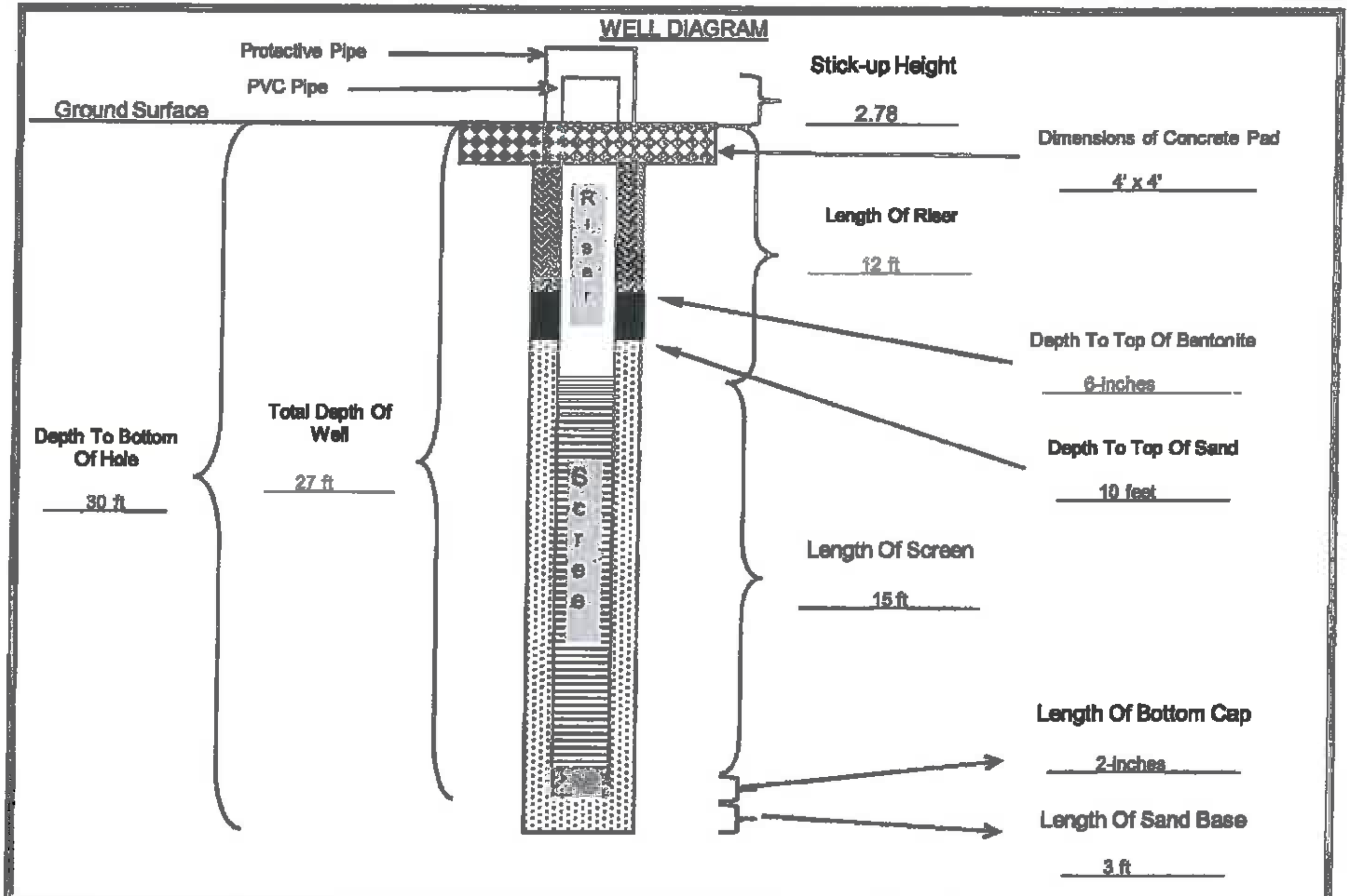
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0084
DATE/TIME: 23-Jul-09
WELL LOCATION:
WELL NO.: **GB-06**
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION:	357.41 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	345.41 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	327.41 (ft, msl)	CEMENT TYPE:	
NORTHING: 740.4893	EASTING: -2166.134	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Unimum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	2.5 bags lbs
RISER DIAMETER:	2 (in) Length: 12 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 15 (ft)	AMOUNT SAND USED:	7 bags lbs
BOREHOLE DIAMETER:	6.75 (in)	STATIC WATER:	15.3 depth from TOC
DRILLING TECHNIQUE:	Hollow Stem Size: 6.75 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.78

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 12 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 10 feet

Depth To Bottom Of Hole: 30 ft

Total Depth Of Well: 27 ft

Length Of Screen: 15 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 3 ft

▨ Cement/Bentonite Grout ░ Sand Pack ◆ Neat Concrete ■ Bentonite ▒ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: 23-Jul-09
OBSERVED BY: Kush Chohan
CHECKED BY:
DATE:

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**GB-07/MW-7**
TOTAL DEPTH:	**34'**
TOP OF CASING ELEV.:	**362.75 ft. NGVD**
GROUND SURFACE ELEV.:	**360.20 ft. NGVD**

CLIENT:	**AEP**
PROJECT:	**Metal Cleaning Waste Pond**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0120**
LOGGED BY:	**James Meleton, Jr.**

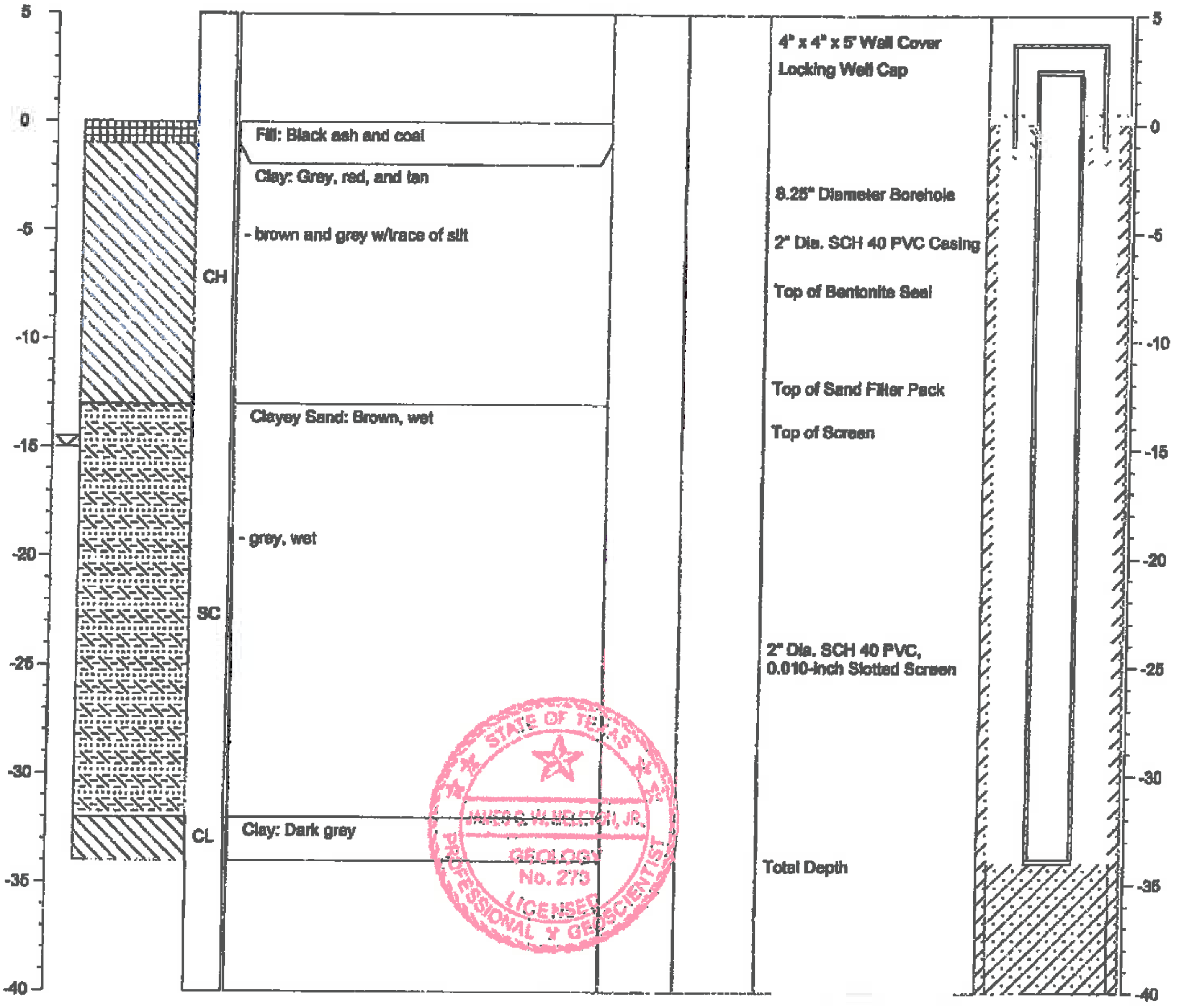
DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**12/1/09**

NOTES: **Latitude: 33.05455**
Longitude: 94.84674

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



JAMES G. W. MELETON, JR.
GEOLOGY
No. 273

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-1

PROJECT: Welsh Power Plant
Pittsburgh, Texas

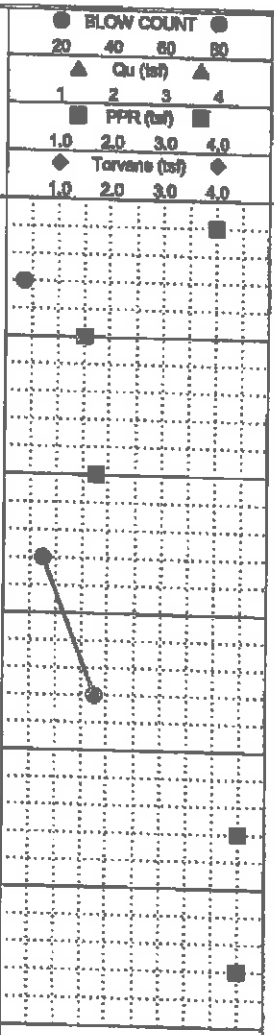
PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

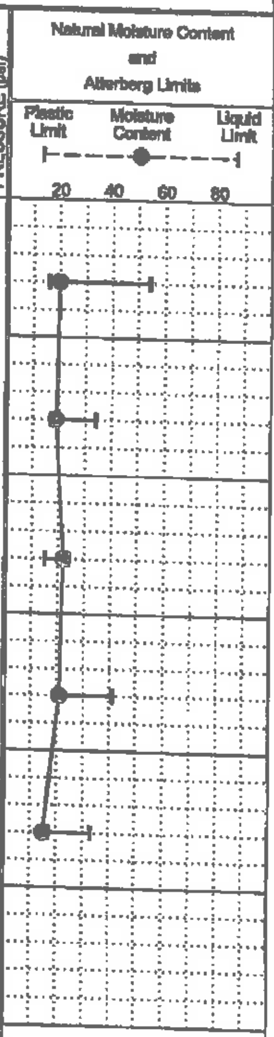
DATE 10/27/09

SURFACE ELEVATION 324.1

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	SANDY LEAN CLAY(CL) very stiff; brownish orange	P=4.0 SF						
	SM	SILTY SAND(SM) tannish orange	N=7						
5	CH	SANDY FAT CLAY(CH) medium stiff; tannish orange		20	54	16	38	63	+40Sieve=10%, +4 Sieve=1%
		~stiff	P=1.5						
	SC	CLAYEY SAND(SC) medium dense; tannish orange; with clay seams	P=1.75	19	34	17	17	32	+40 Sieve=7%, +4 Sieve=3%
10	CL	SANDY LEAN CLAY(CL) stiff; orange							
15	SC	CLAYEY SAND(SC) medium dense; orange; saturated; with iron oxide cemented sandstone rock	N=15	22	24	15	9	19	+40Sieve=35%, +4 Sieve=22%
20	CL	LEAN CLAY WITH SAND(CL) hard; dark gray; with clay seams	N=35	21	41	21	20	75	+40 Sieve=2%, +4 Sieve=0%
25	CL	SANDY LEAN CLAY(CL) hard; dark brown	P=4.5+	15	33	17	16	52	+40 Sieve=1%, +4 Sieve=0%
		~grayish brown; laminated with silt	P=4.5+						
30		Bottom of Boring @ 30'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



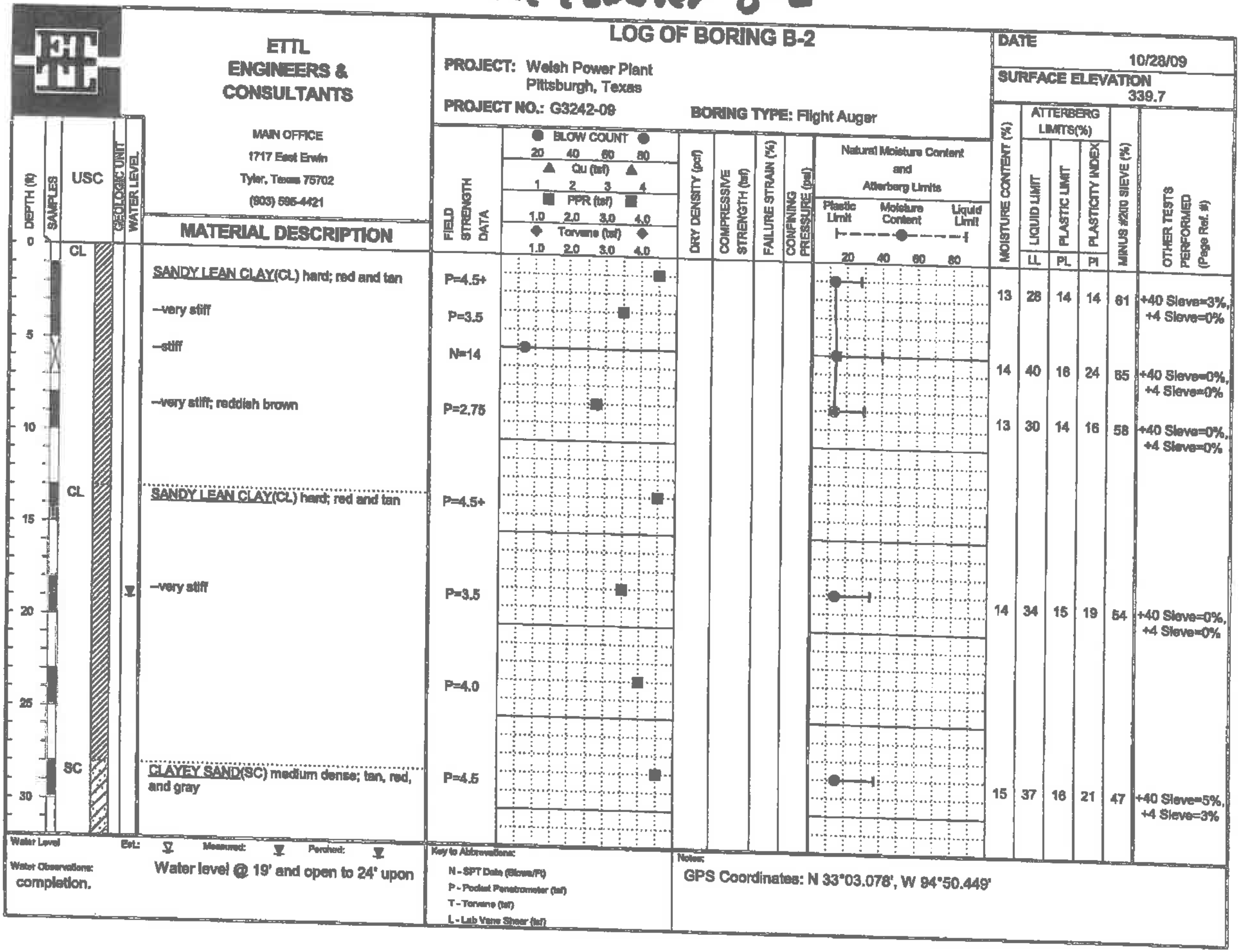
Water Level — Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 5' while drilling. Water level @ 4' and open to 30' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.090', W 94°50.417'

Piezometer B-2



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LOG OF BORING B-2

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7

USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL		SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+						
				13	28	14	14	61	+40 Sieve=3%, +4 Sieve=0%
		--very stiff	P=3.5						
		--stiff	N=14						
				14	40	16	24	65	+40 Sieve=0%, +4 Sieve=0%
		--very stiff; reddish brown	P=2.75						
				13	30	14	16	58	+40 Sieve=0%, +4 Sieve=0%
CL		SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+						
	▼	--very stiff	P=3.5						
				14	34	15	19	54	+40 Sieve=0%, +4 Sieve=0%
			P=4.0						
SC		CLAYEY SAND(SC) medium dense; tan, red, and gray	P=4.5						
				15	37	16	21	47	+40 Sieve=5%, +4 Sieve=3%

Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

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LOG OF BORING B-2

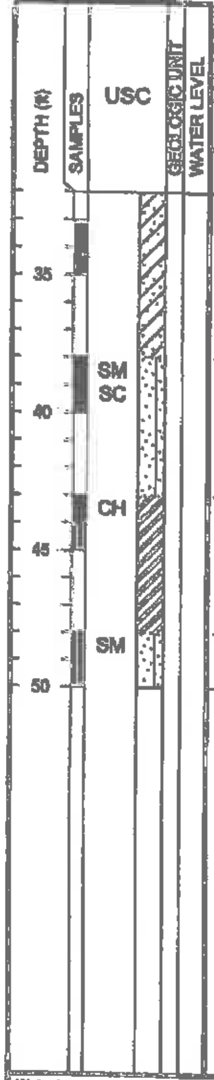
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

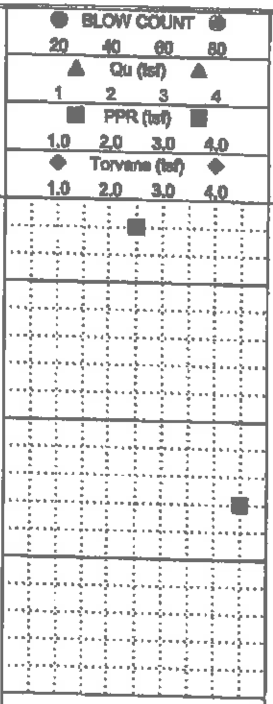
BORING TYPE: Flight Auger

DATE 10/28/09

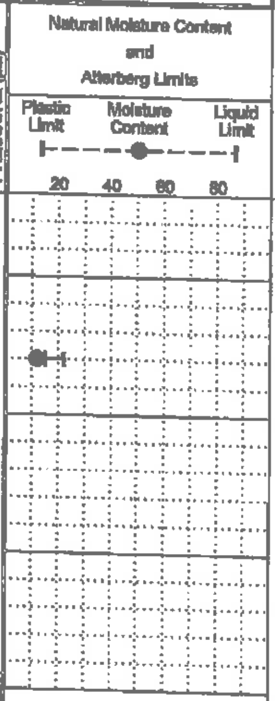
SURFACE ELEVATION 339.7



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
--red and tan	P=2.5						
SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated	SF	12	22	15	7	48	+40 Sieve=0%, +4 Sieve=0%
FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams	P=4.5+						
SILTY SAND(SM) black and gray	SF						
Bottom of Boring @ 50'							



DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)



Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

Piezometer B-2

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

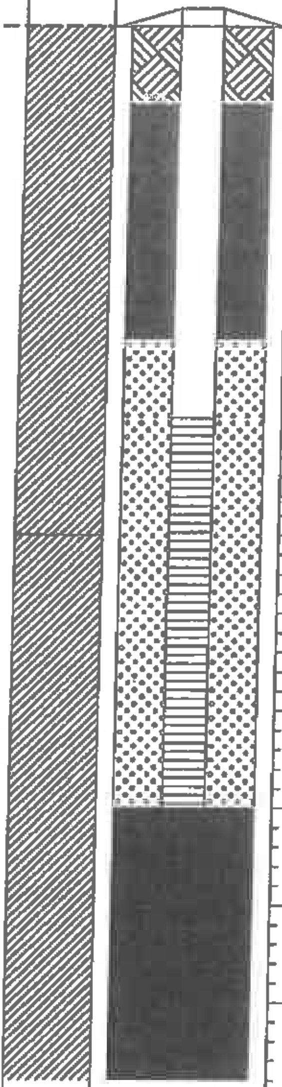
Well No. B-2

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		SANDY LEAN CLAY(CL) hard; red and tan					
		—very stiff					
5		—stiff				5	
		—very stiff; reddish brown					
10						10	
		SANDY LEAN CLAY(CL) hard; red and tan					
15						15	
		—very stiff					
20						20	
25						25	



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/28/09

Drilling Completed 10/28/09

Construction Completed

Development Completed

Type of Well

Drilling Method Solid Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-8' & 20-50'

Filter Pack Qty. 8-20'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-2

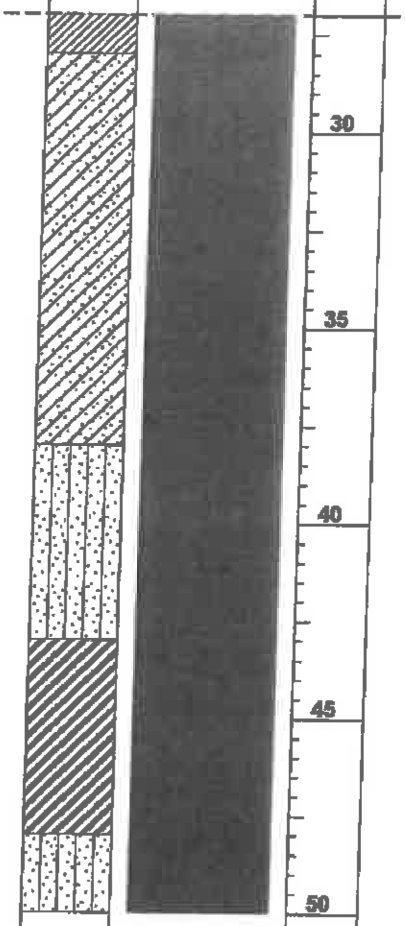
Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details

Continued from previous page



CLAYEY SAND(SC) medium dense; tan, red, and gray

–red and tan

SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated

FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams

SILTY SAND(SM) black and gray

Bottom of Boring @ 50'

30
35
40
45
50
55
60

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Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

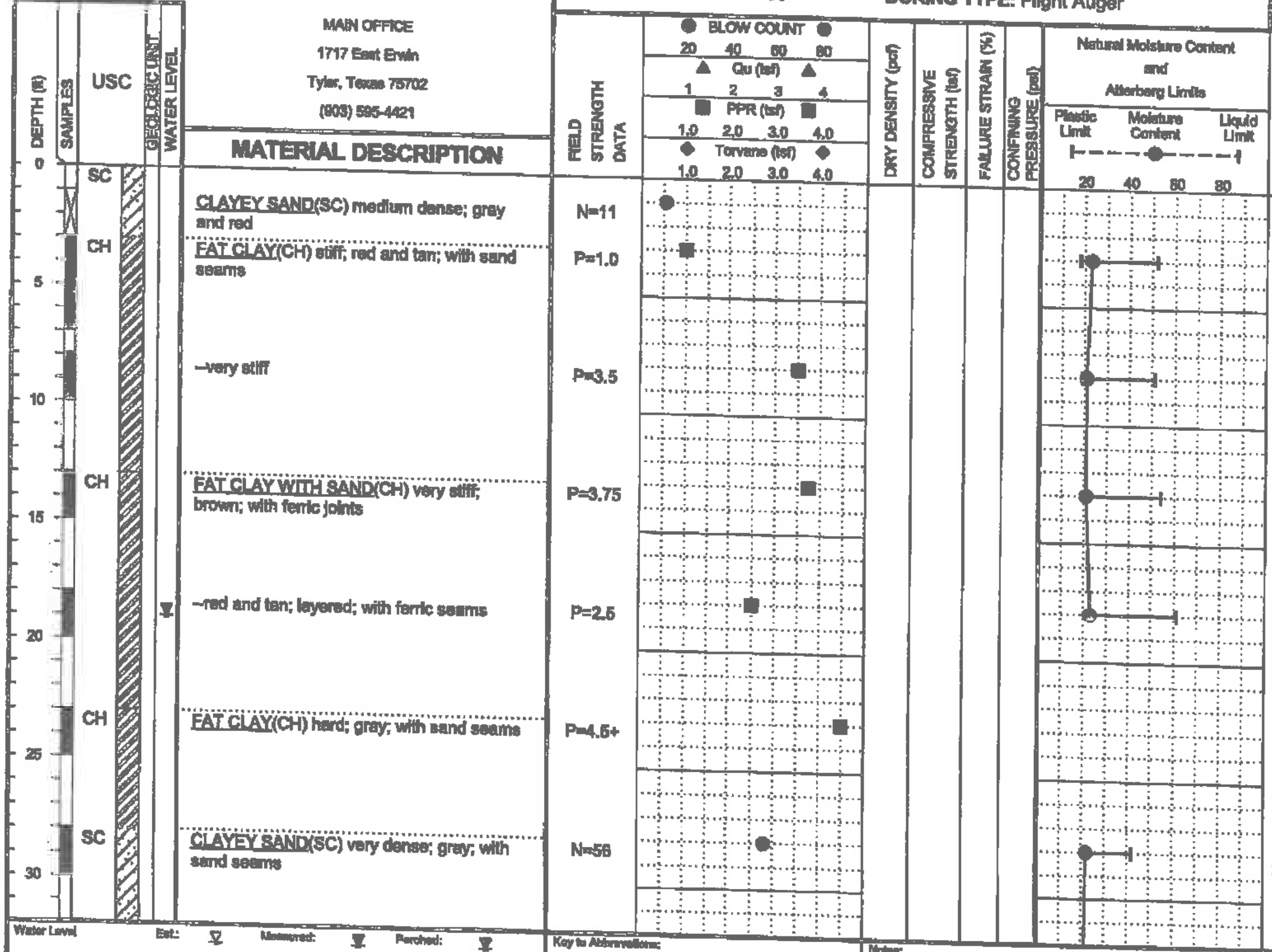
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6



USC	MATERIAL DESCRIPTION	WATER LEVEL	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	CLAYEY SAND(SC) medium dense; gray and red		N=11										
CH	FAT CLAY(CH) stiff; red and tan; with sand seams		P=1.0					23	52	18	34	87	+40 Sieve=3%, +4 Sieve=0%
	--very stiff		P=3.5					21	51	19	32	86	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) very stiff; brown; with ferric joints		P=3.75					21	54	20	34	85	+40Sieve=10%, +4 Sieve=1%
	--red and tan; layered; with ferric seams	▼	P=2.5					23	61	24	37	81	+40Sieve=11%, +4 Sieve=0%
CH	FAT CLAY(CH) hard; gray; with sand seams		P=4.5+										
SC	CLAYEY SAND(SC) very dense; gray; with sand seams		N=56					22	42	22	20	35	+40 Sieve=1%, +4 Sieve=0%

Water Level   Est: ∇   Measured: ▼   Perched: ∇

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

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LOG OF BORING B-3

PROJECT: Welsh Power Plant
Pittsburgh, Texas

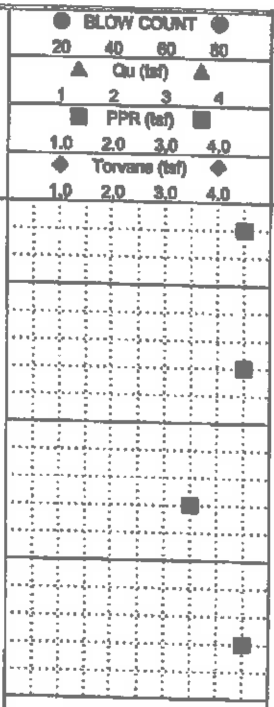
PROJECT NO.: G3242-09

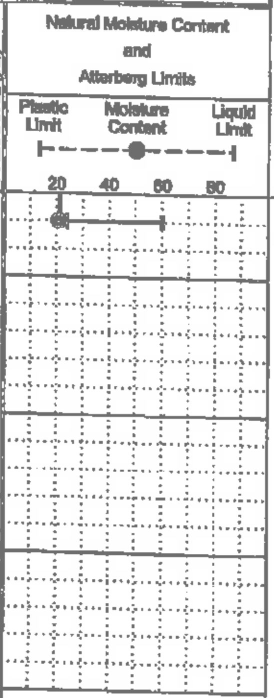
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	CH	FAT CLAY(CH) hard; brown; layered and with sand seams	P=4.5+					21	60	24	36	95	+40 Sieve=1%, +4 Sieve=0%
40		–gray and green	P=4.5+										
45	CL	SANDY LEAN CLAY(CL) very stiff; gray and dark green; layered; with sand seams	P=3.5										
50	CH	FAT CLAY(CH) hard; gray and dark green; layered; with silt seams	P=4.5+										
		Bottom of Boring @ 50'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

Piezometer B-4

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LOG OF BORING B-4

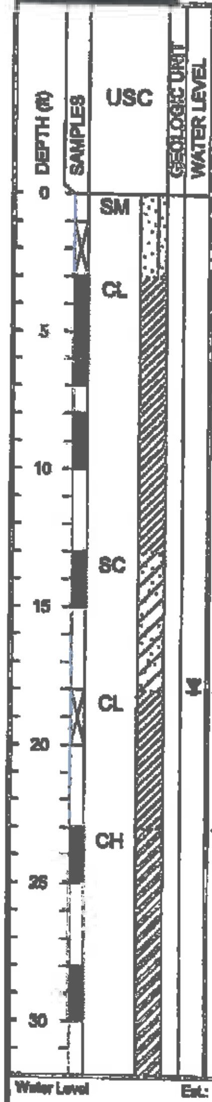
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

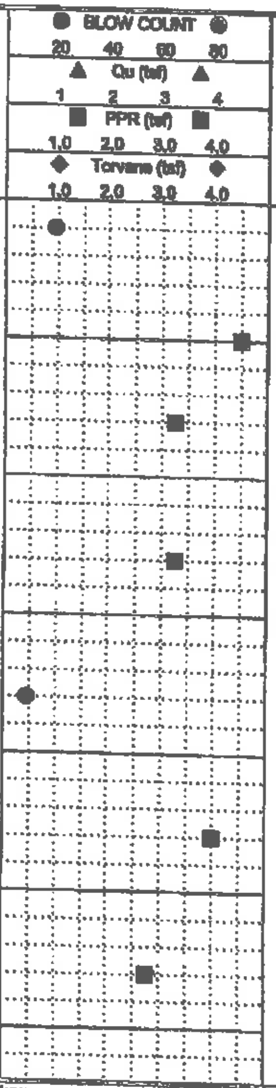
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SM	SILTY SAND(SM) medium dense; tan; with gravel	N=19						
CL	SANDY LEAN CLAY(CL) dark brown	SF						
	—tannish orange		14	24	15	9	59	+40 Sieve=1%, +4 Sieve=0%
	—hard; orangish tan	P=4.5						
		P=3.25	22	45	21	24	94	+40 Sieve=2%, +4 Sieve=0%
	—very stiff; white							
SC	CLAYEY SAND(SC) medium dense; tan —orangish gray; with sand seams	P=3.25	15	31	15	16	40	+40 Sieve=1%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) stiff; orangish tan	N=9						
CH	FAT CLAY(CH) very stiff; orangish tan; with ferric seams	P=4.0	25	59	24	35	88	+40 Sieve=4%, +4 Sieve=0%
	—tannish brown; with iron ore seams	P=2.75						

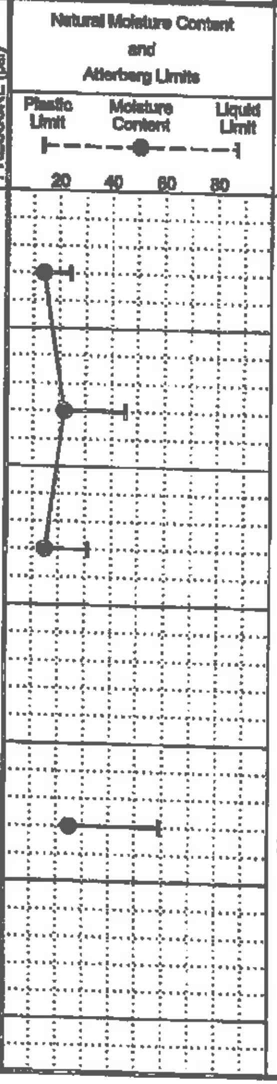


DRY DENSITY (pcf)

COMPRESSIVE STRENGTH (tsf)

FAILURE STRAIN (%)

CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

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LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

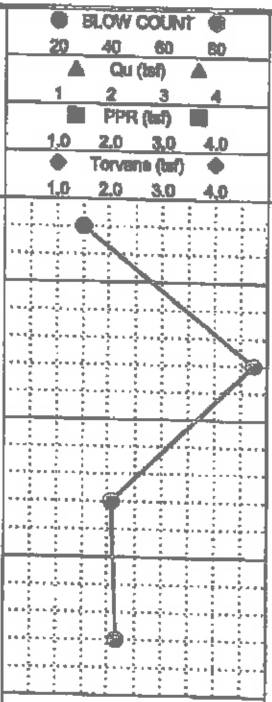
BORING TYPE: Flight Auger

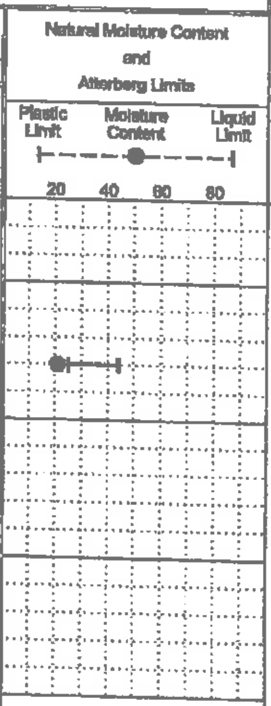
DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	SAMPLES	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	☒		–hard; light gray; layered and with silt seams	N=30						
40	☒	CL	LEAN CLAY(CL) hard; light gray; layered and with silt seams	N=50/5.75"	21	44	25	19	93	+40 Sieve=1%, +4 Sieve=0%
45	☒		–light gray	N=41						
50	☒		–layered and with sand seams; with lignite	N=43						
			Bottom of Boring @ 50'							

Columns with no entries: GEOLOGIC UNIT; WATER LEVEL; DRY DENSITY (pcf); COMPRESSIVE STRENGTH (tsf); FAILURE STRAIN (%); CONFINING PRESSURE (psi)





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

Piezometer B-4

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-4

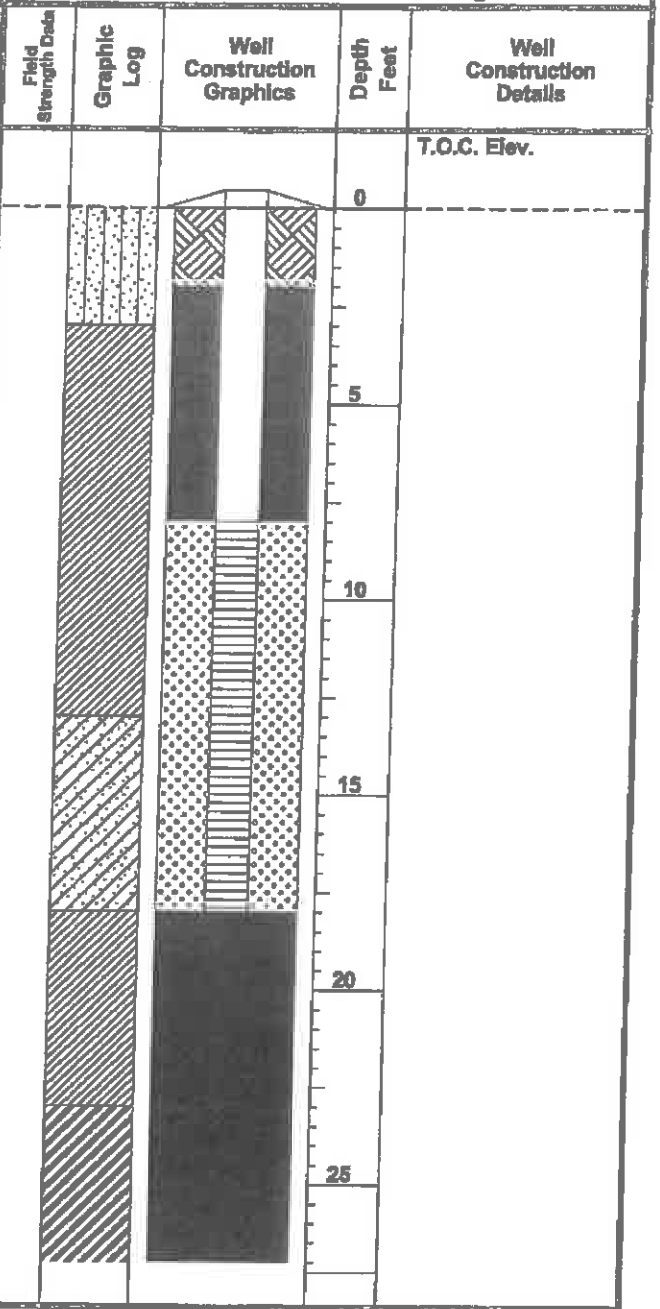
Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description
0	Ground Surface
	SILTY SAND(SM) medium dense; tan; with gravel
	SANDY LEAN CLAY(CL) dark brown
	--tannish orange
5	--hard; orangish tan
10	
	--very stiff; white
	CLAYEY SAND(SC) medium dense; tan
15	--orangish gray; with sand seams
	SANDY LEAN CLAY(CL) stiff; orangish tan
20	
	FAT CLAY(CH) very stiff; orangish tan; with ferric seams
25	

Continued Next Page



Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed

Development Completed

Type of Well

Drilling Method Solid Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 8.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 8.0' **to** 18.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-8' & 18-50'

Filter Pack Qty. 6-18'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

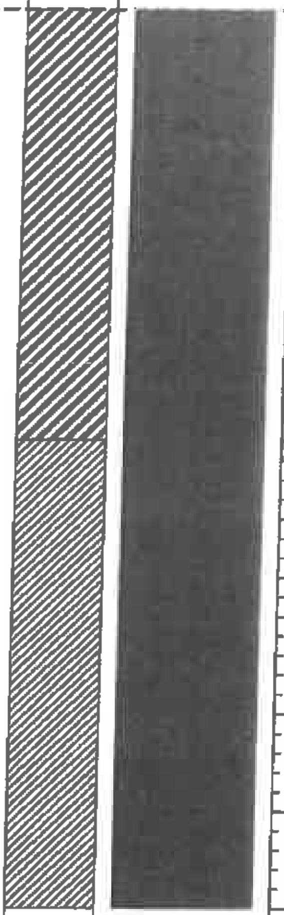
Well No. B-4

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		--tannish brown; with iron ore seams					
30						30	
		--hard; light gray; layered and with silt seams					
35						35	
		LEAN CLAY(CL) hard; light gray; layered and with silt seams					
40						40	
		--light gray					
45						45	
		--layered and with sand seams; with lignite					
50						50	
		Bottom of Boring @ 50'					
55							
60							



Piezometer B-5

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

● BLOW COUNT ● 20 40 60 80
▲ Qu (tsf) ▲ 1 2 3 4
■ PPR (tsf) ■ 1.0 2.0 3.0 4.0
◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits: Plastic Limit ├ - - - ● - - - ┤ Liquid Limit, Moisture Content; 20 40 60 80

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	LEAN CLAY WITH SAND(CL) stiff; red and tan	P=2.0					22	47	19	28	81	+40 Sieve=9%, +4 Sieve=3%
	CL	LEAN CLAY(CL) hard; red and tan	P=4.5+										
5		--very stiff	P=4.0					21	46	18	28	94	+40 Sieve=3%, +4 Sieve=0%
	CH	FAT CLAY(CL) very stiff; brown and tan	P=3.0										
10													
	CH	FAT CLAY WITH SAND(CH) hard; red and tan	P=4.5+					22	52	24	28	88	+40 Sieve=3%, +4 Sieve=0%
15													
	CL	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams	P=3.0										
20													
	SC	CLAYEY SAND(SC) very loose; tan, red, and gray	P=0.5					19	33	17	16	44	+40 Sieve=1%, +4 Sieve=0%
25													
	CH	FAT CLAY WITH SAND(CH) stiff; red and gray	P=2.0					25	61	19	42	83	+40 Sieve=5%, +4 Sieve=3%
30													

Water Level Est: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

DEPTH (ft): 35, 40, 45, 50

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	● BLOW COUNT ● 20 40 60 80 ▲ Qu (tsf) ▲ 1 2 3 4 ■ PPR (tsf) ■ 1.0 2.0 3.0 4.0 ◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	Natural Moisture Content and Atterberg Limits Plastic Limit ├ - - - ● - - - ┤ Liquid Limit, Moisture Content 20 40 60 80	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	SILTY CLAYEY SAND(SC) gray and red; saturated	SF												
CH	FAT CLAY(CH) hard; red and gray; with sand seams	P=4.5+							25	51	31	20	87	+40 Sieve=6%, +4 Sieve=0%
	–gray, tan, and red; with sand seams	P=4.5+												
SM SC	SILTY SAND(SM-SC) red and gray	SF												
	Bottom of Boring @ 50'													

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

Renamed B-5

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

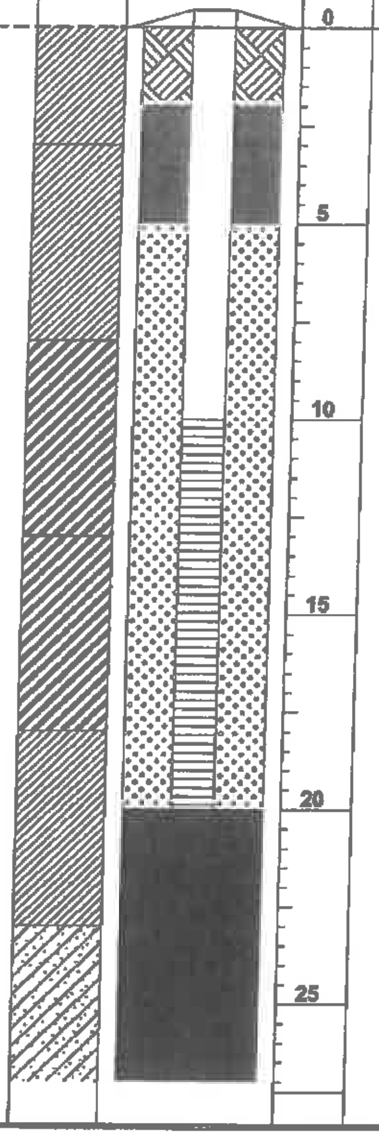
Well No. B-5

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Overburden/Lithologic Description
0	Ground Surface
	LEAN CLAY WITH SAND(CL) stiff; red and tan
	LEAN CLAY(CL) hard; red and tan
5	—very stiff
	FAT CLAY(CL) very stiff; brown and tan
10	
	FAT CLAY WITH SAND(CH) hard; red and tan
15	
	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams
20	
	CLAYEY SAND(SC) very loose; tan, red, and gray
25	



Well Construction Details

T.O.C. Elev.

Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed ____

Development Completed ____

Type of Well ____

Drilling Method Solid Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-5' & 20-50'

Filter Pack Qty. 5-20'

Filter Pack Type 20/40 Sand

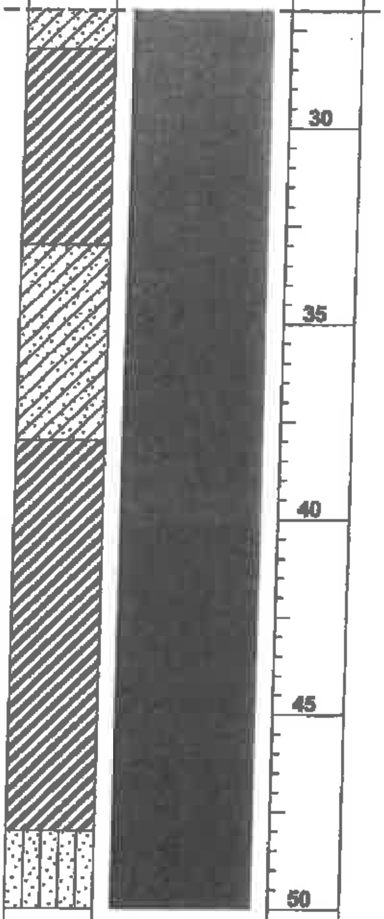
Static Water Level ____

Notes: ____

ENVIRONMENTAL LOG

Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**
Well No. B-5
Location Pittsburg, Texas
Surface Elev.
Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
	FAT CLAY WITH SAND(CH) stiff; red and gray					
30					30	
	SILTY CLAYEY SAND(SC) gray and red; saturated					
35					35	
	FAT CLAY(CH) hard; red and gray; with sand seams					
40					40	
	–gray, tan, and red; with sand seams					
45					45	
	SILTY SAND(SM-SC) red and gray					
50	Bottom of Boring @ 50'				50	
55						
60						



Piezometer B-6

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

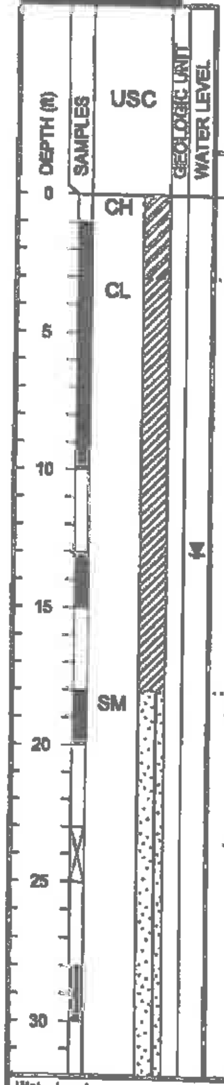
PROJECT: Welsh Power Plant
Pittsburgh, Texas

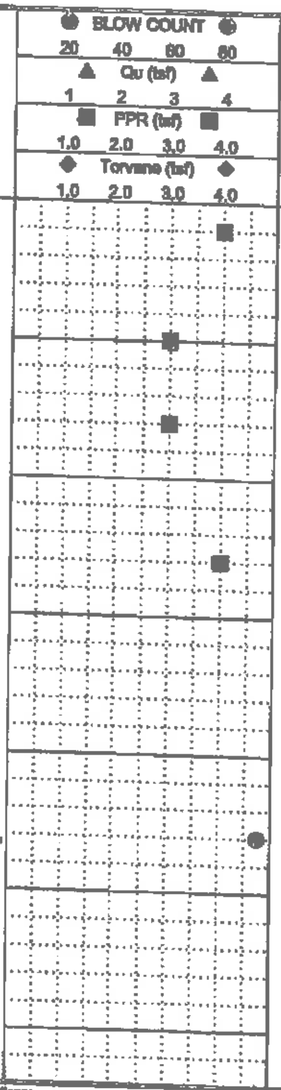
PROJECT NO.: G3242-09

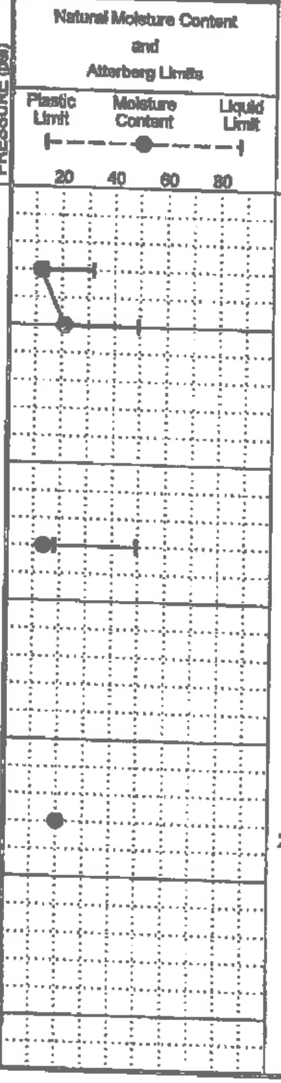
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY(CH) very stiff; red and gray; with ferric seams	P=4.0										
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+					12	32	14	18	60	+40 Sieve=0%, +4 Sieve=0%
	—very stiff; red, gray, and brown; with gravel —with sand seams	P=3.0					21	49	20	29	93	+40 Sieve=2%, +4 Sieve=0%
		P=3.0										
		P=4.0					14	49	18	31	85	+40 Sieve=0%, +4 Sieve=0%
SM	SILTY SAND(SM) gray; saturated	P=3.0										
	—very dense; gray and red	N=50/5.25"					20				18	+40 Sieve=0%, +4 Sieve=0%
		SF										

Water Level Est.: ∇ Measured: ▼ Parched: ∇̲

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

PROJECT: Welsh Power Plant
Pittsburgh, Texas

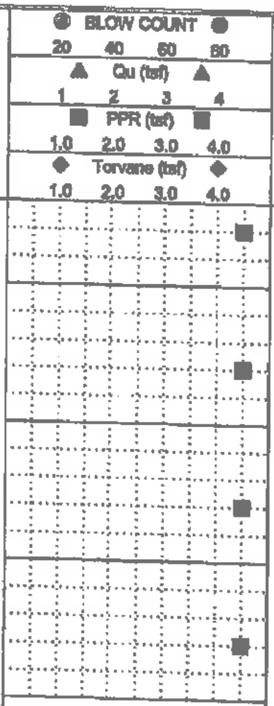
PROJECT NO.: G3242-09

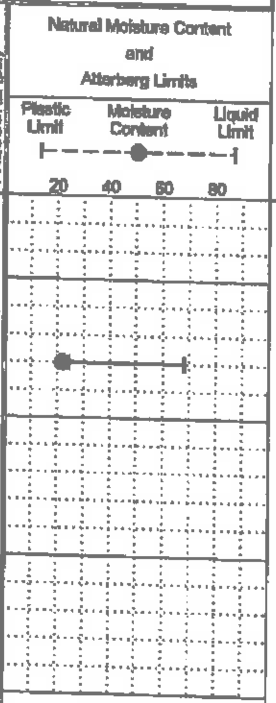
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
33–35	CH	FAT CLAY(CH) hard; brown; with sand seams	P=4.5+										
38–40			P=4.5+					22	68	24	44	95	+40 Sieve=0%, +4 Sieve=0%
43–45		--dark green	P=4.5+										
48–50	CL	LEAN CLAY(CL) hard; dark green; laminated with lignite	P=4.5+										
50		Bottom of Boring @ 50'											





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

Piezometer B-6

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

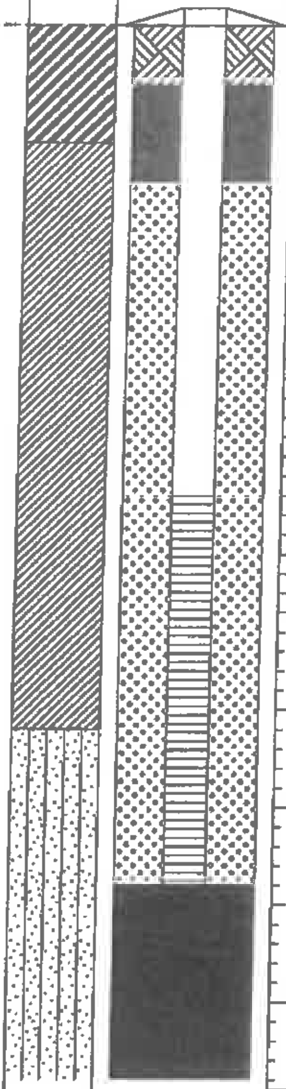
Well No. B-6

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
						T.O.C. Elev.
0	Ground Surface				0	
	FAT CLAY(CH) very stiff; red and gray; with ferric seams					
	SANDY LEAN CLAY(CL) hard; red and tan					
5					5	
	–very stiff; red, gray, and brown; with gravel					
	–with sand seams					
10					10	
15					15	
	SILTY SAND(SM) gray; saturated					
20					20	
	–very dense; gray and red					
25					25	



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/28/09

Drilling Completed 10/28/09

Construction Completed

Development Completed

Type of Well

Drilling Method Solid Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" Dia. 0.0' to 12.0'

Casing Type PVC

Well Screen 2.0" Dia. 12.0' to 22.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 1.5-4' & 22-50'

Filter Pack Qty. 4-22'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

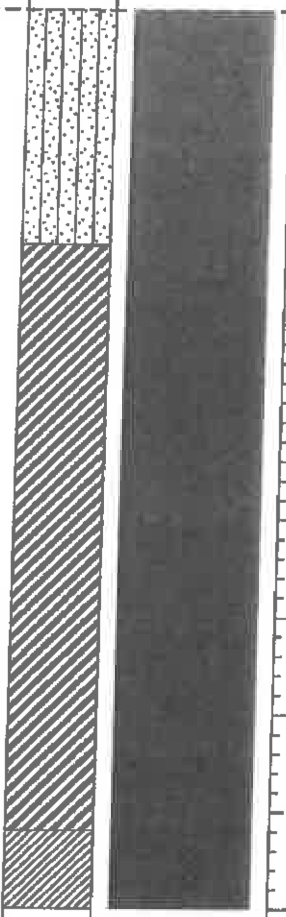
ETTL Engineers & Consultants Inc.

ENVIRONMENTAL LOG

Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**

Well No. B-6
Location Pittsburg, Texas
Surface Elev.
Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
30					30	
35	FAT CLAY(CH) hard; brown; with sand seams				35	
40					40	
45	–dark green				45	
50	LEAN CLAY(CL) hard; dark green; laminated with lignite				50	
	Bottom of Boring @ 50'					
55						
60						



ETTL Engineers & Consultants Inc.

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-7

PROJECT: Welsh Power Plant
Pittsburgh, Texas

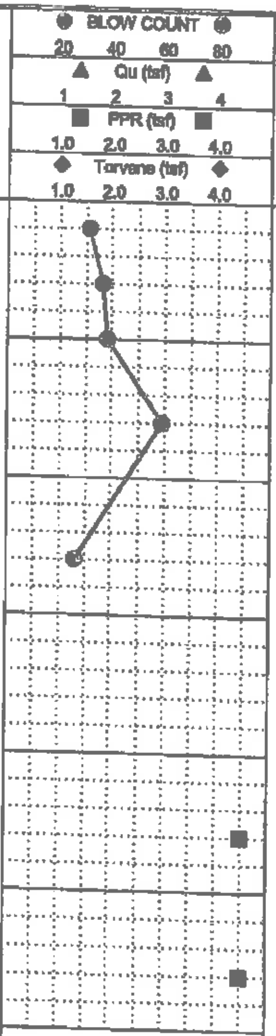
PROJECT NO.: G3242-09

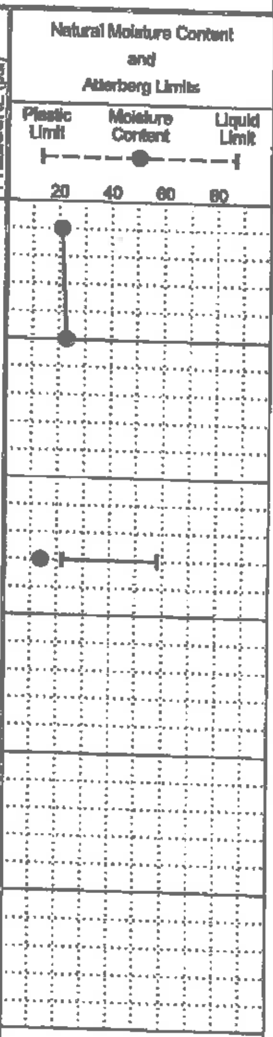
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.4

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	SM	⊻	SILTY SAND(SM) dense; tan	N=31					21				21	+40 Sieve=0%, +4 Sieve=0%
				N=38										
5			--gray; saturated	N=38					23				15	+40 Sieve=0%, +4 Sieve=0%
			--very dense	N=59										
10														
15	CH		FAT CLAY(CH) very stiff; dark gray; with silt and ferric seams	N=26					14	58	22	36	98	+40 Sieve=0%, +4 Sieve=0%
20														
			--hard; gray and black; with trace of lignite	P=4.5+										
25			--gray											
				P=4.5+										
30			Bottom of Boring @ 30'											





Water Level Est.: ⊻ Measured: ⊻ Perched: ⊻

Water Observations: Seepage @ 4' while drilling. Water level @ 2' and open to 7' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.898', W 94°50.519'

Landfill Boring B-2

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest. Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

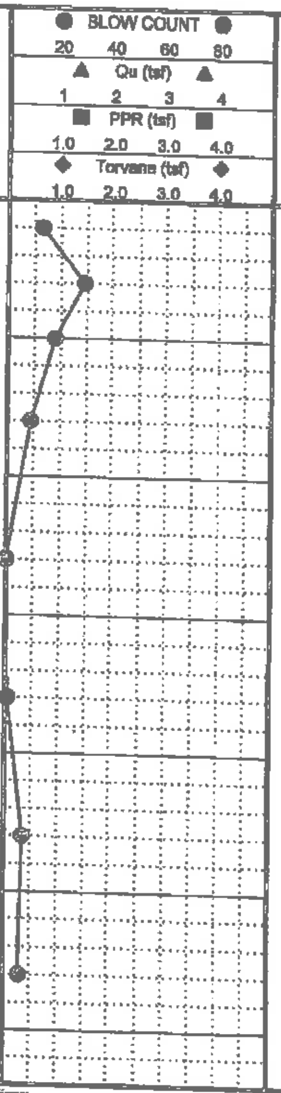
DRILL RIG: B-61 HDX

BORING TYPE: Rotary Wash/Flight Auger

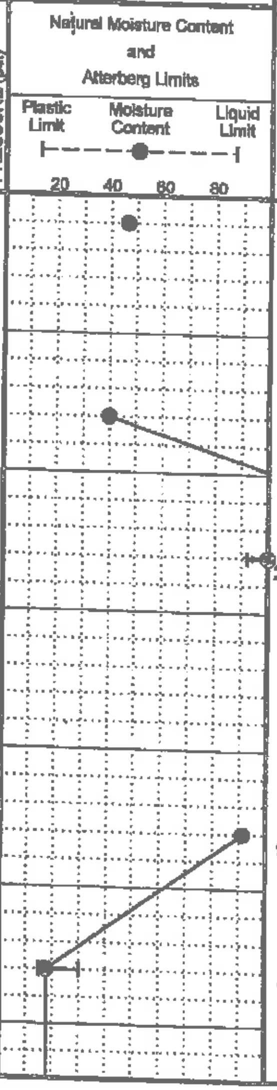
DATE 10/8/14

SURFACE ELEVATION 373.8

DEPTH (ft)	USC	GEOLOGIC UNIT	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	ML	Eoc @ 28-43' & Er @ 43-60'	ASH (SILT WITH GRAVEL(ML)) medium dense; light grayish brown; with coarse-grained sand and lightly cemented gravel pieces; dry	N=13						
	SM		ASH (SILTY SAND(SM)) medium dense; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces	N=29	46				59	+40 Sieve=27% +4 Sieve=16%
5				N=18						
			--loose; moist	N=9						
10					40				40	+40 Sieve=19% +4 Sieve=2%
	MH		ASH (ELASTIC SILT(MH)) very loose; black; with fine-grained sand and lightly cemented gravel pieces; saturated	N=0						
15					200	134	92	42	100	+40 Sieve=0% +4 Sieve=0%
	SM		ASH (SILTY SAND(SM)) very loose; dark brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=1						
20										
			--loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7						
25					91				61	+40 Sieve=11% +4 Sieve=1%
	CL		SANDY LEAN CLAY(CL) medium stiff; dark brown and black; with fine-grained sand and cemented gravel pieces; saturated	N=6						
30					18	30	15	15	63	+40 Sieve=1% +4 Sieve=0%



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

ETTL
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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

DRILL RIG: B-61 HDX

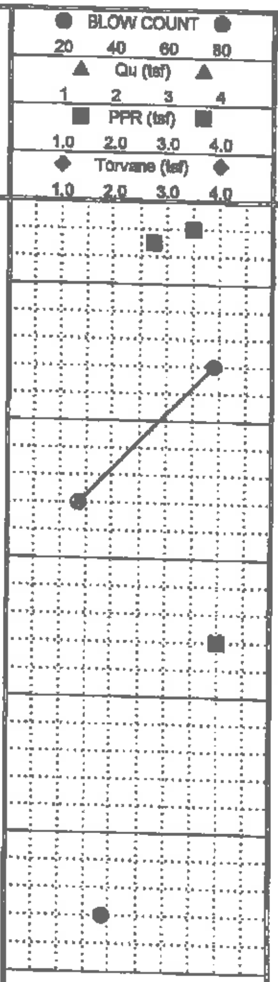
PROJECT NO.: G4207-146

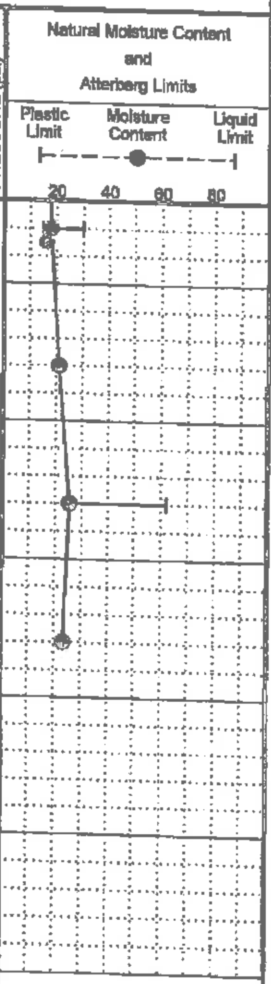
BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14

SURFACE ELEVATION 373.8

DEPTH (ft)	USC	GEOLOGIC UNIT	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	SC	Ecc @ 28-43' & Ef @ 43-60'	CLAYEY SAND(SC) dense; light brown, light gray and reddish brown; moist; with fine-grained sand; mottled	P=3.5 P=2.75	110	1.39	4.3	21	18 16	30	15	15	39	+40 Sieve=0% +4 Sieve=0%
40	SM		SILTY SAND(SM) very dense; light brown, yellowish brown and light gray; moist; mottled; with fine-grained sand	N=78					21				24	+40 Sieve=0% +4 Sieve=0%
45	CH		FAT CLAY(CH) very stiff; dark brown and light brown; moist; with sand seams; laminated	N=27					25	62	26	36	96	+40 Sieve=2% +4 Sieve=0%
50			--dark brown with light gray; moist; with silt seams	P=4.0	98				24					
55														
60			--hard; dark brown; moist	N=37										
			Bottom of Boring @ 60'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill boring B-10

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

BORING TYPE: Rotary Wash/Flight Auger

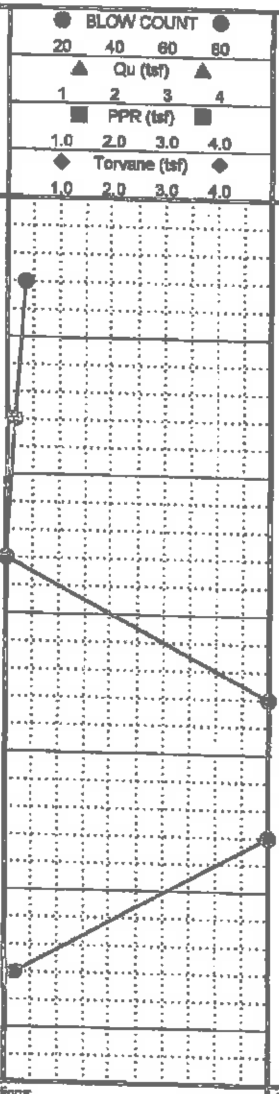
DATE 10/8/14

SURFACE ELEVATION 373.2

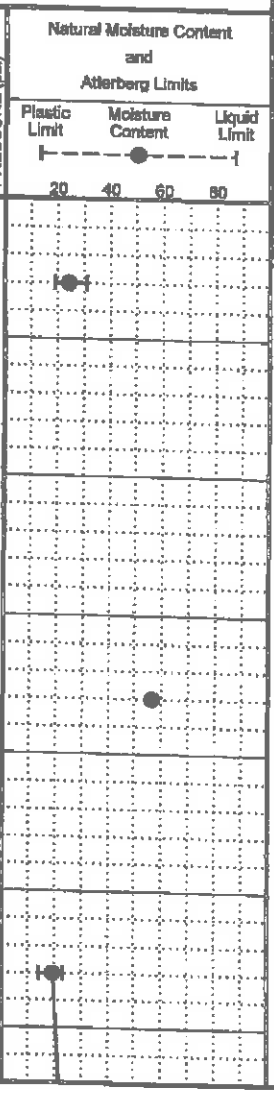
USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	ASH (CLAYEY SAND(SC)) loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7	24	31	19	12	41	+40 Sieve=21% +4 Sieve=11%
MH	ASH (ELASTIC SILT(MH)) very loose; black; moist	N=3						
	--wet	N=0						
SM	ASH (SILTY SAND WITH GRAVEL(SM)) very dense; light brown and dark brown; with lightly cemented gravel pieces and coarse-grained sand; moist; cemented layer from 17.5' to 21'	N=50/1"	56				14	+40 Sieve=71% +4 Sieve=28%
	--cemented layer from 23' to 27'	N=50/4"						
CL	SANDY LEAN CLAY(CL) medium stiff; grayish brown and yellowish brown; saturated; mottled	N=4	19	23	14	9	57	+40 Sieve=1% +4 Sieve=0%

DEPTH (ft): 0, 5, 10, 15, 20, 25, 30

GEOLOGIC UNIT: Eqc @ 27-43' & Er @ 43-60'



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

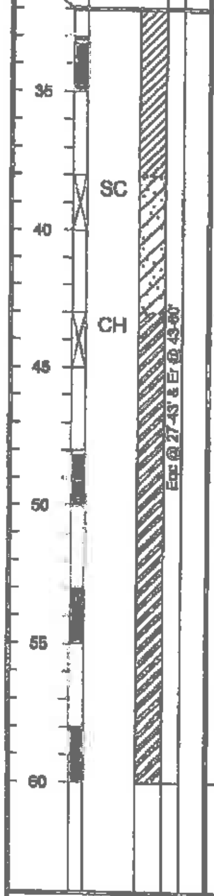
PROJECT NO.: G4207-148

DRILL RIG: B-61 HDX

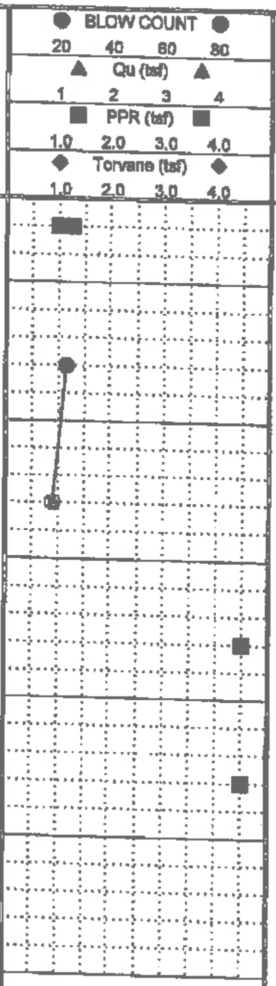
BORING TYPE: Rotary Wash/Flight Auger

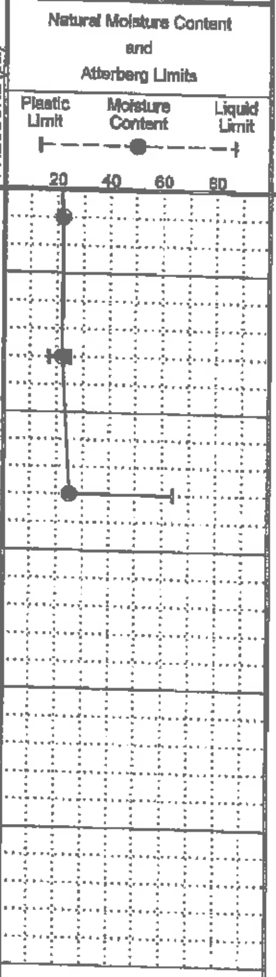
DATE 10/8/14

SURFACE ELEVATION 373.2



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
		P=1.25 P=1.0	107	2.10	6.1	21	22					
SC	CLAYEY SAND(SC) medium dense; reddish brown and grayish brown; moist; mottled	N=23					22	25	17	8	27	+40 Sieve=3% +4 Sieve=0%
CH	FAT CLAY(CH) very stiff; dark brown with light gray; with silt seams; moist	N=18					25	64	24	40	90	+40 Sieve=7% +4 Sieve=0%
	–hard	P=4.5+										
		P=4.5+										
	Bottom of Boring @ 60'											





Water Level Est.: ▽ Measured: ▼ Parched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill Boring B-12

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-12

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

DRILL RIG:

PROJECT NO.: G4207-146

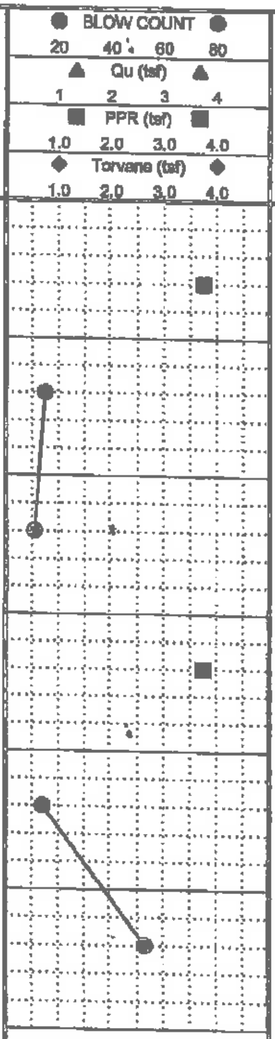
BORING TYPE: Flight Auger

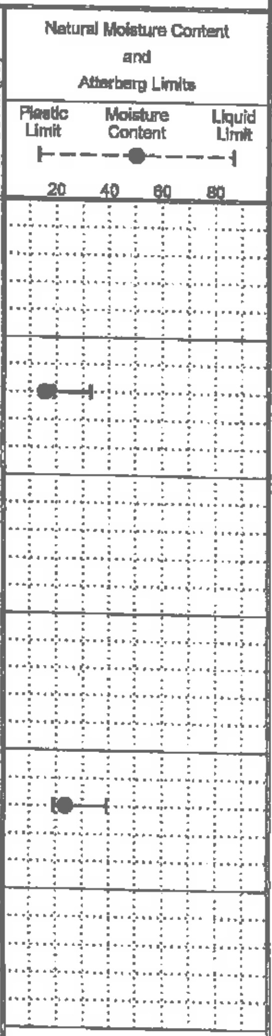
DATE 10/15/14

SURFACE ELEVATION 361.7

DEPTH (ft)	USC	GEOLOGIC UNIT	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	Eqc	LEAN CLAY WITH SAND(CL) stiff; light gray and reddish brown; moist; mottled	P=3.75						
5	CL		SANDY LEAN CLAY(CL) stiff; light brown, light gray and reddish brown; moist; mottled	N=15	16	33	19	14	58	+40 Sieve=1% +4 Sieve=0%
10			--grayish brown and brown; moist	N=11						
15	CH		FAT CLAY WITH SAND(CH) stiff; light gray and reddish brown; moist; mottled; with ferric seams	P=3.75						
20	CL		LEAN CLAY(CL) stiff; light gray and brownish gray; moist; layered with silt	N=14	24	39	19	20	93	+40 Sieve=1% +4 Sieve=0%
25	ML		SILT WITH SAND(ML) very dense; light brown and yellowish brown; moist; with clay seams	N=53						
30			Bottom of Boring @ 30'							

Columns DRY DENSITY (pcf), COMPRESSIVE STRENGTH (tsf), FAILURE STRAIN (%), CONFINING PRESSURE (psi): no entries.





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 27' and open upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04713°, W94.84486°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Land fill Boring B-13

LOG OF BORING B-13

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

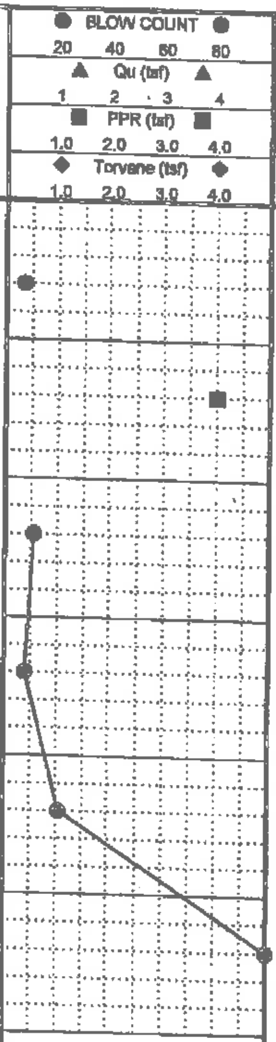
DRILL RIG:

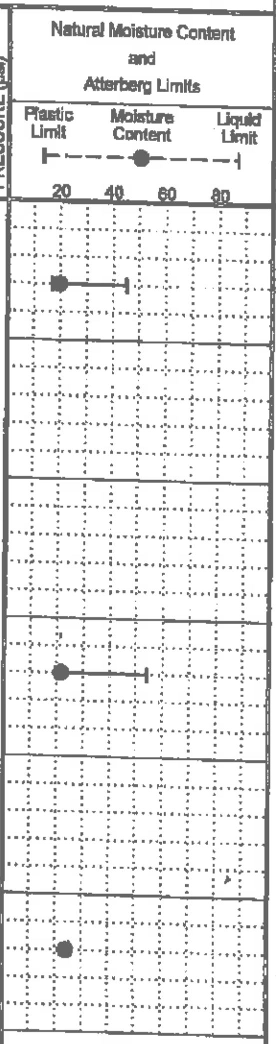
BORING TYPE: Flight Auger

DATE 10/15/14

SURFACE ELEVATION 361.4

DEPTH (ft)	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0–5	CL	Eqc		LEAN CLAY WITH SAND(CL) medium stiff; reddish brown with light gray; moist	N=7					20	45	17	28	76	+40 Sieve=1% +4 Sieve=0%
10	CL			SANDY LEAN CLAY(CL) very stiff; light brown, gray and reddish brown; moist; mottled	P=4.0										
	SC			CLAYEY SAND(SC) medium dense; grayish brown; moist	N=11										
15–20	CH			FAT CLAY WITH SAND(CH) medium stiff; reddish brown and light gray; moist; mottled	N=8					22	54	20	34	79	+40 Sieve=1% +4 Sieve=0%
25	CL			LEAN CLAY(CL) very stiff; light gray and grayish brown; moist; layered with silt	N=21										
30	ML		▼	SILT WITH SAND(ML) very dense; light gray and yellowish brown; wet; with clay seams	N=50/5"					24				80	+40 Sieve=0% +4 Sieve=0%
				Bottom of Boring @ 30'											





Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 28' and open upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.047160°, W94.84384°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-14

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-14

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

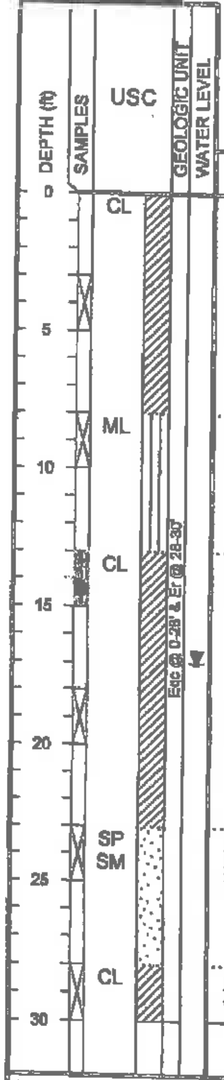
PROJECT NO.: G4207-148

DRILL RIG:

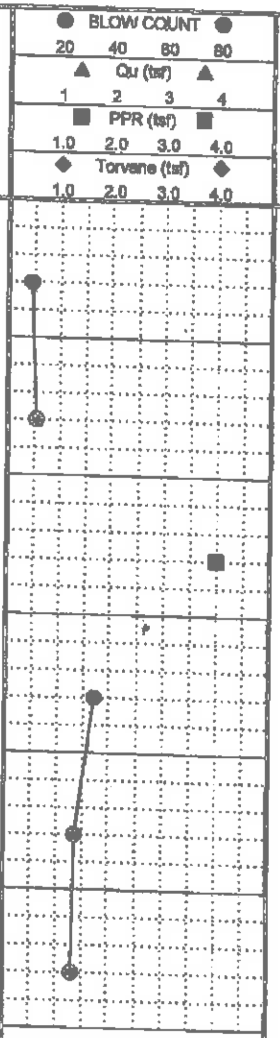
BORING TYPE: Flight Auger

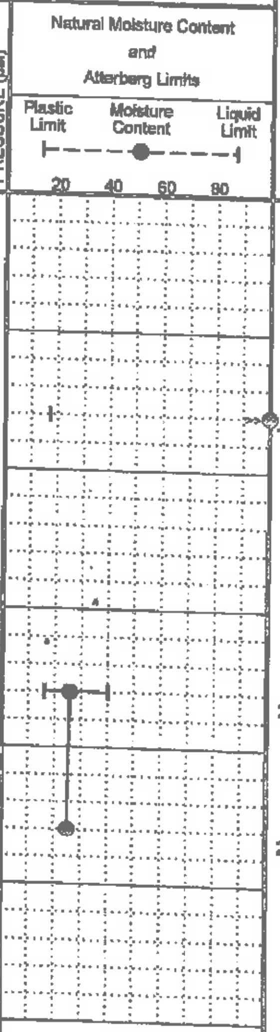
DATE 10/14/14

SURFACE ELEVATION 347.2



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) medium stiff; yellowish brown with reddish brown; dry; with clay seams	N=9										
ML	SANDY SILT(ML) medium dense; grayish brown; moist; with clay seams	N=11					108	17	17	NP	68	+40 Sieve=1% +4 Sieve=1%
CL	SANDY LEAN CLAY(CL) very stiff; light gray and gray; moist	P=4.0										
	--light gray and grayish brown; moist; layered with silt	N=34					26	40	16	24	67	+40 Sieve=1% +4 Sieve=0%
SP SM	POORLY GRADED SAND WITH SILT(SP-SM) medium dense; yellowish brown, light gray and reddish brown; wet	N=27					25				10	+40 Sieve=0% +4 Sieve=0%
CL	LEAN CLAY(CL) very stiff; dark brown; moist; with silt partings	N=26										
	Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 23' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04774°, W94.84290°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-15

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-15

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

DRILL RIG:

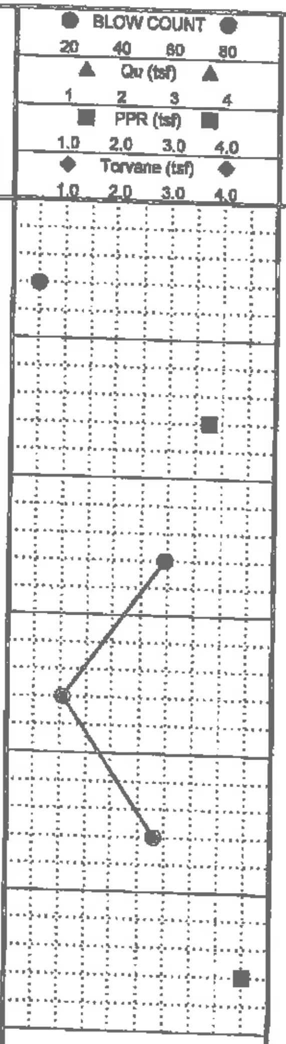
BORING TYPE: Flight Auger

DATE 10/14/14

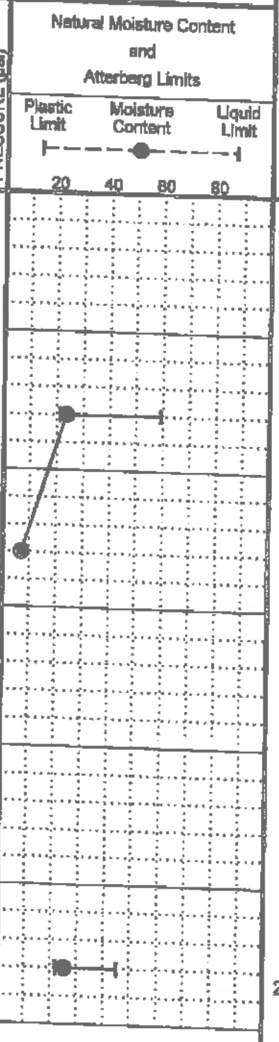
SURFACE ELEVATION 348.2

Geologic unit: Eqc @ 0-28' & Er @ 28-30'

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CH								
5		FAT CLAY(CH) stiff; reddish brown and light gray; moist; mottled	N=10						
10		--very stiff; light gray, grayish brown and reddish brown; moist; layered	P=3.75	24	59	21	38	85	+40 Sieve=0% +4 Sieve=0%
15	SM	SILTY SAND(SM) very dense; light brown; dry	N=59	7				12	+40 Sieve=0% +4 Sieve=0%
20		--medium dense; wet	N=21						
25		--very dense	N=56						
30	CL	LEAN CLAY(CL) hard; dark brown; moist; with silt partings	P=4.5	25	45	22	23	92	+40 Sieve=0% +4 Sieve=0%
		Bottom of Boring @ 30'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 19' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04857°, W94.84286°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

ARCADIS

Appendix B

Photographic Log

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 1

Date: 8/20/2015

Direction Photo Taken:

North

Description:
Staging area west of landfill.

P8200493

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 2

Date: 8/20/2015

Direction Photo Taken:

South Southeast

Description:

Potential wetland on the top (west) end of the Primary Ash Pond.

P8200495

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 3

Date: 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Ditch between road and railway west of landfill, this ditch would be non-jurisdictional.

P8200497

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 4

Date: 8/20/2015

Direction Photo Taken:

Northeast

Description:

Ground Water Monitoring Well AD-12 near northwest end of landfill.

P8200501

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 5

Date: 8/20/2015

Direction Photo Taken:

East Northeast

Description:

View of plant from top of landfill. Primary ash pond is within the wooded area on left.

P8200506

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 6

Date: 8/20/2015

Direction Photo Taken:

East Northeast

Description:

Drainage canal that drains from primary ash pond to clear water pond.

P8200510

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 7

Date: 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Vegetated strip between landfill and road. This would be isolated due to lack of connectivity.

P8200521

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 8

Date: 8/20/2015

Direction Photo Taken:

North

Description:

Dike between landfill and primary ash pond. Facility in the background.

P8200522

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 9	**Date:** 8/20/2015

Direction Photo Taken:

West

Description:

Vegetated strip between landfill and road. This area would be isolated due to lack of connectivity.

P8200527

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 10	**Date:** 8/20/2015

Direction Photo Taken:

North Northeast

Description:

Road east of landfill running toward facility and clear water pond.

P8200530

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	**Location:**	**Project No.**
AEP – J. ROBERT WELSH POWER PLANT	PITTSBURG, TITUS COUNTY, TEXAS	OK001625.0001

Photo No.	**Date:**
11	8/20/2015

Direction Photo Taken:

South

Description:

Top of landfill.

P8200534

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	**Location:**	**Project No.**
AEP – J. ROBERT WELSH POWER PLANT	PITTSBURG, TITUS COUNTY, TEXAS	OK001625.0001

Photo No.	**Date:**
12	8/20/2015

Direction Photo Taken:

Southeast

Description:

View of lined bottom ash storage pond.

P8200538

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 13	**Date:** 8/20/2015

Direction Photo Taken:

Southeast

Description:

Lined bottom ash storage pond.

P8200545

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 14	**Date:** 8/20/2015

Direction Photo Taken:

South

Description:

Southside of lined bottom ash storage pond.

P8200547

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 15

Date: 8/20/2015

Direction Photo Taken:

West

Description:

East side of lined bottom ash storage pond.

P8200560

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 16

Date: 8/20/2015

Direction Photo Taken:

North

Description:

Upland with pine and ground water monitoring well AD-2 south of lined bottom ash storage pond.

P8200563

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No.
17

Date:
8/20/2015

Direction Photo Taken:

Description:

Outflow of water from plant into the northeast portion of the Primary Ash Pond.

P8200577

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No.
18

Date:
8/20/2015

Direction Photo Taken:

South Southwest

Description:

Northeast portion of primary ash pond, view facing south-southwest.

P8200578

4.2 – Bottom Ash Storage Pond – CCR Groundwater Monitoring Well Network Evaluation, May 16, 2017

ARCADIS
Infrastructure · Water · Environment · Buildings

Imagine the result

American Electric Power Service Corporation

Bottom Ash Storage Pond - CCR Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187 County Road 4865
Titus County
Pittsburg, Texas

May 16, 2017

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

Kenneth J Brandner

Kenneth Brandner, P.E., P.G.
Senior Project Engineer

Matthew J. Lamb/KJB

Matthew J. Lamb
Project Manager

Bottom Ash Storage Pond - CCR Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187County Road 4865
Titus County
Pittsburg, Texas

Prepared for:
AEP

Prepared by:
ARCADIS U.S., Inc.
100 E Campus View Blvd
Suite 200
Columbus
Ohio 43235-1447
Tel 614 985 9100
Fax 614 985 9170

Our Ref.:
OH015976.0011

Date:
May 16, 2017

Tables

Figures

Appendices

Acronyms and Abbreviation

AEP	American Electric Power Service Cooperation
amsl	above mean sea level
ARCADIS	ARCADIS U.S., Inc.
BAP	bottom ash pond
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
FAP	fly ash pond
FGD	flue gas desulfurization
ft	feet
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
PTI	Permit to Install
TDS	total dissolved solids

Bottom Ash Storage Pond-CCR Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187 County Road 4865
Titus County, Pittsburg, Texas

1. Objective

This report was prepared by ARCADIS U.S., Inc. (ARCADIS) for American Electric Power Service Corporation (AEP) to assess the adequacy of the groundwater monitoring well network included in the Coal Combustion Residual (CCR) requirements, as specified in Code of Federal Regulations (CFR) 40 CFR 257.91, for the Bottom Ash Storage Pond (CCR Unit) at the AEP Generating Plant (Plant) located at 1187 County Road 4865 in Pittsburg, Titus County, Texas (**Figure 1**). The CCR requirements include an evaluation of the adequacy of the groundwater monitoring well network to characterize groundwater quality up and down gradient of the CCR unit.

Three regulated CCR units associated with the Plant were identified for review, which include the primary ash pond, landfill, and Bottom Ash Storage Pond (**Figure 2**). This report summarizes the evaluation of the groundwater monitoring well network in the uppermost aquifer at the Bottom Ash Storage Pond (Site).

This evaluation included a review of AEP-provided data associated with previously completed subsurface investigation activities in the vicinity of the Bottom Ash Storage Pond CCR unit, as well as publically-available geologic and hydrogeologic data. The following report also presents the current Conceptual Site Model based on all documents reviewed and will further describe the uppermost aquifer, include an evaluation of the adequacy of the existing monitoring well network, and provide recommendations for monitoring well augmentation, as necessary.

2. Background Information

The following section provides background information for the AEP J. Robert Welsh Generating Plant (Welsh Plant) Bottom Ash Storage Pond.

2.1 Facility Location Description

The AEP Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The Bottom Ash Storage Pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir (**Figures 1** and **2**).

2.2 Description of Bottom Ash Storage Pond CCR Unit

The following section will discuss the embankment configuration, area, volume, construction and operational history, and surface water control associated with the Bottom Ash Storage Pond.

2.2.1 Embankment Configuration

The Bottom Ash Storage Pond was placed into operation in 2000, and is located in a topographically high area of the Plant. The Bottom Ash Storage Pond embankments are approximately 20 feet in height and are constructed of compacted clay on a 3:1 slope (3 feet horizontal, 1 foot vertical). The elevation at the base of the embankment is approximately 340 feet amsl, and the elevation at the top of the embankment around the perimeter of the Bottom Ash Storage Pond is approximately 360 feet amsl (Southwestern Electric Power Company, 2000).

2.2.2 Area/Volume

The Bottom Ash Storage Pond is 22 acres in size. Per the *Hydraulic Analysis of Welsh Power Plant Ash Ponds Report,* dated December 2010 (Freese and Nichols, 2010), the principal spillway for the Bottom Ash Storage Pond is located near the southeast corner of the pond and consists primarily of an 18 inch drain at elevation 350.5 feet amsl and also of a 40-foot-long broad-crested weir with a crest elevation of 355 feet amsl. The emergency spillway is an 8-foot-wide weir with a rock rip-rap discharge chute located along the southern embankment at an elevation of 358 feet amsl. The storage capacity of the Bottom Ash Storage Pond at elevation 358 feet amsl is 86.50 acre-ft (Freese and Nichols, 2010).

2.2.3 Construction and Operational History

The AEP J. Robert Welsh Plant began operations in approximately 1977 with three coal-fired generating units (Units 1, 2, and 3). Throughout the life of the generating plant, CCR materials (fly ash, bottom ash, economizer ash) have been generated. All of these byproducts were stored in the primary ash pond and in the adjacent landfill that was constructed in the late 1970's. In 2000, the 22-acre Bottom Ash Storage Pond was installed south of the landfill. The Bottom Ash Storage Pond was constructed with a 60-mil high-density polyethylene (HDPE) liner, and receives bottom ash and economizer ash dredged and sluiced from the primary ash pond (**Figure 2**).

The Bottom Ash Storage Pond 60-mil HDPE liner is located at the base of the Bottom Ash Storage Pond at an elevation of 340 feet amsl. The liner also extends along the base of the Bottom Ash Storage Pond sidewalls and is keyed into the top of the Bottom Ash Storage Pond earthen embankment at an elevation of 360 feet amsl (Southwestern Electric Power Company, 2000).

The southeast corner of the Bottom Ash Storage Pond contains an approximate ¼-acre clear water pond with a base elevation of 347 feet amsl (**Figure 3**). The clear water pond receives clear water primarily through an 18 inch drain and then through an overflow structure from the main part of the Bottom Ash Storage Pond through the 40-foot-long broad-crested weir discussed above in Section 2.2.2. Water in the ¼-acre clear water pond at the southeast corner of the Bottom Ash Storage Pond discharges through a 30-inch-diameter pipe into the primary ash pond system.

2.2.4 Surface Water Control

Surface water flow within the Bottom Ash Storage Pond is primarily controlled by an 18 inch drain and then by a weir located on the southeast side of the pond below the embankments. The pond elevation is maintained so that surface water flows through the drain pipe at invert elevation 350.5 amsl or weir which has a crest elevation of 355 feet amsl. Clear water flows through the weir into the ¼-acre clear water pond at the southeast corner of the Bottom Ash Storage Pond, then discharges through a 30-inch-diameter pipe into the primary ash pond (**Figure 3**).

The emergency spillway for the Bottom Ash Storage Pond is located along the southern embankment, and is 8 feet wide with a crest elevation of 358 feet amsl. The perimeter embankments of the Bottom Ash Storage Pond are located at an elevation of 360 feet amsl. Therefore the perimeter embankments have approximately five feet of freeboard above the clear water discharge weir, and approximately two feet of freeboard above the emergency spillway.

2.3 Previous Investigations

The initial soils investigation for the site was provided in a 1973 report prepared by McClelland Engineers, Inc. entitled "*Soils Investigation, Welsh Power Plant, Cason, Texas*". This investigation included advancement of soil borings in the primary ash pond area, and geotechnical soil testing to characterize the area encompassed by the primary ash pond.

In 2000, Maxim Technologies prepared a report entitled "*Subsurface Exploration for Ash Storage Area, Phase II, Welsh Power Plant, Cason, Texas*". This report evaluated the geotechnical properties of the soils below the Bottom Ash Storage Pond.

In 2000, an HDPE liner installation report was prepared by Alliance Incorporated. This report provided details regarding installation of the 60-mil HDPE liner on the bottom of the Bottom Ash Storage Pond.

In 2001, five monitoring wells (AD-1 through AD-5) were installed in the area of the primary ash pond and Bottom Ash Storage Pond to obtain hydrologic data for the uppermost water-bearing unit. Twelve additional monitoring wells (AD-4a, AD-4b, AD-4c, AD-6 through AD-14) were installed in the area of the primary ash pond, Bottom Ash Storage Pond, and landfill by Eagle Environmental Services in 2009 to obtain more detailed hydrologic data for the uppermost water-bearing unit.

In 2010, Freese and Nichols performed a *Hydraulic Analysis of the Welsh Power Plant Ash Ponds* (Freese and Nichols, 2010). The report concluded the spillways for the primary ash pond, clear water pond, and Bottom Ash Storage Pond are hydraulically adequate for the full range of storm events from the 10-year to the 100-year storm events.

In December 2015, Auckland Consulting further expanded the groundwater monitoring well system at the Plant by installation of monitoring wells AD-15 through AD-18 (Auckland Consulting, 2016). In April 2017, ARCADIS installed monitoring well AD-16R as a replacement for monitoring well AD-16, which was nearly dry following drilling. Monitoring well completion diagrams are provided in **Appendix A.**

2.4 Hydrogeologic Setting

The site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently southeast. The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966).

These features are further illustrated on five lines of cross section that were prepared through the Bottom Ash Storage Pond area, with three lines trending from west to east (A-A'; B-B'; C-C'), and the other two lines trending from north to south (D-D'; E-E'). The cross section location map is included as **Figure 3** and the lines of cross section are included as **Figure** 4 (A-A') through **Figure 8** (E-E').

2.4.1 Climate and Water Budget

The climate of Titus County, Texas is moist subhumid. The normal January temperature is 45°Fahrenheit (F), and the normal July temperature is 82.9°F. The mean annual growing season is 228 days (Broom, 1965). Average annual precipitation (including liquid water equivalent from snowfall) is approximately 47 inches according to weatherdb.com.

2.4.2 Regional and Local Geologic Setting

The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966). The Recklaw Formation attains a thickness of approximately 110 feet in Titus County, and is underlain by the Eocene-age Carrizo Sand which consists of fine to coarse sand, silt, and clay (Broom, 1965). In the topographically low areas underling the Welsh Reservoir to the east of the Bottom Ash Storage Pond, Quarternary alluvial sediments associated with Swauano Creek are present (Flawn, 1966).

Detailed regional geologic characterization can be found in several published reports including Texas Water Commission Bulletin 6517 "*Ground-Water Resources of Camp, Franklin, Morris and Titus Counties, Texas*" (Broom, 1965), and The University of Texas at Austin Bureau of Economic Geology "*Geologic Atlas of Texas – Texarkana Sheet*" (Flawn, 1966).

Detailed regional and site geologic characterization can be found in the 2010 ETTL report entitled "*Geotechnical Investigation, Welsh Power Station, Existing Ash Storage Ponds Embankment Investigation, Pittsburg, Texas*" (ETTL, 2010).

2.4.3 Surface Water and Surface Water Groundwater Interactions

The Site is generally less than one-half mile from Swauano Creek, which was dammed near the southern end of the Site during plant development to form the Welsh Reservoir. Groundwater flow direction at the Site is generally from west to east, following surface topography towards the Welsh Reservoir. The Welsh Reservoir is likely a gaining surface water feature, and groundwater elevations on site are higher than the normal stage elevation of the Welsh Reservoir (approximately 320 feet amsl).

The Bottom Ash Storage Pond normal operating level is near the clear water overflow weir which has a crest elevation of 355 feet amsl. **Figure 9** is a potentiometric surface map based on March 2016 water level data for the uppermost aquifer at the Site, and water level elevations in the Site monitoring wells are summarized on **Table 1**. As shown on **Figure 9**, shallow groundwater flow direction in the area of the Bottom Ash Storage Pond is east-southeasterly toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.01 foot per foot.

2.4.4 Water Users

A water well inventory conducted by Banks Information Solutions showed one water well within a ½-mile radius of the Site (Banks, 2013). The water well is located on-site to the southwest (sidegradient) of the primary ash pond, and was installed for Southwestern Electric Company in 1974 with screens from 515 to 535 feet below ground surface, and plugged at a later date.

3. Groundwater Monitoring Well Network Evaluation

The existing monitoring well network present at the Site was evaluated to determine if any of the wells were viable for continued use as part of the groundwater monitoring well network or also retained as part of a larger groundwater hydraulic monitoring well network. The hydrogeologic conditions were also evaluated to determine if the uppermost aquifer unit has an effective well network. The evaluation was completed in accordance with 40 CFR 257.91 to have an established monitoring well network that effectively monitors the uppermost aquifer up gradient and down gradient of the Site. The up gradient wells represent background groundwater quality and the down gradient wells are to be placed down gradient of the CCR unit boundary to monitor water quality.

3.1 Hydrostratigraphic Units

3.1.1 Horizontal and Vertical Position Relative to CCR Unit

Geologic data from soil borings and monitoring wells installed at the site show the uppermost aquifer in the area of the Bottom Ash Storage Pond is a very fine to fine grained silty sand and sandy silt stratum with an average thickness of approximately 12 feet that is located between an elevation of approximately 320 and 332 feet amsl **(Appendix A)**. The base of the Bottom Ash Storage Pond is at an elevation of 340 feet feet amsl. Therefore the separation distance between the uppermost aquifer and the base of the Bottom Ash Storage Pond is approximately 8 feet. This separation distance is further illustrated on cross section C-C' (**Figure 6)** and cross section D-D' **(Figure 7)**.

3.1.2 Overall Flow Conditions

Groundwater is recharged from regional precipitation infiltration. The uppermost aquifer (silty sand) is expected to have a hydraulic conductivity of approximately 10^{-4} centimeters per second (Fetter, 1980). Based on the hydraulic conductivity and saturated thickness (approximately 12 feet), the yield of the uppermost aquifer is anticipated to exceed the TCEQ non-useable (Class 3) limit of 150 gallons per day (TCEQ, 2010).

Available groundwater elevations are summarized on **Table 1** for 2011 through 2016. The most recent comprehensive groundwater data set is depicted on **Figure 9**. The groundwater flow is generally easterly towards the Welsh Reservoir.

3.2 Uppermost Aquifer

3.2.1 CCR Rule Definition

The CCR rule definitions for an aquifer and the uppermost aquifer as specified in 40 CFR 257.53 indicates an aquifer is a geologic formation capable of yielding usable quantities of groundwater to wells or springs while an uppermost aquifer is defined as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers, that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural groundwater surface to which the aquifer rises during the wet season.

3.2.1.1 Common Definitions

An aquifer is commonly defined as a geologic unit that stores and transmits water (readily or at sufficient flow rates) to supply wells and springs (USGS, 2015; Fetter, 2001). The uppermost aquifer is considered the first encountered aquifer nearest to the CCR unit.

3.2.2 Identified Onsite Hydrostratigraphic Unit

The identified on-Site hydrostratigraphic unit in the area of the Bottom Ash Storage Pond is the very fine to fine grained silty sand and sandy silt stratum that is located between an elevation of approximately 320 and 332 feet amsl. This unit is not used locally for groundwater supply or industrial water use, but meets the TCEQ definition of a useable aquifer.

3.3 Review of Existing Monitoring Well Network

3.3.1 Overview

The Site was visited by ARCADIS and AEP personnel on August 20, 2015 to review existing well network conditions and locations. A well construction table that summarizes the location, ground surface elevation, borehole depth, installation date, and associated well construction details of the monitoring well network is included as **Table 2**. Photo documentation of the located wells during the August 20, 2015 site visit is provided in **Appendix B**.

Monitoring wells AD-1 through AD-4, AD-4a, AD-4b, and AD-4c were previously installed at the Site to monitor the uppermost aquifer (very fine to fine grained silty sand and sandy silt stratum) associated with the Bottom Ash Storage Pond. As discussed above in Section 3.1.1, the aquifer below the Bottom Ash Storage Pond is approximately 12 feet thick and is located between an elevation of approximately 320 and 332 feet amsl.

3.3.2 Gaps in Monitoring Network

As shown on Geologic Cross Sections A-A' (**Figure 4**) and C-C' (**Figure 6**), existing monitoring wells AD-5 and AD-1 are screened at the top of the uppermost aquifer up gradient (northwest) of the Bottom Ash Storage Pond, and existing monitoring wells AD-4a, AD-4b, and AD4c are screened in the uppermost aquifer down gradient (east) of the Bottom Ash Storage Pond. Existing monitoring wells AD-1 and AD-5 will be utilized as the up gradient monitoring wells for the Bottom Ash Storage Pond. Monitoring wells AD-17 and AD-18, installed northwest (up gradient) of the Bottom Ash Storage Pond during December 2015, will also be utilized as up gradient monitoring wells for the Bottom Ash Storage Pond.

Existing monitoring well AD-3, located east of the Bottom Ash Storage Pond, will be utilized as a down gradient monitoring well for the Bottom Ash Storage Pond. Existing monitoring wells AD-4, AD-4a, AD-4b, and AD-4c are located in close proximity to each other, and as shown on **Figure 9**, monitoring well AD-4c is the furthest down gradient of these four monitoring wells. Therefore monitoring well AD-4c will be utilized as a down gradient monitoring well for the Bottom Ash Storage Pond.

As shown on **Figure 9**, existing monitoring well AD-14 is located east of the northeast corner of the Bottom Ash Storage Pond. However, due to the close proximity of the landfill CCR unit directly north of the Bottom Ash Storage Pond, groundwater at monitoring well AD-14 could be affected by the landfill. Therefore monitoring well AD-14 will not be utilized as part of the groundwater monitoring system for the Bottom Ash Storage Pond. This data gap was addressed by installation of new monitoring well AD-16 during December 2015 east (down gradient) of the Bottom Ash Storage Pond as shown on **Figure 9** and **Figure 10**. However, monitoring well AD-16 was nearly dry following drilling. Therefore monitoring well AD-16 was replaced with monitoring well AD-16R during April 2017. With the addition of monitoring wells AD-16R, AD-17, and AD-18, there are no gaps remaining in the groundwater monitoring network for the Bottom Ash Storage Pond.

4. Recommended Monitoring Network and PE Certification

The recommended existing groundwater monitoring well network is intended to meet specifications stated in 40 CFR 257.91. Recommended wells are further discussed with respect to location to the Bottom Ash Storage Pond (up gradient or down gradient), well depth, and well construction. The recommended network would provide an improved understanding of groundwater quality, hydraulics, and groundwater flow at the Bottom Ash Storage Pond.

4.1 Recommended Monitoring Well Network Distribution

Four up gradient well locations (existing monitoring wells AD-1, AD-5, AD-17, and AD-18) and three down gradient well locations (existing monitoring wells AD-3, AD-4c, and AD-16R) are recommended to establish a groundwater quality monitoring well network for the Bottom Ash Storage Pond. In addition, existing monitoring wells AD-2, AD-4, AD-4a, AD-4b, and AD-16 may be utilized as piezometers to obtain additional groundwater flow direction and gradient data for the Bottom Ash Storage Pond.

4.1.1 Location

The recommended monitoring well network for groundwater quality of the uppermost aquifer at the Bottom Ash Storage Pond is summarized on **Table 3** and illustrated on **Figure 10.**

4.1.2 Depth

The screen depths for the monitoring wells recommended for inclusion in the monitoring network are within the shallow saturated sand stratum (uppermost aquifer) that occurs between an elevation of approximately 320 and 332 feet amsl as shown on Geologic Cross Sections C-C' (**Figure 6**) and D-D' (**Figure 7**). The screen elevations are presented in **Table 3.**

4.1.3 Well Construction

As discussed above in Section 3.3.2, the gap in the monitoring well network for the uppermost aquifer at the Bottom Ash Storage Pond was addressed by installation of monitoring wells AD-16R, AD-17, and AD-18. Monitoring wells AD-16R, AD-17, and AD-18 were installed by a Texas Department of Licensing and Regulation (TDLR)-licensed water well driller. Well construction data for the monitoring well network are summarized on **Tables 2** and **3**, and the monitoring well completion diagrams are provided in **Appendix A**.

4.2 Professional Engineer's Certification

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the proposed groundwater monitoring system **will** be adequate to meet the requirements of 40 CFR Part 257.91.

Kenneth J. Brandner
Printed Name of Registered Professional Engineer

Kenneth J Brandner
Signature

69586
Registration No.

Texas
Registration State

5-16-17
Date

KENNETH J. BRANDNER
69586

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Tables

Table 1
Water Level Data
AEP J. Robert Welsh Power Plant - CCR Storage Areas
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Screen		Bottom of Screen		6/7/2011	12/6/2011	5/2/2012	11/1/2012	5/14/2013	11/19/2013	5/12/2014	11/16/2014	5/12/2015	3/4/2016
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																						
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57	338.46	334.92	337.88	337.18	337.43	336.73	338.03	337.64	340.82	342.83
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16	330.16	329.07	330.00	329.26	329.83	329.70	330.09	329.69	332.56	332.32
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10	323.81	323.19	323.99	323.29	323.77	323.98	324.12	323.28	325.58	325.12
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61	324.81	324.84	324.62	324.40	324.74	325.52	325.44	325.13	327.00	326.90
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19	325.01	324.19	325.24	322.90	324.86	324.68	325.64	325.34	327.19	327.12
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55	324.35	324.32	324.50	324.30	324.30	325.21	325.22	324.90	326.58	326.67
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15	324.18	324.50	324.64	324.37	324.11	325.06	325.01	324.71	326.50	326.19
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00	336.34	336.58	336.82	336.99	336.78	336.47	336.80	336.01	339.07	338.04
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31	333.04	333.02	332.83	333.02	333.11	332.81	333.11	332.81	333.38	334.00
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86	334.32	334.12	334.19	334.20	334.13	334.58	333.77	333.98	334.09	333.61
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53	325.41	324.09	325.69	325.15	325.79	325.75	325.98	325.77	326.05	325.70
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32	328.46	328.53	328.63	328.44	328.74	329.38	NM	330.18	329.98	329.74
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23	323.44	322.55	323.27	323.35	323.51	323.76	323.57	323.88	323.95	323.55
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61	327.99	328.37	327.82	327.93	327.94	328.13	328.20	327.97	328.96	328.13
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27	348.30	348.29	349.86	349.56	349.99	349.65	349.89	350.01	350.65	350.39
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12	332.36	332.24	333.09	332.26	332.68	333.25	333.35	332.01	337.58	334.76
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32	330.40	329.80	331.67	330.34	330.94	331.69	332.12	330.17	336.63	334.83
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71	---	---	---	---	---	---	---	---	---	322.14
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86	---	---	---	---	---	---	---	---	---	337.09
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99	---	---	---	---	---	---	---	---	---	334.64
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17	---	---	---	---	---	---	---	---	---	343.66
Piezometers																						
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

NM - Not measured.
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through March 2016.

Table 2
Well Construction Details
AEP J. Robert Welsh Power Plant - CCR Units
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Filter Pack		Bottom of Filter Pack		Top of Screen		Bottom of Screen	
								Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl
Monitoring Wells															
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	25.0	1/11/2001	PVC	2	13	343	25	331	15.0	340.57	25.0	330.57
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	25.0	4/26/2001	PVC	2	12	332	25	319	15.0	329.16	25.0	319.16
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	17.0	4/26/2001	PVC	2	5	326	17	314	7.0	324.10	17.0	314.10
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	30.0	4/26/2001	PVC	2	16	325	30	311	19.0	321.61	29.0	311.61
AD-4a (a)	33.04527	94.84258	340.19	30.0	9/22/2009	PVC	2	17	323	30	310	20.0	320.19	30.0	310.19
AD-4b (a)	33.04531	94.84230	329.55	15.0	9/23/2009	PVC	2	4	326	15	315	5.0	324.55	15.0	314.55
AD-4c (a)	33.04507	94.84244	329.15	15.0	9/23/2009	PVC	2	4	325	15	314	5.0	324.15	15.0	314.15
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	30.0	1/11/2001	PVC	2	16	333	30	319	20.0	329.00	30.0	319.00
AD-6 (a)	33.05235	94.84757	343.31	33.0	9/23/2009	PVC	2	21	322	33	310	23.0	320.31	33.0	310.31
AD-7 (a)	33.05257	94.84219	347.86	38.0	9/24/2009	PVC	2	26	322	38	310	28.0	319.86	38.0	309.86
AD-8 (a)	33.05187	94.84026	337.53	29.0	9/21/2009	PVC	2	14	324	29	309	16.0	321.53	26.0	311.53
AD-9 (a)	33.04995	94.84196	340.32	35.0	9/21/2009	PVC	2	18	322	35	305	20.0	320.32	35.0	305.32
AD-10 (a)	33.04881	94.84047	340.23	35.0	9/22/2009	PVC	2	18	322	35	305	20.0	320.23	35.0	305.23
AD-11 (a)	33.04824	94.84177	339.61	20.0	9/22/2009	PVC	2	8	332	20	320	10.0	329.61	20.0	319.61
AD-12 (a)	33.04901	94.84977	366.27	30.0	9/24/2009	PVC	2	18	348	30	336	20.0	346.27	30.0	336.27
AD-13 (a)	33.04918	94.84275	344.12	20.0	9/22/2009	PVC	2	4	340	20	324	6.0	338.12	16.0	328.12
AD-14 (a)	33.04715	94.84256	342.32	19.0	9/22/2009	PVC	2	6	336	18	324	8.0	334.32	18.0	324.32
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	46.0	12/12/15	PVC	2	22	318	45.5	295	25.5	314.71	45.5	294.71
AD-16R	33° 02' 49"	94° 50' 29"	350.55	27.0	4/12/17	PVC	2	10	341	27	324	12.0	338.55	27.0	323.55
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	40.0	12/10/15	PVC	2	22	332	39	315	24.0	329.99	39.0	314.99
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	29.0	12/11/15	PVC	2	12	334	29	317	14.0	332.17	29.0	317.17
Piezometers															
B-2 (b)	33° 03.078'	94° 50.449'	339.7	50.0	10/28/2009	PVC	2	8	332	20	320	10.0	329.70	20.0	319.70
B-4 (b)	33° 03.011'	94° 50.462'	340.6	50.0	10/27/2009	PVC	2	8	333	18	323	8.0	332.60	18.0	322.60
B-5 (b)	33° 02.964'	94° 50.428'	340.0	50.0	10/27/2009	PVC	2	5	335	20	320	10.0	330.00	20.0	320.00
B-6 (b)	33° 02.912'	94° 50.462'	340.1	50.0	10/28/2009	PVC	2	4	336	22	318	12.0	328.10	22.0	318.10
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	21.0	12/10/15	PVC	2	9	342	21	330	11.0	339.86	21.0	329.86

General Notes:
Elevation in feet above mean sea level.

Footnotes:
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.

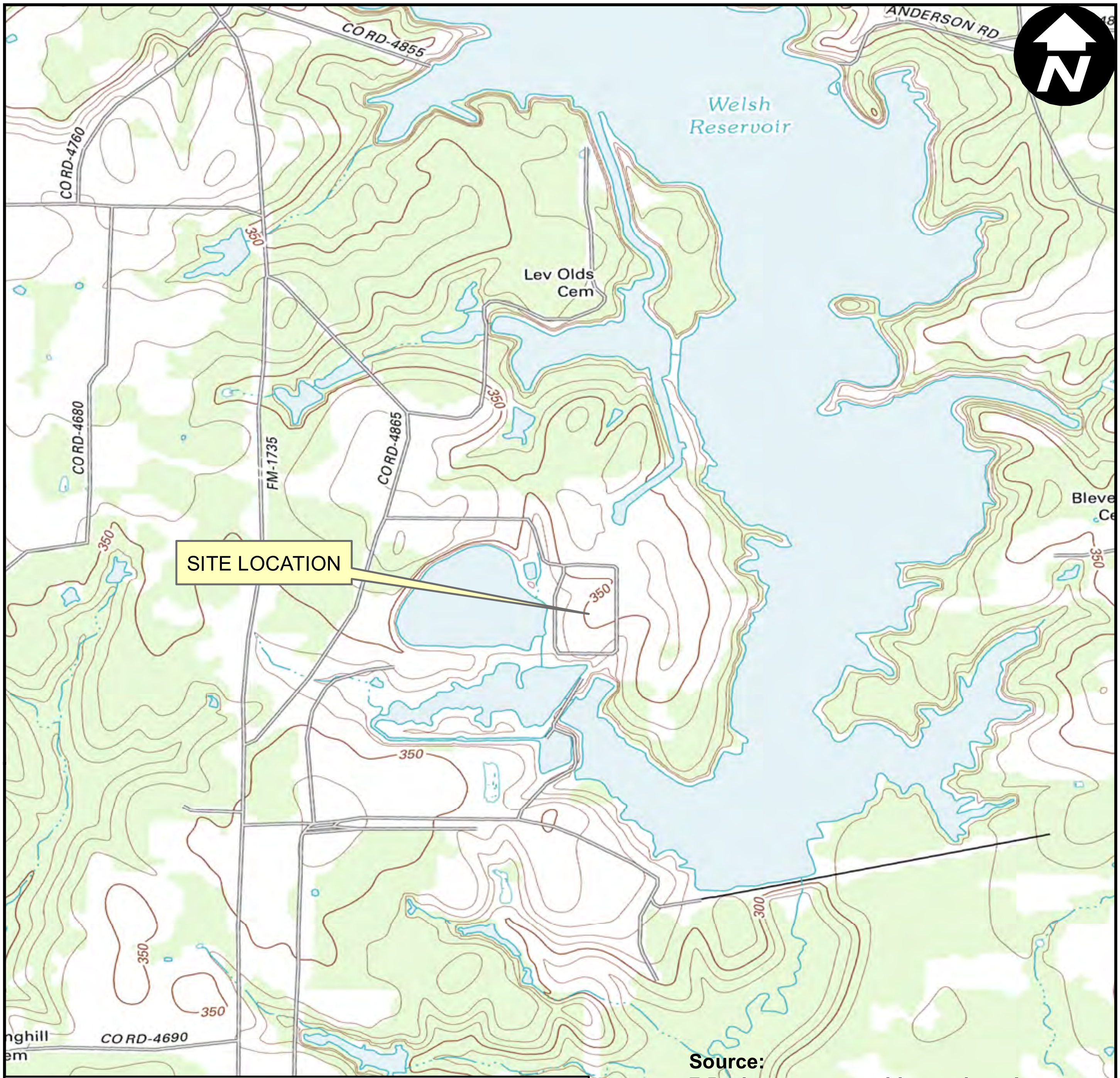
Acronyms and Abbreviations:
NA = Data not available
ft = feet
bls = below land surface
msl = mean sea level

Table 3
Proposed Well Network
AEP J. Robert Welsh Power Plant - Bottom Ash Storage Pond
Pittsburg, Titus County, Texas

Well ID	Exisiting/ Proposed	Hydrostratigraphic Unit Target	Location Description		Screen Top Elevation (ft amsl)	Screen Bottom Elevation (ft amsl)	Screen Length (ft)	Comments
Upgradient								
AD-1	Existing	Uppermost Water-Bearing Unit	West of Bottom Ash Storage Pond	Upgradient	340.6	330.6	10	Existing well installed in 2001; well will be utilitzed to establish backgroud water quality
AD-5	Existing	Uppermost Water-Bearing Unit	NW of Bottom Ash Storage Pond	Upgradient	329.0	319.0	10	Existing well installed in 2001; well will be utilitzed to establish backgroud water quality
AD-17	Existing	Uppermost Water-Bearing Unit	NW of Bottom Ash Storage Pond	Upgradient	330.0	315.0	15	New monitoring well installed during December 2015 in uppermost shallow aquifer northwest of Bottom Ash Storage Pond - upgradient; well will be utilized to establish background water quality
AD-18	Existing	Uppermost Water-Bearing Unit	NW of Bottom Ash Storage Pond	Upgradient	332.2	317.2	15	New monitoring well installed during December 2015 in uppermost shallow aquifer northwest of Bottom Ash Storage Pond - upgradient; well will be utilized to establish background water quality
Downgradient								
AD-3	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	324.1	314.1	10	Existing well installed in 2001; uppermost shallow aquifer adjacent to the bottom ash storage pond - downgradient
AD-4c	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	324.2	314.2	10	Existing well installed in 2009; uppermost shallow aquifer adjacent to the bottom ash storage pond - downgradient
AD-16R	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	338.6	323.6	15	New monitoring well installed during April 2017 in uppermost shallow aquifer adjacent to the bottom ash storage pond - downgradient
Piezometers								
AD-2	Existing	Uppermost Water-Bearing Unit	South of Bottom Ash Storage Pond	Side gradient	329.2	319.2	10	Existing well installed in 2001; and utilitzed to obtain water level data for uppermost water-bearing unit
AD-4	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	321.6	311.6	10	Existing well installed in 2001; and utilitzed to obtain water level data for uppermost water-bearing unit
AD-4a	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	320.2	310.2	10	Existing well installed in 2009; and utilitzed to obtain water level data for uppermost water-bearing unit
AD-4b	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	324.6	314.6	10	Existing well installed in 2009; and utilitzed to obtain water level data for uppermost water-bearing unit
AD-16	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	339.9	329.9	10	New piezometer installed during December 2015 in uppermost shallow aquifer adjacent to the bottom ash storage pond - downgradient

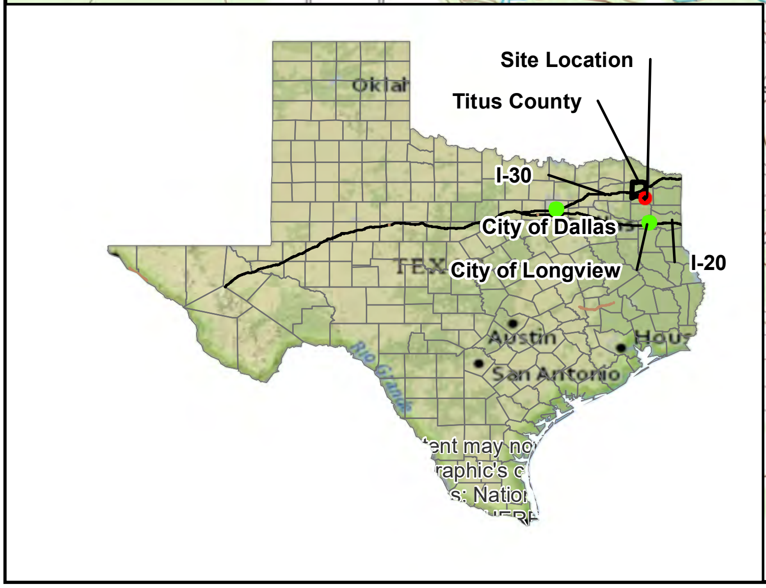
Acronyms and Abbreviations:
U=Upgradient
D=Downgradient
ft = feet
amsl = above mean sea level

Figures



Source:
7.5 minute topographic quadrangle
Cason, Texas, 2013

0 2,000 4,000
SCALE IN FEET



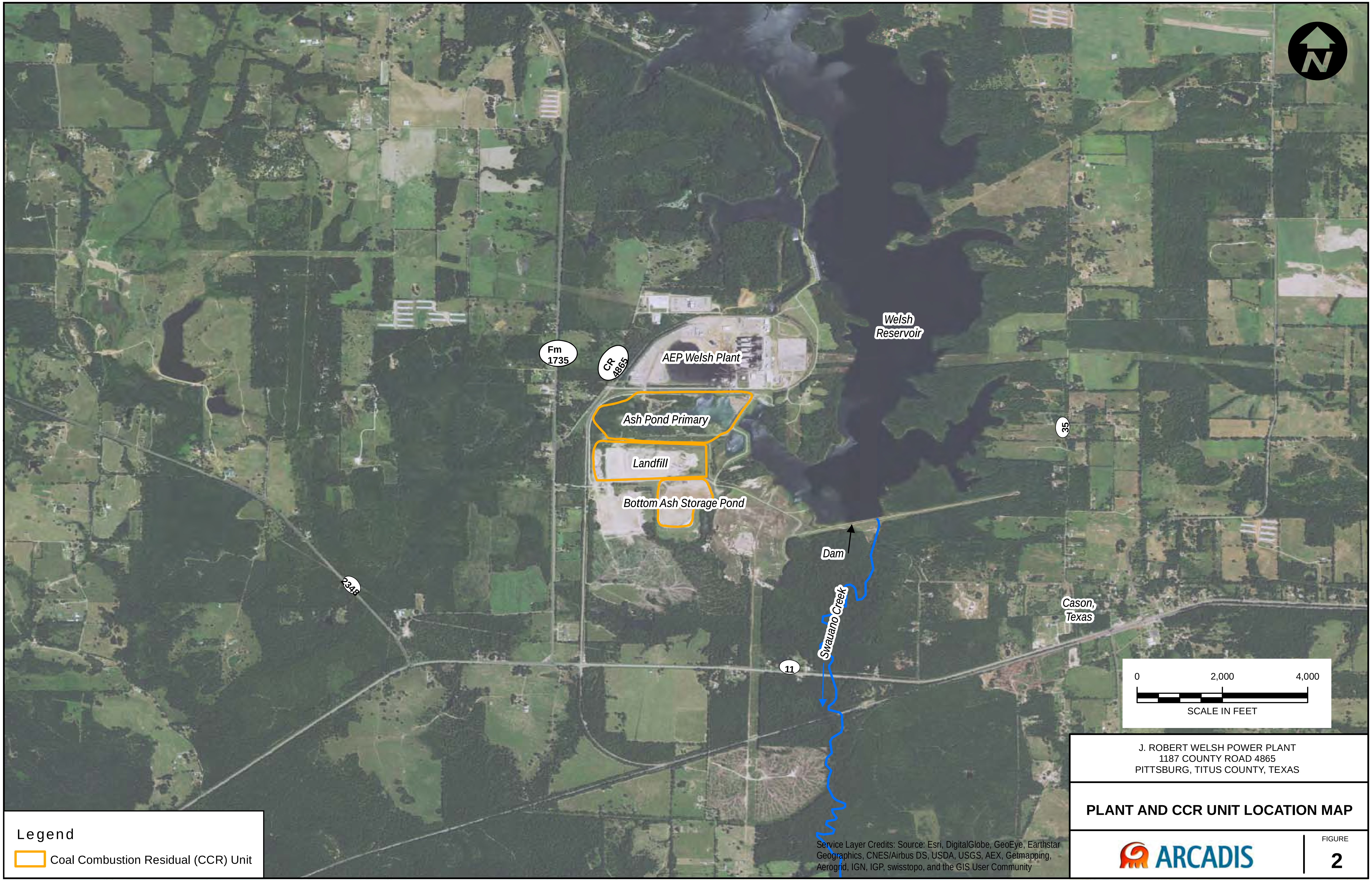
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LOCATION MAP

ARCADIS

FIGURE
1

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 1 - site map.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

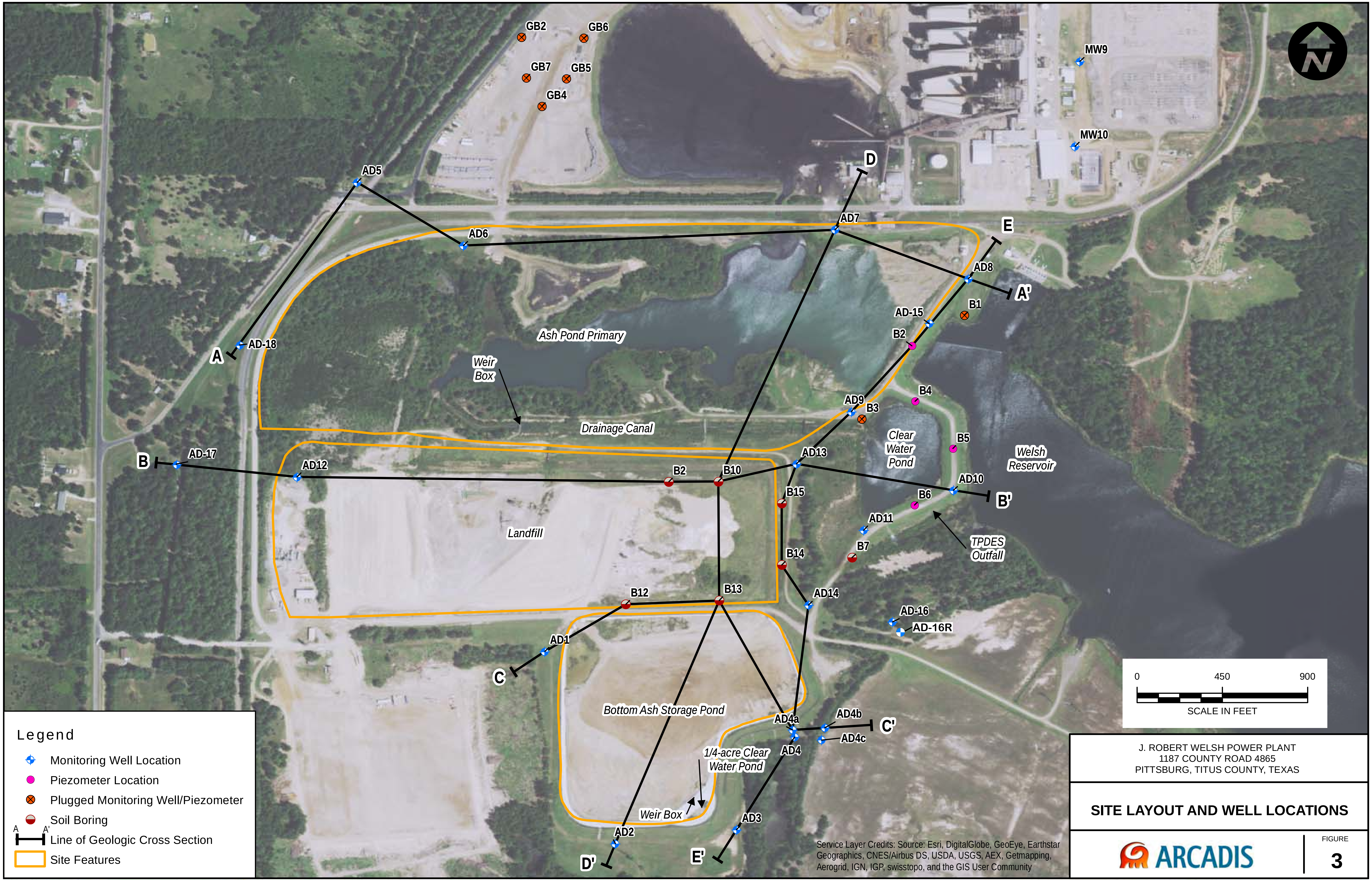
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PLANT AND CCR UNIT LOCATION MAP

ARCADIS

FIGURE
2

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 2 - CCR location.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

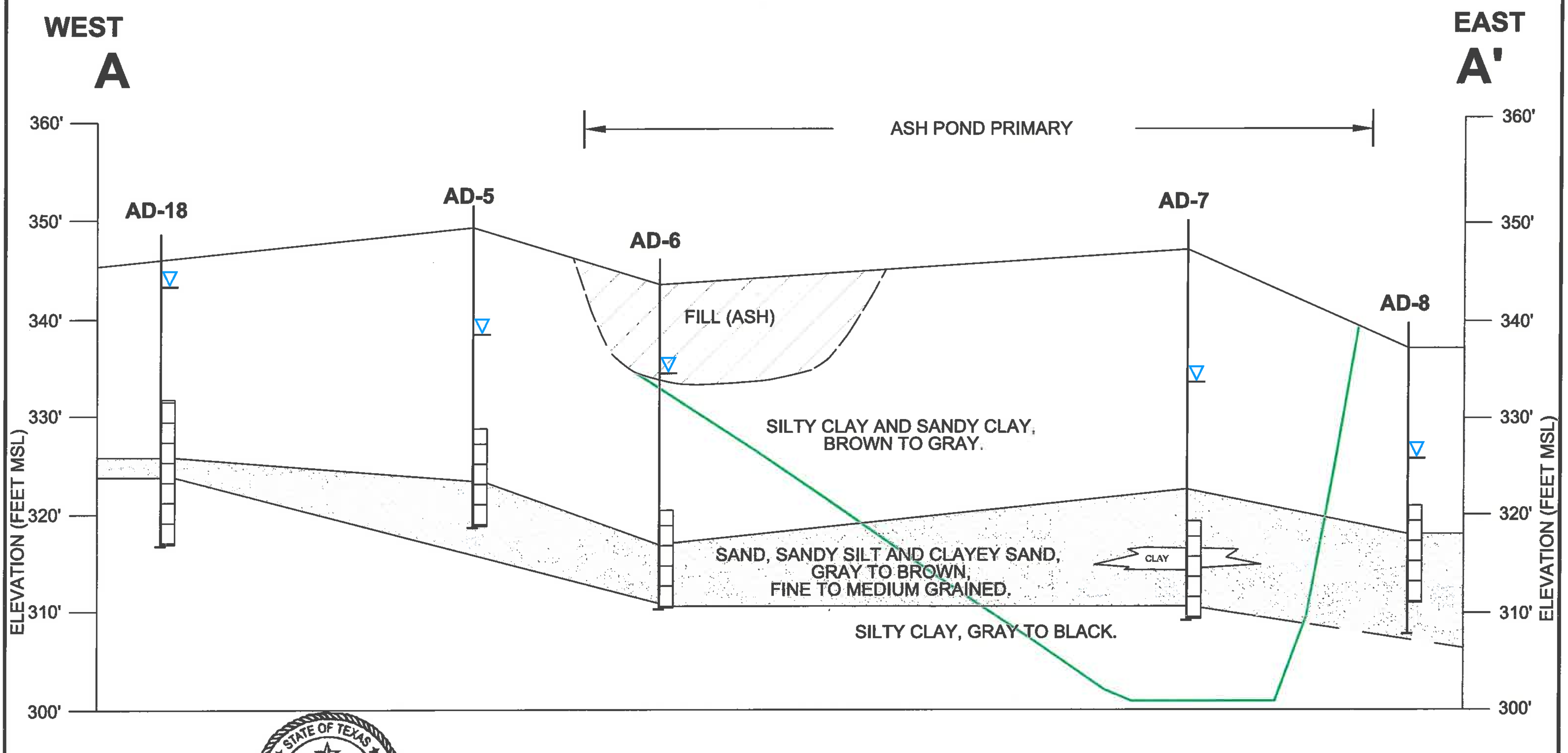
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LAYOUT AND WELL LOCATIONS

ARCADIS

FIGURE
3

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 3 - site layout.mxd



Kenneth J. Brandner
Geology
1787

5-6-17

0 300'
HORIZONTAL SCALE

NOTE: BASE OF ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

▯	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	PROJECTED BASE OF ASH POND (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
A - A'

ARCADIS

FIGURE
4

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEPOH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 4 Cross Section A-A'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:46 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE: —
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CITY: DIV/GROUP: DB: LD: AM: PO: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 5 Cross Section B-B'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:41 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE:
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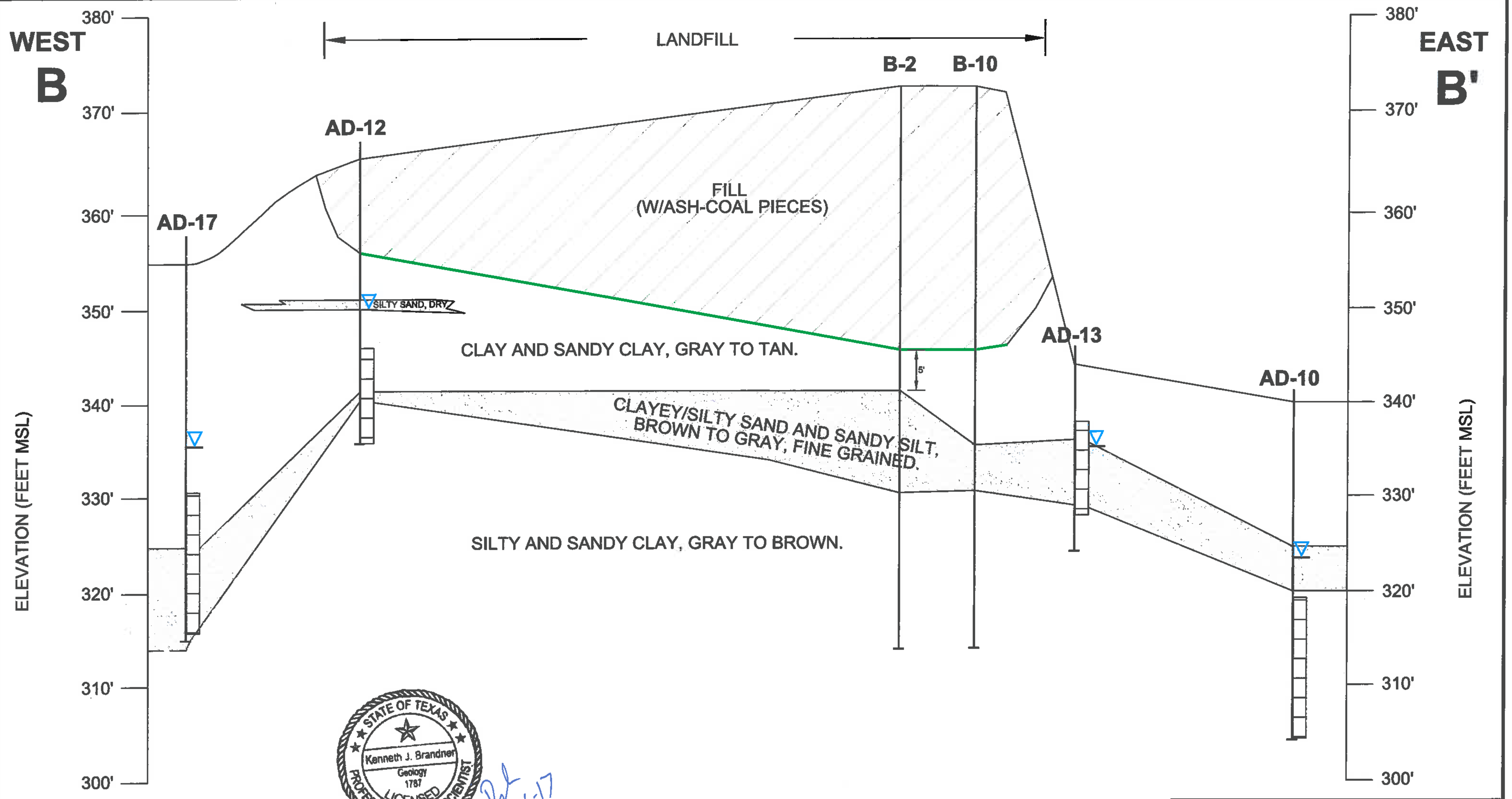


Kenneth J. Brandner
Geology
1787

5-6-17

0 300'
HORIZONTAL SCALE

NOTE: BASE OF LANDFILL ELEVATION TAKEN FROM "WELSH POWER PLANT- UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12/3/76.

LEGEND

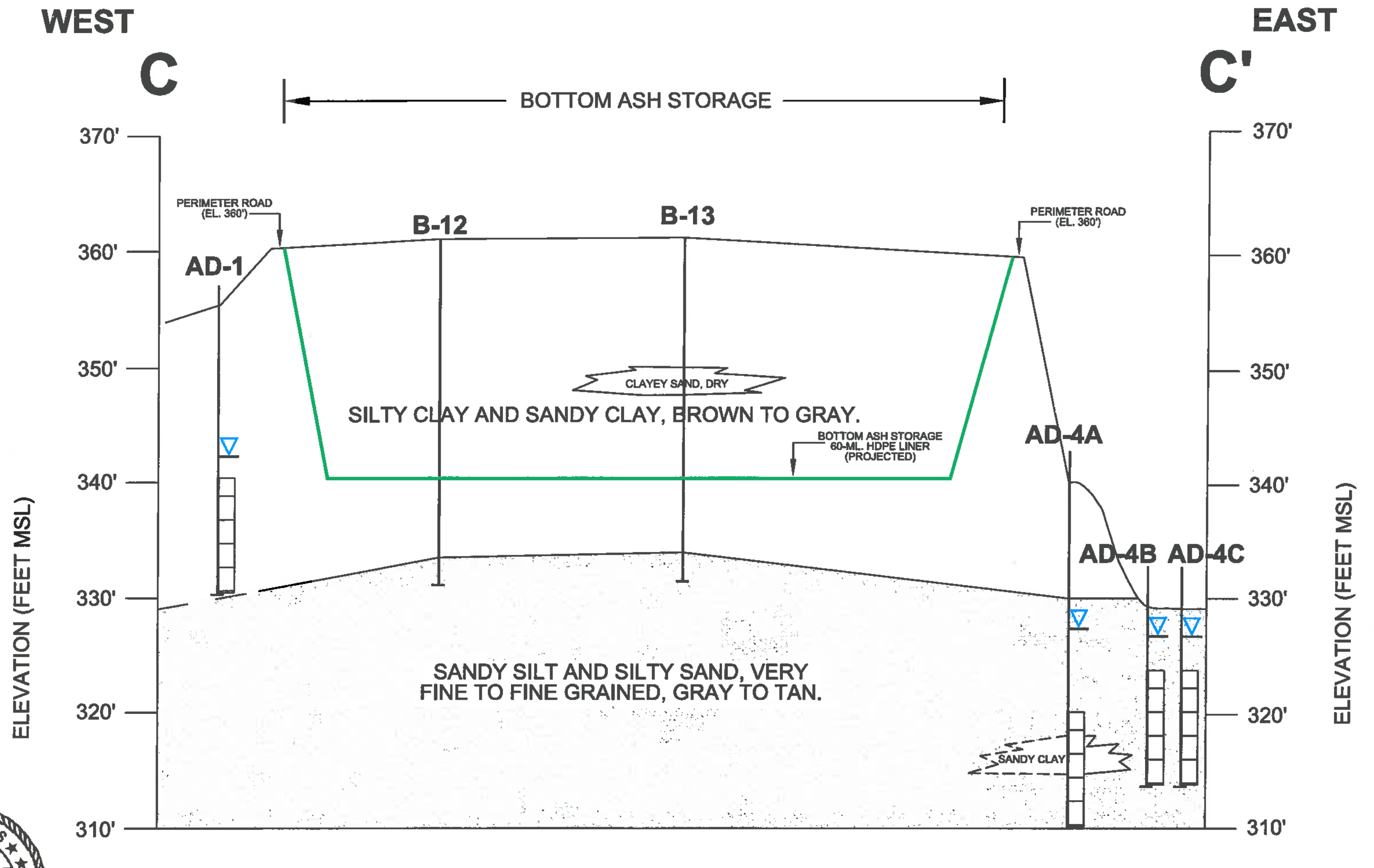
⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
🟩	BASE OF LANDFILL (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
B - B'

ARCADIS

FIGURE
5



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Geology
1787

5-6-17

0 200'
HORIZONTAL SCALE

NOTE: BASE OF BOTTOM ASH STORAGE HAS A 60-ML. HDPE LINER AT ELEVATION 340.0', TAKEN FROM FREESE AND NICHOLS "HYDRAULIC ANALYSIS OF WELSH POWER PLANT ASH PONDS, AMERICAN ELECTRIC POWER COMPANY", DATED DECEMBER 2010.

LEGEND

▤	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
🟩	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION C - C'

ARCADIS

FIGURE
6

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 6 Cross Section C-C'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:54 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: —
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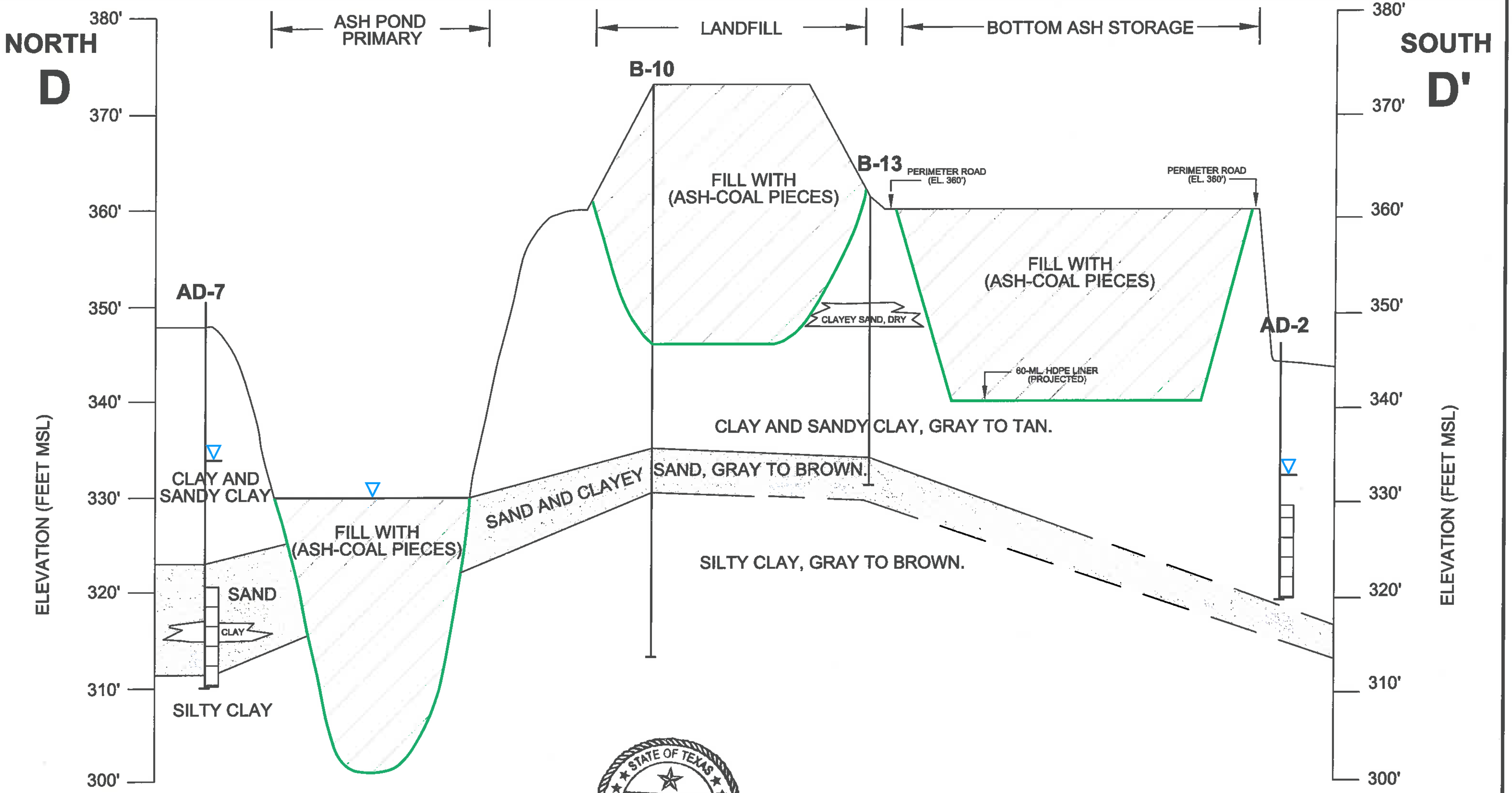

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Geology
1737

5-6-17

LEGEND

- ▯ MONITORING WELL SCREENED INTERVAL
- ▽ WATER LEVEL IN MONITORING WELL (3/4/16)
- 🟩 BASE OF CCR UNIT

NOTE: BASE OF ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

0 300'
HORIZONTAL SCALE

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION D - D'

ARCADIS

FIGURE
7

CITY: DIV/GROUP: DB: LD: AM: PIC: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\ON015076 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 7 Cross Section D-D'.dwg LAYOUT: MODEL SAVED: 8/26/2016 9:07 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE: —
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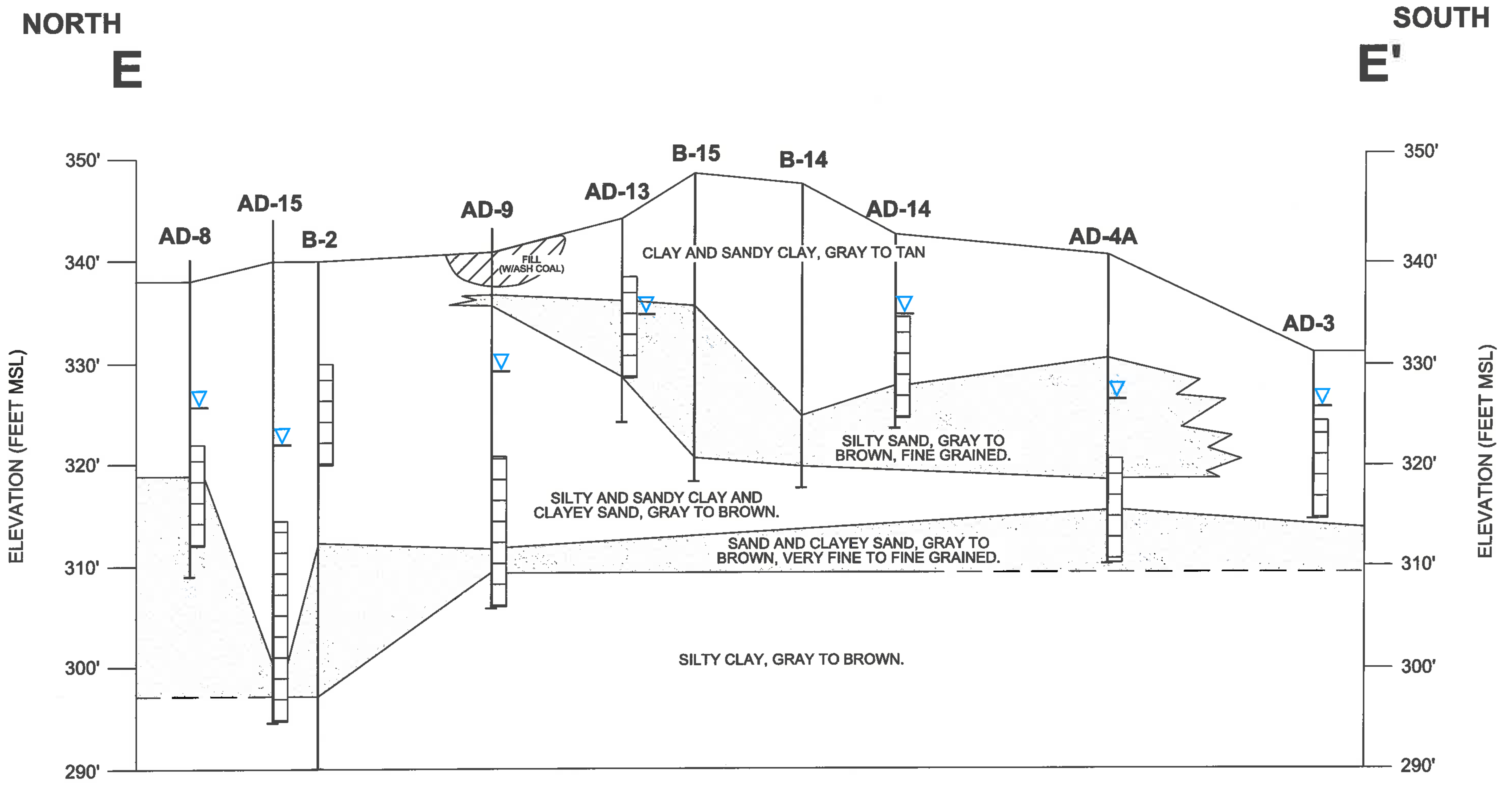

0 300'
HORIZONTAL SCALE

Kenneth J. Brandner
Geology
1737

5-6-17

LEGEND

- ▯ MONITORING WELL SCREENED INTERVAL
- ▽ WATER LEVEL IN MONITORING WELL (3/4/16)
- — PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
E - E'

ARCADIS

FIGURE
8

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 8 Cross Section E-E'.dwg LAYOUT: MODEL SAVED: 3/11/2016 12:08 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE:
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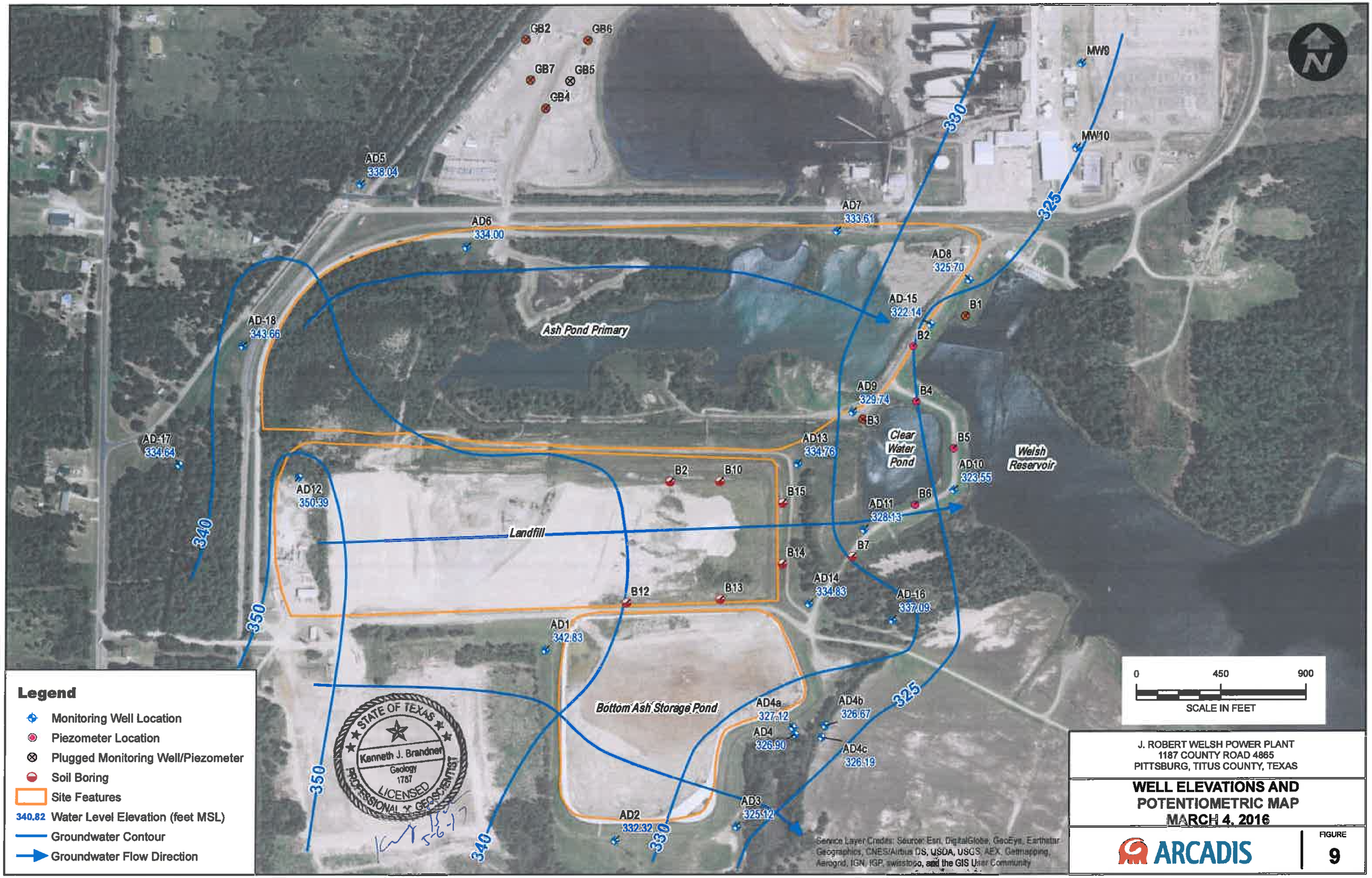

Legend

- ⌖ Monitoring Well Location
- ● Piezometer Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◒ Soil Boring
- ▭ Site Features
- 340.82 Water Level Elevation (feet MSL)
- — Groundwater Contour
- → Groundwater Flow Direction

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1787

5-6-17

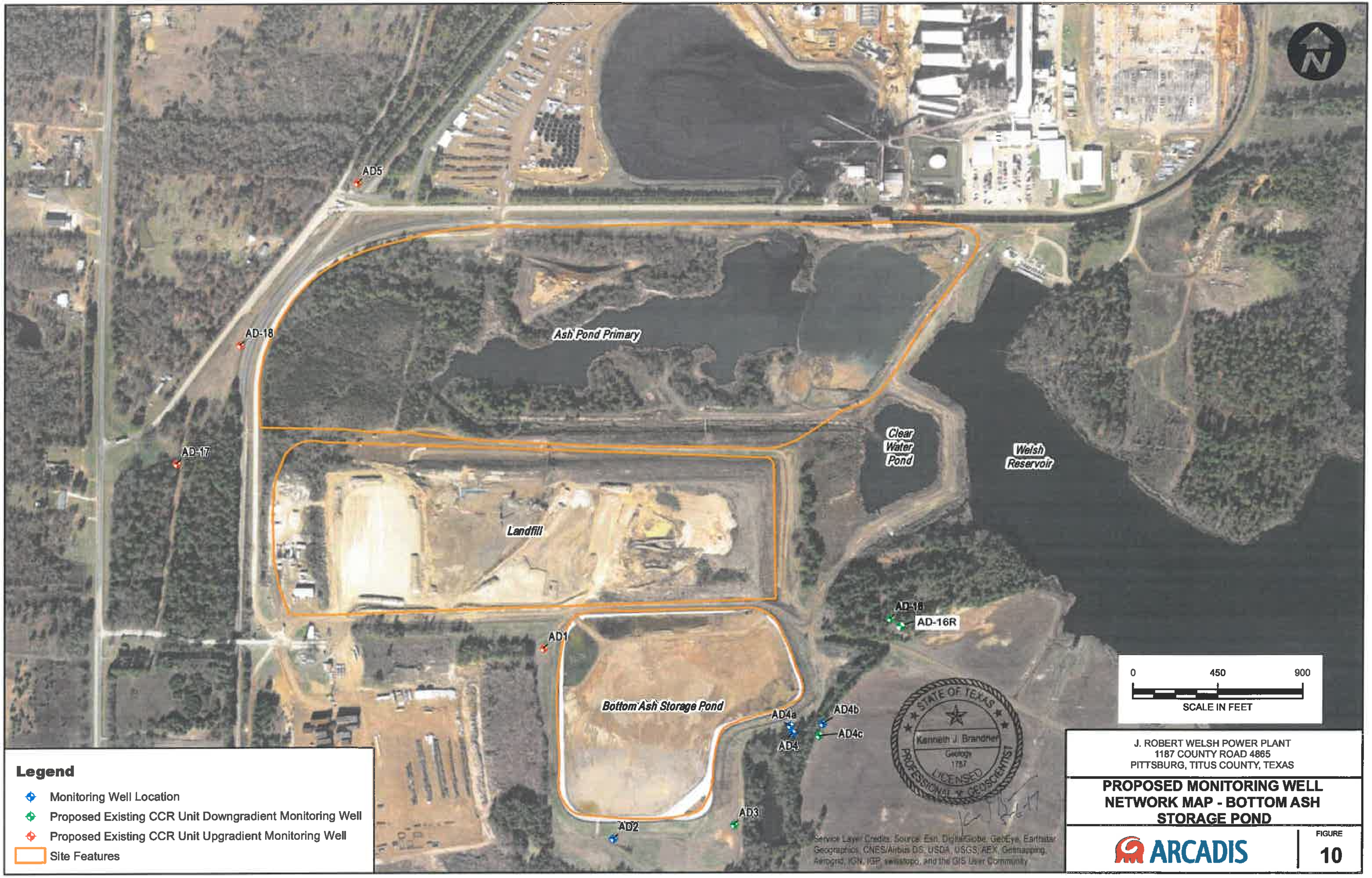
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

WELL ELEVATIONS AND POTENTIOMETRIC MAP MARCH 4, 2016

ARCADIS

FIGURE
9

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 9 - Mar2016_POT.mxd



Legend

- 🔷 Monitoring Well Location
- 🟩 Proposed Existing CCR Unit Downgradient Monitoring Well
- 🟥 Proposed Existing CCR Unit Upgradient Monitoring Well
- ▭ Site Features

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Geology
1787

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PROPOSED MONITORING WELL NETWORK MAP - BOTTOM ASH STORAGE POND

ARCADIS

FIGURE
10

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Bottom Ash Storage\fig 10 - proposed wells.mxd

ARCADIS

Appendix A

Boring/Well Construction Logs

AD-1

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4, Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic
☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'48"N
94°50'47"W
N

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven
☐ Air Rotary ☐ Mud Rotary ☒ Bored
☐ Air Hammer ☐ Cable Tool ☐ Jetted
☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	25	gray silty clay with some hard red streaks
		AP-1

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall
☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 13 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	sch 40
2	N	#10 slot screen	15	25	sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 13 ft. to 0 ft. No. of sacks used 6-50#
ft. to ft. No. of sacks used
Method used bentonite
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 12'8" ft. below land surface Date 1-11-01
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-2

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

County ~~Camp~~ Titus

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'37"N
94°50'44"W
N↑

6) WELL LOG:
Date Drilling:
Started 4/26 2001
Completed 4/26 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	2	top soil
2	5	red & gray clay w/ silt
5	10	red & gray clay w/ silt
10	25	gray silty clay w/ tan streaks
		AP-2

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other

If Gravel Packed give interval ... from 12 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	Sch 40
2	N	#10 slot screen	15	25	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]

Cemented from 12 ft. to +2 ft. No. of sacks used 5-50#

ft. to ft. No. of sacks used

Method used bentonite pellets

Cemented by

Distance to septic system field lines or other concentrated contamination ft.

Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) Gilbert M (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-3

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'38"N
94°50'37"W
N↑

6) WELL LOG:
Date Drilling:
Started 4/26 2001
Completed 4/26 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	17

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ____

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other ____

If Gravel Packed give interval ... from 5 ft. to 17 ft.

From (ft.)	To (ft.)	Description and color of formation material
0	12	gray silty clay w/tan streaks
12	15	very stiff gray/blood red clay
15	17	Very stiff gray clay w/ red nodules and tan streaks

AP-3

(Use reverse side if necessary)

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	7	Sch 40
2	N	#10 slot screen	7	17	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 2 ft. to 5 ft. No. of sacks used 2 1/2 - 50#
____ ft. to ____ ft. No. of sacks used ____
Method used bentonite pellets
Cemented by ____
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance ____

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ____ ft. below land surface Date ____
Artesian flow ____ gpm. Date ____

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ____
Depth to pump bowls, cylinder, jet, etc., ____ ft.

14) WELL TESTS: NA
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ____ (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS ____ (Street or RFD) (City) (State) (Zip)

(Signed) ____ (Licensed Well Driller) (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-4

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS 33°02'43"N 94°50'33"W

6) WELL LOG:
Date Drilling:
Started 4/26 19 2001
Completed 4/26 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	5	red silty clay with gray streaks
5 -	30	gray silty clay with red streaks

AD-4

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	19	Sch. 40
2	N	#10 slot screen	19	29	Sch. 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 2 ft. No. of sacks used 8-50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other NA
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete Items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4A**
TOTAL DEPTH:	**30'**
TOP OF CASING ELEV.:	**342.85 ft. NGVD**
GROUND SURFACE ELEV.:	**340.19 ft. NGVD**

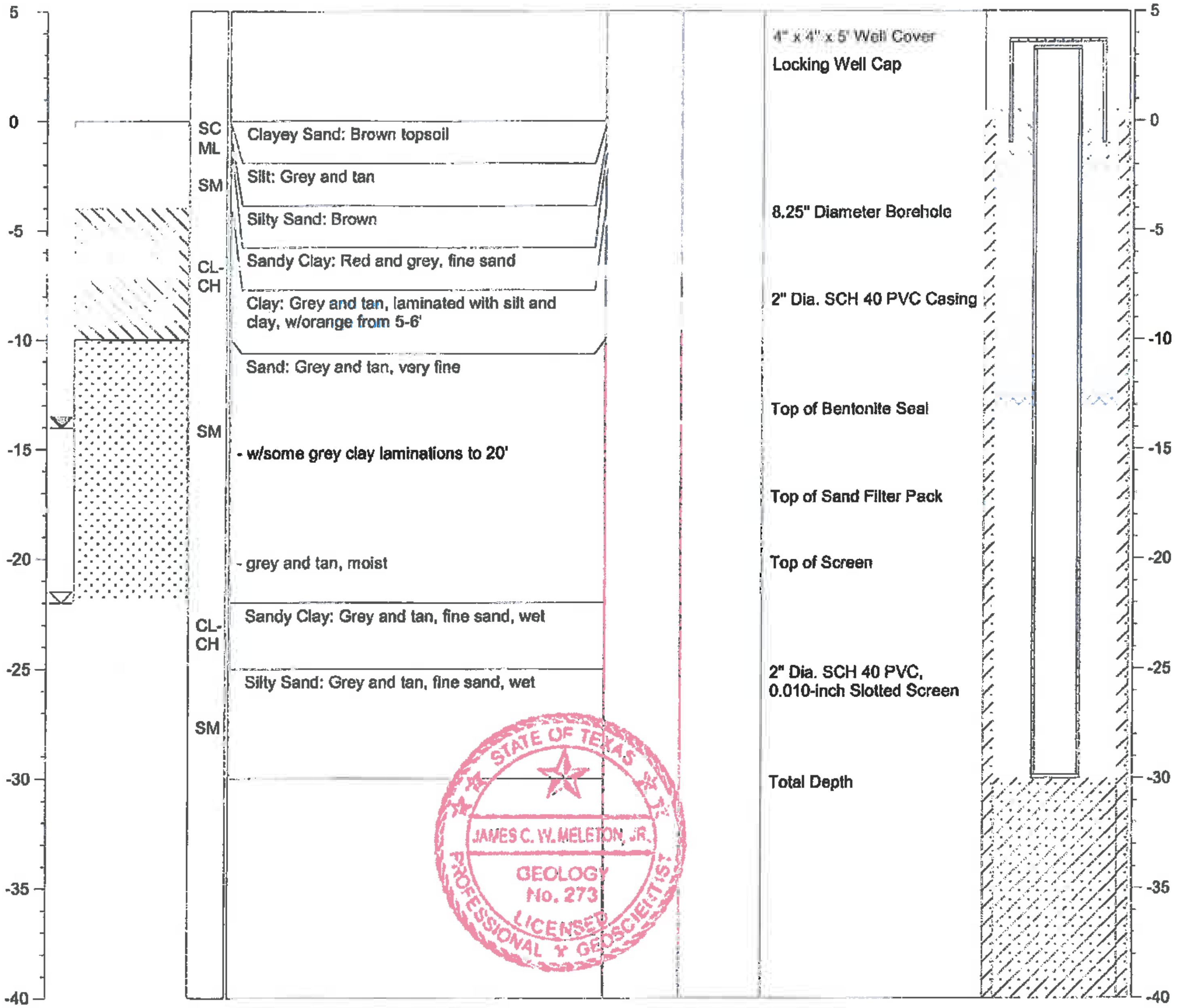
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04527**
Longitude: 94.84258

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



SC Clayey Sand: Brown topsoil

ML Silt: Grey and tan

SM Silty Sand: Brown

CL-CH Sandy Clay: Red and grey, fine sand

Clay: Grey and tan, laminated with silt and clay, w/orange from 5-6'

SM Sand: Grey and tan, very fine

- w/some grey clay laminations to 20'

- grey and tan, moist

CL-CH Sandy Clay: Grey and tan, fine sand, wet

SM Silty Sand: Grey and tan, fine sand, wet

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4B**
TOTAL DEPTH:	**15'**
TOP OF CASING ELEV.:	**333.23 ft. NGVD**
GROUND SURFACE ELEV.:	**329.55 ft. NGVD**

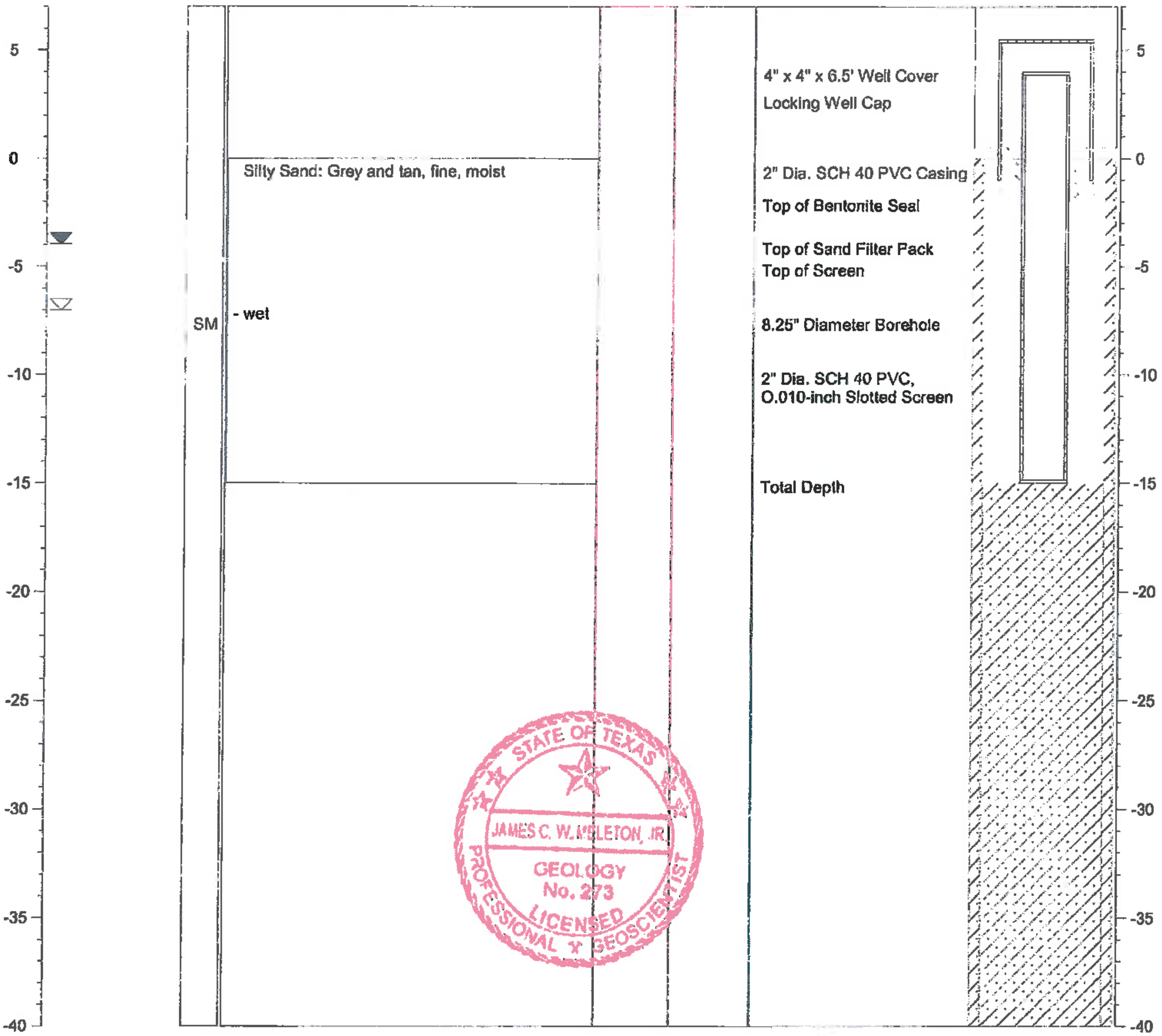
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.04531**
Longitude: 94.84230

▼ Water level during drilling
▽ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Silty Sand: Grey and tan, fine, moist

- wet

4" x 4" x 6.5' Well Cover
Locking Well Cap
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
8.25" Diameter Borehole
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
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SOIL BORING LOG

BORING/WELL NO.:	**AD-4C**
TOTAL DEPTH:	**15'**
TOP OF CASING ELEV.:	**333.28 ft. NGVD**
GROUND SURFACE ELEV.:	**329.15 ft. NGVD**

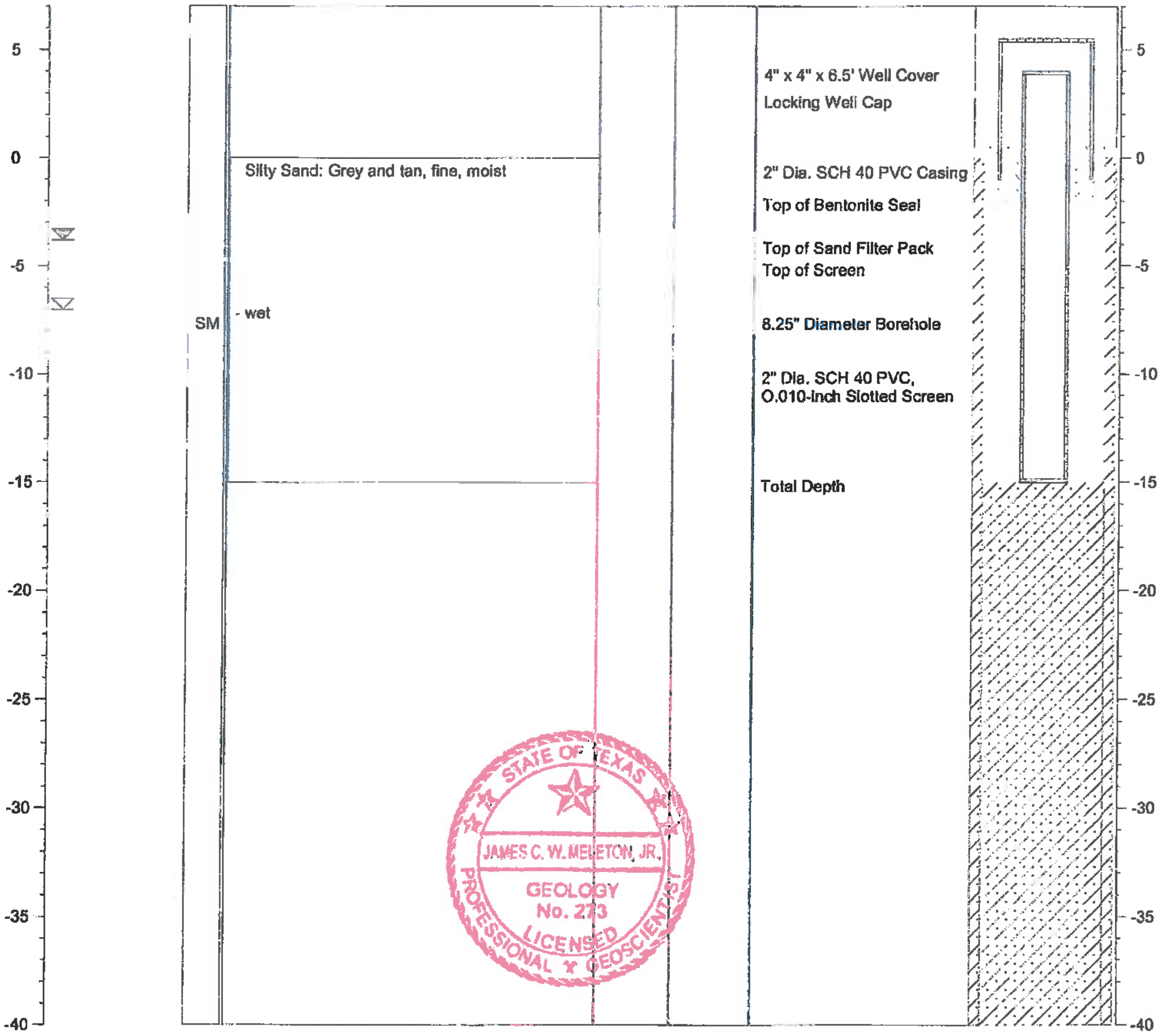
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.04507**
Longitude: 94.84244

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

AD-5

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt.4, Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) 33°03'13"N
94°51'00"W

N↑

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	10	red & gray clay with orange streaks
10	20	gray/black clay with tan clay
20	25	stiff clay with lignite streak
25	30	fine gray sand

AP-5

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other

If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	risor	+2	20	Sch 40
2	N	#10 slot screen	20	30	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 0 ft. No. of sacks used ______
______ ft. to ______ ft. No. of sacks used ______
Method used bentonite
Cemented by ______
Distance to septic system field lines or other concentrated contamination ______ ft.
Method of verification of above distance ______

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 11'9" ft. below land surface Date 1-11-01
Artesian flow ______ gpm. Date ______

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc., ______ ft.

14) WELL TESTS:
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ______ (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS ______ (Street or RFD) (City) (State) (Zip)

(Signed) Gilbert M R (Licensed Well Driller) (Signed) ______ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

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ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

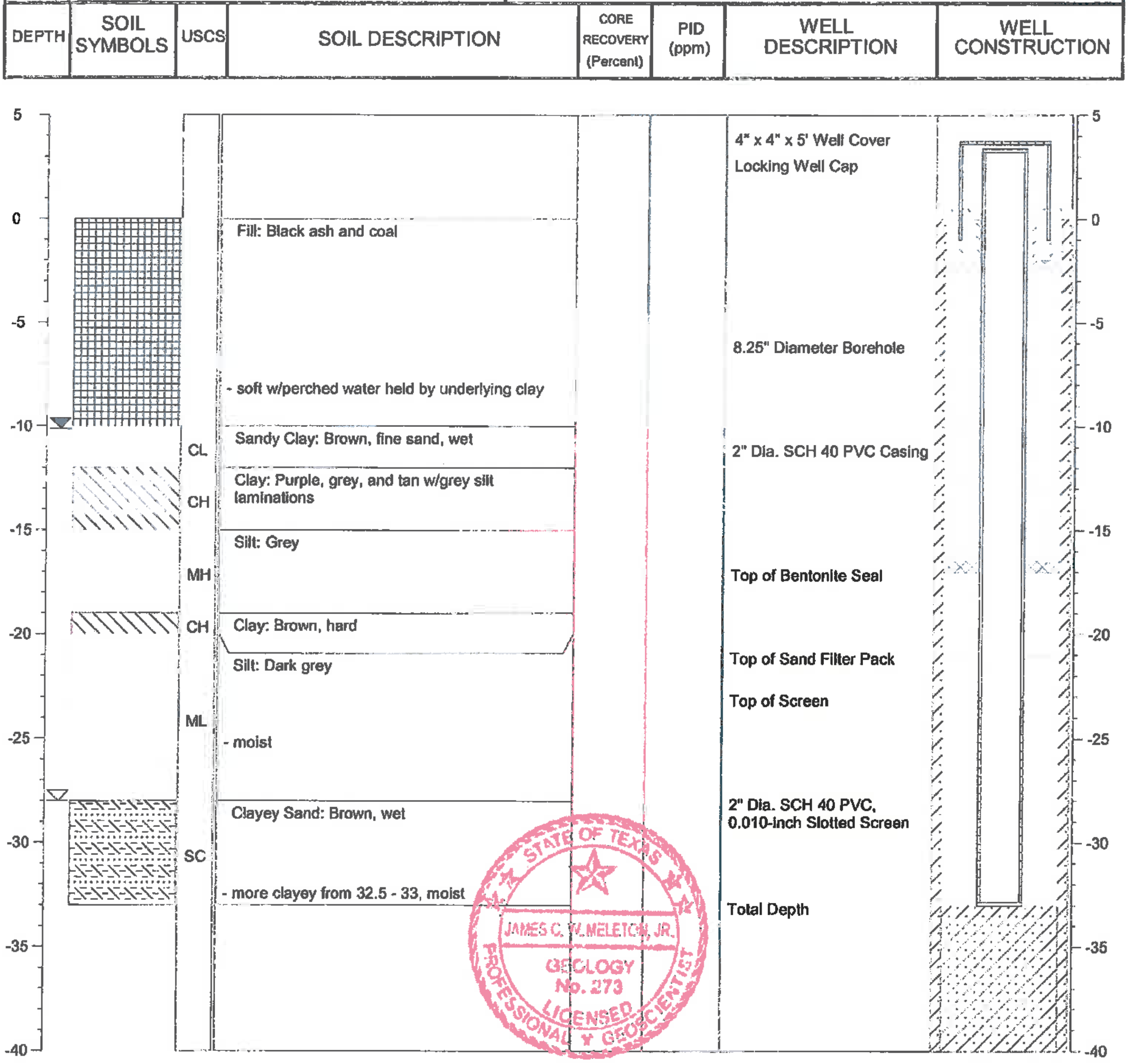
BORING/WELL NO.:	**AD-6**
TOTAL DEPTH:	**33'**
TOP OF CASING ELEV.:	**346.33 ft. NGVD**
GROUND SURFACE ELEV.:	**343.31 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.05235**
Longitude: 94.84757

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



Fill: Black ash and coal

- soft w/perched water held by underlying clay

Sandy Clay: Brown, fine sand, wet

Clay: Purple, grey, and tan w/grey silt laminations

Silt: Grey

Clay: Brown, hard

Silt: Dark grey

- moist

Clayey Sand: Brown, wet

- more clayey from 32.5 - 33, moist

4" x 4" x 5' Well Cover
Locking Well Cap

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Bentonite Seal

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen

Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED PROFESSIONAL GEOSCIENTIST

EAGLE ENVIRONMENTAL SERVICES OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.:	**AD-7**
TOTAL DEPTH:	**38'**
TOP OF CASING ELEV.:	**350.82 ft. NGVD**
GROUND SURFACE ELEV.:	**347.86 ft. NGVD**

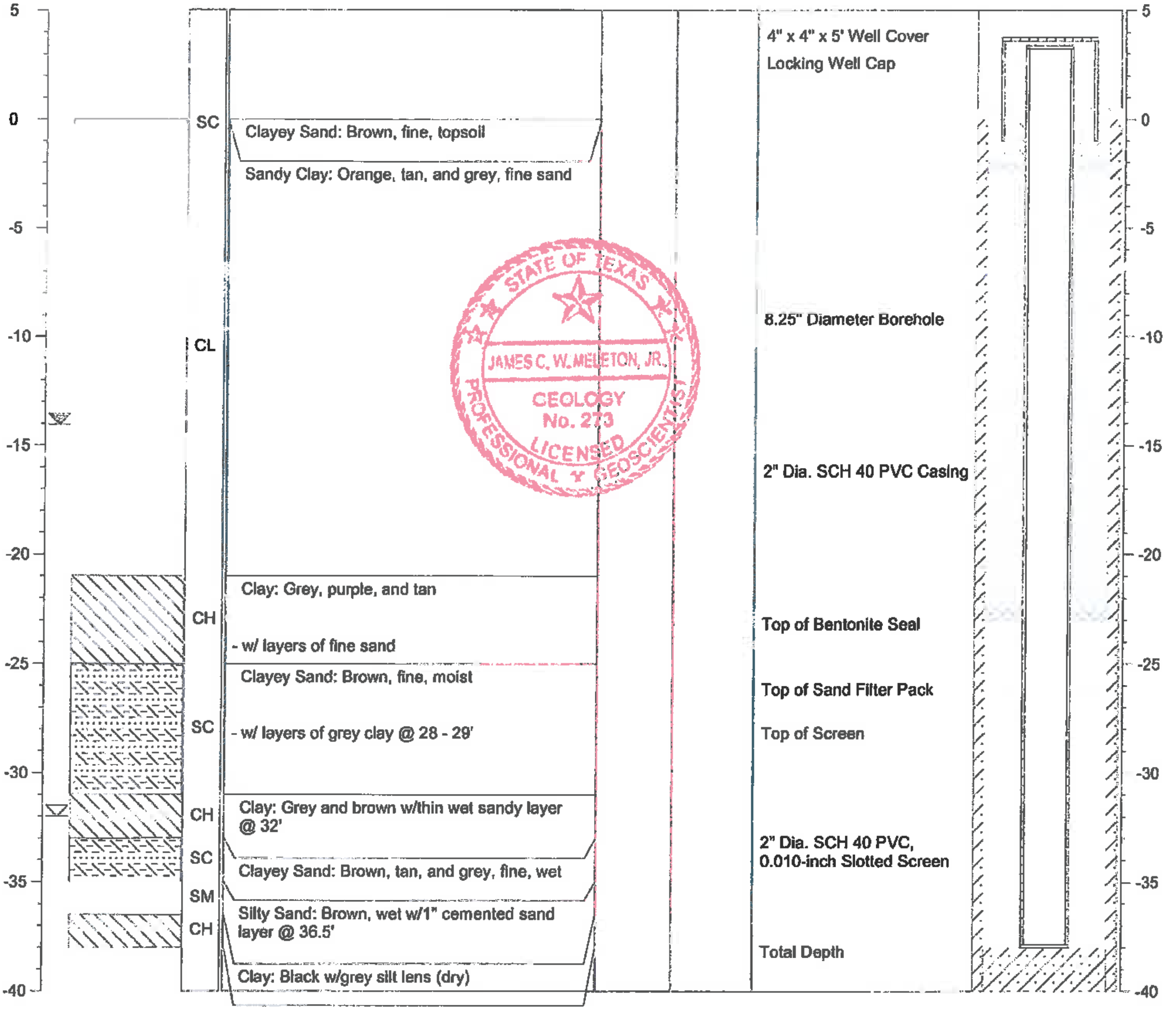
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/24/09**

NOTES: **Latitude: 33.05257**
Longitude: 94.84219

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Clayey Sand: Brown, fine, topsoil

Sandy Clay: Orange, tan, and grey, fine sand

Clay: Grey, purple, and tan
- w/ layers of fine sand

Clayey Sand: Brown, fine, moist
- w/ layers of grey clay @ 28 - 29'

Clay: Grey and brown w/thin wet sandy layer @ 32'

Clayey Sand: Brown, tan, and grey, fine, wet

Silty Sand: Brown, wet w/1" cemented sand layer @ 36.5'

Clay: Black w/grey silt lens (dry)

4" x 4" x 5' Well Cover
Locking Well Cap

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Bentonite Seal

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen

Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED PROFESSIONAL GEOSCIENTIST

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ENVIRONMENTAL SERVICES
OF SHREVEPORT INC

SOIL BORING LOG

BORING/WELL NO.:	**AD-8**
TOTAL DEPTH:	**29'**
TOP OF CASING ELEV.:	**340.01 ft. NGVD**
GROUND SURFACE ELEV.:	**337.53 ft. NGVD**

CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

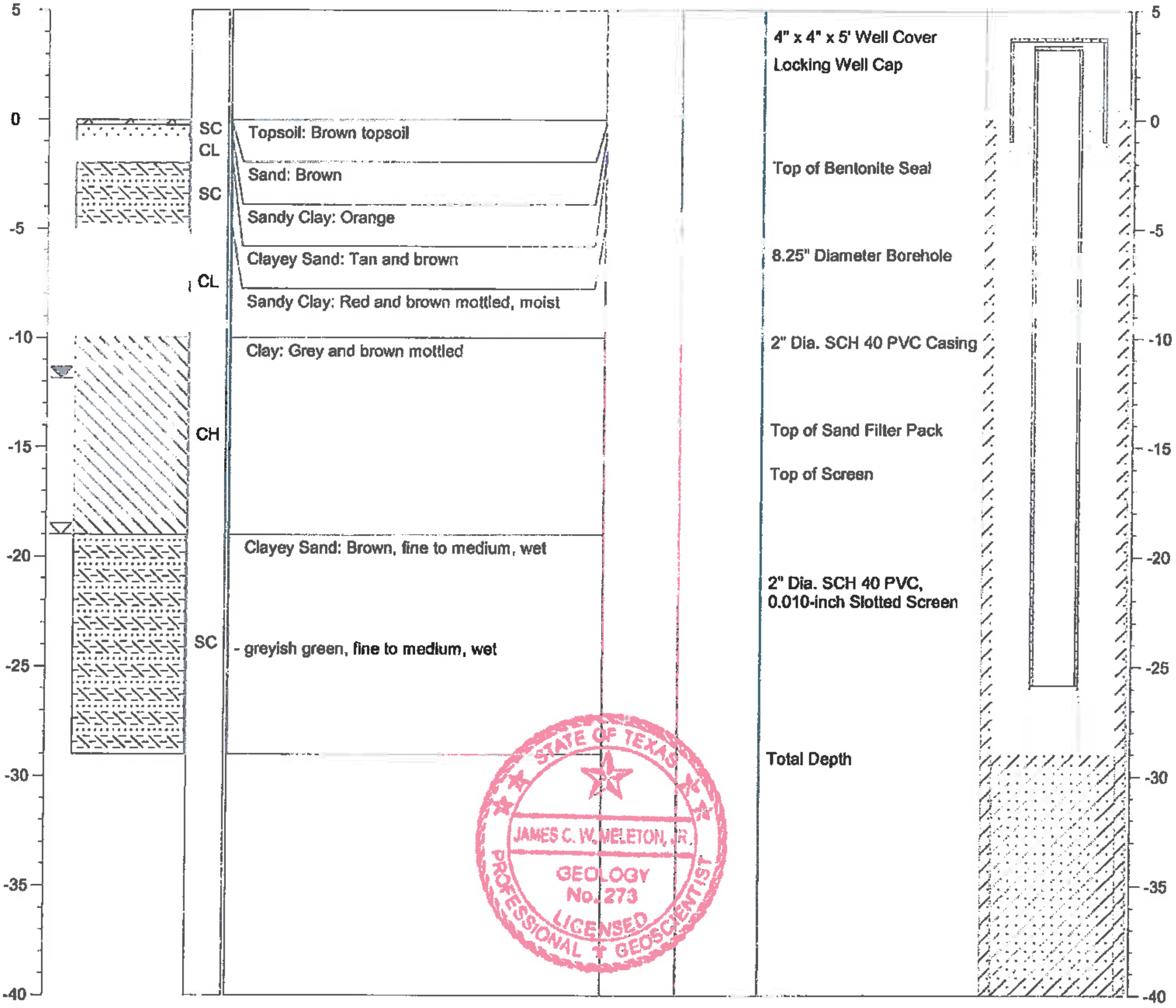
DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/21/09**

NOTES: **Latitude: 33.05187**
Longitude: 94.84026

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Topsoil: Brown topsoil
Sand: Brown
Sandy Clay: Orange
Clayey Sand: Tan and brown
Sandy Clay: Red and brown mottled, moist
Clay: Grey and brown mottled
Clayey Sand: Brown, fine to medium, wet
- greyish green, fine to medium, wet

4" x 4" x 5' Well Cover
Locking Well Cap
Top of Bentonite Seal
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC,
0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.:	**AD-9**
TOTAL DEPTH:	**35'**
TOP OF CASING ELEV.:	**343.09 ft. NGVD**
GROUND SURFACE ELEV.:	**340.32 ft. NGVD**

CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

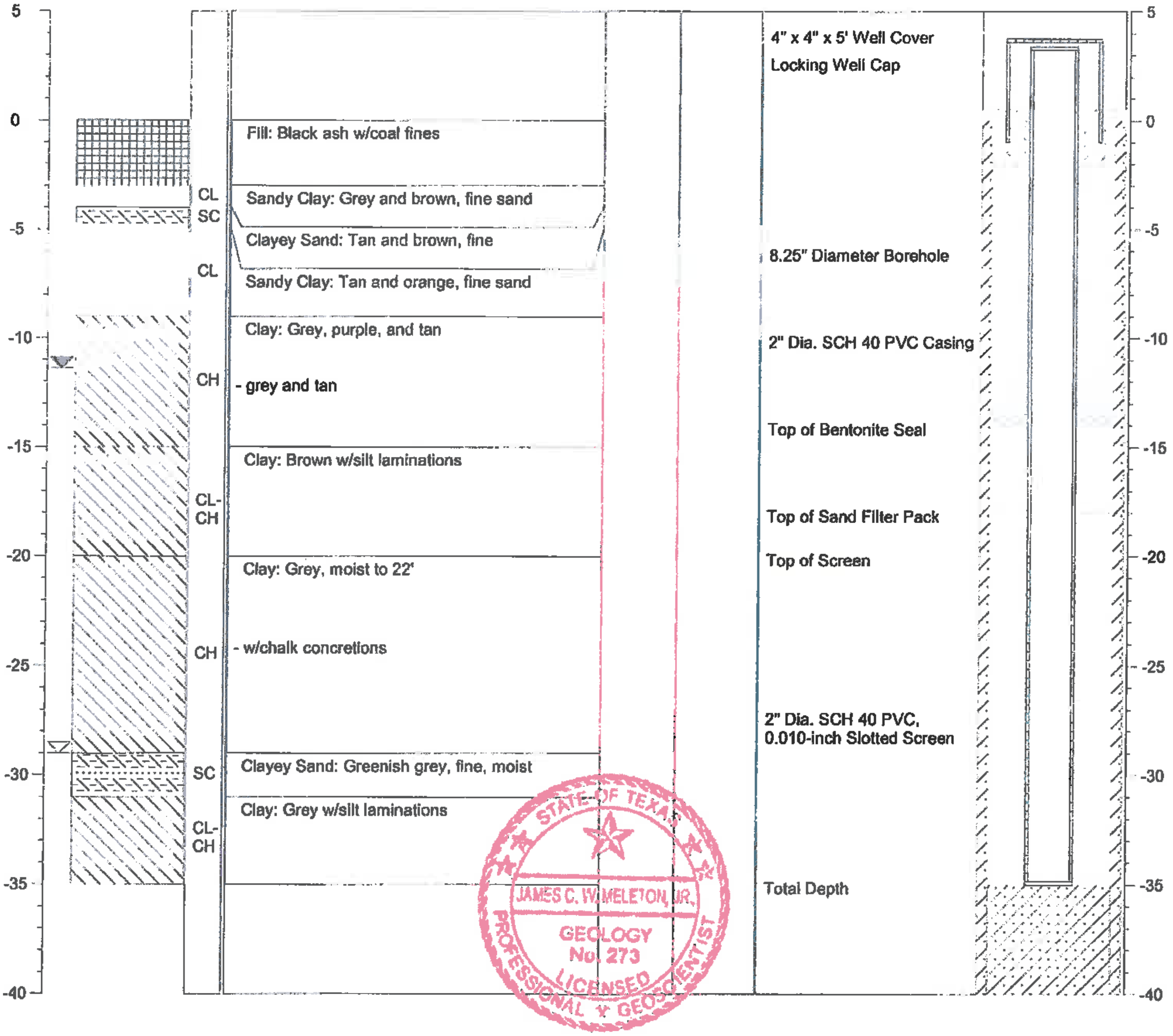
DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/21/09**

NOTES: **Latitude: 33.04995**
Longitude: 94.84196

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
	Fill: Black ash w/coal fines
CL	Sandy Clay: Grey and brown, fine sand
SC	Clayey Sand: Tan and brown, fine
CL	Sandy Clay: Tan and orange, fine sand
CH	Clay: Grey, purple, and tan - grey and tan
CL-CH	Clay: Brown w/silt laminations
CH	Clay: Grey, moist to 22' - w/chalk concretions
SC	Clayey Sand: Greenish grey, fine, moist
CL-CH	Clay: Grey w/silt laminations

WELL DESCRIPTION
4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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BORING/WELL NO.:	**AD-10**
TOTAL DEPTH:	**35'**
TOP OF CASING ELEV.:	**343.01 ft. NGVD**
GROUND SURFACE ELEV.:	**340.23 ft. NGVD**

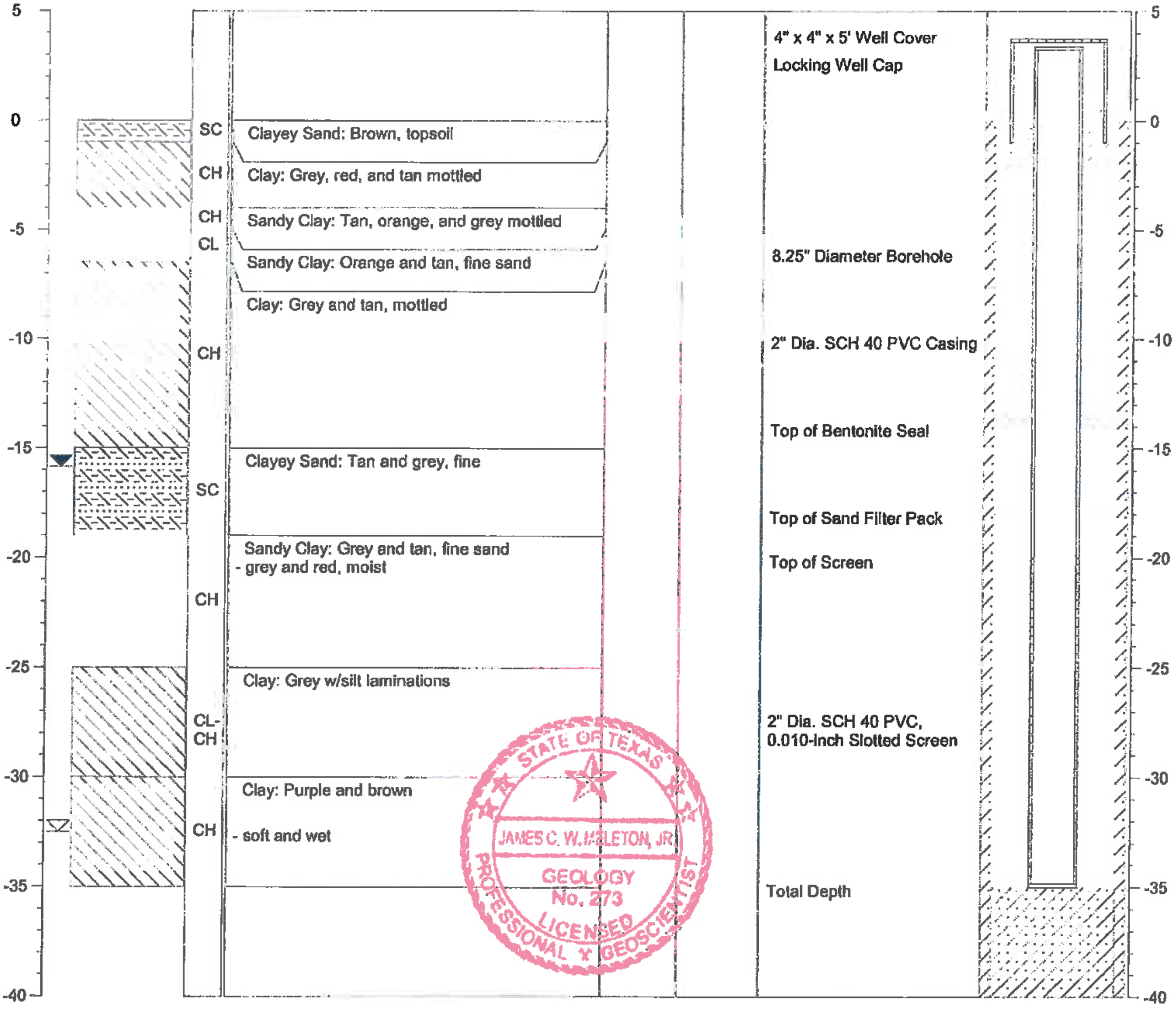
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04881**
Longitude: 94.84047

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, topsoil
CH	Clay: Grey, red, and tan mottled
CH	Sandy Clay: Tan, orange, and grey mottled
CL	Sandy Clay: Orange and tan, fine sand
CH	Clay: Grey and tan, mottled
SC	Clayey Sand: Tan and grey, fine
CH	Sandy Clay: Grey and tan, fine sand - grey and red, moist
CL-CH	Clay: Grey w/silt laminations
CH	Clay: Purple and brown - soft and wet

WELL DESCRIPTION:

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

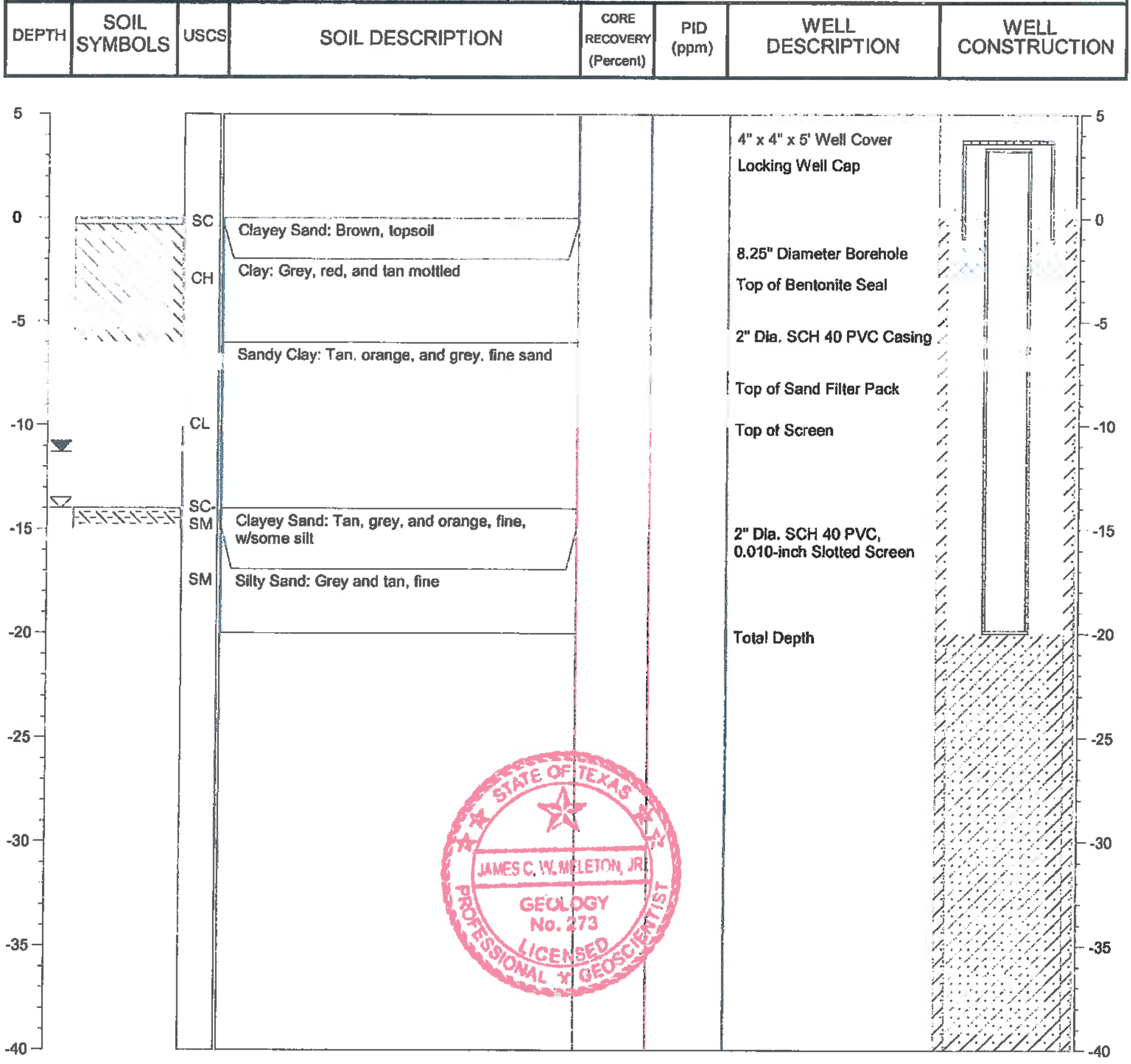
BORING/WELL NO.:	**AD-11**
TOTAL DEPTH:	**20'**
TOP OF CASING ELEV.:	**342.18 ft. NGVD**
GROUND SURFACE ELEV.:	**339.61 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04824**
Longitude: 94.84177

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, topsoil
CH	Clay: Grey, red, and tan mottled
CL	Sandy Clay: Tan, orange, and grey, fine sand
SC-SM	Clayey Sand: Tan, grey, and orange, fine, w/some silt
SM	Silty Sand: Grey and tan, fine

WELL DESCRIPTION
4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
Top of Bentonite Seal
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

BORING/WELL NO.:	**AD-12**
TOTAL DEPTH:	**30'**
TOP OF CASING ELEV.:	**369.33 ft. NGVD**
GROUND SURFACE ELEV.:	**366.27 ft. NGVD**

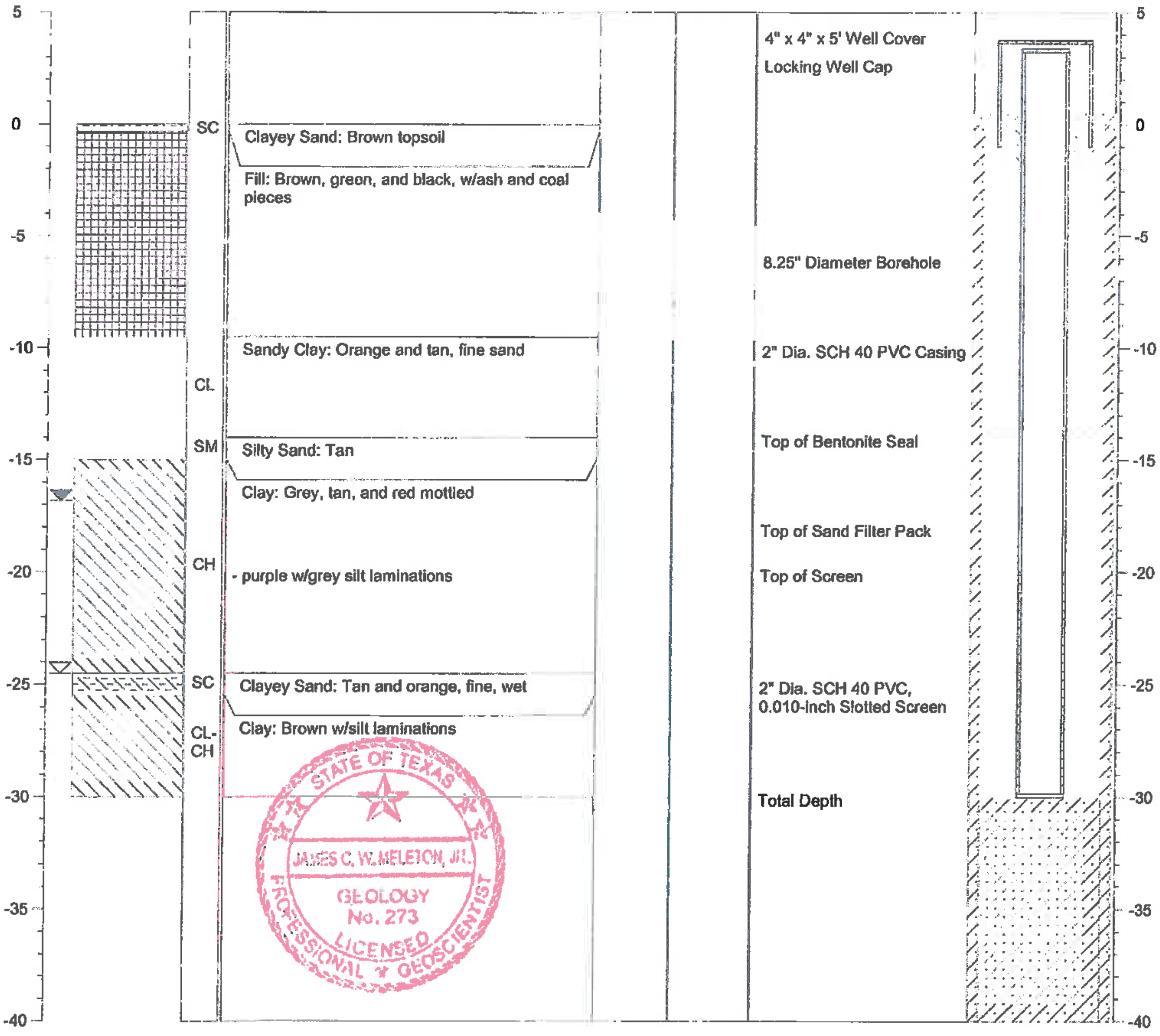
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/24/09**

NOTES: **Latitude: 33.04901**
Longitude: 94.84977

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown topsoil
	Fill: Brown, green, and black, w/ash and coal pieces
CL	Sandy Clay: Orange and tan, fine sand
SM	Silty Sand: Tan
CH	Clay: Grey, tan, and red mottled - purple w/grey silt laminations
SC	Clayey Sand: Tan and orange, fine, wet
CL-CH	Clay: Brown w/silt laminations

WELL DESCRIPTION:
- 4" x 4" x 5' Well Cover
- Locking Well Cap
- 8.25" Diameter Borehole
- 2" Dia. SCH 40 PVC Casing
- Top of Bentonite Seal
- Top of Sand Filter Pack
- Top of Screen
- 2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
- **Total Depth**

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SOIL BORING LOG

BORING/WELL NO.:	**AD-13**
TOTAL DEPTH:	**20'**
TOP OF CASING ELEV.:	**347.00 ft. NGVD**
GROUND SURFACE ELEV.:	**344.12 ft. NGVD**

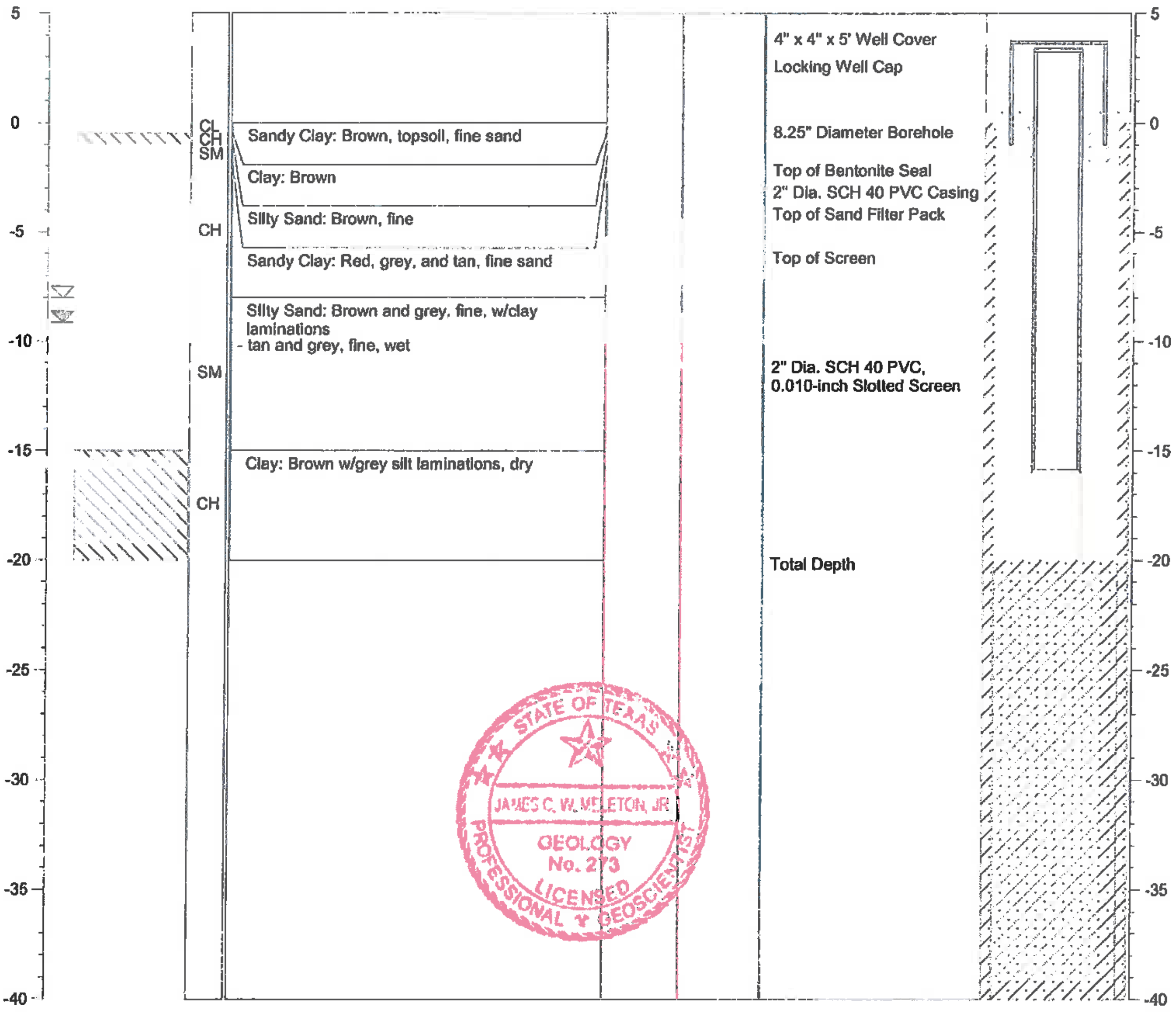
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04918**
Longitude: 94.84275

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Sandy Clay: Brown, topsoil, fine sand

Clay: Brown

Silty Sand: Brown, fine

Sandy Clay: Red, grey, and tan, fine sand

Silty Sand: Brown and grey, fine, w/clay laminations
- tan and grey, fine, wet

Clay: Brown w/grey silt laminations, dry

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
Top of Bentonite Seal
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
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SOIL BORING LOG

E·A·G·L·E ENVIRONMENTAL SERVICES OF SHREVEPORT, INC

BORING/WELL NO.:	**AD-14**
TOTAL DEPTH:	**18.5'**
TOP OF CASING ELEV.:	**345.43 ft. NGVD**
GROUND SURFACE ELEV.:	**342.32 ft. NGVD**

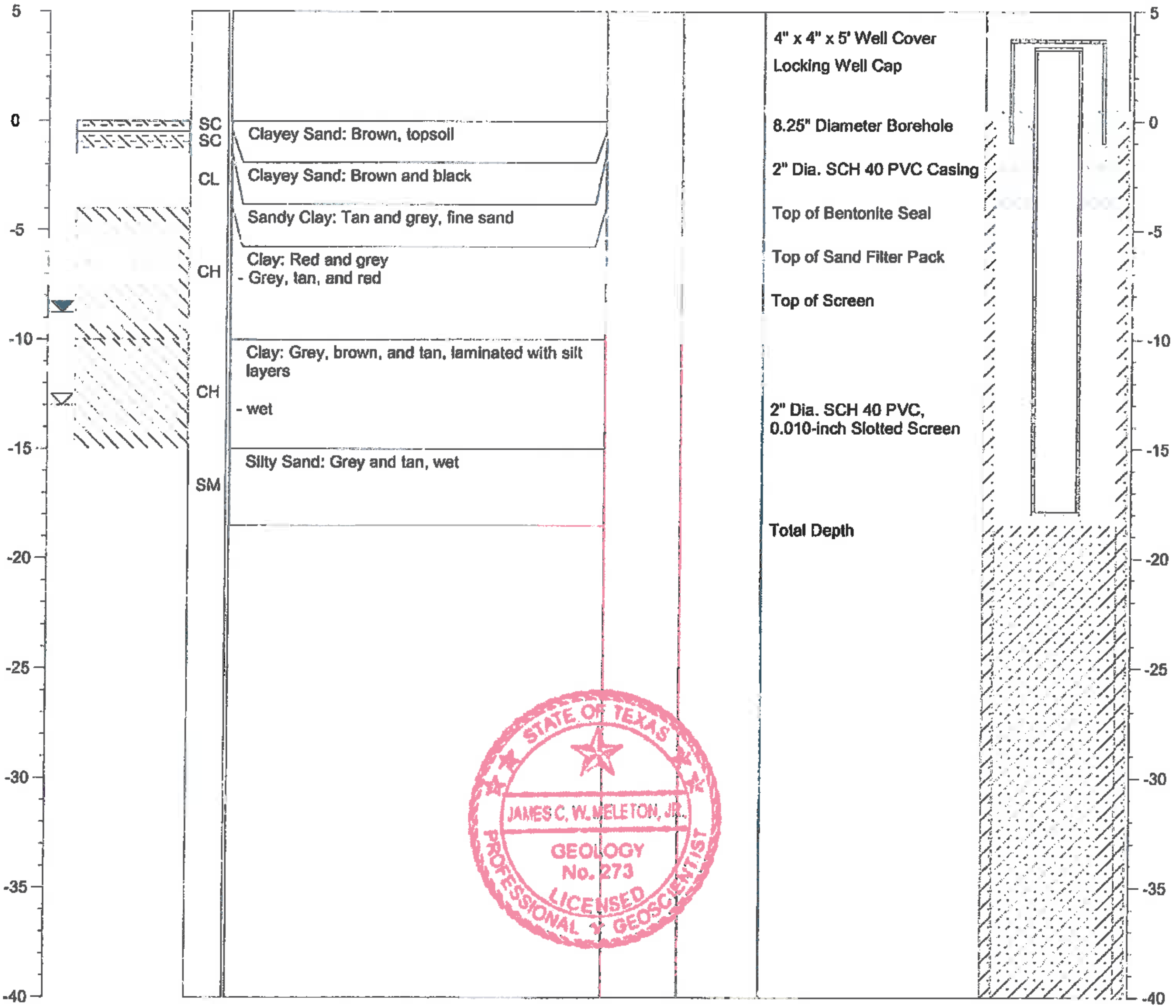
CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04715**
Longitude: 94.84256

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION
						4" x 4" x 5' Well Cover Locking Well Cap	
		SC	Clayey Sand: Brown, topsoil			8.25" Diameter Borehole	
		SC	Clayey Sand: Brown and black			2" Dia. SCH 40 PVC Casing	
		CL	Sandy Clay: Tan and grey, fine sand			Top of Bentonite Seal	
		CH	Clay: Red and grey - Grey, tan, and red			Top of Sand Filter Pack Top of Screen	
		CH	Clay: Grey, brown, and tan, laminated with silt layers - wet			2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen	
		SM	Silty Sand: Grey and tan, wet				
						Total Depth	

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No. 273
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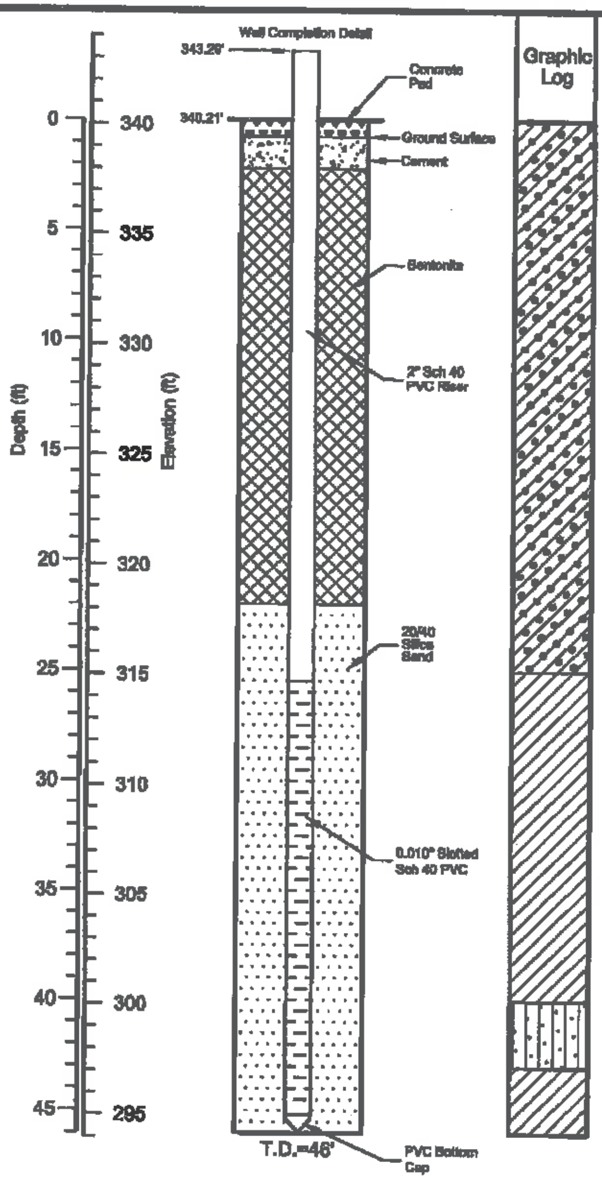


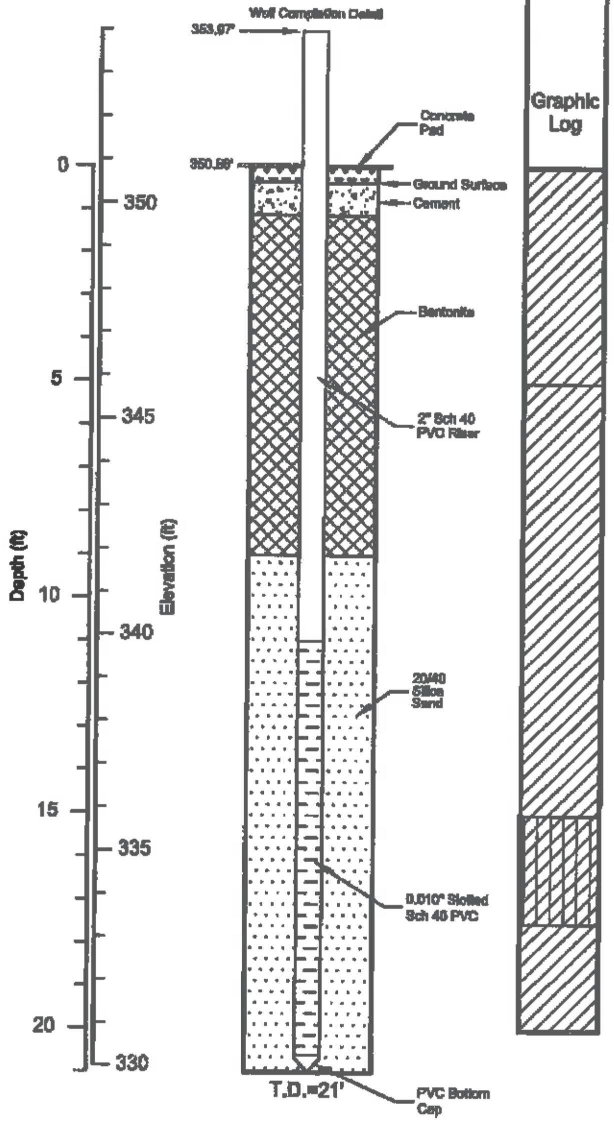
PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		SC	Clayey SAND: reddish brown					
					16	48	37	18	19
				- 2" lense of brown sand					
				- 3" lense of brown sand					
	Direct Push		CL	Sandy Lean CLAY: reddish brown, very moist					
				- less moisture					
					22	51	36	19	17
			SM	Silty SAND: light brown & light gray, wet.	27	24	28	NP	-
			CL	Lean CLAY: orangish brown & light gray, mottled, with sand	28	94	45	21	24

STEVEN R. WEMPLE
2176
1-22-16

west
DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahatchie, Texas 75165

DATE: 12/12/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-15
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/12/15	DRAWN BY: HDS	PROJECT NO.: —
			SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



PID Reading (ppm)	Sampling Device	Sample Interval	Description Interva (feet bgs)	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		CL	Lean CLAY w/ Sand: light brown & light gray - orangish brown, with silt	16	82	26	16	10
			CL	Lean CLAY w/ Sand: orangish-brown & light gray	22	88	31	19	12
			CL-ML	Silty CLAY: orange w/ brown, wet	30	69	27	20	7
			CL	Sandy, Lean CLAY: brown w/ orange, stiff	26	66	46	26	20

STEVEN R. WEMPLE
SOIL SCIENCE
LICENSE NUMBER
2176

1-22-16

west
DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/10/15
Drilling Method: H.S.A.
Bit Diameter: 7.25"
Depth to Water: –

Logged by: Robert Williams, PE
Driller: Robert Williams
Date Completed: 12/10/15
Depth to Product: NA

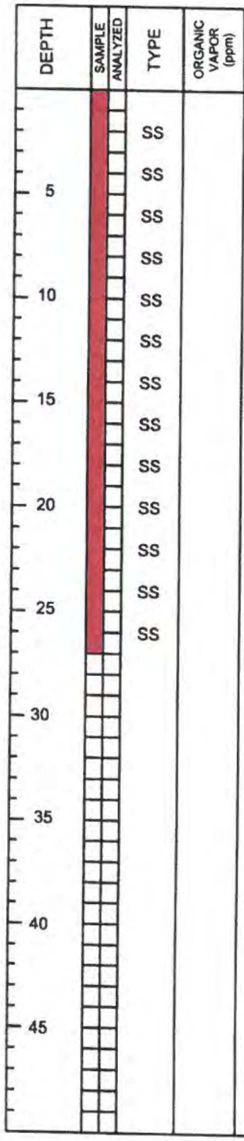
Welsh Power Station
Pittsburg, Texas

DRAWN BY: HDS
CHECKED BY: SRW

Log of Boring
AD-16

PROJECT NO.: —
SCALE: AS SHOWN
FILE NAME: JR Welsh Power Plant LOGS.dwg

WELL LOG



SAMPLE DESCRIPTION

(0-15') SILTY CLAY (CL), BROWN TO ORANGE-BROWN, STIFF, DRY.

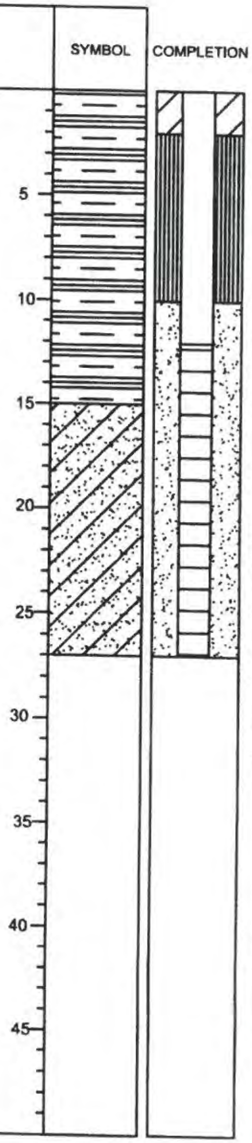
(15-18') SILTY CLAY AND SANDY CLAY, ORANGE-BROWN TO LIGHT GRAY, MOIST.

(18-27') SILTY CLAY AND SANDY CLAY, DARK BROWN TO GRAY, MOIST TO WET.

TOTAL DEPTH = 27' BGS

Kenneth J. Brandner
Geology
1787

4-27-17



AD-16R
WELL

AEP
CLIENT

BOTTOM ASH STORAGE POND
PROJECT

WELSH POWER PLANT
LOCATION

4/12/17
DATE

HSA
DRILLING METHOD

2" PVC, 2' AGL-12' BGL
CASING

2" PVC, 12'-27' BGS
SCREEN

0-2' BGS
CEMENT

2-10' BGS
BENTONITE

10-27' BGS
SAND PACK

350.55' / 353.49'
GROUND ELEV. / TOP OF CASING ELEV.

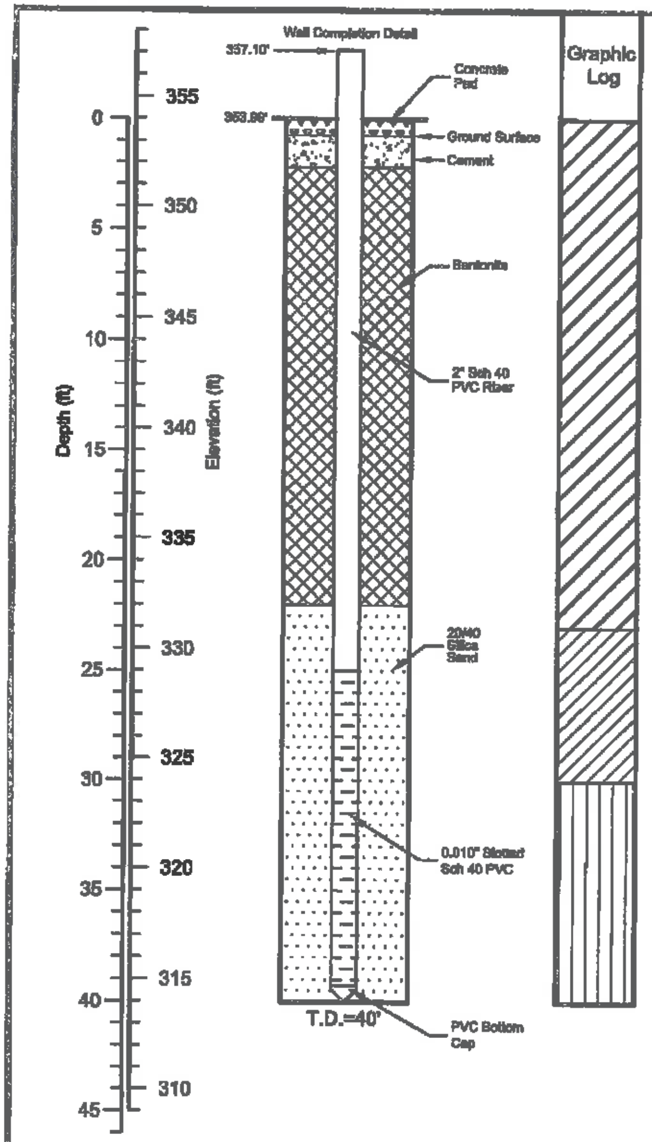
CT - CUTTINGS
SB - SPLIT BARREL(5')
SS - SPLIT SPOON(2')

▽ HC LEVEL
▼ WATER LEVEL

░ SAND	▨ FILL/CONCRETE
▤ SILT	▥ BENTONITE
▤ CLAY	⁘ GRAVEL

START: FINISH:

ARCADIS Design & Consultancy for natural and built assets
711 N. CARANCAHUA, #1080
CORPUS CHRISTI, TEXAS 78401
TEL: (361) 883-1353 FAX: (361) 883-7565



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0		Direct Push		CH	Fat CLAY: reddish-brown					
5					- light gray to light brown, reddish brown w/ Sand and gravel lenses	24	97	83	30	53
10					- light brown					
15					- brown Sand lenses, wet					
20					- gray, w/ some Silt	18	90	53	25	28
25				CL	Lean CLAY with Sand: gray	22	81	43	22	21
30		Direct Push		ML	Sandy SILT: gray	23	63	26	NP	-
35										
40										

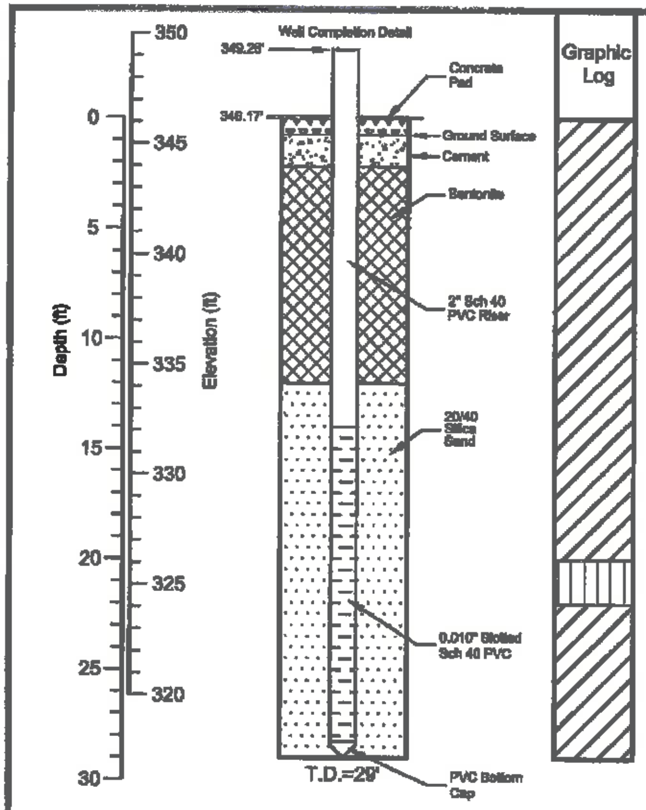
STEVEN R. WEMPLE
SOIL SCIENCE
LICENSE NUMBER 2176

1/22/16

WEST DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahatchie, Texas 75165

DATE: 12/10/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-17
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: —
			SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0		Direct Push		CH	Fat CLAY: light brown & light gray, sandy - reddish brown and light gray, with Sand - gray with silt - gray, stiff	19	88	50	24	26
20				ML	SILT: gray, with Clay and Sand, wet	29	86	26	NP	-
25				CH	Fat CLAY: light gray, silty w/ Sand, very stiff	20	85	50	23	27
30										

STEVEN R. WEMPLE
SOIL SCIENCE
LICENSE NUMBER
2176

1-22-16

west DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/11/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-18
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: —
			SCALE: AS SHOWN
Depth to Water: –	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg

Project: AEP Welsh Power Plant **Project Location: Cason, TX** **Project Number: TXL0064**	# Log of Boring GB-1 Sheet 1 of 2

Date(s) Drilled **July 23, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **37 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **367 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Bentonite Chips**	Location **On the Northern edge of proposed chemical pond along the screening berm.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
367	0					Other		Black COAL, a few fine roots and organics.						
			ST											Shelby tube pulled black COAL
			SS	10										SPT 4, 5, 5, 5. 24" recovered
362	5													
			SS	11	Soft to Firm	SC		Reddish Brown fine SAND, little clay, trace silt, Dry. Natural Ground.						SPT 4, 5, 6, 7. 24" recovered
			SS	11	Soft	SM		Reddish brown fine SAND with silt, trace clay. Vertical sand seams in sample, Dry.						SPT 3, 5, 6, 6. 24" recovered.
357	10		ST						23.6	22	48.9	5.4E-07		Shelby tube sample, 18" recovered.
					Soft	SC		Reddish brown well graded fine SAND, trace silt and clay. Damp.						
			SS	12	Firm	CL		Greyish red CLAY, little sand, horizontal sand seams, Dry.						SPT 5, 6, 6, 9. 24" recovered
			SS	13	Soft	SC		Brownish red fine SAND, little clay, Damp.						SPT 7, 6, 7, 9. 24" recovered.
					Firm	SC-CL		) Four-inch CLAY seam, little fine sand.						
					Firm	CL		Reddish grey CLAY, little sand, oxidized iron ore. Dry						
352	15													
			SS	16	Soft	SM		Brownish red fine SAND, trace clay, thin clay seams. Moist.	17.74	14	40.1			SPT 8, 9, 9, 9. 24" recovered.
			ST						16.25	NP	28.9	3.6E-05		Shelby tube samples look like SC. 17" recovered.
347	20		SS	17	Soft	Other		) Iron oxidized material						SPT 9, 8, 9, 11. 24 inches recovered.
					Soft	SC		Brownish red fine SAND, little clay. Moist.						
			SS	15										SPT 5, 7, 8, 50/2. 21" recovered
			SS	50	Soft	CL		Dark grey CLAY, little fine sand, Wet.						SPT 50/3".
					Very Hard	SP		Dark grey-black cemented SAND, little clay. Wet. Driller comments that cemented sand terminates at 25.5 feet.						
342	25													
			SS	27	Soft to Firm	SC		Dark grey fine SAND, little clay. Moist. Soft sand with lenses of firm clay.						SPT 11, 13, 14, 16. 24" recovered.
					Hard	CL		I Dark grey CLAY, little sand, Dry.						
			SS	46	Soft	SC		Dark grey-black fine SAND, little clay, Wet. Encountered water but water rose to 19 feet after 15 min break.						SPT 11, 16, 30, 14. 24" recovered.
			SS	37										SPT 11, 15, 22, 25. 24" recovered.
337	30				Hard	CL								

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
337	30		SS	37	Hard	CL		Dark grey CLAY, little fine sand, occasional horizontal sand seams. Wet. (cont.)						SPT 11, 15, 22, 25. 24" recovered.
			SS	29	Soft	ML		Dark grey-black fine SAND, with clay, frequent hard clay lenses (1-3"), Wet.	26.37	NP	57.5			SPT 6, 11, 18, 24. 24 recovered.
332	35		SS	34	Hard	CL		Black CLAY, trace to little fine sand, trace silt. Dry						SPT 9, 16, 18, 23. 24" recovered.
								Bottom of Boring at 37 feet bgs						
327	40													
322	45													
317	50													
312	55													
307	60													
302	65													

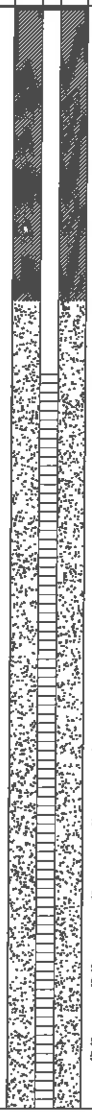
Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-02

Sheet 1 of 1

Date(s) Drilled **August 14, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **364.56 feet MSL**
Groundwater Level and Date Measured **21.53 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Western edge of proposed chemical pond near perimeter fence.**	



Elevation, feet	Depth, feet	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
364.6	0			Soft	Other	Coal					
		SS	4	Soft	CL	Greyish brown CLAY, with little silt, little sand, damp.					SPT 2, 2, 2. 12" recovered.
		SS	13								SPT 4, 7, 6, 12.
359.6	5	ST									Shelby Tube Sample
				Firm	CH	Brownish tan CLAY with silt, little sand, Damp. Occasional sand and iron ore.					SPT 8, 12, 17, 21
		SS	29				23.71	38	77.3		
		SS	80								SPT 20, 30, 50/5. 17" recovered
354.6	10			Soft	SC	Red-orange fine SAND, little clay, damp. Occasional iron ore.					SPT 15, 20, 24, 31. 18" recovered.
				Soft	CL	Brownish tan CLAY, little silt, little sand, Damp.					
		SS	44	Soft	SM	Red-orange fine SAND, little clay, Damp.					
		SS	21				20.35	NP	33.5		SPT 11, 12, 9, 32.
349.6	15	SS	18								SPT 6, 6, 12, 6.
				Soft	SM-SC	Light brown fine SAND, with little silt, little sand, Damp.					
				Firm	CL	Black CLAY, with fine sand, Wet.					SPT 12, 25, 50/5.
		SS	75	Soft	SM-SC	Dark red fine SAND, little clay, little silt, Wet.					
				Soft-Firm	SC	Dark grey fine SAND, little clay, Wet. Occasional clay seams.					SPT 9, 16, 12, 15.
		SS	28								
344.6	20										SPT 9, 17, 21, 27.
		SS	38	Firm	SC	Frequent clay lenses.	22.55	13	36.6		
						8/11/09 ▼					SPT 22, 35, 50/4".
		SS	65								
											SPT 10, 15, 18, 26.
339.6	25	SS	33								
				Soft	SC	Less clay lenses, Wet.					SPT 12, 27, 37, 50/5".
		SS	64								
											SPT 19, 24, 21, 50/5".
		SS	44								
				Hard	CL	Dark grey CLAY, little trace silt, Wet. Bottom of Boring at 30 feet bgs					
334.6	30										

Figure

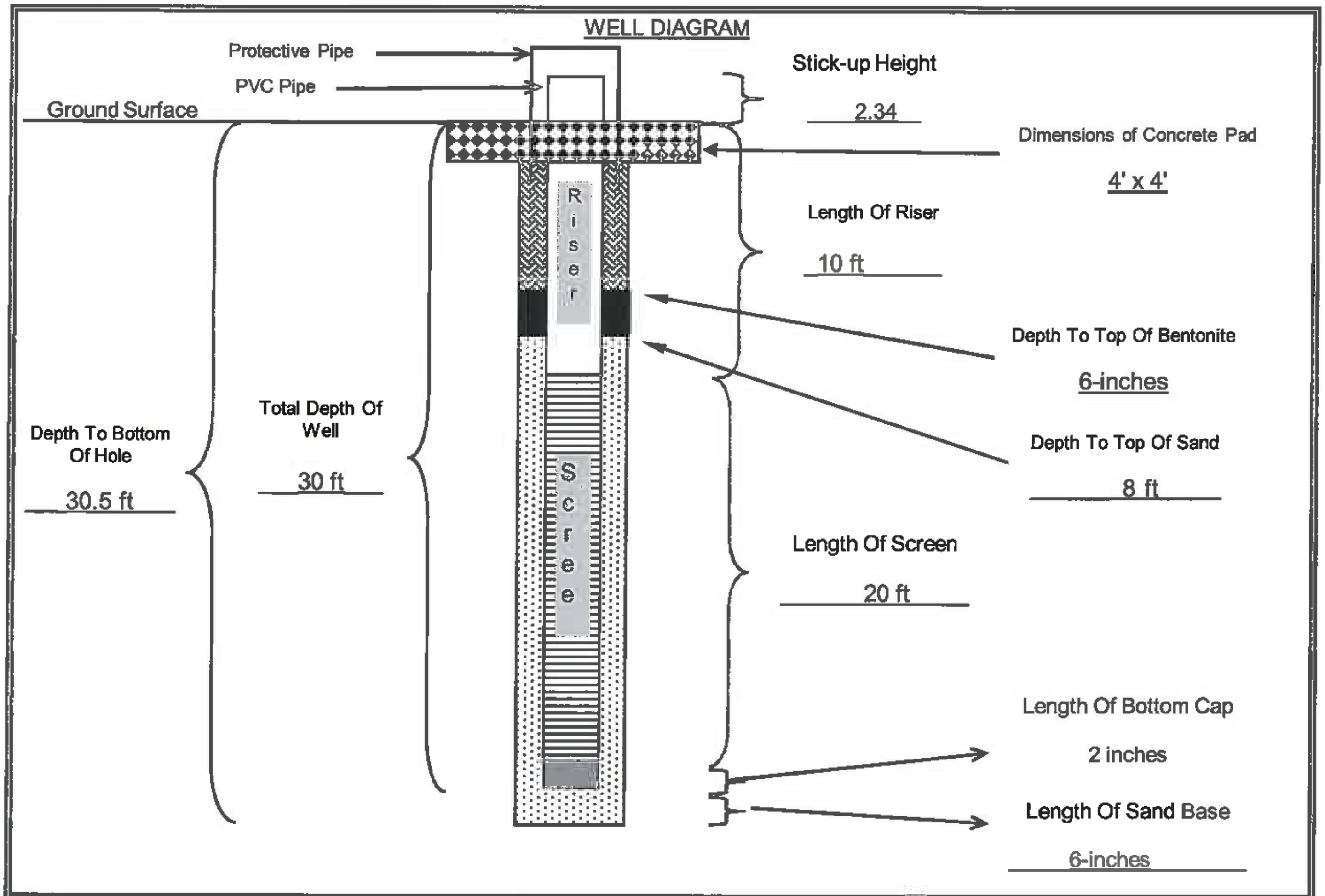
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL NO.: GB-02
WELL LOCATION:
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION:	364.56	(ft, msl)	BENTONITE TYPE:	Western Bentonite	
TOP OF SCREEN ELEVATION:	354.56	(ft, msl)	MANUFACTURER:	PDS	
BOTTOM OF WELL ELEVATION:	334.06	(ft, msl)	CEMENT TYPE:	Not used-sealed with bentonite chips	
NORTHING: 747.0223	EASTING: -2442.888		CEMENT MANUFACTURER:		
SCREEN MATERIAL:	PVC		SAND PACK TYPE AND SIZE:	Silica 20/40	
SCREEN MANUFACTURER:			SAND MANUFACTURER:	Uninum	
RISER MATERIAL:	PVC		DRILLING CONTRACTOR:	Total Support Services	
RISER MANUFACTURER:			AMOUNT BENTONITE USED:	4	bags lbs
RISER DIAMETER:	2 (in)	Length: 10 (ft)	AMOUNT CEMENT USED:		bags lbs
SCREEN DIAMETER:	2 (in)	Length: 20 (ft)	AMOUNT SAND USED:	13	bags lbs
BOREHOLE DIAMETER:	8	(in)	STATIC WATER:	21.53	depth from TOC
DRILLING TECHNIQUE:	Hollow stem	Size: (in)	ENCOUNTERED WATER:		depth from ground

WELL DIAGRAM



Stick-up Height 2.34

Dimensions of Concrete Pad 4' x 4'

Length Of Riser 10 ft

Depth To Top Of Bentonite 6-inches

Depth To Top Of Sand 8 ft

Depth To Bottom Of Hole 30.5 ft

Total Depth Of Well 30 ft

Length Of Screen 20 ft

Length Of Bottom Cap 2 inches

Length Of Sand Base 6-inches

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC INSTALLED BY:	Total Support Services	OBSERVED BY:	Kush Chohan
DATE:	August 7th, 2009	CHECKED BY:	DATE:

Project: AEP Welsh Power Plant **Project Location: Cason, Texas** **Project Number: TXL0064**	**Log of Boring GB-03** Sheet 1 of 2

Date(s) Drilled **August 7, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **31 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **359.91 feet MSL**
Groundwater Level and Date Measured **21.89 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Southwest corner of proposed chemical pond near screening pile.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
359.9	0				Soft	Other		Coal						
354.9	5				Soft	CH		Shelby Tube						Shelby tube sample.
			ST							43	96.1			
					Firm	CH		Light brown-grey CLAY, little silt, occasional sand seams (fine), Damp.						SPT 29, 22, 19, 21.
			SS	41					24.04	29	90.4			
					Soft	CH		Brownish dark grey CLAY, trace sand, trace silt, Wet.						SPT 6, 12, 15, 20.
349.9	10		SS	27										
														SPT 17, 29, 24, 25.
			SS	53	Soft	SC		Dark orange red SAND, little clay, trace silt, Wet. Occasional clay seam (dark grey).						
					Soft	SC		Clay lenses.						SPT 7, 15, 17, 40.
			SS	32										
344.9	15													SPT 9, 17, 30, 20.
			SS	47	Soft	SC		Clay lense						
					Soft	SC		Dark grey fine SAND with clay, occasional clay lense, Wet.						SPT 11, 50/4".
			SS	50	Firm	CL		Dark grey CLAY, little fine sand, Wet.						
														SPT 11, 27, 17, 21.
					Soft	SC		Dark grey fine SAND, little clay, occasional clay seam, iron ore, Wet.						
339.9	20		SS	44										
								8/11/09 ▼						
334.9	25													SPT 27, 40, 50/4".
			SS	90										
					Firm	SC		Dark grey clay lense						SPT 11, 15, 40, 50/3".
			SS	55										
			SS	55										SPT 17, 50/5.5".
329.9	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
329.9	30	▨	SS	65	Hard	CL	▨	Dark gray CLAY, trace silt, trace fine sand.						SPT 17, 50/5.5".
								Bottom of Boring at 31 feet bgs						
324.9	35													
319.9	40													
314.9	45													
309.9	50													
304.9	55													
299.9	60													
294.9	65													

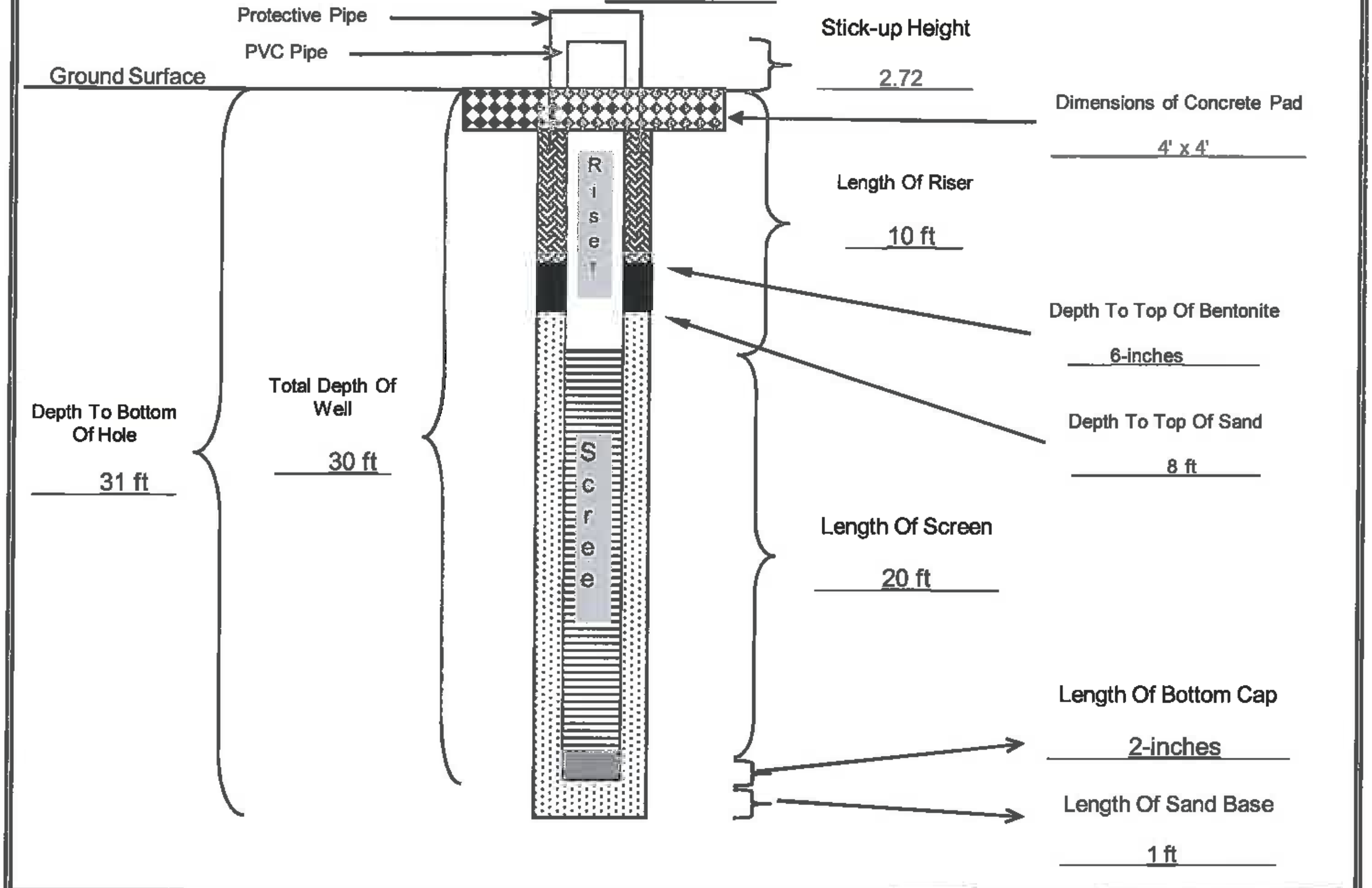
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME:	AEP Welsh Power Plant		
JOB NO.:	TXL0064		
DATE/TIME:	8/7/2009	WELL NO.:	GB-03
WELL LOCATION:		FIELD REP:	Kush Chohan

GROUND SURFACE ELEVATION:	359.57 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	349.57 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	328.57 (ft, msl)	CEMENT TYPE:	None used-sealed with bentonite chips
NORTHING: 460.5803	EASTING: -2507.6332	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	4 bags lbs
RISER DIAMETER:	2 (in) Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 20 (ft)	AMOUNT SAND USED:	12 bags lbs
BOREHOLE DIAMETER:	8 (in)	STATIC WATER:	21.89 depth from TOC
DRILLING TECHNIQUE:	Hollow Stem Size: 8 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.72

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 10 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 8 ft

Length Of Screen: 20 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 1 ft

Depth To Bottom Of Hole: 31 ft

Total Depth Of Well: 30 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC INSTALLED BY:	Total Support Services	OBSERVED BY:	Kush S. Chohan
DATE:	7-Aug-09	CHECKED BY:	DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **34 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.22 feet MSL**
Groundwater Level and Date Measured **20.54 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Southeast corner of proposed chemical evaportation pond. Located in a grassy field.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
357.2	0				Soft	SM-SC		Reddish brown fine SAND, little silt, trace clay, damp.						SPT 1, 3, 6, 6. 24" recovered.
			SS	9	Soft	Other		COAL						
					Firm	SC		Brownish red SAND, little clay, trace silt. Damp.						
					Firm	CL		Reddish pink CLAY, some fine sand, Dry.						SPT 4, 4, 4, 4. 24" recovered.
			SS	8					24.49	47	90.2			
														SPT 5, 6, 8, 4. 18" recovered.
					Soft	Other		Oxidized SAND and clay with iron ore.						
352.2	5		SS	14	Soft	CH		Light reddish brown CLAY and sand mixture, Dry.						
					Soft	SC		Reddish brown SAND, little clay, Dry.						
			ST						28.4	38	61.1	7.7E-09		12" Shelby tube. 9" recovered.
			SS	17	Firm	CH		Light brownish tan CLAY, little sand, occasional sand seams, Dry.						SPT 3, 4, 13, 15. 27" recovered.
347.2	10													
342.2	15				Soft	SC		Red/yellowish brown SAND, some clay, Wet.						SPT 3, 7, 3, 15. 24" recovered.
			SS	10					6.95	14	47			
					Firm	SC		Occasional clay lenses.						
337.2	20		ST					8/11/09						Shelby tube. 12" driven 0" pulled. Gravel material encountered.
					Soft to Firm	SM		Black to dark grey fine/med SAND, little clay, occasional clay lenses, Wet.						SPT 7, 10, 9, 13. 24" recovered.
			SS	19										
332.2	25				Soft	SM		Well graded light grey fine/med SAND, trace silt, Wet.						SPT 17, 24, 50/5.5". 19" recovered.
			SS	74					22.29	NP	13.5			
					Firm	CL		Dark grey clay lense, Wet.						
					Firm	SM-SC		Well graded light grey fine/med SAND, trace silt, Wet.						
327.2	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.2	30	☒	ST		Hard	ML	▥	Dark grey CLAY, little sand, Wet.						12" Shelby tube. Bent shelby tube.
		☒	ST				▥		21.3	NP	84.2	2.0E-08		12" Shelby tube.
		▨	SS	38	Hard	CL	▨	Dark grey CLAY, trace sand, Wet.	25.44	18	92.5			SPT 15, 19, 19, 25. 24" recovered.
								Bottom of Boring at 34 feet bgs						
322.2	35													
317.2	40													
312.2	45													
307.2	50													
302.2	55													
297.2	60													
292.2	65													

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

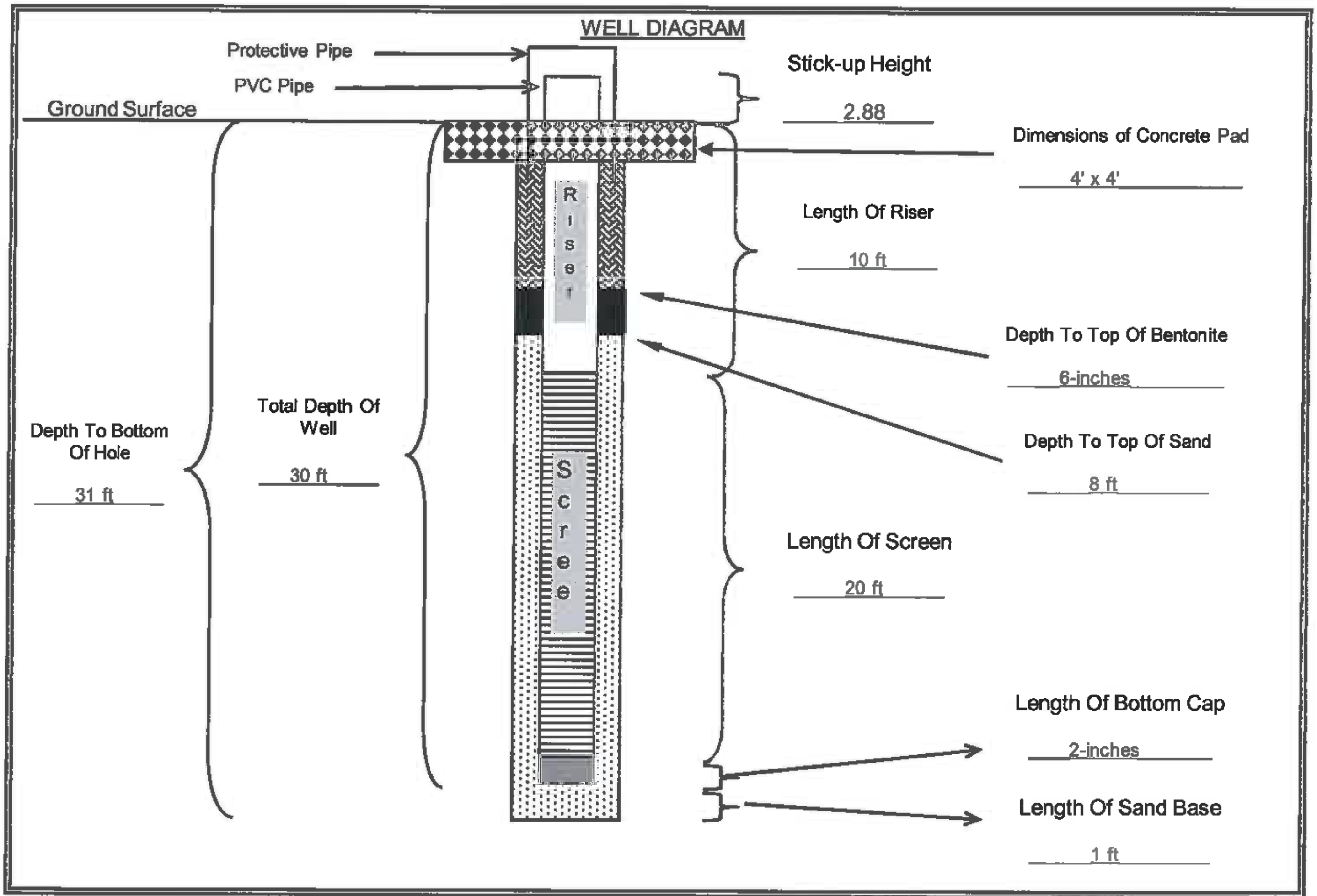
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 24-Jul-09
WELL NO.: GB-04
WELL LOCATION:
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.22 (ft, msl)
TOP OF SCREEN ELEVATION: 347.22 (ft, msl)
BOTTOM OF WELL ELEVATION: 326.22 (ft, msl)
NORTHING: -384.9666 EASTING: -2353.7375
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 6.75 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 6.75 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 3 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 20.54 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height 2.88
Dimensions of Concrete Pad 4' x 4'
Length Of Riser 10 ft
Depth To Top Of Bentonite 6-inches
Depth To Top Of Sand 8 ft
Depth To Bottom Of Hole 31 ft
Total Depth Of Well 30 ft
Length Of Screen 20 ft
Length Of Bottom Cap 2-inches
Length Of Sand Base 1 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: 24-Jul-09
OBSERVED BY: Kush S. Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30.5 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.49 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8-11-09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Eastern edge of proposed chemical evaporation pond.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
357.5	0				Soft	SW-SM		Dark fine SAND with brown organic material and roots.						SPT 2, 2, 5, 5. 24" recovered
			SS	7	Firm	CH		Dark red/grey CLAY, trace silt. Dry.	23.37	44	68.6			
														SPT 4, 4, 7, 9. 24" recovered.
			SS	11								7E-07		
														SPT 5, 6, 8, 13. 24 recovered
352.5	5		SS	14										
						CH		Trace of sand						
			ST		Soft	CH		Dark red fine SAND, trace clay, Damp.	16.5	41	73.8	3.2E-08		Shelby tube. Pushed 12 recovered 9".
														SPT 5, 7, 11, 11. 24" recovered.
					Firm	CH		Light tan CLAY, trace sand, Dry.						
			SS	18										
					Soft	SC		Dark red SAND, trace of CLAY, Damp.						
					Firm	CL		Light tan CLAY, trace fine sand, Dry.						
					Soft	SC		Dark red SAND, little clay, frequent clay seams, Damp						SPT 6, 7, 11, 14. 24" recovered.
347.5	10		SS	18										
						SC		Frequent clay seams						SPT 11, 22, 13, 14. 24" recovered.
					Soft	SC		Red/orange fine SAND, trace clay, trace coarse sand, poorly sorted, Moist.						
			SS	35										
														SPT 17, 27, 50/5". 17" recovered.
			SS	77										
					Firm	CL		Brownish grey CLAY, trace sand, Moist.						
					Soft	SC		Tanish grey fine SAND, some clay, Wet.						
342.5	15													
			ST					8-11-09 ▼	19.9	13	35.7	6.6E-07		Shelby tube. Pushed 12" recovered 9".
														SPT 11, 13, 10, 14. 24" recovered.
			SS	23					27.98	NP	32.3			
					Soft	SM		Dark grey coarse SAND/GRAVEL mix, some fine sand, trace clay, Wet.						
					Soft	SM-SC		Red fine SAND, trace clay, Moist. cemented. Moist.						SPT 7, 8, 11, 13. 24" recovered.
			SS	19										
					Firm	SC		Black fine SAND, occasional clay, Wet.						
337.5	20													
					Firm	CL		Dark grey CLAY, little sand, Wet.						SPT 8, 10, 12, 15. 24" recovered.
					Firm	SM		Black fine SAND, some medium sand, some clay, Wet.						
			SS	22					32.23	NP	35.5			
					Firm	CL		Dark grey CLAY, little sand, Wet.						
					Firm	SM		Black fine SAND, some medium sand, some clay, Wet.						
														SPT 6, 11, 17, 21. 24" recovered.
					Firm	SM		Frequent clay seams						
			SS	28										
					Firm	SM		Frequent clay seams.						
			ST											Shelby tube. 12" driven 0 recovered.
332.5	25													SPT 15, 19, 21, 27. 24" recovered.
					Hard	CL		Dark grey CLAY, trace of sand, Dry.						
			SS	40										
														SPT 10, 11, 11, 50/5". 23" recovered.
			SS	22										
					Very Hard	CL		Dark grey CLAY, frequent iron stone/ore. Rig chatter driller comments						
			ST						24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
327.5	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.5	30	☒	ST		Hard	CL	▨	Dark grey CLAY, trace of sand, Dry. (cont.)	24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
								Bottom of Boring at 30.5 feet bgs						
322.5	35													
317.5	40													
312.5	45													
307.5	50													
302.5	55													
297.5	60													
292.5	65													

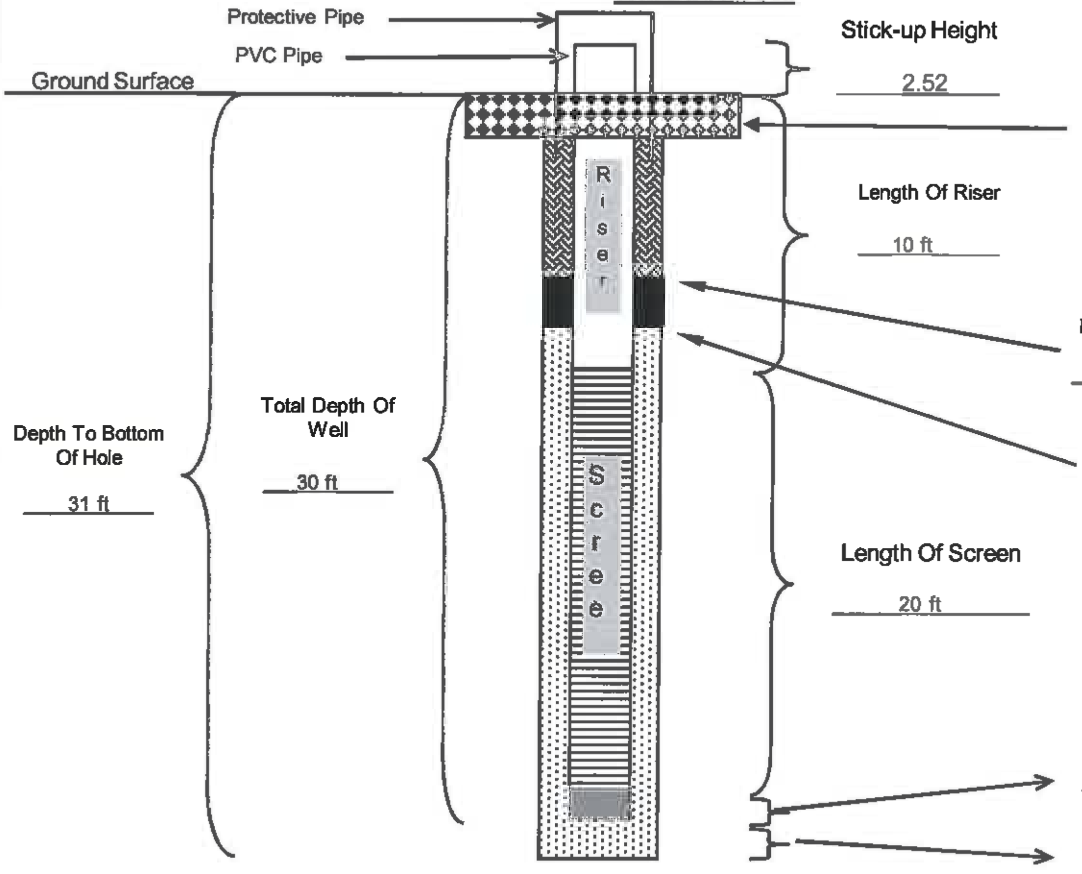
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: August 6 2009
WELL NO.: GB-05
WELL LOCATION:
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION:	357.49 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	347.49 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	326.49 (ft, msl)	CEMENT TYPE:	
NORTHING: 529.1865	EASTING: -2243.9973	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	3 bags lbs
RISER DIAMETER: 2 (in)	Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER: 2 (in)	Length: 20 (ft)	AMOUNT SAND USED:	7 bags lbs
BOREHOLE DIAMETER:	8 (in)	STATIC WATER:	17.33 depth from TOC
DRILLING TECHNIQUE: Hollow Stem	Size: 8 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.52

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 10 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 8 ft

Depth To Bottom Of Hole: 31 ft

Total Depth Of Well: 30 ft

Length Of Screen: 20 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 1 ft

▨	Cement/Bentonite Grout	░	Sand Pack	▦	Neat Concrete	■	Bentonite	▩	Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
OBSERVED BY: Kush Chohan
DATE: 6-Aug-09
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

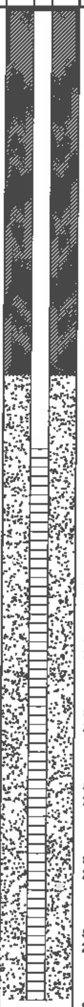
Log of Boring GB-06

Sheet 1 of 1

Date(s) Drilled **7/23/2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.41 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube, Other**	Hammer Data **140 lb, 30 in drop, auto hammer**
Borehole Backfill **Well Completion**	Location **Northeast corner of proposed chemical pond in the middle of open grass field.**	

Elevation, feet	Depth, feet	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
357.4	0			Soft	SP	Greyish brown fine SAND with trace fines. Organic material (roots).					Hand Auger
		HA		Soft	SP-SM	Greyish red fine SAND, little silt. Poorly sorted, less organic material.					
				Soft	SM	Greyish red fine SAND, with little silt and clay. Dry.					
				Soft		Tanish grey fine SAND, trace silt and clay, frequent iron oxide, frequent discoloration.					SPT 4, 7, 7. 16" recovered
		SS	14				12.74	34	67.9		
				Firm	CL	Red light brown CLAY, little sand, trace silt, Dry.					
352.4	5										SPT 3, 5, 6, 8. 20" recovered
		SS	11	Soft	SC	Dark reddish brown fine SAND, little clay.					
				Soft	CL	Light grey CLAY, little sand, trace silt. Dry.					
				Soft	SC	Reddish brown fine SAND, trace clay, trace silt. Occansional clay seams. Damp.					SPT 3, 5, 7, 7. 24" recovered
		SS	12				17.65	NP	43.2		
				Soft	CL	Light grey CLAY, little fine sand					
		SS		Soft to Firm	SC	Brownish red fine SAND, little to some clay, some cementation, Damp.					24" driven, 15" recovered.
347.4	10										
											SPT 8, 9, 10, 10. 24" recovered.
		SS	19								
				Soft to Firm	CL	Brown CLAY, little fine sand, frequent brown sand-clay mixture with iron ore oxide.					Shelby Tube. 24" driven/16" recovered
		ST					22.9	21	43.2	6.0e-07	
342.4	15			Firm	CL	Dark redish brown CLAY, little fine sand, Damp. 8/11/09 ▼					SPT 15, 10, 22, 30. 24" recovered
				Firm	SC	Dark reddish brown SAND, little to some clay, Moist.					
		SS	40								
				Firm	CL	Black CLAY, little fine sand, Wet.					SPT 2, 8, 14, 10. 24" recovered
				Firm	SW	Black fine SAND, trace clay, trace med sand, Wet.					
		SS	22								
				Firm	CL	Black CLAY, trace fine sand, trace silt, Wet.					SPT 5, 8, 22, 50/4". 22 recovered.
					SC	Black fine SAND, little clay, Wet.					
337.4	20	SS	30	Firm	CL	Black CLAY, trace sand, trace silt. Wet.					
				Firm	SC	Black fine SAND, trace to little clay, Wet. Occansional black clay seams.					
											SPT 10, 11, 23, 33. 24" recovered
		SS	34	Firm	SP-SC	Black fine SAND, with little clay, trace med sand, Wet.					
					SW-SC	Grading to med SAND, Wet.					SPT 11, 16, 16, 24. 24" recovered.
		SS	36								
332.4	25										SPT 9, 11, 12, 22. 24" recovered.
		SS	23	Firm	SW-SC	Occasional CLAY lenses, Wet.					
				Firm	SC	Black fine SAND, little med sand and clay, Wet.					SPT 7, 15, 25, 50/3". 21 recovered.
		SS	40	Hard	CL	Dark grey CLAY, little sand, little silt, Dry.					
		ST						19	45.1		Shelby tube. 12" driven-8" recovered.
327.4	30					Bottom of Boring at 30 feet bgs					

Well Log



Figure

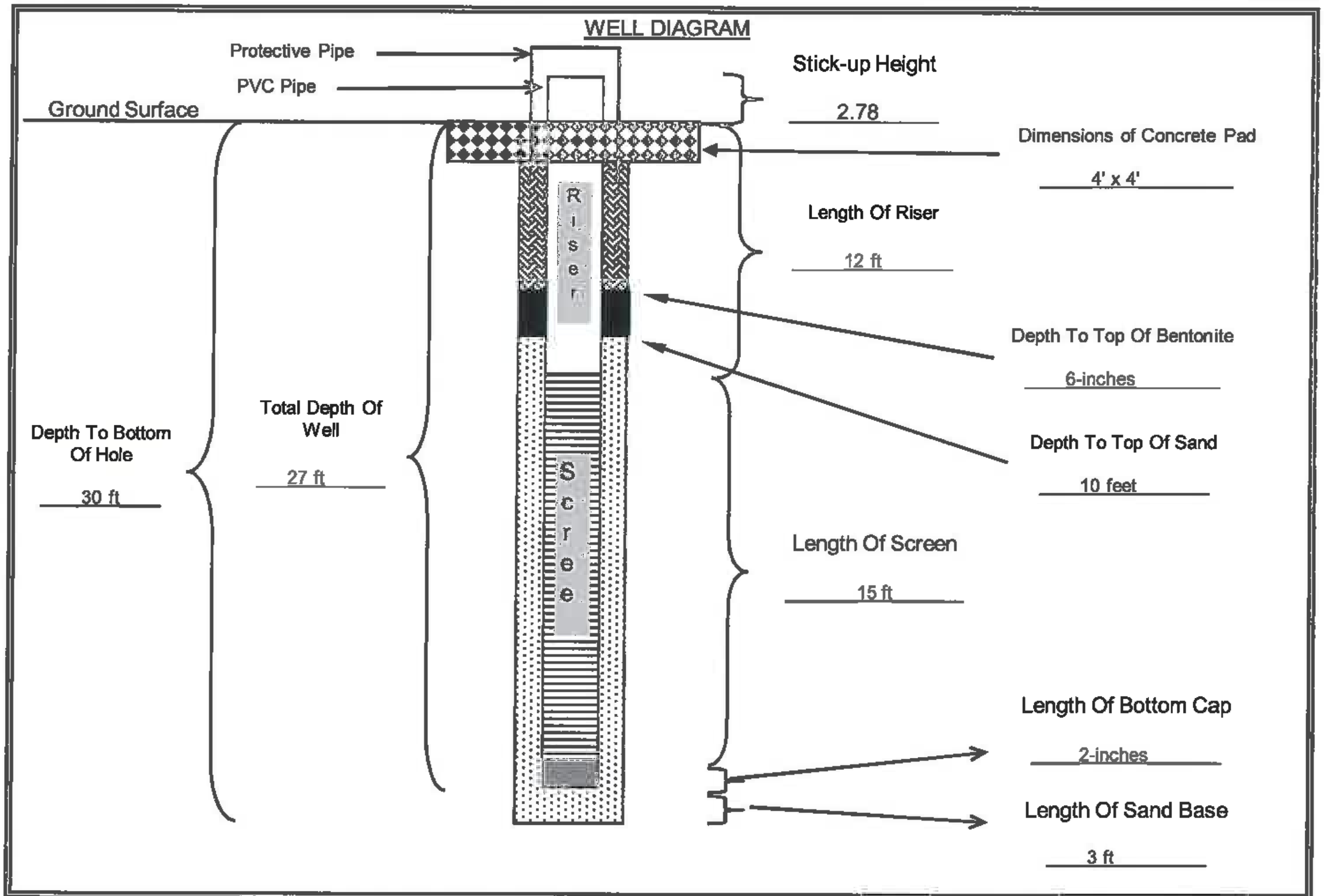
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 23-Jul-09
WELL LOCATION:
WELL NO.: **GB-06**
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION:	357.41 (ft, msl)	BENTONITE TYPE:	Western Bentonite	
TOP OF SCREEN ELEVATION:	345.41 (ft, msl)	MANUFACTURER:	PDS	
BOTTOM OF WELL ELEVATION:	327.41 (ft, msl)	CEMENT TYPE:		
NORTHING: 740.4893	EASTING: -2166.134	CEMENT MANUFACTURER:		
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40	
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum	
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services	
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	2.5	bags lbs
RISER DIAMETER:	2 (in) Length: 12 (ft)	AMOUNT CEMENT USED:		bags lbs
SCREEN DIAMETER:	2 (in) Length: 15 (ft)	AMOUNT SAND USED:	7	bags lbs
BOREHOLE DIAMETER:	6.75 (in)	STATIC WATER:	15.3	depth from TOC
DRILLING TECHNIQUE:	Hollow Stem Size: 6.75 (in)	ENCOUNTERED WATER:		depth from ground

WELL DIAGRAM



Stick-up Height: 2.78

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 12 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 10 feet

Depth To Bottom Of Hole: 30 ft

Total Depth Of Well: 27 ft

Length Of Screen: 15 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 3 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC INSTALLED BY:	Total Support Services	OBSERVED BY:	Kush Chohan
DATE:	23-Jul-09	CHECKED BY:	DATE:

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

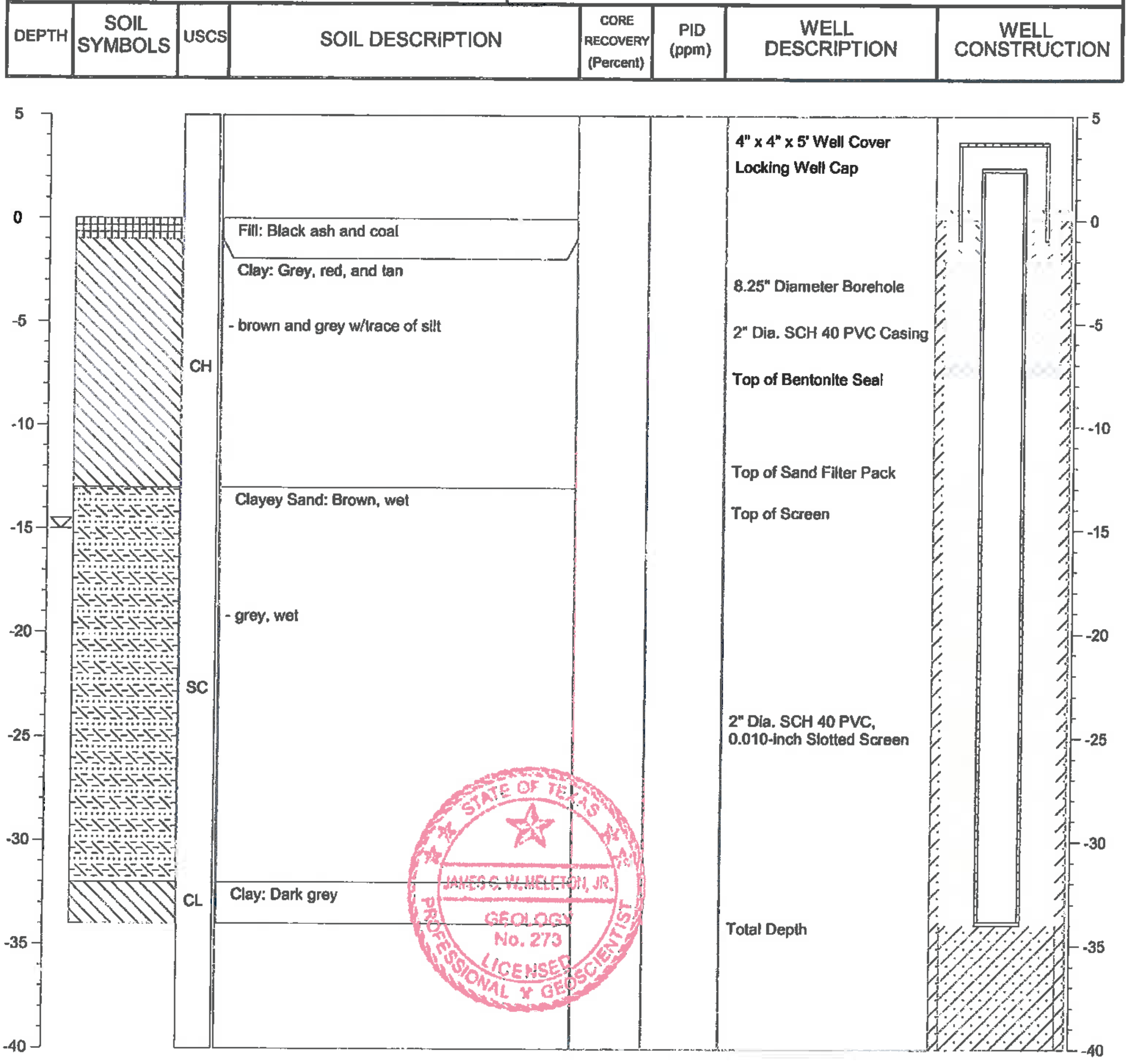
BORING/WELL NO.:	**GB-07/MW-7**
TOTAL DEPTH:	**34'**
TOP OF CASING ELEV.:	**362.75 ft. NGVD**
GROUND SURFACE ELEV.:	**360.20 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Metal Cleaning Waste Pond**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0120**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**12/1/09**

NOTES: **Latitude: 33.05455**
Longitude: 94.84674

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

ETTL ENGINEERS & CONSULTANTS

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-1

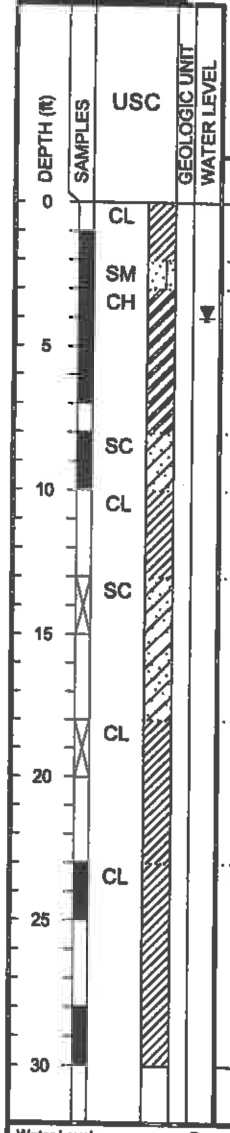
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

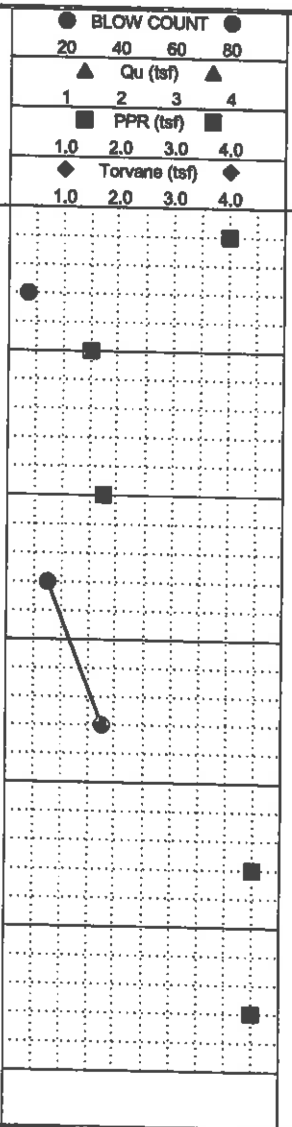
DATE 10/27/09

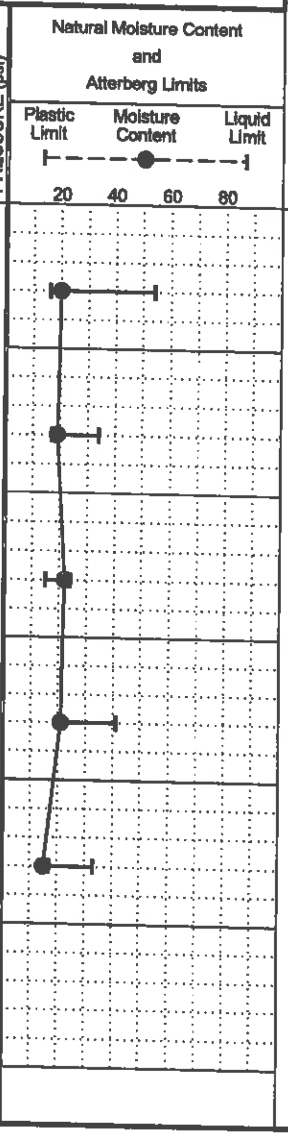
SURFACE ELEVATION 324.1



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; brownish orange	P=4.0 SF										
SM	SILTY SAND(SM) tannish orange	N=7										
CH	SANDY FAT CLAY(CH) medium stiff; tannish orange						20	54	16	38	63	+40Sieve=10%, +4 Sieve=1%
	–stiff	P=1.5										
SC	CLAYEY SAND(SC) medium dense; tannish orange; with clay seams	P=1.75					19	34	17	17	32	+40 Sieve=7%, +4 Sieve=3%
CL	SANDY LEAN CLAY(CL) stiff; orange											
SC	CLAYEY SAND(SC) medium dense; orange; saturated; with iron oxide cemented sandstone rock	N=15					22	24	15	9	19	+40Sieve=35%, +4 Sieve=22%
CL	LEAN CLAY WITH SAND(CL) hard; dark gray; with clay seams	N=35					21	41	21	20	75	+40 Sieve=2%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; dark brown	P=4.5+					15	33	17	16	52	+40 Sieve=1%, +4 Sieve=0%
	–grayish brown; laminated with silt	P=4.5+										
	Bottom of Boring @ 30'											

ATTERBERG LIMITS(%)





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 5' while drilling. Water level @ 4' and open to 30' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.090', W 94°50.417'

Piezometer B-2

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ENGINEERS &
CONSULTANTS

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

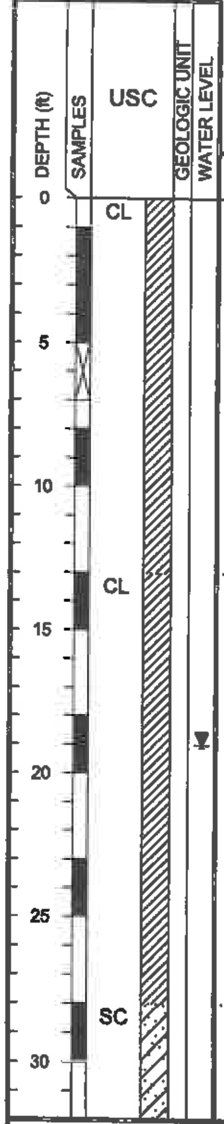
PROJECT: Welsh Power Plant
Pittsburgh, Texas

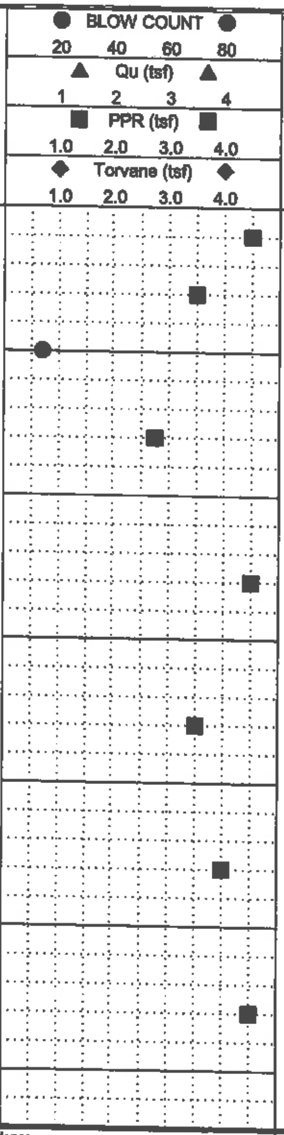
PROJECT NO.: G3242-09

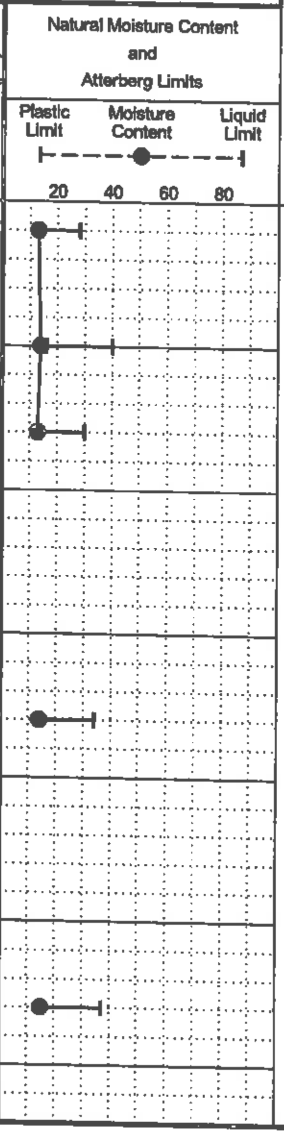
BORING TYPE: Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7







MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+					13	28	14	14	61	+40 Sieve=3%, +4 Sieve=0%
–very stiff	P=3.5										
–stiff	N=14					14	40	16	24	65	+40 Sieve=0%, +4 Sieve=0%
–very stiff; reddish brown	P=2.75					13	30	14	16	58	+40 Sieve=0%, +4 Sieve=0%
SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+										
–very stiff	P=3.5					14	34	15	19	54	+40 Sieve=0%, +4 Sieve=0%
	P=4.0										
CLAYEY SAND(SC) medium dense; tan, red, and gray	P=4.5					15	37	16	21	47	+40 Sieve=5%, +4 Sieve=3%

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

PROJECT: Welsh Power Plant
Pittsburgh, Texas

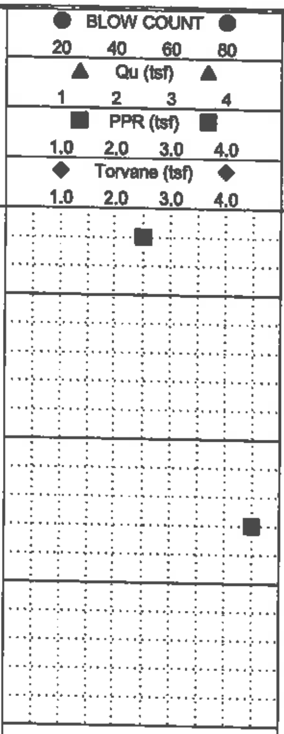
PROJECT NO.: G3242-09

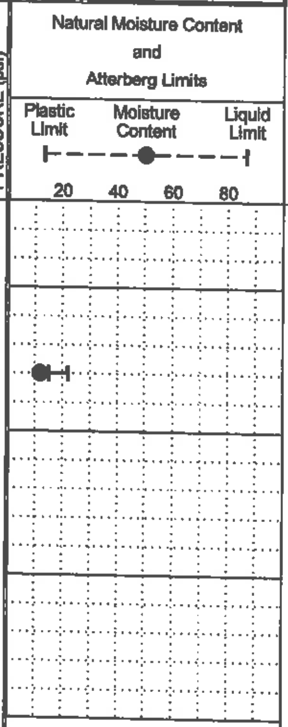
BORING TYPE: Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
		--red and tan	P=2.5										
35													
	SM SC	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated	SF					12	22	15	7	48	+40 Sieve=0%, +4 Sieve=0%
40													
	CH	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams	P=4.5+										
45													
	SM	SILTY SAND(SM) black and gray	SF										
50		Bottom of Boring @ 50'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

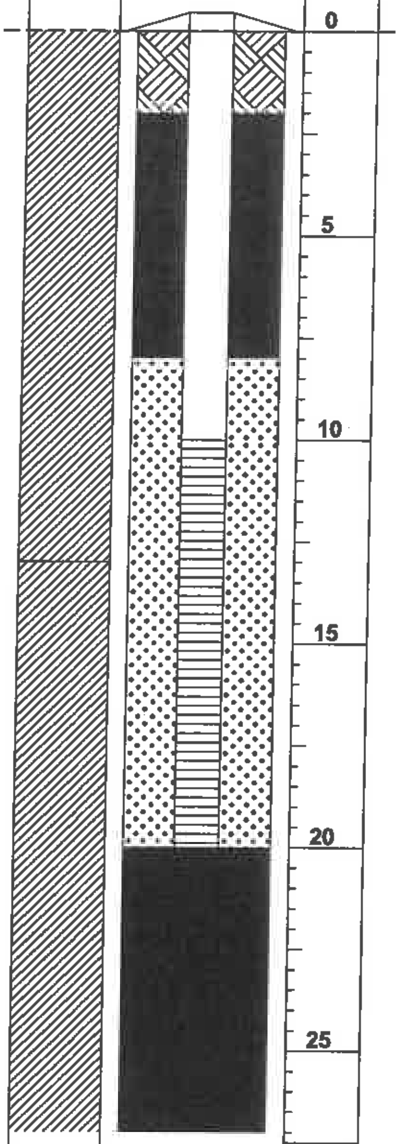
Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

Piezometer B-2

ENVIRONMENTAL LOG **Client:** Welsh Power Plant **Project No:** G3242-095 **Phase** **Task**	**Well No.** B-2 **Location** Pittsburg, Texas **Surface Elev.** **Page** 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		SANDY LEAN CLAY(CL) hard; red and tan					
		–very stiff					
5		–stiff				5	
		–very stiff; reddish brown					
10						10	
		SANDY LEAN CLAY(CL) hard; red and tan					
15						15	
		–very stiff					
20						20	
25						25	



Continued Next Page

Driller Doug Hinds
Logged By James Griffith
Drilling Started 10/28/09
Drilling Completed 10/28/09
Construction Completed
Development Completed
Type of Well

Drilling Method Soild Stem Auger
Borehole Diameter 6.5"
Well Casing 2.0" **Dia.** 0.0' **to** 10.0'
Casing Type PVC
Well Screen 2.0" **Dia.** 10.0' **to** 20.0'
Screen Type Slotted
Slot Size 0.010"
Grout Type Bentonite

Bentonite Seal 2-8' & 20-50'
Filter Pack Qty. 8-20'
Filter Pack Type 20/40 Sand
Static Water Level
Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

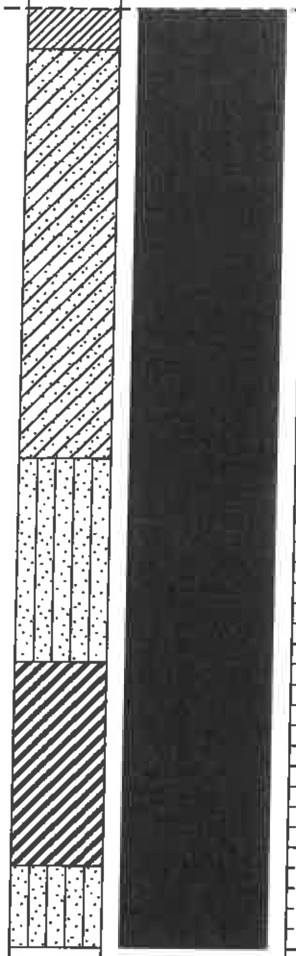
Well No. B-2

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	**Sampler**	**Overburden/Lithologic Description**	**Field Strength Data**	**Graphic Log**	**Well Construction Graphics**	**Depth Feet**	**Well Construction Details**
		Continued from previous page					
		CLAYEY SAND(SC) medium dense; tan, red, and gray					
30						30	
		--red and tan					
35						35	
		SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated					
40						40	
		FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams					
45						45	
		SILTY SAND(SM) black and gray					
50						50	
		Bottom of Boring @ 50'					
55							
60							



LOG OF BORING B-3

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

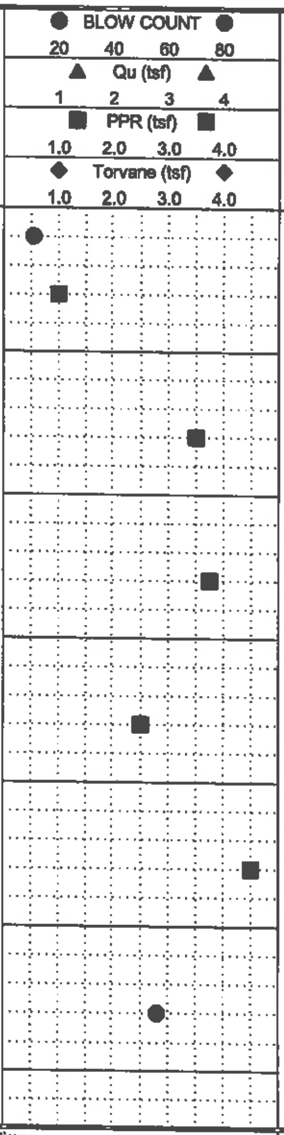
PROJECT NO.: G3242-09

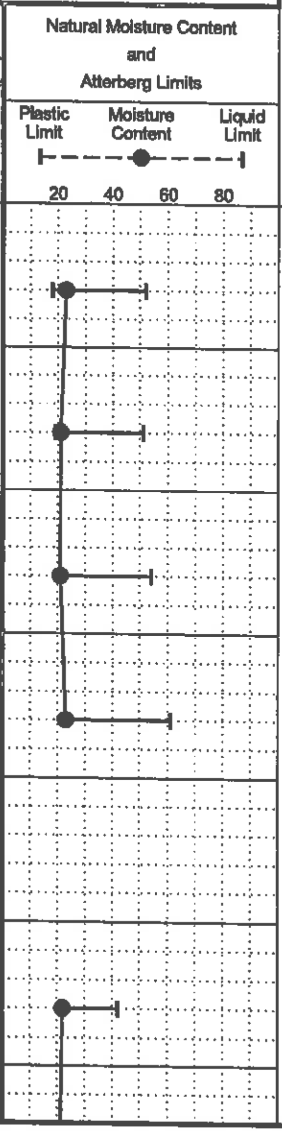
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	SC		CLAYEY SAND(SC) medium dense; gray and red	N=11										
	CH		FAT CLAY(CH) stiff; red and tan; with sand seams	P=1.0					23	52	18	34	87	+40 Sieve=3%, +4 Sieve=0%
			--very stiff	P=3.5					21	51	19	32	86	+40 Sieve=3%, +4 Sieve=0%
	CH		FAT CLAY WITH SAND(CH) very stiff; brown; with ferric joints	P=3.75					21	54	20	34	85	+40Sieve=10%, +4 Sieve=1%
		▼	--red and tan; layered; with ferric seams	P=2.5					23	61	24	37	81	+40Sieve=11%, +4 Sieve=0%
	CH		FAT CLAY(CH) hard; gray; with sand seams	P=4.5+										
30	SC		CLAYEY SAND(SC) very dense; gray; with sand seams	N=56					22	42	22	20	35	+40 Sieve=1%, +4 Sieve=0%





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

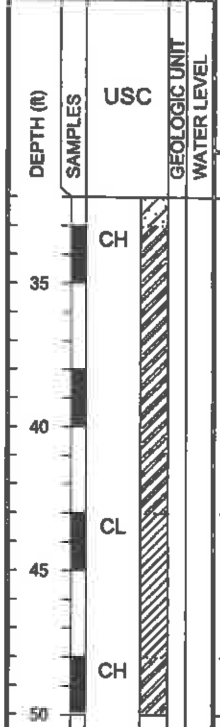
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

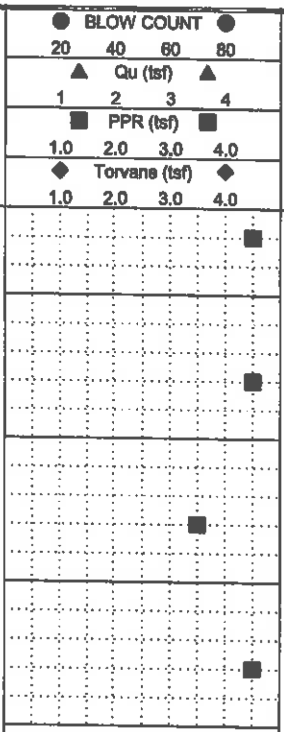
BORING TYPE: Flight Auger

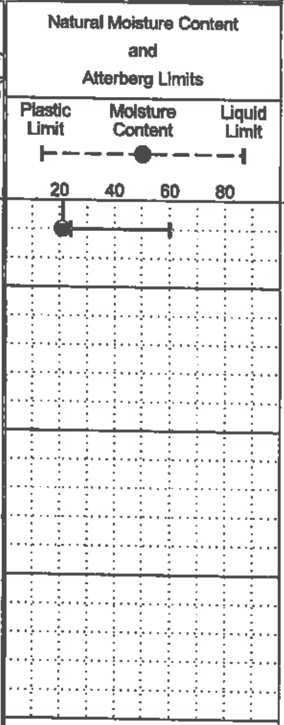
DATE 10/27/09

SURFACE ELEVATION 339.6



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY(CH) hard; brown; layered and with sand seams	P=4.5+					21	60	24	36	95	+40 Sieve=1%, +4 Sieve=0%
	--gray and green	P=4.5+										
CL	SANDY LEAN CLAY(CL) very stiff; gray and dark green; layered; with sand seams	P=3.5										
CH	FAT CLAY(CH) hard; gray and dark green; layered; with silt seams	P=4.5+										
	Bottom of Boring @ 50'											





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

Piezometer B-4

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

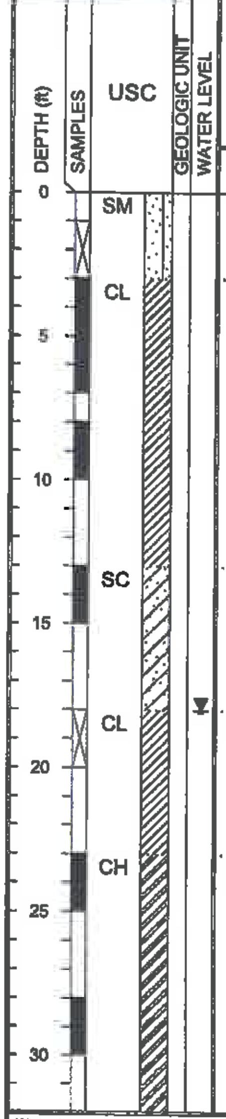
PROJECT: Welsh Power Plant
Pittsburgh, Texas

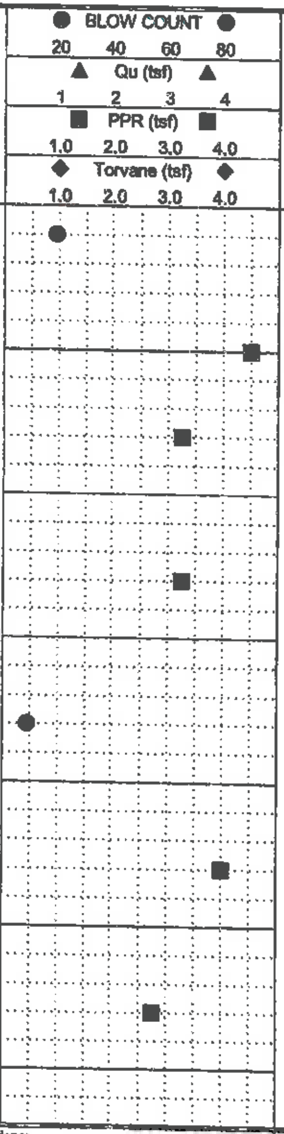
PROJECT NO.: G3242-09

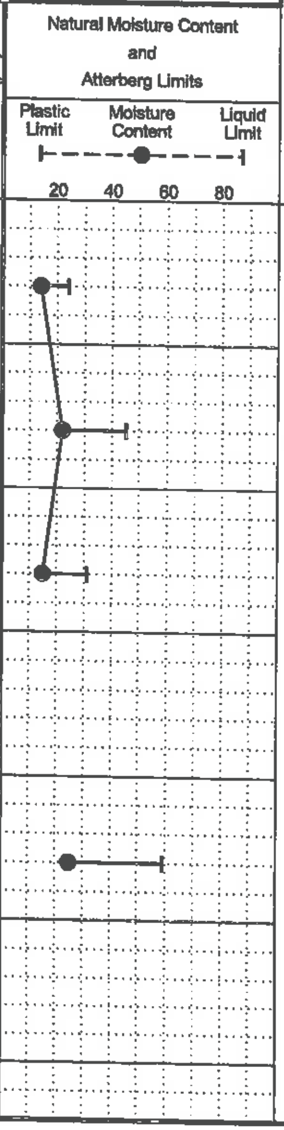
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6







MATERIAL DESCRIPTION

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SM	SILTY SAND(SM) medium dense; tan; with gravel	N=19										
CL	SANDY LEAN CLAY(CL) dark brown	SF										
	--tannish orange						14	24	15	9	59	+40 Sieve=1%, +4 Sieve=0%
	--hard; orangish tan	P=4.5										
		P=3.25					22	45	21	24	94	+40 Sieve=2%, +4 Sieve=0%
	--very stiff; white											
SC	CLAYEY SAND(SC) medium dense; tan	P=3.25										
	--orangish gray; with sand seams						15	31	15	16	40	+40 Sieve=1%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) stiff; orangish tan	N=9										
CH	FAT CLAY(CH) very stiff; orangish tan; with ferric seams	P=4.0					25	59	24	35	88	+40 Sieve=4%, +4 Sieve=0%
	--tannish brown; with iron ore seams	P=2.75										

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

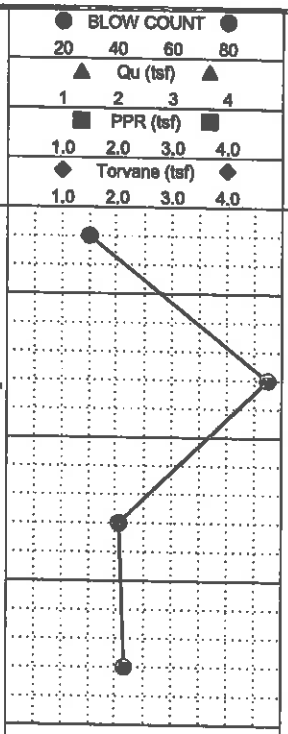
PROJECT: Welsh Power Plant
Pittsburgh, Texas

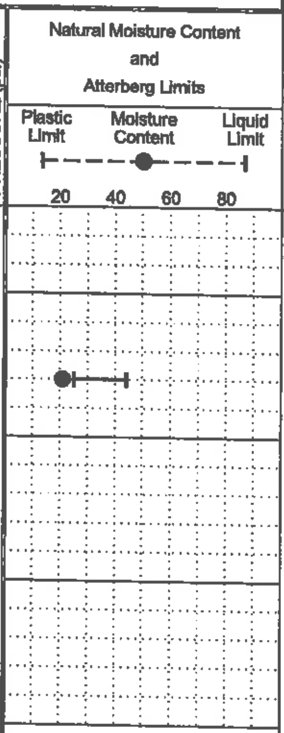
PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6





DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	☒				–hard; light gray; layered and with silt seams	N=30										
40	☒	CL			LEAN CLAY(CL) hard; light gray; layered and with silt seams	N=50/5.75"					21	44	25	19	93	+40 Sieve=1%, +4 Sieve=0%
45	☒				–light gray	N=41										
50	☒				–layered and with sand seams; with lignite	N=43										
					Bottom of Boring @ 50'											

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

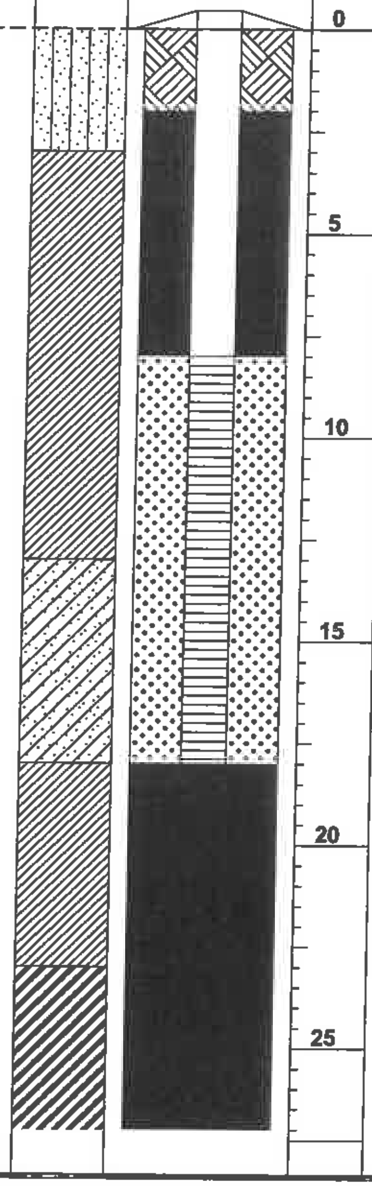
Piezometer B-4

ENVIRONMENTAL LOG

Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**

Well No. B-4
Location Pittsburg, Texas
Surface Elev.
Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		SILTY SAND(SM) medium dense; tan; with gravel					
		SANDY LEAN CLAY(CL) dark brown					
		–tannish orange					
5		–hard; orangish tan				5	
10		–very stiff; white				10	
		CLAYEY SAND(SC) medium dense; tan					
15		–orangish gray; with sand seams				15	
		SANDY LEAN CLAY(CL) stiff; orangish tan					
20						20	
		FAT CLAY(CH) very stiff; orangish tan; with ferric seams					
25						25	



Continued Next Page

Driller Doug Hinds
Logged By James Griffith
Drilling Started 10/27/09
Drilling Completed 10/27/09
Construction Completed
Development Completed
Type of Well

Drilling Method Soild Stem Auger
Borehole Diameter 6.5"
Well Casing 2.0" **Dia.** 0.0' **to** 8.0'
Casing Type PVC
Well Screen 2.0" **Dia.** 8.0' **to** 18.0'
Screen Type Slotted
Slot Size 0.010"
Grout Type Bentonite

Bentonite Seal 2-8' & 18-50'
Filter Pack Qty. 6-18'
Filter Pack Type 20/40 Sand
Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

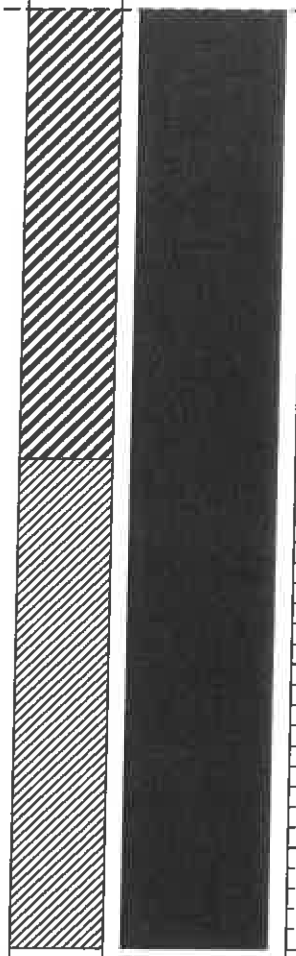
Well No. B-4

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		--tannish brown; with iron ore seams					
30						30	
		--hard; light gray; layered and with silt seams					
35						35	
		LEAN CLAY(CL) hard; light gray; layered and with silt seams					
40						40	
		--light gray					
45						45	
		--layered and with sand seams; with lignite					
50						50	
		Bottom of Boring @ 50'					
55							
60							



Piezometer B-5

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

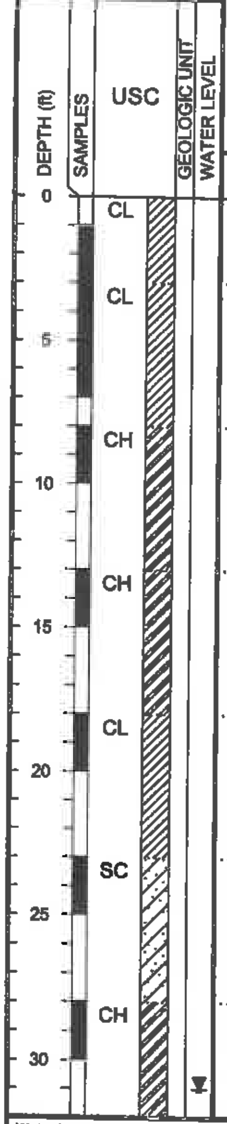
PROJECT NO.: G3242-09

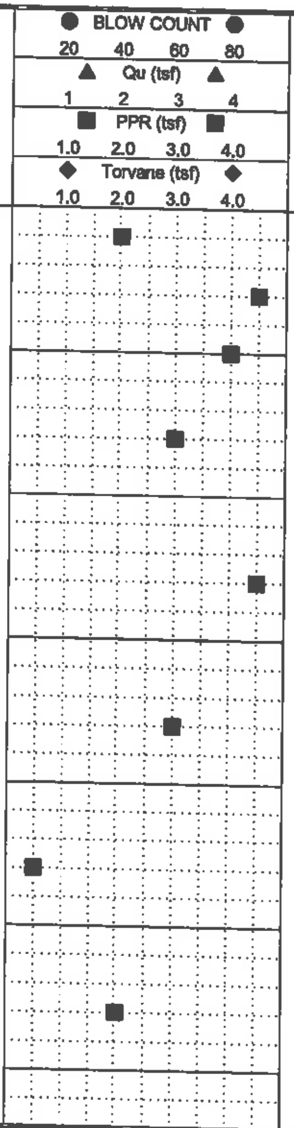
BORING TYPE: Flight Auger

DATE 10/27/09

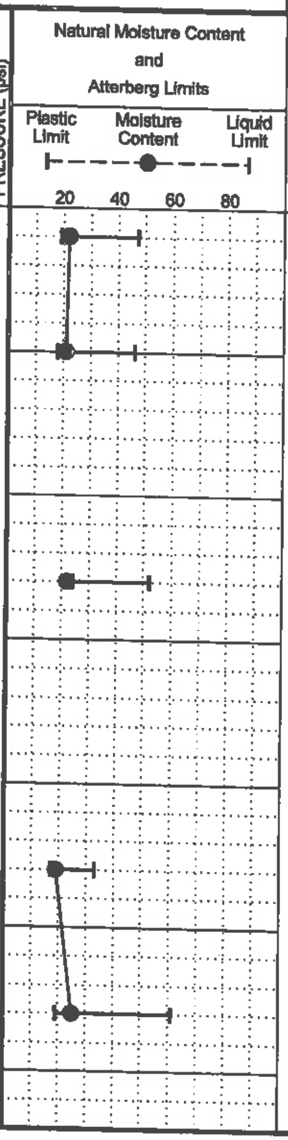
SURFACE ELEVATION 340.0

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) stiff; red and tan	P=2.0	22	47	19	28	81	+40 Sieve=9%, +4 Sieve=3%
CL	LEAN CLAY(CL) hard; red and tan	P=4.5+						
	–very stiff	P=4.0	21	46	18	28	94	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY(CL) very stiff; brown and tan	P=3.0						
CH	FAT CLAY WITH SAND(CH) hard; red and tan	P=4.5+	22	52	24	28	88	+40 Sieve=3%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams	P=3.0						
SC	CLAYEY SAND(SC) very loose; tan, red, and gray	P=0.5	19	33	17	16	44	+40 Sieve=1%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) stiff; red and gray	P=2.0	25	61	19	42	83	+40 Sieve=5%, +4 Sieve=3%





DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
33–38	SC	SILTY CLAYEY SAND(SC) gray and red; saturated	SF										
38–43	CH	FAT CLAY(CH) hard; red and gray; with sand seams	P=4.5+					25	51	31	20	87	+40 Sieve=6%, +4 Sieve=0%
43–48		–gray, tan, and red; with sand seams	P=4.5+										
48–50	SM SC	SILTY SAND(SM-SC) red and gray	SF										
50		Bottom of Boring @ 50'											

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

Renumber B-5

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-5

Location Pittsburg, Texas

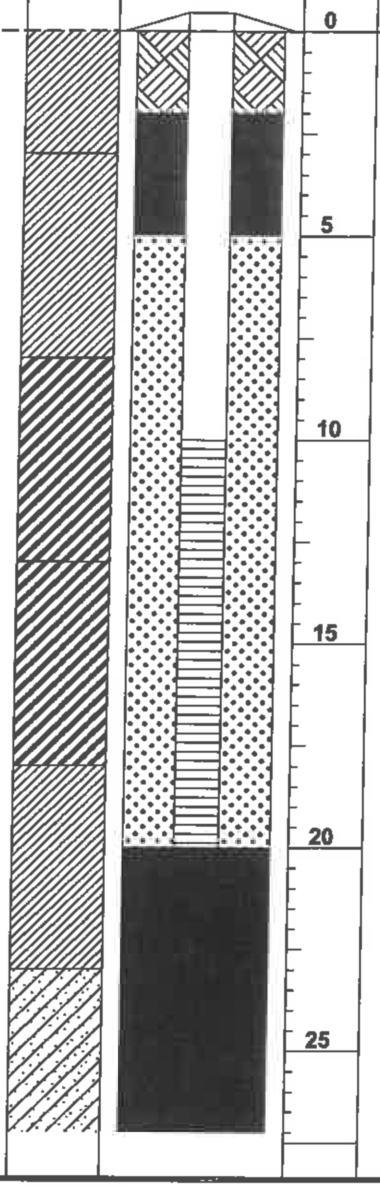
Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description
0		Ground Surface
		LEAN CLAY WITH SAND(CL) stiff; red and tan
		LEAN CLAY(CL) hard; red and tan
5		--very stiff
		FAT CLAY(CL) very stiff; brown and tan
10		
		FAT CLAY WITH SAND(CH) hard; red and tan
15		
		SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams
20		
		CLAYEY SAND(SC) very loose; tan, red, and gray
25		

Field Strength Data | **Graphic Log** | **Well Construction Graphics** | **Depth Feet** | **Well Construction Details**

T.O.C. Elev.



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed ______

Development Completed ______

Type of Well ______

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-5' & 20-50'

Filter Pack Qty. 5-20'

Filter Pack Type 20/40 Sand

Static Water Level ______

Notes: ______

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

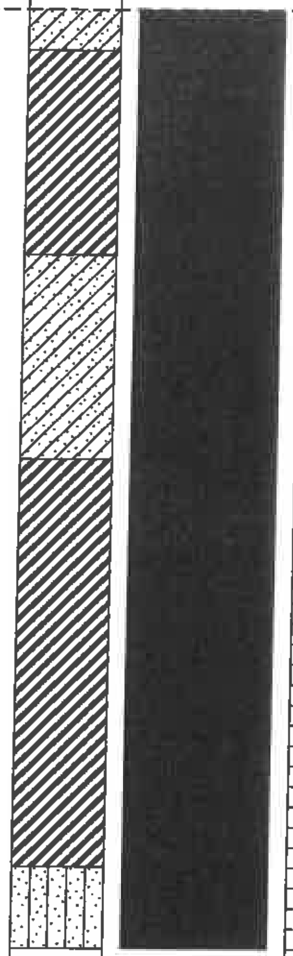
Well No. B-5

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		FAT CLAY WITH SAND(CH) stiff; red and gray					
30						30	
		SILTY CLAYEY SAND(SC) gray and red; saturated					
35						35	
		FAT CLAY(CH) hard; red and gray; with sand seams					
40						40	
		–gray, tan, and red; with sand seams					
45						45	
		SILTY SAND(SM-SC) red and gray					
50		Bottom of Boring @ 50'				50	
55							
60							



ETTL Engineers & Consultants Inc.

Piezometer B-6

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

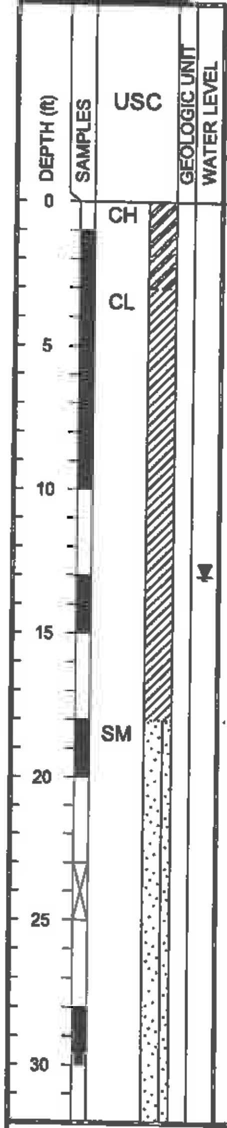
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

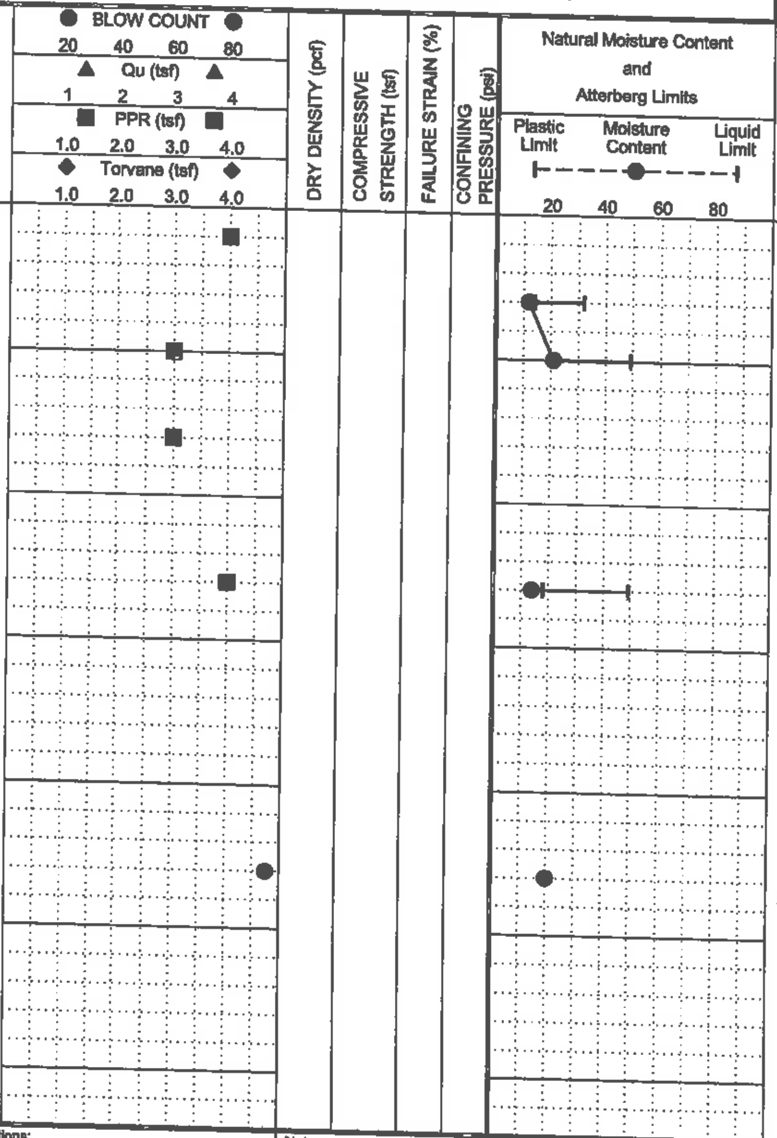
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY(CH) very stiff; red and gray; with ferric seams	P=4.0						
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+	12	32	14	18	60	+40 Sieve=0%, +4 Sieve=0%
		P=3.0	21	49	20	29	93	+40 Sieve=2%, +4 Sieve=0%
	–very stiff; red, gray, and brown; with gravel –with sand seams	P=3.0						
		P=4.0	14	49	18	31	65	+40 Sieve=0%, +4 Sieve=0%
SM	SILTY SAND(SM) gray; saturated	P=3.0						
	–very dense; gray and red	N=50/5.25"	20				18	+40 Sieve=0%, +4 Sieve=0%
		SF						



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

PROJECT: Welsh Power Plant
Pittsburgh, Texas

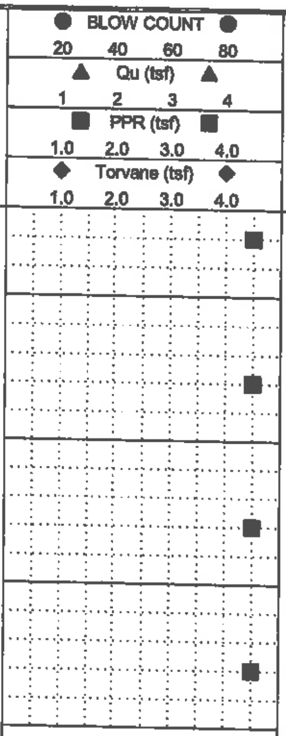
PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

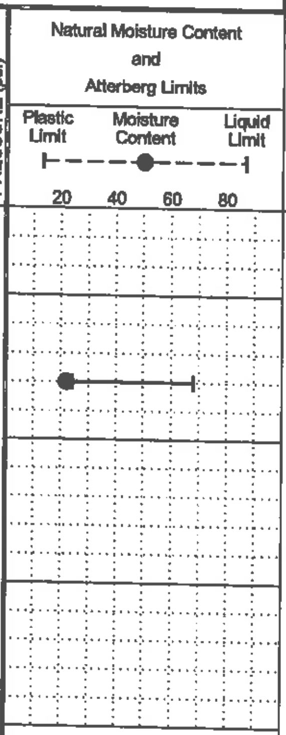
DATE 10/27/09

SURFACE ELEVATION 340.1

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	CH	FAT CLAY(CH) hard; brown; with sand seams	P=4.5+						
40			P=4.5+	22	68	24	44	95	+40 Sieve=0%, +4 Sieve=0%
45		--dark green	P=4.5+						
50	CL	LEAN CLAY(CL) hard; dark green; laminated with lignite	P=4.5+						
		Bottom of Boring @ 50'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

Piezometer B-6

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-6

Location Pittsburg, Texas

Surface Elev.

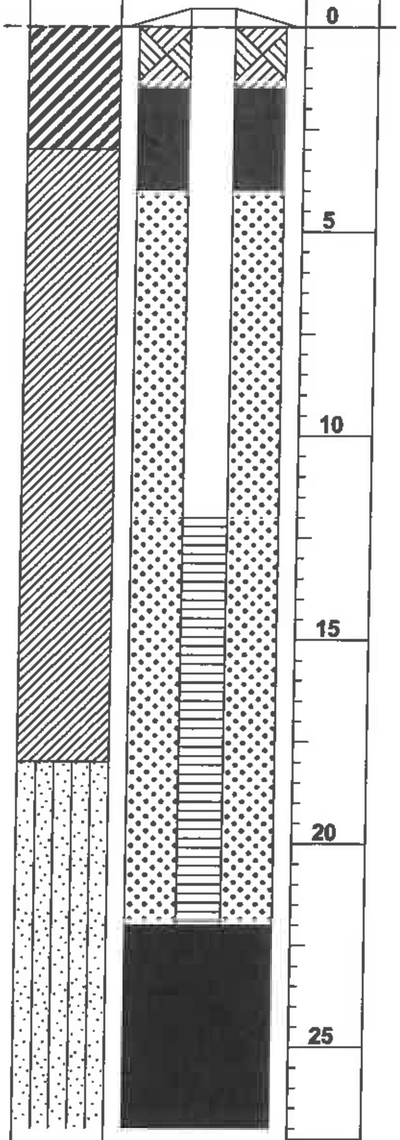
Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data
0		Ground Surface	
		FAT CLAY(CH) very stiff; red and gray; with ferric seams	
		SANDY LEAN CLAY(CL) hard; red and tan	
5			
		–very stiff; red, gray, and brown; with gravel	
		–with sand seams	
10			
15			
		SILTY SAND(SM) gray; saturated	
20			
		–very dense; gray and red	
25			

Continued Next Page

Graphic Log / **Well Construction Graphics** / **Depth Feet** / **Well Construction Details**

T.O.C. Elev.



Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/28/09

Drilling Completed 10/28/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 12.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 12.0' **to** 22.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 1.5-4' & 22-50'

Filter Pack Qty. 4-22'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

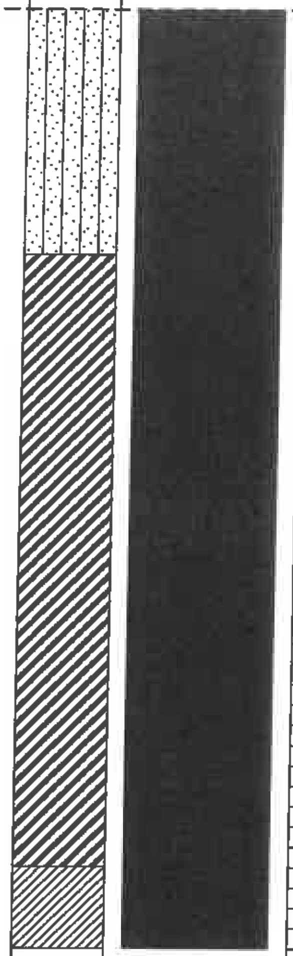
ETTL Engineers & Consultants Inc.

ENVIRONMENTAL LOG

Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**

Well No. B-6
Location Pittsburg, Texas
Surface Elev.
Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
30					30	
	FAT CLAY(CH) hard; brown; with sand seams					
35					35	
40					40	
	–dark green					
45					45	
	LEAN CLAY(CL) hard; dark green; laminated with lignite					
50	Bottom of Boring @ 50'				50	
55						
60						



ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-7

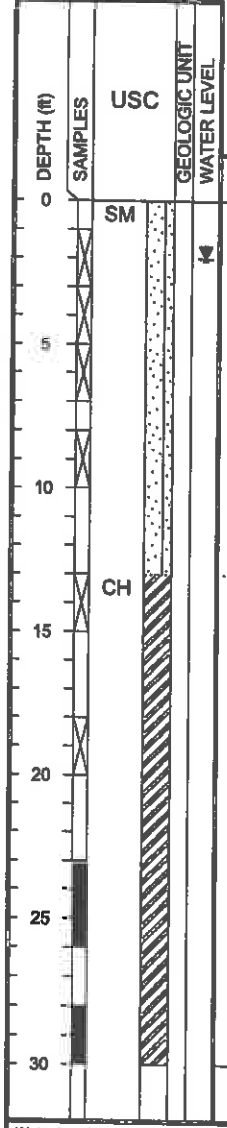
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

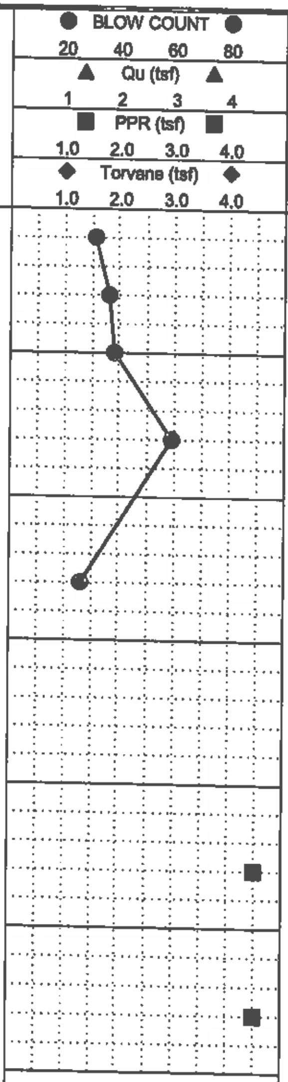
SURFACE ELEVATION 340.4

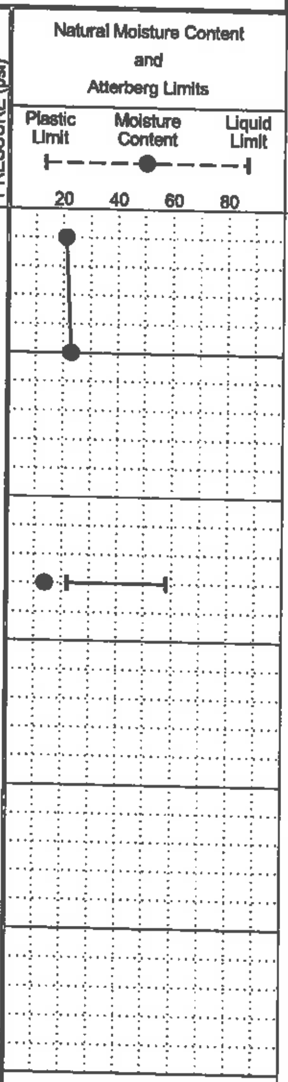


MATERIAL DESCRIPTION

MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SILTY SAND(SM) dense; tan	N=31	21				21	+40 Sieve=0%, +4 Sieve=0%
	N=36						
--gray; saturated	N=38	23				15	+40 Sieve=0%, +4 Sieve=0%
--very dense	N=59						
FAT CLAY(CH) very stiff; dark gray; with silt and ferric seams	N=26	14	58	22	36	98	+40 Sieve=0%, +4 Sieve=0%
--hard; gray and black; with trace of lignite	P=4.5+						
--gray							
	P=4.5+						
Bottom of Boring @ 30'							

DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 4' while drilling. Water level @ 2' and open to 7' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.898', W 94°50.519'

Landfill Boring B-2

ETTL
ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

DRILL RIG: B-61 HDX

PROJECT NO.: G4207-146

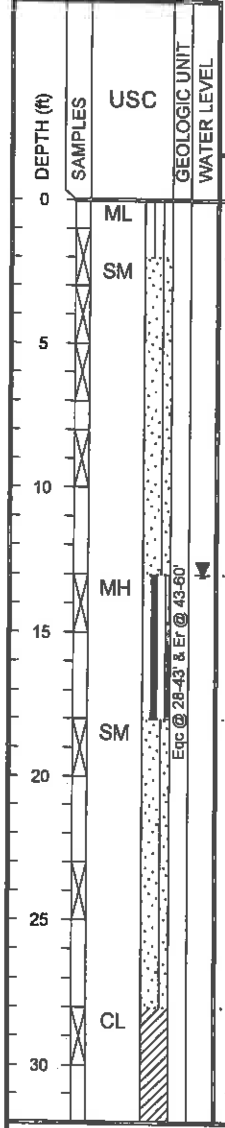
BORING TYPE: Rotary Wash/Flight Auger

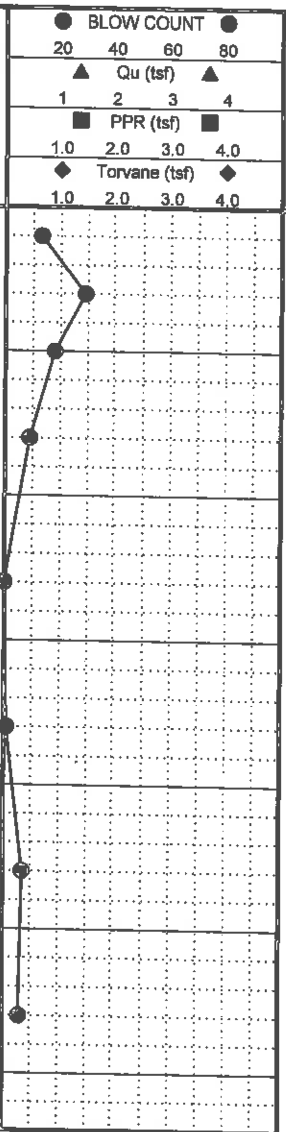
DATE 10/8/14

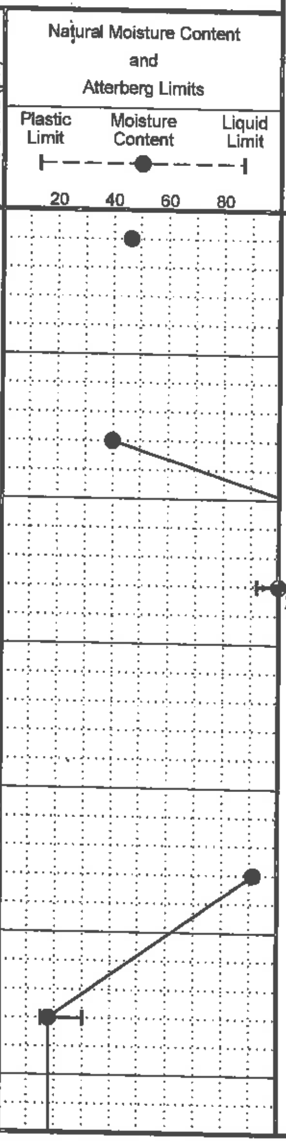
SURFACE ELEVATION 373.8

Geologic unit: Eqc @ 28-43' & Er @ 43-60'

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
ML SM	ASH (SILT WITH GRAVEL(ML)) medium dense; light grayish brown; with coarse-grained sand and lightly cemented gravel pieces; dry	N=13 N=29					46				59	+40 Sieve=27% +4 Sieve=16%
	ASH (SILTY SAND(SM)) medium dense; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces	N=18										
	--loose; moist	N=9					40				40	+40 Sieve=19% +4 Sieve=2%
MH	ASH (ELASTIC SILT(MH)) very loose; black; with fine-grained sand and lightly cemented gravel pieces; saturated	N=0					200	134	92	42	100	+40 Sieve=0% +4 Sieve=0%
SM	ASH (SILTY SAND(SM)) very loose; dark brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=1										
	--loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7					91				61	+40 Sieve=11% +4 Sieve=1%
CL	SANDY LEAN CLAY(CL) medium stiff; dark brown and black; with fine-grained sand and cemented gravel pieces; saturated	N=6					18	30	15	15	63	+40 Sieve=1% +4 Sieve=0%







Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

ETTL
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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

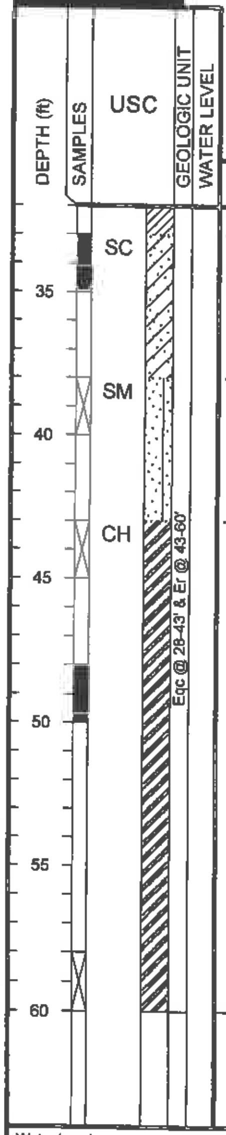
PROJECT NO.: G4207-146

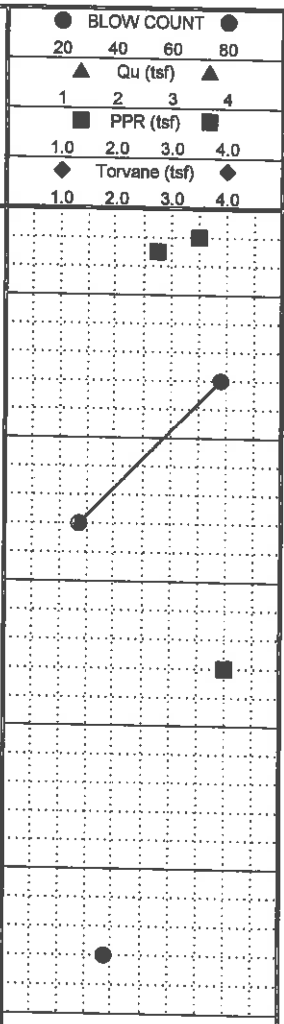
DRILL RIG: B-61 HDX

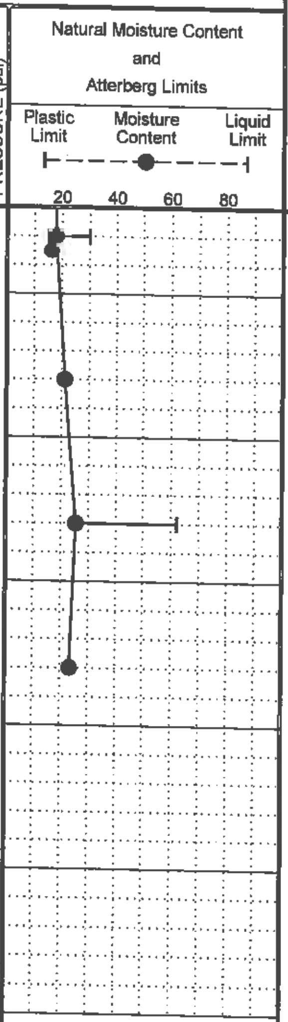
BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14

SURFACE ELEVATION 373.8







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	CLAYEY SAND(SC) dense; light brown, light gray and reddish brown; moist; with fine-grained sand; mottled	P=3.5 P=2.75	110	1.39	4.3	21	18 16	30	15	15	39	+40 Sieve=0% +4 Sieve=0%
SM	SILTY SAND(SM) very dense; light brown, yellowish brown and light gray; moist; mottled; with fine-grained sand	N=78					21				24	+40 Sieve=0% +4 Sieve=0%
CH	FAT CLAY(CH) very stiff; dark brown and light brown; moist; with sand seams; laminated	N=27					25	62	26	36	96	+40 Sieve=2% +4 Sieve=0%
	--dark brown with light gray; moist; with silt seams	P=4.0	98				24					
	--hard; dark brown; moist	N=37										
	Bottom of Boring @ 60'											

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill boring B-10

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

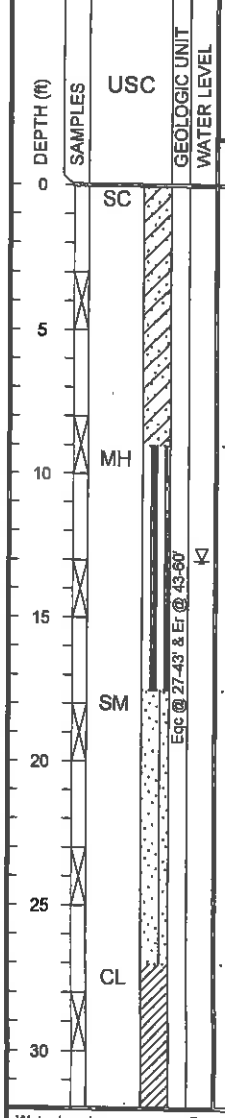
PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

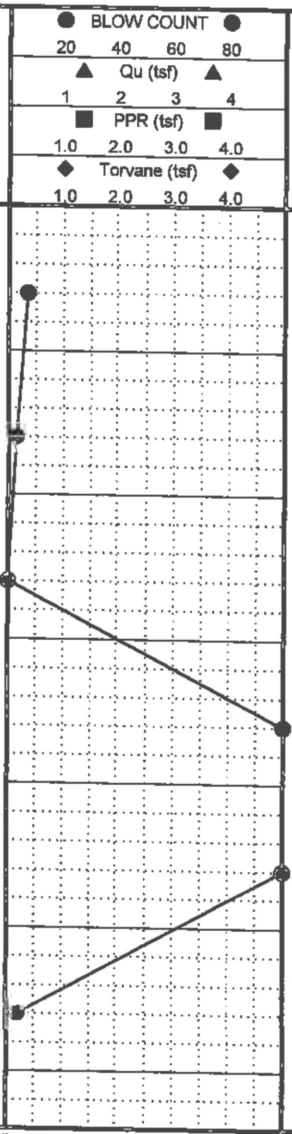
BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14

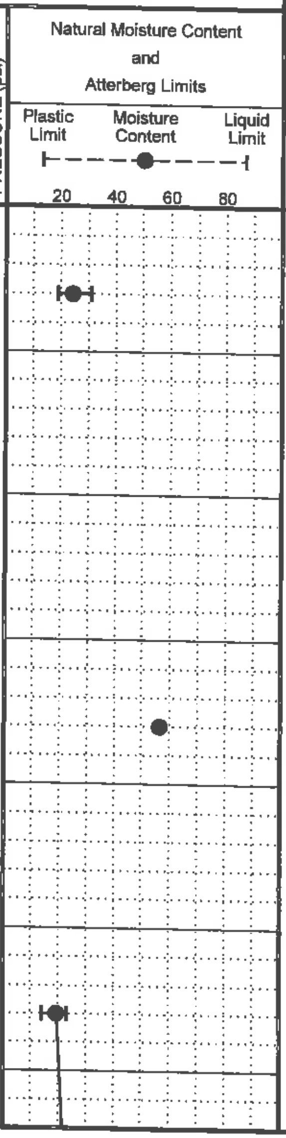
SURFACE ELEVATION 373.2



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	ASH (CLAYEY SAND(SC)) loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7	24	31	19	12	41	+40 Sieve=21% +4 Sieve=11%
MH	ASH (ELASTIC SILT(MH)) very loose; black; moist	N=3						
	--wet	N=0						
SM	ASH (SILTY SAND WITH GRAVEL(SM)) very dense; light brown and dark brown; with lightly cemented gravel pieces and coarse-grained sand; moist; cemented layer from 17.5' to 21'	N=50/1"	56				14	+40 Sieve=71% +4 Sieve=28%
	--cemented layer from 23' to 27'	N=50/4"						
CL	SANDY LEAN CLAY(CL) medium stiff; grayish brown and yellowish brown; saturated; mottled	N=4	19	23	14	9	57	+40 Sieve=1% +4 Sieve=0%



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

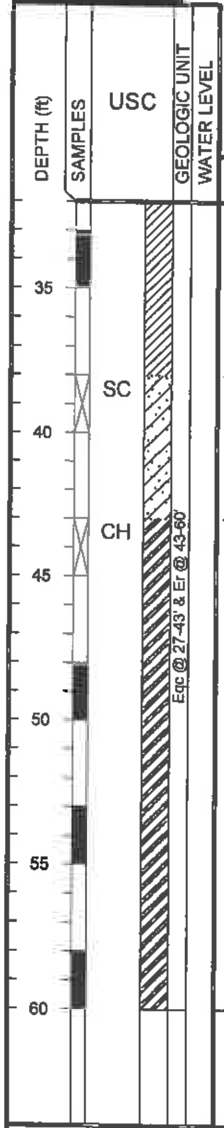
PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

BORING TYPE: Rotary Wash/Flight Auger

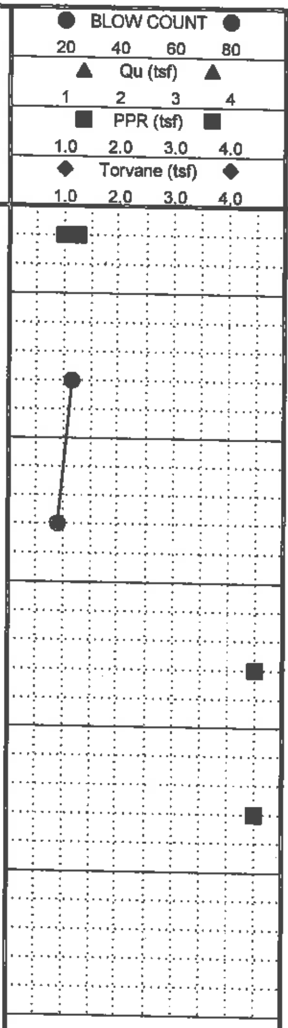
DATE 10/8/14

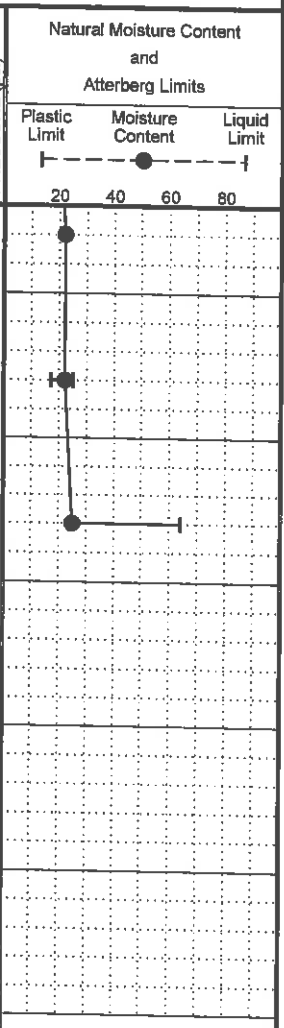
SURFACE ELEVATION 373.2



MATERIAL DESCRIPTION

USC	Material Description	Field Strength Data	Dry Density (pcf)	Compressive Strength (tsf)	Failure Strain (%)	Confining Pressure (psi)	Moisture Content (%)	Atterberg Limits (%) Liquid Limit LL	Atterberg Limits (%) Plastic Limit PL	Atterberg Limits (%) Plasticity Index PI	Minus #200 Sieve (%)	Other Tests Performed (Page Ref. #)
		P=1.25 P=1.0	107	2.10	6.1	21	22					
SC	CLAYEY SAND(SC) medium dense; reddish brown and grayish brown; moist; mottled	N=23					22	25	17	8	27	+40 Sieve=3% +4 Sieve=0%
CH	FAT CLAY(CH) very stiff; dark brown with light gray; with silt seams; moist	N=18					25	64	24	40	90	+40 Sieve=7% +4 Sieve=0%
	--hard	P=4.5+										
		P=4.5+										
	Bottom of Boring @ 60'											





Water Level Est.: ▽ Measured: ▼ Parched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill Boring B-12

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-12

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

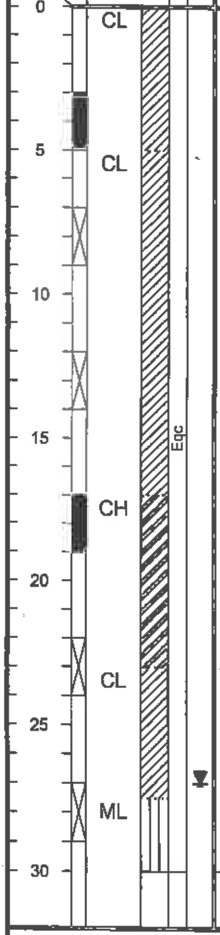
DRILL RIG:

PROJECT NO.: G4207-146

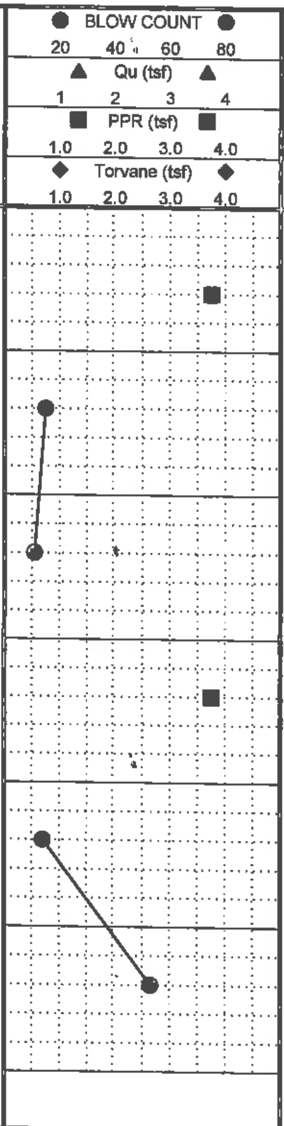
BORING TYPE: Flight Auger

DATE 10/15/14

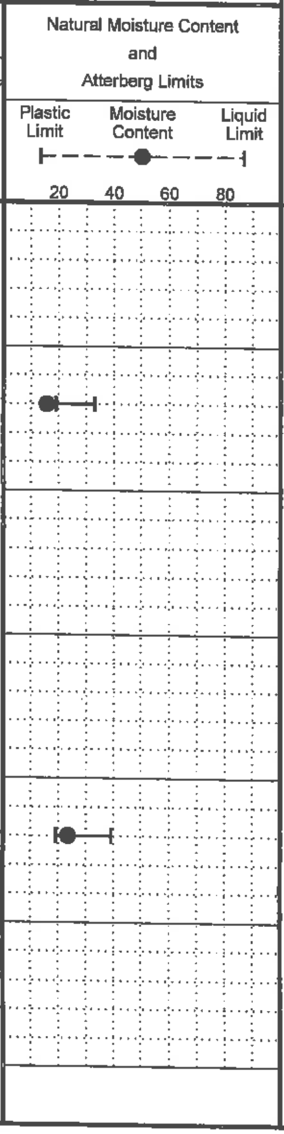
SURFACE ELEVATION 361.7



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) stiff; light gray and reddish brown; moist; mottled	P=3.75						
CL	SANDY LEAN CLAY(CL) stiff; light brown, light gray and reddish brown; moist; mottled	N=15	16	33	19	14	58	+40 Sieve=1% +4 Sieve=0%
	--grayish brown and brown; moist	N=11						
CH	FAT CLAY WITH SAND(CH) stiff; light gray and reddish brown; moist; mottled; with ferric seams	P=3.75						
CL	LEAN CLAY(CL) stiff; light gray and brownish gray; moist; layered with silt	N=14	24	39	19	20	93	+40 Sieve=1% +4 Sieve=0%
ML	SILT WITH SAND(ML) very dense; light brown and yellowish brown; moist; with clay seams	N=53						
	Bottom of Boring @ 30'							



DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)



Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 27' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04713°, W94.84486°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-13

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-13

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

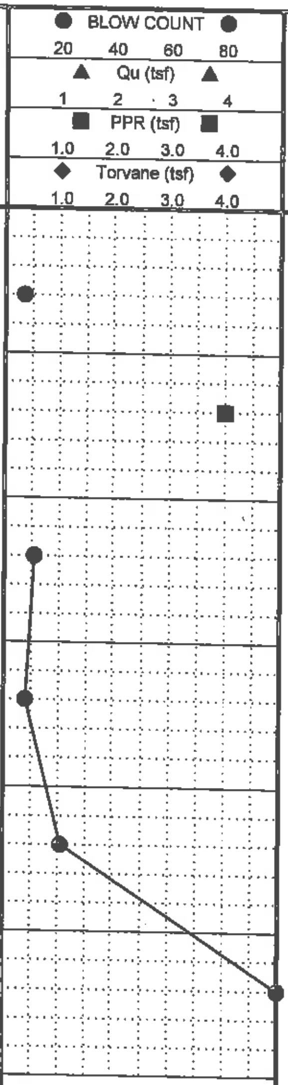
DRILL RIG:

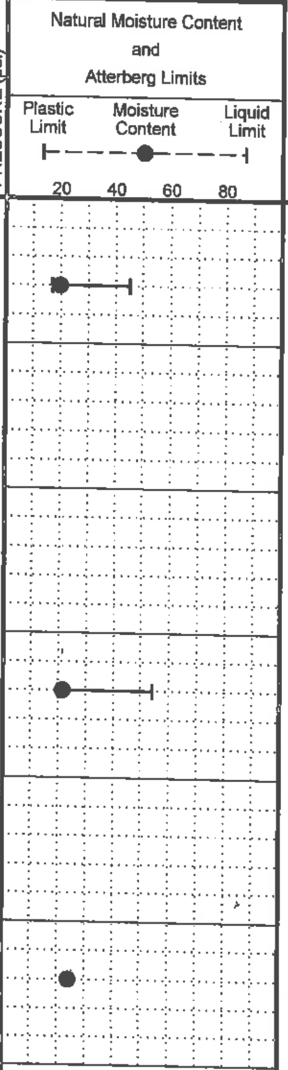
BORING TYPE: Flight Auger

DATE 10/15/14

SURFACE ELEVATION 361.4

DEPTH (ft)	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	Eqc		LEAN CLAY WITH SAND(CL) medium stiff; reddish brown with light gray; moist	N=7					20	45	17	28	76	+40 Sieve=1% +4 Sieve=0%
	CL			SANDY LEAN CLAY(CL) very stiff; light brown, gray and reddish brown; moist; mottled	P=4.0										
10	SC			CLAYEY SAND(SC) medium dense; grayish brown; moist											
	CH			FAT CLAY WITH SAND(CH) medium stiff; reddish brown and light gray; moist; mottled	N=11										
					N=8					22	54	20	34	79	+40 Sieve=1% +4 Sieve=0%
	CL			LEAN CLAY(CL) very stiff; light gray and grayish brown; moist; layered with silt	N=21										
	ML		▼	SILT WITH SAND(ML) very dense; light gray and yellowish brown; wet; with clay seams	N=50/5"					24				80	+40 Sieve=0% +4 Sieve=0%
30				Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 28' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates:	Driller:	Logger:
N33.047160°, W94.84384°	Lewis Drilling, Inc.	O.Sanderson

Landfill Boring B-14

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-14

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

DRILL RIG:

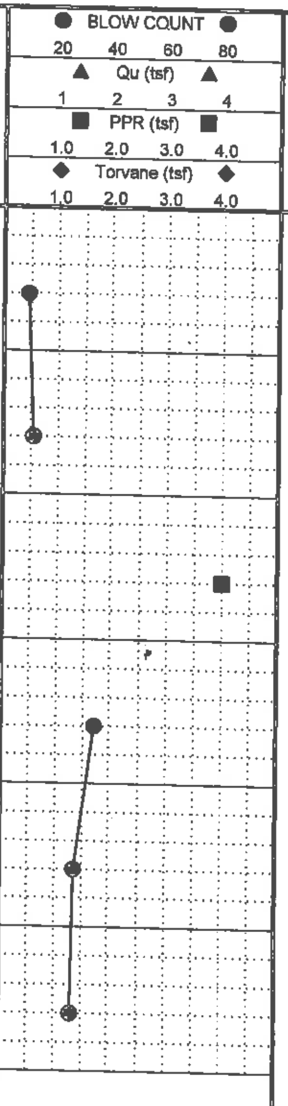
BORING TYPE: Flight Auger

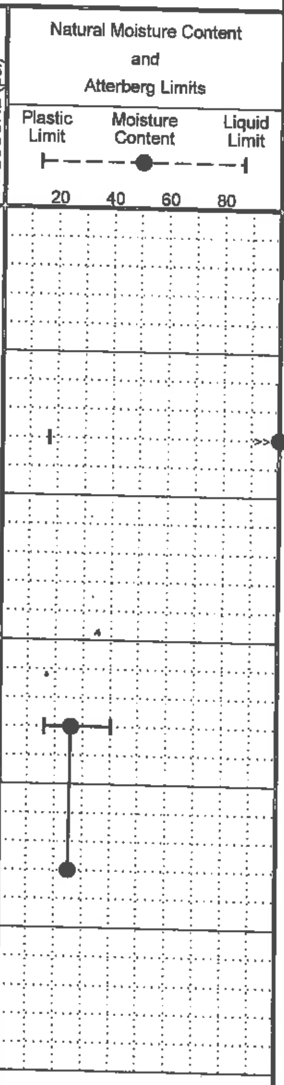
DATE 10/14/14

SURFACE ELEVATION 347.2

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0–8	CL	SANDY LEAN CLAY(CL) medium stiff; yellowish brown with reddish brown; dry; with clay seams	N=9										
8–13	ML	SANDY SILT(ML) medium dense; grayish brown; moist; with clay seams	N=11					108	17	17	NP	68	+40 Sieve=1% +4 Sieve=1%
13–23	CL	SANDY LEAN CLAY(CL) very stiff; light gray and gray; moist	P=4.0										
		--light gray and grayish brown; moist; layered with silt	N=34					26	40	16	24	67	+40 Sieve=1% +4 Sieve=0%
23–28	SP SM	POORLY GRADED SAND WITH SILT(SP-SM) medium dense; yellowish brown, light gray and reddish brown; wet	N=27					25				10	+40 Sieve=0% +4 Sieve=0%
28–30	CL	LEAN CLAY(CL) very stiff; dark brown; moist; with silt partings	N=26										
		Bottom of Boring @ 30'											

GEOLOGIC UNIT: Eqc @ 0-28' & Er @ 28-30'





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 23' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04774°, W94.84290°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-15

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ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-15

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

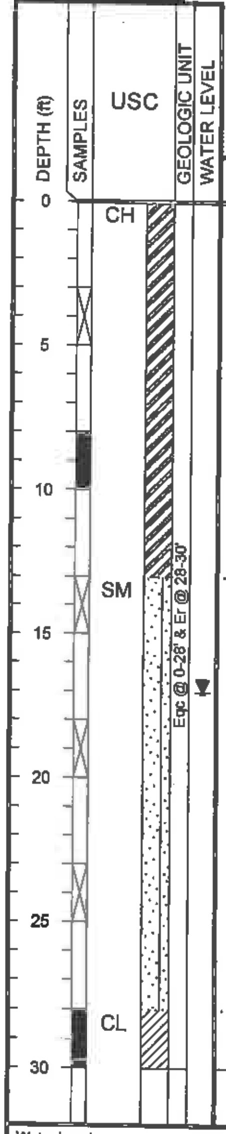
DRILL RIG:

PROJECT NO.: G4207-146

BORING TYPE: Flight Auger

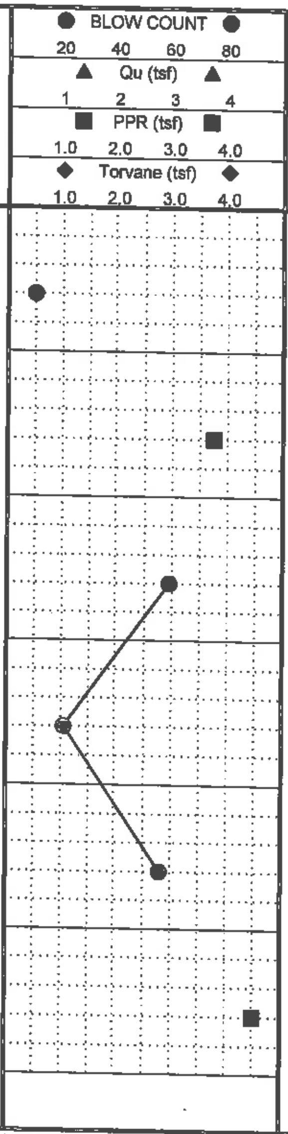
DATE 10/14/14

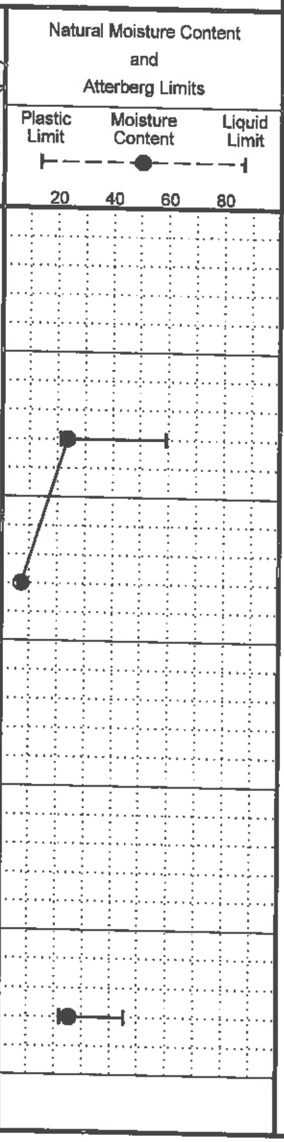
SURFACE ELEVATION 348.2



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
FAT CLAY(CH) stiff; reddish brown and light gray; moist; mottled	N=10										
--very stiff; light gray, grayish brown and reddish brown; moist; layered	P=3.75					24	59	21	38	85	+40 Sieve=0% +4 Sieve=0%
SILTY SAND(SM) very dense; light brown; dry	N=59					7				12	+40 Sieve=0% +4 Sieve=0%
--medium dense; wet	N=21										
--very dense	N=56										
LEAN CLAY(CL) hard; dark brown; moist; with silt partings	P=4.5					25	45	22	23	92	+40 Sieve=0% +4 Sieve=0%
Bottom of Boring @ 30'											

ATTERBERG LIMITS(%): LL LIQUID LIMIT, PL PLASTIC LIMIT, PI PLASTICITY INDEX





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 19' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04857°, W94.84286°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

ARCADIS

Appendix B

Photographic Log

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No. 1

Date: 8/20/2015

Direction Photo Taken:

North

Description:
Staging area west of landfill.

P8200493

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No. 2

Date: 8/20/2015

Direction Photo Taken:

South Southeast

Description:

Potential wetland on the top (west) end of the Primary Ash Pond.

P8200495

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 3

Date: 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Ditch between road and railway west of landfill, this ditch would be non-jurisdictional.

P8200497

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 4

Date: 8/20/2015

Direction Photo Taken:

Northeast

Description:

Ground Water Monitoring Well AD-12 near northwest end of landfill.

P8200501

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No.
5

Date:
8/20/2015

Direction Photo Taken:

East Northeast

Description:

View of plant from top of landfill. Primary ash pond is within the wooded area on left.

P8200506

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No.
6

Date:
8/20/2015

Direction Photo Taken:

East Northeast

Description:

Drainage canal that drains from primary ash pond to clear water pond.

P8200510

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **7**	**Date:** 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Vegetated strip between landfill and road. This would be isolated due to lack of connectivity.

P8200521

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **8**	**Date:** 8/20/2015

Direction Photo Taken:

North

Description:

Dike between landfill and primary ash pond. Facility in the background.

P8200522

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 9

Date: 8/20/2015

Direction Photo Taken:

West

Description:

Vegetated strip between landfill and road. This area would be isolated due to lack of connectivity.

P8200527

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 10

Date: 8/20/2015

Direction Photo Taken:

North Northeast

Description:

Road east of landfill running toward facility and clear water pond.

P8200530

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **11**	**Date:** 8/20/2015

Direction Photo Taken:

South

Description:

Top of landfill.

P8200534

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **12**	**Date:** 8/20/2015

Direction Photo Taken:

Southeast

Description:

View of lined bottom ash storage pond.

P8200538

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 13

Date: 8/20/2015

Direction Photo Taken:

Southeast

Description:

Lined bottom ash storage pond.

P8200545

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 14

Date: 8/20/2015

Direction Photo Taken:

South

Description:

Southside of lined bottom ash storage pond.

P8200547

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 15

Date: 8/20/2015

Direction Photo Taken:

West

Description:

East side of lined bottom ash storage pond.

P8200560

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 16

Date: 8/20/2015

Direction Photo Taken:

North

Description:

Upland with pine and ground water monitoring well AD-2 south of lined bottom ash storage pond.

P8200563

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 17

Date: 8/20/2015

Direction Photo Taken:

Description:

Outflow of water from plant into the northeast portion of the Primary Ash Pond.

P8200577

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 18

Date: 8/20/2015

Direction Photo Taken:

South Southwest

Description:

Northeast portion of primary ash pond, view facing south-southwest.

P8200578

4.3 – Landfill – CCR Groundwater Monitoring Well Network Evaluation, February 5, 2018

ARCADIS
Infrastructure · Water · Environment · Buildings

Imagine the result

American Electric Power Service Corporation

Landfill - CCR Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187 County Road 4865
Titus County
Pittsburg, Texas

February 5, 2018

ARCADIS

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

Kenneth J Brandner

Kenneth Brandner, P.E., P.G.
Senior Project Engineer

Matthew J. Lamb / KJB

Matthew J. Lamb
Project Manager

John Holm / DPL

John Holm, P.E.
Professional Engineer

Landfill - CCR Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187County Road 4865
Titus County
Pittsburg, Texas

Prepared for:
AEP

Prepared by:
ARCADIS U.S., Inc.
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Ohio 43235-1447
Tel 614 985 9100
Fax 614 985 9170

Our Ref.:
OH015976.0011

Date:
February 5, 2018

Tables

Figures

Appendices

Acronyms and Abbreviation

AEP	American Electric Power Service Cooperation
amsl	above mean sea level
ARCADIS	ARCADIS U.S., Inc.
BAP	bottom ash pond
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
FAP	fly ash pond
FGD	flue gas desulfurization
ft	feet
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
PTI	Permit to Install
TDS	total dissolved solids

1. Objective

This report was prepared by ARCADIS U.S., Inc. (ARCADIS) for American Electric Power Service Corporation (AEP) to assess the adequacy of the groundwater monitoring well network included in the Coal Combustion Residual (CCR) requirements, as specified in Code of Federal Regulations (CFR) 40 CFR 257.91, for the existing landfill (CCR Unit) at the AEP J. Robert Welsh Generating Plant (Plant) located at 1187 County Road 4865 in Pittsburg, Titus County, Texas (**Figure 1**). The CCR requirements include an evaluation of the adequacy of the groundwater monitoring well network to characterize groundwater quality up and down gradient of the CCR unit.

Three regulated CCR units associated with the Plant were identified for review, which include the primary bottom ash pond, existing landfill, and bottom ash storage pond (**Figure 2**). This report summarizes the evaluation of the groundwater monitoring well network in the uppermost aquifer at the existing landfill (landfill). The evaluation of location restriction criteria is not included in this report and will be completed under separate cover.

This evaluation included a review of AEP-provided data associated with previously completed subsurface investigation activities in the vicinity of the landfill CCR unit, as well as publicly-available geologic and hydrogeologic data. This report also presents the current Conceptual Site Model based on all documents reviewed and will further describe the uppermost aquifer, include an evaluation of the adequacy of the existing monitoring well network, and provide recommendations for monitoring well augmentation, as necessary.

2. Background Information

This section provides background information for the AEP Welsh Generating Plant landfill.

2.1 Facility Location Description

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The landfill CCR unit is located approximately 2,000 feet southwest of the Plant generating units, directly south of the primary bottom ash pond CCR unit, and approximately 800 feet west of the Welsh Reservoir (**Figures 1** and **2**).

2.2 Description of Landfill CCR Unit

The following section will discuss the embankment configuration, area, volume, construction and operational history, and surface water control associated with the landfill.

2.2.1 Embankment Configuration

The landfill was placed into operation in approximately 1977, and is located in a topographically high area south of the primary bottom ash pond. The landfill is approximately 40 acres in size, and is located directly above native clayey soils. The base of the landfill ranges in elevation from approximately 355 feet amsl on the west side to 345 feet amsl on the east side. These landfill base elevations were confirmed by soil borings installed through the landfill in 2014 (ETTL, 2015).

The western two thirds of the landfill is used as a temporary storage and processing area for marketable CCR that is sold for beneficial reuse including road base material. The eastern third of the landfill is an approximate 13-acre active ash disposal area where ash is placed above the base of the landfill to a top surface elevation that currently ranges from approximately 364 to 380 feet amsl.

Ash material had previously been placed into the landfill against an earthen embankment with 2:1 side slopes (2 feet horizontal, 1 foot vertical). However, to reduce the potential for slope failure, the side slopes of the landfill embankment were re-graded to 3:1 (3 feet horizontal, 1 foot vertical) in 2010.

2.2.2 Area/Volume

The landfill occupies an area of approximately 40 acres. A capacity analysis of the landfill was conducted by AEP in 2008 (AEP, 2008). The capacity analysis concluded the landfill has a maximum ash storage capacity of approximately 1,770,000 cubic yards beyond April 2008. Based on soil borings installed through the landfill (ETTL, 2015), the maximum ash thickness is approximately 33 feet, and the average ash thickness within the 40-acre landfill is approximately 20 feet. This corresponds to a current ash volume of approximately 800 acre-feet (1,290,000 cubic yards).

2.2.3 Construction and Operational History

The AEP J. Robert Welsh Plant began operations in 1977 with three coal-fired generating units (Units 1, 2, and 3). Throughout the life of the generating plant, CCR materials (fly ash, bottom ash, economizer ash) have been generated. All of these byproducts were stored in the primary bottom ash pond and in the landfill that was constructed in the late 1970's. In 2000, the 22-acre bottom ash storage pond was installed south of the landfill (**Figure 3**).

The landfill received fly ash, bottom ash, and economizer ash from the generating plant. The ash was sluiced to the landfill between approximately 1982 and 2000. Currently, dry ash is trucked to the landfill. The landfill is also utilized for disposal of ash dredged from the bottom ash storage pond that was constructed in 2000. The ash is currently stored in the eastern third of the landfill, and the western two thirds of the landfill is currently used as a temporary storage and processing area for marketable ash material that is sold for beneficial reuse, loaded into trucks, and transported offsite for reuse (highway road base, etc.).

2.2.4 Surface Water Control

Surface water flow within the landfill is controlled by drainage ditches at the north and east toes of the landfill. Surface water in the drainage ditches flows to a culvert at the northeast corner of the landfill, then discharges into the primary ash pond directly north of the landfill.

2.3 Previous Investigations

The initial soils investigation for the site was provided in a 1973 report prepared by McClelland Engineers, Inc. entitled "*Soils Investigation, Welsh Power Plant, Cason,* *Texas*". This investigation included advancement of soil borings in the primary bottom ash pond area, and geotechnical soil testing to characterize the area encompassed by the primary bottom ash pond.

In 2001, five monitoring wells (AD-1 through AD-5) were installed in the area of the primary bottom ash pond and bottom ash storage pond to obtain hydrologic data for the uppermost water-bearing unit. Twelve additional monitoring wells (AD-4a, AD-4b, AD-4c, AD-6 through AD-14) were installed in the area of the primary bottom ash pond, bottom ash storage pond, and landfill by Eagle Environmental Services in 2009 to obtain more detailed hydrologic data for the uppermost water-bearing unit. Monitoring well completion diagrams are provided in **Appendix A.**

In 2015, ETTL conducted a *Geotechnical Investigation* of the Landfill (ETTL, 2015). The report concluded the risk of slope failure due to liquefaction is very low, and recommended regrading of the top surface of the existing ash at the southeast corner of the landfill to eliminate ponding of surface water. The report also recommended dredged ash be spread out to drain water prior to placement in the landfill, emplacement of a 3-foot-thick clay cap on the existing side slopes in the eastern third of the landfill on a 3:1 slope (3 feet horizontal, 1 foot vertical), and improve drainage along the toe of the eastern third of the landfill using either horizontal drains at the toe of the slope or trenches containing perforated pipe with a geotextile cover.

In December 2015, Auckland Consulting further expanded the groundwater monitoring well system at the Plant by installation of monitoring wells AD-15 through AD-18 (Auckland Consulting, 2016). Monitoring well completion diagrams are provided in **Appendix A.**

2.4 Hydrogeologic Setting

The site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently southeast. The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966).

These features are further illustrated on five lines of cross section that were prepared through the landfill area, with three lines trending from west to east (A-A'; B-B'; C-C'), and the other two lines trending from north to south (D-D'; E-E'). The cross section location map is included as **Figure 3** and the lines of cross section are included as **Figure** 4 (A-A') through **Figure 8** (E-E').

2.4.1 Climate and Water Budget

The climate of Titus County, Texas is moist subhumid. The average January temperature is 45˚ Fahrenheit (F), and the average July temperature is 82.9˚F. The mean annual growing season is 228 days (Broom, 1965). Average annual precipitation (including liquid water equivalent from snowfall) is approximately 47 inches according to weatherdb.com.

2.4.2 Regional and Local Geologic Setting

The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966). The Recklaw Formation attains a thickness of approximately 110 feet in Titus County, and is underlain by the Eocene-age Carrizo Sand which consists of fine to coarse sand, silt, and clay (Broom, 1965). In the topographically low areas underling the Welsh Reservoir to the east of the landfill, Quarternary alluvial sediments associated with Swauano Creek are present (Flawn, 1966).

Detailed regional geologic characterization can be found in several published reports including Texas Water Commission Bulletin 6517 "*Ground-Water Resources of Camp, Franklin, Morris and Titus Counties, Texas*" (Broom, 1965), and The University of Texas at Austin Bureau of Economic Geology "*Geologic Atlas of Texas – Texarkana Sheet*" (Flawn, 1966).

Detailed regional and site geologic characterization can be found in the 2015 ETTL report entitled "*Geotechnical Investigation, Phase 1 Landfill Seepage Evaluation and Vertical Expansion, Pittsburg, Texas"* (ETTL, 2015).

2.4.3 Surface Water and Surface Water Groundwater Interactions

The Site is generally less than one-half mile from Swauano Creek, which was dammed near the southern end of the site during plant development to form the Welsh Reservoir. Groundwater flow direction at the Site is generally from west to east, following surface topography towards the Welsh Reservoir. The Welsh Reservoir is likely a gaining surface water feature, and groundwater elevations on site are higher than the normal stage elevation of the Welsh Reservoir (approximately 320 feet amsl).

Figure 9 and **Figure 10** are potentiometric surface maps for the uppermost aquifer at the Site based on March 2016 and February 2017 water level data, respectively. Water level elevations in the Site monitoring wells are summarized on **Table 1**. As shown on **Figures 9** and **10**, a hydraulic ridge is present in the uppermost aquifer in the area of monitoring well AD-12 at the west end of the landfill. Shallow groundwater flow often follows surface topography, and the hydraulic ridge location corresponds to a topographically high area of the Site. Shallow groundwater flow direction at the landfill is northeasterly to easterly toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.01 foot per foot. Shallow groundwater flow directly west of the landfill in the area of monitoring well AD-17 is westerly toward a topographically low-lying area west of monitoring well AD-17.

2.4.4 Water Users

A water well inventory conducted by Banks Information Solutions showed one water well within a ½-mile radius of the Site (Banks, 2013). The water well is located on-site to the northwest (up gradient) of the landfill, and was installed for Southwestern Electric Company in 1974 with screens from 515 to 535 feet below ground surface, and plugged at a later date.

3. Groundwater Monitoring Well Network Evaluation

The existing monitoring well network present at the Site was evaluated to determine if any of the wells were viable for continued use as part of the groundwater monitoring well network or also retained as part of a larger groundwater hydraulic monitoring well network. The hydrogeologic conditions were also evaluated to determine if the uppermost aquifer unit has an effective well network. The evaluation was completed in accordance with 40 CFR 257.91 to have an established monitoring well network that effectively monitors the uppermost aquifer upgradient and down gradient of the Site. The upgradient wells represent background groundwater quality and the down gradient wells are to be placed down gradient of the CCR unit boundary to monitor water quality.

3.1 Hydrostratigraphic Units

3.1.1 Horizontal and Vertical Position Relative to CCR Unit

Geologic data from soil borings and monitoring wells installed at the site show the uppermost aquifer in the area of the landfill is a very fine to fine grained clayey and silty sand stratum with an average thickness of approximately 10 feet that is located between an average elevation of approximately 325 and 335 feet amsl (**Appendix A**). The base of the landfill is at an elevation of approximately 345 to 355 feet amsl. This separation distance is further illustrated on cross section B-B' (**Figure 5)** and cross section D-D' (**Figure 7)**.

3.1.2 Overall Flow Conditions

Groundwater is recharged from regional precipitation infiltration and locally from ash pond use. The uppermost aquifer (clayey and silty sand) is expected to have a hydraulic conductivity of approximately 10^{-4} centimeters per second (Fetter, 1980). Based on the hydraulic conductivity and saturated thickness (approximately 10 feet), the yield of the uppermost aquifer is anticipated to exceed the TCEQ non-useable (Class 3) limit of 150 gallons per day (TCEQ, 2010).

Available groundwater elevations are summarized on **Table 1** for 2011 through 2017. The most recent comprehensive groundwater data set from February 2017 is depicted on **Figure 10**. A hydraulic ridge is present in the uppermost aquifer in the area of monitoring well AD-12 at the west end of the landfill. The hydraulic ridge extends northerly from AD-12 toward monitoring well AD-18, which is located hydraulically sidegradient of the landfill. Shallow groundwater flow direction at the landfill is easterly toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.01 foot per foot. Shallow groundwater flow directly west of the landfill in the area of monitoring well AD-17 is westerly toward a topographically low-lying area west of monitoring well AD-17.

3.2 Uppermost Aquifer

3.2.1 CCR Rule Definition

The CCR rule definitions for an aquifer and the uppermost aquifer as specified in 40 CFR 257.53 indicates an aquifer is a geologic formation capable of yielding usable quantities of groundwater to wells or springs while an uppermost aquifer is defined as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers, that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural groundwater surface to which the aquifer rises during the wet season.

3.2.1.1 Common Definitions

An aquifer is commonly defined as a geologic unit that stores and transmits water (readily or at sufficient flow rates) to supply wells and springs (USGS, 2015; Fetter, 2001). The uppermost aquifer is considered the first encountered aquifer below the CCR unit.

3.2.2 Identified Onsite Hydrostratigraphic Unit

The identified on-Site hydrostratigraphic unit in the area of the landfill is the very fine to fine grained clayey and silty sand stratum that is located between an elevation of approximately 325 and 335 feet amsl. This unit is not used locally for groundwater supply or industrial water use, but meets the TCEQ definition of a useable aquifer.

3.3 Review of Existing Monitoring Well Network

3.3.1 Overview

The Site was visited by ARCADIS and AEP personnel on August 20, 2015 to review existing well network conditions and locations. A well construction table that summarizes the location, ground surface elevation, borehole depth, installation date, and associated well construction details of the monitoring well network is included as **Table 2**. Photo documentation of the located wells during the August 20, 2015 site visit is provided in **Appendix B**.

Monitoring wells AD-11 through AD-14 were previously installed at the Site to monitor the uppermost aquifer (very fine to fine grained clayey and silty sand stratum) associated with the landfill. As discussed above in Section 3.1.1, the uppermost aquifer below the landfill is approximately 10 feet thick and is located between an elevation of approximately 325 and 335 feet amsl. In addition to these four monitoring wells, several soil borings were installed through the landfill as part of the ETTL geotechnical investigation of the landfill embankments (ETTL, 2015). These soil borings confirmed the presence of the uppermost aquifer beneath the landfill between an average elevation of approximately 325 and 335 feet amsl.

3.3.2 Gaps in Monitoring Network

As shown on the monitoring well completion diagrams in **Appendix A** and Geologic Cross Sections B-B’ (**Figure 5**) and E-E’ (**Figure 8**), existing monitoring wells AD-11, AD-13, and AD-14 are screened in the uppermost aquifer down gradient (east) of the landfill. These three monitoring wells will be utilized as down gradient monitoring wells for the landfill groundwater monitoring system. Existing monitoring wells AD-1 and AD-5 are screened in the uppermost aquifer south and north, respectively, of the landfill. As shown on **Figures 9** and **10**, the groundwater flow path at the landfill is easterly toward the Welsh Reservoir, and monitoring wells AD-1 and AD-5 are not within this groundwater flow path. Therefore, monitoring wells AD-1 and AD-5 will be utilized as background (upgradient) monitoring wells to collect background water quality data for the landfill.

As shown on **Figure 3** and Geologic Cross Section B-B’ (**Figure 5**), existing monitoring well AD-12 is located in the upgradient (west) portion of the landfill, but is located within the landfill boundaries as confirmed by the presence of ash material in the uppermost 10 feet of the boring. Therefore, due to the presence of ash material at the AD-12 location, this monitoring well will not be utilized as an upgradient monitoring well. This data gap was addressed by installation of new monitoring wells AD-17 and AD-18 outside of the landfill boundary approximately 500 feet west and 700 feet northwest, respectively, of monitoring well AD-12. As shown on **Figures 9** and **10**, monitoring well AD-17 is located west of the hydraulic ridge along the western boundary of the landfill that extends north toward monitoring well AD-18. Therefore, monitoring well AD-17 will be utilized as a background (upgradient) monitoring well for the landfill groundwater monitoring system. Monitoring well AD-18 is located along the hydraulic ridge in uppermost aquifer in the western portion of the Site, and is therefore side gradient of the landfill. Therefore, monitoring well MW-18 may be utilized as a piezometer to obtain water level data for the uppermost aquifer. With the addition of monitoring wells AD-17 and AD-18 during December 2015, there are no data gaps remaining in the groundwater monitoring system for the landfill.

4. Recommended Monitoring Network and PE Certification

The recommended modifications to the existing groundwater monitoring well network are intended to meet specifications stated in 40 CFR 257.91. Recommended wells are further discussed with respect to location to the landfill (upgradient or down gradient), well depth, and well construction. The recommended network would provide an improved understanding of groundwater quality, hydraulics, and groundwater flow at the landfill.

4.1 Recommended Monitoring Well Network Distribution

A total of three down gradient well locations (existing monitoring wells AD-11, AD-13 and AD-14) and three upgradient well locations (existing monitoring wells AD-1, AD-5 and AD-17) are recommended to establish a groundwater quality monitoring well network for the landfill. In addition, existing monitoring wells AD-12 and AD-18 may be utilized as piezometers to obtain additional groundwater flow direction and gradient data for the landfill.

4.1.1 Location

The recommended monitoring well network for groundwater quality of the uppermost aquifer at the landfill is summarized on **Table 3** and illustrated on **Figure 11.**

4.1.2 Depth

The screen depths for the monitoring wells recommended for inclusion in the monitoring network are within the shallow saturated sand stratum (uppermost aquifer) that occurs beneath the landfill between an average elevation of approximately 325 and 335 feet amsl. The screen elevations are presented in **Table 3**.

4.1.3 Well Construction

As discussed above in Section 3.3.2, the gap in the monitoring well network for the uppermost aquifer beneath the landfill was addressed by installation of monitoring wells AD-17 and AD-18 during December 2015. Monitoring wells AD-17 and AD-18 were installed by a Texas Department of Licensing and Regulation (TDLR)-licensed water well driller. Well construction data for the monitoring well network are summarized on **Tables 2** and **3**, and the monitoring well completion diagrams are provided in **Appendix A**.

4.2 Professional Engineer's Certification

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the proposed groundwater monitoring system will be adequate to meet the requirements of 40 CFR Part 257.91.

Kenneth J. Brandner
Printed Name of Registered Professional Engineer

Signature

KENNETH J. BRANDNER
69586

69586
Registration No.

TX
Registration State

2-5-18
Date

5. References

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Tables

Table 1
Water Level Data
AEP J. Robert Welsh Power Plant - CCR Storage Areas
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Screen		Bottom of Screen		6/7/2011	12/6/2011	5/2/2012	11/1/2012	5/14/2013	11/19/2013	5/12/2014	11/16/2014	5/12/2015	3/4/2016	5/26/2016	7/27/2016	10/19/2016	12/12/2016	1/17/2017	2/23/2017
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																												
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57	338.46	334.92	337.88	337.18	337.43	336.73	338.03	337.64	340.82	342.83	344.89	342.89	341.23	340.58	341.18	339.74
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16	330.16	329.07	330.00	329.26	329.83	329.70	330.09	329.69	332.56	332.32	---	---	---	---	---	---
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10	323.81	323.19	323.99	323.29	323.77	323.98	324.12	323.28	325.58	325.12	324.59	323.70	323.47	323.78	325.04	324.92
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61	324.81	324.84	324.62	324.40	324.74	325.52	325.44	325.13	327.00	326.90	---	---	---	---	---	---
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19	325.01	324.19	325.24	322.90	324.86	324.68	325.64	325.34	327.19	327.12	---	---	---	---	---	---
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55	324.35	324.32	324.50	324.30	324.30	325.21	325.22	324.90	326.58	326.67	---	---	---	---	---	---
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15	324.18	324.50	324.64	324.37	324.11	325.06	325.01	324.71	326.50	326.19	325.89	324.01	323.76	325.07	326.39	324.89
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00	336.34	336.58	336.82	336.99	336.78	336.47	336.80	336.01	339.07	338.04	337.62	337.24	337.74	337.01	338.34	336.17
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31	333.04	333.02	332.83	333.02	333.11	332.81	333.11	332.81	333.38	334.00	---	---	---	---	---	---
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86	334.32	334.12	334.19	334.20	334.13	334.58	333.77	333.98	334.09	333.61	---	---	---	---	---	---
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53	325.41	324.09	325.69	325.15	325.79	325.75	325.98	325.77	326.05	325.70	325.68	325.05	325.29	325.92	326.76	324.27
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32	328.46	328.53	328.63	328.44	328.74	329.38	NM	330.18	329.98	329.74	329.28	329.53	328.92	329.31	330.50	328.05
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23	323.44	322.55	323.27	323.35	323.51	323.76	323.57	323.88	323.95	323.55	---	---	---	---	---	---
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61	327.99	328.37	327.82	327.93	327.94	328.13	328.20	327.97	328.96	328.13	328.39	328.14	327.87	328.20	328.90	328.25
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27	348.30	348.29	349.86	349.56	349.99	349.65	349.89	350.01	350.65	350.39	---	---	---	---	---	---
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12	332.36	332.24	333.09	332.26	332.68	333.25	333.35	332.01	337.58	334.76	334.54	332.93	332.39	332.84	334.54	331.83
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32	330.40	329.80	331.67	330.34	330.94	331.69	332.12	330.17	336.63	334.83	334.51	331.71	330.94	330.79	332.63	330.87
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71	---	---	---	---	---	---	---	---	---	322.14	321.93	321.28	321.42	321.71	321.64	322.81
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86	---	---	---	---	---	---	---	---	---	337.09	335.84	332.14	331.52	331.43	330.96	330.71
AD-16R(e)	33° 02' 49"	94° 50' 28.9"	350.55	353.49	27.0	4/12/17	Sch. 40 PVC	2	12.0	338.55	27.0	323.55	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99	---	---	---	---	---	---	---	---	---	334.64	334.26	334.30	334.45	334.64	334.05	333.94
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17	---	---	---	---	---	---	---	---	---	343.66	343.26	340.81	339.92	339.38	338.97	340.38
Piezometers																												
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

NM - Not measured.
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
(e) Monitoring well installed by ARCADIS on April 12, 2017 as a replacement for monitoring well AD-16.
Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through February 2017.

Table 2
Well Construction Details
AEP J. Robert Welsh Power Plant - CCR Units
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Filter Pack		Bottom of Filter Pack		Top of Screen		Bottom of Screen	
								Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl
Monitoring Wells															
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	25.0	1/11/2001	PVC	2	13	343	25	331	15.0	340.57	25.0	330.57
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	25.0	4/26/2001	PVC	2	12	332	25	319	15.0	329.16	25.0	319.16
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	17.0	4/26/2001	PVC	2	5	326	17	314	7.0	324.10	17.0	314.10
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	30.0	4/26/2001	PVC	2	16	325	30	311	19.0	321.61	29.0	311.61
AD-4a (a)	33.04527	94.84258	340.19	30.0	9/22/2009	PVC	2	17	323	30	310	20.0	320.19	30.0	310.19
AD-4b (a)	33.04531	94.84230	329.55	15.0	9/23/2009	PVC	2	4	326	15	315	5.0	324.55	15.0	314.55
AD-4c (a)	33.04507	94.84244	329.15	15.0	9/23/2009	PVC	2	4	325	15	314	5.0	324.15	15.0	314.15
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	30.0	1/11/2001	PVC	2	16	333	30	319	20.0	329.00	30.0	319.00
AD-6 (a)	33.05235	94.84757	343.31	33.0	9/23/2009	PVC	2	21	322	33	310	23.0	320.31	33.0	310.31
AD-7 (a)	33.05257	94.84219	347.86	38.0	9/24/2009	PVC	2	26	322	38	310	28.0	319.86	38.0	309.86
AD-8 (a)	33.05187	94.84026	337.53	29.0	9/21/2009	PVC	2	14	324	29	309	16.0	321.53	26.0	311.53
AD-9 (a)	33.04995	94.84196	340.32	35.0	9/21/2009	PVC	2	18	322	35	305	20.0	320.32	35.0	305.32
AD-10 (a)	33.04881	94.84047	340.23	35.0	9/22/2009	PVC	2	18	322	35	305	20.0	320.23	35.0	305.23
AD-11 (a)	33.04824	94.84177	339.61	20.0	9/22/2009	PVC	2	8	332	20	320	10.0	329.61	20.0	319.61
AD-12 (a)	33.04901	94.84977	366.27	30.0	9/24/2009	PVC	2	18	348	30	336	20.0	346.27	30.0	336.27
AD-13 (a)	33.04918	94.84275	344.12	20.0	9/22/2009	PVC	2	4	340	20	324	6.0	338.12	16.0	328.12
AD-14 (a)	33.04715	94.84256	342.32	19.0	9/22/2009	PVC	2	6	336	18	324	8.0	334.32	18.0	324.32
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	46.0	12/12/15	PVC	2	22	318	45.5	295	25.5	314.71	45.5	294.71
AD-16R	33° 02' 49"	94° 50' 29"	350.55	27.0	4/12/17	PVC	2	10	341	27	324	12.0	338.55	27.0	323.55
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	40.0	12/10/15	PVC	2	22	332	39	315	24.0	329.99	39.0	314.99
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	29.0	12/11/15	PVC	2	12	334	29	317	14.0	332.17	29.0	317.17
Piezometers															
B-2 (b)	33° 03.078'	94° 50.449'	339.7	50.0	10/28/2009	PVC	2	8	332	20	320	10.0	329.70	20.0	319.70
B-4 (b)	33° 03.011'	94° 50.462'	340.6	50.0	10/27/2009	PVC	2	8	333	18	323	8.0	332.60	18.0	322.60
B-5 (b)	33° 02.964'	94° 50.428'	340.0	50.0	10/27/2009	PVC	2	5	335	20	320	10.0	330.00	20.0	320.00
B-6 (b)	33° 02.912'	94° 50.462'	340.1	50.0	10/28/2009	PVC	2	4	336	22	318	12.0	328.10	22.0	318.10
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	21.0	12/10/15	PVC	2	9	342	21	330	11.0	339.86	21.0	329.86

General Notes:
Elevation in feet above mean sea level.

Footnotes:
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
Acronyms and Abbreviations:
NA = Data not available
ft = feet
bls = below land surface
msl = mean sea level

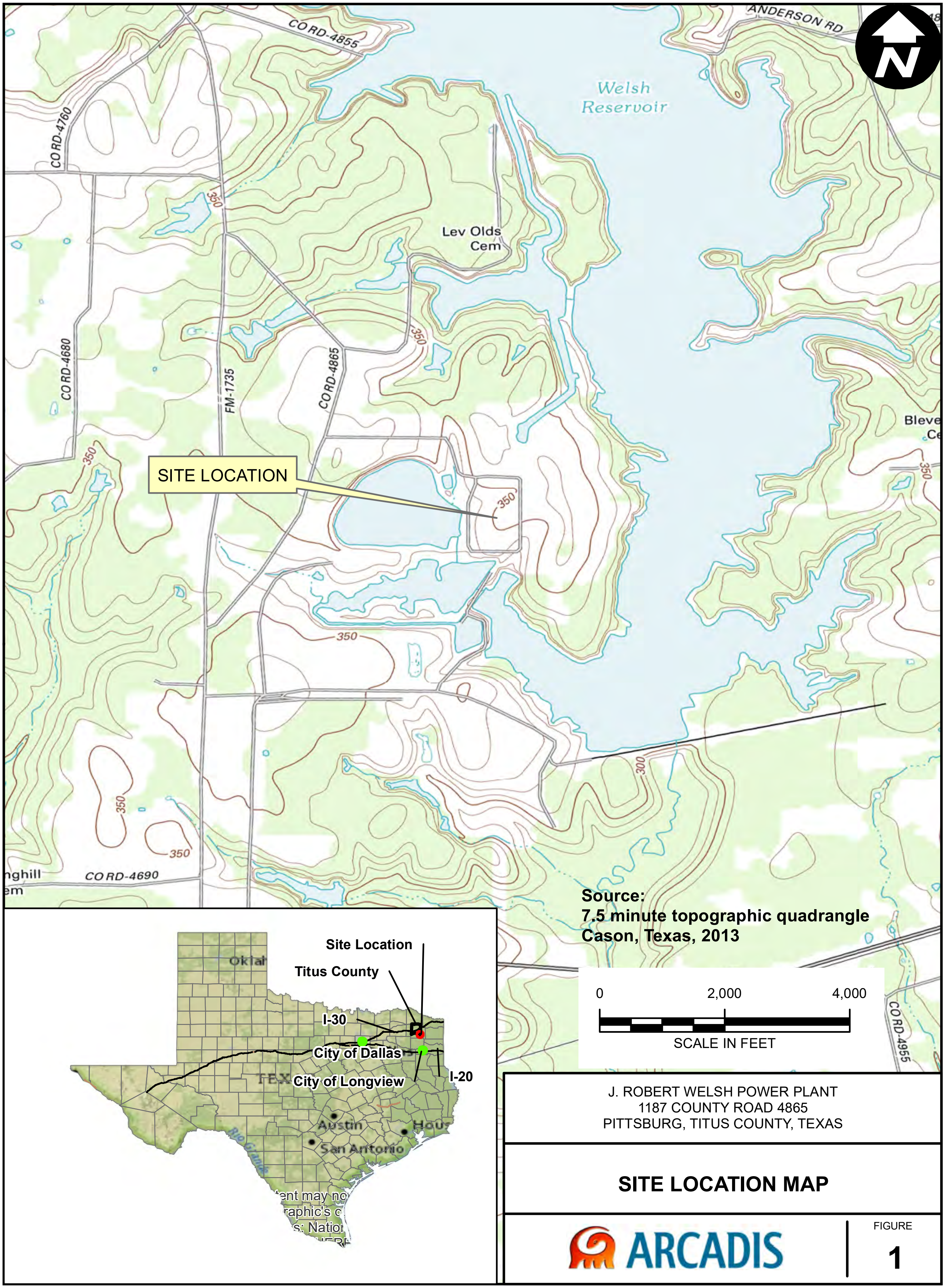
Table 3
Proposed Well Network
AEP J. Robert Welsh Power Plant - Landfill
Pittsburg, Titus County, Texas

Well ID	Exisiting/ Proposed	Hydrostratigraphic Unit Target	Location Description		Screen Top Target Elevation(a) (ft amsl)	Screen Bottom Target Elevation(a) (ft amsl)	Screen Length (ft)	Comments
Upgradient								
AD-1	Existing	Uppermost Water-Bearing Unit	South of Landfill	Upgradient	340.6	330.6	10	Existing well installed in 2001; well will be utilitzed to establish backgroud water quality
AD-5	Existing	Uppermost Water-Bearing Unit	NW of Landfill	Upgradient	329.0	319.0	10	Existing well installed in 2001; well will be utilitzed to establish backgroud water quality
AD-17	Existing	Uppermost Water-Bearing Unit	West of Landfill	Upgradient	330.0	315.0	15	New monitoring well installed during December 2015 in uppermost shallow aquifer west of Landfill - upgradient; well will be utilized to establish background water quality
Downgradient								
AD-11	Existing	Uppermost Water-Bearing Unit	East of Landfill	Down gradient	329.6	319.6	10	Existing well installed in 2009; uppermost shallow aquifer adjacent to the landfill - downgradient
AD-13	Existing	Uppermost Water-Bearing Unit	East of Landfill	Down gradient	338.1	328.1	10	Existing well installed in 2009; uppermost shallow aquifer adjacent to the landfill - downgradient
AD-14	Existing	Uppermost Water-Bearing Unit	East of Landfill	Down gradient	334.3	324.3	10	Existing well installed in 2009; uppermost shallow aquifer adjacent to the landfill - downgradient
Piezometers								
AD-12	Existing	Uppermost Water-Bearing Unit	Within Landfill Boundary	Upgradient	346.3	336.3	10	Existing well installed in 2009; and utilitzed to obtain water level data for uppermost water-bearing unit
AD-18	Existing	Uppermost Water-Bearing Unit	NW of Landfill	Side gradient	332.2	317.2	15	New monitoring well installed during December 2015 in uppermost shallow aquifer sidegradient of Landfill: will be utilized to obtain water level data for uppermost water-bearing unit.

Footnotes:
a. Target elevations are an estimated range.

Acronyms and Abbreviations:
U=Upgradient
D=Downgradient
ft = feet
amsl = above mean sea level

Figures



Source:
7.5 minute topographic quadrangle
Cason, Texas, 2013

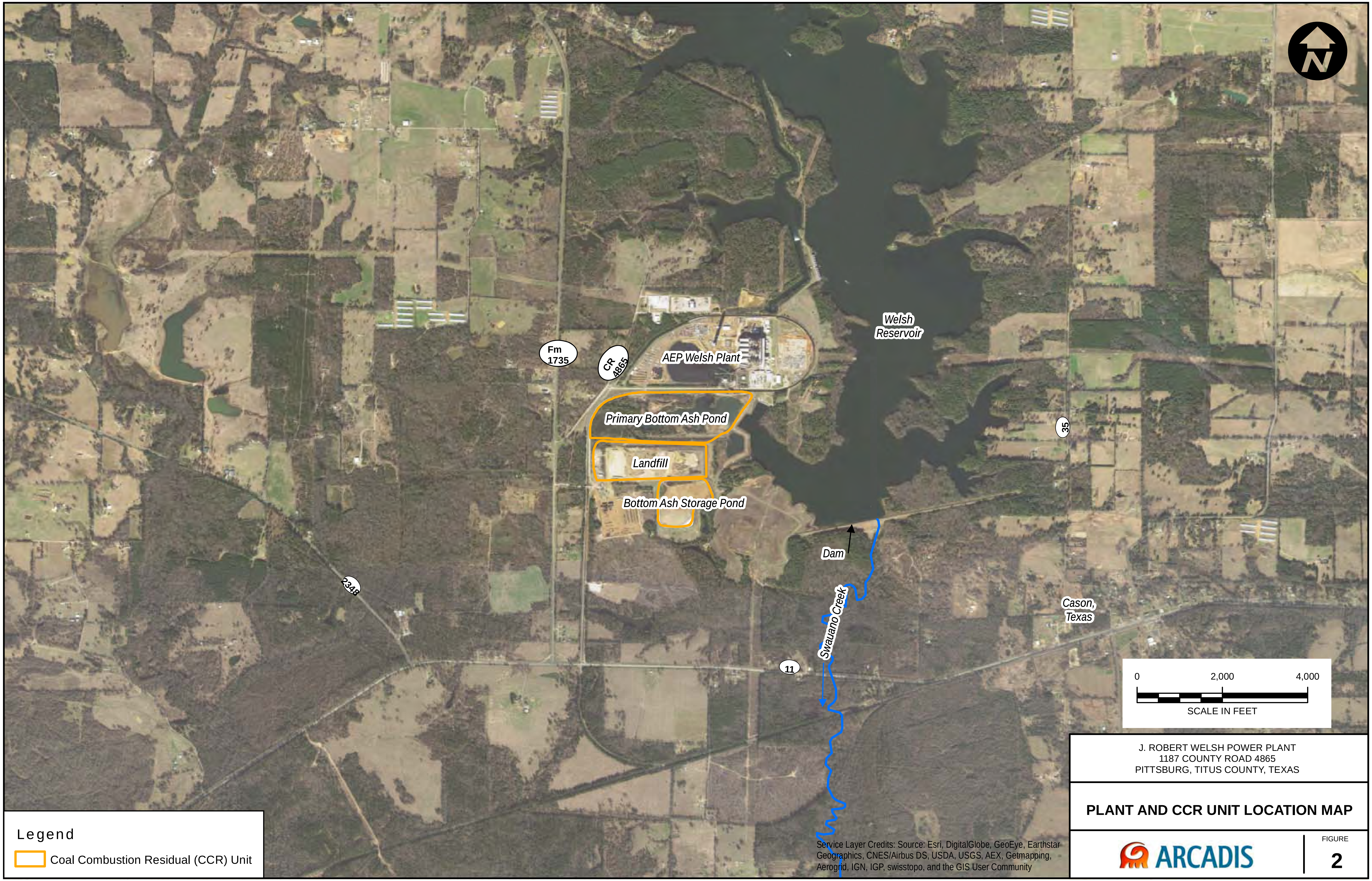
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LOCATION MAP

ARCADIS

FIGURE
1

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 1 - site map.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

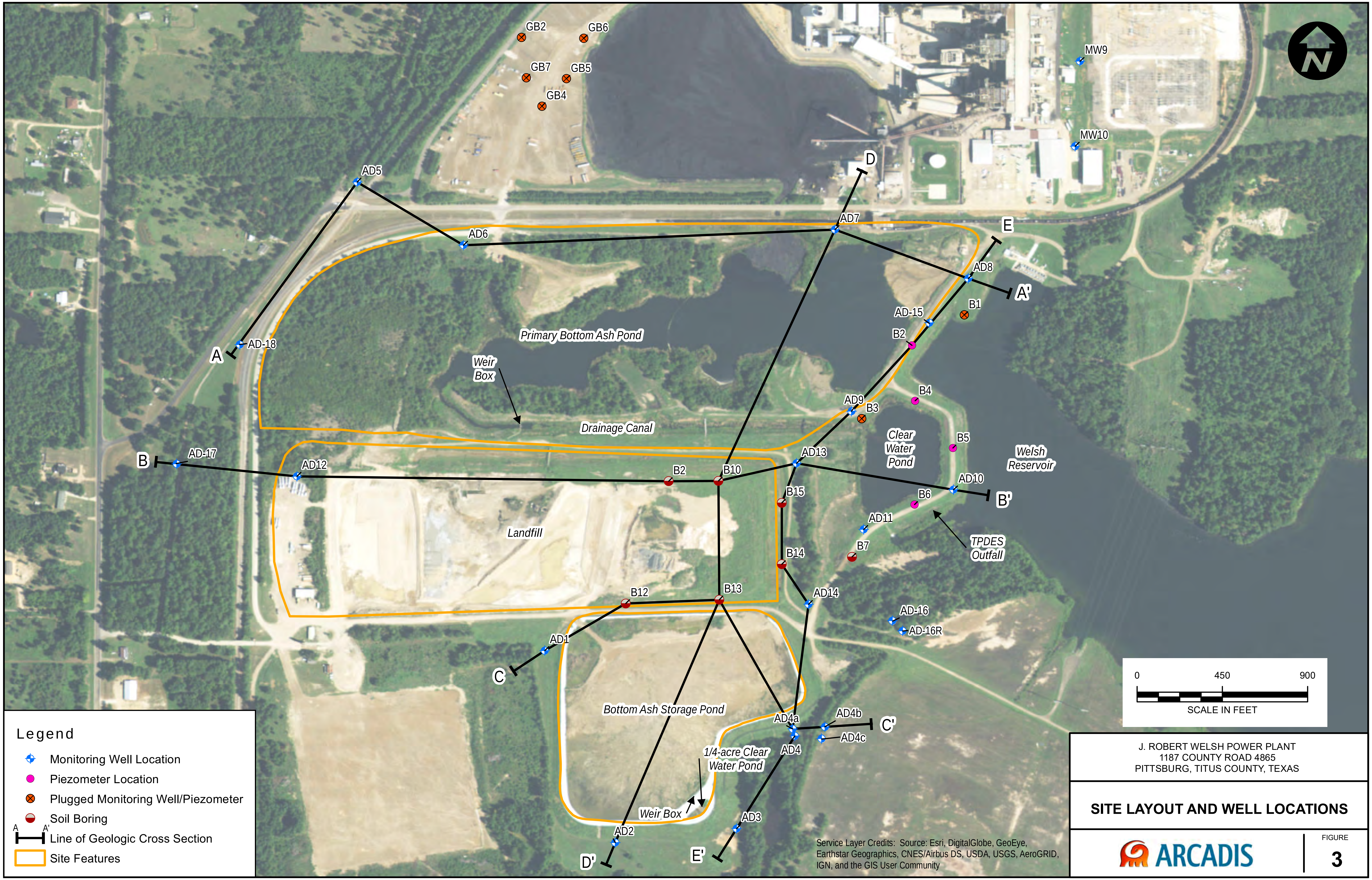
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PLANT AND CCR UNIT LOCATION MAP

ARCADIS

FIGURE
2

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 2 - CCR location.mxd



Legend

- ✥ Monitoring Well Location
- ● Piezometer Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◓ Soil Boring
- A ├─┤ A' Line of Geologic Cross Section
- ▭ Site Features

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

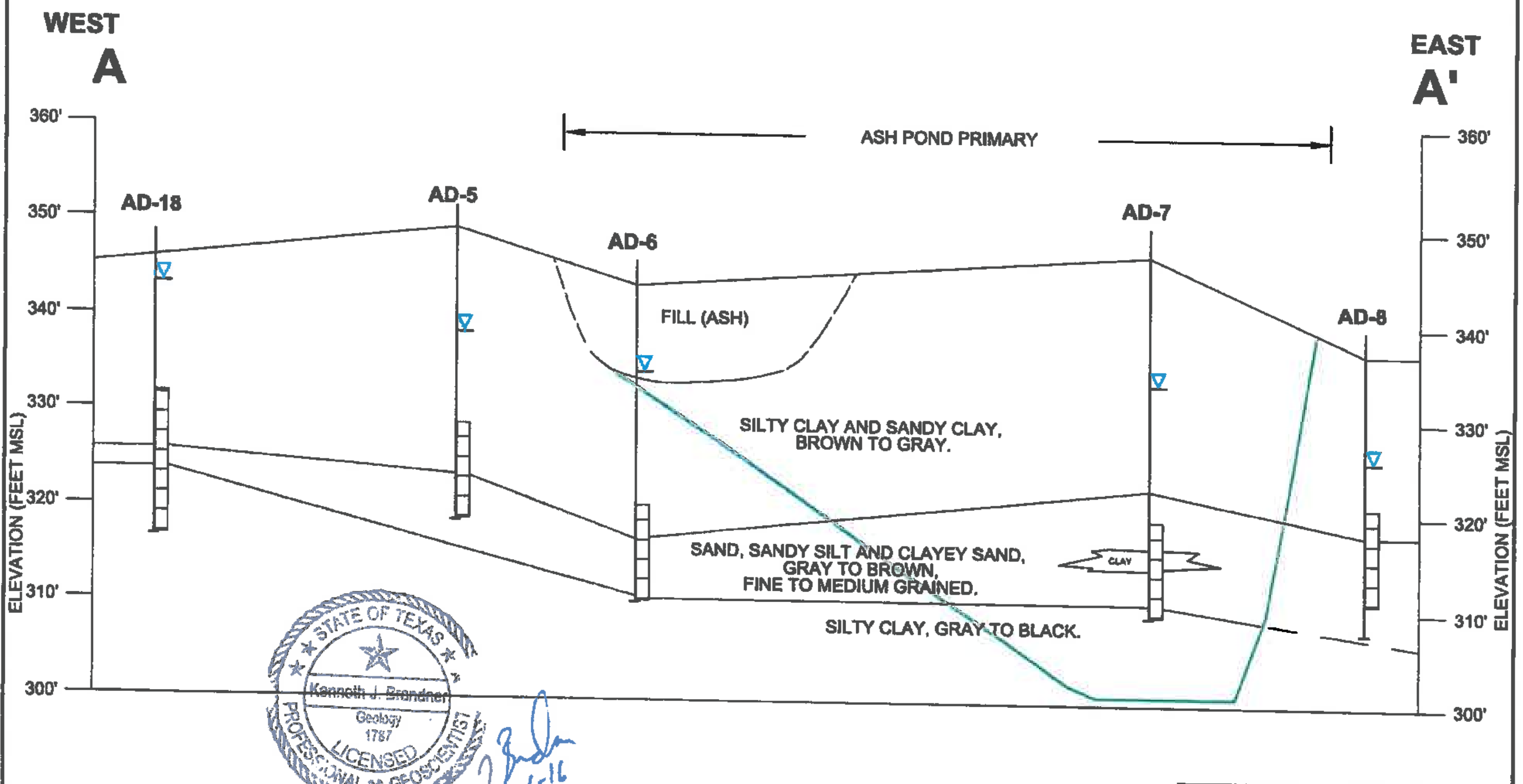
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LAYOUT AND WELL LOCATIONS

ARCADIS

FIGURE
3

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 3 - site layout.mxd



Kenneth J. Brandner
1787

5-6-16

0 300'
HORIZONTAL SCALE

NOTE: BASE OF ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-75; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

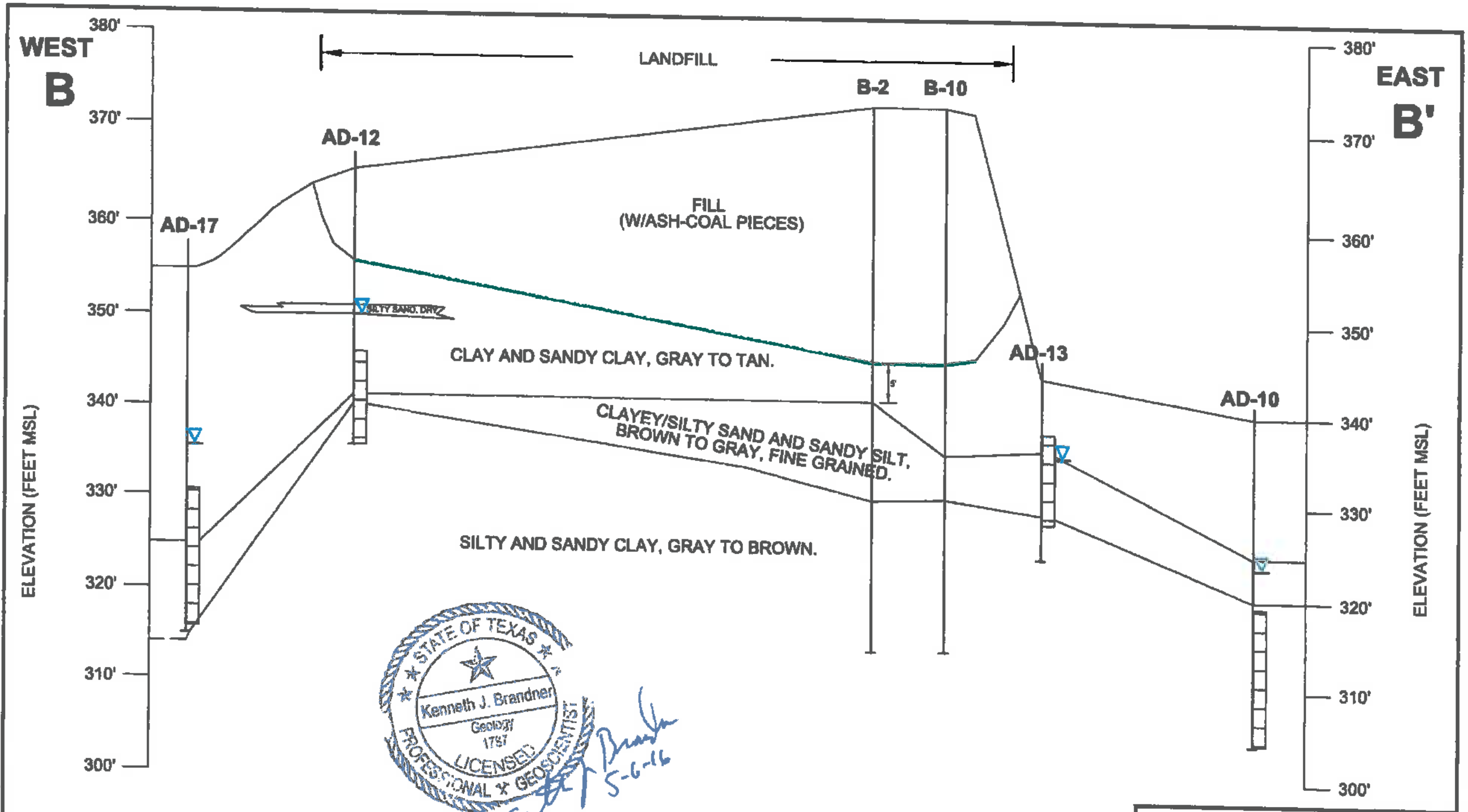
▤ MONITORING WELL SCREENED INTERVAL
▽ WATER LEVEL IN MONITORING WELL (3/4/16)
— PROJECTED BASE OF ASH POND (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
A - A'

ARCADIS

FIGURE
4



Kenneth J. Brandner
1757

5-6-16

0 300'
HORIZONTAL SCALE

NOTE: BASE OF LANDFILL ELEVATION TAKEN FROM "WELSH POWER PLANT- UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12/3/76.

LEGEND

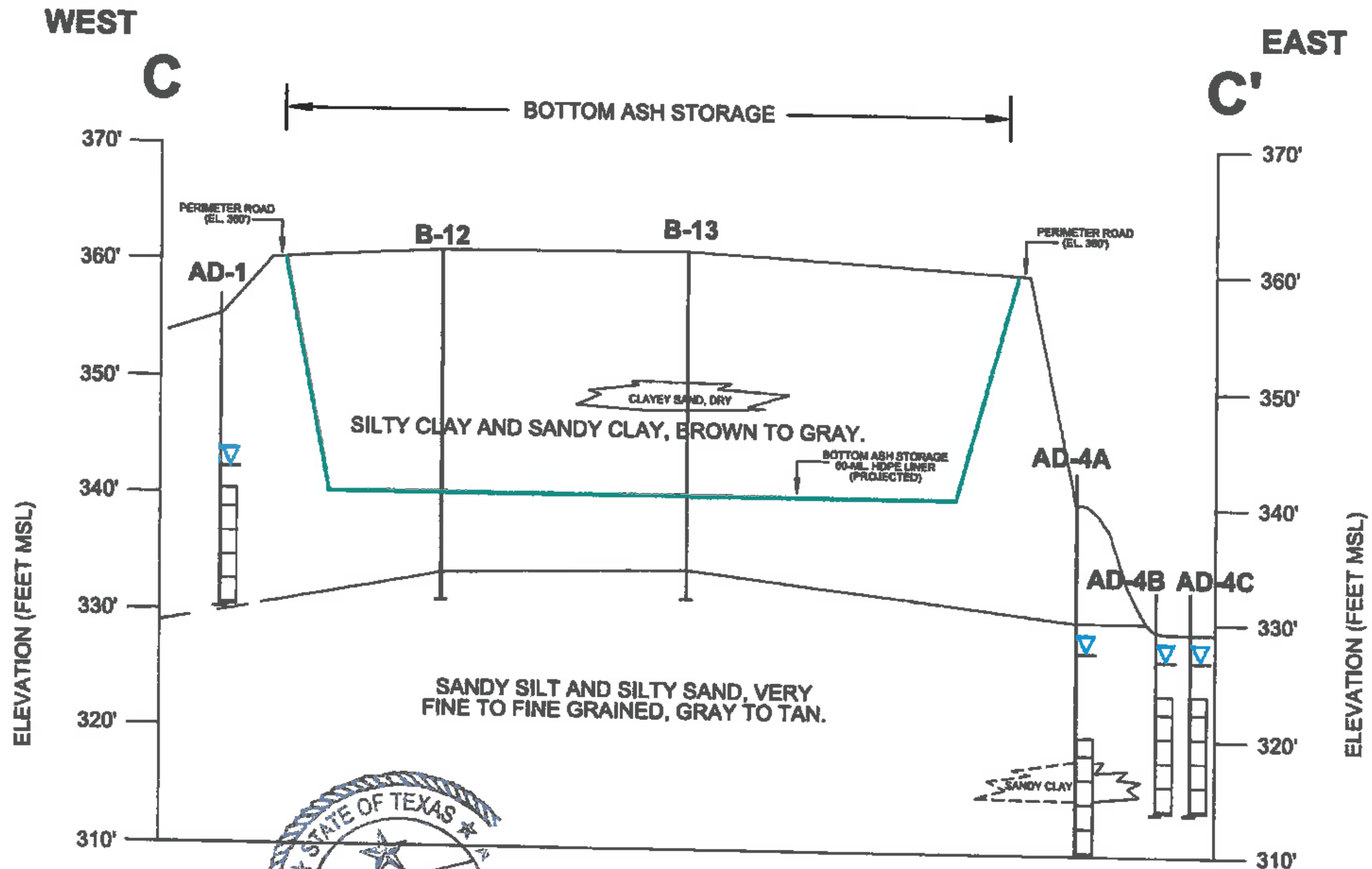
▯	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	BASE OF LANDFILL (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
B - B'

ARCADIS

FIGURE
5



Kenneth J. Brandner
Geology
1787

5-6-16

0 200'
HORIZONTAL SCALE

NOTE: BASE OF BOTTOM ASH STORAGE HAS A 60-MIL HDPE LINER AT ELEVATION 340.0', TAKEN FROM FREESE AND NICHOLS "HYDRAULIC ANALYSIS OF WELSH POWER PLANT ASH PONDS, AMERICAN ELECTRIC POWER COMPANY", DATED DECEMBER 2010.

LEGEND

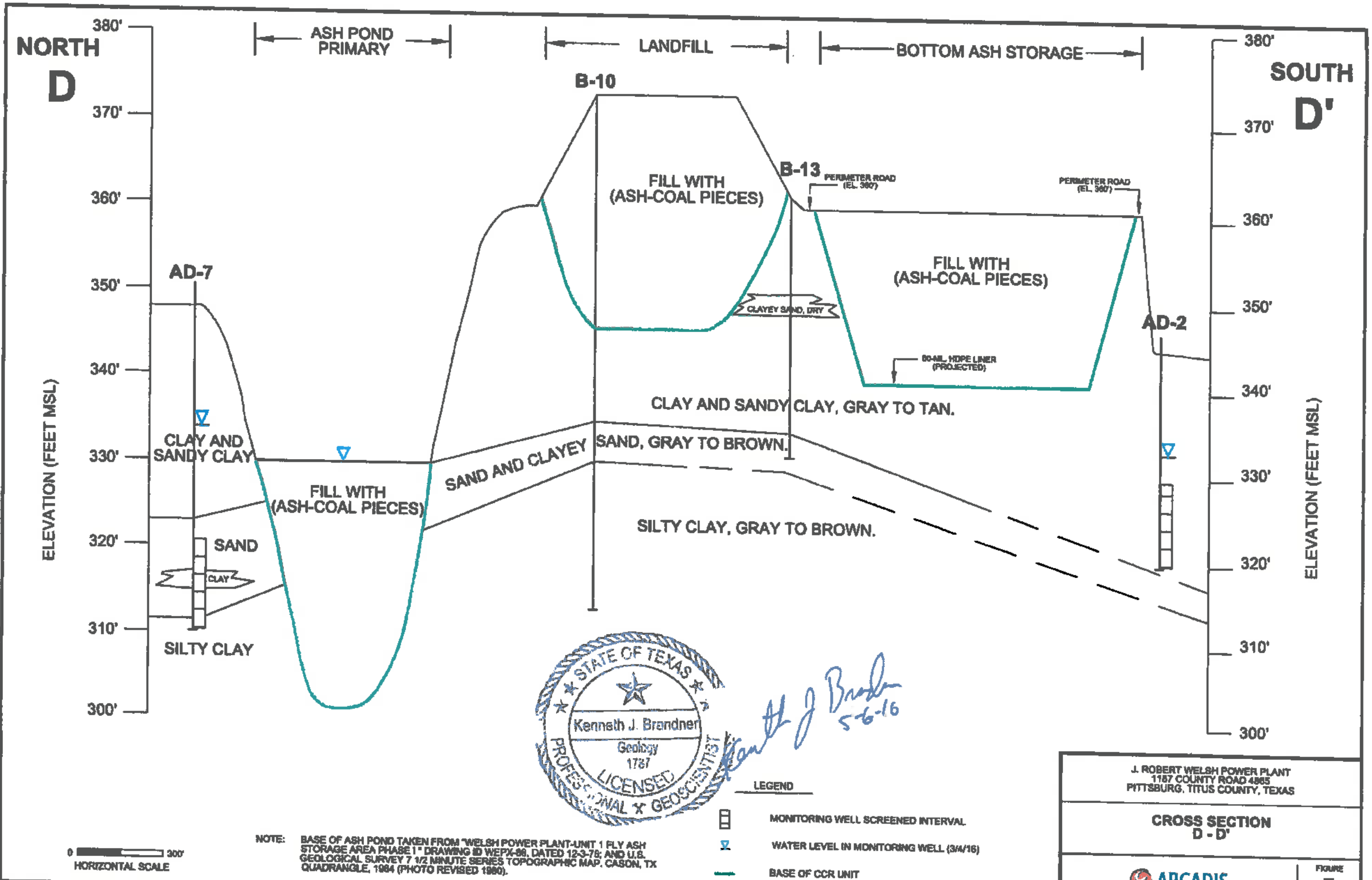
⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
C - C'

ARCADIS

FIGURE
6



Kenneth J. Brandner
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1787

Kenneth J Brandner
5-6-16

NOTE: BASE OF ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-89, DATED 12-3-78; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1984 (PHOTO REVISED 1990).

LEGEND

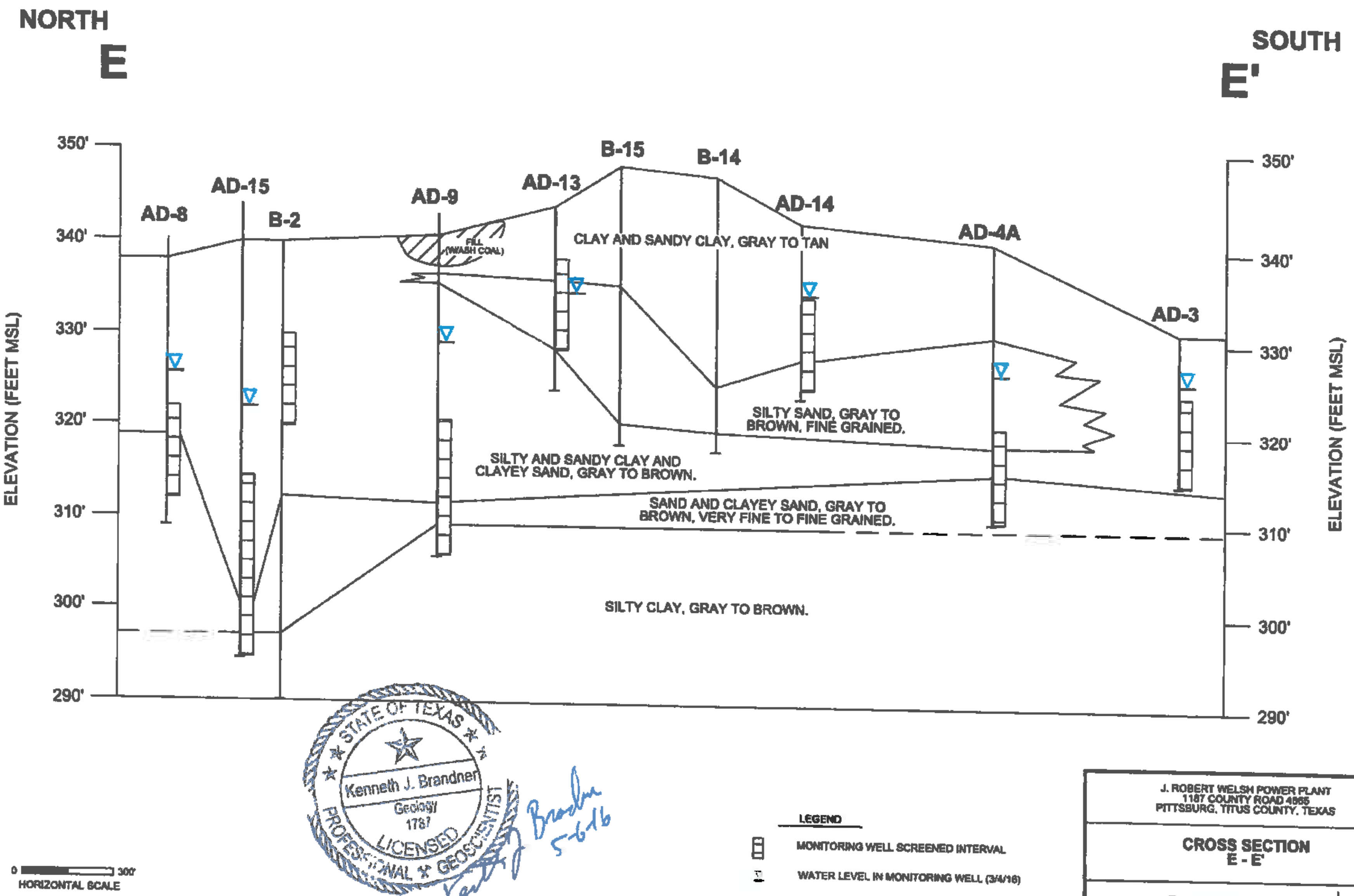
- ⌸ MONITORING WELL SCREENED INTERVAL
- ▽ WATER LEVEL IN MONITORING WELL (3/4/16)
- — BASE OF CCR UNIT

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION D - D'

ARCADIS

FIGURE
7



Kenneth J. Brandner
Geology
1787

Brandner
5-6-16

LEGEND

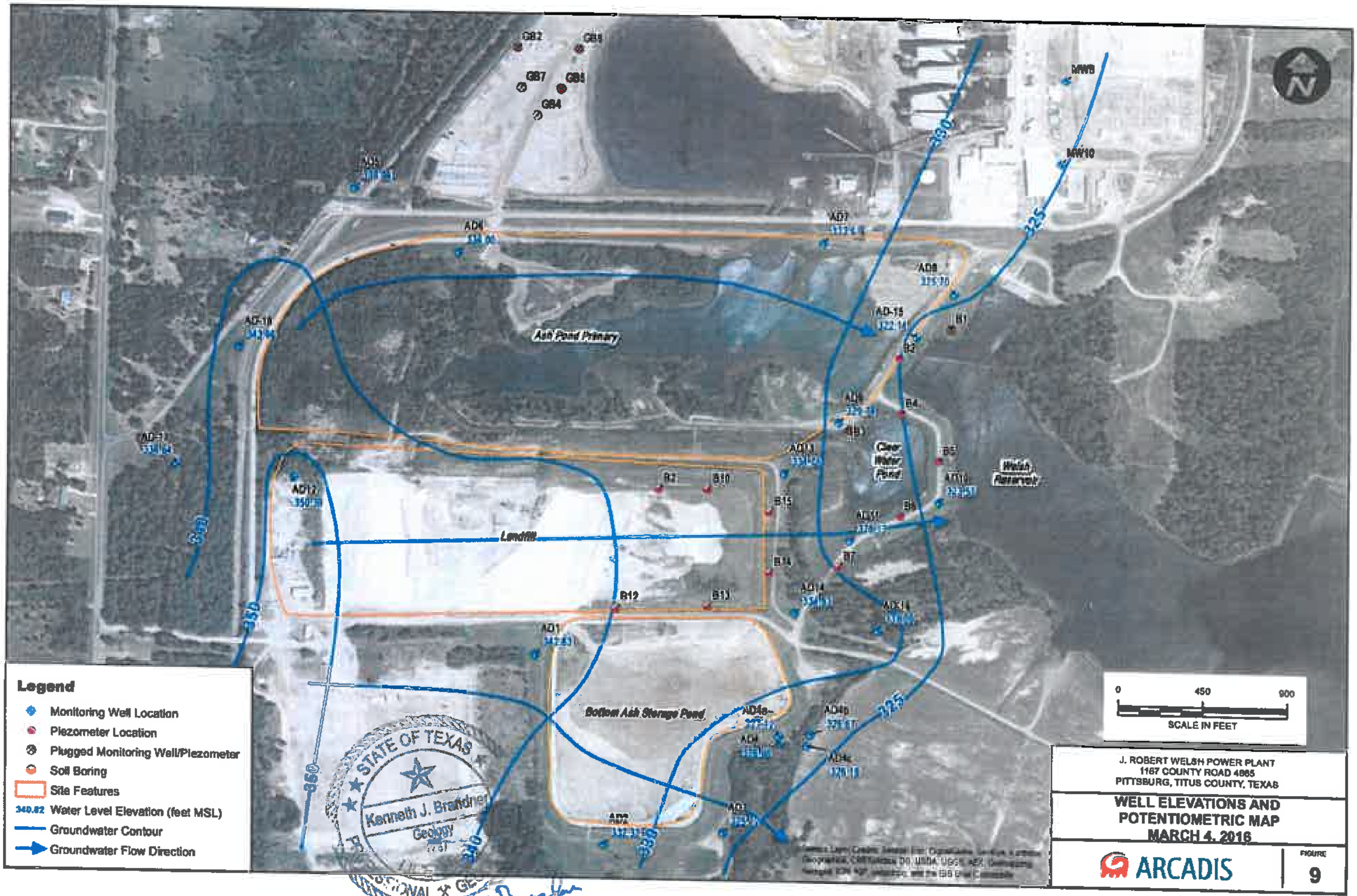
- 目 MONITORING WELL SCREENED INTERVAL
- ▽ WATER LEVEL IN MONITORING WELL (3/4/16)
- — PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
E - E'

ARCADIS

FIGURE
8



Legend
- ● Monitoring Well Location
- ● Piezometer Location
- ⊗ Plugged Monitoring Well/Piezometer
- ● Soil Boring
- ▭ Site Features
- 340.82 Water Level Elevation (feet MSL)
- — Groundwater Contour
- ➔ Groundwater Flow Direction

J. ROBERT WELSH POWER PLANT
1167 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

WELL ELEVATIONS AND POTENTIOMETRIC MAP
MARCH 4, 2016

ARCADIS

FIGURE
9

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill reporting 9 - Mar2016_POT.mxd

Kenneth J. Brandner
Geology

5-6-16

Legend

- ◆ Monitoring Well Location
- ◆ Proposed Exiting CCR Unit Upgradient Monitoring Well
- ◆ Proposed Exiting CCR Unit Downgradient Monitoring Well
- ☐ Site Features

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PROPOSED MONITORING WELL NETWORK MAP - LANDFILL

ARCADIS

FIGURE
10

Document Path: Z:\GISPROJECTS_ENV\AEP\Welch Plant\MXD\Landfill reporting 10 - proposed wells_v2.mxd

1787

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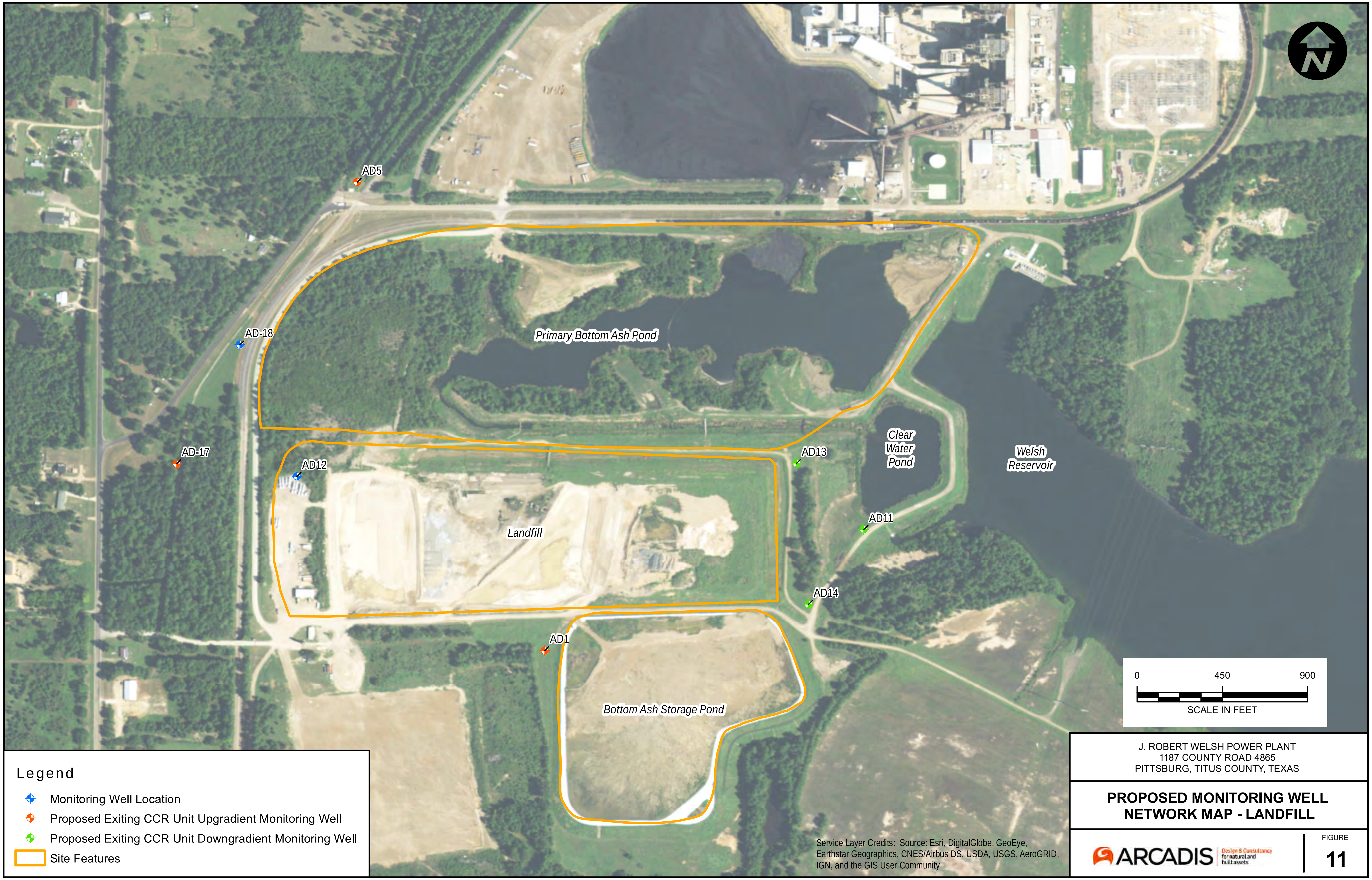
5-6-16



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PROPOSED MONITORING WELL NETWORK MAP - LANDFILL

ARCADIS Design & Consultancy for natural and built assets

FIGURE
11

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\Dec2017Update\fig 11 - proposed wells_v2.mxd

ARCADIS

Boring/Well Construction Logs

AD-1

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt.4, Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'48"N
94°50'47"W
N

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ______

From (ft.)	To (ft.)	Description and color of formation material
0	25	gray silty Clay with some hard red streaks

AP-1

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other ______
If Gravel Packed give interval ... from 13 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Casting Screen
			From	To	
2	N	riser	+2	15	Sch 40
2	N	#10 slot screen	15	25	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 13 ft. to 0 ft. No. of sacks used 6-50#
______ ft. to ______ ft. No. of sacks used ______
Method used bentonite
Cemented by ______
Distance to septic system field lines or other concentrated contamination ______ ft.
Method of verification of above distance ______

✓ 10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 12'8" ft. below land surface Date 1-11-01
Artesian flow ______ gpm. Date ______

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc., ______ ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.

✓ 15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ______ (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS ______ (Street or RFD) ______ (City) ______ (State) ______ (Zip)

(Signed) ______ (Licensed Well Driller) (Signed) ______ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-2

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4
County ~~Camp~~ Titus

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ PublicSupply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'37"N
94°50'44"W
N

6) WELL LOG:
Date Drilling:
Started 4/26 ~~19~~ 2001
Completed 4/26 ~~19~~ 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	2	top soil
2	5	red & gray clay w/ silt
5	10	red & gray clay w/ silt
10	25	gray silty clay w/ tan streaks
		AP-2

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 12 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	Sch. 40
2	N	#10 slot screen	15	25	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 12 ft. to +2 ft. No. of sacks used 5-50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

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AD-3

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State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

County ~~Camp~~ Titus

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'38"N
94°50'37"W
N↑

6) WELL LOG:
Date Drilling:
Started 4/26 2001
Completed 4/26 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	17

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	12	gray silty clay w/ tan streaks
12	15	very stiff gray/blood red clay
15	17	Very stiff gray clay w/ red nodules and tan streaks

AP-3

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other

If Gravel Packed give interval ... from 5 ft. to 17 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	7	Sch 40
2	N	#10 slot screen	7	17	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 2 ft. to 5 ft. No. of sacks used 2 1/2 - 50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

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(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

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TNRCC-0199 (Rev. 11-01-94)

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AD-4

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State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33° 02' 43" N
94° 50' 33" W

6) WELL LOG:
Date Drilling:
Started 4/26 19 2001
Completed 4/26 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	5	red silty clay with gray streaks
5 -	30	gray silty clay with red streaks
		AD-4

(*Use reverse side if necessary*)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	19	Sch 40
2	N	#10 slot screen	19	29	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 2 ft. No. of sacks used 8-50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other NA
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete Items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

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(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4A**
TOTAL DEPTH:	**30'**
TOP OF CASING ELEV.:	**342.85 ft. NGVD**
GROUND SURFACE ELEV.:	**340.19 ft. NGVD**

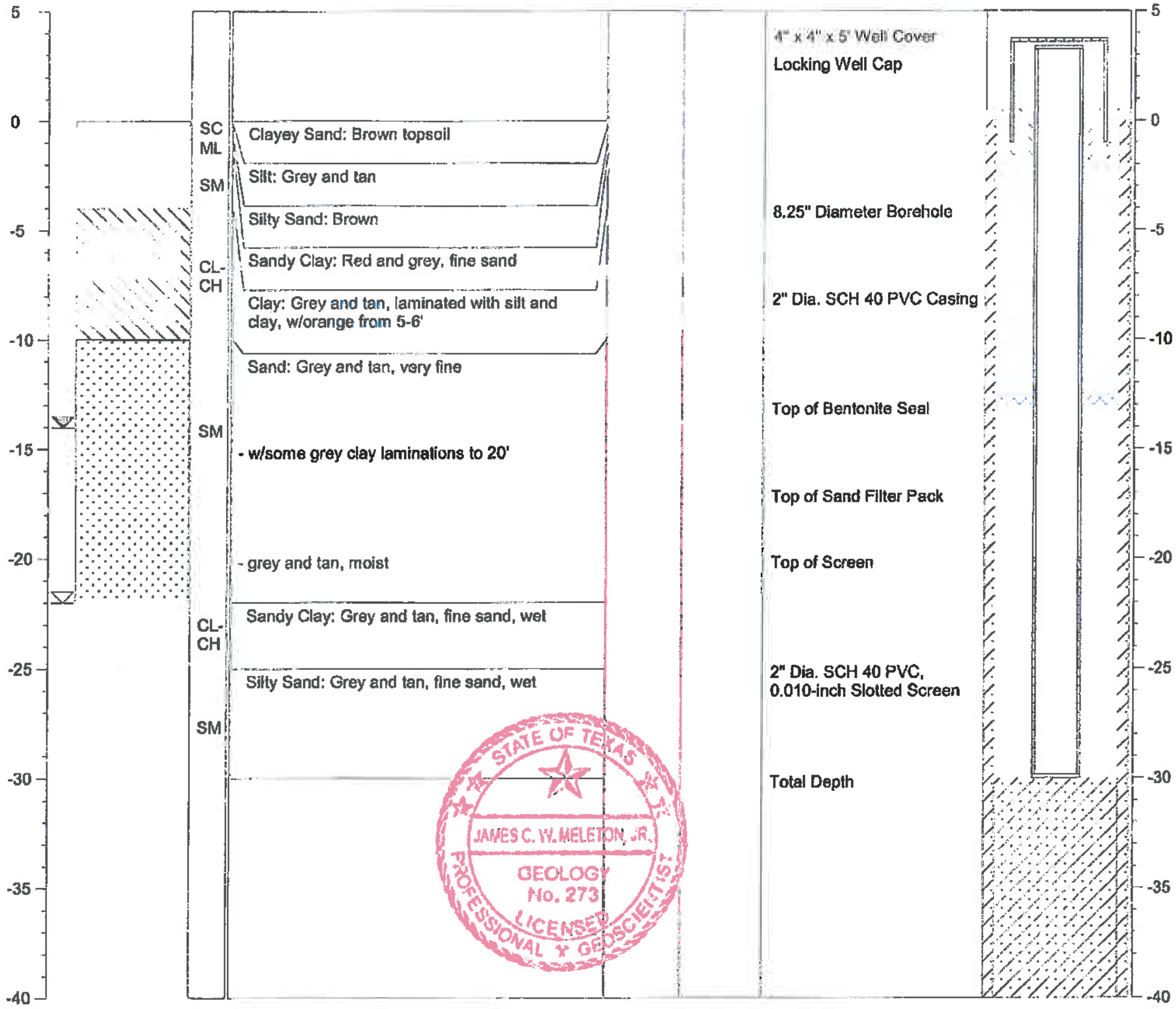
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04527**
Longitude: 94.84258

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown topsoil
ML	Silt: Grey and tan
SM	Silty Sand: Brown
CL-CH	Sandy Clay: Red and grey, fine sand
	Clay: Grey and tan, laminated with silt and clay, w/orange from 5-6'
SM	Sand: Grey and tan, very fine
	- w/some grey clay laminations to 20'
	- grey and tan, moist
CL-CH	Sandy Clay: Grey and tan, fine sand, wet
SM	Silty Sand: Grey and tan, fine sand, wet

WELL DESCRIPTION:

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

JAMES C. W. MELETON, JR.
GEOLOGY
No. 273

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4B**
TOTAL DEPTH:	**15'**
TOP OF CASING ELEV.:	**333.23 ft. NGVD**
GROUND SURFACE ELEV.:	**329.55 ft. NGVD**

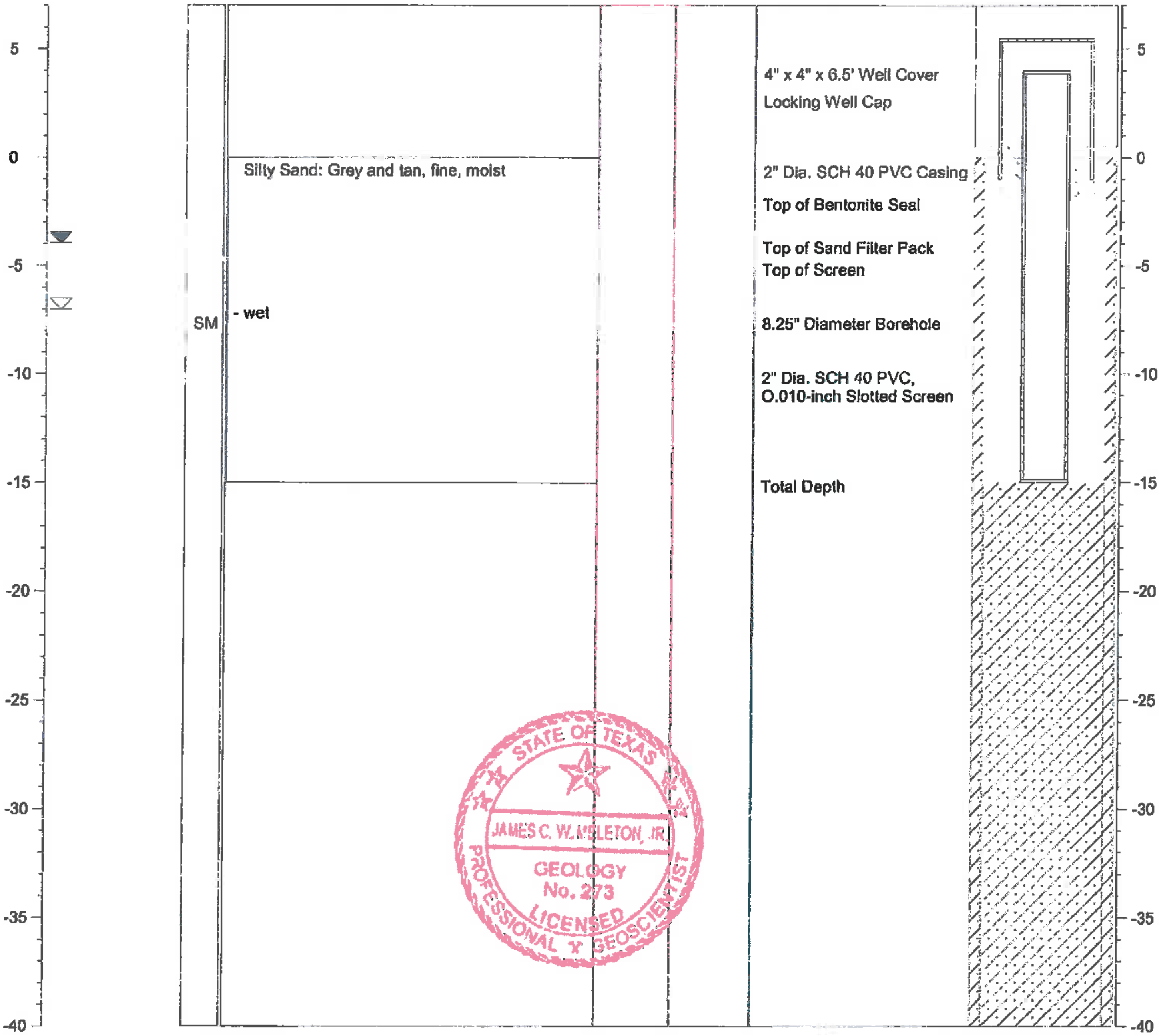
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.04531**
Longitude: 94.84230

▼ Water level during drilling
▽ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4C**
TOTAL DEPTH:	**15'**
TOP OF CASING ELEV.:	**333.28 ft. NGVD**
GROUND SURFACE ELEV.:	**329.15 ft. NGVD**

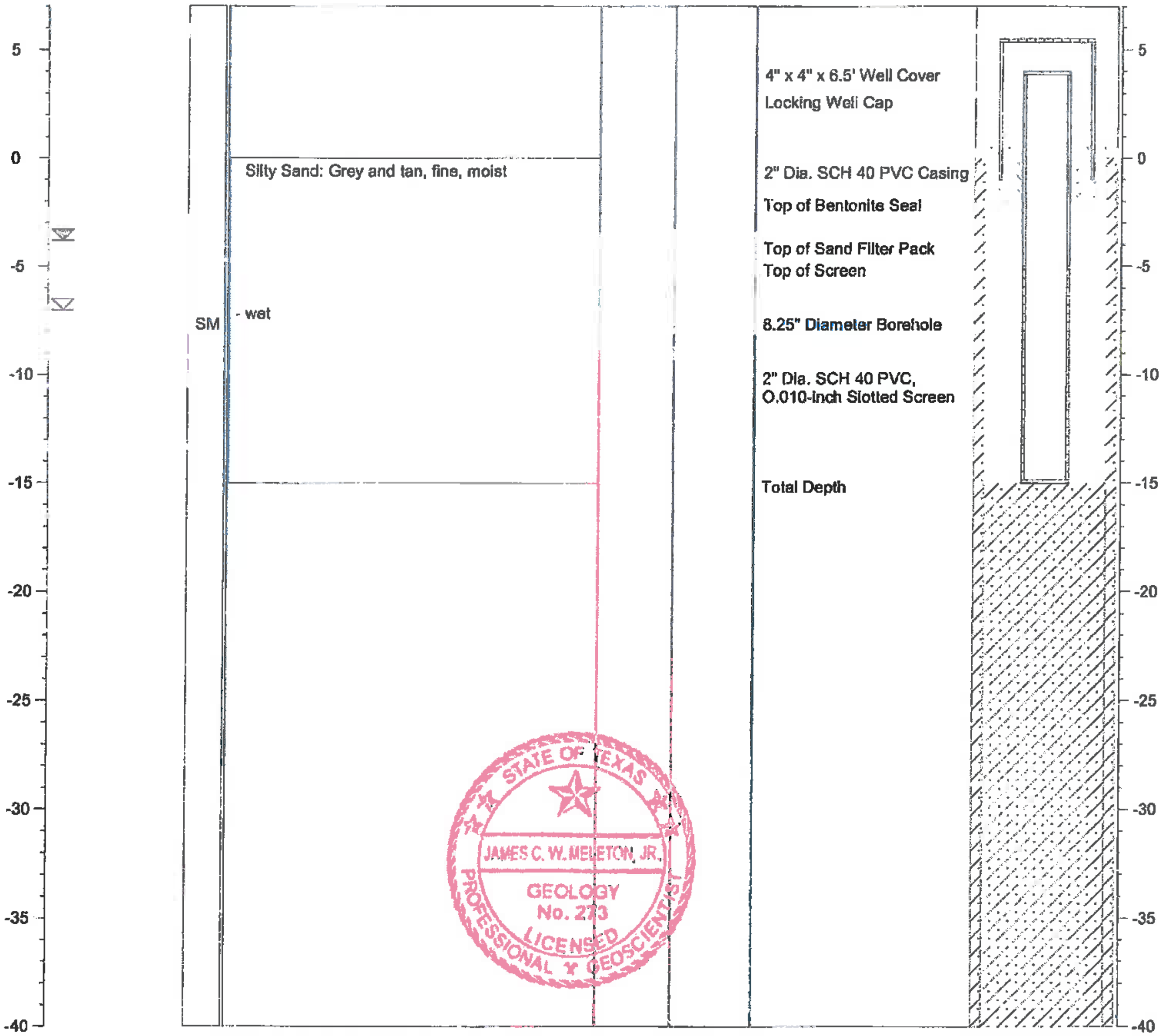
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.04507**
Longitude: 94.84244

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
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PROFESSIONAL GEOSCIENTIST

AD-5

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt.4, Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) 33°03'13"N 94°51'00"W N

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	10	red & gray clay with orange streaks
10	20	gray/black clay with tan clay
20	25	stiff clay with lignite streak
25	30	fine gray sand

AP-5

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	risor	+2	20	Sch 40
2	N	#10 slot screen	20	30	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 0 ft. No. of sacks used
ft. to ft. No. of sacks used
Method used bentonite
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

✓10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 11' 9" ft. below land surface Date 1-11-01
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS:
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

✓15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) Gilbert M (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-6**
TOTAL DEPTH:	**33'**
TOP OF CASING ELEV.:	**346.33 ft. NGVD**
GROUND SURFACE ELEV.:	**343.31 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.05235**
Longitude: 94.84757

▽ Water level during drilling
▼ Water level in completed well

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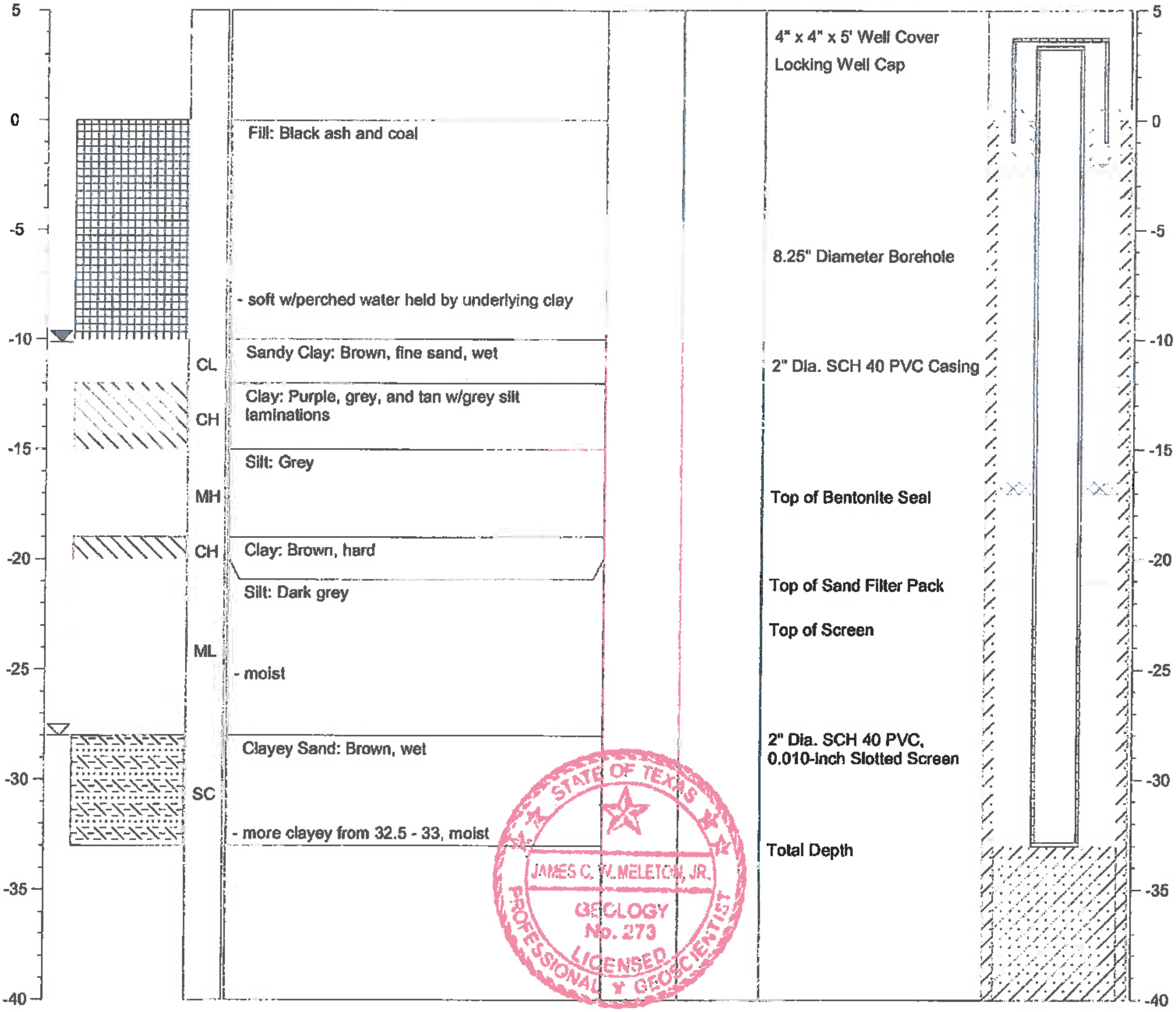

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION
5						4" x 4" x 5' Well Cover Locking Well Cap	
0			Fill: Black ash and coal				
-5						8.25" Diameter Borehole	
			- soft w/perched water held by underlying clay				
-10 ▼		CL	Sandy Clay: Brown, fine sand, wet			2" Dia. SCH 40 PVC Casing	
		CH	Clay: Purple, grey, and tan w/grey silt laminations				
-15		MH	Silt: Grey			Top of Bentonite Seal	
-20		CH	Clay: Brown, hard				
		ML	Silt: Dark grey			Top of Sand Filter Pack	
						Top of Screen	
-25			- moist				
▽		SC	Clayey Sand: Brown, wet			2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen	
-30			- more clayey from 32.5 - 33, moist			Total Depth	
-35							
-40							

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
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PROFESSIONAL GEOSCIENTIST

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OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.: **AD-7**
TOTAL DEPTH: **38'**
TOP OF CASING ELEV.: **350.82 ft. NGVD**
GROUND SURFACE ELEV.: **347.86 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/24/09**

NOTES: **Latitude: 33.05257**
Longitude: 94.84219

▽ Water level during drilling
▼ Water level in completed well

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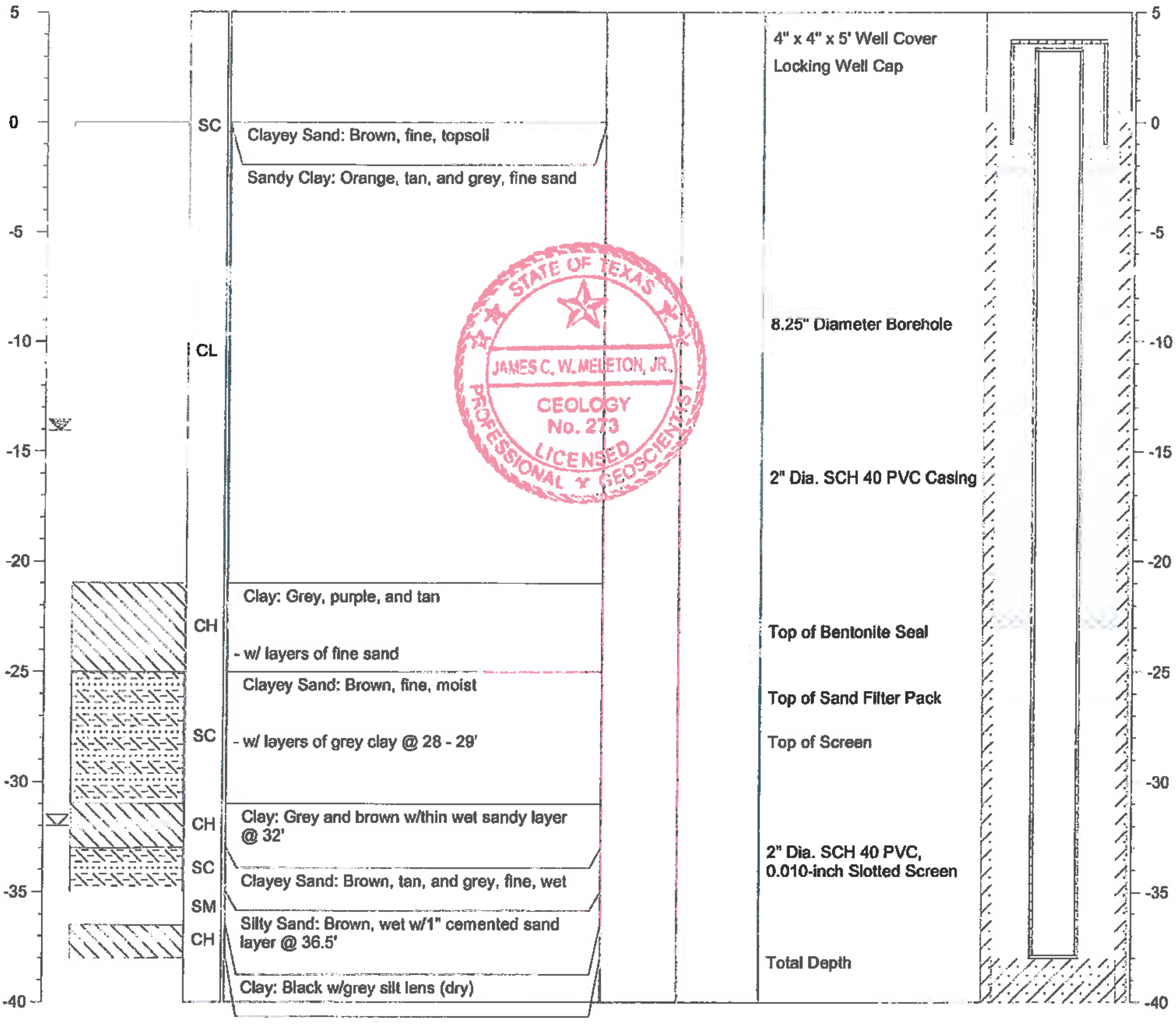
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, fine, topsoil
CL	Sandy Clay: Orange, tan, and grey, fine sand
CH	Clay: Grey, purple, and tan - w/ layers of fine sand
SC	Clayey Sand: Brown, fine, moist - w/ layers of grey clay @ 28 - 29'
CH	Clay: Grey and brown w/thin wet sandy layer @ 32'
SC	Clayey Sand: Brown, tan, and grey, fine, wet
SM	Silty Sand: Brown, wet w/1" cemented sand layer @ 36.5'
CH	Clay: Black w/grey silt lens (dry)

WELL DESCRIPTION:
4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

BORING/WELL NO.: **AD-8**
TOTAL DEPTH: **29'**
TOP OF CASING ELEV.: **340.01 ft. NGVD**
GROUND SURFACE ELEV.: **337.53 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/21/09**

NOTES: **Latitude: 33.05187**
Longitude: 94.84026

▽ Water level during drilling
▼ Water level in completed well

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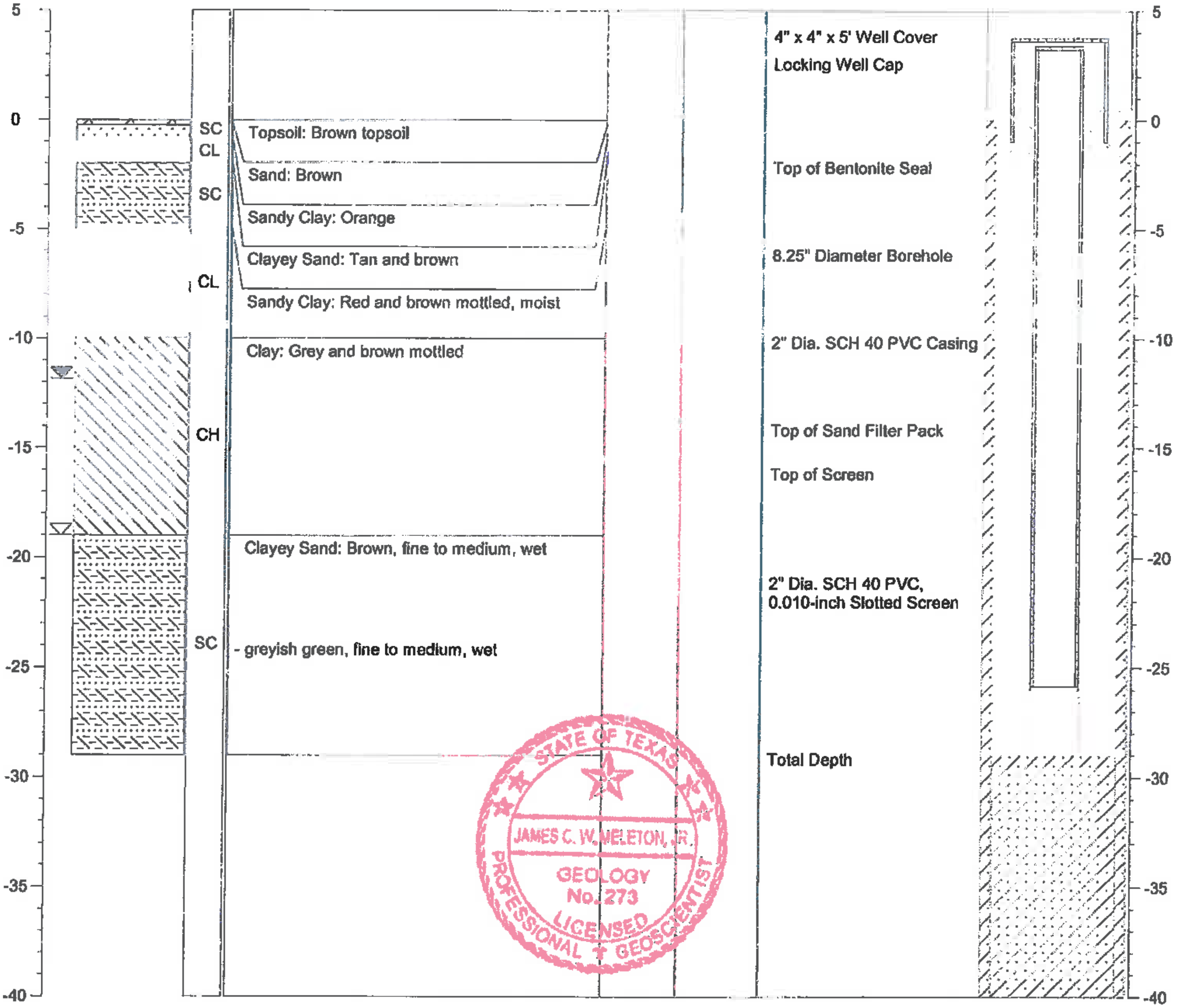
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Topsoil: Brown topsoil
Sand: Brown
Sandy Clay: Orange
Clayey Sand: Tan and brown
Sandy Clay: Red and brown mottled, moist
Clay: Grey and brown mottled
Clayey Sand: Brown, fine to medium, wet
- greyish green, fine to medium, wet

4" x 4" x 5' Well Cover
Locking Well Cap
Top of Bentonite Seal
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

BORING/WELL NO.:	**AD-9**
TOTAL DEPTH:	**35'**
TOP OF CASING ELEV.:	**343.09 ft. NGVD**
GROUND SURFACE ELEV.:	**340.32 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/21/09**

NOTES: **Latitude: 33.04995**
Longitude: 94.84196

▽ Water level during drilling
▼ Water level in completed well

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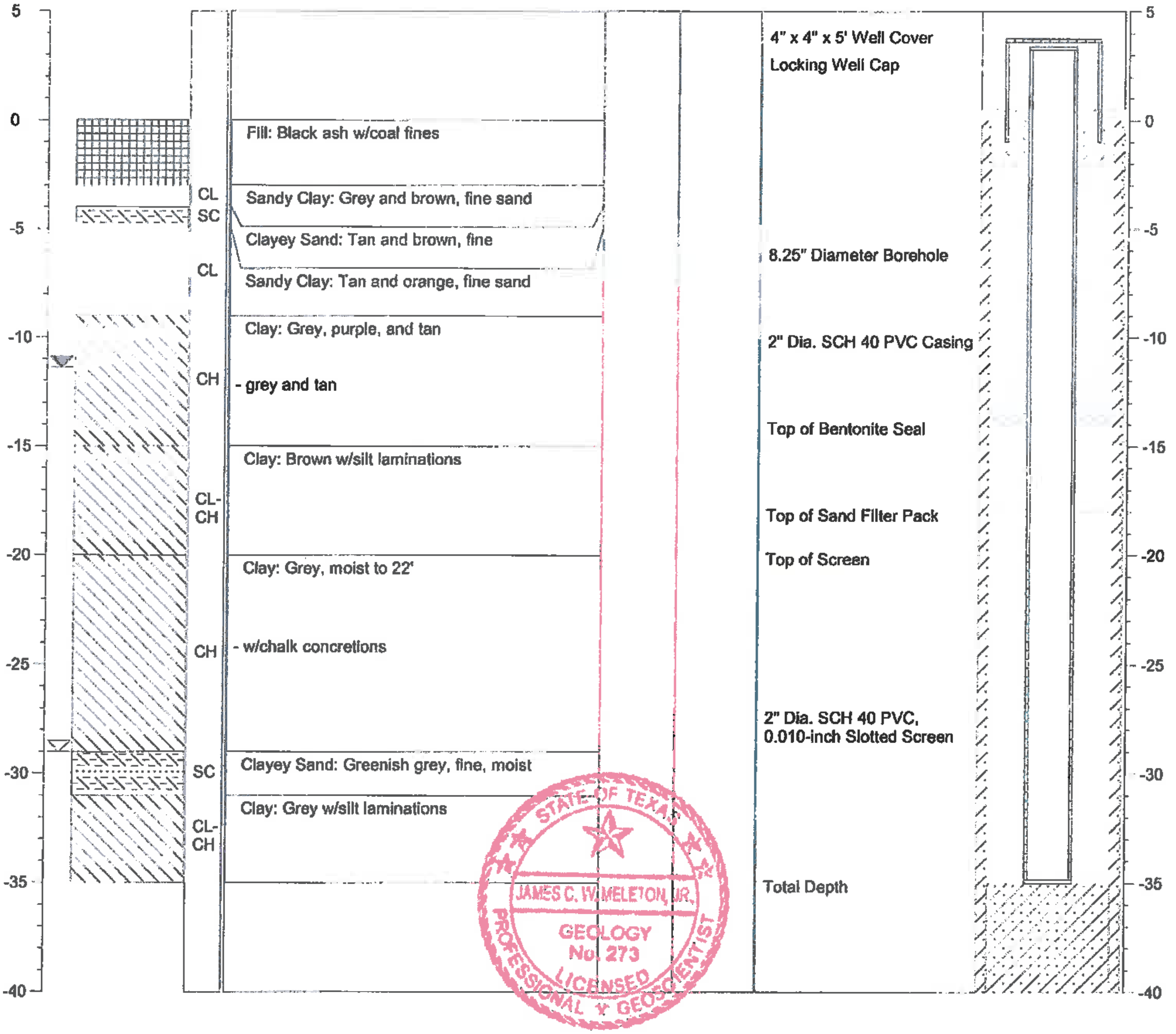
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



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SOIL BORING LOG

BORING/WELL NO.:	**AD-10**
TOTAL DEPTH:	**35'**
TOP OF CASING ELEV.:	**343.01 ft. NGVD**
GROUND SURFACE ELEV.:	**340.23 ft. NGVD**

EAGLE ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04881**
Longitude: 94.84047

▽ Water level during drilling
▼ Water level in completed well

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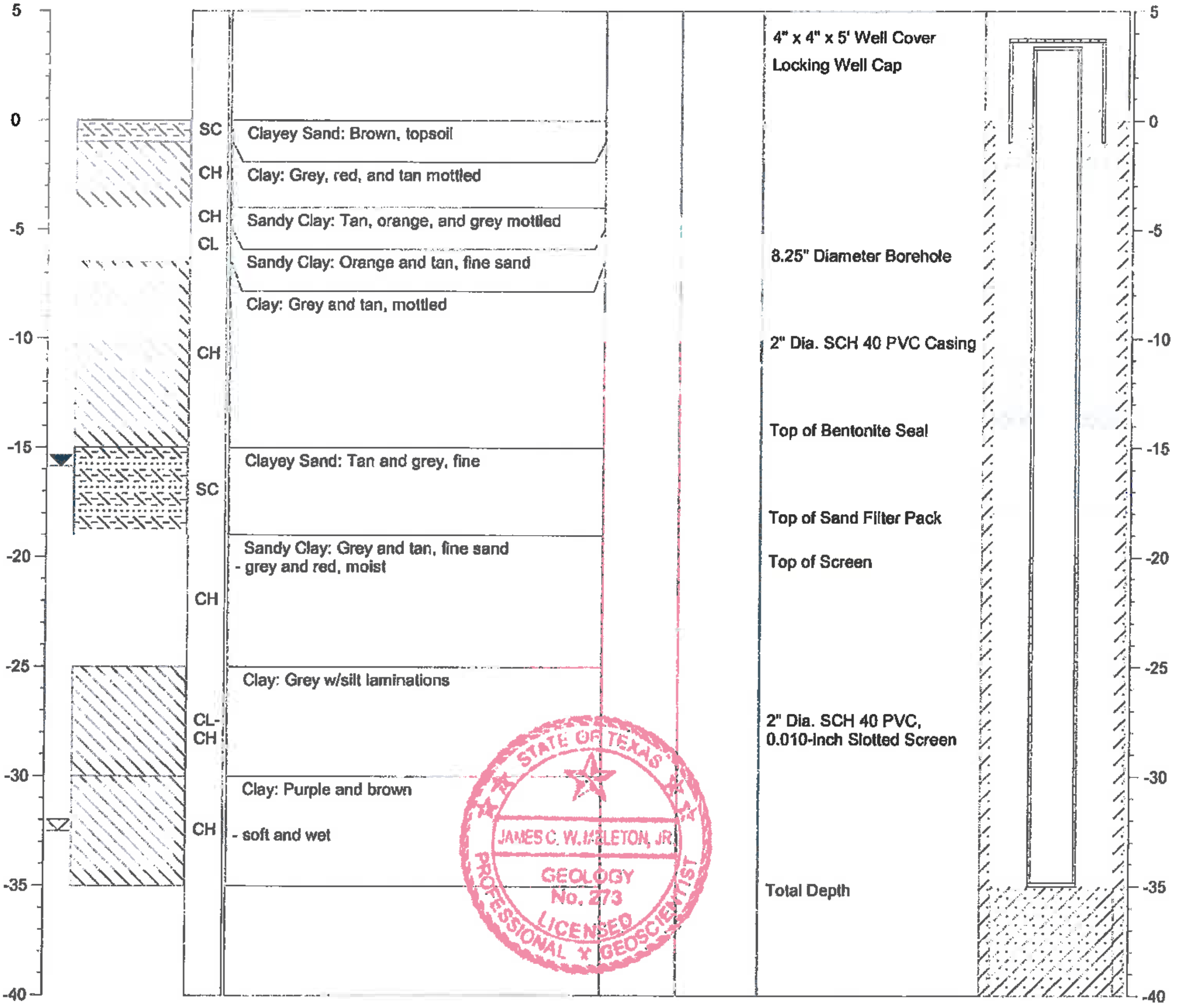
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, topsoil
CH	Clay: Grey, red, and tan mottled
CH	Sandy Clay: Tan, orange, and grey mottled
CL	Sandy Clay: Orange and tan, fine sand
CH	Clay: Grey and tan, mottled
SC	Clayey Sand: Tan and grey, fine
CH	Sandy Clay: Grey and tan, fine sand - grey and red, moist
CL-CH	Clay: Grey w/silt laminations
CH	Clay: Purple and brown - soft and wet

WELL DESCRIPTION:

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

BORING/WELL NO.:	**AD-11**
TOTAL DEPTH:	**20'**
TOP OF CASING ELEV.:	**342.18 ft. NGVD**
GROUND SURFACE ELEV.:	**339.61 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04824**
Longitude: 94.84177

▽ Water level during drilling
▼ Water level in completed well

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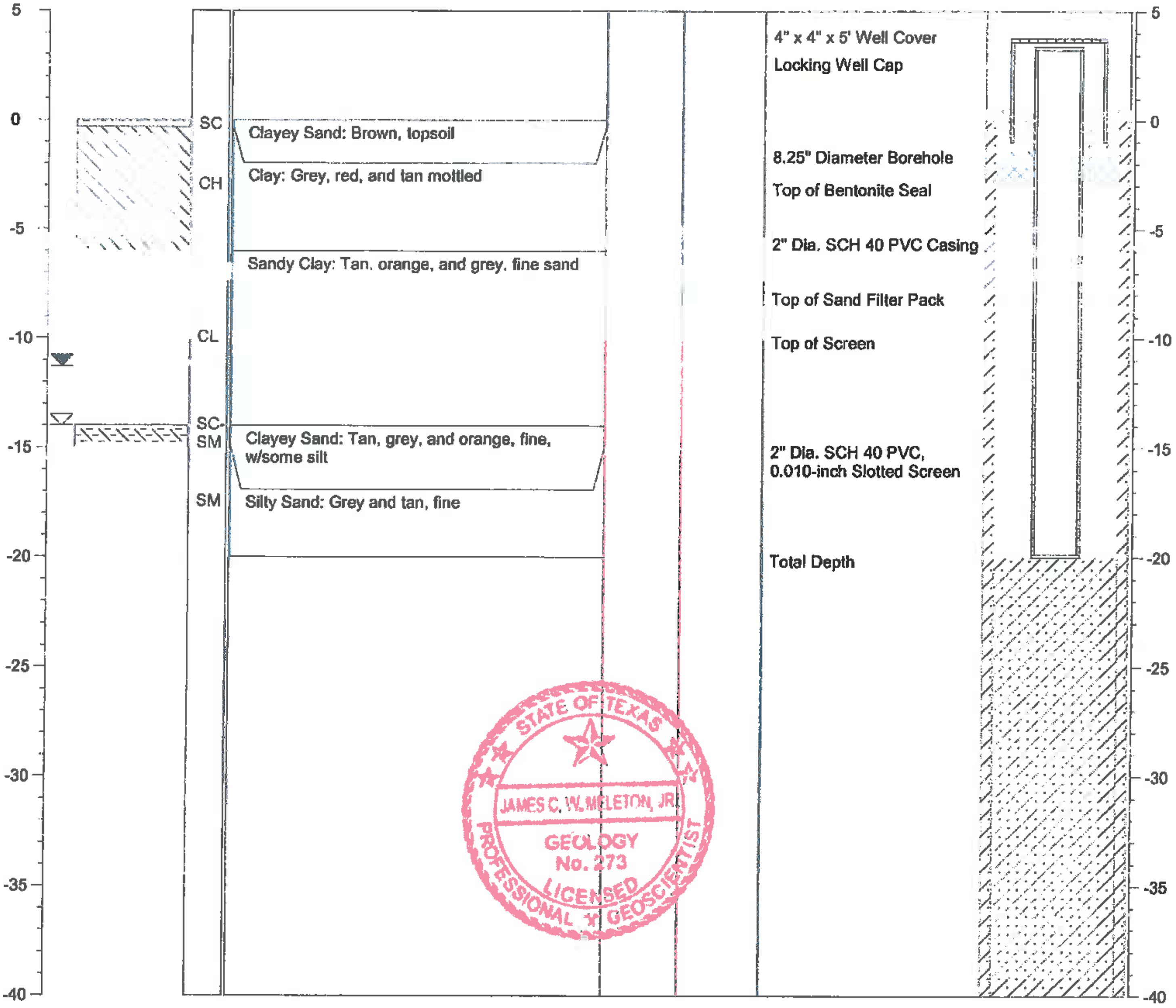
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



SC — Clayey Sand: Brown, topsoil

CH — Clay: Grey, red, and tan mottled

CL — Sandy Clay: Tan, orange, and grey, fine sand

SC-SM — Clayey Sand: Tan, grey, and orange, fine, w/some silt

SM — Silty Sand: Grey and tan, fine

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
Top of Bentonite Seal
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

BORING/WELL NO.: **AD-12**
TOTAL DEPTH: **30'**
TOP OF CASING ELEV.: **369.33 ft. NGVD**
GROUND SURFACE ELEV.: **366.27 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/24/09**

NOTES: **Latitude: 33.04901**
Longitude: 94.84977

▽ Water level during drilling
▼ Water level in completed well

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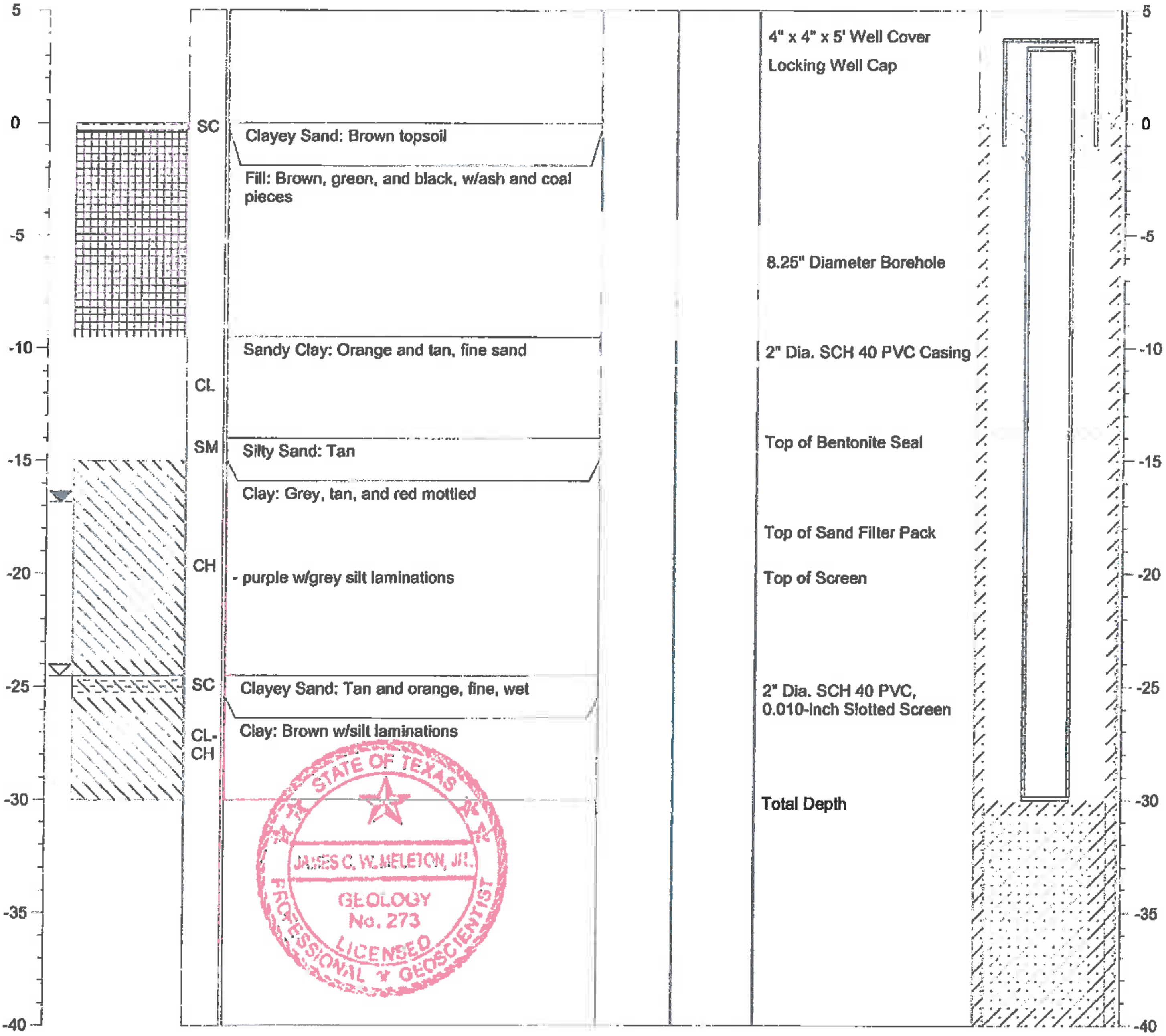
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Clayey Sand: Brown topsoil

Fill: Brown, green, and black, w/ash and coal pieces

Sandy Clay: Orange and tan, fine sand

Silty Sand: Tan

Clay: Grey, tan, and red mottled

- purple w/grey silt laminations

Clayey Sand: Tan and orange, fine, wet

Clay: Brown w/silt laminations

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SOIL BORING LOG

BORING/WELL NO.: **AD-13**
TOTAL DEPTH: **20'**
TOP OF CASING ELEV.: **347.00 ft. NGVD**
GROUND SURFACE ELEV.: **344.12 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/22/09**

NOTES: **Latitude: 33.04918**
Longitude: 94.84275

▽ Water level during drilling
▼ Water level in completed well

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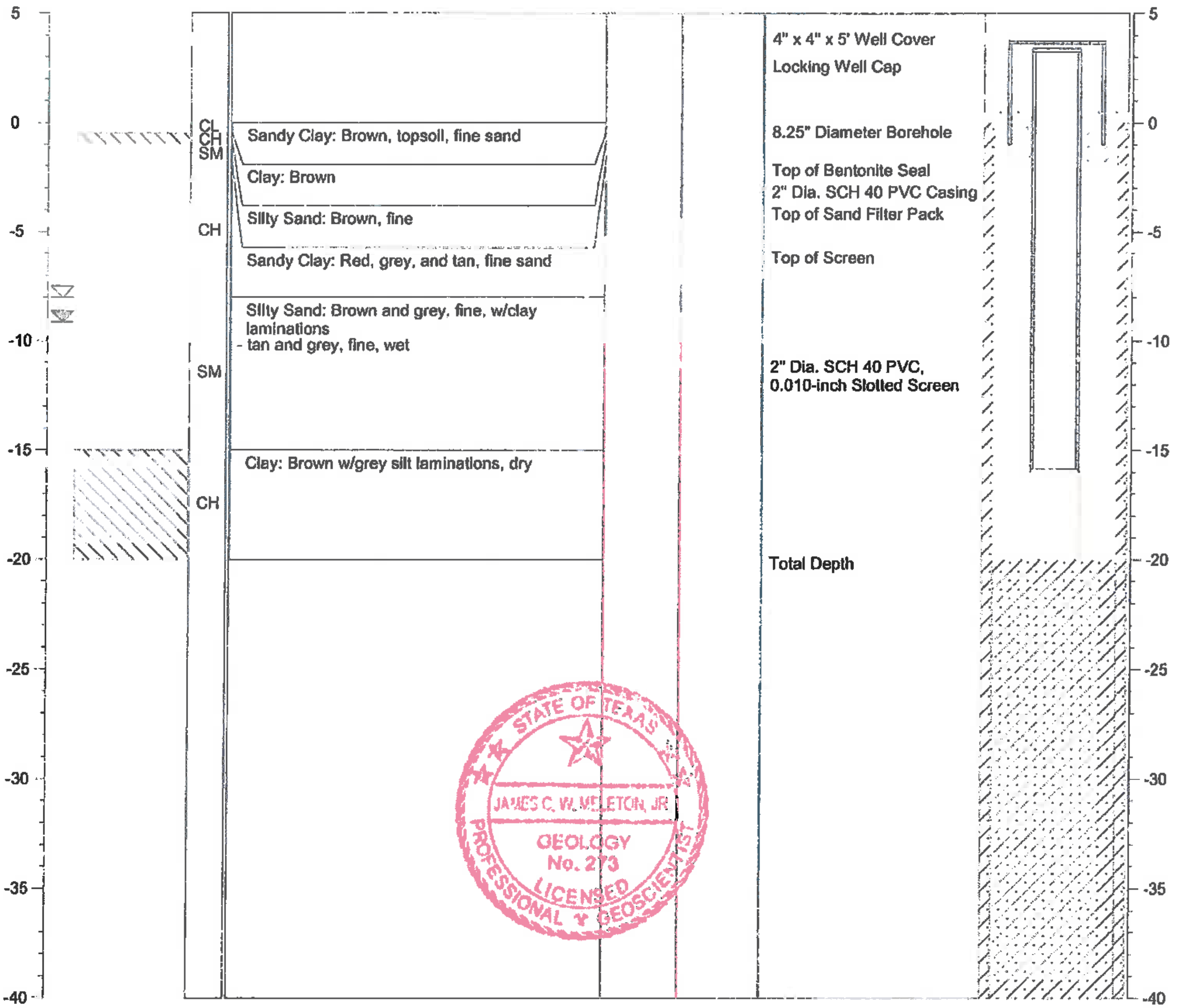
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Sandy Clay: Brown, topsoil, fine sand

Clay: Brown

Silty Sand: Brown, fine

Sandy Clay: Red, grey, and tan, fine sand

Silty Sand: Brown and grey, fine, w/clay laminations
- tan and grey, fine, wet

Clay: Brown w/grey silt laminations, dry

4" x 4" x 5' Well Cover
Locking Well Cap

8.25" Diameter Borehole

Top of Bentonite Seal
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC,
0.010-inch Slotted Screen

Total Depth

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SOIL BORING LOG

BORING/WELL NO.: **AD-14**
TOTAL DEPTH: **18.5'**
TOP OF CASING ELEV.: **345.43 ft. NGVD**
GROUND SURFACE ELEV.: **342.32 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/22/09**

NOTES: **Latitude: 33.04715**
Longitude: 94.84256

▽ Water level during drilling
▼ Water level in completed well

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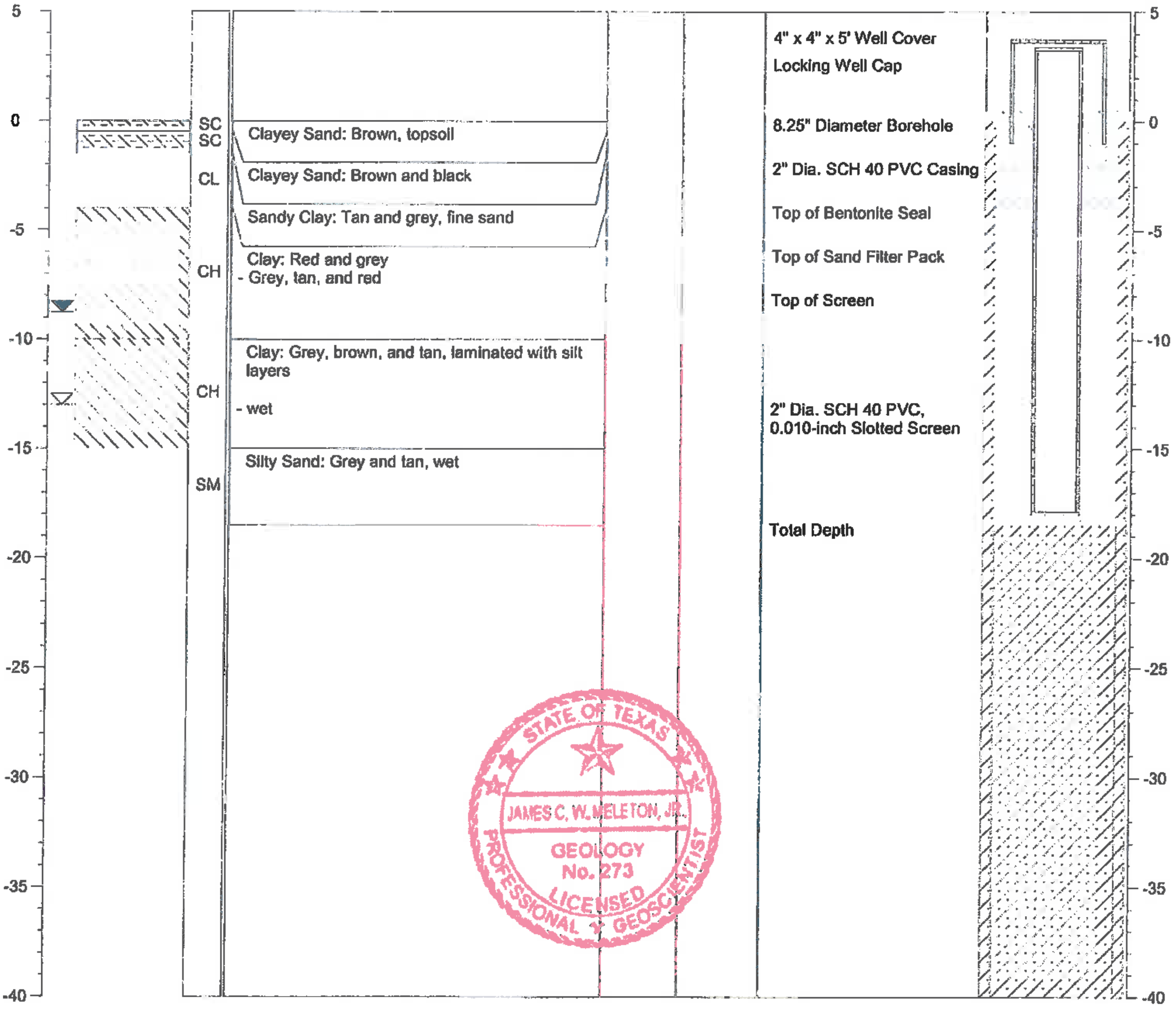
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Clayey Sand: Brown, topsoil

Clayey Sand: Brown and black

Sandy Clay: Tan and grey, fine sand

Clay: Red and grey
- Grey, tan, and red

Clay: Grey, brown, and tan, laminated with silt layers
- wet

Silty Sand: Grey and tan, wet

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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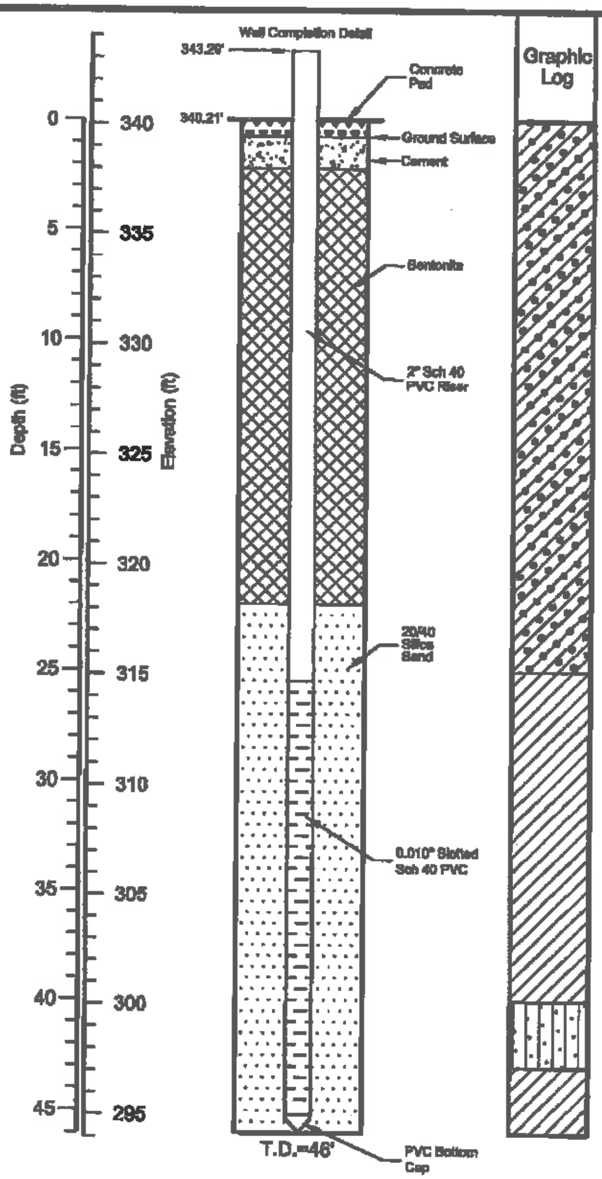


Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0–25		Direct Push		SC	Clayey SAND: reddish brown - 2" lense of brown sand - 3" lense of brown sand	16	48	37	18	19
25–40		Direct Push		CL	Sandy Lean CLAY: reddish brown, very moist - less moisture	22	51	36	19	17
40–43				SM	Silty SAND: light brown & light gray, wet.	27	24	26	NP	-
43–45				CL	Lean CLAY: orangish brown & light gray, mottled, with sand	26	94	45	21	24

STEVEN R. WEMPLE
SOIL SCIENCE
LICENSE NUMBER 2176
1-22-16

west DRILLING
environmental & geotechnical
WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

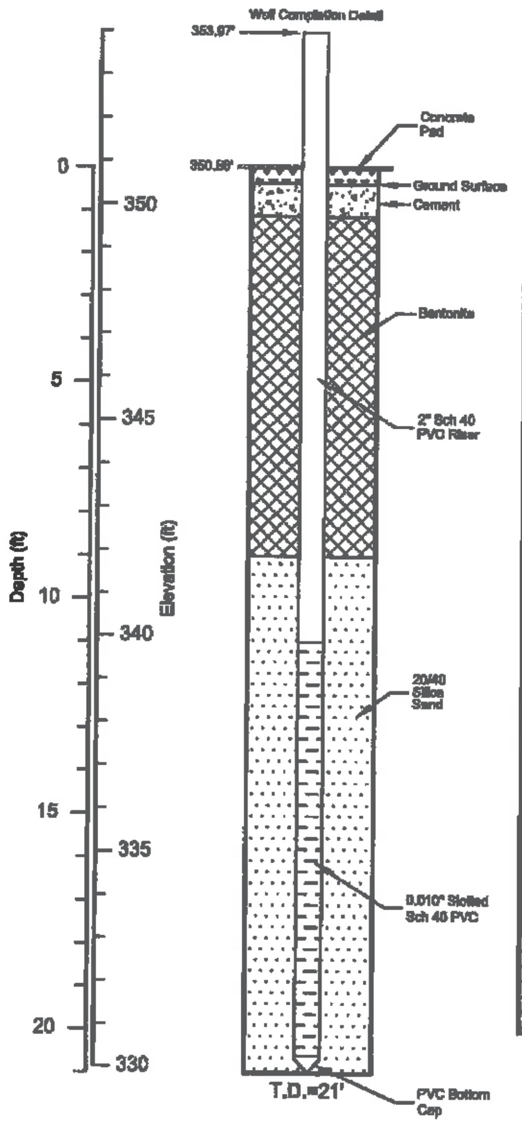
DATE: 12/12/15
Drilling Method: H.S.A.
Bit Diameter: 7.25"
Depth to Water: —

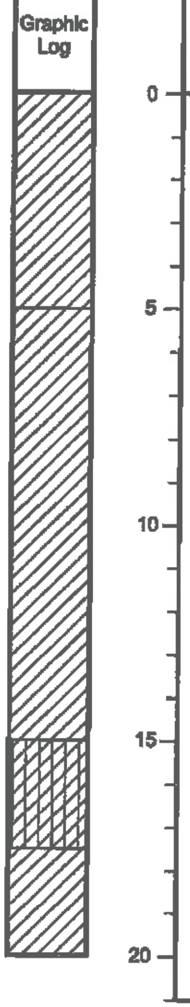
Logged by: Robert Williams, PE
Driller: Robert Williams
Date Completed: 12/12/15
Depth to Product: NA

Welsh Power Station
Pittsburg, Texas
DRAWN BY: HDS
CHECKED BY: SRW

Log of Boring AD-15

PROJECT NO.: —
SCALE: AS SHOWN
FILE NAME: JR Welsh Power Plant LOGS.dwg





PID Reading (ppm)	Sampling Device	Sample Interval	Description Interval (feet bgs)	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		CL	Lean CLAY w/ Sand: light brown & light gray - orangish brown, with silt	16	82	26	16	10
			CL	Lean CLAY w/ Sand: orangish-brown & light gray	22	88	31	19	12
			CL-ML	Silty CLAY: orange w/ brown, wet	30	89	27	20	7
			CL	Sandy, Lean CLAY: brown w/ orange, stiff	26	66	46	26	20

STEVEN R. WEMPLE
SOIL SCIENCE
LICENSE NUMBER 2178

1-22-16

WEST DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/10/15
Drilling Method: H.S.A.
Bit Diameter: 7.25"
Depth to Water: --

Logged by: Robert Williams, PE
Driller: Robert Williams
Date Completed: 12/10/15
Depth to Product: NA

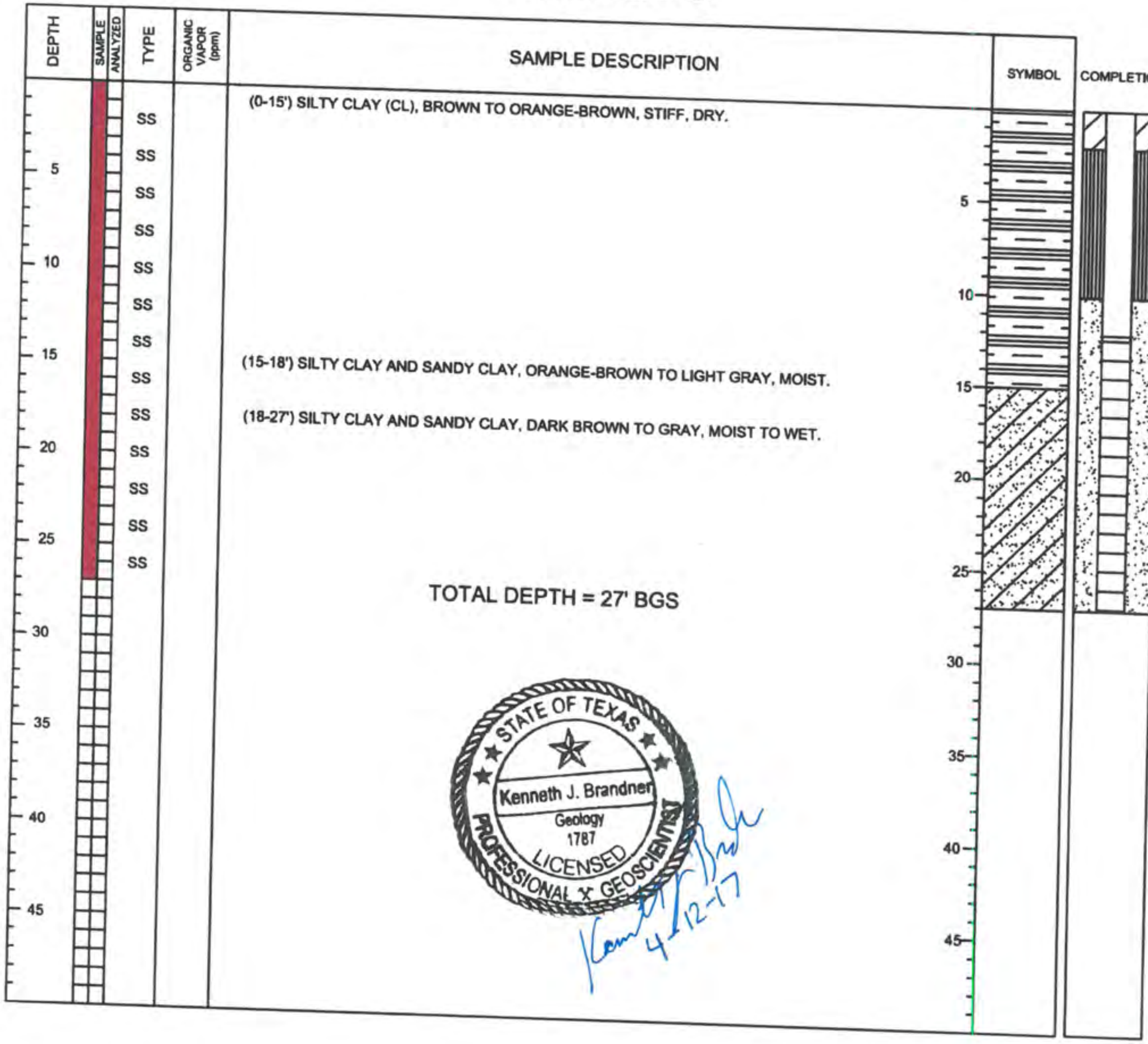
Welsh Power Station
Pittsburg, Texas

DRAWN BY: HDS
CHECKED BY: SRW

Log of Boring
AD-16

PROJECT NO.: --
SCALE: AS SHOWN
FILE NAME: JR Welsh Power Plant LOGS.dwg

WELL LOG



(0-15') SILTY CLAY (CL), BROWN TO ORANGE-BROWN, STIFF, DRY.

(15-18') SILTY CLAY AND SANDY CLAY, ORANGE-BROWN TO LIGHT GRAY, MOIST.

(18-27') SILTY CLAY AND SANDY CLAY, DARK BROWN TO GRAY, MOIST TO WET.

TOTAL DEPTH = 27' BGS

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

Kenneth J. Brandner
4-12-17

AD-16R
WELL

AEP
CLIENT

BOTTOM ASH STORAGE POND
PROJECT

WELSH POWER PLANT
LOCATION

4/12/17
DATE

HSA
DRILLING METHOD

2" PVC, 2' AGL-12' BGL
CASING

2" PVC, 12'-27' BGS
SCREEN

0-2' BGS
CEMENT

2-10' BGS
BENTONITE

10-27' BGS
SAND PACK

350.55' / 353.49'
GROUND ELEV. / TOP OF CASING ELEV.

CT - CUTTINGS
SB - SPLIT BARREL(5')
SS - SPLIT SPOON(2')

▽ HC LEVEL
▼ WATER LEVEL

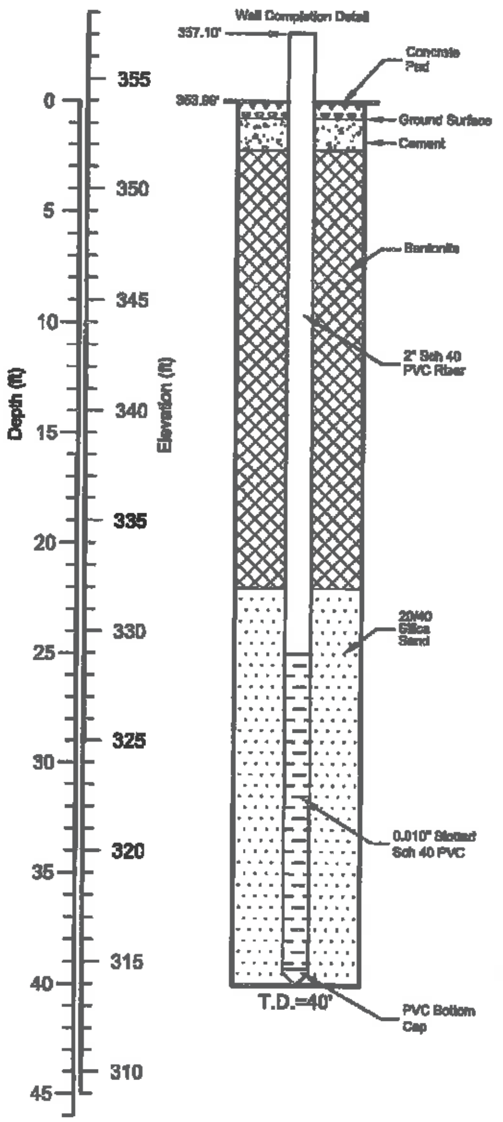
▒ SAND
▤ SILT
▤ CLAY
▨ FILL/CONCRETE
▥ BENTONITE
⁘ GRAVEL

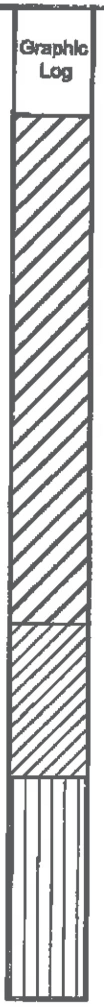
START: FINISH:

PAGE 1 OF 1

ARCADIS Design & Consultancy for natural and built assets

711 N. CARANCAHUA, #1080
CORPUS CHRISTI, TEXAS 78401
TEL: (361) 883-1353 FAX: (361) 883-7565





Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0		Direct Push		CH	Fat CLAY: reddish-brown					
5					- light gray to light brown, reddish brown w/ Sand and gravel lenses	24	97	83	30	53
10					- light brown					
15					- brown Sand lenses, wet					
20					- gray, w/ some Silt	18	90	53	25	28
25		Direct Push		CL	Lean CLAY with Sand: gray	22	81	43	22	21
30				ML	Sandy SILT: gray	23	63	26	NP	-
35										
40										

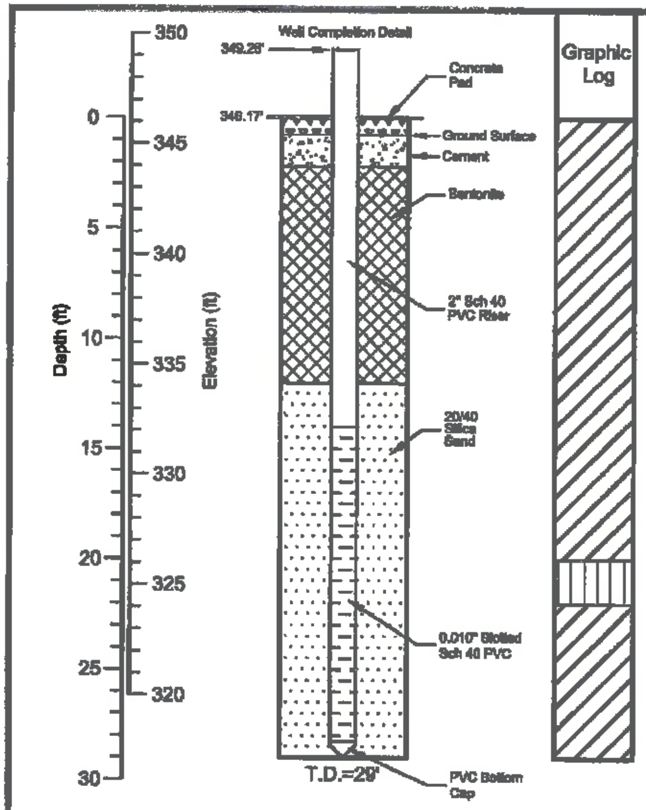
STEVEN R. WEMPLE
SOIL SCIENCE
2176

1/22/16

WEST DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahatchie, Texas 75165

DATE: 12/10/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-17
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: — / SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0–20		Direct Push		CH	Fat CLAY: light brown & light gray, sandy - reddish brown and light gray, with Sand - gray with silt - gray, stiff	19	88	50	24	26
20–22				ML	SILT: gray, with Clay and Sand, wet	29	86	26	NP	-
22–29				CH	Fat CLAY: light gray, silty w/ Sand, very stiff	20	85	50	23	27

STEVEN R. WEMPLE
SOIL SCIENCE
LICENSE NUMBER 2176
1-22-21

west
DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/11/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-18
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: — / SCALE: AS SHOWN
Depth to Water: –	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 1 of 2

Date(s) Drilled **July 23, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **37 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **367 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Bentonite Chips**	Location **On the Northern edge of proposed chemical pond along the screening berm.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
367	0					Other		Black COAL, a few fine roots and organics.						
			ST											Shelby tube pulled black COAL
			SS	10										SPT 4, 5, 5, 5. 24" recovered
362	5		SS	11	Soft to Firm	SC		Reddish Brown fine SAND, little clay, trace silt, Dry. Natural Ground.						SPT 4, 5, 6, 7. 24" recovered
					Soft	SM		Reddish brown fine SAND with silt, trace clay. Vertical sand seams in sample, Dry.						
			SS	11										SPT 3, 5, 6, 6. 24" recovered.
357	10		ST						23.6	22	48.9	5.4E-07		Shelby tube sample, 18" recovered.
					Soft	SC		Reddish brown well graded fine SAND, trace silt and clay. Damp.						
			SS	12	Firm	CL		Greyish red CLAY, little sand, horizontal sand seams, Dry.						SPT 5, 6, 6, 9. 24" recovered
					Soft	SC		Brownish red fine SAND, little clay, Damp.						SPT 7, 6, 7, 9. 24" recovered.
			SS	13	Firm	SC-CL		> Four-inch CLAY seam, little fine sand.						
					Firm	CL		Reddish grey CLAY, little sand, oxidized iron ore. Dry						
352	15				Soft	SM		Brownish red fine SAND, trace clay, thin clay seams. Moist.						SPT 8, 9, 9, 9. 24" recovered.
			SS	16					17.74	14	40.1			
			ST						16.25	NP	28.9	3.6E-05		Shelby tube samples look like SC. 17" recovered.
														SPT 9, 8, 9, 11. 24 Inches recovered.
347	20		SS	17	Soft	Other		> Iron oxidized material						
					Soft	SC		Brownish red fine SAND, little clay. Moist.						
			SS	15										SPT 5, 7, 8, 50/2. 21" recovered
			SS	50	Soft	CL		Dark grey CLAY, little fine sand, Wet.						SPT 50/3".
					Very Hard	SP		Dark grey-black cemented SAND, little clay. Wet. Driller comments that cemented sand terminates at 25.5 feet.						
342	25													
			SS	27	Soft to Firm	SC		Dark grey fine SAND, little clay. Moist. Soft sand with lenses of firm clay.						SPT 11, 13, 14, 16. 24" recovered.
					Hard	CL		| Dark grey CLAY, little sand, Dry.						
			SS	46	Soft	SC		Dark grey-black fine SAND, little clay, Wet. Encountered water but water rose to 19 feet after 15 min break.						SPT 11, 16, 30, 14. 24" recovered.
			SS	37										SPT 11, 15, 22, 25. 24" recovered.
337	30				Hard	CL								

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
337	30	▨	SS	37	Hard	CL	▨	Dark grey CLAY, little fine sand, occasional horizontal sand seams. Wet. (cont.)						SPT 11, 15, 22, 25. 24" recovered.
		▨	SS	29	Soft	ML	▥	Dark grey-black fine SAND, with clay, frequent hard clay lenses (1-3"), Wet.	26.37	NP	57.5			SPT 6, 11, 18, 24. 24 recovered.
332	35		SS	34	Hard	CL	▨	Black CLAY, trace to little fine sand, trace silt. Dry						SPT 9, 16, 18, 23. 24" recovered.
								Bottom of Boring at 37 feet bgs						
327	40													
322	45													
317	50													
312	55													
307	60													
302	65													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-02

Sheet 1 of 1

Date(s) Drilled **August 14, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **364.56 feet MSL**
Groundwater Level and Date Measured **21.53 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Western edge of proposed chemical pond near perimeter fence.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
364.6	0				Soft	Other		Coal						
			SS	4	Soft	CL		Greyish brown CLAY, with little silt, little sand, damp.						SPT 2, 2, 2. 12" recovered.
			SS	13										SPT 4, 7, 6, 12.
359.6	5		ST											Shelby Tube Sample
					Firm	CH		Brownish tan CLAY with silt, little sand, Damp. Occasional sand and iron ore.						SPT 8, 12, 17, 21
			SS	29					23.71	36	77.3			
			SS	80										SPT 20, 30, 50/5. 17" recovered
354.6	10				Soft	SC		Red-orange fine SAND, little clay, damp. Occasional iron ore.						SPT 15, 20, 24, 31. 18" recovered.
					Soft	CL		Brownish tan CLAY, little silt, little sand, Damp.						
			SS	44	Soft	SM		Red-orange fine SAND, little clay, Damp.						
														SPT 11, 12, 9, 32.
			SS	21					20.35	NP	33.5			
														SPT 6, 6, 12, 6.
349.6	15		SS	18										
					Soft	SM-SC		Light brown fine SAND, with little silt, little sand, Damp.						
					Firm	CL		Black CLAY, with fine sand, Wet.						SPT 12, 25, 50/5.
			SS	75	Soft	SM-SC		Dark red fine SAND, little clay, little silt, Wet.						
					Soft-Firm	SC		Dark grey fine SAND, little clay, Wet. Occasional clay seams.						SPT 9, 16, 12, 15.
			SS	28										
344.6	20													SPT 9, 17, 21, 27.
			SS	38	Firm	SC		Frequent clay lenses. 8/11/09 ▼	22.55	13	36.6			
														SPT 22, 35, 50/4".
			SS	65										
														SPT 10, 15, 18, 28.
339.6	25		SS	33										
					Soft	SC		Less clay lenses, Wet.						SPT 12, 27, 37, 50/5".
			SS	64										
														SPT 19, 24, 21, 50/5".
			SS	44										
					Hard	CL		Dark grey CLAY, [illegible] trace silt, Wet.						
334.6	30													

Figure

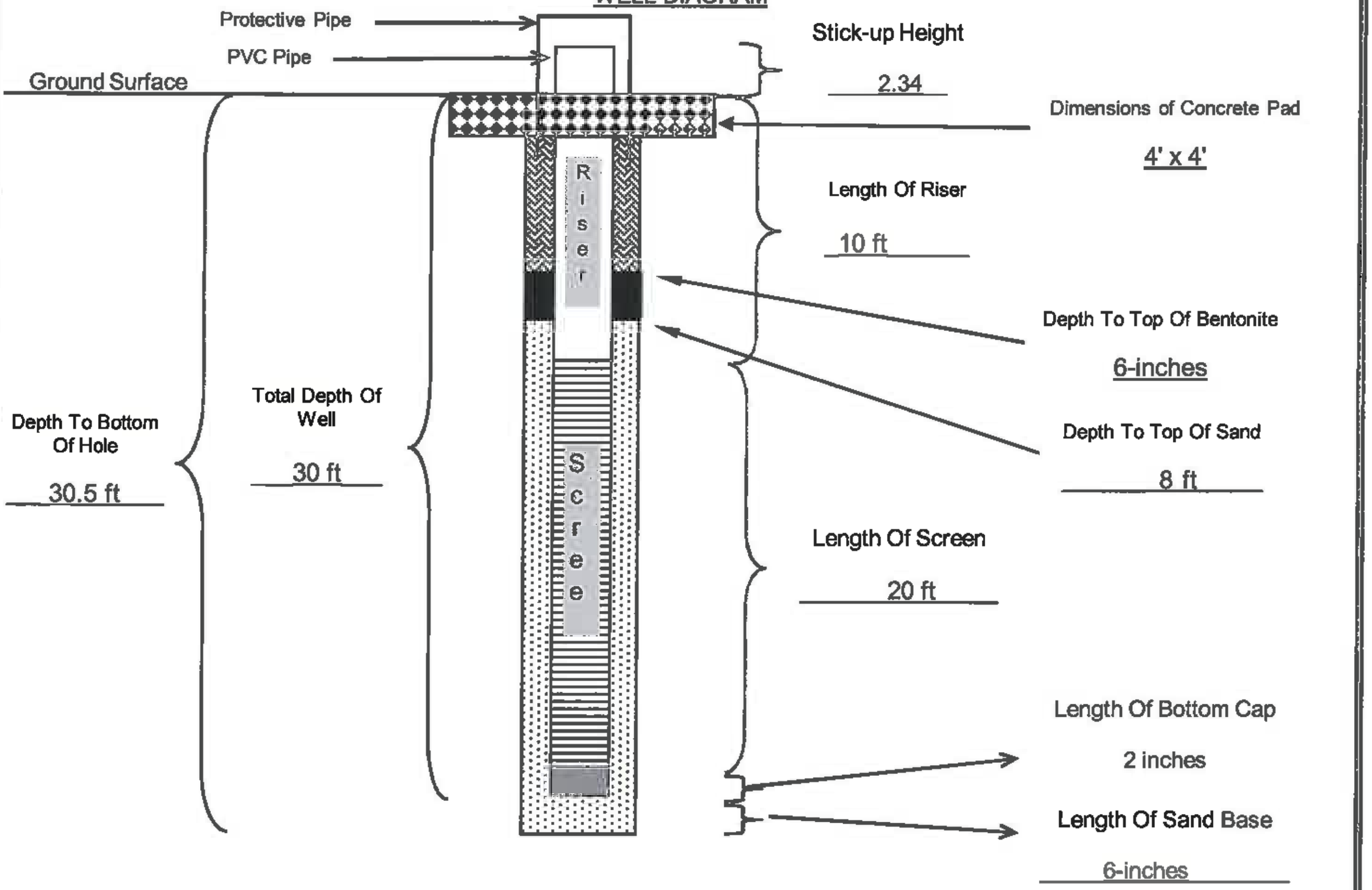
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL NO.: GB-02
WELL LOCATION:
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 364.56 (ft, msl)
BENTONITE TYPE: Western Bentonite
TOP OF SCREEN ELEVATION: 354.56 (ft, msl)
MANUFACTURER: PDS
BOTTOM OF WELL ELEVATION: 334.06 (ft, msl)
CEMENT TYPE: Not used-sealed with bentonite chips
NORTHING: 747.0223 EASTING: -2442.888
CEMENT MANUFACTURER:
SCREEN MATERIAL: PVC
SAND PACK TYPE AND SIZE: Silica 20/40
SCREEN MANUFACTURER:
SAND MANUFACTURER: Uninum
RISER MATERIAL: PVC
DRILLING CONTRACTOR: Total Support Services
RISER MANUFACTURER:
AMOUNT BENTONITE USED: 4 bags lbs
RISER DIAMETER: 2 (in) Length: 10 (ft)
AMOUNT CEMENT USED: bags lbs
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
AMOUNT SAND USED: 13 bags lbs
BOREHOLE DIAMETER: 8 (in)
STATIC WATER: 21.53 depth from TOC
DRILLING TECHNIQUE: Hollow stem Size: (in)
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.34

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 10 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 8 ft

Depth To Bottom Of Hole: 30.5 ft

Total Depth Of Well: 30 ft

Length Of Screen: 20 ft

Length Of Bottom Cap: 2 inches

Length Of Sand Base: 6-inches

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

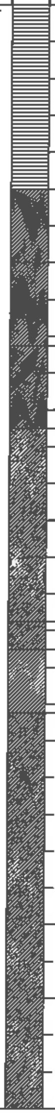
QA/QC
INSTALLED BY: Total Support Services
OBSERVED BY: Kush Chohan
DATE: August 7th, 2009
CHECKED BY:
DATE:

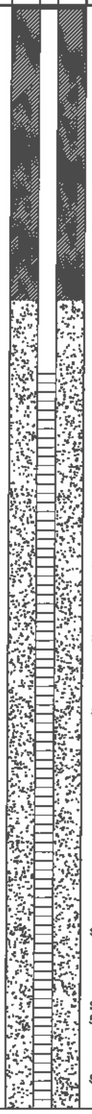
Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 1 of 2

Date(s) Drilled **August 7, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **31 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **359.91 feet MSL**
Groundwater Level and Date Measured **21.89 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Southwest corner of proposed chemical pond near screening pile.**	





Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
359.9	0				Soft	Other		Coal						
354.9	5				Soft	CH		Shelby Tube						Shelby tube sample.
			ST							43	96.1			
					Firm	CH		Light brown-grey CLAY, little silt, occasional sand seams (fine), Damp.						SPT 29, 22, 19, 21.
			SS	41					24.04	29	90.4			
														SPT 6, 12, 15, 20.
					Soft	CH		Brownish dark grey CLAY, trace sand, trace silt, Wet.						
349.9	10		SS	27										
														SPT 17, 29, 24, 25.
					Soft	SC		Dark orange red SAND, little clay, trace silt, Wet. Occasional clay seam (dark grey).						
			SS	53										
					Soft	SC		Clay lenses.						SPT 7, 15, 17, 40.
			SS	32										
344.9	15													SPT 9, 17, 30, 20.
			SS	47	Soft	SC		Clay lense						
					Soft	SC		Dark grey fine SAND with clay, occasional clay lense, Wet.						SPT 11, 50/4".
					Firm	CL		Dark grey CLAY, little fine sand, Wet.						
			SS	50										
														SPT 11, 27, 17, 21.
					Soft	SC		Dark grey fine SAND, little clay, occasional clay seam, iron ore, Wet.						
339.9	20		SS	44										
								8/11/09 ▼						
334.9	25													SPT 27, 40, 50/4".
			SS	90										
					Firm	SC		Dark grey clay lense						SPT 11, 15, 40, 50/3".
			SS	55										
			SS	55										SPT 17, 50/5.5".
329.9	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
329.9	30	▧	SS	55	Hard	CL	▨	Dark grey CLAY, trace silt, trace fine sand.					▨	SPT 17, 50/5.5".
								Bottom of Boring at 31 feet bgs						
324.9	35													
319.9	40													
314.9	45													
309.9	50													
304.9	55													
299.9	60													
294.9	65													

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

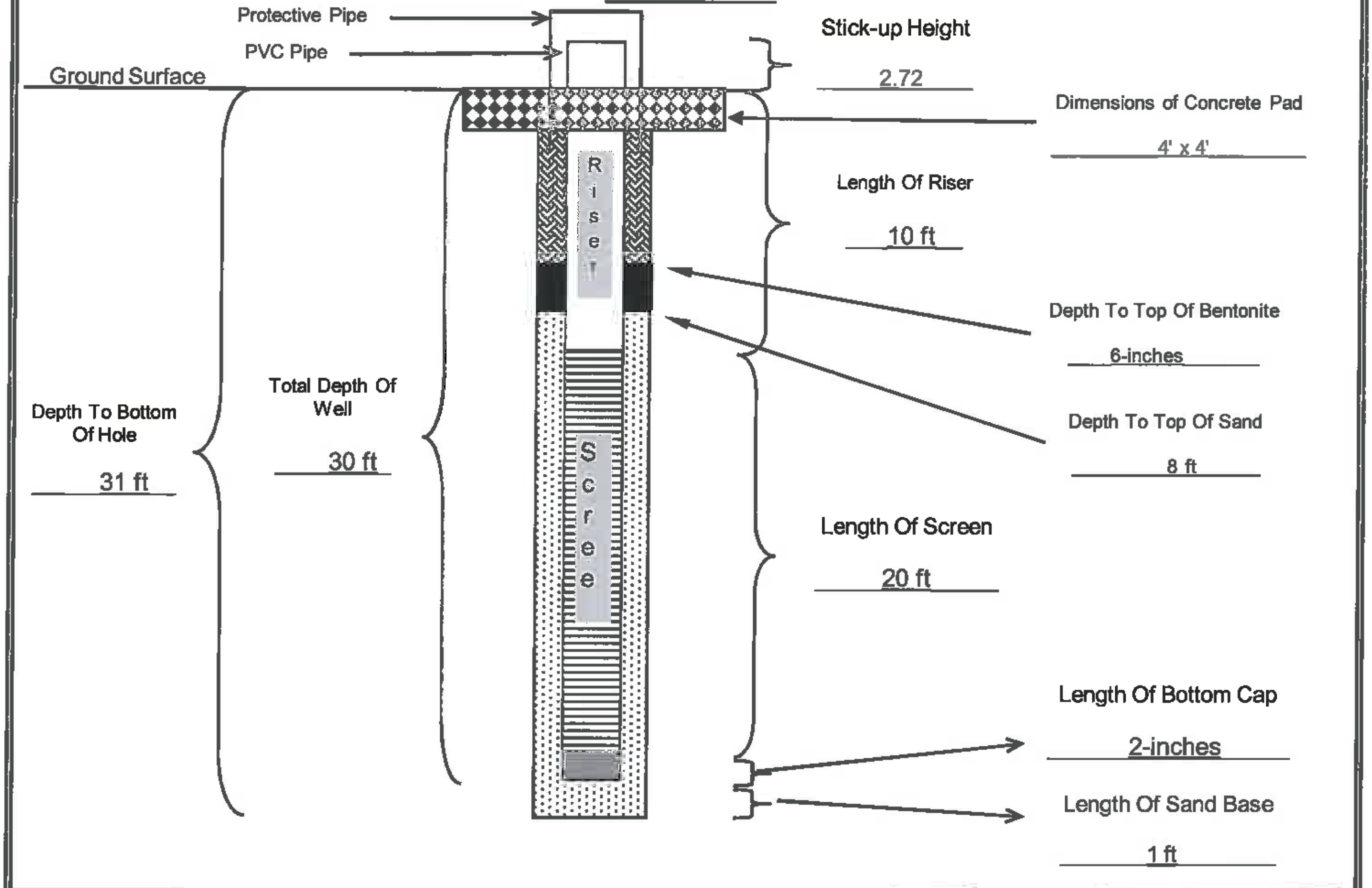
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL LOCATION:
WELL NO.: GB-03
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 359.57 (ft, msl)
TOP OF SCREEN ELEVATION: 349.57 (ft, msl)
BOTTOM OF WELL ELEVATION: 328.57 (ft, msl)
NORTHING: 460.5803 EASTING: -2507.6332
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 8 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 8 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE: None used-sealed with bentonite chips
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 4 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 12 bags lbs
STATIC WATER: 21.89 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.72
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 1 ft
Depth To Bottom Of Hole: 31 ft
Total Depth Of Well: 30 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▒ Bottom Cap

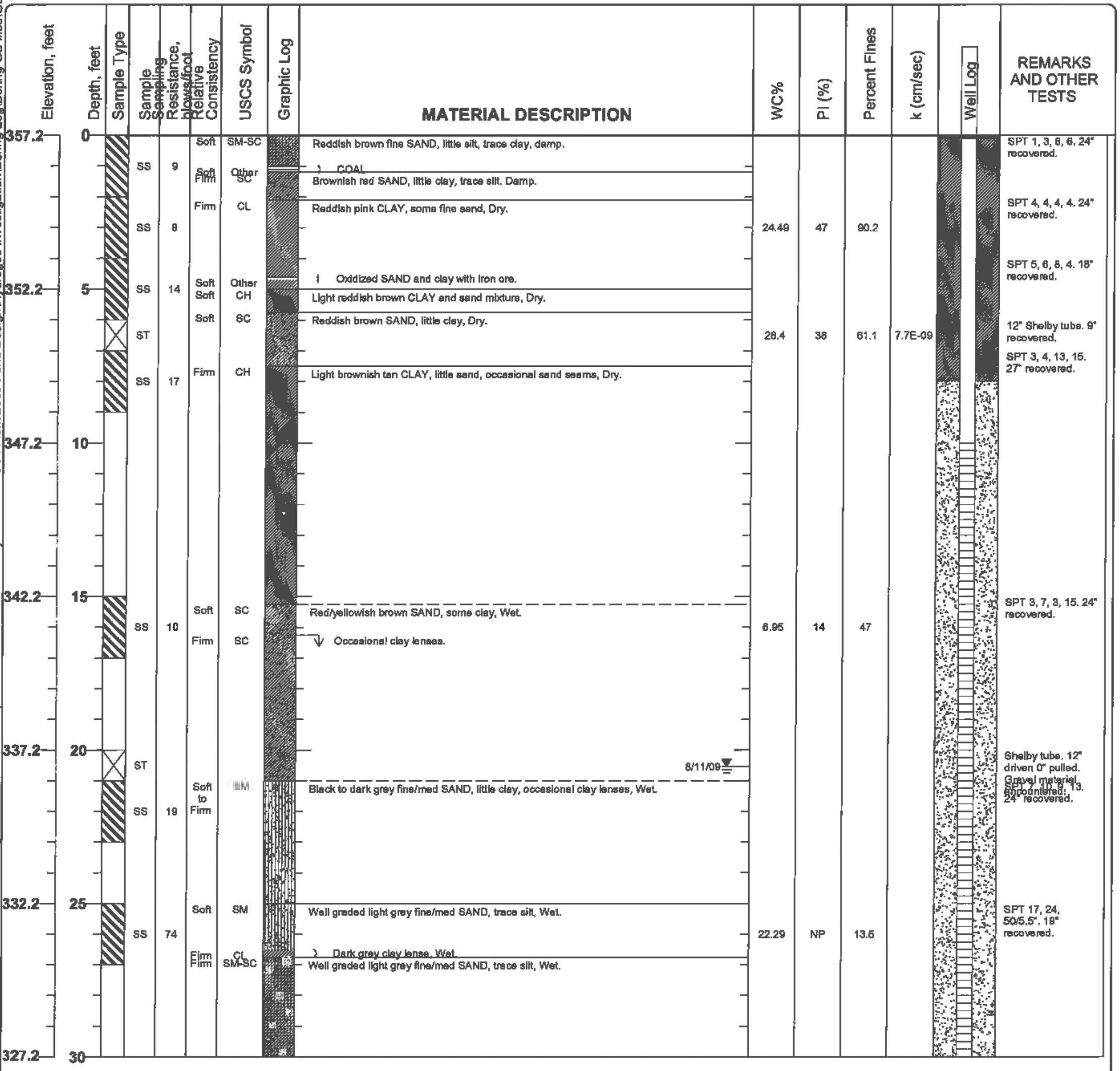
QA/QC
INSTALLED BY: Total Support Services
DATE: 7-Aug-09
OBSERVED BY: Kush S. Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **34 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.22 feet MSL**
Groundwater Level and Date Measured **20.54 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Southeast corner of proposed chemical evaportation pond. Located in a grassy field.**	



Elevation, feet	Depth, feet	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
357.2	0			Soft	SM-SC	Reddish brown fine SAND, little silt, trace clay, damp.					SPT 1, 3, 6, 6. 24" recovered.
		SS	9	Soft	Other	COAL					
				Firm	SC	Brownish red SAND, little clay, trace silt. Damp.					
				Firm	CL	Reddish pink CLAY, some fine sand, Dry.					SPT 4, 4, 4, 4. 24" recovered.
		SS	8				24.49	47	90.2		
				Soft	Other	Oxidized SAND and clay with iron ore.					SPT 5, 6, 8, 4. 18" recovered.
352.2	5	SS	14	Soft	CH	Light reddish brown CLAY and sand mixture, Dry.					
				Soft	SC	Reddish brown SAND, little clay, Dry.					
		ST					28.4	36	61.1	7.7E-09	12" Shelby tube. 9" recovered.
				Firm	CH	Light brownish tan CLAY, little sand, occasional sand seams, Dry.					SPT 3, 4, 13, 15. 27" recovered.
		SS	17								
347.2	10										
342.2	15			Soft	SC	Red/yellowish brown SAND, some clay, Wet.					SPT 3, 7, 3, 15. 24" recovered.
		SS	10				6.95	14	47		
				Firm	SC	Occasional clay lenses.					
337.2	20	ST				8/11/09					Shelby tube. 12" driven 0" pulled. Gravel material encountered.
				Soft to Firm	SM	Black to dark grey fine/med SAND, little clay, occasional clay lenses, Wet.					SPT 7, 10, 9, 13. 24" recovered.
		SS	19								
332.2	25			Soft	SM	Well graded light grey fine/med SAND, trace silt, Wet.					SPT 17, 24, 50/5.5". 19" recovered.
		SS	74				22.29	NP	13.5		
				Firm	CL	Dark grey clay lense, Wet.					
				Firm	SM-SC	Well graded light grey fine/med SAND, trace silt, Wet.					
327.2	30										

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.2	30	☒	ST		Hard	ML	▥	Dark grey CLAY, little sand, Wet.					░	12" Shelby tube. Bent shelby tube.
		☒	ST				▥		21.3	NP	84.2	2.0E-08	░	12" Shelby tube.
		▧	SS	38	Hard	CL	▨	Dark grey CLAY, trace sand, Wet.	25.44	18	92.5		░	SPT 15, 19, 19, 25. 24" recovered.
								Bottom of Boring at 34 feet bgs						
322.2	35													
317.2	40													
312.2	45													
307.2	50													
302.2	55													
297.2	60													
292.2	65													

Figure

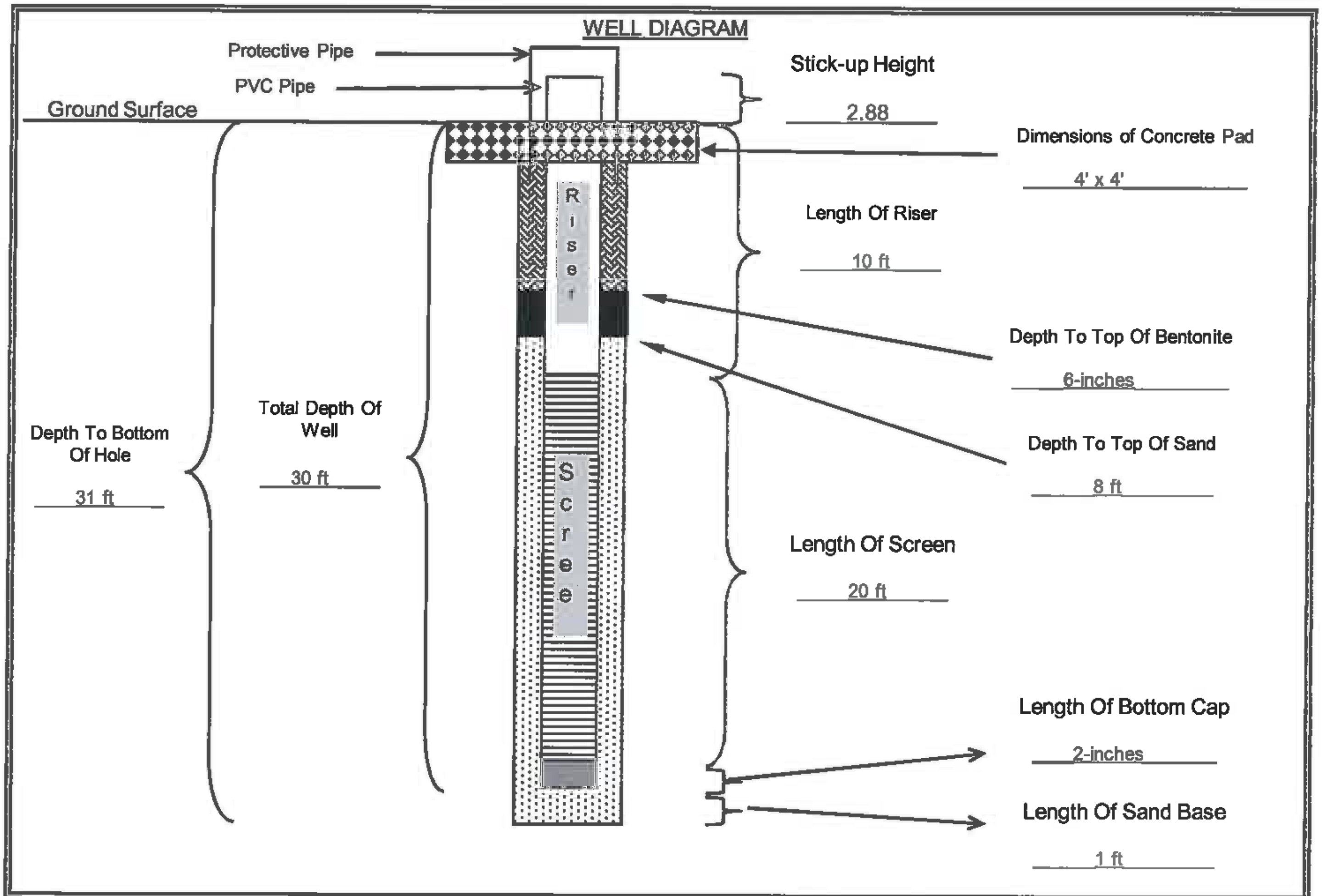
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME:	AEP Welsh Power Plant		
JOB NO.:	TXL0064		
DATE/TIME:	24-Jul-09	WELL NO.:	GB-04
WELL LOCATION:		FIELD REP:	Kush Chohan

GROUND SURFACE ELEVATION:	357.22 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	347.22 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	326.22 (ft, msl)	CEMENT TYPE:	
NORTHING: -384.9666	EASTING: -2353.7375	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	3 bags lbs
RISER DIAMETER:	2 (in) Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 20 (ft)	AMOUNT SAND USED:	7 bags lbs
BOREHOLE DIAMETER:	6.75 (in)	STATIC WATER:	20.54 depth from TOC
DRILLING TECHNIQUE:	Hollow Stem Size: 6.75 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.88

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 10 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 8 ft

Length Of Screen: 20 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 1 ft

Total Depth Of Well: 30 ft

Depth To Bottom Of Hole: 31 ft

▩	Cement/Bentonite Grout	▒	Sand Pack	▦	Neat Concrete	■	Bentonite	▨	Bottom Cap

QA/QC	INSTALLED BY: Total Support Services	OBSERVED BY:	Kush S. Chohan
	DATE: 24-Jul-09	CHECKED BY:	DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 1 of 2

Date(s) Drilled	**July 24, 2009**	Logged By	**Kush S. Chohan**	Checked By	
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type		Total Depth of Borehole	**30.5 feet bgs**
Drill Rig Type	**Mobil B61**	Drilling Contractor	**Total Support Services**	Approximate Surface Elevation	**357.49 feet MSL**
Groundwater Level and Date Measured	**15.3 feet measured on 8-11-09**	Sampling Method(s)	**SPT, Tube**	Hammer Data	**140 lb, 30 in drop, Auto-hammer**
Borehole Backfill	**Well Completion**	Location	**Eastern edge of proposed chemical evaporation pond.**		

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
357.5	0				Soft	SW-SM		Dark fine SAND with brown organic material and roots.						SPT 2, 2, 5, 5. 24" recovered
			SS	7	Firm	CH		Dark red/grey CLAY, trace silt. Dry.	23.37	44	68.6			
														SPT 4, 4, 7, 9. 24" recovered.
			SS	11								7E-07		
														SPT 5, 6, 8, 13. 24 recovered
352.5	5		SS	14										
						CH		Trace of sand						
			ST		Soft	CH		Dark red fine SAND, trace clay, Damp.	16.5	41	73.8	3.2E-08		Shelby tube. Pushed 12 recovered 9".
														SPT 5, 7, 11, 11. 24" recovered.
					Firm	CH		Light tan CLAY, trace sand, Dry.						
			SS	18										
					Soft	SC		Dark red SAND, trace of CLAY, Damp.						
					Firm	CL		Light tan CLAY, trace fine sand, Dry.						
														SPT 6, 7, 11, 14. 24" recovered.
					Soft	SC		Dark red SAND, little clay, frequent clay seams, Damp						
347.5	10		SS	18										
						SC		Frequent clay seams						SPT 11, 22, 13, 14. 24" recovered.
			SS	35	Soft	SC		Red/orange fine SAND, trace clay, trace coarse sand, poorly sorted, Moist.						
														SPT 17, 27, 50/5". 17" recovered.
			SS	77										
					Firm	CL		Brownish grey CLAY, trace sand, Moist.						
					Soft	SC		Tanish grey fine SAND, some clay, Wet.						
342.5	15													
			ST					8-11-09 ▼	19.9	13	35.7	8.6E-07		Shelby tube. Pushed 12" recovered 9".
														SPT 11, 13, 10, 14. 24" recovered.
			SS	23					27.98	NP	32.3			
					Soft	SM		Dark grey coarse SAND/GRAVEL mix, some fine sand, trace clay, Wet.						
					Soft	SM-SC		Red fine SAND, trace clay, Moist. cemented. Moist.						SPT 7, 8, 11, 13. 24" recovered.
			SS	19										
					Firm	SC		Black fine SAND, occasional clay, Wet.						
337.5	20													SPT 8, 10, 12, 15. 24" recovered.
					Firm	CL		Dark grey CLAY, little sand, Wet.						
					Firm	SM		Black fine SAND, some medium sand, some clay, Wet.						
			SS	22					32.23	NP	35.5			
					Firm	CL		Dark grey CLAY, little sand, Wet.						
					Firm	SM		Black fine SAND, some medium sand, some clay, Wet.						
														SPT 6, 11, 17, 21. 24" recovered.
			SS	28	Firm	SM		Frequent clay seams						
					Firm	SM		Frequent clay seams.						
			ST											Shelby tube. 12" driven 0 recovered.
332.5	25													SPT 15, 19, 21, 27. 24" recovered.
			SS	40	Hard	CL		Dark grey CLAY, trace of sand, Dry.						
														SPT 10, 11, 11, 50/5". 23" recovered.
			SS	22										
					Very Hard	CL		Dark grey CLAY, frequent iron stone/ore. Rig chatter driller comments						
			ST						24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
327.5	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.5	30	⊠	ST	Hard	CL	▨	Dark grey CLAY, trace of sand, Dry. (cont.)	24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
							Bottom of Boring at 30.5 feet bgs						
322.5	35												
317.5	40												
312.5	45												
307.5	50												
302.5	55												
297.5	60												
292.5	65												

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

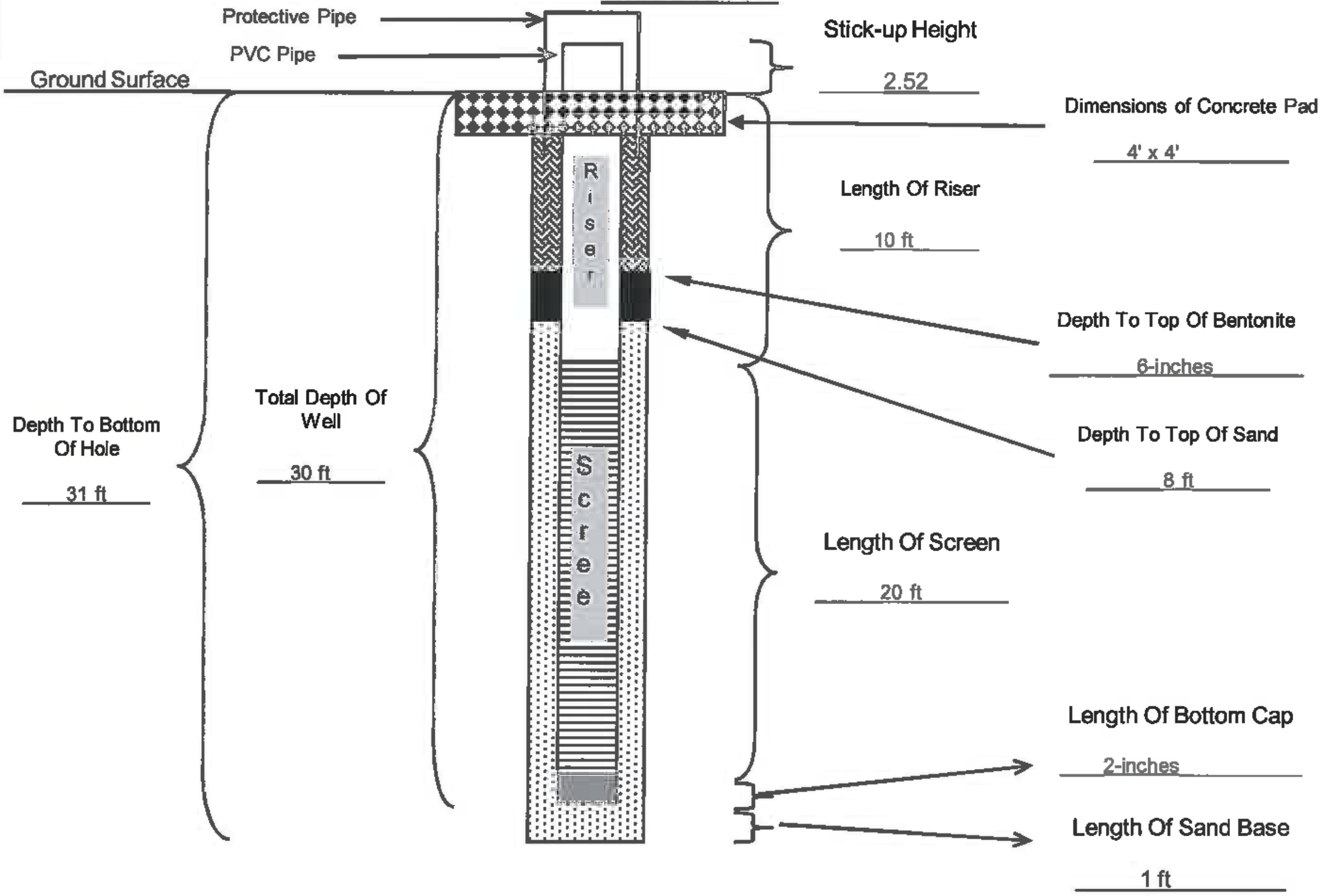
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: August 6 2009
WELL LOCATION:
WELL NO.: GB-05
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.49 (ft, msl)
TOP OF SCREEN ELEVATION: 347.49 (ft, msl)
BOTTOM OF WELL ELEVATION: 326.49 (ft, msl)
NORTHING: 529.1865 EASTING: -2243.9973
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 8 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 8 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 3 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 17.33 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.52
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Depth To Bottom Of Hole: 31 ft
Total Depth Of Well: 30 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 1 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
OBSERVED BY: Kush Chohan
DATE: 6-Aug-09
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-06

Sheet 1 of 1

Date(s) Drilled **7/23/2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.41 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube, Other**	Hammer Data **140 lb, 30 in drop, auto hammer**
Borehole Backfill **Well Completion**	Location **Northeast corner of proposed chemical pond in the middle of open grass field.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
357.4	0				Soft	SP		Greyish brown fine SAND with trace fines. Organic material (roots).						Hand Auger
			HA		Soft	SP-SM		Greyish red fine SAND, little silt. Poorly sorted, less organic material.						
					Soft	SM		Greyish red fine SAND, with little silt and clay. Dry.						
					Soft			Tanish grey fine SAND, trace silt and clay, frequent iron oxide, frequent discoloration.						SPT 4, 7, 7. 16" recovered
			SS	14	Firm	CL		Red light brown CLAY, little sand, trace silt, Dry.	12.74	34	67.9			
352.4	5													SPT 3, 5, 6, 8. 20" recovered
			SS	11	Soft	SC		Dark reddish brown fine SAND, little clay.						
					Soft	CL		Light grey CLAY, little sand, trace silt. Dry.						SPT 3, 5, 7, 7. 24" recovered
					Soft	SC		Reddish brown fine SAND, trace clay, trace silt. Occasional clay seams. Damp.						
			SS	12					17.65	NP	43.2			
					Soft	CL		Light grey CLAY, little fine sand						
			SS		Soft to Firm	SC		Brownish red fine SAND, little to some clay, some cementation, *Damp*.						24" driven, 15" recovered.
347.4	10													
			SS	19										SPT 8, 9, 10, 10. 24" recovered.
					Soft to Firm	CL		Brown CLAY, little fine sand, frequent brown sand-clay mixture with iron ore oxide.						Shelby Tube. 24" driven/16" recovered
			ST						22.9	21	43.2	6.0e-07		
342.4	15				Firm	CL		Dark redish brown CLAY, little fine sand, Damp. 8/11/09						
					Firm	SC		Dark reddish brown SAND, little to some clay, Moist.						SPT 15, 10, 22, 30. 24" recovered
			SS	40										
					Firm	CL		Black CLAY, little fine sand, Wet.						SPT 2, 8, 14, 10. 24" recovered
					Firm	SW		Black fine SAND, trace clay, trace med sand, Wet.						
			SS	22										
					Firm	CL		Black CLAY, trace fine sand, trace silt, Wet.						SPT 5, 8, 22, 50/4". 22 recovered.
						SC		Black fine SAND, little clay, Wet.						
337.4	20		SS	30	Firm	CL		Black CLAY, trace sand, trace silt. Wet.						
					Firm	SC		Black fine SAND, trace to little clay, Wet. Occasional black clay seams.						SPT 10, 11, 23, 33. 24" recovered
			SS	34										
					Firm	SP-SC		Black fine SAND, with little clay, trace med sand, Wet.						
						SW-SC		Grading to med SAND, Wet.						SPT 11, 18, 18, 24. 24" recovered.
			SS	36										
332.4	25													SPT 9, 11, 12, 22. 24" recovered.
			SS	23	Firm	SW-SC		Occasional CLAY lenses, Wet.						
					Firm	SC		Black fine SAND, little med sand and clay, Wet.						SPT 7, 15, 25, 50/3". 21 recovered.
			SS	40	Hard	CL		Dark grey CLAY, little sand, little silt, Dry.						
			ST							19	45.1			Shelby tube. 12" driven-8" recovered.
327.4	30							Bottom of Boring at 30 feet bgs						

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

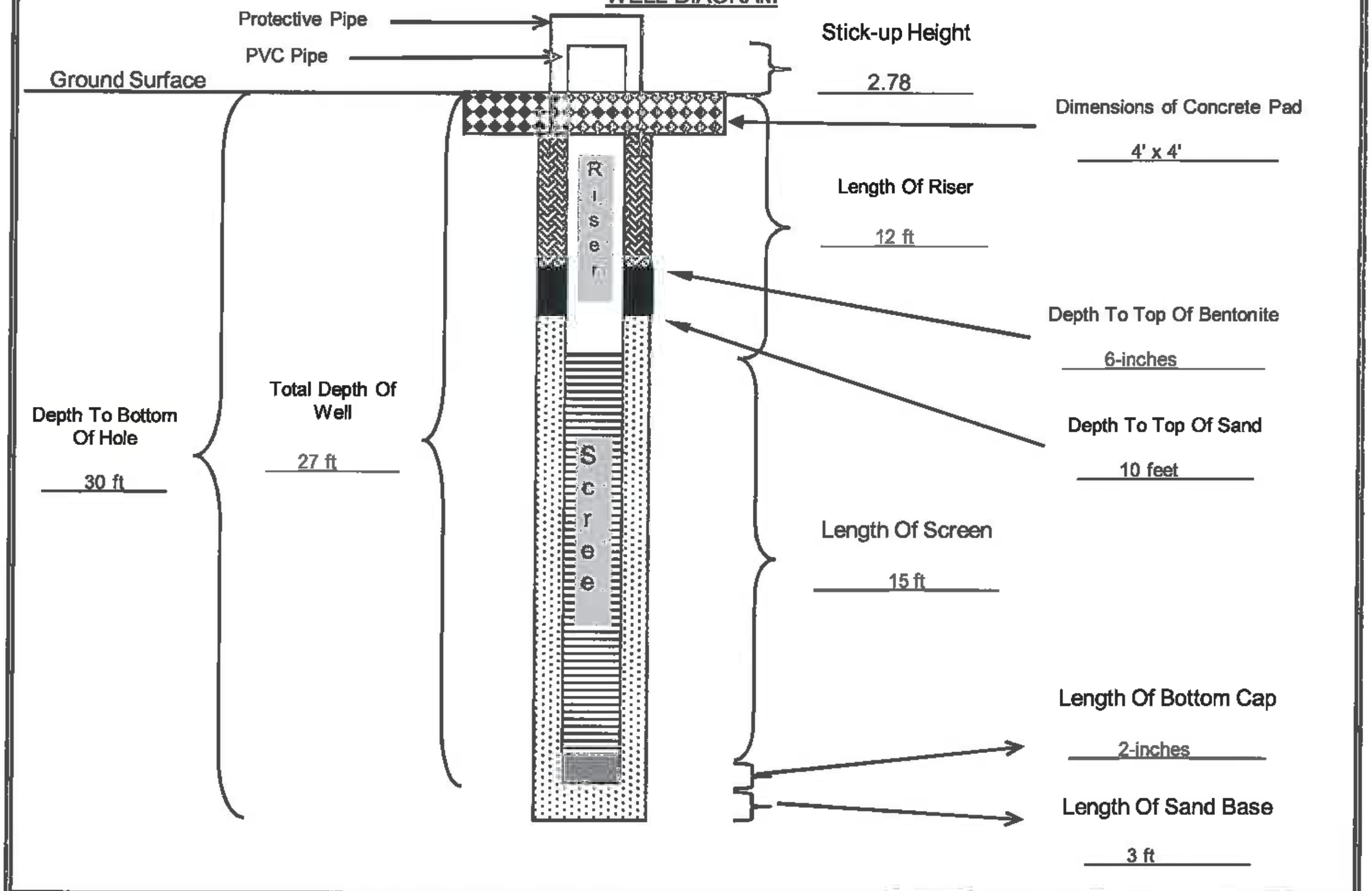
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 23-Jul-09
WELL LOCATION:
WELL NO.: **GB-06**
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.41 (ft, msl)
TOP OF SCREEN ELEVATION: 345.41 (ft, msl)
BOTTOM OF WELL ELEVATION: 327.41 (ft, msl)
NORTHING: 740.4893 EASTING: -2166.134
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 12 (ft)
SCREEN DIAMETER: 2 (in) Length: 15 (ft)
BOREHOLE DIAMETER: 6.75 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 6.75 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 2.5 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 15.3 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.78
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 12 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 10 feet
Length Of Screen: 15 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 3 ft
Depth To Bottom Of Hole: 30 ft
Total Depth Of Well: 27 ft

▨	Cement/Bentonite Grout	░	Sand Pack	◆	Neat Concrete	■	Bentonite	▒	Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: 23-Jul-09
OBSERVED BY: Kush Chohan
CHECKED BY:
DATE:

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**GB-07/MW-7**
TOTAL DEPTH:	**34'**
TOP OF CASING ELEV.:	**362.75 ft. NGVD**
GROUND SURFACE ELEV.:	**360.20 ft. NGVD**

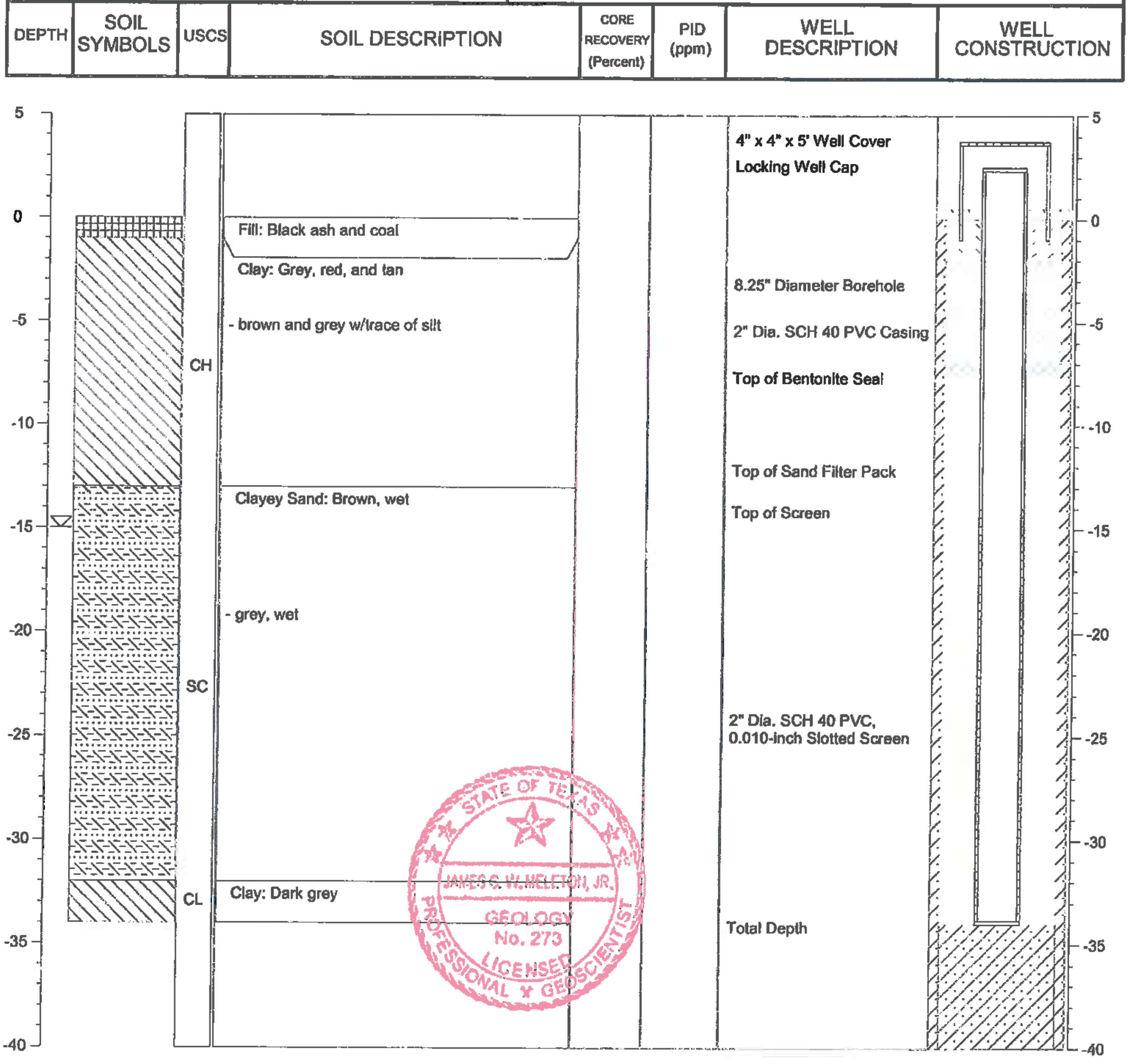
CLIENT:	**AEP**
PROJECT:	**Metal Cleaning Waste Pond**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0120**
LOGGED BY:	**James Meleton, Jr.**

DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**12/1/09**

NOTES: **Latitude: 33.05455**
Longitude: 94.84674

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED PROFESSIONAL GEOSCIENTIST

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-1

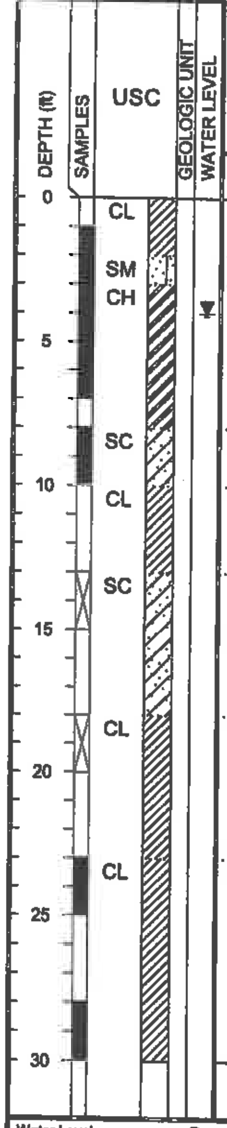
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

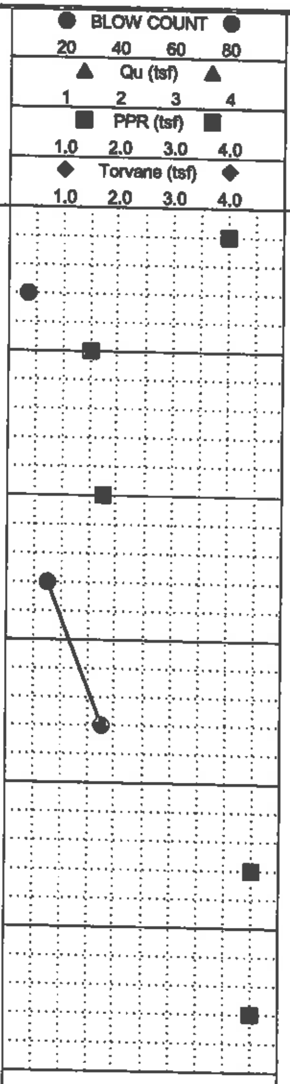
BORING TYPE: Flight Auger

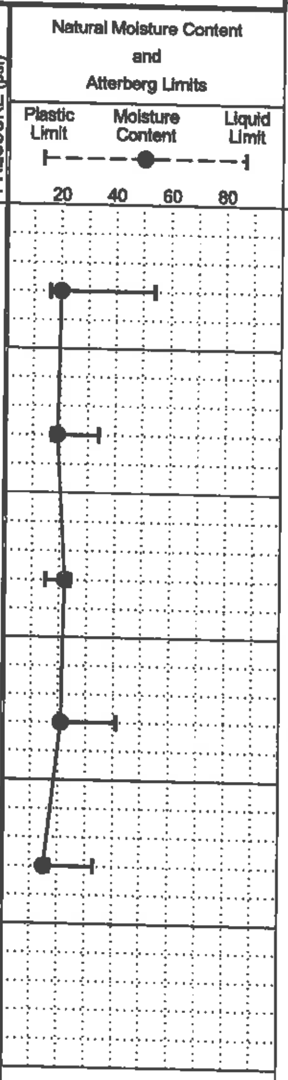
DATE 10/27/09

SURFACE ELEVATION 324.1



USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL		SANDY LEAN CLAY(CL) very stiff; brownish orange	P=4.0 SF										
SM		SILTY SAND(SM) tannish orange	N=7										
CH	▼	SANDY FAT CLAY(CH) medium stiff; tannish orange						20	54	16	38	63	+40Sieve=10%, +4 Sieve=1%
		–stiff	P=1.5										
SC		CLAYEY SAND(SC) medium dense; tannish orange; with clay seams	P=1.75					19	34	17	17	32	+40 Sieve=7%, +4 Sieve=3%
CL		SANDY LEAN CLAY(CL) stiff; orange											
SC		CLAYEY SAND(SC) medium dense; orange; saturated; with iron oxide cemented sandstone rock	N=15					22	24	15	9	19	+40Sieve=35%, +4 Sieve=22%
CL		LEAN CLAY WITH SAND(CL) hard; dark gray; with clay seams	N=35					21	41	21	20	75	+40 Sieve=2%, +4 Sieve=0%
CL		SANDY LEAN CLAY(CL) hard; dark brown	P=4.5+					15	33	17	16	52	+40 Sieve=1%, +4 Sieve=0%
		–grayish brown; laminated with silt	P=4.5+										
		Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 5' while drilling. Water level @ 4' and open to 30' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.090', W 94°50.417'

Piezometer B-2

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

PROJECT: Welsh Power Plant
Pittsburgh, Texas

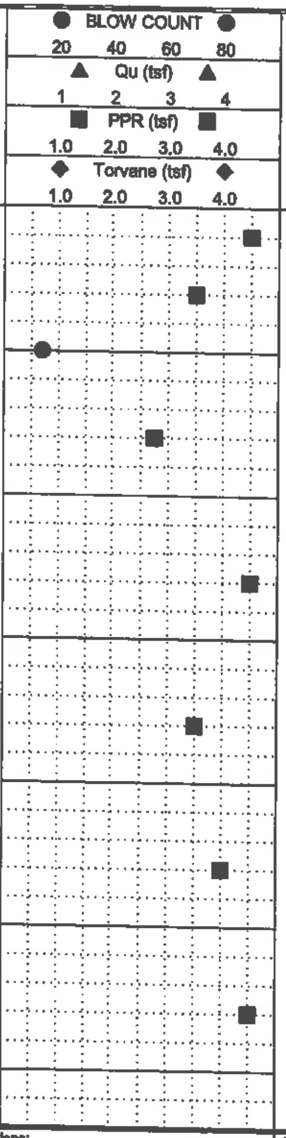
PROJECT NO.: G3242-09

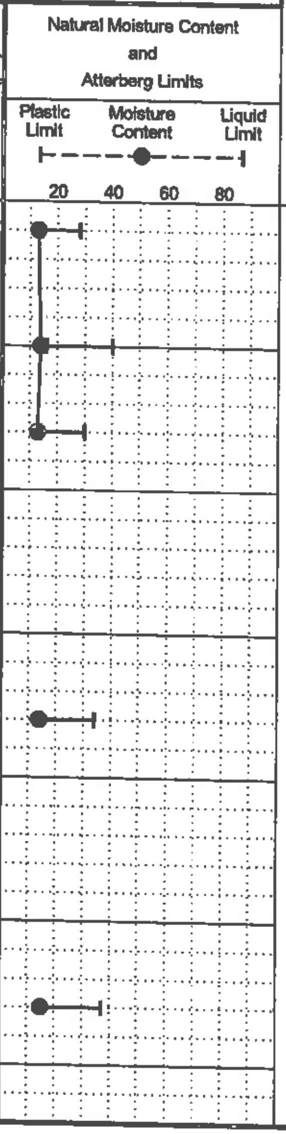
BORING TYPE: Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+					13	28	14	14	61	+40 Sieve=3%, +4 Sieve=0%
		–very stiff	P=3.5										
5		–stiff	N=14					14	40	16	24	65	+40 Sieve=0%, +4 Sieve=0%
		–very stiff; reddish brown	P=2.75					13	30	14	16	58	+40 Sieve=0%, +4 Sieve=0%
10													
	CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+										
15													
		–very stiff	P=3.5					14	34	15	19	54	+40 Sieve=0%, +4 Sieve=0%
20													
			P=4.0										
25													
	SC	CLAYEY SAND(SC) medium dense; tan, red, and gray	P=4.5					15	37	16	21	47	+40 Sieve=5%, +4 Sieve=3%
30													





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

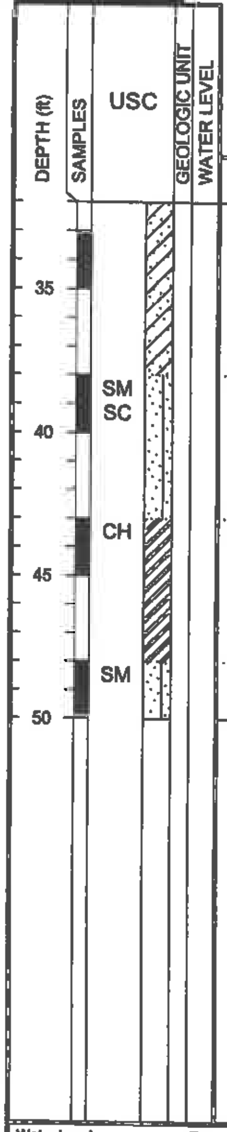
PROJECT: Welsh Power Plant
Pittsburgh, Texas

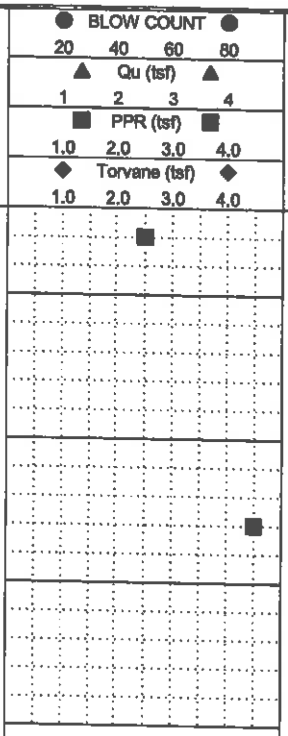
PROJECT NO.: G3242-09

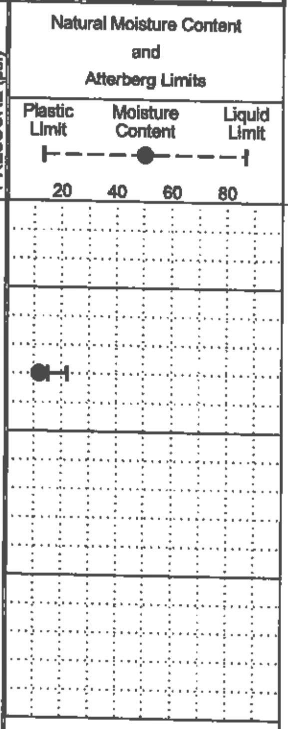
BORING TYPE: Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	--red and tan	P=2.5										
SM SC	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated	SF					12	22	15	7	48	+40 Sieve=0%, +4 Sieve=0%
CH	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams	P=4.5+										
SM	SILTY SAND(SM) black and gray	SF										

Bottom of Boring @ 50'

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

Piezometer B-2

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-2

Location Pittsburg, Texas

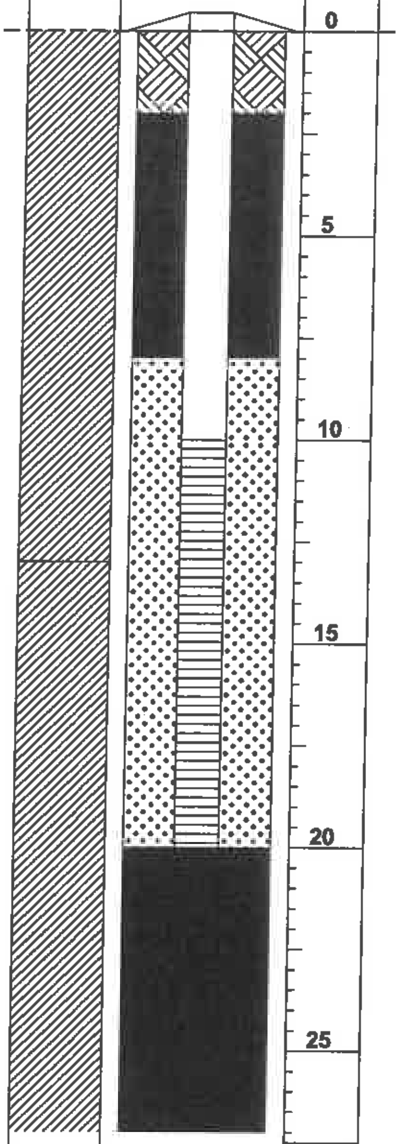
Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description
0		Ground Surface
		SANDY LEAN CLAY(CL) hard; red and tan
		–very stiff
5		–stiff
		–very stiff; reddish brown
10		
		SANDY LEAN CLAY(CL) hard; red and tan
15		
		–very stiff
20		
25		

Field Strength Data | **Graphic Log** | **Well Construction Graphics** | **Depth Feet** | **Well Construction Details**

T.O.C. Elev.



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/28/09

Drilling Completed 10/28/09

Construction Completed ____

Development Completed ____

Type of Well ____

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-8' & 20-50'

Filter Pack Qty. 8-20'

Filter Pack Type 20/40 Sand

Static Water Level ____

Notes: ____

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

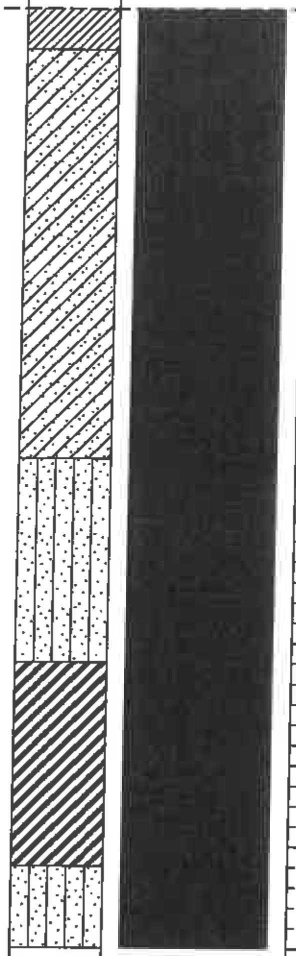
Well No. B-2

Location Pittsburg, Texas

Surface Elev.

Page 2 of 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
	CLAYEY SAND(SC) medium dense; tan, red, and gray					
30					30	
	--red and tan					
35					35	
	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated					
40					40	
	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams					
45					45	
	SILTY SAND(SM) black and gray					
50					50	
	Bottom of Boring @ 50'					
55						
60						



ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

PROJECT: Welsh Power Plant
Pittsburgh, Texas

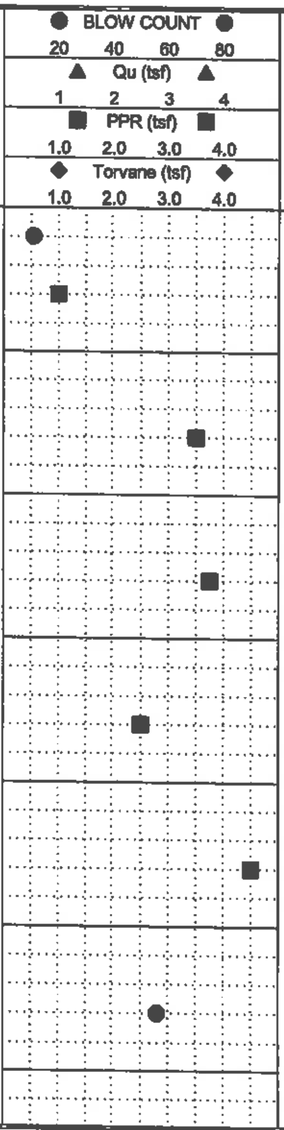
PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

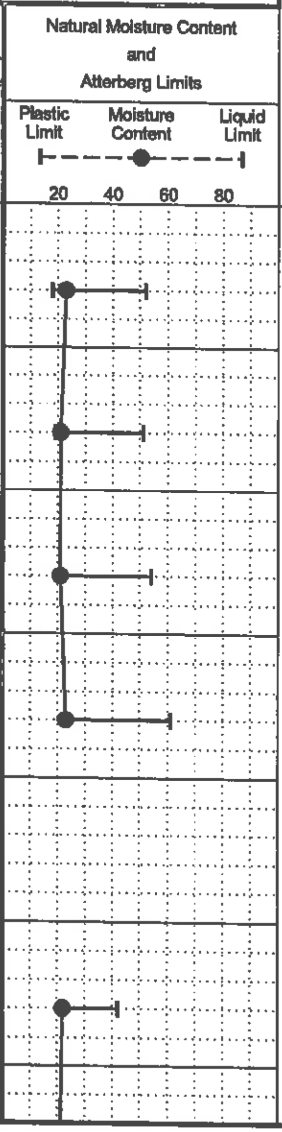
DATE 10/27/09

SURFACE ELEVATION 339.6

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	CLAYEY SAND(SC) medium dense; gray and red	N=11						
CH	FAT CLAY(CH) stiff; red and tan; with sand seams	P=1.0	23	52	18	34	87	+40 Sieve=3%, +4 Sieve=0%
	–very stiff	P=3.5	21	51	19	32	86	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) very stiff; brown; with ferric joints	P=3.75	21	54	20	34	85	+40Sieve=10%, +4 Sieve=1%
	–red and tan; layered; with ferric seams	P=2.5	23	61	24	37	81	+40Sieve=11%, +4 Sieve=0%
CH	FAT CLAY(CH) hard; gray; with sand seams	P=4.5+						
SC	CLAYEY SAND(SC) very dense; gray; with sand seams	N=56	22	42	22	20	35	+40 Sieve=1%, +4 Sieve=0%



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



DEPTH (ft): 0, 5, 10, 15, 20, 25, 30

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	CH	FAT CLAY(CH) hard; brown; layered and with sand seams	P=4.5+					21	60	24	36	95	+40 Sieve=1%, +4 Sieve=0%
40		--gray and green	P=4.5+										
45	CL	SANDY LEAN CLAY(CL) very stiff; gray and dark green; layered; with sand seams	P=3.5										
50	CH	FAT CLAY(CH) hard; gray and dark green; layered; with silt seams	P=4.5+										
		Bottom of Boring @ 50'											

● BLOW COUNT ● 20 40 60 80
▲ Qu (tsf) ▲ 1 2 3 4
■ PPR (tsf) ■ 1.0 2.0 3.0 4.0
◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits
Plastic Limit ⊢ - - - ● - - - ⊣ Liquid Limit; Moisture Content
20 40 60 80

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

Piezometer B-4

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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

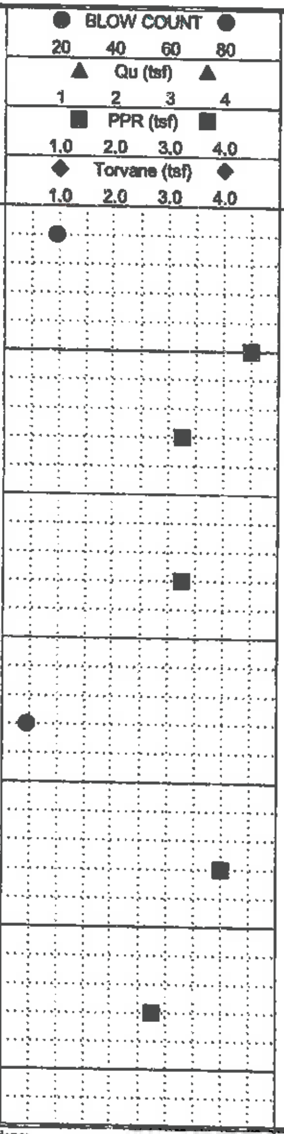
PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

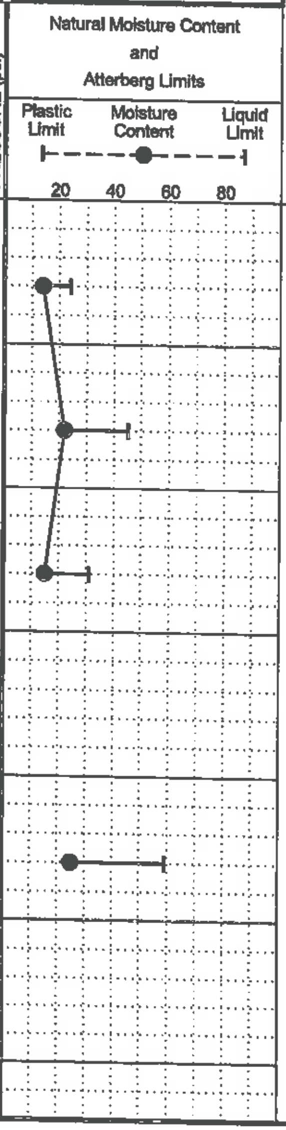
DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	SM	SILTY SAND(SM) medium dense; tan; with gravel	N=19						
	CL	SANDY LEAN CLAY(CL) dark brown							
5		—tannish orange	SF	14	24	15	9	59	+40 Sieve=1%, +4 Sieve=0%
		—hard; orangish tan	P=4.5						
			P=3.25	22	45	21	24	94	+40 Sieve=2%, +4 Sieve=0%
10		—very stiff; white							
	SC	CLAYEY SAND(SC) medium dense; tan —orangish gray; with sand seams	P=3.25	15	31	15	16	40	+40 Sieve=1%, +4 Sieve=0%
15									
	CL	SANDY LEAN CLAY(CL) stiff; orangish tan	N=9						
20									
	CH	FAT CLAY(CH) very stiff; orangish tan; with ferric seams	P=4.0	25	59	24	35	88	+40 Sieve=4%, +4 Sieve=0%
25									
		—tannish brown; with iron ore seams	P=2.75						
30									



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

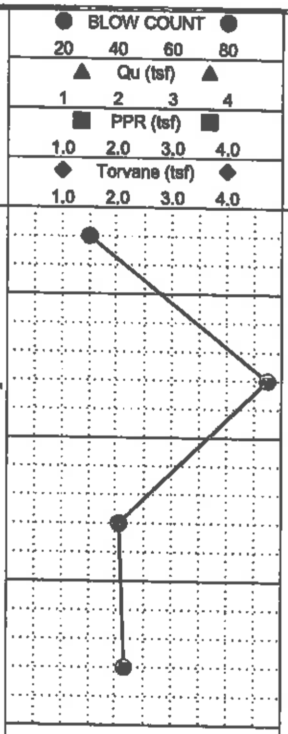
PROJECT NO.: G3242-09

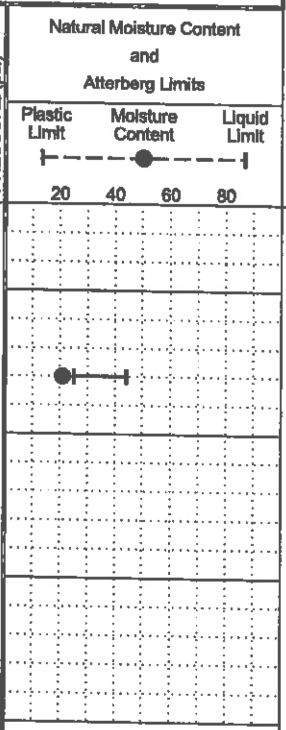
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
33-35	☒	CL			–hard; light gray; layered and with silt seams	N=30										
38-40	☒	CL			LEAN CLAY(CL) hard; light gray; layered and with silt seams	N=50/5.75"					21	44	25	19	93	+40 Sieve=1%, +4 Sieve=0%
43-45	☒				–light gray	N=41										
48-50	☒				–layered and with sand seams; with lignite	N=43										
50					Bottom of Boring @ 50'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

Piezometer B-4

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

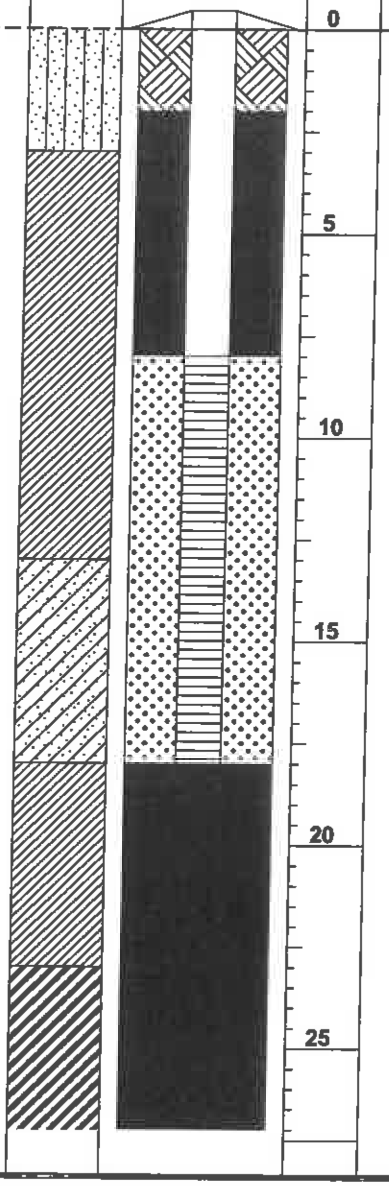
Well No. B-4

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		SILTY SAND(SM) medium dense; tan; with gravel					
		SANDY LEAN CLAY(CL) dark brown					
		--tannish orange					
5		--hard; orangish tan				5	
10		--very stiff; white				10	
		CLAYEY SAND(SC) medium dense; tan					
15		--orangish gray; with sand seams				15	
		SANDY LEAN CLAY(CL) stiff; orangish tan					
20						20	
		FAT CLAY(CH) very stiff; orangish tan; with ferric seams					
25						25	



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed ______

Development Completed ______

Type of Well ______

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 8.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 8.0' **to** 18.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-8' & 18-50'

Filter Pack Qty. 6-18'

Filter Pack Type 20/40 Sand

Static Water Level ______

Notes: ______

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

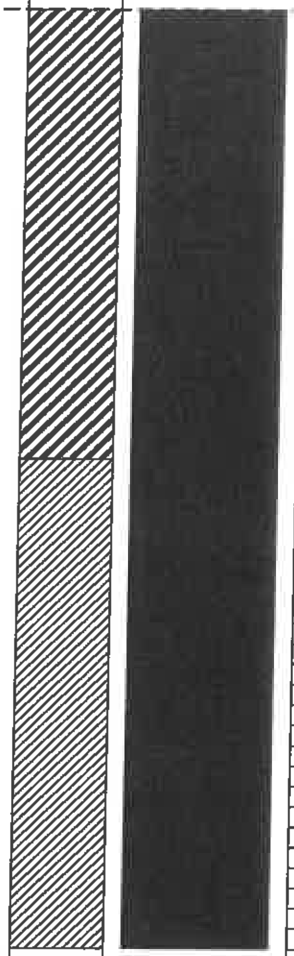
Well No. B-4

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		--tannish brown; with iron ore seams					
30						30	
		--hard; light gray; layered and with silt seams					
35						35	
		LEAN CLAY(CL) hard; light gray; layered and with silt seams					
40						40	
		--light gray					
45						45	
		--layered and with sand seams; with lignite					
50						50	
		Bottom of Boring @ 50'					
55							
60							



ETTL Engineers & Consultants Inc.

Piezometer B-5

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

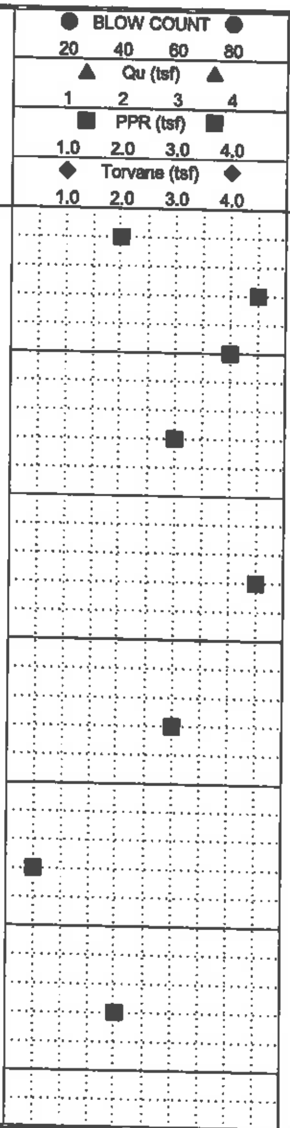
BORING TYPE: Flight Auger

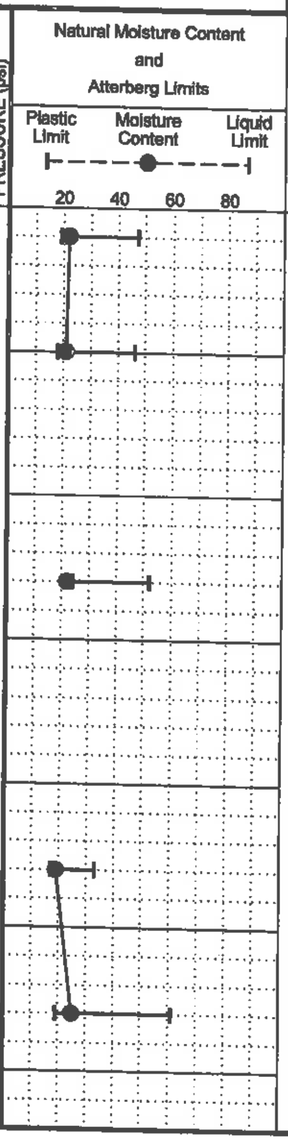
DATE 10/27/09

SURFACE ELEVATION 340.0

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	LEAN CLAY WITH SAND(CL) stiff; red and tan	P=2.0	22	47	19	28	81	+40 Sieve=9%, +4 Sieve=3%
	CL	LEAN CLAY(CL) hard; red and tan	P=4.5+						
5		–very stiff	P=4.0	21	46	18	28	94	+40 Sieve=3%, +4 Sieve=0%
	CH	FAT CLAY(CL) very stiff; brown and tan	P=3.0						
10									
	CH	FAT CLAY WITH SAND(CH) hard; red and tan	P=4.5+	22	52	24	28	88	+40 Sieve=3%, +4 Sieve=0%
15									
	CL	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams	P=3.0						
20									
	SC	CLAYEY SAND(SC) very loose; tan, red, and gray	P=0.5	19	33	17	16	44	+40 Sieve=1%, +4 Sieve=0%
25									
	CH	FAT CLAY WITH SAND(CH) stiff; red and gray	P=2.0	25	61	19	42	83	+40 Sieve=5%, +4 Sieve=3%
30									

DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

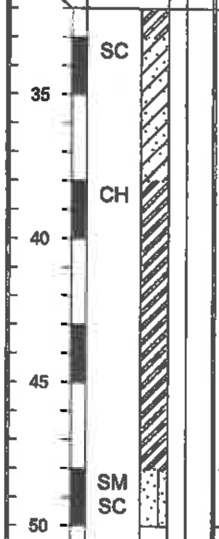
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

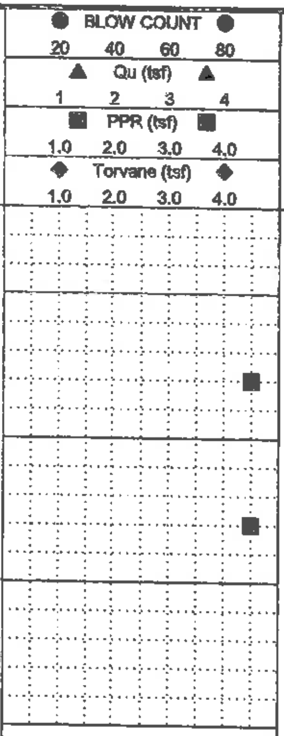
BORING TYPE: Flight Auger

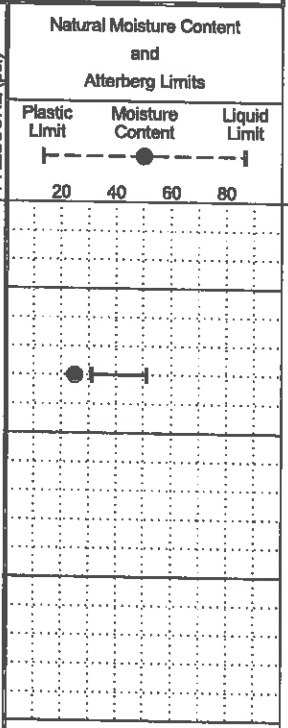
DATE 10/27/09

SURFACE ELEVATION 340.0



DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	SC	SILTY CLAYEY SAND(SC) gray and red; saturated	SF										
40	CH	FAT CLAY(CH) hard; red and gray; with sand seams	P=4.5+					25	51	31	20	87	+40 Sieve=6%, +4 Sieve=0%
45		–gray, tan, and red; with sand seams	P=4.5+										
	SM SC	SILTY SAND(SM-SC) red and gray	SF										
50		Bottom of Boring @ 50'											





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

Pezometer P-5

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-5

Location Pittsburg, Texas

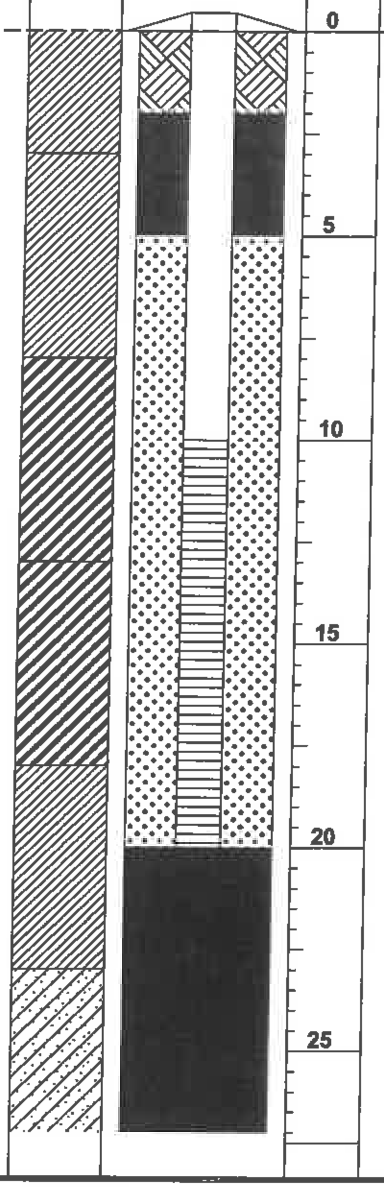
Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description
0		Ground Surface
		LEAN CLAY WITH SAND(CL) stiff; red and tan
		LEAN CLAY(CL) hard; red and tan
5		--very stiff
		FAT CLAY(CL) very stiff; brown and tan
10		
		FAT CLAY WITH SAND(CH) hard; red and tan
15		
		SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams
20		
		CLAYEY SAND(SC) very loose; tan, red, and gray
25		

Continued Next Page

Field Strength Data | **Graphic Log** | **Well Construction Graphics** | **Depth Feet** | **Well Construction Details**



T.O.C. Elev.

Driller Doug Hinds	**Drilling Method** Soild Stem Auger	**Bentonite Seal** 2-5' & 20-50'
Logged By James Griffith	**Borehole Diameter** 6.5"	**Filter Pack Qty.** 5-20'
Drilling Started 10/27/09	**Well Casing** 2.0" **Dia.** 0.0' **to** 10.0'	**Filter Pack Type** 20/40 Sand
Drilling Completed 10/27/09	**Casing Type** PVC	**Static Water Level**
Construction Completed	**Well Screen** 2.0" **Dia.** 10.0' **to** 20.0'	
Development Completed	**Screen Type** Slotted	**Notes:**
Type of Well	**Slot Size** 0.010"	
	Grout Type Bentonite	

ETTL Engineers & Consultants Inc.

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

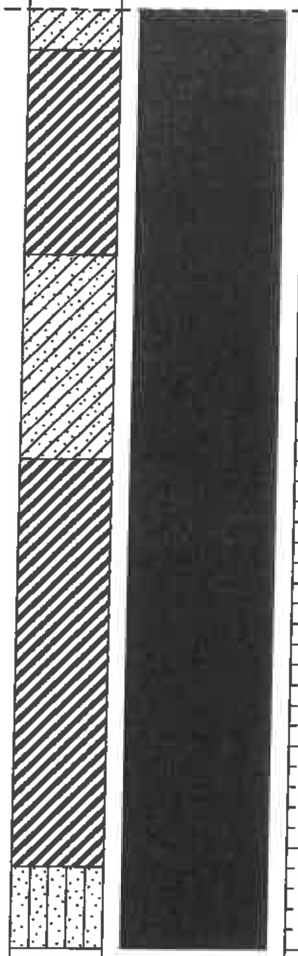
Well No. B-5

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		FAT CLAY WITH SAND(CH) stiff; red and gray					
30						30	
		SILTY CLAYEY SAND(SC) gray and red; saturated					
35						35	
		FAT CLAY(CH) hard; red and gray; with sand seams					
40						40	
		–gray, tan, and red; with sand seams					
45						45	
		SILTY SAND(SM-SC) red and gray					
50						50	
		Bottom of Boring @ 50'					
55							
60							



Piezometer B-6

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

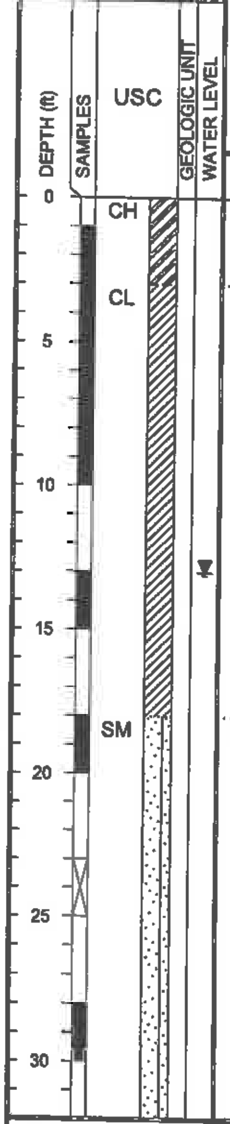
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

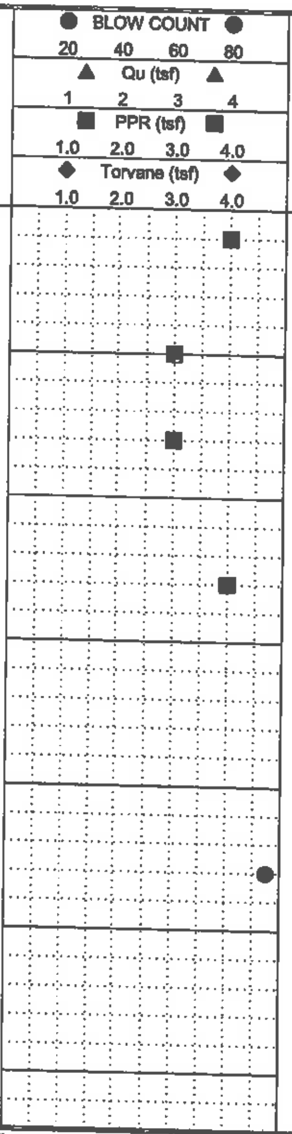
BORING TYPE: Flight Auger

DATE 10/27/09

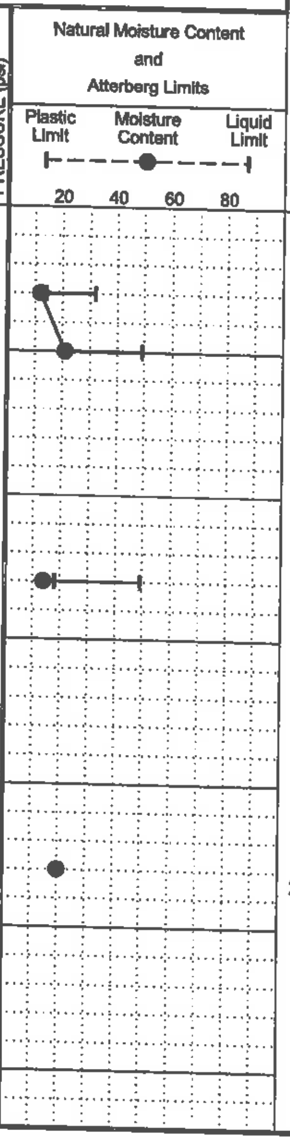
SURFACE ELEVATION 340.1



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY(CH) very stiff; red and gray; with ferric seams	P=4.0						
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+						
			12	32	14	18	60	+40 Sieve=0%, +4 Sieve=0%
		P=3.0	21	49	20	29	93	+40 Sieve=2%, +4 Sieve=0%
	–very stiff; red, gray, and brown; with gravel –with sand seams	P=3.0						
		P=4.0	14	49	18	31	65	+40 Sieve=0%, +4 Sieve=0%
SM	SILTY SAND(SM) gray; saturated	P=3.0						
	–very dense; gray and red	N=50/5.25"	20				18	+40 Sieve=0%, +4 Sieve=0%
		SF						



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1

Legend: ● BLOW COUNT ● 20 40 60 80; ▲ Qu (tsf) ▲ 1 2 3 4; ■ PPR (tsf) ■ 1.0 2.0 3.0 4.0; ◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits: Plastic Limit ├ – – – ● – – – ┤ Liquid Limit, Moisture Content; 20 40 60 80

DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35		CH			FAT CLAY(CH) hard; brown; with sand seams	P=4.5+										
40						P=4.5+					22	68	24	44	95	+40 Sieve=0%, +4 Sieve=0%
45					--dark green	P=4.5+										
50		CL			LEAN CLAY(CL) hard; dark green; laminated with lignite	P=4.5+										
					Bottom of Boring @ 50'											

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

Piezometer B-6

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

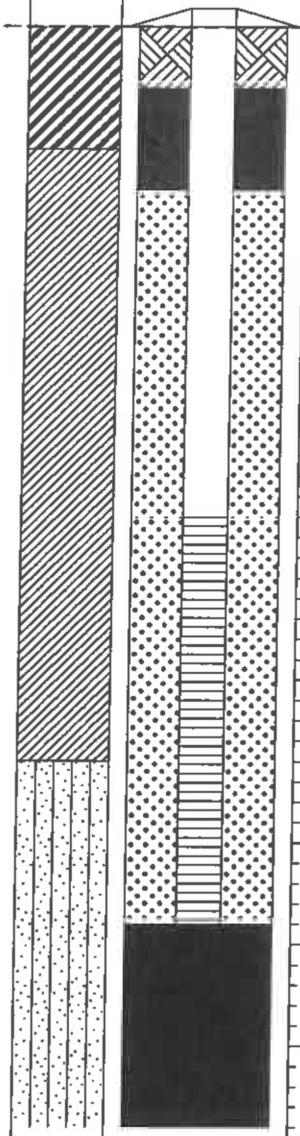
Well No. B-6

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		FAT CLAY(CH) very stiff; red and gray; with ferric seams					
		SANDY LEAN CLAY(CL) hard; red and tan					
5						5	
		–very stiff; red, gray, and brown; with gravel					
		–with sand seams					
10						10	
15						15	
		SILTY SAND(SM) gray; saturated					
20						20	
		–very dense; gray and red					
25						25	



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/28/09

Drilling Completed 10/28/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 12.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 12.0' **to** 22.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 1.5-4' & 22-50'

Filter Pack Qty. 4-22'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ETTL Engineers & Consultants Inc.

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

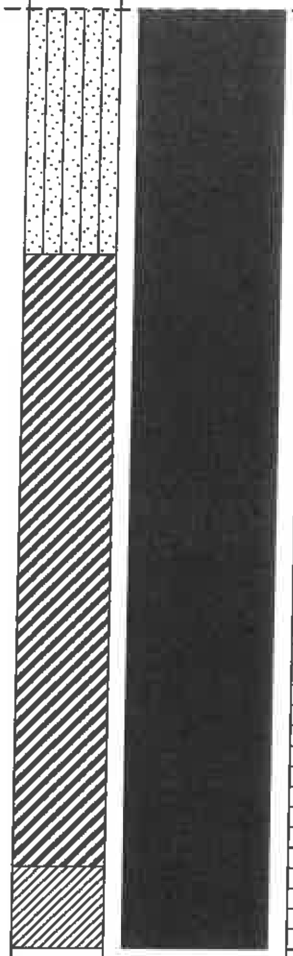
Well No. B-6

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
30					30	
	FAT CLAY(CH) hard; brown; with sand seams					
35					35	
40					40	
	–dark green					
45					45	
	LEAN CLAY(CL) hard; dark green; laminated with lignite					
50					50	
	Bottom of Boring @ 50'					
55						
60						



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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-7

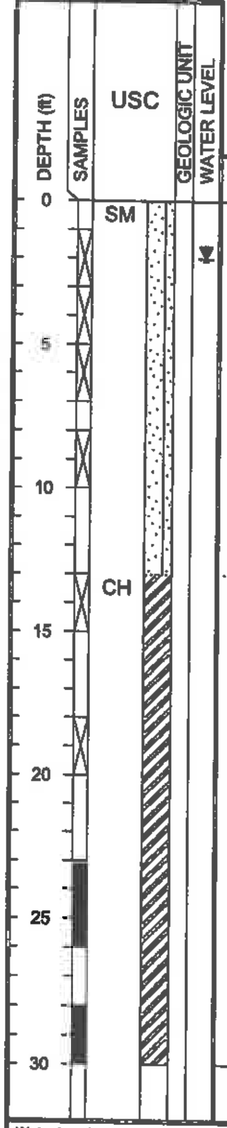
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

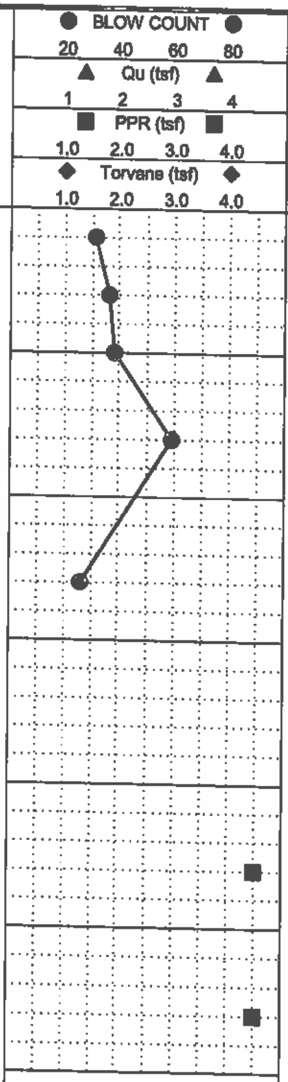
BORING TYPE: Flight Auger

DATE 10/27/09

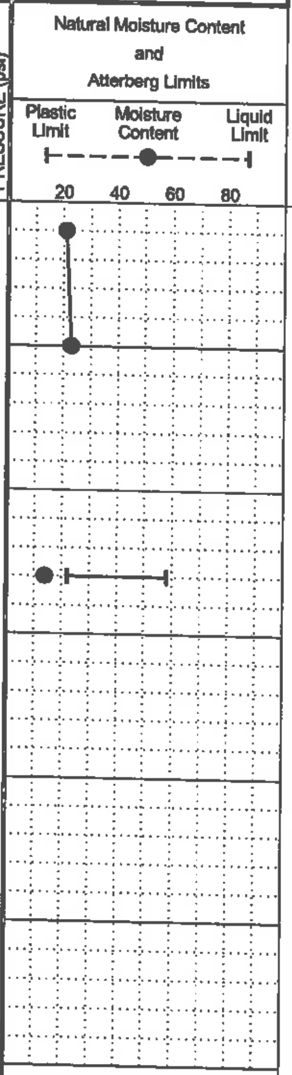
SURFACE ELEVATION 340.4



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SILTY SAND(SM) dense; tan	N=31	21				21	+40 Sieve=0%, +4 Sieve=0%
	N=36						
--gray; saturated	N=38	23				15	+40 Sieve=0%, +4 Sieve=0%
--very dense	N=59						
FAT CLAY(CH) very stiff; dark gray; with silt and ferric seams	N=26	14	58	22	36	98	+40 Sieve=0%, +4 Sieve=0%
--hard; gray and black; with trace of lignite	P=4.5+						
--gray	P=4.5+						
Bottom of Boring @ 30'							



DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 4' while drilling. Water level @ 2' and open to 7' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.898', W 94°50.519'

Landfill Boring B-2

ETTL
ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

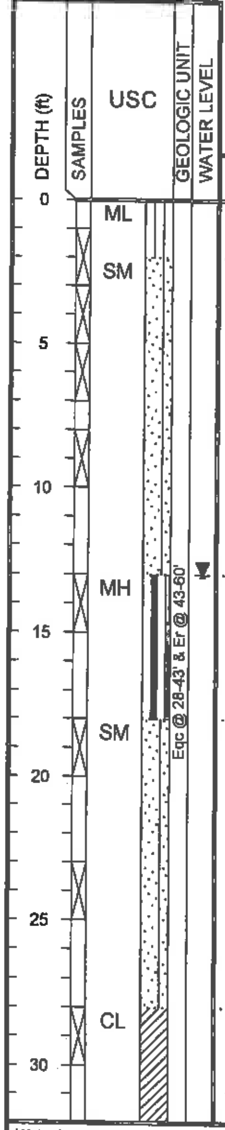
PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

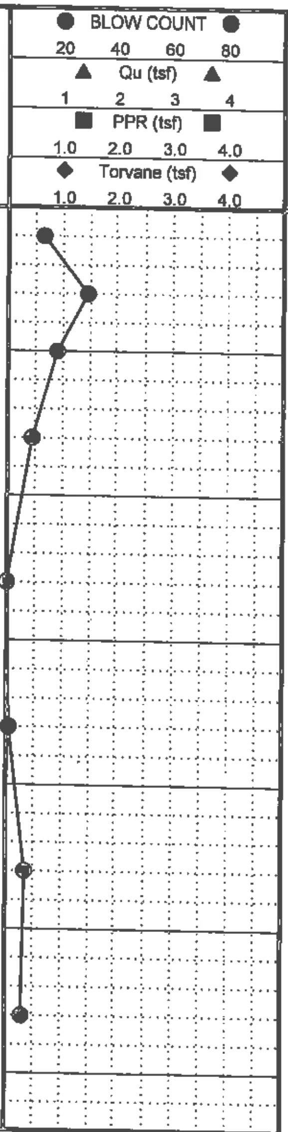
BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14

SURFACE ELEVATION 373.8



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
ML	ASH (SILT WITH GRAVEL(ML)) medium dense; light grayish brown; with coarse-grained sand and lightly cemented gravel pieces; dry	N=13	46				59	+40 Sieve=27% +4 Sieve=16%
SM		N=29						
	ASH (SILTY SAND(SM)) medium dense; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces	N=18						
	--loose; moist	N=9	40				40	+40 Sieve=19% +4 Sieve=2%
MH	ASH (ELASTIC SILT(MH)) very loose; black; with fine-grained sand and lightly cemented gravel pieces; saturated	N=0	200	134	92	42	100	+40 Sieve=0% +4 Sieve=0%
SM	ASH (SILTY SAND(SM)) very loose; dark brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=1						
	--loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7	91				61	+40 Sieve=11% +4 Sieve=1%
CL	SANDY LEAN CLAY(CL) medium stiff; dark brown and black; with fine-grained sand and cemented gravel pieces; saturated	N=6	18	30	15	15	63	+40 Sieve=1% +4 Sieve=0%

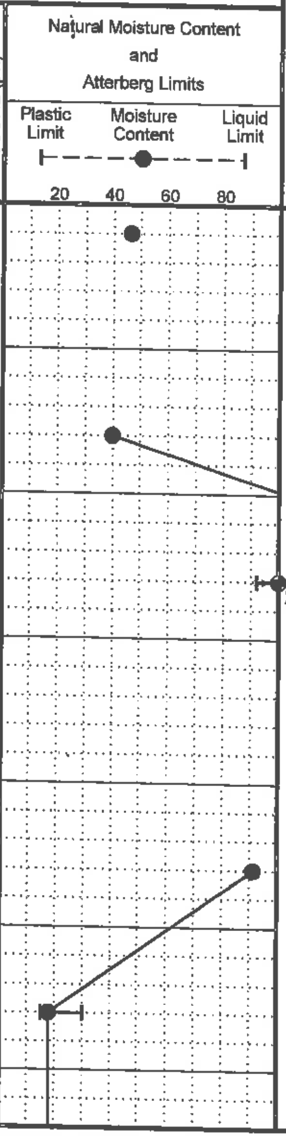


DRY DENSITY (pcf)

COMPRESSIVE STRENGTH (tsf)

FAILURE STRAIN (%)

CONFINING PRESSURE (psi)



Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbrevations:
- N - SPT Data (Blows/Ft)
- P - Pocket Penetrometer (tsf)
- T - Torvane (tsf)
- L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

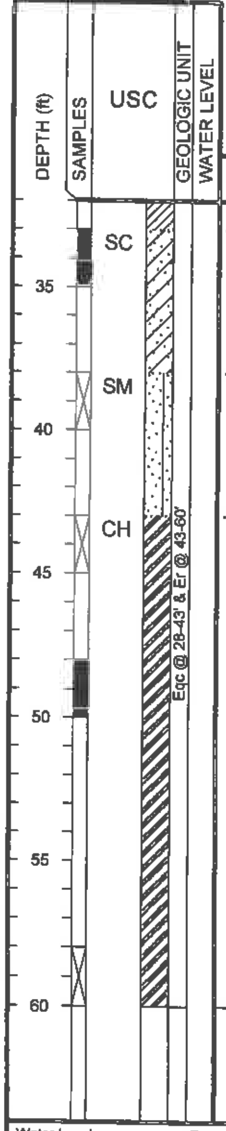
PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

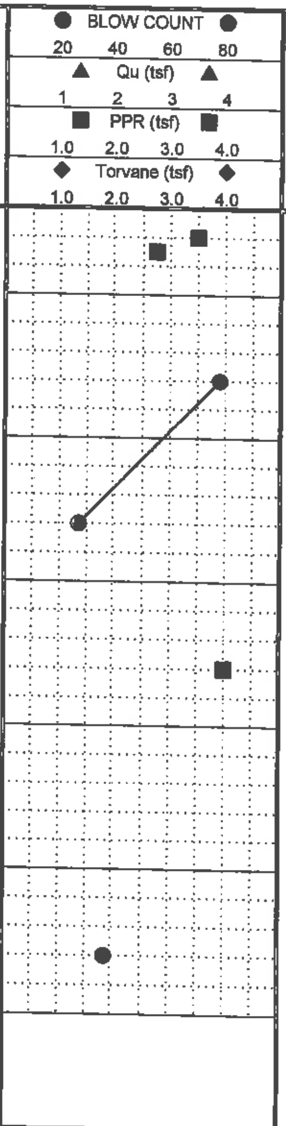
BORING TYPE: Rotary Wash/Flight Auger

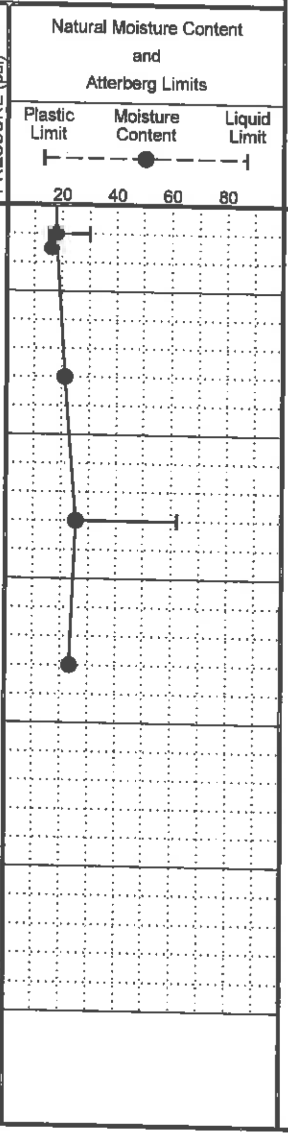
DATE 10/8/14

SURFACE ELEVATION 373.8



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	CLAYEY SAND(SC) dense; light brown, light gray and reddish brown; moist; with fine-grained sand; mottled	P=3.5 P=2.75	110	1.39	4.3	21	18 16	30	15	15	39	+40 Sieve=0% +4 Sieve=0%
SM	SILTY SAND(SM) very dense; light brown, yellowish brown and light gray; moist; mottled; with fine-grained sand	N=78					21				24	+40 Sieve=0% +4 Sieve=0%
CH	FAT CLAY(CH) very stiff; dark brown and light brown; moist; with sand seams; laminated	N=27					25	62	26	36	96	+40 Sieve=2% +4 Sieve=0%
	--dark brown with light gray; moist; with silt seams	P=4.0	98				24					
	--hard; dark brown; moist	N=37										
	Bottom of Boring @ 60'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill boring B-10

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

BORING TYPE: Rotary Wash/Flight Auger

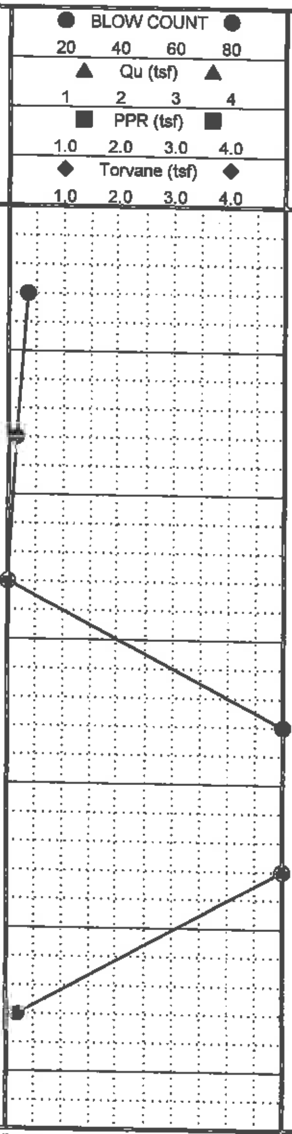
DATE 10/8/14

SURFACE ELEVATION 373.2

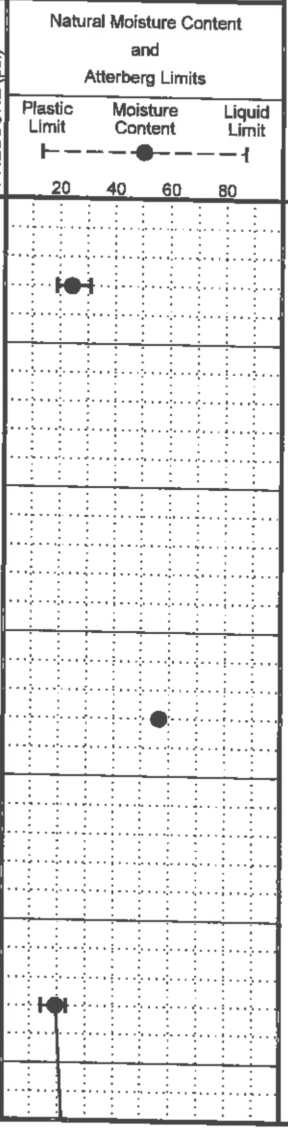
GEOLOGIC UNIT: Egc @ 27-43' & Er @ 43-60'

WATER LEVEL: ∇ at approx. 13'

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	ASH (CLAYEY SAND(SC)) loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7	24	31	19	12	41	+40 Sieve=21% +4 Sieve=11%
MH	ASH (ELASTIC SILT(MH)) very loose; black; moist	N=3						
	--wet	N=0						
SM	ASH (SILTY SAND WITH GRAVEL(SM)) very dense; light brown and dark brown; with lightly cemented gravel pieces and coarse-grained sand; moist; cemented layer from 17.5' to 21'	N=50/1"	56				14	+40 Sieve=71% +4 Sieve=28%
	--cemented layer from 23' to 27'	N=50/4"						
CL	SANDY LEAN CLAY(CL) medium stiff; grayish brown and yellowish brown; saturated; mottled	N=4	19	23	14	9	57	+40 Sieve=1% +4 Sieve=0%



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



DEPTH (ft): 0, 5, 10, 15, 20, 25, 30

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

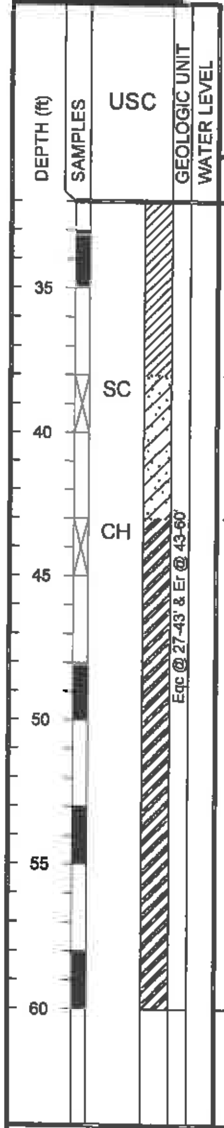
PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

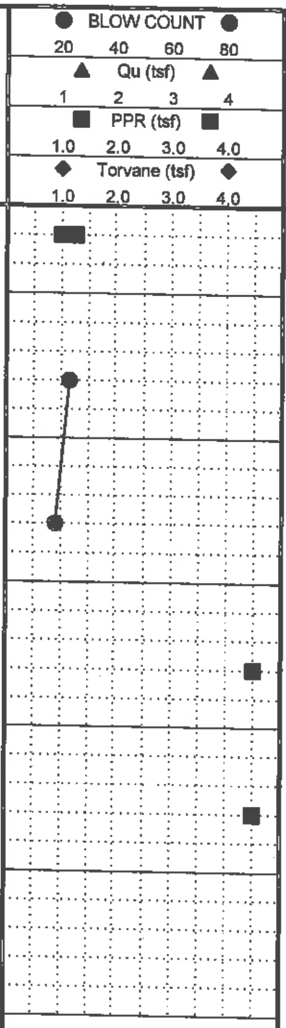
BORING TYPE: Rotary Wash/Flight Auger

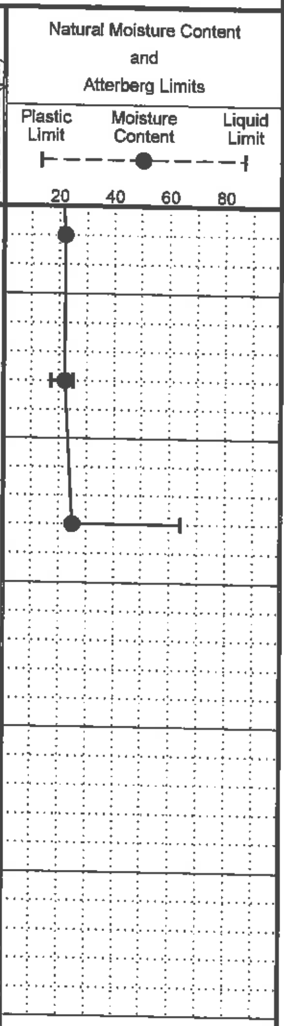
DATE 10/8/14

SURFACE ELEVATION 373.2



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	P=1.25 P=1.0	107	2.10	6.1	21	22					
CLAYEY SAND(SC) medium dense; reddish brown and grayish brown; moist; mottled	N=23					22	25	17	8	27	+40 Sieve=3% +4 Sieve=0%
FAT CLAY(CH) very stiff; dark brown with light gray; with silt seams; moist	N=18					25	64	24	40	90	+40 Sieve=7% +4 Sieve=0%
--hard	P=4.5+										
	P=4.5+										
Bottom of Boring @ 60'											





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill Boring B-12

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-12

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

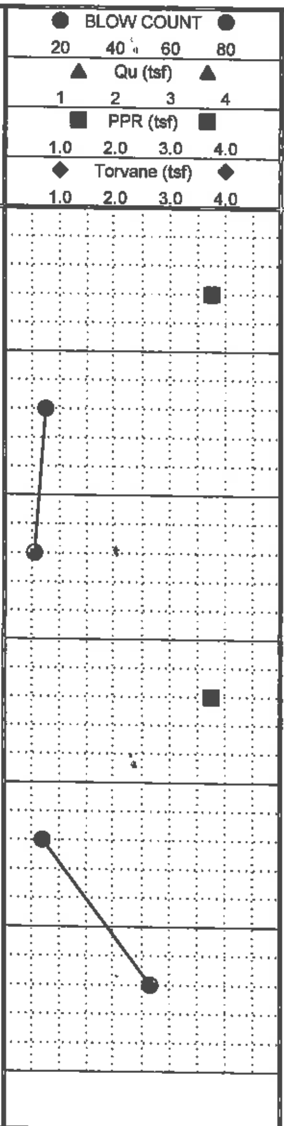
PROJECT NO.: G4207-146

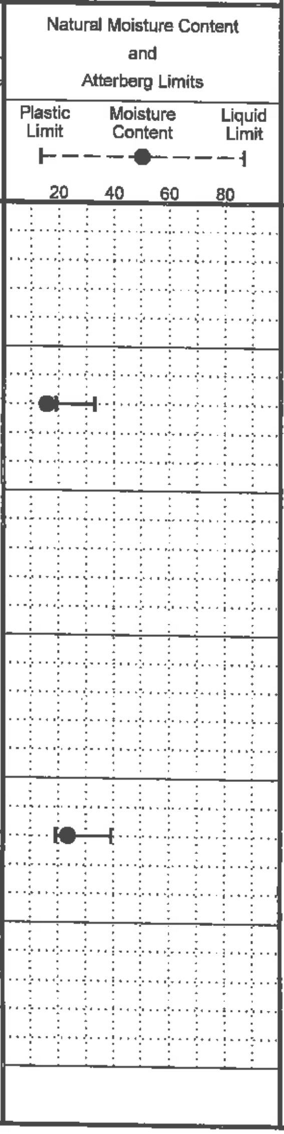
DRILL RIG:

BORING TYPE: Flight Auger

DATE 10/15/14

SURFACE ELEVATION 361.7





DEPTH (ft)	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	Egc		LEAN CLAY WITH SAND(CL) stiff; light gray and reddish brown; moist; mottled	P=3.75										
5	CL			SANDY LEAN CLAY(CL) stiff; light brown, light gray and reddish brown; moist; mottled	N=15					16	33	19	14	58	+40 Sieve=1% +4 Sieve=0%
10				--grayish brown and brown; moist	N=11										
15	CH			FAT CLAY WITH SAND(CH) stiff; light gray and reddish brown; moist; mottled; with ferric seams	P=3.75										
20					N=14					24	39	19	20	93	+40 Sieve=1% +4 Sieve=0%
25	CL		▼	LEAN CLAY(CL) stiff; light gray and brownish gray; moist; layered with silt											
30	ML			SILT WITH SAND(ML) very dense; light brown and yellowish brown; moist; with clay seams	N=53										
				Bottom of Boring @ 30'											

Water Level Est.: ▽ Measured: ▼ Perched: ▽

Water Observations: Water level @ 27' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04713°, W94.84486°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Land RU Boring B-13

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-13

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

DRILL RIG:

PROJECT NO.: G4207-146

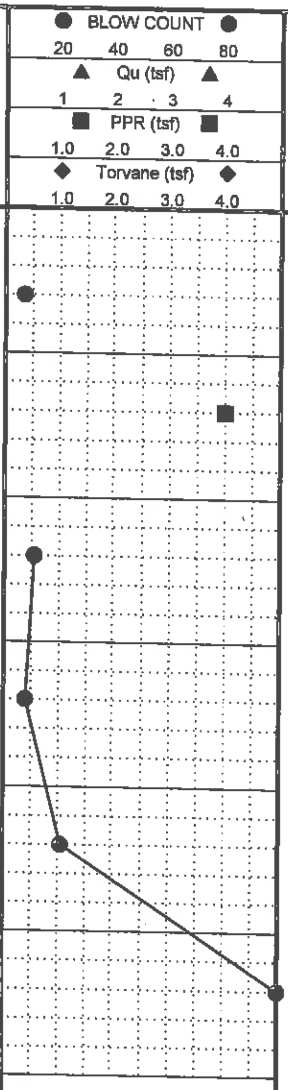
BORING TYPE: Flight Auger

DATE 10/15/14

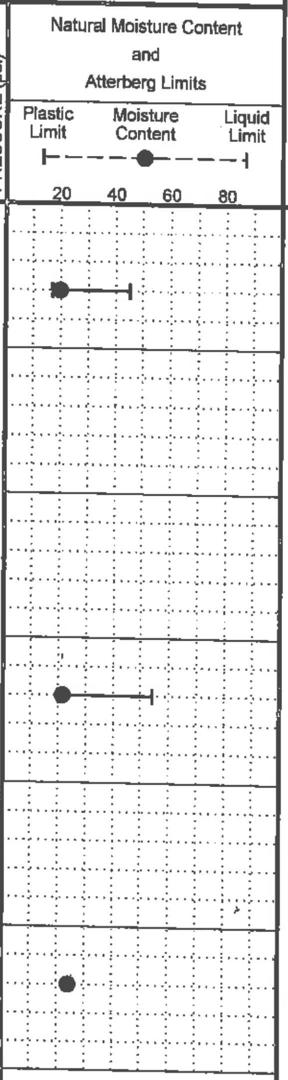
SURFACE ELEVATION 361.4

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	LEAN CLAY WITH SAND(CL) medium stiff; reddish brown with light gray; moist	N=7	20	45	17	28	76	+40 Sieve=1% +4 Sieve=0%
	CL	SANDY LEAN CLAY(CL) very stiff; light brown, gray and reddish brown; moist; mottled	P=4.0						
	SC	CLAYEY SAND(SC) medium dense; grayish brown; moist	N=11						
	CH	FAT CLAY WITH SAND(CH) medium stiff; reddish brown and light gray; moist; mottled	N=8	22	54	20	34	79	+40 Sieve=1% +4 Sieve=0%
	CL	LEAN CLAY(CL) very stiff; light gray and grayish brown; moist; layered with silt	N=21						
	ML	SILT WITH SAND(ML) very dense; light gray and yellowish brown; wet; with clay seams	N=50/5"	24				80	+40 Sieve=0% +4 Sieve=0%
30		Bottom of Boring @ 30'							

Geologic Unit: Eqc



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 28' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.047160°, W94.84384°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-14

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-14

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

DRILL RIG:

BORING TYPE: Flight Auger

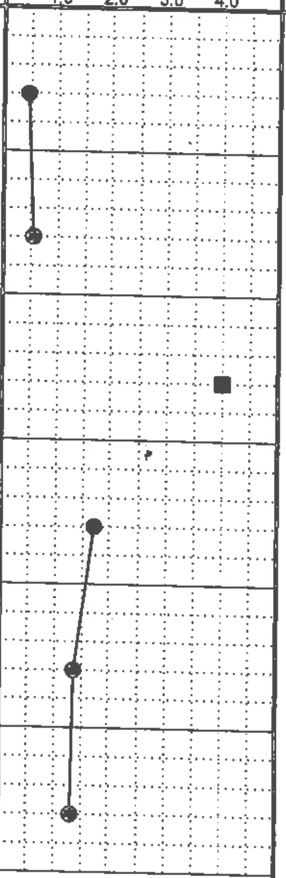
DATE 10/14/14

SURFACE ELEVATION 347.2

Geologic Unit: Eqc @ 0-28' & Er @ 28-30'

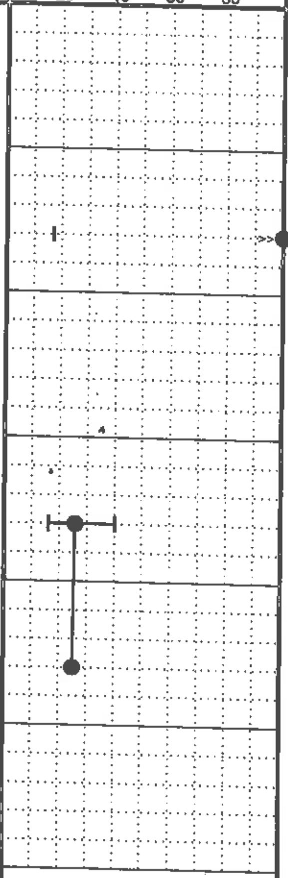
DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0–8	CL	SANDY LEAN CLAY(CL) medium stiff; yellowish brown with reddish brown; dry; with clay seams	N=9						
8–13	ML	SANDY SILT(ML) medium dense; grayish brown; moist; with clay seams	N=11	>>108	17	17	NP	68	+40 Sieve=1% +4 Sieve=1%
13–23	CL	SANDY LEAN CLAY(CL) very stiff; light gray and gray; moist	P=4.0						
		--light gray and grayish brown; moist; layered with silt	N=34	26	40	16	24	67	+40 Sieve=1% +4 Sieve=0%
23–28	SP SM	POORLY GRADED SAND WITH SILT(SP-SM) medium dense; yellowish brown, light gray and reddish brown; wet	N=27	25				10	+40 Sieve=0% +4 Sieve=0%
28–30	CL	LEAN CLAY(CL) very stiff; dark brown; moist; with silt partings	N=26						
30		Bottom of Boring @ 30'							

BLOW COUNT ● 20 40 60 80 ●; ▲ Qu (tsf) ▲ 1 2 3 4; ■ PPR (tsf) ■ 1.0 2.0 3.0 4.0; ◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)

Natural Moisture Content and Atterberg Limits: Plastic Limit ⊢ – – Moisture Content ● – – Liquid Limit ⊣ 20 40 60 80



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 23' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04774°, W94.84290°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-15

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-15

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

DRILL RIG:

PROJECT NO.: G4207-146

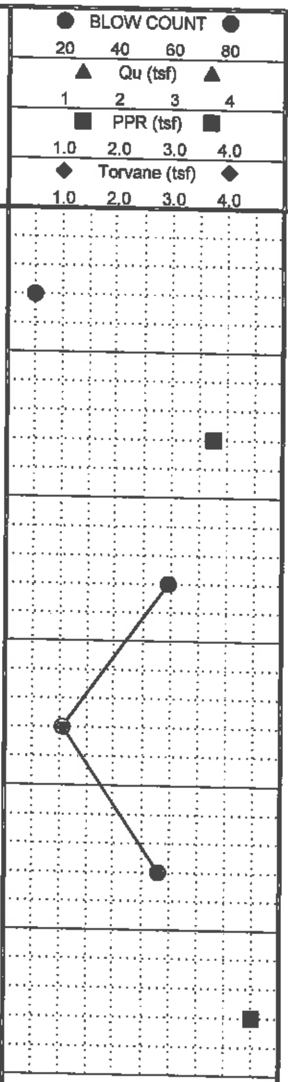
BORING TYPE: Flight Auger

DATE 10/14/14

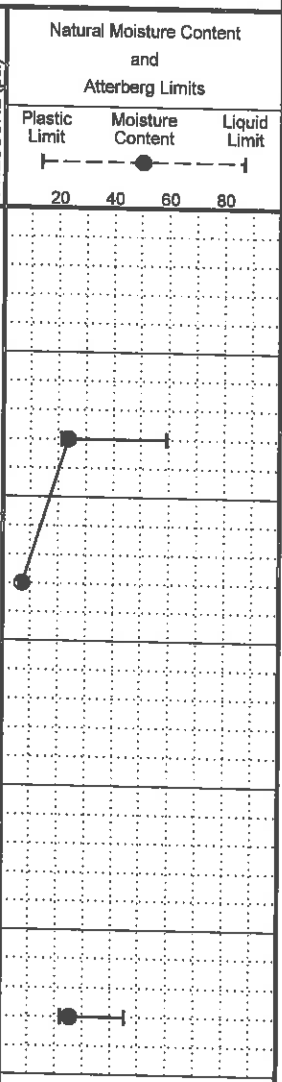
SURFACE ELEVATION 348.2

Geologic Unit: Eqc @ 0-28' & Er @ 28-30'

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CH								
4		FAT CLAY(CH) stiff; reddish brown and light gray; moist; mottled	N=10						
9		--very stiff; light gray, grayish brown and reddish brown; moist; layered	P=3.75	24	59	21	38	85	+40 Sieve=0% +4 Sieve=0%
14	SM	SILTY SAND(SM) very dense; light brown; dry	N=59	7				12	+40 Sieve=0% +4 Sieve=0%
17		▼							
19		--medium dense; wet	N=21						
24		--very dense	N=56						
29	CL	LEAN CLAY(CL) hard; dark brown; moist; with silt partings	P=4.5	25	45	22	23	92	+40 Sieve=0% +4 Sieve=0%
30		Bottom of Boring @ 30'							



DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 19' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04857°, W94.84286°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

ARCADIS

Appendix B

Photographic Log

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No.
1

Date:
8/20/2015

Direction Photo Taken:

North

Description:
Staging area west of landfill.

P8200493

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No.
2

Date:
8/20/2015

Direction Photo Taken:

South Southeast

Description:

Potential wetland on the top (west) end of the Primary Ash Pond.

P8200495

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 3

Date: 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Ditch between road and railway west of landfill, this ditch would be non-jurisdictional.

P8200497

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 4

Date: 8/20/2015

Direction Photo Taken:

Northeast

Description:

Ground Water Monitoring Well AD-12 near northwest end of landfill.

P8200501

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **5**	**Date:** 8/20/2015

Direction Photo Taken:

East Northeast

Description:

View of plant from top of landfill. Primary ash pond is within the wooded area on left.

P8200506

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **6**	**Date:** 8/20/2015

Direction Photo Taken:

East Northeast

Description:

Drainage canal that drains from primary ash pond to clear water pond.

P8200510

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 7

Date: 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Vegetated strip between landfill and road. This would be isolated due to lack of connectivity.

P8200521

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 8

Date: 8/20/2015

Direction Photo Taken:

North

Description:

Dike between landfill and primary ash pond. Facility in the background.

P8200522

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 9	**Date:** 8/20/2015

Direction Photo Taken:

West

Description:

Vegetated strip between landfill and road. This area would be isolated due to lack of connectivity.

P8200527

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 10	**Date:** 8/20/2015

Direction Photo Taken:

North Northeast

Description:

Road east of landfill running toward facility and clear water pond.

P8200530

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No. 11

Date: 8/20/2015

Direction Photo Taken:

South

Description:

Top of landfill.

P8200534

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No. 12

Date: 8/20/2015

Direction Photo Taken:

Southeast

Description:

View of lined bottom ash storage pond.

P8200538

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – J. ROBERT WELSH POWER PLANT	PITTSBURG, TITUS COUNTY, TEXAS	OK001625.0001

Photo No. 13

Date: 8/20/2015

Direction Photo Taken:

Southeast

Description:

Lined bottom ash storage pond.

P8200545

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – J. ROBERT WELSH POWER PLANT	PITTSBURG, TITUS COUNTY, TEXAS	OK001625.0001

Photo No. 14

Date: 8/20/2015

Direction Photo Taken:

South

Description:

Southside of lined bottom ash storage pond.

P8200547

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **15**	**Date:** 8/20/2015

Direction Photo Taken:

West

Description:

East side of lined bottom ash storage pond.

P8200560

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **16**	**Date:** 8/20/2015

Direction Photo Taken:

North

Description:

Upland with pine and ground water monitoring well AD-2 south of lined bottom ash storage pond.

P8200563

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 17

Date: 8/20/2015

Direction Photo Taken:

Description:

Outflow of water from plant into the northeast portion of the Primary Ash Pond.

P8200577

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 18

Date: 8/20/2015

Direction Photo Taken:

South Southwest

Description:

Northeast portion of primary ash pond, view facing south-southwest.

P8200578

4.4 – A Groundwater Sampling and Analysis Plan for Welsh Power Plant's CCR Units: Landfill, Bottom Ash Storage Pond, and Primary Bottom Ash Pond, Coal Combustion Residuals Rule Compliance, May 2018 (Rev 2), November 2021 (Rev 3)

A Groundwater Sampling and Analysis Plan for Welsh Power Plant's

CCR Units: Landfill, Bottom Ash Storage Pond, and Primary Bottom Ash Pond

Coal Combustion Residuals Rule Compliance

Prepared by: AEP Environmental Services

Date: May 2018 – Rev 2
Nov 2021 – Rev 3

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BOUNDLESS ENERGY℠

Table of Contents

1. Introduction

The following sections address the Texas Commission on Environmental Quality (TCEQ) Coal Combustion Residual (CCR) rule (30 TAC 352) and includes protocols and considerations for gathering groundwater samples, preserving them, proper documentation and shipping them to the analytical lab.

The TCEQ's CCR Rule requires that a monitoring program include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and down gradient wells and that a sampling and analysis program be developed that includes procedures and techniques for:

- Sample collection
- Sample preservation and shipment
- Analytical procedures
- Chain of custody control
- Quality assurance and quality control
- Statistical analysis procedures

The purpose of this groundwater sampling and analysis plan (GW-SAP) is to lay out these details and is aimed at satisfying the monitoring of the PE-certified groundwater monitoring network according to the requirements of TCEQ's CCR Rule.

2. Sampling and Analysis Plan

This GW-SAP includes consistent sampling and analysis procedures that are protective of human health, safety, and the environment, and that are designed to ensure monitoring results that provide an accurate representation of groundwater quality.

The TCEQ's CCR Rules have a performance standard that calls for establishment of consistent sampling, laboratory analysis, and quality assurance/quality control procedures. The development of a GW-SAP in advance of performing the sampling provides an added benefit that analytical results will be less subject to variability over time. This is important because a change in sampling methods, laboratory analytical methods, or even analytical laboratories, can cause shifts in data that can complicate statistical analyses and potentially trigger a false SSI or SSL.

CCR Rules require analysis of total recoverable metals (i.e., no field filtering) in measuring groundwater quality. As a result, groundwater samples from some monitoring wells may exhibit variable levels of turbidity that can potentially trigger false SSIs or SSLs. This sampling and analysis plan calls for the use of low-flow sampling techniques, which are designed to minimize turbidity at the time of sample collection. However, other sampling techniques, such as passive sample collection or sample collection within 24 hours of purging may be used if low-flow sampling cannot be supported by the aquifer. This GW-SAP also includes a specification to collect an optional filtered sample. If the optional field filtered samples are to be collected, then there will be a specific instruction to collect the field filtered samples. Filtered samples will not be used for compliance purposes.

TCEQ CCR Rules have a performance standard that analytical methods be appropriate and accurate for groundwater analysis. There are a variety of laboratory analytical methods that meet these criteria, and selection of appropriate methods can be based on desired reporting limits, accuracy, precision, potential for interferences, and cost. A list of appropriate analytical methods is included in Appendix C.

Appendix B contains Instruction to sampler for sampling event. This form can be customized for a specific sampling event. This document can be used to communicate to the sampler the wells to be sampled, and which parameters to the sampled. Other information pertinent to the specific sampling event may be included on this instruction sheet.

2.1 Measurement of Groundwater Level

As reference, a site map showing locations and ID of the monitoring wells is included in **Appendix A**. **Appendix B** contains monitoring well construction information and Field Data Log. Immediately prior to purging, static water levels in each well monitoring the same CCR management area are to be measured within a period of time short enough to avoid temporal variations in groundwater flow. To measure the static water level, an electronic probe on a measuring tape is lowered into the groundwater well riser pipe. When the probe contacts the water a visual and audible alarm are activated. The static water level is established by reading the measurement on the tape to a hundredth of a foot (0.01-foot) at the top of the riser pipe, i.e., top of casing (TOC). Results are to be recorded on a Field Data Log (see example in Appendix B) along with the date, time, monitoring well number, and the name of the person recording the data. The probe is rinsed with deionized water before using in the first well and then after each use. This data can be used to determine the rate and direction of groundwater flow each time groundwater is sampled.

2.2 Collection and Handling of Groundwater Samples

If low flow sampling is used for collecting the groundwater samples, the sample collector needs to be well versed in the intricacies of low flow sampling.

Low flow purging and sampling - Equipment needed

Low flow pump. The pump will have the ability to regulate flow in the range of 0.1-0.5 liters per minute or a greater range. The amount of groundwater drawdown needs to be checked every 3-5 minutes.

Field parameter measurement instruments. The instruments should include instruments for measuring:

depth to water
pH
specific conductivity
turbidity
temperature
dissolved oxygen (DO, if requested by AEP)
oxidation reduction potential (ORP, if requested by AEP)

See Appendix B for a check list of equipment to be considered for use.

Procedures to follow at the beginning of the sampling event.

Before beginning sampling all field instruments should be calibrated. Additional calibrations may be needed during the sampling procedure.

The instruments used to make the measurements will be instruments designed by the manufacturer to perform such measurements. The instruments will be calibrated in accordance with the manufacturer's instructions and decontaminated between each well by rinsing with deionized water or as recommended by the manufacturer. A record of the calibration procedures used and information on the specific standards used should be recorded on the Calibration Record Form (see Appendix B for example) or a similar form. At a minimum, a notation will be made stating that each instrument is in calibration or not in calibration.

Duplicate samples will be needed. Select suitable sampling locations for duplicates.

Blanks will be needed. Select suitable times and locations to collect blanks.

Purging and sampling procedures for each sampling location.

Decontaminate equipment

Reusable sampling equipment, including pumps, tubing, and instrumentation is decontaminated using deionized water, soap solution, or other appropriate methods after each use. This includes all non-dedicated equipment that is submerged in a monitoring well or otherwise contacts a groundwater sample. The disposable equipment is to be purchased in a clean state, maintained clean until used for sampling, and new disposable equipment will be used for each well.

Measure groundwater level

If not previously measured as stated in paragraph 2.1, prior to well purging or sampling, the depth to water in each well is measured. The data are recorded on the Field Data Log or similar form with date, time, monitoring well number, depth to water, and the name of the person recording the data. The probe is rinsed with deionized water before and after each use.

Install pump

Install the intake for the pump near the mid-point of the screened interval of the monitoring well to avoid mixing formation water with sediments in the well bottom or overlying stagnant water within the well casing. Minimize disturbances in the groundwater. Agitation of the groundwater will result in suspension of any particulates in the well and may result in chemistry changes in the groundwater due to aeration of the groundwater. Such conditions are to be avoided. Non-dedicated equipment must be decontaminated between wells to prevent cross-contamination.

Monitoring groundwater level

The amount of groundwater drawdown needs to be checked every 3-5 minutes. Ideally, only a small amount (<0.33 feet) of drawdown should occur as the result of purging the well. This measurement may be taken with a groundwater tape or an electronic pressure transducer or other suitable measuring instrument. This measurement may not have the same reference elevation as the depth to groundwater measurement and the measurement may not be the same value as the original depth to groundwater measurement.

Record the measurement.

Purge monitoring well

Purging with a Low-Flow Method

Calculate the volume of water in each well. Slowly lower the pump into the well and set the pump level at least 3 feet off the bottom of the well, if possible, to avoid stirring up accumulated sediments at the bottom of the well. Purge rates for low-flow purging are typically in the range of 0.1 to 0.5 liters per min. Start the pump at low speed and slowly increase the speed until discharge occurs. Adjust the flow to a rate that results in a minimal (<0.33 feet) well drawdown. Purge rates should ideally be equivalent to the well recharge rate at the pump intake.

Check equipment for water leaks and if present fix or replace the affected equipment. Try to match pumping rate used during previous sampling event(s). Otherwise, adjust pump speed until there is little or no water level drawdown. Pumping rates should, as needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. If the drawdown is greater than 0.33 feet, but remains stable, continue purging.

Monitor the water level every 3-5 minutes and adjust purge rates to prevent drawdown. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. Record the optimum pumping rate for each well on the Field Data Log (or similar form) during purging. Record any pumping rate adjustments (both time and flow rate). Purge the desired volume from the well. The minimum well purge volume should be the equivalent to at least two pump and tubing volumes.

If the well runs dry, discontinue the purging and record the volume of water removed and allowed the well to recharge. If the well will not produce the required volume for all the samples after recharging, collect the samples that the well will provide for (i.e. 0.25 liters for metals or 1 Liter for general water chemistry). If the well will not produce the required volume for any samples after recharge, the well volume will be considered inadequate for sampling.

Monitor parameters

In order to determine if the pumped groundwater has chemically stabilized to the point where a representative sample may be taken, certain field parameters are monitored.

Field parameters will include at least pH, specific conductivity, and turbidity. Other parameters that may be included are dissolved oxygen, oxidation reduction potential, and temperature.

Field parameters stabilize

Field parameter stabilization is considered to be achieved when two consecutive readings are within the following limits:

pH (± 0.1 unit),

Specific Conductance (3%),

Turbidity (10% for values greater than 5 NTU; if three Turbidity values are less than 5 NTU, consider the values as stabilized),

Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),

Oxidation/Reduction Potential (± 10 millivolts),

Temperature (± 3%).

Purging with a Non-Low-Flow Method

If the low-flow purging criteria cannot be met, then an alternate purging and sampling collection procedure will apply. The well will be purged of its water with manual bailers, or electric or air operated pumps. Record the volume of water removed and allowed the well to recharge.

If the well will not produce the required volume for all the samples after recharging, collect the samples that the well will provide for (i.e. 0.25 liters for metals or 1 Liter for general water chemistry). If the well will not produce the required volume for any samples after recharging, the well volume will be considered inadequate for sampling.

Collect samples

Groundwater samples collected from the monitoring wells for compliance purposes will not be field filtered. So care must be taken to collect an undisturbed sample to the extent practicable. The low flow pumping rate used during purging is also used for sample collection. Appropriate sample preservatives will be used for each sample collected and may be put into the sample bottle before or immediately after the sample is collected. See Appendices B and C for types of sample containers needed and preservative needed.

Complete paperwork for this sample location

The Field Data Log, sample labels, and chain of custody are to be complete for the sample location.

Decontaminate equipment, dispose of consumables

Any equipment that will be used on another sample location must be decontaminated before reuse. Any used consumable supplies needs to be collected for disposal or other disposition.

Clean up sample location and move to next sample location

The sample site should be cleaned up. Close and lock the monitoring well.

Analytical Parameters

All parameters shown below are to be analyzed to establishing background concentrations. After collection of that initial background set of data from at least eight discrete samples, sampling the groundwater monitor well continue on a semi-annual basis under Detection Monitoring or Assessment Monitoring. Annual screening samples will be collected from Units in Assessment Monitoring.

Parameters for Detection Monitoring	**Parameters for Assessment Monitoring**
Boron (B)	Antimony (Sb)
Calcium (Ca)	Arsenic (As)
Chloride (Cl-)	Barium (Ba)
Fluoride (F-)	Beryllium (Be)
pH	Cadmium (Cd)
Sulfate (SO4-)	Chromium(Cr)
Total Dissolved Solids	Cobalt(Co)
	Fluoride (F-)
	Lead (Pb)
	Lithium(Li)
	Mercury (Hg)
	Molybdenum (Mo)
	Selenium (Se)
	Thallium (Tl)
	Radium 226 and 228 combined (Ra)

Field Filtered Samples (not to be used for compliance purposes)

<u>If directed by AEP</u> the sampler will collect a field filtered sample. **NOTE:** The results from this sampling will not be used for compliance purposes.

Field filtered samples are collected by placing a 0.10 micron filter on the end of the groundwater discharge tube. If single use (disposable) 0.10 micron filters are used then a new filter will be used for each sample. The filtered groundwater flowing out of the filter will be collected in a separate sample bottle and marked as a field filtered metals sample. See Appendix C for the type of sample bottle and the preservation method.

Sample Preservation and Shipping

The proper containers for the parameters to be analyzed will be pre-cleaned and supplied by the contractor performing the sampling effort. Care will be taken during sampling not to overfill the sample bottles that contain preservatives. In addition to the sample bottles, one or more sample containers may be used in lieu of an in-line monitor for the field determination of parameters. The containers must be rinsed with distilled water and dried after each use or new clean sample containers utilized.

Upon completion of sampling of each monitoring well, all relevant sampling information should be recorded on the appropriate Field Data Log, and the sample bottles placed in a cooler or ice chest at 40^0F (±2^0F, 4^0C ±2^0C), as necessary, for storage until analyzed. If ice is the coolant then the sample bottles must be enclosed in sealed plastic bags. These procedures are necessary to insure that the maximum allowable holding time or maximum allowable shipping temperature for any of the parameters is not exceeded.

Sample Identification

Samples must be properly labeled. Information that should be transmitted to the laboratory includes:

- Plant name
- Sample/well identification number
- Analyses to be performed
- Date and time of collection
- Initials of field sampling personnel

The identification labels and/or indelible markings will be completed and attached to the appropriate container. The date and time of sampling will then be added at the time of collection.

Chain of Custody

To establish the documentation necessary to trace sample possession from the time of collection through analyses and final disposition, a chain of custody form will be filled out and must accompany the sample shipment it reflects.

When transferring possession of the samples, each individual relinquishing and receiving possession will sign, date and note the time on the form. Relevant information regarding the samples should be entered on the form. This record is required for verification of sample integrity. Upon arrival at the Lab the chain of custody will serve to identify the shipment of samples.

An example of a chain of custody that fits the need of this Plan and that has been used in the past at AEP is in **Appendix B**, as well as a sample container list to be used and preservation methods/protocols.

2.3 Laboratory Analyses

The analytical methods used by the laboratory must be appropriate for groundwater and accurately measure constituent concentrations in the water samples. Some state agencies require EPA sanctioned analytical methods. Appendix C lists many of the laboratory analytical methods used at AEP's own laboratory. Also listed is the type of sample container needed, the preservative, the holding time, and the name of the method.

The laboratory reports will be prepared in accordance with the laboratory's quality assurance procedures. The laboratories accreditation organization, e.g., NELAC, and the analytical method may also have reporting requirements.

2.4 Quality Assurance and Quality Control

Field quality assurance

Field quality control measures are proven procedures for collecting representative samples, calibrating field testing equipment, preserving samples for analysis, and documenting chain of custody. These measures contribute to producing monitoring results that are reliable indications of groundwater quality.

Calibration of field instruments

The instruments will be calibrated in accordance with the manufacturer's instructions. A record of the calibration procedures used and information on the specific standards used should be recorded on the Calibration Record Form or a similar form. At a minimum, a notation will be made stating that each instrument is in calibration or not in calibration.

Quality control samples collected in the field

As Requested by AEP:

FIELD DUPLICATE: A second sample collected as close as possible in space and time to an original sample. To do so, fill 1/3 of the parent bottle followed by filling 1/3 of the duplicate bottle and repeat this until both bottles are filled. The original and duplicate samples are assigned different laboratory identification numbers and analyzed independently. The duplicate is typically identified with a code that does not enable the laboratory to correlate it to the original sample. The code and sample location are recorded on the Field Data Log so that the analytical results from the duplicate can be compared to the original sample after laboratory analysis is complete. In groundwater monitoring, one field duplicate is commonly collected each day.

EQUIPMENT RINSATE: A sample of analyte-free media which has been used to rinse the reusable sampling equipment. It is collected after completion of decontamination and prior to sampling. This blank is useful in documenting adequate decontamination of sampling equipment. One equipment rinsate is typically collected per day, although additional rinsate samples may be collected if the sampler deems appropriate. **Note:** If disposal equipment is used, an equipment rinsate sample is not required.

FIELD BLANK: In the field, analyte-free water is collected into a sample container with the same preservatives as used for the groundwater samples. The sample containers are the same lot as used for the groundwater samples. These samples are used to evaluate contamination introduced from the sample container(s) with applicable preservatives.

TRIP BLANK: A sample of analyte-free media taken from the office to the sampling site and in the shipping container unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures.

ACID BLANK OR PRESERVATIVE BLANK: An acid or preservative blank is prepared by filling a sample container with deionized water. The sampling technician adds the same preservative used for the groundwater sample to the blank sample container. One preservative blank is taken per sampling event per source container of preservative used. The laboratory analyzes the blank for the same constituents as the samples. This will demonstrate that the preservative contains no contaminants or that it is contaminated with some of the constituents for which the sample is being analyzed.

NOTE: If the laboratory provides the sample bottles with preservative already in them or laboratory grade preservatives are used then **a preservative blank sample will not be obtained.**

Laboratory quality assurance

The laboratory's quality assurance procedures are documented in the laboratory's quality assurance manual. The requirements of the quality assurance manual will be followed by the laboratory.

3. Well Development

Well development is not part of sampling and analysis but may be requested to take place during a sampling event. If well development is indicated as part of the sampling event, well development will take place after groundwater sampling for that particular well has been completed.

Well development is intended to remove fine particulate matter (turbidity), commonly clay and silt, from the geologic formation near the well intake. The groundwater is disturbed, suspending particulates into the groundwater, and then the groundwater with suspended particulates is removed.

Well development is accomplished through surging and pumping of the well.

Surging is performed with a surge block or device. The movement of the surge block causes the water to move in a turbulent manner inside the well. This water movement causes particulates to be suspended in the groundwater. The surge block should be of sufficient weight and density that when lowered it will force water out of the well and into the formation. The surge block should be lifted quickly in order to cause turbulent flow into the well. After the groundwater has been agitated with the surging activity the monitoring well will be pumped to remove the turbid water. Repeated cycles of surging and pumping may occur if there is an adequate supply of groundwater and the activity results in the removal of particulates (turbidity).

Well development will be documented on the Well Development Record form.

References

USEPA. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance*. EPA 530-R-09-007. U.S. Environmental Protection Agency, March 2009.

USEPA. *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells. EQASOP-GW 001.* U.S. Environmental Protection Agency Region 1, January 2010.

Nelson, P. *Index to EPA Test Methods*. USEPA Region 1. April 2003. (http://www.epa.gov/region01/oarm/testmeth.pdf)

USEPA. *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers.* EPA-542-S-02-001, U.S. Environmental Protection Agency, May 2002.

USEPA. *Handbook for Analytical Quality Control in Water and Wastewater Laboratories.* EPA-600/4-79-019. U.S. Environmental Protection Agency, March 1979.

USEPA. *Methods for Chemical Analysis of Water and Wastes.* Environmental Protection Agency, Environmental Monitoring Systems Laboratory—Cincinnati (EMSL-CI), EPA–600/4–79–020, Revised March 1983 and 1979 where applicable.

USEPA. *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*. EPA–600/4–80–032 (1980), U.S. Environmental Protection Agency, August 1980.

USEPA. *RCRA Ground-Water Monitoring: Draft Technical Guidance.* Office of Solid Waste, U.S. Environmental Protection Agency, November 1992.

USEPA. *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods.* EPA Report SW-846. Latest revision. See 70 FR 34537 dated June 14, 2005 for latest revisions.

APPENDIX A

Site Map with Groundwater Monitoring Wells

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PROPOSED MONITORING WELL
NETWORK MAP - LANDFILL

ARCADIS

FIGURE
10

Kenneth J. Brandner

Kenneth J Brandner
5-6-16

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PROPOSED MONITORING WELL NETWORK MAP - PRIMARY ASH POND

ARCADIS

FIGURE 10

Kenneth J. Brandner
1707

5-6-16

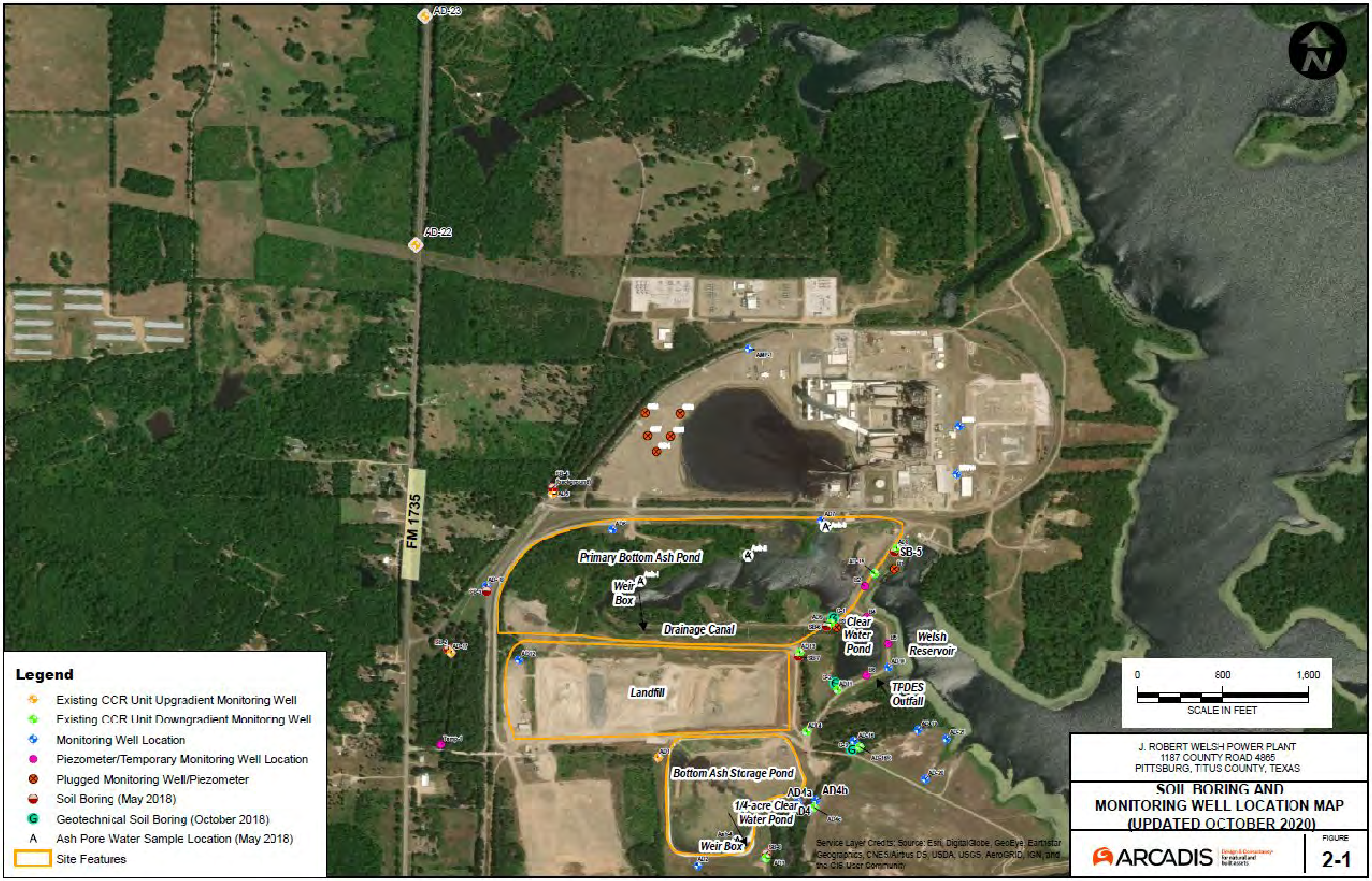
Kathleen J. Bradley
Geology
1151

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PROPOSED MONITORING WELL NETWORK MAP - BOTTOM ASH STORAGE POND

ARCADIS

FIGURE
10



Legend

- Existing CCR Unit Upgradient Monitoring Well
- Existing CCR Unit Downgradient Monitoring Well
- Monitoring Well Location
- Piezometer/Temporary Monitoring Well Location
- Plugged Monitoring Well/Piezometer
- Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SOIL BORING AND
MONITORING WELL LOCATION MAP
(UPDATED OCTOBER 2020)

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-1

Document Path: Z:\GIS\Projects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 2-1-SoilBoring_MonitoringWellLocations.mxd

APPENDIX B

Forms

Instructions to sampler for sampling event

Field Data Log

Calibration Record Form

Well Inspection Form

Chain of Custody Form

Monitoring Well Inspection Form

Monitoring Well Construction Data

Instructions to sampler for sampling event

Location	Welsh
Event	
Scheduled sample date	
Contact information	Jasmine Gilbert, PEC: 903.855.5444: jgilbert@aep.com
Number of wells to gauge and sample	ADs 1, 5, 17 – Background ADs 8, 9, 15 – PBAP ADs 11, 13, 14 – Landfill ADs 3, 4C, 16R - BASP
Number of duplicate samples needed including blanks	1 per day -metal; 1 per day- WQ; 1 per 10 samples - Ra-226*; 1 per 10 samples - Ra-228*
Parameters to sample	Appendix III (Detection Monitoring) and/or Appendix IV (assessment Monitoring), special water quality parameters (see lists of parameters below)

CCR samples						
Well	CCR Metals (and special metals parameters on request)	CCR WQ (and special WQ parameters on request)	Ra-226	Ra-228	Field parameters	Depth gauge
CCR Monitoring wells	x	x	x	x	x	x
duplicates	1 per sampling day	1 per sampling day				
Ra duplicates - see below			1 per 10 samples or less	1 per 10 samples or less (2 bottles needed/dup)		
Equipment blank	1 per sampling day					

CCR Monitoring wells

Background - ADs 1, 5, 17; PBAP- ADs 8, 9, 15; Landfill - ADs 11, 13, 14;BASP - ADs 3, 4C, 16R

Monitoring wells to be **gauged only** during the Semi- annual events: ADs 2, 6, 7, 10, 12, 18, 19, 20, 21, 22, and 23

Duplicate Samples

*Duplicate samples for Ra-226 and Ra-228.

The Ra-226 and Ra-228 samples are two separate samples.

For the radium duplicates mark the well name on the sample label and mark it 'Laboratory QC duplicate'.

The duplicate for Ra-226 may come from a different well than the duplicate for Ra-228.

For every 10 wells or less obtain 1 duplicate for Ra-226 - The duplicate sample for Ra-226 will be 1, 1-liter bottle.

For every 10 wells or less obtain 1 duplicate for Ra-228 – The duplicate sample for Ra-228 requires, 2, 1-liter bottles.

Sample Bottles

Sample bottles and preservatives needed:

Metals: 1-250 ml plastic bottle, preserve with nitric acid.

Mercury: 1, 125 ml PTFE lined container for mercury, preserved with Hydrochloric Acid

Water quality/special WQ parameters: 1- 1 L plastic bottle, preserve with ice.

Radium: 3-1 liter plastic bottles (1-Liter plastic for Ra-226 (nitric acid), 1, 1-Liter plastic for Ra-228 (nitric acid), 1, 1-Liter plastic for Ra QA/QC (nitric acid))

Parameters

Appendix III Detection Monitoring parameters
Boron (B)
Calcium (Ca)
Chloride (Cl-)
Fluoride (F-)
pH
Sulfate (SO4-)
Total Dissolved Solids
Special Water Quality
Alkalinity
Bromine (Br)
Special Metals
Sodium (Na)
Potassium (K)
Magnesium (Mg)
Strontium (Sr)
Dissolved Fe and Mn

Appendix IV Assessment Monitoring parameters
Antimony (Sb)
Arsenic (As)
Barium (Ba)
Beryllium (Be)
Cadmium (Cd)
Chromium(Cr)
Cobalt(Co)
Fluoride (F-)
Lead (Pb)
Lithium(Li)
Mercury (Hg)
Molybdenum (Mo)
Selenium (Se)
Thallium (Tl)
Radium 226 and 228 (Ra)

Field Data Log

Facility Name	
Sampled by	

Sample Location ID	

Depth to water, feet(TOC)	
Measured Total Depth, feet(TOC)	

Depth to water Date	

Purge Stabilization Data

Time	Water Depth	Flow Rate	pH	Spec Cond	Turbidity	D.O.	ORP	Temp, deg C	Comments

Total volume purged	
Sample appearance	
Sample time	
Sample date	

CALIBRATION RECORD FORM

Name: ___________________________________ Date: ___________________________________

pH Meter
Manufacturer____
Model ____
Serial Number ____
Calibration method ____
Calibration standard: Part no.: ______________________ Lot no.: ______________________________
Expiration Date:____
Calibration standard: Part no.: ______________________ Lot no.: ______________________________
Expiration Date:____
Manufacturer's recommended calibration procedure was followed: YES / NO
Specific Conductivity Meter
Manufacturer____
Model ____
Serial Number ____
Calibration method ____
Calibration standard: Part no.: ______________________ Lot no.: ______________________________
Expiration Date:____
Calibration standard: Part no.: ______________________ Lot no.: ______________________________
Expiration Date:____
Manufacturer's recommended calibration procedure was followed: YES / NO
Turbidity Meter
Manufacturer____
Model ____
Serial Number ____
Calibration method ____
Calibration standard: Part no.: ______________________ Lot no./Serial no.:______________________
Expiration Date:____
Calibration standard: Part no.: ______________________ Lot no. /Serial no.:_____________________
Expiration Date:____
Manufacturer's recommended calibration procedure was followed: YES / NO
Other
Manufacturer____
Model ____
Serial Number ____
Calibration method ____
Calibration standard: Part no.: ______________________ Lot no. /Serial no.:_____________________
Expiration Date:____
Calibration standard: Part no.: ______________________ Lot no. /Serial no.:______________________
Expiration Date:____
Manufacturer's recommended calibration procedure was followed: YES / NO

Well Inspection Log

Facility: Welsh PP

Sampling Period: ____________________

Sampling Contractor: ____________________

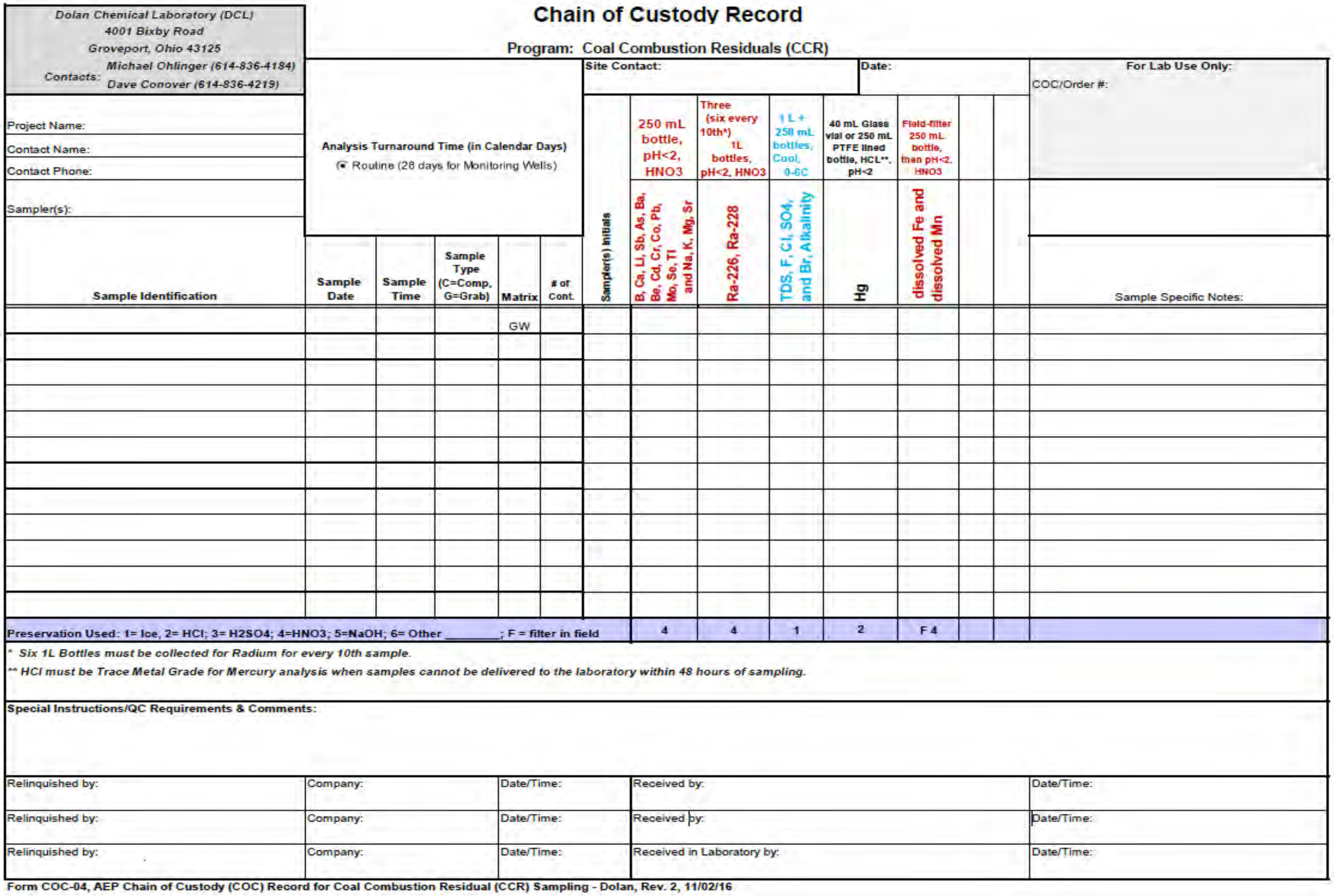
Signature: ____________________

Well No.	Well Locked	Lock Functioning	Well Locked After Sampling	Access to Well Maintained	Well Housing and Pad in Good Shape	Well Properly Labeled	Comments

Instructions: Complete form and submit to AEP Environmental Services with Field Data Log. Place check mark for items that are satisfactory. Unsatisfactory items should be left blank with a note in the comments section on what needs to be remedied.

Chain of Custody

It is preferred that one chain of custody be used for each CCR unit and one for background wells. (a total of 4 COCs)



Dolan Chemical Laboratory (DCL)
4001 Bixby Road
Groveport, Ohio 43125
Contacts: Michael Ohlinger (614-836-4184)
Dave Conover (614-836-4219)

Chain of Custody Record

Program: Coal Combustion Residuals (CCR)

Site Contact:

Date:

For Lab Use Only:
COC/Order #:

Project Name:
Contact Name:
Contact Phone:
Sampler(s):

Analysis Turnaround Time (in Calendar Days)
● Routine (28 days for Monitoring Wells)

							250 mL bottle, pH<2, HNO3	Three (six every 10th*) 1L bottles, pH<2, HNO3	1 L + 250 mL bottles, Cool, 0-6C	40 mL Glass vial or 250 mL PTFE lined bottle, HCL**, pH<2	Field-filter 250 mL bottle, then pH<2, HNO3			
Sample Identification	**Sample Date**	**Sample Time**	**Sample Type (C=Comp, G=Grab)**	**Matrix**	**# of Cont.**	**Sampler(s) Initials**	B, Ca, Li, Sb, As, Ba, Be, Cd, Cr, Co, Pb, Mo, Se, Tl and Na, K, Mg, Sr	Ra-226, Ra-228	TDS, F, Cl, SO4, and Br, Alkalinity	Hg	dissolved Fe and dissolved Mn			Sample Specific Notes:
				GW										
Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______; F = filter in field							4	4	1	2	F 4			

** Six 1L Bottles must be collected for Radium for every 10th sample.*
*** HCl must be Trace Metal Grade for Mercury analysis when samples cannot be delivered to the laboratory within 48 hours of sampling.*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Date/Time:

Form COC-04, AEP Chain of Custody (COC) Record for Coal Combustion Residual (CCR) Sampling - Dolan, Rev. 2, 11/02/16

MW	**TOC**	**TD (TOC)**	**Screen, top (ft below TOC)**	**Screen, middle (ft below TOC)**	**Screen, bottom (ft below TOC)**
AD01	357.57	28.71	15	20	25
AD02*	346.16	27.33	15	20	25
AD03	333.1	20.13	7	12	17
AD04*	342.61	32.08	19	24	29
AD04c	333.28	15.00	5	10	15
AD05	351	32.88	20	25	30
AD06*	346.33	33.00	23	28	33
AD07*	350.82	38.00	28	33	38
AD08	340.01	29.00	16	21	26
AD09	343.09	35.00	20	27.5	35
AD10*	343.01	35.00	20	27.5	35
AD11	342.18	20.00	10	15	20
AD12*	369.33	30.00	20	25	30
AD13	347.00	16.00	6	11	16
AD14	345.43	18.00	8	13	18
AD15	343.29	46	25	35	45
AD16R	353.97	21	11	16	21
AD17	357.1	40	24	31.5	39
AD18*	349.28	29	14	21.5	29
AD-19*	323.58	15	5.0	10	15
AD-20*	324.85	20	4	11.5	19
AD-21*	322.04	20	3.5	11	18.5
AD-22*	360.94	20	5	12.5	20
AD-23*	369.37	20	5	12.2	20

*=gauged only wells

APPENDIX C

Laboratory Analysis Methods, Sample Containers, and Preservation Protocols

Cooling is not prohibited unless specifically noted. Cooling is required if specified for the analyte.

Analyte	**Metals -** aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, nickel, selenium, silver, strontium, thallium, tin, vanadium, zinc	
Method	EPA 200 series	Method 6010B
Container	plastic; glass (not acceptable for boron); perfluoropolymer	
Preservation	HNO_3 to pH<2	
Hold time	180 days	

Analyte	**Mercury**	
Method	EPA 7470A	EPA 245.7-2005
Container	PTFE lined (245.7-2005), 40 ml glass vial	
Preservation	Hydrochloric to pH<2 (EPA 245.7); HNO_3 to pH<2 (EPA 7470)	
Hold time	28 days	

Analyte	**Chloride**
Method	EPA 300 series
Container	plastic; glass; perfluoropolymer
Preservation	None required
Hold time	28 days

Analyte	**Fluoride**
Method	EPA 300 series
Container	plastic; glass; perfluoropolymer
Preservation	None required
Hold time	28 days

Analyte	**Sulfate**
Method	EPA 300 series
Container	plastic; glass; perfluoropolymer
Preservation	cool, ≤ 6^{o}C
Hold time	28 days

Analyte	**Solids, total dissolved (TDS)**
Method	SM 2540 C
Container	plastic; glass; perfluoropolymer
Preservation	cool, ≤ 6^{o}C
Hold time	7 days

Analyte	**Radium 226**
Method	Method 9315
Container	plastic; glass; perfluoropolymer
Preservation	HNO_3 to pH<2
Hold time	180 days

Analyte	**Radium 228**
Method	Method 9320
Container	plastic; glass; perfluoropolymer
Preservation	HNO_3 to pH<2
Hold time	180 days

Analyte	**combined Ra-226 and Ra-228**
Method	The laboratory performs two analysis - one for Ra-226 and another for Ra-228 and then adds the results for these two analysis and reports the sum for the combined result.

APPENDIX D

Statistical Method

STATISTICAL ANALYSIS PLAN
J. Robert Welsh Plant
Pittsburg, Texas

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

In collaboration with

Kristina Rayner
Groundwater Stats Consulting

and

Kirk M. Cameron, Ph.D.
MacStat Consulting, Ltd.

CHA8500
December 2021
Revision 2

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

Annual Report	Annual Groundwater Monitoring and Corrective Action Report
ANOVA	analysis of variance
CCR	coal combustion residuals
CFR	Code of Federal Regulations
GWPS	groundwater protection standard
LCL	lower confidence limit
MCL	maximum contaminant level
OLS	ordinary least-squares
ORP	oxidation-reduction potential
PQL	practical quantitation limit
QC	quality control
RCRA	Resource Conservation and Recovery Act
RL	reporting limit
ROS	regression on order statistics
SAP	Statistical Analysis Plan
SSI	statistically significant increase
SSL	statistically significant level
SWFPR	site-wide false positive rate
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
UCL	upper confidence limit
Unified Guidance	*Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (USEPA, 2009)
UPL	upper prediction limit
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit

SECTION 1

INTRODUCTION

In June 2021, the Texas Commission on Environmental Quality (TCEQ) issued new regulations regarding the disposal of coal combustion residuals (CCR) in certain landfills and impoundments under Title 30, Chapter 352, “Coal Combustion Residuals Waste Management.” This Chapter is referred to herein as the “CCR rules.” Facilities regulated under the CCR rules are required to develop and sample a groundwater monitoring well network to evaluate if landfilled CCR materials are impacting downgradient groundwater quality. As part of the evaluation, the analytical data collected during the sampling events must undergo statistical analysis to identify statistically significant increases (SSIs) in analyte concentrations above background levels. A description of acceptable statistical programs is provided in USEPA’s document *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (USEPA, 2009), which is commonly referred to as the “Unified Guidance.”

The CCR rules are not prescriptive regarding what statistical analyses should be selected so that groundwater data are interpreted in a consistent manner and the results meet certification requirements. Geosyntec Consultants, Inc. (Geosyntec) prepared this Statistical Analysis Plan (SAP) on behalf of American Electric Power (AEP) to develop a logic process regarding the appropriate statistical analysis of groundwater data collected in compliance with the CCR rules. The SAP will provide a narrative description of the statistical approach and methods used in accordance with the CCR rule reporting requirements [30 TAC 352.931].

This SAP describes statistical procedures to be used to establish background conditions, implement detection monitoring, implement assessment monitoring (as needed), and implement corrective action monitoring (as needed) for the J. Robert Welsh Plant Bottom Ash Storage Pond (BASP), Landfill (LF), and Primary Bottom Ash Pond (PBAP), all of which are located in Pittsburg, Texas.

Procedures for collecting, preserving, and shipping groundwater samples are not included in this SAP. It is assumed that samples are collected and handled in accordance with AEP’s statistical analysis plan and the requirements of 30 TAC 352.901 *et seq.*

SECTION 2

ANALYSES FOR REVIEWING AND PREPARING DATA

2.1 Physical Independence

Most statistical analyses require separate sampling events to be statistically independent. Statistical independence of groundwater samples is most likely to be realized when the samples are collected at time intervals that are sufficiently far apart that the samples are not from the same volume of groundwater. In such cases, the samples of groundwater are considered physically independent. To ensure physical independence, the minimum time between sampling events must be longer than the residence time of groundwater that would be collected in the monitoring well. The minimum time interval between sampling events (t_{min}) can be determined by calculating the groundwater velocity, as follows:

$$v = \frac{Ki}{n} \quad (1)$$

$$t_{min} = \frac{v}{D} \quad (2)$$

where:

$v =$ groundwater velocity
$K =$ hydraulic conductivity
$i =$ hydraulic gradient
$n =$ effective porosity
$t_{min} =$ minimum time interval between sampling events
$D =$ well bore volume (i.e., diameter of well and surrounding filter pack)

2.2 Testing for Normality

Many statistical analyses assume that the sample data are normally distributed. If such an analysis is used, the assumption of normality can be tested using the Shapiro-Wilk test (for sample sizes up to 50) or the Shapiro-Francía test (for sample sizes greater than 50). Normality can also be tested by less computationally intensive means such as graphing data on a probability plot. If the data appear not to be normally distributed (e.g., they are skewed in some fashion), then data may be transformed mathematically such that the transformed data do follow a normal distribution (e.g., lognormal distributions, Box-Cox transformations). Alternatively, a non-parametric test (i.e., a test that does not assume a particular distribution of the data) may be used. However, since non-parametric tests generally require large datasets to maintain an adequately low site-wide false positive rate (SWFPR), transforming the data is preferred.

2.3 Testing for Outliers

Outliers are extreme data points that may represent an anomaly or error. Datasets should be visually inspected for outliers using time series and/or box-and-whisker plots. While they are valuable as screening tools, visual methods are not foolproof. For example, if data are skewed according to a lognormal distribution, the boxplot screening may identify more outliers than actually exist. Typically, goodness-of-fit testing must be done on the non-outlier portion of the data to determine at what scale to test the possible outliers.

Potential outliers should be evaluated for potential sources of error (e.g., in transcription or calculation) or evidence that the data point is not representative (e.g., by examining quality control [QC] data, groundwater geochemistry, sampling procedures, etc.). Errors should be corrected prior to further statistical analysis, and data points that are flagged as non-representative should not be used in the statistical analysis. In addition, data points can be considered extreme outliers if they meet one of the following criteria:

$$x_i < \tilde{x}_{0.25} - 3 \times IQR \quad (3)$$

or

$$x_i > \tilde{x}_{0.75} + 3 \times IQR \quad (4)$$

where:

$x_i =$ individual data point
$\tilde{x}_{0.25} =$ first quartile
$\tilde{x}_{0.75} =$ third quartile
$IQR =$ the interquartile range $= \tilde{x}_{0.75} - \tilde{x}_{0.25}$

Extreme outliers may be excluded from the statistical analysis based on professional judgment. Goodness-of-fit testing may be needed to corroborate the classification of data points as extreme outliers. Flagged data and extreme outliers should still be maintained in the database and should be reevaluated as new data are collected.

2.4 Handling Duplicate or Replicate Data

Duplicate or replicate samples are often collected for QC purposes. Averaging the parent sample and duplicate sample results may give a more accurate representation of the constituent concentration at the time, but doing so would reduce the sample variability. Since many statistical tests assume that data are homoscedastic (i.e., the population variance does not change across samples), this technique is not recommended. Unless there is reason to suspect that either the parent sample or the duplicate sample is more representative of site groundwater, one of the samples should be selected at random and that value should be used in the subsequent statistical analysis. However, it should be reported when parent sample and duplicate sample results are different from a decision-making perspective, e.g., when the duplicate sample exceeds the groundwater protection standard (GWPS) but the parent sample does not.

2.5 Handling Non-Detect Data

If non-detect data are infrequent (less than 15%), half of the reporting limit (RL) can be used in place of these data without significantly altering the results of a statistical test. The RL may be either the laboratory practical quantification limit (PQL) or an established project limit which is less than the maximum contaminant level (MCL). If non-detect data are more frequent, parametric methods that explicitly consider non-detects or non-parametric methods insensitive to the presence of non-detect data should be used. Where available, estimated results less than the RL (i.e., "J-flagged" data) should be used, and these data should be considered detections for the purposes of statistical analysis.

2.6 Deseasonalizing Data

Most statistical tests assume that data are independent and identically distributed. Datasets with seasonal or cyclic patterns violate this assumption. If seasonal trends are not corrected, the variance of the data will be overestimated, lessening the statistical power of the test. False positives may also be identified for elevated results that are caused by seasonal variation instead of a release.

At the same time, deseasonalizing data inherently assumes that the seasonal pattern will continue into the future, so care should be taken when correcting for seasonality. There should be a physical explanation for the seasonal pattern, and the seasonal pattern should be observed for at least three cycles before deseasonalizing data.

To evaluate whether a seasonal pattern exists, data should first be visually inspected on a time series plot. Observing parallel or antiparallel patterns for the same constituent across multiple wells or for multiple constituents within a single well provides greater assurance of a seasonal pattern and may be used to infer a physical explanation.

If a seasonal pattern is observed, the dataset should undergo a statistical test for seasonality before deseasonalizing the data. First, results are categorized into seasons based on the observed seasonal pattern and the frequency of sampling (e.g., summer or winter; dry season or wet season; first, second, third, or fourth quarter; etc.). Then, the Kruskal-Wallis test can be applied to the various seasonal datasets to test whether the different seasons are statistically significantly different from one another.

To deseasonalize the data, a seasonal mean should be calculated for each season based on the categorization for the dataset, and a grand mean (i.e., the overall mean of all data) should be calculated. Each result should then be corrected based on the difference between the grand mean and the seasonal mean for that result's season. Similar to transforming apparently non-normal data, statistics should be calculated based on the deseasonalized data.

SECTION 3

DETECTION MONITORING

3.1 Establishing Background

By October 17, 2017, eight independent background samples should be collected from each monitoring well in the CCR unit groundwater monitoring system as part of the initial monitoring period [30 TAC 352.941(a)]. Background wells do not necessarily need to be hydraulically upgradient of the CCR unit, but they must not be affected by a release from the CCR unit [30 TAC 352.911(a)]. The sampling frequency should be such that samples are physically independent, as described in **Section 2.1**. Samples should be analyzed for the Appendix III and Appendix IV constituents listed in **Table 1**.

Once analytical data are received, summary statistics (e.g., mean and variance) should be calculated for the background datasets. Initially, analysis should be done independently for each constituent at each well. As part of our protocol in such situations, time series plots and box plots will be prepared along with the summary statistics. The Kaplan-Meier method or robust regression on order statistics (ROS) can be used to compute summary statistics when there are large fractions (i.e., 15% to 50%) of non-detects; these methods are discussed below. If more than 50% of the data are non-detect, then summary statistics cannot be reliably calculated. Procedures for evaluating future data against these background datasets are described in **Section 3.2.1** (for detection monitoring) and **Section 4.1.1** (for assessment monitoring and corrective action monitoring).

Background data will be evaluated for statistically significant temporal trends using (a) ordinary least-squares (OLS) linear regression with a *t*-test ($\alpha = 0.01$) on the slope and/or (b) the non-parametric Theil-Sen slope estimator with Mann-Kendall trend test ($\alpha = 0.05$, or 0.01 for larger datasets). Non-detect data are replaced with half the RL for these analyses. The OLS linear regression or Theil-Sen slope estimator will be used to estimate the rate of change (increasing, no change, or decreasing) over time for each constituent at each well. The *t*-test or Mann-Kendall statistic will be used to determine whether a trend is statistically significant. OLS linear regression should only be used when at most 15% of the data are non-detect, when regression residuals are normally distributed, and when the variance from the regression line does not change over time. The Theil-Sen/Mann-Kendall analysis requires at least five observations for meaningful results; at least eight observations are recommended. Note that a statistically significant increasing trend in background data (or a statistically significant decreasing trend in pH) could indicate an existing release from the CCR unit or another source, and further investigation may be needed to determine the source of this trend.

Background data will also be evaluated for statistically significant seasonal patterns and, if present, will be deseasonalized using the procedure described in **Section 2.6**.

If the trend analysis does not indicate a statistically significant trend, the proposed background data will be tested for normality using one of the methods outlined in **Section 2.2**. When data follow a normal or transformed-normal distribution (e.g. lognormal or other Box-Cox transformation), parametric methods are applied. If fewer than 15% of the data are non-detect, non-detect data may be replaced with half the RL and the mean and variance can be calculated normally. If 15% to 50% of the data are non-detect, two methods – the Kaplan-Meier or Robust ROS method – can be used to determine the sample mean and variance. Kaplan-Meier should not be used if all non-detect data have the same RL or if the maximum detected value is less than the highest RL of the non-detect data. When data do not follow a normal or transformed-normal distribution, or when more than 50% of the data are non-detect, nonparametric methods may be used.

Once the sample mean and variance are calculated for each constituent at each well (assuming no significant trends over time), the data from background wells should be compared for each constituent. The purpose of this exercise is to test for significant spatial variation and to decide between interwell and intrawell approaches. First, the equality of variance across background wells should be tested visually using box-and-whisker plots and/or analytically using Levene's test ($\alpha = 0.01$). If the variances appear equal, then one-way, parametric analysis of variance (ANOVA) should be conducted across background wells ($\alpha = 0.05$). If there are no statistically significant differences among the background wells, then interwell comparisons may be appropriate to evaluate SSIs.

If ANOVA indicates statistically significant differences among background wells, then spatial variability can be concluded. As with temporal trends, the existence of spatial variability could indicate an existing release from the CCR unit or another source, and further investigation may be needed to determine the source of this variability. If the spatial variability is not caused by a release from the CCR unit, then intrawell comparisons would be appropriate to evaluate SSIs.

3.2 Evaluating Statistically Significant Increases (SSIs)

After the initial eight rounds of background sampling, groundwater sampling and analysis should be conducted on a semiannual basis. The statistical evaluation of each groundwater monitoring event must be completed within 90 days of receiving the analytical results from the laboratory [30 TAC 352.931(a)].

The CCR rules only require analysis of the Appendix III constituents; however, analyzing additional constituents should be considered. Turbidity, dissolved oxygen, and oxidation-reduction potential (ORP), should be measured in the field in addition to pH. Other geochemical parameters, such as alkalinity, magnesium, potassium, sodium, iron, and manganese, should also be analyzed in the laboratory periodically (e.g., once every one to four years). Both the field and laboratory geochemical parameters can help identify the cause of any apparent change in groundwater quality. Additionally, analyzing for the Appendix IV constituents periodically should be considered to ensure the background dataset for these constituents is complete and current should assessment monitoring be needed. Statistical analyses should still be limited to the Appendix III constituents to help meet the dual goals of a SWFPR less than 10% per year and an adequate statistical power.

The CCR rules specifically list four methods acceptable for statistical analysis: ANOVA, tolerance intervals, prediction intervals, and control charts [30 TAC 352.931(a)]. Of these, the Unified Guidance recommends prediction limits combined with retesting for maintaining a low SWFPR while providing high statistical power (USEPA, 2009). Control charts are also acceptable as long as parametric methods can be used (i.e., the data or transformed data are normally distributed and the frequency of non-detects is at most 50%), as there is no nonparametric counterpart to the control chart. ANOVA is not recommended as the CCR rules mandate a minimum Type I error (α) of 0.05, at which it would be difficult to maintain an annual SWFPR less than 10%.

Prediction intervals and control charts can be used for both interwell and intrawell comparisons. For interwell comparisons, the pooled data from background monitoring wells should be used for the background dataset; for intrawell comparisons, the background dataset should be a subset of historical data at each monitoring well. (See **Section 3.4** below for procedures for updating background datasets.) Interwell comparisons are preferable, but they should only be used when there are no trends and no statistically significant population differences among background wells; otherwise, a significant test result may only indicate natural spatial variability instead of an SSI.

For prediction intervals, the upper prediction limit (UPL) is calculated according to the following formula:

$$\mathrm{UPL} = \bar{x} + ks \quad (5)$$

where:

$\bar{x} =$ mean concentration of the background dataset
$s =$ standard deviation of the background dataset
$k =$ multiplier based on the characteristics of the site and the statistical test

Values for k are chosen to maintain an SWFPR less than 10% and depend on the following: (1) number of wells, (2) number of constituents being evaluated, (3) size of the background dataset, (4) retesting regime, and (5) whether intrawell or interwell comparisons are being used. Values for k are listed in Tables 19-1, 19-2, 19-10, and 19-11 in Appendix D of the Unified Guidance (USEPA, 2009). If the k value that precisely matches site conditions does not appear in these tables, it can be estimated using the provided values by linear interpolation.

A one-of-two or one-of-three testing regime should be employed; i.e., if at least one sample in a series of two or three (respectively) does not exceed the UPL, then it can be concluded that an SSI has not occurred. In practice, if the initial result does not exceed the UPL, then no resampling is needed. If the initial result does exceed the UPL, then a resample should be collected prior to the next regularly scheduled sampling event at the monitoring well(s) and for the constituent(s) exceeding the UPL. Additional geochemical parameters, such as alkalinity, magnesium, potassium, sodium, iron, and manganese, should also be analyzed during resampling to help identify the source of the apparent increase. Enough time should elapse between the initial sample and each resample so that the samples are physically independent (**Section 2.1**). If both the initial result and the subsequent resample(s) exceed the UPL, then an SSI can be concluded.

Choosing between a one-of-two and a one-of-three testing regime should be done before conducting the statistical analysis, as the UPL calculation depends on the resampling regime selected. The choice should depend on site conditions and the size of the background dataset. First, if three physically independent samples cannot be collected in a six-month period, then a one-of-two testing regime should be used. A one-of-two testing regime may also be considered (a) if the background dataset has at least 16 data points or (b) if the CCR unit's monitoring well network has nine or fewer downgradient monitoring wells and a background dataset of at least 8 data points. Otherwise, a one-of-three testing regime should be employed to achieve an acceptably high statistical power and an acceptably low SWFPR.

If two physically independent samples cannot be collected in a six-month period, then a reduced monitoring frequency may be warranted. In this case, a demonstration must be made documenting the need for – and effectiveness of – a reduced monitoring frequency. This demonstration must be certified by a qualified professional engineer, and monitoring must still be done on at least an annual basis [30 TAC 352.941(a)].

The above procedure can be used wherever a mean and variance can be calculated for background data, including datasets that are transformed-normal and datasets where the mean and variance are calculated using the Kaplan-Meier or Robust ROS method. (Note that if data are transformed-normal, prediction intervals or control limits should first be calculated for the transformed data and then be transformed back into concentration terms.) Methods for determining prediction intervals where more than half of the background data are non-detect, where background data are neither normal nor transformed-normal, or where statistically significant trends or seasonal patterns exist are described below.

Different analyses can and should be used for different constituents and different monitoring wells within a CCR unit depending on the background data. For instance, if background wells have similar chloride data but different pH data, then interwell comparisons may be considered for chloride analysis and intrawell comparisons may be considered for pH analysis. If boron data are stable above the RL at MW-1 and mostly non-detect at MW-2, then it would be appropriate to use parametric prediction limits at MW-1 and non-parametric prediction limits at MW-2.

3.2.1 Most Background Data Are Non-Detect

If at least half of the data are non-detect, non-parametric prediction intervals with retesting should be used. In this method, the UPL is set either at the highest or at the second-highest concentration observed in the background dataset. A sufficiently large background dataset is paramount for this procedure to achieve an acceptably low SWFPR. To this end, the Kruskal-Wallis test should be performed on all background monitoring wells where at least 50% of the data for the constituent are non-detect to evaluate spatial variability. If the Kruskal-Wallis test indicates that there is no significant spatial variability among background wells, then the data from the background wells should be pooled to form a larger background dataset and thus to run an interwell test.

The choice between a one-of-two and a one-of-three testing regime should be based on the same criteria used for parametric testing, as described in **Section 3.2**. Choosing between using the highest or second-highest observed concentration as the UPL should depend in part on the size of the background dataset and the number of monitoring wells around the CCR unit. Assuming a one-of-three testing regime is used, the highest observed concentration should be used when the background dataset has fewer than 32 data points and the monitoring network has twelve or fewer wells. If there are at least thirteen wells, the highest observed concentration should be used when the background dataset has fewer than 48 data points. The second-highest observed concentration may be used for larger datasets.

If a one-of-two testing regime must be used due to aquifer conditions, then the highest observed concentration should be used (a) when the background dataset has fewer than 64 data points if there are fifteen or fewer wells or (b) when the background dataset has fewer than 88 data points if there are at least sixteen wells. The second-highest observed concentration may be used for larger datasets.

3.2.2 All Background Data Are Non-Detect

If all of the background data are non-detect, then the Double Quantification Rule should be used. According to this rule, if a sample and verification resample both exceed the PQL, then an SSI can be concluded. This can be thought of as setting the UPL at the PQL with a one-of-two testing regime. The possibility of false positives from this rule does not count against the calculated SWFPR because the false positive risk is small when all previous background data have been non-detect.

3.2.3 Background Data Are neither Normal nor Transformed-Normal

If background data are non-normal and cannot be transformed such that the transformed data do follow a normal distribution, then non-parametric prediction intervals with retesting should be used. In this method, the UPL is set either at the highest or at the second-highest concentration observed in the background dataset. A sufficiently large background dataset is paramount for this procedure to achieve an acceptably low SWFPR. To this end, the Kruskal-Wallis test should be performed on all background monitoring wells where at least 50% of the data for the constituent are non-detect to evaluate spatial variability. If the Kruskal-Wallis test indicates that there is no significant spatial variability among background wells, then the data from the background wells should be pooled to form a larger background dataset and thus to run an interwell test.

The choice between a one-of-two and a one-of-three testing regime should be based on the same criteria used for parametric testing, as described in **Section 3.2**. The choice between using the highest or second-highest observed concentration as the UPL should be based on the same considerations described in **Section 3.2.1**.

3.2.4 A Significant Temporal Trend Exists

True temporal trends in background data (i.e., absent a release from the facility or another source) are considered unlikely. Thus, a truncated dataset that does not exhibit a statistically significant trend may be used. In these cases, UPLs would be calculated as described in the previous sections.

Alternatively, if there is a significant temporal trend in the background data that is not attributable to a release, prediction limits can be constructed around a trend line. A trend line can be constructed parametrically using OLS linear regression. OLS linear regression should only be used when at most 15% of the data are non-detect, when regression residuals are normally distributed, and when the variance from the regression line does not change over time. If OLS linear regression is used, the UPL can be calculated according to the following equation:

$$\mathrm{UPL} = \widehat{x_0} + t_{1-\alpha,n-2} * s_e * \sqrt{1 + \frac{1}{n} + \frac{(t_0 - \bar{t})^2}{(n-1)s_t^2}} \quad (6)$$

where:

$\widehat{x_0} =$ regression-line estimate of the mean concentration at time t_0
$t_{1-\alpha,n-2} =$ one-tailed t-value at a confidence of 1 – α and n – 2 degrees of freedom
$s_e =$ standard error of the regression line
$n =$ number of samples in the background dataset
$t_0 =$ date the groundwater sample being compared to the UPL was collected
$\bar{t} =$ mean of the sampling dates in the background dataset
$s_t =$ standard deviation of the sampling dates in the background dataset

The choice between a one-of-two and a one-of-three testing regime should be based on the same criteria used when there is no significant trend, as described in **Section 3.2**. The choice of α depends on the retesting regime and the number of wells within the monitoring network. If a one-of-two testing regime is employed, an α = 0.02 is recommended if there are eighteen or fewer wells and an α = 0.01 is recommended if there are at least nineteen wells within the monitoring network. If a one-of-three testing regime is employed, an α = 0.05 should be used.

3.2.5 A Significant Seasonal Pattern Exists

If a statistically significant seasonal pattern exists and if there is a physical explanation for the seasonality, the background data should be deseasonalized using the procedure described in **Section 2.6**. The background UPL should be calculated based on the deseasonalized data. Results should then be deseasonalized by subtracting the difference between the seasonal mean and the grand mean before comparing results to the UPL.

3.3 Responding to an Identified SSI

If the statistical evaluation indicates that an SSI is present, TCEQ and any local pollution agencies with jurisdiction that had requested to be notified should be notified in writing within 14 days of the SSI determination [30 TAC 352.941(b)] and intention to make an alternative source demonstration [30 TAC 352.941(c)(1)]. The data should be evaluated to assess whether the SSI is caused by a release from the CCR unit. If it can be shown that the SSI resulted from a release from another source, from an error in sampling or analysis, or from natural variability, then a demonstration of this must be made in writing and certified by a qualified professional engineer within 90 days of completing the statistical evaluation [30 TAC 352.941(c)(2)]. (The statistical evaluation itself must be completed within 90 days of receiving the analytical data from the laboratory.) If this demonstration is not made within 90 days of completing the statistical evaluation or was not satisfactory to TCEQ, then the site must begin assessment monitoring [30 TAC 352.941(d)].

3.4 Updating Background

As recommended in the Unified Guidance, background values should be updated every four to eight measurements, assuming no confirmed SSI is identified (USEPA, 2009). (See **Section 4.4** for procedures for updating background if an SSI has been identified.) A Student's *t*-test or the nonparametric Mann-Whitney test (also known as the Wilcoxon rank-sum test) should be conducted to compare the set of new data points against the existing background dataset, as appropriate. An $\alpha = 0.05$ is recommended given the relatively small size of the datasets, particularly if background is updated every four measurements and particularly if the nonparametric Mann-Whitney test is used. However, an α as low as 0.01 may be used if the existing background dataset is sufficiently large (i.e., contains at least five data points) or if Student's *t*-test is used.

If the *t*-test or Mann-Whitney test does not indicate significant differences, the new data should be combined with the existing background data to calculate an updated UPL. Increasing the size of the background dataset will increase the power of subsequent statistical tests.

If the *t*-test or Mann-Whitney test indicates a statistically significant difference between the two populations, then the data should not be combined with the existing background data until further review determines the cause of the difference. If the differences appear to be caused by a release, then the previous background dataset should continue to be used. Absent evidence of a release, the new dataset should be considered more representative of present-day groundwater conditions and used for background. Note that the *t*-test or Mann-Whitney test is used to compare new data to the existing background dataset for the purposes of updating background. The tests are not used to determine whether an SSI is present or whether a release has occurred.

Periodically, spatial variability among background wells may be re-assessed to determine whether using an interwell or intrawell comparison is appropriate on a constituent-by-constituent basis, as outlined in **Section 3.1**.

SECTION 4

ASSESSMENT MONITORING

A CCR unit must begin assessment monitoring if an SSI is identified and is not attributed to some cause besides a release from the CCR unit. Assessment monitoring must begin within 90 days of identifying the SSI. During this 90-day period, the monitoring well network must be sampled for all Appendix IV constituents [30 TAC 352.951(a)]. Within 90 days of obtaining the results from this sampling event, all of the CCR unit wells must be sampled for all Appendix III constituents and those Appendix IV constituents that were detected during the initial assessment monitoring event [30 TAC 352.951(a)].

After these initial assessment monitoring events, the CCR unit wells must be sampled for all Appendix III constituents and previously detected Appendix IV constituents on a semiannual basis [30 TAC 352.951(a)]. Additionally, the CCR unit wells must be sampled for all Appendix IV constituents on an annual basis [30 TAC 352.951(a)].

As with detection monitoring, if physically independent samples cannot be collected on a semiannual basis, then a reduced monitoring frequency may be warranted. A demonstration must be made documenting the need for – and effectiveness of – a reduced monitoring frequency. This demonstration must be certified by a qualified professional engineer, and monitoring must still be done on at least an annual basis [30 TAC 352.951(a)].

GWPSs must be established for each detected Appendix IV constituent. The GWPS shall be the greater of the background concentration and the MCL established by the USEPA for that constituent [30 TAC 352.951(b)]. If no MCL exists for that constituent, then the background concentration shall be the GWPS for that constituent [30 TAC 352.951(b)(2)]. An upper tolerance limit (UTL) with 95% confidence and 95% coverage is often used as the representative background concentration.

A single site-wide GWPS would be recommended for each constituent based on pooled background data, even if natural spatial variability exists. If background data are not pooled, background concentrations and consequently GWPSs would vary from well to well. One difficulty with this approach is that concentrations at one monitoring well may exceed the location-specific GWPS and still be below levels considered as natural background at other locations within the site. The pooled background is often more interpretable and less cumbersome for developing a single background-based GWPS per constituent.

To determine whether a move to corrective action is warranted, a confidence interval constructed on recent data at each compliance monitoring well should be compared to the site-wide GWPS. When the lower confidence limit (LCL) of this interval exceeds the GWPS, an assessment of corrective measures may be justified.

When corrective action is not warranted, to return from assessment monitoring to detection monitoring, the CCR rules specify that all Appendix III and IV constituents must be at or below background levels for two consecutive sampling events and after written approval from TCEQ [30 TAC 352.951(c)]. Procedures for comparing results to background are described in **Section 4.2**.

4.1 Comparing Data to the GWPS

As stated in **Section 4**, the GWPS is set at the MCL or (if an MCL does not exist for that constituent or if background data are higher than the MCL) a value based on background data, whichever is greater. The UTL calculated from the background dataset is often used as the background value.

Tolerance intervals are similar to prediction intervals. However, whereas prediction intervals represent a range where a future result is expected to lie, tolerance intervals represent a range where a proportion of the population is expected to lie. Tolerance intervals have both an associated coverage (i.e., the proportion of the population covered by the tolerance interval) and an associated confidence. A coverage of 95% ($\gamma = 0.95$) and a confidence of 95% ($\alpha = 0.05$) are typically used.

The UTL is calculated similarly to the UPL:

$$\mathrm{UTL} = \bar{x} + \tau s \quad (7)$$

Similar to the UPL calculation, $\bar{x}$ is the mean concentration and s is the standard deviation of the background dataset. However, in this case the multiplier τ is different from that of the UPL calculation and is a function of the chosen coverage and confidence and the size of the background dataset. Values of τ are tabulated in Table 17-3 in Appendix D of the Unified Guidance (USEPA, 2009). As with prediction limits, if the τ value that precisely matches site conditions does not appear in these tables, it can be estimated using the provided values by linear interpolation.

Once a GWPS is established, new data must be evaluated to determine whether they are statistically significantly higher than the GWPS. The statistical analyses listed in 40 CFR 257.93(f), as included by reference in 30 TAC 352.931(a), are appropriate for comparing new data to a background dataset but are not appropriate for comparing new data to a fixed standard. For these cases, the Unified Guidance recommends using confidence intervals around the mean or median (USEPA, 2009).

Evaluations should be done for each detected Appendix IV constituent at each well. Data from different wells should not be pooled. When selecting which data to include in the recent dataset, time series plots of concentration data at each well should be created and visually inspected. Only data that exhibit the same behavior as recent data should be included. For instance, if the last eight arsenic results cluster around 9 μg/L and the previous eight results cluster around 4 μg/L, then only the eight most recent results should be used in the statistical analysis. Similarly, if chromium concentrations steadily increased over the last ten samples and were stable previously, then the statistical analysis should only use the ten most recent results and (since they are steadily increasing) should involve constructing a confidence interval around a trend line.

At the same time, datasets should also be sufficiently large to maintain statistical power. As many data points that exhibit the same behavior as recent data as possible should be included, including data collected prior to assessment monitoring (e.g., during the initial eight monitoring events). Ideally, datasets should have at least eight data points; in no case should a dataset have fewer than four data points.

If at least 50% of the recent dataset is non-detect, then a parametric confidence interval should not be used, and the procedure in **Section 4.1.1** should be followed.

New data will be evaluated for statistically significant temporal trends using (1) OLS linear regression with a *t*-test ($\alpha = 0.01$) on the slope and/or (2) the non-parametric Theil-Sen slope estimator with Mann-Kendall trend test ($\alpha = 0.05$, or 0.01 for larger datasets). Non-detect data are replaced with half the RL for these analyses. The OLS linear regression or Theil-Sen slope estimator will be used to estimate the rate of change (increasing, no change, or decreasing) over time for each constituent at each well. The *t*-test or Mann-Kendall statistic will be used to determine whether a trend is statistically significant. OLS linear regression should only be used when at most 15% of the data are non-detect, when regression residuals are normally distributed, and when the variance from the regression line does not change over time. The Theil-Sen/Mann-Kendall analysis requires at least five observations for meaningful results; at least eight observations are recommended. If a significant temporal trend exists, then a confidence interval around the trend line should be constructed as outlined in **Section 4.1.3**.

If the trend analysis does not indicate a statistically significant trend, then the mean and variance should be calculated. If fewer than 15% of the data are non-detect, then the non-detect data can be replaced with half the RL and the mean and variance can be calculated normally. Tolerance intervals are sensitive to the choice of population distribution. Normality should be confirmed using the Shapiro-Wilk (or Shapiro-Francía) test and/or probability plots, as described in **Section 2.2**. If data appear not to be normally distributed, data should be transformed so that the transformed data are normally distributed.

Two methods – the Kaplan-Meier or Robust ROS method – can be used to determine the sample mean and variance when 15% to 50% of the data are non-detect. Kaplan-Meier should not be used if all non-detect data have the same RL or if the maximum detected value is less than the highest RL of the non-detect data.

When most of the data are detections, data are normally distributed, and there is no significant temporal trend, the LCL is calculated according to the following equation:

$$\mathrm{LCL} = \bar{x} - t_{1-\alpha,n-1} * \frac{s}{\sqrt{n}} \quad (8)$$

where:

$\bar{x} =$ mean concentration of the recent dataset
$t_{1-\alpha,n-1} =$ one-tailed t-value at a confidence of 1 – α and at n – 1 degrees of freedom
$s =$ standard deviation of the recent dataset
$n =$ number of samples in the recent dataset

The *t* value must be chosen in such a way to balance the competing goals of a low false-positive rate and a high statistical power. The Unified Guidance recommends that the statistical test have at least 80% power ($1 - \beta = 0.8$) when the underlying mean concentration is twice the MCL (USEPA, 2009). Values of the minimum α (from which *t* values can be determined) are tabulated for this criterion for various values of n in Table 22-2 in Appendix D of the Unified Guidance (USEPA, 2009). The selected α should be the maximum of the value in Table 22-2 and 0.01.

If data are transformed normal, the LCL should first be calculated for the transformed data and then be transformed back into concentration terms. Correction factors are available but are not expected to be required. Alternatively, a non-parametric LCL can be used, as described in **Section 4.1.2**.

If data are non-normal and cannot be transformed such that the transformed data do follow a normal distribution, then a non-parametric LCL should be used, as described in **Section 4.1.2**.

If the LCL exceeds the GWPS, then a statistically significant exceedance can be concluded. If this occurs, the owner/operator is required to take several actions, including potentially moving the facility to corrective action, as described in **Section 4.3**.

4.1.1 Most Data Are Non-Detect

If background data are mostly non-detect, non-parametric tolerance intervals should be used. In these cases, the UTL is set at either the highest or second-highest concentration observed in the background dataset. If all background data are non-detect, then the UTL would default to the RL. The highest or second-highest observed concentration (or RL) effectively becomes the GWPS when this value is greater than the MCL or if an MCL does not exist for the constituent. However, if most background data are non-detect, then detected concentrations are likely less than the MCL (if the MCL exists), and the GWPS will be set at the MCL.

If recent data are mostly non-detect, non-parametric confidence intervals can be constructed around the median by ranking the data from least to greatest and setting the LCL equal to one of the lower values of data. The confidence can be calculated based on the rank of the data point used and the sample size. Confidence values are tabulated in Table 21-11 in Appendix D of the Unified Guidance for sample sizes up to 20 (USEPA, 2009).

However, if most of the recent data are non-detect, then the data point selected for the LCL will also be non-detect. If the RL is less than the GWPS, then no statistically significant exceedance has occurred.

GWPSs should only be determined for detected Appendix IV constituents [30 TAC 352.951(b)]. If all the data for a constituent are non-detect, no statistical evaluation need be performed.

4.1.2 Data Are neither Normal nor Transformed-Normal

If background data are non-normal and cannot be transformed such that the transformed data do follow a normal distribution, then non-parametric tolerance intervals should be used. In these cases, the UTL is set at either the highest or second-highest concentration observed in the background dataset.

If recent data are non-normal and cannot be transformed such that the transformed data do follow a normal distribution, non-parametric confidence intervals can be constructed around the median by ranking the data from least to greatest and setting the LCL equal to one of the lower values of data. The confidence can be calculated based on the rank of the data point used and the sample size. Confidence values are tabulated in Table 21-11 in Appendix D of the Unified Guidance for sample sizes up to 20 (USEPA, 2009).

4.1.3 A Significant Temporal Trend Exists

If recent data show a significant temporal trend, then an LCL below the trend line can be calculated according to the following equation:

$$\mathrm{LCL} = \widehat{x_0} - \sqrt{2s_e^2 * F_{1-2\alpha,2,n-2} * \left(\frac{1}{n} + \frac{(t_0 - \bar{t})^2}{(n-1)s_t^2}\right)} \quad (9)$$

where:

$\widehat{x_0} =$ regression-line estimate of the mean concentration at time t_0
$s_e =$ standard error of the regression line
$F_{1-2\alpha,2,n-2} =$ upper (1 - 2α)th percentage point from an F-distribution with 2 and n – 2 degrees of freedom
$n =$ number of samples in the recent dataset
$t_0 =$ date of the most recent groundwater sample
$\bar{t} =$ mean of the sampling dates in the recent dataset
$s_t =$ standard deviation of the sampling dates in the recent dataset

Note that the LCL is a function of time; to assess current compliance, the date of the most recent sample should be used for t_0. If and only if the LCL is greater than the GWPS at this time, then a statistically significant exceedance can be concluded. This equation can also be used to assess when the LCL will exceed the GWPS (assuming the current trend continues).

The same α that would have been selected if there were no significant trend (as described in **Section 4.1**) should be used here to determine the proper *F* value.

If the Theil-Sen method is used to determine the trend line, a computationally intensive technique known as bootstrapping can be used to determine the LCL. This procedure is described in Section 21.3.2 of the Unified Guidance (USEPA, 2009).

4.1.4 A Significant Seasonal Pattern Exists

If a statistically significant seasonal pattern exists in the background data and if there is a physical explanation for the seasonality, the background data should be deseasonalized using the procedure described in **Section 2.6**. The background-based UTL should be calculated based on the deseasonalized data, and the GWPS should be set at the MCL or (if an MCL does not exist for that constituent or if background data are higher than the MCL) the background-based UTL, whichever is greater.

Similarly, if a statistically significant seasonal pattern exists in compliance well data and if there is a physical explanation for the seasonality, the compliance well data should be deseasonalized using the procedure described in **Section 2.6**. The LCL to be compared to the GWPS should be calculated based on the deseasonalized compliance well data.

4.2 Comparing Data to Background

Assessment monitoring data must be compared to the GWPS to assess whether corrective action is warranted at the CCR unit (i.e. the LCL exceeds the GWPS). Additionally, assessment monitoring data may be compared to background data to assess whether the CCR unit can move from assessment monitoring back to detection monitoring.

To return from assessment monitoring to detection monitoring, the CCR rules specify that all Appendix III and IV constituents must be at or below background levels for two consecutive sampling events and written approval needs to be received from TCEQ [30 TAC 352.951(c)]. However, the analysis of all Appendix III and IV constituents is not required for every monitoring event. Therefore, all Appendix III and IV constituents should be collected during two consecutive sampling events on a periodic basis (e.g., every two to four years) and/or when statistical evaluation of assessment monitoring data suggests groundwater concentrations are at or below background levels.

A UTL can be used to represent “a reasonable maximum on likely background concentrations” for Appendix III and IV constituents (USEPA, 2009). As described previously, UTLs can be determined parametrically or non-parametrically. For the parametric intervals, the UTL is calculated according to Equation 7. Non-parametric UTLs can be determined by setting the UTL to the highest or second-highest measured background value. If all background data are non-detect, then non-detect results in compliance wells can be considered statistically similar to background. If a temporal trend in background data exists and is not attributable to a release, background data can be truncated so that no significant temporal trend is evident.

To determine whether Appendix III and IV constituents are at or below background levels, a confidence interval constructed on recent data at each compliance monitoring well should be compared to the background UTL for each constituent. When the upper confidence limit (UCL) is below the background UTL, then it can be concluded that concentrations are at or below background. If UCLs are less than background UTLs for every constituent at every monitoring well for two consecutive events, then the CCR unit may return to detection monitoring.

When most of the data are detections, data are normally distributed, and there is no significant temporal trend, the UCL is calculated according to the following equation:

$$\mathrm{UCL} = \bar{x} + t_{1-\alpha,n-1} * \frac{s}{\sqrt{n}} \quad (10)$$

where:

$\bar{x} =$ mean concentration of the recent dataset
$t_{1-\alpha,n-1} =$ one-tailed t-value at a confidence of 1 – α and at n – 1 degrees of freedom
$s =$ standard deviation of the recent dataset
$n =$ number of samples in the recent dataset

If recent data are mostly non-detect or are non-normal and cannot be transformed such that the transformed data follow a normal distribution, non-parametric confidence intervals can be constructed around the median by ranking the data from least to greatest and setting the UCL equal to one of the higher values of data. The confidence can be calculated based on the rank of the data point used and the sample size. Confidence values are tabulated in Table 21-11 in Appendix D of the Unified Guidance for sample sizes up to 20 (USEPA, 2009).

If recent data show a significant temporal trend, then a UCL above the trend line can be calculated according to the following equation:

$$\mathrm{UCL} = \widehat{x_0} + \sqrt{2s_e^2 * F_{1-2\alpha,2,n-2} * \left(\frac{1}{n} + \frac{(t_0 - \bar{t})^2}{(n-1)s_t^2}\right)} \quad (11)$$

where:

$\widehat{x_0} =$ regression-line estimate of the mean concentration at time t_0
$s_e =$ standard error of the regression line
$F_{1-2\alpha,2,n-2} =$ upper (1 - 2α)th percentage point from an F-distribution with 2 and n – 2 degrees of freedom
$n =$ number of samples in the recent dataset
$t_0 =$ date of the most recent groundwater sample
$\bar{t} =$ mean of the sampling dates in the recent dataset
$s_t =$ standard deviation of the sampling dates in the recent dataset

In all cases, the choice of τ and α (for parametric UTLs and UCLs, respectively), the choice of the highest or second-highest data point (for non-parametric UTLs and UCLs), etc. should be made based on sound statistical judgment and site characteristics (e.g., size of datasets, number of monitoring wells, etc.).

4.3 Required Responses to the Results of the Statistical Evaluation

If the statistical evaluation demonstrates that the concentrations of all Appendix III and Appendix IV constituents are at or below background levels for two consecutive sampling events, then the CCR unit may return to detection monitoring with written approval from TCEQ [30 TAC 352.951(c)]. A notification that the CCR unit is returning to detection monitoring must be placed in the facility's operating record.

If the statistical evaluation demonstrates that some Appendix III or Appendix IV constituents are at concentrations above background levels but there are no statistically significant exceedances of GWPSs, then the CCR unit must remain in assessment monitoring [30 TAC 352.951(a)].

If the statistical evaluation demonstrates that an Appendix IV constituent is present at a statistically significant level (SSL) above its GWPS (i.e., if the LCL exceeds the GWPS), then the owner/operator must:

- Provide a written notification to TCEQ and any local pollution agencies with jurisdiction that had requested to be notified within 14 days of the determination [30 TAC 352.951(d)];
- Include a notification in the facility's operating record that identifies the constituents exceeding GWPSs [30 TAC 352.951(a)];

- Characterize the nature and extent of the release, including installing monitoring wells needed to delineate the plume, installing a monitoring well at the downgradient property boundary, quantifying the nature and the amount of the release, and sampling all wells for Appendix III and detected Appendix IV constituents [30 TAC 352.951(a)];

- If the plume has migrated off-site, notify property owners overlying the plume [30 TAC 352.951(a)]; and

- Either begin an assessment of corrective measures or demonstrate that the SSL is not due to a release from the CCR unit within 90 days of completing the statistical evaluation [30 TAC 352.951(e)]. This demonstration must be made in writing, certified by a qualified professional engineer, and submitted to TCEQ and any local pollution agency with jurisdiction that had requested to be notified [30 TAC 352.951(e)]. The CCR rules require the previous four actions to be taken even if it can be demonstrated that the SSL is not due to a release from the CCR unit.

Reporting requirements for assessment monitoring are summarized in **Section 6.2**.

4.4 Updating Background

Care should be taken when updating background during assessment monitoring since, by definition, an SSI over background has already occurred. Data that appear to be affected by a release from the CCR unit should not be included in updated background datasets. However, it may be possible to update some background datasets (e.g., constituents not associated with a release, wells upgradient of the CCR unit, etc.). Formal updating of Appendix III and Appendix IV constituents may be considered when there are at least four new points.

Data should be reviewed every four to eight measurements to assess the possibility of updating background datasets. Professional judgment should first be applied; any data that appear to be affected by a release should be excluded from the background update, even if there is no statistically significant difference between the new data and the existing background data.

For data that appear not to be affected by a release, a Student's *t*-test or Mann-Whitney test should be conducted to compare the set of new data points against the existing background dataset. If the *t*-test or Mann-Whitney test corroborates that there are no significant differences, the new data should be combined with the existing background data to create an updated and expanded background dataset. Increasing the size of the background dataset will increase the power of subsequent statistical tests.

If the *t*-test or Mann-Whitney test indicates a statistically significant difference between the two datasets, then it should be considered that the difference results from a release and the existing background dataset should continue to be used. If and only if there is evidence to suggest that the difference is not related to a release from the CCR unit, then the newer set of measurements should be used for background so that resulting statistical limits are representative of present-day groundwater quality conditions.

Periodically, spatial variability among background wells may be re-assessed to determine whether using an interwell or intrawell comparison is appropriate on a constituent-by-constituent basis, as outlined in **Section 3.1**.

SECTION 5

CORRECTIVE ACTION MONITORING

A CCR unit must begin an assessment of corrective measures if an SSL is identified and is not attributed to some cause other than a release from the CCR unit. The assessment of corrective measures must begin within 90 days of identifying the SSL [30 TAC 352.951(f)]. Based on the results of the corrective measures assessment, a remedy must be selected as soon as feasible [30 TAC 352.971(a)]. A schedule for implementing and completing the remedial activities must be included in the remedy selection [30 TAC 352.971(a)]. The owner/operator must begin remedial activities within 90 days of selecting a remedy, and a corrective action groundwater monitoring program must be implemented based on the schedule established as part of the remedy selection [30 TAC 352.981(a)].

The corrective action monitoring program must [30 TAC 352.981(a)]:

- Meet the requirements of an assessment monitoring program;
- Document the effectiveness of the remedy; and
- Demonstrate compliance with the GWPS.

The statistical methods used in corrective action monitoring are similar to those used in assessment monitoring. For each detected Appendix IV constituent, a GWPS is set at the MCL or (if an MCL does not exist for that constituent or if background data are higher than the MCL) a value based on background data, whichever is greater. A confidence interval is constructed based on recent data at each compliance well, and the confidence interval is compared to the site-wide GWPS. However, in assessment monitoring, the presumption is that a release has not occurred, and a release is concluded when average concentrations are higher than the GWPS (i.e., when the *lower* confidence limit [LCL] is *greater* than the GWPS). If a CCR unit is in corrective action monitoring, then evidence of a release has already been identified. Therefore, in corrective action monitoring, the presumption is that a release has occurred, and the conclusion that the remedy has successfully decreased concentrations below the GWPS is made when average concentrations are less than the GWPS (i.e., when the *upper* confidence limit [UCL] is *less* than the GWPS). (Note that this presumption only applies to well-constituent pairs where an SSL has previously been identified. Well-constituent pairs in assessment monitoring where an SSL has not been identified effectively remain in assessment monitoring until the entire unit returns to detection monitoring.)

A remedy is considered complete when, among other things, confidence intervals constructed for Appendix IV constituents for wells identified with SSLs have not exceeded the GWPS for three consecutive years [30 TAC 352.981(a)]. In this instance, a return to assessment monitoring would be warranted.

Upon completion of the remedy, the owner/operator must prepare a notification stating that the remedy is complete. The notification must be certified by a qualified professional engineer and submitted to TCEQ for approval before placement in the operating record [30 TAC 352.981(a)].

Prior to returning to assessment monitoring, documentation must be submitted to TCEQ that includes:

- Analytical data prepared and presented in accordance with 30 TAC 352.931 [30 TAC 352.981(b)(1)];
- A narrative discussing how the requirements of this section have been fulfilled for the impacted property [30 TAC 352.981(b)(2)]; and
- A description of the volume and final disposal location, and copies of waste manifests or documentation of disposal for waste or environmental media that had been removed from the impacted property [30 TAC 352.981(b)(3)].

The return to assessment monitoring must be approved by TCEQ in writing.

Otherwise, the owner/operator should follow the reporting requirements for assessment monitoring, as summarized in **Section 6.2**.

5.1 Comparing Data to the GWPS

As stated in **Section 5**, the GWPS is set at the MCL or (if an MCL does not exist for that constituent or if background data are higher than the MCL) a value based on background data, whichever is greater. The UTL calculated from the background dataset is often used as the background value. The UTL is calculated as described in **Section 4.1**. Methods for updating background are described in **Section 4.4**.

For well-constituent pairs in corrective action monitoring, new data must be evaluated to determine whether they are statistically significantly lower than the GWPS. The statistical analyses listed in 40 CFR 257.93(f), as included by reference in 30 TAC 352.931(a) are appropriate for comparing new data to a background dataset but are not appropriate for comparing new data to a fixed standard. For these cases, the Unified Guidance recommends using confidence intervals around the mean or median (USEPA, 2009).

When selecting which data to include in the recent dataset, time series plots of concentration data at each well should be created and visually inspected. Only data that exhibit the same behavior as recent data should be included. For instance, if the last eight arsenic results cluster around 9 µg/L and the previous eight results cluster around 4 µg/L, then only the eight most recent results should be used in the statistical analysis. Similarly, if chromium concentrations steadily increased over the last ten samples and were stable previously, then the statistical analysis should only use the ten most recent results and (since they are steadily increasing) should involve constructing a confidence interval around a trend line.

At the same time, datasets should also be sufficiently large to maintain statistical power. As many data points that exhibit the same behavior as recent data as possible should be included, including data collected prior to assessment monitoring (e.g., during the initial eight monitoring events). Ideally, datasets should have at least eight data points; in no case should a dataset have fewer than four data points.

If at least 50% of the recent dataset is non-detect, then a parametric confidence interval should not be used, and the procedure in **Section 5.1.1** should be followed.

New data will be evaluated for statistically significant temporal trends using (1) OLS linear regression with a *t*-test ($\alpha = 0.01$) on the slope and/or (2) the non-parametric Theil-Sen slope estimator with Mann-Kendall trend test ($\alpha = 0.05$, or 0.01 for larger datasets). Non-detect data are replaced with half the RL for these analyses. The OLS linear regression or Theil-Sen slope estimator will be used to estimate the rate of change (increasing, no change, or decreasing) over time for each constituent at each well. The *t*-test or Mann-Kendall statistic will be used to determine whether a trend is statistically significant. OLS linear regression should only be used when at most 15% of the data are non-detect, when regression residuals are normally distributed, and when the variance from the regression line does not change over time. The Theil-Sen/Mann-Kendall analysis requires at least five observations for meaningful results; at least eight observations are recommended. If a significant temporal trend exists, then a confidence interval around the trend line should be constructed as outlined in **Section 5.1.3**.

If the trend analysis does not indicate a statistically significant trend, then the mean and variance should be calculated. If fewer than 15% of the data are non-detect, then the non-detect data can be replaced with half the RL and the mean and variance can be calculated normally. Tolerance intervals are sensitive to the choice of population distribution. Normality should be confirmed using the Shapiro-Wilk (or Shapiro-Francía) test and/or probability plots, as described in **Section 2.2**. If data appear not to be normally distributed, data should be transformed so that the transformed data are normally distributed.

Two methods – the Kaplan-Meier or Robust ROS method – can be used to determine the sample mean and variance when 15% to 50% of the data are non-detect. Kaplan-Meier should not be used if all non-detect data have the same RL or if the maximum detected value is less than the highest RL of the non-detect data.

When most of the data are detections, data are normally distributed, and there is no significant temporal trend, the UCL is calculated according to the following equation:

$$\text{UCL} = \bar{x} + t_{1-\alpha,n-1} * \frac{s}{\sqrt{n}} \quad (10)$$

where:

$\bar{x} =$ mean concentration of the recent dataset
$t_{1-\alpha,n-1} =$ one-tailed t-value at a confidence of 1 – α and at n – 1 degrees of freedom
$s =$ standard deviation of the recent dataset
$n =$ number of samples in the recent dataset

The *t* value must be chosen in such a way to balance the competing goals of a low false-positive rate and a high statistical power. The Unified Guidance recommends that the statistical test have at least 80% power ($1 - \beta = 0.8$) when the underlying mean concentration is twice the MCL (USEPA, 2009). Values of the minimum α (from which *t* values can be determined) are tabulated for this criterion for various values of n in Table 22-2 in Appendix D of the Unified Guidance (USEPA, 2009). The selected α should be the maximum of the value in Table 22-2 and 0.01.

If data are transformed normal, the UCL should first be calculated for the transformed data and then be transformed back into concentration terms. Correction factors are available but are not expected to be required. Alternatively, a non-parametric UCL can be used, as described in **Section 5.1.2**.

If data are non-normal and cannot be transformed such that the transformed data do follow a normal distribution, then a non-parametric UCL should be used, as described in **Section 5.1.2**.

5.1.1 Most Data Are Non-Detect

If recent data are mostly non-detect, non-parametric confidence intervals can be constructed around the median by ranking the data from least to greatest and setting the UCL equal to one of the higher values of data. The confidence can be calculated based on the rank of the data point used and the sample size. Confidence values are tabulated in Table 21-11 in Appendix D of the Unified Guidance for sample sizes up to 20 (USEPA, 2009).

5.1.2 Data Are neither Normal nor Transformed-Normal

If recent data are non-normal and cannot be transformed such that the transformed data do follow a normal distribution, non-parametric confidence intervals can be constructed around the median by ranking the data from least to greatest and setting the UCL equal to one of the higher values of data. The confidence can be calculated based on the rank of the data point used and the sample size. Confidence values are tabulated in Table 21-11 in Appendix D of the Unified Guidance for sample sizes up to 20 (USEPA, 2009).

5.1.3 A Significant Temporal Trend Exists

If recent data show a significant temporal trend, then a UCL above the trend line can be calculated according to the following equation:

$$\mathrm{UCL} = \widehat{x_0} + \sqrt{2s_e^2 * F_{1-2\alpha,2,n-2} * \left(\frac{1}{n} + \frac{(t_0 - \bar{t})^2}{(n-1)s_t^2}\right)} \quad (11)$$

where:

$\widehat{x_0} =$ regression-line estimate of the mean concentration at time t_0
$s_e =$ standard error of the regression line
$F_{1-2\alpha,2,n-2} =$ upper (1 - 2α)th percentage point from an F-distribution with 2 and $n - 2$ degrees of freedom
$n =$ number of samples in the recent dataset
$t_0 =$ date of the most recent groundwater sample
$\bar{t} =$ mean of the sampling dates in the recent dataset
$s_t =$ standard deviation of the sampling dates in the recent dataset

Note that the UCL is a function of time; to assess current compliance, the date of the most recent sample should be used for t_0. If and only if the UCL is less than the GWPS at this time, then it can be concluded that the remedy has successfully decreased concentrations below the GWPS. This equation can also be used to assess when the UCL will decrease below the GWPS (assuming the current trend continues).

The same α that would have been selected if there were no significant trend (as described in **Section 5.1**) should be used here to determine the proper *F* value.

If the Theil-Sen method is used to determine the trend line, a computationally intensive technique known as bootstrapping can be used to determine the UCL. This procedure is described in Section 21.3.2 of the Unified Guidance (USEPA, 2009).

5.1.4 A Significant Seasonal Pattern Exists

If a statistically significant seasonal pattern exists in compliance well data and if there is a physical explanation for the seasonality, the compliance well data should be deseasonalized using the procedure described in **Section 2.6**. The UCL to be compared to the GWPS should be calculated based on the deseasonalized compliance well data.

SECTION 6

REPORTING REQUIREMENTS

The CCR rule specifies reporting requirements throughout the monitoring process. Throughout the process, the required documentation is required to be posted both to the site's operating record and to a public internet set for review. As required by 30 TAC 352.931(a), the chosen statistical methods described within this SAP are certified by a qualified professional engineer as appropriate for groundwater evaluation (**Section 7**).

6.1 Annual Groundwater Monitoring and Corrective Action Report

By January 31 of each year, all existing facilities must submit an Annual Groundwater Monitoring and Corrective Action Report (Annual Report) [30 TAC 352.901(a)]. The Annual Report should be prepared and posted to both the site operating record and the public internet site. The Annual Report must also be submitted to TCEQ for approval no later than 30 days after the report has been placed on the facility's operating record [30 TAC 352.902].

The Annual Report should document site status, summarize key actions taken, describe problems encountered and their resolutions, and project key actions to be taken for the following year. The Annual Report should also include [30 TAC 352.901(a)]:

- A figure showing the CCR unit and the monitoring well network;
- An identification of monitoring wells installed or abandoned during the preceding year and the rationale for doing so;
- A summary of groundwater samples collected, which wells were sampled, what dates the samples were collected, and whether the samples were collected for detection monitoring or assessment monitoring; and
- A discussion of any transition between monitoring programs (i.e., detection monitoring vs. assessment monitoring vs. corrective action monitoring.

If appropriate, the Annual Report should detail a demonstration for an alternative groundwater sampling frequency. If no SSIs are identified during each sampling event, an updated Annual Report should be submitted yearly.

6.2 Detection Monitoring

If SSIs are identified, TCEQ and any local pollution agencies with jurisdiction that had requested to be notified should be notified in writing within 14 days of the SSI determination [30 TAC 352.941(b)] and intention to make an alternative source demonstration [30 TAC 352.941(c)(1)]. The facility should demonstrate within 90 days of the detection, where possible, that SSIs over background are not due to a release from the facility, along with a certification by a qualified professional engineer that the information is accurate. The report documenting this demonstration must be submitted to TCEQ for approval and to any local pollution agencies with jurisdiction that had requested to be notified [30 TAC 352.941(c)(2)]. Additionally, the report should be included in the Annual Report. If the SSIs over background are attributed to a release from the facility, the facility should prepare and place in the operating record within 90 days a notification stating that an assessment monitoring program has been established [30 TAC 352.941(a)]. Additionally, the assessment monitoring program must be approved by TCEQ [30 TAC 352.941(d)].

6.3 Assessment Monitoring

If an assessment monitoring program is in place, the Annual Report must also include [30 TAC 352.951(a)]:

- Analytical results for Appendix III and detected Appendix IV constituents,
- Background concentrations for all Appendix III and Appendix IV constituents, and
- GWPSs established for detected Appendix IV constituents.

The semiannual analytical results for Appendix III and detected Appendix IV constituents must also be posted to the facility's operating record within 90 days of receipt [30 TAC 352.951(a)]. If a constituent is detected at an SSL above its GWPS, a notification must be reported to the site's operating record [30 TAC 352.951(a)]. The owner or operator must also submit a written notification to TCEQ and any local pollution agencies with jurisdiction that had requested to be notified within 14 days identifying the SSLs and specifying a plan and schedule for analyzing the release and for developing appropriate corrective action [30 TAC 352.951(d)].

Additionally, the facility must notify any person who owns or resides on land that directly overlies any part of an off-site contaminant plume and record the notifications in the facility's operating record. Within 90 days, the facility must either initiate an assessment of corrective measures or demonstrate that the SSL is not due to a release from the CCR unit. The demonstration must be supported by a report certified by a qualified professional engineer and submitted to TCEQ for approval [30 TAC 352.951(e)].

If the facility determines it may return to detection monitoring and received approval from TCEQ, the facility should issue a notification to the operating record and public site within 30 days [30 TAC 352.1301(a)].

6.4 Corrective Action Monitoring

If a corrective action monitoring program is in place, it must meet the requirements of an assessment monitoring program [30 TAC 352.981(a)]. Thus, the reporting requirements for corrective action monitoring will be similar to assessment monitoring, as described in **Section 6.3**. Upon completion of the remedy, the facility must prepare a notification that the remedy has been completed [30 TAC 352.981(b)]. The notification must be certified by a qualified professional engineer, approved by TCEQ, and placed in the operating record [30 TAC 352.981(a) and 30 TAC 352.981(c)].

SECTION 7

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

By means of this certification, I certify that I am a qualified professional engineer as defined in 30 TAC 352.3(a), that I have reviewed this SAP, and that the statistical methods described therein are appropriate and meet the requirements of 30 TAC 352.931.

American Electric Power Service Corporation
Texas Registered Engineering Firm No. F-3341

DAVID ANTHONY MILLER

Printed Name of Qualified Professional Engineer

STATE OF TEXAS
DAVID ANTHONY MILLER
112498
LICENSED
PROFESSIONAL ENGINEER

David Anthony Miller

Signature

112498	TEXAS	12.09.21
Registration No.	Registration State	Date

SECTION 8

REFERENCES

Electric Power Research Institute. 2015. Groundwater Monitoring Guidance for the Coal Combustion Residuals Rule. Palo Alto, CA. 3002006287.

Environmental Protection Agency. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance. EPA 530/R-09-007.

Texas Administrative Code. Coal Combustion Residuals Waste Management. Title 30, Part 1, Chapter 352. (2021).

TABLES

Table 1: Monitored Constituents under the CCR Rule

Appendix III Constituents	Appendix IV Constituents
Boron	Antimony
Calcium	Arsenic
Chloride	Barium
Fluoride	Beryllium
pH	Cadmium
Sulfate	Chromium
Total Dissolved Solids (TDS)	Cobalt
	Fluoride
	Lead
	Lithium
	Mercury
	Molybdenum
	Radium 226+228
	Selenium
	Thallium

ATTACHMENT A

Record of Revisions

ATTACHMENT A

RECORD OF REVISIONS

Revision 1 (October 2020)

- Added statistical procedures used to implement corrective action monitoring (Section 5) and reporting requirements for corrective action monitoring (Section 6.5).

- Added references to CCR rule-specified screening levels for constituents that do not have an MCL (i.e., cobalt, lead, lithium, and molybdenum) in Sections 2.5, 4, 4.1, and 5.1.

- Added statistical procedures used to evaluate whether a seasonal pattern exists and to deseasonalize data (Sections 2.6, 3.2.5, 4.1.4, and 5.1.4).

- Specified that the Mann-Kendall trend test can use an α of 0.01 for sufficiently large datasets (Sections 3.1, 4.1, and 5.1).

- Removed references to control limits in Section 3.2 because prediction limits are generally being used to conduct detection monitoring.

- Removed references to using trend tests to evaluate SSIs at the end of Section 3.2 because prediction limits are generally being used to conduct detection monitoring.

- Clarified that non-parametric limits should be used when data are non-normal and cannot be transformed such that the transformed data do follow a normal distribution (Sections 3.2.3, 4.1.2, and 5.1.2).

- Referred to the Wilcoxon rank-sum/Mann-Whitney test as the Mann-Whitney test to match the statistical output from Sanitas (Sections 3.4 and 4.4).

- Clarified that a background dataset that contains at least five data points is sufficiently large to use an α as low as 0.01 to conduct the Mann-Whitney test as part of a background update, in line with recommendations in the Unified Guidance (Section 3.4).

- Clarified the procedure to be used if the Mann-Whitney test indicates a statistically significant difference between existing background data and newer data (Sections 3.4 and 4.4).

- Clarified that spatial variability among background wells may be assessed periodically as part of a background update because spatial variability is evaluated when background values are initially established (Sections 3.4 and 4.4).

- Added statistical procedures to determine when Appendix III and Appendix IV concentrations are at or below background to evaluate whether units in assessment monitoring may return to detection monitoring (Section 4.2).

- Generally replaced “parameter” with “constituent”.

- Added references to the Unified Guidance and the CCR rule throughout the document.

- Made minor grammatical and stylistic changes throughout the document.

Revision 2 (November 2021)

- Removed references to screening levels for constituents that do not have an MCL.

- Updated references from the Code of Federal Regulations to Texas Administrative Code.

4.5 – Statistical Analysis Summary – Primary Bottom Ash Pond, January 15, 2018

Purpose of Statistical Analysis Summary Report

During the initial phase of ground water monitoring, the CCR rule requires AEP to collect at least eight independent samples from at least one up-gradient and three downgradient wells for 21 substances listed in the CCR rule. The CCR rule also requires us to select a statistical method that will be used to evaluate the samples in the later phases of the ground water monitoring program. The Statistical Plan, which has been posted to AEP's CCR website, describes the methods selected by AEP. *See* AEP's Statistical Analysis Plans.

Each **Statistical Analysis Summary Report** is based on the results of the 8 independent samples that were collected by October 17, 2017, and reported in the Annual Groundwater Monitoring Report. Using the statistical methods chosen by AEP, the samples were evaluated to eliminate outliers, determine variability and general trends in the data, and establish background values for: boron, calcium chloride, fluoride, pH, sulfate, and total dissolved solids. Appendix IV substances were evaluated for purposes of identifying outliers and understanding data trends.

A subsequent sample taken during the first detection monitoring sampling event was also compared using the proper statistical methods to the background values that were established for these seven substances from the eight independent samples. A second or third re-sampling event occurred, and the results compared using the same methods. This work is reported in the memorandum included in attachment A. If confirmed, AEP will be required to enter the next phase of monitoring. The results of future sampling will be further analyzed to target any specific substances for which ongoing monitoring or potential corrective action is required.

STATISTICAL ANALYSIS SUMMARY
PRIMARY BOTTOM ASH POND
J. Robert Welsh Plant
Pittsburg, Texas

Submitted to

AEP AMERICAN ELECTRIC POWER

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ANOVA	Analysis of Variance
BAPs	Bottom Ash Ponds
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Value
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LFB	Laboratory Fortified Blank
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blank
NELAP	National Environmental Laboratory Accreditation Program
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SWFPR	Site-Wide False-Positive Rate
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Primary Bottom Ash Pond (PBAP), an existing CCR unit at the J. Robert Welsh Power Plant located in Pittsburg, Texas.

Eight monitoring events were completed prior to October 17, 2017 to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule. Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. The background data were reviewed for outliers, which were removed (when appropriate) prior to calculating upper prediction limits (UPLs) for each Appendix III parameter to represent background values. Additional quality assurance oversight was provided by Dr. Kirk Cameron of MacStat Consulting, Ltd.

A detection monitoring event was completed on October 6, 2017 at the PBAP. This sampling event obtained the first sample for the 1-of-2 prediction interval statistical test used for detection monitoring. The results of this sampling event are included in this report.

SECTION 2

PRIMARY BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the background monitoring program, eight sets of samples were collected for analysis from each background and downgradient well. A summary of data collected during background sampling and the first sample for the 1-of-2 prediction interval statistical test used for detection may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.5.32 statistics software. The export was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

The groundwater analytical data used to establish background groundwater quality for each constituent required in detection monitoring are summarized in Table 1. Statistical analyses for the PBAPB were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Results for all completed statistical tests are provided in Attachment A.

Time series plots of Appendix III and IV parameters are included in Attachment A. Mann-Kendall analyses ($\alpha = 0.01$) were conducted to evaluate trends in the background data. Barium, calcium, and sulfate were found to be significantly decreasing at downgradient well AD-8. No other significant increasing or decreasing trends were observed for other Appendix III parameters or at other monitoring wells.

2.2.1 Background Outlier Evaluation

Potential outliers were identified using Tukey's outlier test; i.e., data points were considered potential outliers if they met one of the following criteria:

$$x_i < \tilde{x}_{0.25} - 3 \times IQR \quad (1)$$

or

$$x_i > \tilde{x}_{0.75} + 3 \times IQR \quad (2)$$

where:

$x_i =$ individual data point
$\tilde{x}_{0.25} =$ first quartile
$\tilde{x}_{0.75} =$ third quartile
$IQR =$ the interquartile range $= \tilde{x}_{0.75} - \tilde{x}_{0.25}$

Background well data were first pooled and Tukey's outlier test was performed on the pooled dataset. For the downgradient wells, Tukey's outlier test was applied individually to each downgradient well.

Data that were evaluated as potential outliers are summarized in Attachment A. Tukey's outlier test indicated four potential outliers for Appendix III parameters, which are summarized in Table 2. Next, the data were reviewed to identify possible sources of errors or discrepancies, including data recording errors, unusual sampling conditions, laboratory quality, or inconsistent sample turbidity. The findings of this data review are summarized below.

In one instance, a primary sample concentration was replaced with that of the duplicate sample. For the January 20, 2017 sample for boron at downgradient well AD-9, the reported concentration of 0.312 was replaced with the reported boron concentration for the duplicate sample of 0.283 mg/L. While the duplicate sample was considered more representative based on the reported concentrations from the other background sampling events, it was also identified as an outlier and removed from the dataset. The removal of the anomalously high boron outlier would result in more conservative (i.e., lower) background levels should interwell tests be run for boron, and its removal is recommended by USEPA's *Unified Guidance* (USEPA, 2009).

The reported total dissolved solids (TDS) concentrations of 367 mg/L and 88 mg/L for the September 30, 2017 and February 24, 2017 sampling events at downgradient well AD-15 were both identified as potential outliers. These values were not removed from the dataset as they were only slightly outside the Tukey's test cutoffs and they appeared similar in concentration to neighboring wells.

The remaining outlier for calcium at downgradient well AD-15 was anomalously high and was removed from the dataset. Removal of this outliers would result in the generation of more conservative (i.e., lower) background values, and removing this outlier is recommended by USEPA's *Unified Guidance* (USEPA, 2009).

2.2.2 Establishment of Background Levels

Analysis of variance (ANOVA) was conducted to determine whether spatial variation was present among the three background wells (Attachment A). ANOVA indicated no significant variation among the three background wells for pH. Consequently, interwell tests were used for pH. Significant variation was observed for boron, calcium, chloride, fluoride, sulfate, and TDS. Therefore, the appropriateness of using intrawell tests was evaluated for these parameters at the Welsh PBAP.

Intrawell tests presume that the groundwater quality in the downgradient wells was not initially impacted by the CCR unit. To test this presumption, the data from the background wells were pooled, and the data from each downgradient well were compared to a pooled background value. Tolerance limits were calculated using the pooled background data for boron, calcium, chloride, fluoride, sulfate, and TDS. Parametric tolerance limits with 99% confidence and 95% coverage were calculated for boron and chloride; non-parametric tolerance limits were calculated for calcium, fluoride, sulfate, and TDS, given the apparent non-normality of the pooled background datasets for these four parameters. Confidence intervals were calculated for each of these six parameters at each downgradient monitoring well. If the lower confidence limit from a downgradient well exceeded the upper tolerance limit for the pooled background data, it was concluded that downgradient groundwater concentrations were above background concentrations. In these instances, intrawell tests would not be appropriate. However, these analyses indicated no significant exceedances for calcium, chloride, fluoride, sulfate, and TDS; elevated concentrations of boron were observed. (Non-parametric analyses indicated elevated concentrations of both boron and chloride in downgradient wells.) Therefore, intrawell tests were used to evaluate potential statistically significant increases (SSIs) for calcium, chloride, fluoride, sulfate, and TDS. Parametric interwell tests were used to evaluate potential SSIs for boron and pH.

After equality of variance was tested and identified outliers were removed (where appropriate), a parametric or non-parametric analysis was selected based on the distribution of the data and the frequency of non-detect data. Estimated results less than the practical quantitation limit (PQL) – i.e., “J-flagged” data – were considered detections and the estimated results were used in the statistical analyses. Non-parametric analyses were selected for datasets with at least 50% non-detect data or datasets that could not be normalized. Parametric analyses were selected for datasets (either transformed or untransformed) that passed the Shapiro-Wilk / Shapiro-Francía test for normality. The Kaplan-Meier non-detect adjustment was applied to datasets with between 15% and 50% non-detect data. For datasets with fewer than 15% non-detect data, non-detect data were replaced with one half of the PQL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment A.

Upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. To conduct the intrawell tests for calcium, chloride, fluoride, sulfate, and TDS, a separate UPL was calculated for each downgradient well for each of these parameters. To conduct the interwell tests for boron and pH, a single prediction interval was calculated for each of these parameters using pooled data from the three background wells. The background data used for the UPL calculations are summarized in Table 1; the calculated UPLs are summarized in Table 3.

Although significant decreasing trends in calcium and sulfate concentrations were observed at downgradient well AD-8, the UPLs were calculated as if no trend were present; i.e., the dataset was not limited to more recent data nor was the prediction interval constructed around a trendline. This was done because the relative changes in calcium and sulfate concentrations are low relative to the absolute calcium and sulfate concentrations at this well. The possibility of ongoing decreases and the need for truncating the datasets for calcium and sulfate at AD-8 will be reevaluated after additional data are collected.

UPLs were calculated for a one-of-two retesting procedure; i.e., if at least one sample in a series of two does not exceed the UPL, then it can be concluded that an SSI has not occurred. In practice, where initial results did not exceed the UPL, a second sample was not collected. The one-of-two retesting procedure allowed achieving an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less. Power curves were constructed for the interwell and intrawell parametric tests and are compared with the EPA Reference Power Curve in Attachment A. The power curves associated with the statistical tests for the PBAP exceed the EPA Reference Power Curve at 3 and 4 standard deviations; this is considered a "good" level of statistical power according to USEPA's *Unified Guidance* (USEPA, 2009).

2.2.3 Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the J. Robert Welsh Primary Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

DAVID ANTHONY MILLER
112498

112498
License Number

TEXAS
Licensing State

01.15.18
Date

American Electric Power Service Corporation
Texas Registered Engineering Firm No.
F-3341

2.3 Conclusions

Eight monitoring events and collection of the first sample for the 1-of-2 prediction interval statistical test used for detection were completed in accordance with the CCR Rules. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified four potential outliers. Three outliers were removed from the dataset without replacement. One value was replaced with the sample duplicate result, which was also identified as an outlier and removed. Prediction intervals were constructed based on the remaining background data and a one-of-two retesting procedure. Interwell tests were selected for boron, and pH, whereas intrawell tests were selected for calcium, chloride, fluoride, sulfate, and TDS.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Welsh Plant. January 2017.

United States Environmental Protection Agency (USEPA). 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March 2009.

TABLES

Table 1 - Groundwater Data Summary
Welsh Plant - Primary Bottom Ash Pond

Parameter	Unit	AD-1								
		5/26/2016	7/29/2016	9/30/2016	10/21/2016	12/14/2016	1/20/2017	2/24/2017	6/8/2017	10/6/2017
		Background								Detection
Antimony	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Arsenic	mg/L	0.00139J	0.005U	0.00297J	0.005U	0.005U	0.005U	0.005U	0.00114J	-
Barium	mg/L	0.191	0.191	0.141	0.114	0.072	0.41	0.488	0.09346	-
Beryllium	mg/L	0.00027J	0.00032J	0.00038J	0.00031J	0.00034J	0.00004J	0.001U	0.00037J	-
Boron	mg/L	0.346	0.35	0.332	0.398	0.394	0.656	0.7	0.449	0.453
Cadmium	mg/L	0.00021J	0.00009J	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	-
Calcium	mg/L	36.5	39.6	15	19.1	8.74	129	147	15.1	14.3
Chloride	mg/L	5	4	5	4	4	4	9	4	4
Chromium	mg/L	0.00024J	0.001U	0.005	0.00041J	0.001U	0.001U	0.001U	0.00066J	-
Cobalt	mg/L	0.00115J	0.00062J	0.00085J	0.00065J	0.00042J	0.00048J	0.00077J	0.00077J	-
Combined Radium	pCi/L	1.184	0.9952	1.38	1.141	0.719	3.009	4.309	0.676	-
Fluoride	mg/L	1U	1U	1U	1U	1U	1U	1U	1U	1U
Lead	mg/L	0.005U	0.005U	0.00338J	0.005U	0.005U	0.005U	0.005U	0.005U	-
Lithium	mg/L	0.01	0.019	0.014	0.008	0.008	0.00028J	0.001	0.00902	-
Mercury	mg/L	0.00003	0.00001J	0.00002J	0.00001J	0.00002J	0.00002U	0.00002U	0.00001J	-
Molybdenum	mg/L	0.00053J	0.005U	0.005U	0.0014J	0.005U	0.005U	0.005U	0.005U	-
Selenium	mg/L	0.00175J	0.00182J	0.00103J	0.00203J	0.00186J	0.00405J	0.005U	0.0021J	-
Total Dissolved Solids	mg/L	252	239	173	192	200	538	612	176	160
Sulfate	mg/L	42	36	35	42	40	68	68	42	40
Thallium	mg/L	0.00096J	0.002U	0.002U	0.00125J	0.002U	0.002U	0.002U	0.002U	-
pH	SU	5.93	5.34	5.37	5.15	5.18	7.13	6.88	5.06	5.25

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Component was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1 - Groundwater Data Summary
Welsh Plant - Primary Bottom Ash Pond

Parameter	Unit	AD-5								
		5/31/2016	7/29/2016	9/30/2016	10/21/2016	12/14/2016	1/20/2017	2/24/2017	6/8/2017	10/6/2017
		Background								Detection
Antimony	mg/L	0.005U	0.00205J	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Arsenic	mg/L	0.005U	0.00291J	0.00476J	0.005U	0.00115J	0.005U	0.005U	0.00385J	-
Barium	mg/L	0.057	0.093	0.087	0.07	0.053	0.047	0.042	0.0877	-
Beryllium	mg/L	0.00015J	0.00052J	0.00025J	0.00009J	0.00016J	0.00006J	0.00003J	0.00008J	-
Boron	mg/L	0.03	0.04	0.04	0.05	0.05	0.04	0.04	0.05281	0.0432
Cadmium	mg/L	0.00008J	0.0005J	0.001U	0.00011J	0.0002J	0.00018J	0.001U	0.00039J	-
Calcium	mg/L	36.9	44.7	46.3	50.7	49.6	49.8	33	49.7	33.1
Chloride	mg/L	15	16	15	14	13	14	15	14	16
Chromium	mg/L	0.00056J	0.00041J	0.00091J	0.00025J	0.00075J	0.001U	0.001U	0.00028J	-
Cobalt	mg/L	0.014	0.015	0.014	0.009	0.013	0.012	0.013	0.01193	-
Combined Radium	pCi/L	1.634	4.75	3.33	2.319	2.182	1.023	1.788	2.32	-
Fluoride	mg/L	0.3469J	1U	0.2436J	1U	1U	1U	1U	1U	1U
Lead	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Lithium	mg/L	0.135	0.191	0.186	0.225	0.199	0.239	0.166	0.124	-
Mercury	mg/L	0.00001J	0.00002J	0.00002U	0.00002U	0.00001J	0.00002U	0.00002U	0.00002U	-
Molybdenum	mg/L	0.005U	0.005U	0.005U	0.00137J	0.005U	0.005U	0.005U	0.005U	-
Selenium	mg/L	0.005U	0.00109J	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Total Dissolved Solids	mg/L	337	360	416	448	484	438	286	300	258
Sulfate	mg/L	123	163	190	267	233	234	127	82	82
Thallium	mg/L	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	-
pH	SU	6.38	5.36	5.29	5.92	6.21	6.27	5.48	5.96	5.59

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Component was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1 - Groundwater Data Summary
Welsh Plant - Primary Bottom Ash Pond

Parameter	Unit	AD-8								
		5/31/2016	7/29/2016	9/30/2016	10/21/2016	12/14/2016	1/20/2017	2/24/2017	6/8/2017	10/6/2017
		Background								Detection
Antimony	mg/L	0.005U	0.00146J	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Arsenic	mg/L	0.00106J	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Barium	mg/L	0.034	0.026	0.023	0.024	0.021	0.02	0.019	0.01908	-
Beryllium	mg/L	0.00011J	0.00017J	0.001U	0.00003J	0.001U	0.001U	0.001U	0.001U	-
Boron	mg/L	1.46	1.44	1.51	1.54	1.53	1.53	1.67	1.39	1.49
Cadmium	mg/L	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	-
Calcium	mg/L	32.6	25.9	24.3	25.9	23.6	18.7	19.3	17.4	14.9
Chloride	mg/L	36	26	28	30	27	24	22	22	20
Chromium	mg/L	0.002	0.00075J	0.00051J	0.00062J	0.001U	0.001U	0.001U	0.001U	-
Cobalt	mg/L	0.007	0.009	0.007	0.007	0.007	0.006	0.006	0.00386J	-
Combined Radium	pCi/L	1.046	1.584	6.3	0.3449	1.083	0.823	0.536	1.0735	-
Fluoride	mg/L	0.6507J	0.485J	0.4912J	0.6234J	0.5355J	0.5574J	1U	0.6628J	1U
Lead	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Lithium	mg/L	0.122	0.098	0.111	0.135	0.11	0.094	0.092	0.09491	-
Mercury	mg/L	0.00002J	0.00001J	0.00002U	0.00002U	0.00001J	0.00002U	0.00002U	0.00001J	-
Molybdenum	mg/L	0.00101J	0.00148J	0.005U	0.00084J	0.005U	0.005U	0.005U	0.005U	-
Selenium	mg/L	0.00137J	0.00196J	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Total Dissolved Solids	mg/L	524	469	432	424	442	352	356	368	284
Sulfate	mg/L	217	202	186	184	168	153	163	151	128
Thallium	mg/L	0.00118J	0.002U	0.002U	0.00164J	0.002U	0.002U	0.002U	0.002U	-
pH	SU	6.91	5.35	7.65	6.07	5.62	6.21	6.78	5.63	6.68

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Component was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1 - Groundwater Data Summary
Welsh Plant - Primary Bottom Ash Pond

Parameter	Unit	AD-9								
		5/31/2016	7/29/2016	9/30/2016	10/21/2016	12/14/2016	1/20/2017	2/24/2017	6/8/2017	10/6/2017
		Background								Detection
Antimony	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Arsenic	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Barium	mg/L	0.051	0.031	0.033	0.026	0.027	0.098	0.022	0.04227	-
Beryllium	mg/L	0.001J	0.00073J	0.00058J	0.00048J	0.00048J	0.002	0.0003J	0.00077J	-
Boron	mg/L	0.12	0.105	0.115	0.109	0.108	0.312	0.1	0.146	0.129
Cadmium	mg/L	0.001	0.002	0.00019J	0.00097J	0.002	0.00069J	0.00068J	0.00222	-
Calcium	mg/L	229	255	220	228	250	91.1	258	191	9.64
Chloride	mg/L	88	98	86	76	92	54	86	19	20
Chromium	mg/L	0.001U	0.00026J	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	-
Cobalt	mg/L	0.027	0.022	0.012	0.016	0.024	0.042	0.024	0.02416	-
Combined Radium	pCi/L	2.945	1.447	3.199	1.311	3	2.349	2.32	1.586	-
Fluoride	mg/L	0.4191J	0.4339J	0.304J	0.6227J	1U	1U	1U	1U	1U
Lead	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Lithium	mg/L	1.32	1.38	1.17	1.44	1.33	0.634	1.41	1	-
Mercury	mg/L	0.00002J	0.00004	0.00001J	0.00002U	0.00002J	0.00001J	0.00002U	0.00001J	-
Molybdenum	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Selenium	mg/L	0.00104J	0.008	0.00353J	0.00309J	0.005U	0.005U	0.00106J	0.005U	-
Total Dissolved Solids	mg/L	2541	2564	2448	2494	2667	1360	2662	308	248
Sulfate	mg/L	1352	1464	1301	1350	1639	884	1774	105	86
Thallium	mg/L	0.002U	0.002U	0.002U	0.002U	0.002U	0.00178J	0.00145J	0.002U	-
pH	SU	6.32	5.04	4.72	5.22	5.72	5.43	5.77	4.61	5.78

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Component was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1 - Groundwater Data Summary
Welsh Plant - Primary Bottom Ash Pond

Parameter	Unit	AD-15								
		5/31/2016	7/29/2016	9/30/2016	10/21/2016	12/14/2016	1/20/2017	2/24/2017	6/8/2017	10/6/2017
		Background								Detection
Antimony	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Arsenic	mg/L	0.012	0.006	0.131	0.023	0.006	0.006	0.02	0.00854	-
Barium	mg/L	0.215	0.124	1.93	0.415	0.184	0.153	0.353	0.166	-
Beryllium	mg/L	0.00096J	0.00036J	0.015	0.002	0.0007J	0.00045J	0.002	0.00061J	-
Boron	mg/L	0.329	0.407	0.36	0.152	0.334	0.413	0.1	0.321	0.395
Cadmium	mg/L	0.00035J	0.00011J	0.007	0.00058J	0.00025J	0.001U	0.00032J	0.00048J	-
Calcium	mg/L	5.09	3.83	13.7	4.57	3.6	3.35	4.21	3.57	3.08
Chloride	mg/L	30	34	28	26	26	32	20	27	30
Chromium	mg/L	0.017	0.004	0.28	0.054	0.015	0.009	0.049	0.01235	-
Cobalt	mg/L	0.011	0.006	0.134	0.019	0.01	0.007	0.02	0.00844	-
Combined Radium	pCi/L	2.284	1.322	9.92	3.567	3.36	2.386	2.261	2.491	-
Fluoride	mg/L	1U	1U	0.2621J	1U	1U	1U	1U	1U	1U
Lead	mg/L	0.007	0.005U	0.161	0.022	0.00396J	0.00288J	0.019	0.00298J	-
Lithium	mg/L	0.017	0.021	0.149	0.036	0.013	0.008	0.025	0.0108	-
Mercury	mg/L	0.00005	0.00002J	0.00071	0.0001	0.00003	0.00002J	0.00006	0.00002J	-
Molybdenum	mg/L	0.00177J	0.00059J	0.0036J	0.00155J	0.00046J	0.005U	0.00143J	0.005U	-
Selenium	mg/L	0.00346J	0.00119J	0.014	0.00118J	0.00133J	0.005U	0.005U	0.00271J	-
Total Dissolved Solids	mg/L	188	196	367	152	204	176	88	184	200
Sulfate	mg/L	24	28	23	17	19	25	8	19	21
Thallium	mg/L	0.002U	0.002U	0.002U	0.00156J	0.002U	0.002U	0.002U	0.002U	-
pH	SU	5.58	4.8	4.57	4.35	4.67	5.77	4.55	4.83	5.94

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Component was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1 - Groundwater Data Summary
Welsh Plant - Primary Bottom Ash Pond

Parameter	Unit	AD-17								
		5/26/2016	7/29/2016	9/30/2016	10/21/2016	12/14/2016	1/20/2017	2/24/2017	6/8/2017	10/6/2017
		Background								Detection
Antimony	mg/L	0.005U	0.00114J	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Arsenic	mg/L	0.00138J	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Barium	mg/L	0.021	0.02	0.031	0.034	0.017	0.014	0.02	0.01033	-
Beryllium	mg/L	0.00017J	0.00031J	0.00018J	0.0002J	0.00005J	0.00003J	0.00007J	0.001U	-
Boron	mg/L	0.121	0.119	0.111	0.124	0.135	0.101	0.135	0.121	0.183
Cadmium	mg/L	0.002	0.004	0.00085J	0.002	0.003	0.003	0.002	0.00606	-
Calcium	mg/L	200	195	191	194	196	196	189	188	183
Chloride	mg/L	43	32	36	32	31	33	30	30	31
Chromium	mg/L	0.001	0.001	0.003	0.004	0.00082J	0.068	0.001	0.001U	-
Cobalt	mg/L	0.063	0.068	0.058	0.065	0.068	0.068	0.073	0.0748	-
Combined Radium	pCi/L	1.525	2.78	2.358	2.224	2.384	2.436	2.288	1.598	-
Fluoride	mg/L	0.4023J	0.4135J	0.3055J	0.583J	0.5399J	1U	1U	1U	1U
Lead	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Lithium	mg/L	0.37	0.374	0.354	0.394	0.323	0.341	0.331	0.329	-
Mercury	mg/L	0.00003	0.00002J	0.00002U	0.00002U	0.00001J	0.00002U	0.00002U	0.00001J	-
Molybdenum	mg/L	0.005U	0.00104J	0.005U	0.00032J	0.005U	0.005U	0.005U	0.005U	-
Selenium	mg/L	0.005U	0.00457J	0.005U	0.00334J	0.005U	0.005U	0.005U	0.005U	-
Total Dissolved Solids	mg/L	1810	1576	1663	1612	1560	1686	1628	1578	1548
Sulfate	mg/L	1166	1005	1055	1163	1096	1445	1055	1105	1090
Thallium	mg/L	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	-
pH	SU	7.17	5.72	6.17	6.14	6.03	5.9	5.67	5.81	5.92

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Component was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 2: Outlier Analysis Summary
Welsh Plant - Primary Bottom Ash Pond

Location	Well ID	Sample Date	Parameter	Reported Value	Units	Conclusions
Downgradient	AD-9	1/20/2017	Boron	0.312	mg/L	This value was replaced with 0.283 mg/L, the reported boron concentration for the duplicate sample collected at AD-15. The revised value was also identified as an outlier and was conservatively removed from the dataset as an outlier per the *Unified Guidance* .
Downgradient	AD-15	9/30/2016	Calcium	13.7	mg/L	This value was conservatively removed from the dataset as an outlier per the *Unified Guidance.*
Downgradient	AD-15	2/24/2017	Total Dissolved Solids	88	mg/L	This value was not removed from the dataset, as it was only slightly outside the Tukey's test cutoff and was similar to results from neighboring wells.
Downgradient	AD-15	9/30/2016	Total Dissolved Solids	367	mg/L	This value was not removed from the dataset, as it was only slightly outside the Tukey's test cutoff and was similar to results from neighboring wells.

Table 3: Background Level Summary
Welsh Plant - Primary Bottom Ash Pond

Parameter	Units	Description	AD-8	AD-9	AD-15
Boron	mg/L	Interwell Background Value (UPL)	0.6515		
Calcium	mg/L	Intrawell Background Value (UPL)	35.68	349.9	5.711
Chloride	mg/L	Intrawell Background Value (UPL)	38.29	139.3	38.42
Fluoride	mg/L	Intrawell Background Value (UPL)	1.034	0.7259	1
pH	SU	Interwell Background Value (UPL)	6.986		
	SU	Interwell Background Value (LPL)	4.808		
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	568.6	3147	388.1
Sulfate	mg/L	Intrawell Background Value (UPL)	235.8	2527	35.58

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit

ATTACHMENT A

Evaluation of Detection Monitoring Data

Geosyntec consultants

150 E.Wilson Bridge Road, Suite 232
Columbus, Ohio 43085
PH 614.468.0415
FAX 614.468.0416
www.geosyntec.com

Memorandum

Date:	February 27, 2018
To:	David Miller (AEP)
Copies to:	Jill Parker-Witt (AEP)
From:	Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Welsh Plant's Primary Bottom Ash Pond (PBAP)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), detection monitoring events were completed on October 6, 2017 and January 4, 2018 at the Primary Bottom Ash Pond (PBAP), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas.

Eight background monitoring events were conducted at the Welsh PBAP prior to these detection monitoring events, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 15, 2018.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are summarized in Table 1. Boron concentrations exceeded the interwell UPL of 0.652 mg/L in both the initial (1.49 mg/L) and second (1.47 mg/L) samples collected at AD-8. Therefore, an SSI over background is concluded for boron at AD-8. As a result, the Welsh PBAP CCR unit will conduct an alternate source demonstration.

No other exceedances of UPLs were observed during these detection monitoring events.

Table 1 ("Groundwater Data Summary") of Geosyntec's *Statistical Analysis Summary* report was revised following the certification date of January 15, 2018 to reflect appropriate significant digits for estimated (J-flagged) values.

* * * * *

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Welsh PBAP CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

DAVID ANTHONY MILLER
112498

112498

License Number

TEXAS

Licensing State

02.27.18

Date

American Electric Power
Service Corporation
Texas Registered
Engineering Firm No.
F-3341

Table 1: Detection Monitoring Data Evaluation
Welsh Plant - Primary Bottom Ash Pond

Parameter	Units	Description	AD-8		AD-9	AD-15
			10/6/2017	1/4/2018	10/6/2017	10/6/2017
Boron	mg/L	Interwell Background Value (UPL)	0.652			
	mg/L	Detection Monitoring Result	**1.49**	**1.47**	0.129	0.395
Calcium	mg/L	Intrawell Background Value (UPL)	35.68		350	5.71
	mg/L	Detection Monitoring Result	14.9	--	9.64	3.08
Chloride	mg/L	Intrawell Background Value (UPL)	38.3		139.3	38.42
	mg/L	Detection Monitoring Result	20	--	20	30
Fluoride	mg/L	Intrawell Background Value (UPL)	1.034		0.7259	1
	mg/L	Detection Monitoring Result	<0.083	--	<0.083	<0.083
pH	SU	Interwell Background Value (UPL)	6.99			
	SU	Interwell Background Value (LPL)	4.81			
	SU	Detection Monitoring Result	6.68	--	5.78	5.94
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	569		3147	388
	mg/L	Detection Monitoring Result	284	--	248	200
Sulfate	mg/L	Intrawell Background Value (UPL)	236		2527	35.6
	mg/L	Detection Monitoring Result	128	--	86	21

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

--: not sampled

Bold values exceed the background value.

Background values are shaded gray.

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

December 27, 2017

Geosyntec Consultants
Attn: Mr. Bruce Sass
150 E. Wilson Bridge Rd., #232
Worthington, OH 43085

Dear Mr. Sass,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the screening and statistical analysis of background groundwater data for American Electric Power's Welsh PBAP. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at Welsh PBAP for the CCR program in 2016, and 8 background samples have been collected at each of the groundwater monitoring wells. The monitoring well network, as provided by Geosyntec Consultants, consists of the following: upgradient wells AD-1, AD-5, and AD-17; and downgradient wells AD-8, AD-9, and AD-15.

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis was reviewed by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting.

The following constituents were evaluated: Appendix III parameters – boron, calcium, chloride, fluoride, pH, sulfate, and TDS; and Appendix IV parameters - antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 & 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters at all wells are provided for the purpose of screening data at these wells (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells.

Data at all wells were evaluated for the following: 1) outliers; 2) trends; 3) most appropriate statistical method for Appendix III parameters based on site characteristics of groundwater data upgradient of the facility; and 4) eligibility of downgradient wells when intrawell statistical methods are recommended. Power curves are provided to demonstrate that the selected statistical methods for Appendix III parameters comply with the USEPA Unified Guidance recommendations as discussed below.

Summary of Statistical Method:

1) Intrawell prediction limits, combined with a 1-of-2 resample plan for calcium, chloride, fluoride, sulfate, and TDS; and
2) Interwell prediction limits combined with a 1-of-2 resample plan for boron and pH.

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are nondetects, a nonparametric test is utilized. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% nondetects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for nondetects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% nondetects.

Background Screening

Outlier Evaluation

Time series plots are used to identify suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective, in proposed background data. Suspected outliers at all wells for Appendix III and Appendix IV parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits (Figure C).

Tukey's outlier test noted a few outliers as may be seen on the Outlier Summary Table and accompanying graphs. These values were flagged in the database and deselected prior to construction of statistical limits.
The outliers identified by Tukey's test for TDS in well AD-15 were not flagged as these values were not unusual to the data set and were similar to observations reported in neighboring wells. Additionally, it was noted that well AD-15 had a single high value for several parameters that were not identified as statistical outliers. If it is determined that some type of sampling or analytical error is the cause, those reported observations will be flagged as outliers in the future. Flagged values may be seen in a lighter font on the time series graphs. A substitution of the most recent reporting limit was applied when varying detection limits existed in data.

No true seasonal patterns were observed on the time series plots for any of the detected data; therefore, no deseasonalizing adjustments were made to the data. When seasonal patterns are observed, data may be deseasonalized so that the resulting limits will correctly account for the seasonality as a predictable pattern rather than random variation or a release. It was noted that for each constituent evaluated, the highest concentrations are reported in the upgradient wells.

While trends may be visual, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends (Figure D). In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed a couple statistically significant decreasing trends as may be seen on the Trend Test Summary table. These trends were relatively low in magnitude when compared to average concentrations; therefore, no adjustments were required.

Appendix III – Determination of Spatial Variation

The Analysis of Variance (ANOVA) was used to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying the most appropriate statistical approach (Figure E). Interwell tests, which compare downgradient well data to statistical limits constructed from pooled upgradient well data, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation; when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter.

All Appendix III parameters except pH exhibited variation when evaluated using the ANOVA. Therefore, these parameters were further evaluated as described for the appropriateness of intrawell testing to accommodate the groundwater quality. A summary table of the ANOVA results is included with the reports.

Appendix III - Statistical Limits

Intrawell limits constructed from carefully screened background data from within each well serve to provide statistical limits that are conservative (i.e. lower) from a regulatory perspective, and that will rapidly identify a change in more recent compliance data from within a given well. This statistical method removes the element of variation from across wells and eliminates the chance of mistaking natural spatial variation for a release from the facility. Prior to performing intrawell prediction limits, several steps are required to reasonably demonstrate downgradient water quality does not have existing impacts from the practices of the facility.

Exploratory data analysis was used as a general comparison of concentrations in downgradient wells for all Appendix III parameters recommended for intrawell analyses to concentrations reported in upgradient wells. Upper tolerance limits are used in conjunction with confidence intervals to determine whether the estimated averages in downgradient wells are higher than observed levels upgradient of the facility. The upper tolerance limits were constructed to represent the extreme upper range of possible background levels at the site.

In cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to justify an intrawell approach. Such an assessment is beyond the scope of services provided by Groundwater Stats Consulting. When there is not an obvious explanation for observed concentration differences in downgradient wells relative to reported concentrations in upgradient wells, interwell prediction limits will initially be selected for the statistical method until further evidence shows that concentrations are due to natural variation rather than a result of the facility.

Parametric tolerance limits were constructed with a target of 99% confidence and 95% coverage using pooled upgradient well data for each of the Appendix III parameters (Figure F). The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. As more data are collected, the background population is better represented and the confidence and coverage levels increase.

Confidence intervals were constructed on downgradient wells for each of the Appendix III parameters, using the tolerance limits discussed above, to determine intrawell eligibility (Figure G). When the entire confidence interval is above a background standard for a given parameter, interwell methods are initially recommended as the statistical method. Therefore, only parameters with confidence intervals which did not exceed background standards are eligible for intrawell prediction limits.

Confidence intervals for the above parameters were found to be within their respective background limit for all Appendix III parameters with the exception of boron. Therefore, intrawell methods are recommended for calcium, chloride, fluoride, sulfate and TDS; and interwell methods are initially recommended for boron as well as pH which the ANOVA identified as having no variation among upgradient wells. As mentioned earlier, if a demonstration supports natural variation in groundwater, intrawell methods will be considered for all parameters.

All available data through June 2017 at each well were used to establish intrawell background limits for the parameters identified above based on a 1-of-2 resample plan that will be used for future comparisons (Figure H). Interwell prediction limits, combined with a 1-of-2 resample plan, were constructed from upgradient wells for boron and pH (Figure I). Downgradient measurements will be compared to these background limits during each subsequent semi-annual sampling event.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits will be necessary to accommodate these types of changes In the interwell case, newer data will be included in background when a minimum of 2 new samples are available. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of an additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered to be a false positive result and, therefore, no further action is necessary. A summary table of the background prediction limits follows this letter.

Appendix IV – Assessment Monitoring Program

During an Assessment Monitoring program confidence intervals are constructed at all wells for detected Appendix IV parameters. A minimum of 4 samples is required to construct confidence intervals; however, 8 samples are generally recommended for better representation of the true average population. Established Maximum Contaminant Levels (MCLs) are used as the GWPS comparisons, unless background limits are higher as discussed below. Parametric confidence intervals are constructed with 99% confidence when data follow a normal or transformed-normal distribution. For all other cases, nonparametric confidence intervals are constructed, with the confidence level based on the number of samples available. The GWPS is exceeded only when the entire confidence interval exceeds its respective GWPS.

Background limits are established for the Appendix IV parameters using upper tolerance limits constructed with 95% confidence/95% coverage using pooled upgradient well data, for comparison against established MCLs. When background limits, or Alternate Contaminant Levels (ACLs), are higher than established MCLs, the CCR Rule recommends using these ACLs as the GWPS for the confidence interval comparisons. Additionally, tolerance limits are also recommended to establish ACLs for Appendix IV parameters, cobalt, lithium, and molybdenum, which do not have established MCLs. Since the scope of this project included screening and development of background limits for Appendix III Detection Monitoring statistics, comparison of the Appendix IV parameters with confidence intervals was not included in this report.

Recommendations

In summary, as a result of the background screening described in this letter, intrawell prediction limits combined with a 1-of-2 resample plan are recommended for calcium, chloride, fluoride, sulfate and TDS; and interwell prediction limits combined with a 1-of-2 resample plan are recommended for boron and pH. The statistical analyses will be constructed according to the USEPA Unified Guidance, based on seven Appendix III parameters and three downgradient wells.

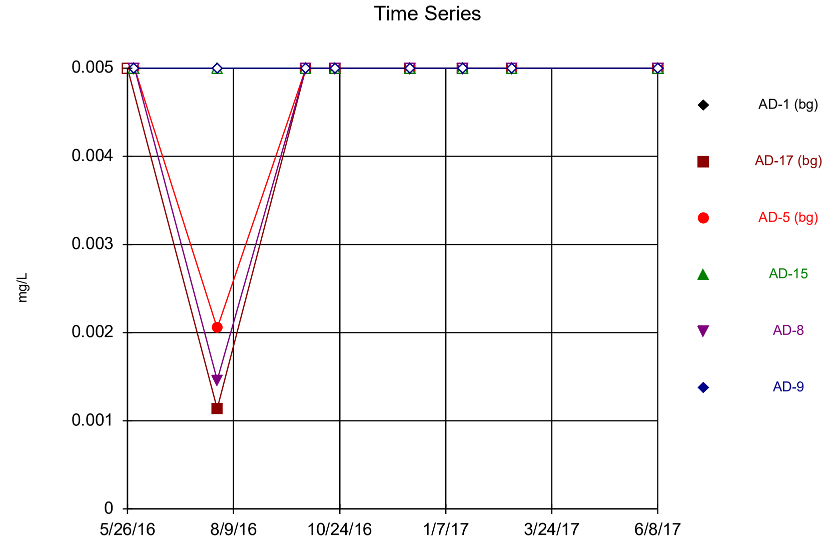
Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Welsh PBAP. If you have any questions or comments, please feel free to contact me.

For Groundwater Stats Consulting,

Kristina Rayner

Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



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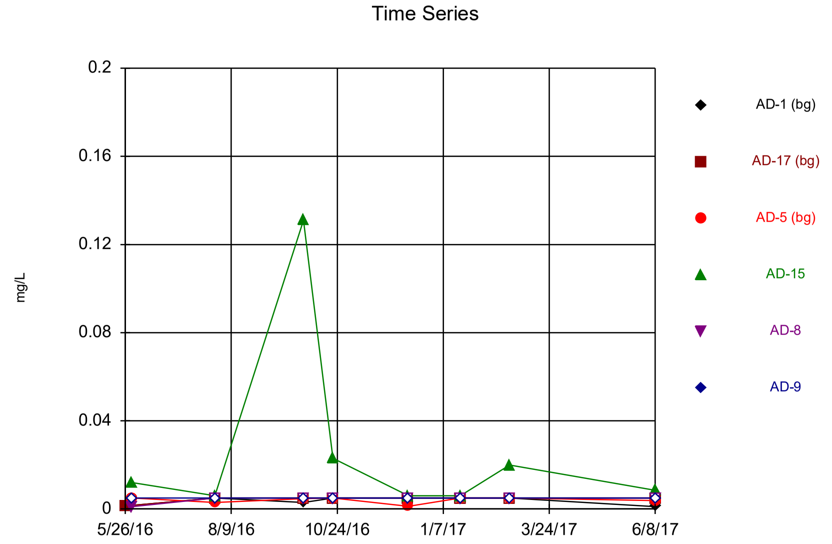
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



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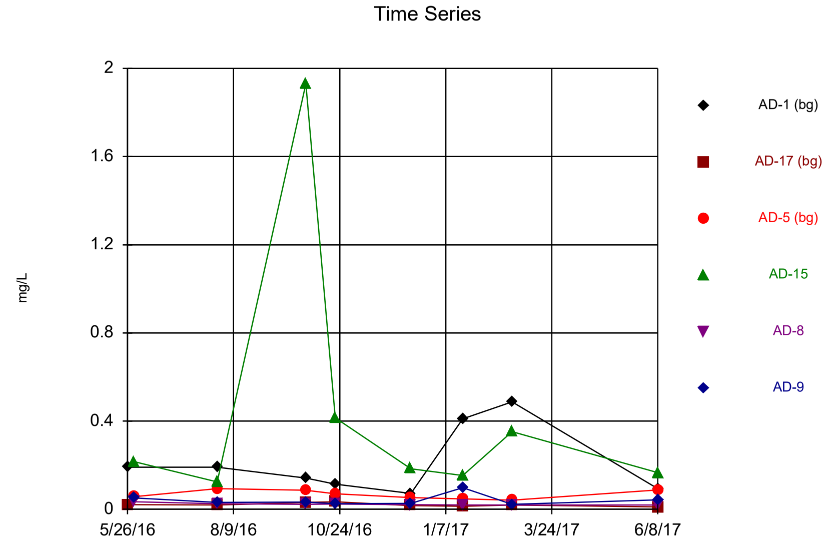
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



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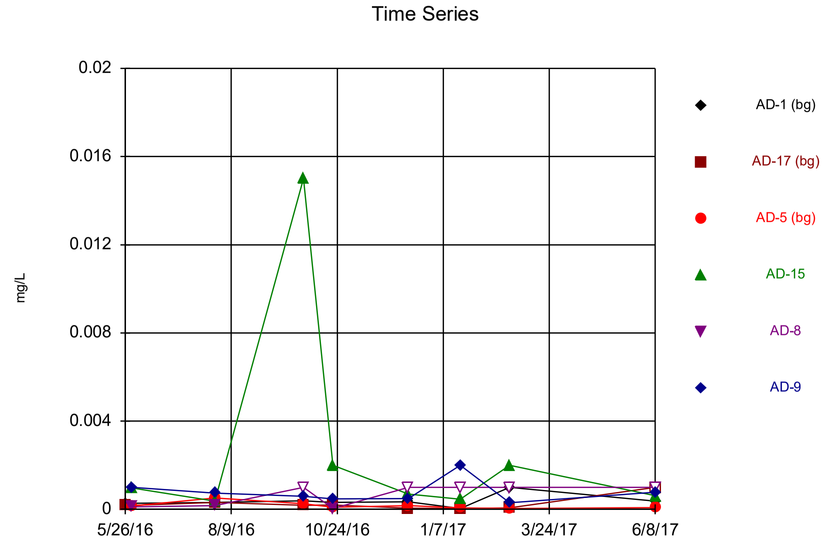

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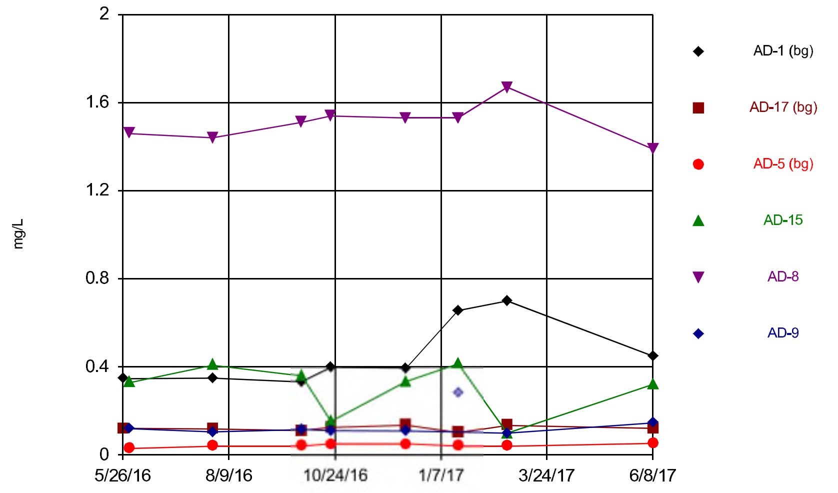
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Time Series



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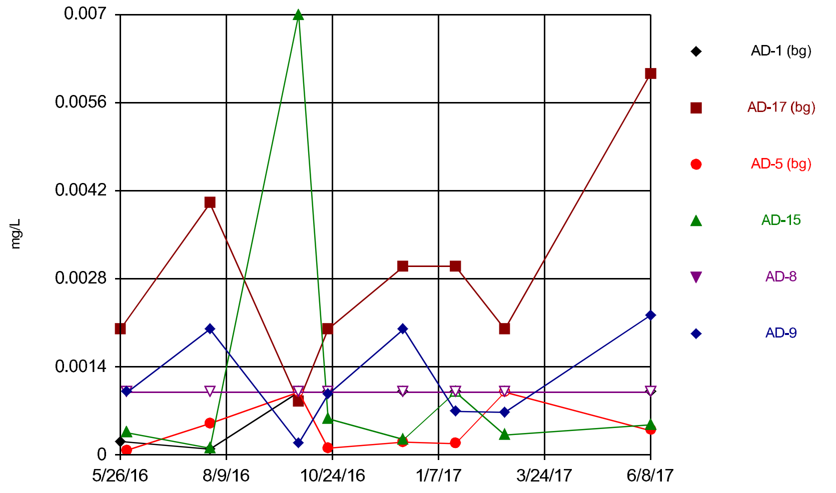
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

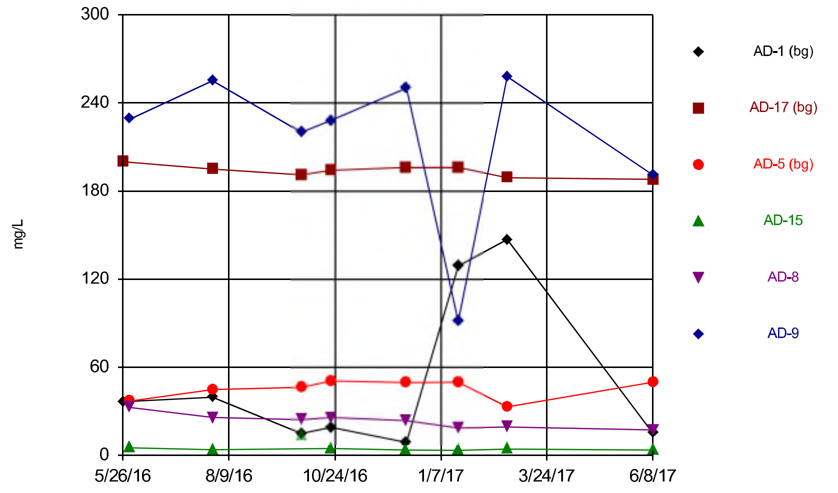
Time Series



Constituent: Cadmium, total Analysis Run 12/27/2017 8:21 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

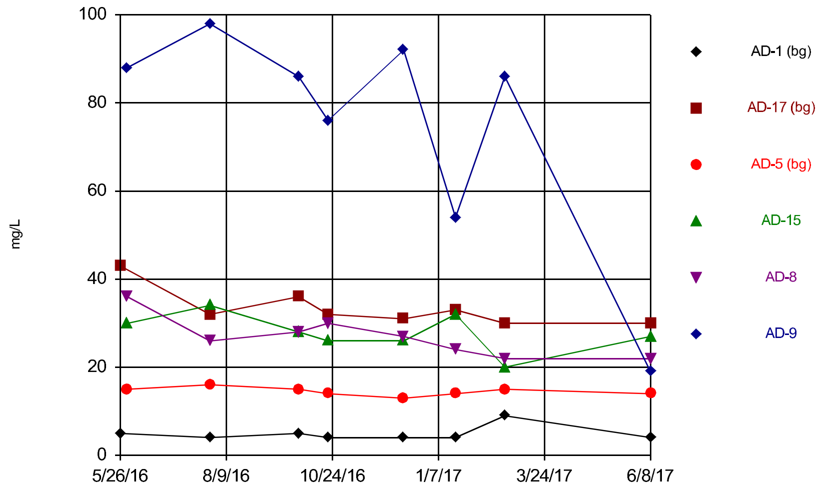
Time Series



Constituent: Calcium, total Analysis Run 12/27/2017 8:21 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

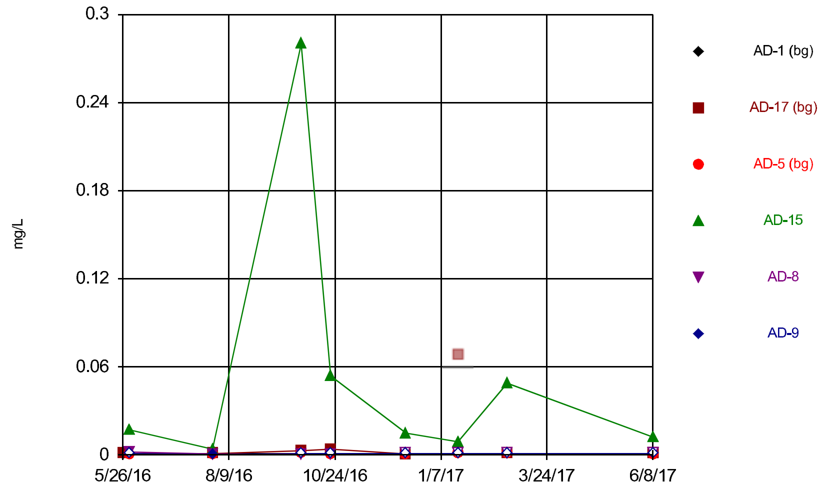
Time Series



Constituent: Chloride, total Analysis Run 12/27/2017 8:21 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

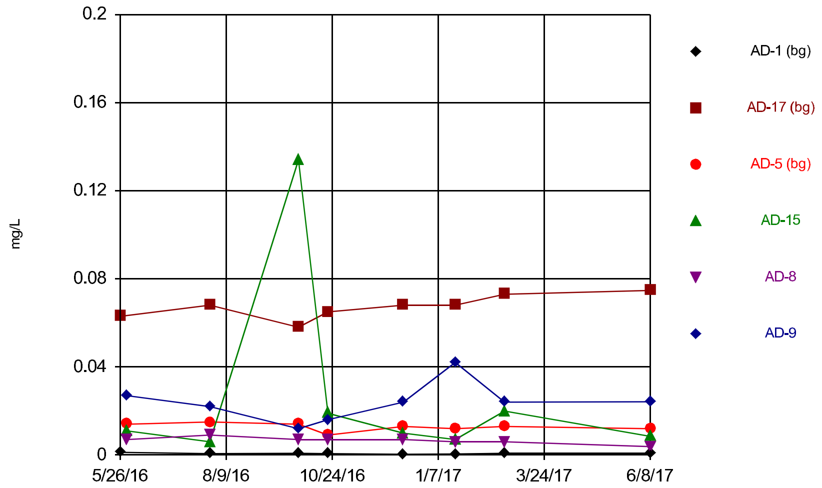
Time Series



Constituent: Chromium, total Analysis Run 12/27/2017 8:21 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

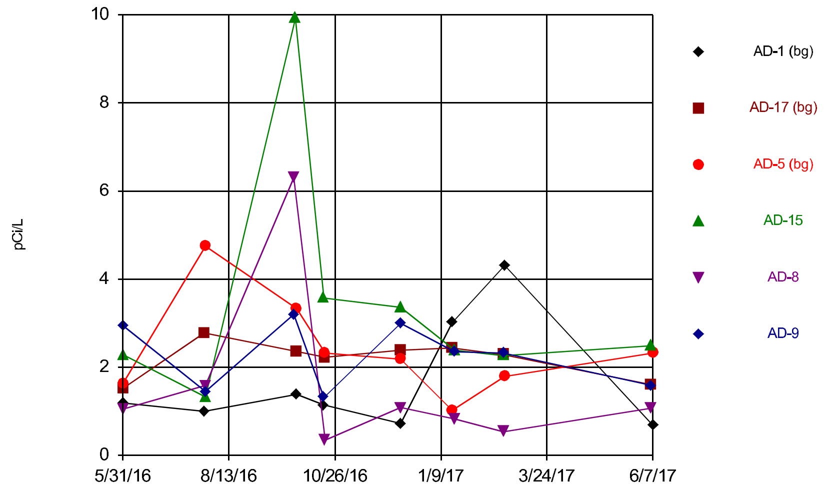
Time Series



Constituent: Cobalt, total Analysis Run 12/27/2017 8:21 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

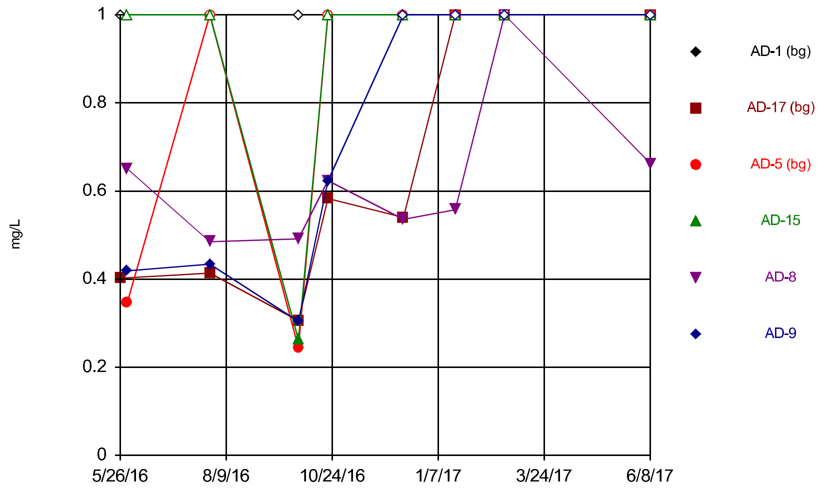
Time Series



Constituent: Combined Radium 226 + 228 Analysis Run 12/27/2017 8:21 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

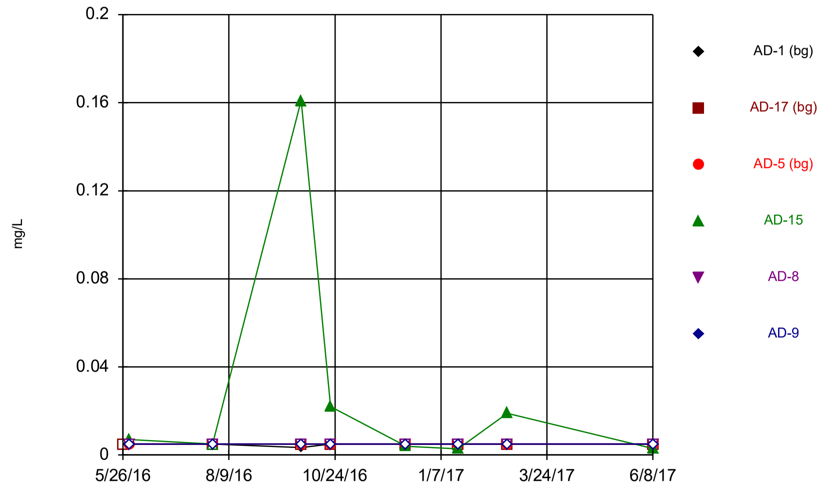
Time Series



Constituent: Fluoride, total Analysis Run 12/27/2017 8:21 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

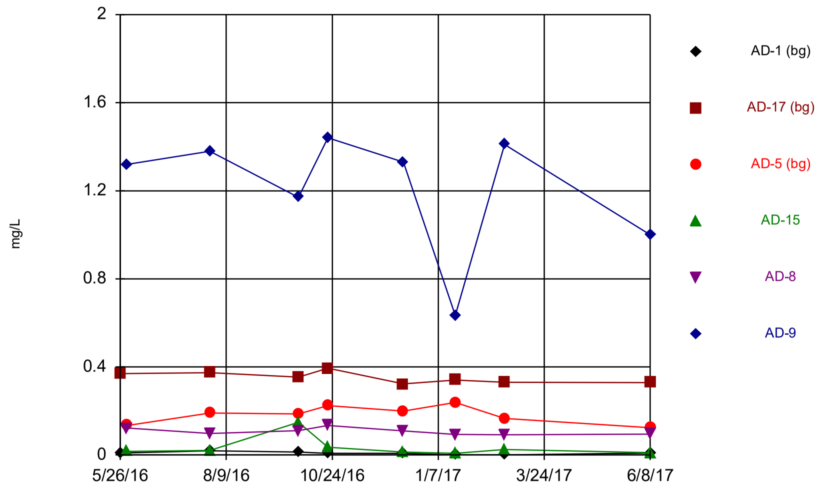
Time Series



Constituent: Lead, total Analysis Run 12/27/2017 8:21 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

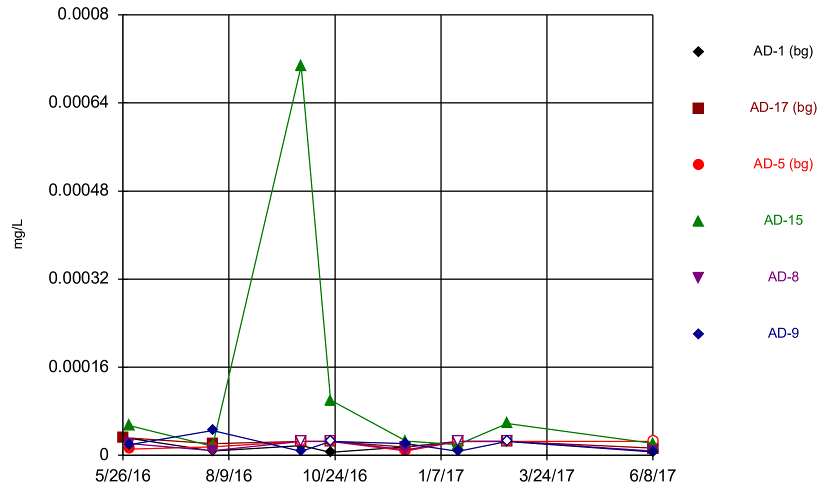
Time Series



Constituent: Lithium, total Analysis Run 12/27/2017 8:21 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

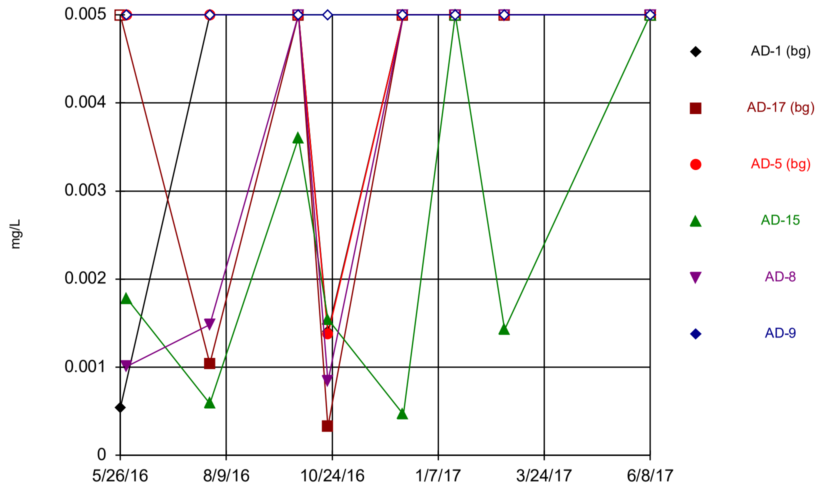
Time Series



Constituent: Mercury, total Analysis Run 12/27/2017 8:21 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

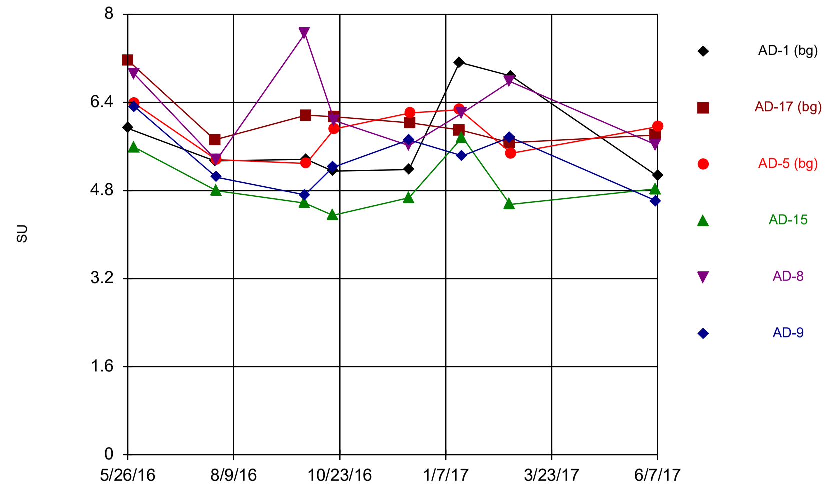
Time Series



Constituent: Molybdenum, total Analysis Run 12/27/2017 8:21 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

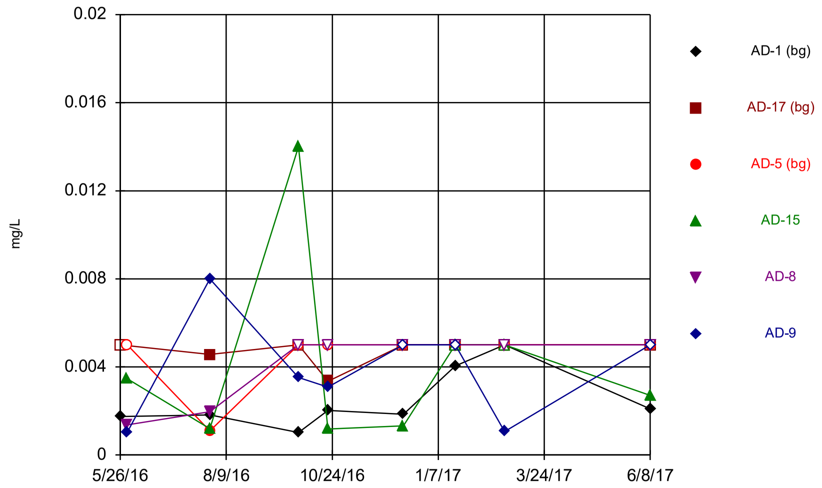
Time Series



Constituent: pH, field   Analysis Run 12/27/2017 8:21 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

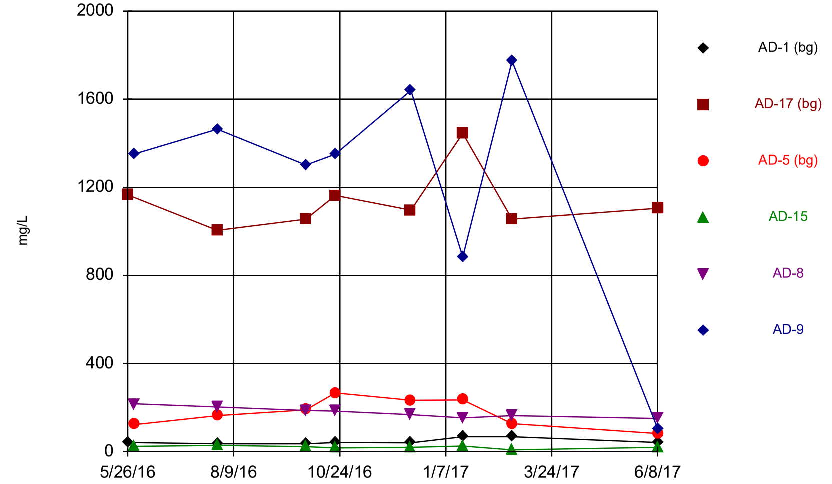
Time Series



Constituent: Selenium, total   Analysis Run 12/27/2017 8:21 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

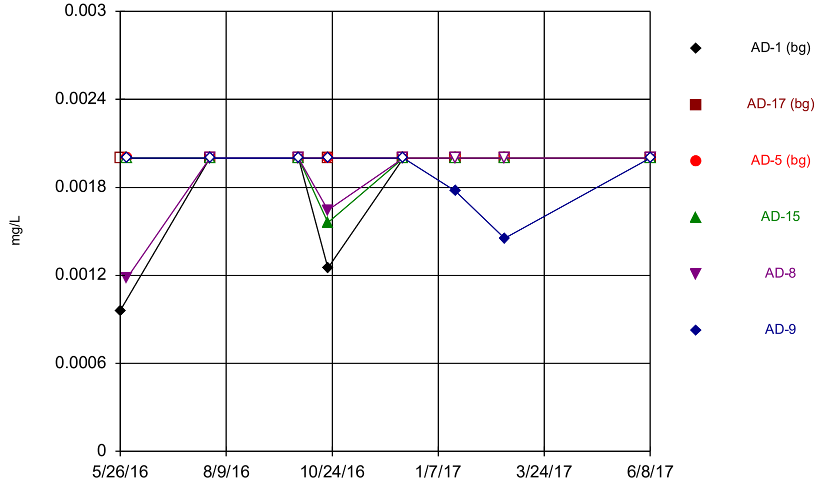
Time Series



Constituent: Sulfate, total   Analysis Run 12/27/2017 8:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

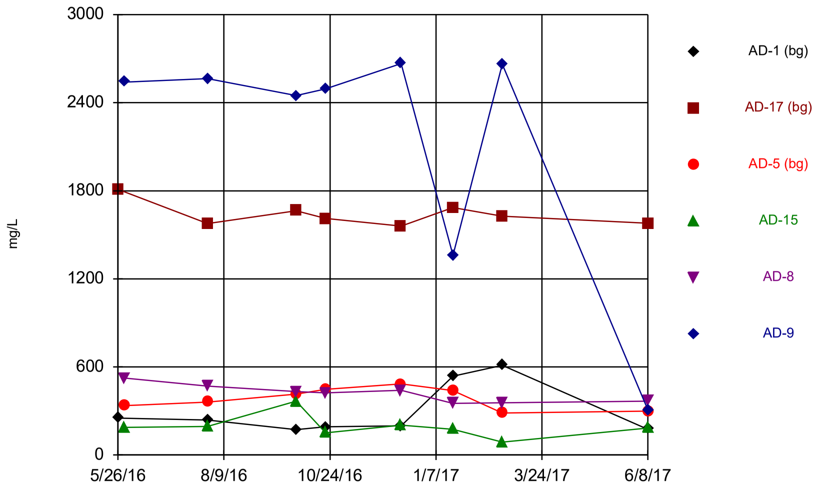
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Thallium, total   Analysis Run 12/27/2017 8:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

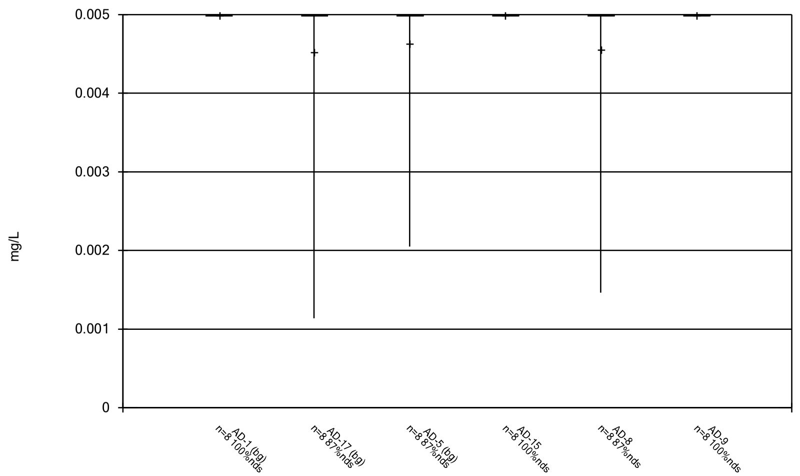
Time Series



Constituent: Total Dissolved Solids Analysis Run 12/27/2017 8:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

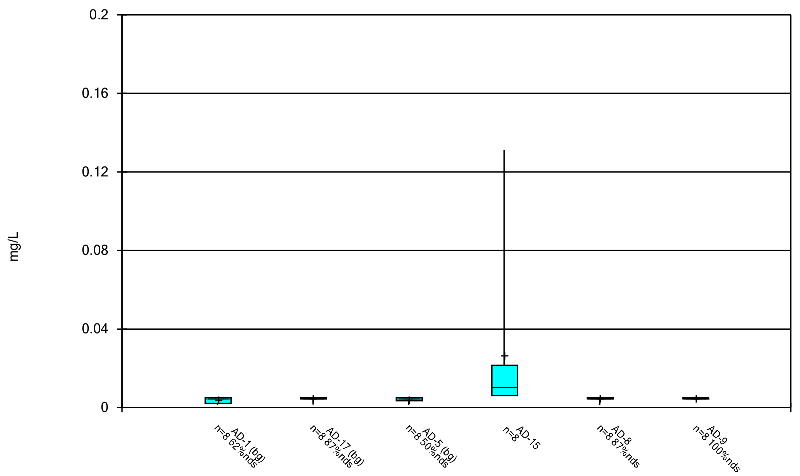
Box & Whiskers Plot



Constituent: Antimony, total Analysis Run 12/27/2017 8:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

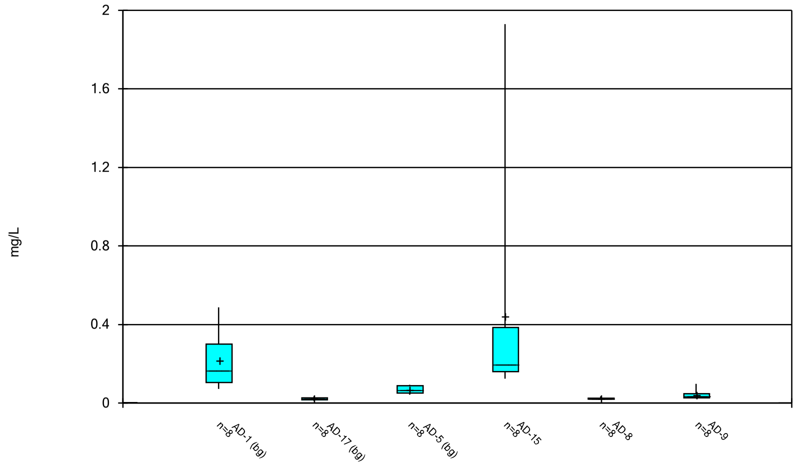
Box & Whiskers Plot



Constituent: Arsenic, total Analysis Run 12/27/2017 8:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

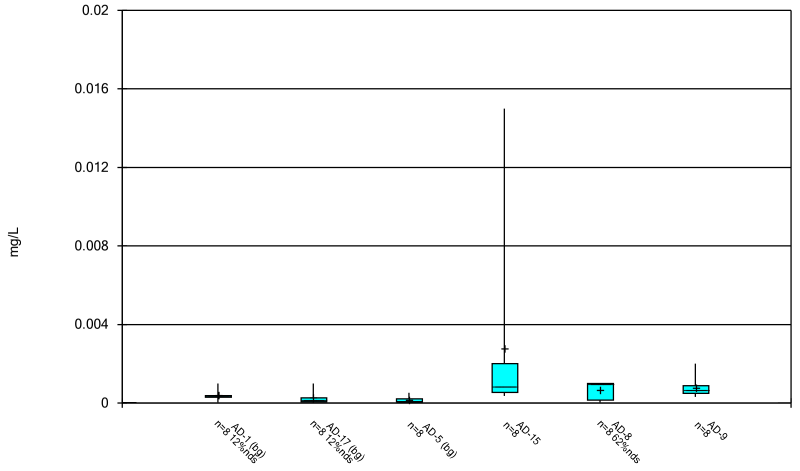
Box & Whiskers Plot



Constituent: Barium, total Analysis Run 12/27/2017 8:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

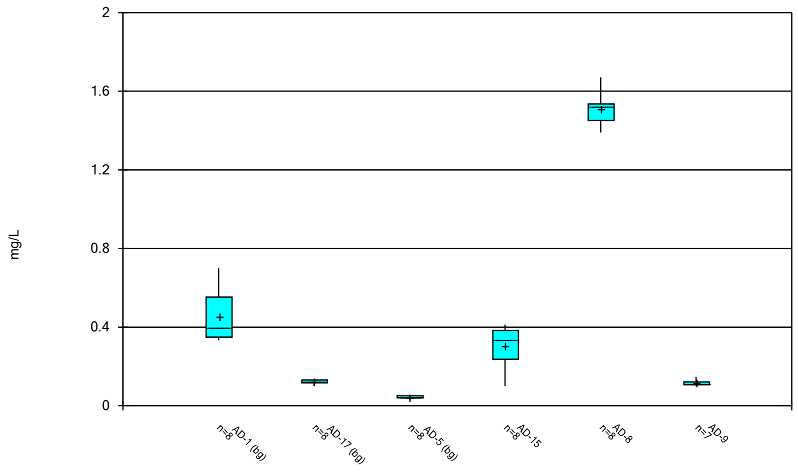
Box & Whiskers Plot



Constituent: Beryllium, total Analysis Run 12/27/2017 8:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

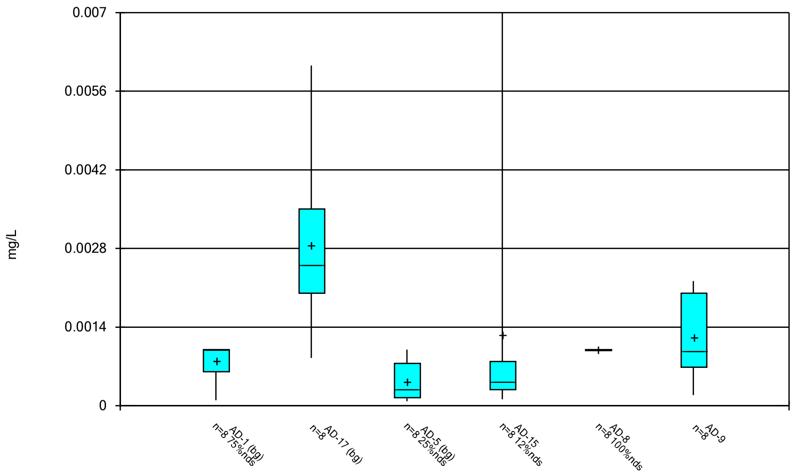
Box & Whiskers Plot



Constituent: Boron, total Analysis Run 12/27/2017 8:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

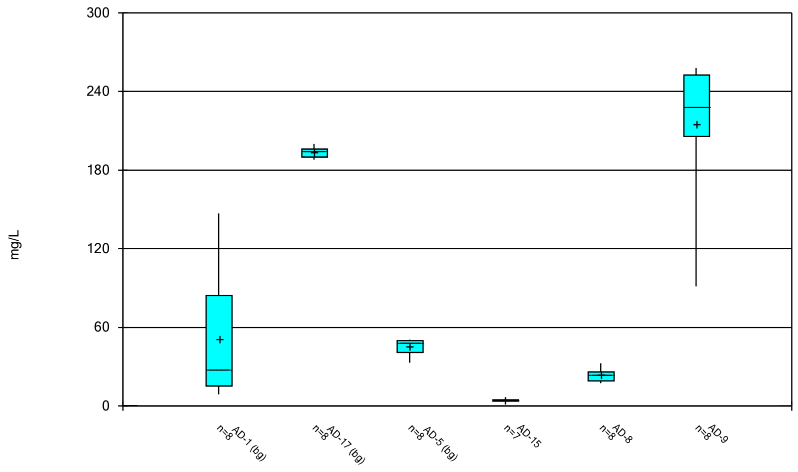
Box & Whiskers Plot



Constituent: Cadmium, total Analysis Run 12/27/2017 8:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

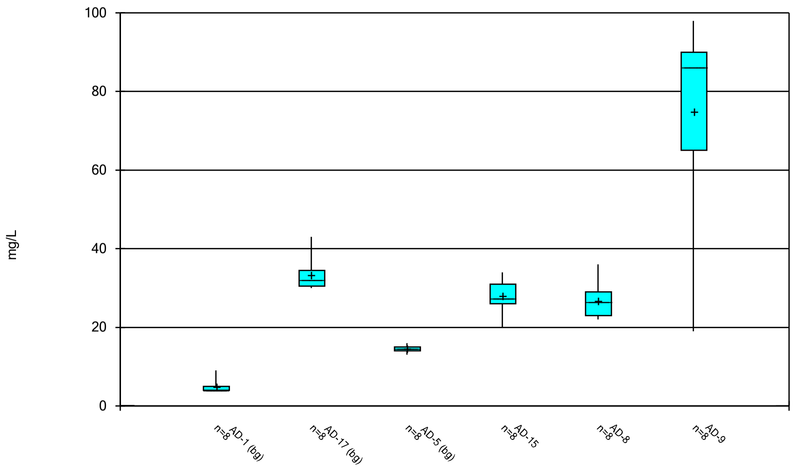
Box & Whiskers Plot



Constituent: Calcium, total Analysis Run 12/27/2017 8:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

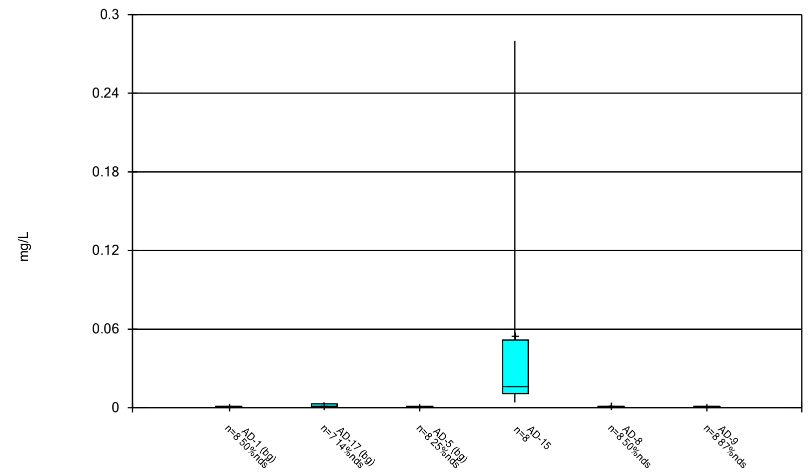
Box & Whiskers Plot



Constituent: Chloride, total Analysis Run 12/27/2017 8:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

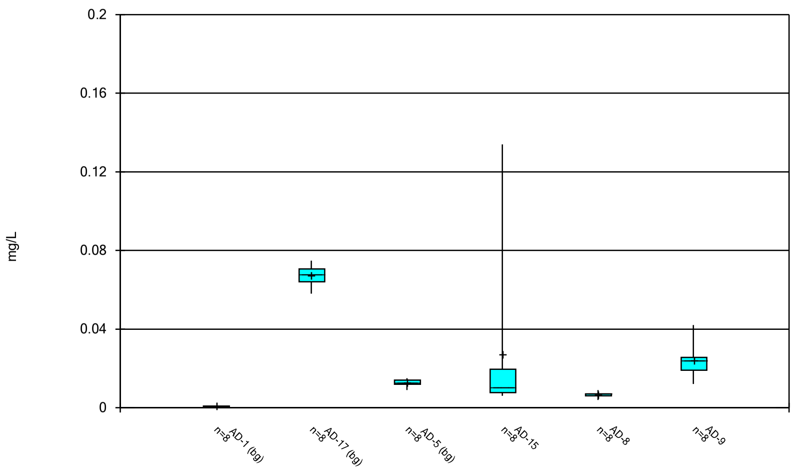
Box & Whiskers Plot



Constituent: Chromium, total Analysis Run 12/27/2017 8:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

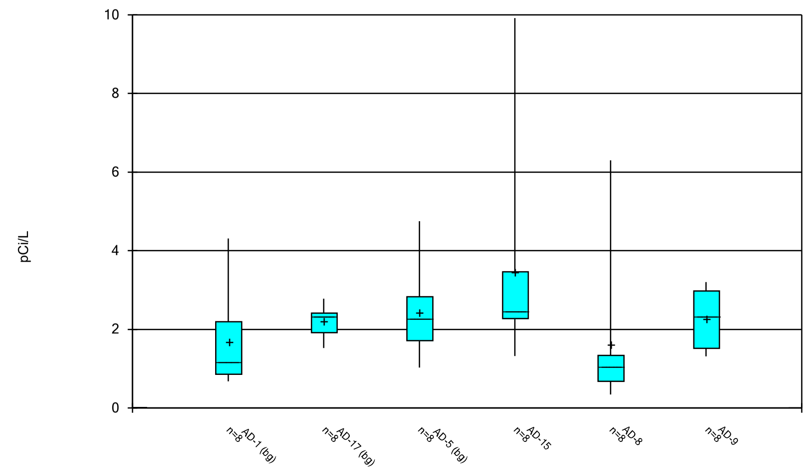
Box & Whiskers Plot



Constituent: Cobalt, total Analysis Run 12/27/2017 8:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

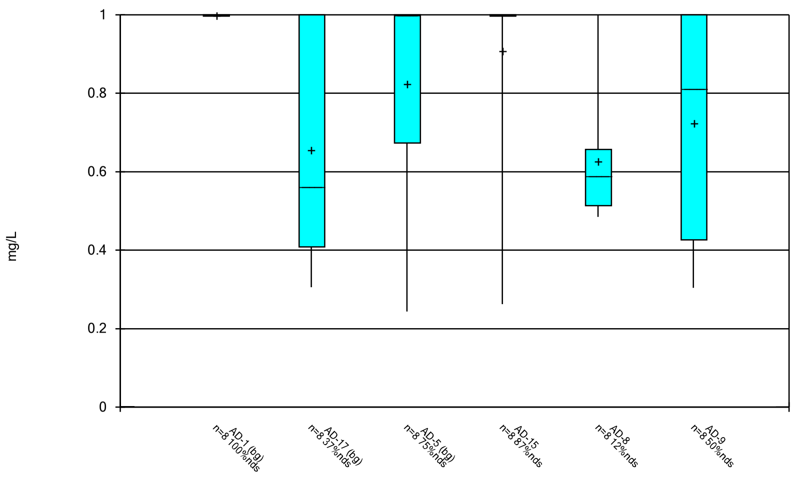
Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 12/27/2017 8:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

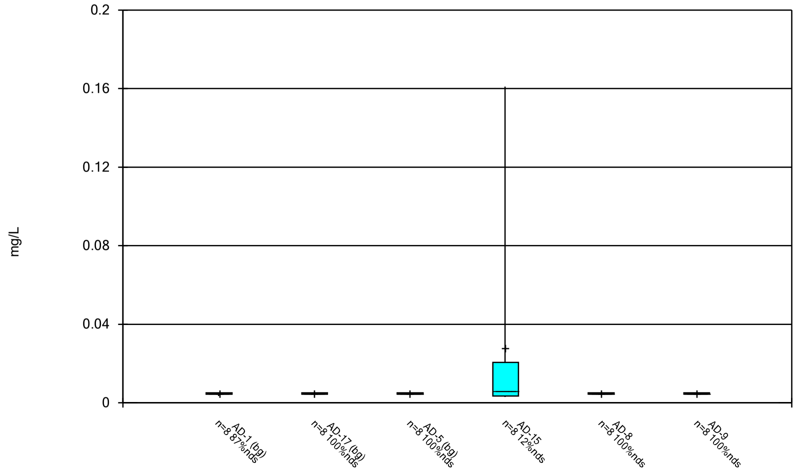
Box & Whiskers Plot



Constituent: Fluoride, total Analysis Run 12/27/2017 8:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

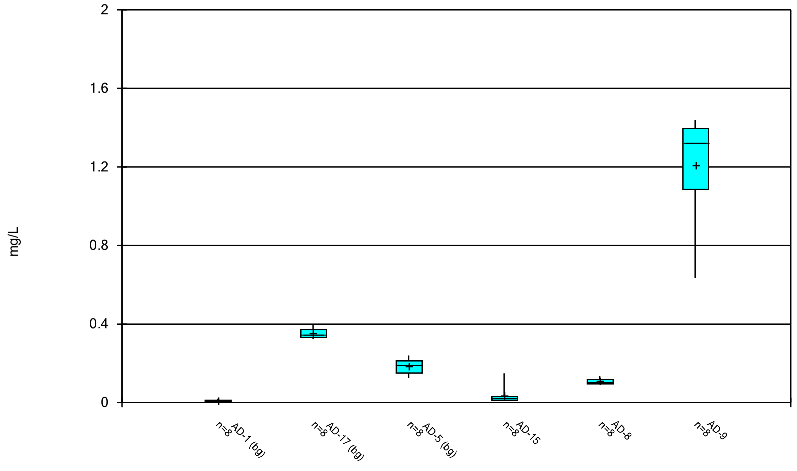
Box & Whiskers Plot



Constituent: Lead, total   Analysis Run 12/27/2017 8:25 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

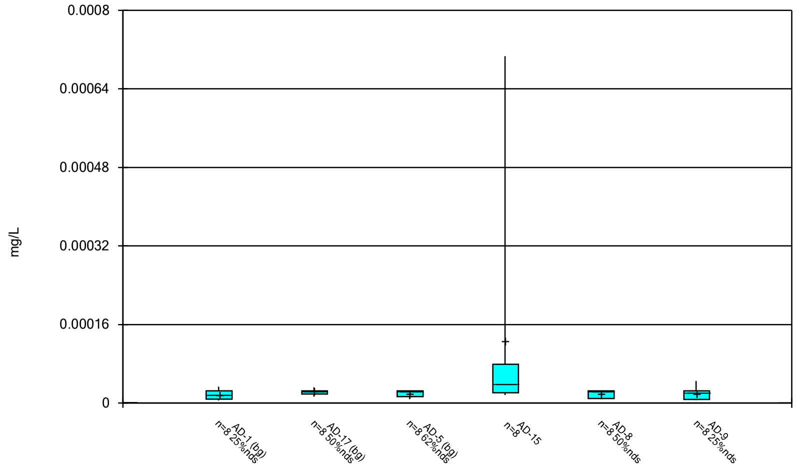
Box & Whiskers Plot



Constituent: Lithium, total   Analysis Run 12/27/2017 8:25 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

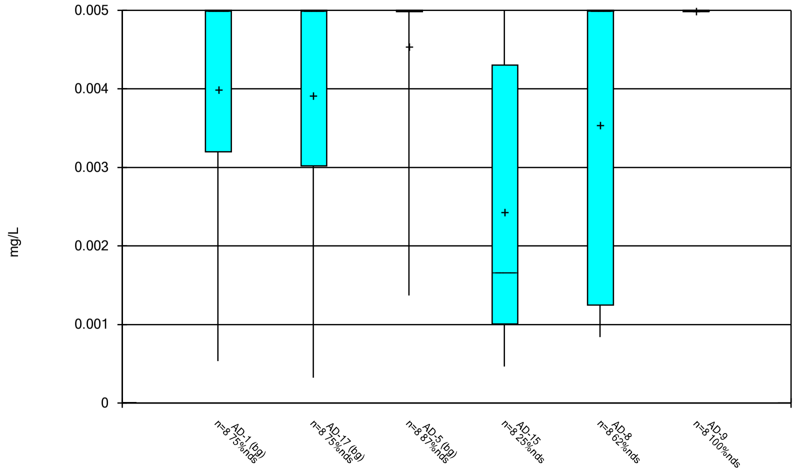
Box & Whiskers Plot



Constituent: Mercury, total   Analysis Run 12/27/2017 8:25 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

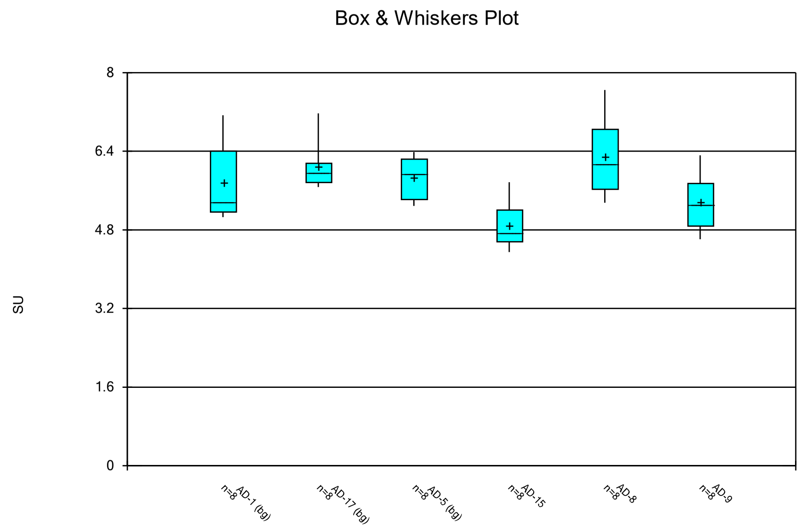
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Box & Whiskers Plot



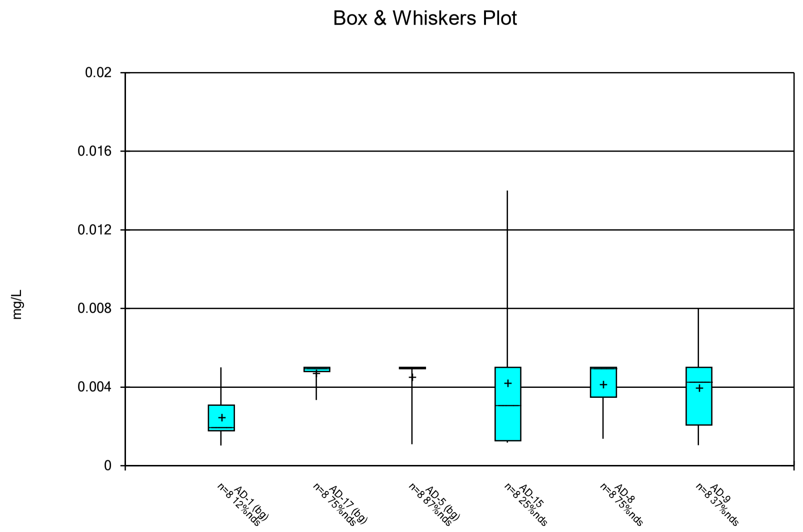
Constituent: Molybdenum, total   Analysis Run 12/27/2017 8:25 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



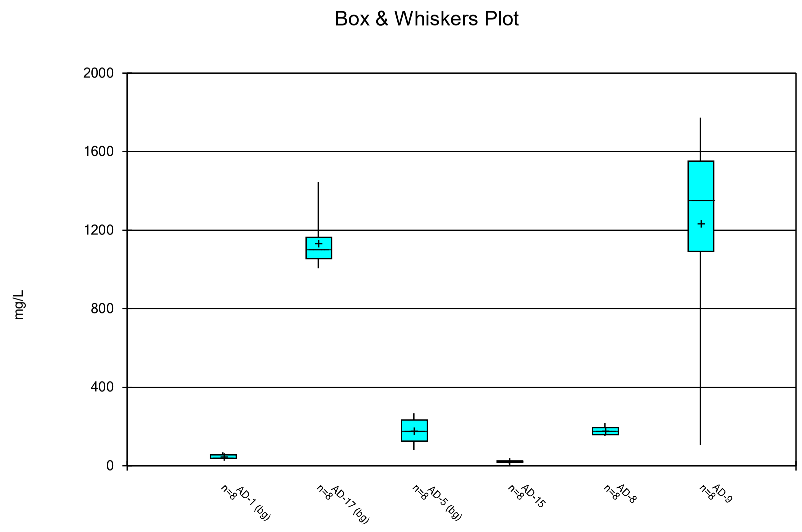
Constituent: pH, field   Analysis Run 12/27/2017 8:25 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



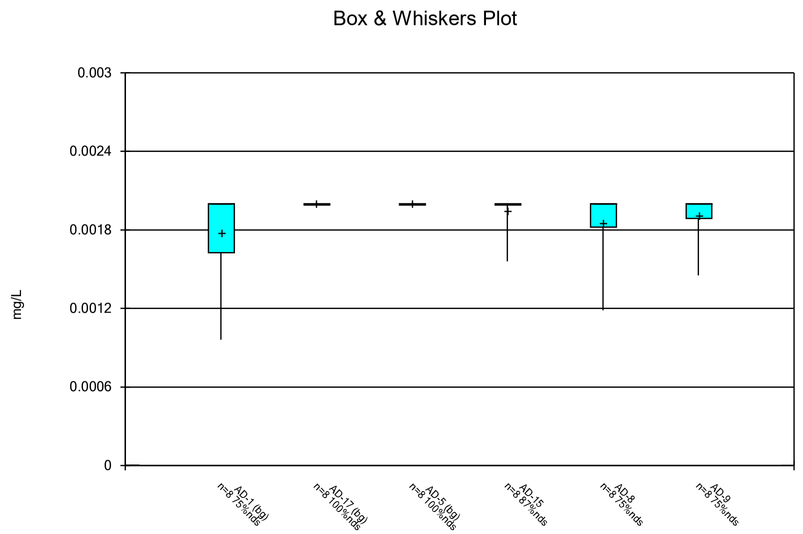
Constituent: Selenium, total   Analysis Run 12/27/2017 8:25 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



Constituent: Sulfate, total   Analysis Run 12/27/2017 8:25 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

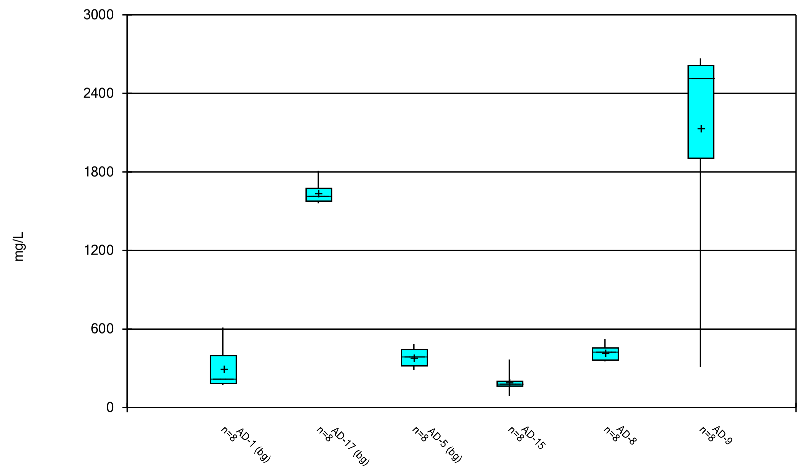
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



Constituent: Thallium, total   Analysis Run 12/27/2017 8:25 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Total Dissolved Solids Analysis Run 12/27/2017 8:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Outlier Summary Table

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 12/27/2017, 8:19 PM

	AD-9 Boron, total (mg/L)	AD-15 Calcium, total (mg/L)	AD-17 Chromium, total (mg/L)
9/30/2016		13.7 (o)	
1/20/2017	0.283 (o)		0.068 (o)

Outlier Analysis - Upgradient Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 12/27/2017, 7:27 PM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	0.004716	0.000971	unknown	ShapiroWilk
Arsenic, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	0.004148	0.001449	unknown	ShapiroWilk
Barium, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP	24	0.1002	0.1194	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP	24	0.0002656	0.0002623	ln(x)	ShapiroWilk
Boron, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	0.2056	0.1985	unknown	ShapiroWilk
Cadmium, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP	24	0.001361	0.001437	x^(1/3)	ShapiroWilk
Calcium, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	96.66	76.45	unknown	ShapiroWilk
Chloride, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	17.58	12.37	unknown	ShapiroWilk
Chromium, total (mg/L)	**AD-1,AD-17,AD-5**	**Yes**	**0.068**	**NP (nrm)**	**24**	**0.003803**	**0.0137**	**unknown**	**ShapiroWilk**
Cobalt, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	0.02689	0.02973	unknown	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-1,AD-17,AD-5	No	n/a	NP	24	2.098	1.034	x^(1/3)	ShapiroWilk
Fluoride, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	0.8264	0.2832	unknown	ShapiroWilk
Lead, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	0.004933	0.0003298	unknown	ShapiroWilk
Lithium, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	0.1813	0.1456	unknown	ShapiroWilk
Mercury, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	0.00001987	0.000007979	unknown	ShapiroWilk
Molybdenum, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	0.004153	0.0017	unknown	ShapiroWilk
pH, field (SU)	AD-1,AD-17,AD-5	No	n/a	NP	24	5.897	0.5904	ln(x)	ShapiroWilk
Selenium, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	0.003901	0.001529	unknown	ShapiroWilk
Sulfate, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	453.4	503.2	unknown	ShapiroWilk
Thallium, total (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	0.001925	0.0002562	unknown	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-1,AD-17,AD-5	No	n/a	NP (nrm)	24	773.5	636.5	unknown	ShapiroWilk

Outlier Analysis - Significant Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 12/27/2017, 7:24 PM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Boron, total (mg/L)	**AD-9**	**Yes**	**0.283**	**NP**	**8**	**0.1358**	**0.06115**	**ln(x)**	**ShapiroWilk**
Calcium, total (mg/L)	**AD-15**	**Yes**	**13.7**	**NP**	**8**	**5.24**	**3.467**	**ln(x)**	**ShapiroWilk**
Total Dissolved Solids (mg/L)	**AD-15**	**Yes**	**367,88**	**NP**	**8**	**194.4**	**78.82**	**ln(x)**	**ShapiroWilk**

Outlier Analysis - All Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 12/27/2017, 7:24 PM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distributior	Normality Test
Antimony, total (mg/L)	AD-15	No	n/a	NP (nrm)	8	0.005	0	unknown	ShapiroWilk
Antimony, total (mg/L)	AD-8	No	n/a	NP (nrm)	8	0.004558	0.001251	unknown	ShapiroWilk
Antimony, total (mg/L)	AD-9	No	n/a	NP (nrm)	8	0.005	0	unknown	ShapiroWilk
Arsenic, total (mg/L)	AD-15	No	n/a	NP	8	0.02657	0.04271	ln(x)	ShapiroWilk
Arsenic, total (mg/L)	AD-8	No	n/a	NP (nrm)	8	0.004508	0.001392	unknown	ShapiroWilk
Arsenic, total (mg/L)	AD-9	No	n/a	NP (nrm)	8	0.005	0	unknown	ShapiroWilk
Barium, total (mg/L)	AD-15	No	n/a	NP	8	0.4425	0.6096	ln(x)	ShapiroWilk
Barium, total (mg/L)	AD-8	No	n/a	NP	8	0.02326	0.004998	ln(x)	ShapiroWilk
Barium, total (mg/L)	AD-9	No	n/a	NP	8	0.04128	0.02477	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AD-15	No	n/a	NP	8	0.00276	0.004988	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AD-8	No	n/a	NP (nrm)	8	0.0006644	0.0004648	unknown	ShapiroWilk
Beryllium, total (mg/L)	AD-9	No	n/a	NP	8	0.0007925	0.0005327	ln(x)	ShapiroWilk
Boron, total (mg/L)	AD-15	No	n/a	NP	8	0.302	0.1147	x^3	ShapiroWilk
Boron, total (mg/L)	AD-8	No	n/a	NP	8	1.509	0.08374	ln(x)	ShapiroWilk
Boron, total (mg/L)	**AD-9**	**Yes**	**0.283**	**NP**	**8**	**0.1358**	**0.06115**	**ln(x)**	**ShapiroWilk**
Cadmium, total (mg/L)	AD-15	No	n/a	NP	8	0.001261	0.002334	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	AD-8	No	n/a	NP (nrm)	8	0.001	0	unknown	ShapiroWilk
Cadmium, total (mg/L)	AD-9	No	n/a	NP	8	0.001218	0.0007526	sqrt(x)	ShapiroWilk
Calcium, total (mg/L)	**AD-15**	**Yes**	**13.7**	**NP**	**8**	**5.24**	**3.467**	**ln(x)**	**ShapiroWilk**
Calcium, total (mg/L)	AD-8	No	n/a	NP	8	23.46	4.969	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-9	No	n/a	NP	8	215.3	54.76	x^5	ShapiroWilk
Chloride, total (mg/L)	AD-15	No	n/a	NP	8	27.88	4.291	x^2	ShapiroWilk
Chloride, total (mg/L)	AD-8	No	n/a	NP	8	26.88	4.643	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AD-9	No	n/a	NP	8	74.88	26.2	x^5	ShapiroWilk
Chromium, total (mg/L)	AD-15	No	n/a	NP	8	0.05504	0.09277	ln(x)	ShapiroWilk
Chromium, total (mg/L)	AD-8	No	n/a	NP	8	0.0009853	0.000454	ln(x)	ShapiroWilk
Chromium, total (mg/L)	AD-9	No	n/a	NP (nrm)	8	0.0009078	0.0002609	unknown	ShapiroWilk
Cobalt, total (mg/L)	AD-15	No	n/a	NP	8	0.02693	0.04358	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	AD-8	No	n/a	NP	8	0.006608	0.001446	x^2	ShapiroWilk
Cobalt, total (mg/L)	AD-9	No	n/a	NP	8	0.0239	0.008823	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-15	No	n/a	NP	8	3.449	2.705	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-8	No	n/a	NP	8	1.599	1.937	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-9	No	n/a	NP	8	2.27	0.7488	normal	ShapiroWilk
Fluoride, total (mg/L)	AD-15	No	n/a	NP (nrm)	8	0.9078	0.2609	unknown	ShapiroWilk
Fluoride, total (mg/L)	AD-8	No	n/a	NP	8	0.6258	0.166	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-9	No	n/a	NP (nrm)	8	0.7225	0.309	unknown	ShapiroWilk
Lead, total (mg/L)	AD-15	No	n/a	NP	8	0.02798	0.05426	ln(x)	ShapiroWilk
Lead, total (mg/L)	AD-8	No	n/a	NP (nrm)	8	0.005	0	unknown	ShapiroWilk
Lead, total (mg/L)	AD-9	No	n/a	NP (nrm)	8	0.005	0	unknown	ShapiroWilk
Lithium, total (mg/L)	AD-15	No	n/a	NP	8	0.03498	0.04693	ln(x)	ShapiroWilk
Lithium, total (mg/L)	AD-8	No	n/a	NP	8	0.1071	0.01538	ln(x)	ShapiroWilk
Lithium, total (mg/L)	AD-9	No	n/a	NP	8	1.211	0.2741	x^6	ShapiroWilk
Mercury, total (mg/L)	AD-15	No	n/a	NP	8	0.0001253	0.0002367	ln(x)	ShapiroWilk
Mercury, total (mg/L)	AD-8	No	n/a	NP (nrm)	8	0.00001846	0.000008061	unknown	ShapiroWilk
Mercury, total (mg/L)	AD-9	No	n/a	NP	8	0.00001952	0.00001306	sqrt(x)	ShapiroWilk
Molybdenum, total (mg/L)	AD-15	No	n/a	NP	8	0.002425	0.001854	ln(x)	ShapiroWilk
Molybdenum, total (mg/L)	AD-8	No	n/a	NP (nrm)	8	0.003542	0.00202	unknown	ShapiroWilk
Molybdenum, total (mg/L)	AD-9	No	n/a	NP (nrm)	8	0.005	0	unknown	ShapiroWilk
pH, field (SU)	AD-15	No	n/a	NP	8	4.89	0.5099	ln(x)	ShapiroWilk
pH, field (SU)	AD-8	No	n/a	NP	8	6.278	0.7834	ln(x)	ShapiroWilk
pH, field (SU)	AD-9	No	n/a	NP	8	5.354	0.5754	ln(x)	ShapiroWilk
Selenium, total (mg/L)	AD-15	No	n/a	NP	8	0.004234	0.004251	ln(x)	ShapiroWilk
Selenium, total (mg/L)	AD-8	No	n/a	NP (nrm)	8	0.004167	0.001551	unknown	ShapiroWilk
Selenium, total (mg/L)	AD-9	No	n/a	NP	8	0.003965	0.002313	normal	ShapiroWilk
Sulfate, total (mg/L)	AD-15	No	n/a	NP	8	20.38	6.186	x^2	ShapiroWilk

Outlier Analysis - All Results

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP   Printed 12/27/2017, 7:24 PM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Sulfate, total (mg/L)	AD-8	No	n/a	NP	8	178	23.53	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-9	No	n/a	NP	8	1234	526.1	x^3	ShapiroWilk
Thallium, total (mg/L)	AD-15	No	n/a	NP (nrm)	8	0.001945	0.0001556	unknown	ShapiroWilk
Thallium, total (mg/L)	AD-8	No	n/a	NP (nrm)	8	0.001854	0.0002977	unknown	ShapiroWilk
Thallium, total (mg/L)	AD-9	No	n/a	NP (nrm)	8	0.001904	0.0001983	unknown	ShapiroWilk
Total Dissolved Solids (mg/L)	**AD-15**	**Yes**	**367,88**	**NP**	**8**	**194.4**	**78.82**	**ln(x)**	**ShapiroWilk**
Total Dissolved Solids (mg/L)	AD-8	No	n/a	NP	8	420.9	60.09	x^(1/3)	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-9	No	n/a	NP	8	2131	851.5	x^6	ShapiroWilk

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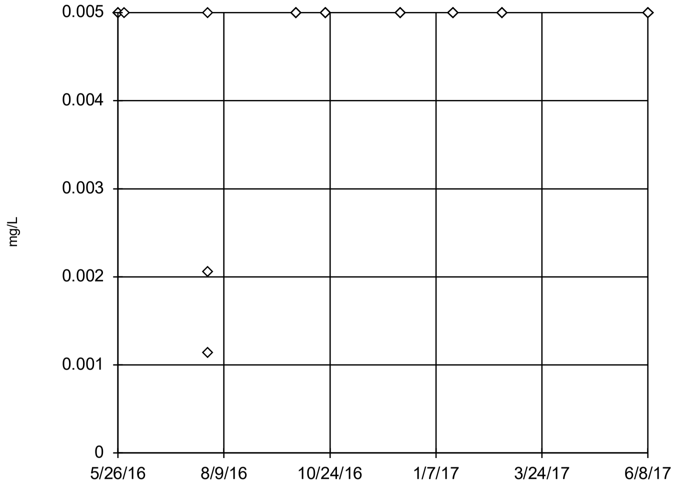
Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

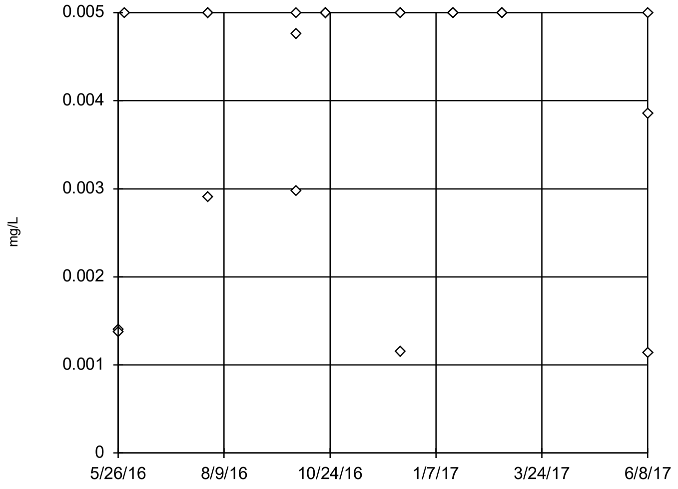
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony, total Analysis Run 12/27/2017 7:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square transformed to achieve best W statistic (graph shown in original units).

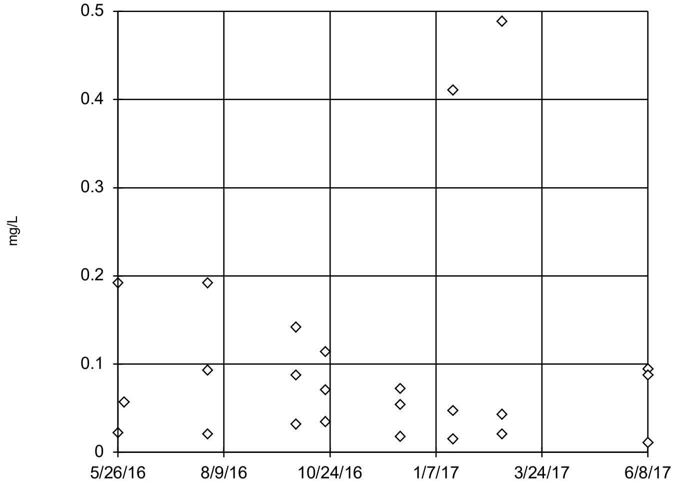
High cutoff = 0.008034, low cutoff = -0.005267, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 12/27/2017 7:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

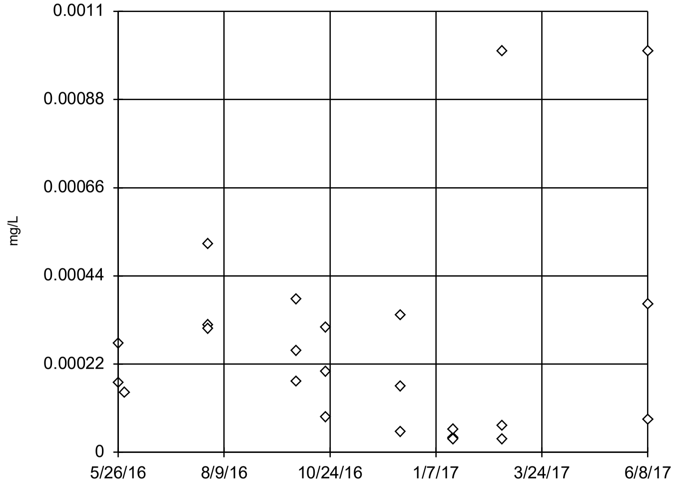
High cutoff = 6.834, low cutoff = 0.0003854, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 12/27/2017 7:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

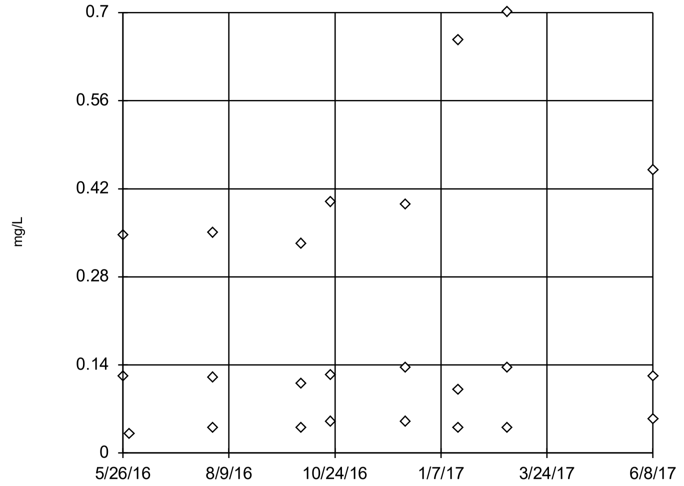
High cutoff = 0.02986, low cutoff = 8.0e-7, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 12/27/2017 7:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.05 alpha level.

Data were natural log
transformed to achieve
best W statistic (graph
shown in original units).

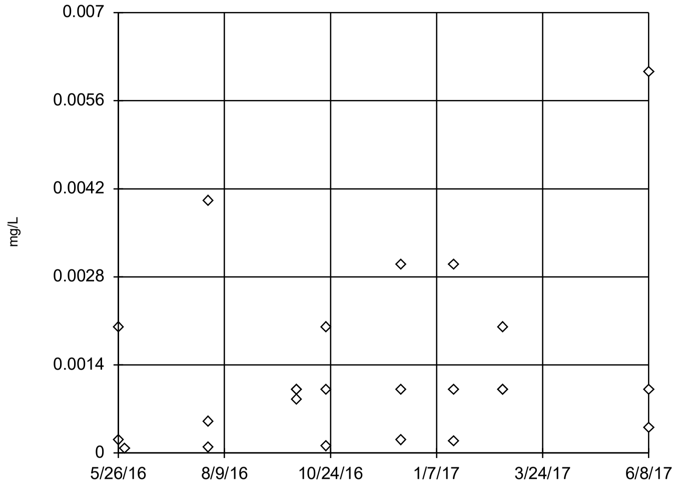
High cutoff = 117.3, low
cutoff = 0.0001483, based
on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 12/27/2017 7:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method selected by user.

Data were cube root transformed to achieve best
W statistic (graph shown
in original units).

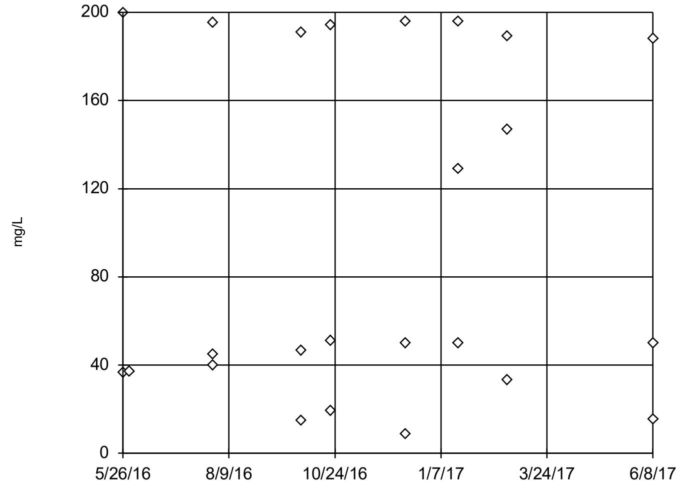
High cutoff = 0.0283,
low cutoff = -0.001418,
based on IQR multiplier
of 3.

Constituent: Cadmium, total Analysis Run 12/27/2017 7:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.05 alpha level.

Data were natural log
transformed to achieve
best W statistic (graph
shown in original units).

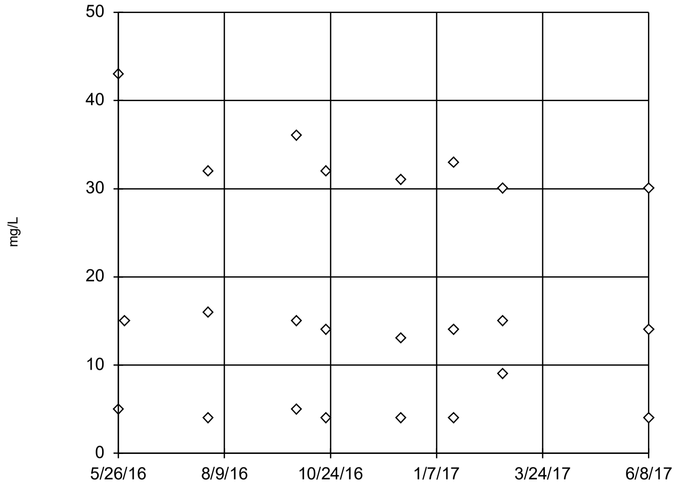
High cutoff = 26364, low
cutoff = 0.2645, based
on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 12/27/2017 7:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.05 alpha level.

Data were square root
transformed to achieve
best W statistic (graph
shown in original units).

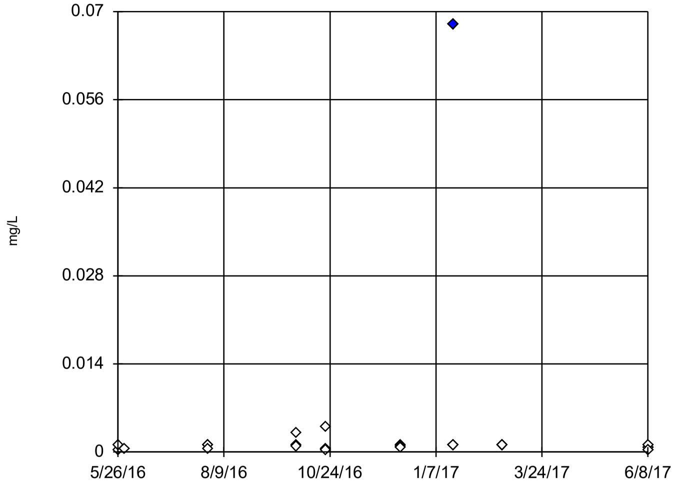
High cutoff = 236.6, low
cutoff = -58.11, based
on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 12/27/2017 7:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

Outlier is drawn as solid. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

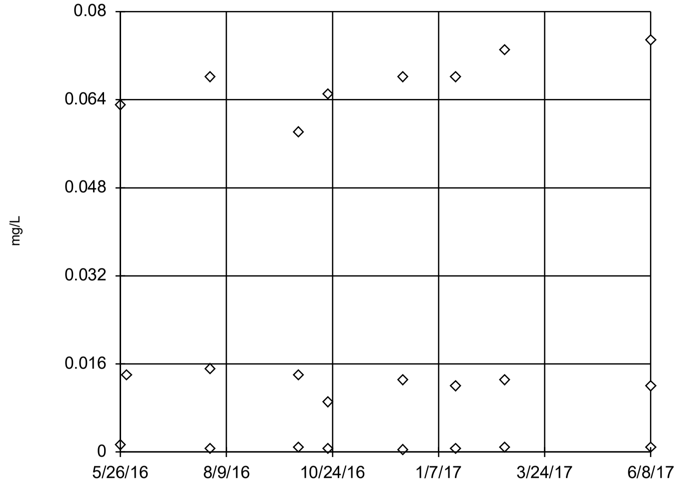
High cutoff = 0.00451, low cutoff = 0.0001342, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 12/27/2017 7:25 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

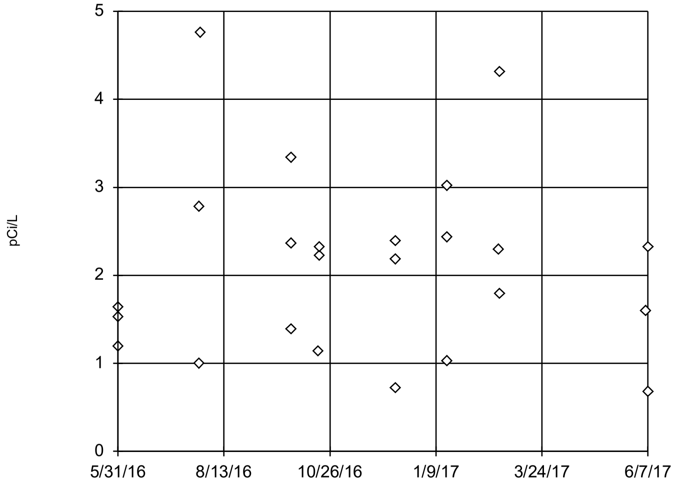
High cutoff = 2.302, low cutoff = -0.566, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 12/27/2017 7:26 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

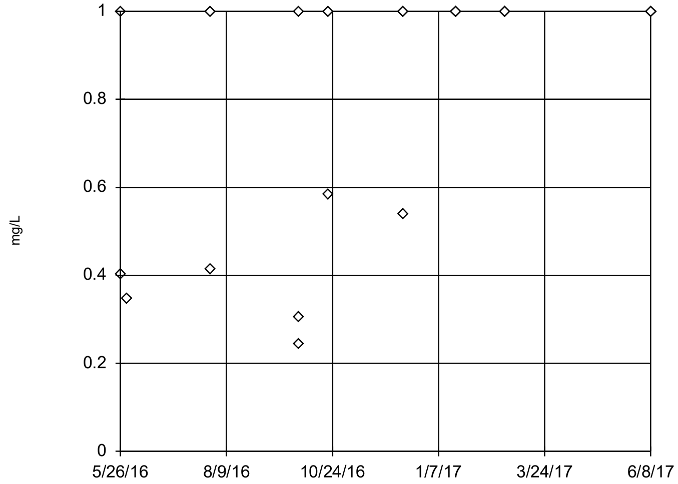
High cutoff = 9.34, low cutoff = 0.03289, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 12/27/2017 7:26 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

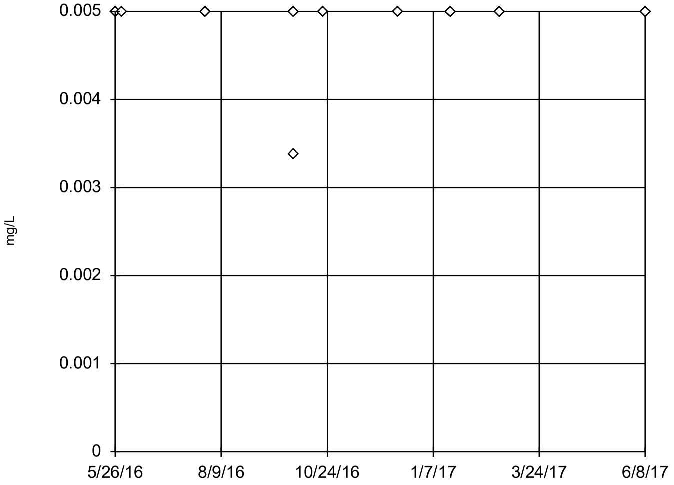
High cutoff = 5.663, low cutoff = 0.09907, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 12/27/2017 7:26 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

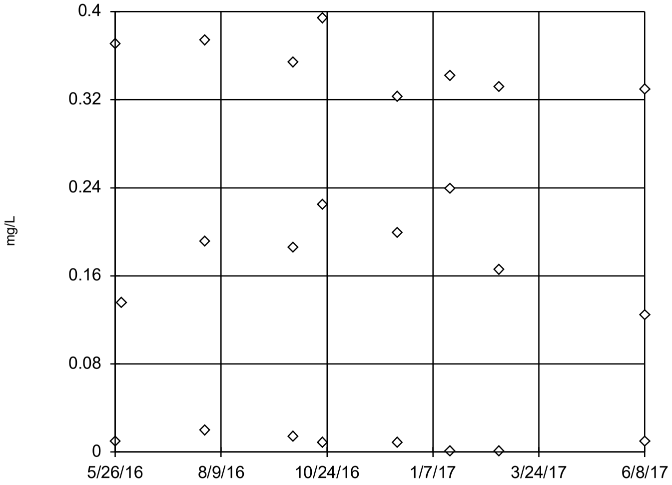
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Lead, total   Analysis Run 12/27/2017 7:26 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

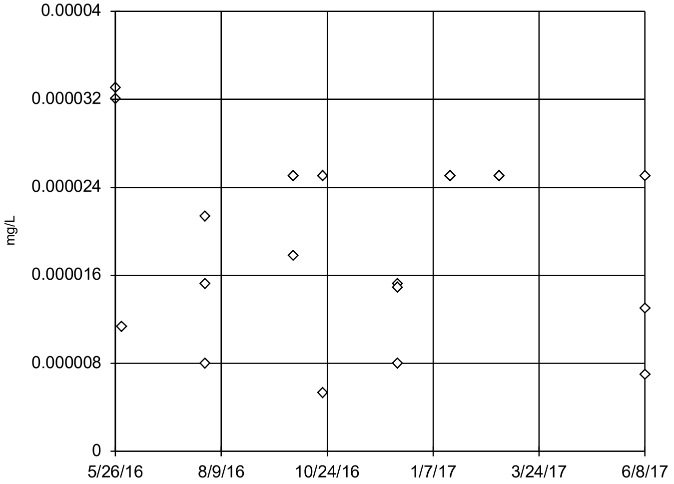
High cutoff = 1.284, low cutoff = -0.942, based on IQR multiplier of 3.

Constituent: Lithium, total   Analysis Run 12/27/2017 7:26 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

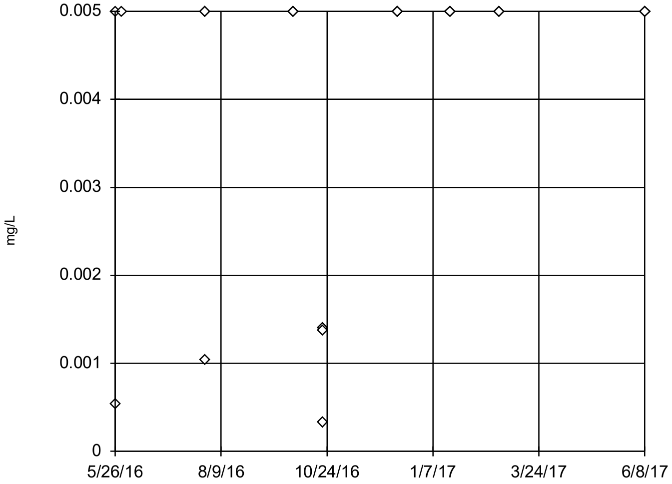
High cutoff = 0.00005822, low cutoff = -0.0000193, based on IQR multiplier of 3.

Constituent: Mercury, total   Analysis Run 12/27/2017 7:26 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

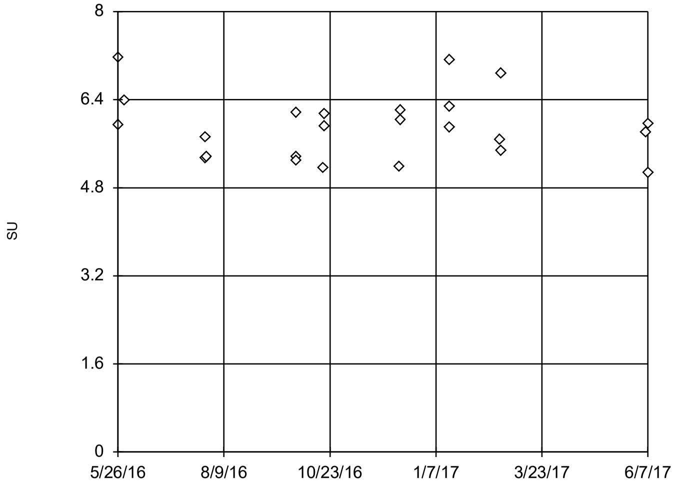
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Molybdenum, total   Analysis Run 12/27/2017 7:26 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

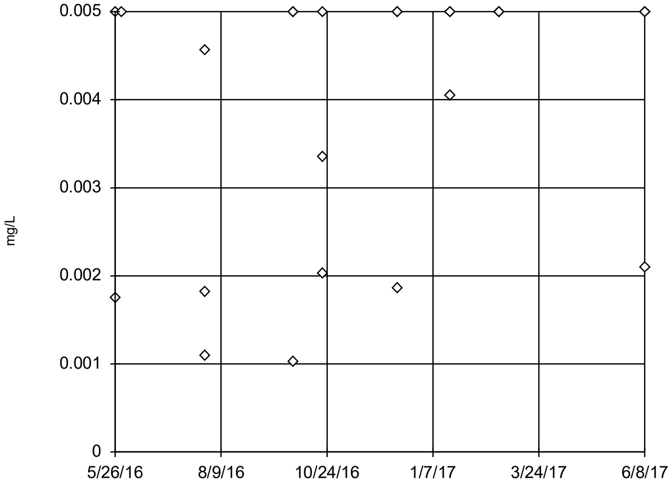
High cutoff = 9.507, low cutoff = 3.493, based on IQR multiplier of 3.

Constituent: pH, field   Analysis Run 12/27/2017 7:26 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

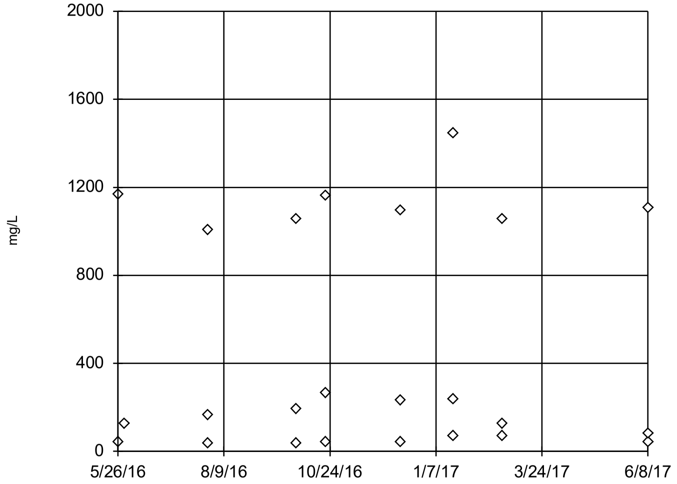
High cutoff = 0.02146, low cutoff = -0.00092, based on IQR multiplier of 3.

Constituent: Selenium, total   Analysis Run 12/27/2017 7:26 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

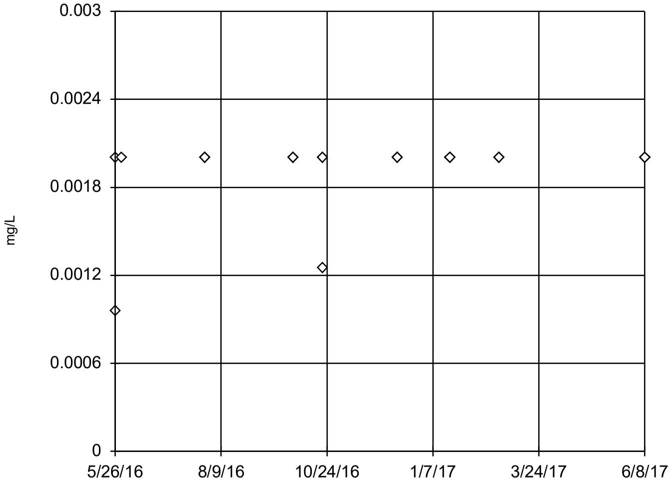
High cutoff = 8116570, low cutoff = 0.006946, based on IQR multiplier of 3.

Constituent: Sulfate, total   Analysis Run 12/27/2017 7:26 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

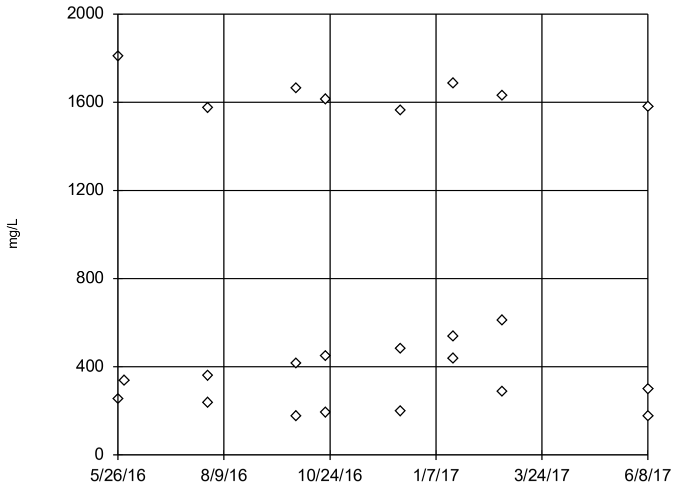
Ladder of Powers transformations did not improve normality; analysis run on raw data.

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium, total   Analysis Run 12/27/2017 7:26 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 24

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.05 alpha level.

Data were natural log
transformed to achieve
best W statistic (graph
shown in original units).

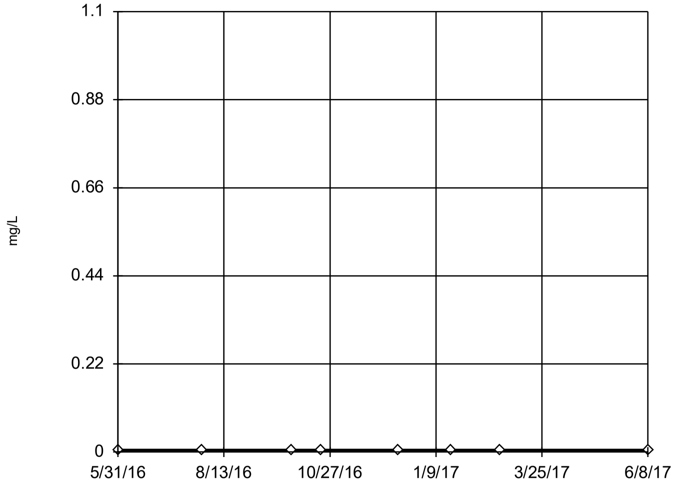
High cutoff = 319651,
low cutoff = 1.324, based
on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 12/27/2017 7:26 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

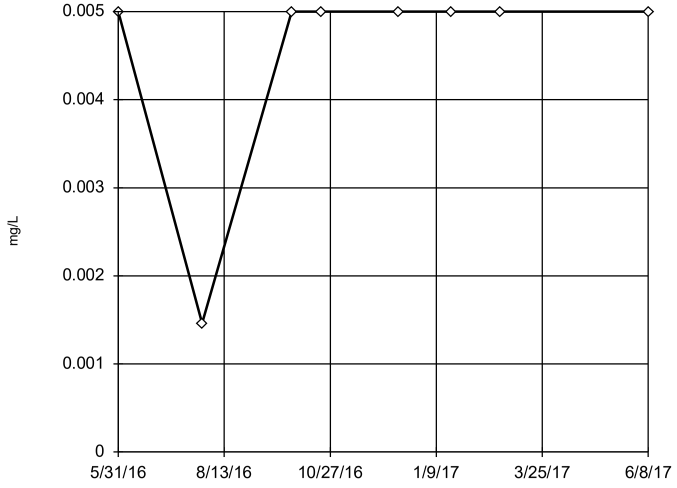
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

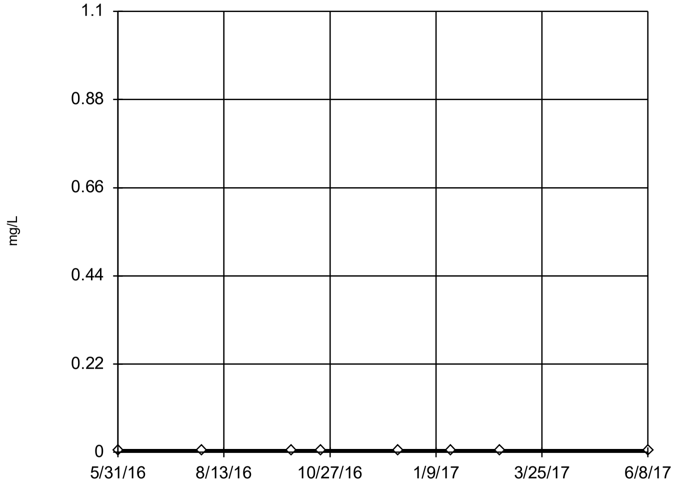
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

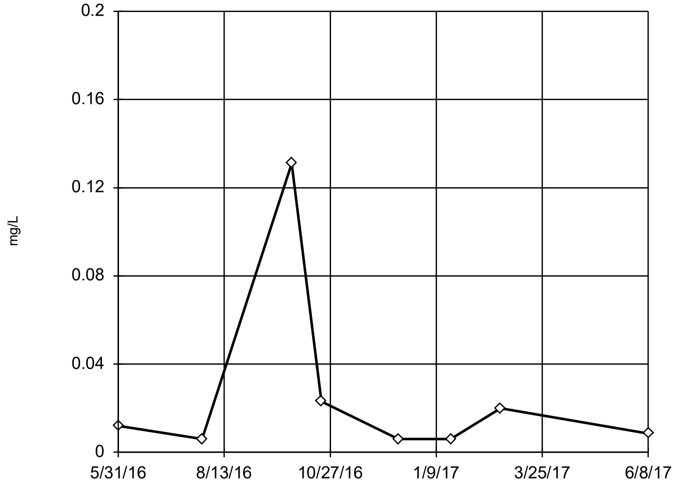
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

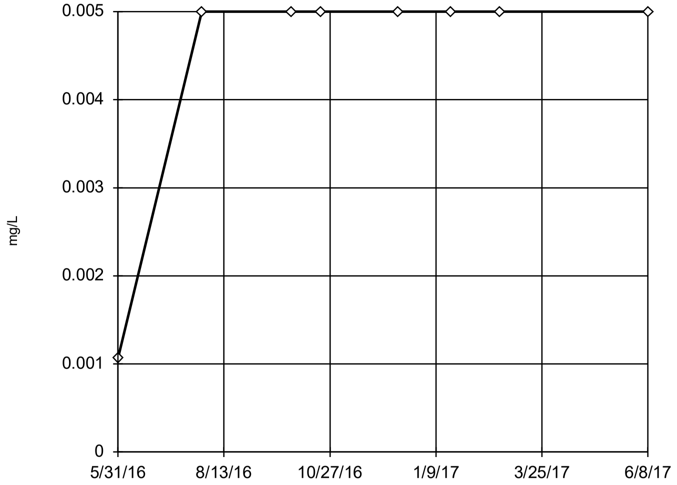
High cutoff = 0.9796, low cutoff = 0.0001314, based on IQR multiplier of 3.

Constituent: Arsenic, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were x^5 transformed to achieve best W statistic (graph shown in original units).

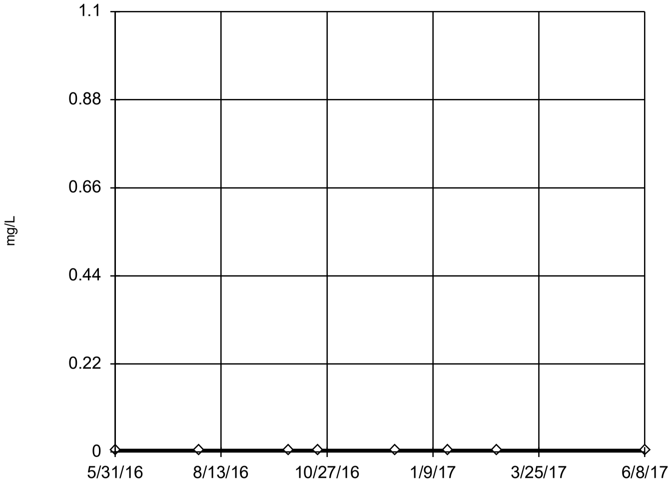
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Arsenic, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

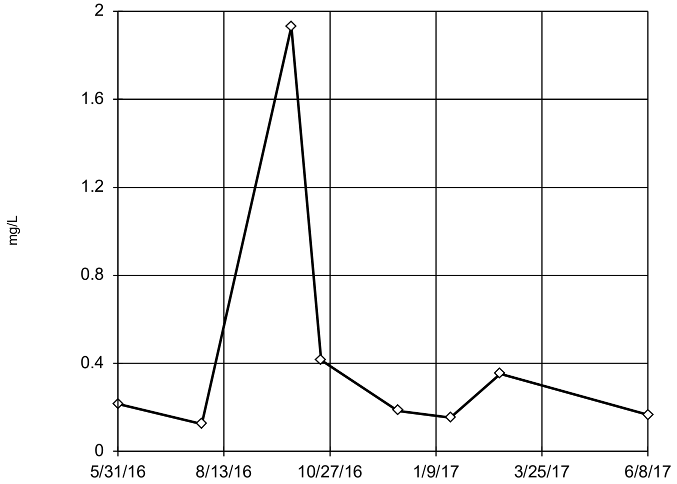
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Arsenic, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

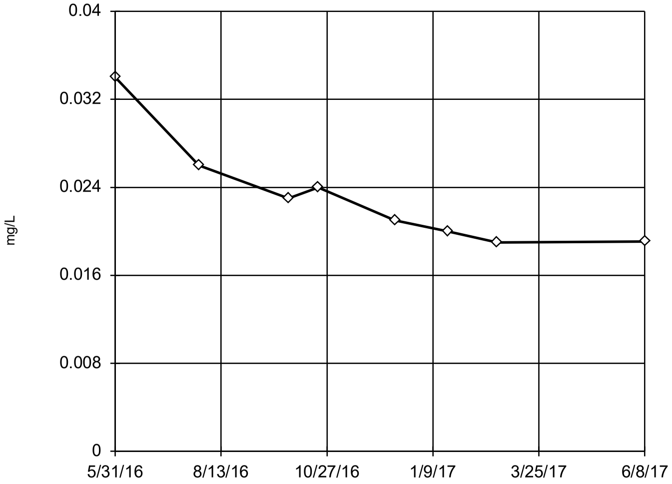
High cutoff = 5.302, low cutoff = 0.0115, based on IQR multiplier of 3.

Constituent: Barium, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

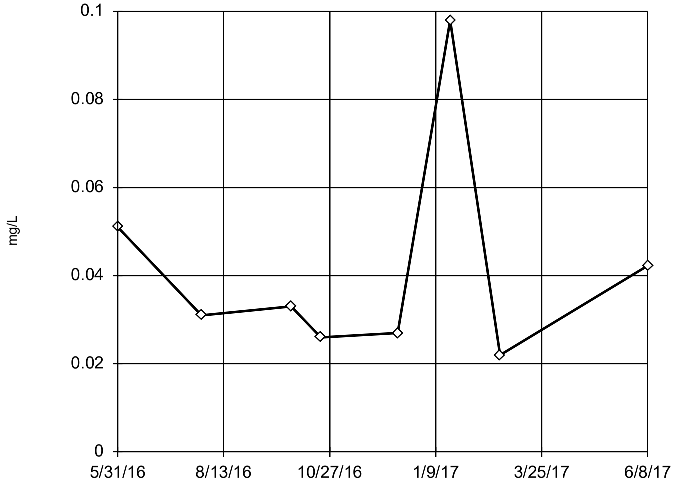
High cutoff = 0.05223, low cutoff = 0.009342, based on IQR multiplier of 3.

Constituent: Barium, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

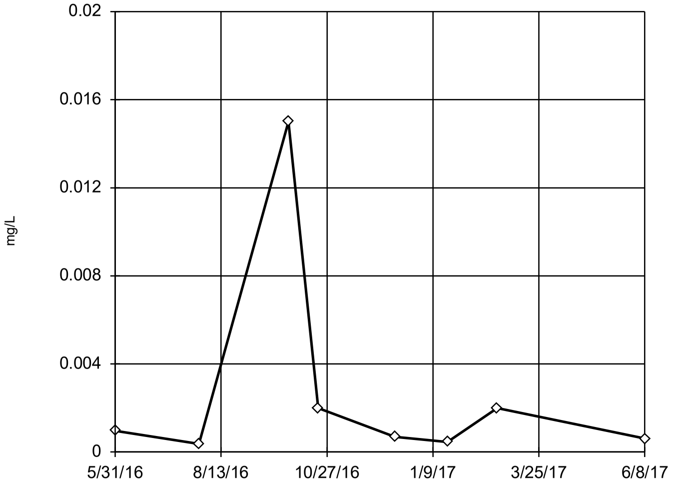
High cutoff = 0.2499, low cutoff = 0.004923, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

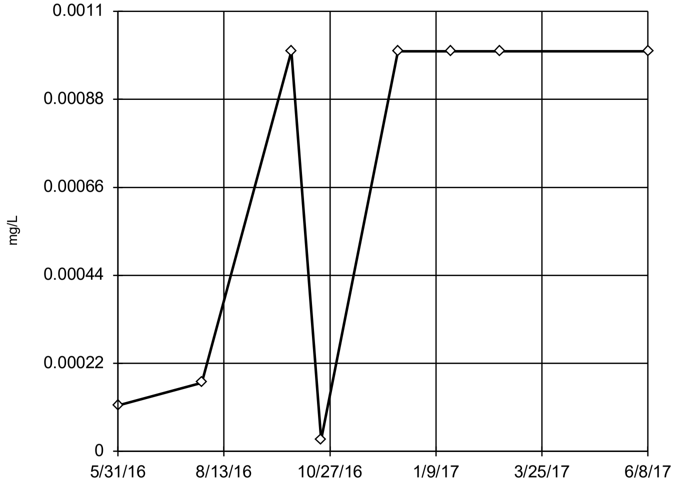
High cutoff = 0.1114, low cutoff = 0.000009403, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

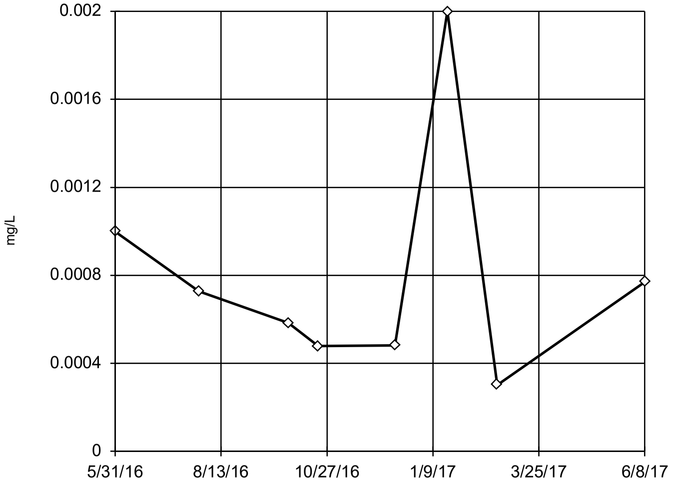
High cutoff = 0.363, low cutoff = 3.9e-7, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

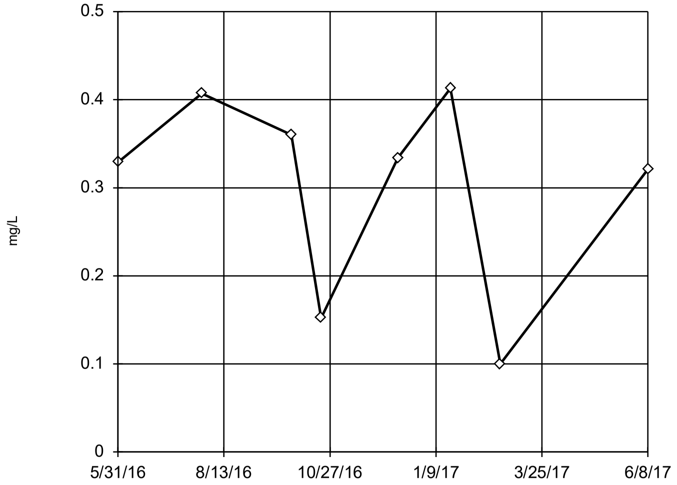
High cutoff = 0.005357, low cutoff = 0.0000786, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found.
Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

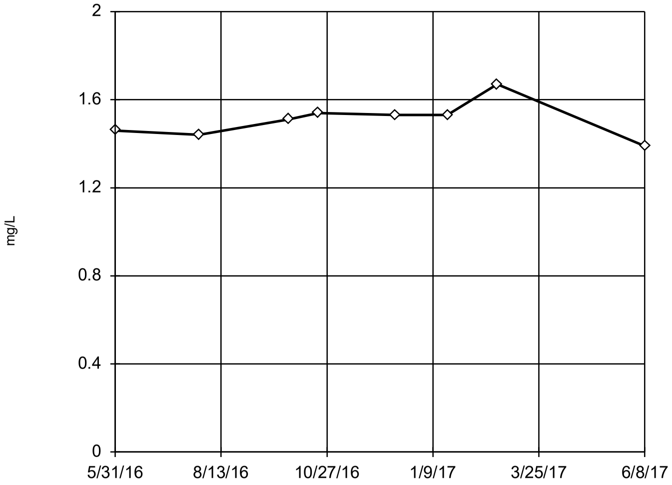
High cutoff = 0.5575, low cutoff = -0.4609, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

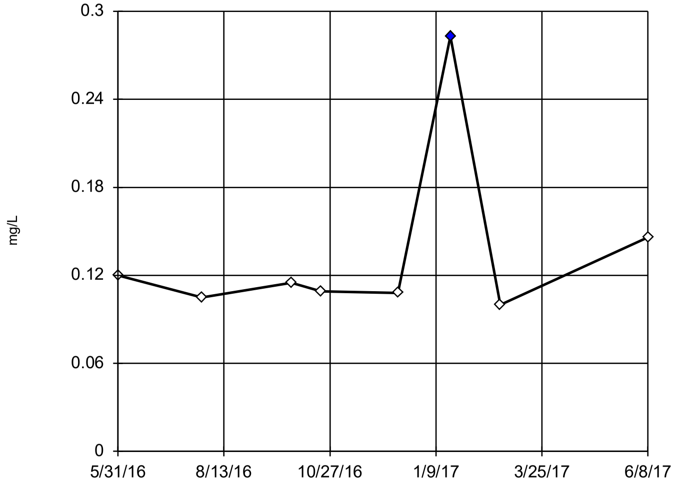
High cutoff = 1.821, low cutoff = 1.222, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

Outlier is drawn as solid.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

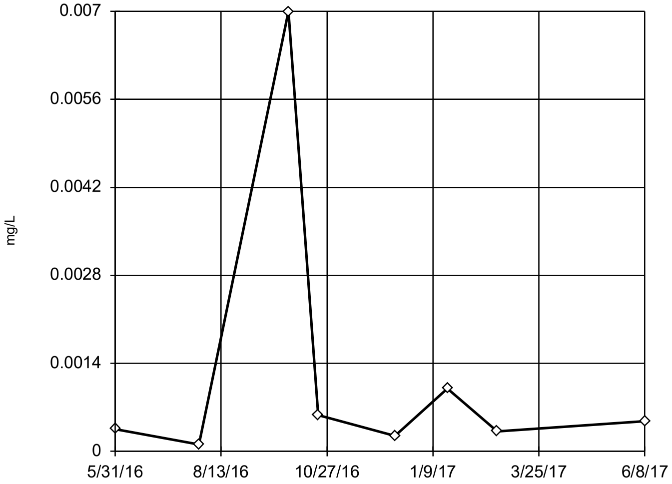
High cutoff = 0.2542, low cutoff = 0.05545, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

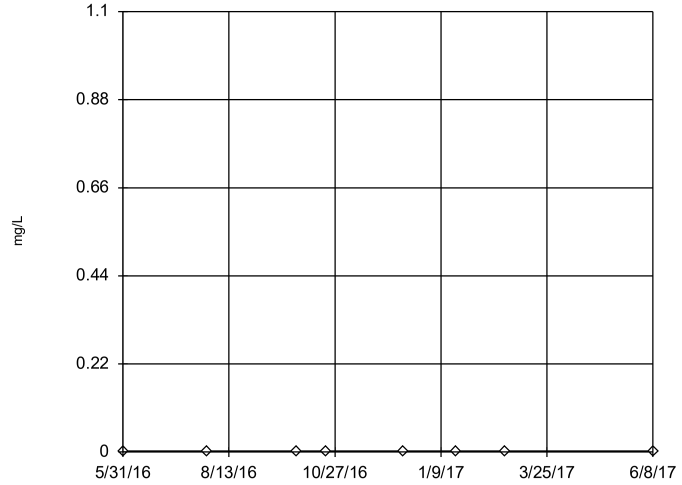
High cutoff = 0.01502, low cutoff = 0.00001418, based on IQR multiplier of 3.

Constituent: Cadmium, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

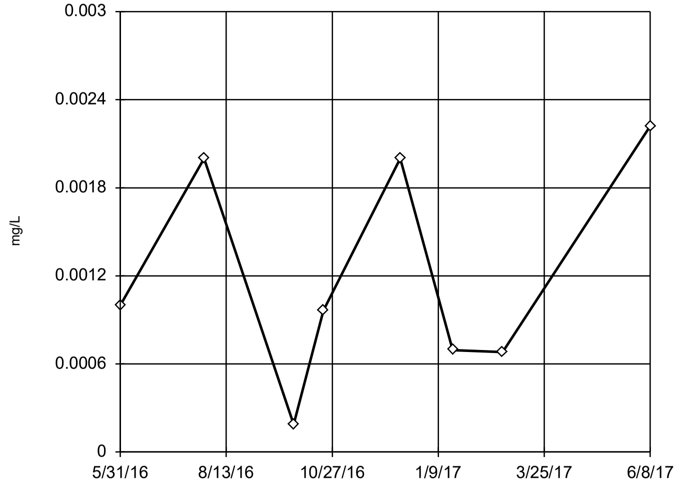
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Cadmium, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

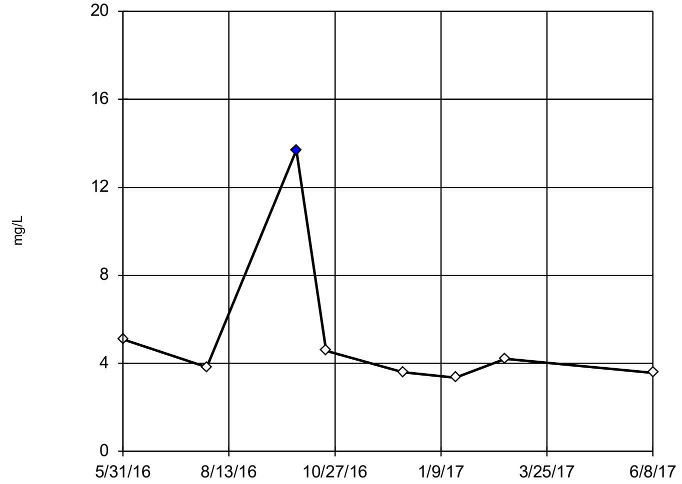
High cutoff = 0.01005, low cutoff = -0.0008603, based on IQR multiplier of 3.

Constituent: Cadmium, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

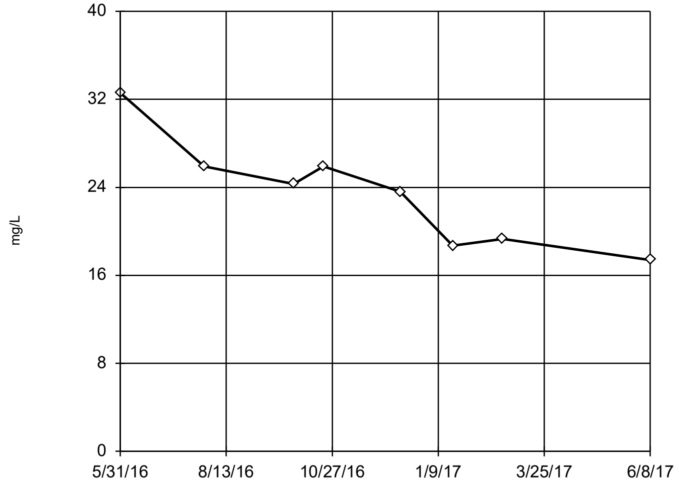
High cutoff = 11.74, low cutoff = 1.472, based on IQR multiplier of 3.

Constituent: Calcium, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

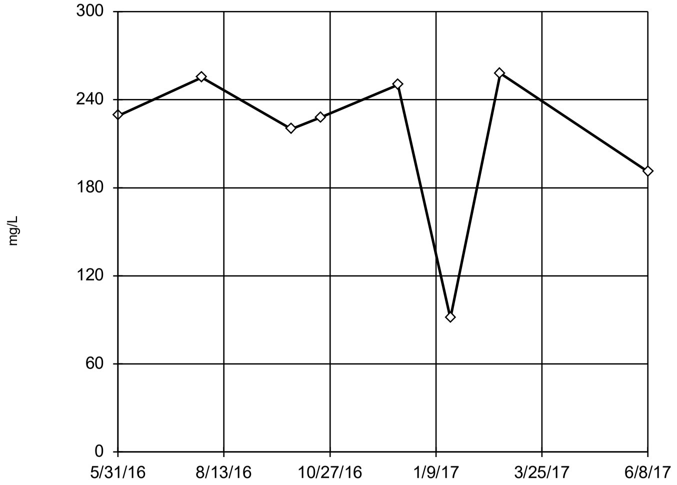
High cutoff = 65.63, low cutoff = 7.497, based on IQR multiplier of 3.

Constituent: Calcium, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found. Tukey's method selected by user.

Data were x^5 transformed to achieve best W statistic (graph shown in original units).

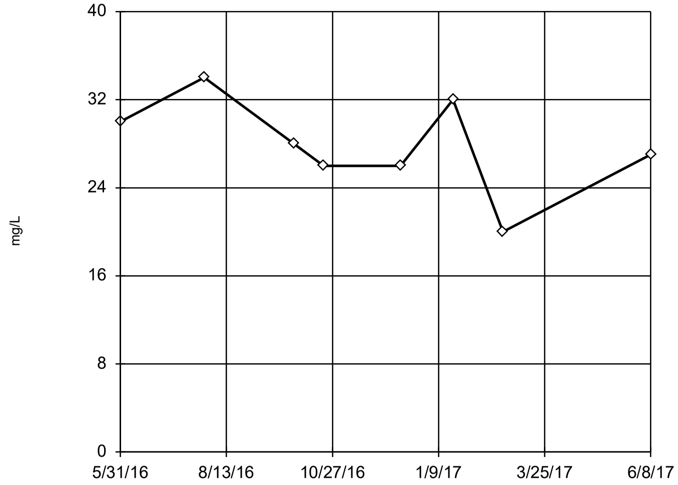
High cutoff = 312, low cutoff = -274, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

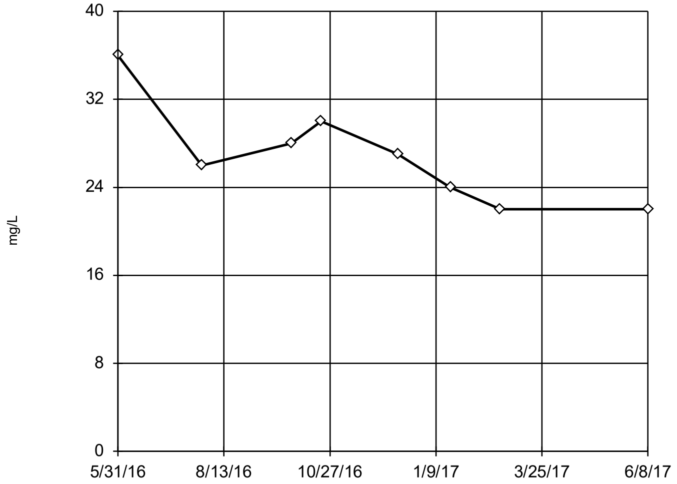
High cutoff = 42.66, low cutoff = -13.49, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

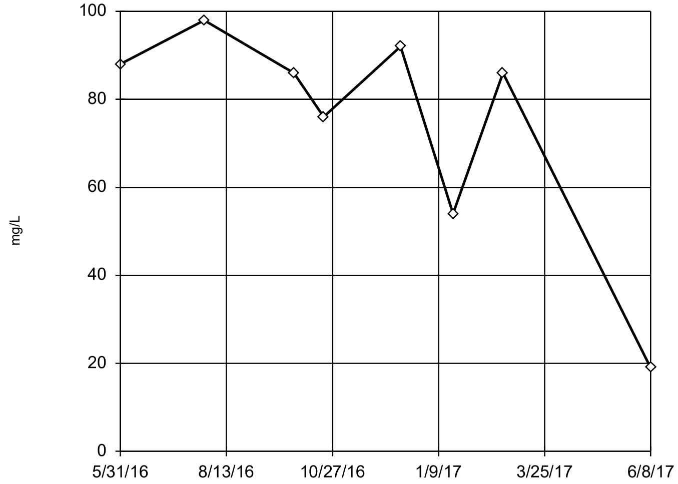
High cutoff = 58.16, low cutoff = 11.45, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found. Tukey's method selected by user.

Data were x^5 transformed to achieve best W statistic (graph shown in original units).

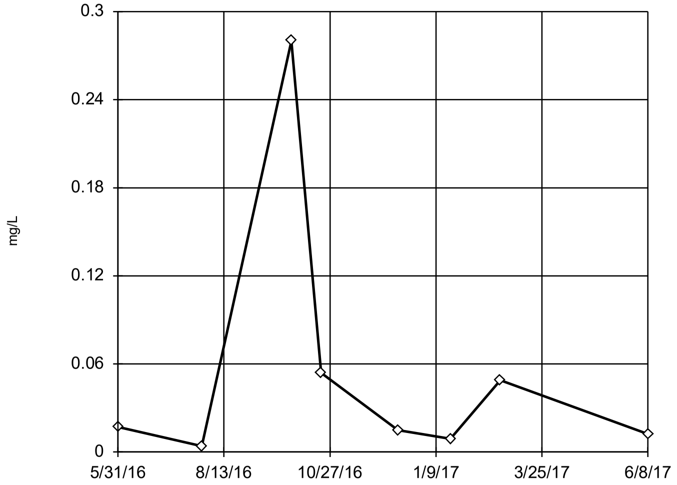
High cutoff = 114, low cutoff = -103.4, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

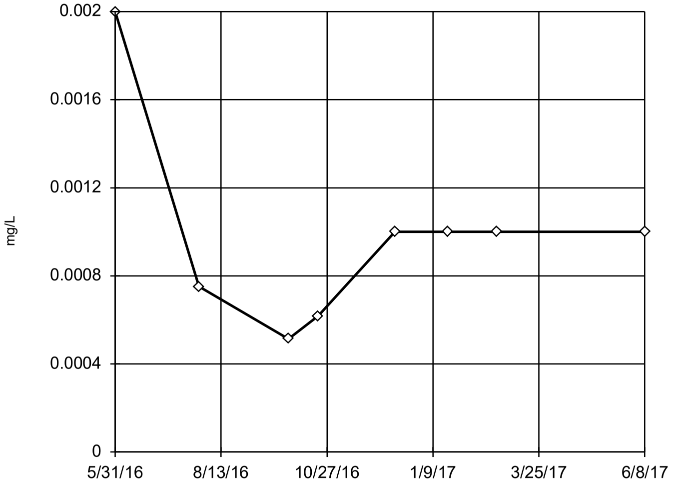
High cutoff = 5.975, low cutoff = 0.00009077, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

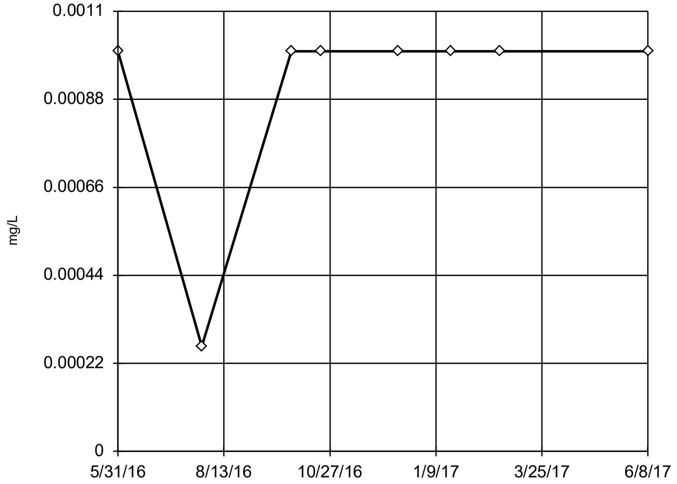
High cutoff = 0.003163, low cutoff = 0.0002154, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were x^5 transformed to achieve best W statistic (graph shown in original units).

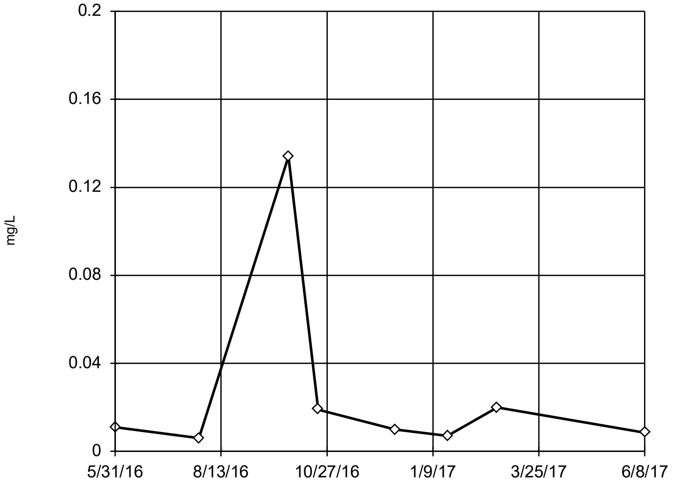
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Chromium, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

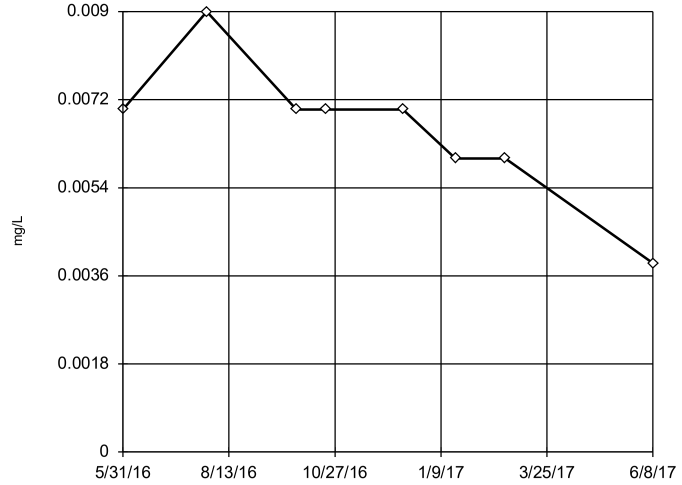
High cutoff = 0.318, low cutoff = 0.0004712, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

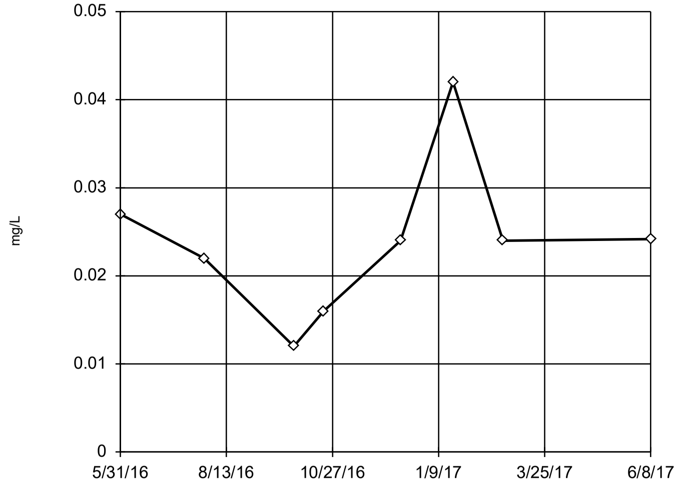
High cutoff = 0.009381, low cutoff = -0.001732, based on IQR multiplier of 3.

Constituent: Cobalt, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

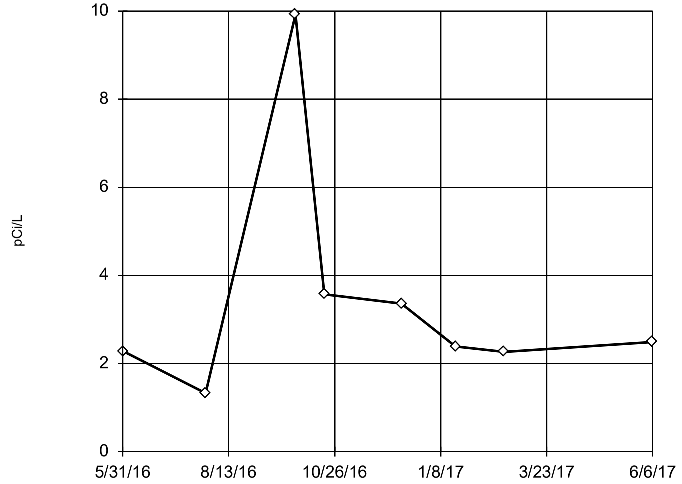
High cutoff = 0.06443, low cutoff = 0.007437, based on IQR multiplier of 3.

Constituent: Cobalt, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

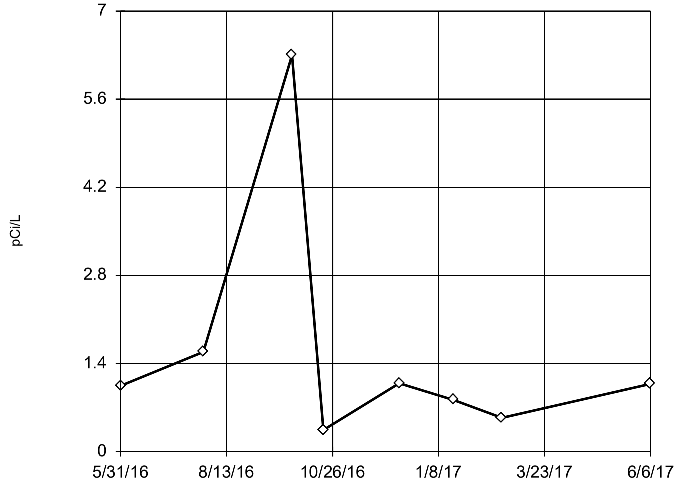
High cutoff = 12.24, low cutoff = 0.6427, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

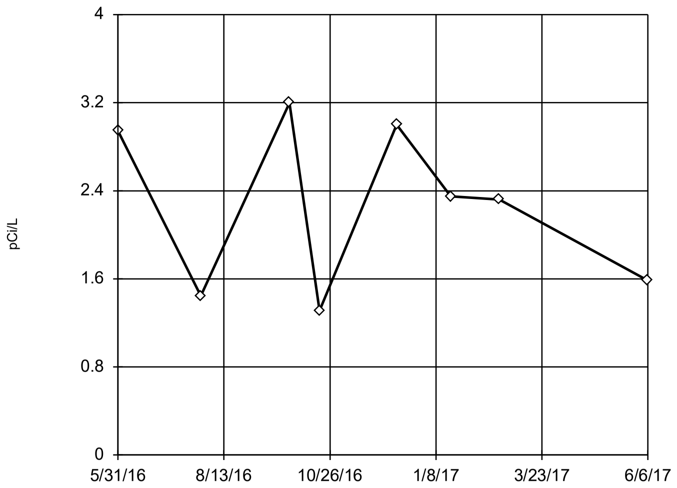
High cutoff = 10.04, low cutoff = 0.08661, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

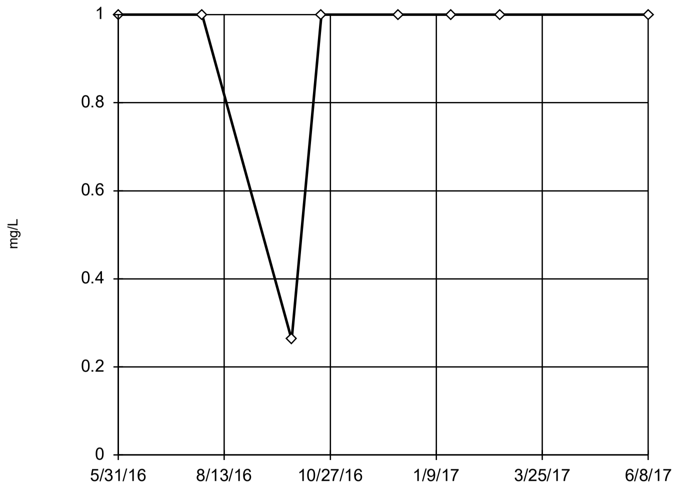
High cutoff = 7.341, low cutoff = -2.852, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

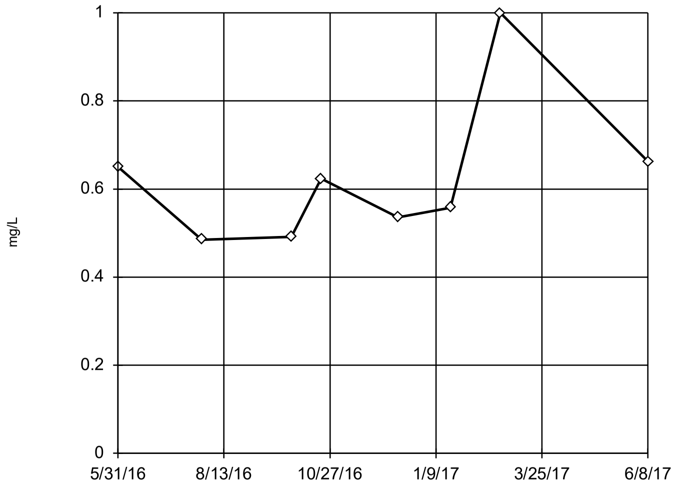
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Fluoride, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

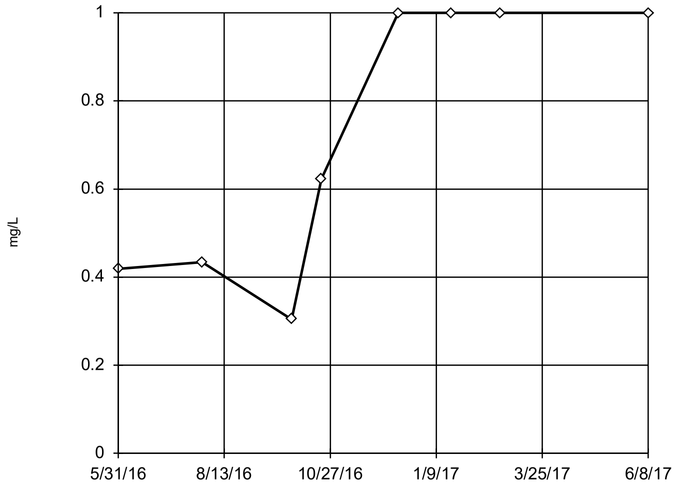
High cutoff = 1.379, low cutoff = 0.2443, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

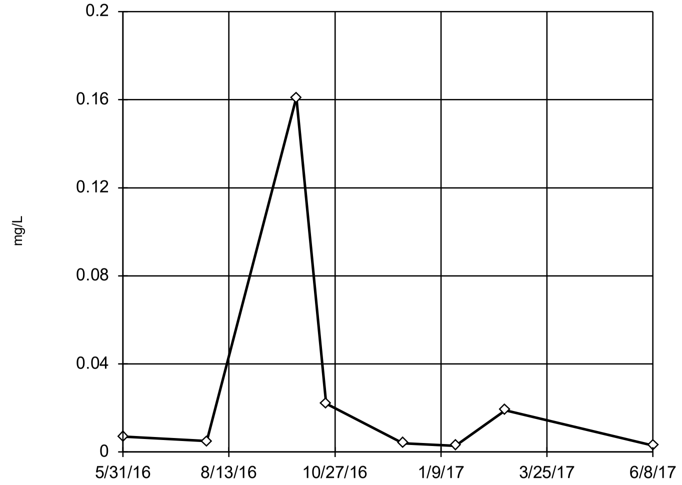
High cutoff = 12.9, low cutoff = 0.03307, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

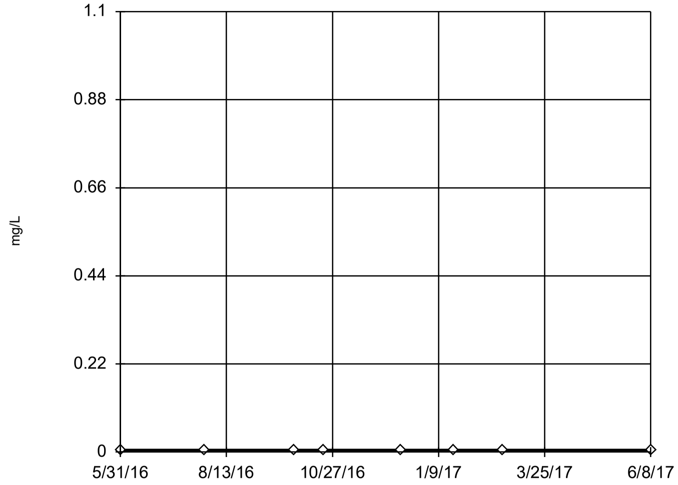
High cutoff = 4.309, low cutoff = 0.0000163, based on IQR multiplier of 3.

Constituent: Lead, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

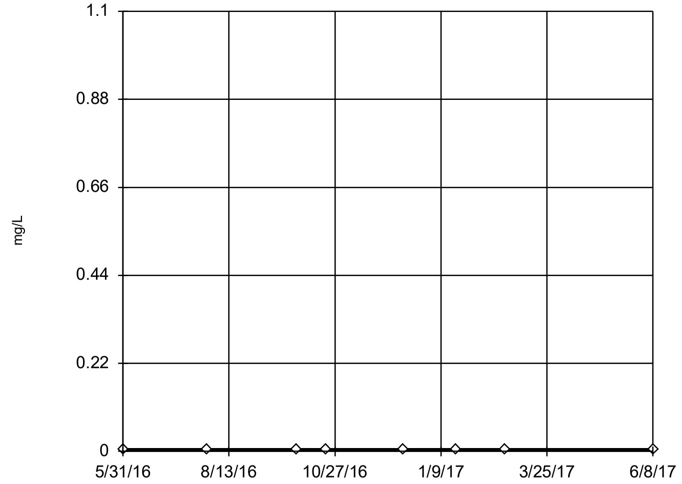
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Lead, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

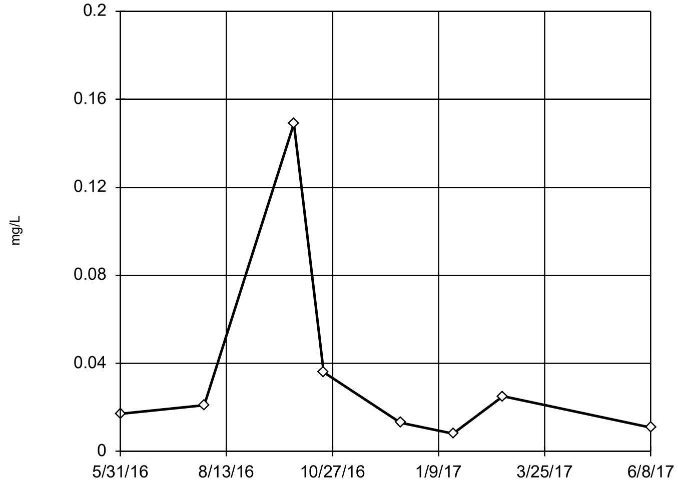
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Lead, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

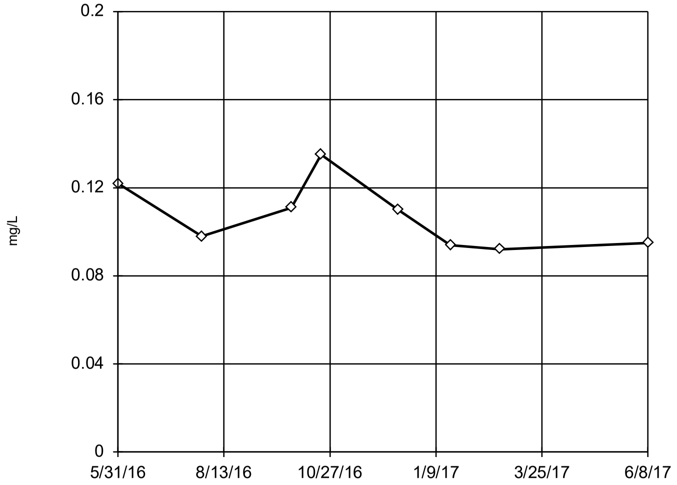
High cutoff = 0.4869, low cutoff = 0.0007301, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

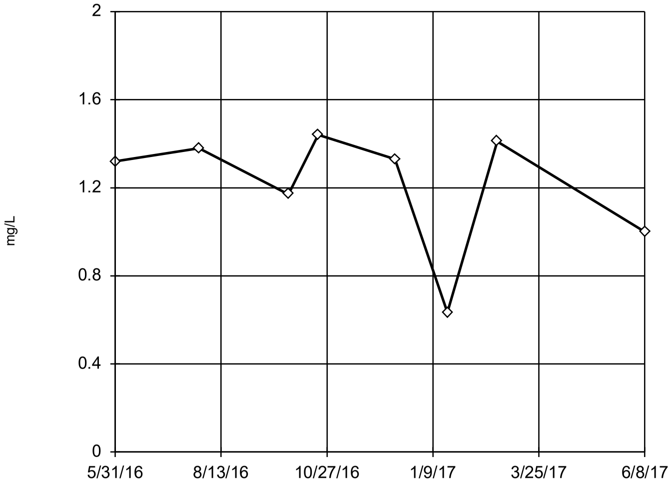
High cutoff = 0.2176, low cutoff = 0.05051, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found.
Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

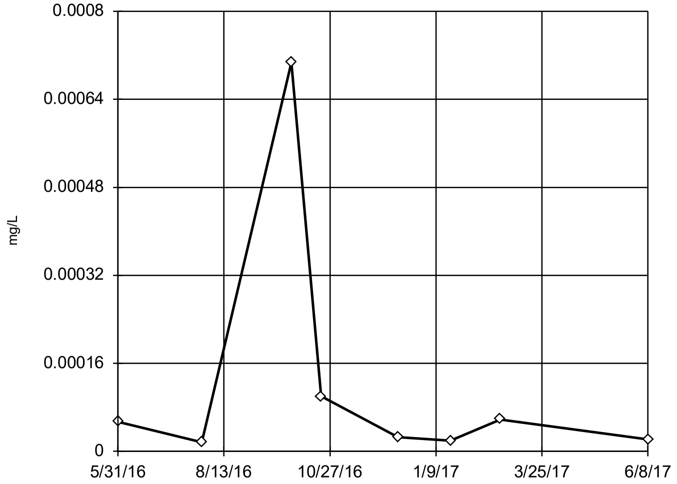
High cutoff = 1.701, low cutoff = -1.571, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

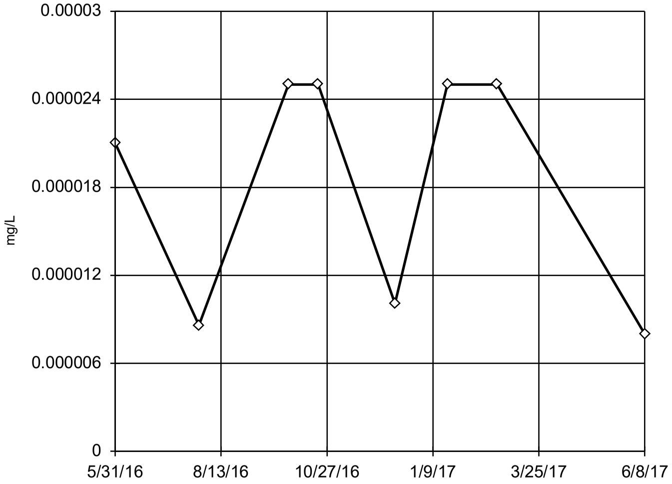
High cutoff = 0.003839, low cutoff = 4.1e-7, based on IQR multiplier of 3.

Constituent: Mercury, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were cube transformed to achieve best W statistic (graph shown in original units).

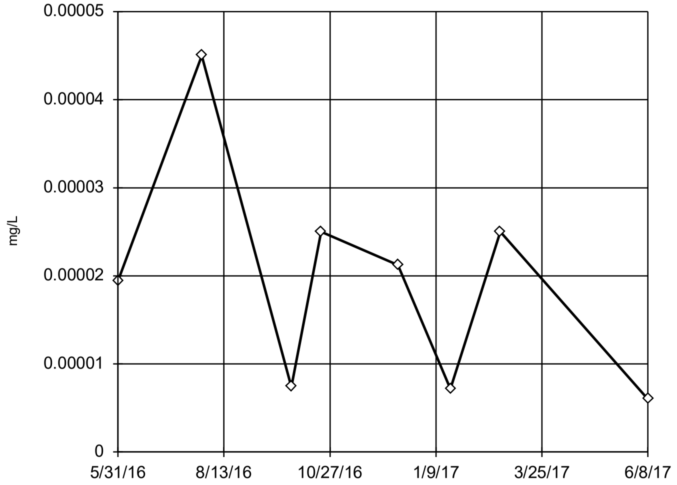
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Mercury, total Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found.
Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

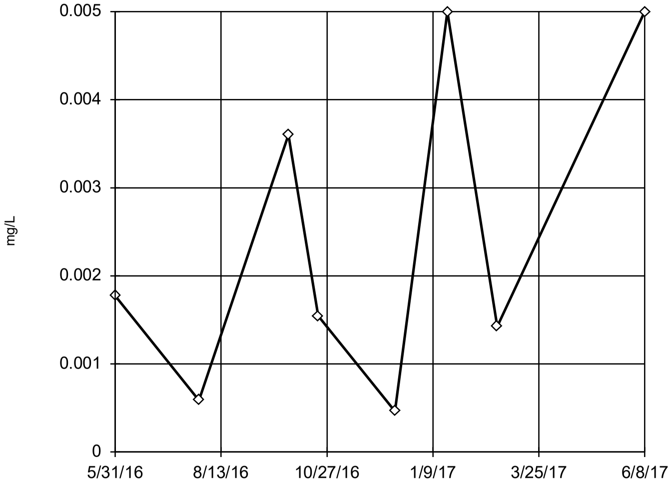
High cutoff = 0.0001417, low cutoff = -0.0000177, based on IQR multiplier of 3.

Constituent: Mercury, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

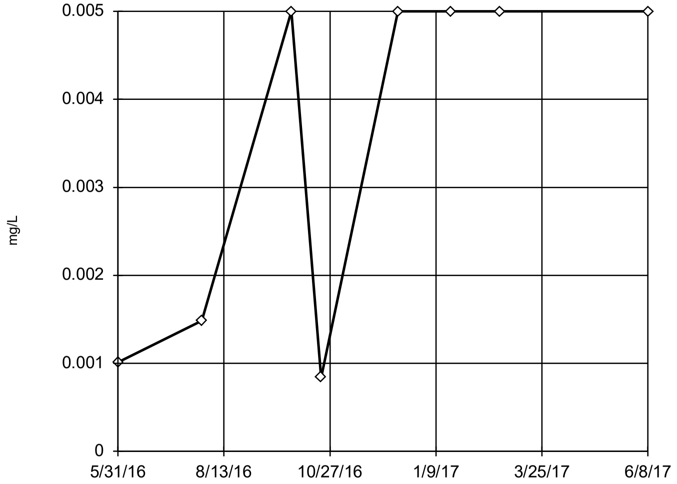
High cutoff = 0.4236, low cutoff = 0.000009168, based on IQR multiplier of 3.

Constituent: Molybdenum, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

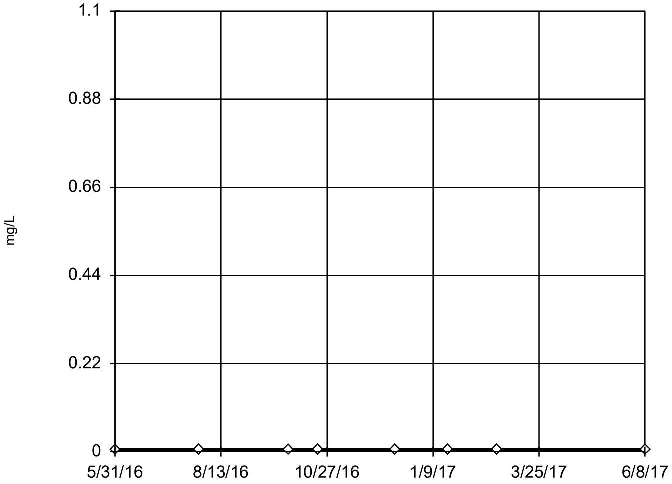
High cutoff = 0.3393, low cutoff = 0.00001806, based on IQR multiplier of 3.

Constituent: Molybdenum, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

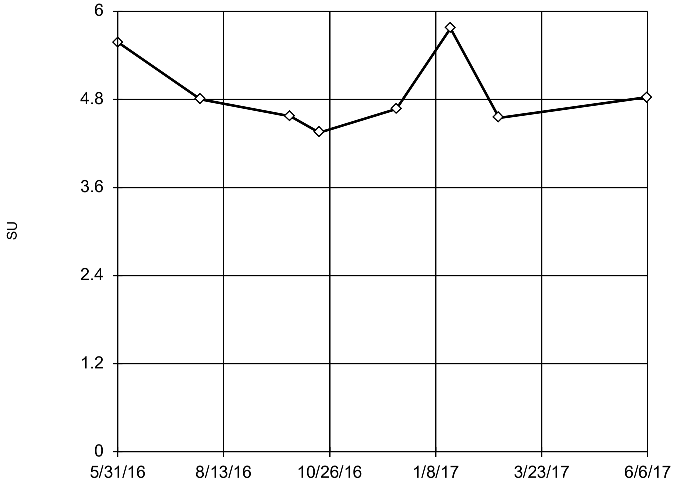
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Molybdenum, total   Analysis Run 12/27/2017 7:22 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

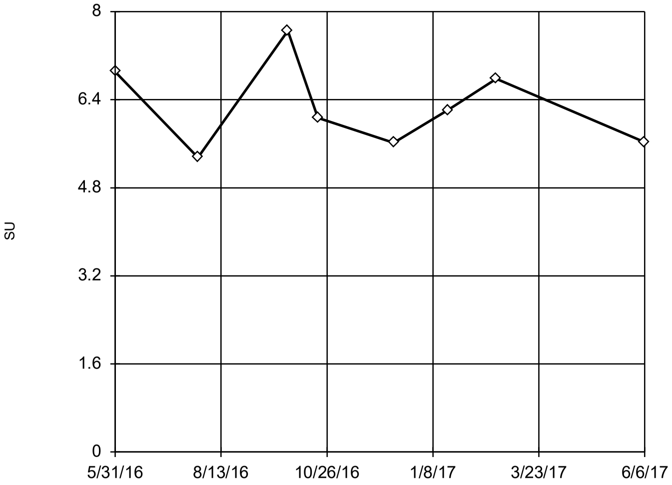
High cutoff = 7.661, low cutoff = 3.09, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

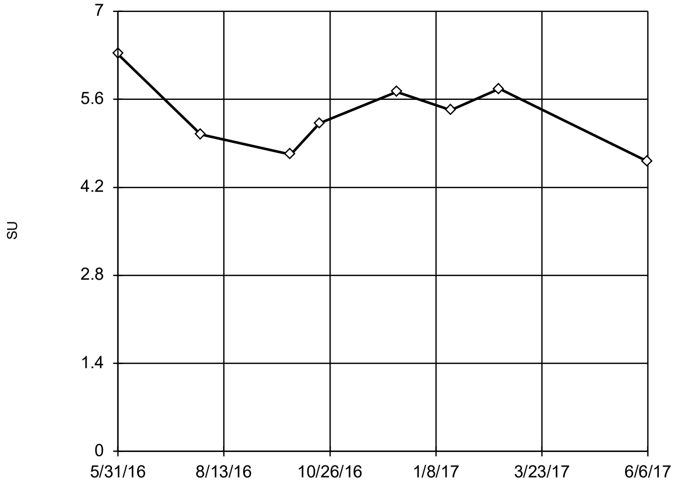
High cutoff = 12.33, low cutoff = 3.122, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 12/27/2017 7:22 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

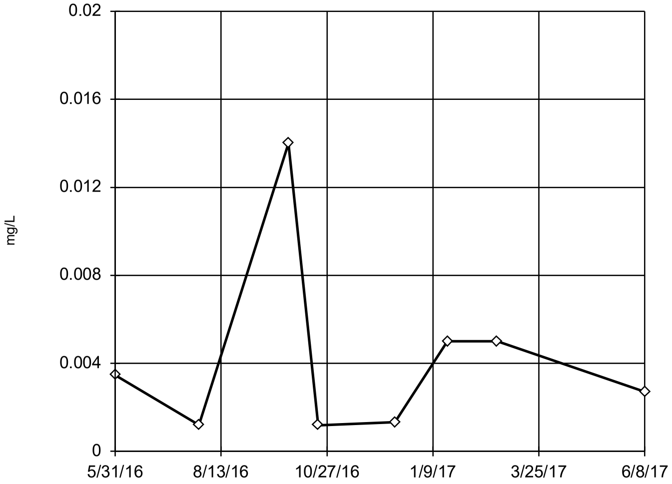
High cutoff = 9.388, low cutoff = 2.985, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 12/27/2017 7:23 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

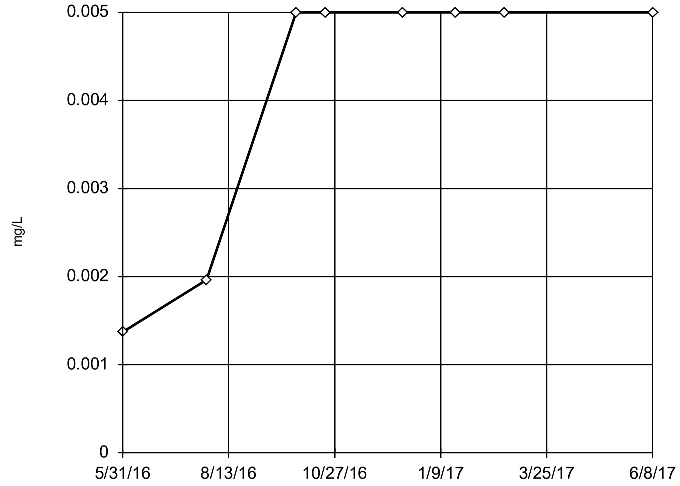
High cutoff = 0.3124, low cutoff = 0.00002017, based on IQR multiplier of 3.

Constituent: Selenium, total Analysis Run 12/27/2017 7:23 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

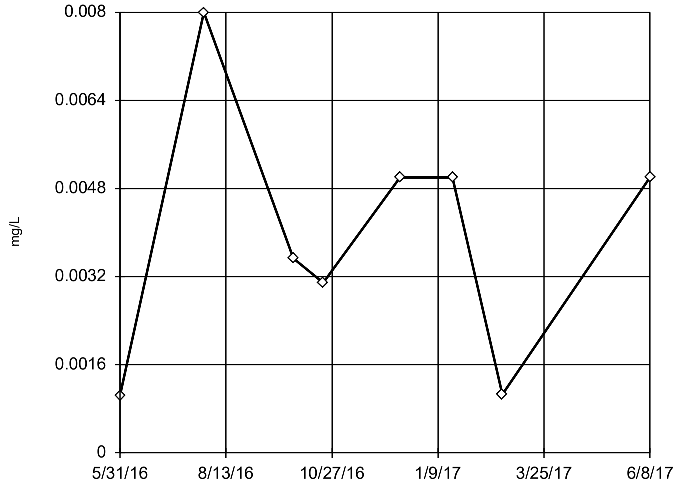
High cutoff = 0.02032, low cutoff = 0.0007709, based on IQR multiplier of 3.

Constituent: Selenium, total   Analysis Run 12/27/2017 7:23 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

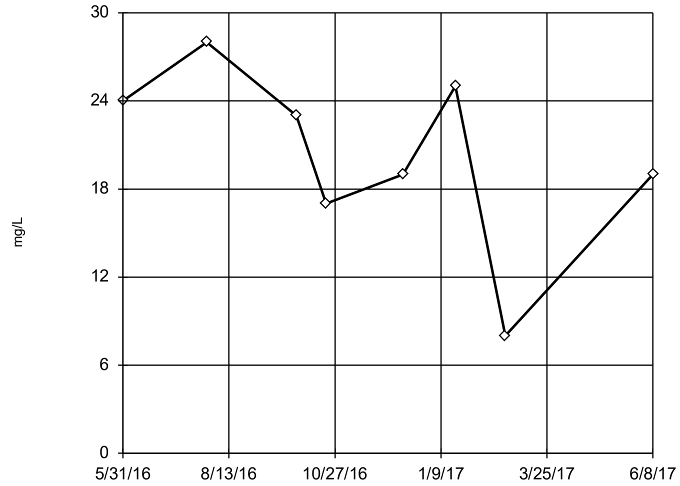
High cutoff = 0.01377, low cutoff = -0.006699, based on IQR multiplier of 3.

Constituent: Selenium, total   Analysis Run 12/27/2017 7:23 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

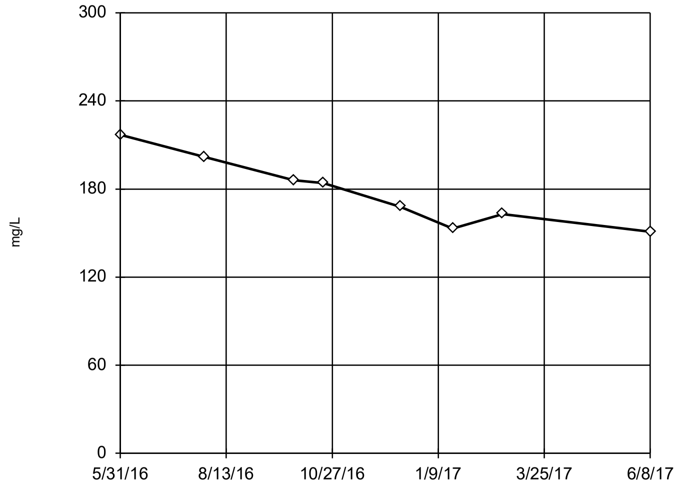
High cutoff = 37.78, low cutoff = -22.39, based on IQR multiplier of 3.

Constituent: Sulfate, total   Analysis Run 12/27/2017 7:23 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

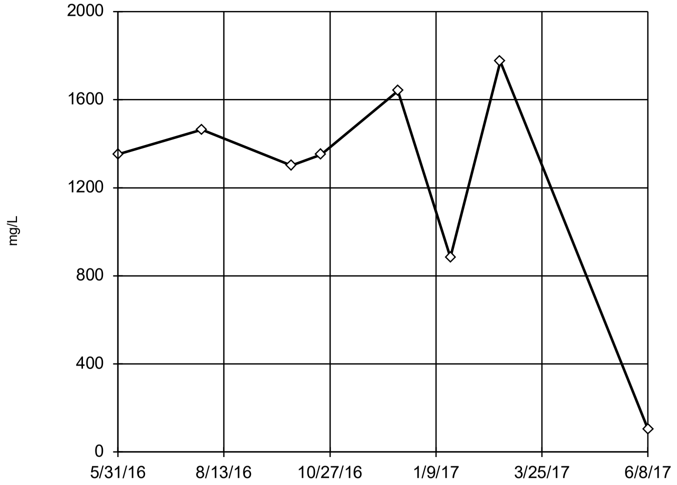
High cutoff = 358.4, low cutoff = 85.4, based on IQR multiplier of 3.

Constituent: Sulfate, total   Analysis Run 12/27/2017 7:23 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found.
Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

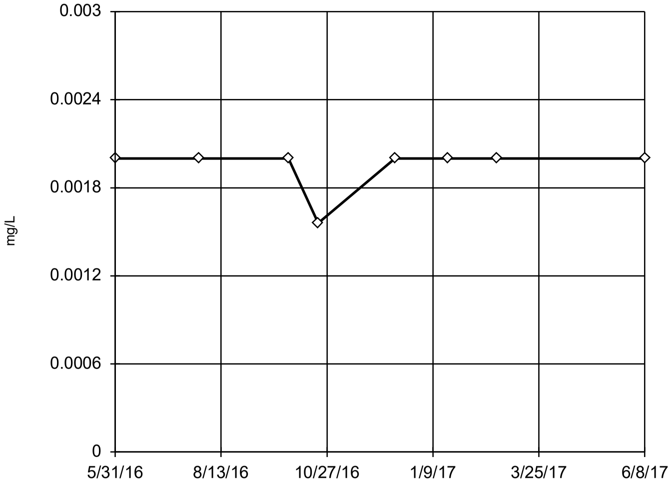
High cutoff = 2206, low cutoff = -1768, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 12/27/2017 7:23 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

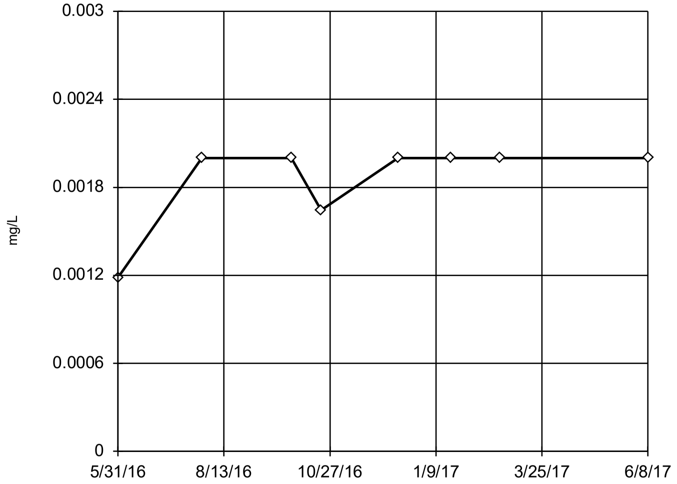
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium, total Analysis Run 12/27/2017 7:23 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were x^4 transformed to achieve best W statistic (graph shown in original units).

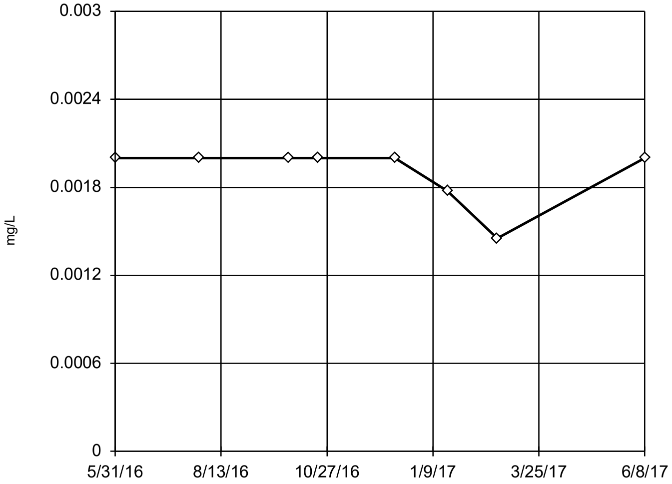
High cutoff = 0.002322, low cutoff = -0.001087, based on IQR multiplier of 3.

Constituent: Thallium, total Analysis Run 12/27/2017 7:23 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

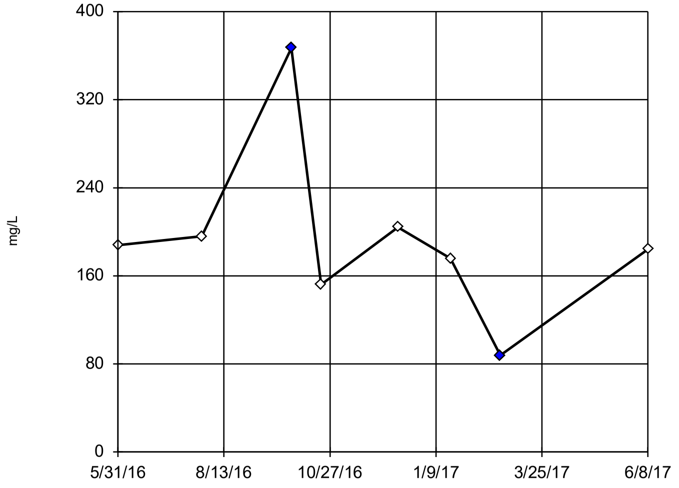
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Thallium, total Analysis Run 12/27/2017 7:23 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-15



n = 8

Outliers are drawn as solid.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

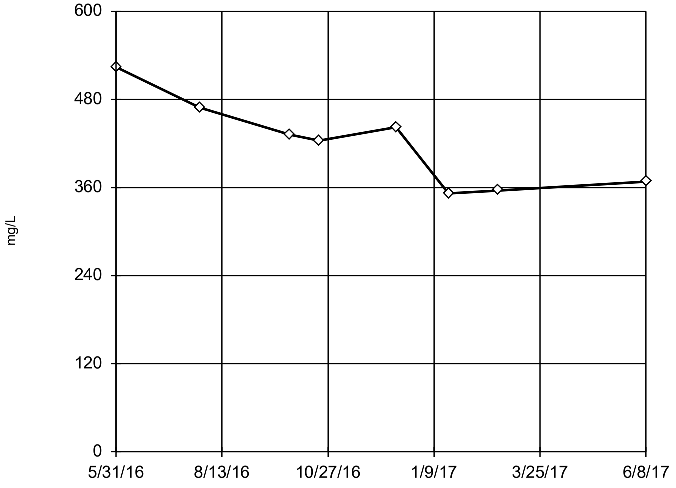
High cutoff = 365.4, low cutoff = 89.51, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 12/27/2017 7:23 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8



n = 8

No outliers found.
Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

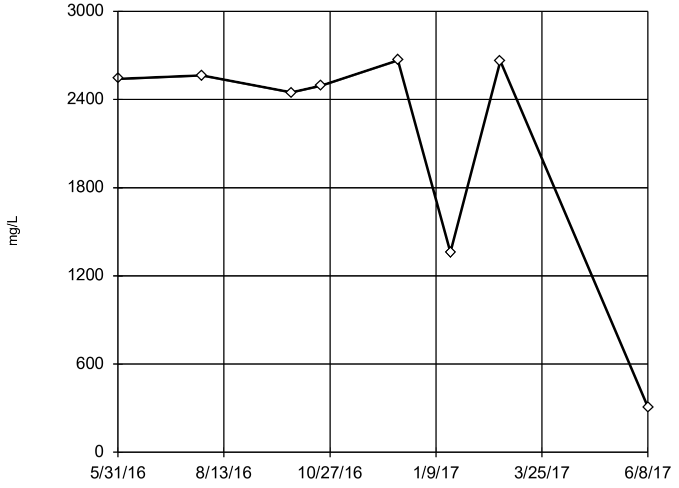
High cutoff = 828.9, low cutoff = 159.8, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 12/27/2017 7:23 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-9



n = 8

No outliers found.
Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 3134, low cutoff = -2833, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 12/27/2017 7:23 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Trend Tests Summary Table - Significant Results

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP   Printed 11/24/2017, 12:59 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Barium, total (mg/L)	**AD-8**	**-0.0113**	**-24**	**-21**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Calcium, total (mg/L)	**AD-8**	**-14.18**	**-23**	**-21**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate, total (mg/L)	**AD-8**	**-75.74**	**-26**	**-21**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.01**	**NP**

Trend Tests Summary Table - All Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 11/24/2017, 12:59 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Antimony, total (mg/L)	AD-1 (bg)	0	0	21	No	8	100	n/a	n/a	0.01	NP
Antimony, total (mg/L)	AD-17 (bg)	0	5	21	No	8	87.5	n/a	n/a	0.01	NP
Antimony, total (mg/L)	AD-5 (bg)	0	5	21	No	8	87.5	n/a	n/a	0.01	NP
Antimony, total (mg/L)	AD-15	0	0	21	No	8	100	n/a	n/a	0.01	NP
Antimony, total (mg/L)	AD-8	0	5	21	No	8	87.5	n/a	n/a	0.01	NP
Antimony, total (mg/L)	AD-9	0	0	21	No	8	100	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AD-1 (bg)	0	2	21	No	8	62.5	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AD-17 (bg)	0	7	21	No	8	87.5	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AD-5 (bg)	0	0	21	No	8	50	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AD-15	-0.001693	-3	-21	No	8	0	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AD-8	0	7	21	No	8	87.5	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AD-9	0	0	21	No	8	100	n/a	n/a	0.01	NP
Barium, total (mg/L)	AD-1 (bg)	-0.05086	-3	-21	No	8	0	n/a	n/a	0.01	NP
Barium, total (mg/L)	AD-17 (bg)	-0.0105	-13	-21	No	8	0	n/a	n/a	0.01	NP
Barium, total (mg/L)	AD-5 (bg)	-0.04345	-10	-21	No	8	0	n/a	n/a	0.01	NP
Barium, total (mg/L)	AD-15	-0.05269	-4	-21	No	8	0	n/a	n/a	0.01	NP
Barium, total (mg/L)	**AD-8**	**-0.0113**	**-24**	**-21**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Barium, total (mg/L)	AD-9	-0.01108	-4	-21	No	8	0	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AD-1 (bg)	0.0000942	8	21	No	8	12.5	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AD-17 (bg)	-0.0001591	-2	-21	No	8	12.5	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AD-5 (bg)	-0.0002124	-16	-21	No	8	0	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AD-15	-0.0002596	-3	-21	No	8	0	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AD-8	0.00061	12	21	No	8	62.5	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AD-9	-0.0005814	-6	-21	No	8	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-1 (bg)	0.1894	18	21	No	8	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-17 (bg)	0.004862	4	21	No	8	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-5 (bg)	0.01423	13	21	No	8	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-15	-0.07834	-6	-21	No	8	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-8	0.1194	7	21	No	8	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-9	-0.00869	-3	-18	No	7	0	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AD-1 (bg)	0	11	21	No	8	75	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AD-17 (bg)	0.002101	8	21	No	8	0	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AD-5 (bg)	0.0002641	7	21	No	8	25	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AD-15	0.0002415	2	21	No	8	12.5	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AD-8	0	0	21	No	8	100	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AD-9	0.0001279	1	21	No	8	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-1 (bg)	6.668	2	21	No	8	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-17 (bg)	-7.682	-13	-21	No	8	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-5 (bg)	7.541	8	21	No	8	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-15	-1.194	-11	-18	No	7	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	**AD-8**	**-14.18**	**-23**	**-21**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Calcium, total (mg/L)	AD-9	-20.08	-4	-21	No	8	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-1 (bg)	0	-3	-21	No	8	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-17 (bg)	-7.318	-18	-21	No	8	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-5 (bg)	-1.507	-10	-21	No	8	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-15	-7.774	-11	-21	No	8	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-8	-13.37	-19	-21	No	8	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-9	-60.28	-15	-21	No	8	0	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AD-1 (bg)	0	2	21	No	8	50	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AD-17 (bg)	0	-1	-18	No	7	14.29	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AD-5 (bg)	0.0002677	5	21	No	8	25	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AD-15	-0.005023	-4	-21	No	8	0	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AD-8	0	4	21	No	8	50	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AD-9	0	5	21	No	8	87.5	n/a	n/a	0.01	NP
Cobalt, total (mg/L)	AD-1 (bg)	-0.0002475	-4	-21	No	8	0	n/a	n/a	0.01	NP

Trend Tests Summary Table - All Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 11/24/2017, 12:59 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Cobalt, total (mg/L)	AD-17 (bg)	0.01268	19	21	No	8	0	n/a	n/a	0.01	NP
Cobalt, total (mg/L)	AD-5 (bg)	-0.002747	-14	-21	No	8	0	n/a	n/a	0.01	NP
Cobalt, total (mg/L)	AD-15	-0.002179	-2	-21	No	8	0	n/a	n/a	0.01	NP
Cobalt, total (mg/L)	AD-8	-0.003635	-19	-21	No	8	0	n/a	n/a	0.01	NP
Cobalt, total (mg/L)	AD-9	0.002994	7	21	No	8	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AD-1 (bg)	0.2489	0	21	No	8	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AD-17 (bg)	-0.3314	-2	-21	No	8	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AD-5 (bg)	-1.506	-6	-21	No	8	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AD-15	-0.6867	-2	-21	No	8	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AD-8	-0.6463	-6	-21	No	8	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AD-9	-0.894	-6	-21	No	8	0	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-1 (bg)	0	0	21	No	8	100	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-17 (bg)	0.7664	19	21	No	8	37.5	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-5 (bg)	0	9	21	No	8	75	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-15	0	3	21	No	8	87.5	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-8	0.2111	12	21	No	8	12.5	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-9	0.8043	18	21	No	8	50	n/a	n/a	0.01	NP
Lead, total (mg/L)	AD-1 (bg)	0	3	21	No	8	87.5	n/a	n/a	0.01	NP
Lead, total (mg/L)	AD-17 (bg)	0	0	21	No	8	100	n/a	n/a	0.01	NP
Lead, total (mg/L)	AD-5 (bg)	0	0	21	No	8	100	n/a	n/a	0.01	NP
Lead, total (mg/L)	AD-15	-0.005031	-10	-21	No	8	12.5	n/a	n/a	0.01	NP
Lead, total (mg/L)	AD-8	0	0	21	No	8	100	n/a	n/a	0.01	NP
Lead, total (mg/L)	AD-9	0	0	21	No	8	100	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AD-1 (bg)	-0.01342	-13	-21	No	8	0	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AD-17 (bg)	-0.04897	-14	-21	No	8	0	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AD-5 (bg)	0.005198	0	21	No	8	0	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AD-15	-0.01295	-8	-21	No	8	0	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AD-8	-0.02495	-14	-21	No	8	0	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AD-9	-0.1897	-4	-21	No	8	0	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AD-1 (bg)	-0.000005869	-3	-21	No	8	25	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AD-17 (bg)	-0.000009504	-10	-21	No	8	50	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AD-5 (bg)	0.000005719	10	21	No	8	62.5	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AD-15	-0.0000416	-4	-21	No	8	0	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AD-8	0	0	21	No	8	50	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AD-9	-0.00001609	-9	-21	No	8	25	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AD-1 (bg)	0	9	21	No	8	75	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AD-17 (bg)	0	5	21	No	8	75	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AD-5 (bg)	0	1	21	No	8	87.5	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AD-15	0.002594	5	21	No	8	25	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AD-8	0.003404	12	21	No	8	62.5	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AD-9	0	0	21	No	8	100	n/a	n/a	0.01	NP
pH, field (SU)	AD-1 (bg)	-0.286	-4	-21	No	8	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-17 (bg)	-0.8238	-16	-21	No	8	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-5 (bg)	0.136	2	21	No	8	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-15	-0.1982	-2	-21	No	8	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-8	-0.4395	-2	-21	No	8	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-9	-0.331	-2	-21	No	8	0	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AD-1 (bg)	0.001246	18	21	No	8	12.5	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AD-17 (bg)	0	5	21	No	8	75	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AD-5 (bg)	0	5	21	No	8	87.5	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AD-15	0.0006966	3	21	No	8	25	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AD-8	0	13	21	No	8	75	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AD-9	0.00001253	3	21	No	8	37.5	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-1 (bg)	10.38	10	21	No	8	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-17 (bg)	45.69	3	21	No	8	0	n/a	n/a	0.01	NP

Trend Tests Summary Table - All Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 11/24/2017, 12:59 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Sulfate, total (mg/L)	AD-5 (bg)	-17.35	0	21	No	8	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-15	-9.863	-11	-21	No	8	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	**AD-8**	**-75.74**	**-26**	**-21**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate, total (mg/L)	AD-9	-324	-4	-21	No	8	0	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AD-1 (bg)	0	9	21	No	8	75	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AD-17 (bg)	0	0	21	No	8	100	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AD-5 (bg)	0	0	21	No	8	100	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AD-15	0	1	21	No	8	87.5	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AD-8	0	9	21	No	8	75	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AD-9	0	-9	-21	No	8	75	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	AD-1 (bg)	29.22	2	21	No	8	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	AD-17 (bg)	-105.3	-6	-21	No	8	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	AD-5 (bg)	6.464	0	21	No	8	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	AD-15	-41.6	-8	-21	No	8	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	AD-8	-192.1	-18	-21	No	8	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	AD-9	-291.2	-6	-21	No	8	0	n/a	n/a	0.01	NP

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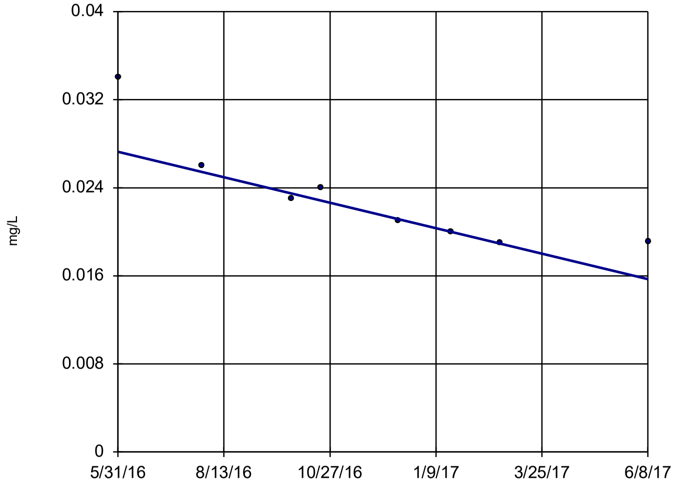
Sen's Slope Estimator

AD-8



n = 8

Slope = -0.0113
units per year.

Mann-Kendall
statistic = -24
critical = -21

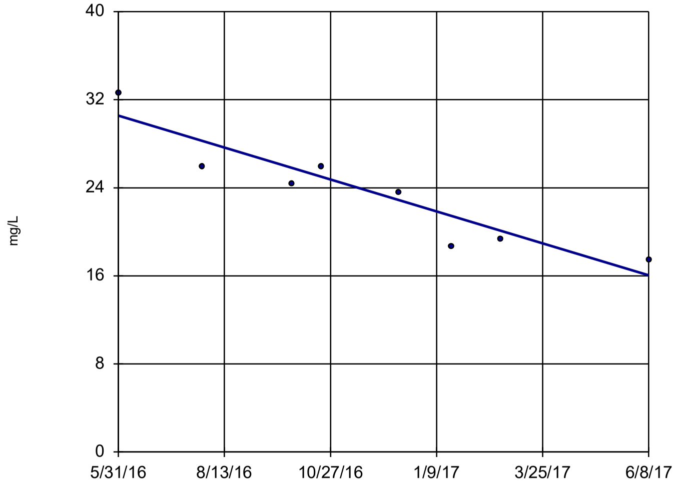
Decreasing trend
significant at 99%
confidence level
(= 0.005 per
tail).

Constituent: Barium, total Analysis Run 11/24/2017 12:57 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-8



n = 8

Slope = -14.18
units per year.

Mann-Kendall
statistic = -23
critical = -21

Decreasing trend
significant at 99%
confidence level
(= 0.005 per
tail).

Constituent: Calcium, total Analysis Run 11/24/2017 12:57 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

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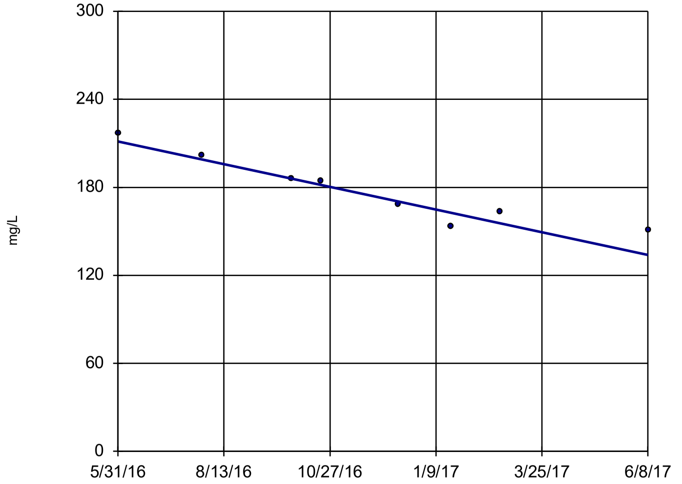
Sen's Slope Estimator

AD-8



n = 8

Slope = -75.74
units per year.

Mann-Kendall
statistic = -26
critical = -21

Decreasing trend
significant at 99%
confidence level
(= 0.005 per
tail).

Constituent: Sulfate, total Analysis Run 11/24/2017 12:58 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Analysis of Variance

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP   Printed 1/15/2018, 7:20 PM

Constituent	Crit.	Sig.	Alpha	Transform	ANOVA Sig.	Calc.	Alpha	Method
Boron, total (mg/L)	n/a	n/a	n/a	No	Yes	20.6	0.05	NP (eq. var.)
Calcium, total (mg/L)	n/a	n/a	n/a	No	Yes	16.21	0.05	NP (eq. var.)
Chloride, total (mg/L)	n/a	n/a	n/a	No	Yes	20.76	0.05	NP (eq. var.)
Fluoride, total (mg/L)	n/a	n/a	n/a	No	Yes	6.075	0.05	NP (eq. var.)
pH, field (SU)	n/a	n/a	n/a	No	No	2.135	0.05	NP (eq. var.)
Sulfate, total (mg/L)	n/a	n/a	n/a	sqrt(x)	Yes	431.4	0.05	Param.
Total Dissolved Solids (mg/L)	n/a	n/a	n/a	No	Yes	16.64	0.05	NP (normality)

Non-Parametric ANOVA

Constituent: Boron, total Analysis Run 1/15/2018 7:19 PM View: ANOVA
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

For observations made between 5/26/2016 and 6/8/2017, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 20.6

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 4 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 20.48
Adjusted Kruskal-Wallis statistic (H') = 20.6

Non-Parametric ANOVA

Constituent: Calcium, total   Analysis Run 1/15/2018 7:19 PM   View: ANOVA
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

For observations made between 5/26/2016 and 6/8/2017, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 16.21

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 1 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 16.21
Adjusted Kruskal-Wallis statistic (H') = 16.21

Non-Parametric ANOVA

Constituent: Chloride, total Analysis Run 1/15/2018 7:19 PM View: ANOVA
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

For observations made between 5/26/2016 and 6/8/2017, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 20.76

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 6 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 20.48
Adjusted Kruskal-Wallis statistic (H') = 20.76

Non-Parametric ANOVA

Constituent: Fluoride, total   Analysis Run 1/15/2018 7:20 PM   View: ANOVA
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

For observations made between 5/26/2016 and 6/8/2017, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 6.075

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 1 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 3.92
Adjusted Kruskal-Wallis statistic (H') = 6.075

Non-Parametric ANOVA

Constituent: pH, field Analysis Run 1/15/2018 7:20 PM View: ANOVA
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

For observations made between 5/26/2016 and 6/7/2017, the non-parametric analysis of variance test indicates NO DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is less than or equal to the Chi-squared value, we conclude that no group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 2.135

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 0 groups of ties in the data, so no adjustment to the Kruskal-Wallis statistic (H) was necessary.

Parametric ANOVA

Constituent: Sulfate, total Analysis Run 1/15/2018 7:20 PM View: ANOVA
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

For observations made between 5/26/2016 and 6/8/2017 the parametric analysis of variance test (after square root transformation) indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 431.4

Tabulated F statistic = 3.47 with 2 and 21 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	3161	2	1581	431.4
Error Within Groups	76.95	21	3.664	
Total	3238	23		

The Shapiro Wilk normality test on the residuals passed after square root transformation. Alpha = 0.05, calculated = 0.9624, critical = 0.916. Levene's Equality of Variance test passed. Calculated = 3.016, tabulated = 3.47.

Non-Parametric ANOVA

Constituent: Total Dissolved Solids   Analysis Run 1/15/2018 7:20 PM   View: ANOVA
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

For observations made between 5/26/2016 and 6/8/2017, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 16.64

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 0 groups of ties in the data, so no adjustment to the Kruskal-Wallis statistic (H) was necessary.

Tolerance Limits - Appendix III

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 11/20/2017, 2:55 PM

Constituent	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	1.043	n/a	24	0.5347	0.1801	0	None	x^(1/3)	0.01	Inter
Calcium, total (mg/L)	200	n/a	24	n/a	n/a	0	n/a	n/a	0.292	NP Inter(normality)
Chloride, total (mg/L)	63.61	n/a	24	3.919	1.523	0	None	sqrt(x)	0.01	Inter
Fluoride, total (mg/L)	1	n/a	24	n/a	n/a	70.83	n/a	n/a	0.292	NP Inter(normality)
pH, field (SU)	7.67	4.123	24	5.897	0.5904	0	None	No	0.01	Inter
Sulfate, total (mg/L)	1445	n/a	24	n/a	n/a	0	n/a	n/a	0.292	NP Inter(normality)
Total Dissolved Solids (mg/L)	1810	n/a	24	n/a	n/a	0	n/a	n/a	0.292	NP Inter(normality)

Confidence Interval Summary Table - Significant Results

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP   Printed 11/20/2017, 2:57 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	**AD-8**	**1.598**	**1.42**	**1.04**	**Yes**	**8**	**1.509**	**0.08374**	**0**	**None**	**No**	**0.01**	**Param.**

Confidence Interval Summary Table - All Results

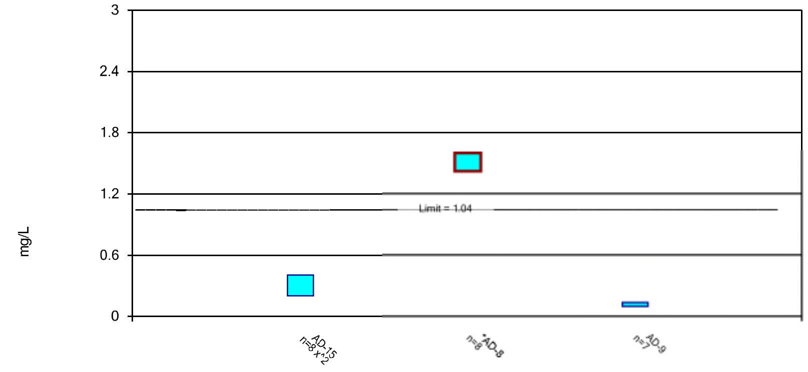
Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 11/20/2017, 2:57 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	AD-15	0.4065	0.2006	1.04	No	8	0.302	0.1147	0	None	x^2	0.01	Param.
Boron, total (mg/L)	**AD-8**	**1.598**	**1.42**	**1.04**	**Yes**	**8**	**1.509**	**0.08374**	**0**	**None**	**No**	**0.01**	**Param.**
Boron, total (mg/L)	AD-9	0.1328	0.0966	1.04	No	7	0.1147	0.01525	0	None	No	0.01	Param.
Calcium, total (mg/L)	AD-15	4.774	3.289	200	No	7	4.031	0.6254	0	None	No	0.01	Param.
Calcium, total (mg/L)	AD-8	28.73	18.2	200	No	8	23.46	4.969	0	None	No	0.01	Param.
Calcium, total (mg/L)	AD-9	258.6	177.8	200	No	8	215.3	54.76	0	None	x^3	0.01	Param.
Chloride, total (mg/L)	AD-15	32.42	23.33	63.6	No	8	27.88	4.291	0	None	No	0.01	Param.
Chloride, total (mg/L)	AD-8	31.8	21.95	63.6	No	8	26.88	4.643	0	None	No	0.01	Param.
Chloride, total (mg/L)	AD-9	97.4	54.11	63.6	No	8	74.88	26.2	0	None	x^2	0.01	Param.
Fluoride, total (mg/L)	AD-15	1	0.2621	1	No	8	0.9078	0.2609	87.5	None	No	0.004	NP (NDs)
Fluoride, total (mg/L)	AD-8	0.7807	0.4763	1	No	8	0.6258	0.166	12.5	None	ln(x)	0.01	Param.
Fluoride, total (mg/L)	AD-9	1	0.304	1	No	8	0.7225	0.309	50	None	No	0.004	NP (normality)
pH, field (SU)	AD-15	5.517	4.28	7.67	No	8	4.89	0.5099	0	None	sqrt(x)	0.005	Param.
pH, field (SU)	AD-8	7.247	5.308	7.67	No	8	6.278	0.7834	0	None	No	0.005	Param.
pH, field (SU)	AD-9	6.066	4.642	7.67	No	8	5.354	0.5754	0	None	No	0.005	Param.
Sulfate, total (mg/L)	AD-15	26.93	13.82	1445	No	8	20.38	6.186	0	None	No	0.01	Param.
Sulfate, total (mg/L)	AD-8	202.9	153.1	1445	No	8	178	23.53	0	None	No	0.01	Param.
Sulfate, total (mg/L)	AD-9	1680	841	1445	No	8	1234	526.1	0	None	x^2	0.01	Param.
Total Dissolved Solids (mg/L)	AD-15	274.6	117.8	1810	No	8	194.4	78.82	0	None	sqrt(x)	0.01	Param.
Total Dissolved Solids (mg/L)	AD-8	484.6	357.2	1810	No	8	420.9	60.09	0	None	No	0.01	Param.
Total Dissolved Solids (mg/L)	AD-9	2667	308	1810	No	8	2131	851.5	0	None	No	0.004	NP (normality)

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

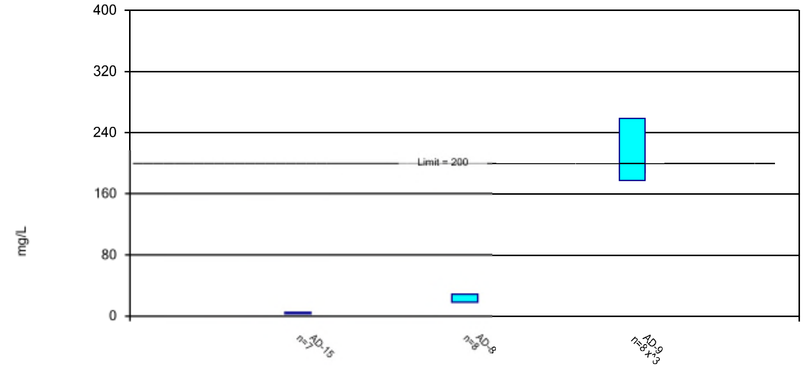


Constituent: Boron, total   Analysis Run 11/20/2017 2:56 PM   View: Confidence Intervals - App III
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

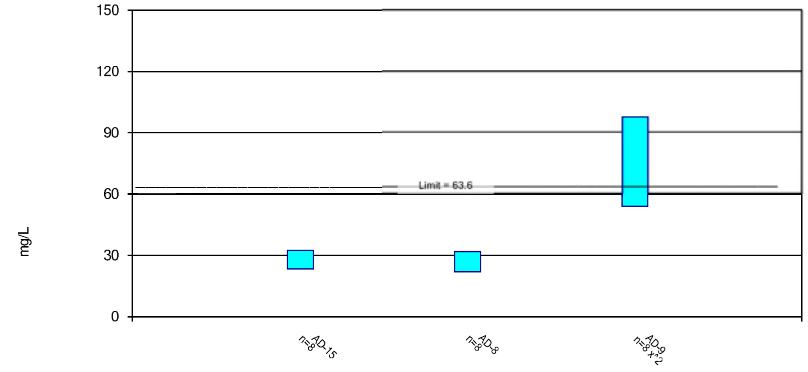


Constituent: Calcium, total   Analysis Run 11/20/2017 2:56 PM   View: Confidence Intervals - App III
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

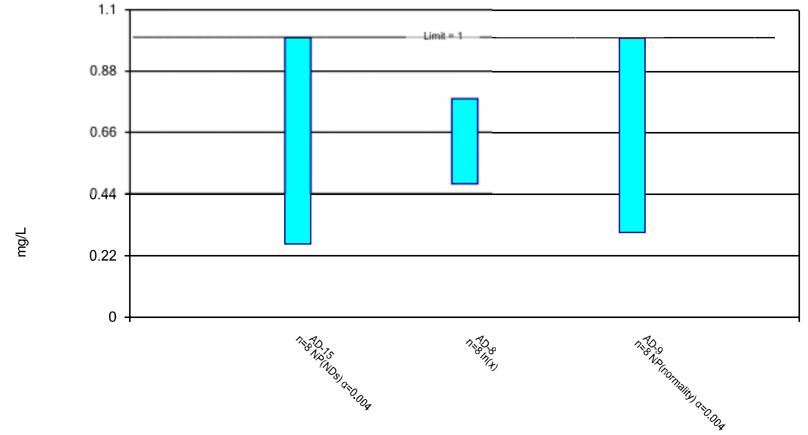


Constituent: Chloride, total   Analysis Run 11/20/2017 2:56 PM   View: Confidence Intervals - App III
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

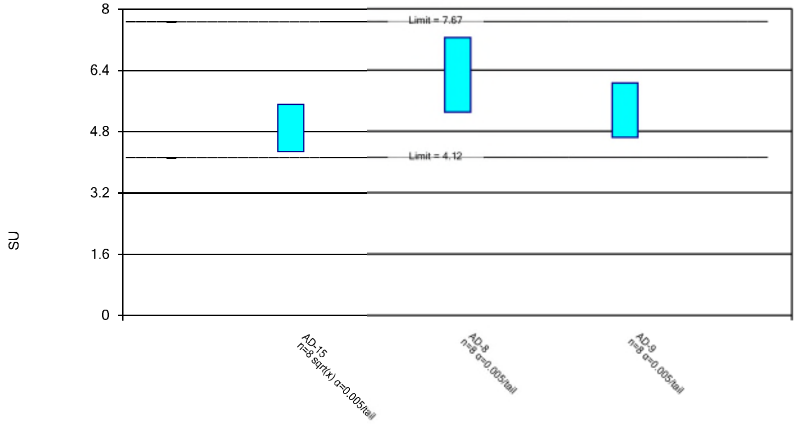


Constituent: Fluoride, total   Analysis Run 11/20/2017 2:56 PM   View: Confidence Intervals - App III
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Normality Test: Shapiro Wilk, alpha based on n.

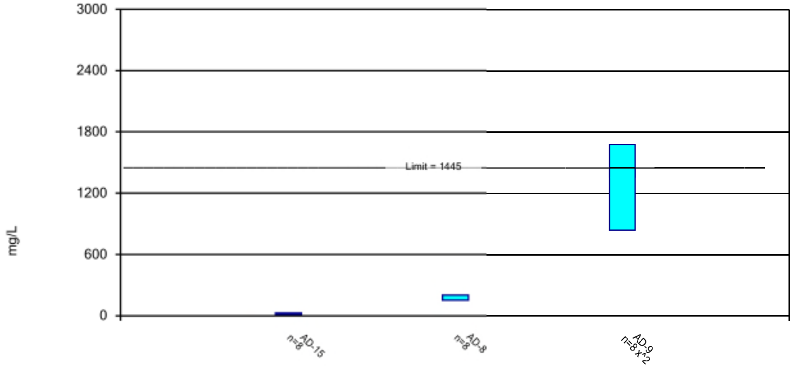


Constituent: pH, field Analysis Run 11/20/2017 2:56 PM View: Confidence Intervals - App III
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

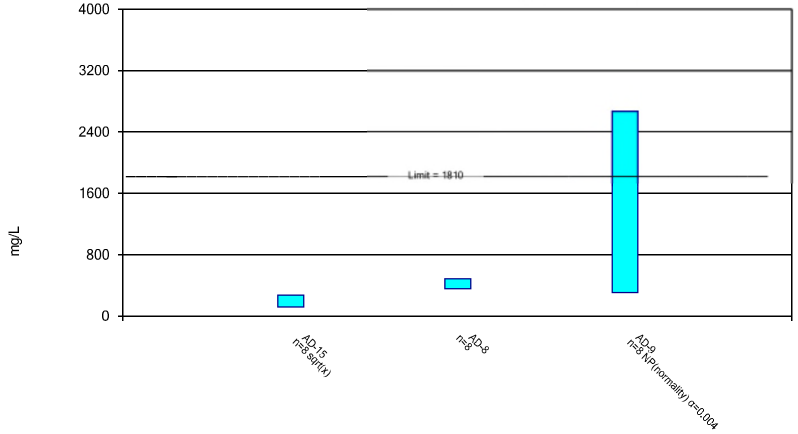


Constituent: Sulfate, total Analysis Run 11/20/2017 2:56 PM View: Confidence Intervals - App III
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



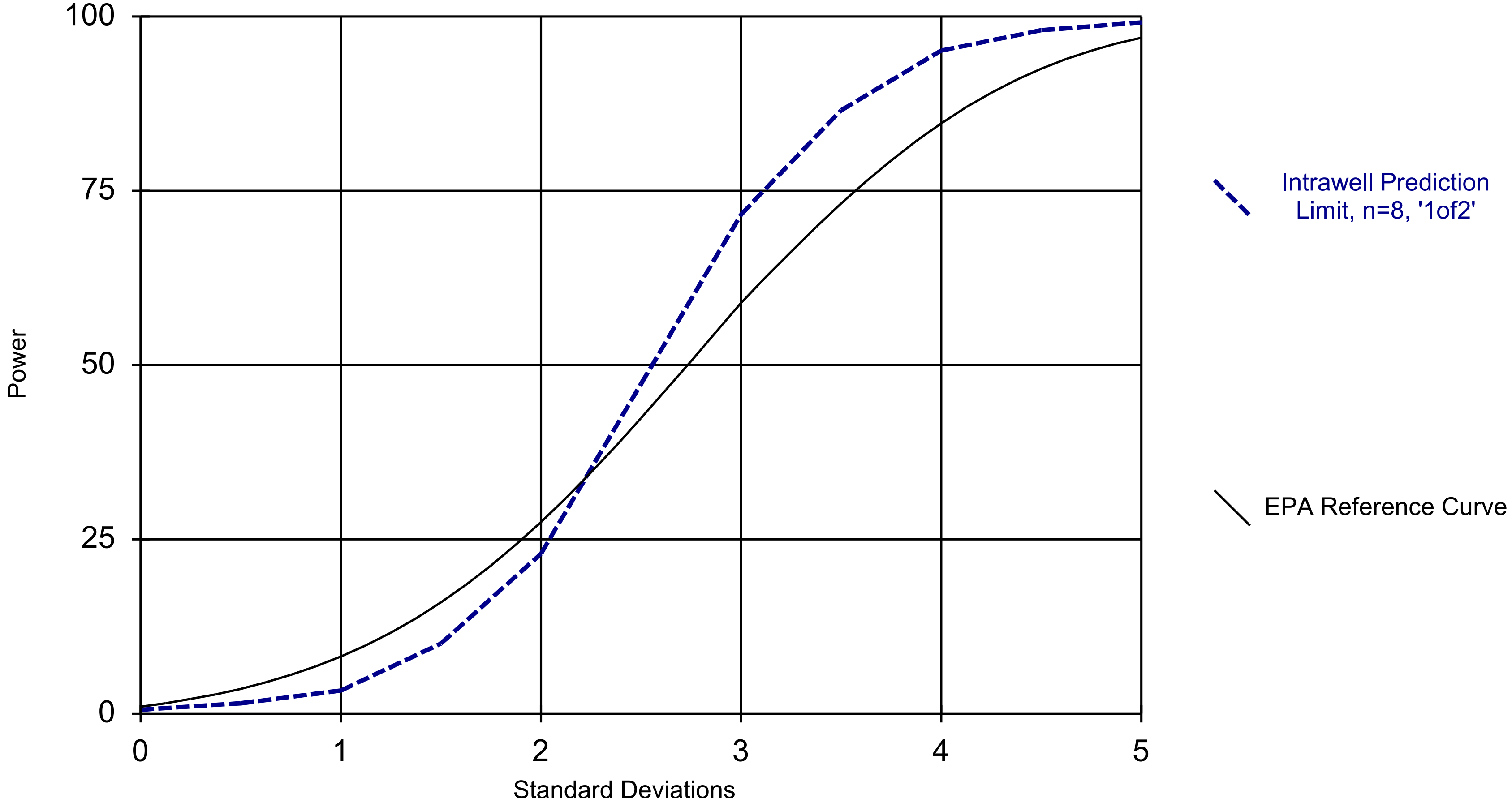
Constituent: Total Dissolved Solids Analysis Run 11/20/2017 2:56 PM View: Confidence Intervals - App III
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Intrawell Prediction Limit Summary Table

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 11/20/2017, 3:02 PM

Constituent	Upper Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Calcium, total (mg/L)	224.6	8	6.363	3.508	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	203.5	8	193.6	4.033	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	61.45	8	45.09	6.656	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	5.711	7	4.031	0.6254	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	35.68	8	23.46	4.969	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	349.9	8	215.3	54.76	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	9	8	n/a	n/a	0	n/a	n/a	0.02144	NP Intra (normality) 1 of 2
Chloride, total (mg/L)	44.04	8	33.38	4.34	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	16.78	8	14.5	0.9258	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	38.42	8	27.88	4.291	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	38.29	8	26.88	4.643	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	139.3	8	74.88	26.2	0	None	No	0.002505	Param Intra 1 of 2
Fluoride, total (mg/L)	1	8	n/a	n/a	100	n/a	n/a	0.02144	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	0.6953	8	0.4488	0.1003	37.5	Kaplan-Meier	No	0.002505	Param Intra 1 of 2
Fluoride, total (mg/L)	1	8	n/a	n/a	75	n/a	n/a	0.02144	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	1	8	n/a	n/a	87.5	n/a	n/a	0.02144	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	1.034	8	0.6258	0.166	12.5	None	No	0.002505	Param Intra 1 of 2
Fluoride, total (mg/L)	0.7259	8	0.4449	0.1143	50	Kaplan-Meier	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	82.3	8	6.772	0.9358	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	1471	8	1136	136.3	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	336.4	8	177.4	64.69	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	35.58	8	20.38	6.186	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	235.8	8	178	23.53	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	2527	8	1234	526.1	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	784.8	8	16.71	4.598	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	1840	8	1639	81.77	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	563.5	8	383.6	73.17	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	388.1	8	194.4	78.82	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	568.6	8	420.9	60.09	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	3147	8	1.3e10	7.4e9	0	None	x^3	0.002505	Param Intra 1 of 2

Power Curve



Kappa = 2.458, based on 3 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

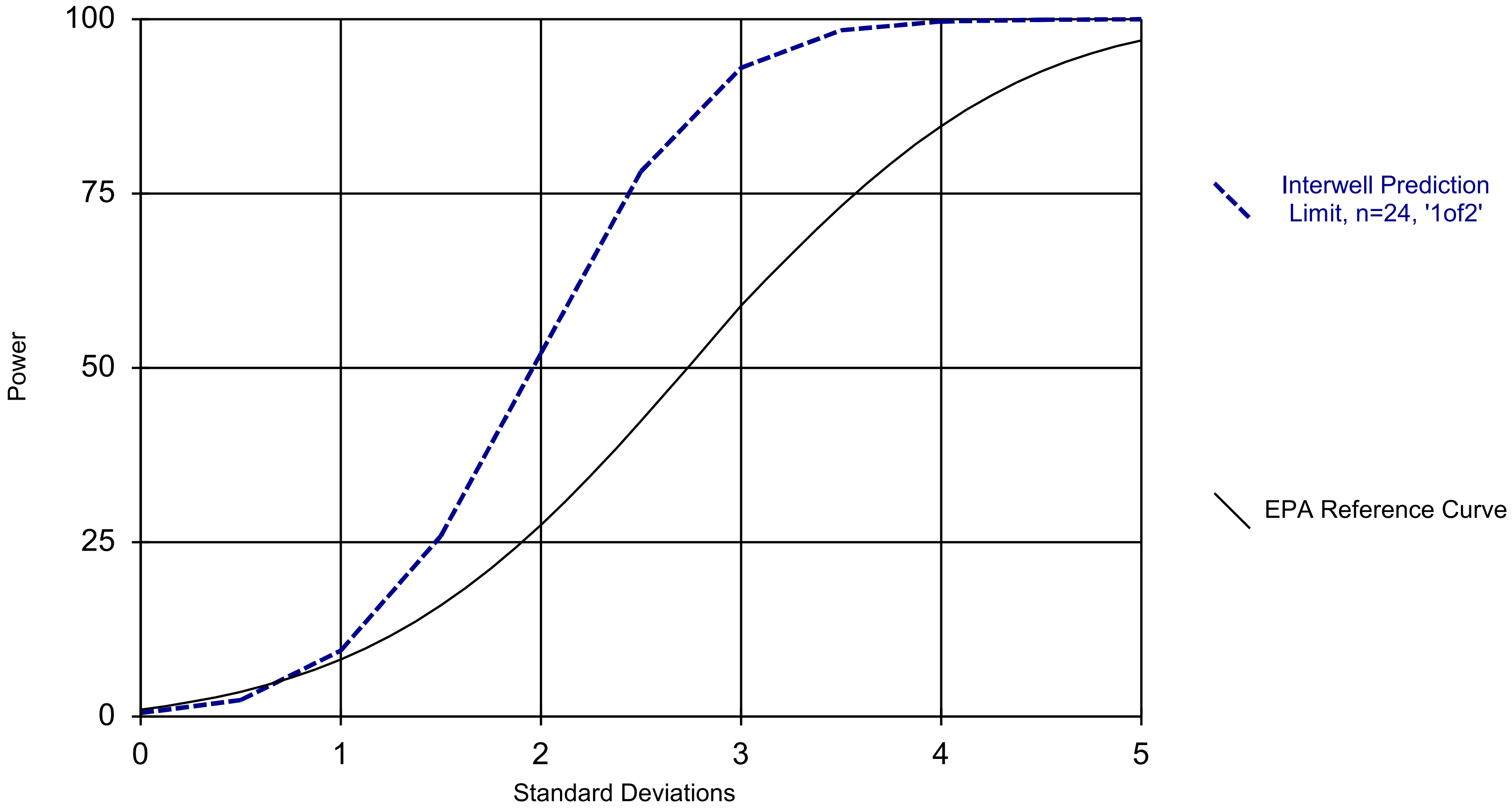
Analysis Run 11/20/2017 3:07 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Interwell Prediction Limit Summary Table

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 11/20/2017, 3:03 PM

Constituent	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	0.6515	n/a	24	0.5347	0.1801	0	None	x^(1/3)	0.002505	Param 1 of 2
pH, field (SU)	6.986	4.808	24	5.897	0.5904	0	None	No	0.001253	Param 1 of 2

Power Curve



Kappa = 1.845, based on 3 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 11/20/2017 3:06 PM View: PL's - Interwell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

4.6 – Statistical Analysis Summary – Background Update Calculations, Bottom Ash Storage Pond, December 8, 2021

STATISTICAL ANALYSIS SUMMARY- Background Update Calculations Bottom Ash Storage Pond – J. Robert Welsh Plant Pittsburg, Texas

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
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Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

December 8, 2021
CHA8500

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
ASD	Alternative Source Demonstration
BASP	Bottom Ash Storage Ponds
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Value
EPA	Environmental Protection Agency
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
NELAP	National Environmental Laboratory Accreditation Program
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

EXECUTIVE SUMMARY

In accordance with the Texas Commission on Environmental Quality's (TCEQ's) regulations regarding the disposal of coal combustion residuals (CCRs) in landfills and surface impoundments (Title 30 Chapter 352, "CCR rule"), groundwater monitoring has been conducted at the Bottom Ash Storage Ponds (BASP), an existing CCR unit at the J. Robert Welsh Power Plant located in Pittsburg, Texas. Recent groundwater monitoring results were incorporated into the BASP background dataset as appropriate and the site-specific background values were re-established for use in future detection monitoring events.

A minimum of eight monitoring events were completed prior to October 2017 to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule. Prediction limits for Appendix III parameters were previously updated in December 2019 using data until May 2019 (Geosyntec, 2019). Since the last background update, four semiannual detection monitoring events were conducted between July 2019 and June 2021.

Data from these four events, including both initial and verification results, were evaluated for inclusion in the background dataset. Two additional events not associated with detection monitoring were also evaluated for inclusion in the background dataset. Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The detection monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. The compliance data were reviewed for outliers, and one value was removed from the compliance dataset prior to updating upper prediction limits (UPLs) for each Appendix III parameter and the lower prediction limit (LPL) for pH to represent background values.

Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

BOTTOM ASH STORAGE POND EVALUATION

2.1 Previous Background Calculations

A minimum of eight background monitoring events were completed from May 2016 through September 2017 to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule. The data were reviewed for outliers and trends prior to calculating upper prediction limits (UPLs) for each Appendix III parameter. Lower prediction limits (LPLs) were also established for pH. Intrawell prediction limits were selected for boron, calcium, chloride, fluoride, sulfate, and total dissolved solids (TDS) with a one-of-two resampling plan, and interwell prediction limits with a one-of-two resampling plan were selected for pH. Tests for pH were revised to intrawell prediction limits based on an alternative source demonstration (ASD) certified on April 13, 2018 (Geosyntec, 2018a). The statistical analyses to establish background levels are detailed in the January 2018 *Statistical Analysis Summary* report (Geosyntec, 2018b).

As recommended in the USEPA *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (Unified Guidance), background values should be updated every four to eight measurements (USEPA, 2009). Prediction limits for Appendix III parameters were previously updated in December 2019 using data until May 2019 (Geosyntec, 2019). Intrawell tests using a one-of-two retesting procedure were selected and updated for all Appendix III parameters. These prediction limits were used for detection monitoring events completed between July 2019 and June 2021.

2.2 Data Validation & QA/QC

Four semiannual detection monitoring events, which were completed between July 2019 and June 2021, have been conducted at the BASP since the previous background update (which used data through May 2019). If the initial results for each detection monitoring event identified possible exceedances, verification sampling was completed on an individual well/parameter basis. Thus, a minimum of four samples have been collected from each compliance well since the previous background update. A summary of data collected during these detection monitoring events is found in Table 1. Two additional sampling events, conducted in February 2020 and February 2021 at select wells, were not associated with detection monitoring efforts. However, these events were also included in the background dataset update. The results from these two additional events are also provided in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.31 statistics software. The export was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.3 Statistical Analysis

The data used to conduct the statistical analyses described below are summarized in Table 1. Statistical analyses for the BASP were conducted in accordance with the *Statistical Analysis Plan* (Geosyntec, 2021). The complete statistical analysis results are included in Attachment B.

Time series plots of Appendix III parameters are included in Attachment B and were used to evaluate concentrations over time and to provide an initial screening of suspected outliers and trends. Box plots were also compiled to provide visual representation of variations between wells and within individual wells (Attachment B).

2.3.1 Outlier Evaluation

Potential outliers were evaluated using Tukey's outlier test; i.e., data points were considered potential outliers if they met one of the following criteria:

$$x_i < \tilde{x}_{0.25} - 3 \times IQR \quad (1)$$

or

$$x_i > \tilde{x}_{0.75} + 3 \times IQR \quad (2)$$

where:

$x_i =$ individual data point
$\tilde{x}_{0.25} =$ first quartile
$\tilde{x}_{0.75} =$ third quartile
$IQR =$ the interquartile range $= \tilde{x}_{0.75} - \tilde{x}_{0.25}$

Data that were evaluated as potential outliers are summarized in Attachment B. One outlier was identified in the data collected for the four most recent detection monitoring events. The high TDS value of 236 mg/L at AD-3 on May 20, 2020 was flagged and removed from the dataset to construct a statistical limit that is representative of present-day groundwater quality and conservative from a regulatory perspective.

2.3.2 Establishment of Updated Background Dataset

Analysis of variance (ANOVA) was conducted during the initial background screening to assist in identifying if intrawell tests are the most appropriate statistical approach for assessing Appendix III parameters. Intrawell tests compare compliance data from a single well to background data within the same well and are most appropriate when 1) upgradient wells exhibit spatial variation; 2) when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; or 3) when downgradient water quality is not impacted compared to upgradient water quality for the same parameter. Periodic updating of background statistical limits is necessary as natural systems continuously change due to physical changes to the environment. For intrawell analyses, data for all wells and constituents are re-evaluated when a minimum of four new data points are available. These four (or more) new data points are used to determine if earlier concentrations are representative of present-day groundwater quality.

Mann-Whitney (Wilcoxon rank-sum) tests were used to compare the medians of historical data (May 2016 – May 2019) to the new compliance samples (July 2019 – June 2021). Results were evaluated to determine if the medians of the two groups were similar at the 99% confidence level. Where no significant difference was found, the new compliance data were added to the background dataset. Where a statistically significant difference was found between the medians of the two groups, the data were reviewed to evaluate the cause of the difference and to determine if adding newer data to the background dataset, replacing the background dataset with the newer data, or continuing to use the existing background dataset was most appropriate. If the differences appeared to have been caused by a release, then the previous background dataset would have continued to be used.

The complete Mann-Whitney test results and a summary of the significant findings can be found in Attachment B.

Significant differences were found between the two groups for the following upgradient well/parameter pairs:

- A decrease was found for chloride at AD-1;
- Decreases were found for fluoride at AD-1, AD-5, and AD-17; and
- An increase was found for TDS at AD-17.

The background datasets for all upgradient wells were updated because the magnitudes of the differences were minimal, and these data represent naturally occurring groundwater quality not impacted by a release.

Statistically significant differences were found between the two groups for the following downgradient well/parameter pairs:

- A decrease was found for chloride at AD-3;
- Decreases were found for fluoride at AD-3 and AD-16R;
- An increase was found sulfate at AD-4C; and
- An increase was found TDS at AD-4C.

For downgradient well/parameter pairs with statistically significant increases or decreases, the magnitude of the difference was small or similar to those observed in upgradient wells; thus, the background dataset was updated to include the compliance dataset. For sulfate in downgradient well AD-4C, a steady increase in concentration was observed in recent measurements. However, previous alternative source demonstrations attributed the increase in concentrations to natural variability since similar patterns were observed in upgradient wells; thus, the background dataset was updated with the new data. In addition, the significant decrease for fluoride resulted from a decrease in reporting limits for the more recent data, and the dataset was also updated to include the new data. The background dataset for fluoride may be truncated in the future to use only the more recent dataset with lower concentrations when it can be demonstrated that the laboratory consistently meets the lower reporting limits.

After the revised background set was established, a parametric or non-parametric analysis was selected based on the distribution of the data and the frequency of non-detect data. Estimated results less than the practical quantitation limit (PQL) – i.e., “J-flagged” data – were considered detections and the estimated results were used in the statistical analyses. Non-parametric analyses were selected for datasets with at least 50% non-detect data or datasets that could not be normalized. Parametric analyses were selected for datasets (either transformed or untransformed) that passed the Shapiro-Wilk / Shapiro-Francía test for normality. The Kaplan-Meier non-detect adjustment was applied to datasets with between 15% and 50% non-detect data. For datasets with fewer than 15% non-detect data, non-detect data were replaced with one half of the PQL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment B.

2.3.3 Updated Prediction Limits

All historical data through July 2021 were used to update the intrawell UPLs and represent background values. Intrawell LPLs were also generated for pH. The updated prediction limits are summarized in Table 2.

The intrawell UPLs and LPLs were calculated for a one-of-two retesting procedure; i.e., if at least one sample in a series of two does not exceed the UPL and the pH result is greater than or equal to the LPL, then it can be concluded that an SSI has not occurred. In practice, where the initial result does not exceed the UPL and the pH result is greater than or equal to the LPL, a second sample will not be collected. The retesting procedures allow achieving an acceptably high statistical power to detect changes at downgradient wells for constituents evaluated using intrawell prediction limits.

2.4 Conclusions

Four detection monitoring events were completed in accordance with the CCR Rule. Two additional events completed in February 2020 and February 2021 were also included in the new dataset. The laboratory and field data from these events were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. Mann-Whitney tests were completed to evaluate whether data from the detection monitoring events could be added to the existing background dataset. Where appropriate, the background datasets were updated, and UPLs and LPLs were recalculated. Intrawell tests using a one-of-two retesting procedure were selected and updated for all Appendix III parameters

SECTION 3

REFERENCES

Geosyntec Consultants, 2018a. Alternative Source Demonstration Report – Federal CCR Rule. J. Robert Welsh Plant. April.

Geosyntec Consultants, 2018b. Statistical Analysis Summary. Bottom Ash Storage Pond – J. Robert Welsh Plant. January.

Geosyntec Consultants, 2019. Statistical Analysis Summary. Bottom Ash Storage Pond – J. Robert Welsh Plant. December.

Geosyntec Consultants. 2021. Statistical Analysis Plan - J. Robert Welsh Plant. December.

United States Environmental Protection Agency (USEPA). 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March

TABLES

Table 1: Groundwater Data Summary
Welsh Plant - Bottom Ash Storage Pond

Parameter	Unit	AD-1						AD-3					
		7/24/2019	2/17/2020	5/20/2020	10/14/2020	2/23/2021	6/2/2021	7/24/2019	11/25/2019	5/20/2020	7/22/2020	10/14/2020	6/2/2021
		2019-D2	*	2020-D1	2020-D2	*	2021-D1	2019-D2	2019-D2-R1	2020-D1	2020-D1-R1	2020-D2	2021-D1
Boron	mg/L	0.644	0.626	0.801	0.670	0.617	0.786	0.05 U	-	0.05 U	-	0.05 U	0.036 J
Calcium	mg/L	62.7	115	126	3.88	113	97.1	1.35	0.734	0.724	-	0.705	0.7
Chloride	mg/L	2	3.41	1.83	2.16	-	2.26	7	-	7.99	-	7.31	7.98
Fluoride	mg/L	0.106 J	0.31	0.20	0.25	0.31	0.30	0.09 J	-	0.11	-	0.16	0.18
Sulfate	mg/L	58	56.3	51.4	66.9	-	61.4	6	-	2.7	-	3.5	3.38
Total Dissolved Solids	mg/L	180	488	508	183	-	400	116	-	236	114	116	110
pH	SU	6.0	5.8	7.2	4.5	6.6	6.2	4.6	-	4.6	4.7	4.6	4.4

Parameter	Unit	AD-4C								
		7/24/2019	12/19/2019	5/20/2020	7/22/2020	10/13/2020	10/14/2020	12/10/2020	6/2/2021	7/26/2021
		2019-D2	2019-D2-R1	2020-D1	2020-D1-R1	2020-D2	2020-D2	2020-D2-R1	2021-D1	2021-D1-R1
Boron	mg/L	0.05 U	-	0.05 U	-	-	0.05 U	-	0.038 J	-
Calcium	mg/L	0.586	-	0.679	-	-	0.613	-	1.1	1.4
Chloride	mg/L	13	-	15.1	-	13.1	-	-	13.3	-
Fluoride	mg/L	1 U	-	0.11	-	0.18	-	-	0.16	-
Sulfate	mg/L	52	-	69.0	71.8	76.1	-	78.2	82.4	71.9
Total Dissolved Solids	mg/L	284	226	268	280	278	-	288	280	280
pH	SU	3.9	-	5.1	4.7	4.9	-	4.9	4.6	4.6

Parameter	Unit	AD-5						AD-16R					
		7/24/2019	2/17/2020	5/20/2020	10/14/2020	2/23/2021	6/2/2021	7/24/2019	12/19/2019	5/20/2020	7/22/2020	10/14/2020	6/2/2021
		2019-D2	*	2020-D1	2020-D2	*	2021-D1	2019-D2	2019-D2-R1	2020-D1	2020-D1-R1	2020-D2	2021-D1
Boron	mg/L	0.04 J	0.03 J	0.03 J	0.04 J	0.03 J	0.027 J	0.03 J	-	0.02 J	-	0.02 J	0.028 J
Calcium	mg/L	41.1	39.8	40.2	36.6	30.9	24.4	1.50	-	1.54	-	0.550	1.0
Chloride	mg/L	18	19.8	22.3	18.8	-	19.6	7	-	7.09	-	6.50	7.02
Fluoride	mg/L	0.112 J	0.22	0.18	0.18	0.23	0.21	0.13 J	-	0.16	-	0.14	0.28
Sulfate	mg/L	90	43.7	55.5	148	-	53.8	70	-	71.4	-	53.1	65.4
Total Dissolved Solids	mg/L	354	248	264	338	-	220	250	134	242	224	183	190
pH	SU	6.3	5.5	6.8	6.5	6.0	5.8	3.6	-	3.4	3.2	3.3	3.7

Parameter	Unit	AD-17					
		7/24/2019	2/17/2020	5/20/2020	10/14/2020	2/23/2021	6/2/2021
		2019-D2	*	2020-D1	2020-D2	*	2021-D1
Boron	mg/L	0.113	0.104	0.115	0.100	0.098	0.124
Calcium	mg/L	216	184	250	185	168	233
Chloride	mg/L	37	36.0	47.7	35.7	-	44.9
Fluoride	mg/L	0.085 J	0.16	0.15	0.17	0.17	0.31
Sulfate	mg/L	1,127	1,070	1,190	1,060	-	1,210
Total Dissolved Solids	mg/L	1,864	1,750	1,890	1,720	-	1,890
pH	SU	6.0	5.9	5.7	5.4	5.6	5.7

Notes:
mg/L: milligrams per liter
SU: standard unit
U: Parameter was not present in concentrations above the method detection limit and is reported as the reporting limit
J: Estimated value. Parameter was detected in concentrations below the reporting limit
--: Not Measured
D1: First semi-annual detection monitoring event of the year
D2: Second semi-annual detection monitoring event of the year
R1: First verification event associated with detection monitoring round
* February 2020 and February 2021 data are not associated with any semiannual detection monitoring events but were included in the background update.

Table 2: Background Level Summary
Welsh Plant: Bottom Ash Storage Pond

Analyte	**Unit**	**Description**	AD-3	AD-4C	AD-16R
Boron	mg/L	Intrawell Background Value (UPL)	0.0444	0.0481	0.0595
Calcium	mg/L	Intrawell Background Value (UPL)	1.31	1.19	2.95
Chloride	mg/L	Intrawell Background Value (UPL)	9.83	16.0	7.79
Fluoride	mg/L	Intrawell Background Value (UPL)	1.00	1.00	1.00
pH	SU	Intrawell Background Value (UPL)	5.3	5.7	4.8
		Intrawell Background Value (LPL)	3.9	4.1	2.7
Sulfate	mg/L	Intrawell Background Value (UPL)	9.54	82.8	75.7
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	136	301	251

<u>Notes</u>
UPL: Upper prediction limit
LPL: Lower prediction limit

ATTACHMENT A

Certification by Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Welsh BASP CCR management area and that the requirements of § 352.931(a) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

DAVID ANTHONY MILLER
112498

112498
License Number

TEXAS
Licensing State

12.09.21
Date

American Electric Power Service Corporation
Texas Registered Engineering Firm No. F-3341

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

November 15, 2021

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Welsh Bottom Ash Storage Pond (BASP)
Background Update - 2021

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the screening for the proposed background update of groundwater data through July 2021 for American Electric Power's Welsh BASP. The analysis complies with the Texas Commission of Environmental Quality rule 30 TAC 352 for the Disposal of Coal Combustion Residuals (CCR) from Electric Utilities (CCR Rule, 2015) as well as with the United States Environmental Protection Agency (USEPA) Unified Guidance (2009).

Sampling began at Welsh BASP for the CCR program in 2016, and 8 background samples have been collected at each of the groundwater monitoring wells. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** AD-1, AD-5, and AD-17
- **Downgradient wells:** AD-3, AD-4C, and AD-16R

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis report was prepared according to the background screening conducted in December 2017 that was approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting. The analysis was reviewed by Andrew Collins, Project Manager for Groundwater Stats Consulting.

The following CCR Detection Monitoring constituents were evaluated:

- **Appendix III Parameters**: boron, calcium, chloride, fluoride, pH, sulfate, and TDS

Time series plots are provided for all wells and constituents, and are used to evaluate concentrations over time as well as for the purpose of updating statistical limits (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells. Values in background which have been flagged as outliers may be seen in a lighter font and as a disconnected symbol on the graph. A summary of these values follows this letter (Figure C).

During the background screening conducted in December 2017 data at all wells were evaluated for the following: 1) outliers; 2) trends; 3) most appropriate statistical method for Appendix III parameters based on site characteristics of groundwater data upgradient of the facility; and 4) eligibility of downgradient wells when intrawell statistical methods are recommended. Power curves were provided with the initial screening and demonstrated that the selected statistical methods for Appendix III parameters comply with the USEPA Unified Guidance recommendations as discussed below.

Summary of Statistical Method:

- Intrawell prediction limits, combined with a 1-of-2 resample plan for boron, calcium, chloride, fluoride, pH, sulfate, and TDS

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are non-detects, a nonparametric test is utilized. While the false positive rate associated with the parametric limits is based on an annual 10% as recommended by the EPA Unified Guidance (2009), the false positive rate associated with the nonparametric limits is dependent upon the available background sample size, number of future comparisons, and verification resample plan. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% non-detects (USEPA Unified Guidance, 2009, Chapter 6).

- When data contain <15% non-detects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for non-detects is the most recent practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% non-detects, the Kaplan-Meier non-detect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% non-detects.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of an additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered to be a false positive result and, therefore, no further action is necessary.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits will be necessary to accommodate these types of changes. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

Summary of Historical Background Screening – December 2017

Outlier Evaluation

Time series plots were used to identify suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective, in proposed background data. Suspected outliers at all wells for Appendix III parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits.

Tukey's outlier test noted a high value for chloride in well AD-16R, and this value was flagged in the database. The results of Tukey's test were submitted with the previous background screening report.

Seasonality

No seasonal patterns were observed on the time series plots for any of the detected data; therefore, no deseasonalizing adjustments were made to the data. When seasonal patterns are observed, data may be deseasonalized so that the resulting limits will correctly account for the seasonality as a predictable pattern rather than random variation or a release.

Trend Tests

While trends may be visual, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends. In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed concentrations were stable over time with no statistically significant increasing or decreasing trends, except for one decreasing trend for TDS in well AD-16R. This trend was relatively low in magnitude when compared to average concentrations; therefore, no adjustments were required.

Appendix III – Determination of Spatial Variation

The Analysis of Variance (ANOVA) is typically used to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying the most appropriate statistical approach. Interwell tests, which compare downgradient well data to statistical limits constructed from pooled upgradient well data, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation and when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective.

The ANOVA identified variation for all Appendix III parameters except for pH. Therefore, intrawell prediction limits were recommended for boron, calcium, chloride, fluoride, sulfate, and TDS. While interwell prediction limits would typically be recommended for pH, due to the variation in groundwater quality upgradient of the facility, evidence provided by Geosyntec Consultants supported the use of intrawell testing to accommodate groundwater quality and natural variability for all parameters.

Background Update – Conducted in October 2021

Background data sets were evaluated during this analysis for the appropriateness of consolidating new measurements through July 2021 with screened historical data for construction of updated intrawell prediction limits. This process requires a minimum of four new measurements as mentioned above. Time series graphs and Tukey's outlier test were used to identify potential outliers. The Mann-Whitney test for equality of medians was used to determine whether background data sets were eligible for updating with newer measurements as discussed below.

Intrawell limits constructed from carefully screened background data from within each well serve to provide statistical limits that are conservative (i.e. lower) from a regulatory perspective, and that will rapidly identify a change in more recent compliance data from within a given well. This statistical method removes the element of variation from across wells and eliminates the chance of mistaking natural spatial variation for a release from the facility. Intrawell prediction limits, which compare the most recent compliance sample from a given well to historical data from the same well, are updated by testing for the appropriateness of consolidating new sampling observations with the screened background data.

Outlier Analysis

Prior to updating background data sets, samples were re-evaluated for all well/constituent pairs using Tukey's outlier test and visual screening on data through the July 2021 sample event. The last background update was performed in 2019 and the results were submitted at that time. In previous reports, Tukey's outlier test noted high values that were flagged as outliers for chloride in wells AD-1 and AD-16R, and for sulfate in well AD-17.

In this background update, Tukey's identified additional outliers for pH and TDS in well AD-3. These values were flagged as outliers in order to construct statistical limits that are conservative from a regulatory perspective and represent present-day groundwater quality. No changes to previously flagged outliers were made during this analysis. As mentioned above, flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. An updated summary of Tukey's test results and flagged measurements follows this letter.

Mann-Whitney Evaluation

For constituents requiring intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through May 2019 to the new compliance samples at each well through July 2021 to evaluate whether the groups are statistically different at the 99% confidence level, in which case background data may be updated with compliance data (Figure D). An exception to this is sulfate in well AD-4C, where previously established historical data through December 2018 is compared to more recent data through July 2021. Statistically significant differences (either an increase or decrease in median concentrations) were found between the two groups for the following well/constituent pairs:

Increase:
- Sulfate: AD-4C
- TDS: AD-17 (upgradient) and AD-4C

Decrease:
- Chloride: AD-1 (upgradient) and AD-3
- Fluoride: AD-1, AD-5, AD-17 (all upgradient), AD-3, and AD-16R

Typically, when the test concludes that the medians of the two groups are statistically significantly different, particularly in the downgradient wells, the background data sets are not updated to include the newer data unless it can be reasonably justified that the change in concentrations reflects a naturally occurring shift unrelated to practices at the site. In studies such as the current one, in which at least one of the segments being compared is of short duration, the comparison is complicated by the fact that normal short-term variation may be mistaken for long-term change in medians.

For upgradient well/constituent pairs determined to have statistically significant differences (both increases and decreases) in median concentrations between background and compliance samples, the differences were minimal and reflective of naturally changing groundwater quality upgradient of the facility.

Additionally, concentrations at downgradient well/constituent pairs with statistically significant differences (both increases and decreases) in median concentrations in all cases were comparable to or less than those observed in upgradient wells. In the case of sulfate at well AD-4C, an alternative source demonstration reportedly attributed the increase in concentrations to natural variability since similar patterns were observed in upgradient wells. The significant differences noted for fluoride resulted from current concentrations reported below the historical reporting limit. Therefore, all records were updated with compliance data through July 2021 for construction of statistical limits reflective of present-day groundwater quality.

Statistical Limits

Intrawell prediction limits using all historical data through July 2021, combined with a 1-of-2 resample plan, were constructed and a summary of the updated limits follows this letter (Figure E).

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Welsh BASP. If you have any questions or comments, please feel free to contact us.

For Groundwater Stats Consulting,

Tristan Clark

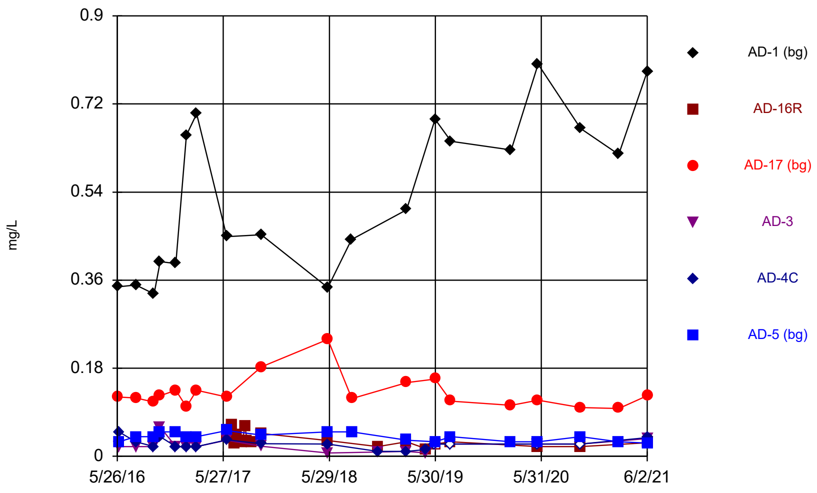
Tristan Clark
Groundwater Analyst

Kristina Rayner

Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

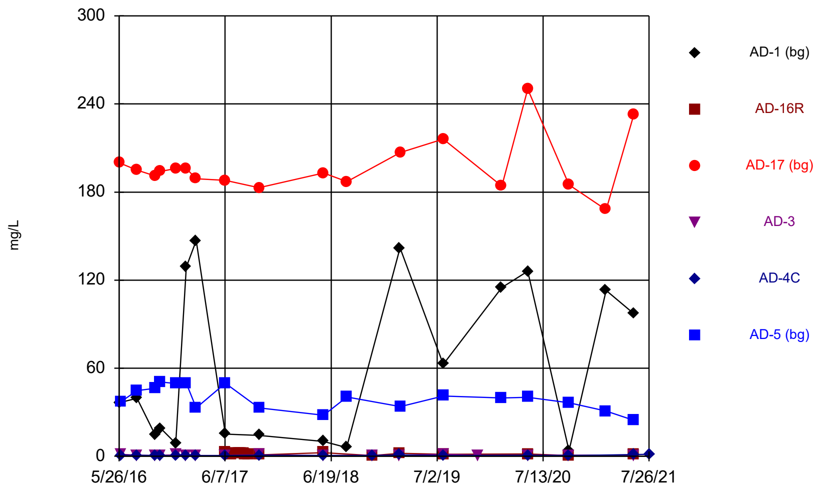
Time Series



Constituent: Boron   Analysis Run 11/4/2021 3:55 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

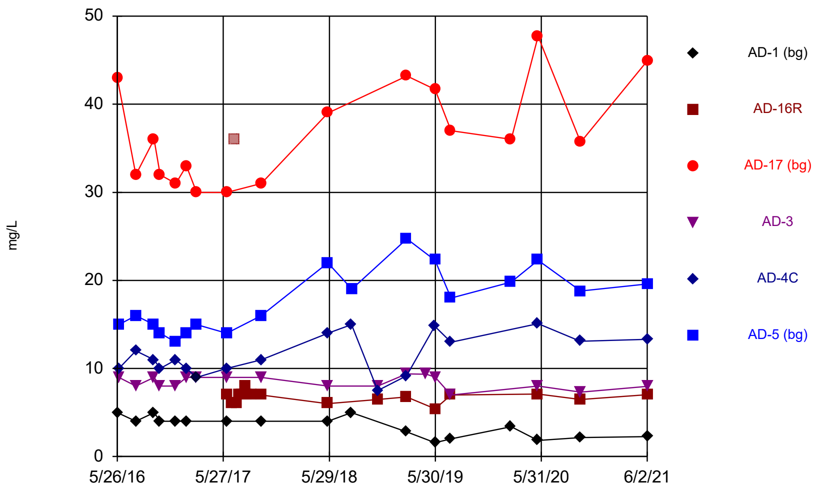
Time Series



Constituent: Calcium   Analysis Run 11/4/2021 3:55 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

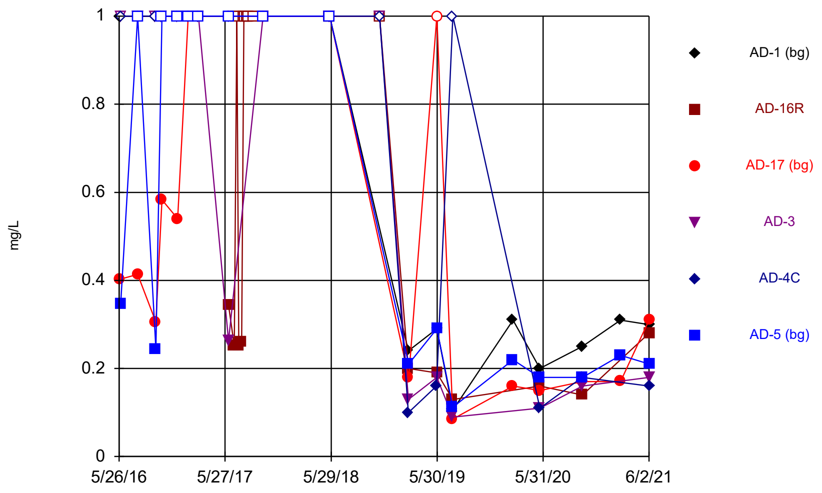
Time Series



Constituent: Chloride   Analysis Run 11/4/2021 3:55 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

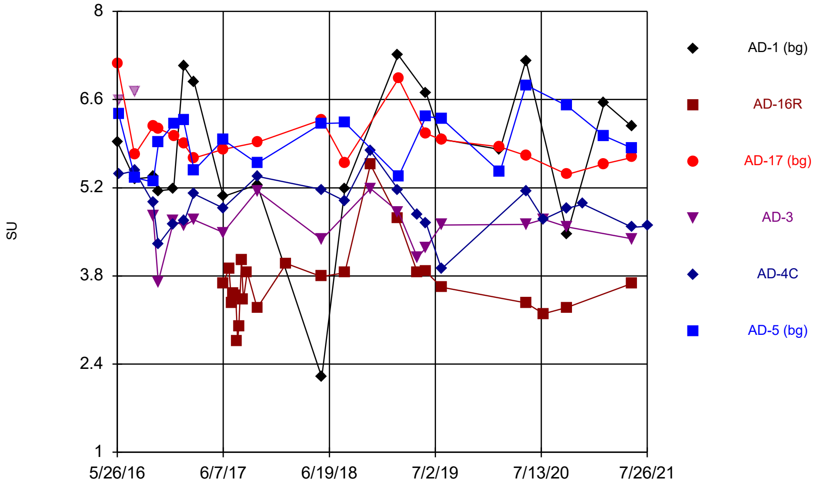
Time Series



Constituent: Fluoride   Analysis Run 11/4/2021 3:55 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Time Series

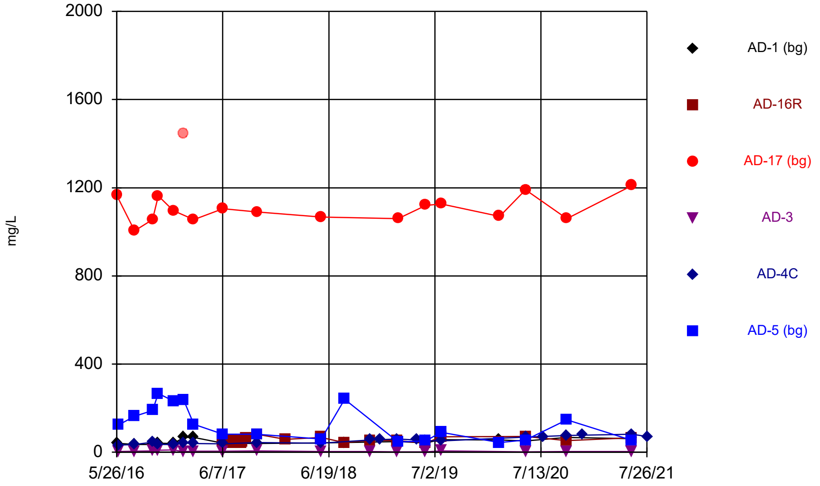


Constituent: pH, field Analysis Run 11/4/2021 3:55 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Time Series

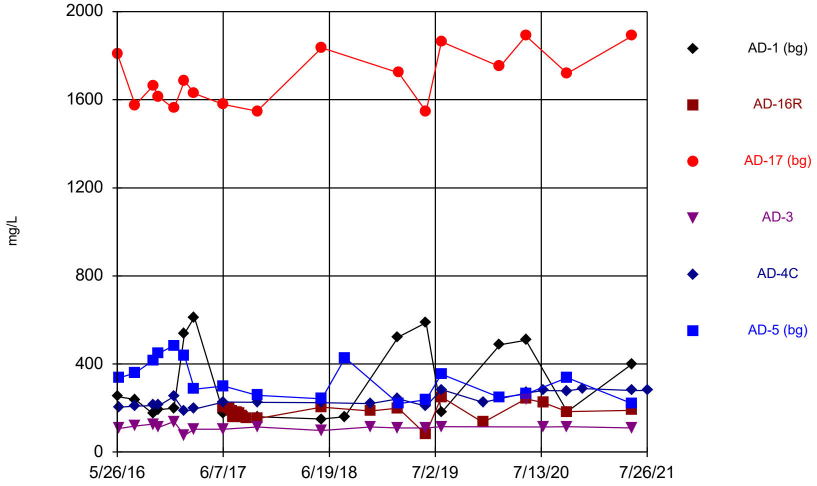


Constituent: Sulfate Analysis Run 11/4/2021 3:55 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

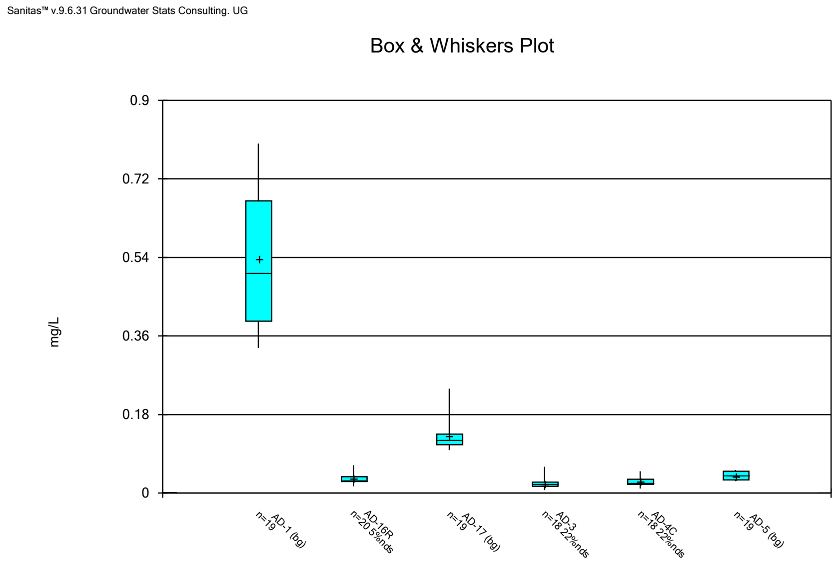
Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Time Series

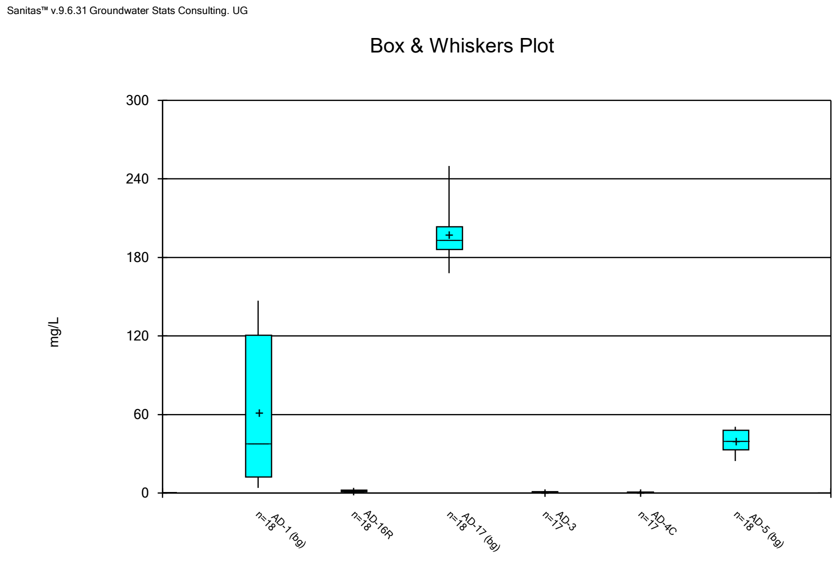


Constituent: Total Dissolved Solids Analysis Run 11/4/2021 3:55 PM

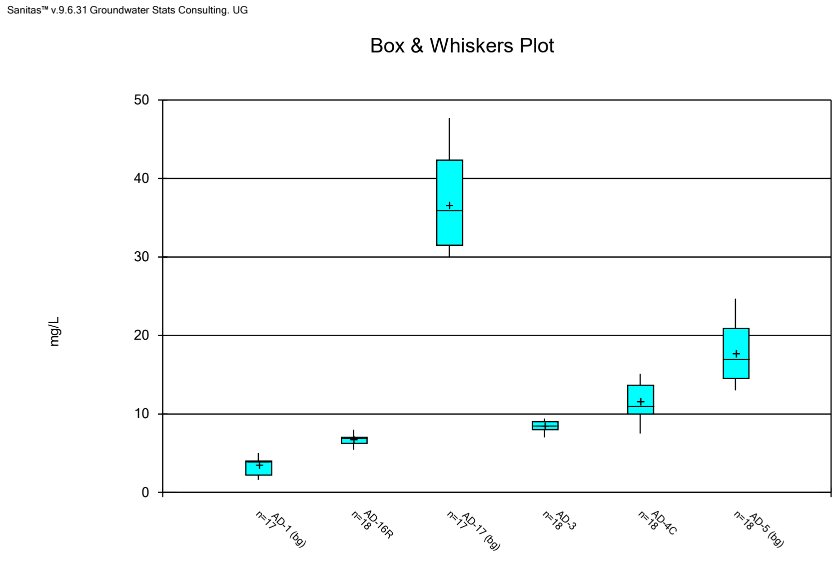
Welsh BASP Client: Geosyntec Data: Welsh BASP



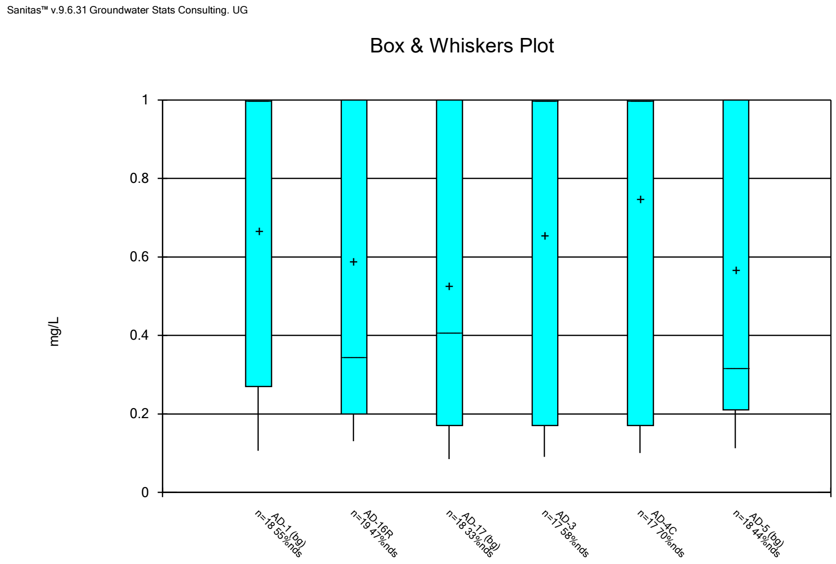
Constituent: Boron   Analysis Run 11/4/2021 3:56 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP



Constituent: Calcium   Analysis Run 11/4/2021 3:56 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP



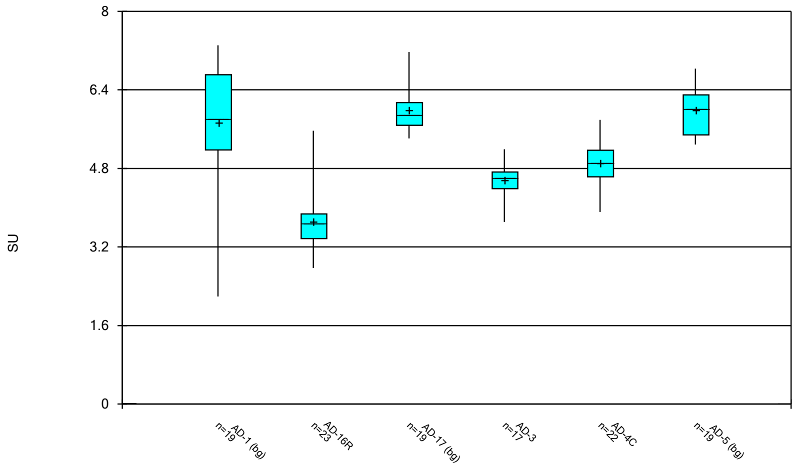
Constituent: Chloride   Analysis Run 11/4/2021 3:56 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP



Constituent: Fluoride   Analysis Run 11/4/2021 3:56 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Box & Whiskers Plot

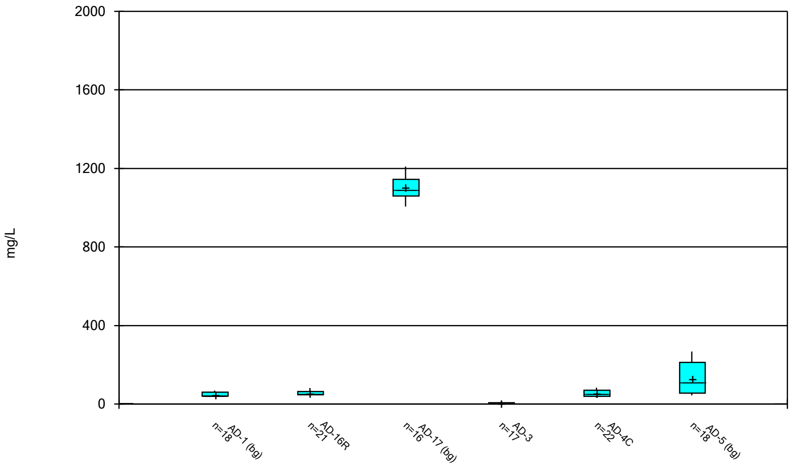


Constituent: pH, field Analysis Run 11/4/2021 3:56 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Box & Whiskers Plot

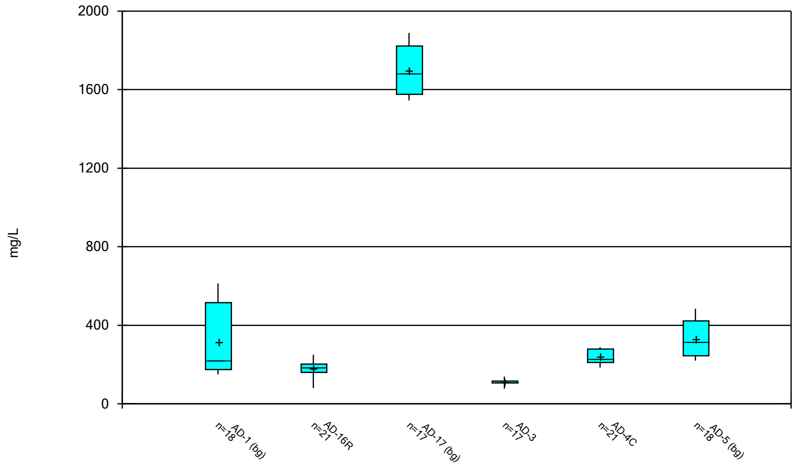


Constituent: Sulfate Analysis Run 11/4/2021 3:56 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Total Dissolved Solids Analysis Run 11/4/2021 3:56 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Outlier Summary

Welsh BASP   Client: Geosyntec   Data: Welsh BASP   Printed 11/4/2021, 4:03 PM

	AD-1 Chloride (mg/L)	AD-16R Chloride (mg/L)	AD-3 pH, field (SU)	AD-17 Sulfate (mg/L)	AD-3 Total Dissolved Solids (mg/L)
5/31/2016			6.58 (o)		
7/27/2016			6.73 (o)		
1/20/2017				1445 (o)	
2/24/2017	9 (o)				
7/7/2017		36 (o)			
5/20/2020					236 (o)

Tukey's Outlier Test - Significant Results

Welsh BASP Client: Geosyntec Data: Welsh BASP Printed 11/4/2021, 4:01 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Chloride (mg/L)	**AD-16R**	**Yes**	**36**	**7/7/2017**	**NP**	**NaN**	**19**	**8.28**	**6.737**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**AD-3**	**Yes**	**6.58,6.73**	**5/31/2016,7/27/2016**	**NP**	**NaN**	**19**	**4.789**	**0.7379**	**ln(x)**	**ShapiroWilk**
Total Dissolved Solids (mg/L)	**AD-3**	**Yes**	**236**	**5/20/2020**	**NP**	**NaN**	**18**	**117.9**	**31.98**	**ln(x)**	**ShapiroWilk**

Tukey's Outlier Test - All Results

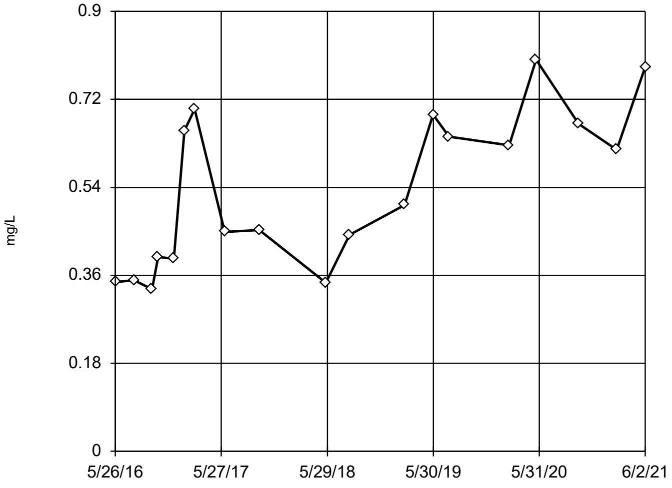
Welsh BASP Client: Geosyntec Data: Welsh BASP Printed 11/4/2021, 4:01 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	19	0.537	0.1588	sqrt(x)	ShapiroWilk
Boron (mg/L)	AD-16R	No	n/a	n/a	NP	NaN	20	0.03411	0.01341	ln(x)	ShapiroWilk
Boron (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	19	0.13	0.03398	ln(x)	ShapiroWilk
Boron (mg/L)	AD-3	No	n/a	n/a	NP	NaN	18	0.02237	0.01235	x^(1/3)	ShapiroWilk
Boron (mg/L)	AD-4C	No	n/a	n/a	NP	NaN	18	0.02533	0.01024	sqrt(x)	ShapiroWilk
Boron (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	19	0.03927	0.008445	sqrt(x)	ShapiroWilk
Calcium (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	18	61.12	54.53	ln(x)	ShapiroWilk
Calcium (mg/L)	AD-16R	No	n/a	n/a	NP	NaN	18	1.656	0.6709	normal	ShapiroWilk
Calcium (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	18	197.5	19.15	ln(x)	ShapiroWilk
Calcium (mg/L)	AD-3	No	n/a	n/a	NP	NaN	17	0.7935	0.2592	ln(x)	ShapiroWilk
Calcium (mg/L)	AD-4C	No	n/a	n/a	NP	NaN	17	0.6876	0.2588	ln(x)	ShapiroWilk
Calcium (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	18	39.41	7.958	normal	ShapiroWilk
Chloride (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	18	3.782	1.712	ln(x)	ShapiroWilk
Chloride (mg/L)	**AD-16R**	**Yes**	**36**	**7/7/2017**	**NP**	**NaN**	**19**	**8.28**	**6.737**	**ln(x)**	**ShapiroWilk**
Chloride (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	17	36.66	5.674	ln(x)	ShapiroWilk
Chloride (mg/L)	AD-3	No	n/a	n/a	NP	NaN	18	8.447	0.7151	x^3	ShapiroWilk
Chloride (mg/L)	AD-4C	No	n/a	n/a	NP	NaN	18	11.61	2.273	x^(1/3)	ShapiroWilk
Chloride (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	18	17.69	3.528	ln(x)	ShapiroWilk
Fluoride (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	18	0.667	0.3857	ln(x)	ShapiroWilk
Fluoride (mg/L)	AD-16R	No	n/a	n/a	NP	NaN	19	0.5899	0.4026	ln(x)	ShapiroWilk
Fluoride (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	18	0.2594	0.1389	ln(x)	ShapiroWilk
Fluoride (mg/L)	AD-3	No	n/a	n/a	NP	NaN	17	0.6537	0.4281	ln(x)	ShapiroWilk
Fluoride (mg/L)	AD-4C	No	n/a	n/a	NP	NaN	17	0.7476	0.4034	ln(x)	ShapiroWilk
Fluoride (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	18	0.5679	0.4004	ln(x)	ShapiroWilk
pH, field (SU)	AD-1 (bg)	No	n/a	n/a	NP	NaN	19	5.73	1.201	x^2	ShapiroWilk
pH, field (SU)	AD-16R	No	n/a	n/a	NP	NaN	23	3.703	0.5718	ln(x)	ShapiroWilk
pH, field (SU)	AD-17 (bg)	No	n/a	n/a	NP	NaN	19	5.978	0.4404	ln(x)	ShapiroWilk
pH, field (SU)	**AD-3**	**Yes**	**6.58,6.73**	**5/31/2016,7/27/2016**	**NP**	**NaN**	**19**	**4.789**	**0.7379**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	AD-4C	No	n/a	n/a	NP	NaN	22	4.911	0.4175	x^2	ShapiroWilk
pH, field (SU)	AD-5 (bg)	No	n/a	n/a	NP	NaN	19	5.976	0.4451	x^3	ShapiroWilk
Sulfate (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	18	49.25	11.12	ln(x)	ShapiroWilk
Sulfate (mg/L)	AD-16R	No	n/a	n/a	NP	NaN	21	55.66	10.66	ln(x)	ShapiroWilk
Sulfate (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	17	1123	99.5	ln(x)	ShapiroWilk
Sulfate (mg/L)	AD-3	No	n/a	n/a	NP	NaN	17	4.872	2.394	ln(x)	ShapiroWilk
Sulfate (mg/L)	AD-4C	No	n/a	n/a	NP	NaN	22	53.43	15.74	ln(x)	ShapiroWilk
Sulfate (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	18	127.2	76.81	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	18	317.8	174.6	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-16R	No	n/a	n/a	NP	NaN	21	180.2	37.34	x^2	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	17	1699	123.5	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	**AD-3**	**Yes**	**236**	**5/20/2020**	**NP**	**NaN**	**18**	**117.9**	**31.98**	**ln(x)**	**ShapiroWilk**
Total Dissolved Solids (mg/L)	AD-4C	No	n/a	n/a	NP	NaN	21	238.1	33.55	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	18	326.6	86.5	ln(x)	ShapiroWilk

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-1 (bg)



n = 19

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

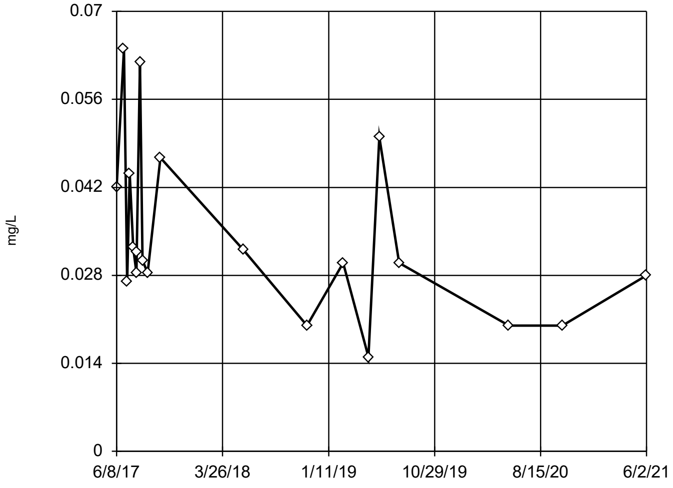
High cutoff = 1.935, low cutoff = 0.003044, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 11/4/2021 4:00 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-16R



n = 20

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

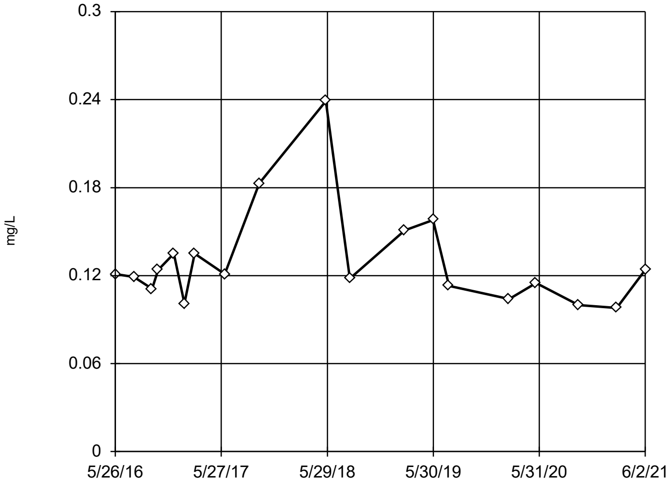
High cutoff = 0.1654, low cutoff = 0.007158, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 11/4/2021 4:00 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-17 (bg)



n = 19

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

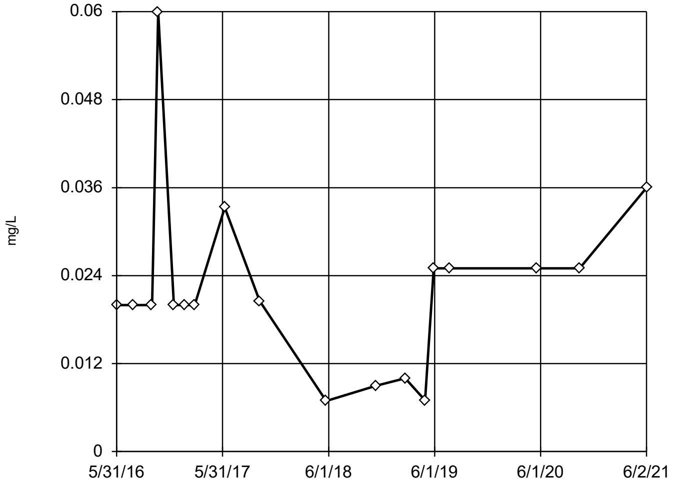
High cutoff = 0.2429, low cutoff = 0.0617, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 11/4/2021 4:00 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-3



n = 18

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

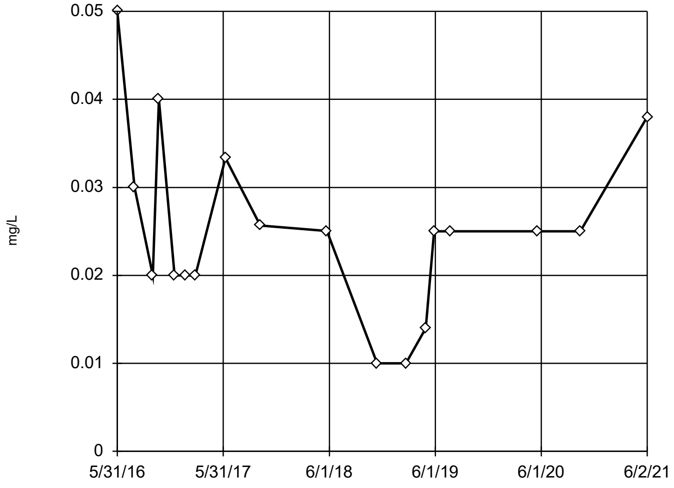
High cutoff = 0.08477, low cutoff = 0.0009005, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 11/4/2021 4:00 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-4C



n = 18

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.08246, low cutoff = 0.001031, based on IQR multiplier of 3.

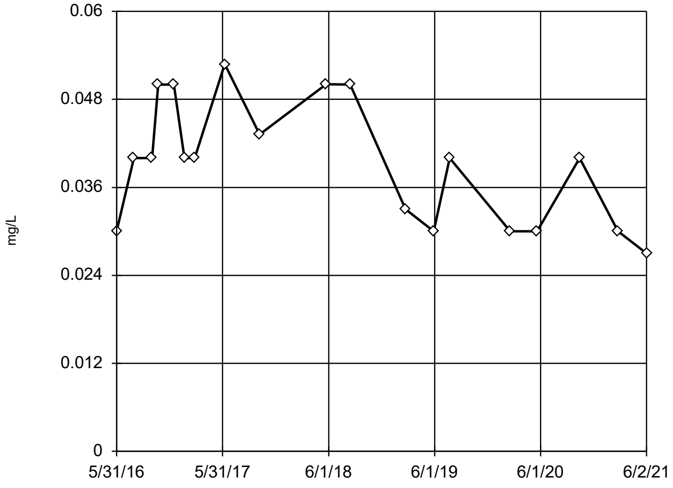
Constituent: Boron   Analysis Run 11/4/2021 4:00 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 19

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1405, low cutoff = 0.000484, based on IQR multiplier of 3.

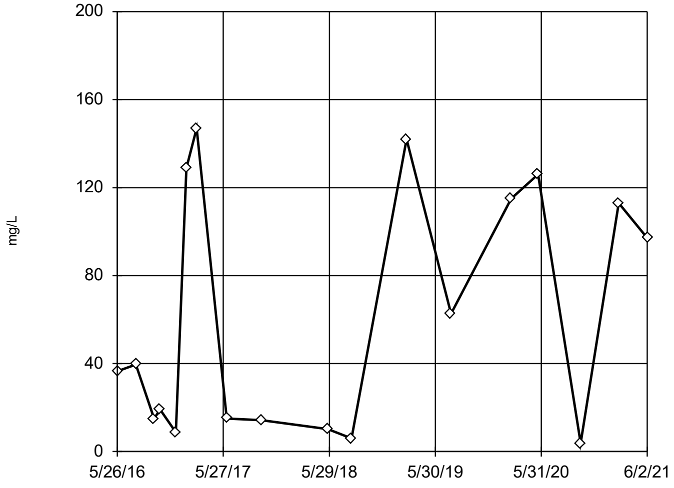
Constituent: Boron   Analysis Run 11/4/2021 4:00 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-1 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 119188, low cutoff = 0.0122, based on IQR multiplier of 3.

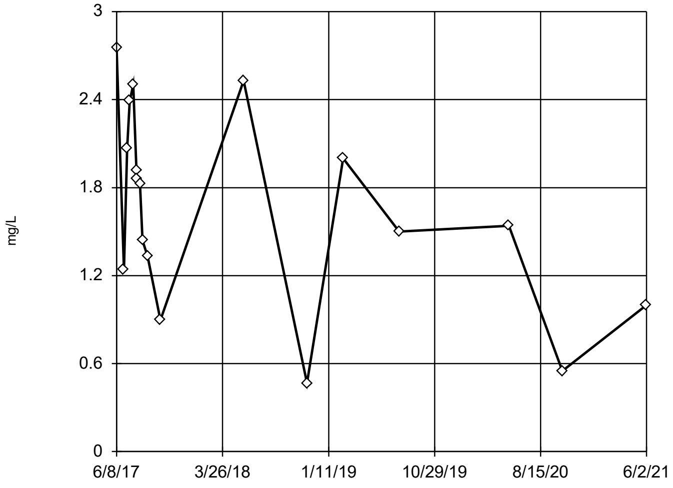
Constituent: Calcium   Analysis Run 11/4/2021 4:00 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-16R



n = 18

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 5.56, low cutoff = -2.21, based on IQR multiplier of 3.

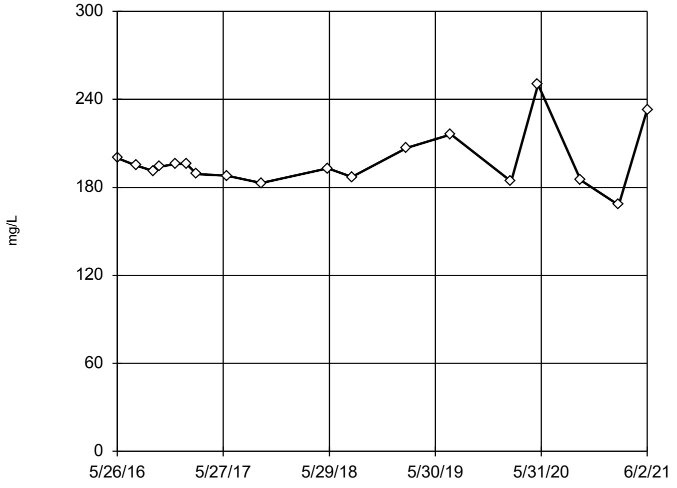
Constituent: Calcium   Analysis Run 11/4/2021 4:00 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-17 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 266.4, low cutoff = 142.1, based on IQR multiplier of 3.

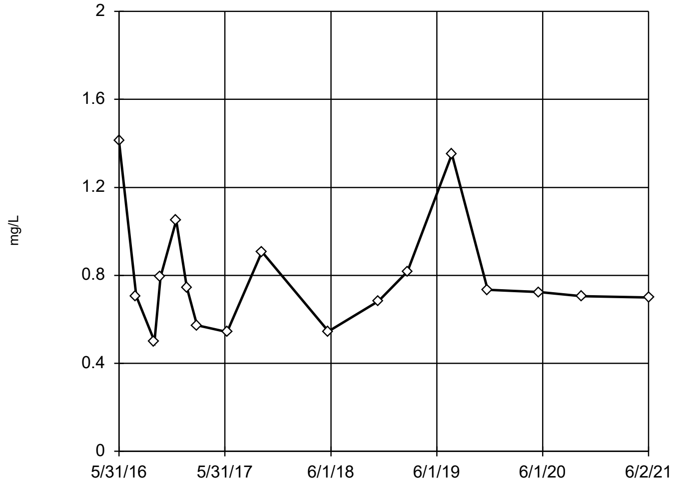
Constituent: Calcium Analysis Run 11/4/2021 4:00 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-3



n = 17

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2.243, low cutoff = 0.2404, based on IQR multiplier of 3.

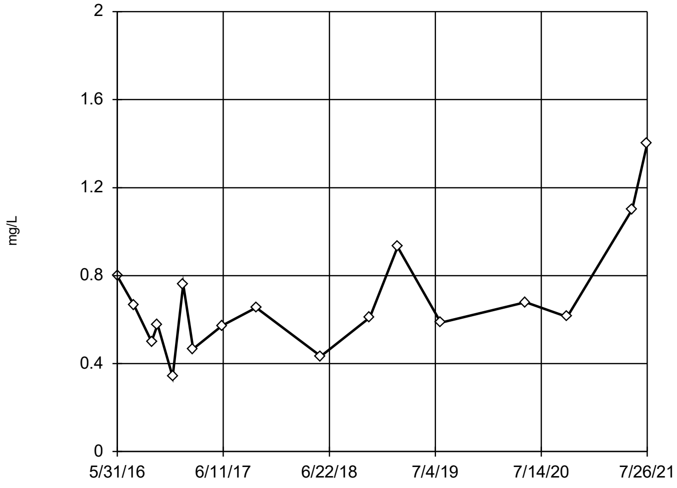
Constituent: Calcium Analysis Run 11/4/2021 4:00 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-4C



n = 17

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2.405, low cutoff = 0.1734, based on IQR multiplier of 3.

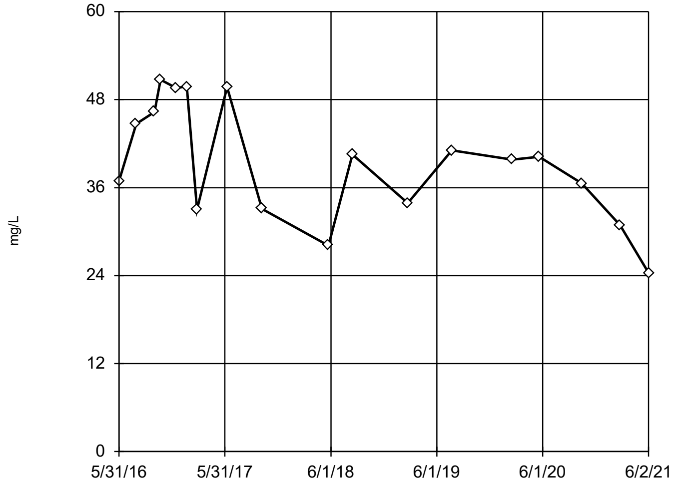
Constituent: Calcium Analysis Run 11/4/2021 4:00 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 92.65, low cutoff = -11.65, based on IQR multiplier of 3.

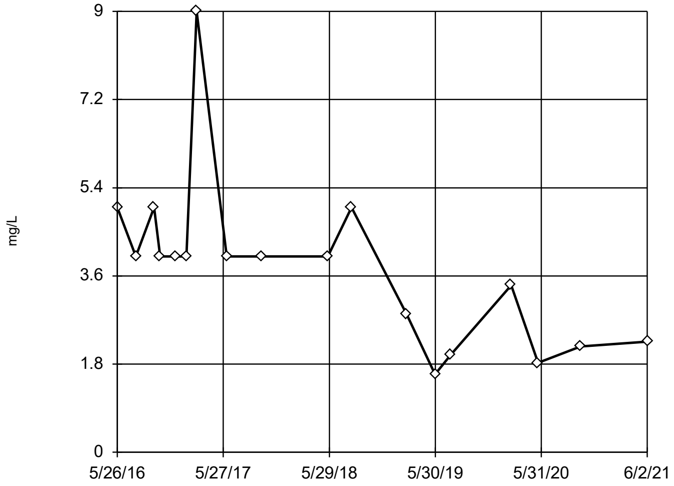
Constituent: Calcium Analysis Run 11/4/2021 4:00 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-1 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 37.09, low cutoff = 0.2664, based on IQR multiplier of 3.

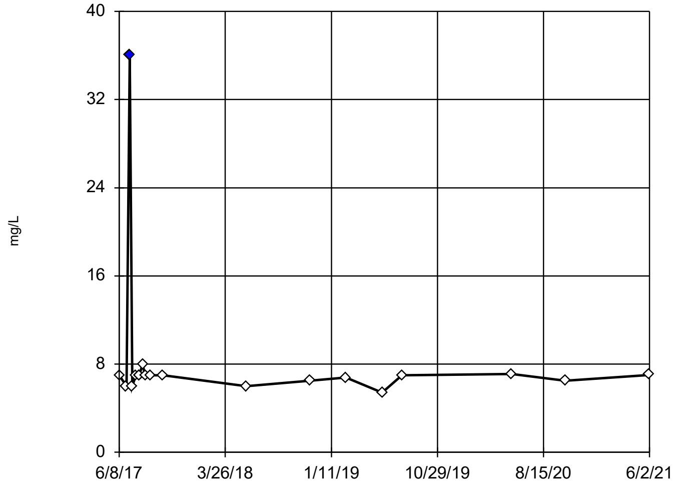
Constituent: Chloride Analysis Run 11/4/2021 4:00 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-16R



n = 19

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 8.743, low cutoff = 5.204, based on IQR multiplier of 3.

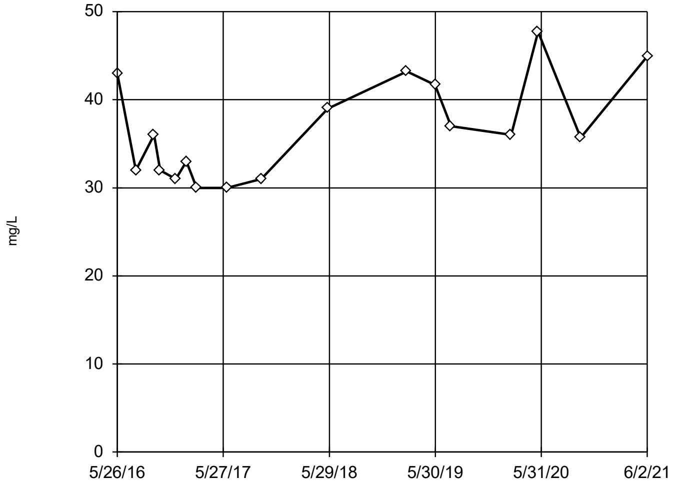
Constituent: Chloride Analysis Run 11/4/2021 4:00 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-17 (bg)



n = 17

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 102.9, low cutoff = 12.96, based on IQR multiplier of 3.

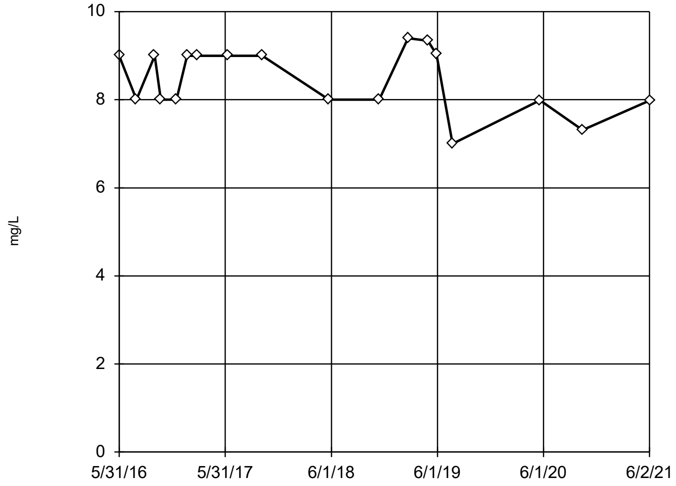
Constituent: Chloride Analysis Run 11/4/2021 4:00 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-3



n = 18

No outliers found. Tukey's method selected by user.

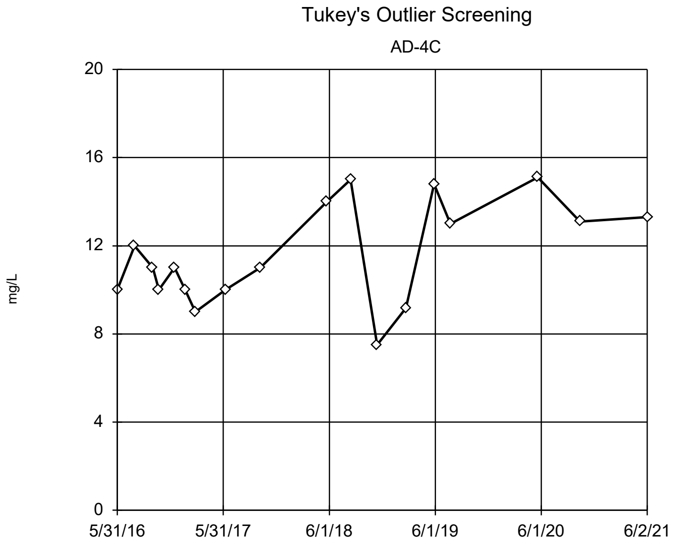
Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 11.14, low cutoff = -5.227, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 11/4/2021 4:00 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG



n = 18

No outliers found. Tukey's method selected by user.

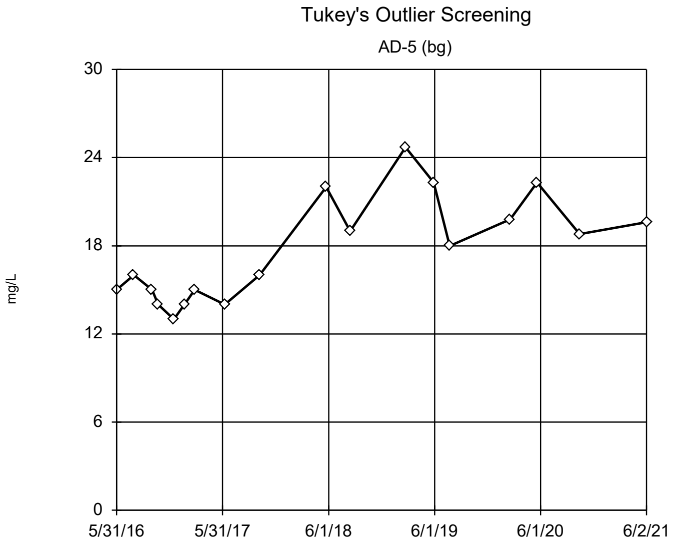
Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 29.66, low cutoff = 3.04, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 11/4/2021 4:00 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG



n = 18

No outliers found. Tukey's method selected by user.

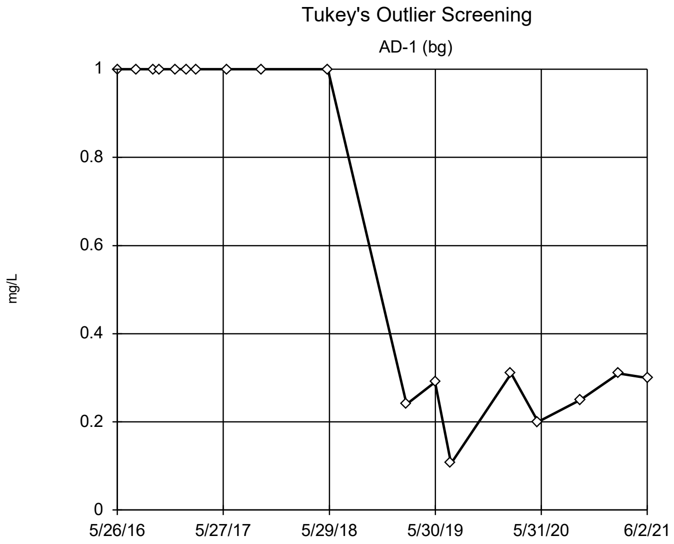
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 62.35, low cutoff = 4.851, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG



n = 18

No outliers found. Tukey's method selected by user.

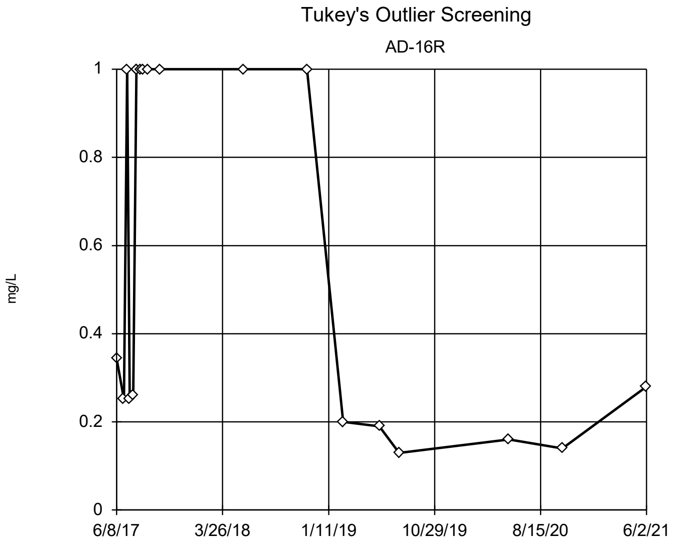
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 51.23, low cutoff = 0.005256, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG



n = 19

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

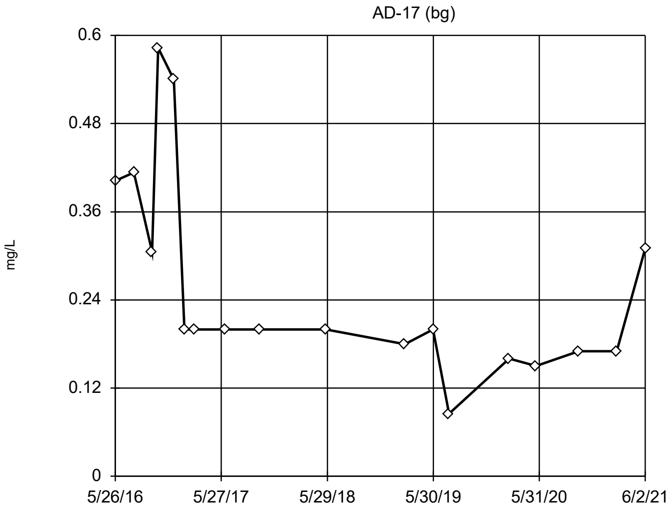
High cutoff = 125, low cutoff = 0.0016, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

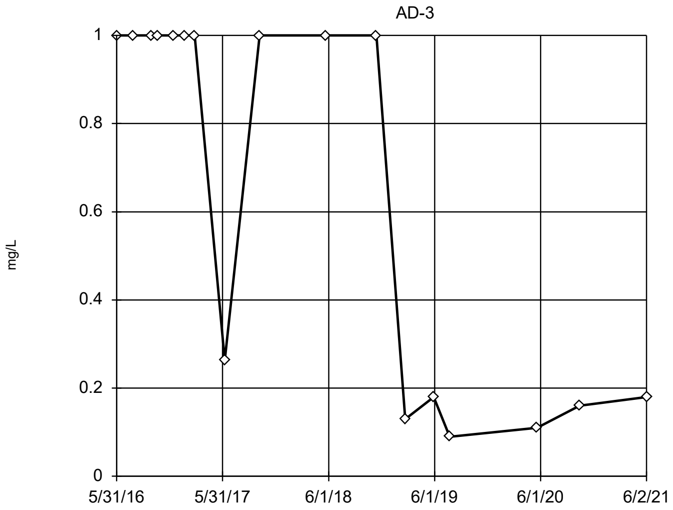
High cutoff = 3.166, low cutoff = 0.01896, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening



n = 17

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

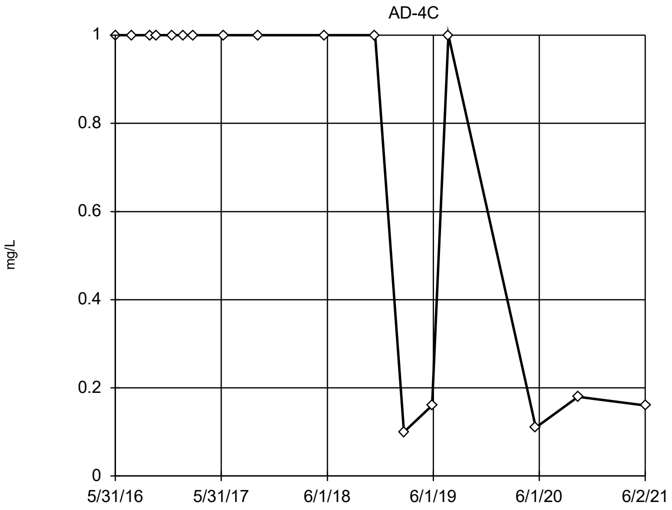
High cutoff = 204.6, low cutoff = 0.0008294, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening



n = 17

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

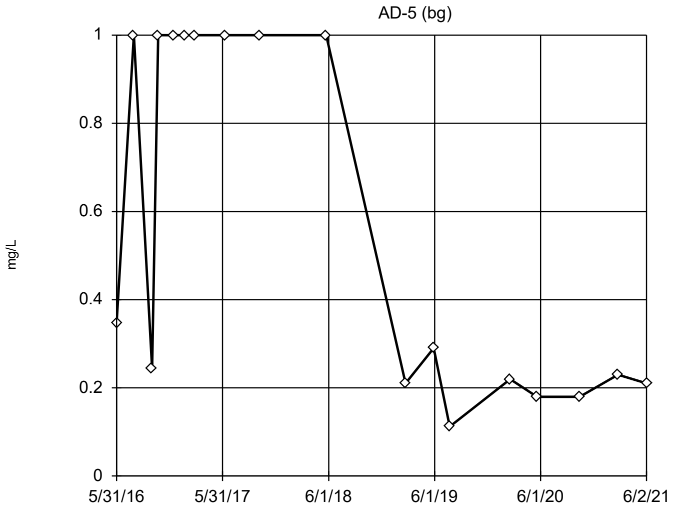
High cutoff = 204.6, low cutoff = 0.0008294, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 108, low cutoff = 0.001945, based on IQR multiplier of 3.

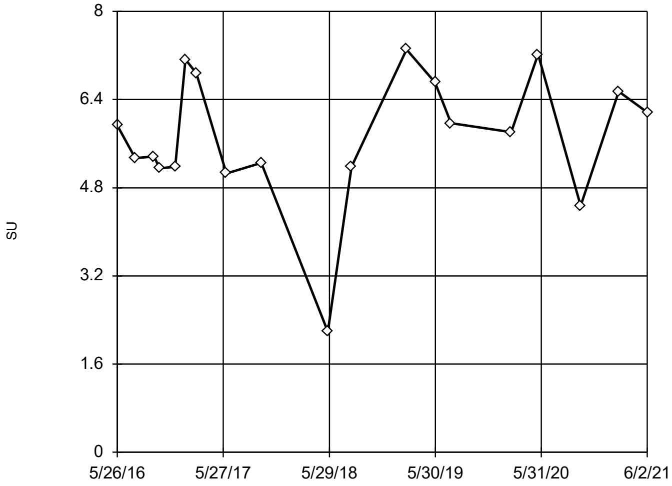
Constituent: Fluoride Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-1 (bg)



n = 19

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 9.98, low cutoff = -5.267, based on IQR multiplier of 3.

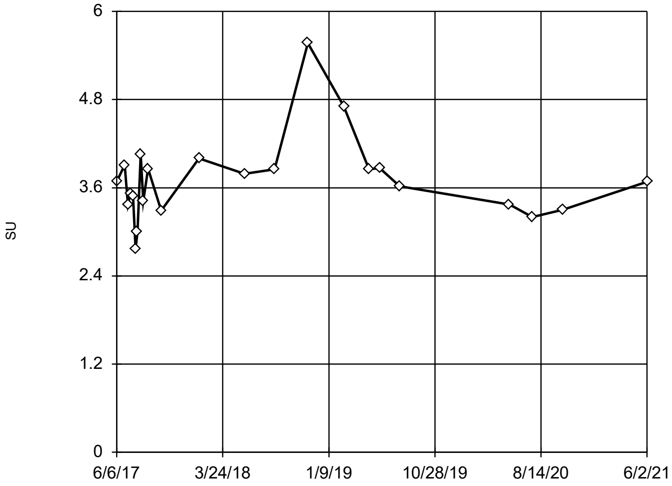
Constituent: pH, field Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-16R



n = 23

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 5.861, low cutoff = 2.225, based on IQR multiplier of 3.

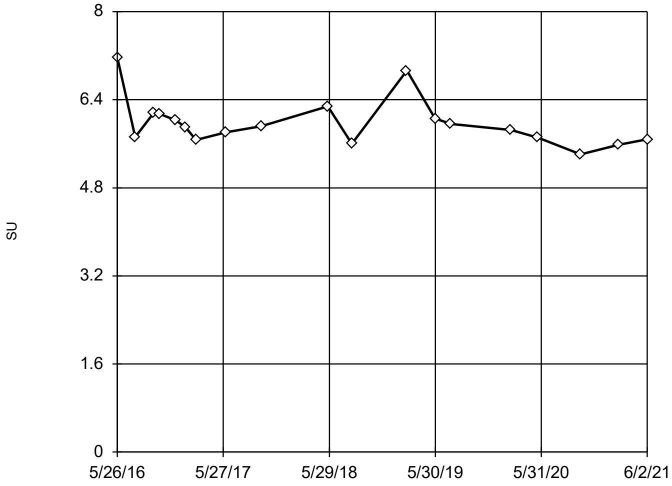
Constituent: pH, field Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-17 (bg)



n = 19

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 7.756, low cutoff = 4.497, based on IQR multiplier of 3.

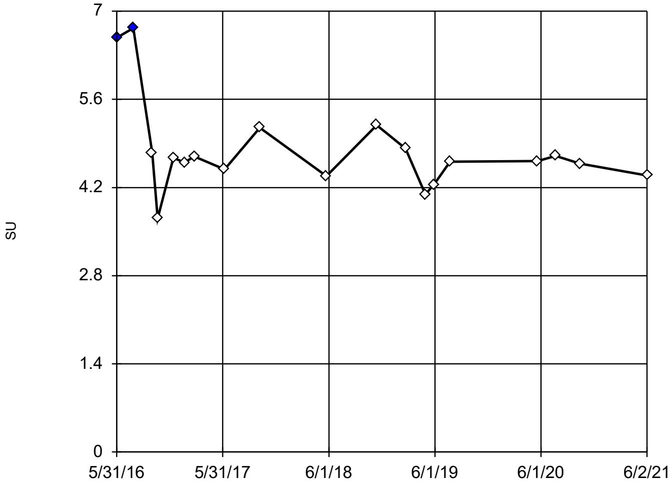
Constituent: pH, field Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-3



n = 19

Outliers are drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 6.38, low cutoff = 3.317, based on IQR multiplier of 3.

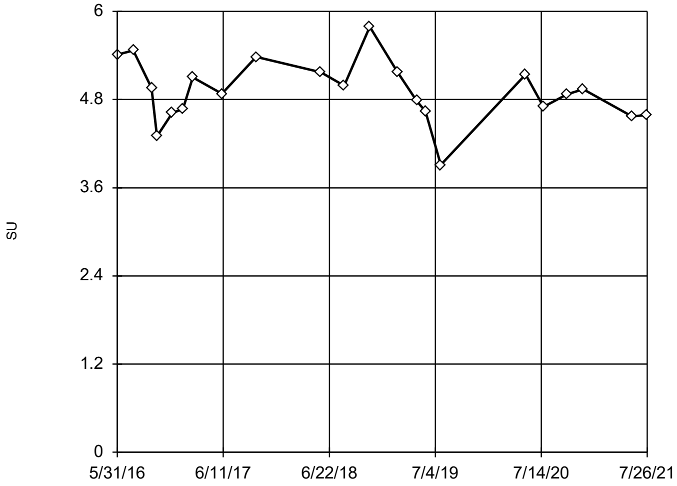
Constituent: pH, field Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-4C



n = 22

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

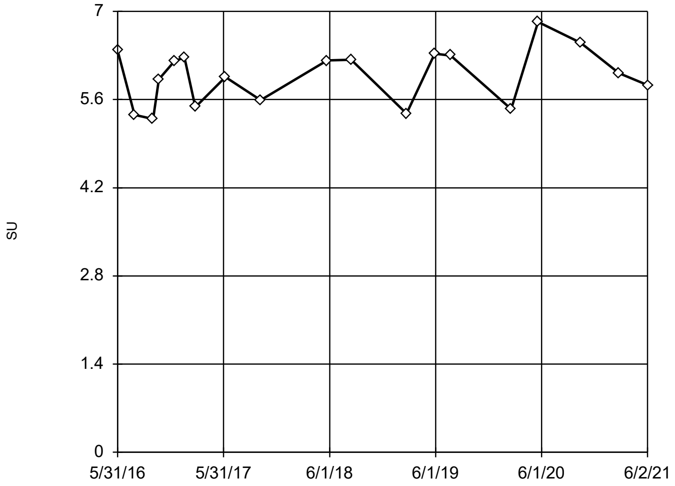
High cutoff = 6.527, low cutoff = 2.358, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 11/4/2021 4:01 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 19

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

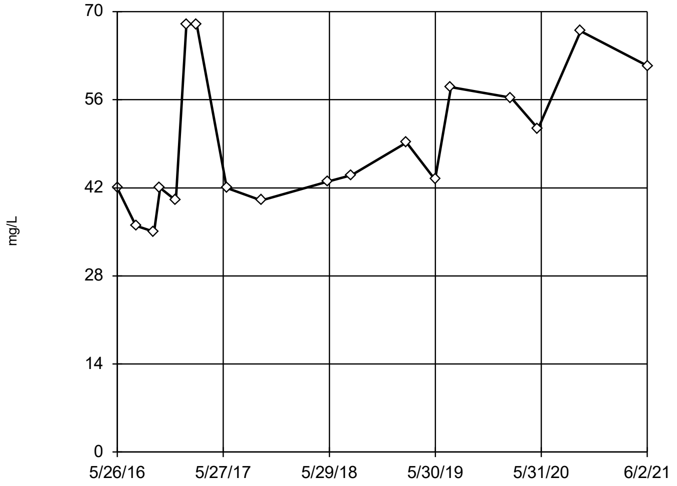
High cutoff = 7.971, low cutoff = -4.512, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 11/4/2021 4:01 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-1 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

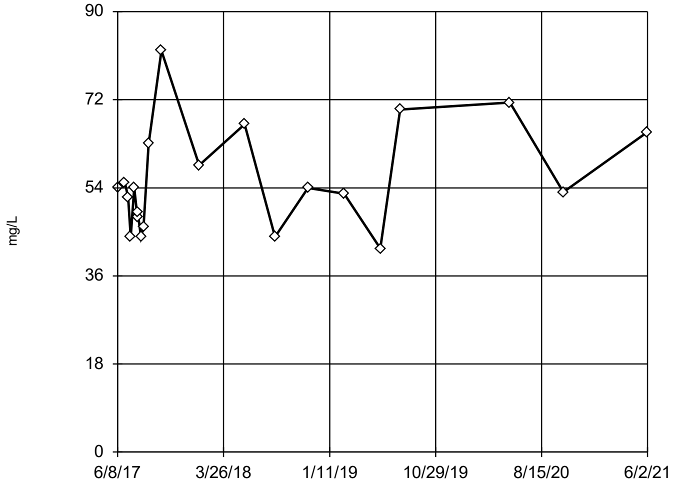
High cutoff = 184.2, low cutoff = 13.28, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 11/4/2021 4:01 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-16R



n = 21

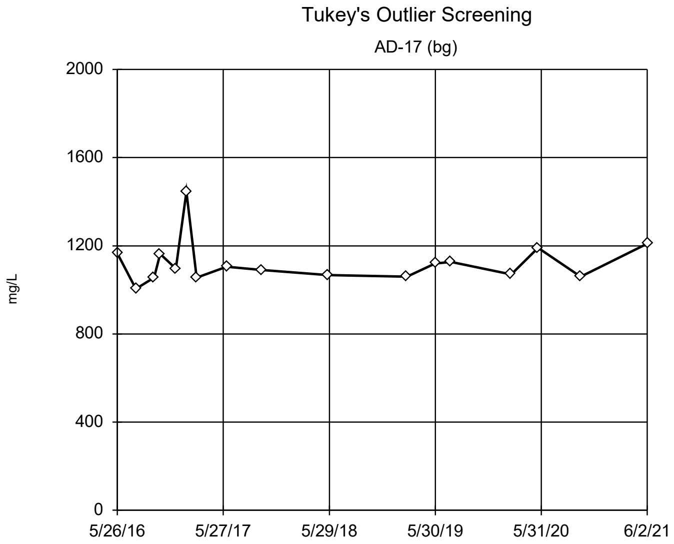
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 163.6, low cutoff = 18.43, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 11/4/2021 4:01 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG



Tukey's Outlier Screening

AD-17 (bg)

n = 17

No outliers found. Tukey's method selected by user.

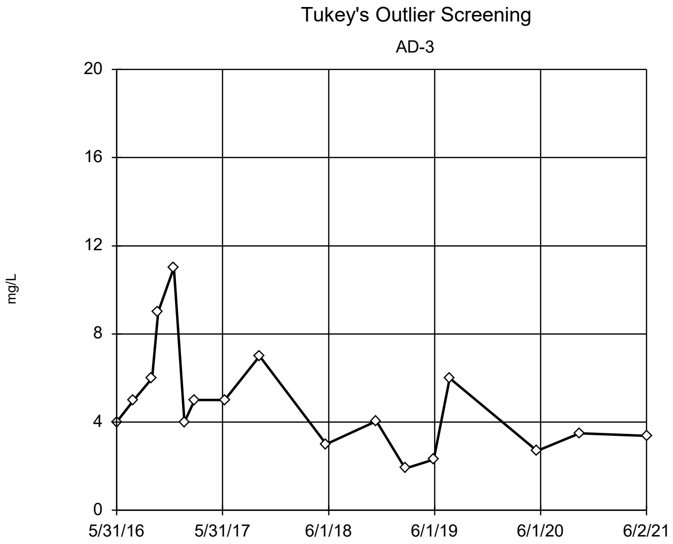
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1544, low cutoff = 799.5, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG



Tukey's Outlier Screening

AD-3

n = 17

No outliers found. Tukey's method selected by user.

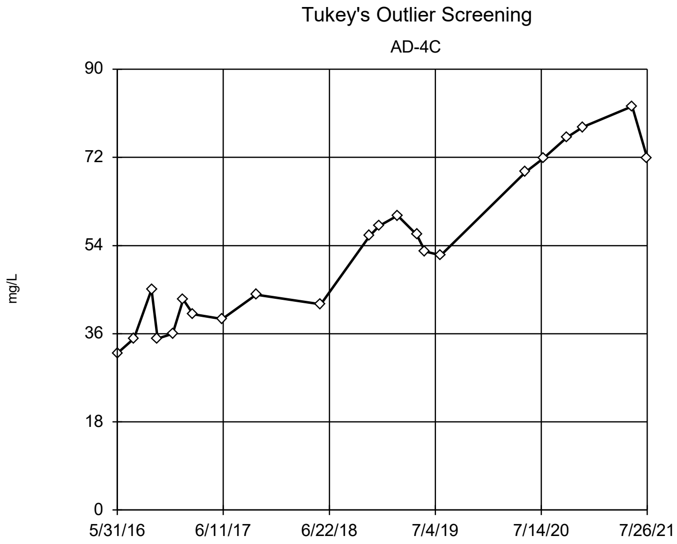
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 40.14, low cutoff = 0.476, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG



Tukey's Outlier Screening

AD-4C

n = 22

No outliers found. Tukey's method selected by user.

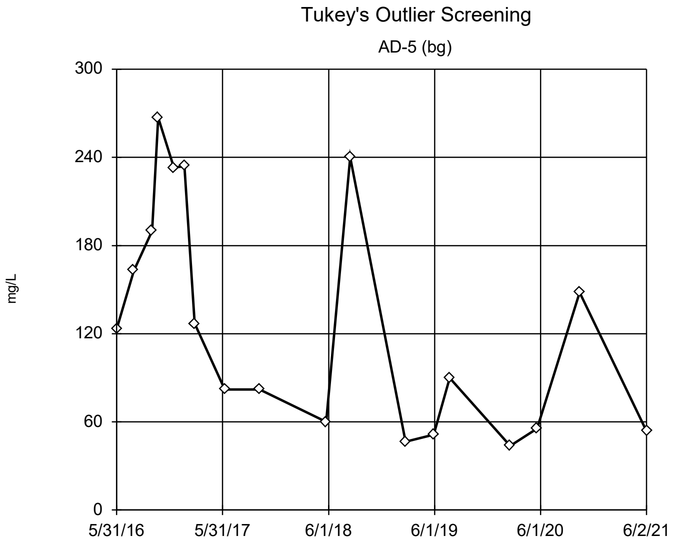
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 398.3, low cutoff = 6.979, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG



Tukey's Outlier Screening

AD-5 (bg)

n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 12012, low cutoff = 0.9572, based on IQR multiplier of 3.

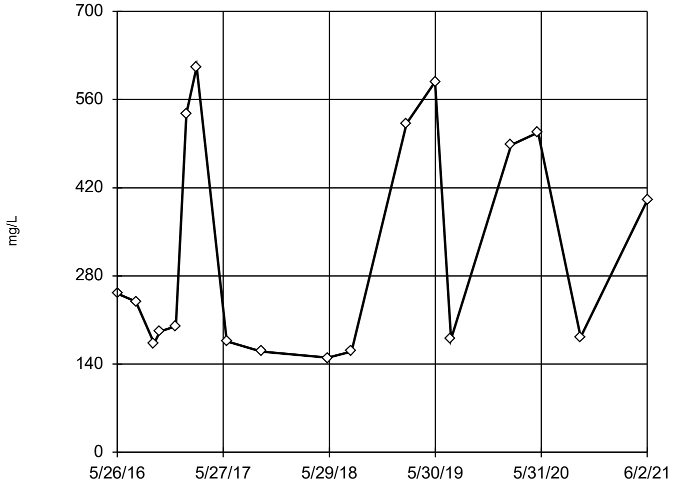
Constituent: Sulfate Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-1 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 13235, low cutoff = 6.789, based on IQR multiplier of 3.

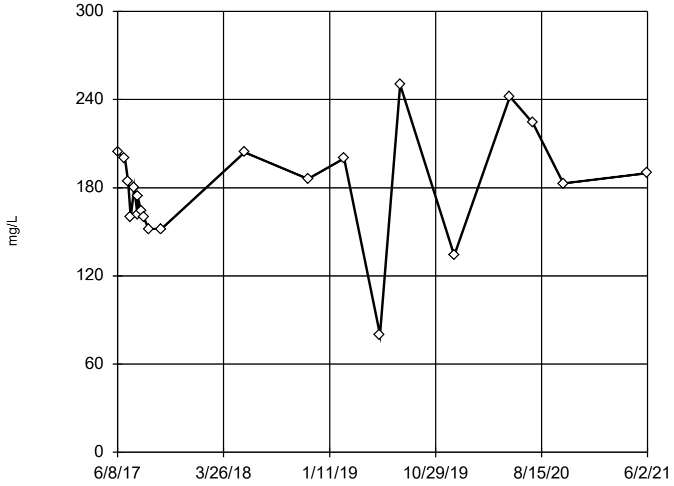
Constituent: Total Dissolved Solids Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-16R



n = 21

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 294, low cutoff = -141.5, based on IQR multiplier of 3.

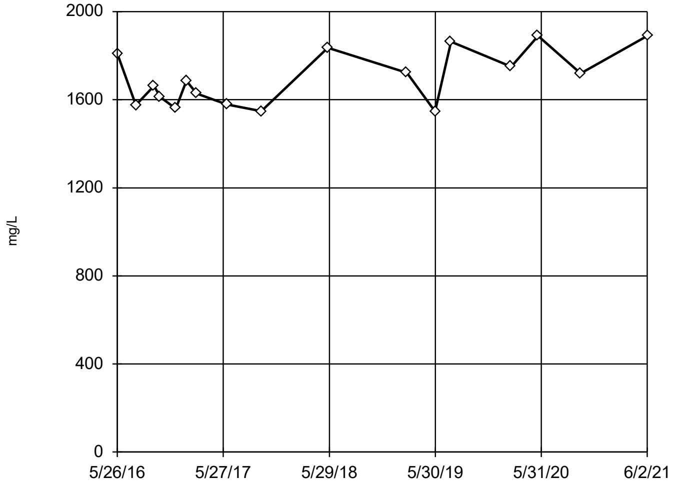
Constituent: Total Dissolved Solids Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-17 (bg)



n = 17

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2816, low cutoff = 1021, based on IQR multiplier of 3.

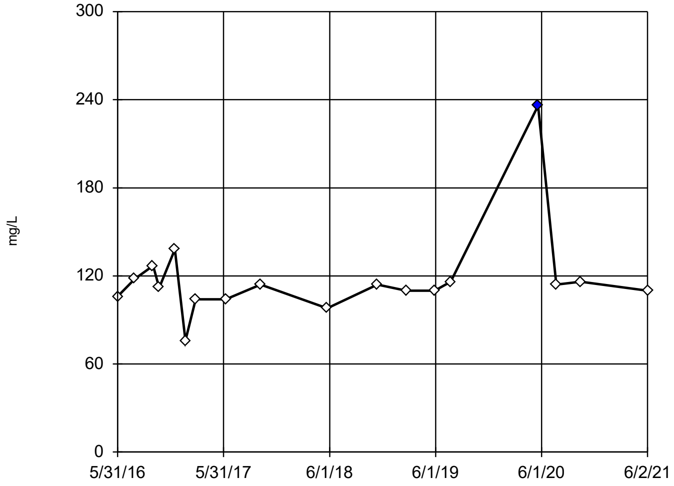
Constituent: Total Dissolved Solids Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-3



n = 18

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

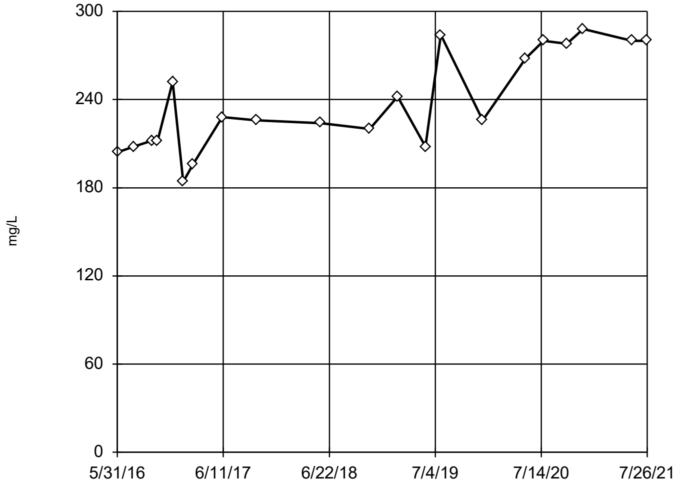
High cutoff = 161.9, low cutoff = 75.89, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Tukey's Outlier Screening

AD-4C



n = 21

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

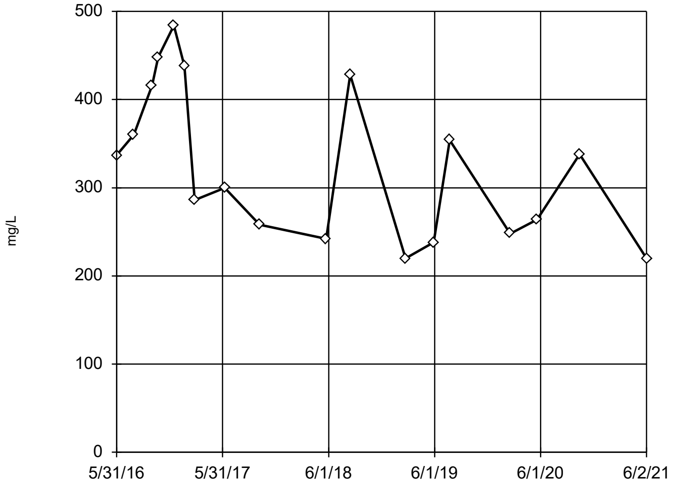
High cutoff = 654.3, low cutoff = 89.54, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Tukey's Outlier Screening

AD-5 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2156, low cutoff = 47.94, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/4/2021 4:01 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Welch's t-test/Mann-Whitney - Significant Results

Welsh BASP   Client: Geosyntec   Data: Welsh BASP   Printed 11/4/2021, 4:09 PM

Constituent	Well	Calc.	0.01	Method
Chloride (mg/L)	**AD-1 (bg)**	**-2.683**	**Yes**	**Mann-W**
Chloride (mg/L)	**AD-3**	**-3.116**	**Yes**	**Mann-W**
Fluoride (mg/L)	**AD-1 (bg)**	**-3.035**	**Yes**	**Mann-W**
Fluoride (mg/L)	**AD-16R**	**-2.696**	**Yes**	**Mann-W**
Fluoride (mg/L)	**AD-17 (bg)**	**-2.72**	**Yes**	**Mann-W**
Fluoride (mg/L)	**AD-3**	**-3.045**	**Yes**	**Mann-W**
Fluoride (mg/L)	**AD-5 (bg)**	**-3.336**	**Yes**	**Mann-W**
Sulfate (mg/L)	**AD-4C**	**3.314**	**Yes**	**Mann-W**
Total Dissolved Solids (mg/L)	**AD-17 (bg)**	**2.584**	**Yes**	**Mann-W**
Total Dissolved Solids (mg/L)	**AD-4C**	**3.484**	**Yes**	**Mann-W**

Welch's t-test/Mann-Whitney - All Results

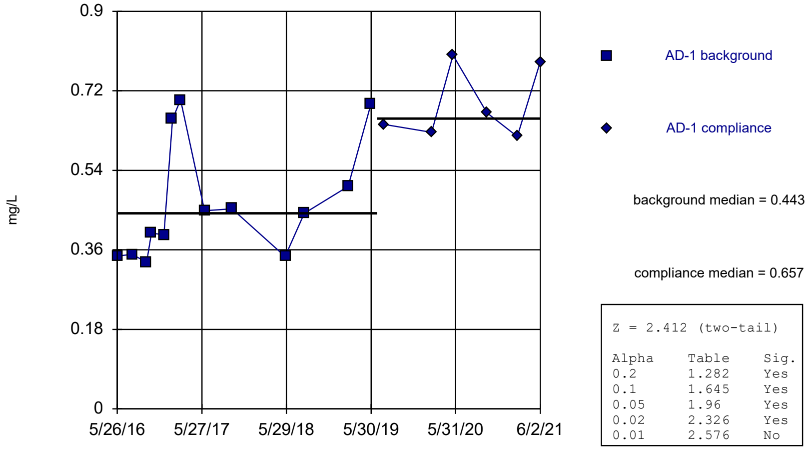
Welsh BASP Client: Geosyntec Data: Welsh BASP Printed 11/4/2021, 4:09 PM

Constituent	Well	Calc.	0.01	Method
Boron (mg/L)	AD-1 (bg)	2.412	No	Mann-W
Boron (mg/L)	AD-16R	-1.989	No	Mann-W
Boron (mg/L)	AD-17 (bg)	-2.459	No	Mann-W
Boron (mg/L)	AD-3	2.066	No	Mann-W
Boron (mg/L)	AD-4C	0.6442	No	Mann-W
Boron (mg/L)	AD-5 (bg)	-2.387	No	Mann-W
Calcium (mg/L)	AD-1 (bg)	0.7961	No	Mann-W
Calcium (mg/L)	AD-16R	-1.646	No	Mann-W
Calcium (mg/L)	AD-17 (bg)	0.1406	No	Mann-W
Calcium (mg/L)	AD-3	0.2635	No	Mann-W
Calcium (mg/L)	AD-4C	1.634	No	Mann-W
Calcium (mg/L)	AD-5 (bg)	-1.452	No	Mann-W
Chloride (mg/L)	**AD-1 (bg)**	**-2.683**	**Yes**	**Mann-W**
Chloride (mg/L)	AD-16R	1.282	No	Mann-W
Chloride (mg/L)	AD-17 (bg)	1.691	No	Mann-W
Chloride (mg/L)	**AD-3**	**-3.116**	**Yes**	**Mann-W**
Chloride (mg/L)	AD-4C	1.979	No	Mann-W
Chloride (mg/L)	AD-5 (bg)	1.635	No	Mann-W
Fluoride (mg/L)	**AD-1 (bg)**	**-3.035**	**Yes**	**Mann-W**
Fluoride (mg/L)	**AD-16R**	**-2.696**	**Yes**	**Mann-W**
Fluoride (mg/L)	**AD-17 (bg)**	**-2.72**	**Yes**	**Mann-W**
Fluoride (mg/L)	**AD-3**	**-3.045**	**Yes**	**Mann-W**
Fluoride (mg/L)	AD-4C	-2.039	No	Mann-W
Fluoride (mg/L)	**AD-5 (bg)**	**-3.336**	**Yes**	**Mann-W**
pH, field (SU)	AD-1 (bg)	0.7458	No	Mann-W
pH, field (SU)	AD-16R	-1.678	No	Mann-W
pH, field (SU)	AD-17 (bg)	-2.236	No	Mann-W
pH, field (SU)	AD-3	-0.1581	No	Mann-W
pH, field (SU)	AD-4C	-1.904	No	Mann-W
pH, field (SU)	AD-5 (bg)	1.096	No	Mann-W
Sulfate (mg/L)	AD-1 (bg)	2.175	No	Mann-W
Sulfate (mg/L)	AD-16R	1.931	No	Mann-W
Sulfate (mg/L)	AD-17 (bg)	1.305	No	Mann-W
Sulfate (mg/L)	AD-3	-1.023	No	Mann-W
Sulfate (mg/L)	**AD-4C**	**3.314**	**Yes**	**Mann-W**
Sulfate (mg/L)	AD-5 (bg)	-1.677	No	Mann-W
Total Dissolved Solids (mg/L)	AD-1 (bg)	0.3945	No	Mann-W
Total Dissolved Solids (mg/L)	AD-16R	1.598	No	Mann-W
Total Dissolved Solids (mg/L)	**AD-17 (bg)**	**2.584**	**Yes**	**Mann-W**
Total Dissolved Solids (mg/L)	AD-3	0.9684	No	Mann-W
Total Dissolved Solids (mg/L)	**AD-4C**	**3.484**	**Yes**	**Mann-W**
Total Dissolved Solids (mg/L)	AD-5 (bg)	-1.134	No	Mann-W

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-1 (bg)



background median = 0.443

compliance median = 0.657

```
Z = 2.412 (two-tail)

Alpha     Table     Sig.
0.2       1.282     Yes
0.1       1.645     Yes
0.05      1.96      Yes
0.02      2.326     Yes
0.01      2.576     No
```

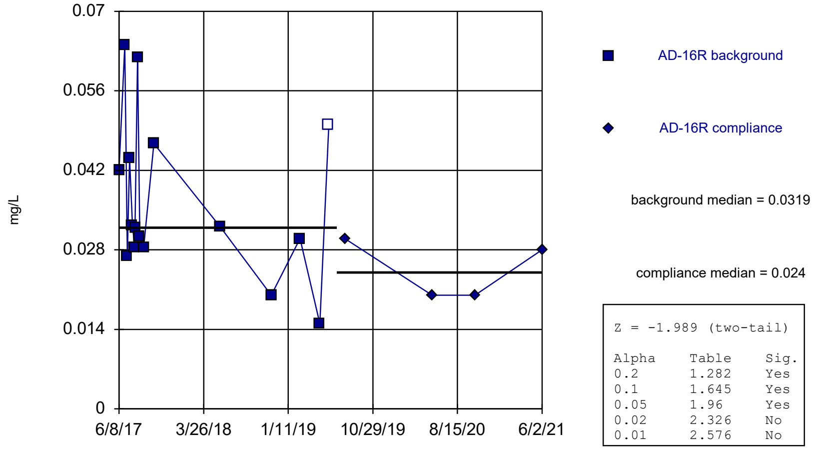
Constituent: Boron   Analysis Run 11/4/2021 4:05 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-16R



background median = 0.0319

compliance median = 0.024

```
Z = -1.989 (two-tail)

Alpha     Table     Sig.
0.2       1.282     Yes
0.1       1.645     Yes
0.05      1.96      Yes
0.02      2.326     No
0.01      2.576     No
```

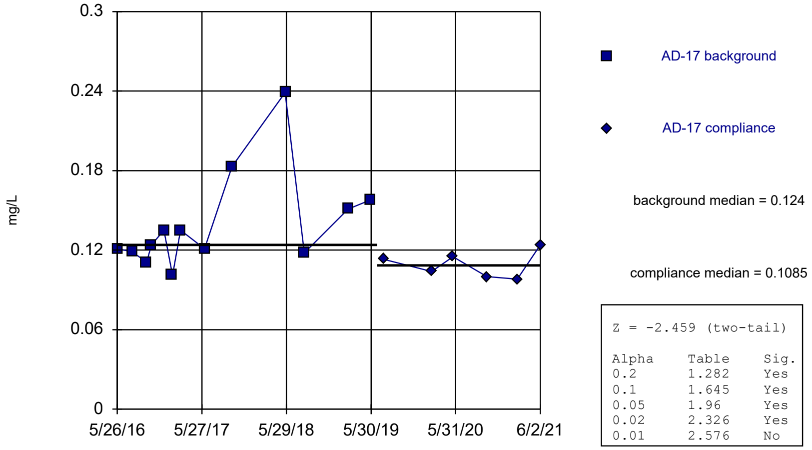
Constituent: Boron   Analysis Run 11/4/2021 4:05 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-17 (bg)



background median = 0.124

compliance median = 0.1085

```
Z = -2.459 (two-tail)

Alpha     Table     Sig.
0.2       1.282     Yes
0.1       1.645     Yes
0.05      1.96      Yes
0.02      2.326     Yes
0.01      2.576     No
```

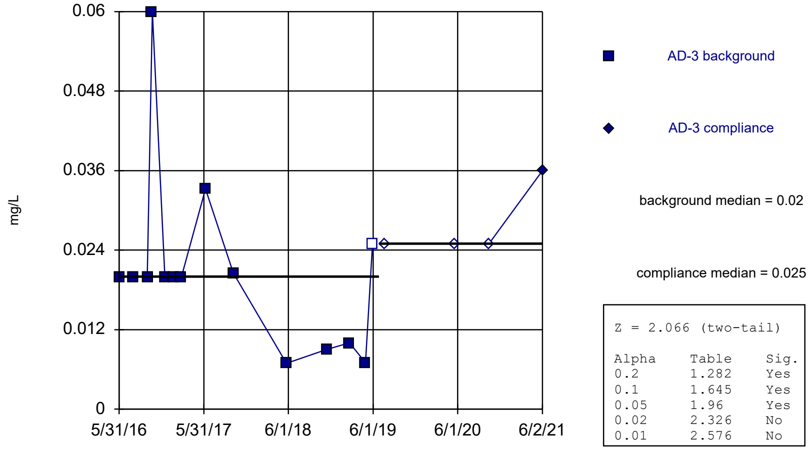
Constituent: Boron   Analysis Run 11/4/2021 4:05 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-3



background median = 0.02

compliance median = 0.025

```
Z = 2.066 (two-tail)

Alpha     Table     Sig.
0.2       1.282     Yes
0.1       1.645     Yes
0.05      1.96      Yes
0.02      2.326     No
0.01      2.576     No
```

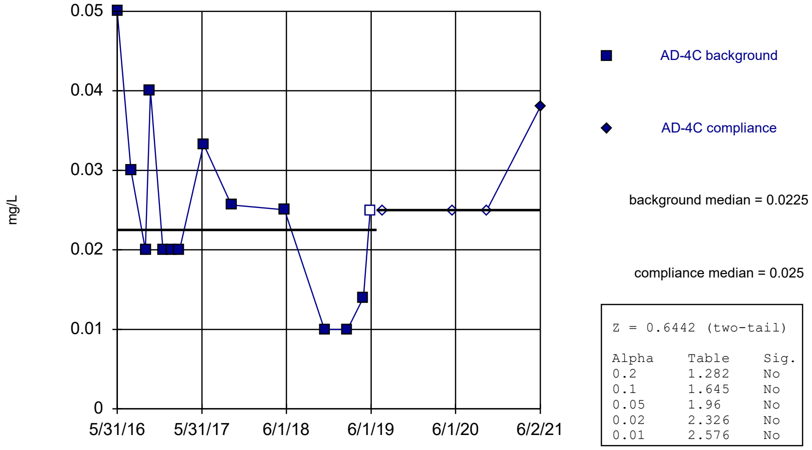
Constituent: Boron   Analysis Run 11/4/2021 4:05 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-4C



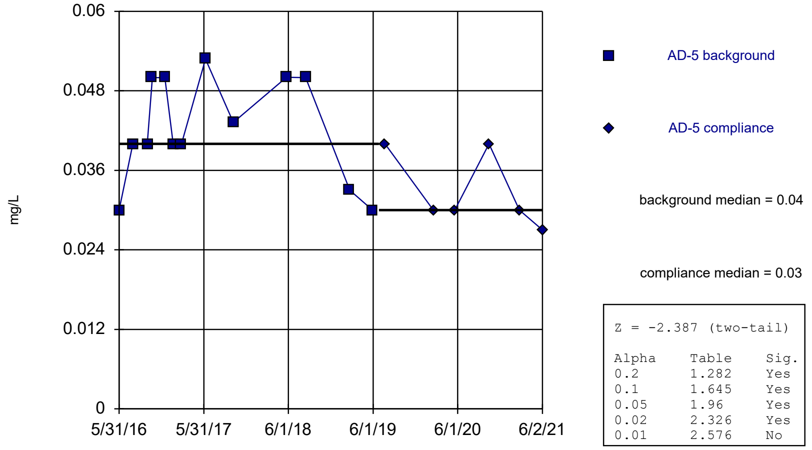
```
Z = 0.6442 (two-tail)

Alpha    Table    Sig.
0.2      1.282    No
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

Constituent: Boron   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-5 (bg)



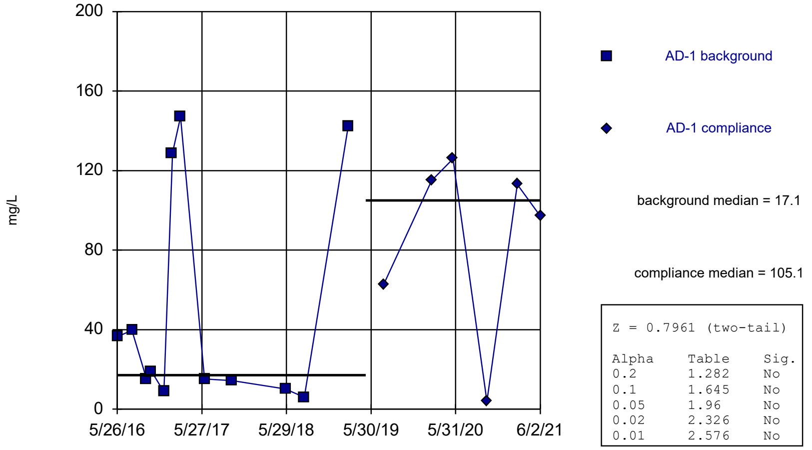
```
Z = -2.387 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     Yes
0.02     2.326    Yes
0.01     2.576    No
```

Constituent: Boron   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-1 (bg)



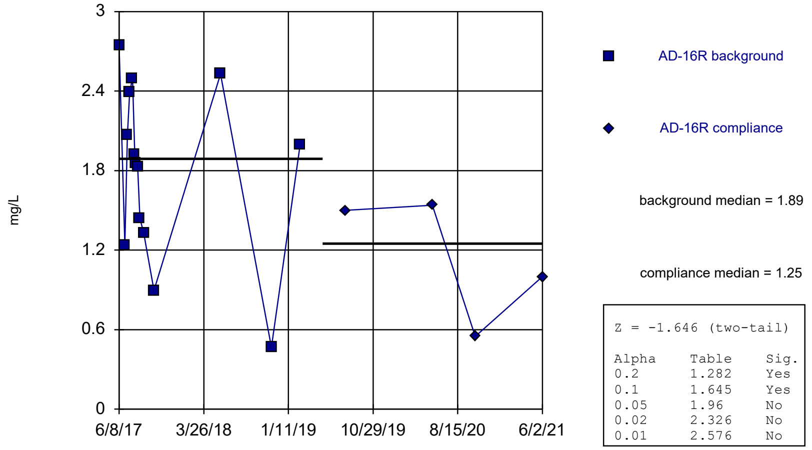
```
Z = 0.7961 (two-tail)

Alpha    Table    Sig.
0.2      1.282    No
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

Constituent: Calcium   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

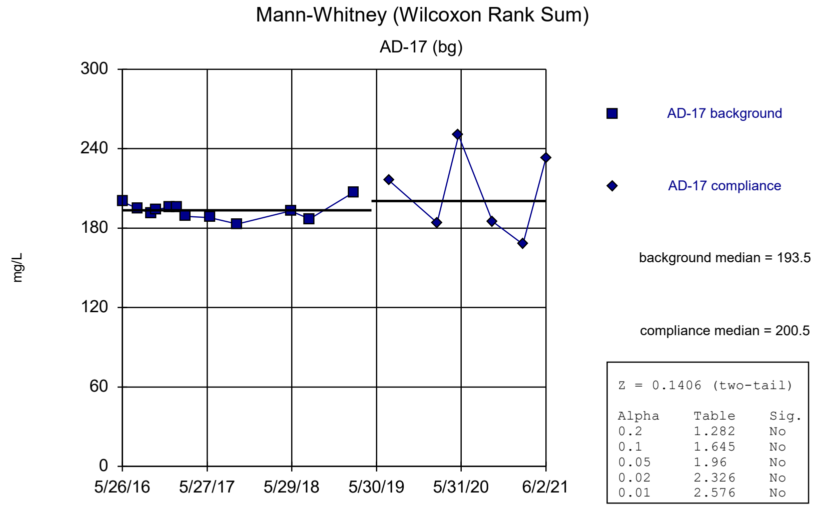
AD-16R



```
Z = -1.646 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

Constituent: Calcium   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

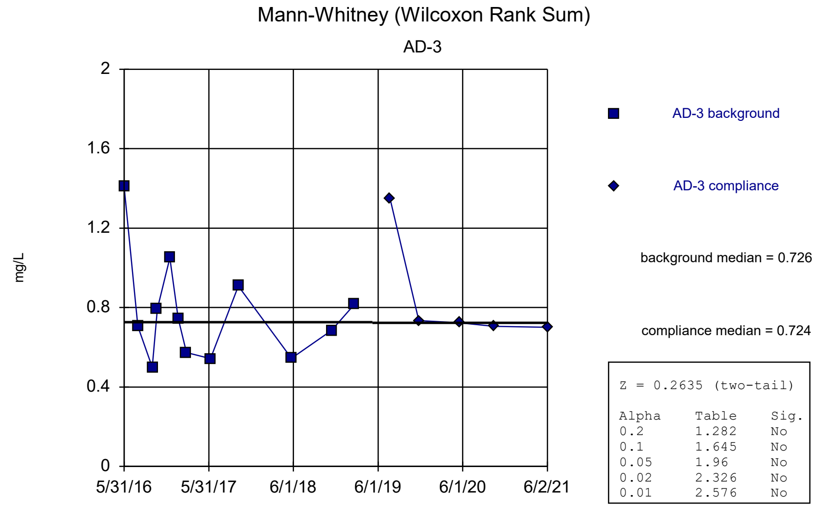
Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG



```
Z = 0.1406 (two-tail)

Alpha    Table    Sig.
0.2      1.282    No
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

Constituent: Calcium   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

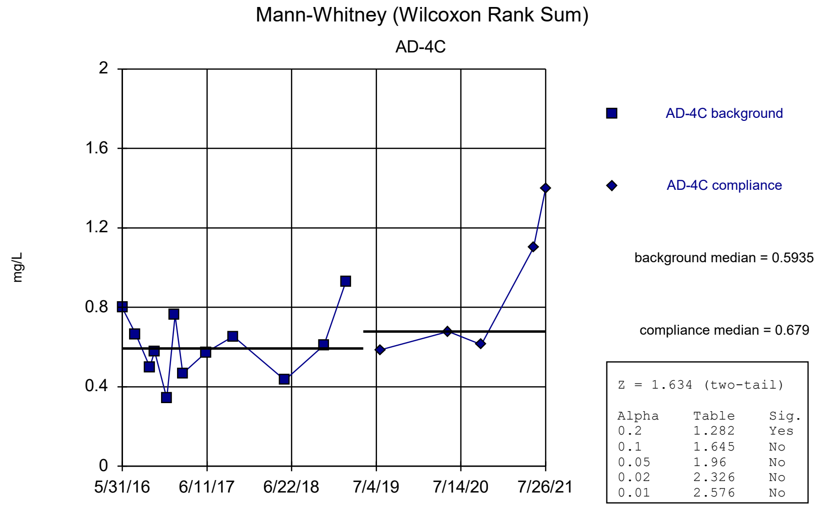
Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG



```
Z = 0.2635 (two-tail)

Alpha    Table    Sig.
0.2      1.282    No
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

Constituent: Calcium   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

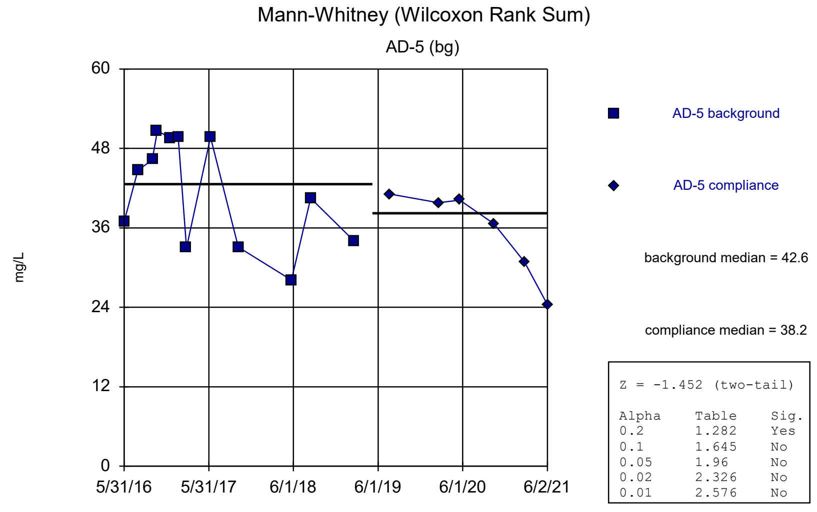
Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG



```
Z = 1.634 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

Constituent: Calcium   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG



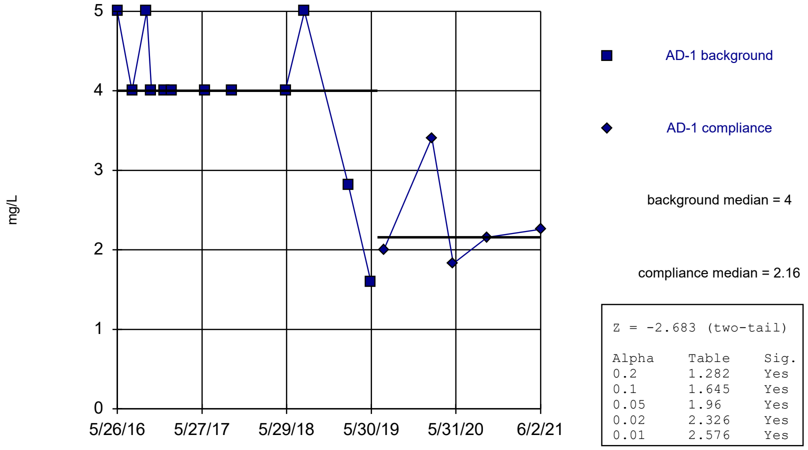
```
Z = -1.452 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

Constituent: Calcium   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-1 (bg)



background median = 4

compliance median = 2.16

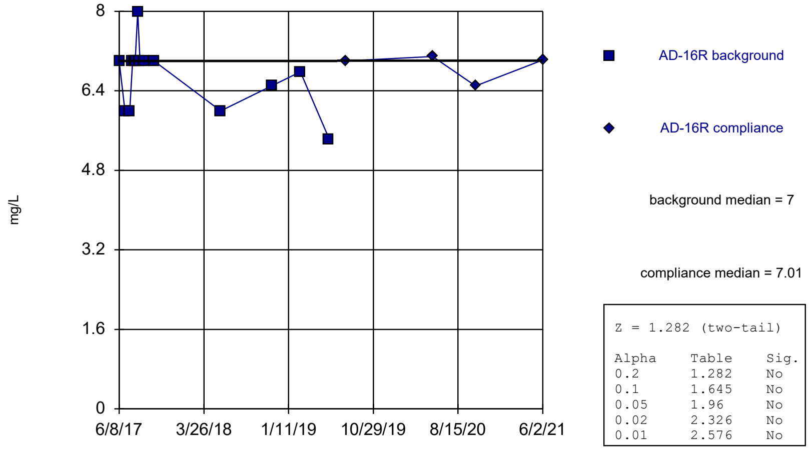
```
Z = -2.683 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     Yes
0.02     2.326    Yes
0.01     2.576    Yes
```

Constituent: Chloride   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-16R



background median = 7

compliance median = 7.01

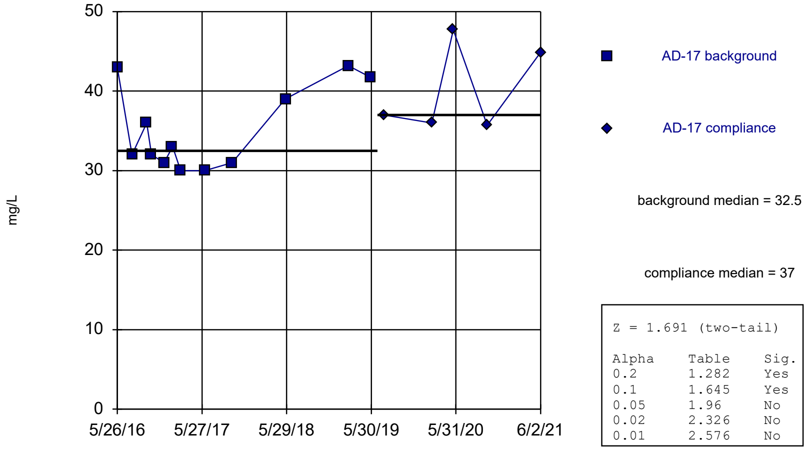
```
Z = 1.282 (two-tail)

Alpha    Table    Sig.
0.2      1.282    No
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

Constituent: Chloride   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-17 (bg)



background median = 32.5

compliance median = 37

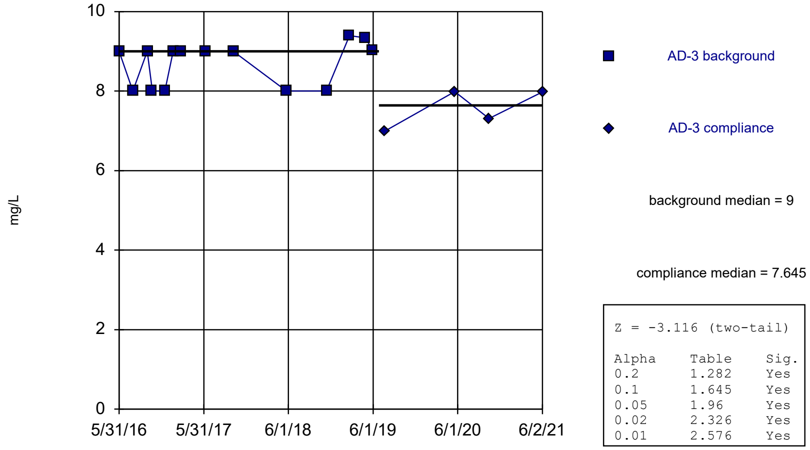
```
Z = 1.691 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

Constituent: Chloride   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-3



background median = 9

compliance median = 7.645

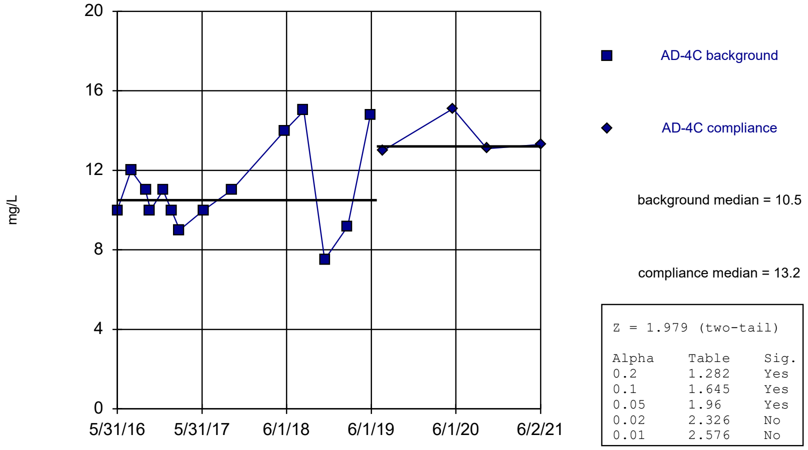
```
Z = -3.116 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     Yes
0.02     2.326    Yes
0.01     2.576    Yes
```

Constituent: Chloride   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-4C



```
Z = 1.979 (two-tail)

Alpha     Table     Sig.
0.2       1.282     Yes
0.1       1.645     Yes
0.05      1.96      Yes
0.02      2.326     No
0.01      2.576     No
```

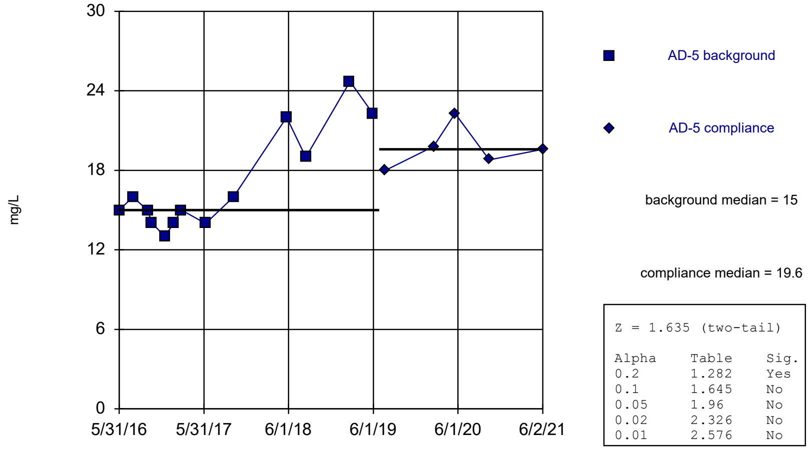
Constituent: Chloride   Analysis Run 11/4/2021 4:05 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-5 (bg)



```
Z = 1.635 (two-tail)

Alpha     Table     Sig.
0.2       1.282     Yes
0.1       1.645     No
0.05      1.96      No
0.02      2.326     No
0.01      2.576     No
```

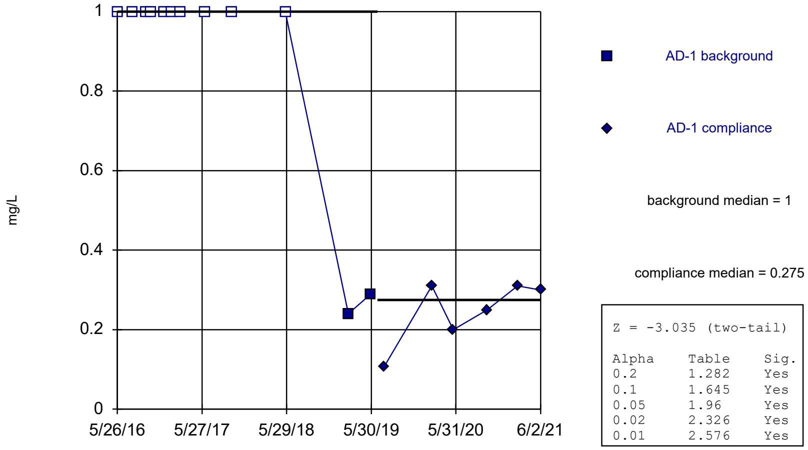
Constituent: Chloride   Analysis Run 11/4/2021 4:05 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-1 (bg)



```
Z = -3.035 (two-tail)

Alpha     Table     Sig.
0.2       1.282     Yes
0.1       1.645     Yes
0.05      1.96      Yes
0.02      2.326     Yes
0.01      2.576     Yes
```

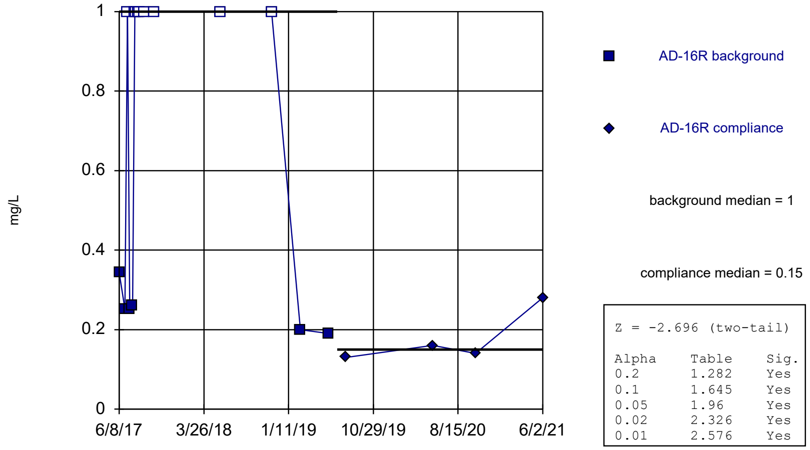
Constituent: Fluoride   Analysis Run 11/4/2021 4:05 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-16R



```
Z = -2.696 (two-tail)

Alpha     Table     Sig.
0.2       1.282     Yes
0.1       1.645     Yes
0.05      1.96      Yes
0.02      2.326     Yes
0.01      2.576     Yes
```

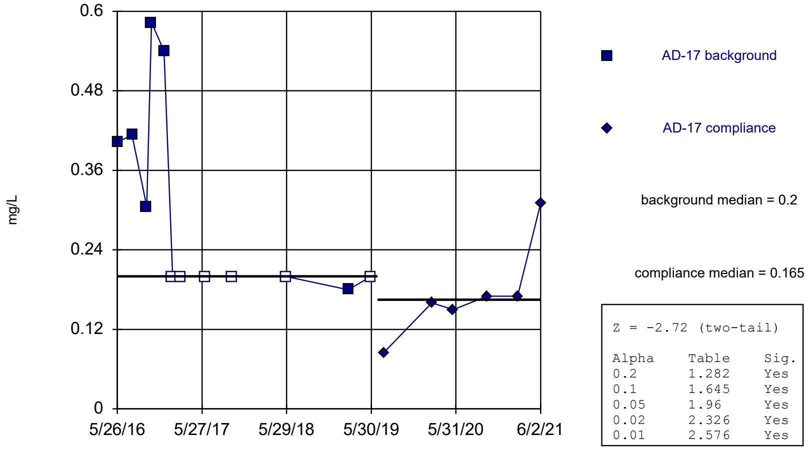
Constituent: Fluoride   Analysis Run 11/4/2021 4:05 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-17 (bg)



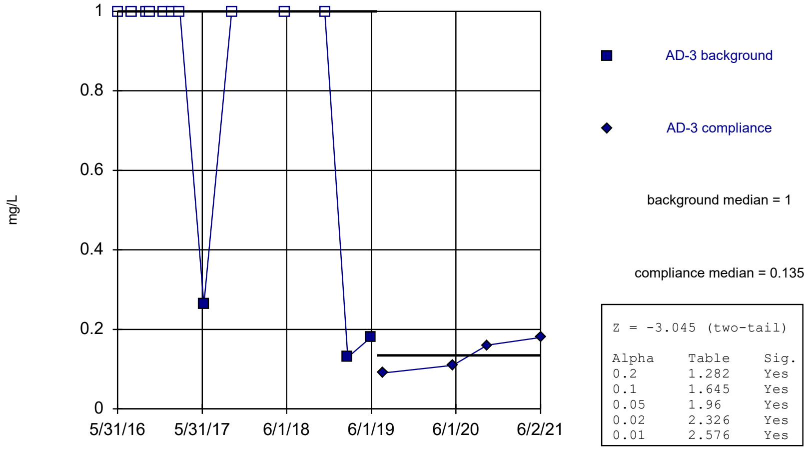
```
Z = -2.72 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     Yes
0.02     2.326    Yes
0.01     2.576    Yes
```

Constituent: Fluoride Analysis Run 11/4/2021 4:05 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-3



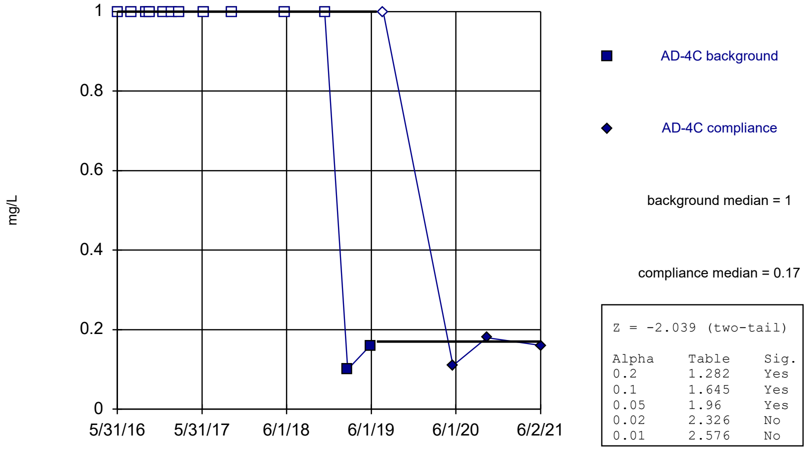
```
Z = -3.045 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     Yes
0.02     2.326    Yes
0.01     2.576    Yes
```

Constituent: Fluoride Analysis Run 11/4/2021 4:05 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-4C



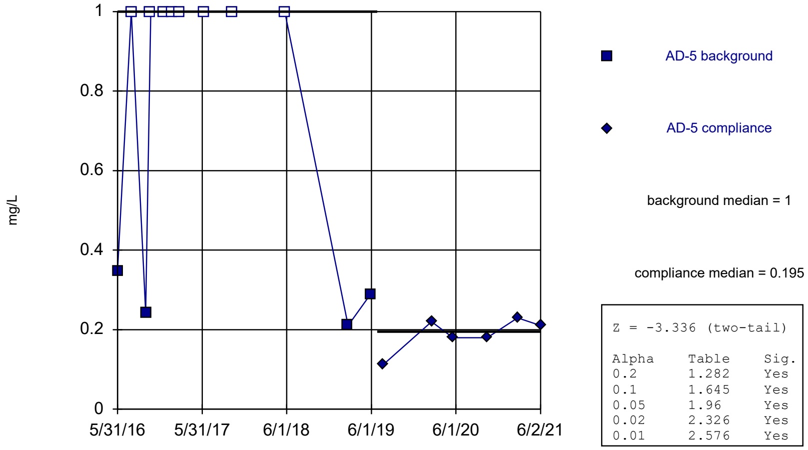
```
Z = -2.039 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     Yes
0.02     2.326    No
0.01     2.576    No
```

Constituent: Fluoride Analysis Run 11/4/2021 4:05 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-5 (bg)



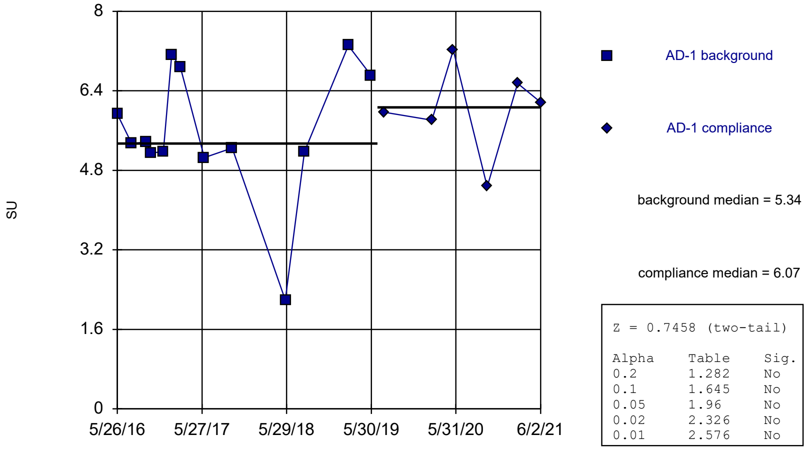
```
Z = -3.336 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     Yes
0.02     2.326    Yes
0.01     2.576    Yes
```

Constituent: Fluoride Analysis Run 11/4/2021 4:05 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-1 (bg)



background median = 5.34

compliance median = 6.07

```
Z = 0.7458 (two-tail)

Alpha     Table     Sig.
0.2       1.282     No
0.1       1.645     No
0.05      1.96      No
0.02      2.326     No
0.01      2.576     No
```

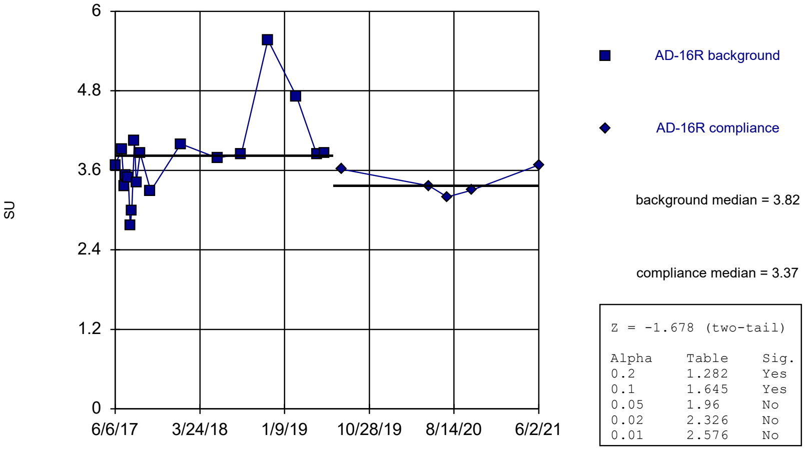
Constituent: pH, field   Analysis Run 11/4/2021 4:05 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-16R



background median = 3.82

compliance median = 3.37

```
Z = -1.678 (two-tail)

Alpha     Table     Sig.
0.2       1.282     Yes
0.1       1.645     Yes
0.05      1.96      No
0.02      2.326     No
0.01      2.576     No
```

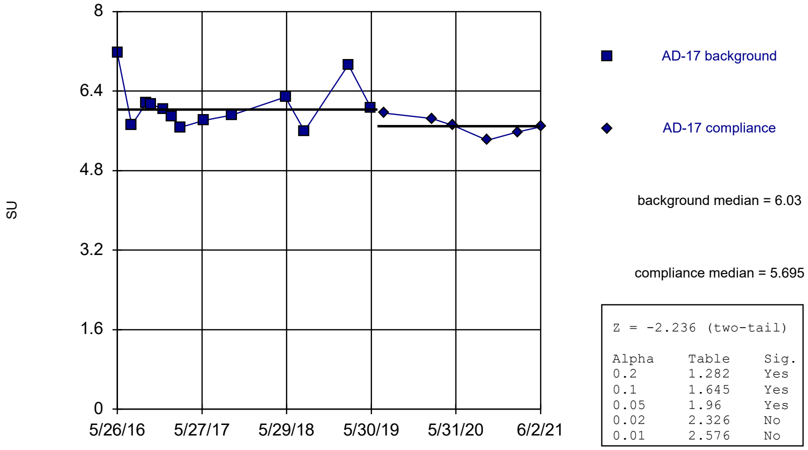
Constituent: pH, field   Analysis Run 11/4/2021 4:05 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-17 (bg)



background median = 6.03

compliance median = 5.695

```
Z = -2.236 (two-tail)

Alpha     Table     Sig.
0.2       1.282     Yes
0.1       1.645     Yes
0.05      1.96      Yes
0.02      2.326     No
0.01      2.576     No
```

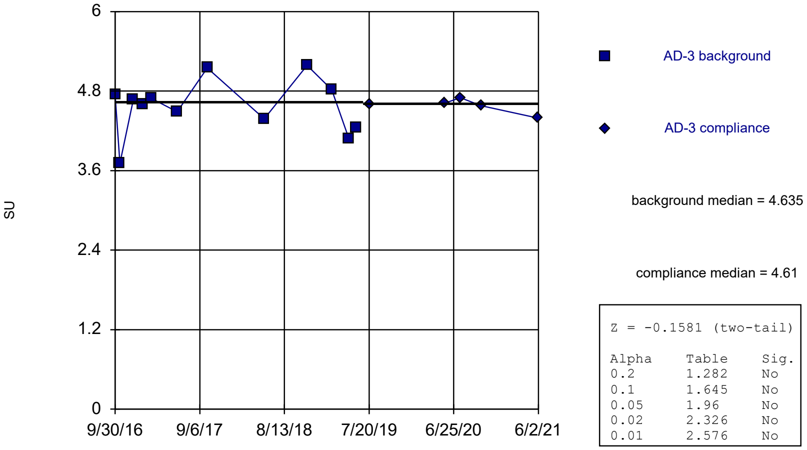
Constituent: pH, field   Analysis Run 11/4/2021 4:05 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-3



background median = 4.635

compliance median = 4.61

```
Z = -0.1581 (two-tail)

Alpha     Table     Sig.
0.2       1.282     No
0.1       1.645     No
0.05      1.96      No
0.02      2.326     No
0.01      2.576     No
```

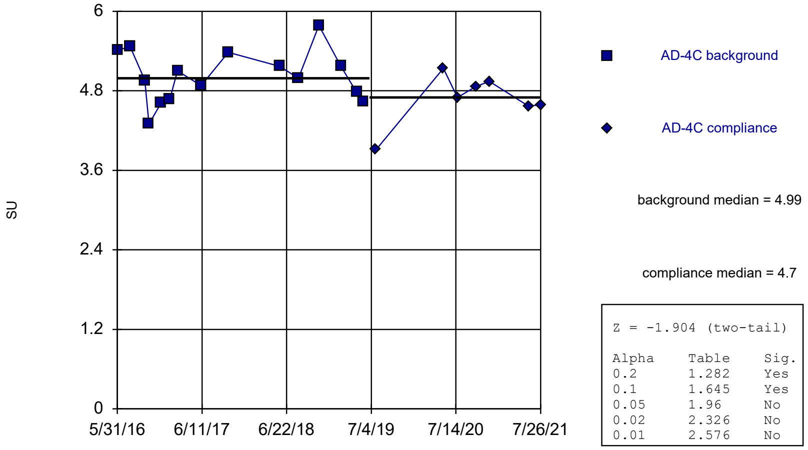
Constituent: pH, field   Analysis Run 11/4/2021 4:05 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-4C



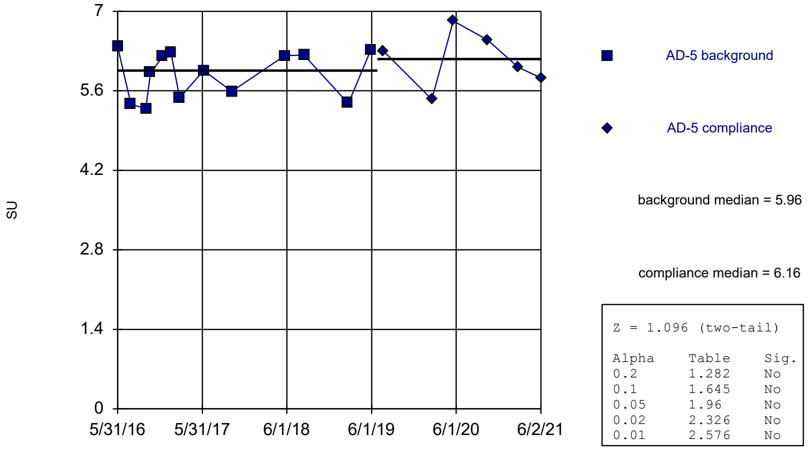
```
Z = -1.904 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

Constituent: pH, field   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-5 (bg)



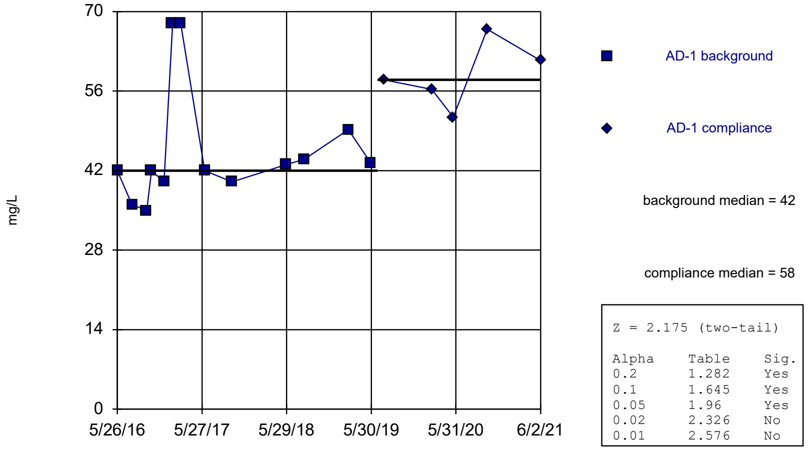
```
Z = 1.096 (two-tail)

Alpha    Table    Sig.
0.2      1.282    No
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

Constituent: pH, field   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-1 (bg)



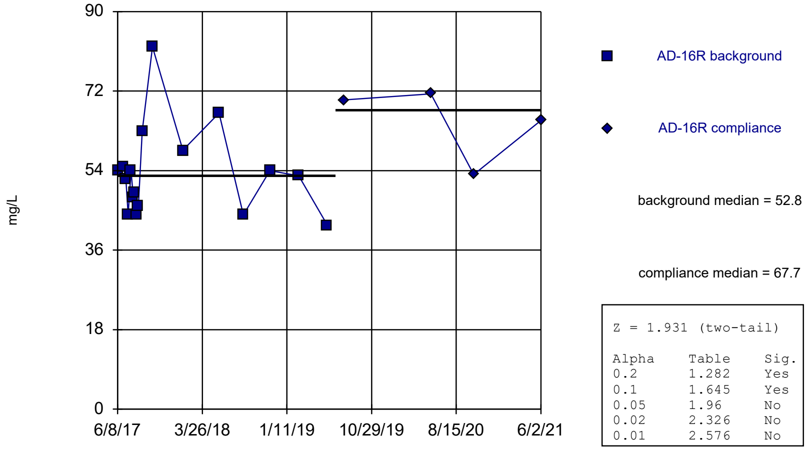
```
Z = 2.175 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     Yes
0.02     2.326    No
0.01     2.576    No
```

Constituent: Sulfate   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-16R



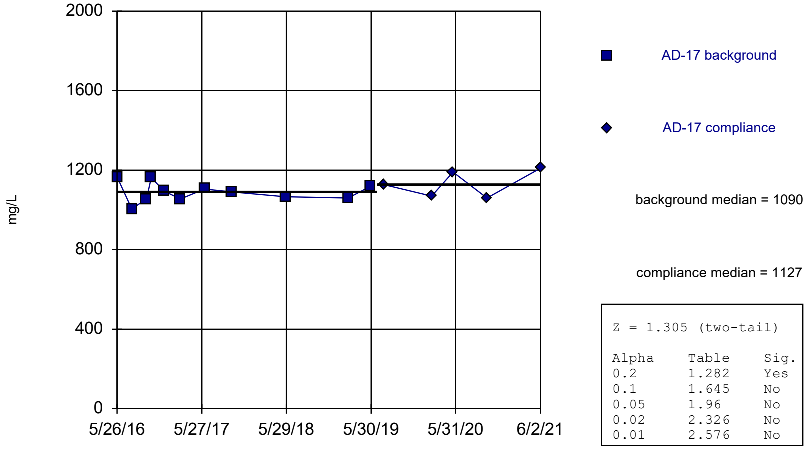
```
Z = 1.931 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

Constituent: Sulfate   Analysis Run 11/4/2021 4:05 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-17 (bg)



Z = 1.305 (two-tail)

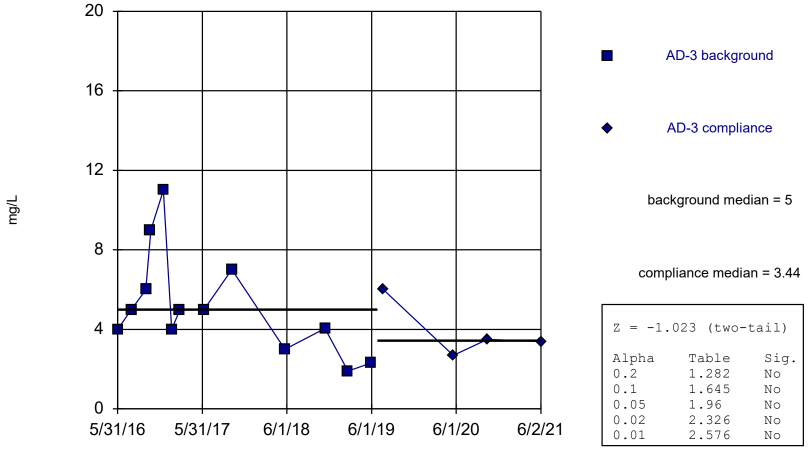
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Sulfate Analysis Run 11/4/2021 4:05 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-3



Z = -1.023 (two-tail)

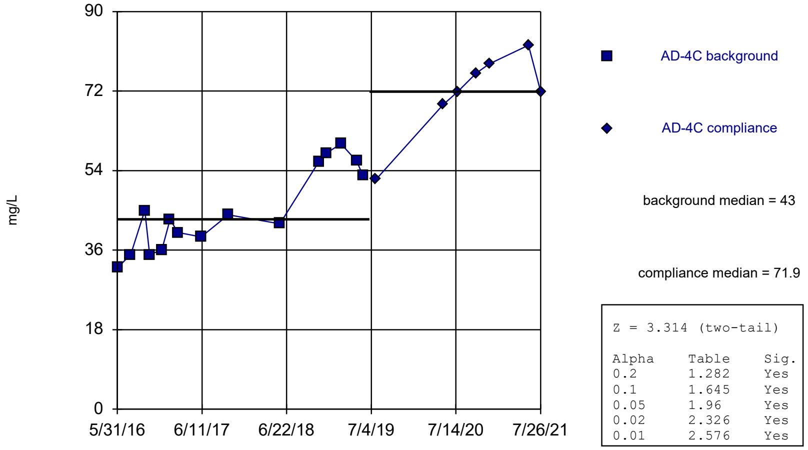
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Sulfate Analysis Run 11/4/2021 4:05 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-4C



Z = 3.314 (two-tail)

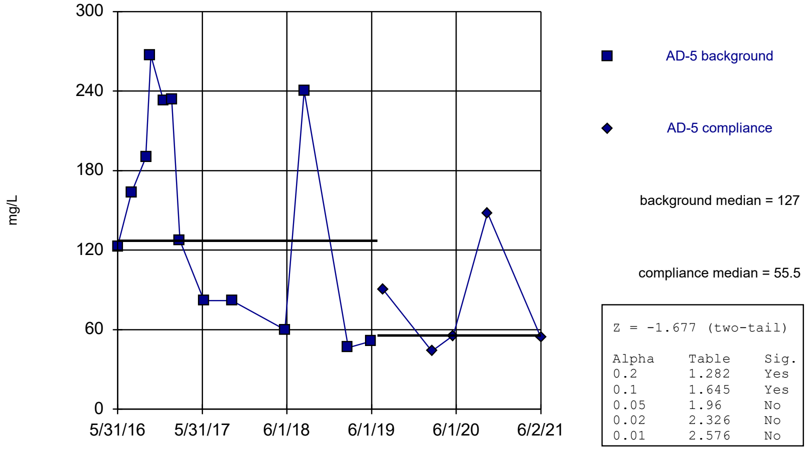
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: Sulfate Analysis Run 11/4/2021 4:05 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-5 (bg)



Z = -1.677 (two-tail)

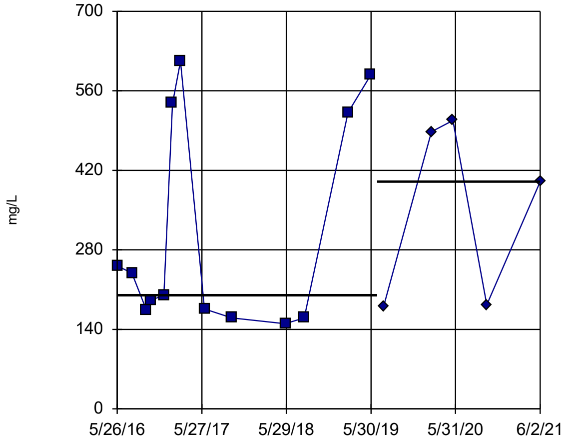
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Sulfate Analysis Run 11/4/2021 4:06 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-1 (bg)



■ AD-1 background

◆ AD-1 compliance

background median = 200

compliance median = 400

```
Z = 0.3945 (two-tail)

Alpha    Table    Sig.
0.2      1.282    No
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

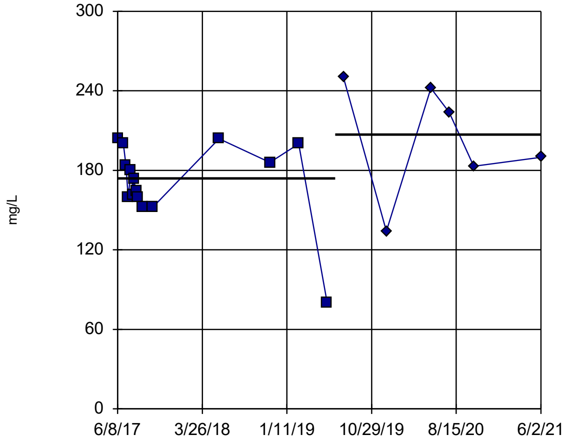
Constituent: Total Dissolved Solids   Analysis Run 11/4/2021 4:06 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-16R



■ AD-16R background

◆ AD-16R compliance

background median = 174

compliance median = 207

```
Z = 1.598 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

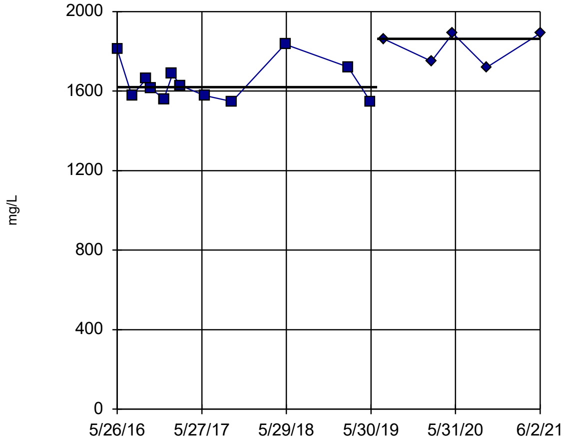
Constituent: Total Dissolved Solids   Analysis Run 11/4/2021 4:06 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-17 (bg)



■ AD-17 background

◆ AD-17 compliance

background median = 1620

compliance median = 1864

```
Z = 2.584 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     Yes
0.02     2.326    Yes
0.01     2.576    Yes
```

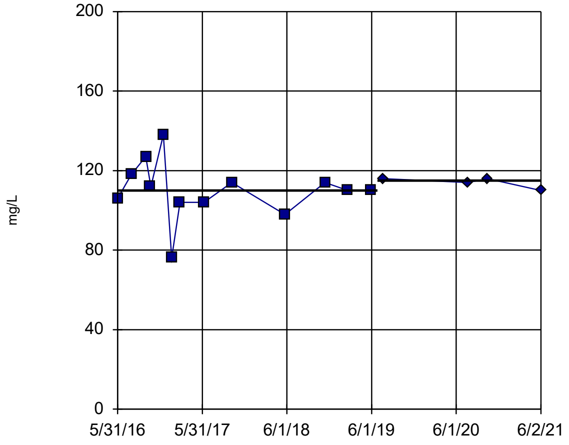
Constituent: Total Dissolved Solids   Analysis Run 11/4/2021 4:06 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-3



■ AD-3 background

◆ AD-3 compliance

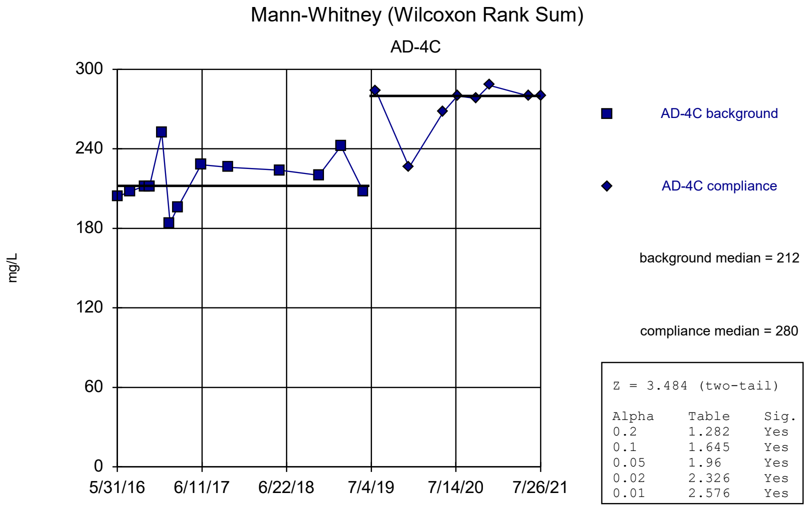
background median = 110

compliance median = 115

```
Z = 0.9684 (two-tail)

Alpha    Table    Sig.
0.2      1.282    No
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

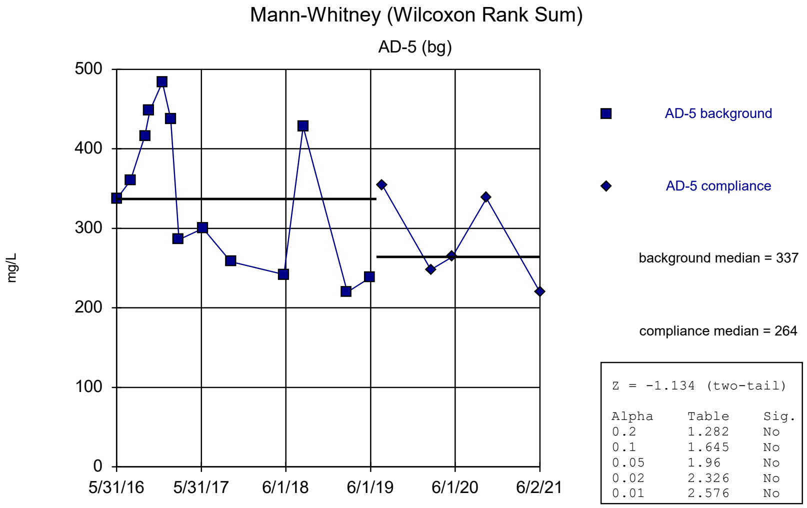
Constituent: Total Dissolved Solids   Analysis Run 11/4/2021 4:06 PM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP



```
Z = 3.484 (two-tail)

Alpha     Table     Sig.
0.2       1.282     Yes
0.1       1.645     Yes
0.05      1.96      Yes
0.02      2.326     Yes
0.01      2.576     Yes
```

Constituent: Total Dissolved Solids   Analysis Run 11/4/2021 4:06 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP



```
Z = -1.134 (two-tail)

Alpha     Table     Sig.
0.2       1.282     No
0.1       1.645     No
0.05      1.96      No
0.02      2.326     No
0.01      2.576     No
```

Constituent: Total Dissolved Solids   Analysis Run 11/4/2021 4:06 PM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Intrawell Prediction Limits

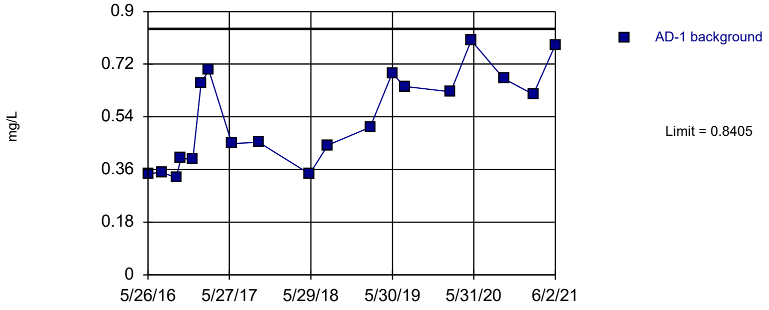
Welsh BASP Client: Geosyntec Data: Welsh BASP Printed 11/4/2021, 4:13 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron (mg/L)	AD-1	0.8405	n/a	n/a	1 future	n/a	19	0.537	0.1588	0	None	No	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-16R	0.05947	n/a	n/a	1 future	n/a	20	0.03411	0.01341	5	None	No	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-17	0.1939	n/a	n/a	1 future	n/a	19	-2.066	0.2226	0	None	ln(x)	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-3	0.04438	n/a	n/a	1 future	n/a	18	0.1204	0.04673	22.22	Kaplan-Meier	sqrt(x)	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-4C	0.04806	n/a	n/a	1 future	n/a	18	0.02357	0.01268	22.22	Kaplan-Meier	No	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-5	0.05541	n/a	n/a	1 future	n/a	19	0.03927	0.008445	0	None	No	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-1	200.2	n/a	n/a	1 future	n/a	18	6.92	3.744	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-16R	2.952	n/a	n/a	1 future	n/a	18	1.656	0.6709	0	None	No	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-17	234.6	n/a	n/a	1 future	n/a	18	14.04	0.6625	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-3	1.314	n/a	n/a	1 future	n/a	17	0.8809	0.136	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-4C	1.192	n/a	n/a	1 future	n/a	17	0.6876	0.2588	0	None	No	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-5	54.77	n/a	n/a	1 future	n/a	18	39.41	7.958	0	None	No	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-1	5.708	n/a	n/a	1 future	n/a	17	3.475	1.145	0	None	No	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-16R	7.794	n/a	n/a	1 future	n/a	18	45.75	7.764	0	None	x^2	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-17	47.73	n/a	n/a	1 future	n/a	17	36.66	5.674	0	None	No	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-3	9.828	n/a	n/a	1 future	n/a	18	8.447	0.7151	0	None	No	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-4C	16	n/a	n/a	1 future	n/a	18	11.61	2.273	0	None	No	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-5	24.51	n/a	n/a	1 future	n/a	18	17.69	3.528	0	None	No	0.002505	Param Intra 1 of 2
Fluoride (mg/L)	AD-1	1	n/a	n/a	1 future	n/a	18	n/a	n/a	55.56	n/a	n/a	0.005373	NP Intra (NDs) 1 of 2
Fluoride (mg/L)	AD-16R	1	n/a	n/a	1 future	n/a	19	n/a	n/a	47.37	n/a	n/a	0.004832	NP Intra (normality) 1 of 2
Fluoride (mg/L)	AD-17	0.5471	n/a	n/a	1 future	n/a	18	0.4686	0.1404	33.33	Kaplan-Meier	sqrt(x)	0.002505	Param Intra 1 of 2
Fluoride (mg/L)	AD-3	1	n/a	n/a	1 future	n/a	17	n/a	n/a	58.82	n/a	n/a	0.005914	NP Intra (NDs) 1 of 2
Fluoride (mg/L)	AD-4C	1	n/a	n/a	1 future	n/a	17	n/a	n/a	70.59	n/a	n/a	0.005914	NP Intra (NDs) 1 of 2
Fluoride (mg/L)	AD-5	1	n/a	n/a	1 future	n/a	18	n/a	n/a	44.44	n/a	n/a	0.005373	NP Intra (normality) 1 of 2
pH, field (SU)	AD-1	8.025	3.435	n/a	1 future	n/a	19	5.73	1.201	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-16R	4.77	2.738	n/a	1 future	n/a	23	1.919	0.1425	0	None	sqrt(x)	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-17	6.822	5.19	n/a	1 future	n/a	19	1.814	0.0432	0	None	x^(1/3)	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-3	5.261	3.879	n/a	1 future	n/a	17	4.57	0.3544	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-4C	5.692	4.131	n/a	1 future	n/a	22	4.911	0.4175	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-5	6.827	5.125	n/a	1 future	n/a	19	5.976	0.4451	0	None	No	0.001253	Param Intra 1 of 2
Sulfate (mg/L)	AD-1	70.73	n/a	n/a	1 future	n/a	18	49.25	11.12	0	None	No	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-16R	75.7	n/a	n/a	1 future	n/a	21	55.66	10.66	0	None	No	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-17	1214	n/a	n/a	1 future	n/a	16	1102	56.55	0	None	No	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-3	9.542	n/a	n/a	1 future	n/a	17	4.872	2.394	0	None	No	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-4C	82.84	n/a	n/a	1 future	n/a	22	53.43	15.74	0	None	No	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-5	275.5	n/a	n/a	1 future	n/a	18	127.2	76.81	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-1	612	n/a	n/a	1 future	n/a	18	n/a	n/a	0	n/a	n/a	0.005373	NP Intra (normality) 1 of 2
Total Dissolved Solids (mg/L)	AD-16R	250.5	n/a	n/a	1 future	n/a	21	180.2	37.34	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-17	1940	n/a	n/a	1 future	n/a	17	1699	123.5	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-3	136	n/a	n/a	1 future	n/a	17	111	12.83	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-4C	301.2	n/a	n/a	1 future	n/a	21	238.1	33.55	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-5	493.6	n/a	n/a	1 future	n/a	18	326.6	86.5	0	None	No	0.002505	Param Intra 1 of 2

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



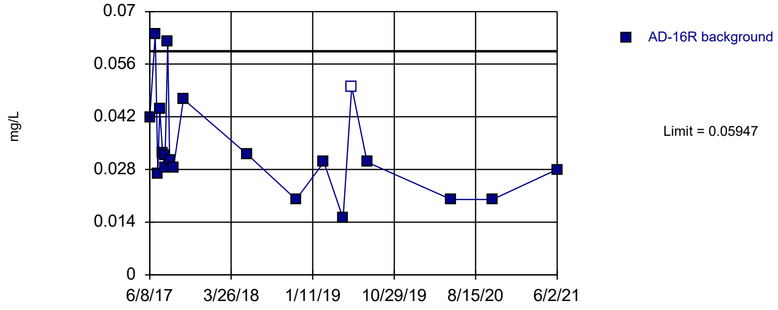
Background Data Summary: Mean=0.537, Std. Dev.=0.1588, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9057, critical = 0.863. Kappa = 1.912 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-16R



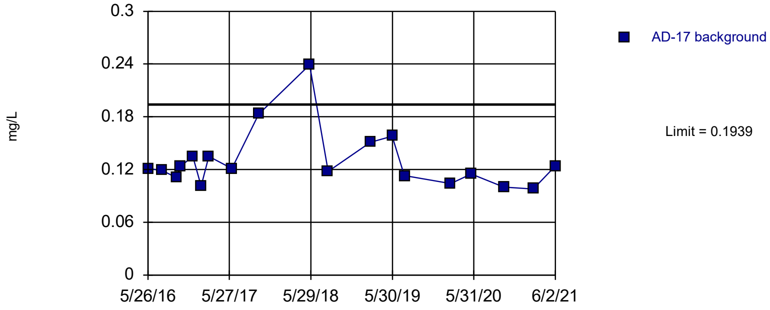
Background Data Summary: Mean=0.03411, Std. Dev.=0.01341, n=20, 5% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8989, critical = 0.868. Kappa = 1.892 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



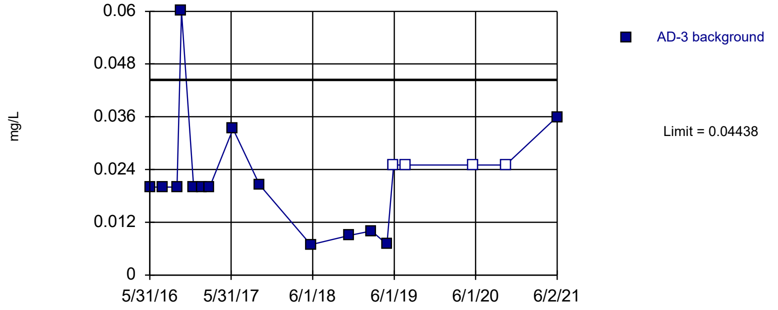
Background Data Summary (based on natural log transformation): Mean=-2.066, Std. Dev.=0.2226, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8694, critical = 0.863. Kappa = 1.912 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-3



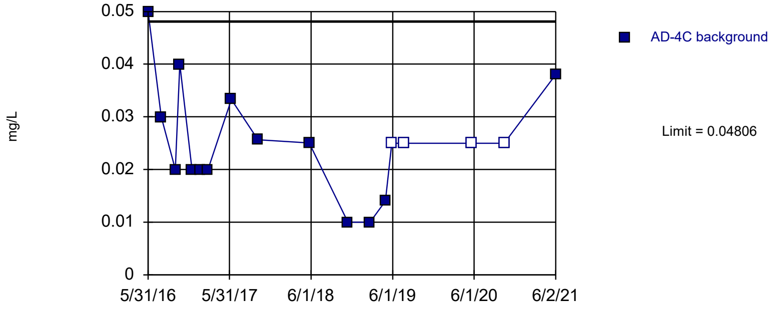
Background Data Summary (based on square root transformation) (after Kaplan-Meier Adjustment): Mean=0.1204, Std. Dev.=0.04673, n=18, 22.22% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9005, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-4C



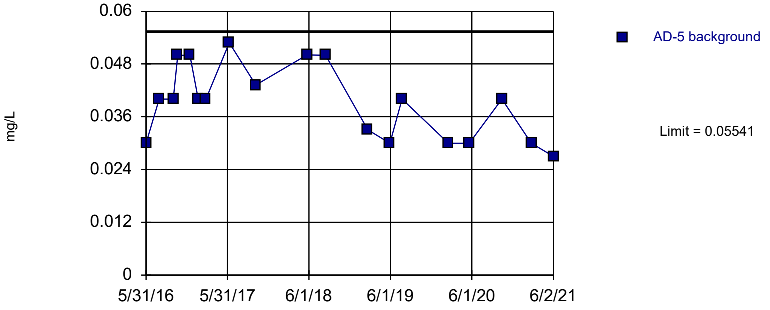
Background Data Summary (after Kaplan-Meier Adjustment): Mean=0.02357, Std. Dev.=0.01268, n=18, 22.22% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9345, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



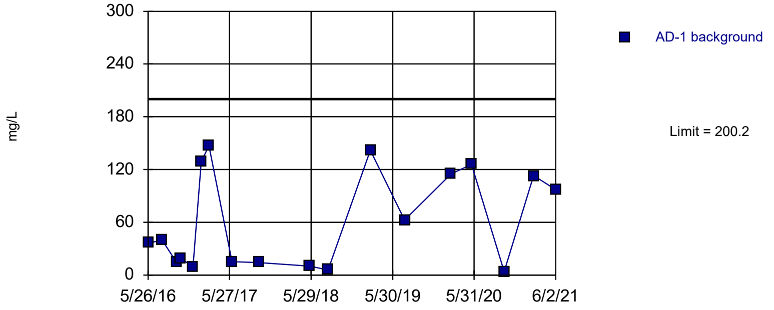
Background Data Summary: Mean=0.03927, Std. Dev.=0.008445, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8874, critical = 0.863. Kappa = 1.912 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



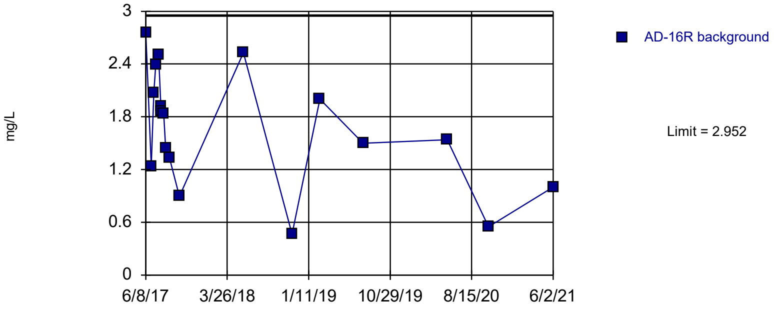
Background Data Summary (based on square root transformation): Mean=6.92, Std. Dev.=3.744, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8711, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16R

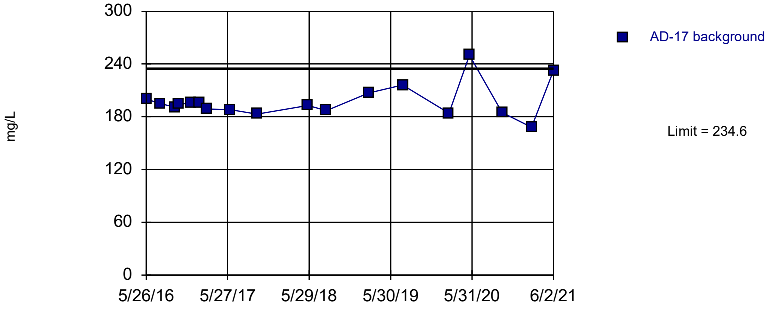


Background Data Summary: Mean=1.656, Std. Dev.=0.6709, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9708, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-17 (bg)

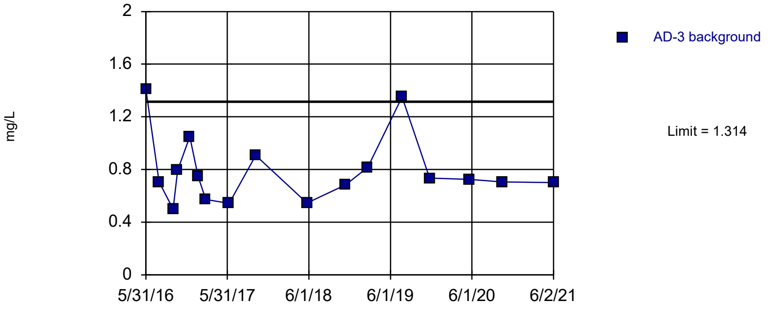


Background Data Summary (based on square root transformation): Mean=14.04, Std. Dev.=0.6625, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8669, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-3

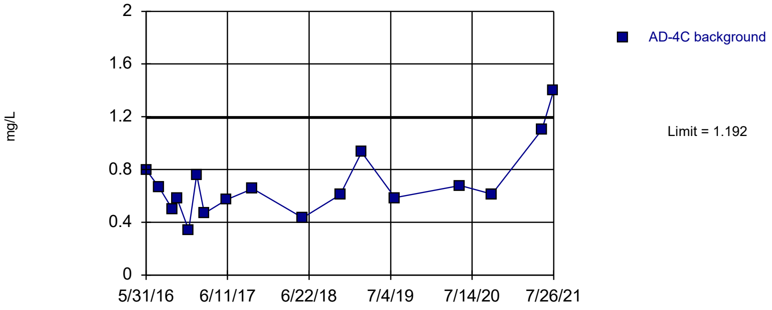


Background Data Summary (based on square root transformation): Mean=0.8809, Std. Dev.=0.136, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8769, critical = 0.851. Kappa = 1.951 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-4C

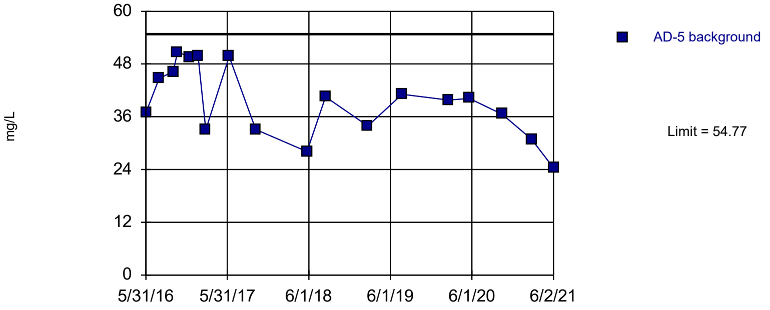


Background Data Summary: Mean=0.6876, Std. Dev.=0.2588, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8753, critical = 0.851. Kappa = 1.951 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-5 (bg)



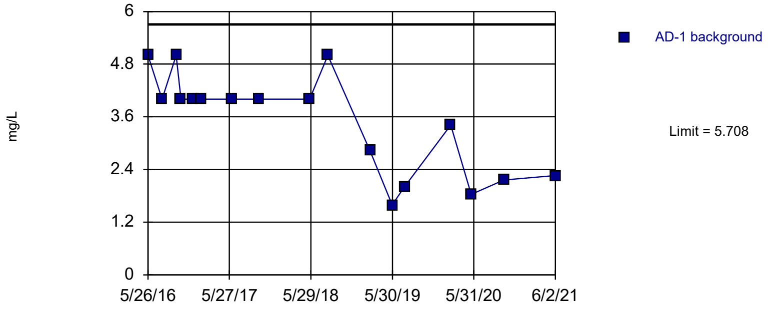
Background Data Summary: Mean=39.41, Std. Dev.=7.958, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9526, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



Background Data Summary: Mean=3.475, Std. Dev.=1.145, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8806, critical = 0.851. Kappa = 1.951 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

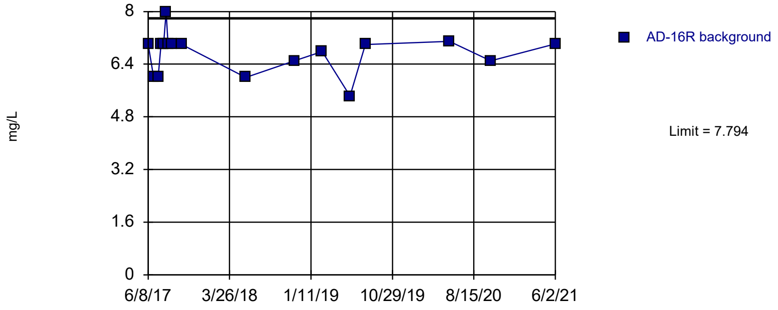
Constituent: Chloride Analysis Run 11/4/2021 4:11 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16R



Background Data Summary (based on square transformation): Mean=45.75, Std. Dev.=7.764, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8587, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

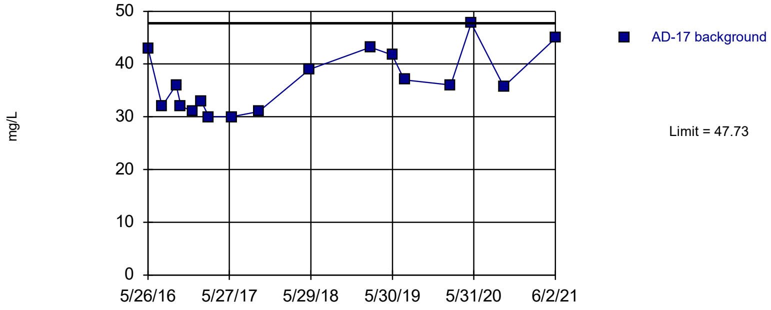
Constituent: Chloride Analysis Run 11/4/2021 4:11 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



Background Data Summary: Mean=36.66, Std. Dev.=5.674, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9149, critical = 0.851. Kappa = 1.951 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

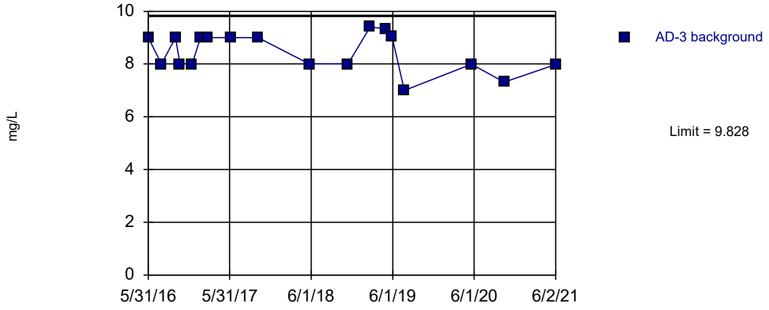
Constituent: Chloride Analysis Run 11/4/2021 4:11 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-3



Background Data Summary: Mean=8.447, Std. Dev.=0.7151, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8597, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

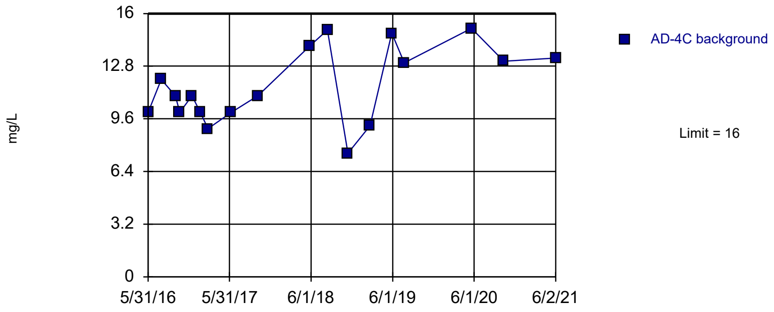
Constituent: Chloride Analysis Run 11/4/2021 4:11 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-4C



Background Data Summary: Mean=11.61, Std. Dev.=2.273, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9443, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

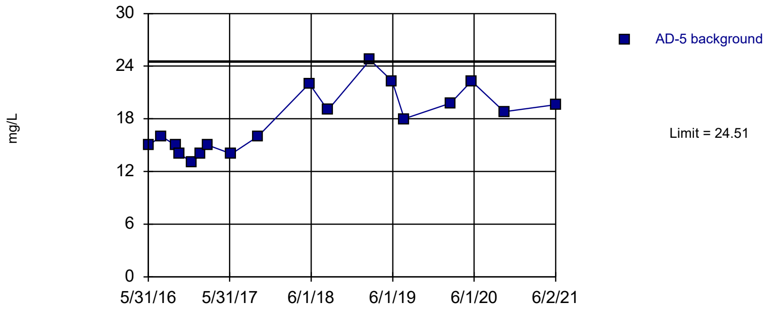
Constituent: Chloride Analysis Run 11/4/2021 4:11 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



Background Data Summary: Mean=17.69, Std. Dev.=3.528, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.923, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

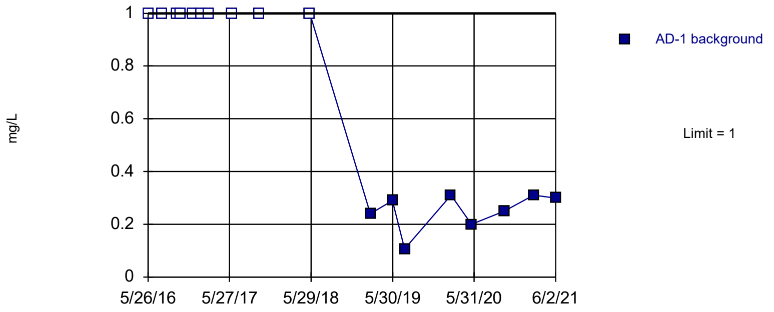
Constituent: Chloride Analysis Run 11/4/2021 4:11 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-1 (bg)



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 18 background values. 55.56% NDs. Well-constituent pair annual alpha = 0.01072. Individual comparison alpha = 0.005373 (1 of 2). Assumes 1 future value.

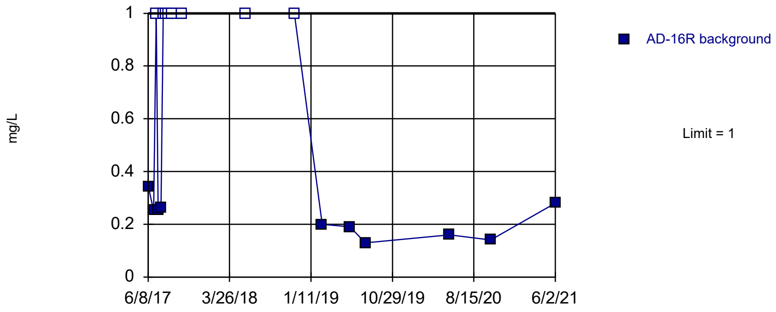
Constituent: Fluoride Analysis Run 11/4/2021 4:11 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-16R



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 19 background values. 47.37% NDs. Well-constituent pair annual alpha = 0.009641. Individual comparison alpha = 0.004832 (1 of 2). Assumes 1 future value.

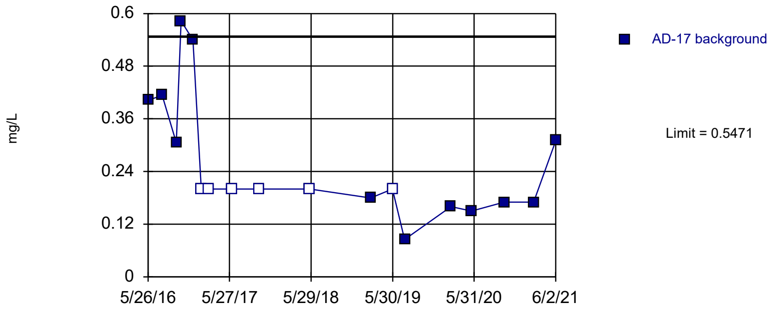
Constituent: Fluoride Analysis Run 11/4/2021 4:11 PM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-17 (bg)



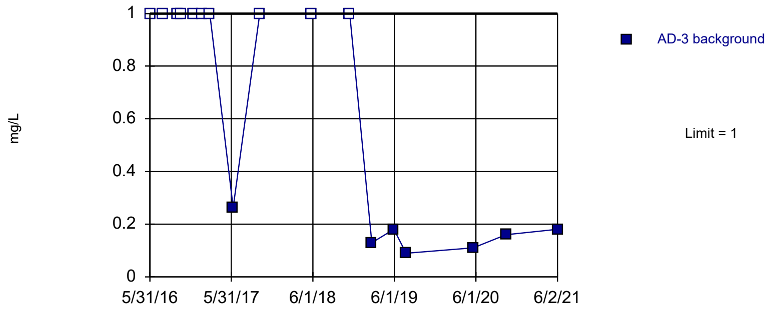
Background Data Summary (based on square root transformation) (after Kaplan-Meier Adjustment): Mean=0.4686, Std. Dev.=0.1404, n=18, 33.33% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8776, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Fluoride Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-3



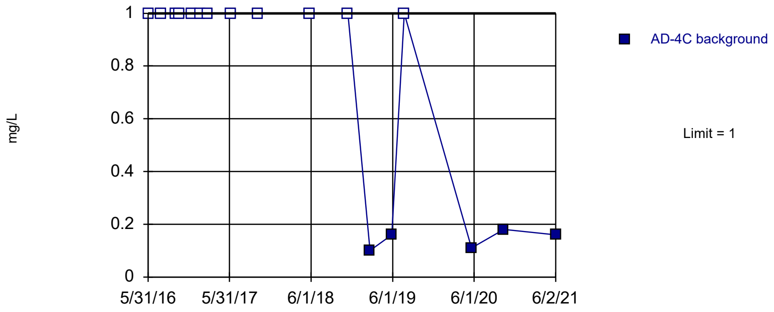
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 17 background values. 58.82% NDs. Well-constituent pair annual alpha = 0.01179. Individual comparison alpha = 0.005914 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-4C



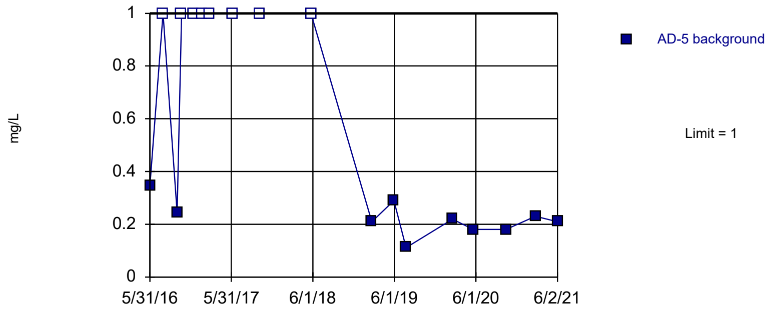
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 17 background values. 70.59% NDs. Well-constituent pair annual alpha = 0.01179. Individual comparison alpha = 0.005914 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-5 (bg)



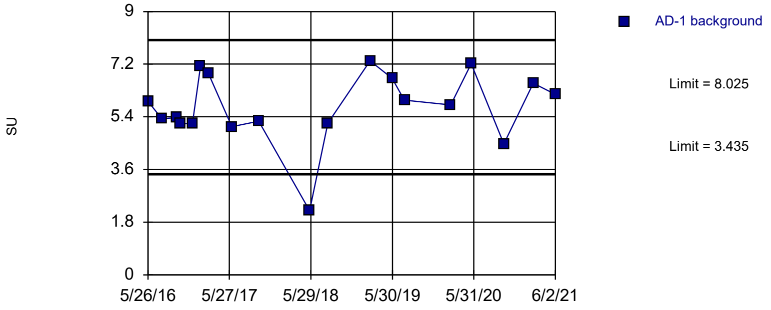
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 18 background values. 44.44% NDs. Well-constituent pair annual alpha = 0.01072. Individual comparison alpha = 0.005373 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



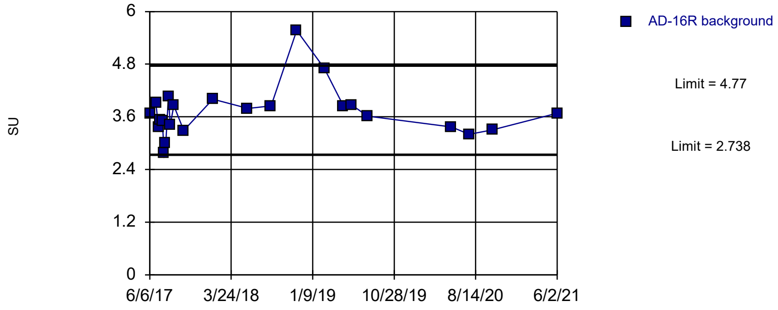
Background Data Summary: Mean=5.73, Std. Dev.=1.201, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.889, critical = 0.863. Kappa = 1.912 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16R



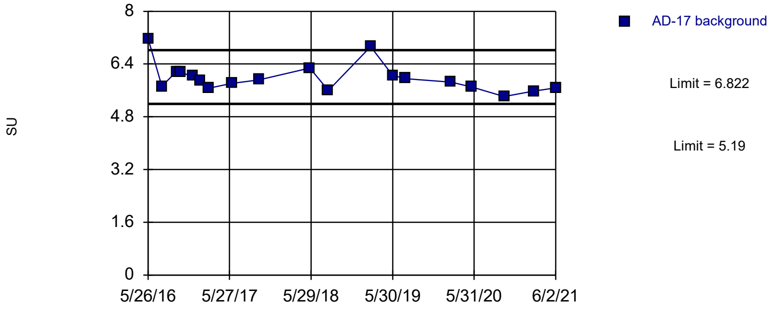
Background Data Summary (based on square root transformation): Mean=1.919, Std. Dev.=0.1425, n=23. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9008, critical = 0.881. Kappa = 1.857 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



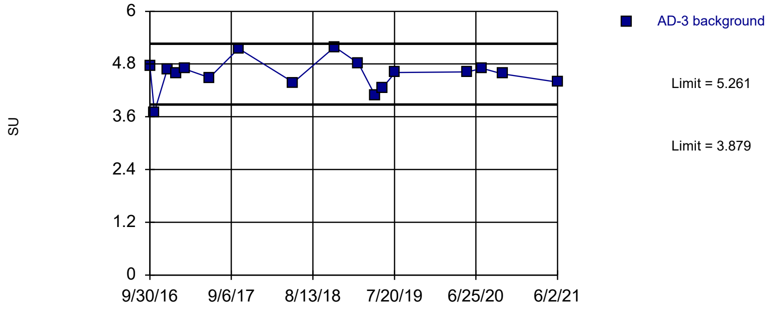
Background Data Summary (based on cube root transformation): Mean=1.814, Std. Dev.=0.0432, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.866, critical = 0.863. Kappa = 1.912 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-3



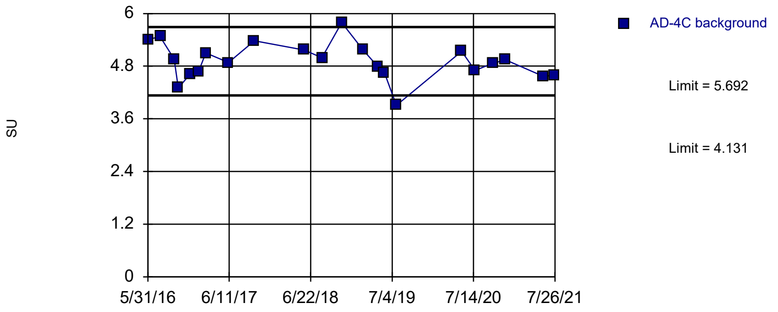
Background Data Summary: Mean=4.57, Std. Dev.=0.3544, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9439, critical = 0.851. Kappa = 1.951 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-4C



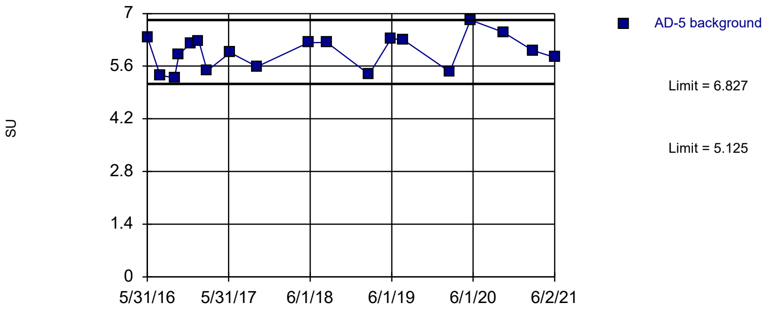
Background Data Summary: Mean=4.911, Std. Dev.=0.4175, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9821, critical = 0.878. Kappa = 1.869 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



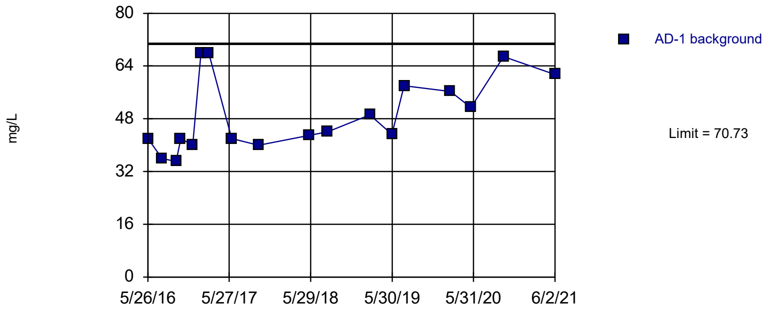
Background Data Summary: Mean=5.976, Std. Dev.=0.4451, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9394, critical = 0.863. Kappa = 1.912 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



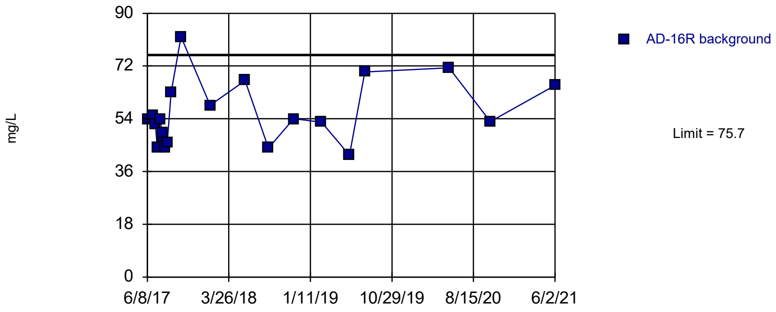
Background Data Summary: Mean=49.25, Std. Dev.=11.12, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8833, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16R



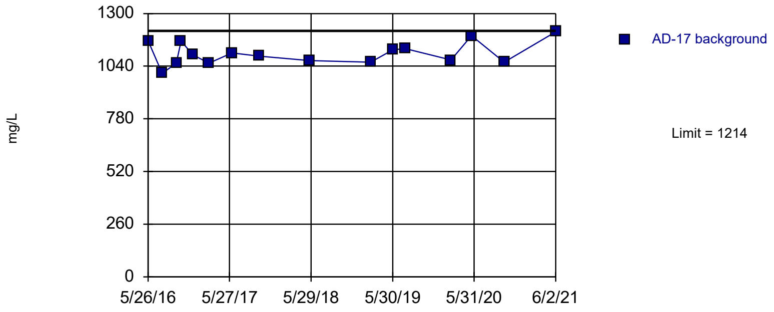
Background Data Summary: Mean=55.66, Std. Dev.=10.66, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9275, critical = 0.873. Kappa = 1.88 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



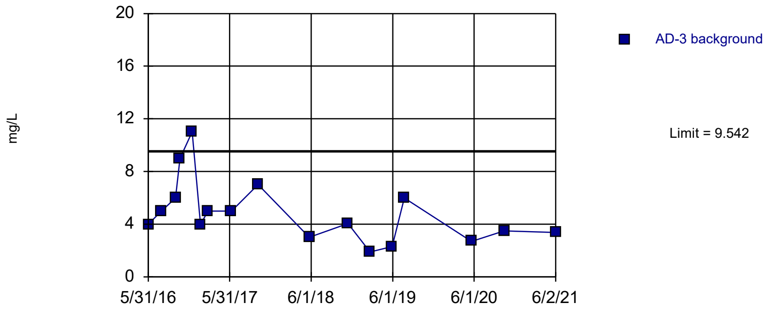
Background Data Summary: Mean=1102, Std. Dev.=56.55, n=16. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.948, critical = 0.844. Kappa = 1.97 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-3



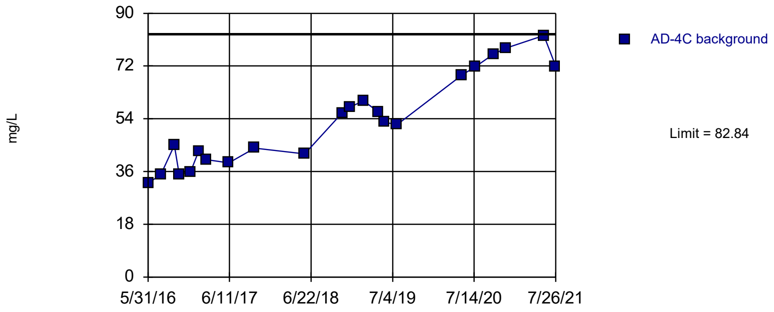
Background Data Summary: Mean=4.872, Std. Dev.=2.394, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8985, critical = 0.851. Kappa = 1.951 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-4C



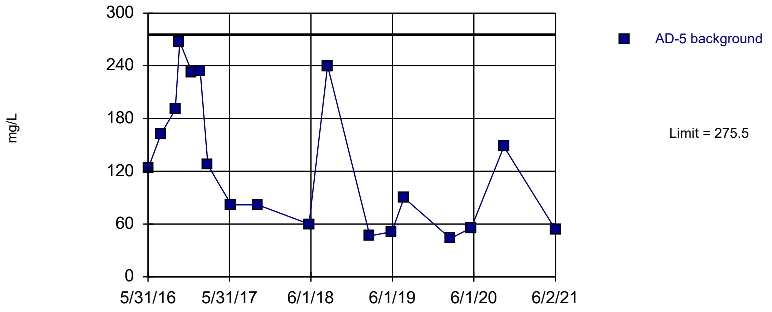
Background Data Summary: Mean=53.43, Std. Dev.=15.74, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9294, critical = 0.878. Kappa = 1.869 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



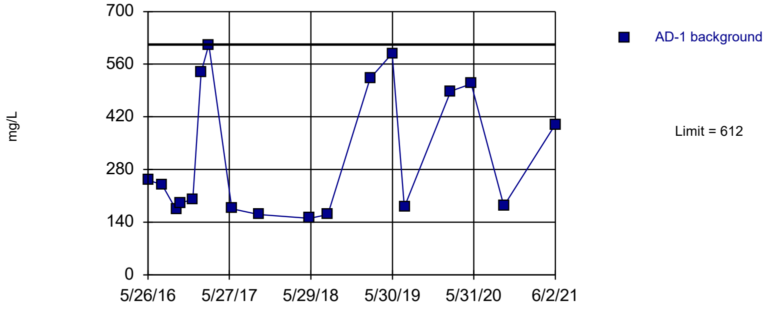
Background Data Summary: Mean=127.2, Std. Dev.=76.81, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8793, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, AD-1 (bg)



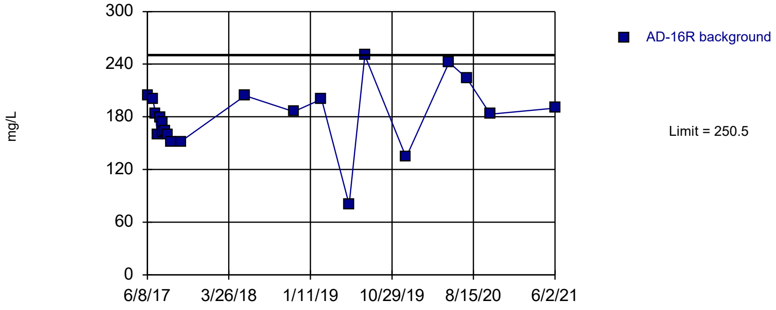
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 18 background values. Well-constituent pair annual alpha = 0.01072. Individual comparison alpha = 0.005373 (1 of 2). Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16R



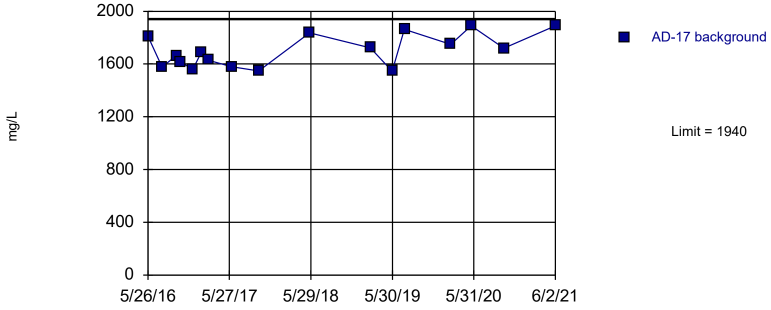
Background Data Summary: Mean=180.2, Std. Dev.=37.34, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.954, critical = 0.873. Kappa = 1.88 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



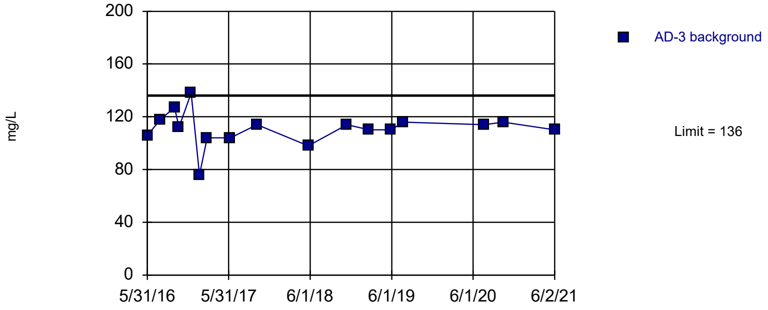
Background Data Summary: Mean=1699, Std. Dev.=123.5, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9094, critical = 0.851. Kappa = 1.951 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-3

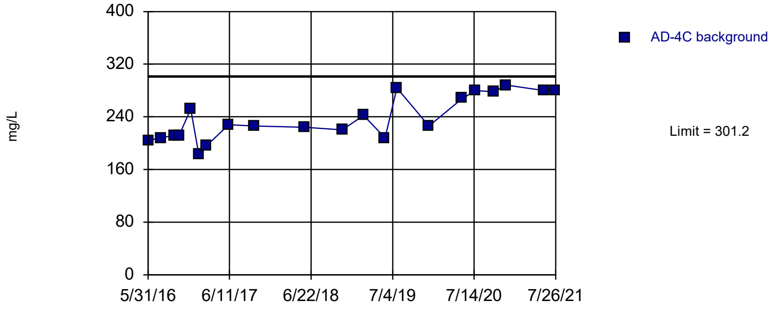


Background Data Summary: Mean=111, Std. Dev.=12.83, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8987, critical = 0.851. Kappa = 1.951 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-4C

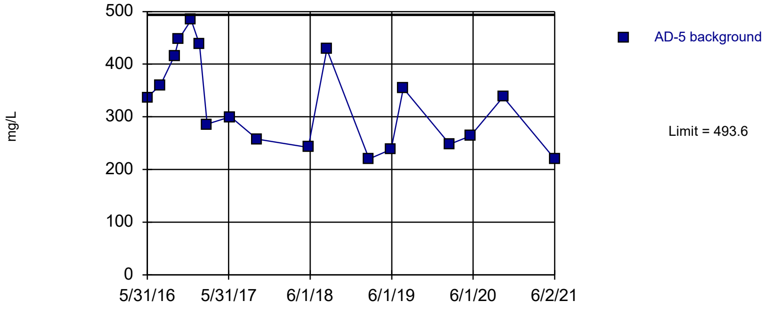


Background Data Summary: Mean=238.1, Std. Dev.=33.55, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.903, critical = 0.873. Kappa = 1.88 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-5 (bg)



Background Data Summary: Mean=326.6, Std. Dev.=86.5, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9169, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 11/4/2021 4:11 PM
Welsh BASP Client: Geosyntec Data: Welsh BASP

4.7 – Statistical Analysis Summary – Landfill, January 15, 2018

Purpose of Statistical Analysis Summary Report

During the initial phase of ground water monitoring, the CCR rule requires AEP to collect at least eight independent samples from at least one up-gradient and three downgradient wells for 21 substances listed in the CCR rule. The CCR rule also requires us to select a statistical method that will be used to evaluate the samples in the later phases of the ground water monitoring program. The Statistical Plan, which has been posted to AEP's CCR website, describes the methods selected by AEP. *See* AEP's Statistical Analysis Plans.

Each **Statistical Analysis Summary Report** is based on the results of the 8 independent samples that were collected by October 17, 2017, and reported in the Annual Groundwater Monitoring Report. Using the statistical methods chosen by AEP, the samples were evaluated to eliminate outliers, determine variability and general trends in the data, and establish background values for: boron, calcium chloride, fluoride, pH, sulfate, and total dissolved solids. Appendix IV substances were evaluated for purposes of identifying outliers and understanding data trends.

A subsequent sample taken during the first detection monitoring sampling event was also compared using the proper statistical methods to the background values that were established for these seven substances from the eight independent samples. A second or third re-sampling event occurred, and the results compared using the same methods. This work is reported in the memorandum included in attachment A. If confirmed, AEP will be required to enter the next phase of monitoring. The results of future sampling will be further analyzed to target any specific substances for which ongoing monitoring or potential corrective action is required.

STATISTICAL ANALYSIS SUMMARY
LANDFILL
J. Robert Welsh Plant
Pittsburg, Texas

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

150 East Wilson Bridge Road
Suite 232
Worthington, Ohio 43085

January 15, 2018

CHA8423

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ANOVA	Analysis of Variance
BAPs	Bottom Ash Ponds
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Value
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
NELAP	National Environmental Laboratory Accreditation Program
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SWFPR	Site-Wide False-Positive Rate
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Landfill, an existing CCR unit at the J. Robert Welsh Power Plant located in Pittsburg, Texas.

Eight monitoring events were completed prior to October 17, 2017 to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule. Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. The background data were reviewed for outliers, which were removed (when appropriate) prior to calculating upper prediction limits (UPLs) for each Appendix III parameter to represent background values. Oversight on the use of statistical calculations was provided by Dr. Kirk Cameron of MacStat Consulting, Ltd.

A detection monitoring event was completed on October 6, 2017 at the Landfill. This sampling event obtained the first sample for the 1-of-2 prediction interval statistical test used for detection monitoring. The results of this sampling event are included in this report.

SECTION 2

LANDFILL EVALUATION

2.1 Data Validation & QA/QC

During the background monitoring program, eight sets of samples were collected for analysis from each background and downgradient well. A summary of data collected during background and the first sample for the 1-of-2 prediction interval statistical test used for detection monitoring may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.5.32 statistics software. The export was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

The groundwater analytical data (background data) used to establish background groundwater quality for each constituent required in detection monitoring are summarized in Table 1. Statistical analyses for the Landfill were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Results for all completed statistical tests are provided in Attachment A.

Time series plots of Appendix III and IV parameters are included in Attachment A. Mann-Kendall analyses ($\alpha = 0.01$) were conducted to evaluate trends in the background data. No statistically significant increasing or decreasing trends were observed.

2.2.1 Background Outlier Evaluation

Potential outliers were identified using Tukey's outlier test; i.e., data points were considered potential outliers if they met one of the following criteria:

$$x_i < \tilde{x}_{0.25} - 3 \times IQR \quad (1)$$

or

$$x_i > \tilde{x}_{0.75} + 3 \times IQR \quad (2)$$

where:

$x_i =$ individual data point
$\tilde{x}_{0.25} =$ first quartile
$\tilde{x}_{0.75} =$ third quartile
$IQR =$ the interquartile range $= \tilde{x}_{0.75} - \tilde{x}_{0.25}$

Data that were evaluated as potential outliers are summarized in Attachment A. Tukey's outlier test indicated no potential outliers for Appendix III parameters.

2.2.2 Establishment of Background Levels

Because only one background well was sampled, analysis of variance (ANOVA) could not be conducted to determine whether spatial variation was present among background wells. Consequently, the appropriateness of using intrawell tests was evaluated for all Appendix III parameters at the Welsh Plant Landfill.

Intrawell tests presume that the groundwater quality in the downgradient wells was not initially impacted by the CCR unit. To test this presumption, data from each downgradient well were compared to an upper (and in the case of pH, lower) tolerance limit based on data collected from background well AD-5. Parametric tolerance limits with 99% confidence and 95% coverage were calculated for boron, calcium, chloride, pH, sulfate, and total dissolved solids (TDS); a non-parametric tolerance limit was calculated for fluoride, given the higher (75%) frequency of non-detect data for fluoride at AD-5. Confidence intervals were calculated for each Appendix III parameter at each downgradient monitoring well. If the lower confidence limit from a downgradient well exceeded the upper tolerance limit for the background data, it was concluded that downgradient groundwater concentrations were above background concentrations. In these instances, intrawell tests would not be appropriate. However, these analyses indicated no significant exceedances for calcium, chloride, and pH; elevated concentrations of boron, fluoride, sulfate, and TDS were observed. Therefore, parametric intrawell tests were used to evaluate potential statistically significant increases (SSIs) for calcium, chloride, and pH. Interwell tests were used to evaluate potential SSIs for boron, fluoride, sulfate, and TDS.

After identified outliers were removed (where appropriate), a parametric or non-parametric analysis was selected based on the distribution of the data and the frequency of non-detect data. Estimated results less than the practical quantitation limit (PQL) – i.e., "J-flagged" data – were considered detections and the estimated results were used in the statistical analyses. Non-parametric analyses were selected for datasets with at least 50% non-detect data or datasets that could not be normalized. Parametric analyses were selected for datasets (either transformed or untransformed) that passed the Shapiro-Wilk / Shapiro-Francía test for normality. The Kaplan-Meier non-detect adjustment was applied to datasets with between 15% and 50% non-detect data. For datasets with fewer than 15% non-detect data, non-detect data were replaced with one half of the PQL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment A.

Upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. To conduct the intrawell tests for calcium, chloride, and pH, a separate UPL was calculated for each downgradient well for each of these parameters. To conduct the interwell tests for boron, fluoride, sulfate, and TDS, a single prediction interval was calculated for each of these parameters using data from background well AD-5. The background data used for the UPL calculations are summarized in Table 1; the calculated UPLs are summarized in Table 2.

UPLs were calculated for a one-of-two retesting procedure; i.e., if at least one sample in a series of two does not exceed the UPL, then it can be concluded that an SSI has not occurred. In practice, where initial results did not exceed the UPL, a second sample was not collected. The one-of-two retesting procedure allowed achieving an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less. Power curves were constructed for the interwell and intrawell parametric tests and are compared with the EPA Reference Power Curve in Attachment A. The power curves associated with the statistical tests for the Landfill exceed the EPA Reference Power Curve at 3 and 4 standard deviations; this is considered a "good" level of statistical power according to USEPA's *Unified Guidance* (USEPA, 2009).

2.2.3 Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the J. Robert Welsh Landfill CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
112498

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

112498
License Number

TEXAS
Licensing State

01.15.18
Date

American Electric Power Service Corporation
Texas Registered Engineering
Firm No. F-3341

2.3 Conclusions

Eight monitoring events and the first sample for the 1-of-2 prediction interval statistical test used for detection were completed in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no outliers for Appendix III parameters. Prediction intervals were constructed based on the remaining background data and a one-of-two retesting procedure. Interwell tests were selected for boron, fluoride, sulfate, and TDS, whereas intrawell tests were selected for calcium, chloride, and pH.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Welsh Plant. January 2017.

United States Environmental Protection Agency (USEPA). 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March 2009.

TABLES

Table 1 - Groundwater Data Summary
Welsh Plant - Landfill

Parameter	Unit	AD-5								
		5/31/2016	7/29/2016	9/30/2016	10/21/2016	12/14/2016	1/20/2017	2/24/2017	6/8/2017	10/6/2017
		Background								Detection
Antimony	mg/L	0.005U	0.00205J	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Arsenic	mg/L	0.005U	0.00291J	0.00476J	0.005U	0.00115J	0.005U	0.005U	0.00385J	-
Barium	mg/L	0.057	0.093	0.087	0.07	0.053	0.047	0.042	0.0877	-
Beryllium	mg/L	0.00015J	0.00052J	0.00025J	0.00009J	0.00016J	0.00006J	0.00003J	0.00008J	-
Boron	mg/L	0.03	0.04	0.04	0.05	0.05	0.04	0.04	0.05281	0.0432
Cadmium	mg/L	0.00008J	0.0005J	0.001U	0.00011J	0.0002J	0.00018J	0.001U	0.00039J	-
Calcium	mg/L	36.9	44.7	46.3	50.7	49.6	49.8	33	49.7	33.1
Chloride	mg/L	15	16	15	14	13	14	15	14	16
Chromium	mg/L	0.00056J	0.00041J	0.00091J	0.00025J	0.00075J	0.001U	0.001U	0.00028J	-
Cobalt	mg/L	0.014	0.015	0.014	0.009	0.013	0.012	0.013	0.01193	-
Combined Radium	pCi/L	1.634	4.75	3.33	2.319	2.182	1.023	1.788	2.32	-
Fluoride	mg/L	0.3469J	1U	0.2436J	1U	1U	1U	1U	1U	1U
Lead	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Lithium	mg/L	0.135	0.191	0.186	0.225	0.199	0.239	0.166	0.124	-
Mercury	mg/L	0.00001J	0.00002J	0.00002U	0.00002U	0.00001J	0.00002U	0.00002U	0.00002U	-
Molybdenum	mg/L	0.005U	0.005U	0.005U	0.00137J	0.005U	0.005U	0.005U	0.005U	-
Selenium	mg/L	0.005U	0.00109J	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Total Dissolved Solids	mg/L	337	360	416	448	484	438	286	300	258
Sulfate	mg/L	123	163	190	267	233	234	127	82	82
Thallium	mg/L	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	-
pH	SU	6.38	5.36	5.29	5.92	6.21	6.27	5.48	5.96	5.59

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Component was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1 - Groundwater Data Summary
Welsh Plant - Landfill

Parameter	Unit	AD-11								
		5/31/2016	7/29/2016	9/30/2016	10/21/2016	12/14/2016	1/20/2017	2/24/2017	6/8/2017	10/6/2017
		Background								Detection
Antimony	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Arsenic	mg/L	0.005U	0.005U	0.00177J	0.005U	0.005U	0.005U	0.005U	0.00123J	-
Barium	mg/L	0.014	0.012	0.052	0.02	0.013	0.013	0.019	0.01012	-
Beryllium	mg/L	0.004	0.004	0.005	0.005	0.004	0.004	0.004	0.00279	-
Boron	mg/L	2.47	2.83	3.4	3.77	3.36	2.81	2.88	2.79	2.58
Cadmium	mg/L	0.00033J	0.00045J	0.00058J	0.00052J	0.00037J	0.00039J	0.00043J	0.00041J	-
Calcium	mg/L	8.47	8.88	10.7	8.78	8.98	10.3	9.31	9.93	6.99
Chloride	mg/L	9	10	12	11	10	11	10	10	10
Chromium	mg/L	0.003	0.00058J	0.007	0.002	0.00037J	0.00075J	0.002	0.00032J	-
Cobalt	mg/L	0.026	0.026	0.03	0.027	0.025	0.025	0.024	0.02216	-
Combined Radium	pCi/L	1.773	2.23	3.92	2.56	1.569	1.082	1.45	1.902	-
Fluoride	mg/L	2	2	2	3	2	2	2	1.366	1U
Lead	mg/L	0.005U	0.005U	0.00425J	0.005U	0.005U	0.005U	0.00118J	0.005U	-
Lithium	mg/L	0.032	0.047	0.047	0.047	0.041	0.046	0.035	0.03654	-
Mercury	mg/L	0.00002J	0.00001J	0.00002J	0.00002J	0.00001J	0.00002U	0.00002J	0.00002U	-
Molybdenum	mg/L	0.005U	0.005U	0.005U	0.00152J	0.005U	0.005U	0.005U	0.005U	-
Selenium	mg/L	0.00155J	0.00163J	0.00209J	0.005U	0.00157J	0.005U	0.005U	0.005U	-
Total Dissolved Solids	mg/L	388	1000	1065	1024	1044	1048	876	960	752
Sulfate	mg/L	518	596	683	706	548	760	558	556	527
Thallium	mg/L	0.002U	0.00132J	0.00107J	0.002U	0.002U	0.00123J	0.002U	0.002U	-
pH	SU	5.21	3.82	4.08	3.68	3.75	4.41	4.34	3.86	4.43

Notes:

mg/L: milligrams per liter

pCi/L: picocuries per liter

SU: standard unit

U: Component was not present in concentrations above method detection limit and is reported as the reporting limit

J: Estimated value. Component was detected in concentrations below the reporting limit

-: Not sampled

Table 1 - Groundwater Data Summary
Welsh Plant - Landfill

Parameter	Unit	AD-13								
		5/31/2016	7/29/2016	9/30/2016	10/21/2016	12/14/2016	1/20/2017	2/24/2017	6/8/2017	10/6/2017
		Background								Detection
Antimony	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.00153J	-
Arsenic	mg/L	0.005U	0.005U	0.005U	0.005U	0.0037J	0.006	0.005U	0.005U	-
Barium	mg/L	0.062	0.036	0.04	0.03	0.051	0.112	0.041	0.01712	-
Beryllium	mg/L	0.00068J	0.00092J	0.00083J	0.00093J	0.001	0.0002J	0.00061J	0.00089J	-
Boron	mg/L	1.19	1.23	1.37	1.67	1.96	0.402	1.27	1.68	2.23
Cadmium	mg/L	0.001U	0.00009J	0.0001J	0.00009J	0.00019J	0.001U	0.001U	0.00014J	-
Calcium	mg/L	8.02	3.7	2.7	3.66	3.77	33.5	10.3	3.03	5.11
Chloride	mg/L	12	15	17	19	18	7	13	15	13
Chromium	mg/L	0.00069J	0.001U	0.00077J	0.00058J	0.007	0.004	0.001U	0.001U	-
Cobalt	mg/L	0.00412J	0.00446J	0.00459J	0.00492J	0.007	0.00177J	0.00456J	0.00624	-
Combined Radium	pCi/L	1.223	1.601	2.213	3.662	2.27	2.228	1.556	1.565	-
Fluoride	mg/L	0.4948J	0.7416J	0.6464J	1.1263	0.4149J	1U	1U	0.6679J	1U
Lead	mg/L	0.005U	0.005U	0.005U	0.005U	0.0011J	0.00273J	0.005U	0.005U	-
Lithium	mg/L	0.011	0.026	0.02	0.022	0.025	0.004	0.015	0.02082	-
Mercury	mg/L	0.00002J	0.00001J	0.00002U	0.00002U	0.00002J	0.00001J	0.00002U	0.00002U	-
Molybdenum	mg/L	0.005U	0.005U	0.005U	0.00087J	0.00035J	0.005U	0.005U	0.005U	-
Selenium	mg/L	0.00148J	0.00201J	0.00103J	0.00104J	0.00164J	0.005U	0.005U	0.00103J	-
Total Dissolved Solids	mg/L	900	404	431	482	596	222	392	494	564
Sulfate	mg/L	177	187	207	226	287	90	183	244	345
Thallium	mg/L	0.002U	0.002U	0.002U	0.00097J	0.002U	0.002U	0.002U	0.002U	-
pH	SU	6.05	4.45	4.56	4.34	4.79	5.38	5.06	4.22	4.61

Notes:

mg/L: milligrams per liter

pCi/L: picocuries per liter

SU: standard unit

U: Component was not present in concentrations above method detection limit and is reported as the reporting limit

J: Estimated value. Component was detected in concentrations below the reporting limit

-: Not sampled

Table 1 - Groundwater Data Summary
Welsh Plant - Landfill

Parameter	**Unit**	**AD-14**								
		5/31/2016	**7/29/2016**	**9/30/2016**	**10/21/2016**	**12/14/2016**	**1/20/2017**	**2/24/2017**	**6/8/2017**	**10/6/2017**
		Background								**Detection**
Antimony	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Arsenic	mg/L	0.00189J	0.005U	0.00145J	0.005U	0.005U	0.005U	0.005U	0.005U	-
Barium	mg/L	0.031	0.084	0.03	0.039	0.047	0.038	0.042	0.04483	-
Beryllium	mg/L	0.00066J	0.00065J	0.00047J	0.00054J	0.00054J	0.00022J	0.00029J	0.00038J	-
Boron	mg/L	1.28	1.14	1.14	1.25	1.25	0.915	1.06	1.26	1.63
Cadmium	mg/L	0.001J	0.00098J	0.00098J	0.001	0.001	0.00023J	0.00019J	0.00067J	-
Calcium	mg/L	2.88	2.51	1.19	2.48	2.41	10.3	9.48	7.69	3.55
Chloride	mg/L	4	5	5	4	5	4	4	6	10
Chromium	mg/L	0.00054J	0.001	0.00078J	0.00064J	0.001	0.0007J	0.001U	0.00127	-
Cobalt	mg/L	0.01	0.009	0.009	0.009	0.009	0.00291J	0.0035J	0.00678	-
Combined Radium	pCi/L	0.871	1.487	4.817	1.972	1.271	1.825	0.512	1.138	-
Fluoride	mg/L	1U	1U	1U	1U	1U	1U	1U	1U	1U
Lead	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Lithium	mg/L	0.012	0.024	0.015	0.014	0.013	0.013	0.012	0.0127	-
Mercury	mg/L	0.00003	0.00002J	0.00002J	0.00002J	0.00004	0.00002J	0.00001J	0.00002J	-
Molybdenum	mg/L	0.005U	0.005U	0.005U	0.0005J	0.005U	0.005U	0.005U	0.005U	-
Selenium	mg/L	0.00292J	0.00193J	0.00274J	0.00247J	0.00332J	0.005U	0.005U	0.00261J	-
Total Dissolved Solids	mg/L	285	267	252	276	296	254	212	256	288
Sulfate	mg/L	115	111	111	118	101	92	90	108	143
Thallium	mg/L	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	-
pH	SU	4.75	4.24	4.17	3.88	4.11	6.07	5.39	4.77	4.57

Notes:

mg/L: milligrams per liter

pCi/L: picocuries per liter

SU: standard unit

U: Component was not present in concentrations above method detection limit and is reported as the reporting limit

J: Estimated value. Component was detected in concentrations below the reporting limit

-: Not sampled

Table 1 - Groundwater Data Summary
Welsh Plant - Landfill

Parameter	**Unit**	**AD-18**								
		5/26/2016	**7/29/2016**	**9/30/2016**	**10/21/2016**	**12/14/2016**	**1/20/2017**	**2/24/2017**	**6/8/2017**	**10/6/2017**
		Background								**Detection**
Antimony	mg/L	0.005U	0.00186J	0.00313J	0.00228J	0.005U	0.005U	0.005U	0.005U	-
Arsenic	mg/L	0.00478J	0.005U	0.005U	0.005U	0.005U	0.01	0.007	0.00331J	-
Barium	mg/L	0.012	0.019	0.02	0.021	0.021	0.014	0.014	0.01038	-
Beryllium	mg/L	0.014	0.005	0.004	0.002	0.007	0.022	0.026	0.01883	-
Boron	mg/L	0.146	0.148	0.156	0.188	0.178	0.05	0.09	0.125	0.177
Cadmium	mg/L	0.003	0.002	0.00064J	0.001	0.001	0.001	0.002	0.00303	-
Calcium	mg/L	409	457	469	498	510	412	401	428	446
Chloride	mg/L	422	432	637	876	695	159	151	304	428
Chromium	mg/L	0.00061J	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	-
Cobalt	mg/L	0.922	0.734	0.666	0.569	0.641	0.929	0.961	0.94	-
Combined Radium	pCi/L	12.58	10.62	7.05	5.82	9.6	22.51	19.11	16.12	-
Fluoride	mg/L	0.4876J	2	4	0.8664J	5	5	6	6.53	0.617J
Lead	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Lithium	mg/L	2.07	1.94	1.86	2.06	1.74	1.95	1.82	2.15	-
Mercury	mg/L	0.00017	0.00009	0.00012	0.00005	0.00005	0.00022	0.00011	0.00011	-
Molybdenum	mg/L	0.0006J	0.005U	0.005U	0.00476J	0.005U	0.005U	0.005U	0.005U	-
Selenium	mg/L	0.006	0.007	0.007	0.005U	0.005U	0.00324J	0.005U	0.00212J	-
Total Dissolved Solids	mg/L	10000	9476	9569	9540	8912	8562	8412	9394	9292
Sulfate	mg/L	5135	4930	4632	5537	4382	5414	5169	5920	5576
Thallium	mg/L	0.003	0.003	0.002U	0.0014J	0.00161J	0.002	0.00228	0.002U	-
pH	SU	5.1	5.34	5.59	5.7	5.71	4.49	4.37	4.27	5.87

Notes:

mg/L: milligrams per liter

pCi/L: picocuries per liter

SU: standard unit

U: Component was not present in concentrations above method detection limit and is reported as the reporting limit

J: Estimated value. Component was detected in concentrations below the reporting limit

-: Not sampled

Table 2: Background Level Summary
Welsh Plant - Landfill

Parameter	Unit	Description	AD-11	AD-13	AD-14
Boron	mg/L	Interwell Background Value (UPL)	0.06109		
Calcium	mg/L	Intrawell Background Value (UPL)	11.39	38.48	13.85
Chloride	mg/L	Intrawell Background Value (UPL)	12.63	23.97	6.454
Fluoride	mg/L	Interwell Background Value (UPL)	1		
pH	SU	Intrawell Background Value (LPL)	2.895	3.338	2.845
	SU	Intrawell Background Value (UPL)	5.392	6.374	6.5
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	560.4		
Sulfate	mg/L	Interwell Background Value (UPL)	333.7		

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

ATTACHMENT A

Evaluation of Detection Monitoring Data

Geosyntec consultants

150 E.Wilson Bridge Road, Suite 232
Columbus, Ohio 43085
PH 614.468.0415
FAX 614.468.0416
www.geosyntec.com

Memorandum

Date:	February 27, 2018
To:	David Miller (AEP)
Copies to:	Jill Parker-Witt (AEP)
From:	Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Welsh Plant's Landfill (LF)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), detection monitoring events were completed on October 6, 2017 and January 18, 2018 at the Landfill (LF), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas.

Eight background monitoring events were conducted at the Welsh LF prior to these detection monitoring events, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 15, 2018.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are summarized in Table 1.

- Boron concentrations exceeded the interwell UPL of 0.0611 mg/L in both the initial (2.58 mg/L) and second (1.9 mg/L) samples collected at AD-11, in both the initial (2.23 mg/L) and second (2.13 mg/L) samples collected at AD-13, and in both the initial (1.63 mg/L) and second (1.57 mg/L) samples collected at AD-14. Therefore, an SSI over background is concluded for boron at AD-11, AD-13, and AD-14.

- Total dissolved solids (TDS) concentrations exceeded the interwell UPL of 560 mg/L in both the initial (752 mg/L) and second (564 mg/L) samples collected at AD-11, and in both the initial (564 mg/L) and second (588 mg/L) samples collected at AD-13. Therefore, an SSI over background is concluded for TDS at AD-11 and AD-13.
- Sulfate concentrations exceeded the interwell UPL of 334 mg/L in both the initial (527 mg/L) and second (377 mg/L) samples collected at AD-11, and in both the initial (345 mg/L) and second (383 mg/L) samples collected at AD-13. Therefore, an SSI over background is concluded for sulfate at AD-11 and AD-13.

As a result, the Welsh LF CCR unit will conduct an alternate source demonstration.

No other exceedances of UPLs were observed during these detection monitoring events.

Table 1 (“Groundwater Data Summary”) of Geosyntec’s *Statistical Analysis Summary* report was revised following the certification date of January 15, 2018 to reflect appropriate significant digits for estimated (J-flagged) values.

* * * * *

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Welsh LF CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

DAVID ANTHONY MILLER
112498

112498
License Number

TEXAS
Licensing State

02.27.18
Date

American Electric Power Service Corporation
Texas Registered Engineering Firm No. F-3341

Table 1: Detection Monitoring Data Evaluation
Welsh Plant - Landfill

Parameter	Units	Description	AD-11		AD-13		AD-14	
			10/6/2017	1/18/2018	10/6/2017	1/18/2018	10/6/2017	1/18/2018
Boron	mg/L	Interwell Background Value (UPL)	0.0611					
	mg/L	Detection Monitoring Result	**2.58**	**1.9**	**2.23**	**2.13**	**1.63**	**1.57**
Calcium	mg/L	Intrawell Background Value (UPL)	11.39		38.48		13.85	
	mg/L	Detection Monitoring Result	6.99	-	5.11	-	3.55	-
Chloride	mg/L	Intrawell Background Value (UPL)	12.6		24.0		6.45	
	mg/L	Detection Monitoring Result	10	-	13	-	**10**	6.43
Fluoride	mg/L	Interwell Background Value (UPL)	1					
	mg/L	Detection Monitoring Result	0.083	-	0.083	-	0.083	-
pH	SU	Intrawell Background Value (UPL)	5.39		6.37		6.50	
	SU	Intrawell Background Value (LPL)	2.90		3.34		2.85	
	SU	Detection Monitoring Result	4.43	4.46	4.61	4.7	4.57	5.66
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	560					
	mg/L	Detection Monitoring Result	**752**	**564**	**564**	**588**	288	-
Sulfate	mg/L	Interwell Background Value (UPL)	334					
	mg/L	Detection Monitoring Result	**527**	**377**	**345**	**383**	143	-

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

-: Not Sampled

Bold values exceed the background value.

Background values are shaded gray.

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

December 29, 2017

Geosyntec Consultants
Attn: Mr. Bruce Sass
150 E. Wilson Bridge Rd., #232
Worthington, OH 43085

Dear Mr. Sass,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the screening and statistical analysis of background groundwater data for American Electric Power's Welsh Landfill. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at Welsh Landfill for the CCR program in 2016, and 8 background samples have been collected at each of the groundwater monitoring wells. The monitoring well network, as provided by Geosyntec Consultants, consists of the following: upgradient well AD-5; and downgradient wells AD-11, AD-13 and AD-14.

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis was reviewed by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting.

The following constituents were evaluated: Appendix III parameters – boron, calcium, chloride, fluoride, pH, sulfate, and TDS; and Appendix IV parameters - antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 & 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters at all wells are provided for the purpose of screening data at these wells (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells.

Data at all wells were evaluated for the following: 1) outliers; 2) trends; 3) most appropriate statistical method for Appendix III parameters based on site characteristics of groundwater data upgradient of the facility; and 4) eligibility of downgradient wells when intrawell statistical methods are recommended. Power curves are provided to demonstrate that the selected statistical methods for Appendix III parameters comply with the USEPA Unified Guidance recommendations as discussed below.

Summary of Statistical Method:

1) Intrawell prediction limits, combined with a 1-of-2 resample plan for calcium, chloride, and pH; and
2) Interwell prediction limits combined with a 1-of-2 resample plan for boron, fluoride, sulfate and TDS.

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are nondetects, a nonparametric test is utilized. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% nondetects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for nondetects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% nondetects.

Background Screening

Outlier Evaluation

Time series plots are used to identify suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective, in proposed background data. Suspected outliers at all wells for Appendix III and Appendix IV parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits (Figure C).

Tukey's outlier test noted one high outlier for lithium at well AD-14. This value was flagged in the database. A substitution of the most recent reporting limit was applied when varying detection limits existed in data.

No true seasonal patterns were observed on the time series plots for any of the detected data; therefore, no deseasonalizing adjustments were made to the data. When seasonal patterns are observed, data may be deseasonalized so that the resulting limits will correctly account for the seasonality as a predictable pattern rather than random variation or a release. It was noted that for each constituent evaluated, the highest concentrations are reported in the upgradient wells.

While trends may be visual, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends (Figure D). In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed no statistically significant increasing or decreasing trends at any of the wells, as may be seen on the Trend Test Summary table. Therefore, no adjustments were required for any other data sets.

Appendix III – Determination of Spatial Variation

The Analysis of Variance (ANOVA) is used, when multiple upgradient wells are available, to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying the most appropriate statistical approach. However, the Welsh Landfill has only one upgradient well which is representative of background water quality; therefore, the ANOVA was not performed. All parameters were, therefore, further evaluated as described for the appropriateness of intrawell or interwell testing to accommodate the groundwater quality.

Appendix III - Statistical Limits

Intrawell limits constructed from carefully screened background data from within each well serve to provide statistical limits that are conservative (i.e. lower) from a regulatory perspective, and will rapidly identify a change in more recent compliance data from within a given well. This statistical method removes the element of variation from across wells and eliminates the chance of mistaking natural spatial variation for a release from the facility. Prior to performing intrawell prediction limits, several steps are required to reasonably demonstrate downgradient water quality does not have existing impacts from the practices of the facility.

Exploratory data analysis was used as a general comparison of concentrations in downgradient wells for all Appendix III parameters recommended for intrawell analyses to concentrations reported in the upgradient well. Upper tolerance limits are used in conjunction with confidence intervals to determine whether the estimated averages in downgradient wells are higher than observed levels upgradient of the facility. The upper tolerance limits were constructed to represent the extreme upper range of possible background levels at the site.

In cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to justify an intrawell approach. Such an assessment is beyond the scope of services provided by Groundwater Stats Consulting. When there is not an obvious explanation for observed concentration differences in downgradient wells relative to reported concentrations in the upgradient well, interwell prediction limits will initially be selected for the statistical method until further evidence shows that concentrations are due to natural variation rather than a result of the facility.

Parametric tolerance limits were constructed with a target of 99% confidence and 95% coverage using upgradient well data for each of the Appendix III parameters (Figure E). The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. As more data are collected, the background population is better represented and the confidence and coverage levels increase.

Confidence intervals were constructed on downgradient wells for each of the Appendix III parameters, using the tolerance limits discussed above, to determine intrawell eligibility (Figure F). When the entire confidence interval is above a background standard for a given parameter, interwell methods are initially recommended as the statistical method. Therefore, only parameters with confidence intervals which did not exceed background standards are eligible for intrawell prediction limits.

Confidence intervals for the above parameters were found to be within their respective background limit for calcium, chloride, and pH. Therefore, intrawell methods are recommended for these parameters; and interwell methods are initially recommended for boron, fluoride, sulfate, and TDS. As mentioned earlier, if a demonstration supports natural variation in groundwater, intrawell methods will be considered for all parameters.

All available data through June 2017 at each well were used to establish intrawell background limits for the parameters identified above based on a 1-of-2 resample plan that will be used for future comparisons (Figure G). Interwell prediction limits, combined with a 1-of-2 resample plan, were constructed from upgradient well AD-5 (Figure H). Downgradient measurements will be compared to these background limits during each subsequent semi-annual sampling event.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits will be necessary to accommodate these types of changes In the interwell case, newer data will be included in background when a minimum of 2 new samples are available. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of an additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered to be a false positive result and, therefore, no further action is necessary. A summary table of the background prediction limits follows this letter.

Appendix IV – Assessment Monitoring Program

During an Assessment Monitoring program confidence intervals are constructed at all wells for detected Appendix IV parameters. A minimum of 4 samples is required to construct confidence intervals; however, 8 samples are generally recommended for better representation of the true average population. Established Maximum Contaminant Levels (MCLs) are used as the GWPS comparisons, unless background limits are higher as discussed below. Parametric confidence intervals are constructed with 99% confidence when data follow a normal or transformed-normal distribution. For all other cases, nonparametric confidence intervals are constructed, with the confidence level based on the number of samples available. The GWPS is exceeded only when the entire confidence interval exceeds its respective GWPS.

Background limits are established for the Appendix IV parameters using upper tolerance limits constructed with 95% confidence/95% coverage using pooled upgradient well data, for comparison against established MCLs. When background limits, or Alternate Contaminant Levels (ACLs), are higher than established MCLs, the CCR Rule recommends using these ACLs as the GWPS for the confidence interval comparisons. Additionally, tolerance limits are also recommended to establish ACLs for Appendix IV parameters, cobalt, lithium, and molybdenum, which do not have established MCLs. Since the scope of this project included screening and development of background limits for Appendix III Detection Monitoring statistics, comparison of the Appendix IV parameters with confidence intervals was not included in this report.

Recommendations

In summary, as a result of the background screening described in this letter, intrawell prediction limits combined with a 1-of-2 resample plan are recommended for calcium, chloride, and pH; and interwell prediction limits combined with a 1-of-2 resample plan are recommended for boron, fluoride, sulfate and TDS. The statistical analyses will be constructed according to the USEPA Unified Guidance, based on seven Appendix III parameters and three downgradient wells.

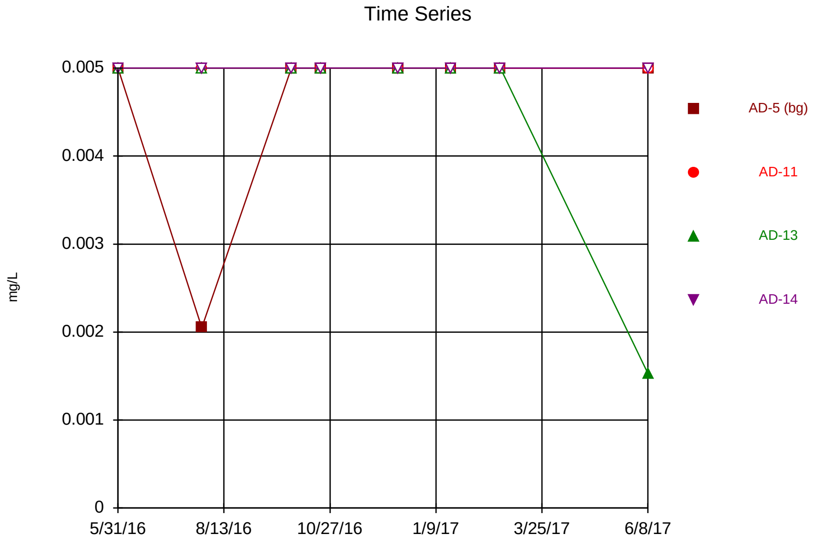
Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Welsh Landfill. If you have any questions or comments, please feel free to contact me.

For Groundwater Stats Consulting,

Kristina Rayner

Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



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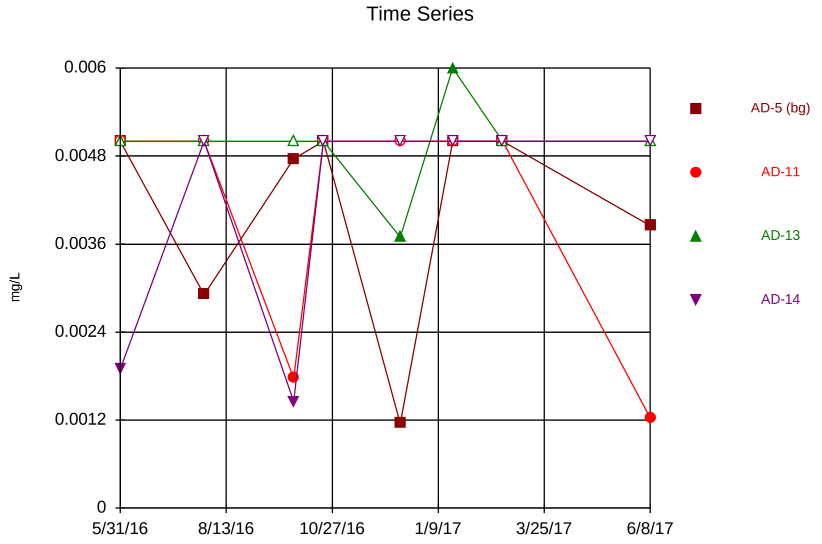
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



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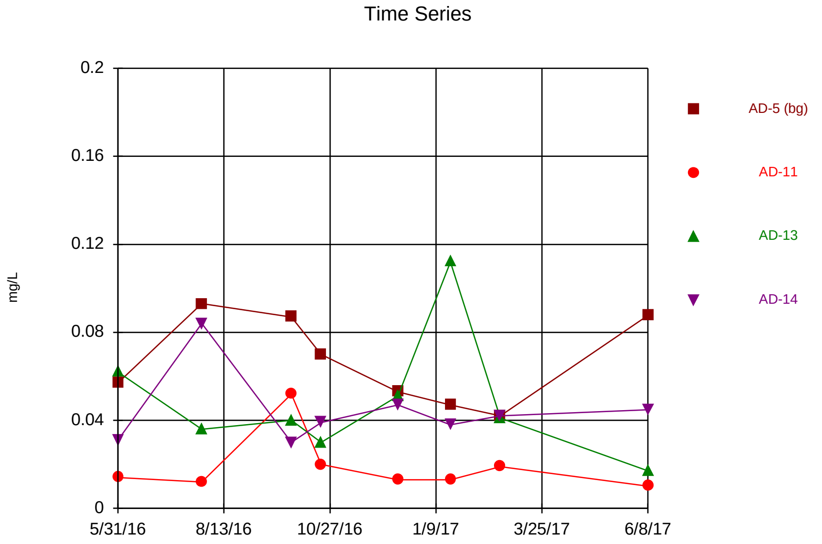

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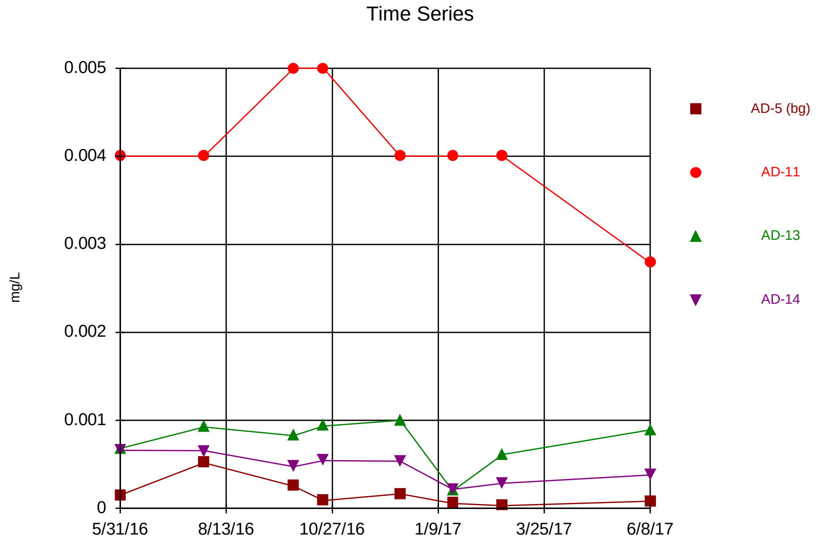

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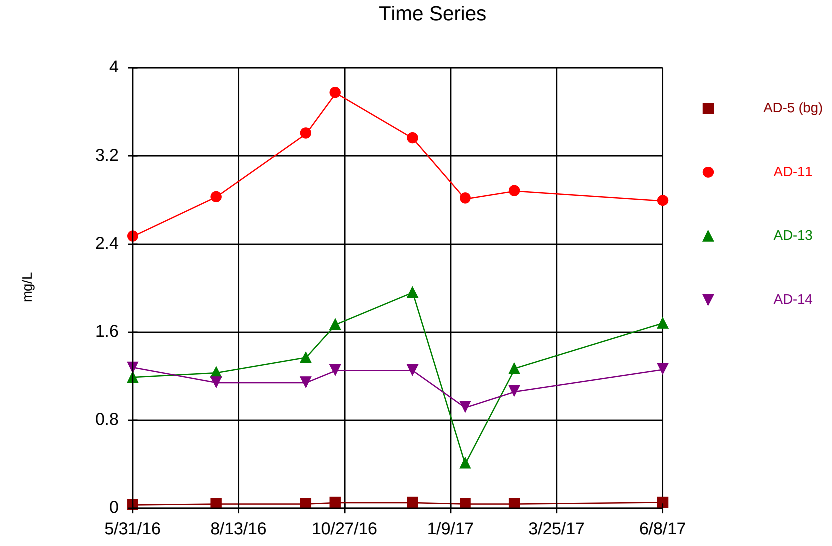

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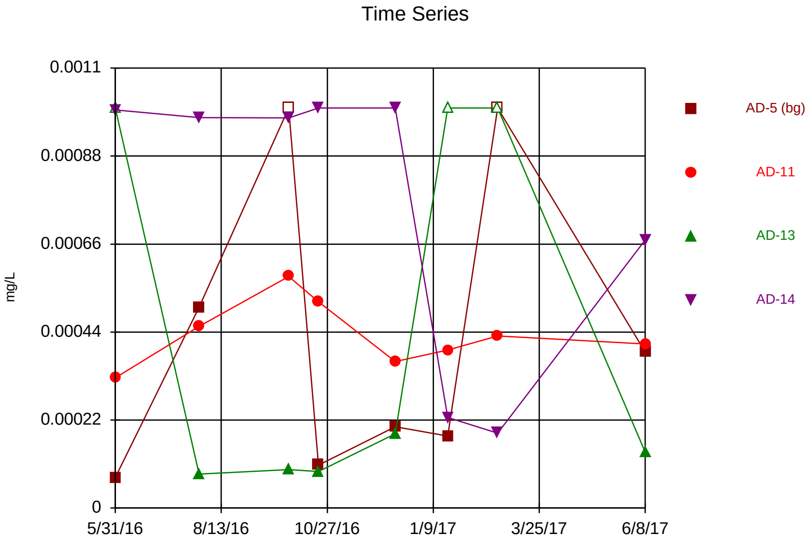
Hollow symbols indicate censored values.



Constituent: Cadmium, total   Analysis Run 12/29/2017 8:39 AM   View: Descriptive
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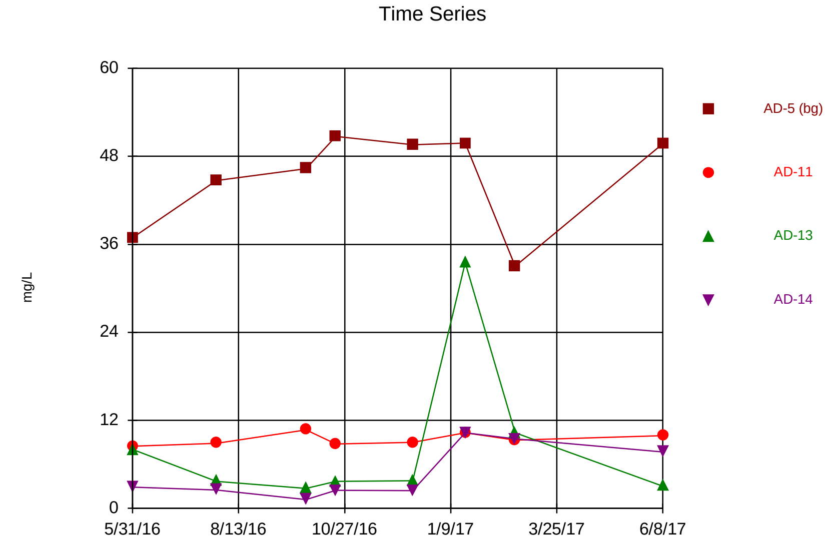

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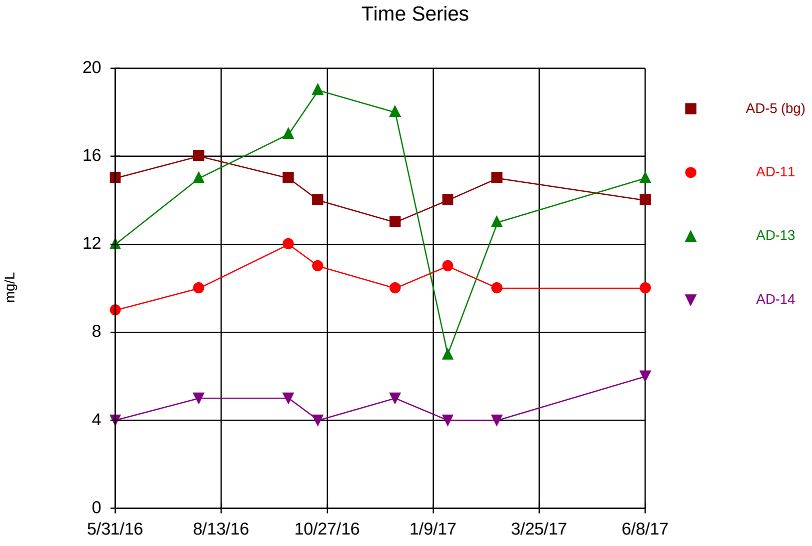
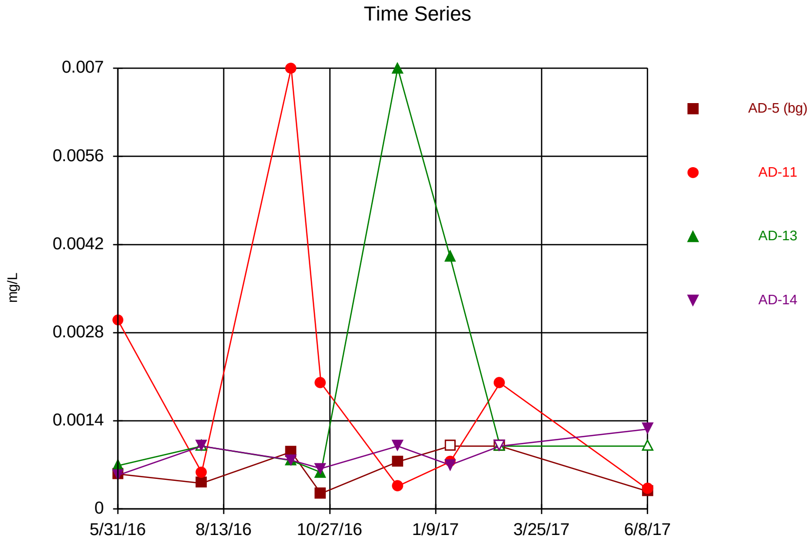


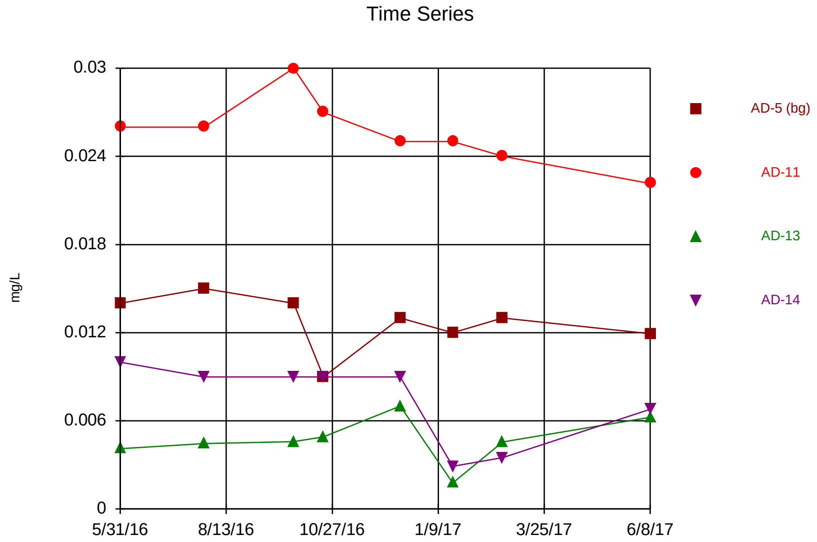
Constituent: Chloride, total   Analysis Run 12/29/2017 8:39 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



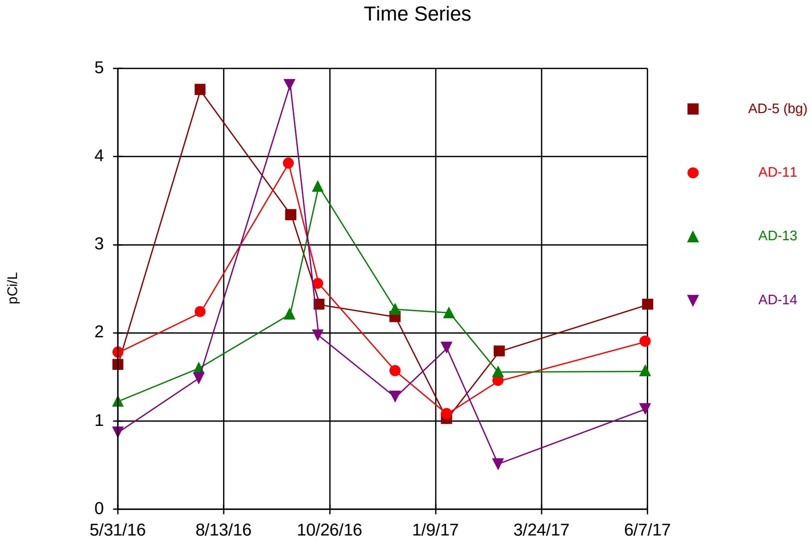
Constituent: Chromium, total   Analysis Run 12/29/2017 8:39 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



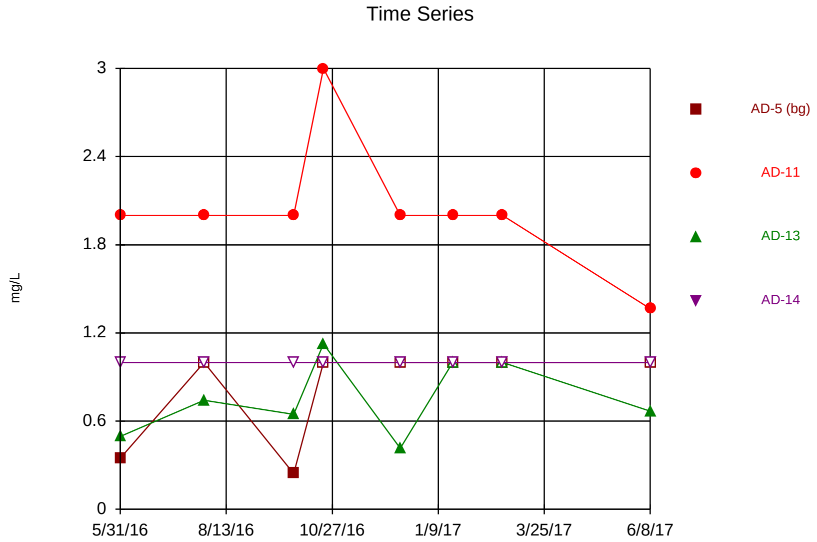
Constituent: Cobalt, total   Analysis Run 12/29/2017 8:39 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



Constituent: Combined Radium 226 + 228   Analysis Run 12/29/2017 8:39 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

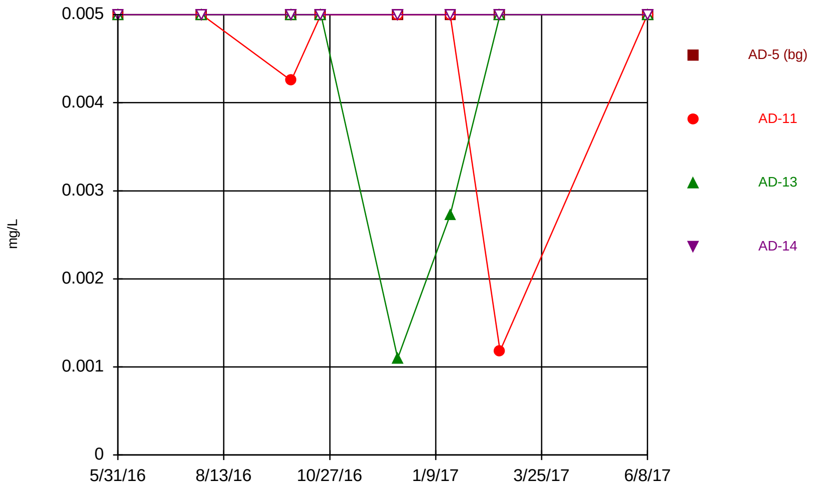
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Fluoride, total   Analysis Run 12/29/2017 8:39 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

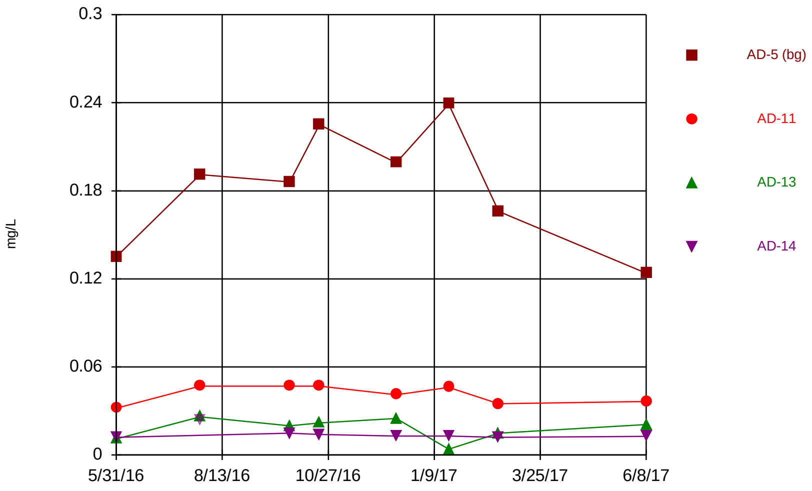
Time Series



Constituent: Lead, total Analysis Run 12/29/2017 8:39 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

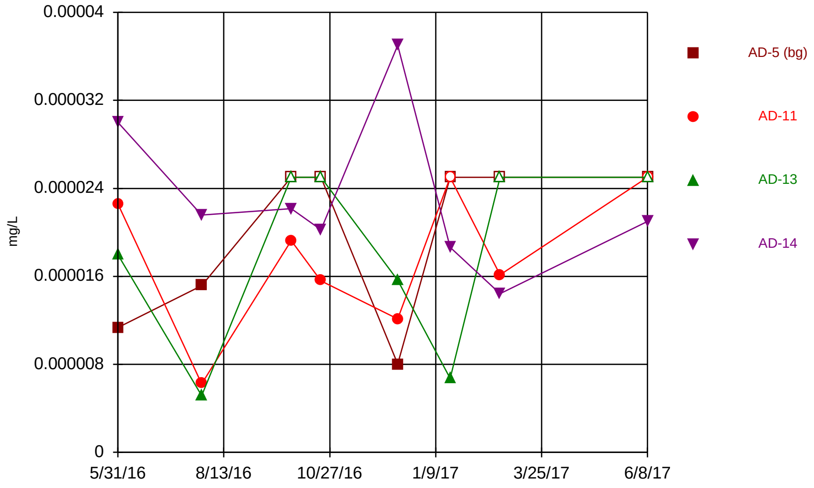
Time Series



Constituent: Lithium, total Analysis Run 12/29/2017 8:39 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

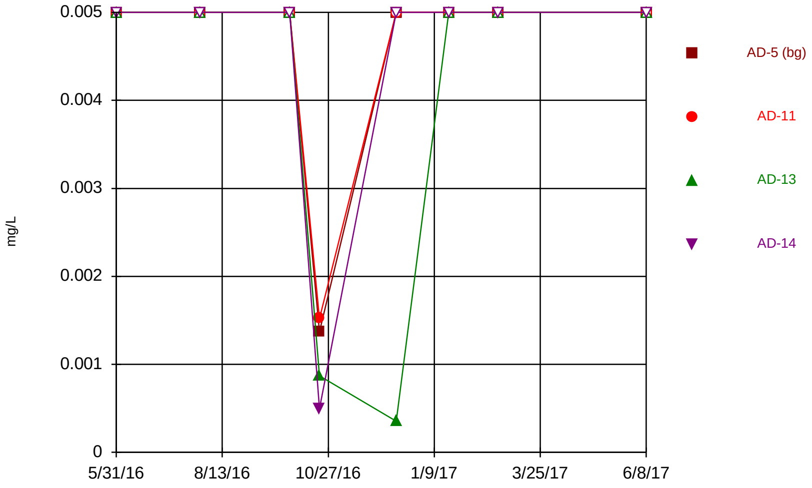
Time Series



Constituent: Mercury, total Analysis Run 12/29/2017 8:39 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

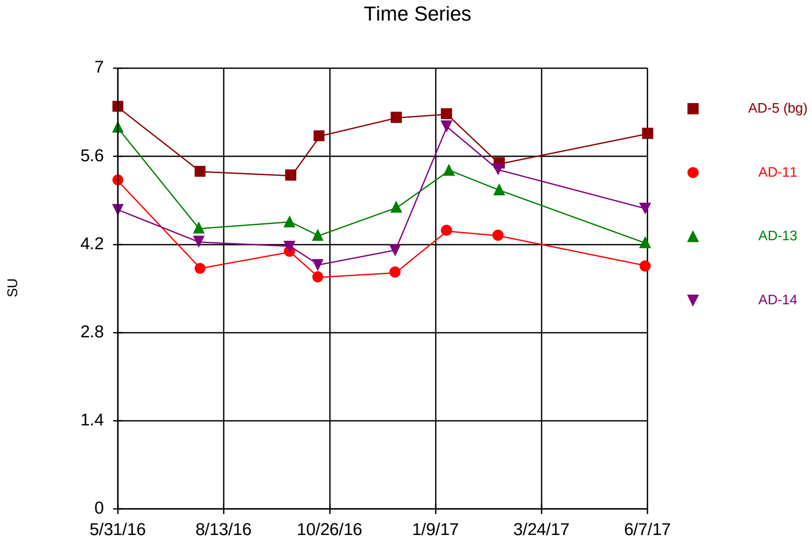
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



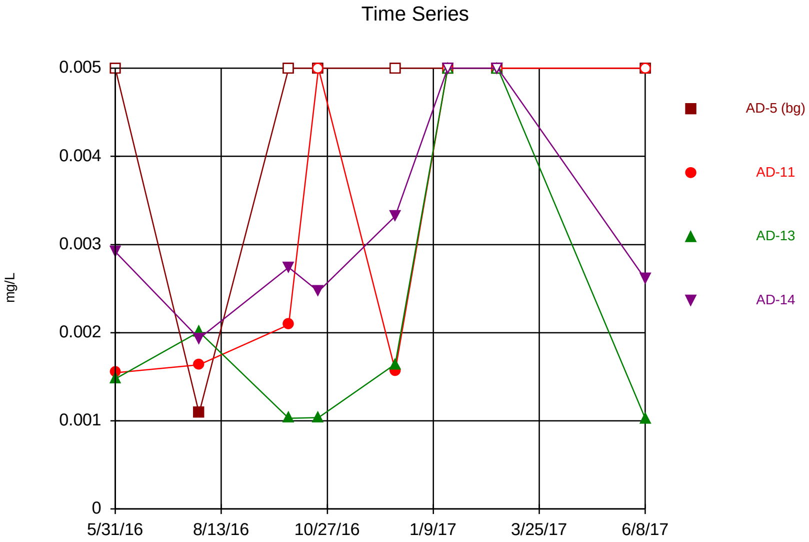
Constituent: Molybdenum, total Analysis Run 12/29/2017 8:39 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



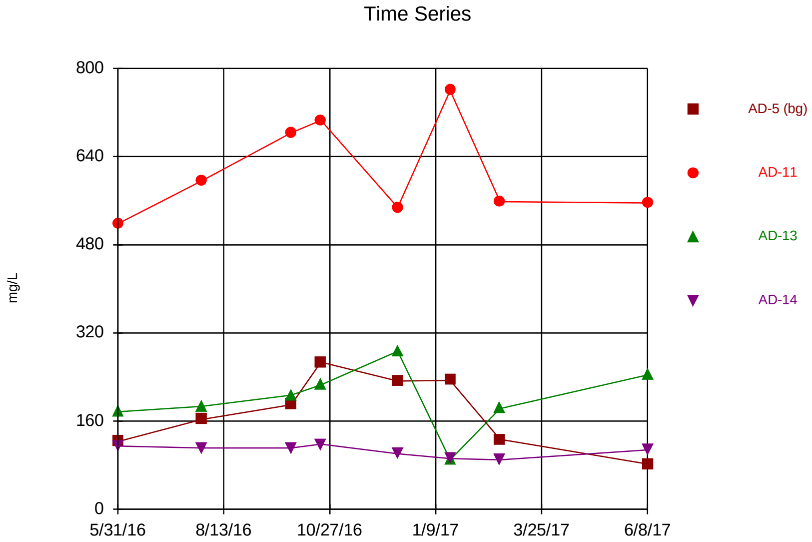
Constituent: pH, field   Analysis Run 12/29/2017 8:39 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



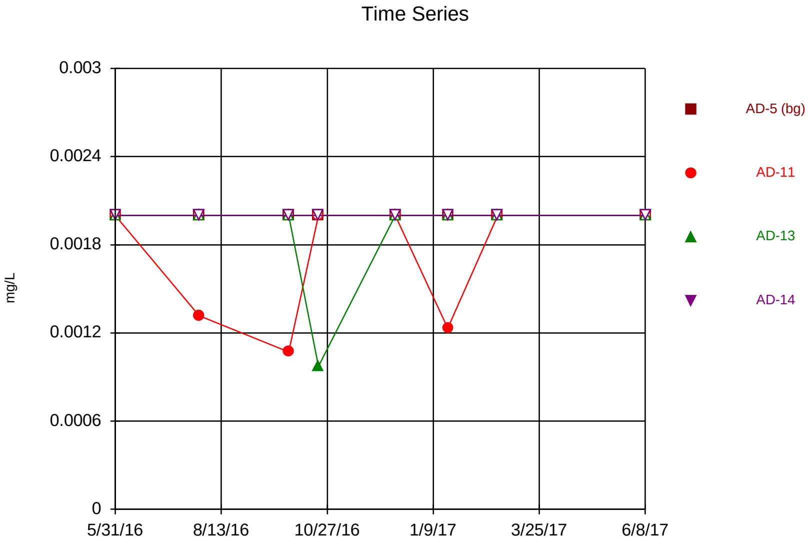
Constituent: Selenium, total   Analysis Run 12/29/2017 8:39 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



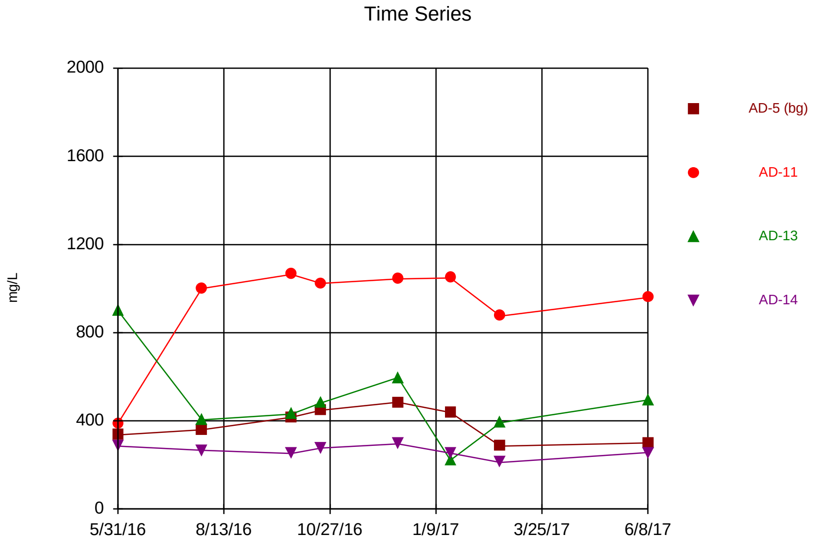
Constituent: Sulfate, total   Analysis Run 12/29/2017 8:39 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Thallium, total   Analysis Run 12/29/2017 8:39 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

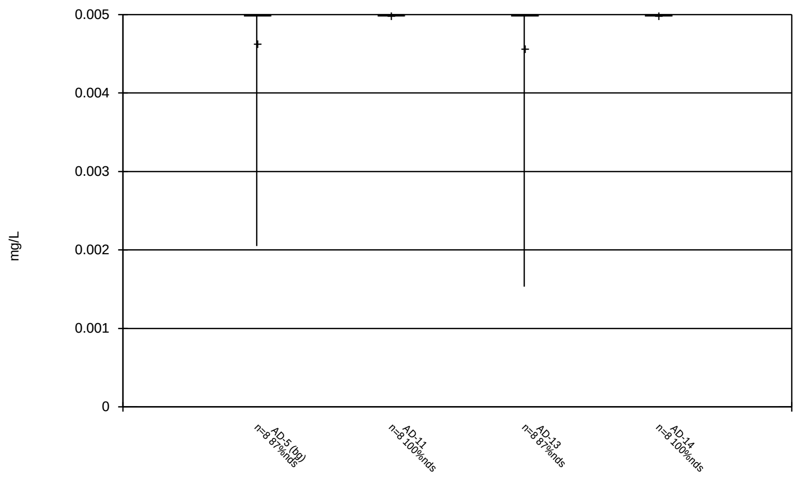
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids   Analysis Run 12/29/2017 8:39 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

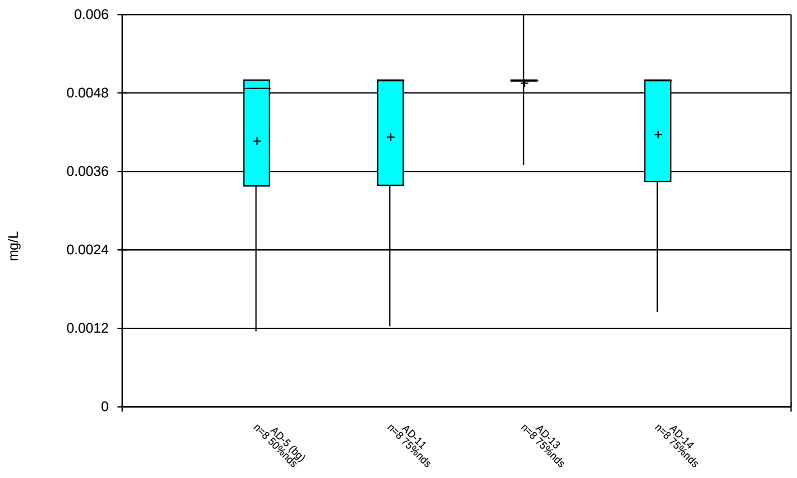
Box & Whiskers Plot



Constituent: Antimony, total   Analysis Run 12/29/2017 8:44 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

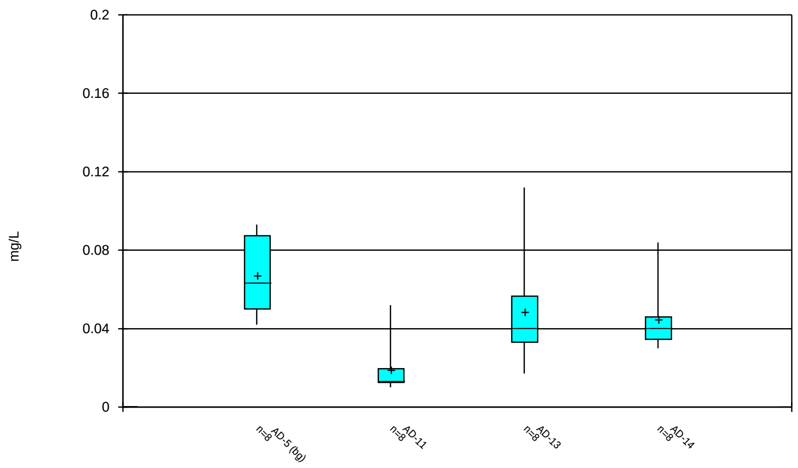
Box & Whiskers Plot



Constituent: Arsenic, total   Analysis Run 12/29/2017 8:44 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

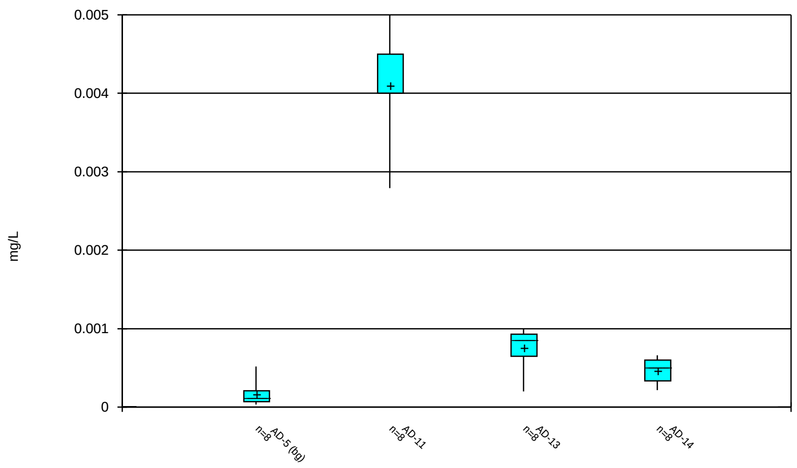
Box & Whiskers Plot



Constituent: Barium, total   Analysis Run 12/29/2017 8:44 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

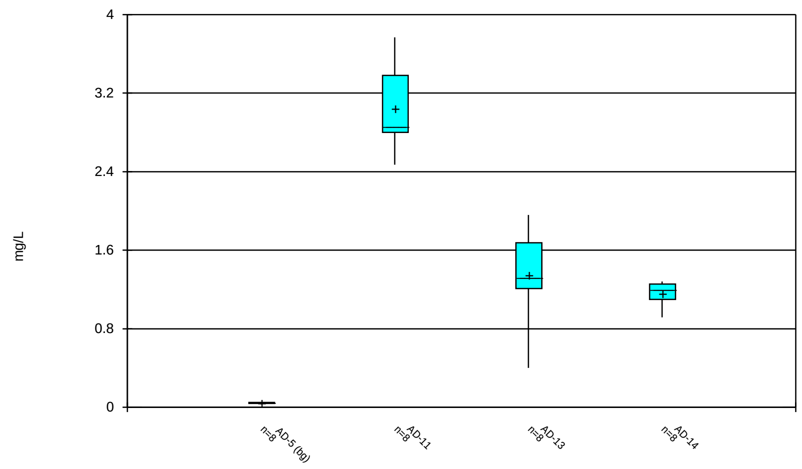
Box & Whiskers Plot



Constituent: Beryllium, total   Analysis Run 12/29/2017 8:44 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

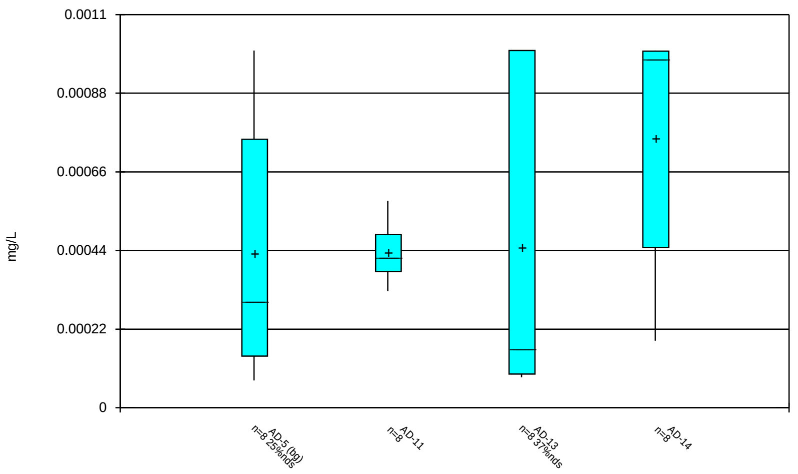
Box & Whiskers Plot



Constituent: Boron, total   Analysis Run 12/29/2017 8:44 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

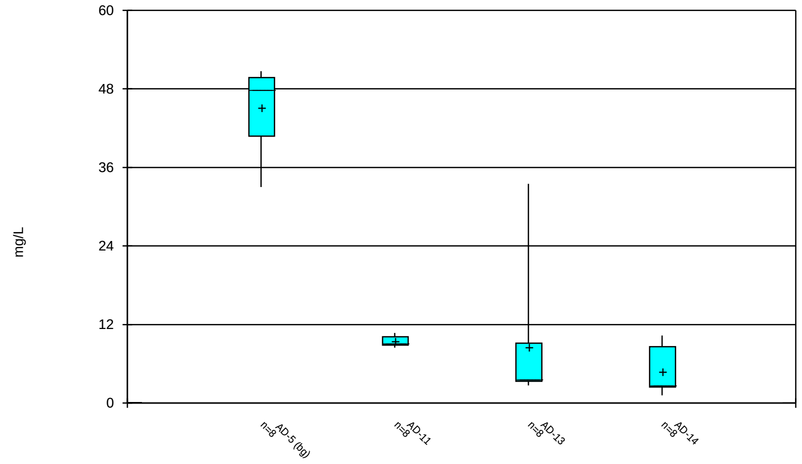
Box & Whiskers Plot



Constituent: Cadmium, total   Analysis Run 12/29/2017 8:44 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

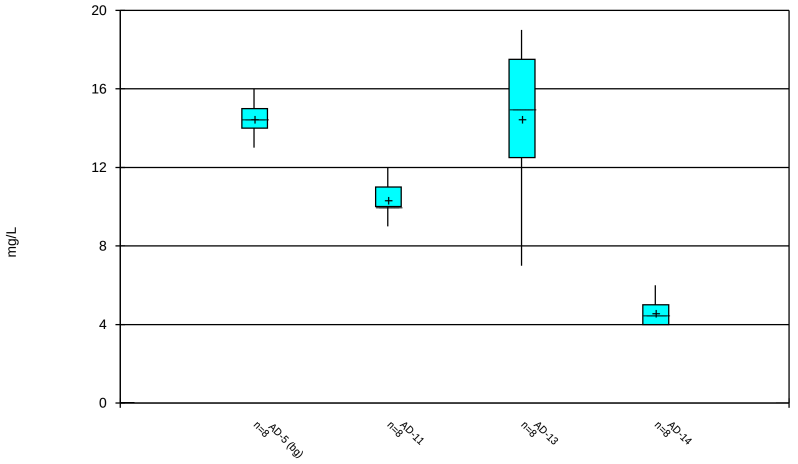
Box & Whiskers Plot



Constituent: Calcium, total   Analysis Run 12/29/2017 8:44 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

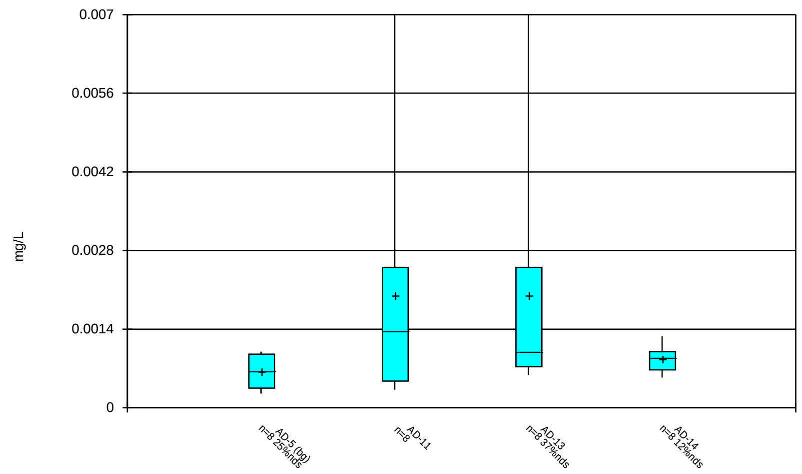
Box & Whiskers Plot



Constituent: Chloride, total   Analysis Run 12/29/2017 8:44 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

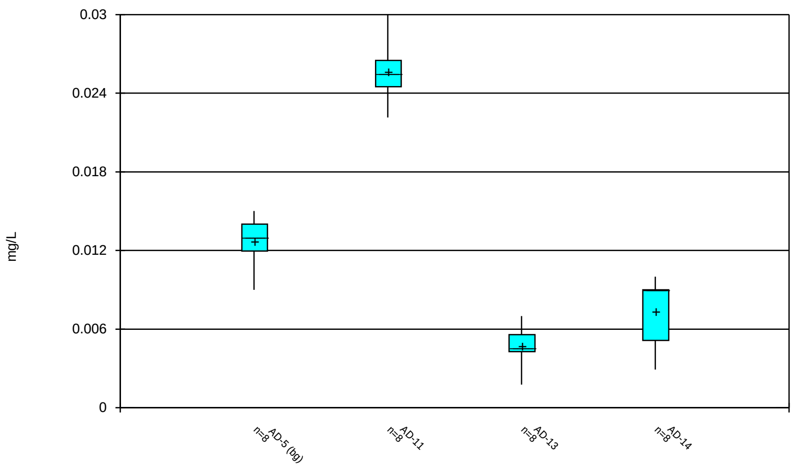
Box & Whiskers Plot



Constituent: Chromium, total Analysis Run 12/29/2017 8:44 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

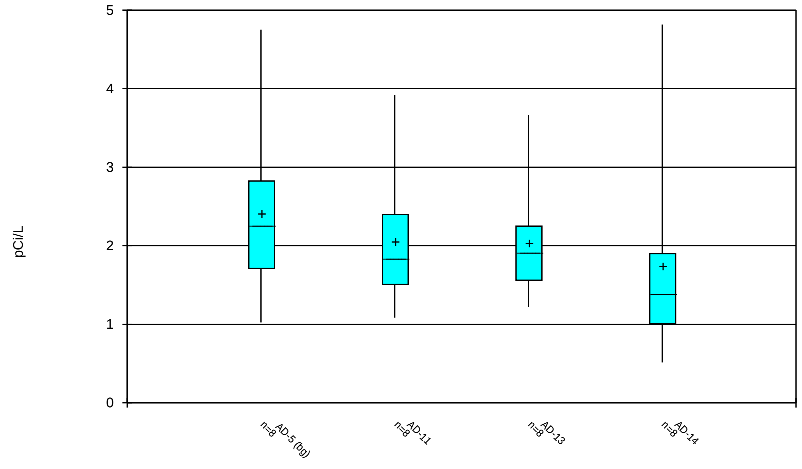
Box & Whiskers Plot



Constituent: Cobalt, total Analysis Run 12/29/2017 8:44 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

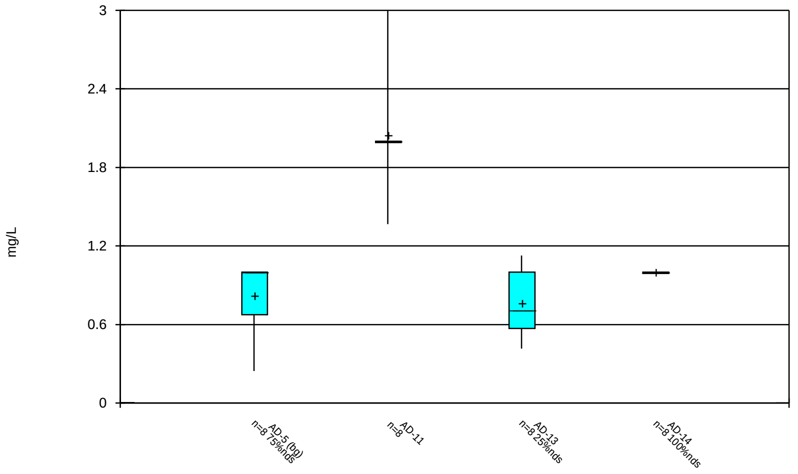
Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 12/29/2017 8:44 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

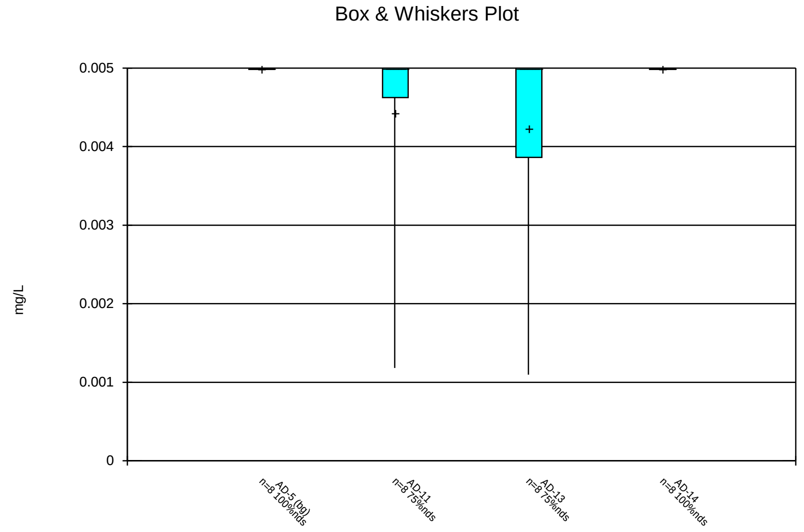
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Box & Whiskers Plot



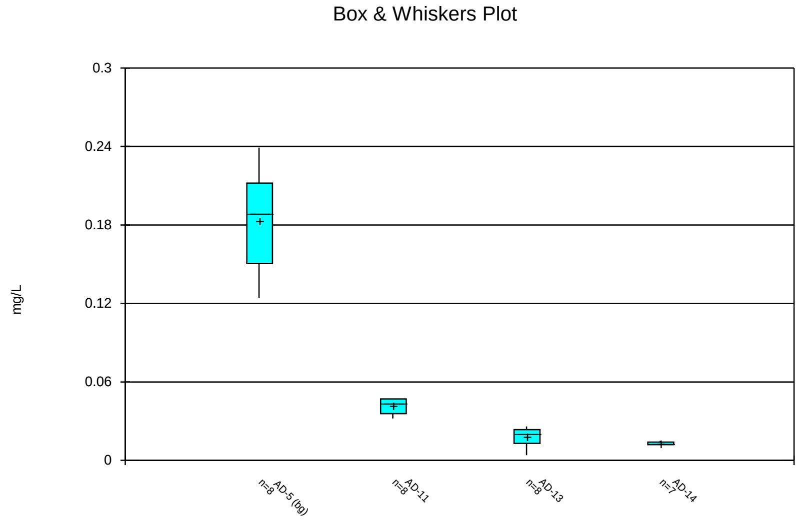
Constituent: Fluoride, total Analysis Run 12/29/2017 8:44 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



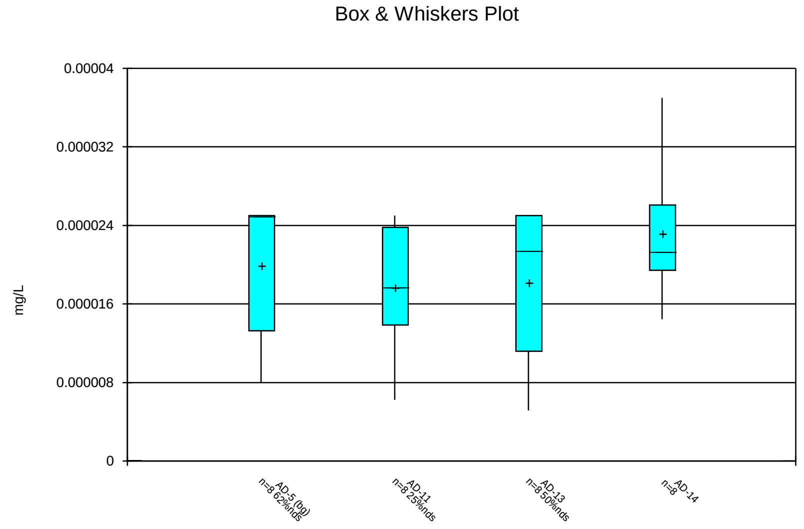
Constituent: Lead, total   Analysis Run 12/29/2017 8:44 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



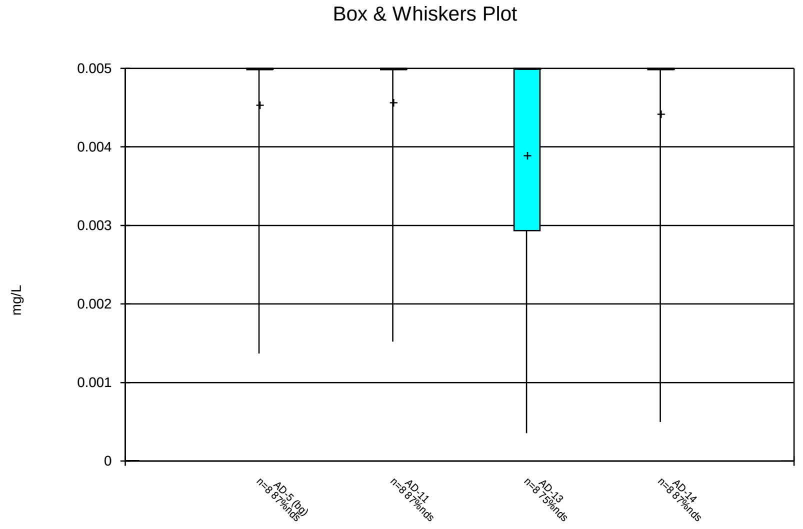
Constituent: Lithium, total   Analysis Run 12/29/2017 8:44 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



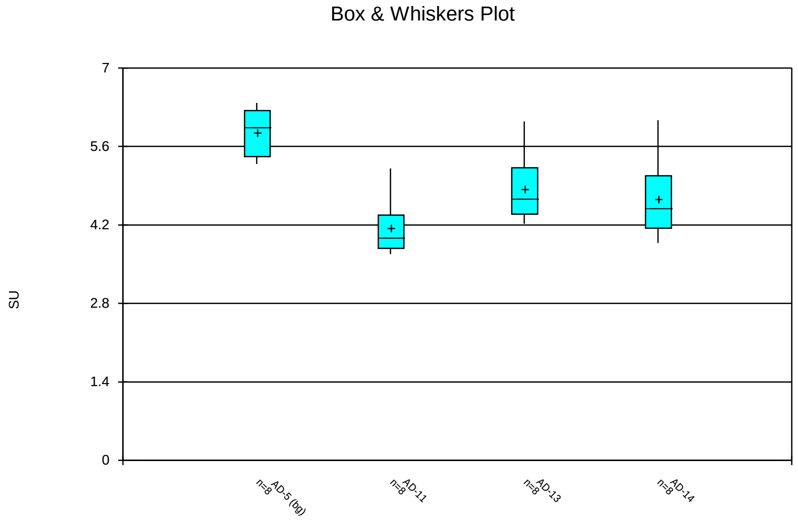
Constituent: Mercury, total   Analysis Run 12/29/2017 8:44 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



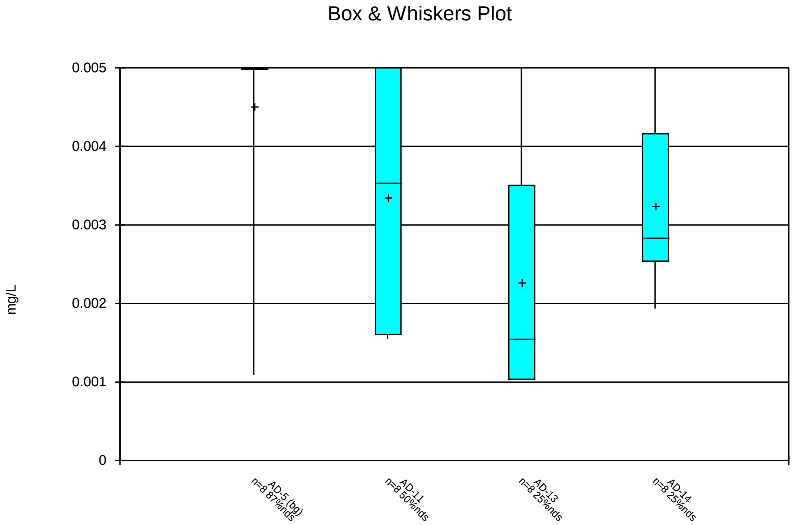
Constituent: Molybdenum, total   Analysis Run 12/29/2017 8:44 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



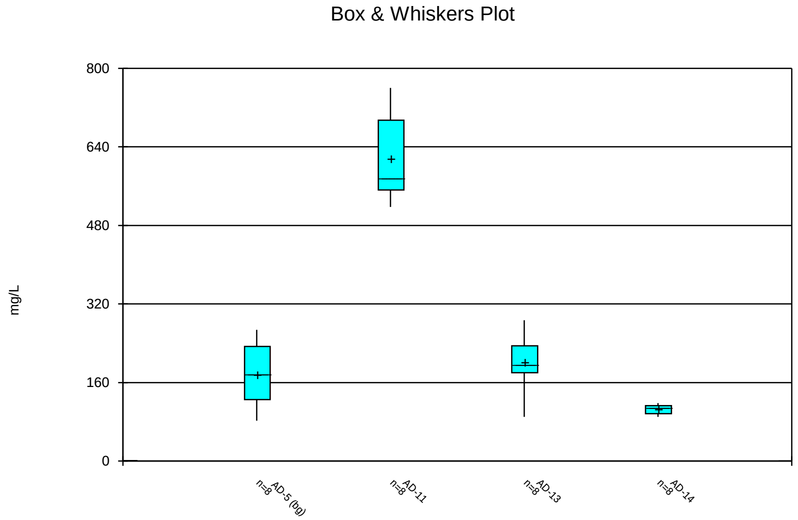
Constituent: pH, field   Analysis Run 12/29/2017 8:44 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



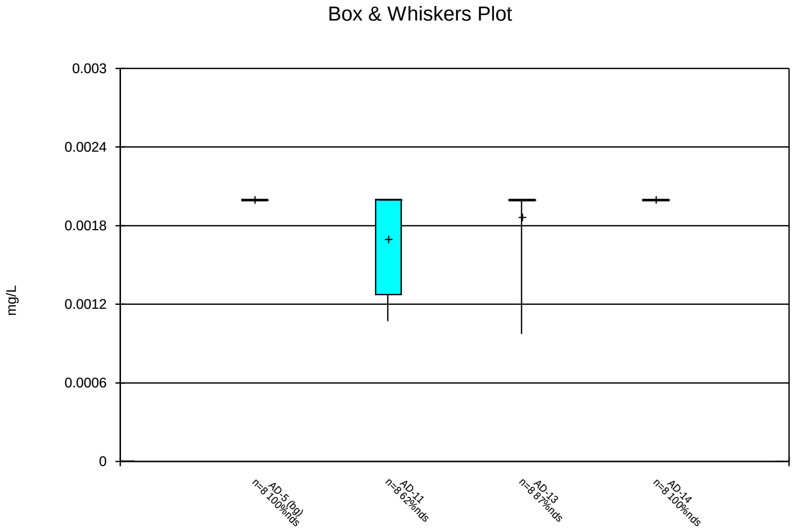
Constituent: Selenium, total   Analysis Run 12/29/2017 8:45 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



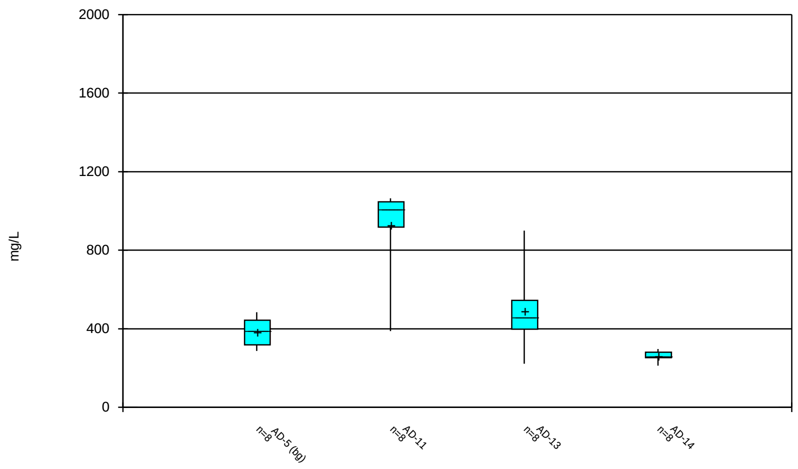
Constituent: Sulfate, total   Analysis Run 12/29/2017 8:45 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



Constituent: Thallium, total   Analysis Run 12/29/2017 8:45 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Box & Whiskers Plot



Constituent: Total Dissolved Solids Analysis Run 12/29/2017 8:45 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Outlier Summary Table

Welsh LF   Client: Geosyntec   Data: Welsh LF   Printed 12/29/2017, 8:24 AM

	AD-14 Lithium, total (mg/L)
7/29/2016	0.024 (o)

Outlier Analysis - All Results

Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/29/2017, 8:35 AM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distributior	Normality Test
Antimony, total (mg/L)	AD-5 (bg)	No	n/a	NP (nrm)	8	0.004631	0.001043	unknown	ShapiroWilk
Antimony, total (mg/L)	AD-11	No	n/a	NP (nrm)	8	0.005	0	unknown	ShapiroWilk
Antimony, total (mg/L)	AD-13	No	n/a	NP (nrm)	8	0.004566	0.001227	unknown	ShapiroWilk
Antimony, total (mg/L)	AD-14	No	n/a	NP (nrm)	8	0.005	0	unknown	ShapiroWilk
Arsenic, total (mg/L)	AD-5 (bg)	No	n/a	NP (nrm)	8	0.004084	0.001406	unknown	ShapiroWilk
Arsenic, total (mg/L)	AD-11	No	n/a	NP (nrm)	8	0.004125	0.001626	unknown	ShapiroWilk
Arsenic, total (mg/L)	AD-13	No	n/a	NP (nrm)	8	0.004962	0.0006199	unknown	ShapiroWilk
Arsenic, total (mg/L)	AD-14	No	n/a	NP (nrm)	8	0.004168	0.001544	unknown	ShapiroWilk
Barium, total (mg/L)	AD-5 (bg)	No	n/a	NP	8	0.06709	0.02012	ln(x)	ShapiroWilk
Barium, total (mg/L)	AD-11	No	n/a	NP	8	0.01914	0.0137	ln(x)	ShapiroWilk
Barium, total (mg/L)	AD-13	No	n/a	NP	8	0.04864	0.02886	ln(x)	ShapiroWilk
Barium, total (mg/L)	AD-14	No	n/a	NP	8	0.04448	0.01706	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AD-5 (bg)	No	n/a	NP	8	0.0001676	0.0001584	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AD-11	No	n/a	NP (nrm)	8	0.004099	0.0006955	unknown	ShapiroWilk
Beryllium, total (mg/L)	AD-13	No	n/a	NP	8	0.0007584	0.0002618	x^4	ShapiroWilk
Beryllium, total (mg/L)	AD-14	No	n/a	NP	8	0.0004684	0.0001629	normal	ShapiroWilk
Boron, total (mg/L)	AD-5 (bg)	No	n/a	NP	8	0.04285	0.00755	normal	ShapiroWilk
Boron, total (mg/L)	AD-11	No	n/a	NP	8	3.039	0.4268	ln(x)	ShapiroWilk
Boron, total (mg/L)	AD-13	No	n/a	NP	8	1.347	0.4673	x^2	ShapiroWilk
Boron, total (mg/L)	AD-14	No	n/a	NP	8	1.162	0.1262	x^6	ShapiroWilk
Cadmium, total (mg/L)	AD-5 (bg)	No	n/a	NP	8	0.0004325	0.0003778	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	AD-11	No	n/a	NP	8	0.0004346	0.00008153	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	AD-13	No	n/a	NP (nrm)	8	0.0004498	0.0004568	unknown	ShapiroWilk
Cadmium, total (mg/L)	AD-14	No	n/a	NP (nrm)	8	0.0007539	0.0003553	unknown	ShapiroWilk
Calcium, total (mg/L)	AD-5 (bg)	No	n/a	NP (nrm)	8	45.09	6.656	unknown	ShapiroWilk
Calcium, total (mg/L)	AD-11	No	n/a	NP	8	9.419	0.8002	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-13	No	n/a	NP	8	8.585	10.43	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-14	No	n/a	NP	8	4.868	3.655	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AD-5 (bg)	No	n/a	NP	8	14.5	0.9258	normal	ShapiroWilk
Chloride, total (mg/L)	AD-11	No	n/a	NP	8	10.38	0.9161	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AD-13	No	n/a	NP	8	14.5	3.854	x^3	ShapiroWilk
Chloride, total (mg/L)	AD-14	No	n/a	NP (nrm)	8	4.625	0.744	unknown	ShapiroWilk
Chromium, total (mg/L)	AD-5 (bg)	No	n/a	NP	8	0.0006437	0.0003127	sqrt(x)	ShapiroWilk
Chromium, total (mg/L)	AD-11	No	n/a	NP	8	0.002002	0.002238	ln(x)	ShapiroWilk
Chromium, total (mg/L)	AD-13	No	n/a	NP (nrm)	8	0.002005	0.002306	unknown	ShapiroWilk
Chromium, total (mg/L)	AD-14	No	n/a	NP	8	0.0008653	0.0002426	x^(1/3)	ShapiroWilk
Cobalt, total (mg/L)	AD-5 (bg)	No	n/a	NP	8	0.01274	0.001837	x^4	ShapiroWilk
Cobalt, total (mg/L)	AD-11	No	n/a	NP	8	0.02565	0.002291	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	AD-13	No	n/a	NP	8	0.004707	0.001546	x^2	ShapiroWilk
Cobalt, total (mg/L)	AD-14	No	n/a	NP (nrm)	8	0.007399	0.002745	unknown	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-5 (bg)	No	n/a	NP	8	2.418	1.153	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-11	No	n/a	NP	8	2.061	0.8796	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-13	No	n/a	NP	8	2.04	0.7624	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-14	No	n/a	NP	8	1.737	1.333	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-5 (bg)	No	n/a	NP (nrm)	8	0.8238	0.3274	unknown	ShapiroWilk
Fluoride, total (mg/L)	AD-11	No	n/a	NP (nrm)	8	2.046	0.4448	unknown	ShapiroWilk
Fluoride, total (mg/L)	AD-13	No	n/a	NP	8	0.7615	0.2565	x^(1/3)	ShapiroWilk
Fluoride, total (mg/L)	AD-14	No	n/a	NP (nrm)	8	1	0	unknown	ShapiroWilk
Lead, total (mg/L)	AD-5 (bg)	No	n/a	NP (nrm)	8	0.005	0	unknown	ShapiroWilk
Lead, total (mg/L)	AD-11	No	n/a	NP (nrm)	8	0.004429	0.001338	unknown	ShapiroWilk
Lead, total (mg/L)	AD-13	No	n/a	NP (nrm)	8	0.004228	0.001494	unknown	ShapiroWilk
Lead, total (mg/L)	AD-14	No	n/a	NP (nrm)	8	0.005	0	unknown	ShapiroWilk
Lithium, total (mg/L)	AD-5 (bg)	No	n/a	NP	8	0.1831	0.04018	x^2	ShapiroWilk
Lithium, total (mg/L)	AD-11	No	n/a	NP	8	0.04144	0.006191	ln(x)	ShapiroWilk
Lithium, total (mg/L)	AD-13	No	n/a	NP	8	0.01798	0.007511	x^2	ShapiroWilk

Outlier Analysis - All Results

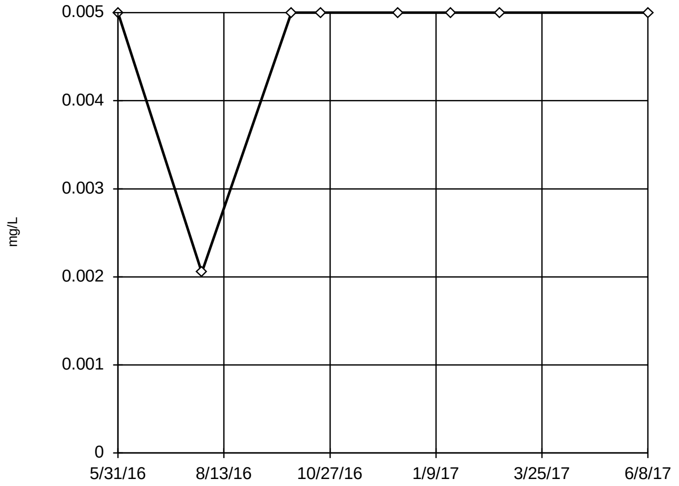
Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/29/2017, 8:35 AM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Lithium, total (mg/L)	**AD-14**	**Yes**	**0.024**	**NP**	**8**	**0.01446**	**0.003982**	**ln(x)**	**ShapiroWilk**
Mercury, total (mg/L)	AD-5 (bg)	No	n/a	NP (nrm)	8	0.00001994	0.000007238	unknown	ShapiroWilk
Mercury, total (mg/L)	AD-11	No	n/a	NP	8	0.00001774	0.000006569	normal	ShapiroWilk
Mercury, total (mg/L)	AD-13	No	n/a	NP (nrm)	8	0.00001819	0.000008395	unknown	ShapiroWilk
Mercury, total (mg/L)	AD-14	No	n/a	NP	8	0.00002313	0.000007088	ln(x)	ShapiroWilk
Molybdenum, total (mg/L)	AD-5 (bg)	No	n/a	NP (nrm)	8	0.004546	0.001283	unknown	ShapiroWilk
Molybdenum, total (mg/L)	AD-11	No	n/a	NP (nrm)	8	0.004565	0.001231	unknown	ShapiroWilk
Molybdenum, total (mg/L)	AD-13	No	n/a	NP (nrm)	8	0.003903	0.002036	unknown	ShapiroWilk
Molybdenum, total (mg/L)	AD-14	No	n/a	NP (nrm)	8	0.004437	0.001592	unknown	ShapiroWilk
pH, field (SU)	AD-5 (bg)	No	n/a	NP	8	5.859	0.4299	x^6	ShapiroWilk
pH, field (SU)	AD-11	No	n/a	NP	8	4.144	0.5079	ln(x)	ShapiroWilk
pH, field (SU)	AD-13	No	n/a	NP	8	4.856	0.6175	ln(x)	ShapiroWilk
pH, field (SU)	AD-14	No	n/a	NP	8	4.673	0.7433	ln(x)	ShapiroWilk
Selenium, total (mg/L)	AD-5 (bg)	No	n/a	NP (nrm)	8	0.004511	0.001383	unknown	ShapiroWilk
Selenium, total (mg/L)	AD-11	No	n/a	NP (nrm)	8	0.003356	0.001766	unknown	ShapiroWilk
Selenium, total (mg/L)	AD-13	No	n/a	NP (nrm)	8	0.002278	0.001715	unknown	ShapiroWilk
Selenium, total (mg/L)	AD-14	No	n/a	NP	8	0.003249	0.00115	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-5 (bg)	No	n/a	NP	8	177.4	64.69	normal	ShapiroWilk
Sulfate, total (mg/L)	AD-11	No	n/a	NP	8	615.6	88.57	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-13	No	n/a	NP	8	200.1	57.71	x^2	ShapiroWilk
Sulfate, total (mg/L)	AD-14	No	n/a	NP	8	105.8	10.39	x^6	ShapiroWilk
Thallium, total (mg/L)	AD-5 (bg)	No	n/a	NP (nrm)	8	0.002	0	unknown	ShapiroWilk
Thallium, total (mg/L)	AD-11	No	n/a	NP (nrm)	8	0.001702	0.0004163	unknown	ShapiroWilk
Thallium, total (mg/L)	AD-13	No	n/a	NP (nrm)	8	0.001872	0.0003629	unknown	ShapiroWilk
Thallium, total (mg/L)	AD-14	No	n/a	NP (nrm)	8	0.002	0	unknown	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-5 (bg)	No	n/a	NP	8	383.6	73.17	x^2	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-11	No	n/a	NP	8	925.6	225.6	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-13	No	n/a	NP	8	490.1	197	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-14	No	n/a	NP	8	262.3	25.65	x^4	ShapiroWilk

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.05 alpha level.

Data were square root
transformed to achieve
best W statistic (graph
shown in original units).

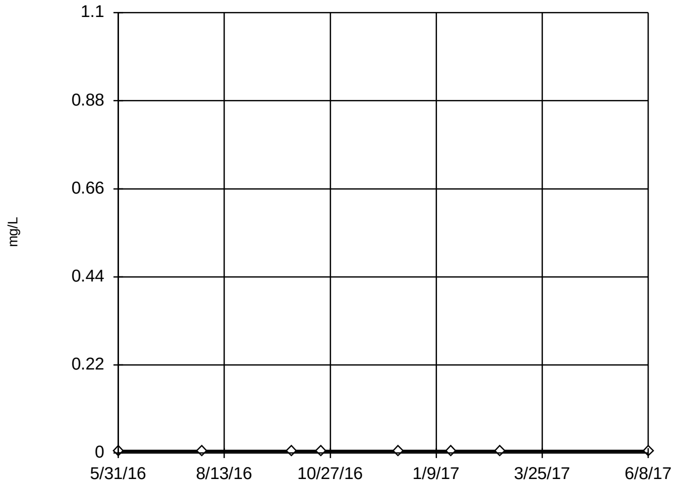
The results were invalidated, because the lower
and upper quartiles are
equal.

Constituent: Antimony, total Analysis Run 12/29/2017 8:25 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.05 alpha level.

Data were square root
transformed to achieve
best W statistic (graph
shown in original units).

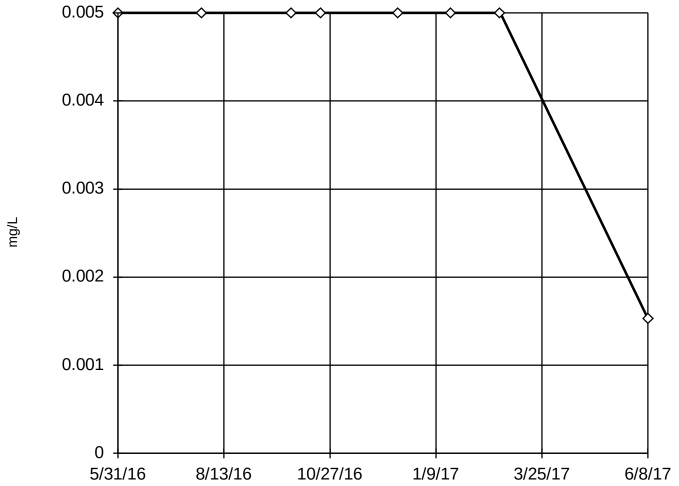
The results were invalidated, because the lower
and upper quartiles are
equal.

Constituent: Antimony, total Analysis Run 12/29/2017 8:25 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.05 alpha level.

Data were square root
transformed to achieve
best W statistic (graph
shown in original units).

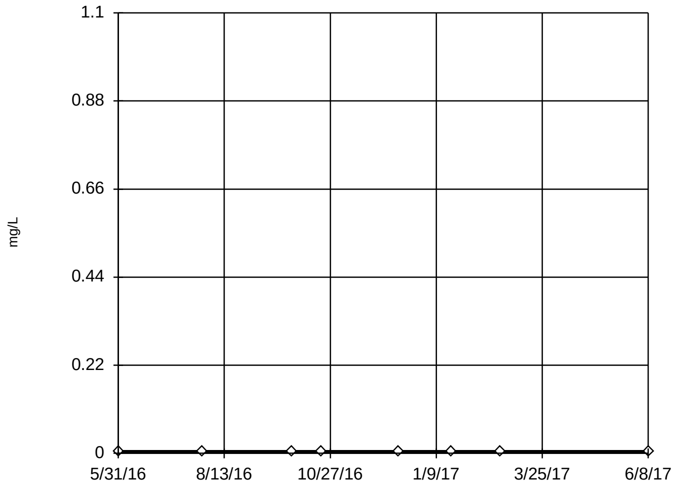
The results were invalidated, because the lower
and upper quartiles are
equal.

Constituent: Antimony, total Analysis Run 12/29/2017 8:25 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.05 alpha level.

Data were square root
transformed to achieve
best W statistic (graph
shown in original units).

The results were invalidated, because the lower
and upper quartiles are
equal.

Constituent: Antimony, total Analysis Run 12/29/2017 8:25 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

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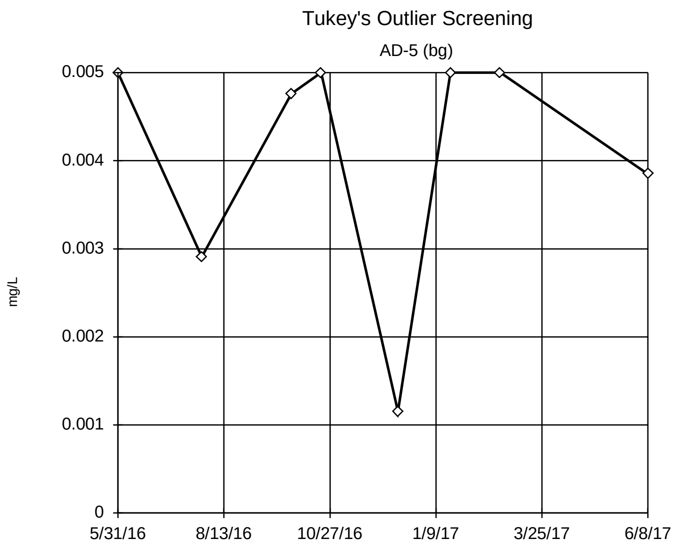

n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.007227, low cutoff = -0.00596, based on IQR multiplier of 3.

Constituent: Arsenic, total   Analysis Run 12/29/2017 8:25 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

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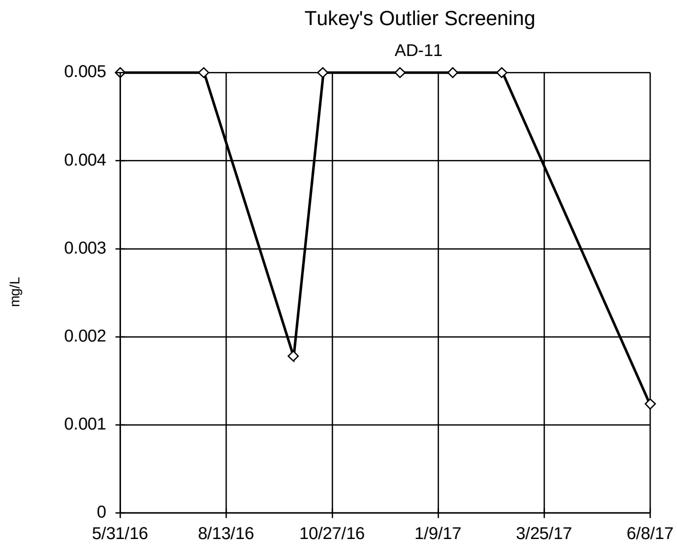


n = 8

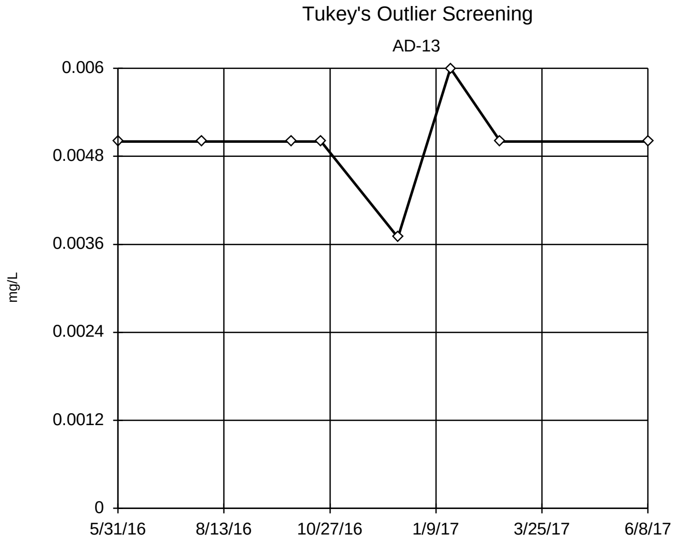
No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.02368, low cutoff = 0.0006288, based on IQR multiplier of 3.

Constituent: Arsenic, total   Analysis Run 12/29/2017 8:25 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

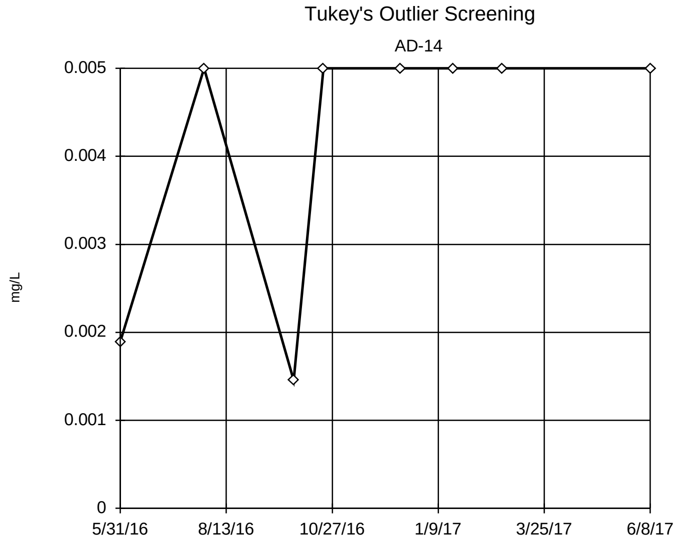
No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Arsenic, total   Analysis Run 12/29/2017 8:25 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

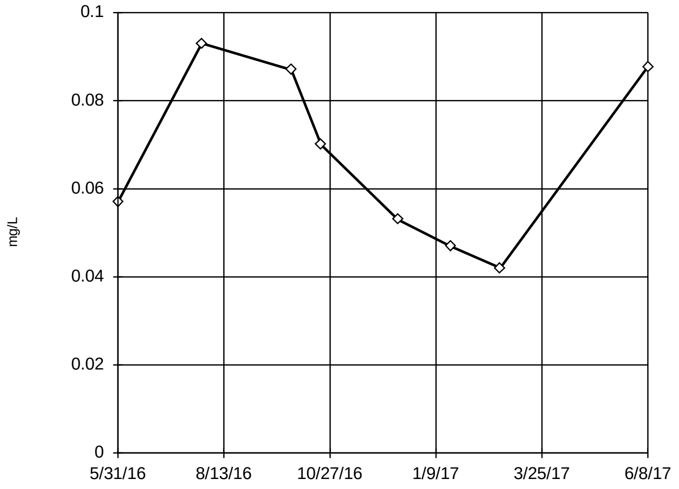
High cutoff = 0.02145, low cutoff = 0.0007173, based on IQR multiplier of 3.

Constituent: Arsenic, total   Analysis Run 12/29/2017 8:25 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.4682, low cutoff = 0.00931, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

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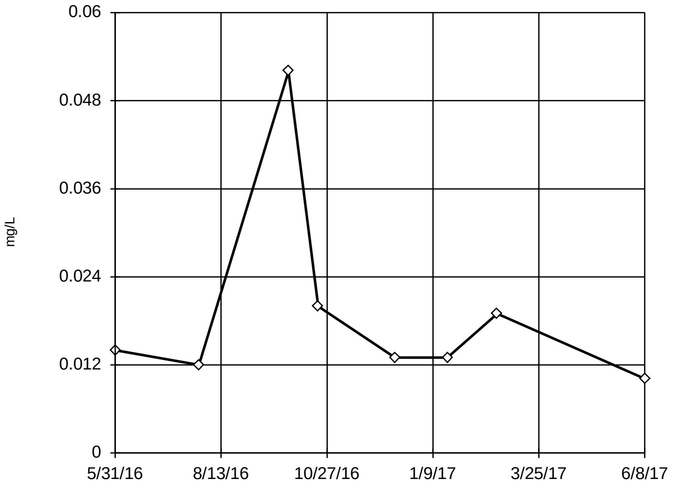
Tukey's Outlier Screening

AD-11



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

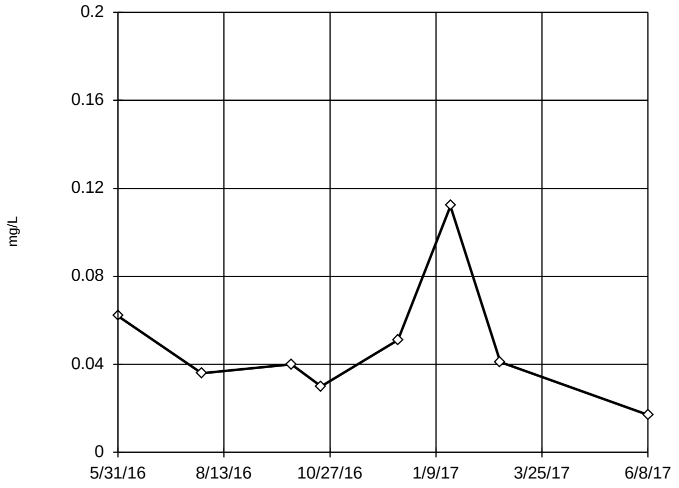
High cutoff = 0.07411, low cutoff = 0.003285, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

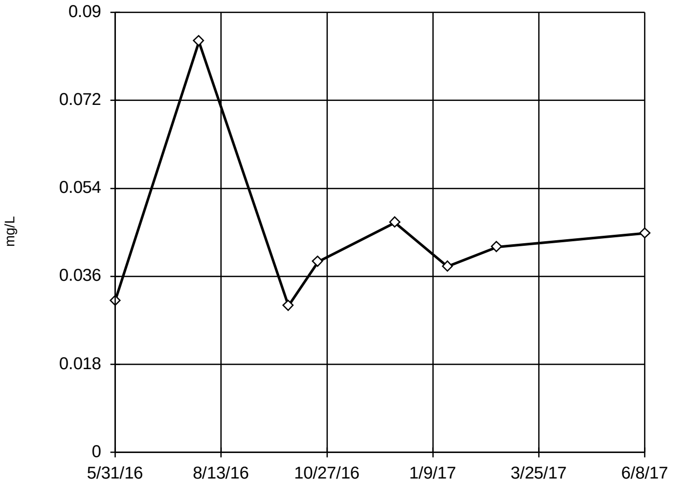
High cutoff = 0.2817, low cutoff = 0.00656, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

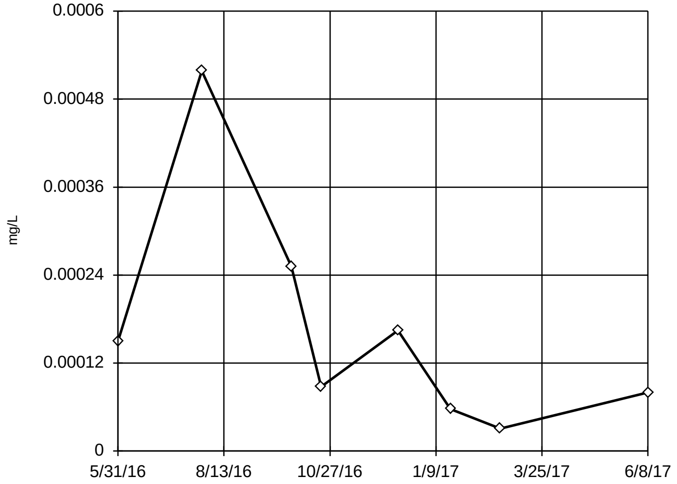
High cutoff = 0.1098, low cutoff = 0.01435, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

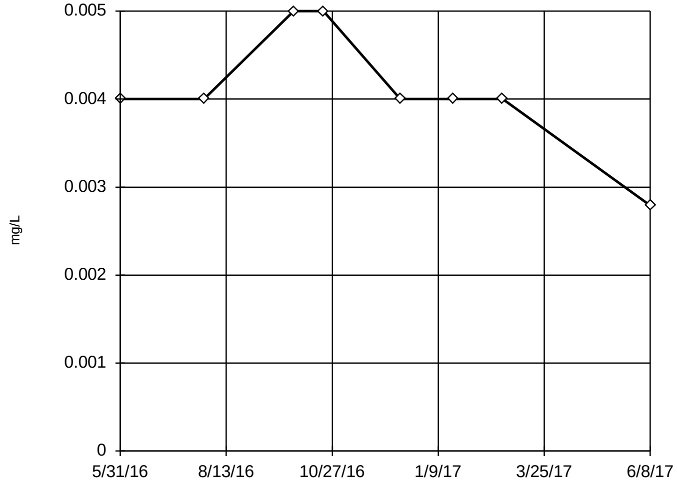
High cutoff = 0.005496, low cutoff = 0.00000251, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square transformed to achieve best W statistic (graph shown in original units).

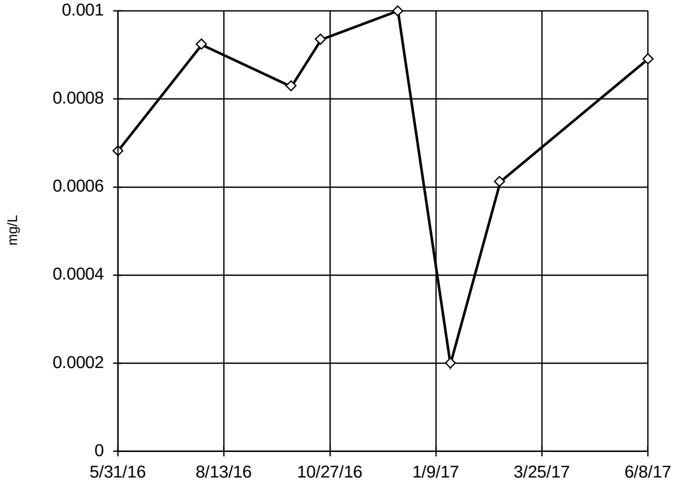
High cutoff = 0.005831, low cutoff = 0.001581, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found.
Tukey's method selected by user.

Data were x^4 transformed to achieve best W statistic (graph shown in original units).

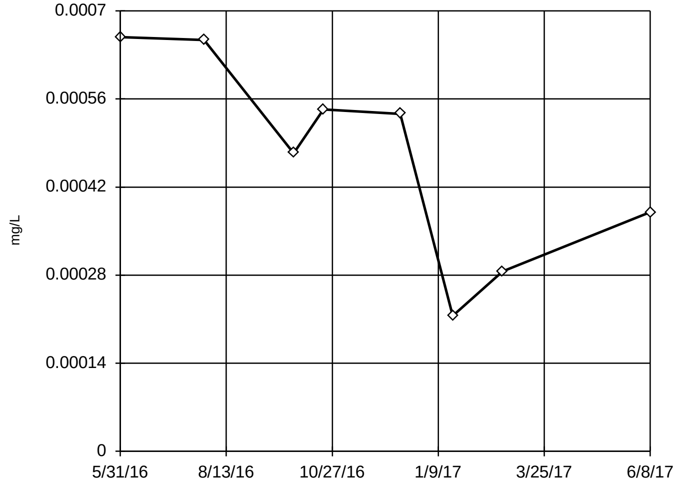
High cutoff = 0.00125, low cutoff = -0.00111, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

No outliers found.
Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

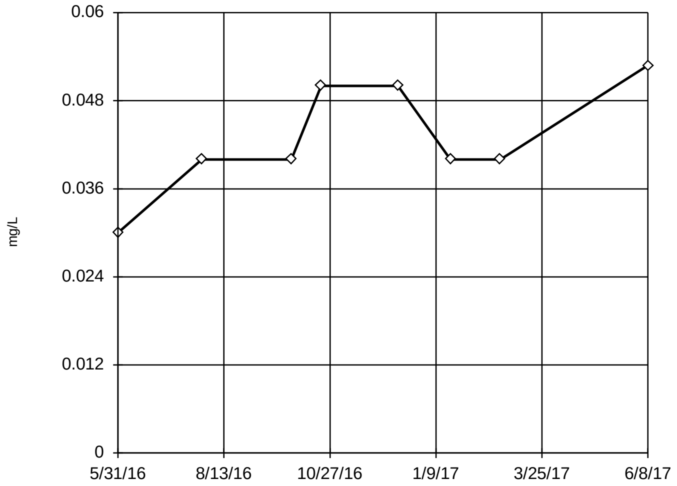
High cutoff = 0.001395, low cutoff = -0.0004635, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

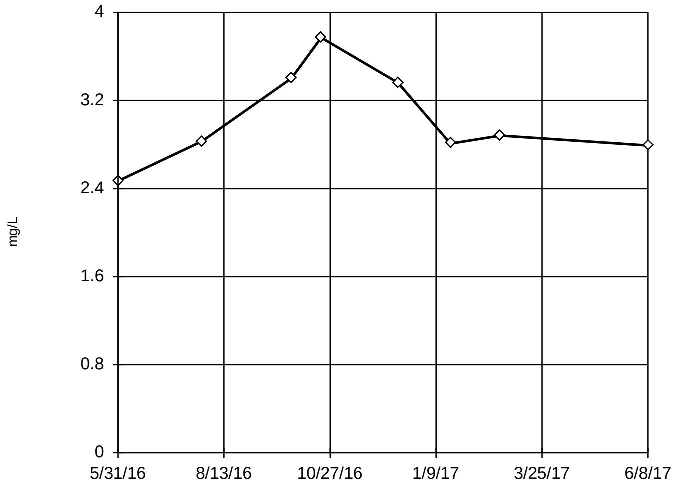
High cutoff = 0.08, low cutoff = 0.01, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

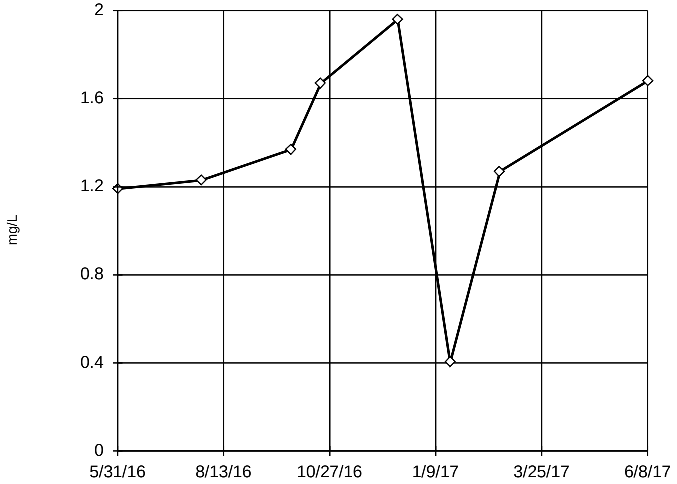
High cutoff = 5.945, low cutoff = 1.592, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

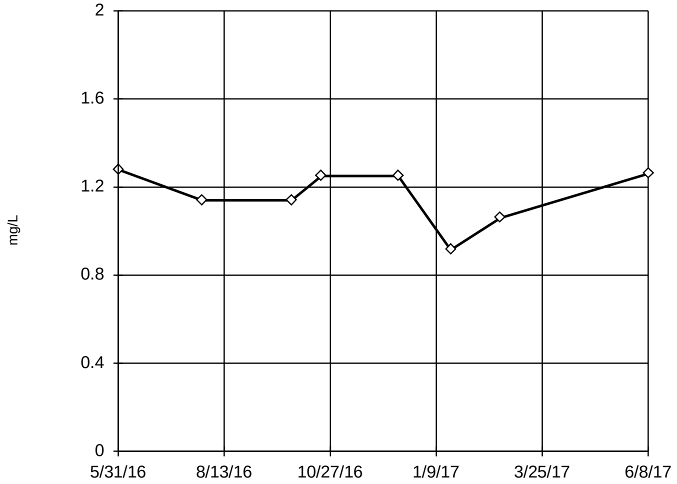
High cutoff = 2.613, low cutoff = -1.6, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

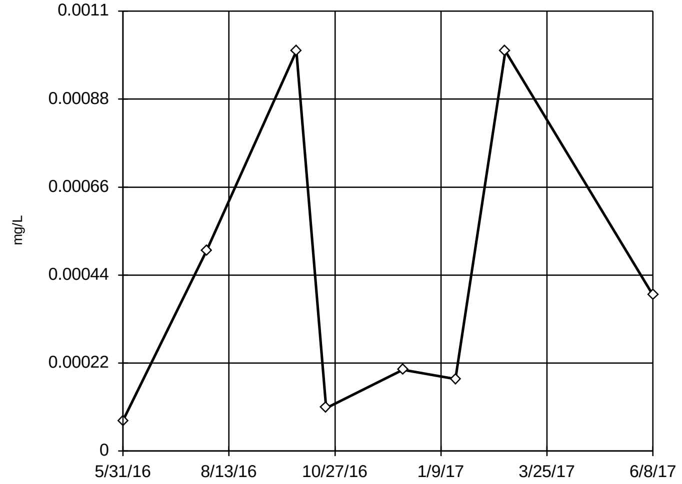
High cutoff = 1.473, low cutoff = -1.285, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

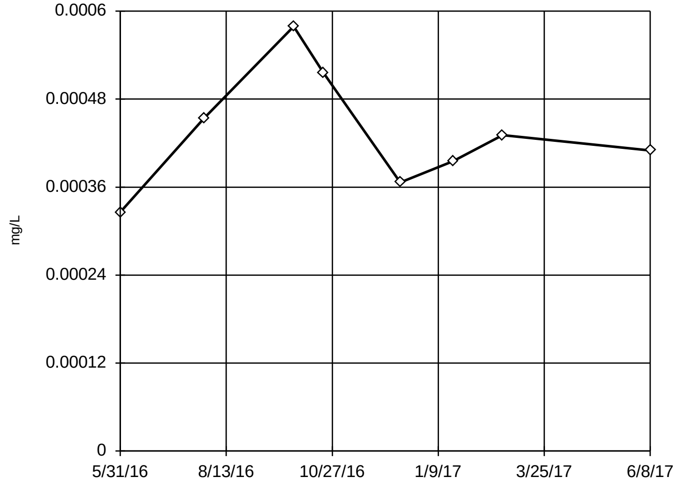
High cutoff = 0.09331, low cutoff = 0.000001058, based on IQR multiplier of 3.

Constituent: Cadmium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

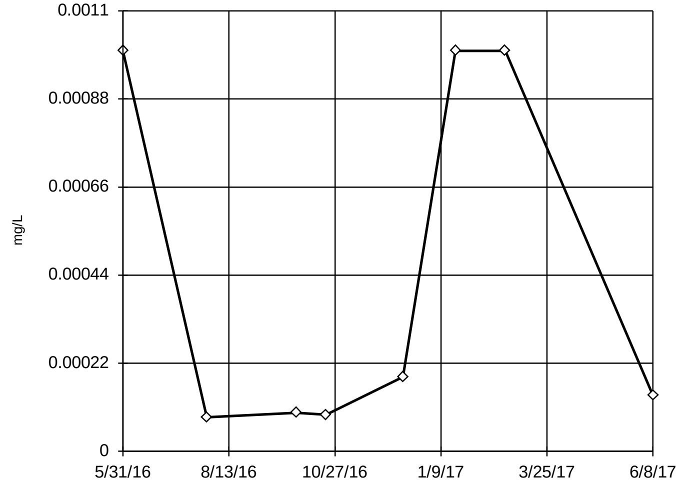
High cutoff = 0.0009957, low cutoff = 0.0001848, based on IQR multiplier of 3.

Constituent: Cadmium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

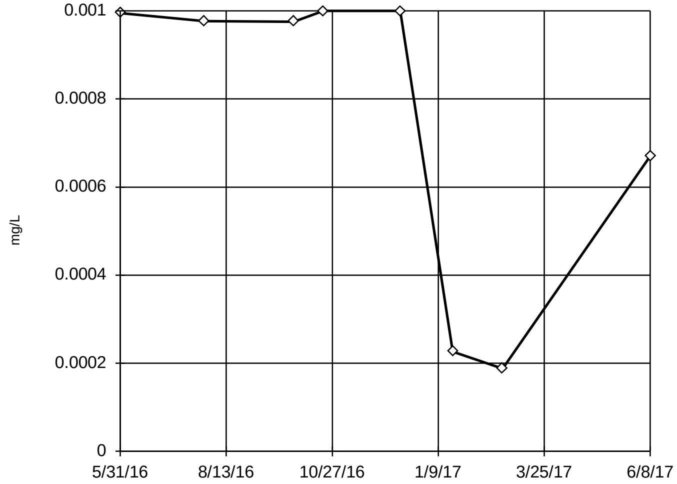
High cutoff = 1.207, low cutoff = 7.8e-8, based on IQR multiplier of 3.

Constituent: Cadmium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

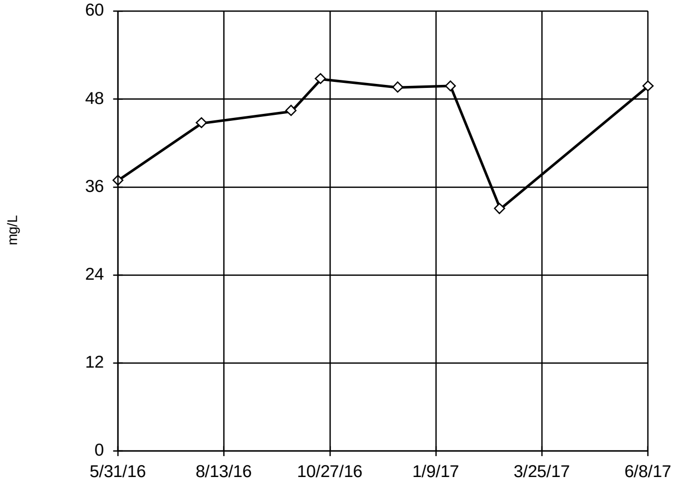
High cutoff = 0.001249, low cutoff = -0.001185, based on IQR multiplier of 3.

Constituent: Cadmium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

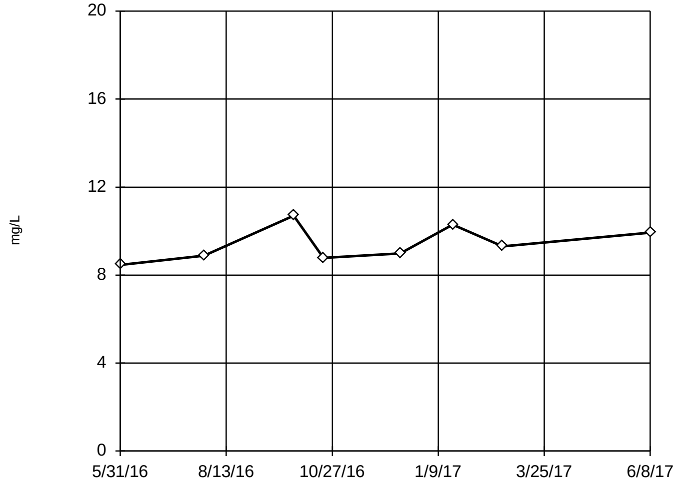
High cutoff = 59.62, low cutoff = -53.89, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

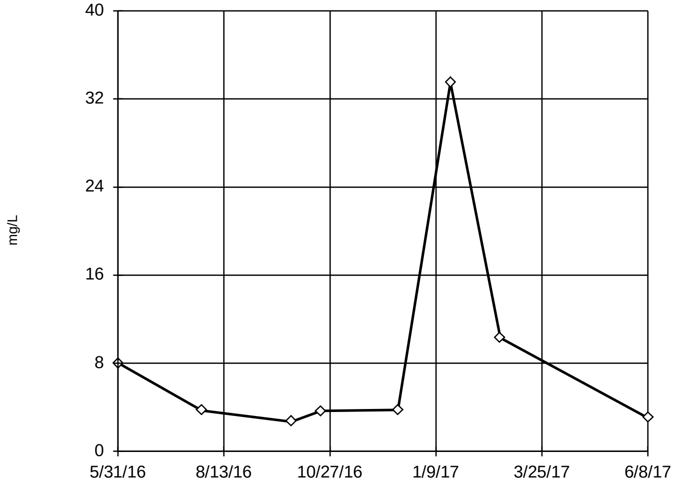
High cutoff = 15.2, low cutoff = 5.877, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

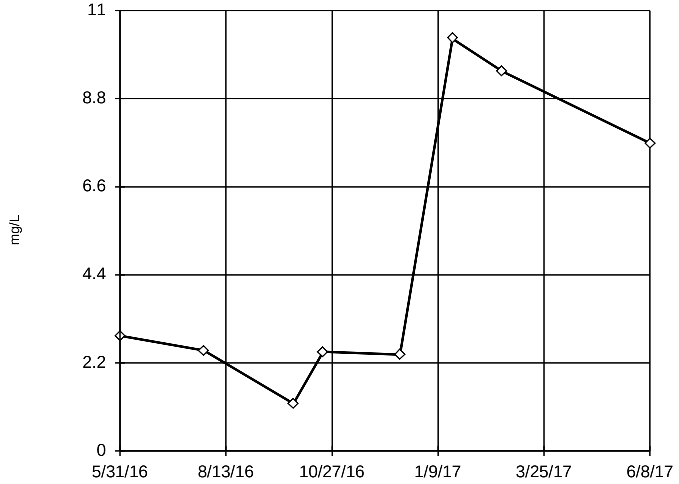
High cutoff = 184.8, low cutoff = 0.1638, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

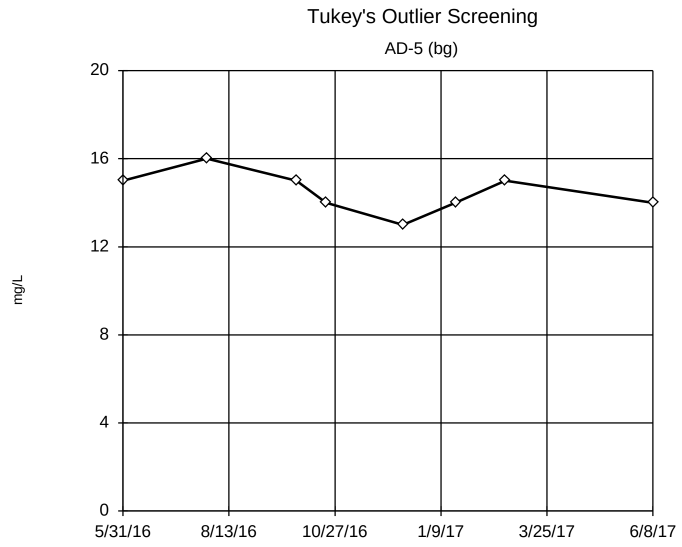
No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 363.7, low cutoff = 0.05739, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

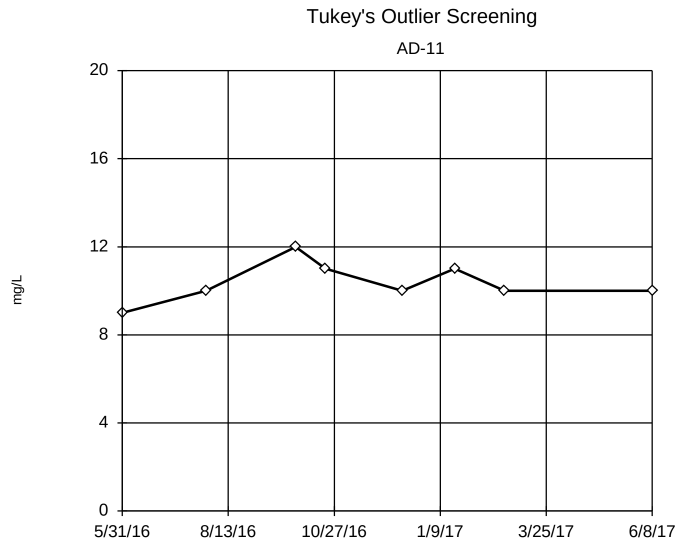
No outliers found.
Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 18, low cutoff = 11, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

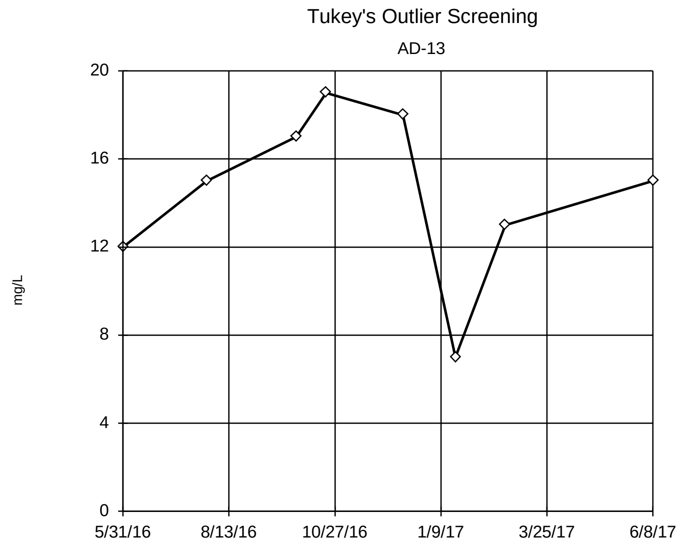
No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 14.64, low cutoff = 7.513, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

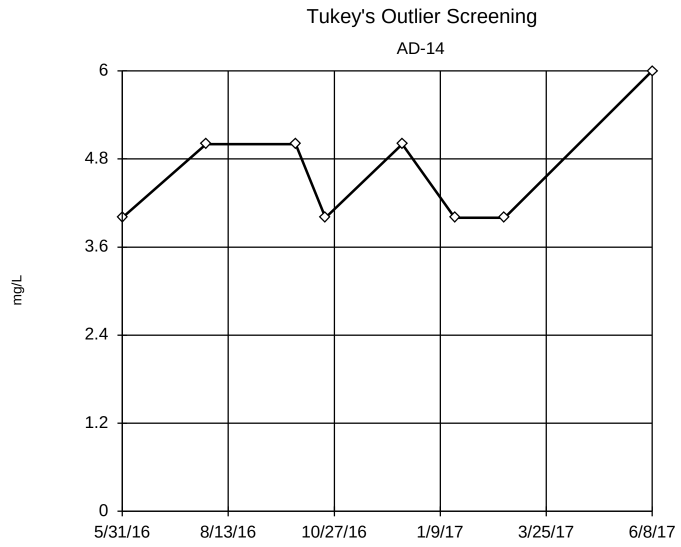
No outliers found.
Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 24.99, low cutoff = -20.22, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

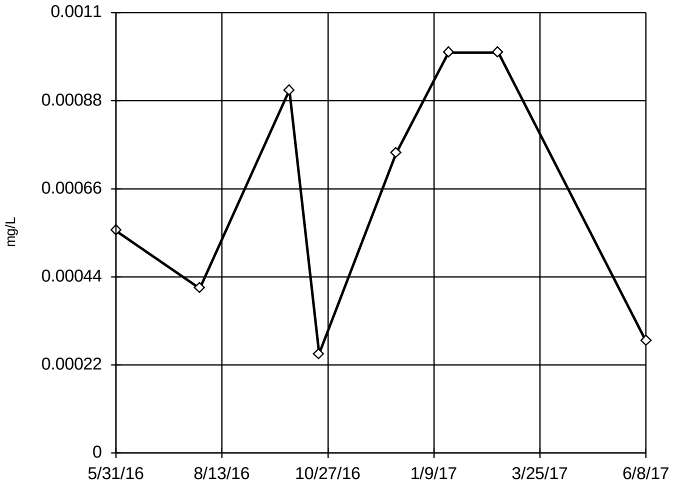
High cutoff = 8.669, low cutoff = 1.669, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

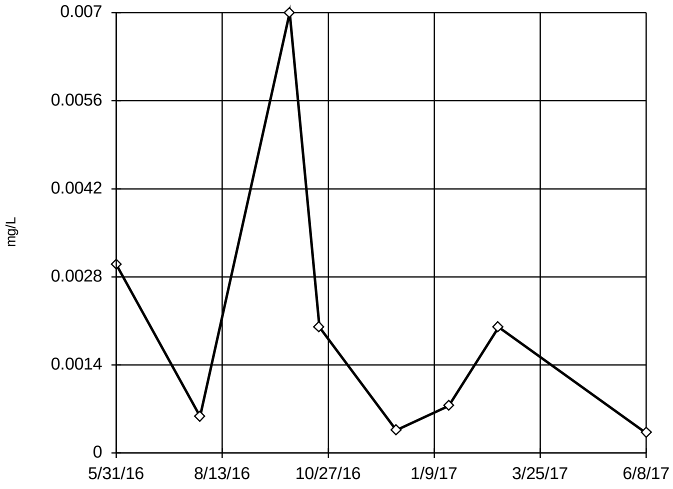
High cutoff = 0.004616, low cutoff = -0.0003447, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

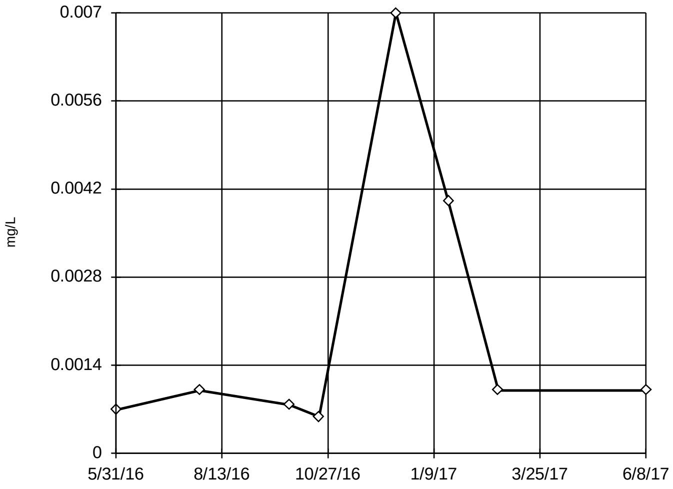
High cutoff = 0.3675, low cutoff = 0.000003072, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

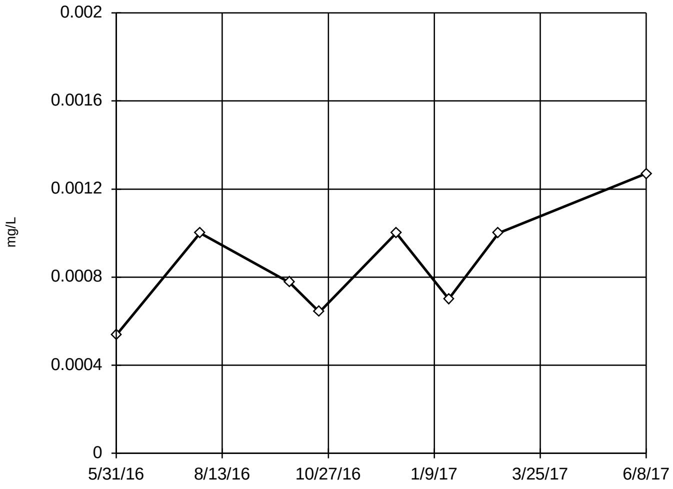
High cutoff = 0.04113, low cutoff = 0.00003549, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

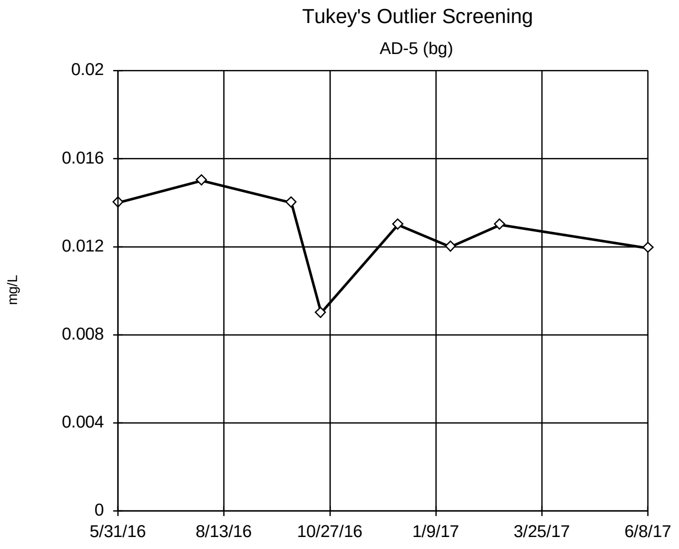
No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.002597, low cutoff = 0.0001254, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

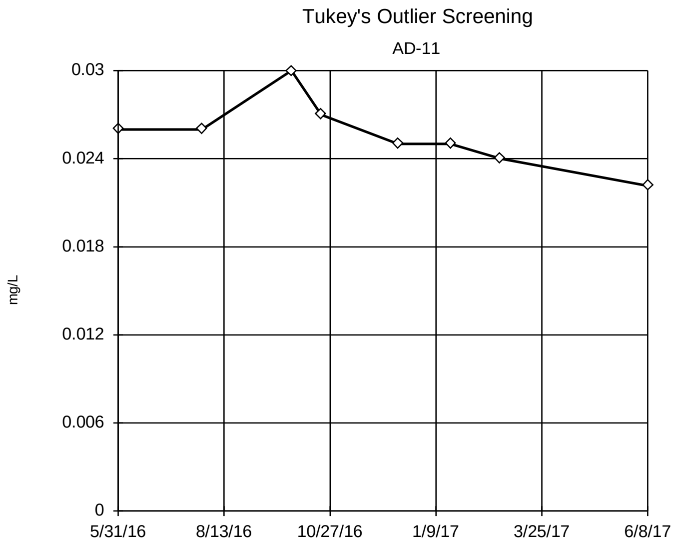
No outliers found. Tukey's method selected by user.

Data were x^4 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.01742, low cutoff = -0.0135, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

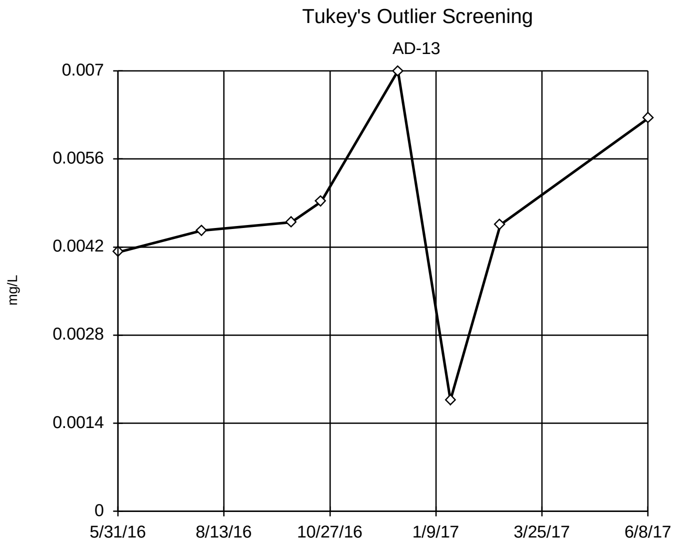
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.03353, low cutoff = 0.01936, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

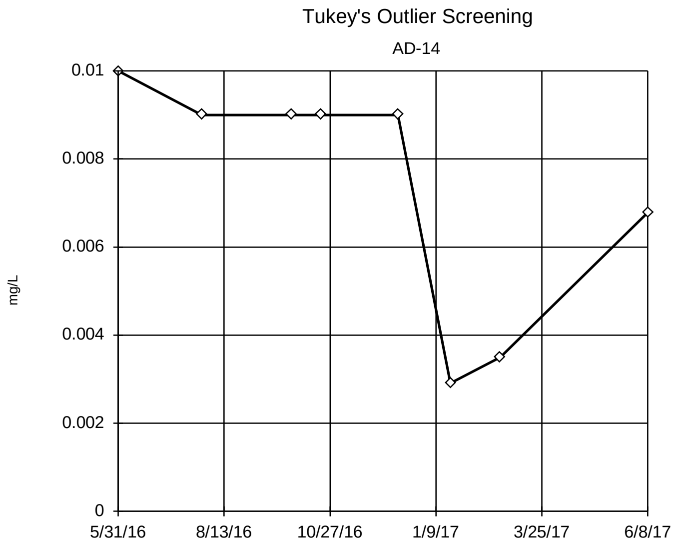
No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.008427, low cutoff = -0.004586, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were x^5 transformed to achieve best W statistic (graph shown in original units).

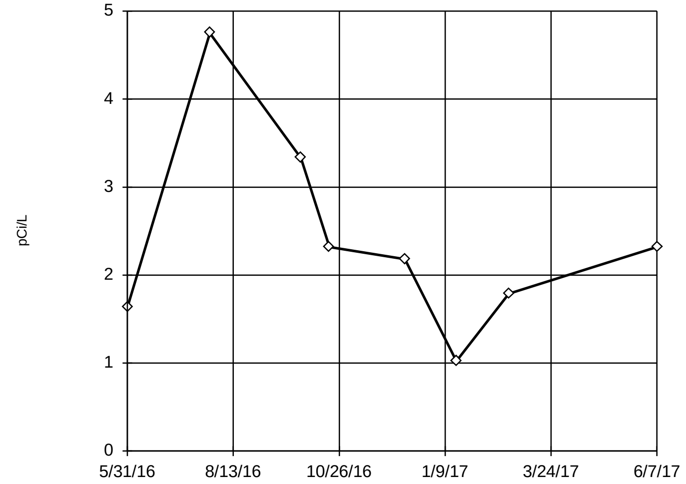
High cutoff = 0.01164, low cutoff = -0.01081, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

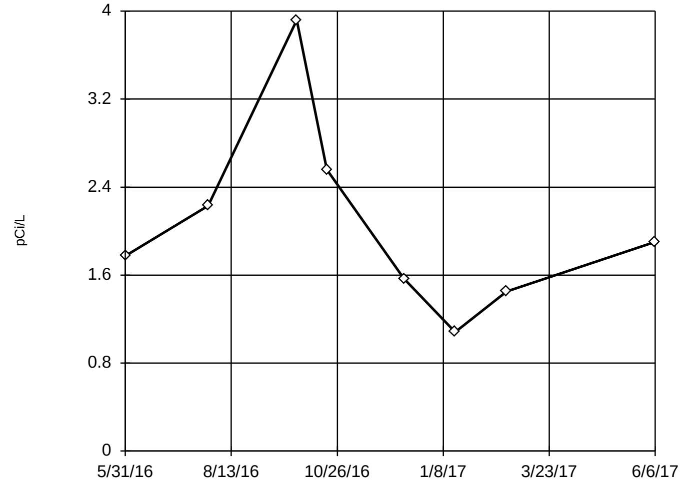
High cutoff = 11.95, low cutoff = 0.3975, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Scree
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

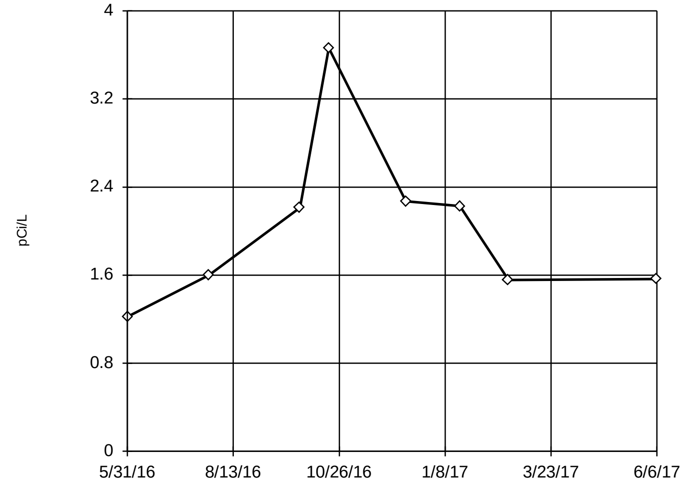
High cutoff = 9.497, low cutoff = 0.3795, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Scree
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

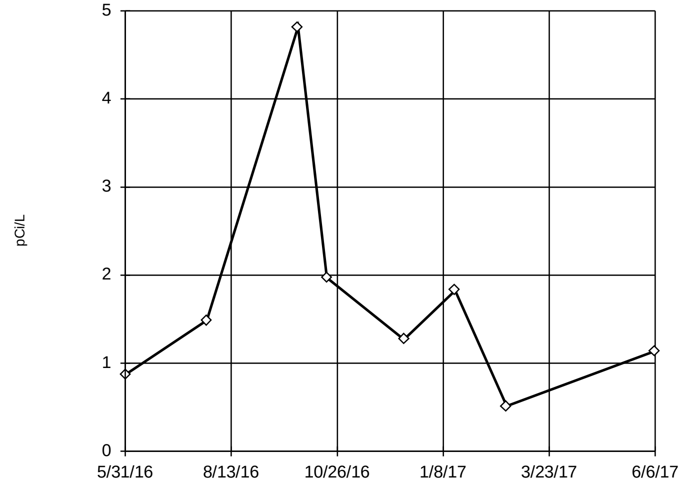
High cutoff = 6.731, low cutoff = 0.5214, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Scree
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

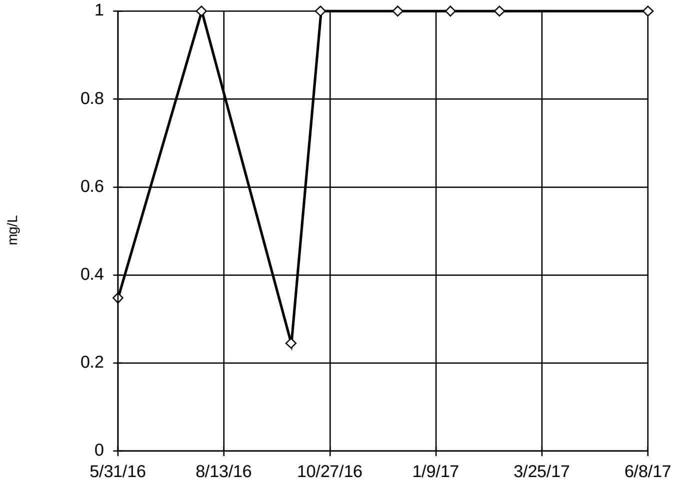
High cutoff = 13.12, low cutoff = 0.1439, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Scree
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

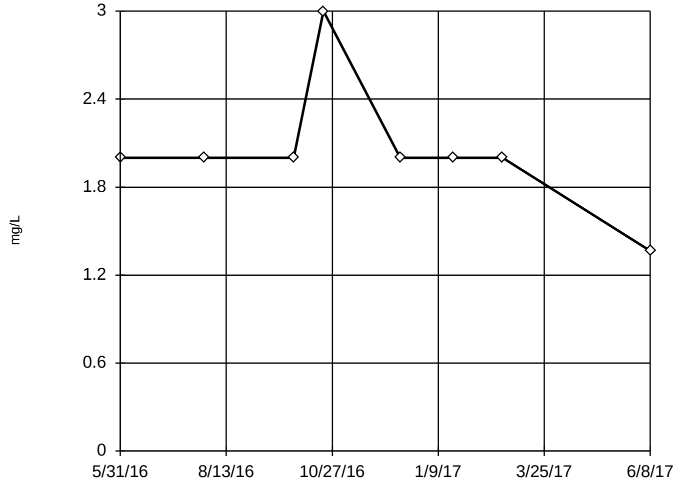
High cutoff = 4.894, low cutoff = 0.1203, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

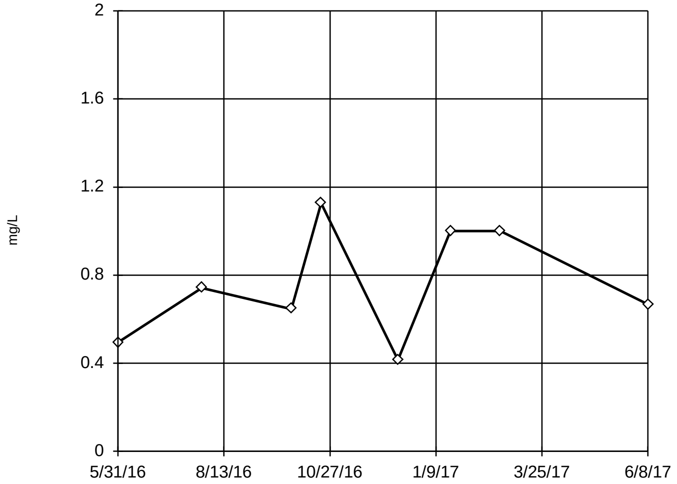
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Fluoride, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found.
Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

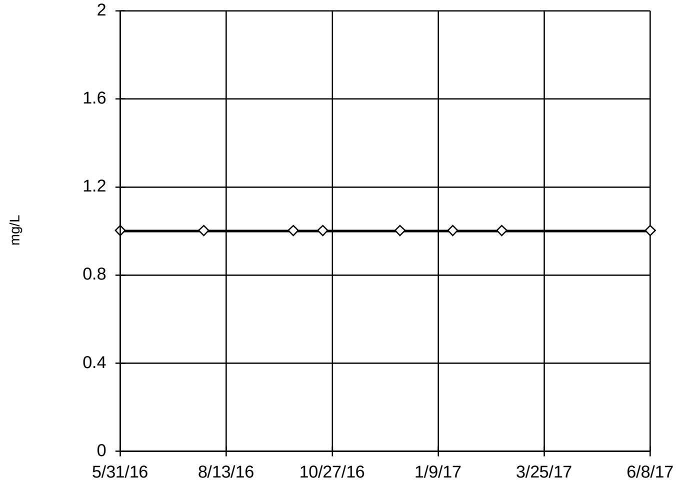
High cutoff = 3.489, low cutoff = 0.03012, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

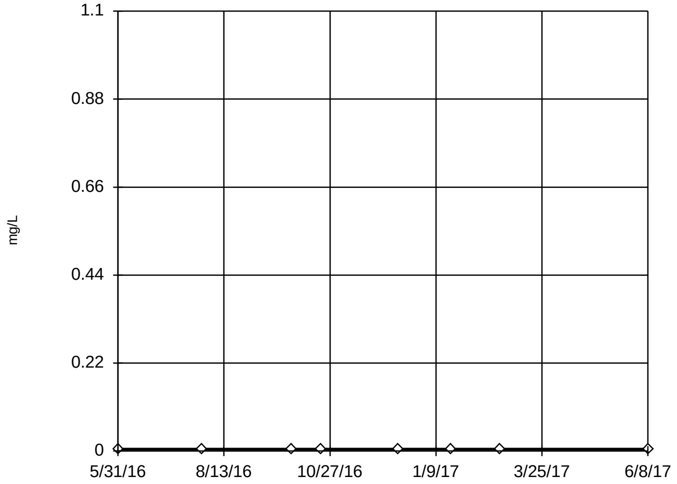
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Fluoride, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

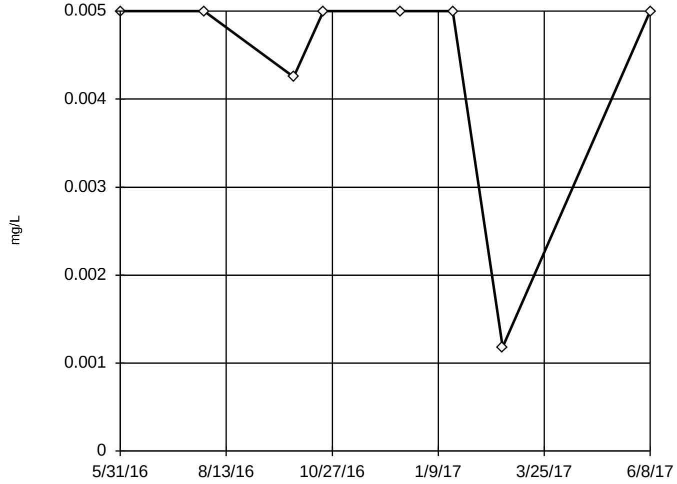
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Lead, total   Analysis Run 12/29/2017 8:26 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

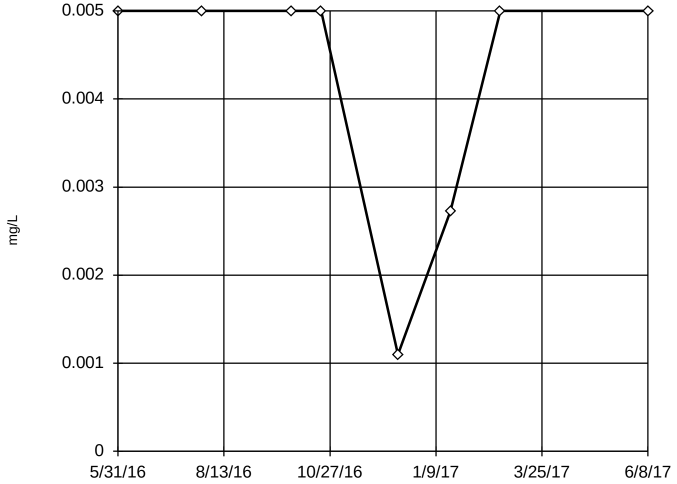
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Lead, total   Analysis Run 12/29/2017 8:26 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

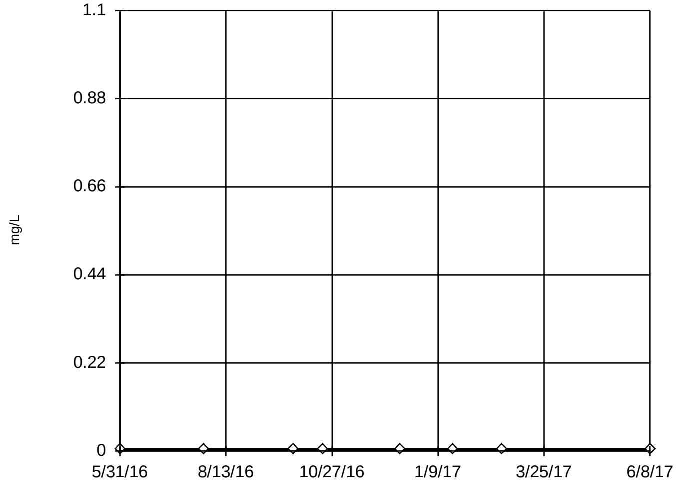
High cutoff = 0.00841, low cutoff = 0.0004532, based on IQR multiplier of 3.

Constituent: Lead, total   Analysis Run 12/29/2017 8:26 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

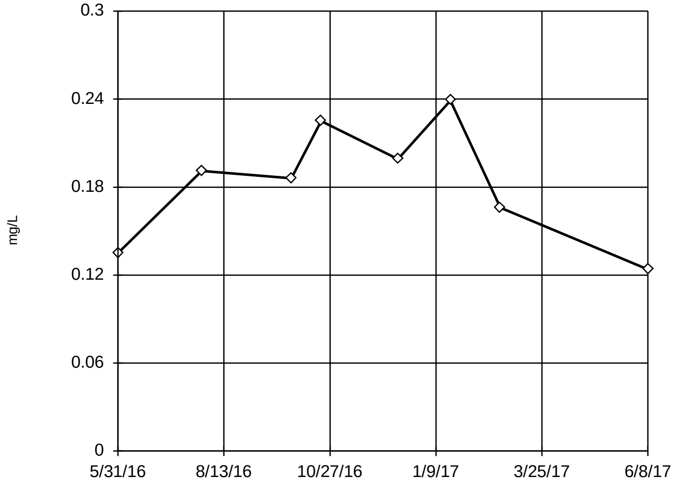
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Lead, total   Analysis Run 12/29/2017 8:26 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

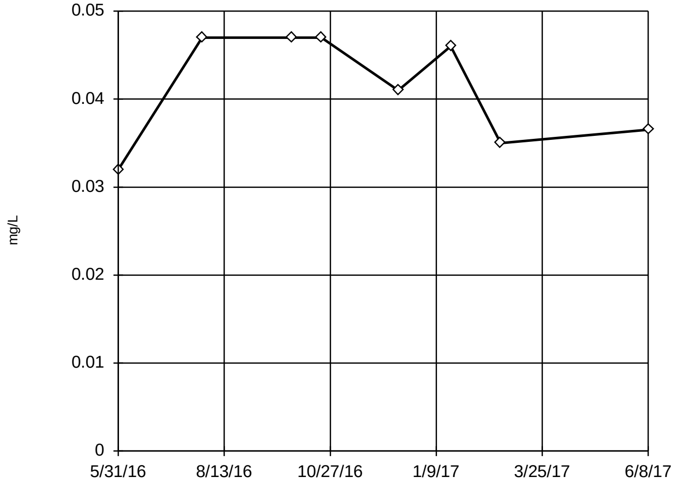
High cutoff = 0.3343, low cutoff = -0.2092, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

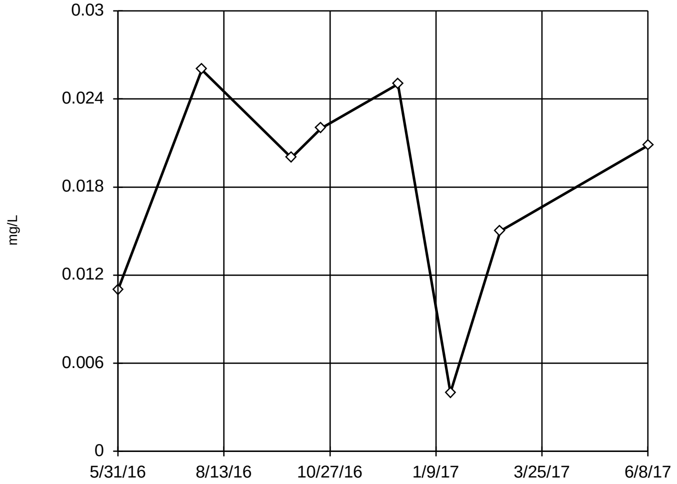
High cutoff = 0.1067, low cutoff = 0.01575, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

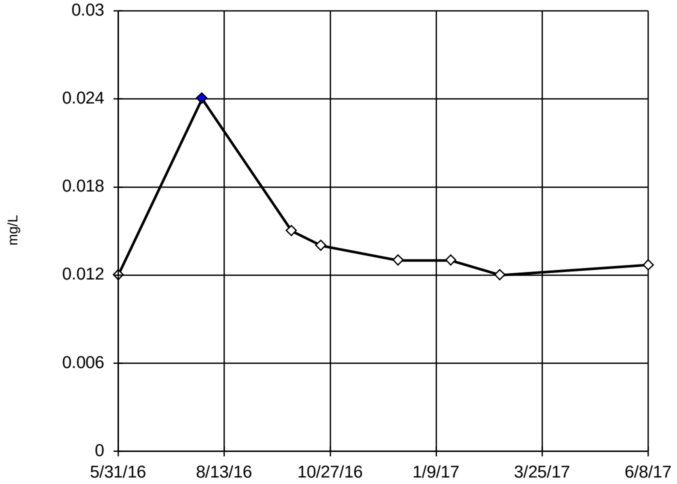
High cutoff = 0.04122, low cutoff = -0.03117, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

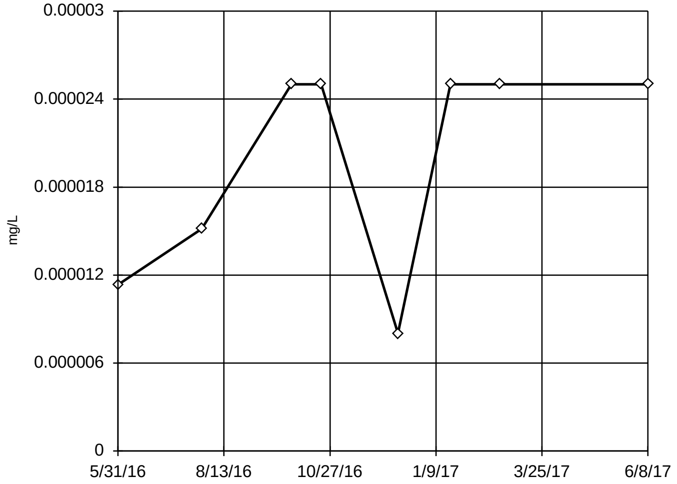
High cutoff = 0.02344, low cutoff = 0.007632, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

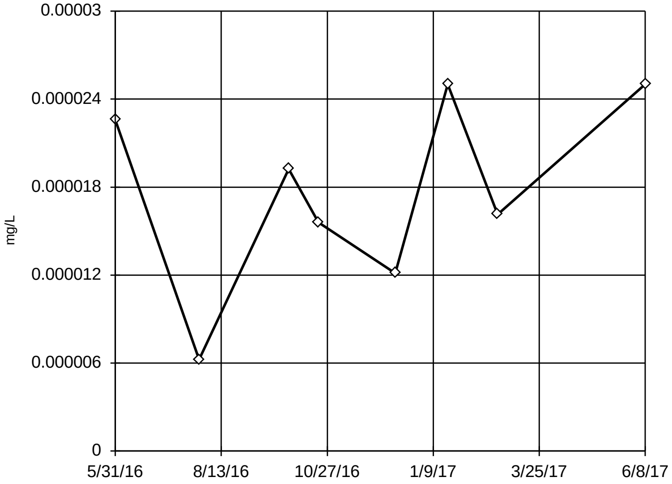
High cutoff = 0.0001731, low cutoff = 0.000001895, based on IQR multiplier of 3.

Constituent: Mercury, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

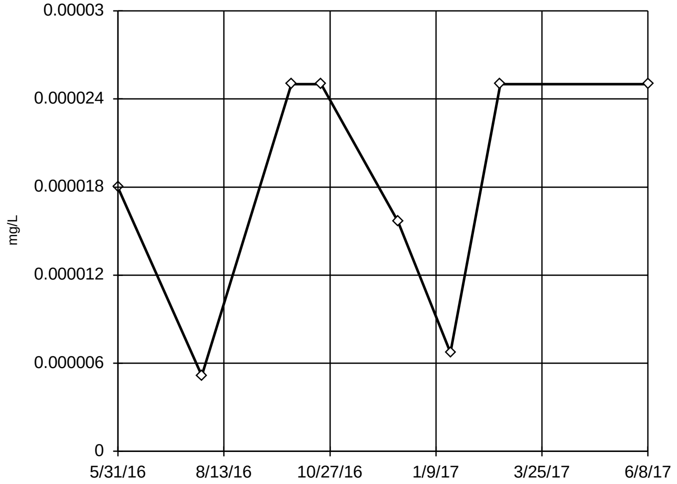
High cutoff = 0.00005358, low cutoff = -0.00001593, based on IQR multiplier of 3.

Constituent: Mercury, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

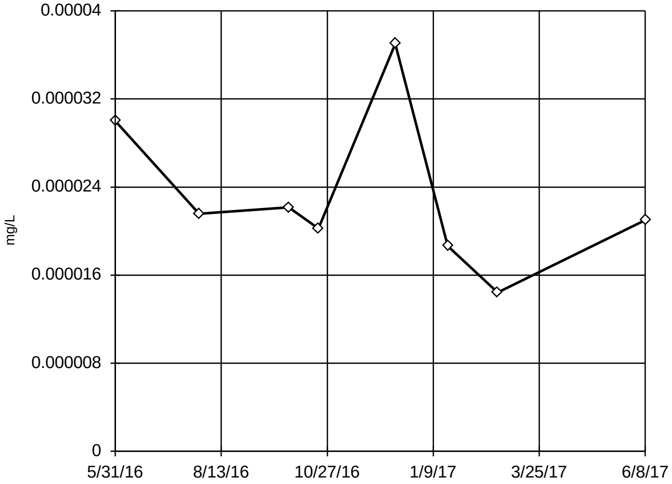
High cutoff = 0.00006643, low cutoff = -0.00003024, based on IQR multiplier of 3.

Constituent: Mercury, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

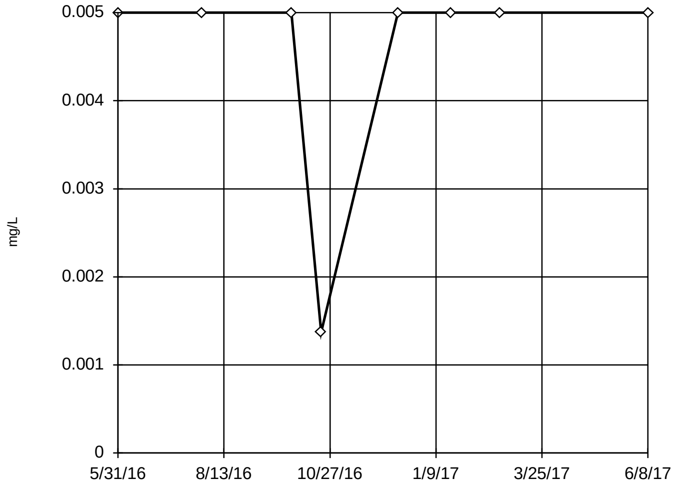
High cutoff = 0.00006041, low cutoff = 0.000008289, based on IQR multiplier of 3.

Constituent: Mercury, total Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

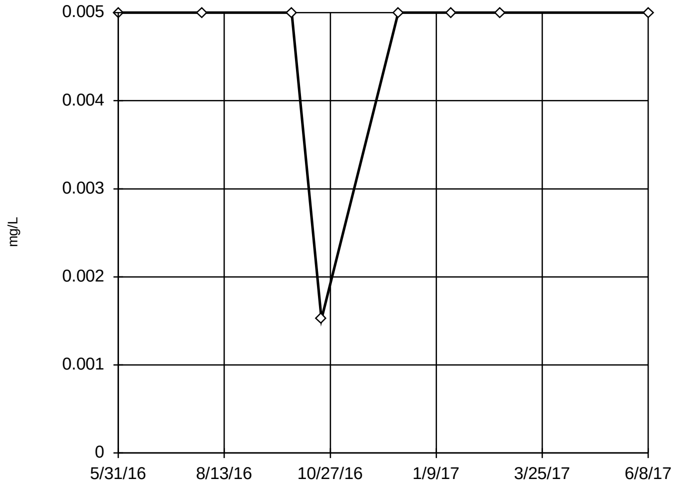
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Molybdenum, total   Analysis Run 12/29/2017 8:26 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

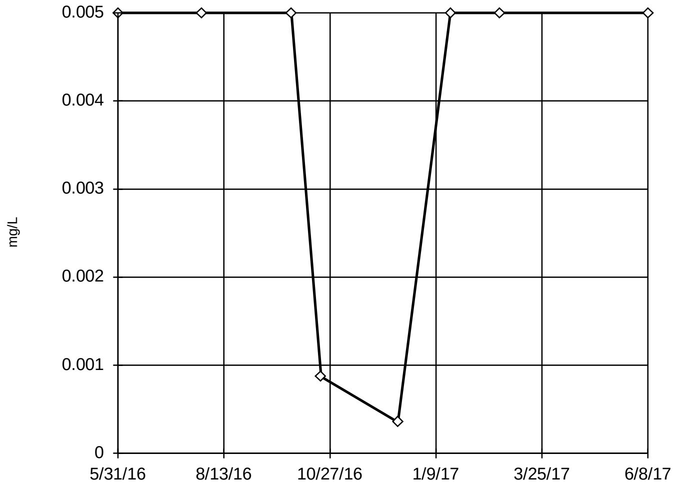
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Molybdenum, total   Analysis Run 12/29/2017 8:26 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

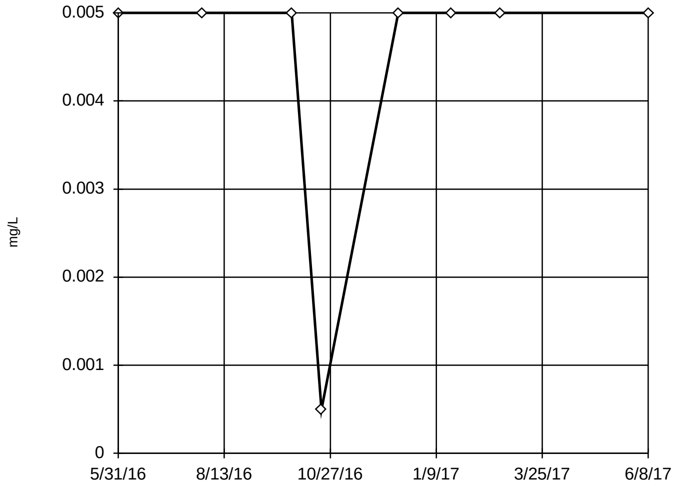
High cutoff = 0.06883, low cutoff = 0.0001516, based on IQR multiplier of 3.

Constituent: Molybdenum, total   Analysis Run 12/29/2017 8:26 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

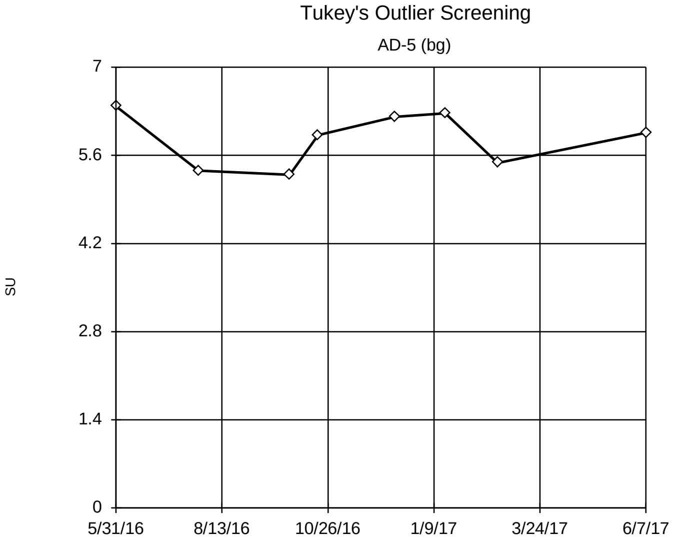
No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Molybdenum, total   Analysis Run 12/29/2017 8:26 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

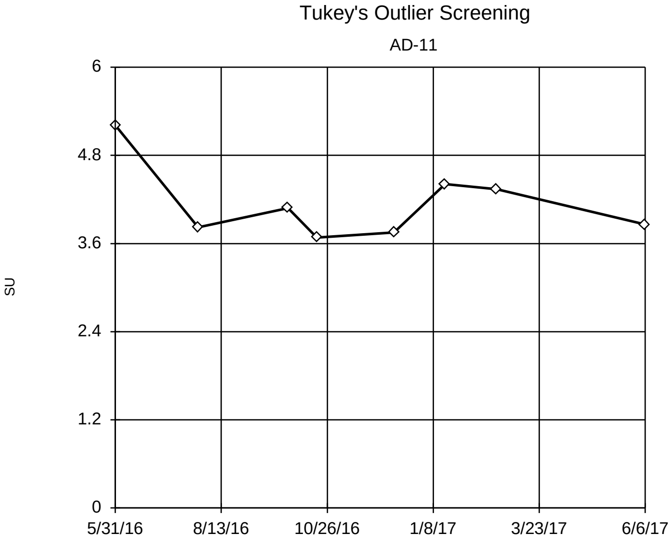
No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 7.368, low cutoff = -6.502, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

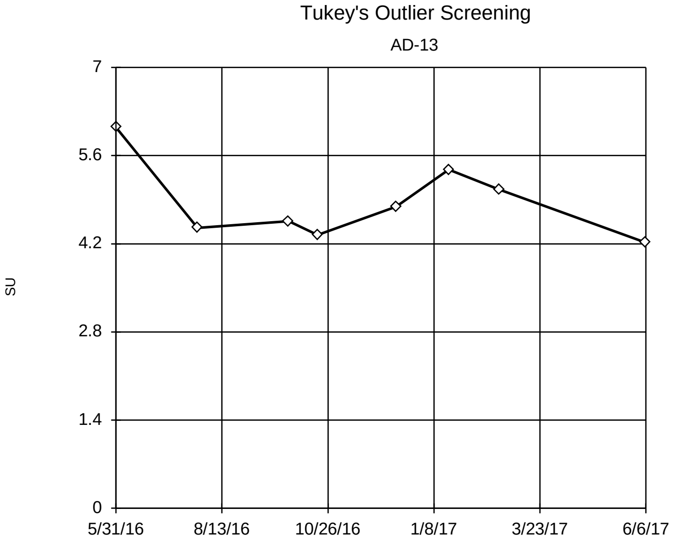
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 6.756, low cutoff = 2.451, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

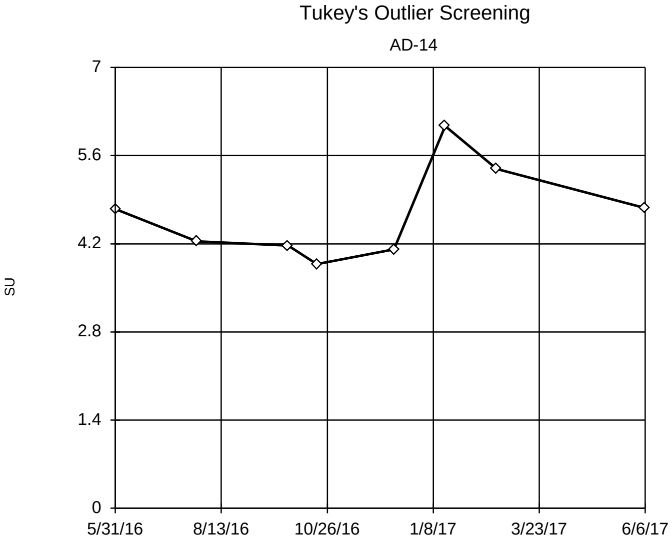
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 8.732, low cutoff = 2.626, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

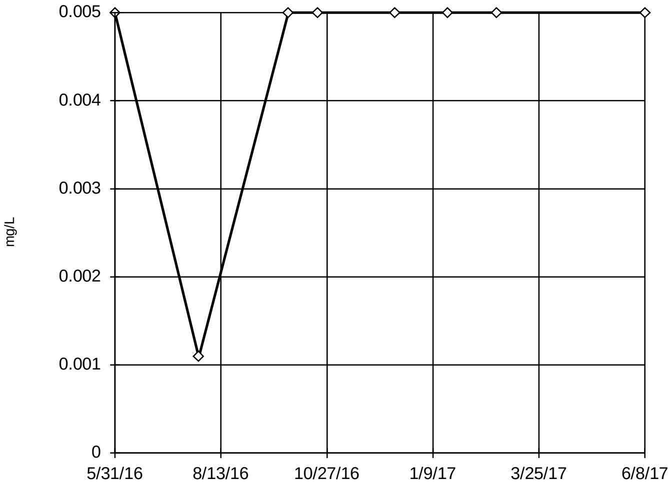
High cutoff = 9.316, low cutoff = 2.253, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 12/29/2017 8:26 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were x^5 transformed to achieve best W statistic (graph shown in original units).

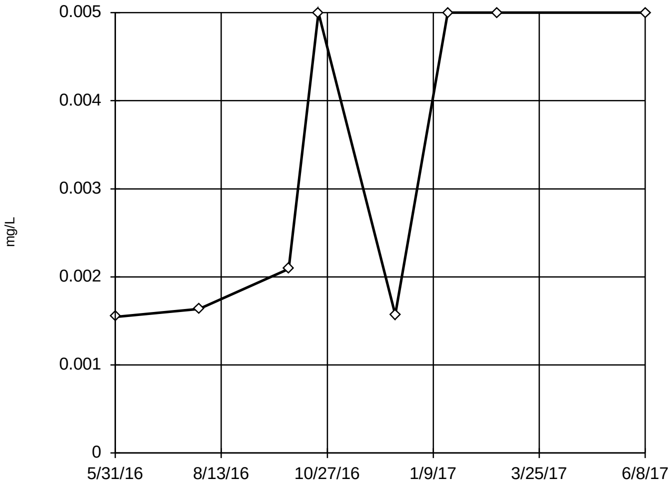
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Selenium, total Analysis Run 12/29/2017 8:27 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

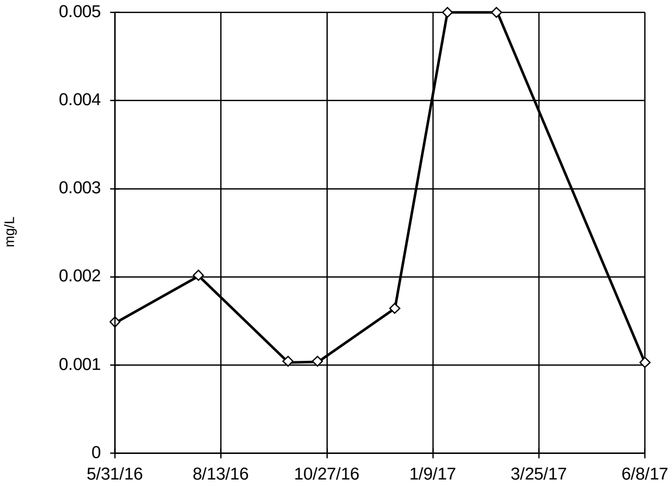
High cutoff = 0.1517, low cutoff = 0.00005284, based on IQR multiplier of 3.

Constituent: Selenium, total Analysis Run 12/29/2017 8:27 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

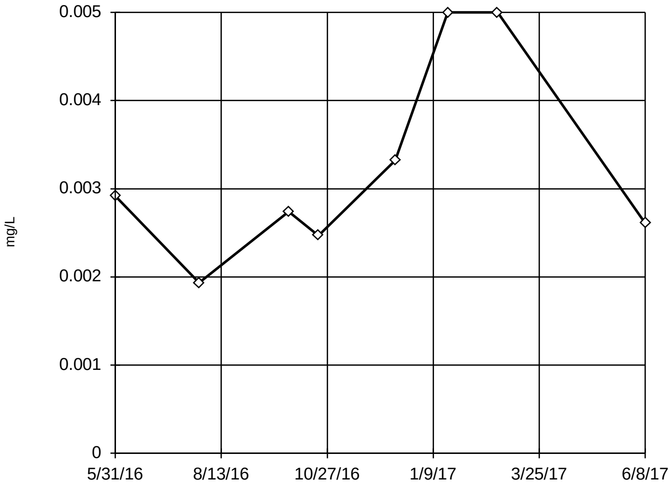
High cutoff = 0.0914, low cutoff = 0.00003586, based on IQR multiplier of 3.

Constituent: Selenium, total Analysis Run 12/29/2017 8:27 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

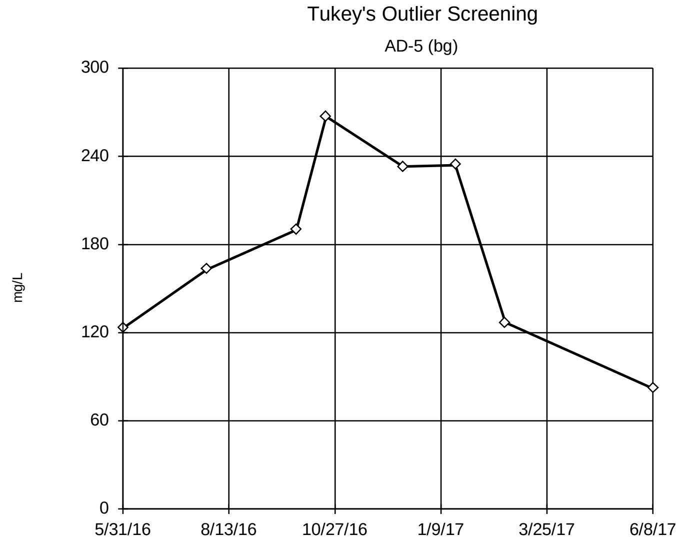
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.01684, low cutoff = 0.000614, based on IQR multiplier of 3.

Constituent: Selenium, total Analysis Run 12/29/2017 8:27 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

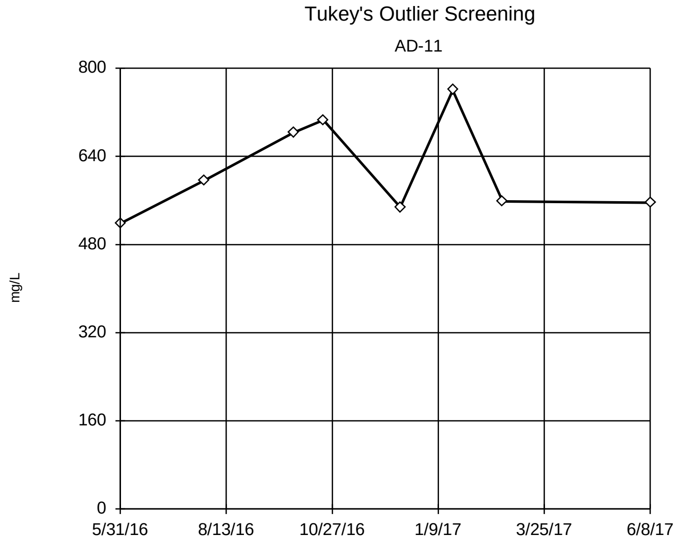
No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 559, low cutoff = -200.5, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 12/29/2017 8:27 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

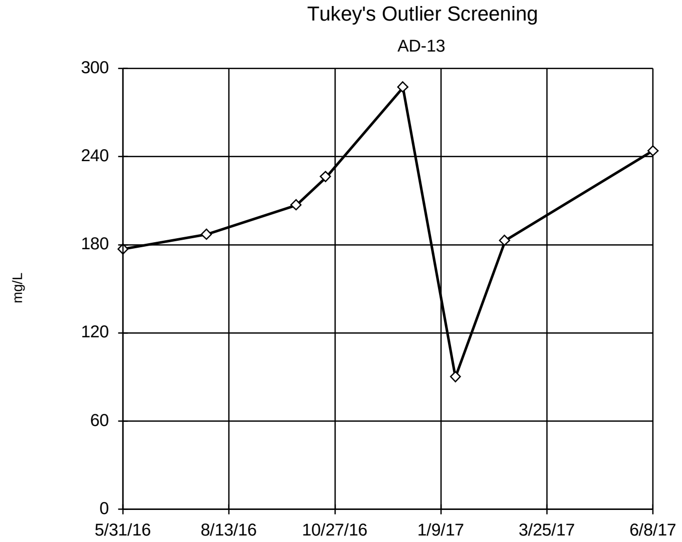
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1383, low cutoff = 277.3, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 12/29/2017 8:27 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

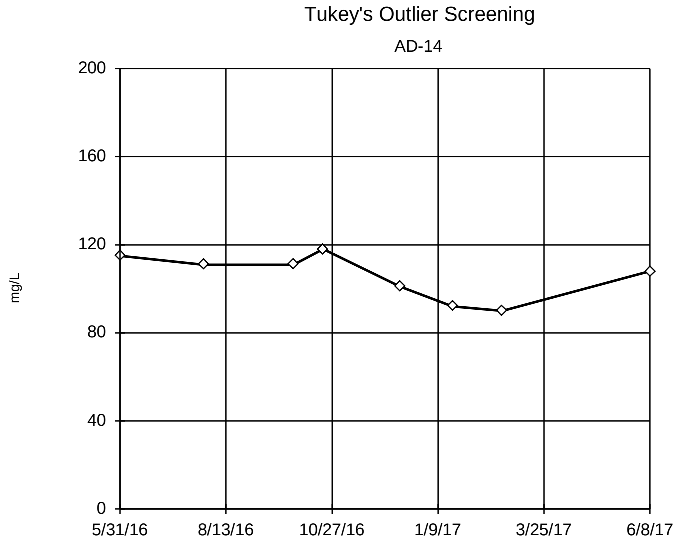
No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 352.1, low cutoff = -190.5, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 12/29/2017 8:27 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



n = 8

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

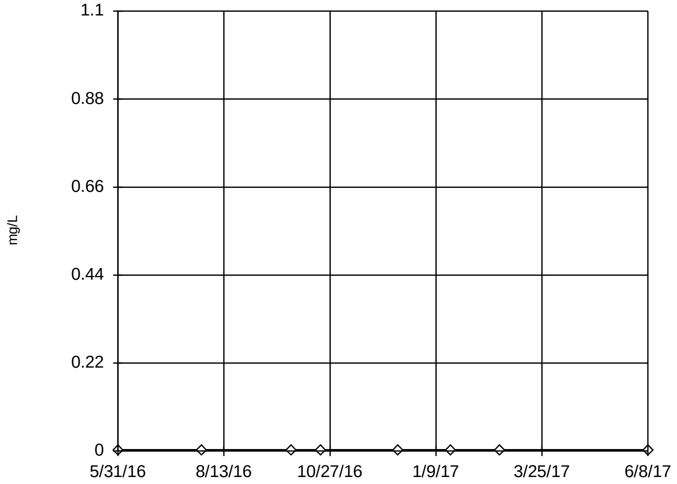
High cutoff = 134.3, low cutoff = -119.7, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 12/29/2017 8:27 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

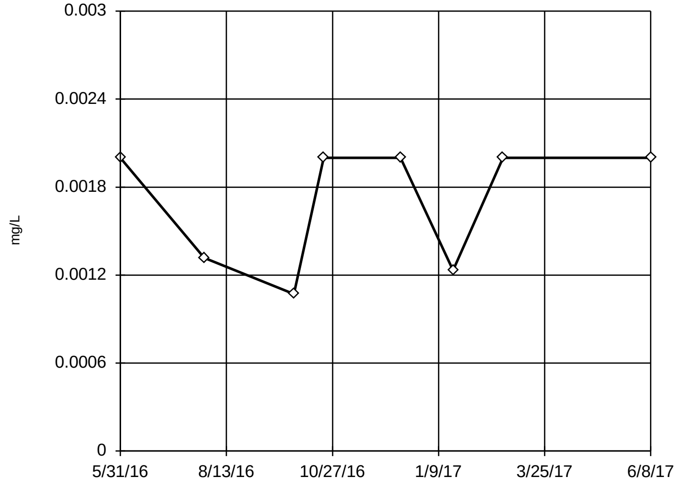
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium, total   Analysis Run 12/29/2017 8:27 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

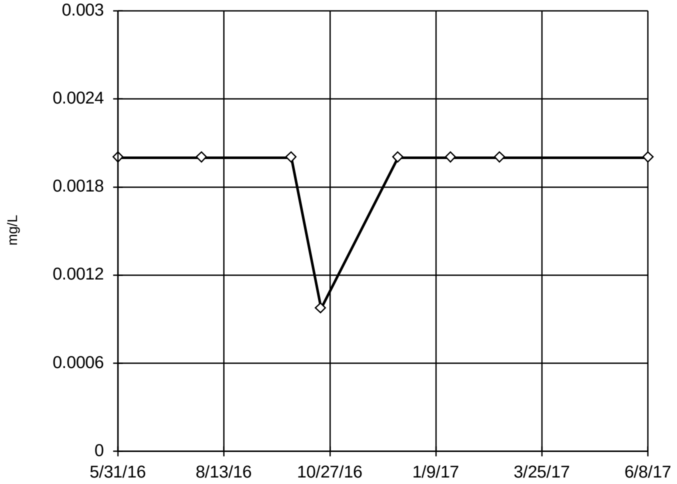
High cutoff = 0.00775, low cutoff = 0.0003286, based on IQR multiplier of 3.

Constituent: Thallium, total   Analysis Run 12/29/2017 8:27 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were cube transformed to achieve best W statistic (graph shown in original units).

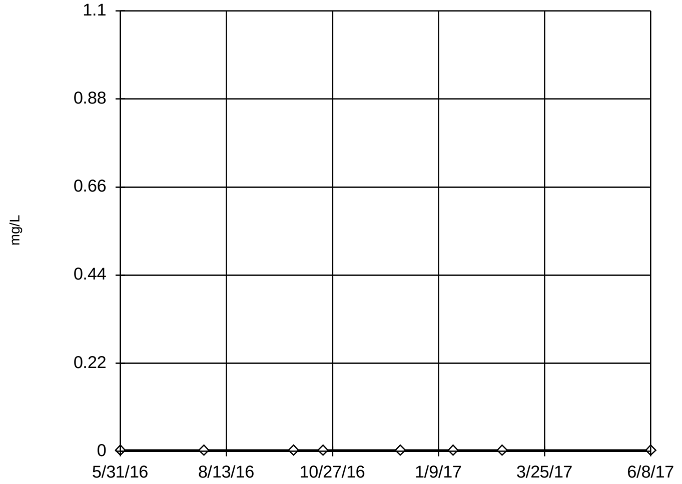
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium, total   Analysis Run 12/29/2017 8:27 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

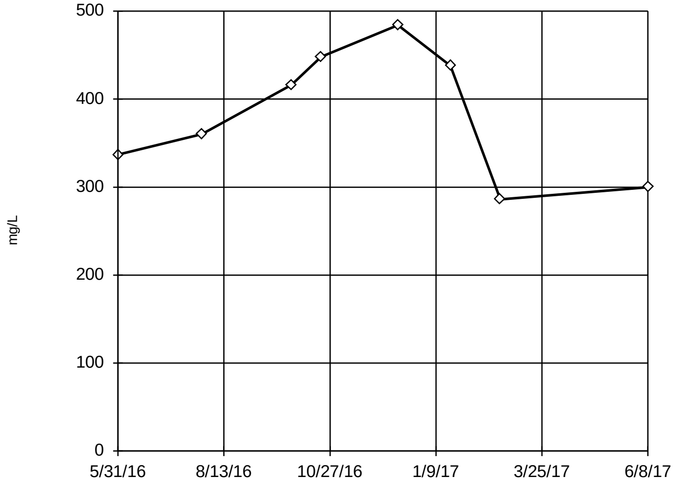
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium, total   Analysis Run 12/29/2017 8:27 AM   View: Tukey's Outlier Screening
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-5 (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

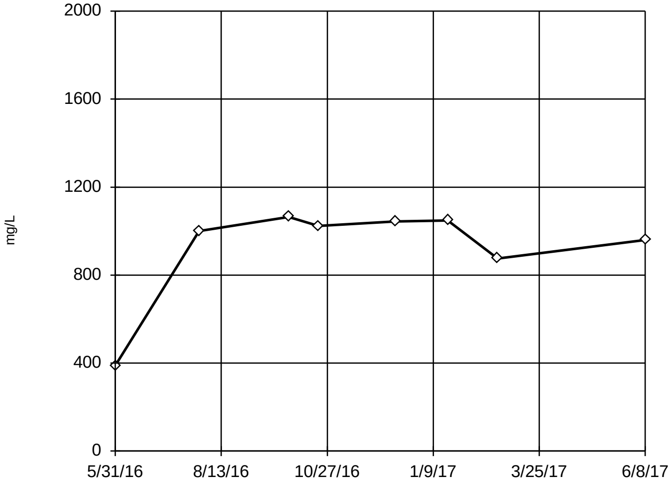
High cutoff = 692.6, low cutoff = -426.2, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 12/29/2017 8:27 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-11



n = 8

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

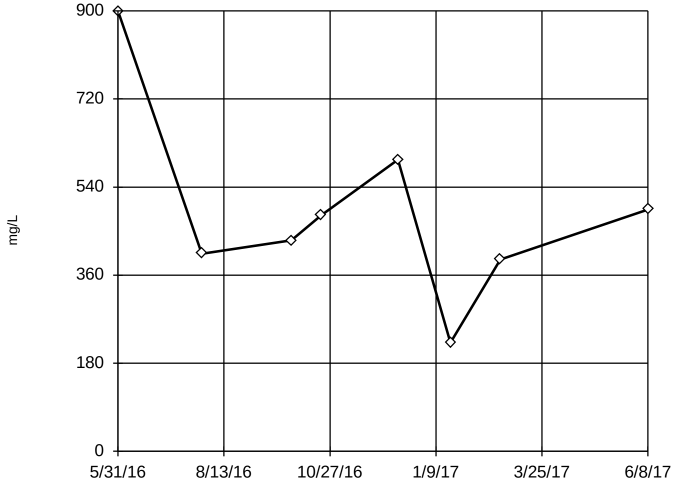
High cutoff = 1225, low cutoff = -1065, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 12/29/2017 8:27 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-13



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

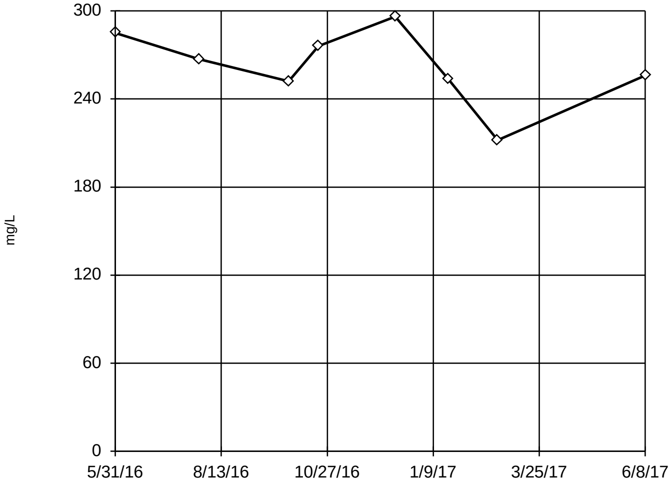
High cutoff = 1375, low cutoff = 157, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 12/29/2017 8:27 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-14



n = 8

No outliers found. Tukey's method selected by user.

Data were x^4 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 334.4, low cutoff = -216.8, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 12/29/2017 8:27 AM View: Tukey's Outlier Screening
Welsh LF Client: Geosyntec Data: Welsh LF

Trend Tests Summary Table - All Results

Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/29/2017, 8:38 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Antimony, total (mg/L)	AD-5 (bg)	0	5	21	No	8	87.5	n/a	n/a	0.01	NP
Antimony, total (mg/L)	AD-11	0	0	21	No	8	100	n/a	n/a	0.01	NP
Antimony, total (mg/L)	AD-13	0	-7	-21	No	8	87.5	n/a	n/a	0.01	NP
Antimony, total (mg/L)	AD-14	0	0	21	No	8	100	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AD-5 (bg)	0	0	21	No	8	50	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AD-11	0	-5	-21	No	8	75	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AD-13	0	1	21	No	8	75	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AD-14	0	9	21	No	8	75	n/a	n/a	0.01	NP
Barium, total (mg/L)	AD-5 (bg)	-0.04345	-10	-21	No	8	0	n/a	n/a	0.01	NP
Barium, total (mg/L)	AD-11	-0.002541	-7	-21	No	8	0	n/a	n/a	0.01	NP
Barium, total (mg/L)	AD-13	-0.02119	-4	-21	No	8	0	n/a	n/a	0.01	NP
Barium, total (mg/L)	AD-14	0.01043	6	21	No	8	0	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AD-5 (bg)	-0.0002124	-16	-21	No	8	0	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AD-11	0	-9	-21	No	8	0	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AD-13	0.000005516	0	21	No	8	0	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AD-14	-0.0003213	-18	-21	No	8	0	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AD-5 (bg)	0.0002641	7	21	No	8	25	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AD-11	-4.0e-7	0	21	No	8	0	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AD-13	0.00006357	7	21	No	8	37.5	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AD-14	-0.0003809	-11	-21	No	8	0	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AD-5 (bg)	0.0002677	5	21	No	8	25	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AD-11	-0.001955	-11	-21	No	8	0	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AD-13	0.0003174	7	21	No	8	37.5	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AD-14	0.0005593	13	21	No	8	12.5	n/a	n/a	0.01	NP
Cobalt, total (mg/L)	AD-5 (bg)	-0.002747	-14	-21	No	8	0	n/a	n/a	0.01	NP
Cobalt, total (mg/L)	AD-11	-0.004767	-18	-21	No	8	0	n/a	n/a	0.01	NP
Cobalt, total (mg/L)	AD-13	0.002022	10	21	No	8	0	n/a	n/a	0.01	NP
Cobalt, total (mg/L)	AD-14	-0.00319	-16	-21	No	8	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AD-5 (bg)	-1.506	-6	-21	No	8	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AD-11	-0.8237	-8	-21	No	8	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AD-13	0.04024	2	21	No	8	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AD-14	-0.531	-6	-21	No	8	0	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-5 (bg)	0	9	21	No	8	75	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-11	0	-7	-21	No	8	0	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-13	0.3093	5	21	No	8	25	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-14	0	0	21	No	8	100	n/a	n/a	0.01	NP
Lead, total (mg/L)	AD-5 (bg)	0	0	21	No	8	100	n/a	n/a	0.01	NP
Lead, total (mg/L)	AD-11	0	-3	-21	No	8	75	n/a	n/a	0.01	NP
Lead, total (mg/L)	AD-13	0	-3	-21	No	8	75	n/a	n/a	0.01	NP
Lead, total (mg/L)	AD-14	0	0	21	No	8	100	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AD-5 (bg)	0.005198	0	21	No	8	0	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AD-11	-0.003635	-7	-21	No	8	0	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AD-13	-0.002259	-2	-21	No	8	0	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AD-14	-0.002063	-7	-18	No	7	0	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AD-5 (bg)	0.000005719	10	21	No	8	62.5	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AD-11	0.000006075	7	21	No	8	25	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AD-13	0.000001648	6	21	No	8	50	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AD-14	-0.00001017	-12	-21	No	8	0	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AD-5 (bg)	0	1	21	No	8	87.5	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AD-11	0	1	21	No	8	87.5	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AD-13	0	-1	-21	No	8	75	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AD-14	0	1	21	No	8	87.5	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AD-5 (bg)	0	5	21	No	8	87.5	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AD-11	0.003646	16	21	No	8	50	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AD-13	0.000197	3	21	No	8	25	n/a	n/a	0.01	NP

Trend Tests Summary Table - All Results

Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/29/2017, 8:38 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Selenium, total (mg/L)	AD-14	0.002575	9	21	No	8	25	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AD-5 (bg)	0	0	21	No	8	100	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AD-11	0	4	21	No	8	62.5	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AD-13	0	1	21	No	8	87.5	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AD-14	0	0	21	No	8	100	n/a	n/a	0.01	NP

Tolerance Limits - Appendix III

Welsh LF   Client: Geosyntec   Data: Welsh LF   Printed 12/29/2017, 7:53 AM

Constituent	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	0.07522	n/a	8	0.04285	0.00755	0	None	No	0.01	Inter
Calcium, total (mg/L)	73.62	n/a	8	45.09	6.656	0	None	No	0.01	Inter
Chloride, total (mg/L)	18.47	n/a	8	14.5	0.9258	0	None	No	0.01	Inter
Fluoride, total (mg/L)	1	n/a	8	n/a	n/a	75	n/a	n/a	0.6634	NP Inter(normality)
pH, field (SU)	7.981	3.737	8	5.859	0.4299	0	None	No	0.01	Inter
Sulfate, total (mg/L)	454.7	n/a	8	177.4	64.69	0	None	No	0.01	Inter
Total Dissolved Solids (mg/L)	697.3	n/a	8	383.6	73.17	0	None	No	0.01	Inter

Confidence Interval Summary Table - Significant Results Appendix III

Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/29/2017, 7:59 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	**AD-11**	**3.491**	**2.586**	**0.075**	**Yes**	**8**	**3.039**	**0.4268**	**0**	**None**	**No**	**0.01**	**Param.**
Boron, total (mg/L)	**AD-13**	**1.842**	**0.8512**	**0.075**	**Yes**	**8**	**1.347**	**0.4673**	**0**	**None**	**No**	**0.01**	**Param.**
Boron, total (mg/L)	**AD-14**	**1.296**	**1.028**	**0.075**	**Yes**	**8**	**1.162**	**0.1262**	**0**	**None**	**No**	**0.01**	**Param.**
Fluoride, total (mg/L)	**AD-11**	**3**	**1.366**	**1**	**Yes**	**8**	**2.046**	**0.4448**	**0**	**None**	**No**	**0.004**	**NP (normality)**
Sulfate, total (mg/L)	**AD-11**	**709.5**	**521.7**	**454.7**	**Yes**	**8**	**615.6**	**88.57**	**0**	**None**	**No**	**0.01**	**Param.**
Total Dissolved Solids (mg/L)	**AD-11**	**1070**	**845**	**697.3**	**Yes**	**8**	**925.6**	**225.6**	**0**	**None**	**x^5**	**0.01**	**Param.**

Confidence Interval Summary Table - All Results Appendix III

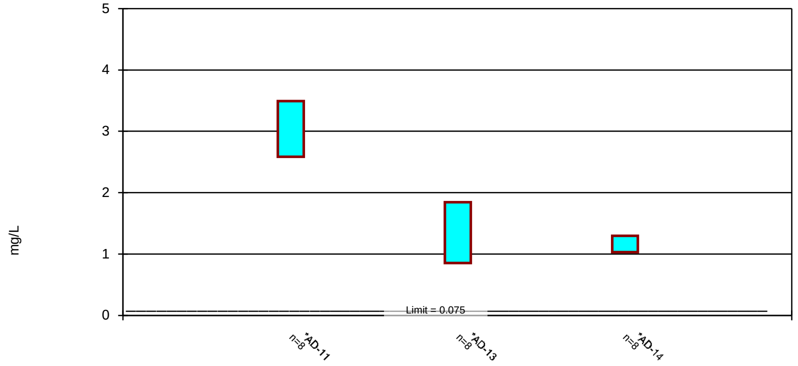
Welsh LF   Client: Geosyntec   Data: Welsh LF   Printed 12/29/2017, 7:59 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	**AD-11**	**3.491**	**2.586**	**0.075**	**Yes**	**8**	**3.039**	**0.4268**	**0**	**None**	**No**	**0.01**	**Param.**
Boron, total (mg/L)	**AD-13**	**1.842**	**0.8512**	**0.075**	**Yes**	**8**	**1.347**	**0.4673**	**0**	**None**	**No**	**0.01**	**Param.**
Boron, total (mg/L)	**AD-14**	**1.296**	**1.028**	**0.075**	**Yes**	**8**	**1.162**	**0.1262**	**0**	**None**	**No**	**0.01**	**Param.**
Calcium, total (mg/L)	AD-11	10.27	8.571	73.62	No	8	9.419	0.8002	0	None	No	0.01	Param.
Calcium, total (mg/L)	AD-13	33.5	2.7	73.62	No	8	8.585	10.43	0	None	No	0.004	NP (normality)
Calcium, total (mg/L)	AD-14	8.586	1.532	73.62	No	8	4.868	3.655	0	None	x^(1/3)	0.01	Param.
Chloride, total (mg/L)	AD-11	11.35	9.404	18.47	No	8	10.38	0.9161	0	None	No	0.01	Param.
Chloride, total (mg/L)	AD-13	18.59	10.41	18.47	No	8	14.5	3.854	0	None	No	0.01	Param.
Chloride, total (mg/L)	AD-14	6	4	18.47	No	8	4.625	0.744	0	None	No	0.004	NP (normality)
Fluoride, total (mg/L)	**AD-11**	**3**	**1.366**	**1**	**Yes**	**8**	**2.046**	**0.4448**	**0**	**None**	**No**	**0.004**	**NP (normality)**
Fluoride, total (mg/L)	AD-13	1.151	0.4712	1	No	8	0.7615	0.2565	25	Cohen`s	No	0.01	Param.
Fluoride, total (mg/L)	AD-14	1	1	1	No	8	1	0	100	Cohen`s	No	0.004	NP (NDs)
pH, field (SU)	AD-11	4.763	3.544	7.98	No	8	4.144	0.5079	0	None	sqrt(x)	0.005	Param.
pH, field (SU)	AD-13	5.62	4.092	7.98	No	8	4.856	0.6175	0	None	No	0.005	Param.
pH, field (SU)	AD-14	5.592	3.753	7.98	No	8	4.673	0.7433	0	None	No	0.005	Param.
Sulfate, total (mg/L)	**AD-11**	**709.5**	**521.7**	**454.7**	**Yes**	**8**	**615.6**	**88.57**	**0**	**None**	**No**	**0.01**	**Param.**
Sulfate, total (mg/L)	AD-13	261.3	139	454.7	No	8	200.1	57.71	0	None	No	0.01	Param.
Sulfate, total (mg/L)	AD-14	116.8	94.74	454.7	No	8	105.8	10.39	0	None	No	0.01	Param.
Total Dissolved Solids (mg/L)	**AD-11**	**1070**	**845**	**697.3**	**Yes**	**8**	**925.6**	**225.6**	**0**	**None**	**x^5**	**0.01**	**Param.**
Total Dissolved Solids (mg/L)	AD-13	699	281.3	697.3	No	8	490.1	197	0	None	No	0.01	Param.
Total Dissolved Solids (mg/L)	AD-14	289.4	235.1	697.3	No	8	262.3	25.65	0	None	No	0.01	Param.

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

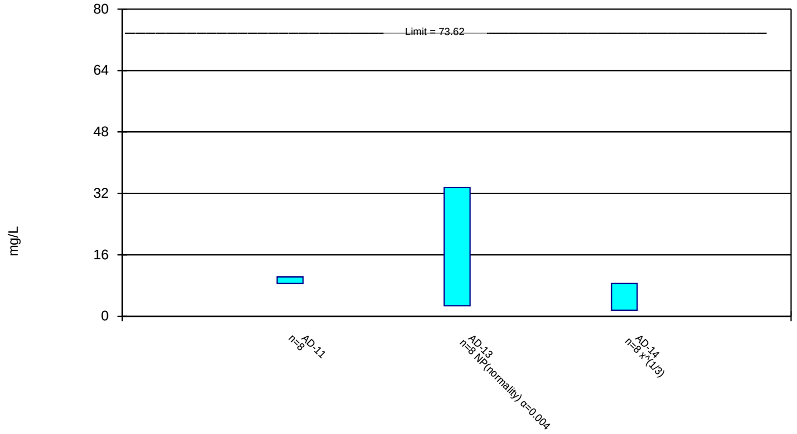


Constituent: Boron, total Analysis Run 12/29/2017 7:58 AM View: Confidence Intervals - App III
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

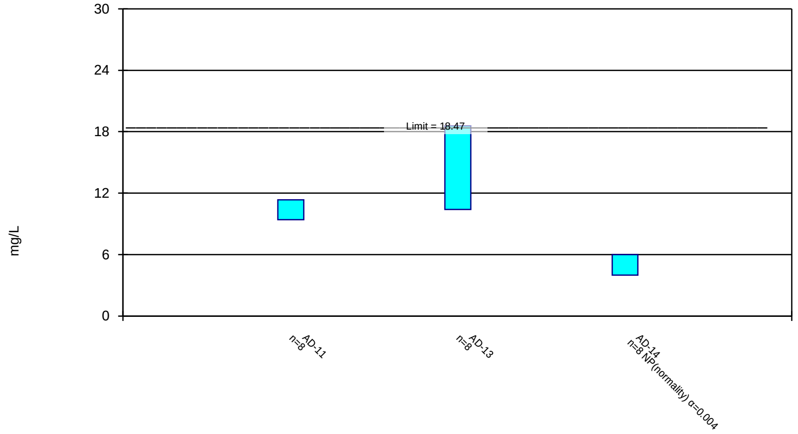


Constituent: Calcium, total Analysis Run 12/29/2017 7:58 AM View: Confidence Intervals - App III
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

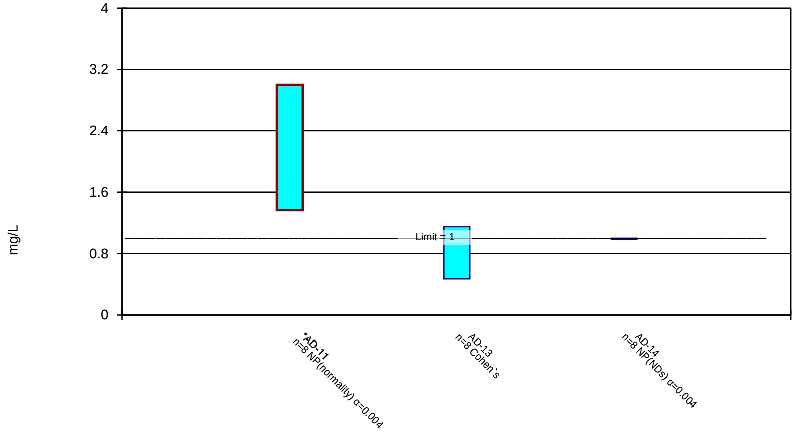


Constituent: Chloride, total Analysis Run 12/29/2017 7:58 AM View: Confidence Intervals - App III
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

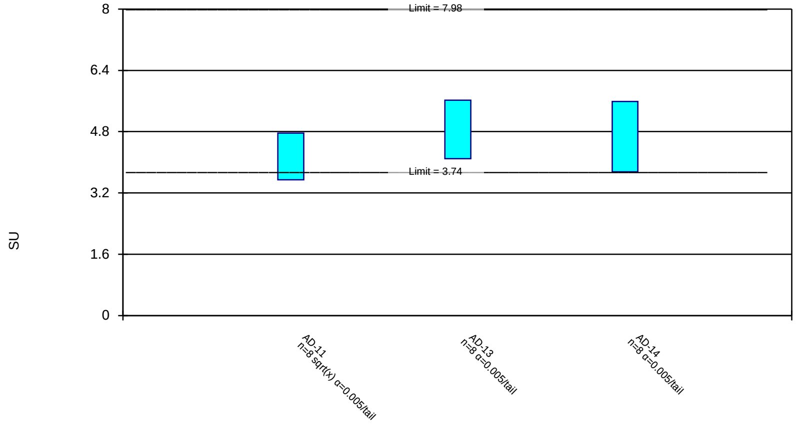


Constituent: Fluoride, total Analysis Run 12/29/2017 7:58 AM View: Confidence Intervals - App III
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Normality Test: Shapiro Wilk, alpha based on n.

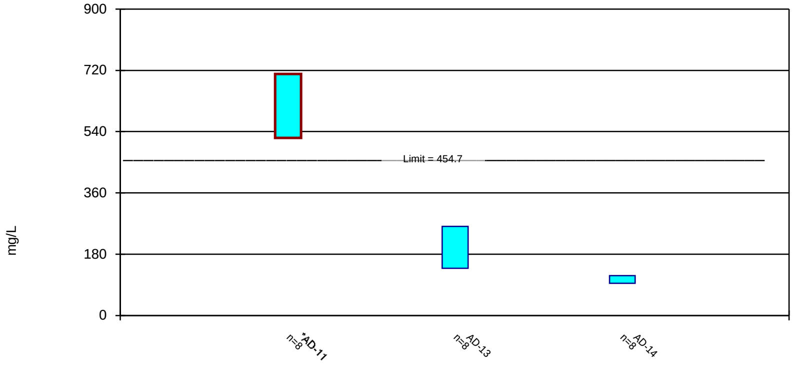


Constituent: pH, field Analysis Run 12/29/2017 7:58 AM View: Confidence Intervals - App III
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

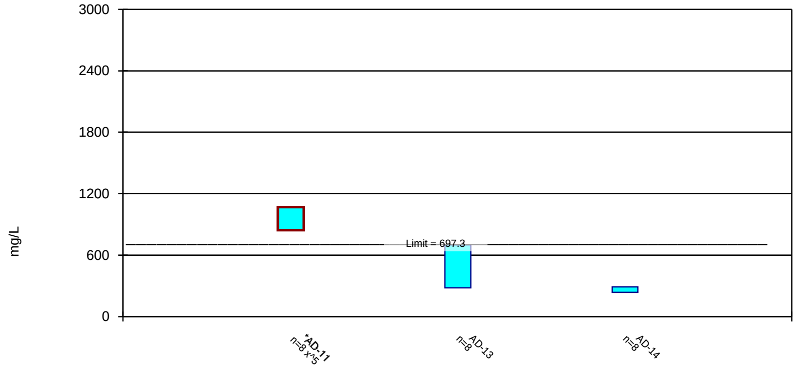


Constituent: Sulfate, total Analysis Run 12/29/2017 7:58 AM View: Confidence Intervals - App III
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



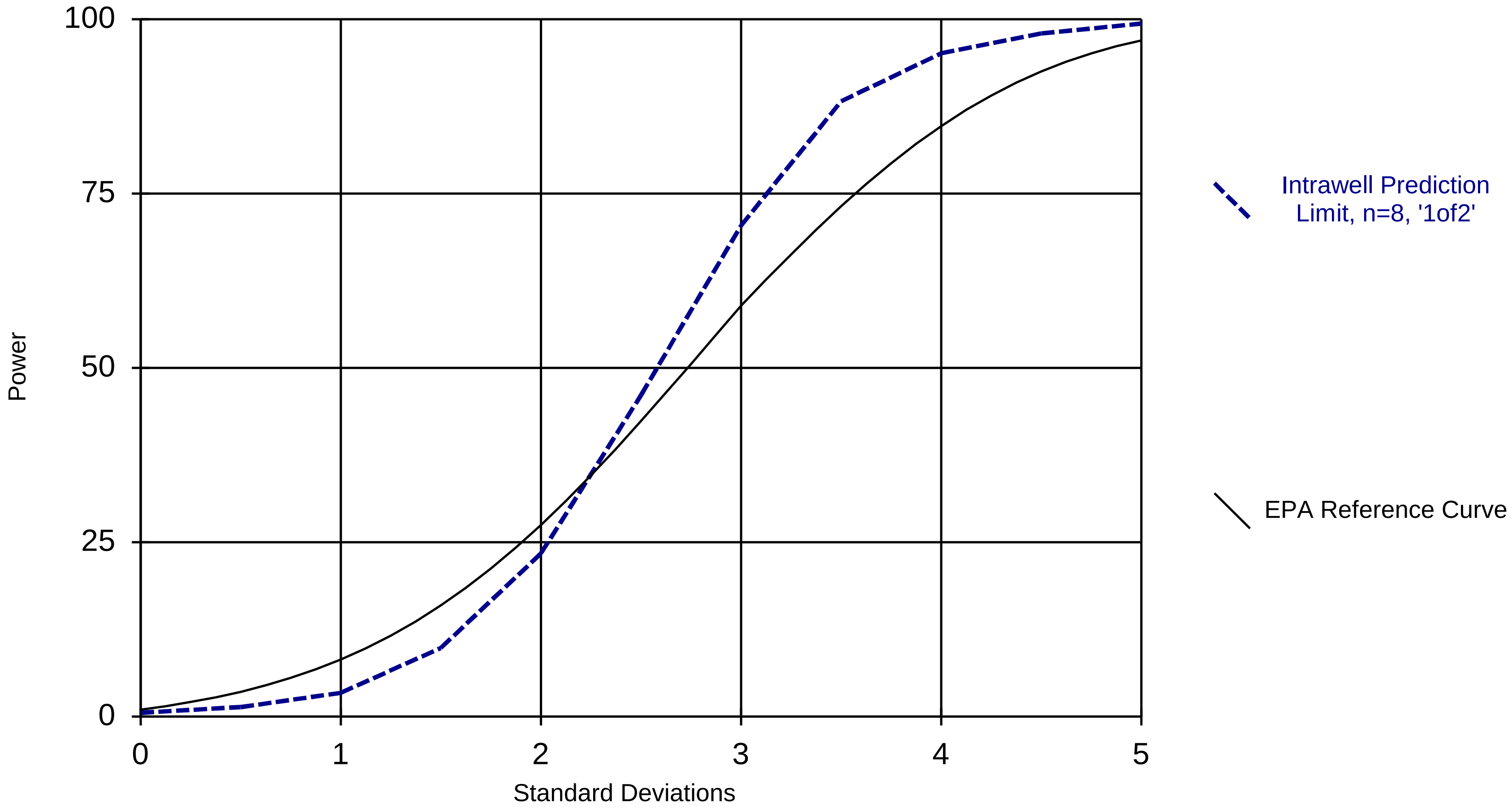
Constituent: Total Dissolved Solids Analysis Run 12/29/2017 7:58 AM View: Confidence Intervals - App III
Welsh LF Client: Geosyntec Data: Welsh LF

Intrawell Prediction Limit Summary Table

Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/29/2017, 8:49 AM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Calcium, total (mg/L)	AD-5	61.45	n/a	8	45.09	6.656	0	None	No	0.002505	Param 1 of 2
Calcium, total (mg/L)	AD-11	11.39	n/a	8	9.419	0.8002	0	None	No	0.002505	Param 1 of 2
Calcium, total (mg/L)	AD-13	38.48	n/a	8	1.861	0.6165	0	None	x^(1/3)	0.002505	Param 1 of 2
Calcium, total (mg/L)	AD-14	13.85	n/a	8	4.868	3.655	0	None	No	0.002505	Param 1 of 2
Chloride, total (mg/L)	AD-5	16.78	n/a	8	14.5	0.9258	0	None	No	0.002505	Param 1 of 2
Chloride, total (mg/L)	AD-11	12.63	n/a	8	10.38	0.9161	0	None	No	0.002505	Param 1 of 2
Chloride, total (mg/L)	AD-13	23.97	n/a	8	14.5	3.854	0	None	No	0.002505	Param 1 of 2
Chloride, total (mg/L)	AD-14	6.454	n/a	8	4.625	0.744	0	None	No	0.002505	Param 1 of 2
pH, field (SU)	AD-5	6.916	4.802	8	5.859	0.4299	0	None	No	0.001253	Param 1 of 2
pH, field (SU)	AD-11	5.392	2.895	8	4.144	0.5079	0	None	No	0.001253	Param 1 of 2
pH, field (SU)	AD-13	6.374	3.338	8	4.856	0.6175	0	None	No	0.001253	Param 1 of 2
pH, field (SU)	AD-14	6.5	2.845	8	4.673	0.7433	0	None	No	0.001253	Param 1 of 2

Power Curve



Kappa = 2.458, based on 3 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 11/20/2017 3:52 PM View: Confidence Intervals - App III

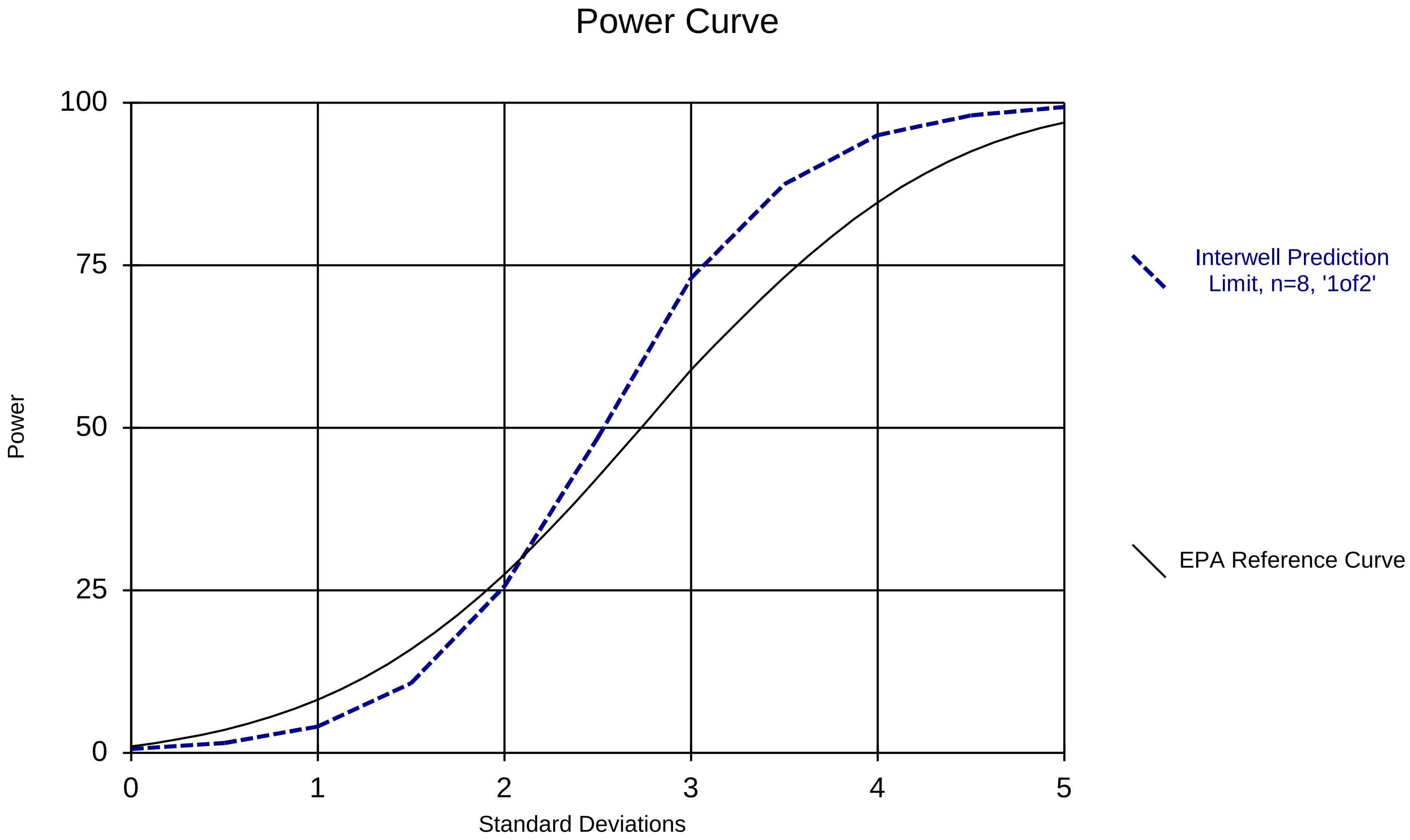
Welsh LF Client: Geosyntec Data: Welsh LF

Interwell Prediction Limit Summary Table

Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/29/2017, 8:50 AM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	n/a	0.06109	n/a	8	0.04285	0.00755	0	None	No	0.002505	Param 1 of 2
Fluoride, total (mg/L)	n/a	1	n/a	8	n/a	n/a	75	n/a	n/a	0.01882	NP (NDs) 1 of 2
Sulfate, total (mg/L)	n/a	333.7	n/a	8	177.4	64.69	0	None	No	0.002505	Param 1 of 2
Total Dissolved Solids (mg/L)	n/a	560.4	n/a	8	383.6	73.17	0	None	No	0.002505	Param 1 of 2

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG



Kappa = 2.416, based on 3 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 12/29/2017 9:03 AM View: Confidence Interval - App IV

Welsh LF Client: Geosyntec Data: Welsh LF

4.8 – Annual Groundwater Monitoring Report, Primary Bottom Ash Pond CCR Management Unit, January 2021

Annual Groundwater Monitoring Report

Southwestern Electric Power Company

J. Robert Welsh Power Plant

CN602843245
RN100213370

Primary Bottom Ash Pond CCR Management Unit

WMU 004

1187 Country Road 4865

Titus County

Pittsburg, Texas

January 2021

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

Table of Contents

I. Overview

This *Annual Groundwater Monitoring Report* (Report) has been prepared to report the status of activities for the preceding year for an existing CCR unit at Southwestern Electric Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), Welsh Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31, 2020.

In general, the following activities were completed:

- This CCR Unit began and remained in assessment monitoring throughout 2020.
- Annual and Semi-Annual groundwater samples were collected and analyzed for Appendix III and Appendix IV constituents, as specified in 40 CFR 257.95 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan (2016)*;
- A statistical process in accordance with 40 CFR 257.93 to evaluate groundwater data was updated and certified (AEP's *Statistical Analysis Plan (*Geosyntec 2020)). The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance," USEPA, 2009);
- Semi-annual groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- An ASD was successfully conducted for the lithium SSL determined in AD-9 during the statistical evaluation of the second semi-annual 2019 groundwater monitoring data.
- Annual groundwater sampling was conducted in February;
- First semi-annual groundwater sampling event;
  - Statistically significant increase (SSI):
    - Boron concentration exceeded the UPL of 0.700 mg/L in AD-8
  - Statistically significant level (SSL):
    - The LCL for lithium exceeded the GWPS of 0.390 mg/L in AD-9
  - Submitted to Texas Commission on Environmental Quality (TCEQ) notification of the SSL
  - A successful alternate source demonstration (ASD) was conducted for the lithium SSL in AD-9 and submitted to TCEQ
- Second semi-annual groundwater sampling event;
  - Statistical evaluation is underway
- SSIs remain without successful ASDs, keeping the unit in assessment monitoring.

- Submitted a demonstration request to develop alternative disposal capacity (40 CFR 257.103(f)) to EPA for approval.
- Received TCEQ approval to extend the receipt of CCR waste and initiate closure activities April 11, 2021. Further extension can be obtained pending a successful demonstration to EPA under 40 CFR 257.103(f).

The major components of this annual report, to the extent applicable at this time, are presented in sections that follow:

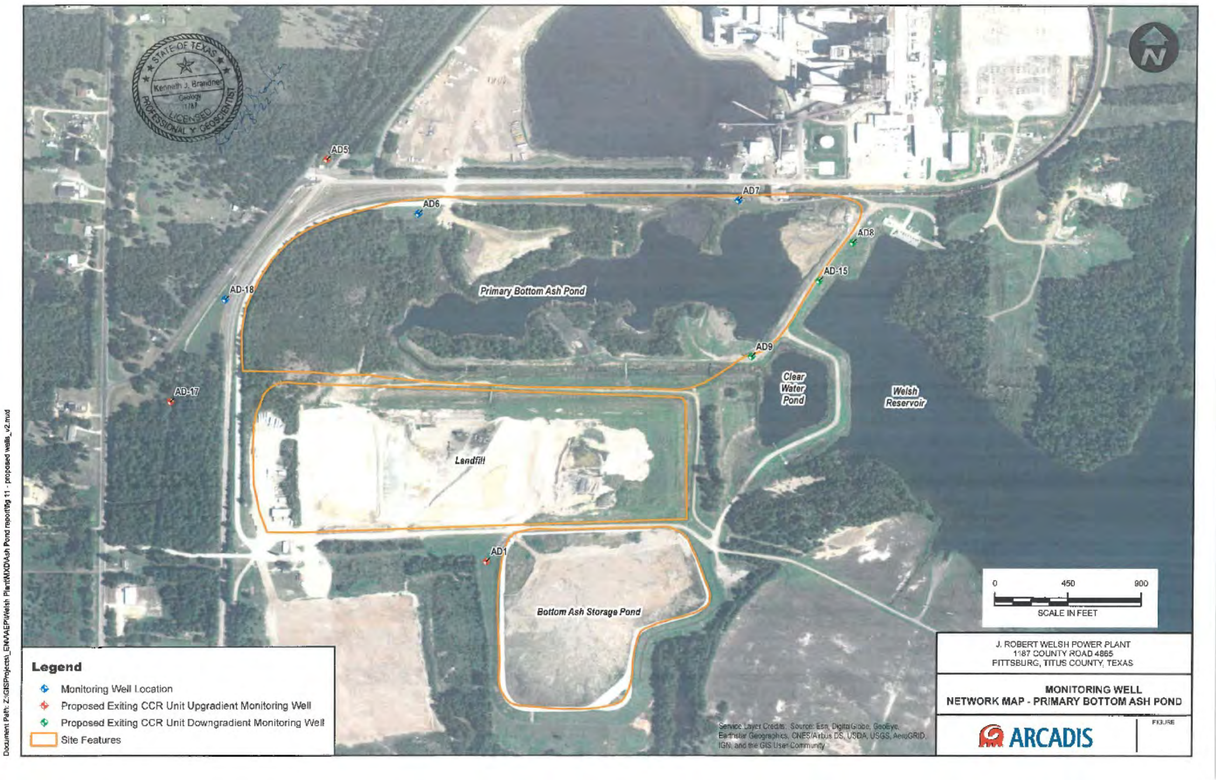
- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers;
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened;
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs is included in Appendix I;
- Statistical reports are located in Appendix II;
- ASDs are located in Appendix III;
- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring, in addition to identifying the constituents at a statistically significant increase or statistically significant level over background concentrations (Appendix IV);
- Other information required to be included in the annual report such as assessment of corrective measures, if applicable (Appendix V);

  In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.

II. Groundwater Monitoring Well Locations and Identification Numbers

The figure that follows depicts the PE-certified groundwater monitoring network, the monitoring well locations and their corresponding identification numbers.

Primary Bottom Ash Pond Monitoring Wells	
Up Gradient	Down Gradient
AD-1	AD-8
AD-5	AD-9
AD-17	AD-15



III. Monitoring Wells Installed or Decommissioned

During 2020, no monitoring wells were installed or decommissioned.

IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction and Discussion

Appendix I contains potentiometric maps with the static water elevation, groundwater flow direction for each monitoring event and tables showing groundwater velocity and the groundwater quality data collected under 40 CFR 257.90 through 257.98.

The sampling event conducted February 17, 2020 satisfies the requirement of 257.95(b).

- The groundwater flow rate and direction for the first semi-annual confirmatory sampling event reflects that seen during the initial first semi-annual sampling event.

V. Statistical Evaluations completed in 2020

First semi-annual 2020 groundwater sampling event conducted in May and confirmed in July:

- the following SSI was determined in September:
    - Boron concentrations exceeded the interwell UPL of 0.700 mg/L at AD-8 (1.23 mg/L and 1.14 mg/L)
- the following SSL was determined in September:
    - The LCL for lithium in AD-9 (0.800 mg/L) exceeded the GWPS of 0.390 mg/L

Second semi-annual groundwater sampling event conducted in October;

- the statistical analysis is underway;

The statistical reports completed in 2020 are found in Appendix II.

VI. Alternate Source Demonstrations completed in 2020

In March an ASD was successfully completed for the lithium SSL determined in AD-9 during the statistical evaluation of the second semi-annual 2019 groundwater monitoring data.

In October an ASD was successfully completed for the lithium SSL determined in AD-9 during the statistical evaluation of the first semi-annual 2020 groundwater monitoring data.

The successful ASDs are found in Appendix III.

VII. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency

This unit remained in assessment monitoring throughout 2020.

VIII. Other Information Required

As required by the CCR assessment monitoring rules in 40 CFR 257.95 (b) and (d)(1), sampling all CCR wells for the required Appendix III and IV parameters was completed in 2020.

IX. Description of Any Problems Encountered in 2020 and Actions Taken

No significant problems were encountered.

X. A Projection of Key Activities for the Upcoming Year

- Assessment monitoring will continue;
- Complete the statistical evaluation of the Second semi-annual 2020 groundwater monitoring event.
- Conducted the annual groundwater sampling event for all constituents listed in appendix IV, as required.
- Evaluation of the assessment monitoring results from a statistical analysis viewpoint, looking for SSIs as well as SSLs above GWPS;
- If needed, ASDs will be conducted to evaluate if the unit can remain in assessment monitoring or the unit will move to an assessment of corrective measures;
- Responding to any new data received in light of CCR rule requirements;
- Submit to TCEQ documentation of EPA’s final closure extension request comments;
- Preparation of the next annual groundwater report.

APPENDIX I

Potentiometric maps and tables follow, showing the groundwater monitoring data collected, the rate and direction of groundwater flow, and a summary showing the number of samples collected per monitoring well. The dates that the samples were collected also is shown.

Legend

⊕ Groundwater Monitoring Well
→ Approximate Groundwater Flow Direction
— Groundwater Elevation Contour
- - - Groundwater Elevation Contour (Inferred)
▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on February 17, 2020) provided by AEP.
-AD-2, AD-3, AD-4C, AD-6, AD-7, AD-10, AD-12, AD-16R, and AD-18 were not gauged during this event.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.

500 250 0 500
Feet

Groundwater Potentiometric Map
February 2020

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Figure
1

Columbus, Ohio
2020/05/11

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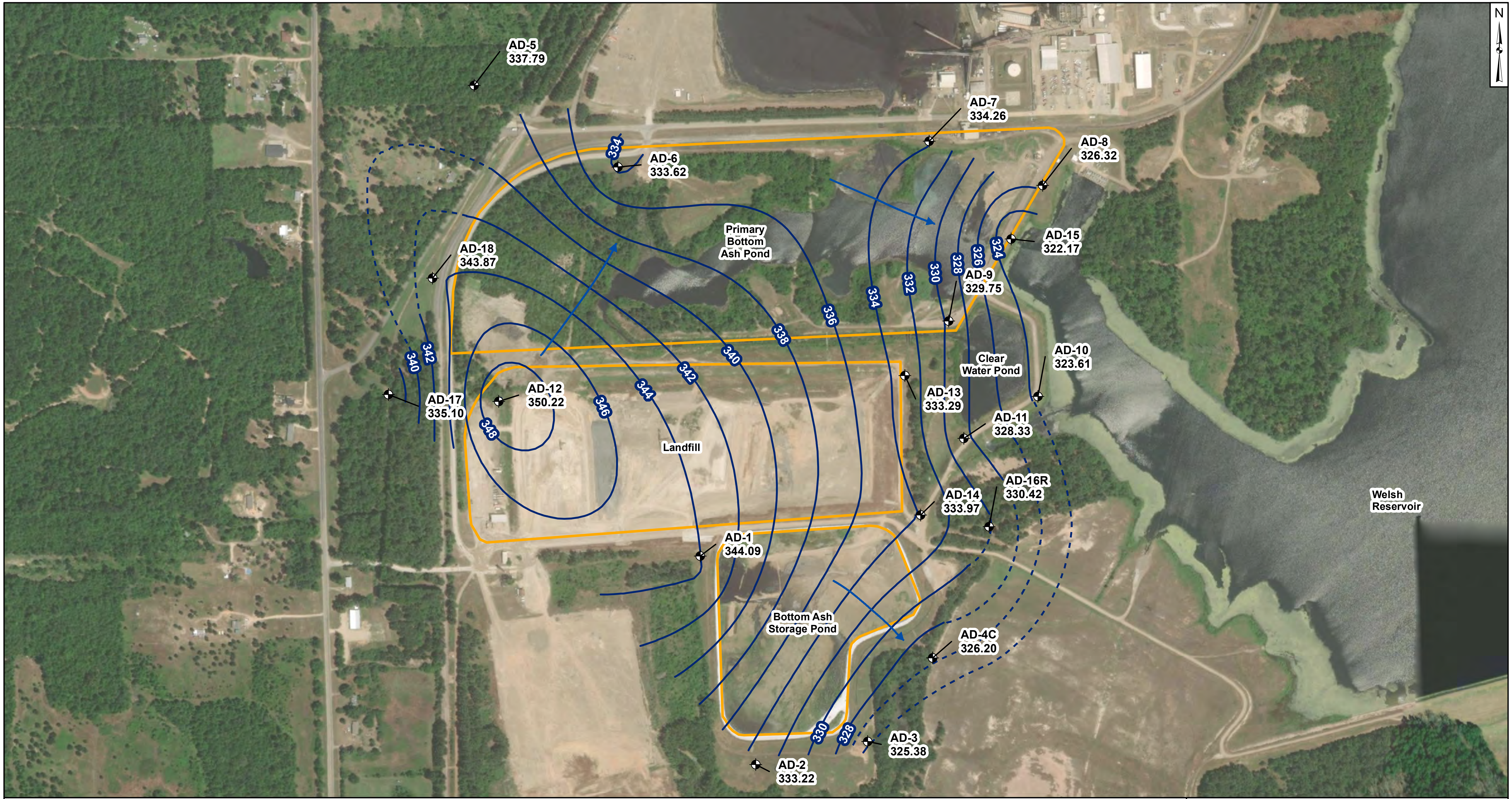

Legend

- ⯐ Groundwater Monitoring Well
- → Approximate Groundwater Flow Direction
- — Groundwater Elevation Contour
- - - Groundwater Elevation Contour (Inferred)
- ▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on May 19-20, 2020) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.

500 250 0 500
Feet

Groundwater Potentiometric Map
May 2020

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Columbus, Ohio

2020/11/04

Figure

2

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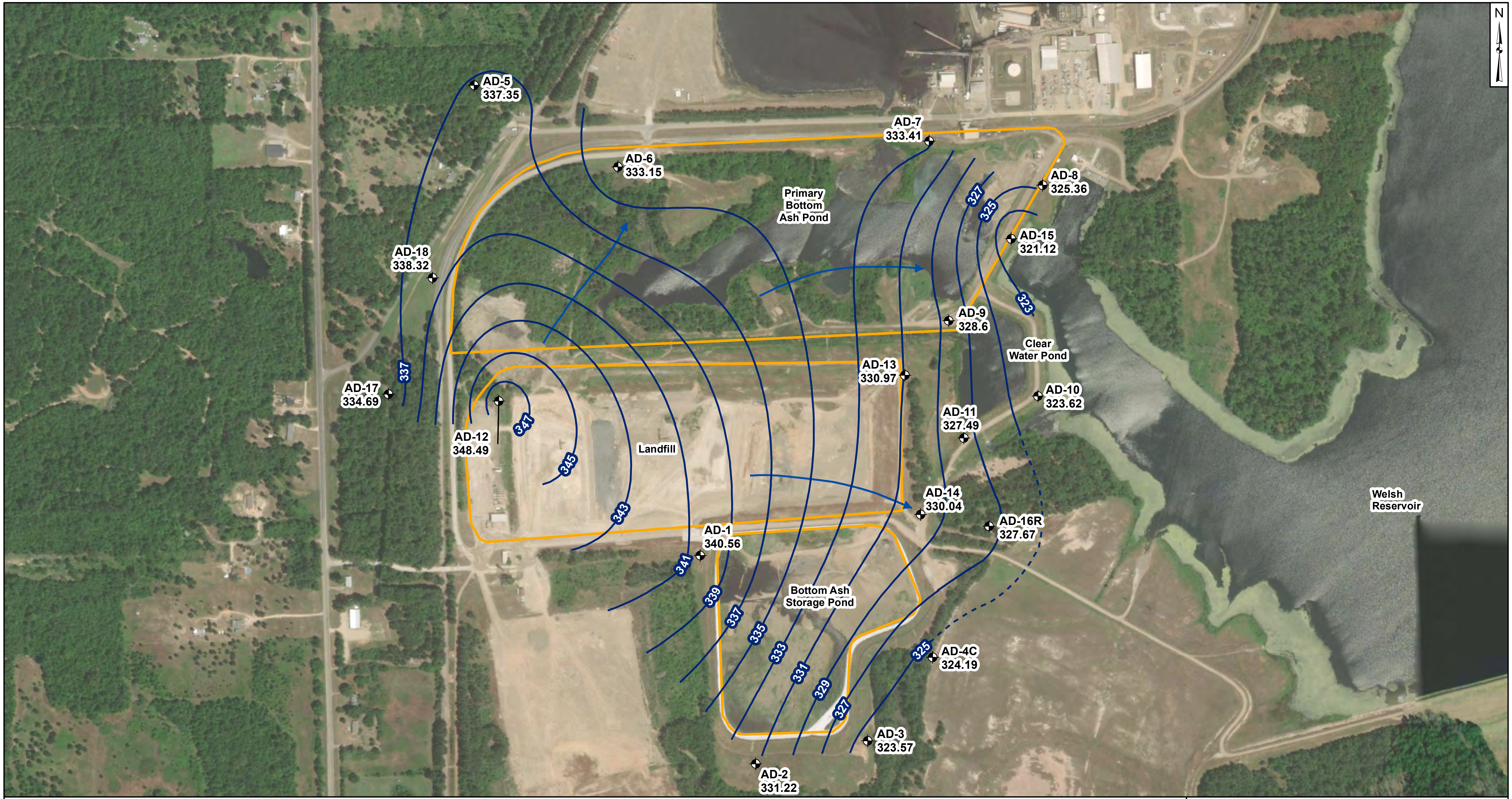

Legend

- ✦ Groundwater Monitoring Well
- — Groundwater Elevation Contour
- - - Groundwater Elevation Contour (Inferred)
- → Approximate Groundwater Flow Direction
- ▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on October 12-14, 2020) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.

500 250 0 500
Feet

Groundwater Potentiometric Map
October 2020

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Columbus, Ohio

2021/01/06

Figure
3

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Residence Time Calculation Summary Welsh Primary Bottom Ash Pond

			2020-02		**2020-05**		**2020-07**[3]		**2020-10**	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Primary Bottom Ash Pond	AD-1 [1]	2.0	4.6	13.1	3.4	17.7	3.8	16.0	3.2	19.0
	AD-5 [1]	2.0	1.0	59.3	3.8	15.9	0.8	73.0	2.6	23.5
	AD-8 [2]	2.0	4.3	14.1	4.4	13.7	4.5	13.4	4.4	13.8
	AD-9 [2]	2.0	4.6	13.2	5.5	11.1	4.2	14.5	4.7	12.9
	AD-15 [2]	2.0	5.1	11.9	6.7	9.0	5.1	11.9	7.3	8.3
	AD-17 [1]	2.0	2.3	26.1	9.3	6.5	1.3	46.0	7.7	7.9

Notes:
[1] - Upgradient Well
[2] - Downgradient Well
[3] - Two-of-two verification sampling
NC - Not Calculated

Residence Time Calculation Summary Welsh
Primary Bottom Ash Pond

			2019-02		2019-05		2019-07	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Primary Bottom Ash Pond	AD-1 [1]	2.0	2.7	22.4	5.3	11.5	4.1	14.9
	AD-5 [1]	2.0	1.5	40.2	2.4	25.4	2.1	29.2
	AD-8 [2]	2.0	4.1	14.7	4.1	14.8	5.3	11.5
	AD-9 [2]	2.0	4.8	12.8	4.5	13.6	5.1	12.0
	AD-15 [2]	2.0	6.4	9.5	5.5	11.1	7.0	8.7
	AD-17 [1]	2.0	8.9	6.9	4.7	13.0	3.5	17.5

Notes:
[1] - Upgradient Well
[2] - Downgradient Well

Residence Time Calculation Summary Welsh - Primary Bottom Ash Pond

			2018-05		2018-08	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Primary Bottom Ash Pond	AD-1 [1]	2.0	3.7	17	3.4	18
	AD-5 [1]	2.0	3.7	17	1.5	40
	AD-8 [2]	2.0	5.7	11	4.3	14
	AD-9 [2]	2.0	5.3	12	4.8	13
	AD-15 [2]	2.0	6.2	10	4.9	12
	AD-17 [1]	2.0	1.6	37	3.2	19

Notes:

[1] - Upgradient Well

[2] - Downgradient Well

Table 1 - Groundwater Data Summary: AD-1
Welsh - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/26/2016	Background	0.346	36.5	5	< 0.083 U	5.9	42	252
7/29/2016	Background	0.35	39.6	4	< 0.083 U	5.3	36	239
9/30/2016	Background	0.332	15	5	< 0.083 U	5.4	35	173
10/21/2016	Background	0.398	19.1	4	< 0.083 U	5.2	42	192
12/14/2016	Background	0.394	8.74	4	< 0.083 U	5.2	40	200
1/20/2017	Background	0.656	129	4	< 0.083 U	7.1	68	538
2/24/2017	Background	0.7	147	9	< 0.083 U	6.9	68	612
6/8/2017	Background	0.449	15.1	4	< 0.083 U	5.1	42	176
10/6/2017	Detection	0.453	14.3	4	< 0.083 U	5.3	40	160
5/24/2018	Assessment	0.345	10.2	4	< 0.083 U	5.2	43	150
8/14/2018	Assessment	0.443	5.95	5	< 0.083 U	5.2	44	160
2/20/2019	Assessment	0.504	142	2.82	0.24	7.3	49.2	522
5/30/2019	Assessment	0.689	138	1.59	0.29	6.7	43.3	588
7/24/2019	Assessment	0.644	62.7	2	0.106 J	6.0	58	180
2/17/2020	Assessment	0.626	115	3.41	0.31	5.8	56.3	488
5/20/2020	Assessment	0.801	126	1.83	0.20	7.2	51.4	508
10/14/2020	Assessment	0.670	3.88	2.16	0.25	4.5	66.9	183

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-1
Welsh - PBAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**pCi/L**	**mg/L**	**µg/L**	**mg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
5/26/2016	Background	< 0.93 U	1.39361 J	191	0.271453 J	0.213294 J	0.240267 J	1.15339 J	1.184	< 0.083 U	< 0.68 U	0.01	0.033	0.53149 J	1.74922 J	0.959865 J
7/29/2016	Background	< 0.93 U	< 1.05 U	191	0.315631 J	0.0940357 J	< 0.23 U	0.615933 J	0.9952	< 0.083 U	< 0.68 U	0.019	0.00793 J	< 0.29 U	1.81763 J	< 0.86 U
9/30/2016	Background	< 0.93 U	2.96797 J	141	0.382874 J	< 0.07 U	5	0.850408 J	1.38	< 0.083 U	3.38434 J	0.014	0.01773 J	< 0.29 U	1.02629 J	< 0.86 U
10/21/2016	Background	< 0.93 U	< 1.05 U	114	0.311247 J	< 0.07 U	0.412131 J	0.649606 J	1.141	< 0.083 U	< 0.68 U	0.008	0.00534 J	1.39872 J	2.03168 J	1.25062 J
12/14/2016	Background	< 0.93 U	< 1.05 U	72	0.34133 J	< 0.07 U	< 0.23 U	0.424105 J	0.719	< 0.083 U	< 0.68 U	0.008	0.01521 J	< 0.29 U	1.85825 J	< 0.86 U
1/20/2017	Background	< 0.93 U	< 1.05 U	410	0.0366913 J	< 0.07 U	< 0.23 U	0.480125 J	3.009	< 0.083 U	< 0.68 U	0.000275956 J	< 0.005 U	< 0.29 U	4.04737 J	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	488	< 0.02 U	< 0.07 U	< 0.23 U	0.765099 J	4.309	< 0.083 U	< 0.68 U	0.001	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	1.14 J	93.46	0.37 J	< 0.07 U	0.66 J	0.77 J	0.676	< 0.083 U	< 0.68 U	0.00902	0.007 J	< 0.29 U	2.1 J	< 0.86 U
5/24/2018	Assessment	3.17 J	< 1.05 U	79.9	0.39 J	< 0.07 U	< 0.23 U	0.35 J	1.983	< 0.083 U	< 0.68 U	0.00814	0.006 J	< 0.29 U	1.38 J	< 0.86 U
8/14/2018	Assessment	0.03 J	0.21	63.0	0.482	0.02	0.160	0.797	1.102	< 0.083 U	0.238	0.00708	0.013 J	0.21	1.7	0.03 J
2/20/2019	Assessment	0.16	0.46	457	0.09 J	0.01 J	0.306	0.399	3.159	0.24	0.124	0.00155	< 0.005 U	1 J	0.7	< 0.1 U
5/30/2019	Assessment	0.16	0.60	512	0.244	0.01 J	0.1 J	0.756	2.717	0.29	0.197	< 0.009 U	< 0.005 U	2.43	1.4	< 0.1 U
7/24/2019	Assessment	0.08 J	0.39	245	0.540	0.02 J	0.1 J	0.789	1.819	0.106 J	0.1 J	0.00557	< 0.005 U	2 J	3.4	< 0.1 U
2/17/2020	Assessment	0.33	0.49	303	0.07 J	0.02 J	0.1 J	0.28	2.665	0.31	0.1 J	0.00105	< 0.002 U	1 J	2.3	< 0.1 U
5/20/2020	Assessment	0.15	0.53	394	0.270	0.02 J	0.1 J	0.490	2.312	0.20	0.1 J	0.00301	< 0.002 U	2 J	2.8	< 0.1 U
10/14/2020	Assessment	< 0.1 U	0.3 J	84.7	0.984	< 0.05 U	0.9 J	2.12	1.552	0.25	0.3 J	0.00932	0.003 J	< 2 U	5.3	< 0.5 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-5
Welsh - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.03	36.9	15	0.3469 J	6.4	123	337
7/29/2016	Background	0.04	44.7	16	< 0.083 U	5.4	163	360
9/30/2016	Background	0.04	46.3	15	0.2436 J	5.3	190	416
10/21/2016	Background	0.05	50.7	14	< 0.083 U	5.9	267	448
12/14/2016	Background	0.05	49.6	13	< 0.083 U	6.2	233	484
1/20/2017	Background	0.04	49.8	14	< 0.083 U	6.3	234	438
2/24/2017	Background	0.04	33	15	< 0.083 U	5.5	127	286
6/8/2017	Background	0.05281	49.7	14	< 0.083 U	6.0	82	300
10/6/2017	Detection	0.04322	33.1	16	< 0.083 U	5.6	82	258
5/24/2018	Assessment	0.05007	28.1	22	< 0.083 U	6.2	60	242
8/15/2018	Assessment	0.050	40.5	19	< 0.083 U	6.2	240	428
2/21/2019	Assessment	0.033	33.9	24.7	0.21	5.4	46.5	220
5/30/2019	Assessment	0.03 J	30.0	22.3	0.29	6.3	51.3	238
7/24/2019	Assessment	0.04 J	41.1	18	0.112 J	6.3	90	354
2/17/2020	Assessment	0.03 J	39.8	19.8	0.22	5.5	43.7	248
5/20/2020	Assessment	0.03 J	40.2	22.3	0.18	6.8	55.5	264
10/14/2020	Assessment	0.04 J	36.6	18.8	0.18	6.5	148	338

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-5
Welsh - PBAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	< 0.93 U	< 1.05 U	57	0.149801 J	0.0765156 J	0.555038 J	14	1.634	0.3469 J	< 0.68 U	0.135	0.01135 J	< 0.29 U	< 0.99 U	< 0.86 U
7/29/2016	Background	2.05116 J	2.90819 J	93	0.518653 J	0.502155 J	0.411466 J	15	4.75	< 0.083 U	< 0.68 U	0.191	0.01516 J	< 0.29 U	1.08901 J	< 0.86 U
9/30/2016	Background	< 0.93 U	4.7609 J	87	0.251584 J	< 0.07 U	0.90676 J	14	3.33	0.2436 J	< 0.68 U	0.186	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
10/21/2016	Background	< 0.93 U	< 1.05 U	70	0.08781 J	0.107488 J	0.248085 J	9	2.319	< 0.083 U	< 0.68 U	0.225	< 0.005 U	1.36984 J	< 0.99 U	< 0.86 U
12/14/2016	Background	< 0.93 U	1.15381 J	53	0.164529 J	0.203546 J	0.747921 J	13	2.182	< 0.083 U	< 0.68 U	0.199	0.00802 J	< 0.29 U	< 0.99 U	< 0.86 U
1/20/2017	Background	< 0.93 U	< 1.05 U	47	0.0574718 J	0.180502 J	< 0.23 U	12	1.023	< 0.083 U	< 0.68 U	0.239	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	42	0.0306858 J	< 0.07 U	< 0.23 U	13	1.788	< 0.083 U	< 0.68 U	0.166	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	3.85 J	87.7	0.08 J	0.39 J	0.28 J	11.93	2.32	< 0.083 U	< 0.68 U	0.124	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
5/24/2018	Assessment	< 0.93 U	< 1.05 U	71.16	< 0.02 U	0.23 J	0.8 J	14.24	1.946	< 0.083 U	< 0.68 U	0.121	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
8/15/2018	Assessment	0.01 J	1.69	63.7	0.055	0.008 J	0.072	11.4	0.316	< 0.083 U	0.079	0.147	< 0.005 U	0.13	0.08 J	< 10 U
2/21/2019	Assessment	0.02 J	1.59	69.4	0.08 J	< 0.01 U	0.432	8.58	1.267	0.21	0.147	0.0807	< 0.005 U	< 0.4 U	0.1 J	< 0.1 U
5/30/2019	Assessment	< 0.02 U	3.05	60.5	0.08 J	< 0.01 U	0.06 J	11.8	1.431	0.29	0.05 J	0.104	0.006 J	< 0.4 U	0.05 J	< 0.1 U
7/24/2019	Assessment	< 0.02 U	2.48	77.4	0.05 J	< 0.01 U	0.05 J	8.38	2.533	0.112 J	< 0.05 U	0.108	< 0.005 U	< 0.4 U	0.06 J	< 0.1 U
2/17/2020	Assessment	0.03 J	2.17	109	0.09 J	0.02 J	0.336	4.52	2.393	0.22	0.227	0.0732	< 0.002 U	0.9 J	0.2	< 0.1 U
5/20/2020	Assessment	< 0.02 U	1.78	93.1	0.05 J	0.01 J	0.1 J	7.65	1.612	0.18	0.07 J	0.0740	< 0.002 U	< 0.4 U	0.09 J	< 0.1 U
10/14/2020	Assessment	< 0.02 U	6.28	71.7	0.09 J	< 0.01 U	0.09 J	14.9	2.7	0.18	0.05 J	0.134	< 0.002 U	< 0.4 U	0.1 J	< 0.1 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-8
Welsh - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	1.46	32.6	36	0.6507 J	6.9	217	524
7/29/2016	Background	1.44	25.9	26	0.485 J	5.4	202	469
9/30/2016	Background	1.51	24.3	28	0.4912 J	7.7	186	432
10/21/2016	Background	1.54	25.9	30	0.6234 J	6.1	184	424
12/14/2016	Background	1.53	23.6	27	0.5355 J	5.6	168	442
1/20/2017	Background	1.53	18.7	24	0.5574 J	6.2	153	352
2/24/2017	Background	1.67	19.3	22	< 0.083 U	6.8	163	356
6/8/2017	Background	1.39	17.4	22	0.6628 J	5.6	151	368
10/6/2017	Detection	1.49	14.9	20	< 0.083 U	6.7	128	284
1/4/2018	Detection	1.47	--	--	--	--	--	--
5/23/2018	Assessment	--	--	--	0.501 J	6.2	--	--
8/15/2018	Assessment	--	--	--	--	6.8	--	--
9/17/2018	Assessment	1.30	15.0	24	--	--	122	288
2/5/2019	Assessment	2.55	19.7	22.8	0.72	5.4	153	--
2/21/2019	Assessment	1.47	17.6	23.2	0.66	6.4	163	352
4/30/2019	Assessment	1.21	--	--	--	6.9	--	--
5/29/2019	Assessment	1.07	16.9	19.5	0.89	5.5	150	324
7/23/2019	Assessment	1.21	20.8	15	0.559 J	6.6	145	392
2/17/2020	Assessment	1.25	14.6	17.0	0.67	6.5	159	344
5/19/2020	Assessment	1.23	15.1	16.5	0.66	6.4	149	336
7/22/2020	Assessment	1.14	--	--	--	6.6	--	--
10/12/2020	Assessment	1.10	17.2	13.6	0.88	6.8	138	298

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-8
Welsh - PBAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	< 0.93 U	1.06251 J	34	0.114491 J	< 0.07 U	2	7	1.046	0.6507 J	< 0.68 U	0.122	0.02103 J	1.01326 J	1.37017 J	1.18455 J
7/29/2016	Background	1.46141 J	< 1.05 U	26	0.171642 J	< 0.07 U	0.751164 J	9	1.584	0.485 J	< 0.68 U	0.098	0.00859 J	1.48301 J	1.96333 J	< 0.86 U
9/30/2016	Background	< 0.93 U	< 1.05 U	23	< 0.02 U	< 0.07 U	0.51348 J	7	6.3	0.4912 J	< 0.68 U	0.111	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
10/21/2016	Background	< 0.93 U	< 1.05 U	24	0.028758 J	< 0.07 U	0.617826 J	7	0.3449	0.6234 J	< 0.68 U	0.135	< 0.005 U	0.838863 J	< 0.99 U	1.64377 J
12/14/2016	Background	< 0.93 U	< 1.05 U	21	< 0.02 U	< 0.07 U	< 0.23 U	7	1.083	0.5355 J	< 0.68 U	0.11	0.01007 J	< 0.29 U	< 0.99 U	< 0.86 U
1/20/2017	Background	< 0.93 U	< 1.05 U	20	< 0.02 U	< 0.07 U	< 0.23 U	6	0.823	0.5574 J	< 0.68 U	0.094	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	19	< 0.02 U	< 0.07 U	< 0.23 U	6	0.536	< 0.083 U	< 0.68 U	0.092	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	< 1.05 U	19.08	< 0.02 U	< 0.07 U	< 0.23 U	3.86 J	1.0735	0.6628 J	< 0.68 U	0.09491	0.008 J	< 0.29 U	< 0.99 U	< 0.86 U
5/23/2018	Assessment	3.19 J	< 1.05 U	22.12	< 0.02 U	< 0.07 U	< 0.23 U	3.19 J	0.3366	0.501 J	< 0.68 U	0.0956	< 0.005 U	< 0.29 U	1.75 J	< 0.86 U
8/15/2018	Assessment	0.01 J	0.31	21.2	0.008 J	0.02 J	0.050	5.36	3.44	--	0.039	0.0555	--	0.16	0.07 J	0.129
2/21/2019	Assessment	< 0.02 U	0.57	28.1	0.03 J	0.03 J	0.456	2.88	0.417	0.66	0.223	0.0911	< 0.005 U	< 0.4 U	0.1 J	< 0.1 U
5/29/2019	Assessment	< 0.02 U	0.37	30.3	< 0.02 U	0.02 J	0.1 J	6.03	0.911	0.89	0.07 J	0.067	< 0.005 U	< 0.4 U	0.06 J	0.1 J
7/23/2019	Assessment	< 0.02 U	0.41	31.0	< 0.02 U	0.02 J	0.09 J	7.07	0.72	0.559 J	0.08 J	0.0641	< 0.005 U	< 0.4 U	0.08 J	0.1 J
2/17/2020	Assessment	< 0.02 U	0.55	38.9	< 0.02 U	0.05 J	0.244	1.02	1.257	0.67	0.1 J	0.124	< 0.002 U	< 0.4 U	0.08 J	< 0.1 U
5/19/2020	Assessment	< 0.02 U	0.27	21.1	< 0.02 U	0.04 J	0.2 J	1.17	0.344	0.66	< 0.05 U	0.0872	< 0.002 U	< 0.4 U	0.07 J	< 0.1 U
10/12/2020	Assessment	< 0.02 U	0.30	25.9	< 0.02 U	0.04 J	0.06 J	5.71	0.267	0.88	0.06 J	0.0615	< 0.002 U	< 0.4 U	0.08 J	0.1 J

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-9
Welsh - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.12	229	88	0.4191 J	6.3	1,352	2,541
7/29/2016	Background	0.105	255	98	0.4339 J	5.0	1,464	2,564
9/30/2016	Background	0.115	220	86	0.304 J	4.7	1,301	2,448
10/21/2016	Background	0.109	228	76	0.6227 J	5.2	1,350	2,494
12/14/2016	Background	0.108	250	92	< 0.083 U	5.7	1,639	2,667
1/20/2017	Background	0.312	91.1	54	< 0.083 U	5.4	884	1,360
2/24/2017	Background	0.1	258	86	< 0.083 U	5.8	1,774	2,662
6/8/2017	Background	0.146	191	19	< 0.083 U	4.6	105	308
10/6/2017	Detection	0.129	9.64	20	< 0.083 U	5.8	86	248
5/23/2018	Assessment	--	--	--	< 0.083 U	5.3	--	--
8/15/2018	Assessment	--	--	--	--	5.0	--	--
9/17/2018	Assessment	0.198	230	103	--	--	1,910	2,694
2/5/2019	Assessment	0.096	133	27.9	0.16	4.2	181	--
2/21/2019	Assessment	1.39	211	89	0.19	5.0	1,350	2,240
4/30/2019	Assessment	0.07	--	--	--	4.5	--	--
5/29/2019	Assessment	0.06 J	10.1	44.0	0.16	3.6	503	1,758
7/23/2019	Assessment	0.081	222	77	0.5736 J	6.3	1,701	2,460
2/17/2020	Assessment	0.12	11.5	19.9	0.15	6.0	100	282
5/19/2020	Assessment	0.066	11.3	44.8	0.1 J	4.9	536	902
10/12/2020	Assessment	0.100	11.8	18.8	0.19	4.8	100	296

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-9
Welsh - PBAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	< 0.93 U	< 1.05 U	51	0.999439 J	1	< 0.23 U	27	2.945	0.4191 J	< 0.68 U	1.32	0.0194 J	< 0.29 U	1.04175 J	< 0.86 U
7/29/2016	Background	< 0.93 U	< 1.05 U	31	0.726564 J	2	0.262163 J	22	1.447	0.4339 J	< 0.68 U	1.38	0.045	< 0.29 U	8	< 0.86 U
9/30/2016	Background	< 0.93 U	< 1.05 U	33	0.582852 J	0.187457 J	< 0.23 U	12	3.199	0.304 J	< 0.68 U	1.17	0.00739 J	< 0.29 U	3.52832 J	< 0.86 U
10/21/2016	Background	< 0.93 U	< 1.05 U	26	0.478576 J	0.965032 J	< 0.23 U	16	1.311	0.6227 J	< 0.68 U	1.44	< 0.005 U	< 0.29 U	3.09028 J	< 0.86 U
12/14/2016	Background	< 0.93 U	< 1.05 U	27	0.481339 J	2	< 0.23 U	24	3	< 0.083 U	< 0.68 U	1.33	0.02123 J	< 0.29 U	< 0.99 U	< 0.86 U
1/20/2017	Background	< 0.93 U	< 1.05 U	98	2	0.693618 J	< 0.23 U	42	2.349	< 0.083 U	< 0.68 U	0.634	0.00717 J	< 0.29 U	< 0.99 U	1.7755 J
2/24/2017	Background	< 0.93 U	< 1.05 U	22	0.301057 J	0.680144 J	< 0.23 U	24	2.32	< 0.083 U	< 0.68 U	1.41	< 0.005 U	< 0.29 U	1.06022 J	1.45295 J
6/8/2017	Background	< 0.93 U	< 1.05 U	42.27	0.77 J	2.22	< 0.23 U	24.16	1.586	< 0.083 U	< 0.68 U	1	0.006 J	< 0.29 U	< 0.99 U	< 0.86 U
5/23/2018	Assessment	< 0.93 U	< 1.05 U	30.45	0.32 J	2.88	< 0.23 U	26.7	2.556	< 0.083 U	< 0.68 U	1.2	< 0.005 U	< 0.29 U	< 0.99 U	8.46
8/15/2018	Assessment	< 10 U	1.68	24.2	0.268	0.06	0.420	11.1	1.864	--	0.262	0.851	--	0.11	0.3	0.062
2/21/2019	Assessment	< 0.02 U	1.18	52.4	0.474	0.09	0.313	14.8	2.51	0.19	0.08 J	1.12	0.01 J	< 0.4 U	0.3	0.1 J
5/29/2019	Assessment	< 0.02 U	0.20	49.7	0.941	0.21	0.346	15.9	1.36	0.16	0.07 J	0.225	< 0.005 U	< 0.4 U	0.2	0.2 J
7/23/2019	Assessment	< 0.02 U	1.39	32.1	0.361	0.06	0.2 J	12.7	1.689	0.5736 J	0.2 J	1.11	< 0.005 U	< 0.4 U	0.4	< 0.1 U
2/17/2020	Assessment	< 0.02 U	0.33	52.8	0.979	0.24	0.608	17.7	1.938	0.15	0.2 J	0.218	0.002 J	< 0.4 U	0.3	0.2 J
5/19/2020	Assessment	< 0.02 U	0.25	51.6	0.933	0.24	0.458	16.5	1.854	0.1 J	0.07 J	0.160	0.003 J	< 0.4 U	0.4	0.2 J
10/12/2020	Assessment	< 0.02 U	0.72	55.3	1.27	0.22	0.471	18.6	2.838	0.19	0.349	0.194	0.003 J	< 0.4 U	0.3	0.2 J

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-15
Welsh - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.329	5.09	30	< 0.083 U	5.6	24	188
7/29/2016	Background	0.407	3.83	34	< 0.083 U	4.8	28	196
9/30/2016	Background	0.36	13.7	28	0.2621 J	4.6	23	367
10/21/2016	Background	0.152	4.57	26	< 0.083 U	4.4	17	152
12/14/2016	Background	0.334	3.6	26	< 0.083 U	4.7	19	204
1/20/2017	Background	0.413	3.35	32	< 0.083 U	5.8	25	176
2/24/2017	Background	0.1	4.21	20	< 0.083 U	4.6	8	88
6/8/2017	Background	0.321	3.57	27	< 0.083 U	4.8	19	184
10/6/2017	Detection	0.395	3.08	30	< 0.083 U	5.9	21	200
5/23/2018	Assessment	--	--	--	< 0.083 U	4.8	--	--
8/15/2018	Assessment	--	--	--	--	4.6	--	--
9/17/2018	Assessment	0.341	3.04	37	--	--	24	174
2/5/2019	Assessment	0.03 J	2.18	20.6	0.06	3.9	0.2 J	--
2/21/2019	Assessment	0.169	2.67	28.2	0.09	5.0	10.6	150
5/29/2019	Assessment	< 0.02 U	2.97	21.4	0.06 J	4.9	2.1	34
7/23/2019	Assessment	0.306	3.45	28	0.086 J	3.2	18	214
2/17/2020	Assessment	0.419	3.64	34.3	0.11	4.5	21.5	234
5/19/2020	Assessment	0.376	3.37	34.1	0.07	5.3	19.0	216
10/12/2020	Assessment	0.334	2.99	30.4	0.10	5.1	17.1	170

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-15
Welsh - PBAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	< 0.93 U	12	215	0.959793 J	0.351465 J	17	11	2.284	< 0.083 U	7	0.017	0.054	1.77432 J	3.46337 J	< 0.86 U
7/29/2016	Background	< 0.93 U	6	124	0.362598 J	0.111427 J	4	6	1.322	< 0.083 U	< 0.68 U	0.021	0.01646 J	0.586779 J	1.19442 J	< 0.86 U
9/30/2016	Background	< 0.93 U	131	1,930	15	7	280	134	9.92	0.2621 J	161	0.149	0.707	3.60313 J	14	< 0.86 U
10/21/2016	Background	< 0.93 U	23	415	2	0.575938 J	54	19	3.567	< 0.083 U	22	0.036	0.1	1.54555 J	1.17613 J	1.55993 J
12/14/2016	Background	< 0.93 U	6	184	0.695316 J	0.246456 J	15	10	3.36	< 0.083 U	3.96087 J	0.013	0.026	0.463544 J	1.32943 J	< 0.86 U
1/20/2017	Background	< 0.93 U	6	153	0.449612 J	< 0.07 U	9	7	2.386	< 0.083 U	2.87518 J	0.008	0.01932 J	< 0.29 U	< 0.99 U	< 0.86 U
2/24/2017	Background	< 0.93 U	20	353	2	0.319406 J	49	20	2.261	< 0.083 U	19	0.025	0.058	1.42695 J	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	8.54	166	0.61 J	0.48 J	12.35	8.44	2.491	< 0.083 U	2.98 J	0.0108	0.022 J	< 0.29 U	2.71 J	< 0.86 U
5/23/2018	Assessment	< 0.93 U	2.56 J	102	0.03 J	0.1 J	2.63	4.74 J	1.46	< 0.083 U	< 0.68 U	0.00562	< 0.005 U	< 0.29 U	1.54 J	1.37 J
8/15/2018	Assessment	0.03 J	3.26	85.2	0.116	0.01 J	0.481	3.71	1.076	--	0.438	0.00338	--	0.05 J	0.9	0.090
2/21/2019	Assessment	< 0.02 U	2.21	76.6	0.208	0.01 J	0.225	2.9	0.841	0.09	0.104	0.00294	< 0.005 U	< 0.4 U	0.4	< 0.1 U
5/29/2019	Assessment	0.05 J	2.95	203	1.50	0.08	9.31	5.49	3.55	0.06 J	9.85	0.01 J	0.081	< 0.4 U	5.1	0.1 J
7/23/2019	Assessment	0.03 J	2.10	113	0.573	0.04 J	2.26	5.41	2.245	0.086 J	2.87	0.00414	0.025	< 0.4 U	1.6	< 0.1 U
2/17/2020	Assessment	0.09 J	9.12	115	0.39	0.02 J	6.01	4.08	2.546	0.11	4.8	0.00509	0.013	3.32	1.7	0.1 J
5/19/2020	Assessment	0.02 J	3.94	80.3	0.09 J	0.01 J	0.2 J	3.28	1.115	0.07	0.09 J	0.00383	< 0.002 U	< 0.4 U	0.7	< 0.1 U
10/12/2020	Assessment	0.03 J	4.90	83.4	0.146	0.01 J	0.425	3.93	1.604	0.10	0.417	0.00393	0.003 J	< 0.4 U	0.7	< 0.1 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-17
Welsh - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/26/2016	Background	0.121	200	43	0.4023 J	7.2	1,166	1,810
7/29/2016	Background	0.119	195	32	0.4135 J	5.7	1,005	1,576
9/30/2016	Background	0.111	191	36	0.3055 J	6.2	1,055	1,663
10/21/2016	Background	0.124	194	32	0.583 J	6.1	1,163	1,612
12/14/2016	Background	0.135	196	31	0.5399 J	6.0	1,096	1,560
1/20/2017	Background	0.101	196	33	< 0.083 U	5.9	1,445	1,686
2/24/2017	Background	0.135	189	30	< 0.083 U	5.7	1,055	1,628
6/8/2017	Background	0.121	188	30	< 0.083 U	5.8	1,105	1,578
10/6/2017	Detection	0.183	183	31	< 0.083 U	5.9	1,090	1,548
5/24/2018	Assessment	0.239	193	39	< 0.083 U	6.3	1,067	1,836
8/15/2018	Assessment	0.118	187	40	< 0.083 U	5.6	1,168	1,748
2/21/2019	Assessment	0.151	207	43.2	0.18	6.9	1,060	1,722
5/30/2019	Assessment	0.158	202	41.7	< 0.04 U	6.1	1,120	1,546
7/24/2019	Assessment	0.113	216	37	0.085 J	6.0	1,127	1,864
2/17/2020	Assessment	0.104	184	36.0	0.16	5.9	1,070	1,750
5/20/2020	Assessment	0.115	250	47.7	0.15	5.7	1,190	1,890
10/14/2020	Assessment	0.100	185	35.7	0.17	5.4	1,060	1,720

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-17
Welsh - PBAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/26/2016	Background	< 0.93 U	1.37501 J	21	0.173275 J	2	1	63	1.525	0.4023 J	< 0.68 U	0.37	0.032	< 0.29 U	< 0.99 U	< 0.86 U
7/29/2016	Background	1.13716 J	< 1.05 U	20	0.307264 J	4	1	68	2.78	0.4135 J	< 0.68 U	0.374	0.02133 J	1.04115 J	4.56733 J	< 0.86 U
9/30/2016	Background	< 0.93 U	< 1.05 U	31	0.175474 J	0.848199 J	3	58	2.358	0.3055 J	< 0.68 U	0.354	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
10/21/2016	Background	< 0.93 U	< 1.05 U	34	0.200656 J	2	4	65	2.224	0.583 J	< 0.68 U	0.394	< 0.005 U	0.322249 J	3.34422 J	< 0.86 U
12/14/2016	Background	< 0.93 U	< 1.05 U	17	0.0498325 J	3	0.816224 J	68	2.384	0.5399 J	< 0.68 U	0.323	0.01485 J	< 0.29 U	< 0.99 U	< 0.86 U
1/20/2017	Background	< 0.93 U	< 1.05 U	14	0.0319852 J	3	68	68	2.436	< 0.083 U	< 0.68 U	0.341	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	20	0.0665729 J	2	1	73	2.288	< 0.083 U	< 0.68 U	0.331	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	< 1.05 U	10.33	< 0.02 U	6.06	< 0.23 U	74.8	1.598	< 0.083 U	< 0.68 U	0.329	0.013 J	< 0.29 U	< 0.99 U	< 0.86 U
5/24/2018	Assessment	< 0.93 U	< 1.05 U	9.65	< 0.02 U	6.46	< 0.23 U	71.73	1.939	< 0.083 U	< 0.68 U	0.308	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
8/15/2018	Assessment	0.02 J	1.83	12.8	0.069	0.25	0.604	43.5	2.35	< 0.083 U	1.10	0.243	0.011 J	0.35	0.3	0.074
2/21/2019	Assessment	0.08 J	2.51	120	0.24	0.27	3.34	64.5	2.657	0.18	2.49	0.268	0.007 J	0.7 J	0.8	< 0.1 U
5/30/2019	Assessment	< 0.02 U	0.41	19.6	0.02 J	0.03 J	0.246	51.1	2.508	< 0.04 U	0.03 J	0.341	< 0.005 U	< 0.4 U	0.06 J	< 0.1 U
7/24/2019	Assessment	< 0.02 U	1.07	14.3	0.130	0.03 J	0.228	57.7	3.45	0.085 J	0.263	0.283	< 0.005 U	< 0.4 U	0.1 J	< 0.1 U
2/17/2020	Assessment	< 0.02 U	0.72	9.6	0.04 J	< 0.01 U	0.08 J	42.3	3.46	0.16	< 0.05 U	0.273	< 0.004 U	< 0.4 U	< 0.03 U	< 0.1 U
5/20/2020	Assessment	< 0.02 U	0.86	11.4	0.07 J	0.02 J	0.231	70.0	2.76	0.15	0.08 J	0.302	< 0.002 U	< 0.4 U	0.09 J	< 0.1 U
10/14/2020	Assessment	< 0.02 U	0.84	10.9	0.04 J	0.01 J	0.327	45.4	2.169	0.17	0.2 J	0.274	< 0.002 U	< 0.4 U	0.06 J	< 0.1 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

APPENDIX II

Where applicable, show in this appendix the results from statistical analyses, and a description of the statistical analysis method chosen. These statistical analyses are to be conducted separately for each constituent in each monitoring well.

STATISTICAL ANALYSIS SUMMARY
PRIMARY BOTTOM ASH POND
J. Robert Welsh Plant
Pittsburg, Texas

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

September 1, 2020

CHA8500

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LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
PBAP	Primary Bottom Ash Pond
QA	Quality Assurance
QC	Quality Control
RSL	Regional Screening Level
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Primary Bottom Ash Pond (PBAP), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron at the PBAP. An alternative source was not identified at the time, so the PBAP has been in assessment monitoring since. Groundwater protection standards (GWPS) were set in accordance with 40 CFR 257.95(d)(2) and a statistical evaluation of the assessment monitoring data was conducted. During the most recent assessment monitoring event, completed in July 2019, an SSL was identified for lithium at well AD-9 (Geosyntec, 2019). A successful alternative source demonstration (ASD) was completed per 40 CFR 257.95(g)(3); therefore, the PBAP remained in assessment monitoring. Two assessment monitoring events were conducted at the PBAP in February and May 2020 in accordance with 40 CFR 257.95. The results of these assessment events are documented in this report.

Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact data usability.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were re-established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at a statistically significant level (SSL) above the GWPS. An SSL was identified for lithium. Thus, either the unit will move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

PRIMARY BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, two sets of samples were collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(b) (February 2020) and 257.95(d)(1) (May 2020). Samples from both sampling events were analyzed for the Appendix III and Appendix IV parameters. A summary of data collected during these assessment monitoring events may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.26 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the PBAP were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained in February and May 2020 were screened for potential outliers. No outliers were identified for these events.

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in 40 CFR 257.95(h)(2) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events. Tolerance limits were calculated parametrically with 95% coverage and 95% confidence for barium, chromium, and combined radium. Non-parametric tolerance limits were calculated for antimony, arsenic, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, and selenium due to apparent non-normal distributions and for thallium due to a high non-detect frequency. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

The following SSL was identified at the Welsh PBAP:

- The LCL for lithium exceeded the GWPS of 0.390 mg/L at AD-9 (0.800 mg/L).

As a result, the Welsh PBAP will either move to an assessment of corrective measures or an alternative source demonstration will be conducted to evaluate if the unit can remain in assessment monitoring.

2.2.3 Evaluation of Potential Appendix III SSIs

While SSLs were identified, a review of the Appendix III results were also completed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations.

Data collected during the July 2020 assessment monitoring event from each compliance well were compared to the prediction limits to evaluate results above background values. Where potential exceedances were noted, verification sampling was completed on July 22, 2020. The results from this event and the prediction limits are summarized in Table 3. The following exceedances of the upper prediction limits (UPLs) were noted:

- Boron concentrations exceeded the interwell UPL of 0.700 mg/L at AD-8 (1.23 mg/L and 1.14 mg/L).

Based on these results, the boron concentrations at AD-8 exceeded background levels at compliance wells at the Welsh PBAP during assessment monitoring.

2.3 Conclusions

A semi-annual assessment monitoring event was conducted in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the February and July 2020 data. GWPSs were re-established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter;

SSLs were concluded if the entire confidence interval exceeded the GWPS. An SSL was identified for lithium. Appendix III parameters were compared to recalculated prediction limits, with an exceedance identified for boron.

Based on this evaluation, the Welsh PBAP CCR unit will either move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Welsh Plant. January 2017.

Geosyntec Consultants (Geosyntec). 2019. Statistical Analysis Summary – Primary Bottom Ash Pond, J. Robert Welsh Plant. December.

TABLES

Table 1 - Groundwater Data Summary
Welsh Plant - Primary Bottom Ash Pond

Parameter	Unit	AD-1		AD-15		AD-17		AD-5		AD-8			AD-9	
		2/17/2020	5/20/2020	2/17/2020	5/19/2020	2/17/2020	5/20/2020	2/17/2020	5/20/2020	2/17/2020	5/19/2020	7/22/2020	2/17/2020	5/19/2020
Antimony	µg/L	0.330	0.15	0.0900 J	0.02 J	0.1 U	0.1 U	0.0300 J	0.1 U	0.1 U	0.1 U	-	0.1 U	0.1 U
Arsenic	µg/L	0.490	0.53	9.12	3.94	0.720	0.86	2.17	1.78	0.550	0.27	-	0.330	0.25
Barium	µg/L	303	394	115	80.3	9.60	11.4	109	93.1	38.9	21.1	-	52.8	51.6
Beryllium	µg/L	0.0700 J	0.270	0.390	0.09 J	0.0400 J	0.07 J	0.0900 J	0.05 J	0.1 U	0.1 U	-	0.979	0.933
Boron	mg/L	0.626	0.801	0.419	0.376	0.104	0.115	0.0300 J	0.03 J	1.25	1.23	1.14	0.120	0.066
Cadmium	µg/L	0.0200 J	0.02 J	0.0200 J	0.01 J	0.05 U	0.02 J	0.0200 J	0.01 J	0.0500 J	0.04 J	-	0.240	0.24
Calcium	mg/L	115	126	3.64	3.37	184	250	39.8	40.2	14.6	15.1	-	11.5	11.3
Chloride	mg/L	3.41	1.83	34.3	34.1	36.0	47.7	19.8	22.3	17.0	16.5	-	19.9	44.8
Chromium	µg/L	0.100 J	0.1 J	6.01	0.2 J	0.0800 J	0.231	0.336	0.1 J	0.244	0.2 J	-	0.608	0.458
Cobalt	µg/L	0.280	0.490	4.08	3.28	42.3	70.0	4.52	7.65	1.02	1.17	-	17.7	16.5
Combined Radium	pCi/L	2.67	2.31	2.55	1.12	3.46	2.76	2.39	1.61	1.26	0.344	-	1.94	1.85
Fluoride	mg/L	0.31	0.20	0.11	0.07	0.16	0.15	0.22	0.18	0.67	0.66	-	0.15	0.1 J
Lead	µg/L	0.100 J	0.1 J	4.80	0.09 J	0.2 U	0.08 J	0.227	0.07 J	0.100 J	0.2 U	-	0.200 J	0.07 J
Lithium	mg/L	0.00105	0.00301	0.00509	0.00383	0.273	0.302	0.0732	0.0740	0.124	0.0872	-	0.218	0.160
Mercury	µg/L	0.005 U	0.005 U	0.0130	0.005 U	0.01 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	-	0.00200 J	0.003 J
Molybdenum	µg/L	1.00 J	2 J	3.32	2 U	2 U	2 U	0.900 J	2 U	2 U	2 U	-	2 U	2 U
Selenium	µg/L	2.30	2.8	1.70	0.7	0.2 U	0.09 J	0.200	0.09 J	0.0800 J	0.07 J	-	0.300	0.4
Sulfate	mg/L	56.3	51.4	21.5	19.0	1,070	1,190	43.7	55.5	159	149	-	100	536
Thallium	µg/L	0.5 U	0.5 U	0.100 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	-	0.200 J	0.2 J
Total Dissolved Solids	mg/L	488	508	234	216	1,750	1,890	248	264	344	336	-	282	902
pH	SU	5.8	7.2	4.5	5.3	5.9	5.7	5.5	6.8	6.5	6.4	-	6.0	4.9

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. For statistical analysis, parameters which were not detected were replaced with the reporting limit.
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not analyzed

Table 2: Groundwater Protection Standards
Welsh Plant - Primary Bottom Ash Pond

Constituent Name	MCL	CCR Rule-Specified	Calculated UTL
Antimony, Total (mg/L)	0.006		0.003
Arsenic, Total (mg/L)	0.01		0.005
Barium, Total (mg/L)	2		0.69
Beryllium, Total (mg/L)	0.004		0.00054
Cadmium, Total (mg/L)	0.005		0.0065
Chromium, Total (mg/L)	0.1		0.0031
Cobalt, Total (mg/L)	n/a	0.006	0.075
Combined Radium, Total (pCi/L)	5		4.07
Fluoride, Total (mg/L)	4		0.58
Lead, Total (mg/L)	n/a	0.015	0.0034
Lithium, Total (mg/L)	n/a	0.04	0.39
Mercury, Total (mg/L)	0.002		0.000033
Molybdenum, Total (mg/L)	n/a	0.1	0.002
Selenium, Total (mg/L)	0.05		0.005
Thallium, Total (mg/L)	0.002		0.001

Notes:

Grey cell indicates calculated UTL is higher than MCL or CCR Rule-specified value.

MCL = Maximum Contaminant Level

Calculated UTL (Upper Tolerance Limit) represents site-specific background values.

The higher of the calculated UTL or MCL/Rule-Specified Level is used as the GWPS.

Table 3: Appendix III Data Summary
Welsh Plant - Primary Bottom Ash Pond

Analyte	Unit	Description	AD-8		AD-9	AD-15
			5/19/2020	7/22/2020	5/19/2020	5/19/2020
Boron	mg/L	Interwell Background Value (UPL)	0.700			
		Analytical Result	**1.23**	**1.14**	0.066	0.376
Calcium	mg/L	Intrawell Background Value (UPL)			299	5.40
		Analytical Result	15.1	-	11.3	3.37
Chloride	mg/L	Intrawell Background Value (UPL)			138	38.8
		Analytical Result	16.5	-	44.8	34.1
Fluoride	mg/L	Interwell Background Value (UPL)			1.00	1.00
		Analytical Result	0.66	-	0.1	0.07
pH	SU	Interwell Background Value (UPL)	7.0			
		Interwell Background Value (LPL)	4.8			
		Analytical Result	6.4	-	4.9	5.3
Sulfate	mg/L	Intrawell Background Value (UPL)			2,530	33.2
		Analytical Result	149	-	536	19.0
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)			3,070	249
		Analytical Result	336	-	902	216

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
-: Not analyzed

ATTACHMENT A
Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Welsh Primary Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

DAVID ANTHONY MILLER
112498

112498
License Number

Texas
Licensing State

09.01.2020
Date

American Electric Power Service Corporation
Texas Registered Engineering Firm No. F-3341

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

July 28, 2020

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Welsh PBAP – 1st Semi-Annual Assessment Monitoring Report

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the statistical analysis of groundwater data for the Assessment Monitoring report for American Electric Power Inc.'s Welsh PBAP. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at the site for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** AD-1, AD-5, and AD-17; and
- **Downgradient wells:** AD-8, AD-9, and AD-15

Data were sent electronically, and the statistical analysis was reviewed by Kristina Rayner, Groundwater Statistician and Founder of Groundwater Stats Consulting (GWS). The analysis was conducted according to the Statistical Analysis Plan prepared by GWS and approved by Dr. Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GWS.

The CCR Assessment Monitoring program consists of the following constituents:

- **Appendix IV** (Assessment Monitoring) – antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium

Time series plots for Appendix IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells. Values previously identified and flagged as outliers may be seen in the Outlier Summary following this letter (Figure C) and are plotted in a lighter font and disconnected symbol on the time series graphs. Note that the measured concentrations of most metals for September 30, 2016 at well AD-15 are very high compared to the rest of the observations and resulted from elevated turbidity levels of >1000 mg/L. These values were flagged as outliers as they do not represent the population at this well.

Evaluation of Appendix IV Parameters

Upper tolerance limits were used to calculate background limits from all available pooled upgradient well data for Appendix IV parameters to determine the background limit for each constituent (Figure D). Background data were screened for any additional outliers or extreme trending patterns that would lead to artificially elevated statistical limits. As mentioned above, all flagged values may be seen on the Outlier Summary following this letter. Parametric tolerance limits are constructed when data follow a normal or transformed-normal distribution and use a target of 95% confidence and 95% coverage. Nonparametric tolerance limits are used for all other data sets and the confidence and coverage levels are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and CCR-Rule specified levels in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure E).

Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters and compared to the highest limit of the MCL, CCR-Rule specified level, or background as discussed above (Figure F). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No confidence intervals exceedances were found except for lithium in well AD-9. A summary of the confidence interval results follows this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Welsh PBAP. If you have any questions or comments, please feel free to contact me.

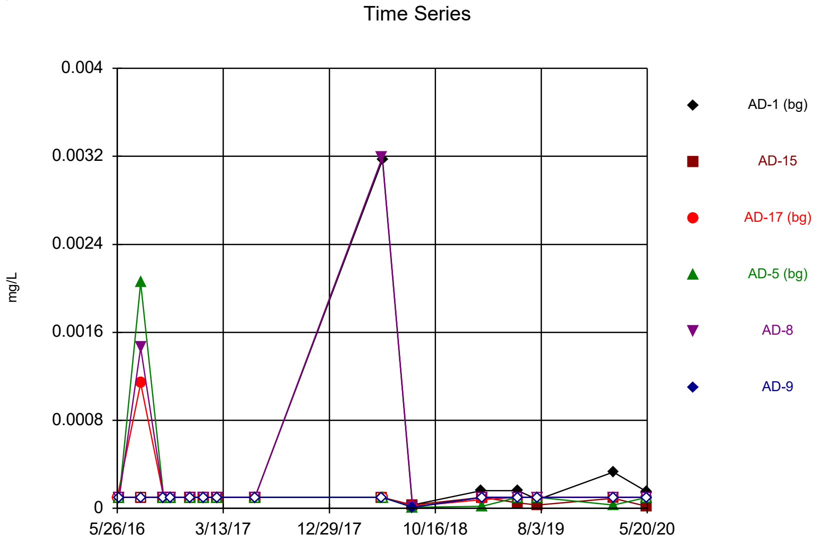
For Groundwater Stats Consulting,

Easton Rayner
Groundwater Analyst

Kristina Rayner

Kristina L. Rayner
Groundwater Statistician

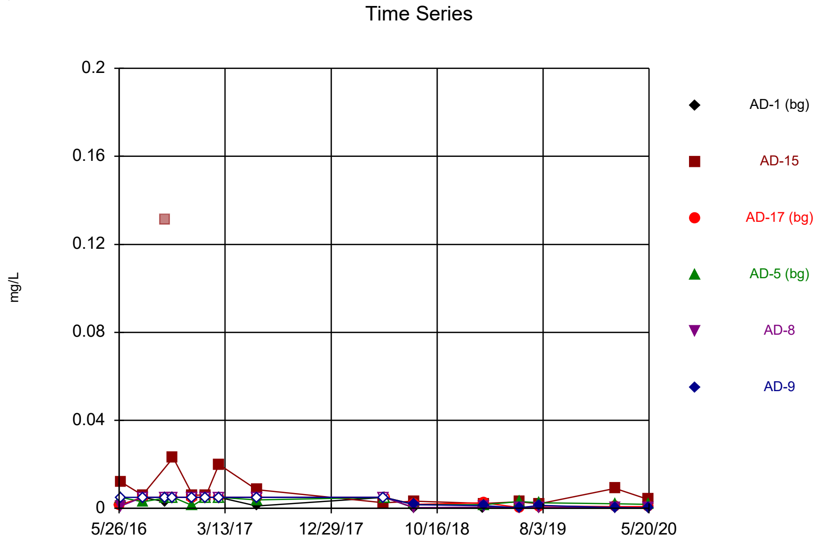
Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.



Constituent: Antimony, total   Analysis Run 7/2/2020 12:08 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.



Constituent: Arsenic, total   Analysis Run 7/2/2020 12:08 PM

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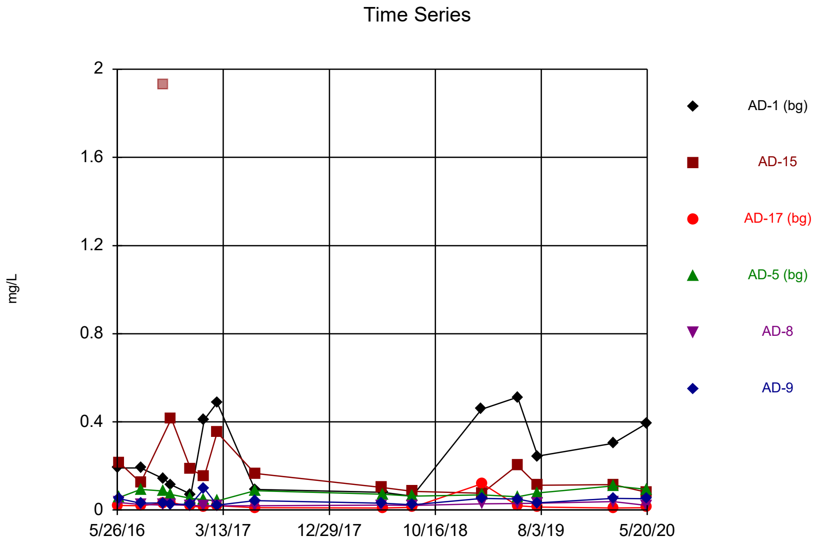
Sanitas™ v.9.6.26 . UG



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Sanitas™ v.9.6.26 . UG
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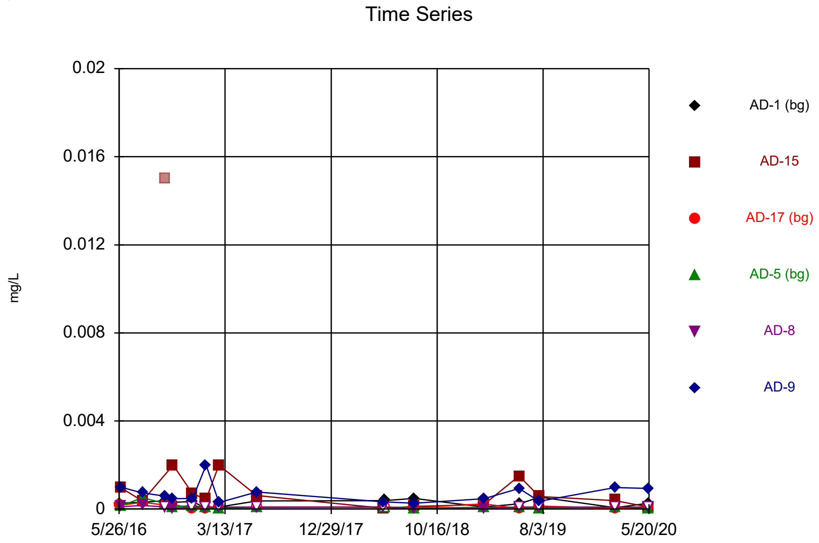
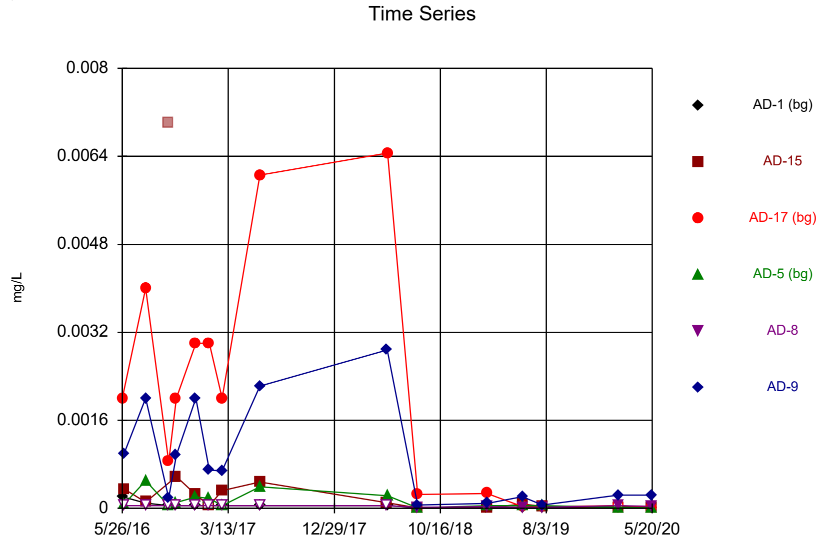


Constituent: Beryllium, total   Analysis Run 7/2/2020 12:08 PM

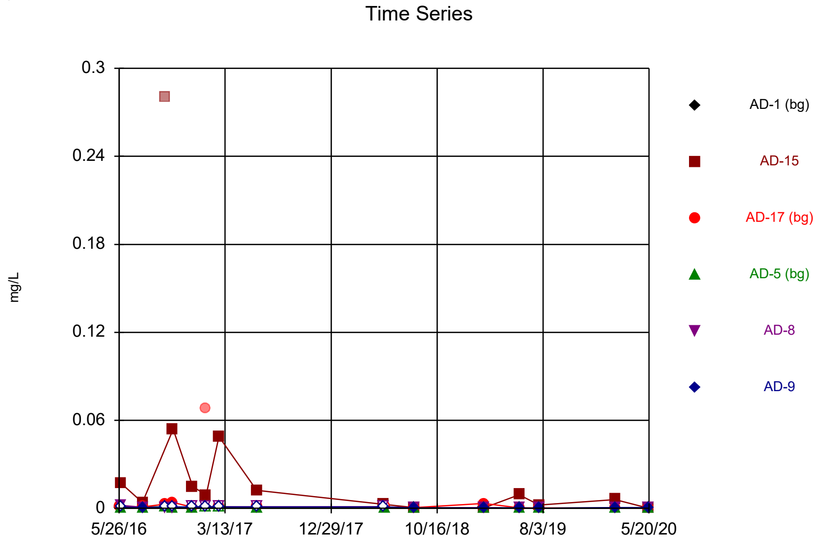
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.



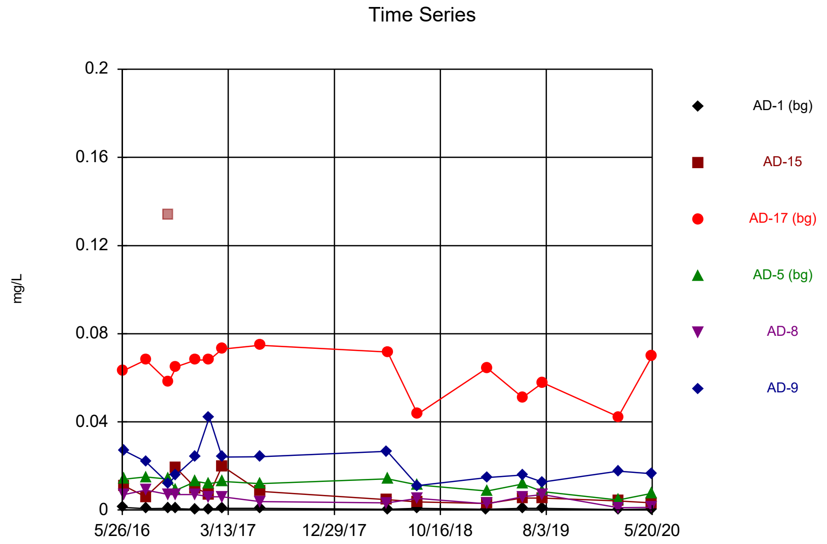
Constituent: Cadmium, total Analysis Run 7/2/2020 12:08 PM
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.



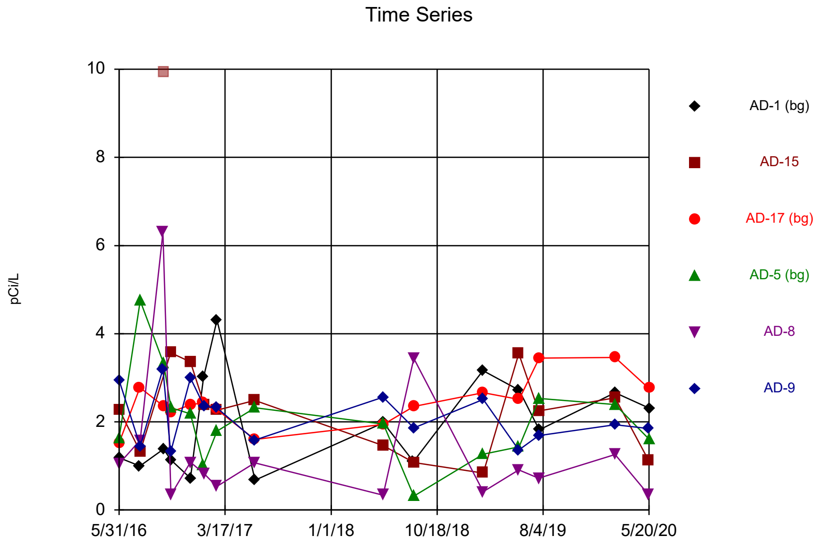
Constituent: Chromium, total Analysis Run 7/2/2020 12:08 PM
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG



Constituent: Cobalt, total Analysis Run 7/2/2020 12:08 PM
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

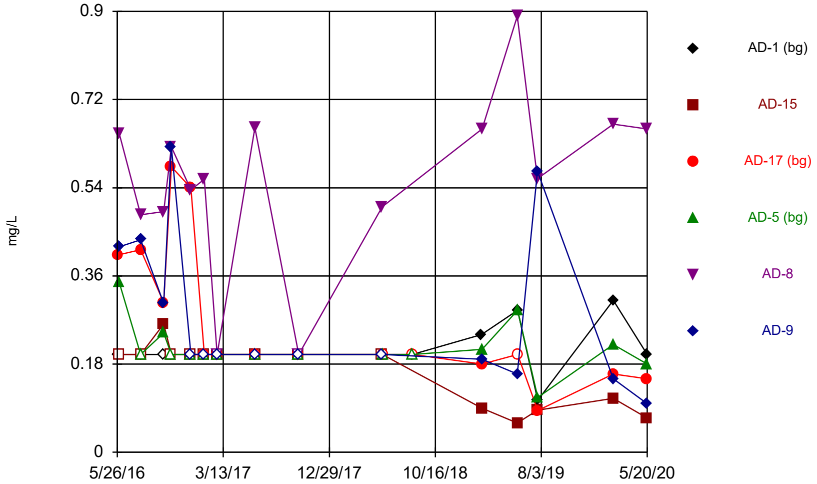
Sanitas™ v.9.6.26 . UG



Constituent: Combined Radium 226 + 228 Analysis Run 7/2/2020 12:08 PM
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.

Time Series

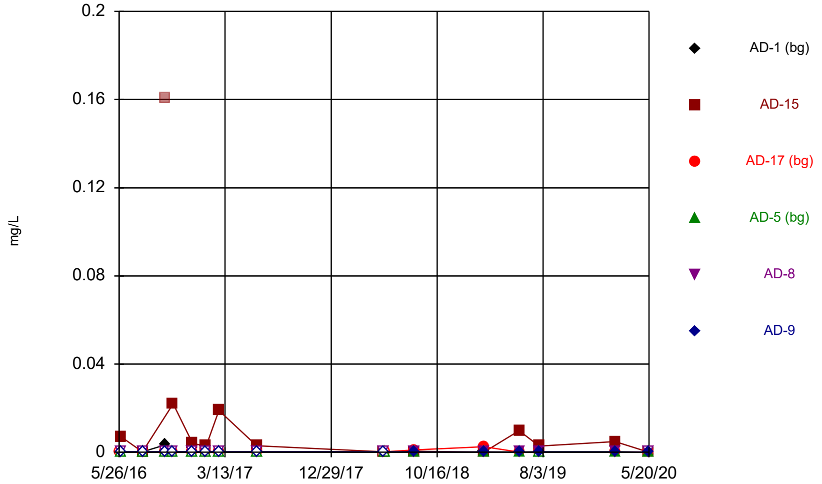


Constituent: Fluoride, total   Analysis Run 7/2/2020 12:08 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.

Time Series

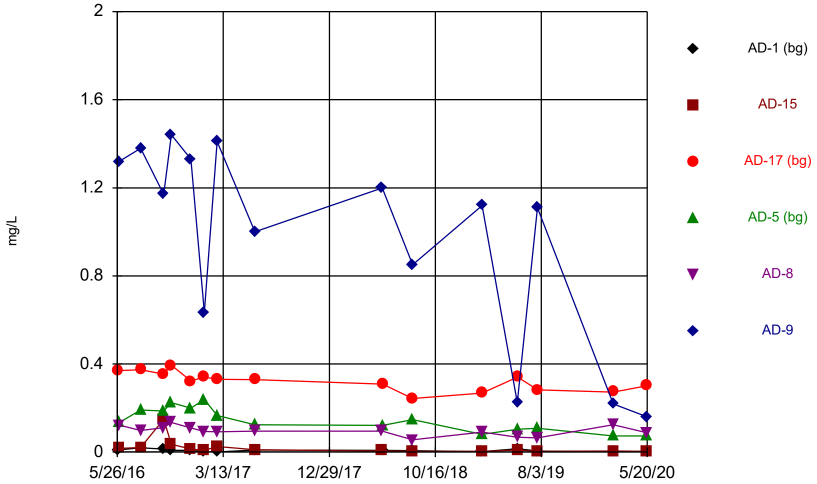


Constituent: Lead, total   Analysis Run 7/2/2020 12:08 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.

Time Series

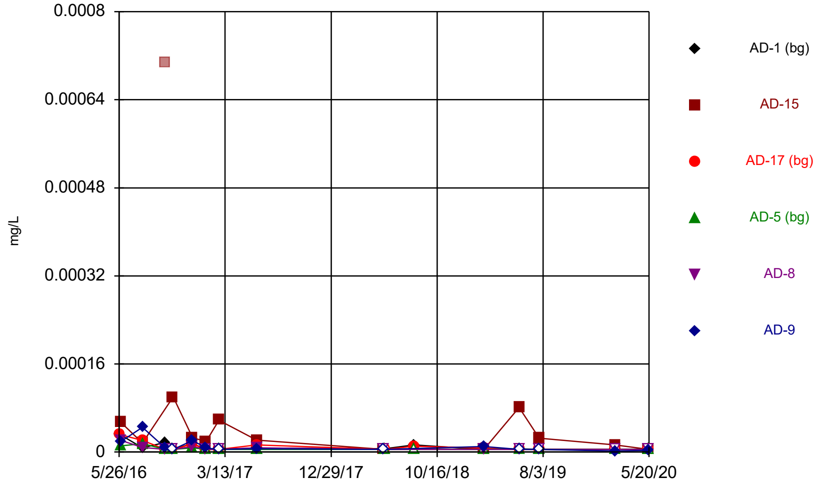


Constituent: Lithium, total   Analysis Run 7/2/2020 12:08 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

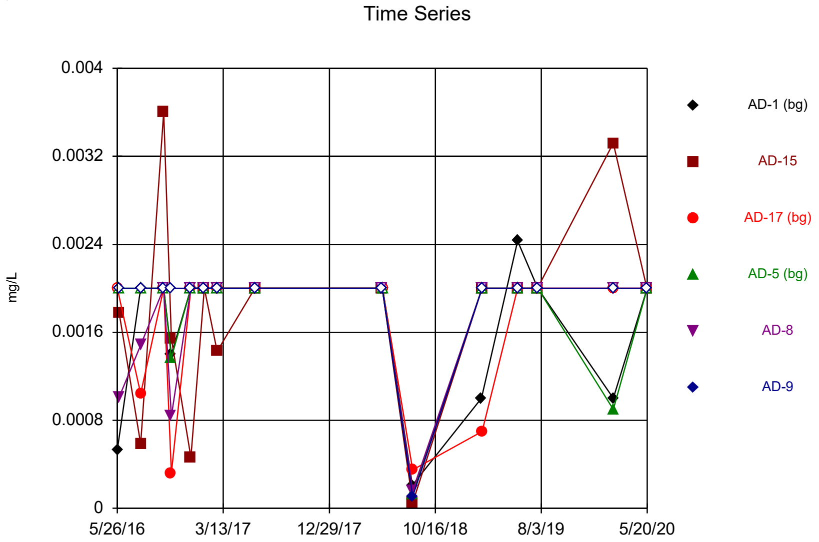
Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.

Time Series



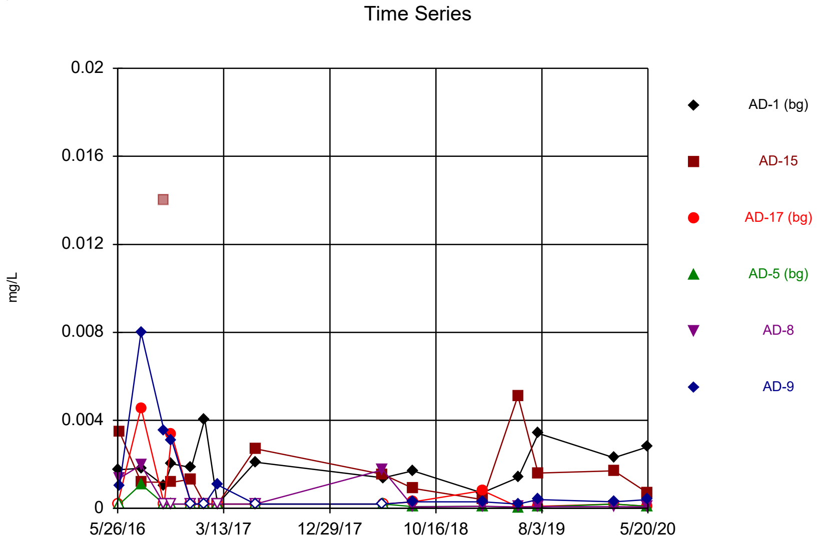
Constituent: Mercury, total   Analysis Run 7/2/2020 12:08 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP



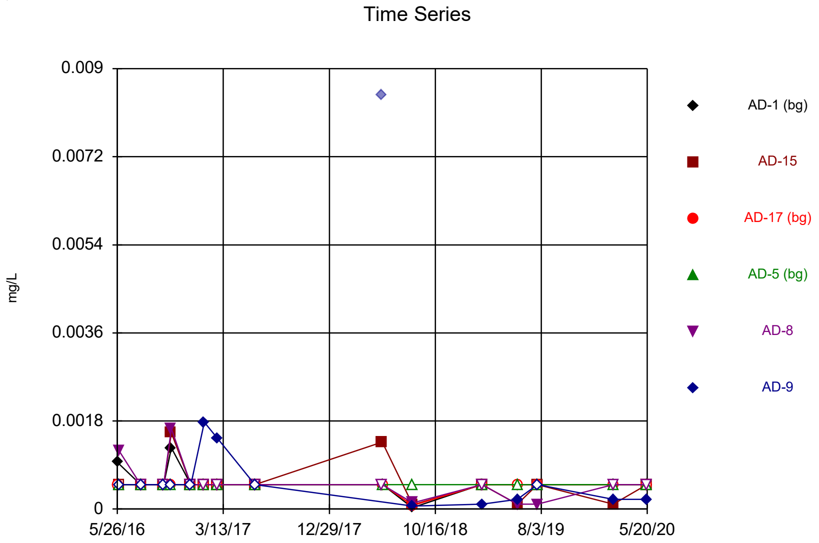
Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.

Constituent: Molybdenum, total   Analysis Run 7/2/2020 12:08 PM
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP



Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.

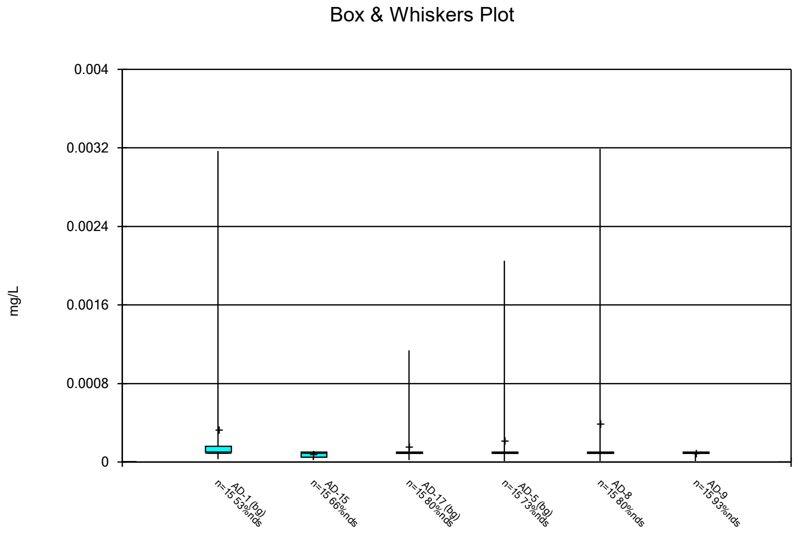
Constituent: Selenium, total   Analysis Run 7/2/2020 12:08 PM
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP



Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.

Constituent: Thallium, total   Analysis Run 7/2/2020 12:08 PM
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

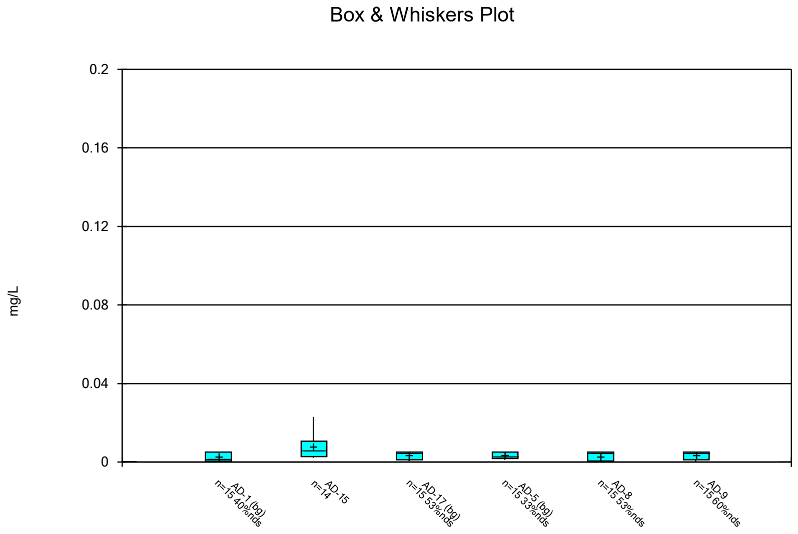
Sanitas™ v.9.6.26 . UG



Constituent: Antimony, total   Analysis Run 7/2/2020 12:09 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

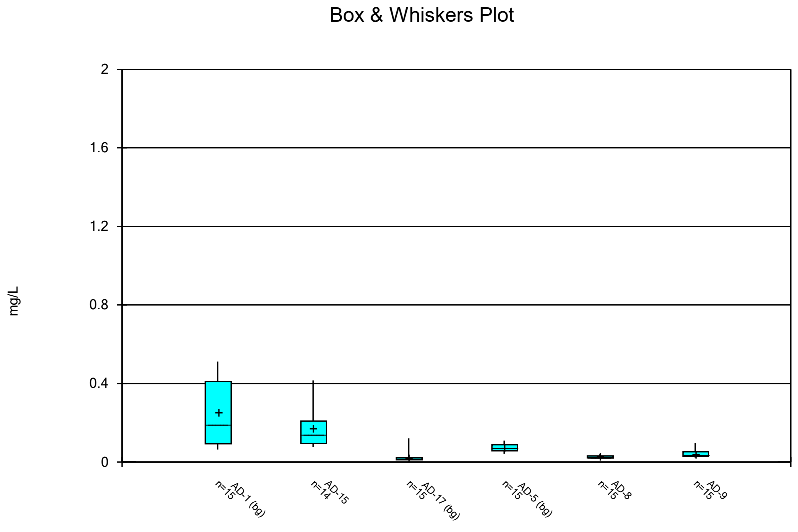
Sanitas™ v.9.6.26 . UG



Constituent: Arsenic, total   Analysis Run 7/2/2020 12:09 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

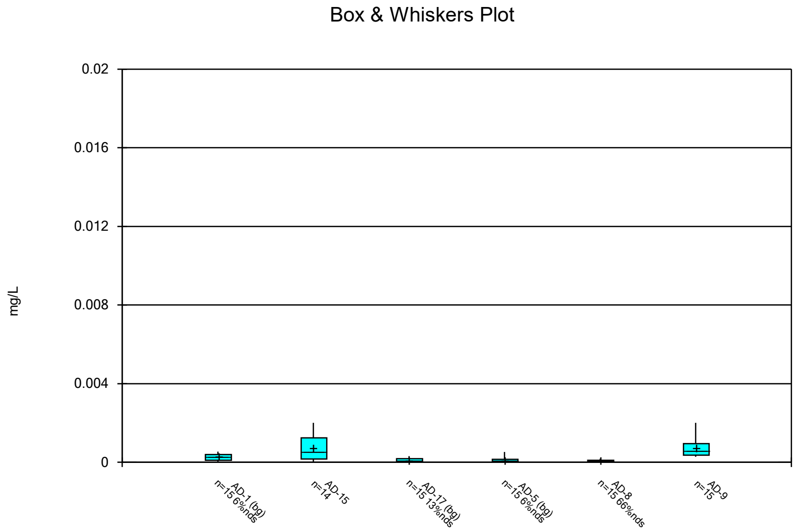
Sanitas™ v.9.6.26 . UG



Constituent: Barium, total   Analysis Run 7/2/2020 12:09 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

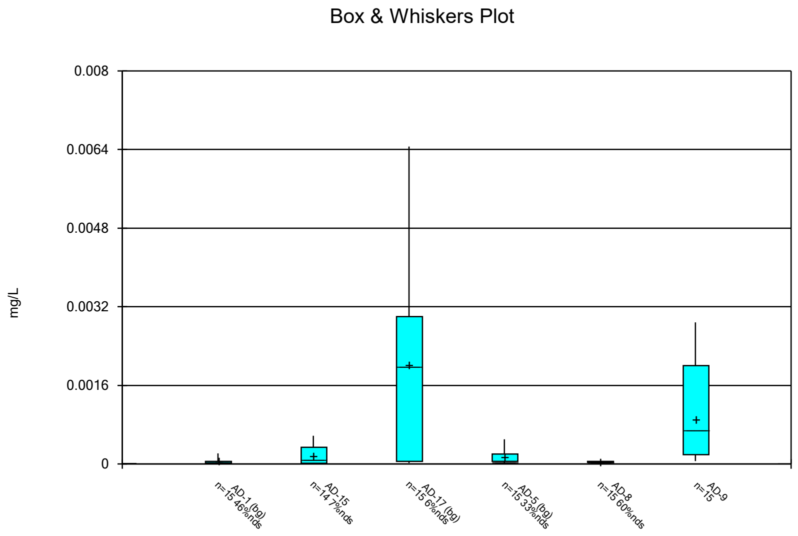
Sanitas™ v.9.6.26 . UG



Constituent: Beryllium, total   Analysis Run 7/2/2020 12:09 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

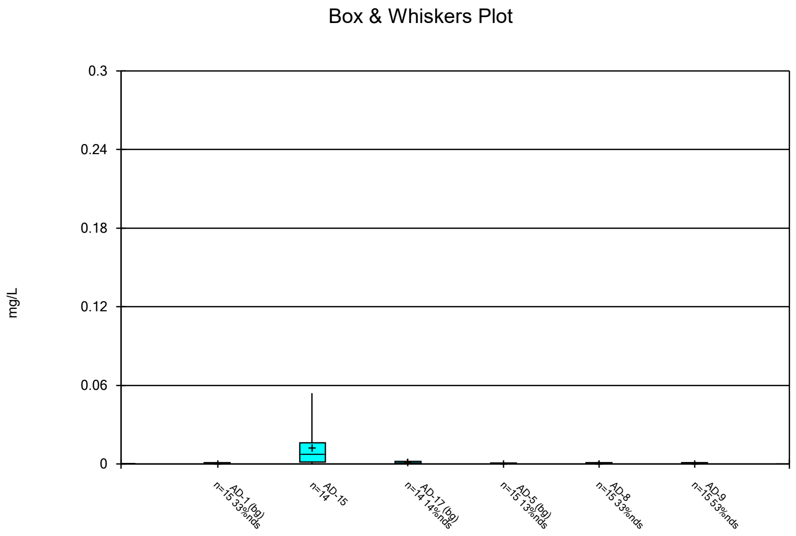
Sanitas™ v.9.6.26 . UG



Constituent: Cadmium, total   Analysis Run 7/2/2020 12:10 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

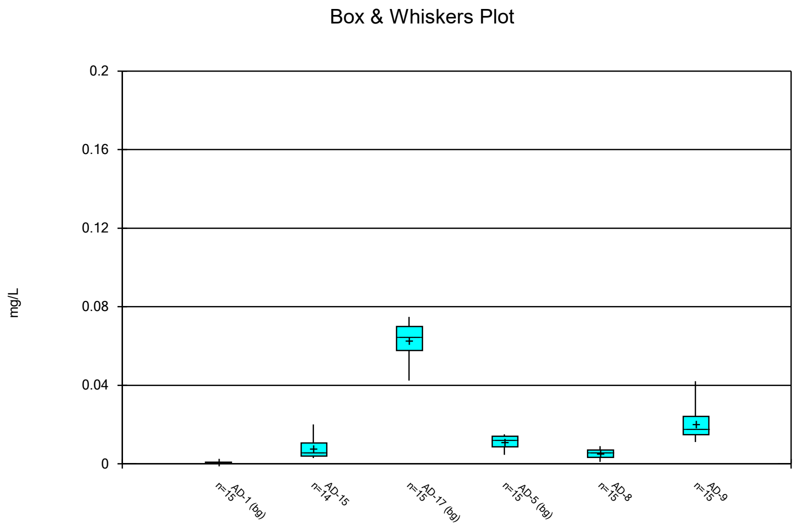
Sanitas™ v.9.6.26 . UG



Constituent: Chromium, total   Analysis Run 7/2/2020 12:10 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

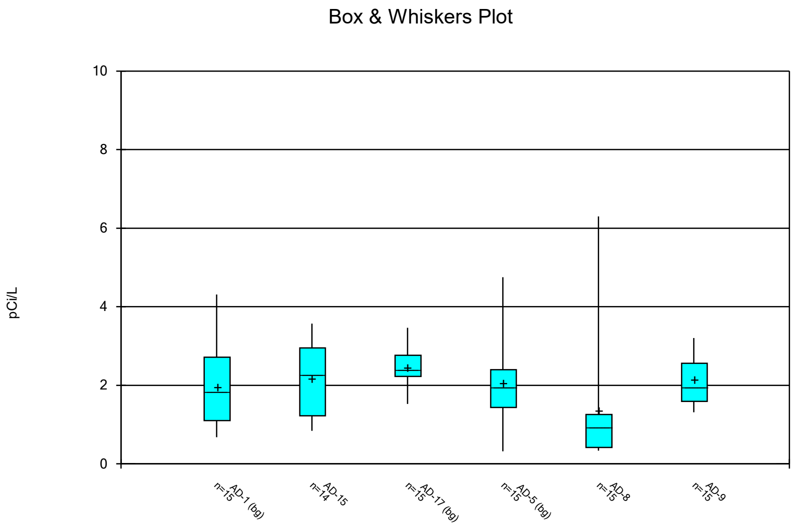
Sanitas™ v.9.6.26 . UG



Constituent: Cobalt, total   Analysis Run 7/2/2020 12:10 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

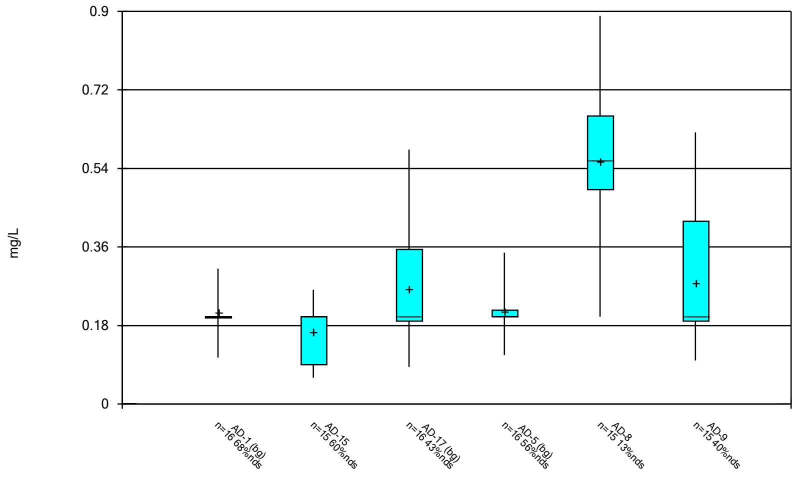


Constituent: Combined Radium 226 + 228   Analysis Run 7/2/2020 12:10 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot

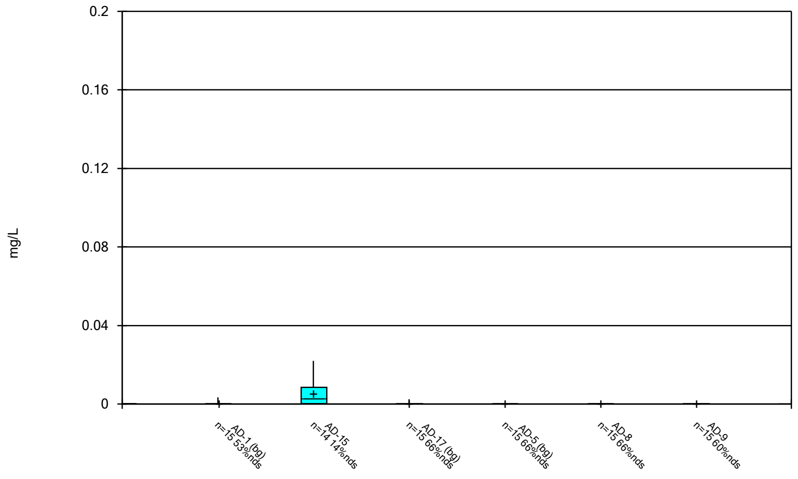


Constituent: Fluoride, total   Analysis Run 7/2/2020 12:10 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot

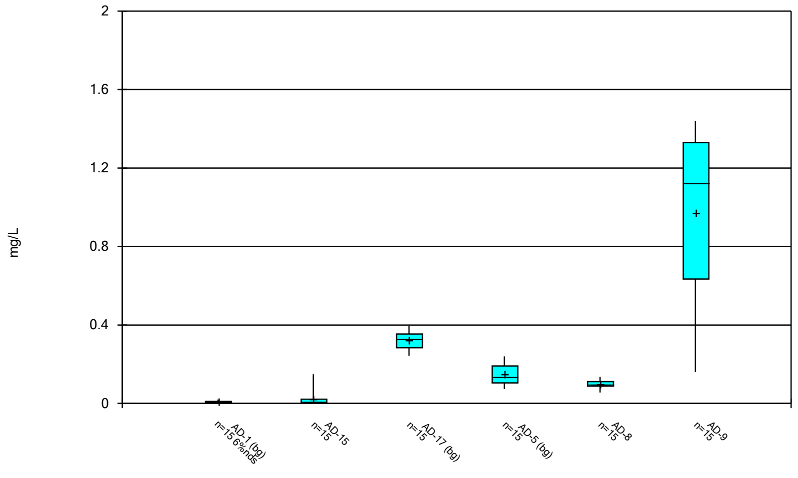


Constituent: Lead, total   Analysis Run 7/2/2020 12:10 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot

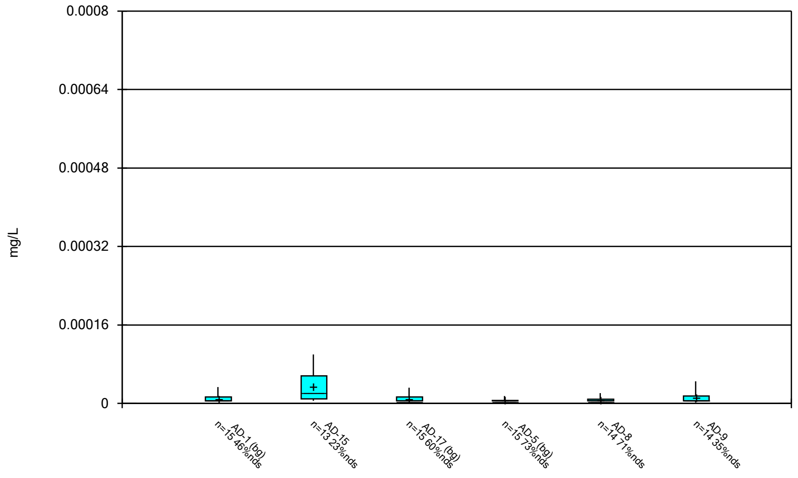


Constituent: Lithium, total   Analysis Run 7/2/2020 12:10 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

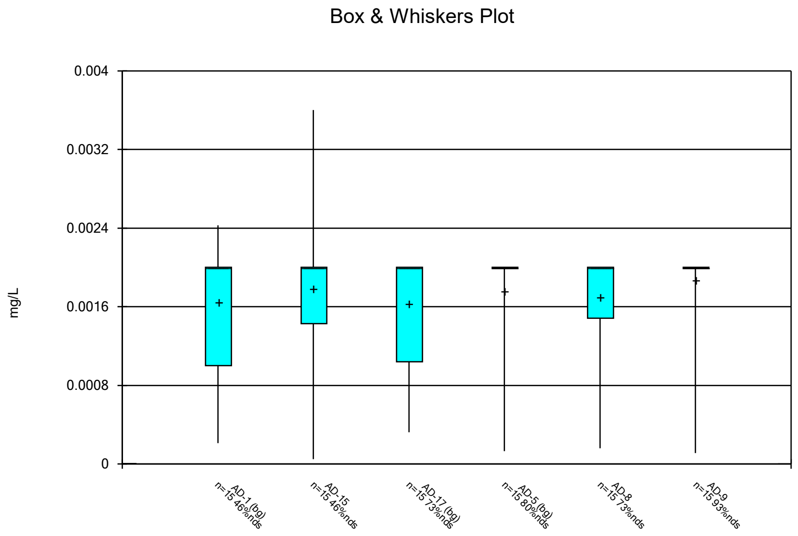
Box & Whiskers Plot



Constituent: Mercury, total   Analysis Run 7/2/2020 12:10 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

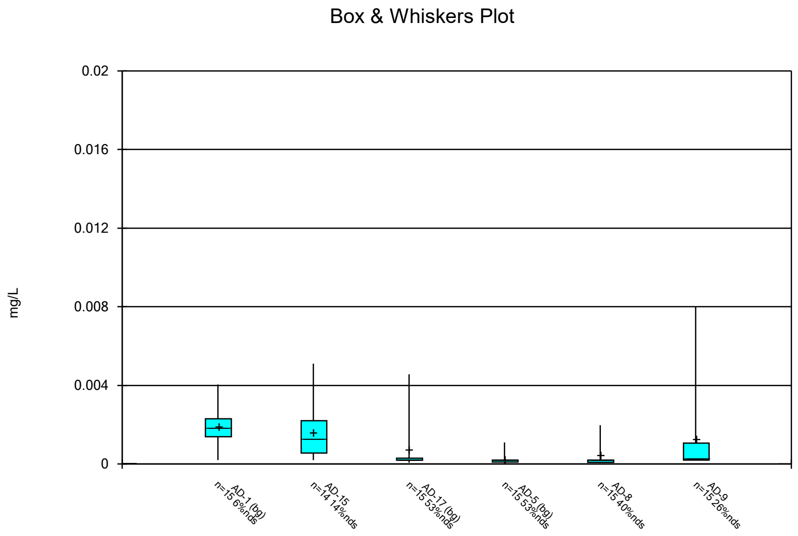
Sanitas™ v.9.6.26 . UG



Constituent: Molybdenum, total   Analysis Run 7/2/2020 12:10 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

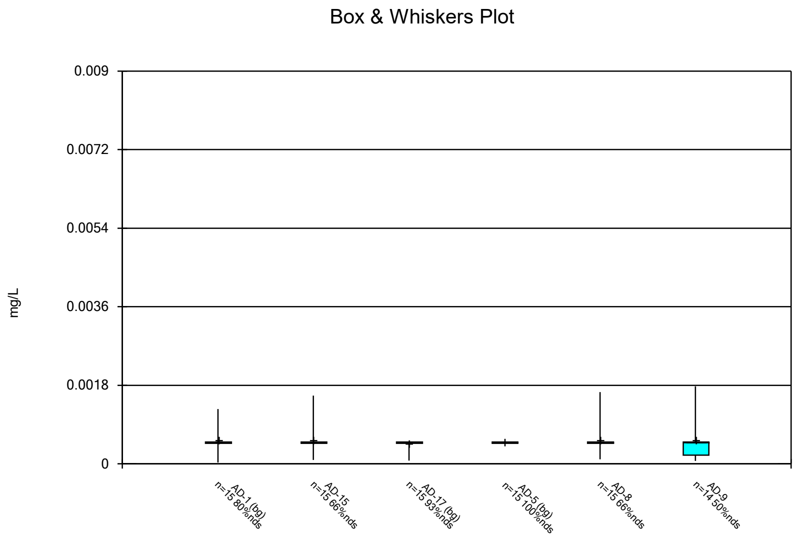
Sanitas™ v.9.6.26 . UG



Constituent: Selenium, total   Analysis Run 7/2/2020 12:10 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG



Constituent: Thallium, total   Analysis Run 7/2/2020 12:10 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Outlier Summary

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 7/2/2020, 12:43 PM

	AD-15 Arsenic, total (mg/L)	AD-15 Barium, total (mg/L)	AD-15 Beryllium, total (mg/L)	AD-15 Cadmium, total (mg/L)	AD-15 Chromium, total (mg/L)	AD-17 Chromium, total (mg/L)	AD-15 Cobalt, total (mg/L)	AD-15 Combined Radium 226 + 228 (pCi/L)	AD-15 Lead, total (mg/L)	AD-15 Mercury, total (mg/L)
9/29/2016								9.92 (o)		
9/30/2016	0.131 (o)	1.93 (o)	0.015 (o)	0.007 (o)	0.28 (o)		0.134 (o)		0.161 (o)	0.000707 (o)
1/20/2017						0.068 (o)				
5/23/2018										

	AD-15 Selenium, total (mg/L)	AD-9 Thallium, total (mg/L)
9/29/2016		
9/30/2016	0.014 (o)	
1/20/2017		
5/23/2018		0.00846 (o)

Upper Tolerance Limits

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP   Printed 7/2/2020, 12:12 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Bg N	Std. Dev.	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	n/a	0.00317	n/a	n/a	n/a	45	n/a	68.89	n/a	0.09944	NP Inter(normal...
Arsenic, total (mg/L)	n/a	0.005	n/a	n/a	n/a	45	n/a	42.22	n/a	0.09944	NP Inter(normal...
Barium, total (mg/L)	n/a	0.6857	n/a	n/a	n/a	45	1.139	0	ln(x)	0.05	Inter
Beryllium, total (mg/L)	n/a	0.00054	n/a	n/a	n/a	45	n/a	8.889	n/a	0.09944	NP Inter(normal...
Cadmium, total (mg/L)	n/a	0.00646	n/a	n/a	n/a	45	n/a	28.89	n/a	0.09944	NP Inter(normal...
Chromium, total (mg/L)	n/a	0.003134	n/a	n/a	n/a	44	1.145	20.45	ln(x)	0.05	Inter
Cobalt, total (mg/L)	n/a	0.0748	n/a	n/a	n/a	45	n/a	0	n/a	0.09944	NP Inter(normal...
Combined Radium 226 + 228 (pCi/L)	n/a	4.068	n/a	n/a	n/a	45	0.9169	0	No	0.05	Inter
Fluoride, total (mg/L)	n/a	0.583	n/a	n/a	n/a	48	n/a	56.25	n/a	0.08526	NP Inter(normal...
Lead, total (mg/L)	n/a	0.003384	n/a	n/a	n/a	45	n/a	62.22	n/a	0.09944	NP Inter(normal...
Lithium, total (mg/L)	n/a	0.394	n/a	n/a	n/a	45	n/a	2.222	n/a	0.09944	NP Inter(normal...
Mercury, total (mg/L)	n/a	0.000033	n/a	n/a	n/a	45	n/a	60	n/a	0.09944	NP Inter(normal...
Molybdenum, total (mg/L)	n/a	0.00243	n/a	n/a	n/a	45	n/a	66.67	n/a	0.09944	NP Inter(normal...
Selenium, total (mg/L)	n/a	0.004567	n/a	n/a	n/a	45	n/a	37.78	n/a	0.09944	NP Inter(normal...
Thallium, total (mg/L)	n/a	0.001251	n/a	n/a	n/a	45	n/a	91.11	n/a	0.09944	NP Inter(NDs)

WELSH PBAP GWPS				
Constituent Name	**MCL**	**CCR-Rule Specified**	**Background Limit**	**GWPS**
Antimony, Total (mg/L)	0.006		0.0032	0.006
Arsenic, Total (mg/L)	0.01		0.005	0.01
Barium, Total (mg/L)	2		0.69	2
Beryllium, Total (mg/L)	0.004		0.00054	0.004
Cadmium, Total (mg/L)	0.005		0.00646	0.00646
Chromium, Total (mg/L)	0.1		0.0031	0.1
Cobalt, Total (mg/L)	n/a	0.006	0.075	0.075
Combined Radium, Total (pCi/L)	5		4.07	5
Fluoride, Total (mg/L)	4		0.58	4
Lead, Total (mg/L)	0.015		0.0034	0.015
Lithium, Total (mg/L)	n/a	0.04	0.39	0.39
Mercury, Total (mg/L)	0.002		0.000033	0.002
Molybdenum, Total (mg/L)	n/a	0.1	0.0024	0.1
Selenium, Total (mg/L)	0.05		0.0046	0.05
Thallium, Total (mg/L)	0.002		0.0013	0.002

**Grey cell indicates background is higher than MCL.*

**MCL = Maximum Contaminant Level*

Confidence Interval Summary Table - Significant Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 7/2/2020, 12:20 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Lithium, total (mg/L)	**AD-9**	**1.276**	**0.8002**	**0.39**	**Yes**	**15**	**0**	**x^2**	**0.01**	**Param.**

Confidence Interval Summary Table - All Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 7/2/2020, 12:20 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	AD-15	0.0001	0.00003	0.006	No	15	66.67	No	0.01	NP (normality)
Antimony, total (mg/L)	AD-8	0.001461	0.00001	0.006	No	15	80	No	0.01	NP (NDs)
Antimony, total (mg/L)	AD-9	0.0001	0.00001	0.006	No	15	93.33	No	0.01	NP (NDs)
Arsenic, total (mg/L)	AD-15	0.0111	0.003317	0.01	No	14	0	sqrt(x)	0.01	Param.
Arsenic, total (mg/L)	AD-8	0.005	0.00037	0.01	No	15	53.33	No	0.01	NP (normality)
Arsenic, total (mg/L)	AD-9	0.005	0.00033	0.01	No	15	60	No	0.01	NP (normality)
Barium, total (mg/L)	AD-15	0.2281	0.102	2	No	14	0	sqrt(x)	0.01	Param.
Barium, total (mg/L)	AD-8	0.02931	0.02119	2	No	15	0	No	0.01	Param.
Barium, total (mg/L)	AD-9	0.05162	0.02914	2	No	15	0	x^(1/3)	0.01	Param.
Beryllium, total (mg/L)	AD-15	0.001067	0.0002277	0.004	No	14	0	sqrt(x)	0.01	Param.
Beryllium, total (mg/L)	AD-8	0.0001145	0.00003	0.004	No	15	66.67	No	0.01	NP (normality)
Beryllium, total (mg/L)	AD-9	0.0009417	0.0004202	0.004	No	15	0	sqrt(x)	0.01	Param.
Cadmium, total (mg/L)	AD-15	0.0003685	0.0000418	0.0065	No	14	7.143	sqrt(x)	0.01	Param.
Cadmium, total (mg/L)	AD-8	0.001	0.00002	0.0065	No	15	60	No	0.01	NP (normality)
Cadmium, total (mg/L)	AD-9	0.001336	0.0002367	0.0065	No	15	0	sqrt(x)	0.01	Param.
Chromium, total (mg/L)	AD-15	0.01996	0.001971	0.1	No	14	0	sqrt(x)	0.01	Param.
Chromium, total (mg/L)	AD-8	0.001319	0.0003585	0.1	No	15	33.33	No	0.01	Param.
Chromium, total (mg/L)	AD-9	0.001	0.000313	0.1	No	15	53.33	No	0.01	NP (normality)
Cobalt, total (mg/L)	AD-15	0.01094	0.00427	0.075	No	14	0	sqrt(x)	0.01	Param.
Cobalt, total (mg/L)	AD-8	0.006901	0.003709	0.075	No	15	0	No	0.01	Param.
Cobalt, total (mg/L)	AD-9	0.02516	0.01504	0.075	No	15	0	sqrt(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-15	2.827	1.532	5	No	14	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-8	1.61	0.5172	5	No	15	0	ln(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-9	2.549	1.708	5	No	15	0	No	0.01	Param.
Fluoride, total (mg/L)	AD-15	1	0.086	4	No	15	60	No	0.01	NP (normality)
Fluoride, total (mg/L)	AD-8	0.7575	0.5492	4	No	15	13.33	ln(x)	0.01	Param.
Fluoride, total (mg/L)	AD-9	1	0.16	4	No	15	40	No	0.01	NP (normality)
Lead, total (mg/L)	AD-15	0.008402	0.0007393	0.015	No	14	14.29	sqrt(x)	0.01	Param.
Lead, total (mg/L)	AD-8	0.000223	0.00008	0.015	No	15	66.67	No	0.01	NP (normality)
Lead, total (mg/L)	AD-9	0.0002	0.00008	0.015	No	15	60	No	0.01	NP (normality)
Lithium, total (mg/L)	AD-15	0.02181	0.005159	0.39	No	15	0	ln(x)	0.01	Param.
Lithium, total (mg/L)	AD-8	0.1113	0.08091	0.39	No	15	0	No	0.01	Param.
Lithium, total (mg/L)	**AD-9**	**1.276**	**0.8002**	**0.39**	**Yes**	**15**	**0**	**x^2**	**0.01**	**Param.**
Mercury, total (mg/L)	AD-15	0.000081	0.000005	0.002	No	13	23.08	No	0.01	NP (Cohens/xfrm)
Mercury, total (mg/L)	AD-8	0.00000859	0.000005	0.002	No	14	71.43	No	0.01	NP (normality)
Mercury, total (mg/L)	AD-9	0.0000194	0.000003	0.002	No	14	35.71	No	0.01	NP (Cohens/xfrm)
Molybdenum, total (mg/L)	AD-15	0.002421	0.001148	0.1	No	15	46.67	No	0.01	Param.
Molybdenum, total (mg/L)	AD-8	0.002	0.001013	0.1	No	15	73.33	No	0.01	NP (normality)
Molybdenum, total (mg/L)	AD-9	0.002	0.00011	0.1	No	15	93.33	No	0.01	NP (NDs)
Selenium, total (mg/L)	AD-15	0.003233	0.001061	0.05	No	14	14.29	sqrt(x)	0.01	Param.
Selenium, total (mg/L)	AD-8	0.005	0.00007	0.05	No	15	40	No	0.01	NP (normality)
Selenium, total (mg/L)	AD-9	0.005	0.0003	0.05	No	15	26.67	No	0.01	NP (normality)
Thallium, total (mg/L)	AD-15	0.00137	0.0001	0.002	No	15	66.67	No	0.01	NP (normality)
Thallium, total (mg/L)	AD-8	0.001185	0.000129	0.002	No	15	66.67	No	0.01	NP (normality)
Thallium, total (mg/L)	AD-9	0.001453	0.0001	0.002	No	14	50	No	0.01	NP (Cohens/xfrm)

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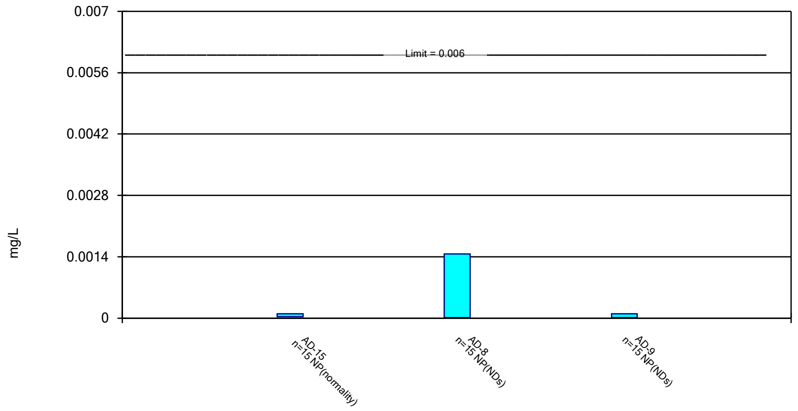
Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



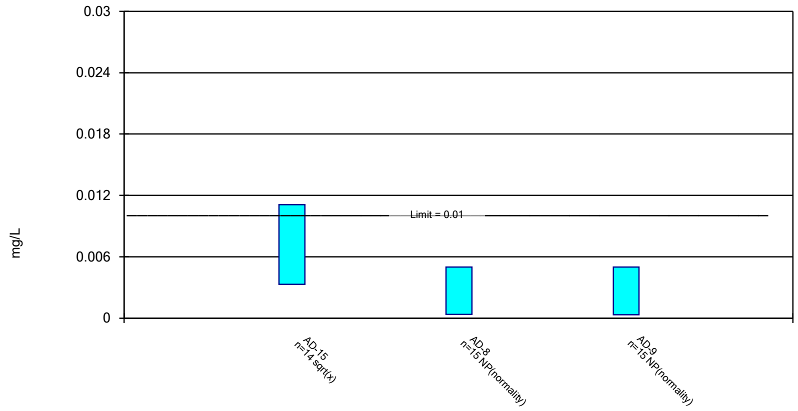
Constituent: Antimony, total Analysis Run 7/2/2020 12:18 PM

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



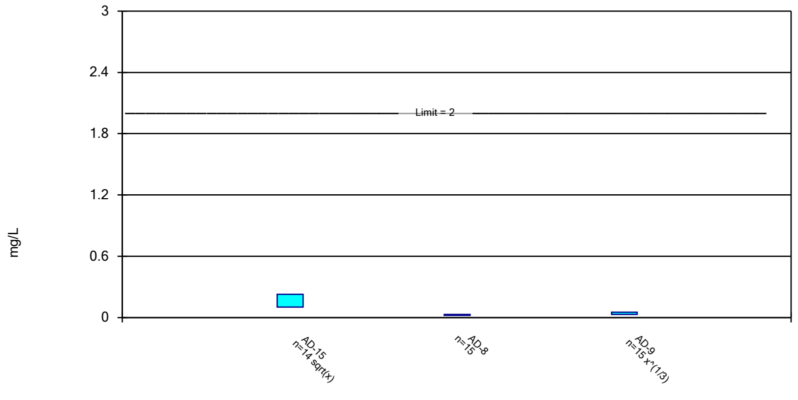
Constituent: Arsenic, total Analysis Run 7/2/2020 12:18 PM

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



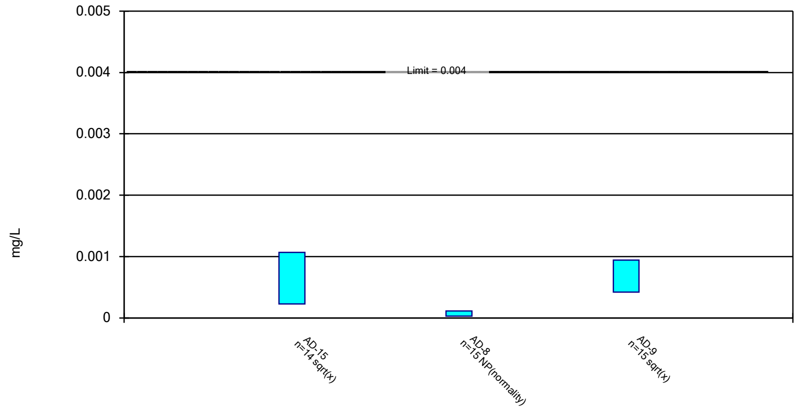
Constituent: Barium, total Analysis Run 7/2/2020 12:18 PM

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



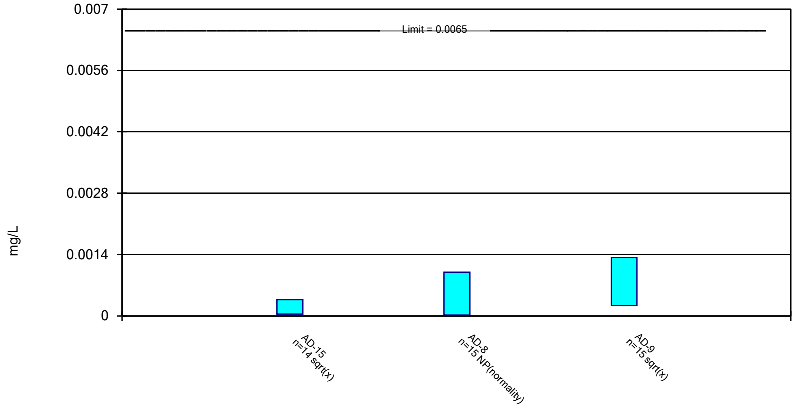
Constituent: Beryllium, total Analysis Run 7/2/2020 12:18 PM

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



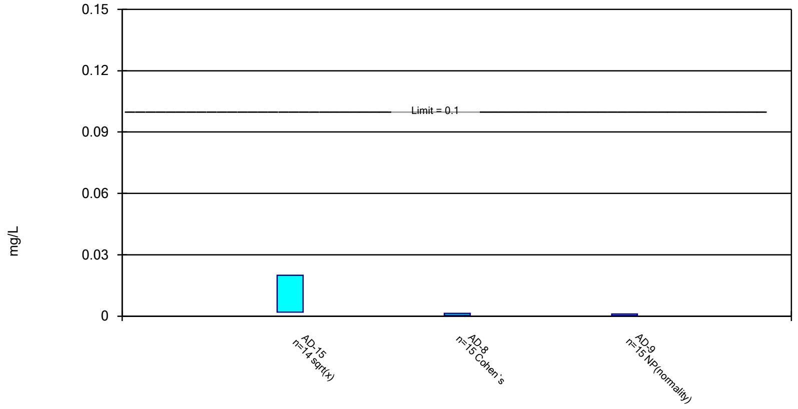
Constituent: Cadmium, total   Analysis Run 7/2/2020 12:18 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



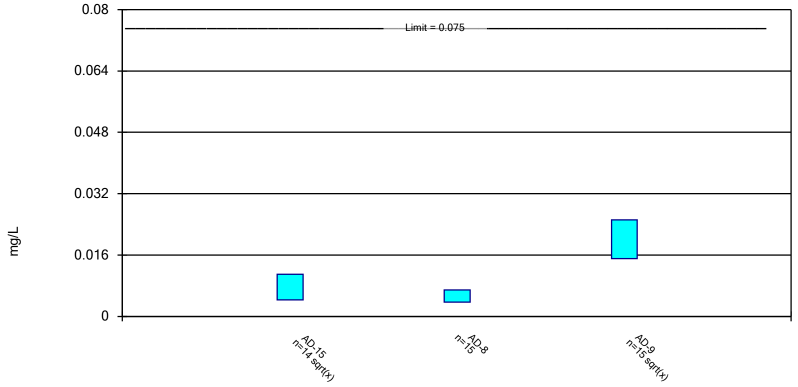
Constituent: Chromium, total   Analysis Run 7/2/2020 12:18 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



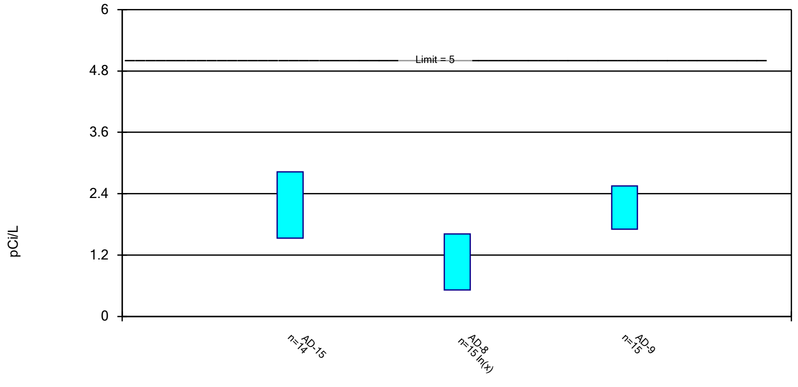
Constituent: Cobalt, total   Analysis Run 7/2/2020 12:18 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



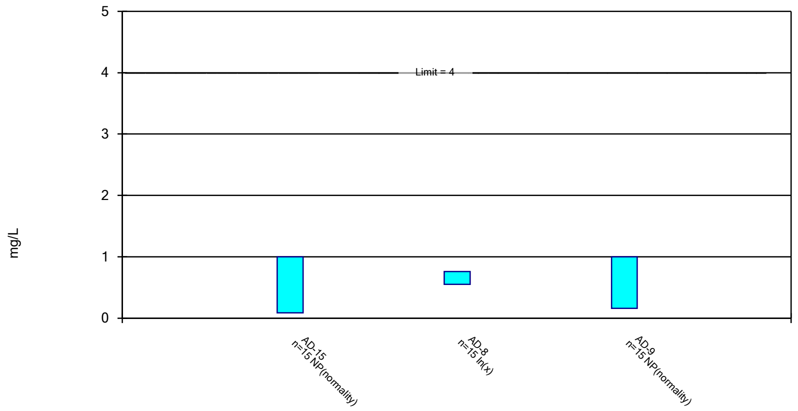
Constituent: Combined Radium 226 + 228   Analysis Run 7/2/2020 12:18 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



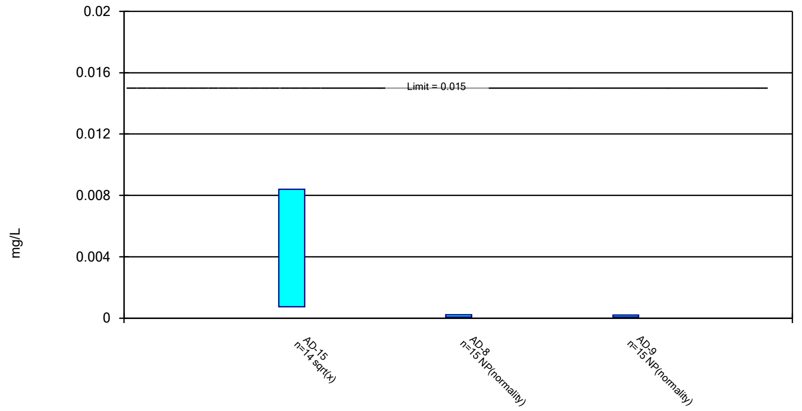
Constituent: Fluoride, total   Analysis Run 7/2/2020 12:18 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



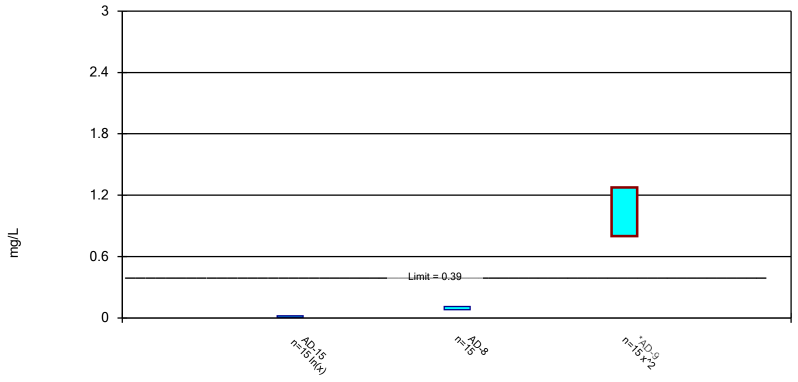
Constituent: Lead, total   Analysis Run 7/2/2020 12:18 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



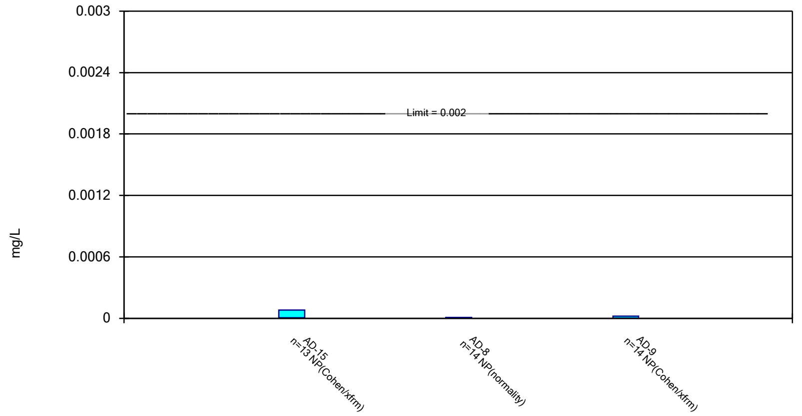
Constituent: Lithium, total   Analysis Run 7/2/2020 12:18 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



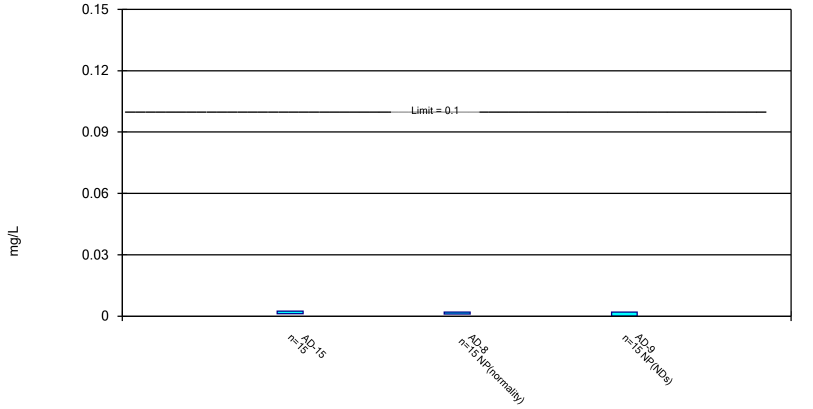
Constituent: Mercury, total   Analysis Run 7/2/2020 12:18 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

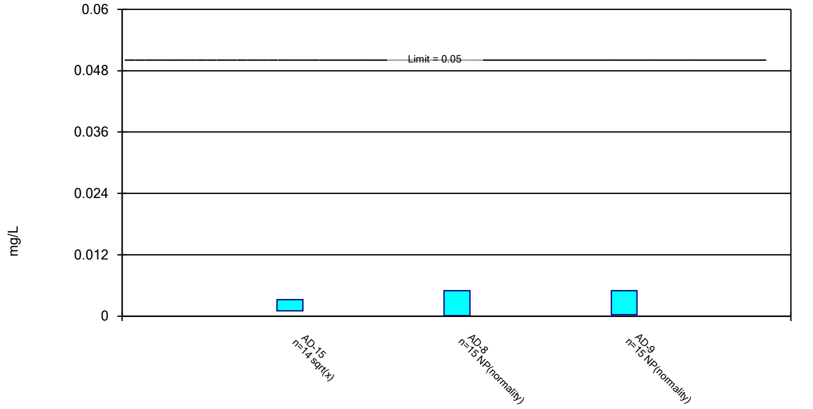


Constituent: Molybdenum, total   Analysis Run 7/2/2020 12:18 PM
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

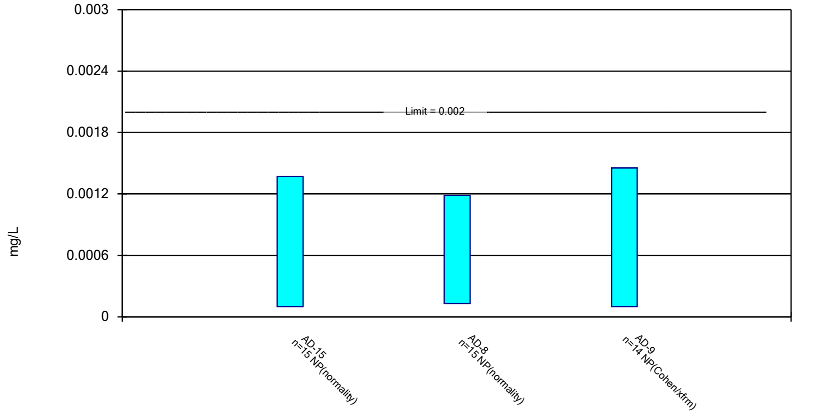


Constituent: Selenium, total   Analysis Run 7/2/2020 12:18 PM
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.26 . UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Thallium, total   Analysis Run 7/2/2020 12:18 PM
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

APPENDIX III

Alternate source demonstrations are included in this appendix. Alternate sources are sources or reasons that explain that statistically significant increases over background or statistically significant levels above the groundwater protection standard are not attributable to the CCR unit.

ALTERNATIVE SOURCE DEMONSTRATION - LITHIUM PRIMARY BOTTOM ASH POND

J. Robert Welsh Power Plant
1187 County Road 4865
Pittsburg, Titus County, Texas

March 10, 2020

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ALTERNATIVE SOURCE DEMONSTRATION - LITHIUM PRIMARY BOTTOM ASH POND

J. Robert Welsh Power Plant
1187 County Road 4865
Pittsburg, Titus County, Texas

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Firm Reg. No. F-533

Our Ref.:

30047655

Date:

March 10, 2020

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ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
Arcadis	Arcadis U.S., Inc.
ASD	Alternate Source Demonstration
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
ft	feet
GWPS	groundwater protection standard
MCL	maximum contaminant limit
mg/kg	milligram per kilogram
mg/L	milligram per liter
PBAP	Primary Bottom Ash Pond
SPLP	Synthetic Precipitation Leaching Procedure
SSI	statistically significant increase
SSL	statistically significant level
USDA	United States Department of Agriculture
USGS	United States Geologic Survey

1 INTRODUCTION

This Alternate Source Demonstration (ASD) report has been prepared on behalf of American Electric Power Corporation for lithium detected in groundwater at hydraulically downgradient monitoring well AD-9 at the Primary Bottom Ash Pond (PBAP) at the J. Robert Welsh Plant site located in Titus County, Texas. This ASD report was prepared in accordance with the Coal Combustion Residual (CCR) Rule (the Rule) specified in 40 Code of Federal Regulations (CFR) §257 and based on recommendations provided in the Electric Power Research Institute "Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites" (Electric Power Research Institute [EPRI] 2017). As part of the Rule, CCR facility owners are required to conduct detection and assessment monitoring of "Appendix III" and "Appendix IV" constituents, respectively, to ensure compliance with applicable groundwater standards (described further below). Because the monitored constituents also have natural sources and can be influenced by sampling methodology implementation, the Rule allows owners or operators to evaluate and demonstrate whether a source other than the CCR unit caused a statistically significant increase (SSI) over background levels for an Appendix III constituent or at statistically significant levels (SSLs) over groundwater protection standards for an Appendix IV constituent, such as natural variation in groundwater quality or sampling methodology error.

The owner or operator must complete the written ASD within 90 days of identifying the SSI or SSL and include the certification from a qualified professional engineer to verify the accuracy of the information in the report. An SSL was identified for lithium at monitoring well AD-9 as detailed in the December 16, 2019 report entitled "Statistical Analysis Summary, Primary Bottom Ash Pond" (Geosyntec, 2019c). Therefore, this ASD report was prepared by Arcadis U.S., Inc. (Arcadis) on behalf of American Electric Power Corporation within the 90-day period and has been certified by a qualified professional engineer.

1.1 Facility History

The J. Robert Welsh Plant is located within southern Titus County, approximately eight miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas (**Figure 1-1**). The Plant began operations in 1977 with three coal-fired generating units (Units 1, 2, and 3). Throughout the life of the Plant, CCR materials (fly ash, bottom ash, economizer ash) have been generated. These byproducts were stored in the PBAP and in the adjacent Landfill that were constructed in the late 1970s. In 2000, the 22-acre Bottom Ash Storage Pond was installed south of the Landfill. The Bottom Ash Storage Pond was constructed with a 60-mil high-density polyethylene liner (**Figure 1-2**).

Presently bottom ash and economizer ash from the Plant are sluiced to the PBAP. Solids settle as the clear liquids flow through a drainage canal into the clear water pond (a non-CCR unit). Solids (bottom ash and economizer ash) in the PBAP are dredged and sluiced into the Bottom Ash Storage Pond. Marketable ash material from the PBAP is also temporarily stored in the western two thirds of the Landfill for processing, then loaded into trucks and sold for beneficial reuse (highway road base, etc.).

2 PHYSICAL SETTING

2.1 Regional Topography

The elevation at the Site ranges from approximately 300 feet (ft) above mean sea level (amsl) at Swauano Creek downstream of the Welsh Reservoir, to 360 ft amsl at a topographically high ridge at the west end of the Landfill. The PBAP is in a topographically low area that had been an un-named intermittent tributary of Swauano Creek prior to development of the Site. The Landfill is approximately 40 acres in size and is located in a topographically higher area directly south of the PBAP. The Bottom Ash Storage Pond is approximately 22 acres in size and in a topographically higher area directly south of the Landfill.

A topographically high ridge is present directly northwest of the Site where offsite monitoring wells AD-22 and AD-23 were installed along the FM 1735 right-of-way during June 2019. Ground surface elevation at these offsite monitoring wells ranges from approximately 361 ft amsl at AD-22 to 369 ft amsl at AD-23.

2.2 Geology and Soils

2.2.1 Regional and Local Geology

The Site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently to the southeast. The Site, including all three CCR Units (PBAP, Landfill, Bottom Ash Storage Pond), is located along the outcrop of the Eocene-age Reklaw Formation, which consists of very fine to fine grained sand and clay (Flawn 1966). The Reklaw Formation attains a thickness of approximately 110 ft in Titus County, and is underlain by the Eocene-age Carrizo Sand which consists of fine to coarse sand, silt, and clay (United States Geologic Survey [USGS] 1965). In the topographically low areas underlying the Welsh Reservoir to the east of the PBAP, Quaternary alluvial sediments associated with Swauano Creek are present (Flawn 1966).

All of the CCR monitoring wells at the Site are completed in the Reklaw Formation. The two offsite monitoring wells (AD-22, AD-23) west of the Site are completed in the overlying Queen City Formation. Monitoring well locations are shown on **Figure 2-1**.

As shown on the regional geologic map and legend (**Figure 2-2A** and **Figure 2-2B**), the Reklaw Formation outcrop (Er) at the Site is relatively narrow (less than 1 mile in width). The Reklaw Formation is overlain by the Eocene-age Queen City Formation, which outcrops in topographically higher areas west of the Site, including the area where monitoring wells AD-22 and AD-23 are located. The Queen City Formation consists of fine to medium grained sand, shale, silt, and impure lignite, and attains a thickness of approximately 210 ft in Titus County (USGS 1965). The Queen City Formation also contains ironstone concretions (Flawn 1966).

2.2.2 Regional and Local Soil Composition

Information gathered from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Services soil data provides a detailed inventory of the regional soils and their characteristics, including the widespread distribution of clay-bearing soils, that support data collected at the Site from soil borings and groundwater monitoring locations. Two main named soil layers are present in the Pittsburgh, TX, area in the vicinity of the Site:

- Norfolk sandy loam
- Susquehanna fine sandy loam

Both soils are similar in the uppermost 1.5 ft of material, generally grayish in color and containing fine sand, silt, and clay. However, the subsoils of both units have subtle differences from one another and are described herein. Observations from soil borings at the Site are consistent with the characteristics of one or both of these soil units, as described in the USDA Natural Resources Conservation Services document.

The Norfolk sandy loam is a widely distributed soil unit that is uniformly developed in the lowland areas and is derived from weathering Eocene-aged deposits. It is a generally porous soil, allowing infiltrating water to migrate downward toward the water table. The soil layer is generally yellowish-gray in color, however the subsoil at greater depths is characterized by increased clay content and a mottled red and yellow appearance. As noted in the USDA soil descriptions, the soil and subsoils of the Norfolk sandy loam may be broken down into the grain size distributions presented in **Table 2-1**.

The Susquehanna fine sandy loam is also widely distributed and generally resembles the Norfolk sandy loam at the surface. Subsoils of the Susquehanna contain a greater component of clay, and likely contain increased iron content, as evidenced by observed iron concretions and iron crust formation within the subsoil. This soil is often mottled in appearance, ranging from red and yellow to a reddish brown or gray. Despite the greater clay content, the soil and subsoil is not impervious to infiltrating water that migrates toward the water table. As noted in the USDA soil descriptions, the soil and subsoils of the Susquehanna fine sandy loam may be broken down into the grain size distributions presented in **Table 2-2**.

These soil descriptions are important for the understanding of contributing sources of key constituents, such as lithium to the groundwater system. Lithium can occur in soils through natural weathering processes and the development of clay minerals. In particular, lithium can be incorporated into the structure of clays in the smectite group through cation substitution, which is further influenced by the presence of iron within the clay structure (Drever 2002; Stucki 2005). The widespread distribution of clay deposits in the native soils in and near the Site and the propensity for clays to contain trace constituents of potential concern supports the potential for natural sources of lithium.

Geologic cross-sections were generated to evaluate the stratigraphy in the area of the PBAP. The lines of geologic cross-section are shown on **Figure 2-3** and the cross-section details for cross-sections A-A' through E-E' are shown on **Figures 2-4** through **2-8**, respectively. As shown on **Figure 2-4**, an unsaturated brown to gray clay and sandy clay stratum is present in the area of the PBAP from the surface to a depth of approximately 20 ft below ground surface. The clay stratum is underlain by a saturated fine to medium grained clayey and silty sand stratum with an average thickness of approximately 10 ft and is consistent with the soils of the Susquehanna fine sandy loam deposits. As discussed below in Section 2.3.2, this saturated sand stratum is the uppermost water-bearing unit in the area of the PBAP. This sand stratum is underlain by an unsaturated gray to black silty clay stratum that locally serves as a lower confining layer (aquitard) for the uppermost water-bearing unit.

As shown on **Figures 2-2A** and **2-4**, the Queen City Formation outcrops in the topographically high area to the northwest of the Site. The geologic contact between the Queen City Formation, in which offsite monitoring wells AD-22 and AD-23 are completed, and the Reklaw Formation, in which the CCR monitoring wells are completed, is located near an elevation of 340 ft amsl as shown on **Figure 2-4**. The Queen City Formation directly west of the Site consists predominantly of clayey sand, and the underlying Reklaw Formation consists of interbedded sand, silt, and clay strata.

2.3 Hydrology and Water Quality

2.3.1 Regional Hydrology and Water Quality

The Reklaw Formation, which outcrops at the Site, and the overlying Queen City Formation, which outcrops west of the Site, are part of the Cypress Aquifer, which also includes the underlying Carrizo Sand and Wilcox Formation (USGS 1965). As shown on **Figure 2-9,** the Cypress Aquifer is approximately 900 ft thick in the Site area, and the base of fresh water in the Cypress Aquifer is approximately 800 ft below ground surface.

Regional groundwater characteristics are presented in Texas Water Commission Bulletin 6517 "*Ground-Water Resources of Camp, Franklin, Morris, and Titus Counties, Texas, Texas*" (USGS 1965). All of the regional aquifer units are combined in this document, and considered as one interconnected unit, referred to as the "Cypress aquifer". This singular aquifer unit, composed of all water bearing units of similar character, was divided into three zones based on water quality characteristics of each zone rather than lithology. The following three zones were identified, in order of increasing relative depth:

- Zone A: characterized by minimal iron content and low pH, ranging from 4.5 to 6.5.
- Zone B: characterized by increased dissolved iron content and pH ranging from 5.0 to 7.0
- Zone C: characterized by iron concentrations of less than 0.3 milligrams per liter (mg/L) and neutral to alkaline pH (7.0 to 8.0)

Groundwater at the Site is generally assumed to be influenced by groundwater from Zones A and B. As described in USGS, 1965, Zones A and B can be more simply described as:

- Zone A: zone of oxidation and acidic groundwater
- Zone B: intermediate zone

The dissolved iron content in the A and B zones (ranging from non-detect to greater than 10 mg/L; USGS 1965) is likely influenced by iron present in the soils and sediments, which are described in Section 2.2. Slow recharge rates and transmissive properties of these zones contributes to longer residence times whereby the infiltrating groundwater may react with soil and sediments, allowing for the oxidation of sulfides to generate sulfate and mobilizing ferrous iron into solution. In addition, groundwater from several wells completed in shallow (less than 60 ft in depth) sediments contained sulfate concentrations above

1,000 mg/L. Sulfate concentrations observed at the Site are consistent with the range of data for other similar depth wells in the four-county area (USGS 1965).

Additional regional groundwater information is provided in the 107th Annual Meeting of the Texas Academy of Science abstract titled “Natural Sources of Poor Water Quality in Streams of East Texas” (Ledger et. al. 2004). This study characterized surface water streams associated with the regional groundwater in the Eocene-aged Reklaw Formation as acidic with high concentrations of sulfate, and arsenic concentrations greater than 0.01 mg/L.

An observed decline in surface water quality was also noted if springs from the Reklaw Formation discharge to surface water bodies. Abundant sulfur is noted in the Reklaw formation and sediments undergo acid-sulfate weathering, as evidenced in the red-stained soils and sulfate concentrations of greater than 1,000 mg/L (Ledger et. al. 2004). In streams associated with the Reklaw Formation, sulfate levels may exceed 1,000 mg/L.

2.3.2 Local Hydrology

Groundwater flow direction at the Site is generally from west to east, following surface topography towards the Welsh Reservoir. Groundwater elevations and well construction information from monitoring wells completed in the uppermost water-bearing unit at the Site are summarized on **Table 2-3**. Depth to groundwater in the monitoring wells in the area of the PBAP ranges from approximately 10 to 15 ft below ground surface.

Figures 2-10 and **2-11** are potentiometric surface maps for the uppermost water-bearing unit at the Site based on June 19, 2019 and July 24, 2019 water level data, respectively. As shown on **Figure 2-10** and **2-11**, shallow groundwater flow direction in the area of the CCR Units is in a general easterly direction toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.005 foot per foot. Shallow groundwater flow direction in the area of monitoring wells AD-22 and AD-23, which are completed in the Queen City Formation, is southeasterly toward the CCR monitoring wells, which are completed in the Reklaw Formation. The groundwater flow direction and downward vertical flow indicates shallow groundwater in the Queen City Formation likely is hydraulically connected to the underlying Reklaw Formation. This is consistent with Texas Water Commission Bulletin 6517 description of the Cypress Aquifer: “The Wilcox Group and the Carrizo Sand, Reklaw Formation, and Queen City Sand of the Claiborne Group have similar hydrologic properties and are the principal source of freshwater in the four-county area. The units probably are interconnected hydraulically and they function as single aquifer” (USGS 1965). **Figure 2-12** is a regional hydrologic cross section of the site area.

The hydraulic conductivity of the uppermost water-bearing unit at the Site was determined by conducting aquifer tests. A constant-rate pumping test was conducted at monitoring well AD-6 on September 21, 2017. Based on the AD-6 pumping test data, the hydraulic conductivity for the uppermost water-bearing unit was calculated at 0.05 ft per day (1.83×10^{-5} centimeters per second).

To provide a broader understanding of the hydraulic conductivity distribution across the Site, bail down slug tests were performed in October 2018 on a total of 5 wells; 1 up gradient well (AD-17) and 4 down gradient wells (AD-6, AD-9, AD-13 and AD-19) on October 30 and 31, 2018. These wells are all screened in the uppermost water-bearing unit and were chosen based on their distribution across the Site. The hydraulic conductivity estimates from the five monitoring wells tested ranged from 0.15 ft per day (AD-6)

to 2.0 ft per day (AD-13). The overall mean hydraulic conductivity estimate was 0.84 ft per day, while the overall geometric mean was 0.60 ft per day.

2.4 Surface Water

The Site is located directly west of Swauano Creek, which was dammed near the southern end of the Site during plant development to form the Welsh Reservoir. The PBAP normal operating water level is near the weir box which has a bottom elevation of 325 ft amsl. The surface water elevation of the Welsh Reservoir, located east of the PBAP, is maintained at approximately 320 ft amsl. The Welsh Reservoir is likely a gaining surface water feature, and groundwater elevations at the Site are higher than the normal stage elevation of the Welsh Reservoir (approximately 320 ft amsl) as shown on **Figures 2-10** and **2-11**.

There are no current or historic gauging stations on Swauano Creek; however, there was a historic gauging station on adjacent Boggy Creek, which has a drainage basin area of 72 square miles versus 21.2 square miles for Swauano Creek. The average annual flow of the Boggy Creek gauging station during the driest year on record (1956) was 10.65 cubic feet per second, which corresponds to a flow of approximately 3 cubic feet per second for Swauano Creek.

3 DETECTION AND ASSESSMENT MONITORING STATISTICAL EVALUATION

3.1 General

The groundwater monitoring network for the uppermost water-bearing unit at the PBAP consists of three upgradient monitoring wells (AD-1, AD-5, AD-17) and three downgradient monitoring wells (AD-8, AD-9, AD-15; Figure 2-1). Additional details regarding the groundwater monitoring network are provided in the August 22, 2017 report entitled "*Primary Bottom Ash Pond – CCR Groundwater Monitoring Well Network Evaluation*" (Arcadis 2017).

3.2 Detection Monitoring Results

Detection monitoring at the Site involves collection of groundwater samples from the groundwater monitoring network upgradient and downgradient monitoring wells for analyses of Appendix III CCR constituents, which includes boron, calcium, chloride, fluoride, sulfate, pH, and total dissolved solids. Following the baseline monitoring program, which included a minimum collection of eight independent samples from each of the background and downgradient wells that are part of the certified monitoring network, the first round of Detection Monitoring was conducted. Based on detection monitoring conducted at the PBAP in 2017 and 2018, an SSI over the background concentration was calculated for boron in AD-8 (Geosyntec 2019c). Because of the SSIs noted for boron in groundwater samples from AD-8, an Alternate Source Demonstration was completed which did not identify an alternate source for the boron SSI (Geosyntec 2018).

3.3 Assessment Monitoring Results

Groundwater protection standards (GWPSs) were established for the Appendix IV parameters in accordance with 40 CFR Part 257.95(h). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or regional screening level for each Appendix IV parameter.

Confidence intervals were calculated for Appendix IV parameters at the compliance wells (AD-8, AD-9, AD-15) to assess whether Appendix IV parameters were present at an SSL above the GWPS. An SSL was identified for lithium in December 2019, which exceeded the GWPS of 0.390 mg/L at monitoring well AD-9 (1.11 mg/L), despite no observed SSIs in Appendix III parameters for this well (Geosyntec 2019c). Additional details regarding the statistical evaluations of the groundwater monitoring data is provided in the December 16, 2019 report entitled "*Statistical Analysis Summary, Primary Bottom Ash Pond*" (Geosyntec 2019c).

Because the native soils have the potential to be a natural source of lithium in the regional and local groundwater and soil composition, ASD reports were prepared in February 2019 and September 2019 to provide additional information on the sources and distribution of lithium SSLs previously identified in groundwater at PBAP monitoring well AD-9 (Arcadis 2019a, Arcadis 2019b). The conclusions from the February 2019 and September 2019 ASDs indicated several lines of evidence demonstrating that the lithium concentration in groundwater at AD-9 is from naturally occurring sources (ASD Type V), with some additional contributions from sampling methodology error (ASD Type I). This ASD report updates the previous reports based on the recently collected Site-specific soil and groundwater data, including soil and groundwater analytical data collected outlined in Section 4.

4 SOIL AND GROUNDWATER ANALYTICAL DATA EVALUATION

4.1 General

In addition to the detection and assessment monitoring groundwater sampling events conducted at the PBAP in 2017, 2018, and 2019 for statistical evaluation, a comprehensive site-wide groundwater sampling event was conducted by Arcadis during May 2018, and an offsite soil and groundwater sampling event was conducted by Arcadis during June 2019 to evaluate alternate potential sources of lithium detected in downgradient monitoring well AD-9. The May 2018 evaluation included the following tasks:

- Collection of groundwater samples from the PBAP upgradient monitoring wells (AD-1, AD-5, AD-17), the PBAP downgradient monitoring wells (AD-8, AD-9, AD-15), and other monitoring wells in the area completed in the uppermost water-bearing unit, including upgradient monitoring well AD-18; side gradient monitoring wells MW-9, MW-10, and Temp-1; and downgradient monitoring wells AD-3, AD-4c, AD-10, AD-11, AD-13, AD-14, AD-16R, and AD-19.
- Collection of soil samples from eight soil borings (Temp-1, SB-2 through SB-8) around the perimeter of the CCR units at the site.
- Collection of three CCR material samples from the PBAP (Sample IDs: Ash-1, Ash-2, Ash-3) and one CCR material sample from the HDPE-lined Bottom Ash Storage Pond (Sample ID: Ash-4) for analysis of total metals, pore water concentrations, and leachate water using the Synthetic Precipitation Leaching Procedure (SPLP) (**Table 4-1**).

The June 2019 evaluation included the following tasks:

- Installation of two offsite monitoring wells (AD-22, AD-23) in the Queen City Formation northwest (hydraulically upgradient) of the Site. Monitoring well completion diagrams are provided in **Appendix A**.
- Collection of soil and groundwater samples from the Queen City Formation monitoring wells for Appendix III and Appendix IV parameter analyses.

Additionally, two sentinel downgradient monitoring wells (AD-20, AD-21) were installed in the uppermost water-bearing unit (Reklaw Formation) near the shoreline of the Welsh Reservoir east (hydraulically downgradient) of the CCR units during October 2018.

4.2 Soil and Groundwater Analytical Data Evaluation

4.2.1 Soil Evaluation

The soil evaluation results demonstrate a correlation between lithium and iron in soil. Boring logs from Site area monitoring locations highlight similarities with observations provided in the county-wide soil survey reports. For example, boring locations SB-04 (adjacent to AD-5), SB-05 (adjacent to AD-8), AD-22, and AD-23 contain a greater content of the reddish-brown clay subsoils as noted in the Susquehanna fine sandy loam, which directly overlie the water table in these locations. The reddish brown color generally denotes the presence of iron in these locations, which can be either incorporated directly into the clay mineral structure (e.g. smectite), or as a secondary mineral (e.g. iron hydroxide) that is also present in the aquifer matrix (Stucki 2005). The role of iron incorporated into the clay structure is important to localized geochemical processes, such as cation exchange, redox conditions, and hydrophilic properties, which can influence weathering characteristics and the mobility of trace constituents (i.e. lithium) in groundwater (Stucki 2005). Specifically, in the event that geochemical conditions are or become conducive to iron dissolution (e.g., if conditions become microbially/geochemically reducing), then the mobilization of iron associated with soil can result in the co-mobilization of trace constituents.

As shown on **Table 4-1** and **Figure 4-1**, the highest concentrations of lithium in soil were detected from 3 to 5 feet below ground surface in hydraulically upgradient and offsite Queen City Formation monitoring well AD-22 (up to 18 milligrams per kilogram [mg/kg]), and onsite Reklaw Formation soil boring SB-4 (13.6 mg/kg) located adjacent to monitoring well AD-5 which is hydraulically upgradient (northwest) of the PBAP. This upgradient (background) data indicates lithium concentrations in soil in the area of the PBAP are naturally occurring and not the result of impacts from CCR materials. This is one line of evidence that the lithium detected in groundwater at monitoring well AD-9 is from a naturally occurring source, and not the CCR unit. As shown on **Table 4-1** and **Figure 4-2**, the highest iron concentrations in soil are from soil borings AD-22 and AD-23 (17,600 to 85,500 mg/kg) which are located in the Queen City Formation upgradient of the Site; SB-4 (AD-5; 10,400 mg/kg), located in the Reklaw Formation upgradient (northwest) of the PBAP; and soil boring SB-8 (AD-3; 11,000 mg/kg), located in the Reklaw Formation over 1,000 ft south (side gradient) of the PBAP. **Figure 4-3** shows an apparent correlation between the iron and lithium content in the coal ash, upgradient locations, and downgradient locations. However, SPLP and pore water results from the coal ash samples show that the iron and lithium present in the coal ash is not in a mobile (leachable) form. Therefore, it is more likely that the regional groundwater interaction with naturally occurring lithium and iron in soil is responsible for the observed lithium concentrations and variability across the Site. As detailed below in Section 4.2.2, iron and lithium concentrations in groundwater at the Site show a similar distribution to iron and lithium concentrations in soil, indicating naturally occurring sources for iron and lithium.

4.2.2 Groundwater Evaluation

Groundwater analytical results for the PBAP, the landfill, and the bottom ash storage pond are summarized on **Tables 4-2**, **4-3**, and **4-4**, respectively. As shown on **Figure 4-4**, the highest lithium concentration in the most recent (2019) groundwater samples is at monitoring well AD-18 (1.27 mg/L), which is west (upgradient) relative to the PBAP. This data indicates lithium concentrations in groundwater in the area of the PBAP are from a source other than the PBAP.

As shown on **Figure 4-5**, iron concentrations in groundwater are also elevated upgradient (west) relative to the PBAP. **Figure 4-6** shows the relationship of total and dissolved iron concentrations to lithium concentrations in upgradient, side-gradient, and downgradient monitoring wells. These results demonstrate a clear correlation between aqueous iron and lithium, with higher lithium concentrations associated with elevated iron. The greatest concentrations of both iron and lithium are observed in the upgradient monitoring wells AD-17 and AD-18. As identified in **Table 4-1** and noted on **Figure 4-6**, SPLP leachate and pore water analyzed from coal ash samples contain lithium in concentrations below detection, or at very low concentrations less than 0.02 mg/L. This data indicates lithium concentrations in groundwater in the area of the PBAP are from a source other than the PBAP. Additionally, the most recent data is included on a lithium concentration versus time graph provided as **Figure 4-7**. As shown, the lithium concentration in AD-18 from May 2019 is consistent and higher than lithium concentrations in the downgradient PBAP monitoring wells.

As discussed above in Section 2.2.1, the Queen City Formation, which overlies the Reklaw Formation, is located directly west of the Site. Therefore, groundwater from the Queen City Formation west (upgradient) of the CCR units may be the source of lithium and iron detected in soils and groundwater in the area of the CCR units. As discussed above in Section 2.3.1, elevated naturally occurring iron is documented in the Cypress Aquifer, and as discussed above in Section 2.2.1, the Queen City Formation contains naturally-occurring iron concretions and correspondingly high iron concentrations in soil samples.

Another line of evidence the lithium detected in groundwater in the area of the PBAP is from a naturally occurring source is provided in the 2002 Publication "Springs of Texas" (Gunnar Brune 1981). The Springs of Texas publication states "*Hynson Springs, also known as Marshall, Noonday Camp, and Iron Springs, are six kilometers north of Hallsville. They became very popular as a health resort about 1851. The waters are highly mineralized, containing much iron, sulfur, aluminum, and lithium. Originally there were said to be over 100 springs flowing from the Queen City Formation*." This spring, which contains naturally-occurring lithium, is located approximately 35 miles southeast of the Site. A copy of this reference is provided in **Appendix B**.

When reviewing historical and recent datasets, a broad relationship was noted between trace metal chemistry and turbidity. Where turbidity values were greatest, greater concentrations of selected CCR monitored constituents were also observed (e.g. arsenic and cadmium) and in some cases, in exceedance of Federal MCLs. As a result, low-flow sampling methodology was employed to reduce the amount of turbidity in the groundwater sample.

A comprehensive groundwater sampling event was conducted at the Site by Arcadis during May 2018 using low-flow methodology. A clean stainless steel low-flow sampling pump with new, well-dedicated polyethylene piping was slowly lowered into the mid-point of the water column at each monitoring well, and groundwater was then pumped at a low flow rate of less than 0.1 liters per minute until the produced water was visually clear. The turbidity of the produced water was measured using calibrated field instruments during well development, and groundwater samples were not collected until the turbidity measurements declined and stabilized. Once low-flow groundwater sampling techniques were properly followed by Arcadis during May 2018, water quality results indicated concentrations of selected constituents to be much less than previously reported and did not exceed criteria. Therefore, it was determined that the sediment disturbances generated during well purging and improper (turbid) groundwater sampling were contributing to the Federal MCL groundwater exceedances. Specifically, since CCR Rule monitoring requires analysis of unfiltered samples, the results suggest that the exceedances were associated with constituents present in undissolved suspended solid particulates rather than in a dissolved form, on a location by location basis. The May 2018 groundwater analytical results are most representative of groundwater quality at the Site because proper low-flow sampling protocols were adhered to and sediment contributions to the analytical results were minimized.

5 SUMMARY AND CONCLUSIONS

This ASD has been prepared in consultation with the Electric Power Research Institute “Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites”. The following lines of evidence indicate the SSL related to the lithium concentration in groundwater at AD-9 is from naturally occurring sources (ASD Type V), with some additional contributions from sampling methodology error (ASD Type I):

- An SSI was confirmed for boron within monitoring well AD-8 followed by a failed Alternate Source Demonstration for boron, triggering the assessment monitoring program for the PBAP. Under the assessment monitoring program, an SSL was identified for lithium which exceeded the GWPS of 0.390 mg/L at monitoring well AD-9 (1.11 mg/L), despite no observed SSIs in Appendix III parameters for this well (Geosyntec, 2019c). SSIs would be expected for Appendix III parameters if there was a CCR unit source for the lithium exceedance of the SSL, indicating that there may be an alternate source of lithium. This is a key line of evidence that the PBAP is not the source of elevated lithium concentrations in soil at the Site.
- As demonstrated in this ASD report, iron and lithium are associated in the sediments and in groundwater. The subsoils at the Site, particularly the Susquehanna fine sandy loam, contain naturally occurring high clay content. The role of iron incorporated into the clay structure is important to localized geochemical processes, such as cation exchange, redox conditions, and hydrophilic properties, which can influence weathering characteristics and the mobility of trace constituents (i.e. lithium) in groundwater (Stucki, 2005). This is a supporting line of evidence.
- The highest lithium concentrations in the soil samples collected during the Arcadis May 2018 and June 2019 investigations was from background soil samples (AD-22, 3-5 ft depth; SB-4, 27 ft depth) located upgradient (northwest) of the PBAP. This is a key line of evidence that the PBAP is not the source of elevated lithium concentrations in soil at the Site.
- Leachate and pore water analyzed from coal ash samples contain lithium in concentrations below detection, or at very low concentrations less than 0.02 mg/L. This data indicates lithium concentrations in groundwater in the area of the PBAP are from a source other than the PBAP. This is a key line of evidence.
- The highest lithium concentration in groundwater samples collected during the Arcadis May 2018 investigation was from an upgradient (background) monitoring well (AD-18) located west of the PBAP. This is a key line of evidence that the PBAP is not the source of elevated lithium concentrations in groundwater at the Site.
- Iron and lithium concentrations in soil and groundwater at the Site show a similar distribution, indicating there is likely a common source for these metals. The 1965 USGS publication “*Ground-Water Resources of Camp, Franklin, Morris and Titus Counties, Texas”* documents naturally occurring high iron concentrations within zones of the Cypress Aquifer, in which the monitoring wells at the Site are completed. The University of Texas at Austin Bureau of Economic Geology 1966 publication “*Geologic Atlas of Texas, Texarkana Sheet*” documents naturally occurring iron concretions in the Queen City Formation, which outcrops directly west (upgradient) of the PBAP. This is a supporting line of evidence.

- The 1981 Gunnar Brune publication "*Springs of Texas"* documents naturally occurring elevated lithium in groundwater in the Queen City Formation at Hynson Springs, which is approximately 35 miles from the Site. The publication states "*Hynson Springs, also known as Marshall, Noonday Camp, and Iron Springs, are six kilometers north of Hallsville. They became very popular as a health resort about 1851. The waters are highly mineralized, containing much iron, sulfur, aluminum, and lithium. Originally there were said to be over 100 springs flowing from Queen City sand".* This publication, along with soil and groundwater analytical data at the Site, supports the conclusion that the primary source of lithium in groundwater at the PBAP is from the Queen City Formation, which outcrops directly west (upgradient) of the PBAP. This is a key line of evidence.
- As summarized on **Tables 4-2** through **4-4**, elevated turbidity (>10 nephelometric turbidity units) was present in many of the groundwater samples collected at the Site. Metals concentrations were generally lower during the May 2018 Arcadis groundwater sampling event when proper low-flow sampling techniques were utilized and turbidity was low. Effective well development and proper low flow sampling techniques minimize the potential for groundwater analyses to be unrepresentative of formation groundwater. This is a supporting line of evidence.
- This ASD report provides a strong demonstration of naturally occurring sources of lithium in groundwater (ASD Type V) as supported by five key lines of evidence and three supporting lines of evidence.

6 PROFESSIONAL ENGINEER'S CERTIFICATION

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the alternate source demonstration for lithium at the Primary Bottom Ash Pond meets the requirements of 40 CFR Part 257.95.

Kenneth J. Brandner

Printed Name of Registered Professional Engineer

KENNETH J. BRANDNER
69586

Kenneth J Brandner

Signature

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Registration No.

Texas

Registration State

3-10-20

Date

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TABLES

Table 2-1
Grain Size Distribution in Soil and Subsoil of the Norfolk Sandy Loam
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Grain Size	Soil	Subsoil
Fine Gravel	0.0%	0.0%
Coarse Sand	0.2%	0.1%
Medium Sand	0.4%	0.3%
Fine Sand	29.4%	29.9%
Very Fine Sand	37.9%	24.0%
Silt	25.9%	25.1%
Clay	5.9%	20.2%

Table 2-2
Grain Size Distribution in Soil and Subsoil of the Susquehanna Fine Sandy Loam
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

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Grain Size	Soil	Subsoil
Fine Gravel	0.4%	0.0%
Coarse Sand	0.7%	0.2%
Medium Sand	0.9%	0.8%
Fine Sand	53.4%	36.6%
Very Fine Sand	16.0%	10.8%
Silt	21.2%	19.0%
Clay	7.2%	32.8%

Table 2-3
Well Construction and Water Level Data - CCR Storage Areas
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole Depth ft. bls	Date Installed	Screen Material	Well Diameter inches	Top of Screen		Bottom of Screen		6/7/2011	12/6/2011	5/2/2012	11/1/2012	5/14/2013	11/19/2013
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																		
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57	338.46	334.92	337.88	337.18	337.43	336.73
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16	330.16	329.07	330.00	329.26	329.83	329.70
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10	323.81	323.19	323.99	323.29	323.77	323.98
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61	324.81	324.84	324.62	324.40	324.74	325.52
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19	325.01	324.19	325.24	322.90	324.86	324.68
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55	324.35	324.32	324.50	324.30	324.30	325.21
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15	324.18	324.50	324.64	324.37	324.11	325.06
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00	336.34	336.58	336.82	336.99	336.78	336.47
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31	333.04	333.02	332.83	333.02	333.11	332.81
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86	334.32	334.12	334.19	334.20	334.13	334.58
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53	325.41	324.09	325.69	325.15	325.79	325.75
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32	328.46	328.53	328.63	328.44	328.74	329.38
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23	323.44	322.55	323.27	323.35	323.51	323.76
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61	327.99	328.37	327.82	327.93	327.94	328.13
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27	348.30	348.29	349.86	349.56	349.99	349.65
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12	332.36	332.24	333.09	332.26	332.68	333.25
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32	330.40	329.80	331.67	330.34	330.94	331.69
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71	---	---	---	---	---	---
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86	---	---	---	---	---	---
AD-16R (e)	33° 02' 49"	94° 50' 28.9"	350.55	353.49	27.0	4/12/17	Sch. 40 PVC	2	12.0	338.55	27.0	323.55	---	---	---	---	---	---
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99	---	---	---	---	---	---
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17	---	---	---	---	---	---
AD-19	33.047201°	94.839694°	323.58	326.35	15.0	5/8/18	Sch. 40 PVC	2	5.0	318.58	15.0	308.58	---	---	---	---	---	---
AD-20	33° 02' 45.6"	94° 50' 22.8"	324.85	327.65	20.0	10/23/18	Sch. 40 PVC	2	4.0	320.85	19.0	305.85	---	---	---	---	---	---
AD-21	33° 02' 49.6"	94° 50' 20"	322.04	325.29	20.0	10/23/18	Sch. 40 PVC	2	3.5	318.54	18.5	303.54	---	---	---	---	---	---
AD-22	33° 03' 35"	94° 51' 09"	360.94	360.22	20.0	6/18/19	Sch. 40 PVC	2	5.0	355.94	20.0	340.94	---	---	---	---	---	---
AD-23	33° 03' 56"	94° 51' 08"	369.37	368.82	20.0	6/18/19	Sch. 40 PVC	2	5.0	364.37	20.0	349.37	---	---	---	---	---	---
Piezometers																		
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70	NM	NM	NM	NM	NM	NM
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60	NM	NM	NM	NM	NM	NM
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00	NM	NM	NM	NM	NM	NM
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10	NM	NM	NM	NM	NM	NM
Temp-1	33.046864°	94.852059°	356.36	358.17	28.0	5/8/18	Sch. 40 PVC	2	8.0	348.36	28.0	328.36	---	---	---	---	---	---
MW-9	33° 03' 18"	94° 50' 19.4"	342.00	344.54	18.0	11/19/01	Sch. 40 PVC	2	3.0	339.00	18.0	324.00	---	---	---	---	---	---
MW-10	33° 03' 13.6"	94° 50' 19.4"	341.96	344.80	19.0	11/19/01	Sch. 40 PVC	2	4.0	337.96	19.0	322.96	---	---	---	---	---	---

NOTES:

NM - Not measured.

(a) Source: Eagle Environmental Services Well Logs (2009).

(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).

(c) Source: Southwest Electric Power, State of Texas Well Report (2001).

(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.

(e) Monitoring well installed by ARCADIS on April 12, 2017 as a replacement for monitoring well AD-16.

Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through February 2017.

1983 State Plane Lambert Coordinate System

Datum: NAD 83

ft bls = feet below land surface

ft msl = feet above mean sea level

Elev. = Elevation

---- = No record

5/12/2014	11/16/2014	5/12/2015	3/4/2016	5/26/2016	7/27/2016	10/19/2016	12/12/2016	1/17/2017	2/23/2017	10/6/2017	5/15/2018	10/29/2018	6/19/2019	7/24/2019
GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
338.03	337.64	340.82	342.83	344.89	342.89	341.23	340.58	341.18	339.74	337.70	340.57	339.10	345.37	343.95
330.09	329.69	332.56	332.32	---	---	---	---	---	---	---	331.50	331.25	333.61	332.55
324.12	323.28	325.58	325.12	324.59	323.70	323.47	323.78	325.04	324.92	323.24	324.30	324.15	325.42	324.72
325.44	325.13	327.00	326.90	---	---	---	---	---	---	---	---	---	---	325.58
325.64	325.34	327.19	327.12	---	---	---	---	---	---	---	---	---	---	325.74
325.22	324.90	326.58	326.67	---	---	---	---	---	---	---	---	---	---	324.95
325.01	324.71	326.50	326.19	325.89	324.01	323.76	325.07	326.39	324.89	324.20	324.95	325.62	325.98	324.73
336.80	336.01	339.07	338.04	337.62	337.24	337.74	337.01	338.34	336.17	337.40	337.25	336.98	337.18	336.89
333.11	332.81	333.38	334.00	---	---	---	---	---	---	---	---	333.42	333.42	---
333.77	333.98	334.09	333.61	---	---	---	---	---	---	---	---	---	335.00	334.61
325.98	325.77	326.05	325.70	325.68	325.05	325.29	325.92	326.76	324.27	326.12	325.63	326.36	326.17	325.80
NM	330.18	329.98	329.74	329.28	329.53	328.92	329.31	330.50	328.05	329.47	329.40	329.98	330.01	329.57
323.57	323.88	323.95	323.55	---	---	---	---	---	---	---	323.53	324.19	324.06	323.76
328.20	327.97	328.96	328.13	328.39	328.14	327.87	328.20	328.90	328.25	327.85	327.61	327.83	328.72	327.97
349.89	350.01	350.65	350.39	---	---	---	---	---	---	---	349.52	348.28	350.81	---
333.35	332.01	337.58	334.76	334.54	332.93	332.39	332.84	334.54	331.83	331.42	331.83	331.52	332.98	332.23
332.12	330.17	336.63	334.83	334.51	331.71	330.94	330.79	332.63	330.87	329.91	330.76	330.52	333.94	331.85
---	---	---	322.14	321.93	321.28	321.42	321.71	321.64	322.81	322.07	321.74	322.01	322.24	321.43
---	---	---	337.09	335.84	332.14	331.52	331.43	330.96	330.71	---	---	---	---	---
---	---	---	---	---	---	---	---	---	---	327.12	328.68	326.71	335.13	332.11
---	---	---	334.64	334.26	334.30	334.45	334.64	334.05	333.94	334.17	334.35	333.91	335.39	334.94
---	---	---	343.66	343.26	340.81	339.92	339.38	338.97	340.38	339.43	342.75	340.97	343.70	342.65
---	---	---	---	---	---	---	---	---	---	---	321.24	321.54	322.65	---
---	---	---	---	---	---	---	---	---	---	---	---	323.28	322.89	---
---	---	---	---	---	---	---	---	---	---	---	---	320.26	320.72	---
---	---	---	---	---	---	---	---	---	---	---	---	---	358.24	---
---	---	---	---	---	---	---	---	---	---	---	---	---	364.98	---
NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
---	---	---	---	---	---	---	---	---	---	---	345.55	342.79	350.08	NM
---	---	---	---	---	---	---	---	---	---	---	331.34	331.24	NM	NM
---	---	---	---	---	---	---	---	---	---	---	332.29	332.75	337.26	NM

Table 4-1
Soil and Coal Ash Sample Analytical Results (mg/kg) - CCR Units
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Sample ID	Date Sampled	Sample Depth (feet)	Units	Appendix III Parameters						Appendix IV Parameters															
				Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Soil Samples																									
Temp-1	5/8/18	15'	mg/kg	14.3	43.3	15	<1	5.0	93	<0.25	1.77	16.8	<0.05	<0.05	5.22	0.28	1.77	0.104	0.004	1.18	<0.25	1.26	0.273	<12.5	5.4
SB-2	5/10/18	22'	mg/kg	11.9	35.8	13	2	3.9	878	<0.25	<0.25	18.3	0.08	<0.05	3.53	0.551	3.98	0.08	0.005	0.287	0.684	<0.25	0.159	890	4.46
(AD-17)																									
SB-3	5/10/18	30'	mg/kg	3.05	90.2	94	1	3.8	1,194	<0.25	3.83	13.6	<0.05	0.132	9.21	0.649	4.22	0.322	0.009	1.64	<0.25	<0.25	0.593	3,960	6.87
(AD-18)																									
SB-4	5/9/18	5'	mg/kg	(FOC = 0.00723 g/g)			---	4.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
(AD-5)		27'	mg/kg	7.76	634	8	1	6.4	724	<0.25	1.81	20.4	0.115	0.417	6.73	4.76	3.2	13.6	0.006	0.561	0.536	<0.25	0.657	10,400	65.5
(Background)		27'	mg/kg	(FOC = 0.00688 g/g)																					
SB-5	5/9/18	19'	mg/kg	5.45	655	16	3	7.2	69	<0.25	1.11	8.53	0.109	0.241	3.75	3.58	2.96	10.5	0.044	0.313	0.297	<0.25	0.216	6,210	35.5
(AD-8)																									
SB-6	5/9/18	21'	mg/kg	5.33	397	20	2	7.8	116	<0.25	1.11	17.9	0.09	0.24	3.5	3.37	2.67	10.3	0.051	0.299	0.471	<0.25	2.502	5,970	38.4
(AD-9)																									
SB-7	5/9/18	13'	mg/kg	8.11	1,360	19	<1	5.0	198	<0.25	10.1	65	0.154	0.356	6.87	3.21	3.14	5.3	0.004	1.39	<0.25	<0.25	0.262	9,220	28.4
(AD-13)																									
SB-8	5/9/18	12'	mg/kg	16.6	6,150	13	1	5.2	24	<0.25	3.3	213	0.409	0.452	8.22	4.13	9.05	4.63	0.013	0.488	<0.25	<0.25	0.433	11,000	25.4
(AD-3)																									
AD-20	10/23/18	15-17	mg/kg	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.567	---	---
AD-21	10/23/18	15-17	mg/kg	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.424	---	---
AD-22	6/18/19	3-5	mg/kg	16.7	110	---	---	4.84	---	<0.25	8.43	136	0.544	0.935	29.9	13	18.9	18	0.053	0.711	1.81	<0.25	---	25,800	---
		6-8	mg/kg	10.2	18.7	---	---	4.1	---	<0.25	20.9	30.4	0.246	0.723	17.7	9.65	8.95	2.9	0.009	0.446	1.08	<0.25	---	22,500	---
		11-13	mg/kg	8.83	219	---	---	4.26	---	<0.25	5.96	77.1	0.293	0.571	16.5	8.75	6.57	4.4	0.045	0.536	0.885	<0.25	---	17,600	---
AD-23	6/18/19	3-5	mg/kg	32.7	115	---	---	4.64	---	<0.25	14.1	45.5	0.805	3.23	49	30.8	11	7.74	0.035	1.14	4.27	<0.25	---	85,500	---
		5-7	mg/kg	10.2	22.7	---	---	4.25	---	<0.25	6.3	31.7	0.288	0.775	19	9.74	8.56	4.83	0.014	0.378	1.12	<0.25	---	22,700	---
		10-12	mg/kg	9.16	200	---	---	4.21	---	<0.25	4.13	28.3	0.288	0.613	23.9	8.19	7.03	3.41	0.015	1.03	0.635	<0.25	---	18,500	---
Coal Ash Samples																									
Ash-1	5/10/18	1-2'	mg/kg	34.4	33,800	30.5	8.21	7.1	219	<0.877	14.6	607	1.02	0.464	31.8	5.55	16.9	11.6	0.0473	2.66	2.27	<0.54	*2.92*	37,500	139
		SPLP:	*mg/L*	*0.594*	*30.2*	---	---	---	---	*<0.00344*	*<0.00411*	*0.284*	*<0.000333*	*<0.000164*	*0.00273*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0176*	*<0.00363*	*<0.00287*	*0.0991*	*<0.0305*	*<0.00267*
		Pore Water:	*mg/L*	*0.643*	*113*	*20.1*	*1.86*	*7.4*	*6.6*	*<0.00344*	*0.0095*	*3.43*	*<0.000333*	*<0.000164*	*0.00396*	*<0.000553*	*<0.00285*	*0.0123*	*<0.0000653*	*0.00484*	*<0.00363*	*<0.00287*	0.755	---	*0.357*
Ash-2	5/10/18	1-2'	mg/kg	92.6	96,000	53.8	11.2	7.3	293	<1.56	19.4	2,760	1.64	1.56	41.2	9.63	24.5	15.5	0.0967	2.08	5.25	<0.957	*2.32*	18,300	365
		SPLP:	*mg/L*	*0.526*	*24.1*	---	---	---	---	*<0.00344*	*<0.00411*	*0.192*	*<0.000333*	*<0.000164*	*0.00222*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0165*	*<0.00363*	*<0.00287*	*0.112*	*<0.0305*	*<0.00267*
		Pore Water:	*mg/L*	*0.772*	*143*	*20.4*	*0.28*	*7.6*	*8.73*	*<0.00344*	*0.0106*	*3.99*	*<0.000333*	*<0.000164*	*0.00196*	*<0.000553*	*0.00346*	*0.0173*	*<0.0000653*	*0.00428*	*<0.00363*	*<0.00287*	0.508	---	*0.376*
Ash-3	5/10/18	1-2'	mg/kg	29	14,300	11.5	10.7	7.4	152	<0.687	11.8	766	0.845	0.394	19.2	5.77	12.2	6.87	0.0403	1.79	1.44	<0.423	*1.754*	21,100	110
		SPLP:	*mg/L*	*0.958*	*19.8*	---	---	---	---	*<0.00344*	*<0.00411*	*0.0315*	*<0.000333*	*<0.000164*	*0.00389*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0222*	*<0.00363*	*<0.00287*	*<0.256*	*0.471*	*<0.00267*
		Pore Water:	*mg/L*	*1.000*	*103*	*13.0*	*0.998*	*7.6*	*51.1*	*<0.00344*	*0.0108*	*1.54*	*<0.000333*	*<0.000164*	*0.00110*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0111*	*<0.00363*	*<0.00287*	0.594	---	*0.715*
Ash-4	5/10/18	1-2'	mg/kg	281	106,000	27.6	1.34	10.5	961	<0.757	9.72	3,390	2.23	1.06	35.1	16.2	16.3	20.4	0.0340	2.21	1.30	<0.466	*3.18*	24,200	177
		SPLP:	*mg/L*	*1.3*	*25.1*	---	---	---	---	*<0.00344*	*<0.00411*	*0.0216*	*<0.000333*	*<0.000164*	*0.00329*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*<0.00281*	*<0.00363*	*<0.00287*	*<0.407*	*<0.0305*	*<0.00267*
		Pore Water:	*mg/L*	*4.75*	*63.5*	*28.8*	*0.697*	*10.8*	*381*	*<0.00344*	*0.00745*	*0.217*	*<0.000333*	*<0.000164*	*0.00225*	*0.00093*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0798*	*<0.00363*	*<0.00287*	0.259	---	*0.00814*

NOTES:
mg/kg = Milligrams per kilogram
mg/L = Milligrams per liter
FOC = Fraction organic carbon (Walkley Black)
--- = Not analyzed
SPLP = Synthetic precipitation leaching procedure (concentrations shown in milligrams per liter)
Total concentrations (mg/kg) shown in normal font, SPLP and Pore Water concentrations (mg/L) shown in italics.
Radium concentrations for soil shown in picoCuries per gram. SPLP concentrations shown in picoCuries per liter.

Table 4-2
Groundwater Sampling Analytical Results (mg/L) - Primary Bottom Ash Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Background (Upgradient) Wells																									
AD-1	05/26/16	0.346	36.5	5	<1	5.93	--	42	252	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.010	0.000033	<0.005	<0.005	<0.002	1.18	--	--
	07/27/16	0.350	39.6	4	<1	5.93	--	36	239	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.019	<0.000025	<0.005	<0.005	<0.002	0.9952	--	--
	09/29/16	0.332	15	5	<1	5.37	--	35	173	<0.005	<0.005	0.141	<0.001	<0.001	0.005	<0.005	<0.005	0.014	<0.000025	<0.005	<0.005	<0.002	1.38	--	--
	10/19/16	0.398	19.1	4	<1	5.15	--	42	192	<0.005	<0.005	0.114	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	1.141	--	--
	12/12/16	0.394	8.74	4	<1	5.18	--	40	200	<0.005	<0.005	0.072	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	0.719	--	--
	01/17/17	0.656	129	4	<1	7.13	--	68	538	<0.005	<0.005	0.410	<0.001	<0.001	<0.001	<0.005	<0.005	<0.001	<0.000025	<0.005	<0.005	<0.002	3.009	--	--
	02/23/17	0.700	147	9	<1	6.88	--	68	612	<0.005	<0.005	0.488	<0.001	<0.001	<0.001	<0.005	<0.005	0.001	<0.000025	<0.005	<0.005	<0.002	4.309	--	--
	06/07/17	0.449	15.1	4	<0.083	5.06	109	42	176	<0.00093	0.00114	0.09346	0.00037	<0.00007	0.00066	0.00077	<0.00068	0.00902	0.000007	<0.00029	0.0021	<0.00086	0.676	--	--
	10/06/17	--	--	--	--	5.25	97.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.352	12.1	3	<0.083	4.82	8.4	--	174	<0.00093	<0.00105	0.08823	0.00048	<0.00007	<0.00023	0.0008	<0.00068	0.00816	<0.000005	<0.00029	<0.00099	<0.00086	0.837	0.03	0.025
	Dissolved	*0.35*	*12*	--	--	4.82	8.4	--	--	*<0.00093*	*<0.00105*	*0.08582*	*0.00044*	*<0.00007*	*<0.00023*	*0.00083*	*<0.00068*	*0.00799*	*<0.000005*	*<0.00029*	*0.00197*	*<0.00086*	*0.531*	0.01	0.026
	05/24/18	0.345	10.2	4	<0.083	5.19	118	43	150	0.00317 J	<0.00105	0.0799	0.00039 J	<0.00007	<0.00023	0.00035 J	<0.00068	0.00814	0.000006 J	<0.00029	0.00138 J	<0.00086	1.983	--	--
	08/14/18	0.443	5.95	5	<0.083	5.18	102	44	160	0.00003 J	0.00021	0.063	0.000482	0.00002	0.00016	0.000797	0.000238	0.00708	0.000013 J	0.00021	0.0017	0.00003 J	1.10	--	--
	02/20/19	0.504	142	2.82	0.24	7.31	113	49.2	522	0.00016	0.00046	0.457	0.00009 J	0.00001 J	0.000306	0.000399	0.000124	0.00155	<0.000025	0.001 J	0.0007	<0.0005	3.16	--	--
	05/30/19	0.689	--	1.59	0.29	--	61.3	43.3	588	0.00016	0.00060	0.512	0.000244	0.00001 J	0.0001 J	0.000756	0.000197	<0.009	<0.000005	0.00243	0.0014	<0.0001	--	0.099	0.0625
	07/24/19	0.644	62.7	2	0.106 J	5.97	52.1	58	180	0.00008 J	0.00039	0.245	0.00054	0.00002 J	0.0001 J	0.000789	0.0001 J	0.00557	<0.000005	0.002 J	0.0034	<0.0001	1.819	--	--
AD-5	05/31/16	0.03	36.9	15	<1	6.38	--	123	337	<0.005	<0.005	0.057	<0.001	<0.001	<0.001	0.014	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	1.63	--	--
	07/28/16	0.04	44.7	16	<1	6.38	--	163	360	<0.005	<0.005	0.093	<0.001	<0.001	<0.001	0.015	<0.005	0.191	<0.000025	<0.005	<0.005	<0.002	4.75	--	--
	09/29/16	0.04	46.3	15	<1	5.29	--	190	416	<0.005	<0.005	0.087	<0.001	<0.001	<0.001	0.014	<0.005	0.186	<0.000025	<0.005	<0.005	<0.002	3.33	--	--
	10/20/16	0.05	50.7	14	<1	5.92	--	267	448	<0.005	<0.005	0.07	<0.001	<0.001	<0.001	0.009	<0.005	0.225	<0.000025	<0.005	<0.005	<0.002	2.319	--	--
	12/13/16	0.05	49.6	13	<1	6.29	--	233	484	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	0.013	<0.005	0.199	<0.000025	<0.005	<0.005	<0.002	2.182	--	--
	01/17/17	0.04	49.8	14	<1	6.27	--	234	438	<0.005	<0.005	0.047	<0.001	<0.001	<0.001	0.012	<0.005	0.239	<0.000025	<0.005	<0.005	<0.002	1.023	--	--
	02/23/17	0.04	33.0	15	<1	5.48	--	127	286	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	0.013	<0.005	0.166	<0.000025	<0.005	<0.005	<0.002	1.788	--	--
	06/07/17	0.05281	49.7	14	<0.083	5.96	867	82	300	<0.00093	0.00385	0.0877	0.00008	0.00039	0.00028	0.01193	<0.00068	0.124	<0.000005	<0.00029	<0.00099	<0.00086	2.32	--	--
	10/06/17	--	--	--	--	5.59	249	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.05063	30.1	21	<0.083	5.79	<100	--	248	<0.00093	<0.00105	0.07627	0.00014	0.00037	<0.00023	0.01907	<0.00068	0.118	<0.000005	<0.00029	<0.00099	<0.00086	1.495	14.4	0.45
	Dissolved	*0.03752*	*29.1*	--	--	5.79	<100	--	--	*<0.00093*	*<0.00105*	*0.06865*	*<0.00002*	*<0.00007*	*<0.00023*	*0.01747*	*<0.00068*	*0.119*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.043*	*2.051*	8.38	0.43
	05/24/18	0.05007	28.1	22	<0.083	6.22	17.8	60	242	<0.00093	<0.00105	0.07116	<0.00002	0.00023 J	0.0008 J	0.01424	<0.00068	0.121	<0.000005	<0.00029	<0.00099	<0.00086	1.946	--	--
	08/15/18	0.05	40.5	19	<0.083	6.23	57.1	240	428	0.00001 J	0.00169	0.0637	0.000055	0.000008 J	0.000072	0.0114	0.000079	0.147	<0.000005	0.00013	0.00008 J	<0.00005	0.316	--	--
	02/21/19	0.033	33.9	24.7	0.21	5.38	164	46.5	220	0.00002 J	0.00159	0.0694	0.00008 J	<0.00005	0.000432	0.00858	0.000147	0.0807	<0.000025	<0.002	0.0001 J	<0.0005	1.27	--	--
	05/30/19	0.03 J	--	22.3	0.29	--	150	51.3	238	<0.00002	0.00305	0.0605	0.00008 J	<0.00001	0.00006 J	0.0118	0.00005 J	0.104	0.000006	<0.0004	0.00005 J	<0.0001	--	23.4	0.331
	07/24/19	0.04 J	41.1	18	0.112 J	6.3	108	90	354	<0.00002	0.00248	0.0774	0.00005 J	<0.00001	0.00005 J	0.00838	<0.00005	0.108	<0.000005	<0.0004	0.00006 J	<0.0001	2.533	--	--
AD-17	05/26/16	0.121	200	43	<1	7.17	--	1,166	1,810	<0.005	<0.005	0.021	<0.001	0.002	0.001	0.063	<0.005	0.370	0.000032	<0.005	<0.005	<0.002	1.53	--	--
	07/27/16	0.119	195	32	<1	7.17	--	1,005	1,576	<0.005	<0.005	0.020	<0.001	0.004	0.001	0.068	<0.005	0.374	<0.000025	<0.005	<0.005	<0.002	2.78	--	--
	09/29/16	0.111	191	36	<1	6.17	--	1,055	1,663	<0.005	<0.005	0.031	<0.001	<0.001	0.003	0.058	<0.005	0.354	<0.000025	<0.005	<0.005	<0.002	2.358	--	--
	10/20/16	0.124	194	32	1.0	6.14	--	1,163	1,612	<0.005	<0.005	0.034	<0.001	0.002	0.004	0.065	<0.005	0.394	<0.000025	<0.005	<0.005	<0.002	2.224	--	--
	12/13/16	0.135	196	31	<1	6.03	--	1,096	1,560	<0.005	<0.005	0.017	<0.001	0.003	<0.001	0.068	<0.005	0.323	<0.000025	<0.005	<0.005	<0.002	2.384	--	--
	01/17/17	0.101	196	33	<1	5.96	--	1,445	1,686	<0.005	<0.005	0.014	<0.001	0.003	0.068	0.068	<0.005	0.341	<0.000025	<0.005	<0.005	<0.002	2.436	--	--
	02/22/17	0.135	189	30	<1	5.67	--	1,055	1,628	<0.005	<0.005	0.020	<0.001	0.002	0.001	0.073	<0.005	0.331	<0.000025	<0.005	<0.005	<0.002	2.288	--	--
	06/06/17	0.121	188	30	<0.083	5.81	156	1,105	1,578	<0.00093	<0.00105	0.01033	<0.00002	0.00606	<0.00023	0.0748	<0.00068	0.329	0.000013	<0.00029	<0.00099	<0.00086	1.598	--	--
	10/05/17	--	--	--	--	5.92	598	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.247	213	45	<0.083	5.51	<100	--	1,846	<0.00093	<0.00105	0.00978	<0.00002	0.00915	<0.00023	0.07451	<0.00068	0.306	<0.000005	<0.00029	0.00414	<0.00086	1.514	260	3.72
	Dissolved	*0.231*	*205*	--	--	5.51	<100	--	--	*<0.00093*	*<0.00105*	*0.00737*	*<0.00002*	*0.00609*	*<0.00023*	*0.07938*	*<0.00068*	*0.301*	*<0.000005*	*<0.00029*	*0.00515*	*0.02*	*1.57*	241	3.56
	05/24/18	0.239	193	39	<0.083	6.28	7.8	1,067	1,836	<0.00093	<0.00105	0.00965	<0.00002	0.00646	<0.00023	0.07173	<0.00068	0.308	<0.000005	<0.00029	<0.00099	<0.00086	1.939	--	--
	08/15/18	0.118	187	40	<0.083	5.60	418	1,170	1,750	0.00002 J	0.00183	0.0128	0.000069	0.00025	0.000604	0.0435	0.0011	0.243	0.000011 J	0.00035	0.0003	0.000074	2.35	--	--
	02/21/19	0.151	207	43.2	0.180	6.93	274	1,060	1,720	0.00008 J	0.00251	0.120	0.00024	0.00027	0.00334	0.0645	0.00249	0.268	0.000007 J	0.0007 J	0.0008	<0.0005	2.66	--	--
	05/30/19	0.158	--	41.7	<0.04	--	176	1,120	1,546	<0.00002	0.00041	0.0196	0.00002 J	0.00003 J	0.000246	0.0511	0.00003 J	0.341	<0.000005	<0.0004	0.00006 J	<0.0001	--	145	3.40
	07/24/19	0.113	216	37	0.085 J	5.96	113	1,127	1,864	<0.00002	0.00107	0.0143	0.00013	0.00003 J	0.000228	0.0577	0.000263	0.283	<0.000005	<0.0004	0.0001 J	<0.0001	3.45	--	--
Offsite Background (Upgradient) Monitoring Wells																									
AD-22	06/19/19	0.04 J	2.61	17.3	0.1 J	5.59	<100	17.4	148	<0.0002	0.00163	0.104	0.0004 J	<0.0001	0.002 J	0.0181	0.0007 J	0.03 J	0.000003 J	<0.004	0.0006 J	<0.001	1.403	16.2	--
AD-23	06/19/19	0.03 J	1.16	6.04	0.05 J	5.72	44.1	0.8	52	<0.0002	0.00201	0.082	0.0006 J	<0.0001	0.00911	0.0111	0.001 J	<0.009	0.000004 J	<0.004	0.0009 J	<0.001	0.617	6.54	--
Background Statistical Evaluation Summary - Upper Prediction Limits:[a]										0.005	0.005	0.62	0.00079	0.0037	0.004	0.075	0.005	0.39	0.000033	0.005	0.005	0.002	4.11[e]	--	--

Table 4-2
Groundwater Sampling Analytical Results (mg/L) - Primary Bottom Ash Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

		Appendix III Parameters								Appendix IV Parameters														
Well	**Date Sampled**	**Boron (total)**	**Calcium (total)**	**Chloride**	**Fluoride**	**pH**	**Turbidity (field)**	**Sulfate**	**TDS**	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Cobalt**	**Lead**	**Lithium**	**Mercury**	**Molybdenum**	**Selenium**	**Thallium**	**Radium 226 and 228 (pCi/L)**	**Iron**	**Manganese**
Point of Compliance Wells																									
AD-8	05/31/16	1.46	32.6	36	1	6.91	--	217	524	<0.005	<0.005	0.034	<0.001	<0.001	0.002	0.007	<0.005	0.122	<0.000025	<0.005	<0.005	<0.002	1.046	--	--
	07/28/16	1.44	25.9	26	<1	6.91	--	202	469	<0.005	<0.005	0.026	<0.001	<0.001	<0.001	0.009	<0.005	0.098	<0.000025	<0.005	<0.005	<0.002	1.584	--	--
	09/29/16	1.51	24.3	28	<1	7.65	--	186	432	<0.005	<0.005	0.023	<0.001	<0.001	<0.001	0.007	<0.005	0.111	<0.000025	<0.005	<0.005	<0.002	6.3	--	--
	10/20/16	1.54	25.9	30	<1	6.07	--	184	424	<0.005	<0.005	0.024	<0.001	<0.001	<0.001	0.007	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	0.345	--	--
	12/12/16	1.53	23.6	27	<1	5.62	--	168	442	<0.005	<0.005	0.021	<0.001	<0.001	<0.001	0.007	<0.005	0.11	<0.000025	<0.005	<0.005	<0.002	1.083	--	--
	01/19/17	1.53	18.7	24	1	6.21	--	153	352	<0.005	<0.005	0.02	<0.001	<0.001	<0.001	0.006	<0.005	0.094	<0.000025	<0.005	<0.005	<0.002	0.823	--	--
	02/22/17	1.67	19.3	22	<1	6.78	--	163	356	<0.005	<0.005	0.019	<0.001	<0.001	<0.001	0.006	<0.005	0.092	<0.000025	<0.005	<0.005	<0.002	0.536	--	--
	06/06/17	1.39	17.4	22	0.6628	5.63	54	151	368	<0.00093	<0.00105	0.01908	<0.00002	<0.00007	<0.00023	0.00386	<0.00068	0.09491	0.000008	<0.00029	<0.00099	<0.00086	1.0735	--	--
	10/05/17	--	--	--	--	6.68	41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/18	1.29	17.2	22	0.716	6.07	3.0	--	368	<0.00093	<0.00105	0.02283	0.00004	<0.00007	<0.00023	0.00521	<0.00068	0.08418	0.000009	<0.00029	<0.00099	<0.00086	1.106	0.673	0.388
	Dissolved	*1.31*	*17.1*	--	--	6.07	3.0	--	--	*<0.00093*	*<0.00105*	*0.02046*	*<0.00002*	*<0.00007*	*<0.00023*	*0.00513*	*<0.00068*	*0.08356*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*0.5773*	< 0.01	0.363
	05/23/18	--	--	--	0.501 J	6.20	*48.2*	--	--	0.00319 J	<0.00105	0.02212	<0.00002	<0.00007	<0.00023	0.00319 J	<0.00068	0.0956	<0.000005	<0.00029	0.00175 J	<0.00086	0.3366	--	--
	8/15/18[b]	1.30	15.0	24	0.615 J	6.77	104	122	288	0.00001 J	0.00031	0.0212	0.000008 J	0.000002 J	0.00005	0.00536	0.000039	0.0555	0.000007 J	0.00016	0.00007 J	0.000129	3.44	--	--
	02/21/19	1.47	17.6	23.2	0.660	6.40	88.2	163	352	<0.0001	0.00057	0.0281	0.00003 J	0.00003 J	0.000456	0.00288	0.000223	0.0911	<0.000025	<0.002	0.0001 J	<0.0005	0.417	--	--
	05/29/19	1.07	--	19.5	0.89	--	76.4	150	324	<0.00002	0.00037	0.0303	<0.00002	0.00002 J	0.0001 J	0.00603	0.00007 J	0.067	<0.000005	<0.0004	0.00006 J	0.0001 J	--	1.07	0.457
	07/23/19	1.21	20.8	15	0.559 J	6.58	31.4	145	392	<0.00002	0.00041	0.031	<0.00002	0.00002 J	0.00009 J	0.00707	0.00008 J	0.0641	<0.000005	<0.0004	0.00008 J	0.0001 J	0.72	--	--
AD-9	05/31/16	0.12	229	88	<1	6.32	--	1,352	2,541	<0.005	<0.005	0.051	<0.001	0.001	<0.001	0.027	<0.005	1.32	<0.000025	<0.005	<0.005	<0.002	2.95	--	--
	07/28/16	0.105	255	98	<1	6.32	--	1,464	2,564	<0.005	<0.005	0.031	<0.001	0.002	<0.001	0.022	<0.005	1.38	0.000045	<0.005	0.008	<0.002	1.447	--	--
	09/29/16	0.115	220	86	<1	4.72	--	1,301	2,448	<0.005	<0.005	0.033	<0.001	<0.001	<0.001	0.012	<0.005	1.17	<0.000025	<0.005	<0.005	<0.002	3.199	--	--
	10/19/16	0.109	228	76	1	5.22	--	1,350	2,494	<0.005	<0.005	0.026	<0.001	<0.001	<0.001	0.016	<0.005	1.44	<0.000025	<0.005	<0.005	<0.002	1.311	--	--
	12/12/16	0.108	250	92	<1	5.72	--	1,639	2,667	<0.005	<0.005	0.027	<0.001	0.002	<0.001	0.024	<0.005	1.33	<0.000025	<0.005	<0.005	<0.002	3.0	--	--
	01/19/17	0.312	91.1	54	<1	5.43	--	884	1,360	<0.005	<0.005	0.098	0.002	<0.001	<0.001	0.042	<0.005	0.634	<0.000025	<0.005	<0.005	<0.002	2.349	--	--
	02/22/17	0.1	258	86	<1	5.77	--	1,774	2,662	<0.005	<0.005	0.022	<0.001	<0.001	<0.001	0.024	<0.005	1.41	<0.000025	<0.005	<0.005	<0.002	2.32	--	--
	06/06/17	0.146	191	19	<0.083	4.61	100	105	308	<0.00093	<0.00105	0.04227	0.00077	0.00222	<0.00023	0.02416	<0.00068	1.00	0.000006	<0.00029	<0.00099	<0.00086	1.586	--	--
	10/05/17	--	--	--	--	5.78	102	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	0.08607	10.5	85	<0.083	4.20	<100		1,972	<0.00093	<0.00105	0.04937	0.00134	0.00023	<0.00023	0.01628	<0.00068	0.217	<0.000005	<0.00029	<0.00099	<0.00086	1.582	0.446	0.378
	Dissolved	*0.07126*	*10.2*	--	--	4.20	<100	--	--	*<0.00093*	*<0.00105*	*0.04695*	*0.00122*	*0.00012*	*<0.00023*	*0.01592*	*<0.00068*	*0.204*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.549*	0.166	0.369
	05/23/18	--	--	--	<0.083	5.30	44.6	--	--	<0.00093	<0.00105	0.03045	0.00032 J	0.00288	<0.00023	0.0267	<0.00068	1.20	<0.000005	<0.00029	<0.00099	0.00846	2.556	--	--
	8/15/18[b]	0.198	230	103	<0.083	4.96	237	1,910	2,694	<0.01	0.00168	0.0242	0.000268	0.00006	0.00042	0.0111	0.000262	0.851	0.000013 J	0.00011	0.0003	0.000062	1.864	--	--
	02/21/19	1.39	211	89	0.19	4.98	115	1,350	2,240	<0.0001	0.00118	0.0524	0.000474	0.00009	0.000313	0.0148	0.00008 J	1.12	0.00001 J	<0.002	0.0003	0.0001 J	2.51	--	--
	05/29/19	0.06 J	--	44	0.16	--	27.2	503	1,758	<0.00002	0.0002	0.0497	0.000941	0.00021	0.000346	0.0159	0.00007 J	0.225	<0.000005	<0.0004	0.0002	0.0002 J	--	0.485	0.363
	07/23/19	0.081	222	77	0.5736 J	6.28	8.7	1,701	2,460	<0.00002	0.00139	0.0321	0.000361	0.00006	0.0002 J	0.0127	0.0002 J	1.11	<0.000005	<0.0004	0.0004	<0.0001	1.689	--	--
AD-15	05/31/16	0.329	5.09	30	<1	5.58	--	24	188	<0.005	0.012	0.215	<0.001	<0.001	0.017	0.011	0.007	0.017	0.000054	<0.005	<0.005	<0.002	2.28	--	--
	07/28/16	0.407	3.83	34	<1	5.58	--	28	196	<0.005	0.006	0.124	<0.001	<0.001	0.004	0.006	<0.005	0.021	<0.000025	<0.005	<0.005	<0.002	1.322	--	--
	09/29/16	0.360	13.7	28	<1	4.57	--	23	367	<0.005	0.131	1.93	0.015	0.007	0.28	0.134	0.161	0.149	0.000707	<0.005	0.014	<0.002	9.92	--	--
	10/19/16	0.152	4.57	26	<1	4.35	--	17	152	<0.005	0.023	0.415	0.002	<0.001	0.054	0.019	0.022	0.036	0.0001	<0.005	<0.005	<0.002	3.567	--	--
	12/12/16	0.334	3.60	26	<1	4.67	--	19	204	<0.005	0.006	0.184	<0.001	<0.001	0.015	0.010	<0.005	0.013	0.000026	<0.005	<0.005	<0.002	3.36	--	--
	01/19/17	0.413	3.35	32	<1	5.77	--	25	176	<0.005	0.006	0.153	<0.001	<0.001	0.009	0.007	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	2.386	--	--
	02/22/17	0.100	4.21	20	<1	4.95	--	8	88	<0.005	0.020	0.353	0.002	<0.001	0.049	0.020	0.019	0.025	0.000058	<0.005	<0.005	<0.002	2.261	--	--
	06/06/17	0.321	3.57	27	<0.083	4.83	246	19	184	<0.00093	0.00854	0.166	0.00061	0.00048	0.01235	0.00844	0.00298	0.0108	0.000022	<0.00029	0.00271	<0.00086	2.491	--	--
	10/05/17	--	--	--	--	5.94	208	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/18	0.08009	2.49	22	<0.083	4.60	7.32		94	<0.00093	0.00222	0.08419	0.00024	<0.00007	<0.00023	0.00403	<0.00068	0.00395	<0.000005	<0.00029	<0.00099	<0.00086	1.749	6.64	0.036
	Dissolved	*0.05773*	*2.49*	--	--	4.60	7.32	--	--	*<0.00093*	*<0.00105*	*0.08405*	*0.00019*	*<0.00007*	*<0.00023*	*0.00346*	*<0.00068*	*0.00378*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*0.748*	< 0.01	0.034
	Field Filtered[c]	*0.301*	*3.03*	*35*	*<0.083*	4.60	7.32	--	*8*	*<0.00093*	*0.00216*	*0.08611*	*0.00012*	*<0.00007*	*<0.00023*	*0.00421*	*<0.00068*	*0.00498*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.630*	7.09	0.061
	FF Dissolved[c]	*0.309*	*3*	--	--	4.60	7.32	--	--	*<0.00093*	*<0.00105*	*0.08373*	*0.00024*	*<0.00007*	*<0.00023*	*0.0038*	*<0.00068*	*0.00516*	*<0.000005*	*0.00048*	*<0.00099*	*<0.00086*	*5.743*	<0.01	0.062
	05/23/18	--	--	--	<0.083	4.76	147	--	--	<0.00093	0.00256 J	0.102	0.00003 J	0.0001 J	0.00263	0.00474 J	<0.00068	0.00562	<0.000005	<0.00029	0.00154 J	0.00137 J	1.46	--	--
	8/15/18[b]	0.341	3.04	37	<0.083	4.59	249	24	174	0.00003 J	0.00326	0.0852	0.000116	0.00001 J	0.000481	0.00371	0.000438	0.00338	0.000008 J	0.00005 J	0.0009	0.00009	1.076	--	--
	02/21/19	0.169	2.67	28.2	0.09	4.98	116	10.6	150	<0.0001	0.00221	0.0766	0.000208	0.00001 J	0.000225	0.0029	0.000104	0.00294	<0.000025	<0.002	0.0004	<0.0005	0.841	--	--
	05/29/19	<0.02	--	21.4	0.06	--	185	2.1	34	<0.0001	0.00410	0.199	0.00186	0.00008 J	0.0103	0.00595	0.0101	0.01 J	0.000081	<0.002	0.0057	<0.0005	--	18.4	0.0423
	07/23/19	0.306	3.45	28	0.086 J	3.17	885	18	214	0.00003 J	0.00210	0.113	0.000573	0.00004 J	0.00226	0.00541	0.00287	0.00414	0.000025	<0.0004	0.0016	<0.0001	2.245	--	--

Table 4-2
Groundwater Sampling Analytical Results (mg/L) - Primary Bottom Ash Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters																
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Supplemental Downgradient Monitoring Wells																										
AD-10	5/16/2018	0.08311	15.5	40	<0.083	3.72	<100	--	280	<0.00093	0.0022	0.03855	0.00166	0.00033	<0.00023	0.02432	<0.00068	0.316	<0.000005	<0.00029	<0.00099	0.00098	1.704	0.338	0.25
	Dissolved	*0.07733*	*15.3*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.03712*	*0.00149*	*0.00009*	*<0.00023*	*0.02412*	*<0.00068*	*0.296*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.505*	0.282	0.251
Supplemental Sidegradient Monitoring Wells																										
MW-9	5/15/2018	0.578	44.8	93	<0.083	4.74	57.4	--	780	0.00097	<0.00105	0.01661	0.00021	0.00019	<0.00023	0.03083	<0.00068	0.03225	0.000127	<0.00029	<0.00099	<0.00086	0.779	0.142	0.306
	Dissolved	*0.556*	*44.7*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.01588*	*0.00015*	*0.00036*	*<0.00023*	*0.03189*	*0.00813*	*0.03151*	*0.00015*	*<0.00029*	*<0.00099*	*<0.00086*	*0.2578*	< 0.01	0.308
MW-10	5/15/2018	0.707	59.3	5	<0.083	6.68	1.7	--	346	<0.00093	0.00128	0.08634	0.00006	<0.00007	<0.00023	0.00385	<0.00068	0.01001	<0.000005	0.00079	0.01898	<0.00086	0.969	0.101	0.054
	Dissolved	*0.689*	*59.8*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.08253*	*<0.00002*	*<0.00007*	*<0.00023*	*0.00064*	*<0.00068*	*0.00924*	*<0.000005*	*0.00082*	*0.01651*	*<0.00086*	*1.026*	< 0.01	0.002
EPA MCLs:																										
MCL					4					0.006	0.01	2	0.004	0.005	0.1				0.002		0.05	0.002	5^e		
Rule Specified																0.006	0.015	0.04		0.1					
Background Limit					1					0.005	0.005	0.62	0.00079	0.0037	0.004	0.075^d	0.005	0.39^d	0.000033	0.005	0.005	0.002	4.11^e		
Interwell Background Value(s) (UPL, LPL where applicable) AD-8, AD-9, AD-15		0.700				4.8-7.0																			
Intrawell Background Value (UPL) AD-8			32.4	35.5	0.737			230	553																
Intrawell Background Value (UPL) AD-9			299	138	1.00			2530	3070																
Intrawell Background Value (UPL) AD-15			5.40	38.8	1.00			33.2	249																

NOTES:
All concentration data are provided in milligrams per liter (mg/L) unless otherwise noted.
J = Analyte was positively identified, though the quantitation was below Reporting Limit.
MCL - Maximum contaminant level
LPL = Lower prediction limit
UPL = Upper prediction limit
pCi/L = PicoCuries per liter
-- = Not analyzed
a = Data taken from Geosyntec "Statistical Analysis Summary, Primary Bottom Ash Pond" dated December 16, 2019.
b = Some inorganic analyte groundwater samples collected 9/17/18.
c = Sample ID "AD-15 DUP" was field filtered (FF) using a 5 micron filter.
d = Calculated Upper Tolerance Limit is higher than MCL.
e = Data is "Combined Radium, Total".
🟨 Denotes groundwater sample collected by ARCADIS using low-flow methods.
Unless otherwise noted, values shown are total (unfiltered) analyses.
Dissolved (0.45-micron lab filtered) parameter concentrations shown in italics.

Table 4-3
Groundwater Sampling Analytical Results (mg/L) - Landfill
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Background (Upgradient) Wells																									
AD-5	05/31/16	0.03	36.9	15	<1	6.38	--	123	337	<0.005	<0.005	0.057	<0.001	<0.001	<0.001	0.014	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	1.63	--	--
	07/28/16	0.04	44.7	16	<1	6.38	--	163	360	<0.005	<0.005	0.093	<0.001	<0.001	<0.001	0.015	<0.005	0.191	<0.000025	<0.005	<0.005	<0.002	4.75	--	--
	09/29/16	0.04	46.3	15	<1	5.29	--	190	416	<0.005	<0.005	0.087	<0.001	<0.001	<0.001	0.014	<0.005	0.186	<0.000025	<0.005	<0.005	<0.002	3.33	--	--
	10/20/16	0.05	50.7	14	<1	5.92	--	267	448	<0.005	<0.005	0.07	<0.001	<0.001	<0.001	0.009	<0.005	0.225	<0.000025	<0.005	<0.005	<0.002	2.319	--	--
	12/13/16	0.05	49.6	13	<1	6.29	--	233	484	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	0.013	<0.005	0.199	<0.000025	<0.005	<0.005	<0.002	2.182	--	--
	01/17/17	0.04	49.8	14	<1	6.27	--	234	438	<0.005	<0.005	0.047	<0.001	<0.001	<0.001	0.012	<0.005	0.239	<0.000025	<0.005	<0.005	<0.002	1.023	--	--
	02/23/17	0.04	33.0	15	<1	5.48	--	127	286	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	0.013	<0.005	0.166	<0.000025	<0.005	<0.005	<0.002	1.788	--	--
	06/07/17	0.05281	49.7	14	<0.083	5.96	867	82	300	<0.00093	0.00385	0.0877	0.00008	0.00039	0.00028	0.01193	<0.00068	0.124	<0.000005	<0.00029	<0.00099	<0.00086	2.32	--	--
	10/06/17	--	--	--	--	5.59	249	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.05063	30.1	21	<0.083	5.79	<100	--	248	<0.00093	<0.00105	0.07627	0.00014	0.00037	<0.00023	0.01907	<0.00068	0.118	<0.000005	<0.00029	<0.00099	<0.00086	1.495	14.4	0.45
	Dissolved	*0.03752*	*29.1*	--	--	5.79	<100	--	--	*<0.00093*	*<0.00105*	*0.06865*	*<0.00002*	*<0.00007*	*<0.00023*	*0.01747*	*<0.00068*	*0.119*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.043*	*2.051*	8.38	0.43
	05/24/18	0.05007	28.1	22	<0.083	6.22	17.8	60	242	<0.00093	<0.00105	0.07116	<0.00002	0.00023 J	0.0008 J	0.01424	<0.00068	0.121	<0.000005	<0.00029	<0.00099	<0.00086	1.946	--	--
	08/15/18	0.05	40.5	19	<0.083	6.23	57.1	240	428	0.00001 J	0.00169	0.0637	0.000055	0.000008 J	0.000072	0.0114	0.000079	0.147	<0.000005	0.00013	0.00008 J	<0.01	0.316	--	--
	02/21/19	0.033	33.9	24.7	0.21	5.38	164	46.5	220	0.00002 J	0.00159	0.0694	0.00008 J	<0.00005	0.000432	0.00858	0.000147	0.0807	<0.000025	<0.002	0.0001 J	<0.0005	1.27	--	--
	05/30/19	0.03 J	--	22.3	0.29	--	150	51.3	238	<0.00002	0.00305	0.0605	0.00008 J	<0.00001	0.00006 J	0.0118	0.00005 J	0.104	0.000006	<0.0004	0.00005 J	<0.0001	--	23.4	0.331
	07/24/19	0.04 J	41.1	18	0.112 J	6.3	108	90	354	<0.00002	0.00248	0.0774	0.00005 J	<0.00001	0.00005 J	0.00838	<0.00005	0.108	<0.000005	<0.0004	0.00006 J	<0.0001	2.533	--	--
AD-18[d]	05/26/16	0.146	409	422	<1	5.1	--	5,135	10,000	<0.005	<0.005	0.012	0.014	0.003	<0.001	0.922	<0.005	2.07	0.000168	<0.005	0.006	0.003	12.58	--	--
	07/27/16	0.148	457	432	2	5.1	--	4,930	9,476	<0.005	<0.005	0.019	0.005	0.002	<0.001	0.734	<0.005	1.94	0.000091	<0.005	0.007	0.003	10.62	--	--
	09/29/16	0.156	469	637	4	5.59	--	4,632	9,569	<0.005	<0.005	0.02	0.004	<0.001	<0.001	0.666	<0.005	1.86	0.000117	<0.005	0.007	<0.002	7.05	--	--
	10/20/16	0.188	498	876	0.8664	5.7	--	5,537	9,540	<0.005	<0.005	0.021	0.002	0.001	<0.001	0.569	<0.005	2.06	0.000053	<0.005	<0.005	<0.002	5.82	--	--
	12/13/16	0.178	510	695	5	5.75	--	4,382	8,912	<0.005	<0.005	0.021	0.007	0.001	<0.001	0.641	<0.005	1.74	0.00005	<0.005	<0.005	<0.002	9.6	--	--
	01/17/17	0.050	412	159	5	4.49	--	5,414	8,562	<0.005	0.01	0.014	0.022	0.001	<0.001	0.929	<0.005	1.95	0.000224	<0.005	<0.005	0.002	22.51	--	--
	02/22/17	0.090	401	151	6	4.37	--	5,169	8,412	<0.005	<0.005	0.014	0.026	0.002	<0.001	0.961	<0.005	1.82	0.000107	<0.005	<0.005	0.00228	19.11	--	--
	06/06/17	0.125	428	304	6.53	4.27	121	5,920	9,394	<0.00093	0.00331	0.01038	0.01883	0.00303	<0.00023	0.940	<0.00068	2.15	0.000113	<0.00029	0.00212	<0.00086	16.12	--	--
	10/05/17	--	--	--	--	5.87	165	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.163	433	362	9.4	3.61	104.1	--	9,952	0.00224	0.00276	0.00813	0.01733	0.0036	0.00098	0.928	<0.00068	2.07	0.000043	<0.00029	0.00194	0.00144	19.95	19.7	14.1
	Dissolved	*0.153*	*423*	--	--	--	--	--	--	*0.00467*	*0.00189*	*0.00748*	*0.01676*	*0.00316*	*<0.00023*	*0.898*	*<0.00068*	*2.06*	*0.000012*	*<0.00029*	*0.00135*	*0.01466*	*18.09*	19.1	13.7
	05/30/19	0.09 J	--	390	3.56	--	91.3	6,120	9,564	<0.0002	0.040	0.009 J	0.021	0.004 J	<0.004	1.130	0.005 J	1.27	0.000035	<0.04	0.103	<0.01	--	11.2	7.53
Background Statistical Evaluation Summary - Upper Prediction Limits:[a]										0.005	0.005	0.62	0.00079	0.0037	0.004	0.075	0.005	0.39	0.000033	0.005	0.005	0.002	4.11[e]	--	--
Point of Compliance Wells																									
AD-11	05/31/16	2.47	8.47	9	2	5.21	--	518	388	<0.005	<0.005	0.014	0.004	<0.001	0.003	0.026	<0.005	0.032	<0.000025	<0.005	<0.005	<0.002	1.77	--	--
	07/28/16	2.83	8.88	10	2	5.21	--	596	1,000	<0.005	<0.005	0.012	0.004	<0.001	<0.001	0.026	<0.005	0.047	<0.000025	<0.005	<0.005	<0.002	2.23	--	--
	09/29/16	3.4	10.7	12	2	4.08	--	683	1,065	<0.005	<0.005	0.052	0.005	<0.001	0.007	0.03	<0.005	0.047	<0.000025	<0.005	<0.005	<0.002	3.92	--	--
	10/19/16	3.77	8.78	11	<1	3.68	--	706	1,024	<0.005	<0.005	0.02	0.005	<0.001	0.002	0.027	<0.005	0.047	<0.000025	<0.005	<0.005	<0.002	2.56	--	--
	12/12/16	3.36	8.98	10	2	3.75	--	548	1,044	<0.005	<0.005	0.013	0.004	<0.001	<0.001	0.025	<0.005	0.041	<0.000025	<0.005	<0.005	<0.002	1.569	--	--
	01/17/17	2.81	10.3	11	2	4.41	--	760	1,048	<0.005	<0.005	0.013	0.004	<0.001	<0.001	0.025	<0.005	0.046	<0.000025	<0.005	<0.005	<0.002	1.082	--	--
	02/22/17	2.88	9.31	10	2	4.34	--	558	876	<0.005	<0.005	0.019	0.004	<0.001	0.002	0.024	<0.005	0.035	<0.000025	<0.005	<0.005	<0.002	1.45	--	--
	06/06/17	2.79	9.93	10	1.366	3.86	219	556	960	<0.00093	0.00123	0.01012	0.00279	0.00041	0.00032	0.02216	<0.00068	0.03654	<0.000005	<0.00029	<0.00099	<0.00086	1.902	--	--
	10/05/17	--	--	--	--	4.43	162	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	1.48	4.37	10	<0.083	3.77	75.3		558	0.00417	0.00127	0.01281	0.00148	0.00053	0.00041	0.00935	<0.00068	0.01978	<0.000005	0.00094	0.00103	<0.00086	1.264	1.35	0.063
	Dissolved	*1.45*	*4.28*	--	--	3.77	75.3	--	--	*<0.00093*	*0.00278*	*0.01202*	*0.00098*	*<0.00007*	*<0.00023*	*0.00877*	*<0.00068*	*0.01836*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.656*	1.25	0.062
	05/23/18	--	--	--	<0.083	*4.05*	*49.8*	--	--	<0.00093	0.0026 J	0.01627	0.00089 J	0.00018 J	0.0008 J	0.00863	<0.00068	0.01875	0.000007 J	<0.00029	0.00134 J	0.046	1.912	--	--
	08/15/18	1.84	6.61	15	<0.083	4.73	112	410	720	--	0.00105	0.0119	0.00118	0.00037	0.000257	0.0153	--	0.0175	<0.000005	--	0.0024	0.0002	2.6	--	--
	05/29/19	1.40	--	6.96	0.47	--	67.6	367	680	<0.0001	0.00113	0.0182	0.00138	0.0002 J	0.0004 J	0.00969	0.000804	0.02 J	<0.000005	<0.002	0.0022	<0.0005	--	1.46	0.0669
	07/23/19	1.56	7.19	6	0.338	--	170	342	700	<0.0002	0.00059	0.0164	0.000987	0.00024	0.000413	0.0105	0.000976	0.0153	<0.000005	<0.0004	0.001	0.0002 J	2.246	--	--
AD-13	05/31/16	1.19	8.02	12	<1	6.05		177	900	<0.005	<0.005	0.062	<0.001	<0.001	<0.001	<0.005	<0.005	0.011	<0.000025	<0.005	<0.005	<0.002	1.22	--	--
	07/27/16	1.23	3.7	15	1	6.05		187	--	<0.005	<0.005	0.036	<0.001	<0.001	<0.001	<0.005	<0.005	0.026	<0.000025	<0.005	<0.005	<0.002	1.601	--	--
	09/29/16	1.37	2.7	17	1	4.56		207	431	<0.005	<0.005	0.04	<0.001	<0.001	<0.001	<0.005	<0.005	0.02	<0.000025	<0.005	<0.005	<0.002	2.213	--	--
	10/19/16	1.67	3.66	19	1	4.34		226	482	<0.005	<0.005	0.03	<0.001	<0.001	<0.001	<0.005	<0.005	0.022	<0.000025	<0.005	<0.005	<0.002	3.662	--	--
	12/05/16	--	--	--	--	--		--	532	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/16	1.96	3.77	18	1	4.79		287	596	<0.005	<0.005	0.051	0.001	<0.001	0.007	0.007	<0.005	0.025	<0.000025	<0.005	<0.005	<0.002	2.27	--	--
	01/19/17	0.402	33.5	7	<1	5.38		90	222	<0.005	0.006	0.112	<0.001	<0.001	0.004	<0.005	<0.005	0.004	<0.000025	<0.005	<0.005	<0.002	2.228	--	--
	02/23/17	1.27	10.3	13	<1	5.06		183	392	<0.005	<0.005	0.041	<0.001	<0.001	<0.001	<0.005	<0.005	0.015	<0.000025	<0.005	<0.005	<0.002	1.556	--	--
	06/06/17	1.68	3.03	15	0.6679	4.22	171	244	494	0.00153	<0.00105	0.01712	0.00089	0.00014	<0.00023	0.00624	<0.00068	0.02082	<0.000005	<0.00029	0.00103	<0.00086	1.565	--	--
	10/06/17	--	--	--	--	4.61	173	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	1.42	7.48	10	0.5362	4.20	1.4		532	<0.00093	<0.00105	0.0216	0.00088	0.00011	<0.00023	0.00809	<0.00068	0.02603	<0.000005	<0.00029	<0.00099	<0.00086	2.064	0.858	0.046
	Dissolved	*1.41*	*7.31*	--	--	4.20	1.4	--	--	*<0.00093*	*<0.00105*	*0.02097*	*0.0008*	*<0.00007*	*<0.00023*	*0.00784*	*<0.00068*	*0.02439*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.407*	0.712	0.045
	05/23/18	--	--	--	0.6534 J	*4.52*	*52.7*	--	--	<0.00093	<0.00105	0.02653	0.00087 J	<0.00007	0.00073 J	0.00937	<0.00068	0.0291	0.000008 J	<0.00029	<0.00099	<0.043	2.16	--	--
	08/14/18	1.49	10.1	18	0.7442	4.82	131	316	620	--	0.00137	0.0169	0.000971	0.00031	0.000503	0.0131	--	0.0321	<0.000005	--	0.0017	0.000277	4.0	--	--
	05/30/19	0.477	--	3.6	0.53	--	83.6	94	196	0.00003 J	0.00032	0.0609	0.000385	0.00007	0.00031	0.00315	0.00005 J	0.009 J	<0.000005	<0.0004	0.0004	<0.0001	--	0.086	0.0141
	07/23/19	0.780	6.16	5	0.169	--	216	146	334	0.00002 J	0.00037	0.0236	0.000443	0.00009	0.000283	0.00382	0.000204	0.0175	<0.000005	<0.0004	0.0003	0.0001 J	1.748	--	--

Table 4-3
Groundwater Sampling Analytical Results (mg/L) - Landfill
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
AD-14	05/31/16	1.28	2.88	4	<1	4.75	--	115	285	<0.005	<0.005	0.031	<0.001	<0.001	<0.001	0.010	<0.005	0.012	0.00003	<0.005	<0.005	<0.002	0.87	--	--
	07/27/16	1.14	2.51	5	<1	4.75	--	111	267	<0.005	<0.005	0.084	<0.001	<0.001	0.001	0.009	<0.005	0.024	<0.000025	<0.005	<0.005	<0.002	1.487	--	--
	09/29/16	1.14	1.19	5	<1	4.17	--	111	252	<0.005	<0.005	0.03	<0.001	<0.001	<0.001	0.009	<0.005	0.015	<0.000025	<0.005	<0.005	<0.002	4.817	--	--
	10/19/16	1.25	2.48	4	<1	3.88	--	118	276	<0.005	<0.005	0.039	<0.001	0.001	<0.001	0.009	<0.005	0.014	<0.000025	<0.005	<0.005	<0.002	1.972	--	--
	12/12/16	1.25	2.41	5	<1	4.11	--	101	296	<0.005	<0.005	0.047	<0.001	0.001	0.001	0.009	<0.005	0.013	0.000037	<0.005	<0.005	<0.002	1.271	--	--
	01/17/17	0.915	10.3	4	<1	6.07	--	92	254	<0.005	<0.005	0.038	<0.001	<0.001	<0.001	<0.005	<0.005	0.013	<0.000025	<0.005	<0.005	<0.002	1.825	--	--
	02/22/17	1.06	9.48	4	<1	5.39	--	90	212	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	<0.005	<0.005	0.012	<0.000025	<0.005	<0.005	<0.002	0.512	--	--
	06/06/17	1.26	7.69	6	<0.083	4.77	167	108	256	<0.00093	<0.00105	0.04483	0.00038	0.00067	0.00127	0.00678	<0.00068	0.0127	0.000021	<0.00029	0.00261	<0.00086	1.138	--	--
	10/06/17	--	--	--	--	4.57	150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	1.61	4.67	11	<0.083	4.11	5.1	--	332	<0.00093	<0.00105	0.03161	0.00094	0.00204	<0.00023	0.01501	<0.00068	0.01638	0.000137	<0.00029	0.00221	<0.00086	1.097	0.09	0.008
	Dissolved	*1.56*	*4.55*	--	--	4.11	5.1	--	--	*<0.00093*	*<0.00105*	*0.02938*	*0.00094*	*0.00193*	*<0.00023*	*0.01476*	*<0.00068*	*0.01523*	*0.000149*	*<0.00029*	*0.00387*	*<0.00086*	*0.5903*	0.06	0.007
	05/23/18	--	--	--	<0.083	4.17	43.2	--	--	<0.00093	<0.00105	0.02817	0.00078 J	0.00161	<0.00023	0.01434	<0.00068	0.0152	0.000145	<0.00029	0.00362	<0.043	1.601	--	--
	08/14/18	1.51	4.51	12	<0.083	4.27	198	204	384	--	0.00039	0.024	0.000854	0.00199	0.000276	0.0176	--	0.011	0.000181	--	0.0037	0.000242	1.5	--	--
	05/29/19	1.21	--	3.65	0.19	--	20.6	122	274	<0.0001	0.0005	0.0434	0.000709	0.00087	0.0002 J	0.00774	0.0001 J	0.02 J	0.000181	<0.0002	0.0019	<0.0005		0.005 J	0.00023
	07/23/19	1.25	9.93	8	0.162	--	21.7	171	440	<0.00002	0.00043	0.0362	0.000934	0.00249	0.000286	0.0185	0.0002	0.0155	0.000123	<0.0004	0.0027	0.0002 J	2.731	--	--
Supplemental Downgradient Monitoring Well																									
AD-10	5/16/2018	0.08311	15.5	40	<0.083	3.72	<100	--	280	<0.00093	0.0022	0.03855	0.00166	0.00033	<0.00023	0.02432	<0.00068	0.316	<0.000005	<0.00029	<0.00099	0.00098	1.704	0.338	0.25
	Dissolved	*0.07733*	*15.3*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.03712*	*0.00149*	*0.00009*	*<0.00023*	*0.02412*	*<0.00068*	*0.296*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.505*	0.282	0.251
Supplemental Sidegradient Monitoring Wells																									
Temp-1	5/17/2018	0.662	26.2	34	<0.083	4.90	23.8	--	556	<0.00093	<0.00105	0.07752	0.00058	<0.00007	0.00102	0.01058	<0.00068	0.01075	<0.000005	<0.00029	<0.00099	<0.00086	1.277	1.94	0.203
	Dissolved	*0.621*	*24.6*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.06778*	*0.00042*	*<0.00007*	*<0.00023*	*0.00946*	*<0.00068*	*0.00986*	*<0.000005*	*<0.00029*	*<0.00099*	*0.00191*	*2.278*	0.813	0.192
AD-12	6/19/2019	0.569	34.1	44.1	0.32	6.3	40.1	131	436	<0.0001	0.00123	0.0581	0.0004 J	0.00005 J	0.0003 J	0.0126	<0.0001	0.042	<0.000002	<0.002	0.0005 J	<0.0005	2.007	25.9	--
EPA MCLs:																									
MCL					4					0.006	0.01	2	0.004	0.005	0.1				0.002		0.05	0.002	5[c]		
Rule Specified																0.006	0.015	0.04		0.1					
Background Limit					1					0.005	0.005	0.62	0.00079	0.0037	0.004	0.075[d]	0.005	0.39[d]	0.000033	0.005	0.005	0.002	4.11[e]		
Interwell Background Value(s) (UPL, LPL where applicable) AD-8, AD-9, AD-15		0.700				4.8-7.0																			
Intrawell Background Value (UPL) AD-8			32.4	35.5	0.737			230	553																
Intrawell Background Value (UPL) AD-9			299	138	1.00			2530	3070																
Intrawell Background Value (UPL) AD-15			5.40	38.8	1.00			33.2	249																

NOTES:
All concentration data are provided in milligrams per liter (mg/L) unless otherwise noted.
J = Analyte was positively identified, though the quantitation was below Reporting Limit.
MCL = Maximum contaminant level
LPL = Lower prediction limit
UPL = Upper prediction limit
pCi/L = PicoCuries per liter
-- = Not analyzed
a = Data taken from Geosyntec "Statistical Analysis Summary, Primary Bottom Ash Pond" dated December 16, 2019.
b = Calculated Upper Tolerance Limit is higher than MCL.
c = Data is "Combined Radium, Total".
d = AD-18 is not part of the designated CCR Monitoring Well Network and used for background understanding only
🟨 Denotes groundwater sample collected by ARCADIS using low-flow methods.
Unless otherwise noted, values shown are total (unfiltered) analyses.
Dissolved (0.45-micron lab filtered) parameter concentrations shown in italics.

Table 4-4
Groundwater Sampling Analytical Results (mg/L) - Bottom Ash Storage Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

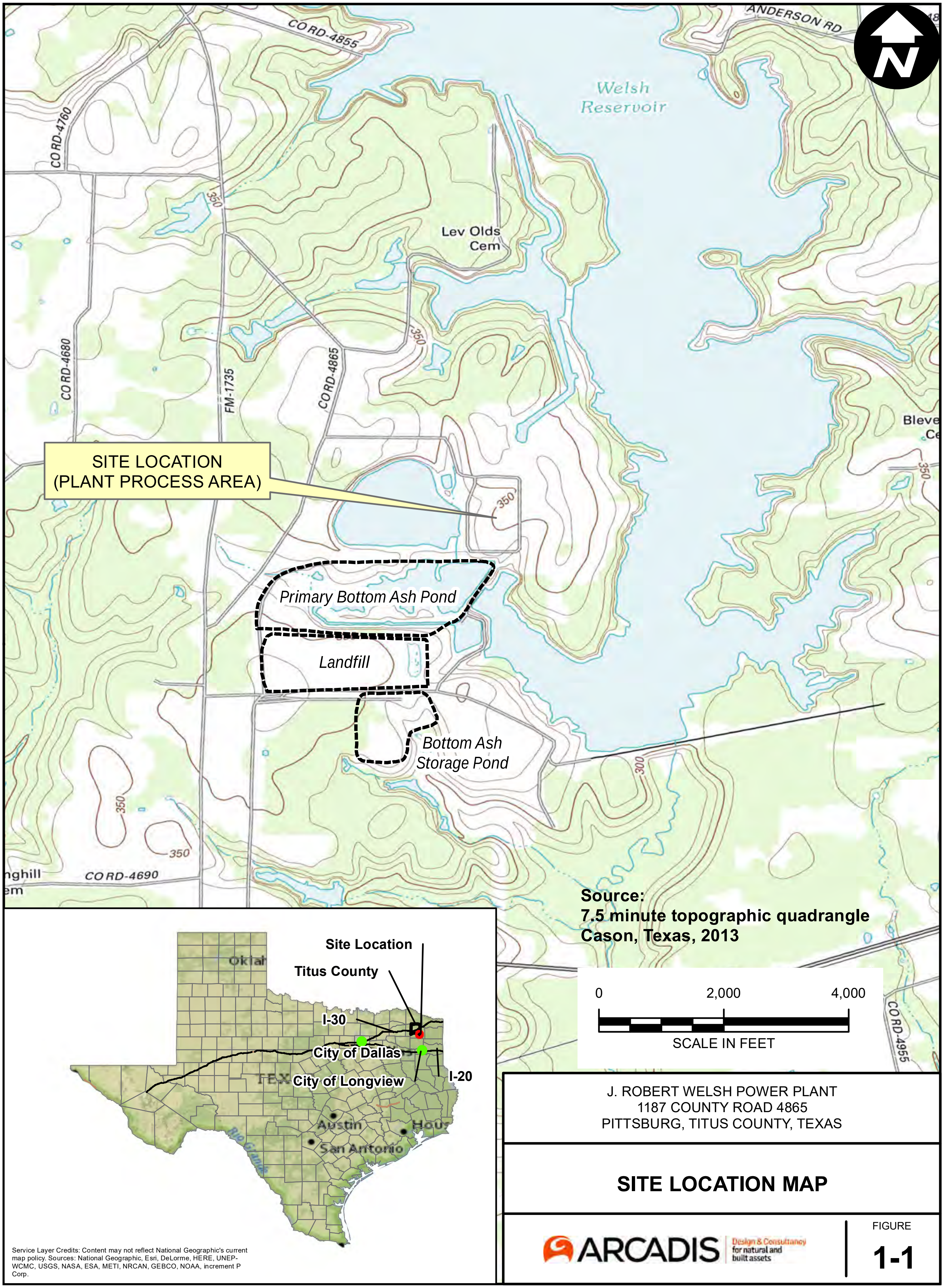
Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Background (Upgradient) Wells																									
AD-1	05/26/16	0.346	36.5	5	<1	5.93	--	42	252	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.010	0.000033	<0.005	<0.005	<0.002	1.18	--	--
	07/27/16	0.350	39.6	4	<1	5.93	--	36	239	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.019	<0.000025	<0.005	<0.005	<0.002	0.9952	--	--
	09/29/16	0.332	15	5	<1	5.37	--	35	173	<0.005	<0.005	0.141	<0.001	<0.001	0.005	<0.005	<0.005	0.014	<0.000025	<0.005	<0.005	<0.002	1.38	--	--
	10/19/16	0.398	19.1	4	<1	5.15	--	42	192	<0.005	<0.005	0.114	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	1.141	--	--
	12/12/16	0.394	8.74	4	<1	5.18	--	40	200	<0.005	<0.005	0.072	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	0.719	--	--
	01/17/17	0.656	129	4	<1	7.13	--	68	538	<0.005	<0.005	0.410	<0.001	<0.001	<0.001	<0.005	<0.005	<0.001	<0.000025	<0.005	<0.005	<0.002	3.009	--	--
	02/23/17	0.700	147	9	<1	6.88	--	68	612	<0.005	<0.005	0.488	<0.001	<0.001	<0.001	<0.005	<0.005	0.001	<0.000025	<0.005	<0.005	<0.002	4.309	--	--
	06/07/17	0.449	15.1	4	<0.083	5.06	109	42	176	<0.00093	0.00114	0.09346	0.00037	<0.00007	0.00066	0.00077	<0.00068	0.00902	0.000007	<0.00029	0.0021	<0.00086	0.676	--	--
	10/06/17	--	--	--	--	5.25	97.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.352	12.1	3	<0.083	4.82	8.4	--	174	<0.00093	<0.00105	0.08823	0.00048	<0.00007	<0.00023	0.0008	<0.00068	0.00816	<0.000005	<0.00029	<0.00099	<0.00086	0.837	0.03	0.025
	Dissolved	*0.35*	*12*	--	--	4.82	8.4	--	--	*<0.00093*	*<0.00105*	*0.08582*	*0.00044*	*<0.00007*	*<0.00023*	*0.00083*	*<0.00068*	*0.00799*	*<0.000005*	*<0.00029*	*0.00197*	*<0.00086*	*0.531*	0.01	0.026
	05/24/18	0.345	10.2	4	<0.083	5.19	118	43	150	0.00317 J	<0.00105	0.0799	0.00039 J	<0.00007	<0.00023	0.00035 J	<0.00068	0.00814	0.000006 J	<0.00029	0.00138 J	<0.00086	1.983	--	--
	08/14/18	0.443	5.95	5	<0.083	5.18	102	44	160	0.00003 J	0.00021	0.063	0.000482	0.00002	0.00016	0.000797	0.000238	0.00708	0.000013 J	0.00021	0.0017	0.00003 J	1.10	--	--
	02/20/19	0.504	142	2.82	0.24	7.31	113	49.2	522	0.00016	0.00046	0.457	0.00009 J	0.00001 J	0.000306	0.000399	0.000124	0.00155	<0.000025	0.001 J	0.0007	<0.0005	3.16	--	--
	05/30/19	0.689	--	1.59	0.29	--	61.3	43.3	588	0.00016	0.00060	0.512	0.000244	0.00001 J	0.0001 J	0.000756	0.000197	<0.009	<0.000005	0.00243	0.0014	<0.0001	--	0.099	0.0625
	07/24/19	0.644	62.7	2	0.106 J	5.97	52.1	58	180	0.00008 J	0.00039	0.245	0.00054	0.00002 J	0.0001 J	0.000789	0.0001 J	0.00557	<0.000005	0.002 J	0.0034	<0.0001	1.819	--	--
AD-5	05/31/16	0.03	36.9	15	<1	6.38	--	123	337	<0.005	<0.005	0.057	<0.001	<0.001	<0.001	0.014	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	1.63	--	--
	07/28/16	0.04	44.7	16	<1	6.38	--	163	360	<0.005	<0.005	0.093	<0.001	<0.001	<0.001	0.015	<0.005	0.191	<0.000025	<0.005	<0.005	<0.002	4.75	--	--
	09/29/16	0.04	46.3	15	<1	5.29	--	190	416	<0.005	<0.005	0.087	<0.001	<0.001	<0.001	0.014	<0.005	0.186	<0.000025	<0.005	<0.005	<0.002	3.33	--	--
	10/20/16	0.05	50.7	14	<1	5.92	--	267	448	<0.005	<0.005	0.07	<0.001	<0.001	<0.001	0.009	<0.005	0.225	<0.000025	<0.005	<0.005	<0.002	2.319	--	--
	12/13/16	0.05	49.6	13	<1	6.29	--	233	484	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	0.013	<0.005	0.199	<0.000025	<0.005	<0.005	<0.002	2.182	--	--
	01/17/17	0.04	49.8	14	<1	6.27	--	234	438	<0.005	<0.005	0.047	<0.001	<0.001	<0.001	0.012	<0.005	0.239	<0.000025	<0.005	<0.005	<0.002	1.023	--	--
	02/23/17	0.04	33.0	15	<1	5.48	--	127	286	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	0.013	<0.005	0.166	<0.000025	<0.005	<0.005	<0.002	1.788	--	--
	06/07/17	0.05281	49.7	14	<0.083	5.96	867	82	300	<0.00093	0.00385	0.0877	0.00008	0.00039	0.00028	0.01193	<0.00068	0.124	<0.000005	<0.00029	<0.00099	<0.00086	2.32	--	--
	10/06/17	--	--	--	--	5.59	249	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.05063	30.1	21	<0.083	5.79	<100	--	248	<0.00093	<0.00105	0.07627	0.00014	0.00037	<0.00023	0.01907	<0.00068	0.118	<0.000005	<0.00029	<0.00099	<0.00086	1.495	14.4	0.45
	Dissolved	*0.03752*	*29.1*	--	--	5.79	<100	--	--	*<0.00093*	*<0.00105*	*0.06865*	*<0.00002*	*<0.00007*	*<0.00023*	*0.01747*	*<0.00068*	*0.119*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.043*	*2.051*	8.38	0.43
	05/24/18	0.05007	28.1	22	<0.083	6.22	17.8	60	242	<0.00093	<0.00105	0.07116	<0.00002	0.00023 J	0.0008 J	0.01424	<0.00068	0.121	<0.000005	<0.00029	<0.00099	<0.00086	1.946	--	--
	08/15/18	0.05	40.5	19	<0.083	6.23	57.1	240	428	0.00001 J	0.00169	0.0637	0.000055	0.000008 J	0.000072	0.0114	0.000079	0.147	<0.000005	0.00013	0.00008 J	<0.01	0.316	--	--
	02/21/19	0.033	33.9	24.7	0.21	5.38	164	46.5	220	0.00002 J	0.00159	0.0694	0.00008 J	<0.00005	0.000432	0.00858	0.000147	0.0807	<0.000025	<0.002	0.0001 J	<0.0005	1.27	--	--
	05/30/19	0.03 J	--	22.3	0.29	--	150	51.3	238	<0.00002	0.00305	0.0605	0.00008 J	<0.00001	0.00006 J	0.0118	0.00005 J	0.104	0.000006	<0.0004	0.00005 J	<0.0001	--	23.4	0.331
	07/24/19	0.04 J	41.1	18	0.112 J	6.3	108	90	354	<0.00002	0.00248	0.0774	0.00005 J	<0.00001	0.00005 J	0.00838	<0.00005	0.108	<0.000005	<0.0004	0.00006 J	<0.0001	2.533	--	--
AD-17	05/26/16	0.121	200	43	<1	7.17	--	1,166	1,810	<0.005	<0.005	0.021	<0.001	0.002	0.001	0.063	<0.005	0.370	0.000032	<0.005	<0.005	<0.002	1.53	--	--
	07/27/16	0.119	195	32	<1	7.17	--	1,005	1,576	<0.005	<0.005	0.020	<0.001	0.004	0.001	0.068	<0.005	0.374	<0.000025	<0.005	<0.005	<0.002	2.78	--	--
	09/29/16	0.111	191	36	<1	6.17	--	1,055	1,663	<0.005	<0.005	0.031	<0.001	<0.001	0.003	0.058	<0.005	0.354	<0.000025	<0.005	<0.005	<0.002	2.358	--	--
	10/20/16	0.124	194	32	1.0	6.14	--	1,163	1,612	<0.005	<0.005	0.034	<0.001	0.002	0.004	0.065	<0.005	0.394	<0.000025	<0.005	<0.005	<0.002	2.224	--	--
	12/13/16	0.135	196	31	<1	6.03	--	1,096	1,560	<0.005	<0.005	0.017	<0.001	0.003	<0.001	0.068	<0.005	0.323	<0.000025	<0.005	<0.005	<0.002	2.384	--	--
	01/17/17	0.101	196	33	<1	5.96	--	1,445	1,686	<0.005	<0.005	0.014	<0.001	0.003	0.068	0.068	<0.005	0.341	<0.000025	<0.005	<0.005	<0.002	2.436	--	--
	02/22/17	0.135	189	30	<1	5.67	--	1,055	1,628	<0.005	<0.005	0.020	<0.001	0.002	0.001	0.073	<0.005	0.331	<0.000025	<0.005	<0.005	<0.002	2.288	--	--
	06/06/17	0.121	188	30	<0.083	5.81	156	1,105	1,578	<0.00093	<0.00105	0.01033	<0.00002	0.00606	<0.00023	0.0748	<0.00068	0.329	0.000013	<0.00029	<0.00099	<0.00086	1.598	--	--
	10/05/17	--	--	--	--	5.92	598	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.247	213	45	<0.083	5.51	<100	--	1,846	<0.00093	<0.00105	0.00978	<0.00002	0.00915	<0.00023	0.07451	<0.00068	0.306	<0.000005	<0.00029	0.00414	<0.00086	1.514	260	3.72
	Dissolved	*0.231*	*205*	--	--	5.51	<100	--	--	*<0.00093*	*<0.00105*	*0.00737*	*<0.00002*	*0.00609*	*<0.00023*	*0.07938*	*<0.00068*	*0.301*	*<0.000005*	*<0.00029*	*0.00515*	*0.02*	*1.57*	241	3.56
	05/24/18	0.239	193	39	<0.083	6.28	7.8	1,067	1,836	<0.00093	<0.00105	0.00965	<0.00002	0.00646	<0.00023	0.07173	<0.00068	0.308	<0.000005	<0.00029	<0.00099	<0.00086	1.939	--	--
	08/15/18	0.118	187	40	<0.083	5.6	418	1,170	1,750	0.00002 J	0.00183	0.0128	0.000069	0.00025	0.000604	0.0435	0.0011	0.243	0.000011 J	0.00035	0.0003	0.000074	2.35	--	--
	02/21/19	0.151	207	43.2	0.180	6.93	274	1,060	1,720	0.00008 J	0.00251	0.120	0.00024	0.00027	0.00334	0.0645	0.00249	0.268	0.000007 J	0.0007 J	0.0008	<0.0005	2.66	--	--
	05/30/19	0.158	--	41.7	<0.04	--	176	1,120	1,546	<0.00002	0.00041	0.0196	0.00002 J	0.00003 J	0.000246	0.0511	0.00003 J	0.341	<0.000005	<0.0004	0.00006 J	<0.0001	--	145	3.40
	07/24/19	0.113	216	37	0.085 J	5.96	113	1,127	1,864	<0.00002	0.00107	0.0143	0.00013	0.00003 J	0.000228	0.0577	0.000263	0.283	<0.000005	<0.0004	0.0001 J	<0.0001	3.45	--	--
AD-18[c]	05/26/16	0.146	409	422	<1	5.1	--	5,135	10,000	<0.005	<0.005	0.012	0.014	0.003	<0.001	0.922	<0.005	2.07	0.000168	<0.005	0.006	0.003	12.58	--	--
	07/27/16	0.148	457	432	2	5.1	--	4,930	9,476	<0.005	<0.005	0.019	0.005	0.002	<0.001	0.734	<0.005	1.94	0.000091	<0.005	0.007	0.003	10.62	--	--
	09/29/16	0.156	469	637	4	5.59	--	4,632	9,569	<0.005	<0.005	0.02	0.004	<0.001	<0.001	0.666	<0.005	1.86	0.000117	<0.005	0.007	<0.002	7.05	--	--
	10/20/16	0.188	498	876	0.8664	5.7	--	5,537	9,540	<0.005	<0.005	0.021	0.002	0.001	<0.001	0.569	<0.005	2.06	0.000053	<0.005	<0.005	<0.002	5.82	--	--
	12/13/16	0.178	510	695	5	5.75	--	4,382	8,912	<0.005	<0.005	0.021	0.007	0.001	<0.001	0.641	<0.005	1.74	0.00005	<0.005	<0.005	<0.002	9.60	--	--
	01/17/17	0.050	412	159	5	4.49	--	5,414	8,562	<0.005	0.01	0.014	0.022	0.001	<0.001	0.929	<0.005	1.95	0.000224	<0.005	<0.005	0.002	22.51	--	--
	02/22/17	0.090	401	151	6	4.37	--	5,169	8,412	<0.005	<0.005	0.014	0.026	0.002	<0.001	0.961	<0.005	1.82	0.000107	<0.005	<0.005	0.00228	19.11	--	--
	06/06/17	0.125	428	304	6.53	4.27	121	5,920	9,394	<0.00093	0.00331	0.01038	0.01883	0.00303	<0.00023	0.940	<0.00068	2.15	0.000113	<0.00029	0.00212	<0.00086	16.12	--	--
	10/05/17	--	--	--	--	5.87	165	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.163	433	362	9.4	3.61	104.1	--	9,952	0.00224	0.00276	0.00813	0.01733	0.0036	0.00098	0.928	<0.00068	2.07	0.000043	<0.00029	0.00194	0.00144	19.95	19.7	14.1
	Dissolved	*0.153*	*423*	--	--	--	--	--	--	*0.00467*	*0.00189*	*0.00748*	*0.01676*	*0.00316*	*<0.00023*	*0.898*	*<0.00068*	*2.06*	*0.000012*	*<0.00029*	*0.00135*	*0.01466*	*18.09*	19.1	13.7
	05/30/19	0.09 J	--	390	3.56	--	91.3	*6,120*	9,564	<0.0002	0.04	0.009 J	0.021	0.004 J	<0.004	1.130	0.005 J	1.27	0.000035	<0.04	0.103	<0.01	--	11.2	7.53

Table 4-4
Groundwater Sampling Analytical Results (mg/L) - Bottom Ash Storage Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Point of Compliance Wells																									
AD-3	05/31/16	0.02	1.41	9	<1	6.58	--	4	106	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	<0.005	<0.005	0.010	0.00085	<0.005	<0.005	<0.002	1.02	--	--
	07/27/16	0.02	0.706	8	<1	6.58	--	5	118	<0.005	<0.005	0.036	<0.001	<0.001	<0.001	<0.005	<0.005	0.024	0.000589	<0.005	<0.005	<0.002	0.1786	--	--
	09/30/16	0.02	<0.5	9	<1	4.75	--	6	127	<0.005	<0.005	0.043	<0.001	<0.001	<0.001	<0.005	<0.005	0.019	0.00039	<0.005	<0.005	<0.002	0.552	--	--
	10/19/16	0.06	0.794	8	<1	3.71	--	9	112	<0.005	<0.005	0.041	<0.001	<0.001	<0.001	<0.005	<0.005	0.018	0.000351	0.006	<0.005	<0.002	1.589	--	--
	12/12/16	0.02	1.05	8	<1	4.67	--	11	138	<0.005	<0.005	0.045	<0.001	<0.001	<0.001	<0.005	<0.005	0.017	0.000321	<0.005	<0.005	<0.002	0.546	--	--
	01/19/17	0.02	0.746	9	<1	4.60	--	4	76	<0.005	<0.005	0.041	<0.001	<0.001	<0.001	<0.005	<0.005	0.014	0.000504	<0.005	<0.005	<0.002	0.229	--	--
	02/23/17	0.02	0.573	9	<1	4.69	--	5	104	<0.005	<0.005	0.037	<0.001	<0.001	<0.001	<0.005	<0.005	0.014	0.000501	<0.005	<0.005	<0.002	0.4592	--	--
	06/07/17	0.03326	0.543	9	0.2625	4.49	56.6	5	104	<0.00093	0.00191	0.038	0.00024	0.00008	0.00075	0.00128	<0.00068	0.01503	0.000365	<0.00029	<0.00099	<0.00086	0.459	--	--
	10/06/17	--	--	--	--	5.15	65.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/15/18	0.01869	0.56	9	<0.083	4.31	11.1		132	0.00166	0.0016	0.0365	0.00034	0.00008	<0.00023	0.00136	<0.00068	0.01459	0.00037	<0.00029	0.00323	0.00127	0.016	0.188	0.004
	Dissolved	*0.01132*	*0.595*	--	--	4.31	11.1	--	--	*<0.00093*	*<0.00105*	*0.0361*	*0.00023*	*<0.00007*	*<0.00023*	*0.00133*	*<0.00068*	*0.01445*	*0.000379*	*<0.00029*	*<0.00099*	*<0.00086*	*0.242*	< 0.01	0.004
	05/24/18	0.0069 J	0.545	8	<0.083	4.58	8.50	3	98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/19	<0.02	--	9.03	0.18	--	57.2	2.3	110	0.00006 J	0.00103	0.0632	0.000158	0.00005 J	0.000316	0.00171	0.000382	0.03 J	0.000245	<0.0004	0.0003	<0.0001	--	*1.54*	0.011
	11/25/19	--	0.734	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AD-4c	05/31/16	0.05	0.798	10	<1	5.41	--	32	204	<0.005	<0.005	0.088	<0.001	<0.001	0.009	<0.005	<0.005	0.004	0.000191	<0.005	<0.005	<0.002	1.29	--	--
	07/27/16	0.03	0.666	12	<1	5.41	--	35	208	<0.005	<0.005	0.059	<0.001	<0.001	0.004	<0.005	<0.005	0.015	0.000185	<0.005	<0.005	<0.002	0.5075	--	--
	09/29/16	0.02	<0.5	11	<1	4.96	--	45	212	<0.005	<0.005	0.074	<0.001	<0.001	0.008	<0.005	<0.005	0.006	0.00016	<0.005	<0.005	<0.002	2.572	--	--
	10/19/16	0.04	0.578	10	<1	4.30	--	35	212	<0.005	<0.005	0.069	<0.001	<0.001	0.009	<0.005	<0.005	0.006	0.000141	<0.005	<0.005	<0.002	1.657	--	--
	12/12/16	0.02	0.341	11	<1	4.62	--	36	252	<0.005	<0.005	0.021	<0.001	<0.001	<0.001	<0.005	<0.005	0.004	0.000143	<0.005	<0.005	<0.002	0.685	--	--
	01/19/17	0.02	0.761	10	<1	4.67	--	43	184	<0.005	<0.005	0.075	<0.001	<0.001	0.004	<0.005	<0.005	0.005	0.000125	<0.005	<0.005	<0.002	2.045	--	--
	02/23/17	0.02	0.467	9	<1	5.10	--	40	196	<0.005	<0.005	0.030	<0.001	<0.001	<0.001	<0.005	<0.005	0.004	0.000098	<0.005	<0.005	<0.002	0.517	--	--
	06/07/17	0.03331	0.573	10	<0.083	4.88	351	39	228	<0.00093	0.00119	0.05142	0.00019	0.00008	0.00403	0.00075	<0.00068	0.00482	0.000147	<0.00029	<0.00099	<0.00086	0.953	--	--
	10/06/17	--	--	--	--	5.38	308	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	0.0186	0.498	14	<0.083	4.67	6.40		232	<0.00093	<0.00105	0.02572	0.0001	<0.00007	0.00044	0.00049	<0.00068	0.00394	0.000228	<0.00029	<0.00099	<0.00086	0.435	0.592	< 0.001
	Dissolved	*0.02017*	*0.468*	--	--	4.67	6.40	--	--	*<0.00093*	*<0.00105*	*0.02223*	*0.00006*	*<0.00007*	*<0.00023*	*0.00043*	*<0.00068*	*0.0039*	*0.000031*	*<0.00029*	*<0.00099*	*<0.00086*	*0.354*	0.394	0.002
	05/24/18	0.02505	0.434	14	<0.083	*5.17*	*48.1*	42	224	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	08/14/18	--	--	15	--	--	125	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/29/19	<0.02	--	14.8	0.16	--	158	52.8	208	<0.0004	0.0006 J	0.0295	<0.0004	<0.0002	<0.0008	<0.0004	<0.0004	<0.009	0.000206	<0.008	<0.0006	<0.002	--	0.327	0.0007 J
	11/25/19	--	--	--	--	--	--	--	290	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AD-16	01/26/16	0.05	2.81	6	<1	3.84	--	49	180	<0.005	0.02	0.198	0.002	<0.001	0.054	0.013	0.016	0.015	0.000259	<0.005	<0.005	<0.002	4.478	--	--
	03/21/16	0.04	2.04	6	<1	4.20	--	47	104	<0.005	<0.005	0.119	<0.001	<0.001	0.009	<0.005	<0.005	0.007	0.000114	<0.005	<0.005	<0.002	4.44	--	--
	05/31/16	0.03	1.55	6	<1	4.44	--	40	96	<0.005	<0.005	0.127	<0.001	<0.001	0.001	<0.005	<0.005	0.002	0.000037	<0.005	<0.005	<0.002	5.99	--	--
	07/27/16	0.04	3.42	7	<1	4.44	--	70	184	<0.005	0.01	0.123	0.002	<0.001	0.011	0.022	<0.005	0.035	0.000212	<0.005	<0.005	<0.002	7.21	--	--
AD-16R	06/06/17	0.04198	2.75	7	0.3438	3.68	46.9	54	204	<0.00093	0.00707	0.0464	0.00221	0.00103	0.00176	0.04174	<0.00068	0.0293	<0.000005	<0.00029	0.00198	<0.00086	6.66	--	--
	06/28/17	0.06398	1.24	6	0.2512	3.91	--	55	200	<0.00093	0.00528	0.04143	0.00216	0.00092	0.00095	0.04087	<0.00068	0.02932	<0.000005	<0.00029	<0.00099	<0.00086	12.11	--	--
	07/28/17	0.02841	1.92	7	<0.083	2.77	--	48	162	<0.00093	0.0037	0.04851	0.00217	0.00128	0.00107	0.04533	<0.00068	0.02617	0.000006	<0.00029	0.00127	0.00143	8.52	--	--
	08/02/17	0.03177	1.86	7	<0.083	3.00	--	49	174	<0.00093	0.00446	0.04961	0.00206	0.00122	0.00095	0.04311	<0.00068	0.02498	<0.000005	<0.00029	0.00174	0.00202	5.45	--	--
	10/06/17	--	--	--	--	3.29	31.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/15/18	0.04030	2.73	6	<0.083	3.18	0.0		212	0.00269	0.0074	0.04301	0.00278	0.00129	0.0007	0.04123	<0.00068	0.02977	<0.000005	0.00103	<0.00099	<0.00086	5.89	1.47	0.053
	Dissolved	*0.02614*	*2.59*	--	--	3.18	0.0	--	--	*<0.00093*	*0.00294*	*0.04155*	*0.0022*	*0.00071*	*0.00025*	*0.03996*	*<0.00068*	*0.0278*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*5.90*	0.599	0.05
	05/23/18	0.03202	2.53	6	<0.083	*3.79*	*36.9*	67	204	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	08/14/18	--	--	--	--	--	142	44	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/19	<0.02	--	5.43	0.19	--	77.1	41.6	80	0.00002 J	0.00176	0.0724	0.000424	0.00008	0.000334	0.00438	0.00006 J	0.01 J	0.000296	<0.0004	0.0006	0.0002 J	--	0.072	0.0079
	11/25/19	--	--	--	--	--	--	--	222	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Supplemental Downgradient Monitoring Wells																									
AD-19	5/17/2018	0.07234	9.4	34	<0.083	5.72	42.1	--	372	<0.00093	<0.00105	0.05026	0.00073	<0.00007	0.00117	0.0111	<0.00068	0.02924	<0.000005	0.00078	0.00194	<0.00086	1.421	3.04	0.089
	Dissolved	*0.06293*	*8.76*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.04*	*0.00025*	*<0.00007*	*<0.00023*	*0.00965*	*<0.00068*	*0.02842*	*<0.000005*	*0.00041*	*<0.00099*	*0.012*	*2.577*	2.13	0.08
AD-20	10/31/18	0.029	3.14	18.4	0.09	4.88	13	12.5	140	0.00004	0.00185	0.205	0.000651	0.00114	0.000514	0.0161	0.000425	0.0126	<0.00005	<0.0004	0.0008	0.0003	4.16	1.11	0.0742
AD-21	10/30/18	0.025	5.0	17	0.23	5.04	0.0	27.4	180	0.00006	0.00124	0.0868	0.00181	0.00065	0.000263	0.0337	0.000148	0.034	<0.00005	<0.0004	0.0011	0.0002	3.76	3.13	0.154
EPA MCLs:																									
MCL					4					0.006	0.01	2	0.004	0.005	0.1				0.002	N/A	0.05	0.002	5[b]		
Rule Specified																0.006	0.015	0.04		0.1					
Background Limit					1					0.005	0.005	0.62	0.00079	0.0037	0.004	0.075[d]	0.005	0.39[d]	0.000033	0.005	0.005	0.002	4.11[e]		
Interwell Background Value(s) (UPL, LPL where applicable) AD-8, AD-9, AD-15		0.700				4.8-7.0																			
Intrawell Background Value (UPL) AD-8			32.4	35.5	0.737			230	553																
Intrawell Background Value (UPL) AD-9			299	138	1.00			2530	3070																
Intrawell Background Value (UPL) AD-15			5.40	38.8	1.00			33.2	249																

NOTES:
All concentration data are provided in milligrams per liter (mg/L) unless otherwise noted.
J = Analyte was positively identified, though the quantitation was below Reporting Limit.
MCL = Maximum contaminant level
LPL = Lower prediction limit
UPL = Upper prediction limit
pCi/L = PicoCuries per liter.
-- = Not analyzed.
a = Calculated Upper Tolerance Limit is higher than MCL.
b = Data is "Combined Radium, Total".
c = AD-18 is not part of the designated CCR Monitoring Well Network and used for background understanding only
🟨 Denotes groundwater sample collected by ARCADIS using low-flow sampling methods.
Unless otherwise noted, values shown are total (unfiltered) analyses.
Dissolved (0.45-micron lab filtered) parameter concentrations shown in italics.

FIGURES



Source:
7.5 minute topographic quadrangle
Cason, Texas, 2013

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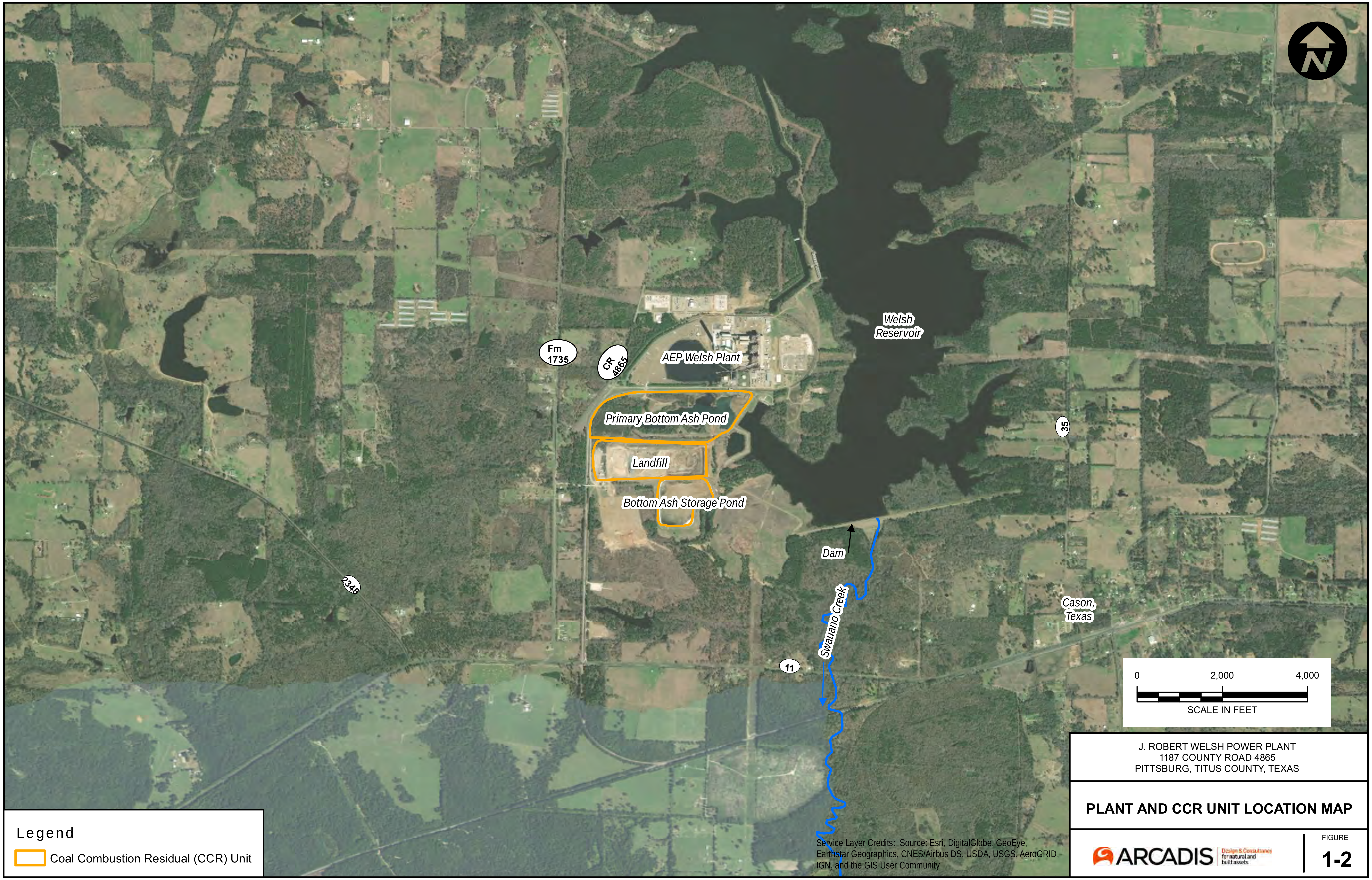
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-1

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\Dec2017Update\fig 1 - site map.mxd



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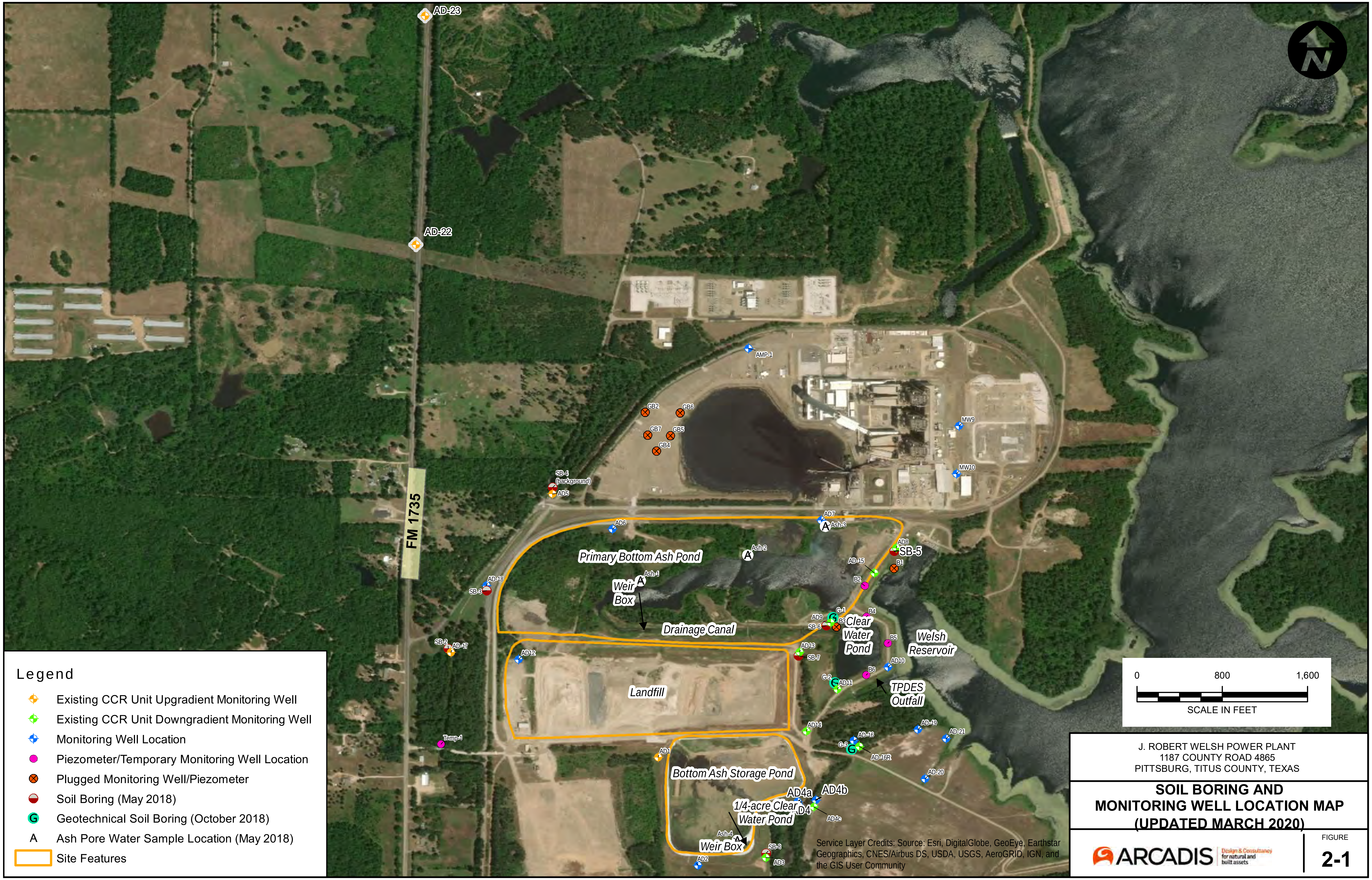
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PLANT AND CCR UNIT LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-2

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Lithium_ASD_Report\fig 1-2 - CCR location.mxd



Legend

- 🔶 Existing CCR Unit Upgradient Monitoring Well
- 🟩 Existing CCR Unit Downgradient Monitoring Well
- 🔷 Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◓ Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

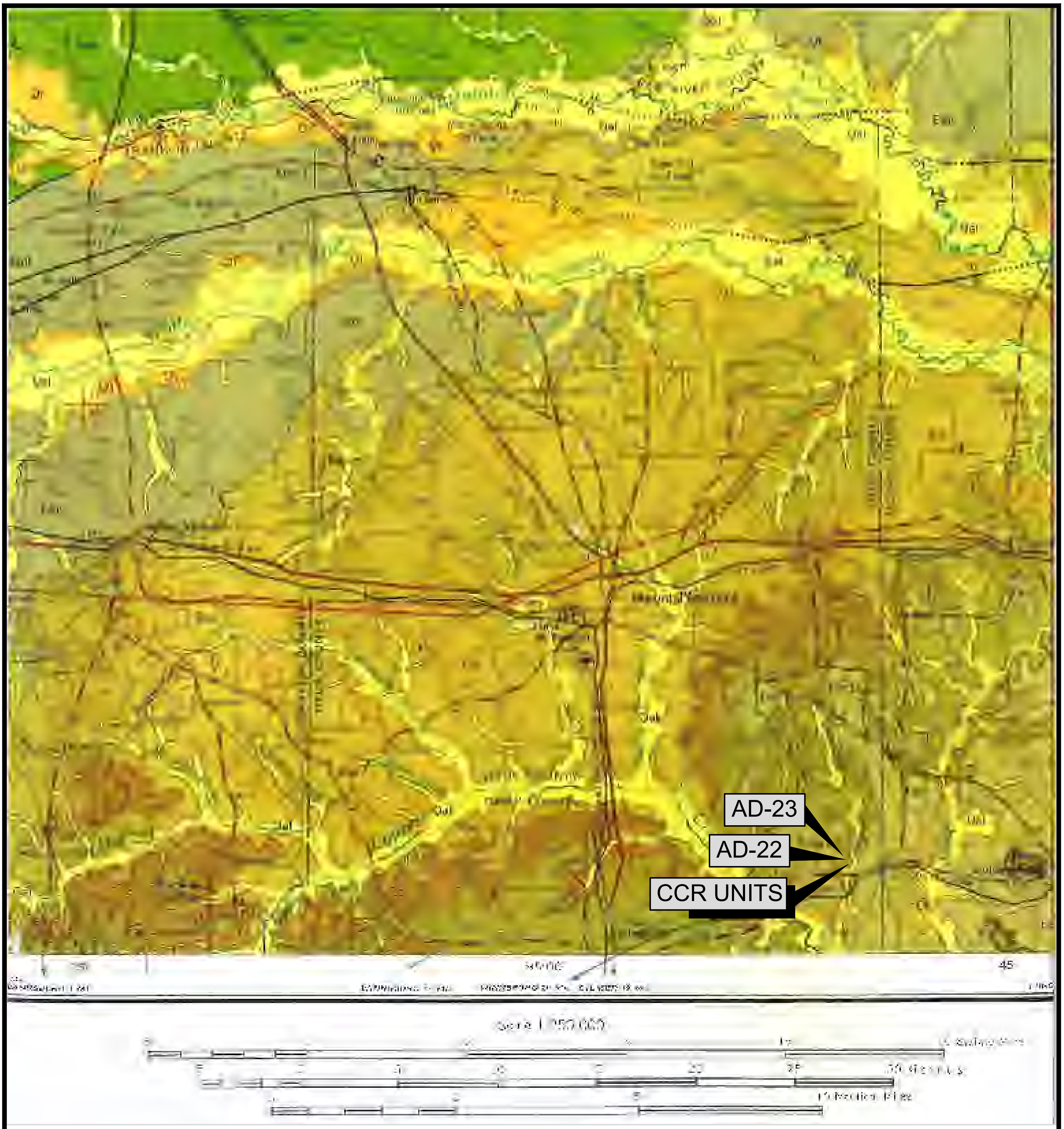
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SOIL BORING AND MONITORING WELL LOCATION MAP (UPDATED MARCH 2020)

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-1

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 2-1-SoilBoring_MonitoringWellLocations.mxd



REF: "GEOLOGIC ATLAS OF TEXAS, TEXARKANA SHEET", UNIVERSITY OF TEXAS AT AUSTIN BUREAU OF ECONOMIC GEOLOGY, 1966.

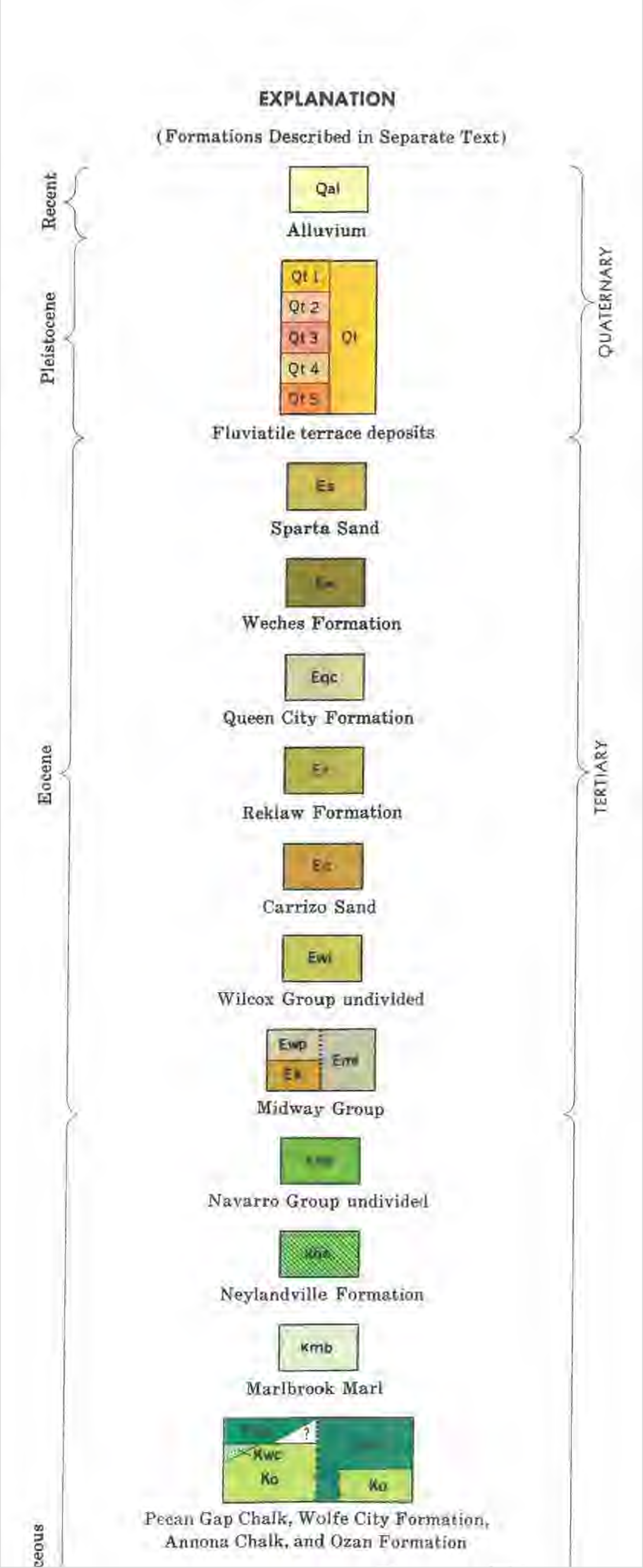
J. ROBERT WELSH POWER PLANT
PITTSBURG, TITUS COUNTY, TEXAS

REGIONAL GEOLOGIC MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-2A

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\30034022 - Welsh Lithium ASD August 2019\Figures-Maps\Figure 2-2A Regional Geo Map.dwg LAYOUT: MODEL SAVED: 8/6/2019 9:16 AM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 9/9/2019 10:33 AM BY: LEASE, DIANA



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REGIONAL GEOLOGIC MAP LEGEND

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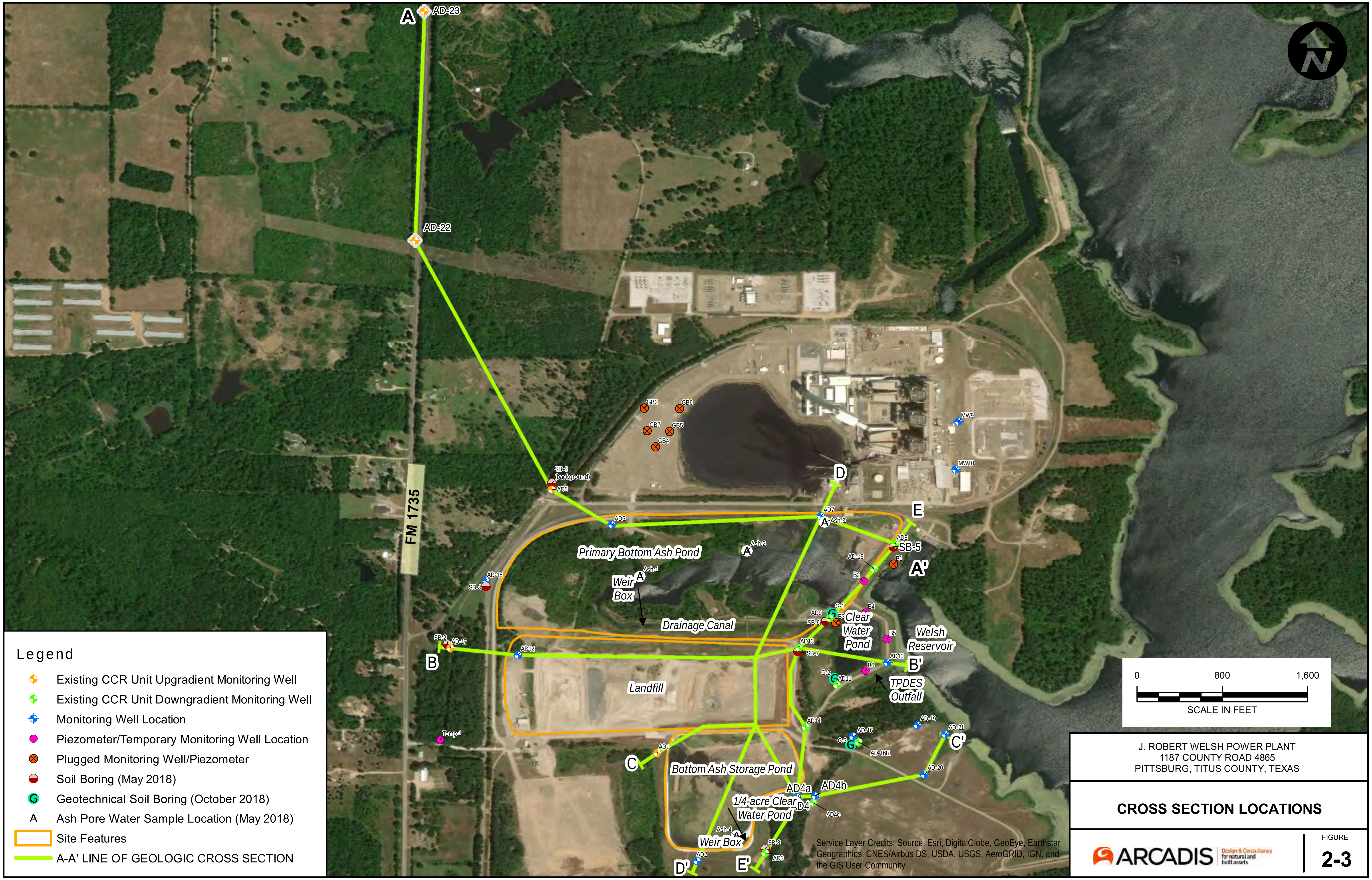
FIGURE
2-2B



Legend

- Existing CCR Unit Upgradient Monitoring Well
- Existing CCR Unit Downgradient Monitoring Well
- Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features
- A-A' LINE OF GEOLOGIC CROSS SECTION

0 800 1,600
SCALE IN FEET

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
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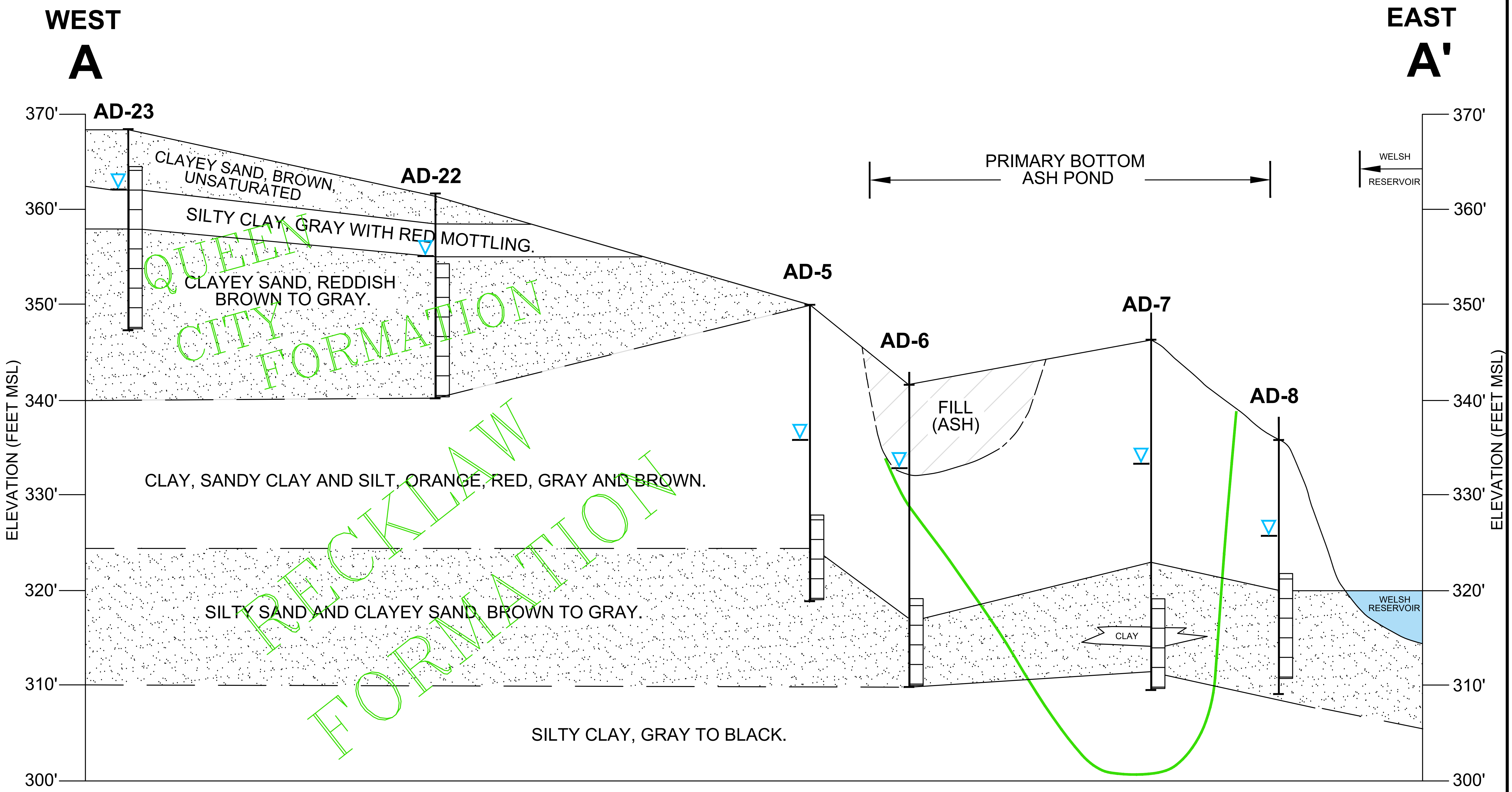
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION LOCATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-3

Document Path: Z:\GISProjects_ENVAEP\Welsh Plant\MXD\Landfill report\September 2019\Fig2-3-Cross Section LocationsREV.mxd



0 600'
HORIZONTAL SCALE

NOTE: BASE OF ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

▤	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN EVALUATION (6/19/19)
—	PROJECTED BASE OF PRIMARY BOTTOM ASH POND (SEE NOTE)

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PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
A - A'

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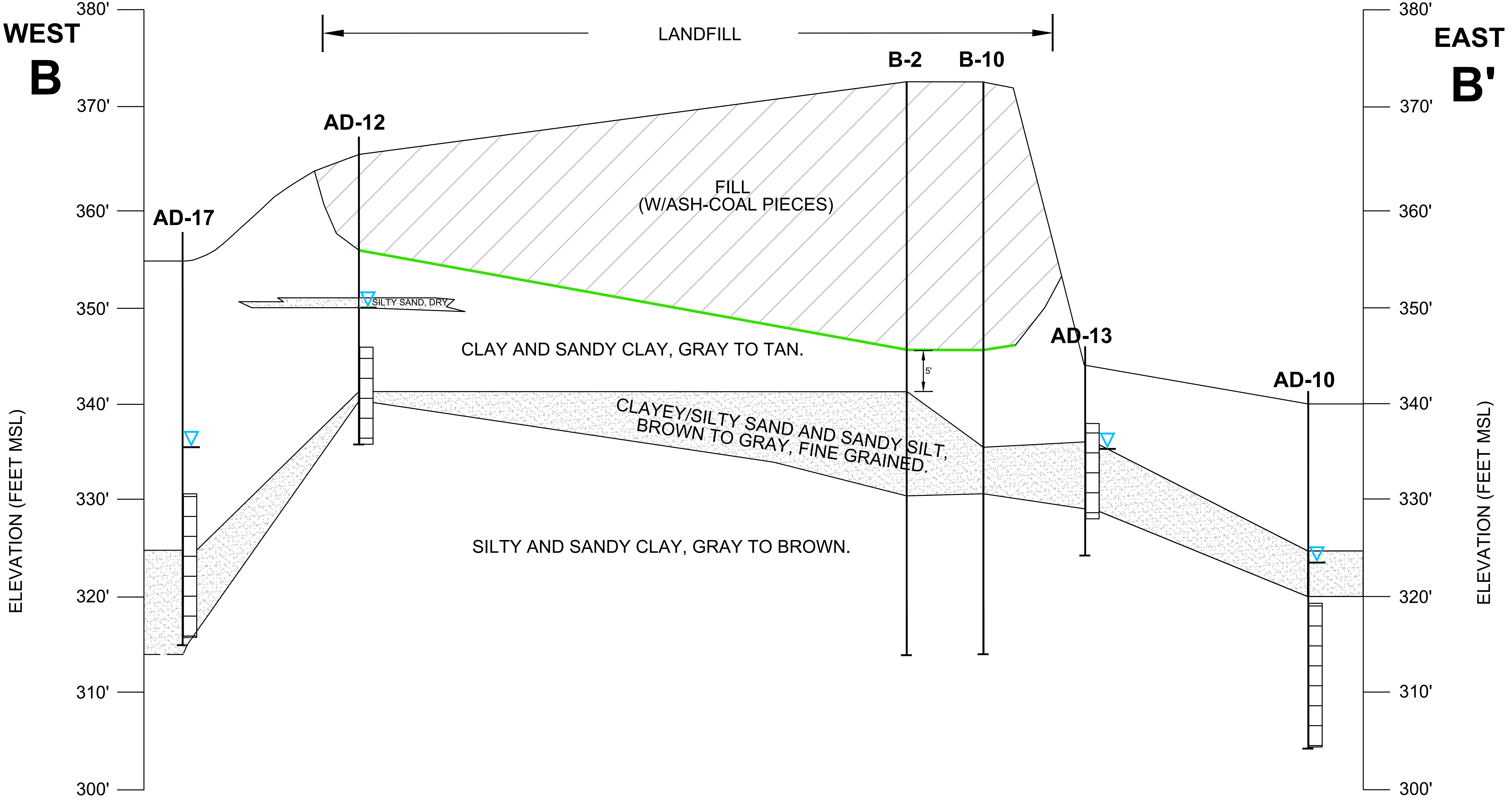
FIGURE
2-4

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\30034022 - Welsh Lithium ASD August 2019\Figures-Maps\Figure 2-4 Cross Section A-A'.dwg LAYOUT: MODEL SAVED: 8/7/2019 9:49 AM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 9/9/2019 10:45 AM BY: LEASE, DIANA



0 300'
HORIZONTAL SCALE

NOTE: BASE OF LANDFILL ELEVATION TAKEN FROM "WELSH POWER PLANT- UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12/3/76.

LEGEND

▤	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	BASE OF LANDFILL (SEE NOTE)

J. ROBERT WELSH POWER PLANT
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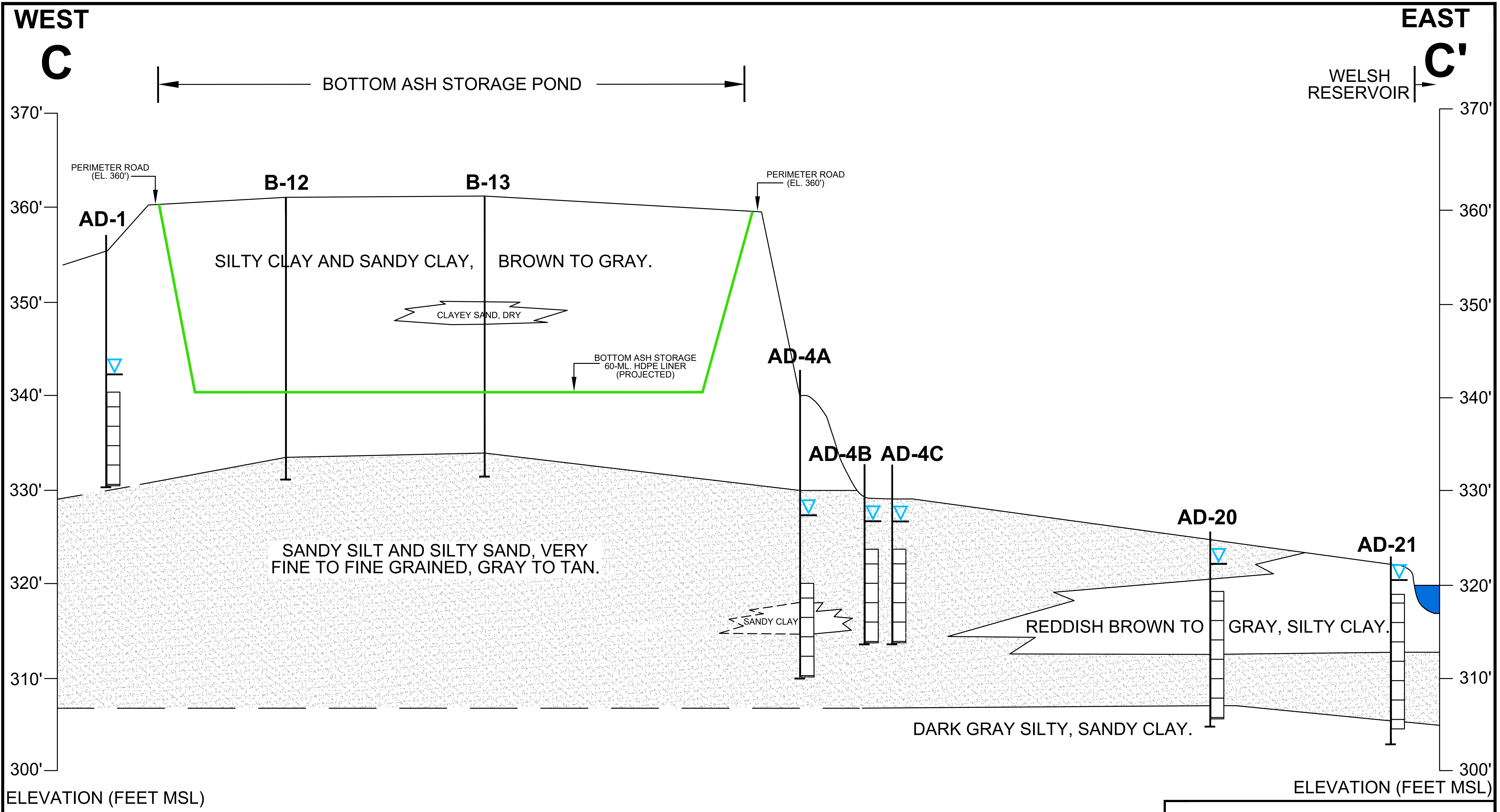
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION B - B'

ARCADIS

FIGURE
2-5

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\30047655 - Welsh Lithium ASD Jan 2020\Figures\Figure 2-5 Cross Section B-B'.dwg LAYOUT: MODEL SAVED: 1/28/2019 3:31 PM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 3/3/2020 3:11 PM BY: LEASE, DIANA



0 200'
HORIZONTAL SCALE

NOTE: BASE OF BOTTOM ASH STORAGE HAS A 60-ML. HDPE LINER AT ELEVATION 340.0' , TAKEN FROM FREESE AND NICHOLS "HYDRAULIC ANALYSIS OF WELSH POWER PLANT ASH PONDS, AMERICAN ELECTRIC POWER COMPANY", DATED DECEMBER 2010.

LEGEND

▤	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (10/29/18)
🟩	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
C - C'

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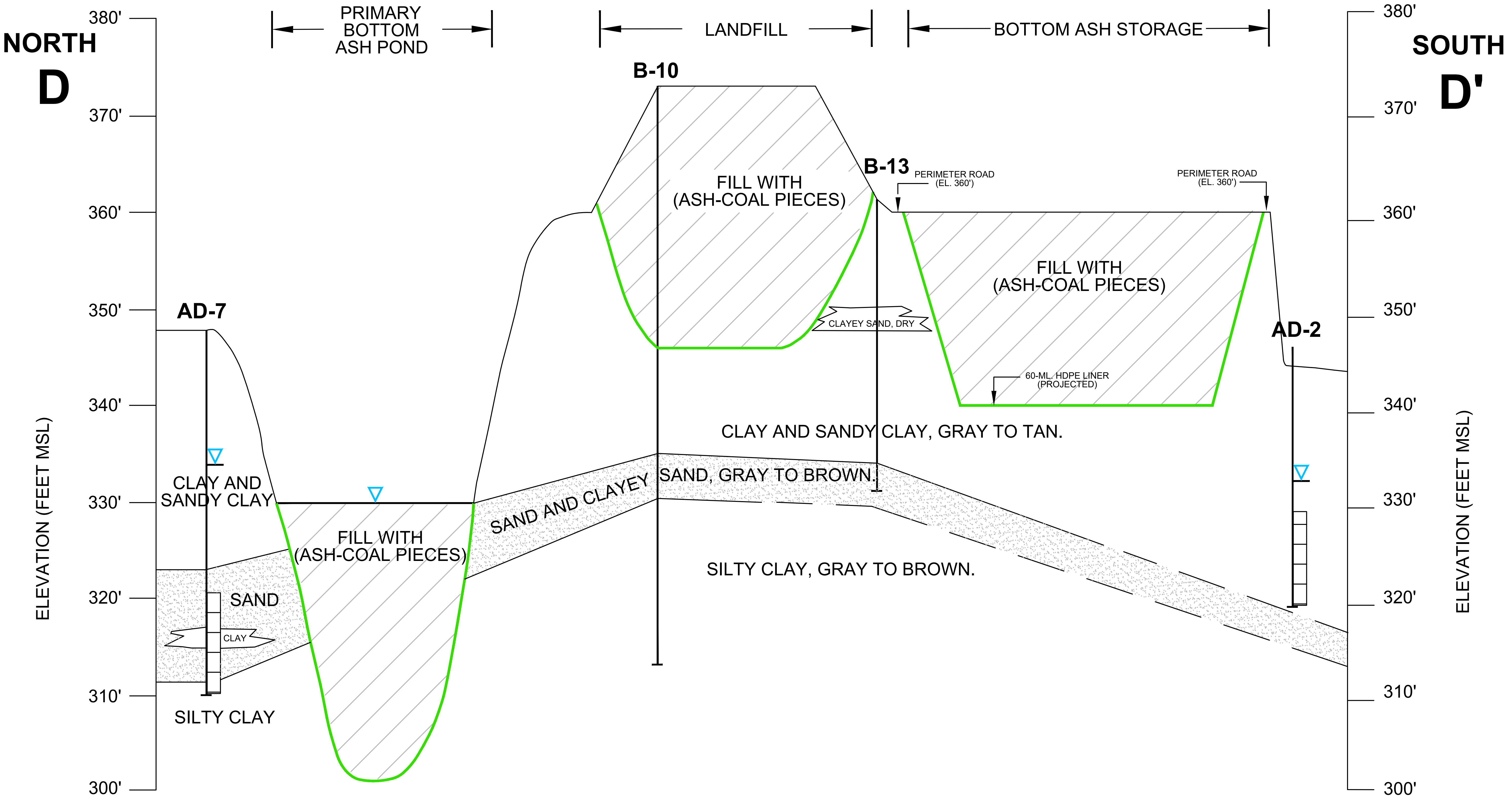
FIGURE
2-6



0 ▬▬ 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

▯ MONITORING WELL SCREENED INTERVAL

▽ WATER LEVEL IN MONITORING WELL (5/12/15)

▬ BASE OF CCR UNIT

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

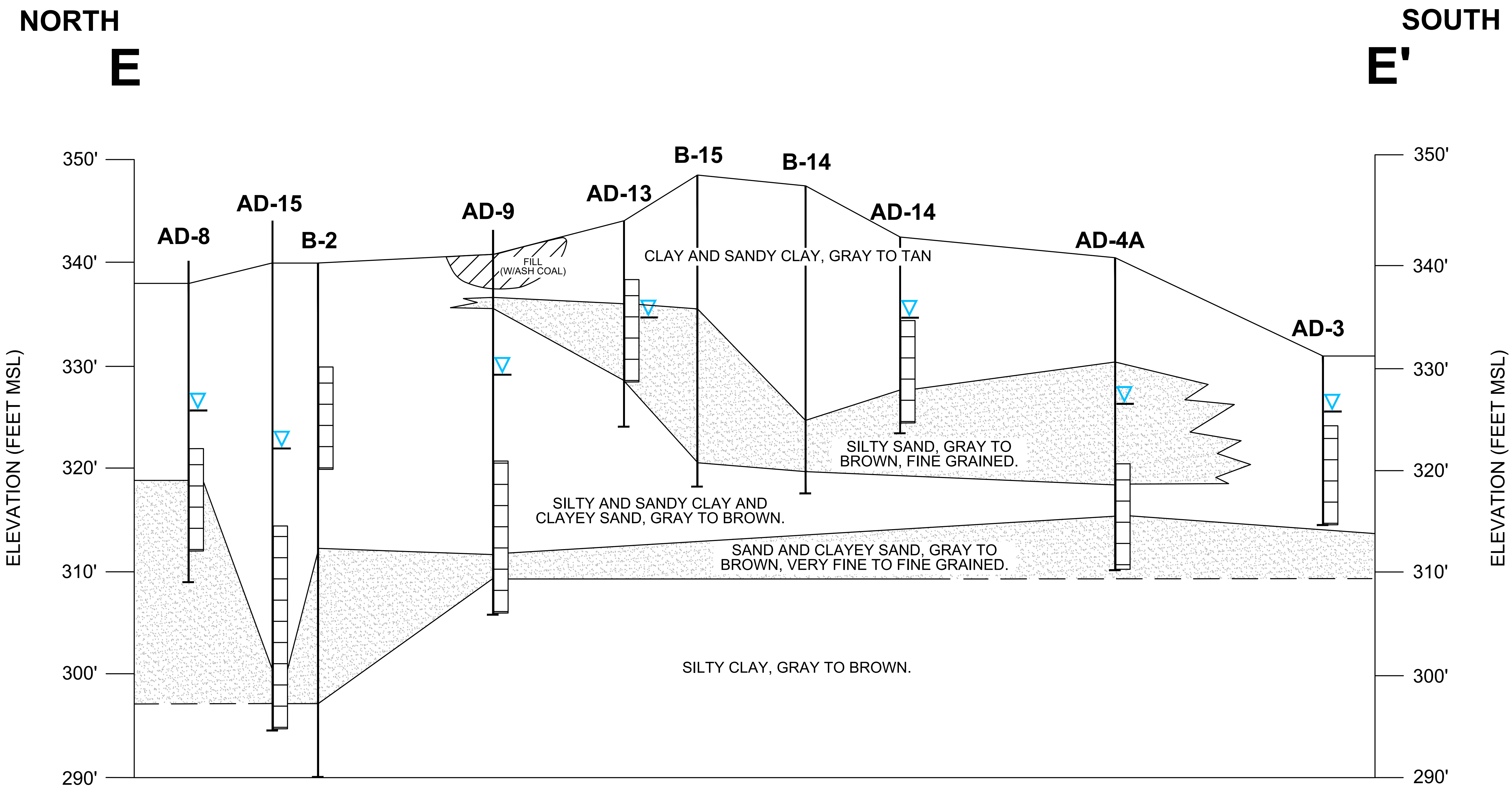
CROSS SECTION
D - D'

ARCADIS

FIGURE
2-7

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\30047655 - Welsh Lithium ASD Jan 2020\Figures\Figure 2-7 Cross Section D-D'.dwg LAYOUT: MODEL SAVED: 1/28/2019 3:42 PM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 3/3/2020 3:17 PM BY: LEASE, DIANA

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF* LAYOUT: MODEL SAVED: 1/29/2019 8:54 AM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 3/3/2020 3:19 PM BY: LEASE, DIANA
G:\Active Projects\AEP\30047655 - Welsh Lithium ASD Jan 2020\Figures\Figure 2-8 Cross Section E-E'.dwg



0 300'
HORIZONTAL SCALE

LEGEND

▤ MONITORING WELL SCREENED INTERVAL

▽ WATER LEVEL IN MONITORING WELL (3/4/16)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
E - E'

ARCADIS

FIGURE
2-8

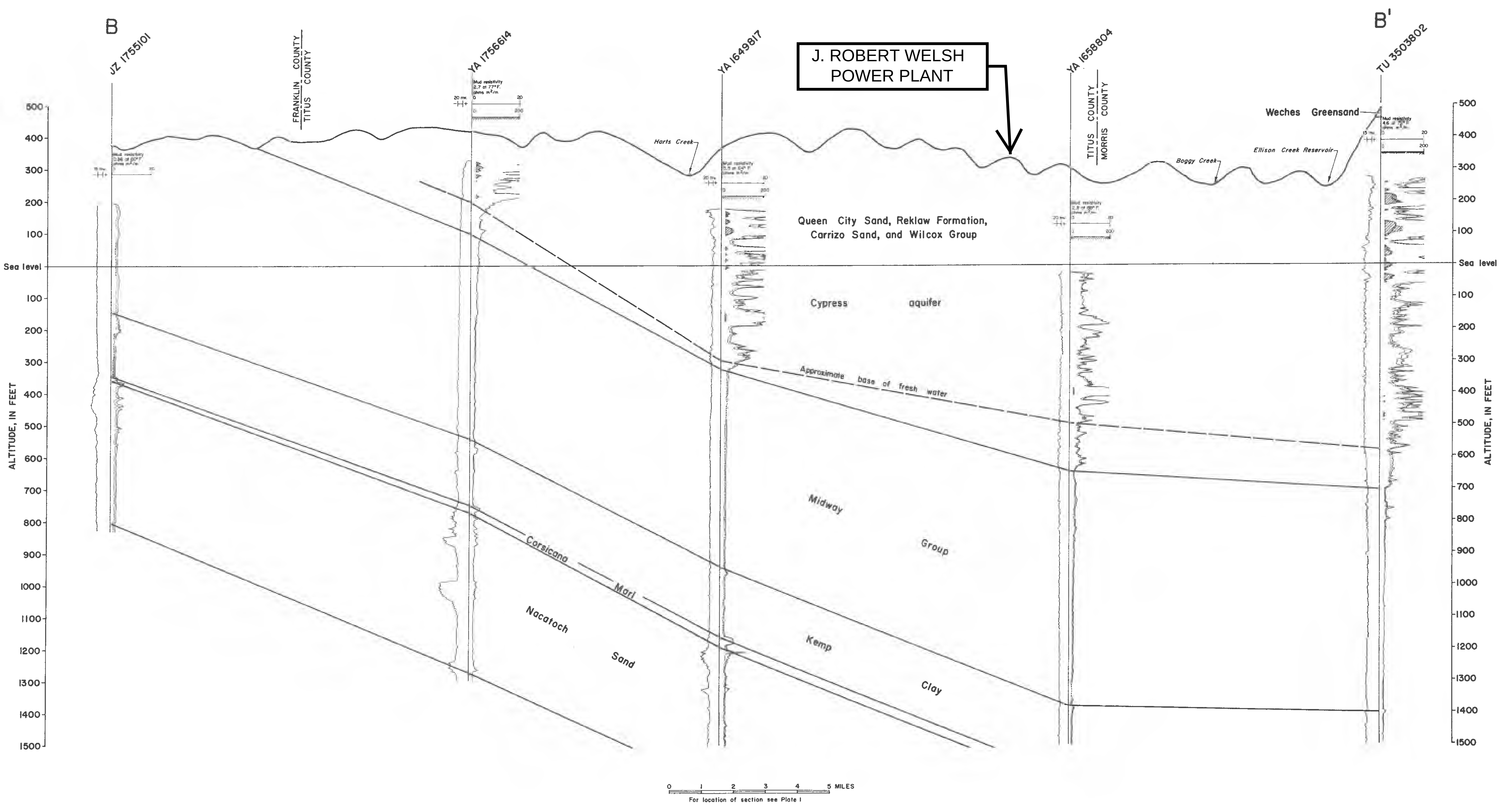


Plate 3

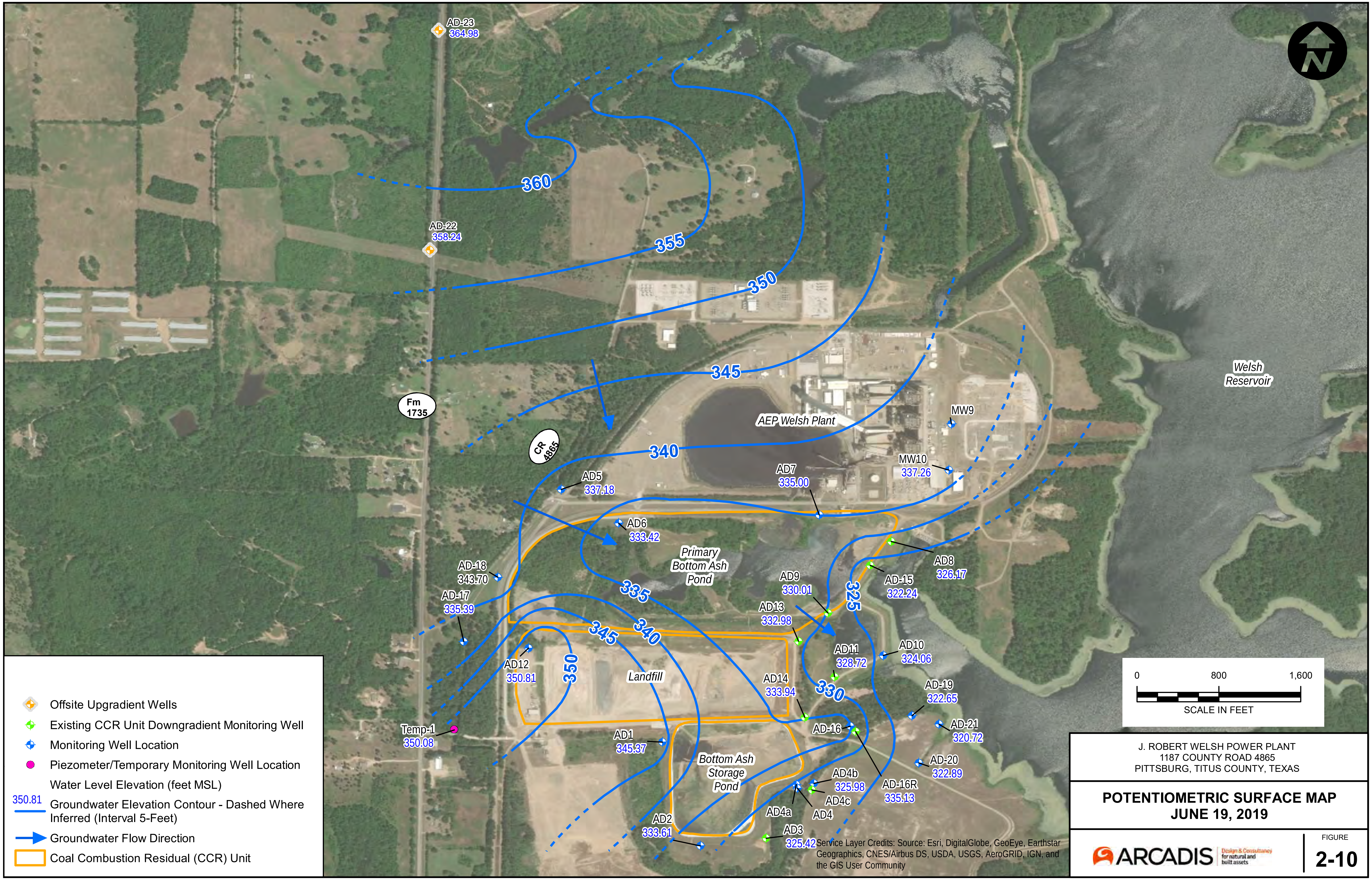
Geologic Section B – B', Franklin, Titus, and Morris Counties

U. S. Geological Survey in cooperation with the Texas Water Commission **(TWC BULLETIN 6517)**

REGIONAL GEOLOGIC CROSS SECTION

FIGURE 2-9

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\fig 2-10 - Potentiometric June2019.mxd



🔶 Offsite Upgradient Wells

🟢 Existing CCR Unit Downgradient Monitoring Well

🔵 Monitoring Well Location

● Piezometer/Temporary Monitoring Well Location

350.81 Water Level Elevation (feet MSL)

— Groundwater Elevation Contour - Dashed Where Inferred (Interval 5-Feet)

→ Groundwater Flow Direction

🟧 Coal Combustion Residual (CCR) Unit

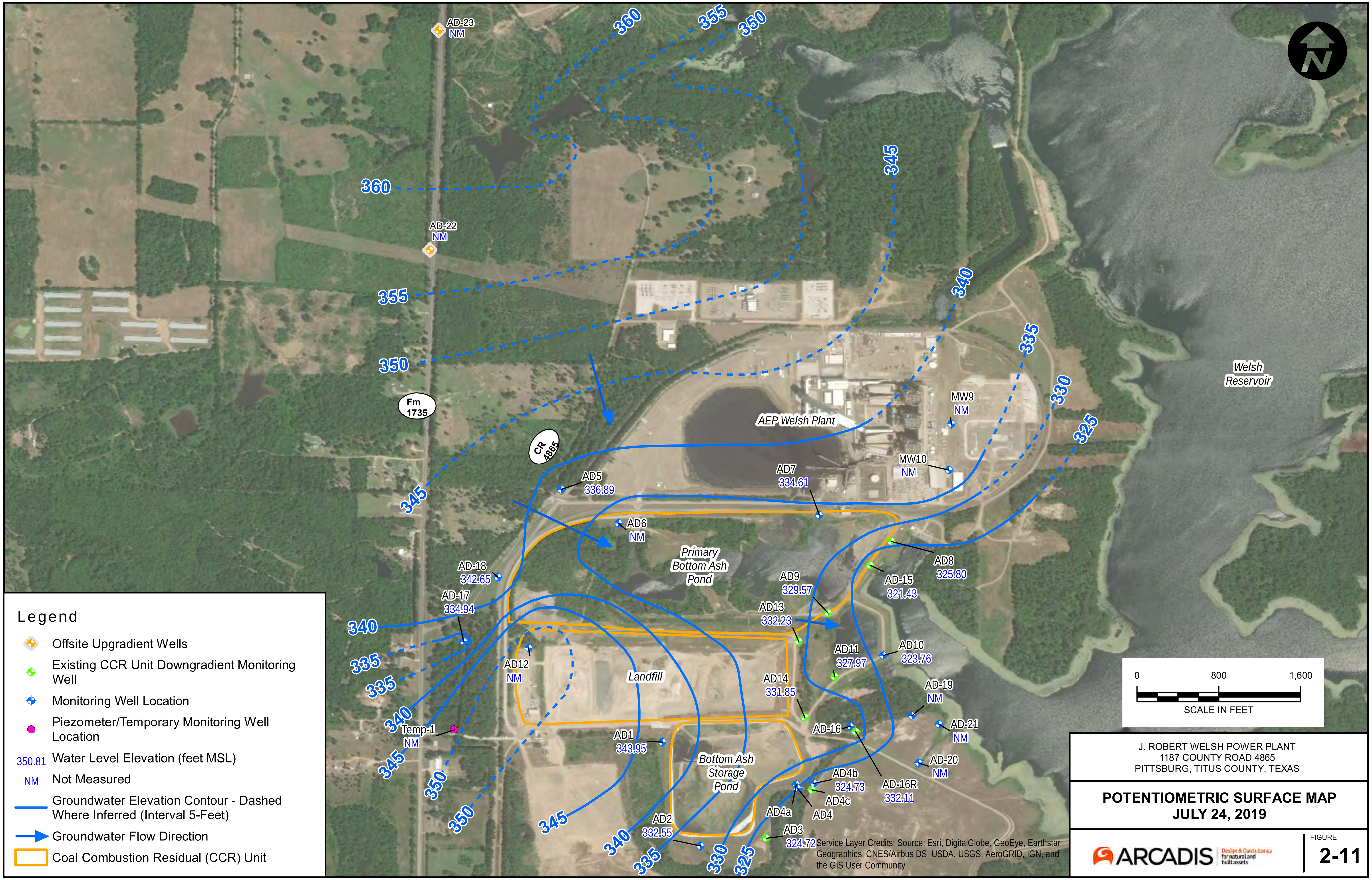
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

POTENTIOMETRIC SURFACE MAP
JUNE 19, 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-10



Legend

- Offsite Upgradient Wells
- Existing CCR Unit Downgradient Monitoring Well
- Monitoring Well Location
- Piezometer/Temporary Monitoring Well Location
- 350.81 Water Level Elevation (feet MSL)
- NM Not Measured
- Groundwater Elevation Contour - Dashed Where Inferred (Interval 5-Feet)
- Groundwater Flow Direction
- Coal Combustion Residual (CCR) Unit

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

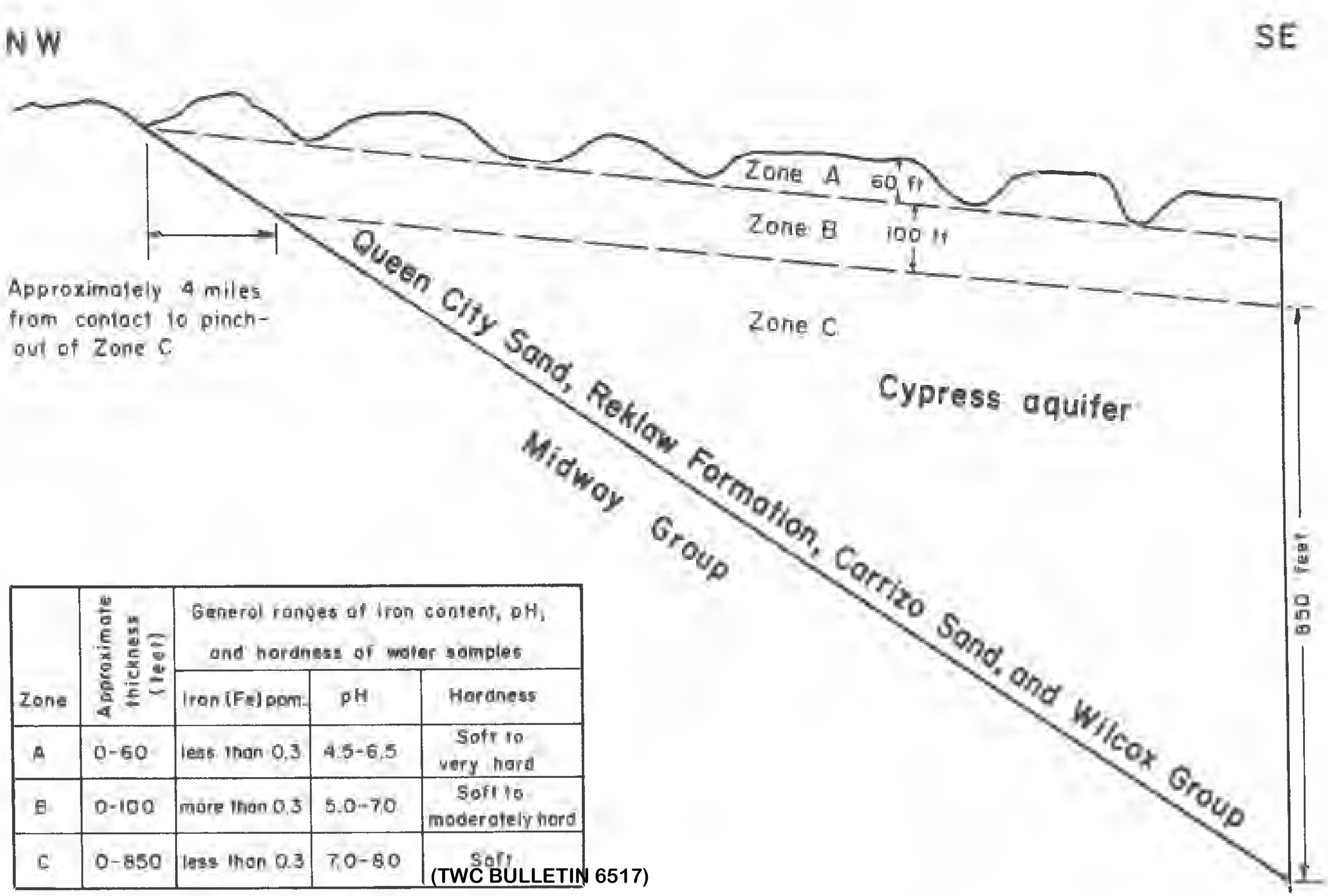
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

POTENTIOMETRIC SURFACE MAP
JULY 24, 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-11

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\July2019\fig 8 - Potentiometric July2019.mxd



Zone	Approximate thickness (feet)	General ranges of iron content, pH, and hardness of water samples		
		Iron (Fe) ppm.	pH	Hardness
A	0-60	less than 0.3	4.5-6.5	Soft to very hard
B	0-100	more than 0.3	5.0-7.0	Soft to moderately hard
C	0-850	less than 0.3	7.0-8.0	Soft

(TWC BULLETIN 6517)

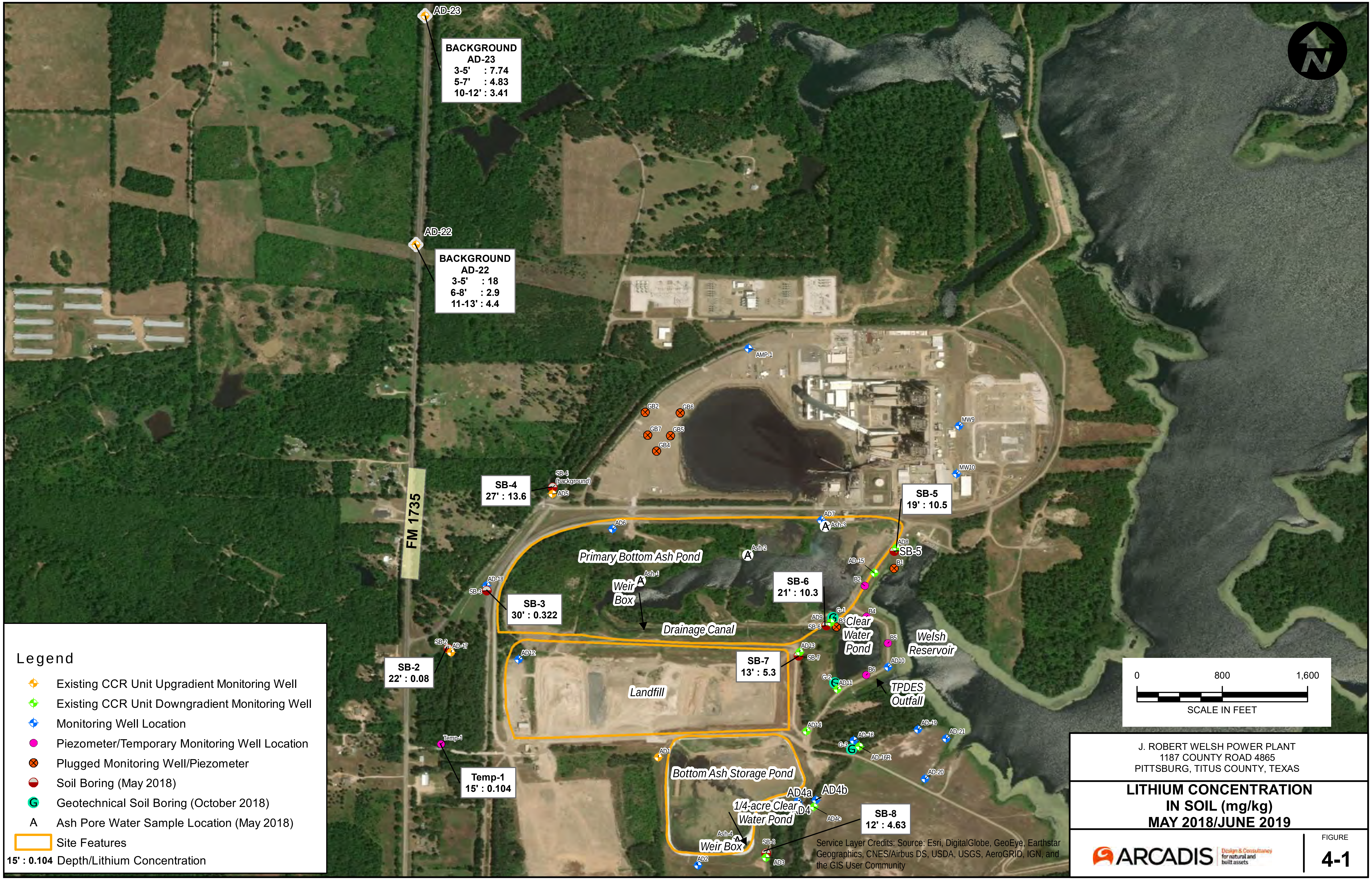
REGIONAL HYDROLOGIC CROSS SECTION

FIGURE 2-12

Figure 12

Diagrammatic Section Showing Zones A, B, and C in the Cypress Aquifer

U.S. Geological Survey in cooperation with the Texas Water Commission



Legend

- ⊕ Existing CCR Unit Upgradient Monitoring Well
- ⊕ Existing CCR Unit Downgradient Monitoring Well
- ⊕ Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◓ Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features
- **15' : 0.104** Depth/Lithium Concentration

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM CONCENTRATION IN SOIL (mg/kg) MAY 2018/JUNE 2019

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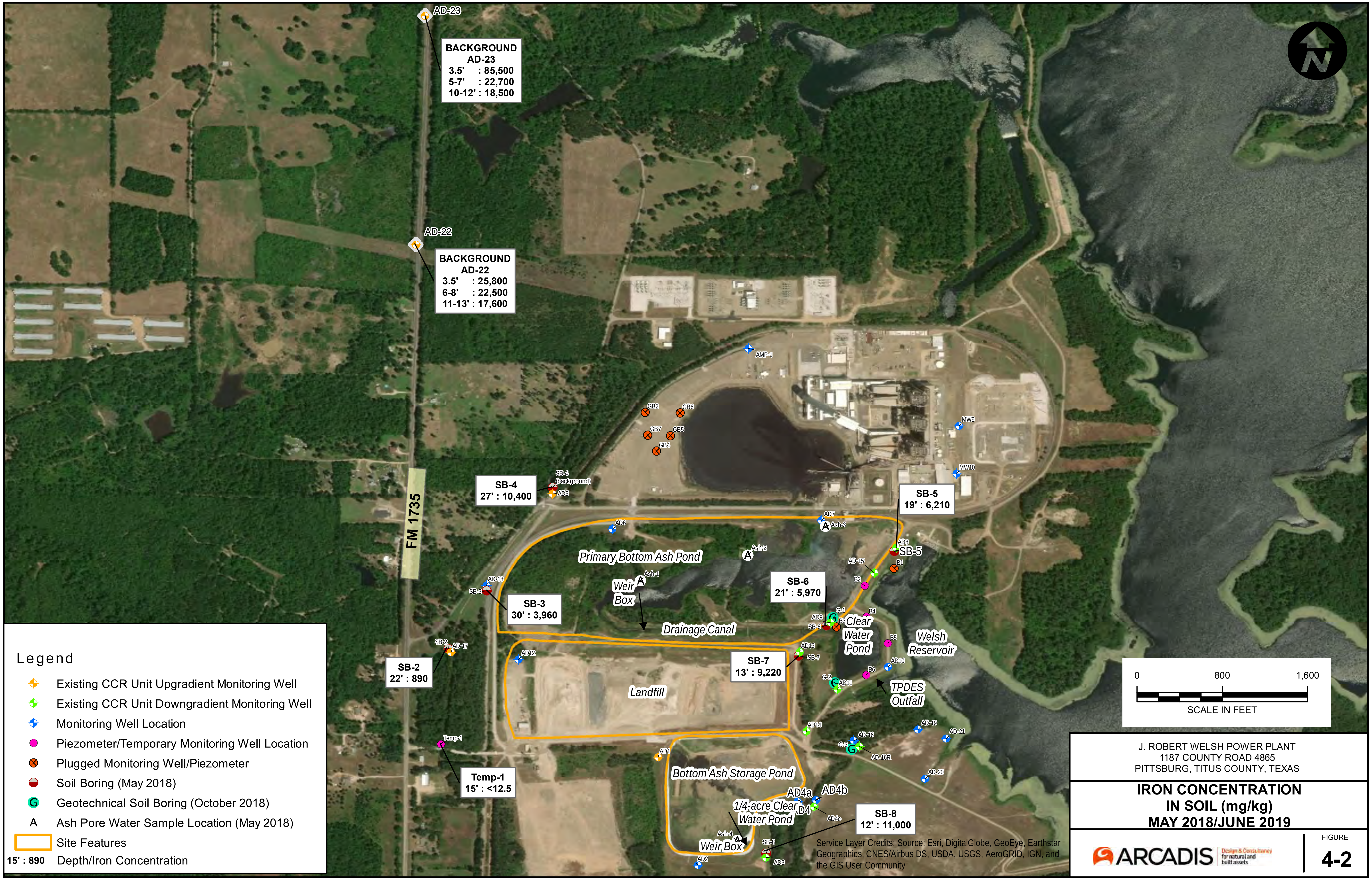
FIGURE
4-1

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 4-1-SoilBoring_LithiumresultsMay2018-June2018.mxd



Legend

- 🔶 Existing CCR Unit Upgradient Monitoring Well
- 🟢 Existing CCR Unit Downgradient Monitoring Well
- 🔷 Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◒ Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features
- **15' : 890** Depth/Iron Concentration

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

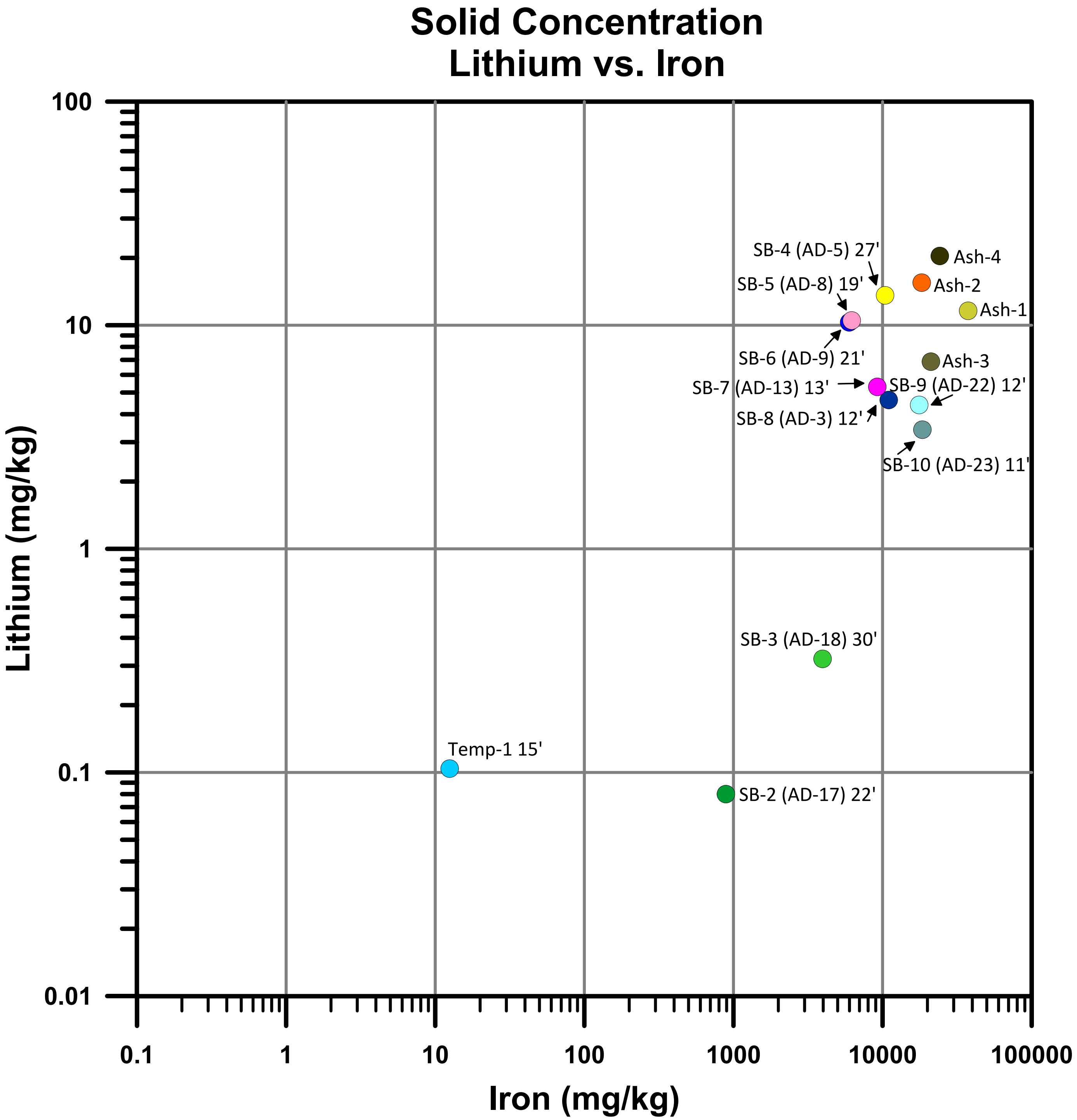
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

IRON CONCENTRATION IN SOIL (mg/kg) MAY 2018/JUNE 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-2

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 4-2-SoilBoring_IronresultsMay2018-June2019.mxd



Native Soil

Upgradient
- ● SB-2 (AD-17) 22'
- ● SB-3 (AD-18) 30'
- ● SB-4 (AD-5) 27' Background
- ● SB-9 (AD-22) 12'
- ● SB-10 (AD-23) 11'

Downgradient
- ● SB-8 (AD-3) 12'
- ● SB-5 (AD-8) 19'
- ● SB-6 (AD-9) 21'
- ● SB-7 (AD-13) 13'

Supplemental Sidegradient
- ● Temp-1 15'

Coal Ash
- ● Ash-1
- ● Ash-2
- ● Ash-3
- ● Ash-4

Notes:
mg/kg - milligrams per kilogram

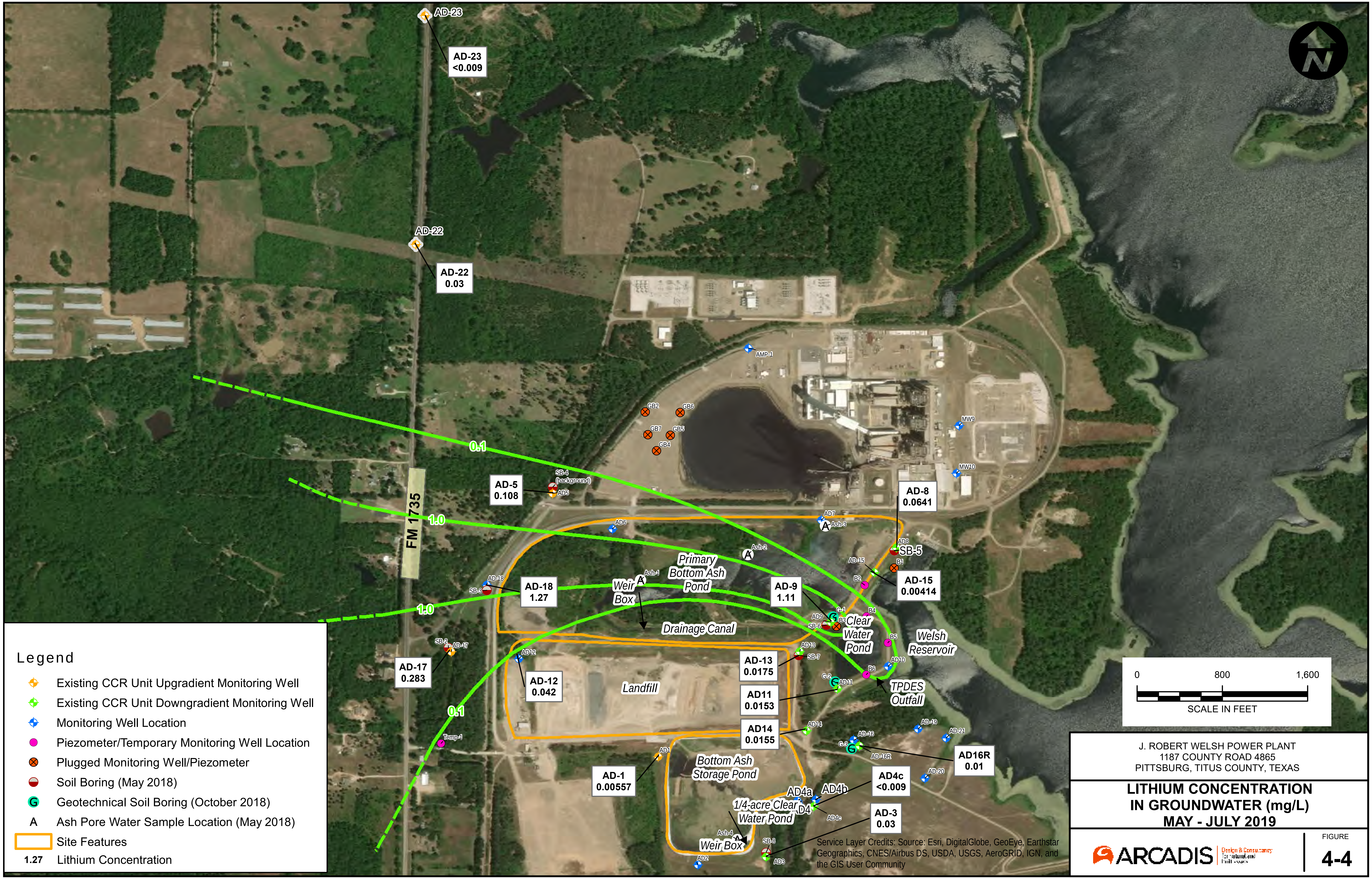
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM VS. IRON SOLIDS CONCENTRATION PLOT

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-3

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\July2019\Fig 4-4-SoilBoring_LithiumGWresultsMay2018-July2019.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

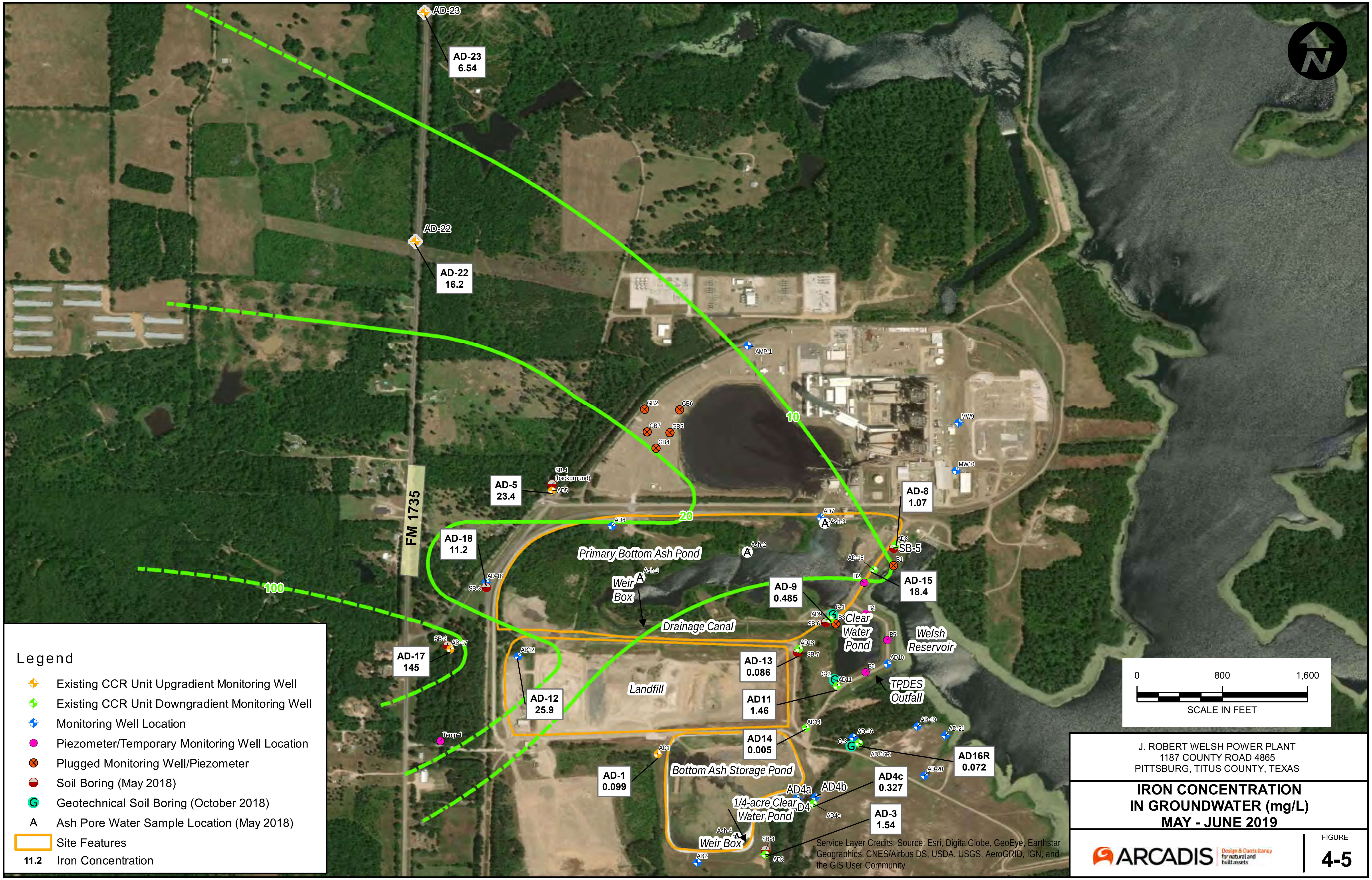
- ◆ Existing CCR Unit Upgradient Monitoring Well
- ◆ Existing CCR Unit Downgradient Monitoring Well
- ◆ Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◓ Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features
- 1.27 Lithium Concentration

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM CONCENTRATION IN GROUNDWATER (mg/L) MAY - JULY 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-4



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

✛	Existing CCR Unit Upgradient Monitoring Well
✛	Existing CCR Unit Downgradient Monitoring Well
✛	Monitoring Well Location
●	Piezometer/Temporary Monitoring Well Location
⊗	Plugged Monitoring Well/Piezometer
◐	Soil Boring (May 2018)
G	Geotechnical Soil Boring (October 2018)
A	Ash Pore Water Sample Location (May 2018)
▭	Site Features
11.2	Iron Concentration

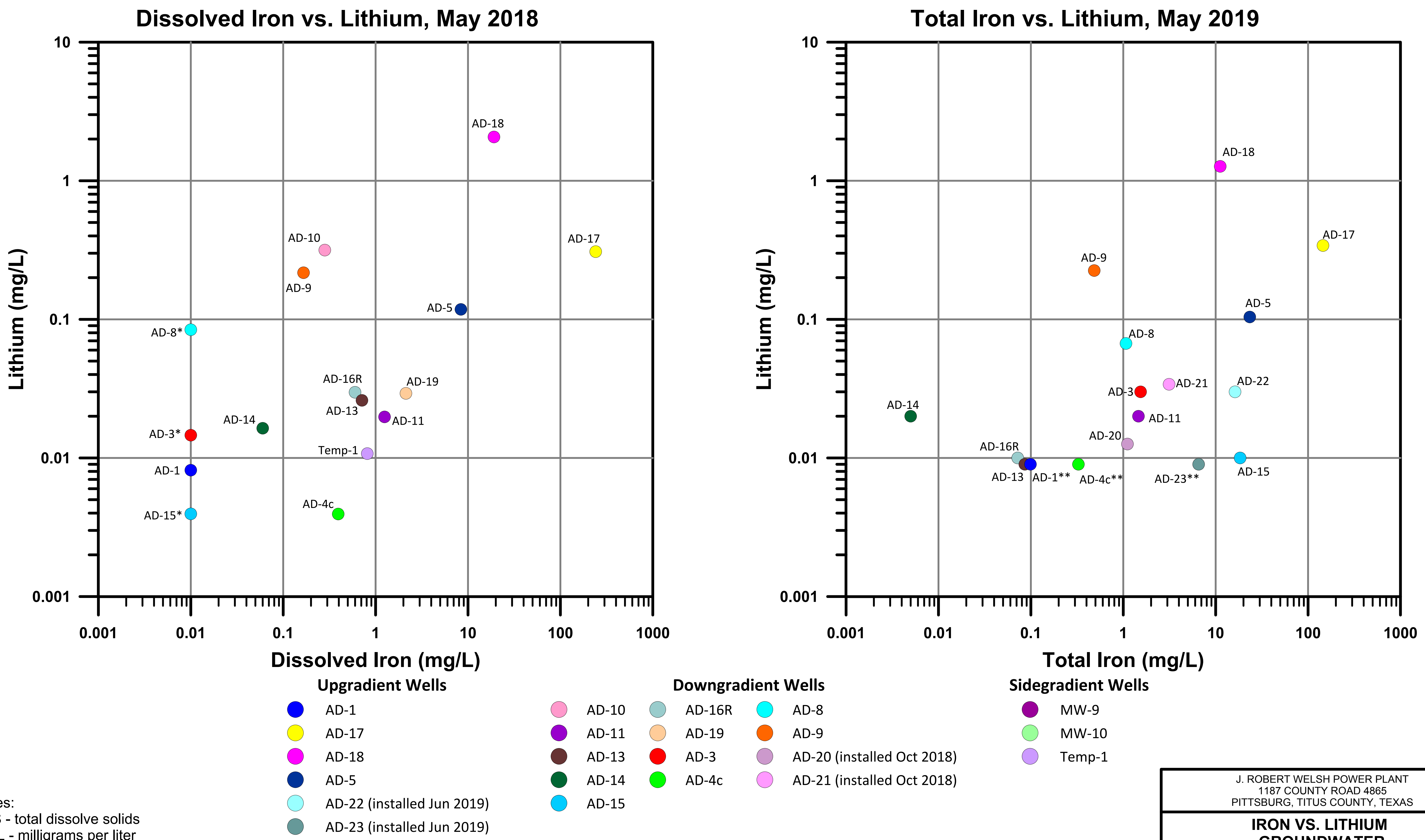
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

IRON CONCENTRATION IN GROUNDWATER (mg/L) MAY - JUNE 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-5

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 4-5-SoilBoring_IronGWresultsMay2018-June2019.mxd



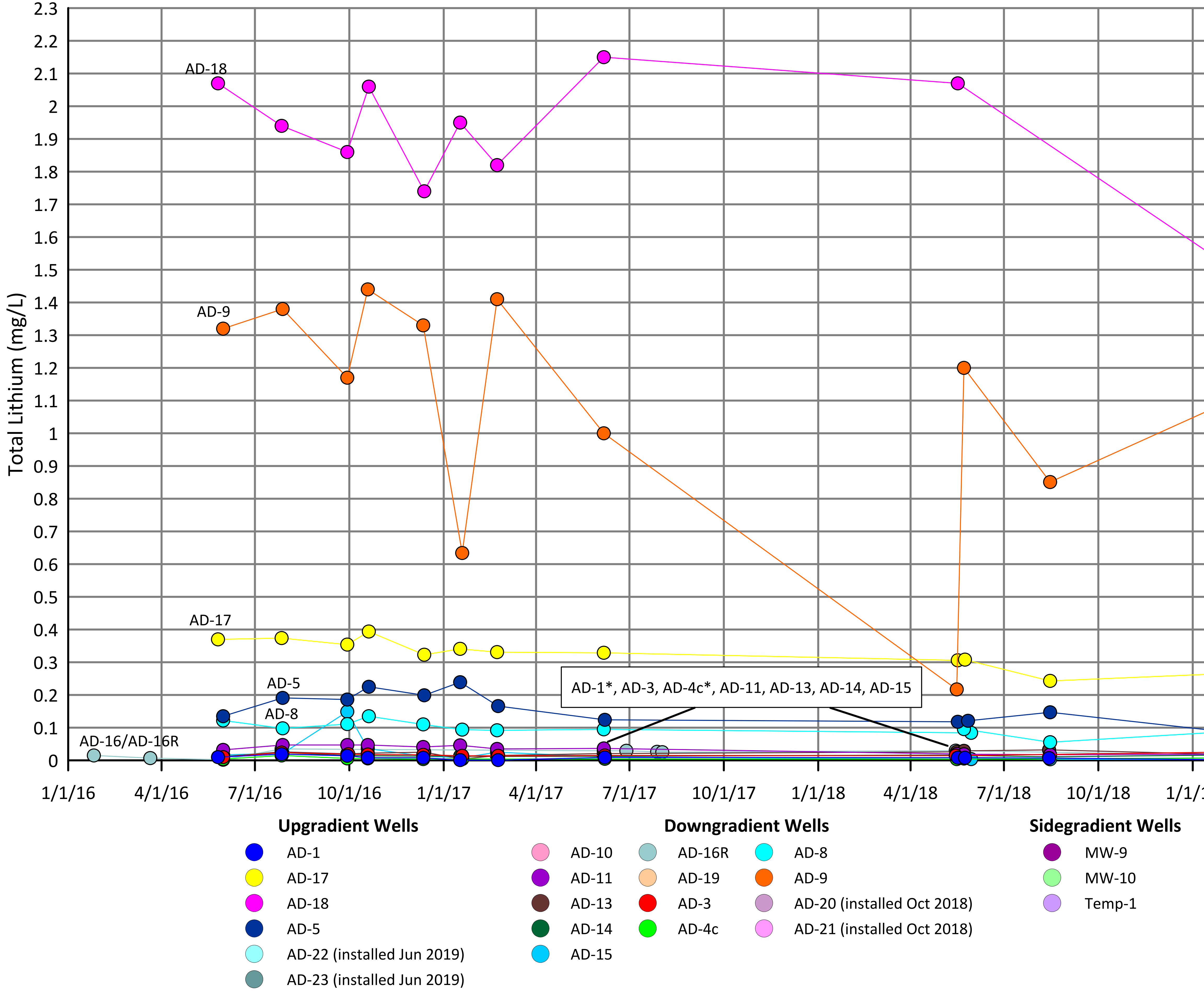
Notes:
TDS - total dissolve solids
mg/L - milligrams per liter
Concentrations of iron and lithium in coal ash were below detection
Concentrations of lithium in coal ash porewater were less than 0.02 mg/L
AD-22 and AD-23 groundwater concentrations are total only
*Iron was not detected, result is plotted at the reporting limit
**Lithium was not detected, result is plotted at the reporting limit

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

IRON VS. LITHIUM GROUNDWATER CONCENTRATION PLOT

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-6



Notes:
mg/L - milligrams per liter
*When lithium was not detected, result is plotted at the reporting limit

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

TOTAL LITHIUM VS. TIME GROUNDWATER CONCENTRATION PLOT

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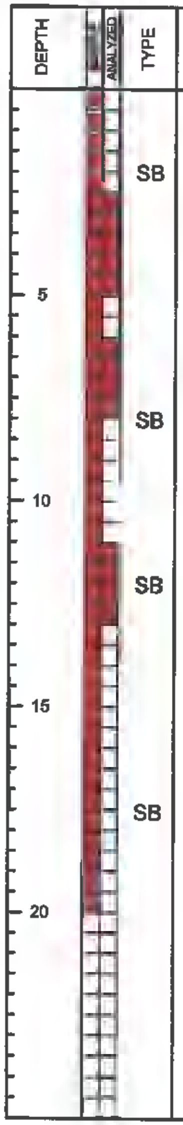
FIGURE
4-7

APPENDIX A

Monitoring Well Completion Diagrams – 2019 Monitoring Wells

WELL LOG



SAMPLE DESCRIPTION

(0-2.5') SAND (SP), BROWN, FINE GRAINED.

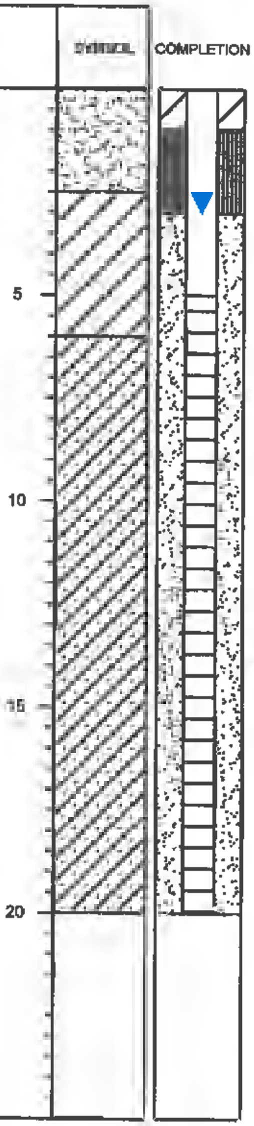
(2.5-6') SILTY CLAY (CL), GRAY WITH RED MOTTLING AND IRON NODULES.

(6-20') CLAYEY SAND (SC), GRAY WITH RED MOTTLING, FINE GRAINED, WET @ 9.5'.

Kenneth J. Brandner
Geology
1187

8-7-19

TOTAL DEPTH = 20 FEET BGS



AD-22
WELL

AEP
CLIENT

TX015976.0004
PROJECT

WELSH POWER PLANT
LOCATION

6/18/19
DATE

HSA
DRILLING METHOD

2" PVC, 0-5' BGS
CASING

5-20' BGS, 2" PVC MILL-SLOT
SCREEN

0-1' BGS
CEMENT

1-3' BGS
BENTONITE

3-20' BGS
SAND PACK

360.94' / 360.22'
GROUND ELEV. / TOP OF CASING ELEV

CT - CUTTINGS
SB - SPLIT BARREL (5')
SS - SPLIT SPOON (2')

▽ HC LEVEL
▼ WATER LEVEL

░ SAND	░ FILL/CONCRETE
▥ SILT	▨ BENTONITE
▨ CLAY	⁘ GRAVEL

PAGE 1 OF 1

711 N. CARANCAHUA, #1080
CORPUS CHRISTI, TEXAS 78401
TEL. (361) 883-1353 FAX: (361) 883-7565

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STATE OF TEXAS WELL REPORT for Tracking #515172

Owner:	**AEP**	Owner Well #:	**AD-22**
Address:	**1187 County Road 4865 Pittsburg, TX 75686**	Grid #:	**16-58-4**
Well Location:	**FM 1735 Pittsburg, TX 75686**	Latitude:	**33° 03' 35" N**
	In ROW along west side of FM 1735, WNW of the AEP - Welsh Plant	Longitude:	**094° 51' 09" W**
		Elevation:	**No Data**
Well County:	**Titus**		

Type of Work: **New Well**

Proposed Use: **Monitor**

Drilling Start Date: **6/18/2019** Drilling End Date: **6/18/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**7.25**	**0**	**20**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Screened**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**0**	**1**	**Concrete**
	1	**3**	**Bentonite**
	3	**20**	**Sand**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

	Strata Depth (ft.)	*Water Type*
Water Quality:	**No Data**	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **WEST Drilling**

101 Industrial Drive
Waxahachie, TX 75165

Driller Name: **Robert Williams** License Number: **59501**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	*Bottom (ft.)*	*Description*
0	**2.5**	**brown sand**
2.5	**6**	**gray and red, mottled, silty clay with Fe nodules**
6	**20**	**gray, clayey sand**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	*Type*	*Material*	*Sch./Gage*	*Top (ft.)*	*Bottom (ft.)*
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**5**
2	**Screen**	**New Plastic (PVC)**	**40** **0.010**	**5**	**20**

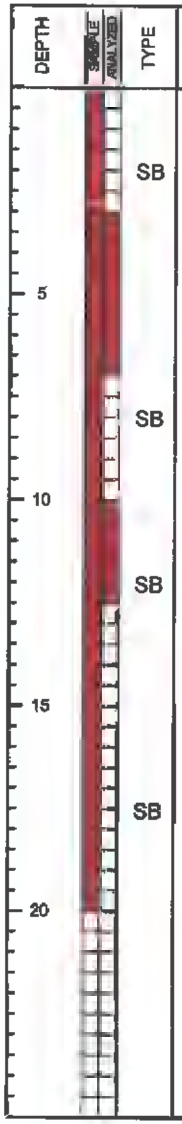
IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

WELL LOG



SAMPLE DESCRIPTION

(0-1') SAND (SP), BROWN, FINE GRAINED.
(1-6') CLAYEY SAND (SC), BROWN TO RED.

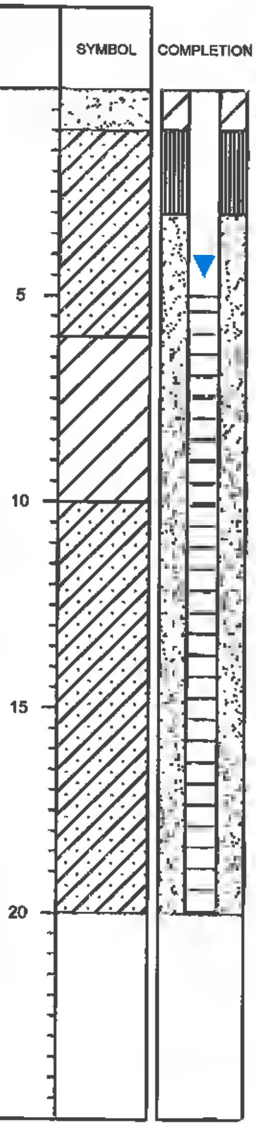
(6-10') SILTY CLAY (CL), GRAY WITH RED MOTTLING AND IRON NODULES.

(10-20') CLAYEY SAND (SC), REDDISH-BROWN, FINE GRAINED, WET @ 10'.

Kenneth J. Brandner

8-7-19

TOTAL DEPTH = 20 FEET BGS



PAGE 1 OF 1

AD-23
WELL

AEP
CLIENT

TX015976.0004
PROJECT

WELSH POWER PLANT
LOCATION

6/18/19
DATE

HSA
DRILLING METHOD

2" PVC, 0-5' BGS
CASING

5-20' BGS, 2" PVC MILL-SLOT
SCREEN

0-1' BGS
CEMENT

1-3' BGS
BENTONITE

3-20' BGS
SAND PACK

369.37' / 368.82'
GROUND ELEV. / TOP OF CASING ELEV.

CT - CUTTINGS
SB - SPLIT BARREL (5')
SS - SPLIT SPOON (2')

▽ HC LEVEL
▼ WATER LEVEL

▨ SAND
▥ SILT
▨ CLAY
▨ FILL/CONCRETE
▨ BENTONITE
▨ GRAVEL

711 N. CARANCAHUA, #1080
CORPUS CHRISTI, TEXAS 78401
TEL: (361) 883-1353 FAX: (361) 883-7565

ARCADIS

STATE OF TEXAS WELL REPORT for Tracking #515173

Owner:	**AEP**	Owner Well #:	**AD-23**
Address:	**1187 County Road 4865 Pittsburg, TX 75686**	Grid #:	**16-58-4**
Well Location:	**FM 1735 Pittsburg, TX 75686**	Latitude:	**33° 03' 56" N**
	In ROW along west side of FM 1735, WNW of the AEP - Welsh Plant	Longitude:	**094° 51' 08" W**
		Elevation:	**No Data**
Well County:	**Titus**		
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **6/18/2019** Drilling End Date: **6/18/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**7.25**	**0**	**20**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Screened**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**0**	**1**	**Concrete**
	1	**3**	**Bentonite**
	3	**20**	**Sand**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level:	**No Data**
Packers:	**No Data**
Type of Pump:	**No Data**
Well Tests:	**No Test Data Specified**

	Strata Depth (ft.)	Water Type
Water Quality:	**No Data**	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **WEST Drilling**

101 Industrial Drive
Waxahachie, TX 75165

Driller Name: **Robert Williams** License Number: **59501**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	1	brown sand
1	6	gray and red, clayey sand
6	10	gray and red, mottled, silty clay with Fe nodules
10	20	reddish brown, clayey sand

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	Riser	New Plastic (PVC)	40	0	5
2	Screen	New Plastic (PVC)	40 0.010	5	20

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

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Texas Department of Licensing and Regulation
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Austin, TX 78711
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APPENDIX B

Springs of Texas Reference

Springs of Texas

VOLUME I

Gunnar Brune

Second edition

The paper used in this book meets the minimum
requirements of the American National Standard for
Permanence of Paper for Printed Library Materials,
Z39.48-1984. Binding materials have been
chosen for durability.

∞

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whose grants helped make this edition possible:*

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INTRODUCTION TO THE SECOND EDITION

Helen C. Besse

When Gunnar Brune self-published *Springs of Texas, Volume I*, in 1981, most of the state water planning agencies and local environmental communities either did not recognize the importance of his work or were not aware of its existence. Brune had spent the previous decade conducting research and field studies, and then writing this book that describes the physical characteristics of springs, the archeology and history of springs' use, the ecological setting of springs, and the local use and lore surrounding springs for 183 out of 254 Texas counties. Gunnar Brune died before he could complete volume II.

Gunnar Brune described many of the large springs across the state as well as innumerable small springs present along river and stream courses that provide the base flow for waterways across the state. Brune repeatedly stated in the 1981 edition of this book that many of the springs he described had failed or were failing. With the pronounced influx of population in the last twenty years and the increased agricultural and industrial activities around the state, one can only wonder how many of the more than 2,000 springs have gone dry since he described them through the 1970s.

Nevertheless, this book is even more important today. Its value to water planners, elected officials, policy makers, municipal, county, and state administrators, wildlife stewards, environmentalists, and water lovers has not diminished. Springs are "the canary in the coal mine." The health of our springs reflects the health of our underground water resources and is seen in the state's surface resources as well.

In the section "The Prehistoric Setting of Springs," Brune provided a quote from another book on the beliefs that early Americans had about springs. It is appropriate to repeat those words here.

> Gods and heroes were born out of springs, and ever afterward came and went between the above and below worlds through their pools. Every pueblo had sacred springs somewhere near-by. There was every reason to sanctify them – physical, as life depended upon water; spiritual, as they had natural mystery which suggested supernatural qualities; for how could it be that when water fell as rain, or as snow, and ran away, or dried up, there should be other water which came and came, secretly and sweetly, out of the ground and never failed (Horgan, 1954).

F. Halley's farm. According to Dr. John Klein, a nearby resident and writer, the Klein settlement began here in 1848. The Sellars store was at the springs. They issued from Montgomery silt with many iron concretions at about 0.72 lps on April 11, 1978. The pools, containing duckweed, pennywort, and water primrose, were home to a family of ducks and ducklings. Probably the flow formerly continued down Spring Gully past Klein cemetery, 0.6 kilometer downstream, but on this date, even after rains, the channel here was dry except for some standing water. Many wells pump nearby.

Magnolia Garden Springs (15) are four kilometers northeast of Sheldon along the San Jacinto River. At Martha Dempsey's Good Times marina several very small springs trickle from Deweyville sand, including one which flows 0.15 lps from a pipe. Near the entrance to the nearby Magnolia Gardens marina, according to Jean Manson, springs flowed until about 1923. They are quite dry now. Very small springs are said to feed Simms Lake, across the river and 0.6 kilometer farther east. This formerly popular swimming hole is now closed to the public.

At Beaumont Place northeast of Houston, near the intersection of Highways 90 and 526, is another Spring Gully. The channel is now a drainage ditch into which very small springs and seeps (14) drain from Beaumont silt and sand.

Eight kilometers west of La Porte is Willow Springs Bayou, also called Willow Springs Gully or Ditch. **Willow Springs (8)** are chiefly between North L Street and Spencer Road. On April 9, 1978, the discharge of Willow Springs Bayou at North L Street was 0.18 lps, and at Spencer Road it was 0.70 lps. Many willows still fringe the channel, along with cattails.

A third Spring Gully is located eight kilometers southwest of La Porte. Springs (9) in Beaumont silt produced a discharge of about 0.18 lps in 1978 in the gully at the Red Bluff road crossing. Cottonmouths hide here among the willows and cattails.

HARRISON COUNTY

Harrison County is endowed with numerous springs of all types, some highly mineralized and valued for their healing properties. Most appear to be flowing as strongly as ever, because there has been little demand on the groundwater reservoirs. However, water levels in the artesian sands are declining as much as 4.6 meters per year in some areas. Most of the Caddo Indian villages were located at springs. Early French and Spanish explorers, some over 400 years ago, visited many of the same springs that can be seen today. The New Madrid earthquake of 1811 - 1812, which enlarged Caddo Lake, may have affected the flow of some springs. In general, however, the water-bearing formations were not greatly affected by the quake.

Most of the spring waters of the county issue from Eocene sands. They are usually fresh, soft, and acid, being of the sodium bicarbonate type. The iron content is often very high. Mineralized waters may also be high in aluminum and sulfate, may be slightly saline, and can be very hard. The analyses shown for 1942 in the table of Selected Chemical Analyses are probably too low in dissolved-solids content, perhaps because of high rainfall at the time the samples were collected. Most of the writer's field studies were made on January 23 - 28, 1976.

It was around **Locke Springs (1)** that the community of Marshall first appeared. In 1831 there were at least 20 springs flowing from the Reklaw sand near the intersection of Franklin and Houston Streets and up the hill toward the courthouse. In early times water was hauled from these springs in barrels to fill the cisterns on the town square. Most of the springs have now been paved over, but the remaining ones still flowed 1.4 liters per second in 1976.

Hynson Springs (10), also known as **Marshall**, **Noonday Camp**, and **Iron Springs**, are six kilometers north of Hallsville. They became very popular as a health resort about 1851. The waters are highly mineralized, containing much iron, sulfur, aluminum, and lithium. Originally there were said to be over 100 springs flowing from Queen City sand. Now not more than 20 can be found, possibly because the water table has fallen. During the Civil War the water from the springs was used in a leather-tanning factory. From 1891 to 1905 the large Hotel Randell accommodated thousands of visitors to the springs. Today there are an open-air auditorium and a number of cabins, but everything is in a sad state of disrepair. A historical marker is located at the springs. The discharge record, in liters per second, is as follows:

Jan. 28, 1942	0.13	
Jul. 21, 1964	0.06	
Jan. 27, 1976	0.13 (main spring)	1.6 (all springs)

Rock Springs (7) are just east of the Rock Springs church on Highway 449 about 13 kilometers west of Marshall. This and several other springs upstream flowed 2.3 lps from the Queen City sand in 1976. The Frenchman Henri Joutel of La Salle's party may have stopped here for refreshment in 1687.

Mulberry Springs (9), nine kilometers south-southwest of Harleton, are 100 meters north of the

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Welsh Power Plant
Primary Bottom Ash Pond
Alternate Source Demonstration

The Welsh Power Plant Primary Bottom Ash Pond initiated an assessment monitoring program in accordance with 40 CFR 257.95 on April 13, 2018. Groundwater protection standards (GWPS) were set in accordance with 257.95(d)(2) and a statistical evaluation of the assessment monitoring data was conducted. The statistical evaluation revealed an exceedance of the lithium GWPS on July 12, 2019. A successful alternate source demonstration (ASD) was completed per 257.95(g)(3), therefore, the Welsh Primary Bottom Ash Pond will remain in assessment monitoring. An ASD is documentation that shows a source other than the CCR unit was responsible for causing the statistics to exceed the GWPS. The ASD document will explain the alternate cause of the GWPS exceedance. The successful ASD is attached.

ALTERNATIVE SOURCE DEMONSTRATION - LITHIUM PRIMARY BOTTOM ASH POND

J. Robert Welsh Power Plant
1187 County Road 4865
Pittsburg, Titus County, Texas

October 28, 2020

ALTERNATIVE SOURCE DEMONSTRATION - LITHIUM PRIMARY BOTTOM ASH POND

J. Robert Welsh Power Plant
1187 County Road 4865
Pittsburg, Titus County, Texas

Prepared for:

American Electric Power Corporation

Prepared by:

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Our Ref.:

30060035

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October 28, 2020

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Michael Hay, PhD
Principal Geochemist

Matthew J

Matthew J. Lamb
Project Manager

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FIGURES

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ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
Arcadis	Arcadis U.S., Inc.
ASD	Alternate Source Demonstration
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
ft	feet
GWPS	groundwater protection standard
MCL	maximum contaminant limit
mg/kg	milligram per kilogram
mg/L	milligram per liter
PBAP	Primary Bottom Ash Pond
SPLP	Synthetic Precipitation Leaching Procedure
SSI	statistically significant increase
SSL	statistically significant level
USDA	United States Department of Agriculture
USGS	United States Geologic Survey

1 INTRODUCTION

This Alternate Source Demonstration (ASD) report has been prepared on behalf of American Electric Power Corporation for lithium detected in groundwater at hydraulically downgradient monitoring well AD-9 at the Primary Bottom Ash Pond (PBAP) at the J. Robert Welsh Plant site located in Titus County, Texas. This ASD report was prepared in accordance with the Coal Combustion Residual (CCR) Rule (the Rule) specified in 40 Code of Federal Regulations (CFR) §257 and based on recommendations provided in the Electric Power Research Institute “Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites” (Electric Power Research Institute [EPRI] 2017). As part of the Rule, CCR facility owners are required to conduct detection and assessment monitoring of “Appendix III” and “Appendix IV” constituents, respectively, to ensure compliance with applicable groundwater standards (described further below). Because the monitored constituents also have natural sources and can be influenced by sampling methodology implementation, the Rule allows owners or operators to evaluate and demonstrate whether a source other than the CCR unit caused a statistically significant increase (SSI) over background levels for an Appendix III constituent or at statistically significant levels (SSLs) over groundwater protection standards for an Appendix IV constituent, such as natural variation in groundwater quality or sampling methodology error.

The owner or operator must complete the written ASD within 90 days of identifying the SSI or SSL and include the certification from a qualified professional engineer to verify the accuracy of the information in the report. An SSL was identified for lithium at monitoring well AD-9 as detailed in the September 1, 2020 report entitled “Statistical Analysis Summary, Primary Bottom Ash Pond” (Geosyntec 2020). Therefore, this ASD report was prepared by Arcadis U.S., Inc. (Arcadis) on behalf of American Electric Power Corporation within the 90-day period and has been certified by a qualified professional engineer.

1.1 Facility History

The J. Robert Welsh Plant is located within southern Titus County, approximately eight miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas (**Figure 1-1**). The Plant began operations in 1977 with three coal-fired generating units (Units 1, 2, and 3). Currently, only Units 1 and 3 are operational. Throughout the life of the Plant, CCR materials (fly ash, bottom ash, economizer ash) have been generated. These byproducts were stored in the PBAP and in the adjacent Landfill that were constructed in the late 1970s. In 2000, the 22-acre Bottom Ash Storage Pond was installed south of the Landfill. The Bottom Ash Storage Pond was constructed with a 60-mil high-density polyethylene liner (**Figure 1-2**).

Presently bottom ash and economizer ash from the Plant are sluiced to the PBAP. Solids settle as the clear liquids flow through a drainage canal into the clear water pond (a non-CCR unit). Solids (bottom ash and economizer ash) in the PBAP are dredged and sluiced into the Bottom Ash Storage Pond. Marketable ash material from the PBAP is also temporarily stored in the western two thirds of the Landfill for processing, then loaded into trucks and sold for beneficial reuse (highway road base, etc.).

2 PHYSICAL SETTING

2.1 Regional Topography

The elevation at the Site ranges from approximately 300 feet (ft) above mean sea level (amsl) at Swauano Creek downstream of the Welsh Reservoir, to 360 ft amsl at a topographically high ridge at the west end of the Landfill. The PBAP is in a topographically low area that had been an un-named intermittent tributary of Swauano Creek prior to development of the Site. The Landfill is approximately 40 acres in size and is located in a topographically higher area directly south of the PBAP. The Bottom Ash Storage Pond is approximately 22 acres in size and in a topographically higher area directly south of the Landfill.

A topographically high ridge is present directly northwest of the Site where offsite monitoring wells AD-22 and AD-23 were installed along the FM 1735 right-of-way during June 2019. Ground surface elevation at these offsite monitoring wells ranges from approximately 361 ft amsl at AD-22 to 369 ft amsl at AD-23.

2.2 Geology and Soils

2.2.1 Regional and Local Geology

The Site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently to the southeast. The Site, including all three CCR Units (PBAP, Landfill, Bottom Ash Storage Pond), is located along the outcrop of the Eocene-age Reklaw Formation, which consists of very fine to fine grained sand and clay (Flawn 1966). The Reklaw Formation attains a thickness of approximately 110 ft in Titus County, and is underlain by the Eocene-age Carrizo Sand which consists of fine to coarse sand, silt, and clay (United States Geologic Survey [USGS] 1965). In the topographically low areas underlying the Welsh Reservoir to the east of the PBAP, Quaternary alluvial sediments associated with Swauano Creek are present (Flawn 1966).

All of the CCR monitoring wells at the Site are completed in the Reklaw Formation. The two offsite monitoring wells (AD-22, AD-23) west of the Site are completed in the overlying Queen City Formation. Monitoring well locations are shown on **Figure 2-1**.

As shown on the regional geologic map and legend (**Figure 2-2A** and **Figure 2-2B**), the Reklaw Formation outcrop (Er) at the Site is relatively narrow (less than 1 mile in width). The Reklaw Formation is overlain by the Eocene-age Queen City Formation, which outcrops in topographically higher areas west of the Site, including the area where monitoring wells AD-22 and AD-23 are located. The Queen City Formation consists of fine to medium grained sand, shale, silt, and impure lignite, and attains a thickness of approximately 210 ft in Titus County (USGS 1965). The Queen City Formation also contains ironstone concretions (Flawn 1966).

2.2.2 Regional and Local Soil Composition

Information gathered from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Services soil data provides a detailed inventory of the regional soils and their characteristics, including the widespread distribution of clay-bearing soils, that support data collected at the Site from soil borings and groundwater monitoring well locations. Two main named soil layers are present in the Pittsburgh, TX, area in the vicinity of the Site:

- Norfolk sandy loam
- Susquehanna fine sandy loam

Both soils are similar in the uppermost 1.5 ft of material, generally grayish in color and containing fine sand, silt, and clay. However, the subsoils of both units have subtle differences from one another and are described herein. Observations from soil borings at the Site are consistent with the characteristics of one or both of these soil units, as described in the USDA Natural Resources Conservation Services document.

The Norfolk sandy loam is a widely distributed soil unit that is uniformly developed in the lowland areas and is derived from weathering Eocene-aged deposits. It is a generally porous soil, allowing infiltrating water to migrate downward toward the water table. The soil layer is generally yellowish-gray in color, however the subsoil at greater depths is characterized by increased clay content and a mottled red and yellow appearance. As noted in the USDA soil descriptions, the soil and subsoils of the Norfolk sandy loam may be broken down into the grain size distributions presented in **Table 2-1**.

The Susquehanna fine sandy loam is also widely distributed and generally resembles the Norfolk sandy loam at the surface. Subsoils of the Susquehanna contain a greater component of clay, and likely contain increased iron content, as evidenced by observed iron concretions and iron crust formation within the subsoil. This soil is often mottled in appearance, ranging from red and yellow to a reddish brown or gray. Despite the greater clay content, the soil and subsoil is not impervious to infiltrating water that migrates toward the water table. As noted in the USDA soil descriptions, the soil and subsoils of the Susquehanna fine sandy loam may be broken down into the grain size distributions presented in **Table 2-2**.

These soil descriptions are important for the understanding of contributing sources of key constituents, such as lithium to the groundwater system. Lithium can occur in soils through natural weathering processes and the development of clay minerals. In particular, lithium can be incorporated into the structure of clays in the smectite group through cation substitution, which is further influenced by the presence of iron within the clay structure (Drever 2002; Stucki 2005). The widespread distribution of clay deposits in the native soils in and near the Site and the propensity for clays to contain trace constituents of potential concern supports the potential for natural sources of lithium.

Geologic cross-sections were generated to evaluate the stratigraphy in the area of the PBAP. The lines of geologic cross-section are shown on **Figure 2-3** and the cross-section details for cross-sections A-A' through E-E' are shown on **Figures 2-4** through **2-8**, respectively. As shown on **Figure 2-4**, an unsaturated brown to gray clay and sandy clay stratum is present in the area of the PBAP from the surface to a depth of approximately 20 ft below ground surface. The clay stratum is underlain by a saturated fine to medium grained clayey and silty sand stratum with an average thickness of approximately 10 ft and is consistent with the soils of the Susquehanna fine sandy loam deposits. As discussed below in Section 2.3.2, this saturated sand stratum is the uppermost water-bearing unit in the area of the PBAP. This sand stratum is underlain by an unsaturated gray to black silty clay stratum that locally serves as a lower confining layer (aquitard) for the uppermost water-bearing unit.

As shown on **Figures 2-2A** and **2-4**, the Queen City Formation outcrops in the topographically high area to the northwest of the Site. The geologic contact between the Queen City Formation, in which offsite monitoring wells AD-22 and AD-23 are completed, and the Reklaw Formation, in which the CCR monitoring wells are completed, is located near an elevation of 340 ft amsl as shown on **Figure 2-4**. The Queen City Formation directly west of the Site consists predominantly of clayey sand, and the underlying Reklaw Formation consists of interbedded sand, silt, and clay strata.

2.3 Hydrology and Water Quality

2.3.1 Regional Hydrology and Water Quality

The Reklaw Formation, which outcrops at the Site, and the overlying Queen City Formation, which outcrops west of the Site, are part of the Cypress Aquifer, which also includes the underlying Carrizo Sand and Wilcox Formation (USGS 1965). As shown on **Figure 2-9**, the Cypress Aquifer is approximately 900 ft thick in the Site area, and the base of fresh water in the Cypress Aquifer is approximately 800 ft below ground surface.

Regional groundwater characteristics are presented in Texas Water Commission Bulletin 6517 "*Ground-Water Resources of Camp, Franklin, Morris, and Titus Counties, Texas, Texas*" (USGS 1965). All of the regional aquifer units are combined in this document, and considered as one interconnected unit, referred to as the "Cypress aquifer". This singular aquifer unit, composed of all water bearing units of similar character, was divided into three zones based on water quality characteristics of each zone rather than lithology. The following three zones were identified, in order of increasing relative depth:

- Zone A: characterized by minimal iron content and low pH, ranging from 4.5 to 6.5.
- Zone B: characterized by increased dissolved iron content and pH ranging from 5.0 to 7.0
- Zone C: characterized by iron concentrations of less than 0.3 milligrams per liter (mg/L) and neutral to alkaline pH (7.0 to 8.0)

Groundwater at the Site is generally assumed to be influenced by groundwater from Zones A and B. As described in USGS, 1965, Zones A and B can be more simply described as:

- Zone A: zone of oxidation and acidic groundwater
- Zone B: intermediate zone

The dissolved iron content in the A and B zones (ranging from non-detect to greater than 10 mg/L; USGS 1965) is likely influenced by iron present in the soils and sediments, which are described in Section 2.2. Slow recharge rates and transmissive properties of these zones contributes to longer residence times whereby the infiltrating groundwater may react with soil and sediments, allowing for the oxidation of sulfides to generate sulfate and mobilizing ferrous iron into solution. In addition, groundwater from several wells completed in shallow (less than 60 ft in depth) sediments contained sulfate concentrations above

1,000 mg/L. Sulfate concentrations observed at the Site are consistent with the range of data for other similar depth wells in the four-county area (USGS 1965).

Additional regional groundwater information is provided in the 107th Annual Meeting of the Texas Academy of Science abstract titled “Natural Sources of Poor Water Quality in Streams of East Texas” (Ledger et. al. 2004). This study characterized surface water streams associated with the regional groundwater in the Eocene-aged Reklaw Formation as acidic with high concentrations of sulfate, and arsenic concentrations greater than 0.01 mg/L.

An observed decline in surface water quality was also noted if springs from the Reklaw Formation discharge to surface water bodies. Abundant sulfur is noted in the Reklaw formation and sediments undergo acid-sulfate weathering, as evidenced in the red-stained soils and sulfate concentrations of greater than 1,000 mg/L (Ledger et. al. 2004). In streams associated with the Reklaw Formation, sulfate levels may exceed 1,000 mg/L.

2.3.2 Local Hydrology

Groundwater flow direction at the Site is generally from west to east, following surface topography towards the Welsh Reservoir. Groundwater elevations and well construction information from monitoring wells completed in the uppermost water-bearing unit at the Site are summarized on **Table 2-3**. Depth to groundwater in the monitoring wells in the area of the PBAP ranges from approximately 10 to 15 ft below ground surface.

Figure 2-10 is a current potentiometric surface map for the uppermost water-bearing unit at the Site based on May 20, 2020 water level data. As shown on **Figure 2-10**, shallow groundwater flow direction in the area of the CCR Units is in a general easterly direction toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.005 foot per foot. Shallow groundwater flow direction in the area of monitoring wells AD-22 and AD-23, which are completed in the Queen City Formation, is southeasterly toward the CCR monitoring wells, which are completed in the Reklaw Formation. The groundwater flow direction and downward vertical gradient indicates shallow groundwater in the Queen City Formation likely is hydraulically connected to the underlying Reklaw Formation. This is consistent with Texas Water Commission Bulletin 6517 description of the Cypress Aquifer: “The Wilcox Group and the Carrizo Sand, Reklaw Formation, and Queen City Sand of the Claiborne Group have similar hydrologic properties and are the principal source of freshwater in the four-county area. The units probably are interconnected hydraulically and they function as single aquifer” (USGS 1965). **Figure 2-11** is a regional hydrologic cross section of the site area.

The hydraulic conductivity of the uppermost water-bearing unit at the Site was determined by conducting aquifer tests. A constant-rate pumping test was conducted at monitoring well AD-6 on September 21, 2017. Based on the AD-6 pumping test data, the hydraulic conductivity for the uppermost water-bearing unit was calculated at 0.05 ft per day (1.83 x 10^{-5} centimeters per second).

To provide a broader understanding of the hydraulic conductivity distribution across the Site, bail down slug tests were performed in October 2018 on a total of 5 wells; 1 up gradient well (AD-17) and 4 down gradient wells (AD-6, AD-9, AD-13 and AD-19) on October 30 and 31, 2018. These wells are all screened in the uppermost water-bearing unit and were chosen based on their distribution across the Site. The hydraulic conductivity estimates from the five monitoring wells tested ranged from 0.15 ft per day (AD-6)

to 2.0 ft per day (AD-13). The overall mean hydraulic conductivity estimate was 0.84 ft per day, while the overall geometric mean was 0.60 ft per day.

2.4 Surface Water

The Site is located directly west of Swauano Creek, which was dammed near the southern end of the Site during plant development to form the Welsh Reservoir. The PBAP normal operating water level is near the weir box which has a bottom elevation of 325 ft amsl. The surface water elevation of the Welsh Reservoir, located east of the PBAP, is maintained at approximately 320 ft amsl. The Welsh Reservoir is likely a gaining surface water feature because groundwater elevations at the Site are higher than the normal stage elevation of the Welsh Reservoir (approximately 320 ft amsl) as shown on **Figure 2-10**.

There are no current or historic gauging stations on Swauano Creek; however, there was a historic gauging station on adjacent Boggy Creek, which has a drainage basin area of 72 square miles versus 21.2 square miles for Swauano Creek. The average annual flow of the Boggy Creek gauging station during the driest year on record (1956) was 10.65 cubic feet per second, which corresponds to a flow of approximately 3 cubic feet per second for Swauano Creek.

3 DETECTION AND ASSESSMENT MONITORING STATISTICAL EVALUATION

3.1 General

The groundwater monitoring network for the uppermost water-bearing unit at the PBAP consists of three upgradient monitoring wells (AD-1, AD-5, AD-17) and three downgradient monitoring wells (AD-8, AD-9, AD-15; **Figure 2-1**). Additional details regarding the groundwater monitoring network are provided in the August 22, 2017 report entitled "*Primary Bottom Ash Pond – CCR Groundwater Monitoring Well Network Evaluation*" (Arcadis 2017).

3.2 Detection Monitoring Results

Detection monitoring at the Site involves collection of groundwater samples from the groundwater monitoring network upgradient and downgradient monitoring wells for analyses of Appendix III CCR constituents, which includes boron, calcium, chloride, fluoride, sulfate, pH, and total dissolved solids. Following the baseline monitoring program, which included a minimum collection of eight independent samples from each of the background and downgradient wells that are part of the certified monitoring network, the first round of Detection Monitoring was conducted. Based on detection monitoring conducted at the PBAP in 2017 and 2018, an SSI over the background concentration was calculated for boron in AD-8 (Geosyntec 2019c). Because of the SSIs noted for boron in groundwater samples from AD-8, an Alternate Source Demonstration was completed which did not identify an alternate source for the boron SSI (Geosyntec 2018).

3.3 Assessment Monitoring Results

Groundwater protection standards (GWPSs) were established for the Appendix IV parameters in accordance with 40 CFR Part 257.95(h). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or regional screening level for each Appendix IV parameter.

Confidence intervals were calculated for Appendix IV parameters at the compliance wells (AD-8, AD-9, AD-15) to assess whether Appendix IV parameters were present at an SSL above the GWPS. An SSL was identified for lithium in May 2020, which exceeded the GWPS of 0.390 mg/L at monitoring well AD-9 (0.800 mg/L), despite no observed SSIs in Appendix III parameters for this well (Geosyntec 2020). Additional details regarding the statistical evaluations of the groundwater monitoring data is provided in the September 1, 2020 report entitled "*Statistical Analysis Summary, Primary Bottom Ash Pond*" (Geosyntec 2020).

Because the native soils have the potential to be a natural source of lithium in the regional and local groundwater and soil composition, ASD reports were prepared in February 2019, September 2019, and March 2020 to provide additional information on the sources and distribution of lithium SSLs previously identified in groundwater at PBAP monitoring well AD-9 (Arcadis 2019a, Arcadis 2019b, Arcadis 2020). The conclusions from the ASDs indicated several lines of evidence demonstrating the lithium concentration in groundwater at AD-9 is from naturally occurring sources (ASD Type V), with some additional contributions from sampling methodology error (ASD Type I). This ASD report updates the previous reports based on the recently collected Site-specific soil and groundwater data, including soil and groundwater analytical data collected outlined in Section 4.

4 SOIL AND GROUNDWATER ANALYTICAL DATA EVALUATION

4.1 General

In addition to the detection and assessment monitoring groundwater sampling events conducted at the PBAP in 2017, 2018, 2019, and 2020 for statistical evaluation, a comprehensive site-wide groundwater sampling event was conducted by Arcadis during May 2018, and an offsite soil and groundwater sampling event was conducted by Arcadis during June 2019 to evaluate alternate potential sources of lithium detected in downgradient monitoring well AD-9. The May 2018 evaluation included the following tasks:

- Collection of groundwater samples from the PBAP upgradient monitoring wells (AD-1, AD-5, AD-17), the PBAP downgradient monitoring wells (AD-8, AD-9, AD-15), and other monitoring wells in the area completed in the uppermost water-bearing unit, including upgradient monitoring well AD-18; side gradient monitoring wells MW-9, MW-10, and Temp-1; and downgradient monitoring wells AD-3, AD-4c, AD-10, AD-11, AD-13, AD-14, AD-16R, and AD-19.
- Collection of soil samples from eight soil borings (Temp-1, SB-2 through SB-8) around the perimeter of the CCR units at the site.
- Collection of three CCR material samples from the PBAP (Sample IDs: Ash-1, Ash-2, Ash-3) and one CCR material sample from the HDPE-lined Bottom Ash Storage Pond (Sample ID: Ash-4) for analysis of total metals, pore water concentrations, and leachate water using the Synthetic Precipitation Leaching Procedure (SPLP) (**Table 4-1**).

The June 2019 evaluation included the following tasks:

- Installation of two offsite monitoring wells (AD-22, AD-23) in the Queen City Formation northwest (hydraulically upgradient) of the Site. Monitoring well completion diagrams are provided in **Appendix A**.
- Collection of soil and groundwater samples from the Queen City Formation monitoring wells for Appendix III and Appendix IV parameter analyses.

Additionally, two sentinel downgradient monitoring wells (AD-20, AD-21) were installed in the uppermost water-bearing unit (Reklaw Formation) near the shoreline of the Welsh Reservoir east (hydraulically downgradient) of the CCR units during October 2018.

4.2 Soil and Groundwater Analytical Data Evaluation

4.2.1 Soil Evaluation

The soil evaluation results demonstrate a correlation between lithium and iron in soil. Boring logs from Site area monitoring locations highlight similarities with observations provided in the county-wide soil survey reports. For example, boring locations SB-04 (adjacent to AD-5), SB-05 (adjacent to AD-8), AD-22, and AD-23 contain a greater content of the reddish-brown clay subsoils as noted in the Susquehanna fine sandy loam, which directly overlie the water table in these locations. The reddish brown color generally denotes the presence of iron in these locations, which can be either incorporated directly into the clay mineral structure (e.g. smectite), or as a secondary mineral (e.g. iron hydroxide) that is also present in the aquifer matrix (Stucki 2005). The role of iron incorporated into the clay structure is important to localized geochemical processes, such as cation exchange, redox conditions, and hydrophilic properties, which can influence weathering characteristics and the mobility of trace constituents (i.e. lithium) in groundwater (Stucki 2005). Specifically, in the event that geochemical conditions are or become conducive to iron dissolution (e.g., if conditions become microbially/geochemically reducing), then the mobilization of iron associated with soil can result in the co-mobilization of trace constituents.

As shown on **Table 4-1** and **Figure 4-1**, the highest concentrations of lithium in soil were detected from 3 to 5 feet below ground surface in hydraulically upgradient and offsite Queen City Formation monitoring well AD-22 (up to 18 milligrams per kilogram [mg/kg]), and onsite Reklaw Formation soil boring SB-4 (13.6 mg/kg) located adjacent to monitoring well AD-5 which is hydraulically upgradient (northwest) of the PBAP. This upgradient (background) data indicates lithium concentrations in soil in the area of the PBAP are naturally occurring and not the result of impacts from CCR materials. This is one line of evidence that the lithium detected in groundwater at monitoring well AD-9 is from a naturally occurring source, and not the CCR unit. As shown on **Table 4-1** and **Figure 4-2**, the highest iron concentrations in soil are from soil borings AD-22 and AD-23 (17,600 to 85,500 mg/kg) which are located in the Queen City Formation upgradient of the Site; SB-4 (AD-5; 10,400 mg/kg), located in the Reklaw Formation upgradient (northwest) of the PBAP; and soil boring SB-8 (AD-3; 11,000 mg/kg), located in the Reklaw Formation over 1,000 ft south (side gradient) of the PBAP. **Figure 4-3** shows an apparent correlation between the iron and lithium content in the coal ash, upgradient locations, and downgradient locations. However, SPLP and pore water results from the coal ash samples show that the iron and lithium present in the coal ash is not in a mobile (leachable) form. Therefore, it is more likely that the regional groundwater interaction with naturally occurring lithium and iron in soil is responsible for the observed lithium concentrations and variability across the Site. As detailed below in Section 4.2.2, iron and lithium concentrations in groundwater at the Site show a similar distribution to iron and lithium concentrations in soil, indicating naturally occurring sources for iron and lithium.

4.2.2 Groundwater Evaluation

Groundwater analytical results for the PBAP, the landfill, and the bottom ash storage pond are summarized on **Tables 4-2**, **4-3**, and **4-4**, respectively. As shown on **Figure 4-4** and **Figure 4-5**, the highest lithium concentrations in the most recent (February and May 2020) groundwater samples is at monitoring well AD-17 (0.273 and 0.302 mg/L, respectively), which is west (upgradient) relative to the PBAP. Monitoring well AD-18, which is also west (upgradient) relative to the PBAP, was not sampled during February and May 2020 but historically has the highest lithium concentrations in groundwater at the Site. This data indicates lithium concentrations in groundwater in the area of the PBAP are from a source other than the PBAP.

As shown on **Figure 4-6**, iron concentrations in groundwater are also elevated upgradient (west) relative to the PBAP. **Figure 4-7** shows the relationship of total and dissolved iron concentrations to lithium concentrations in upgradient, side-gradient, and downgradient monitoring wells for 2018 and 2019 data. These results demonstrate a clear correlation between aqueous iron and lithium, with higher lithium concentrations associated with elevated iron. The greatest concentrations of both iron and lithium are observed in the upgradient monitoring wells AD-17 and AD-18. This is consistent with 2020 groundwater data at AD-17. As identified in **Table 4-1** and noted on **Figure 4-7**, SPLP leachate and pore water analyzed from coal ash samples contain lithium in concentrations below detection, or at very low concentrations less than 0.02 mg/L. This data indicates lithium concentrations in groundwater in the area of the PBAP are from a source other than the PBAP. Additionally, the most recent data is included on a lithium concentration versus time graph provided as **Figure 4-8**. Lithium concentrations in AD-9 show a decreasing trend during 2020, which corresponds to lower turbidity in those samples. As shown, the lithium concentration in groundwater at AD-18 is consistent and higher than lithium concentrations in the downgradient PBAP monitoring wells. Lithium concentrations in groundwater at AD-17 are also higher than downgradient PBAP monitoring wells. In addition, coal ash pore water lithium concentrations are plotted at an average concentration of 0.015 mg/L. As shown, upgradient lithium concentrations are higher than the coal ash pore water samples and support that lithium groundwater concentrations in the area of the PBAP are from a source other than the PBAP.

Lithium groundwater concentrations at monitoring well AD-9 were further evaluated with respect to coal ash pore water samples. The coal ash pore water samples exhibit lower concentrations of lithium, as well as lower concentrations of sulfate and chloride (Appendix III constituents typically associated with coal ash), suggesting the groundwater signature at AD-9 is not associated with coal ash influence (**Figure 4-9** and 4-10). This is further supported by the fact that boron, which is present in coal ash pore water at concentrations greater than 0.6 mg/L, is higher in the coal ash pore water than at AD-9 (**Figure 4-9**). If for example the coal ash water samples collected were diluted relative to more representative water emanating from the bottom of the PBAP, then a higher signature would also be expected for boron at AD-9. Concentration ratios of boron, lithium, sulfate, and chloride (constituents which are anticipated to travel with limited attenuation in groundwater) are therefore not consistent with coal ash influence. Similarly, the chloride concentration was compared to lithium concentrations over time in AD-9 (**Figure 4-10**). As shown, there is a general correlation with lithium and chloride concentrations over time that may be related to seasonal variation, weather variability, and/or sampling methodology. Since naturally-occurring lithium in the soil is likely controlled by ion exchange, it would be expected that lithium concentrations would be higher in waters with greater TDS or ionic strength releasing lithium from the soil.

As discussed above in Section 2.2.1, the Queen City Formation, which overlies the Reklaw Formation, is located directly west of the Site. Therefore, groundwater from the Queen City Formation west (upgradient) of the CCR units may be the source of lithium and iron detected in soils and groundwater in the area of the CCR units. As discussed above in Section 2.3.1, elevated naturally occurring iron is documented in the Cypress Aquifer, and as discussed above in Section 2.2.1, the Queen City Formation contains naturally-occurring iron concretions and correspondingly high iron concentrations in soil samples.

Another line of evidence the lithium detected in groundwater in the area of the PBAP is from a naturally occurring source is provided in the 2002 Publication “Springs of Texas” (Gunnar Brune 1981). The Springs of Texas publication states “*Hynson Springs, also known as Marshall, Noonday Camp, and Iron Springs, are six kilometers north of Hallsville. They became very popular as a health resort about 1851. The waters are highly mineralized, containing much iron, sulfur, aluminum, and lithium. Originally there were said to be over 100 springs flowing from the Queen City Formation*.” This spring, which contains naturally-occurring lithium, is located approximately 35 miles southeast of the Site. A copy of this reference is provided in **Appendix B**.

When reviewing historical and recent datasets, a broad relationship was noted between trace metal chemistry and turbidity. Where turbidity values were greatest, greater concentrations of selected CCR monitored constituents were also observed (e.g. arsenic and cadmium) and in some cases, in exceedance of Federal MCLs. As a result, low-flow sampling methodology was employed to reduce the amount of turbidity in the groundwater sample.

A comprehensive groundwater sampling event was conducted at the Site by Arcadis during May 2018 using low-flow methodology. A clean stainless steel low-flow sampling pump with new, well-dedicated polyethylene piping was slowly lowered into the mid-point of the water column at each monitoring well, and groundwater was then pumped at a low flow rate of less than 0.1 liters per minute until the produced water was visually clear. The turbidity of the produced water was measured using calibrated field instruments during well development, and groundwater samples were not collected until the turbidity measurements declined and stabilized. Once low-flow groundwater sampling techniques were properly followed by Arcadis during May 2018, water quality results indicated concentrations of selected constituents to be much less than previously reported and did not exceed criteria. Therefore, it was determined that the sediment disturbances generated during well purging and improper (turbid) groundwater sampling were contributing to the Federal MCL groundwater exceedances. Specifically, since CCR Rule monitoring requires analysis of unfiltered samples, the results suggest that the exceedances were associated with constituents present in undissolved suspended solid particulates rather than in a dissolved form, on a location by location basis. The May 2018 groundwater analytical results are most representative of groundwater quality at the Site because proper low-flow sampling protocols were adhered to and sediment contributions to the analytical results were minimized.

5 SUMMARY AND CONCLUSIONS

This ASD has been prepared in consultation with the Electric Power Research Institute "Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites". The following lines of evidence indicate the SSL related to the lithium concentration in groundwater at AD-9 is from naturally occurring sources (ASD Type V), with some additional contributions from sampling methodology error (ASD Type I):

- An SSI was confirmed for boron within monitoring well AD-8 followed by a failed Alternate Source Demonstration for boron, triggering the assessment monitoring program for the PBAP. Under the assessment monitoring program, an SSL was identified for lithium which exceeded the GWPS of 0.390 mg/L at monitoring well AD-9 (1.11 mg/L), despite no observed SSIs in Appendix III parameters for this well (Geosyntec 2019c). SSIs would be expected for Appendix III parameters if there was a CCR unit source for the lithium exceedance of the SSL, indicating that there may be an alternate source of lithium. This is a key line of evidence that the PBAP is not the source of elevated lithium concentrations in soil at the Site.
- As demonstrated in this ASD report, iron and lithium are associated in the sediments and in groundwater. The subsoils at the Site, particularly the Susquehanna fine sandy loam, contain naturally occurring high clay content. The role of iron incorporated into the clay structure is important to localized geochemical processes, such as cation exchange, redox conditions, and hydrophilic properties, which can influence weathering characteristics and the mobility of trace constituents (i.e. lithium) in groundwater (Stucki 2005). This is a supporting line of evidence.
- The highest lithium concentrations in the soil samples collected during the Arcadis May 2018 and June 2019 investigations was from background soil samples (AD-22, 3-5 ft depth; SB-4, 27 ft depth) located upgradient (northwest) of the PBAP. This is a key line of evidence that the PBAP is not the source of elevated lithium concentrations in soil at the Site.
- Leachate and pore water analyzed from coal ash samples contain lithium in concentrations below detection, or at very low concentrations less than 0.02 mg/L. Comparisons with other potential CCR constituents (chloride, sulfate, and boron) further demonstrate that ion ratios are not consistent with lithium impacts by coal ash at AD-9. This data indicates lithium concentrations in groundwater in the area of the PBAP are from a source other than the PBAP. This is a key line of evidence.
- The highest lithium concentration in groundwater samples collected during the Arcadis May 2018 investigation was from an upgradient (background) monitoring well (AD-18) located west of the PBAP. This is a key line of evidence that the PBAP is not the source of elevated lithium concentrations in groundwater at the Site.
- Iron and lithium concentrations in soil and groundwater at the Site show a similar distribution, indicating there is likely a common source for these metals. The 1965 USGS publication "*Ground-Water Resources of Camp, Franklin, Morris and Titus Counties, Texas"* documents naturally occurring high iron concentrations within zones of the Cypress Aquifer, in which the monitoring wells at the Site are completed. The University of Texas at Austin Bureau of Economic Geology 1966 publication "*Geologic Atlas of Texas, Texarkana Sheet*" documents naturally occurring iron

concretions in the Queen City Formation, which outcrops directly west (upgradient) of the PBAP. This is a supporting line of evidence.

- The 1981 Gunnar Brune publication "*Springs of Texas*" documents naturally occurring elevated lithium in groundwater in the Queen City Formation at Hynson Springs, which is approximately 35 miles from the Site. The publication states "*Hynson Springs, also known as Marshall, Noonday Camp, and Iron Springs, are six kilometers north of Hallsville. They became very popular as a health resort about 1851. The waters are highly mineralized, containing much iron, sulfur, aluminum, and lithium. Originally there were said to be over 100 springs flowing from Queen City sand*". This publication, along with soil and groundwater analytical data at the Site, supports the conclusion that the primary source of lithium in groundwater at the PBAP is from the Queen City Formation, which outcrops directly west (upgradient) of the PBAP. This is a key line of evidence.
- As summarized on **Tables 4-2** through **4-4**, elevated turbidity (>10 nephelometric turbidity units) was present in many of the groundwater samples collected at the Site. Metals concentrations were generally lower during the May 2018 Arcadis groundwater sampling event when proper low-flow sampling techniques were utilized and turbidity was low. Lithium concentrations in AD-9 show a decreasing trend during 2020 which corresponds to lower turbidity in those samples. Effective well development and proper low flow sampling techniques minimize the potential for groundwater analyses to be unrepresentative of formation groundwater. This is a supporting line of evidence.
- This ASD report provides a strong demonstration of naturally occurring sources of lithium in groundwater (ASD Type V) as supported by five key lines of evidence and three supporting lines of evidence.

6 PROFESSIONAL ENGINEER'S CERTIFICATION

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the alternate source demonstration for lithium at the Primary Bottom Ash Pond meets the requirements of 40 CFR Part 257.95.

Kenneth J. Brandner

Printed Name of Registered Professional Engineer

Kenneth J Brandner

10-28-20

Signature

KENNETH J. BRANDNER

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Registration No.	Registration State	Date

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TABLES

Table 2-1
Grain Size Distribution in Soil and Subsoil of the Norfolk Sandy Loam
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Grain Size	Soil	Subsoil
Fine Gravel	0.0%	0.0%
Coarse Sand	0.2%	0.1%
Medium Sand	0.4%	0.3%
Fine Sand	29.4%	29.9%
Very Fine Sand	37.9%	24.0%
Silt	25.9%	25.1%
Clay	5.9%	20.2%

Table 2-2
Grain Size Distribution in Soil and Subsoil of the Susquehanna Fine Sandy Loam
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Grain Size	Soil	Subsoil
Fine Gravel	0.4%	0.0%
Coarse Sand	0.7%	0.2%
Medium Sand	0.9%	0.8%
Fine Sand	53.4%	36.6%
Very Fine Sand	16.0%	10.8%
Silt	21.2%	19.0%
Clay	7.2%	32.8%

Table 2-3
Well Construction and Water Level Data - CCR Units
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole Depth ft. bls	Date Installed	Screen Material	Well Diameter inches	Top of Screen		Bottom of Screen		6/7/2011	12/6/2011	5/2/2012	11/1/2012	5/14/2013	11/19/2013	5/12/2014	11/16/2014	5/12/2015	3/4/2016	5/26/2016	7/27/2016	10/19/2016
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																									
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57	338.46	334.92	337.88	337.18	337.43	336.73	338.03	337.64	340.82	342.83	344.89	342.89	341.23
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16	330.16	329.07	330.00	329.26	329.83	329.70	330.09	329.69	332.56	332.32	---	---	---
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10	323.81	323.19	323.99	323.29	323.77	323.98	324.12	323.28	325.58	325.12	324.59	323.70	323.47
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61	324.81	324.84	324.62	324.40	324.74	325.52	325.44	325.13	327.00	326.90	---	---	---
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19	325.01	324.19	325.24	322.90	324.86	324.68	325.64	325.34	327.19	327.12	---	---	---
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55	324.35	324.32	324.50	324.30	324.30	325.21	325.22	324.90	326.58	326.67	---	---	---
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15	324.18	324.50	324.64	324.37	324.11	325.06	325.01	324.71	326.50	326.19	325.89	324.01	323.76
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00	336.34	336.58	336.82	336.99	336.78	336.47	336.80	336.01	339.07	338.04	337.62	337.24	337.74
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31	333.04	333.02	332.83	333.02	333.11	332.81	333.11	332.81	333.38	334.00	---	---	---
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86	334.32	334.12	334.19	334.20	334.13	334.58	333.77	333.98	334.09	333.61	---	---	---
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53	325.41	324.09	325.69	325.15	325.79	325.75	325.98	325.77	326.05	325.70	325.68	325.05	325.29
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32	328.46	328.53	328.63	328.44	328.74	329.38	NM	330.18	329.98	329.74	329.28	329.53	328.92
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23	323.44	322.55	323.27	323.35	323.51	323.76	323.57	323.88	323.95	323.55	---	---	---
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61	327.99	328.37	327.82	327.93	327.94	328.13	328.20	327.97	328.96	328.13	328.39	328.14	327.87
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27	348.30	348.29	349.86	349.56	349.99	349.65	349.89	350.01	350.65	350.39	---	---	---
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12	332.36	332.24	333.09	332.26	332.68	333.25	333.35	332.01	337.58	334.76	334.54	332.93	332.39
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32	330.40	329.80	331.67	330.34	330.94	331.69	332.12	330.17	336.63	334.83	334.51	331.71	330.94
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71	---	---	---	---	---	---	---	---	---	322.14	321.93	321.28	321.42
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86	---	---	---	---	---	---	---	---	---	337.09	335.84	332.14	331.52
AD-16R (e)	33° 02' 49"	94° 50' 28.9"	350.55	353.49	27.0	4/12/17	Sch. 40 PVC	2	12.0	338.55	27.0	323.55	---	---	---	---	---	---	---	---	---	---	---	---	---
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99	---	---	---	---	---	---	---	---	---	334.64	334.26	334.30	334.45
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17	---	---	---	---	---	---	---	---	---	343.66	343.26	340.81	339.92
AD-19	33.047201°	94.839694°	323.58	326.35	15.0	5/8/18	Sch. 40 PVC	2	5.0	318.58	15.0	308.58	---	---	---	---	---	---	---	---	---	---	---	---	---
AD-20	33° 02' 45.6"	94° 50' 22.8"	324.85	327.65	20.0	10/23/18	Sch. 40 PVC	2	4.0	320.85	19.0	305.85	---	---	---	---	---	---	---	---	---	---	---	---	---
AD-21	33° 02' 49.6"	94° 50' 20"	322.04	325.29	20.0	10/23/18	Sch. 40 PVC	2	3.5	318.54	18.5	303.54	---	---	---	---	---	---	---	---	---	---	---	---	---
AD-22	33° 03' 35"	94° 51' 09"	360.94	360.22	20.0	6/18/19	Sch. 40 PVC	2	5.0	355.94	20.0	340.94	---	---	---	---	---	---	---	---	---	---	---	---	---
AD-23	33° 03' 56"	94° 51' 08"	369.37	368.82	20.0	6/18/19	Sch. 40 PVC	2	5.0	364.37	20.0	349.37	---	---	---	---	---	---	---	---	---	---	---	---	---
Piezometers																									
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Temp-1	33.046864°	94.852059°	356.36	358.17	28.0	5/8/18	Sch. 40 PVC	2	8.0	348.36	28.0	328.36	---	---	---	---	---	---	---	---	---	---	---	---	---
MW-9	33° 03' 18"	94° 50' 19.4"	342.00	344.54	18.0	11/19/01	Sch. 40 PVC	2	3.0	339.00	18.0	324.00	---	---	---	---	---	---	---	---	---	---	---	---	---
MW-10	33° 03' 13.6"	94° 50' 19.4"	341.96	344.80	19.0	11/19/01	Sch. 40 PVC	2	4.0	337.96	19.0	322.96	---	---	---	---	---	---	---	---	---	---	---	---	---

NOTES:

NM - Not measured.

(a) Source: Eagle Environmental Services Well Logs (2009).

(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).

(c) Source: Southwest Electric Power, State of Texas Well Report (2001).

(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.

(e) Monitoring well installed by ARCADIS on April 12, 2017 as a replacement for monitoring well AD-16.

Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through February 2017.

1983 State Plane Lambert Coordinate System

Datum: NAD 83

ft bls = feet below land surface

ft msl = feet above mean sea level

Elev. = Elevation

--- = No record

Table 2-3
Well Construction and Water Level Data - CCR Units
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole Depth ft. bls	Date Installed	Screen Material	Well Diameter inches	Top of Screen		Bottom of Screen		12/12/2016	1/17/2017	2/23/2017	10/6/2017	5/15/2018	10/29/2018	6/19/2019	7/24/2019	2/17/2020	5/20/2020
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																						
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57	340.58	341.18	339.74	337.70	340.57	339.10	345.37	343.95	341.88	344.09
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16	---	---	---	---	331.50	331.25	333.61	332.55	---	333.22
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10	323.78	325.04	324.92	323.24	324.30	324.15	325.42	324.72	---	325.38
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61	---	---	---	---	---	---	---	325.58	---	326.90
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19	---	---	---	---	---	---	---	325.74	---	327.10
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55	---	---	---	---	---	---	---	324.95	---	326.60
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15	325.07	326.39	324.89	324.20	324.95	325.62	325.98	324.73	---	326.20
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00	337.01	338.34	336.17	337.40	337.25	336.98	337.18	336.89	338.56	337.79
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31	---	---	---	---	---	333.42	333.42	---	---	333.62
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86	---	---	---	---	---	---	335.00	334.61	---	334.26
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53	325.92	326.76	324.27	326.12	325.63	326.36	326.17	325.80	326.04	326.32
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32	329.31	330.50	328.05	329.47	329.40	329.98	330.01	329.57	329.58	329.75
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23	---	---	---	---	323.53	324.19	324.06	323.76	---	323.61
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61	328.20	328.90	328.25	327.85	327.61	327.83	328.72	327.97	328.10	328.33
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27	---	---	---	---	349.52	348.28	350.81	---	---	350.22
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12	332.84	334.54	331.83	331.42	331.83	331.52	332.98	332.23	333.38	333.29
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32	330.79	332.63	330.87	329.91	330.76	330.52	333.94	331.85	333.44	333.97
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71	321.71	321.64	322.81	322.07	321.74	322.01	322.24	321.43	322.12	322.17
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86	331.43	330.96	330.71	---	---	---	---	---	---	---
AD-16R (e)	33° 02' 49"	94° 50' 28.9"	350.55	353.49	27.0	4/12/17	Sch. 40 PVC	2	12.0	338.55	27.0	323.55	---	---	---	327.12	328.68	326.71	335.13	332.11	---	330.36
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99	334.64	334.05	333.94	334.17	334.35	333.91	335.39	334.94	334.94	335.10
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17	339.38	338.97	340.38	339.43	342.75	340.97	343.70	342.65	---	343.87
AD-19	33.047201°	94.839694°	323.58	326.35	15.0	5/8/18	Sch. 40 PVC	2	5.0	318.58	15.0	308.58	---	---	---	---	321.24	321.54	322.65	---	---	---
AD-20	33° 02' 45.6"	94° 50' 22.8"	324.85	327.65	20.0	10/23/18	Sch. 40 PVC	2	4.0	320.85	19.0	305.85	---	---	---	---	---	323.28	322.89	---	---	---
AD-21	33° 02' 49.6"	94° 50' 20"	322.04	325.29	20.0	10/23/18	Sch. 40 PVC	2	3.5	318.54	18.5	303.54	---	---	---	---	---	320.26	320.72	---	---	---
AD-22	33° 03' 35"	94° 51' 09"	360.94	360.22	20.0	6/18/19	Sch. 40 PVC	2	5.0	355.94	20.0	340.94	---	---	---	---	---	---	358.24	---	---	357.93
AD-23	33° 03' 56"	94° 51' 08"	369.37	368.82	20.0	6/18/19	Sch. 40 PVC	2	5.0	364.37	20.0	349.37	---	---	---	---	---	---	364.98	---	---	364.61
Piezometers																						
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Temp-1	33.046864°	94.852059°	356.36	358.17	28.0	5/8/18	Sch. 40 PVC	2	8.0	348.36	28.0	328.36	---	---	---	---	345.55	342.79	350.08	NM	NM	NM
MW-9	33° 03' 18"	94° 50' 19.4"	342.00	344.54	18.0	11/19/01	Sch. 40 PVC	2	3.0	339.00	18.0	324.00	---	---	---	---	331.34	331.24	NM	NM	NM	NM
MW-10	33° 03' 13.6"	94° 50' 19.4"	341.96	344.80	19.0	11/19/01	Sch. 40 PVC	2	4.0	337.96	19.0	322.96	---	---	---	---	332.29	332.75	337.26	NM	NM	NM

NOTES:
NM - Not measured.
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
(e) Monitoring well installed by ARCADIS on April 12, 2017 as a replacement for monitoring well AD-16.
Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through February 2017.
1983 State Plane Lambert Coordinate System
Datum: NAD 83
ft bls = feet below land surface
ft msl = feet above mean sea level
Elev. = Elevation
--- = No record

Table 4-1
Soil and Coal Ash Sample Analytical Results (mg/kg) - CCR Units
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Sample ID	Date Sampled	Sample Depth (feet)	Units	Appendix III Parameters						Appendix IV Parameters															
				Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Soil Samples																									
Temp-1	5/8/18	15'	mg/kg	14.3	43.3	15	<1	5.0	93	<0.25	1.77	16.8	<0.05	<0.05	5.22	0.28	1.77	0.104	0.004	1.18	<0.25	1.26	0.273	<12.5	5.4
SB-2	5/10/18	22'	mg/kg	11.9	35.8	13	2	3.9	878	<0.25	<0.25	18.3	0.08	<0.05	3.53	0.551	3.98	0.08	0.005	0.287	0.684	<0.25	0.159	890	4.46
(AD-17)																									
SB-3	5/10/18	30'	mg/kg	3.05	90.2	94	1	3.8	1,194	<0.25	3.83	13.6	<0.05	0.132	9.21	0.649	4.22	0.322	0.009	1.64	<0.25	<0.25	0.593	3,960	6.87
(AD-18)																									
SB-4	5/9/18	5'	mg/kg	(FOC = 0.00723 g/g)			---	4.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
(AD-5)		27'	mg/kg	7.76	634	8	1	6.4	724	<0.25	1.81	20.4	0.115	0.417	6.73	4.76	3.2	13.6	0.006	0.561	0.536	<0.25	0.657	10,400	65.5
(Background)		27'	mg/kg	(FOC = 0.00688 g/g)																					
SB-5	5/9/18	19'	mg/kg	5.45	655	16	3	7.2	69	<0.25	1.11	8.53	0.109	0.241	3.75	3.58	2.96	10.5	0.044	0.313	0.297	<0.25	0.216	6,210	35.5
(AD-8)																									
SB-6	5/9/18	21'	mg/kg	5.33	397	20	2	7.8	116	<0.25	1.11	17.9	0.09	0.24	3.5	3.37	2.67	10.3	0.051	0.299	0.471	<0.25	2.502	5,970	38.4
(AD-9)																									
SB-7	5/9/18	13'	mg/kg	8.11	1,360	19	<1	5.0	198	<0.25	10.1	65	0.154	0.356	6.87	3.21	3.14	5.3	0.004	1.39	<0.25	<0.25	0.262	9,220	28.4
(AD-13)																									
SB-8	5/9/18	12'	mg/kg	16.6	6,150	13	1	5.2	24	<0.25	3.3	213	0.409	0.452	8.22	4.13	9.05	4.63	0.013	0.488	<0.25	<0.25	0.433	11,000	25.4
(AD-3)																									
AD-20	10/23/18	15-17	mg/kg	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.567	---	---
AD-21	10/23/18	15-17	mg/kg	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.424	---	---
AD-22	6/18/19	3-5	mg/kg	16.7	110	---	---	4.84	---	<0.25	8.43	136	0.544	0.935	29.9	13	18.9	18	0.053	0.711	1.81	<0.25	---	25,800	---
		6-8	mg/kg	10.2	18.7	---	---	4.1	---	<0.25	20.9	30.4	0.246	0.723	17.7	9.65	8.95	2.9	0.009	0.446	1.08	<0.25	---	22,500	---
		11-13	mg/kg	8.83	219	---	---	4.26	---	<0.25	5.96	77.1	0.293	0.571	16.5	8.75	6.57	4.4	0.045	0.536	0.885	<0.25	---	17,600	---
AD-23	6/18/19	3-5	mg/kg	32.7	115	---	---	4.64	---	<0.25	14.1	45.5	0.805	3.23	49	30.8	11	7.74	0.035	1.14	4.27	<0.25	---	85,500	---
		5-7	mg/kg	10.2	22.7	---	---	4.25	---	<0.25	6.3	31.7	0.288	0.775	19	9.74	8.56	4.83	0.014	0.378	1.12	<0.25	---	22,700	---
		10-12	mg/kg	9.16	200	---	---	4.21	---	<0.25	4.13	28.3	0.288	0.613	23.9	8.19	7.03	3.41	0.015	1.03	0.635	<0.25	---	18,500	---
Coal Ash Samples																									
Ash-1	5/10/18	1-2'	mg/kg	34.4	33,800	30.5	8.21	7.1	219	<0.877	14.6	607	1.02	0.464	31.8	5.55	16.9	11.6	0.0473	2.66	2.27	<0.54	*2.92*	37,500	139
		SPLP:	*mg/L*	*0.594*	*30.2*	---	---	---	---	*<0.00344*	*<0.00411*	*0.284*	*<0.000333*	*<0.000164*	*0.00273*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0176*	*<0.00363*	*<0.00287*	*0.0991*	*<0.0305*	*<0.00267*
		Pore Water:	*mg/L*	*0.643*	*113*	*20.1*	*1.86*	*7.4*	*6.6*	*<0.00344*	*0.0095*	*3.43*	*<0.000333*	*<0.000164*	*0.00396*	*<0.000553*	*<0.00285*	*0.0123*	*<0.0000653*	*0.00484*	*<0.00363*	*<0.00287*	0.755	---	*0.357*
Ash-2	5/10/18	1-2'	mg/kg	92.6	96,000	53.8	11.2	7.3	293	<1.56	19.4	2,760	1.64	1.56	41.2	9.63	24.5	15.5	0.0967	2.08	5.25	<0.957	*2.32*	18,300	365
		SPLP:	*mg/L*	*0.526*	*24.1*	---	---	---	---	*<0.00344*	*<0.00411*	*0.192*	*<0.000333*	*<0.000164*	*0.00222*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0165*	*<0.00363*	*<0.00287*	*0.112*	*<0.0305*	*<0.00267*
		Pore Water:	*mg/L*	*0.772*	*143*	*20.4*	*0.28*	*7.6*	*8.73*	*<0.00344*	*0.0106*	*3.99*	*<0.000333*	*<0.000164*	*0.00196*	*<0.000553*	*0.00346*	*0.0173*	*<0.0000653*	*0.00428*	*<0.00363*	*<0.00287*	0.508	---	*0.376*
Ash-3	5/10/18	1-2'	mg/kg	29	14,300	11.5	10.7	7.4	152	<0.687	11.8	766	0.845	0.394	19.2	5.77	12.2	6.87	0.0403	1.79	1.44	<0.423	*1.754*	21,100	110
		SPLP:	*mg/L*	*0.958*	*19.8*	---	---	---	---	*<0.00344*	*<0.00411*	*0.0315*	*<0.000333*	*<0.000164*	*0.00389*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0222*	*<0.00363*	*<0.00287*	*<0.256*	*0.471*	*<0.00267*
		Pore Water:	*mg/L*	*1.000*	*103*	*13.0*	*0.998*	*7.6*	*51.1*	*<0.00344*	*0.0108*	*1.54*	*<0.000333*	*<0.000164*	*0.00110*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0111*	*<0.00363*	*<0.00287*	0.594	---	*0.715*
Ash-4	5/10/18	1-2'	mg/kg	281	106,000	27.6	1.34	10.5	961	<0.757	9.72	3,390	2.23	1.06	35.1	16.2	16.3	20.4	0.0340	2.21	1.30	<0.466	*3.18*	24,200	177
		SPLP:	*mg/L*	*1.3*	*25.1*	---	---	---	---	*<0.00344*	*<0.00411*	*0.0216*	*<0.000333*	*<0.000164*	*0.00329*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*<0.00281*	*<0.00363*	*<0.00287*	*<0.407*	*<0.0305*	*<0.00267*
		Pore Water:	*mg/L*	*4.75*	*63.5*	*28.8*	*0.697*	*10.8*	*381*	*<0.00344*	*0.00745*	*0.217*	*<0.000333*	*<0.000164*	*0.00225*	*0.00093*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0798*	*<0.00363*	*<0.00287*	0.259	---	*0.00814*

NOTES:
mg/kg = Milligrams per kilogram
mg/L = Milligrams per liter
FOC = Fraction organic carbon (Walkley Black)
--- = Not analyzed
SPLP = Synthetic precipitation leaching procedure (concentrations shown in milligrams per liter)
Total concentrations (mg/kg) shown in normal font, SPLP and Pore Water concentrations (mg/L) shown in italics.
Radium concentrations for soil shown in picoCuries per gram. SPLP concentrations shown in picoCuries per liter.

Table 4-2
Groundwater Sampling Analytical Results (mg/L) - Primary Bottom Ash Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

		Appendix III Parameters								Appendix IV Parameters															
Well	**Date Sampled**	**Boron (total)**	**Calcium (total)**	**Chloride**	**Fluoride**	**pH**	**Turbidity (field)**	**Sulfate**	**TDS**	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Cobalt**	**Lead**	**Lithium**	**Mercury**	**Molybdenum**	**Selenium**	**Thallium**	**Radium 226 and 228 (pCi/L)**	**Iron**	**Manganese**
Background (Upgradient) Wells																									
AD-1	05/26/16	0.346	36.5	5	<1	5.93	--	42	252	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.010	0.000033	<0.005	<0.005	<0.002	1.18	--	--
	07/27/16	0.350	39.6	4	<1	5.93	--	36	239	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.019	<0.000025	<0.005	<0.005	<0.002	0.9952	--	--
	09/29/16	0.332	15	5	<1	5.37	--	35	173	<0.005	<0.005	0.141	<0.001	<0.001	0.005	<0.005	<0.005	0.014	<0.000025	<0.005	<0.005	<0.002	1.38	--	--
	10/19/16	0.398	19.1	4	<1	5.15	--	42	192	<0.005	<0.005	0.114	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	1.141	--	--
	12/12/16	0.394	8.74	4	<1	5.18	--	40	200	<0.005	<0.005	0.072	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	0.719	--	--
	01/17/17	0.656	129	4	<1	7.13	--	68	538	<0.005	<0.005	0.410	<0.001	<0.001	<0.001	<0.005	<0.005	<0.001	<0.000025	<0.005	<0.005	<0.002	3.009	--	--
	02/23/17	0.700	147	9	<1	6.88	--	68	612	<0.005	<0.005	0.488	<0.001	<0.001	<0.001	<0.005	<0.005	0.001	<0.000025	<0.005	<0.005	<0.002	4.309	--	--
	06/07/17	0.449	15.1	4	<0.083	5.06	109	42	176	<0.00093	0.00114	0.09346	0.00037	<0.00007	0.00066	0.00077	<0.00068	0.00902	0.000007	<0.00029	0.0021	<0.00086	0.676	--	--
	10/06/17	--	--	--	--	5.25	97.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.352	12.1	3	<0.083	4.82	8.4	--	174	<0.00093	<0.00105	0.08823	0.00048	<0.00007	<0.00023	0.0008	<0.00068	0.00816	<0.000005	<0.00029	<0.00099	<0.00086	0.837	0.03	0.025
	Dissolved	*0.35*	*12*	--	--	4.82	8.4	--	--	*<0.00093*	*<0.00105*	*0.08582*	*0.00044*	*<0.00007*	*<0.00023*	*0.00083*	*<0.00068*	*0.00799*	*<0.000005*	*<0.00029*	*0.00197*	*<0.00086*	*0.531*	0.01	0.026
	05/24/18	0.345	10.2	4	<0.083	5.19	118	43	150	0.00317 J	<0.00105	0.0799	0.00039 J	<0.00007	<0.00023	0.00035 J	<0.00068	0.00814	0.000006 J	<0.00029	0.00138 J	<0.00086	1.983	--	--
	08/14/18	0.443	5.95	5	<0.083	5.18	102	44	160	0.00003 J	0.00021	0.063	0.000482	0.00002	0.00016	0.000797	0.000238	0.00708	0.000013 J	0.00021	0.0017	0.00003 J	1.10	--	--
	02/20/19	0.504	142	2.82	0.24	7.31	113	49.2	522	0.00016	0.00046	0.457	0.00009 J	0.00001 J	0.000306	0.000399	0.000124	0.00155	<0.000025	0.001 J	0.0007	<0.0005	3.16	--	--
	05/30/19	0.689	--	1.59	0.29	--	61.3	43.3	588	0.00016	0.00060	0.512	0.000244	0.00001 J	0.0001 J	0.000756	0.000197	<0.009	<0.000005	0.00243	0.0014	<0.0001	--	0.099	0.0625
	07/24/19	0.644	62.7	2	0.106 J	5.97	52.1	58	180	0.00008 J	0.00039	0.245	0.00054	0.00002 J	0.0001 J	0.000789	0.0001 J	0.00557	<0.000005	0.002 J	0.0034	<0.0001	1.819	--	--
	02/17/20	0.626	115	3.41	0.31	5.81	29.4	56.3	488	0.00033	0.00049	0.303	0.00007 J	0.00002 J	0.0001 J	0.00028	0.0001 J	0.00105	<0.000002	0.001 J	0.0023	<0.0001	2.665	--	--
	05/20/20	0.801	126	1.83	0.20	7.22	0.0	51.4	508	0.00015	0.00053	0.394	0.000270	0.00002 J	0.0001 J	0.000490	0.0001 J	0.00301	<0.000002	0.002 J	0.0028	<0.0001	2.312	--	--
AD-5	05/31/16	0.03	36.9	15	<1	6.38	--	123	337	<0.005	<0.005	0.057	<0.001	<0.001	<0.001	0.014	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	1.63	--	--
	07/28/16	0.04	44.7	16	<1	6.38	--	163	360	<0.005	<0.005	0.093	<0.001	<0.001	<0.001	0.015	<0.005	0.191	<0.000025	<0.005	<0.005	<0.002	4.75	--	--
	09/29/16	0.04	46.3	15	<1	5.29	--	190	416	<0.005	<0.005	0.087	<0.001	<0.001	<0.001	0.014	<0.005	0.186	<0.000025	<0.005	<0.005	<0.002	3.33	--	--
	10/20/16	0.05	50.7	14	<1	5.92	--	267	448	<0.005	<0.005	0.07	<0.001	<0.001	<0.001	0.009	<0.005	0.225	<0.000025	<0.005	<0.005	<0.002	2.319	--	--
	12/13/16	0.05	49.6	13	<1	6.29	--	233	484	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	0.013	<0.005	0.199	<0.000025	<0.005	<0.005	<0.002	2.182	--	--
	01/17/17	0.04	49.8	14	<1	6.27	--	234	438	<0.005	<0.005	0.047	<0.001	<0.001	<0.001	0.012	<0.005	0.239	<0.000025	<0.005	<0.005	<0.002	1.023	--	--
	02/23/17	0.04	33.0	15	<1	5.48	--	127	286	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	0.013	<0.005	0.166	<0.000025	<0.005	<0.005	<0.002	1.788	--	--
	06/07/17	0.05281	49.7	14	<0.083	5.96	867	82	300	<0.00093	0.00385	0.0877	0.00008	0.00039	0.00028	0.01193	<0.00068	0.124	<0.000005	<0.00029	<0.00099	<0.00086	2.32	--	--
	10/06/17	--	--	--	--	5.59	249	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.05063	30.1	21	<0.083	5.79	<100	--	248	<0.00093	<0.00105	0.07627	0.00014	0.00037	<0.00023	0.01907	<0.00068	0.118	<0.000005	<0.00029	<0.00099	<0.00086	1.495	14.4	0.45
	Dissolved	*0.03752*	*29.1*	--	--	5.79	<100	--	--	*<0.00093*	*<0.00105*	*0.06865*	*<0.00002*	*<0.00007*	*<0.00023*	*0.01747*	*<0.00068*	*0.119*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.043*	*2.051*	8.38	0.43
	05/24/18	0.05007	28.1	22	<0.083	6.22	17.8	60	242	<0.00093	<0.00105	0.07116	<0.00002	0.00023 J	0.0008 J	0.01424	<0.00068	0.121	<0.000005	<0.00029	<0.00099	<0.00086	1.946	--	--
	08/15/18	0.05	40.5	19	<0.083	6.23	57.1	240	428	0.00001 J	0.00169	0.0637	0.000055	0.000008 J	0.000072	0.0114	0.000079	0.147	<0.000005	0.00013	0.00008 J	<0.00005	0.316	--	--
	02/21/19	0.033	33.9	24.7	0.21	5.38	164	46.5	220	0.00002 J	0.00159	0.0694	0.00008 J	<0.00005	0.000432	0.00858	0.000147	0.0807	<0.000025	<0.002	0.0001 J	<0.0005	1.27	--	--
	05/30/19	0.03 J	--	22.3	0.29	--	150	51.3	238	<0.00002	0.00305	0.0605	0.00008 J	<0.00001	0.00006 J	0.0118	0.00005 J	0.104	0.000006	<0.0004	0.00005 J	<0.0001	--	23.4	0.331
	07/24/19	0.04 J	41.1	18	0.112 J	6.3	108	90	354	<0.00002	0.00248	0.0774	0.00005 J	<0.00001	0.00005 J	0.00838	<0.00005	0.108	<0.000005	<0.0004	0.00006 J	<0.0001	2.533	--	--
	02/17/20	0.03 J	39.8	19.8	0.22	5.45	422	43.7	248	0.00003 J	0.00217	0.109	0.00009 J	0.00002 J	0.000336	0.00452	0.000227	0.0732	<0.000002	0.0009 J	0.0002	<0.0001	2.393	--	--
	05/20/20	0.03 J	40.2	22.3	0.18	6.83	355	55.5	264	<0.00002	0.00178	0.0931	0.00005 J	0.00001 J	0.0001 J	0.00765	0.00007 J	0.0740	<0.000002	<0.0004	0.00009 J	<0.0001	1.612	--	--
AD-17	05/26/16	0.121	200	43	<1	7.17	--	1,166	1,810	<0.005	<0.005	0.021	<0.001	0.002	0.001	0.063	<0.005	0.370	0.000032	<0.005	<0.005	<0.002	1.53	--	--
	07/27/16	0.119	195	32	<1	7.17	--	1,005	1,576	<0.005	<0.005	0.020	<0.001	0.004	0.001	0.068	<0.005	0.374	<0.000025	<0.005	<0.005	<0.002	2.78	--	--
	09/29/16	0.111	191	36	<1	6.17	--	1,055	1,663	<0.005	<0.005	0.031	<0.001	<0.001	0.003	0.058	<0.005	0.354	<0.000025	<0.005	<0.005	<0.002	2.358	--	--
	10/20/16	0.124	194	32	1.0	6.14	--	1,163	1,612	<0.005	<0.005	0.034	<0.001	0.002	0.004	0.065	<0.005	0.394	<0.000025	<0.005	<0.005	<0.002	2.224	--	--
	12/13/16	0.135	196	31	<1	6.03	--	1,096	1,560	<0.005	<0.005	0.017	<0.001	0.003	<0.001	0.068	<0.005	0.323	<0.000025	<0.005	<0.005	<0.002	2.384	--	--
	01/17/17	0.101	196	33	<1	5.96	--	1,445	1,686	<0.005	<0.005	0.014	<0.001	0.003	0.068	0.068	<0.005	0.341	<0.000025	<0.005	<0.005	<0.002	2.436	--	--
	02/22/17	0.135	189	30	<1	5.67	--	1,055	1,628	<0.005	<0.005	0.020	<0.001	0.002	0.001	0.073	<0.005	0.331	<0.000025	<0.005	<0.005	<0.002	2.288	--	--
	06/06/17	0.121	188	30	<0.083	5.81	156	1,105	1,578	<0.00093	<0.00105	0.01033	<0.00002	0.00606	<0.00023	0.0748	<0.00068	0.329	0.000013	<0.00029	<0.00099	<0.00086	1.598	--	--
	10/05/17	--	--	--	--	5.92	598	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.247	213	45	<0.083	5.51	<100	--	1,846	<0.00093	<0.00105	0.00978	<0.00002	0.00915	<0.00023	0.07451	<0.00068	0.306	<0.000005	<0.00029	0.00414	<0.00086	1.514	260	3.72
	Dissolved	*0.231*	*205*	--	--	5.51	<100	--	--	*<0.00093*	*<0.00105*	*0.00737*	*<0.00002*	*0.00609*	*<0.00023*	*0.07938*	*<0.00068*	*0.301*	*<0.000005*	*<0.00029*	*0.00515*	*0.02*	*1.57*	241	3.56
	05/24/18	0.239	193	39	<0.083	6.28	7.8	1,067	1,836	<0.00093	<0.00105	0.00965	<0.00002	0.00646	<0.00023	0.07173	<0.00068	0.308	<0.000005	<0.00029	<0.00099	<0.00086	1.939	--	--
	08/15/18	0.118	187	40	<0.083	5.60	418	1,170	1,750	0.00002 J	0.00183	0.0128	0.000069	0.00025	0.000604	0.0435	0.0011	0.243	0.000011 J	0.00035	0.0003	0.000074	2.35	--	--
	02/21/19	0.151	207	43.2	0.180	6.93	274	1,060	1,720	0.00008 J	0.00251	0.120	0.00024	0.00027	0.00334	0.0645	0.00249	0.268	0.000007 J	0.0007 J	0.0008	<0.0005	2.66	--	--
	05/30/19	0.158	--	41.7	<0.04	--	176	1,120	1,546	<0.00002	0.00041	0.0196	0.00002 J	0.00003 J	0.000246	0.0511	0.00003 J	0.341	<0.000005	<0.0004	0.00006 J	<0.0001	--	145	3.40
	07/24/19	0.113	216	37	0.085 J	5.96	113	1,127	1,864	<0.00002	0.00107	0.0143	0.00013	0.00003 J	0.000228	0.0577	0.000263	0.283	<0.000005	<0.0004	0.0001 J	<0.0001	3.45	--	--
	02/17/20	0.104	184	36	0.16	5.85	52.4	1,070	1,750	<0.00002	0.00072	0.00960	0.00004 J	<0.00001	0.00008 J	0.0423	<0.00005	0.273	<0.000004	<0.0004	<0.00003	<0.0001	3.46	--	--
	05/20/20	0.115	250	47.7	0.15	5.71	35.9	1,190	1,890	<0.00002	0.00086	0.0114	0.00007 J	0.00002 J	0.000231	0.0700	0.00008 J	0.302	<0.000002	<0.0004	0.00009 J	<0.0001	2.76	--	--
Offsite Background (Upgradient) Monitoring Wells																									
AD-22	06/19/19	0.04 J	2.61	17.3	0.1 J	5.59	<100	17.4	148	<0.0002	0.00163	0.104	0.0004 J	<0.0001	0.002 J	0.0181	0.0007 J	0.03 J	0.000003 J	<0.004	0.0006 J	<0.001	1.403	16.2	--
AD-23	06/19/19	0.03 J	1.16	6.04	0.05 J	5.72	44.1	0.8	52	<0.0002	0.00201	0.082	0.0006 J	<0.0001	0.00911	0.0111	0.001 J	<0.009	0.000004 J	<0.004	0.0009 J	<0.001	0.617	6.54	--
Background Statistical Evaluation Summary - Upper Prediction Limits:^{a}										0.003	0.005	0.69	0.00054	0.0065^{d}	0.0031	0.075^{d}	0.0034	0.39^{d}	0.000033	0.002	0.005	0.001	4.07^{e}	--	--

Table 4-2
Groundwater Sampling Analytical Results (mg/L) - Primary Bottom Ash Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

		Appendix III Parameters								Appendix IV Parameters															
Well	**Date Sampled**	**Boron (total)**	**Calcium (total)**	**Chloride**	**Fluoride**	**pH**	**Turbidity (field)**	**Sulfate**	**TDS**	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Cobalt**	**Lead**	**Lithium**	**Mercury**	**Molybdenum**	**Selenium**	**Thallium**	**Radium 226 and 228 (pCi/L)**	**Iron**	**Manganese**
Point of Compliance Wells																									
AD-8	05/31/16	1.46	32.6	36	1	6.91	--	217	524	<0.005	<0.005	0.034	<0.001	<0.001	0.002	0.007	<0.005	0.122	<0.000025	<0.005	<0.005	<0.002	1.046	--	--
	07/28/16	1.44	25.9	26	<1	6.91	--	202	469	<0.005	<0.005	0.026	<0.001	<0.001	<0.001	0.009	<0.005	0.098	<0.000025	<0.005	<0.005	<0.002	1.584	--	--
	09/29/16	1.51	24.3	28	<1	7.65	--	186	432	<0.005	<0.005	0.023	<0.001	<0.001	<0.001	0.007	<0.005	0.111	<0.000025	<0.005	<0.005	<0.002	6.3	--	--
	10/20/16	1.54	25.9	30	<1	6.07	--	184	424	<0.005	<0.005	0.024	<0.001	<0.001	<0.001	0.007	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	0.345	--	--
	12/12/16	1.53	23.6	27	<1	5.62	--	168	442	<0.005	<0.005	0.021	<0.001	<0.001	<0.001	0.007	<0.005	0.11	<0.000025	<0.005	<0.005	<0.002	1.083	--	--
	01/19/17	1.53	18.7	24	1	6.21	--	153	352	<0.005	<0.005	0.02	<0.001	<0.001	<0.001	0.006	<0.005	0.094	<0.000025	<0.005	<0.005	<0.002	0.823	--	--
	02/22/17	1.67	19.3	22	<1	6.78	--	163	356	<0.005	<0.005	0.019	<0.001	<0.001	<0.001	0.006	<0.005	0.092	<0.000025	<0.005	<0.005	<0.002	0.536	--	--
	06/06/17	1.39	17.4	22	0.6628	5.63	54	151	368	<0.00093	<0.00105	0.01908	<0.00002	<0.00007	<0.00023	0.00386	<0.00068	0.09491	0.000008	<0.00029	<0.00099	<0.00086	1.0735	--	--
	10/05/17	--	--	--	--	6.68	41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/18	1.29	17.2	22	0.716	6.07	3.0	--	368	<0.00093	<0.00105	0.02283	0.00004	<0.00007	<0.00023	0.00521	<0.00068	0.08418	0.000009	<0.00029	<0.00099	<0.00086	1.106	0.673	0.388
	Dissolved	*1.31*	*17.1*	--	--	6.07	3.0	--	--	*<0.00093*	*<0.00105*	*0.02046*	*<0.00002*	*<0.00007*	*<0.00023*	*0.00513*	*<0.00068*	*0.08356*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*0.5773*	< 0.01	0.363
	05/23/18	--	--	--	0.501 J	6.20	*48.2*	--	--	0.00319 J	<0.00105	0.02212	<0.00002	<0.00007	<0.00023	0.00319 J	<0.00068	0.0956	<0.000005	<0.00029	0.00175 J	<0.00086	0.3366	--	--
	8/15/18[b]	1.30	15.0	24	0.615 J	6.77	104	122	288	0.00001 J	0.00031	0.0212	0.000008 J	0.000002 J	0.00005	0.00536	0.000039	0.0555	0.000007 J	0.00016	0.00007 J	0.000129	3.44	--	--
	02/21/19	1.47	17.6	23.2	0.660	6.40	88.2	163	352	<0.0001	0.00057	0.0281	0.00003 J	0.00003 J	0.000456	0.00288	0.000223	0.0911	<0.000025	<0.002	0.0001 J	<0.0005	0.417	--	--
	05/29/19	1.07	--	19.5	0.89	--	76.4	150	324	<0.00002	0.00037	0.0303	<0.00002	0.00002 J	0.0001 J	0.00603	0.00007 J	0.067	<0.000005	<0.0004	0.00006 J	0.0001 J	--	1.07	0.457
	07/23/19	1.21	20.8	15	0.559 J	6.58	31.4	145	392	<0.00002	0.00041	0.031	<0.00002	0.00002 J	0.00009 J	0.00707	0.00008 J	0.0641	<0.000005	<0.0004	0.00008 J	0.0001 J	0.72	--	--
	02/17/20	1.25	14.6	17	0.67	6.50	78.4	159	344	<0.00002	0.00055	0.0389	<0.00002	0.00005 J	0.000244	0.00102	0.0001 J	0.124	<0.000002	<0.0004	0.00008 J	<0.0001	1.257	--	--
	05/19/20	1.23	15.1	16.5	0.66	6.37	2.2	149	336	<0.00002	0.00027	0.0211	<0.00002	0.00004 J	0.0002 J	0.00117	<0.00005	0.0872	<0.000002	<0.0004	0.00007 J	<0.0001	0.344	--	--
AD-9	05/31/16	0.12	229	88	<1	6.32	--	1,352	2,541	<0.005	<0.005	0.051	<0.001	0.001	<0.001	0.027	<0.005	1.32	<0.000025	<0.005	<0.005	<0.002	2.95	--	--
	07/28/16	0.105	255	98	<1	6.32	--	1,464	2,564	<0.005	<0.005	0.031	<0.001	0.002	<0.001	0.022	<0.005	1.38	0.000045	<0.005	0.008	<0.002	1.447	--	--
	09/29/16	0.115	220	86	<1	4.72	--	1,301	2,448	<0.005	<0.005	0.033	<0.001	<0.001	<0.001	0.012	<0.005	1.17	<0.000025	<0.005	<0.005	<0.002	3.199	--	--
	10/19/16	0.109	228	76	1	5.22	--	1,350	2,494	<0.005	<0.005	0.026	<0.001	<0.001	<0.001	0.016	<0.005	1.44	<0.000025	<0.005	<0.005	<0.002	1.311	--	--
	12/12/16	0.108	250	92	<1	5.72	--	1,639	2,667	<0.005	<0.005	0.027	<0.001	0.002	<0.001	0.024	<0.005	1.33	<0.000025	<0.005	<0.005	<0.002	3.0	--	--
	01/19/17	0.312	91.1	54	<1	5.43	--	884	1,360	<0.005	<0.005	0.098	0.002	<0.001	<0.001	0.042	<0.005	0.634	<0.000025	<0.005	<0.005	<0.002	2.349	--	--
	02/22/17	0.1	258	86	<1	5.77	--	1,774	2,662	<0.005	<0.005	0.022	<0.001	<0.001	<0.001	0.024	<0.005	1.41	<0.000025	<0.005	<0.005	<0.002	2.32	--	--
	06/06/17	0.146	191	19	<0.083	4.61	100	105	308	<0.00093	<0.00105	0.04227	0.00077	0.00222	<0.00023	0.02416	<0.00068	1.00	0.000006	<0.00029	<0.00099	<0.00086	1.586	--	--
	10/05/17	--	--	--	--	5.78	102	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	0.08607	10.5	85	<0.083	4.20	<100		1,972	<0.00093	<0.00105	0.04937	0.00134	0.00023	<0.00023	0.01628	<0.00068	0.217	<0.000005	<0.00029	<0.00099	<0.00086	1.582	0.446	0.378
	Dissolved	*0.07126*	*10.2*	--	--	4.20	<100	--	--	*<0.00093*	*<0.00105*	*0.04695*	*0.00122*	*0.00012*	*<0.00023*	*0.01592*	*<0.00068*	*0.204*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.549*	0.166	0.369
	05/23/18	--	--	--	<0.083	5.30	44.6	--	--	<0.00093	<0.00105	0.03045	0.00032 J	0.00288	<0.00023	0.0267	<0.00068	1.20	<0.000005	<0.00029	<0.00099	0.00846	2.556	--	--
	8/15/18[b]	0.198	230	103	<0.083	4.96	237	1,910	2,694	<0.01	0.00168	0.0242	0.000268	0.00006	0.00042	0.0111	0.000262	0.851	0.000013 J	0.00011	0.0003	0.000062	1.864	--	--
	02/21/19	1.39	211	89	0.19	4.98	115	1,350	2,240	<0.0001	0.00118	0.0524	0.000474	0.00009	0.000313	0.0148	0.00008 J	1.12	0.00001 J	<0.002	0.0003	0.0001 J	2.51	--	--
	05/29/19	0.06 J	--	44	0.16	--	27.2	503	1,758	<0.00002	0.0002	0.0497	0.000941	0.00021	0.000346	0.0159	0.00007 J	0.225	<0.000005	<0.0004	0.0002	0.0002 J	--	0.485	0.363
	07/23/19	0.081	222	77	0.5736 J	6.28	8.7	1,701	2,460	<0.00002	0.00139	0.0321	0.000361	0.00006	0.0002 J	0.0127	0.0002 J	1.11	<0.000005	<0.0004	0.0004	<0.0001	1.689	--	--
	02/17/20	0.120	11.5	19.9	0.15	6.02	6.8	100	282	<0.00002	0.00033	0.0528	0.000979	0.00024	0.000608	0.0177	0.0002 J	0.218	0.000002 J	<0.0004	0.0003	0.0002 J	1.938	--	--
	05/19/20	0.066	11.3	44.8	0.1 J	4.90	8.3	536	902	<0.00002	0.00025	0.0516	0.000933	0.00024	0.000458	0.0165	0.00007 J	0.160	0.000003 J	<0.0004	0.0004	0.0002 J	1.854	--	--
AD-15	05/31/16	0.329	5.09	30	<1	5.58	--	24	188	<0.005	0.012	0.215	<0.001	<0.001	0.017	0.011	0.007	0.017	0.000054	<0.005	<0.005	<0.002	2.28	--	--
	07/28/16	0.407	3.83	34	<1	5.58	--	28	196	<0.005	0.006	0.124	<0.001	<0.001	0.004	0.006	<0.005	0.021	<0.000025	<0.005	<0.005	<0.002	1.322	--	--
	09/29/16	0.360	13.7	28	<1	4.57	--	23	367	<0.005	0.131	1.93	0.015	0.007	0.28	0.134	0.161	0.149	0.000707	<0.005	0.014	<0.002	9.92	--	--
	10/19/16	0.152	4.57	26	<1	4.35	--	17	152	<0.005	0.023	0.415	0.002	<0.001	0.054	0.019	0.022	0.036	0.0001	<0.005	<0.005	<0.002	3.567	--	--
	12/12/16	0.334	3.60	26	<1	4.67	--	19	204	<0.005	0.006	0.184	<0.001	<0.001	0.015	0.010	<0.005	0.013	0.000026	<0.005	<0.005	<0.002	3.36	--	--
	01/19/17	0.413	3.35	32	<1	5.77	--	25	176	<0.005	0.006	0.153	<0.001	<0.001	0.009	0.007	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	2.386	--	--
	02/22/17	0.100	4.21	20	<1	4.95	--	8	88	<0.005	0.020	0.353	0.002	<0.001	0.049	0.020	0.019	0.025	0.000058	<0.005	<0.005	<0.002	2.261	--	--
	06/06/17	0.321	3.57	27	<0.083	4.83	246	19	184	<0.00093	0.00854	0.166	0.00061	0.00048	0.01235	0.00844	0.00298	0.0108	0.000022	<0.00029	0.00271	<0.00086	2.491	--	--
	10/05/17	--	--	--	--	5.94	208	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/18	0.08009	2.49	22	<0.083	4.60	7.32		94	<0.00093	0.00222	0.08419	0.00024	<0.00007	<0.00023	0.00403	<0.00068	0.00395	<0.000005	<0.00029	<0.00099	<0.00086	1.749	6.64	0.036
	Dissolved	*0.05773*	*2.49*	--	--	4.60	7.32	--	--	*<0.00093*	*<0.00105*	*0.08405*	*0.00019*	*<0.00007*	*<0.00023*	*0.00346*	*<0.00068*	*0.00378*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*0.748*	< 0.01	0.034
	Field Filtered[c]	*0.301*	*3.03*	*35*	*<0.083*	4.60	7.32	--	*8*	*<0.00093*	*0.00216*	*0.08611*	*0.00012*	*<0.00007*	*<0.00023*	*0.00421*	*<0.00068*	*0.00498*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.630*	7.09	0.061
	FF Dissolved[c]	*0.309*	*3*	--	--	4.60	7.32	--	--	*<0.00093*	*<0.00105*	*0.08373*	*0.00024*	*<0.00007*	*<0.00023*	*0.0038*	*<0.00068*	*0.00516*	*<0.000005*	*0.00048*	*<0.00099*	*<0.00086*	*5.743*	<0.01	0.062
	05/23/18	--	--	--	<0.083	4.76	147	--	--	<0.00093	0.00256 J	0.102	0.00003 J	0.0001 J	0.00263	0.00474 J	<0.00068	0.00562	<0.000005	<0.00029	0.00154 J	0.00137 J	1.46	--	--
	8/15/18[b]	0.341	3.04	37	<0.083	4.59	249	24	174	0.00003 J	0.00326	0.0852	0.000116	0.00001 J	0.000481	0.00371	0.000438	0.00338	0.000008 J	0.00005 J	0.0009	0.00009	1.076	--	--
	02/21/19	0.169	2.67	28.2	0.09	4.98	116	10.6	150	<0.0001	0.00221	0.0766	0.000208	0.00001 J	0.000225	0.0029	0.000104	0.00294	<0.000025	<0.002	0.0004	<0.0005	0.841	--	--
	05/29/19	<0.02	--	21.4	0.06	--	185	2.1	34	<0.0001	0.00410	0.199	0.00186	0.00008 J	0.0103	0.00595	0.0101	0.01 J	0.000081	<0.002	0.0057	<0.0005	--	18.4	0.0423
	07/23/19	0.306	3.45	28	0.086 J	3.17	885	18	214	0.00003 J	0.00210	0.113	0.000573	0.00004 J	0.00226	0.00541	0.00287	0.00414	0.000025	<0.0004	0.0016	<0.0001	2.245	--	--
	02/17/20	0.419	3.64	34.3	0.11	4.48	211	21.5	234	0.00009 J	0.00912	0.115	0.000390	0.00002 J	0.00601	0.00408	0.00480	0.00509	0.000013	0.00332	0.0017	0.0001 J	2.546	--	--
	05/19/20	0.376	3.37	34.1	0.07	5.26	24.8	19	216	0.00002 J	0.00394	0.0803	0.00009 J	0.00001 J	0.0002 J	0.00328	0.00009 J	0.00383	<0.000002	<0.0004	0.0007	<0.0001	1.115	--	--

Table 4-2
Groundwater Sampling Analytical Results (mg/L) - Primary Bottom Ash Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Supplemental Downgradient Monitoring Wells																									
AD-10	5/16/2018	0.08311	15.5	40	<0.083	3.72	<100	--	280	<0.00093	0.0022	0.03855	0.00166	0.00033	<0.00023	0.02432	<0.00068	0.316	<0.000005	<0.00029	<0.00099	0.00098	1.704	0.338	0.25
	Dissolved	*0.07733*	*15.3*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.03712*	*0.00149*	*0.00009*	*<0.00023*	*0.02412*	*<0.00068*	*0.296*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.505*	0.282	0.251
Supplemental Sidegradient Monitoring Wells																									
MW-9	5/15/2018	0.578	44.8	93	<0.083	4.74	57.4	--	780	0.00097	<0.00105	0.01661	0.00021	0.00019	<0.00023	0.03083	<0.00068	0.03225	0.000127	<0.00029	<0.00099	<0.00086	0.779	0.142	0.306
	Dissolved	*0.556*	*44.7*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.01588*	*0.00015*	*0.00036*	*<0.00023*	*0.03189*	*0.00813*	*0.03151*	*0.00015*	*<0.00029*	*<0.00099*	*<0.00086*	*0.2578*	< 0.01	0.308
MW-10	5/15/2018	0.707	59.3	5	<0.083	6.68	1.7	--	346	<0.00093	0.00128	0.08634	0.00006	<0.00007	<0.00023	0.00385	<0.00068	0.01001	<0.000005	0.00079	0.01898	<0.00086	0.969	0.101	0.054
	Dissolved	*0.689*	*59.8*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.08253*	*<0.00002*	*<0.00007*	*<0.00023*	*0.00064*	*<0.00068*	*0.00924*	*<0.000005*	*0.00082*	*0.01651*	*<0.00086*	*1.026*	< 0.01	0.002
EPA MCLs:																									
MCL					4					0.006	0.01	2	0.004	0.005	0.1				0.002		0.05	0.002	5^{e}		
Rule Specified																0.006	0.015	0.04		0.1					
Background Limit					0.58					0.003	0.005	0.69	0.00054	0.0065^{d}	0.0031	0.075^{d}	0.0034	0.39^{d}	0.000033	0.002	0.005	0.001	4.07^{e}		
Interwell Background Value(s) (UPL, LPL where applicable) AD-8, AD-9, AD-15		0.700				4.8-7.0																			
Intrawell Background Value (UPL) AD-8			15.1	16.5	0.66			149	336																
Intrawell Background Value (UPL) AD-9			299	138	1.00			2,530	3,070																
Intrawell Background Value (UPL) AD-15			5.40	38.8	1.00			33.2	249																

NOTES:
All concentration data are provided in milligrams per liter (mg/L) unless otherwise noted.
J = Analyte was positively identified, though the quantitation was below Reporting Limit.
MCL - Maximum contaminant level
LPL = Lower prediction limit
UPL = Upper prediction limit
pCi/L = PicoCuries per liter
-- = Not analyzed
a = Data taken from Geosyntec "Statistical Analysis Summary, Primary Bottom Ash Pond" dated September 1, 2020".
b = Some inorganic analyte groundwater samples collected 9/17/18.
c = Sample ID "AD-15 DUP" was field filtered (FF) using a 5 micron filter.
d = Calculated Upper Tolerance Limit is higher than MCL.
e = Data is "Combined Radium, Total".
🟨 Denotes groundwater sample collected by ARCADIS using low-flow methods.
Unless otherwise noted, values shown are total (unfiltered) analyses.
Dissolved (0.45-micron lab filtered) parameter concentrations shown in italics.

Table 4-3
Groundwater Sampling Analytical Results (mg/L) - Landfill
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Background (Upgradient) Wells																									
AD-5	05/31/16	0.03	36.9	15	<1	6.38	--	123	337	<0.005	<0.005	0.057	<0.001	<0.001	<0.001	0.014	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	1.63	--	--
	07/28/16	0.04	44.7	16	<1	6.38	--	163	360	<0.005	<0.005	0.093	<0.001	<0.001	<0.001	0.015	<0.005	0.191	<0.000025	<0.005	<0.005	<0.002	4.75	--	--
	09/29/16	0.04	46.3	15	<1	5.29	--	190	416	<0.005	<0.005	0.087	<0.001	<0.001	<0.001	0.014	<0.005	0.186	<0.000025	<0.005	<0.005	<0.002	3.33	--	--
	10/20/16	0.05	50.7	14	<1	5.92	--	267	448	<0.005	<0.005	0.07	<0.001	<0.001	<0.001	0.009	<0.005	0.225	<0.000025	<0.005	<0.005	<0.002	2.319	--	--
	12/13/16	0.05	49.6	13	<1	6.29	--	233	484	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	0.013	<0.005	0.199	<0.000025	<0.005	<0.005	<0.002	2.182	--	--
	01/17/17	0.04	49.8	14	<1	6.27	--	234	438	<0.005	<0.005	0.047	<0.001	<0.001	<0.001	0.012	<0.005	0.239	<0.000025	<0.005	<0.005	<0.002	1.023	--	--
	02/23/17	0.04	33.0	15	<1	5.48	--	127	286	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	0.013	<0.005	0.166	<0.000025	<0.005	<0.005	<0.002	1.788	--	--
	06/07/17	0.05281	49.7	14	<0.083	5.96	867	82	300	<0.00093	0.00385	0.0877	0.00008	0.00039	0.00028	0.01193	<0.00068	0.124	<0.000005	<0.00029	<0.00099	<0.00086	2.32	--	--
	10/06/17	--	--	--	--	5.59	249	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.05063	30.1	21	<0.083	5.79	<100	--	248	<0.00093	<0.00105	0.07627	0.00014	0.00037	<0.00023	0.01907	<0.00068	0.118	<0.000005	<0.00029	<0.00099	<0.00086	1.495	14.4	0.45
	Dissolved	*0.03752*	*29.1*	--	--	5.79	<100	--	--	*<0.00093*	*<0.00105*	*0.06865*	*<0.00002*	*<0.00007*	*<0.00023*	*0.01747*	*<0.00068*	*0.119*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.043*	*2.051*	8.38	0.43
	05/24/18	0.05007	28.1	22	<0.083	6.22	17.8	60	242	<0.00093	<0.00105	0.07116	<0.00002	0.00023 J	0.0008 J	0.01424	<0.00068	0.121	<0.000005	<0.00029	<0.00099	<0.00086	1.946	--	--
	08/15/18	0.05	40.5	19	<0.083	6.23	57.1	240	428	0.00001 J	0.00169	0.0637	0.000055	0.000008 J	0.000072	0.0114	0.000079	0.147	<0.000005	0.00013	0.00008 J	<0.01	0.316	--	--
	02/21/19	0.033	33.9	24.7	0.21	5.38	164	46.5	220	0.00002 J	0.00159	0.0694	0.00008 J	<0.00005	0.000432	0.00858	0.000147	0.0807	<0.000025	<0.002	0.0001 J	<0.0005	1.27	--	--
	05/30/19	0.03 J	--	22.3	0.29	--	150	51.3	238	<0.00002	0.00305	0.0605	0.00008 J	<0.00001	0.00006 J	0.0118	0.00005 J	0.104	0.000006	<0.0004	0.00005 J	<0.0001	--	23.4	0.331
	07/24/19	0.04 J	41.1	18	0.112 J	6.3	108	90	354	<0.00002	0.00248	0.0774	0.00005 J	<0.00001	0.00005 J	0.00838	<0.00005	0.108	<0.000005	<0.0004	0.00006 J	<0.0001	2.533	--	--
	02/17/20	0.03 J	39.8	19.8	0.22	5.45	422	43.7	248	0.00003 J	0.00217	0.109	0.00009 J	0.00002 J	0.000336	0.00452	0.000227	0.0732	<0.000002	0.0009 J	0.0002	<0.0001	2.393	--	--
	05/20/20	0.03 J	40.2	22.3	0.18	6.83	355	55.5	264	<0.00002	0.00178	0.0931	0.00005 J	0.00001 J	0.0001 J	0.00765	0.00007 J	0.0740	<0.000002	<0.0004	0.00009 J	<0.0001	1.612	--	--
AD-18[d]	05/26/16	0.146	409	422	<1	5.1	--	5,135	10,000	<0.005	<0.005	0.012	0.014	0.003	<0.001	0.922	<0.005	2.07	0.000168	<0.005	0.006	0.003	12.58	--	--
	07/27/16	0.148	457	432	2	5.1	--	4,930	9,476	<0.005	<0.005	0.019	0.005	0.002	<0.001	0.734	<0.005	1.94	0.000091	<0.005	0.007	0.003	10.62	--	--
	09/29/16	0.156	469	637	4	5.59	--	4,632	9,569	<0.005	<0.005	0.02	0.004	<0.001	<0.001	0.666	<0.005	1.86	0.000117	<0.005	0.007	<0.002	7.05	--	--
	10/20/16	0.188	498	876	0.8664	5.7	--	5,537	9,540	<0.005	<0.005	0.021	0.002	0.001	<0.001	0.569	<0.005	2.06	0.000053	<0.005	<0.005	<0.002	5.82	--	--
	12/13/16	0.178	510	695	5	5.75	--	4,382	8,912	<0.005	<0.005	0.021	0.007	0.001	<0.001	0.641	<0.005	1.74	0.00005	<0.005	<0.005	<0.002	9.6	--	--
	01/17/17	0.050	412	159	5	4.49	--	5,414	8,562	<0.005	0.01	0.014	0.022	0.001	<0.001	0.929	<0.005	1.95	0.000224	<0.005	<0.005	0.002	22.51	--	--
	02/22/17	0.090	401	151	6	4.37	--	5,169	8,412	<0.005	<0.005	0.014	0.026	0.002	<0.001	0.961	<0.005	1.82	0.000107	<0.005	<0.005	0.00228	19.11	--	--
	06/06/17	0.125	428	304	6.53	4.27	121	5,920	9,394	<0.00093	0.00331	0.01038	0.01883	0.00303	<0.00023	0.940	<0.00068	2.15	0.000113	<0.00029	0.00212	<0.00086	16.12	--	--
	10/05/17	--	--	--	--	5.87	165	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.163	433	362	9.4	3.61	104.1	--	9,952	0.00224	0.00276	0.00813	0.01733	0.0036	0.00098	0.928	<0.00068	2.07	0.000043	<0.00029	0.00194	0.00144	19.95	19.7	14.1
	Dissolved	*0.153*	*423*	--	--	--	--	--	--	*0.00467*	*0.00189*	*0.00748*	*0.01676*	*0.00316*	*<0.00023*	*0.898*	*<0.00068*	*2.06*	*0.000012*	*<0.00029*	*0.00135*	*0.01466*	*18.09*	19.1	13.7
	05/30/19	0.09 J	--	390	3.56	--	91.3	6,120	9,564	<0.0002	0.040	0.009 J	0.021	0.004 J	<0.004	1.130	0.005 J	1.27	0.000035	<0.04	0.103	<0.01	--	11.2	7.53
Background Statistical Evaluation Summary - Upper Prediction Limits:[a]										0.003	0.005	0.69	0.00054	0.0065d	0.0031	0.075[d]	0.0034	0.39[d]	0.000033	0.002	0.005	0.001	4.07[e]	--	--
Point of Compliance Wells																									
AD-11	05/31/16	2.47	8.47	9	2	5.21	--	518	388	<0.005	<0.005	0.014	0.004	<0.001	0.003	0.026	<0.005	0.032	<0.000025	<0.005	<0.005	<0.002	1.77	--	--
	07/28/16	2.83	8.88	10	2	5.21	--	596	1,000	<0.005	<0.005	0.012	0.004	<0.001	<0.001	0.026	<0.005	0.047	<0.000025	<0.005	<0.005	<0.002	2.23	--	--
	09/29/16	3.4	10.7	12	2	4.08	--	683	1,065	<0.005	<0.005	0.052	0.005	<0.001	0.007	0.03	<0.005	0.047	<0.000025	<0.005	<0.005	<0.002	3.92	--	--
	10/19/16	3.77	8.78	11	<1	3.68	--	706	1,024	<0.005	<0.005	0.02	0.005	<0.001	0.002	0.027	<0.005	0.047	<0.000025	<0.005	<0.005	<0.002	2.56	--	--
	12/12/16	3.36	8.98	10	2	3.75	--	548	1,044	<0.005	<0.005	0.013	0.004	<0.001	<0.001	0.025	<0.005	0.041	<0.000025	<0.005	<0.005	<0.002	1.569	--	--
	01/17/17	2.81	10.3	11	2	4.41	--	760	1,048	<0.005	<0.005	0.013	0.004	<0.001	<0.001	0.025	<0.005	0.046	<0.000025	<0.005	<0.005	<0.002	1.082	--	--
	02/22/17	2.88	9.31	10	2	4.34	--	558	876	<0.005	<0.005	0.019	0.004	<0.001	0.002	0.024	<0.005	0.035	<0.000025	<0.005	<0.005	<0.002	1.45	--	--
	06/06/17	2.79	9.93	10	1.366	3.86	219	556	960	<0.00093	0.00123	0.01012	0.00279	0.00041	0.00032	0.02216	<0.00068	0.03654	<0.000005	<0.00029	<0.00099	<0.00086	1.902	--	--
	10/05/17	--	--	--	--	4.43	162	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	1.48	4.37	10	<0.083	3.77	75.3		558	0.00417	0.00127	0.01281	0.00148	0.00053	0.00041	0.00935	<0.00068	0.01978	<0.000005	0.00094	0.00103	<0.00086	1.264	1.35	0.063
	Dissolved	*1.45*	*4.28*	--	--	3.77	75.3	--	--	*<0.00093*	*0.00278*	*0.01202*	*0.00098*	*<0.00007*	*<0.00023*	*0.00877*	*<0.00068*	*0.01836*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.656*	1.25	0.062
	05/23/18	--	--	--	<0.083	*4.05*	*49.8*	--	--	<0.00093	0.0026 J	0.01627	0.00089 J	0.00018 J	0.0008 J	0.00863	<0.00068	0.01875	0.000007 J	<0.00029	0.00134 J	0.046	1.912	--	--
	08/15/18	1.84	6.61	15	<0.083	4.73	112	410	720	--	0.00105	0.0119	0.00118	0.00037	0.000257	0.0153	--	0.0175	<0.000005	--	0.0024	0.0002	2.6	--	--
	05/29/19	1.40	--	6.96	0.47	--	67.6	367	680	<0.0001	0.00113	0.0182	0.00138	0.0002 J	0.0004 J	0.00969	0.000804	0.02 J	<0.000005	<0.002	0.0022	<0.0005	--	1.46	0.0669
	07/23/19	1.56	7.19	6	0.338	--	170	342	700	<0.0002	0.00059	0.0164	0.000987	0.00024	0.000413	0.0105	0.000976	0.0153	<0.000005	<0.0004	0.001	0.0002 J	2.246	--	--
	02/17/20	1.47	20.5	8.19	0.42	4.85	25.5	350	622	0.00003 J	0.00039	0.0579	0.000431	0.00021	0.000334	0.00841	0.000493	0.0142	0.000007	0.002 J	0.0008	0.001 J	2.106	--	--
	05/19/20	1.54	24.3	--	--	6.25	1.0	--	--	0.00004 J	0.00055	0.0357	0.000782	0.00026	0.000254	0.0114	0.000427	0.0138	0.000006	<0.0004	0.0014	0.0001 J	2.352	--	--
AD-13	05/31/16	1.19	8.02	12	<1	6.05		177	900	<0.005	<0.005	0.062	<0.001	<0.001	<0.001	<0.005	<0.005	0.011	<0.000025	<0.005	<0.005	<0.002	1.22	--	--
	07/27/16	1.23	3.7	15	1	6.05		187	--	<0.005	<0.005	0.036	<0.001	<0.001	<0.001	<0.005	<0.005	0.026	<0.000025	<0.005	<0.005	<0.002	1.601	--	--
	09/29/16	1.37	2.7	17	1	4.56		207	431	<0.005	<0.005	0.04	<0.001	<0.001	<0.001	<0.005	<0.005	0.02	<0.000025	<0.005	<0.005	<0.002	2.213	--	--
	10/19/16	1.67	3.66	19	1	4.34		226	482	<0.005	<0.005	0.03	<0.001	<0.001	<0.001	<0.005	<0.005	0.022	<0.000025	<0.005	<0.005	<0.002	3.662	--	--
	12/05/16	--	--	--	--	--		--	532	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/16	1.96	3.77	18	1	4.79		287	596	<0.005	<0.005	0.051	0.001	<0.001	0.007	0.007	<0.005	0.025	<0.000025	<0.005	<0.005	<0.002	2.27	--	--
	01/19/17	0.402	33.5	7	<1	5.38		90	222	<0.005	0.006	0.112	<0.001	<0.001	0.004	<0.005	<0.005	0.004	<0.000025	<0.005	<0.005	<0.002	2.228	--	--
	02/23/17	1.27	10.3	13	<1	5.06		183	392	<0.005	<0.005	0.041	<0.001	<0.001	<0.001	<0.005	<0.005	0.015	<0.000025	<0.005	<0.005	<0.002	1.556	--	--
	06/06/17	1.68	3.03	15	0.6679	4.22	171	244	494	0.00153	<0.00105	0.01712	0.00089	0.00014	<0.00023	0.00624	<0.00068	0.02082	<0.000005	<0.00029	0.00103	<0.00086	1.565	--	--
	10/06/17	--	--	--	--	4.61	173	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 4-3
Groundwater Sampling Analytical Results (mg/L) - Landfill
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
AD-13 (cont.)	05/16/18	1.42	7.48	10	0.5362	4.20	1.4		532	<0.00093	<0.00105	0.0216	0.00088	0.00011	<0.00023	0.00809	<0.00068	0.02603	<0.000005	<0.00029	<0.00099	<0.00086	2.064	0.858	0.046
	Dissolved	*1.41*	*7.31*	--	--	4.20	1.4	--	--	*<0.00093*	*<0.00105*	*0.02097*	*0.0008*	*<0.00007*	*<0.00023*	*0.00784*	*<0.00068*	*0.02439*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.407*	0.712	0.045
	05/23/18	--	--	--	0.6534 J	*4.52*	*52.7*	--	--	<0.00093	<0.00105	0.02653	0.00087 J	<0.00007	0.00073 J	0.00937	<0.00068	0.0291	0.000008 J	<0.00029	<0.00099	<0.043	2.16	--	--
	08/14/18	1.49	10.1	18	0.7442	4.82	131	316	620	--	0.00137	0.0169	0.000971	0.00031	0.000503	0.0131	--	0.0321	<0.000005	--	0.0017	0.000277	4.0	--	--
	05/30/19	0.477	--	3.6	0.53	--	83.6	94	196	0.00003 J	0.00032	0.0609	0.000385	0.00007	0.00031	0.00315	0.00005 J	0.009 J	<0.000005	<0.0004	0.0004	<0.0001	--	0.086	0.0141
	07/23/19	0.780	6.16	5	0.169	--	216	146	334	0.00002 J	0.00037	0.0236	0.000443	0.00009	0.000283	0.00382	0.000204	0.0175	<0.000005	<0.0004	0.0003	0.0001 J	1.748	--	--
	02/17/20	0.929	17.6	7.79	0.69	4.93	104	236	442	0.00003 J	0.00059	0.0594	0.000528	0.00012	0.000354	0.00384	0.0001 J	0.0132	0.000012	0.0005 J	0.0011	<0.0001	3.790	--	--
	05/19/20	0.936	19.2	--	--	5.49	0.0	--	--	0.00005 J	0.00053	0.0503	0.000533	0.00009	0.000261	0.00387	0.00006 J	0.0147	0.000034	0.001 J	0.0013	<0.0001	1.977	--	--
AD-14	05/31/16	1.28	2.88	4	<1	4.75	--	115	285	<0.005	<0.005	0.031	<0.001	<0.001	<0.001	0.010	<0.005	0.012	0.00003	<0.005	<0.005	<0.002	0.87	--	--
	07/27/16	1.14	2.51	5	<1	4.75	--	111	267	<0.005	<0.005	0.084	<0.001	<0.001	0.001	0.009	<0.005	0.024	<0.000025	<0.005	<0.005	<0.002	1.487	--	--
	09/29/16	1.14	1.19	5	<1	4.17	--	111	252	<0.005	<0.005	0.03	<0.001	<0.001	<0.001	0.009	<0.005	0.015	<0.000025	<0.005	<0.005	<0.002	4.817	--	--
	10/19/16	1.25	2.48	4	<1	3.88	--	118	276	<0.005	<0.005	0.039	<0.001	0.001	<0.001	0.009	<0.005	0.014	<0.000025	<0.005	<0.005	<0.002	1.972	--	--
	12/12/16	1.25	2.41	5	<1	4.11	--	101	296	<0.005	<0.005	0.047	<0.001	0.001	0.001	0.009	<0.005	0.013	0.000037	<0.005	<0.005	<0.002	1.271	--	--
	01/17/17	0.915	10.3	4	<1	6.07	--	92	254	<0.005	<0.005	0.038	<0.001	<0.001	<0.001	<0.005	<0.005	0.013	<0.000025	<0.005	<0.005	<0.002	1.825	--	--
	02/22/17	1.06	9.48	4	<1	5.39	--	90	212	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	<0.005	<0.005	0.012	<0.000025	<0.005	<0.005	<0.002	0.512	--	--
	06/06/17	1.26	7.69	6	<0.083	4.77	167	108	256	<0.00093	<0.00105	0.04483	0.00038	0.00067	0.00127	0.00678	<0.00068	0.0127	0.000021	<0.00029	0.00261	<0.00086	1.138	--	--
	10/06/17	--	--	--	--	4.57	150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	1.61	4.67	11	<0.083	4.11	5.1	--	332	<0.00093	<0.00105	0.03161	0.00094	0.00204	<0.00023	0.01501	<0.00068	0.01638	0.000137	<0.00029	0.00221	<0.00086	1.097	0.09	0.008
	Dissolved	*1.56*	*4.55*	--	--	4.11	5.1	--	--	*<0.00093*	*<0.00105*	*0.02938*	*0.00094*	*0.00193*	*<0.00023*	*0.01476*	*<0.00068*	*0.01523*	*0.000149*	*<0.00029*	*0.00387*	*<0.00086*	*0.5903*	0.06	0.007
	05/23/18	--	--	--	<0.083	4.17	43.2	--	--	<0.00093	<0.00105	0.02817	0.00078 J	0.00161	<0.00023	0.01434	<0.00068	0.0152	0.000145	<0.00029	0.00362	<0.043	1.601	--	--
	08/14/18	1.51	4.51	12	<0.083	4.27	198	204	384	--	0.00039	0.024	0.000854	0.00199	0.000276	0.0176	--	0.011	0.000181	--	0.0037	0.000242	1.5	--	--
	05/29/19	1.21	--	3.65	0.19	--	20.6	122	274	<0.0001	0.0005	0.0434	0.000709	0.00087	0.0002 J	0.00774	0.0001 J	0.02 J	0.000181	<0.0002	0.0019	<0.0005		0.005 J	0.00023
	07/23/19	1.25	9.93	8	0.162	--	21.7	171	440	<0.00002	0.00043	0.0362	0.000934	0.00249	0.000286	0.0185	0.0002	0.0155	0.000123	<0.0004	0.0027	0.0002 J	2.731	--	--
	02/17/20	1.12	38.7	2	0.24	5.21	5.5	85.6	294	0.00007 J	0.00043	0.0444	0.000179	0.00020	0.0002 J	0.00232	0.00007 J	0.00630	0.000003 J	0.002 J	0.0025	0.0001 J	2.552	--	--
	05/19/20	1.22	15.1	--	--	5.36	0.5	--	--	0.00003 J	0.00032	0.0353	0.000396	0.00032	0.000307	0.00381	0.0001 J	0.00875	0.000002 J	0.001 J	0.0015	<0.0001	0.778	--	--
Supplemental Downgradient Monitoring Well																									
AD-10	5/16/2018	0.08311	15.5	40	<0.083	3.72	<100	--	280	<0.00093	0.0022	0.03855	0.00166	0.00033	<0.00023	0.02432	<0.00068	0.316	<0.000005	<0.00029	<0.00099	0.00098	1.704	0.338	0.25
	Dissolved	*0.07733*	*15.3*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.03712*	*0.00149*	*0.00009*	*<0.00023*	*0.02412*	*<0.00068*	*0.296*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.505*	0.282	0.251
Supplemental Sidegradient Monitoring Wells																									
Temp-1	5/17/2018	0.662	26.2	34	<0.083	4.90	23.8	--	556	<0.00093	<0.00105	0.07752	0.00058	<0.00007	0.00102	0.01058	<0.00068	0.01075	<0.000005	<0.00029	<0.00099	<0.00086	1.277	1.94	0.203
	Dissolved	*0.621*	*24.6*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.06778*	*0.00042*	*<0.00007*	*<0.00023*	*0.00946*	*<0.00068*	*0.00986*	*<0.000005*	*<0.00029*	*<0.00099*	*0.00191*	*2.278*	0.813	0.192
AD-12	6/19/2019	0.569	34.1	44.1	0.32	6.3	40.1	131	436	<0.0001	0.00123	0.0581	0.0004 J	0.00005 J	0.0003 J	0.0126	<0.0001	0.042	<0.000002	<0.002	0.0005 J	<0.0005	2.007	25.9	--
EPA MCLs:																									
MCL					4					0.006	0.01	2	0.004	0.005	0.1				0.002		0.05	0.002	5^{c}		
Rule Specified																0.006	0.015	0.04		0.1					
Background Limit					0.58					0.003	0.005	0.69	0.00054	0.0065d	0.0031	0.075^{d}	0.0034	0.39^{d}	0.000033	0.002	0.005	0.001	4.07^{e}		
Interwell Background Value(s) (UPL, LPL where applicable) AD-8, AD-9, AD-15		0.700				4.8-7.0																			
Intrawell Background Value (UPL) AD-8			15.1	16.5	0.660			149	336																
Intrawell Background Value (UPL) AD-9			299	138	1.00			2,530	3,070																
Intrawell Background Value (UPL) AD-15			5.40	38.8	1.00			33.2	249																

NOTES:
All concentration data are provided in milligrams per liter (mg/L) unless otherwise noted.
J = Analyte was positively identified, though the quantitation was below Reporting Limit.
MCL = Maximum contaminant level
LPL = Lower prediction limit
UPL = Upper prediction limit
pCi/L = PicoCuries per liter
-- = Not analyzed
a = Data taken from Geosyntec "Statistical Analysis Summary, Primary Bottom Ash Pond" dated September 1, 2020.
b = Calculated Upper Tolerance Limit is higher than MCL.
c = Data is "Combined Radium, Total".
d = AD-18 is not part of the designated CCR Monitoring Well Network and used for background understanding only
🟨 Denotes groundwater sample collected by ARCADIS using low-flow methods.
Unless otherwise noted, values shown are total (unfiltered) analyses.
Dissolved (0.45-micron lab filtered) parameter concentrations shown in italics.

Table 4-4
Groundwater Sampling Analytical Results (mg/L) - Bottom Ash Storage Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

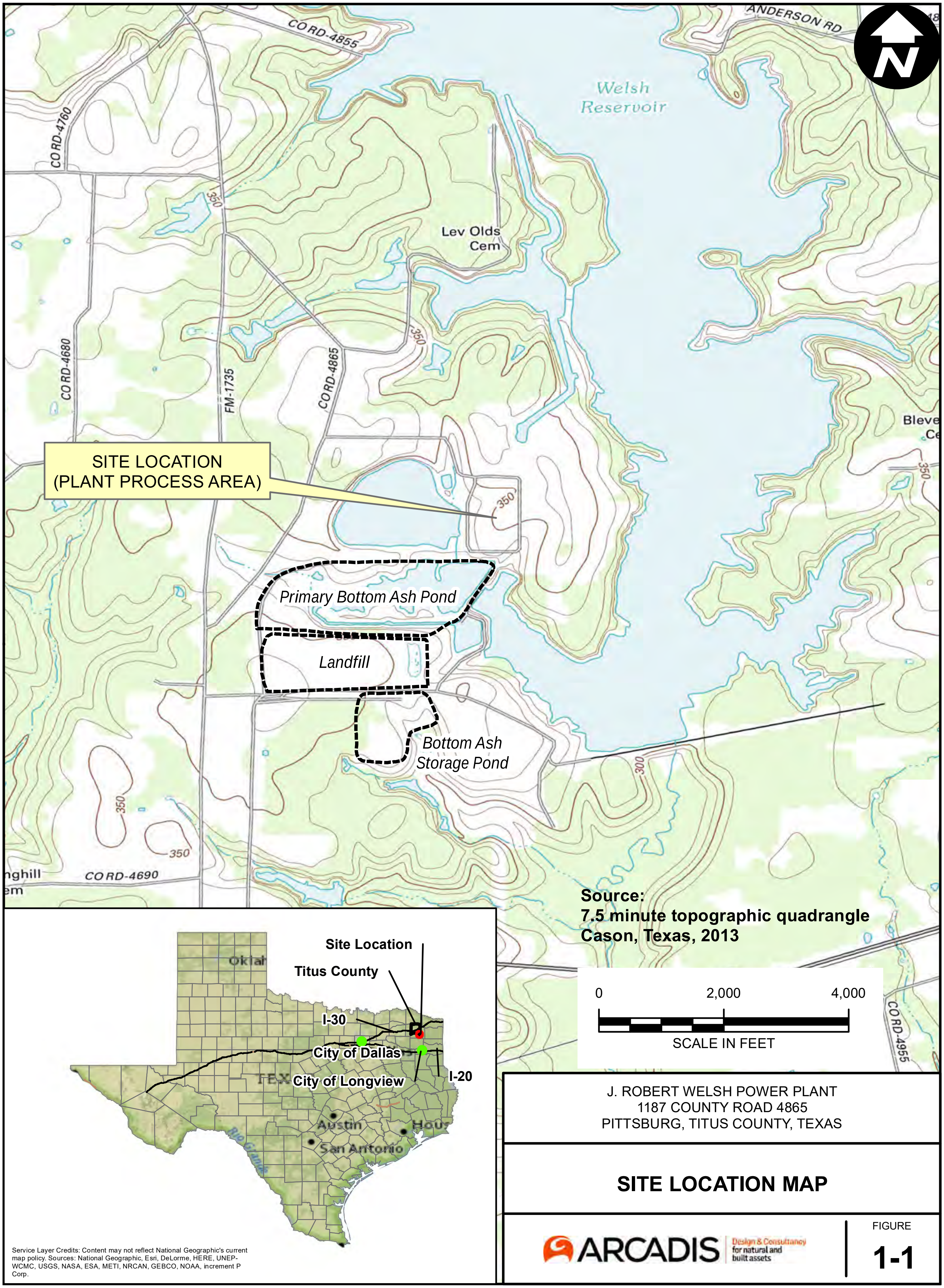
Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters																
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Background (Upgradient) Wells																										
AD-1	05/26/16	0.346	36.5	5	<1	5.93	--	42	252	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.010	0.000033	<0.005	<0.005	<0.002	1.18	--	--
	07/27/16	0.350	39.6	4	<1	5.93	--	36	239	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.019	<0.000025	<0.005	<0.005	<0.002	0.9952	--	--
	09/29/16	0.332	15	5	<1	5.37	--	35	173	<0.005	<0.005	0.141	<0.001	<0.001	0.005	<0.005	<0.005	0.014	<0.000025	<0.005	<0.005	<0.002	1.38	--	--
	10/19/16	0.398	19.1	4	<1	5.15	--	42	192	<0.005	<0.005	0.114	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	1.141	--	--
	12/12/16	0.394	8.74	4	<1	5.18	--	40	200	<0.005	<0.005	0.072	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	0.719	--	--
	01/17/17	0.656	129	4	<1	7.13	--	68	538	<0.005	<0.005	0.410	<0.001	<0.001	<0.001	<0.005	<0.005	<0.001	<0.000025	<0.005	<0.005	<0.002	3.009	--	--
	02/23/17	0.700	147	9	<1	6.88	--	68	612	<0.005	<0.005	0.488	<0.001	<0.001	<0.001	<0.005	<0.005	0.001	<0.000025	<0.005	<0.005	<0.002	4.309	--	--
	06/07/17	0.449	15.1	4	<0.083	5.06	109	42	176	<0.00093	0.00114	0.09346	0.00037	<0.00007	0.00066	0.00077	<0.00068	0.00902	0.000007	<0.00029	0.0021	<0.00086	0.676	--	--
	10/06/17	--	--	--	--	5.25	97.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.352	12.1	3	<0.083	4.82	8.4	--	174	<0.00093	<0.00105	0.08823	0.00048	<0.00007	<0.00023	0.0008	<0.00068	0.00816	<0.000005	<0.00029	<0.00099	<0.00086	0.837	0.03	0.025
	Dissolved	*0.35*	*12*	--	--	4.82	8.4	--	--	*<0.00093*	*<0.00105*	*0.08582*	*0.00044*	*<0.00007*	*<0.00023*	*0.00083*	*<0.00068*	*0.00799*	*<0.000005*	*<0.00029*	*0.00197*	*<0.00086*	*0.531*	0.01	0.026
	05/24/18	0.345	10.2	4	<0.083	5.19	118	43	150	0.00317 J	<0.00105	0.0799	0.00039 J	<0.00007	<0.00023	0.00035 J	<0.00068	0.00814	0.000006 J	<0.00029	0.00138 J	<0.00086	1.983	--	--
	08/14/18	0.443	5.95	5	<0.083	5.18	102	44	160	0.00003 J	0.00021	0.063	0.000482	0.00002	0.00016	0.000797	0.000238	0.00708	0.000013 J	0.00021	0.0017	0.00003 J	1.10	--	--
	02/20/19	0.504	142	2.82	0.24	7.31	113	49.2	522	0.00016	0.00046	0.457	0.00009 J	0.00001 J	0.000306	0.000399	0.000124	0.00155	<0.000025	0.001 J	0.0007	<0.0005	3.16	--	--
	05/30/19	0.689	--	1.59	0.29	--	61.3	43.3	588	0.00016	0.00060	0.512	0.000244	0.00001 J	0.0001 J	0.000756	0.000197	<0.009	<0.000005	0.00243	0.0014	<0.0001	--	0.099	0.0625
	07/24/19	0.644	62.7	2	0.106 J	5.97	52.1	58	180	0.00008 J	0.00039	0.245	0.00054	0.00002 J	0.0001 J	0.000789	0.0001 J	0.00557	<0.000005	0.002 J	0.0034	<0.0001	1.819	--	--
	02/17/20	0.626	115	3.41	0.31	5.81	29.4	56.3	488	0.00033	0.00049	0.303	0.00007 J	0.00002 J	0.0001 J	0.00028	0.0001 J	0.00105	<0.000002	0.001 J	0.0023	<0.0001	2.665	--	--
	05/20/20	0.801	126	1.83	0.20	7.22	0.0	51.4	508	0.00015	0.00053	0.394	0.000270	0.00002 J	0.0001 J	0.000490	0.0001 J	0.00301	<0.000002	0.002 J	0.0028	<0.0001	2.312	--	--
AD-5	05/31/16	0.03	36.9	15	<1	6.38	--	123	337	<0.005	<0.005	0.057	<0.001	<0.001	<0.001	0.014	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	1.63	--	--
	07/28/16	0.04	44.7	16	<1	6.38	--	163	360	<0.005	<0.005	0.093	<0.001	<0.001	<0.001	0.015	<0.005	0.191	<0.000025	<0.005	<0.005	<0.002	4.75	--	--
	09/29/16	0.04	46.3	15	<1	5.29	--	190	416	<0.005	<0.005	0.087	<0.001	<0.001	<0.001	0.014	<0.005	0.186	<0.000025	<0.005	<0.005	<0.002	3.33	--	--
	10/20/16	0.05	50.7	14	<1	5.92	--	267	448	<0.005	<0.005	0.07	<0.001	<0.001	<0.001	0.009	<0.005	0.225	<0.000025	<0.005	<0.005	<0.002	2.319	--	--
	12/13/16	0.05	49.6	13	<1	6.29	--	233	484	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	0.013	<0.005	0.199	<0.000025	<0.005	<0.005	<0.002	2.182	--	--
	01/17/17	0.04	49.8	14	<1	6.27	--	234	438	<0.005	<0.005	0.047	<0.001	<0.001	<0.001	0.012	<0.005	0.239	<0.000025	<0.005	<0.005	<0.002	1.023	--	--
	02/23/17	0.04	33.0	15	<1	5.48	--	127	286	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	0.013	<0.005	0.166	<0.000025	<0.005	<0.005	<0.002	1.788	--	--
	06/07/17	0.05281	49.7	14	<0.083	5.96	867	82	300	<0.00093	0.00385	0.0877	0.00008	0.00039	0.00028	0.01193	<0.00068	0.124	<0.000005	<0.00029	<0.00099	<0.00086	2.32	--	--
	10/06/17	--	--	--	--	5.59	249	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.05063	30.1	21	<0.083	5.79	<100	--	248	<0.00093	<0.00105	0.07627	0.00014	0.00037	<0.00023	0.01907	<0.00068	0.118	<0.000005	<0.00029	<0.00099	<0.00086	1.495	14.4	0.45
	Dissolved	*0.03752*	*29.1*	--	--	5.79	<100	--	--	*<0.00093*	*<0.00105*	*0.06865*	*<0.00002*	*<0.00007*	*<0.00023*	*0.01747*	*<0.00068*	*0.119*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.043*	*2.051*	8.38	0.43
	05/24/18	0.05007	28.1	22	<0.083	6.22	17.8	60	242	<0.00093	<0.00105	0.07116	<0.00002	0.00023 J	0.0008 J	0.01424	<0.00068	0.121	<0.000005	<0.00029	<0.00099	<0.00086	1.946	--	--
	08/15/18	0.05	40.5	19	<0.083	6.23	57.1	240	428	0.00001 J	0.00169	0.0637	0.000055	0.000008 J	0.000072	0.0114	0.000079	0.147	<0.000005	0.00013	0.00008 J	<0.01	0.316	--	--
	02/21/19	0.033	33.9	24.7	0.21	5.38	164	46.5	220	0.00002 J	0.00159	0.0694	0.00008 J	<0.00005	0.000432	0.00858	0.000147	0.0807	<0.000025	<0.002	0.0001 J	<0.0005	1.27	--	--
	05/30/19	0.03 J	--	22.3	0.29	--	150	51.3	238	<0.00002	0.00305	0.0605	0.00008 J	<0.00001	0.00006 J	0.0118	0.00005 J	0.104	0.000006	<0.0004	0.00005 J	<0.0001	--	23.4	0.331
	07/24/19	0.04 J	41.1	18	0.112 J	6.3	108	90	354	<0.00002	0.00248	0.0774	0.00005 J	<0.00001	0.00005 J	0.00838	<0.00005	0.108	<0.000005	<0.0004	0.00006 J	<0.0001	2.533	--	--
	02/17/20	0.03 J	39.8	19.8	0.22	5.45	422	43.7	248	0.00003 J	0.00217	0.109	0.00009 J	0.00002 J	0.000336	0.00452	0.000227	0.0732	<0.000002	0.0009 J	0.0002	<0.0001	2.393	--	--
	05/20/20	0.03 J	40.2	22.3	0.18	6.83	355	55.5	264	<0.00002	0.00178	0.0931	0.00005 J	0.00001 J	0.0001 J	0.00765	0.00007 J	0.0740	<0.000002	<0.0004	0.00009 J	<0.0001	1.612	--	--
AD-17	05/26/16	0.121	200	43	<1	7.17	--	1,166	1,810	<0.005	<0.005	0.021	<0.001	0.002	0.001	0.063	<0.005	0.370	0.000032	<0.005	<0.005	<0.002	1.53	--	--
	07/27/16	0.119	195	32	<1	7.17	--	1,005	1,576	<0.005	<0.005	0.020	<0.001	0.004	0.001	0.068	<0.005	0.374	<0.000025	<0.005	<0.005	<0.002	2.78	--	--
	09/29/16	0.111	191	36	<1	6.17	--	1,055	1,663	<0.005	<0.005	0.031	<0.001	<0.001	0.003	0.058	<0.005	0.354	<0.000025	<0.005	<0.005	<0.002	2.358	--	--
	10/20/16	0.124	194	32	1.0	6.14	--	1,163	1,612	<0.005	<0.005	0.034	<0.001	0.002	0.004	0.065	<0.005	0.394	<0.000025	<0.005	<0.005	<0.002	2.224	--	--
	12/13/16	0.135	196	31	<1	6.03	--	1,096	1,560	<0.005	<0.005	0.017	<0.001	0.003	<0.001	0.068	<0.005	0.323	<0.000025	<0.005	<0.005	<0.002	2.384	--	--
	01/17/17	0.101	196	33	<1	5.96	--	1,445	1,686	<0.005	<0.005	0.014	<0.001	0.003	0.068	0.068	<0.005	0.341	<0.000025	<0.005	<0.005	<0.002	2.436	--	--
	02/22/17	0.135	189	30	<1	5.67	--	1,055	1,628	<0.005	<0.005	0.020	<0.001	0.002	0.001	0.073	<0.005	0.331	<0.000025	<0.005	<0.005	<0.002	2.288	--	--
	06/06/17	0.121	188	30	<0.083	5.81	156	1,105	1,578	<0.00093	<0.00105	0.01033	<0.00002	0.00606	<0.00023	0.0748	<0.00068	0.329	0.000013	<0.00029	<0.00099	<0.00086	1.598	--	--
	10/05/17	--	--	--	--	5.92	598	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.247	213	45	<0.083	5.51	<100	--	1,846	<0.00093	<0.00105	0.00978	<0.00002	0.00915	<0.00023	0.07451	<0.00068	0.306	<0.000005	<0.00029	0.00414	<0.00086	1.514	260	3.72
	Dissolved	*0.231*	*205*	--	--	5.51	<100	--	--	*<0.00093*	*<0.00105*	*0.00737*	*<0.00002*	*0.00609*	*<0.00023*	*0.07938*	*<0.00068*	*0.301*	*<0.000005*	*<0.00029*	*0.00515*	*0.02*	*1.57*	241	3.56
	05/24/18	0.239	193	39	<0.083	6.28	7.8	1,067	1,836	<0.00093	<0.00105	0.00965	<0.00002	0.00646	<0.00023	0.07173	<0.00068	0.308	<0.000005	<0.00029	<0.00099	<0.00086	1.939	--	--
	08/15/18	0.118	187	40	<0.083	5.6	418	1,170	1,750	0.00002 J	0.00183	0.0128	0.000069	0.00025	0.000604	0.0435	0.0011	0.243	0.000011 J	0.00035	0.0003	0.000074	2.35	--	--
	02/21/19	0.151	207	43.2	0.180	6.93	274	1,060	1,720	0.00008 J	0.00251	0.120	0.00024	0.00027	0.00334	0.0645	0.00249	0.268	0.000007 J	0.0007 J	0.0008	<0.0005	2.66	--	--
	05/30/19	0.158	--	41.7	<0.04	--	176	1,120	1,546	<0.00002	0.00041	0.0196	0.00002 J	0.00003 J	0.000246	0.0511	0.00003 J	0.341	<0.000005	<0.0004	0.00006 J	<0.0001	--	145	3.40
	07/24/19	0.113	216	37	0.085 J	5.96	113	1,127	1,864	<0.00002	0.00107	0.0143	0.00013	0.00003 J	0.000228	0.0577	0.000263	0.283	<0.000005	<0.0004	0.0001 J	<0.0001	3.45	--	--
	02/17/20	0.104	184	36	0.16	5.85	52.4	1,070	1,750	<0.00002	0.00072	0.0096	0.00004 J	<0.00001	0.00008 J	0.0423	<0.00005	0.273	<0.000004	<0.0004	<0.00003	<0.0001	3.46	--	--
	05/20/20	0.115	250	47.7	0.15	5.71	35.9	1,190	1,890	<0.00002	0.00086	0.0114	0.00007 J	0.00002 J	0.000231	0.07	0.00008 J	0.302	<0.000002	<0.0004	0.00009 J	<0.0001	2.76	--	--
AD-18[c]	05/26/16	0.146	409	422	<1	5.1	--	5,135	10,000	<0.005	<0.005	0.012	0.014	0.003	<0.001	0.922	<0.005	2.07	0.000168	<0.005	0.006	0.003	12.58	--	--
	07/27/16	0.148	457	432	2	5.1	--	4,930	9,476	<0.005	<0.005	0.019	0.005	0.002	<0.001	0.734	<0.005	1.94	0.000091	<0.005	0.007	0.003	10.62	--	--
	09/29/16	0.156	469	637	4	5.59	--	4,632	9,569	<0.005	<0.005	0.02	0.004	<0.001	<0.001	0.666	<0.005	1.86	0.000117	<0.005	0.007	<0.002	7.05	--	--
	10/20/16	0.188	498	876	0.8664	5.7	--	5,537	9,540	<0.005	<0.005	0.021	0.002	0.001	<0.001	0.569	<0.005	2.06	0.000053	<0.005	<0.005	<0.002	5.82	--	--
	12/13/16	0.178	510	695	5	5.75	--	4,382	8,912	<0.005	<0.005	0.021	0.007	0.001	<0.001	0.641	<0.005	1.74	0.00005	<0.005	<0.005	<0.002	9.60	--	--
	01/17/17	0.050	412	159	5	4.49	--	5,414	8,562	<0.005	0.01	0.014	0.022	0.001	<0.001	0.929	<0.005	1.95	0.000224	<0.005	<0.005	0.002	22.51	--	--
	02/22/17	0.090	401	151	6	4.37	--	5,169	8,412	<0.005	<0.005	0.014	0.026	0.002	<0.001	0.961	<0.005	1.82	0.000107	<0.005	<0.005	0.00228	19.11	--	--
	06/06/17	0.125	428	304	6.53	4.27	121	5,920	9,394	<0.00093	0.00331	0.01038	0.01883	0.00303	<0.00023	0.940	<0.00068	2.15	0.000113	<0.00029	0.00212	<0.00086	16.12	--	--
	10/05/17	--	--	--	--	5.87	165	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.163	433	362	9.4	3.61	104.1	--	9,952	0.00224	0.00276	0.00813	0.01733	0.0036	0.00098	0.928	<0.00068	2.07	0.000043	<0.00029	0.00194	0.00144	19.95	19.7	14.1
	Dissolved	*0.153*	*423*	--	--	--	--	--	--	*0.00467*	*0.00189*	*0.00748*	*0.01676*	*0.00316*	*<0.00023*	*0.898*	*<0.00068*	*2.06*	*0.000012*	*<0.00029*	*0.00135*	*0.01466*	*18.09*	19.1	13.7
	05/30/19	0.09 J	--	390	3.56	--	91.3	*6,120*	9,564	<0.0002	0.04	0.009 J	0.021	0.004 J	<0.004	1.130	0.005 J	1.27	0.000035	<0.04	0.103	<0.01	--	11.2	7.53

Table 4-4
Groundwater Sampling Analytical Results (mg/L) - Bottom Ash Storage Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Point of Compliance Wells																									
AD-3	05/31/16	0.02	1.41	9	<1	6.58	--	4	106	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	<0.005	<0.005	0.010	0.00085	<0.005	<0.005	<0.002	1.02	--	--
	07/27/16	0.02	0.706	8	<1	6.58	--	5	118	<0.005	<0.005	0.036	<0.001	<0.001	<0.001	<0.005	<0.005	0.024	0.000589	<0.005	<0.005	<0.002	0.1786	--	--
	09/30/16	0.02	<0.5	9	<1	4.75	--	6	127	<0.005	<0.005	0.043	<0.001	<0.001	<0.001	<0.005	<0.005	0.019	0.00039	<0.005	<0.005	<0.002	0.552	--	--
	10/19/16	0.06	0.794	8	<1	3.71	--	9	112	<0.005	<0.005	0.041	<0.001	<0.001	<0.001	<0.005	<0.005	0.018	0.000351	0.006	<0.005	<0.002	1.589	--	--
	12/12/16	0.02	1.05	8	<1	4.67	--	11	138	<0.005	<0.005	0.045	<0.001	<0.001	<0.001	<0.005	<0.005	0.017	0.000321	<0.005	<0.005	<0.002	0.546	--	--
	01/19/17	0.02	0.746	9	<1	4.60	--	4	76	<0.005	<0.005	0.041	<0.001	<0.001	<0.001	<0.005	<0.005	0.014	0.000504	<0.005	<0.005	<0.002	0.229	--	--
	02/23/17	0.02	0.573	9	<1	4.69	--	5	104	<0.005	<0.005	0.037	<0.001	<0.001	<0.001	<0.005	<0.005	0.014	0.000501	<0.005	<0.005	<0.002	0.4592	--	--
	06/07/17	0.03326	0.543	9	0.2625	4.49	56.6	5	104	<0.00093	0.00191	0.038	0.00024	0.00008	0.00075	0.00128	<0.00068	0.01503	0.000365	<0.00029	<0.00099	<0.00086	0.459	--	--
	10/06/17	--	--	--	--	5.15	65.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/15/18	0.01869	0.56	9	<0.083	4.31	11.1		132	0.00166	0.0016	0.0365	0.00034	0.00008	<0.00023	0.00136	<0.00068	0.01459	0.00037	<0.00029	0.00323	0.00127	0.016	0.188	0.004
	Dissolved	*0.01132*	*0.595*	--	--	4.31	11.1	--	--	*<0.00093*	*<0.00105*	*0.0361*	*0.00023*	*<0.00007*	*<0.00023*	*0.00133*	*<0.00068*	*0.01445*	*0.000379*	*<0.00029*	*<0.00099*	*<0.00086*	*0.242*	< 0.01	0.004
	05/24/18	0.0069 J	0.545	8	<0.083	4.58	8.50	3	98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/19	<0.02	--	9.03	0.18	--	57.2	2.3	110	0.00006 J	0.00103	0.0632	0.000158	0.00005 J	0.000316	0.00171	0.000382	0.03 J	0.000245	<0.0004	0.0003	<0.0001	--	*1.54*	0.011
	11/25/19	--	0.734	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AD-4c	05/31/16	0.05	0.798	10	<1	5.41	--	32	204	<0.005	<0.005	0.088	<0.001	<0.001	0.009	<0.005	<0.005	0.004	0.000191	<0.005	<0.005	<0.002	1.29	--	--
	07/27/16	0.03	0.666	12	<1	5.41	--	35	208	<0.005	<0.005	0.059	<0.001	<0.001	0.004	<0.005	<0.005	0.015	0.000185	<0.005	<0.005	<0.002	0.5075	--	--
	09/29/16	0.02	<0.5	11	<1	4.96	--	45	212	<0.005	<0.005	0.074	<0.001	<0.001	0.008	<0.005	<0.005	0.006	0.00016	<0.005	<0.005	<0.002	2.572	--	--
	10/19/16	0.04	0.578	10	<1	4.30	--	35	212	<0.005	<0.005	0.069	<0.001	<0.001	0.009	<0.005	<0.005	0.006	0.000141	<0.005	<0.005	<0.002	1.657	--	--
	12/12/16	0.02	0.341	11	<1	4.62	--	36	252	<0.005	<0.005	0.021	<0.001	<0.001	<0.001	<0.005	<0.005	0.004	0.000143	<0.005	<0.005	<0.002	0.685	--	--
	01/19/17	0.02	0.761	10	<1	4.67	--	43	184	<0.005	<0.005	0.075	<0.001	<0.001	0.004	<0.005	<0.005	0.005	0.000125	<0.005	<0.005	<0.002	2.045	--	--
	02/23/17	0.02	0.467	9	<1	5.10	--	40	196	<0.005	<0.005	0.030	<0.001	<0.001	<0.001	<0.005	<0.005	0.004	0.000098	<0.005	<0.005	<0.002	0.517	--	--
	06/07/17	0.03331	0.573	10	<0.083	4.88	351	39	228	<0.00093	0.00119	0.05142	0.00019	0.00008	0.00403	0.00075	<0.00068	0.00482	0.000147	<0.00029	<0.00099	<0.00086	0.953	--	--
	10/06/17	--	--	--	--	5.38	308	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	0.0186	0.498	14	<0.083	4.67	6.40		232	<0.00093	<0.00105	0.02572	0.0001	<0.00007	0.00044	0.00049	<0.00068	0.00394	0.000228	<0.00029	<0.00099	<0.00086	0.435	0.592	< 0.001
	Dissolved	*0.02017*	*0.468*	--	--	4.67	6.40	--	--	*<0.00093*	*<0.00105*	*0.02223*	*0.00006*	*<0.00007*	*<0.00023*	*0.00043*	*<0.00068*	*0.0039*	*0.000031*	*<0.00029*	*<0.00099*	*<0.00086*	*0.354*	0.394	0.002
	05/24/18	0.02505	0.434	14	<0.083	*5.17*	*48.1*	42	224	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	08/14/18	--	--	15	--	--	125	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/29/19	<0.02	--	14.8	0.16	--	158	52.8	208	<0.0004	0.0006 J	0.0295	<0.0004	<0.0002	<0.0008	<0.0004	<0.0004	<0.009	0.000206	<0.008	<0.0006	<0.002	--	0.327	0.0007 J
	11/25/19	--	--	--	--	--	--	--	290	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AD-16	01/26/16	0.05	2.81	6	<1	3.84	--	49	180	<0.005	0.02	0.198	0.002	<0.001	0.054	0.013	0.016	0.015	0.000259	<0.005	<0.005	<0.002	4.478	--	--
	03/21/16	0.04	2.04	6	<1	4.20	--	47	104	<0.005	<0.005	0.119	<0.001	<0.001	0.009	<0.005	<0.005	0.007	0.000114	<0.005	<0.005	<0.002	4.44	--	--
	05/31/16	0.03	1.55	6	<1	4.44	--	40	96	<0.005	<0.005	0.127	<0.001	<0.001	0.001	<0.005	<0.005	0.002	0.000037	<0.005	<0.005	<0.002	5.99	--	--
	07/27/16	0.04	3.42	7	<1	4.44	--	70	184	<0.005	0.01	0.123	0.002	<0.001	0.011	0.022	<0.005	0.035	0.000212	<0.005	<0.005	<0.002	7.21	--	--
AD-16R	06/06/17	0.04198	2.75	7	0.3438	3.68	46.9	54	204	<0.00093	0.00707	0.0464	0.00221	0.00103	0.00176	0.04174	<0.00068	0.0293	<0.000005	<0.00029	0.00198	<0.00086	6.66	--	--
	06/28/17	0.06398	1.24	6	0.2512	3.91	--	55	200	<0.00093	0.00528	0.04143	0.00216	0.00092	0.00095	0.04087	<0.00068	0.02932	<0.000005	<0.00029	<0.00099	<0.00086	12.11	--	--
	07/28/17	0.02841	1.92	7	<0.083	2.77	--	48	162	<0.00093	0.0037	0.04851	0.00217	0.00128	0.00107	0.04533	<0.00068	0.02617	0.000006	<0.00029	0.00127	0.00143	8.52	--	--
	08/02/17	0.03177	1.86	7	<0.083	3.00	--	49	174	<0.00093	0.00446	0.04961	0.00206	0.00122	0.00095	0.04311	<0.00068	0.02498	<0.000005	<0.00029	0.00174	0.00202	5.45	--	--
	10/06/17	--	--	--	--	3.29	31.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/15/18	0.04030	2.73	6	<0.083	3.18	0.0		212	0.00269	0.0074	0.04301	0.00278	0.00129	0.0007	0.04123	<0.00068	0.02977	<0.000005	0.00103	<0.00099	<0.00086	5.89	1.47	0.053
	Dissolved	*0.02614*	*2.59*	--	--	3.18	0.0	--	--	*<0.00093*	*0.00294*	*0.04155*	*0.0022*	*0.00071*	*0.00025*	*0.03996*	*<0.00068*	*0.0278*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*5.90*	0.599	0.05
	05/23/18	0.03202	2.53	6	<0.083	*3.79*	*36.9*	67	204	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	08/14/18	--	--	--	--	--	142	44	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/19	<0.02	--	5.43	0.19	--	77.1	41.6	80	0.00002 J	0.00176	0.0724	0.000424	0.00008	0.000334	0.00438	0.00006 J	0.01 J	0.000296	<0.0004	0.0006	0.0002 J	--	0.072	0.0079
	11/25/19	--	--	--	--	--	--	--	222	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Supplemental Downgradient Monitoring Wells																									
AD-19	5/17/2018	0.07234	9.4	34	<0.083	5.72	42.1	--	372	<0.00093	<0.00105	0.05026	0.00073	<0.00007	0.00117	0.0111	<0.00068	0.02924	<0.000005	0.00078	0.00194	<0.00086	1.421	3.04	0.089
	Dissolved	*0.06293*	*8.76*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.04*	*0.00025*	*<0.00007*	*<0.00023*	*0.00965*	*<0.00068*	*0.02842*	*<0.000005*	*0.00041*	*<0.00099*	*0.012*	*2.577*	2.13	0.08
AD-20	10/31/18	0.029	3.14	18.4	0.09	4.88	13	12.5	140	0.00004	0.00185	0.205	0.000651	0.00114	0.000514	0.0161	0.000425	0.0126	<0.00005	<0.0004	0.0008	0.0003	4.16	1.11	0.0742
AD-21	10/30/18	0.025	5.0	17	0.23	5.04	0.0	27.4	180	0.00006	0.00124	0.0868	0.00181	0.00065	0.000263	0.0337	0.000148	0.034	<0.00005	<0.0004	0.0011	0.0002	3.76	3.13	0.154
EPA MCLs:																									
MCL					4					0.006	0.01	2	0.004	0.005	0.1				0.002	N/A	0.05	0.002	5^{b}		
Rule Specified																0.006	0.015	0.04		0.1					
Background Limit					0.58					0.003	0.005	0.69	0.00054	0.0065^{d}	0.0031	0.075^{d}	0.0034	0.39^{d}	0.000033	0.002	0.005	0.001	4.07^{e}		
Interwell Background Value(s) (UPL, LPL where applicable) AD-8, AD-9, AD-15		0.700				4.8-7.0																			
Intrawell Background Value (UPL) AD-8			15.1	16.5	0.66			149	336																
Intrawell Background Value (UPL) AD-9			299	138	1.00			2,530	3,070																
Intrawell Background Value (UPL) AD-15			5.40	38.8	1.00			33.2	249																

NOTES:
All concentration data are provided in milligrams per liter (mg/L) unless otherwise noted.
J = Analyte was positively identified, though the quantitation was below Reporting Limit.
MCL = Maximum contaminant level
LPL = Lower prediction limit
UPL = Upper prediction limit
pCi/L = PicoCuries per liter.
-- = Not analyzed.
a = Calculated Upper Tolerance Limit is higher than MCL.
b = Data is "Combined Radium, Total".
c = AD-18 is not part of the designated CCR Monitoring Well Network and used for background understanding only
🟨 Denotes groundwater sample collected by ARCADIS using low-flow sampling methods.
Unless otherwise noted, values shown are total (unfiltered) analyses.
Dissolved (0.45-micron lab filtered) parameter concentrations shown in italics.

FIGURES



Source:
7.5 minute topographic quadrangle
Cason, Texas, 2013

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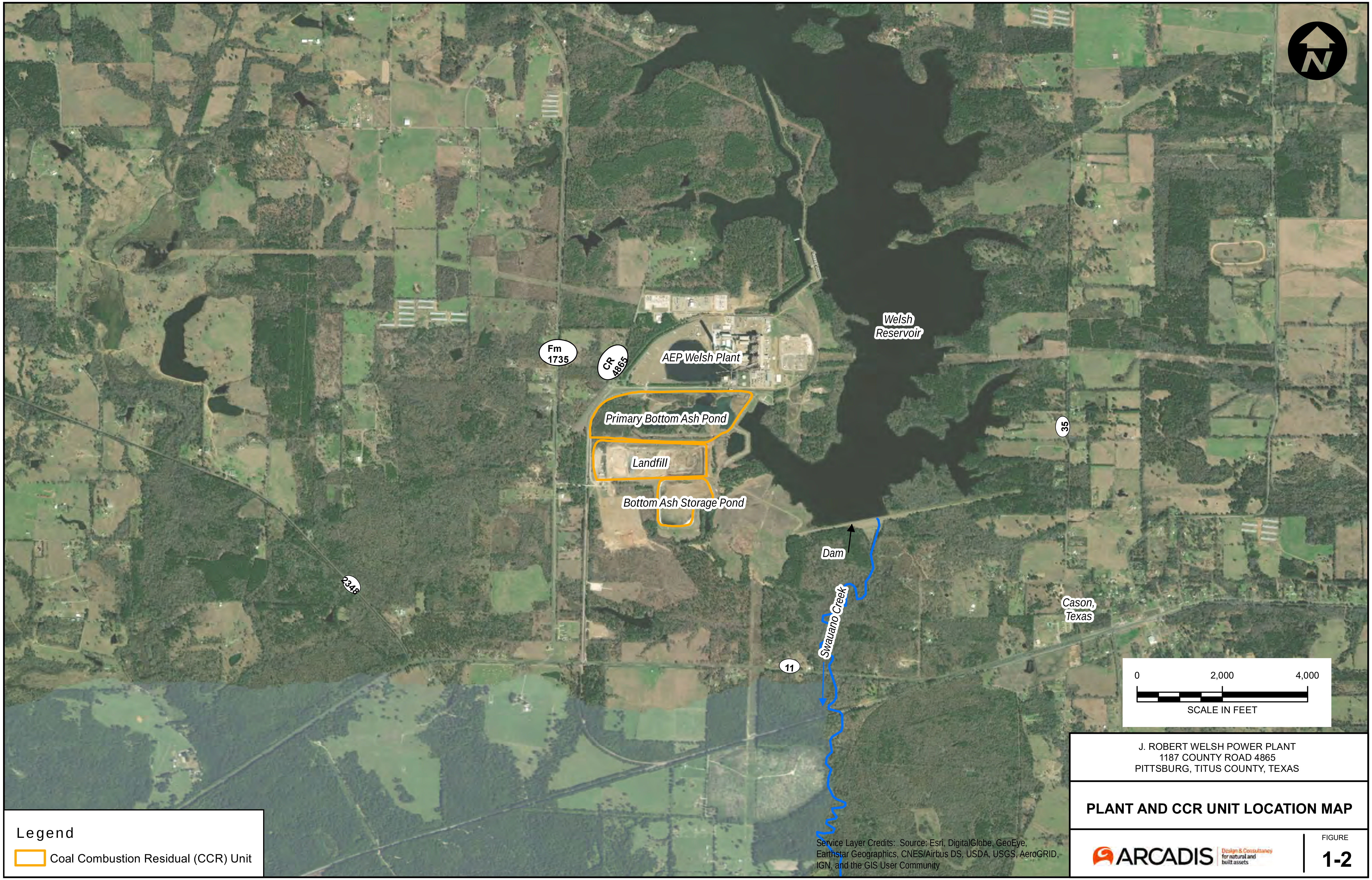
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-1

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\Dec2017Update\fig 1 - site map.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

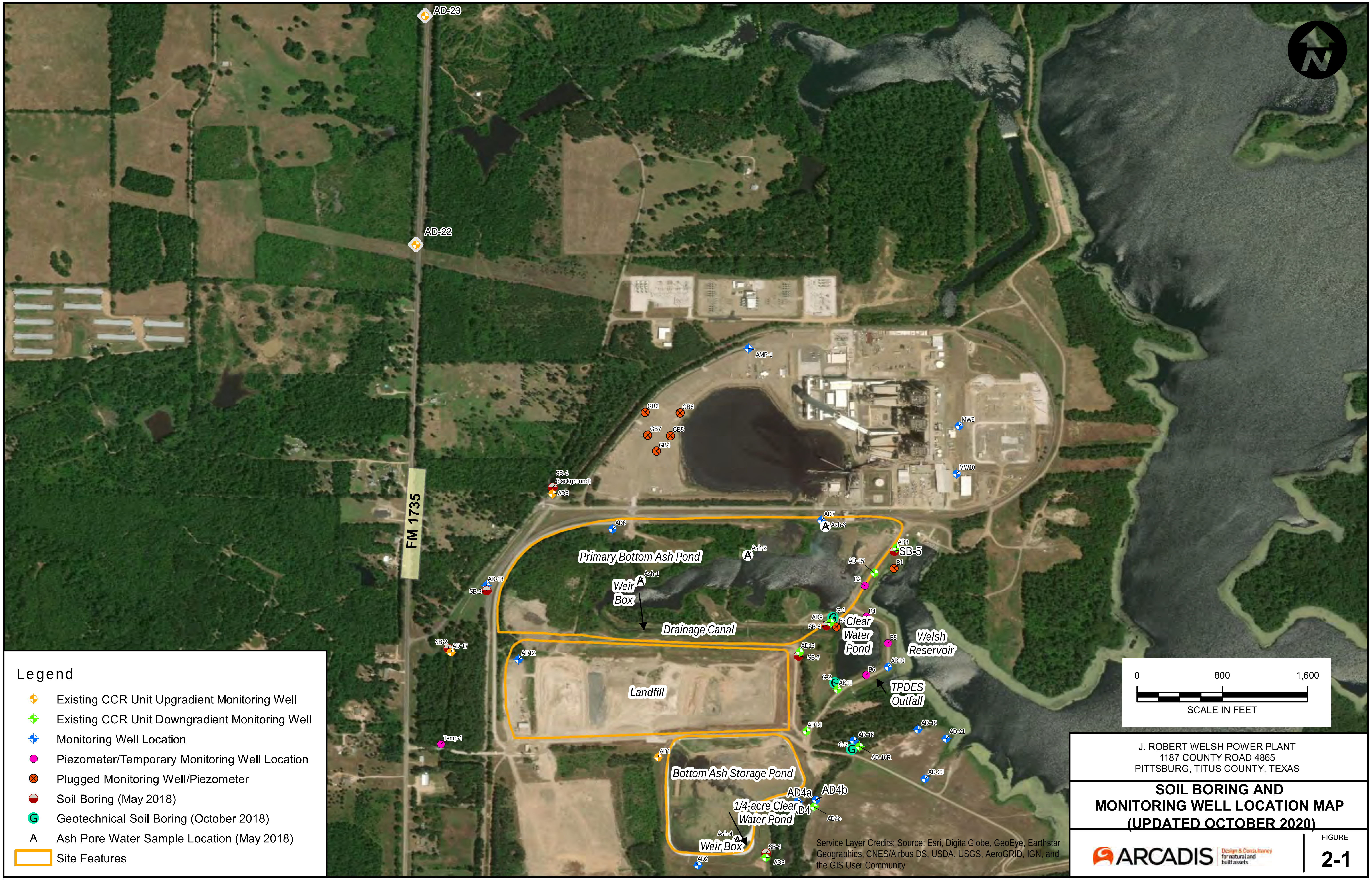
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PLANT AND CCR UNIT LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-2

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Lithium_ASD_Report\fig 1-2 - CCR location.mxd



Legend

- ✚ Existing CCR Unit Upgradient Monitoring Well
- ✚ Existing CCR Unit Downgradient Monitoring Well
- ✚ Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◐ Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features

0 800 1,600
SCALE IN FEET

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
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PITTSBURG, TITUS COUNTY, TEXAS

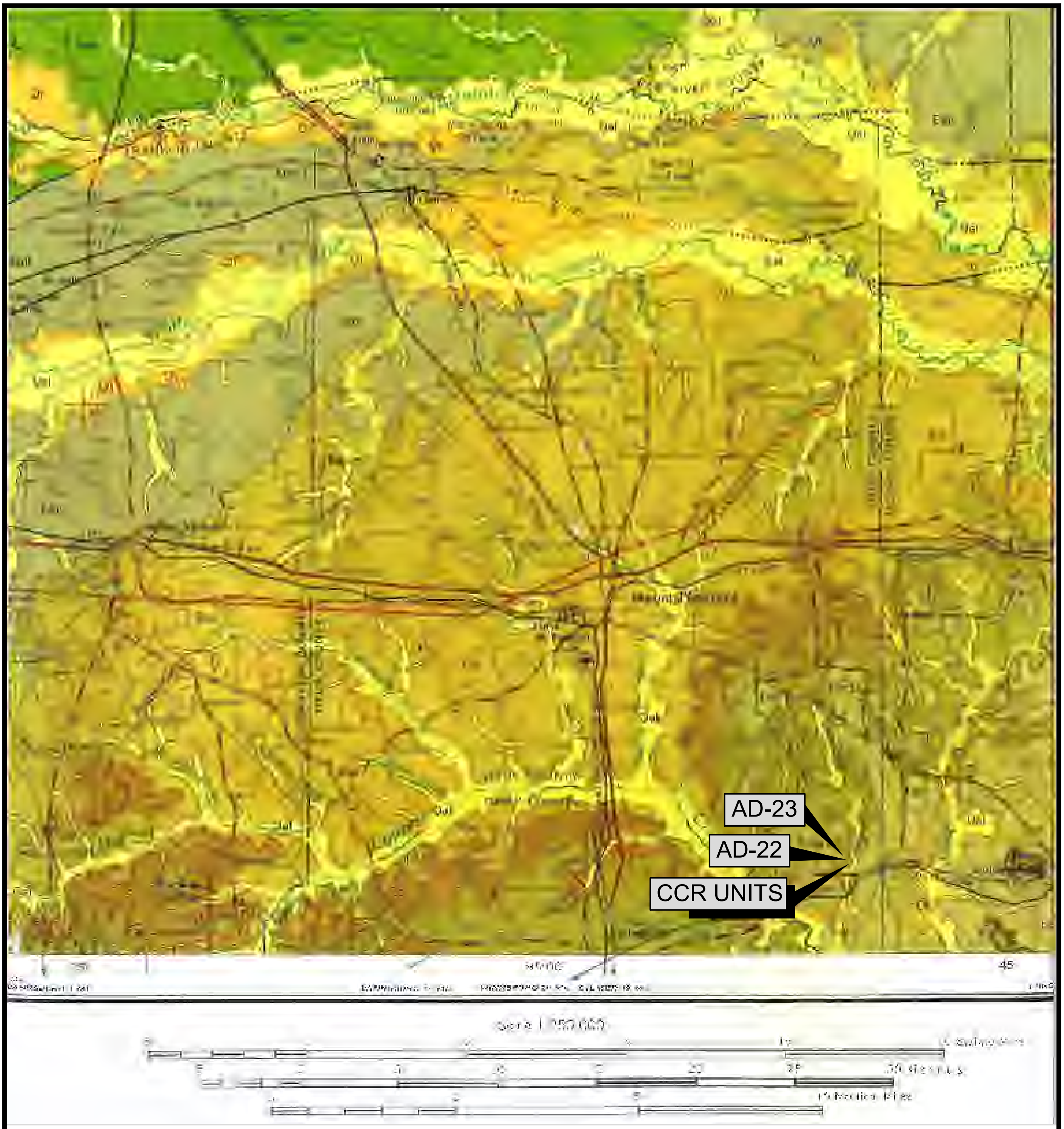
SOIL BORING AND MONITORING WELL LOCATION MAP (UPDATED OCTOBER 2020)

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-1

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 2-1-SoilBoring_MonitoringWellLocations.mxd

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\30034022 - Welsh Lithium ASD August 2019\Figures-Maps\Figure 2-2A Regional Geo Map.dwg LAYOUT: MODEL SAVED: 8/6/2019 9:16 AM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 9/9/2019 10:33 AM BY: LEASE, DIANA



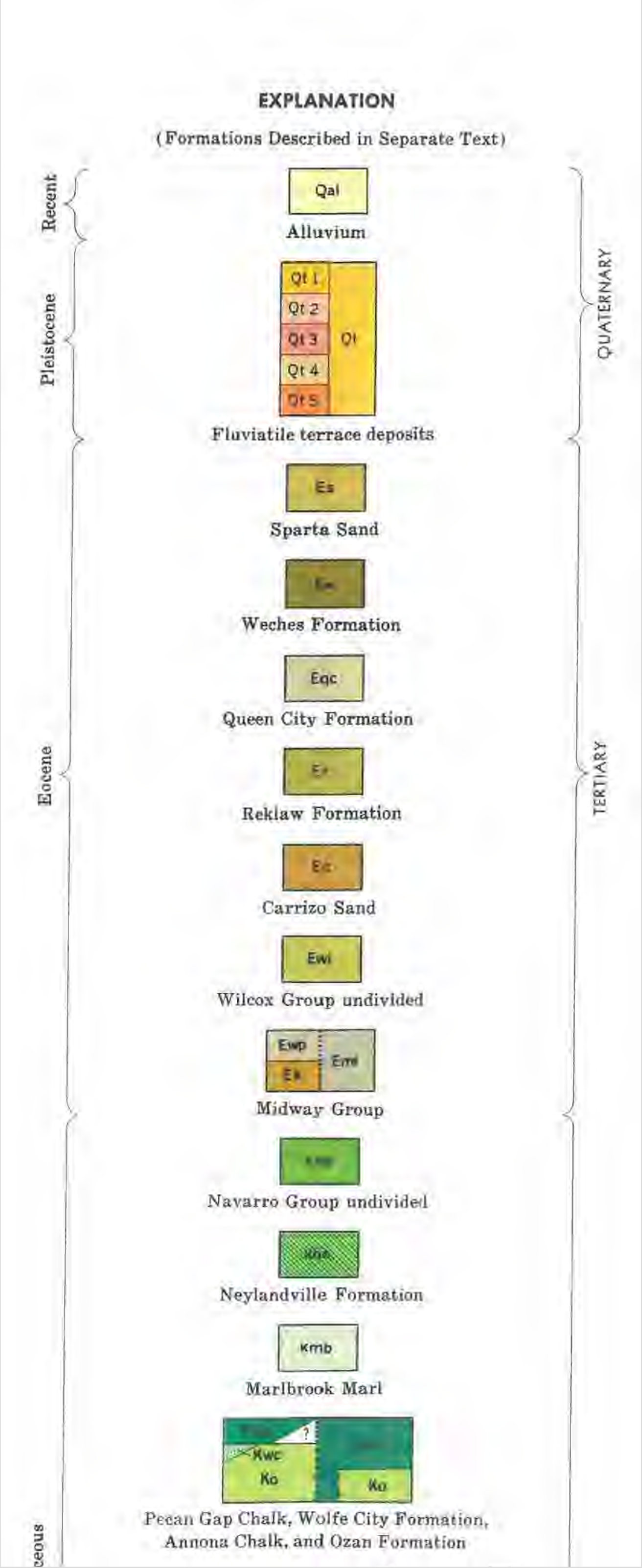
REF: "GEOLOGIC ATLAS OF TEXAS, TEXARKANA SHEET", UNIVERSITY OF TEXAS AT AUSTIN BUREAU OF ECONOMIC GEOLOGY, 1966.

J. ROBERT WELSH POWER PLANT
PITTSBURG, TITUS COUNTY, TEXAS

REGIONAL GEOLOGIC MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-2A



J. ROBERT WELSH POWER PLANT
PITTSBURG, TITUS COUNTY, TEXAS

REGIONAL
GEOLOGIC MAP LEGEND

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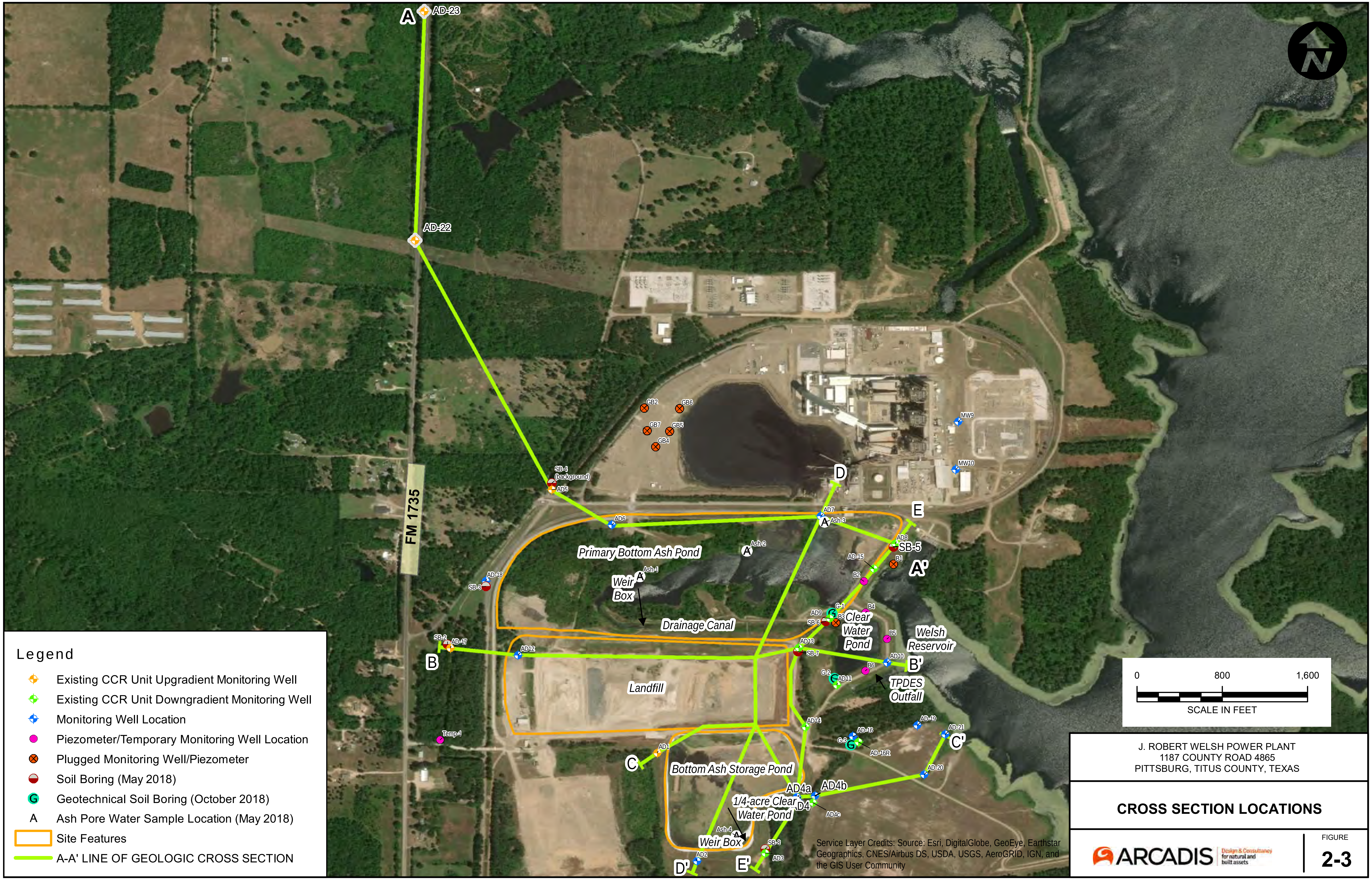
FIGURE
2-2B

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\30034022 - Welsh Lithium ASD August 2019\Figures-Maps\Figure 2-2B Reg Geo Map Legend.dwg LAYOUT: MODEL SAVED: 8/6/2019 9:19 AM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 9/9/2019 10:37 AM BY: LEASE, DIANA



Legend

- ◆ Existing CCR Unit Upgradient Monitoring Well
- ◆ Existing CCR Unit Downgradient Monitoring Well
- ◆ Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◐ Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features
- — A-A' LINE OF GEOLOGIC CROSS SECTION

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

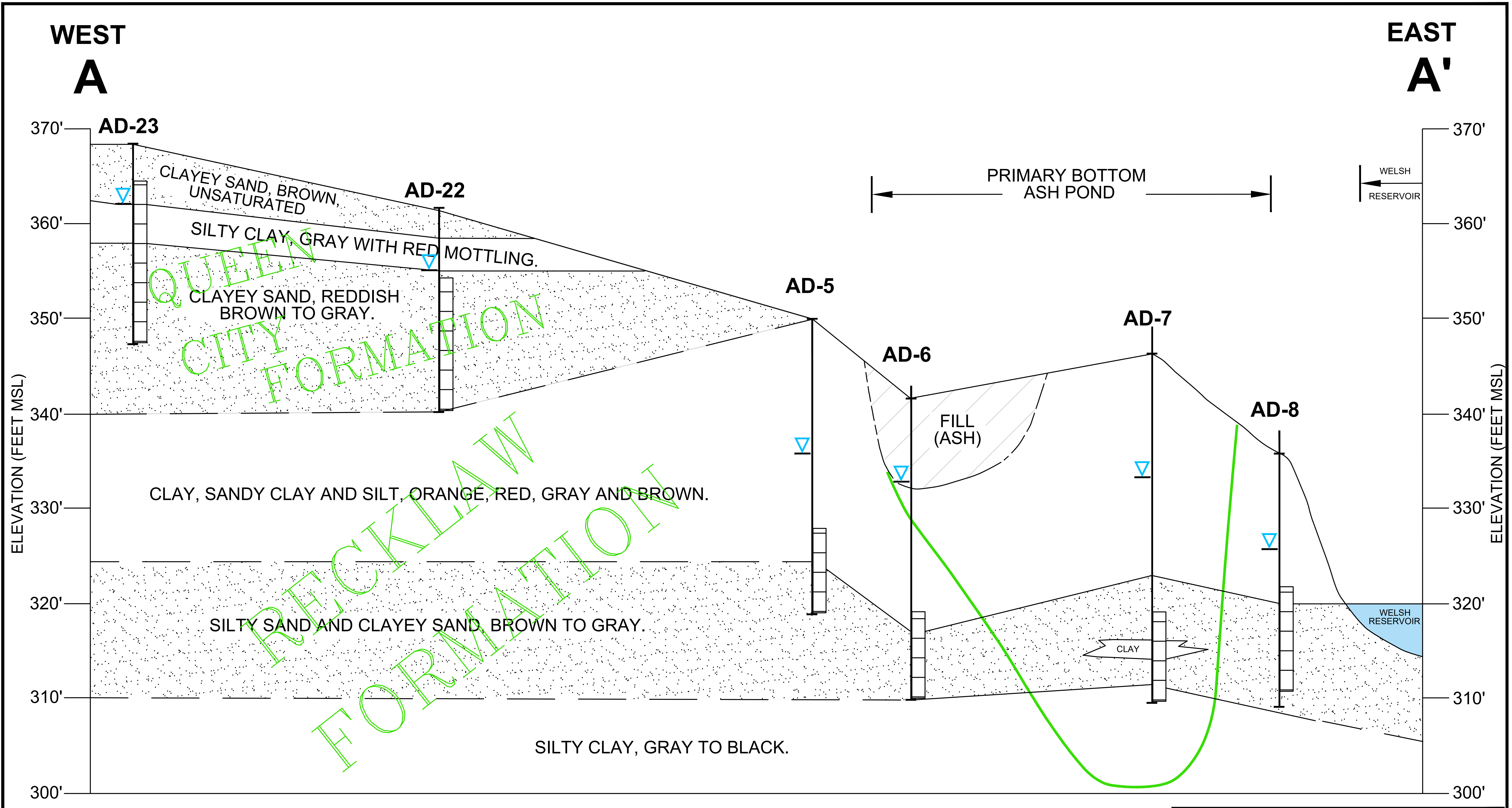
CROSS SECTION LOCATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-3

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig2-3-Cross Section LocationsREV.mxd

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\30034022 - Welsh Lithium ASD August 2019\Figures-Maps\Figure 2-4 Cross Section A-A'.dwg LAYOUT: MODEL SAVED: 8/7/2019 9:49 AM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 9/9/2019 10:45 AM BY: LEASE, DIANA



0 600'
HORIZONTAL SCALE

NOTE: BASE OF ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

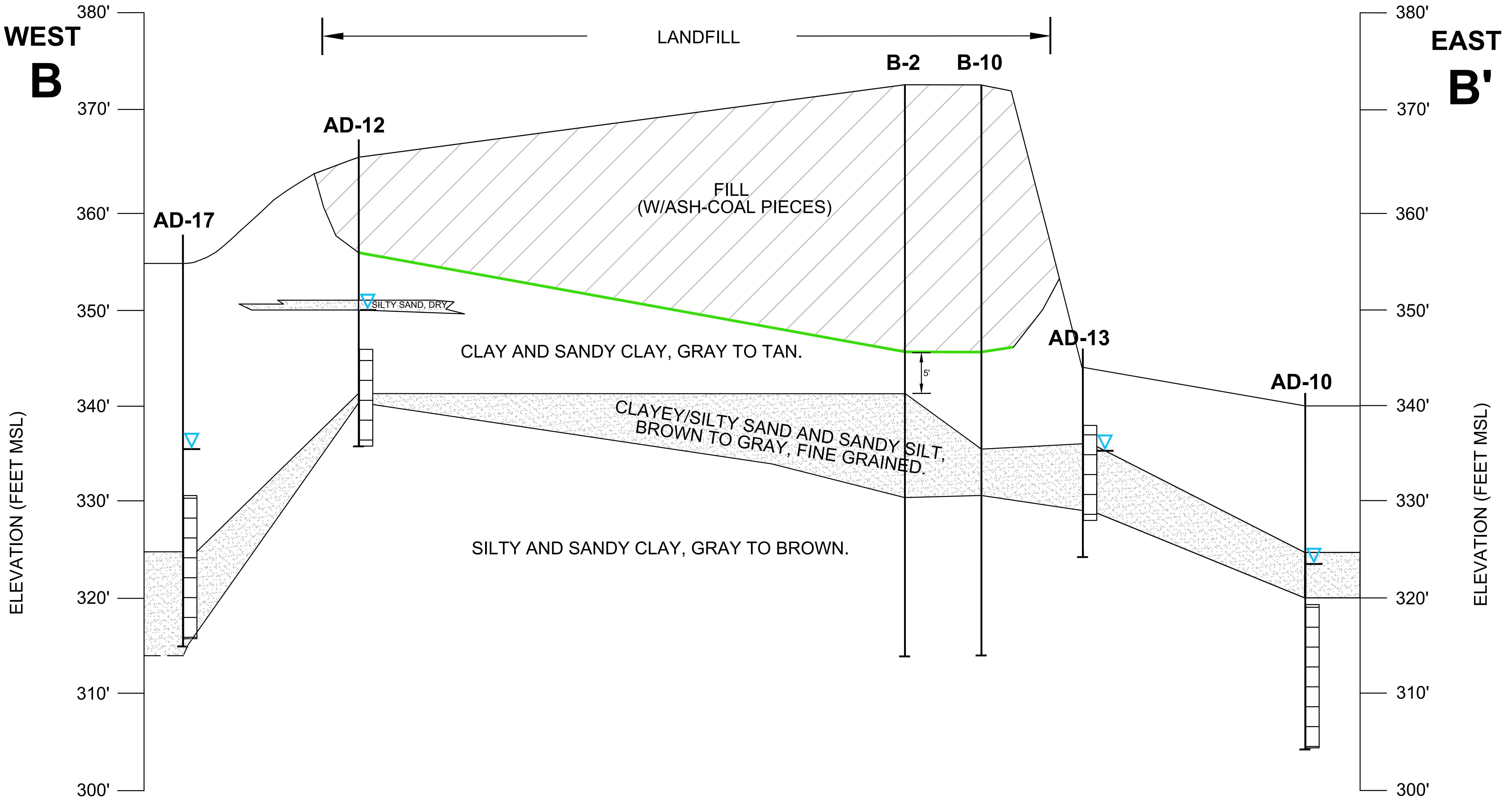
▤	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN EVALUATION (6/19/19)
—	PROJECTED BASE OF PRIMARY BOTTOM ASH POND (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
A - A'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-4



0 ▬▭ 300'
HORIZONTAL SCALE

NOTE: BASE OF LANDFILL ELEVATION TAKEN FROM "WELSH POWER PLANT- UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12/3/76.

LEGEND

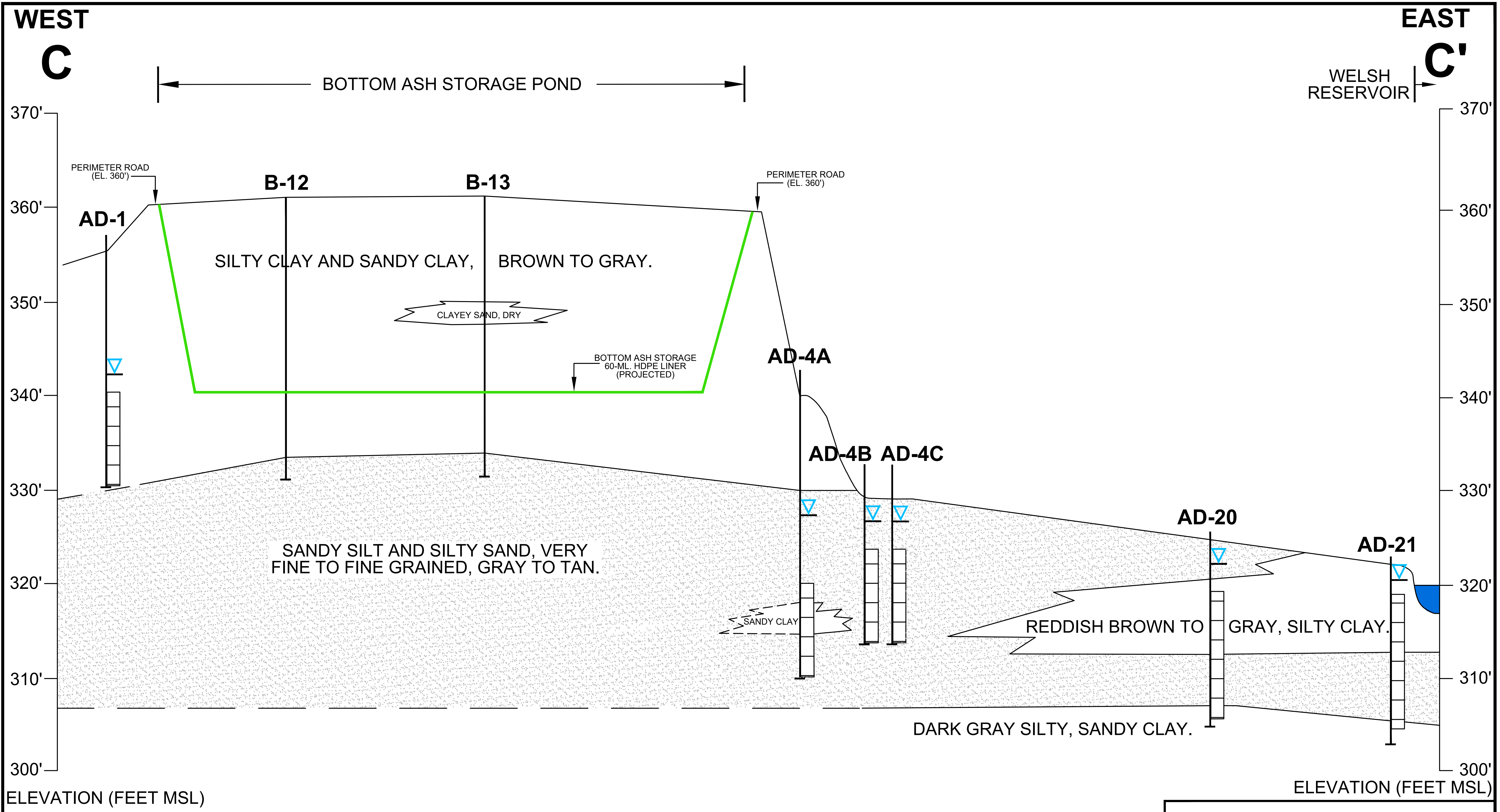
▤	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
🟩	BASE OF LANDFILL (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
B - B'

ARCADIS

FIGURE
2-5



0 200'
HORIZONTAL SCALE

NOTE: BASE OF BOTTOM ASH STORAGE HAS A 60-ML. HDPE LINER AT ELEVATION 340.0' , TAKEN FROM FREESE AND NICHOLS "HYDRAULIC ANALYSIS OF WELSH POWER PLANT ASH PONDS, AMERICAN ELECTRIC POWER COMPANY", DATED DECEMBER 2010.

LEGEND

▤	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (10/29/18)
🟩	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
C - C'

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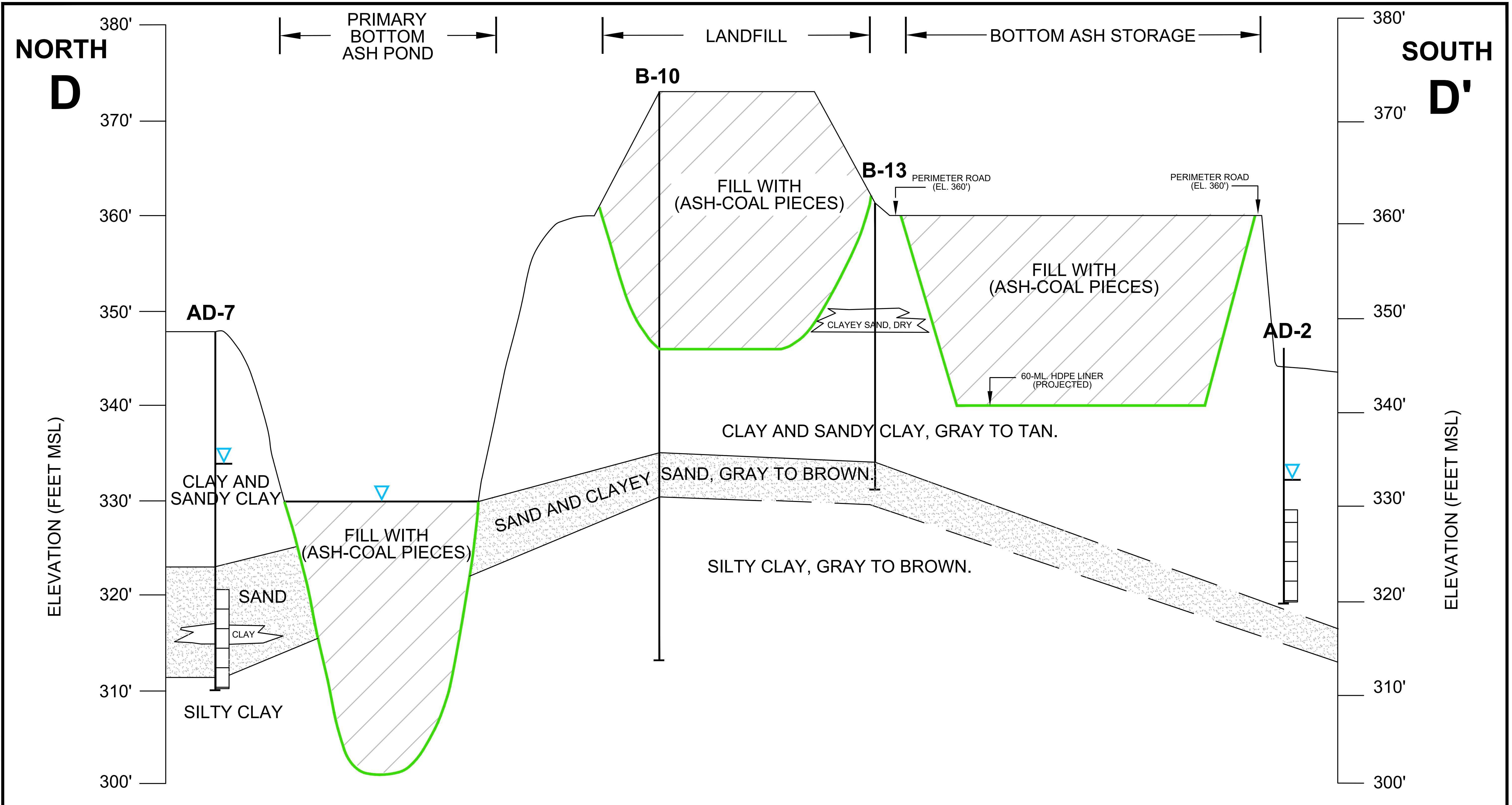
FIGURE
2-6



0 ▬▬ 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

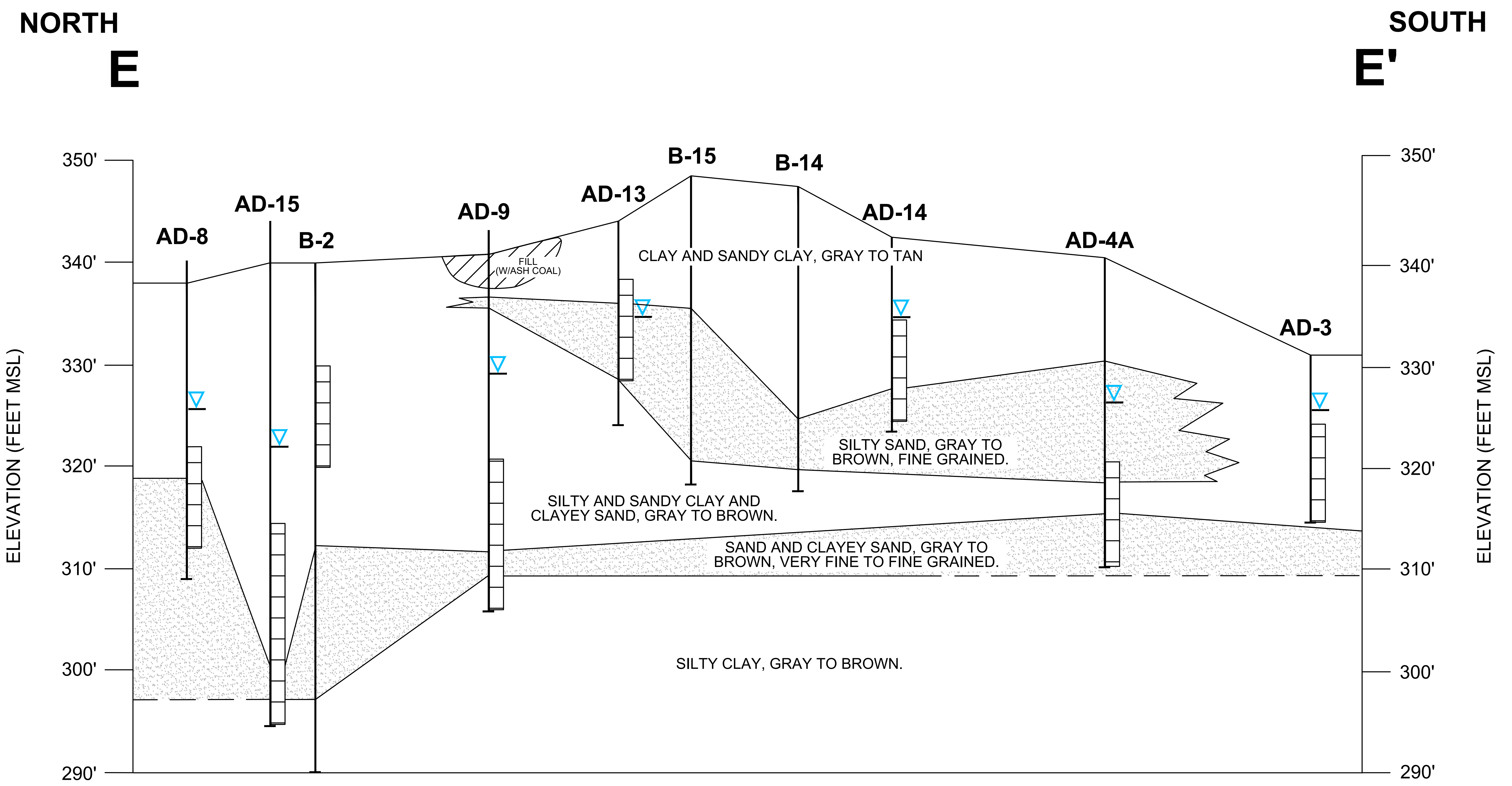
▤	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (5/12/15)
🟩	BASE OF CCR UNIT

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
D - D'

ARCADIS

FIGURE
2-7



0 300'
HORIZONTAL SCALE

LEGEND

⊟ MONITORING WELL SCREENED INTERVAL

▽ WATER LEVEL IN MONITORING WELL (3/4/16)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
E - E'

ARCADIS

FIGURE
2-8

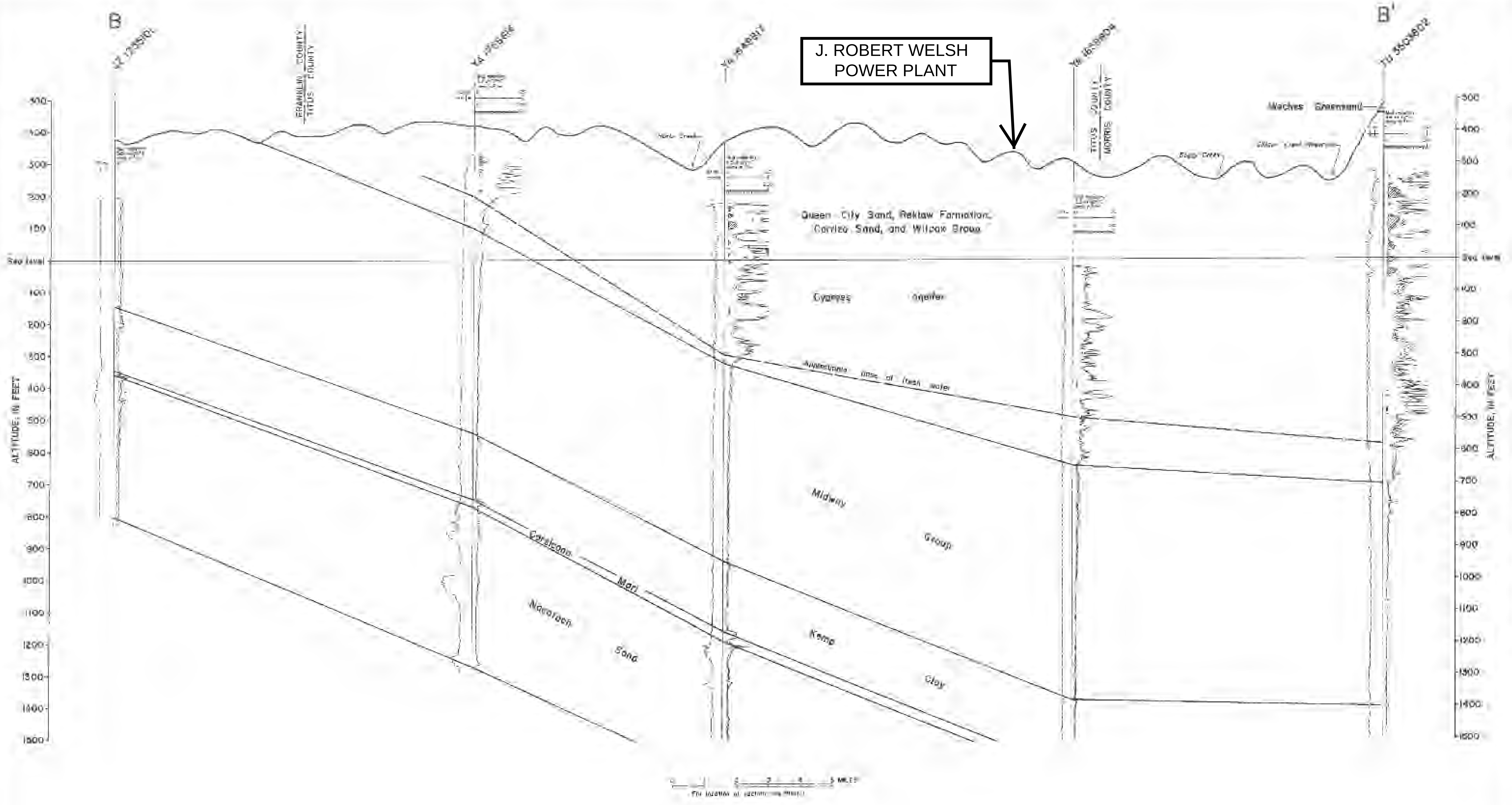


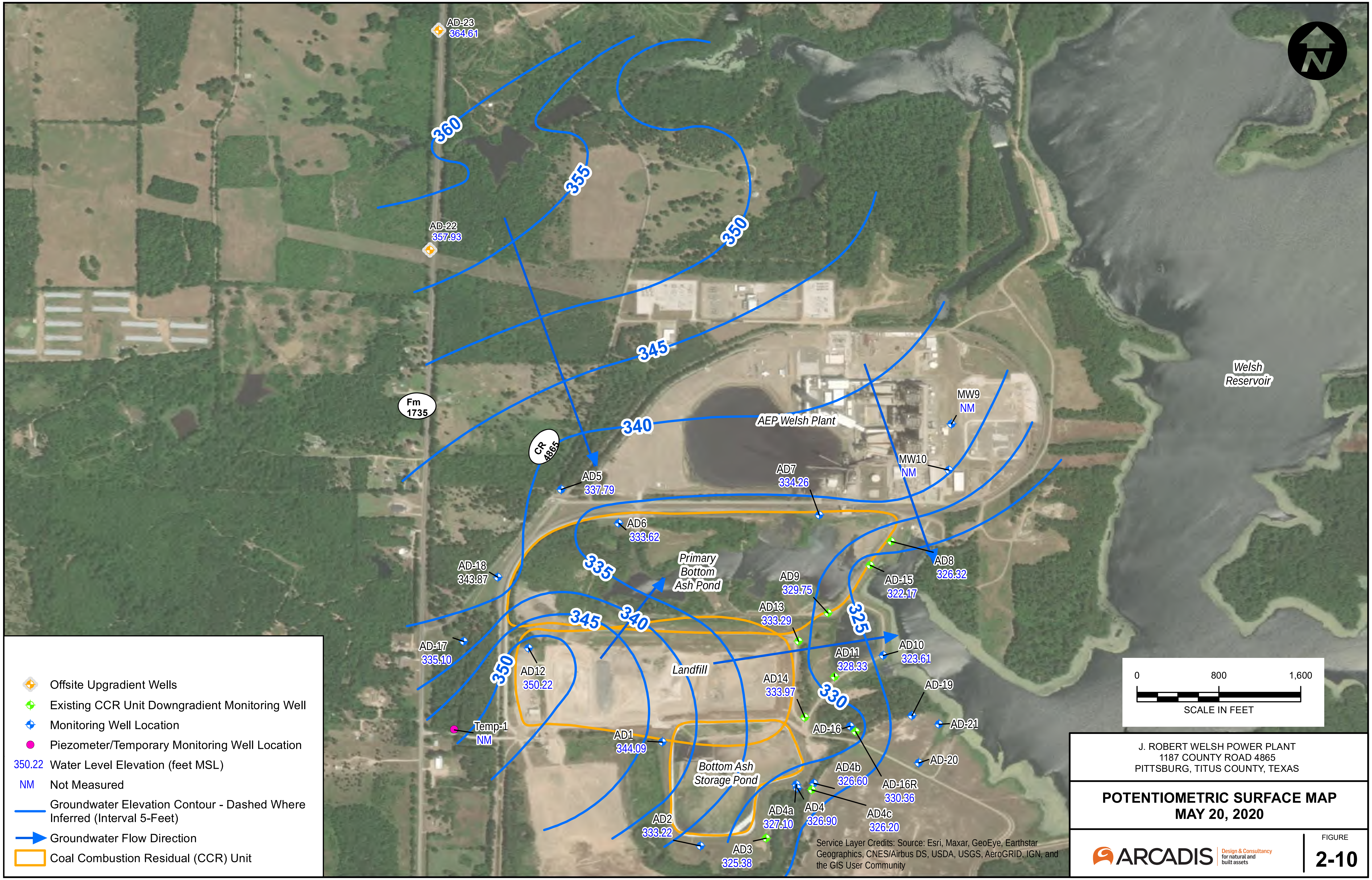
Plate 3

Geologic Section B – B', Franklin, Titus, and Morris Counties

U. S. Geological Survey in cooperation with the Texas Water Commission **(TWC BULLETIN 6517)**

REGIONAL GEOLOGIC CROSS SECTION

FIGURE 2-9



◆	Offsite Upgradient Wells
◆	Existing CCR Unit Downgradient Monitoring Well
◆	Monitoring Well Location
●	Piezometer/Temporary Monitoring Well Location
350.22	Water Level Elevation (feet MSL)
NM	Not Measured
—	Groundwater Elevation Contour - Dashed Where Inferred (Interval 5-Feet)
→	Groundwater Flow Direction
▭	Coal Combustion Residual (CCR) Unit

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

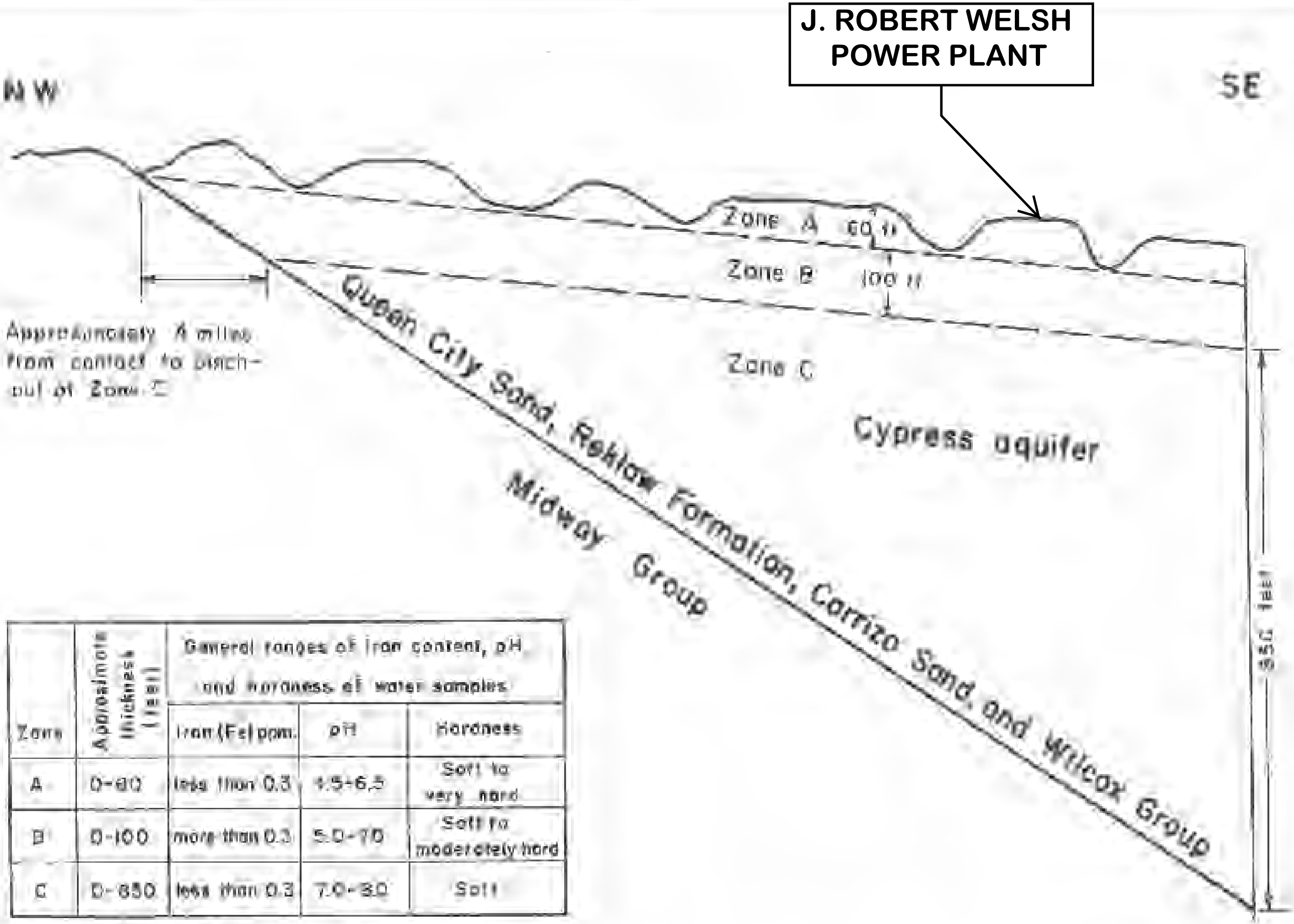
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

POTENTIOMETRIC SURFACE MAP
MAY 20, 2020

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-10

Document Path: U:_ENV\AEP\Welsh Plant\MXD\Landfill report\May 2020\fig 2-10 - Potentiometric May2020.mxd



Zone	Approximate thickness (feet)	General ranges of iron content, pH and hardness of water samples		
		Iron (Fe) ppm.	pH	Hardness
A	0-60	less than 0.3	4.5-6.5	Soft to very hard
B	0-100	more than 0.3	5.0-7.0	Soft to moderately hard
C	0-850	less than 0.3	7.0-8.0	Soft

Figure 12

Diagrammatic Section Showing Zones A, B, and C in the Cypress Aquifer

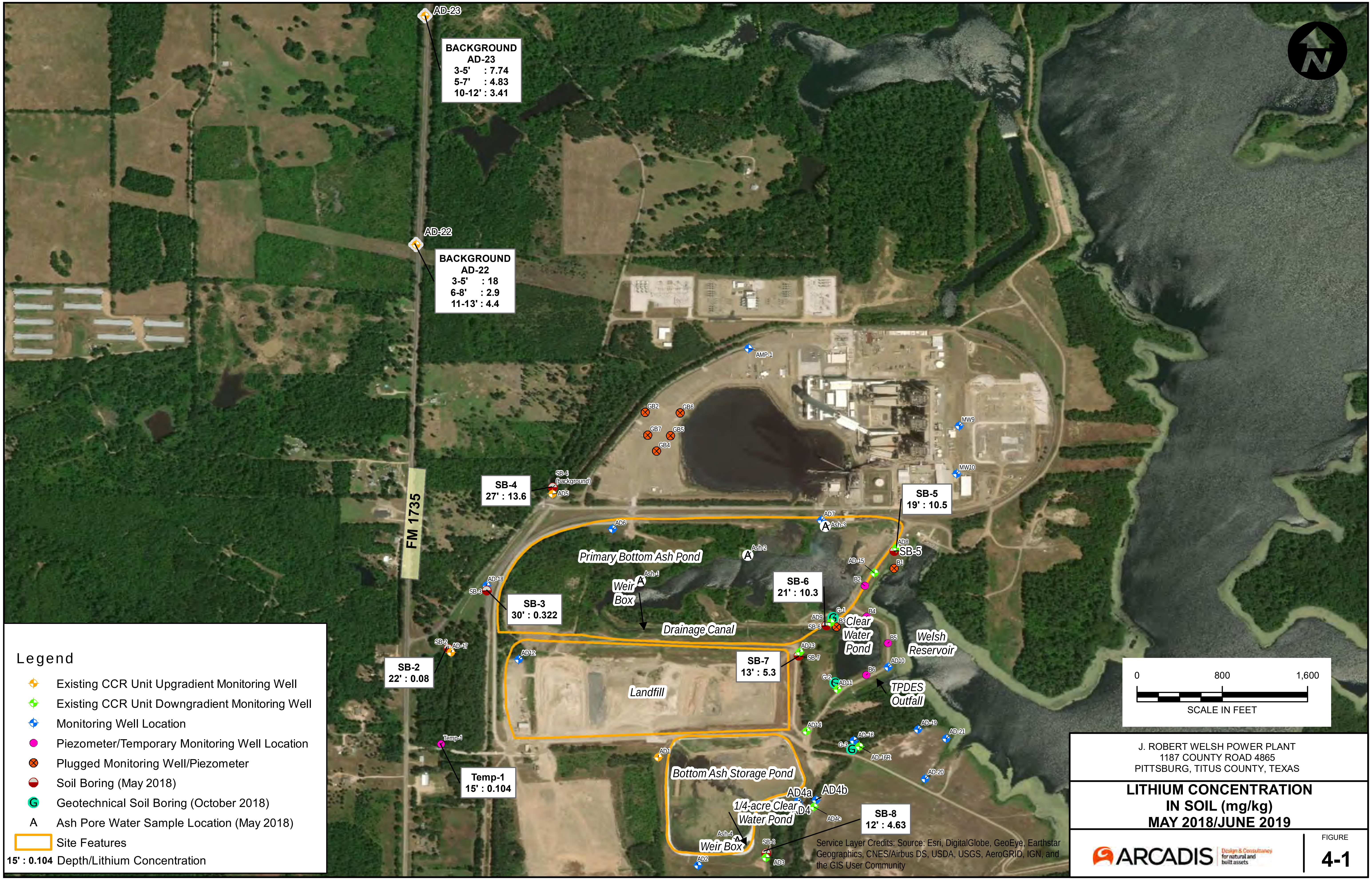
U.S. Geological Survey in cooperation with the Texas Water Commission

(TWC BULLETIN 6517)

201

REGIONAL HYDROLOGIC CROSS SECTION

FIGURE 2-11



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

⊕	Existing CCR Unit Upgradient Monitoring Well
⊕	Existing CCR Unit Downgradient Monitoring Well
⊕	Monitoring Well Location
●	Piezometer/Temporary Monitoring Well Location
⊗	Plugged Monitoring Well/Piezometer
◒	Soil Boring (May 2018)
G	Geotechnical Soil Boring (October 2018)
A	Ash Pore Water Sample Location (May 2018)
▭	Site Features
15' : 0.104	Depth/Lithium Concentration

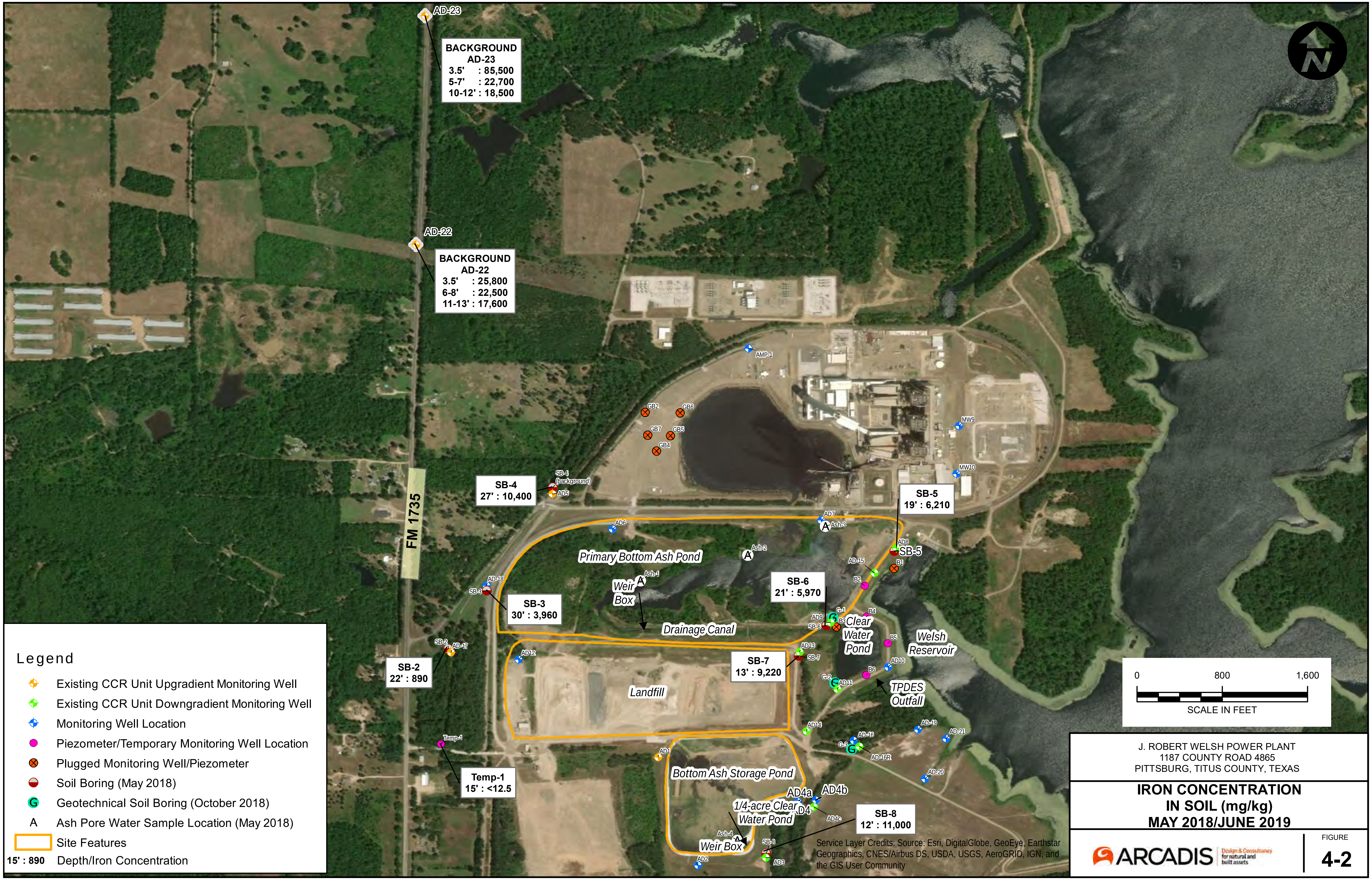
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM CONCENTRATION IN SOIL (mg/kg) MAY 2018/JUNE 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-1

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 4-1-SoilBoring_LithiumresultsMay2018-June2018.mxd



Legend

⊕	Existing CCR Unit Upgradient Monitoring Well
⊕	Existing CCR Unit Downgradient Monitoring Well
⊕	Monitoring Well Location
●	Piezometer/Temporary Monitoring Well Location
⊗	Plugged Monitoring Well/Piezometer
◒	Soil Boring (May 2018)
G	Geotechnical Soil Boring (October 2018)
A	Ash Pore Water Sample Location (May 2018)
▭	Site Features
15' : 890	Depth/Iron Concentration

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

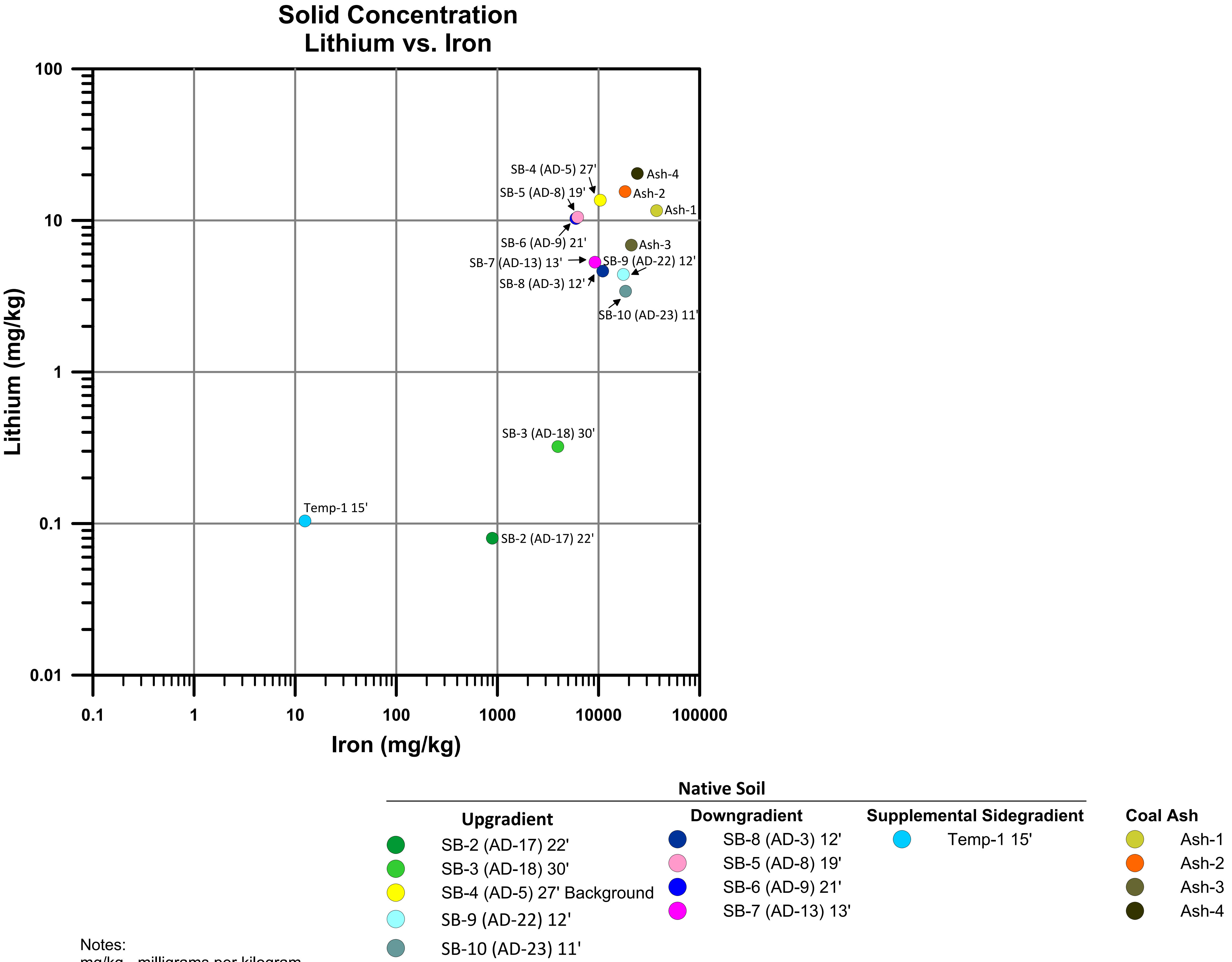
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

IRON CONCENTRATION IN SOIL (mg/kg) MAY 2018/JUNE 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-2

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 4-2-SoilBoring_IronresultsMay2018-June2019.mxd



Notes:
mg/kg - milligrams per kilogram

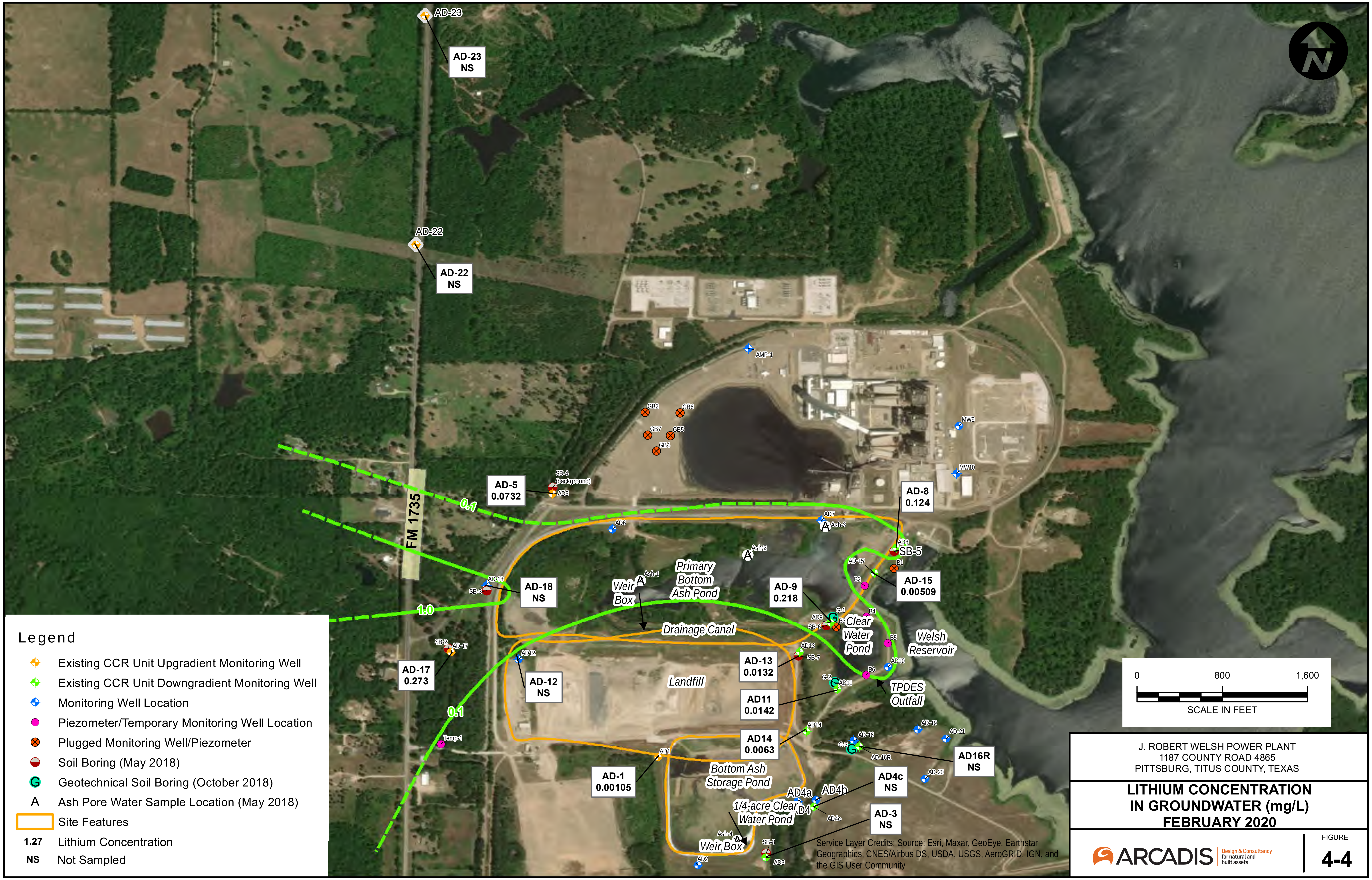
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM VS. IRON SOLIDS CONCENTRATION PLOT

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-3

Document Path: U:_ENV\AEP\Welsh Plant\MXD\Landfill report\May 2020\Fig 4-4-SoilBoring_LithiumGWresultsFeb2020.mxd



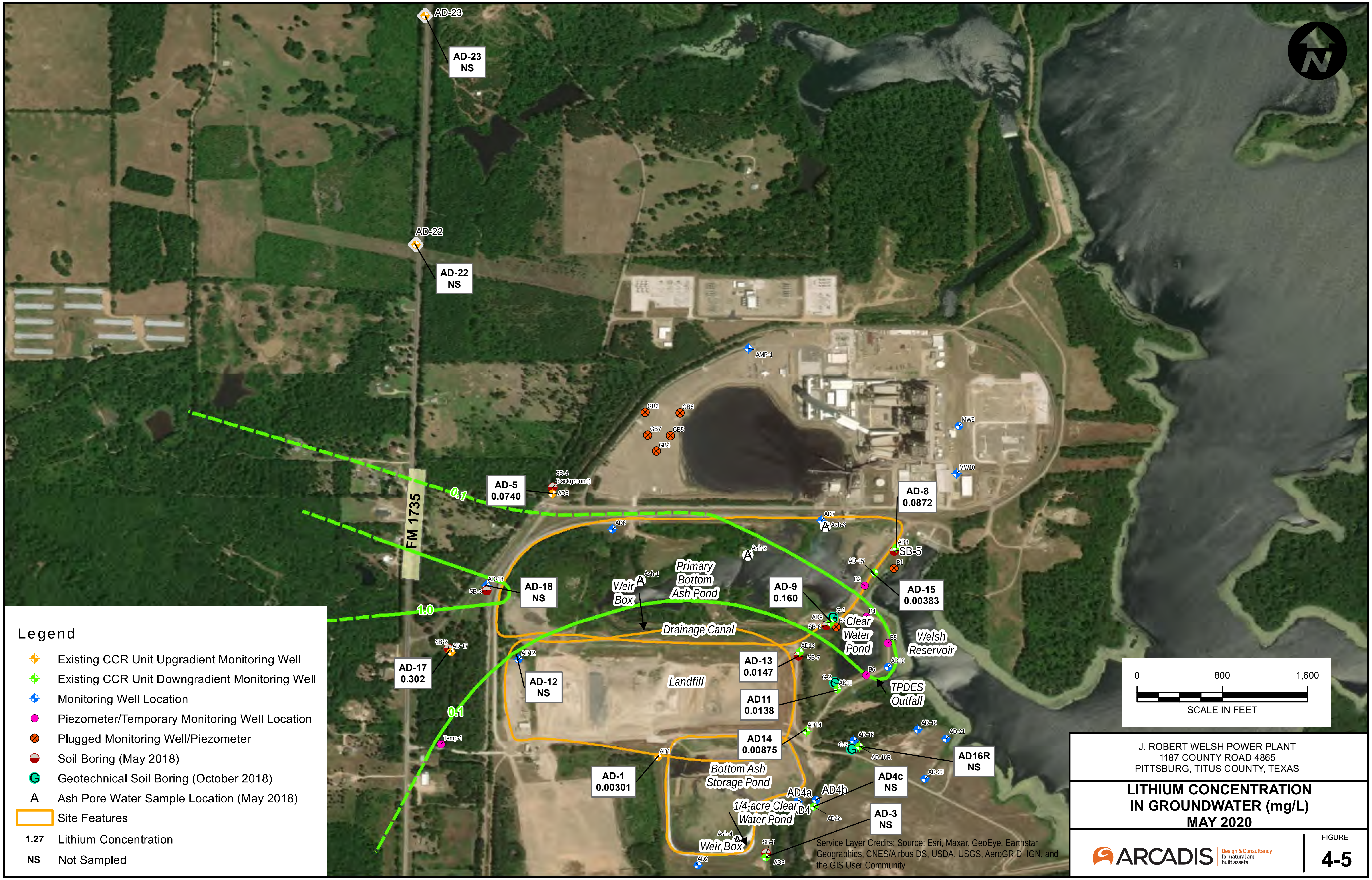
Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM CONCENTRATION IN GROUNDWATER (mg/L) FEBRUARY 2020

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-4



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

◆	Existing CCR Unit Upgradient Monitoring Well
◆	Existing CCR Unit Downgradient Monitoring Well
◆	Monitoring Well Location
●	Piezometer/Temporary Monitoring Well Location
⊗	Plugged Monitoring Well/Piezometer
◒	Soil Boring (May 2018)
G	Geotechnical Soil Boring (October 2018)
A	Ash Pore Water Sample Location (May 2018)
▭	Site Features
1.27	Lithium Concentration
NS	Not Sampled

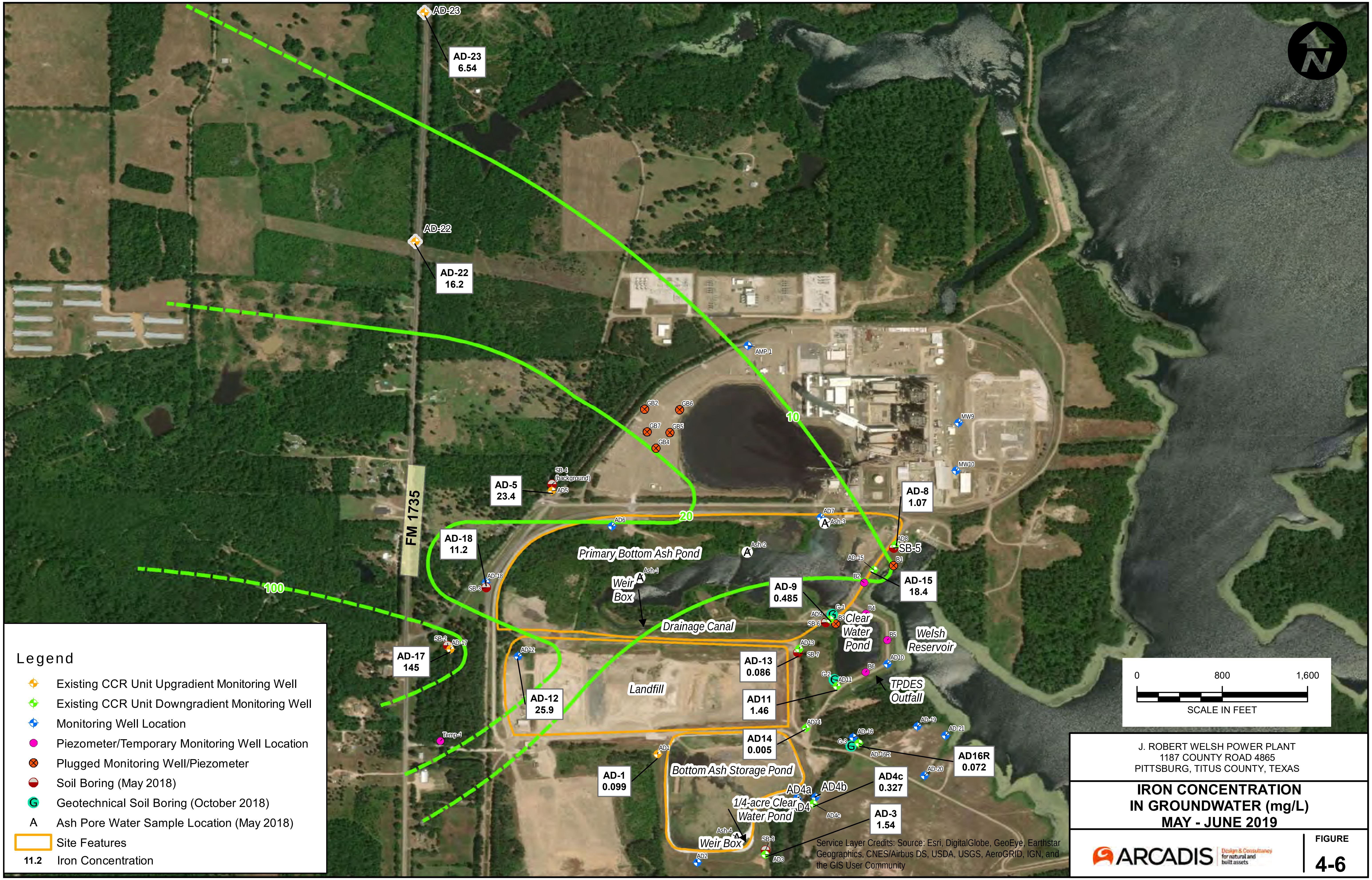
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM CONCENTRATION IN GROUNDWATER (mg/L) MAY 2020

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-5

Document Path: U:_ENV\AEP\Welsh Plant\MXD\Landfill report\May 2020\Fig 4-5-SoilBoring_LithiumGWresultsMay2020.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

✦	Existing CCR Unit Upgradient Monitoring Well
✦	Existing CCR Unit Downgradient Monitoring Well
✦	Monitoring Well Location
●	Piezometer/Temporary Monitoring Well Location
⊗	Plugged Monitoring Well/Piezometer
◓	Soil Boring (May 2018)
G	Geotechnical Soil Boring (October 2018)
A	Ash Pore Water Sample Location (May 2018)
▭	Site Features
11.2	Iron Concentration

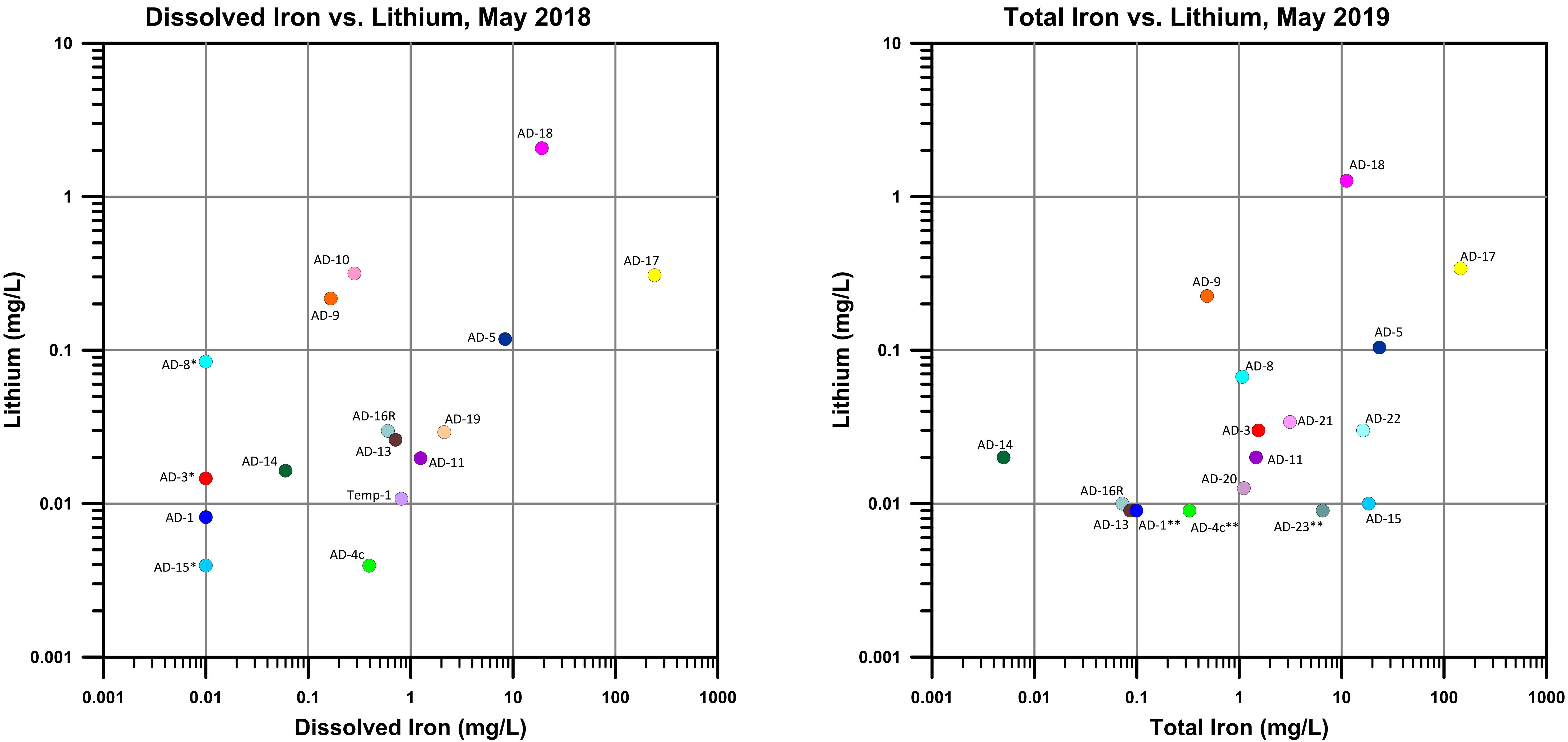
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

IRON CONCENTRATION IN GROUNDWATER (mg/L) MAY - JUNE 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-6

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 4-5-SoilBoring_IronGWresultsMay2018-June2019.mxd



Upgradient Wells

- ● AD-1
- ● AD-17
- ● AD-18
- ● AD-5
- ● AD-22 (installed Jun 2019)
- ● AD-23 (installed Jun 2019)

Downgradient Wells

- ● AD-10
- ● AD-11
- ● AD-13
- ● AD-14
- ● AD-15
- ● AD-16R
- ● AD-19
- ● AD-3
- ● AD-4c
- ● AD-8
- ● AD-9
- ● AD-20 (installed Oct 2018)
- ● AD-21 (installed Oct 2018)

Sidegradient Wells

- ● MW-9
- ● MW-10
- ● Temp-1

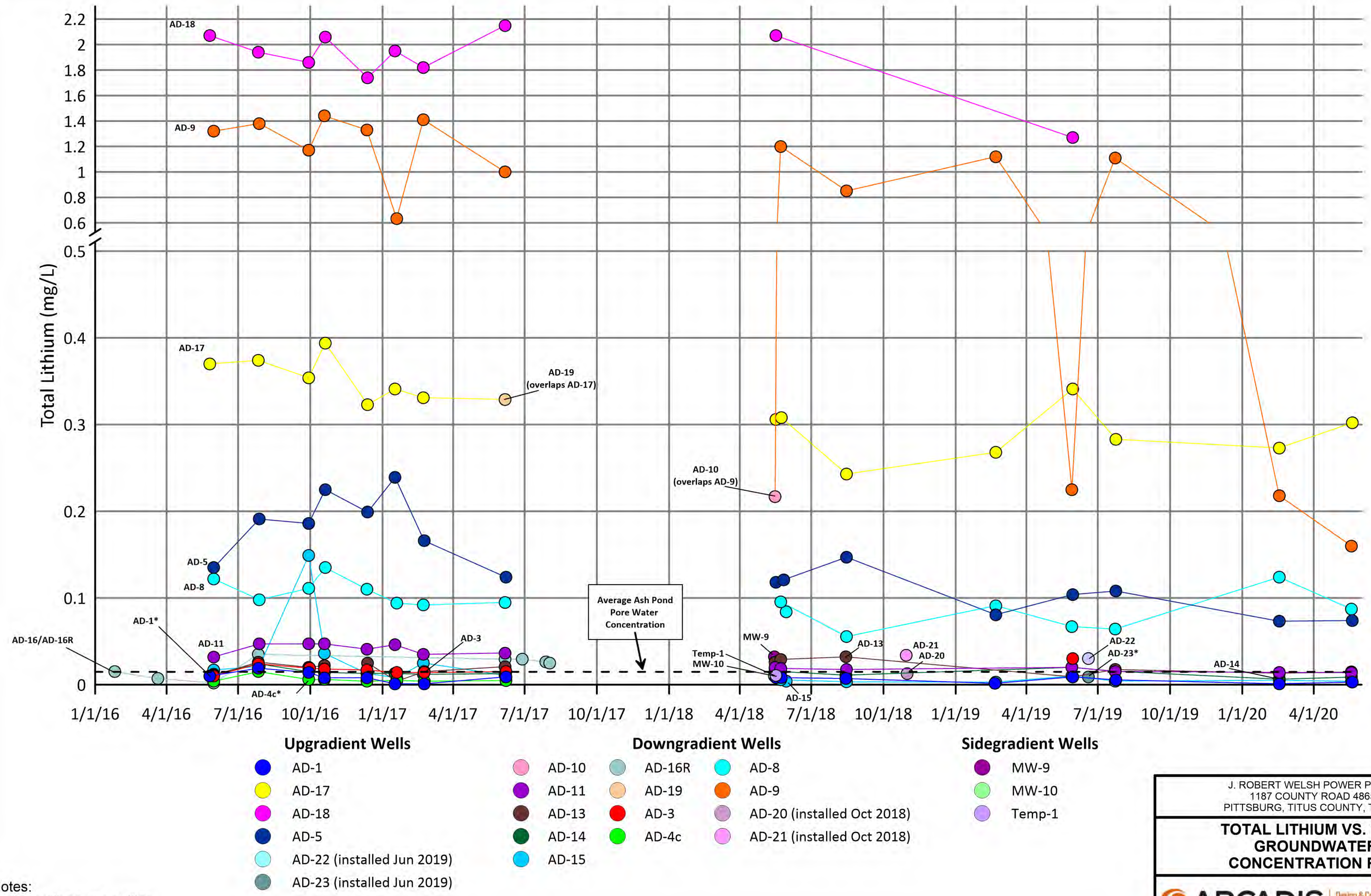
Notes:
TDS - total dissolve solids
mg/L - milligrams per liter
Concentrations of iron and lithium in coal ash were below detection
Concentrations of lithium in coal ash porewater were less than 0.02 mg/L
AD-22 and AD-23 groundwater concentrations are total only
*Iron was not detected, result is plotted at the reporting limit
**Lithium was not detected, result is plotted at the reporting limit

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

IRON VS. LITHIUM GROUNDWATER CONCENTRATION PLOT

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-7



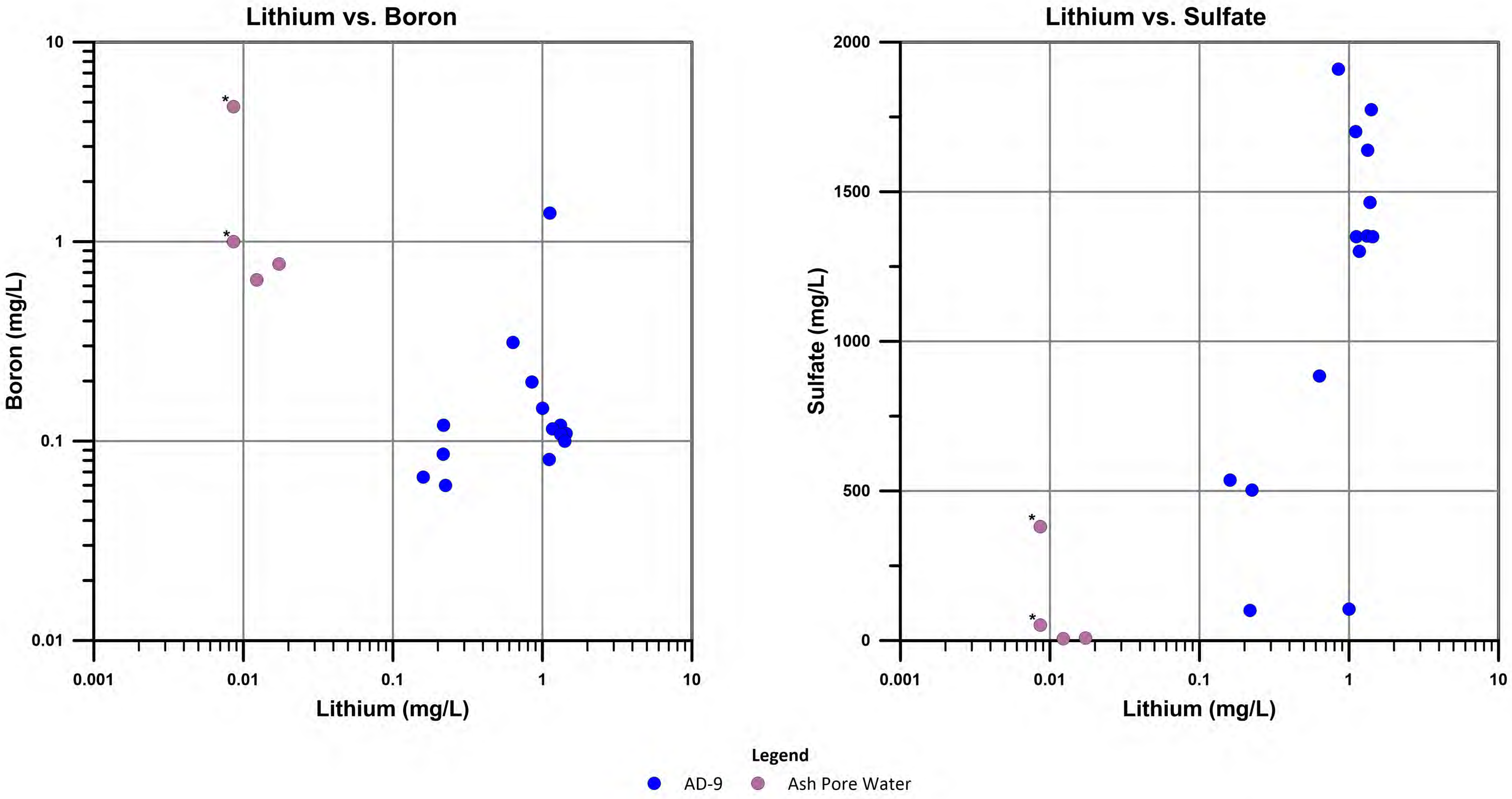
Notes:
mg/L - milligrams per liter
*When lithium was not detected, result is plotted at the reporting limit

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

TOTAL LITHIUM VS. TIME GROUNDWATER CONCENTRATION PLOT

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-8



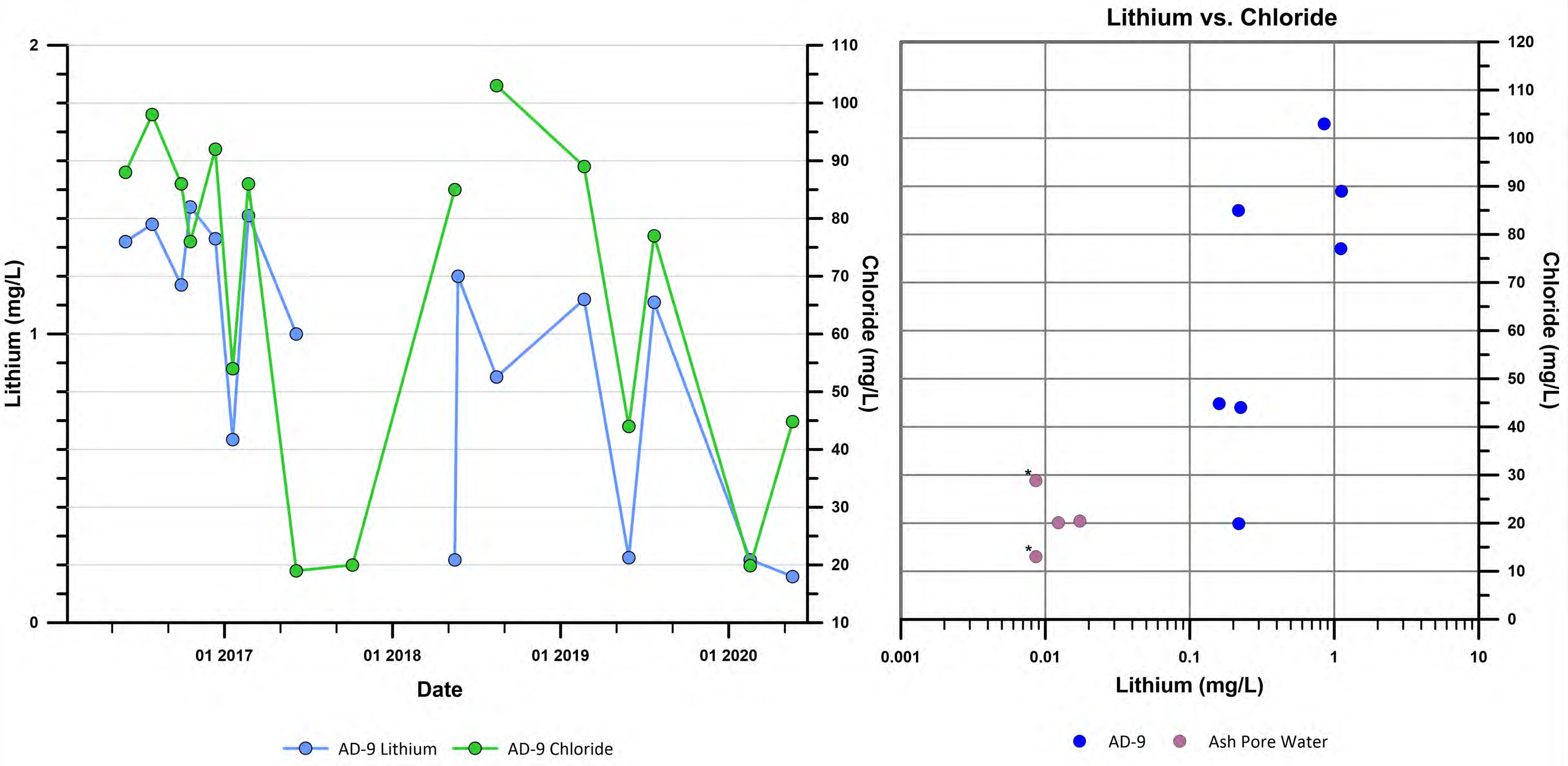
Notes:
mg/L - milligrams per liter
*When lithium was not detected, result is plotted at the reporting limit

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM VS. BORON AND SULFATE GROUNDWATER CONCENTRATION PLOT

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-9



Notes:
mg/L - milligrams per liter
*When lithium was not detected, result is plotted at the reporting limit

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM VS. CHLORIDE GROUNDWATER CONCENTRATION PLOT

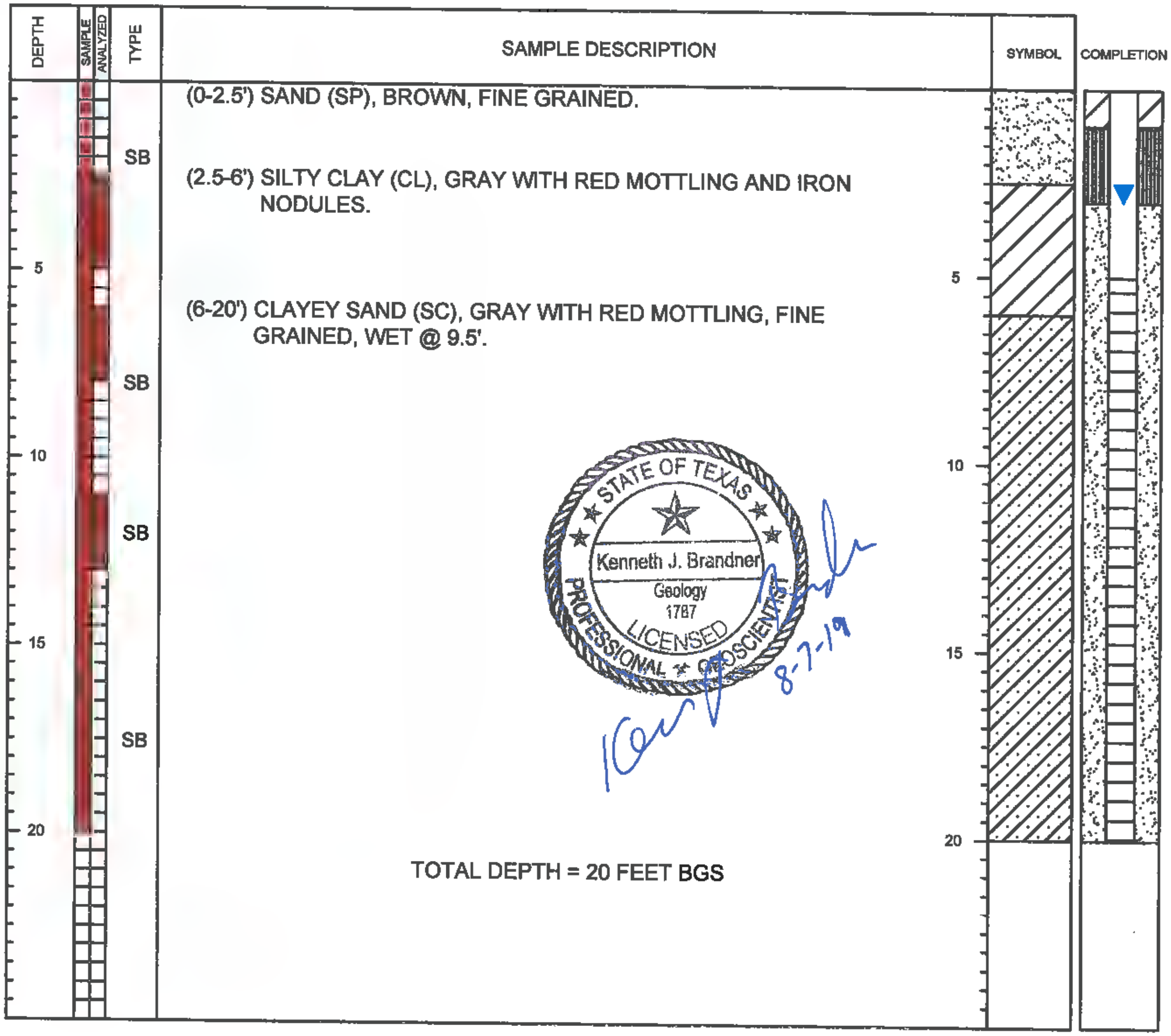
ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-10

APPENDIX A

Monitoring Well Completion Diagrams – 2019 Monitoring Wells

WELL LOG



(0-2.5') SAND (SP), BROWN, FINE GRAINED.

(2.5-6') SILTY CLAY (CL), GRAY WITH RED MOTTLING AND IRON NODULES.

(6-20') CLAYEY SAND (SC), GRAY WITH RED MOTTLING, FINE GRAINED, WET @ 9.5'.

Kenneth J. Brandner
Geology
1787

8-7-19

TOTAL DEPTH = 20 FEET BGS

WELL: AD-22
CLIENT: AEP
PROJECT: TX015976.0004
LOCATION: WELSH POWER PLANT
DATE: 6/18/19
DRILLING METHOD: HSA
CASING: 2" PVC, 0-5' BGS
SCREEN: 5-20' BGS, 2" PVC MILL-SLOT
CEMENT: 0-1' BGS
BENTONITE: 1-3' BGS
SAND PACK: 3-20' BGS
GROUND ELEV. / TOP OF CASING ELEV.: 360.94' / 360.22'

CT - CUTTINGS
SB - SPLIT BARREL (5')
SS - SPLIT SPOON (2')

▽ HC LEVEL
▼ WATER LEVEL

SAND	FILL/CONCRETE
SILT	BENTONITE
CLAY	GRAVEL

711 N. CARANCAHUA, #1080
CORPUS CHRISTI, TEXAS 78401
TEL: (361) 883-1353 FAX: (361) 883-7565

ARCADIS Design & Consultancy for natural and built assets

STATE OF TEXAS WELL REPORT for Tracking #515172

Owner:	**AEP**	Owner Well #:	**AD-22**
Address:	**1187 County Road 4865** **Pittsburg, TX 75686**	Grid #:	**16-58-4**
Well Location:	**FM 1735** **Pittsburg, TX 75686**	Latitude:	**33° 03' 35" N**
	In ROW along west side of FM 1735, WNW of the AEP - Welsh Plant	Longitude:	**094° 51' 09" W**
		Elevation:	**No Data**
Well County:	**Titus**		

Type of Work: **New Well** Proposed Use: **Monitor**

Drilling Start Date: **6/18/2019** Drilling End Date: **6/18/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**7.25**	**0**	**20**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Screened**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**0**	**1**	**Concrete**
	1	**3**	**Bentonite**
	3	**20**	**Sand**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

	Strata Depth (ft.)	*Water Type*
Water Quality:	**No Data**	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **WEST Drilling**

101 Industrial Drive
Waxahachie, TX 75165

Driller Name: **Robert Williams** License Number: **59501**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	*Bottom (ft.)*	*Description*
0	**2.5**	**brown sand**
2.5	**6**	**gray and red, mottled, silty clay with Fe nodules**
6	**20**	**gray, clayey sand**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	*Type*	*Material*	*Sch./Gage*	*Top (ft.)*	*Bottom (ft.)*
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**5**
2	**Screen**	**New Plastic (PVC)**	**40** **0.010**	**5**	**20**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

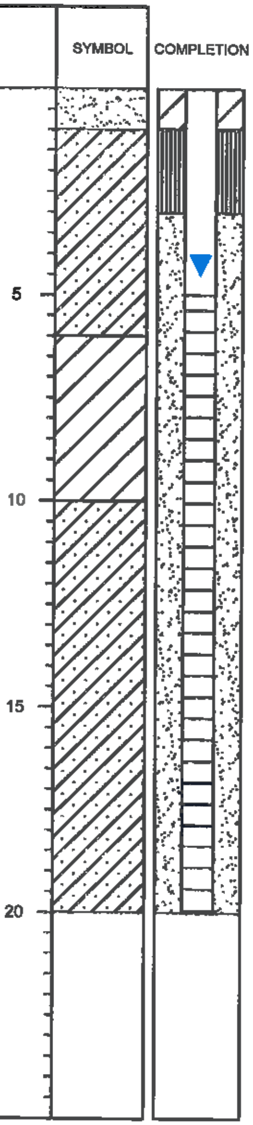
WELL LOG

DEPTH	SAMPLE ANALYZED	TYPE	SAMPLE DESCRIPTION
0–5		SB	(0-1') SAND (SP), BROWN, FINE GRAINED. (1-6') CLAYEY SAND (SC), BROWN TO RED.
5–10		SB	(6-10') SILTY CLAY (CL), GRAY WITH RED MOTTLING AND IRON NODULES.
10–15		SB	(10-20') CLAYEY SAND (SC), REDDISH-BROWN, FINE GRAINED, WET @ 10'.
15–20		SB	

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
PROFESSIONAL LICENSED GEOSCIENTIST

8-7-19

TOTAL DEPTH = 20 FEET BGS



AD-23	WELL
AEP	CLIENT
TX015976.0004	PROJECT
WELSH POWER PLANT	LOCATION
6/18/19	DATE
HSA	DRILLING METHOD
2" PVC, 0-5' BGS	CASING
5-20' BGS, 2" PVC MILL-SLOT	SCREEN
0-1' BGS	CEMENT
1-3' BGS	BENTONITE
3-20' BGS	SAND PACK
369.37' / 368.82'	GROUND ELEV. / TOP OF CASING ELEV.

CT - CUTTINGS
SB - SPLIT BARREL (5')
SS - SPLIT SPOON (2')

▽ HC LEVEL
▼ WATER LEVEL

SAND
SILT
CLAY
FILL/CONCRETE
BENTONITE
GRAVEL

PAGE 1 OF 1

711 N. CARANCAHUA, #1080
CORPUS CHRISTI, TEXAS 78401
TEL: (361) 883-1353 FAX: (361) 883-7565

ARCADIS Design & Consultancy for natural and built assets

STATE OF TEXAS WELL REPORT for Tracking #515173

Owner:	**AEP**	Owner Well #:	**AD-23**
Address:	**1187 County Road 4865** **Pittsburg, TX 75686**	Grid #:	**16-58-4**
Well Location:	**FM 1735** **Pittsburg, TX 75686** **In ROW along west side of FM 1735, WNW of the AEP - Welsh Plant**	Latitude:	**33° 03' 56" N**
		Longitude:	**094° 51' 08" W**
		Elevation:	**No Data**
Well County:	**Titus**		
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **6/18/2019** Drilling End Date: **6/18/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**7.25**	**0**	**20**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Screened**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**0**	**1**	**Concrete**
	1	**3**	**Bentonite**
	3	**20**	**Sand**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

	Strata Depth (ft.)	Water Type
Water Quality:	**No Data**	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **WEST Drilling**

101 Industrial Drive
Waxahachie, TX 75165

Driller Name: **Robert Williams** License Number: **59501**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	*Bottom (ft.)*	*Description*
0	**1**	**brown sand**
1	**6**	**gray and red, clayey sand**
6	**10**	**gray and red, mottled, silty clay with Fe nodules**
10	**20**	**reddish brown, clayey sand**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	*Type*	*Material*	*Sch./Gage*	*Top (ft.)*	*Bottom (ft.)*
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**5**
2	**Screen**	**New Plastic (PVC)**	**40** **0.010**	**5**	**20**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

APPENDIX B

Springs of Texas Reference

Springs of Texas

VOLUME I

Gunnar Brune

Manufactured in the United States of America

Second edition

The paper used in this book meets the minimum requirements of the American National Standard for Permanence of Paper for Printed Library Materials, Z39.48-1984. Binding materials have been chosen for durability.

∞

The publisher gratefully acknowledges those whose grants helped make this edition possible:

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Helen C. Besse.—2nd ed.
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2002017373

INTRODUCTION TO THE SECOND EDITION

Helen C. Besse

When Gunnar Brune self-published *Springs of Texas, Volume I*, in 1981, most of the state water planning agencies and local environmental communities either did not recognize the importance of his work or were not aware of its existence. Brune had spent the previous decade conducting research and field studies, and then writing this book that describes the physical characteristics of springs, the archeology and history of springs' use, the ecological setting of springs, and the local use and lore surrounding springs for 183 out of 254 Texas counties. Gunnar Brune died before he could complete volume II.

Gunnar Brune described many of the large springs across the state as well as innumerable small springs present along river and stream courses that provide the base flow for waterways across the state. Brune repeatedly stated in the 1981 edition of this book that many of the springs he described had failed or were failing. With the pronounced influx of population in the last twenty years and the increased agricultural and industrial activities around the state, one can only wonder how many of the more than 2,000 springs have gone dry since he described them through the 1970s.

Nevertheless, this book is even more important today. Its value to water planners, elected officials, policy makers, municipal, county, and state administrators, wildlife stewards, environmentalists, and water lovers has not diminished. Springs are "the canary in the coal mine." The health of our springs reflects the health of our underground water resources and is seen in the state's surface resources as well.

In the section "The Prehistoric Setting of Springs," Brune provided a quote from another book on the beliefs that early Americans had about springs. It is appropriate to repeat those words here:

> Gods and heroes were born out of springs, and rain messengers came and went between the above and below worlds through their pools. Every pueblo had sacred springs somewhere nearby. There was every reason to sanctify them — physical, as life depended upon water; spiritual, as they had natural mystery which suggested supernatural qualities: for how could it be that when water fell as rain, or as snow, and ran away, or dried up, there should be other water which continued to come, secretly and sweetly, out of the ground and never failed (Horgan 1954).

F. Halley's farm. According to Dr. John Klein, a nearby resident and writer, the Klein settlement began here in 1848. The Sellars store was at the springs. They issued from Montgomery silt with many iron concretions at about 0.72 lps on April 11, 1978. The pools, containing duckweed, pennywort, and water primrose, were home to a family of ducks and ducklings. Probably the flow formerly continued down Spring Gully past Klein cemetery, 0.6 kilometer downstream, but on this date, even after rains, the channel here was dry except for some standing water. Many wells pump nearby.

Magnolia Garden Springs (15) are four kilometers northeast of Sheldon along the San Jacinto River. At Martha Dempsey's Good Times marina several very small springs trickle from Deweyville sand, including one which flows 0.15 lps from a pipe. Near the entrance to the nearby Magnolia Gardens marina, according to Jean Manson, springs flowed until about 1923. They are quite dry now. Very small springs are said to feed Simms Lake, across the river and 0.6 kilometer farther east. This formerly popular swimming hole is now closed to the public.

At Beaumont Place northeast of Houston, near the intersection of Highways 90 and 526, is another Spring Gully. The channel is now a drainage ditch into which very small springs and seeps (14) drain from Beaumont silt and sand.

Eight kilometers west of La Porte is Willow Springs Bayou, also called Willow Springs Gully or Ditch. **Willow Springs (8)** are chiefly between North L Street and Spencer Road. On April 9, 1978, the discharge of Willow Springs Bayou at North L Street was 0.18 lps, and at Spencer Road it was 0.70 lps. Many willows still fringe the channel, along with cattails.

A third Spring Gully is located eight kilometers southwest of La Porte. Springs (9) in Beaumont silt produced a discharge of about 0.18 lps in 1978 in the gully at the Red Bluff road crossing. Cottonmouths hide here among the willows and cattails.

HARRISON COUNTY

Harrison County is endowed with numerous springs of all types, some highly mineralized and valued for their healing properties. Most appear to be flowing as strongly as ever, because there has been little demand on the groundwater reservoirs. However, water levels in the artesian sands are declining as much as 4.6 meters per year in some areas. Most of the Caddo Indian villages were located at springs. Early French and Spanish explorers, some over 400 years ago, visited many of the same springs that can be seen today. The New Madrid earthquake of 1811 - 1812, which enlarged Caddo Lake, may have affected the flow of some springs. In general, however, the water-bearing formations were not greatly affected by the quake.

Most of the spring waters of the county issue from Eocene sands. They are usually fresh, soft, and acid, being of the sodium bicarbonate type. The iron content is often very high. Mineralized waters may also be high in aluminum and sulfate, may be slightly saline, and can be very hard. The analyses shown for 1942 in the table of Selected Chemical Analyses are probably too low in dissolved-solids content, perhaps because of high rainfall at the time the samples were collected. Most of the writer's field studies were made on January 23 - 28, 1976.

It was around **Locke Springs (1)** that the community of Marshall first appeared. In 1831 there were at least 20 springs flowing from the Reklaw sand near the intersection of Franklin and Houston Streets and up the hill toward the courthouse. In early times water was hauled from these springs in barrels to fill the cisterns on the town square. Most of the springs have now been paved over, but the remaining ones still flowed 1.4 liters per second in 1976.

Hynson Springs (10), also known as **Marshall, Noonday Camp**, and **Iron Springs**, are six kilometers north of Hallsville. They became very popular as a health resort about 1851. The waters are highly mineralized, containing much iron, sulfur, aluminum, and lithium. Originally there were said to be over 100 springs flowing from Queen City sand. Now not more than 20 can be found, possibly because the water table has fallen. During the Civil War the water from the springs was used in a leather-tanning factory. From 1891 to 1905 the large Hotel Randall accommodated thousands of visitors to the springs. Today there are an open-air auditorium and a number of cabins, but everything is in a sad state of disrepair. A historical marker is located at the springs. The discharge record, in liters per second, is as follows:

Jan. 28, 1942	[illegible]	
Jul. 27, 1964	[illegible]	
Jan. 27, 1976	0.13 (one spring)	1.4 (all springs)

Rock Springs (7) are just east of the Rock Springs church on Highway 449 about 13 kilometers west of Marshall. This and several other springs upstream flowed 2.3 lps from the Queen City sand in 1976. The Frenchman Henri Joutel of La Salle's party may have stopped here for refreshment in 1687.

Mulberry Springs (9), nine kilometers south-southwest of Harleton, are 100 meters north of the

APPENDIX IV-NA

A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring

APPENDIX V- NA

Reports documenting monitoring well plugging and abandonment or well installation are included in the appendix. or other information required to be included in the annual report such as program related notification or assessment of corrective measures.

4.9 – Annual Groundwater Monitoring Report, Bottom Ash Storage Pond CCR Management Unit, January 2021

Annual Groundwater Monitoring Report

Southwestern Electric Power Company

J. Robert Welsh Power Plant
CN 602843245; RN100213370

Bottom Ash Storage Pond CCR Management Unit
WMU 014

1187 Country Road 4865

Titus County

Pittsburg, Texas

January 2021

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

Table of Contents

I. **Overview**

This *Annual Groundwater Monitoring Report* (Report) has been prepared to report the status of activities for the preceding year for an existing CCR unit at Southwestern Electric Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), J. Robert Welsh Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31, 2021.

In general, the following activities were completed:

- This CCR Unit began and remained in Detection Monitoring throughout 2020;
- Semi-Annual groundwater samples were collected and analyzed for detection monitoring Appendix III constituents, as specified in 40 CFR 257.94 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan (2016)*;
- A statistical process in accordance with 40 CFR 257.93 to evaluate groundwater data was updated and certified (AEP's *Statistical Analysis Plan (*Geosyntec 2020)). The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance," USEPA, 2009);
- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- First semi-annual groundwater sampling event;
    - Statistically significant increases (SSIs) were determined for Sulfate and Total Dissolved Solids (TDS) in AD-4C and TDS in AD-16R
    - Successful alternate source demonstrations (ASDs) were conducted for the SSIs
    - Submitted to Texas Commission on Environmental Quality (TCEQ) notification of the SSIs and ASD
- Second semi-annual groundwater sampling event;
    - Statistical evaluation is underway
- Received TCEQ approval to extend the receipt of CCR waste and initiate closure activities April 11, 2021.

The major components of this annual report, to the extent applicable at this time, are presented in sections that follow:

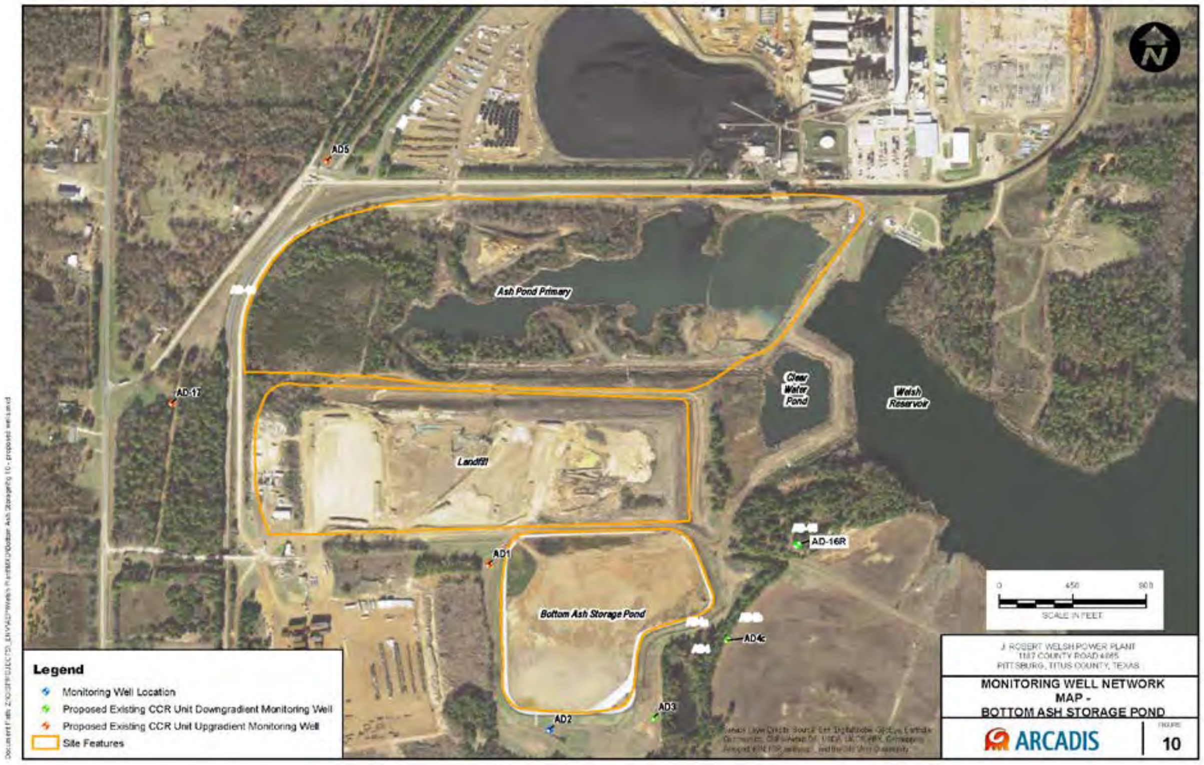
- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers;
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened;
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs is included in Appendix I;
- Statistically reports are located in Appendix II;
- ASDs are located in Appendix III;
- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring, in addition to notification identifying the constituents detected at a statistically significant increase over background concentrations;
- Other information required to be included in the annual report such as program related notification or assessment of corrective measures, if applicable;

In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.

II. Groundwater Monitoring Well Locations and Identification Numbers

The figure that follows depicts the PE-certified groundwater monitoring network, the monitoring well locations and their corresponding identification numbers.

Bottom Ash Storage Pond Monitoring Wells	
Up Gradient	Down Gradient
AD-1	AD-3
AD-5	AD-4C
AD-17	AD-16R



III. Monitoring Wells Installed or Decommissioned

During 2020, no monitoring wells were installed or decommissioned.

IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction and Discussion

Appendix I contains potentiometric maps with the static water elevation, groundwater flow direction for each monitoring event and tables showing groundwater velocity and the groundwater quality data collected under 40 CFR 257.90 through 257.98.

- The groundwater flow rate and direction for the first semi-annual confirmatory sampling event reflects that seen during the initial first semi-annual sampling event.
- The groundwater flow rate and direction for the second semi-annual confirmatory sampling event reflects that seen during the initial second semi-annual initial sampling.

V. Statistical Evaluations Completed in 2020

Background values for the BASP were previously calculated in January 2018. After a minimum of four detection monitoring events, the results of those events were compared to the existing background and the dataset was updated as appropriate. Revised and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these revised background values are described in Geosyntec's *Statistical Analysis Summary* report, dated December 10, 2019.

First semi-annual groundwater sampling event May 20, 2020, with verification sampling on July 22, 2020:

- the following SSI were determined:
  - Sulfate and TDS in AD-4C
  - TDS in AD-16R
  - Submitted to TCEQ notification of the SSIs

Second semi-annual groundwater sampling event October 14, 2020, with verification sampling on December 10, 2020:

- Statistical evaluation for this data set is currently under way.

Statistical reports are found in Appendix II.

VI. Alternate Source Demonstrations Completed in 2020

A successful ASD confirmed that the all SSIs determined during the first semi-annual 2020 groundwater monitoring event were the result of natural variation, therefore the unit remained in detection monitoring.

The demonstrations are in Appendix III.

VII. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency

As of this annual groundwater report, the CCR Unit remains in detection monitoring.

VIII. Other Information Required

The sampling frequency of twice per year will be maintained for the current monitoring program.

IX. Description of Any Problems Encountered in 2020 and Actions Taken

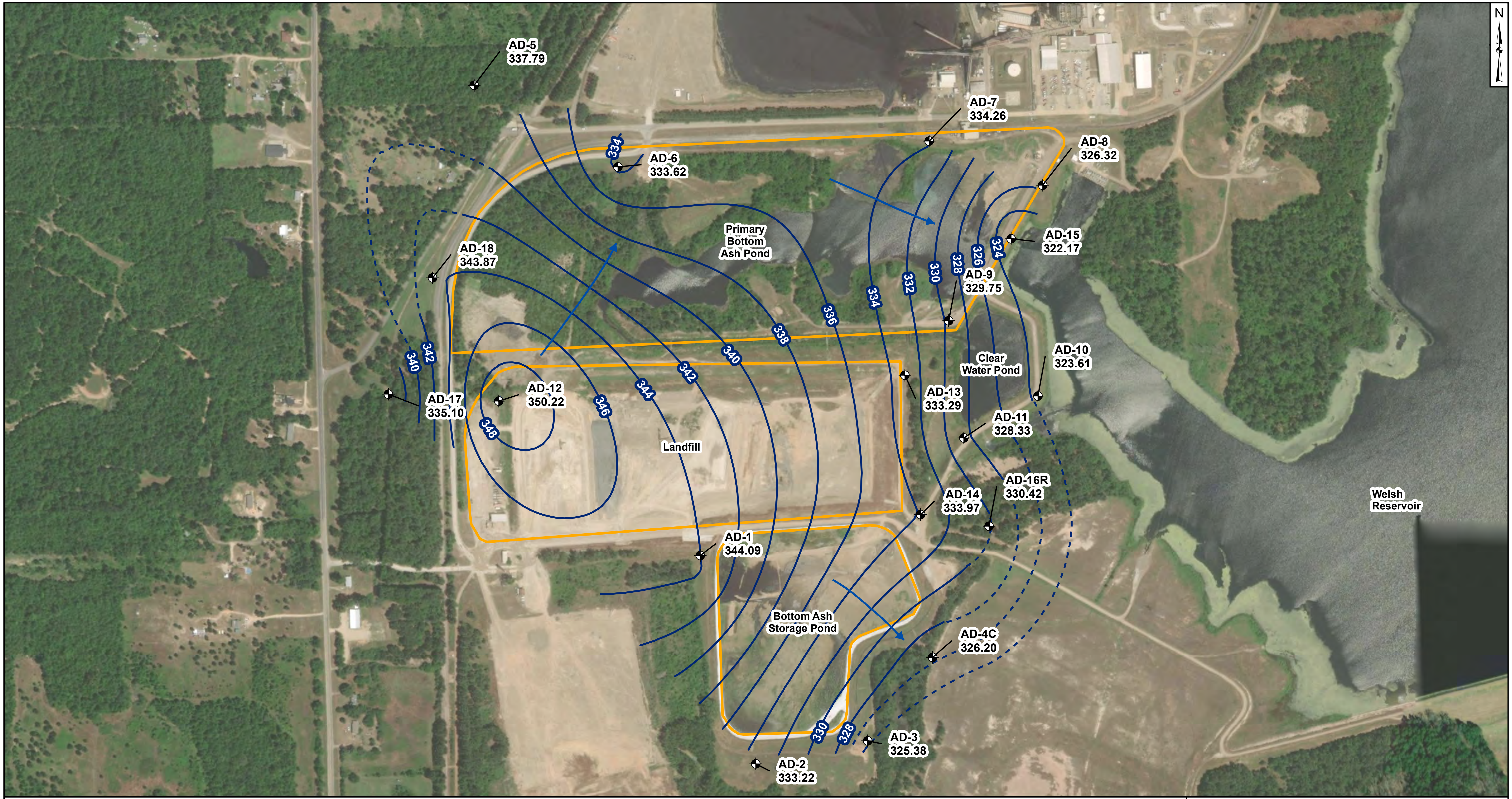
No significant problems were encountered.

X. A Projection of Key Activities for the Upcoming Year

- Detection monitoring on a twice per year schedule;
- Complete statistical analysis of the Second 2020 semi-annual groundwater monitoring data;
- Evaluation of the detection monitoring results from a statistical analysis viewpoint, looking for any SSIs;
- If needed, ASDs will be conducted to evaluate if the unit can remain in detection monitoring or the unit will move to an assessment monitoring;
- Responding to any new data received in light of CCR rule requirements;
- Preparation of the next annual groundwater report;
- Initiate closure of the unit.

APPENDIX I

Potentiometric maps, Tables follow, showing the groundwater monitoring data collected, the rate and direction of groundwater flow, and a summary showing the number of samples collected per monitoring well. The dates that the samples were collected also is shown.



Legend

- ⌖ Groundwater Monitoring Well
- → Approximate Groundwater Flow Direction
- — Groundwater Elevation Contour
- - - Groundwater Elevation Contour (Inferred)
- ▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on May 19-20, 2020) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.

500 250 0 500 Feet

Groundwater Potentiometric Map
May 2020

AEP Welsh Power Plant
Cason, Texas

Geosyntec consultants

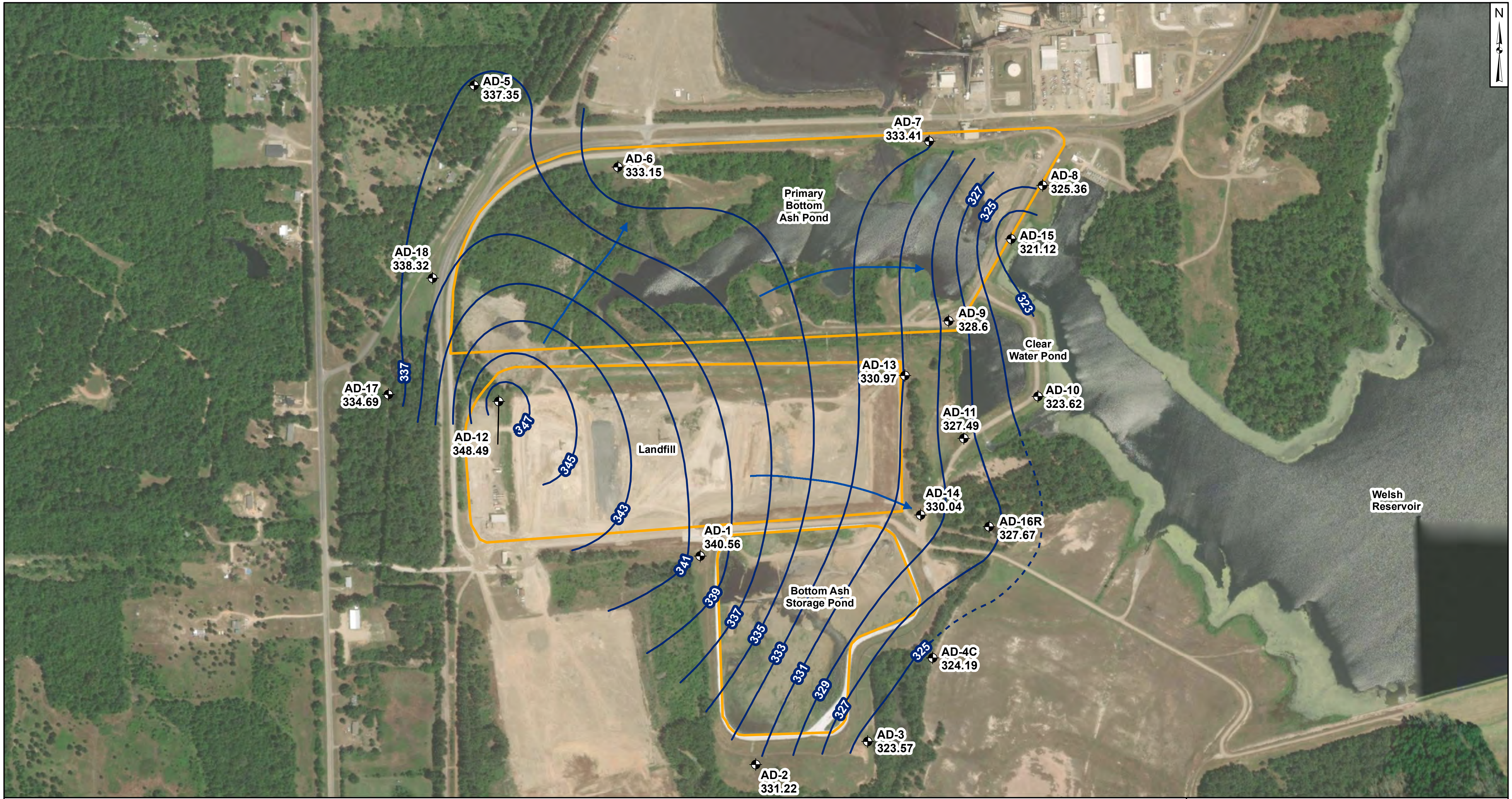
Columbus, Ohio

2020/11/04

Figure

1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Welsh\2020\AEP-Welsh_GW_2020-05May.mxd. HDuff. 11/4/2020. CHA8423/14/08.



Legend

- ⯐ Groundwater Monitoring Well
- ── Groundwater Elevation Contour
- - - Groundwater Elevation Contour (Inferred)
- → Approximate Groundwater Flow Direction
- ▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on October 12-14, 2020) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.

500 250 0 500
Feet

Groundwater Potentiometric Map
October 2020

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Figure
2

Columbus, Ohio
2021/01/06

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Residence Time Calculation Summary Welsh Bottom Ash Storage Pond

			2020-02		2020-05		2020-07[3]		2020-10	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Bottom Ash Storage Pond	AD-1 [1]	2.0	4.6	13.1	3.4	17.7	3.8	16.0	3.2	19.0
	AD-3 [2]	2.0	NC	NC	3.1	19.5	6.2	9.8	7.4	8.3
	AD-4C [2]	2.0	NC	NC	4.2	14.6	3.9	15.7	3.5	17.1
	AD-5 [1]	2.0	1.0	59.3	1.8	34.5	0.8	73.0	2.6	23.5
	AD-16R [2]	2.0	NC	NC	4.7	12.9	4.2	14.3	3.1	19.5
	AD-17 [1]	2.0	2.4	25.4	9.3	6.5	1.3	46.0	7.7	7.9

Notes:
[1] - Upgradient Well
[2] - Downgradient Well
[3] - Two-of-two verification sampling
NC - Not Calculated

Residence Time Calculation Summary Welsh Bottom Ash Storage Pond

			2019-02		2019-04[3]		2019-05		2019-07	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Bottom Ash Storage Pond	AD-1 [1]	2.0	2.7	22.4	NC	NC	5.3	11.5	4.1	14.9
	AD-3 [2]	2.0	4.9	12.4	0.5	127	5.7	10.7	5.1	11.9
	AD-4C [2]	2.0	4.0	15.3	0.5	127	5.2	11.6	4.2	14.4
	AD-5 [1]	2.0	1.5	40.2	NC	NC	2.4	25.4	2.1	29.2
	AD-16R [2]	2.0	3.7	16.3	3.7	16.4	6.5	9.4	4.6	13.3
	AD-17 [1]	2.0	8.9	6.9	NC	NC	4.7	13.0	3.5	17.5

Notes:

[1] - Upgradient Well

[2] - Downgradient Well

[3] - Upgradient wells were not gauged at the time of sampling, residence time estimates are based on available data.

NC - Not Calculated

Residence Time Calculation Summary Welsh - Bottom Ash Storage Pond

			2018-05		2018-08		2018-11[3]	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Bottom Ash Storage Pond	AD-1 [1]	2.0	3.7	16.7	3.4	17.6	NC	NC
	AD-3 [2]	2.0	6.5	9.4	5.1	11.9	0.4	158
	AD-4C [2]	2.0	3.0	20.1	3.3	18.6	0.4	158
	AD-5 [1]	2.0	3.7	16.6	1.5	40.5	NC	NC
	AD-16R [2]	2.0	2.9	20.8	1.6	37.6	0.4	162
	AD-17 [1]	2.0	1.6	37.4	3.2	18.8	NC	NC

Notes:

[1] - Upgradient Well

[2] - Downgradient Well

[3] - Upgradient wells were not gauged at the time of sampling, residence time estimates are based on available data.

NC - Groundwater residence time could not be calculated

Table 1 - Groundwater Data Summary: AD-1
Welsh - BASP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/26/2016	Background	0.346	36.5	5	< 0.083 U	5.9	42	252
7/29/2016	Background	0.35	39.6	4	< 0.083 U	5.3	36	239
9/30/2016	Background	0.332	15	5	< 0.083 U	5.4	35	173
10/21/2016	Background	0.398	19.1	4	< 0.083 U	5.2	42	192
12/14/2016	Background	0.394	8.74	4	< 0.083 U	5.2	40	200
1/20/2017	Background	0.656	129	4	< 0.083 U	7.1	68	538
2/24/2017	Background	0.7	147	9	< 0.083 U	6.9	68	612
6/8/2017	Background	0.449	15.1	4	< 0.083 U	5.1	42	176
10/6/2017	Detection	0.453	14.3	4	< 0.083 U	5.3	40	160
5/24/2018	Detection	0.345	10.2	4	< 0.083 U	2.2	43	150
8/14/2018	Detection	0.443	5.95	5	< 0.083 U	5.2	44	160
2/20/2019	Detection	0.504	142	2.82	0.24	7.3	49.2	522
5/30/2019	*	0.689	138	1.59	0.29	6.7	43.3	588
7/24/2019	Detection	0.644	62.7	2	0.106 J	6.0	58	180
2/17/2020	*	0.626	115	3.41	0.31	5.8	56.3	488
5/20/2020	Detection	0.801	126	1.83	0.20	7.2	51.4	508
10/14/2020	Detection	0.670	3.88	2.16	0.25	4.5	66.9	183

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
* Sample is not associated with a specific monitoring program

Table 1 - Groundwater Data Summary: AD-1
Welsh - BASP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/26/2016	Background	< 0.93 U	1.39361 J	191	0.271453 J	0.213294 J	0.240267 J	1.15339 J	1.184	< 0.083 U	< 0.68 U	0.01	0.033	0.53149 J	1.74922 J	0.959865 J
7/29/2016	Background	< 0.93 U	< 1.05 U	191	0.315631 J	0.0940357 J	< 0.23 U	0.615933 J	0.9952	< 0.083 U	< 0.68 U	0.019	0.00793 J	< 0.29 U	1.81763 J	< 0.86 U
9/30/2016	Background	< 0.93 U	2.96797 J	141	0.382874 J	< 0.07 U	5	0.850408 J	1.38	< 0.083 U	3.38434 J	0.014	0.01773 J	< 0.29 U	1.02629 J	< 0.86 U
10/21/2016	Background	< 0.93 U	< 1.05 U	114	0.311247 J	< 0.07 U	0.412131 J	0.649606 J	1.141	< 0.083 U	< 0.68 U	0.008	0.00534 J	1.39872 J	2.03168 J	1.25062 J
12/14/2016	Background	< 0.93 U	< 1.05 U	72	0.34133 J	< 0.07 U	< 0.23 U	0.424105 J	0.719	< 0.083 U	< 0.68 U	0.008	0.01521 J	< 0.29 U	1.85825 J	< 0.86 U
1/20/2017	Background	< 0.93 U	< 1.05 U	410	0.0366913 J	< 0.07 U	< 0.23 U	0.480125 J	3.009	< 0.083 U	< 0.68 U	0.000275956 J	< 0.005 U	< 0.29 U	4.04737 J	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	488	< 0.02 U	< 0.07 U	< 0.23 U	0.765099 J	4.309	< 0.083 U	< 0.68 U	0.001	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	1.14 J	93.46	0.37 J	< 0.07 U	0.66 J	0.77 J	0.676	< 0.083 U	< 0.68 U	0.00902	0.007 J	< 0.29 U	2.1 J	< 0.86 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-3
Welsh - BASP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.02	1.41	9	< 0.083 U	6.6	4	106
7/29/2016	Background	0.02	0.706	8	< 0.083 U	6.7	5	118
9/30/2016	Background	0.02	0.5	9	< 0.083 U	4.8	6	127
10/21/2016	Background	0.06	0.794	8	< 0.083 U	3.7	9	112
12/14/2016	Background	0.02	1.05	8	< 0.083 U	4.7	11	138
1/20/2017	Background	0.02	0.746	9	< 0.083 U	4.6	4	76
2/24/2017	Background	0.02	0.573	9	< 0.083 U	4.7	5	104
6/8/2017	Background	0.03326	0.543	9	0.2625 J	4.5	5	104
10/6/2017	Detection	0.02055	0.908	9	< 0.083 U	5.2	7	114
5/24/2018	Detection	0.0069 J	0.545	8	< 0.083 U	4.4	3	98
11/13/2018	Detection	0.009 J	0.684	8	< 0.083 U	5.2	4.05	114
2/20/2019	Detection	0.01 J	0.817	9.4	0.13	4.8	1.9	110
4/30/2019	Detection	0.007	--	9.34	--	4.1	--	--
5/30/2019	*	< 0.02 U	3.02	9.03	0.18	4.3	2.3	110
7/24/2019	Detection	< 0.02 U	1.35	7	0.09 J	4.6	6	116
11/25/2019	Detection	--	0.734	--	--	--	--	--
5/20/2020	Detection	< 0.02 U	0.724	7.99	0.11	4.6	2.7	236
7/22/2020	Detection	--	--	--	--	4.7	--	114
10/14/2020	Detection	< 0.02 U	0.705	7.31	0.16	4.6	3.5	116

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
* Sample is not associated with a specific monitoring program

Table 1 - Groundwater Data Summary: AD-3
Welsh - BASP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**pCi/L**	**mg/L**	**µg/L**	**mg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
5/31/2016	Background	< 0.93 U	1.56793 J	53	0.286352 J	< 0.07 U	0.464721 J	1.49214 J	1.018	< 0.083 U	< 0.68 U	0.01	0.85	< 0.29 U	0.995807 J	1.31537 J
7/29/2016	Background	3.21106 J	< 1.05 U	36	0.349485 J	< 0.07 U	0.515023 J	1.19046 J	0.183	< 0.083 U	< 0.68 U	0.024	0.589	1.43134 J	2.40188 J	< 0.86 U
9/30/2016	Background	2.70729 J	2.61987 J	43	0.188596 J	0.0802799 J	0.659763 J	1.44845 J	0.552	< 0.083 U	< 0.68 U	0.019	0.39	< 0.29 U	1.79734 J	< 0.86 U
10/21/2016	Background	2.47184 J	1.97572 J	41	0.451723 J	0.277085 J	0.818782 J	1.53187 J	1.589	< 0.083 U	< 0.68 U	0.018	0.351	6	< 0.99 U	< 0.86 U
12/14/2016	Background	< 0.93 U	< 1.05 U	45	0.262387 J	< 0.07 U	0.627352 J	1.34901 J	0.546	< 0.083 U	< 0.68 U	0.017	0.321	< 0.29 U	< 0.99 U	< 0.86 U
1/20/2017	Background	< 0.93 U	2.13113 J	41	0.235263 J	< 0.07 U	0.647294 J	1.6345 J	0.35	< 0.083 U	< 0.68 U	0.014	0.504	< 0.29 U	< 0.99 U	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	37	0.209151 J	< 0.07 U	< 0.23 U	1.1537 J	0.4592	< 0.083 U	< 0.68 U	0.014	0.501	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	1.91 J	38	0.24 J	0.08 J	0.75 J	1.28 J	0.459	0.2625 J	< 0.68 U	0.01503	0.365	< 0.29 U	< 0.99 U	< 0.86 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-4C
Welsh - BASP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.05	0.798	10	< 0.083 U	5.4	32	204
7/29/2016	Background	0.03	0.666	12	< 0.083 U	5.5	35	208
9/30/2016	Background	0.02	0.5	11	< 0.083 U	5.0	45	212
10/21/2016	Background	0.04	0.578	10	< 0.083 U	4.3	35	212
12/14/2016	Background	0.02	0.341	11	< 0.083 U	4.6	36	252
1/20/2017	Background	0.02	0.761	10	< 0.083 U	4.7	43	184
2/24/2017	Background	0.02	0.467	9	< 0.083 U	5.1	40	196
6/8/2017	Background	0.03331	0.573	10	< 0.083 U	4.9	39	228
10/6/2017	Detection	0.02565	0.654	11	< 0.083 U	5.4	44	226
5/24/2018	Detection	0.02505	0.434	14	< 0.083 U	5.2	42	224
8/14/2018	Assessment	--	--	15	--	5.0	--	--
11/13/2018	Detection	0.01 J	0.609	7.5	< 0.083 U	5.8	56	220
12/18/2018	Detection	--	--	--	--	4.9	58	--
2/20/2019	Detection	0.01 J	0.931	9.18	0.1 J	5.2	60.1	242
4/30/2019	Detection	0.014	--	--	--	4.8	56.2	--
5/30/2019	*	< 0.02 U	0.564	14.8	0.16	4.6	52.8	208
7/24/2019	Detection	< 0.02 U	0.586	13	< 0.083 U	3.9	52	284
12/19/2019	Detection	--	--	--	--	--	--	226
5/20/2020	Detection	< 0.02 U	0.679	15.1	0.11	5.1	69.0	268
7/22/2020	Detection	--	--	--	--	4.7	71.8	280
10/14/2020	Detection	< 0.02 U	0.613	13.1	0.18	4.9	76.1	278
12/10/2020	Detection	--	--	--	--	4.9	78.2	288

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
*Sample is not associated with a specific monitoring program

Table 1 - Groundwater Data Summary: AD-4C
Welsh - BASP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	< 0.93 U	< 1.05 U	88	0.407928 J	< 0.07 U	9	1.19093 J	1.289	< 0.083 U	< 0.68 U	0.004	0.191	< 0.29 U	1.12526 J	< 0.86 U
7/29/2016	Background	< 0.93 U	< 1.05 U	59	0.335947 J	< 0.07 U	4	0.852951 J	0.571	< 0.083 U	< 0.68 U	0.015	0.185	1.09296 J	2.52271 J	< 0.86 U
9/30/2016	Background	< 0.93 U	1.51249 J	74	0.274296 J	< 0.07 U	8	0.986752 J	2.572	< 0.083 U	< 0.68 U	0.006	0.16	< 0.29 U	1.95938 J	< 0.86 U
10/21/2016	Background	< 0.93 U	1.74748 J	69	0.347477 J	0.0809157 J	9	1.08565 J	1.657	< 0.083 U	< 0.68 U	0.006	0.141	3.20217 J	1.18291 J	< 0.86 U
12/14/2016	Background	< 0.93 U	2.24683 J	21	0.133622 J	< 0.07 U	0.944028 J	0.305391 J	0.685	< 0.083 U	< 0.68 U	0.004	0.143	< 0.29 U	1.27423 J	< 0.86 U
1/20/2017	Background	< 0.93 U	1.85604 J	75	0.221609 J	< 0.07 U	4	1.02773 J	2.045	< 0.083 U	< 0.68 U	0.005	0.125	< 0.29 U	< 0.99 U	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	30	0.102645 J	< 0.07 U	0.421354 J	0.364739 J	0.517	< 0.083 U	< 0.68 U	0.004	0.098	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	1.19 J	51.42	0.19 J	0.08 J	4.03	0.75 J	0.953	< 0.083 U	< 0.68 U	0.00482	0.147	< 0.29 U	< 0.99 U	< 0.86 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-5
Welsh - BASP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.03	36.9	15	0.3469 J	6.4	123	337
7/29/2016	Background	0.04	44.7	16	< 0.083 U	5.4	163	360
9/30/2016	Background	0.04	46.3	15	0.2436 J	5.3	190	416
10/21/2016	Background	0.05	50.7	14	< 0.083 U	5.9	267	448
12/14/2016	Background	0.05	49.6	13	< 0.083 U	6.2	233	484
1/20/2017	Background	0.04	49.8	14	< 0.083 U	6.3	234	438
2/24/2017	Background	0.04	33	15	< 0.083 U	5.5	127	286
6/8/2017	Background	0.05281	49.7	14	< 0.083 U	6.0	82	300
10/6/2017	Detection	0.04322	33.1	16	< 0.083 U	5.6	82	258
5/24/2018	Detection	0.05007	28.1	22	< 0.083 U	6.2	60	242
8/15/2018	Detection	0.050	40.5	19	< 0.083 U	6.2	240	428
2/21/2019	Detection	0.033	33.9	24.7	0.21	5.4	46.5	220
5/30/2019	*	0.03 J	30.0	22.3	0.29	6.3	51.3	238
7/24/2019	Detection	0.04 J	41.1	18	0.112 J	6.3	90	354
2/17/2020	*	0.03 J	39.8	19.8	0.22	5.5	43.7	248
5/20/2020	Detection	0.03 J	40.2	22.3	0.18	6.8	55.5	264
10/14/2020	Detection	0.04 J	36.6	18.8	0.18	6.5	148	338

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
*Sample is not associated with a specific monitoring program

Table 1 - Groundwater Data Summary: AD-5
Welsh - BASP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	< 0.93 U	< 1.05 U	57	0.149801 J	0.0765156 J	0.555038 J	14	1.634	0.3469 J	< 0.68 U	0.135	0.01135 J	< 0.29 U	< 0.99 U	< 0.86 U
7/29/2016	Background	2.05116 J	2.90819 J	93	0.518653 J	0.502155 J	0.411466 J	15	4.75	< 0.083 U	< 0.68 U	0.191	0.01516 J	< 0.29 U	1.08901 J	< 0.86 U
9/30/2016	Background	< 0.93 U	4.7609 J	87	0.251584 J	< 0.07 U	0.90676 J	14	3.33	0.2436 J	< 0.68 U	0.186	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
10/21/2016	Background	< 0.93 U	< 1.05 U	70	0.08781 J	0.107488 J	0.248085 J	9	2.319	< 0.083 U	< 0.68 U	0.225	< 0.005 U	1.36984 J	< 0.99 U	< 0.86 U
12/14/2016	Background	< 0.93 U	1.15381 J	53	0.164529 J	0.203546 J	0.747921 J	13	2.182	< 0.083 U	< 0.68 U	0.199	0.00802 J	< 0.29 U	< 0.99 U	< 0.86 U
1/20/2017	Background	< 0.93 U	< 1.05 U	47	0.0574718 J	0.180502 J	< 0.23 U	12	1.023	< 0.083 U	< 0.68 U	0.239	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	42	0.0306858 J	< 0.07 U	< 0.23 U	13	1.788	< 0.083 U	< 0.68 U	0.166	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	3.85 J	87.7	0.08 J	0.39 J	0.28 J	11.93	2.32	< 0.083 U	< 0.68 U	0.124	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-16R
Welsh - BASP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/8/2017	Background	0.04198	2.75	7	0.3438 J	3.7	54	204
6/28/2017	Background	0.06398	1.24	6	0.2512 J	3.9	55	200
7/7/2017	Background	0.02699	2.07	36	< 0.083 U	3.4	52	184
7/14/2017	Background	0.04415	2.39	6	0.2516 J	3.5	44	160
7/28/2017	Background	0.03237	2.5	7	0.2615 J	3.5	54	180
8/2/2017	Background	0.03177	1.92	7	< 0.083 U	3.0	49	174
8/11/2017	Background	0.06192	1.83	8	< 0.083 U	4.1	44	164
8/18/2017	Background	0.0304	1.44	7	< 0.083 U	3.4	46	160
9/1/2017	Background	0.02841	1.33	7	< 0.083 U	3.9	63	152
10/6/2017	Detection	0.04672	0.896	7	< 0.083 U	3.3	82	152
1/18/2018	Detection	--	--	--	--	4.0	58.6	--
5/23/2018	Detection	0.03202	2.53	6	< 0.083 U	3.8	67	204
8/14/2018	Detection	--	--	--	--	3.9	44	--
11/13/2018	Detection	0.02 J	0.467	6.5	< 0.083 U	5.6	54	186
2/20/2019	Detection	0.03 J	2	6.78	0.2	4.7	52.8	200
4/30/2019	Detection	0.015	--	--	--	3.9	--	--
5/30/2019	*	< 0.02 U	1.36	5.43	0.19	3.9	41.6	80
7/24/2019	Detection	0.03 J	1.50	7	0.13 J	3.6	70	250
12/19/2019	Detection	--	--	--	--	--	--	134
5/20/2020	Detection	0.02 J	1.54	7.09	0.16	3.4	71.4	242
7/22/2020	Detection	--	--	--	--	3.2	--	224
10/14/2020	Detection	0.02 J	0.550	6.50	0.14	3.3	53.1	183

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
* Sample is not associated with a specific monitoring program

Table 1 - Groundwater Data Summary: AD-16R
Welsh - BASP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**pCi/L**	**mg/L**	**µg/L**	**mg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
6/8/2017	Background	< 0.93 U	7.07	46.4	2.21	1.03	1.76	41.74	6.66	0.3438 J	< 0.68 U	0.0293	< 0.005 U	< 0.29 U	1.98 J	< 0.86 U
6/28/2017	Background	< 0.93 U	5.28	41.43	2.16	0.92 J	0.95 J	40.87	12.11	0.2512 J	< 0.68 U	0.02932	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
7/7/2017	Background	< 0.93 U	4.13 J	44.56	2.08	0.97 J	1.44	41.75	25.16	< 0.083 U	< 0.68 U	0.02846	< 0.005 U	< 0.29 U	2.09 J	1.2 J
7/14/2017	Background	< 0.93 U	6.31	54.35	2.01	1.09	0.84 J	37.88	9.12	0.2516 J	< 0.68 U	0.02391	0.009 J	< 0.29 U	< 0.99 U	< 0.86 U
7/28/2017	Background	< 0.93 U	3.88 J	51.06	2.09	1.02	1.43	40.86	9.81	0.2615 J	< 0.68 U	0.02653	< 0.005 U	< 0.29 U	1 J	< 0.86 U
8/2/2017	Background	< 0.93 U	4.46 J	49.61	2.17	1.28	1.07	45.33	5.45	< 0.083 U	< 0.68 U	0.02617	0.006 J	< 0.29 U	1.74	2.02
8/11/2017	Background	< 0.93 U	4.93 J	47.52	1.89	1.13	0.96 J	40.37	--	< 0.083 U	< 0.68 U	0.02347	0.008 J	< 0.29 U	1.36 J	< 0.86 U
8/18/2017	Background	< 0.93 U	2.35 J	43.85	1.91	1.08	0.8 J	40.05	5.56	< 0.083 U	< 0.68 U	0.02466	0.009 J	< 0.29 U	< 0.99 U	0.92 J
9/1/2017	Background	< 0.93 U	2.12 J	44.14	1.75	1.04	1.18	37.56	6.68	< 0.083 U	< 0.68 U	0.02429	0.006 J	< 0.29 U	< 0.99 U	< 0.86 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-17
Welsh - BASP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/26/2016	Background	0.121	200	43	0.4023 J	7.2	1,166	1,810
7/29/2016	Background	0.119	195	32	0.4135 J	5.7	1,005	1,576
9/30/2016	Background	0.111	191	36	0.3055 J	6.2	1,055	1,663
10/21/2016	Background	0.124	194	32	0.583 J	6.1	1,163	1,612
12/14/2016	Background	0.135	196	31	0.5399 J	6.0	1,096	1,560
1/20/2017	Background	0.101	196	33	< 0.083 U	5.9	1,445	1,686
2/24/2017	Background	0.135	189	30	< 0.083 U	5.7	1,055	1,628
6/8/2017	Background	0.121	188	30	< 0.083 U	5.8	1,105	1,578
10/6/2017	Detection	0.183	183	31	< 0.083 U	5.9	1,090	1,548
5/24/2018	Detection	0.239	193	39	< 0.083 U	6.3	1,067	1,836
8/15/2018	Detection	0.118	187	--	--	5.6	--	--
2/21/2019	Detection	0.151	207	43.2	0.18	6.9	1,060	1,722
5/30/2019	*	0.158	202	41.7	< 0.04 U	6.1	1,120	1,546
7/24/2019	Detection	0.113	216	37	0.085 J	6.0	1,127	1,864
2/17/2020	*	0.104	184	36.0	0.16	5.9	1,070	1,750
5/20/2020	Detection	0.115	250	47.7	0.15	5.7	1,190	1,890
10/14/2020	Detection	0.100	185	35.7	0.17	5.4	1,060	1,720

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
* Sample is not associated with a specific monitoring program

Table 1 - Groundwater Data Summary: AD-17
Welsh - BASP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/26/2016	Background	< 0.93 U	1.37501 J	21	0.173275 J	2	1	63	1.525	0.4023 J	< 0.68 U	0.37	0.032	< 0.29 U	< 0.99 U	< 0.86 U
7/29/2016	Background	1.13716 J	< 1.05 U	20	0.307264 J	4	1	68	2.78	0.4135 J	< 0.68 U	0.374	0.02133 J	1.04115 J	4.56733 J	< 0.86 U
9/30/2016	Background	< 0.93 U	< 1.05 U	31	0.175474 J	0.848199 J	3	58	2.358	0.3055 J	< 0.68 U	0.354	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
10/21/2016	Background	< 0.93 U	< 1.05 U	34	0.200656 J	2	4	65	2.224	0.583 J	< 0.68 U	0.394	< 0.005 U	0.322249 J	3.34422 J	< 0.86 U
12/14/2016	Background	< 0.93 U	< 1.05 U	17	0.0498325 J	3	0.816224 J	68	2.384	0.5399 J	< 0.68 U	0.323	0.01485 J	< 0.29 U	< 0.99 U	< 0.86 U
1/20/2017	Background	< 0.93 U	< 1.05 U	14	0.0319852 J	3	68	68	2.436	< 0.083 U	< 0.68 U	0.341	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	20	0.0665729 J	2	1	73	2.288	< 0.083 U	< 0.68 U	0.331	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	< 1.05 U	10.33	< 0.02 U	6.06	< 0.23 U	74.8	1.598	< 0.083 U	< 0.68 U	0.329	0.013 J	< 0.29 U	< 0.99 U	< 0.86 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

APPENDIX II

Where applicable, show in this appendix the results from statistical analyses, and a description of the statistical analysis method chosen. These statistical analyses are to be conducted separately for each constituent in each monitoring well.

Geosyntec consultants

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Memorandum

Date: August 18, 2020

To: David Miller (AEP)

Copies to: Jill Parker-Witt (AEP)

From: Allison Kreinberg (Geosyntec)

Subject: Evaluation of Detection Monitoring Data at Welsh Plant's Bottom Ash Storage Pond (BASP)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), the first semi-annual detection monitoring event at the Bottom Ash Storage Pond (BASP), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas, was completed on May 20, 2020. Based on the results, a two-of-two verification sampling was completed on July 22, 2020.

Background values for the BASP were previously calculated in January 2018. After a minimum of four detection monitoring events, the results of those events were compared to the existing background and the dataset was updated as appropriate. Revised and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these revised background values are described in Geosyntec's *Statistical Analysis Summary* report, dated December 10, 2019.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL (or are below the LPL for pH). In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are compared in Table 1 and noted exceedances are described in the list below.

- Sulfate concentrations exceeded the intrawell UPL of 63.7 mg/L in both the initial (69.0 mg/L) and second (71.8 mg/L) samples collected at AD-4C. Thus, an SSI over background is concluded for sulfate at AD-4C.

- Total dissolved solids (TDS) concentrations exceeded the intrawell UPL of 255 mg/L in both the initial (268 mg/L) and second (280 mg/L) samples collected at AD-4C and also exceeded the intrawell UPL of 221 mg/L in both the initial (242 mg/L) and second (224 mg/L) samples collected at AD-16R.

In response to the exceedance noted above, the Welsh BASP CCR unit will either transition to assessment monitoring or an alternative source demonstration (ASD) for sulfate and TDS will be conducted in accordance with 40 CFR 257.94(e)(2). If the ASD is successful, the Welsh BASP will remain in detection monitoring.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evalation
Welsh Plant - Bottom Ash Storage Pond

Parameter	Unit	Description	AD-3		AD-4C		AD-16R	
			5/20/2020	7/22/2020	5/20/2020	7/22/2020	5/20/2020	7/22/2020
Boron	mg/L	Intrawell Background Value (UPL)	0.0580		0.0529		0.0638	
		Detection Monitoring Result	0.02	--	0.02	--	0.02	--
Calcium	mg/L	Intrawell Background Value (UPL)	1.32		0.961		3.15	
		Detection Monitoring Result	0.724	--	0.679	--	1.54	--
Chloride	mg/L	Intrawell Background Value (UPL)	9.40		15.6		8.02	
		Detection Monitoring Result	7.99	--	15.1	--	7.09	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1.00		1.00		1.00	
		Detection Monitoring Result	0.11	--	0.11	--	0.16	--
pH	SU	Intrawell Background Value (UPL)	6.6		5.8		5.0	
		Intrawell Background Value (LPL)	3.1		4.2		2.6	
		Detection Monitoring Result	4.6	--	5.1	--	3.4	--
Sulfate	mg/L	Intrawell Background Value (UPL)	10.6		63.7		73.2	
		Detection Monitoring Result	2.7	--	**69.0**	**71.8**	71.4	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	140		255		221	
		Detection Monitoring Result	**236**	114	**268**	**280**	**242**	**224**

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.

ATTACHMENT A

Certification by a Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the December 10, 2019 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Welsh BASP CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

DAVID ANTHONY MILLER
112498

David Anthony Miller
Signature

112498
License Number

TEXAS
Licensing State

08.18.2020
Date

American Electric Power Service Corporation
Texas Registered Engineering Firm No. F-3341

APPENDIX III

Alternate source demonstration(s) included in this appendix. Alternate sources are sources or reasons that explain that statistically significant increases over background or statistically significant levels above the groundwater protection standard are not attributable to the CCR unit.

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

J. Robert Welsh Plant
Bottom Ash Storage Pond
Pittsburg, Texas

Submitted to

AMERICAN ELECTRIC POWER

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Columbus, Ohio 43215-2372

Beth Ann Gross
11/13/2020

STATE OF TEXAS
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Geosyntec Consultants
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Submitted by

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November 2020

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11/13/2020

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
BASP	Bottom Ash Storage Pond
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LPL	Lower Prediction Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SWFPR	Site-Wide False Positive Rate
TCEQ	Texas Commission on Environmental Quality
TPDES	Texas Pollutant Discharge Elimination System
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

This Alternative Source Demonstration (ASD) report has been prepared to address statistically significant increases (SSIs) for sulfate and total dissolved solids (TDS) in the groundwater monitoring network at the J. Robert Welsh Plant Bottom Ash Storage Pond (BASP) following the first semiannual detection monitoring event of 2020. The BASP is a wastewater pond permitted under the Texas Commission on Environmental Quality (TCEQ) Texas Pollutant Discharge Elimination System Permit No. WQ0001811000 as Pond No. 3.

Background values for the BASP were initially calculated in January 2018 with data from at least eight monitoring events. After a minimum of four detection monitoring events, the results of those events were compared to the existing background values, and the dataset was updated as appropriate (Geosyntec, 2019a). Revised upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Prediction limits were calculated based on a one-of-two retesting procedure to maintain an appropriate site-wide false positive rate (SWFPR). With this procedure, a statistically significant increase (SSI) is concluded only if both samples in a series of two exceed the UPL, or in the case of pH are below the LPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

The first semi-annual detection monitoring event of 2020 was performed in May 2020 (initial sampling event), and the results were compared to the calculated prediction limits. Where initial exceedances were identified, verification resampling was completed in July 2020. Following verification resampling, SSIs were identified for sulfate at well AD-4C by intrawell analysis, and total dissolved solids (TDS) at wells AD-4C and AD-16R by intrawell analysis. A summary of the detection monitoring analytical results and the calculated prediction limits to which they were compared is provided in **Table 1**.

1.1 CCR Rule Requirements

United States Environmental Protection Agency (USEPA) regulations (USEPA, 2015) regarding detection monitoring programs for coal combustion residuals (CCR) landfills and surface impoundments provide owners and operators with the option to make an alternative source demonstration (ASD) when an SSI is identified (40 CFR 257.94(e)(2)):

> *The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to*

> *include obtaining a certification from a qualified professional engineer… verifying the accuracy of the information in the report.*

The SSIs were identified for the detection monitoring events conducted on May 20, 2020, and July 22, 2020. Pursuant to 40 CFR 257.94(e)(2) of the CCR Rule (40 CFR 257), Geosyntec Consultants, Inc. (Geosyntec) has prepared this ASD report, which documents that the SSIs should not be attributed to the BASP at the Welsh Plant.

1.2 Demonstration of Alternative Sources

An evaluation was completed to assess possible alternative sources to which the identified SSI could be attributed. Alternative sources were identified from amongst five types:

- ASD Type I: Sampling Causes;
- ASD Type II: Laboratory Causes;
- ASD Type III: Statistical Evaluation Causes;
- ASD Type IV: Natural Variation; and
- ASD Type V: Alternative Sources.

A demonstration was conducted to assess whether the increases in sulfate concentrations at well AD-4C and TDS concentrations at wells AD-4C and AD-16R were based on Type IV causes (natural variation) and not by a release from the BASP.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The methods used to assess possible alternative sources of the SSIs for sulfate at AD-4C and TDS at AD-4C and AD-16R and the proposed alternative source are described below.

2.1 Proposed Alternative Source

An initial review of field forms, site geochemistry, and site historical data did not identify alternative sources due to a Type I issue (sampling causes). A review of the laboratory and statistical analyses did not identify any Type II (laboratory causes) or Type III (statistical evaluation causes) issues. Groundwater sampling, laboratory analysis, and statistical evaluations were generally completed in accordance with draft TCEQ guidance for groundwater monitoring (TCEQ, 2020). An initial review of site geochemistry did not identify evidence of any Type V (anthropogenic) impacts. As described below, the SSIs at AD-4C and AD-16R were attributed to natural variation, which is a Type IV cause.

2.1.1 Sulfate

An SSI for sulfate was identified at monitoring well AD-4C. A site map showing the location of AD-4C and other network well locations is presented in **Figure 1**. The monitoring network includes background locations AD-1, AD-5, and AD-17 and compliance wells AD-3, AD-4C, and AD-16R. Groundwater flow beneath the BASP is generally toward the southeast, as shown in **Figure 2**.

Sulfate concentrations at background well AD-1, which is located immediately upgradient of the BASP and upgradient of AD-4C, have historically been above those observed at AD-4C (**Figure 3**). Prior to 2009, sulfate concentrations at AD-1 were generally higher and subject to significant variability, including a peak value of 616 milligrams per liter (mg/L) sulfate on June 2007. Since background monitoring was initiated in 2016, sulfate concentrations at both AD-1 and AD-4C appear to trend upwards at a similar rate. Thus, recent increases in sulfate concentrations at AD-4C may represent the migration of groundwater with higher concentrations of sulfate from upgradient locations.

Likewise, boron concentrations at AD-1 are consistently higher than those observed at AD-4C (**Figure 4**). Boron is a conservative parameter which functions as a ‘tracer’ for potential CCR unit releases due to its lack of attenuation by chemical processes in groundwater flow and its high relative concentration in CCR. Generally, boron concentrations at AD-4C have slightly decreased since the October 2017 sampling event and have been relatively consistent compared to upgradient well AD-1. If BASP water, which has a boron concentration approximately one order of magnitude greater than at AD-1 (reported October 2020 concentration of 4.58 mg/L), was impacting groundwater quality at downgradient monitoring wells, an increase in boron concentrations would be expected. The current boron concentrations at AD-4C do not display an increasing or decreasing trend, which suggests that groundwater quality changes should not be attributed to a release from the BASP.

A mixing model was created to further illustrate how concentrations at AD-4C would be expected to change if the groundwater at AD-4C was affected by infiltration from the BASP. Groundwater data at AD-4C collected under the Federal CCR program in October 2016 was used to represent initial conditions at the monitoring location (100% groundwater), and BASP water data collected in August 2020 was used to represent the conditions in the BASP. A geochemical model (PHREEQC) was used to mix the groundwater sample with the BASP water at varying ratios in order to evaluate the changes in groundwater geochemistry under BASP water infiltration conditions. The output was compared to the reported groundwater concentrations at AD-4C in October 2020, which was the most recent sample collected containing the necessary major ion data. The mixing model output is included in a Piper Diagram presented as **Figure 5**, which visually represents the relative concentrations of major cations and anions in the analytical samples and mixing model outputs.

As illustrated in **Figure 5**, the mixing model predicts greater relative concentrations of calcium as the percent of BASP water added to the 2016 groundwater sample increases. However, the cation composition of groundwater at AD-4C appears unchanged between the 2016 and 2020 samples. Additionally, with greater inputs of the BASP water, the model predicts an increase in the relative percentage of sulfate as the relative percentage of chloride declines. However, the change in anion distribution between 2016 and 2020 in groundwater at AD-4C indicates that the chloride contribution has remained consistent while the relative concentration of alkalinity has declined.

The inconsistency of recently collected data at AD-4C with modeled outputs indicates that changes in sulfate concentrations should not be attributed to mixing with BASP water. Rather, the elevated sulfate and boron concentrations at upgradient background well AD-1 suggest that changes in sulfate concentration at AD-4C are attributable to natural variation. This same conclusion was noted in a previously completed ASD for sulfate at well AD-4C (Geosyntec, 2019b).

2.1.2 TDS

SSIs for TDS were identified at AD-16R and AD-4C. The second semi-annual detection sampling event was conducted on October 14, 2020. The reported TDS concentration for the sample from well AD-16R was 183 mg/L, which is below the calculated UPL (**Figure 6**). Based on the three results for AD-16R during the 2020 groundwater monitoring events, a positive trend is not demonstrated for TDS. Additionally, no other Appendix III exceedances were observed for AD-16R during the first semi-annual event, which was completed in May and July 2020. Thus, the observed TDS concentrations during the first semi-annual event are not considered indicative of a release from the BASP and are instead likely due to natural variability in the aquifer.

TDS concentrations at all wells within the BASP network are displayed on **Figure 7**. TDS concentrations at background wells AD-1, AD-5, and AD-17 are all generally higher than either of the two monitoring wells with TDS exceedances (AD-16R and AD-4C). The TDS concentrations of these background wells indicate TDS is highly variable within the aquifer unit. TDS concentrations at AD-1, which is directly upgradient of AD-4C, have been greater than TDS at AD-4C and AD-16R for four of the past five monitoring events. Even greater TDS concentrations are observed at AD-17, which is located further upgradient.

As mentioned in Section 2.1.1, boron is a conservative parameter which functions as a 'tracer' for potential CCR unit releases due to its lack of attenuation by chemical processes in groundwater flow and its high relative concentration in CCR. Boron concentrations in compliance wells AD-16R and AD-4C and background well AD-1 are displayed in **Figure 7**. The lack of increasing boron concentrations at AD-4C was previously discussed in Section 2.1.1. A similar trend is observed for boron concentrations at AD-16R, which have been relatively consistent compared to upgradient well AD-1. If infiltration from BASP water, which has a boron concentration approximately one order of magnitude greater than at AD-1, was impacting groundwater quality at downgradient monitoring wells, an increase in boron concentrations would be expected. The current boron concentrations at both AD-16R and AD-4C do not display an increasing or decreasing trend, which suggests that groundwater quality changes should not be attributed to a release from the BASP.

The recent SSIs for TDS at AD-16R and AD-4C are best attributed to natural variations in the groundwater chemistry within the aquifer.

2.2 Sampling Requirements

The ASD described above supports the determination that the identified SSIs are from natural variation and not due to a release from the Welsh BASP. Therefore, the unit will remain in the detection monitoring. Groundwater at the unit will continue to be sampled for Appendix III parameters on a semi-annual basis.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and supports the position that the identified sulfate and TDS SSIs should be attributed to natural variation and are not due to a release from the Welsh BASP. Therefore, no further action is warranted, and the Welsh BASP will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in **Attachment A**.

SECTION 4

REFERENCES

Geosyntec, 2019a. Statistical Analysis Summary – Background Update Calculations. Bottom Ash Storage Pond – J. Robert Welsh Plant. December 2019.

Geosyntec, 2019b. Alternative Source Demonstration Report – Federal CCR Rule. J. Robert Welsh Plant – Bottom Ash Storage Pond. May 2019.

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TABLES

Table 1: Detection Monitoring Data Evalation
Welsh Plant - Bottom Ash Storage Pond

Parameter	Unit	Description	AD-3		AD-4C		AD-16R	
			5/20/2020	7/22/2020	5/20/2020	7/22/2020	5/20/2020	7/22/2020
Boron	mg/L	Intrawell Background Value (UPL)	0.0580		0.0529		0.0638	
		Detection Monitoring Result	<0.02	--	<0.02	--	0.02 J	--
Calcium	mg/L	Intrawell Background Value (UPL)	1.32		0.961		3.15	
		Detection Monitoring Result	0.724	--	0.679	--	1.54	--
Chloride	mg/L	Intrawell Background Value (UPL)	9.40		15.6		8.02	
		Detection Monitoring Result	7.99	--	15.1	--	7.09	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1.00		1.00		1.00	
		Detection Monitoring Result	0.11	--	0.11	--	0.16	--
pH	SU	Intrawell Background Value (UPL)	6.6		5.8		5.0	
		Intrawell Background Value (LPL)	3.1		4.2		2.6	
		Detection Monitoring Result	4.6	--	5.1	--	3.4	--
Sulfate	mg/L	Intrawell Background Value (UPL)	10.6		63.7		73.2	
		Detection Monitoring Result	2.7	--	**69.0**	**71.8**	71.4	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	140		255		221	
		Detection Monitoring Result	**236**	114	**268**	**280**	**242**	**224**

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

Bold values exceed the background value.

Background values are shaded gray.

Value which were not detected are shown as less than the Method Detection Limit.

'J' represented an estimated value which was detected above the Method Detection Limit but below the Reporting Limit.

FIGURES

Monitoring Well Network

- ⊕ Downgradient Sampling Location
- ⊕ Background Sampling Location

▭ Bottom Ash Storage Pond

Notes
- Monitoring well coordinates provided by AEP.
- Site features based on information avilable in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).

500 250 0 500
Feet

Site Layout
Bottom Ash Storage Pond

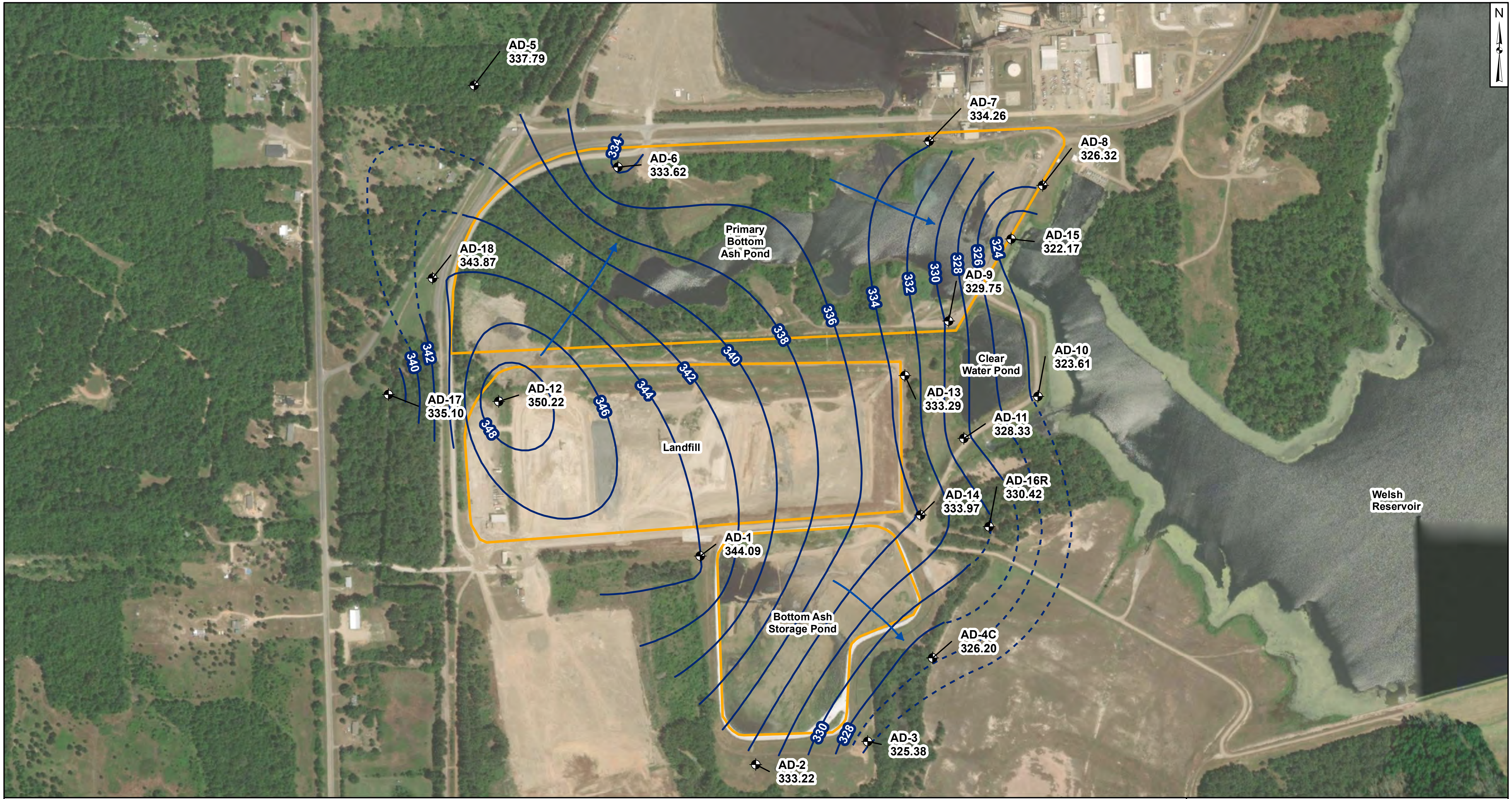
AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Columbus, Ohio
2020/09/23

Figure
1

C:\Users\mmuenich\Documents\local_projects\AEP_GIS\Welsh\MXDs\AEP-Welsh_BASP_Site_Layout.mxd. MMuenich. 1/26/2018. CHA8423/14/08.



Legend

⊕ Groundwater Monitoring Well

→ Approximate Groundwater Flow Direction

— Groundwater Elevation Contour

- - - Groundwater Elevation Contour (Inferred)

▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on May 19-20, 2020) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.

500 250 0 500
Feet

Groundwater Potentiometric Map
May 2020

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Figure
2

Columbus, Ohio
2020/11/04

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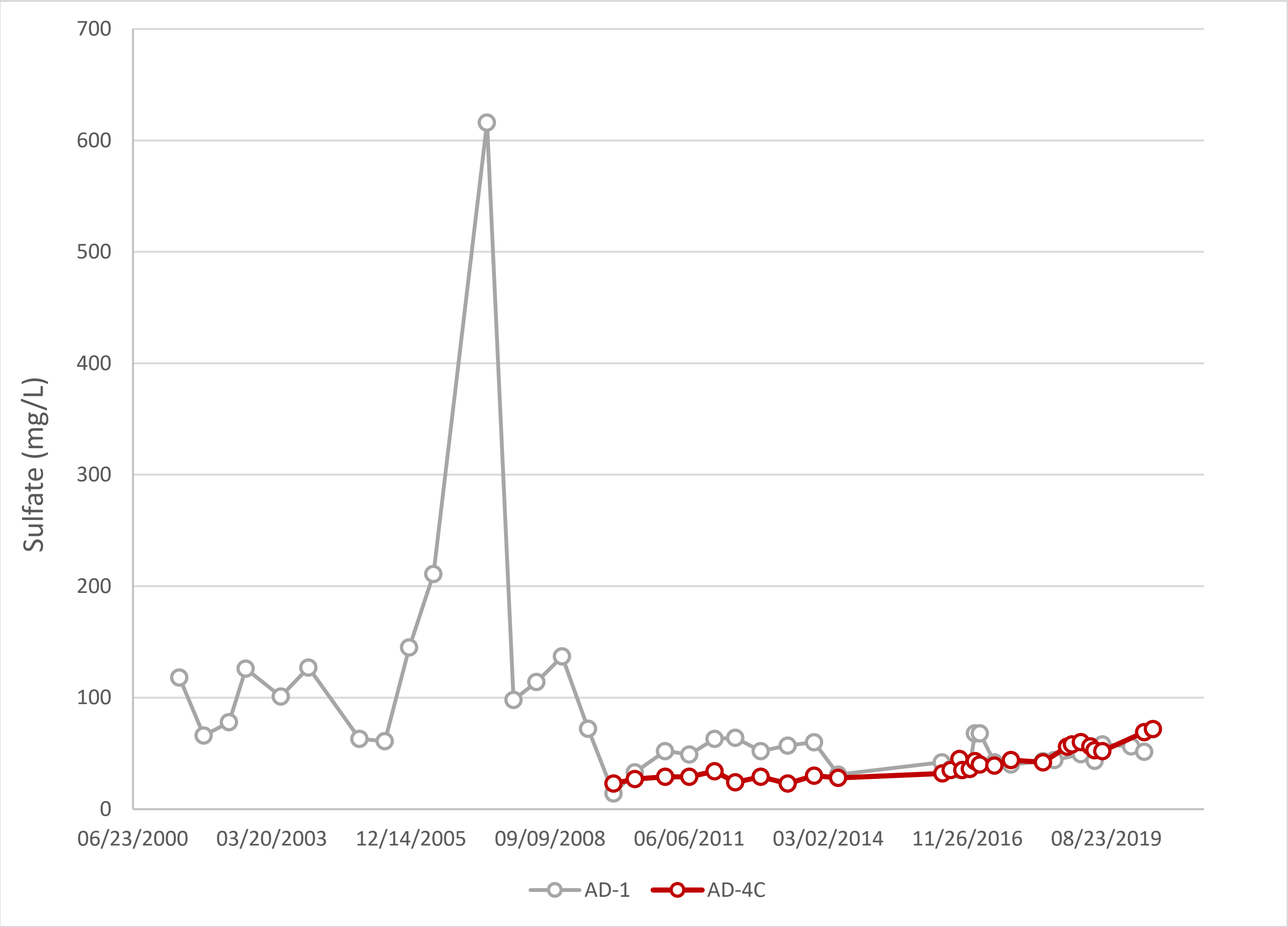


Notes: Sulfate time series diagram for BASP upgradient well AD-1 and downgradient well AD-4C. Data for AD-1 was collected as part of state and Federal CCR programs. Data for AD-4C was collected under the Federal CCR program.

Sulfate Time Series Graph at AD-4C and Upgradient Background Well AD-1

Welsh Bottom Ash Storage Pond

Geosyntec consultants

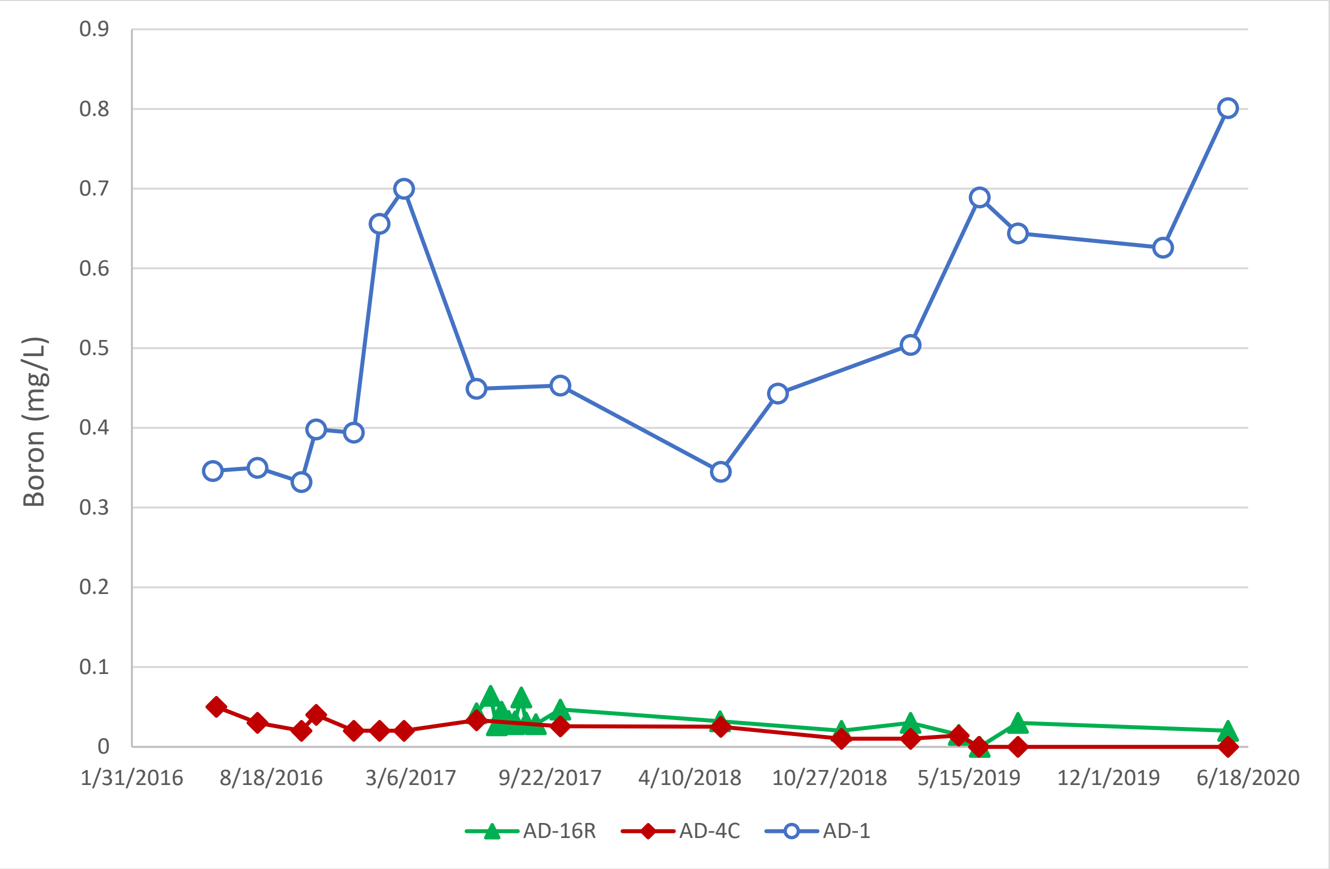
AMERICAN ELECTRIC POWER

Figure

3

Columbus, Ohio

12-December-2020



Notes: Boron data were collected under the Federal CCR program. Concentrations are shown in milligrams per liter (mg/L).

Boron Time Series Graph

Welsh Bottom Ash Storage Pond

Geosyntec consultants

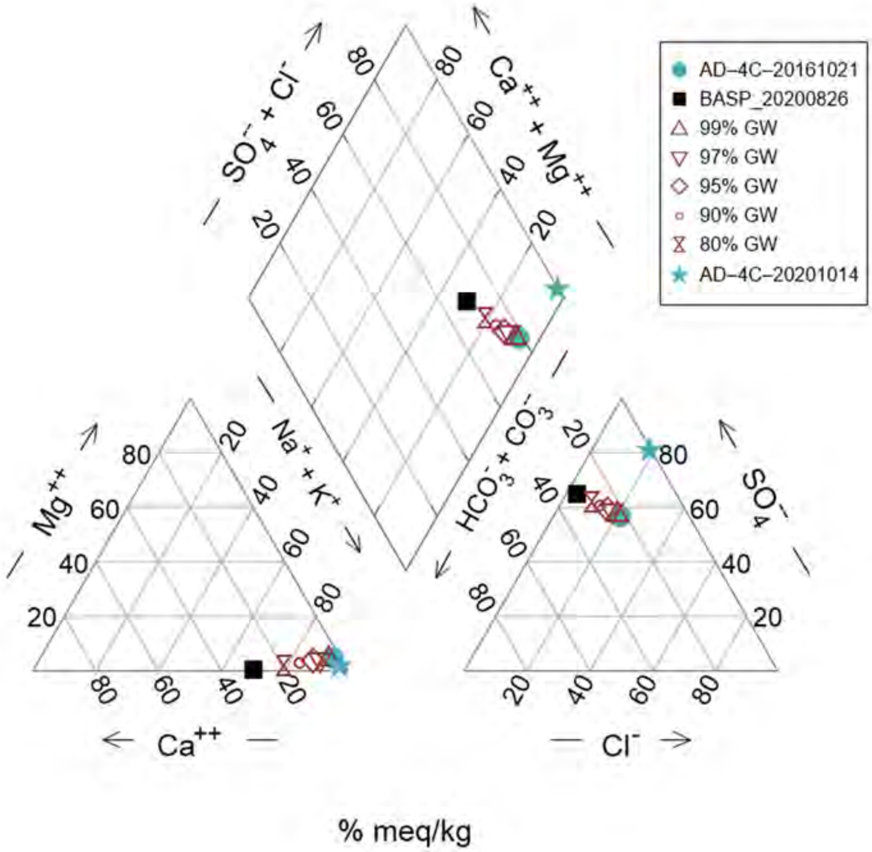
AMERICAN ELECTRIC POWER

Figure

4

Columbus, Ohio

03-November-2020



Notes: The October 2016 AD-4C groundwater sample the and October 2020 BASP sample were used as mixing model end members. The percentage input of the October 2020 BASP sample was varied, and the modeled output was compared to the October 2020 AD-4C groundwater sample. Results are shown in the relative percentage of milliequivalents per kilogram (meq/kg).

Piper Diagram – Mixing Model

Welsh Bottom Ash Storage Pond

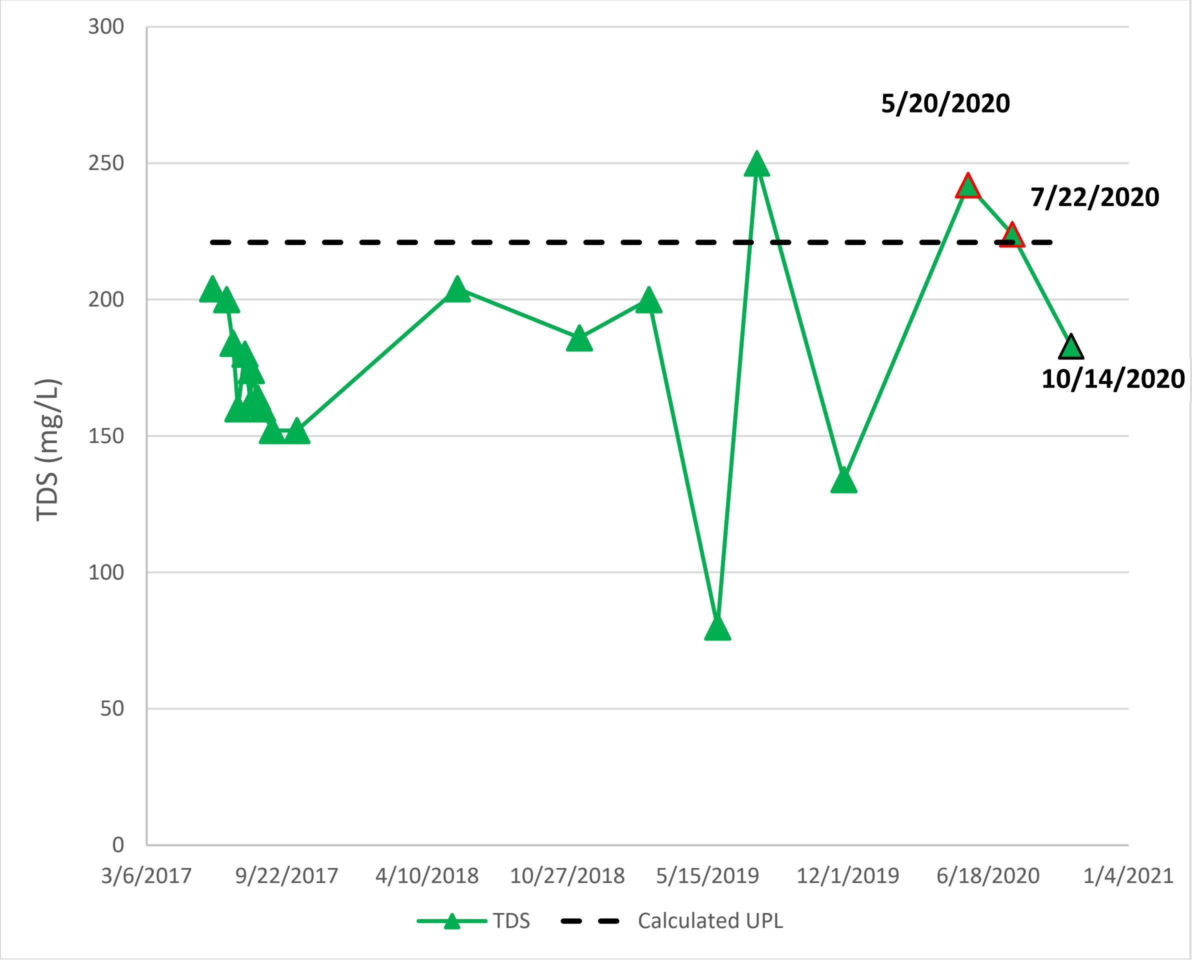
Geosyntec consultants

Figure 5

Columbus, OH

2020/11/10

internal info: path, date revised, author



Notes: Initial sampling for the first semi-annual detection monitoring event occurred on 5/20/2020. Verification resampling for the first semi-annual event occurred on 7/22/2020. Initial sampling for the second semi-annual event occurred on 10/14/2020. The upper prediction limit (UPL) was calculated using intrawell analyses.

TDS Time Series Graph at AD-16R

Northeastern Landfill

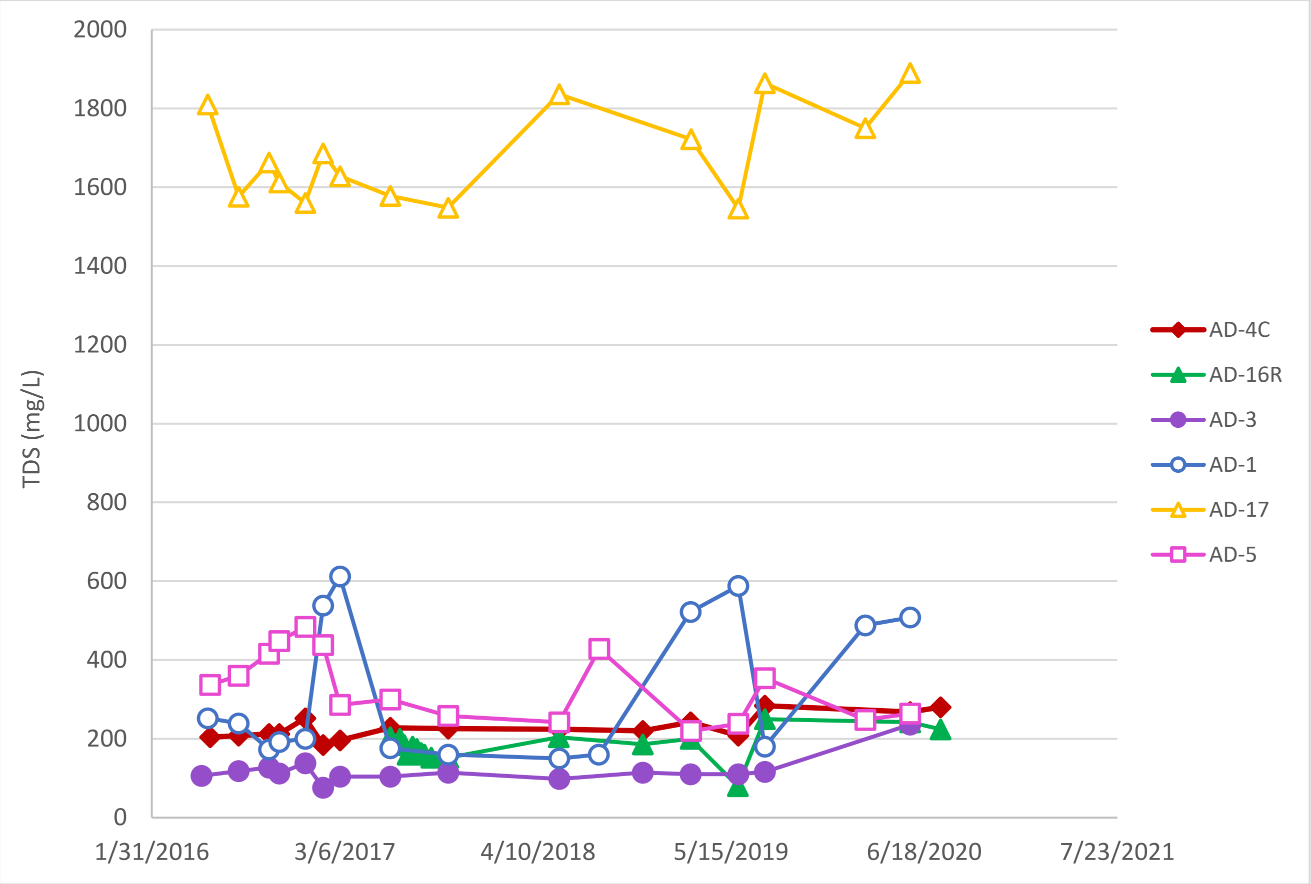
Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure 6

Columbus, Ohio

05-November-2020



Notes: TDS data was collected under the Federal CCR rule. Monitoring wells AD-1, AD-5, and AD-17 are background wells, whereas AD-3, AD-4C, and AD-16R are compliance wells. Concentrations are shown in miligrams per liter (mg/L).

TDS Time Series Graph

Welsh Bottom Ash Storage Pond

Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure
7

Columbus, Ohio

3-November-2020

internal info: path, date revised, author

ATTACHMENT A

Certification by a Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Welsh Bottom Ash Storage Pond CCR management area and that the requirements of 40 CFR 257.94(e)(2) have been met.

BETH ANN GROSS
79864

Beth Ann Gross
Printed Name of Licensed Professional Engineer

Beth Ann Gross
Signature

Geosyntec Consultants
2039 Centre Pointe Boulevard, Suite 103
Tallahassee, FL 32308

Texas Registered Engineering Firm
No. F-1182

79864	Texas	November 13, 2020
License Number	Licensing State	Date

4.10 – Annual Groundwater Monitoring Report, Landfill CCR Management Unit, January 2021

Annual Groundwater Monitoring Report

Southwestern Electric Power Company
J. Robert Welsh Power Plant
CN602843245
RN100213370

Landfill CCR Management Unit

WMU 001
1187 Country Road 4865
Titus County
Pittsburg, Texas

January 2021

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

Table of Contents

I. Overview

This *Annual Groundwater Monitoring Report* (Report) has been prepared to report the status of activities for the preceding year for an existing CCR unit at Southwestern Electric Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), Welsh Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31, 2021.

In general, the following activities were completed:

- This CCR Unit began and remained in assessment monitoring throughout 2020.
- Annual and Semi-Annual groundwater samples were collected and analyzed for Appendix III and Appendix IV constituents, as specified in 40 CFR 257.95 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan (2016)*;
- A statistical process in accordance with 40 CFR 257.93 to evaluate groundwater data was updated and certified (AEP's *Statistical Analysis Plan (*Geosyntec 2020)). The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance," USEPA, 2009);
- Semi-annual groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Annual groundwater sampling event was conducted in February;
- First semi-annual groundwater sampling event:
    - Statistically significant increases(SSIs):
        - Boron concentrations exceeded the interwell UPL of 0.700 mg/L at AD-11, AD-13, and AD-14;
        - Calcium concentrations exceeded the intrawell UPL of 12.2 mg/L at AD-14;
    - Statistically significant levels (SSLs):
        - None were identified;
- Second semi-annual groundwater sampling event:
    - Statistical analysis is underway;
- SSIs remain without successful alternate source demonstrations (ASDs), keeping the unit in assessment monitoring.

The major components of this annual report, to the extent applicable at this time, are presented in sections that follow:

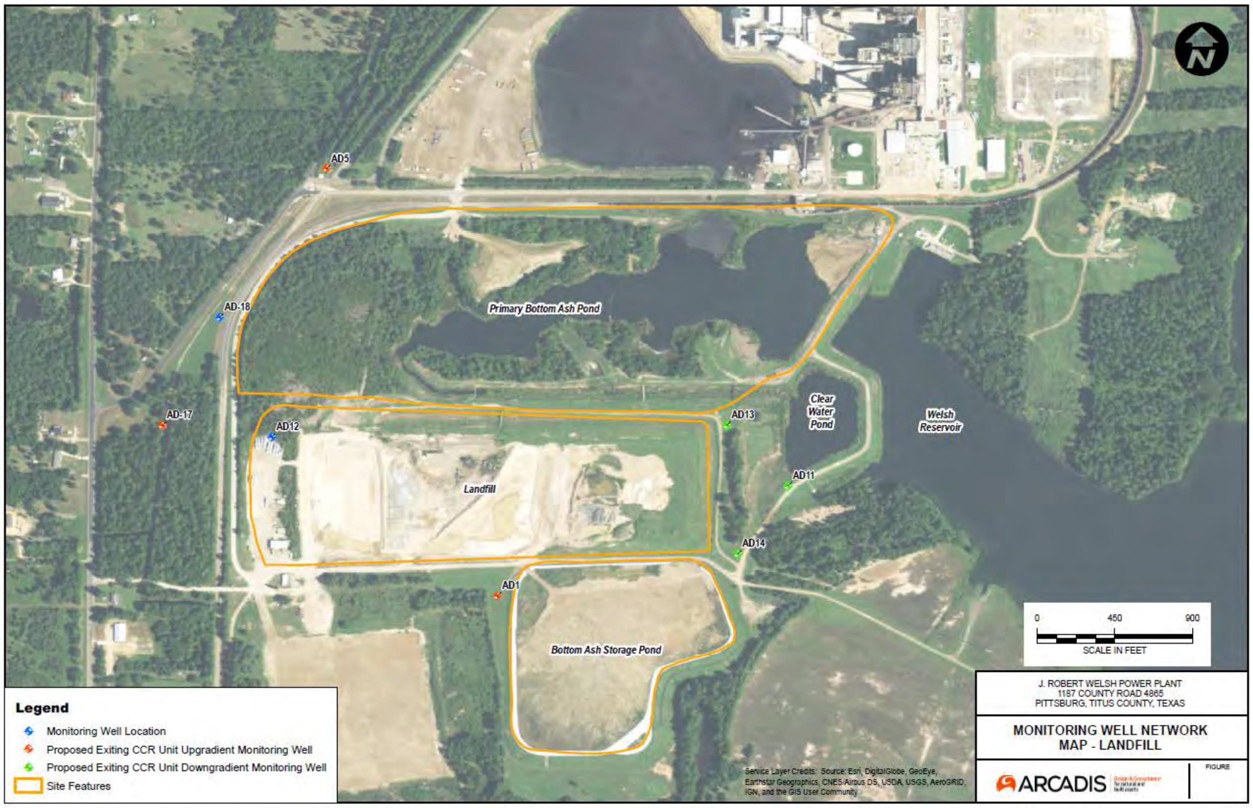
- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers;
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened;
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs is included in Appendix I;
- Statistical reports are located in Appendix II
- Alternate source demonstration, if any, are presented in Appendix III.
- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring, in addition to identifying the constituents detected at a statistically significant increase over background concentrations (Appendix IV).
- Other information required to be included in the annual report such as program related notification or assessment of corrective measures, if applicable, are presented in Appendix V;

In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.

II. Groundwater Monitoring Well Locations and Identification Numbers

The figure that follows depicts the PE-certified groundwater monitoring network, the monitoring well locations and their corresponding identification numbers.

Landfill Monitoring Wells	
Up Gradient	Down Gradient
AD-1	AD-11
AD-5	AD-13
AD-17	AD-14



III. Monitoring Wells Installed or Decommissioned

During 2020, no monitoring wells were installed or decommissioned.

IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction and Discussion

Appendix I contains potentiometric maps with the static water elevation, groundwater flow direction for each monitoring event and tables showing groundwater velocity and the groundwater quality data collected under 40 CFR 257.90 through 257.98.

The sampling event conducted February 17, 2020 satisfies the requirement of 257.95(b).

- The groundwater flow rate and direction for the first semi-annual confirmatory sampling event reflects that seen during the initial first semi-annual sampling event.

V. Statistical Evaluations completed in 2020

First semi-annual 2020 event conducted in May:

- the following SSIs were determined:
    - Boron concentrations exceeded the interwell UPL of 0.700 mg/L at AD-11, AD-13, and AD-14
    - Calcium concentrations exceeded the intrawell UPL of 12.2 mg/L at AD-14
- No SSLs were determined for the landfill during the First semi-annual 2020 event

Second semi-annual groundwater sampling event was conducted in October:

- statistical analysis is underway

The statistical reports completed in 2020 are found in Appendix II

VI. Alternate Source Demonstrations completed in 2020

No ASDs were conducted for the landfill's SSIs.

VII. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency

This unit remains in assessment monitoring.

VIII. Other Information Required

As required by the CCR assessment monitoring rules in 40 CFR 257.95 (b) and (d)(1), sampling all CCR wells for the required Appendix III and IV parameters was completed in 2020.

IX. Description of Any Problems Encountered in 2020 and Actions Taken

No significant problems were encountered.

X. A Projection of Key Activities for the Upcoming Year

- Assessment monitoring will continue;
- Complete the statistical evaluation of the Second 2020 semi-annual groundwater monitoring event.
- Conducted the annual groundwater sampling event, as required.
- Evaluation of the assessment monitoring results from a statistical analysis viewpoint, looking for SSIs above background as well as SSLs above GWPS;
- If needed, ASDs will be conducted to evaluate if the unit can remain in assessment monitoring or the unit will move to an assessment of corrective measures.
- Responding to any new data received in light of CCR rule requirements;
- Preparation of the next annual groundwater report.

APPENDIX I

Potentiometric maps and tables follow, showing the groundwater monitoring data collected, the rate and direction of groundwater flow, and a summary showing the number of samples collected per monitoring well. The dates that the samples were collected also is shown.

Legend

- ⯐ Groundwater Monitoring Well
- → Approximate Groundwater Flow Direction
- — Groundwater Elevation Contour
- - - Groundwater Elevation Contour (Inferred)
- ▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on February 17, 2020) provided by AEP.
-AD-2, AD-3, AD-4C, AD-6, AD-7, AD-10, AD-12, AD-16R, and AD-18 were not gauged during this event.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.

500 250 0 500
Feet

Groundwater Potentiometric Map
February 2020

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Columbus, Ohio
2020/05/11

Figure
1

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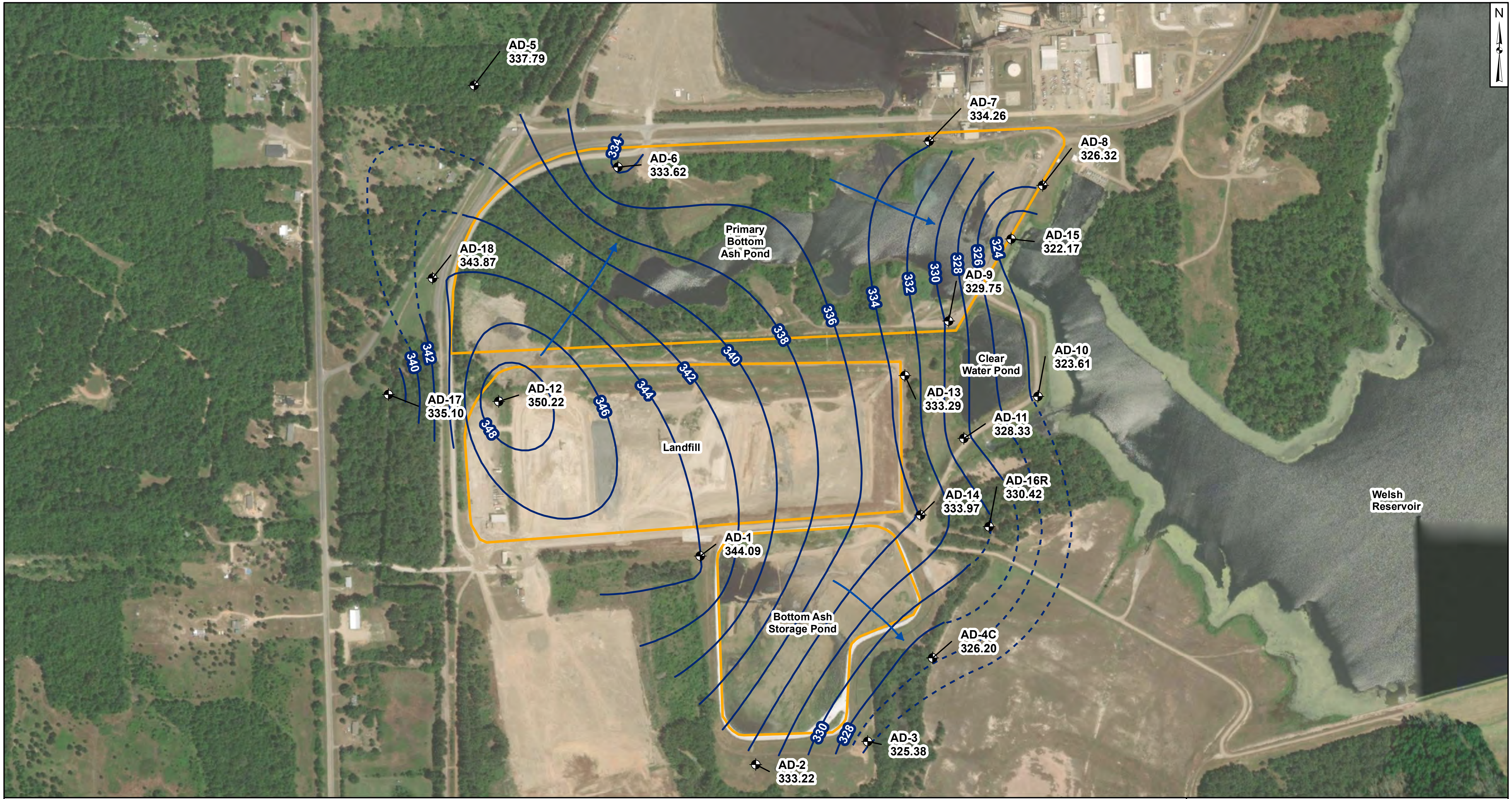

Legend

- ⯐ Groundwater Monitoring Well
- → Approximate Groundwater Flow Direction
- — Groundwater Elevation Contour
- - - Groundwater Elevation Contour (Inferred)
- ▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on May 19-20, 2020) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.

500 250 0 500
Feet

Groundwater Potentiometric Map
May 2020

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Columbus, Ohio

2020/11/04

Figure
2

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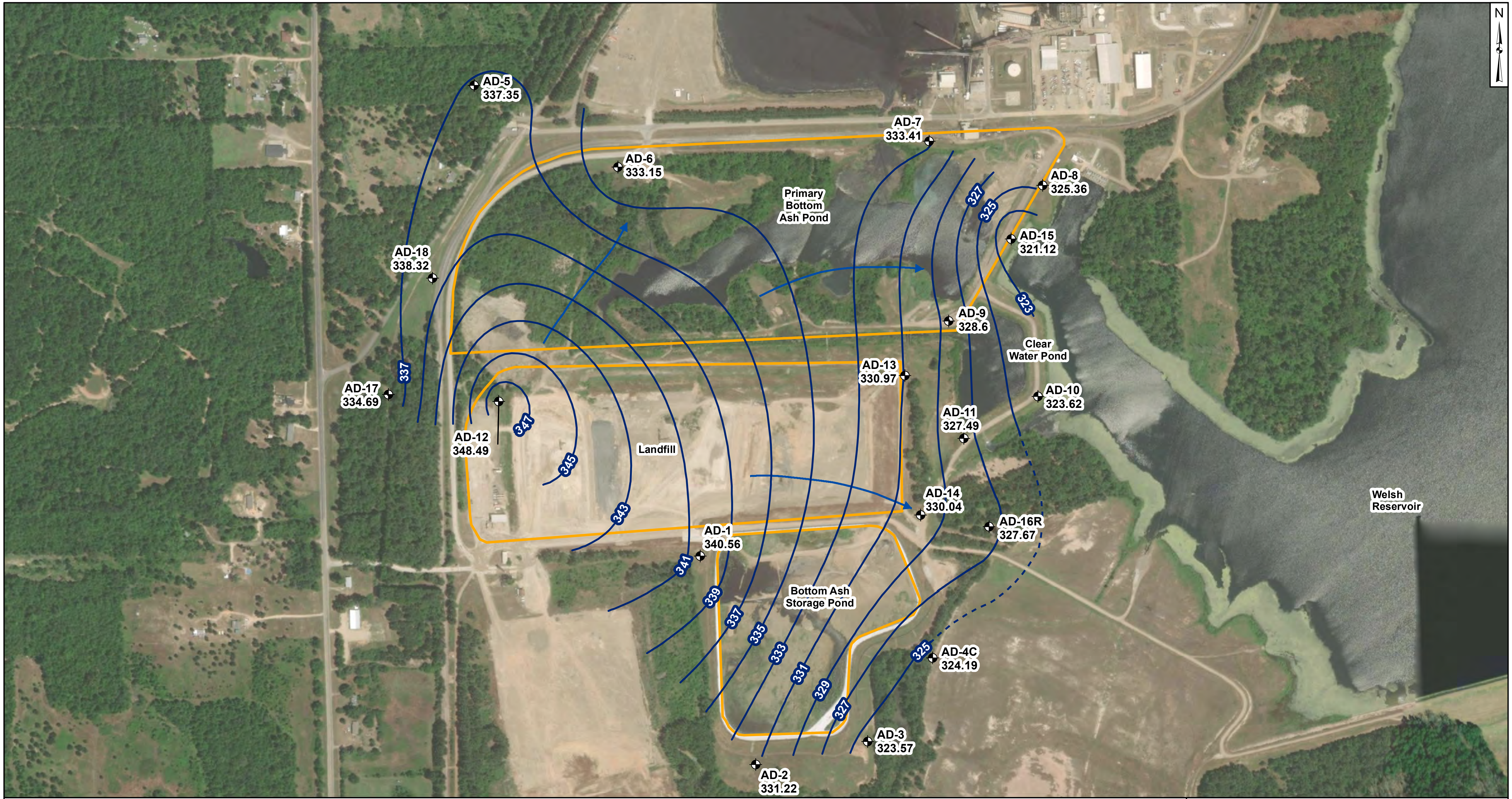

Legend
- ⊕ Groundwater Monitoring Well
- — Groundwater Elevation Contour
- - - Groundwater Elevation Contour (Inferred)
- → Approximate Groundwater Flow Direction
- ▭ CCR Units

Notes
- Monitoring well coordinates and water level data (collected on October 12-14, 2020) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.

500 250 0 500
Feet

Groundwater Potentiometric Map
October 2020

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Figure
3

Columbus, Ohio
2021/01/06

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Residence Time Calculation Summary Welsh Landfill

			2020-02		2020-05		2020-07[3]		2020-10	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	AD-5 [1]	2.0	1.0	59.3	1.8	34.5	0.8	73.0	2.6	23.5
	AD-11 [2]	2.0	5.0	12.1	2.9	20.8	3.7	16.2	2.6	23.8
	AD-13 [2]	0.0	4.8	12.7	2.8	21.4	3.3	18.7	3.1	19.5
	AD-14 [2]	0.0	3.2	18.9	3.9	15.5	2.2	28.0	2.7	22.9
	AD-1 [1]	2.0	4.6	13.1	3.4	17.7	3.8	16.0	3.2	19.0
	AD-17 [1]	2.0	2.4	25.1	9.3	6.5	1.3	46.0	7.7	7.9

Notes:
[1] - Upgradient Well
[2] - Downgradient Well
[3] - Two-of-two verification sampling
NC - Not Calculated

Residence Time Calculation Summary Welsh Landfill

			2019-02		**2019-05**		**2019-07**	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	AD-5 [1]	2.0	1.5	40.2	2.4	25.4	2.1	29.2
	AD-11 [2]	2.0	5.3	11.4	7.4	8.2	4.4	13.9
	AD-13 [2]	0.0	2.5	24.7	4.8	12.8	3.8	15.8
	AD-14 [2]	0.0	3.5	17.2	1.9	32.2	1.9	32.9
	AD-1 [1]	2.0	2.7	22.4	5.3	11.5	4.1	14.9
	AD-17 [1]	2.0	8.9	6.9	4.7	13.0	3.5	17.5

Notes:

[1] - Upgradient Well

[2] - Downgradient Well

Residence Time Calculation Summary Welsh - Landfill

			2018-05		**2018-08**	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	AD-5 [1]	2.0	3.7	16.6	1.5	40.5
	AD-11 [2]	2.0	4.0	15.3	2.7	22.9
	AD-13 [2]	0.0	2.6	23.8	2.4	25.7
	AD-14 [2]	0.0	2.7	22.1	1.8	34.4
	AD-1	2.0	3.7	16.7	3.4	17.6
	AD-17	2.0	1.6	37.4	3.2	18.8

Notes:

[1] - Upgradient Well

[2] - Downgradient Well

Table 1 - Groundwater Data Summary: AD-1
Welsh - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	**mg/L**	**mg/L**	**mg/L**	**SU**	**mg/L**	**mg/L**
5/26/2016	Background	0.346	36.5	5	< 0.083 U	5.9	42	252
7/29/2016	Background	0.35	39.6	4	< 0.083 U	5.3	36	239
9/30/2016	Background	0.332	15	5	< 0.083 U	5.4	35	173
10/21/2016	Background	0.398	19.1	4	< 0.083 U	5.2	42	192
12/14/2016	Background	0.394	8.74	4	< 0.083 U	5.2	40	200
1/20/2017	Background	0.656	129	4	< 0.083 U	7.1	68	538
2/24/2017	Background	0.7	147	9	< 0.083 U	6.9	68	612
6/8/2017	Background	0.449	15.1	4	< 0.083 U	5.1	42	176
10/6/2017	Detection	0.453	14.3	4	< 0.083 U	5.3	40	160
5/24/2018	Assessment	0.345	10.2	4	< 0.083 U	2.2	43	150
8/14/2018	Assessment	0.443	5.95	5	< 0.083 U	5.2	44	160
2/20/2019	Assessment	0.504	142	2.82	0.24	7.3	49.2	522
5/30/2019	Assessment	0.689	138	1.59	0.29	6.7	43.3	588
7/24/2019	Assessment	0.644	62.7	2	0.106 J	6.0	58	180
2/17/2020	Assessment	0.626	115	3.41	0.31	5.8	56.3	488
5/20/2020	Assessment	0.801	126	1.83	0.20	7.2	51.4	508
10/14/2020	Assessment	0.670	3.88	2.16	0.25	4.5	66.9	183

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-1
Welsh - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/26/2016	Background	< 0.93 U	1.39361 J	191	0.271453 J	0.213294 J	0.240267 J	1.15339 J	1.184	< 0.083 U	< 0.68 U	0.01	0.033	0.53149 J	1.74922 J	0.959865 J
7/29/2016	Background	< 0.93 U	< 1.05 U	191	0.315631 J	0.0940357 J	< 0.23 U	0.615933 J	0.9952	< 0.083 U	< 0.68 U	0.019	0.00793 J	< 0.29 U	1.81763 J	< 0.86 U
9/30/2016	Background	< 0.93 U	2.96797 J	141	0.382874 J	< 0.07 U	5	0.850408 J	1.38	< 0.083 U	3.38434 J	0.014	0.01773 J	< 0.29 U	1.02629 J	< 0.86 U
10/21/2016	Background	< 0.93 U	< 1.05 U	114	0.311247 J	< 0.07 U	0.412131 J	0.649606 J	1.141	< 0.083 U	< 0.68 U	0.008	0.00534 J	1.39872 J	2.03168 J	1.25062 J
12/14/2016	Background	< 0.93 U	< 1.05 U	72	0.34133 J	< 0.07 U	< 0.23 U	0.424105 J	0.719	< 0.083 U	< 0.68 U	0.008	0.01521 J	< 0.29 U	1.85825 J	< 0.86 U
1/20/2017	Background	< 0.93 U	< 1.05 U	410	0.0366913 J	< 0.07 U	< 0.23 U	0.480125 J	3.009	< 0.083 U	< 0.68 U	0.000275956 J	< 0.005 U	< 0.29 U	4.04737 J	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	488	< 0.02 U	< 0.07 U	< 0.23 U	0.765099 J	4.309	< 0.083 U	< 0.68 U	0.001	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	1.14 J	93.46	0.37 J	< 0.07 U	0.66 J	0.77 J	0.676	< 0.083 U	< 0.68 U	0.00902	0.007 J	< 0.29 U	2.1 J	< 0.86 U
5/24/2018	Assessment	3.17 J	< 1.05 U	79.9	0.39 J	< 0.07 U	< 0.23 U	0.35 J	1.983	< 0.083 U	< 0.68 U	0.00814	0.006 J	< 0.29 U	1.38 J	< 0.86 U
8/14/2018	Assessment	0.03 J	0.21	63.0	0.482	0.02	--	--	1.102	< 0.083 U	0.238	0.00708	0.013 J	0.21	1.7	0.03 J
2/20/2019	Assessment	0.16	0.46	457	0.09 J	0.01 J	0.306	0.399	3.159	0.24	0.124	0.00155	< 0.005 U	1 J	0.7	< 0.1 U
5/30/2019	Assessment	0.16	0.60	512	0.244	0.01 J	0.1 J	0.756	2.717	0.29	0.197	< 0.009 U	< 0.005 U	2.43	1.4	< 0.1 U
7/24/2019	Assessment	0.08 J	0.39	245	0.540	0.02 J	0.1 J	0.789	1.819	0.106 J	0.1 J	0.00557	< 0.005 U	2 J	3.4	< 0.1 U
2/17/2020	Assessment	0.33	0.49	303	0.07 J	0.02 J	0.1 J	0.28	2.665	0.31	0.1 J	0.00105	< 0.002 U	1 J	2.3	< 0.1 U
5/20/2020	Assessment	0.15	0.53	394	0.270	0.02 J	0.1 J	0.490	2.312	0.20	0.1 J	0.00301	< 0.002 U	2 J	2.8	< 0.1 U
10/14/2020	Assessment	< 0.1 U	0.3 J	84.7	0.984	< 0.05 U	0.9 J	2.12	1.552	0.25	0.3 J	0.00932	0.003 J	< 2 U	5.3	< 0.5 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-5
Welsh - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.03	36.9	15	0.3469 J	6.4	123	337
7/29/2016	Background	0.04	44.7	16	< 0.083 U	5.4	163	360
9/30/2016	Background	0.04	46.3	15	0.2436 J	5.3	190	416
10/21/2016	Background	0.05	50.7	14	< 0.083 U	5.9	267	448
12/14/2016	Background	0.05	49.6	13	< 0.083 U	6.2	233	484
1/20/2017	Background	0.04	49.8	14	< 0.083 U	6.3	234	438
2/24/2017	Background	0.04	33	15	< 0.083 U	5.5	127	286
6/8/2017	Background	0.05281	49.7	14	< 0.083 U	6.0	82	300
10/6/2017	Detection	0.04322	33.1	16	< 0.083 U	5.6	82	258
5/24/2018	Assessment	0.05007	28.1	22	< 0.083 U	6.2	60	242
8/15/2018	Assessment	0.050	--	19	< 0.083 U	6.2	240	428
2/21/2019	Assessment	0.033	33.9	24.7	0.21	5.4	46.5	220
5/30/2019	Assessment	0.03 J	30.0	22.3	0.29	6.3	51.3	238
7/24/2019	Assessment	0.04 J	41.1	18	0.112 J	6.3	90	354
2/17/2020	Assessment	0.03 J	39.8	19.8	0.22	5.5	43.7	248
5/20/2020	Assessment	0.03 J	40.2	22.3	0.18	6.8	55.5	264
10/14/2020	Assessment	0.04 J	36.6	18.8	0.18	6.5	148	338

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-5
Welsh - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	< 0.93 U	< 1.05 U	57	0.149801 J	0.0765156 J	0.555038 J	14	1.634	0.3469 J	< 0.68 U	0.135	0.01135 J	< 0.29 U	< 0.99 U	< 0.86 U
7/29/2016	Background	2.05116 J	2.90819 J	93	0.518653 J	0.502155 J	0.411466 J	15	4.75	< 0.083 U	< 0.68 U	0.191	0.01516 J	< 0.29 U	1.08901 J	< 0.86 U
9/30/2016	Background	< 0.93 U	4.7609 J	87	0.251584 J	< 0.07 U	0.90676 J	14	3.33	0.2436 J	< 0.68 U	0.186	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
10/21/2016	Background	< 0.93 U	< 1.05 U	70	0.08781 J	0.107488 J	0.248085 J	9	2.319	< 0.083 U	< 0.68 U	0.225	< 0.005 U	1.36984 J	< 0.99 U	< 0.86 U
12/14/2016	Background	< 0.93 U	1.15381 J	53	0.164529 J	0.203546 J	0.747921 J	13	2.182	< 0.083 U	< 0.68 U	0.199	0.00802 J	< 0.29 U	< 0.99 U	< 0.86 U
1/20/2017	Background	< 0.93 U	< 1.05 U	47	0.0574718 J	0.180502 J	< 0.23 U	12	1.023	< 0.083 U	< 0.68 U	0.239	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	42	0.0306858 J	< 0.07 U	< 0.23 U	13	1.788	< 0.083 U	< 0.68 U	0.166	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	3.85 J	87.7	0.08 J	0.39 J	0.28 J	11.93	2.32	< 0.083 U	< 0.68 U	0.124	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
5/24/2018	Assessment	< 0.93 U	< 1.05 U	71.16	< 0.02 U	0.23 J	0.8 J	14.24	1.946	< 0.083 U	< 0.68 U	0.121	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
8/15/2018	Assessment	0.01 J	1.69	63.7	0.055	0.008 J	0.072	11.4	0.316	< 0.083 U	0.079	0.147	< 0.005 U	0.13	0.08 J	< 0.01 U
2/21/2019	Assessment	0.02 J	1.59	69.4	0.08 J	< 0.01 U	0.432	8.58	1.267	0.21	0.147	0.0807	< 0.005 U	< 0.4 U	0.1 J	< 0.1 U
5/30/2019	Assessment	< 0.02 U	3.05	60.5	0.08 J	< 0.01 U	0.06 J	11.8	1.431	0.29	0.05 J	0.104	0.006 J	< 0.4 U	0.05 J	< 0.1 U
7/24/2019	Assessment	< 0.02 U	2.48	77.4	0.05 J	< 0.01 U	0.05 J	8.38	2.533	0.112 J	< 0.05 U	0.108	< 0.005 U	< 0.4 U	0.06 J	< 0.1 U
2/17/2020	Assessment	0.03 J	2.17	109	0.09 J	0.02 J	0.336	4.52	2.393	0.22	0.227	0.0732	< 0.002 U	0.9 J	0.2	< 0.1 U
5/20/2020	Assessment	< 0.02 U	1.78	93.1	0.05 J	0.01 J	0.1 J	7.65	1.612	0.18	0.07 J	0.0740	< 0.002 U	< 0.4 U	0.09 J	< 0.1 U
10/14/2020	Assessment	< 0.02 U	6.28	71.7	0.09 J	< 0.01 U	0.09 J	14.9	2.7	0.18	0.05 J	0.134	< 0.002 U	< 0.4 U	0.1 J	< 0.1 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-11
Welsh - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	2.47	8.47	9	2	5.2	518	388
7/29/2016	Background	2.83	8.88	10	2	3.8	596	1,000
9/30/2016	Background	3.4	10.7	12	2	4.1	683	1,065
10/21/2016	Background	3.77	8.78	11	3	3.7	706	1,024
12/14/2016	Background	3.36	8.98	10	2	3.8	548	1,044
1/20/2017	Background	2.81	10.3	11	2	4.4	760	1,048
2/24/2017	Background	2.88	9.31	10	2	4.3	558	876
6/8/2017	Background	2.79	9.93	10	1.366	3.9	556	960
10/6/2017	Detection	2.58	6.99	10	< 0.083 U	4.4	527	752
1/18/2018	Detection	1.9	--	--	--	4.5	377	564
5/23/2018	Assessment	--	--	--	< 0.083 U	4.1	--	--
8/15/2018	Assessment	--	--	--	< 0.083 U	4.7	--	--
9/17/2018	Assessment	1.84	6.61	15	--	--	410	720
2/5/2019	Assessment	1.47	4.56	9.47	0.47	4.3	225	--
2/21/2019	Assessment	1.63	19.1	9.23	0.41	4.9	306	542
4/30/2019	Assessment	1.34	7.53	--	--	5.3	--	--
5/29/2019	Assessment	1.40	5.78	6.96	0.47	4.2	367	680
7/23/2019	Assessment	1.56	7.19	6	0.338 J	4.5	342	700
2/17/2020	Assessment	1.47	20.5	8.19	0.42	4.9	350	622
5/19/2020	Assessment	1.54	24.3	6.83	0.51	6.3	419	720
7/22/2020	Assessment	1.81	9.45	--	--	4.0	--	--
10/12/2020	Assessment	1.69	8.57	8.16	0.63	3.9	604	764

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-11
Welsh - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	< 0.93 U	< 1.05 U	14	4	0.325877 J	3	26	1.773	2	< 0.68 U	0.032	0.02258 J	< 0.29 U	1.54658 J	< 0.86 U
7/29/2016	Background	< 0.93 U	< 1.05 U	12	4	0.453906 J	0.581828 J	26	2.23	2	< 0.68 U	0.047	0.00624 J	< 0.29 U	1.63477 J	1.31673 J
9/30/2016	Background	< 0.93 U	1.77308 J	52	5	0.579196 J	7	30	3.92	2	4.25302 J	0.047	0.01924 J	< 0.29 U	2.09096 J	1.07034 J
10/21/2016	Background	< 0.93 U	< 1.05 U	20	5	0.515668 J	2	27	2.56	3	< 0.68 U	0.047	0.0156 J	1.51918 J	< 0.99 U	< 0.86 U
12/14/2016	Background	< 0.93 U	< 1.05 U	13	4	0.366319 J	0.365212 J	25	1.569	2	< 0.68 U	0.041	0.01212 J	< 0.29 U	1.57203 J	< 0.86 U
1/20/2017	Background	< 0.93 U	< 1.05 U	13	4	0.394925 J	0.749253 J	25	1.082	2	< 0.68 U	0.046	< 0.005 U	< 0.29 U	< 0.99 U	1.23139 J
2/24/2017	Background	< 0.93 U	< 1.05 U	19	4	0.430668 J	2	24	1.45	2	1.18289 J	0.035	0.01613 J	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	1.23 J	10.12	2.79	0.41 J	0.32 J	22.16	1.902	1.366	< 0.68 U	0.03654	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
5/23/2018	Assessment	< 0.93 U	2.6 J	16.27	0.89 J	0.18 J	0.8 J	8.63	1.912	< 0.083 U	< 0.68 U	0.01875	0.007 J	< 0.29 U	1.34 J	46
8/15/2018	Assessment	0.02 J	1.05	11.9	1.18	0.37	0.257	15.3	2.568	< 0.083 U	1.42	0.0175	< 0.005 U	0.05 J	2.4	0.200
2/21/2019	Assessment	0.03 J	0.51	40.3	0.824	0.19	0.259	8.58	1.506	0.41	0.523	0.0157	< 0.005 U	< 0.4 U	1.5	0.1 J
5/29/2019	Assessment	< 0.02 U	0.78	19.1	1.05	0.20	0.369	9.82	1.473	0.47	0.847	0.02 J	< 0.005 U	< 0.4 U	2.2	0.1 J
7/23/2019	Assessment	< 0.02 U	0.59	16.4	0.987	0.24	0.413	10.5	2.246	0.338 J	0.976	0.0153	< 0.005 U	< 0.4 U	1.0	0.2 J
2/17/2020	Assessment	0.03 J	0.39	57.9	0.431	0.21	0.334	8.41	2.106	0.42	0.493	0.0142	0.007	2 J	0.8	0.1 J
5/19/2020	Assessment	0.04 J	0.55	35.7	0.782	0.26	0.254	11.4	2.352	0.51	0.427	0.0138	0.006	< 0.4 U	1.4	0.1 J
10/12/2020	Assessment	0.02 J	0.64	14.1	1.52	0.31	0.306	14.0	2.651	0.63	1.25	0.0246	0.006	< 0.4 U	1.8	0.2 J

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-13
Welsh - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	1.19	8.02	12	0.4948 J	6.1	177	900
7/29/2016	Background	1.23	3.7	15	0.7416 J	4.5	187	404
9/30/2016	Background	1.37	2.7	17	0.6464 J	4.6	207	431
10/21/2016	Background	1.67	3.66	19	1.1263	4.3	226	482
12/14/2016	Background	1.96	3.77	18	0.4149 J	4.8	287	596
1/20/2017	Background	0.402	33.5	7	< 0.083 U	5.4	90	222
2/24/2017	Background	1.27	10.3	13	< 0.083 U	5.1	183	392
6/8/2017	Background	1.68	3.03	15	0.6679 J	4.2	244	494
10/6/2017	Detection	2.23	5.11	13	< 0.083 U	4.6	345	564
1/18/2018	Detection	2.13	--	--	--	4.7	383	588
5/23/2018	Assessment	--	--	--	0.6534 J	4.5	--	--
8/14/2018	Assessment	--	--	--	0.7442 J	4.8	--	--
9/17/2018	Assessment	1.49	10.1	18	--	--	316	620
2/5/2019	Assessment	0.656	5.85	5.43	0.39	4.5	130	--
2/21/2019	Assessment	0.484	17.7	3.95	0.28	4.9	96.3	234
4/30/2019	Assessment	0.483	--	--	--	4.9	--	--
5/30/2019	Assessment	0.477	9.88	3.60	0.53	5.2	94.0	196
7/23/2019	Assessment	0.780	6.16	5	0.169 J	4.8	146	334
2/17/2020	Assessment	0.929	17.6	7.79	0.69	4.9	236	442
5/19/2020	Assessment	0.936	19.2	8.38	0.44	5.5	193	390
7/22/2020	Assessment	1.44	--	--	--	4.8	--	--
10/12/2020	Assessment	1.52	8.03	18.1	0.33	4.5	278	522

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-13
Welsh - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	< 0.93 U	< 1.05 U	62	0.682114 J	< 0.07 U	0.690428 J	4.11633 J	1.223	0.4948 J	< 0.68 U	0.011	0.01797 J	< 0.29 U	1.4772 J	< 0.86 U
7/29/2016	Background	< 0.93 U	< 1.05 U	36	0.922975 J	0.0850015 J	< 0.23 U	4.46011 J	1.601	0.7416 J	< 0.68 U	0.026	0.00515 J	< 0.29 U	2.00998 J	< 0.86 U
9/30/2016	Background	< 0.93 U	< 1.05 U	40	0.827513 J	0.0965393 J	0.77177 J	4.59287 J	2.213	0.6464 J	< 0.68 U	0.02	< 0.005 U	< 0.29 U	1.03137 J	< 0.86 U
10/21/2016	Background	< 0.93 U	< 1.05 U	30	0.934335 J	0.0913657 J	0.581648 J	4.91926 J	3.662	1.1263	< 0.68 U	0.022	< 0.005 U	0.870491 J	1.03637 J	0.97358 J
12/14/2016	Background	< 0.93 U	3.69546 J	51	1	0.185393 J	7	7	2.27	0.4149 J	1.09698 J	0.025	0.01565 J	0.353324 J	1.64297 J	< 0.86 U
1/20/2017	Background	< 0.93 U	6	112	0.198035 J	< 0.07 U	4	1.76949 J	2.228	< 0.083 U	2.72659 J	0.004	0.00673 J	< 0.29 U	< 0.99 U	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	41	0.612394 J	< 0.07 U	< 0.23 U	4.55541 J	1.556	< 0.083 U	< 0.68 U	0.015	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	1.53 J	< 1.05 U	17.12	0.89 J	0.14 J	< 0.23 U	6.24	1.565	0.6679 J	< 0.68 U	0.02082	< 0.005 U	< 0.29 U	1.03 J	< 0.86 U
5/23/2018	Assessment	< 0.93 U	< 1.05 U	26.53	0.87 J	< 0.07 U	0.73 J	9.37	2.16	0.6534 J	< 0.68 U	0.0291	0.008 J	< 0.29 U	< 0.99 U	< 0.86 U
8/15/2018	Assessment	0.03 J	1.37	16.9	0.971	0.31	0.503	13.1	4.073	0.7442 J	1.00	0.0321	< 0.005 U	0.06 J	1.7	0.277
2/21/2019	Assessment	0.02 J	0.38	55.2	0.302	0.05	0.2 J	2.35	2.534	0.28	0.05 J	0.0094	< 0.005 U	< 0.4 U	0.4	< 0.1 U
5/30/2019	Assessment	0.03 J	0.32	60.9	0.385	0.07	0.310	3.15	3.15	0.53	0.05 J	0.009 J	< 0.005 U	< 0.4 U	0.4	< 0.1 U
7/23/2019	Assessment	0.02 J	0.37	23.6	0.443	0.09	0.283	3.82	1.748	0.169 J	0.204	0.0175	< 0.005 U	< 0.4 U	0.3	0.1 J
2/17/2020	Assessment	0.03 J	0.59	59.4	0.528	0.12	0.354	3.84	3.79	0.69	0.1 J	0.0132	0.012	0.5 J	1.1	< 0.1 U
5/19/2020	Assessment	0.05 J	0.53	50.3	0.533	0.09	0.261	3.87	1.977	0.44	0.06 J	0.0147	0.034	1 J	1.3	< 0.1 U
10/12/2020	Assessment	< 0.02 U	0.55	18.5	0.834	0.17	0.410	8.50	1.546	0.33	0.324	0.0480	< 0.002 U	< 0.4 U	0.5	0.2 J

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-14
Welsh - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	1.28	2.88	4	< 0.083 U	4.8	115	285
7/29/2016	Background	1.14	2.51	5	< 0.083 U	4.2	111	267
9/30/2016	Background	1.14	1.19	5	< 0.083 U	4.2	111	252
10/21/2016	Background	1.25	2.48	4	< 0.083 U	3.9	118	276
12/14/2016	Background	1.25	2.41	5	< 0.083 U	4.1	101	296
1/20/2017	Background	0.915	10.3	4	< 0.083 U	6.1	92	254
2/24/2017	Background	1.06	9.48	4	< 0.083 U	5.4	90	212
6/8/2017	Background	1.26	7.69	6	< 0.083 U	4.8	108	256
10/6/2017	Detection	1.63	3.55	10	< 0.083 U	4.6	143	288
1/18/2018	Detection	1.57	--	6.43	--	5.7	--	--
5/23/2018	Assessment	--	--	--	< 0.083 U	4.2	--	--
8/14/2018	Assessment	--	--	--	< 0.083 U	4.3	--	--
9/17/2018	Assessment	1.51	4.51	12	--	--	204	384
2/5/2019	Assessment	1.10	4.13	3.13	0.15	4.3	99.9	--
2/21/2019	Assessment	1.2	10.3	2.2	0.14	4.3	90.4	236
4/30/2019	Assessment	1.04	--	--	--	4.4	--	--
5/29/2019	Assessment	1.21	9.80	3.65	0.19	4.5	122	274
7/23/2019	Assessment	1.25	9.93	8	0.162 J	5.5	171	440
2/17/2020	Assessment	1.12	38.7	2.00	0.24	5.2	85.6	294
5/19/2020	Assessment	1.22	15.1	1.46	0.15	5.4	88.5	263
7/22/2020	Assessment	1.24	17.3	--	--	5.2	--	--
10/12/2020	Assessment	1.14	9.63	8.59	0.24	4.3	246	469

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-14
Welsh - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	< 0.93 U	1.89384 J	31	0.65845 J	0.99504 J	0.536293 J	10	0.871	< 0.083 U	< 0.68 U	0.012	0.03	< 0.29 U	2.91711 J	< 0.86 U
7/29/2016	Background	< 0.93 U	< 1.05 U	84	0.653837 J	0.976466 J	1	9	1.487	< 0.083 U	< 0.68 U	0.024	0.02159 J	< 0.29 U	1.93417 J	< 0.86 U
9/30/2016	Background	< 0.93 U	1.45308 J	30	0.473938 J	0.975306 J	0.775009 J	9	4.817	< 0.083 U	< 0.68 U	0.015	0.02217 J	< 0.29 U	2.73939 J	< 0.86 U
10/21/2016	Background	< 0.93 U	< 1.05 U	39	0.543258 J	1	0.640984 J	9	1.972	< 0.083 U	< 0.68 U	0.014	0.02024 J	0.49697 J	2.46916 J	< 0.86 U
12/14/2016	Background	< 0.93 U	< 1.05 U	47	0.536415 J	1	1	9	1.271	< 0.083 U	< 0.68 U	0.013	0.037	< 0.29 U	3.32013 J	< 0.86 U
1/20/2017	Background	< 0.93 U	< 1.05 U	38	0.215525 J	0.226476 J	0.700394 J	2.91252 J	1.825	< 0.083 U	< 0.68 U	0.013	0.01863 J	< 0.29 U	< 0.99 U	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	42	0.286071 J	0.187588 J	< 0.23 U	3.50056 J	0.512	< 0.083 U	< 0.68 U	0.012	0.01443 J	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	< 1.05 U	44.83	0.38 J	0.67 J	1.27	6.78	1.138	< 0.083 U	< 0.68 U	0.0127	0.021 J	< 0.29 U	2.61 J	< 0.86 U
5/23/2018	Assessment	< 0.93 U	< 1.05 U	28.17	0.78 J	1.61	< 0.23 U	14.34	1.601	< 0.083 U	< 0.68 U	0.0152	0.145	< 0.29 U	3.62 J	< 0.86 U
8/15/2018	Assessment	0.01 J	0.39	24.0	0.854	1.99	0.276	17.6	1.502	< 0.083 U	0.174	0.0110	0.181	0.03 J	3.7	0.242
2/21/2019	Assessment	0.03 J	0.34	41.2	0.387	0.35	0.247	4.37	1.172	0.14	0.09 J	0.0114	< 0.005 U	< 0.4 U	0.8	< 0.1 U
5/29/2019	Assessment	0.03 J	0.40	44.8	0.556	0.81	0.2 J	7.82	1.946	0.19	0.137	0.02 J	0.181	< 0.4 U	2.0	< 0.1 U
7/23/2019	Assessment	< 0.02 U	0.43	36.2	0.934	2.49	0.286	18.5	2.731	0.162 J	0.200	0.0155	0.123	< 0.4 U	2.7	0.2 J
2/17/2020	Assessment	0.07 J	0.43	44.4	0.179	0.2	0.2 J	2.32	2.552	0.24	0.07 J	0.0063	0.003 J	2 J	2.5	0.1 J
5/19/2020	Assessment	0.03 J	0.32	35.3	0.396	0.32	0.307	3.81	0.778	0.15	0.1 J	0.00875	0.002 J	1 J	1.5	< 0.1 U
10/12/2020	Assessment	< 0.02 U	0.44	22.9	1.46	3.21	0.357	26.0	4.259	0.24	0.307	0.0195	0.391	< 0.4 U	2.0	0.3 J

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-17
Welsh - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/26/2016	Background	0.121	200	43	0.4023 J	7.2	1,166	1,810
7/29/2016	Background	0.119	195	32	0.4135 J	5.7	1,005	1,576
9/30/2016	Background	0.111	191	36	0.3055 J	6.2	1,055	1,663
10/21/2016	Background	0.124	194	32	0.583 J	6.1	1,163	1,612
12/14/2016	Background	0.135	196	31	0.5399 J	6.0	1,096	1,560
1/20/2017	Background	0.101	196	33	< 0.083 U	5.9	1,445	1,686
2/24/2017	Background	0.135	189	30	< 0.083 U	5.7	1,055	1,628
6/8/2017	Background	0.121	188	30	< 0.083 U	5.8	1,105	1,578
10/6/2017	Detection	0.183	183	31	< 0.083 U	5.9	1,090	1,548
5/24/2018	Assessment	0.239	193	39	< 0.083 U	6.3	1,067	1,836
8/15/2018	Assessment	0.118	187	40	< 0.083 U	5.6	1,168	1,748
2/21/2019	Assessment	0.151	207	43.2	0.18	6.9	1,060	1,722
5/30/2019	Assessment	0.158	202	41.7	< 0.04 U	6.1	1,120	1,546
7/24/2019	Assessment	0.113	216	37	0.085 J	6.0	1,127	1,864
2/17/2020	Assessment	0.104	184	36.0	0.16	5.9	1,070	1,750
5/20/2020	Assessment	0.115	250	47.7	0.15	5.7	1,190	1,890
10/14/2020	Assessment	0.100	185	35.7	0.17	5.4	1,060	1,720

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-17
Welsh - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/26/2016	Background	< 0.93 U	1.37501 J	21	0.173275 J	2	1	63	1.525	0.4023 J	< 0.68 U	0.37	0.032	< 0.29 U	< 0.99 U	< 0.86 U
7/29/2016	Background	1.13716 J	< 1.05 U	20	0.307264 J	4	1	68	2.78	0.4135 J	< 0.68 U	0.374	0.02133 J	1.04115 J	4.56733 J	< 0.86 U
9/30/2016	Background	< 0.93 U	< 1.05 U	31	0.175474 J	0.848199 J	3	58	2.358	0.3055 J	< 0.68 U	0.354	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
10/21/2016	Background	< 0.93 U	< 1.05 U	34	0.200656 J	2	4	65	2.224	0.583 J	< 0.68 U	0.394	< 0.005 U	0.322249 J	3.34422 J	< 0.86 U
12/14/2016	Background	< 0.93 U	< 1.05 U	17	0.0498325 J	3	0.816224 J	68	2.384	0.5399 J	< 0.68 U	0.323	0.01485 J	< 0.29 U	< 0.99 U	< 0.86 U
1/20/2017	Background	< 0.93 U	< 1.05 U	14	0.0319852 J	3	68	68	2.436	< 0.083 U	< 0.68 U	0.341	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
2/24/2017	Background	< 0.93 U	< 1.05 U	20	0.0665729 J	2	1	73	2.288	< 0.083 U	< 0.68 U	0.331	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
6/8/2017	Background	< 0.93 U	< 1.05 U	10.33	< 0.02 U	6.06	< 0.23 U	74.8	1.598	< 0.083 U	< 0.68 U	0.329	0.013 J	< 0.29 U	< 0.99 U	< 0.86 U
5/24/2018	Assessment	< 0.93 U	< 1.05 U	9.65	< 0.02 U	6.46	< 0.23 U	71.73	1.939	< 0.083 U	< 0.68 U	0.308	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
8/15/2018	Assessment	0.02 J	1.83	12.8	0.069	0.25	0.604	43.5	2.35	< 0.083 U	1.10	0.243	0.011 J	0.35	0.3	--
2/21/2019	Assessment	0.08 J	2.51	120	0.24	0.27	3.34	64.5	2.657	0.18	2.49	0.268	0.007 J	0.7 J	0.8	< 0.1 U
5/30/2019	Assessment	< 0.02 U	0.41	19.6	0.02 J	0.03 J	0.246	51.1	2.508	< 0.04 U	0.03 J	0.341	< 0.005 U	< 0.4 U	0.06 J	< 0.1 U
7/24/2019	Assessment	< 0.02 U	1.07	14.3	0.130	0.03 J	0.228	57.7	3.45	0.085 J	0.263	0.283	< 0.005 U	< 0.4 U	0.1 J	< 0.1 U
2/17/2020	Assessment	< 0.02 U	0.72	9.6	0.04 J	< 0.01 U	0.08 J	42.3	3.46	0.16	< 0.05 U	0.273	< 0.004 U	< 0.4 U	< 0.03 U	< 0.1 U
5/20/2020	Assessment	< 0.02 U	0.86	11.4	0.07 J	0.02 J	0.231	70.0	2.76	0.15	0.08 J	0.302	< 0.002 U	< 0.4 U	0.09 J	< 0.1 U
10/14/2020	Assessment	< 0.02 U	0.84	10.9	0.04 J	0.01 J	0.327	45.4	2.169	0.17	0.2 J	0.274	< 0.002 U	< 0.4 U	0.06 J	< 0.1 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

APPENDIX II

Where applicable, show in this appendix the results from statistical analyses, and a description of the statistical analysis method chosen. These statistical analyses are to be conducted separately for each constituent in each monitoring well.

STATISTICAL ANALYSIS SUMMARY
LANDFILL
J. Robert Welsh Plant
Pittsburg, Texas

Submitted to

AMERICAN ELECTRIC POWER

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September 1, 2020

CHA8500

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LF	Landfill
LFB	Laboratory Fortified Blanks
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Landfill (LF), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron, total dissolved solids (TDS), and sulfate at the LF. An alternative source was not identified at the time, so the LF has been in assessment monitoring since. Groundwater protection standards (GWPS) were set in accordance with 40 CFR 257.95(d)(2) and a statistical evaluation of the assessment monitoring data was conducted. During the most recent semi-annual assessment monitoring event, completed in July 2019, no statistically significant levels (SSLs) were identified during this event, and the unit remained in assessment monitoring (Geosyntec, 2019). Two assessment monitoring events were conducted at the LF in February 2020 and May 2020, in accordance with 40 CFR 257.95. The results of these assessment events are documented in this report.

Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact data usability.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. GWPSs were re-established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at an SSL above the GWPS. No SSLs were identified; however, concentrations of Appendix III parameters remained above background. Thus, the unit will remain in assessment monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

LANDFILL EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, two sets of samples were collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(b) (February 2020) and 257.95(d)(1) (May 2020). Samples from both sampling events were analyzed for the Appendix III and Appendix IV parameters. A summary of data collected during these assessment monitoring events may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.26 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the LF were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained in February and May 2020 were screened for potential outliers. No outliers were identified for these events.

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in 40 CFR 257.95(h)(2) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events. Tolerance limits were calculated parametrically with 95% coverage and 95% confidence for barium, chromium, and combined radium. Non-parametric tolerance limits were calculated for antimony, arsenic, beryllium, cadmium, cobalt, fluoride, lead, lithium, mercury, molybdenum, and selenium due to apparent non-normal distributions and for thallium due to a high non-detect frequency. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

No SSLs were identified at the Welsh LF.

2.2.3 Evaluation of Potential Appendix III SSIs

The Appendix III results were analyzed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations. Data collected during the May 2020 assessment monitoring events from each compliance well were compared to the prediction limits to evaluate results above background values. Where potential exceedances were noted, verification sampling was completed on July 22, 2020. The results from these events and the prediction limits are summarized in Table 3. The following exceedances of the upper prediction limits (UPLs) were noted:

- Boron concentrations exceeded the interwell UPL of 0.700 mg/L at AD-11 (1.54 mg/L and 1.81 mg/L), AD-13 (0.936 mg/L and 1.44 mg/L), and AD-14 (1.22 mg/L and 1.24 mg/L).

- Calcium concentrations exceeded the intrawell UPL of 12.2 mg/L at AD-14 (15.1 mg/L and 17.3 mg/L).

Based on these results, concentrations of boron and calcium appear to be above background concentrations and the unit will remain in assessment monitoring.

2.3 Conclusions

A semi-annual assessment monitoring event was conducted in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the February and May 2020 data. GWPSs were re-established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPS. No SSLs were identified.

The Appendix III results were evaluated to assess whether concentrations of Appendix III parameters exceeded background levels. Boron and Calcium results exceeded background levels at select downgradient wells.

Based on this evaluation, the Welsh LF CCR unit will remain in assessment monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Welsh Plant. January.

Geosyntec Consultants. 2019. Statistical Analysis Summary -Landfill. J. Robert Welsh Plant. December.

TABLES

Table 1 - Groundwater Data Summary
Welsh Plant - Landfill

Parameter	Unit	AD-1		AD-11		AD-13		AD-14		AD-17		AD-5	
		2/17/2020	5/20/2020	2/17/2020	5/19/2020	2/17/2020	5/19/2020	2/17/2020	5/19/2020	2/17/2020	5/20/2020	2/17/2020	5/20/2020
Antimony	µg/L	0.330	0.15	0.0300 J	0.04 J	0.0300 J	0.05 J	0.0700 J	0.03 J	0.1 U	0.1 U	0.0300 J	0.1 U
Arsenic	µg/L	0.490	0.53	0.390	0.55	0.590	0.53	0.430	0.32	0.720	0.86	2.17	1.78
Barium	µg/L	303	394	57.9	35.7	59.4	50.3	44.4	35.3	9.60	11.4	109	93.1
Beryllium	µg/L	0.0700 J	0.270	0.431	0.782	0.528	0.533	0.179	0.396	0.0400 J	0.07 J	0.0900 J	0.05 J
Boron	mg/L	0.626	0.801	1.47	1.54	0.929	0.936	1.12	1.22	0.104	0.115	0.0300 J	0.03 J
Cadmium	µg/L	0.0200 J	0.02 J	0.210	0.26	0.120	0.09	0.200	0.32	0.05 U	0.02 J	0.0200 J	0.01 J
Calcium	mg/L	115	126	20.5	24.3	17.6	19.2	38.7	15.1	184	250	39.8	40.2
Chloride	mg/L	3.41	1.83	8.19	6.83	7.79	8.38	2.00	1.46	36.0	47.7	19.8	22.3
Chromium	µg/L	0.100 J	0.1 J	0.334	0.254	0.354	0.261	0.200 J	0.307	0.0800 J	0.231	0.336	0.1 J
Cobalt	µg/L	0.280	0.490	8.41	11.4	3.84	3.87	2.32	3.81	42.3	70.0	4.52	7.65
Combined Radium	pCi/L	2.67	2.31	2.11	2.35	3.79	1.98	2.55	0.778	3.46	2.76	2.39	1.61
Fluoride	mg/L	0.31	0.20	0.42	0.51	0.69	0.44	0.24	0.15	0.16	0.15	0.22	0.18
Lead	µg/L	0.100 J	0.1 J	0.493	0.427	0.100 J	0.06 J	0.0700 J	0.1 J	0.2 U	0.08 J	0.227	0.07 J
Lithium	mg/L	0.00105	0.00301	0.0142	0.0138	0.0132	0.0147	0.00630	0.00875	0.273	0.302	0.0732	0.0740
Mercury	µg/L	0.005 U	0.005 U	0.00700	0.006	0.0120	0.034	0.00300 J	0.002 J	0.01 U	0.005 U	0.005 U	0.005 U
Molybdenum	µg/L	1.00 J	2 J	2.00 J	2 U	0.500 J	1 J	2.00 J	1 J	2 U	2 U	0.900 J	2 U
Selenium	µg/L	2.30	2.8	0.800	1.4	1.10	1.3	2.50	1.5	0.2 U	0.09 J	0.200	0.09 J
Sulfate	mg/L	56.3	51.4	350	419	236	193	85.6	88.5	1,070	1,190	43.7	55.5
Thallium	µg/L	0.5 U	0.5 U	0.100 J	0.1 J	0.5 U	0.5 U	0.100 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Total Dissolved Solids	mg/L	488	508	622	720	442	390	294	263	1,750	1,890	248	264
pH	SU	5.8	7.2	4.9	6.3	4.9	5.5	5.2	5.4	5.9	5.7	5.5	6.8

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. For statistical analysis, parameters which were not detected were replaced with the reporting limit.
J: Estimated value. Parameter was detected in concentrations below the reporting limit.

Table 2: Groundwater Protection Standards
Welsh Plant - Landfill

Constituent Name	MCL	CCR Rule-Specified	Background Limit	GWPS
Antimony, Total (mg/L)	0.006		0.0032	0.006
Arsenic, Total (mg/L)	0.01		0.005	0.010
Barium, Total (mg/L)	2		0.69	2
Beryllium, Total (mg/L)	0.004		0.00054	0.004
Cadmium, Total (mg/L)	0.005		0.0065	0.0065
Chromium, Total (mg/L)	0.1		0.0031	0.1
Cobalt, Total (mg/L)	n/a	0.006	0.075	0.075
Combined Radium, Total (pCi/L)	5		4.07	5
Fluoride, Total (mg/L)	4		0.58	4
Lead, Total (mg/L)	0.015		0.0034	0.015
Lithium, Total (mg/L)	n/a	0.04	0.39	0.39
Mercury, Total (mg/L)	0.002		0.000033	0.002
Molybdenum, Total (mg/L)	n/a	0.1	0.0024	0.1
Selenium, Total (mg/L)	0.05		0.005	0.05
Thallium, Total (mg/L)	0.002		0.0013	0.002

Notes:

Grey cell indicates calculated UTL is higher than MCL or CCR Rule-specified value.

MCL = Maximum Contaminant Level

Calculated UTL (Upper Tolerance Limit) represents site-specific background values.

The higher of the calculated UTL or MCL/Rule-Specified Level is used as the GWPS.

Table 3: Appendix III Data Summary
Welsh Plant - Landfill

Analyte	Unit	Description	AD-11		AD-13		AD-14	
			5/19/2020	7/22/2020	5/19/2020	7/22/2020	5/19/2020	7/22/2020
Boron	mg/L	Interwell Background Value (UPL)	0.700					
		Analytical Result	**1.54**	**1.81**	**0.936**	**1.44**	**1.22**	**1.24**
Calcium	mg/L	Intrawell Background Value (UPL)	17.1		28.4		12.2	
		Analytical Result	**24.3**	9.45	19.2	-	**15.1**	**17.3**
Chloride	mg/L	Intrawell Background Value (UPL)	14.3		24.0		11.5	
		Analytical Result	6.83	-	8.38	-	1.46	-
Fluoride	mg/L	Interwell Background Value (UPL)	0.583					
		Analytical Result	0.51	-	0.44	-	0.15	-
pH	SU	Interwell Background Value (UPL)	7.1					
		Interwell Background Value (LPL)	4.3					
		Analytical Result	6.3	-	5.5	-	5.4	-
Sulfate	mg/L	Intrawell Background Value (UPL)	829		422		189	
		Analytical Result	419	-	193	-	88.5	-
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	1330		881		369	
		Analytical Result	720	-	390	-	263	-

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
-: Not analyzed

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Welsh Landfill CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
112498

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

112498	TEXAS	09.01.2020
License Number	Licensing State	Date

American Electric Power Service Corporation
Texas Registered Engineering Firm No. F-3341

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

July 3, 2020

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Welsh Landfill - Assessment Monitoring Report

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the statistical analysis of groundwater data for the Assessment Monitoring report for American Electric Power Inc.'s Welsh Landfill. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at the site for the CCR program in 2016. Below is a list of the monitoring well network, as provided by Geosyntec Consultants. Note that originally the network included upgradient well AD-18; however, further research, reportedly, identified that this well was not providing adequate representation of the groundwater quality upgradient of this site and exhibited different chemical properties from the neighboring upgradient wells. Therefore, data from this well is no longer included in the statistical analysis.

- **Upgradient wells:** AD-1, AD-5, and AD-17
- **Downgradient wells:** AD-11, AD-13 and AD-14

Data were sent electronically, and the statistical analysis was reviewed by Kristina Rayner, Groundwater Statistician and Founder of Groundwater Stats Consulting (GWS). The analysis was conducted according to the Statistical Analysis Plan prepared by GWS and approved by Dr. Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GWS.

The CCR Assessment Monitoring program consists of the following constituents:

- **Appendix IV** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium

Time series plots for Appendix IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells. Values identified and flagged as outliers in previous screening reports may be seen in the Outlier Summary following this letter (Figure C). These values are plotted in a lighter font and disconnected symbol on the time series graphs.

Evaluation of Appendix IV Parameters

Interwell Tolerance limits were used to calculate background limits from all available pooled upgradient well data for Appendix IV parameters to determine the background limits for each constituent (Figure D). Background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits. Any flagged values may be seen on the Outlier Summary following this letter.

Parametric limits use a target of 95% confidence and 95% coverage. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and CCR-Rule specified levels in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure E).

Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters using the highest limit of either the MCL, CCR-rule specified, or background as discussed above (Figure F). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No confidence intervals exceedances were found for any of the downgradient wells. A summary of the confidence interval results follows this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Welsh Landfill. If you have any questions or comments, please feel free to contact me.

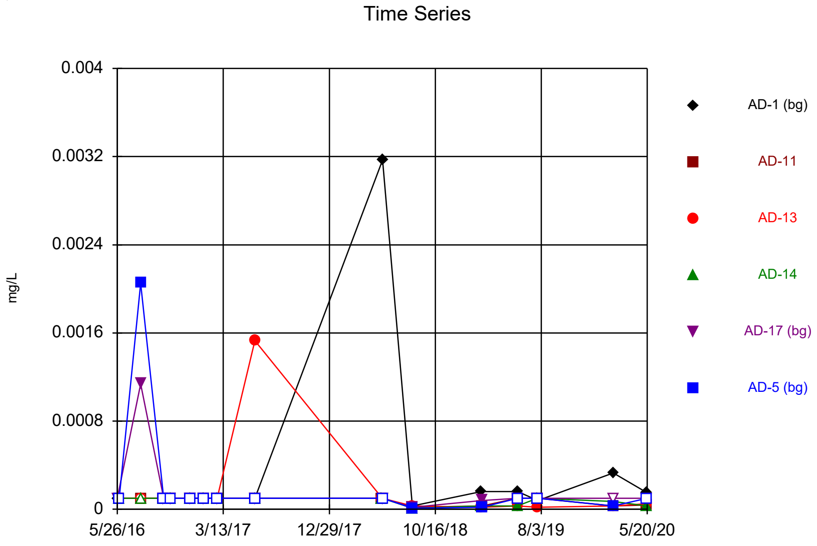
For Groundwater Stats Consulting,

Easton Rayner
Groundwater Analyst

Kristina Rayner

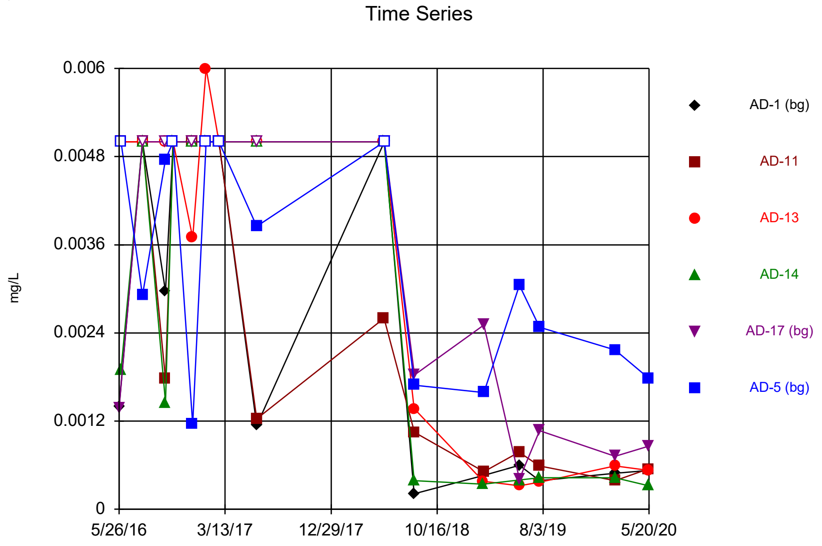
Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.



Constituent: Antimony, total Analysis Run 7/2/2020 12:33 PM
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.



Constituent: Arsenic, total Analysis Run 7/2/2020 12:33 PM
Welsh Landfill Client: Geosyntec Data: Welsh LF

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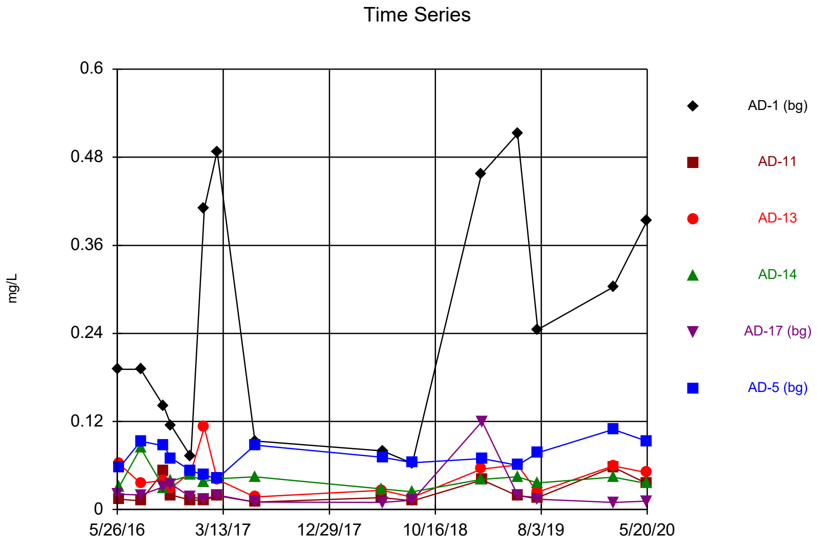

Constituent: Barium, total Analysis Run 7/2/2020 12:33 PM
Welsh Landfill Client: Geosyntec Data: Welsh LF

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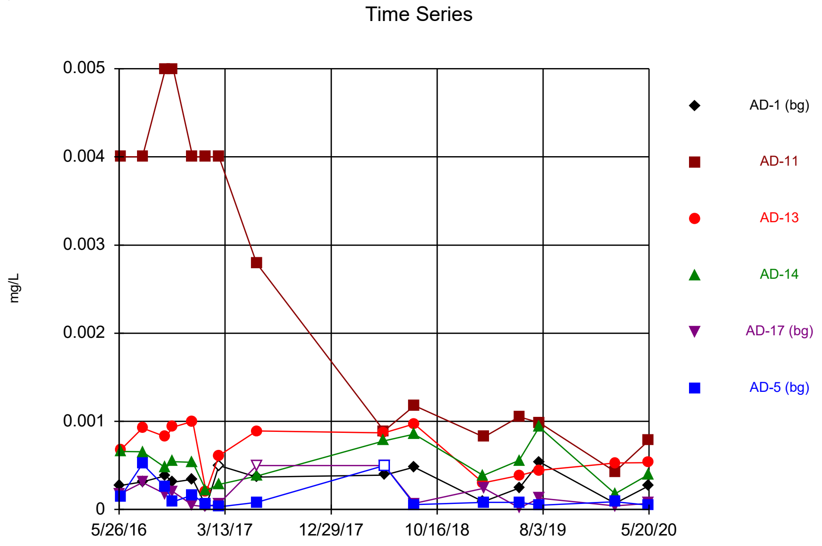
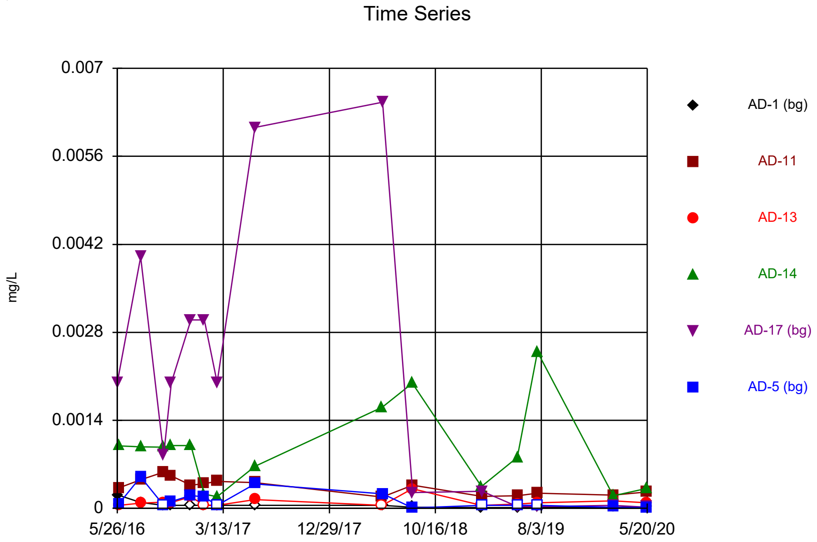


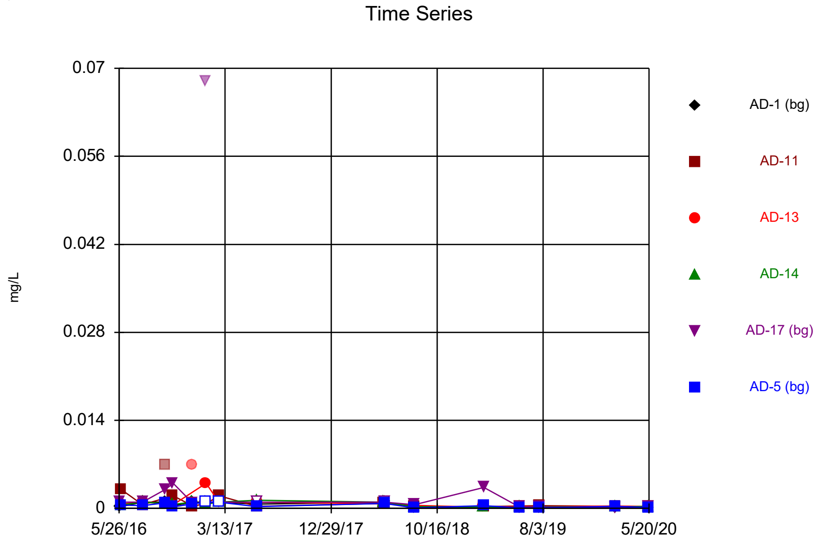
Constituent: Beryllium, total Analysis Run 7/2/2020 12:33 PM
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.



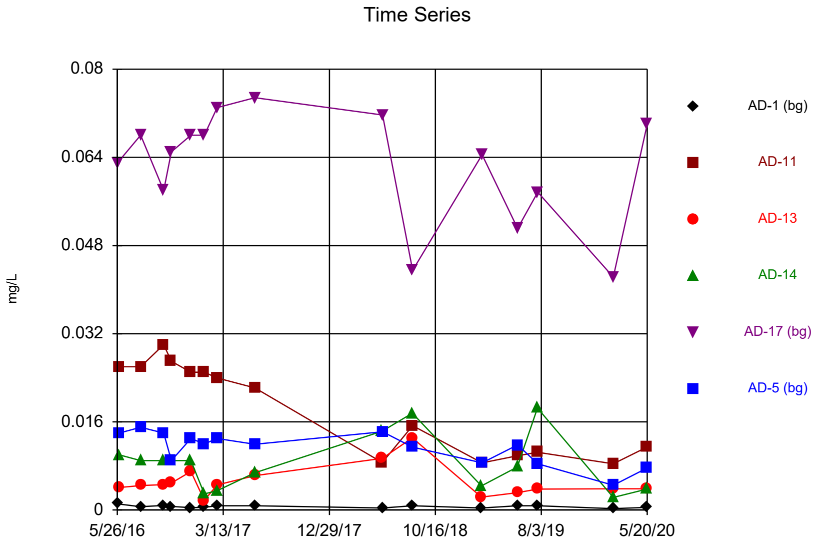
Constituent: Cadmium, total   Analysis Run 7/2/2020 12:33 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.



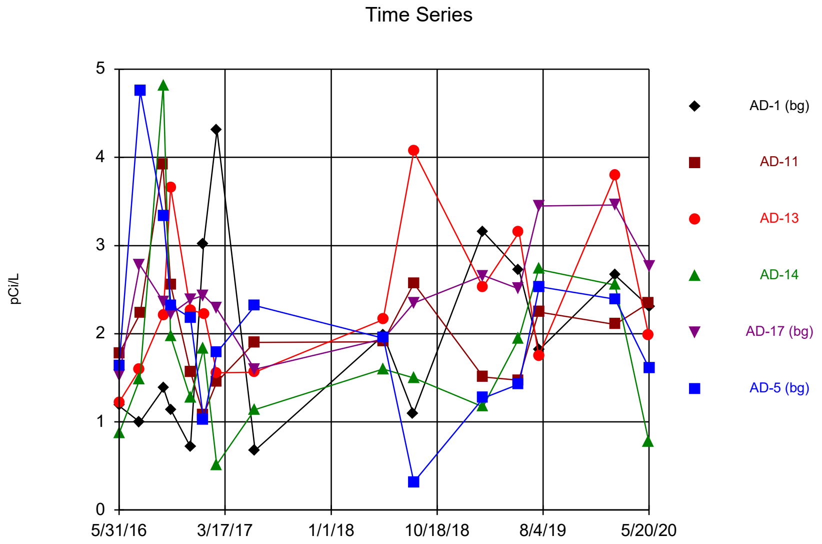
Constituent: Chromium, total   Analysis Run 7/2/2020 12:33 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG



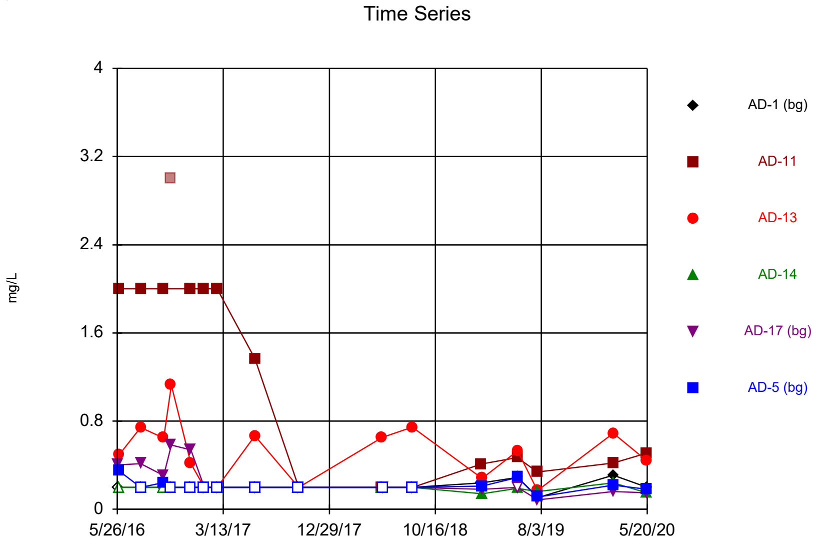
Constituent: Cobalt, total   Analysis Run 7/2/2020 12:33 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG



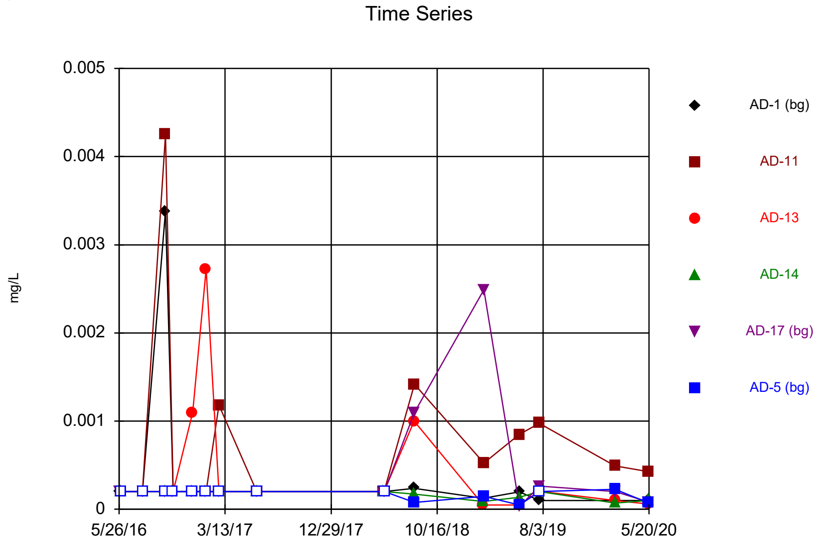
Constituent: Combined Radium 226 + 228   Analysis Run 7/2/2020 12:33 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.



Constituent: Fluoride, total Analysis Run 7/2/2020 12:33 PM
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.



Constituent: Lead, total Analysis Run 7/2/2020 12:33 PM
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG
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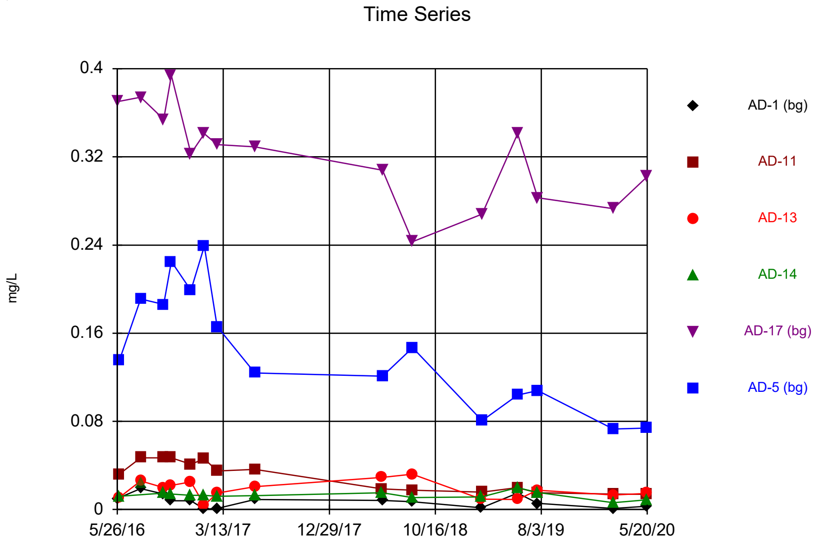
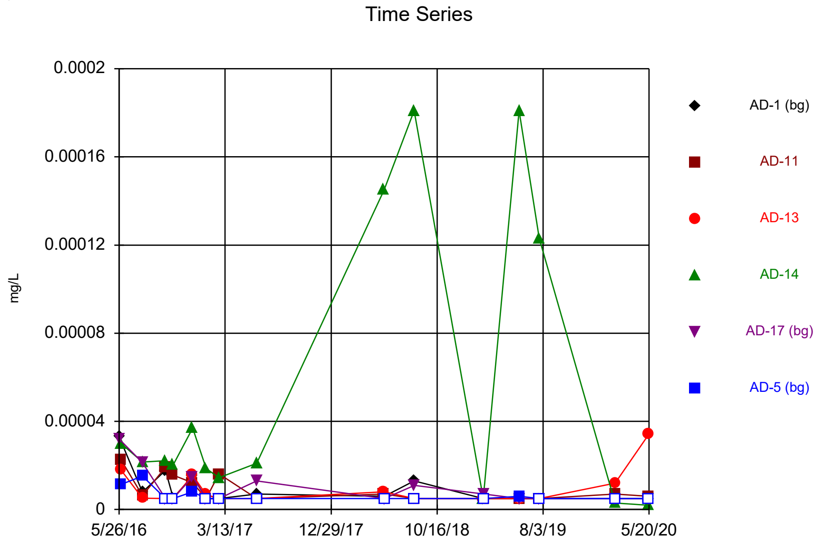


Constituent: Lithium, total Analysis Run 7/2/2020 12:33 PM
Welsh Landfill Client: Geosyntec Data: Welsh LF

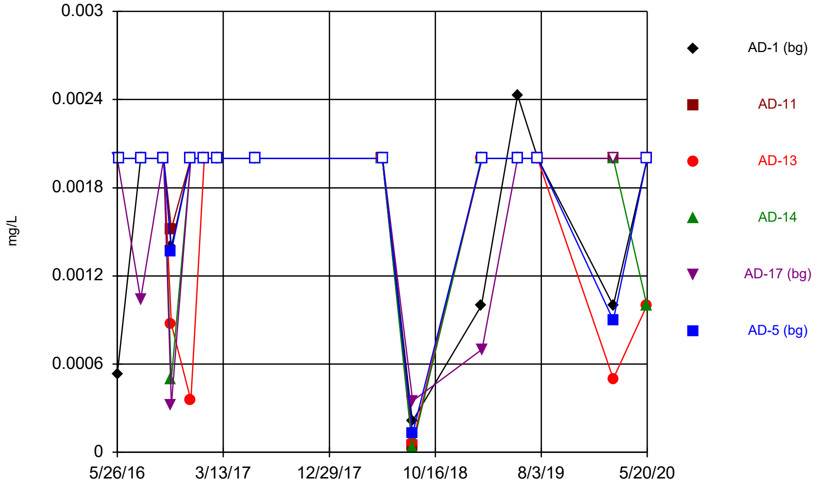
Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.



Constituent: Mercury, total Analysis Run 7/2/2020 12:33 PM
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.

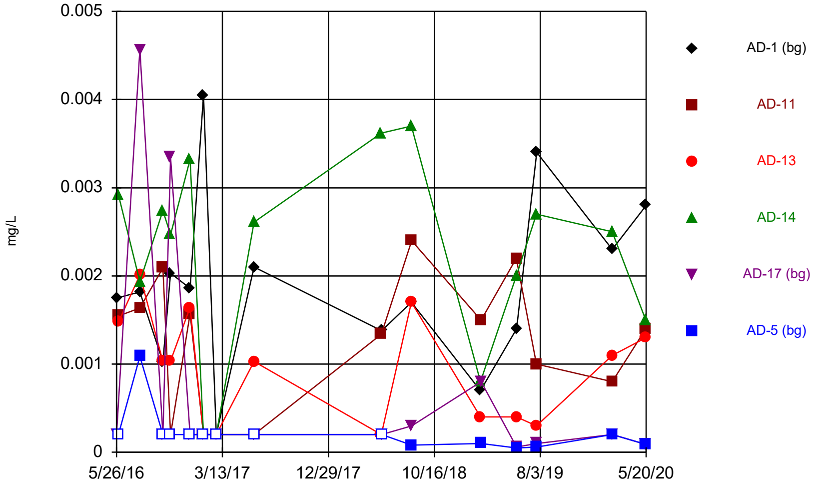
Time Series



Constituent: Molybdenum, total   Analysis Run 7/2/2020 12:33 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.

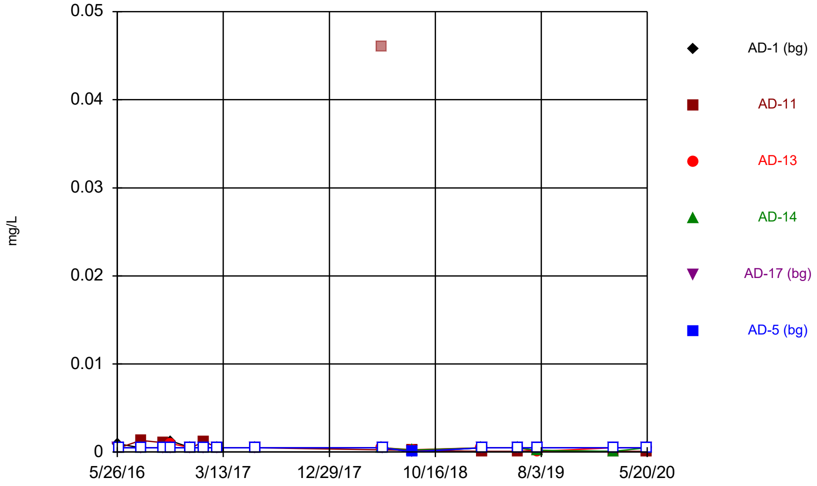
Time Series



Constituent: Selenium, total   Analysis Run 7/2/2020 12:33 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG
Hollow symbols indicate censored values.

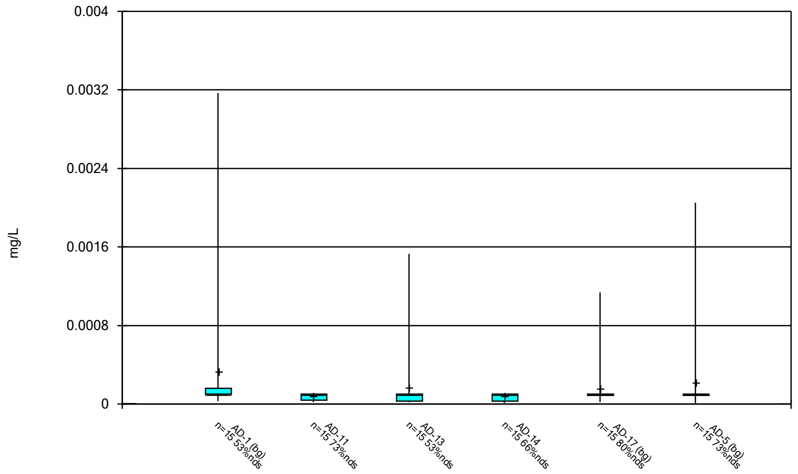
Time Series



Constituent: Thallium, total   Analysis Run 7/2/2020 12:33 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot

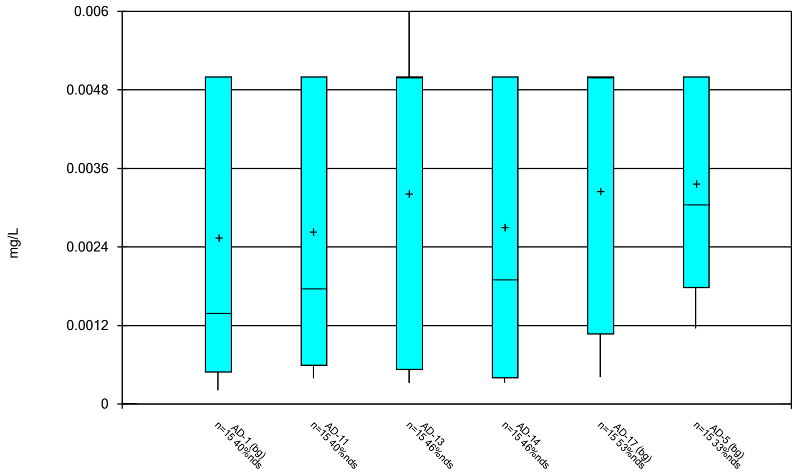


Constituent: Antimony, total Analysis Run 7/2/2020 12:34 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot

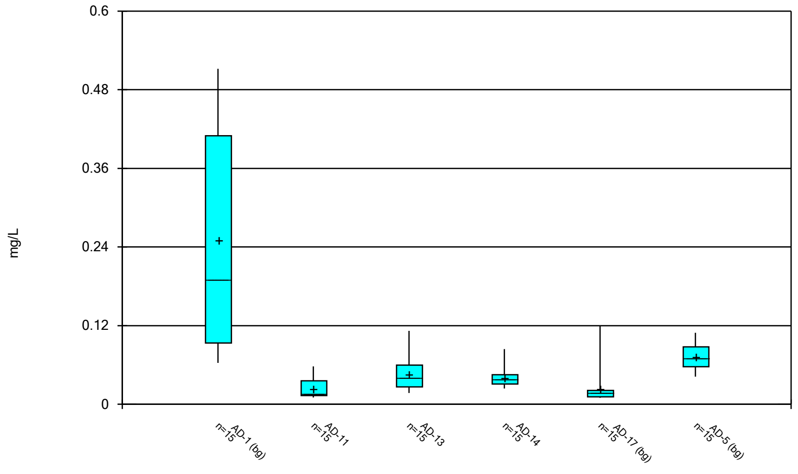


Constituent: Arsenic, total Analysis Run 7/2/2020 12:34 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot

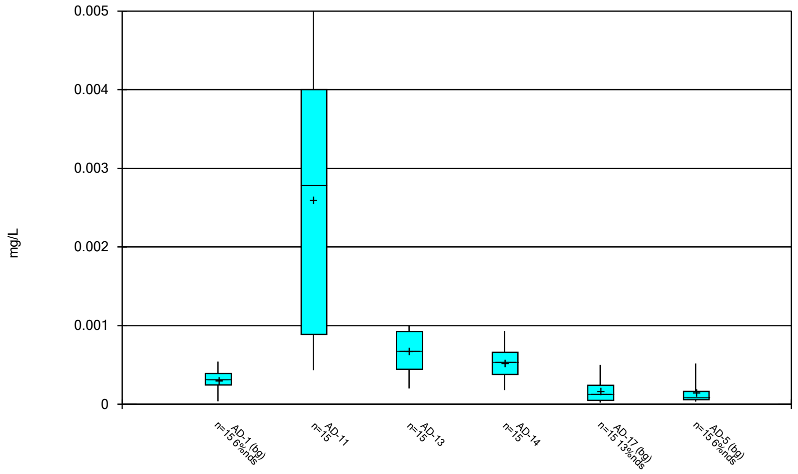


Constituent: Barium, total Analysis Run 7/2/2020 12:34 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot

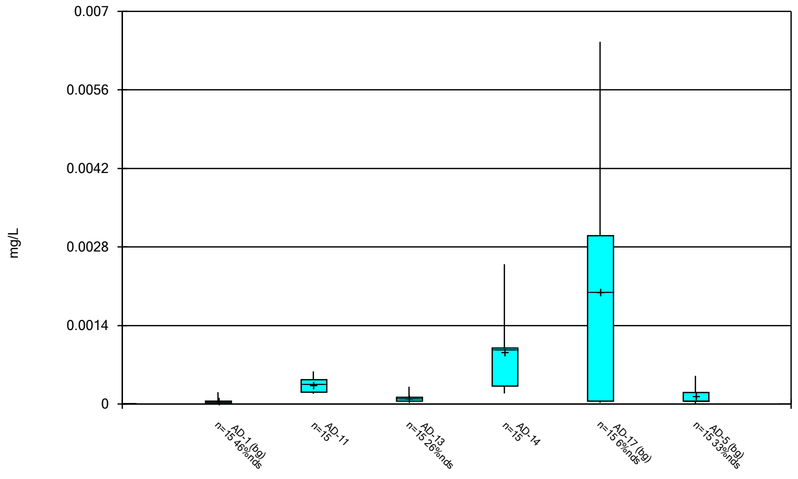


Constituent: Beryllium, total Analysis Run 7/2/2020 12:34 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot

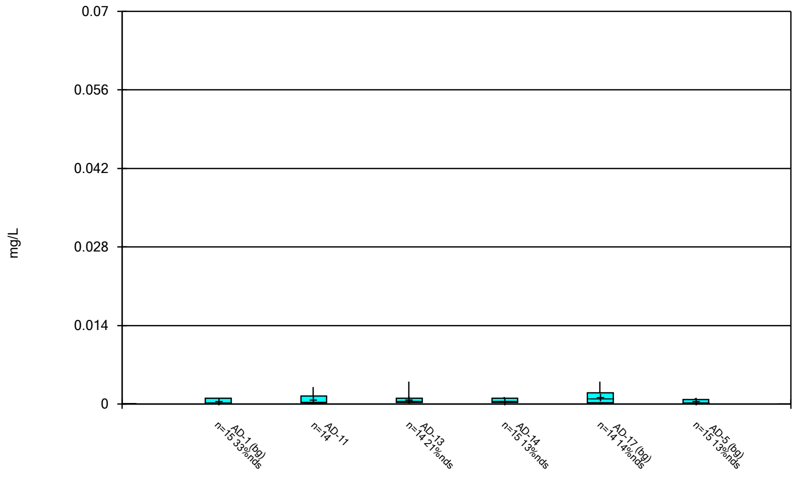


Constituent: Cadmium, total   Analysis Run 7/2/2020 12:34 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot

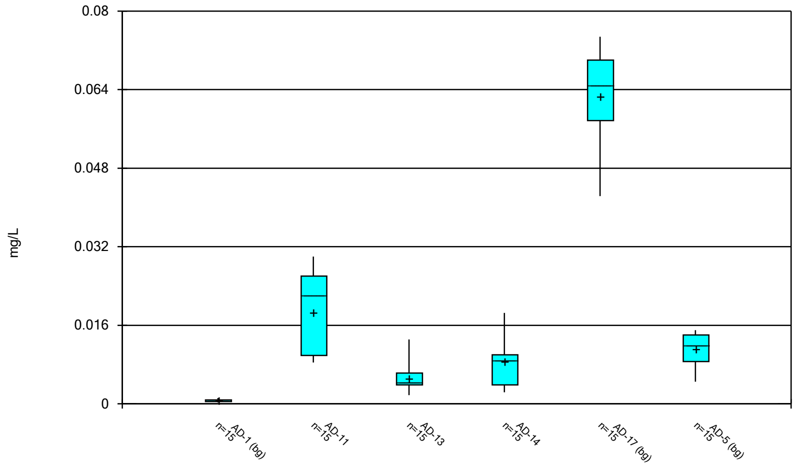


Constituent: Chromium, total   Analysis Run 7/2/2020 12:34 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot

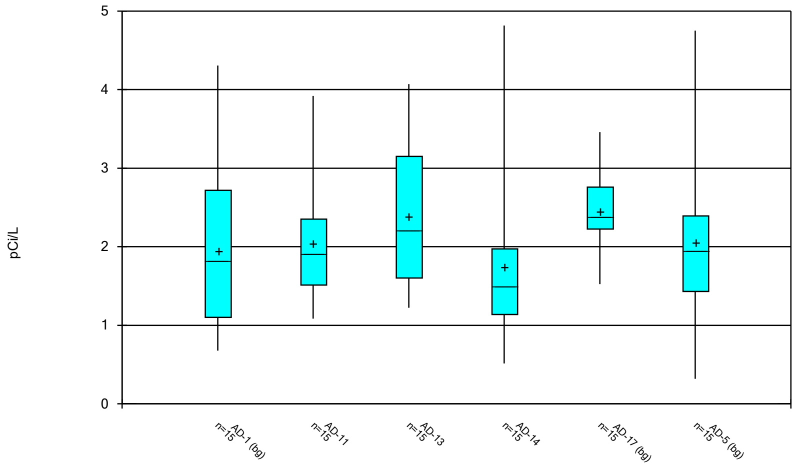


Constituent: Cobalt, total   Analysis Run 7/2/2020 12:34 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot

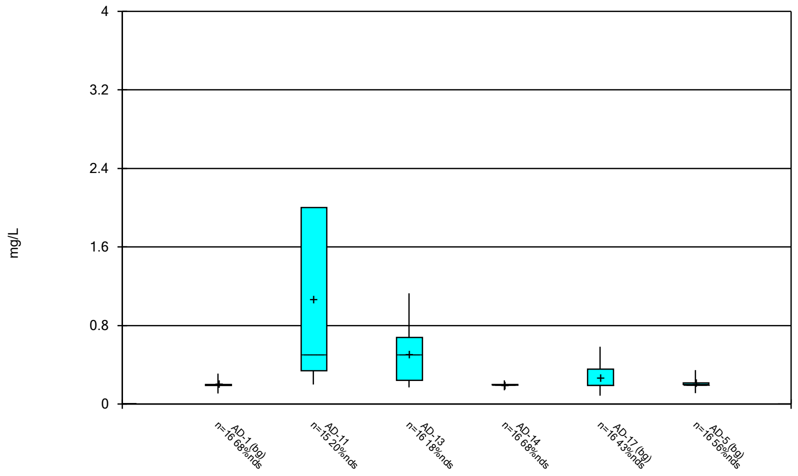


Constituent: Combined Radium 226 + 228   Analysis Run 7/2/2020 12:34 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

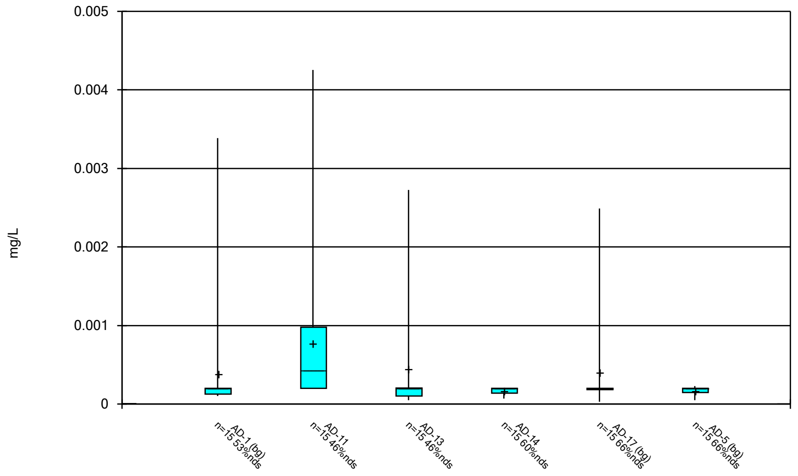
Box & Whiskers Plot



Constituent: Fluoride, total   Analysis Run 7/2/2020 12:34 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

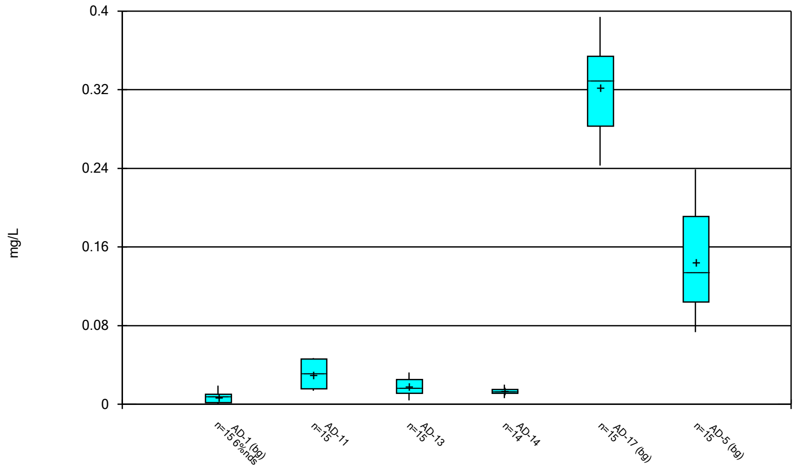
Box & Whiskers Plot



Constituent: Lead, total   Analysis Run 7/2/2020 12:34 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

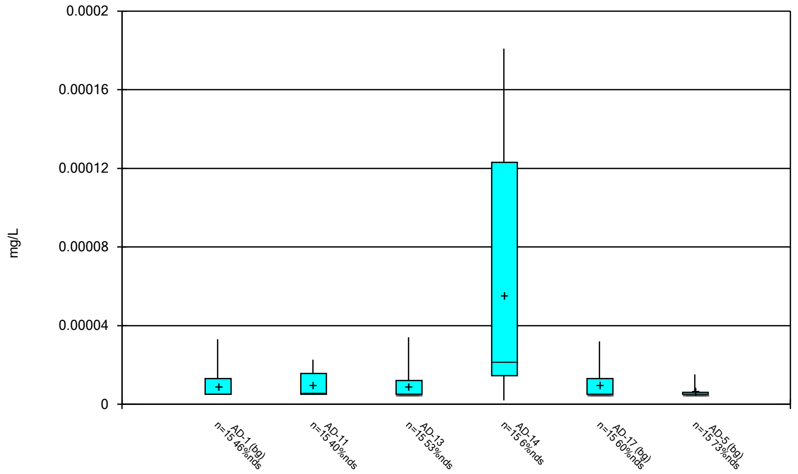
Box & Whiskers Plot



Constituent: Lithium, total   Analysis Run 7/2/2020 12:34 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

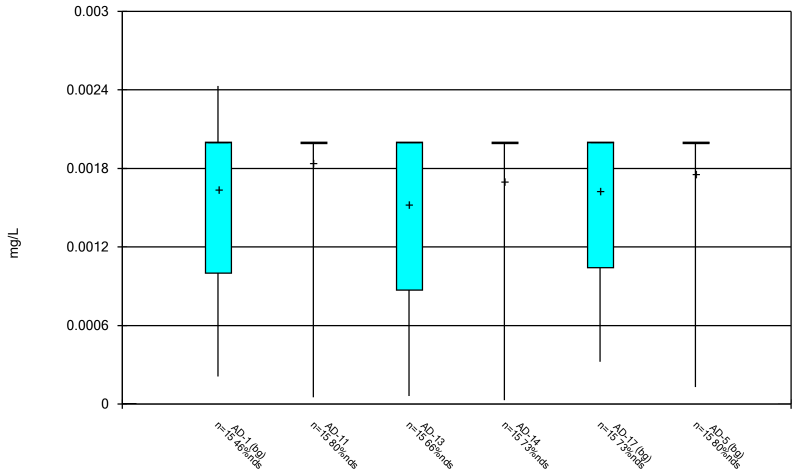
Box & Whiskers Plot



Constituent: Mercury, total   Analysis Run 7/2/2020 12:34 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot

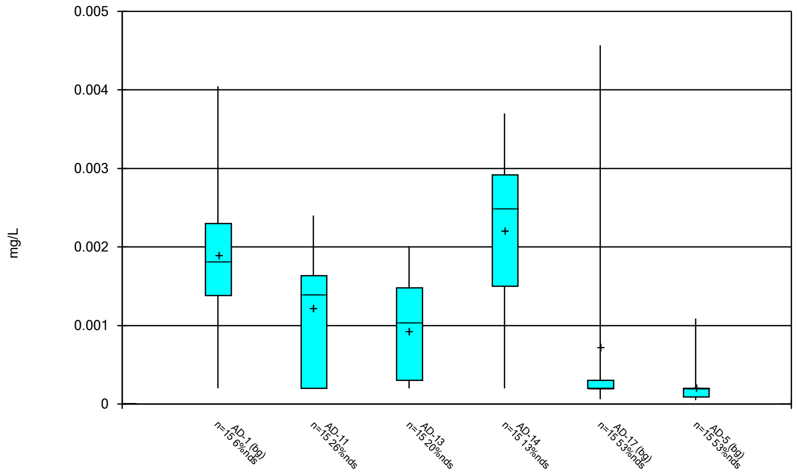


Constituent: Molybdenum, total   Analysis Run 7/2/2020 12:34 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot

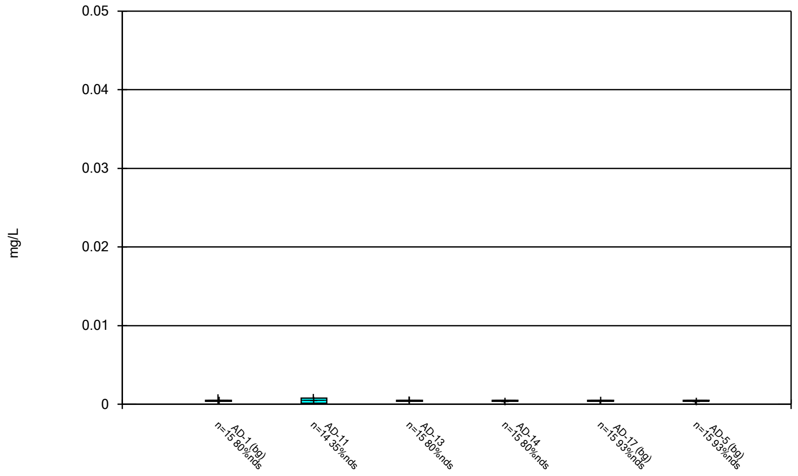


Constituent: Selenium, total   Analysis Run 7/2/2020 12:34 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Box & Whiskers Plot



Constituent: Thallium, total   Analysis Run 7/2/2020 12:34 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Outlier Summary

Welsh Landfill   Client: Geosyntec   Data: Welsh LF   Printed 7/2/2020, 12:41 PM

	AD-11 Chromium, total (mg/L)	AD-13 Chromium, total (mg/L)	AD-17 Chromium, total (mg/L)	AD-11 Fluoride, total (mg/L)	AD-14 Lithium, total (mg/L)	AD-11 Thallium, total (mg/L)
7/29/2016					0.024 (o)	
9/30/2016	0.007 (o)					
10/21/2016				3 (o)		
12/14/2016		0.007 (o)				
1/20/2017			0.068 (O)			
5/23/2018						0.046 (o)

Upper Tolerance Limits

Welsh Landfill Client: Geosyntec Data: Welsh LF Printed 7/2/2020, 12:37 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Bg N	Std. Dev.	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	n/a	0.00317	n/a	n/a	n/a	45	n/a	68.89	n/a	0.09944	NP Inter(normal...
Arsenic, total (mg/L)	n/a	0.005	n/a	n/a	n/a	45	n/a	42.22	n/a	0.09944	NP Inter(normal...
Barium, total (mg/L)	n/a	0.6857	n/a	n/a	n/a	45	1.139	0	ln(x)	0.05	Inter
Beryllium, total (mg/L)	n/a	0.00054	n/a	n/a	n/a	45	n/a	8.889	n/a	0.09944	NP Inter(normal...
Cadmium, total (mg/L)	n/a	0.00646	n/a	n/a	n/a	45	n/a	28.89	n/a	0.09944	NP Inter(normal...
Chromium, total (mg/L)	n/a	0.003134	n/a	n/a	n/a	44	1.145	20.45	ln(x)	0.05	Inter
Cobalt, total (mg/L)	n/a	0.0748	n/a	n/a	n/a	45	n/a	0	n/a	0.09944	NP Inter(normal...
Combined Radium 226 + 228 (pCi/L)	n/a	4.068	n/a	n/a	n/a	45	0.9169	0	No	0.05	Inter
Fluoride, total (mg/L)	n/a	0.583	n/a	n/a	n/a	48	n/a	56.25	n/a	0.08526	NP Inter(normal...
Lead, total (mg/L)	n/a	0.003384	n/a	n/a	n/a	45	n/a	62.22	n/a	0.09944	NP Inter(normal...
Lithium, total (mg/L)	n/a	0.394	n/a	n/a	n/a	45	n/a	2.222	n/a	0.09944	NP Inter(normal...
Mercury, total (mg/L)	n/a	0.000033	n/a	n/a	n/a	45	n/a	60	n/a	0.09944	NP Inter(normal...
Molybdenum, total (mg/L)	n/a	0.00243	n/a	n/a	n/a	45	n/a	66.67	n/a	0.09944	NP Inter(normal...
Selenium, total (mg/L)	n/a	0.004567	n/a	n/a	n/a	45	n/a	37.78	n/a	0.09944	NP Inter(normal...
Thallium, total (mg/L)	n/a	0.001251	n/a	n/a	n/a	45	n/a	88.89	n/a	0.09944	NP Inter(NDs)

WELSH LANDFILL GWPS				
Constituent Name	**MCL**	**CCR Rule Specified**	**Background Limit**	**GWPS**
Antimony, Total (mg/L)	0.006		0.0032	0.006
Arsenic, Total (mg/L)	0.01		0.005	0.01
Barium, Total (mg/L)	2		0.69	2
Beryllium, Total (mg/L)	0.004		0.00054	0.004
Cadmium, Total (mg/L)	0.005		0.0065	0.0065
Chromium, Total (mg/L)	0.1		0.0031	0.1
Cobalt, Total (mg/L)	n/a	0.006	0.075	0.075
Combined Radium, Total (pCi/L)	5		4.07	5
Fluoride, Total (mg/L)	4		0.58	4
Lead, Total (mg/L)	0.015		0.0034	0.015
Lithium, Total (mg/L)	n/a	0.04	0.39	0.39
Mercury, Total (mg/L)	0.002		0.000033	0.002
Molybdenum, Total (mg/L)	n/a	0.1	0.0024	0.1
Selenium, Total (mg/L)	0.05		0.005	0.05
Thallium, Total (mg/L)	0.002		0.0013	0.002

**Grey cell indicates Background Limit is higher than MCL.*

**MCL = Maximum Contaminant Level*

Confidence Interval Summary Table - All Results (No Significant)

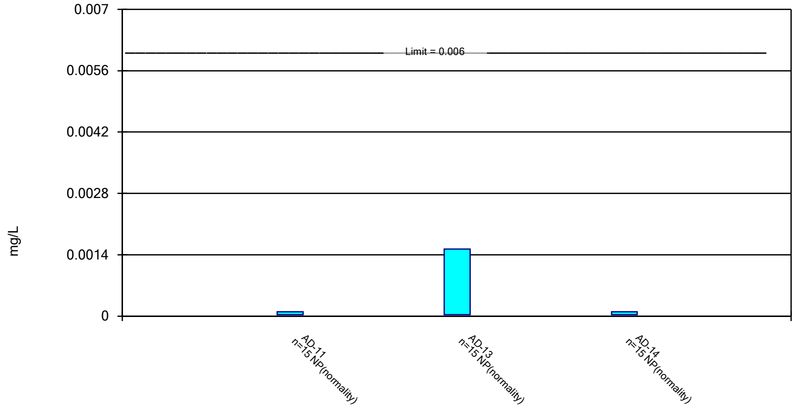
Welsh Landfill Client: Geosyntec Data: Welsh LF Printed 7/2/2020, 12:41 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	AD-11	0.0001	0.00003	0.006	No	15	73.33	No	0.01	NP (normality)
Antimony, total (mg/L)	AD-13	0.00153	0.00003	0.006	No	15	53.33	No	0.01	NP (normality)
Antimony, total (mg/L)	AD-14	0.0001	0.00003	0.006	No	15	66.67	No	0.01	NP (normality)
Arsenic, total (mg/L)	AD-11	0.005	0.00055	0.01	No	15	40	No	0.01	NP (normality)
Arsenic, total (mg/L)	AD-13	0.006	0.00038	0.01	No	15	46.67	No	0.01	NP (normality)
Arsenic, total (mg/L)	AD-14	0.005	0.00039	0.01	No	15	46.67	No	0.01	NP (normality)
Barium, total (mg/L)	AD-11	0.0403	0.012	2	No	15	0	No	0.01	NP (normality)
Barium, total (mg/L)	AD-13	0.05916	0.02902	2	No	15	0	sqrt(x)	0.01	Param.
Barium, total (mg/L)	AD-14	0.04739	0.03205	2	No	15	0	ln(x)	0.01	Param.
Beryllium, total (mg/L)	AD-11	0.005	0.000824	0.004	No	15	0	No	0.01	NP (normality)
Beryllium, total (mg/L)	AD-13	0.0008526	0.000494	0.004	No	15	0	No	0.01	Param.
Beryllium, total (mg/L)	AD-14	0.0006746	0.0003698	0.004	No	15	0	No	0.01	Param.
Cadmium, total (mg/L)	AD-11	0.0004267	0.0002568	0.0065	No	15	0	No	0.01	Param.
Cadmium, total (mg/L)	AD-13	0.0005	0.000085	0.0065	No	15	26.67	No	0.01	NP (normality)
Cadmium, total (mg/L)	AD-14	0.001288	0.0004358	0.0065	No	15	0	sqrt(x)	0.01	Param.
Chromium, total (mg/L)	AD-11	0.002	0.000259	0.1	No	14	0	No	0.01	NP (normality)
Chromium, total (mg/L)	AD-13	0.00073	0.000283	0.1	No	14	21.43	No	0.01	NP (normality)
Chromium, total (mg/L)	AD-14	0.0007879	0.0003372	0.1	No	15	13.33	No	0.01	Param.
Cobalt, total (mg/L)	AD-11	0.026	0.00863	0.075	No	15	0	No	0.01	NP (normality)
Cobalt, total (mg/L)	AD-13	0.006702	0.00327	0.075	No	15	0	sqrt(x)	0.01	Param.
Cobalt, total (mg/L)	AD-14	0.01195	0.005108	0.075	No	15	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-11	2.504	1.583	5	No	15	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-13	2.985	1.781	5	No	15	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-14	2.306	1.06	5	No	15	0	sqrt(x)	0.01	Param.
Fluoride, total (mg/L)	AD-11	2	0.083	4	No	15	20	No	0.01	NP (normality)
Fluoride, total (mg/L)	AD-13	0.684	0.2293	4	No	16	18.75	No	0.01	Param.
Fluoride, total (mg/L)	AD-14	0.162	0.083	4	No	16	68.75	No	0.01	NP (normality)
Lead, total (mg/L)	AD-11	0.005	0.000523	0.015	No	15	46.67	No	0.01	NP (normality)
Lead, total (mg/L)	AD-13	0.005	0.00006	0.015	No	15	46.67	No	0.01	NP (normality)
Lead, total (mg/L)	AD-14	0.005	0.0001	0.015	No	15	60	No	0.01	NP (normality)
Lithium, total (mg/L)	AD-11	0.047	0.0153	0.39	No	15	0	No	0.01	NP (normality)
Lithium, total (mg/L)	AD-13	0.02337	0.01247	0.39	No	15	0	No	0.01	Param.
Lithium, total (mg/L)	AD-14	0.01514	0.01055	0.39	No	14	0	No	0.01	Param.
Mercury, total (mg/L)	AD-11	0.000025	0.000007	0.002	No	15	40	No	0.01	NP (normality)
Mercury, total (mg/L)	AD-13	0.000034	0.000008	0.002	No	15	53.33	No	0.01	NP (normality)
Mercury, total (mg/L)	AD-14	0.00006923	0.00001139	0.002	No	15	6.667	ln(x)	0.01	Param.
Molybdenum, total (mg/L)	AD-11	0.002	0.002	0.1	No	15	80	No	0.01	NP (NDs)
Molybdenum, total (mg/L)	AD-13	0.002	0.0005	0.1	No	15	66.67	No	0.01	NP (normality)
Molybdenum, total (mg/L)	AD-14	0.002	0.001	0.1	No	15	73.33	No	0.01	NP (normality)
Selenium, total (mg/L)	AD-11	0.005	0.00134	0.05	No	15	26.67	No	0.01	NP (Cohens/xfrm)
Selenium, total (mg/L)	AD-13	0.005	0.0004	0.05	No	15	20	No	0.01	NP (Cohens/xfrm)
Selenium, total (mg/L)	AD-14	0.003638	0.00207	0.05	No	15	13.33	No	0.01	Param.
Thallium, total (mg/L)	AD-11	0.00107	0.0001	0.002	No	14	35.71	No	0.01	NP (normality)
Thallium, total (mg/L)	AD-13	0.0009736	0.000277	0.002	No	15	80	No	0.01	NP (NDs)
Thallium, total (mg/L)	AD-14	0.0005	0.000242	0.002	No	15	80	No	0.01	NP (NDs)

Sanitas™ v.9.6.26 . UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



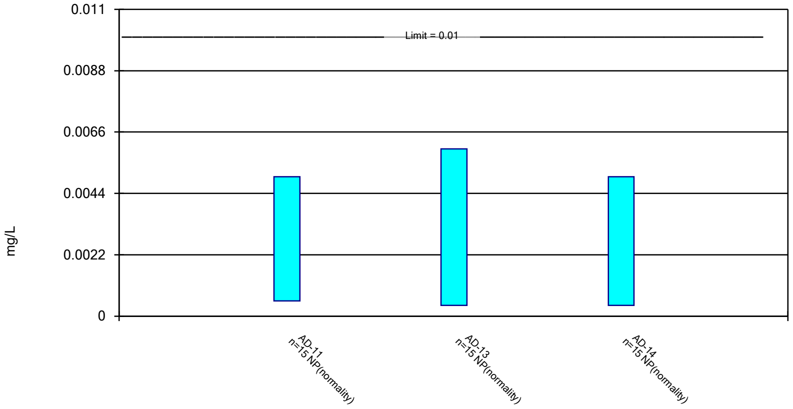
Constituent: Antimony, total Analysis Run 7/2/2020 12:39 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



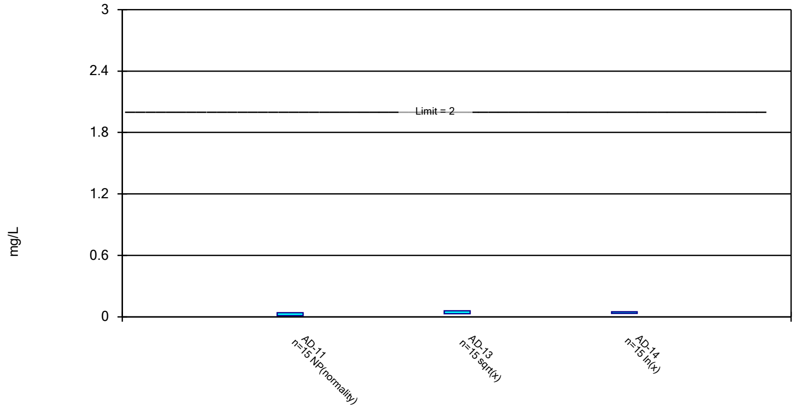
Constituent: Arsenic, total Analysis Run 7/2/2020 12:39 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



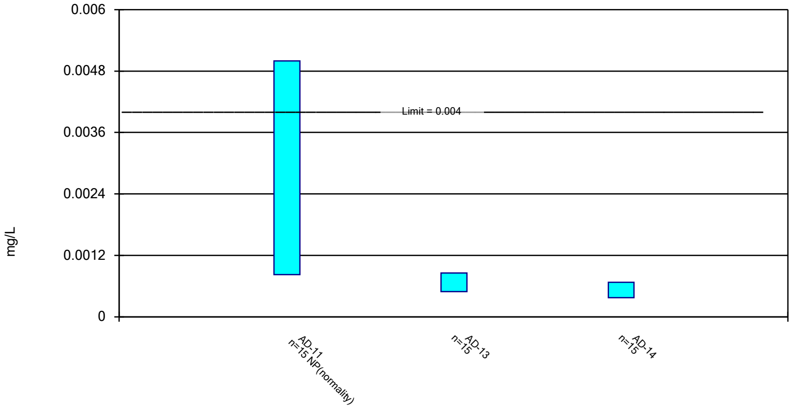
Constituent: Barium, total Analysis Run 7/2/2020 12:39 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



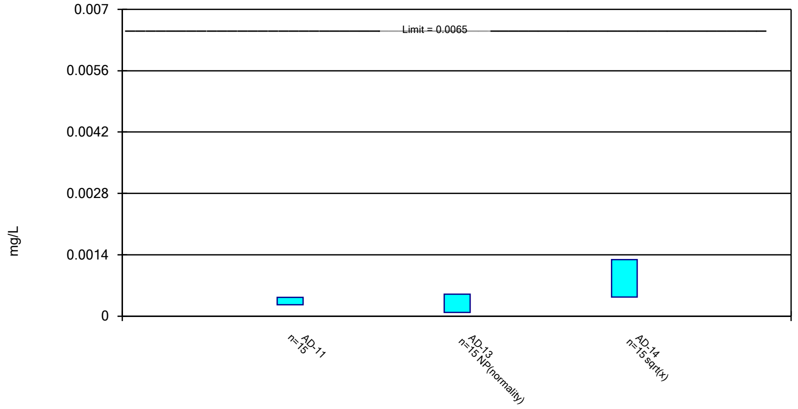
Constituent: Beryllium, total Analysis Run 7/2/2020 12:39 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



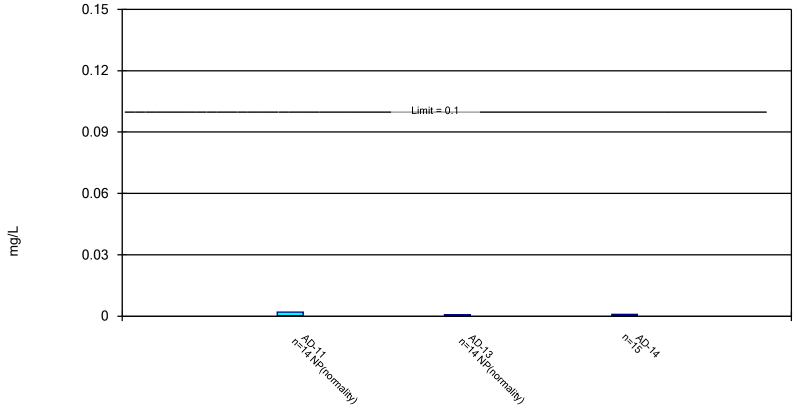
Constituent: Cadmium, total   Analysis Run 7/2/2020 12:39 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



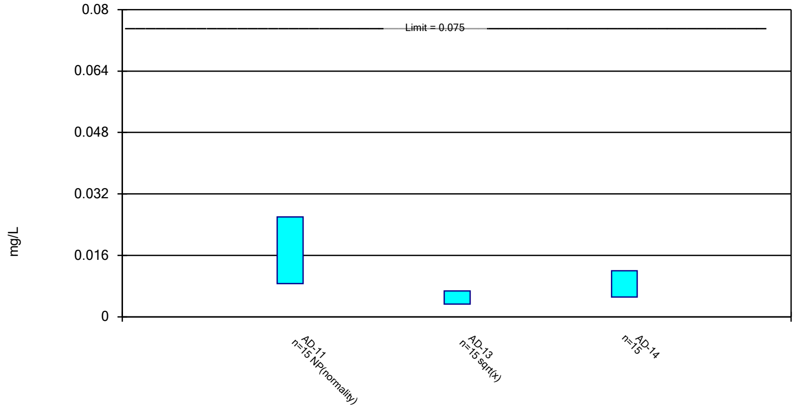
Constituent: Chromium, total   Analysis Run 7/2/2020 12:39 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



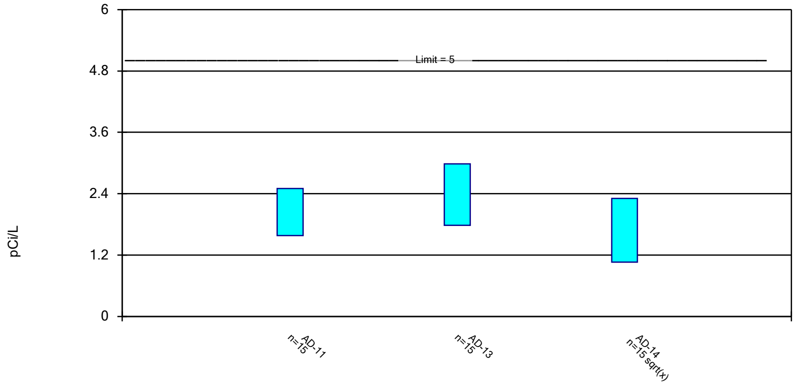
Constituent: Cobalt, total   Analysis Run 7/2/2020 12:39 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



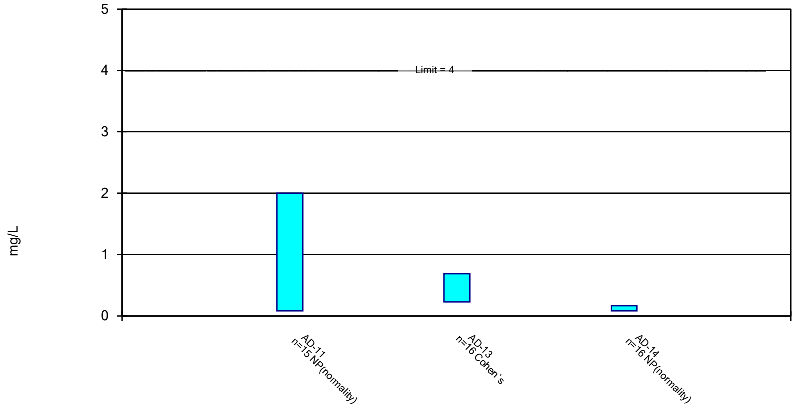
Constituent: Combined Radium 226 + 228   Analysis Run 7/2/2020 12:39 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



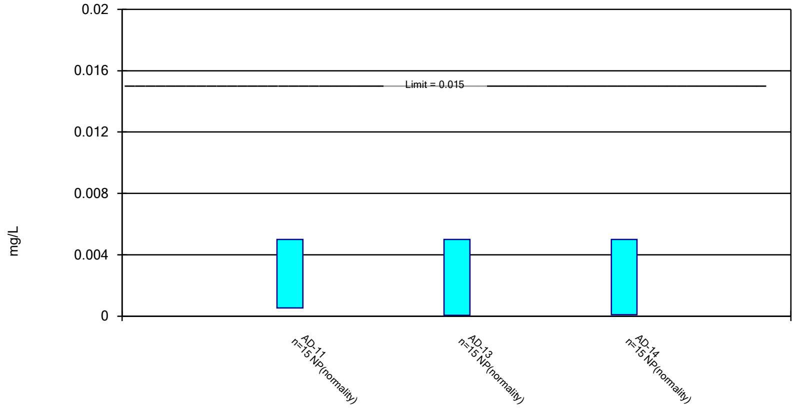
Constituent: Fluoride, total   Analysis Run 7/2/2020 12:39 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



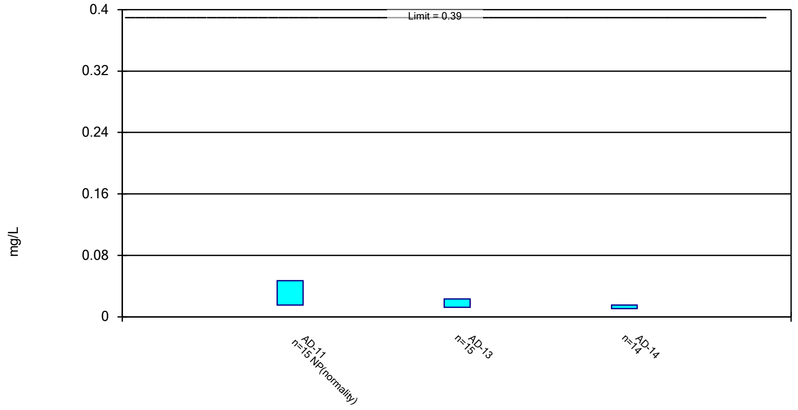
Constituent: Lead, total   Analysis Run 7/2/2020 12:39 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



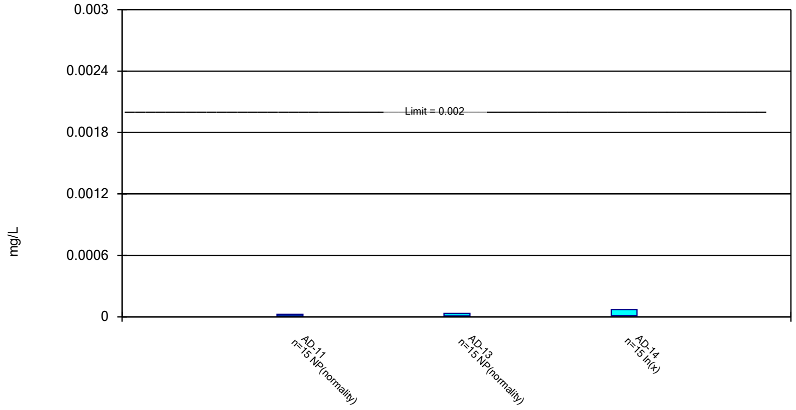
Constituent: Lithium, total   Analysis Run 7/2/2020 12:39 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG

Parametric and Non-Parametric (NP) Confidence Interval

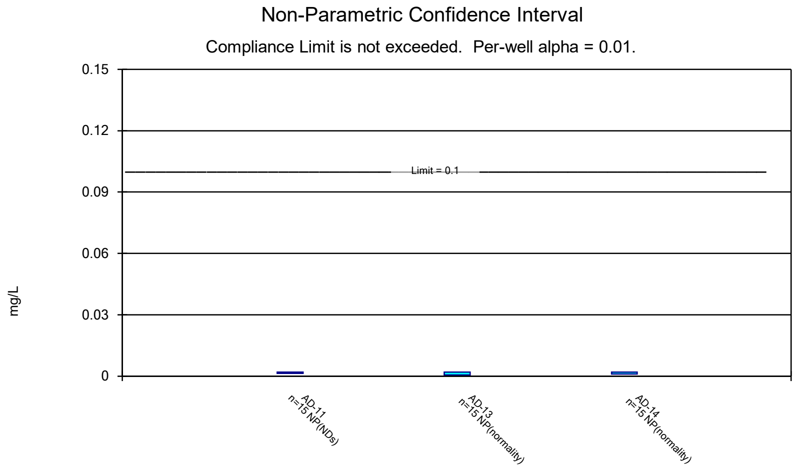
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Mercury, total   Analysis Run 7/2/2020 12:39 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.26 . UG



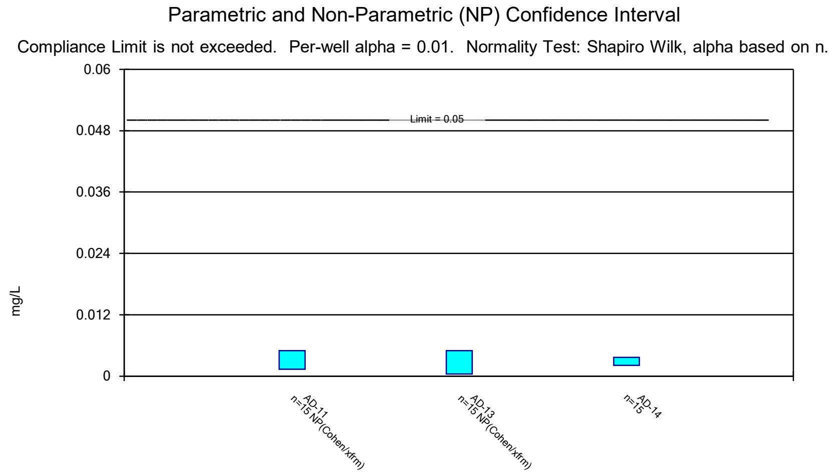
Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

Constituent: Molybdenum, total Analysis Run 7/2/2020 12:39 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG



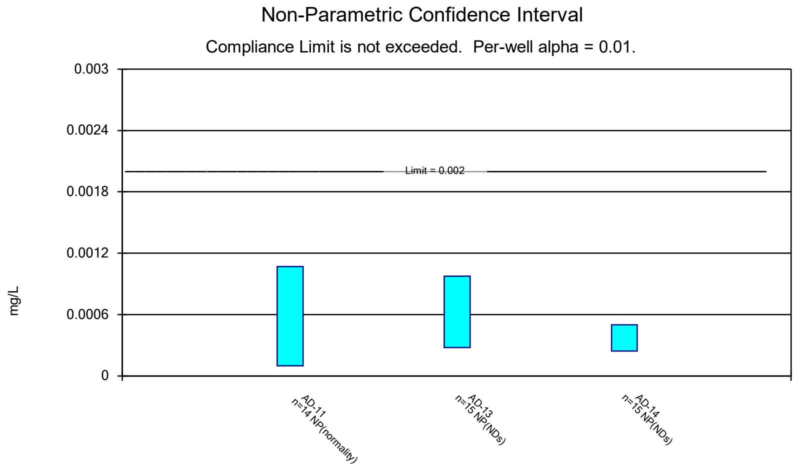
Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

Constituent: Selenium, total Analysis Run 7/2/2020 12:39 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.26 . UG



Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

Constituent: Thallium, total Analysis Run 7/2/2020 12:39 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

APPENDIX III

Alternate source demonstrations are included in this appendix. Alternate sources are sources or reasons that explain that statistically significant increases over background or statistically significant levels above the groundwater protection standard are not attributable to the CCR unit.

APPENDIX IV

A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring

APPENDIX V- NA

Reports documenting monitoring well plugging and abandonment or well installation are included in the appendix. or other information required to be included in the annual report such as program related notification or assessment of corrective measures.

Volume 4

- **Attachment 5 – Closure Plans**
- **Attachment 6 – Post-Closure Plans**
- **Attachment 7 – Post-Closure Care Cost Estimate for Landfill**

ATTACHMENT 5
Closure Plans

30 TAC §352.301 – Closure and Post-Closure Care Application Submittal

Submit documentation demonstrating compliance with Subchapter J: Closure and Post Closure Care 30 TAC §352.1101(b), §352.1200, §352.1201, §352.1211, §352.1221, §352.1231, §352.1241.
(40 CFR §257.100 - §257.104)

PBAP – Closure Plan – Closure by Removal

Extension Demonstration submitted to EPA

TCEQ approval of extension request

BASP – Closure Plan – Closure by Removal

Intent to Initiate Closure Notification – 4/6/2021

Landfill – Closure Plan – Closure in Place

5.1 – Closure Plan, Primary Bottom Ash Pond, November 2020

CLOSURE PLAN

CFR 257.102(b)

Primary Bottom Ash Pond

Welsh Power Plant
Pittsburg, Texas

October 2016
Revised November 2020

Prepared for: Southwest Electric Power Company - Welsh Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

GERS – 20 –011

CLOSURE PLAN
CFR 257.102(b)
WELSH POWER PLANT
PRIMARY BOTTOM ASH POND

PREPARED BY Gary F. Zych DATE 11/22/2020
Gary F. Zych, P.E.

REVIEWED BY Arthur W. Rentzsch DATE 11/23/2020
Arthur W. Rentzsch

APPROVED BY Gary F. Zych DATE 11/24/2020
Gary F. Zych, P.E.
Section Manager – AEP Geotechnical Engineering

American Electric Power Service Corporation
Texas Registered Engineering Firm No. F-3341

Gary F. Zych
GARY F. ZYCH
127152
11/24/2020

I certify to the best of my knowledge, information, and belief that the information contained in this closure plan meets the requirements of 40 CFR § 257.102(b)

Table of CONTENTS

1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CFR 257.102(b) for Closure Plans of Existing CCR Surface Impoundments

2.0 DESCRIPTION OF THE CCR UNIT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. It is owned and operated by Southwest Electric Power Company (SWEPCO). The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash pond and the Bottom Ash Storage pond. This report addresses the closure plan for the Primary Bottom Ash Pond. The Primary Bottom Ash pond CCR unit is located southwest of the Plant and directly west of the Welsh Reservoir.

The Primary Bottom Ash pond is bounded by natural ground surface (topographically higher areas) to the north and west, and embankment dikes to the south and east. The elevation at the top of embankment along the crest area is approximately 340.0 feet above msl.

3.0 DESCRIPTION OF CLOSURE PLAN 257.102(b)(1)(i)

[A narrative description of how the CCR unit will be closed in accordance with this section]

Closure of the Welsh Power Plant Primary Bottom Ash Pond will be completed by CCR removal.

The closure of the Primary Bottom Ash Pond will include removal of CCR materials within the pond by dredging and/or mechanical means.

4.0 CLOSURE BY REMOVAL 257.102 (b)(1)(ii)

[If closure of the CCR unit will be accomplished through removal of CCR from the CCR unit, a description of the procedures to remove the CCR and decontaminate the CCR unit in accordance with paragraph (c) of this section.]

Closure will include removal of all CCR from the CCR unit. The removal of all CCR unit will be accomplished by dredging and/or mechanical means as decided by the construction contractor with approval by the engineer and AEP. Prior to actual removal, the initial work will include rerouting of non-CCR flows and stormwater runoff that discharge into the pond. The CCR material will be either hauled and placed at the onsite CCR landfill or hauled offsite for beneficial reuse.

A 3rd party QAQC consultant will verify the removal of the CCR material. After verification of CCR removal, 12 inches of bottom soil will be removed as part of the closure of the CCR surface impoundment.

4.1 CLOSURE PERFORMANCE STANDARDS 257.102 (c)

[An owner or operator may elect to close a CCR unit by removing and decontaminating all areas affected by releases from the CCR unit. CCR removal and decontamination of the CCR unit are complete when constituent concentrations throughout the CCR unit and any areas affected by releases from the CCR unit have been removed and groundwater monitoring concentrations do not exceed the groundwater protection standard established pursuant to §257.95(h) for constituents listed in appendix IV to this part.]

Closure of the CCR unit will be completed when all CCR materials in the unit and any soils affected by releases from the CCR unit have been removed and groundwater monitoring demonstrates that all concentrations of the assessment monitoring constituents listed in appendix IV to part 257 do not exceed either statistically equivalent background levels or MCLs for two consecutive sampling events using the statistical procedures in § 257.93(g).

5.0 ESTIMATE OF MAXIMUM CCR VOLUME 257.102 (b)(1)(iv)

[An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit.]

The estimated maximum CCR volume on-site is 530,000 cubic yards for the Primary Bottom Ash Pond.

6.0 ESTIMATE OF LARGEST AREA OF CCR REQUIRING COVER 257.102 (b)(1)(v)

[An estimate of the largest area of CCR unit ever requiring a final cover

This pond will be closed by removal of CCR materials as such this section is not applicable.

7.0 CLOSURE SCHEDULE 257.102(b)(1)(vi)

[A schedule for completing all activities necessary to satisfy the closure criteria in the section, including an estimate of the year in which all closure activities for the CCR unit will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR unit, including identification of major milestones such as coordinating with and obtaining necessary approvals and permits from other agencies, the dewatering and stabilization phases of the CCR surface impoundment closure, or installation of the final cover system, and the estimated timeframes to complete each step or phase of the CCR unit closure.

Table below summarizes the major tasks and durations associated with closing the PBAP.

Initiate PBAP Closure	January 2025
Closure Planning and Engineering	6 months
Environmental and Construction Permits	15 months
Spec, bid, and Award construction contracts	6 months
Commence CCR Closure Phase 1 Construction no later than	February 2027
Dewatering and Wastewater/Stormwater Diversion	3 months
Pond Segregation Berm	2 months
Phase 1 CCR Removal	6 months
Phase 1 Impacted Soil Removal	4 months
Cease Coal Combustion; Start of Phase 2	March 2028
Phase 2 Dewatering	2 months
Phase 2 CCR material removal in remaining PBAP	4 months
Phase 2 Impacted soil removal	3 months
Site Regrading and Restoration	4 months
Complete closure by	October 17, 2028

5.2 – Documentation of No Alternative Disposal Capacity and Risk Mitigation Plan for Permanent Cessation of Boiler(s) by a Date Certain, CCR Units – Primary Bottom Ash Pond, November 2020

J. Robert Welsh Power Plant

State HWY 11 and FM 1735, Pittsburg, Tx
CN600126767
RN100213370
WMU 004

Notice of Intent to Comply With the Site-Specific Alternative to Initiation of Closure

CCR Unit – Primary Bottom Ash Pond

As required by 40 CFR 257.103(f)(2)(viii), this is a notification that on November 30, 2020 J. Robert Welsh Power Plant (Welsh Plant) submitted a site-specific alternative to initiation of closure due to permanent cessation of a coal-fired boiler by a date certain to US EPA. The submission has been placed in Welsh Plant’s operating record and posted to the CCR Rule Compliance Data and Information website.

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

American Electric Power
1 Riverside Plaza
Columbus, OH 43215
aep.com

November 30, 2020

Submitted Electronically via Email

Mr. Andrew R. Wheeler, EPA Administrator
Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Mail Code 5304-P
Washington, DC 20460

RE: Southwestern Electric Power Company
Welsh Power Plant Alternative Closure Demonstration

Dear Administrator Wheeler,

Southwestern Electric Power Company (SWEPCO) Welsh Power Plant (Welsh Plant), hereby submits this request to the U.S. Environmental Protection Agency (EPA) for approval of a site-specific alternative deadline to initiate closure pursuant to 40 C.F.R. § 257.103(f)(2) for the Primary Bottom Ash Pond (PBAP) located at the Welsh Plant near Pittsburgh, Texas. Welsh Plant is requesting an extension pursuant to 40 C.F.R. § 257.103(f)(2) to allow the PBAP to continue to receive CCR and non-CCR wastestreams after April 11, 2021. Enclosed is a demonstration prepared by American Electric Power and Burns & McDonnell that addresses all of the criteria in 40 C.F.R. § 257.103(f)(2)(i)-(iv) and contains the documentation required by 40 C.F.R. § 257.103(f)(2)(v). As allowed by the agency, in lieu of hard copies of these documents, electronic files were submitted to Kirsten Hillyer, Frank Behan, and Richard Huggins via email. If you have any questions regarding this submittal, please contact me at 614-716-2281 or damiller@aep.com.

Sincerely,

David A. Miller

David A. Miller, P.E.
Director, Land Environment & Remediation Services
Environmental Services Division

Attachments

cc: Kirsten Hillyer – USEPA
Frank Behan – USEPA
Richard Huggins – USEPA

Southwestern Electric Power Company

J. Robert Welsh Power Plant

SOUTHWESTERN
ELECTRIC POWER
COMPANY

An AEP Company

BOUNDLESS ENERGY

Documentation of No Alternative Disposal Capacity and Risk Mitigation Plan for Permanent Cessation of a Coal-Fired Boiler(s) by a Date Certain

Prepared by:

American Electric Power Service Corporation
1 Riverside Plaza
Columbus, OH 43215

and

Burns & McDonnell Engineering Inc.
9400 Ward Parkway
Kansas City, MO 64114

Submitted

11/25/2020

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Professional Engineer's Certification

I certify, as a Professional Engineer in the State of Texas, that the information in this document was assembled under my direct supervisory control and is accurate as of the date of my signature. This report is not intended or represented to be suitable for reuse without the specific verification or adaptation by the engineer.

DAVID ANTHONY MILLER

Printed Name of Registered Professional Engineer

DAVID ANTHONY MILLER
112498

David Anthony Miller

Signature

American Electric Power Service Corporation
Texas Registered Engineering Firm No. F-3341

112498	TEXAS	11.30.2020
Registration No.	**Registration State**	**Date**

INTRODUCTION

American Electric Power Service Corporation (AEP) as agent for its affiliate Southwestern Electric Power Company (SWEPCO), an owner and operator of the J. Robert Welsh Power Plant (Welsh Plant) (1187 County Road 4865 (Titus County) in Pittsburg, Texas), seeks Environmental Protection Agency (EPA) approval under 40 CFR §257.103(f)(2) - *"Permanent cessation of a coal-fired boiler(s) by a date certain"* for its Coal Combustion Residual (CCR) surface impoundments. As discussed herein, the two remaining coal-fired generating units at Welsh Plant will cease combusting coal in March 2028 and the CCR surface impoundments will be closed in order to comply with EPA's recently revised CCR regulations. Closure of the Primary Bottom Ash Pond (PBAP) impoundment will be completed no later than October 17, 2028, while the Bottom Ash Storage Pond (BASP) will cease receipt of CCR and non-CCR wastestreams no later than April 11, 2021 and initiate closure. This document will provide the required information to support the requested alternative closure deadline, including: (1) the options considered to obtain alternative disposal capacity both on and off site; (2) the risk mitigation plan developed to expedite any required corrective action; (3) required documentation and a certification of compliance with the applicable requirements of 40 CFR Part 257, Subpart D; and (4) a closure plan to demonstrate that the coal-fired units will cease combustion of coal and complete closure of the surface impoundments by the required deadlines.

On August 28, 2020, the EPA Administrator issued revisions to the CCR Rule (40 CFR Part 257, Subpart D) that require all unlined surface impoundments to initiate closure by April 11, 2021, unless an alternative deadline is requested and approved (40 CFR §257.101(a)(1) (85 Fed. Reg. 53,516)). Specifically, owners and operators of a CCR surface impoundment may continue to receive CCR and non-CCR wastestreams in an unlined surface impoundment if the facility will cease operation of the coal-fired boiler(s) and complete closure of the impoundments within certain specified timeframes (40 CFR § 257.103(f)(2)). To qualify for this alternative closure deadline, a facility must meet the following four criteria:

1. §257.103(f)(2)(i) – No alternative disposal capacity is available on-site or off-site. An increase in costs or the inconvenience of existing capacity is not sufficient to support qualification.
2. §257.103(f)(2)(ii) - Potential risks to human health and the environment from the continued operation of the CCR surface impoundment have been adequately mitigated;
3. §257.103(f)(2)(iii) - The facility is in compliance with the CCR rule, including the requirement to conduct any necessary corrective action; and
4. §257.103(f)(2)(iv) - The coal-fired boilers must cease operation and closure of the impoundment must be completed within the following timeframes:
    a. For a CCR surface impoundment that is 40 acres or smaller, the coal-fired boiler(s) must cease operation and the CCR surface impoundment must complete closure no later than October 17, 2023.
    b. For a CCR surface impoundment that is larger than 40 acres, the coal-fired boiler(s) must cease operation, and the CCR surface impoundment must complete closure no later than October 17, 2028.

40 CFR §257.103(f)(2)(v) details the documentation that must be provided to EPA to demonstrate that the four criteria set out above have been met. Therefore, this demonstration is organized based on the documentation requirements of 40 CFR§ 257.103(f)(2)(v)(A) – (D).

OVERVIEW OF WELSH PLANT AND AFFECTED CCR UNITS

The Welsh Plant began operations in 1977 as a coal-fired electric generating power plant. The Welsh Plant had three coal-fired generating units, each capable of producing approximately 528 megawatts (MW) of power. Welsh Unit 2 retired in 2015. The remaining units produce bottom ash, economizer ash, and flyash, all of which are classified as coal combustion residuals (CCR). Bottom ash and economizer ash are sluiced from the operating generating units to the Primary Bottom Ash Pond (PBAP), along with other non-CCR wastewaters. The PBAP was constructed with the generating units in the 1970s and is approximately 65 acres in size. Solids settle and CCR material is dredged from the PBAP to the BASP. The BASP was constructed in 2000, and a portion of the CCR material is dewatered and sold for beneficial uses from this area. The remainder is taken to the on-site Welsh Plant Landfill (LF) for final disposal. The locations of the CCR surface impoundments are shown on Figure 1.

The BASP is a 22-acre impoundment located in a topographically high area of Welsh Plant. The BASP was constructed with a 60-mil high-density polyethylene (HDPE) liner at the base of the BASP at an elevation of 340 feet amsl which extends along the base of the BASP sidewalls and is keyed into the top of the BASP earthen embankment at an elevation of 360 feet amsl. The BASP embankments are approximately 20 feet in height and are constructed of sandy clays and clayey sands on a 3:1 slope. The southeast corner of the BASP contains an approximate ¼-acre clear water pond with a base elevation of 347 feet amsl. The clear water pond's elevation is maintained so that surface water flows through the drainpipe at invert elevation 350.5 feet amsl or weir set at a crest elevation of 355 feet amsl. The water that flows from the BASP's ¼ acre clear water pond discharges through a 30-inch-diameter pipe into the PBAP. The BASP meets the location restriction requirements including the minimum aquifer separation, but does not meet the liner requirements of the CCR regulation. A groundwater monitoring system was developed for the BASP in 2017 and Detection Monitoring was initiated in January of 2018. There have been no statistically significant increases over Appendix III background levels for any constituent at any monitoring well in the BASP groundwater monitoring network.

The PBAP is located in a topographically low area that had been an unnamed intermittent tributary of Swauano Creek prior to development of the Site. The PBAP resides in a drainage area that is approximately 450 acres in size. The PBAP is bounded by natural ground surface (topographically higher areas) to the north, south, and west, and an embankment dike to the east. The embankment dike is constructed of compacted sandy clay and clayey sand and is approximately 40 feet in height. The water level in the PBAP is controlled by a weir box which discharges into a drainage canal that receives treated wastewater from the PBAP and has an emergency spillway with a crest elevation at approximately 334 feet amsl. Assessment monitoring identified an exceedance of the ground water protection standard for lithium, but an alternate source demonstration was completed showing higher upgradient lithium concentrations, and widespread correlation of higher iron and lithium concentrations in native soils in the surrounding area, demonstrating that the PBAP was not the source of the lithium detected. However, the PBAP does not meet either the aquifer separation distance or the liner requirements of the CCR regulation and is therefore subject to the closure requirements in 40 CFR §257.101(a)(1) and (b)(1)(i), but eligible for an alternative closure deadline in accordance with 40 CFR §257.101(b)(4) and (f)(2). The most recent groundwater monitoring report with the alternate source demonstrations, structural stability assessment, and safety factor assessment for the PBAP are included in Appendices C, D, and E, respectively.

The treated wastewater in the drainage canal flows east and thence discharges into the facility's Clearwater Pond (a 4.5-acre, non-CCR impoundment). Water in the Clearwater Pond discharges through a weir box into a 36-inch-diameter pipe, and then into the Welsh Reservoir via Outfall #001 under Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ0001811000. The Clearwater Pond is designed as a final polishing pond for the plant's wastestreams prior to discharging to the outfall.

These CCR surface impoundments are subject to closure in order to comply with EPA's recently revised CCR regulations. Therefore, the boilers associated with generating Units 1 and 3 will cease combusting coal and closure of the PBAP impoundment will be completed no later than October 17, 2028, while the BASP will cease receipt of CCR and non-CCR wastestreams no later than April 11, 2021 and initiate closure.

SATIFACTION OF THE CRITERIA IN 40 CFR §257.101(f)(2) FOR THE PBAP

NO ALTERNATIVE DISPOSAL CAPACITY

From the regulatory text

> 40 CFR §*257.103(f)(2)(i) No alternative disposal capacity is available on or off-site. An increase in costs or the inconvenience of existing capacity is not sufficient to support qualification under this section.*
>
> 40 CFR §*257.103(f)(2)(v)(A)To demonstrate that the criteria in paragraph (f)(2)(i) of this section have been met the owner or operator must submit a narrative that explains the options considered to obtain alternative capacity for CCR and/or non-CCR wastestreams both on and off-site.*

To demonstrate that the criteria in 40 CFR §257.103(f)(2)(i) have been met, the following provides documentation that no alternative disposal capacity is currently available on-site or off-site for each CCR and non-CCR wastestream that Welsh Plant seeks to continue using the PBAP for after April 11, 2021. Consistent with the regulations, neither an increase in costs nor the inconvenience of existing capacity was used to support qualification under this criterion. Instead, as EPA explained in the preamble to the proposed Part A revisions, "it would be illogical to require facilities [ceasing power generation] to construct new capacity to manage CCR and non-CCR wastestreams." 84 Fed. Reg. 65,941, 65,956 (Dec. 2, 2019). EPA again reiterated in the preamble to the final revisions that "[i]n contrast to the provision under 40 CFR § 257.103(f)(1), the owner or operator does not need to develop alternative capacity because of the impending closure of the coal fired boiler. Since the coal-fired boiler will shortly cease power generation, it would be illogical to require these facilities to construct new capacity to manage CCR and non-CCR wastestreams." 85 Fed. Reg. at 53,547. Thus, new construction or the development of new alternative disposal capacity was not considered a viable option for any wastestream discussed below. Similarly, for the reasons documented below there is insufficient existing alternative disposal capacity available on or off-site for each waste stream.

<u>CCR Wastestreams:</u>

The PBAP receives approximately 0.63 million gallons a day (MGD) of sluiced flows containing economizer and bottom ash.

AEP evaluated each CCR wastestream placed in the PBAP at Welsh Plant. For the reasons discussed below and in Table 1, the following CCR wastestreams must continue to be placed in the PBAP due to lack of alternative capacity both on and off-site.

Table 1. Welsh Plant CCR Wastestreams

CCR Wastestream	Average Flow (gpd)	Current Configuration	Alternative Capacity Currently Available? Yes/No	AEP Notes
Bottom Ash	630,000	Bottom ash is currently sluiced to the PBAP.	No	There are currently no alternative CCR compliant ponds onsite and extensive modifications would be required to manage the bottom ash so that it could be disposed in the onsite landfill. These alternatives are not practicable for generating units that will cease combusting coal in 2028.
Economizer Ash	Included with Bottom Ash flows	Sluiced to the existing PBAP with bottom ash	No	There are currently no alternative CCR compliant ponds onsite and extensive modifications would be required to manage the economizer ash so that it could be disposed in the onsite landfill. These alternatives are not practicable for generating units that will cease combusting coal in 2028.
Pyrites (non-CCR but handled with CCR wastestreams)	Included with Bottom Ash flows	Sluiced to the existing PBAP using the existing bottom ash pumps and piping.	No	No alternate system is available for collection of pyrites which are comingled with bottom and economizer ash. Extensive modifications would be required to manage the pyrites so that it could be disposed in the onsite landfill. These alternatives are not practicable for generating units that will cease combusting coal in 2028.

Welsh Plant does not have an existing alternate impoundment on-site that meets the liner or aquifer separation requirements of EPA's CCR regulation, and considerable modifications to plant equipment, facilities, and processes will be necessary before Welsh Plant can cease sluicing CCR and placing non-CCR wastestreams into the PBAP. A new CCR compliant impoundment approximately 10 acres in size would be required to treat the CCR and non-CCR wastestreams, with the exception of the coal pile runoff flow, in order to meet the TPDES permit limits. A new non-CCR impoundment approximately 5 acres in size with chemical treatment would be required to treat the coal pile runoff flow. Since Welsh Plant has elected to pursue the option to permanently cease the use of the coal fired boilers by a date certain, developing alternative disposal capacity is "illogical" as stated by EPA, and also counterproductive to the work to retire the boilers and close the CCR surface impoundments. As EPA explained in the preamble of the 2015 rule, it is not possible for sites that sluice CCR material to an impoundment to eliminate the impoundment and dispose of the material offsite. See 80 Fed. Reg. 21,301, 21,423 (Apr. 17, 2015) ("[W]hile it is possible to transport dry ash off-site to [an] alternate disposal facility that is simply not feasible for wet-generated CCR. Nor can facilities immediately convert to dry handling systems."). A new CCR compliant impoundment would be required to treat the CCR flows as noted above.

If temporary frac tanks were used for treatment of the CCR sluice water and if 24 hours would provide sufficient residence time for the settling of the fine solids in the CCR wastestreams, approximately 75 frac tanks would be required to store and treat the bottom ash transport water. The number of tanks required was estimated by taking the total sluice flow (630,000 gallons) divided by the frac tank capacity (21,000 gallons) and doubling it to account for the 24 hours settling time requirement which resulted in 60 frac tanks. Because approximately 10 of these frac tanks would need to be rotated out of service each day for solids removal and disposal in the Welsh landfill, an allowance, or emergency margin, of 15 frac tanks was added to this value, which resulted in a total of 75 tanks being required. These tanks would require significant amounts of interconnecting piping which could create an unacceptable potential for significant leaks or spills.

For off-site disposal, 630,000gpd on average would require approximately 84 trucks per day based on 7,500 gallons per truck to haul off and dispose of the water collected. This operation would need to take place 24 hours a day and 7 days a week and poses significant safety risks both on and off-site due to the truck traffic and is not feasible to achieve.

The most likely facility type capable of managing industrial wastewaters are publicly-owned or private treatment works, underground injection wells, or publicly available waste management facilities capable of solidifying liquid wastes for disposal in a landfill. Given the volume and characteristics of the CCR wastestreams, increases in permitted capacity or other modifications to the permitted pretreatment programs of a public or private wastewater treatment facility would likely be required to manage this flow, if one were available. Off-site disposal is not an option for Welsh Plant CCR material.

As a result, the conditions at Welsh Plant satisfy the demonstration requirement in 40 CFR § 257.103(f)(2)(i) and in the interim period (prior to permanent cessation of the coal-fired boilers) Welsh Plant must continue to use the PBAP due to the absence of alternative disposal capacity both on and off-site of the facility.

Non-CCR Wastestreams:

Approximately 12 MGD of various non-CCR wastestreams are sent to the PBAP. These wastewater streams include coal pile runoff, wash down of the electrostatic precipitator area, hydrovactor vacuum system discharges, boiler blowdown, water treatment waste (ultrafiltration, reverse osmosis, demineralizer), plant drains and sumps, contact and non-contact storm water runoff as well as contact storm water runoff from and through the ash landfill.

AEP evaluated each non-CCR wastestream placed in the PBAP at Welsh Plant. For the reasons discussed below and in Table 2, each of the following non-CCR wastestreams must continue to be placed in the PBAP due to lack of alternative capacity both on and off-site.

Table 2. Welsh Plant non-CCR Wastestreams

Non-CCR Wastestream	Average Flow (gpd)	Current Configuration	Alternative Capacity Currently Available? Yes/No	AEP Notes
Hydrovactor Flows	11,800,000	Pumped to the existing PBAP, using the existing bottom ash pumps and piping	No	The PBAP provides treatment for these non-CCR wastestreams (primarily solids settling) to allow them to meet the TPDES discharge limits and no on-site alternative capacity exists for treatment. Significant physical alterations would be required to treat the flows as noted in the discussion above. Off-site disposal of these flows is not practical as noted in the discussion below.
Coal Pile Runoff	260,000	Gravity flows to the existing PBAP	No	
Ecology Pit flows	668,000	Collects flow from multiple sources including plant drains, coolers and sumps pumped to the PBAP	No	
Washdowns of Electrostatic Precipitator Area	36,000	Flows to the existing PBAP through sump and exiting plumbing	No	
Water Treatment Waste	692,000	Wastewater from demineralizer regenerant, reverse osmosis and ultrafilter. Flows to the existing PBAP through sump and exiting plumbing	No	
Lab Drains & Boiler Blowdown	132,000	Flow to the existing PBAP	No	
Ash Landfill Stormwater Runoff	180,000	Flow is directed to the existing PBAP through a system of ditches	No	

Non-CCR Wastestream	Average Flow (gpd)	Current Configuration	Alternative Capacity Currently Available? Yes/No	AEP Notes
Non-contact stormwater runoff	Intermittent	Flow is directed to the existing PBAP through a system of ditches	No	

Welsh Plant does not have an existing alternate impoundment on-site that can be utilized for the non-CCR wastestreams as discussed above.

Relative to off-site disposal capacity for the non-CCR streams; the sheer volume which would need to be handled on a daily basis makes this impractical. 12 MGD on average would require approximately 1600 trucks per day based on 7,500 gallons per truck to haul off and dispose of the water collected. This operation would need to take place 24 hours a day and 7 days a week and poses significant safety risks both on and off-site due to the truck traffic. Collection of the flows would require the installation of significant infrastructure (sumps, piping, loading facilities) that currently does not exist at the plant for most of the non-CCR wastrestreams. Furthermore, the 12 MGD flow rate is an average flow rate. Several of the non-CCR wastestreams (coal pile runoff, landfill runoff, etc) are mostly a result of rain events which are not predictable and could result in daily flows that significantly exceeds the 12 MGD average flowrate. The most likely facility type capable of managing industrial wastewaters are publicly-owned or private treatment works, underground injection wells, or publicly available waste management facilities capable of solidifying liquid wastes for disposal in a landfill. Given the volume and characteristics of the non-CCR wastestreams, increases in permitted capacity or other modifications to the permitted pretreatment programs of a public or private wastewater treatment facility would likely be required to manage this flow, if one were available.

Consequently, there are no feasible offsite-disposal options for the non-CCR wastestreams at Welsh Plant. As stated previously, since AEP has elected to pursue the option to permanently cease the use of the coal fired boilers by a certain date, developing alternative disposal capacity is “illogical,” to use EPA’s words, and also counterproductive to the work to retire the boilers and close the impoundments. There is currently no existing installed infrastructure at the plant to support reroute of these flows. For the reasons discussed above, each of the remaining non-CCR wastestreams must continue to be placed in the PBAP due to lack of alternative capacity both on and off-site. Consequently, in order to continue to operate and generate electricity, Welsh Plant must continue to use the PBAP to manage the non-CCR wastestreams discussed above.

Based on the evaluation of alternative disposal options, AEP selected the following options for compliance at Welsh Plant:

- Cessation of the coal burning boilers
- Closure of the PBAP by CCR material removal.

Impact to Plant Operations if Alternative Capacity Not Obtained

If the Welsh Plant were required to immediately cease the placement of CCR and non-CCR wastestreams into the PBAP, which is necessary for handling more than 12.6 MGD of CCR and non-CCR wastestreams, and initiate closure by April 11, 2021, AEP would have to temporarily or permanently cease power production at the Welsh Plant. Idling or closure of the Welsh Plant would stop the production of CCR wastestreams and some non-CCR wastestreams, but would not eliminate the need for handling other non-CCR wastestreams, such as coal pile runoff and low volume wastewater from various water collection sumps from around the plant. The PBAP is integral in receiving and treating these flows as required to meet the TPDES discharge limits. Therefore, the need for uninterrupted non-CCR wastestream capacity in the PBAP will be necessary for a significant amount of time until alternate capacity from the new wastewater ponds is available. Put simply, the PBAP will be unable to immediately cease operation even if the Welsh Plant immediately discontinued the combustion of coal and production of CCR wastestreams.

SWEPCO owns and operates three coal-fired generating facilities within northwest Arkansas and the eastern panhandle of Texas that are seeking additional time to provide alternative disposal capacity or cease combusting coal. Together, these facilities have a maximum generating capacity of over 2,000 MW. All of these facilities operate within the Southwest Power Pool Regional Transmission Organization (SPP). Because of their close geographic proximity, simultaneous immediate closure of a significant portion of this capacity would compromise SWEPCO's ability to meet electrical demand and capacity obligations of the SPP, would destabilize portions of the electricity grid and, therefore, would not be in the public interest. One facility will retire in 2023, one will be converted to satisfy both the ELG and CCR requirements, and the third will cease combusting coal in 2028. The requested extensions will allow for an orderly transition of generating resources, provide time to initiate transmission mitigation plans to avoid compromising the reliability of the grid, and maintain SWEPCO's ability to provide affordable electricity to customers.

RISK MITIGATION PLAN

From the regulatory text

40 CFR §*257.103(f)(2)(v)(B) A risk mitigation plan describing the measures that will be taken to expedite any required corrective action, and that contains all of the following elements:*

> *(1) A discussion of any physical or chemical measures a facility can take to limit any future releases to groundwater during operation.*

In order to demonstrate that the criteria in §257.103(f)(2)(ii) have been met, 40 CFR §257.103(f)(2)(v)(B) requires the applicant to describe the risk mitigation measures that will be taken to expedite any required corrective action at the plant. The following is a discussion of the physical and chemical measures the plant can take to limit any future releases to groundwater during operation to address the requirements in 40 CFR §257.103(f)(2)(v)(B)(1).

Currently, the plant applies chemical additives to the PBAP to help settle bottom ash and economizer ash. There is a pH control system in place for the effluent from the Clearwater Pond into the Welsh Reservoir as necessary to meet the current NPDES permit limits.

The plant could take physical precautionary measure of minimizing the volume of CCR stored in the PBAP. This will include periodic removal of the CCR. During any time of periodic removal of CCR, the plant will implement administrative controls to limit the depth of removal to ensure the original bottom of the pond is not disturbed, thereby eliminating any integrity issues with the current in-situ liner material.

Additionally, to prevent future groundwater contamination from entering the Welsh Reservoir, east of the PBAP, steps could be taken to lower the operational levels as low as possible to minimize the free liquids accompanied with diminishing the amount of CCR stored in the impoundment. This action can be initiated very quickly, but there is a limit on how low the pond can be lowered due to the physical configuration of the outlet structure from the PBAP.

Another potential physical measure that could be implement, if necessary, is the installation of a hydraulic barrier within the reservoir. These mitigation measures would promptly address any contaminate migrating toward the reservoir.

> *(2) A discussion of the surface impoundment's groundwater monitoring data and any found exceedances; the delineation of the plume (if necessary based on the groundwater monitoring data); identification of any nearby receptors that might be exposed to current or future groundwater contamination; and how such exposures could be promptly mitigated.*

Groundwater monitoring data

Groundwater monitoring at the CCR Units is accomplished using a PE-certified groundwater monitoring network composed of three upgradient wells shared by all CCR Units and three downgradient monitoring wells distinctive for each CCR Unit. The certified Groundwater Monitoring Well Evaluation Report is included in Appendix D.

Groundwater at the PBAP is monitored in accordance with an assessment monitoring program, following the requirements of 40 CFR §257.95 in the CCR rule. Assessment monitoring identified an exceedance of the ground water protection standard for lithium, but alternate source demonstrations have been completed showing higher upgradient lithium concentrations, and widespread correlation of higher iron and lithium concentrations in native soils in the surrounding area, demonstrating that the PBAP was not the source of the lithium detected. Following the requirements of 40 CFR §257.95, groundwater samples from each monitoring well are analyzed for all parameters in Appendix IV of the CCR rule during the first monitoring event of the annual monitoring cycle, then during the two subsequent events in the cycle, samples from each well are analyzed for all parameters in Appendix III and at a minimum those parameters in Appendix IV that were detected during the first sampling event in the cycle. Analysis results for each constituent at each monitoring well are compared to corresponding groundwater protection standards according to statistical procedures and performance standards specified in 40 CFR §257.93(f) and 40 CFR §257.93(g). The PBAP is expected to remain in assessment monitoring until closure by removal is complete, but will transition to an assessment of corrective measures and selection of a remedy following requirements in 40 CFR §257.96 and 40 CFR §257.97, and a corrective action program following requirements in 40 CFR §257.98, if necessary. The concentrations of the Appendix III and IV constituents detected are presented in the Groundwater Monitoring and Corrective Action Reports in Appendix C.

Plume

The PBAP is currently in assessment monitoring and has not exceeded a groundwater protection standard for any appendix IV parameter, therefore, no plume delineation has been necessary.

Nearby receptors and mitigation

There are no private water wells located within a 0.5 mile radius from Welsh Plant, see Figure 6. Therefore the only reasonable receptor would be the Welsh Reservoir. The Welsh Reservoir was constructed primarily to provide the plant with a source of water for generating steam and for cooling, with most of these waters returned to the reservoir. There are no surface water intakes within the reservoir for any other water supply.

The PBAP is located directly west of the Welsh Reservoir. The PBAP normal operating water level is near the weir box which has a bottom elevation of 325 feet amsl. The surface water elevation of the Welsh Reservoir is maintained at approximately 320 feet amsl. The Welsh Reservoir is likely a gaining surface water feature and groundwater elevations at the impoundments are approximately 324 feet amsl, which are higher than the normal stage elevation of the Welsh Reservoir. To prevent future groundwater contamination from entering the Welsh Reservoir, east of the PBAP, steps could be taken to lower the operational levels as low as possible to minimize the free liquids accompanied with diminishing the amount of CCR stored in the impoundment and/or a hydraulic barrier could be constructed by the impoundments. These mitigation measures would promptly address any contaminate migrating toward the reservoir.

> *(3) A plan to expedite and maintain the containment of any contaminant plume that is either present or identified during continued operation of the unit*

AEP will establish contracts with consultants and drilling companies who are immediately available to prepare and execute a nature and extent report. Based on the results of the report, AEP will be able to readily implement a temporary containment plan until the proper Assessment of Corrective Action Report evaluates the appropriate potential methods for remediation.

As noted above, a hydraulic barrier (cutoff wall) could be implemented within 4 to 6 months after the identification of a release from the PBAP. This could be accomplished while the Assessment of Correct Action is being evaluated. Cutoff walls act as barriers to migration of impacted groundwater and can isolate soils that have been impacted by CCR to prevent contact with unimpacted groundwater. Cutoff walls are often used in conjunction with an interior pumping system to establish a reverse gradient within the cutoff wall. The reverse gradient maintains an inward flow through the wall, keeping it from acting as a groundwater dam and controlling potential end-around or breakout flow of contaminated groundwater.

Hydraulic barriers are commonly used to contain and/or isolate the migration of a plume and are incorporated into other Corrective Measures for groundwater remediation. A slurry wall, which is constructed with low permeable material such as bentonite, would be applicable to the Welsh site since the uppermost aquifer is not deep below the surface. Slurry walls can be constructed up to depths of 60-80 feet. Sheet pile walls are limited to depths less than 60 feet. If the density of the subsurface materials are very consolidated, the depths may even be less.

Vertical cutoff walls (a type of hydraulic barrier) are used to control and/or isolate impacted groundwater. Low permeability cutoff walls can be used to prevent horizontal off-site migration of potentially impacted groundwater.

A commonly used cutoff wall construction technology is the slurry trench method, which consists of excavating a trench and backfilling it with a soil-bentonite mixture, often created with the soils excavated from the trench. The trench is temporarily supported with bentonite slurry that is pumped into the trench as it is excavated. Excavation for cutoff walls is conducted with conventional hydraulic excavators, hydraulic excavators equipped with specialized booms to extend their reach (i.e., long-stick excavators), or chisels and clamshells, depending upon the depth of the trench and the material to be excavated. For a cutoff wall to be technically feasible, there must be a low-permeability lower confining layer into which the barrier can be keyed, and it must be at a technically feasible depth.

Another measure to contain the migration of the plume is extraction of the groundwater. This measure includes installation of a series of groundwater pumping wells or trenches to control and extract impacted groundwater. Groundwater extraction captures and contains impacted groundwater and can limit plume expansion.

Installation of a groundwater extraction system, whether wells or trenches, can be expedited with the assumption that there is a good conceptual site model (CSM) of the hydrogeological system around the CCR unit, groundwater flow and transport model, and aquifer test if a well system is the best option for intercepting the groundwater contaminant plume. Upon notification of an SSL exceedance of a GWPS for one or more Appendix IV parameters, an aquifer test will be conducted, and groundwater model developed for designing a groundwater extraction system for optimization of contaminant plume capture.

Based on site specific hydrogeology and future potential plume width and depth, a groundwater extraction system will typically consist of one to three extraction wells with pitless adapters manifolded together with HDPE conveyance pipe to a common tank or lined collection vault prior to treatment at the on-site wastewater treatment plant and discharge via the NPDES permitted outfall.

NARRATIVE STRATEGY FOR COMPLIANCE WITH ALL REQUIREMENTS OF 40 CFR 257 SUBPART D

From the regulatory text

40 CFR §257.103(f)(2)(v)(C)(1) To demonstrate that the criteria in paragraph (f)(2)(iii) of this section have been met, the owner or operator must submit all of the following:

> *(1) A certification signed by the owner or operator that the facility is in compliance with all of the requirements of this subpart;*
>
> I hereby certify that, based on my inquiry of those persons who are immediately responsible for compliance with environmental regulations for the Welsh Plant, the facility is in compliance with all of the requirements contained in 40 CFR §257 Subpart D – *Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments*.
>
> x David A. Miller
>
> David A. Miller P.E.
> Director – Land Environmental and Remediation Services

The Welsh Plants CCR units are maintaining compliance with all requirements of Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments found at 40 CFR §257 Subpart D. Reports documenting compliance with the rule's provisions, such as location restriction, design criteria, operating criteria, and groundwater monitoring are posted to the AEP public CCR Rule Compliance Data and Information Internet site at the following link: http://www.aep.com/about/codeofconduct/ccrrule/.

From the regulatory text

40 CFR §257.103(f)(2)(v)(C)(2) Visual representation of hydrogeologic information at and around the CCR unit(s) that supports the design, construction and installation of the groundwater monitoring system. This includes all of the following:

> *(i) Map(s) of groundwater monitoring well locations in relation to the CCR unit;*
> *(ii) Well construction diagrams and drilling logs for all groundwater monitoring wells; and*
> *(iii) Maps that characterize the direction of groundwater flow accounting for seasonal variations;*

Groundwater monitoring at the Welsh Plant CCR units is accomplished using PE-certified groundwater monitoring networks comprised of three upgradient wells shared by all CCR Units and three downgradient wells distinctive for each CCR Unit. The complete Groundwater Monitoring and Network Evaluation Reports are provided in Appendix D and include:

- A map showing the location of the monitoring wells relative to the CCR units
- Boring logs and well construction diagrams
- Maps that characterize the direction of groundwater flow accounting for seasonal variations

40 CFR §257.103(f)(2)(v)(C)(3) Constituent concentrations, summarized in table form, at each groundwater monitoring well monitored during each sampling event;

The most recent Groundwater Monitoring and Corrective Action Reports summarize Appendix III and IV constituent concentrations at each groundwater monitoring well monitored during each sampling event as Table 1(see Appendix C).

40 CFR §257.103(f)(2)(v)(C)(4) Description of site hydrogeology including stratigraphic cross-sections;

The Groundwater Monitoring Well Network Evaluation Reports, included in Appendix D, provide a description of the site hydrogeology and stratigraphic cross-sections of the site.

Based on the soil borings completed at Welsh Plant, native soils consist primarily of stiff to hard lean clay (CL) and fat clay (CH) with intermittent layers of medium dense to very dense clayey sand (SC) and silty sand (SM). Atterberg Plasticity Indices of the tested soils ranged from 9 to 44. These features are further illustrated on five lines of cross section that were prepared through the CCR units at Welsh Plant, with three lines trending from west to east (A-A'; B-B'; C-C'), and the other two lines trending from north to south (D-D'; E-E'). The cross-section location map and the lines of cross section are included as Figures 4 - 8 in the Groundwater Monitoring Well Network Evaluation Reports in Appendix D.

Welsh Plant is less than one-half mile from Swauano Creek, which was dammed near the southern end of the Welsh Plant during plant development to form the Welsh Reservoir. Groundwater flow direction at Welsh Plant is generally from west to east, following surface topography towards the Welsh Reservoir. The Welsh Reservoir is likely a gaining surface water feature, and groundwater elevations on site are higher than the normal stage elevation of the Welsh Reservoir (approximately 320 feet amsl). The PBAP's normal operating level is near the weir box which has a bottom elevation of 325 feet amsl. Figures 2 through 5 represent the seasonal potentiometric surfaces. As shown on these figures, the groundwater flow direction in the upper most aquifer is easterly toward the Welsh Reservoir.

40 CFR §257.103(f)(2)(v)(C)(5) Any corrective measures assessment required at § 257.96;

The Welsh Plant CCR units have not entered Assessment of Corrective Measures, therefore, no corrective measures assessment reports have been required or prepared.

40 CFR §257.103(f)(2)(v)(C)(6) Any progress reports on remedy selection and design and the report of final remedy selection required at § 257.97(a);

The Welsh Plant CCR units have not entered Assessment of Corrective Measures, therefore no progress reports on remedy selection and design and reports of final remedy selection have been required or prepared.

40 CFR §257.103(f)(2)(v)(C)(7) The most recent structural stability assessment required at § 257.73(d); and

The most recent structural stability assessment required at 40 CFR§ 257.73(d) for the PBAP and BASP can be found in Appendix E. These reports will be updated every 5 years as required by the CCR rule.

40 CFR §257.103(f)(2)(v)(C)(8) The most recent safety factor assessment required at § 257.73(e).

The most recent safety factor assessment required at 40 CFR § 257.73(e) for the PBAP and BASP can be found in Appendix F. These reports will be updated every 5 years as required by the CCR rule.

COAL-FIRED BOILERS CEASE OPERATION AND IMPOUNDMENT CLOSURE

From the regulatory text

40 CFR §257.103(f)(2)(v)(D) To demonstrate that the criteria in paragraph (f)(2)(iv) of this section have been met, the owner or operator must submit the closure plan required by §257.102(b) and a narrative that specifies and justifies the date by which they intend to cease receipt of waste into the unit in order to meet the closure deadlines.

AEP will oversee detailed planning and design of the closure activities which includes: engineering and design; prepare and file all required permit applications; receive approval from the respective regulatory agencies; bid and award construction contract; development of a revised water balance diagram after the generating units cease combusting coal; and the sequence construction activities. Welsh Plant will conduct periodic removal of CCR material from the PBAP for placement into the landfill. AEP will plan to operate the PBAP at the lowest practical operating level to minimize the amount of free water stored.

The following are the planned activities that will be necessary to meet the closure date of October 17, 2028 for the PBAP (greater than 40 acres):

Engineering, Design and Permitting
The conceptual design of the PBAP pond closure and retrofit has been completed. A geotechnical investigation is being performed to verify current CCR material depths at certain locations and provide information to support the conceptual design and projected construction efforts. The detailed design of the closure for the PBAP will begin in early 2025 to support closure by October 2028. The closure engineering and design is to support submitting and obtaining revisions to the Welsh Plant TPDES discharge permit and construction environmental permits. The current plan is based on permit revision and construction permit submittal and review being 12 to 15 months, based on past site experience.

Contractor Selection
During permit review and approval, construction bid packages with detailed design will be issued for bid to support starting construction once permits have been received. Six months have been allowed for bidding, selection and award of construction contracts to the selected contractors in accordance with AEP's typical process.

Construction
The closure of the PBAP requires specific sequencing in order to complete the work while continuing to meet the TPDES discharge permit requirements throughout construction. The PBAP is located at the low point of a drainage area that is approximately 450 acres in size. The continuous flows from stormwater runoff create a difficult environment for removing CCR material from the pond. The means and methods of excavating or removing the CCR material from the pond will be decided by the construction contractor with approval by the engineer and AEP. Mechanical excavation and dredging of the material are viable options. The construction sequence and duration described herein assumes that the area will be dewatered and CCR material removed by excavation. It is feasible that during execution of the project the selected construction contractor may submit a plan that utilizes dredging that can support the same or better schedule which would be evaluated by AEP and the engineer.

In order to facilitate the work to be completed in the PBAP, AEP has chosen to separate the construction into two phases.

Phase 1 - Construction will start immediately after the award of the construction contract and after receipt of the necessary permits which is forecasted for and by February 2027. The first phase will consist of rerouting the non-CCR wastewater, stormwater drainage, and the sluiced CCR material around the primary working area of the pond in temporary diversion ditches or berm sections of the pond. Following completion of the diversion channel, a diversion berm to segregate the pond area will be constructed. The rerouting of flows and segregation berm will allow for the working area to be dewatered. Bottom ash and economizer ash sluice water along with most non-CCR flows will be routed in a ditch along the east and south perimeter of the pond. Stormwater from the west and coal pile runoff flows will be routed in a berm section and/or ditch on the west side of the pond. Solids will be managed in these ditches by the addition of chemicals and regular cleaning to allow for the discharge to meet the TPDES limits at the Clearwater Pond discharge. This phase will involve CCR removal in the western area of the PBAP (approx. 310,000 CY). CCR material will be disposed of in the on-site landfill. Phase 1 is expected to take approximately 6 months to complete. When the excavation of the PBAP has reached the pre-construction contours (verified by comparing the excavated contours to the original contours when the plant was constructed), the contractor will remove an additional one foot of material (approx. 44,000 CY) and confirm removal of CCR material. Additionally, an engineer will perform quality assurance/quality control (QAQC) services to independently verify that all CCR materials are removed.

Phase 2 - Construction will start immediately after the facility ceases combustion of coal which is planned for March 2028. The second phase of work will include removal of the remaining CCR material from the PBAP (approx. 200,000 CY) that was not removed in Phase 1. CCR removal is expected to take 4 months based on removal rates from similar projects. An additional one foot of material (approx. 20,000 CY) will be removed to confirm removal of CCR material and an engineer will perform quality assurance/quality control to verify all CCR materials are removed. Though the additional one foot of material will take 3 months to remove, the work will be performed concurrently with CCR material removal.

After completion of Phase 2, site regrading of the area will be performed to ensure proper drainage and temporary construction facilities, laydown areas, and erosion controls will be removed. Completion of Phase 2 will be the completion of closure and will be by October 17, 2028

Table below summarizes the major tasks and durations associated with closing the PBAP.

Initiate PBAP Closure	January 2025
Closure Planning and Engineering	6 months
Environmental and Construction Permits	15 months
Spec, bid, and Award construction contracts	6 months
Commence CCR Closure Phase 1 Construction no later than	February 2027
Dewatering and Wastewater/Stormwater Diversion	3 months
Pond Segregation Berm	2 months
Phase 1 CCR Removal	6 months
Phase 1 Impacted Soil Removal	4 months
Cease Coal Combustion; Start of Phase 2	March 2028
Phase 2 Dewatering	2 months
Phase 2 CCR material removal in remaining PBAP	4 months
Phase 2 Impacted soil removal	3 months
Site Regrading and Restoration	4 months
Complete closure by	October 17, 2028

The closure plan for the PBAP required by 40 CFR §257.102(b) can be found in Appendix B.

CONCLUSION

Based upon the information submitted in this demonstration for the PBAP, it has been shown that the Welsh Plant is unable to obtain alternative disposal capacity for the generated CCR and non-CCR wastestreams before April 11, 2021 for the PBAP and qualifies for the site specific alternate time frame for the initiation of closure as allowed by 40 CFR §257.103 – Alternate Closure Requirements and specifically 40 CFR §257.103(f)(2) – *Permanent cessation of a coal-fired boiler(s) by a date certain*. Therefore, it is requested that EPA approve this demonstration.

Figures

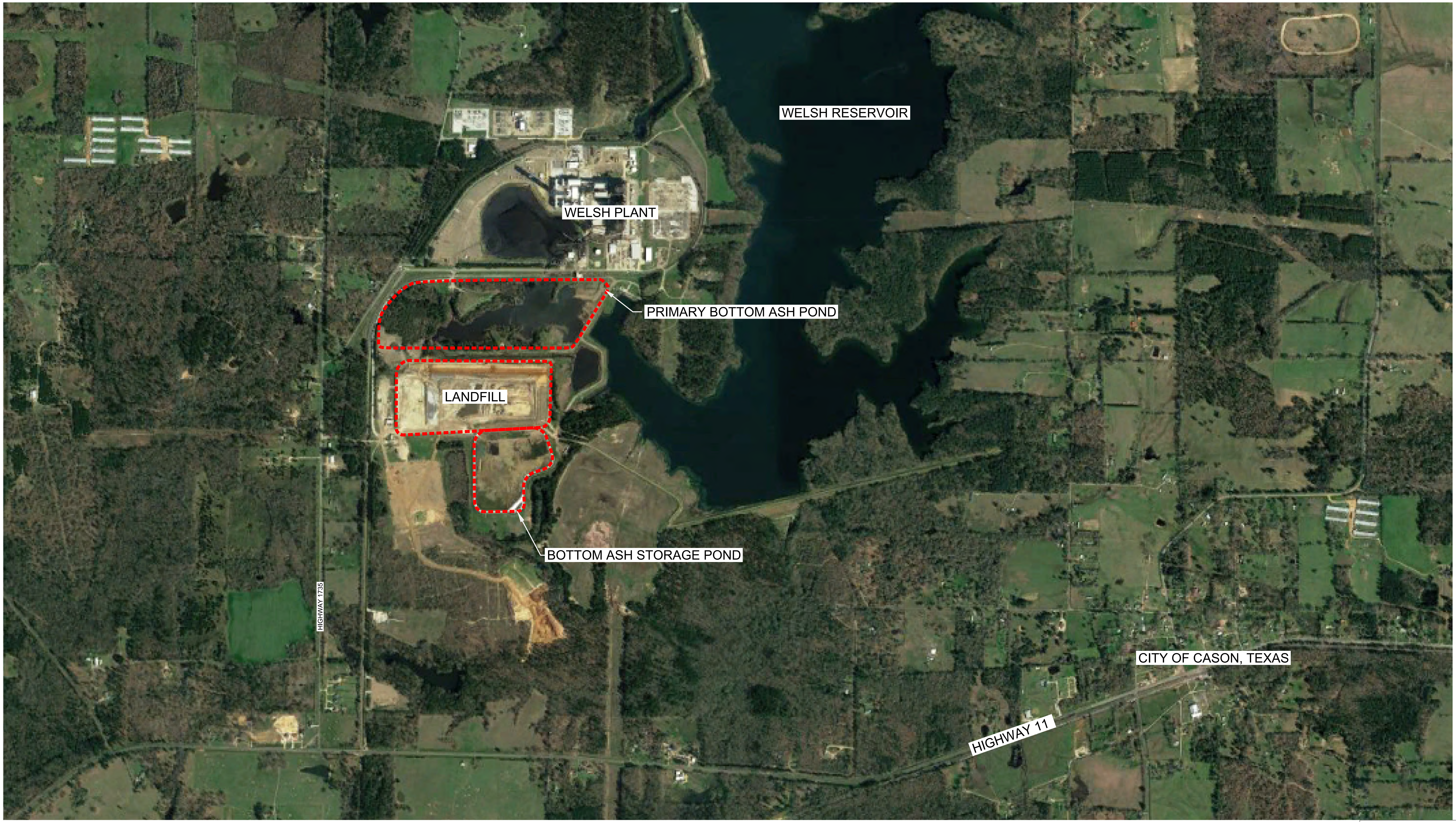

Figure 1

PRELIMINARY - NOT FOR CONSTRUCTION

no.	date	by	ckd	description	no.	date	by	ckd	description
A	06/22/20	KTM	RNO	ISSUED FOR EXTENSION REQUEST					

LIMITS OF CCR UNIT

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Company, Inc.
Firm Reg. No. F-845

designed R. OWENS
detailed J. RIDDER

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY™

CCR / ELG COMPLIANCE PROJECT

WELSH POWER PLANT
TITUS COUNTY, TEXAS

CCR UNIT LOCATION MAP

project 120798
contract

drawing SK - C502 — rev. A

sheet of sheets

file 120798SK-C502.DGN

C:\Users\rowens\Desktop\AEP\WELSH\120798SK-C502.dgn

6/29/2020

Legend

- ⊕ Groundwater Monitoring Well
- → Approximate Groundwater Flow Direction
- — Groundwater Elevation Contour
- ▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on February 20-21, 2019) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.
- AD-16 was replaced with AD-16R on 4/12/2017.

Groundwater Potentiometric Map
February 2019

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Columbus, Ohio

2020/01/22

Figure

2

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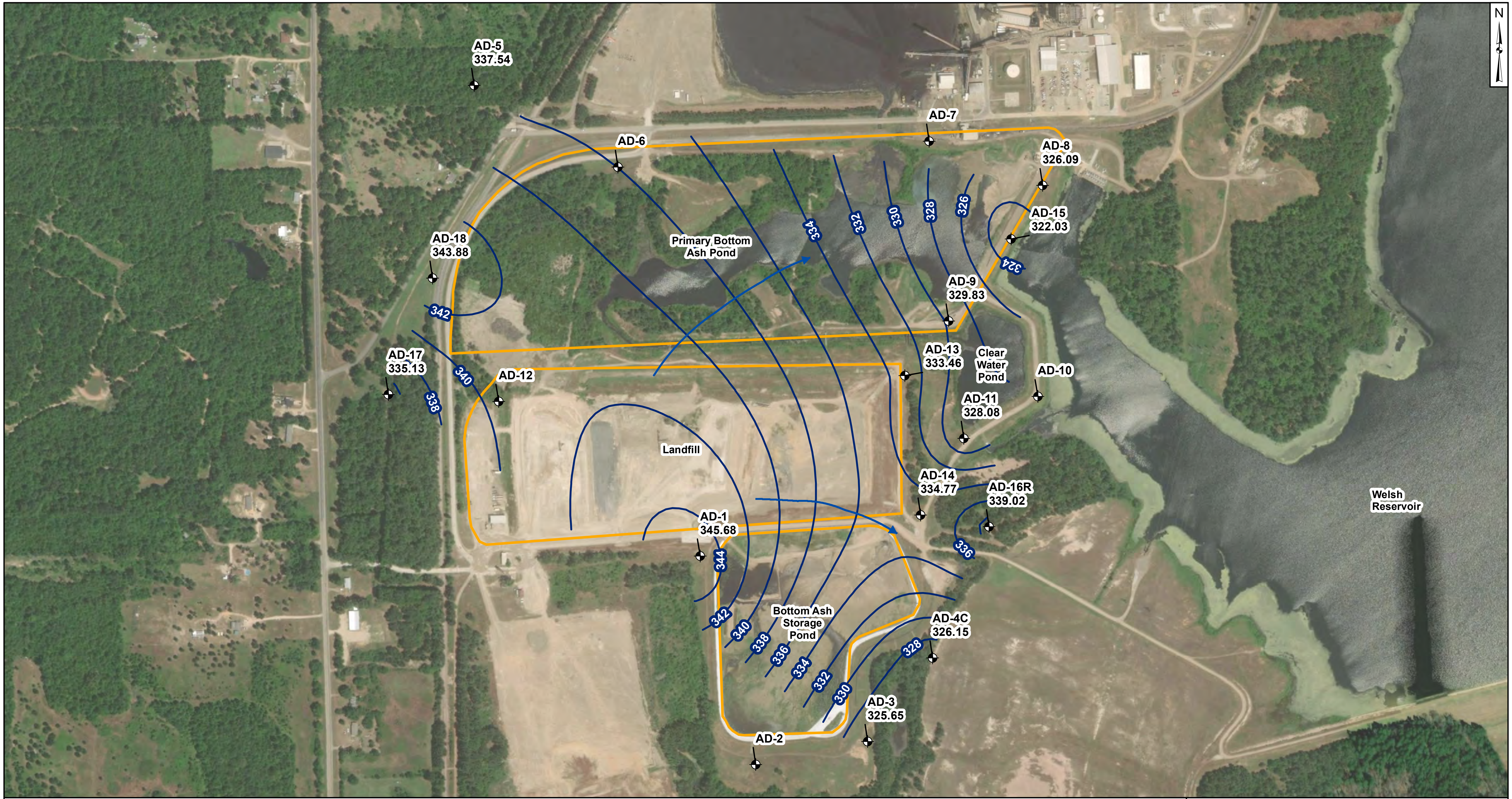


Legend
- ⯐ Groundwater Monitoring Well
- → Approximate Groundwater Flow Direction
- — Groundwater Elevation Contour
- ▭ CCR Units

Notes
- Monitoring well coordinates and water level data (collected on May 29-30, 2019) provided by AEP.
- AD-10, AD-6, AD-7, AD-2, and AD-12 were not gauged during this event
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.
- AD-16 was replaced with AD-16R on 4/12/2017.

750 375 0 750
Feet

Groundwater Potentiometric Map
May 2019

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Figure
3

Columbus, Ohio

2019/12/12

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Welsh\2019\AEP-Welsh_GW_2019-05May.mxd. ARevezzo. 12/12/2019. CHA8423/14/08.

Legend

⊕ Monitoring Well

— Groundwater Elevation Contour

→ Groundwater Flow Direction

Notes

- Well coordinates and water level data provided by AEP.

750 375 0 750
Feet

Groundwater Elevation Contour Map
July 2016

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Ann Arbor, Michigan

2016/11/10

Figure
4

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Welsh_July2016.mxd. CGregory. 11/10/2016. CHA8423/14/08.

Legend

⊕ Monitoring Well

— Groundwater Elevation Contour

➔ Groundwater Flow Direction; 0

Notes

- Well coordinates and water level data provided by AEP and collected on October 19, 2016.

750 375 0 750
Feet

Groundwater Elevation Contour Map
October 2016

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Figure

5

Ann Arbor, Michigan

2016/12/06

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Welsh\Welsh_Oct2016.mxd. MMuenich. 12/6/2016. CHA8423/14/08.

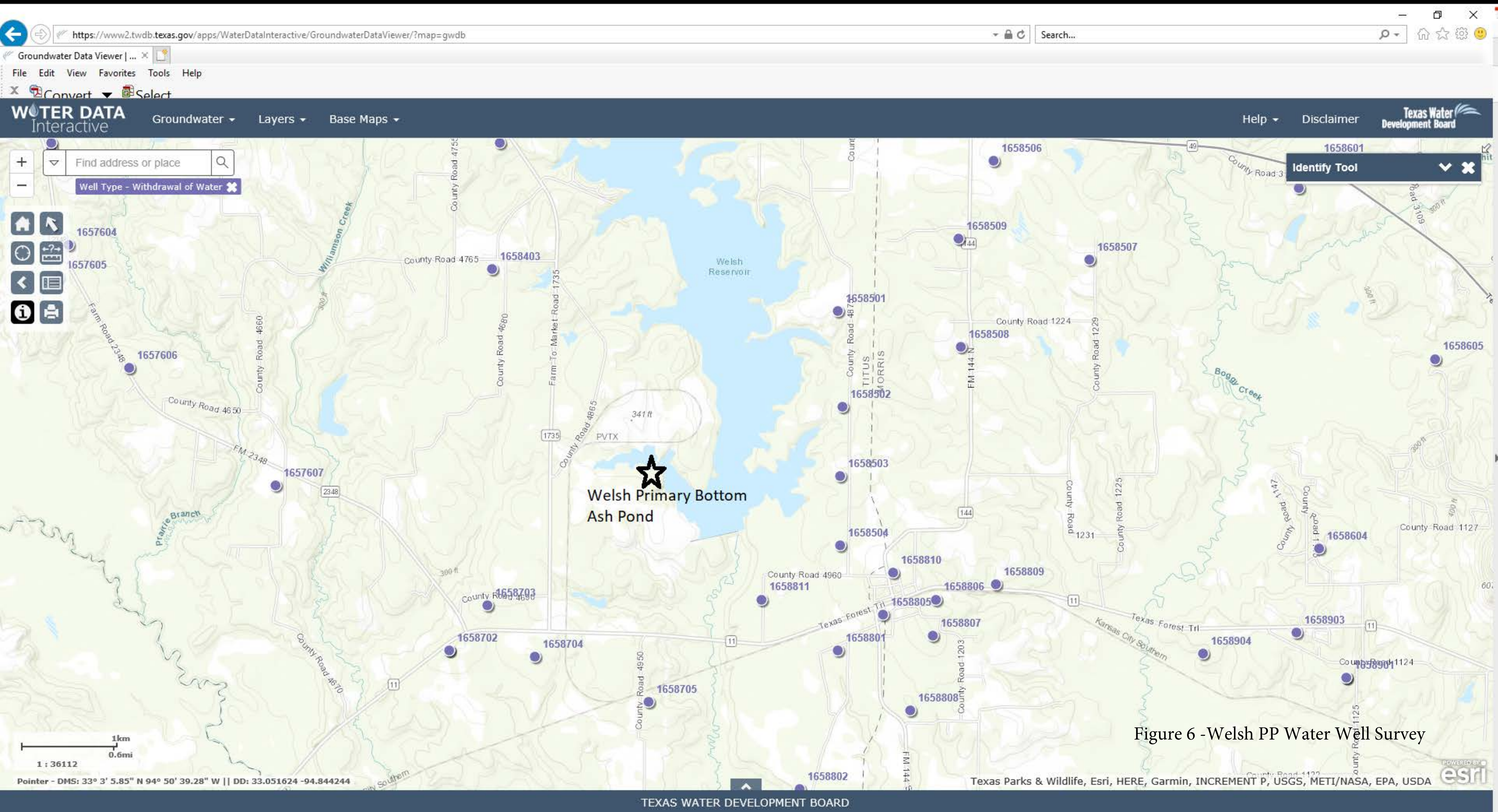
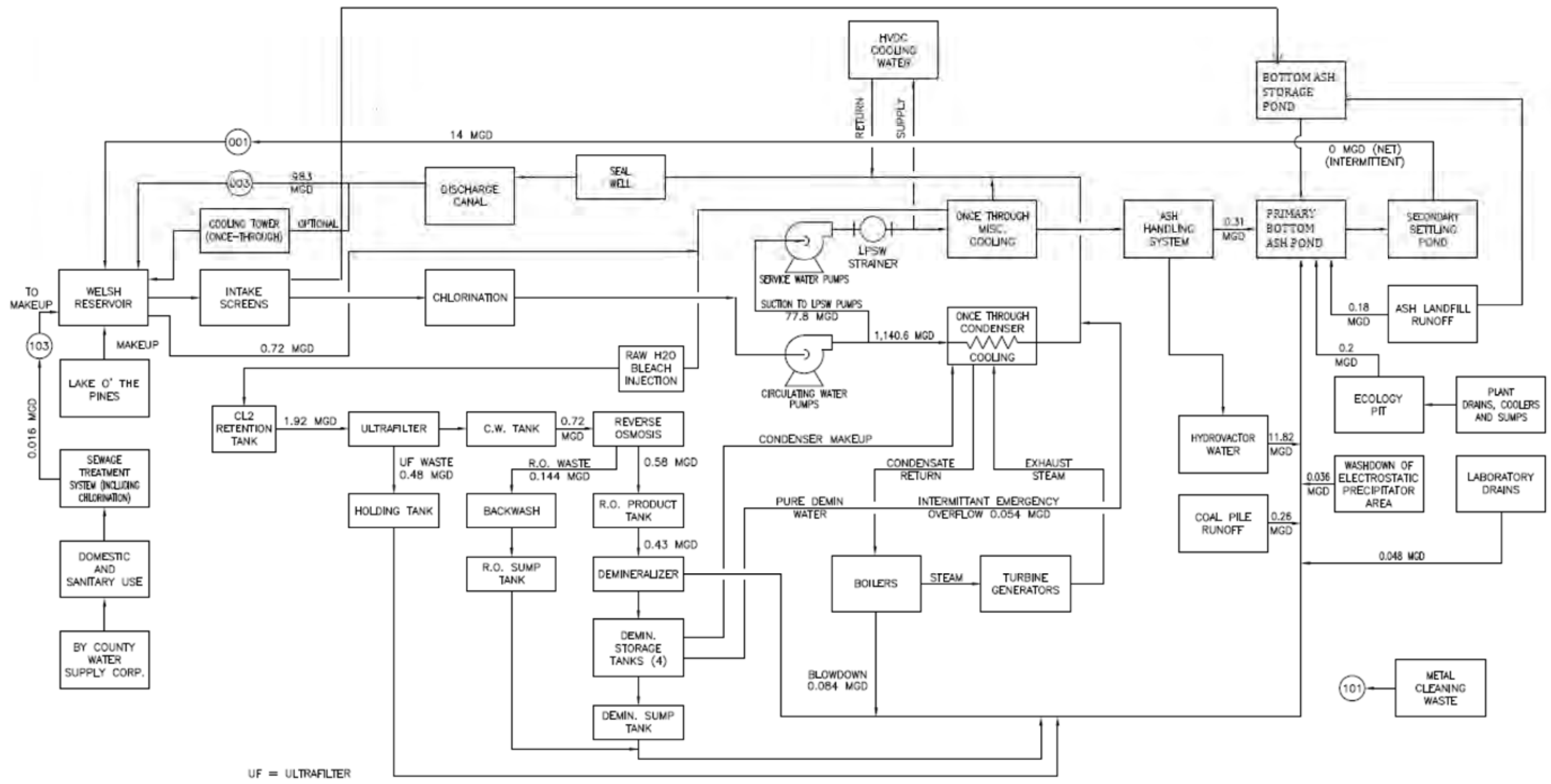


Figure 6 -Welsh PP Water Well Survey

Appendix A
Existing Water Balance



DATE	NO.	DESCRIPTION	APPD.
	11	ISSUED FOR PERMIT RENEWAL PROCESS, PRELIMINARY - REFERENCE ONLY TDA	EM BV

REVISIONS

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SOUTHWESTERN ELECTRIC POWER COMPANY

WELSH PLANT

CASON TEXAS

ENVIRONMENTAL

WATER FLOW DIAGRAM

UNIT: 123

DRAWING NUMBER: WSH7

REV: 11

CIVIL ENGINEERING

SCALE: -
DR: -
CH: -
SUP: -
ENG: -
DATE: SEE REV 0

APPROVED BY

AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

Appendix B
Closure Plan required by 40 CFR §257.102(b)

CLOSURE PLAN

CFR 257.102(b)

Primary Bottom Ash Pond

Welsh Power Plant
Pittsburg, Texas

October 2016
Revised November 2020

Prepared for: Southwest Electric Power Company - Welsh Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

GERS – 20 –011

CLOSURE PLAN
CFR 257.102(b)
WELSH POWER PLANT
PRIMARY BOTTOM ASH POND

PREPARED BY Gary F. Zych DATE 11/22/2020
Gary F. Zych, P.E.

REVIEWED BY Arthur W. Rentzsch DATE 11/23/2020
Arthur W. Rentzsch

APPROVED BY Gary F. Zych DATE 11/24/2020
Gary F. Zych, P.E.
Section Manager – AEP Geotechnical Engineering

American Electric Power Service Corporation
Texas Registered Engineering Firm
No. F-3341

Gary F. Zych
GARY F. ZYCH
127152
11/24/2020

I certify to the best of my knowledge, information, and belief that the information contained in this closure plan meets the requirements of 40 CFR § 257.102(b)

Table of CONTENTS

1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CFR 257.102(b) for Closure Plans of Existing CCR Surface Impoundments

2.0 DESCRIPTION OF THE CCR UNIT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. It is owned and operated by Southwest Electric Power Company (SWEPCO). The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash pond and the Bottom Ash Storage pond. This report addresses the closure plan for the Primary Bottom Ash Pond. The Primary Bottom Ash pond CCR unit is located southwest of the Plant and directly west of the Welsh Reservoir.

The Primary Bottom Ash pond is bounded by natural ground surface (topographically higher areas) to the north and west, and embankment dikes to the south and east. The elevation at the top of embankment along the crest area is approximately 340.0 feet above msl.

3.0 DESCRIPTION OF CLOSURE PLAN 257.102(b)(1)(i)

[A narrative description of how the CCR unit will be closed in accordance with this section]

Closure of the Welsh Power Plant Primary Bottom Ash Pond will be completed by CCR removal.

The closure of the Primary Bottom Ash Pond will include removal of CCR materials within the pond by dredging and/or mechanical means.

4.0 CLOSURE BY REMOVAL 257.102 (b)(1)(ii)

[If closure of the CCR unit will be accomplished through removal of CCR from the CCR unit, a description of the procedures to remove the CCR and decontaminate the CCR unit in accordance with paragraph (c) of this section.]

Closure will include removal of all CCR from the CCR unit. The removal of all CCR unit will be accomplished by dredging and/or mechanical means as decided by the construction contractor with approval by the engineer and AEP. Prior to actual removal, the initial work will include rerouting of non-CCR flows and stormwater runoff that discharge into the pond. The CCR material will be either hauled and placed at the onsite CCR landfill or hauled offsite for beneficial reuse.

A 3rd party QAQC consultant will verify the removal of the CCR material. After verification of CCR removal, 12 inches of bottom soil will be removed as part of the closure of the CCR surface impoundment.

4.1 CLOSURE PERFORMANCE STANDARDS 257.102 (c)

[An owner or operator may elect to close a CCR unit by removing and decontaminating all areas affected by releases from the CCR unit. CCR removal and decontamination of the CCR unit are complete when constituent concentrations throughout the CCR unit and any areas affected by releases from the CCR unit have been removed and groundwater monitoring concentrations do not exceed the groundwater protection standard established pursuant to §257.95(h) for constituents listed in appendix IV to this part.]

Closure of the CCR unit will be completed when all CCR materials in the unit and any soils affected by releases from the CCR unit have been removed and groundwater monitoring demonstrates that all concentrations of the assessment monitoring constituents listed in appendix IV to part 257 do not exceed either statistically equivalent background levels or MCLs for two consecutive sampling events using the statistical procedures in § 257.93(g).

5.0 ESTIMATE OF MAXIMUM CCR VOLUME 257.102 (b)(1)(iv)

[An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit.]

The estimated maximum CCR volume on-site is 530,000 cubic yards for the Primary Bottom Ash Pond.

6.0 ESTIMATE OF LARGEST AREA OF CCR REQUIRING COVER 257.102 (b)(1)(v)

[An estimate of the largest area of CCR unit ever requiring a final cover

This pond will be closed by removal of CCR materials as such this section is not applicable.

7.0 CLOSURE SCHEDULE 257.102(b)(1)(vi)

[A schedule for completing all activities necessary to satisfy the closure criteria in the section, including an estimate of the year in which all closure activities for the CCR unit will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR unit, including identification of major milestones such as coordinating with and obtaining necessary approvals and permits from other agencies, the dewatering and stabilization phases of the CCR surface impoundment closure, or installation of the final cover system, and the estimated timeframes to complete each step or phase of the CCR unit closure.

Table below summarizes the major tasks and durations associated with closing the PBAP.

Initiate PBAP Closure	January 2025
Closure Planning and Engineering	6 months
Environmental and Construction Permits	15 months
Spec, bid, and Award construction contracts	6 months
Commence CCR Closure Phase 1 Construction no later than	February 2027
Dewatering and Wastewater/Stormwater Diversion	3 months
Pond Segregation Berm	2 months
Phase 1 CCR Removal	6 months
Phase 1 Impacted Soil Removal	4 months
Cease Coal Combustion; Start of Phase 2	March 2028
Phase 2 Dewatering	2 months
Phase 2 CCR material removal in remaining PBAP	4 months
Phase 2 Impacted soil removal	3 months
Site Regrading and Restoration	4 months
Complete closure by	October 17, 2028

Appendix C

Groundwater Monitoring and Corrective Action Reports

Annual Groundwater Monitoring Report

Southwestern Electric Power Company
J. Robert Welsh Power Plant

Primary Bottom Ash Pond CCR Management Unit

1187 Country Road 4865
Titus County
Pittsburg, Texas

January 2020

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

Page

Table of Contents

I. Overview

This *Annual Groundwater Monitoring Report* (Report) has been prepared to report the status of activities for the preceding year for an existing CCR unit at Southwestern Electric Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), Welsh Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31, 2020.

In general, the following activities were completed:

- Groundwater samples were collected and analyzed for Appendix III and Appendix IV constituents, as specified in 40 CFR 257.95 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan (2016)*;
- Semi-annual groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- SSL for lithium was determined in AD-9 during the 2nd semi-annual 2018 groundwater monitoring event as well as during the 1st and 2nd semi-annual 2019 groundwater monitoring events;
- SSIs were also determined;
- Successful alternate source demonstrations (ASDs) were conducted for the lithium SSLs in AD-9;
- With regard to the SSL determined in AD-9 during the 2nd semi-annual groundwater monitoring event of 2019, either an ASD will be conducted to evaluate if the unit can remain in assessment monitoring or the unit will move to an assessment of corrective measures;
- Groundwater Monitoring Statistical Evaluation Reports to evaluate groundwater data were prepared in accordance with 40 CFR 257.93 and certified in accordance with 40 CFR 257.93. The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance," USEPA, 2009).
- This CCR Unit remains in assessment monitoring throughout 2019.

The major components of this annual report, to the extent applicable at this time, are presented in sections that follow:

- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers;

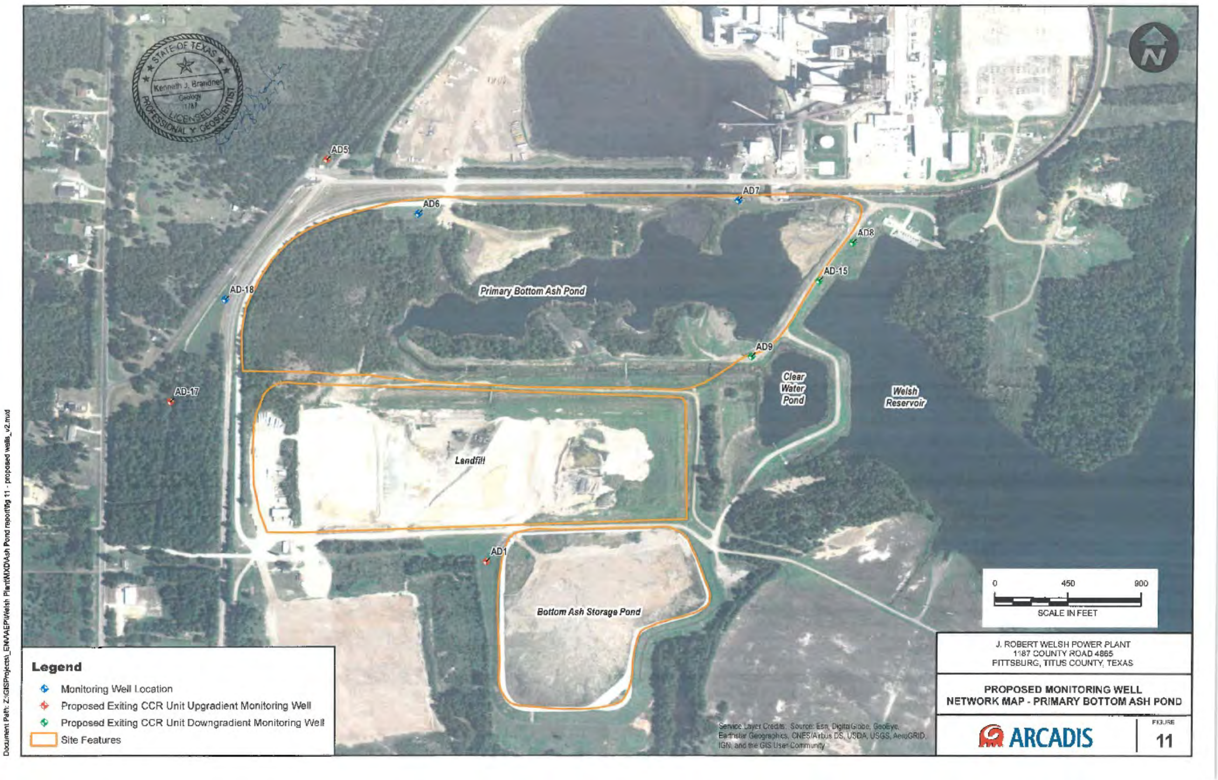
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened;
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs is included in Appendix I;
- Statistical reports are located in Appendix II;
- Alternate source demonstrations are located in Appendix III;
- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring, in addition to identifying the constituents at a statistically significant increase or statistically significant level over background concentrations (Appendix IV);
- Other information required to be included in the annual report such as assessment of corrective measures, if applicable;

  In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.

II. Groundwater Monitoring Well Locations and Identification Numbers

The figure that follows depicts the PE-certified groundwater monitoring network, the monitoring well locations and their corresponding identification numbers.

Primary Bottom Ash Pond Monitoring Wells	
Up Gradient	Down Gradient
AD-1	AD-8
AD-5	AD-9
AD-17	AD-15



III. Monitoring Wells Installed or Decommissioned

During 2019, no monitoring wells were installed or decommissioned.

IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction and Discussion

Appendix I contains tables showing the groundwater quality data collected under 40 CFR 257.90 through 257.98. Static water elevation data from each monitoring event also are shown in Appendix I, along with the groundwater velocity, groundwater flow direction and potentiometric maps developed after each sampling event.

The sampling event conducted 5/30/19 satisfies the requirement of 257.95(b).

V. Statistical Evaluations completed in 2018 and 2019

During the 2nd semi-annual 2018 event the following SSIs were determined:

- Boron concentration exceeded the interwell UPL of 0.765 mg/L at AD-8 (1.3 mg/L)
- pH value was below the interwell LPL of 4.84 SU at AD-15 (4.59 SU).

During the 1st semi-annual 2019 event, the following SSIs were determined:

- Boron concentrations exceeded the interwell UPL of 0.775 mg/L at AD-8 (1.27 mg/L and 1.21 mg/L).

During the 2nd semi-annual 2019 event, the following SSIs were determined:

- Boron concentrations exceeded the interwell UPL of 0.700 mg/L at AD-8 (1.21 mg/L).
- pH measurements were recorded below the interwell LPL of 4.8 SU at AD-15 (3.2 SU).

A SSL was determined for lithium in AD-9 during the 2nd semi-annual 2018 event, 1st and 2nd semi-annual 2019 events.

The statistical reports completed in 2019 are found in Appendix II.

VI. Alternate Source Demonstrations completed in 2019

ASDs were successfully conducted for the lithium SSLs which were determined during the 2nd semi-annual 2018 event and the 1st semi-annual 2019 event.

With regard to the lithium SSL in AD-9 determined during the 2nd semi-annual 2019 groundwater monitoring event, either an ASD will be conducted to evaluate if the unit can remain in assessment monitoring or the unit will move to an assessment of corrective measures.

The successful lithium ASDs are found in Appendix III.

VII. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency

This unit remained in assessment monitoring throughout 2019.

VIII. Other Information Required

As required by the CCR assessment monitoring rules in 40 CFR 257.95 (b) and (d 1), sampling all CCR wells for the required Appendix III and IV parameters was completed in 2019.

IX. Description of Any Problems Encountered in 2019 and Actions Taken

No significant problems were encountered.

X. A Projection of Key Activities for the Upcoming Year

Key activities for 2020 include:

- Assessment monitoring will continue;
- Either an ASD will be conducted to evaluate if the unit can remain in assessment monitoring or the unit will move to an assessment of corrective measures.
- Evaluation of the assessment monitoring results from a statistical analysis viewpoint, looking for SSIs as well as SSLs above GWPS;
- Responding to any new data received in light of CCR rule requirements;
- Preparation of the next annual groundwater report.

APPENDIX I

Tables follow, showing the groundwater monitoring data collected, the rate and direction of groundwater flow, and a summary showing the number of samples collected per monitoring well. The dates that the samples were collected also is shown.

Legend

⊕ Groundwater Monitoring Well

→ Approximate Groundwater Flow Direction

— Groundwater Elevation Contour

▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on February 20-21, 2019) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.
- AD-16 was replaced with AD-16R on 4/12/2017.

500 250 0 500 Feet

Groundwater Potentiometric Map
February 2019

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Figure

1

Columbus, Ohio

2020/01/22

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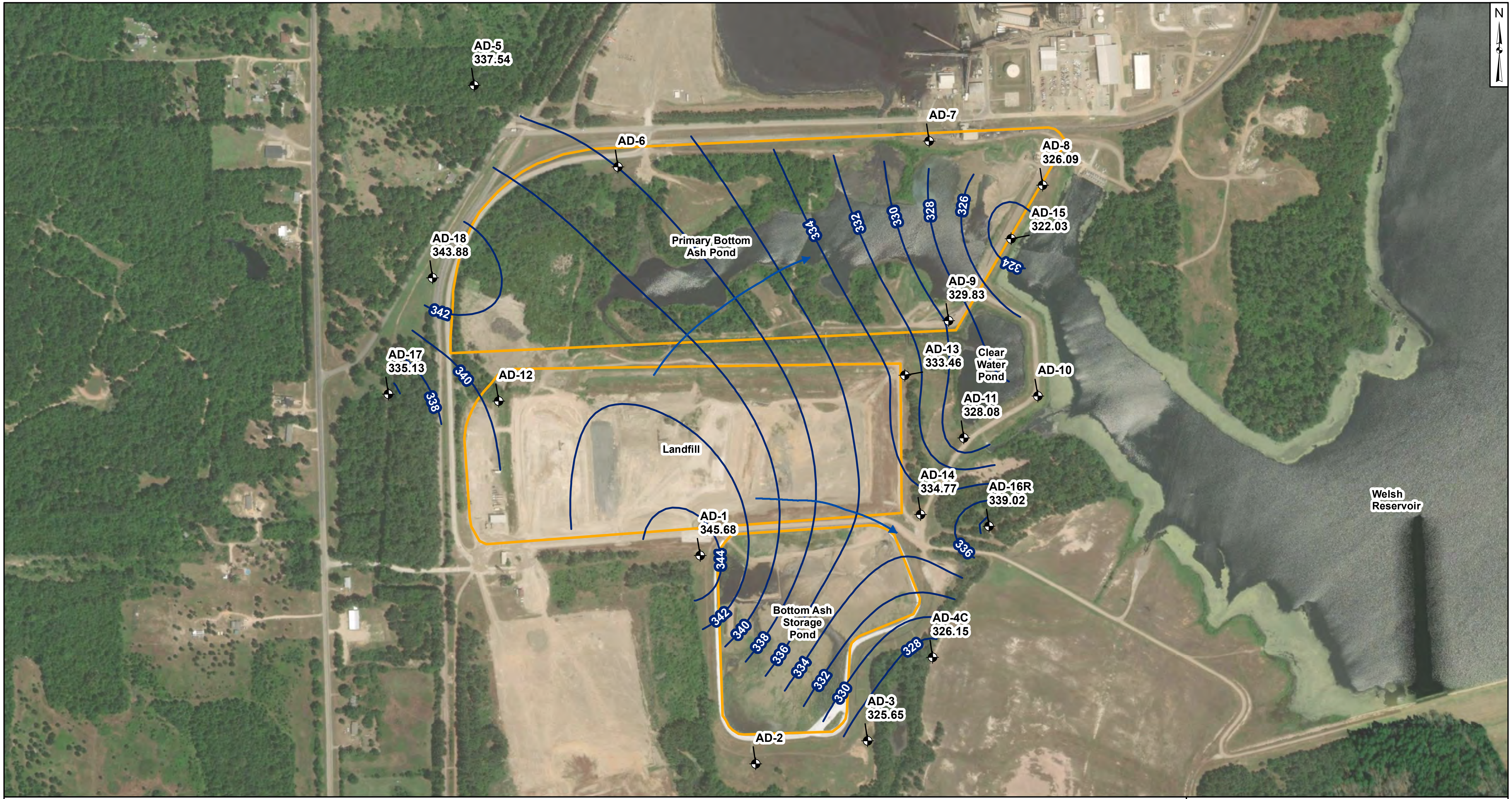

Legend

- ⌖ Groundwater Monitoring Well
- → Approximate Groundwater Flow Direction
- — Groundwater Elevation Contour
- ▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on May 29-30, 2019) provided by AEP.
- AD-10, AD-6, AD-7, AD-2, and AD-12 were not gauged during this event
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.
- AD-16 was replaced with AD-16R on 4/12/2017.

750 375 0 750
Feet

Groundwater Potentiometric Map
May 2019

AEP Welsh Power Plant
Cason, Texas

Geosyntec consultants

Columbus, Ohio
2019/12/12

Figure
2

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Legend
- ⊕ Groundwater Monitoring Well
- → Approximate Groundwater Flow Direction
- — Groundwater Elevation Contour
- - - Groundwater Elevation Contour (Inferred)
- ▭ CCR Units

Notes
- Monitoring well coordinates and water level data (collected on July 23-24, 2019) provided by AEP.
-AD-12 and AD-6 were not gauged during this event.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.
- Inferred groundwater contours were ectrapolated from topographic and hydrographic information as well as previous monitoring events.

750 375 0 750
Feet

Groundwater Potentiometric Map
July 2019

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Columbus, Ohio | 2020/01/22

Figure
3

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Table 1: Residence Time Calculation Summary
Welsh Primary Bottom Ash Pond

			2019-02		**2019-05**		**2019-07**	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Primary Bottom Ash Pond	AD-1 [1]	2.0	2.7	22.4	5.3	11.5	4.1	14.9
	AD-5 [1]	2.0	1.5	40.2	2.4	25.4	2.1	29.2
	AD-8 [2]	2.0	4.1	14.7	4.1	14.8	5.3	11.5
	AD-9 [2]	2.0	4.8	12.8	4.5	13.6	5.1	12.0
	AD-15 [2]	2.0	6.4	9.5	5.5	11.1	7.0	8.7
	AD-17 [1]	2.0	8.9	6.9	4.7	13.0	3.5	17.5

Notes:

[1] - Upgradient Well

[2] - Downgradient Well

Table 1 - Groundwater Data Summary: AD-1
Welsh - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/26/2016	Background	0.346	36.5	5	<0.083 U	5.9	252	42
7/29/2016	Background	0.35	39.6	4	<0.083 U	5.3	239	36
9/30/2016	Background	0.332	15	5	<0.083 U	5.4	173	35
10/21/2016	Background	0.398	19.1	4	<0.083 U	5.2	192	42
12/14/2016	Background	0.394	8.74	4	<0.083 U	5.2	200	40
1/20/2017	Background	0.656	129	4	<0.083 U	7.1	538	68
2/24/2017	Background	0.7	147	9	<0.083 U	6.9	612	68
6/8/2017	Background	0.449	15.1	4	<0.083 U	5.1	176	42
10/6/2017	Detection	0.453	14.3	4	<0.083 U	5.3	160	40
5/24/2018	Assessment	0.345	10.2	4	<0.083 U	2.2	150	43
8/14/2018	Assessment	0.443	5.95	5	<0.083 U	5.2	160	44
2/20/2019	Assessment	0.504	142	2.82	0.24	7.3	522	49.2
5/30/2019	Assessment	0.689	138	1.59	0.29	6.7	588	43.3
7/24/2019	Assessment	0.644	62.7	2	0.106 J	6.0	180	58

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-1
Welsh - PBAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/26/2016	Background	<0.93 U	1.39361 J	191	0.271453 J	0.213294 J	0.240267 J	1.15339 J	1.184	<0.083 U	<0.68 U	0.01	0.033	0.53149 J	1.74922 J	0.959865 J
7/29/2016	Background	<0.93 U	<1.05 U	191	0.315631 J	0.0940357 J	<0.23 U	0.615933 J	0.9952	<0.083 U	<0.68 U	0.019	0.00793 J	<0.29 U	1.81763 J	<0.86 U
9/30/2016	Background	<0.93 U	2.96797 J	141	0.382874 J	<0.07 U	5	0.850408 J	1.38	<0.083 U	3.38434 J	0.014	0.01773 J	<0.29 U	1.02629 J	<0.86 U
10/21/2016	Background	<0.93 U	<1.05 U	114	0.311247 J	<0.07 U	0.412131 J	0.649606 J	1.141	<0.083 U	<0.68 U	0.008	0.00534 J	1.39872 J	2.03168 J	1.25062 J
12/14/2016	Background	<0.93 U	<1.05 U	72	0.34133 J	<0.07 U	<0.23 U	0.424105 J	0.719	<0.083 U	<0.68 U	0.008	0.01521 J	<0.29 U	1.85825 J	<0.86 U
1/20/2017	Background	<0.93 U	<1.05 U	410	0.0366913 J	<0.07 U	<0.23 U	0.480125 J	3.009	<0.083 U	<0.68 U	0.000275956 J	<0.005 U	<0.29 U	4.04737 J	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	488	<0.02 U	<0.07 U	<0.23 U	0.765099 J	4.309	<0.083 U	<0.68 U	0.001	<0.005 U	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	1.14 J	93.46	0.37 J	<0.07 U	0.66 J	0.77 J	0.676	<0.083 U	<0.68 U	0.00902	0.007 J	<0.29 U	2.1 J	<0.86 U
5/24/2018	Assessment	3.17 J	<1.05 U	79.9	0.39 J	<0.07 U	<0.23 U	0.35 J	1.983	<0.083 U	<0.68 U	0.00814	0.006 J	<0.29 U	1.38 J	<0.86 U
8/14/2018	Assessment	0.03 J	0.21	63	0.482	0.02	- -	- -	1.102	<0.083 U	0.238	0.00708	0.013 J	0.210	1.7	0.03 J
2/20/2019	Assessment	0.16	0.46	457	0.09 J	0.01 J	0.306	0.399	3.159	0.24	0.124	0.00155	<0.005 U	1 J	0.7	<0.1 U
5/30/2019	Assessment	0.16	0.60	512	0.244	0.01 J	0.1 J	0.756	2.717	0.29	0.197	<0.009 U	<0.005 U	2.43	1.4	<0.1 U
7/24/2019	Assessment	0.08 J	0.39	245	0.54	0.02 J	0.1 J	0.789	1.819	0.106 J	0.1 J	0.00557	<0.005 U	2 J	3.4	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-5
Welsh - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.03	36.9	15	0.3469 J	6.4	337	123
7/29/2016	Background	0.04	44.7	16	<0.083 U	5.4	360	163
9/30/2016	Background	0.04	46.3	15	0.2436 J	5.3	416	190
10/21/2016	Background	0.05	50.7	14	<0.083 U	5.9	448	267
12/14/2016	Background	0.05	49.6	13	<0.083 U	6.2	484	233
1/20/2017	Background	0.04	49.8	14	<0.083 U	6.3	438	234
2/24/2017	Background	0.04	33	15	<0.083 U	5.5	286	127
6/8/2017	Background	0.05281	49.7	14	<0.083 U	6.0	300	82
10/6/2017	Detection	0.04322	33.1	16	<0.083 U	5.6	258	82
5/24/2018	Assessment	0.05007	28.1	22	<0.083 U	6.2	242	60
8/15/2018	Assessment	0.05	40.5	19	<0.083 U	6.2	428	240
2/21/2019	Assessment	0.033	33.9	24.7	0.21	5.4	220	46.5
5/30/2019	Assessment	0.03 J	30.0	22.3	0.29	6.3	238	51.3
7/24/2019	Assessment	0.04 J	41.1	18	0.112 J	6.3	354	90

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-5
Welsh - PBAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	<0.93 U	<1.05 U	57	0.149801 J	0.0765156 J	0.555038 J	14	1.634	0.3469 J	<0.68 U	0.135	0.01135 J	<0.29 U	<0.99 U	<0.86 U
7/29/2016	Background	2.05116 J	2.90819 J	93	0.518653 J	0.502155 J	0.411466 J	15	4.75	<0.083 U	<0.68 U	0.191	0.01516 J	<0.29 U	1.08901 J	<0.86 U
9/30/2016	Background	<0.93 U	4.7609 J	87	0.251584 J	<0.07 U	0.90676 J	14	3.33	0.2436 J	<0.68 U	0.186	<0.005 U	<0.29 U	<0.99 U	<0.86 U
10/21/2016	Background	<0.93 U	<1.05 U	70	0.08781 J	0.107488 J	0.248085 J	9	2.319	<0.083 U	<0.68 U	0.225	<0.005 U	1.36984 J	<0.99 U	<0.86 U
12/14/2016	Background	<0.93 U	1.15381 J	53	0.164529 J	0.203546 J	0.747921 J	13	2.182	<0.083 U	<0.68 U	0.199	0.00802 J	<0.29 U	<0.99 U	<0.86 U
1/20/2017	Background	<0.93 U	<1.05 U	47	0.0574718 J	0.180502 J	<0.23 U	12	1.023	<0.083 U	<0.68 U	0.239	<0.005 U	<0.29 U	<0.99 U	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	42	0.0306858 J	<0.07 U	<0.23 U	13	1.788	<0.083 U	<0.68 U	0.166	<0.005 U	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	3.85 J	87.7	0.08 J	0.39 J	0.28 J	11.93	2.32	<0.083 U	<0.68 U	0.124	<0.005 U	<0.29 U	<0.99 U	<0.86 U
5/24/2018	Assessment	<0.93 U	<1.05 U	71.16	<0.02 U	0.23 J	0.8 J	14.24	1.946	<0.083 U	<0.68 U	0.121	<0.005 U	<0.29 U	<0.99 U	<0.86 U
8/15/2018	Assessment	0.01 J	1.69	63.7	0.055	0.008 J	0.072	11.4	0.316	<0.083 U	0.079	0.147	<0.005 U	0.13	0.08 J	<0.01 U
2/21/2019	Assessment	0.02 J	1.59	69.4	0.08 J	<0.01 U	0.432	8.58	1.267	0.21	0.147	0.0807	<0.005 U	<0.4 U	0.1 J	<0.1 U
5/30/2019	Assessment	<0.02 U	3.05	60.5	0.08 J	<0.01 U	0.06 J	11.8	1.431	0.29	0.05 J	0.104	0.006 J	<0.4 U	0.05 J	<0.1 U
7/24/2019	Assessment	<0.02 U	2.48	77.4	0.05 J	<0.01 U	0.05 J	8.38	2.533	0.112 J	<0.05 U	0.108	<0.005 U	<0.4 U	0.06 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-8
Welsh - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	1.46	32.6	36	0.6507 J	6.9	524	217
7/29/2016	Background	1.44	25.9	26	0.485 J	5.4	469	202
9/30/2016	Background	1.51	24.3	28	0.4912 J	7.7	432	186
10/21/2016	Background	1.54	25.9	30	0.6234 J	6.1	424	184
12/14/2016	Background	1.53	23.6	27	0.5355 J	5.6	442	168
1/20/2017	Background	1.53	18.7	24	0.5574 J	6.2	352	153
2/24/2017	Background	1.67	19.3	22	<0.083 U	6.8	356	163
6/8/2017	Background	1.39	17.4	22	0.6628 J	5.6	368	151
10/6/2017	Detection	1.49	14.9	20	<0.083 U	6.7	284	128
1/4/2018	Detection	1.47	- -	- -	- -	- -	- -	- -
5/23/2018	Assessment	- -	- -	- -	0.501 J	6.2	- -	- -
8/15/2018	Assessment	- -	- -	- -	- -	6.8	- -	- -
9/17/2018	Assessment	1.3	15	24	- -	- -	288	122
2/5/2019	Assessment	2.55	19.7	22.8	0.72	5.4	- -	153
2/21/2019	Assessment	1.47	17.6	23.2	0.66	6.4	352	163
4/30/2019	Assessment	1.21	- -	- -	- -	6.9	- -	- -
5/29/2019	Assessment	1.07	16.9	19.5	0.89	5.5	324	150
7/23/2019	Assessment	1.21	20.8	15	0.559 J	6.6	392	145

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-8
Welsh - PBAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**pCi/L**	**mg/L**	**µg/L**	**mg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
5/31/2016	Background	<0.93 U	1.06251 J	34	0.114491 J	<0.07 U	2	7	1.046	0.6507 J	<0.68 U	0.122	0.02103 J	1.01326 J	1.37017 J	1.18455 J
7/29/2016	Background	1.46141 J	<1.05 U	26	0.171642 J	<0.07 U	0.751164 J	9	1.584	0.485 J	<0.68 U	0.098	0.00859 J	1.48301 J	1.96333 J	<0.86 U
9/30/2016	Background	<0.93 U	<1.05 U	23	<0.02 U	<0.07 U	0.51348 J	7	6.3	0.4912 J	<0.68 U	0.111	<0.005 U	<0.29 U	<0.99 U	<0.86 U
10/21/2016	Background	<0.93 U	<1.05 U	24	0.028758 J	<0.07 U	0.617826 J	7	0.3449	0.6234 J	<0.68 U	0.135	<0.005 U	0.838863 J	<0.99 U	1.64377 J
12/14/2016	Background	<0.93 U	<1.05 U	21	<0.02 U	<0.07 U	<0.23 U	7	1.083	0.5355 J	<0.68 U	0.11	0.01007 J	<0.29 U	<0.99 U	<0.86 U
1/20/2017	Background	<0.93 U	<1.05 U	20	<0.02 U	<0.07 U	<0.23 U	6	0.823	0.5574 J	<0.68 U	0.094	<0.005 U	<0.29 U	<0.99 U	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	19	<0.02 U	<0.07 U	<0.23 U	6	0.536	<0.083 U	<0.68 U	0.092	<0.005 U	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	<1.05 U	19.08	<0.02 U	<0.07 U	<0.23 U	3.86 J	1.0735	0.6628 J	<0.68 U	0.09491	0.008 J	<0.29 U	<0.99 U	<0.86 U
5/23/2018	Assessment	3.19 J	<1.05 U	22.12	<0.02 U	<0.07 U	<0.23 U	3.19 J	0.3366	0.501 J	<0.68 U	0.0956	<0.005 U	<0.29 U	1.75 J	<0.86 U
8/15/2018	Assessment	0.01 J	0.31	21.2	0.008 J	0.02 J	0.05	5.36	3.44	- -	0.039	0.0555	0.007	0.16	0.07 J	0.129
2/21/2019	Assessment	<0.02 U	0.57	28.1	0.03 J	0.03 J	0.456	2.88	0.417	0.66	0.223	0.0911	<0.005 U	<0.4 U	0.1 J	<0.1 U
5/29/2019	Assessment	<0.02 U	0.37	30.3	<0.02 U	0.02 J	0.1 J	6.03	0.911	0.89	0.07 J	0.067	<0.005 U	<0.4 U	0.06 J	0.1 J
7/23/2019	Assessment	<0.02 U	0.41	31.0	<0.02 U	0.02 J	0.09 J	7.07	0.72	0.559 J	0.08 J	0.0641	<0.005 U	<0.4 U	0.08 J	0.1 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-9
Welsh - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.120	229	88	0.4191 J	6.3	2541	1352
7/29/2016	Background	0.105	255	98	0.4339 J	5.0	2564	1464
9/30/2016	Background	0.115	220	86	0.304 J	4.7	2448	1301
10/21/2016	Background	0.109	228	76	0.6227 J	5.2	2494	1350
12/14/2016	Background	0.108	250	92	<0.083 U	5.7	2667	1639
1/20/2017	Background	0.312	91.1	54	<0.083 U	5.4	1360	884
2/24/2017	Background	0.1	258	86	<0.083 U	5.8	2662	1774
6/8/2017	Background	0.146	191	19	<0.083 U	4.6	308	105
10/6/2017	Detection	0.129	9.64	20	<0.083 U	5.8	248	86
5/23/2018	Assessment	- -	- -	- -	<0.083 U	5.3	- -	- -
8/15/2018	Assessment	- -	- -	- -	- -	5.0	- -	- -
9/17/2018	Assessment	0.198	230	103	- -	- -	2694	1910
2/5/2019	Assessment	0.096	133	27.9	0.16	4.2	- -	181
2/21/2019	Assessment	1.39	211	89	0.19	5.0	2240	1350
4/30/2019	Assessment	0.07	- -	- -	- -	4.5	- -	- -
5/29/2019	Assessment	0.06 J	10.1	44.0	0.16	3.6	1758	503
7/23/2019	Assessment	0.081	222	77	0.5736 J	6.3	2460	1701

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-9
Welsh - PBAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	<0.93 U	<1.05 U	51	0.999439 J	1	<0.23 U	27	2.945	0.4191 J	<0.68 U	1.32	0.0194 J	<0.29 U	1.04175 J	<0.86 U
7/29/2016	Background	<0.93 U	<1.05 U	31	0.726564 J	2	0.262163 J	22	1.447	0.4339 J	<0.68 U	1.38	0.045	<0.29 U	8.00	<0.86 U
9/30/2016	Background	<0.93 U	<1.05 U	33	0.582852 J	0.187457 J	<0.23 U	12	3.199	0.304 J	<0.68 U	1.17	0.00739 J	<0.29 U	3.52832 J	<0.86 U
10/21/2016	Background	<0.93 U	<1.05 U	26	0.478576 J	0.965032 J	<0.23 U	16	1.311	0.6227 J	<0.68 U	1.44	<0.005 U	<0.29 U	3.09028 J	<0.86 U
12/14/2016	Background	<0.93 U	<1.05 U	27	0.481339 J	2	<0.23 U	24	3	<0.083 U	<0.68 U	1.33	0.02123 J	<0.29 U	<0.99 U	<0.86 U
1/20/2017	Background	<0.93 U	<1.05 U	98	2	0.693618 J	<0.23 U	42	2.349	<0.083 U	<0.68 U	0.634	0.00717 J	<0.29 U	<0.99 U	1.7755 J
2/24/2017	Background	<0.93 U	<1.05 U	22	0.301057 J	0.680144 J	<0.23 U	24	2.32	<0.083 U	<0.68 U	1.41	<0.005 U	<0.29 U	1.06022 J	1.45295 J
6/8/2017	Background	<0.93 U	<1.05 U	42.27	0.77 J	2.22	<0.23 U	24.16	1.586	<0.083 U	<0.68 U	1	0.006 J	<0.29 U	<0.99 U	<0.86 U
5/23/2018	Assessment	<0.93 U	<1.05 U	30.45	0.32 J	2.88	<0.23 U	26.7	2.556	<0.083 U	<0.68 U	1.2	<0.005 U	<0.29 U	<0.99 U	8.46
8/15/2018	Assessment	<10 U	1.68	24.2	0.268	0.06	0.42	11.1	1.864	- -	0.262	0.851	0.013	0.11	0.3	0.062
2/21/2019	Assessment	<0.02 U	1.18	52.4	0.474	0.09	0.313	14.8	2.51	0.19	0.08 J	1.12	0.01 J	<0.4 U	0.3	0.1 J
5/29/2019	Assessment	<0.02 U	0.20	49.7	0.941	0.21	0.346	15.9	1.360	0.16	0.07 J	0.225	<0.005 U	<0.4 U	0.2	0.2 J
7/23/2019	Assessment	<0.02 U	1.39	32.1	0.361	0.06	0.2 J	12.7	1.689	0.5736 J	0.2 J	1.11	<0.005 U	<0.4 U	0.4	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-15
Welsh - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.329	5.09	30	<0.083 U	5.6	188	24
7/29/2016	Background	0.407	3.83	34	<0.083 U	4.8	196	28
9/30/2016	Background	0.360	13.7	28	0.2621 J	4.6	367	23
10/21/2016	Background	0.152	4.57	26	<0.083 U	4.4	152	17
12/14/2016	Background	0.334	3.6	26	<0.083 U	4.7	204	19
1/20/2017	Background	0.413	3.35	32	<0.083 U	5.8	176	25
2/24/2017	Background	0.1	4.21	20	<0.083 U	4.6	88	8
6/8/2017	Background	0.321	3.57	27	<0.083 U	4.8	184	19
10/6/2017	Detection	0.395	3.08	30	<0.083 U	5.9	200	21
5/23/2018	Assessment	- -	- -	- -	<0.083 U	4.8	- -	- -
8/15/2018	Assessment	- -	- -	- -	- -	4.6	- -	- -
9/17/2018	Assessment	0.341	3.04	37	- -	- -	174	24
2/5/2019	Assessment	0.03 J	2.18	20.6	0.06	3.9	- -	0.2 J
2/21/2019	Assessment	0.169	2.67	28.2	0.09	5.0	150	10.6
5/29/2019	Assessment	<0.02 U	2.97	21.4	0.06 J	4.9	34	2.1
7/23/2019	Assessment	0.306	3.45	28	0.086 J	3.2	214	18

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-15
Welsh - PBAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	<0.93 U	12	215	0.959793 J	0.351465 J	17	11	2.284	<0.083 U	7	0.017	0.054	1.77432 J	3.46337 J	<0.86 U
7/29/2016	Background	<0.93 U	6	124	0.362598 J	0.111427 J	4	6	1.322	<0.083 U	<0.68 U	0.021	0.01646 J	0.586779 J	1.19442 J	<0.86 U
9/30/2016	Background	<0.93 U	131	1930	15	7.00	280	134	9.92	0.2621 J	161	0.149	0.707	3.60313 J	14.0	<0.86 U
10/21/2016	Background	<0.93 U	23	415	2	0.575938 J	54	19	3.567	<0.083 U	22	0.036	0.1	1.54555 J	1.17613 J	1.55993 J
12/14/2016	Background	<0.93 U	6	184	0.695316 J	0.246456 J	15	10	3.36	<0.083 U	3.96087 J	0.013	0.026	0.463544 J	1.32943 J	<0.86 U
1/20/2017	Background	<0.93 U	6	153	0.449612 J	<0.07 U	9	7	2.386	<0.083 U	2.87518 J	0.008	0.01932 J	<0.29 U	<0.99 U	<0.86 U
2/24/2017	Background	<0.93 U	20	353	2	0.319406 J	49	20	2.261	<0.083 U	19	0.025	0.058	1.42695 J	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	8.54	166	0.61 J	0.48 J	12.35	8.44	2.491	<0.083 U	2.98 J	0.0108	0.022 J	<0.29 U	2.71 J	<0.86 U
5/23/2018	Assessment	<0.93 U	2.56 J	102	0.03 J	0.1 J	2.63	4.74 J	1.46	<0.083 U	<0.68 U	0.00562	<0.005 U	<0.29 U	1.54 J	1.37 J
8/15/2018	Assessment	0.03 J	3.26	85.2	0.116	0.01 J	0.481	3.71	1.076	- -	0.438	0.00338	- -	0.05 J	0.9	0.09
2/21/2019	Assessment	<0.02 U	2.21	76.6	0.208	0.01 J	0.225	2.90	0.841	0.090	0.104	0.00294	<0.005 U	<0.4 U	0.4	<0.1 U
5/29/2019	Assessment	0.05 J	2.95	203	1.50	0.08	9.31	5.49	3.55	0.06 J	9.85	0.01 J	0.081	<0.4 U	5.1	0.1 J
7/23/2019	Assessment	0.03 J	2.10	113	0.573	0.04 J	2.26	5.41	2.245	0.086 J	2.87	0.00414	0.025	<0.4 U	1.6	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-17
Welsh - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/26/2016	Background	0.121	200	43	0.4023 J	7.2	1810	1166
7/29/2016	Background	0.119	195	32	0.4135 J	5.7	1576	1005
9/30/2016	Background	0.111	191	36	0.3055 J	6.2	1663	1055
10/21/2016	Background	0.124	194	32	0.583 J	6.1	1612	1163
12/14/2016	Background	0.135	196	31	0.5399 J	6.0	1560	1096
1/20/2017	Background	0.101	196	33	<0.083 U	5.9	1686	1445
2/24/2017	Background	0.135	189	30	<0.083 U	5.7	1628	1055
6/8/2017	Background	0.121	188	30	<0.083 U	5.8	1578	1105
10/6/2017	Detection	0.183	183	31	<0.083 U	5.9	1548	1090
5/24/2018	Assessment	0.239	193	39	<0.083 U	6.3	1836	1067
8/15/2018	Assessment	0.118	187	40	<0.083 U	5.6	1748	1168
2/21/2019	Assessment	0.151	207	43.2	0.18	6.9	1722	1060
5/30/2019	Assessment	0.158	202	41.7	<0.04 U	6.1	1546	1120
7/24/2019	Assessment	0.113	216	37	0.085 J	6.0	1864	1127

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-17
Welsh - PBAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/26/2016	Background	<0.93 U	1.37501 J	21	0.173275 J	2	1	63	1.525	0.4023 J	<0.68 U	0.37	0.032	<0.29 U	<0.99 U	<0.86 U
7/29/2016	Background	1.13716 J	<1.05 U	20	0.307264 J	4	1	68	2.78	0.4135 J	<0.68 U	0.374	0.02133 J	1.04115 J	4.56733 J	<0.86 U
9/30/2016	Background	<0.93 U	<1.05 U	31	0.175474 J	0.848199 J	3	58	2.358	0.3055 J	<0.68 U	0.354	<0.005 U	<0.29 U	<0.99 U	<0.86 U
10/21/2016	Background	<0.93 U	<1.05 U	34	0.200656 J	2	4	65	2.224	0.583 J	<0.68 U	0.394	<0.005 U	0.322249 J	3.34422 J	<0.86 U
12/14/2016	Background	<0.93 U	<1.05 U	17	0.0498325 J	3	0.816224 J	68	2.384	0.5399 J	<0.68 U	0.323	0.01485 J	<0.29 U	<0.99 U	<0.86 U
1/20/2017	Background	<0.93 U	<1.05 U	14	0.0319852 J	3	68	68	2.436	<0.083 U	<0.68 U	0.341	<0.005 U	<0.29 U	<0.99 U	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	20	0.0665729 J	2	1	73	2.288	<0.083 U	<0.68 U	0.331	<0.005 U	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	<1.05 U	10.3	<0.02 U	6.06	<0.23 U	74.8	1.598	<0.083 U	<0.68 U	0.329	0.013 J	<0.29 U	<0.99 U	<0.86 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

APPENDIX II

Where applicable, show in this appendix the results from statistical analyses, and a description of the statistical analysis method chosen. These statistical analyses are to be conducted separately for each constituent in each monitoring well.

STATISTICAL ANALYSIS SUMMARY
PRIMARY BOTTOM ASH POND
J. Robert Welsh Plant
Pittsburg, Texas

Submitted to

AMERICAN
ELECTRIC
POWER

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Columbus, Ohio 43215-2372

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January 8, 2019

CHA8473

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
PBAP	Primary Bottom Ash Pond
QA	Quality Assurance
QC	Quality Control
RSL	Regional Screening Level
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Primary Bottom Ash Pond (PBAP), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas.

Based on detection monitoring conducted in 2017 and 2018, a statistically significant increase (SSI) over background was concluded for boron at the PBAP. An alternate source was not identified at the time, so two assessment monitoring events were conducted at the PBAP in 2018, in accordance with 40 CFR 257.95.

Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at a statistically significant level (SSL) above the GWPS. An SSL was identified for lithium. Thus, either the unit will move to an assessment of corrective measures or an alternative source demonstration (ASD) will be conducted to evaluate if the unit can remain in assessment monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

PRIMARY BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, samples were collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(b) and 257.95(d)(1). Samples collected from background wells for the May and August 2018 sampling events were analyzed for both Appendix III and Appendix IV parameters, whereas samples collected from downgradient wells were analyzed for Appendix IV parameters only. Lead and molybdenum values for the August 2018 event are not reported as they were not detected in any wells during the first event. Additional samples were collected from downgradient wells for Appendix III parameters in September 2018. A summary of data collected during assessment monitoring may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.5 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the PBAP were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained to meet the requirements of 40 CFR 257.95(b) and 257.95(d)(1) were screened for potential outliers. Outliers for the Appendix III parameters identified from the background and detection monitoring events conducted through January 2018 were summarized in a previous report (Geosyntec, 2018). The reported chromium value of 0.068 milligrams per liter (mg/L) for the January 20, 2017 sampling event at background well AD-17 was removed as an outlier. No other outliers were identified.

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or regional screening level (RSL) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events. Tolerance limits were calculated parametrically with 95% coverage and 95% confidence for barium, beryllium, and combined radium. Non-parametric tolerance limits were calculated for arsenic, chromium, cobalt, lithium, mercury, molybdenum and selenium due to apparent non-normal distributions; for antimony, fluoride, lead, and thallium due to a high non-detect frequency; and for cadmium due to both an apparent non-normal distribution and a high non-detect frequency. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

The following SSL was identified at the Welsh PBAP:

- The LCL for lithium exceeded the GWPS of 0.390 mg/L at AD-9 (0.935 mg/L).

As a result, the Welsh PBAP will either move to an assessment of corrective measures or an alternative source demonstration will be conducted to evaluate if the unit can remain in assessment monitoring.

2.3 Conclusions

Three assessment monitoring events were conducted in 2018 in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the 2018 data. GWPSs were established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPS. An SSL for lithium was identified.

Based on this evaluation, the Welsh PBAP CCR unit will either move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Welsh Plant. January 2017.

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – Primary Bottom Ash Pond, J Robert Welsh Plant, Pittsburg, Texas. January 15, 2018.

TABLES

Table 1 – Groundwater Data Summary
Welsh – Primary Bottom Ash Pond

Parameter	Unit	AD-1		AD-5		AD-8			AD-9			AD-15			AD-17	
		5/24/2018	**8/14/2018**	**5/24/2018**	**8/15/2018**	**5/23/2018**	**8/15/2018**	**9/17/2018**	**5/23/2018**	**8/15/2018**	**9/17/2018**	**5/23/2018**	**8/15/2018**	**9/17/2018**	**5/24/2018**	**8/15/2018**
Antimony	mg/L	0.00317 J	0.0000300 J	0.005 U	0.0000100 J	0.00319 J	0.0000100 J	-	0.005 U	0.00005 U	-	0.005 U	0.0000300 J	-	0.005 U	0.0000200 J
Arsenic	mg/L	0.005 U	0.000210	0.005 U	0.00169	0.005 U	0.000310	-	0.005 U	0.00168	-	0.00256 J	0.00326	-	0.005 U	0.00183
Barium	mg/L	0.0799	0.0630	0.0712	0.0637	0.0221	0.0212	-	0.0305	0.0242	-	0.102	0.0852	-	0.00965	0.0128
Beryllium	mg/L	0.000390 J	0.000482	0.001 U	0.0000550	0.001 U	0.00000800 J	-	0.000320 J	0.000268	-	0.0000300 J	0.000116	-	0.001 U	0.0000690
Boron	mg/L	0.345	0.443	0.0501	0.0500	-	-	1.30	-	-	0.198	-	-	0.341	0.239	0.118
Cadmium	mg/L	0.001 U	0.0000200	0.000230 J	0.00000800 J	0.001 U	0.0000200 J	-	0.00288	0.0000600	-	0.000100 J	0.0000100 J	-	0.00646	0.000250
Calcium	mg/L	10.2	5.95	28.1	40.5	-	-	15.0	-	-	230	-	-	3.04	193	187
Chloride	mg/L	4.00	5.00	22.0	19.0	-	-	24.0	-	-	103	-	-	37.0	39.0	40.0
Chromium	mg/L	0.001 U	0.000160	0.000800 J	0.0000720	0.001 U	0.0000500	-	0.001 U	0.000420	-	0.00263	0.000481	-	0.001 U	0.000604
Cobalt	mg/L	0.000350 J	0.000797	0.0142	0.0114	0.00319 J	0.00536	-	0.0267	0.0111	-	0.00474 J	0.00371	-	0.0717	0.0435
Combined Radium	pCi/L	1.98	1.10	1.95	0.316	0.337	3.44	-	2.56	1.86	-	1.46	1.08	-	1.94	2.35
Fluoride	mg/L	1 U	1 U	1 U	1 U	0.501 J	0.615	-	1 U	1 U	-	1 U	1 U	-	1 U	1 U
Lead	mg/L	0.005 U	NR	0.005 U	NR	0.005 U	NR	-	0.005 U	NR	-	0.005 U	NR	-	0.005 U	NR
Lithium	mg/L	0.00814	0.00708	0.121	0.147	0.0956	0.0555	-	1.20	0.851	-	0.00562	0.00338	-	0.308	0.243
Mercury	mg/L	0.00000600 J	0.0000130 J	0.000025 U	0.000025 U	0.000025 U	0.00000700 J	-	0.000025 U	0.000013 J	-	0.000025 U	0.000008 J	-	0.000025 U	0.0000110 J
Molybdenum	mg/L	0.005 U	NR	0.005 U	NR	0.005 U	NR	-	0.005 U	NR	-	0.005 U	NR	-	0.005 U	NR
Selenium	mg/L	0.00138 J	0.00170	0.005 U	0.0000800 J	0.00175 J	0.0000700 J	-	0.005 U	0.000300	-	0.00154 J	0.000900	-	0.005 U	0.000300
Total Dissolved Solids	mg/L	150	160	242	428	-	-	288	-	-	2690	-	-	174	1840	1750
Sulfate	mg/L	43.0	44.0	60.0	240	-	-	122	-	-	1910	-	-	24.0	1070	1170
Thallium	mg/L	0.002 U	0.0000300 J	0.002 U	0.00005 U	0.002 U	0.000129	-	0.00846	0.0000620	-	0.00137 J	0.0000900	-	0.002 U	0.0000740
pH	SU	5.19	5.18	6.22	6.23	6.20	6.77	-	5.30	4.96	-	4.76	4.59	-	6.28	5.60

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Parameter was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not sampled
NR: Values are not reported as this parameter was not detected during the May 2018 event at any wells
The fluoride and pH values collected on 8/15/2018 were also used in Appendix III analyses.

Table 2: Groundwater Protection Standards
Welsh Plant - Primary Bottom Ash Pond

Constituent Name	MCL	Rule Specified	Background Limit
Antimony, Total (mg/L)	0.006		0.005
Arsenic, Total (mg/L)	0.01		0.005
Barium, Total (mg/L)	2		0.36
Beryllium, Total (mg/L)	0.004		0.00077
Cadmium, Total (mg/L)	0.005		0.0065
Chromium, Total (mg/L)	0.1		0.004
Cobalt, Total (mg/L)	n/a	0.006	0.075
Combined Radium, Total (pCi/L)	5		4.21
Fluoride, Total (mg/L)	4		1
Lead, Total (mg/L)	n/a	0.015	0.005
Lithium, Total (mg/L)	n/a	0.04	0.39
Mercury, Total (mg/L)	0.002		0.000033
Molybdenum, Total (mg/L)	n/a	0.1	0.005
Selenium, Total (mg/L)	0.05		0.005
Thallium, Total (mg/L)	0.002		0.0013

Notes:

Grey cell indicates calculated UTL is higher than MCL.

MCL = Maximum Contaminant Level

RSL = Regional Screening Level

Calculated UTL (Upper Tolerance Limit) represents site-specific background values.

The higher of the calculated UTL or MCL/RSL is used as the GWPS.

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Welsh Primary Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

DAVID ANTHONY MILLER
112498

112498
License Number

TEXAS
Licensing State

01.08.19
Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

December 16, 2018

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Welsh PBAP
Assessment Monitoring Event – September 2018

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the statistical analysis of September 2018 groundwater data for American Electric Power Inc.'s Welsh PBAP. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at the site for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** AD-1, AD-5, and AD-17; and
- **Downgradient wells:** AD-8, AD-9, and AD-15.

Data were sent electronically, and the statistical analysis was conducted according to the Statistical Analysis Plan and screening evaluation prepared by GSC and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC.

The CCR program consists of the following constituents:

- **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS;

- **Appendix IV** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record. Values previously flagged during the screening as outliers may be seen in a lighter font and disconnected symbol on the time series graphs.

Evaluation of Appendix III Parameters

Interwell prediction limits combined with a 1-of-2 verification strategy were constructed for boron and pH; and intrawell prediction limits combined with a 1-of-2 verification strategy were constructed for calcium, chloride, fluoride, sulfate and TDS. The statistical method selected for each parameter was determined based on the results of the screening analysis performed in December 2017.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of one additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered a false positive result and, therefore, no further action is necessary. No SSIs were noted for any of the Appendix III parameters in downgradient wells except for boron in well AD-8 and pH (lower limit) in well AD-15. Chloride in upgradient well AD-5 exceeded its intrawell prediction limit which may be an indication that groundwater is changing naturally upgradient of the facility. Concentrations will continue to be monitored over the next sampling events. The results of those findings may be found in the Prediction Limit Summary tables following this letter.

When a statistically significant increase is identified, the data are further evaluated using the Sen's Slope/Mann Kendall trend test to determine whether concentrations are statistically increasing, decreasing or stable. Upgradient wells are included in the trend analyses to identify whether similar patters exist upgradient of the site which is an indication of natural variability in groundwater unrelated to practices at the site.

No statistically significant increasing or decreasing trends were found for any of the downgradient well/parameter pairs. A Trend Test summary table follows this letter.

Evaluation of Appendix IV Parameters

Parametric tolerance limits were used to calculate background limits from pooled upgradient well data for Appendix IV parameters with a target of 95% confidence and 95% coverage to determine the Alternate Contaminant Level (ACL). The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and Regional Screening Levels (RSLs) in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons.

Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters using the highest limit of either the MCL, RSL, or ACL as discussed above. Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No confidence intervals exceedances were found except for lithium in well AD-9. A summary of the confidence interval results follows this letter.

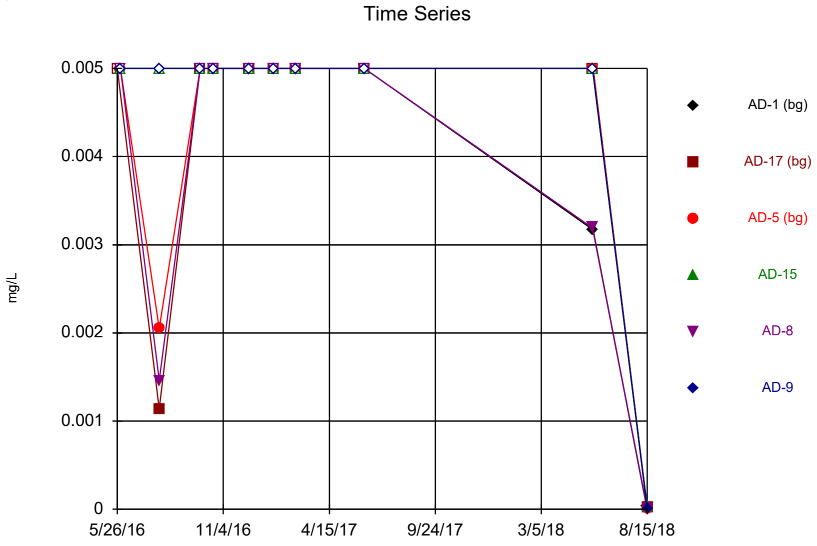
Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Welsh PBAP. If you have any questions or comments, please feel free to contact me.

For Groundwater Stats Consulting,

Kristina Rayner

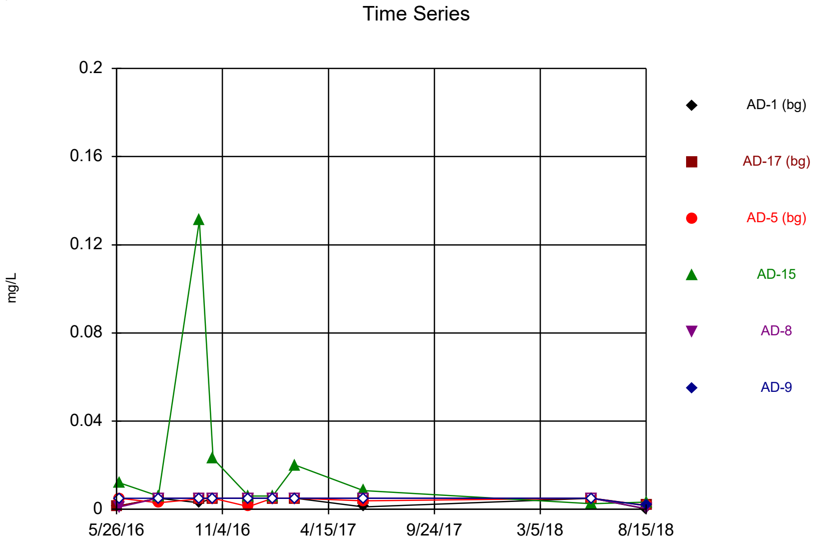
Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



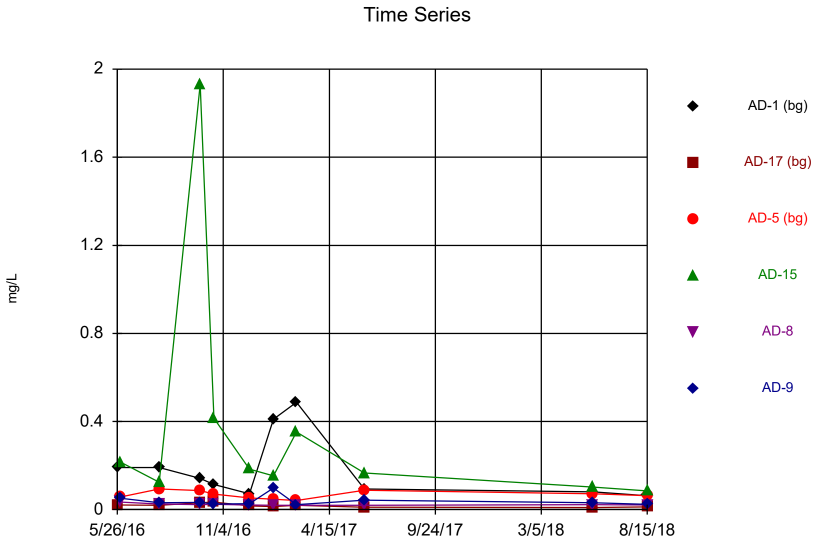
Constituent: Antimony, total   Analysis Run 12/16/2018 8:11 AM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Arsenic, total   Analysis Run 12/16/2018 8:11 AM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Barium, total   Analysis Run 12/16/2018 8:11 AM   View: Descriptive
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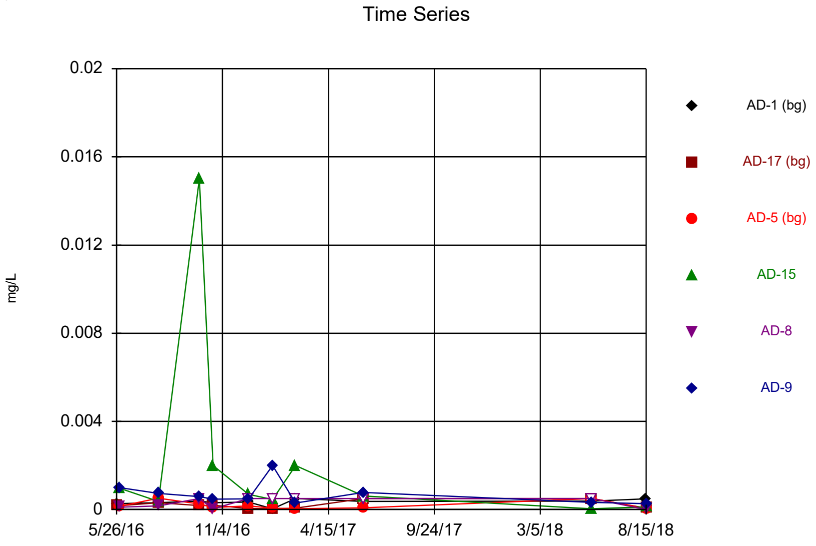
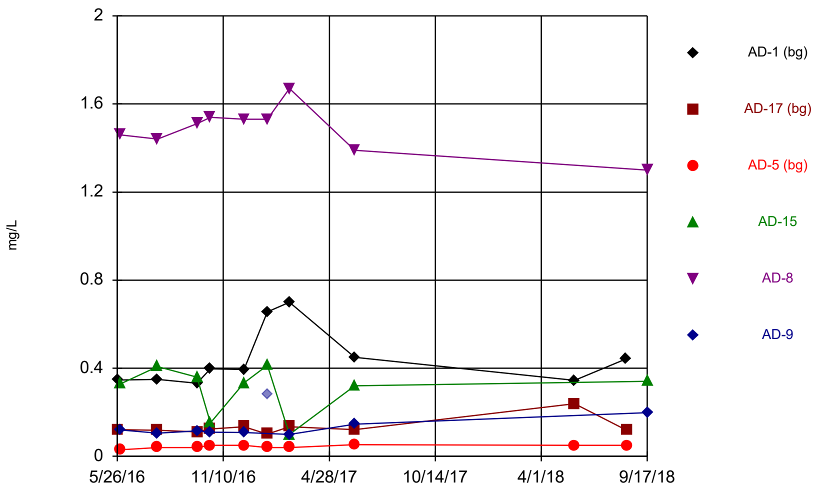
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Beryllium, total   Analysis Run 12/16/2018 8:11 AM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

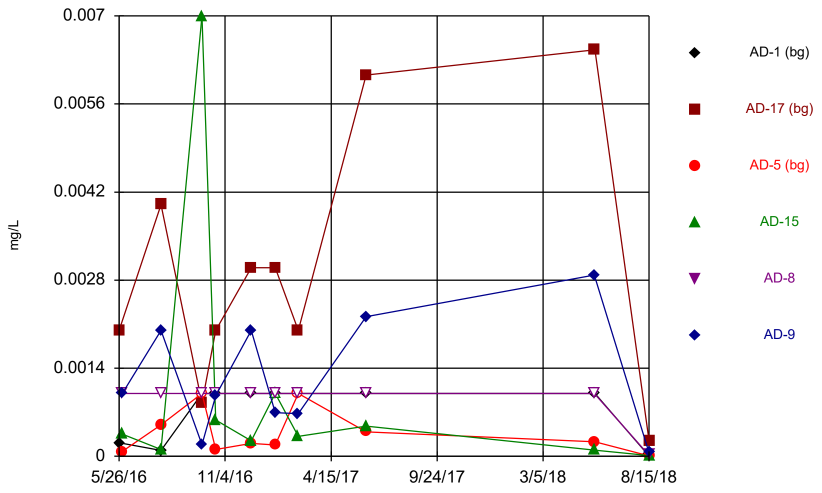
Time Series



Constituent: Boron, total   Analysis Run 12/16/2018 8:11 AM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

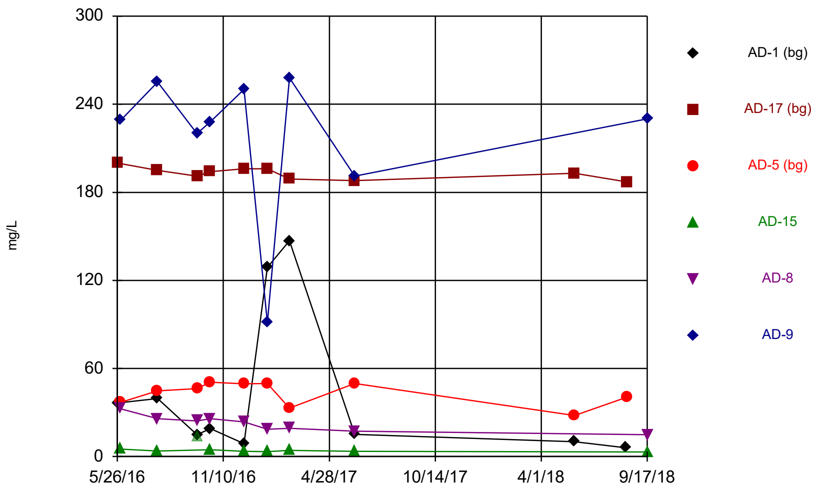
Time Series



Constituent: Cadmium, total   Analysis Run 12/16/2018 8:11 AM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

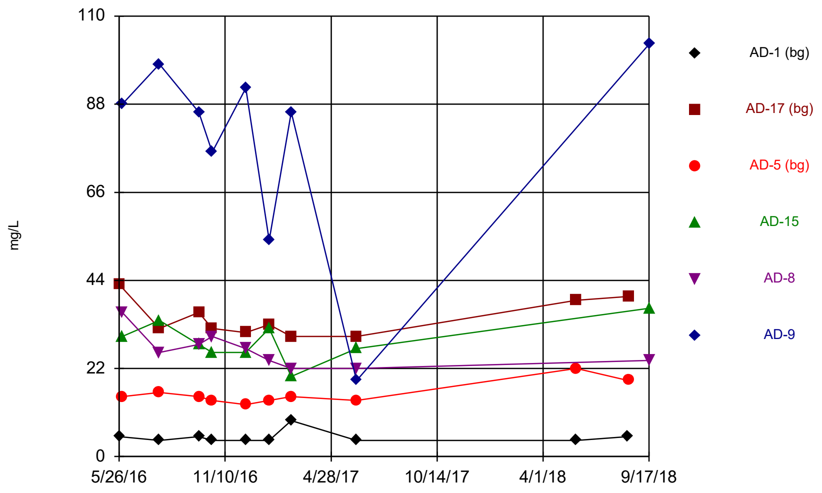
Time Series



Constituent: Calcium, total   Analysis Run 12/16/2018 8:11 AM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Time Series



Constituent: Chloride, total   Analysis Run 12/16/2018 8:11 AM   View: Descriptive
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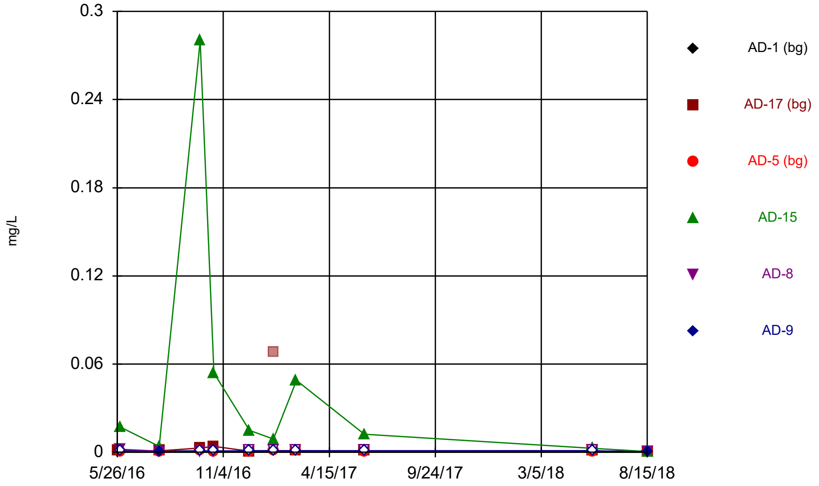
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

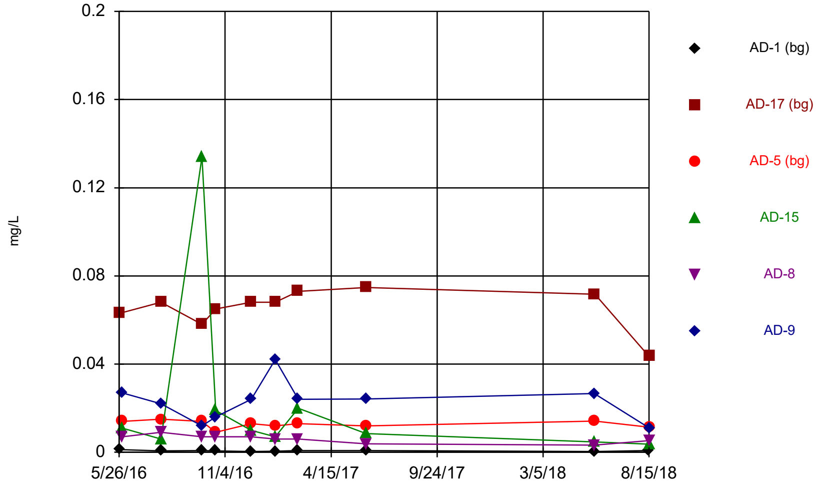
Time Series



Constituent: Chromium, total   Analysis Run 12/16/2018 8:11 AM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

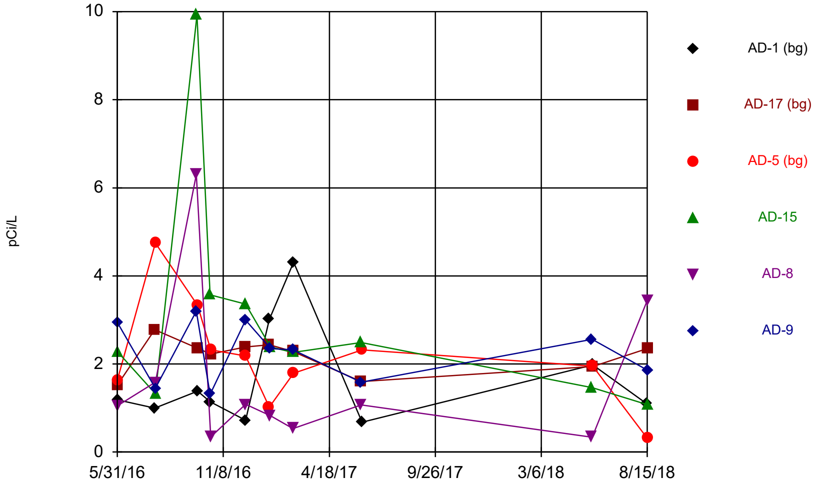
Time Series



Constituent: Cobalt, total   Analysis Run 12/16/2018 8:11 AM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

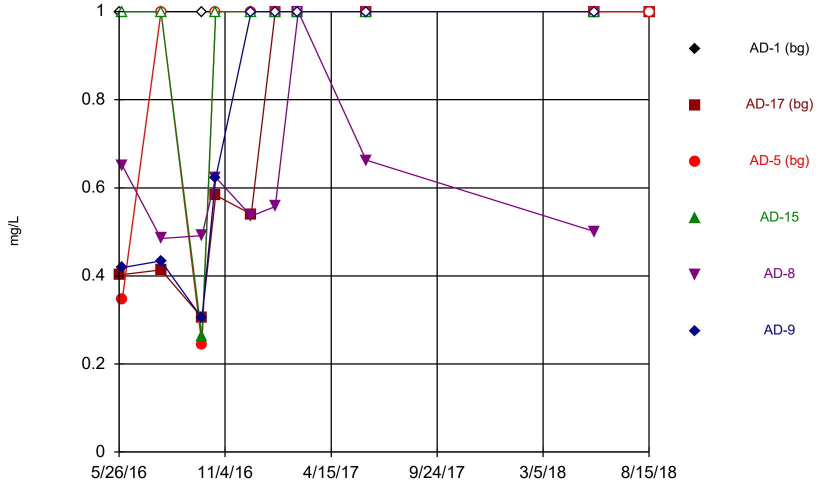
Time Series



Constituent: Combined Radium 226 + 228   Analysis Run 12/16/2018 8:11 AM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

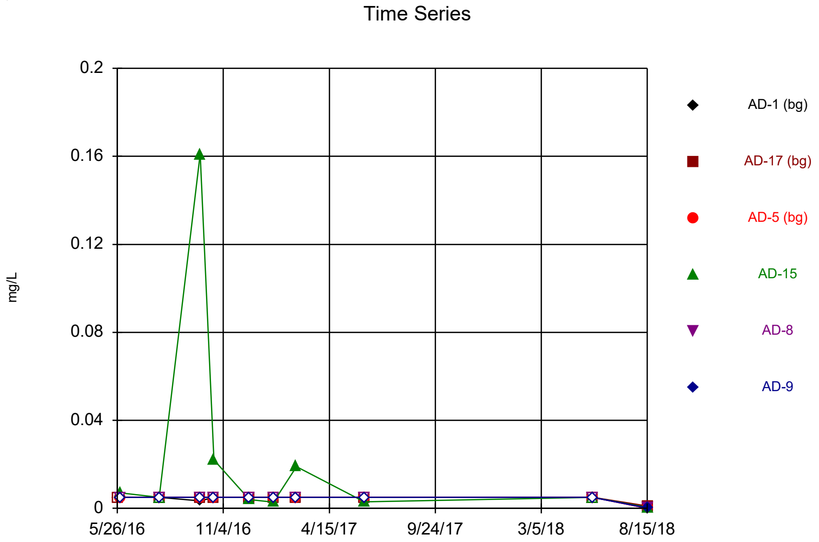
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



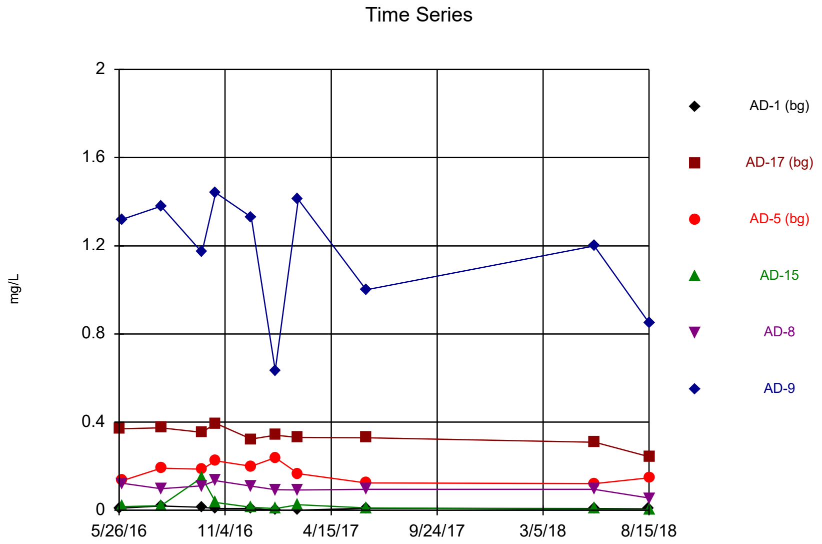
Constituent: Fluoride, total   Analysis Run 12/16/2018 8:11 AM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



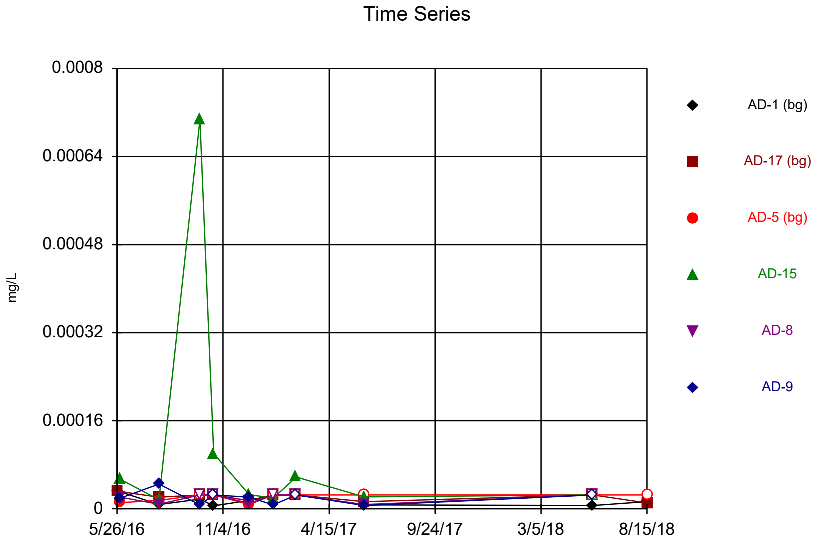
Constituent: Lead, total Analysis Run 12/16/2018 8:11 AM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



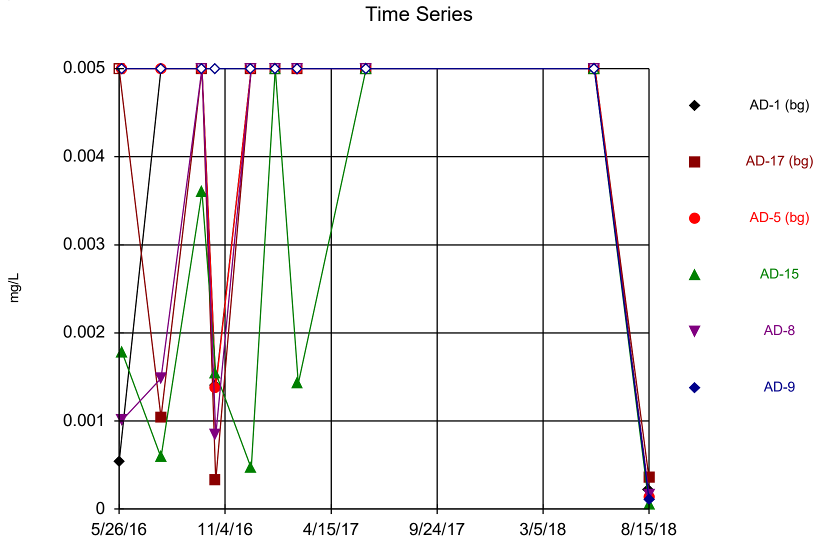
Constituent: Lithium, total Analysis Run 12/16/2018 8:11 AM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Mercury, total Analysis Run 12/16/2018 8:11 AM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

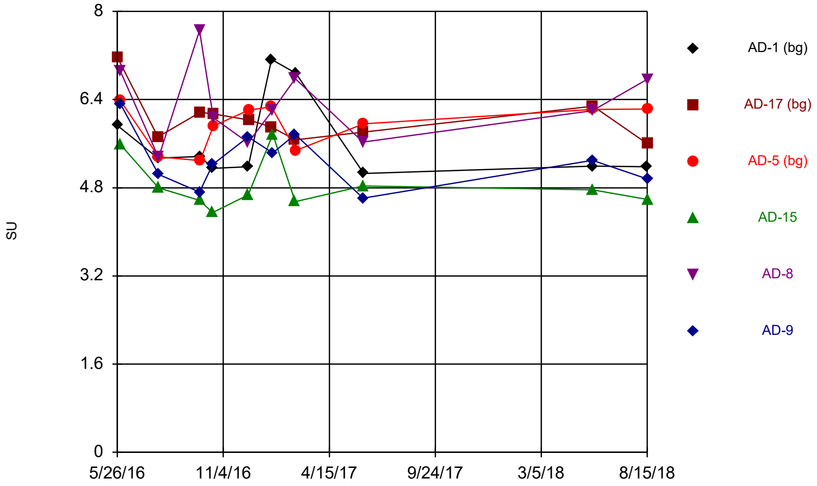
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Molybdenum, total Analysis Run 12/16/2018 8:11 AM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

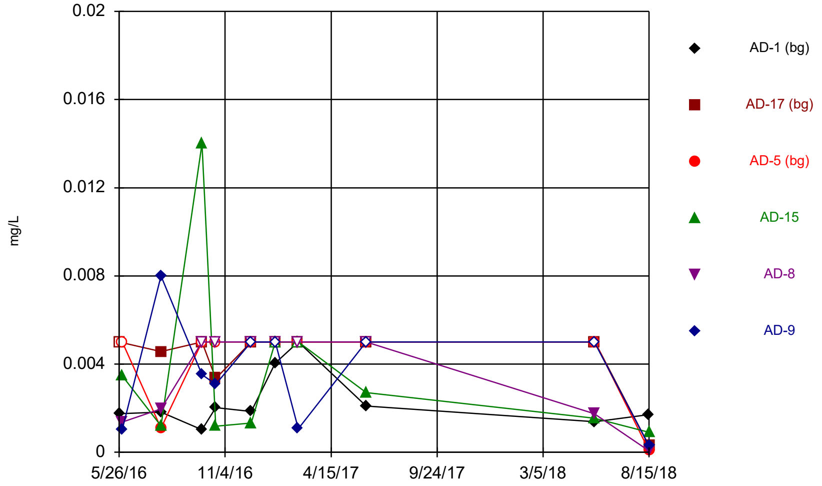
Time Series



Constituent: pH, field Analysis Run 12/16/2018 8:11 AM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

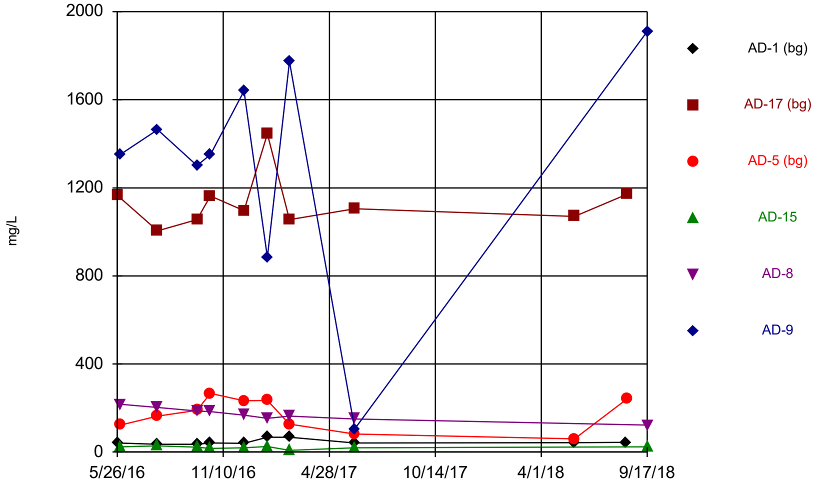
Time Series



Constituent: Selenium, total Analysis Run 12/16/2018 8:11 AM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

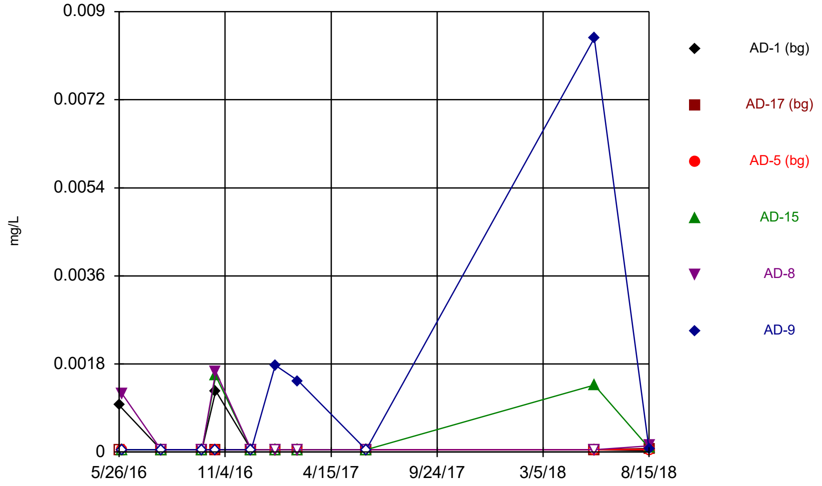
Time Series



Constituent: Sulfate, total Analysis Run 12/16/2018 8:11 AM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Thallium, total Analysis Run 12/16/2018 8:11 AM View: Descriptive
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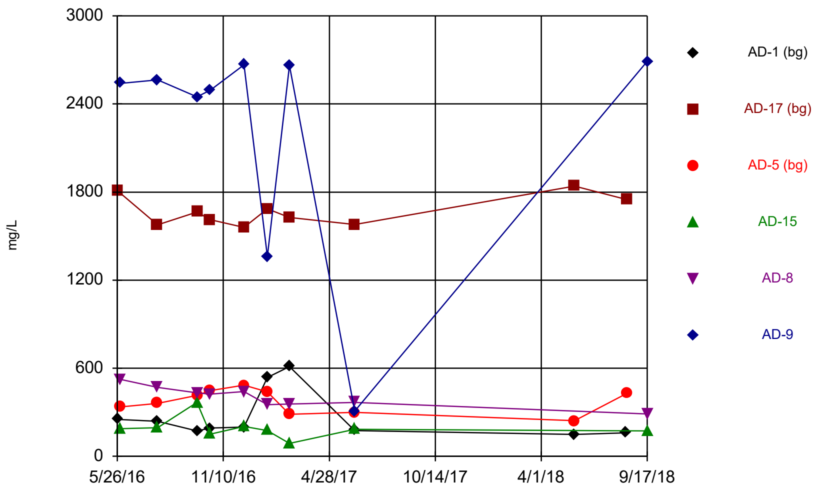
Time Series



Constituent: Total Dissolved Solids Analysis Run 12/16/2018 8:11 AM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Interwell Prediction Limit Summary Table - Significant Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 12/16/2018, 8:10 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	**AD-8**	**0.765**	**n/a**	**9/17/2018**	**1.3**	**Yes**	**30**	**-2.011**	**0.9717**	**0**	**None**	**ln(x)**	**0.002505**	**Param Inter 1 of 2**
pH, field (SU)	**AD-15**	**6.899**	**4.849**	**8/15/2018**	**4.59**	**Yes**	**30**	**5.874**	**0.5713**	**0**	**None**	**No**	**0.001253**	**Param Inter 1 of 2**

Interwell Prediction Limit Summary Table - All Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 12/16/2018, 8:10 AM

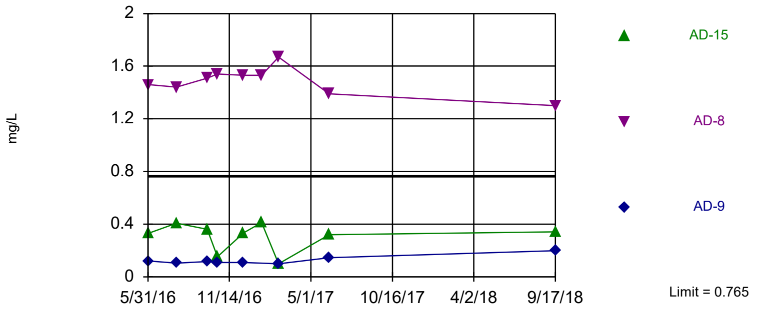
Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj	Transform	Alpha	Method
Boron, total (mg/L)	AD-15	0.765	n/a	9/17/2018	0.341	No	30	-2.011	0.9717	0	None	ln(x)	0.002505	Param Inter 1 of 2
Boron, total (mg/L)	**AD-8**	**0.765**	**n/a**	**9/17/2018**	**1.3**	**Yes**	**30**	**-2.011**	**0.9717**	**0**	**None**	**ln(x)**	**0.002505**	**Param Inter 1 of 2**
Boron, total (mg/L)	AD-9	0.765	n/a	9/17/2018	0.198	No	30	-2.011	0.9717	0	None	ln(x)	0.002505	Param Inter 1 of 2
pH, field (SU)	**AD-15**	**6.899**	**4.849**	**8/15/2018**	**4.59**	**Yes**	**30**	**5.874**	**0.5713**	**0**	**None**	**No**	**0.001253**	**Param Inter 1 of 2**
pH, field (SU)	AD-8	6.899	4.849	8/15/2018	6.77	No	30	5.874	0.5713	0	None	No	0.001253	Param Inter 1 of 2
pH, field (SU)	AD-9	6.899	4.849	8/15/2018	4.96	No	30	5.874	0.5713	0	None	No	0.001253	Param Inter 1 of 2

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: AD-8

Prediction Limit

Interwell Parametric



Background Data Summary (based on natural log transformation): Mean=-2.011, Std. Dev.=0.9717, n=30. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9108, critical = 0.9. Kappa = 1.794 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.002505. Comparing 3 points to limit.

Constituent: Boron, total Analysis Run 12/16/2018 8:00 AM View: PL's - Interwell

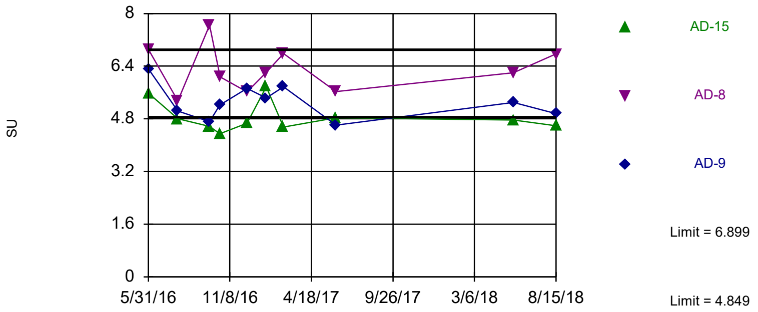
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limits: AD-15

Prediction Limit

Interwell Parametric



Background Data Summary: Mean=5.874, Std. Dev.=0.5713, n=30. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9326, critical = 0.9. Kappa = 1.794 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.001253. Comparing 3 points to limit.

Constituent: pH, field Analysis Run 12/16/2018 8:00 AM View: PL's - Interwell

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Intrawell Prediction Limit Summary Table - Significant Results

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP   Printed 12/9/2018, 2:22 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Chloride, total (mg/L)	**AD-5**	**16.78**	**n/a**	**8/15/2018**	**19**	**Yes**	**8**	**14.5**	**0.9258**	**0**	**None**	**No**	**0.002505**	Param 1 of 2

Intrawell Prediction Limit Summary Table - All Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 12/9/2018, 2:22 PM

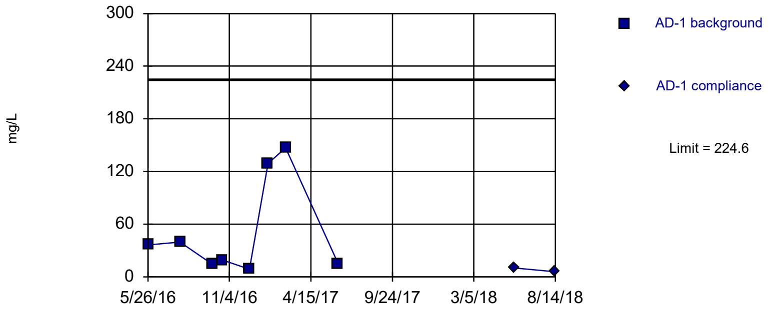
Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Calcium, total (mg/L)	AD-1	224.6	n/a	8/14/2018	5.95	No	8	6.363	3.508	0	None	sqrt(x)	0.002505	Param 1 of 2
Calcium, total (mg/L)	AD-15	5.711	n/a	9/17/2018	3.04	No	7	4.031	0.6254	0	None	No	0.002505	Param 1 of 2
Calcium, total (mg/L)	AD-17	203.5	n/a	8/15/2018	187	No	8	193.6	4.033	0	None	No	0.002505	Param 1 of 2
Calcium, total (mg/L)	AD-5	61.45	n/a	8/15/2018	40.5	No	8	45.09	6.656	0	None	No	0.002505	Param 1 of 2
Calcium, total (mg/L)	AD-8	35.68	n/a	9/17/2018	15	No	8	23.46	4.969	0	None	No	0.002505	Param 1 of 2
Calcium, total (mg/L)	AD-9	349.9	n/a	9/17/2018	230	No	8	215.3	54.76	0	None	No	0.002505	Param 1 of 2
Chloride, total (mg/L)	AD-1	9	n/a	8/14/2018	5	No	8	n/a	n/a	0	n/a	n/a	0.02144	NP (normality) 1 of 2
Chloride, total (mg/L)	AD-15	38.42	n/a	9/17/2018	37	No	8	27.88	4.291	0	None	No	0.002505	Param 1 of 2
Chloride, total (mg/L)	AD-17	44.04	n/a	8/15/2018	40	No	8	33.38	4.34	0	None	No	0.002505	Param 1 of 2
Chloride, total (mg/L)	**AD-5**	**16.78**	**n/a**	**8/15/2018**	**19**	**Yes**	**8**	**14.5**	**0.9258**	**0**	**None**	**No**	**0.002505**	Param 1 of 2
Chloride, total (mg/L)	AD-8	38.29	n/a	9/17/2018	24	No	8	26.88	4.643	0	None	No	0.002505	Param 1 of 2
Chloride, total (mg/L)	AD-9	139.3	n/a	9/17/2018	103	No	8	74.88	26.2	0	None	No	0.002505	Param 1 of 2
Fluoride, total (mg/L)	AD-1	1	n/a	8/14/2018	1ND	No	8	n/a	n/a	100	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	AD-15	1	n/a	5/23/2018	1ND	No	8	n/a	n/a	87.5	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	AD-17	0.6953	n/a	8/15/2018	1ND	No	8	0.4488	0.1003	37.5	Kapla..	No	0.002505	Param 1 of 2
Fluoride, total (mg/L)	AD-5	1	n/a	8/15/2018	1ND	No	8	n/a	n/a	75	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	AD-8	1.034	n/a	5/23/2018	0.501	No	8	0.6258	0.166	12.5	None	No	0.002505	Param 1 of 2
Fluoride, total (mg/L)	AD-9	0.7259	n/a	5/23/2018	1ND	No	8	0.4449	0.1143	50	Kapla..	No	0.002505	Param 1 of 2
Sulfate, total (mg/L)	AD-1	82.3	n/a	8/14/2018	44	No	8	6.772	0.9358	0	None	sqrt(x)	0.002505	Param 1 of 2
Sulfate, total (mg/L)	AD-15	35.58	n/a	9/17/2018	24	No	8	20.38	6.186	0	None	No	0.002505	Param 1 of 2
Sulfate, total (mg/L)	AD-17	1471	n/a	8/15/2018	1170	No	8	1136	136.3	0	None	No	0.002505	Param 1 of 2
Sulfate, total (mg/L)	AD-5	336.4	n/a	8/15/2018	240	No	8	177.4	64.69	0	None	No	0.002505	Param 1 of 2
Sulfate, total (mg/L)	AD-8	235.8	n/a	9/17/2018	122	No	8	178	23.53	0	None	No	0.002505	Param 1 of 2
Sulfate, total (mg/L)	AD-9	2527	n/a	9/17/2018	1910	No	8	1234	526.1	0	None	No	0.002505	Param 1 of 2
Total Dissolved Solids (mg/L)	AD-1	784.8	n/a	8/14/2018	160	No	8	16.71	4.598	0	None	sqrt(x)	0.002505	Param 1 of 2
Total Dissolved Solids (mg/L)	AD-15	388.1	n/a	9/17/2018	174	No	8	194.4	78.82	0	None	No	0.002505	Param 1 of 2
Total Dissolved Solids (mg/L)	AD-17	1840	n/a	8/15/2018	1750	No	8	1639	81.77	0	None	No	0.002505	Param 1 of 2
Total Dissolved Solids (mg/L)	AD-5	563.5	n/a	8/15/2018	428	No	8	383.6	73.17	0	None	No	0.002505	Param 1 of 2
Total Dissolved Solids (mg/L)	AD-8	568.6	n/a	9/17/2018	288	No	8	420.9	60.09	0	None	No	0.002505	Param 1 of 2
Total Dissolved Solids (mg/L)	AD-9	3147	n/a	9/17/2018	2690	No	8	1.3e10	7.4e9	0	None	x^3	0.002505	Param 1 of 2

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on square root transformation): Mean=6.363, Std. Dev.=3.508, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8248, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

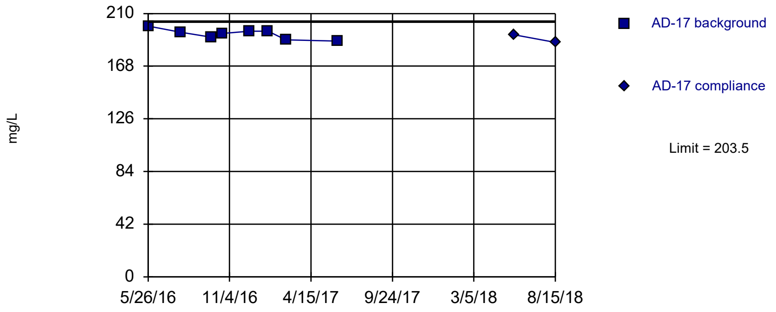
Constituent: Calcium, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=193.6, Std. Dev.=4.033, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9507, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

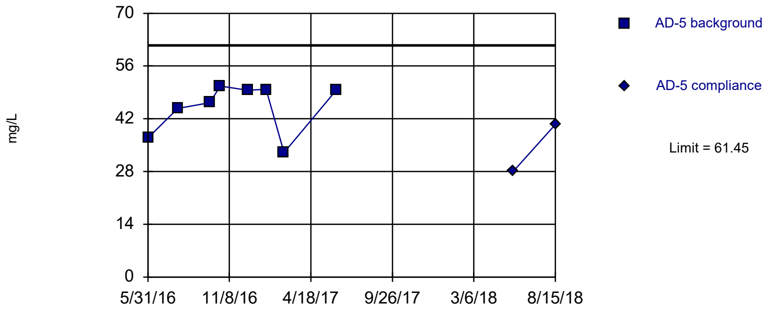
Constituent: Calcium, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=45.09, Std. Dev.=6.656, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8101, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

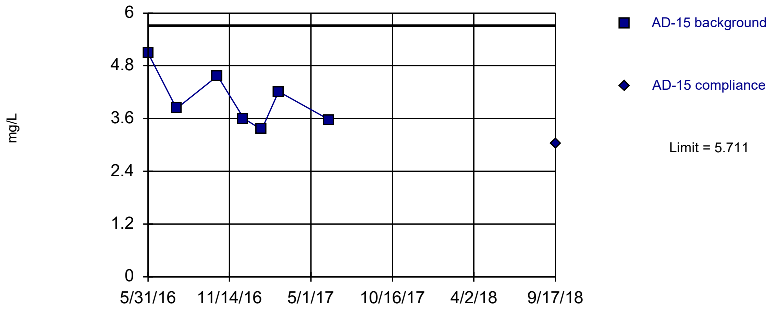
Constituent: Calcium, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=4.031, Std. Dev.=0.6254, n=7. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9248, critical = 0.73. Kappa = 2.685 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

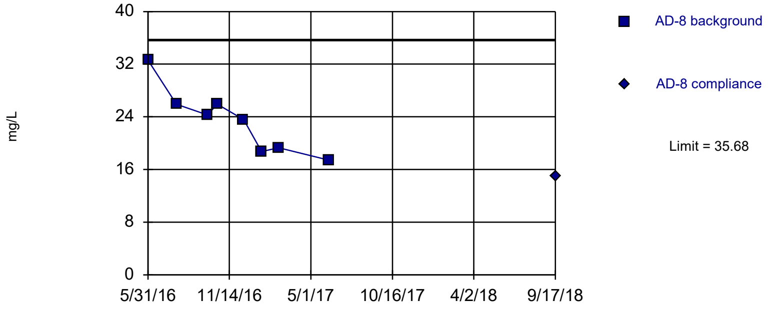
Constituent: Calcium, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=23.46, Std. Dev.=4.969, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9282, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

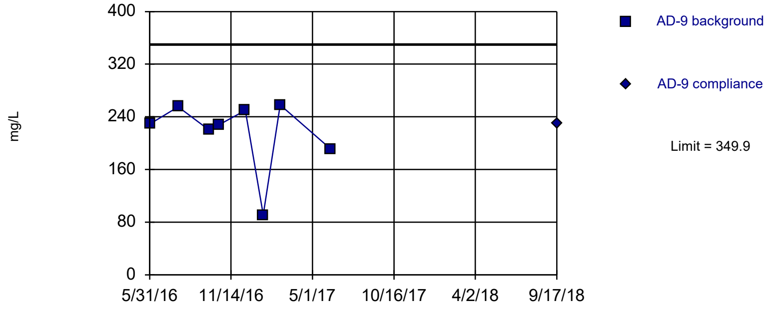
Constituent: Calcium, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=215.3, Std. Dev.=54.76, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7629, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

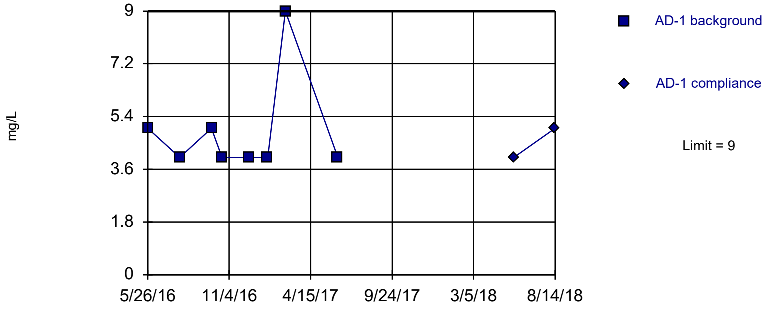
Constituent: Calcium, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

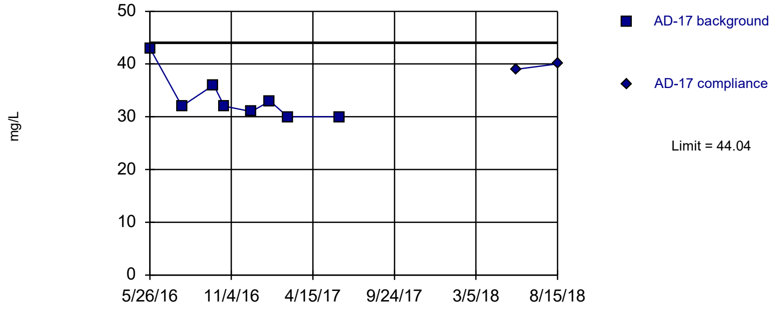
Constituent: Chloride, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=33.38, Std. Dev.=4.34, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7758, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

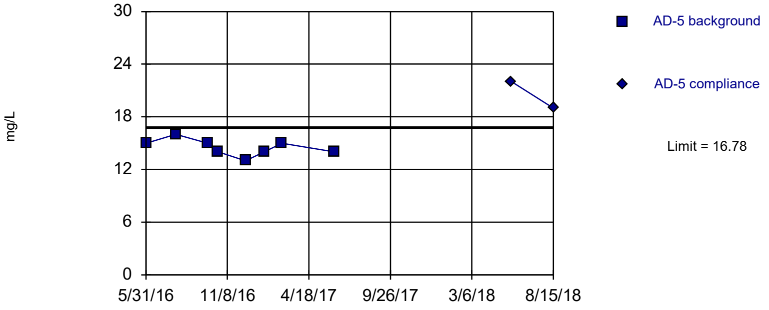
Constituent: Chloride, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=14.5, Std. Dev.=0.9258, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9302, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

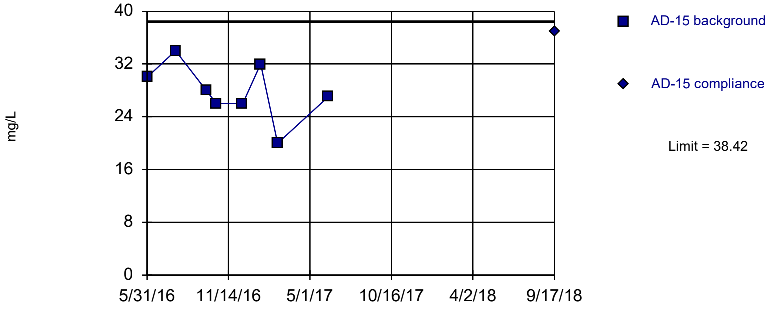
Constituent: Chloride, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=27.88, Std. Dev.=4.291, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9603, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

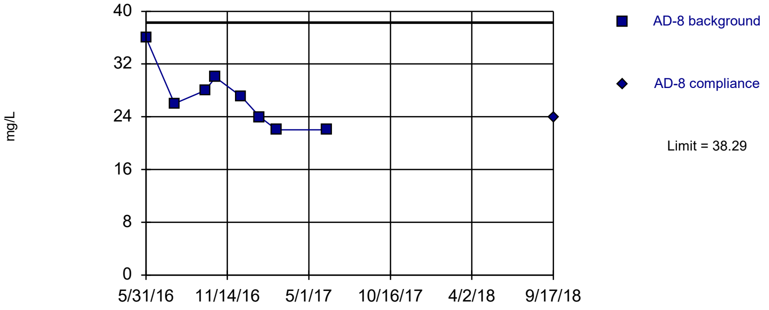
Constituent: Chloride, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=26.88, Std. Dev.=4.643, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9162, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

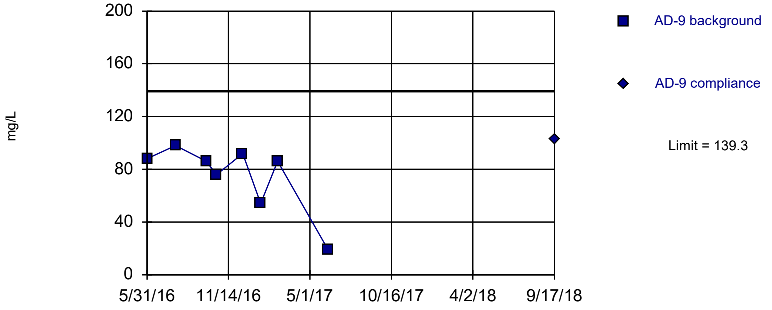
Constituent: Chloride, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=74.88, Std. Dev.=26.2, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7978, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

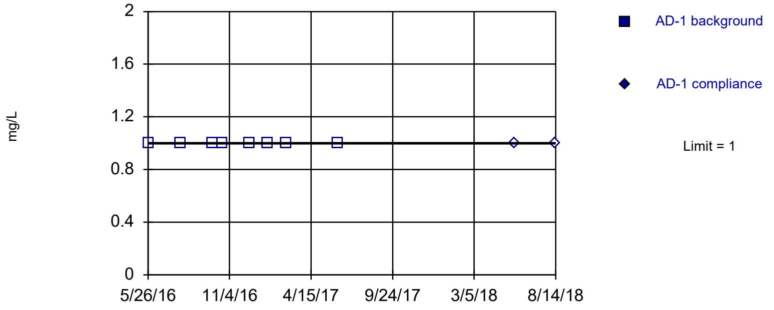
Constituent: Chloride, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 8) were censored; limit is most recent reporting limit. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

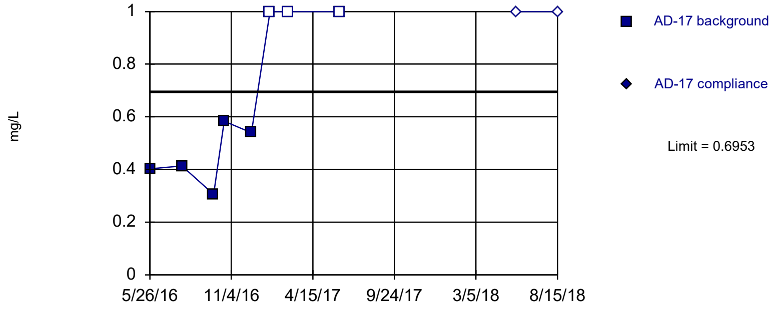
Constituent: Fluoride, total   Analysis Run 12/9/2018 2:17 PM   View: PL's - Intrawell
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (after Kaplan-Meier Adjustment): Mean=0.4488, Std. Dev.=0.1003, n=8, 37.5% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8226, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

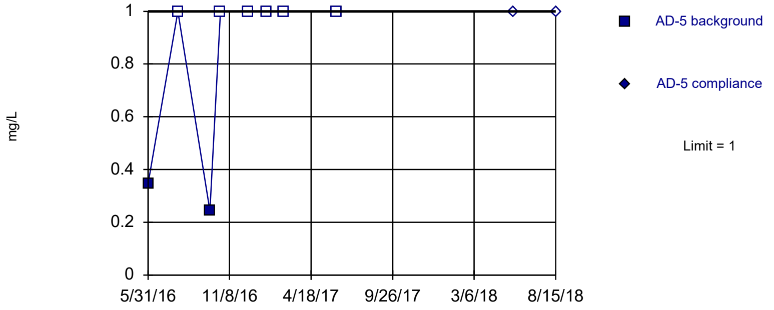
Constituent: Fluoride, total   Analysis Run 12/9/2018 2:17 PM   View: PL's - Intrawell
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 8 background values. 75% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

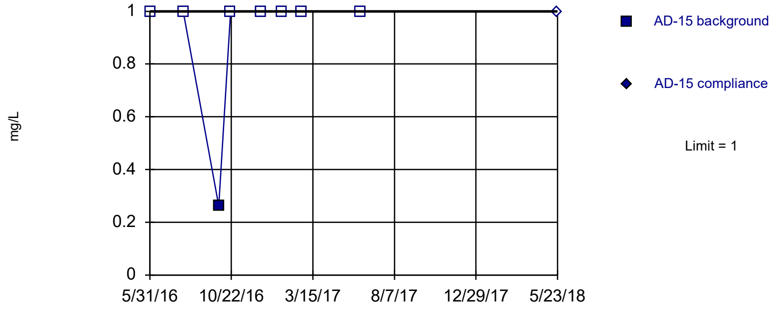
Constituent: Fluoride, total   Analysis Run 12/9/2018 2:17 PM   View: PL's - Intrawell
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 8 background values. 87.5% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

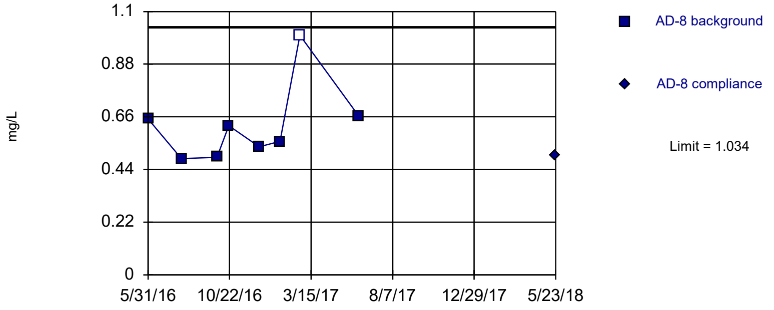
Constituent: Fluoride, total   Analysis Run 12/9/2018 2:17 PM   View: PL's - Intrawell
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=0.6258, Std. Dev.=0.166, n=8, 12.5% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7879, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

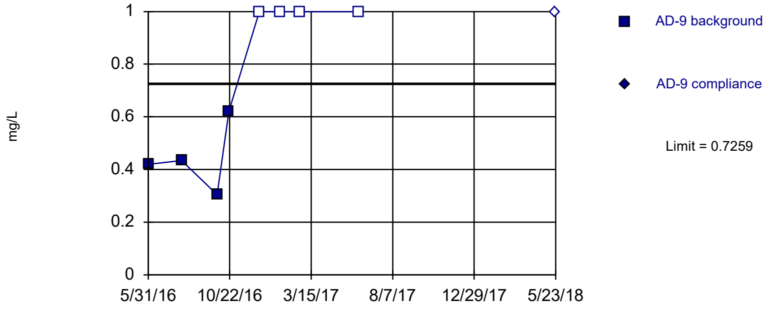
Constituent: Fluoride, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (after Kaplan-Meier Adjustment): Mean=0.4449, Std. Dev.=0.1143, n=8, 50% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.786, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

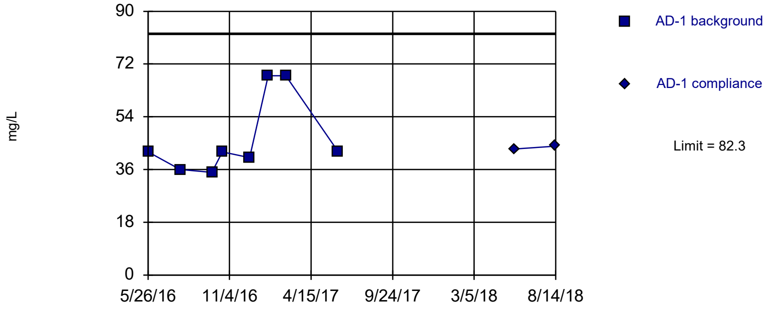
Constituent: Fluoride, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on square root transformation): Mean=6.772, Std. Dev.=0.9358, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7528, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

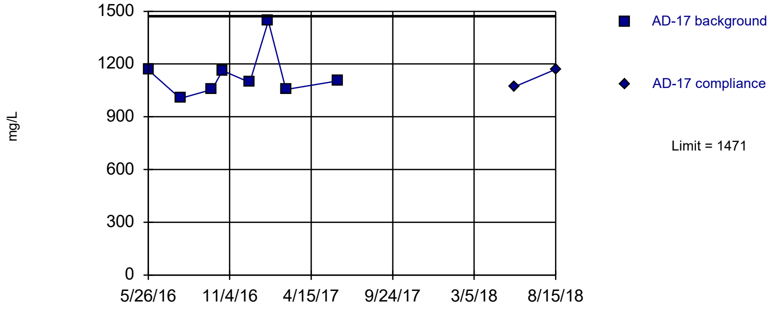
Constituent: Sulfate, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=1136, Std. Dev.=136.3, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7916, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

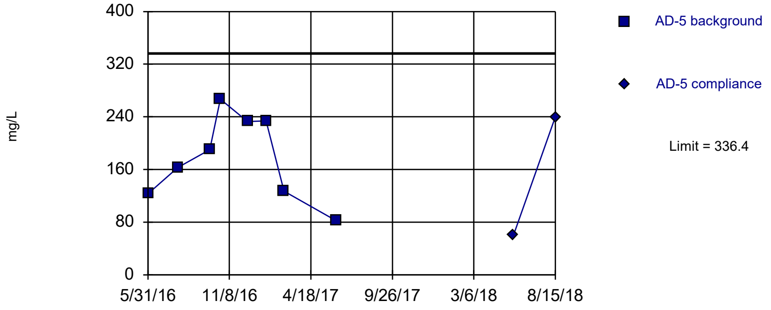
Constituent: Sulfate, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=177.4, Std. Dev.=64.69, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.953, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

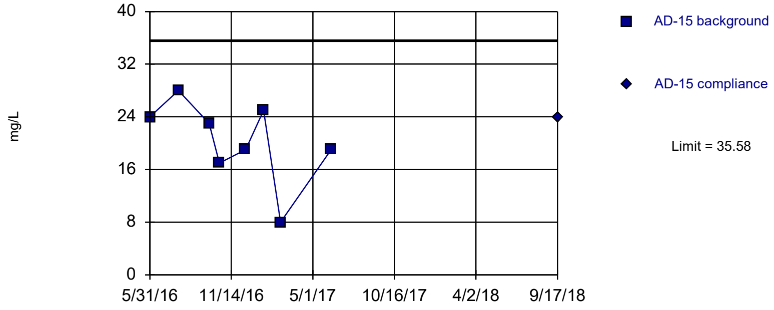
Constituent: Sulfate, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=20.38, Std. Dev.=6.186, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9238, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

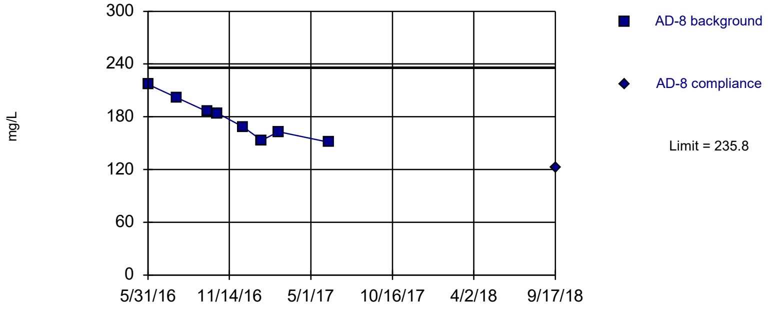
Constituent: Sulfate, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=178, Std. Dev.=23.53, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9398, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

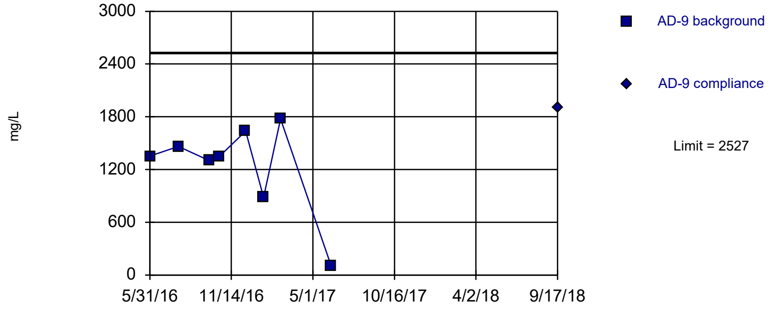
Constituent: Sulfate, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=1234, Std. Dev.=526.1, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8423, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

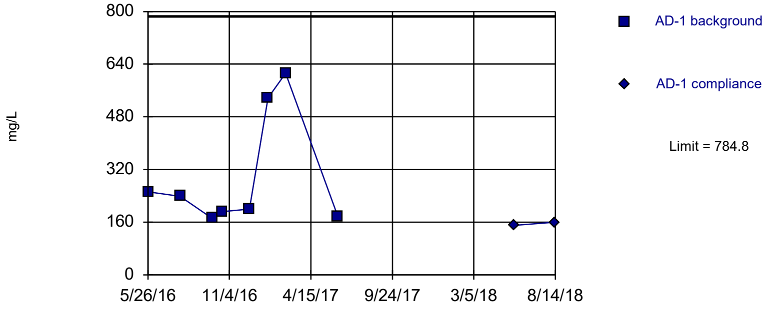
Constituent: Sulfate, total Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on square root transformation): Mean=16.71, Std. Dev.=4.598, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.756, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

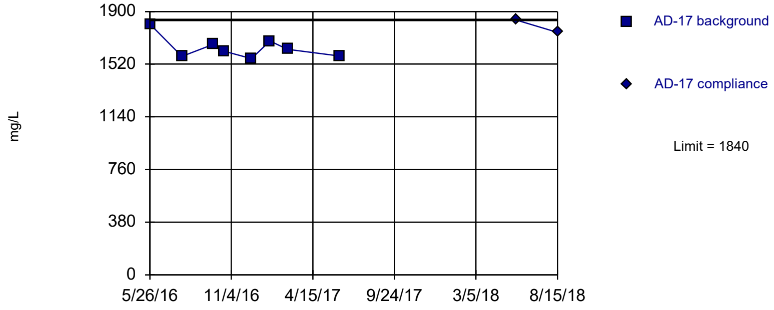
Constituent: Total Dissolved Solids Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=1639, Std. Dev.=81.77, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8702, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

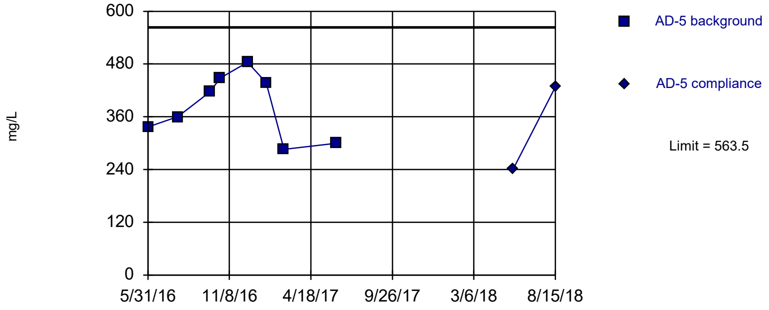
Constituent: Total Dissolved Solids Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=383.6, Std. Dev.=73.17, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.937, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

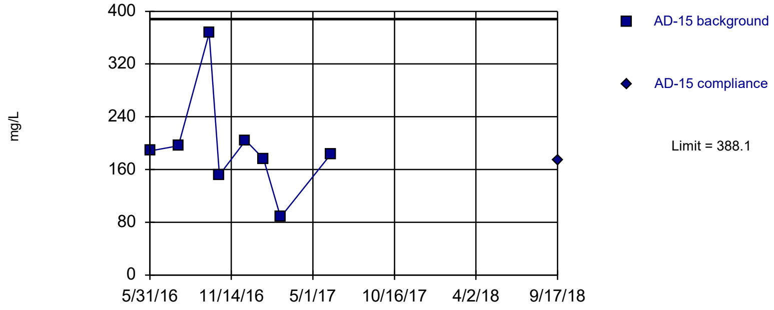
Constituent: Total Dissolved Solids Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



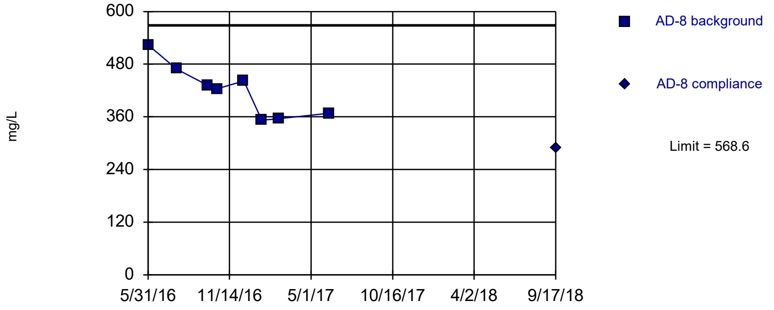
Background Data Summary: Mean=194.4, Std. Dev.=78.82, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8214, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

Constituent: Total Dissolved Solids Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Within Limit

Prediction Limit

Intrawell Parametric



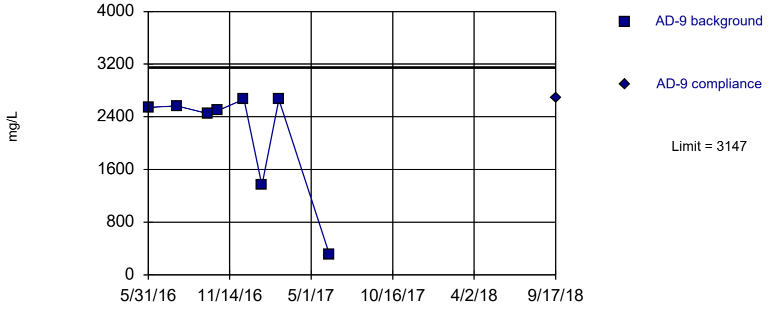
Background Data Summary: Mean=420.9, Std. Dev.=60.09, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9284, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

Constituent: Total Dissolved Solids Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on cube transformation): Mean=1.3e10, Std. Dev.=7.4e9, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.759, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

Constituent: Total Dissolved Solids Analysis Run 12/9/2018 2:17 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Trend Test Summary Table - All Results (No Significant Results)

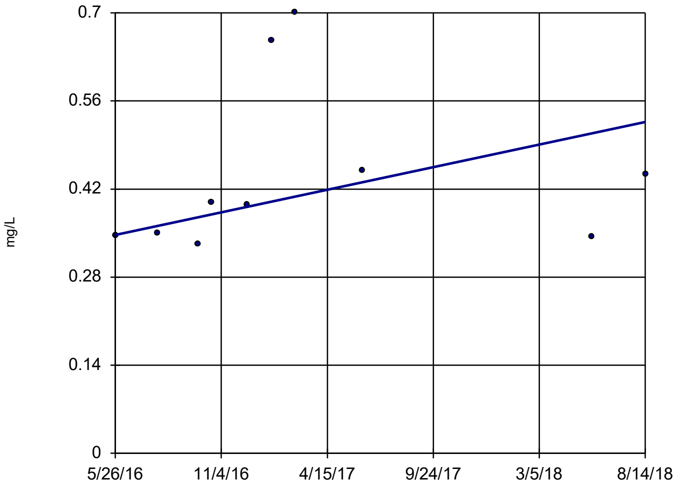
Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 12/16/2018, 8:17 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	AD-1 (bg)	0.08093	15	30	No	10	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-17 (bg)	0.007399	7	30	No	10	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-5 (bg)	0.005828	22	30	No	10	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-8	-0.02005	-1	-25	No	9	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-1 (bg)	-0.1093	-10	-30	No	10	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-17 (bg)	-0.4462	-19	-30	No	10	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-15	-0.05	-5	-30	No	10	0	n/a	n/a	0.01	NP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-1 (bg)



n = 10

Slope = 0.08093
units per year.

Mann-Kendall
statistic = 15
critical = 30

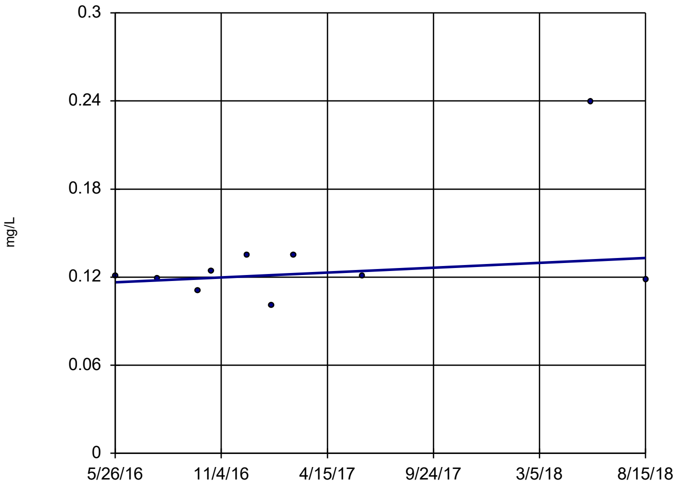
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 12/16/2018 8:16 AM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-17 (bg)



n = 10

Slope = 0.007399
units per year.

Mann-Kendall
statistic = 7
critical = 30

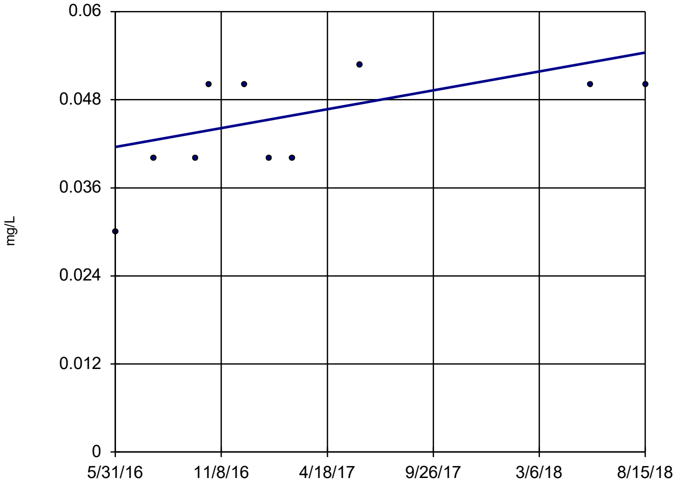
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 12/16/2018 8:16 AM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-5 (bg)



n = 10

Slope = 0.005828
units per year.

Mann-Kendall
statistic = 22
critical = 30

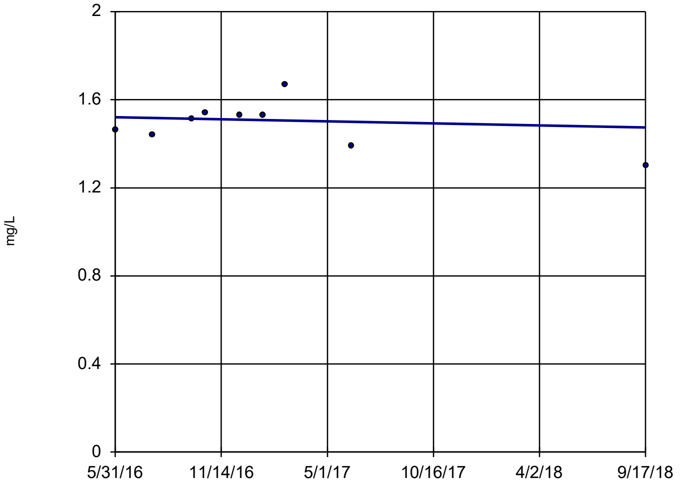
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 12/16/2018 8:16 AM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-8



n = 9

Slope = -0.02005
units per year.

Mann-Kendall
statistic = -1
critical = -25

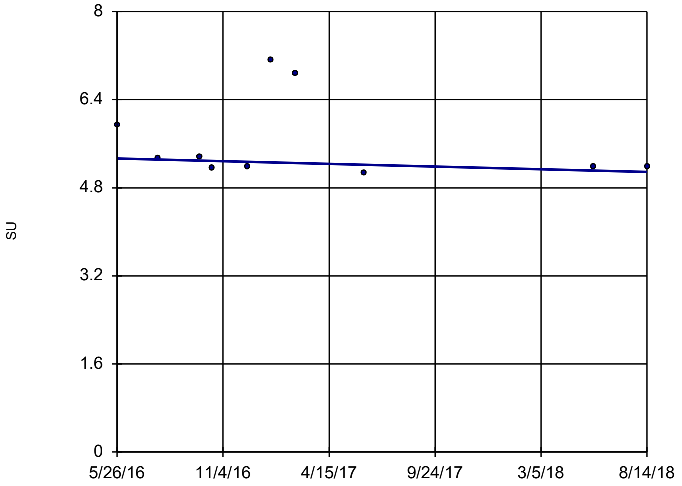
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 12/16/2018 8:16 AM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-1 (bg)



n = 10

Slope = -0.1093 units per year.

Mann-Kendall statistic = -10 critical = -30

Trend not significant at 99% confidence level (α = 0.005 per tail).

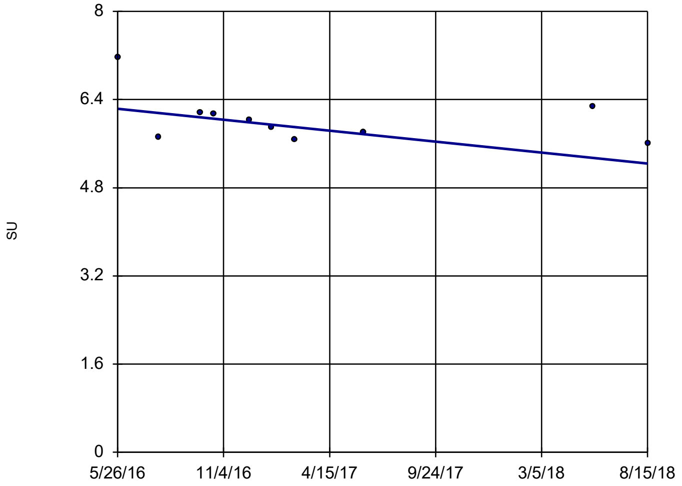
Constituent: pH, field Analysis Run 12/16/2018 8:16 AM View: Trend Tests

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-17 (bg)



n = 10

Slope = -0.4462 units per year.

Mann-Kendall statistic = -19 critical = -30

Trend not significant at 99% confidence level (α = 0.005 per tail).

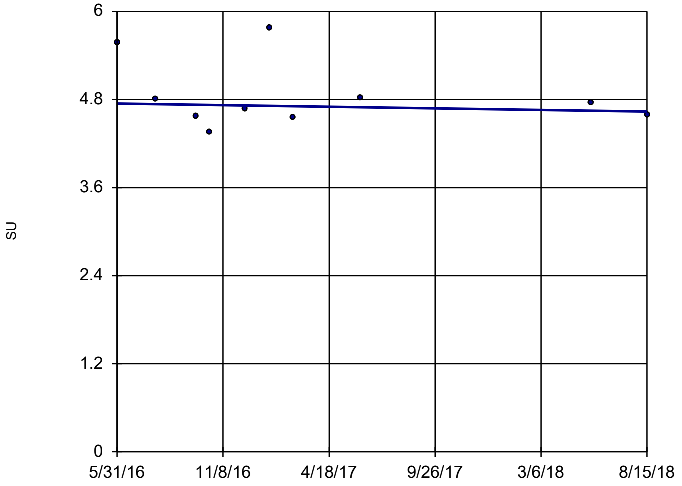
Constituent: pH, field Analysis Run 12/16/2018 8:16 AM View: Trend Tests

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-15



n = 10

Slope = -0.05 units per year.

Mann-Kendall statistic = -5 critical = -30

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field Analysis Run 12/16/2018 8:16 AM View: Trend Tests

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Upper Tolerance Limits - Appendix IV

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP   Printed 12/9/2018, 2:38 PM

Constituent	Upper Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony, total (mg/L)	0.005	30	n/a	n/a	80	n/a	n/a	0.2146	NP Inter(NDs)
Arsenic, total (mg/L)	0.005	30	n/a	n/a	63.33	n/a	n/a	0.2146	NP Inter(normality)
Barium, total (mg/L)	0.362	30	0.4014	0.1402	0	None	x^(1/3)	0.05	Inter
Beryllium, total (mg/L)	0.0007706	30	0.01454	0.005955	13.33	None	sqrt(x)	0.05	Inter
Cadmium, total (mg/L)	0.00646	30	n/a	n/a	30	n/a	n/a	0.2146	NP Inter(Cohens/xform)
Chromium, total (mg/L)	0.004	29	n/a	n/a	31.03	n/a	n/a	0.2259	NP Inter(normality)
Cobalt, total (mg/L)	0.0748	30	n/a	n/a	0	n/a	n/a	0.2146	NP Inter(normality)
Combined Radium 226 + 228 (pCi/L)	4.205	30	2	0.9933	0	None	No	0.05	Inter
Fluoride, total (mg/L)	1	30	n/a	n/a	76.67	n/a	n/a	0.2146	NP Inter(NDs)
Lead, total (mg/L)	0.005	30	n/a	n/a	86.67	n/a	n/a	0.2146	NP Inter(NDs)
Lithium, total (mg/L)	0.394	30	n/a	n/a	0	n/a	n/a	0.2146	NP Inter(normality)
Mercury, total (mg/L)	0.000033	30	n/a	n/a	46.67	n/a	n/a	0.2146	NP Inter(normality)
Molybdenum, total (mg/L)	0.005	30	n/a	n/a	73.33	n/a	n/a	0.2146	NP Inter(normality)
Selenium, total (mg/L)	0.005	30	n/a	n/a	53.33	n/a	n/a	0.2146	NP Inter(normality)
Thallium, total (mg/L)	0.001251	30	n/a	n/a	86.67	n/a	n/a	0.2146	NP Inter(NDs)

Confidence Intervals - Significant Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 12/9/2018, 2:44 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Lithium, total (mg/L)	**AD-9**	**1.412**	**0.9353**	**0.39**	**Yes**	**10**	**0**	**No**	**0.01**	**Param.**

Confidence Intervals - All Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 12/9/2018, 2:44 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	AD-15	0.0025	0.00003	0.006	No	10	90	No	0.011	NP (NDs)
Antimony, total (mg/L)	AD-8	0.0025	0.00001	0.006	No	10	70	No	0.011	NP (normality)
Antimony, total (mg/L)	AD-9	0.0025	0.00001	0.006	No	10	90	No	0.011	NP (NDs)
Arsenic, total (mg/L)	AD-15	0.02801	0.003648	0.01	No	10	0	ln(x)	0.01	Param.
Arsenic, total (mg/L)	AD-8	0.0025	0.00031	0.01	No	10	80	No	0.011	NP (NDs)
Arsenic, total (mg/L)	AD-9	0.0025	0.00168	0.01	No	10	90	No	0.011	NP (NDs)
Barium, total (mg/L)	AD-15	0.5012	0.09935	2	No	10	0	ln(x)	0.01	Param.
Barium, total (mg/L)	AD-8	0.02657	0.01924	2	No	10	0	x^(1/3)	0.01	Param.
Barium, total (mg/L)	AD-9	0.05147	0.02327	2	No	10	0	ln(x)	0.01	Param.
Beryllium, total (mg/L)	AD-15	0.002922	0.0001454	0.004	No	10	0	ln(x)	0.01	Param.
Beryllium, total (mg/L)	AD-8	0.0005	0.000008	0.004	No	10	60	No	0.011	NP (normality)
Beryllium, total (mg/L)	AD-9	0.001065	0.000306	0.004	No	10	0	sqrt(x)	0.01	Param.
Cadmium, total (mg/L)	AD-15	0.001225	0.00006409	0.0065	No	10	10	ln(x)	0.01	Param.
Cadmium, total (mg/L)	AD-8	0.0005	0.00002	0.0065	No	10	90	No	0.011	NP (NDs)
Cadmium, total (mg/L)	AD-9	0.002112	0.0004252	0.0065	No	10	0	No	0.01	Param.
Chromium, total (mg/L)	AD-15	0.07284	0.001981	0.1	No	10	0	x^(1/3)	0.01	Param.
Chromium, total (mg/L)	AD-8	0.0007512	0.00005	0.1	No	10	50	No	0.011	NP (normality)
Chromium, total (mg/L)	AD-9	0.0005	0.0002622	0.1	No	10	80	No	0.011	NP (NDs)
Cobalt, total (mg/L)	AD-15	0.02826	0.004545	0.075	No	10	0	ln(x)	0.01	Param.
Cobalt, total (mg/L)	AD-8	0.007648	0.004634	0.075	No	10	0	No	0.01	Param.
Cobalt, total (mg/L)	AD-9	0.0308	0.01499	0.075	No	10	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-15	4.273	1.398	5	No	10	0	ln(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-8	2.718	0.4242	5	No	10	0	x^(1/3)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-9	2.865	1.65	5	No	10	0	No	0.01	Param.
Fluoride, total (mg/L)	AD-15	0.5	0.2621	4	No	9	88.89	No	0.002	NP (NDs)
Fluoride, total (mg/L)	AD-8	0.6628	0.485	4	No	9	11.11	No	0.002	NP (normality)
Fluoride, total (mg/L)	AD-9	0.5584	0.3926	4	No	9	55.56	No	0.01	Param.
Lead, total (mg/L)	AD-15	0.022	0.000438	0.015	No	10	20	No	0.011	NP (Cohens/xfrm)
Lead, total (mg/L)	AD-8	0.0025	0.000039	0.015	No	10	90	No	0.011	NP (NDs)
Lead, total (mg/L)	AD-9	0.0025	0.000262	0.015	No	10	90	No	0.011	NP (NDs)
Lithium, total (mg/L)	AD-15	0.04766	0.005034	0.39	No	10	0	x^(1/3)	0.01	Param.
Lithium, total (mg/L)	AD-8	0.1197	0.08187	0.39	No	10	0	No	0.01	Param.
Lithium, total (mg/L)	**AD-9**	**1.412**	**0.9353**	**0.39**	**Yes**	**10**	**0**	**No**	**0.01**	**Param.**
Mercury, total (mg/L)	AD-15	0.000707	0.0000125	0.002	No	9	11.11	No	0.002	NP (normality)
Mercury, total (mg/L)	AD-8	0.00002103	0.000008	0.002	No	9	55.56	No	0.002	NP (normality)
Mercury, total (mg/L)	AD-9	0.000045	0.000006	0.002	No	9	33.33	No	0.002	NP (Cohens/xfrm)
Molybdenum, total (mg/L)	AD-15	0.005266	0.0005303	0.1	No	10	30	No	0.01	Param.
Molybdenum, total (mg/L)	AD-8	0.0025	0.00016	0.1	No	10	60	No	0.011	NP (normality)
Molybdenum, total (mg/L)	AD-9	0.0025	0.00011	0.1	No	10	90	No	0.011	NP (NDs)
Selenium, total (mg/L)	AD-15	0.003463	0.0009	0.05	No	10	20	No	0.011	NP (Cohens/xfrm)
Selenium, total (mg/L)	AD-8	0.0025	0.00007	0.05	No	10	60	No	0.011	NP (normality)
Selenium, total (mg/L)	AD-9	0.003528	0.0003	0.05	No	10	40	No	0.011	NP (Cohens/xfrm)
Thallium, total (mg/L)	AD-15	0.00137	0.00009	0.002	No	10	70	No	0.011	NP (normality)
Thallium, total (mg/L)	AD-8	0.001185	0.000129	0.002	No	10	70	No	0.011	NP (normality)
Thallium, total (mg/L)	AD-9	0.001776	0.000062	0.002	No	10	60	No	0.011	NP (normality)

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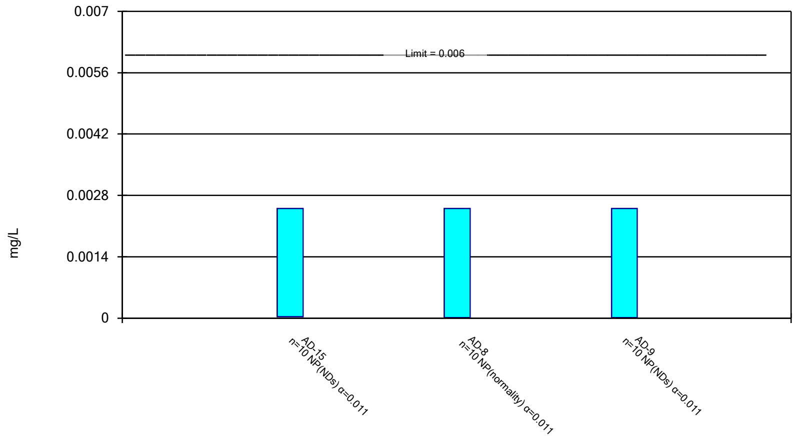
Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

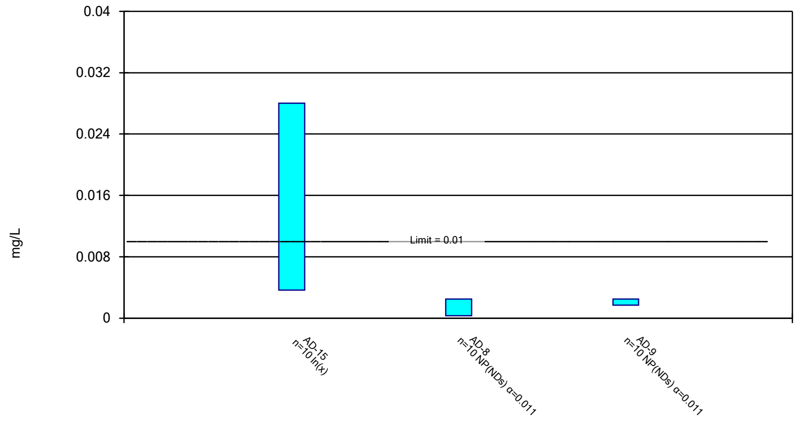


Constituent: Antimony, total   Analysis Run 12/9/2018 2:41 PM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

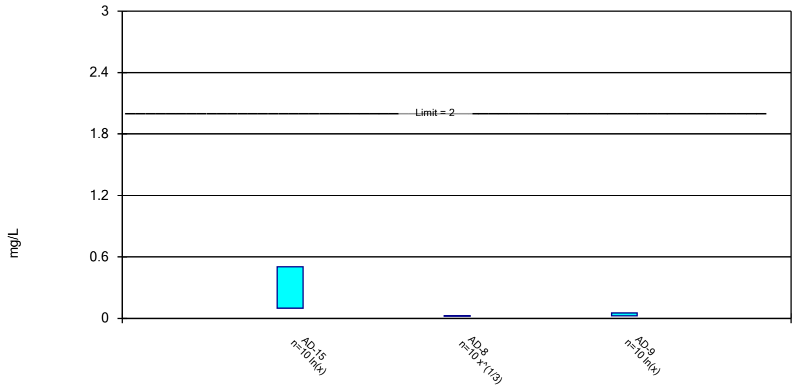


Constituent: Arsenic, total   Analysis Run 12/9/2018 2:41 PM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

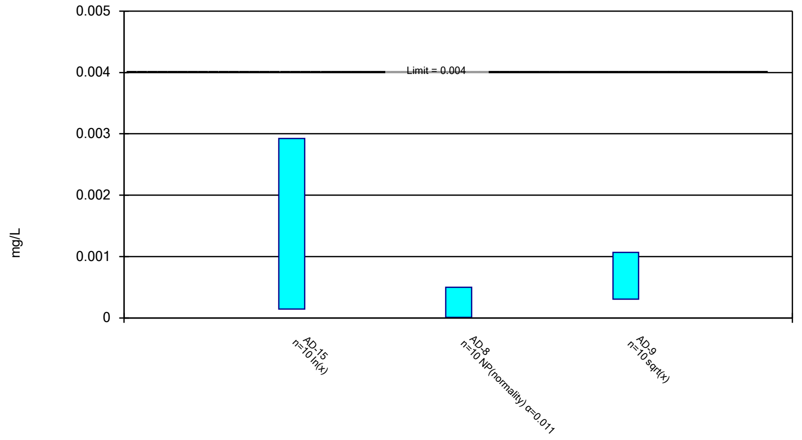


Constituent: Barium, total   Analysis Run 12/9/2018 2:41 PM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

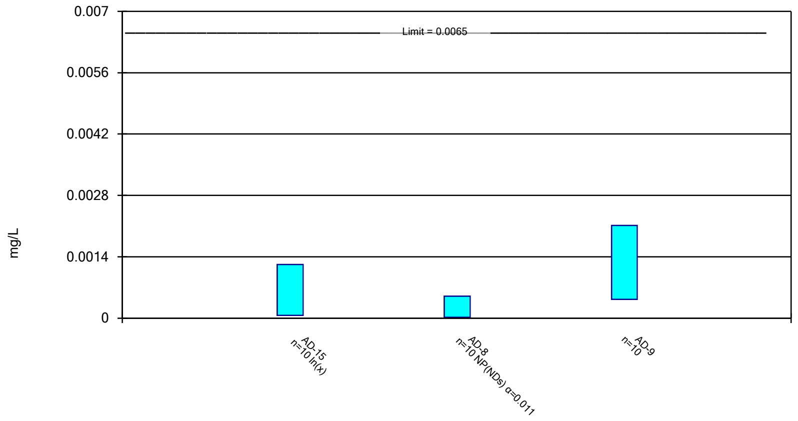


Constituent: Beryllium, total   Analysis Run 12/9/2018 2:41 PM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

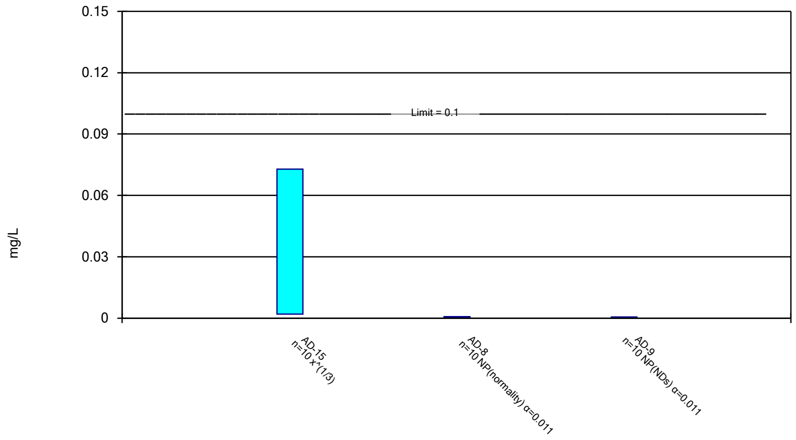


Constituent: Cadmium, total Analysis Run 12/9/2018 2:41 PM View: Confidence Intervals - App IV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

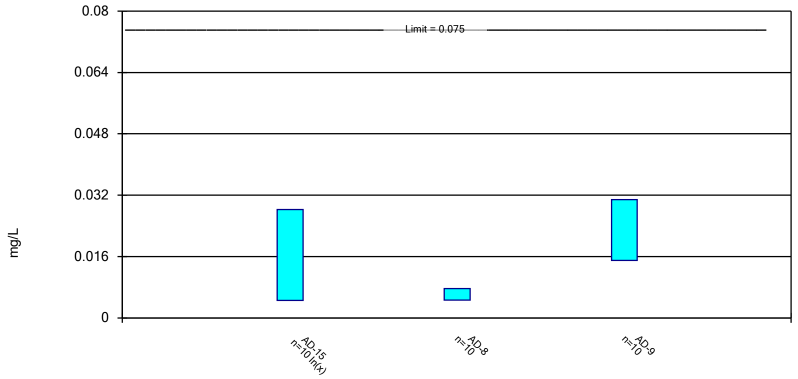


Constituent: Chromium, total Analysis Run 12/9/2018 2:41 PM View: Confidence Intervals - App IV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

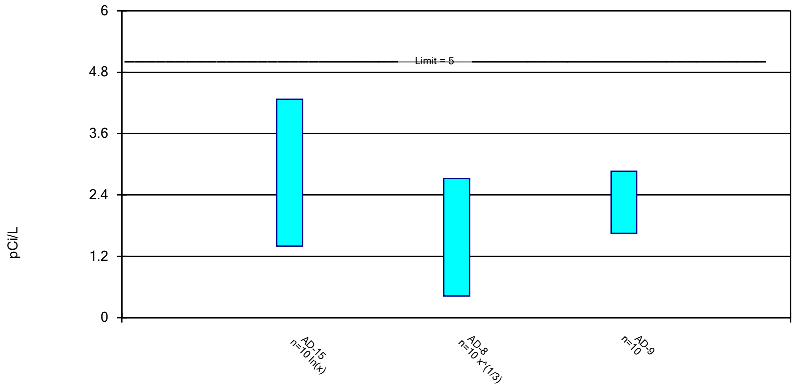


Constituent: Cobalt, total Analysis Run 12/9/2018 2:41 PM View: Confidence Intervals - App IV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

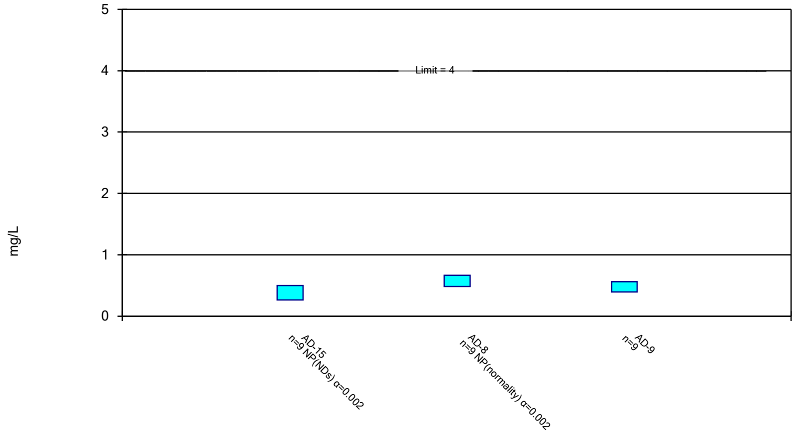


Constituent: Combined Radium 226 + 228 Analysis Run 12/9/2018 2:41 PM View: Confidence Intervals -
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

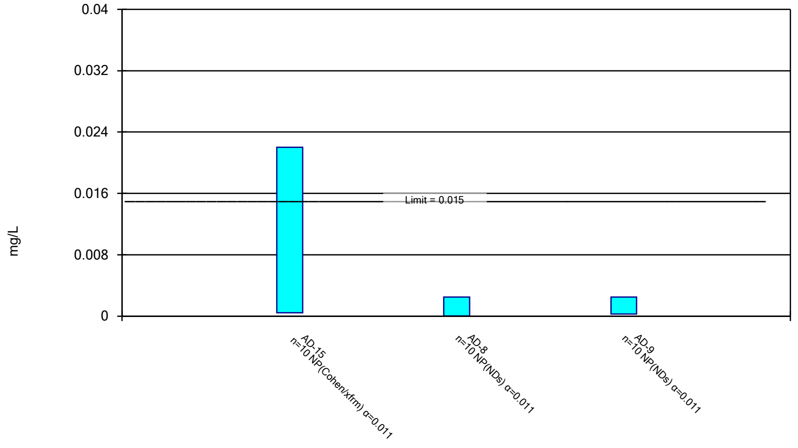


Constituent: Fluoride, total   Analysis Run 12/9/2018 2:41 PM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

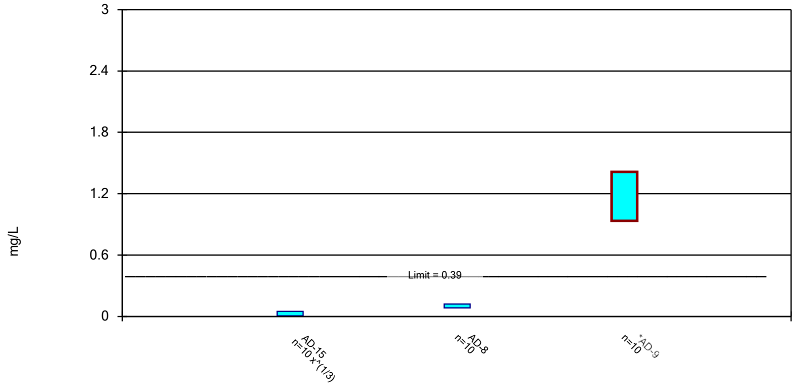


Constituent: Lead, total   Analysis Run 12/9/2018 2:41 PM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

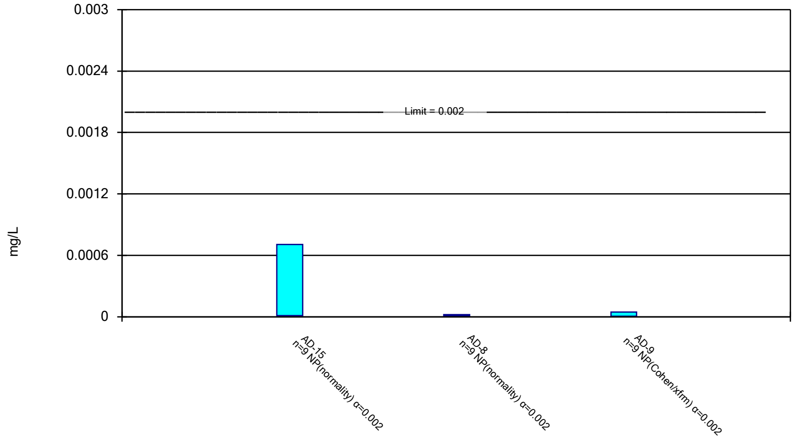


Constituent: Lithium, total   Analysis Run 12/9/2018 2:41 PM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

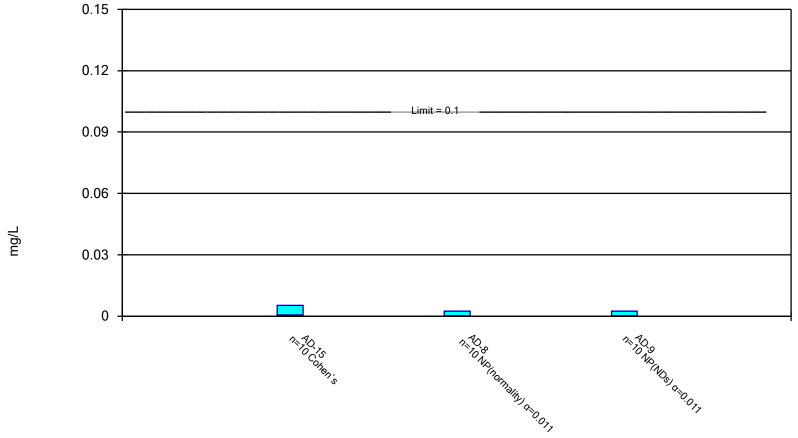


Constituent: Mercury, total   Analysis Run 12/9/2018 2:41 PM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



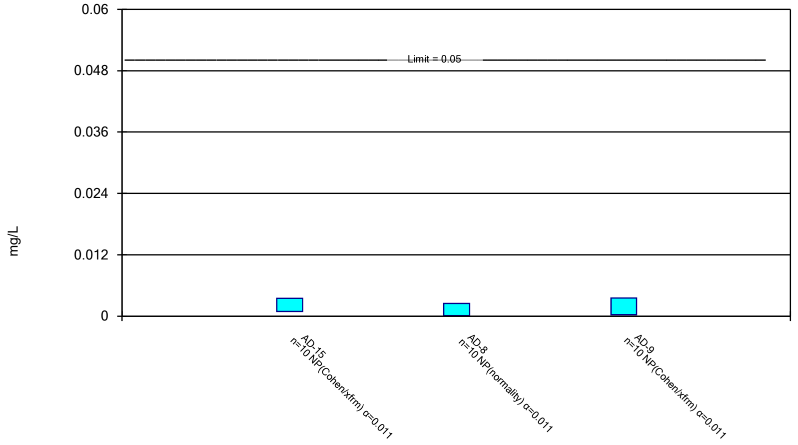
Constituent: Molybdenum, total Analysis Run 12/9/2018 2:41 PM View: Confidence Intervals - App IV

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



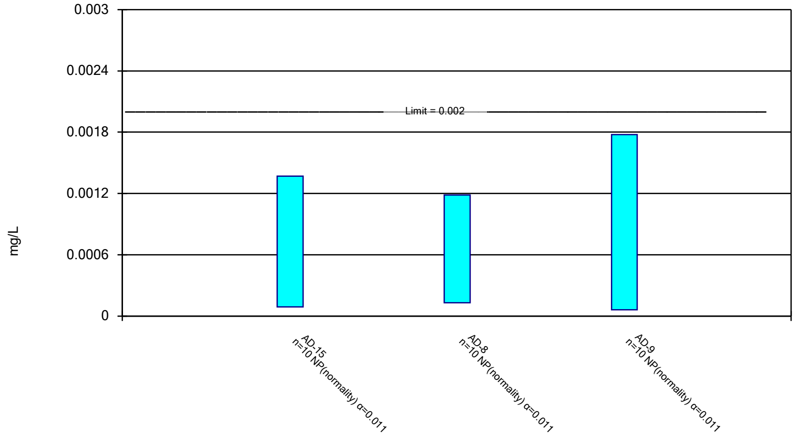
Constituent: Selenium, total Analysis Run 12/9/2018 2:41 PM View: Confidence Intervals - App IV

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



Constituent: Thallium, total Analysis Run 12/9/2018 2:41 PM View: Confidence Intervals - App IV

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

STATISTICAL ANALYSIS SUMMARY PRIMARY BOTTOM ASH POND

J. Robert Welsh Plant

Pittsburg, Texas

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

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July 11, 2019

CHA8473

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
PBAP	Primary Bottom Ash Pond
QA	Quality Assurance
QC	Quality Control
RSL	Regional Screening Level
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Primary Bottom Ash Pond (PBAP), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas.

Based on detection monitoring conducted in 2017 and 2018, a statistically significant increase (SSIs) over background was concluded for boron at the PBAP. An alternative source was not identified at the time, so two assessment monitoring events were conducted at the PBAP in 2018, in accordance with 40 CFR 257.95. An SSL was identified for lithium at well AD-9. An alternative source demonstration (ASD) was successfully completed and the unit remained in assessment monitoring (Arcadis, 2019). A semi-annual assessment monitoring event was also completed in February 2019, with the results of the February 2019 event documented in this report.

Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were re-established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at a statistically significant level (SSL) above the GWPS. An SSL was identified for lithium. Appendix III concentrations for boron and pH remained above background. Thus, either the unit will remain in assessment monitoring or an ASD will be conducted to evaluate if the unit can return to detection monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

PRIMARY BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, one set of samples was collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(d)(1). Samples from the February 2019 semi-annual sampling event were analyzed for the Appendix III and Appendix IV parameters. A summary of data collected during this assessment monitoring event may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.14 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the PBAP were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017). Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained to meet the requirements of 40 CFR 257.95(d)(1) were screened for potential outliers. No outliers were identified.

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in 40 CFR 257.95(h)(2) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events. Generally, tolerance limits were calculated parametrically with 95% coverage and 95% confidence. Non-parametric tolerance limits were calculated for antimony, arsenic, cobalt, fluoride, lithium, mercury, molybdenum, and selenium due to apparent non-normal distributions and for lead and thallium due to a high non-detect frequency. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

The following SSL was identified identified at the Welsh PBAP:

- The LCL for lithium exceeded the GWPS of 0.39 mg/L at AD-9 (0.957 mg/L).

2.2.3 Evaluation of Potential Appendix III SSIs

While SSLs were identified, a review of the Appendix III results were also completed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations. Prediction limits were calculated for the Appendix III parameters to represent background values. As described in the January 2018 *Statistical Analysis Summary* report (Geosyntec, 2018), intrawell tests were used to evaluate potential SSIs for calcium, chloride, fluoride, sulfate, and TDS, whereas interwell tests were used to evaluate potential SSIs for boron and pH.

Prediction limits for the interwell tests were recalculated using data collected during the February 2019 assessment monitoring event. Three data points (i.e., one sample from three background wells) were added to the background dataset for each interwell test during the February 2019 event. New data were tested for outliers prior to being added to the background dataset. The updated prediction limits were calculated for a one-of-two retesting procedure, as during detection monitoring. The values of the updated prediction limits were similar to the values of the prediction limits calculated during detection monitoring. The revised interwell prediction limits were used to evaluate potential SSIs for boron and pH.

For the intrawell tests, limited data made it possible to add only one data point (i.e., one sample from each compliance well) to each background dataset. Because one sample result is insufficient to compare against the existing background dataset, the prediction limits were not updated for the intrawell tests at this time. The intrawell prediction limits calculated during detection monitoring were used to evaluate potential SSIs for calcium, chloride, fluoride, sulfate, and TDS.

Data collected during the February 2019 assessment monitoring event from each compliance well were compared to the prediction limits to evaluate if results were above background values. Verification sampling was completed in April 2019. The results from this event and the prediction limits are summarized in Table 3. The following exceedances of the upper prediction limits (UPLs) were noted:

- Boron concentrations exceeded the interwell UPL of 0.775 mg/L at AD-8 (1.27 mg/L and 1.21 mg/L).

Based on these results, concentrations of Appendix III parameters exceeded background levels at compliance wells at the Welsh PBAP during assessment monitoring.

2.3 Conclusions

A semi-annual assessment monitoring event was conducted in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the February 2019 data. GWPSs were re-established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPS. An SSL for lithium was identified. Appendix III parameters were also evaluated, with an exceedance of boron identified.

Based on this evaluation, the Welsh PBAP CCR unit will either move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Welsh Plant. January 2017.

Arcadis. 2019. Alternative Source Demonstration – Lithium. Primary Bottom Ash Pond, J. Robert. Welsh Plant. February 7, 2019.

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – Primary Bottom Ash Pond, J Robert Welsh Plant, Pittsburg, Texas. January 15, 2018.

TABLES

Table 1 - Groundwater Data Summary
Welsh - Primary Bottom Ash Pond

Parameter	Unit	AD-1	AD-5	AD-8	AD-9	AD-15	AD-17
		2/20/2019	2/21/2019	2/21/2019	2/21/2019	2/21/2019	2/21/2019
Antimony	µg/L	0.160	0.0200 J	0.100 U	0.100 U	0.100 U	0.0800 J
Arsenic	µg/L	0.460	1.59	0.570	1.18	2.21	2.51
Barium	µg/L	457	69.4	28.1	52.4	76.6	120
Beryllium	µg/L	0.0900 J	0.0800 J	0.0300 J	0.474	0.208	0.240
Boron	mg/L	0.504	0.0330	1.47	1.39	0.169	0.151
Cadmium	µg/L	0.0100 J	0.0500 U	0.0300 J	0.0900	0.0100 J	0.270
Calcium	mg/L	142	33.9	17.6	211	2.67	207
Chloride	mg/L	2.82	24.7	23.2	89.0	28.2	43.2
Chromium	µg/L	0.306	0.432	0.456	0.313	0.225	3.34
Cobalt	µg/L	0.399	8.58	2.88	14.8	2.90	64.5
Combined Radium	pCi/L	3.16	1.27	0.417	2.51	0.841	2.66
Fluoride	mg/L	0.240	0.210	0.660	0.190	0.0900	0.180
Lead	µg/L	0.124	0.147	0.223	0.0800 J	0.104	2.49
Lithium	mg/L	0.00155	0.0807	0.0911	1.12	0.00294	0.268
Mercury	mg/L	0.0000250 U	0.0000250 U	0.0000250 U	0.0000100 J	0.0000250 U	0.00000700 J
Molybdenum	µg/L	1.00 J	2.00 U	2.00 U	2.00 U	2.00 U	0.700 J
Selenium	µg/L	0.700	0.100 J	0.100 J	0.300	0.400	0.800
Total Dissolved Solids	mg/L	522	220	352	2240	150	1720
Sulfate	mg/L	49.2	46.5	163	1350	10.6	1060
Thallium	µg/L	0.500 U	0.500 U	0.500 U	0.100 J	0.500 U	0.500 U
pH	SU	7.31	5.38	6.40	4.98	4.98	6.93

Notes:

µg/L: micrograms per liter

mg/L: milligrams per liter

pCi/L: picocuries per liter

SU: standard unit

U: Non-detect value. For statistical analysis, parameters which were not detected were replaced with the reporting limit.

J: Estimated value. Parameter was detected in concentrations below the reporting limit.

Table 2: Groundwater Protection Standards
Welsh Plant - Primary Bottom Ash Pond

Constituent Name	MCL	CCR Rule-Specified	Background Limit
Antimony, Total (mg/L)	0.006		0.005
Arsenic, Total (mg/L)	0.01		0.005
Barium, Total (mg/L)	2		0.58
Beryllium, Total (mg/L)	0.004		0.00073
Cadmium, Total (mg/L)	0.005		0.01
Chromium, Total (mg/L)	0.1		0.0036
Cobalt, Total (mg/L)	n/a	0.006	0.075
Combined Radium, Total (pCi/L)	5		4.18
Fluoride, Total (mg/L)	4		1
Lead, Total (mg/L)	n/a	0.015	0.005
Lithium, Total (mg/L)	n/a	0.04	0.39
Mercury, Total (mg/L)	0.002		0.000033
Molybdenum, Total (mg/L)	n/a	0.1	0.002
Selenium, Total (mg/L)	0.05		0.005
Thallium, Total (mg/L)	0.002		0.0013

Notes:
Grey cell indicates calculated UTL is higher than MCL.
MCL = Maximum Contaminant Level
RSL = Regional Screening Level
Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
The higher of the calculated UTL or MCL/Rule-Specified Level is used as the GWPS.

Table 3: Appendix III Data Summary
Welsh Plant - Primary Bottom Ash Pond

Parameter	Units	Description	AD-15	AD-8		AD-9	
			2/21/2019	2/21/2019	4/30/2019	2/21/2019	4/30/2019
Boron	mg/L	Interwell Background Value (UPL)	0.775				
		Detection Monitoring Result	0.169	**1.47**	**1.21**	**1.39**	0.07
Calcium	mg/L	Intrawell Background Value (UPL)	5.71	35.7		350	
		Detection Monitoring Result	2.67	17.6	--	211	--
Chloride	mg/L	Intrawell Background Value (UPL)	38.4	38.3		139	
		Detection Monitoring Result	28.2	23.2	--	89	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1.00	1.03		0.73	
		Detection Monitoring Result	0.09	0.66	--	0.19	--
pH	SU	Interwell Background Value (UPL)	7.1				
		Interwell Background Value (LPL)	4.8				
		Detection Monitoring Result	5.0	6.4	6.9	5.0	**4.5**
Sulfate	mg/L	Intrawell Background Value (UPL)	35.6	236		2527	
		Detection Monitoring Result	10.6	163	--	1350	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	388	569		3147	
		Detection Monitoring Result	150	352	--	2240	--

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

-: Not Sampled

Bold values exceed the background value.

Background values are shaded gray.

Based on a 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the calculated background value.

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Welsh Primary Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

DAVID ANTHONY MILLER
112498
LICENSED

112498
License Number

TEXAS
Licensing State

07.11.19
Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

July 10, 2019

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Welsh PBAP
Assessment Monitoring Event – April 2019

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the statistical analysis of April 2019 groundwater data for American Electric Power Inc.'s Welsh PBAP. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at the site for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** AD-1, AD-5, and AD-17; and
- **Downgradient wells:** AD-8, AD-9, and AD-15.

Data were sent electronically, and the statistical analysis was conducted according to the Statistical Analysis Plan and screening evaluation prepared by GSC and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC.

The CCR program consists of the following constituents:

- **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS;

- **Appendix IV** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record (Figure A). Values flagged as outliers may be seen in the Outlier Summary following this letter (Figure B), and are plotted in a lighter font and disconnected symbol on the time series graphs. Note that the measured concentrations of most metals for September 30, 2016 at well AD-15 are very high compared to the rest of the observations, which suggests a possible laboratory problem. These values are not currently flagged in the database pending verification.

Evaluation of Appendix III Parameters

Interwell prediction limits combined with a 1-of-2 verification strategy were constructed for boron and pH; and intrawell prediction limits combined with a 1-of-2 verification strategy were constructed for calcium, chloride, fluoride, sulfate and TDS (Figure C & D, respectively). The statistical method selected for each parameter was determined based on the results of the evaluation performed in December 2017; and all proposed background data were screened for outliers and trends at that time. The findings of those reports were submitted with that analysis.

Interwell prediction limits utilize all upgradient well data for construction of statistical limits. During each sample event, upgradient well data are screened for any newly suspected outliers or obvious trending patterns using time series plots. All values flagged as outliers may be seen on the Outlier Summary report following this letter. No obvious trending patterns were observed in the upgradient wells.

Intrawell prediction limits utilize the background data set that was originally screened in 2017. As recommended in the EPA Unified Guidance (2009), the background data set will be tested for the purpose of updating statistical limits using the Mann-Whitney two-sample test when an additional four to eight measurements are available.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of one additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered a false positive result and, therefore, no further action is necessary.

No prediction limit exceedances were noted for any of the Appendix III parameters in downgradient wells except for boron in wells AD-8 and AD-9. Calcium in upgradient well AD-17 and chloride in upgradient well AD-5 exceeded their intrawell prediction limits which is typically an indication that groundwater is changing naturally upgradient of the facility. The results of the prediction limit analyses may be found in the Prediction Limit Summary tables following this letter.

When a statistically significant increase is identified, the data are further evaluated using the Sen's Slope/Mann Kendall trend test to determine whether concentrations are statistically increasing, decreasing or stable (Figure D). Upgradient wells are included in the trend analyses to identify whether similar patterns exist upgradient of the site. Such patterns would be an indication of natural variability in groundwater quality unrelated to practices at the site. No statistically significant increasing or decreasing trends were found for any of the well/parameter pairs. A Trend Test summary table follows this letter.

Evaluation of Appendix IV Parameters

Upper tolerance limits were used to calculate background limits from all available pooled upgradient well data for Appendix IV parameters to determine the Alternate Contaminant Level (ACL) for each constituent (Figure F). Background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits. Any flagged values may be seen on the Outlier Summary following this letter. Parametric tolerance limits use a target of 95% confidence and 95% coverage. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and CCR-Rule specified levels in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure G).

Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters and compared to the highest limit of the MCL, CCR-Rule specified level, or ACL as discussed above (Figure H). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No confidence intervals exceedances were found except for lithium in well AD-9. A summary of the confidence interval results follows this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Welsh PBAP. If you have any questions or comments, please feel free to contact me.

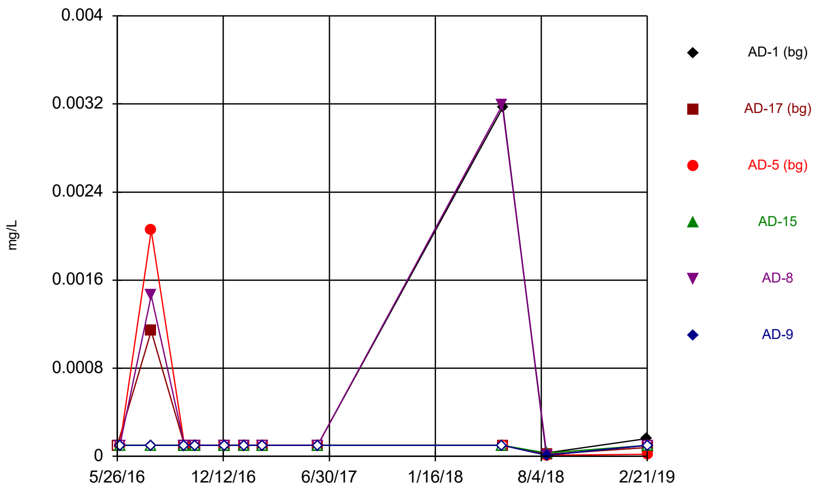
For Groundwater Stats Consulting,

Kristina Rayner

Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

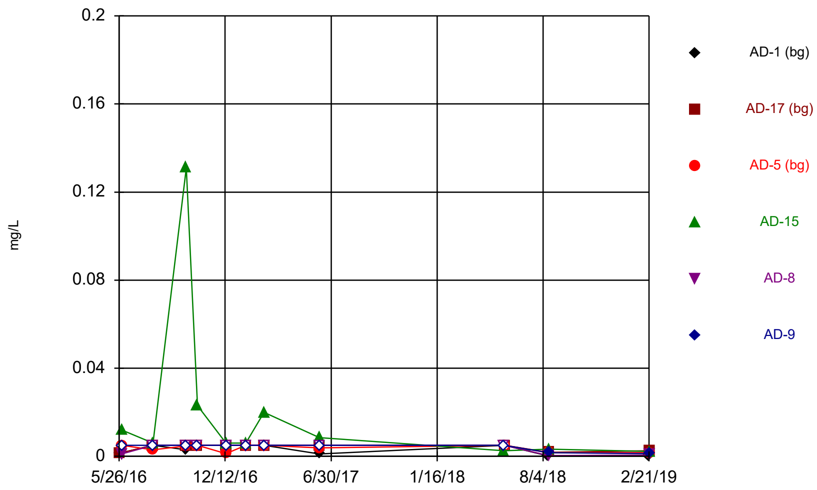
Time Series



Constituent: Antimony, total Analysis Run 6/30/2019 6:49 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

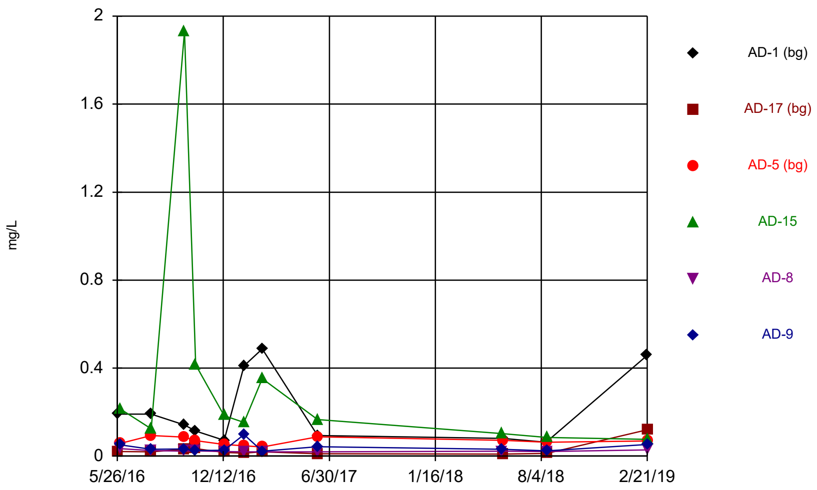
Time Series



Constituent: Arsenic, total Analysis Run 6/30/2019 6:49 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

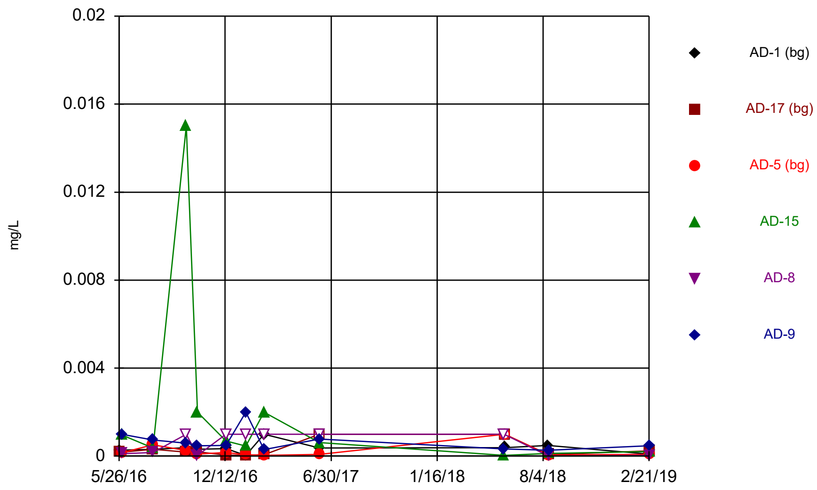
Time Series



Constituent: Barium, total Analysis Run 6/30/2019 6:49 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

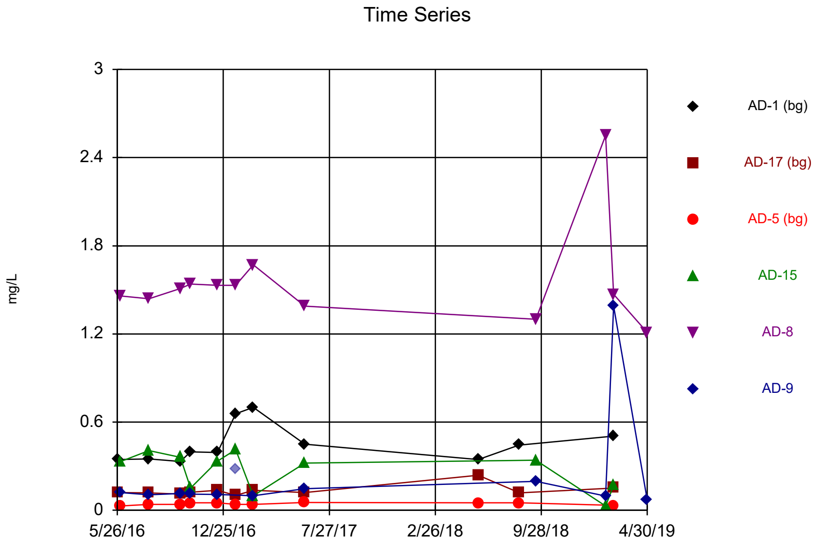
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



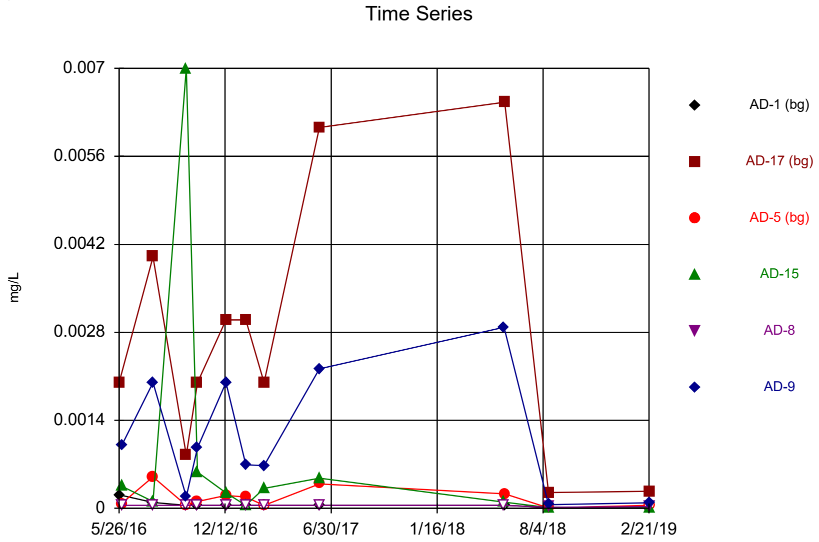
Constituent: Beryllium, total Analysis Run 6/30/2019 6:49 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



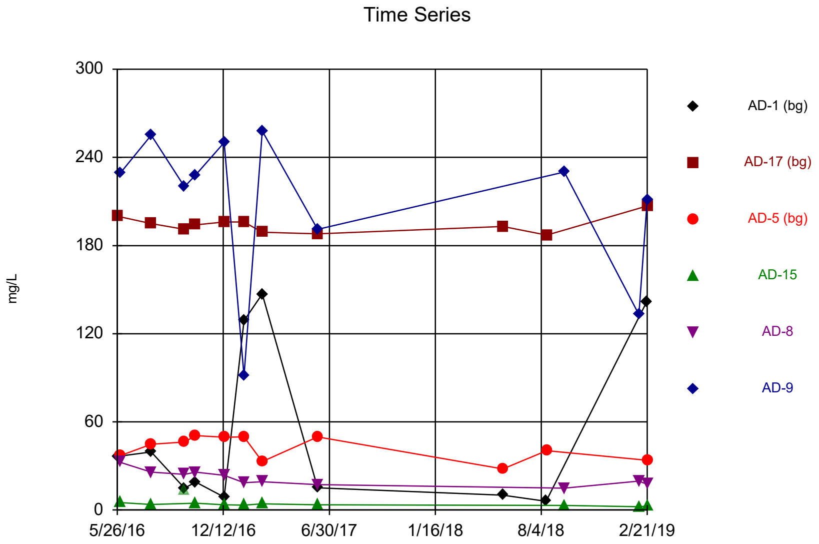
Constituent: Boron, total Analysis Run 6/30/2019 6:49 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



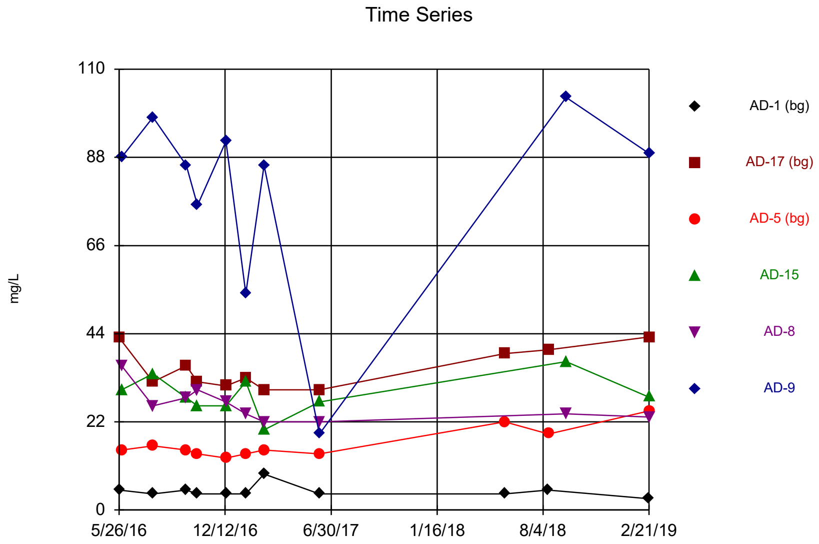
Constituent: Cadmium, total Analysis Run 6/30/2019 6:49 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



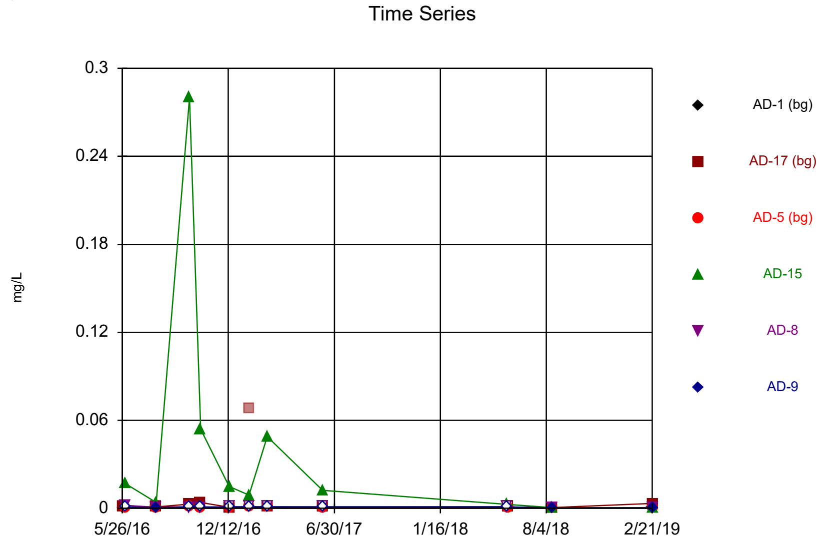
Constituent: Calcium, total Analysis Run 6/30/2019 6:49 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



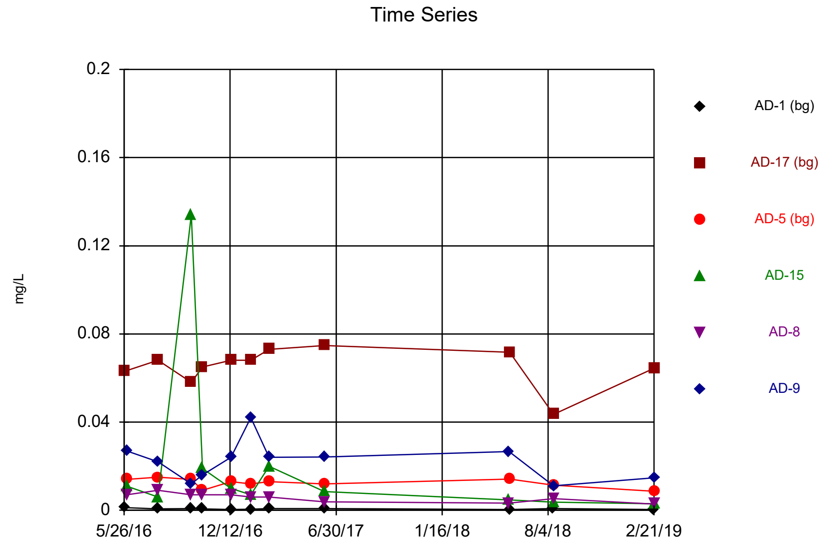
Constituent: Chloride, total Analysis Run 6/30/2019 6:49 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



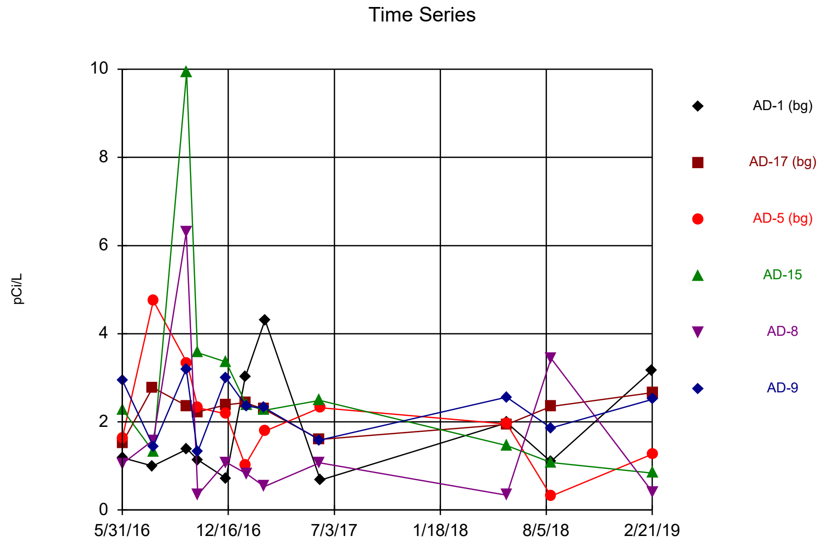
Constituent: Chromium, total   Analysis Run 6/30/2019 6:49 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



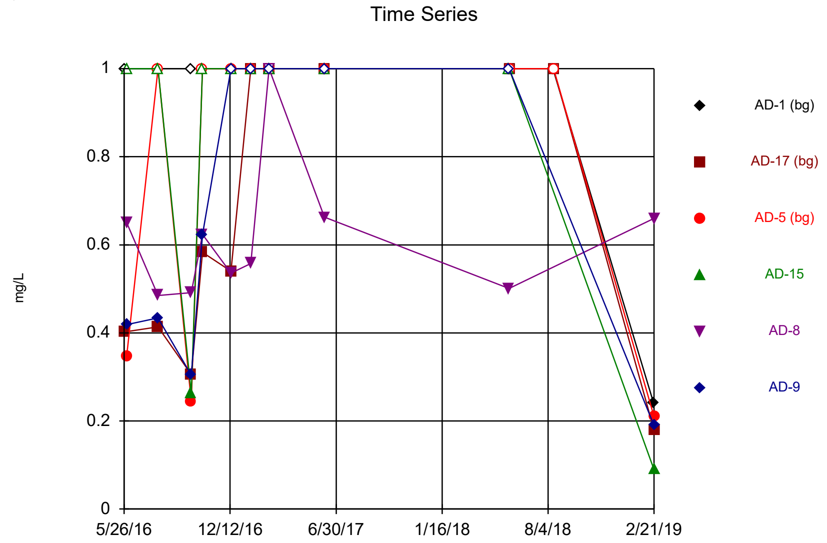
Constituent: Cobalt, total   Analysis Run 6/30/2019 6:49 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Combined Radium 226 + 228   Analysis Run 6/30/2019 6:49 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

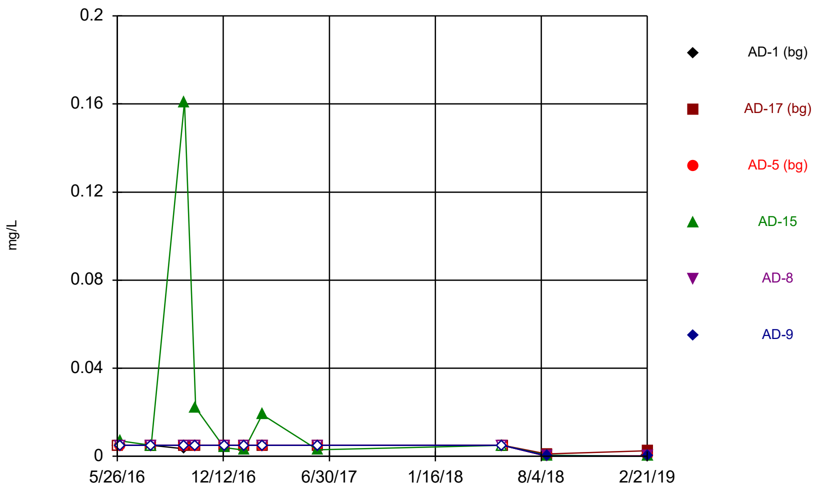
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Fluoride, total   Analysis Run 6/30/2019 6:49 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

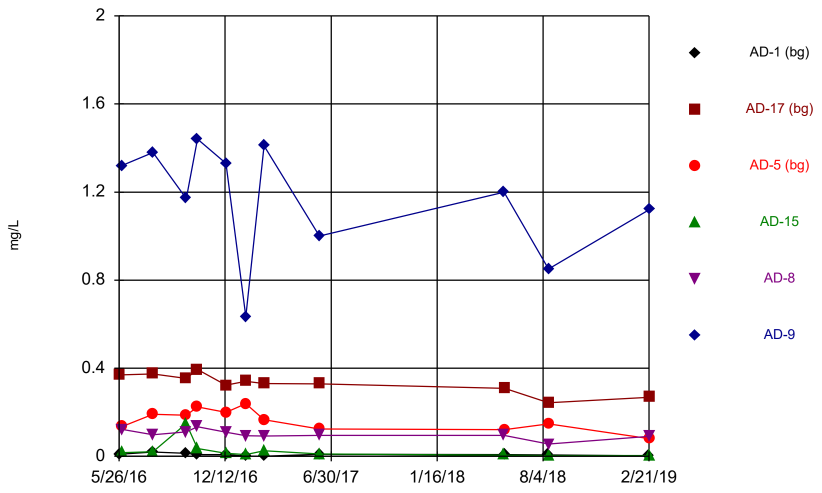
Time Series



Constituent: Lead, total   Analysis Run 6/30/2019 6:49 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

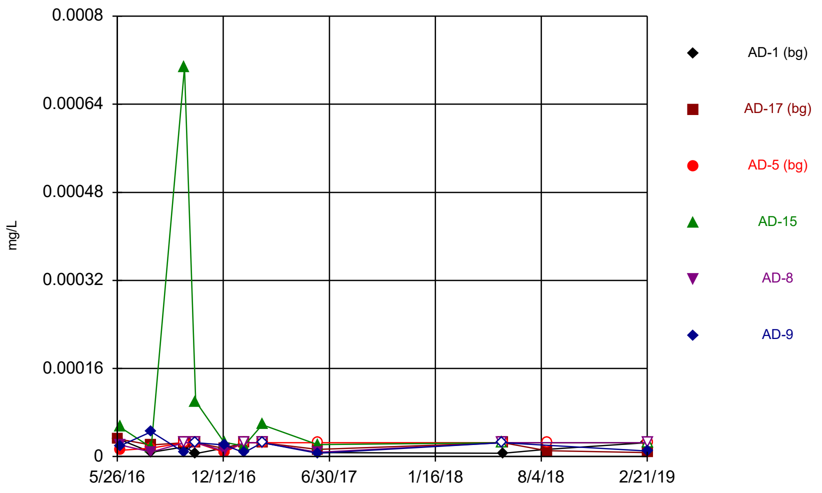
Time Series



Constituent: Lithium, total   Analysis Run 6/30/2019 6:49 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

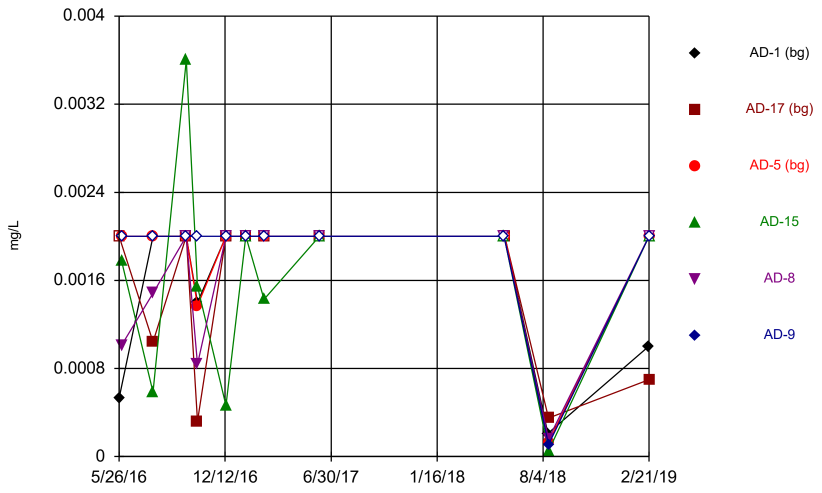
Time Series



Constituent: Mercury, total   Analysis Run 6/30/2019 6:49 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

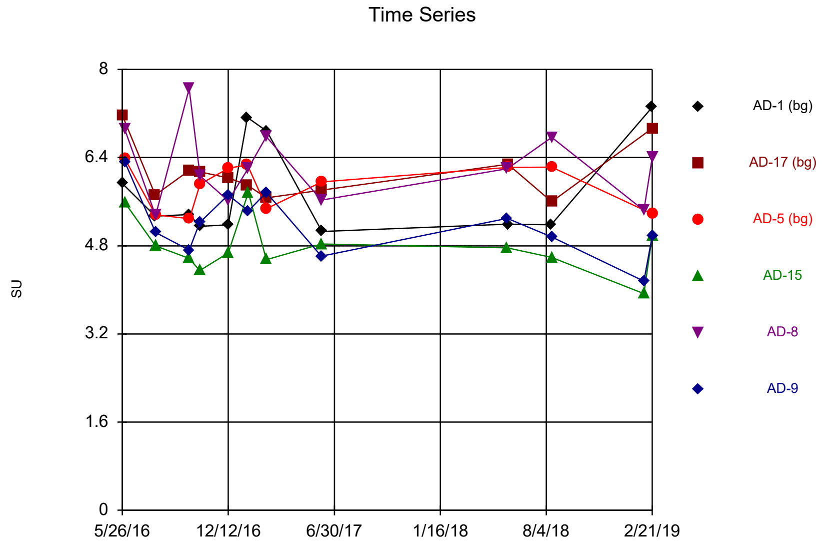
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



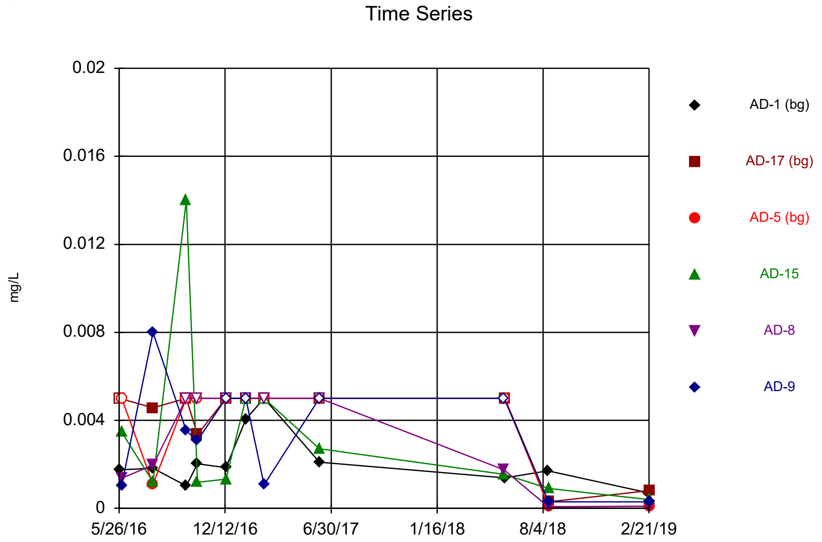
Constituent: Molybdenum, total   Analysis Run 6/30/2019 6:50 PM   View: Descriptive
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



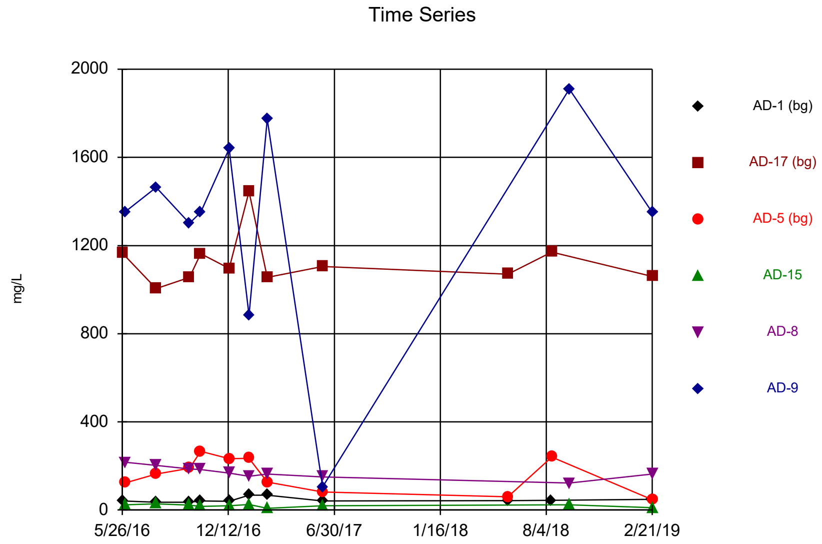
Constituent: pH, field Analysis Run 6/30/2019 6:50 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



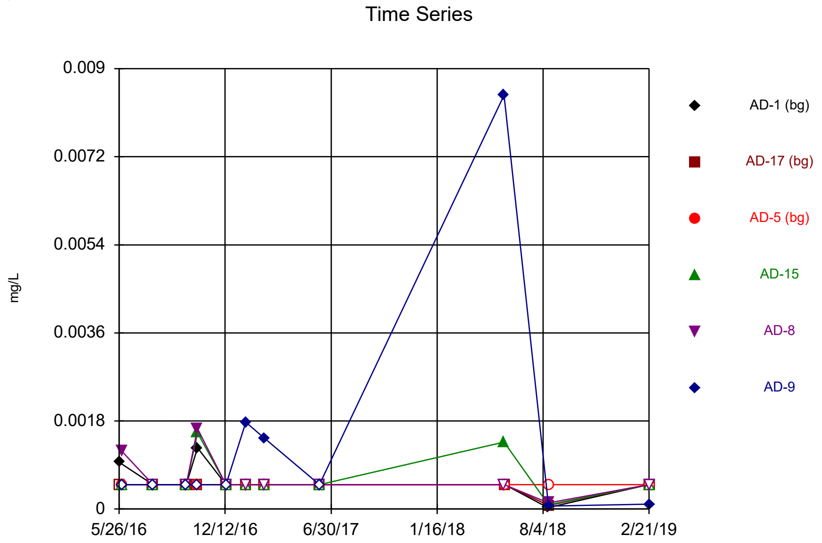
Constituent: Selenium, total Analysis Run 6/30/2019 6:50 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



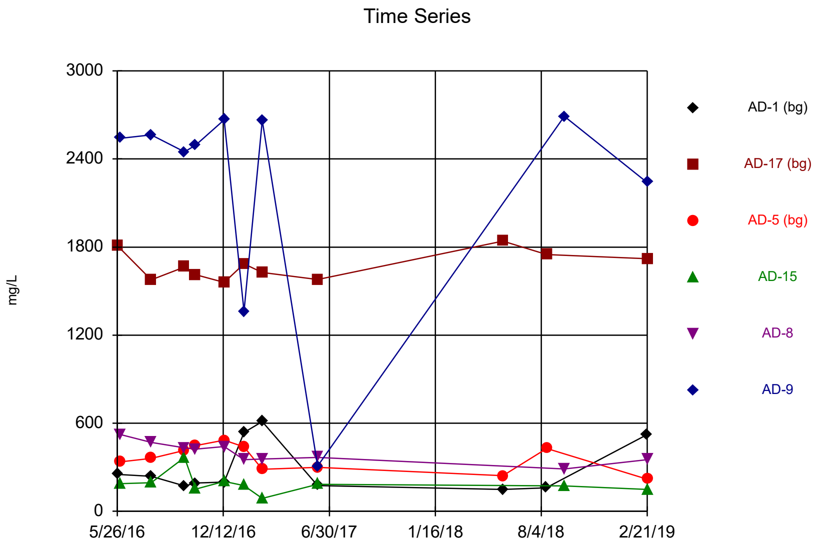
Constituent: Sulfate, total Analysis Run 6/30/2019 6:50 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Thallium, total Analysis Run 6/30/2019 6:50 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids Analysis Run 6/30/2019 6:50 PM View: Descriptive
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Outlier Summary Table

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 07/05/2019, 1:19 PM

	AD-9 Boron, total (mg/L)	AD-15 Calcium, total (mg/L)	AD-17 Chromium, total (mg/L)
9/30/2016		13.7 (o)	
1/20/2017	0.283 (o)		0.068 (o)

Interwell Prediction Limit Summary - Significant Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 6/30/2019, 7:00 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	**AD-8**	**0.775**	**n/a**	**2/21/2019**	**1.47**	**Yes**	**33**	**-2.01**	**0.986**	**0**	**None**	**ln(x)**	**0.002505**	**Param Inter 1 of 2**
Boron, total (mg/L)	**AD-9**	**0.775**	**n/a**	**2/21/2019**	**1.39**	**Yes**	**33**	**-2.01**	**0.986**	**0**	**None**	**ln(x)**	**0.002505**	**Param Inter 1 of 2**

Interwell Prediction Limit Summary - All Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 6/30/2019, 7:00 PM

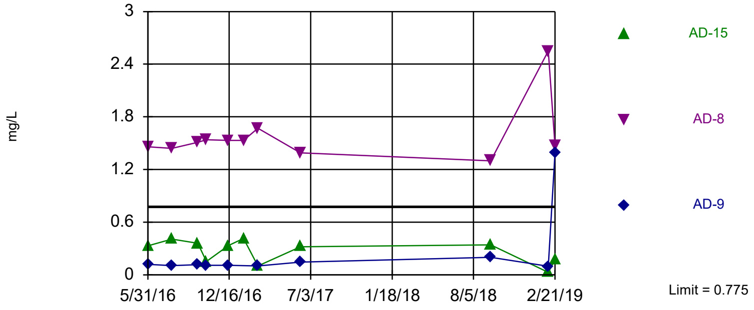
Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	AD-15	0.775	n/a	2/21/2019	0.169	No	33	-2.01	0.986	0	None	ln(x)	0.002505	Param Inter 1 of 2
Boron, total (mg/L)	**AD-8**	**0.775**	**n/a**	**2/21/2019**	**1.47**	**Yes**	**33**	**-2.01**	**0.986**	**0**	**None**	**ln(x)**	**0.002505**	**Param Inter 1 of 2**
Boron, total (mg/L)	**AD-9**	**0.775**	**n/a**	**2/21/2019**	**1.39**	**Yes**	**33**	**-2.01**	**0.986**	**0**	**None**	**ln(x)**	**0.002505**	**Param Inter 1 of 2**
pH, field (SU)	AD-15	7.059	4.811	2/21/2019	4.98	No	33	5.935	0.6316	0	None	No	0.001253	Param Inter 1 of 2
pH, field (SU)	AD-8	7.059	4.811	2/21/2019	6.4	No	33	5.935	0.6316	0	None	No	0.001253	Param Inter 1 of 2
pH, field (SU)	AD-9	7.059	4.811	2/21/2019	4.98	No	33	5.935	0.6316	0	None	No	0.001253	Param Inter 1 of 2

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: AD-8, AD-9

Prediction Limit

Interwell Parametric



Background Data Summary (based on natural log transformation): Mean=-2.01, Std. Dev.=0.986, n=33. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9116, critical = 0.906. Kappa = 1.78 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.002505. Comparing 3 points to limit.

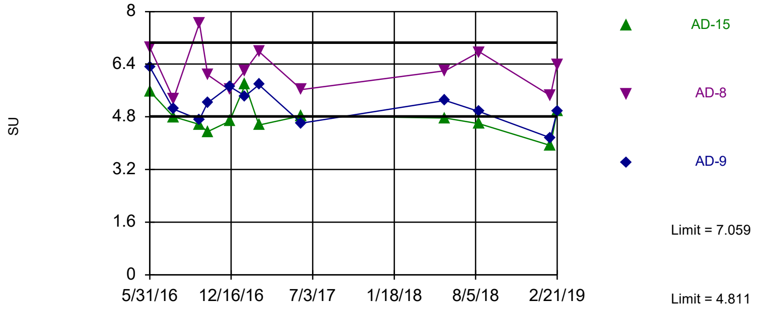
Constituent: Boron, total Analysis Run 6/30/2019 6:58 PM View: PL's - Interwell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Interwell Parametric



Background Data Summary: Mean=5.935, Std. Dev.=0.6316, n=33. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9252, critical = 0.906. Kappa = 1.78 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.001253. Comparing 3 points to limit.

Constituent: pH, field Analysis Run 6/30/2019 6:58 PM View: PL's - Interwell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Intrawell Prediction Limit Summary - Significant Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 6/30/2019, 7:06 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Calcium, total (mg/L)	**AD-17**	**203.5**	**n/a**	**2/21/2019**	**207**	**Yes**	**8**	**193.6**	**4.033**	**0**	**None**	**No**	**0.002505**	Param 1 of 2
Chloride, total (mg/L)	**AD-5**	**16.78**	**n/a**	**2/21/2019**	**24.7**	**Yes**	**8**	**14.5**	**0.9258**	**0**	**None**	**No**	**0.002505**	Param 1 of 2

Intrawell Prediction Limit Summary - All Results

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP   Printed 6/30/2019, 7:06 PM

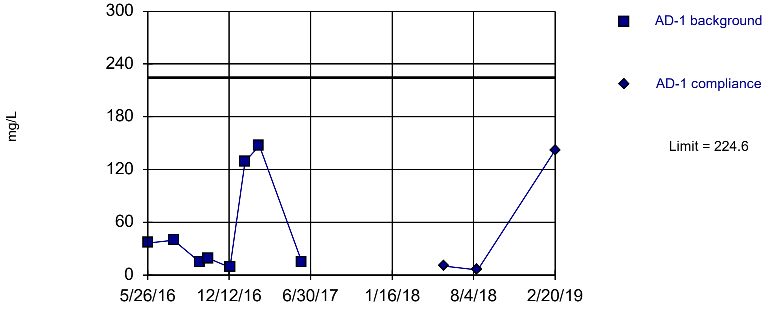
Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Calcium, total (mg/L)	AD-1	224.6	n/a	2/20/2019	142	No	8	6.363	3.508	0	None	sqrt(x)	0.002505	Param 1 of 2
Calcium, total (mg/L)	**AD-17**	**203.5**	**n/a**	**2/21/2019**	**207**	**Yes**	**8**	**193.6**	**4.033**	**0**	**None**	**No**	**0.002505**	Param 1 of 2
Calcium, total (mg/L)	AD-5	61.45	n/a	2/21/2019	33.9	No	8	45.09	6.656	0	None	No	0.002505	Param 1 of 2
Calcium, total (mg/L)	AD-15	5.711	n/a	2/21/2019	2.67	No	7	4.031	0.6254	0	None	No	0.002505	Param 1 of 2
Calcium, total (mg/L)	AD-8	35.68	n/a	2/21/2019	17.6	No	8	23.46	4.969	0	None	No	0.002505	Param 1 of 2
Calcium, total (mg/L)	AD-9	349.9	n/a	2/21/2019	211	No	8	215.3	54.76	0	None	No	0.002505	Param 1 of 2
Chloride, total (mg/L)	AD-1	9	n/a	2/20/2019	2.82	No	8	n/a	n/a	0	n/a	n/a	0.02144	NP (normality) 1 of 2
Chloride, total (mg/L)	AD-17	44.04	n/a	2/21/2019	43.2	No	8	33.38	4.34	0	None	No	0.002505	Param 1 of 2
Chloride, total (mg/L)	**AD-5**	**16.78**	**n/a**	**2/21/2019**	**24.7**	**Yes**	**8**	**14.5**	**0.9258**	**0**	**None**	**No**	**0.002505**	Param 1 of 2
Chloride, total (mg/L)	AD-15	38.42	n/a	2/21/2019	28.2	No	8	27.88	4.291	0	None	No	0.002505	Param 1 of 2
Chloride, total (mg/L)	AD-8	38.29	n/a	2/21/2019	23.2	No	8	26.88	4.643	0	None	No	0.002505	Param 1 of 2
Chloride, total (mg/L)	AD-9	139.3	n/a	2/21/2019	89	No	8	74.88	26.2	0	None	No	0.002505	Param 1 of 2
Fluoride, total (mg/L)	AD-1	1	n/a	2/20/2019	0.24	No	8	n/a	n/a	100	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	AD-17	0.6953	n/a	2/21/2019	0.18	No	8	0.4488	0.1003	37.5	Kaplan-Meier	No	0.002505	Param 1 of 2
Fluoride, total (mg/L)	AD-5	1	n/a	2/21/2019	0.21	No	8	n/a	n/a	75	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	AD-15	1	n/a	2/21/2019	0.09	No	8	n/a	n/a	87.5	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	AD-8	1.034	n/a	2/21/2019	0.66	No	8	0.6258	0.166	12.5	None	No	0.002505	Param 1 of 2
Fluoride, total (mg/L)	AD-9	0.7259	n/a	2/21/2019	0.19	No	8	0.4449	0.1143	50	Kaplan-Meier	No	0.002505	Param 1 of 2
Sulfate, total (mg/L)	AD-1	82.3	n/a	2/20/2019	49.2	No	8	6.772	0.9358	0	None	sqrt(x)	0.002505	Param 1 of 2
Sulfate, total (mg/L)	AD-17	1471	n/a	2/21/2019	1060	No	8	1136	136.3	0	None	No	0.002505	Param 1 of 2
Sulfate, total (mg/L)	AD-5	336.4	n/a	2/21/2019	46.5	No	8	177.4	64.69	0	None	No	0.002505	Param 1 of 2
Sulfate, total (mg/L)	AD-15	35.58	n/a	2/21/2019	10.6	No	8	20.38	6.186	0	None	No	0.002505	Param 1 of 2
Sulfate, total (mg/L)	AD-8	235.8	n/a	2/21/2019	163	No	8	178	23.53	0	None	No	0.002505	Param 1 of 2
Sulfate, total (mg/L)	AD-9	2527	n/a	2/21/2019	1350	No	8	1234	526.1	0	None	No	0.002505	Param 1 of 2
Total Dissolved Solids (mg/L)	AD-1	784.8	n/a	2/20/2019	522	No	8	16.71	4.598	0	None	sqrt(x)	0.002505	Param 1 of 2
Total Dissolved Solids (mg/L)	AD-17	1840	n/a	2/21/2019	1720	No	8	1639	81.77	0	None	No	0.002505	Param 1 of 2
Total Dissolved Solids (mg/L)	AD-5	563.5	n/a	2/21/2019	220	No	8	383.6	73.17	0	None	No	0.002505	Param 1 of 2
Total Dissolved Solids (mg/L)	AD-15	388.1	n/a	2/21/2019	150	No	8	194.4	78.82	0	None	No	0.002505	Param 1 of 2
Total Dissolved Solids (mg/L)	AD-8	568.6	n/a	2/21/2019	352	No	8	420.9	60.09	0	None	No	0.002505	Param 1 of 2
Total Dissolved Solids (mg/L)	AD-9	3147	n/a	2/21/2019	2240	No	8	1.3e10	7.4e9	0	None	x^3	0.002505	Param 1 of 2

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on square root transformation): Mean=6.363, Std. Dev.=3.508, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8248, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

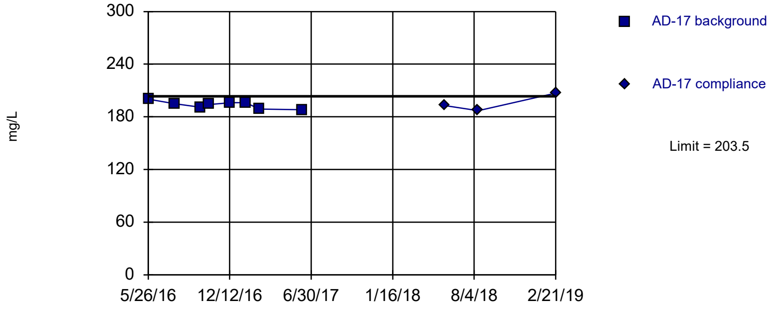
Constituent: Calcium, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=193.6, Std. Dev.=4.033, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9507, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

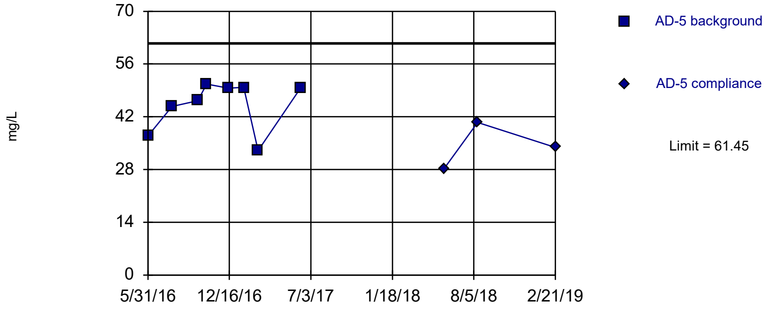
Constituent: Calcium, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=45.09, Std. Dev.=6.656, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8101, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

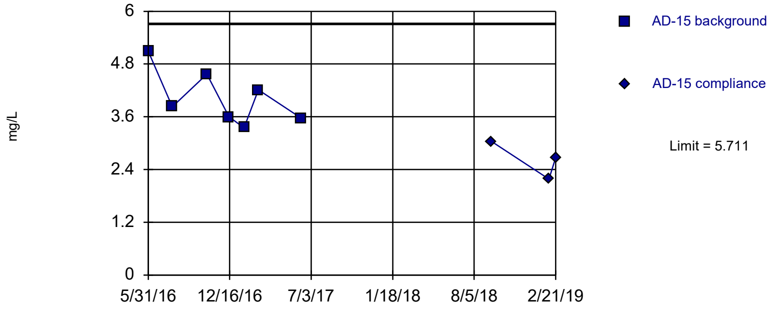
Constituent: Calcium, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=4.031, Std. Dev.=0.6254, n=7. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9248, critical = 0.73. Kappa = 2.685 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

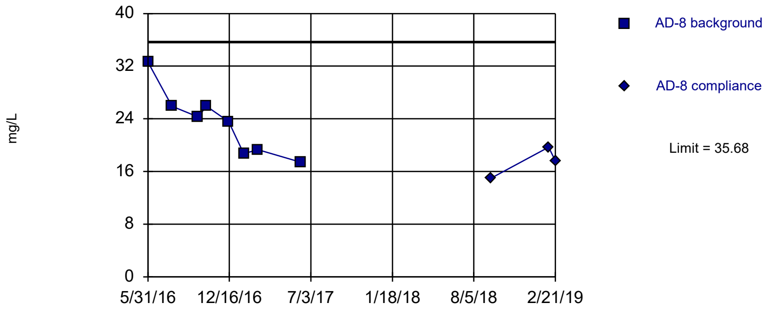
Constituent: Calcium, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=23.46, Std. Dev.=4.969, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9282, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

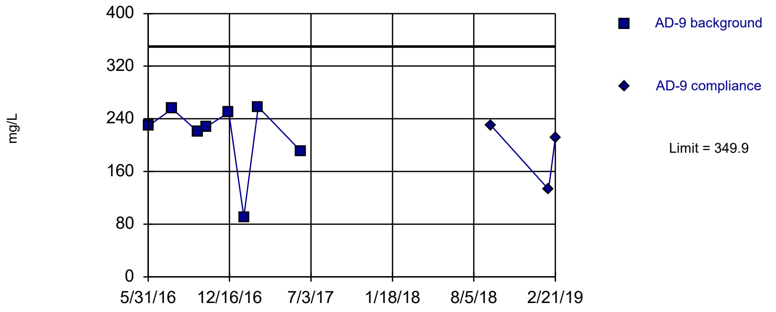
Constituent: Calcium, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=215.3, Std. Dev.=54.76, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7629, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

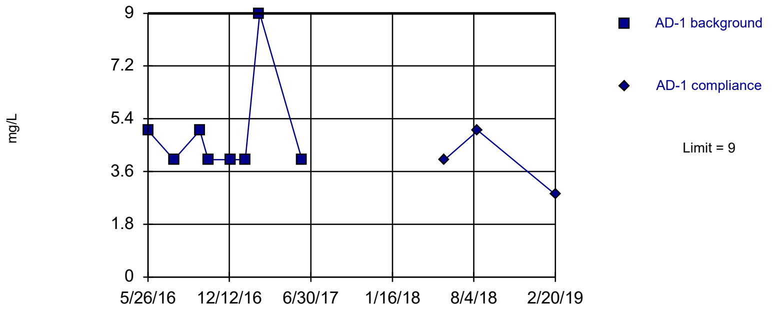
Constituent: Calcium, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

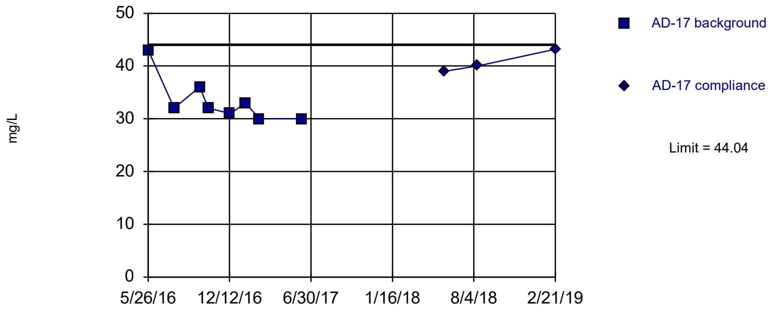
Constituent: Chloride, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=33.38, Std. Dev.=4.34, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7758, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

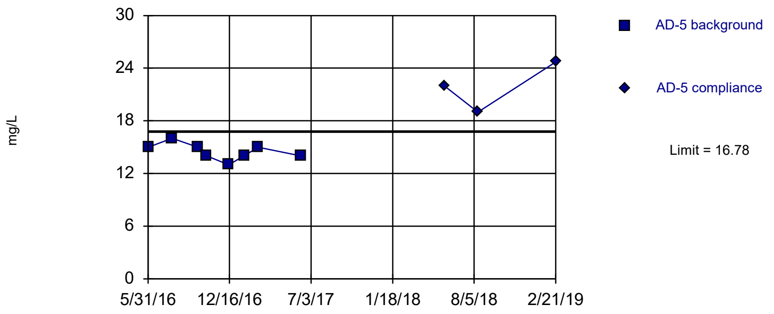
Constituent: Chloride, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=14.5, Std. Dev.=0.9258, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9302, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

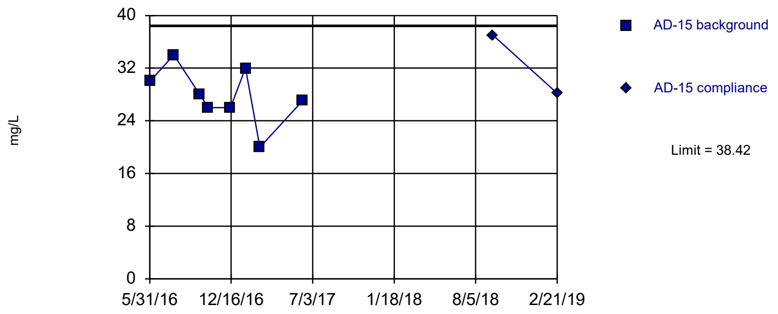
Constituent: Chloride, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=27.88, Std. Dev.=4.291, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9603, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

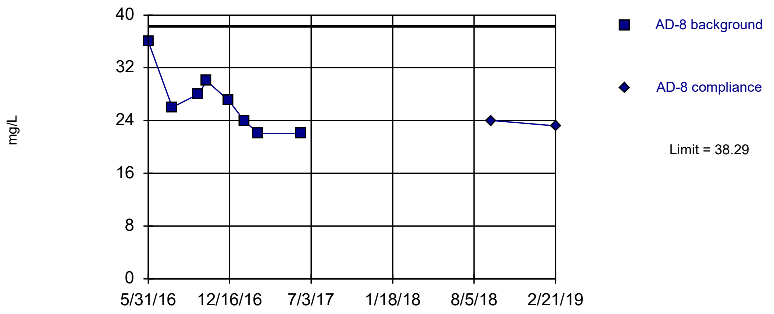
Constituent: Chloride, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=26.88, Std. Dev.=4.643, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9162, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

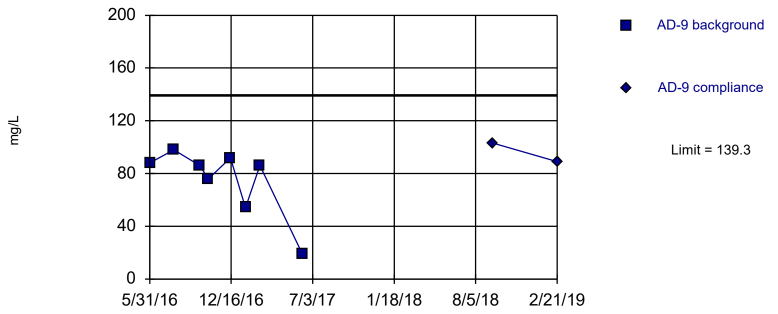
Constituent: Chloride, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=74.88, Std. Dev.=26.2, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7978, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

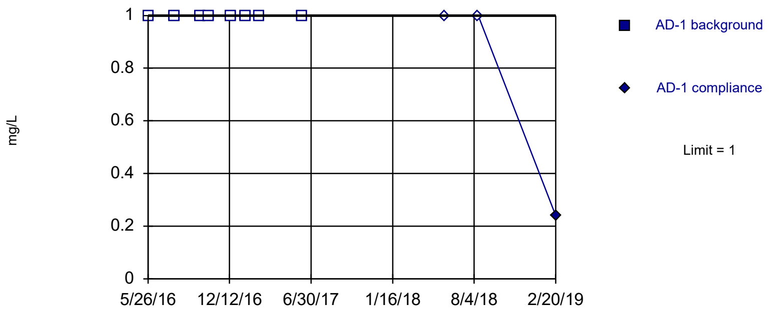
Constituent: Chloride, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 8) were censored; limit is most recent reporting limit. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

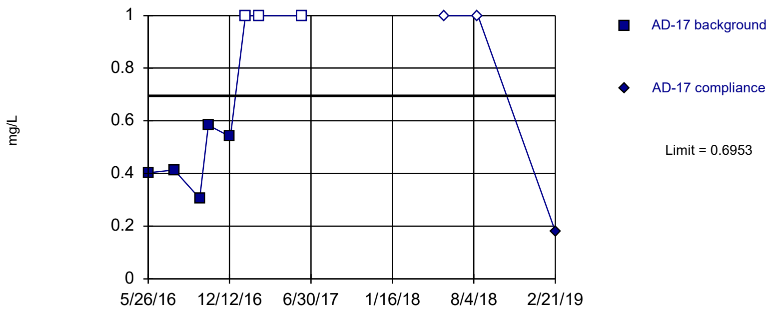
Constituent: Fluoride, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (after Kaplan-Meier Adjustment): Mean=0.4488, Std. Dev.=0.1003, n=8, 37.5% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8226, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

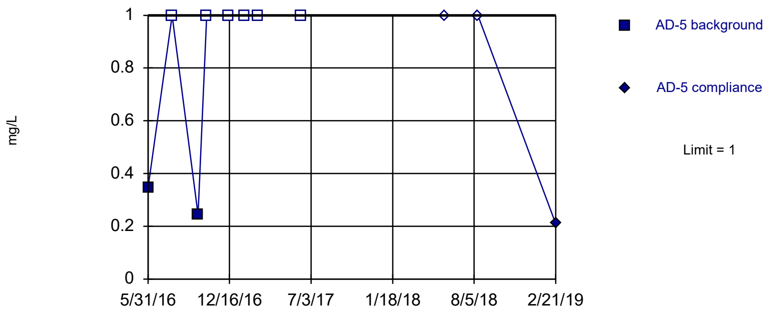
Constituent: Fluoride, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 8 background values. 75% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

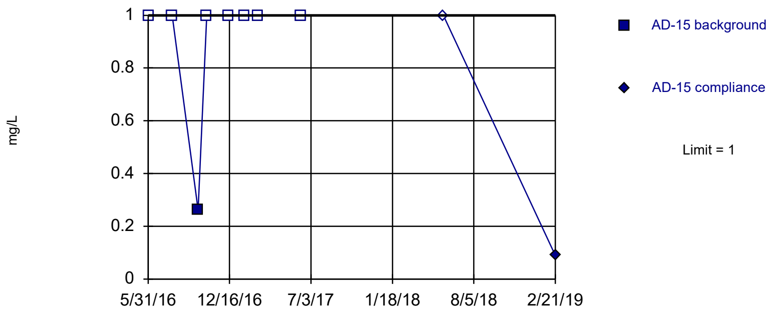
Constituent: Fluoride, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 8 background values. 87.5% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

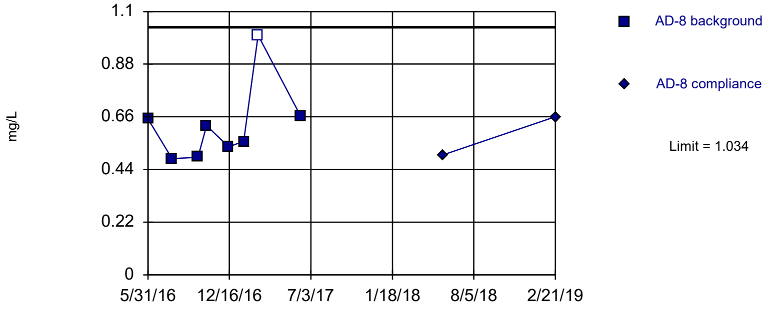
Constituent: Fluoride, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=0.6258, Std. Dev.=0.166, n=8, 12.5% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7879, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

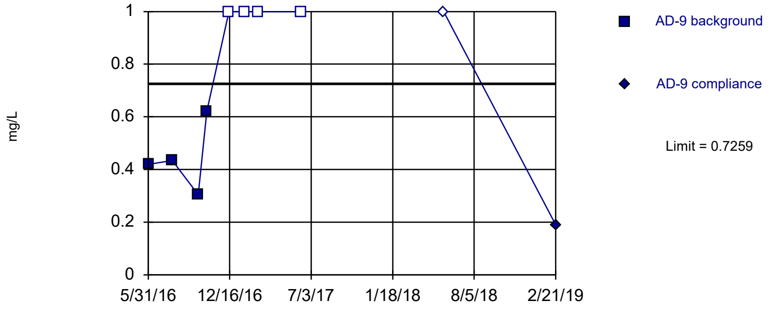
Constituent: Fluoride, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (after Kaplan-Meier Adjustment): Mean=0.4449, Std. Dev.=0.1143, n=8, 50% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.786, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

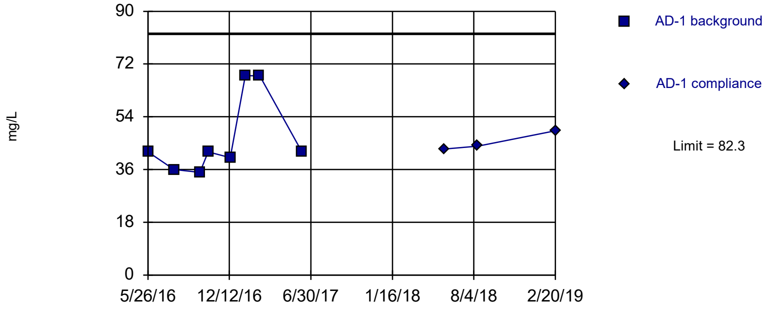
Constituent: Fluoride, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on square root transformation): Mean=6.772, Std. Dev.=0.9358, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7528, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

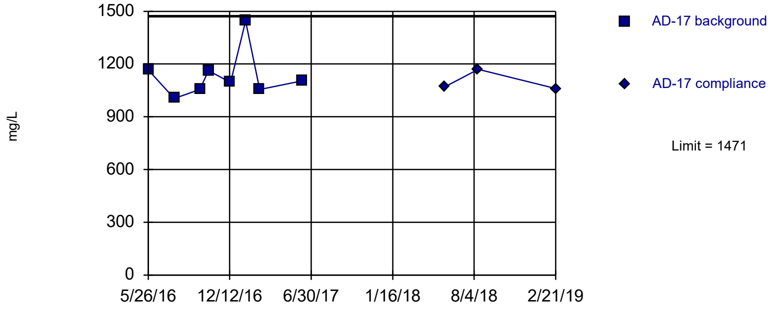
Constituent: Sulfate, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=1136, Std. Dev.=136.3, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7916, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

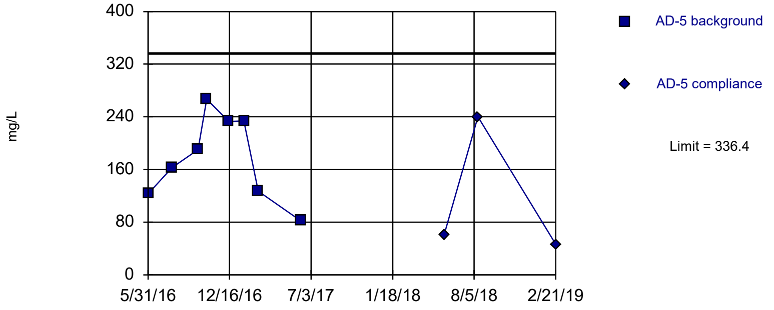
Constituent: Sulfate, total Analysis Run 6/30/2019 7:02 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=177.4, Std. Dev.=64.69, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.953, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

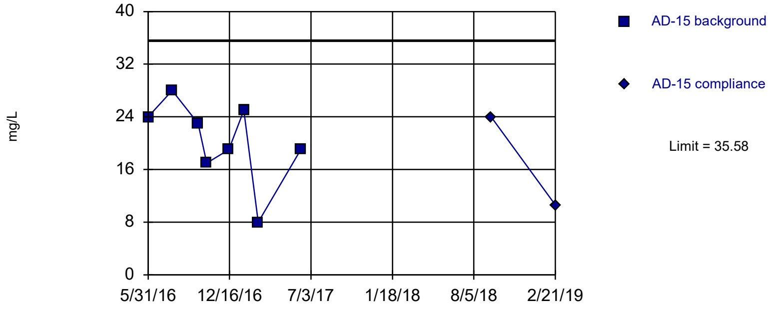
Constituent: Sulfate, total Analysis Run 6/30/2019 7:03 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=20.38, Std. Dev.=6.186, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9238, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

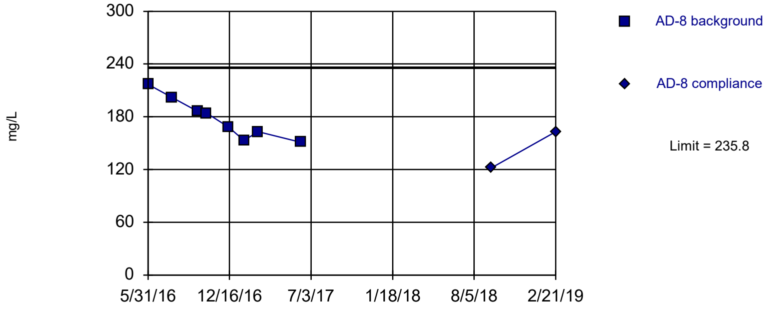
Constituent: Sulfate, total Analysis Run 6/30/2019 7:03 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=178, Std. Dev.=23.53, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9398, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

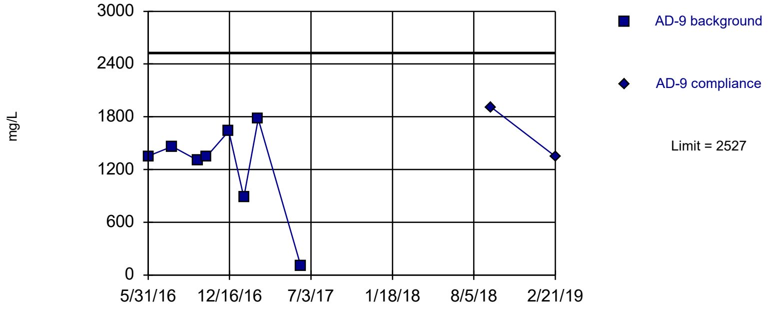
Constituent: Sulfate, total Analysis Run 6/30/2019 7:03 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=1234, Std. Dev.=526.1, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8423, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

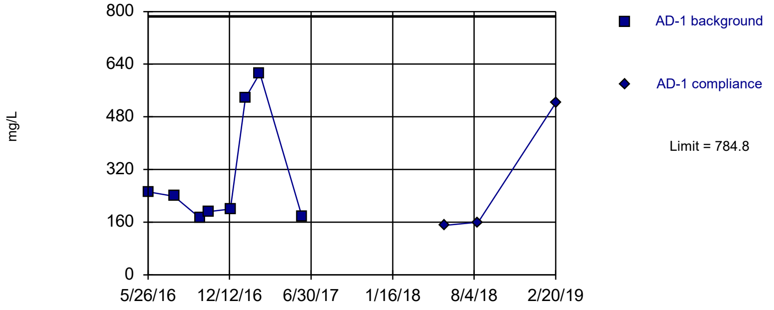
Constituent: Sulfate, total Analysis Run 6/30/2019 7:03 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on square root transformation): Mean=16.71, Std. Dev.=4.598, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.756, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

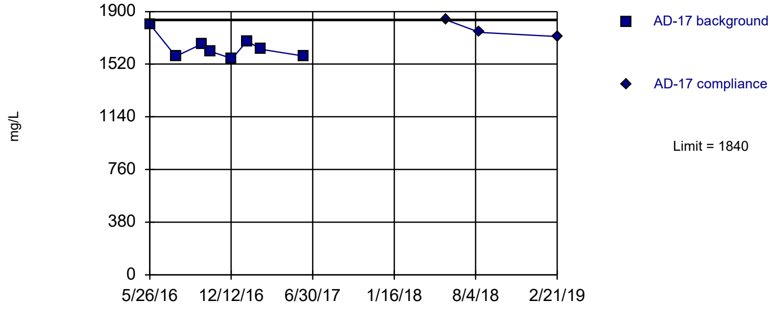
Constituent: Total Dissolved Solids Analysis Run 6/30/2019 7:03 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=1639, Std. Dev.=81.77, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8702, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

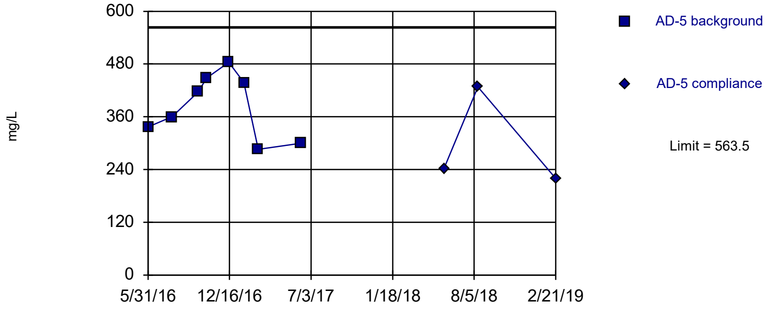
Constituent: Total Dissolved Solids Analysis Run 6/30/2019 7:03 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=383.6, Std. Dev.=73.17, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.937, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

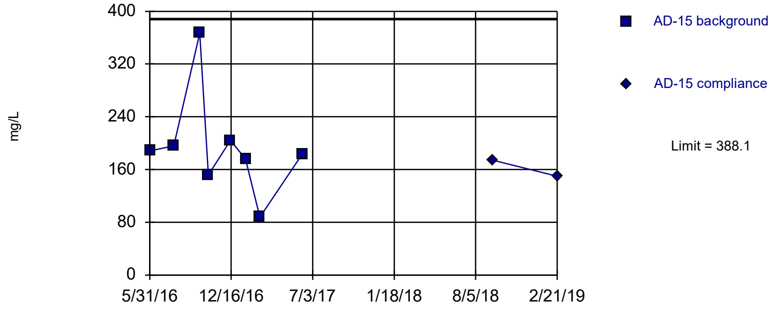
Constituent: Total Dissolved Solids Analysis Run 6/30/2019 7:03 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



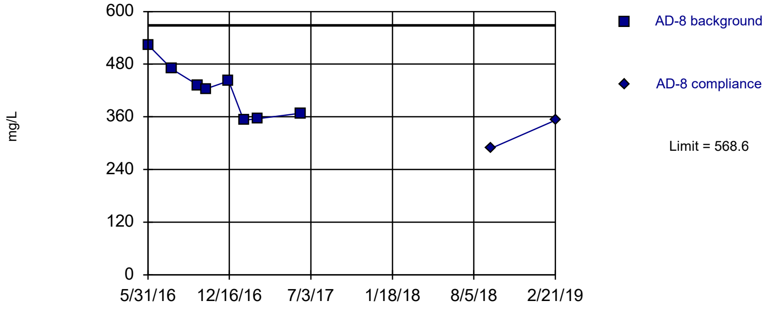
Background Data Summary: Mean=194.4, Std. Dev.=78.82, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8214, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

Constituent: Total Dissolved Solids Analysis Run 6/30/2019 7:03 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Within Limit

Prediction Limit

Intrawell Parametric



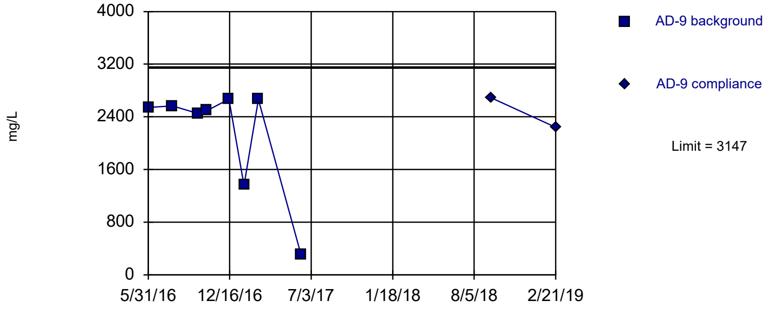
Background Data Summary: Mean=420.9, Std. Dev.=60.09, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9284, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

Constituent: Total Dissolved Solids Analysis Run 6/30/2019 7:03 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on cube transformation): Mean=1.3e10, Std. Dev.=7.4e9, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.759, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

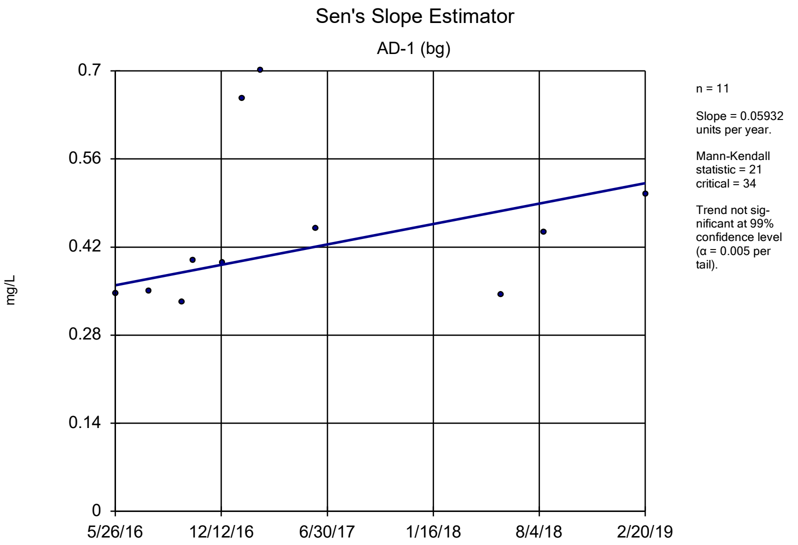
Constituent: Total Dissolved Solids Analysis Run 6/30/2019 7:03 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Trend Test Summary Table - All Results (No Significant)

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 7/5/2019, 3:38 PM

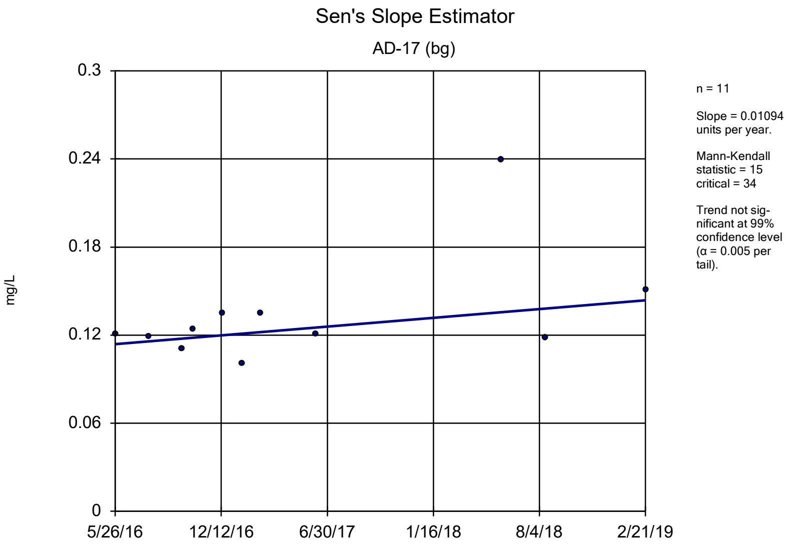
Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	AD-1 (bg)	0.05932	21	34	No	11	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-17 (bg)	0.01094	15	34	No	11	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-5 (bg)	0.001099	14	34	No	11	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-8	-0.02807	-5	-38	No	12	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-9	-0.005594	-5	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-1 (bg)	-2.915	-5	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-17 (bg)	-2.239	-14	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-5 (bg)	-3.095	-9	-34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-1 (bg)	0	-11	-34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-17 (bg)	1.822	5	34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-5 (bg)	2.719	15	34	No	11	0	n/a	n/a	0.01	NP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



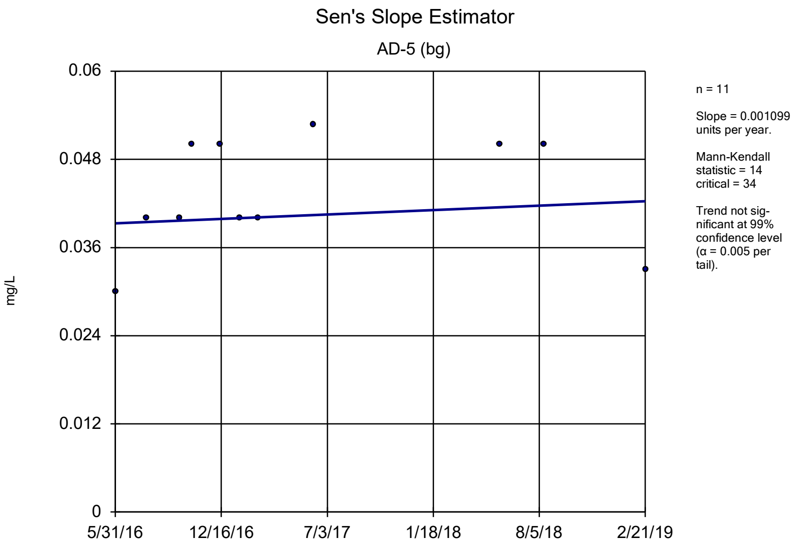
Constituent: Boron, total Analysis Run 7/5/2019 3:37 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



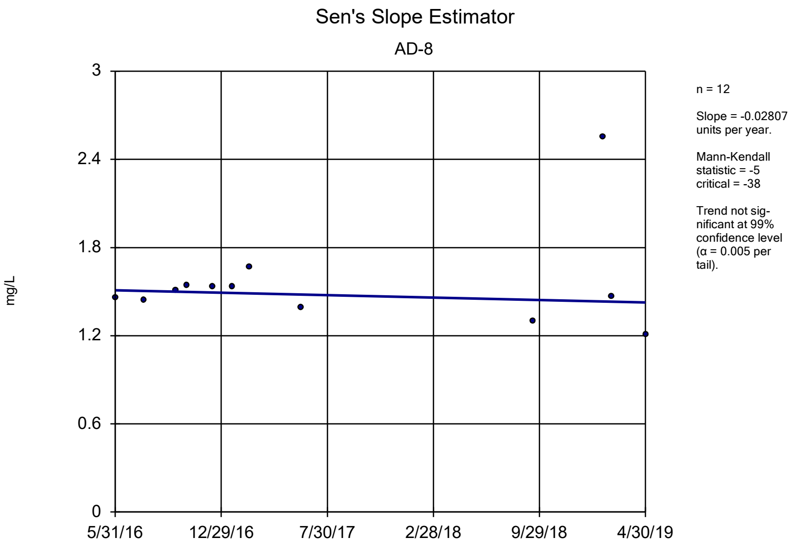
Constituent: Boron, total Analysis Run 7/5/2019 3:37 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Boron, total Analysis Run 7/5/2019 3:37 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

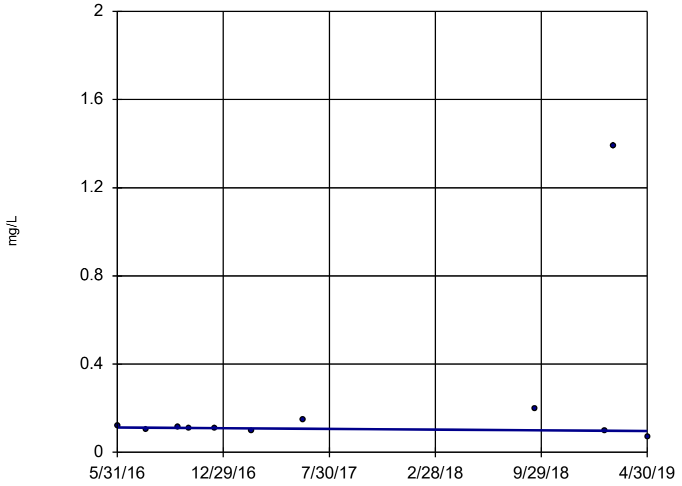


Constituent: Boron, total Analysis Run 7/5/2019 3:37 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-9



n = 11

Slope = -0.005594
units per year.

Mann-Kendall
statistic = -5
critical = -34

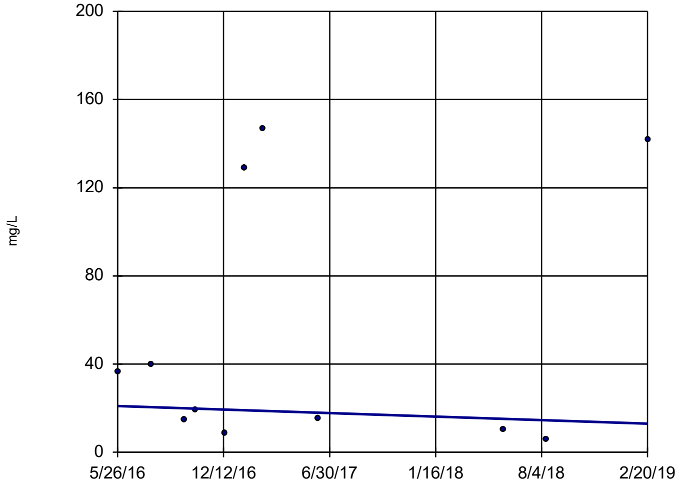
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 7/5/2019 3:37 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-1 (bg)



n = 11

Slope = -2.915
units per year.

Mann-Kendall
statistic = -5
critical = -34

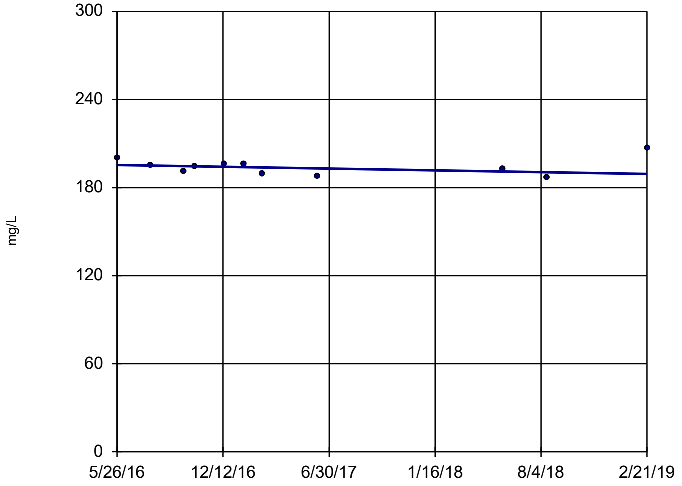
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Calcium, total Analysis Run 7/5/2019 3:37 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-17 (bg)



n = 11

Slope = -2.239
units per year.

Mann-Kendall
statistic = -14
critical = -34

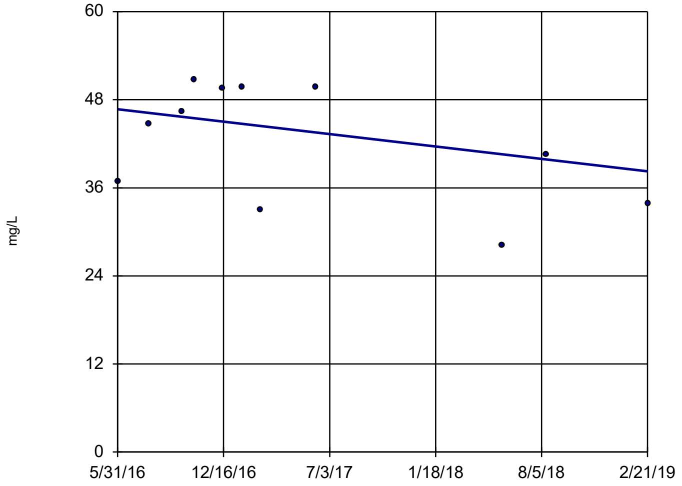
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Calcium, total Analysis Run 7/5/2019 3:38 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-5 (bg)



n = 11

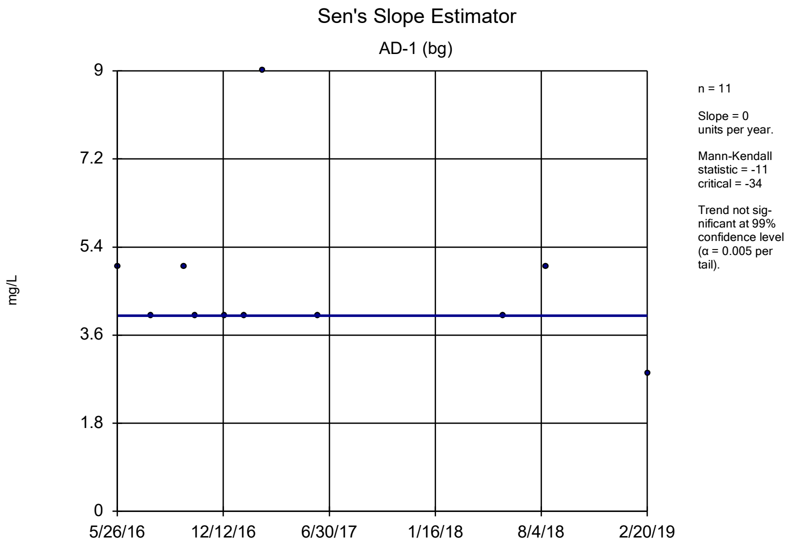
Slope = -3.095
units per year.

Mann-Kendall
statistic = -9
critical = -34

Trend not significant at 99% confidence level (α = 0.005 per tail).

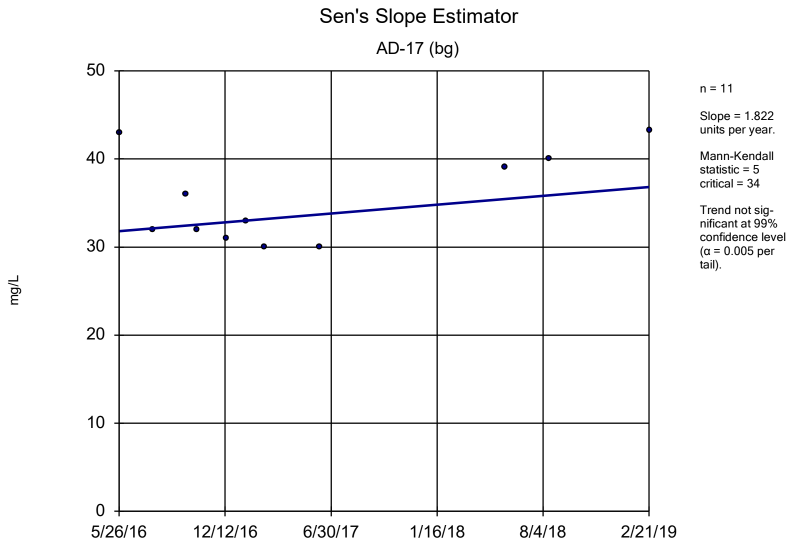
Constituent: Calcium, total Analysis Run 7/5/2019 3:38 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



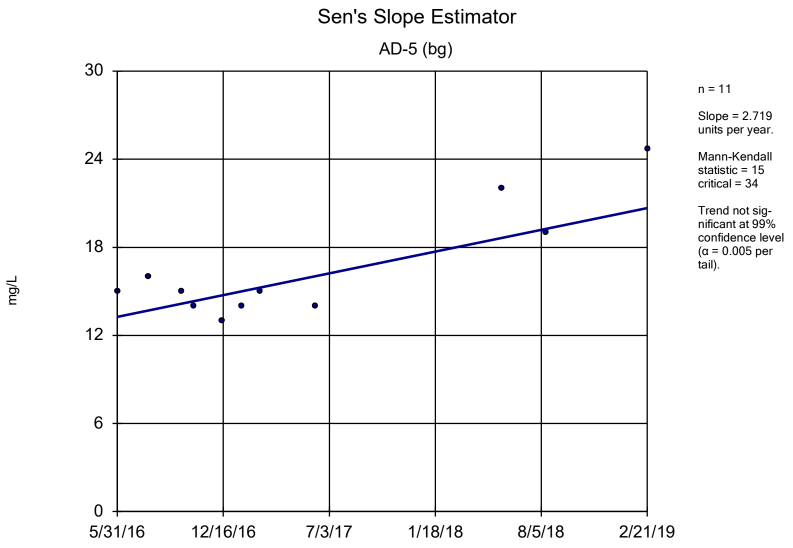
Constituent: Chloride, total Analysis Run 7/5/2019 3:38 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Chloride, total Analysis Run 7/5/2019 3:38 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Chloride, total Analysis Run 7/5/2019 3:38 PM View: Trend Tests
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Tolerance Limit Summary Table

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 6/25/2019, 9:04 AM

Constituent	Well	Upper Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony, total (mg/L)	n/a	0.005	33	n/a	n/a	72.73	n/a	n/a	0.184	NP Inter(normality)
Arsenic, total (mg/L)	n/a	0.005	33	n/a	n/a	57.58	n/a	n/a	0.184	NP Inter(normality)
Barium, total (mg/L)	n/a	0.5818	33	-2.809	1.037	0	None	ln(x)	0.05	Inter
Beryllium, total (mg/L)	n/a	0.0007276	33	0.01425	0.005818	12.12	None	sqrt(x)	0.05	Inter
Cadmium, total (mg/L)	n/a	0.01047	33	-8.594	1.844	30.3	Kaplan-Meier	ln(x)	0.05	Inter
Chromium, total (mg/L)	n/a	0.003606	32	-7.582	0.8902	28.13	Kaplan-Meier	ln(x)	0.05	Inter
Cobalt, total (mg/L)	n/a	0.0748	33	n/a	n/a	0	n/a	n/a	0.184	NP Inter(normality)
Combined Radium 226 + 228 (pCi/L)	n/a	4.182	33	2.033	0.9825	0	None	No	0.05	Inter
Fluoride, total (mg/L)	n/a	1	33	n/a	n/a	69.7	n/a	n/a	0.184	NP Inter(normality)
Lead, total (mg/L)	n/a	0.005	33	n/a	n/a	78.79	n/a	n/a	0.184	NP Inter(NDs)
Lithium, total (mg/L)	n/a	0.394	33	n/a	n/a	0	n/a	n/a	0.184	NP Inter(normality)
Mercury, total (mg/L)	n/a	0.000033	33	n/a	n/a	48.48	n/a	n/a	0.184	NP Inter(normality)
Molybdenum, total (mg/L)	n/a	0.002	33	n/a	n/a	69.7	n/a	n/a	0.184	NP Inter(normality)
Selenium, total (mg/L)	n/a	0.005	33	n/a	n/a	48.48	n/a	n/a	0.184	NP Inter(normality)
Thallium, total (mg/L)	n/a	0.001251	33	n/a	n/a	87.88	n/a	n/a	0.184	NP Inter(NDs)

Confidence Interval Summary Table - Significant Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 6/25/2019, 9:18 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Lower Compl.	Sig.	N	%NDs	Transform	Alpha	Method
Lithium, total (mg/L)	**AD-9**	**1.38**	**0.9572**	**0.39**	**n/a**	**Yes**	**11**	**0**	**No**	**0.01**	**Param.**

Confidence Interval Summary Table - All Results

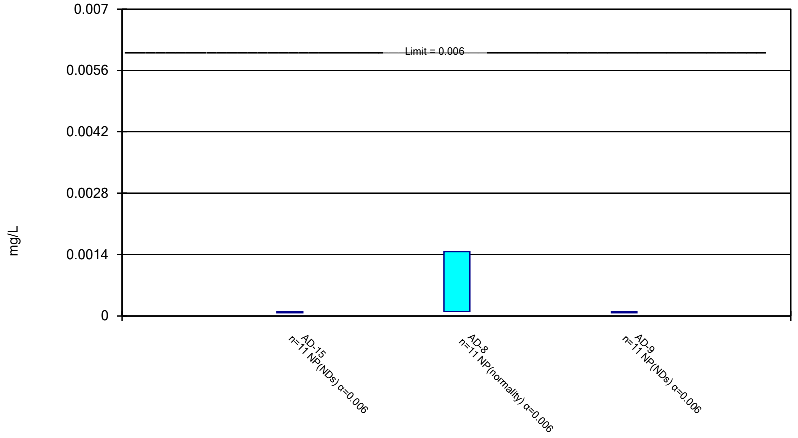
Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 6/25/2019, 9:18 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Lower Compl.	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	AD-15	0.0001	0.0001	0.006	n/a	No	11	90.91	No	0.006	NP (NDs)
Antimony, total (mg/L)	AD-8	0.001461	0.0001	0.006	n/a	No	11	72.73	No	0.006	NP (normality)
Antimony, total (mg/L)	AD-9	0.0001	0.0001	0.006	n/a	No	11	90.91	No	0.006	NP (NDs)
Arsenic, total (mg/L)	AD-15	0.02347	0.003302	0.01	n/a	No	11	0	ln(x)	0.01	Param.
Arsenic, total (mg/L)	AD-8	0.005	0.00057	0.01	n/a	No	11	72.73	No	0.006	NP (normality)
Arsenic, total (mg/L)	AD-9	0.005	0.00168	0.01	n/a	No	11	81.82	No	0.006	NP (NDs)
Barium, total (mg/L)	AD-15	0.4354	0.09415	2	n/a	No	11	0	ln(x)	0.01	Param.
Barium, total (mg/L)	AD-8	0.02717	0.01965	2	n/a	No	11	0	No	0.01	Param.
Barium, total (mg/L)	AD-9	0.05186	0.0249	2	n/a	No	11	0	ln(x)	0.01	Param.
Beryllium, total (mg/L)	AD-15	0.002289	0.0001508	0.004	n/a	No	11	0	ln(x)	0.01	Param.
Beryllium, total (mg/L)	AD-8	0.001	0.00002876	0.004	n/a	No	11	54.55	No	0.006	NP (normality)
Beryllium, total (mg/L)	AD-9	0.0009934	0.0003242	0.004	n/a	No	11	0	sqrt(x)	0.01	Param.
Cadmium, total (mg/L)	AD-15	0.00108	0.00004499	0.01	n/a	No	11	9.091	ln(x)	0.01	Param.
Cadmium, total (mg/L)	AD-8	0.001	0.00003	0.01	n/a	No	11	81.82	No	0.006	NP (NDs)
Cadmium, total (mg/L)	AD-9	0.001965	0.0003576	0.01	n/a	No	11	0	No	0.01	Param.
Chromium, total (mg/L)	AD-15	0.06035	0.00143	0.1	n/a	No	11	0	x^(1/3)	0.01	Param.
Chromium, total (mg/L)	AD-8	0.001262	0.0004447	0.1	n/a	No	11	45.45	No	0.01	Param.
Chromium, total (mg/L)	AD-9	0.001	0.000313	0.1	n/a	No	11	72.73	No	0.006	NP (normality)
Cobalt, total (mg/L)	AD-15	0.02411	0.004157	0.075	n/a	No	11	0	ln(x)	0.01	Param.
Cobalt, total (mg/L)	AD-8	0.007411	0.004278	0.075	n/a	No	11	0	No	0.01	Param.
Cobalt, total (mg/L)	AD-9	0.02945	0.01487	0.075	n/a	No	11	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-15	4.165	1.202	5	n/a	No	11	0	x^(1/3)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-8	2.41	0.4166	5	n/a	No	11	0	x^(1/3)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-9	2.823	1.738	5	n/a	No	11	0	No	0.01	Param.
Fluoride, total (mg/L)	AD-15	1	0.2621	4	n/a	No	9	88.89	No	0.002	NP (NDs)
Fluoride, total (mg/L)	AD-8	1	0.485	4	n/a	No	9	11.11	No	0.002	NP (normality)
Fluoride, total (mg/L)	AD-9	1	0.304	4	n/a	No	9	55.56	No	0.002	NP (normality)
Lead, total (mg/L)	AD-15	0.022	0.000438	0.015	n/a	No	11	18.18	No	0.006	NP (Cohens/xfrm)
Lead, total (mg/L)	AD-8	0.005	0.000223	0.015	n/a	No	11	81.82	No	0.006	NP (NDs)
Lead, total (mg/L)	AD-9	0.005	0.000262	0.015	n/a	No	11	81.82	No	0.006	NP (NDs)
Lithium, total (mg/L)	AD-15	0.04141	0.004534	0.39	n/a	No	11	0	x^(1/3)	0.01	Param.
Lithium, total (mg/L)	AD-8	0.1169	0.08297	0.39	n/a	No	11	0	No	0.01	Param.
Lithium, total (mg/L)	**AD-9**	**1.38**	**0.9572**	**0.39**	**n/a**	**Yes**	**11**	**0**	**No**	**0.01**	**Param.**
Mercury, total (mg/L)	AD-15	0.0001	0.00001932	0.002	n/a	No	10	20	No	0.011	NP (normality)
Mercury, total (mg/L)	AD-8	0.000025	0.00000859	0.002	n/a	No	10	60	No	0.011	NP (normality)
Mercury, total (mg/L)	AD-9	0.00003658	0.000008656	0.002	n/a	No	10	30	No	0.01	Param.
Molybdenum, total (mg/L)	AD-15	0.00309	0.0008551	0.1	n/a	No	11	36.36	No	0.01	Param.
Molybdenum, total (mg/L)	AD-8	0.002	0.0008389	0.1	n/a	No	11	63.64	No	0.006	NP (normality)
Molybdenum, total (mg/L)	AD-9	0.002	0.002	0.1	n/a	No	11	90.91	No	0.006	NP (NDs)
Selenium, total (mg/L)	AD-15	0.005	0.0009	0.05	n/a	No	11	18.18	No	0.006	NP (Cohens/xfrm)
Selenium, total (mg/L)	AD-8	0.005	0.0001	0.05	n/a	No	11	54.55	No	0.006	NP (normality)
Selenium, total (mg/L)	AD-9	0.007246	0.001409	0.05	n/a	No	11	36.36	No	0.01	Param.
Thallium, total (mg/L)	AD-15	0.00137	0.0005	0.002	n/a	No	11	72.73	No	0.006	NP (normality)
Thallium, total (mg/L)	AD-8	0.001185	0.0005	0.002	n/a	No	11	72.73	No	0.006	NP (normality)
Thallium, total (mg/L)	AD-9	0.001776	0.0001	0.002	n/a	No	11	54.55	No	0.006	NP (Cohens/xfrm)

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

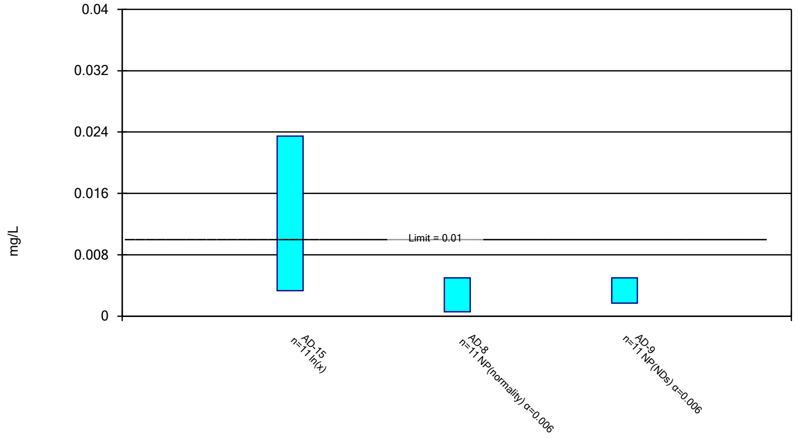


Constituent: Antimony, total   Analysis Run 6/25/2019 9:15 AM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

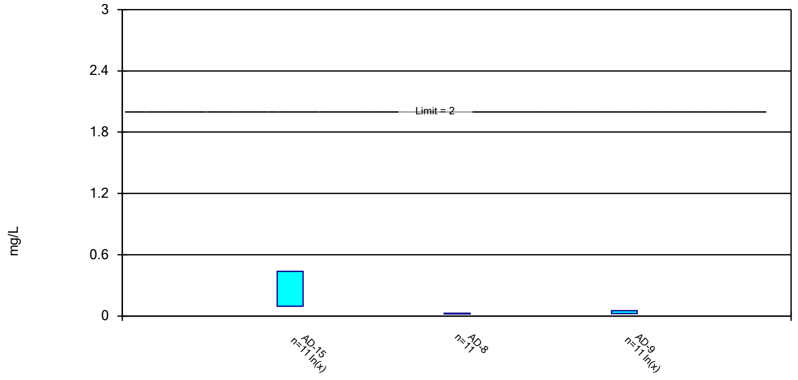


Constituent: Arsenic, total   Analysis Run 6/25/2019 9:15 AM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

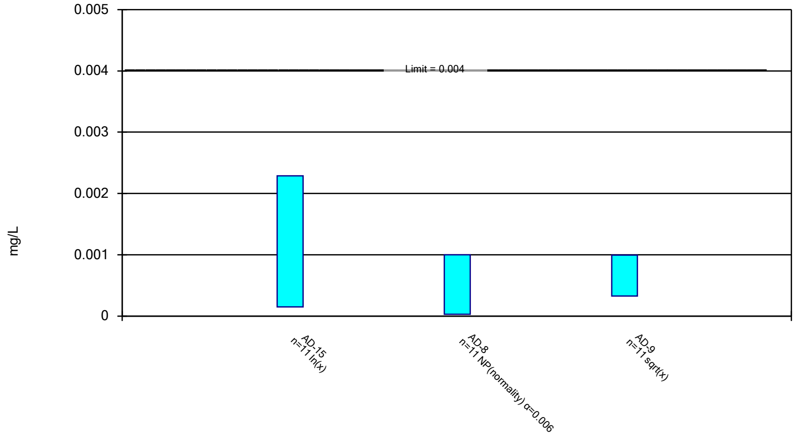


Constituent: Barium, total   Analysis Run 6/25/2019 9:15 AM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

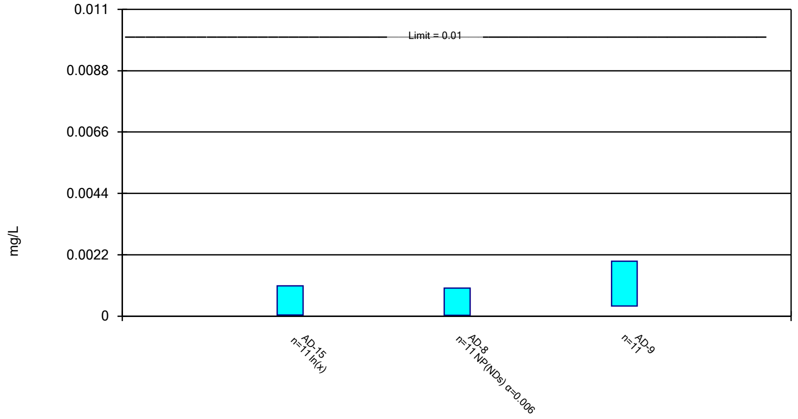


Constituent: Beryllium, total   Analysis Run 6/25/2019 9:16 AM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

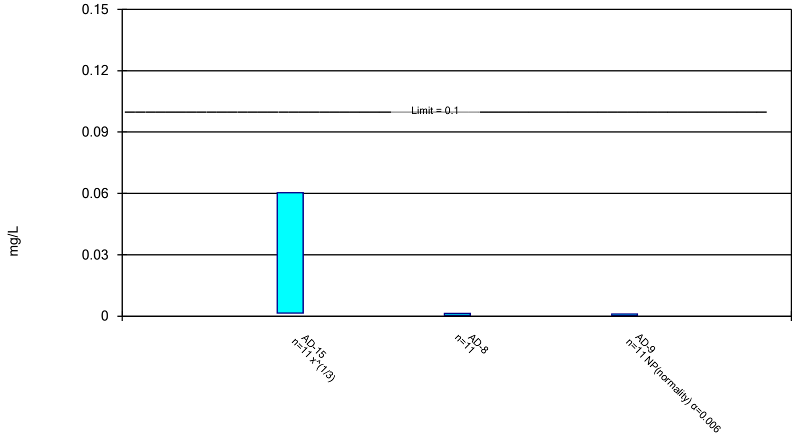


Constituent: Cadmium, total Analysis Run 6/25/2019 9:16 AM View: Confidence Intervals - App IV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

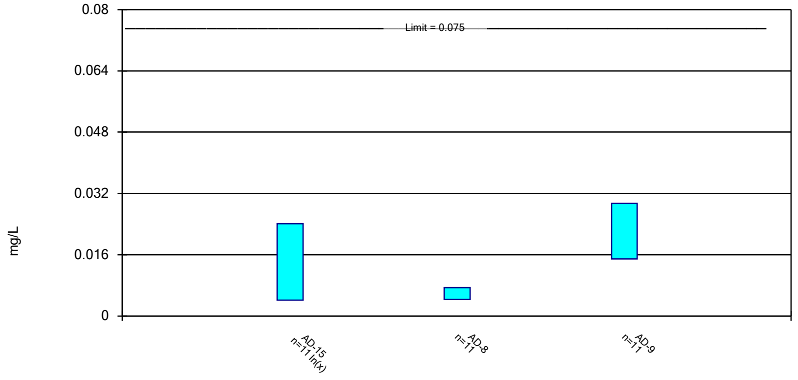


Constituent: Chromium, total Analysis Run 6/25/2019 9:16 AM View: Confidence Intervals - App IV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

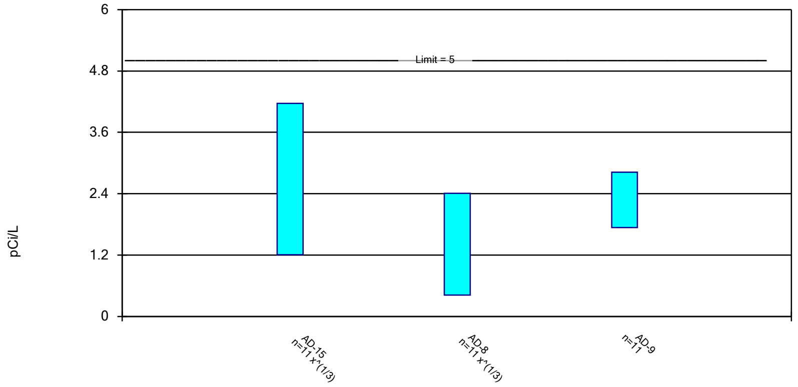


Constituent: Cobalt, total Analysis Run 6/25/2019 9:16 AM View: Confidence Intervals - App IV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

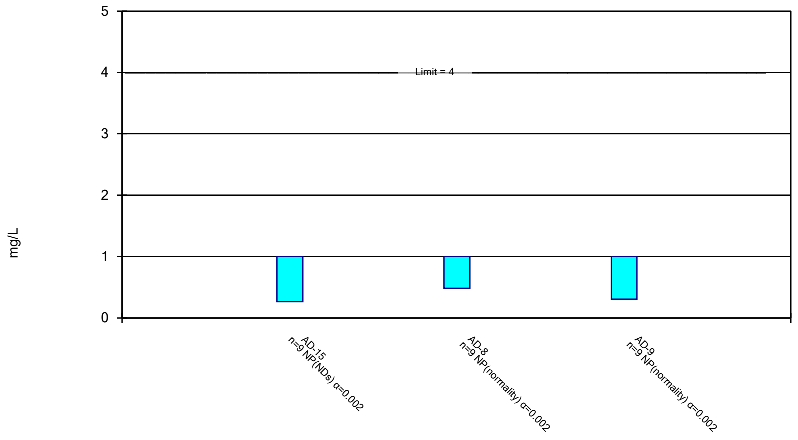


Constituent: Combined Radium 226 + 228 Analysis Run 6/25/2019 9:16 AM View: Confidence Intervals -
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

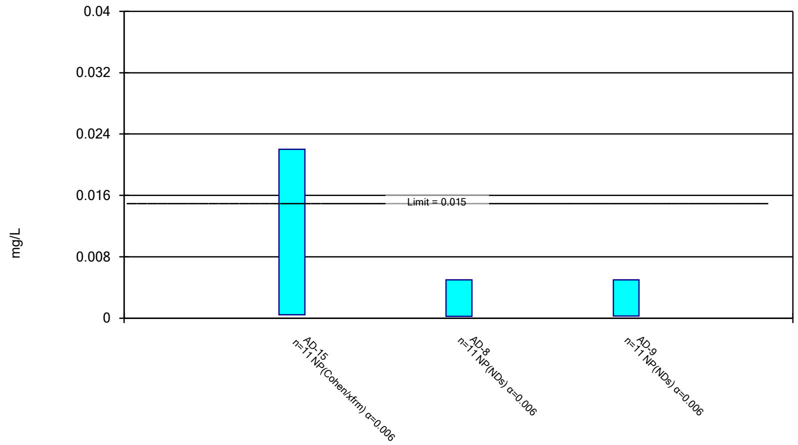


Constituent: Fluoride, total   Analysis Run 6/25/2019 9:16 AM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

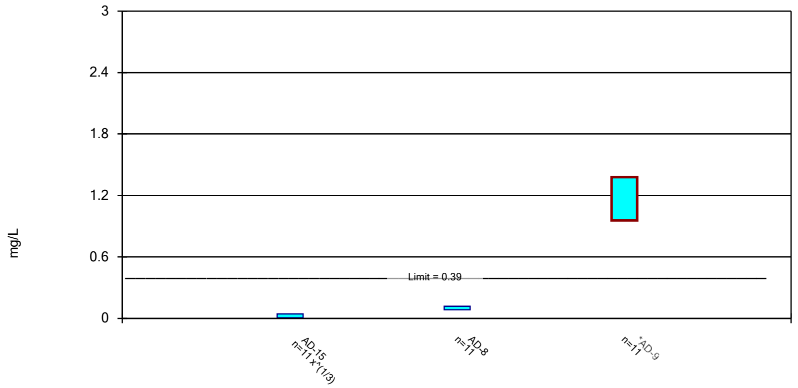


Constituent: Lead, total   Analysis Run 6/25/2019 9:16 AM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

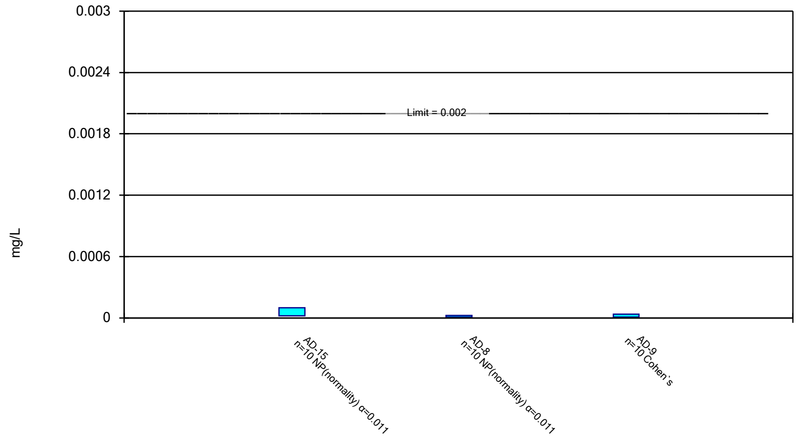


Constituent: Lithium, total   Analysis Run 6/25/2019 9:16 AM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

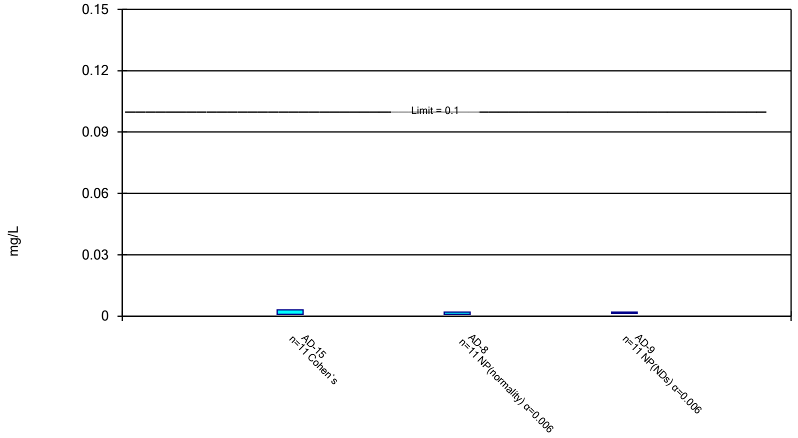


Constituent: Mercury, total   Analysis Run 6/25/2019 9:16 AM   View: Confidence Intervals - App IV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



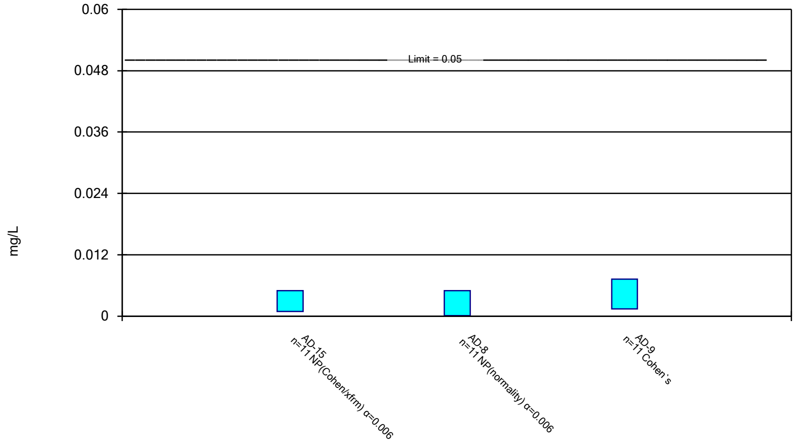
Constituent: Molybdenum, total Analysis Run 6/25/2019 9:16 AM View: Confidence Intervals - App IV

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



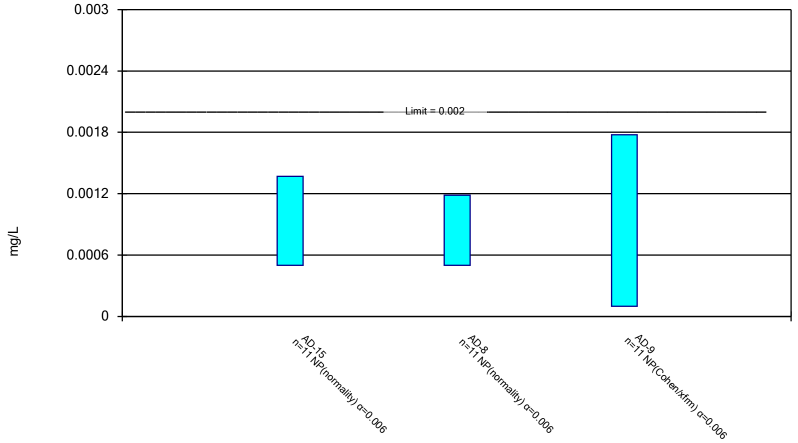
Constituent: Selenium, total Analysis Run 6/25/2019 9:16 AM View: Confidence Intervals - App IV

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



Constituent: Thallium, total Analysis Run 6/25/2019 9:16 AM View: Confidence Intervals - App IV

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

STATISTICAL ANALYSIS SUMMARY
PRIMARY BOTTOM ASH POND
J. Robert Welsh Plant
Pittsburg, Texas

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

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December 16, 2019

CHA8473

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
PBAP	Primary Bottom Ash Pond
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Primary Bottom Ash Pond (PBAP), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron at the PBAP. An alternative source was not identified at the time, so the PBAP has been in assessment monitoring since. Groundwater protection standards (GWPS) were set in accordance with 40 CFR 257.95(d)(2) and a statistical evaluation of the assessment monitoring data was conducted. During the most recent assessment monitoring event, completed in February 2019, an SSL was identified for lithium at well AD-9. A successful alternative source demonstration (ASD) was completed per 40 CFR 257.95(g)(3); therefore, the PBAP remained in assessment monitoring. Two assessment monitoring events were conducted at the PBAP in May and July 2019, in accordance with 40 CFR 257.95(b) and (d) respectively. The results of these events are documented in this report.

Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were re-established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at a statistically significant level (SSL) above the GWPS. An SSL was identified for lithium. Thus, either the unit will move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

PRIMARY BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, two sets of samples were collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(b) (May 2019) and 257.95(d)(1) (July 2019). Samples from both sampling events were analyzed for the Appendix III and Appendix IV parameters. A summary of data collected during these assessment monitoring events may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.23 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the PBAP were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained in May and July 2019 were screened for potential outliers. No outliers were identified.

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in 40 CFR 257.95(h)(2) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events. Tolerance limits were calculated parametrically with 95% coverage and 95% confidence for barium, beryllium, cadmium, and combined radium. Non-parametric tolerance limits were calculated for antimony, arsenic, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, and selenium due to apparent non-normal distributions and for thallium due to a high non-detect frequency. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

The following SSL was identified at the Welsh PBAP:

- The LCL for lithium exceeded the GWPS of 0.390 mg/L at AD-9 (0.916 mg/L).

As a result, the Welsh PBAP will either move to an assessment of corrective measures or an alternative source demonstration will be conducted to evaluate if the unit can remain in assessment monitoring.

2.2.3 Establishment of Appendix III Prediction Limits

Upper prediction limits (UPL) were previously established for all Appendix III parameters following the background monitoring period (Geosyntec, 2018). Intrawell tests were used to evaluate potential SSIs for calcium, chloride, fluoride, sulfate, and TDS, whereas interwell tests were used to evaluate potential SSIs for boron and pH. While interwell prediction limits have been updated periodically during the assessment monitoring period as sufficient data became available, this represents the first update to the background dataset for parameters evaluated using intrawell tests.

Mann-Whitney (Wilcoxon rank-sum) tests were performed to determine whether the newer data are affected by a release from the PBAP. Because the interwell Appendix III limits and the Appendix IV GWPSs are based on data from upgradient wells which we would not expect to have been impacted by a release, these tests were used for intrawell Appendix III tests only. Mann-Whitney tests were used to compare the medians of historical data (May 2016 - June 2017) to the new compliance samples (October 2017 – February 2019) for calcium, chloride, fluoride, sulfate, and TDS. Results were evaluated to determine if the medians of the two groups were similar at the 99% confidence level. Where no significant difference was found, the new compliance data were added to the background dataset. Where a statistically significant difference was found between the medians of the two groups, the data were reviewed to evaluate the cause of the difference and to determine if adding newer data to the background dataset, replacing the background dataset with the newer data, or continuing to use the existing background dataset was most appropriate. If the differences appeared to have been caused by a release, then the previous background dataset would have continued to be used.

The complete Mann-Whitney test results and a summary of the significant findings can be found in Attachment B. Significant differences were found between the two groups for chloride in upgradient well AD-5. However, because AD-5 is an upgradient monitoring well and more recent data are similar to background and better represent the groundwater quality upgradient of the facility, the background dataset was updated to include the compliance data for chloride at AD-5.

After the revised background set was established, a parametric or non-parametric analysis was selected based on the distribution of the data and the frequency of non-detect data. Estimated results less than the practical quantitation limit (PQL) – i.e., "J-flagged" data – were considered detections and the estimated results were used in the statistical analyses. Non-parametric analyses were selected for datasets with at least 50% non-detect data or datasets that could not be normalized. Parametric analyses were selected for datasets (either transformed or untransformed) that passed the Shapiro-Wilk / Shapiro-Francía test for normality. The Kaplan-Meier non-detect adjustment was applied to datasets with between 15% and 50% non-detect data. For datasets with fewer than 15% non-detect data, non-detect data were replaced with one half of the PQL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment B.

UPLs were updated using all the historical data through February 2019 to represent background values. LPLs were also updated for pH. The updated prediction limits are summarized in Table 3. Intrawell tests continued to be used to evaluate potential SSIs for calcium, chloride, fluoride, sulfate, and TDS, whereas interwell tests continued to be used to evaluate potential SSIs for boron and pH. The intrawell UPLs were calculated for a one-of-two retesting procedure; i.e., if at least one sample in a series of two does not exceed the UPL, then it can be concluded that an SSI has not occurred. In practice, where the initial result did not exceed the UPL, a second sample was not collected. The retesting procedures allowed achieving an acceptably high statistical power to detect changes at downgradient wells for constituents evaluated using intrawell prediction limits.

2.2.4 Evaluation of Potential Appendix III SSIs

While SSLs were identified, a review of the Appendix III results were also completed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations.

Appendix III data collected during the July 2019 assessment monitoring event in accordance with 257.95(d) were compared to the prediction limits to evaluate results above background values. The results from the May and July 2019 events and the prediction limits are summarized in Table 4. The following exceedances of the upper prediction limits (UPLs) were noted:

- Boron concentrations exceeded the interwell UPL of 0.700 mg/L at AD-8 (1.21 mg/L).

- The pH measurements were recorded below the interwell LPL of 4.8 SU at AD-15 (3.2 SU).

Based on these results, concentrations of Appendix III parameters exceeded background levels at compliance wells at the Welsh PBAP during assessment monitoring.

2.3 Conclusions

A semi-annual assessment monitoring event was conducted in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the May and July 2019 data. GWPSs were re-established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPS. An SSL was identified for lithium. Appendix III parameters were compared to recalculated prediction limits, with exceedances identified for boron and pH measurements recorded below the LPL.

Based on this evaluation, the Welsh PBAP CCR unit will either move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Welsh Plant. January 2017.

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – Primary Bottom Ash Pond, J. Robert Welsh Plant, Pittsburg, Texas. January 15, 2018.

TABLES

Table 1 - Groundwater Data Summary
Welsh - Primary Bottom Ash Pond

Component	Unit	AD-1		AD-5		AD-8		AD-9		AD-15		AD-17	
		5/30/2019	**7/24/2019**	**5/30/2019**	**7/24/2019**	**5/29/2019**	**7/23/2019**	**5/29/2019**	**7/23/2019**	**5/29/2019**	**7/23/2019**	**5/30/2019**	**7/24/2019**
Antimony	µg/L	0.160	0.0800 J	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.0500 J	0.0300 J	0.100 U	0.100 U
Arsenic	µg/L	0.600	0.390	3.05	2.48	0.370	0.410	0.200	1.39	2.95	2.10	0.410	1.07
Barium	µg/L	512	245	60.5	77.4	30.3	31.0	49.7	32.1	203	113	19.6	14.3
Beryllium	µg/L	0.244	0.540	0.0800 J	0.0500 J	0.100 U	0.100 U	0.941	0.361	1.50	0.573	0.0200 J	0.130
Boron	mg/L	0.689	0.644	0.0300 J	0.0400 J	1.07	1.21	0.0600 J	0.0810	0.100 U	0.306	0.158	0.113
Cadmium	µg/L	0.0100 J	0.0200 J	0.0500 U	0.0500 U	0.0200 J	0.0200 J	0.210	0.0600	0.0800	0.0400 J	0.0300 J	0.0300 J
Calcium	mg/L	138	62.7	30.0	41.1	16.9	20.8	10.1	222	2.97	3.45	202	216
Chloride	mg/L	1.59	2.00	22.3	18.0	19.5	15.0	44.0	77.0	21.4	28.0	41.7	37.0
Chromium	µg/L	0.100 J	0.100 J	0.0600 J	0.0500 J	0.100 J	0.0900 J	0.346	0.200 J	9.31	2.26	0.246	0.228
Cobalt	µg/L	0.756	0.789	11.8	8.38	6.03	7.07	15.9	12.7	5.49	5.41	51.1	57.7
Combined Radium	pCi/L	2.72	1.82	1.43	2.53	0.911	0.720	1.36	1.69	3.55	2.25	2.51	3.45
Fluoride	mg/L	0.290	0.106 J	0.290	0.112 J	0.890	0.559 J	0.160	0.574 J	0.0600 J	0.0860 J	0.200 U	0.0850 J
Lead	µg/L	0.197	0.100 J	0.0500 J	0.200 U	0.0700 J	0.0800 J	0.0700 J	0.200 J	9.85	2.87	0.0300 J	0.263
Lithium	mg/L	0.0300 U	0.00557	0.104	0.108	0.0670	0.0641	0.225	1.11	0.0100 J	0.00414	0.341	0.283
Mercury	mg/L	0.0000250 U	0.0000250 U	0.00000600 J	0.0000250 U	0.0000250 U	0.0000250 U	0.0000250 U	0.0000250 U	0.0000810	0.0000250	0.0000250 U	0.0000250 U
Molybdenum	µg/L	2.43	2.00 J	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
Selenium	µg/L	1.40	3.40	0.0500 J	0.0600 J	0.0600 J	0.0800 J	0.200	0.400	5.10	1.60	0.0600 J	0.100 J
Total Dissolved Solids	mg/L	588	180	238	354	324	392	1760	2460	34.0	214	1550	1860
Sulfate	mg/L	43.3	58.0	51.3	90.0	150	145	503	1700	2.10	18.0	1120	1130
Thallium	µg/L	0.500 U	0.500 U	0.500 U	0.500 U	0.100 J	0.100 J	0.200 J	0.500 U	0.100 J	0.500 U	0.500 U	0.500 U
pH	SU	6.71	5.97	6.33	6.30	5.45	6.58	3.61	6.28	4.85	3.17	6.06	5.96

Notes:

µg/L: micrograms per liter

mg/L: milligrams per liter

pCi/L: picocuries per liter

SU: standard unit

U: Parameter was not present in concentrations above the method detection limit and is reported as the reporting limit

J: Estimated value. Parameter was detected in concentrations below the reporting limit

Table 2: Groundwater Protection Standards
Welsh Plant - Primary Bottom Ash Pond

Constituent Name	MCL	CCR Rule-Specified	Calculated UTL
Antimony, Total (mg/L)	0.006		0.005
Arsenic, Total (mg/L)	0.01		0.005
Barium, Total (mg/L)	2		0.62
Beryllium, Total (mg/L)	0.004		0.00079
Cadmium, Total (mg/L)	0.005		0.0037
Chromium, Total (mg/L)	0.1		0.004
Cobalt, Total (mg/L)	n/a	0.006	0.075
Combined Radium, Total (pCi/L)	5		4.11
Fluoride, Total (mg/L)	4		1
Lead, Total (mg/L)	n/a	0.015	0.005
Lithium, Total (mg/L)	n/a	0.04	0.39
Mercury, Total (mg/L)	0.002		0.000033
Molybdenum, Total (mg/L)	n/a	0.1	0.005
Selenium, Total (mg/L)	0.05		0.005
Thallium, Total (mg/L)	0.002		0.002

Notes:

Grey cell indicates calculated UTL is higher than MCL or CCR Rule-specified value.

MCL = Maximum Contaminant Level

Calculated UTL (Upper Tolerance Limit) represents site-specific background values.

The higher of the calculated UTL or MCL/Rule-Specified Level is used as the GWPS.

Table 3: Revised Prediction Limits
Welsh Plant - Primary Bottom Ash Pond

Parameter	Unit	Description	AD-8	AD-9	AD-15
Boron	mg/L	Interwell Background Value (UPL)	0.700		
Calcium	mg/L	Intrawell Background Value (UPL)	32.4	299	5.40
Chloride	mg/L	Intrawell Background Value (UPL)	35.5	138	38.8
Fluoride	mg/L	Intrawell Background Value (UPL)	0.737	1.00	1.00
pH	SU	Interwell Background Value (UPL)	7.0		
		Interwell Background Value (LPL)	4.8		
Sulfate	mg/L	Intrawell Background Value (UPL)	230	2530	33.2
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	553	3070	249

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit

Table 4: Appendix III Data Summary
Welsh Plant - Primary Bottom Ash Pond

Parameter	Unit	Description	AD-8		AD-9		AD-15	
			5/29/2019*	7/23/2019	5/29/2019*	7/23/2019	5/29/2019*	7/23/2019
Boron	mg/L	Interwell Background Value (UPL)	0.700					
		Detection Monitoring Result	1.07	**1.21**	0.0600	0.0810	0.0200	0.306
Calcium	mg/L	Intrawell Background Value (UPL)	32.4		299		5.40	
		Detection Monitoring Result	16.9	20.8	10.1	222	2.97	3.45
Chloride	mg/L	Intrawell Background Value (UPL)	35.5		138		38.8	
		Detection Monitoring Result	19.5	15.0	44.0	77.0	21.4	28.0
Fluoride	mg/L	Intrawell Background Value (UPL)	0.737		1.00		1.00	
		Detection Monitoring Result	0.890	0.559	0.160	0.574	0.0600	0.0860
pH	SU	Interwell Background Value (UPL)	7.0					
		Interwell Background Value (LPL)	4.8					
		Detection Monitoring Result	5.5	6.6	3.6	6.3	4.9	**3.2**
Sulfate	mg/L	Intrawell Background Value (UPL)	230		2530		33.2	
		Detection Monitoring Result	150	145	503	1700	2.10	18.0
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	553		3070		249	
		Detection Monitoring Result	324	392	1760	2460	34.0	214

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
*257.95(b) results not used to determine SSI

Background values are shaded gray.

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Welsh Primary Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
112498

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

112498
License Number

TEXAS
Licensing State

12.17.19
Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

December 8, 2019

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Welsh PBAP - Assessment Monitoring Event & Background Update 2019

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the statistical analysis and background update of the groundwater data for American Electric Power Inc.'s Welsh PBAP. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at the site for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** AD-1, AD-5, and AD-17; and
- **Downgradient wells:** AD-8, AD-9, and AD-15.

Data were sent electronically, and the statistical analysis was reviewed by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC. The analysis was conducted according to the Statistical Analysis Plan prepared by GSC and approved by Dr. Cameron.

The CCR program consists of the following constituents:

- **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS;

- **Appendix IV** (Assessment Monitoring) – antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells. Values flagged as outliers may be seen in the Outlier Summary following this letter (Figure C) and are plotted in a lighter font and disconnected symbol on the time series graphs. Note that the measured concentrations of most metals for September 30, 2016 at well AD-15 are very high compared to the rest of the observations, which suggests a possible laboratory problem. These values were flagged as outliers as they do not appear to represent the population at this well.

Summary of Statistical Method:

1) Intrawell prediction limits, combined with a 1-of-2 resample plan for calcium, chloride, fluoride, sulfate, and TDS; and
2) Interwell prediction limits combined with a 1-of-2 resample plan for boron and pH.

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are nondetects, a nonparametric test is utilized. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% nondetects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for nondetects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.

- Nonparametric prediction limits are used on data containing greater than 50% nondetects.

Summary of Background Screening Conducted in December 2017

Outlier Evaluation

Time series plots are used to identify suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective, in proposed background data. Suspected outliers at all wells for Appendix III and Appendix IV parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits.

Tukey's outlier test noted a few outliers that were flagged as outliers and a summary of those values was submitted with the screening. The outliers identified by Tukey's test for TDS in well AD-15, however, were not flagged as these values were not unusual to the data set at the time and were similar to observations reported in neighboring wells. Flagged values may be seen in a lighter font on the time series graphs. Note that reporting limits have recently decreased; therefore, no nondetect substitution was made for the data. During the next background update, the more historical and higher reporting limits may be deselected providing there are sufficient samples to construct statistical limits.

No true seasonal patterns were observed on the time series plots for any of the detected data; therefore, no deseasonalizing adjustments were made to the data. When seasonal patterns are observed, data may be deseasonalized so that the resulting limits will correctly account for the seasonality as a predictable pattern rather than random variation or a release. It was noted that for each constituent evaluated, the highest concentrations are reported in the upgradient wells.

While trends may be visual, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends. In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed a couple statistically significant decreasing trends that were relatively low in magnitude when compared to average concentrations; therefore, no adjustments were required.

Appendix III – Determination of Spatial Variation

The Analysis of Variance (ANOVA) was used to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying the most appropriate statistical approach. Interwell tests, which compare downgradient well data to statistical limits constructed from pooled upgradient well data, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation; when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter.

All Appendix III parameters except pH exhibited variation when evaluated using the ANOVA. Therefore, these parameters were further evaluated as described for the appropriateness of intrawell testing to accommodate the groundwater quality. A summary table of the ANOVA results is included with the reports.

Appendix III - Statistical Limits

Intrawell limits constructed from carefully screened background data from within each well serve to provide statistical limits that are conservative (i.e. lower) from a regulatory perspective, and that will rapidly identify a change in more recent compliance data from within a given well. This statistical method removes the element of variation from across wells and eliminates the chance of mistaking natural spatial variation for a release from the facility. Prior to performing intrawell prediction limits, several steps are required to reasonably demonstrate downgradient water quality does not have existing impacts from the practices of the facility.

Exploratory data analysis was used as a general comparison of concentrations in downgradient wells for all Appendix III parameters recommended for intrawell analyses to concentrations reported in upgradient wells. Upper tolerance limits are used in conjunction with confidence intervals to determine whether the estimated averages in downgradient wells are higher than observed levels upgradient of the facility. The upper tolerance limits were constructed to represent the extreme upper range of possible background levels at the site.

In cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to justify an intrawell approach. Such an assessment is beyond the scope of services provided by Groundwater Stats Consulting. When there is not an obvious explanation for observed concentration differences in downgradient wells relative to reported concentrations in upgradient wells, interwell prediction limits will initially be selected for the statistical method until further evidence shows that concentrations are due to natural variation rather than a result of the facility.

Parametric tolerance limits were constructed with a target of 99% confidence and 95% coverage using pooled upgradient well data for each of the Appendix III parameters. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. As more data are collected, the background population is better represented and the confidence and coverage levels increase.

Confidence intervals were constructed on downgradient wells for each of the Appendix III parameters, using the tolerance limits discussed above, to determine intrawell eligibility. When the entire confidence interval is above a background standard for a given parameter, interwell methods are initially recommended as the statistical method. Therefore, only parameters with confidence intervals which did not exceed background standards are eligible for intrawell prediction limits.

Confidence intervals for the above parameters were found to be within their respective background limit for all Appendix III parameters with the exception of boron. Therefore, intrawell methods are recommended for calcium, chloride, fluoride, sulfate and TDS; and interwell methods are initially recommended for boron as well as pH which the ANOVA identified as having no variation among upgradient wells. As mentioned earlier, if a demonstration supports natural variation in groundwater, intrawell methods will be considered for all parameters.

All available data through June 2017 at each well were used to establish intrawell background limits for the parameters identified above based on a 1-of-2 resample plan that will be used for future comparisons. Interwell prediction limits, combined with a 1-of-2 resample plan, were constructed from upgradient wells for boron and pH.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits will be necessary to accommodate these types of changes In the interwell case, newer data will be included in background during each sample event after screening the upgradient well data for any new outliers. Data will also be periodically evaluated for statistically significant trends, and earlier data may be deselected prior to construction of statistical limits so that limits represent present-day conditions. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases as well, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of an additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered to be a false positive result and, therefore, no further action is necessary.

November 2019 - Background Update

Data were re-evaluated using Tukey's outlier test and visual screening with the February 2019 samples. Boron and pH are tested using interwell prediction limits and, therefore, only upgradient wells were tested for outliers for these constituents (Figure C). All other Appendix III parameters, which use intrawell prediction limits, were tested for outliers at each well (Figure C). Tukey's test did not identify any outliers except for TDS at well AD-15. This value was not flagged as an outlier during the initial background screening due to the limited number of samples. However, as more samples have been collected, it does not appear to represent the population at this well and was flagged accordingly as an outlier. Due to data transformations used in Tukey's test, several values were not identified as outliers. However, several values were flagged in the database as outliers because the measurements were significantly different that remaining measurements in the record. A list of all outliers flagged may be seen in the outlier summary (Figure C). The previously flagged outliers at this well were not included during this analysis.

For constituents requiring intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through June 2017 to the new compliance samples at each well through February 2019 to evaluate whether the groups are statistically different at the 99% confidence level, in which case background data may not be updated with more recent compliance data (Figure D). No statistically significant differences were found except for chloride in upgradient well AD-5.

Typically, when the test concludes that the medians of the two groups are significantly different, particularly in the downgradient wells, the background are not updated to include the newer data but will be reconsidered in the future. The chloride concentrations in upgradient well AD-5 are lower than those noted in upgradient well AD-17 and follow a similar pattern. Therefore, the background record was updated with more recent data through February 2019 for chloride in well AD-5 as these data represent natural variability in groundwater quality upgradient of the facility. All data will be reevaluated during the next background update, and earlier measurements will be deselected if they no longer represent present-day groundwater quality. Therefore, all records were updated with data through February 2019. A summary of these results follows this letter and the significant test results are included with the Mann Whitney test section at the end of this report.

Intrawell prediction limits using all historical data reported through February 2019, combined with a 1-of-2 resample plan, were constructed and a summary of the updated limits follows this letter (Figure E).

The Sen's Slope/Mann Kendall trend test was used to evaluate data at upgradient wells for boron and pH to identify statistically significant increasing or decreasing trends. The results of the trend analyses showed all data are consistent over time with no statistically significant increasing or decreasing trends (Figure F).

Interwell prediction limits, combined with a 1-of-2 resample plan, were updated using all available data from upgradient wells for the same time period for boron and pH (Figure G). Interwell prediction limits pool upgradient well data to establish a background limit for an individual constituent. A summary table of the updated limits may be found following this letter in the Prediction Limit Summary Tables.

Evaluation of Appendix IV Parameters

Upper tolerance limits were used to calculate background limits from all available pooled upgradient well data for Appendix IV parameters to determine the Alternate Contaminant Level (ACL) for each constituent (Figure H). Background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits. Any flagged values may be seen on the Outlier Summary following this letter. Parametric tolerance limits use a target of 95% confidence and 95% coverage. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and CCR-Rule specified levels in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure I).

Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters and compared to the highest limit of the MCL, CCR-Rule specified level, or ACL as discussed above (Figure J). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No confidence intervals exceedances were found except for lithium in well AD-9. A summary of the confidence interval results follows this letter.

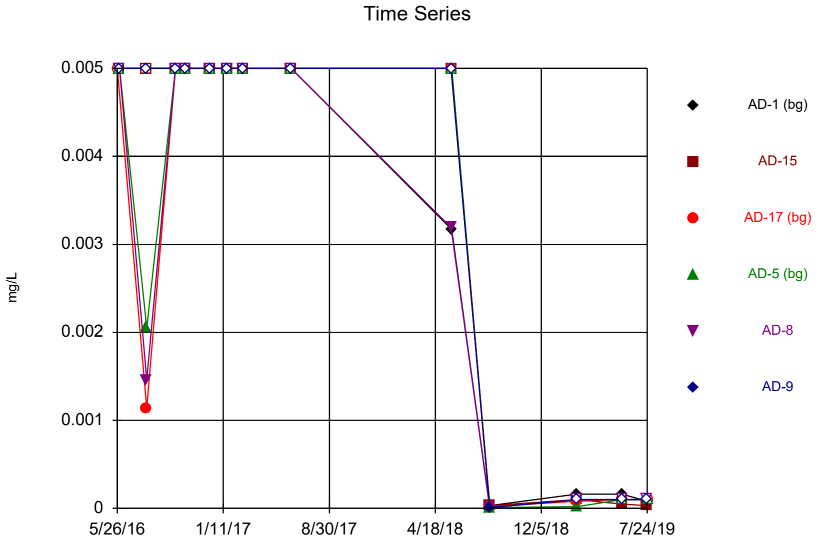
Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Welsh PBAP. If you have any questions or comments, please feel free to contact me.

For Groundwater Stats Consulting,

Kristina Rayner

Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.23 . UG
Hollow symbols indicate censored values.



Constituent: Antimony, total Analysis Run 11/22/2019 8:47 PM
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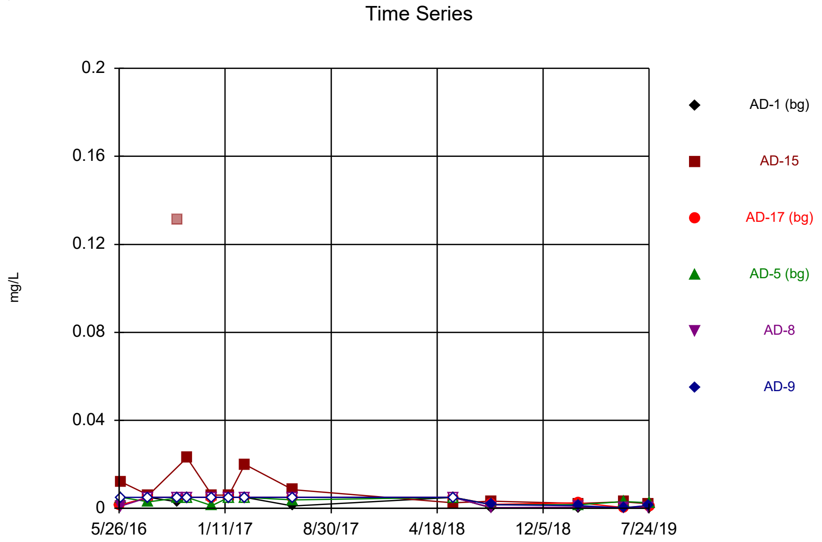

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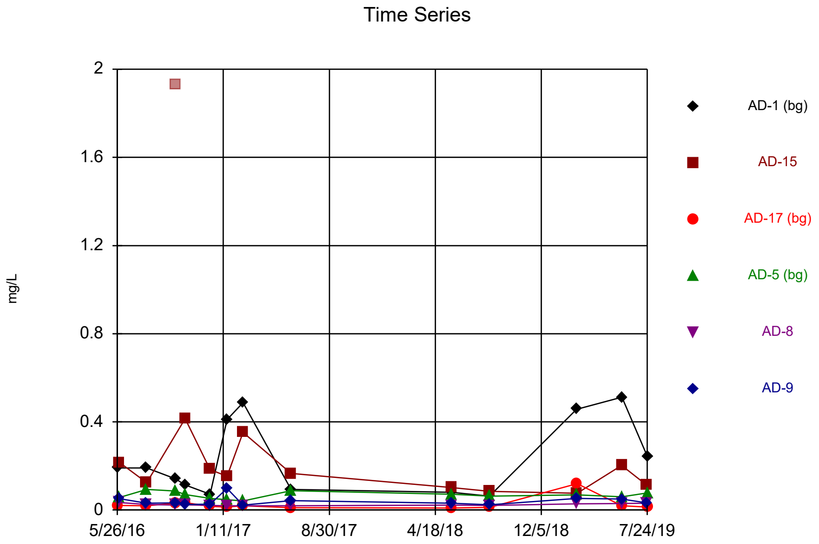

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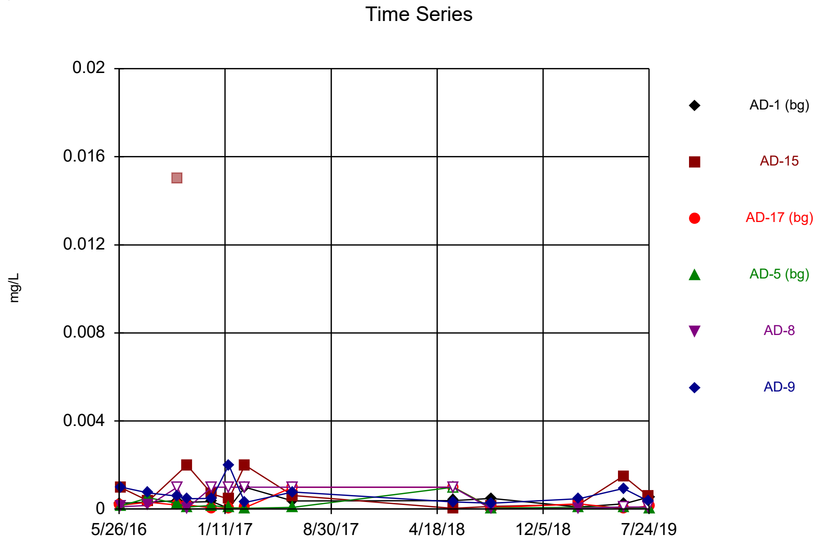

Constituent: Beryllium, total Analysis Run 11/22/2019 8:48 PM
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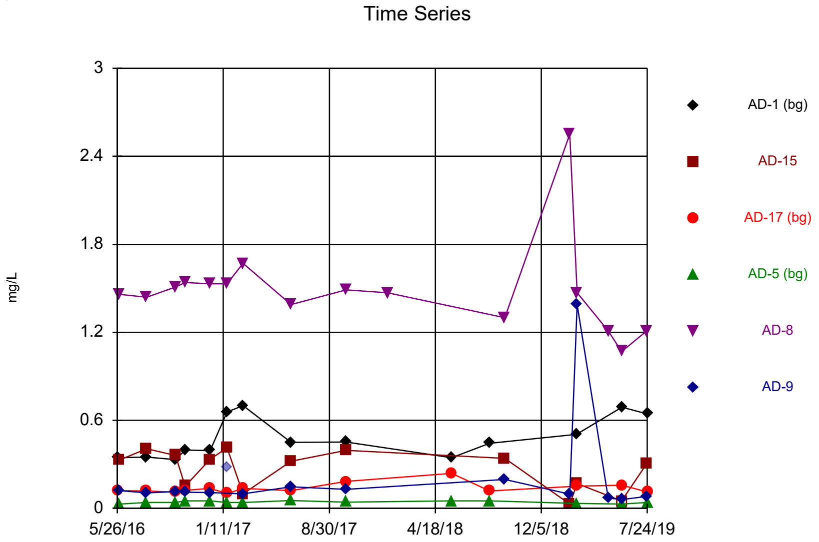

Constituent: Boron, total Analysis Run 11/22/2019 8:48 PM

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

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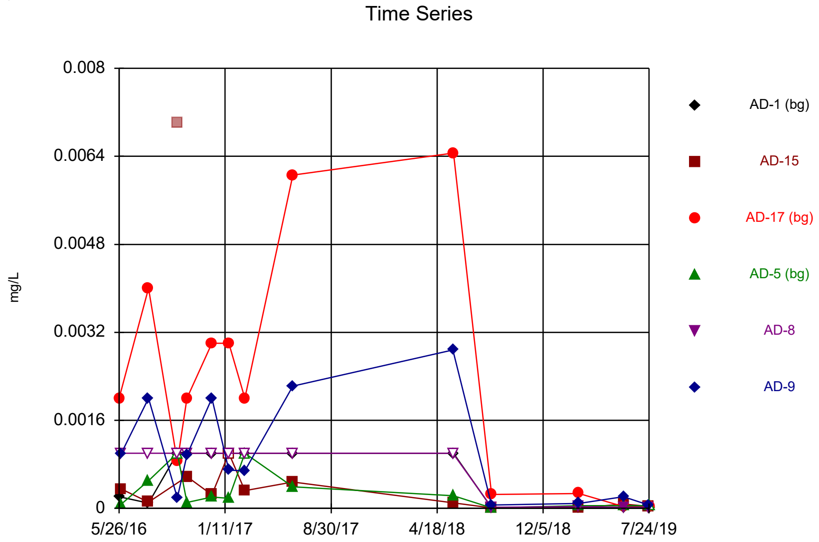
Hollow symbols indicate censored values.



Constituent: Cadmium, total Analysis Run 11/22/2019 8:48 PM

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

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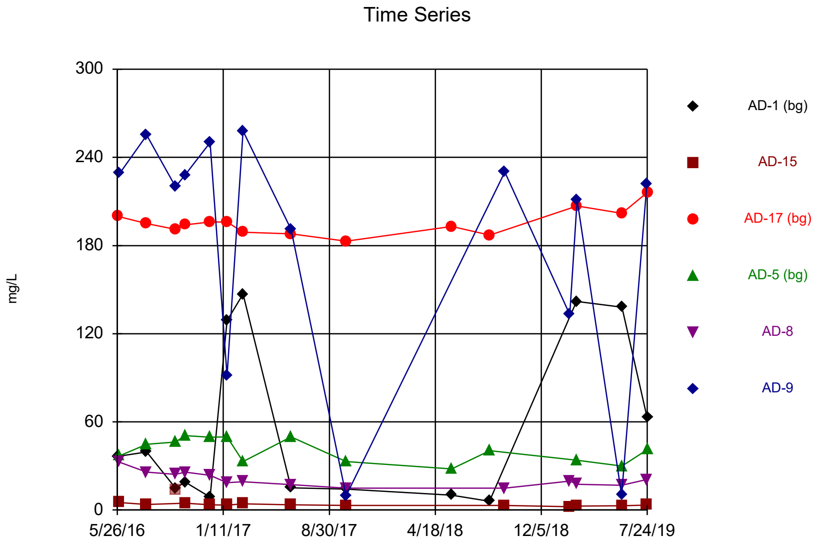

Constituent: Calcium, total Analysis Run 11/22/2019 8:48 PM

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

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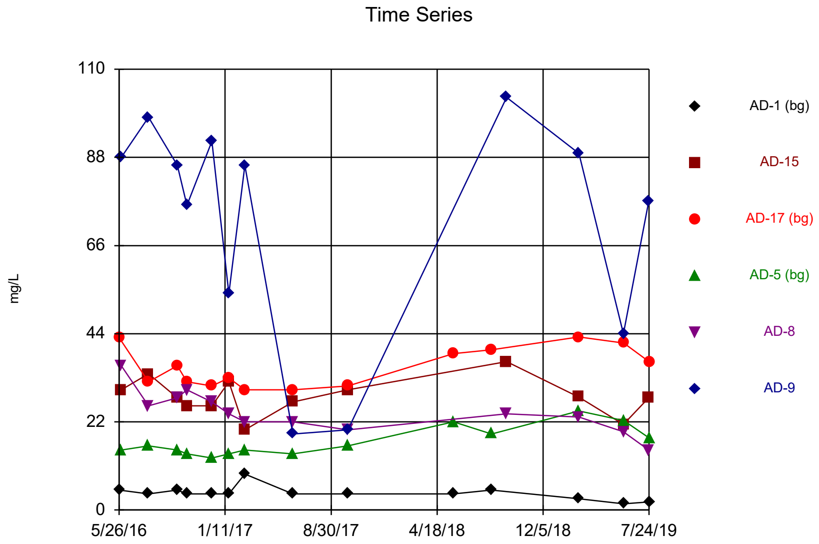

Constituent: Chloride, total Analysis Run 11/22/2019 8:48 PM

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

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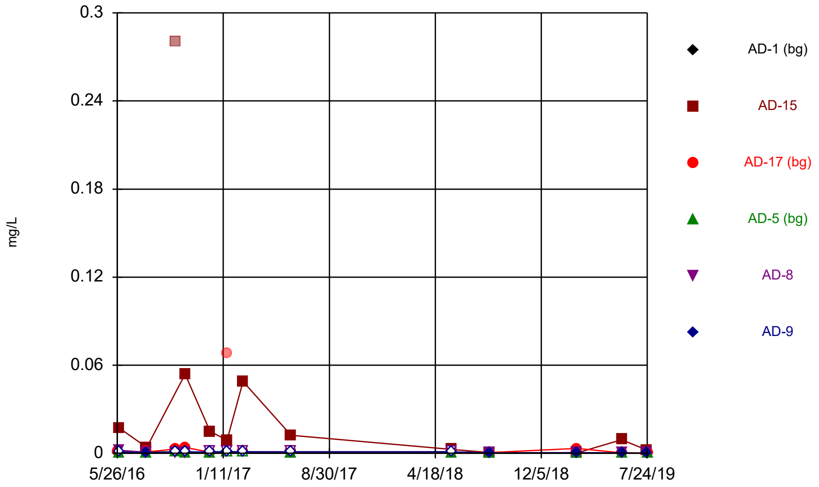
Hollow symbols indicate censored values.

Time Series



Constituent: Chromium, total   Analysis Run 11/22/2019 8:48 PM
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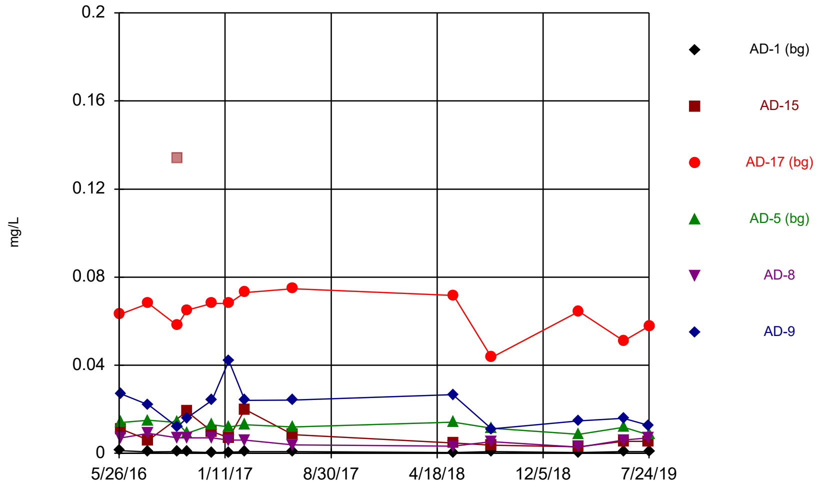
Sanitas™ v.9.6.23 . UG

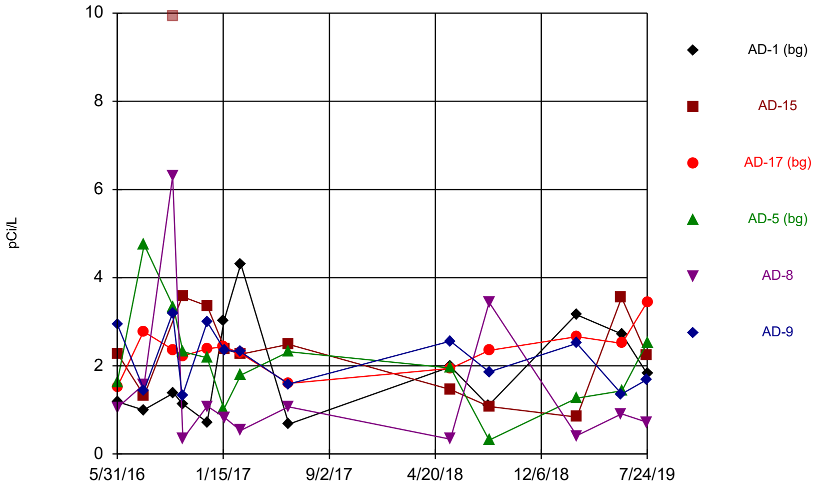
Time Series



Constituent: Cobalt, total   Analysis Run 11/22/2019 8:48 PM
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Time Series



Constituent: Combined Radium 226 + 228   Analysis Run 11/22/2019 8:48 PM
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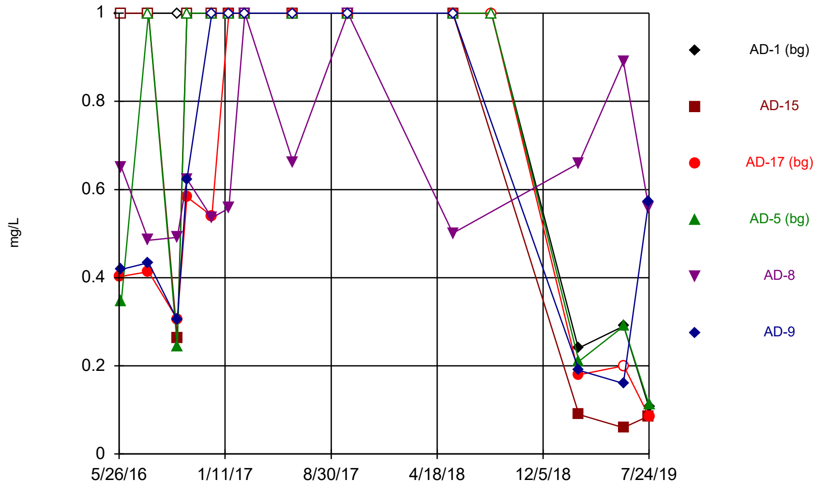
Time Series



Constituent: Fluoride, total   Analysis Run 11/22/2019 8:48 PM
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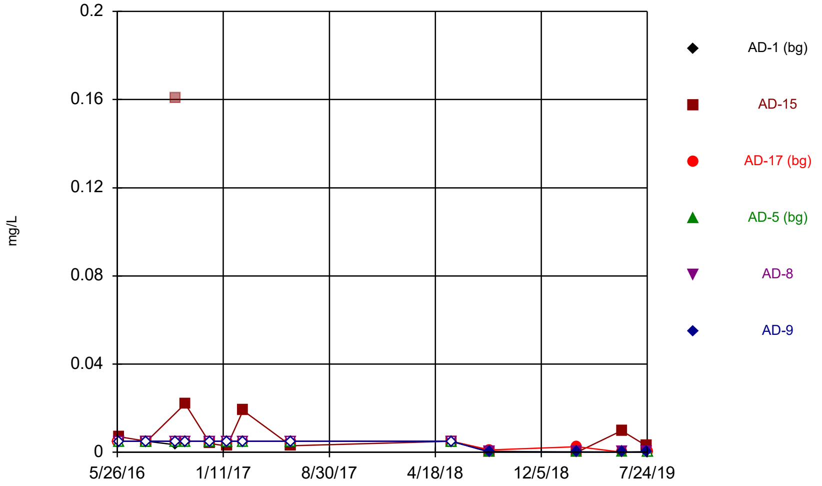

Constituent: Lead, total Analysis Run 11/22/2019 8:48 PM
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

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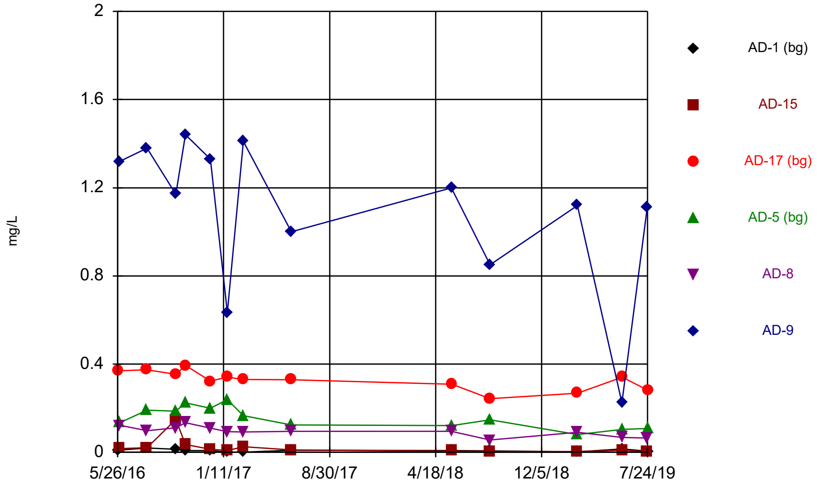
Time Series



Constituent: Lithium, total Analysis Run 11/22/2019 8:48 PM
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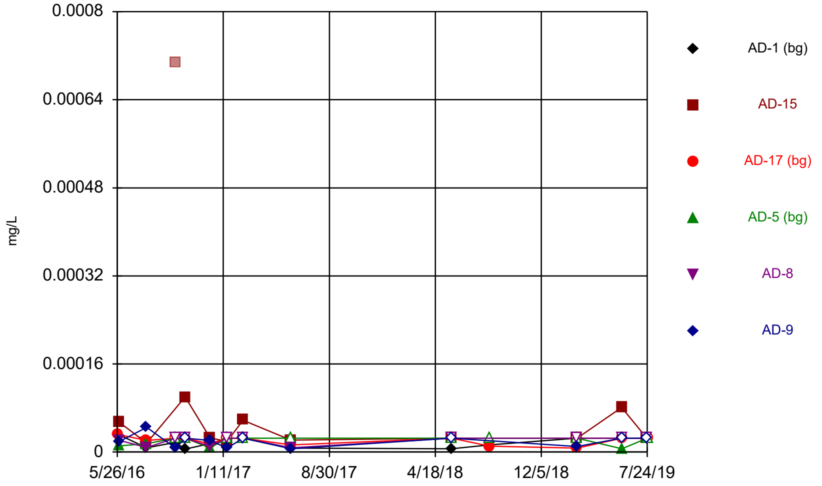
Hollow symbols indicate censored values.

Time Series



Constituent: Mercury, total Analysis Run 11/22/2019 8:48 PM
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

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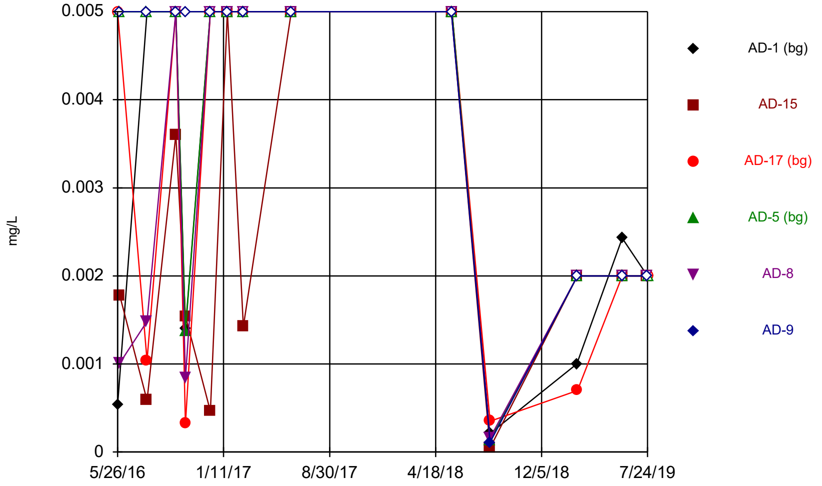
Hollow symbols indicate censored values.

Time Series



Constituent: Molybdenum, total Analysis Run 11/22/2019 8:48 PM
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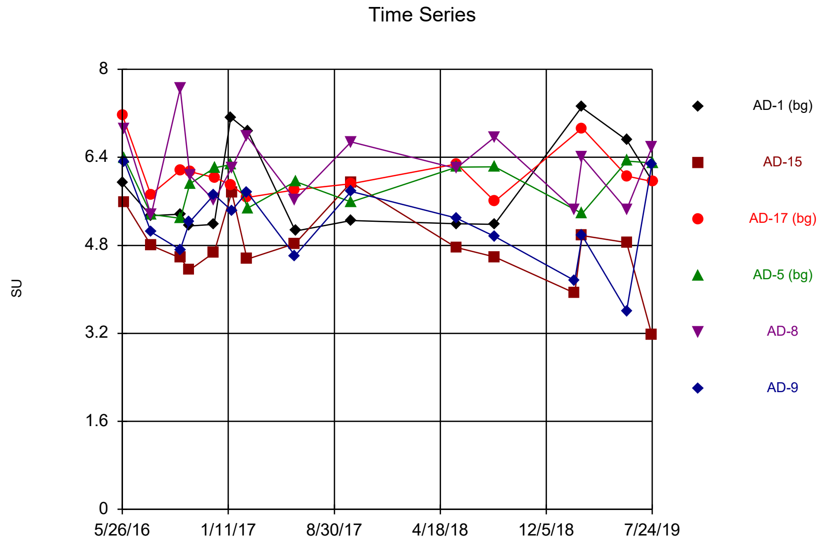

Constituent: pH, field Analysis Run 11/22/2019 8:48 PM
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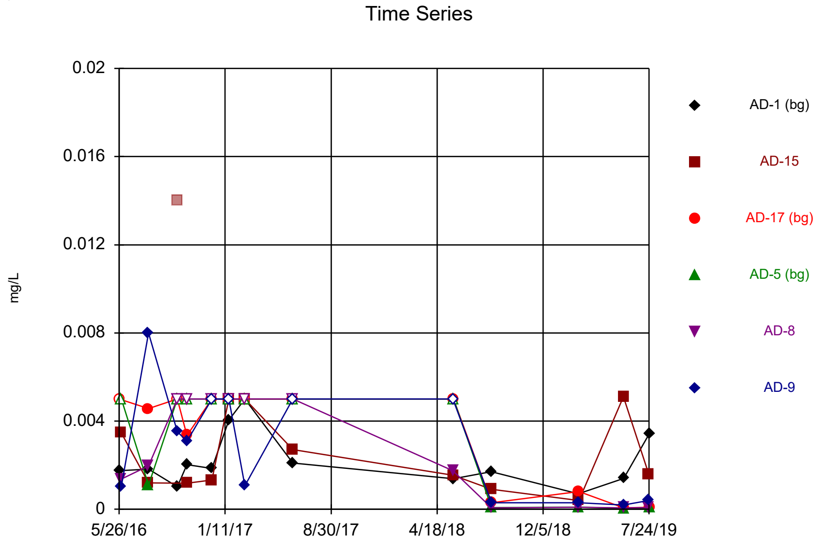
Sanitas™ v.9.6.23 . UG
Hollow symbols indicate censored values.



Constituent: Selenium, total Analysis Run 11/22/2019 8:48 PM
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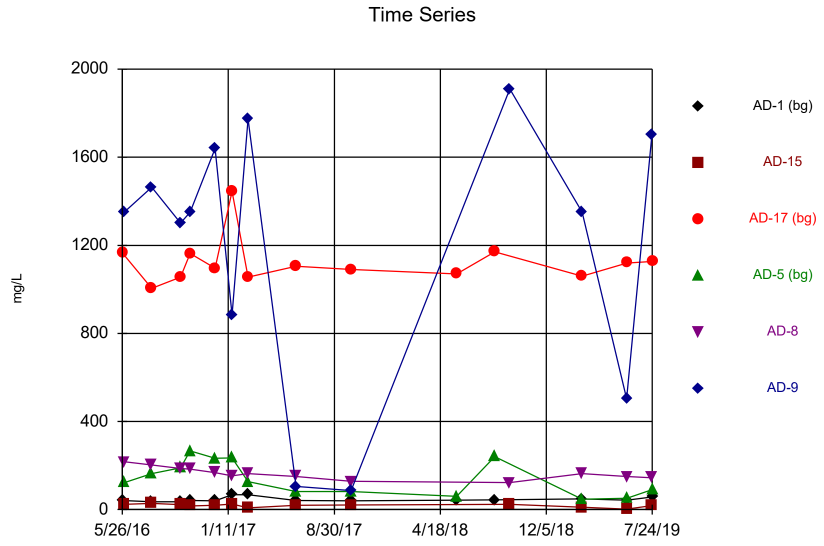
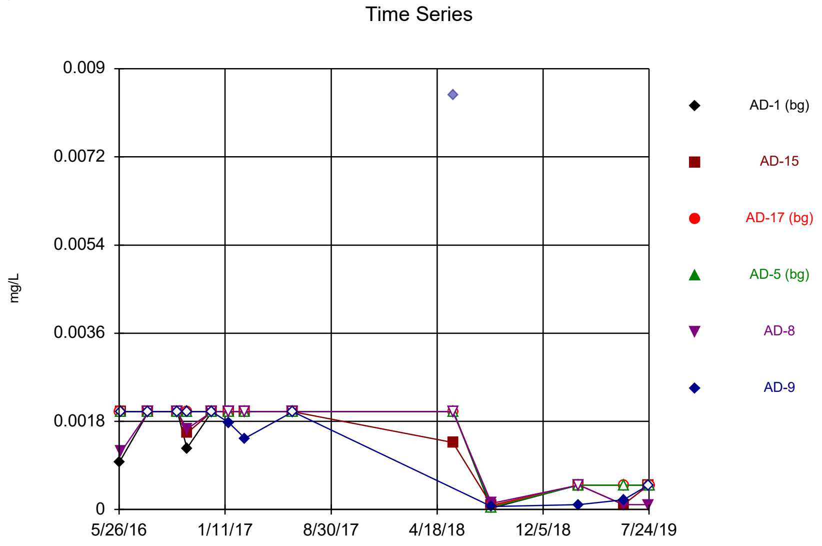
Sanitas™ v.9.6.23 . UG



Constituent: Sulfate, total Analysis Run 11/22/2019 8:48 PM
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG
Hollow symbols indicate censored values.



Constituent: Thallium, total Analysis Run 11/22/2019 8:48 PM
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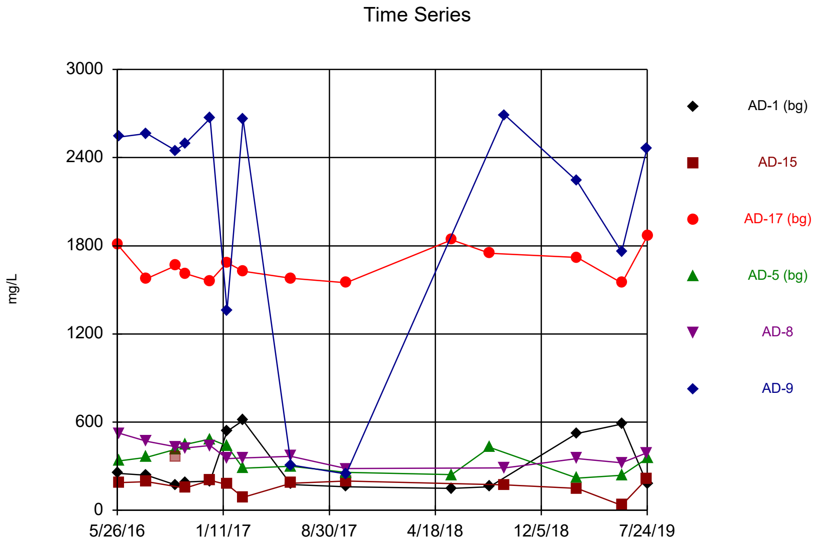

Constituent: Total Dissolved Solids Analysis Run 11/22/2019 8:48 PM

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

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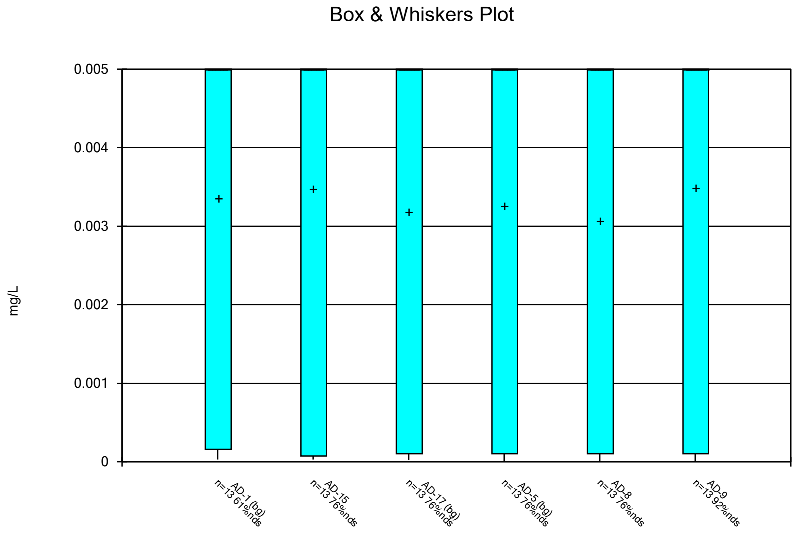
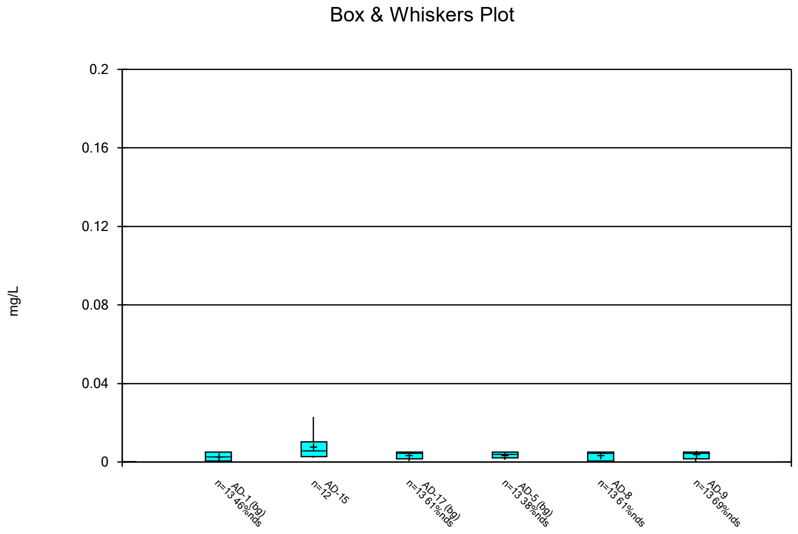


Constituent: Antimony, total Analysis Run 11/22/2019 8:38 PM
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



Constituent: Arsenic, total Analysis Run 11/22/2019 8:38 PM
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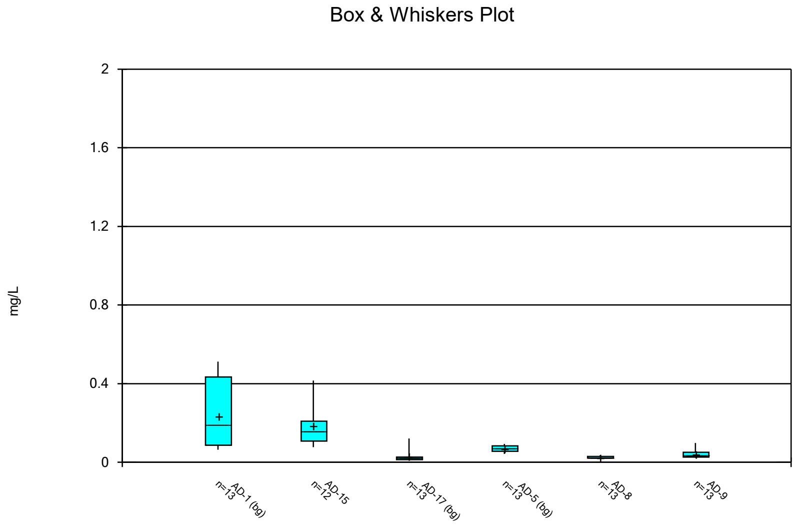

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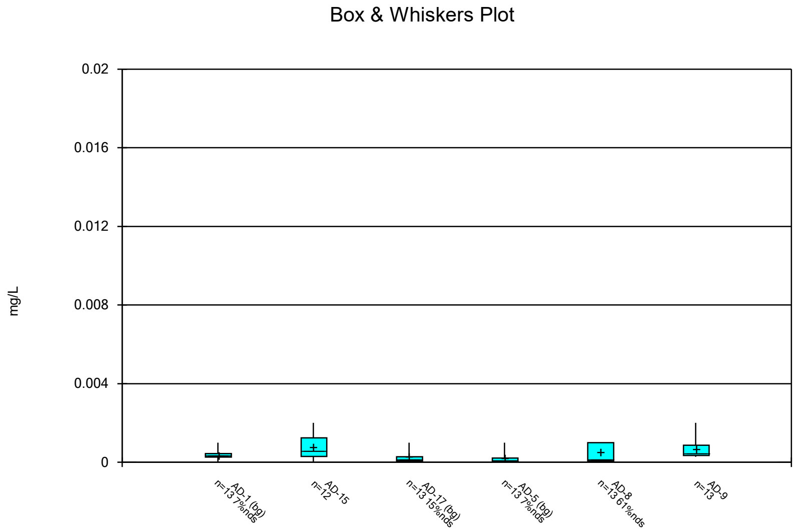
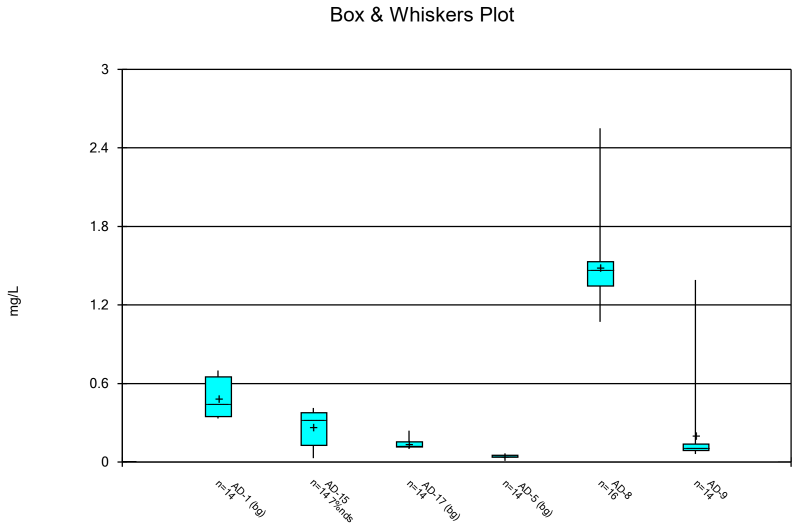
Sanitas™ v.9.6.23 . UG



Constituent: Beryllium, total Analysis Run 11/22/2019 8:38 PM
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

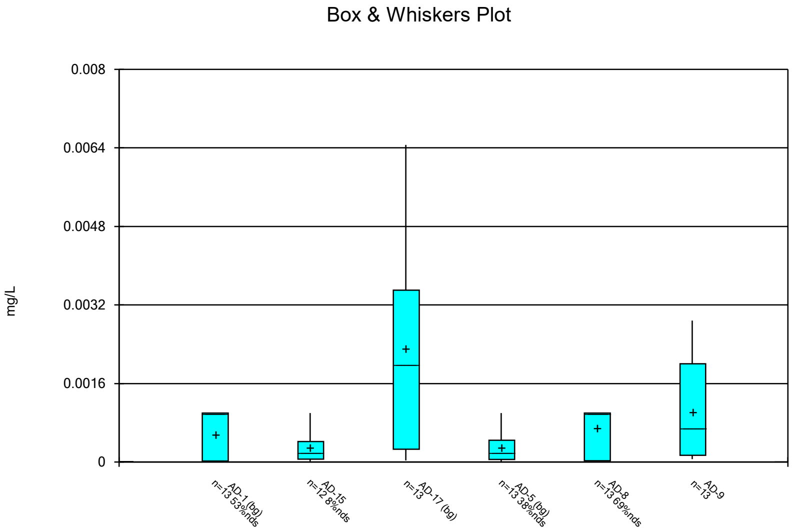
Sanitas™ v.9.6.23 . UG



Constituent: Boron, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

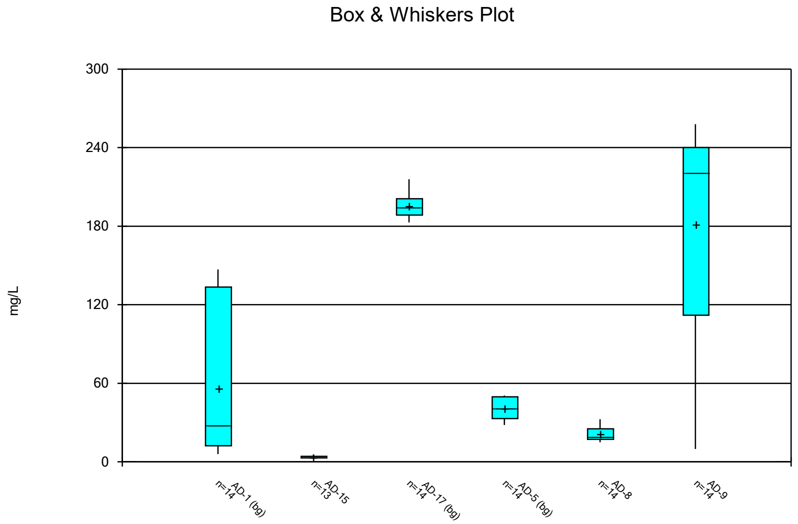
Sanitas™ v.9.6.23 . UG



Constituent: Cadmium, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

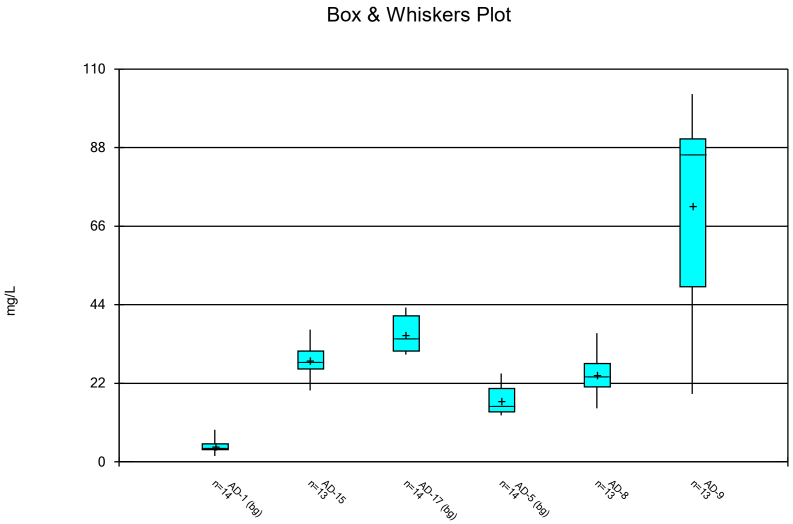
Sanitas™ v.9.6.23 . UG



Constituent: Calcium, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

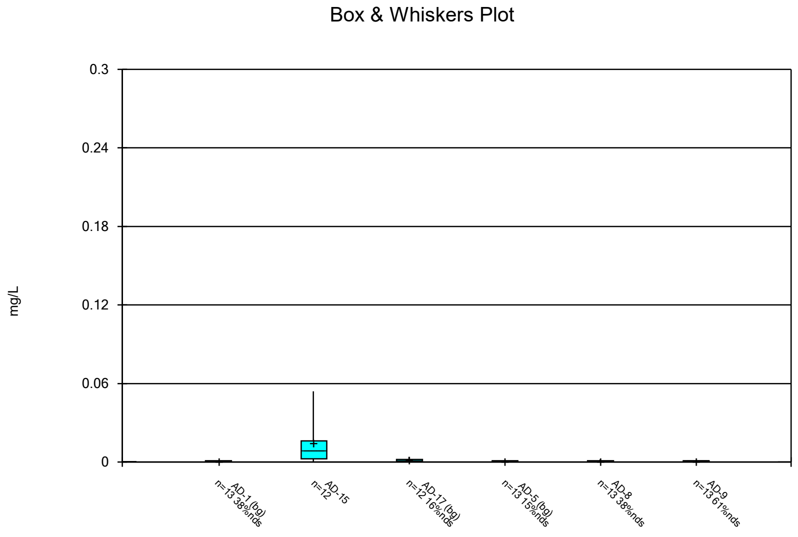
Sanitas™ v.9.6.23 . UG



Constituent: Chloride, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

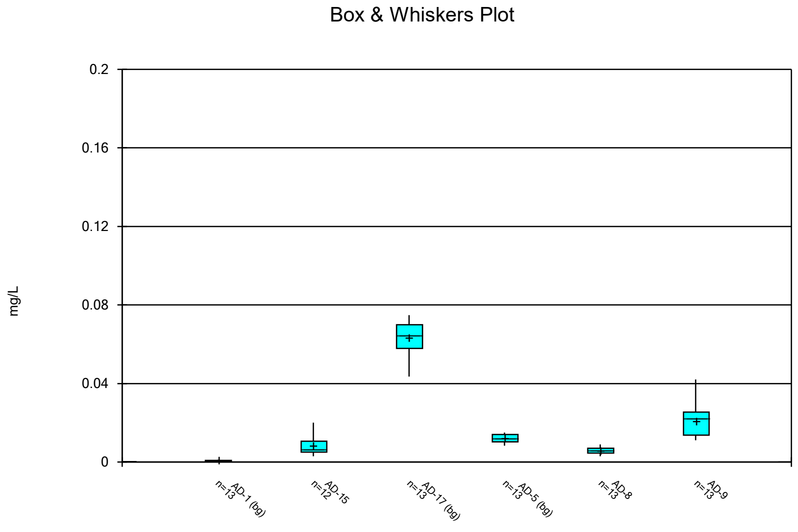
Sanitas™ v.9.6.23 . UG



Constituent: Chromium, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

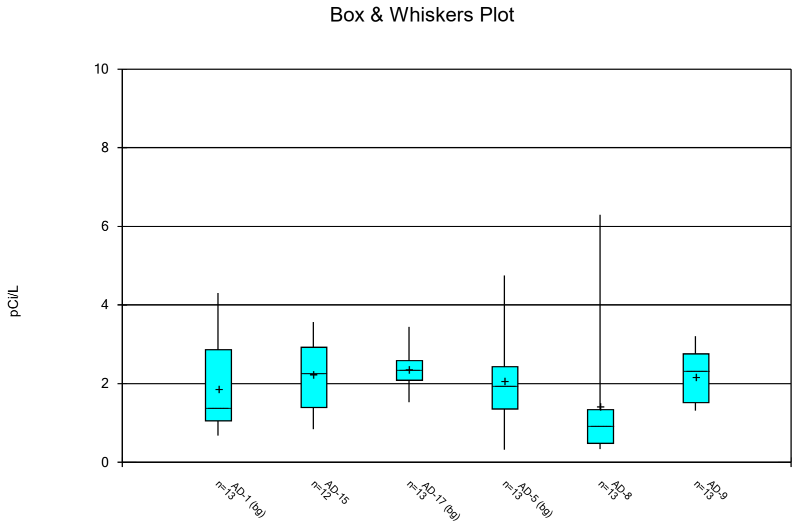
Sanitas™ v.9.6.23 . UG



Constituent: Cobalt, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

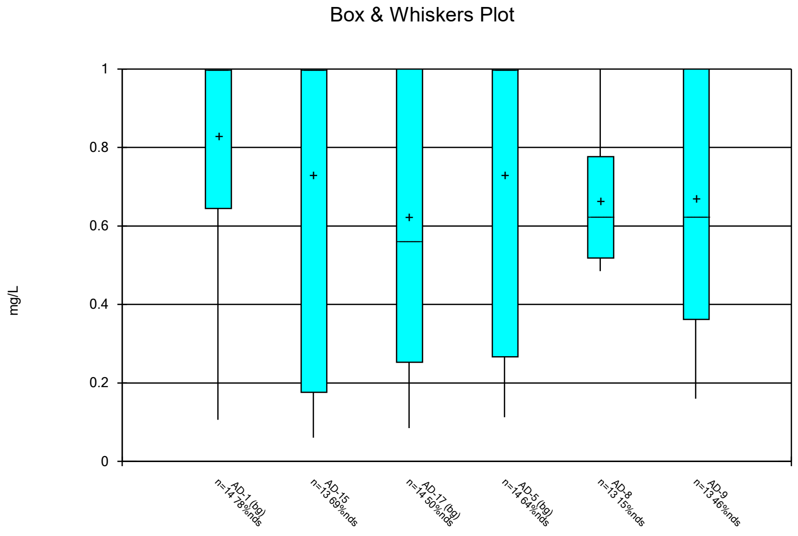
Sanitas™ v.9.6.23 . UG



Constituent: Combined Radium 226 + 228   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

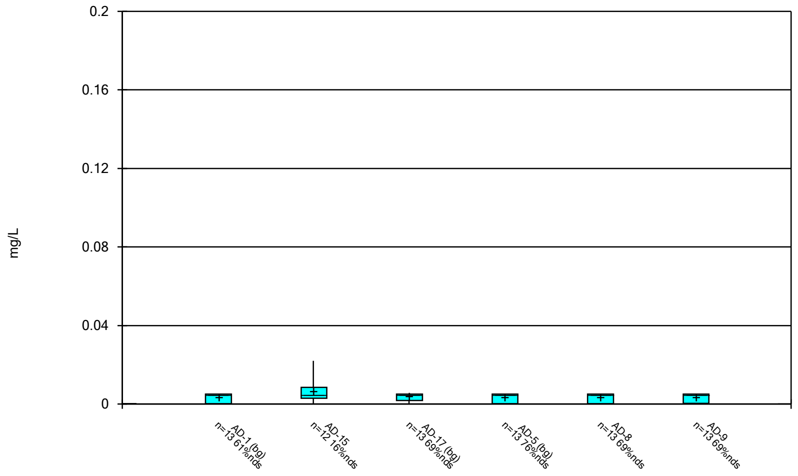


Constituent: Fluoride, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

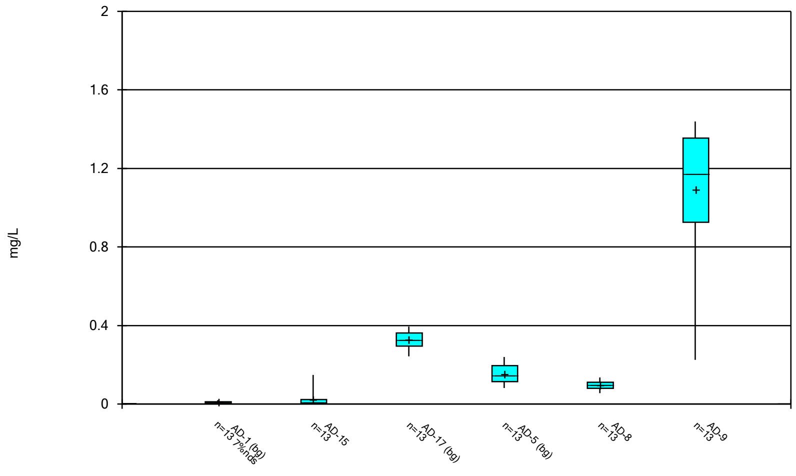


Constituent: Lead, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

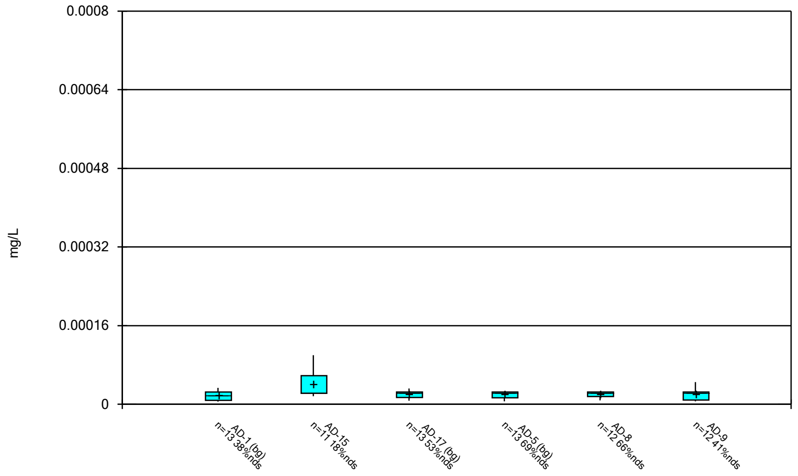


Constituent: Lithium, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

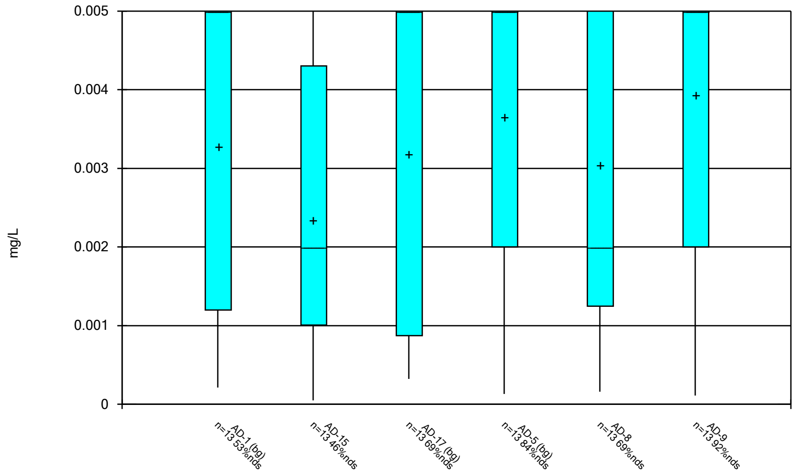


Constituent: Mercury, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

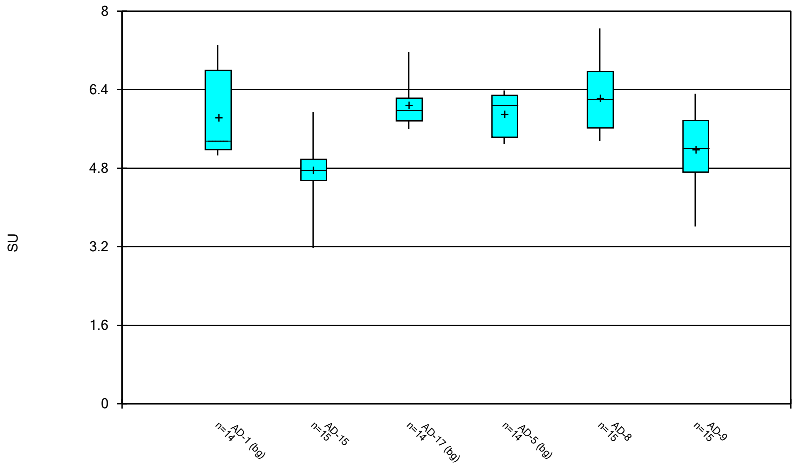


Constituent: Molybdenum, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

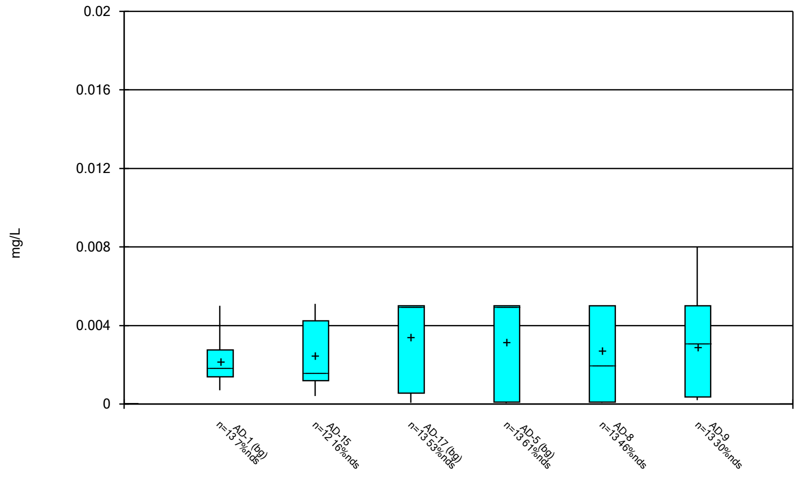


Constituent: pH, field   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

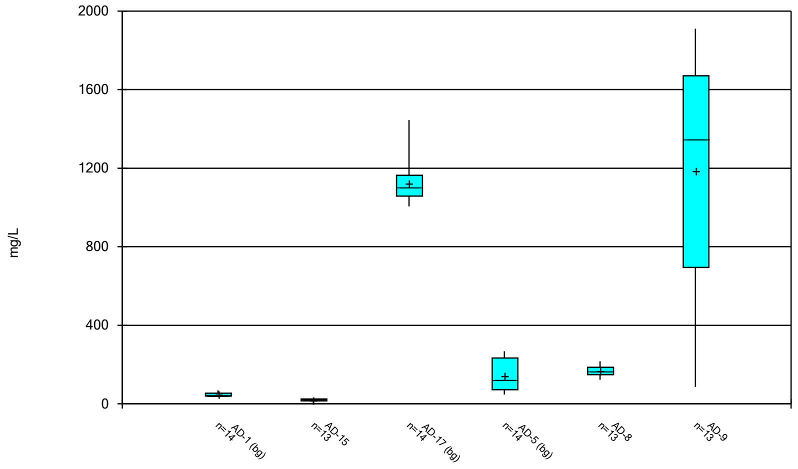


Constituent: Selenium, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

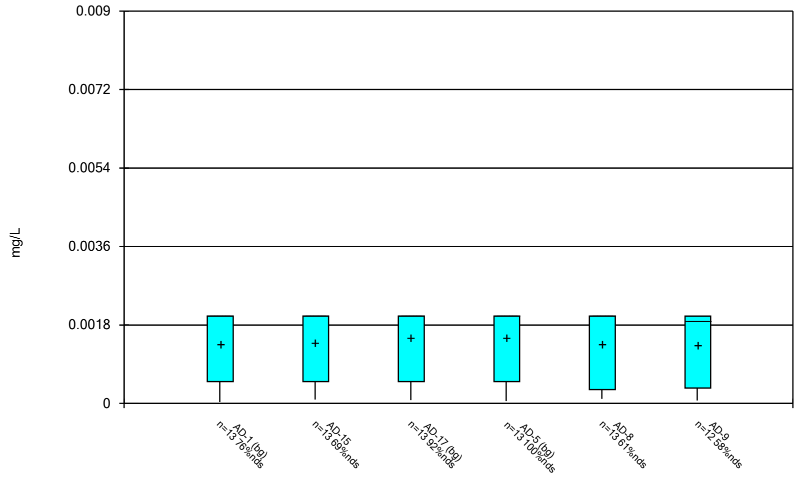


Constituent: Sulfate, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

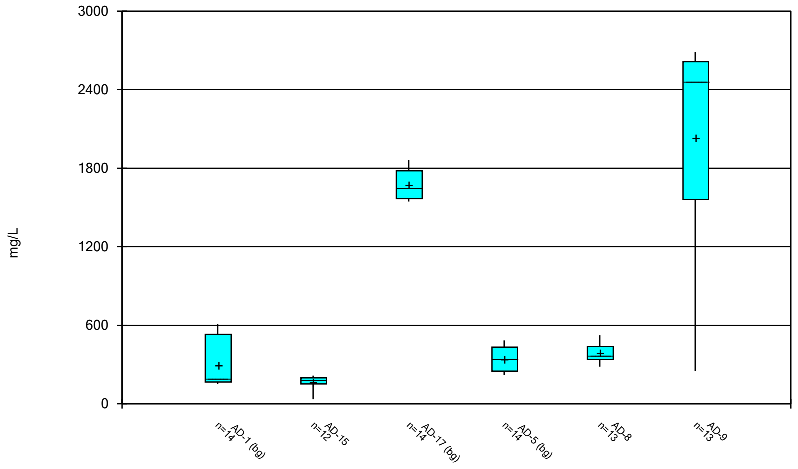


Constituent: Thallium, total   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot



Constituent: Total Dissolved Solids   Analysis Run 11/22/2019 8:38 PM

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Outlier Summary

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP   Printed 11/22/2019, 8:39 PM

	AD-15 Arsenic, total (mg/L)	AD-15 Barium, total (mg/L)	AD-15 Beryllium, total (mg/L)	AD-9 Boron, total (mg/L)	AD-15 Cadmium, total (mg/L)	AD-15 Calcium, total (mg/L)	AD-15 Chromium, total (mg/L)	AD-17 Chromium, total (mg/L)	AD-15 Cobalt, total (mg/L)	AD-15 Combined Radium 226 + 228 (pCi/L)
9/29/2016										9.92 (O)
9/30/2016	0.131 (O)	1.93 (O)	0.015 (o)		0.007 (O)	13.7 (o)	0.28 (O)		0.134 (O)	
1/20/2017				0.283 (o)				0.068 (o)		
5/23/2018										

	AD-15 Lead, total (mg/L)	AD-15 Mercury, total (mg/L)	AD-15 Selenium, total (mg/L)	AD-9 Thallium, total (mg/L)	AD-15 Total Dissolved Solids (mg/L)
9/29/2016					
9/30/2016	0.161 (O)	0.000707 (O)	0.014 (O)		367 (O)
1/20/2017					
5/23/2018				0.00846 (O)	

Downgradient Appendix IV Outlier Analysis - All Results (No Significant)

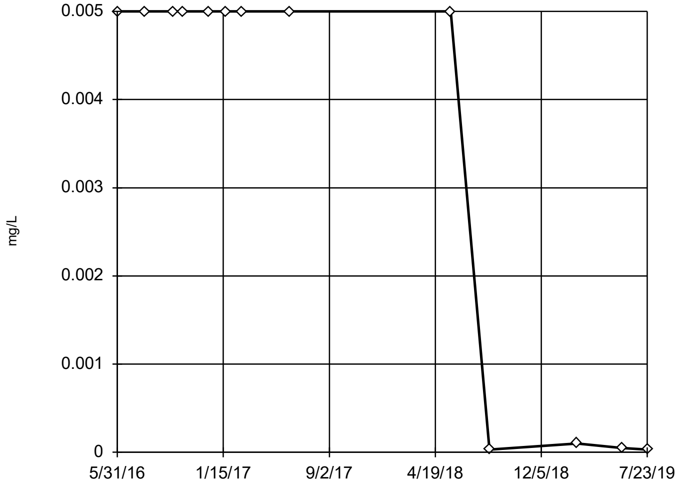
Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 11/20/2019, 1:09 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	0.003478	0.002377	ln(x)	ShapiroWilk
Antimony, total (mg/L)	AD-8	n/a	n/a	n/a	NP	NaN	13	0.003074	0.002318	unknown	ShapiroWilk
Antimony, total (mg/L)	AD-9	n/a	n/a	n/a	NP	NaN	13	0.003485	0.002365	unknown	ShapiroWilk
Arsenic, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	0.01736	0.0348	ln(x)	ShapiroWilk
Arsenic, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	0.003286	0.002263	ln(x)	ShapiroWilk
Arsenic, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	0.003804	0.001895	sqrt(x)	ShapiroWilk
Barium, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	0.3169	0.495	ln(x)	ShapiroWilk
Barium, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	0.02452	0.004938	ln(x)	ShapiroWilk
Barium, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	0.03994	0.02033	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	0.001885	0.003995	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	0.000...	0.0004797	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	0.000...	0.0004653	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	0.000...	0.001886	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	0.000...	0.0004696	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	0.001004	0.0009618	x^(1/3)	ShapiroWilk
Chromium, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	0.03502	0.07563	ln(x)	ShapiroWilk
Chromium, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	0.000...	0.0005308	sqrt(x)	ShapiroWilk
Chromium, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	0.000...	0.0003536	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	0.01828	0.03518	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	0.005953	0.00175	x^2	ShapiroWilk
Cobalt, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	0.02095	0.008543	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-15	No	n/a	n/a	NP	NaN	13	2.828	2.31	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-8	No	n/a	n/a	NP	NaN	13	1.432	1.671	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-9	No	n/a	n/a	NP	NaN	13	2.164	0.6618	sqrt(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	0.7306	0.4231	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	0.6628	0.184	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	0.6695	0.3425	x^(1/3)	ShapiroWilk
Lead, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	0.01862	0.0433	ln(x)	ShapiroWilk
Lead, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	0.003493	0.002353	ln(x)	ShapiroWilk
Lead, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	0.003509	0.002329	ln(x)	ShapiroWilk
Lithium, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	0.02353	0.03892	ln(x)	ShapiroWilk
Lithium, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	0.09463	0.02262	normal	ShapiroWilk
Lithium, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	1.092	0.3489	x^3	ShapiroWilk
Mercury, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	12	0.000...	0.0001941	ln(x)	ShapiroWilk
Mercury, total (mg/L)	AD-8	n/a	n/a	n/a	NP	NaN	12	0.000...	0.0000...	unknown	ShapiroWilk
Mercury, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	12	0.000...	0.0000...	sqrt(x)	ShapiroWilk
Molybdenum, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	0.002342	0.001751	sqrt(x)	ShapiroWilk
Molybdenum, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	0.003038	0.001957	x^(1/3)	ShapiroWilk
Molybdenum, total (mg/L)	AD-9	n/a	n/a	n/a	NP	NaN	13	0.003932	0.001734	unknown	ShapiroWilk
Selenium, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	0.003339	0.003615	ln(x)	ShapiroWilk
Selenium, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	0.002723	0.002281	sqrt(x)	ShapiroWilk
Selenium, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	0.002917	0.002549	sqrt(x)	ShapiroWilk
Thallium, total (mg/L)	AD-15	n/a	n/a	n/a	NP	NaN	13	0.001394	0.0007944	unknown	ShapiroWilk
Thallium, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	0.001358	0.0008371	x^2	ShapiroWilk
Thallium, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	0.001888	0.002136	x^(1/3)	ShapiroWilk

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

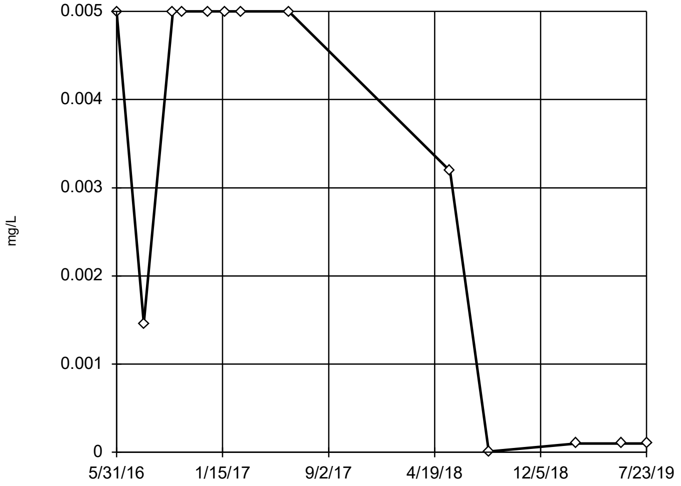
High cutoff = 1768, low cutoff = 2.0e-10, based on IQR multiplier of 3.

Constituent: Antimony, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

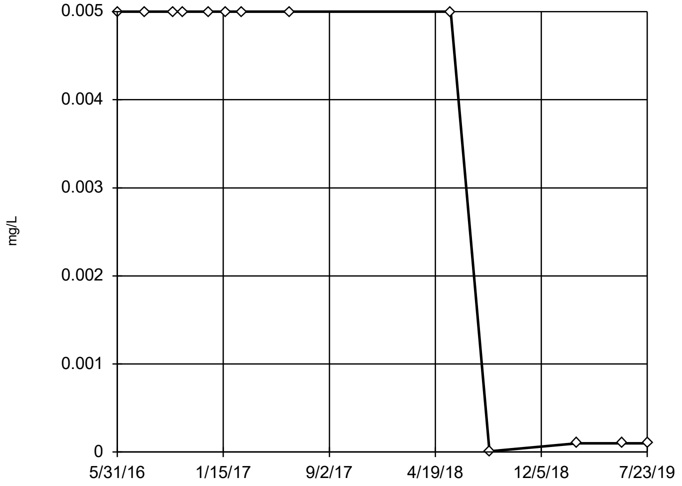
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Antimony, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

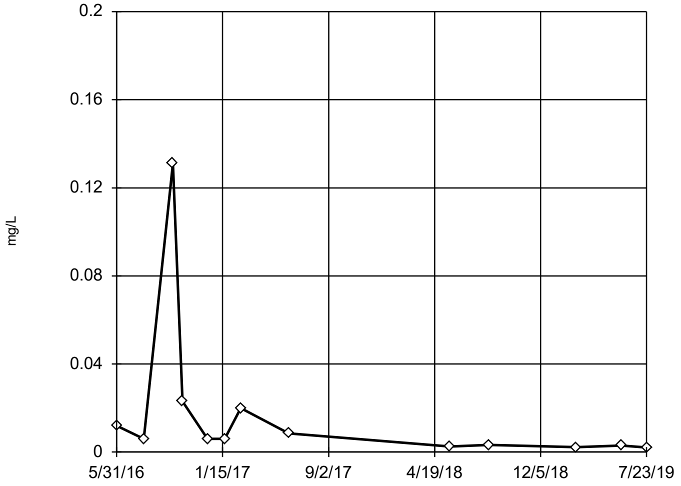
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Antimony, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

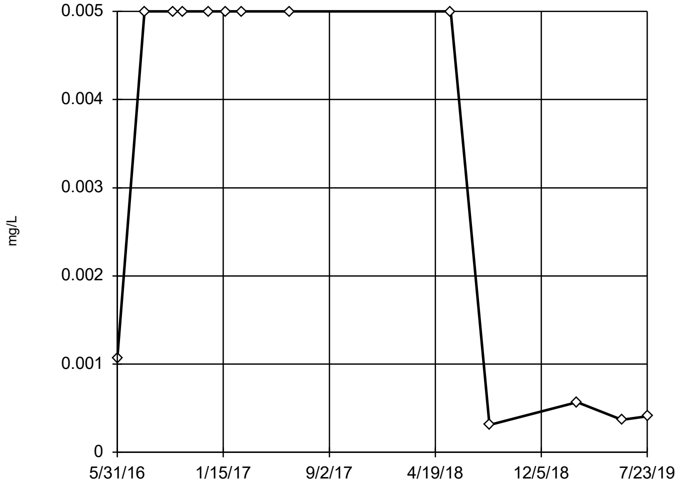
High cutoff = 2.775, low cutoff = 0.00001534, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

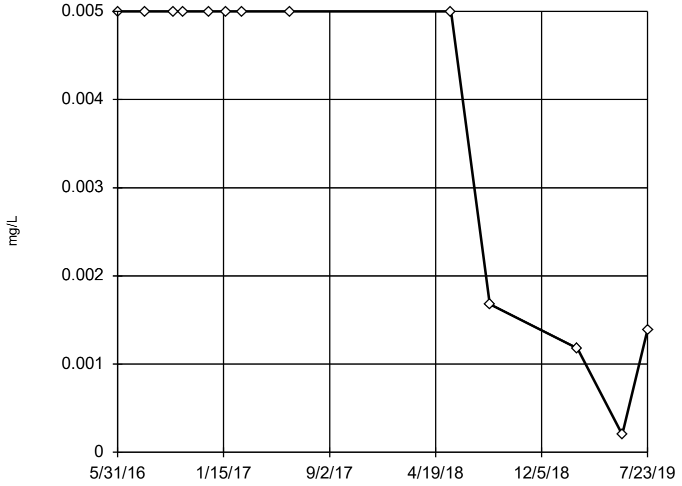
High cutoff = 5.532, low cutoff = 4.4e-7, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 13

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

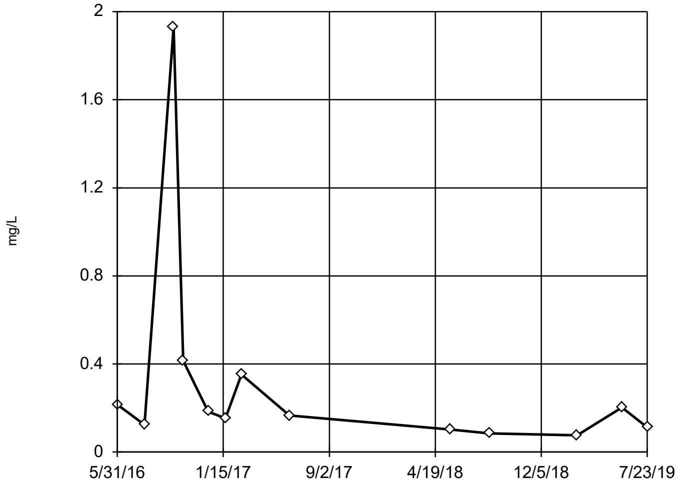
High cutoff = 0.02737, low cutoff = -0.00309, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

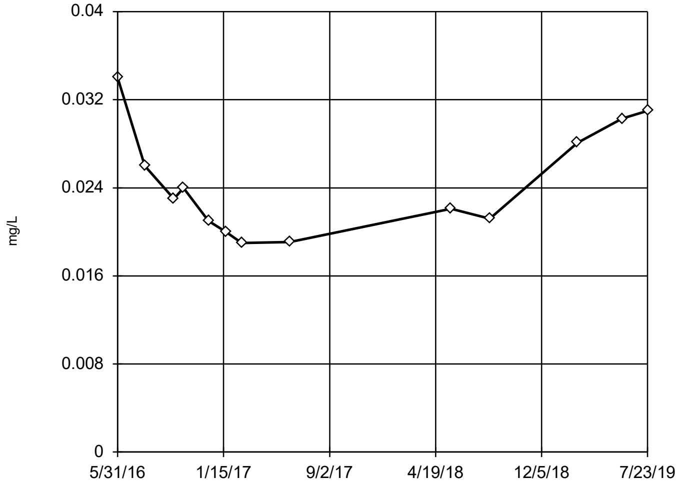
High cutoff = 4.655, low cutoff = 0.006354, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

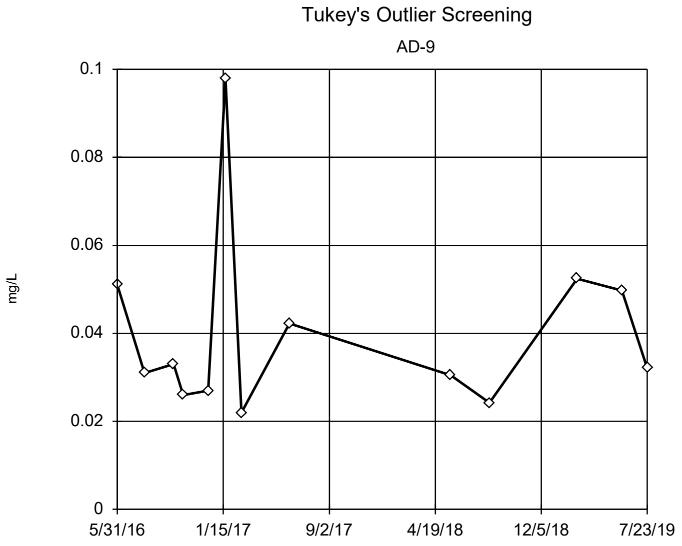
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.08422, low cutoff = 0.0071, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 13

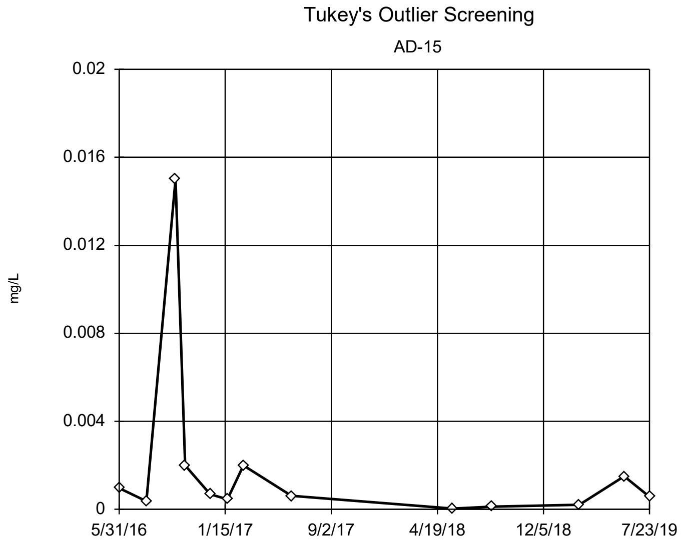
No outliers found.
Tukey's method select-
ed by user.

Data were natural log
transformed to achieve
best W statistic (graph
shown in original units).

High cutoff = 0.3454,
low cutoff = 0.003862,
based on IQR multiplier
of 3.

Constituent: Barium, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 13

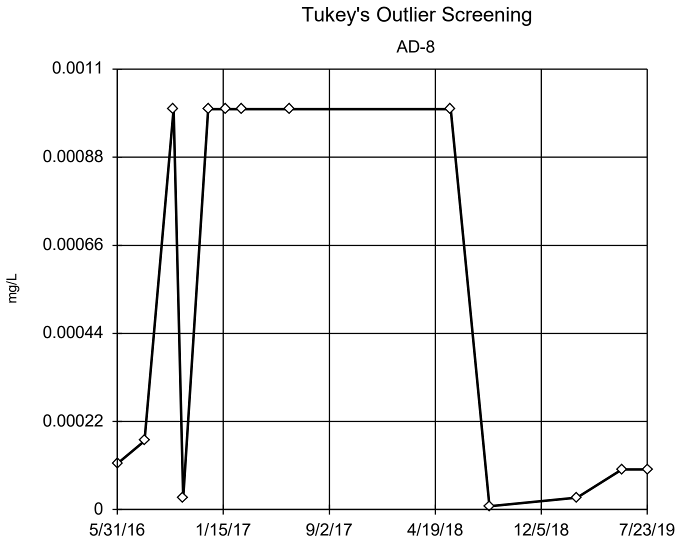
No outliers found.
Tukey's method select-
ed by user.

Data were natural log
transformed to achieve
best W statistic (graph
shown in original units).

High cutoff = 0.4345,
low cutoff = 0.000001095,
based on IQR multiplier
of 3.

Constituent: Beryllium, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 13

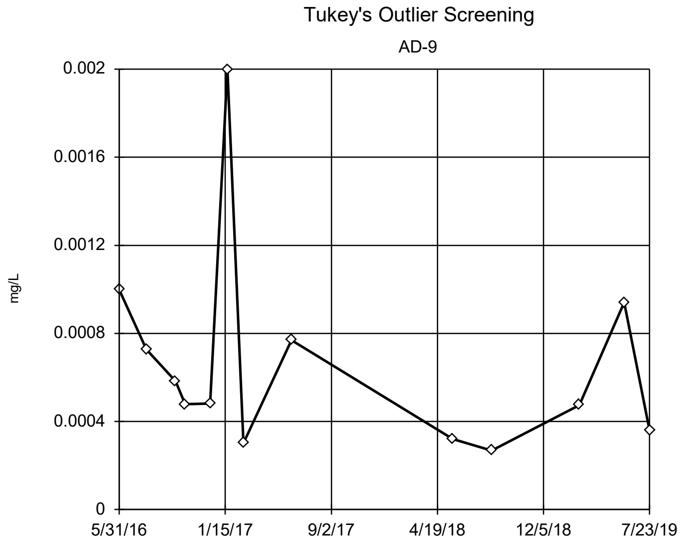
No outliers found.
Tukey's method select-
ed by user.

Data were natural log
transformed to achieve
best W statistic (graph
shown in original units).

High cutoff = 6.086, low
cutoff = 9.0e-9, based
on IQR multiplier of 3.

Constituent: Beryllium, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 13

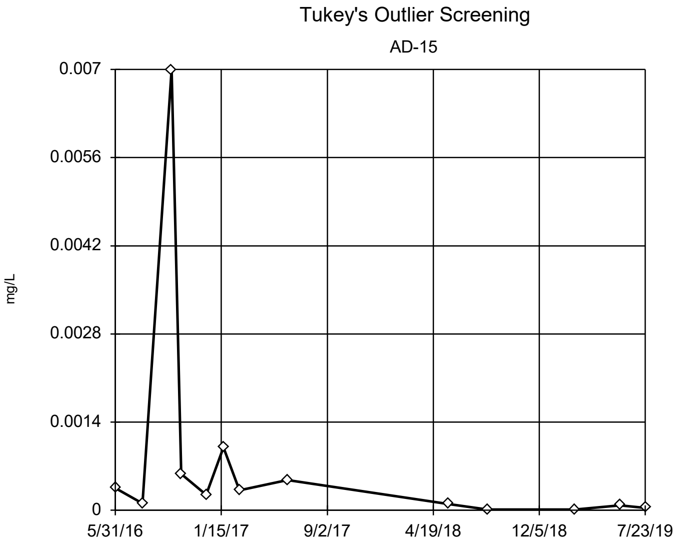
No outliers found.
Tukey's method select-
ed by user.

Data were natural log
transformed to achieve
best W statistic (graph
shown in original units).

High cutoff = 0.01337,
low cutoff = 0.00002164,
based on IQR multiplier
of 3.

Constituent: Beryllium, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 13

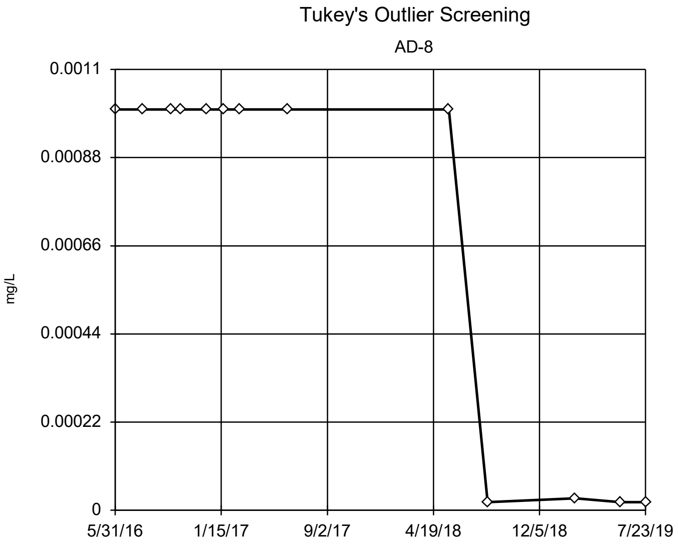
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.4222, low cutoff = 7.0e-8, based on IQR multiplier of 3.

Constituent: Cadmium, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 13

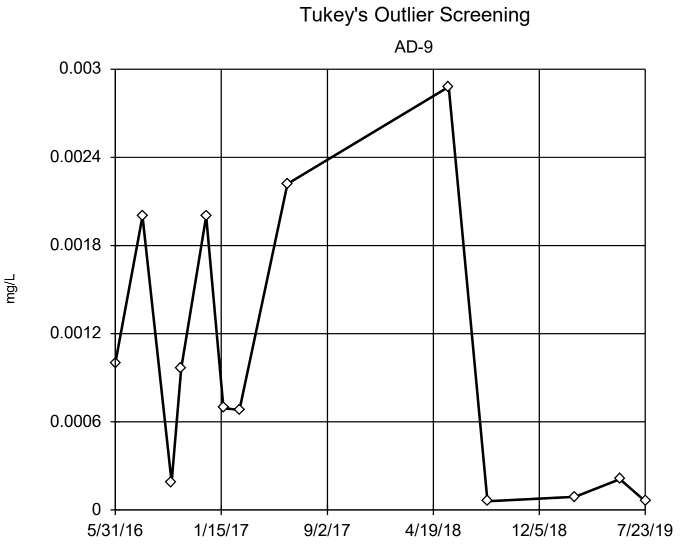
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 68.04, low cutoff = 3.6e-10, based on IQR multiplier of 3.

Constituent: Cadmium, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 13

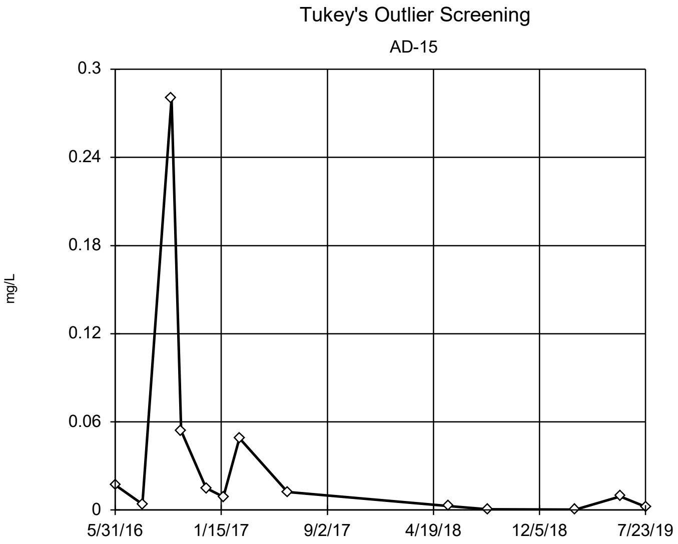
No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.04321, low cutoff = -0.005258, based on IQR multiplier of 3.

Constituent: Cadmium, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

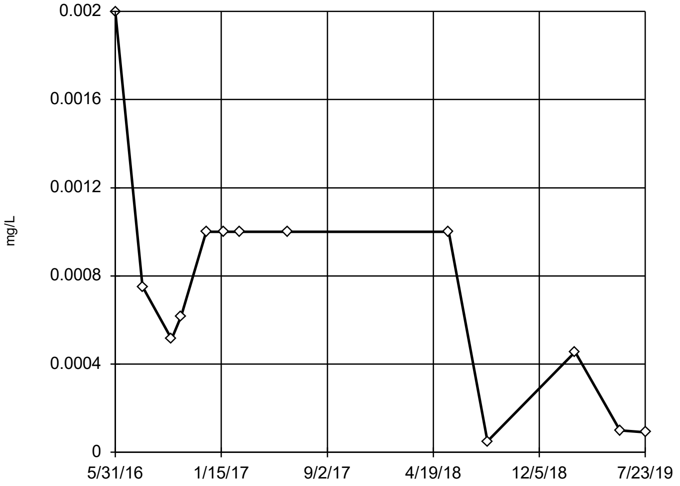
High cutoff = 47.88, low cutoff = 0.000001469, based on IQR multiplier of 3.

Constituent: Chromium, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

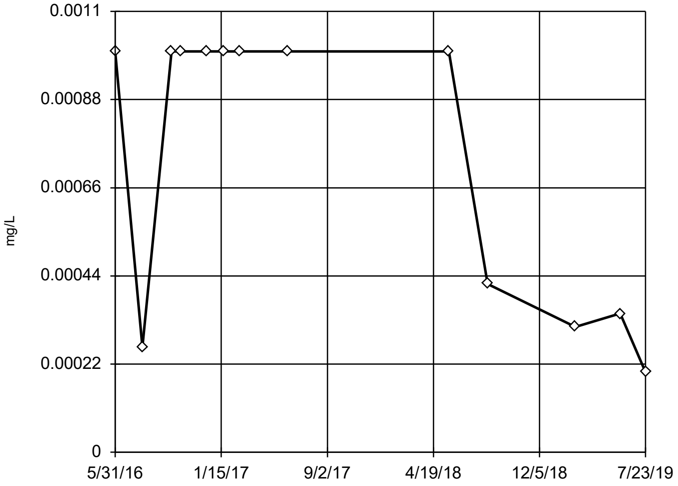
High cutoff = 0.006314, low cutoff = -0.001034, based on IQR multiplier of 3.

Constituent: Chromium, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

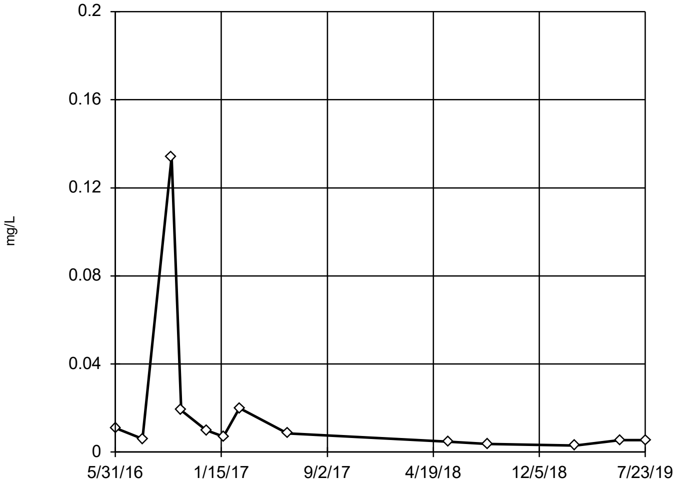
High cutoff = 0.02806, low cutoff = 0.00001173, based on IQR multiplier of 3.

Constituent: Chromium, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

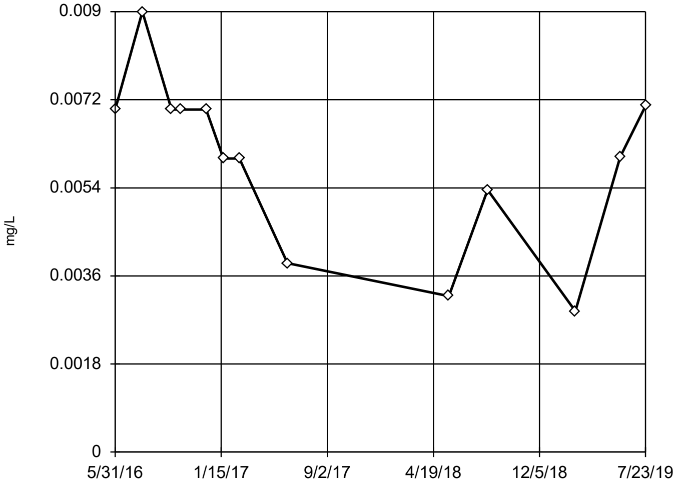
High cutoff = 0.3364, low cutoff = 0.0002176, based on IQR multiplier of 3.

Constituent: Cobalt, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

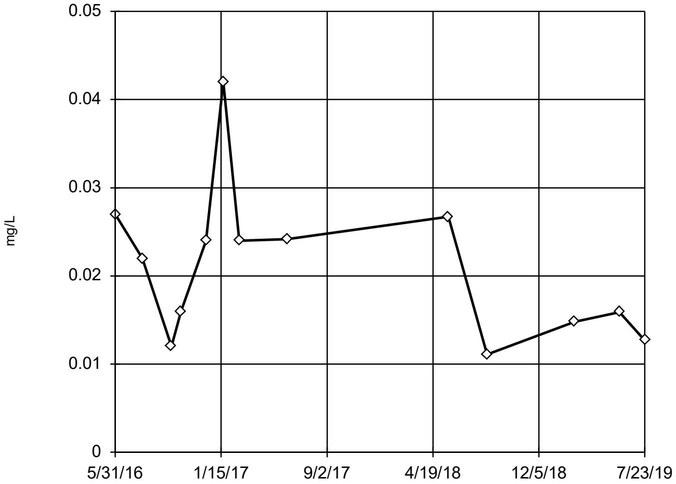
High cutoff = 0.01143, low cutoff = -0.007729, based on IQR multiplier of 3.

Constituent: Cobalt, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

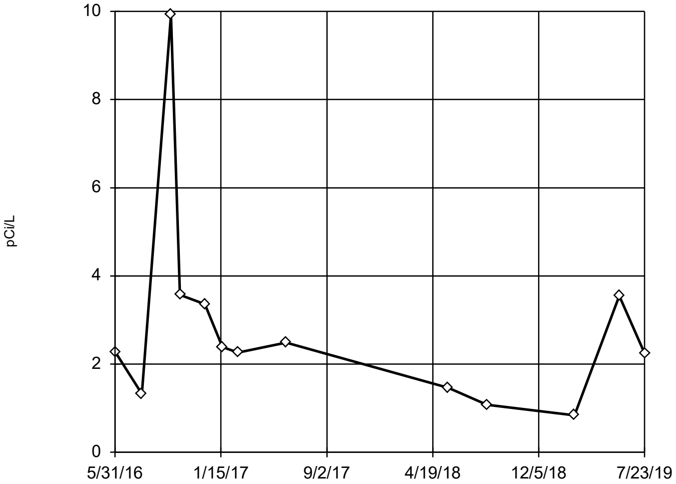
High cutoff = 0.1615, low cutoff = 0.002156, based on IQR multiplier of 3.

Constituent: Cobalt, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

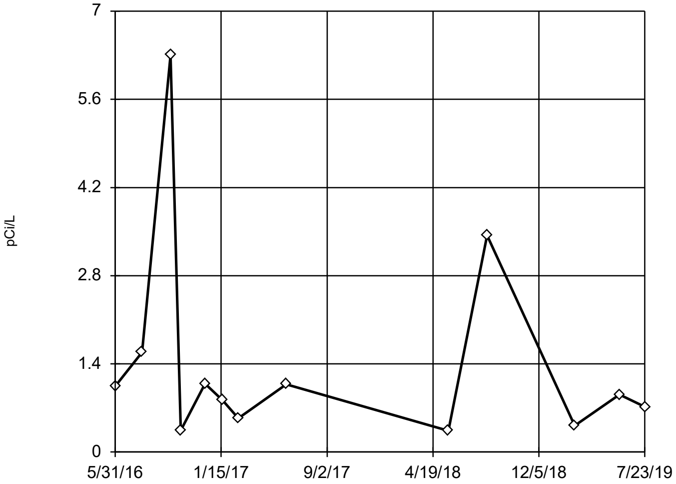
High cutoff = 53.06, low cutoff = 0.09043, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

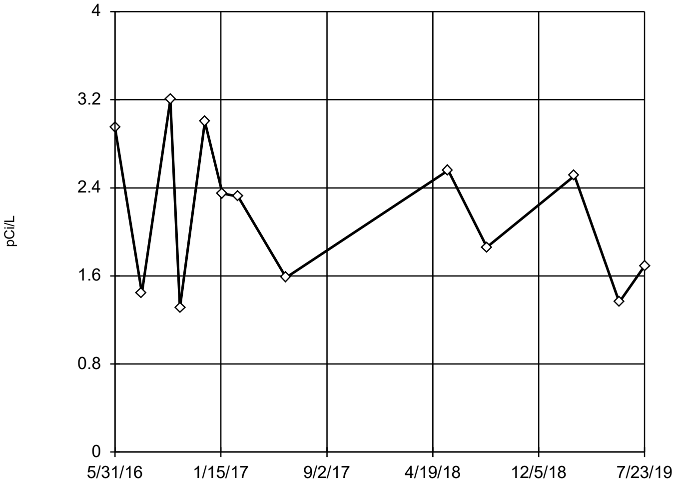
High cutoff = 27.85, low cutoff = 0.02223, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 13

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

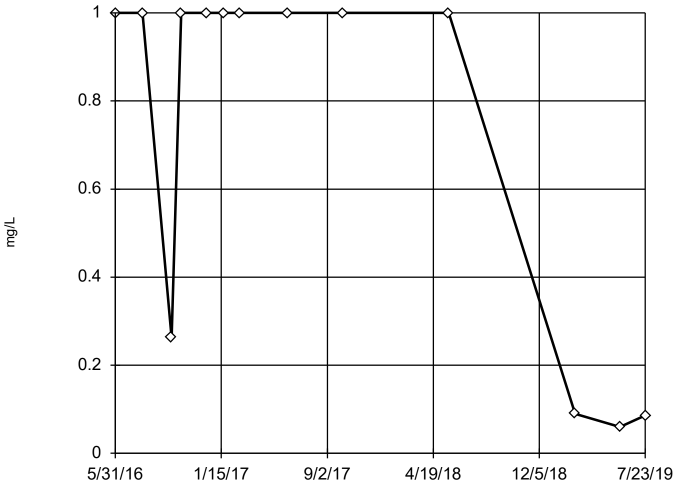
High cutoff = 8.636, low cutoff = -0.00246, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

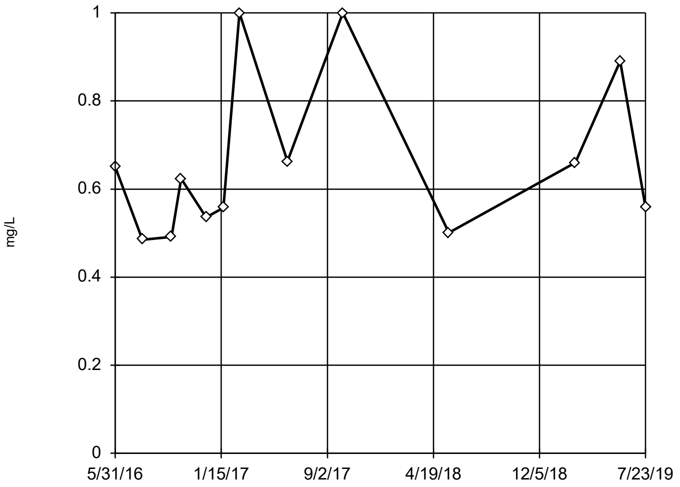
High cutoff = 276, low cutoff = 0.0005564, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

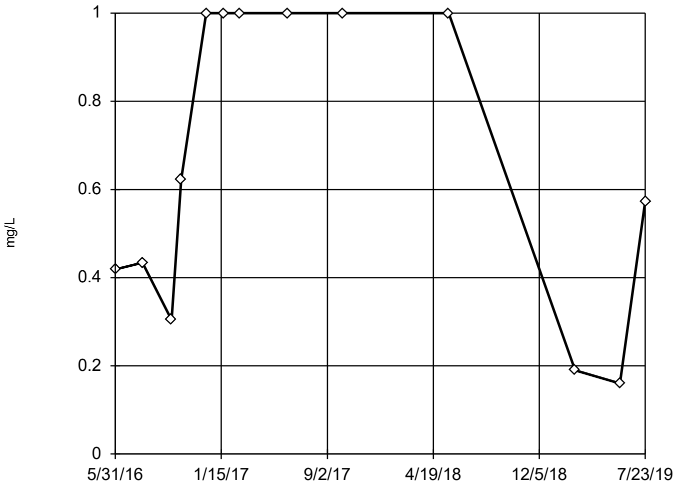
High cutoff = 2.504, low cutoff = 0.1589, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 13

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

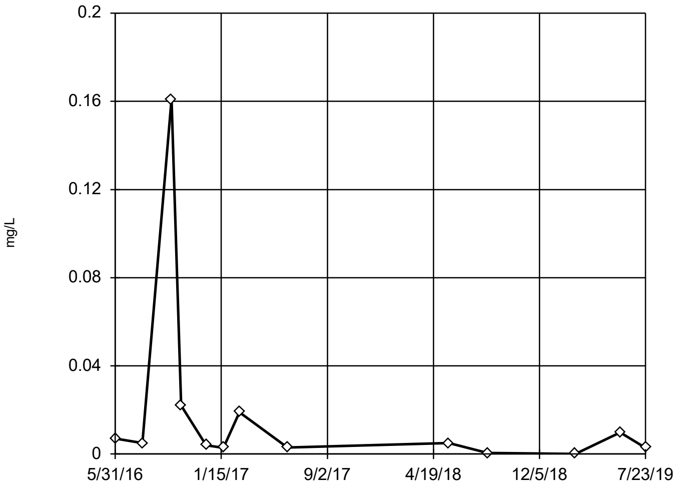
High cutoff = 6.527, low cutoff = -0.003982, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

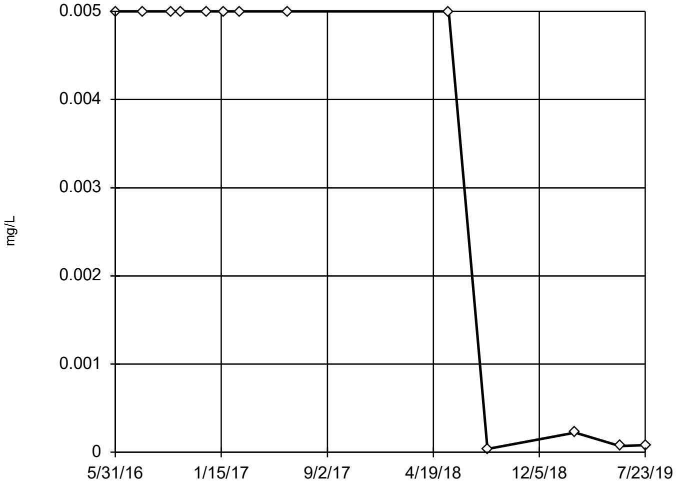
High cutoff = 1.478, low cutoff = 0.0000266, based on IQR multiplier of 3.

Constituent: Lead, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 262.3, low cutoff = 2.5e-9, based on IQR multiplier of 3.

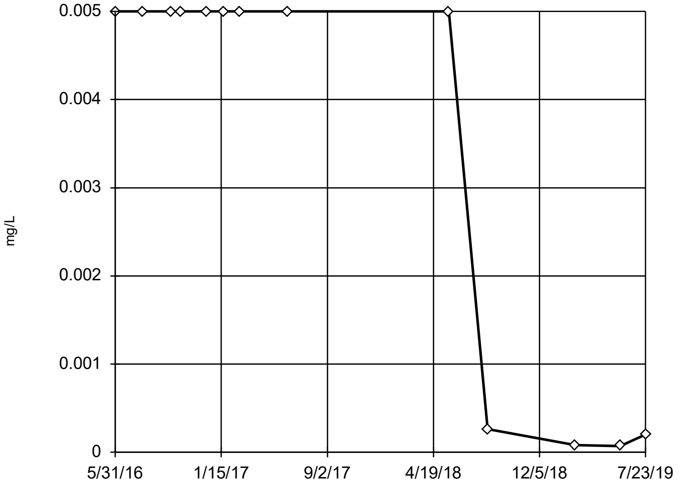
Constituent: Lead, total   Analysis Run 11/20/2019 1:07 PM   View: AIV

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 52.11, low cutoff = 2.2e-8, based on IQR multiplier of 3.

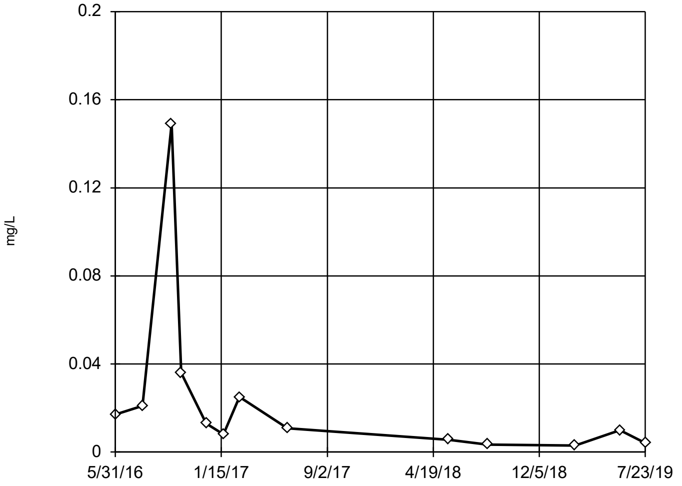
Constituent: Lead, total   Analysis Run 11/20/2019 1:07 PM   View: AIV

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2.456, low cutoff = 0.000045, based on IQR multiplier of 3.

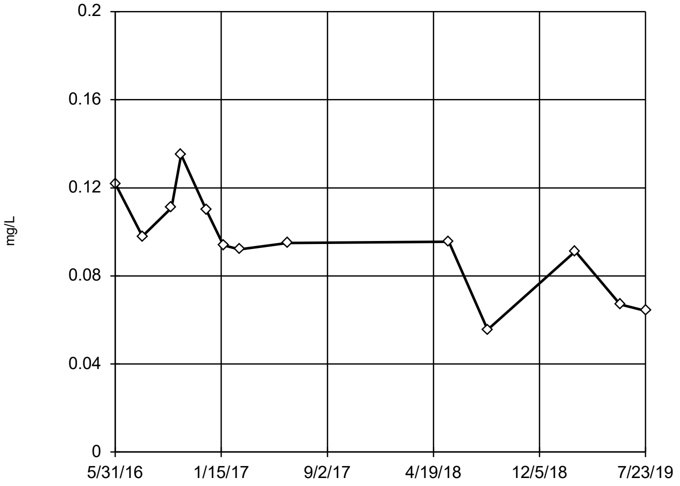
Constituent: Lithium, total   Analysis Run 11/20/2019 1:07 PM   View: AIV

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 0.2049, low cutoff = -0.0153, based on IQR multiplier of 3.

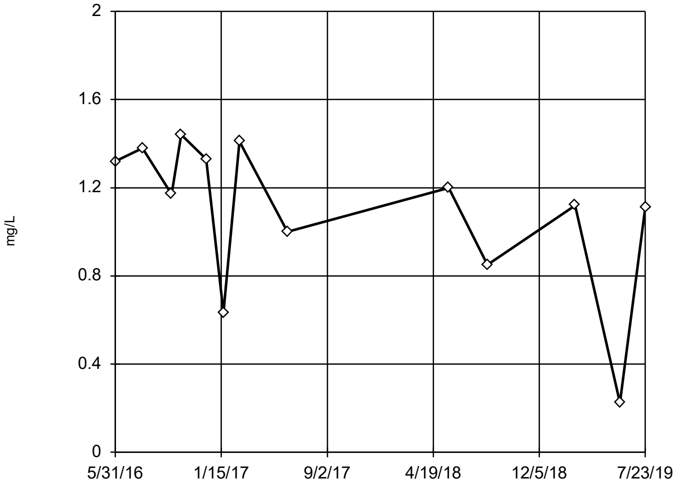
Constituent: Lithium, total   Analysis Run 11/20/2019 1:07 PM   View: AIV

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 13

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

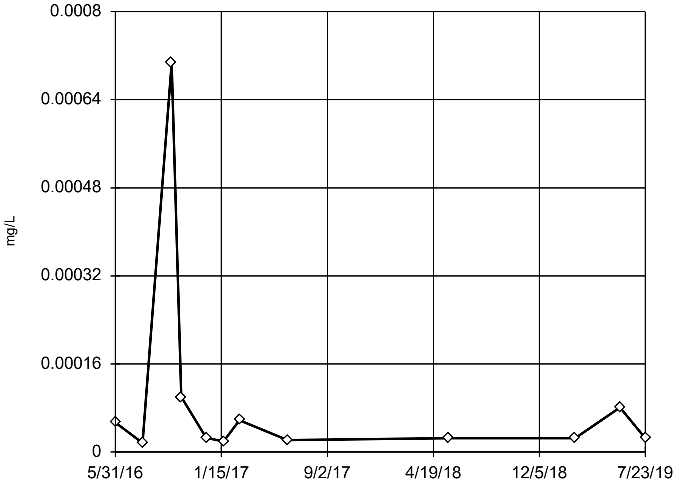
High cutoff = 1.961, low cutoff = -1.618, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

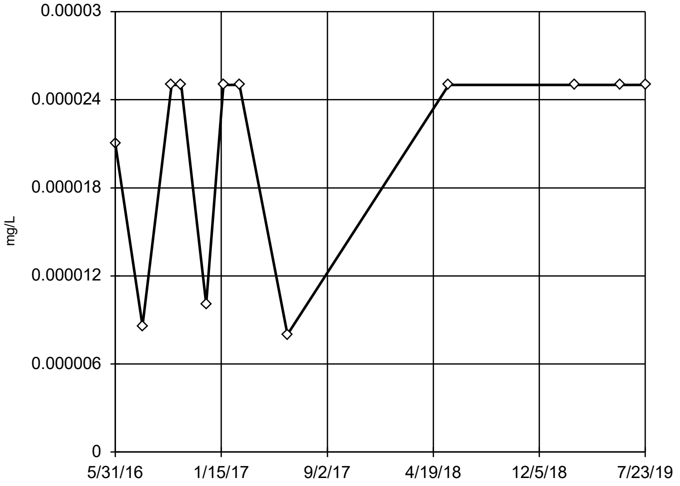
High cutoff = 0.001711, low cutoff = 9.4e-7, based on IQR multiplier of 3.

Constituent: Mercury, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 12

No outliers found. Tukey's method selected by user.

Data were x^4 transformed to achieve best W statistic (graph shown in original units).

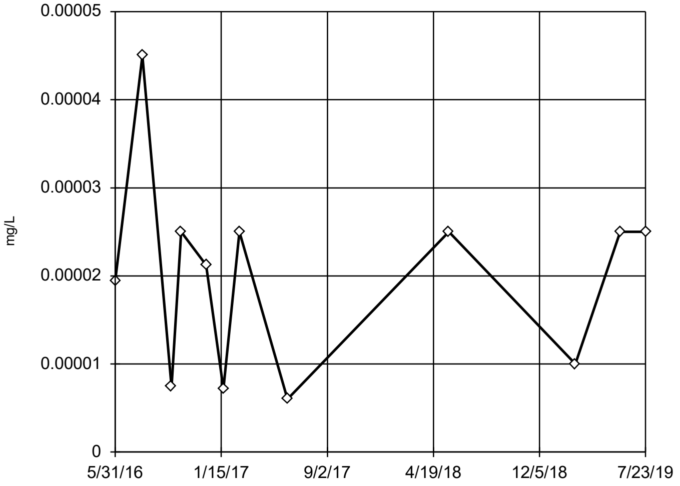
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Mercury, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 12

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

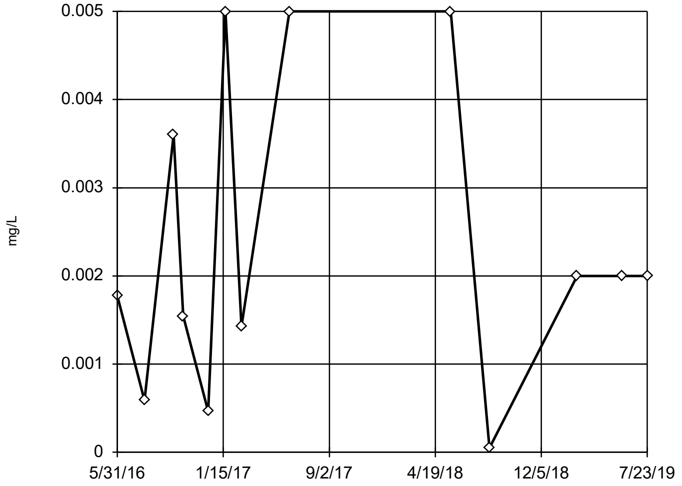
High cutoff = 0.000125, low cutoff = -0.00001049, based on IQR multiplier of 3.

Constituent: Mercury, total Analysis Run 11/20/2019 1:07 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

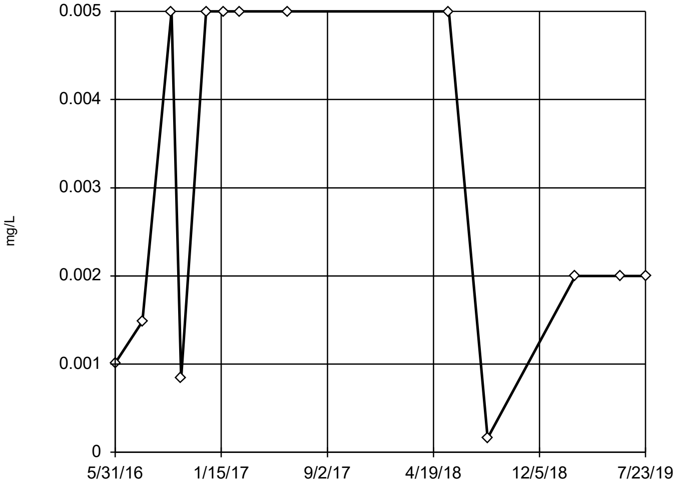
High cutoff = 0.02838, low cutoff = -0.0052, based on IQR multiplier of 3.

Constituent: Molybdenum, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

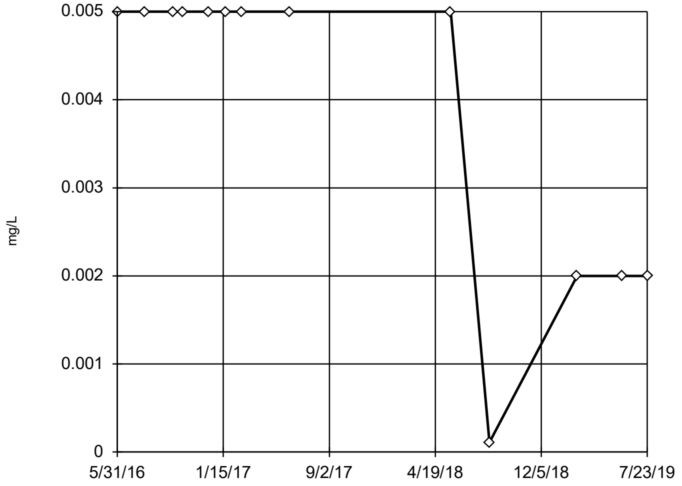
High cutoff = 0.04755, low cutoff = -0.0005935, based on IQR multiplier of 3.

Constituent: Molybdenum, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

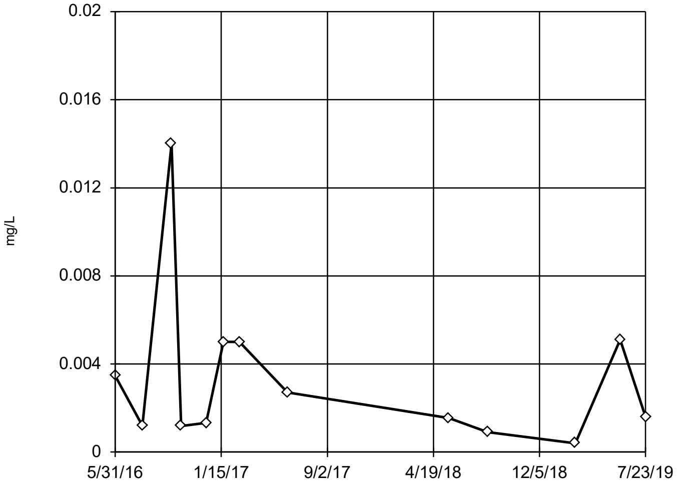
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Molybdenum, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

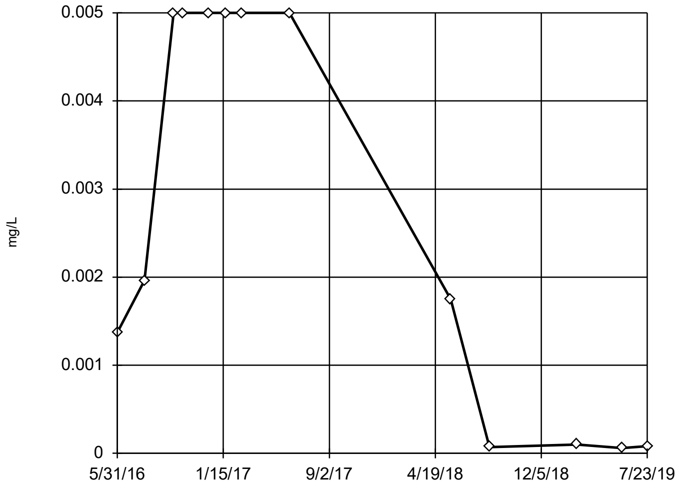
High cutoff = 0.3754, low cutoff = 0.00001579, based on IQR multiplier of 3.

Constituent: Selenium, total   Analysis Run 11/20/2019 1:07 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.06473, low cutoff = -0.03036, based on IQR multiplier of 3.

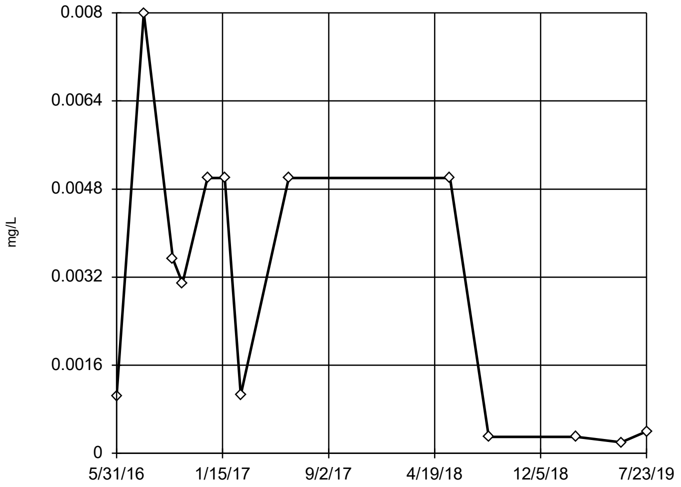
Constituent: Selenium, total Analysis Run 11/20/2019 1:07 PM View: AIV

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 13

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.05147, low cutoff = -0.0189, based on IQR multiplier of 3.

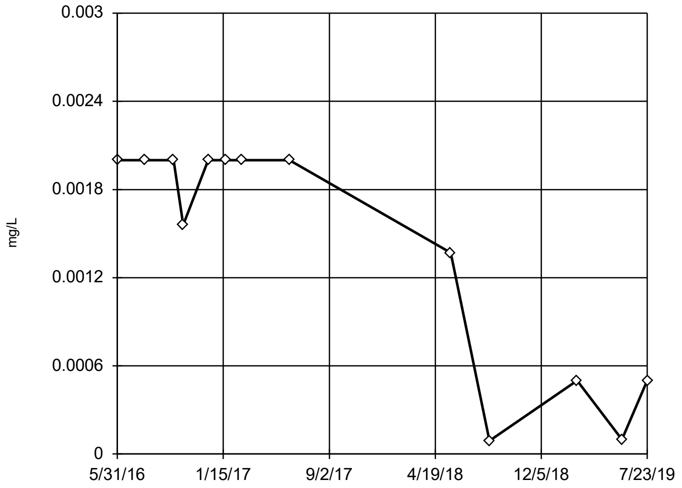
Constituent: Selenium, total Analysis Run 11/20/2019 1:08 PM View: AIV

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

The results were invalidated, because both the lower and upper quartiles represent reporting limits.

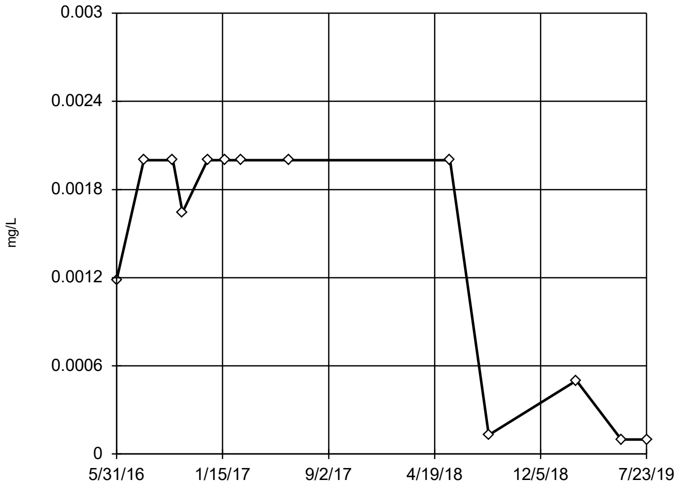
Constituent: Thallium, total Analysis Run 11/20/2019 1:08 PM View: AIV

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

No outliers found. Tukey's method selected by user.

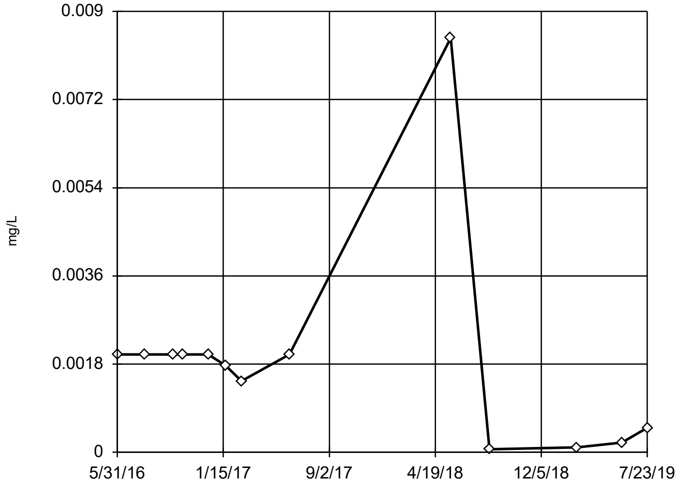
Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.00395, low cutoff = -0.003386, based on IQR multiplier of 3.

Constituent: Thallium, total Analysis Run 11/20/2019 1:08 PM View: AIV

Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Tukey's Outlier Screening



n = 13

No outliers found.
Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.02625, low cutoff = -0.00107, based on IQR multiplier of 3.

Constituent: Thallium, total   Analysis Run 11/20/2019 1:08 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Upgradient Appendix IV Outlier Analysis - All Results (No Significant)

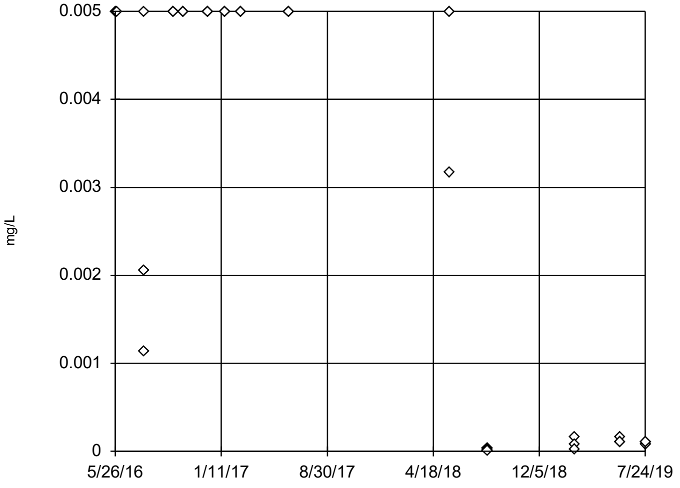
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP   Printed 11/20/2019, 1:10 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony, total (mg/L)	AD-1,AD-1...	n/a	n/a	n/a w/com...	NP	NaN	39	0.003265	0.002294	unknown	ShapiroWilk
Arsenic, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.003355	0.001848	sqrt(x)	ShapiroWilk
Barium, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.1097	0.1337	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.000...	0.000171	x^(1/3)	ShapiroWilk
Cadmium, total (mg/L)	AD-1,AD-1...	n/a	n/a	n/a w/com...	NP	NaN	39	0.001055	0.001552	unknown	ShapiroWilk
Chromium, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	38	0.000...	0.00086	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.02542	0.02821	x^(1/3)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	2.091	0.9476	sqrt(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	42	0.7273	0.3627	ln(x)	ShapiroWilk
Lead, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.003549	0.002164	ln(x)	ShapiroWilk
Lithium, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.1639	0.1373	normal	ShapiroWilk
Mercury, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.000...	0.0000...	x^2	ShapiroWilk
Molybdenum, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.003371	0.001944	x^(1/3)	ShapiroWilk
Selenium, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.002917	0.002031	sqrt(x)	ShapiroWilk
Thallium, total (mg/L)	AD-1,AD-1...	n/a	n/a	n/a w/com...	NP	NaN	39	0.001458	0.000758	unknown	ShapiroWilk

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

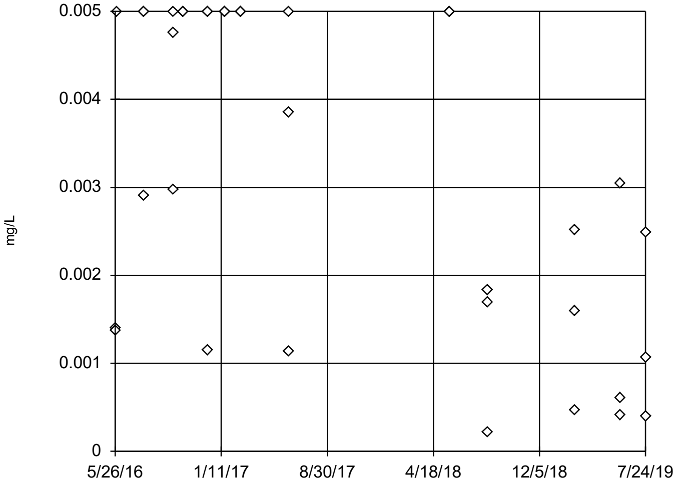
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Antimony, total Analysis Run 11/20/2019 1:09 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

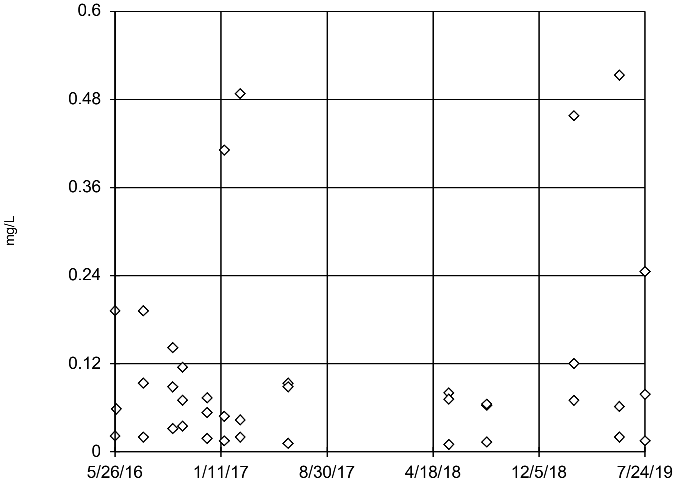
High cutoff = 0.02919, low cutoff = -0.003945, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 11/20/2019 1:09 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

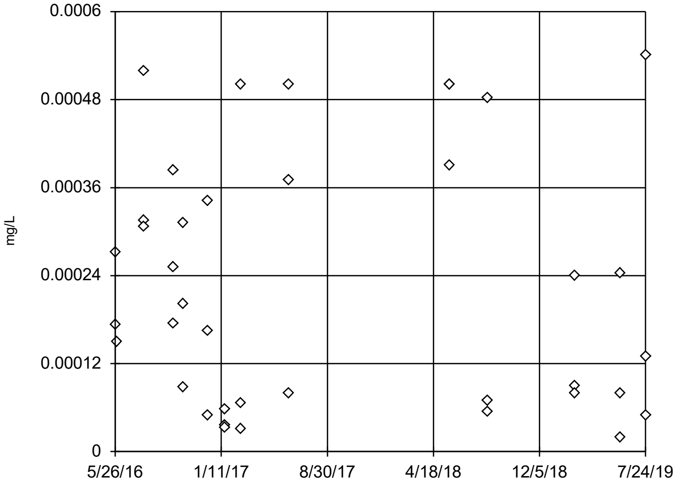
High cutoff = 18.24, low cutoff = 0.0001313, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 11/20/2019 1:09 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

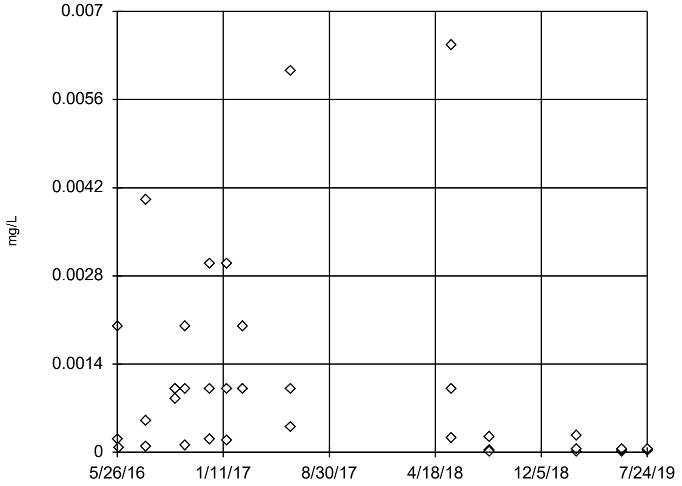
High cutoff = 0.00442, low cutoff = -0.0001351, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 11/20/2019 1:09 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

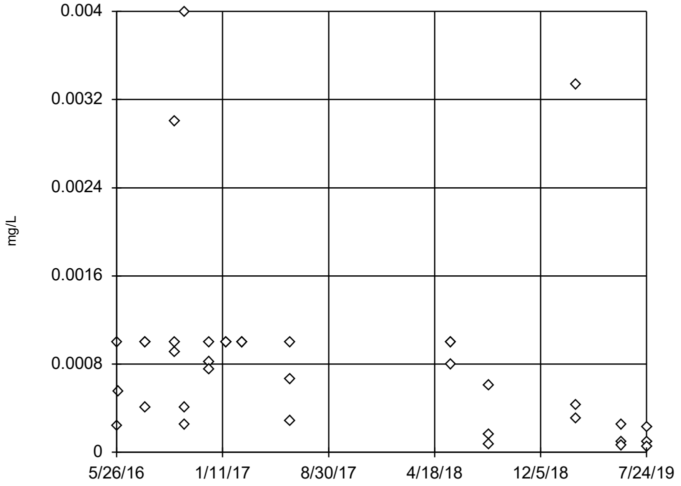
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Cadmium, total   Analysis Run 11/20/2019 1:09 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 38

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

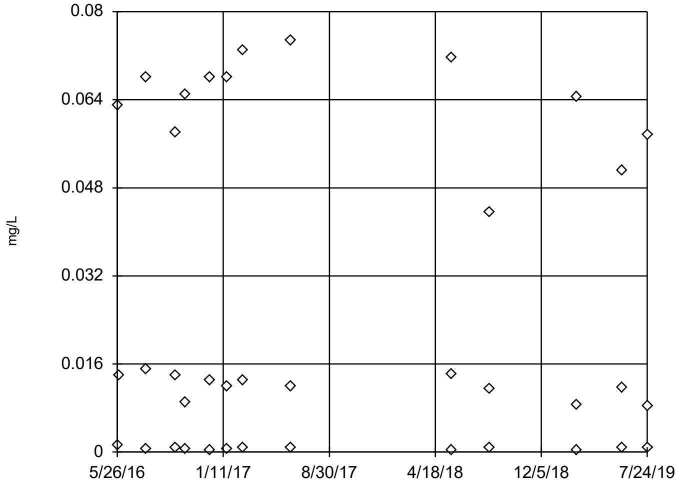
High cutoff = 0.06633, low cutoff = 0.000003725, based on IQR multiplier of 3.

Constituent: Chromium, total   Analysis Run 11/20/2019 1:09 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

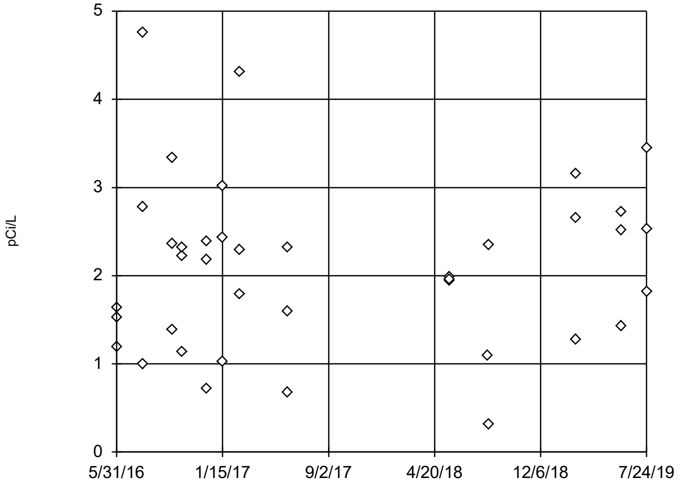
High cutoff = 2.054, low cutoff = -0.4961, based on IQR multiplier of 3.

Constituent: Cobalt, total   Analysis Run 11/20/2019 1:09 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

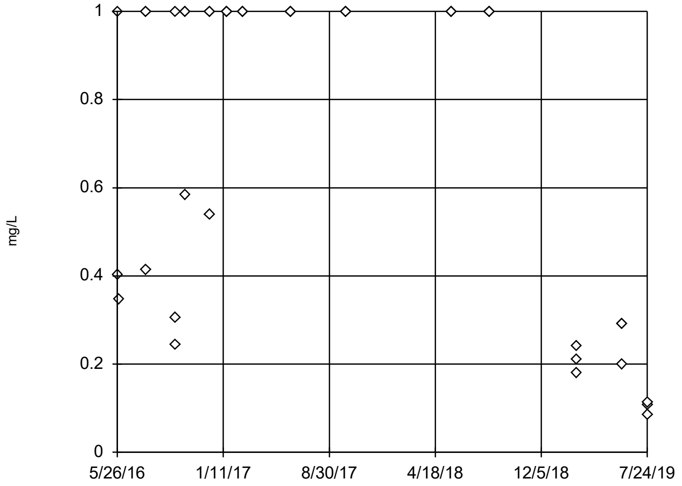
High cutoff = 8.077, low cutoff = -0.005728, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228   Analysis Run 11/20/2019 1:09 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 42

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

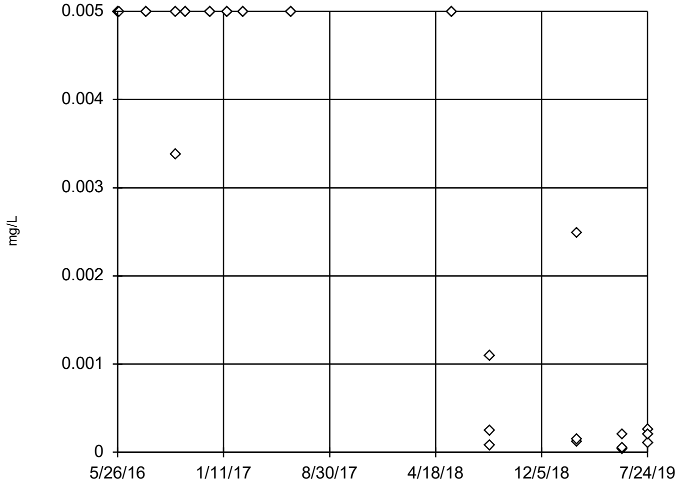
High cutoff = 37.92, low cutoff = 0.007849, based on IQR multiplier of 3.

Constituent: Fluoride, total   Analysis Run 11/20/2019 1:09 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

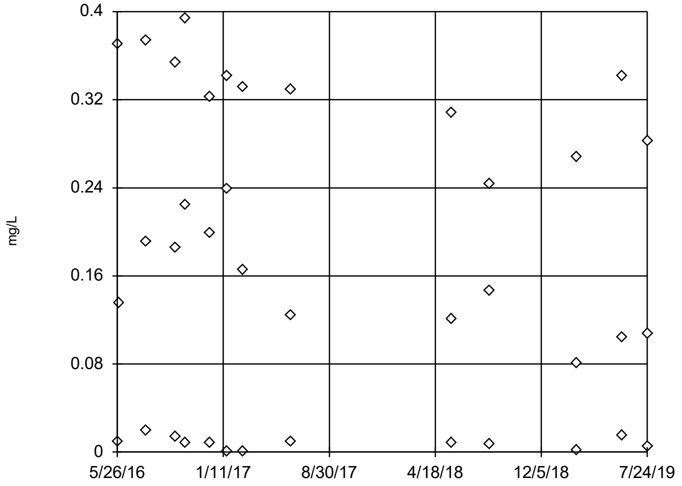
High cutoff = 34.36, low cutoff = 3.8e-8, based on IQR multiplier of 3.

Constituent: Lead, total   Analysis Run 11/20/2019 1:09 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

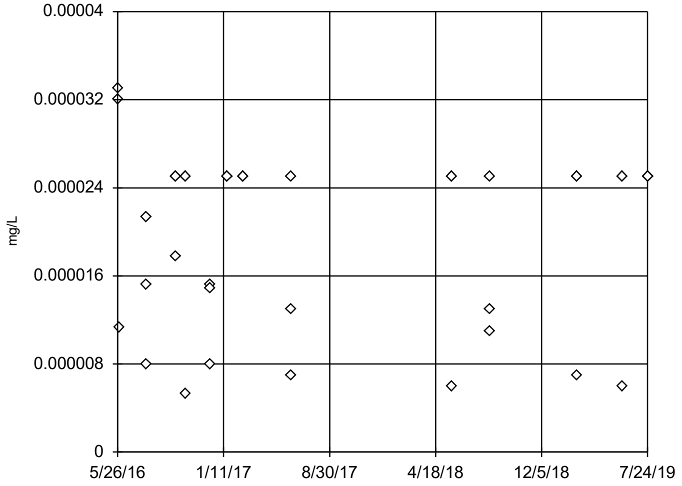
High cutoff = 1.202, low cutoff = -0.884, based on IQR multiplier of 3.

Constituent: Lithium, total   Analysis Run 11/20/2019 1:09 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

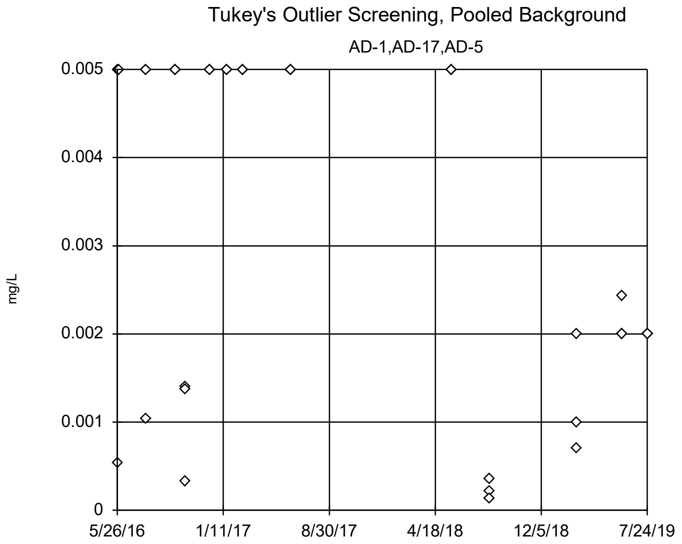
No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.00004464, low cutoff = -0.00003463, based on IQR multiplier of 3.

Constituent: Mercury, total   Analysis Run 11/20/2019 1:09 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 39

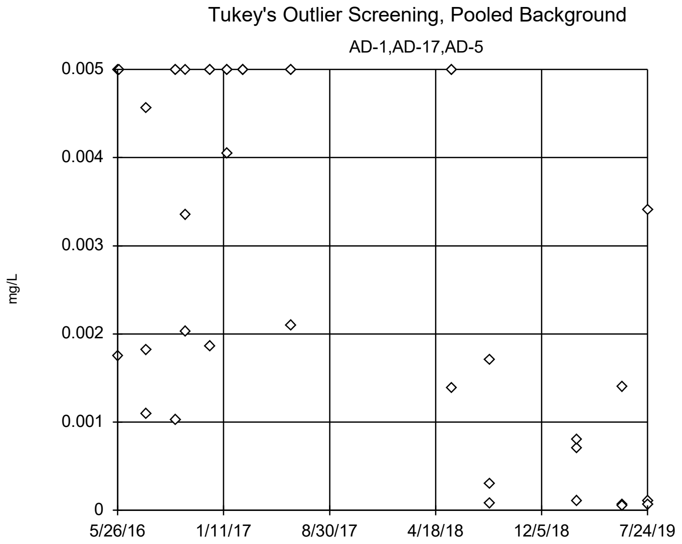
No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.04232, low cutoff = -0.000283, based on IQR multiplier of 3.

Constituent: Molybdenum, total   Analysis Run 11/20/2019 1:09 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 39

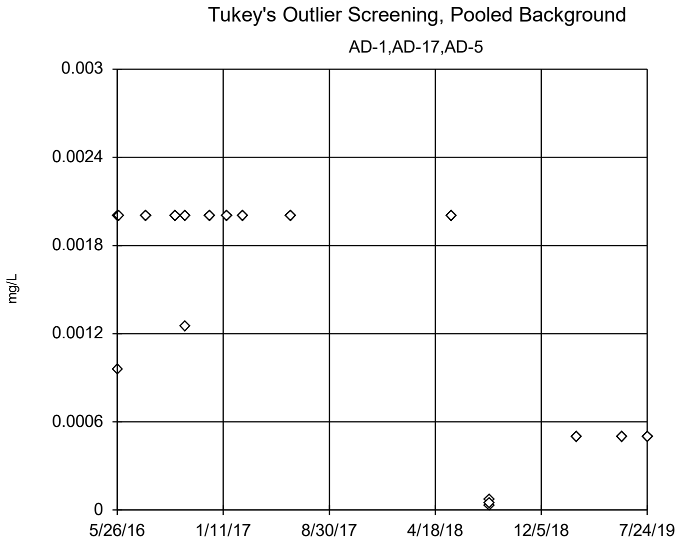
No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.03487, low cutoff = -0.007054, based on IQR multiplier of 3.

Constituent: Selenium, total   Analysis Run 11/20/2019 1:09 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 39

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Thallium, total   Analysis Run 11/20/2019 1:09 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Interwell Appendix III Outlier Analysis - All Results (No Significant)

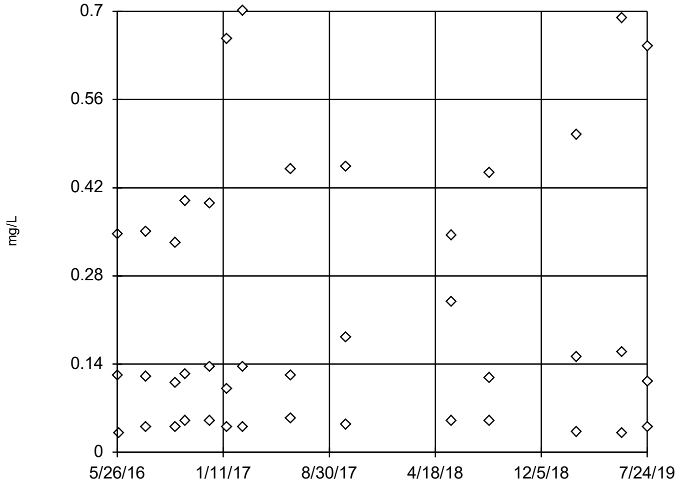
Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 11/20/2019, 1:03 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	42	0.2196	0.2058	ln(x)	ShapiroWilk
pH, field (SU)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	42	5.951	0.5895	ln(x)	ShapiroWilk

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 42

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

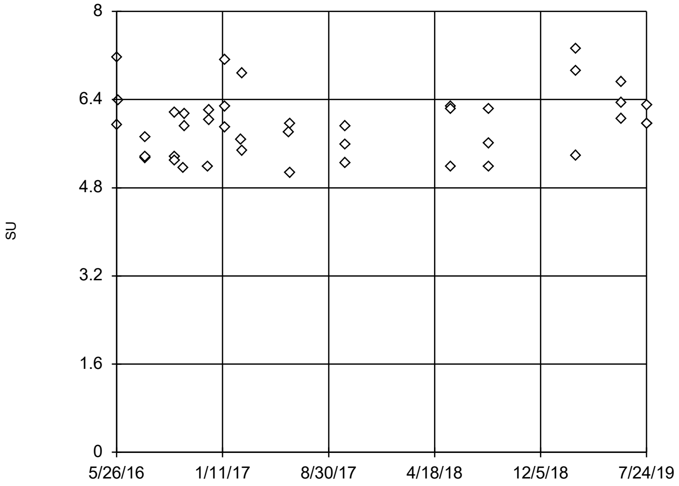
High cutoff = 152.1, low cutoff = 0.000122, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 11/20/2019 1:03 PM View: Interwell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 42

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 9.984, low cutoff = 3.378, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 11/20/2019 1:03 PM View: Interwell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Intrawell Appendix III Outlier Analysis - Significant Results

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP   Printed 11/20/2019, 1:07 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Total Dissolved Solids (mg/L)	**AD-15**	**Yes**	**367**	**9/30/2016**	**NP**	**NaN**	**13**	**179**	**75.8**	**normal**	**ShapiroWilk**

Intrawell Appendix III Outlier Analysis - All Results

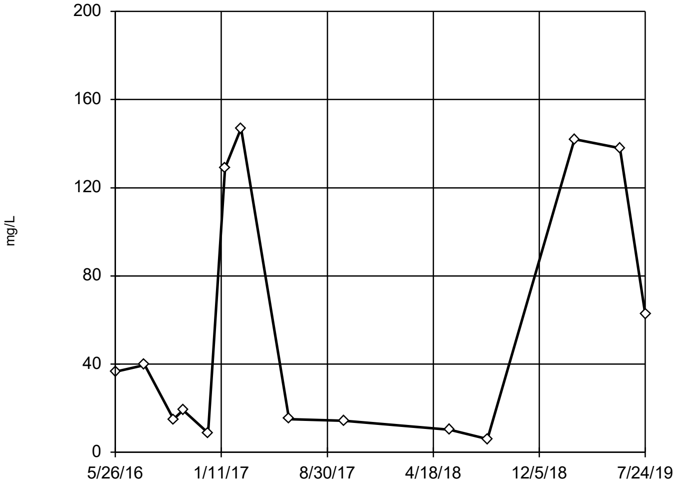
Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 11/20/2019, 1:07 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Calcium, total (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	14	55.94	56.65	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	3.508	0.7866	x^(1/3)	ShapiroWilk
Calcium, total (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	14	195.5	8.645	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	14	40.53	8.044	x^(1/3)	ShapiroWilk
Calcium, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	14	20.9	4.996	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	14	181.3	86.04	x^5	ShapiroWilk
Chloride, total (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	14	4.172	1.727	x^(1/3)	ShapiroWilk
Chloride, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	28.28	4.624	normal	ShapiroWilk
Chloride, total (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	14	35.64	4.965	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	14	17	3.662	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	24.36	5.269	x^(1/3)	ShapiroWilk
Chloride, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	71.69	28.34	x^4	ShapiroWilk
Fluoride, total (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	14	0.8311	0.3376	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	0.7306	0.4231	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	14	0.6221	0.3637	x^(1/3)	ShapiroWilk
Fluoride, total (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	14	0.7288	0.3808	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	0.6628	0.184	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	0.6695	0.3425	x^(1/3)	ShapiroWilk
Sulfate, total (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	14	46.46	10.67	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-15	No	n/a	n/a	NP	NaN	13	18.36	7.438	x^2	ShapiroWilk
Sulfate, total (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	14	1123	104.3	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	14	142.1	78.09	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	164	27.48	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	1186	608.9	x^2	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	14	295.9	180	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	**AD-15**	**Yes**	**367**	**9/30/2016**	**NP**	**NaN**	**13**	**179**	**75.8**	**normal**	**ShapiroWilk**
Total Dissolved Solids (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	14	1670	111	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	14	343.5	88.41	sqrt(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-8	No	n/a	n/a	NP	NaN	13	385.2	70.74	x^(1/3)	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-9	No	n/a	n/a	NP	NaN	13	2034	869.4	x^6	ShapiroWilk

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-1 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

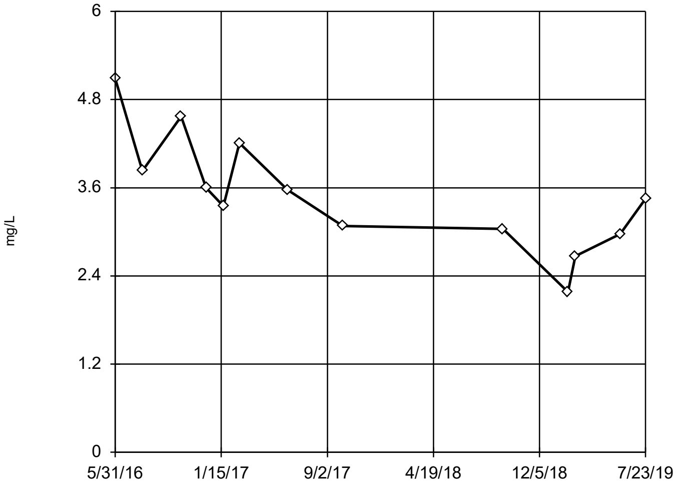
High cutoff = 179901, low cutoff = 0.008957, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/20/2019 1:04 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

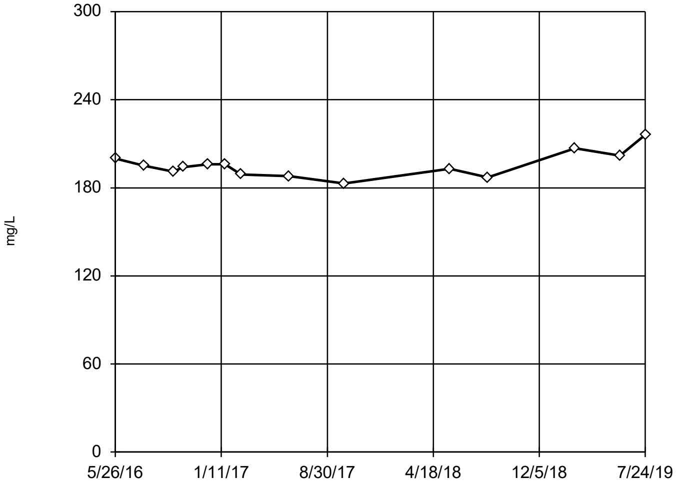
High cutoff = 8.359, low cutoff = 1.01, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/20/2019 1:04 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-17 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

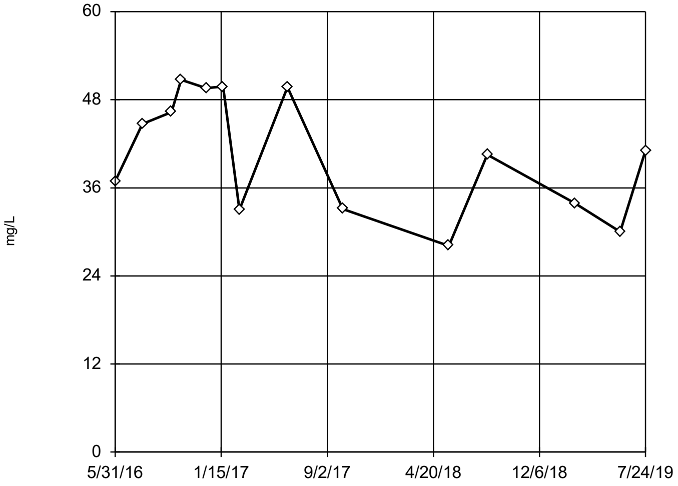
High cutoff = 243.7, low cutoff = 155.5, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/20/2019 1:04 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-5 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

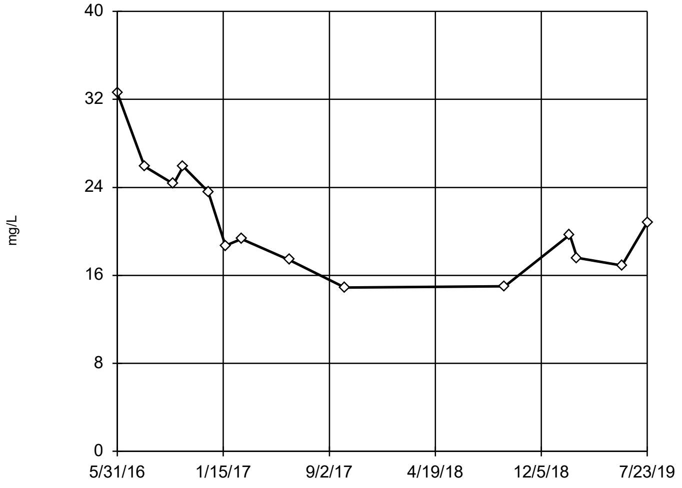
High cutoff = 130.6, low cutoff = 5.933, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/20/2019 1:04 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

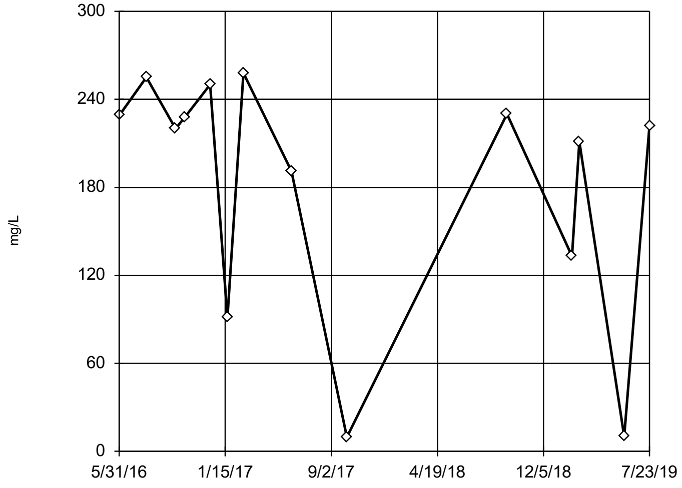
High cutoff = 78.55, low cutoff = 5.477, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/20/2019 1:04 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 14

No outliers found. Tukey's method selected by user.

Data were x^5 transformed to achieve best W statistic (graph shown in original units).

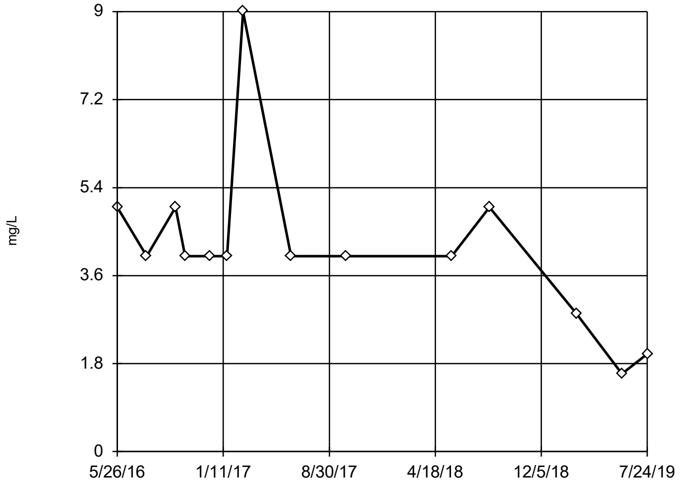
High cutoff = 316.4, low cutoff = -297.6, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/20/2019 1:04 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-1 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

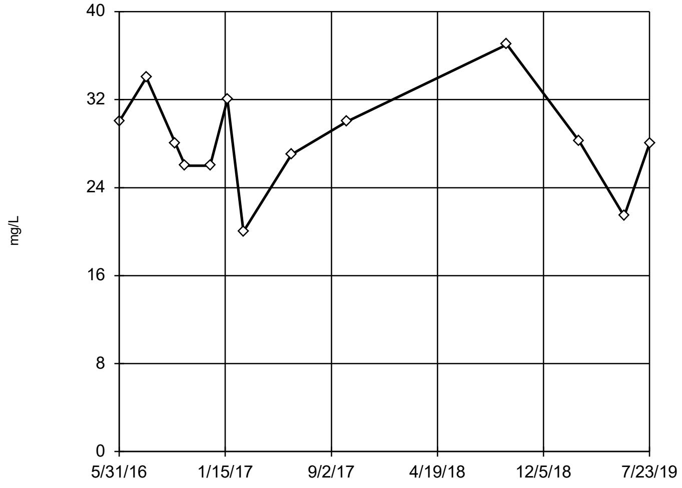
High cutoff = 12.81, low cutoff = 0.6596, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 11/20/2019 1:04 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

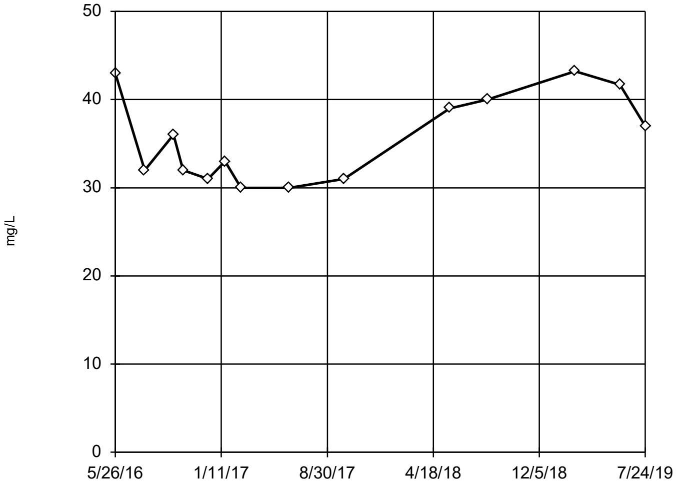
High cutoff = 46, low cutoff = 11, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 11/20/2019 1:04 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-17 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

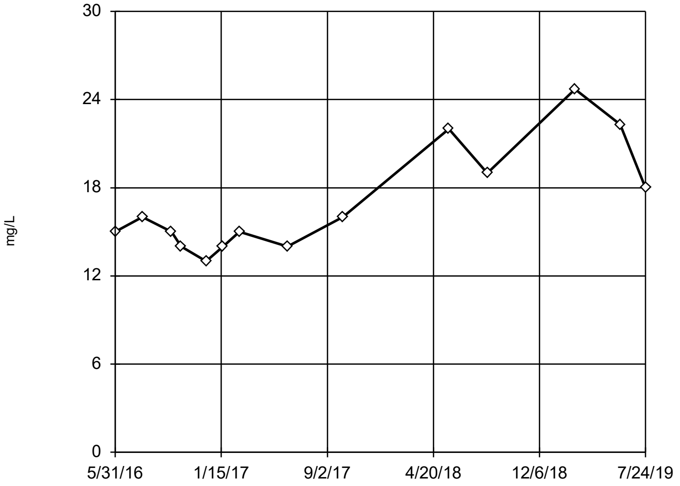
High cutoff = 93.39, low cutoff = 13.56, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 11/20/2019 1:04 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-5 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

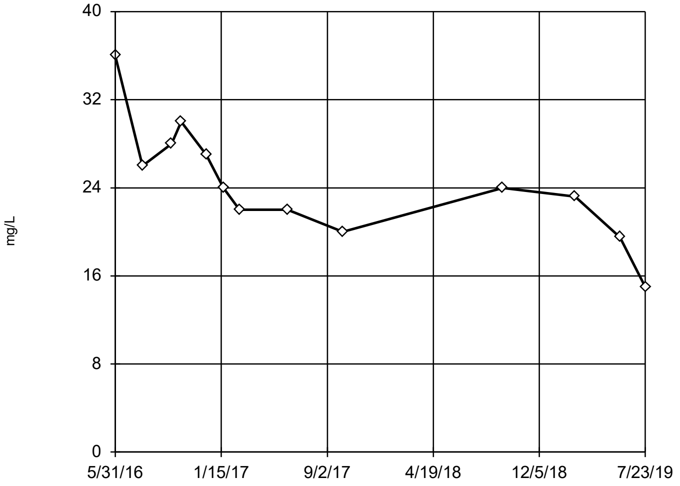
High cutoff = 63.67, low cutoff = 4.495, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 11/20/2019 1:04 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

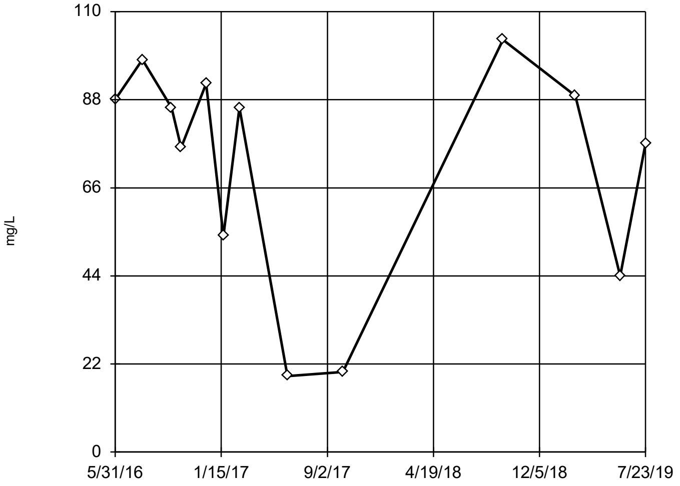
High cutoff = 54.81, low cutoff = 7.739, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 11/20/2019 1:04 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 13

No outliers found. Tukey's method selected by user.

Data were x^4 transformed to achieve best W statistic (graph shown in original units).

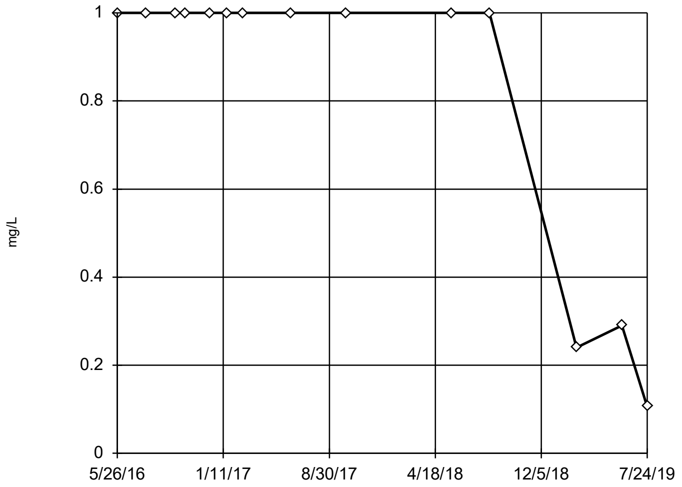
High cutoff = 125.8, low cutoff = -115.4, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 11/20/2019 1:04 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-1 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

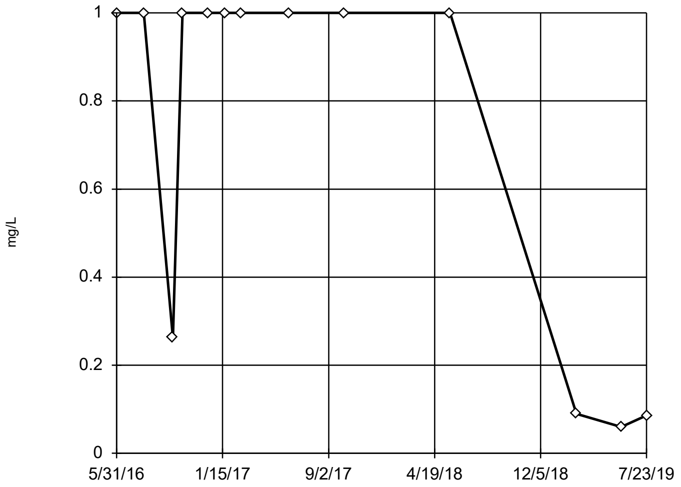
High cutoff = 6.403, low cutoff = 0.0841, based on IQR multiplier of 3.

Constituent: Fluoride, total   Analysis Run 11/20/2019 1:04 PM   View: Intrawell AIII
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-15



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

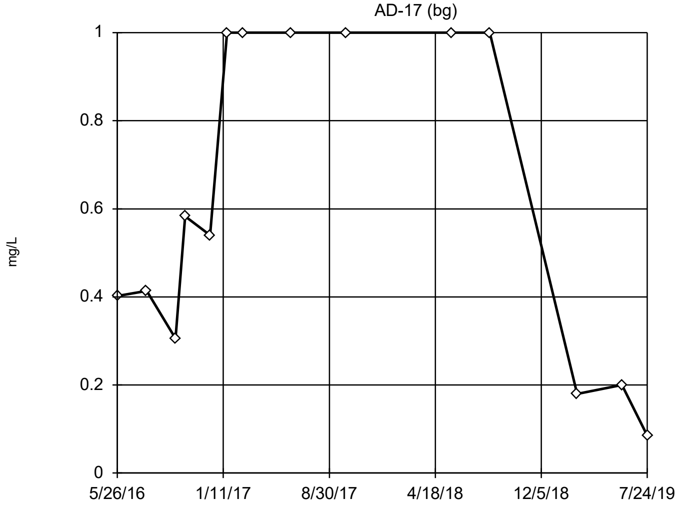
High cutoff = 276, low cutoff = 0.0005564, based on IQR multiplier of 3.

Constituent: Fluoride, total   Analysis Run 11/20/2019 1:04 PM   View: Intrawell AIII
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-17 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

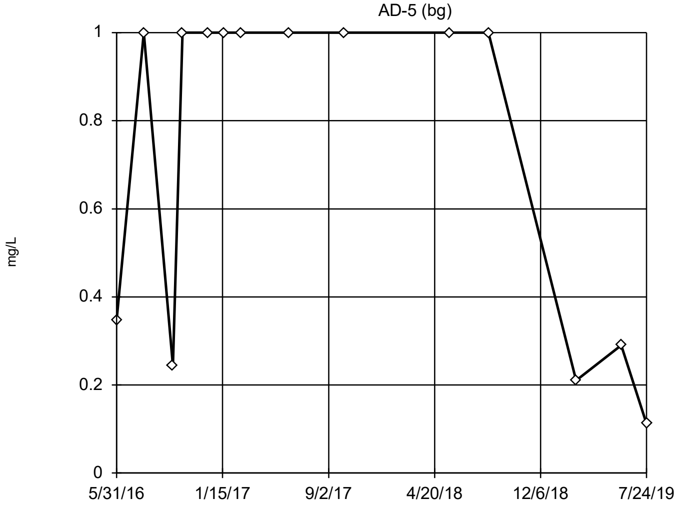
High cutoff = 9.428, low cutoff = -0.113, based on IQR multiplier of 3.

Constituent: Fluoride, total   Analysis Run 11/20/2019 1:04 PM   View: Intrawell AIII
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-5 (bg)



n = 14

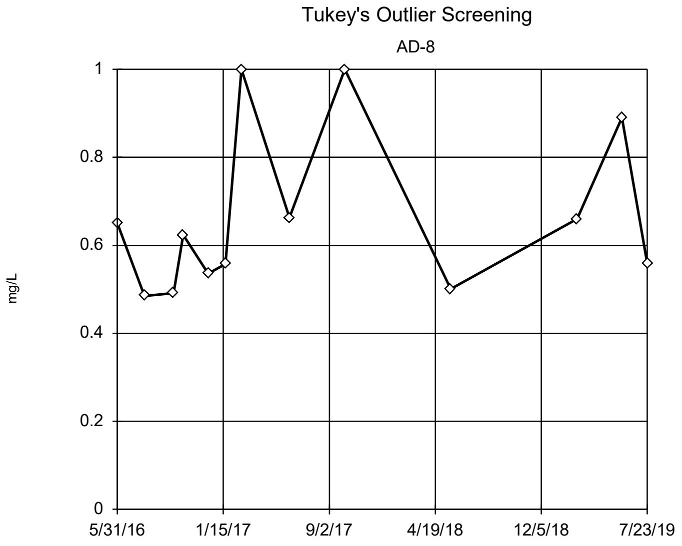
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 53.26, low cutoff = 0.004991, based on IQR multiplier of 3.

Constituent: Fluoride, total   Analysis Run 11/20/2019 1:04 PM   View: Intrawell AIII
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 13

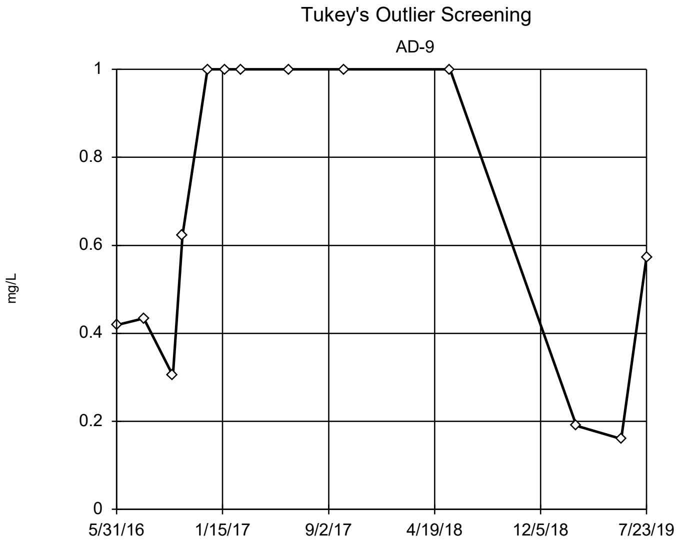
No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2.504, low cutoff = 0.1589, based on IQR multiplier of 3.

Constituent: Fluoride, total   Analysis Run 11/20/2019 1:04 PM   View: Intrawell AIII
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 13

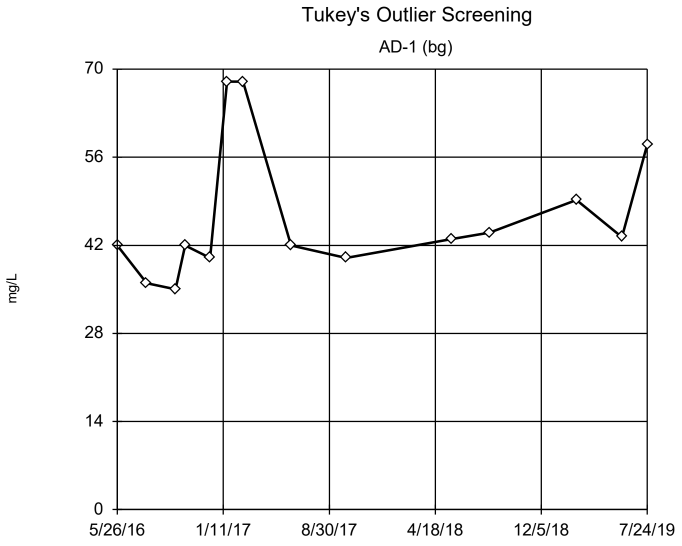
No outliers found.
Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 6.527, low cutoff = -0.003982, based on IQR multiplier of 3.

Constituent: Fluoride, total   Analysis Run 11/20/2019 1:04 PM   View: Intrawell AIII
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 14

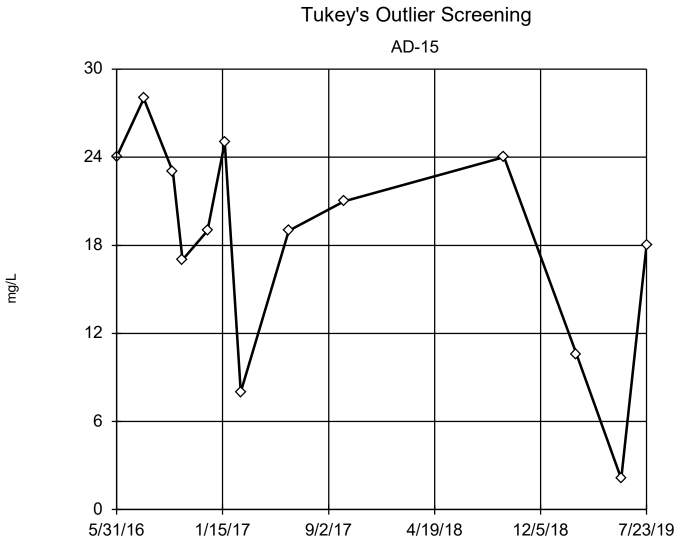
No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 127.2, low cutoff = 16.79, based on IQR multiplier of 3.

Constituent: Sulfate, total   Analysis Run 11/20/2019 1:04 PM   View: Intrawell AIII
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 13

No outliers found.
Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

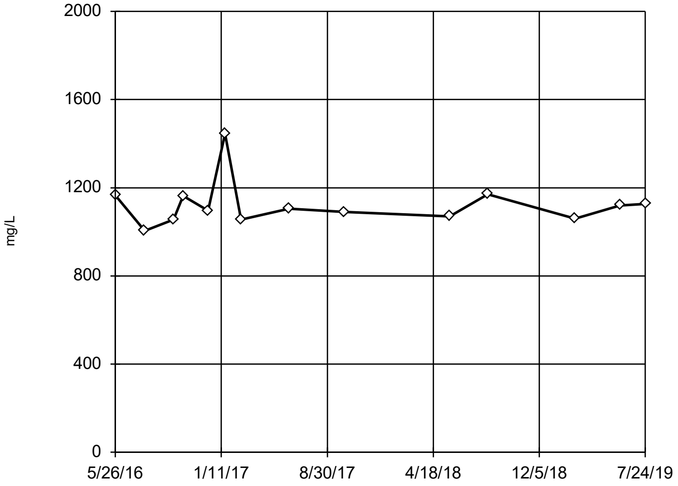
High cutoff = 41.25, low cutoff = -30.42, based on IQR multiplier of 3.

Constituent: Sulfate, total   Analysis Run 11/20/2019 1:04 PM   View: Intrawell AIII
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-17 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

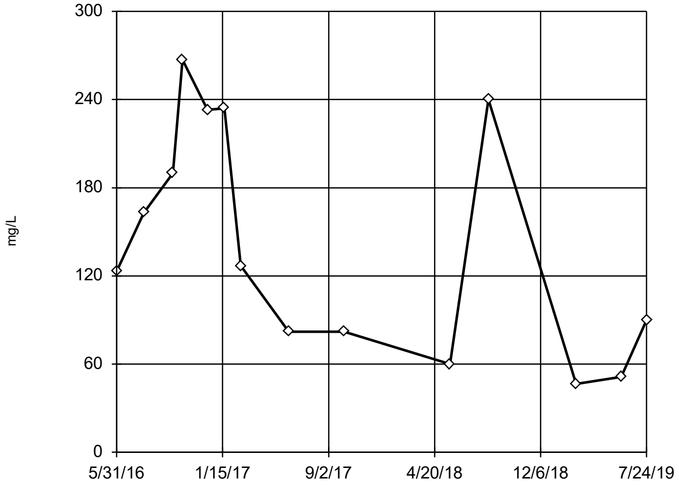
High cutoff = 1555, low cutoff = 792, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/20/2019 1:05 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-5 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

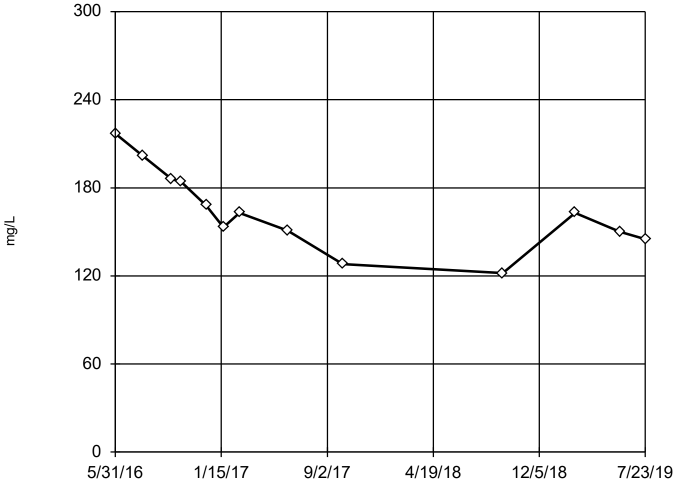
High cutoff = 8614, low cutoff = 1.901, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/20/2019 1:05 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-8



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

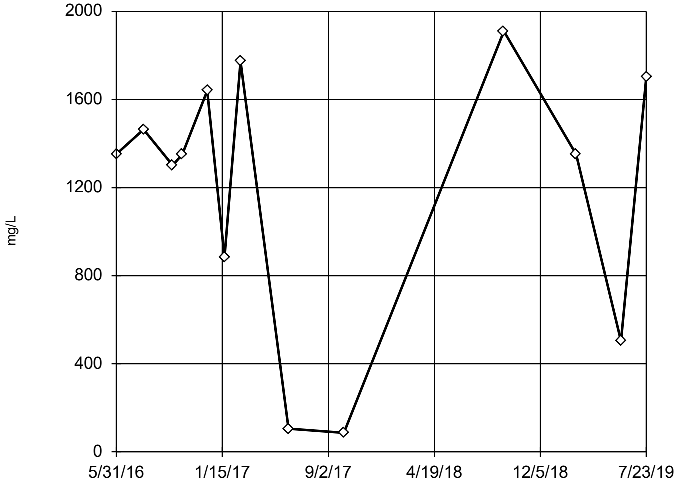
High cutoff = 365.2, low cutoff = 74.72, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/20/2019 1:05 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-9



n = 13

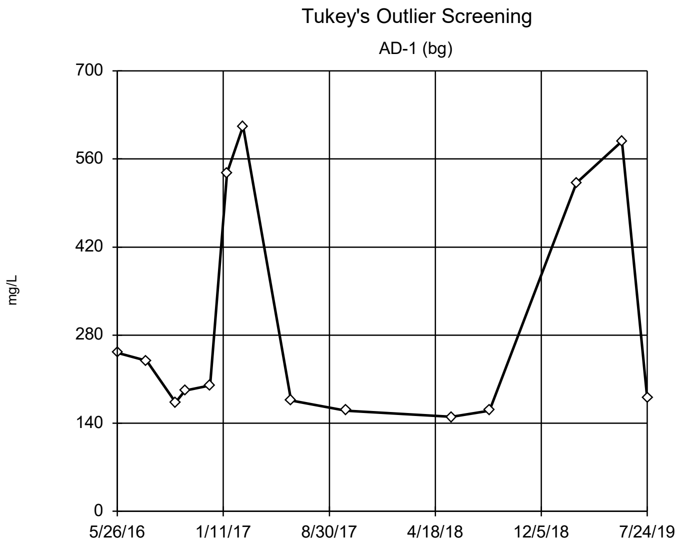
No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 3100, low cutoff = -2510, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/20/2019 1:05 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 14

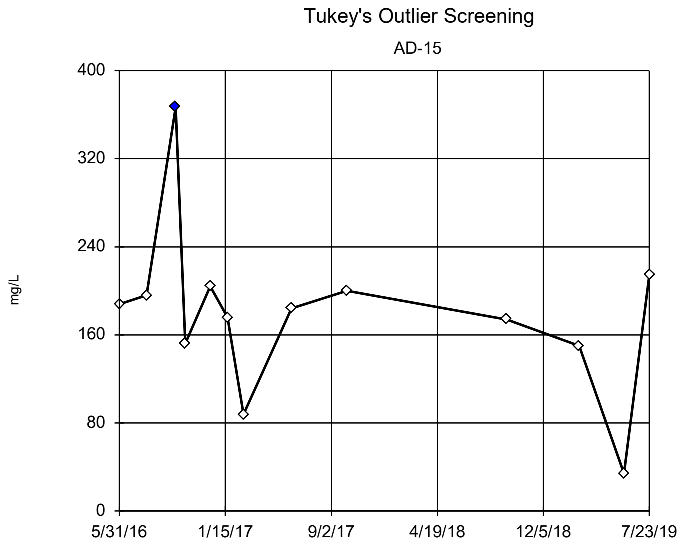
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 17126, low cutoff = 5.148, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/20/2019 1:05 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 13

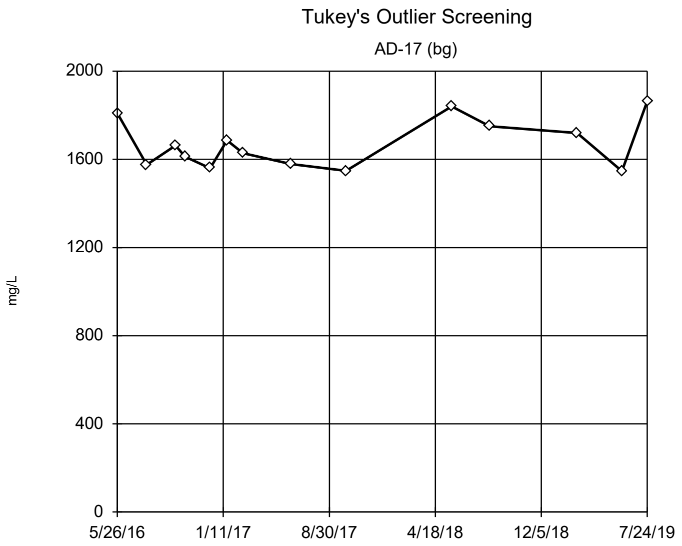
Outlier is drawn as solid. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 355, low cutoff = -2, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/20/2019 1:05 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 14

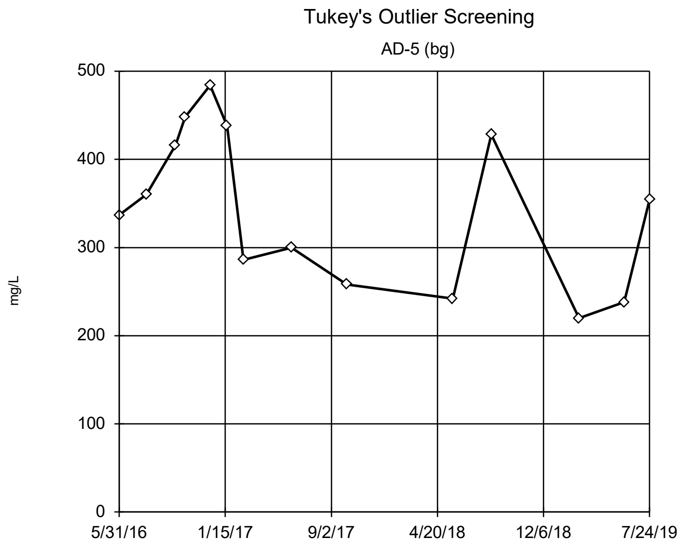
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2603, low cutoff = 1072, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/20/2019 1:05 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



n = 14

No outliers found. Tukey's method selected by user.

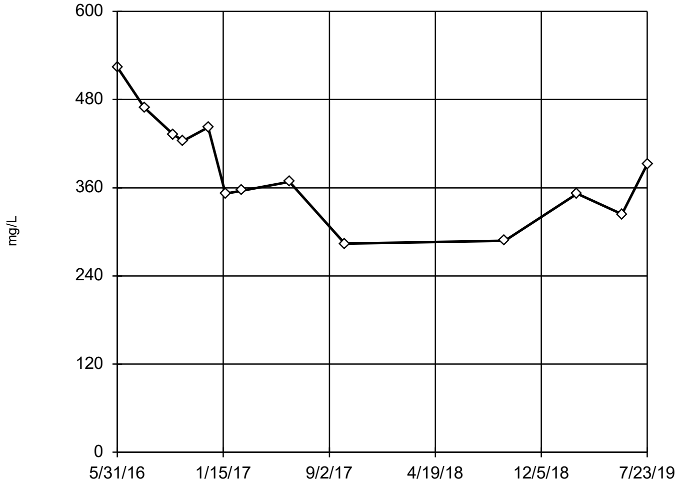
Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1282, low cutoff = 0.6602, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/20/2019 1:05 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Tukey's Outlier Screening

AD-8



n = 13

No outliers found.
Tukey's method selected by user.

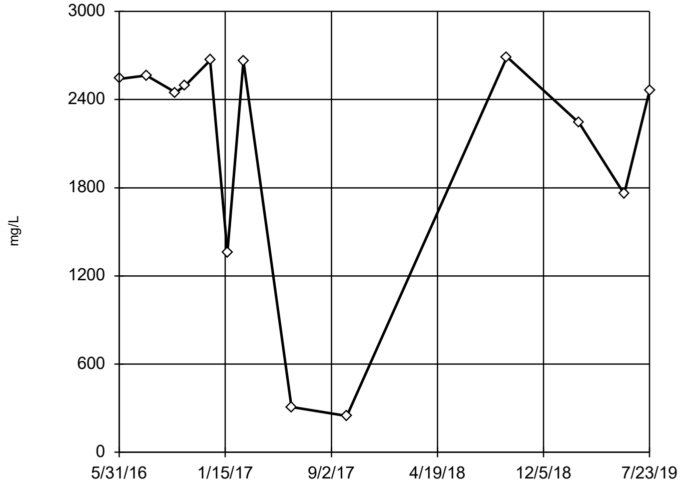
Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 846.7, low cutoff = 132.1, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/20/2019 1:05 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Tukey's Outlier Screening

AD-9



n = 13

No outliers found.
Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 3272, low cutoff = -3100, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/20/2019 1:05 PM View: Intrawell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Mann-Whitney - Significant Results

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP   Printed 12/8/2019, 4:18 PM

Constituent	Well	Calc.	0.01	Sig.	Method
Chloride, total (mg/L)	**AD-5 (bg)**	**2.589**	**Yes**	**Yes**	**Mann-W**

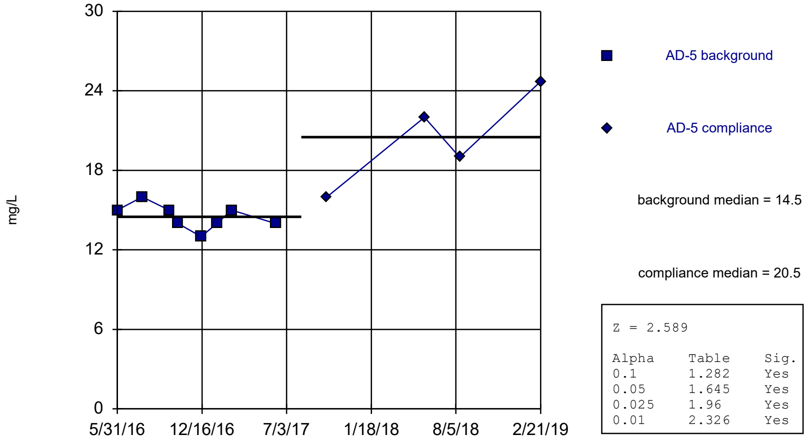
Mann-Whitney - All Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 12/8/2019, 4:18 PM

Constituent	Well	Calc.	0.01	Sig.	Method
Calcium, total (mg/L)	AD-1 (bg)	-1.274	No	No	Mann-W
Calcium, total (mg/L)	AD-17 (bg)	-0.9358	No	No	Mann-W
Calcium, total (mg/L)	AD-5 (bg)	-2.123	No	No	Mann-W
Calcium, total (mg/L)	AD-15	-2.74	No	No	Mann-W
Calcium, total (mg/L)	AD-8	-2.127	No	No	Mann-W
Calcium, total (mg/L)	AD-9	-1.444	No	No	Mann-W
Chloride, total (mg/L)	AD-1 (bg)	-1.051	No	No	Mann-W
Chloride, total (mg/L)	AD-17 (bg)	1.366	No	No	Mann-W
Chloride, total (mg/L)	**AD-5 (bg)**	**2.589**	**Yes**	**Yes**	**Mann-W**
Chloride, total (mg/L)	AD-15	1.23	No	No	Mann-W
Chloride, total (mg/L)	AD-8	-1.64	No	No	Mann-W
Chloride, total (mg/L)	AD-9	0.5115	No	No	Mann-W
Fluoride, total (mg/L)	AD-1 (bg)	-1.591	No	No	Mann-W
Fluoride, total (mg/L)	AD-17 (bg)	0.5439	No	No	Mann-W
Fluoride, total (mg/L)	AD-5 (bg)	-0.3344	No	No	Mann-W
Fluoride, total (mg/L)	AD-15	-1.06	No	No	Mann-W
Fluoride, total (mg/L)	AD-8	0.6138	No	No	Mann-W
Fluoride, total (mg/L)	AD-9	-0.1113	No	No	Mann-W
Sulfate, total (mg/L)	AD-1 (bg)	0.6866	No	No	Mann-W
Sulfate, total (mg/L)	AD-17 (bg)	-0.08507	No	No	Mann-W
Sulfate, total (mg/L)	AD-5 (bg)	-1.531	No	No	Mann-W
Sulfate, total (mg/L)	AD-15	-0.4101	No	No	Mann-W
Sulfate, total (mg/L)	AD-8	-2.046	No	No	Mann-W
Sulfate, total (mg/L)	AD-9	-0.2046	No	No	Mann-W
Total Dissolved Solids (mg/L)	AD-1 (bg)	-1.786	No	No	Mann-W
Total Dissolved Solids (mg/L)	AD-17 (bg)	0.9341	No	No	Mann-W
Total Dissolved Solids (mg/L)	AD-5 (bg)	-1.953	No	No	Mann-W
Total Dissolved Solids (mg/L)	AD-15	-0.4558	No	No	Mann-W
Total Dissolved Solids (mg/L)	AD-8	-2.455	No	No	Mann-W
Total Dissolved Solids (mg/L)	AD-9	-0.5103	No	No	Mann-W

Mann-Whitney (Wilcoxon Rank Sum)

AD-5 (bg)



```
Z = 2.589

Alpha    Table    Sig.
0.1      1.282    Yes
0.05     1.645    Yes
0.025    1.96     Yes
0.01     2.326    Yes
```

Constituent: Chloride, total Analysis Run 12/8/2019 4:15 PM View: Mann Whitney
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Intrawell Prediction Limit Summary

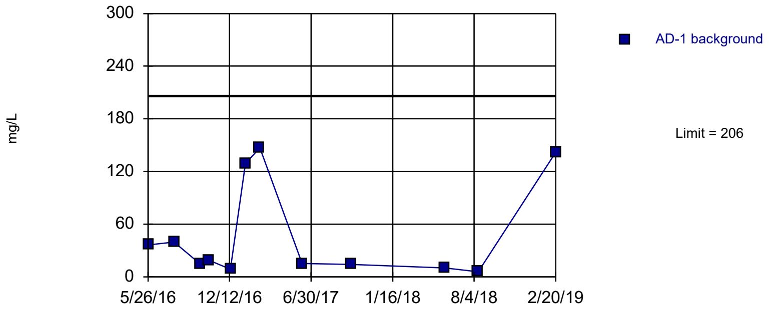
Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 12/8/2019, 4:24 PM

Constituent	Well	Upper Lim.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Calcium, total (mg/L)	AD-1	206	n/a	12	3.196	1.283	0	None	x^(1/3)	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-17	206.7	n/a	12	193.3	6.384	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-5	58.47	n/a	12	41.36	8.1	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-15	5.395	n/a	11	3.563	0.8426	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-8	32.4	n/a	12	21.24	5.284	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-9	298.7	n/a	12	42241	22241	0	None	x^2	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-1	9	n/a	12	n/a	n/a	0	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Chloride, total (mg/L)	AD-17	45.62	n/a	12	35.02	5.02	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-5	24.25	n/a	12	4.039	0.4191	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-15	38.76	n/a	11	28.93	4.523	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-8	35.47	n/a	11	25.65	4.511	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-9	138.2	n/a	11	73.73	29.65	0	None	No	0.002505	Param Intra 1 of 2
Fluoride, total (mg/L)	AD-1	1	n/a	12	n/a	n/a	91.67	n/a	n/a	0.01077	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	AD-17	0.7482	n/a	12	0.6254	0.1134	50	Kaplan-Meier	sqrt(x)	0.002505	Param Intra 1 of 2
Fluoride, total (mg/L)	AD-5	1	n/a	12	n/a	n/a	75	n/a	n/a	0.01077	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	AD-15	1	n/a	11	n/a	n/a	81.82	n/a	n/a	0.01276	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	AD-8	0.7368	n/a	11	0.7562	0.04695	18.18	Kaplan-Meier	sqrt(x)	0.002505	Param Intra 1 of 2
Fluoride, total (mg/L)	AD-9	1	n/a	11	n/a	n/a	54.55	n/a	n/a	0.01276	NP Intra (NDs) 1 of 2
Sulfate, total (mg/L)	AD-1	70.37	n/a	12	3.801	0.2145	0	None	ln(x)	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-17	1445	n/a	12	n/a	n/a	0	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Sulfate, total (mg/L)	AD-5	318.3	n/a	12	154	77.83	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-15	33.18	n/a	11	19.87	6.117	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-8	230.1	n/a	11	167	28.99	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-9	2527	n/a	11	1201	609.4	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-1	612	n/a	12	n/a	n/a	0	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Total Dissolved Solids (mg/L)	AD-17	1872	n/a	12	1664	98.5	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-5	542	n/a	12	351.4	90.26	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-15	248.5	n/a	10	171.2	34.54	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-8	552.8	n/a	11	390.1	74.83	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-9	3070	n/a	11	1.2e10	7.7e9	0	None	x^3	0.002505	Param Intra 1 of 2

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



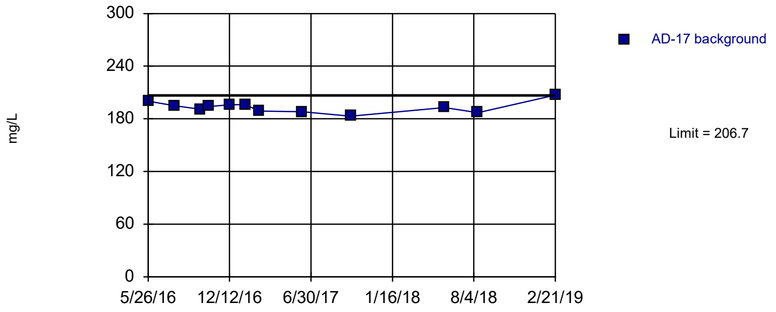
Background Data Summary (based on cube root transformation): Mean=3.196, Std. Dev.=1.283, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8246, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



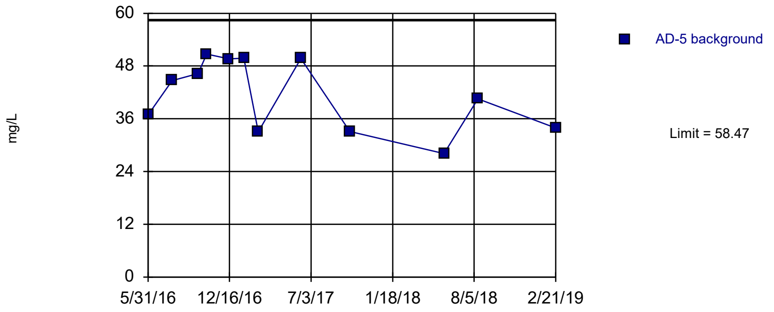
Background Data Summary: Mean=193.3, Std. Dev.=6.384, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9698, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



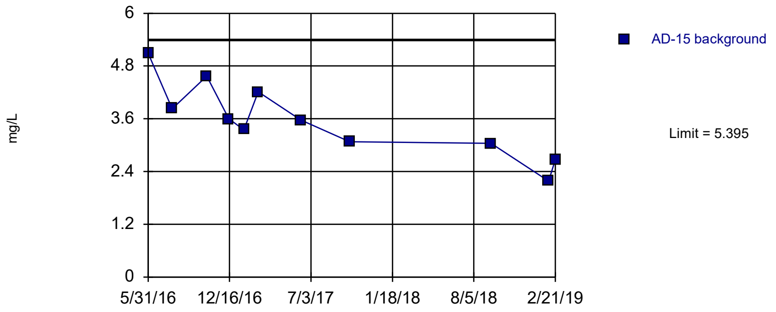
Background Data Summary: Mean=41.36, Std. Dev.=8.1, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8897, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-15



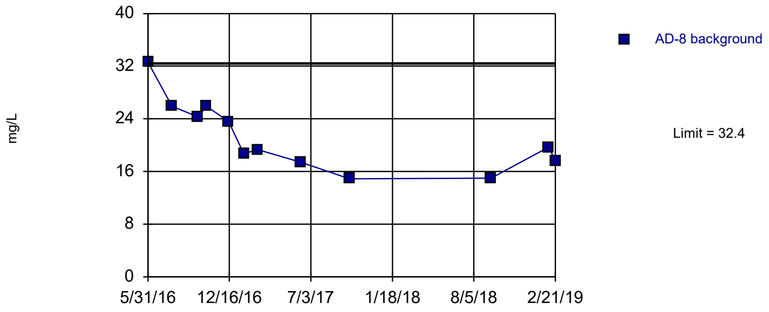
Background Data Summary: Mean=3.563, Std. Dev.=0.8426, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9882, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-8



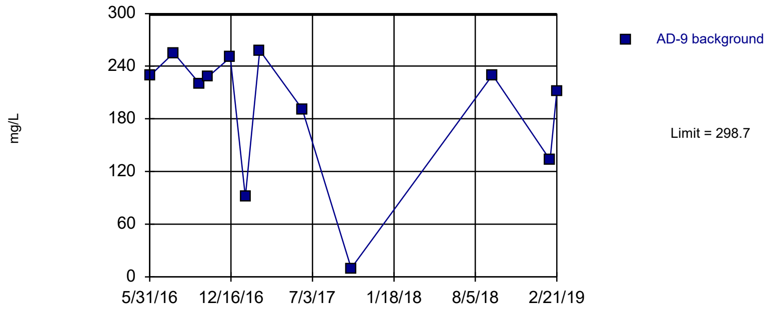
Background Data Summary: Mean=21.24, Std. Dev.=5.284, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.923, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-9



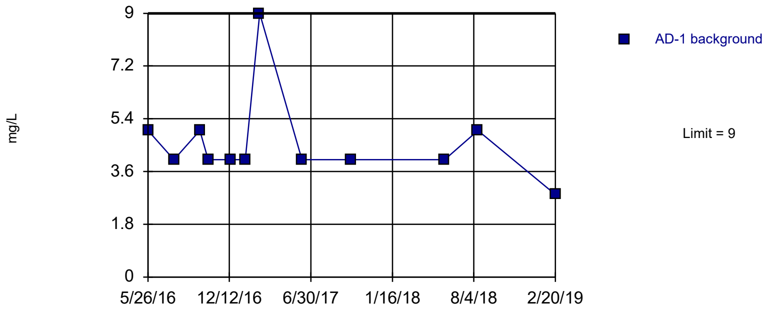
Background Data Summary (based on square transformation): Mean=42241, Std. Dev.=22241, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8804, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, AD-1 (bg)



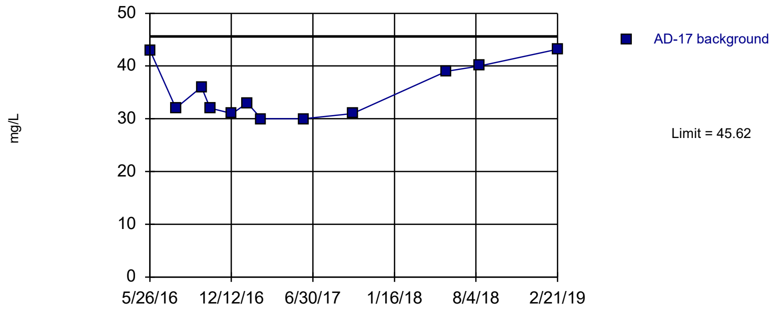
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



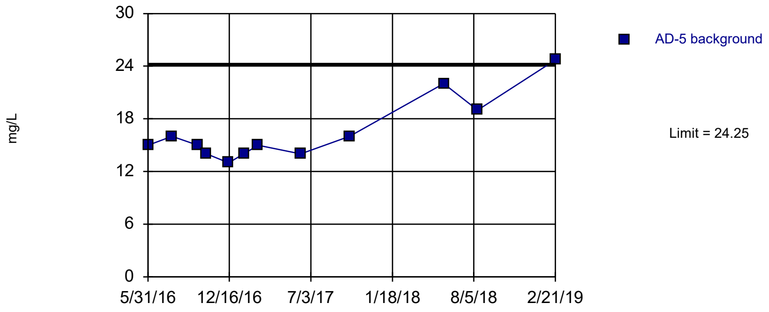
Background Data Summary: Mean=35.02, Std. Dev.=5.02, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8477, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



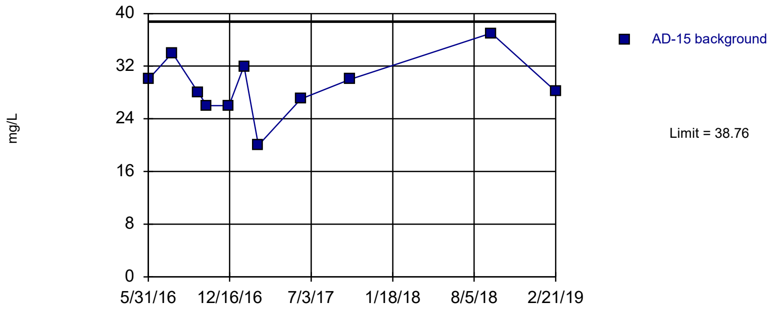
Background Data Summary (based on square root transformation): Mean=4.039, Std. Dev.=0.4191, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8217, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-15



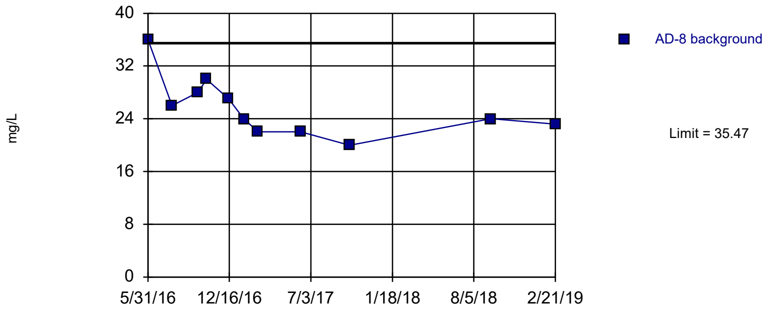
Background Data Summary: Mean=28.93, Std. Dev.=4.523, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9714, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-8



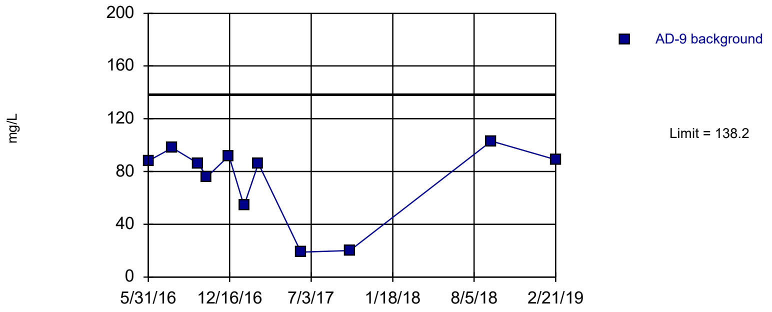
Background Data Summary: Mean=25.65, Std. Dev.=4.511, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9157, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-9



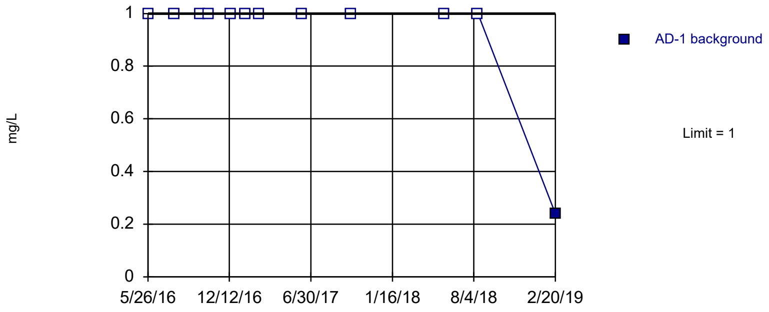
Background Data Summary: Mean=73.73, Std. Dev.=29.65, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7926, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-1 (bg)



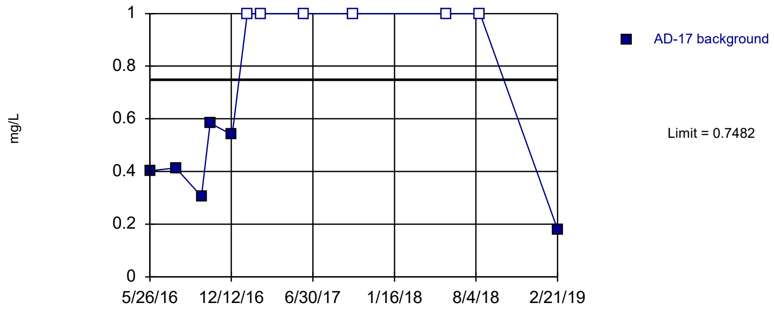
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 12 background values. 91.67% NDs. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-17 (bg)



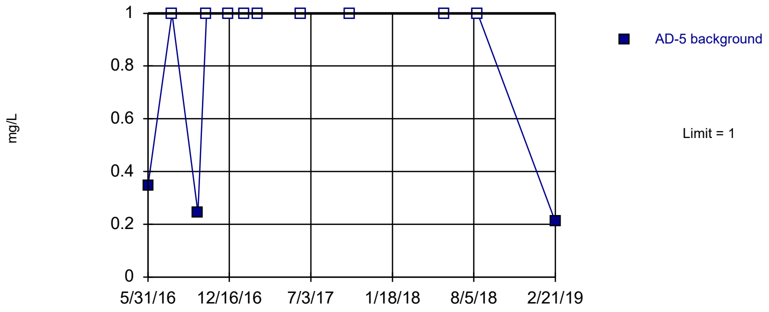
Background Data Summary (based on square root transformation) (after Kaplan-Meier Adjustment): Mean=0.6254, Std. Dev.=0.1134, n=12, 50% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8173, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-5 (bg)



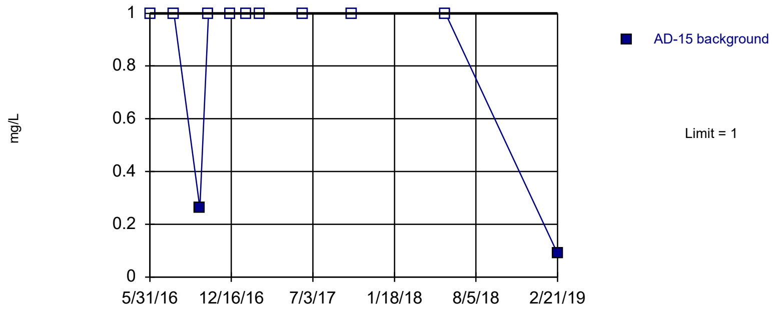
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 12 background values. 75% NDs. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-15



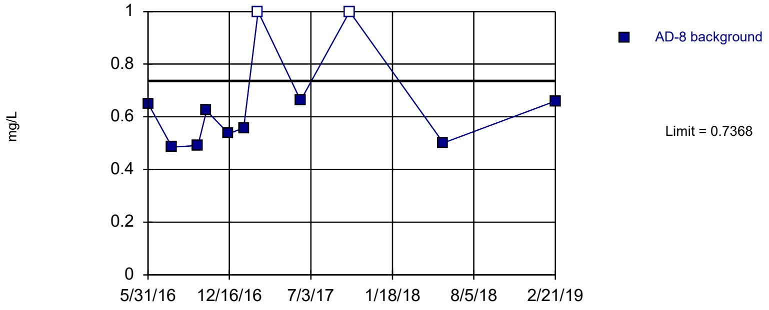
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 11 background values. 81.82% NDs. Well-constituent pair annual alpha = 0.02537. Individual comparison alpha = 0.01276 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-8



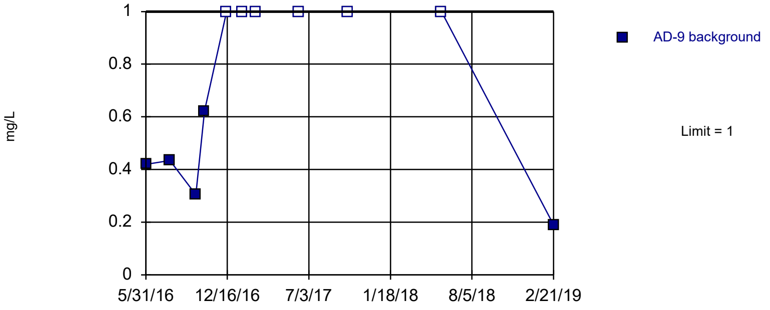
Background Data Summary (based on square root transformation) (after Kaplan-Meier Adjustment): Mean=0.7562, Std. Dev.=0.04695, n=11, 18.18% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8152, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-9



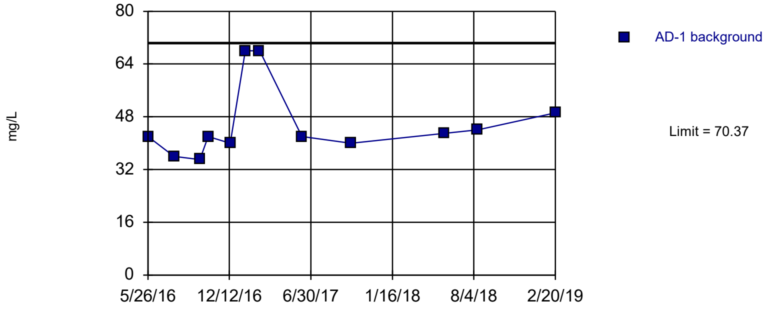
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 11 background values. 54.55% NDs. Well-constituent pair annual alpha = 0.02537. Individual comparison alpha = 0.01276 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/8/2019 4:22 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



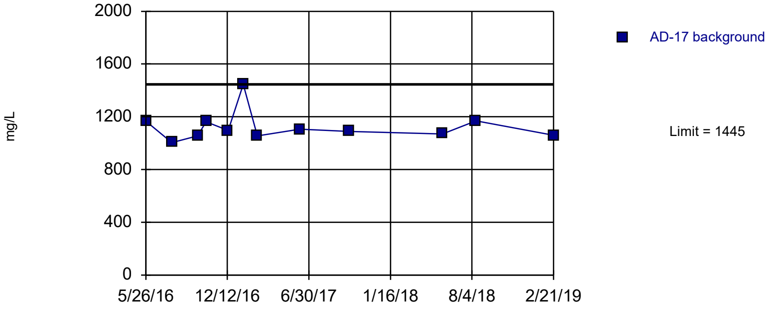
Background Data Summary (based on natural log transformation): Mean=3.801, Std. Dev.=0.2145, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.812, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/8/2019 4:23 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, AD-17 (bg)



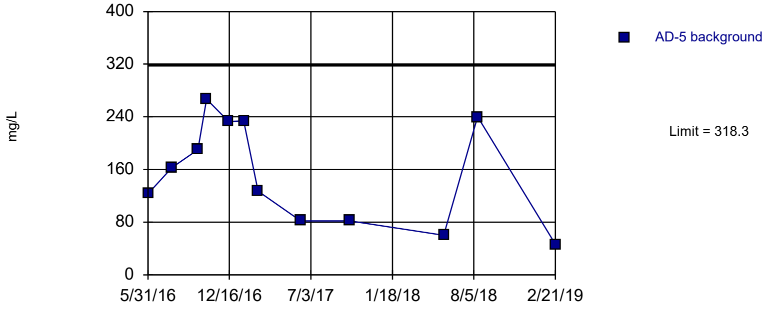
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/8/2019 4:23 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



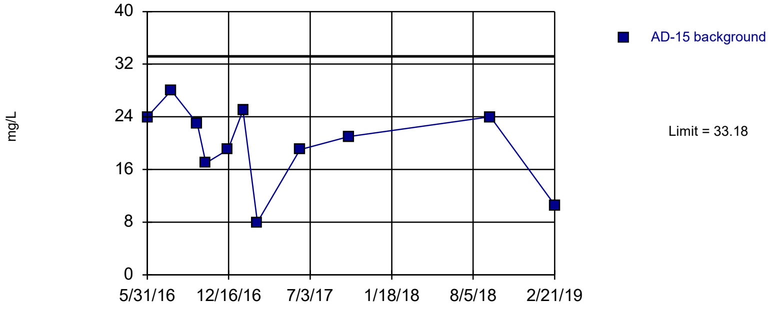
Background Data Summary: Mean=154, Std. Dev.=77.83, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.919, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/8/2019 4:23 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-15



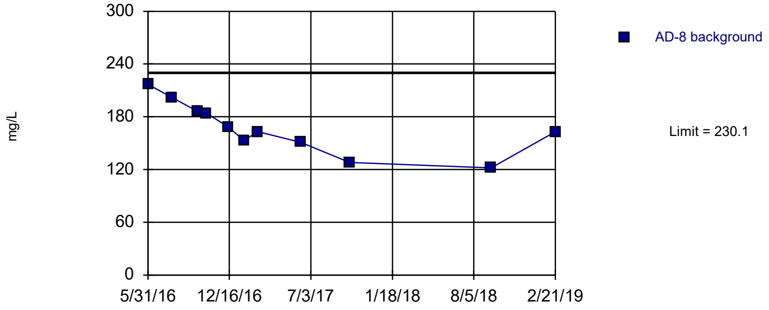
Background Data Summary: Mean=19.87, Std. Dev.=6.117, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9196, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/8/2019 4:23 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-8



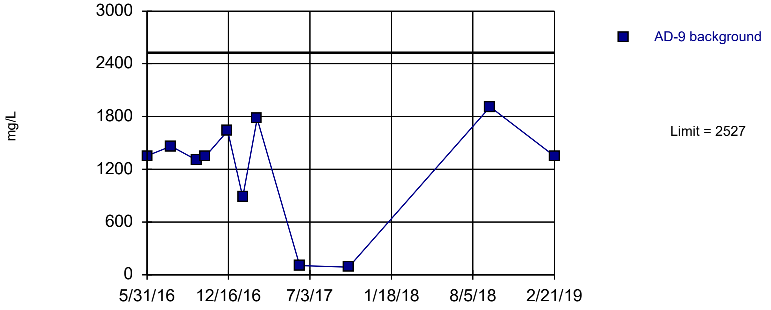
Background Data Summary: Mean=167, Std. Dev.=28.99, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9728, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/8/2019 4:23 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-9



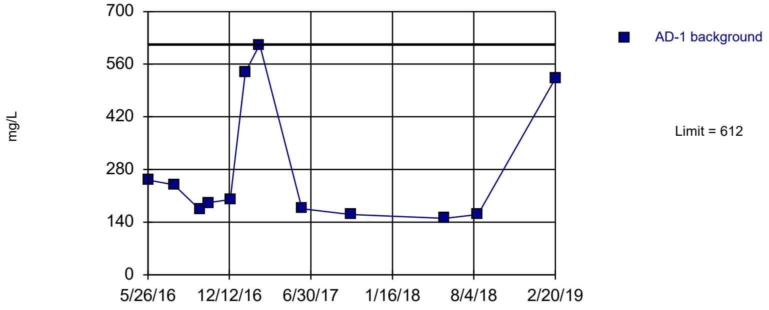
Background Data Summary: Mean=1201, Std. Dev.=609.4, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8425, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/8/2019 4:23 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, AD-1 (bg)



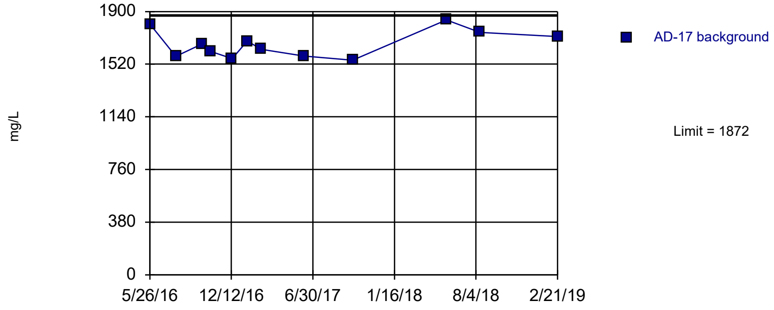
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 12/8/2019 4:23 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



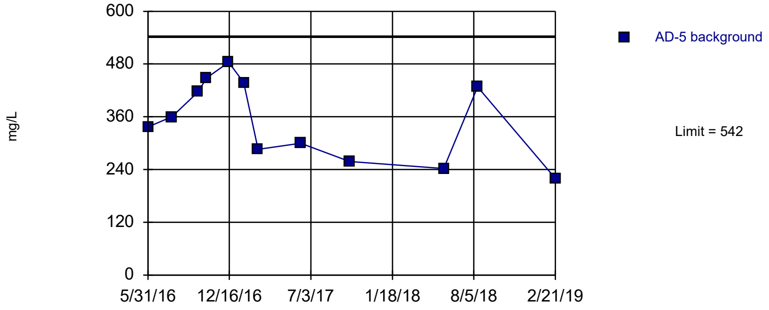
Background Data Summary: Mean=1664, Std. Dev.=98.5, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9253, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 12/8/2019 4:23 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



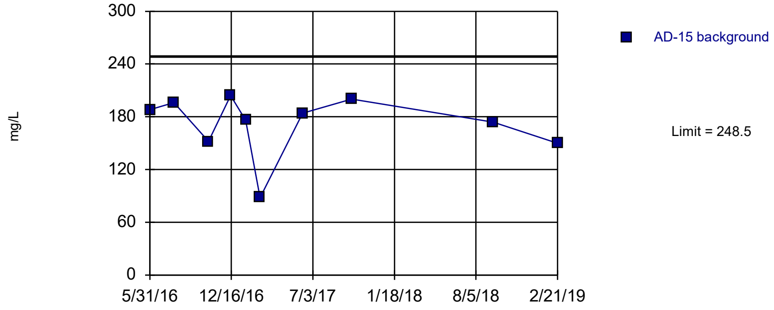
Background Data Summary: Mean=351.4, Std. Dev.=90.26, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9333, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 12/8/2019 4:23 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-15

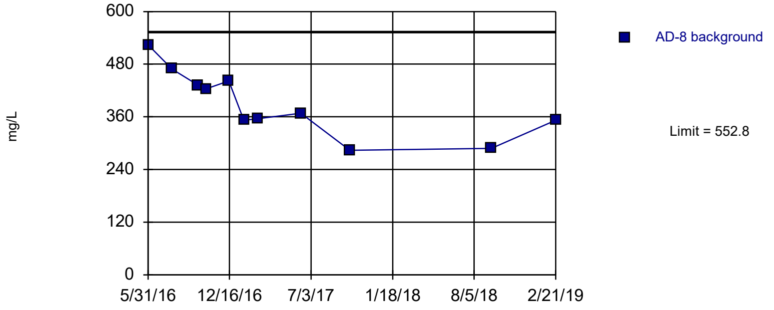


Background Data Summary: Mean=171.2, Std. Dev.=34.54, n=10. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8313, critical = 0.781. Kappa = 2.238 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 12/8/2019 4:23 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Prediction Limit

Intrawell Parametric, AD-8

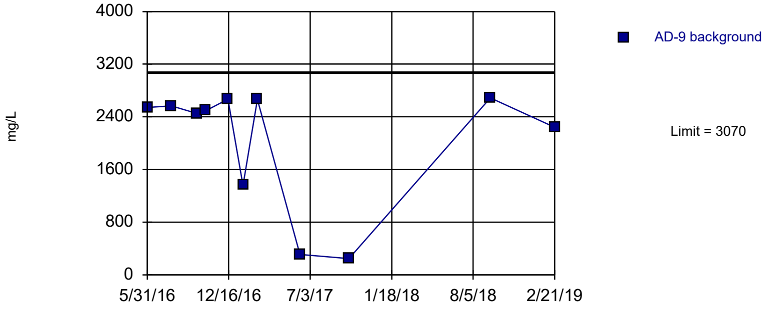


Background Data Summary: Mean=390.1, Std. Dev.=74.83, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9524, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 12/8/2019 4:23 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Prediction Limit

Intrawell Parametric, AD-9



Background Data Summary (based on cube transformation): Mean=1.2e10, Std. Dev.=7.7e9, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8038, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 12/8/2019 4:23 PM View: PL's - Intrawell
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Trend Test Summary Table - All Results (No Significant)

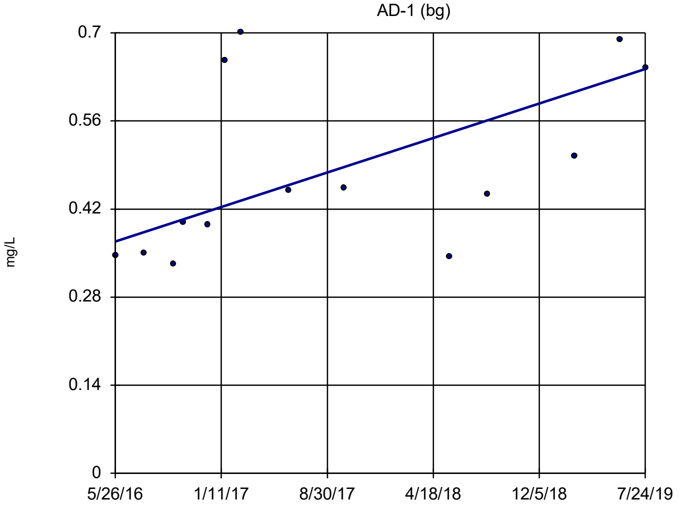
Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 11/22/2019, 8:13 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	AD-1 (bg)	0.08662	41	48	No	14	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-17 (bg)	0.01085	21	48	No	14	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-5 (bg)	0	3	48	No	14	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-1 (bg)	0.02509	8	48	No	14	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-17 (bg)	-0.05848	-9	-48	No	14	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-5 (bg)	0.07449	23	48	No	14	0	n/a	n/a	0.01	NP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-1 (bg)



n = 14

Slope = 0.08662
units per year.

Mann-Kendall
statistic = 41
critical = 48

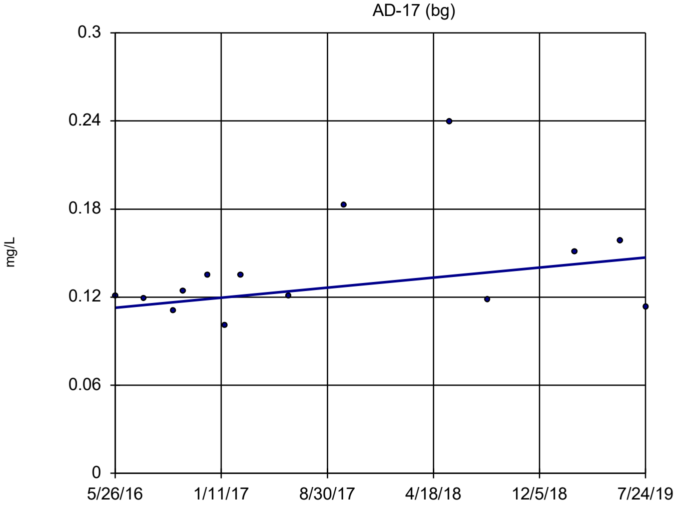
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 11/22/2019 8:12 PM View: Interwell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-17 (bg)



n = 14

Slope = 0.01085
units per year.

Mann-Kendall
statistic = 21
critical = 48

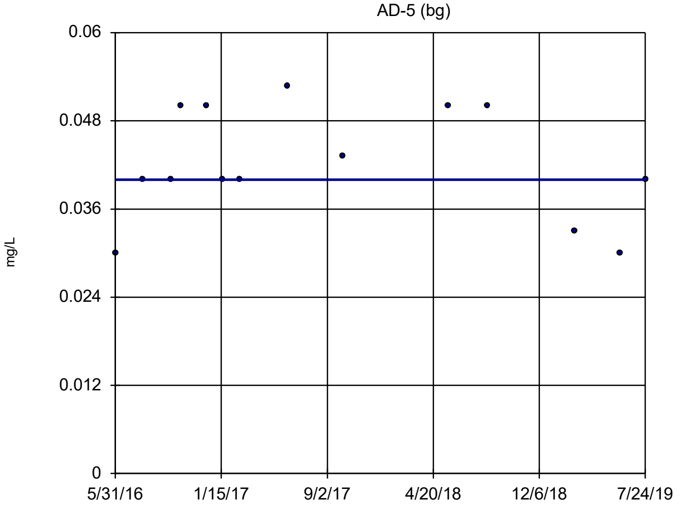
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 11/22/2019 8:12 PM View: Interwell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-5 (bg)



n = 14

Slope = 0
units per year.

Mann-Kendall
statistic = 3
critical = 48

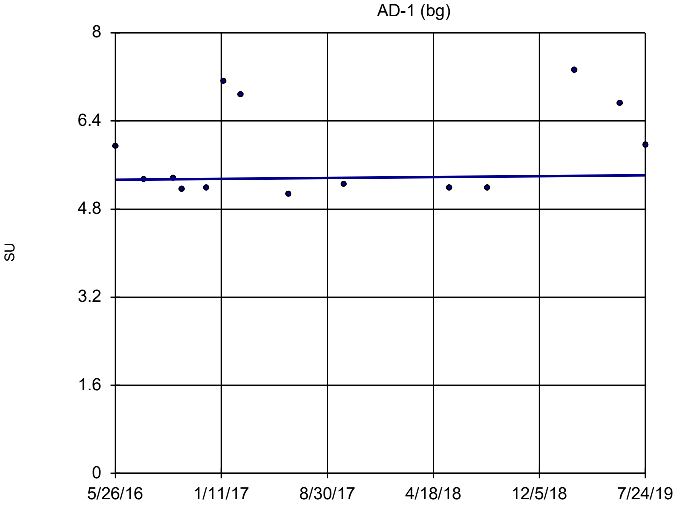
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 11/22/2019 8:13 PM View: Interwell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-1 (bg)



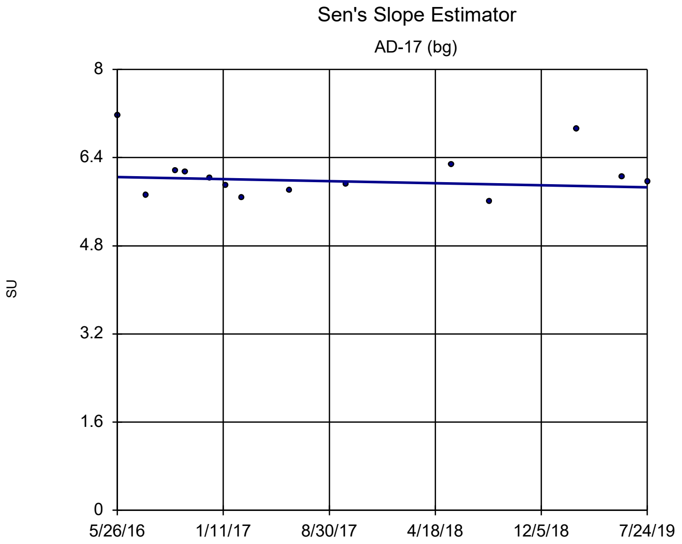
n = 14

Slope = 0.02509
units per year.

Mann-Kendall
statistic = 8
critical = 48

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field Analysis Run 11/22/2019 8:13 PM View: Interwell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP



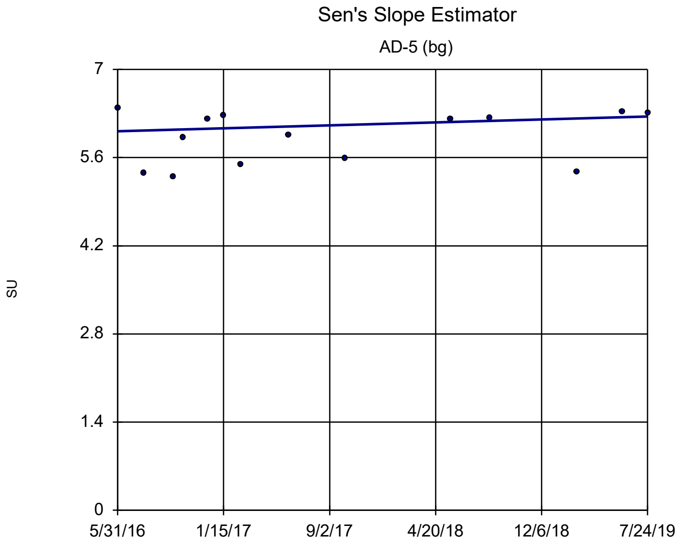
n = 14

Slope = -0.05848 units per year.

Mann-Kendall statistic = -9 critical = -48

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field Analysis Run 11/22/2019 8:13 PM View: Interwell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP



n = 14

Slope = 0.07449 units per year.

Mann-Kendall statistic = 23 critical = 48

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field Analysis Run 11/22/2019 8:13 PM View: Interwell AIII
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Interwell Prediction Limit Summary

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 12/8/2019, 4:25 PM

Constituent	Well	Upper Lim.	Lower Lim.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	n/a	0.7	n/a	n/a	36	n/a	n/a	0	n/a	n/a	0.001409	NP (normality) 1 of 2
pH, field (SU)	n/a	6.995	4.816	n/a	36	5.906	0.6169	0	None	No	0.001253	Param 1 of 2

Upper Tolerance Limits - Appendix IV

Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP   Printed 11/22/2019, 8:15 PM

Constituent	Well	Upper Lim.	Date	Observ.	Sig.	Bg N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	n/a	0.005	n/a	n/a	n/a	39	71.79	n/a	0.1353	NP Inter(normal...
Arsenic, total (mg/L)	n/a	0.005	n/a	n/a	n/a	39	48.72	n/a	0.1353	NP Inter(normal...
Barium, total (mg/L)	n/a	0.6226	n/a	n/a	n/a	39	0	ln(x)	0.05	Inter
Beryllium, total (mg/L)	n/a	0.0007877	n/a	n/a	n/a	39	10.26	x^(1/3)	0.05	Inter
Cadmium, total (mg/L)	n/a	0.00367	n/a	n/a	n/a	39	30.77	x^(1/3)	0.05	Inter
Chromium, total (mg/L)	n/a	0.004	n/a	n/a	n/a	38	23.68	n/a	0.1424	NP Inter(normal...
Cobalt, total (mg/L)	n/a	0.0748	n/a	n/a	n/a	39	0	n/a	0.1353	NP Inter(normal...
Combined Radium 226 + 228 (pCi/L)	n/a	4.113	n/a	n/a	n/a	39	0	No	0.05	Inter
Fluoride, total (mg/L)	n/a	1	n/a	n/a	n/a	42	64.29	n/a	0.116	NP Inter(normal...
Lead, total (mg/L)	n/a	0.005	n/a	n/a	n/a	39	69.23	n/a	0.1353	NP Inter(normal...
Lithium, total (mg/L)	n/a	0.394	n/a	n/a	n/a	39	2.564	n/a	0.1353	NP Inter(normal...
Mercury, total (mg/L)	n/a	0.000033	n/a	n/a	n/a	39	53.85	n/a	0.1353	NP Inter(normal...
Molybdenum, total (mg/L)	n/a	0.005	n/a	n/a	n/a	39	69.23	n/a	0.1353	NP Inter(normal...
Selenium, total (mg/L)	n/a	0.005	n/a	n/a	n/a	39	41.03	n/a	0.1353	NP Inter(normal...
Thallium, total (mg/L)	n/a	0.002	n/a	n/a	n/a	39	89.74	n/a	0.1353	NP Inter(NDs)

Confidence Interval Summary Table - Significant Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 11/22/2019, 8:31 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Lithium, total (mg/L)	**AD-9**	**1.33**	**0.9164**	**0.39**	**Yes**	**13**	**0**	**x^2**	**0.01**	**Param.**

Confidence Interval Summary Table - All Results

Welsh PBAP Client: Geosyntec Data: Welsh PBAP Printed 11/22/2019, 8:31 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	AD-15	0.005	0.00005	0.006	No	13	76.92	No	0.01	NP (NDs)
Antimony, total (mg/L)	AD-8	0.005	0.0001	0.006	No	13	76.92	No	0.01	NP (NDs)
Antimony, total (mg/L)	AD-9	0.005	0.0001	0.006	No	13	92.31	No	0.01	NP (NDs)
Arsenic, total (mg/L)	AD-15	0.01211	0.002878	0.01	No	12	0	sqrt(x)	0.01	Param.
Arsenic, total (mg/L)	AD-8	0.005	0.00037	0.01	No	13	61.54	No	0.01	NP (normality)
Arsenic, total (mg/L)	AD-9	0.005	0.00118	0.01	No	13	69.23	No	0.01	NP (normality)
Barium, total (mg/L)	AD-15	0.2524	0.1048	2	No	12	0	sqrt(x)	0.01	Param.
Barium, total (mg/L)	AD-8	0.02819	0.02085	2	No	13	0	No	0.01	Param.
Barium, total (mg/L)	AD-9	0.04967	0.02686	2	No	13	0	ln(x)	0.01	Param.
Beryllium, total (mg/L)	AD-15	0.001332	0.0002516	0.004	No	12	0	No	0.01	Param.
Beryllium, total (mg/L)	AD-8	0.001	0.00002876	0.004	No	13	61.54	No	0.01	NP (normality)
Beryllium, total (mg/L)	AD-9	0.0009336	0.0003607	0.004	No	13	0	sqrt(x)	0.01	Param.
Cadmium, total (mg/L)	AD-15	0.0004524	0.00005473	0.005	No	12	8.333	sqrt(x)	0.01	Param.
Cadmium, total (mg/L)	AD-8	0.001	0.00002	0.005	No	13	69.23	No	0.01	NP (normality)
Cadmium, total (mg/L)	AD-9	0.001719	0.0002884	0.005	No	13	0	No	0.01	Param.
Chromium, total (mg/L)	AD-15	0.02417	0.002105	0.1	No	12	0	sqrt(x)	0.01	Param.
Chromium, total (mg/L)	AD-8	0.001525	0.0004025	0.1	No	13	38.46	No	0.01	Param.
Chromium, total (mg/L)	AD-9	0.001	0.0002622	0.1	No	13	61.54	No	0.01	NP (normality)
Cobalt, total (mg/L)	AD-15	0.01231	0.004507	0.075	No	12	0	sqrt(x)	0.01	Param.
Cobalt, total (mg/L)	AD-8	0.007254	0.004652	0.075	No	13	0	No	0.01	Param.
Cobalt, total (mg/L)	AD-9	0.0273	0.0146	0.075	No	13	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-15	2.969	1.505	5	No	12	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-8	1.81	0.5087	5	No	13	0	ln(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-9	2.656	1.672	5	No	13	0	No	0.01	Param.
Fluoride, total (mg/L)	AD-15	1	0.086	4	No	13	69.23	No	0.01	NP (normality)
Fluoride, total (mg/L)	AD-8	0.89	0.4912	4	No	13	15.38	No	0.01	NP (Cohens/xfrm)
Fluoride, total (mg/L)	AD-9	1	0.19	4	No	13	46.15	No	0.01	NP (normality)
Lead, total (mg/L)	AD-15	0.019	0.000438	0.015	No	12	16.67	No	0.01	NP (Cohens/xfrm)
Lead, total (mg/L)	AD-8	0.005	0.00007	0.015	No	13	69.23	No	0.01	NP (normality)
Lead, total (mg/L)	AD-9	0.005	0.00008	0.015	No	13	69.23	No	0.01	NP (normality)
Lithium, total (mg/L)	AD-15	0.02713	0.005433	0.39	No	13	0	ln(x)	0.01	Param.
Lithium, total (mg/L)	AD-8	0.1115	0.07781	0.39	No	13	0	No	0.01	Param.
Lithium, total (mg/L)	**AD-9**	**1.33**	**0.9164**	**0.39**	**Yes**	**13**	**0**	**x^2**	**0.01**	**Param.**
Mercury, total (mg/L)	AD-15	0.000081	0.00001932	0.002	No	11	18.18	No	0.006	NP (Cohens/xfrm)
Mercury, total (mg/L)	AD-8	0.000025	0.00000859	0.002	No	12	66.67	No	0.01	NP (normality)
Mercury, total (mg/L)	AD-9	0.00003859	0.00001278	0.002	No	12	41.67	No	0.01	Param.
Molybdenum, total (mg/L)	AD-15	0.006706	0.001625	0.1	No	13	46.15	No	0.01	Param.
Molybdenum, total (mg/L)	AD-8	0.005	0.0008389	0.1	No	13	69.23	No	0.01	NP (normality)
Molybdenum, total (mg/L)	AD-9	0.005	0.002	0.1	No	13	92.31	No	0.01	NP (NDs)
Selenium, total (mg/L)	AD-15	0.005	0.0009	0.05	No	12	16.67	No	0.01	NP (Cohens/xfrm)
Selenium, total (mg/L)	AD-8	0.005	0.00007	0.05	No	13	46.15	No	0.01	NP (normality)
Selenium, total (mg/L)	AD-9	0.006134	0.001092	0.05	No	13	30.77	No	0.01	Param.
Thallium, total (mg/L)	AD-15	0.002	0.0001	0.002	No	13	69.23	No	0.01	NP (normality)
Thallium, total (mg/L)	AD-8	0.002	0.000129	0.002	No	13	61.54	No	0.01	NP (normality)
Thallium, total (mg/L)	AD-9	0.002	0.0001	0.002	No	12	58.33	No	0.01	NP (normality)

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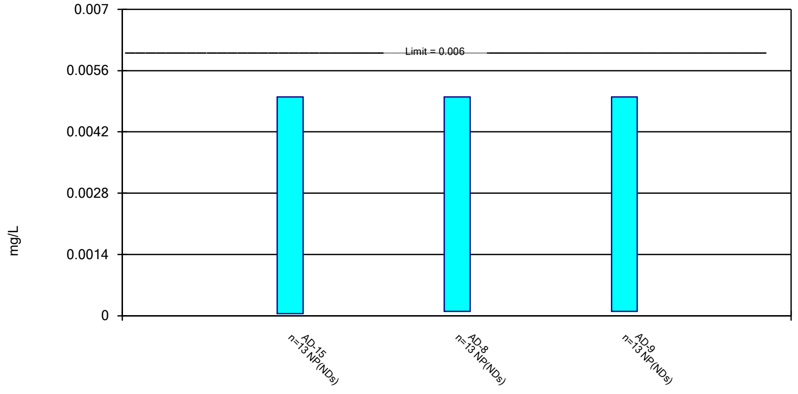
Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

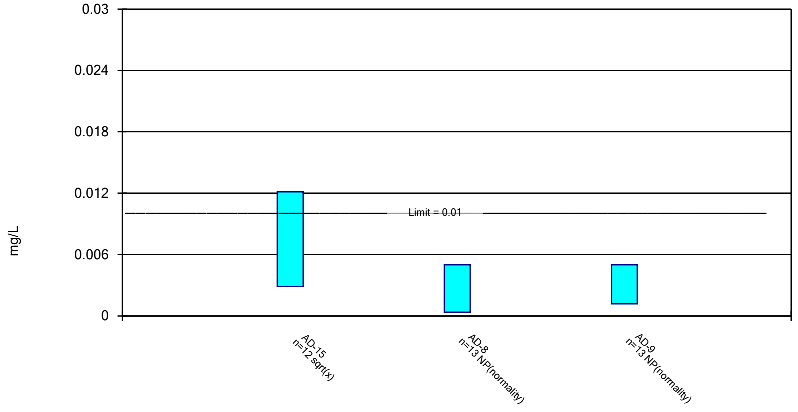


Constituent: Antimony, total   Analysis Run 11/22/2019 8:30 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

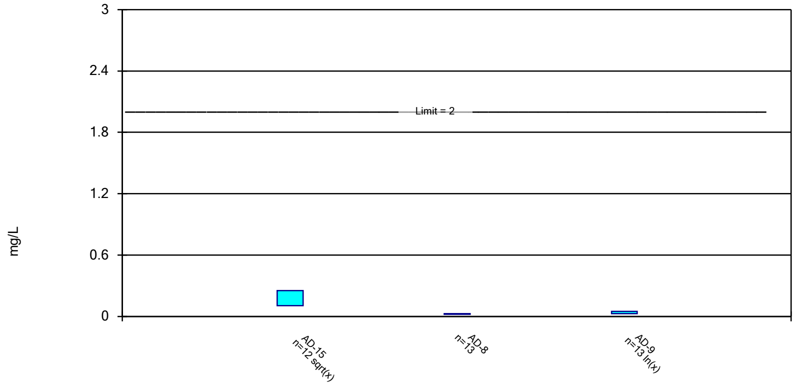


Constituent: Arsenic, total   Analysis Run 11/22/2019 8:30 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

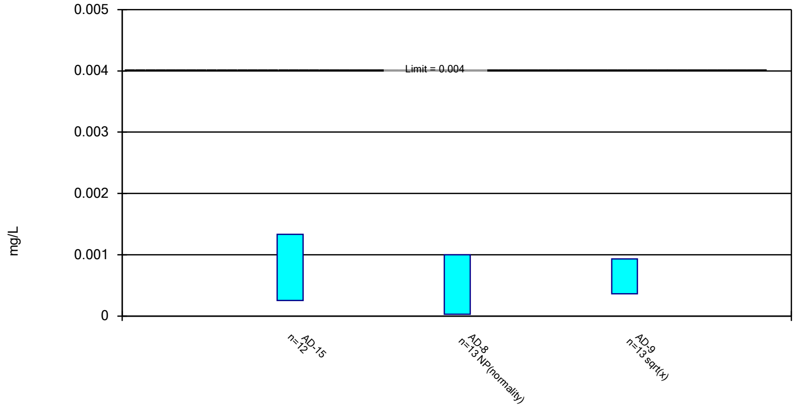


Constituent: Barium, total   Analysis Run 11/22/2019 8:30 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

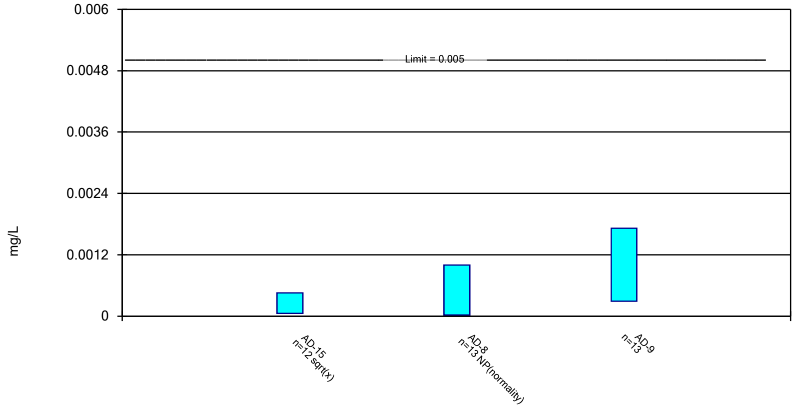


Constituent: Beryllium, total   Analysis Run 11/22/2019 8:30 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

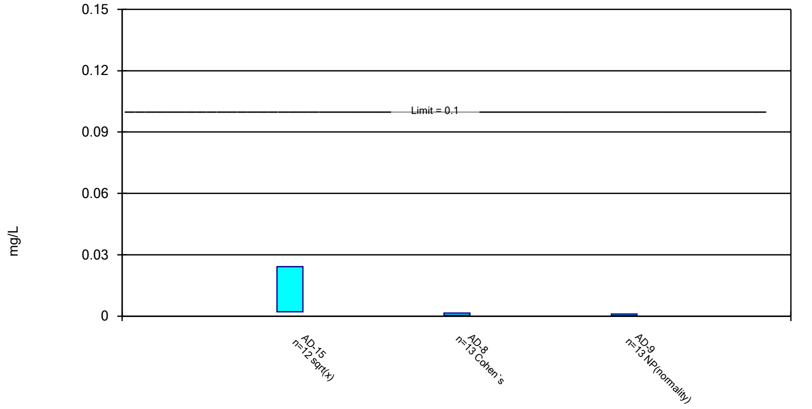


Constituent: Cadmium, total Analysis Run 11/22/2019 8:30 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

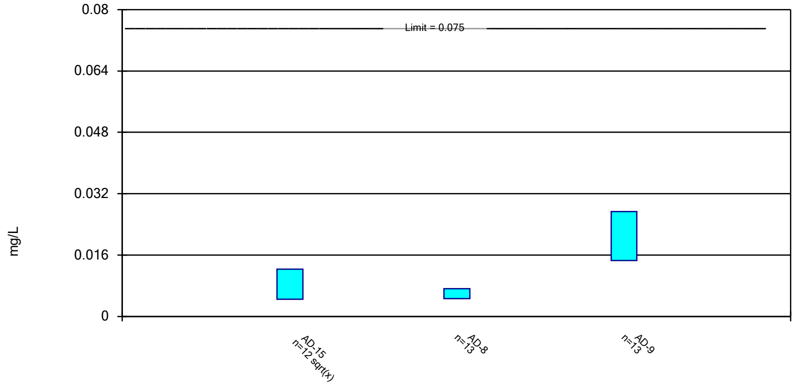


Constituent: Chromium, total Analysis Run 11/22/2019 8:30 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

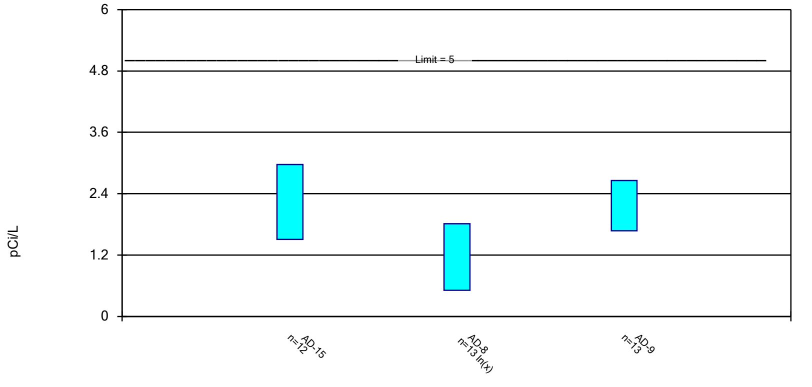


Constituent: Cobalt, total Analysis Run 11/22/2019 8:30 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

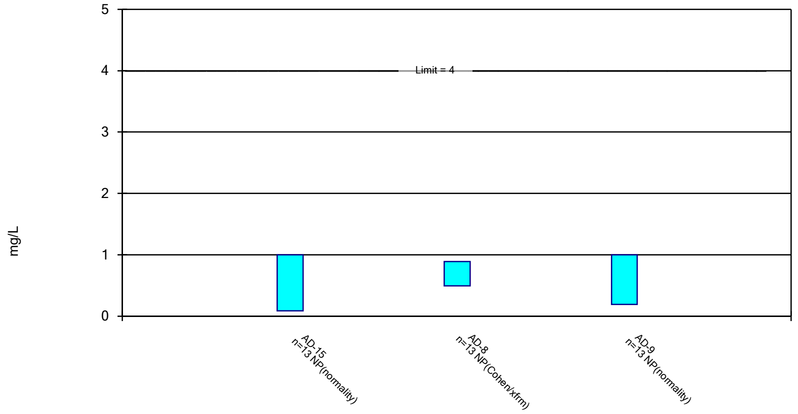


Constituent: Combined Radium 226 + 228 Analysis Run 11/22/2019 8:30 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

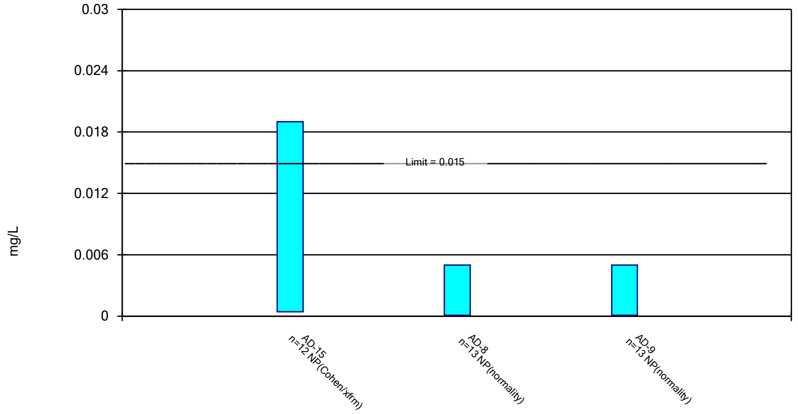


Constituent: Fluoride, total   Analysis Run 11/22/2019 8:30 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

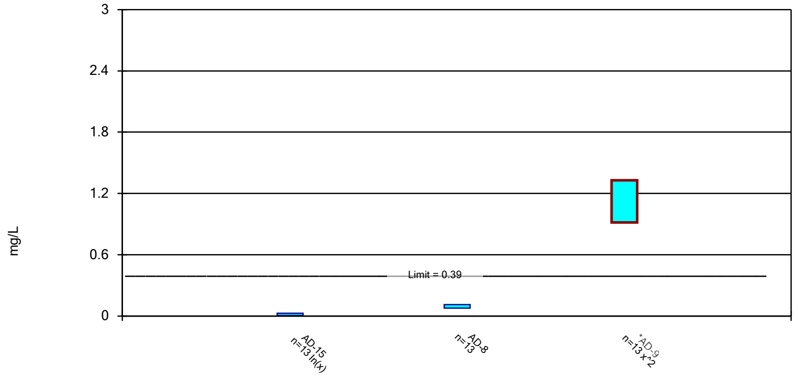


Constituent: Lead, total   Analysis Run 11/22/2019 8:30 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

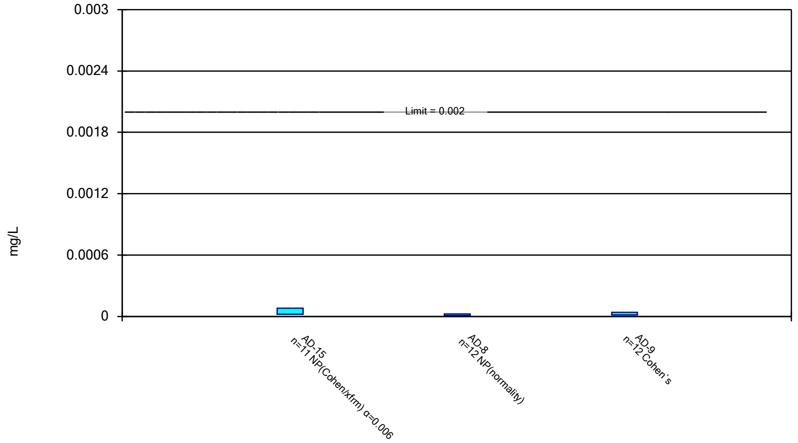


Constituent: Lithium, total   Analysis Run 11/22/2019 8:30 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG

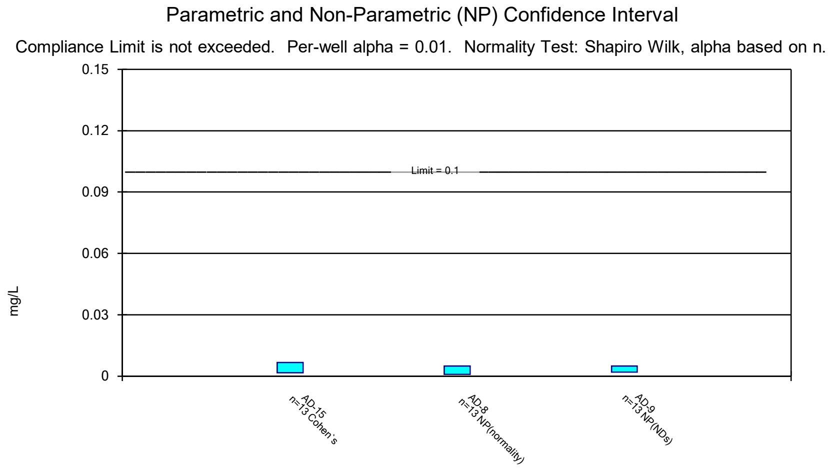
Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



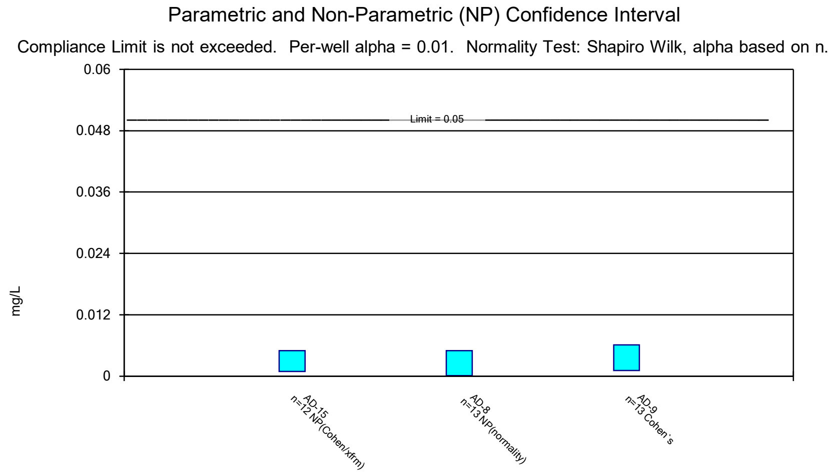
Constituent: Mercury, total   Analysis Run 11/22/2019 8:30 PM   View: AIV
Welsh PBAP   Client: Geosyntec   Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



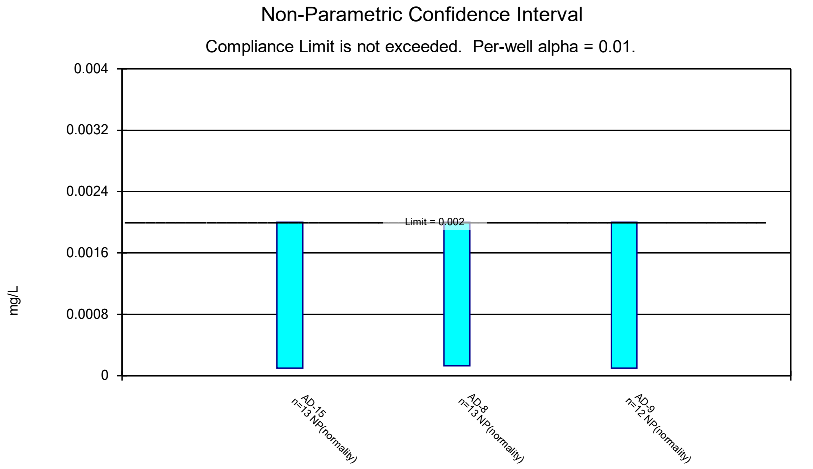
Constituent: Molybdenum, total Analysis Run 11/22/2019 8:30 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



Constituent: Selenium, total Analysis Run 11/22/2019 8:30 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

Sanitas™ v.9.6.23 . UG



Constituent: Thallium, total Analysis Run 11/22/2019 8:30 PM View: AIV
Welsh PBAP Client: Geosyntec Data: Welsh PBAP

APPENDIX III

Alternate source demonstrations are included in this appendix. Alternate sources are sources or reasons that explain that statistically significant increases over background or statistically significant levels above the groundwater protection standard are not attributable to the CCR unit.

Welsh Power Plant
Primary Bottom Ash Pond
Alternate Source Demonstration

The Welsh Power Plant Primary Bottom Ash Pond initiated an assessment monitoring program in accordance with 40 CFR 257.95 on April 13, 2018. Groundwater protection standards (GWPS) were set in accordance with 257.95(d)(2) and a statistical evaluation of the assessment monitoring data was conducted. The statistical evaluation revealed an exceedance of the lithium GWPS on January 8, 2019. A successful alternate source demonstration (ASD) was completed per 257.95(g)(3), therefore, the Welsh Primary Bottom Ash Pond will remain in assessment monitoring. An ASD is documentation that shows a source other than the CCR unit was responsible for causing the statistics to exceed the GWPS. The ASD document will explain the alternate cause of the GWPS exceedance. The successful ASD is attached.

ARCADIS Design & Consultancy for natural and built assets

AEP AMERICAN ELECTRIC POWER

ALTERNATIVE SOURCE DEMONSTRATION - LITHIUM PRIMARY BOTTOM ASH POND

J. Robert Welsh Power Plant
1187 County Road 4865
Pittsburg, Titus County, Texas

February 7, 2019

ALTERNATIVE SOURCE DEMONSTRATION - LITHIUM PRIMARY BOTTOM ASH POND

J. Robert Welsh Power Plant
1187 County Road 4865
Pittsburg, Titus County, Texas

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Our Ref.:

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Date:

February 7, 2019

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ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power Service Corporation
amsl	above mean sea level
Arcadis	Arcadis U.S., Inc.
ASD	Alternate Source Demonstration
bgs	below ground surface
CCR	Coal Combustion Residual
CCR Unit	ash pond system
CFR	Code of Federal Regulations
cfs	cubic feet per second
GWPS	groundwater protection standards
ft	feet
ft/day	feet per day
ft^3/sec	cubic feet per second
MCL	maximum contaminant limit
mg/kg	milligram per kilogram
mg/L	milligram per liter
NRCS	Natural Resources Conservation Services
PBAP	Primary Bottom Ash Pond
PCL	protective concentration level
SPLP	Synthetic Precipitation Leaching Procedure
SSI	statistically significant increase
SSL	statistically significant level
USDA	United States Department of Agriculture

1 INTRODUCTION

This Alternate Source Demonstration (ASD) report has been prepared on behalf of American Electric Power Service Company (AEP) for lithium detected in groundwater in the area of the Primary Bottom Ash Pond (PBAP) at the J. Robert Welsh Plant site located in Titus County, Texas. This ASD report was prepared in accordance with the Coal Combustion Residual (CCR) Rule (the Rule) specified in 40 Code of Federal Regulations (CFR) §257 and in consultation with the Electric Power Research Institute "Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites" (EPRI, 2017). As part of the Rule, CCR facility owners are required to conduct detection and assessment monitoring of "Appendix III" and "Appendix IV" constituents, respectively, to ensure compliance with applicable groundwater standards (described further below). Because the monitored constituents also have natural sources and can be influenced by sampling methodology implementation, the Rule allows owners or operators to evaluate and demonstrate whether a source other than the CCR unit caused a statistically significant increase (SSI) over background levels for an Appendix III or and Statistically significant levels (SSLs) over groundwater protection standards for Appendix IV constituent, such as natural variation in groundwater quality or sampling methodology error.

The owner or operator must complete the written ASD within 90 days of identifying the SSI or SSL and include the certification from a qualified professional engineer to verify the accuracy of the information in the report. This ASD report was prepared by Arcadis U.S., Inc. (Arcadis) on behalf of AEP within the 90-day period and has been certified by a qualified professional engineer.

1.1 Facility History

The J. Robert Welsh Plant is located within southern Titus County, approximately eight miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas (**Figure 1-1**). The Plant began operations in 1977 with three coal-fired generating units (Units 1, 2, and 3). Throughout the life of the Plant, CCR materials (fly ash, bottom ash, economizer ash) have been generated. These byproducts were stored in the PBAP and in the adjacent Landfill that was constructed in the late 1970s. In 2000, the 22-acre Bottom Ash Storage Pond was installed south of the Landfill. The Bottom Ash Storage Pond was constructed with a 60-mil high-density polyethylene liner (**Figure 1-2**).

Presently bottom ash and economizer ash from the Plant are sluiced to the PBAP. Solids settle as the clear liquids flow through a drainage canal into the clear water pond (a non-CCR unit). Solids (bottom ash and economizer ash) in the PBAP are dredged and sluiced into the Bottom Ash Storage Pond. Marketable ash material from the PBAP is also temporarily stored in the western two thirds of the Landfill for processing, then loaded into trucks and sold for beneficial reuse (highway road base, etc.).

2 PHYSICAL SETTING

2.1 Regional Topography

The elevation at the Site ranges from approximately 300 feet (ft) above mean sea level (amsl) at Swauano Creek downstream of the Welsh Reservoir, to 360 ft amsl at a topographically high ridge at the west end of the Landfill. The PBAP is in a topographically low area that had been an un-named intermittent tributary of Swauano Creek prior to development of the Site. The Landfill is approximately 40 acres in size and is located in a topographically higher area directly south of the PBAP. The Bottom Ash Storage Pond is approximately 22 acres in size and in a topographically higher area directly south of the Landfill.

2.2 Geology and Soils

2.2.1 Regional and Local Geology

The Site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently to the southeast. The Site, including all three CCR Units (PBAP, Landfill, Bottom Ash Storage Pond), is located along the outcrop of the Eocene-age Reklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966). The Reklaw Formation attains a thickness of approximately 110 ft in Titus County, and is underlain by the Eocene-age Carrizo Sand which consists of fine to coarse sand, silt, and clay (Broom et al. 1965). In the topographically low areas underlying the Welsh Reservoir to the east of the PBAP, Quaternary alluvial sediments associated with Swauano Creek are present (Flawn 1966). All the CCR monitoring wells at the Site are completed in the Reklaw Formation. Monitoring well locations are shown on **Figure 2-1.**

As shown on the regional geologic map and legend (**Figure 2-2A** and **Figure 2-2B**), the Reklaw Formation outcrop (Er) at the Site is relatively narrow (less than 1 mile in width). The Reklaw Formation is overlain by the Eocene-age Queen City Formation, which outcrops directly to the west of the Site. The Queen City Formation consists of fine to medium grained sand, shale, silt, and impure lignite, and attains a thickness of approximately 210 ft in Titus County (USGS., 1965). The Queen City Formation also contains ironstone concretions (Flawn, 1966).

2.2.2 Regional and Local Soil Composition

Information gathered from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Services (NRCS) soil data provides a detailed inventory of the regional soils and their characteristics, including the widespread distribution of clay-bearing soils, that support data collected at the Site from soil borings and groundwater monitoring locations. Two main named soil layers are present in the Pittsburgh, TX, area in the vicinity of the Site:

- Norfolk sandy loam
- Susquehanna fine sandy loam

Both soils are similar in the uppermost 1.5 ft of material, generally grayish in color and containing fine sand, silt, and clay. However, the subsoils of both units have subtle differences from one another and are described herein. Observations from soil borings at the Site are consistent with the characteristics of one or both of these soil units, as described in the USDA NRCS document.

The Norfolk sandy loam is a widely distributed soil unit that is uniformly developed in the lowland areas and is derived from weathering Eocene-aged deposits. It is a generally porous soil, allowing infiltrating water to migrate downward toward the water table. The soil layer is generally yellowish-gray in color, however the subsoil at greater depths is characterized by increased clay content and a mottled red and yellow appearance. As noted in the USDA soil descriptions, the soil and subsoils of the Norfolk sandy loam may be broken down into the grain size distributions presented in **Table 2-1.**

The Susquehanna fine sandy loam is also widely distributed and generally resembles the Norfolk sandy loam at the surface. Subsoils of the Susquehanna contain a greater component of clay, and likely contain increased iron content, as evidenced by observed iron concretions and iron crust formation within the subsoil. This soil is often mottled in appearance, ranging from red and yellow to a reddish brown or gray. Despite the greater clay content, the soil and subsoil is not impervious to infiltrating water that migrates toward the water table. As noted in the USDA soil descriptions, the soil and subsoils of the Susquehanna fine sandy loam may be broken down into the grain size distributions presented in **Table 2-2.**

These soil descriptions are important for the understanding of contributing sources of key constituents, such as lithium to the groundwater system. Lithium can occur in soils through natural weathering processes and the development of clay minerals. In particular, lithium can be incorporated into the structure of clays in the smectite group through cation substitution, which is further influenced in the presence of iron within the clay structure (Drever, 2002; Stucki, 2005). The widespread distribution of clay deposits in the native soils in and near the Site and the propensity for clays to contain trace constituents of potential concern, supports the potential for natural sources of lithium.

Geologic cross-sections were generated to evaluate the stratigraphy in the localized area of the PBAP. The lines of geologic cross-section are shown on **Figure 2-3** and the cross-section details for cross-sections A-A’ through E-E’ are shown on **Figures 2-4** through **2-8**, respectively. As shown on **Figure 2-4**, an unsaturated brown to gray clay and sandy clay stratum is present in the area of the PBAP from the surface to a depth of approximately 20 ft below ground surface (bgs). The clay stratum is underlain by a saturated fine to medium grained clayey and silty sand stratum with an average thickness of approximately 10 ft and is consistent with the soils of the Susquehanna fine sandy loam deposits. As discussed below in Section 2.3.2, this saturated sand stratum is the uppermost water-bearing unit in the area of the PBAP. This sand stratum is underlain by an unsaturated gray to black silty clay stratum that locally serves as a lower confining layer (aquitard) for the uppermost water-bearing unit.

2.3 Hydrology

2.3.1 Regional Hydrology

The Reklaw Formation, which outcrops in the area of the Site, and the overlying Queen City Formation, which outcrops directly west of the Site, are part of the Cypress Aquifer, which also includes the underlying Carrizo Sand and Wilcox Formation (USGS, 1965). As shown on **Figure 2-9,** the Cypress Aquifer is approximately 900 ft thick in the Site area, and the approximate base of fresh water in the Cypress Aquifer is approximately 800 ft bgs.

Regional groundwater characteristics are presented in Texas Water Commission Bulletin "*Ground-Water Resources of Camp, Franklin, Morris, and Titus Counties, Texas, Texas*" (USGS, 1965). All of the regional aquifer units are combined in this document, and considered as one interconnected unit, referred to as the "Cypress aquifer". This singular aquifer unit, composed of all water bearing units of similar character, was divided into three zones based on water quality characteristics of each zone rather than lithology. The following three zones were identified, in order of increasing relative depth:

- Zone A: characterized by minimal iron content and low pH, ranging from 4.5 to 6.5.
- Zone B: characterized by increased dissolved iron content and pH ranging from 5.0 to 7.0
- Zone C: characterized by iron concentrations of less than 0.3 milligrams per liter (mg/L) and neutral to alkaline pH (7.0 to 8.0)

Groundwater at the Site is generally assumed to be influenced by groundwater from Zones A and B. As described in USGS, 1965, Zones A and B can be more simply described as:

- Zone A: zone of oxidation and acidic groundwater
- Zone B: intermediate zone

The dissolved iron content in the A and B zones (ranging from non-detect to greater than 10 mg/L; USGS 1965) is likely influenced by iron present in the soils and sediments, which are described in Section 2.2. Slow recharge rates and transmissive properties of these zones contributes to longer residence times whereby the infiltrating groundwater may react with soil and sediments, allowing for the oxidation of sulfides to generate sulfate and mobilizing ferrous iron into solution. In addition, groundwater from several wells completed in shallow (less than 60 ft in depth) sediments contained sulfate of up to 1,420 mg/L. Sulfate concentrations observed at the Site are consistent with the range of data for other similar depth wells in the four-county area (USGS, 1965).

Additional regional groundwater information is provided in the 107th Annual Meeting of the Texas Academy of Science abstract titled "Natural Sources of Poor Water Quality in Streams of East Texas" (Ledger et. al., 2004). This study characterized surface water streams associated with the regional groundwater in the Eocene-aged Reklaw Formation as acidic with high concentrations of sulfate and arsenic concentrations greater than 0.01 mg/L.

An observed decline in surface water quality was also noted if springs from the Reklaw Formation discharge to surface water bodies. Abundant sulfur is noted in the Reklaw formation and sediments undergo acid-sulfate weathering, as evidenced in the red-stained soils and sulfate concentrations of greater than 1,000 mg/L (Ledger et. al., 2004). In streams associated with the Reklaw Formation, sulfate levels may exceed 1,000 mg/L.

2.3.2 Local Hydrology

Groundwater flow direction at the Site is generally from west to east, following surface topography towards the Welsh Reservoir. Groundwater elevations and well construction information from monitoring wells completed in the uppermost water-bearing unit at the Site are summarized on **Table 2-3**. Depth to groundwater in the monitoring wells in the area of the PBAP ranges from approximately 10 to 15 ft bgs.

Figure 2-10 is a potentiometric surface map for the uppermost water-bearing unit at the Site based on October 29, 2018 water level data. As shown on **Figure 2-10**, shallow groundwater flow direction in the area of the CCR Units is in a general easterly direction toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.01 foot per foot.

The hydraulic conductivity of the uppermost water-bearing unit at the Site was determined by conducting aquifer tests. A constant-rate pumping test was conducted at monitoring well AD-6 on September 21, 2017. Based on the AD-6 pumping test data, the hydraulic conductivity for the uppermost water-bearing unit was calculated at 0.05 ft per day (1.83 x 10-5 centimeters per second).

To provide a broader understanding of the hydraulic conductivity distribution across the Site, bail down slug tests were performed in October 2018 on a total of 5 wells; 1 up gradient well (AD-17) and 4 down gradient wells (AD-6, AD-9, AD-13 and AD-19) on October 30 and 31, 2018. These wells are all screened in the uppermost water-bearing unit and were chosen based on their distribution across the Site. The hydraulic conductivity estimates from the five monitoring wells tested ranged from 0.15 ft per day (AD-6) to 2.0 ft per day (AD-13). The overall mean hydraulic conductivity estimate was 0.84 ft per day, while the overall geometric mean was 0.60 ft per day.

2.4 Surface Water

The Site is located directly west of Swauano Creek, which was dammed near the southern end of the Site during plant development to form the Welsh Reservoir. The PBAP normal operating water level is near the weir box which has a bottom elevation of 325 ft amsl. The surface water elevation of the Welsh Reservoir, located east of the PBAP, is maintained at approximately 320 ft amsl. The Welsh Reservoir is likely a gaining surface water feature, and groundwater elevations at the Site are higher than the normal stage elevation of the Welsh Reservoir (approximately 320 ft amsl) as shown on **Figure 2-10**.

There are no current or historic gauging stations on Swauano Creek; however, there was a historic gauging station on adjacent Boggy Creek, which has a drainage basin area of 72 square miles versus 21.2 square miles for Swauano Creek. The average annual flow of the Boggy Creek gauging station during the driest year on record (1956) was 10.65 cubic feet per second (cfs), which corresponds to a flow of approximately 3 cfs for Swauano Creek.

3 DETECTION AND ASSESSMENT MONITORING STATISTICAL EVALUATION

3.1 General

The groundwater monitoring network for the uppermost water-bearing unit at the PBAP consists of three upgradient monitoring wells (AD-1, AD-5, AD-17) and three downgradient monitoring wells (AD-8, AD-9, AD-15). Additional details regarding the groundwater monitoring network are provided in the August 22, 2017 report entitled "*Primary Bottom Ash Pond – CCR Groundwater Monitoring Well Network Evaluation*" (Arcadis, 2017).

3.2 Detection Monitoring Results

Detection monitoring at the Site involves collection of groundwater samples from the groundwater monitoring network upgradient and downgradient monitoring wells for analyses of Appendix III CCR constituents, which includes boron, calcium, chloride, fluoride, sulfate, pH, and total dissolved solids. Following the baseline monitoring program, which included a minimum collection of eight independent samples from each of the background and downgradient wells that are part of the certified monitoring network, the first round of Detection Monitoring was conducted. Based on detection monitoring conducted at the PBAP in 2017 and 2018, an SSI over the background concentration was calculated for boron in AD-8. Because of the SSI noted for boron from the 2018 sample from AD-8, an Alternate Source Demonstration was completed which did not identify an alternate source for the boron SSI (Geosyntec, 2018).

3.3 Assessment Monitoring Results

Groundwater protection standards (GWPSs) were established for the Appendix IV parameters in accordance with 40 CFR Part 257.95(h). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or regional screening level for each Appendix IV parameter.

Confidence intervals were calculated for Appendix IV parameters at the compliance wells (AD-8, AD-9, AD-15) to assess whether Appendix IV parameters were present at an SSL above the GWPS. An SSL was identified for lithium, which exceeded the GWPS of 0.390 mg/L at monitoring well AD-9 (0.935 mg/L), despite no observed SSIs in Appendix III parameters for this well (Geosyntec, 2019). Because the native soils have the potential to be a natural source of lithium in the regional and local groundwater and soil composition, this ASD report was prepared to provide additional information on the sources and distribution of lithium in groundwater at the Site. Further discussion of the Site-specific soil and groundwater data is provided in Section 4. Additional details regarding the statistical evaluation of the groundwater monitoring data is provided in the January 8, 2019 report entitled "*Statistical Analysis Summary, Primary Bottom Ash Pond*" (Geosyntec, 2019).

4 SOIL AND GROUNDWATER ANALYTICAL DATA EVALUATION

4.1 General

In addition to the detection and assessment monitoring groundwater sampling events conducted at the PBAP in 2017 and 2018 for statistical evaluation, a comprehensive site-wide groundwater sampling event was conducted by Arcadis during May 2018 to evaluate alternate potential sources of lithium detected in downgradient monitoring well AD-9. This May 2018 evaluation included the following tasks:

- Collection of groundwater samples from the PBAP upgradient monitoring wells (AD-1, AD-5, AD-17), the PBAP downgradient monitoring wells (AD-8, AD-9, AD-15), and other monitoring wells in the area completed in the uppermost water-bearing unit, including upgradient monitoring well AD-18; sidegradient monitoring wells MW-9, MW-10, and Temp-1; and downgradient monitoring wells AD-3, AD-4c, AD-10, AD-11, AD-13, AD-14, AD-16R, and AD-19.
- Collection of soil samples from eight soil borings (Temp-1, SB-2 through SB-8) around the perimeter of the CCR units at the site.
- Collection of three CCR material samples from the PBAP (Sample IDs: Ash-1, Ash-2, Ash-3) and one CCR material sample from the HDPE-lined Bottom Ash Storage Pond (Sample ID: Ash-4) for analysis of total metals, pore water concentrations, and leachate water using the Synthetic Precipitation Leaching Procedure (SPLP) (**Table 4-1**).

In addition, two sentinel downgradient monitoring wells (AD-20, AD-21) were installed in the uppermost water-bearing unit (Reklaw Formation) near the shoreline of the Welsh Reservoir east (hydraulically downgradient) of the CCR units during October 2018.

4.2 Soil and Groundwater Analytical Data Evaluation

4.2.1 Soil Evaluation

The soil evaluation results demonstrate a correlation between lithium in soil and lithium in groundwater in key locations, with a correlation in soil between lithium and iron. Boring logs from Site monitoring locations highlight similarities with observations provided in the county-wide soil survey reports. For example, boring locations SB-04 (AD-5) and SB-05 (AD-8) contain a greater content of the reddish-brown clay subsoils as noted in the Susquehanna fine sandy loam, which directly overlie the water table in these locations. The reddish brown color generally denotes the presence of iron in these locations, which can be either incorporated directly into the clay mineral structure (e.g. smectite), or as a secondary mineral (e.g. iron hydroxide) that is also present in the aquifer matrix (Stucki, 2005). The role of iron incorporated into the clay structure is important to localized geochemical processes, such as cation exchange, redox conditions, and hydrophilic properties, which can influence weathering characteristics and the mobility of trace constituents (i.e. lithium) in groundwater (Stucki, 2005). As shown on **Table 4-1** and **Figure 4-1**, the highest concentration of lithium (13.6 mg/kg) was detected in the soil sample from soil boring SB-4, which is located adjacent to monitoring well AD-5 hydraulically upgradient (northwest) of the PBAP. This data indicates lithium concentrations in soil in the area of the PBAP are naturally occurring and not the result of impacts from CCR materials. This is one line of evidence that the lithium detected in groundwater at monitoring well AD-9 is from a naturally occurring source, and not the CCR unit. Groundwater quality measured in the adjacent monitoring wells (AD-5 and AD-8) generally contained greater lithium concentrations (0.056 mg/L to 0.147 mg/L) than other monitoring locations on Site that did not contain such subsoils. Soil samples collected from monitoring locations SB-04 (AD-5) and SB-05 (AD-8, background) similarly contained greater concentrations of lithium (10.5 milligrams per kilogram [mg/kg] to 13.6 mg/kg) and iron (6,210 mg/kg to 10,400 mg/kg) than other locations on Site. While there is localized variation in the native soil sediments collected, these results demonstrate that the soils are a potential alternative source for lithium.

As shown on **Table 4-1** and **Figure 4-2**, the highest iron concentrations in soil are from soil boring SB-4 (AD-5; 10,400 mg/kg), located upgradient (northwest) of the PBAP, and soil boring SB-8 (AD-3; 11,000 mg/kg), located over 1,000 ft south (side gradient) of the PBAP. **Figure 4-3** shows an apparent correlation between the iron and lithium content in the coal ash, upgradient locations, and downgradient locations. However, SPLP and pore water results from the coal ash samples show that the iron and lithium present in the coal ash is not in a mobile form. Therefore, it is more likely that the regional groundwater interaction with naturally occurring lithium and iron is responsible for the observed lithium concentrations and variability across the Site. As detailed below in Section 4.2.2, iron and lithium concentrations in groundwater at the Site show a similar distribution to iron and lithium concentrations in soil, indicating naturally occurring sources for iron and lithium.

4.2.2 Groundwater Evaluation

Groundwater analytical results for the PBAP, the landfill, and the bottom ash storage pond are summarized on **Tables 4-2**, **4-3**, and **4-4**, respectively. As shown on **Figure 4-4**, the highest lithium concentration in groundwater is at monitoring well AD-18 (2.07 mg/L), which is west (upgradient) relative to the PBAP. This data indicates lithium concentrations in groundwater in the area of the PBAP are from a source other than the PBAP.

As shown on **Figure 4-5**, iron concentrations in groundwater are also elevated upgradient (west) relative to the PBAP. **Figure 4-6** shows the relationship of total and dissolved iron concentrations to lithium concentrations in upgradient, side-gradient, and downgradient monitoring wells. These results demonstrate a clear correlation between aqueous iron and lithium, with higher lithium concentrations associated with elevated iron. The greatest concentrations of both iron and lithium are observed in the upgradient monitoring wells AD-17 and AD-18. As identified in **Table 4-1** and noted on **Figure 4-6**, SPLP leachate and pore water analyzed from coal ash samples contain lithium in concentrations below detection, or at very low concentrations less than 0.02 mg/L. This data indicates lithium concentrations in groundwater in the area of the PBAP are from a source other than the PBAP. As discussed above in Section 2.2.1, the Queen City Formation, which overlies the Reklaw Formation, is located directly west of the Site. Therefore, groundwater from the Queen City Formation west (upgradient) of the CCR units may be the source of lithium and iron detected in soils and groundwater in the area of the CCR units. As discussed above in Section 2.3.1, elevated naturally occurring iron is documented in the Cypress Aquifer, and as discussed above in Section 2.2.1, the Queen City Formation contains naturally-occurring iron concretions.

Another line of evidence the lithium detected in groundwater in the area of the PBAP is from a naturally occurring source is provided in the 2002 Publication “Springs of Texas” (Gunnar Brune, 1981). The Springs of Texas publication states “*Hynoon Springs, also known as Marshall, Noonday Camp, and Iron Springs, are six kilometers north of Hallsville. They became very popular as a health resort about 1851. The waters are highly mineralized, containing much iron, sulfur, aluminum, and lithium. Originally there were said to be over 100 springs flowing from the Queen City Formation*.” This spring, which contains naturally-occurring lithium, is located approximately 35 miles southeast of the Site. A copy of this reference is provided in **Appendix A**.

When reviewing historical and recent datasets, a broad relationship was noted between trace metal chemistry and turbidity. Where turbidity values were greatest, greater concentrations of selected CCR monitored constituents were also observed (e.g. arsenic and cadmium) and in some cases, in exceedance of Federal MCLs. As a result, low-flow sampling methodology was employed to reduce the amount of turbidity in the groundwater sample.

A comprehensive groundwater sampling event was conducted at the Site by Arcadis during May 2018 using low-flow methodology. A clean stainless steel low-flow sampling pump with new, well-dedicated polyethylene piping was slowly lowered into the mid-point of the water column at each monitoring well, and groundwater was then pumped at a low flow rate of less than 0.1 liters per minute until the produced water was visually clear. The turbidity of the produced water was measured using calibrated field instruments during well development, and groundwater samples were not collected until the turbidity measurements declined and stabilized. Once low-flow groundwater sampling techniques were properly followed by Arcadis during May 2018, water quality results indicated concentrations of selected constituents to be much less than previously reported and did not exceed criteria. Therefore, it was determined that the sediment disturbances generated during well purging and improper (turbid) groundwater sampling were causing most of the Federal MCL groundwater exceedances. Specifically, since CCR Rule monitoring requires analysis of unfiltered samples, the results suggest that the exceedances were associated with constituents present in undissolved suspended solid particulates rather than in a dissolved form, on a location by location basis. The May 2018 groundwater analytical results are most representative of groundwater quality at the Site because proper low-flow sampling protocols were adhered to and sediment contributions to the analytical results were minimized.

5 SUMMARY AND CONCLUSIONS

This ASD has been prepared in consultation with the Electric Power Research Institute “Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites”. The following lines of evidence indicate the SSL related to the lithium concentration in groundwater at AD-8 is from naturally occurring sources (ASD Type V), with some additional minor contributions from sampling methodology error (ASD Type I):

- An SSI was confirmed for boron within monitoring well AD-8 followed by a failed Alternate Source Demonstration for boron, triggering the assessment monitoring program for the PBAP. Under the assessment monitoring program, an SSL was identified for lithium which exceeded the GWPS of 0.390 mg/L at monitoring well AD-9 (0.935 mg/L), despite no observed SSIs in Appendix III parameters for this well. SSIs would be expected for Appendix III parameters if there was a CCR unit source for the lithium exceedance of the SSL, indicating that there may be an alternate source of lithium.
- As demonstrated in this ASD report, iron and lithium are associated in the sediments and in groundwater. The subsoils at the Site, particularly the Susquehanna fine sandy loam, contain naturally occurring high clay content. The role of iron incorporated into the clay structure is important to localized geochemical processes, such as cation exchange, redox conditions, and hydrophilic properties, which can influence weathering characteristics and the mobility of trace constituents (i.e. lithium) in groundwater (Stucki, 2005). This is a supporting line of evidence.
- The highest lithium concentration in the uppermost saturated zone soil samples collected during the Arcadis May 2018 investigation was from a background soil sample (SB-4, 27 ft depth) located upgradient (northwest) of the PBAP near AD-5. This is a key line of evidence that the PBAP is not the source of elevated lithium concentrations in soil at the Site.
- Leachate and pore water analyzed from coal ash samples contain lithium in concentrations below detection, or at very low concentrations less than 0.02 mg/L. This data indicates lithium concentrations in groundwater in the area of the PBAP are from a source other than the PBAP. This is a key line of evidence.
- The highest lithium concentration in groundwater samples collected during the Arcadis May 2018 investigation was from an upgradient (background) monitoring well (AD-18) located west of the PBAP. This is a key line of evidence that the PBAP is not the source of elevated lithium concentrations in groundwater at the Site.
- Iron and lithium concentrations in soil and groundwater at the Site show a similar distribution, indicating there is likely a common source for these metals. The 1965 USGS publication “*Ground-Water Resources of Camp, Franklin, Morris and Titus Counties, Texas”* documents naturally occurring high iron concentrations within zones of the Cypress Aquifer, in which the monitoring wells at the Site are completed. The University of Texas at Austin Bureau of Economic Geology 1966 publication “*Geologic Atlas of Texas, Texarkana Sheet*” documents naturally occurring iron concretions in the Queen City Formation, which outcrops directly west (upgradient) of the PBAP. This is a supporting line of evidence.

- The 1981 Gunnar Brune publication "*Springs of Texas"* documents naturally occurring elevated lithium in groundwater in the Queen City Formation at Hynoon Springs, which is approximately 35 miles from the Site. The publication states "*Hynoon Springs, also known as Marshall, Noonday Camp, and Iron Springs, are six kilometers north of Hallsville. They became very popular as a health resort about 1851. The waters are highly mineralized, containing much iron, sulfur, aluminum, and lithium. Originally there were said to be over 100 springs flowing from Queen City sand".* This publication, along with soil and groundwater analytical data at the Site, supports the conclusion that the primary source of lithium in groundwater at the PBAP is from the Queen City Formation, which outcrops directly west (upgradient) of the PBAP. This is a key line of evidence.
- Effective well development and proper low flow sampling techniques minimize the potential for groundwater analyses to be unrepresentative of formation groundwater. This is a supporting line of evidence.
- This ASD report provides a strong demonstration of naturally occurring sources of lithium in groundwater (ASD Type V) as supported by five key lines of evidence and three supporting lines of evidence.

6 PROFESSIONAL ENGINEER'S CERTIFICATION

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the alternate source demonstration for lithium at the Primary Bottom Ash Pond meets the requirements of 40 CFR Part 257.95.

Kenneth J. Brandner

Printed Name of Registered Professional Engineer

KENNETH J. BRANDNER
69586

Kenneth J. Brandner

Signature

69586	Texas	2-7-19
Registration No.	Registration State	Date

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TABLES

Table 2-1
Grain Size Distribution in Soil and Subsoil of the Norfolk Sandy Loam
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Grain Size	Soil	Subsoil
Fine Gravel	0.0%	0.0%
Coarse Sand	0.2%	0.1%
Medium Sand	0.4%	0.3%
Fine Sand	29.4%	29.9%
Very Fine Sand	37.9%	24.0%
Silt	25.9%	25.1%
Clay	5.9%	20.2%

Table 2-2
Grain Size Distribution in Soil and Subsoil of the Susquehanna Fine Sandy Loam
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Grain Size	Soil	Subsoil
Fine Gravel	0.4%	0.0%
Coarse Sand	0.7%	0.2%
Medium Sand	0.9%	0.8%
Fine Sand	53.4%	36.6%
Very Fine Sand	16.0%	10.8%
Silt	21.2%	19.0%
Clay	7.2%	32.8%

Table 2-3
Well Construction and Water Level Data - CCR Units
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole Depth ft. bls	Date Installed	Screen Material	Well Diameter inches	Top of Screen		Bottom of Screen		6/7/2011	12/6/2011	5/2/2012	11/1/2012	5/14/2013	11/19/2013	5/12/2014	11/16/2014	5/12/2015	3/4/2016	5/26/2016	7/27/2016	10/19/2016	12/12/2016	1/17/2017	2/23/2017	10/6/2017	5/15/2018	10/29/2018
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																															
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57	338.46	334.92	337.88	337.18	337.43	336.73	338.03	337.64	340.82	342.83	344.89	342.89	341.23	340.58	341.18	339.74	337.70	340.57	339.10
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16	330.16	329.07	330.00	329.26	329.83	329.70	330.09	329.69	332.56	332.32	---	---	---	---	---	---	---	331.50	331.25
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10	323.81	323.19	323.99	323.29	323.77	323.98	324.12	323.28	325.58	325.12	324.59	323.70	323.47	323.78	325.04	324.92	323.24	324.30	324.15
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61	324.81	324.84	324.62	324.40	324.74	325.52	325.44	325.13	327.00	326.90	---	---	---	---	---	---	---	---	---
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19	325.01	324.19	325.24	322.90	324.86	324.68	325.64	325.34	327.19	327.12	---	---	---	---	---	---	---	---	---
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55	324.35	324.32	324.50	324.30	324.30	325.21	325.22	324.90	326.58	326.67	---	---	---	---	---	---	---	---	---
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15	324.18	324.50	324.64	324.37	324.11	325.06	325.01	324.71	326.50	326.19	325.89	324.01	323.76	325.07	326.39	324.89	324.20	324.95	325.62
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00	336.34	336.58	336.82	336.99	336.78	336.47	336.80	336.01	339.07	338.04	337.62	337.24	337.74	337.01	338.34	336.17	337.40	337.25	336.98
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31	333.04	333.02	332.83	333.02	333.11	332.81	333.11	332.81	333.38	334.00	---	---	---	---	---	---	---	---	333.42
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86	334.32	334.12	334.19	334.20	334.13	334.58	333.77	333.98	334.09	333.61	---	---	---	---	---	---	---	---	---
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53	325.41	324.09	325.69	325.15	325.79	325.75	325.98	325.77	326.05	325.70	325.68	325.05	325.29	325.92	326.76	324.27	326.12	325.63	326.36
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32	328.46	328.53	328.63	328.44	328.74	329.38	NM	330.18	329.98	329.74	329.28	329.53	328.92	329.31	330.50	328.05	329.47	329.40	329.98
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23	323.44	322.55	323.27	323.35	323.51	323.76	323.57	323.88	323.95	323.55	---	---	---	---	---	---	---	323.53	324.19
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61	327.99	328.37	327.82	327.93	327.94	328.13	328.20	327.97	328.96	328.13	328.39	328.14	327.87	328.20	328.90	328.25	327.85	327.61	327.83
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27	348.30	348.29	349.86	349.56	349.99	349.65	349.89	350.01	350.65	350.39	---	---	---	---	---	---	---	349.52	348.28
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12	332.36	332.24	333.09	332.26	332.68	333.25	333.35	332.01	337.58	334.76	334.54	332.93	332.39	332.84	334.54	331.83	331.42	331.83	331.52
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32	330.40	329.80	331.67	330.34	330.94	331.69	332.12	330.17	336.63	334.83	334.51	331.71	330.94	330.79	332.63	330.87	329.91	330.76	330.52
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71	---	---	---	---	---	---	---	---	---	322.14	321.93	321.28	321.42	321.71	321.64	322.81	322.07	321.74	322.01
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86	---	---	---	---	---	---	---	---	---	337.09	335.84	332.14	331.52	331.43	330.96	330.71	---	---	---
AD-16R (e)	33° 02' 49"	94° 50' 28.9"	350.55	353.49	27.0	4/12/17	Sch. 40 PVC	2	12.0	338.55	27.0	323.55	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	327.12	328.68	326.71
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99	---	---	---	---	---	---	---	---	---	334.64	334.26	334.30	334.45	334.64	334.05	333.94	334.17	334.35	333.91
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17	---	---	---	---	---	---	---	---	---	343.66	343.26	340.81	339.92	339.38	338.97	340.38	339.43	342.75	340.97
AD-19	33.047201°	94.839694°	323.58	326.35	15.0	5/8/18	Sch. 40 PVC	2	5.0	318.58	15.0	308.58	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	321.24	321.54
AD-20	33° 02' 45.6"	94° 50' 22.8"	324.85	327.65	20.0	10/23/18	Sch. 40 PVC	2	4.0	320.85	19.0	305.85	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	323.28
AD-21	33° 02' 49.6"	94° 50' 20"	322.04	325.29	20.0	10/23/18	Sch. 40 PVC	2	3.5	318.54	18.5	303.54	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	320.26
Piezometers																															
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Temp-1	33.046864°	94.852059°	356.36	358.17	28.0	5/8/18	Sch. 40 PVC	2	8.0	348.36	28.0	328.36	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	345.55	342.79
MW-9	33° 03' 18"	94° 50' 19.4"	342.00	344.54	18.0	11/19/01	Sch. 40 PVC	2	3.0	339.00	18.0	324.00	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	331.34	331.24
MW-10	33° 03' 13.6"	94° 50' 19.4"	341.96	344.80	19.0	11/19/01	Sch. 40 PVC	2	4.0	337.96	19.0	322.96	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	332.29	332.75

NOTES:
NM = Not measured
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
(e) Monitoring well installed by ARCADIS on April 12, 2017 as a replacement for monitoring well AD-16.
Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through February 2017.
1983 State Plane Lambert Coordinate System
Datum: NAD 83
ft bls = feet below land surface
ft msl = feet above mean sea level
Elev. = Elevation
---- = No record

Table 4-1
Soil and Coal Ash Sample Analytical Results (mg/kg) - CCR Units
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Sample ID	**Date Sampled**	**Sample Depth (feet)**	**Units**	**Appendix III Parameters**						**Appendix IV Parameters**															
				Boron	**Calcium**	**Chloride**	**Fluoride**	**pH**	**Sulfate**	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Cobalt**	**Lead**	**Lithium**	**Mercury**	**Molybdenum**	**Selenium**	**Thallium**	**Radium 226 and 228 (pCi/L)**	**Iron**	**Manganese**
Soil Samples																									
Temp-1	5/8/18	15'	mg/kg	14.3	43.3	15	<1	5.0	93	<0.25	1.77	16.8	<0.05	<0.05	5.22	0.28	1.77	0.104	0.004	1.18	<0.25	1.26	0.273	<12.5	5.4
SB-2	5/10/18	22'	mg/kg	11.9	35.8	13	2	3.9	878	<0.25	<0.25	18.3	0.08	<0.05	3.53	0.551	3.98	0.08	0.005	0.287	0.684	<0.25	0.159	890	4.46
(AD-17)																									
SB-3	5/10/18	30'	mg/kg	3.05	90.2	94	1	3.8	1,194	<0.25	3.83	13.6	<0.05	0.132	9.21	0.649	4.22	0.322	0.009	1.64	<0.25	<0.25	0.593	3,960	6.87
(AD-18)																									
SB-4	5/9/18	5'	mg/kg	(FOC = 0.00723 g/g)			---	4.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
(AD-5)		27'	mg/kg	7.76	634	8	1	6.4	724	<0.25	1.81	20.4	0.115	0.417	6.73	4.76	3.2	13.6	0.006	0.561	0.536	<0.25	0.657	10,400	65.5
(Background)		27'	mg/kg	(FOC = 0.00688 g/g)																					
SB-5	5/9/18	19'	mg/kg	5.45	655	16	3	7.2	69	<0.25	1.11	8.53	0.109	0.241	3.75	3.58	2.96	10.5	0.044	0.313	0.297	<0.25	0.216	6,210	35.5
(AD-8)																									
SB-6	5/9/18	21'	mg/kg	5.33	397	20	2	7.8	116	<0.25	1.11	17.9	0.09	0.24	3.5	3.37	2.67	10.3	0.051	0.299	0.471	<0.25	2.502	5,970	38.4
(AD-9)																									
SB-7	5/9/18	13'	mg/kg	8.11	1,360	19	<1	5.0	198	<0.25	10.1	65	0.154	0.356	6.87	3.21	3.14	5.3	0.004	1.39	<0.25	<0.25	0.262	9,220	28.4
(AD-13)																									
SB-8	5/9/18	12'	mg/kg	16.6	6,150	13	1	5.2	24	<0.25	3.3	213	0.409	0.452	8.22	4.13	9.05	4.63	0.013	0.488	<0.25	<0.25	0.433	11,000	25.4
(AD-3)																									
AD-20	10/23/18	15-17	mg/kg	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.567	---	---
AD-21	10/23/18	15-17	mg/kg	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.424	---	---
Coal Ash Samples																									
Ash-1	5/10/18	1-2'	mg/kg	34.4	33,800	30.5	8.21	7.1	219	<0.877	14.6	607	1.02	0.464	31.8	5.55	16.9	11.6	0.0473	2.66	2.27	<0.54	*2.92*	37,500	139
		SPLP:	*mg/L*	*0.594*	*30.2*	---	---	---	---	*<0.00344*	*<0.00411*	*0.284*	*<0.000333*	*<0.000164*	*0.00273*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0176*	*<0.00363*	*<0.00287*	*0.0991*	*<0.0305*	*<0.00267*
		Pore Water:	*mg/L*	*0.643*	*113*	*20.1*	*1.86*	*7.4*	*6.6*	*<0.00344*	*0.0095*	*3.43*	*<0.000333*	*<0.000164*	*0.00396*	*<0.000553*	*<0.00285*	*0.0123*	*<0.0000653*	*0.00484*	*<0.00363*	*<0.00287*	0.755	---	*0.357*
Ash-2	5/10/18	1-2'	mg/kg	92.6	96,000	53.8	11.2	7.3	293	<1.56	19.4	2,760	1.64	1.56	41.2	9.63	24.5	15.5	0.0967	2.08	5.25	<0.957	*2.32*	18,300	365
		SPLP:	*mg/L*	*0.526*	*24.1*	---	---	---	---	*<0.00344*	*<0.00411*	*0.192*	*<0.000333*	*<0.000164*	*0.00222*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0165*	*<0.00363*	*<0.00287*	*0.112*	*<0.0305*	*<0.00267*
		Pore Water:	*mg/L*	*0.772*	*143*	*20.4*	*0.28*	*7.6*	*8.73*	*<0.00344*	*0.0106*	*3.99*	*<0.000333*	*<0.000164*	*0.00196*	*<0.000553*	*0.00346*	*0.0173*	*<0.0000653*	*0.00428*	*<0.00363*	*<0.00287*	0.508	---	*0.376*
Ash-3	5/10/18	1-2'	mg/kg	29	14,300	11.5	10.7	7.4	152	<0.687	11.8	766	0.845	0.394	19.2	5.77	12.2	6.87	0.0403	1.79	1.44	<0.423	*1.754*	21,100	110
		SPLP:	*mg/L*	*0.958*	*19.8*	---	---	---	---	*<0.00344*	*<0.00411*	*0.0315*	*<0.000333*	*<0.000164*	*0.00389*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0222*	*<0.00363*	*<0.00287*	*<0.256*	*0.471*	*<0.00267*
		Pore Water:	*mg/L*	*1.000*	*103*	*13.0*	*0.998*	*7.6*	*51.1*	*<0.00344*	*0.0108*	*1.54*	*<0.000333*	*<0.000164*	*0.00110*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0111*	*<0.00363*	*<0.00287*	0.594	---	*0.715*
Ash-4	5/10/18	1-2'	mg/kg	281	106,000	27.6	1.34	10.5	961	<0.757	9.72	3,390	2.23	1.06	35.1	16.2	16.3	20.4	0.0340	2.21	1.30	<0.466	*3.18*	24,200	177
		SPLP:	*mg/L*	*1.3*	*25.1*	---	---	---	---	*<0.00344*	*<0.00411*	*0.0216*	*<0.000333*	*<0.000164*	*0.00329*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*<0.00281*	*<0.00363*	*<0.00287*	*<0.407*	*<0.0305*	*<0.00267*
		Pore Water:	*mg/L*	*4.75*	*63.5*	*28.8*	*0.697*	*10.8*	*381*	*<0.00344*	*0.00745*	*0.217*	*<0.000333*	*<0.000164*	*0.00225*	*0.00093*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0798*	*<0.00363*	*<0.00287*	0.259	---	*0.00814*

NOTES:

mg/kg = Milligrams per kilogram

mg/L = Milligrams per liter

FOC = Fraction organic carbon (Walkley Black)

--- = Not analyzed

SPLP = Synthetic precipitation leaching procedure (concentrations shown in milligrams per liter)

Total concentrations (mg/kg) shown in normal font, SPLP and Pore Water concentrations (mg/L) shown in italics.

Radium concentrations for soil shown in picoCuries per gram. SPLP concentrations shown in picoCuries per liter.

Table 4-2
Groundwater Sampling Analytical Results (mg/L) - Primary Bottom Ash Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

		Appendix III Parameters								Appendix IV Parameters															
Well	**Date Sampled**	**Boron (total)**	**Calcium (total)**	**Chloride**	**Fluoride**	**pH (field)**	**Turbidity (field)**	**Sulfate**	**TDS**	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Cobalt**	**Lead**	**Lithium**	**Mercury**	**Molybdenum**	**Selenium**	**Thallium**	**Radium 226 and 228 (pCi/L)**	**Iron**	**Manganese**
Background (Upgradient) Wells																									
AD-1	05/26/16	0.346	36.5	5	<1	5.93	--	42	252	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.010	0.000033	<0.005	<0.005	<0.002	1.18	--	--
	07/27/16	0.350	39.6	4	<1	5.93	--	36	239	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.019	<0.000025	<0.005	<0.005	<0.002	0.9952	--	--
	09/29/16	0.332	15	5	<1	5.37	--	35	173	<0.005	<0.005	0.141	<0.001	<0.001	0.005	<0.005	<0.005	0.014	<0.000025	<0.005	<0.005	<0.002	1.38	--	--
	10/19/16	0.398	19.1	4	<1	5.15	--	42	192	<0.005	<0.005	0.114	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	1.141	--	--
	12/12/16	0.394	8.74	4	<1	5.18	--	40	200	<0.005	<0.005	0.072	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	0.719	--	--
	01/17/17	0.656	129	4	<1	7.13	--	68	538	<0.005	<0.005	0.410	<0.001	<0.001	<0.001	<0.005	<0.005	<0.001	<0.000025	<0.005	<0.005	<0.002	3.009	--	--
	02/23/17	0.700	147	9	<1	6.88	--	68	612	<0.005	<0.005	0.488	<0.001	<0.001	<0.001	<0.005	<0.005	0.001	<0.000025	<0.005	<0.005	<0.002	4.309	--	--
	06/07/17	0.449	15.1	4	<0.083	5.06	109	42	176	<0.00093	0.00114	0.09346	0.00037	<0.00007	0.00066	0.00077	<0.00068	0.00902	0.000007	<0.00029	0.0021	<0.00086	0.676	--	--
	10/06/17	--	--	--	--	5.25	97.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.352	12.1	3	<0.083	4.82	8.4	--	174	<0.00093	<0.00105	0.08823	0.00048	<0.00007	<0.00023	0.0008	<0.00068	0.00816	<0.000005	<0.00029	<0.00099	<0.00086	0.837	0.03	0.025
	Dissolved	*0.35*	*12*	--	--	4.82	8.4	--	--	*<0.00093*	*<0.00105*	*0.08582*	*0.00044*	*<0.00007*	*<0.00023*	*0.00083*	*<0.00068*	*0.00799*	*<0.000005*	*<0.00029*	*0.00197*	*<0.00086*	*0.531*	0.01	0.026
	05/24/18	0.345	10.2	4	<0.083	5.19	118	43	150	0.00317 J	<0.00105	0.0799	0.00039 J	<0.00007	<0.00023	0.00035 J	<0.00068	0.00814	0.000006 J	<0.00029	0.00138 J	<0.00086	1.983	--	--
	08/14/18	0.443	5.95	5	<0.083	5.18	102	44	160	0.00003 J	0.00021	0.063	0.000482	0.00002	0.00016	0.000797	0.000238	0.00708	0.000013 J	0.00021	0.0017	0.00003 J	1.10	--	--
AD-5	05/31/16	0.03	36.9	15	<1	6.38	--	123	337	<0.005	<0.005	0.057	<0.001	<0.001	<0.001	0.014	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	1.63	--	--
	07/28/16	0.04	44.7	16	<1	6.38	--	163	360	<0.005	<0.005	0.093	<0.001	<0.001	<0.001	0.015	<0.005	0.191	<0.000025	<0.005	<0.005	<0.002	4.75	--	--
	09/29/16	0.04	46.3	15	<1	5.29	--	190	416	<0.005	<0.005	0.087	<0.001	<0.001	<0.001	0.014	<0.005	0.186	<0.000025	<0.005	<0.005	<0.002	3.33	--	--
	10/20/16	0.05	50.7	14	<1	5.92	--	267	448	<0.005	<0.005	0.07	<0.001	<0.001	<0.001	0.009	<0.005	0.225	<0.000025	<0.005	<0.005	<0.002	2.319	--	--
	12/13/16	0.05	49.6	13	<1	6.29	--	233	484	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	0.013	<0.005	0.199	<0.000025	<0.005	<0.005	<0.002	2.182	--	--
	01/17/17	0.04	49.8	14	<1	6.27	--	234	438	<0.005	<0.005	0.047	<0.001	<0.001	<0.001	0.012	<0.005	0.239	<0.000025	<0.005	<0.005	<0.002	1.023	--	--
	02/23/17	0.04	33.0	15	<1	5.48	--	127	286	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	0.013	<0.005	0.166	<0.000025	<0.005	<0.005	<0.002	1.788	--	--
	06/07/17	0.05281	49.7	14	<0.083	5.96	867	82	300	<0.00093	0.00385	0.0877	0.00008	0.00039	0.00028	0.01193	<0.00068	0.124	<0.000005	<0.00029	<0.00099	<0.00086	2.32	--	--
	10/06/17	--	--	--	--	5.59	249	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.05063	30.1	21	<0.083	5.79	<100	--	248	<0.00093	<0.00105	0.07627	0.00014	0.00037	<0.00023	0.01907	<0.00068	0.118	<0.000005	<0.00029	<0.00099	<0.00086	1.495	14.4	0.45
	Dissolved	*0.03752*	*29.1*	--	--	5.79	<100	--	--	*<0.00093*	*<0.00105*	*0.06865*	*<0.00002*	*<0.00007*	*<0.00023*	*0.01747*	*<0.00068*	*0.119*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.043*	*2.051*	8.38	0.43
	05/24/18	0.05007	28.1	22	<0.083	6.22	17.8	60	242	<0.00093	<0.00105	0.07116	<0.00002	0.00023 J	0.0008 J	0.01424	<0.00068	0.121	<0.000005	<0.00029	<0.00099	<0.00086	1.946	--	--
	08/15/18	0.05	40.5	19	<0.083	6.23	57.1	240	428	0.00001 J	0.00169	0.0637	0.000055	0.000008 J	0.000072	0.0114	0.000079	0.147	<0.000005	0.00013	0.00008 J	<0.01	0.316	--	--
AD-17	05/26/16	0.121	200	43	<1	7.17	--	1,166	1,810	<0.005	<0.005	0.021	<0.001	0.002	0.001	0.063	<0.005	0.370	0.000032	<0.005	<0.005	<0.002	1.53	--	--
	07/27/16	0.119	195	32	<1	7.17	--	1,005	1,576	<0.005	<0.005	0.020	<0.001	0.004	0.001	0.068	<0.005	0.374	<0.000025	<0.005	<0.005	<0.002	2.78	--	--
	09/29/16	0.111	191	36	<1	6.17	--	1,055	1,663	<0.005	<0.005	0.031	<0.001	<0.001	0.003	0.058	<0.005	0.354	<0.000025	<0.005	<0.005	<0.002	2.358	--	--
	10/20/16	0.124	194	32	1.0	6.14	--	1,163	1,612	<0.005	<0.005	0.034	<0.001	0.002	0.004	0.065	<0.005	0.394	<0.000025	<0.005	<0.005	<0.002	2.224	--	--
	12/13/16	0.135	196	31	<1	6.03	--	1,096	1,560	<0.005	<0.005	0.017	<0.001	0.003	<0.001	0.068	<0.005	0.323	<0.000025	<0.005	<0.005	<0.002	2.384	--	--
	01/17/17	0.101	196	33	<1	5.96	--	1,445	1,686	<0.005	<0.005	0.014	<0.001	0.003	0.068	0.068	<0.005	0.341	<0.000025	<0.005	<0.005	<0.002	2.436	--	--
	02/22/17	0.135	189	30	<1	5.67	--	1,055	1,628	<0.005	<0.005	0.020	<0.001	0.002	0.001	0.073	<0.005	0.331	<0.000025	<0.005	<0.005	<0.002	2.288	--	--
	06/06/17	0.121	188	30	<0.083	5.81	156	1,105	1,578	<0.00093	<0.00105	0.01033	<0.00002	0.00606	<0.00023	0.0748	<0.00068	0.329	0.000013	<0.00029	<0.00099	<0.00086	1.598	--	--
	10/05/17	--	--	--	--	5.92	598	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.247	213	45	<0.083	5.51	<100	--	1,846	<0.00093	<0.00105	0.00978	<0.00002	0.00915	<0.00023	0.07451	<0.00068	0.306	<0.000005	<0.00029	0.00414	<0.00086	1.514	260	3.72
	Dissolved	*0.231*	*205*	--	--	5.51	<100	--	--	*<0.00093*	*<0.00105*	*0.00737*	*<0.00002*	*0.00609*	*<0.00023*	*0.07938*	*<0.00068*	*0.301*	*<0.000005*	*<0.00029*	*0.00515*	*0.02*	*1.57*	241	3.56
	05/24/18	0.239	193	39	<0.083	6.28	7.8	1,067	1,836	<0.00093	<0.00105	0.00965	<0.00002	0.00646	<0.00023	0.07173	<0.00068	0.308	<0.000005	<0.00029	<0.00099	<0.00086	1.939	--	--
	08/15/18	0.118	187	40	<0.083	5.60	418	1,170	1,750	0.00002 J	0.00183	0.0128	0.000069	0.00025	0.000604	0.0435	0.0011	0.243	0.000011 J	0.00035	0.0003	0.000074	2.35	--	--
Background Statistical Evaluation Summary - Upper Prediction Limits:[a]										0.005	0.005	0.36	0.00077	0.0065	0.004	0.075	0.005	0.39	0.000033	0.005	0.005	0.0013	4.21	--	--

Table 4-2
Groundwater Sampling Analytical Results (mg/L) - Primary Bottom Ash Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters																
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Point of Compliance Wells																										
AD-8	05/31/16	1.46	32.6	36	1	6.91	--	217	524	<0.005	<0.005	0.034	<0.001	<0.001	0.002	0.007	<0.005	0.122	<0.000025	<0.005	<0.005	<0.002	1.046	--	--
	07/28/16	1.44	25.9	26	<1	6.91	--	202	469	<0.005	<0.005	0.026	<0.001	<0.001	<0.001	0.009	<0.005	0.098	<0.000025	<0.005	<0.005	<0.002	1.584	--	--
	09/29/16	1.51	24.3	28	<1	7.65	--	186	432	<0.005	<0.005	0.023	<0.001	<0.001	<0.001	0.007	<0.005	0.111	<0.000025	<0.005	<0.005	<0.002	6.3	--	--
	10/20/16	1.54	25.9	30	<1	6.07	--	184	424	<0.005	<0.005	0.024	<0.001	<0.001	<0.001	0.007	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	0.345	--	--
	12/12/16	1.53	23.6	27	<1	5.62	--	168	442	<0.005	<0.005	0.021	<0.001	<0.001	<0.001	0.007	<0.005	0.11	<0.000025	<0.005	<0.005	<0.002	1.083	--	--
	01/19/17	1.53	18.7	24	1	6.21	--	153	352	<0.005	<0.005	0.02	<0.001	<0.001	<0.001	0.006	<0.005	0.094	<0.000025	<0.005	<0.005	<0.002	0.823	--	--
	02/22/17	1.67	19.3	22	<1	6.78	--	163	356	<0.005	<0.005	0.019	<0.001	<0.001	<0.001	0.006	<0.005	0.092	<0.000025	<0.005	<0.005	<0.002	0.536	--	--
	06/06/17	1.39	17.4	22	0.6628	5.63	54	151	368	<0.00093	<0.00105	0.01908	<0.00002	<0.00007	<0.00023	0.00386	<0.00068	0.09491	0.000008	<0.00029	<0.00099	<0.00086	1.0735	--	--
	10/05/17	--	--	--	--	6.68	41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/18	1.29	17.2	22	0.716	6.07	3.0	--	368	<0.00093	<0.00105	0.02283	0.00004	<0.00007	<0.00023	0.00521	<0.00068	0.08418	0.000009	<0.00029	<0.00099	<0.00086	1.106	0.673	0.388
	Dissolved	*1.31*	*17.1*	--	--	6.07	3.0	--	--	*<0.00093*	*<0.00105*	*0.02046*	*<0.00002*	*<0.00007*	*<0.00023*	*0.00513*	*<0.00068*	*0.08356*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*0.5773*	< 0.01	0.363
	05/23/18	--	--	--	0.501 J	6.20	*48.2*	--	--	0.00319 J	<0.00105	0.02212	<0.00002	<0.00007	<0.00023	0.00319 J	<0.00068	0.0956	<0.000005	<0.00029	0.00175 J	<0.00086	0.3366	--	--
	8/15/18[b]	1.30	15.0	24	0.615 J	6.77	104	122	288	0.00001 J	0.00031	0.0212	0.000008 J	0.000002 J	0.00005	0.00536	0.000039	0.0555	0.000007 J	0.00016	0.00007 J	0.000129	3.44	--	--
AD-9	05/31/16	0.12	229	88	<1	6.32	--	1,352	2,541	<0.005	<0.005	0.051	<0.001	0.001	<0.001	0.027	<0.005	1.32	<0.000025	<0.005	<0.005	<0.002	2.95	--	--
	07/28/16	0.105	255	98	<1	6.32	--	1,464	2,564	<0.005	<0.005	0.031	<0.001	0.002	<0.001	0.022	<0.005	1.38	0.000045	<0.005	0.008	<0.002	1.447	--	--
	09/29/16	0.115	220	86	<1	4.72	--	1,301	2,448	<0.005	<0.005	0.033	<0.001	<0.001	<0.001	0.012	<0.005	1.17	<0.000025	<0.005	<0.005	<0.002	3.199	--	--
	10/19/16	0.109	228	76	1	5.22	--	1,350	2,494	<0.005	<0.005	0.026	<0.001	<0.001	<0.001	0.016	<0.005	1.44	<0.000025	<0.005	<0.005	<0.002	1.311	--	--
	12/12/16	0.108	250	92	<1	5.72	--	1,639	2,667	<0.005	<0.005	0.027	<0.001	0.002	<0.001	0.024	<0.005	1.33	<0.000025	<0.005	<0.005	<0.002	3.0	--	--
	01/19/17	0.312	91.1	54	<1	5.43	--	884	1,360	<0.005	<0.005	0.098	0.002	<0.001	<0.001	0.042	<0.005	0.634	<0.000025	<0.005	<0.005	<0.002	2.349	--	--
	02/22/17	0.1	258	86	<1	5.77	--	1,774	2,662	<0.005	<0.005	0.022	<0.001	<0.001	<0.001	0.024	<0.005	1.41	<0.000025	<0.005	<0.005	<0.002	2.32	--	--
	06/06/17	0.146	191	19	<0.083	4.61	100	105	308	<0.00093	<0.00105	0.04227	0.00077	0.00222	<0.00023	0.02416	<0.00068	1.00	0.000006	<0.00029	<0.00099	<0.00086	1.586	--	--
	10/05/17	--	--	--	--	5.78	102	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	0.08607	10.5	85	<0.083	4.20	<100		1,972	<0.00093	<0.00105	0.04937	0.00134	0.00023	<0.00023	0.01628	<0.00068	0.217	<0.000005	<0.00029	<0.00099	<0.00086	1.582	0.446	0.378
	Dissolved	*0.07126*	*10.2*	--	--	4.20	<100	--	--	*<0.00093*	*<0.00105*	*0.04695*	*0.00122*	*0.00012*	*<0.00023*	*0.01592*	*<0.00068*	*0.204*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.549*	0.166	0.369
	05/23/18	--	--	--	<0.083	5.30	44.6	--	--	<0.00093	<0.00105	0.03045	0.00032 J	0.00288	<0.00023	0.0267	<0.00068	1.20	<0.000005	<0.00029	<0.00099	0.00846	2.556	--	--
	8/15/18[b]	0.198	230	103	<0.083	4.96	237	1,910	2,694	<0.01	0.00168	0.0242	0.000268	0.00006	0.00042	0.0111	0.000262	0.851	0.000013 J	0.00011	0.0003	0.000062	1.864	--	--
AD-15	05/31/16	0.329	5.09	30	<1	5.58	--	24	188	<0.005	0.012	0.215	<0.001	<0.001	0.017	0.011	0.007	0.017	0.000054	<0.005	<0.005	<0.002	2.28	--	--
	07/28/16	0.407	3.83	34	<1	5.58	--	28	196	<0.005	0.006	0.124	<0.001	<0.001	0.004	0.006	<0.005	0.021	<0.000025	<0.005	<0.005	<0.002	1.322	--	--
	09/29/16	0.360	13.7	28	<1	4.57	--	23	367	<0.005	0.131	1.93	0.015	0.007	0.28	0.134	0.161	0.149	0.000707	<0.005	0.014	<0.002	9.92	--	--
	10/19/16	0.152	4.57	26	<1	4.35	--	17	152	<0.005	0.023	0.415	0.002	<0.001	0.054	0.019	0.022	0.036	0.0001	<0.005	<0.005	<0.002	3.567	--	--
	12/12/16	0.334	3.60	26	<1	4.67	--	19	204	<0.005	0.006	0.184	<0.001	<0.001	0.015	0.010	<0.005	0.013	0.000026	<0.005	<0.005	<0.002	3.36	--	--
	01/19/17	0.413	3.35	32	<1	5.77	--	25	176	<0.005	0.006	0.153	<0.001	<0.001	0.009	0.007	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	2.386	--	--
	02/22/17	0.100	4.21	20	<1	4.95	--	8	88	<0.005	0.020	0.353	0.002	<0.001	0.049	0.020	0.019	0.025	0.000058	<0.005	<0.005	<0.002	2.261	--	--
	06/06/17	0.321	3.57	27	<0.083	4.83	246	19	184	<0.00093	0.00854	0.166	0.00061	0.00048	0.01235	0.00844	0.00298	0.0108	0.000022	<0.00029	0.00271	<0.00086	2.491	--	--
	10/05/17	--	--	--	--	5.94	208	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/18	0.08009	2.49	22	<0.083	4.60	7.32		94	<0.00093	0.00222	0.08419	0.00024	<0.00007	<0.00023	0.00403	<0.00068	0.00395	<0.000005	<0.00029	<0.00099	<0.00086	1.749	6.64	0.036
	Dissolved	*0.05773*	*2.49*	--	--	4.60	7.32	--	--	*<0.00093*	*<0.00105*	*0.08405*	*0.00019*	*<0.00007*	*<0.00023*	*0.00346*	*<0.00068*	*0.00378*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*0.748*	< 0.01	0.034
	Field Filtered[c]	*0.301*	*3.03*	*35*	*<0.083*	4.60	7.32	--	*8*	*<0.00093*	*0.00216*	*0.08611*	*0.00012*	*<0.00007*	*<0.00023*	*0.00421*	*<0.00068*	*0.00498*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.630*	7.09	0.061
	FF Dissolved[c]	*0.309*	*3*	--	--	4.60	7.32	--	--	*<0.00093*	*<0.00105*	*0.08373*	*0.00024*	*<0.00007*	*<0.00023*	*0.0038*	*<0.00068*	*0.00516*	*<0.000005*	*0.00048*	*<0.00099*	*<0.00086*	*5.743*	<0.01	0.062
	05/23/18	--	--	--	<0.083	4.76	147	--	--	<0.00093	0.00256 J	0.102	0.00003 J	0.0001 J	0.00263	0.00474 J	<0.00068	0.00562	<0.000005	<0.00029	0.00154 J	0.00137 J	1.46	--	--
	8/15/18[b]	0.341	3.04	37	<0.083	4.59	249	24	174	0.00003 J	0.00326	0.0852	0.000116	0.00001 J	0.000481	0.00371	0.000438	0.00338	0.000008 J	0.00005 J	0.0009	0.00009	1.076	--	--

Table 4-2
Groundwater Sampling Analytical Results (mg/L) - Primary Bottom Ash Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Supplemental Downgradient Monitoring Wells																									
AD-10	5/16/2018	0.08311	15.5	40	<0.083	3.72	<100	--	280	<0.00093	0.0022	0.03855	0.00166	0.00033	<0.00023	0.02432	<0.00068	0.316	<0.000005	<0.00029	<0.00099	0.00098	1.704	0.338	0.25
	Dissolved	*0.07733*	*15.3*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.03712*	*0.00149*	*0.00009*	*<0.00023*	*0.02412*	*<0.00068*	*0.296*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.505*	0.282	0.251
Supplemental Sidegradient Monitoring Wells																									
MW-9	5/15/2018	0.578	44.8	93	<0.083	4.74	57.4	--	780	0.00097	<0.00105	0.01661	0.00021	0.00019	<0.00023	0.03083	<0.00068	0.03225	0.000127	<0.00029	<0.00099	<0.00086	0.779	0.142	0.306
	Dissolved	*0.556*	*44.7*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.01588*	*0.00015*	*0.00036*	*<0.00023*	*0.03189*	*0.00813*	*0.03151*	*0.00015*	*<0.00029*	*<0.00099*	*<0.00086*	*0.2578*	< 0.01	0.308
MW-10	5/15/2018	0.707	59.3	5	<0.083	6.68	1.7	--	346	<0.00093	0.00128	0.08634	0.00006	<0.00007	<0.00023	0.00385	<0.00068	0.01001	<0.000005	0.00079	0.01898	<0.00086	0.969	0.101	0.054
	Dissolved	*0.689*	*59.8*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.08253*	*<0.00002*	*<0.00007*	*<0.00023*	*0.00064*	*<0.00068*	*0.00924*	*<0.000005*	*0.00082*	*0.01651*	*<0.00086*	*1.026*	< 0.01	0.002
Reference Values:																									
MCL					4					0.006	0.01	2	0.004	0.005	0.1				0.002		0.05	0.002	5[e]		
Rule Specified																0.006	0.015	0.04		0.1					
Background Limit					1					0.005	0.005	0.36	0.00077	0.0065[d]	0.004	0.075[d]	0.005	0.39[d]	0.000033	0.005	0.005	0.0013	4.21[e]		
Interwell Background Value(s) (UPL, LPL where applicable) AD-8, AD-9, AD-15		0.652				4.81-6.99																			
Intrawell Background Value (UPL) AD-8			35.68	38.3	1.034			236	569																
Intrawell Background Value (UPL) AD-9			350	139.3	0.7259			2527	3147																
Intrawell Background Value (UPL) AD-15			5.71	38.42	1			35.6	388																

NOTES:
All concentration data are provided in milligrams per liter (mg/L) unless otherwise noted.
J = Analyte was positively identified, though the quantitation was below Reporting Limit.
MCL = Maximum contaminant level
LPL = Lower prediction limit
UPL = Upper prediction limit
pCi/L = PicoCuries per liter
-- = Not analyzed
a = Data taken from Geosyntec "Statistical Analysis Summary, Primary Bottom Ash Pond" dated January 8, 2019.
b = Some inorganic analyte groundwater samples collected 9/17/18.
c = Sample ID "AD-15 DUP" was field filtered (FF) using a 5 micron filter.
d = Calculated Upper Tolerance Limit is higher than MCL.
e = Data is "Combined Radium, Total".
▨ Denotes groundwater sample collected by ARCADIS using low-flow methods.
Unless otherwise noted, values shown are total (unfiltered) analyses.
Dissolved (0.45-micron lab filtered) parameter concentrations shown in italics.

Table 4-3
Groundwater Sampling Analytical Results (mg/L) - Landfill
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Background (Upgradient) Wells																									
AD-5	05/31/16	0.03	36.9	15	<1	6.38	--	123	337	<0.005	<0.005	0.057	<0.001	<0.001	<0.001	0.014	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	1.63	--	--
	07/28/16	0.04	44.7	16	<1	6.38	--	163	360	<0.005	<0.005	0.093	<0.001	<0.001	<0.001	0.015	<0.005	0.191	<0.000025	<0.005	<0.005	<0.002	4.75	--	--
	09/29/16	0.04	46.3	15	<1	5.29	--	190	416	<0.005	<0.005	0.087	<0.001	<0.001	<0.001	0.014	<0.005	0.186	<0.000025	<0.005	<0.005	<0.002	3.33	--	--
	10/20/16	0.05	50.7	14	<1	5.92	--	267	448	<0.005	<0.005	0.07	<0.001	<0.001	<0.001	0.009	<0.005	0.225	<0.000025	<0.005	<0.005	<0.002	2.319	--	--
	12/13/16	0.05	49.6	13	<1	6.29	--	233	484	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	0.013	<0.005	0.199	<0.000025	<0.005	<0.005	<0.002	2.182	--	--
	01/17/17	0.04	49.8	14	<1	6.27	--	234	438	<0.005	<0.005	0.047	<0.001	<0.001	<0.001	0.012	<0.005	0.239	<0.000025	<0.005	<0.005	<0.002	1.023	--	--
	02/23/17	0.04	33.0	15	<1	5.48	--	127	286	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	0.013	<0.005	0.166	<0.000025	<0.005	<0.005	<0.002	1.788	--	--
	06/07/17	0.05281	49.7	14	<0.083	5.96	867	82	300	<0.00093	0.00385	0.0877	0.00008	0.00039	0.00028	0.01193	<0.00068	0.124	<0.000005	<0.00029	<0.00099	<0.00086	2.32	--	--
	10/06/17	--	--	--	--	5.59	249	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.05063	30.1	21	<0.083	5.79	<100	--	248	<0.00093	<0.00105	0.07627	0.00014	0.00037	<0.00023	0.01907	<0.00068	0.118	<0.000005	<0.00029	<0.00099	<0.00086	1.495	14.4	0.45
	Dissolved	*0.03752*	*29.1*	--	--	5.79	<100	--	--	*<0.00093*	*<0.00105*	*0.06865*	*<0.00002*	*<0.00007*	*<0.00023*	*0.01747*	*<0.00068*	*0.119*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.043*	*2.051*	8.38	0.43
	05/24/18	0.05007	28.1	22	<0.083	6.22	17.8	60	242	<0.00093	<0.00105	0.07116	<0.00002	0.00023 J	0.0008 J	0.01424	<0.00068	0.121	<0.000005	<0.00029	<0.00099	<0.00086	1.946	--	--
	08/15/18	0.05	40.5	19	<0.083	6.23	57.1	240	428	0.00001 J	0.00169	0.0637	0.000055	0.000008 J	0.000072	0.0114	0.000079	0.147	<0.000005	0.00013	0.00008 J	<0.01	0.316	--	--
AD-18	05/26/16	0.146	409	422	<1	5.1	--	5,135	10,000	<0.005	<0.005	0.012	0.014	0.003	<0.001	0.922	<0.005	2.07	0.000168	<0.005	0.006	0.003	12.6	--	--
	07/27/16	0.148	457	432	2	5.1	--	4,930	9,476	<0.005	<0.005	0.019	0.005	0.002	<0.001	0.734	<0.005	1.94	0.000091	<0.005	0.007	0.003	10.62	--	--
	09/29/16	0.156	469	637	4	5.59	--	4,632	9,569	<0.005	<0.005	0.02	0.004	<0.001	<0.001	0.666	<0.005	1.86	0.000117	<0.005	0.007	<0.002	7.05	--	--
	10/20/16	0.188	498	876	0.8664	5.7	--	5,537	9,540	<0.005	<0.005	0.021	0.002	0.001	<0.001	0.569	<0.005	2.06	0.000053	<0.005	<0.005	<0.002	5.82	--	--
	12/13/16	0.178	510	695	5	5.75	--	4,382	8,912	<0.005	<0.005	0.021	0.007	0.001	<0.001	0.641	<0.005	1.74	0.00005	<0.005	<0.005	<0.002	9.6	--	--
	01/17/17	0.050	412	159	5	4.49	--	5,414	8,562	<0.005	0.01	0.014	0.022	0.001	<0.001	0.929	<0.005	1.95	0.000224	<0.005	<0.005	0.002	22.51	--	--
	02/22/17	0.090	401	151	6	4.37	--	5,169	8,412	<0.005	<0.005	0.014	0.026	0.002	<0.001	0.961	<0.005	1.82	0.000107	<0.005	<0.005	0.00228	19.11	--	--
	06/06/17	0.125	428	304	6.53	4.27	121	5,920	9,394	<0.00093	0.00331	0.01038	0.01883	0.00303	<0.00023	0.940	<0.00068	2.15	0.000113	<0.00029	0.00212	<0.00086	16.12	--	--
	10/05/17	--	--	--	--	5.87	165	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.163	433	362	9.4	3.61	104.1	--	9,952	0.00224	0.00276	0.00813	0.01733	0.0036	0.00098	0.928	<0.00068	2.07	0.000043	<0.00029	0.00194	0.00144	19.95	19.7	14.1
	Dissolved	*0.153*	*423*	--	--	--	--	--	--	*0.00467*	*0.00189*	*0.00748*	*0.01676*	*0.00316*	*<0.00023*	*0.898*	*<0.00068*	*2.06*	*0.000012*	*<0.00029*	*0.00135*	*0.01466*	*18.09*	19.1	13.7
Background Statistical Evaluation Summary - Upper Prediction Limits:[a]										0.005	0.005	0.36	0.00077	0.0065	0.004	0.075	0.005	0.39	0.000033	0.005	0.005	0.002	4.21	---	---
Point of Compliance Wells																									
AD-11	05/31/16	2.47	8.47	9	2	5.21	--	518	388	<0.005	<0.005	0.014	0.004	<0.001	0.003	0.026	<0.005	0.032	<0.000025	<0.005	<0.005	<0.002	1.77	--	--
	07/28/16	2.83	8.88	10	2	5.21	--	596	1,000	<0.005	<0.005	0.012	0.004	<0.001	<0.001	0.026	<0.005	0.047	<0.000025	<0.005	<0.005	<0.002	2.23	--	--
	09/29/16	3.4	10.7	12	2	4.08	--	683	1,065	<0.005	<0.005	0.052	0.005	<0.001	0.007	0.03	<0.005	0.047	<0.000025	<0.005	<0.005	<0.002	3.92	--	--
	10/19/16	3.77	8.78	11	<1	3.68	--	706	1,024	<0.005	<0.005	0.02	0.005	<0.001	0.002	0.027	<0.005	0.047	<0.000025	<0.005	<0.005	<0.002	2.56	--	--
	12/12/16	3.36	8.98	10	2	3.75	--	548	1,044	<0.005	<0.005	0.013	0.004	<0.001	<0.001	0.025	<0.005	0.041	<0.000025	<0.005	<0.005	<0.002	1.569	--	--
	01/17/17	2.81	10.3	11	2	4.41	--	760	1,048	<0.005	<0.005	0.013	0.004	<0.001	<0.001	0.025	<0.005	0.046	<0.000025	<0.005	<0.005	<0.002	1.082	--	--
	02/22/17	2.88	9.31	10	2	4.34	--	558	876	<0.005	<0.005	0.019	0.004	<0.001	0.002	0.024	<0.005	0.035	<0.000025	<0.005	<0.005	<0.002	1.45	--	--
	06/06/17	2.79	9.93	10	1.366	3.86	219	556	960	<0.00093	0.00123	0.01012	0.00279	0.00041	0.00032	0.02216	<0.00068	0.03654	<0.000005	<0.00029	<0.00099	<0.00086	1.902	--	--
	10/05/17	--	--	--	--	4.43	162	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	1.48	4.37	10	<0.083	3.77	75.3		558	0.00417	0.00127	0.01281	0.00148	0.00053	0.00041	0.00935	<0.00068	0.01978	<0.000005	0.00094	0.00103	<0.00086	1.264	1.35	0.063
	Dissolved	*1.45*	*4.28*	--	--	3.77	75.3	--	--	*<0.00093*	*0.00278*	*0.01202*	*0.00098*	*<0.00007*	*<0.00023*	*0.00877*	*<0.00068*	*0.01836*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.656*	1.25	0.062
	05/23/18	--	--	--	<0.083	*4.05*	*49.8*	--	--	<0.00093	0.0026 J	0.01627	0.00089 J	0.00018 J	0.0008 J	0.00863	<0.00068	0.01875	0.000007 J	<0.00029	0.00134 J	0.046	1.912	--	--
	08/15/18	1.84	6.61	15	<0.083	4.73	112	410	720	--	0.00105	0.0119	0.00118	0.00037	0.000257	0.0153	--	0.0175	<0.000005	--	0.0024	0.0002	2.6	--	--

Table 4-3
Groundwater Sampling Analytical Results (mg/L) - Landfill
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
AD-13	05/31/16	1.19	8.02	12	<1	6.05		177	900	<0.005	<0.005	0.062	<0.001	<0.001	<0.001	<0.005	<0.005	0.011	<0.000025	<0.005	<0.005	<0.002	1.22	--	--
	07/27/16	1.23	3.7	15	1	6.05		187	--	<0.005	<0.005	0.036	<0.001	<0.001	<0.001	<0.005	<0.005	0.026	<0.000025	<0.005	<0.005	<0.002	1.601	--	--
	09/29/16	1.37	2.7	17	1	4.56		207	431	<0.005	<0.005	0.04	<0.001	<0.001	<0.001	<0.005	<0.005	0.02	<0.000025	<0.005	<0.005	<0.002	2.213	--	--
	10/19/16	1.67	3.66	19	1	4.34		226	482	<0.005	<0.005	0.03	<0.001	<0.001	<0.001	<0.005	<0.005	0.022	<0.000025	<0.005	<0.005	<0.002	3.662	--	--
	12/05/16	--	--	--	--	--		--	532	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/16	1.96	3.77	18	1	4.79		287	596	<0.005	<0.005	0.051	0.001	<0.001	0.007	0.007	<0.005	0.025	<0.000025	<0.005	<0.005	<0.002	2.27	--	--
	01/19/17	0.402	33.5	7	<1	5.38		90	222	<0.005	0.006	0.112	<0.001	<0.001	0.004	<0.005	<0.005	0.004	<0.000025	<0.005	<0.005	<0.002	2.228	--	--
	02/23/17	1.27	10.3	13	<1	5.06		183	392	<0.005	<0.005	0.041	<0.001	<0.001	<0.001	<0.005	<0.005	0.015	<0.000025	<0.005	<0.005	<0.002	1.556	--	--
	06/06/17	1.68	3.03	15	0.6679	4.22	171	244	494	0.00153	<0.00105	0.01712	0.00089	0.00014	<0.00023	0.00624	<0.00068	0.02082	<0.000005	<0.00029	0.00103	<0.00086	1.565	--	--
	10/06/17	--	--	--	--	4.61	173	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	1.42	7.48	10	0.5362	4.20	1.4		532	<0.00093	<0.00105	0.0216	0.00088	0.00011	<0.00023	0.00809	<0.00068	0.02603	<0.000005	<0.00029	<0.00099	<0.00086	2.064	0.858	0.046
	Dissolved	*1.41*	*7.31*	--	--	4.20	1.4	--	--	*<0.00093*	*<0.00105*	*0.02097*	*0.0008*	*<0.00007*	*<0.00023*	*0.00784*	*<0.00068*	*0.02439*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.407*	0.712	0.045
	05/23/18	--	--	--	0.6534 J	*4.52*	*52.7*	--	--	<0.00093	<0.00105	0.02653	0.00087 J	<0.00007	0.00073 J	0.00937	<0.00068	0.0291	0.000008 J	<0.00029	<0.00099	<0.043	2.16	--	--
	08/14/18	1.49	10.1	18	0.7442	4.82	131	316	620	--	0.00137	0.0169	0.000971	0.00031	0.000503	0.0131	--	0.0321	<0.000005	--	0.0017	0.000277	4.0	--	--
AD-14	05/31/16	1.28	2.88	4	<1	4.75	--	115	285	<0.005	<0.005	0.031	<0.001	<0.001	<0.001	0.010	<0.005	0.012	0.00003	<0.005	<0.005	<0.002	0.87	--	--
	07/27/16	1.14	2.51	5	<1	4.75	--	111	267	<0.005	<0.005	0.084	<0.001	<0.001	0.001	0.009	<0.005	0.024	<0.000025	<0.005	<0.005	<0.002	1.487	--	--
	09/29/16	1.14	1.19	5	<1	4.17	--	111	252	<0.005	<0.005	0.03	<0.001	<0.001	<0.001	0.009	<0.005	0.015	<0.000025	<0.005	<0.005	<0.002	4.817	--	--
	10/19/16	1.25	2.48	4	<1	3.88	--	118	276	<0.005	<0.005	0.039	<0.001	0.001	<0.001	0.009	<0.005	0.014	<0.000025	<0.005	<0.005	<0.002	1.972	--	--
	12/12/16	1.25	2.41	5	<1	4.11	--	101	296	<0.005	<0.005	0.047	<0.001	0.001	0.001	0.009	<0.005	0.013	0.000037	<0.005	<0.005	<0.002	1.271	--	--
	01/17/17	0.915	10.3	4	<1	6.07	--	92	254	<0.005	<0.005	0.038	<0.001	<0.001	<0.001	<0.005	<0.005	0.013	<0.000025	<0.005	<0.005	<0.002	1.825	--	--
	02/22/17	1.06	9.48	4	<1	5.39	--	90	212	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	<0.005	<0.005	0.012	<0.000025	<0.005	<0.005	<0.002	0.512	--	--
	06/06/17	1.26	7.69	6	<0.083	4.77	167	108	256	<0.00093	<0.00105	0.04483	0.00038	0.00067	0.00127	0.00678	<0.00068	0.0127	0.000021	<0.00029	0.00261	<0.00086	1.138	--	--
	10/06/17	--	--	--	--	4.57	150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	1.61	4.67	11	<0.083	4.11	5.1	--	332	<0.00093	<0.00105	0.03161	0.00094	0.00204	<0.00023	0.01501	<0.00068	0.01638	0.000137	<0.00029	0.00221	<0.00086	1.097	0.09	0.008
	Dissolved	*1.56*	*4.55*	--	--	4.11	5.1	--	--	*<0.00093*	*<0.00105*	*0.02938*	*0.00094*	*0.00193*	*<0.00023*	*0.01476*	*<0.00068*	*0.01523*	*0.000149*	*<0.00029*	*0.00387*	*<0.00086*	*0.5903*	0.06	0.007
	05/23/18	--	--	--	<0.083	4.17	43.2	--	--	<0.00093	<0.00105	0.02817	0.00078 J	0.00161	<0.00023	0.01434	<0.00068	0.0152	0.000145	<0.00029	0.00362	<0.043	1.601	--	--
	08/14/18	1.51	4.51	12	<0.083	4.27	198	204	384	--	0.00039	0.024	0.000854	0.00199	0.000276	0.0176	--	0.011	0.000181	--	0.0037	0.000242	1.5	--	--
Supplemental Downgradient Monitoring Well																									
AD-10	5/16/2018	0.08311	15.5	40	<0.083	3.72	<100	--	280	<0.00093	0.0022	0.03855	0.00166	0.00033	<0.00023	0.02432	<0.00068	0.316	<0.000005	<0.00029	<0.00099	0.00098	1.704	0.338	0.25
	Dissolved	*0.07733*	*15.3*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.03712*	*0.00149*	*0.00009*	*<0.00023*	*0.02412*	*<0.00068*	*0.296*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.505*	0.282	0.251
Supplemental Sidegradient Monitoring Well																									
Temp-1	5/17/2018	0.662	26.2	34	<0.083	4.90	23.8	--	556	<0.00093	<0.00105	0.07752	0.00058	<0.00007	0.00102	0.01058	<0.00068	0.01075	<0.000005	<0.00029	<0.00099	<0.00086	1.277	1.94	0.203
	Dissolved	*0.621*	*24.6*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.06778*	*0.00042*	*<0.00007*	*<0.00023*	*0.00946*	*<0.00068*	*0.00986*	*<0.000005*	*<0.00029*	*<0.00099*	*0.00191*	*2.278*	0.813	0.192
Reference Values:																									
MCL					4					0.006	0.01	2	0.004	0.005	0.1				0.002		0.05	0.002	5[c]		
Rule Specified																0.006	0.015	0.04		0.1					
Background Limit					1					0.005	0.005	0.36	0.00077	0.0065[b]	0.004	0.075[b]	0.005	0.39[b]	0.000033	0.005	0.005	0.0013	4.21[c]		
Interwell Background Value(s) (UPL, LPL where applicable) AD-8, AD-9, AD-15		0.652				4.81-6.99																			
Intrawell Background Value (UPL) AD-8			35.68	38.3	1.034			236	569																
Intrawell Background Value (UPL) AD-9			350	139.3	0.7259			2527	3147																
Intrawell Background Value (UPL) AD-15			5.71	38.42	1			35.6	388																

NOTES:
All concentration data are provided in milligrams per liter (mg/L) unless otherwise noted.
J = Analyte was positively identified, though the quantitation was below Reporting Limit.
MCL = Maximum contaminant level
LPL = Lower prediction limit
UPL = Upper prediction limit
pCi/L = PicoCuries per liter
-- - Not analyzed
a = Data taken from Geosyntec "Statistical Analysis Summary, Primary Bottom Ash Pond" dated January 8, 2019.
b = Calculated Upper Tolerance Limit is higher than MCL.
c = Data is "Combined Radium, Total".
▨ Denotes groundwater sample collected by ARCADIS using low-flow methods.
Unless otherwise noted, values shown are total (unfiltered) analyses.
Dissolved (0.45-micron lab filtered) parameter concentrations shown in italics.

Table 4-4
Groundwater Sampling Analytical Results (mg/L) - Bottom Ash Storage Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

		Appendix III Parameters								Appendix IV Parameters															
Well	**Date Sampled**	**Boron (total)**	**Calcium (total)**	**Chloride**	**Fluoride**	**pH (field)**	**Turbidity (field)**	**Sulfate**	**TDS**	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Cobalt**	**Lead**	**Lithium**	**Mercury**	**Molybdenum**	**Selenium**	**Thallium**	**Radium 226 and 228 (pCi/L)**	**Iron**	**Manganese**
Background (Upgradient) Wells																									
AD-1	05/26/16	0.346	36.5	5	<1	5.93	--	42	252	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.010	0.000033	<0.005	<0.005	<0.002	1.18	--	--
	07/27/16	0.350	39.6	4	<1	5.93	--	36	239	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.019	<0.000025	<0.005	<0.005	<0.002	0.9952	--	--
	09/29/16	0.332	15	5	<1	5.37	--	35	173	<0.005	<0.005	0.141	<0.001	<0.001	0.005	<0.005	<0.005	0.014	<0.000025	<0.005	<0.005	<0.002	1.38	--	--
	10/19/16	0.398	19.1	4	<1	5.15	--	42	192	<0.005	<0.005	0.114	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	1.141	--	--
	12/12/16	0.394	8.74	4	<1	5.18	--	40	200	<0.005	<0.005	0.072	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	0.719	--	--
	01/17/17	0.656	129	4	<1	7.13	--	68	538	<0.005	<0.005	0.410	<0.001	<0.001	<0.001	<0.005	<0.005	<0.001	<0.000025	<0.005	<0.005	<0.002	3.009	--	--
	02/23/17	0.700	147	9	<1	6.88	--	68	612	<0.005	<0.005	0.488	<0.001	<0.001	<0.001	<0.005	<0.005	0.001	<0.000025	<0.005	<0.005	<0.002	4.309	--	--
	06/07/17	0.449	15.1	4	<0.083	5.06	109	42	176	<0.00093	0.00114	0.09346	0.00037	<0.00007	0.00066	0.00077	<0.00068	0.00902	0.000007	<0.00029	0.0021	<0.00086	0.676	--	--
	10/06/17	--	--	--	--	5.25	97.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.352	12.1	3	<0.083	4.82	8.4	--	174	<0.00093	<0.00105	0.08823	0.00048	<0.00007	<0.00023	0.0008	<0.00068	0.00816	<0.000005	<0.00029	<0.00099	<0.00086	0.837	0.03	0.025
	Dissolved	*0.35*	*12*	--	--	4.82	8.4	--	--	*<0.00093*	*<0.00105*	*0.08582*	*0.00044*	*<0.00007*	*<0.00023*	*0.00083*	*<0.00068*	*0.00799*	*<0.000005*	*<0.00029*	*0.00197*	*<0.00086*	*0.531*	0.01	0.026
	05/24/18	0.345	10.2	4	<0.083	5.19	118	43	150	0.00317 J	<0.00105	0.0799	0.00039 J	<0.00007	<0.00023	0.00035 J	<0.00068	0.00814	0.000006 J	<0.00029	0.00138 J	<0.00086	1.983	--	--
	08/14/18	0.443	5.95	5	<0.083	5.18	102	44	160	0.00003 J	0.00021	0.063	0.000482	0.00002	0.00016	0.000797	0.000238	0.00708	0.000013 J	0.00021	0.0017	0.00003 J	1.10	--	--
AD-5	05/31/16	0.03	36.9	15	<1	6.38	--	123	337	<0.005	<0.005	0.057	<0.001	<0.001	<0.001	0.014	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	1.63	--	--
	07/28/16	0.04	44.7	16	<1	6.38	--	163	360	<0.005	<0.005	0.093	<0.001	<0.001	<0.001	0.015	<0.005	0.191	<0.000025	<0.005	<0.005	<0.002	4.75	--	--
	09/29/16	0.04	46.3	15	<1	5.29	--	190	416	<0.005	<0.005	0.087	<0.001	<0.001	<0.001	0.014	<0.005	0.186	<0.000025	<0.005	<0.005	<0.002	3.33	--	--
	10/20/16	0.05	50.7	14	<1	5.92	--	267	448	<0.005	<0.005	0.07	<0.001	<0.001	<0.001	0.009	<0.005	0.225	<0.000025	<0.005	<0.005	<0.002	2.319	--	--
	12/13/16	0.05	49.6	13	<1	6.29	--	233	484	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	0.013	<0.005	0.199	<0.000025	<0.005	<0.005	<0.002	2.182	--	--
	01/17/17	0.04	49.8	14	<1	6.27	--	234	438	<0.005	<0.005	0.047	<0.001	<0.001	<0.001	0.012	<0.005	0.239	<0.000025	<0.005	<0.005	<0.002	1.023	--	--
	02/23/17	0.04	33.0	15	<1	5.48	--	127	286	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	0.013	<0.005	0.166	<0.000025	<0.005	<0.005	<0.002	1.788	--	--
	06/07/17	0.05281	49.7	14	<0.083	5.96	867	82	300	<0.00093	0.00385	0.0877	0.00008	0.00039	0.00028	0.01193	<0.00068	0.124	<0.000005	<0.00029	<0.00099	<0.00086	2.32	--	--
	10/06/17	--	--	--	--	5.59	249	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.05063	30.1	21	<0.083	5.79	<100	--	248	<0.00093	<0.00105	0.07627	0.00014	0.00037	<0.00023	0.01907	<0.00068	0.118	<0.000005	<0.00029	<0.00099	<0.00086	1.495	14.4	0.45
	Dissolved	*0.03752*	*29.1*	--	--	5.79	<100	--	--	*<0.00093*	*<0.00105*	*0.06865*	*<0.00002*	*<0.00007*	*<0.00023*	*0.01747*	*<0.00068*	*0.119*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.043*	*2.051*	8.38	0.43
	05/24/18	0.05007	28.1	22	<0.083	6.22	17.8	60	242	<0.00093	<0.00105	0.07116	<0.00002	0.00023 J	0.0008 J	0.01424	<0.00068	0.121	<0.000005	<0.00029	<0.00099	<0.00086	1.946	--	--
	08/15/18	0.05	40.5	19	<0.083	6.23	57.1	240	428	0.00001 J	0.00169	0.0637	0.000055	0.000008 J	0.000072	0.0114	0.000079	0.147	<0.000005	0.00013	0.00008 J	<0.01	0.316	--	--
AD-17	05/26/16	0.121	200	43	<1	7.17	--	1,166	1,810	<0.005	<0.005	0.021	<0.001	0.002	0.001	0.063	<0.005	0.370	0.000032	<0.005	<0.005	<0.002	1.53	--	--
	07/27/16	0.119	195	32	<1	7.17	--	1,005	1,576	<0.005	<0.005	0.020	<0.001	0.004	0.001	0.068	<0.005	0.374	<0.000025	<0.005	<0.005	<0.002	2.78	--	--
	09/29/16	0.111	191	36	<1	6.17	--	1,055	1,663	<0.005	<0.005	0.031	<0.001	<0.001	0.003	0.058	<0.005	0.354	<0.000025	<0.005	<0.005	<0.002	2.358	--	--
	10/20/16	0.124	194	32	1.0	6.14	--	1,163	1,612	<0.005	<0.005	0.034	<0.001	0.002	0.004	0.065	<0.005	0.394	<0.000025	<0.005	<0.005	<0.002	2.224	--	--
	12/13/16	0.135	196	31	<1	6.03	--	1,096	1,560	<0.005	<0.005	0.017	<0.001	0.003	<0.001	0.068	<0.005	0.323	<0.000025	<0.005	<0.005	<0.002	2.384	--	--
	01/17/17	0.101	196	33	<1	5.96	--	1,445	1,686	<0.005	<0.005	0.014	<0.001	0.003	0.068	0.068	<0.005	0.341	<0.000025	<0.005	<0.005	<0.002	2.436	--	--
	02/22/17	0.135	189	30	<1	5.67	--	1,055	1,628	<0.005	<0.005	0.020	<0.001	0.002	0.001	0.073	<0.005	0.331	<0.000025	<0.005	<0.005	<0.002	2.288	--	--
	06/06/17	0.121	188	30	<0.083	5.81	156	1,105	1,578	<0.00093	<0.00105	0.01033	<0.00002	0.00606	<0.00023	0.0748	<0.00068	0.329	0.000013	<0.00029	<0.00099	<0.00086	1.598	--	--
	10/05/17	--	--	--	--	5.92	598	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.247	213	45	<0.083	5.51	<100	--	1,846	<0.00093	<0.00105	0.00978	<0.00002	0.00915	<0.00023	0.07451	<0.00068	0.306	<0.000005	<0.00029	0.00414	<0.00086	1.514	260	3.72
	Dissolved	*0.231*	*205*	--	--	5.51	<100	--	--	*<0.00093*	*<0.00105*	*0.00737*	*<0.00002*	*0.00609*	*<0.00023*	*0.07938*	*<0.00068*	*0.301*	*<0.000005*	*<0.00029*	*0.00515*	*0.02*	*1.57*	241	3.56
	05/24/18	0.239	193	39	<0.083	6.28	7.8	1,067	1,836	<0.00093	<0.00105	0.00965	<0.00002	0.00646	<0.00023	0.07173	<0.00068	0.308	<0.000005	<0.00029	<0.00099	<0.00086	1.939	--	--
	08/15/18	0.118	187	40	<0.083	5.6	418	1,170	1,750	0.00002 J	0.00183	0.0128	0.000069	0.00025	0.000604	0.0435	0.0011	0.243	0.000011 J	0.00035	0.0003	0.000074	2.35	--	--
AD-18	05/26/16	0.146	409	422	<1	5.1	--	5,135	10,000	<0.005	<0.005	0.012	0.014	0.003	<0.001	0.922	<0.005	2.07	0.000168	<0.005	0.006	0.003	12.58	--	--
	07/27/16	0.148	457	432	2	5.1	--	4,930	9,476	<0.005	<0.005	0.019	0.005	0.002	<0.001	0.734	<0.005	1.94	0.000091	<0.005	0.007	0.003	10.62	--	--
	09/29/16	0.156	469	637	4	5.59	--	4,632	9,569	<0.005	<0.005	0.02	0.004	<0.001	<0.001	0.666	<0.005	1.86	0.000117	<0.005	0.007	<0.002	7.05	--	--
	10/20/16	0.188	498	876	0.8664	5.7	--	5,537	9,540	<0.005	<0.005	0.021	0.002	0.001	<0.001	0.569	<0.005	2.06	0.000053	<0.005	<0.005	<0.002	5.82	--	--
	12/13/16	0.178	510	695	5	5.75	--	4,382	8,912	<0.005	<0.005	0.021	0.007	0.001	<0.001	0.641	<0.005	1.74	0.00005	<0.005	<0.005	<0.002	9.60	--	--
	01/17/17	0.050	412	159	5	4.49	--	5,414	8,562	<0.005	0.01	0.014	0.022	0.001	<0.001	0.929	<0.005	1.95	0.000224	<0.005	<0.005	0.002	22.51	--	--
	02/22/17	0.090	401	151	6	4.37	--	5,169	8,412	<0.005	<0.005	0.014	0.026	0.002	<0.001	0.961	<0.005	1.82	0.000107	<0.005	<0.005	0.00228	19.11	--	--
	06/06/17	0.125	428	304	6.53	4.27	121	5,920	9,394	<0.00093	0.00331	0.01038	0.01883	0.00303	<0.00023	0.940	<0.00068	2.15	0.000113	<0.00029	0.00212	<0.00086	16.12	--	--
	10/05/17	--	--	--	--	5.87	165	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.163	433	362	9.4	3.61	104.1	--	9,952	0.00224	0.00276	0.00813	0.01733	0.0036	0.00098	0.928	<0.00068	2.07	0.000043	<0.00029	0.00194	0.00144	19.95	19.7	14.1
	Dissolved	*0.153*	*423*	--	--	--	--	--	--	*0.00467*	*0.00189*	*0.00748*	*0.01676*	*0.00316*	*<0.00023*	*0.898*	*<0.00068*	*2.06*	*0.000012*	*<0.00029*	*0.00135*	*0.01466*	*18.09*	19.1	13.7

Table 4-4
Groundwater Sampling Analytical Results (mg/L) - Bottom Ash Storage Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

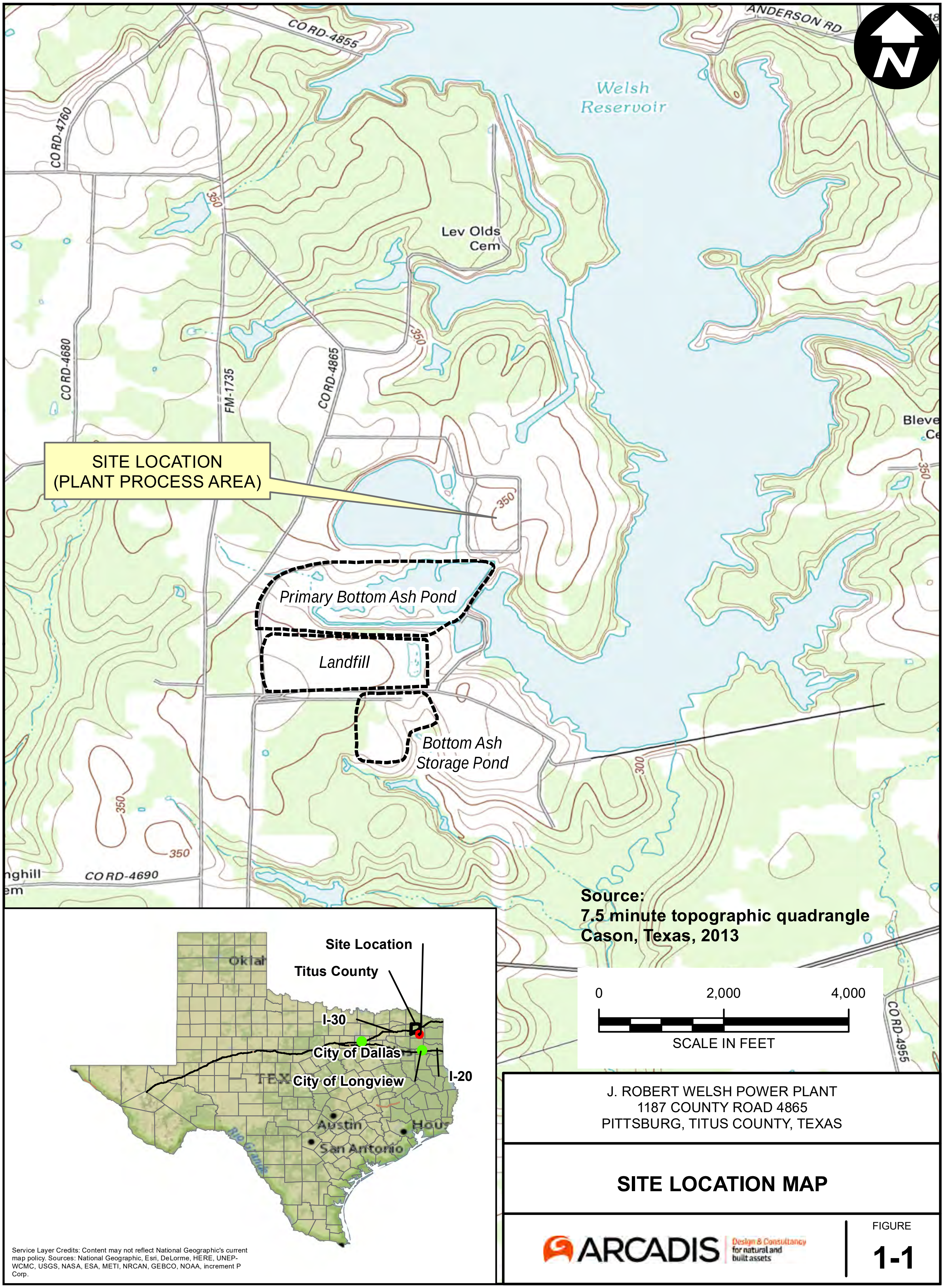
		Appendix III Parameters								Appendix IV Parameters															
Well	**Date Sampled**	**Boron (total)**	**Calcium (total)**	**Chloride**	**Fluoride**	**pH (field)**	**Turbidity (field)**	**Sulfate**	**TDS**	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Cobalt**	**Lead**	**Lithium**	**Mercury**	**Molybdenum**	**Selenium**	**Thallium**	**Radium 226 and 228 (pCi/L)**	**Iron**	**Manganese**
Point of Compliance Wells																									
AD-3	05/31/16	0.02	1.41	9	<1	6.58	--	4	106	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	<0.005	<0.005	0.010	0.00085	<0.005	<0.005	<0.002	1.02	--	--
	07/27/16	0.02	0.706	8	<1	6.58	--	5	118	<0.005	<0.005	0.036	<0.001	<0.001	<0.001	<0.005	<0.005	0.024	0.000589	<0.005	<0.005	<0.002	0.1786	--	--
	09/30/16	0.02	<0.5	9	<1	4.75	--	6	127	<0.005	<0.005	0.043	<0.001	<0.001	<0.001	<0.005	<0.005	0.019	0.00039	<0.005	<0.005	<0.002	0.552	--	--
	10/19/16	0.06	0.794	8	<1	3.71	--	9	112	<0.005	<0.005	0.041	<0.001	<0.001	<0.001	<0.005	<0.005	0.018	0.000351	0.006	<0.005	<0.002	1.589	--	--
	12/12/16	0.02	1.05	8	<1	4.67	--	11	138	<0.005	<0.005	0.045	<0.001	<0.001	<0.001	<0.005	<0.005	0.017	0.000321	<0.005	<0.005	<0.002	0.546	--	--
	01/19/17	0.02	0.746	9	<1	4.60	--	4	76	<0.005	<0.005	0.041	<0.001	<0.001	<0.001	<0.005	<0.005	0.014	0.000504	<0.005	<0.005	<0.002	0.229	--	--
	02/23/17	0.02	0.573	9	<1	4.69	--	5	104	<0.005	<0.005	0.037	<0.001	<0.001	<0.001	<0.005	<0.005	0.014	0.000501	<0.005	<0.005	<0.002	0.4592	--	--
	06/07/17	0.03326	0.543	9	0.2625	4.49	56.6	5	104	<0.00093	0.00191	0.038	0.00024	0.00008	0.00075	0.00128	<0.00068	0.01503	0.000365	<0.00029	<0.00099	<0.00086	0.459	--	--
	10/06/17	--	--	--	--	5.15	65.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/15/18	0.01869	0.56	9	<0.083	4.31	11.1		132	0.00166	0.0016	0.0365	0.00034	0.00008	<0.00023	0.00136	<0.00068	0.01459	0.00037	<0.00029	0.00323	0.00127	0.016	0.188	0.004
	Dissolved	*0.01132*	*0.595*	--	--	4.31	11.1	--	--	*<0.00093*	*<0.00105*	*0.0361*	*0.00023*	*<0.00007*	*<0.00023*	*0.00133*	*<0.00068*	*0.01445*	*0.000379*	*<0.00029*	*<0.00099*	*<0.00086*	*0.242*	< 0.01	0.004
	05/24/18	0.0069 J	0.545	8	<0.083	4.58	8.50	3	98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AD-4c	05/31/16	0.05	0.798	10	<1	5.41	--	32	204	<0.005	<0.005	0.088	<0.001	<0.001	0.009	<0.005	<0.005	0.004	0.000191	<0.005	<0.005	<0.002	1.29	--	--
	07/27/16	0.03	0.666	12	<1	5.41	--	35	208	<0.005	<0.005	0.059	<0.001	<0.001	0.004	<0.005	<0.005	0.015	0.000185	<0.005	<0.005	<0.002	0.5075	--	--
	09/29/16	0.02	<0.5	11	<1	4.96	--	45	212	<0.005	<0.005	0.074	<0.001	<0.001	0.008	<0.005	<0.005	0.006	0.00016	<0.005	<0.005	<0.002	2.572	--	--
	10/19/16	0.04	0.578	10	<1	4.30	--	35	212	<0.005	<0.005	0.069	<0.001	<0.001	0.009	<0.005	<0.005	0.006	0.000141	<0.005	<0.005	<0.002	1.657	--	--
	12/12/16	0.02	0.341	11	<1	4.62	--	36	252	<0.005	<0.005	0.021	<0.001	<0.001	<0.001	<0.005	<0.005	0.004	0.000143	<0.005	<0.005	<0.002	0.685	--	--
	01/19/17	0.02	0.761	10	<1	4.67	--	43	184	<0.005	<0.005	0.075	<0.001	<0.001	0.004	<0.005	<0.005	0.005	0.000125	<0.005	<0.005	<0.002	2.045	--	--
	02/23/17	0.02	0.467	9	<1	5.10	--	40	196	<0.005	<0.005	0.030	<0.001	<0.001	<0.001	<0.005	<0.005	0.004	0.000098	<0.005	<0.005	<0.002	0.517	--	--
	06/07/17	0.03331	0.573	10	<0.083	4.88	351	39	228	<0.00093	0.00119	0.05142	0.00019	0.00008	0.00403	0.00075	<0.00068	0.00482	0.000147	<0.00029	<0.00099	<0.00086	0.953	--	--
	10/06/17	--	--	--	--	5.38	308	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	0.0186	0.498	14	<0.083	4.67	6.40		232	<0.00093	<0.00105	0.02572	0.0001	<0.00007	0.00044	0.00049	<0.00068	0.00394	0.000228	<0.00029	<0.00099	<0.00086	0.435	0.592	< 0.001
	Dissolved	*0.02017*	*0.468*	--	--	4.67	6.40	--	--	*<0.00093*	*<0.00105*	*0.02223*	*0.00006*	*<0.00007*	*<0.00023*	*0.00043*	*<0.00068*	*0.0039*	*0.000031*	*<0.00029*	*<0.00099*	*<0.00086*	*0.354*	0.394	0.002
	05/24/18	0.02505	0.434	14	<0.083	*5.17*	*48.1*	42	224	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	08/14/18	--	--	15	--	--	125	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AD-16	01/26/16	0.05	2.81	6	<1	3.84	--	49	180	<0.005	0.02	0.198	0.002	<0.001	0.054	0.013	0.016	0.015	0.000259	<0.005	<0.005	<0.002	4.478	--	--
	03/21/16	0.04	2.04	6	<1	4.20	--	47	104	<0.005	<0.005	0.119	<0.001	<0.001	0.009	<0.005	<0.005	0.007	0.000114	<0.005	<0.005	<0.002	4.44	--	--
	05/31/16	0.03	1.55	6	<1	4.44	--	40	96	<0.005	<0.005	0.127	<0.001	<0.001	0.001	<0.005	<0.005	0.002	0.000037	<0.005	<0.005	<0.002	5.99	--	--
	07/27/16	0.04	3.42	7	<1	4.44	--	70	184	<0.005	0.01	0.123	0.002	<0.001	0.011	0.022	<0.005	0.035	0.000212	<0.005	<0.005	<0.002	7.21	--	--
AD-16R	06/06/17	0.04198	2.75	7	0.3438	3.68	46.9	54	204	<0.00093	0.00707	0.0464	0.00221	0.00103	0.00176	0.04174	<0.00068	0.0293	<0.000005	<0.00029	0.00198	<0.00086	6.66	--	--
	06/28/17	0.06398	1.24	6	0.2512	3.91	--	55	200	<0.00093	0.00528	0.04143	0.00216	0.00092	0.00095	0.04087	<0.00068	0.02932	<0.000005	<0.00029	<0.00099	<0.00086	12.11	--	--
	07/28/17	0.02841	1.92	7	<0.083	2.77	--	48	162	<0.00093	0.0037	0.04851	0.00217	0.00128	0.00107	0.04533	<0.00068	0.02617	0.000006	<0.00029	0.00127	0.00143	8.52	--	--
	08/02/17	0.03177	1.86	7	<0.083	3.00	--	49	174	<0.00093	0.00446	0.04961	0.00206	0.00122	0.00095	0.04311	<0.00068	0.02498	<0.000005	<0.00029	0.00174	0.00202	5.45	--	--
	10/06/17	--	--	--	--	3.29	31.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/15/18	0.04030	2.73	6	<0.083	3.18	0.0		212	0.00269	0.0074	0.04301	0.00278	0.00129	0.0007	0.04123	<0.00068	0.02977	<0.000005	0.00103	<0.00099	<0.00086	5.89	1.47	0.053
	Dissolved	*0.02614*	*2.59*	--	--	3.18	0.0	--	--	*<0.00093*	*0.00294*	*0.04155*	*0.0022*	*0.00071*	*0.00025*	*0.03996*	*<0.00068*	*0.0278*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*5.90*	0.599	0.05
	05/23/18	0.03202	2.53	6	<0.083	*3.79*	*36.9*	67	204	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	08/14/18	--	--	--	--	--	142	44	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Supplemental Downgradient Monitoring Wells																									
AD-19	5/17/2018	0.07234	9.4	34	<0.083	5.72	42.1	--	372	<0.00093	<0.00105	0.05026	0.00073	<0.00007	0.00117	0.0111	<0.00068	0.02924	<0.000005	0.00078	0.00194	<0.00086	1.421	3.04	0.089
	Dissolved	*0.06293*	*8.76*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.04*	*0.00025*	*<0.00007*	*<0.00023*	*0.00965*	*<0.00068*	*0.02842*	*<0.000005*	*0.00041*	*<0.00099*	*0.012*	*2.577*	2.13	0.08
AD-20	10/31/18	0.029	3.14	18.4	0.09	4.88	13	12.5	140	0.00004	0.00185	0.205	0.000651	0.00114	0.000514	0.0161	0.000425	0.0126	<0.00005	<0.0004	0.0008	0.0003	4.16	1.11	0.0742
AD-21	10/30/18	0.025	5.0	17	0.23	5.04	0.0	27.4	180	0.00006	0.00124	0.0868	0.00181	0.00065	0.000263	0.0337	0.000148	0.034	<0.00005	<0.0004	0.0011	0.0002	3.76	3.13	0.154

Table 4-4
Groundwater Sampling Analytical Results (mg/L) - Bottom Ash Storage Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Reference Values:																									
MCL					4					0.006	0.01	2	0.004	0.005	0.1				0.002	N/A	0.05	0.002	5[b]		
Rule Specified																0.006	0.015	0.04		0.1					
Background Limit					1					0.005	0.005	0.36	0.00077	0.0065[a]	0.004	0.075[a]	0.005	0.39[a]	0.000033	0.005	0.005	0.0013	4.21[b]		
Interwell Background Value(s) (UPL, LPL where applicable) AD-8, AD-9, AD-15		0.652				4.81-6.99																			
Intrawell Background Value (UPL) AD-8			35.68	38.3	1.034			236	569																
Intrawell Background Value (UPL) AD-9			350	139.3	0.7259			2527	3147																
Intrawell Background Value (UPL) AD-15			5.71	38.42	1			35.6	388																

NOTES:
All concentration data are provided in milligrams per liter (mg/L) unless otherwise noted.
J = Analyte was positively identified, though the quantitation was below Reporting Limit.
MCL = Maximum contaminant level
LPL = Lower prediction limit
UPL = Upper prediction limit
pCi/L = PicoCuries per liter.
-- = Not analyzed.
a = Calculated Upper Tolerance Limit is higher than MCL.
b = Data is "Combined Radium, Total".
🟧 Denotes groundwater sample collected by ARCADIS using low-flow sampling methods.
Unless otherwise noted, values shown are total (unfiltered) analyses.
Dissolved (0.45-micron lab filtered) parameter concentrations shown in italics.

FIGURES



Source:
7.5 minute topographic quadrangle
Cason, Texas, 2013

Service Layer Credits: Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

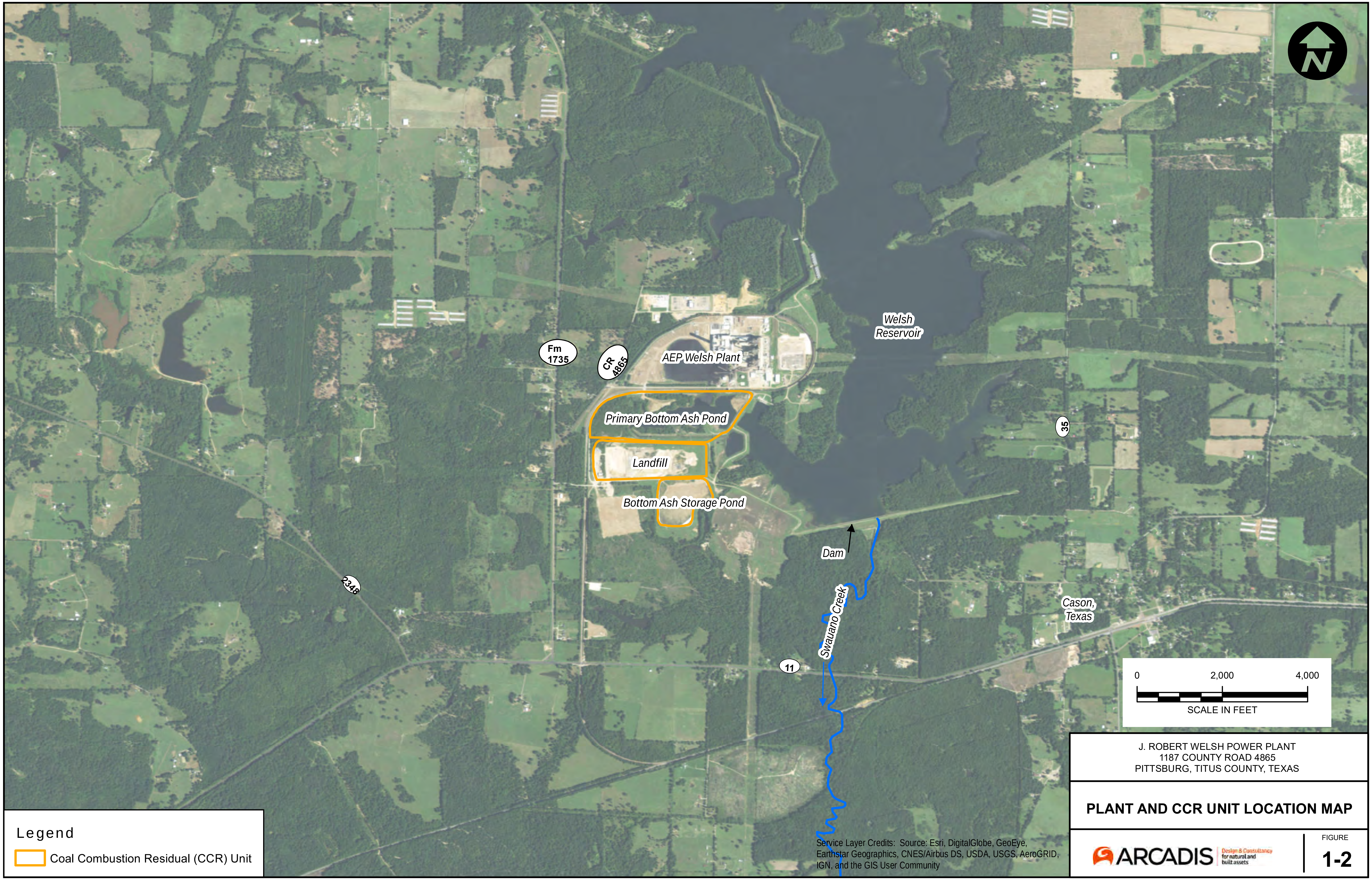
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-1

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\Dec2017Update\fig 1 - site map.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

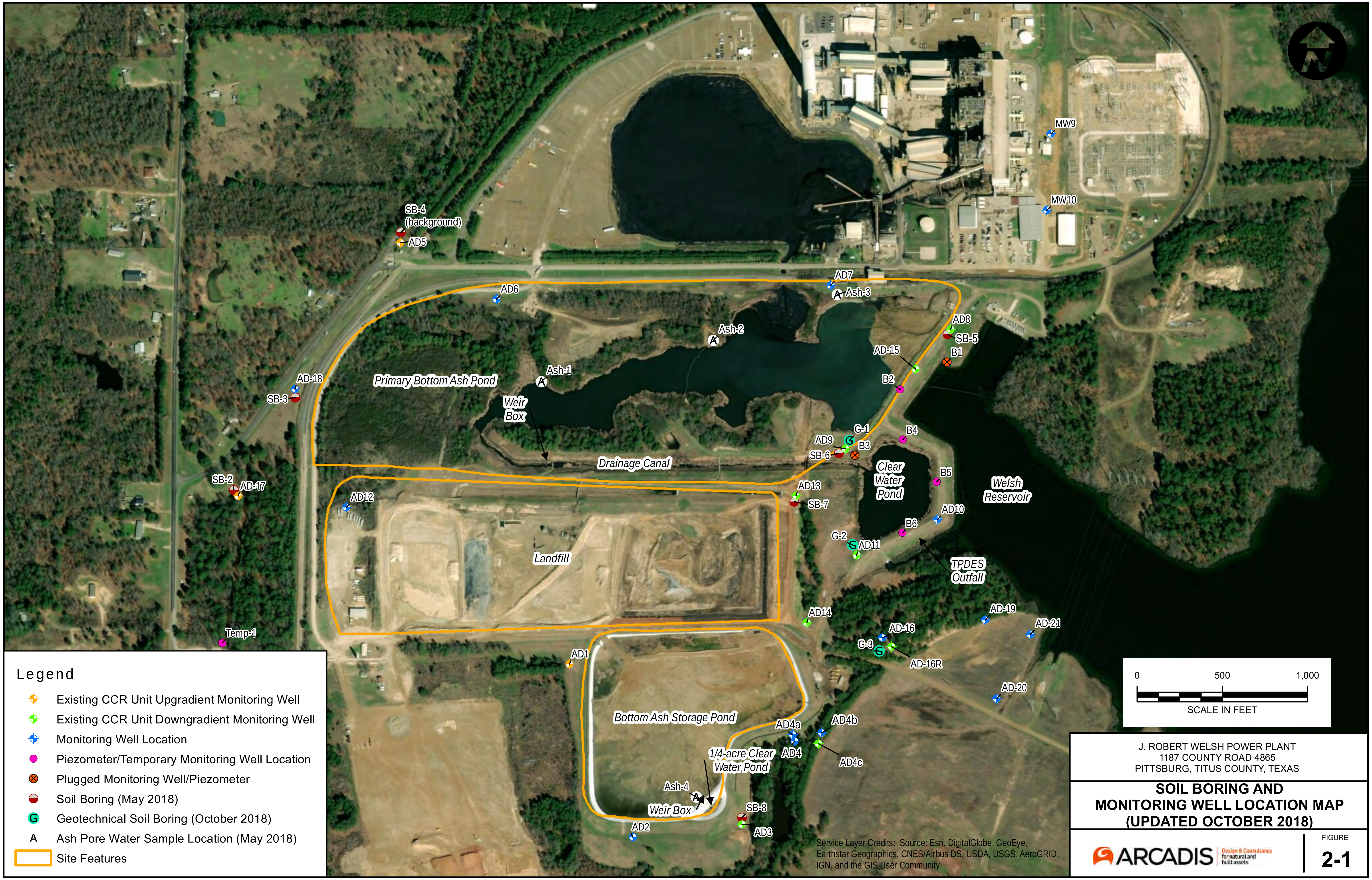
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PLANT AND CCR UNIT LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-2

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\Dec2017Update\fig 1-2 - CCR location.mxd



Legend

- ◆ Existing CCR Unit Upgradient Monitoring Well
- ◆ Existing CCR Unit Downgradient Monitoring Well
- ◆ Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◐ Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

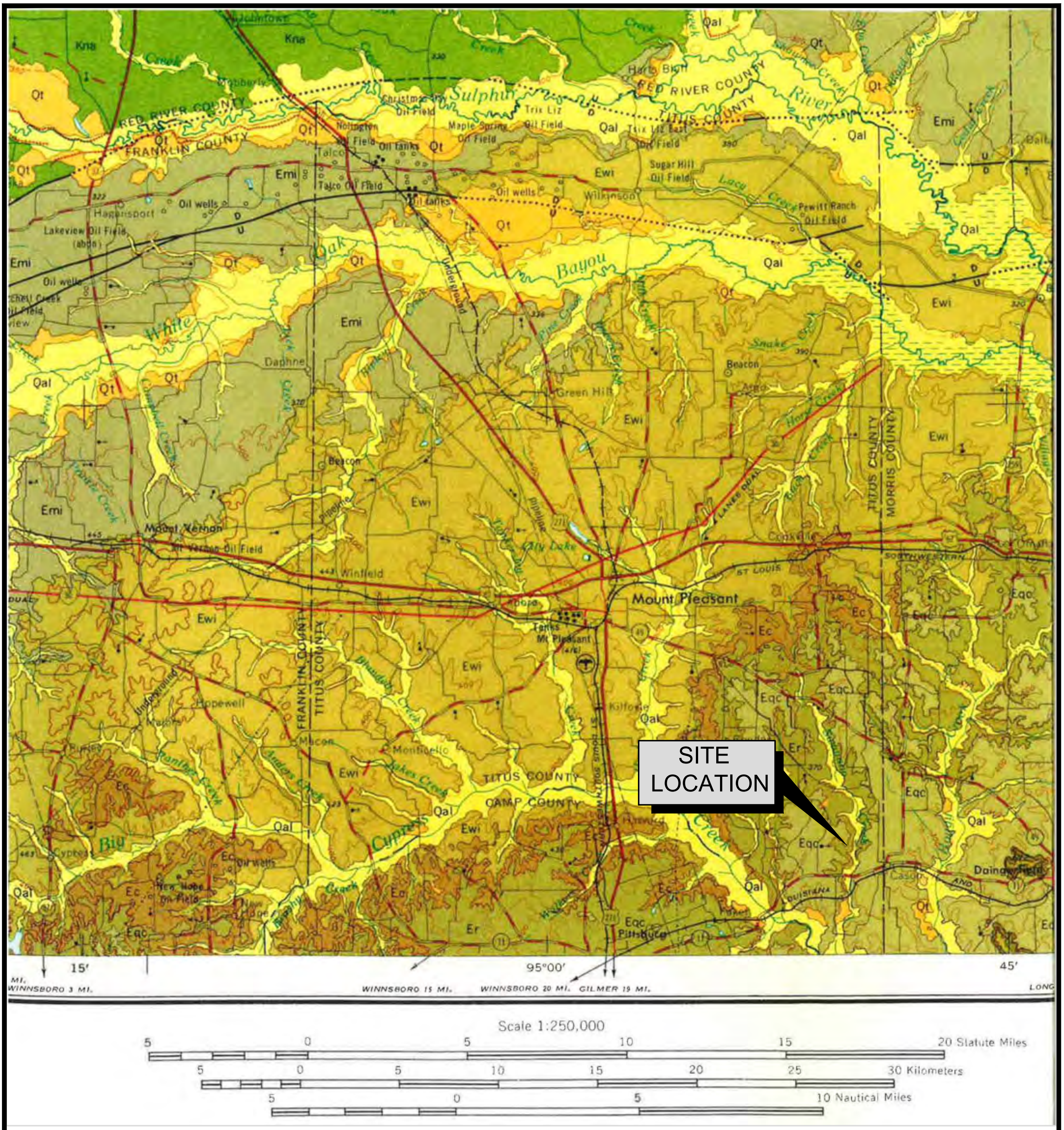
SOIL BORING AND MONITORING WELL LOCATION MAP (UPDATED OCTOBER 2018)

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-1

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\November2018\Fig2-1-SoilBoring_MonitoringWellLocations.mxd

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\TX015976.0005 - Welsh Lithium ASD\Figures-Maps\Figure 2-1 Regional Geo Map.dwg LAYOUT: MODEL SAVED: 11/7/2018 1:36 PM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 1/28/2019 4:04 PM BY: LEASE, DIANA



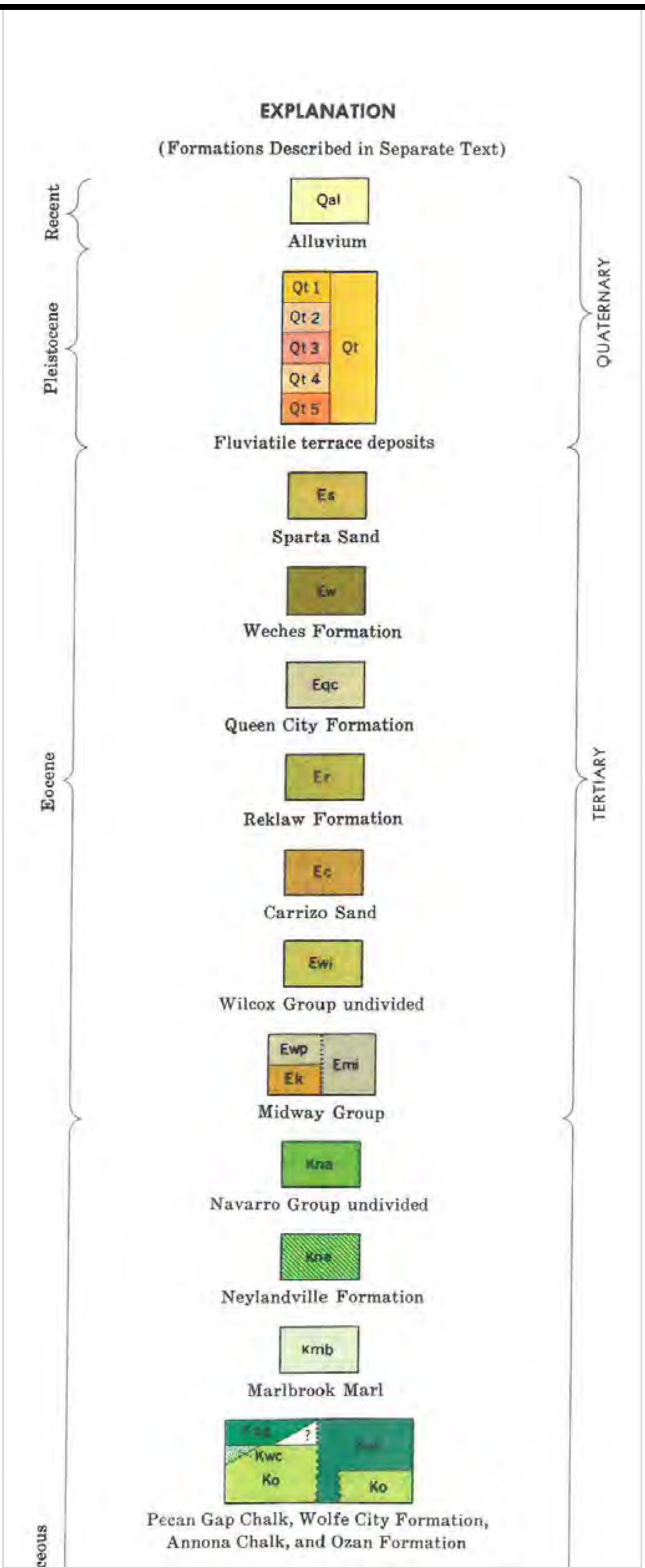
N

J. ROBERT WELSH POWER PLANT
PITTSBURG, TITUS COUNTY, TEXAS

REGIONAL GEOLOGIC MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-2A



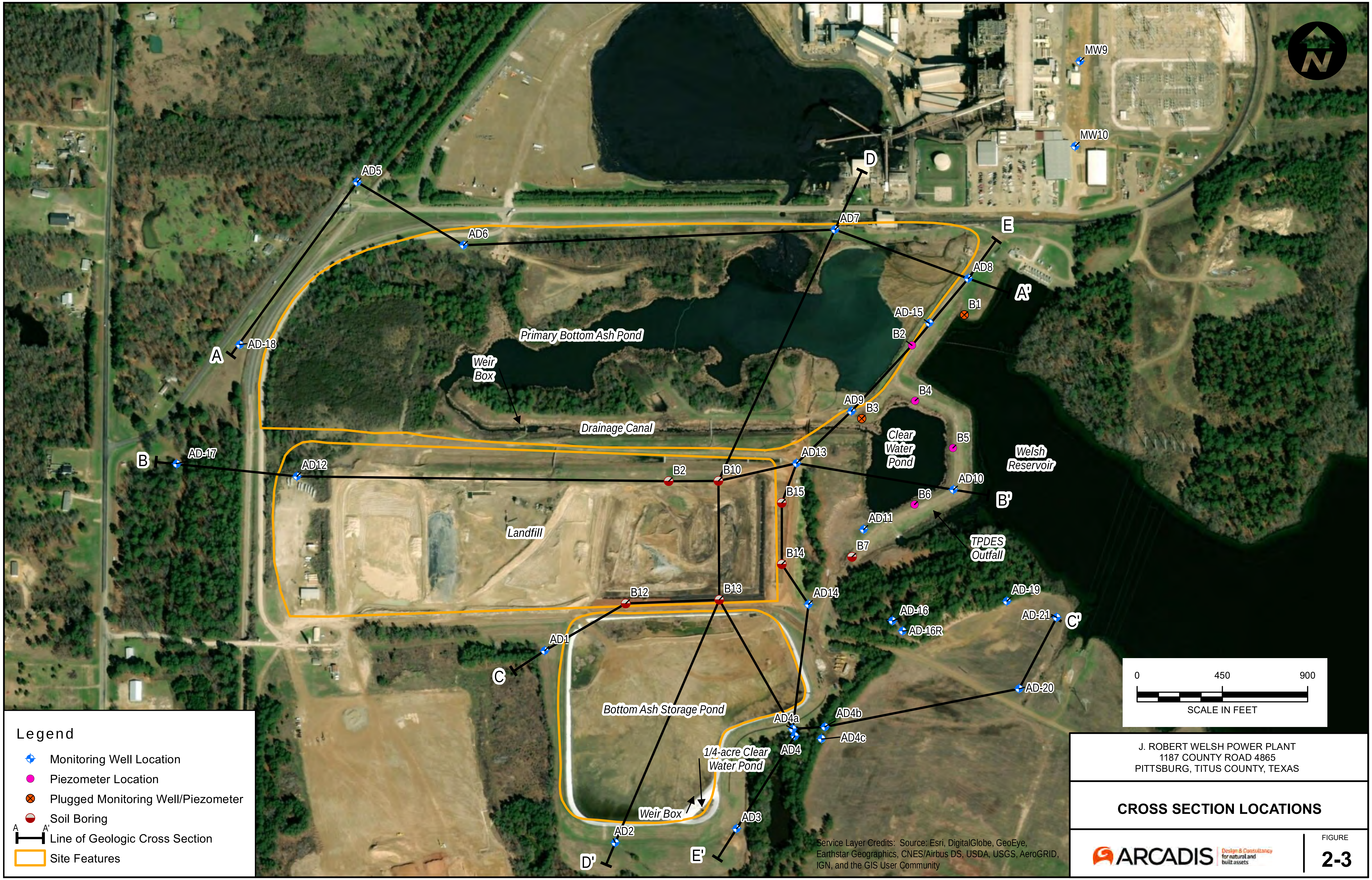
J. ROBERT WELSH POWER PLANT
PITTSBURG, TITUS COUNTY, TEXAS

REGIONAL
GEOLOGIC LEGEND

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-2B

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\TX015976.0005 - Welsh Lithium ASD\Figures-Maps\Figure 2-1B Regional Geo Legend.dwg LAYOUT: MODEL SAVED: 11/7/2018 1:51 PM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 1/28/2019 3:59 PM BY: LEASE, DIANA



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

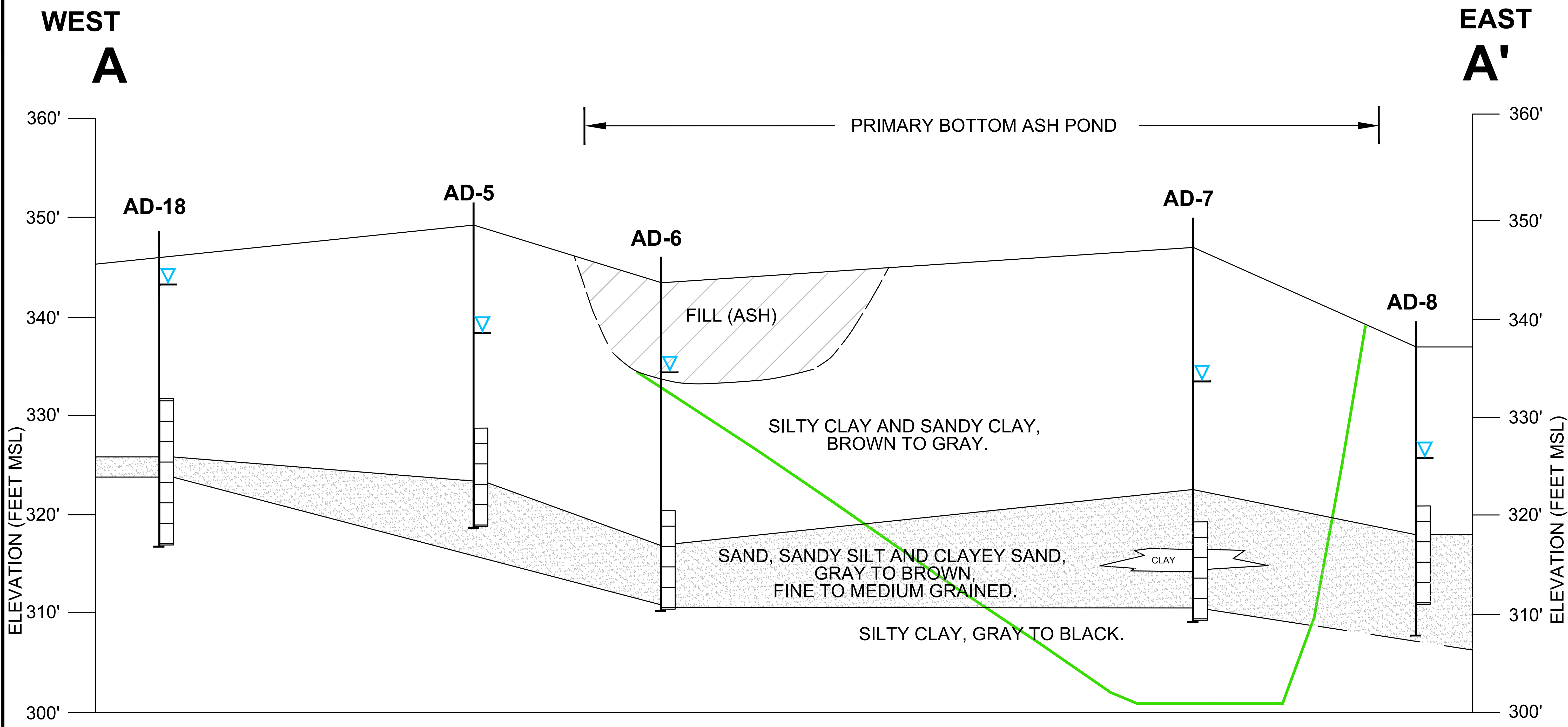
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION LOCATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-3

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Lithium_ASD_Report\Fig2-3-Cross Section LocationsREV.mxd



0 300'
HORIZONTAL SCALE

NOTE: BASE OF ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

▤ MONITORING WELL SCREENED INTERVAL

▽ WATER LEVEL IN MONITORING WELL (3/4/16)

— PROJECTED BASE OF ASH POND (SEE NOTE)

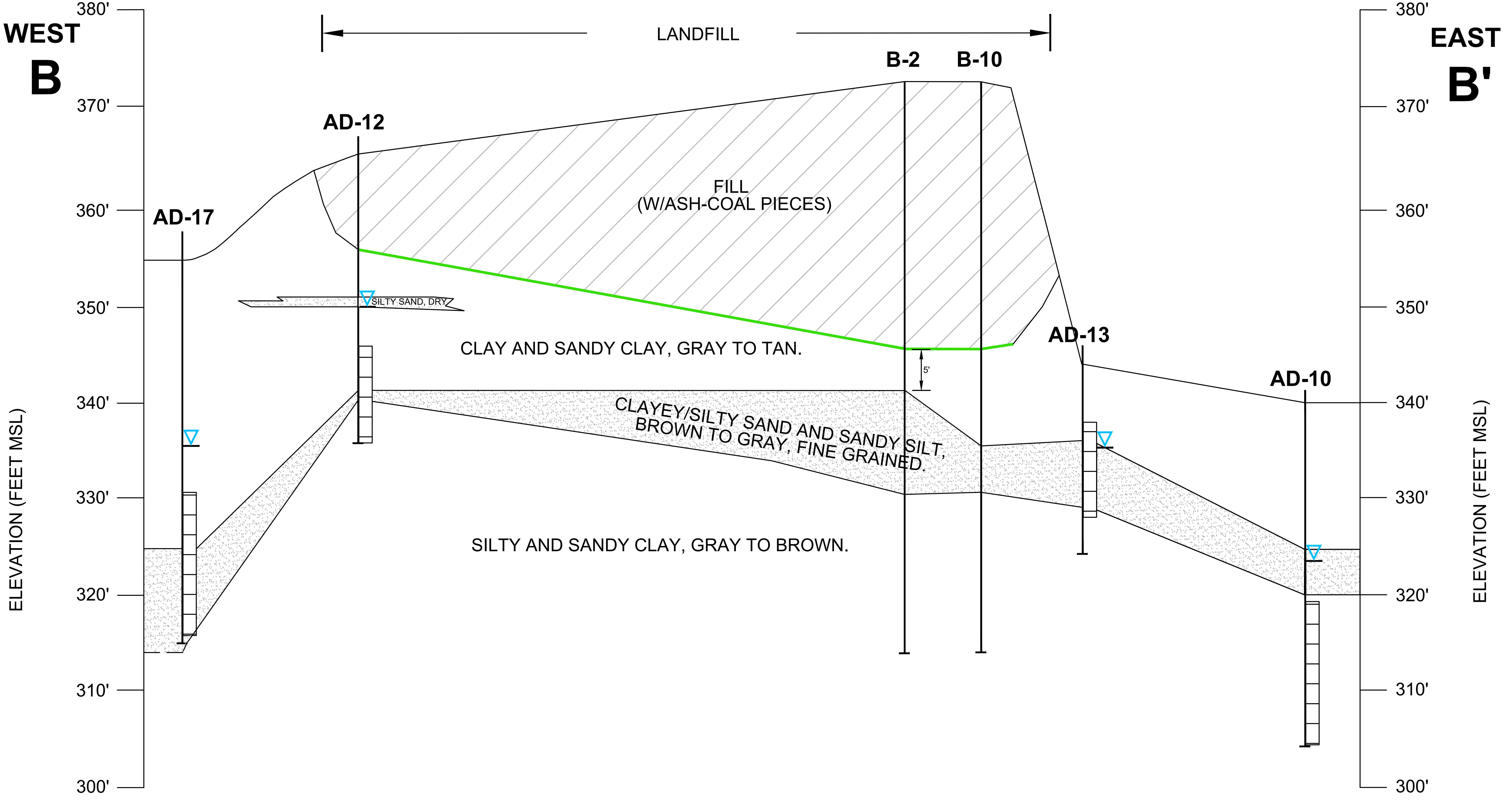
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
A - A'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-4

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\TX015976.0005 - Welsh Lithium ASD\Figures-Maps\Figure 2-2 Cross Section A-A'.dwg LAYOUT: MODEL SAVED: 1/28/2019 1:30 PM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 1/28/2019 3:24 PM BY: LEASE, DIANA



0 300'
HORIZONTAL SCALE

NOTE: BASE OF LANDFILL ELEVATION TAKEN FROM "WELSH POWER PLANT- UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12/3/76.

LEGEND

▤	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
🟩	BASE OF LANDFILL (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
B - B'

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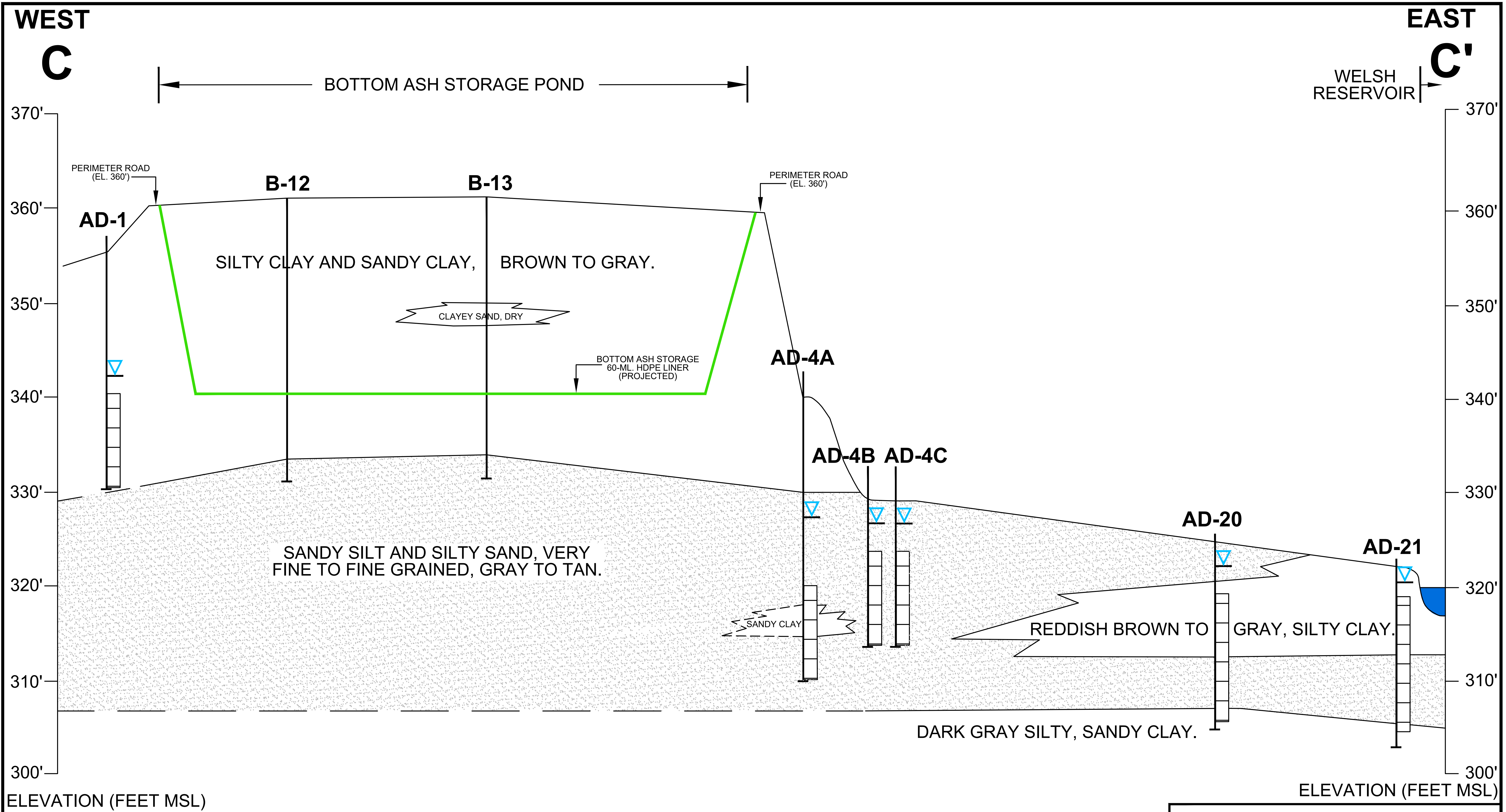
FIGURE
2-5



0 200'
HORIZONTAL SCALE

NOTE: BASE OF BOTTOM ASH STORAGE HAS A 60-ML. HDPE LINER AT ELEVATION 340.0', TAKEN FROM FREESE AND NICHOLS "HYDRAULIC ANALYSIS OF WELSH POWER PLANT ASH PONDS, AMERICAN ELECTRIC POWER COMPANY", DATED DECEMBER 2010.

LEGEND

▤	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (10/29/18)
🟩	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
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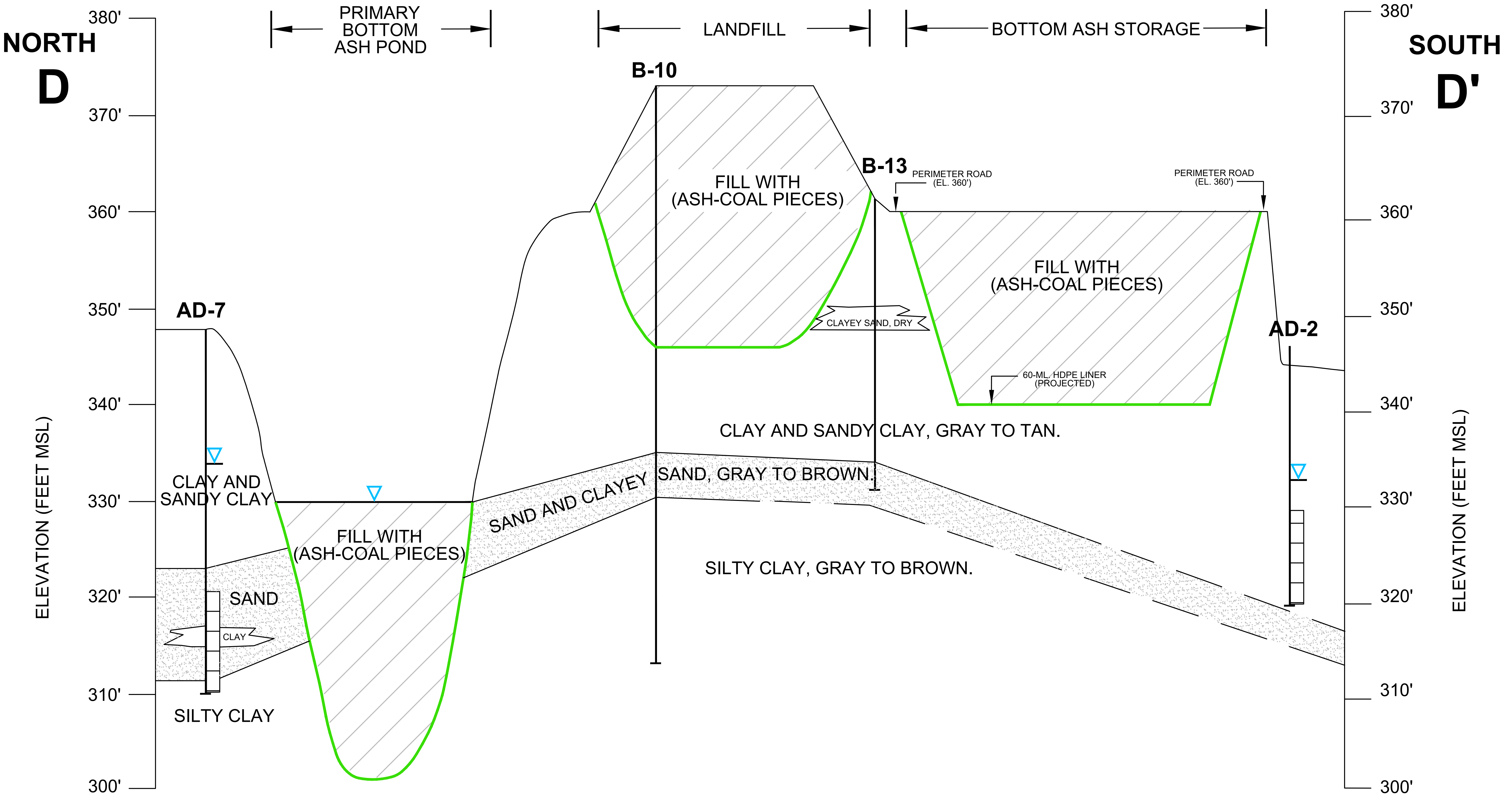
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
C - C'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-6

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\TX015976.0005 - Welsh Lithium ASD\Figures-Maps\Figure 2-4 Cross Section C-C'.dwg LAYOUT: MODEL SAVED: 11/13/2018 3:29 PM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 1/28/2019 3:35 PM BY: LEASE, DIANA



0 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (5/12/15)
—	BASE OF CCR UNIT

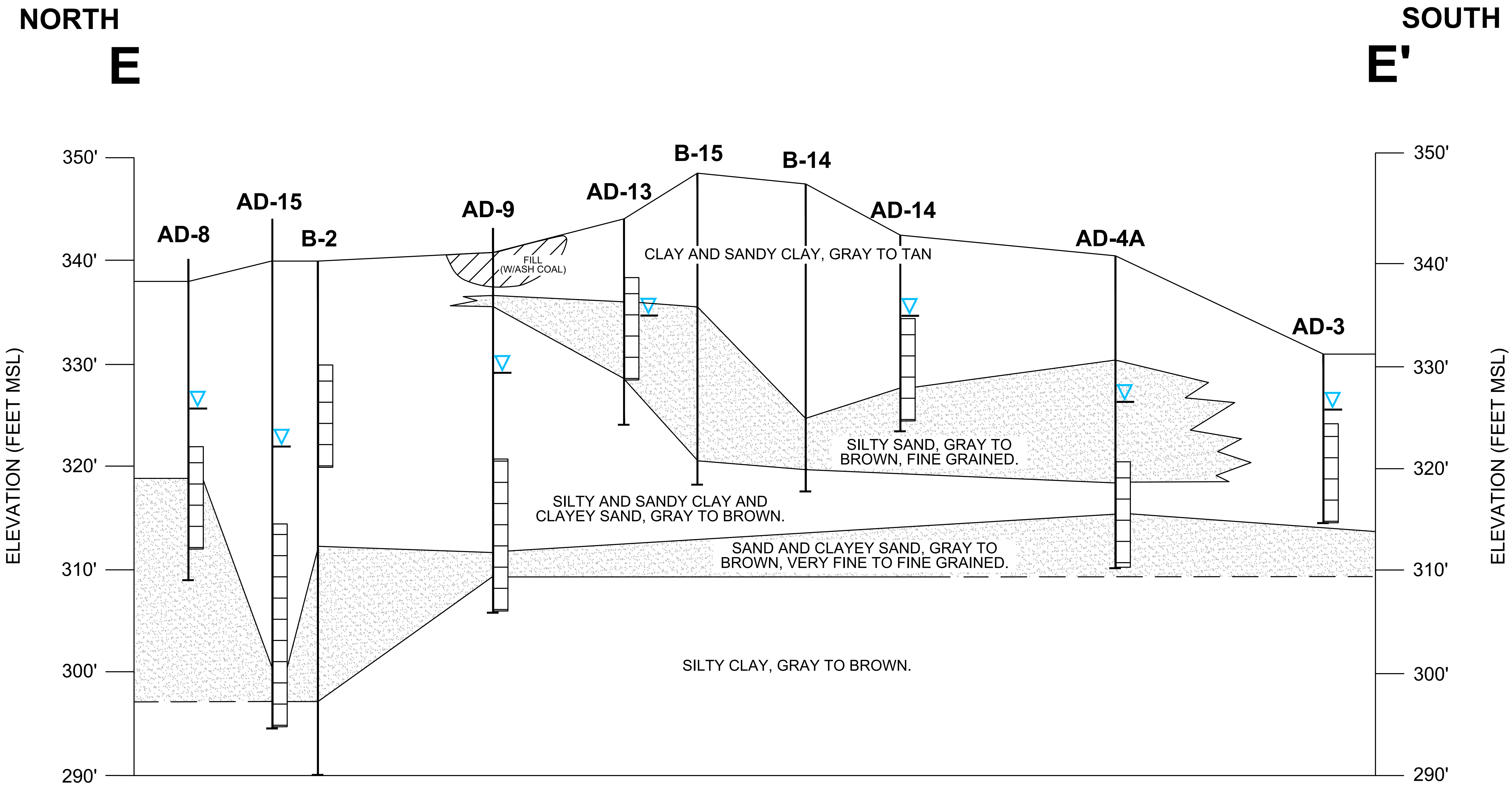
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
D - D'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-7

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\TX015976.0005 - Welsh Lithium ASD\Figures-Maps\Figure 2-5 Cross Section D-D'.dwg LAYOUT: MODEL SAVED: 6/23/2016 9:39 AM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 1/28/2019 3:41 PM BY: LEASE, DIANA



0 300'
HORIZONTAL SCALE

LEGEND

MONITORING WELL SCREENED INTERVAL

WATER LEVEL IN MONITORING WELL (3/4/16)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION E - E'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-8

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\TX015976.0005 - Welsh Lithium ASD\Figures-Maps\Figure 2-6 Cross Section E-E'.dwg LAYOUT: MODEL SAVED: 1/28/2019 3:51 PM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 1/29/2019 8:53 AM BY: LEASE, DIANA

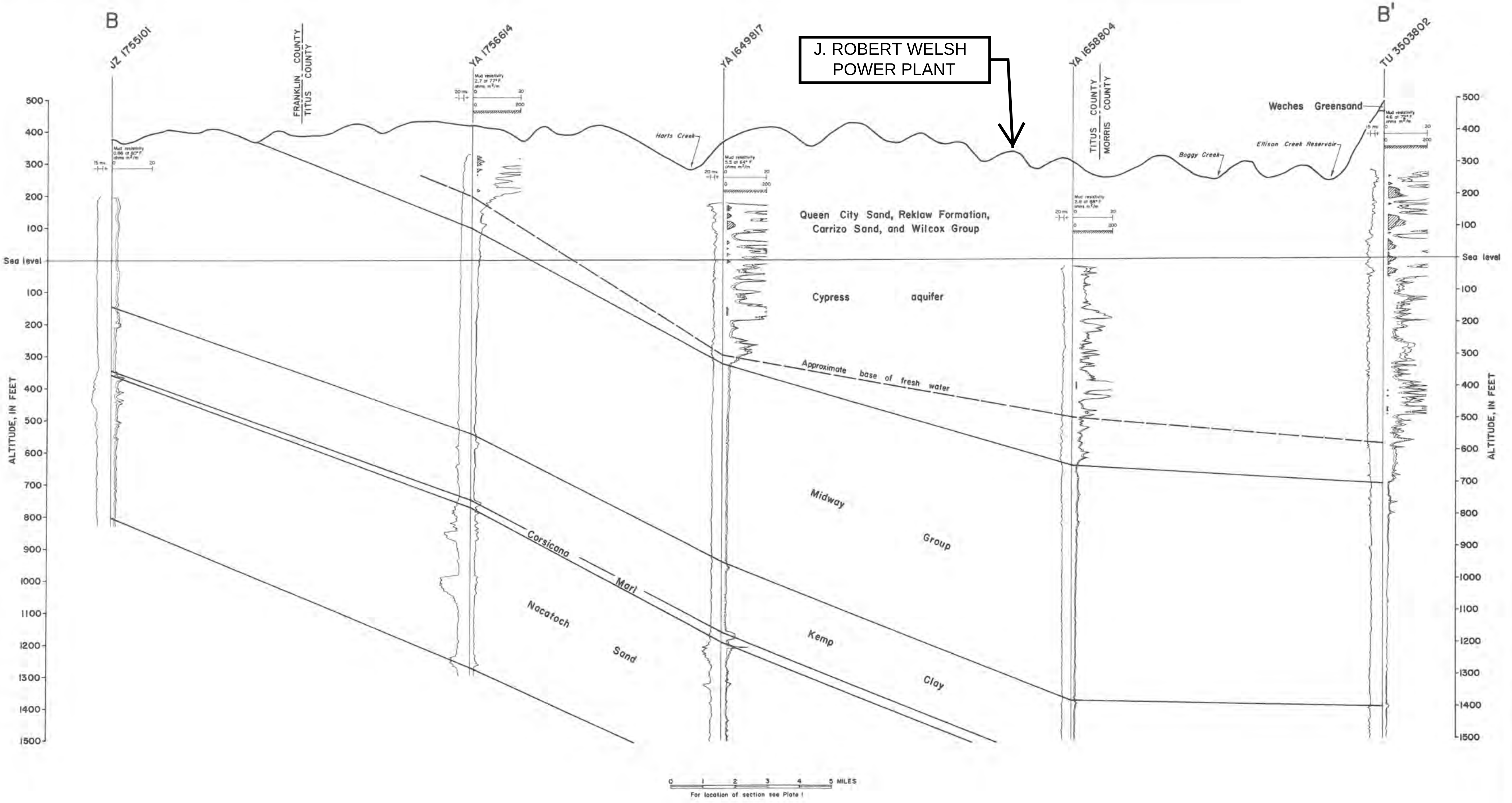


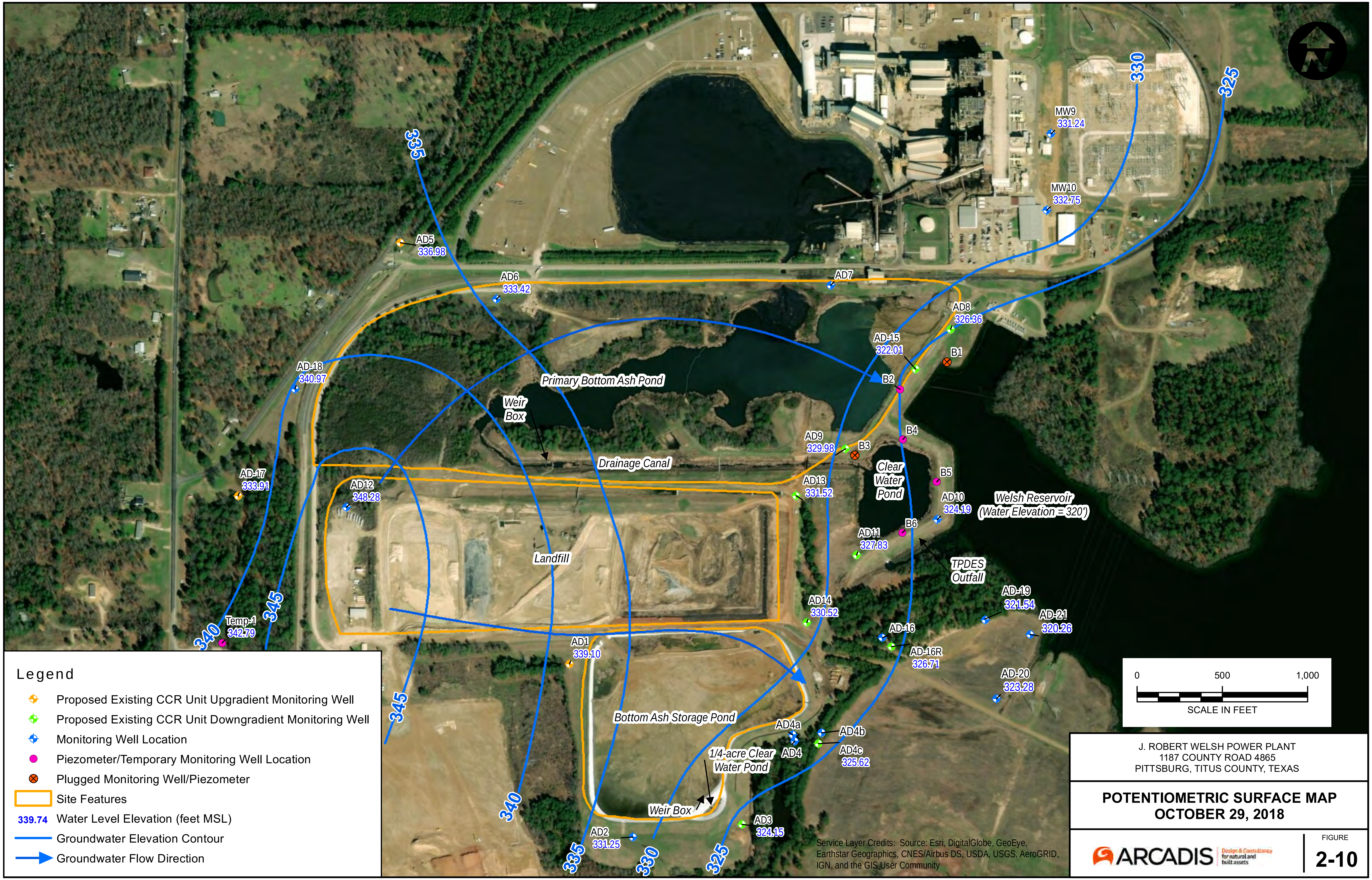
Plate 3

Geologic Section B–B', Franklin, Titus, and Morris Counties

U. S. Geological Survey in cooperation with the Texas Water Commission **(TWC BULLETIN 6517)**

REGIONAL GEOLOGIC CROSS SECTION

FIGURE 2-9



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

POTENTIOMETRIC SURFACE MAP
OCTOBER 29, 2018

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FIGURE
2-10

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Lithium_ASD_Report\Fig2-10-POT_Oct2018.mxd

Legend

- ◆ Existing CCR Unit Upgradient Monitoring Well
- ◆ Existing CCR Unit Downgradient Monitoring Well
- ◆ Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◓ Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM CONCENTRATION IN SOIL (mg/kg)
MAY 2018

ARCADIS

FIGURE
4-1

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\May2018\Fig4-1-SoilBoring_LithiumConcentrationsSoilREV.mxd

Legend

- ◈ Existing CCR Unit Upgradient Monitoring Well
- ◈ Existing CCR Unit Downgradient Monitoring Well
- ◈ Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◓ Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

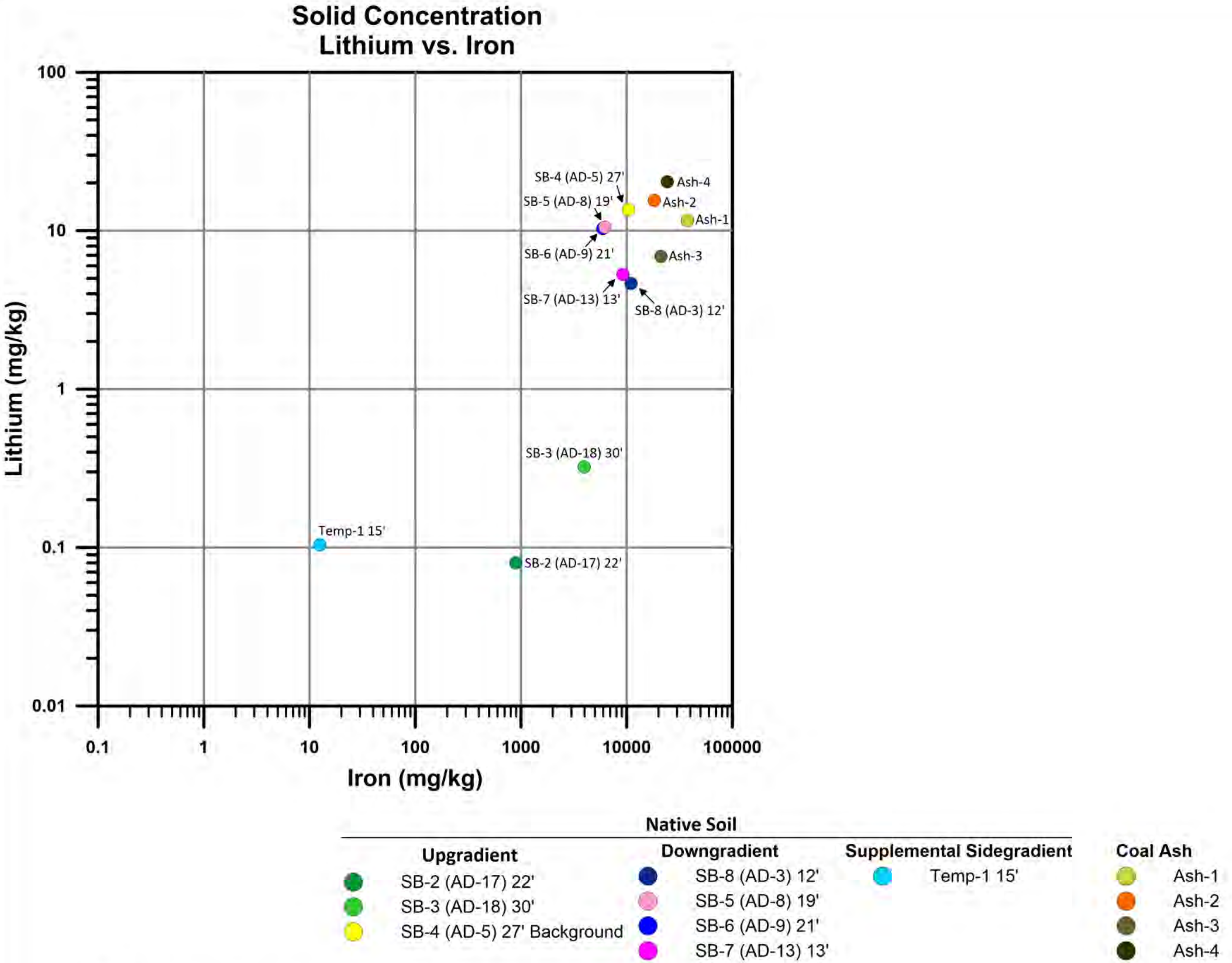
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

IRON CONCENTRATION IN SOIL (mg/kg)
MAY 2018

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-2

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\May2018\Fig4-2-SoilBoring_IronConcentrationsSoil.mxd



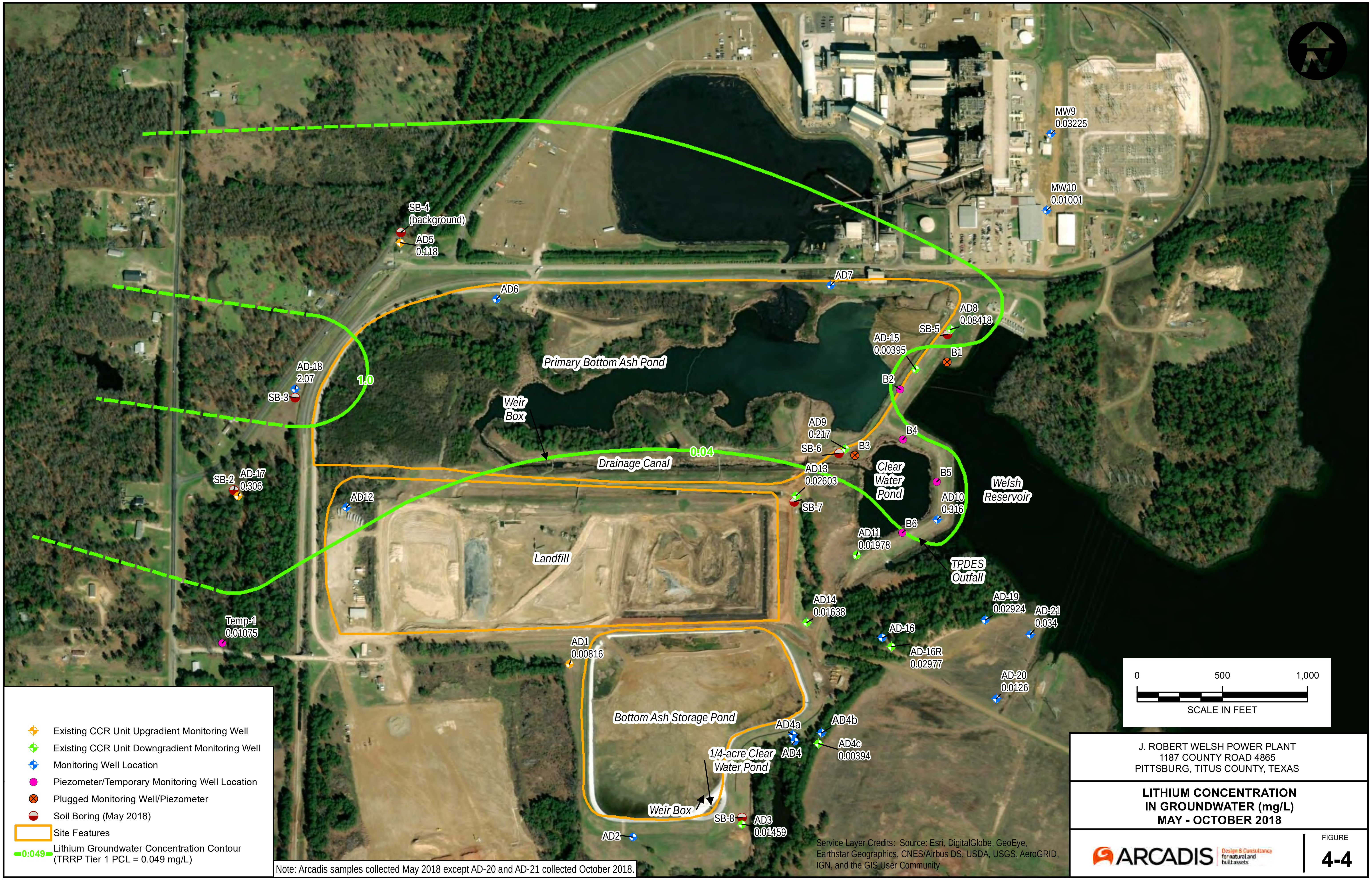
Notes:
mg/kg - milligrams per kilogram

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM VS. IRON SOLIDS CONCENTRATION PLOT

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-3



Note: Arcadis samples collected May 2018 except AD-20 and AD-21 collected October 2018.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

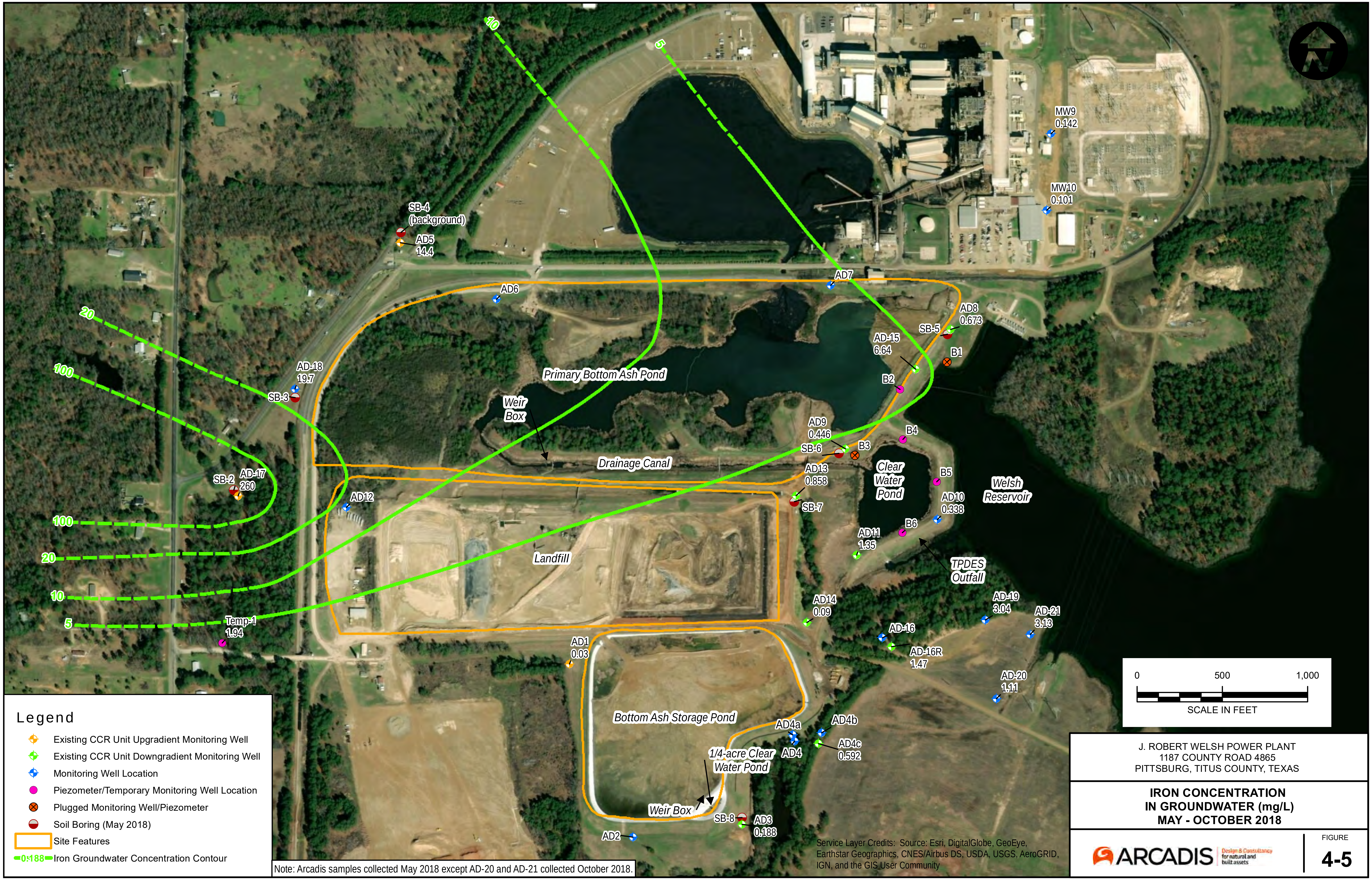
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM CONCENTRATION IN GROUNDWATER (mg/L) MAY - OCTOBER 2018

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-4

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\May2018\Fig4-4-LithiumConcentrationsREV.mxd



Legend

- ◆ Existing CCR Unit Upgradient Monitoring Well
- ◆ Existing CCR Unit Downgradient Monitoring Well
- ◆ Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◐ Soil Boring (May 2018)
- ▭ Site Features
- 0.188 Iron Groundwater Concentration Contour

Note: Arcadis samples collected May 2018 except AD-20 and AD-21 collected October 2018.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

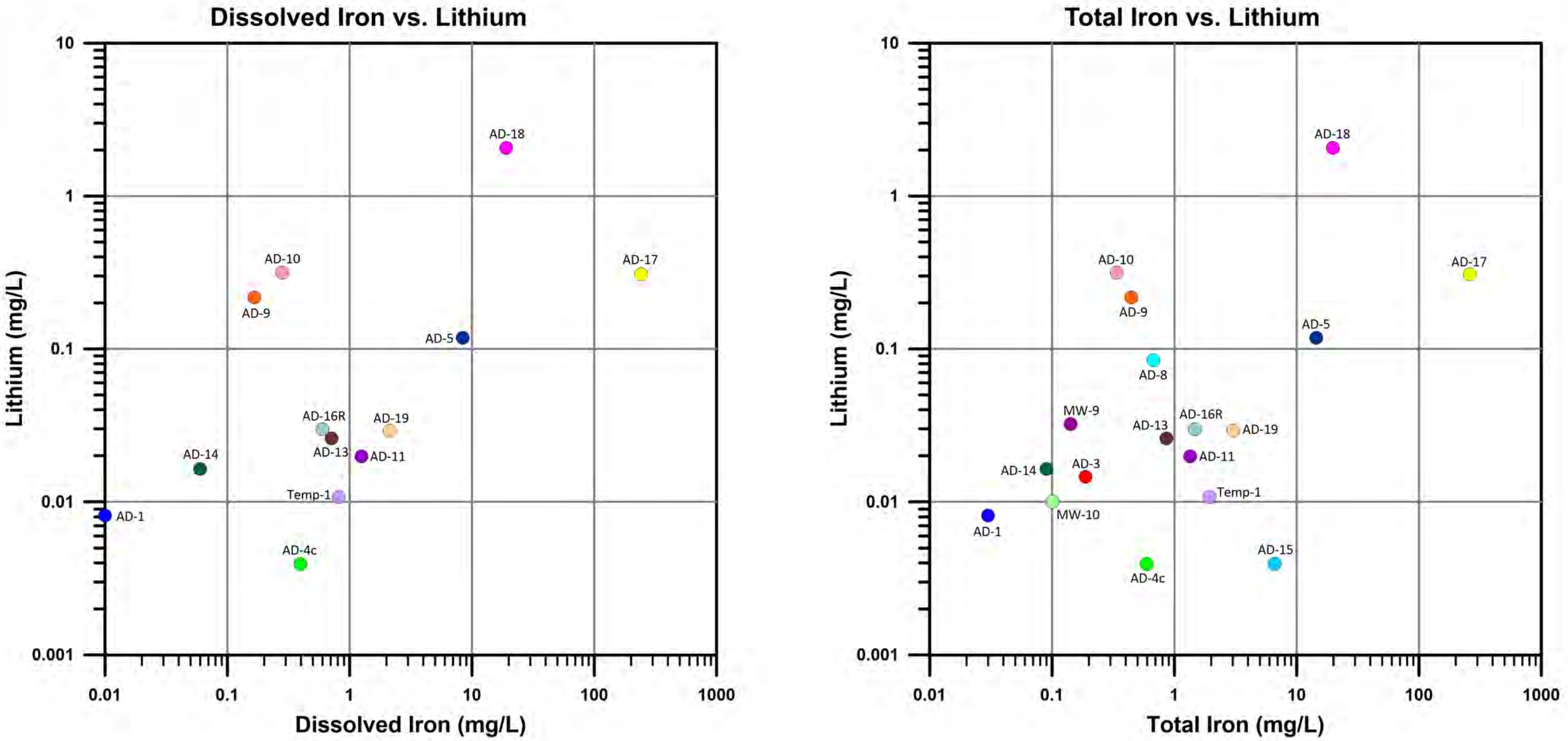
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

IRON CONCENTRATION
IN GROUNDWATER (mg/L)
MAY - OCTOBER 2018

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-5

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\May2018\Fig4-5-IronConcentrationsREV.mxd



Upgradient Wells
- ● AD-1
- ● AD-17
- ● AD-18
- ● AD-5

Downgradient Wells
- ● AD-10
- ● AD-11
- ● AD-13
- ● AD-14
- ● AD-15
- ● AD-16R
- ● AD-19
- ● AD-3
- ● AD-4c
- ● AD-8
- ● AD-9

Sidegradient Wells
- ● MW-9
- ● MW-10
- ● Temp-1

Notes:
TDS - total dissolve solids
mg/L - milligrams per liter
Concentrations of iron and lithium in coal ash were below detection
Concentrations of lithium in coal ash porewater were less than 0.02 mg/L

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

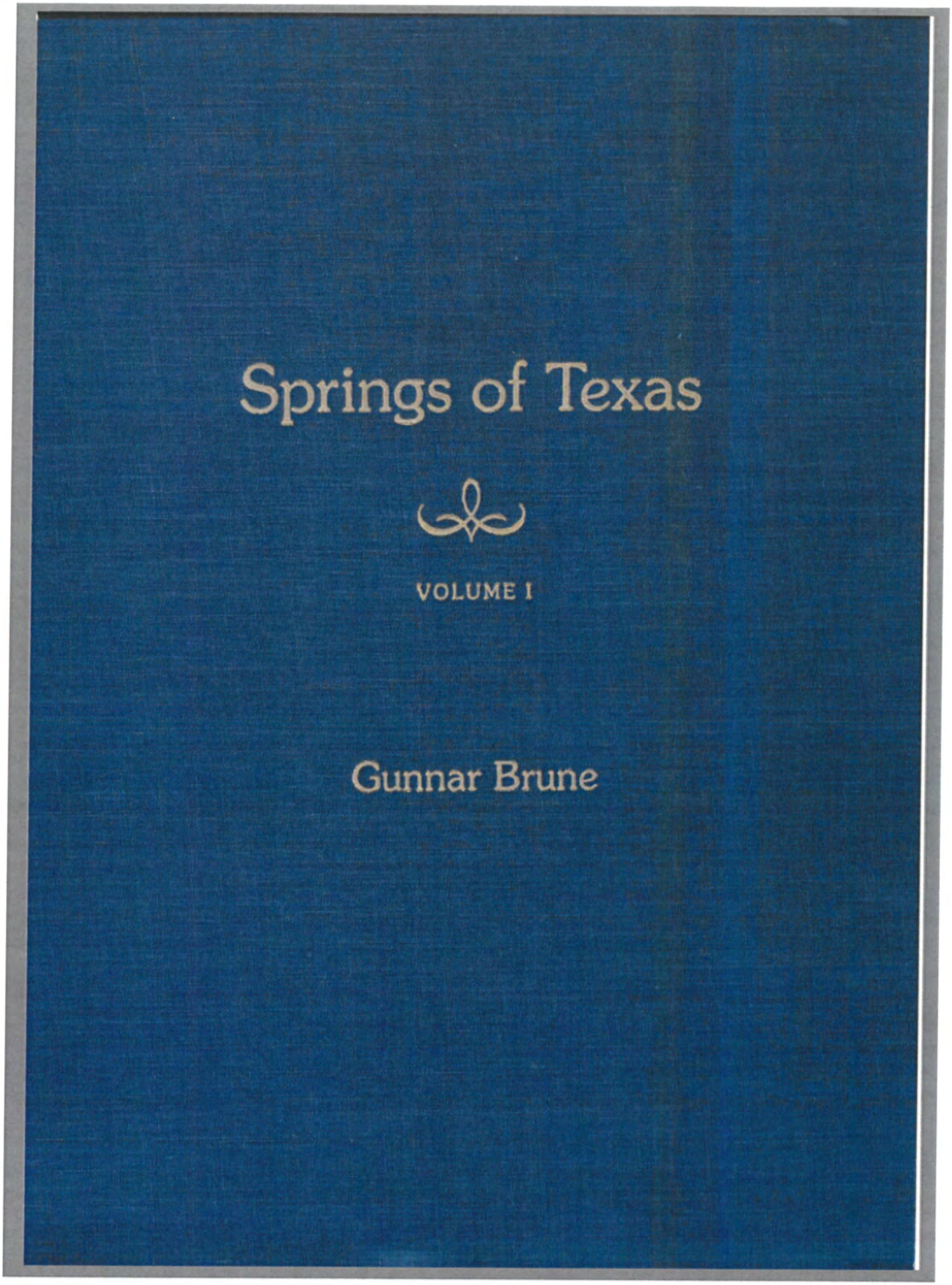
**Iron VS. Lithium
GROUNDWATER
CONCENTRATION PLOT**

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-6

APPENDIX A

Springs of Texas Reference



Springs of Texas

VOLUME I

Gunnar Brune

Manufactured in the United States of America

Second edition

The publisher gratefully acknowledges those whose grants helped make this edition possible:

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Lower Colorado River Authority
Wray Charitable Trust
Save Barton Creek Association
College of Agriculture and Life Sciences,
Texas A&M University

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333.91'04'09764—dc21
2002017373

INTRODUCTION TO THE SECOND EDITION

Helen C. Besse

When Gunnar Brune self-published *Springs of Texas, Volume I,* in 1981, most of the state water planning agencies and local environmental communities either did not recognize the importance of his work or were not aware of its existence. Brune had spent the previous decade conducting research and field studies, and then writing this book that describes the physical characteristics of springs, the archeology and history of springs' use, the ecological setting of springs, and the local use and lore surrounding springs for 183 out of 254 Texas counties. Gunnar Brune died before he could complete volume II.

Gunnar Brune described many of the large springs across the state as well as innumerable small springs present along river and stream courses that provide the base flow for waterways across the state. Brune repeatedly stated in the 1981 edition of this book that many of the springs he described had failed or were failing. With the pronounced influx of population in the last twenty years and the increased agricultural and industrial activities around the state, one can only wonder how many of the more than 2,000 springs have gone dry since he described them through the 1970s.

Nevertheless, this book is even more important today. Its value to water planners, elected officials, policy makers, municipal, county, and state administrators, wildlife stewards, environmentalists, and water lovers has not diminished. Springs are "the canary in the coal mine." The health of our springs reflects the health of our underground water resources and is seen in the state's surface resources as well.

In the section "The Prehistoric Setting of Springs," Brune provided a quote from another book on the beliefs that early Americans had about springs. It is appropriate to repeat those words here:

> Gods and heroes were born out of springs, and ever afterward came and went between the above and below worlds through their pools. Every pueblo had sacred springs somewhere near-by. There was every reason to sanctify them – physical, as life depended upon water; spiritual, as they had natural mystery which suggested supernatural qualities; for how could it be that when water fell as rain, or as snow, and ran away, or dried up, there should be other water which came and came, secretly and sweetly, out of the ground and never failed (Horgan, 1954).

F. Halley's farm. According to Dr. John Klein, a nearby resident and writer, the Klein settlement began here in 1848. The Sellars store was at the springs. They issued from Montgomery silt with many iron concretions at about 0.72 lps on April 11, 1978. The pools, containing duckweed, pennywort, and water primrose, were home to a family of ducks and ducklings. Probably the flow formerly continued down Spring Gully past Klein cemetery, 0.6 kilometer downstream, but on this date, even after rains, the channel here was dry except for some standing water. Many wells pump nearby.

Magnolia Garden Springs (15) are four kilometers northeast of Sheldon along the San Jacinto River. At Martha Dempsey's Good Times marina several very small springs trickle from Deweyville sand, including one which flows 0.15 lps from a pipe. Near the entrance to the nearby Magnolia Gardens marina, according to Jean Manson, springs flowed until about 1923. They are quite dry now. Very small springs are said to feed Simms Lake, across the river and 0.6 kilometer farther east. This formerly popular swimming hole is now closed to the public.

At Beaumont Place northeast of Houston, near the intersection of Highways 90 and 526, is another Spring Gully. The channel is now a drainage ditch into which very small springs and seeps (14) drain from Beaumont silt and sand.

Eight kilometers west of La Porte is Willow Springs Bayou, also called Willow Springs Gully or Ditch. **Willow Springs (8)** are chiefly between North L Street and Spencer Road. On April 9, 1978, the discharge of Willow Springs Bayou at North L Street was 0.18 lps, and at Spencer Road it was 0.70 lps. Many willows still fringe the channel, along with cattails.

A third Spring Gully is located eight kilometers southwest of La Porte. Springs (9) in Beaumont silt produced a discharge of about 0.18 lps in 1978 in the gully at the Red Bluff road crossing. Cottonmouths hide here among the willows and cattails.

HARRISON COUNTY

Harrison County is endowed with numerous springs of all types, some highly mineralized and valued for their healing properties. Most appear to be flowing as strongly as ever, because there has been little demand on the groundwater reservoirs. However, water levels in the artesian sands are declining as much as 4.6 meters per year in some areas. Most of the Caddo Indian villages were located at springs. Early French and Spanish explorers, some over 400 years ago, visited many of the same springs that can be seen today. The New Madrid earthquake of 1811 - 1812, which enlarged Caddo Lake, may have affected the flow of some springs. In general, however, the water-bearing formations were not greatly affected by the quake.

Most of the spring waters of the county issue from Eocene sands. They are usually fresh, soft, and acid, being of the sodium bicarbonate type. The iron content is often very high. Mineralized waters may also be high in aluminum and sulfate, may be slightly saline, and can be very hard. The analyses shown for 1942 in the table of Selected Chemical Analyses are probably too low in dissolved-solids content, perhaps because of high rainfall at the time the samples were collected. Most of the writer's field studies were made on January 23 - 28, 1976.

It was around **Locke Springs (1)** that the community of Marshall first appeared. In 1831 there were at least 20 springs flowing from the Reklaw sand near the intersection of Franklin and Houston Streets and up the hill toward the courthouse. In early times water was hauled from these springs in barrels to fill the cisterns on the town square. Most of the springs have now been paved over, but the remaining ones still flowed 1.4 liters per second in 1976.

Hynson Springs (10), also known as **Marshall, Noonday Camp**, and **Iron Springs**, are six kilometers north of Hallsville. They became very popular as a health resort about 1851. The waters are highly mineralized, containing much iron, sulfur, aluminum, and lithium. Originally there were said to be over 100 springs flowing from Queen City sand. Now not more than 20 can be found, possibly because the water table has fallen. During the Civil War the water from the springs was used in a leather-tanning factory. From 1891 to 1905 the large Hotel Randell accommodated thousands of visitors to the springs. Today there are an open-air auditorium and a number of cabins, but everything is in a sad state of disrepair. A historical marker is located at the springs. The discharge record, in liters per second, is as follows:

Jan. 28, 1942	0.13	
Jul. 21, 1964	0.06	
Jan. 27, 1976	0.13 (main spring)	1.6 (all springs)

Rock Springs (7) are just east of the Rock Springs church on Highway 449 about 13 kilometers west of Marshall. This and several other springs upstream flowed 2.3 lps from the Queen City sand in 1976. The Frenchman Henri Joutel of La Salle's party may have stopped here for refreshment in 1687.

Mulberry Springs (9), nine kilometers south-southwest of Harleton, are 100 meters north of the

Welsh Power Plant
Primary Bottom Ash Pond
Alternate Source Demonstration

The Welsh Power Plant Primary Bottom Ash Pond initiated an assessment monitoring program in accordance with 40 CFR 257.95 on April 13, 2018. Groundwater protection standards (GWPS) were set in accordance with 257.95(d)(2) and a statistical evaluation of the assessment monitoring data was conducted. The statistical evaluation revealed an exceedance of the lithium GWPS on July 12, 2019. A successful alternate source demonstration (ASD) was completed per 257.95(g)(3), therefore, the Welsh Primary Bottom Ash Pond will remain in assessment monitoring. An ASD is documentation that shows a source other than the CCR unit was responsible for causing the statistics to exceed the GWPS. The ASD document will explain the alternate cause of the GWPS exceedance. The successful ASD is attached.

ALTERNATIVE SOURCE DEMONSTRATION - LITHIUM PRIMARY BOTTOM ASH POND

J. Robert Welsh Power Plant
1187 County Road 4865
Pittsburg, Titus County, Texas

September 24, 2019

STATE OF TEXAS
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ALTERNATIVE SOURCE DEMONSTRATION - LITHIUM PRIMARY BOTTOM ASH POND

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ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
Arcadis	Arcadis U.S., Inc.
ASD	Alternate Source Demonstration
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
ft	feet
GWPS	groundwater protection standard
MCL	maximum contaminant limit
mg/kg	milligram per kilogram
mg/L	milligram per liter
PBAP	Primary Bottom Ash Pond
SPLP	Synthetic Precipitation Leaching Procedure
SSI	statistically significant increase
SSL	statistically significant level
USDA	United States Department of Agriculture
USGS	United States Geologic Survey

1 INTRODUCTION

This Alternate Source Demonstration (ASD) report has been prepared on behalf of American Electric Power Service Company for lithium detected in groundwater at hydraulically downgradient monitoring well AD-9 at the Primary Bottom Ash Pond (PBAP) at the J. Robert Welsh Plant site located in Titus County, Texas. This ASD report was prepared in accordance with the Coal Combustion Residual (CCR) Rule (the Rule) specified in 40 Code of Federal Regulations (CFR) §257 and based on recommendations provided in the Electric Power Research Institute "Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites" (Electric Power Research Institute [EPRI] 2017). As part of the Rule, CCR facility owners are required to conduct detection and assessment monitoring of "Appendix III" and "Appendix IV" constituents, respectively, to ensure compliance with applicable groundwater standards (described further below). Because the monitored constituents also have natural sources and can be influenced by sampling methodology implementation, the Rule allows owners or operators to evaluate and demonstrate whether a source other than the CCR unit caused a statistically significant increase (SSI) over background levels for an Appendix III constituent or at statistically significant levels (SSLs) over groundwater protection standards for an Appendix IV constituent, such as natural variation in groundwater quality or sampling methodology error.

The owner or operator must complete the written ASD within 90 days of identifying the SSI or SSL and include the certification from a qualified professional engineer to verify the accuracy of the information in the report. This ASD report was prepared by Arcadis U.S., Inc. (Arcadis) on behalf of American Electric Power Service Company within the 90-day period and has been certified by a qualified professional engineer.

1.1 Facility History

The J. Robert Welsh Plant is located within southern Titus County, approximately eight miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas (**Figure 1-1**). The Plant began operations in 1977 with three coal-fired generating units (Units 1, 2, and 3). Throughout the life of the Plant, CCR materials (fly ash, bottom ash, economizer ash) have been generated. These byproducts were stored in the PBAP and in the adjacent Landfill that were constructed in the late 1970s. In 2000, the 22-acre Bottom Ash Storage Pond was installed south of the Landfill. The Bottom Ash Storage Pond was constructed with a 60-mil high-density polyethylene liner (**Figure 1-2**).

Presently bottom ash and economizer ash from the Plant are sluiced to the PBAP. Solids settle as the clear liquids flow through a drainage canal into the clear water pond (a non-CCR unit). Solids (bottom ash and economizer ash) in the PBAP are dredged and sluiced into the Bottom Ash Storage Pond. Marketable ash material from the PBAP is also temporarily stored in the western two thirds of the Landfill for processing, then loaded into trucks and sold for beneficial reuse (highway road base, etc.).

2 PHYSICAL SETTING

2.1 Regional Topography

The elevation at the Site ranges from approximately 300 feet (ft) above mean sea level (amsl) at Swauano Creek downstream of the Welsh Reservoir, to 360 ft amsl at a topographically high ridge at the west end of the Landfill. The PBAP is in a topographically low area that had been an un-named intermittent tributary of Swauano Creek prior to development of the Site. The Landfill is approximately 40 acres in size and is located in a topographically higher area directly south of the PBAP. The Bottom Ash Storage Pond is approximately 22 acres in size and in a topographically higher area directly south of the Landfill.

A topographically high ridge is present directly northwest of the Site where offsite monitoring wells AD-22 and AD-23 were installed along the FM 1735 right-of-way during June 2019. Ground surface elevation at these offsite monitoring wells ranges from approximately 361 ft amsl at AD-22 to 369 ft amsl at AD-23.

2.2 Geology and Soils

2.2.1 Regional and Local Geology

The Site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently to the southeast. The Site, including all three CCR Units (PBAP, Landfill, Bottom Ash Storage Pond), is located along the outcrop of the Eocene-age Reklaw Formation, which consists of very fine to fine grained sand and clay (Flawn 1966). The Reklaw Formation attains a thickness of approximately 110 ft in Titus County, and is underlain by the Eocene-age Carrizo Sand which consists of fine to coarse sand, silt, and clay (United States Geologic Survey [USGS] 1965). In the topographically low areas underlying the Welsh Reservoir to the east of the PBAP, Quaternary alluvial sediments associated with Swauano Creek are present (Flawn 1966).

All of the CCR monitoring wells at the Site are completed in the Reklaw Formation. The two offsite monitoring wells (AD-22, AD-23) west of the Site are completed in the overlying Queen City Formation. Monitoring well locations are shown on **Figure 2-1**.

As shown on the regional geologic map and legend (**Figure 2-2A** and **Figure 2-2B**), the Reklaw Formation outcrop (Er) at the Site is relatively narrow (less than 1 mile in width). The Reklaw Formation is overlain by the Eocene-age Queen City Formation, which outcrops in topographically higher areas west of the Site, including the area where monitoring wells AD-22 and AD-23 are located. The Queen City Formation consists of fine to medium grained sand, shale, silt, and impure lignite, and attains a thickness of approximately 210 ft in Titus County (USGS 1965). The Queen City Formation also contains ironstone concretions (Flawn 1966).

2.2.2 Regional and Local Soil Composition

Information gathered from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Services soil data provides a detailed inventory of the regional soils and their characteristics, including the widespread distribution of clay-bearing soils, that support data collected at the Site from soil borings and groundwater monitoring locations. Two main named soil layers are present in the Pittsburgh, TX, area in the vicinity of the Site:

- Norfolk sandy loam
- Susquehanna fine sandy loam

Both soils are similar in the uppermost 1.5 ft of material, generally grayish in color and containing fine sand, silt, and clay. However, the subsoils of both units have subtle differences from one another and are described herein. Observations from soil borings at the Site are consistent with the characteristics of one or both of these soil units, as described in the USDA Natural Resources Conservation Services document.

The Norfolk sandy loam is a widely distributed soil unit that is uniformly developed in the lowland areas and is derived from weathering Eocene-aged deposits. It is a generally porous soil, allowing infiltrating water to migrate downward toward the water table. The soil layer is generally yellowish-gray in color, however the subsoil at greater depths is characterized by increased clay content and a mottled red and yellow appearance. As noted in the USDA soil descriptions, the soil and subsoils of the Norfolk sandy loam may be broken down into the grain size distributions presented in **Table 2-1**.

The Susquehanna fine sandy loam is also widely distributed and generally resembles the Norfolk sandy loam at the surface. Subsoils of the Susquehanna contain a greater component of clay, and likely contain increased iron content, as evidenced by observed iron concretions and iron crust formation within the subsoil. This soil is often mottled in appearance, ranging from red and yellow to a reddish brown or gray. Despite the greater clay content, the soil and subsoil is not impervious to infiltrating water that migrates toward the water table. As noted in the USDA soil descriptions, the soil and subsoils of the Susquehanna fine sandy loam may be broken down into the grain size distributions presented in **Table 2-2**.

These soil descriptions are important for the understanding of contributing sources of key constituents, such as lithium to the groundwater system. Lithium can occur in soils through natural weathering processes and the development of clay minerals. In particular, lithium can be incorporated into the structure of clays in the smectite group through cation substitution, which is further influenced by the presence of iron within the clay structure (Drever 2002; Stucki 2005). The widespread distribution of clay deposits in the native soils in and near the Site and the propensity for clays to contain trace constituents of potential concern supports the potential for natural sources of lithium.

Geologic cross-sections were generated to evaluate the stratigraphy in the area of the PBAP. The lines of geologic cross-section are shown on **Figure 2-3** and the cross-section details for cross-sections A-A’ through E-E’ are shown on **Figures 2-4** through **2-8**, respectively. As shown on **Figure 2-4**, an unsaturated brown to gray clay and sandy clay stratum is present in the area of the PBAP from the surface to a depth of approximately 20 ft below ground surface. The clay stratum is underlain by a saturated fine to medium grained clayey and silty sand stratum with an average thickness of approximately 10 ft and is consistent with the soils of the Susquehanna fine sandy loam deposits. As discussed below in Section 2.3.2, this saturated sand stratum is the uppermost water-bearing unit in the area of the PBAP. This sand stratum is underlain by an unsaturated gray to black silty clay stratum that locally serves as a lower confining layer (aquitard) for the uppermost water-bearing unit.

As shown on **Figures 2-2A** and **2-4**, the Queen City Formation outcrops in the topographically high area to the northwest of the Site. The geologic contact between the Queen City Formation, in which offsite monitoring wells AD-22 and AD-23 are completed, and the Reklaw Formation, in which the CCR monitoring wells are completed, is located near an elevation of 340 ft amsl as shown on **Figure 2-4**. The Queen City Formation directly west of the Site consists predominantly of clayey sand, and the underlying Reklaw Formation consists of interbedded sand, silt, and clay strata.

2.3 Hydrology

2.3.1 Regional Hydrology

The Reklaw Formation, which outcrops at the Site, and the overlying Queen City Formation, which outcrops west of the Site, are part of the Cypress Aquifer, which also includes the underlying Carrizo Sand and Wilcox Formation (USGS 1965). As shown on **Figure 2-9,** the Cypress Aquifer is approximately 900 ft thick in the Site area, and the base of fresh water in the Cypress Aquifer is approximately 800 ft below ground surface.

Regional groundwater characteristics are presented in Texas Water Commission Bulletin 6517 "*Ground-Water Resources of Camp, Franklin, Morris, and Titus Counties, Texas, Texas*" (USGS 1965). All of the regional aquifer units are combined in this document, and considered as one interconnected unit, referred to as the "Cypress aquifer". This singular aquifer unit, composed of all water bearing units of similar character, was divided into three zones based on water quality characteristics of each zone rather than lithology. The following three zones were identified, in order of increasing relative depth:

- Zone A: characterized by minimal iron content and low pH, ranging from 4.5 to 6.5.
- Zone B: characterized by increased dissolved iron content and pH ranging from 5.0 to 7.0
- Zone C: characterized by iron concentrations of less than 0.3 milligrams per liter (mg/L) and neutral to alkaline pH (7.0 to 8.0)

Groundwater at the Site is generally assumed to be influenced by groundwater from Zones A and B. As described in USGS, 1965, Zones A and B can be more simply described as:

- Zone A: zone of oxidation and acidic groundwater
- Zone B: intermediate zone

The dissolved iron content in the A and B zones (ranging from non-detect to greater than 10 mg/L; USGS 1965) is likely influenced by iron present in the soils and sediments, which are described in Section 2.2. Slow recharge rates and transmissive properties of these zones contributes to longer residence times whereby the infiltrating groundwater may react with soil and sediments, allowing for the oxidation of sulfides to generate sulfate and mobilizing ferrous iron into solution. In addition, groundwater from several wells completed in shallow (less than 60 ft in depth) sediments contained sulfate concentrations above

1,000 mg/L. Sulfate concentrations observed at the Site are consistent with the range of data for other similar depth wells in the four-county area (USGS 1965).

Additional regional groundwater information is provided in the 107th Annual Meeting of the Texas Academy of Science abstract titled “Natural Sources of Poor Water Quality in Streams of East Texas” (Ledger et. al. 2004). This study characterized surface water streams associated with the regional groundwater in the Eocene-aged Reklaw Formation as acidic with high concentrations of sulfate, and arsenic concentrations greater than 0.01 mg/L.

An observed decline in surface water quality was also noted if springs from the Reklaw Formation discharge to surface water bodies. Abundant sulfur is noted in the Reklaw formation and sediments undergo acid-sulfate weathering, as evidenced in the red-stained soils and sulfate concentrations of greater than 1,000 mg/L (Ledger et. al. 2004). In streams associated with the Reklaw Formation, sulfate levels may exceed 1,000 mg/L.

2.3.2 Local Hydrology

Groundwater flow direction at the Site is generally from west to east, following surface topography towards the Welsh Reservoir. Groundwater elevations and well construction information from monitoring wells completed in the uppermost water-bearing unit at the Site are summarized on **Table 2-3**. Depth to groundwater in the monitoring wells in the area of the PBAP ranges from approximately 10 to 15 ft below ground surface.

Figure 2-10 is a potentiometric surface map for the uppermost water-bearing unit at the Site based on June 19, 2019 water level data. As shown on **Figure 2-10**, shallow groundwater flow direction in the area of the CCR Units is in a general easterly direction toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.01 foot per foot. Shallow groundwater flow direction in the area of monitoring wells AD-22 and AD-23, which are completed in the Queen City Formation, is southeasterly toward the CCR monitoring wells, which are completed in the Reklaw Formation. The groundwater flow direction and downward vertical flow indicates shallow groundwater in the Queen City Formation likely is hydraulically connected to the underlying Reklaw Formation. This is consistent with Texas Water Commission Bulletin 6517 description of the Cypress Aquifer: “The Wilcox Group and the Carrizo Sand, Reklaw Formation, and Queen City Sand of the Claiborne Group have similar hydrologic properties and are the principal source of freshwater in the four-county area. The units probably are interconnected hydraulically and they function as single aquifer” (USGS 1965). **Figure 2-11** is a regional hydrologic cross section of the site area.

The hydraulic conductivity of the uppermost water-bearing unit at the Site was determined by conducting aquifer tests. A constant-rate pumping test was conducted at monitoring well AD-6 on September 21, 2017. Based on the AD-6 pumping test data, the hydraulic conductivity for the uppermost water-bearing unit was calculated at 0.05 ft per day (1.83 x 10^{-5} centimeters per second).

To provide a broader understanding of the hydraulic conductivity distribution across the Site, bail down slug tests were performed in October 2018 on a total of 5 wells; 1 up gradient well (AD-17) and 4 down gradient wells (AD-6, AD-9, AD-13 and AD-19) on October 30 and 31, 2018. These wells are all screened in the uppermost water-bearing unit and were chosen based on their distribution across the Site. The hydraulic conductivity estimates from the five monitoring wells tested ranged from 0.15 ft per day (AD-6)

to 2.0 ft per day (AD-13). The overall mean hydraulic conductivity estimate was 0.84 ft per day, while the overall geometric mean was 0.60 ft per day.

2.4 Surface Water

The Site is located directly west of Swauano Creek, which was dammed near the southern end of the Site during plant development to form the Welsh Reservoir. The PBAP normal operating water level is near the weir box which has a bottom elevation of 325 ft amsl. The surface water elevation of the Welsh Reservoir, located east of the PBAP, is maintained at approximately 320 ft amsl. The Welsh Reservoir is likely a gaining surface water feature, and groundwater elevations at the Site are higher than the normal stage elevation of the Welsh Reservoir (approximately 320 ft amsl) as shown on **Figure 2-10**.

There are no current or historic gauging stations on Swauano Creek; however, there was a historic gauging station on adjacent Boggy Creek, which has a drainage basin area of 72 square miles versus 21.2 square miles for Swauano Creek. The average annual flow of the Boggy Creek gauging station during the driest year on record (1956) was 10.65 cubic feet per second, which corresponds to a flow of approximately 3 cubic feet per second for Swauano Creek.

3 DETECTION AND ASSESSMENT MONITORING STATISTICAL EVALUATION

3.1 General

The groundwater monitoring network for the uppermost water-bearing unit at the PBAP consists of three upgradient monitoring wells (AD-1, AD-5, AD-17) and three downgradient monitoring wells (AD-8, AD-9, AD-15). Additional details regarding the groundwater monitoring network are provided in the August 22, 2017 report entitled "*Primary Bottom Ash Pond – CCR Groundwater Monitoring Well Network Evaluation*" (Arcadis 2017).

3.2 Detection Monitoring Results

Detection monitoring at the Site involves collection of groundwater samples from the groundwater monitoring network upgradient and downgradient monitoring wells for analyses of Appendix III CCR constituents, which includes boron, calcium, chloride, fluoride, sulfate, pH, and total dissolved solids. Following the baseline monitoring program, which included a minimum collection of eight independent samples from each of the background and downgradient wells that are part of the certified monitoring network, the first round of Detection Monitoring was conducted. Based on detection monitoring conducted at the PBAP in 2017, 2018, and 2019, an SSI over the background concentration was calculated for boron in AD-8 (Geosyntec 2019b). Because of the SSIs noted for boron in groundwater samples from AD-8, an Alternate Source Demonstration was completed which did not identify an alternate source for the boron SSI (Geosyntec 2018).

3.3 Assessment Monitoring Results

Groundwater protection standards (GWPSs) were established for the Appendix IV parameters in accordance with 40 CFR Part 257.95(h). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or regional screening level for each Appendix IV parameter.

Confidence intervals were calculated for Appendix IV parameters at the compliance wells (AD-8, AD-9, AD-15) to assess whether Appendix IV parameters were present at an SSL above the GWPS. An SSL was identified for lithium in January 2019, which exceeded the GWPS of 0.390 mg/L at monitoring well AD-9 (0.935 mg/L), despite no observed SSIs in Appendix III parameters for this well (Geosyntec 2019a). An additional statistical analysis was completed from an assessment monitoring event in February and verification sampling April 2019 at downgradient wells AD-8 and AD-9 for Appendix III parameters. An update to the statistical analysis was completed in July to re-establish the GWPSs for Appendix IV parameters. The results similarly identified an SSL for lithium updated for AD-9 at 0.957 ug/L (Geosyntec 2019b). Additional details regarding the statistical evaluations of the groundwater monitoring data is provided in the January 8, 2019 and July 11, 2019 reports both entitled "*Statistical Analysis Summary, Primary Bottom Ash Pond*" (Geosyntec 2019a, 2019b).

Because the native soils have the potential to be a natural source of lithium in the regional and local groundwater and soil composition, an ASD report was prepared in February 2019 to provide additional information on the sources and distribution of lithium in groundwater at the Site from the data that was available (Arcadis 2019). The conclusions from the February 2019 ASD indicated several lines of evidence demonstrating that the lithium concentration in groundwater at AD-9 is from naturally occurring sources (ASD Type V), with some additional contributions from sampling methodology error (ASD Type I). This ASD report updates the previous report based on the recently collected Site-specific soil and groundwater data, including soil and groundwater analytical data collected outlined in Section 4.

4 SOIL AND GROUNDWATER ANALYTICAL DATA EVALUATION

4.1 General

In addition to the detection and assessment monitoring groundwater sampling events conducted at the PBAP in 2017, 2018, and February 2019 for statistical evaluation, a comprehensive site-wide groundwater sampling event was conducted by Arcadis during May 2018, and an offsite soil and groundwater sampling event was conducted by Arcadis during June 2019 to evaluate alternate potential sources of lithium detected in downgradient monitoring well AD-9. The May 2018 evaluation included the following tasks:

- Collection of groundwater samples from the PBAP upgradient monitoring wells (AD-1, AD-5, AD-17), the PBAP downgradient monitoring wells (AD-8, AD-9, AD-15), and other monitoring wells in the area completed in the uppermost water-bearing unit, including upgradient monitoring well AD-18; sidegradient monitoring wells MW-9, MW-10, and Temp-1; and downgradient monitoring wells AD-3, AD-4c, AD-10, AD-11, AD-13, AD-14, AD-16R, and AD-19.
- Collection of soil samples from eight soil borings (Temp-1, SB-2 through SB-8) around the perimeter of the CCR units at the site.
- Collection of three CCR material samples from the PBAP (Sample IDs: Ash-1, Ash-2, Ash-3) and one CCR material sample from the HDPE-lined Bottom Ash Storage Pond (Sample ID: Ash-4) for analysis of total metals, pore water concentrations, and leachate water using the Synthetic Precipitation Leaching Procedure (SPLP) (**Table 4-1**).

The June 2019 evaluation included the following tasks:

- Installation of two offsite monitoring wells (AD-22, AD-23) in the Queen City Formation northwest (hydraulically upgradient) of the Site. Monitoring well completion diagrams are provided in **Appendix A**.
- Collection of soil and groundwater samples from the Queen City Formation monitoring wells for Appendix III and Appendix IV parameter analyses.

Additionally, two sentinel downgradient monitoring wells (AD-20, AD-21) were installed in the uppermost water-bearing unit (Reklaw Formation) near the shoreline of the Welsh Reservoir east (hydraulically downgradient) of the CCR units during October 2018.

4.2 Soil and Groundwater Analytical Data Evaluation

4.2.1 Soil Evaluation

The soil evaluation results demonstrate a correlation between lithium and iron in soil. Boring logs from Site area monitoring locations highlight similarities with observations provided in the county-wide soil survey reports. For example, boring locations SB-04 (adjacent to AD-5), SB-05 (adjacent to AD-8), AD-22, and AD-23 contain a greater content of the reddish-brown clay subsoils as noted in the Susquehanna fine sandy loam, which directly overlie the water table in these locations. The reddish brown color generally denotes the presence of iron in these locations, which can be either incorporated directly into the clay mineral structure (e.g. smectite), or as a secondary mineral (e.g. iron hydroxide) that is also present in the aquifer matrix (Stucki 2005). The role of iron incorporated into the clay structure is important to localized geochemical processes, such as cation exchange, redox conditions, and hydrophilic properties, which can influence weathering characteristics and the mobility of trace constituents (i.e. lithium) in groundwater (Stucki 2005). Specifically, in the event that geochemical conditions are or become conducive to iron dissolution (e.g., if conditions become microbially/geochemically reducing), then the mobilization of iron associated with soil can result in the co-mobilization of trace constituents.

As shown on **Table 4-1** and **Figure 4-1**, the highest concentrations of lithium in soil were detected from 3 to 5 feet below ground surface in hydraulically upgradient and offsite Queen City Formation monitoring well AD-22 (up to 18 milligrams per kilogram [mg/kg]), and onsite Reklaw Formation soil boring SB-4 (13.6 mg/kg) located adjacent to monitoring well AD-5 which is hydraulically upgradient (northwest) of the PBAP. This upgradient (background) data indicates lithium concentrations in soil in the area of the PBAP are naturally occurring and not the result of impacts from CCR materials. This is one line of evidence that the lithium detected in groundwater at monitoring well AD-9 is from a naturally occurring source, and not the CCR unit. As shown on **Table 4-1** and **Figure 4-2**, the highest iron concentrations in soil are from soil borings AD-22 and AD-23 (17,600 to 85,500 mg/kg) which are located in the Queen City Formation upgradient of the Site; SB-4 (AD-5; 10,400 mg/kg), located in the Reklaw Formation upgradient (northwest) of the PBAP; and soil boring SB-8 (AD-3; 11,000 mg/kg), located in the Reklaw Formation over 1,000 ft south (side gradient) of the PBAP. **Figure 4-3** shows an apparent correlation between the iron and lithium content in the coal ash, upgradient locations, and downgradient locations. However, SPLP and pore water results from the coal ash samples show that the iron and lithium present in the coal ash is not in a mobile (leachable) form. Therefore, it is more likely that the regional groundwater interaction with naturally occurring lithium and iron in soil is responsible for the observed lithium concentrations and variability across the Site. As detailed below in Section 4.2.2, iron and lithium concentrations in groundwater at the Site show a similar distribution to iron and lithium concentrations in soil, indicating naturally occurring sources for iron and lithium.

4.2.2 Groundwater Evaluation

Groundwater analytical results for the PBAP, the landfill, and the bottom ash storage pond are summarized on **Tables 4-2**, **4-3**, and **4-4**, respectively. As shown on **Figure 4-4**, the highest lithium concentration in the most recent (2019) groundwater samples is at monitoring well AD-18 (1.27 mg/L), which is west (upgradient) relative to the PBAP. This data indicates lithium concentrations in groundwater in the area of the PBAP are from a source other than the PBAP.

As shown on **Figure 4-5**, iron concentrations in groundwater are also elevated upgradient (west) relative to the PBAP. **Figure 4-6** shows the relationship of total and dissolved iron concentrations to lithium concentrations in upgradient, side-gradient, and downgradient monitoring wells. These results demonstrate a clear correlation between aqueous iron and lithium, with higher lithium concentrations associated with elevated iron. The greatest concentrations of both iron and lithium are observed in the upgradient monitoring wells AD-17 and AD-18. As identified in **Table 4-1** and noted on **Figure 4-6**, SPLP leachate and pore water analyzed from coal ash samples contain lithium in concentrations below detection, or at very low concentrations less than 0.02 mg/L. This data indicates lithium concentrations in groundwater in the area of the PBAP are from a source other than the PBAP. As discussed above in Section 2.2.1, the Queen City Formation, which overlies the Reklaw Formation, is located directly west of the Site. Therefore, groundwater from the Queen City Formation west (upgradient) of the CCR units may be the source of lithium and iron detected in soils and groundwater in the area of the CCR units. As discussed above in Section 2.3.1, elevated naturally occurring iron is documented in the Cypress Aquifer, and as discussed above in Section 2.2.1, the Queen City Formation contains naturally-occurring iron concretions and correspondingly high iron concentrations in soil samples.

Another line of evidence the lithium detected in groundwater in the area of the PBAP is from a naturally occurring source is provided in the 2002 Publication "Springs of Texas" (Gunnar Brune 1981). The Springs of Texas publication states "*Hynson Springs, also known as Marshall, Noonday Camp, and Iron Springs, are six kilometers north of Hallsville. They became very popular as a health resort about 1851. The waters are highly mineralized, containing much iron, sulfur, aluminum, and lithium. Originally there were said to be over 100 springs flowing from the Queen City Formation*." This spring, which contains naturally-occurring lithium, is located approximately 35 miles southeast of the Site. A copy of this reference is provided in **Appendix B**.

When reviewing historical and recent datasets, a broad relationship was noted between trace metal chemistry and turbidity. Where turbidity values were greatest, greater concentrations of selected CCR monitored constituents were also observed (e.g. arsenic and cadmium) and in some cases, in exceedance of Federal MCLs. As a result, low-flow sampling methodology was employed to reduce the amount of turbidity in the groundwater sample.

A comprehensive groundwater sampling event was conducted at the Site by Arcadis during May 2018 using low-flow methodology. A clean stainless steel low-flow sampling pump with new, well-dedicated polyethylene piping was slowly lowered into the mid-point of the water column at each monitoring well, and groundwater was then pumped at a low flow rate of less than 0.1 liters per minute until the produced water was visually clear. The turbidity of the produced water was measured using calibrated field instruments during well development, and groundwater samples were not collected until the turbidity measurements declined and stabilized. Once low-flow groundwater sampling techniques were properly followed by Arcadis during May 2018, water quality results indicated concentrations of selected constituents to be much less than previously reported and did not exceed criteria. Therefore, it was determined that the sediment disturbances generated during well purging and improper (turbid) groundwater sampling were causing most of the Federal MCL groundwater exceedances. Specifically, since CCR Rule monitoring requires analysis of unfiltered samples, the results suggest that the exceedances were associated with constituents present in undissolved suspended solid particulates rather than in a dissolved form, on a location by location basis. The May 2018 groundwater analytical results are most representative of groundwater quality at the Site because proper low-flow sampling protocols were adhered to and sediment contributions to the analytical results were minimized.

The most recently collected groundwater samples from PBAP downgradient monitoring well AD-9 support improper (turbid) groundwater sampling as a contributor to the lithium Federal MCL exceedance in February 2019. The lithium concentration in the May 2019 groundwater sample from monitoring well AD-9 (0.225 mg/L) is over 4 times lower than the lithium concentration in the February 2019 groundwater sample (1.12 mg/L), and correspondingly the field-measured turbidity in the May 2019 groundwater sample (27.2 nephelometric turbidity units) is over 4 times lower than the field-measured turbidity in the February 2019 groundwater sample (115 nephelometric turbidity units).

5 SUMMARY AND CONCLUSIONS

This ASD has been prepared in consultation with the Electric Power Research Institute “Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites”. The following lines of evidence indicate the SSL related to the lithium concentration in groundwater at AD-9 is from naturally occurring sources (ASD Type V), with some additional contributions from sampling methodology error (ASD Type I):

- An SSI was confirmed for boron within monitoring well AD-8 followed by a failed Alternate Source Demonstration for boron, triggering the assessment monitoring program for the PBAP. Under the assessment monitoring program, an SSL was identified for lithium which exceeded the GWPS of 0.390 mg/L at monitoring well AD-9 (0.957 mg/L), despite no observed SSIs in Appendix III parameters for this well. SSIs would be expected for Appendix III parameters if there was a CCR unit source for the lithium exceedance of the SSL, indicating that there may be an alternate source of lithium.
- As demonstrated in this ASD report, iron and lithium are associated in the sediments and in groundwater. The subsoils at the Site, particularly the Susquehanna fine sandy loam, contain naturally occurring high clay content. The role of iron incorporated into the clay structure is important to localized geochemical processes, such as cation exchange, redox conditions, and hydrophilic properties, which can influence weathering characteristics and the mobility of trace constituents (i.e. lithium) in groundwater (Stucki, 2005). This is a supporting line of evidence.
- The highest lithium concentrations in the soil samples collected during the Arcadis May 2018 and June 2019 investigations was from background soil samples (AD-22, 3-5 ft depth; SB-4, 27 ft depth) located upgradient (northwest) of the PBAP. This is a key line of evidence that the PBAP is not the source of elevated lithium concentrations in soil at the Site.
- Leachate and pore water analyzed from coal ash samples contain lithium in concentrations below detection, or at very low concentrations less than 0.02 mg/L. This data indicates lithium concentrations in groundwater in the area of the PBAP are from a source other than the PBAP. This is a key line of evidence.
- The highest lithium concentration in groundwater samples collected during the Arcadis May 2018 investigation was from an upgradient (background) monitoring well (AD-18) located west of the PBAP. This is a key line of evidence that the PBAP is not the source of elevated lithium concentrations in groundwater at the Site.
- Iron and lithium concentrations in soil and groundwater at the Site show a similar distribution, indicating there is likely a common source for these metals. The 1965 USGS publication “*Ground-Water Resources of Camp, Franklin, Morris and Titus Counties, Texas”* documents naturally occurring high iron concentrations within zones of the Cypress Aquifer, in which the monitoring wells at the Site are completed. The University of Texas at Austin Bureau of Economic Geology 1966 publication “*Geologic Atlas of Texas, Texarkana Sheet*” documents naturally occurring iron concretions in the Queen City Formation, which outcrops directly west (upgradient) of the PBAP. This is a supporting line of evidence.

- The 1981 Gunnar Brune publication "*Springs of Texas"* documents naturally occurring elevated lithium in groundwater in the Queen City Formation at Hynson Springs, which is approximately 35 miles from the Site. The publication states "*Hynson Springs, also known as Marshall, Noonday Camp, and Iron Springs, are six kilometers north of Hallsville. They became very popular as a health resort about 1851. The waters are highly mineralized, containing much iron, sulfur, aluminum, and lithium. Originally there were said to be over 100 springs flowing from Queen City sand".* This publication, along with soil and groundwater analytical data at the Site, supports the conclusion that the primary source of lithium in groundwater at the PBAP is from the Queen City Formation, which outcrops directly west (upgradient) of the PBAP. This is a key line of evidence.
- The water quality sample exhibiting elevated lithium at AD-9 in February 2019 also showed elevated turbidity. Upon resampling in May 2019, both the lithium concentration and turbidity decreased, indicating that the elevated lithium observed in February 2019 was likely associated with suspended particulates and not entirely in a dissolved form. Effective well development and proper low flow sampling techniques minimize the potential for groundwater analyses to be unrepresentative of formation groundwater. This is a supporting line of evidence.
- This ASD report provides a strong demonstration of naturally occurring sources of lithium in groundwater (ASD Type V) as supported by five key lines of evidence and three supporting lines of evidence.

6 PROFESSIONAL ENGINEER'S CERTIFICATION

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the alternate source demonstration for lithium at the Primary Bottom Ash Pond meets the requirements of 40 CFR Part 257.95.

Kenneth J. Brandner

Printed Name of Registered Professional Engineer

KENNETH J. BRANDNER
69586

Kenneth J Brandner

Signature

69586

Registration No.

Texas

Registration State

9-24-19

Date

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TABLES

Table 2-1
Grain Size Distribution in Soil and Subsoil of the Norfolk Sandy Loam
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Grain Size	Soil	Subsoil
Fine Gravel	0.0%	0.0%
Coarse Sand	0.2%	0.1%
Medium Sand	0.4%	0.3%
Fine Sand	29.4%	29.9%
Very Fine Sand	37.9%	24.0%
Silt	25.9%	25.1%
Clay	5.9%	20.2%

Table 2-2
Grain Size Distribution in Soil and Subsoil of the Susquehanna Fine Sandy Loam
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Grain Size	Soil	Subsoil
Fine Gravel	0.4%	0.0%
Coarse Sand	0.7%	0.2%
Medium Sand	0.9%	0.8%
Fine Sand	53.4%	36.6%
Very Fine Sand	16.0%	10.8%
Silt	21.2%	19.0%
Clay	7.2%	32.8%

Table 2-3
Well Construction and Water Level Data - CCR Units
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole Depth ft. bls	Date Installed	Screen Material	Well Diameter inches	Top of Screen		Bottom of Screen	
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl
Monitoring Wells												
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86
AD-16R (e)	33° 02' 49"	94° 50' 28.9"	350.55	353.49	27.0	4/12/17	Sch. 40 PVC	2	12.0	338.55	27.0	323.55
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17
AD-19	33.047201°	94.839694°	323.58	326.35	15.0	5/8/18	Sch. 40 PVC	2	5.0	318.58	15.0	308.58
AD-20	33° 02' 45.6"	94° 50' 22.8"	324.85	327.65	20.0	10/23/18	Sch. 40 PVC	2	4.0	320.85	19.0	305.85
AD-21	33° 02' 49.6"	94° 50' 20"	322.04	325.29	20.0	10/23/18	Sch. 40 PVC	2	3.5	318.54	18.5	303.54
AD-22	33° 03' 35"	94° 51' 09"	360.94	360.22	20.0	6/18/19	Sch. 40 PVC	2	5.0	355.94	20.0	340.94
AD-23	33° 03' 56"	94° 51' 08"	369.37	368.82	20.0	6/18/19	Sch. 40 PVC	2	5.0	364.37	20.0	349.37
Piezometers												
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10
Temp-1	33.046864°	94.852059°	356.36	358.17	28.0	5/8/18	Sch. 40 PVC	2	8.0	348.36	28.0	328.36
MW-9	33° 03' 18"	94° 50' 19.4"	342.00	344.54	18.0	11/19/01	Sch. 40 PVC	2	3.0	339.00	18.0	324.00
MW-10	33° 03' 13.6"	94° 50' 19.4"	341.96	344.80	19.0	11/19/01	Sch. 40 PVC	2	4.0	337.96	19.0	322.96

Well ID	6/7/2011 GW Elev. ft. msl	12/6/2011 GW Elev. ft. msl	5/2/2012 GW Elev. ft. msl	11/1/2012 GW Elev. ft. msl	5/14/2013 GW Elev. ft. msl	11/19/2013 GW Elev. ft. msl	5/12/2014 GW Elev. ft. msl	11/16/2014 GW Elev. ft. msl	5/12/2015 GW Elev. ft. msl	3/4/2016 GW Elev. ft. msl	5/26/2016 GW Elev. ft. msl	7/27/2016 GW Elev. ft. msl	10/19/2016 GW Elev. ft. msl	12/12/2016 GW Elev. ft. msl	1/17/2017 GW Elev. ft. msl	2/23/2017 GW Elev. ft. msl	10/6/2017 GW Elev. ft. msl	5/15/2018 GW Elev. ft. msl	10/29/2018 GW Elev. ft. msl	6/19/2019 GW Elev. ft. msl
Monitoring Wells																				
AD-1 (c)	338.46	334.92	337.88	337.18	337.43	336.73	338.03	337.64	340.82	342.83	344.89	342.89	341.23	340.58	341.18	339.74	337.70	340.57	339.10	345.37
AD-2 (c)	330.16	329.07	330.00	329.26	329.83	329.70	330.09	329.69	332.56	332.32	---	---	---	---	---	---	---	331.50	331.25	333.61
AD-3 (c)	323.81	323.19	323.99	323.29	323.77	323.98	324.12	323.28	325.58	325.12	324.59	323.70	323.47	323.78	325.04	324.92	323.24	324.30	324.15	325.42
AD-4 (c)	324.81	324.84	324.62	324.40	324.74	325.52	325.44	325.13	327.00	326.90	---	---	---	---	---	---	---	---	---	---
AD-4a (a)	325.01	324.19	325.24	322.90	324.86	324.68	325.64	325.34	327.19	327.12	---	---	---	---	---	---	---	---	---	---
AD-4b (a)	324.35	324.32	324.50	324.30	324.30	325.21	325.22	324.90	326.58	326.67	---	---	---	---	---	---	---	---	---	---
AD-4c (a)	324.18	324.50	324.64	324.37	324.11	325.06	325.01	324.71	326.50	326.19	325.89	324.01	323.76	325.07	326.39	324.89	324.20	324.95	325.62	325.98
AD-5 (c)	336.34	336.58	336.82	336.99	336.78	336.47	336.80	336.01	339.07	338.04	337.62	337.24	337.74	337.01	338.34	336.17	337.40	337.25	336.98	337.18
AD-6 (a)	333.04	333.02	332.83	333.02	333.11	332.81	333.11	332.81	333.38	334.00	---	---	---	---	---	---	---	---	333.42	333.42
AD-7 (a)	334.32	334.12	334.19	334.20	334.13	334.58	333.77	333.98	334.09	333.61	---	---	---	---	---	---	---	---	---	335.00
AD-8 (a)	325.41	324.09	325.69	325.15	325.79	325.75	325.98	325.77	326.05	325.70	325.68	325.05	325.29	325.92	326.76	324.27	326.12	325.63	326.36	326.17
AD-9 (a)	328.46	328.53	328.63	328.44	328.74	329.38	NM	330.18	329.98	329.74	329.28	329.53	328.92	329.31	330.50	328.05	329.47	329.40	329.98	330.01
AD-10 (a)	323.44	322.55	323.27	323.35	323.51	323.76	323.57	323.88	323.95	323.55	---	---	---	---	---	---	---	323.53	324.19	324.06
AD-11 (a)	327.99	328.37	327.82	327.93	327.94	328.13	328.20	327.97	328.96	328.13	328.39	328.14	327.87	328.20	328.90	328.25	327.85	327.61	327.83	328.72
AD-12 (a)	348.30	348.29	349.86	349.56	349.99	349.65	349.89	350.01	350.65	350.39	---	---	---	---	---	---	---	349.52	348.28	350.81
AD-13 (a)	332.36	332.24	333.09	332.26	332.68	333.25	333.35	332.01	337.58	334.76	334.54	332.93	332.39	332.84	334.54	331.83	331.42	331.83	331.52	332.98
AD-14 (a)	330.40	329.80	331.67	330.34	330.94	331.69	332.12	330.17	336.63	334.83	334.51	331.71	330.94	330.79	332.63	330.87	329.91	330.76	330.52	333.94
AD-15 (d)	---	---	---	---	---	---	---	---	---	322.14	321.93	321.28	321.42	321.71	321.64	322.81	322.07	321.74	322.01	322.24
AD-16 (d)	---	---	---	---	---	---	---	---	---	337.09	335.84	332.14	331.52	331.43	330.96	330.71	---	---	---	---
AD-16R (e)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	327.12	328.68	326.71	335.13
AD-17 (d)	---	---	---	---	---	---	---	---	---	334.64	334.26	334.30	334.45	334.64	334.05	333.94	334.17	334.35	333.91	335.39
AD-18 (d)	---	---	---	---	---	---	---	---	---	343.66	343.26	340.81	339.92	339.38	338.97	340.38	339.43	342.75	340.97	343.70
AD-19	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	321.24	321.54	322.65
AD-20	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	323.28	322.89
AD-21	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	320.26	320.72
AD-22	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	358.24
AD-23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	364.98
Piezometers																				
B-2 (b)	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-4 (b)	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-5 (b)	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-6 (b)	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Temp-1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	345.55	342.79	350.08
MW-9	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	331.34	331.24	NM
MW-10	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	332.29	332.75	337.26

NOTES:
NM = Not measured
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
(e) Monitoring well installed by ARCADIS on April 12, 2017 as a replacement for monitoring well AD-16.
Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through February 2017.
1983 State Plane Lambert Coordinate System
Datum: NAD 83
ft bls = feet below land surface
ft msl = feet above mean sea level
Elev. = Elevation
---- = No record

Table 4-1
Soil and Coal Ash Sample Analytical Results (mg/kg) - CCR Units
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Sample ID	Date Sampled	Sample Depth (feet)	Units	Appendix III Parameters						Appendix IV Parameters														
				Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Soil Samples																									
Temp-1	5/8/18	15'	mg/kg	14.3	43.3	15	<1	5.0	93	<0.25	1.77	16.8	<0.05	<0.05	5.22	0.28	1.77	0.104	0.004	1.18	<0.25	1.26	0.273	<12.5	5.4
SB-2	5/10/18	22'	mg/kg	11.9	35.8	13	2	3.9	878	<0.25	<0.25	18.3	0.08	<0.05	3.53	0.551	3.98	0.08	0.005	0.287	0.684	<0.25	0.159	890	4.46
(AD-17)																									
SB-3	5/10/18	30'	mg/kg	3.05	90.2	94	1	3.8	1,194	<0.25	3.83	13.6	<0.05	0.132	9.21	0.649	4.22	0.322	0.009	1.64	<0.25	<0.25	0.593	3,960	6.87
(AD-18)																									
SB-4	5/9/18	5'	mg/kg	(FOC = 0.00723 g/g)			---	4.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
(AD-5)		27'	mg/kg	7.76	634	8	1	6.4	724	<0.25	1.81	20.4	0.115	0.417	6.73	4.76	3.2	13.6	0.006	0.561	0.536	<0.25	0.657	10,400	65.5
(Background)		27'	mg/kg	(FOC = 0.00688 g/g)																					
SB-5	5/9/18	19'	mg/kg	5.45	655	16	3	7.2	69	<0.25	1.11	8.53	0.109	0.241	3.75	3.58	2.96	10.5	0.044	0.313	0.297	<0.25	0.216	6,210	35.5
(AD-8)																									
SB-6	5/9/18	21'	mg/kg	5.33	397	20	2	7.8	116	<0.25	1.11	17.9	0.09	0.24	3.5	3.37	2.67	10.3	0.051	0.299	0.471	<0.25	2.502	5,970	38.4
(AD-9)																									
SB-7	5/9/18	13'	mg/kg	8.11	1,360	19	<1	5.0	198	<0.25	10.1	65	0.154	0.356	6.87	3.21	3.14	5.3	0.004	1.39	<0.25	<0.25	0.262	9,220	28.4
(AD-13)																									
SB-8	5/9/18	12'	mg/kg	16.6	6,150	13	1	5.2	24	<0.25	3.3	213	0.409	0.452	8.22	4.13	9.05	4.63	0.013	0.488	<0.25	<0.25	0.433	11,000	25.4
(AD-3)																									
AD-20	10/23/18	15-17	mg/kg	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.567	---	---
AD-21	10/23/18	15-17	mg/kg	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.424	---	---
AD-22	6/18/19	3-5	mg/kg	16.7	110	---	---	4.84	---	<0.25	8.43	136	0.544	0.935	29.9	13	18.9	18	0.053	0.711	1.81	<0.25	---	25,800	---
		6-8	mg/kg	10.2	18.7	---	---	4.1	---	<0.25	20.9	30.4	0.246	0.723	17.7	9.65	8.95	2.9	0.009	0.446	1.08	<0.25	---	22,500	---
		11-13	mg/kg	8.83	219	---	---	4.26	---	<0.25	5.96	77.1	0.293	0.571	16.5	8.75	6.57	4.4	0.045	0.536	0.885	<0.25	---	17,600	---
AD-23	6/18/19	3-5	mg/kg	32.7	115	---	---	4.64	---	<0.25	14.1	45.5	0.805	3.23	49	30.8	11	7.74	0.035	1.14	4.27	<0.25	---	85,500	---
		5-7	mg/kg	10.2	22.7	---	---	4.25	---	<0.25	6.3	31.7	0.288	0.775	19	9.74	8.56	4.83	0.014	0.378	1.12	<0.25	---	22,700	---
		10-12	mg/kg	9.16	200	---	---	4.21	---	<0.25	4.13	28.3	0.288	0.613	23.9	8.19	7.03	3.41	0.015	1.03	0.635	<0.25	---	18,500	---
Coal Ash Samples																									
Ash-1	5/10/18	1-2'	mg/kg	34.4	33,800	30.5	8.21	7.1	219	<0.877	14.6	607	1.02	0.464	31.8	5.55	16.9	11.6	0.0473	2.66	2.27	<0.54	*2.92*	37,500	139
		SPLP:	*mg/L*	*0.594*	*30.2*	---	---	---	---	*<0.00344*	*<0.00411*	*0.284*	*<0.000333*	*<0.000164*	*0.00273*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0176*	*<0.00363*	*<0.00287*	*0.0991*	*<0.0305*	*<0.00267*
		Pore Water:	*mg/L*	*0.643*	*113*	*20.1*	*1.86*	*7.4*	*6.6*	*<0.00344*	*0.0095*	*3.43*	*<0.000333*	*<0.000164*	*0.00396*	*<0.000553*	*<0.00285*	*0.0123*	*<0.0000653*	*0.00484*	*<0.00363*	*<0.00287*	0.755	---	*0.357*
Ash-2	5/10/18	1-2'	mg/kg	92.6	96,000	53.8	11.2	7.3	293	<1.56	19.4	2,760	1.64	1.56	41.2	9.63	24.5	15.5	0.0967	2.08	5.25	<0.957	*2.32*	18,300	365
		SPLP:	*mg/L*	*0.526*	*24.1*	---	---	---	---	*<0.00344*	*<0.00411*	*0.192*	*<0.000333*	*<0.000164*	*0.00222*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0165*	*<0.00363*	*<0.00287*	*0.112*	*<0.0305*	*<0.00267*
		Pore Water:	*mg/L*	*0.772*	*143*	*20.4*	*0.28*	*7.6*	*8.73*	*<0.00344*	*0.0106*	*3.99*	*<0.000333*	*<0.000164*	*0.00196*	*<0.000553*	*0.00346*	*0.0173*	*<0.0000653*	*0.00428*	*<0.00363*	*<0.00287*	0.508	---	*0.376*
Ash-3	5/10/18	1-2'	mg/kg	29	14,300	11.5	10.7	7.4	152	<0.687	11.8	766	0.845	0.394	19.2	5.77	12.2	6.87	0.0403	1.79	1.44	<0.423	*1.754*	21,100	110
		SPLP:	*mg/L*	*0.958*	*19.8*	---	---	---	---	*<0.00344*	*<0.00411*	*0.0315*	*<0.000333*	*<0.000164*	*0.00389*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0222*	*<0.00363*	*<0.00287*	*<0.256*	*0.471*	*<0.00267*
		Pore Water:	*mg/L*	*1.000*	*103*	*13.0*	*0.998*	*7.6*	*51.1*	*<0.00344*	*0.0108*	*1.54*	*<0.000333*	*<0.000164*	*0.00110*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0111*	*<0.00363*	*<0.00287*	0.594	---	*0.715*
Ash-4	5/10/18	1-2'	mg/kg	281	106,000	27.6	1.34	10.5	961	<0.757	9.72	3,390	2.23	1.06	35.1	16.2	16.3	20.4	0.0340	2.21	1.30	<0.466	*3.18*	24,200	177
		SPLP:	*mg/L*	*1.3*	*25.1*	---	---	---	---	*<0.00344*	*<0.00411*	*0.0216*	*<0.000333*	*<0.000164*	*0.00329*	*<0.000553*	*<0.00285*	*<0.0086*	*<0.0000653*	*<0.00281*	*<0.00363*	*<0.00287*	*<0.407*	*<0.0305*	*<0.00267*
		Pore Water:	*mg/L*	*4.75*	*63.5*	*28.8*	*0.697*	*10.8*	*381*	*<0.00344*	*0.00745*	*0.217*	*<0.000333*	*<0.000164*	*0.00225*	*0.00093*	*<0.00285*	*<0.0086*	*<0.0000653*	*0.0798*	*<0.00363*	*<0.00287*	0.259	---	*0.00814*

NOTES:
mg/kg = Milligrams per kilogram
mg/L = Milligrams per liter
FOC = Fraction organic carbon (Walkley Black)
--- = Not analyzed
SPLP = Synthetic precipitation leaching procedure (concentrations shown in milligrams per liter)
Total concentrations (mg/kg) shown in normal font, SPLP and Pore Water concentrations (mg/L) shown in italics.
Radium concentrations for soil shown in picoCuries per gram. SPLP concentrations shown in picoCuries per liter.

Table 4-2
Groundwater Sampling Analytical Results (mg/L) - Primary Bottom Ash Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Background (Upgradient) Wells																									
AD-1	05/26/16	0.346	36.5	5	<1	5.93	--	42	252	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.010	0.000033	<0.005	<0.005	<0.002	1.18	--	--
	07/27/16	0.350	39.6	4	<1	5.93	--	36	239	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.019	<0.000025	<0.005	<0.005	<0.002	0.9952	--	--
	09/29/16	0.332	15	5	<1	5.37	--	35	173	<0.005	<0.005	0.141	<0.001	<0.001	0.005	<0.005	<0.005	0.014	<0.000025	<0.005	<0.005	<0.002	1.38	--	--
	10/19/16	0.398	19.1	4	<1	5.15	--	42	192	<0.005	<0.005	0.114	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	1.141	--	--
	12/12/16	0.394	8.74	4	<1	5.18	--	40	200	<0.005	<0.005	0.072	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	0.719	--	--
	01/17/17	0.656	129	4	<1	7.13	--	68	538	<0.005	<0.005	0.410	<0.001	<0.001	<0.001	<0.005	<0.005	<0.001	<0.000025	<0.005	<0.005	<0.002	3.009	--	--
	02/23/17	0.700	147	9	<1	6.88	--	68	612	<0.005	<0.005	0.488	<0.001	<0.001	<0.001	<0.005	<0.005	0.001	<0.000025	<0.005	<0.005	<0.002	4.309	--	--
	06/07/17	0.449	15.1	4	<0.083	5.06	109	42	176	<0.00093	0.00114	0.09346	0.00037	<0.00007	0.00066	0.00077	<0.00068	0.00902	0.000007	<0.00029	0.0021	<0.00086	0.676	--	--
	10/06/17	--	--	--	--	5.25	97.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.352	12.1	3	<0.083	4.82	8.4	--	174	<0.00093	<0.00105	0.08823	0.00048	<0.00007	<0.00023	0.0008	<0.00068	0.00816	<0.000005	<0.00029	<0.00099	<0.00086	0.837	0.03	0.025
	Dissolved	*0.35*	*12*	--	--	4.82	8.4	--	--	*<0.00093*	*<0.00105*	*0.08582*	*0.00044*	*<0.00007*	*<0.00023*	*0.00083*	*<0.00068*	*0.00799*	*<0.000005*	*<0.00029*	*0.00197*	*<0.00086*	*0.531*	0.01	0.026
	05/24/18	0.345	10.2	4	<0.083	5.19	118	43	150	0.00317 J	<0.00105	0.0799	0.00039 J	<0.00007	<0.00023	0.00035 J	<0.00068	0.00814	0.000006 J	<0.00029	0.00138 J	<0.00086	1.983	--	--
	08/14/18	0.443	5.95	5	<0.083	5.18	102	44	160	0.00003 J	0.00021	0.063	0.000482	0.00002	0.00016	0.000797	0.000238	0.00708	0.000013 J	0.00021	0.0017	0.00003 J	1.10	--	--
	02/20/19	0.504	142	2.82	0.24	7.31	113	49.2	522	0.00016	0.00046	0.457	0.00009 J	0.00001 J	0.000306	0.000399	0.000124	0.00155	<0.000025	0.001 J	0.0007	<0.0005	3.16	--	--
	05/30/19	0.689	--	1.59	0.29	--	61.3	43.3	588	0.00016	0.00060	0.512	0.000244	0.00001 J	0.0001 J	0.000756	0.000197	<0.009	<0.000005	0.00243	0.0014	<0.0001	--	0.099	0.0625
AD-5	05/31/16	0.03	36.9	15	<1	6.38	--	123	337	<0.005	<0.005	0.057	<0.001	<0.001	<0.001	0.014	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	1.63	--	--
	07/28/16	0.04	44.7	16	<1	6.38	--	163	360	<0.005	<0.005	0.093	<0.001	<0.001	<0.001	0.015	<0.005	0.191	<0.000025	<0.005	<0.005	<0.002	4.75	--	--
	09/29/16	0.04	46.3	15	<1	5.29	--	190	416	<0.005	<0.005	0.087	<0.001	<0.001	<0.001	0.014	<0.005	0.186	<0.000025	<0.005	<0.005	<0.002	3.33	--	--
	10/20/16	0.05	50.7	14	<1	5.92	--	267	448	<0.005	<0.005	0.07	<0.001	<0.001	<0.001	0.009	<0.005	0.225	<0.000025	<0.005	<0.005	<0.002	2.319	--	--
	12/13/16	0.05	49.6	13	<1	6.29	--	233	484	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	0.013	<0.005	0.199	<0.000025	<0.005	<0.005	<0.002	2.182	--	--
	01/17/17	0.04	49.8	14	<1	6.27	--	234	438	<0.005	<0.005	0.047	<0.001	<0.001	<0.001	0.012	<0.005	0.239	<0.000025	<0.005	<0.005	<0.002	1.023	--	--
	02/23/17	0.04	33.0	15	<1	5.48	--	127	286	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	0.013	<0.005	0.166	<0.000025	<0.005	<0.005	<0.002	1.788	--	--
	06/07/17	0.05281	49.7	14	<0.083	5.96	867	82	300	<0.00093	0.00385	0.0877	0.00008	0.00039	0.00028	0.01193	<0.00068	0.124	<0.000005	<0.00029	<0.00099	<0.00086	2.32	--	--
	10/06/17	--	--	--	--	5.59	249	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.05063	30.1	21	<0.083	5.79	<100	--	248	<0.00093	<0.00105	0.07627	0.00014	0.00037	<0.00023	0.01907	<0.00068	0.118	<0.000005	<0.00029	<0.00099	<0.00086	1.495	14.4	0.45
	Dissolved	*0.03752*	*29.1*	--	--	5.79	<100	--	--	*<0.00093*	*<0.00105*	*0.06865*	*<0.00002*	*<0.00007*	*<0.00023*	*0.01747*	*<0.00068*	*0.119*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.043*	*2.051*	8.38	0.43
	05/24/18	0.05007	28.1	22	<0.083	6.22	17.8	60	242	<0.00093	<0.00105	0.07116	<0.00002	0.00023 J	0.0008 J	0.01424	<0.00068	0.121	<0.000005	<0.00029	<0.00099	<0.00086	1.946	--	--
	08/15/18	0.05	40.5	19	<0.083	6.23	57.1	240	428	0.00001 J	0.00169	0.0637	0.000055	0.000008 J	0.000072	0.0114	0.000079	0.147	<0.000005	0.00013	0.00008 J	<0.00005	0.316	--	--
	02/21/19	0.033	33.9	24.7	0.21	5.38	164	46.5	220	0.00002 J	0.00159	0.0694	0.00008 J	<0.00005	0.000432	0.00858	0.000147	0.0807	<0.000025	<0.002	0.0001 J	<0.0005	1.27	--	--
	05/30/19	0.03 J	--	22.3	0.29	--	150	51.3	238	<0.00002	0.00305	0.0605	0.00008 J	<0.00001	0.00006 J	0.0118	0.00005 J	0.104	0.000006	<0.0004	0.00005 J	<0.0001	--	23.4	0.331
AD-17	05/26/16	0.121	200	43	<1	7.17	--	1,166	1,810	<0.005	<0.005	0.021	<0.001	0.002	0.001	0.063	<0.005	0.370	0.000032	<0.005	<0.005	<0.002	1.53	--	--
	07/27/16	0.119	195	32	<1	7.17	--	1,005	1,576	<0.005	<0.005	0.020	<0.001	0.004	0.001	0.068	<0.005	0.374	<0.000025	<0.005	<0.005	<0.002	2.78	--	--
	09/29/16	0.111	191	36	<1	6.17	--	1,055	1,663	<0.005	<0.005	0.031	<0.001	<0.001	0.003	0.058	<0.005	0.354	<0.000025	<0.005	<0.005	<0.002	2.358	--	--
	10/20/16	0.124	194	32	1.0	6.14	--	1,163	1,612	<0.005	<0.005	0.034	<0.001	0.002	0.004	0.065	<0.005	0.394	<0.000025	<0.005	<0.005	<0.002	2.224	--	--
	12/13/16	0.135	196	31	<1	6.03	--	1,096	1,560	<0.005	<0.005	0.017	<0.001	0.003	<0.001	0.068	<0.005	0.323	<0.000025	<0.005	<0.005	<0.002	2.384	--	--
	01/17/17	0.101	196	33	<1	5.96	--	1,445	1,686	<0.005	<0.005	0.014	<0.001	0.003	0.068	0.068	<0.005	0.341	<0.000025	<0.005	<0.005	<0.002	2.436	--	--
	02/22/17	0.135	189	30	<1	5.67	--	1,055	1,628	<0.005	<0.005	0.020	<0.001	0.002	0.001	0.073	<0.005	0.331	<0.000025	<0.005	<0.005	<0.002	2.288	--	--
	06/06/17	0.121	188	30	<0.083	5.81	156	1,105	1,578	<0.00093	<0.00105	0.01033	<0.00002	0.00606	<0.00023	0.0748	<0.00068	0.329	0.000013	<0.00029	<0.00099	<0.00086	1.598	--	--
	10/05/17	--	--	--	--	5.92	598	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.247	213	45	<0.083	5.51	<100	--	1,846	<0.00093	<0.00105	0.00978	<0.00002	0.00915	<0.00023	0.07451	<0.00068	0.306	<0.000005	<0.00029	0.00414	<0.00086	1.514	260	3.72
	Dissolved	*0.231*	*205*	--	--	5.51	<100	--	--	*<0.00093*	*<0.00105*	*0.00737*	*<0.00002*	*0.00609*	*<0.00023*	*0.07938*	*<0.00068*	*0.301*	*<0.000005*	*<0.00029*	*0.00515*	*0.02*	*1.57*	241	3.56
	05/24/18	0.239	193	39	<0.083	6.28	7.8	1,067	1,836	<0.00093	<0.00105	0.00965	<0.00002	0.00646	<0.00023	0.07173	<0.00068	0.308	<0.000005	<0.00029	<0.00099	<0.00086	1.939	--	--
	08/15/18	0.118	187	40	<0.083	5.60	418	1,170	1,750	0.00002 J	0.00183	0.0128	0.000069	0.00025	0.000604	0.0435	0.0011	0.243	0.000011 J	0.00035	0.0003	0.000074	2.35	--	--
	02/21/19	0.151	207	43.2	0.180	6.93	274	1,060	1,720	0.00008 J	0.00251	0.120	0.00024	0.00027	0.00334	0.0645	0.00249	0.268	0.000007 J	0.0007 J	0.0008	<0.0005	2.66	--	--
	05/30/19	0.158	--	41.7	<0.04	--	176	1,120	1,546	<0.00002	0.00041	0.0196	0.00002 J	0.00003 J	0.000246	0.0511	0.00003 J	0.341	<0.000005	<0.0004	0.00006 J	<0.0001	--	145	3.40
Offsite Background (Upgradient) Monitoring Wells																									
AD-22	06/19/19	0.04 J	2.61	17.3	0.1 J	5.59	<100	17.4	148	<0.0002	0.00163	0.104	0.0004 J	<0.0001	0.002 J	0.0181	0.0007 J	0.03 J	0.000003 J	<0.004	0.0006 J	<0.001	1.403	16.2	--
AD-23	06/19/19	0.03 J	1.16	6.04	0.05 J	5.72	44.1	0.8	52	<0.0002	0.00201	0.082	0.0006 J	<0.0001	0.00911	0.0111	0.001 J	<0.009	0.000004 J	<0.004	0.0009 J	<0.001	0.617	6.54	--
Background Statistical Evaluation Summary - Upper Prediction Limits:[a]										0.005	0.005	0.58	0.00073	0.01	0.0036	0.075	0.005	0.39	0.000033	0.002	0.005	0.0013	4.18	--	--

Table 4-2
Groundwater Sampling Analytical Results (mg/L) - Primary Bottom Ash Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Point of Compliance Wells																									
AD-8	05/31/16	1.46	32.6	36	1	6.91	--	217	524	<0.005	<0.005	0.034	<0.001	<0.001	0.002	0.007	<0.005	0.122	<0.000025	<0.005	<0.005	<0.002	1.046	--	--
	07/28/16	1.44	25.9	26	<1	6.91	--	202	469	<0.005	<0.005	0.026	<0.001	<0.001	<0.001	0.009	<0.005	0.098	<0.000025	<0.005	<0.005	<0.002	1.584	--	--
	09/29/16	1.51	24.3	28	<1	7.65	--	186	432	<0.005	<0.005	0.023	<0.001	<0.001	<0.001	0.007	<0.005	0.111	<0.000025	<0.005	<0.005	<0.002	6.3	--	--
	10/20/16	1.54	25.9	30	<1	6.07	--	184	424	<0.005	<0.005	0.024	<0.001	<0.001	<0.001	0.007	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	0.345	--	--
	12/12/16	1.53	23.6	27	<1	5.62	--	168	442	<0.005	<0.005	0.021	<0.001	<0.001	<0.001	0.007	<0.005	0.11	<0.000025	<0.005	<0.005	<0.002	1.083	--	--
	01/19/17	1.53	18.7	24	1	6.21	--	153	352	<0.005	<0.005	0.02	<0.001	<0.001	<0.001	0.006	<0.005	0.094	<0.000025	<0.005	<0.005	<0.002	0.823	--	--
	02/22/17	1.67	19.3	22	<1	6.78	--	163	356	<0.005	<0.005	0.019	<0.001	<0.001	<0.001	0.006	<0.005	0.092	<0.000025	<0.005	<0.005	<0.002	0.536	--	--
	06/06/17	1.39	17.4	22	0.6628	5.63	54	151	368	<0.00093	<0.00105	0.01908	<0.00002	<0.00007	<0.00023	0.00386	<0.00068	0.09491	0.000008	<0.00029	<0.00099	<0.00086	1.0735	--	--
	10/05/17	--	--	--	--	6.68	41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/18	1.29	17.2	22	0.716	6.07	3.0	--	368	<0.00093	<0.00105	0.02283	0.00004	<0.00007	<0.00023	0.00521	<0.00068	0.08418	0.000009	<0.00029	<0.00099	<0.00086	1.106	0.673	0.388
	Dissolved	*1.31*	*17.1*	--	--	6.07	3.0	--	--	*<0.00093*	*<0.00105*	*0.02046*	*<0.00002*	*<0.00007*	*<0.00023*	*0.00513*	*<0.00068*	*0.08356*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*0.5773*	< 0.01	0.363
	05/23/18	--	--	--	0.501 J	6.20	*48.2*	--	--	0.00319 J	<0.00105	0.02212	<0.00002	<0.00007	<0.00023	0.00319 J	<0.00068	0.0956	<0.000005	<0.00029	0.00175 J	<0.00086	0.3366	--	--
	8/15/18[b]	1.30	15.0	24	0.615 J	6.77	104	122	288	0.00001 J	0.00031	0.0212	0.000008 J	0.000002 J	0.00005	0.00536	0.000039	0.0555	0.000007 J	0.00016	0.00007 J	0.000129	3.44	--	--
	02/21/19	1.47	17.6	23.2	0.660	6.40	88.2	163	352	<0.0001	0.00057	0.0281	0.00003 J	0.00003 J	0.000456	0.00288	0.000223	0.0911	<0.000025	<0.002	0.0001 J	<0.0005	0.417	--	--
	05/29/19	1.07	--	19.5	0.89	--	76.4	150	324	<0.00002	0.00037	0.0303	<0.00002	0.00002 J	0.0001 J	0.00603	0.00007 J	0.067	<0.000005	<0.0004	0.00006 J	0.0001 J	--	1.07	0.457
AD-9	05/31/16	0.12	229	88	<1	6.32	--	1,352	2,541	<0.005	<0.005	0.051	<0.001	0.001	<0.001	0.027	<0.005	1.32	<0.000025	<0.005	<0.005	<0.002	2.95	--	--
	07/28/16	0.105	255	98	<1	6.32	--	1,464	2,564	<0.005	<0.005	0.031	<0.001	0.002	<0.001	0.022	<0.005	1.38	0.000045	<0.005	0.008	<0.002	1.447	--	--
	09/29/16	0.115	220	86	<1	4.72	--	1,301	2,448	<0.005	<0.005	0.033	<0.001	<0.001	<0.001	0.012	<0.005	1.17	<0.000025	<0.005	<0.005	<0.002	3.199	--	--
	10/19/16	0.109	228	76	1	5.22	--	1,350	2,494	<0.005	<0.005	0.026	<0.001	<0.001	<0.001	0.016	<0.005	1.44	<0.000025	<0.005	<0.005	<0.002	1.311	--	--
	12/12/16	0.108	250	92	<1	5.72	--	1,639	2,667	<0.005	<0.005	0.027	<0.001	0.002	<0.001	0.024	<0.005	1.33	<0.000025	<0.005	<0.005	<0.002	3.0	--	--
	01/19/17	0.312	91.1	54	<1	5.43	--	884	1,360	<0.005	<0.005	0.098	0.002	<0.001	<0.001	0.042	<0.005	0.634	<0.000025	<0.005	<0.005	<0.002	2.349	--	--
	02/22/17	0.1	258	86	<1	5.77	--	1,774	2,662	<0.005	<0.005	0.022	<0.001	<0.001	<0.001	0.024	<0.005	1.41	<0.000025	<0.005	<0.005	<0.002	2.32	--	--
	06/06/17	0.146	191	19	<0.083	4.61	100	105	308	<0.00093	<0.00105	0.04227	0.00077	0.00222	<0.00023	0.02416	<0.00068	1.00	0.000006	<0.00029	<0.00099	<0.00086	1.586	--	--
	10/05/17	--	--	--	--	5.78	102	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	0.08607	10.5	85	<0.083	4.20	<100		1,972	<0.00093	<0.00105	0.04937	0.00134	0.00023	<0.00023	0.01628	<0.00068	0.217	<0.000005	<0.00029	<0.00099	<0.00086	1.582	0.446	0.378
	Dissolved	*0.07126*	*10.2*	--	--	4.20	<100	--	--	*<0.00093*	*<0.00105*	*0.04695*	*0.00122*	*0.00012*	*<0.00023*	*0.01592*	*<0.00068*	*0.204*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.549*	0.166	0.369
	05/23/18	--	--	--	<0.083	5.30	44.6	--	--	<0.00093	<0.00105	0.03045	0.00032 J	0.00288	<0.00023	0.0267	<0.00068	1.20	<0.000005	<0.00029	<0.00099	0.00846	2.556	--	--
	8/15/18[b]	0.198	230	103	<0.083	4.96	237	1,910	2,694	<0.01	0.00168	0.0242	0.000268	0.00006	0.00042	0.0111	0.000262	0.851	0.000013 J	0.00011	0.0003	0.000062	1.864	--	--
	02/21/19	1.39	211	89	0.19	4.98	115	1,350	2,240	<0.0001	0.00118	0.0524	0.000474	0.00009	0.000313	0.0148	0.00008 J	1.12	0.00001 J	<0.002	0.0003	0.0001 J	2.51	--	--
	05/29/19	0.06 J	--	44	0.16	--	27.2	503	1,758	<0.00002	0.0002	0.0497	0.000941	0.00021	0.000346	0.0159	0.00007 J	0.225	<0.000005	<0.0004	0.0002	0.0002 J	--	0.485	0.363
AD-15	05/31/16	0.329	5.09	30	<1	5.58	--	24	188	<0.005	0.012	0.215	<0.001	<0.001	0.017	0.011	0.007	0.017	0.000054	<0.005	<0.005	<0.002	2.28	--	--
	07/28/16	0.407	3.83	34	<1	5.58	--	28	196	<0.005	0.006	0.124	<0.001	<0.001	0.004	0.006	<0.005	0.021	<0.000025	<0.005	<0.005	<0.002	1.322	--	--
	09/29/16	0.360	13.7	28	<1	4.57	--	23	367	<0.005	0.131	1.93	0.015	0.007	0.28	0.134	0.161	0.149	0.000707	<0.005	0.014	<0.002	9.92	--	--
	10/19/16	0.152	4.57	26	<1	4.35	--	17	152	<0.005	0.023	0.415	0.002	<0.001	0.054	0.019	0.022	0.036	0.0001	<0.005	<0.005	<0.002	3.567	--	--
	12/12/16	0.334	3.60	26	<1	4.67	--	19	204	<0.005	0.006	0.184	<0.001	<0.001	0.015	0.010	<0.005	0.013	0.000026	<0.005	<0.005	<0.002	3.36	--	--
	01/19/17	0.413	3.35	32	<1	5.77	--	25	176	<0.005	0.006	0.153	<0.001	<0.001	0.009	0.007	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	2.386	--	--
	02/22/17	0.100	4.21	20	<1	4.95	--	8	88	<0.005	0.020	0.353	0.002	<0.001	0.049	0.020	0.019	0.025	0.000058	<0.005	<0.005	<0.002	2.261	--	--
	06/06/17	0.321	3.57	27	<0.083	4.83	246	19	184	<0.00093	0.00854	0.166	0.00061	0.00048	0.01235	0.00844	0.00298	0.0108	0.000022	<0.00029	0.00271	<0.00086	2.491	--	--
	10/05/17	--	--	--	--	5.94	208	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/18	0.08009	2.49	22	<0.083	4.60	7.32		94	<0.00093	0.00222	0.08419	0.00024	<0.00007	<0.00023	0.00403	<0.00068	0.00395	<0.000005	<0.00029	<0.00099	<0.00086	1.749	6.64	0.036
	Dissolved	*0.05773*	*2.49*	--	--	4.60	7.32	--	--	*<0.00093*	*<0.00105*	*0.08405*	*0.00019*	*<0.00007*	*<0.00023*	*0.00346*	*<0.00068*	*0.00378*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*0.748*	< 0.01	0.034
	Field Filtered[c]	*0.301*	*3.03*	*35*	*<0.083*	4.60	7.32	--	*8*	*<0.00093*	*0.00216*	*0.08611*	*0.00012*	*<0.00007*	*<0.00023*	*0.00421*	*<0.00068*	*0.00498*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.630*	7.09	0.061
	FF Dissolved[c]	*0.309*	*3*	--	--	4.60	7.32	--	--	*<0.00093*	*<0.00105*	*0.08373*	*0.00024*	*<0.00007*	*<0.00023*	*0.0038*	*<0.00068*	*0.00516*	*<0.000005*	*0.00048*	*<0.00099*	*<0.00086*	*5.743*	<0.01	0.062
	05/23/18	--	--	--	<0.083	4.76	147	--	--	<0.00093	0.00256 J	0.102	0.00003 J	0.0001 J	0.00263	0.00474 J	<0.00068	0.00562	<0.000005	<0.00029	0.00154 J	0.00137 J	1.46	--	--
	8/15/18[b]	0.341	3.04	37	<0.083	4.59	249	24	174	0.00003 J	0.00326	0.0852	0.000116	0.00001 J	0.000481	0.00371	0.000438	0.00338	0.000008 J	0.00005 J	0.0009	0.00009	1.076	--	--
	02/21/19	0.169	2.67	28.2	0.09	4.98	116	10.6	150	<0.0001	0.00221	0.0766	0.000208	0.00001 J	0.000225	0.0029	0.000104	0.00294	<0.000025	<0.002	0.0004	<0.0005	0.841	--	--
	05/29/19	<0.02	--	21.4	0.06	--	185	2.1	34	<0.0001	0.00410	0.199	0.00186	0.00008 J	0.0103	0.00595	0.0101	0.01 J	0.000081	<0.002	0.0057	<0.0005	--	18.4	0.0423

Table 4-2
Groundwater Sampling Analytical Results (mg/L) - Primary Bottom Ash Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Supplemental Downgradient Monitoring Wells																									
AD-10	5/16/2018	0.08311	15.5	40	<0.083	3.72	<100	--	280	<0.00093	0.0022	0.03855	0.00166	0.00033	<0.00023	0.02432	<0.00068	0.316	<0.000005	<0.00029	<0.00099	0.00098	1.704	0.338	0.25
	Dissolved	*0.07733*	*15.3*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.03712*	*0.00149*	*0.00009*	*<0.00023*	*0.02412*	*<0.00068*	*0.296*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.505*	0.282	0.251
Supplemental Sidegradient Monitoring Wells																									
MW-9	5/15/2018	0.578	44.8	93	<0.083	4.74	57.4	--	780	0.00097	<0.00105	0.01661	0.00021	0.00019	<0.00023	0.03083	<0.00068	0.03225	0.000127	<0.00029	<0.00099	<0.00086	0.779	0.142	0.306
	Dissolved	*0.556*	*44.7*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.01588*	*0.00015*	*0.00036*	*<0.00023*	*0.03189*	*0.00813*	*0.03151*	*0.00015*	*<0.00029*	*<0.00099*	*<0.00086*	*0.2578*	< 0.01	0.308
MW-10	5/15/2018	0.707	59.3	5	<0.083	6.68	1.7	--	346	<0.00093	0.00128	0.08634	0.00006	<0.00007	<0.00023	0.00385	<0.00068	0.01001	<0.000005	0.00079	0.01898	<0.00086	0.969	0.101	0.054
	Dissolved	*0.689*	*59.8*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.08253*	*<0.00002*	*<0.00007*	*<0.00023*	*0.00064*	*<0.00068*	*0.00924*	*<0.000005*	*0.00082*	*0.01651*	*<0.00086*	*1.026*	< 0.01	0.002
EPA MCLs:																									
MCL					4					0.006	0.01	2	0.004	0.005	0.1				0.002		0.05	0.002	5[e]		
Rule Specified																0.006	0.015	0.04		0.1					
Background Limit					1					0.005	0.005	0.36	0.00077	0.0065[d]	0.004	0.075[d]	0.005	0.39[d]	0.000033	0.005	0.005	0.0013	4.21[e]		
Interwell Background Value(s) (UPL, LPL where applicable) AD-8, AD-9, AD-15		0.775				4.8-7.1																			
Intrawell Background Value (UPL) AD-8			35.7	38.3	1.03			236	569																
Intrawell Background Value (UPL) AD-9			350	139	0.73			2527	3147																
Intrawell Background Value (UPL) AD-15			5.71	38.4	1.00			35.6	388																

NOTES:
All concentration data are provided in milligrams per liter (mg/L) unless otherwise noted.
J = Analyte was positively identified, though the quantitation was below Reporting Limit.
MCL - Maximum contaminant level
LPL = Lower prediction limit
UPL = Upper prediction limit
pCi/L = PicoCuries per liter
-- = Not analyzed
a = Data taken from Geosyntec "Statistical Analysis Summary, Primary Bottom Ash Pond" dated July 11, 2019.
b = Some inorganic analyte groundwater samples collected 9/17/18.
c = Sample ID "AD-15 DUP" was field filtered (FF) using a 5 micron filter.
d = Calculated Upper Tolerance Limit is higher than MCL.
e = Data is "Combined Radium, Total".
🟨 Denotes groundwater sample collected by ARCADIS using low-flow methods.
Unless otherwise noted, values shown are total (unfiltered) analyses.
Dissolved (0.45-micron lab filtered) parameter concentrations shown in italics.

Table 4-3
Groundwater Sampling Analytical Results (mg/L) - Landfill
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

		Appendix III Parameters								Appendix IV Parameters															
Well	**Date Sampled**	**Boron (total)**	**Calcium (total)**	**Chloride**	**Fluoride**	**pH (field)**	**Turbidity (field)**	**Sulfate**	**TDS**	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Cobalt**	**Lead**	**Lithium**	**Mercury**	**Molybdenum**	**Selenium**	**Thallium**	**Radium 226 and 228 (pCi/L)**	**Iron**	**Manganese**
Background (Upgradient) Wells																									
AD-5	05/31/16	0.03	36.9	15	<1	6.38	--	123	337	<0.005	<0.005	0.057	<0.001	<0.001	<0.001	0.014	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	1.63	--	--
	07/28/16	0.04	44.7	16	<1	6.38	--	163	360	<0.005	<0.005	0.093	<0.001	<0.001	<0.001	0.015	<0.005	0.191	<0.000025	<0.005	<0.005	<0.002	4.75	--	--
	09/29/16	0.04	46.3	15	<1	5.29	--	190	416	<0.005	<0.005	0.087	<0.001	<0.001	<0.001	0.014	<0.005	0.186	<0.000025	<0.005	<0.005	<0.002	3.33	--	--
	10/20/16	0.05	50.7	14	<1	5.92	--	267	448	<0.005	<0.005	0.07	<0.001	<0.001	<0.001	0.009	<0.005	0.225	<0.000025	<0.005	<0.005	<0.002	2.319	--	--
	12/13/16	0.05	49.6	13	<1	6.29	--	233	484	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	0.013	<0.005	0.199	<0.000025	<0.005	<0.005	<0.002	2.182	--	--
	01/17/17	0.04	49.8	14	<1	6.27	--	234	438	<0.005	<0.005	0.047	<0.001	<0.001	<0.001	0.012	<0.005	0.239	<0.000025	<0.005	<0.005	<0.002	1.023	--	--
	02/23/17	0.04	33.0	15	<1	5.48	--	127	286	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	0.013	<0.005	0.166	<0.000025	<0.005	<0.005	<0.002	1.788	--	--
	06/07/17	0.05281	49.7	14	<0.083	5.96	867	82	300	<0.00093	0.00385	0.0877	0.00008	0.00039	0.00028	0.01193	<0.00068	0.124	<0.000005	<0.00029	<0.00099	<0.00086	2.32	--	--
	10/06/17	--	--	--	--	5.59	249	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.05063	30.1	21	<0.083	5.79	<100	--	248	<0.00093	<0.00105	0.07627	0.00014	0.00037	<0.00023	0.01907	<0.00068	0.118	<0.000005	<0.00029	<0.00099	<0.00086	1.495	14.4	0.45
	Dissolved	*0.03752*	*29.1*	--	--	5.79	<100	--	--	*<0.00093*	*<0.00105*	*0.06865*	*<0.00002*	*<0.00007*	*<0.00023*	*0.01747*	*<0.00068*	*0.119*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.043*	*2.051*	8.38	0.43
	05/24/18	0.05007	28.1	22	<0.083	6.22	17.8	60	242	<0.00093	<0.00105	0.07116	<0.00002	0.00023 J	0.0008 J	0.01424	<0.00068	0.121	<0.000005	<0.00029	<0.00099	<0.00086	1.946	--	--
	08/15/18	0.05	40.5	19	<0.083	6.23	57.1	240	428	0.00001 J	0.00169	0.0637	0.000055	0.000008 J	0.000072	0.0114	0.000079	0.147	<0.000005	0.00013	0.00008 J	<0.01	0.316	--	--
	02/21/19	0.033	33.9	24.7	0.21	5.38	164	46.5	220	0.00002 J	0.00159	0.0694	0.00008 J	<0.00005	0.000432	0.00858	0.000147	0.0807	<0.000025	<0.002	0.0001 J	<0.0005	1.27	--	--
	05/30/19	0.03 J	--	22.3	0.29	--	150	51.3	238	<0.00002	0.00305	0.0605	0.00008 J	<0.00001	0.00006 J	0.0118	0.00005 J	0.104	0.000006	<0.0004	0.00005 J	<0.0001	--	23.4	0.331
AD-18[d]	05/26/16	0.146	409	422	<1	5.1	--	5,135	10,000	<0.005	<0.005	0.012	0.014	0.003	<0.001	0.922	<0.005	2.07	0.000168	<0.005	0.006	0.003	12.58	--	--
	07/27/16	0.148	457	432	2	5.1	--	4,930	9,476	<0.005	<0.005	0.019	0.005	0.002	<0.001	0.734	<0.005	1.94	0.000091	<0.005	0.007	0.003	10.62	--	--
	09/29/16	0.156	469	637	4	5.59	--	4,632	9,569	<0.005	<0.005	0.02	0.004	<0.001	<0.001	0.666	<0.005	1.86	0.000117	<0.005	0.007	<0.002	7.05	--	--
	10/20/16	0.188	498	876	0.8664	5.7	--	5,537	9,540	<0.005	<0.005	0.021	0.002	0.001	<0.001	0.569	<0.005	2.06	0.000053	<0.005	<0.005	<0.002	5.82	--	--
	12/13/16	0.178	510	695	5	5.75	--	4,382	8,912	<0.005	<0.005	0.021	0.007	0.001	<0.001	0.641	<0.005	1.74	0.00005	<0.005	<0.005	<0.002	9.6	--	--
	01/17/17	0.050	412	159	5	4.49	--	5,414	8,562	<0.005	0.01	0.014	0.022	0.001	<0.001	0.929	<0.005	1.95	0.000224	<0.005	<0.005	0.002	22.51	--	--
	02/22/17	0.090	401	151	6	4.37	--	5,169	8,412	<0.005	<0.005	0.014	0.026	0.002	<0.001	0.961	<0.005	1.82	0.000107	<0.005	<0.005	0.00228	19.11	--	--
	06/06/17	0.125	428	304	6.53	4.27	121	5,920	9,394	<0.00093	0.00331	0.01038	0.01883	0.00303	<0.00023	0.940	<0.00068	2.15	0.000113	<0.00029	0.00212	<0.00086	16.12	--	--
	10/05/17	--	--	--	--	5.87	165	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.163	433	362	9.4	3.61	104.1	--	9,952	0.00224	0.00276	0.00813	0.01733	0.0036	0.00098	0.928	<0.00068	2.07	0.000043	<0.00029	0.00194	0.00144	19.95	19.7	14.1
	Dissolved	*0.153*	*423*	--	--	--	--	--	--	*0.00467*	*0.00189*	*0.00748*	*0.01676*	*0.00316*	*<0.00023*	*0.898*	*<0.00068*	*2.06*	*0.000012*	*<0.00029*	*0.00135*	*0.01466*	*18.09*	19.1	13.7
	05/30/19	0.09 J	--	390	3.56	--	91.3	6,120	9,564	<0.0002	0.040	0.009 J	0.021	0.004 J	<0.004	1.130	0.005 J	1.27	0.000035	<0.04	0.103	<0.01	--	11.2	7.53
Background Statistical Evaluation Summary - Upper Prediction Limits:[a]										0.005	0.005	0.36	0.00077	0.0065	0.004	0.075	0.005	0.39	0.000033	0.005	0.005	0.002	4.21	--	--
Point of Compliance Wells																									
AD-11	05/31/16	2.47	8.47	9	2	5.21	--	518	388	<0.005	<0.005	0.014	0.004	<0.001	0.003	0.026	<0.005	0.032	<0.000025	<0.005	<0.005	<0.002	1.77	--	--
	07/28/16	2.83	8.88	10	2	5.21	--	596	1,000	<0.005	<0.005	0.012	0.004	<0.001	<0.001	0.026	<0.005	0.047	<0.000025	<0.005	<0.005	<0.002	2.23	--	--
	09/29/16	3.4	10.7	12	2	4.08	--	683	1,065	<0.005	<0.005	0.052	0.005	<0.001	0.007	0.03	<0.005	0.047	<0.000025	<0.005	<0.005	<0.002	3.92	--	--
	10/19/16	3.77	8.78	11	<1	3.68	--	706	1,024	<0.005	<0.005	0.02	0.005	<0.001	0.002	0.027	<0.005	0.047	<0.000025	<0.005	<0.005	<0.002	2.56	--	--
	12/12/16	3.36	8.98	10	2	3.75	--	548	1,044	<0.005	<0.005	0.013	0.004	<0.001	<0.001	0.025	<0.005	0.041	<0.000025	<0.005	<0.005	<0.002	1.569	--	--
	01/17/17	2.81	10.3	11	2	4.41	--	760	1,048	<0.005	<0.005	0.013	0.004	<0.001	<0.001	0.025	<0.005	0.046	<0.000025	<0.005	<0.005	<0.002	1.082	--	--
	02/22/17	2.88	9.31	10	2	4.34	--	558	876	<0.005	<0.005	0.019	0.004	<0.001	0.002	0.024	<0.005	0.035	<0.000025	<0.005	<0.005	<0.002	1.45	--	--
	06/06/17	2.79	9.93	10	1.366	3.86	219	556	960	<0.00093	0.00123	0.01012	0.00279	0.00041	0.00032	0.02216	<0.00068	0.03654	<0.000005	<0.00029	<0.00099	<0.00086	1.902	--	--
	10/05/17	--	--	--	--	4.43	162	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	1.48	4.37	10	<0.083	3.77	75.3		558	0.00417	0.00127	0.01281	0.00148	0.00053	0.00041	0.00935	<0.00068	0.01978	<0.000005	0.00094	0.00103	<0.00086	1.264	1.35	0.063
	Dissolved	*1.45*	*4.28*	--	--	3.77	75.3	--	--	*<0.00093*	*0.00278*	*0.01202*	*0.00098*	*<0.00007*	*<0.00023*	*0.00877*	*<0.00068*	*0.01836*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.656*	1.25	0.062
	05/23/18	--	--	--	<0.083	*4.05*	*49.8*	--	--	<0.00093	0.0026 J	0.01627	0.00089 J	0.00018 J	0.0008 J	0.00863	<0.00068	0.01875	0.000007 J	<0.00029	0.00134 J	0.046	1.912	--	--
	08/15/18	1.84	6.61	15	<0.083	4.73	112	410	720	--	0.00105	0.0119	0.00118	0.00037	0.000257	0.0153	--	0.0175	<0.000005	--	0.0024	0.0002	2.6	--	--
	05/29/19	1.40	--	6.96	0.47	--	67.6	367	680	<0.0001	0.00113	0.0182	0.00138	0.0002 J	0.0004 J	0.00969	0.000804	0.02 J	<0.000005	<0.002	0.0022	<0.0005	--	1.46	0.0669
AD-13	05/31/16	1.19	8.02	12	<1	6.05		177	900	<0.005	<0.005	0.062	<0.001	<0.001	<0.001	<0.005	<0.005	0.011	<0.000025	<0.005	<0.005	<0.002	1.22	--	--
	07/27/16	1.23	3.7	15	1	6.05		187	--	<0.005	<0.005	0.036	<0.001	<0.001	<0.001	<0.005	<0.005	0.026	<0.000025	<0.005	<0.005	<0.002	1.601	--	--
	09/29/16	1.37	2.7	17	1	4.56		207	431	<0.005	<0.005	0.04	<0.001	<0.001	<0.001	<0.005	<0.005	0.02	<0.000025	<0.005	<0.005	<0.002	2.213	--	--
	10/19/16	1.67	3.66	19	1	4.34		226	482	<0.005	<0.005	0.03	<0.001	<0.001	<0.001	<0.005	<0.005	0.022	<0.000025	<0.005	<0.005	<0.002	3.662	--	--
	12/05/16	--	--	--	--	--		--	532	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/13/16	1.96	3.77	18	1	4.79		287	596	<0.005	<0.005	0.051	0.001	<0.001	0.007	0.007	<0.005	0.025	<0.000025	<0.005	<0.005	<0.002	2.27	--	--
	01/19/17	0.402	33.5	7	<1	5.38		90	222	<0.005	0.006	0.112	<0.001	<0.001	0.004	<0.005	<0.005	0.004	<0.000025	<0.005	<0.005	<0.002	2.228	--	--
	02/23/17	1.27	10.3	13	<1	5.06		183	392	<0.005	<0.005	0.041	<0.001	<0.001	<0.001	<0.005	<0.005	0.015	<0.000025	<0.005	<0.005	<0.002	1.556	--	--
	06/06/17	1.68	3.03	15	0.6679	4.22	171	244	494	0.00153	<0.00105	0.01712	0.00089	0.00014	<0.00023	0.00624	<0.00068	0.02082	<0.000005	<0.00029	0.00103	<0.00086	1.565	--	--
	10/06/17	--	--	--	--	4.61	173	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	1.42	7.48	10	0.5362	4.20	1.4		532	<0.00093	<0.00105	0.0216	0.00088	0.00011	<0.00023	0.00809	<0.00068	0.02603	<0.000005	<0.00029	<0.00099	<0.00086	2.064	0.858	0.046
	Dissolved	*1.41*	*7.31*	--	--	4.20	1.4	--	--	*<0.00093*	*<0.00105*	*0.02097*	*0.0008*	*<0.00007*	*<0.00023*	*0.00784*	*<0.00068*	*0.02439*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.407*	0.712	0.045
	05/23/18	--	--	--	0.6534 J	*4.52*	*52.7*	--	--	<0.00093	<0.00105	0.02653	0.00087 J	<0.00007	0.00073 J	0.00937	<0.00068	0.0291	0.000008 J	<0.00029	<0.00099	<0.043	2.16	--	--
	08/14/18	1.49	10.1	18	0.7442	4.82	131	316	620	--	0.00137	0.0169	0.000971	0.00031	0.000503	0.0131	--	0.0321	<0.000005	--	0.0017	0.000277	4.0	--	--
	05/30/19	0.477	--	3.6	0.53	--	83.6	94	196	0.00003 J	0.00032	0.0609	0.000385	0.00007	0.00031	0.00315	0.00005 J	0.009 J	<0.000005	<0.0004	0.0004	<0.0001	--	0.086	0.0141

Table 4-3
Groundwater Sampling Analytical Results (mg/L) - Landfill
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
AD-14	05/31/16	1.28	2.88	4	<1	4.75	--	115	285	<0.005	<0.005	0.031	<0.001	<0.001	<0.001	0.010	<0.005	0.012	0.00003	<0.005	<0.005	<0.002	0.87	--	--
	07/27/16	1.14	2.51	5	<1	4.75	--	111	267	<0.005	<0.005	0.084	<0.001	<0.001	0.001	0.009	<0.005	0.024	<0.000025	<0.005	<0.005	<0.002	1.487	--	--
	09/29/16	1.14	1.19	5	<1	4.17	--	111	252	<0.005	<0.005	0.03	<0.001	<0.001	<0.001	0.009	<0.005	0.015	<0.000025	<0.005	<0.005	<0.002	4.817	--	--
	10/19/16	1.25	2.48	4	<1	3.88	--	118	276	<0.005	<0.005	0.039	<0.001	0.001	<0.001	0.009	<0.005	0.014	<0.000025	<0.005	<0.005	<0.002	1.972	--	--
	12/12/16	1.25	2.41	5	<1	4.11	--	101	296	<0.005	<0.005	0.047	<0.001	0.001	0.001	0.009	<0.005	0.013	0.000037	<0.005	<0.005	<0.002	1.271	--	--
	01/17/17	0.915	10.3	4	<1	6.07	--	92	254	<0.005	<0.005	0.038	<0.001	<0.001	<0.001	<0.005	<0.005	0.013	<0.000025	<0.005	<0.005	<0.002	1.825	--	--
	02/22/17	1.06	9.48	4	<1	5.39	--	90	212	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	<0.005	<0.005	0.012	<0.000025	<0.005	<0.005	<0.002	0.512	--	--
	06/06/17	1.26	7.69	6	<0.083	4.77	167	108	256	<0.00093	<0.00105	0.04483	0.00038	0.00067	0.00127	0.00678	<0.00068	0.0127	0.000021	<0.00029	0.00261	<0.00086	1.138	--	--
	10/06/17	--	--	--	--	4.57	150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	1.61	4.67	11	<0.083	4.11	5.1	--	332	<0.00093	<0.00105	0.03161	0.00094	0.00204	<0.00023	0.01501	<0.00068	0.01638	0.000137	<0.00029	0.00221	<0.00086	1.097	0.09	0.008
	Dissolved	*1.56*	*4.55*	--	--	4.11	5.1	--	--	*<0.00093*	*<0.00105*	*0.02938*	*0.00094*	*0.00193*	*<0.00023*	*0.01476*	*<0.00068*	*0.01523*	*0.000149*	*<0.00029*	*0.00387*	*<0.00086*	*0.5903*	0.06	0.007
	05/23/18	--	--	--	<0.083	4.17	43.2	--	--	<0.00093	<0.00105	0.02817	0.00078 J	0.00161	<0.00023	0.01434	<0.00068	0.0152	0.000145	<0.00029	0.00362	<0.043	1.601	--	--
	08/14/18	1.51	4.51	12	<0.083	4.27	198	204	384	--	0.00039	0.024	0.000854	0.00199	0.000276	0.0176	--	0.011	0.000181	--	0.0037	0.000242	1.5	--	--
	05/29/19	1.21	--	3.65	0.19	--	20.6	122	274	<0.0001	0.0005	0.0434	0.000709	0.00087	0.0002 J	0.00774	0.0001 J	0.02 J	0.000181	<0.0002	0.0019	<0.0005		0.005 J	0.00023
Supplemental Downgradient Monitoring Well																									
AD-10	5/16/2018	0.08311	15.5	40	<0.083	3.72	<100	--	280	<0.00093	0.0022	0.03855	0.00166	0.00033	<0.00023	0.02432	<0.00068	0.316	<0.000005	<0.00029	<0.00099	0.00098	1.704	0.338	0.25
	Dissolved	*0.07733*	*15.3*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.03712*	*0.00149*	*0.00009*	*<0.00023*	*0.02412*	*<0.00068*	*0.296*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*1.505*	0.282	0.251
Supplemental Sidegradient Monitoring Wells																									
Temp-1	5/17/2018	0.662	26.2	34	<0.083	4.90	23.8	--	556	<0.00093	<0.00105	0.07752	0.00058	<0.00007	0.00102	0.01058	<0.00068	0.01075	<0.000005	<0.00029	<0.00099	<0.00086	1.277	1.94	0.203
	Dissolved	*0.621*	*24.6*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.06778*	*0.00042*	*<0.00007*	*<0.00023*	*0.00946*	*<0.00068*	*0.00986*	*<0.000005*	*<0.00029*	*<0.00099*	*0.00191*	*2.278*	0.813	0.192
AD-12	6/19/2019	0.569	34.1	44.1	0.32	6.3	40.1	131	436	<0.0001	0.00123	0.0581	0.0004 J	0.00005 J	0.0003 J	0.0126	<0.0001	0.042	<0.000002	<0.002	0.0005 J	<0.0005	2.007	25.9	--
EPA MCLs:																									
MCL					4					0.006	0.01	2	0.004	0.005	0.1				0.002		0.05	0.002	5[c]		
Rule Specified																0.006	0.015	0.04		0.1					
Background Limit					1					0.005	0.005	0.36	0.00077	0.0065[b]	0.004	0.075[b]	0.005	0.39[b]	0.000033	0.005	0.005	0.0013	4.21[c]		
Interwell Background Value(s) (UPL, LPL where applicable) AD-8, AD-9, AD-15		0.775				4.8-7.1																			
Intrawell Background Value (UPL) AD-8			35.7	38.3	1.03			236	569																
Intrawell Background Value (UPL) AD-9			350	139	0.73			2527	3147																
Intrawell Background Value (UPL) AD-15			5.71	38.4	1.00			35.6	388																

NOTES:
All concentration data are provided in milligrams per liter (mg/L) unless otherwise noted.
J = Analyte was positively identified, though the quantitation was below Reporting Limit.
MCL = Maximum contaminant level
LPL = Lower prediction limit
UPL = Upper prediction limit
pCi/L = PicoCuries per liter
-- = Not analyzed
a = Data taken from Geosyntec "Statistical Analysis Summary, Primary Bottom Ash Pond" dated July 11, 2019.
b = Calculated Upper Tolerance Limit is higher than MCL.
c = Data is "Combined Radium, Total".
d = AD-18 is not part of the designated CCR Monitoring Well Network and used for background understanding only
🟨 Denotes groundwater sample collected by ARCADIS using low-flow methods.
Unless otherwise noted, values shown are total (unfiltered) analyses.
Dissolved (0.45-micron lab filtered) parameter concentrations shown in italics.

Table 4-4
Groundwater Sampling Analytical Results (mg/L) - Bottom Ash Storage Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

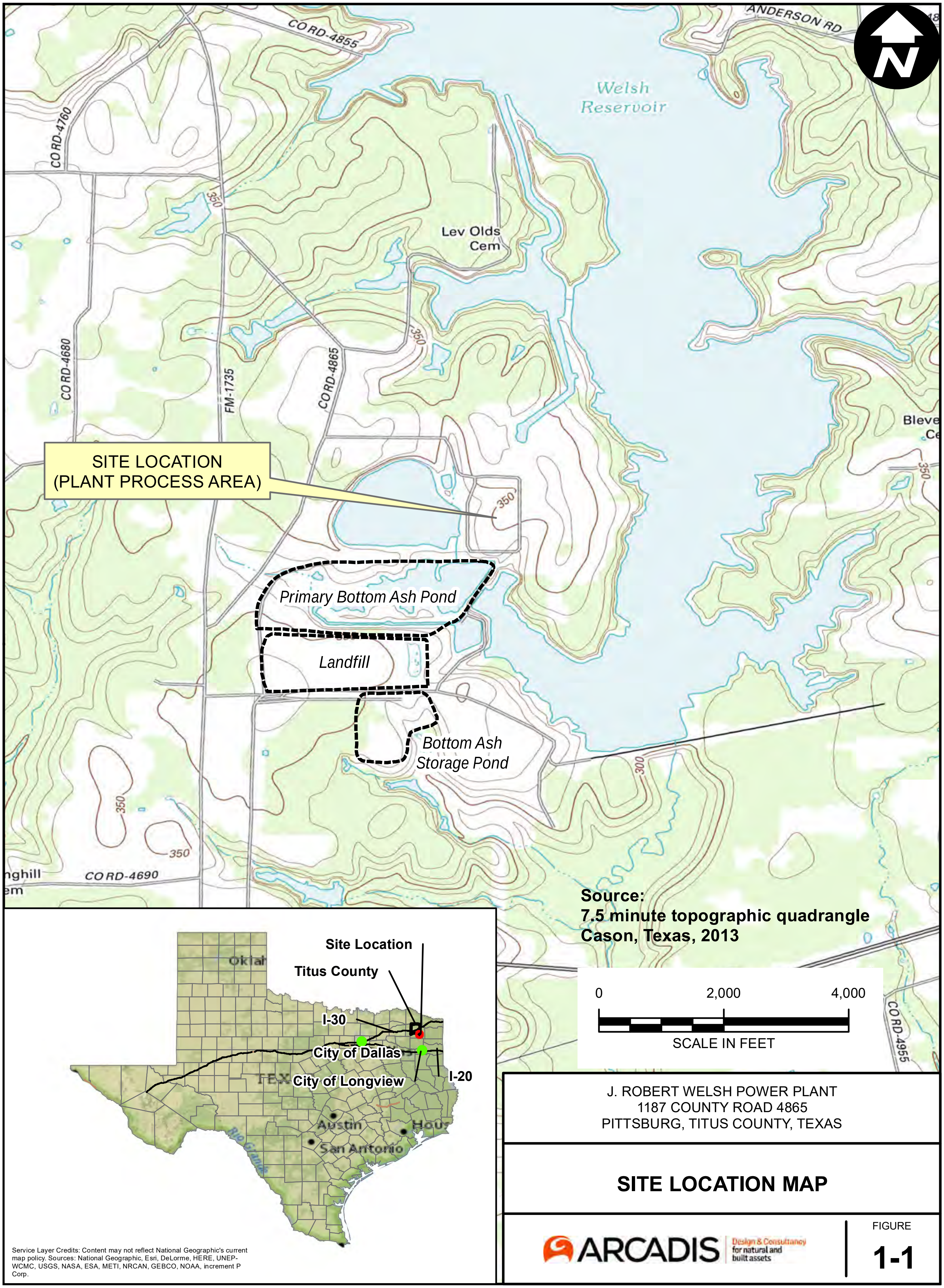
Well	Date Sampled	Appendix III Parameters								Appendix IV Parameters															
		Boron (total)	Calcium (total)	Chloride	Fluoride	pH (field)	Turbidity (field)	Sulfate	TDS	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (pCi/L)	Iron	Manganese
Background (Upgradient) Wells																									
AD-1	05/26/16	0.346	36.5	5	<1	5.93	--	42	252	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.010	0.000033	<0.005	<0.005	<0.002	1.18	--	--
	07/27/16	0.350	39.6	4	<1	5.93	--	36	239	<0.005	<0.005	0.191	<0.001	<0.001	<0.001	<0.005	<0.005	0.019	<0.000025	<0.005	<0.005	<0.002	0.9952	--	--
	09/29/16	0.332	15	5	<1	5.37	--	35	173	<0.005	<0.005	0.141	<0.001	<0.001	0.005	<0.005	<0.005	0.014	<0.000025	<0.005	<0.005	<0.002	1.38	--	--
	10/19/16	0.398	19.1	4	<1	5.15	--	42	192	<0.005	<0.005	0.114	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	1.141	--	--
	12/12/16	0.394	8.74	4	<1	5.18	--	40	200	<0.005	<0.005	0.072	<0.001	<0.001	<0.001	<0.005	<0.005	0.008	<0.000025	<0.005	<0.005	<0.002	0.719	--	--
	01/17/17	0.656	129	4	<1	7.13	--	68	538	<0.005	<0.005	0.410	<0.001	<0.001	<0.001	<0.005	<0.005	<0.001	<0.000025	<0.005	<0.005	<0.002	3.009	--	--
	02/23/17	0.700	147	9	<1	6.88	--	68	612	<0.005	<0.005	0.488	<0.001	<0.001	<0.001	<0.005	<0.005	0.001	<0.000025	<0.005	<0.005	<0.002	4.309	--	--
	06/07/17	0.449	15.1	4	<0.083	5.06	109	42	176	<0.00093	0.00114	0.09346	0.00037	<0.00007	0.00066	0.00077	<0.00068	0.00902	0.000007	<0.00029	0.0021	<0.00086	0.676	--	--
	10/06/17	--	--	--	--	5.25	97.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.352	12.1	3	<0.083	4.82	8.4	--	174	<0.00093	<0.00105	0.08823	0.00048	<0.00007	<0.00023	0.0008	<0.00068	0.00816	<0.000005	<0.00029	<0.00099	<0.00086	0.837	0.03	0.025
	Dissolved	*0.35*	*12*	--	--	4.82	8.4	--	--	*<0.00093*	*<0.00105*	*0.08582*	*0.00044*	*<0.00007*	*<0.00023*	*0.00083*	*<0.00068*	*0.00799*	*<0.000005*	*<0.00029*	*0.00197*	*<0.00086*	*0.531*	0.01	0.026
	05/24/18	0.345	10.2	4	<0.083	5.19	118	43	150	0.00317 J	<0.00105	0.0799	0.00039 J	<0.00007	<0.00023	0.00035 J	<0.00068	0.00814	0.000006 J	<0.00029	0.00138 J	<0.00086	1.983	--	--
	08/14/18	0.443	5.95	5	<0.083	5.18	102	44	160	0.00003 J	0.00021	0.063	0.000482	0.00002	0.00016	0.000797	0.000238	0.00708	0.000013 J	0.00021	0.0017	0.00003 J	1.10	--	--
	02/20/19	0.504	142	2.82	0.24	7.31	113	49.2	522	0.00016	0.00046	0.457	0.00009 J	0.00001 J	0.000306	0.000399	0.000124	0.00155	<0.000025	0.001 J	0.0007	<0.0005	3.16	--	--
	05/30/19	0.689	--	1.59	0.29	--	61.3	43.3	588	0.00016	0.00060	0.512	0.000244	0.00001 J	0.0001 J	0.000756	0.000197	<0.009	<0.000005	0.00243	0.0014	<0.0001	--	0.099	0.0625
AD-5	05/31/16	0.03	36.9	15	<1	6.38	--	123	337	<0.005	<0.005	0.057	<0.001	<0.001	<0.001	0.014	<0.005	0.135	<0.000025	<0.005	<0.005	<0.002	1.63	--	--
	07/28/16	0.04	44.7	16	<1	6.38	--	163	360	<0.005	<0.005	0.093	<0.001	<0.001	<0.001	0.015	<0.005	0.191	<0.000025	<0.005	<0.005	<0.002	4.75	--	--
	09/29/16	0.04	46.3	15	<1	5.29	--	190	416	<0.005	<0.005	0.087	<0.001	<0.001	<0.001	0.014	<0.005	0.186	<0.000025	<0.005	<0.005	<0.002	3.33	--	--
	10/20/16	0.05	50.7	14	<1	5.92	--	267	448	<0.005	<0.005	0.07	<0.001	<0.001	<0.001	0.009	<0.005	0.225	<0.000025	<0.005	<0.005	<0.002	2.319	--	--
	12/13/16	0.05	49.6	13	<1	6.29	--	233	484	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	0.013	<0.005	0.199	<0.000025	<0.005	<0.005	<0.002	2.182	--	--
	01/17/17	0.04	49.8	14	<1	6.27	--	234	438	<0.005	<0.005	0.047	<0.001	<0.001	<0.001	0.012	<0.005	0.239	<0.000025	<0.005	<0.005	<0.002	1.023	--	--
	02/23/17	0.04	33.0	15	<1	5.48	--	127	286	<0.005	<0.005	0.042	<0.001	<0.001	<0.001	0.013	<0.005	0.166	<0.000025	<0.005	<0.005	<0.002	1.788	--	--
	06/07/17	0.05281	49.7	14	<0.083	5.96	867	82	300	<0.00093	0.00385	0.0877	0.00008	0.00039	0.00028	0.01193	<0.00068	0.124	<0.000005	<0.00029	<0.00099	<0.00086	2.32	--	--
	10/06/17	--	--	--	--	5.59	249	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.05063	30.1	21	<0.083	5.79	<100	--	248	<0.00093	<0.00105	0.07627	0.00014	0.00037	<0.00023	0.01907	<0.00068	0.118	<0.000005	<0.00029	<0.00099	<0.00086	1.495	14.4	0.45
	Dissolved	*0.03752*	*29.1*	--	--	5.79	<100	--	--	*<0.00093*	*<0.00105*	*0.06865*	*<0.00002*	*<0.00007*	*<0.00023*	*0.01747*	*<0.00068*	*0.119*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.043*	*2.051*	8.38	0.43
	05/24/18	0.05007	28.1	22	<0.083	6.22	17.8	60	242	<0.00093	<0.00105	0.07116	<0.00002	0.00023 J	0.0008 J	0.01424	<0.00068	0.121	<0.000005	<0.00029	<0.00099	<0.00086	1.946	--	--
	08/15/18	0.05	40.5	19	<0.083	6.23	57.1	240	428	0.00001 J	0.00169	0.0637	0.000055	0.000008 J	0.000072	0.0114	0.000079	0.147	<0.000005	0.00013	0.00008 J	<0.01	0.316	--	--
	02/21/19	0.033	33.9	24.7	0.21	5.38	164	46.5	220	0.00002 J	0.00159	0.0694	0.00008 J	<0.00005	0.000432	0.00858	0.000147	0.0807	<0.000025	<0.002	0.0001 J	<0.0005	1.27	--	--
	05/30/19	0.03 J	--	22.3	0.29	--	150	51.3	238	<0.00002	0.00305	0.0605	0.00008 J	<0.00001	0.00006 J	0.0118	0.00005 J	0.104	0.000006	<0.0004	0.00005 J	<0.0001	--	23.4	0.331
AD-17	05/26/16	0.121	200	43	<1	7.17	--	1,166	1,810	<0.005	<0.005	0.021	<0.001	0.002	0.001	0.063	<0.005	0.370	0.000032	<0.005	<0.005	<0.002	1.53	--	--
	07/27/16	0.119	195	32	<1	7.17	--	1,005	1,576	<0.005	<0.005	0.020	<0.001	0.004	0.001	0.068	<0.005	0.374	<0.000025	<0.005	<0.005	<0.002	2.78	--	--
	09/29/16	0.111	191	36	<1	6.17	--	1,055	1,663	<0.005	<0.005	0.031	<0.001	<0.001	0.003	0.058	<0.005	0.354	<0.000025	<0.005	<0.005	<0.002	2.358	--	--
	10/20/16	0.124	194	32	1.0	6.14	--	1,163	1,612	<0.005	<0.005	0.034	<0.001	0.002	0.004	0.065	<0.005	0.394	<0.000025	<0.005	<0.005	<0.002	2.224	--	--
	12/13/16	0.135	196	31	<1	6.03	--	1,096	1,560	<0.005	<0.005	0.017	<0.001	0.003	<0.001	0.068	<0.005	0.323	<0.000025	<0.005	<0.005	<0.002	2.384	--	--
	01/17/17	0.101	196	33	<1	5.96	--	1,445	1,686	<0.005	<0.005	0.014	<0.001	0.003	0.068	0.068	<0.005	0.341	<0.000025	<0.005	<0.005	<0.002	2.436	--	--
	02/22/17	0.135	189	30	<1	5.67	--	1,055	1,628	<0.005	<0.005	0.020	<0.001	0.002	0.001	0.073	<0.005	0.331	<0.000025	<0.005	<0.005	<0.002	2.288	--	--
	06/06/17	0.121	188	30	<0.083	5.81	156	1,105	1,578	<0.00093	<0.00105	0.01033	<0.00002	0.00606	<0.00023	0.0748	<0.00068	0.329	0.000013	<0.00029	<0.00099	<0.00086	1.598	--	--
	10/05/17	--	--	--	--	5.92	598	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.247	213	45	<0.083	5.51	<100	--	1,846	<0.00093	<0.00105	0.00978	<0.00002	0.00915	<0.00023	0.07451	<0.00068	0.306	<0.000005	<0.00029	0.00414	<0.00086	1.514	260	3.72
	Dissolved	*0.231*	*205*	--	--	5.51	<100	--	--	*<0.00093*	*<0.00105*	*0.00737*	*<0.00002*	*0.00609*	*<0.00023*	*0.07938*	*<0.00068*	*0.301*	*<0.000005*	*<0.00029*	*0.00515*	*0.02*	*1.57*	241	3.56
	05/24/18	0.239	193	39	<0.083	6.28	7.8	1,067	1,836	<0.00093	<0.00105	0.00965	<0.00002	0.00646	<0.00023	0.07173	<0.00068	0.308	<0.000005	<0.00029	<0.00099	<0.00086	1.939	--	--
	08/15/18	0.118	187	40	<0.083	5.6	418	1,170	1,750	0.00002 J	0.00183	0.0128	0.000069	0.00025	0.000604	0.0435	0.0011	0.243	0.000011 J	0.00035	0.0003	0.000074	2.35	--	--
	02/21/19	0.151	207	43.2	0.180	6.93	274	1,060	1,720	0.00008 J	0.00251	0.120	0.00024	0.00027	0.00334	0.0645	0.00249	0.268	0.000007 J	0.0007 J	0.0008	<0.0005	2.66	--	--
	05/30/19	0.158	--	41.7	<0.04	--	176	1,120	1,546	<0.00002	0.00041	0.0196	0.00002 J	0.00003 J	0.000246	0.0511	0.00003 J	0.341	<0.000005	<0.0004	0.00006 J	<0.0001	--	145	3.40
AD-18^{c}	05/26/16	0.146	409	422	<1	5.1	--	5,135	10,000	<0.005	<0.005	0.012	0.014	0.003	<0.001	0.922	<0.005	2.07	0.000168	<0.005	0.006	0.003	12.58	--	--
	07/27/16	0.148	457	432	2	5.1	--	4,930	9,476	<0.005	<0.005	0.019	0.005	0.002	<0.001	0.734	<0.005	1.94	0.000091	<0.005	0.007	0.003	10.62	--	--
	09/29/16	0.156	469	637	4	5.59	--	4,632	9,569	<0.005	<0.005	0.02	0.004	<0.001	<0.001	0.666	<0.005	1.86	0.000117	<0.005	0.007	<0.002	7.05	--	--
	10/20/16	0.188	498	876	0.8664	5.7	--	5,537	9,540	<0.005	<0.005	0.021	0.002	0.001	<0.001	0.569	<0.005	2.06	0.000053	<0.005	<0.005	<0.002	5.82	--	--
	12/13/16	0.178	510	695	5	5.75	--	4,382	8,912	<0.005	<0.005	0.021	0.007	0.001	<0.001	0.641	<0.005	1.74	0.00005	<0.005	<0.005	<0.002	9.60	--	--
	01/17/17	0.050	412	159	5	4.49	--	5,414	8,562	<0.005	0.01	0.014	0.022	0.001	<0.001	0.929	<0.005	1.95	0.000224	<0.005	<0.005	0.002	22.51	--	--
	02/22/17	0.090	401	151	6	4.37	--	5,169	8,412	<0.005	<0.005	0.014	0.026	0.002	<0.001	0.961	<0.005	1.82	0.000107	<0.005	<0.005	0.00228	19.11	--	--
	06/06/17	0.125	428	304	6.53	4.27	121	5,920	9,394	<0.00093	0.00331	0.01038	0.01883	0.00303	<0.00023	0.940	<0.00068	2.15	0.000113	<0.00029	0.00212	<0.00086	16.12	--	--
	10/05/17	--	--	--	--	5.87	165	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/17/18	0.163	433	362	9.4	3.61	104.1	--	9,952	0.00224	0.00276	0.00813	0.01733	0.0036	0.00098	0.928	<0.00068	2.07	0.000043	<0.00029	0.00194	0.00144	19.95	19.7	14.1
	Dissolved	*0.153*	*423*	--	--	--	--	--	--	*0.00467*	*0.00189*	*0.00748*	*0.01676*	*0.00316*	*<0.00023*	*0.898*	*<0.00068*	*2.06*	*0.000012*	*<0.00029*	*0.00135*	*0.01466*	*18.09*	19.1	13.7
	05/30/19	0.09 J	--	390	3.56	--	91.3	*6,120*	9,564	<0.0002	0.04	0.009 J	0.021	0.004 J	<0.004	1.130	0.005 J	1.27	0.000035	<0.04	0.103	<0.01	--	11.2	7.53

Table 4-4
Groundwater Sampling Analytical Results (mg/L) - Bottom Ash Storage Pond
AEP J. Robert Welsh Power Plant
Pittsburg, Titus County, Texas

		Appendix III Parameters								Appendix IV Parameters															
Well	**Date Sampled**	**Boron (total)**	**Calcium (total)**	**Chloride**	**Fluoride**	**pH (field)**	**Turbidity (field)**	**Sulfate**	**TDS**	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Cobalt**	**Lead**	**Lithium**	**Mercury**	**Molybdenum**	**Selenium**	**Thallium**	**Radium 226 and 228 (pCi/L)**	**Iron**	**Manganese**
Point of Compliance Wells																									
AD-3	05/31/16	0.02	1.41	9	<1	6.58	--	4	106	<0.005	<0.005	0.053	<0.001	<0.001	<0.001	<0.005	<0.005	0.010	0.00085	<0.005	<0.005	<0.002	1.02	--	--
	07/27/16	0.02	0.706	8	<1	6.58	--	5	118	<0.005	<0.005	0.036	<0.001	<0.001	<0.001	<0.005	<0.005	0.024	0.000589	<0.005	<0.005	<0.002	0.1786	--	--
	09/30/16	0.02	<0.5	9	<1	4.75	--	6	127	<0.005	<0.005	0.043	<0.001	<0.001	<0.001	<0.005	<0.005	0.019	0.00039	<0.005	<0.005	<0.002	0.552	--	--
	10/19/16	0.06	0.794	8	<1	3.71	--	9	112	<0.005	<0.005	0.041	<0.001	<0.001	<0.001	<0.005	<0.005	0.018	0.000351	0.006	<0.005	<0.002	1.589	--	--
	12/12/16	0.02	1.05	8	<1	4.67	--	11	138	<0.005	<0.005	0.045	<0.001	<0.001	<0.001	<0.005	<0.005	0.017	0.000321	<0.005	<0.005	<0.002	0.546	--	--
	01/19/17	0.02	0.746	9	<1	4.60	--	4	76	<0.005	<0.005	0.041	<0.001	<0.001	<0.001	<0.005	<0.005	0.014	0.000504	<0.005	<0.005	<0.002	0.229	--	--
	02/23/17	0.02	0.573	9	<1	4.69	--	5	104	<0.005	<0.005	0.037	<0.001	<0.001	<0.001	<0.005	<0.005	0.014	0.000501	<0.005	<0.005	<0.002	0.4592	--	--
	06/07/17	0.03326	0.543	9	0.2625	4.49	56.6	5	104	<0.00093	0.00191	0.038	0.00024	0.00008	0.00075	0.00128	<0.00068	0.01503	0.000365	<0.00029	<0.00099	<0.00086	0.459	--	--
	10/06/17	--	--	--	--	5.15	65.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/15/18	0.01869	0.56	9	<0.083	4.31	11.1		132	0.00166	0.0016	0.0365	0.00034	0.00008	<0.00023	0.00136	<0.00068	0.01459	0.00037	<0.00029	0.00323	0.00127	0.016	0.188	0.004
	Dissolved	*0.01132*	*0.595*	--	--	4.31	11.1	--	--	*<0.00093*	*<0.00105*	*0.0361*	*0.00023*	*<0.00007*	*<0.00023*	*0.00133*	*<0.00068*	*0.01445*	*0.000379*	*<0.00029*	*<0.00099*	*<0.00086*	*0.242*	< 0.01	0.004
	05/24/18	0.0069 J	0.545	8	<0.083	4.58	8.50	3	98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/19	<0.02	--	9.03	0.18	--	57.2	2.3	110	0.00006 J	0.00103	0.0632	0.000158	0.00005 J	0.000316	0.00171	0.000382	0.03 J	0.000245	<0.0004	0.0003	<0.0001	--	*1.54*	0.011
AD-4c	05/31/16	0.05	0.798	10	<1	5.41	--	32	204	<0.005	<0.005	0.088	<0.001	<0.001	0.009	<0.005	<0.005	0.004	0.000191	<0.005	<0.005	<0.002	1.29	--	--
	07/27/16	0.03	0.666	12	<1	5.41	--	35	208	<0.005	<0.005	0.059	<0.001	<0.001	0.004	<0.005	<0.005	0.015	0.000185	<0.005	<0.005	<0.002	0.5075	--	--
	09/29/16	0.02	<0.5	11	<1	4.96	--	45	212	<0.005	<0.005	0.074	<0.001	<0.001	0.008	<0.005	<0.005	0.006	0.00016	<0.005	<0.005	<0.002	2.572	--	--
	10/19/16	0.04	0.578	10	<1	4.30	--	35	212	<0.005	<0.005	0.069	<0.001	<0.001	0.009	<0.005	<0.005	0.006	0.000141	<0.005	<0.005	<0.002	1.657	--	--
	12/12/16	0.02	0.341	11	<1	4.62	--	36	252	<0.005	<0.005	0.021	<0.001	<0.001	<0.001	<0.005	<0.005	0.004	0.000143	<0.005	<0.005	<0.002	0.685	--	--
	01/19/17	0.02	0.761	10	<1	4.67	--	43	184	<0.005	<0.005	0.075	<0.001	<0.001	0.004	<0.005	<0.005	0.005	0.000125	<0.005	<0.005	<0.002	2.045	--	--
	02/23/17	0.02	0.467	9	<1	5.10	--	40	196	<0.005	<0.005	0.030	<0.001	<0.001	<0.001	<0.005	<0.005	0.004	0.000098	<0.005	<0.005	<0.002	0.517	--	--
	06/07/17	0.03331	0.573	10	<0.083	4.88	351	39	228	<0.00093	0.00119	0.05142	0.00019	0.00008	0.00403	0.00075	<0.00068	0.00482	0.000147	<0.00029	<0.00099	<0.00086	0.953	--	--
	10/06/17	--	--	--	--	5.38	308	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/16/18	0.0186	0.498	14	<0.083	4.67	6.40		232	<0.00093	<0.00105	0.02572	0.0001	<0.00007	0.00044	0.00049	<0.00068	0.00394	0.000228	<0.00029	<0.00099	<0.00086	0.435	0.592	< 0.001
	Dissolved	*0.02017*	*0.468*	--	--	4.67	6.40	--	--	*<0.00093*	*<0.00105*	*0.02223*	*0.00006*	*<0.00007*	*<0.00023*	*0.00043*	*<0.00068*	*0.0039*	*0.000031*	*<0.00029*	*<0.00099*	*<0.00086*	*0.354*	0.394	0.002
	05/24/18	0.02505	0.434	14	<0.083	*5.17*	*48.1*	42	224	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	08/14/18	--	--	15	--	--	125	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/29/19	<0.02	--	14.8	0.16	--	158	52.8	208	<0.0004	0.0006 J	0.0295	<0.0004	<0.0002	<0.0008	<0.0004	<0.0004	<0.009	0.000206	<0.008	<0.0006	<0.002	--	0.327	0.0007 J
AD-16	01/26/16	0.05	2.81	6	<1	3.84	--	49	180	<0.005	0.02	0.198	0.002	<0.001	0.054	0.013	0.016	0.015	0.000259	<0.005	<0.005	<0.002	4.478	--	--
	03/21/16	0.04	2.04	6	<1	4.20	--	47	104	<0.005	<0.005	0.119	<0.001	<0.001	0.009	<0.005	<0.005	0.007	0.000114	<0.005	<0.005	<0.002	4.44	--	--
	05/31/16	0.03	1.55	6	<1	4.44	--	40	96	<0.005	<0.005	0.127	<0.001	<0.001	0.001	<0.005	<0.005	0.002	0.000037	<0.005	<0.005	<0.002	5.99	--	--
	07/27/16	0.04	3.42	7	<1	4.44	--	70	184	<0.005	0.01	0.123	0.002	<0.001	0.011	0.022	<0.005	0.035	0.000212	<0.005	<0.005	<0.002	7.21	--	--
AD-16R	06/06/17	0.04198	2.75	7	0.3438	3.68	46.9	54	204	<0.00093	0.00707	0.0464	0.00221	0.00103	0.00176	0.04174	<0.00068	0.0293	<0.000005	<0.00029	0.00198	<0.00086	6.66	--	--
	06/28/17	0.06398	1.24	6	0.2512	3.91	--	55	200	<0.00093	0.00528	0.04143	0.00216	0.00092	0.00095	0.04087	<0.00068	0.02932	<0.000005	<0.00029	<0.00099	<0.00086	12.11	--	--
	07/28/17	0.02841	1.92	7	<0.083	2.77	--	48	162	<0.00093	0.0037	0.04851	0.00217	0.00128	0.00107	0.04533	<0.00068	0.02617	0.000006	<0.00029	0.00127	0.00143	8.52	--	--
	08/02/17	0.03177	1.86	7	<0.083	3.00	--	49	174	<0.00093	0.00446	0.04961	0.00206	0.00122	0.00095	0.04311	<0.00068	0.02498	<0.000005	<0.00029	0.00174	0.00202	5.45	--	--
	10/06/17	--	--	--	--	3.29	31.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/15/18	0.04030	2.73	6	<0.083	3.18	0.0		212	0.00269	0.0074	0.04301	0.00278	0.00129	0.0007	0.04123	<0.00068	0.02977	<0.000005	0.00103	<0.00099	<0.00086	5.89	1.47	0.053
	Dissolved	*0.02614*	*2.59*	--	--	3.18	0.0	--	--	*<0.00093*	*0.00294*	*0.04155*	*0.0022*	*0.00071*	*0.00025*	*0.03996*	*<0.00068*	*0.0278*	*<0.000005*	*<0.00029*	*<0.00099*	*<0.00086*	*5.90*	0.599	0.05
	05/23/18	0.03202	2.53	6	<0.083	*3.79*	*36.9*	67	204	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	08/14/18	--	--	--	--	--	142	44	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/30/19	<0.02	--	5.43	0.19	--	77.1	41.6	80	0.00002 J	0.00176	0.0724	0.000424	0.00008	0.000334	0.00438	0.00006 J	0.01 J	0.000296	<0.0004	0.0006	0.0002 J	--	0.072	0.0079
Supplemental Downgradient Monitoring Wells																									
AD-19	5/17/2018	0.07234	9.4	34	<0.083	5.72	42.1	--	372	<0.00093	<0.00105	0.05026	0.00073	<0.00007	0.00117	0.0111	<0.00068	0.02924	<0.000005	0.00078	0.00194	<0.00086	1.421	3.04	0.089
	Dissolved	*0.06293*	*8.76*	--	--	--	--	--	--	*<0.00093*	*<0.00105*	*0.04*	*0.00025*	*<0.00007*	*<0.00023*	*0.00965*	*<0.00068*	*0.02842*	*<0.000005*	*0.00041*	*<0.00099*	*0.012*	*2.577*	2.13	0.08
AD-20	10/31/18	0.029	3.14	18.4	0.09	4.88	13	12.5	140	0.00004	0.00185	0.205	0.000651	0.00114	0.000514	0.0161	0.000425	0.0126	<0.00005	<0.0004	0.0008	0.0003	4.16	1.11	0.0742
AD-21	10/30/18	0.025	5.0	17	0.23	5.04	0.0	27.4	180	0.00006	0.00124	0.0868	0.00181	0.00065	0.000263	0.0337	0.000148	0.034	<0.00005	<0.0004	0.0011	0.0002	3.76	3.13	0.154
EPA MCLs:																									
MCL					4					0.006	0.01	2	0.004	0.005	0.1				0.002	N/A	0.05	0.002	5^{b}		
Rule Specified																0.006	0.015	0.04		0.1					
Background Limit					1					0.005	0.005	0.36	0.00077	0.0065^{a}	0.004	0.075^{a}	0.005	0.39^{a}	0.000033	0.005	0.005	0.0013	4.21^{b}		
Interwell Background Value(s) (UPL, LPL where applicable) AD-8, AD-9, AD-15		0.775				4.8-7.1																			
Intrawell Background Value (UPL) AD-8			35.7	38.3	1.03			236	569																
Intrawell Background Value (UPL) AD-9			350	139	0.73			2527	3147																
Intrawell Background Value (UPL) AD-15			5.71	38.4	1.00			35.6	388																

NOTES:
All concentration data are provided in milligrams per liter (mg/L) unless otherwise noted.
J = Analyte was positively identified, though the quantitation was below Reporting Limit.
MCL = Maximum contaminant level
LPL = Lower prediction limit
UPL = Upper prediction limit
pCi/L = PicoCuries per liter.
-- = Not analyzed.
a = Calculated Upper Tolerance Limit is higher than MCL.
b = Data is "Combined Radium, Total".
c = AD-18 is not part of the designated CCR Monitoring Well Network and used for background understanding only
🟨 Denotes groundwater sample collected by ARCADIS using low-flow sampling methods.
Unless otherwise noted, values shown are total (unfiltered) analyses.
Dissolved (0.45-micron lab filtered) parameter concentrations shown in italics.

FIGURES



Source:
7.5 minute topographic quadrangle
Cason, Texas, 2013

Service Layer Credits: Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

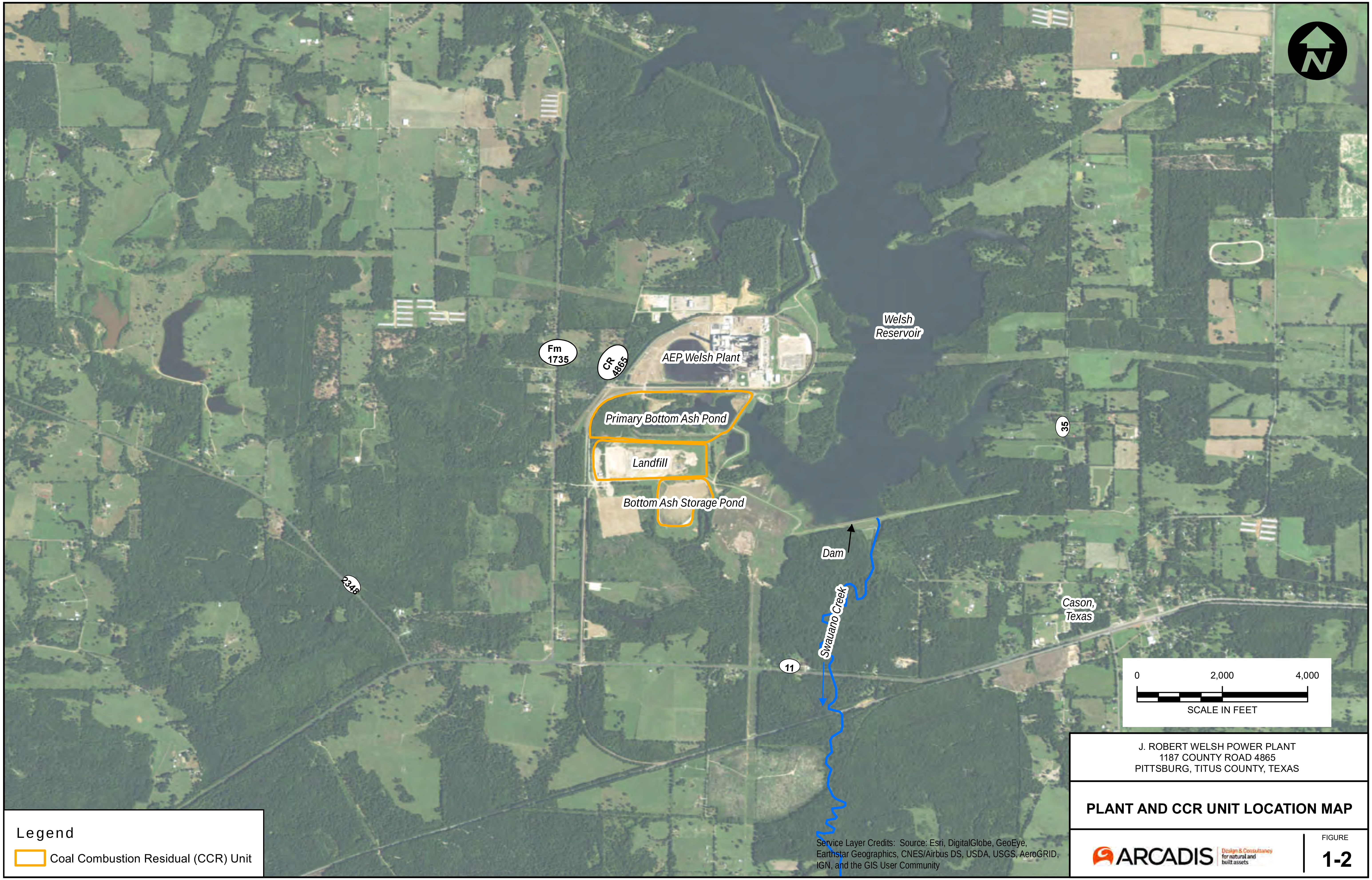
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-1

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\Dec2017Update\fig 1 - site map.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

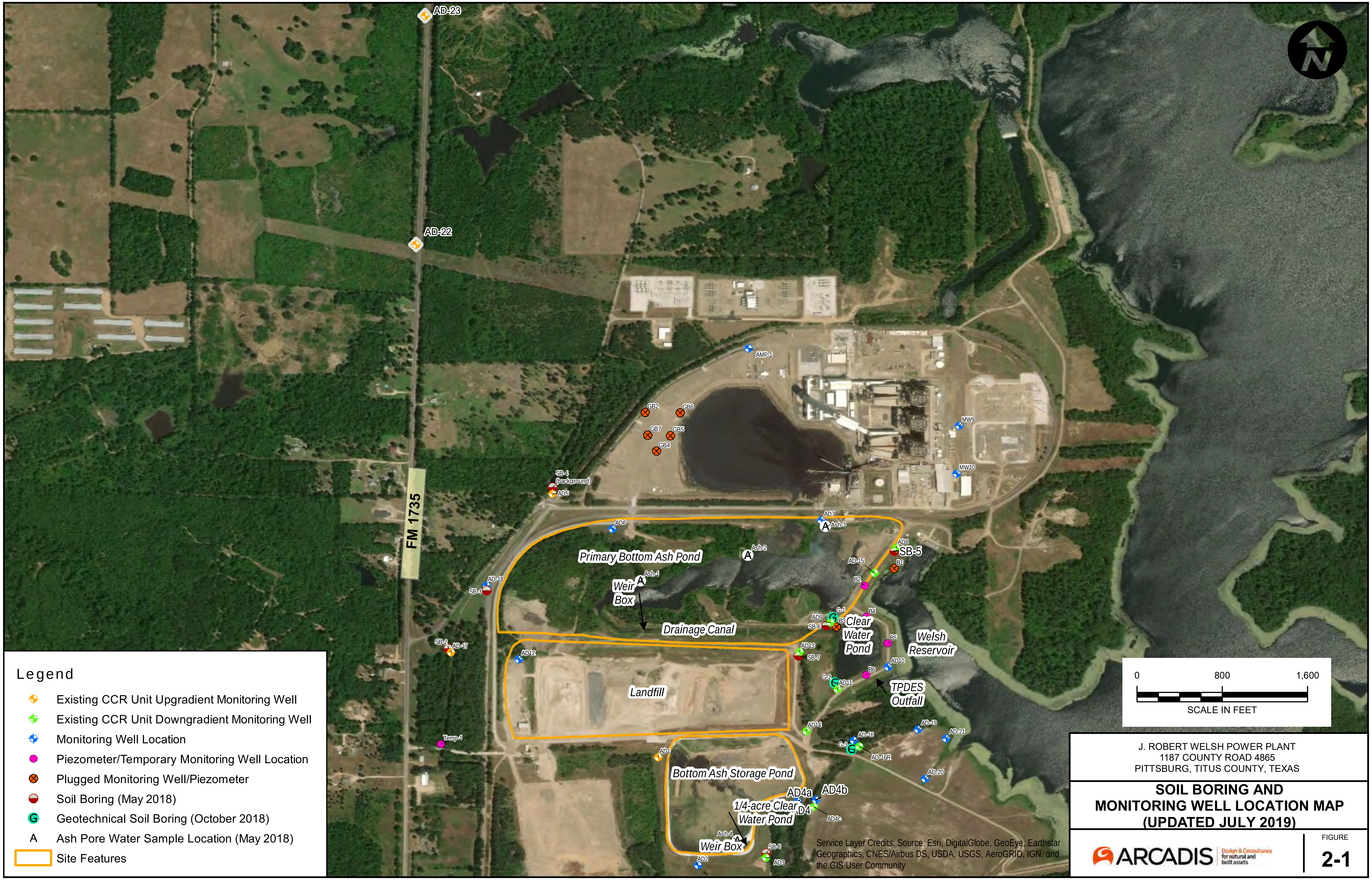
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PLANT AND CCR UNIT LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-2

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\Dec2017Update\fig 1-2 - CCR location.mxd



Legend

- Existing CCR Unit Upgradient Monitoring Well
- Existing CCR Unit Downgradient Monitoring Well
- Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

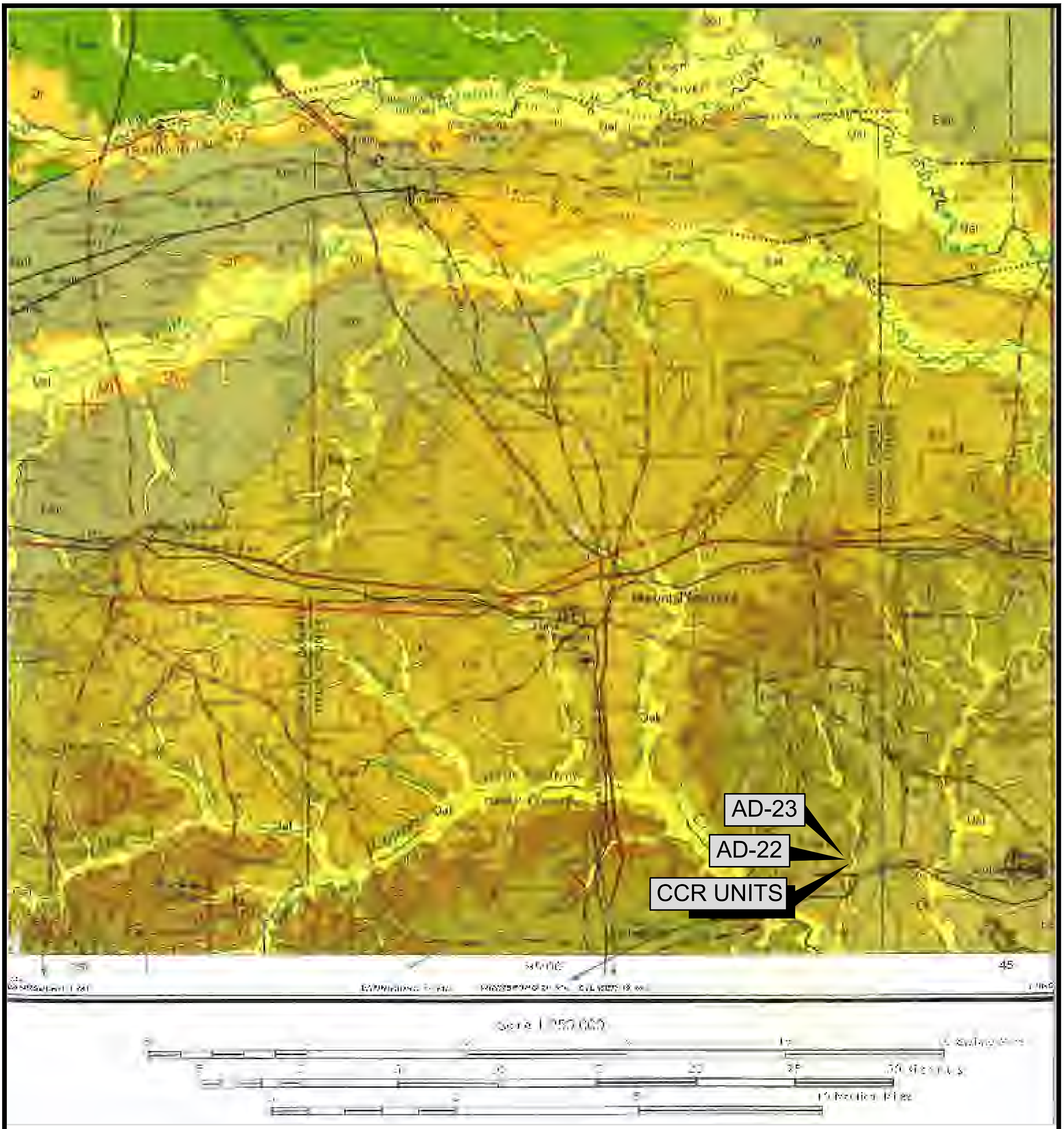
SOIL BORING AND MONITORING WELL LOCATION MAP (UPDATED JULY 2019)

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-1

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 2-1-SoilBoring_MonitoringWellLocations.mxd

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\30034022 - Welsh Lithium ASD August 2019\Figures-Maps\Figure 2-2A Regional Geo Map.dwg LAYOUT: MODEL SAVED: 8/6/2019 9:16 AM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 9/9/2019 10:33 AM BY: LEASE, DIANA



REF: "GEOLOGIC ATLAS OF TEXAS, TEXARKANA SHEET", UNIVERSITY OF TEXAS AT AUSTIN BUREAU OF ECONOMIC GEOLOGY, 1966.

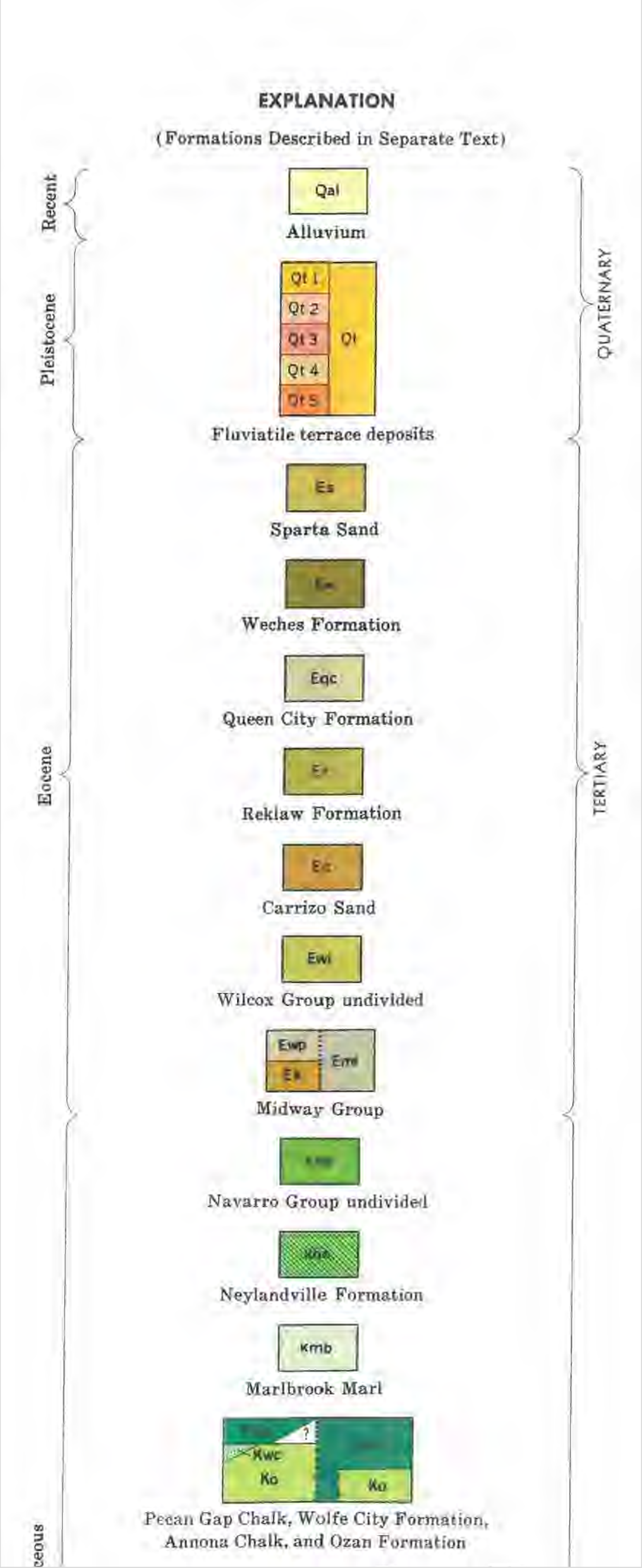
J. ROBERT WELSH POWER PLANT
PITTSBURG, TITUS COUNTY, TEXAS

REGIONAL GEOLOGIC MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-2A

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\30034022 - Welsh Lithium ASD August 2019\Figures-Maps\Figure 2-2B Reg Geo Map Legend.dwg LAYOUT: MODEL SAVED: 8/6/2019 9:19 AM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 9/9/2019 10:37 AM BY: LEASE, DIANA

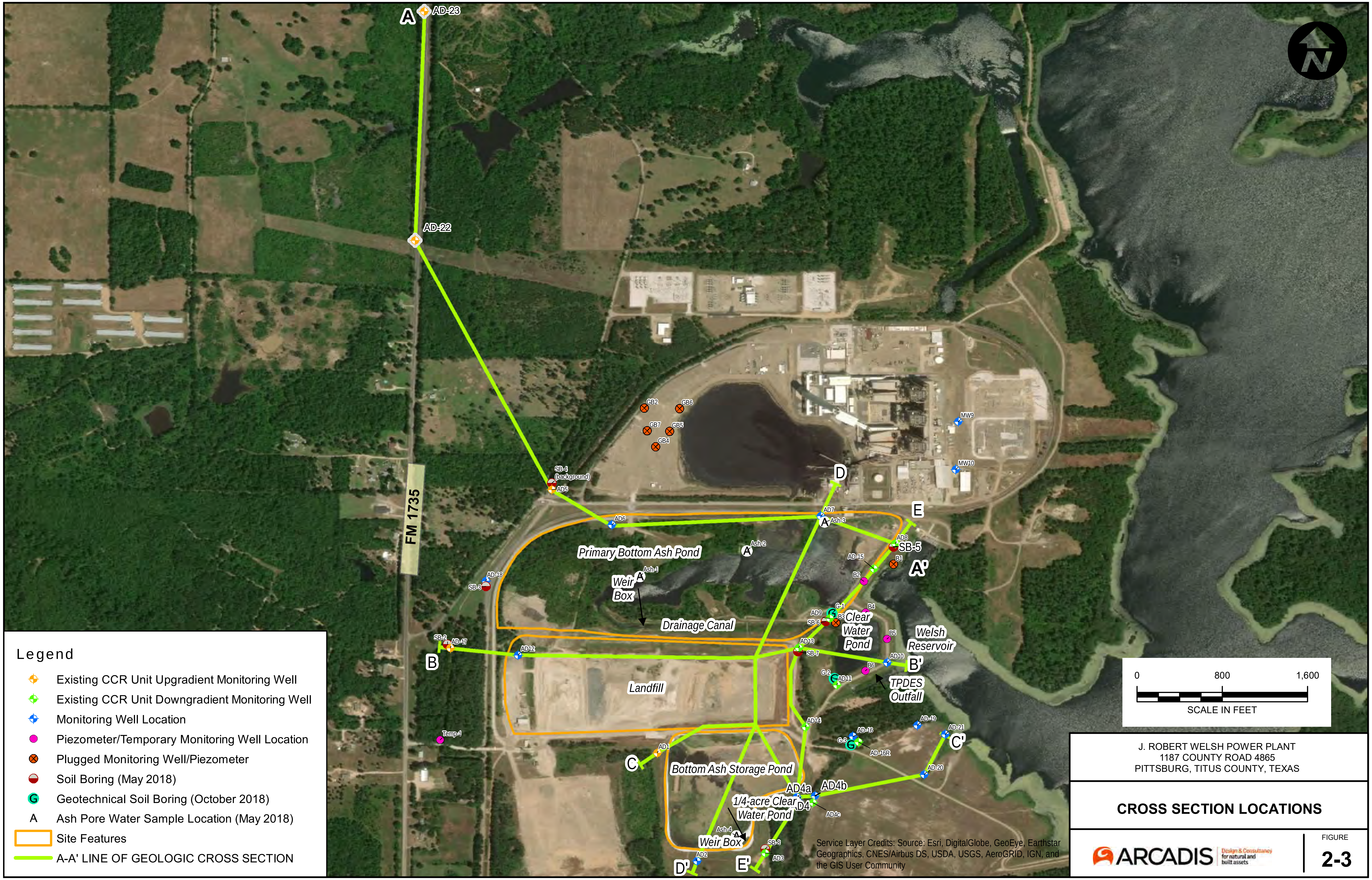


J. ROBERT WELSH POWER PLANT
PITTSBURG, TITUS COUNTY, TEXAS

REGIONAL
GEOLOGIC MAP LEGEND

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-2B



Legend

- ◆ Existing CCR Unit Upgradient Monitoring Well
- ◆ Existing CCR Unit Downgradient Monitoring Well
- ◆ Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ● Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features
- ━ A-A' LINE OF GEOLOGIC CROSS SECTION

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

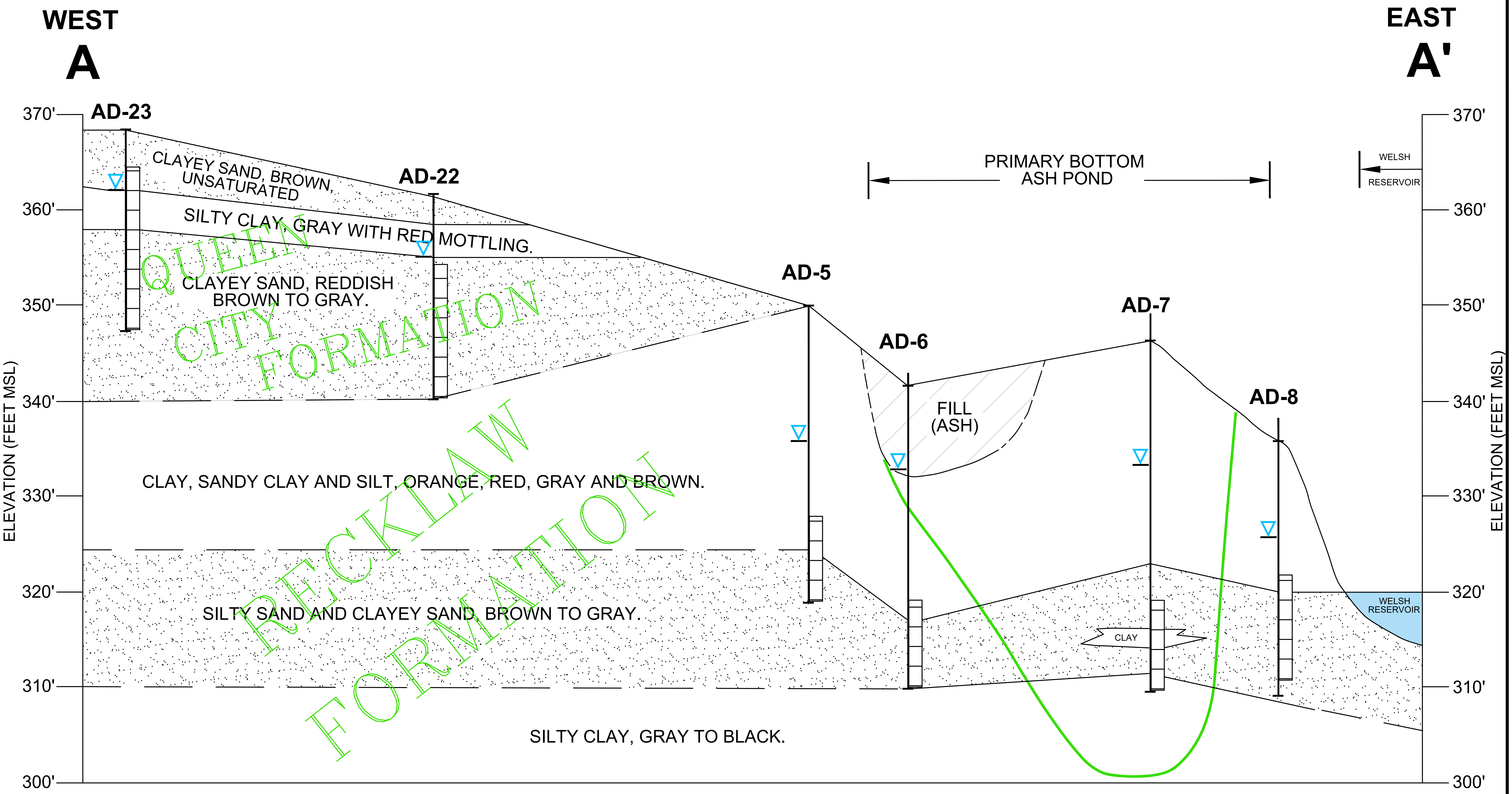
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION LOCATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-3

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig2-3-Cross Section LocationsREV.mxd



0 600'
HORIZONTAL SCALE

NOTE: BASE OF ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

- ▤ MONITORING WELL SCREENED INTERVAL
- ▽ WATER LEVEL IN EVALUATION (6/19/19)
- 🟩 PROJECTED BASE OF PRIMARY BOTTOM ASH POND (SEE NOTE)

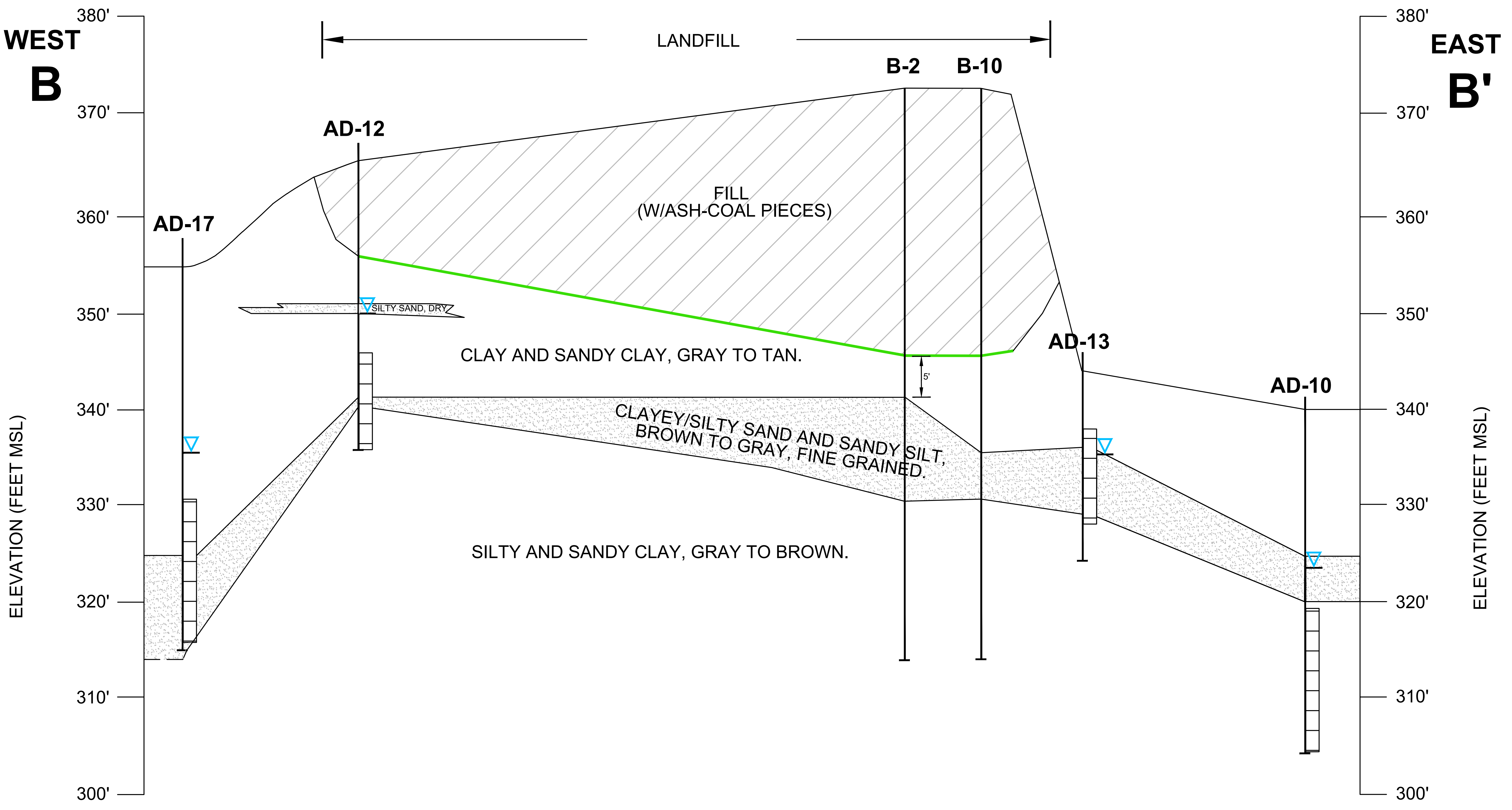
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
A - A'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-4

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\30034022 - Welsh Lithium ASD August 2019\Figures-Maps\Figure 2-4 Cross Section A-A'.dwg LAYOUT: MODEL SAVED: 8/7/2019 9:49 AM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 9/9/2019 10:45 AM BY: LEASE, DIANA



0 300'
HORIZONTAL SCALE

NOTE: BASE OF LANDFILL ELEVATION TAKEN FROM "WELSH POWER PLANT- UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12/3/76.

LEGEND

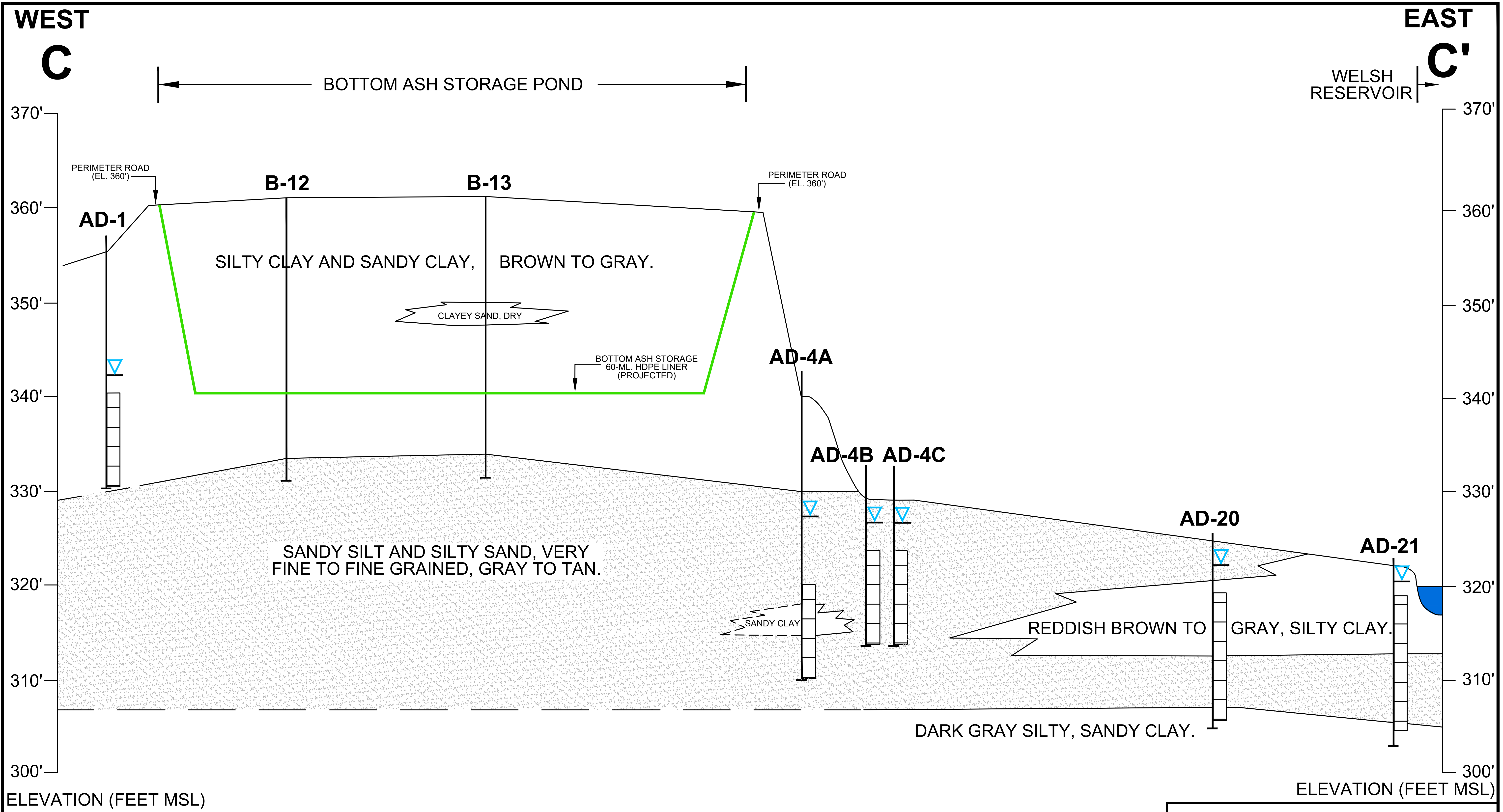
⊟	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	BASE OF LANDFILL (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
B - B'

ARCADIS

FIGURE
2-5



0 200'

HORIZONTAL SCALE

NOTE: BASE OF BOTTOM ASH STORAGE HAS A 60-ML. HDPE LINER AT ELEVATION 340.0', TAKEN FROM FREESE AND NICHOLS "HYDRAULIC ANALYSIS OF WELSH POWER PLANT ASH PONDS, AMERICAN ELECTRIC POWER COMPANY", DATED DECEMBER 2010.

LEGEND

⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (10/29/18)
🟩	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

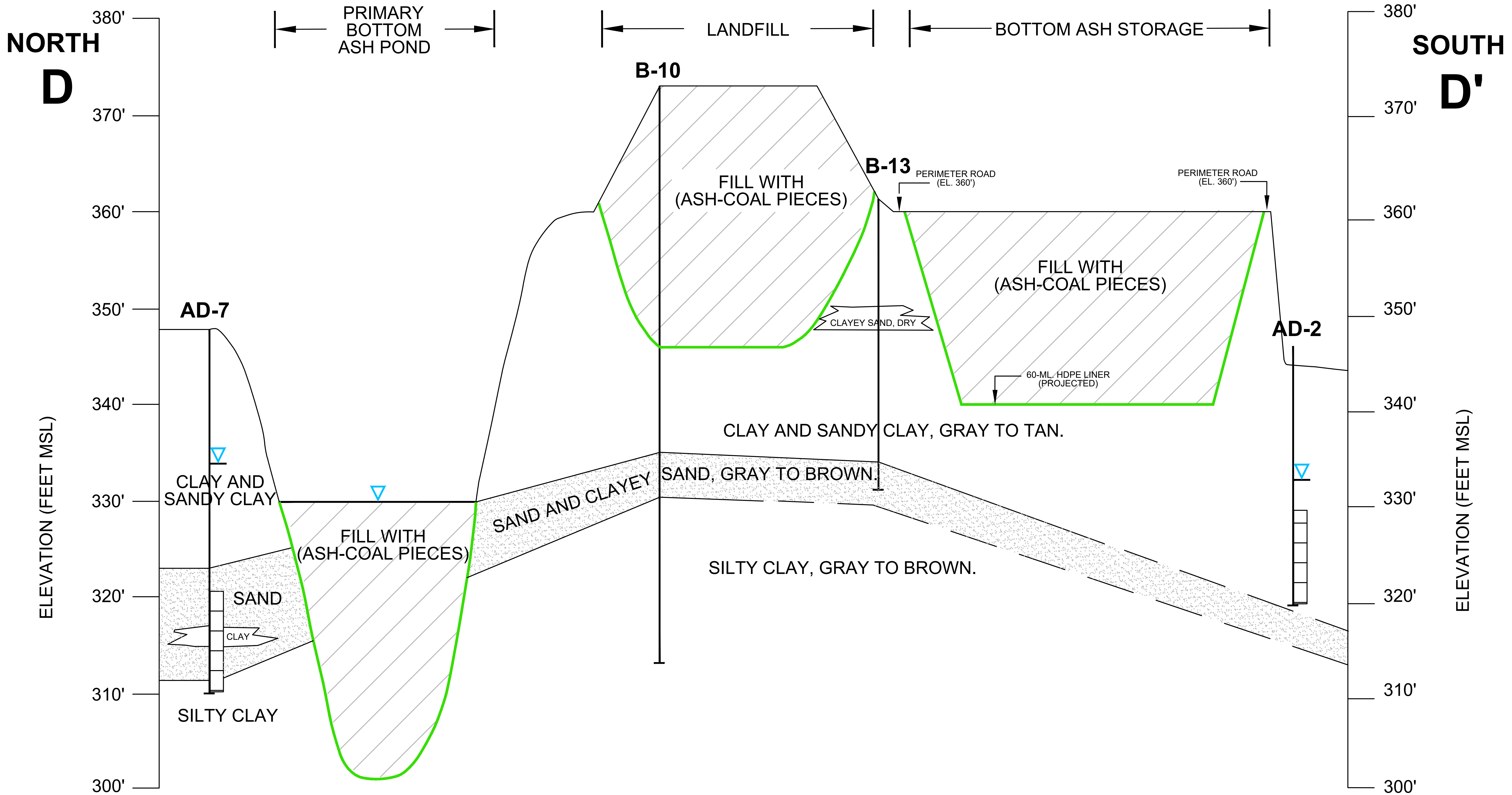
CROSS SECTION
C - C'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-6

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\TX015976.0005 - Welsh Lithium ASD\Figures-Maps\Figure 2-4 Cross Section C-C'.dwg LAYOUT: MODEL SAVED: 11/13/2018 3:29 PM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 1/28/2019 3:35 PM BY: LEASE, DIANA

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\TX015976.0005 - Welsh Lithium ASD\Figures-Maps\Figure 2-5 Cross Section D-D'.dwg LAYOUT: MODEL SAVED: 6/23/2016 9:39 AM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 1/28/2019 3:41 PM BY: LEASE, DIANA



0 ▬▬ 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

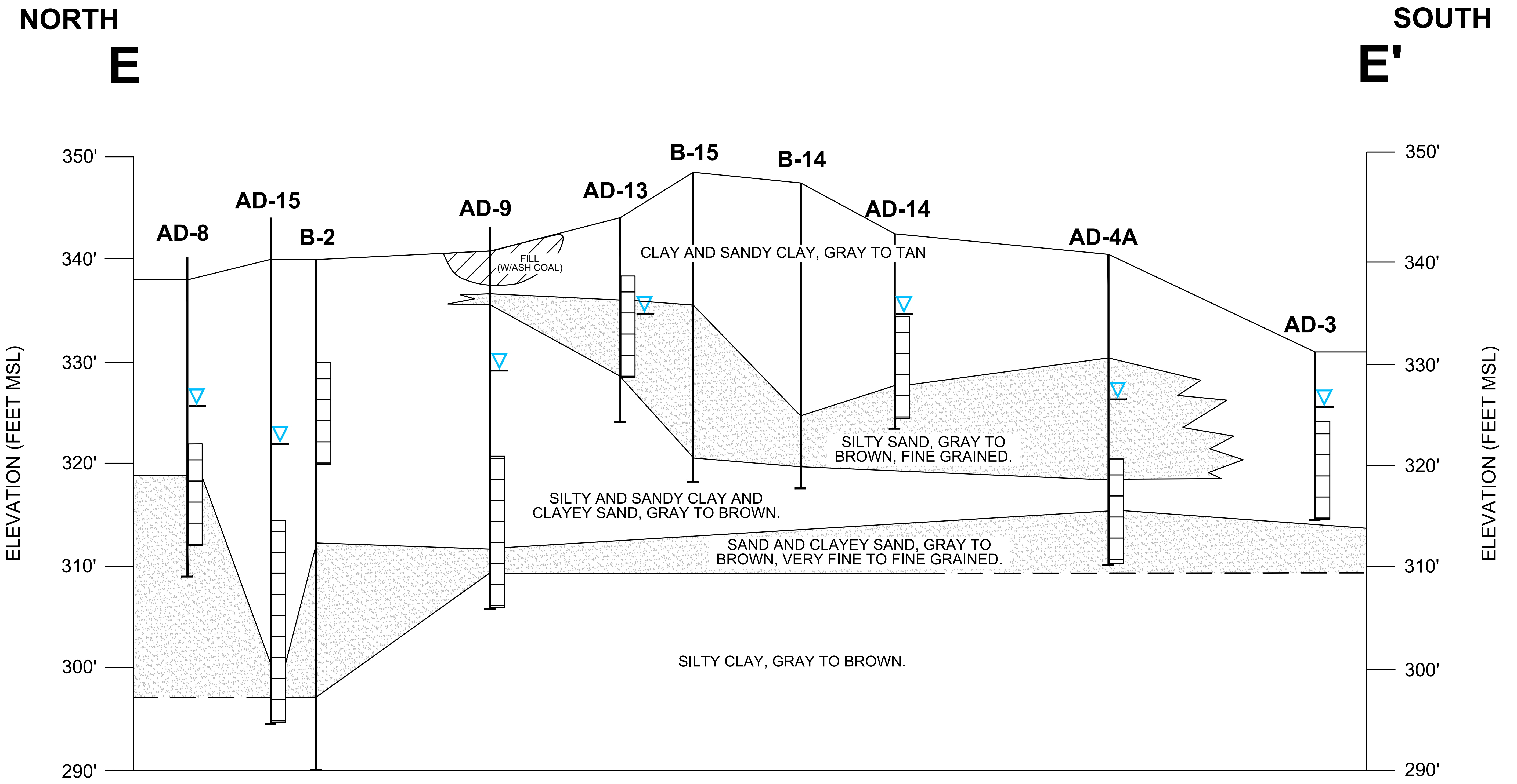
▯	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (5/12/15)
🟩	BASE OF CCR UNIT

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
D - D'

ARCADIS

FIGURE
2-7



0 ▬▬ 300'
HORIZONTAL SCALE

LEGEND

▤ MONITORING WELL SCREENED INTERVAL

▽ WATER LEVEL IN MONITORING WELL (3/4/16)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
E - E'

ARCADIS

FIGURE
2-8

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\TX015976.0005 - Welsh Lithium ASD\Figures-Maps\Figure 2-6 Cross Section E-E'.dwg LAYOUT: MODEL SAVED: 1/28/2019 3:51 PM ACADVER: 20.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 1/29/2019 8:53 AM BY: LEASE, DIANA

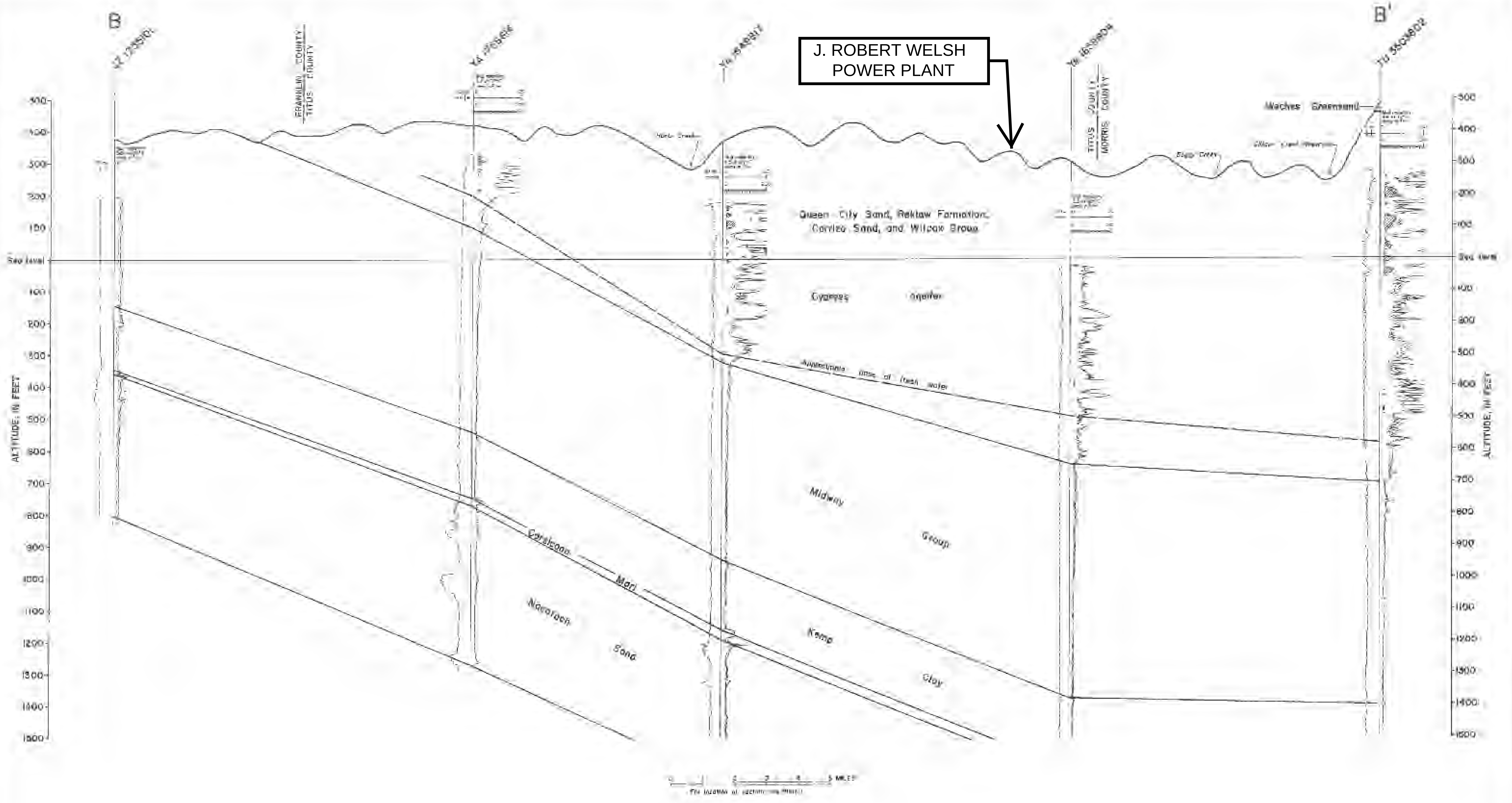


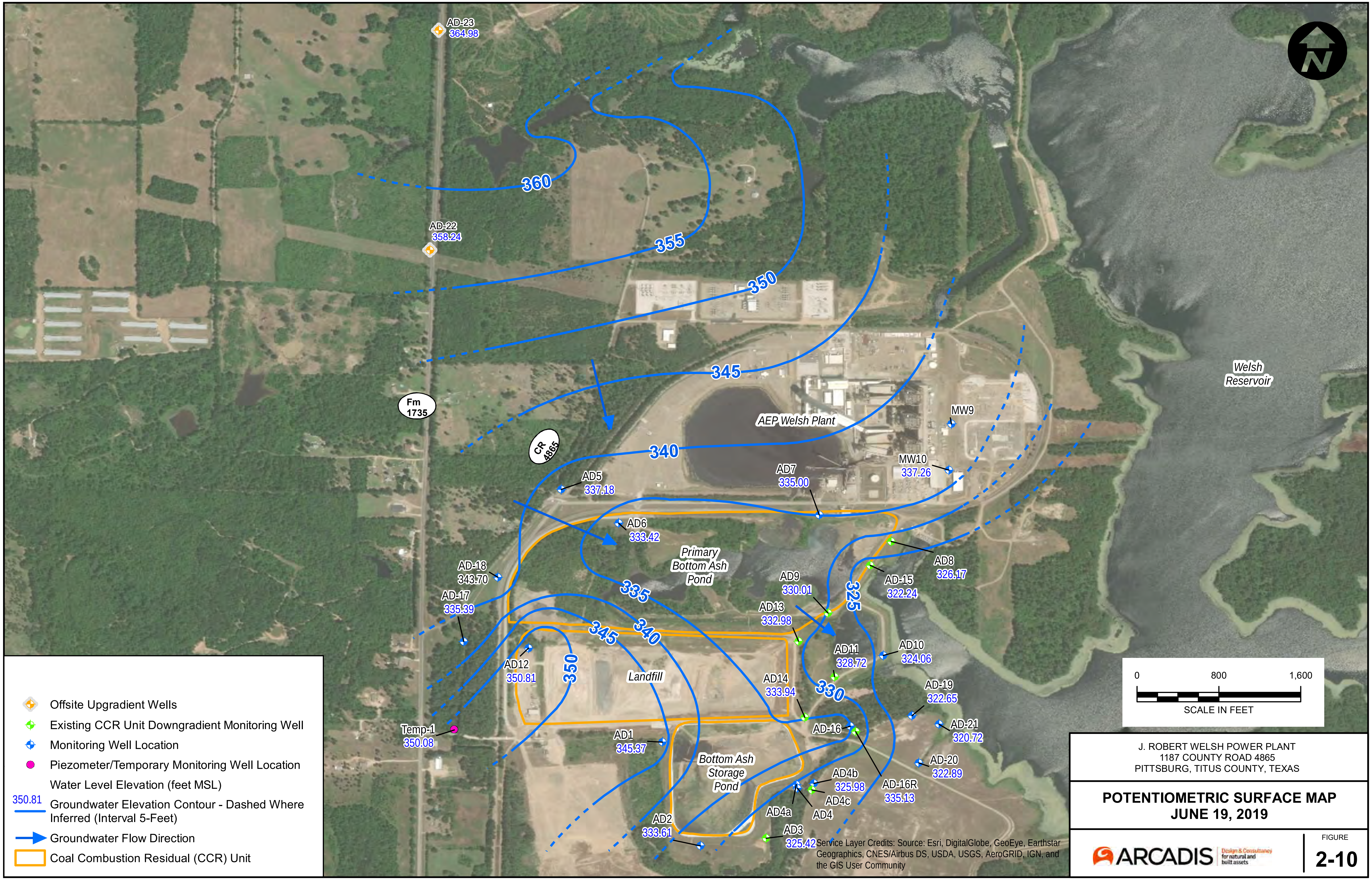
Plate 3

Geologic Section B – B', Franklin, Titus, and Morris Counties

U. S. Geological Survey in cooperation with the Texas Water Commission **(TWC BULLETIN 6517)**

REGIONAL GEOLOGIC CROSS SECTION

FIGURE 2-9



Offsite Upgradient Wells

Existing CCR Unit Downgradient Monitoring Well

Monitoring Well Location

Piezometer/Temporary Monitoring Well Location

350.81 Water Level Elevation (feet MSL)

Groundwater Elevation Contour - Dashed Where Inferred (Interval 5-Feet)

Groundwater Flow Direction

Coal Combustion Residual (CCR) Unit

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

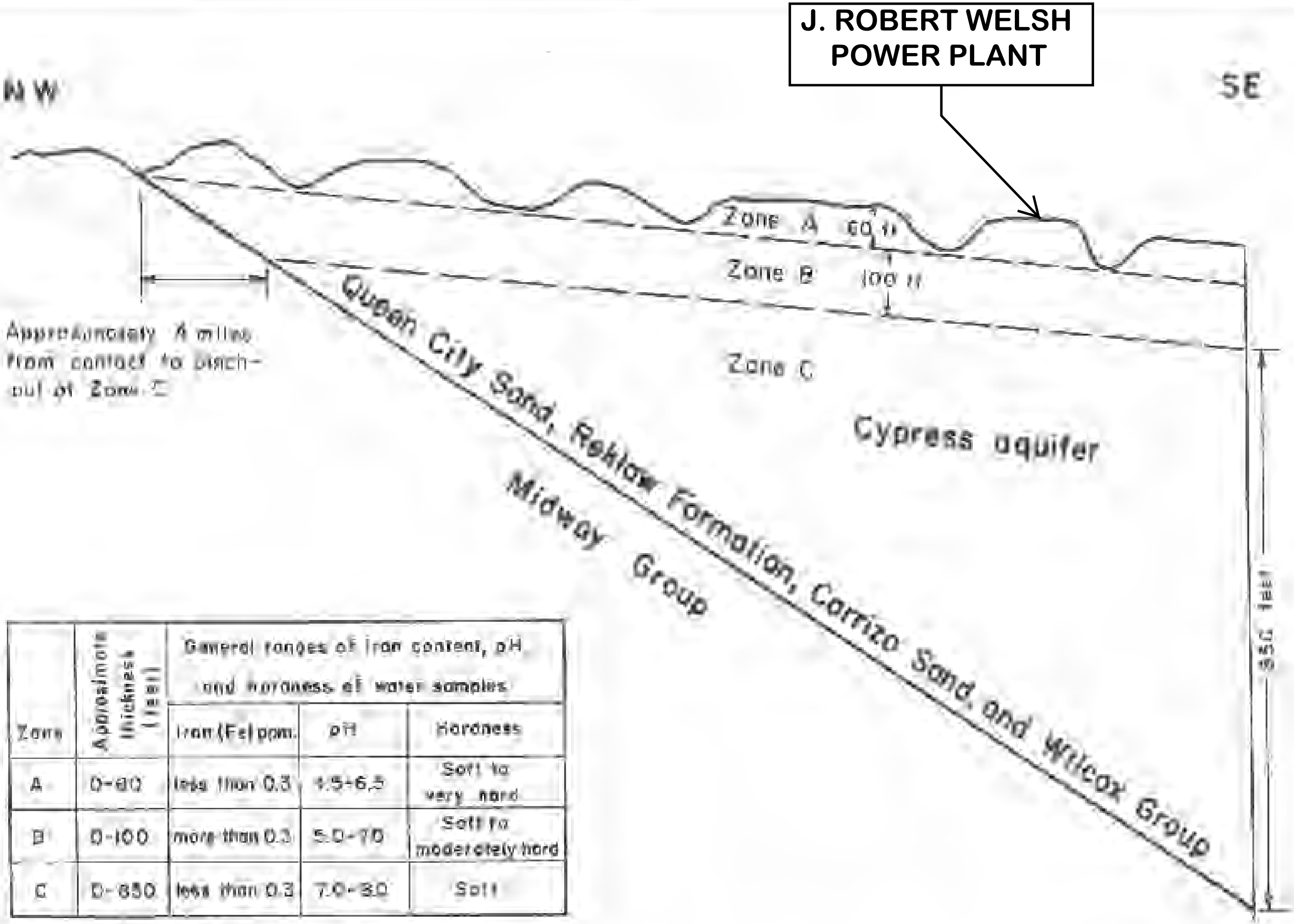
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

POTENTIOMETRIC SURFACE MAP
JUNE 19, 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-10

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\fig 2-10 - Potentiometric June2019.mxd



Zone	Approximate thickness (feet)	General ranges of iron content, pH and hardness of water samples		
		Iron (Fe) ppm.	pH	Hardness
A	0-60	less than 0.3	4.5-6.5	Soft to very hard
B	0-100	more than 0.3	5.0-7.0	Soft to moderately hard
C	0-850	less than 0.3	7.0-8.0	Soft

Figure 12

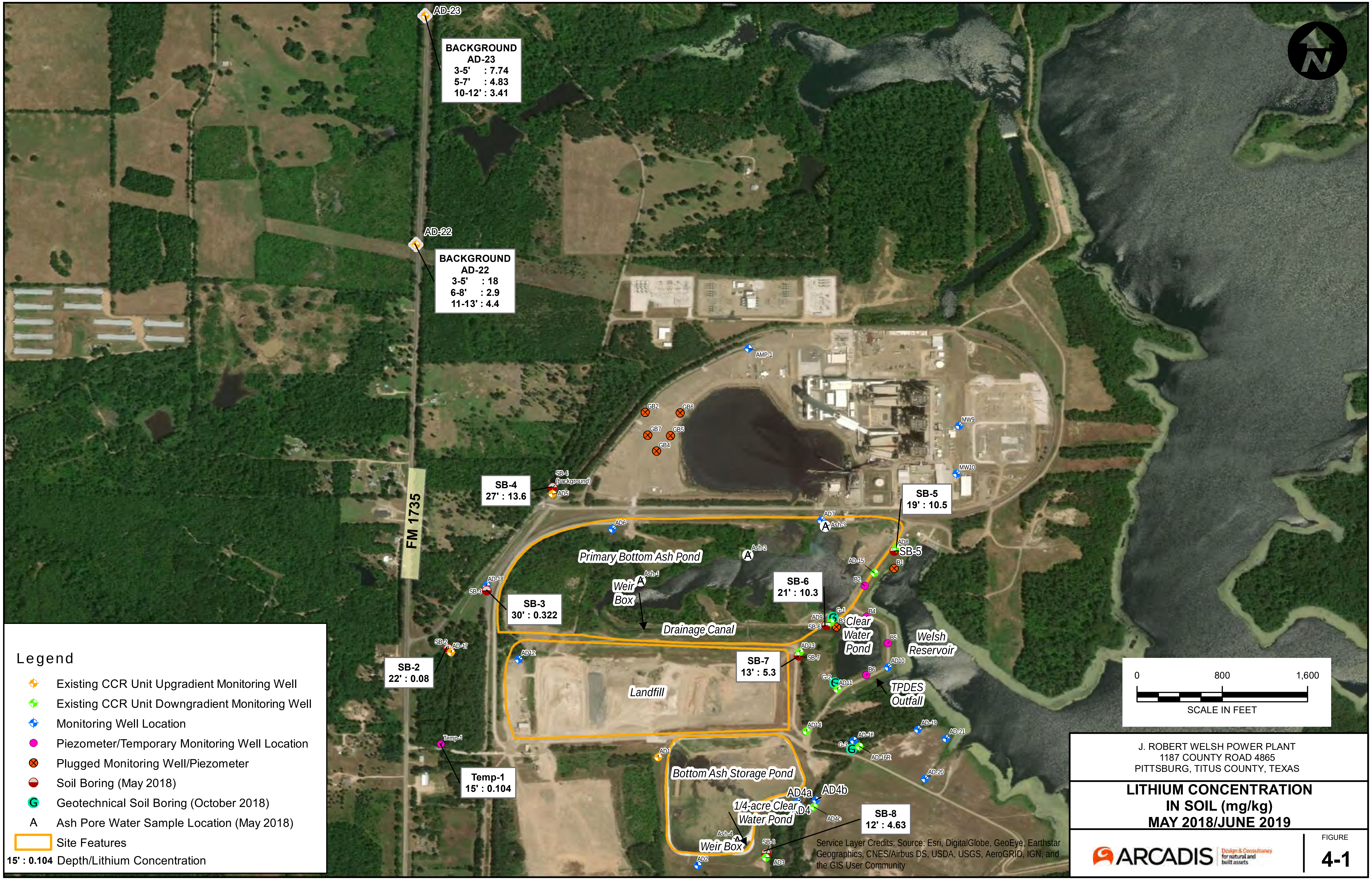
Diagrammatic Section Showing Zones A, B, and C in the Cypress Aquifer

U.S. Geological Survey in cooperation with the Texas Water Commission

(TWC BULLETIN 6517)

REGIONAL HYDROLOGIC CROSS SECTION

FIGURE 2-11



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- ◈ Existing CCR Unit Upgradient Monitoring Well
- ◈ Existing CCR Unit Downgradient Monitoring Well
- ◈ Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◓ Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features
- **15' : 0.104** Depth/Lithium Concentration

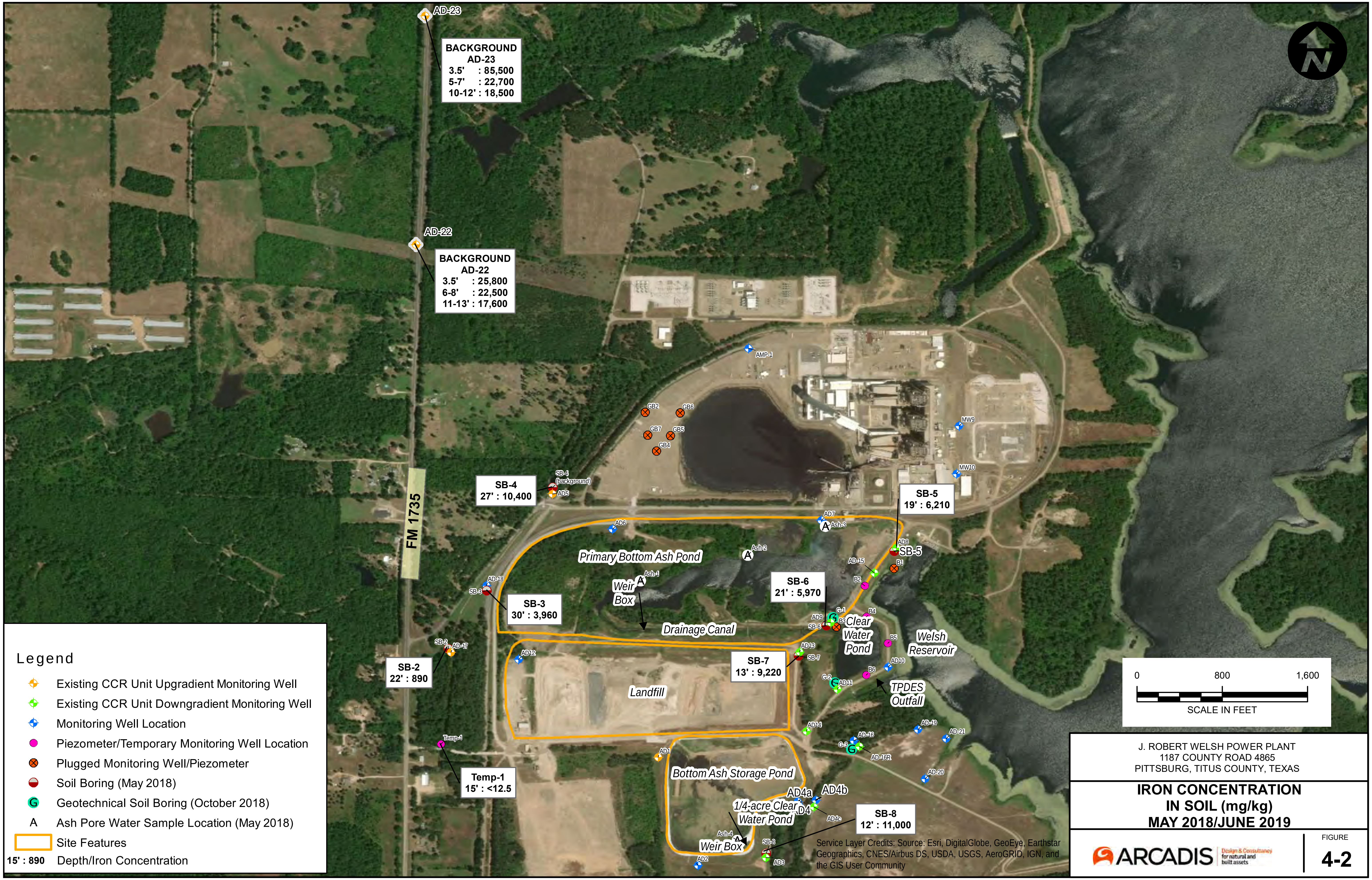
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM CONCENTRATION IN SOIL (mg/kg) MAY 2018/JUNE 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-1

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 4-1-SoilBoring_LithiumresultsMay2018-June2018.mxd



Legend

- 🟧 Existing CCR Unit Upgradient Monitoring Well
- 🟩 Existing CCR Unit Downgradient Monitoring Well
- 🟦 Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◒ Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features
- **15' : 890** Depth/Iron Concentration

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

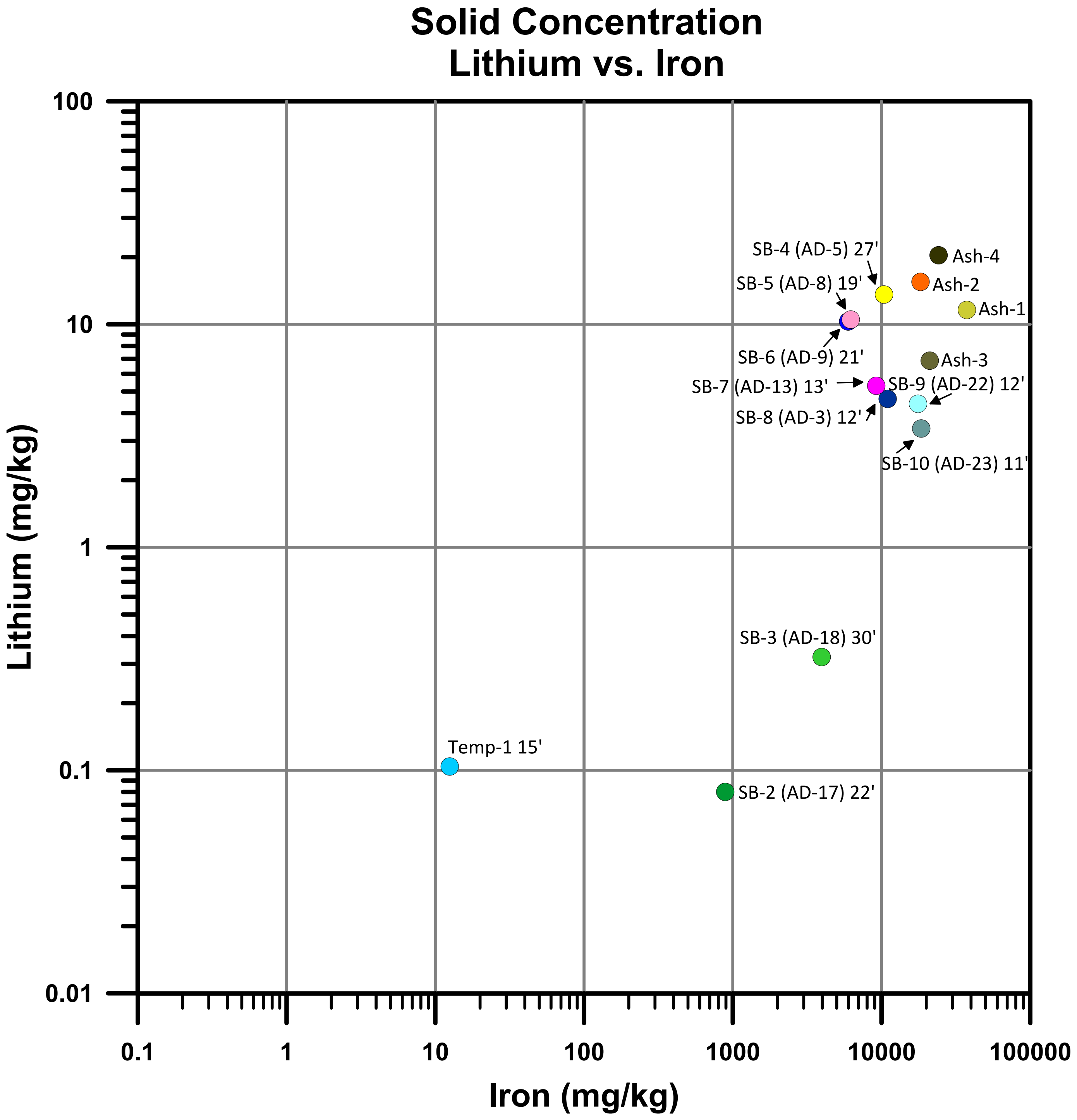
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

IRON CONCENTRATION IN SOIL (mg/kg) MAY 2018/JUNE 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-2

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 4-2-SoilBoring_IronresultsMay2018-June2019.mxd



Native Soil

Upgradient
- ● SB-2 (AD-17) 22'
- ● SB-3 (AD-18) 30'
- ● SB-4 (AD-5) 27' Background
- ● SB-9 (AD-22) 12'
- ● SB-10 (AD-23) 11'

Downgradient
- ● SB-8 (AD-3) 12'
- ● SB-5 (AD-8) 19'
- ● SB-6 (AD-9) 21'
- ● SB-7 (AD-13) 13'

Supplemental Sidegradient
- ● Temp-1 15'

Coal Ash
- ● Ash-1
- ● Ash-2
- ● Ash-3
- ● Ash-4

Notes:
mg/kg - milligrams per kilogram

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

LITHIUM VS. IRON SOLIDS CONCENTRATION PLOT

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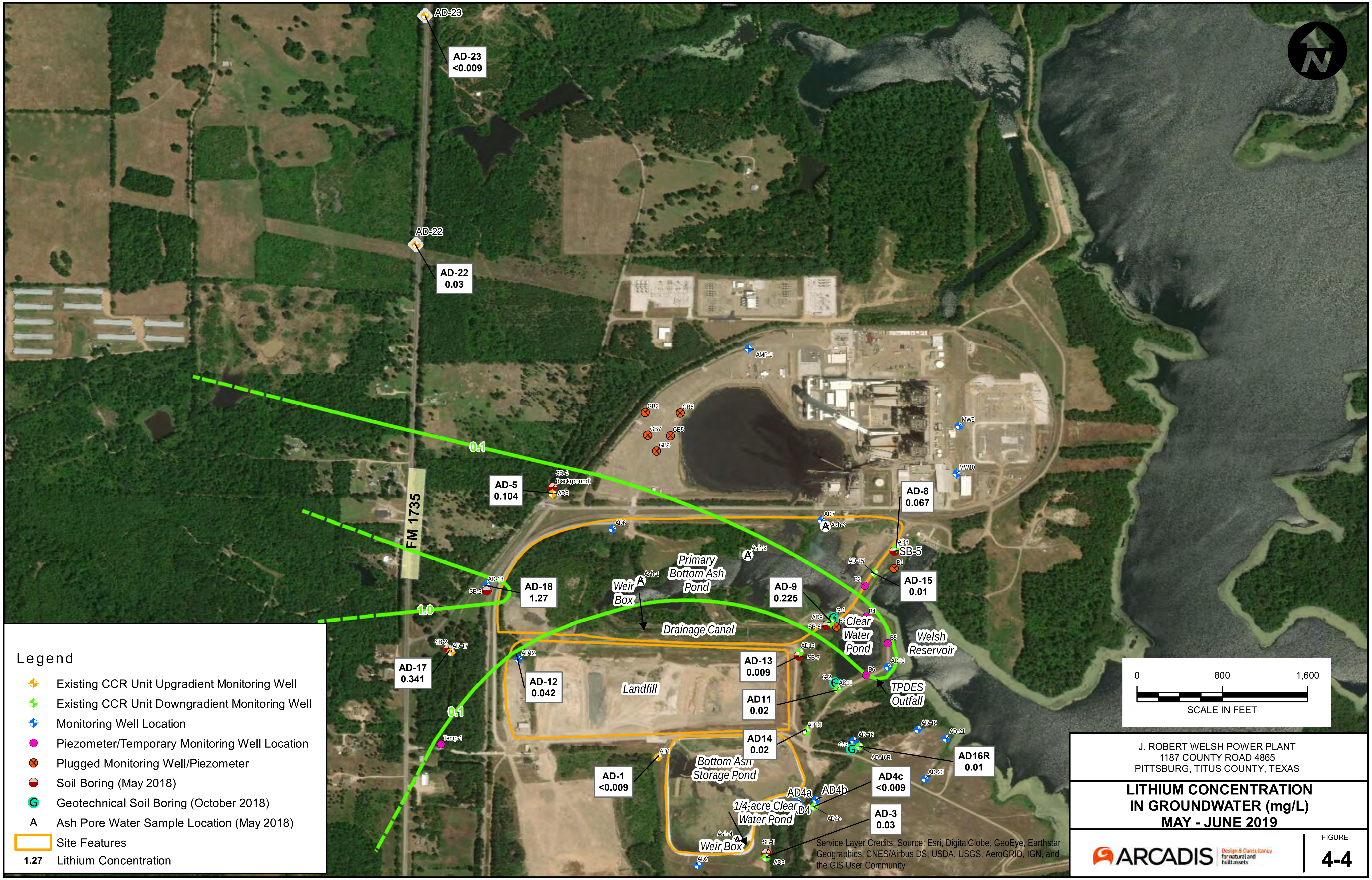
FIGURE
4-3



Legend

- 🔶 Existing CCR Unit Upgradient Monitoring Well
- 🟢 Existing CCR Unit Downgradient Monitoring Well
- 🔷 Monitoring Well Location
- ● Piezometer/Temporary Monitoring Well Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◐ Soil Boring (May 2018)
- G Geotechnical Soil Boring (October 2018)
- A Ash Pore Water Sample Location (May 2018)
- ▭ Site Features
- 1.27 Lithium Concentration

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

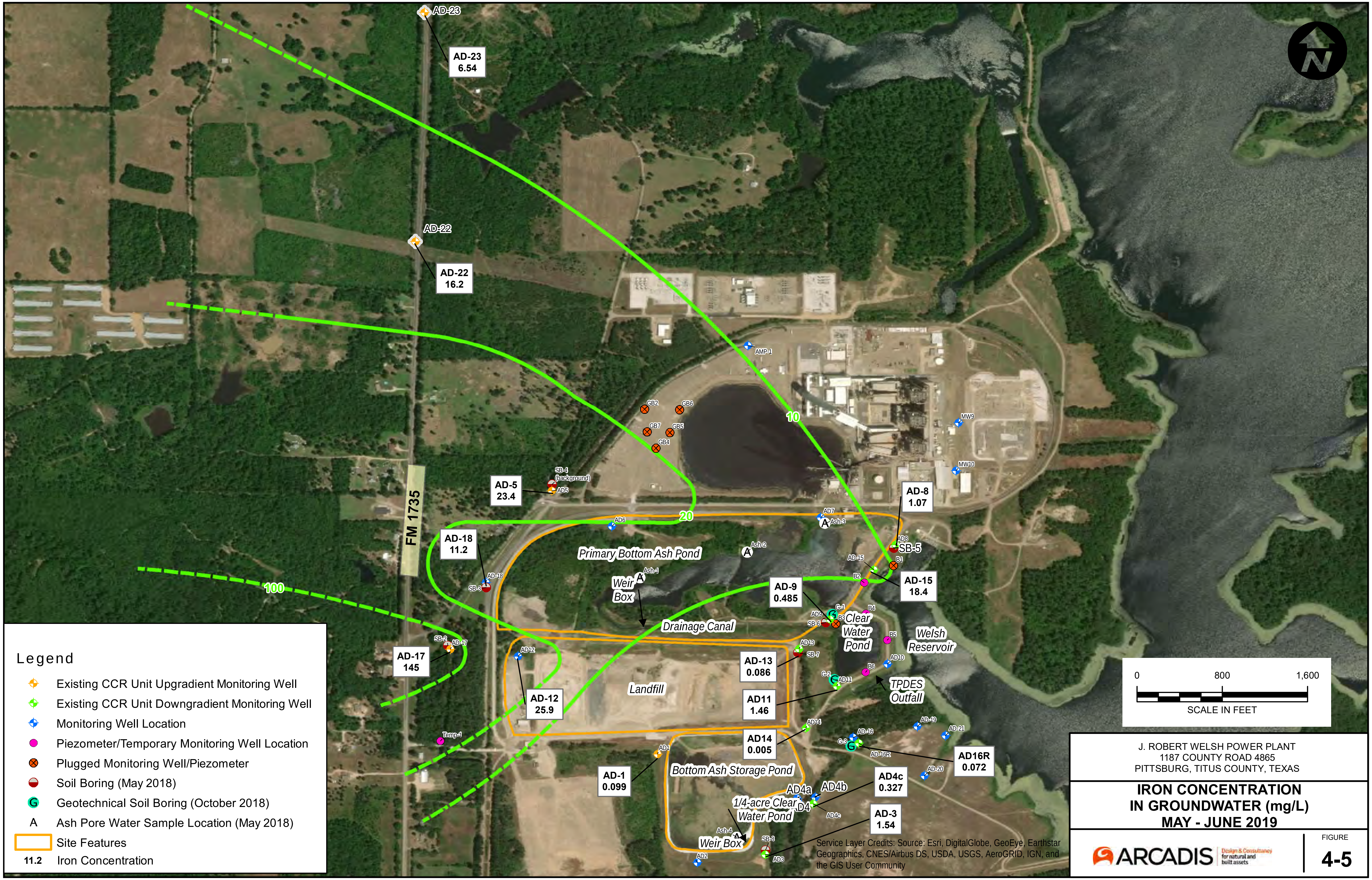
LITHIUM CONCENTRATION IN GROUNDWATER (mg/L) MAY - JUNE 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4-4

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 4-4-SoilBoring_LithiumGWresultsMay2018-June2019.mxd

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\September 2019\Fig 4-5-SoilBoring_IronGWresultsMay2018-June2019.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

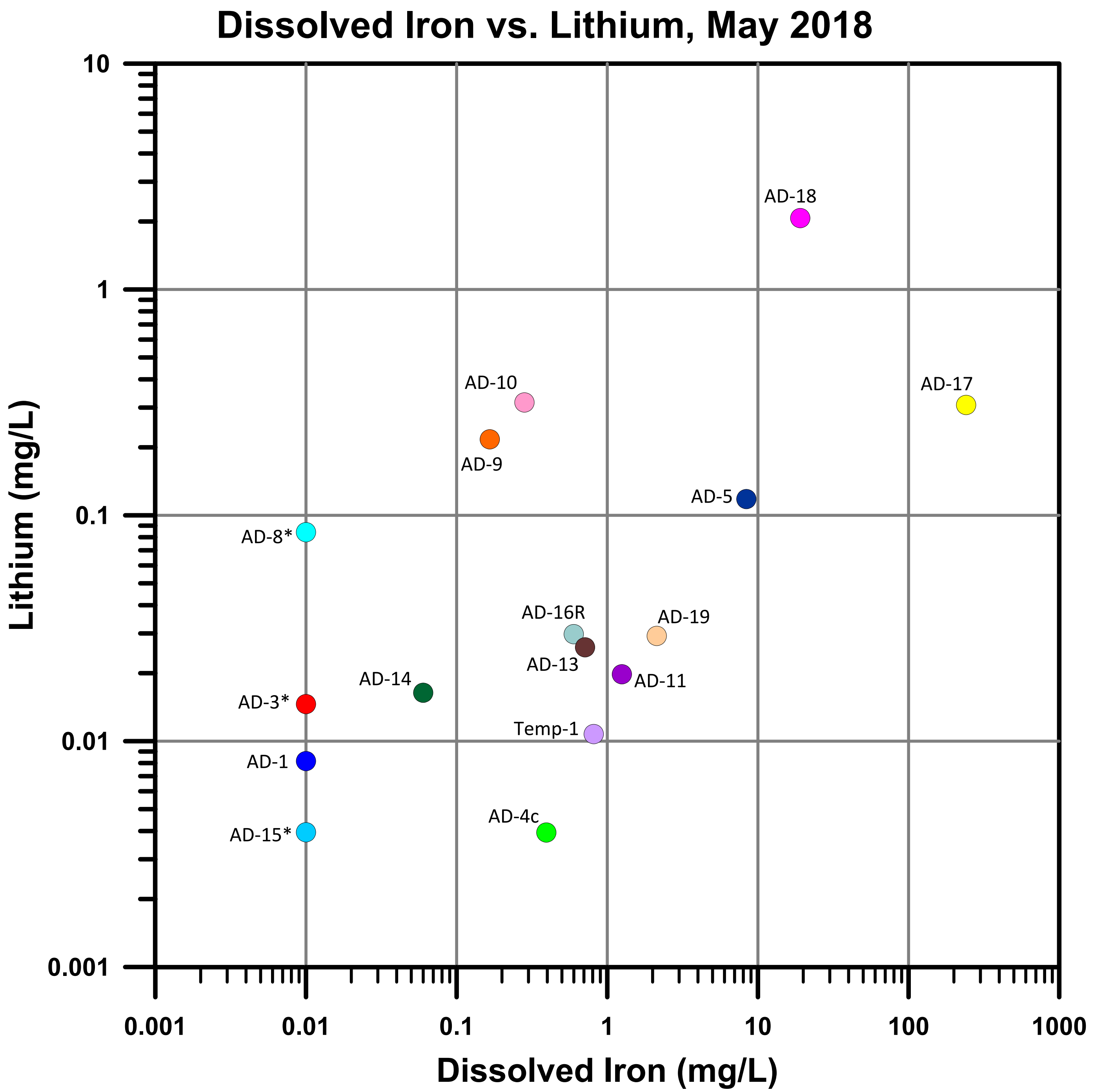
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

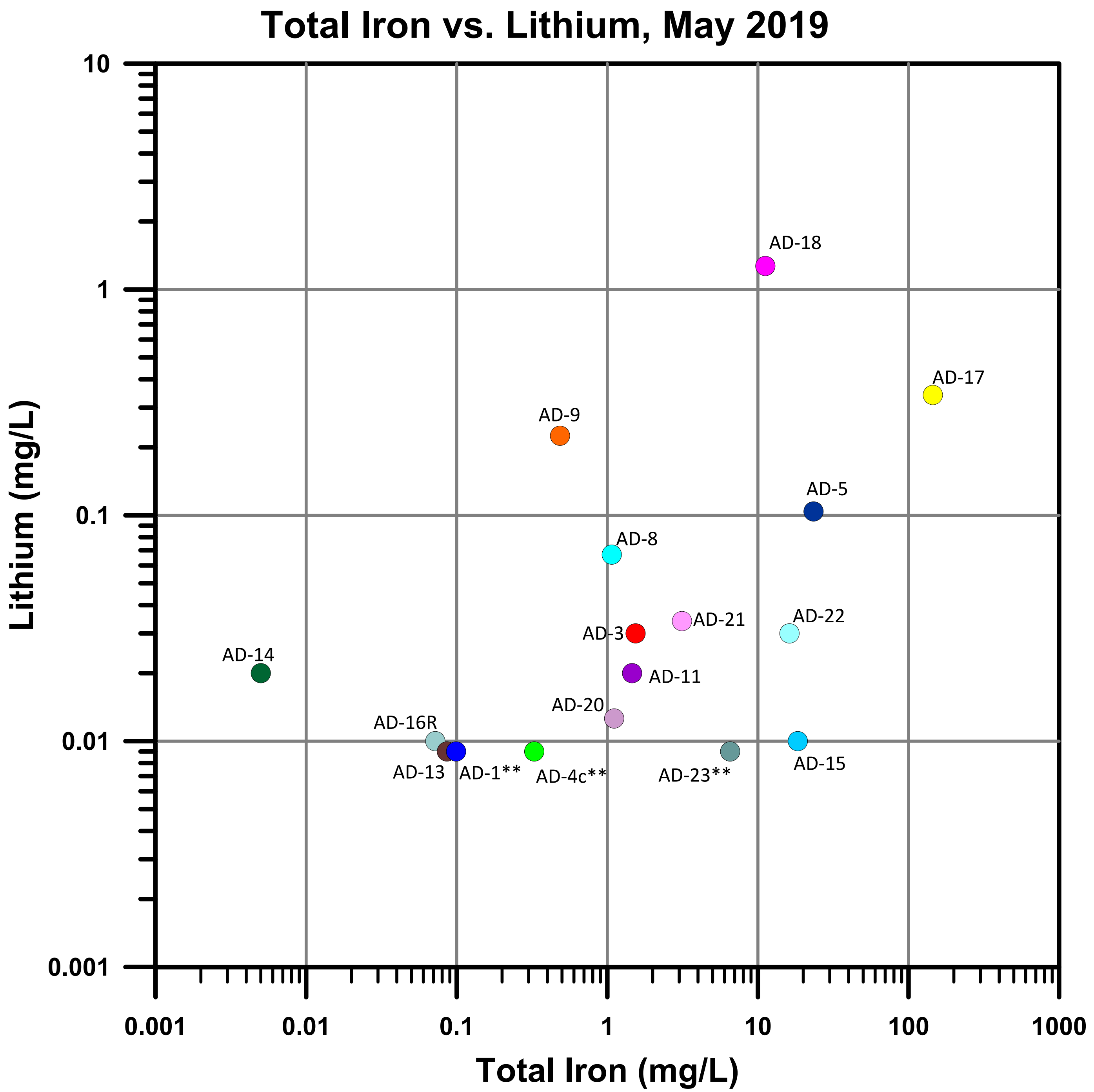
IRON CONCENTRATION IN GROUNDWATER (mg/L) MAY - JUNE 2019

ARCADIS Design & Consultancy for natural and built assets

FIGURE

4-5





Upgradient Wells

- ● AD-1
- ● AD-17
- ● AD-18
- ● AD-5
- ● AD-22 (installed Jun 2019)
- ● AD-23 (installed Jun 2019)

Downgradient Wells

- ● AD-10
- ● AD-11
- ● AD-13
- ● AD-14
- ● AD-15
- ● AD-16R
- ● AD-19
- ● AD-3
- ● AD-4c
- ● AD-8
- ● AD-9
- ● AD-20 (installed Oct 2018)
- ● AD-21 (installed Oct 2018)

Sidegradient Wells

- ● MW-9
- ● MW-10
- ● Temp-1

Notes:
TDS - total dissolve solids
mg/L - milligrams per liter
Concentrations of iron and lithium in coal ash were below detection
Concentrations of lithium in coal ash porewater were less than 0.02 mg/L
AD-22 and AD-23 groundwater concentrations are total only
*Iron was not detected, result is plotted at the reporting limit
**Lithium was not detected, result is plotted at the reporting limit

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

**IRON VS. LITHIUM
GROUNDWATER
CONCENTRATION PLOT**

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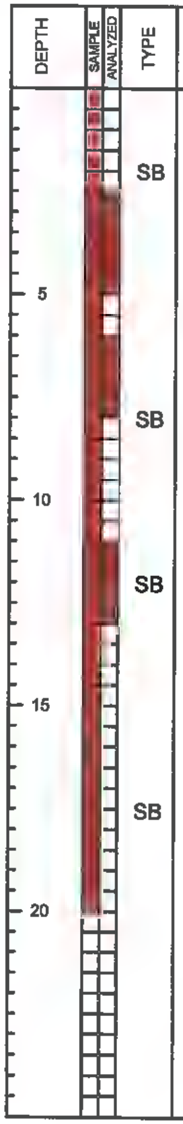
FIGURE
4-6

APPENDIX A

Monitoring Well Completion Diagrams – 2019 Monitoring Wells

WELL LOG



SAMPLE DESCRIPTION

(0-2.5') SAND (SP), BROWN, FINE GRAINED.

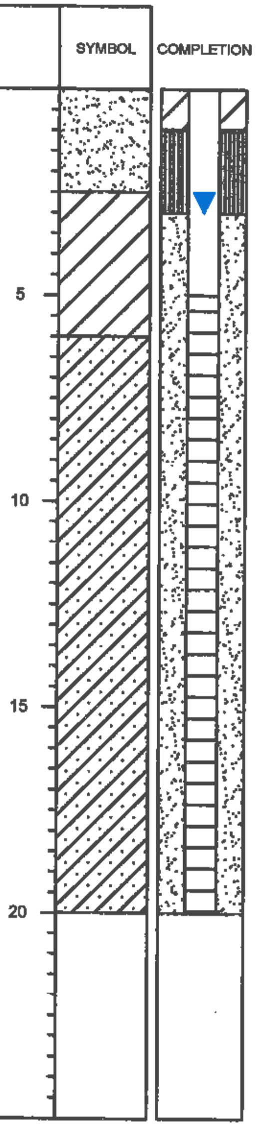
(2.5-6') SILTY CLAY (CL), GRAY WITH RED MOTTLING AND IRON NODULES.

(6-20') CLAYEY SAND (SC), GRAY WITH RED MOTTLING, FINE GRAINED, WET @ 9.5'.

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED PROFESSIONAL GEOSCIENTIST

8-7-19

TOTAL DEPTH = 20 FEET BGS



AD-22	WELL
AEP	CLIENT
TX015976.0004	PROJECT
WELSH POWER PLANT	LOCATION
6/18/19	DATE
HSA	DRILLING METHOD
2" PVC, 0-5' BGS	CASING
5-20' BGS, 2" PVC MILL-SLOT	SCREEN
0-1' BGS	CEMENT
1-3' BGS	BENTONITE
3-20' BGS	SAND PACK
360.94' / 360.22'	GROUND ELEV. / TOP OF CASING ELEV.

CT - CUTTINGS
SB - SPLIT BARREL (5')
SS - SPLIT SPOON (2')

▽ HC LEVEL
▼ WATER LEVEL

▨ SAND
▨ SILT
▨ CLAY
▨ FILL/CONCRETE
▨ BENTONITE
▨ GRAVEL

PAGE 1 OF 1

711 N. CARANCAHUA, #1080
CORPUS CHRISTI, TEXAS 78401
TEL: (361) 883-1353 FAX: (361) 883-7565

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STATE OF TEXAS WELL REPORT for Tracking #515172

Owner:	**AEP**	Owner Well #:	**AD-22**
Address:	**1187 County Road 4865 Pittsburg, TX 75686**	Grid #:	**16-58-4**
Well Location:	**FM 1735 Pittsburg, TX 75686**	Latitude:	**33° 03' 35" N**
	In ROW along west side of FM 1735, WNW of the AEP - Welsh Plant	Longitude:	**094° 51' 09" W**
		Elevation:	**No Data**
Well County:	**Titus**		
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **6/18/2019** Drilling End Date: **6/18/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**7.25**	**0**	**20**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Screened**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**0**	**1**	**Concrete**
	1	**3**	**Bentonite**
	3	**20**	**Sand**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

	Strata Depth (ft.)	*Water Type*
Water Quality:	**No Data**	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **WEST Drilling**

101 Industrial Drive
Waxahachie, TX 75165

Driller Name: **Robert Williams** License Number: **59501**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	*Bottom (ft.)*	*Description*
0	**2.5**	**brown sand**
2.5	**6**	**gray and red, mottled, silty clay with Fe nodules**
6	**20**	**gray, clayey sand**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	*Type*	*Material*	*Sch./Gage*	*Top (ft.)*	*Bottom (ft.)*
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**5**
2	**Screen**	**New Plastic (PVC)**	**40** **0.010**	**5**	**20**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

WELL LOG

DEPTH | SAMPLE ANALYZED | TYPE | SAMPLE DESCRIPTION | SYMBOL | COMPLETION

SB
(0-1') SAND (SP), BROWN, FINE GRAINED.
(1-6') CLAYEY SAND (SC), BROWN TO RED.

SB
(6-10') SILTY CLAY (CL), GRAY WITH RED MOTTLING AND IRON NODULES.

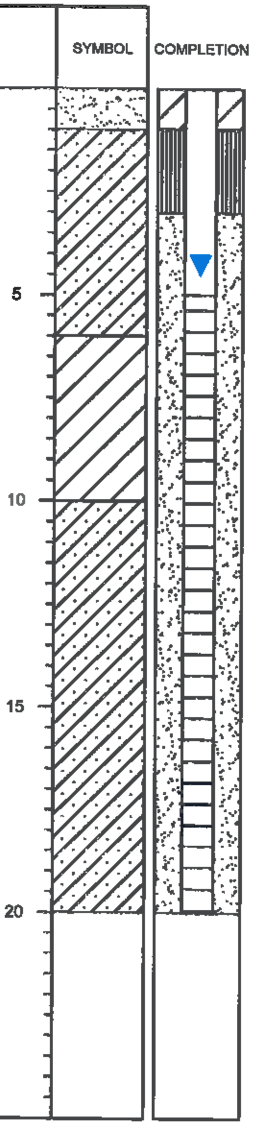
SB
(10-20') CLAYEY SAND (SC), REDDISH-BROWN, FINE GRAINED, WET @ 10'.

SB

Kenneth J. Brandner
Geology
1787
STATE OF TEXAS
PROFESSIONAL LICENSED GEOSCIENTIST

Kenneth J. Brandner
8-7-19

TOTAL DEPTH = 20 FEET BGS



AD-23
WELL

AEP
CLIENT

TX015976.0004
PROJECT

WELSH POWER PLANT
LOCATION

6/18/19
DATE

HSA
DRILLING METHOD

2" PVC, 0-5' BGS
CASING

5-20' BGS, 2" PVC MILL-SLOT
SCREEN

0-1' BGS
CEMENT

1-3' BGS
BENTONITE

3-20' BGS
SAND PACK

369.37' / 368.82'
GROUND ELEV. / TOP OF CASING ELEV.

CT - CUTTINGS
SB - SPLIT BARREL (5')
SS - SPLIT SPOON (2')

▽ HC LEVEL
▼ WATER LEVEL

▨ SAND	▨ FILL/CONCRETE
▥ SILT	▨ BENTONITE
▨ CLAY	▨ GRAVEL

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CORPUS CHRISTI, TEXAS 78401
TEL: (361) 883-1353 FAX: (361) 883-7565
ARCADIS Design & Consultancy for natural and built assets

STATE OF TEXAS WELL REPORT for Tracking #515173

Owner: **AEP**

Address: **1187 County Road 4865**
Pittsburg, TX 75686

Well Location: **FM 1735**
Pittsburg, TX 75686

In ROW along west side of FM 1735, WNW of the AEP - Welsh Plant

Well County: **Titus**

Owner Well #: **AD-23**

Grid #: **16-58-4**

Latitude: **33° 03' 56" N**

Longitude: **094° 51' 08" W**

Elevation: **No Data**

Type of Work: **New Well**

Proposed Use: **Monitor**

Drilling Start Date: **6/18/2019** Drilling End Date: **6/18/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**7.25**	**0**	**20**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Screened**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**0**	**1**	**Concrete**
	1	**3**	**Bentonite**
	3	**20**	**Sand**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed**

Surface Completion by Driller

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

	Strata Depth (ft.)	Water Type
Water Quality:	**No Data**	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **WEST Drilling**

101 Industrial Drive
Waxahachie, TX 75165

Driller Name: **Robert Williams** License Number: **59501**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	1	brown sand
1	6	gray and red, clayey sand
6	10	gray and red, mottled, silty clay with Fe nodules
10	20	reddish brown, clayey sand

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	Riser	New Plastic (PVC)	40	0	5
2	Screen	New Plastic (PVC)	40 0.010	5	20

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

APPENDIX B

Springs of Texas Reference

Springs of Texas

VOLUME I

Gunnar Brune

Manufactured in the United States of America

Second edition

The publisher gratefully acknowledges those whose grants helped make this edition possible:

Texas Parks and Wildlife Department
Lower Colorado River Authority
Wray Charitable Trust
Save Barton Creek Association
College of Agriculture and Life Sciences,
Texas A&M University

Library of Congress Cataloging-in-Publication Data

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GB1198.3T4 B78 2002
333.91'04'09764—dc21
2002017373

INTRODUCTION TO THE SECOND EDITION

Helen C. Besse

When Gunnar Brune self-published *Springs of Texas, Volume I*, in 1981, most of the state water planning agencies and local environmental communities either did not recognize the importance of his work or were not aware of its existence. Brune had spent the previous decade conducting research and field studies, and then writing this book that describes the physical characteristics of springs, the archeology and history of springs' use, the ecological setting of springs, and the local use and lore surrounding springs for 183 out of 254 Texas counties. Gunnar Brune died before he could complete volume II.

Gunnar Brune described many of the large springs across the state as well as innumerable small springs present along river and stream courses that provide the base flow for waterways across the state. Brune repeatedly stated in the 1981 edition of this book that many of the springs he described had failed or were failing. With the pronounced influx of population in the last twenty years and the increased agricultural and industrial activities around the state, one can only wonder how many of the more than 2,000 springs have gone dry since he described them through the 1970s.

Nevertheless, this book is even more important today. Its value to water planners, elected officials, policy makers, municipal, county, and state administrators, wildlife stewards, environmentalists, and water lovers has not diminished. Springs are "the canary in the coal mine." The health of our springs reflects the health of our underground water resources and is seen in the state's surface resources as well.

In the section "The Prehistoric Setting of Springs," Brune provided a quote from another book on the beliefs that early Americans had about springs. It is appropriate to repeat those words here:

> Gods and heroes were born out of springs, and they alternately came and went between the above and below worlds through their pools. Every pueblo had sacred springs somewhere nearby. There was every reason to sanctify them – physical, as life depended upon water; spiritual, as they had natural mystery which suggested supernatural qualities; for how could it be that when water fell as rain, or as snow, and ran away, or dried up, there should be other water which came and came, secretly and sweetly, out of the ground and never failed (Horgan, 1954).

F. Halley's farm. According to Dr. John Klein, a nearby resident and writer, the Klein settlement began here in 1848. The Sellars store was at the springs. They issued from Montgomery silt with many iron concretions at about 0.72 lps on April 11, 1978. The pools, containing duckweed, pennywort, and water primrose, were home to a family of ducks and ducklings. Probably the flow formerly continued down Spring Gully past Klein cemetery, 0.6 kilometer downstream, but on this date, even after rains, the channel here was dry except for some standing water. Many wells pump nearby.

Magnolia Garden Springs (15) are four kilometers northeast of Sheldon along the San Jacinto River. At Martha Dempsey's Good Times marina several very small springs trickle from Deweyville sand, including one which flows 0.15 lps from a pipe. Near the entrance to the nearby Magnolia Gardens marina, according to Jean Manson, springs flowed until about 1923. They are quite dry now. Very small springs are said to feed Simms Lake, across the river and 0.6 kilometer farther east. This formerly popular swimming hole is now closed to the public.

At Beaumont Place northeast of Houston, near the intersection of Highways 90 and 526, is another Spring Gully. The channel is now a drainage ditch into which very small springs and seeps (14) drain from Beaumont silt and sand.

Eight kilometers west of La Porte is Willow Springs Bayou, also called Willow Springs Gully or Ditch. **Willow Springs (8)** are chiefly between North L Street and Spencer Road. On April 9, 1978, the discharge of Willow Springs Bayou at North L Street was 0.18 lps, and at Spencer Road it was 0.70 lps. Many willows still fringe the channel, along with cattails.

A third Spring Gully is located eight kilometers southwest of La Porte. Springs (9) in Beaumont silt produced a discharge of about 0.18 lps in 1978 in the gully at the Red Bluff road crossing. Cottonmouths hide here among the willows and cattails.

HARRISON COUNTY

Harrison County is endowed with numerous springs of all types, some highly mineralized and valued for their healing properties. Most appear to be flowing as strongly as ever, because there has been little demand on the groundwater reservoirs. However, water levels in the artesian sands are declining as much as 4.6 meters per year in some areas. Most of the Caddo Indian villages were located at springs. Early French and Spanish explorers, some over 400 years ago, visited many of the same springs that can be seen today. The New Madrid earthquake of 1811 - 1812, which enlarged Caddo Lake, may have affected the flow of some springs. In general, however, the water-bearing formations were not greatly affected by the quake.

Most of the spring waters of the county issue from Eocene sands. They are usually fresh, soft, and acid, being of the sodium bicarbonate type. The iron content is often very high. Mineralized waters may also be high in aluminum and sulfate, may be slightly saline, and can be very hard. The analyses shown for 1942 in the table of Selected Chemical Analyses are probably too low in dissolved-solids content, perhaps because of high rainfall at the time the samples were collected. Most of the writer's field studies were made on January 23 - 28, 1976.

It was around **Locke Springs (1)** that the community of Marshall first appeared. In 1831 there were at least 20 springs flowing from the Reklaw sand near the intersection of Franklin and Houston Streets and up the hill toward the courthouse. In early times water was hauled from these springs in barrels to fill the cisterns on the town square. Most of the springs have now been paved over, but the remaining ones still flowed 1.4 liters per second in 1976.

Hynson Springs (10), also known as **Marshall**, **Noonday Camp**, and **Iron Springs**, are six kilometers north of Hallsville. They became very popular as a health resort about 1851. The waters are highly mineralized, containing much iron, sulfur, aluminum, and lithium. Originally there were said to be over 100 springs flowing from Queen City sand. Now not more than 20 can be found, possibly because the water table has fallen. During the Civil War the water from the springs was used in a leather-tanning factory. From 1891 to 1905 the large Hotel Randall accommodated thousands of visitors to the springs. Today there are an open-air auditorium and a number of cabins, but everything is in a sad state of disrepair. A historical marker is located at the springs. The discharge record, in liters per second, is as follows:

Jan. [illegible], 1942	[illegible]	
[illegible], 1964	[illegible]	
Jan. [illegible], 1976	[illegible] (main spring)	1.4 (all springs)

Rock Springs (7) are just east of the Rock Springs church on Highway 449 about 13 kilometers west of Marshall. This and several other springs upstream flowed 2.3 lps from the Queen City sand in 1976. The Frenchman Henri Joutel of La Salle's party may have stopped here for refreshment in 1687.

Mulberry Springs (9), nine kilometers south-southwest of Harleton, are 100 meters north of the

APPENDIX IV

Notices of groundwater monitoring programs are included in this appendix.

SOUTHWESTERN ELECTRIC POWER COMPANY

An AEP Company

BOUNDLESS ENERGY

NOTE:
Pulled from the OR because ASD was completed w/in 30 days of SSL negating the need for placing this notification into the OR.

Welsh Power Plant

Notice of Statistically Significant Levels (SSLs) above the Groundwater Protection Standard (GWPS)

CCR Unit – Primary Bottom Ash Pond

As required by 40 CFR 257.95(g), this is a notification that on January 8, 2019 lithium was detected at an SSL above the GWPS. This notification is being placed in the plant's operating record, as required by 40 CFR 257.105(h)(8).

SOUTHWESTERN
ELECTRIC POWER
COMPANY
An AEP Company
BOUNDLESS ENERGY

Welsh Power Plant

Notice of Statistically Significant Levels (SSLs) above the Groundwater Protection Standard (GWPS)

CCR Unit – Primary Bottom Ash Pond

As required by 40 CFR 257.95(g), this is a notification that on July 11, 2019 lithium was detected at an SSL above the GWPS. This notification is being placed in the plant's operating record, as required by 40 CFR 257.105(h)(8).

APPENDIX V- NA

Reports documenting monitoring well plugging and abandonment or well installation are included in the appendix.

Annual Groundwater Monitoring Report

Southwestern Electric Power Company
J. Robert Welsh Power Plant

Bottom Ash Storage Pond CCR Management Unit

1187 Country Road 4865
Titus County
Pittsburg, Texas

January 2020

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

Page

Table of Contents

I. Overview

This *Annual Groundwater Monitoring Report* (Report) has been prepared to report the status of activities for the preceding year for an existing CCR unit at Southwestern Electric Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), J. Robert Welsh Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31, 2020.

In general, the following activities were completed:

- Semi-Annual groundwater samples were collected and analyzed for detection monitoring Appendix III constituents, as specified in 40 CFR 257.94 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan (2016)*;
- Groundwater Monitoring Statistical Evaluation Reports to evaluate groundwater data were prepared in accordance with 40 CFR 257.93 and certified. The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance", USEPA, 2009);
- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Statistically significant increases (SSI) were determined for Chloride and Sulfate in AD-4C and Chloride in AD-3.
- Successful alternate source demonstrations (ASDs) were conducted for the SSIs;
- This CCR Unit remained in Detection Monitoring during 2019.

The major components of this annual report, to the extent applicable at this time, are presented in sections that follow:

- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers;
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened;
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs is included in Appendix I;
- Statistically reports are located in Appendix II;
- ASDs are located in Appendix III;

- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring, in addition to notification identifying the constituents detected at a statistically significant increase over background concentrations (Appendix IV);
- Other information required to be included in the annual report such as program related notification or assessment of corrective measures, if applicable;

In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.

II. Groundwater Monitoring Well Locations and Identification Numbers

The figure that follows depicts the PE-certified groundwater monitoring network, the monitoring well locations and their corresponding identification numbers.

Bottom Ash Storage Pond Monitoring Wells	
Up Gradient	Down Gradient
AD-1	AD-3
AD-5	AD-4C
AD-17	AD-16R


AD5
Ash Pond Primary
AD-17
Clear Water Pond
Welsh Reservoir
Landfill
AD1
AD-16R
Bottom Ash Storage Pond
AD4c
AD3
AD2
0
450
900
SCALE IN FEET
Legend
Monitoring Well Location
Proposed Existing CCR Unit Downgradient Monitoring Well
Proposed Existing CCR Unit Upgradient Monitoring Well
Site Features
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS
MONITORING WELL NETWORK MAP - BOTTOM ASH STORAGE POND
ARCADIS
FIGURE
10

III. Monitoring Wells Installed or Decommissioned

During 2019, no monitoring wells were installed or decommissioned.

IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction and Discussion

Appendix I contains tables showing the groundwater quality data collected under 40 CFR 257.90 through 257.98. Static water elevation data from each monitoring event also are shown in Appendix I, along with the groundwater velocity, groundwater flow direction and potentiometric maps developed after each sampling event.

V. Statistical Evaluations Completed in 2018 and 2019

A SSI were determined for:

- Chloride in AD-4C during the 1st semi-annual 2018 groundwater sampling event.
- Sulfate in AD-4C during the 2nd semi-annual 2018 groundwater sampling event.
- Chloride in AD-3 during the 1st semi-annual 2019 groundwater sampling event.

The statistical evaluation for the 2nd semi-annual 2019 groundwater sampling event demonstrated no SSIs.

Mann-Whitney tests were completed to evaluate whether data from the detection monitoring events could be added to the existing background dataset. Where appropriate, the background datasets were updated, and UPLs and LPLs were recalculated.

Statistical reports are found in Appendix II.

VI. Alternate Source Demonstrations Completed in 2019

Alternate source investigations were conducted for:

- Chloride in AD-4C during the 1st semi-annual 2018 groundwater sampling event.
- Sulfate in AD-4C during the 2nd semi-annual 2018 groundwater sampling event.
- Chloride in AD-3 during the 1st semi-annual 2019 groundwater sampling event.

Successful ASDs were completed for all SSIs.

Those demonstrations are found in Appendix III.

VII. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency

As of this annual groundwater report, the CCR Unit remains in detection monitoring.

VIII. Other Information Required

The sampling frequency of twice per year will be maintained for the current monitoring program.

IX. Description of Any Problems Encountered in 2019 and Actions Taken

No significant problems were encountered.

X. A Projection of Key Activities for the Upcoming Year

Key activities for 2020 include:

- Detection monitoring on a twice per year schedule;
- Evaluation of the detection monitoring results from a statistical analysis viewpoint, looking for any SSIs;
- Responding to any new data received in light of CCR rule requirements;
- Preparation of the next annual groundwater report.

APPENDIX I

Tables follow, showing the groundwater monitoring data collected, the rate and direction of groundwater flow, and a summary showing the number of samples collected per monitoring well. The dates that the samples were collected also is shown.

Legend
- ⌖ Groundwater Monitoring Well
- → Approximate Groundwater Flow Direction
- — Groundwater Elevation Contour
- ▭ CCR Units

Notes
- Monitoring well coordinates and water level data (collected on February 20-21, 2019) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.
- AD-16 was replaced with AD-16R on 4/12/2017.

500 250 0 500
Feet

Groundwater Potentiometric Map
February 2019

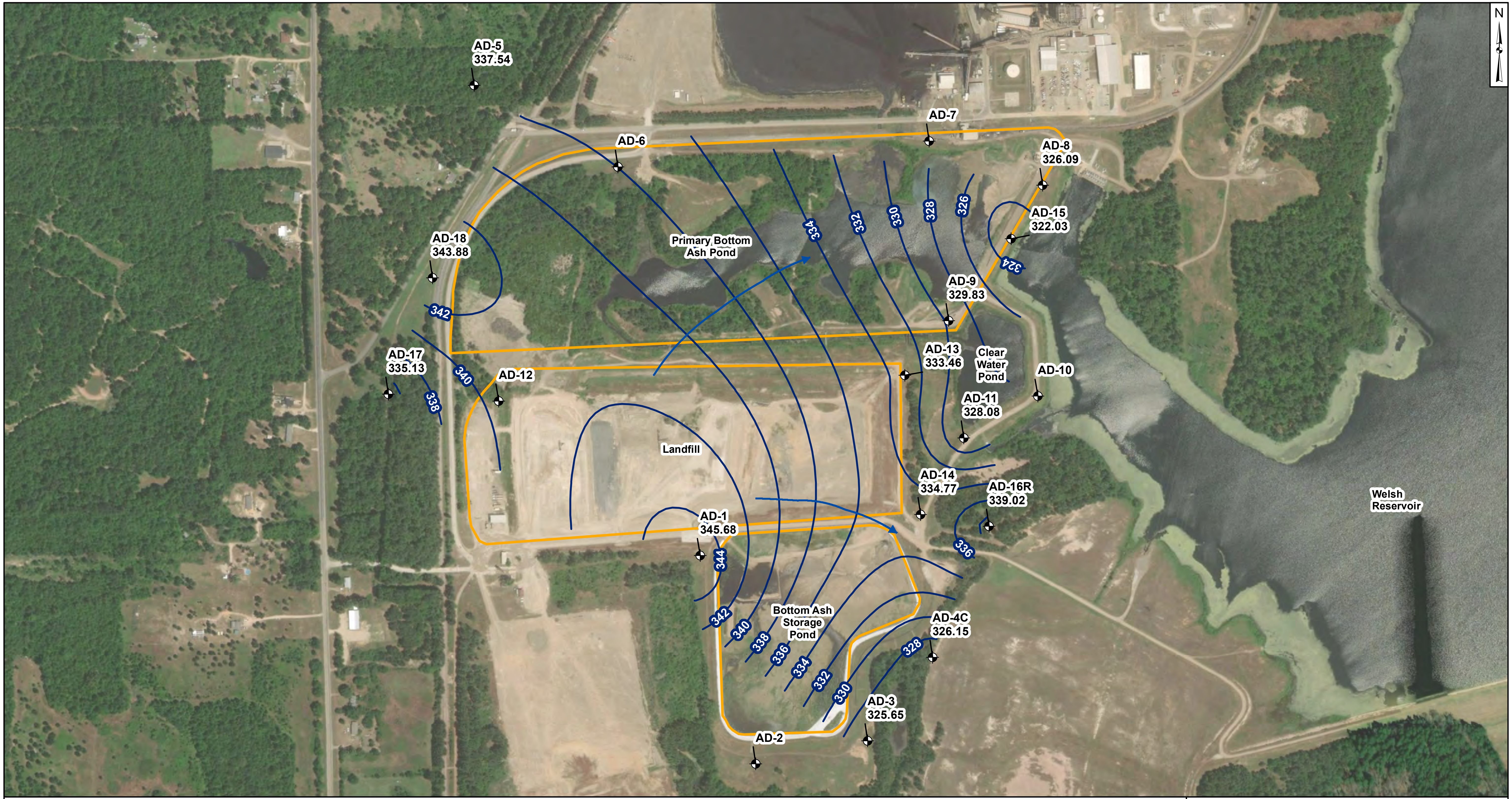
AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Figure
1

Columbus, Ohio
2020/01/22

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Welsh\2019\AEP-Welsh_GW_2019-20Feb.mxd. ARevezzo. 1/22/2020. CHA8423/14/08.



Legend
- ⯐ Groundwater Monitoring Well
- → Approximate Groundwater Flow Direction
- — Groundwater Elevation Contour
- ▭ CCR Units

Notes
- Monitoring well coordinates and water level data (collected on May 29-30, 2019) provided by AEP.
- AD-10, AD-6, AD-7, AD-2, and AD-12 were not gauged during this event
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.
- AD-16 was replaced with AD-16R on 4/12/2017.

750 375 0 750
Feet

Groundwater Potentiometric Map
May 2019

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Columbus, Ohio
2019/12/12

Figure
2

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Legend

- ⯐ Groundwater Monitoring Well
- ➞ Approximate Groundwater Flow Direction
- ― Groundwater Elevation Contour
- - - Groundwater Elevation Contour (Inferred)
- ▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on July 23-24, 2019) provided by AEP.
-AD-12 and AD-6 were not gauged during this event.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.
- Inferred groundwater contours were ectrapolated from topographic and hydrographic information as well as previous monitoring events.

750 375 0 750
Feet

Groundwater Potentiometric Map
July 2019

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Figure
3

Columbus, Ohio
2020/01/22

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Table 1: Residence Time Calculation Summary
Welsh Bottom Ash Storage Pond

			2019-02		**2019-04**[3]		**2019-05**		**2019-07**	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Bottom Ash Storage Pond	AD-1 [1]	2.0	2.7	22.4	NC	NC	5.3	11.5	4.1	14.9
	AD-3 [2]	2.0	4.9	12.4	0.5	127	5.7	10.7	5.1	11.9
	AD-4C [2]	2.0	4.0	15.3	0.5	127	5.2	11.6	4.2	14.4
	AD-5 [1]	2.0	1.5	40.2	NC	NC	2.4	25.4	2.1	29.2
	AD-16R [2]	2.0	3.7	16.3	3.7	16.4	6.5	9.4	4.6	13.3
	AD-17 [1]	2.0	8.9	6.9	NC	NC	4.7	13.0	3.5	17.5

Notes:

[1] - Upgradient Well

[2] - Downgradient Well

[3] - Upgradient wells were not gauged at the time of sampling, residence time estimates are based on available data.

NC - Not Calculated

Table 1 - Groundwater Data Summary: AD-1
Welsh - BASP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/26/2016	Background	0.346	36.5	5	<0.083 U	5.9	252	42
7/29/2016	Background	0.35	39.6	4	<0.083 U	5.3	239	36
9/30/2016	Background	0.332	15	5	<0.083 U	5.4	173	35
10/21/2016	Background	0.398	19.1	4	<0.083 U	5.2	192	42
12/14/2016	Background	0.394	8.74	4	<0.083 U	5.2	200	40
1/20/2017	Background	0.656	129	4	<0.083 U	7.1	538	68
2/24/2017	Background	0.7	147	9	<0.083 U	6.9	612	68
6/8/2017	Background	0.449	15.1	4	<0.083 U	5.1	176	42
10/6/2017	Detection	0.453	14.3	4	<0.083 U	5.3	160	40
5/24/2018	Detection	0.345	10.2	5	<0.083 U	2.2	150	43
8/14/2018	Detection	0.443	5.95	5	<0.083 U	5.2	160	44
2/20/2019	Detection	0.504	142	2.82	0.240	7.3	522	49.2
5/30/2019	*	0.689	138	1.59	0.290	6.7	588	43.3
7/24/2019	Detection	0.644	62.7	2	0.106 J	6.0	180	58

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
* Sample is not associated with a specific monitoring program but was included in the updated background dataset.

Table 1 - Groundwater Data Summary: AD-1
Welsh - BASP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/26/2016	Background	<0.93 U	1.39361 J	191	0.271453 J	0.213294 J	0.240267 J	1.15339 J	1.184	<0.083 U	<0.68 U	0.010	0.033	0.53149 J	1.74922 J	0.959865 J
7/29/2016	Background	<0.93 U	<1.05 U	191	0.315631 J	0.0940357 J	<0.23 U	0.615933 J	0.9952	<0.083 U	<0.68 U	0.019	0.00793 J	<0.29 U	1.81763 J	<0.86 U
9/30/2016	Background	<0.93 U	2.96797 J	141	0.382874 J	<0.07 U	5	0.850408 J	1.380	<0.083 U	3.38434 J	0.014	0.01773 J	<0.29 U	1.02629 J	<0.86 U
10/21/2016	Background	<0.93 U	<1.05 U	114	0.311247 J	<0.07 U	0.412131 J	0.649606 J	1.141	<0.083 U	<0.68 U	0.008	0.00534 J	1.39872 J	2.03168 J	1.25062 J
12/14/2016	Background	<0.93 U	<1.05 U	72	0.34133 J	<0.07 U	<0.23 U	0.424105 J	0.7190	<0.083 U	<0.68 U	0.008	0.01521 J	<0.29 U	1.85825 J	<0.86 U
1/20/2017	Background	<0.93 U	<1.05 U	410	0.0366913 J	<0.07 U	<0.23 U	0.480125 J	3.009	<0.083 U	<0.68 U	0.000275956 J	<0.005 U	<0.29 U	4.04737 J	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	488	<0.02 U	<0.07 U	<0.23 U	0.765099 J	4.309	<0.083 U	<0.68 U	0.001	<0.005 U	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	1.14 J	93.46	0.37 J	<0.07 U	0.66 J	0.77 J	0.6760	<0.083 U	<0.68 U	0.00902	0.007 J	<0.29 U	2.1 J	<0.86 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-3
Welsh - BASP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.02	1.41	9	<0.083 U	6.6	106	4
7/29/2016	Background	0.02	0.706	8	<0.083 U	6.7	118	5
9/30/2016	Background	0.02	< 0.5 U	9	<0.083 U	4.8	127	6
10/21/2016	Background	0.06	0.794	8	<0.083 U	3.7	112	9
12/14/2016	Background	0.02	1.05	8	<0.083 U	4.7	138	11
1/20/2017	Background	0.02	0.746	9	<0.083 U	4.6	76.0	4
2/24/2017	Background	0.02	0.573	9	<0.083 U	4.7	104	5
6/8/2017	Background	0.03326	0.543	9	0.2625 J	4.5	104	5
10/6/2017	Detection	0.02055	0.908	9	<0.083 U	5.2	114	7
5/24/2018	Detection	0.0069 J	0.545	8	<0.083 U	4.4	98.0	3
11/13/2018	Detection	0.009 J	0.684	8.0	<0.083 U	5.2	114	4.05
2/20/2019	Detection	0.01 J	0.817	9.40	0.13	4.8	110	1.9
4/30/2019	Detection	0.007	- -	9.34	- -	4.1	- -	- -
5/30/2019	*	<0.02 U	3.02	9.03	0.18	4.3	110	2.3
7/24/2019	Detection	<0.02 U	1.35	7	0.09 J	4.6	116	6

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
* Sample is not associated with a specific monitoring program but was included in the updated background dataset.

Table 1 - Groundwater Data Summary: AD-3
Welsh - BASP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	<0.93 U	1.56793 J	53	0.286352 J	<0.07 U	0.464721 J	1.49214 J	1.018	<0.083 U	<0.68 U	0.01	0.85	<0.29 U	0.995807 J	1.31537 J
7/29/2016	Background	3.21106 J	<1.05 U	36	0.349485 J	<0.07 U	0.515023 J	1.19046 J	0.183	<0.083 U	<0.68 U	0.024	0.589	1.43134 J	2.40188 J	<0.86 U
9/30/2016	Background	2.70729 J	2.61987 J	43	0.188596 J	0.0802799 J	0.659763 J	1.44845 J	0.552	<0.083 U	<0.68 U	0.019	0.39	<0.29 U	1.79734 J	<0.86 U
10/21/2016	Background	2.47184 J	1.97572 J	41	0.451723 J	0.277085 J	0.818782 J	1.53187 J	1.589	<0.083 U	<0.68 U	0.018	0.351	6	<0.99 U	<0.86 U
12/14/2016	Background	<0.93 U	<1.05 U	45	0.262387 J	<0.07 U	0.627352 J	1.34901 J	0.546	<0.083 U	<0.68 U	0.017	0.321	<0.29 U	<0.99 U	<0.86 U
1/20/2017	Background	<0.93 U	2.13113 J	41	0.235263 J	<0.07 U	0.647294 J	1.6345 J	0.350	<0.083 U	<0.68 U	0.014	0.504	<0.29 U	<0.99 U	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	37	0.209151 J	<0.07 U	<0.23 U	1.1537 J	0.4592	<0.083 U	<0.68 U	0.014	0.501	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	1.91 J	38	0.24 J	0.08 J	0.75 J	1.28 J	0.459	0.2625 J	<0.68 U	0.01503	0.365	<0.29 U	<0.99 U	<0.86 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-4C
Welsh - BASP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.05	0.798	10	<0.083 U	5.4	204	32
7/29/2016	Background	0.03	0.666	12	<0.083 U	5.5	208	35
9/30/2016	Background	0.02	<0.5 U	11	<0.083 U	5.0	212	45
10/21/2016	Background	0.04	0.578	10	<0.083 U	4.3	212	35
12/14/2016	Background	0.02	0.341	11	<0.083 U	4.6	252	36
1/20/2017	Background	0.02	0.761	10	<0.083 U	4.7	184	43
2/24/2017	Background	0.02	0.467	9	<0.083 U	5.1	196	40
6/8/2017	Background	0.03331	0.573	10	<0.083 U	4.9	228	39
10/6/2017	Detection	0.02565	0.654	11	<0.083 U	5.4	226	44
5/24/2018	Detection	0.02505	0.434	14	<0.083 U	5.2	224	42
8/14/2018	Detection	- -	- -	15	- -	5.0	- -	- -
11/13/2018	Detection	0.01 J	0.609	7.5	<0.083 U	5.8	220	56
12/18/2018	Detection	- -	- -	- -	- -	4.9	- -	58
2/20/2019	Detection	0.01 J	0.931	9.18	0.1 J	5.2	242	60.1
4/30/2019	Detection	0.014	- -	- -	- -	4.8	- -	56.2
5/30/2019	*	<0.02 U	0.564	14.8	0.16	4.6	208	52.8
7/24/2019	Detection	<0.02 U	0.586	13	<0.083 U	3.9	284	52

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
* Sample is not associated with a specific monitoring program but was included in the updated background dataset.

Table 1 - Groundwater Data Summary: AD-4C
Welsh - BASP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	<0.93 U	<1.05 U	88	0.407928 J	<0.07 U	9	1.19093 J	1.289	<0.083 U	<0.68 U	0.004	0.191	<0.29 U	1.12526 J	<0.86 U
7/29/2016	Background	<0.93 U	<1.05 U	59	0.335947 J	<0.07 U	4	0.852951 J	0.571	<0.083 U	<0.68 U	0.015	0.185	1.09296 J	2.52271 J	<0.86 U
9/30/2016	Background	<0.93 U	1.51249 J	74	0.274296 J	<0.07 U	8	0.986752 J	2.572	<0.083 U	<0.68 U	0.006	0.16	<0.29 U	1.95938 J	<0.86 U
10/21/2016	Background	<0.93 U	1.74748 J	69	0.347477 J	0.0809157 J	9	1.08565 J	1.657	<0.083 U	<0.68 U	0.006	0.141	3.20217 J	1.18291 J	<0.86 U
12/14/2016	Background	<0.93 U	2.24683 J	21	0.133622 J	<0.07 U	0.944028 J	0.305391 J	0.685	<0.083 U	<0.68 U	0.004	0.143	<0.29 U	1.27423 J	<0.86 U
1/20/2017	Background	<0.93 U	1.85604 J	75	0.221609 J	<0.07 U	4	1.02773 J	2.045	<0.083 U	<0.68 U	0.005	0.125	<0.29 U	<0.99 U	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	30	0.102645 J	<0.07 U	0.421354 J	0.364739 J	0.517	<0.083 U	<0.68 U	0.004	0.098	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	1.19 J	51.42	0.19 J	0.08 J	4.03	0.75 J	0.953	<0.083 U	<0.68 U	0.00482	0.147	<0.29 U	<0.99 U	<0.86 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-5
Welsh - BASP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.03	36.9	15	0.3469 J	6.4	337	123
7/29/2016	Background	0.04	44.7	16	<0.083 U	5.4	360	163
9/30/2016	Background	0.04	46.3	15	0.2436 J	5.3	416	190
10/21/2016	Background	0.05	50.7	14	<0.083 U	5.9	448	267
12/14/2016	Background	0.05	49.6	13	<0.083 U	6.2	484	233
1/20/2017	Background	0.04	49.8	14	<0.083 U	6.3	438	234
2/24/2017	Background	0.04	33	15	<0.083 U	5.5	286	127
6/8/2017	Background	0.05281	49.7	14	<0.083 U	6.0	300	82
10/6/2017	Detection	0.04322	33.1	16	<0.083 U	5.6	258	82
5/24/2018	Detection	0.05007	28.1	22	<0.083 U	6.2	242	60
8/15/2018	Detection	0.050	40.5	19	<0.083 U	6.2	428	240
2/21/2019	Detection	0.033	33.9	24.7	0.210	5.4	220	46.5
5/30/2019	*	0.03 J	30.0	22.3	0.290	6.3	238	51.3
7/24/2019	Detection	0.04 J	41.1	18	0.112 J	6.3	354	90

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
* Sample is not associated with a specific monitoring program but was included in the updated background dataset.

Table 1 - Groundwater Data Summary: AD-5
Welsh - BASP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	<0.93 U	<1.05 U	57	0.149801 J	0.0765156 J	0.555038 J	14	1.634	0.3469 J	<0.68 U	0.135	0.01135 J	<0.29 U	<0.99 U	<0.86 U
7/29/2016	Background	2.05116 J	2.90819 J	93	0.518653 J	0.502155 J	0.411466 J	15	4.750	<0.083 U	<0.68 U	0.191	0.01516 J	<0.29 U	1.08901 J	<0.86 U
9/30/2016	Background	<0.93 U	4.7609 J	87	0.251584 J	<0.07 U	0.90676 J	14	3.330	0.2436 J	<0.68 U	0.186	<0.005 U	<0.29 U	<0.99 U	<0.86 U
10/21/2016	Background	<0.93 U	<1.05 U	70	0.08781 J	0.107488 J	0.248085 J	9	2.319	<0.083 U	<0.68 U	0.225	<0.005 U	1.36984 J	<0.99 U	<0.86 U
12/14/2016	Background	<0.93 U	1.15381 J	53	0.164529 J	0.203546 J	0.747921 J	13	2.182	<0.083 U	<0.68 U	0.199	0.00802 J	<0.29 U	<0.99 U	<0.86 U
1/20/2017	Background	<0.93 U	<1.05 U	47	0.0574718 J	0.180502 J	<0.23 U	12	1.023	<0.083 U	<0.68 U	0.239	<0.005 U	<0.29 U	<0.99 U	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	42	0.0306858 J	<0.07 U	<0.23 U	13	1.788	<0.083 U	<0.68 U	0.166	<0.005 U	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	3.85 J	87.7	0.08 J	0.39 J	0.28 J	11.93	2.320	<0.083 U	<0.68 U	0.124	<0.005 U	<0.29 U	<0.99 U	<0.86 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-16R
Welsh - BASP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/8/2017	Background	0.04198	2.75	7	0.3438 J	3.7	204	54
6/28/2017	Background	0.06398	1.24	6	0.2512 J	3.9	200	55
7/7/2017	Background	0.02699	2.07	36	<0.083 U	3.4	184	52
7/14/2017	Background	0.04415	2.39	6	0.2516 J	3.5	160	44
7/24/2017	Background	0.03237	2.5	7	0.2615 J	3.5	180	54
8/1/2017	Background	0.02841	1.92	7	<0.083 U	2.8	162	48
8/2/2017	Background	0.03177	1.86	7	<0.083 U	3.0	174	49
8/11/2017	Background	0.06192	1.83	8	<0.083 U	4.1	164	44
8/18/2017	Background	0.0304	1.44	7	<0.083 U	3.4	160	46
9/1/2017	Background	0.02841	1.33	7	<0.083 U	3.9	152	63
10/6/2017	Detection	0.04672	0.896	7	<0.083 U	3.3	152	82
1/18/2018	Detection	- -	- -	- -	- -	4.0	- -	58.6
5/23/2018	Detection	0.03202	2.53	6	<0.083 U	3.8	204	67
8/14/2018	Detection	- -	- -	- -	- -	3.9	- -	44
11/13/2018	Detection	0.02 J	0.467	6.5	<0.083 U	5.6	186	54
2/20/2019	Detection	0.03 J	2.00	6.78	0.20	4.7	200	52.8
4/30/2019	Detection	0.015	- -	- -	- -	3.9	- -	- -
5/30/2019	*	<0.02 U	1.36	5.43	0.19	3.9	80	41.6
7/24/2019	Detection	0.03 J	1.50	7	0.13 J	3.6	250	70

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
* Sample is not associated with a specific monitoring program but was included in the updated background dataset.

Table 1 - Groundwater Data Summary: AD-16R
Welsh - BASP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/8/2017	Background	<0.93 U	7.07	46.4	2.21	1.03	1.76	41.74	6.66	0.3438 J	<0.68 U	0.0293	<0.005 U	<0.29 U	1.98 J	<0.86 U
6/28/2017	Background	<0.93 U	5.28	41.43	2.16	0.92 J	0.95 J	40.87	12.11	0.2512 J	<0.68 U	0.02932	<0.005 U	<0.29 U	<0.99 U	<0.86 U
7/7/2017	Background	<0.93 U	4.13 J	44.56	2.08	0.97 J	1.44	41.75	25.16	<0.083 U	<0.68 U	0.02846	<0.005 U	<0.29 U	2.09 J	1.2 J
7/14/2017	Background	<0.93 U	6.31	54.35	2.01	1.09	0.84 J	37.88	9.12	0.2516 J	<0.68 U	0.02391	0.009 J	<0.29 U	<0.99 U	<0.86 U
7/24/2017	Background	<0.93 U	3.88 J	51.06	2.09	1.02	1.43	40.86	9.81	0.2615 J	<0.68 U	0.02653	<0.005 U	<0.29 U	1 J	<0.86 U
7/28/2017	Background	- -	- -	- -	- -	- -	- -	- -	8.52		- -	- -	- -	- -	- -	- -
8/1/2017	Background	<0.93 U	3.7	48.51	2.17	1.28	1.07	45.33	- -	<0.083 U	<0.68 U	0.02617	0.006 J	<0.29 U	1.27 J	1.43 J
8/2/2017	Background	<0.93 U	4.46 J	49.61	2.06	1.22	0.95 J	43.11	5.45	<0.083 U	<0.68 U	0.02498	<0.005 U	<0.29 U	1.74	2.02
8/11/2017	Background	<0.93 U	4.93 J	47.52	1.89	1.13	0.96 J	40.37	5.78	<0.083 U	<0.68 U	0.02347	0.008 J	<0.29 U	1.36 J	<0.86 U
8/18/2017	Background	<0.93 U	2.35 J	43.85	1.91	1.08	0.8 J	40.05	5.56	<0.083 U	<0.68 U	0.02466	0.009 J	<0.29 U	<0.99 U	0.92 J
9/1/2017	Background	<0.93 U	2.12 J	44.14	1.75	1.04	1.18	37.56	6.68	<0.083 U	<0.68 U	0.02429	0.006 J	<0.29 U	<0.99 U	<0.86 U
5/30/2019	Detection	0.02 J	1.76	72.4	0.424	0.08	0.334	4.38	4.41	<0.083 U	0.06 J	0.01 J	- -	<0.4 U	0.6	0.2 J

Notes:

µg/L: micrograms per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

- -: Not analyzed

pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-17
Welsh - BASP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/26/2016	Background	0.121	200	43	0.4023 J	7.2	1810	1166
7/29/2016	Background	0.119	195	32	0.4135 J	5.7	1576	1005
9/30/2016	Background	0.111	191	36	0.3055 J	6.2	1663	1055
10/21/2016	Background	0.124	194	32	0.583 J	6.1	1612	1163
12/14/2016	Background	0.135	196	31	0.5399 J	6.0	1560	1096
1/20/2017	Background	0.101	196	33	<0.083 U	5.9	1686	1445
2/24/2017	Background	0.135	189	30	<0.083 U	5.7	1628	1055
6/8/2017	Background	0.121	188	30	<0.083 U	5.8	1578	1105
10/6/2017	Detection	0.183	183	31	<0.083 U	5.9	1548	1090
5/24/2018	Detection	0.239	193	39	<0.083 U	6.3	1836	1067
8/15/2018	Detection	0.118	187	40	<0.083 U	5.6	1748	1168
2/21/2019	Detection	0.151	207	43.2	0.18	6.9	1722	1060
5/30/2019	*	0.158	202	41.7	<0.04 U	6.1	1546	1120
7/24/2019	Detection	0.113	216	37	0.085 J	6.0	1864	1127

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
* Sample is not associated with a specific monitoring program but was included in the updated background dataset.

Table 1 - Groundwater Data Summary: AD-17
Welsh - BASP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/26/2016	Background	<0.93 U	1.37501 J	21	0.173275 J	2	1	63	1.525	0.4023 J	<0.68 U	0.37	0.032	<0.29 U	<0.99 U	<0.86 U
7/29/2016	Background	1.13716 J	<1.05 U	20	0.307264 J	4	1	68	2.78	0.4135 J	<0.68 U	0.374	0.02133 J	1.04115 J	4.56733 J	<0.86 U
9/30/2016	Background	<0.93 U	<1.05 U	31	0.175474 J	0.848199 J	3	58	2.358	0.3055 J	<0.68 U	0.354	<0.005 U	<0.29 U	<0.99 U	<0.86 U
10/21/2016	Background	<0.93 U	<1.05 U	34	0.200656 J	2	4	65	2.224	0.583 J	<0.68 U	0.394	<0.005 U	0.322249 J	3.34422 J	<0.86 U
12/14/2016	Background	<0.93 U	<1.05 U	17	0.0498325 J	3	0.816224 J	68	2.384	0.5399 J	<0.68 U	0.323	0.01485 J	<0.29 U	<0.99 U	<0.86 U
1/20/2017	Background	<0.93 U	<1.05 U	14	0.0319852 J	3	68	68	2.436	<0.083 U	<0.68 U	0.341	<0.005 U	<0.29 U	<0.99 U	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	20	0.0665729 J	2	1	73	2.288	<0.083 U	<0.68 U	0.331	<0.005 U	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	<1.05 U	10.3	<0.02 U	6.06	<0.23 U	74.8	1.598	<0.083 U	<0.68 U	0.329	0.013 J	<0.29 U	<0.99 U	<0.86 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

APPENDIX II

Where applicable, show in this appendix the results from statistical analyses, and a description of the statistical analysis method chosen. These statistical analyses are to be conducted separately for each constituent in each monitoring well.

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Memorandum

Date: January 11, 2019

To: David Miller (AEP)

Copies to: Jill Parker-Witt (AEP)

From: Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)

Subject: Evaluation of Detection Monitoring Data at Welsh Plant's Bottom Ash Storage Pond (BASP)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), the first semi-annual detection monitoring event detection at the Bottom Ash Storage Pond (BASP), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas, was completed on May 24, 2018. Based on the results, a two-of-two verification sampling was completed on August 14, 2018.

Eight background monitoring events were conducted at the Welsh BASP prior to these detection monitoring events, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 15, 2018. An alternative source demonstration (ASD) was certified on April 14, 2018 which resulted in a revision to the calculated prediction limits.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are compared in Table 1 and noted exceedances are described in the list below.

- Chloride concentrations exceeded the intrawell UPL of 12.6 mg/L in both the initial (14 mg/L) and second (15 mg/L) samples collected at AD-4C. Therefore, an SSI over background is concluded for chloride at AD-4C.

No other exceedances of UPLs were observed during these detection monitoring events.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). Within 90 days of identification of the above-listed SSIs, a written demonstration that a source other than the Welsh BASP caused the increases was completed in accordance with 40 CFR 257.94(e)(2). Thus, the Welsh BASP will remain in detection monitoring.

A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evaluation
Welsh Plant - Bottom Ash Storage Pond

Parameter	**Units**	**Description**	AD-3	AD-4C		AD-16R	
			5/24/2018	5/24/2018	8/14/2018	5/23/2018	8/14/2018
Boron	mg/L	Intrawell Background Value (UPL)	0.0333	0.0571		0.0700	
		Detection Monitoring Data	0.0069 J	0.0251	--	0.0320	--
Calcium	mg/L	Intrawell Background Value (UPL)	1.541	0.962		3.069	
		Detection Monitoring Data	0.545	0.434	--	2.53	--
Chloride	mg/L	Intrawell Background Value (UPL)	9	12.6		8.3	
		Detection Monitoring Data	8	**14**	**15**	6	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1	1		1	
		Detection Monitoring Data	<0.083	<0.083	--	<0.083	--
pH	SU	Intrawell Background Value (UPL)	7.63	5.91		4.4	
		Intrawell Background Value (LPL)	2.43	3.95		2.61	
		Detection Monitoring Data	4.38	5.17	--	3.79	--
Sulfate	mg/L	Intrawell Background Value (UPL)	12.4	49.0		64.1	
		Detection Monitoring Data	3	42	--	**67**	44
TDS	mg/L	Intrawell Background Value (UPL)	156	263		214	
		Detection Monitoring Data	98	224	--	204	--

Notes

UPL: Upper prediction limit

LPL: Lower prediction limit

TDS: Total dissolved solids

J: Estimated value

<: Indicates the parameter was not detected

Bold values exceed the background value.

Background values are shaded gray.

--: sample was not collected

ATTACHMENT A

Certification by Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Welsh BASP CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
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Memorandum

Date:	February 16, 2019
To:	David Miller (AEP)
Copies to:	Jill Parker-Witt (AEP)
From:	Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Welsh Plant's Bottom Ash Storage Pond (BASP)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), the second semi-annual detection monitoring event detection at the Bottom Ash Storage Pond (BASP), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas, was completed on November 13, 2018. Based on the results, a two-of-two verification sampling was completed on December 18, 2018 and January 11, 2019.

Eight to ten background monitoring events were conducted at the Welsh BASP prior to these detection monitoring events, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 15, 2018. An alternative source demonstration (ASD) was certified on April 14, 2018 which resulted in a revision to the calculated prediction limits.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are compared in Table 1 and noted exceedances are described in the list below.

- Sulfate concentrations exceeded the intrawell UPL of 49 mg/L in both the initial (56 mg/L) and second (58 mg/L) samples collected at AD-4C. Therefore, an SSI over background is concluded for Sulfate at AD-4C.

No other exceedances of UPLs were observed during these detection monitoring events.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). Within 90 days of identification of the above-listed SSIs, a written demonstration that a source other than the Welsh BASP caused the increases will be completed in accordance with 40 CFR 257.94(e)(2). If the ASD is successful, the Welsh BASP will remain in detection monitoring.

A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evaluation
Welsh Plant - Bottom Ash Storage Pond

Parameter	Units	Description	AD-3		AD-4C		AD-16R	
			11/13/2018	12/18/2018	11/13/2018	12/18/2018	11/13/2018	1/11/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.033		0.057		0.070	
		Detection Monitoring Result	0.009	-	0.010	-	0.020	-
Calcium	mg/L	Intrawell Background Value (UPL)	1.54		0.962		3.07	
		Detection Monitoring Result	0.684	-	0.609	-	0.467	-
Chloride	mg/L	Intrawell Background Value (UPL)	9.0		12.6		8.3	
		Detection Monitoring Result	8.0	-	7.5	-	6.5	-
Fluoride	mg/L	Intrawell Background Value (UPL)	1.00		1.00		1.00	
		Detection Monitoring Result	<0.083	-	<0.083	-	<0.083	-
pH	SU	Intrawell Background Value (UPL)	7.63		5.91		4.40	
		Intrawell Background Value (LPL)	2.43		3.95		2.61	
		Detection Monitoring Result	5.19	-	5.79	-	**5.57**	2.66
Sulfate	mg/L	Intrawell Background Value (UPL)	12.4		49		64	
		Detection Monitoring Result	4.05	-	**56**	**58**	54	-
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	156		263		214	
		Detection Monitoring Result	114	-	220	-	186	-

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
-: Not Sampled
Bold values exceed the background value.
Background values are shaded gray.
Based on a 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the calculated background

ATTACHMENT A
Certification by Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Welsh BASP CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

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Memorandum

Date: June 26, 2019

To: David Miller (AEP)

Copies to: Jill Parker-Witt (AEP)

From: Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)

Subject: Evaluation of Detection Monitoring Data at
Welsh Plant's Bottom Ash Storage Pond (BASP)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), the first semi-annual detection monitoring event at the Bottom Ash Storage Pond (BASP), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas, was completed on February 20, 2019. Based on the results, a two-of-two verification sampling was completed on April 30, 2019.

Eight to ten background monitoring events were conducted at the Welsh BASP prior to these detection monitoring events, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 15, 2018. An alternative source demonstration (ASD) was certified on April 14, 2018 which resulted in a revision to the calculated prediction limits. The calculated prediction limit for sulfate at AD-4C was also revised during a subsequent ASD which was certified on May 17, 2019. While another ASD was certified on January 7, 2019, the calculated prediction limits were not revised as part of that demonstration.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL (or are below the LPL for pH). In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are compared in Table 1 and noted exceedances are described in the list below.

- Chloride concentrations exceeded the intrawell UPL of 9.00 mg/L in both the initial (9.40 mg/L) and second (9.34 mg/L) samples collected at AD-3. Therefore, an SSI over background is concluded for chloride at AD-3.

No other exceedances of UPLs were observed during these detection monitoring events.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). Within 90 days of identification of the above-listed SSIs, a written demonstration that a source other than the Welsh BASP caused the increases will be completed in accordance with 40 CFR 257.94(e)(2). If the ASD is successful, the Welsh BASP will remain in detection monitoring.

A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evaluation
Welsh Plant - Bottom Ash Storage Pond

Parameter	Units	Description	AD-3		AD-4C		AD-16R	
			2/20/2019	4/30/2019	2/20/2019	4/30/2019	2/20/2019	4/30/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.0333		0.0571		0.0700	
		Detection Monitoring Data	0.01 J	0.0070	0.01 J	0.0140	0.03 J	**0.0150**
Calcium	mg/L	Intrawell Background Value (UPL)	1.54		0.962		3.07	
		Detection Monitoring Data	0.817	--	0.931	--	2.00	-
Chloride	mg/L	Intrawell Background Value (UPL)	9.00		12.6		8.30	
		Detection Monitoring Data	**9.40**	**9.34**	9.18	--	6.78	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1.0		1.0		1.0	
		Detection Monitoring Data	0.13	--	0.10	--	0.20	--
pH	SU	Intrawell Background Value (UPL)	7.6		5.9		4.4	
		Intrawell Background Value (LPL)	2.4		3.9		2.6	
		Detection Monitoring Data	4.8	4.1	5.2	4.8	**4.7**	3.9
Sulfate	mg/L	Intrawell Background Value (UPL)	12.4		59.1		64.1	
		Detection Monitoring Data	1.90	--	**60.1**	56.2	52.8	--
TDS	mg/L	Intrawell Background Value (UPL)	156		263		214	
		Detection Monitoring Data	110	--	242	--	200	--

Notes

UPL: Upper prediction limit

LPL: Lower prediction limit

TDS: Total dissolved solids

Bold values exceed the background value.

Background values are shaded gray.

ATTACHMENT A

Certification by Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Welsh BASP CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

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Memorandum

Date:	December 23, 2019
To:	David Miller (AEP)
Copies to:	Jill Parker-Witt (AEP)
From:	Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Welsh Plant's Bottom Ash Storage Pond (BASP)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), the second semi-annual detection monitoring event at the Bottom Ash Storage Pond (BASP), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas, was completed on July 24, 2019. Based on the results, a two-of-two verification sampling was completed on November 25, 2019 and on December 19, 2019.

Background values for the BASP were previously calculated in January 2018. After a minimum of four detection monitoring events, the results of those events were compared to the existing background and the dataset was updated as appropriate. Revised and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these revised background values are described in Geosyntec's *Statistical Analysis Summary* report, dated December 10, 2019.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL (or are below the LPL for pH). In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are compared in Table 1. No SSIs were observed at the Welsh BASP CCR unit, and as a result the Welsh BASP will remain in detection monitoring.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evalation
Welsh Plant - Bottom Ash Storage Pond

Parameter	Unit	Description	AD-16R		AD-3		AD-4C	
			7/24/2019	12/19/2019	7/24/2019	11/25/2019	7/24/2019	12/19/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.0638		0.0580		0.0529	
		Detection Monitoring Result	0.0300	-	0.0200	-	0.0200	-
Calcium	mg/L	Intrawell Background Value (UPL)	3.15		1.32		0.961	
		Detection Monitoring Result	1.50	-	**1.35**	0.734	0.586	-
Chloride	mg/L	Intrawell Background Value (UPL)	8.02		9.40		15.6	
		Detection Monitoring Result	7.00	-	7.00	-	13.0	-
Fluoride	mg/L	Intrawell Background Value (UPL)	1.00		1.000		1.000	
		Detection Monitoring Result	0.130	-	0.0900	-	0.0830	-
pH	SU	Intrawell Background Value (UPL)	5.0		6.6		5.8	
		Intrawell Background Value (LPL)	2.6		3.1		4.2	
		Detection Monitoring Result	3.6	**-**	4.6	**-**	**3.9**	4.7 on 11/25/19
Sulfate	mg/L	Intrawell Background Value (UPL)	73.2		10.6		63.7	
		Detection Monitoring Result	70.0	**-**	6.00	**-**	52.0	**-**
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	221		140		255	
		Detection Monitoring Result	**250**	134	116	**-**	**284**	226

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

Bold values exceed the background value.

Background values are shaded gray.

ATTACHMENT A

Certification by Qualified Professional Engineer

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I certify that the selected statistical method, described above and in the January 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Welsh BASP CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
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STATISTICAL ANALYSIS SUMMARY-
Background Update Calculations
Bottom Ash Storage Pond –
J. Robert Welsh Plant
Pittsburg, Texas

Submitted to

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December 10, 2019

CHA847

TABLE OF CONTENTS

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LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
ASD	Alternative Source Demonstration
BASP	Bottom Ash Storage Ponds
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Value
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
NELAP	National Environmental Laboratory Accreditation Program
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Bottom Ash Storage Ponds (BASP), an existing CCR unit at the J. Robert Welsh Power Plant located in Pittsburg, Texas.

A minimum of eight monitoring events were completed prior to October 2017 to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule. Four semiannual detection monitoring events were conducted between October 2017 and May 2019. Data from these four events, including both initial and verification results, and an additional event conducted in May 2019 were evaluated for inclusion in the background dataset. Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The detection monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. The compliance data were reviewed for outliers, with no values removed prior to updating upper prediction limits (UPLs) for each Appendix III parameter to represent background values. Oversight on the use of statistical calculations was provided by Dr. Jim Loftis, Professor Emeritus of Civil & Environmental Engineering at Colorado State University and Senior Advisor to Groundwater Stats Consulting.

SECTION 2

BOTTOM ASH STORAGE POND EVALUATION

2.1 Previous Background Calculations

Eight to ten background monitoring events were completed from May 2016 through September 2017 to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule. The data were reviewed for outliers and trends prior to calculating upper prediction limits (UPLs) for each Appendix III parameter. Lower prediction limits (LPLs) were also established for pH. Interwell prediction limits were selected for all parameters with a one-of-two resampling plan. Tests for pH were revised to intrawell prediction limits based on an alternative source demonstration (ASD) certified on April 13, 2018 (Geosyntec, 2018a). The statistical analyses to establish background levels were previously documented in the January 2018 *Statistical Analysis Summary* report (Geosyntec, 2018b).

2.2 Data Validation & QA/QC

Since October 2017, four semiannual detection monitoring events have been conducted at the BASP. If the initial results for each detection monitoring event identified possible exceedances, verification sampling was completed on an individual well/parameter basis. Thus, a minimum of four samples were collected from each compliance well. A summary of data collected during these detection monitoring events may be found in Table 1. Results for an additional event conducted in May 2019, which was also included in the update to background levels, is also provided in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.23 statistics software. The export was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.3 Statistical Analysis

The data used to conduct the statistical analyses described below are summarized in Table 1. Statistical analyses for the BASP were conducted in accordance with the January 2017 *Statistical*

Analysis Plan (AEP, 2017), except where noted below. The complete statistical analysis results are included in Attachment A.

Time series plots of Appendix III parameters are included in Attachment A and were used to evaluate concentrations over time and to provide an initial screening of suspected outliers and trends. Box plots were also compiled to provide visual representation of variations between wells and within individual wells (Attachment A).

2.3.1 Outlier Evaluation

Potential outliers were evaluated using Tukey's outlier test; i.e., data points were considered potential outliers if they met one of the following criteria:

$$x_i < \tilde{x}_{0.25} - 3 \times IQR \quad (1)$$

or

$$x_i > \tilde{x}_{0.75} + 3 \times IQR \quad (2)$$

where:

$x_i =$ individual data point
$\tilde{x}_{0.25} =$ first quartile
$\tilde{x}_{0.75} =$ third quartile
$IQR =$ the interquartile range $= \tilde{x}_{0.75} - \tilde{x}_{0.25}$

No potential outliers were identified in the data collected for the four most recent detection monitoring events.

2.3.2 Establishment of Updated Background Levels

Analysis of variance (ANOVA) was conducted during the initial background screening to assist in identifying if intrawell tests are the most appropriate statistical approach for assessing Appendix III parameters. Intrawell tests compare compliance data from a single well to background data within the same well and are most appropriate when 1) upgradient wells exhibit spatial variation; 2) when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; or 3) when downgradient water quality is not impacted compared to upgradient water quality for the same parameter. Periodic updating of background statistical limits is necessary as natural systems continuously change due to physical changes to the environment. For intrawell analyses, data for all wells and constituents are re-evaluated when a minimum of four new data points are available. These four (or more) new data points are used to determine if earlier concentrations are representative of present-day groundwater quality.

Mann-Whitney (Wilcoxon rank-sum) tests were used to compare the medians of historical data (May 2016 - September 2017) to the new compliance samples (October 2017 – May 2019).

Results were evaluated to determine if the medians of the two groups were similar at the 99% confidence level. Where no significant difference was found, the new compliance data were added to the background dataset. Where a statistically significant difference was found between the medians of the two groups, the data were reviewed to evaluate the cause of the difference and to determine if adding newer data to the background dataset, replacing the background dataset with the newer data, or continuing to use the existing background dataset was most appropriate. If the differences appeared to have been caused by a release, then the previous background dataset would have continued to be used.

The complete Mann-Whitney test results and a summary of the significant findings can be found in Appendix B. Significant differences were found between the two groups for chloride in upgradient well AD-5. However, because AD-5 is an upgradient monitoring well and more recent data are similar to background and better represent the groundwater quality upgradient of the facility, the background dataset was updated to include the compliance data for chloride at AD-5.

After the revised background set was established, a parametric or non-parametric analysis was selected based on the distribution of the data and the frequency of non-detect data. Estimated results less than the practical quantitation limit (PQL) – i.e., “J-flagged” data – were considered detections and the estimated results were used in the statistical analyses. Non-parametric analyses were selected for datasets with at least 50% non-detect data or datasets that could not be normalized. Parametric analyses were selected for datasets (either transformed or untransformed) that passed the Shapiro-Wilk / Shapiro-Francía test for normality. The Kaplan-Meier non-detect adjustment was applied to datasets with between 15% and 50% non-detect data. For datasets with fewer than 15% non-detect data, non-detect data were replaced with one half of the PQL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment A.

2.3.3 Updated Prediction Limits

Intrawell UPLs were updated using all the historical data through May 2019 to represent background values. Intrawell LPLs were also generated for pH. The updated prediction limits are summarized in Table 2.

The intrawell UPLs were calculated for a one-of-two retesting procedure; i.e., if at least one sample in a series of two does not exceed the UPL, then it can be concluded that an SSI has not occurred. In practice, where the initial result did not exceed the UPL, a second sample was not collected. The retesting procedures allowed achieving an acceptably high statistical power to detect changes at downgradient wells for constituents evaluated using intrawell prediction limits.

2.4 Conclusions

Four detection monitoring events were completed in accordance with the CCR Rule. An additional event completed in May 2019 was also included in the new dataset. The laboratory and field data from these events were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. Mann-Whitney tests were completed to evaluate whether data from the detection monitoring events could be added to the existing background dataset. Where appropriate, the background datasets were updated, and UPLs and LPLs were recalculated. Intrawell tests using a one-of-two retesting procedure were selected and updated for all Appendix III parameters

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – J. Robert Welsh Plant. January 2017.

Geosyntec Consultants, 2018a. Alternative Source Demonstration Report – Federal CCR Rule. J. Robert Welsh Plant. April 2018.

Geosyntec Consultants, 2018b. Statistical Analysis Summary. Bottom Ash Storage Pond – J. Robert Welsh Plant. January 2018.

United States Environmental Protection Agency (USEPA). 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March

TABLES

Table 1: Groundwater Data Summary
Welsh - Bottom Ash Storage Pond

Parameter	Unit	AD-1					AD-3					
		10/6/2017	5/24/2018	8/14/2018	2/20/2019	5/30/2019	10/6/2017	5/24/2018	11/13/2018	2/20/2019	4/30/2019	5/30/2019
		2017-D1	2018-D1	2018-D1-R1	2019-D1	*	2017-D1	2018-D1	2018-D2	2019-D1	2019-D1-R1	*
Boron	mg/L	0.453	0.345	0.443	0.504	0.689	0.021	0.007 J	0.009 J	0.010 J	0.007	0.100 U
Calcium	mg/L	14.3	10.2	5.95	142	138	0.908	0.545	0.684	0.817		3.02
Chloride	mg/L	4.00	4.00	5.00	2.82	1.59	9.00	8.00	8.00	9.40	9.34	9.03
Fluoride	mg/L	1.00 U	1.00 U	1.00 U	0.240	0.290	1.00 U	1.00 U	1.00 U	0.130	-	0.180
Total Dissolved Solids	mg/L	160	150	160	522	588	114	98.0	114	110	-	110
Sulfate	mg/L	40.0	43.0	44.0	49.2	43.3	7.00	3.00	4.05	1.90	-	2.30
pH	SU	5.3	2.2	5.2	7.3	6.7	5.2	4.4	5.2	4.8	4.1	4.3

Parameter	Unit	AD-4C							
		10/6/2017	5/24/2018	8/14/2018	11/13/2018	12/18/2018	2/20/2019	4/30/2019	5/29/2019
		2017-D1	2018-D1	2018-D1-R1	2018-D2	2018-D2-R1	2019-D1	2019-D1-R1	*
Boron	mg/L	0.026	0.025	-	0.010 J	-	0.010 J	0.014	0.100 U
Calcium	mg/L	0.654	0.434	-	0.609	-	0.931	-	0.564
Chloride	mg/L	11.0	14.0	15.0	7.50	-	9.18	-	14.8
Fluoride	mg/L	1.00 U	1.00 U	-	1.00 U	-	0.100 J	-	0.160
Total Dissolved Solids	mg/L	226	224	-	220	-	242	-	208
Sulfate	mg/L	44.0	42.0	-	56.0	58.0	60.1	56.2	52.8
pH	SU	5.4	5.2	5.0	5.8	4.9	5.2	4.8	4.6

Notes:
mg/L: milligrams per liter
SU: standard unit
U: Parameter was not present in concentrations above the method detection limit and is reported as the reporting limit
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not Measured
D1: First semi-annual detection monitoring event of the year
D2: Second semi-annual detection monitoring event of the year
R1: First verification event associated with detection monitoring round
*May 2019 data are not associated with any semiannual detection monitoring events but were included in the background update.

Table 1: Groundwater Data Summary
Welsh - Bottom Ash Storage Pond

Parameter	Unit	AD-5					AD-16R						
		10/6/2017	5/24/2018	8/15/2018	2/21/2019	5/30/2019	10/6/2017	5/23/2018	8/14/2018	11/13/2018	2/20/2019	4/30/2019	5/30/2019
		2017-D1	2018-D1	2018-D1-R1	2019-D1	*	2017-D1	2018-D1	2018-D1-R1	2018-D2	2019-D1	2019-D1-R1	*
Boron	mg/L	0.043	0.050	0.050	0.033	0.030 J	0.047	0.032	-	0.020 J	0.030 J	0.015	0.100 U
Calcium	mg/L	33.1	28.1	40.5	33.9	30.0	0.896	2.53	-	0.467	2.00	-	1.36
Chloride	mg/L	16.0	22.0	19.0	24.7	22.3	7.00	6.00	-	6.50	6.78	-	5.43
Fluoride	mg/L	1.00 U	1.00 U	1.00 U	0.210	0.290	1.00 U	1.00 U	-	1.00 U	0.2	-	0.190
Total Dissolved Solids	mg/L	258	242	428	220	238	152	204	-	186	200	-	80.0
Sulfate	mg/L	82.0	60.0	240	46.5	51.3	82.0	67.0	44.0	54.0	52.8	-	41.6
pH	SU	5.6	6.2	6.2	5.4	6.3	3.3	3.8	3.9	5.6	4.7	3.9	3.9

Parameter	Unit	AD-17				
		10/6/2017	5/24/2018	8/15/2018	2/21/2019	5/30/2019
		2017-D1	2018-D1	2018-D1-R1	2019-D1	*
Boron	mg/L	0.183	0.239	0.118	0.151	0.158
Calcium	mg/L	183	193	187	207	202
Chloride	mg/L	31.0	39.0	-	43.2	41.7
Fluoride	mg/L	1.00 U	1.00 U	-	0.180	0.200 U
Total Dissolved Solids	mg/L	1550	1840	-	1720	1550
Sulfate	mg/L	1090	1070	-	1060	1120
pH	SU	5.9	6.3	5.6	6.9	6.1

Notes:
mg/L: milligrams per liter
SU: standard unit
U: Parameter was not present in concentrations above the method detection limit and is reported as the reporting limit
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not Measured
D1: First semi-annual detection monitoring event of the year
D2: Second semi-annual detection monitoring event of the year
R1: First verification event associated with detection monitoring round
*May 2019 data are not associated with any semiannual detection monitoring events but were included in the background update.

Table 2: Background Level Summary
Welsh Plant - Bottom Ash Storage Pond

Parameter	Unit	Description	AD-16R	AD-3	AD-4C
Boron	mg/L	Intrawell Background Value (UPL)	0.0638	0.0580	0.0529
Calcium	mg/L	Intrawell Background Value (UPL)	3.15	1.32	0.961
Chloride	mg/L	Intrawell Background Value (UPL)	8.02	9.40	15.6
Fluoride	mg/L	Intrawell Background Value (UPL)	1.00	1.00	1.00
pH	SU	Intrawell Background Value (UPL)	5.0	6.6	5.8
		Intrawell Background Value (LPL)	2.6	3.1	4.2
Sulfate	mg/L	Intrawell Background Value (UPL)	73.2	10.6	63.7
Solids	mg/L	Intrawell Background Value (UPL)	221	140	255

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

ATTACHMENT A
Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

November 12, 2019

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Welsh BASP
Background Update - 2019

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the screening and statistical analysis of background groundwater data for American Electric Power's Welsh BASP. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at Welsh BASP for the CCR program in 2016, and at least 8 background samples have been collected at each of the groundwater monitoring wells. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** AD-1, AD-5, and AD-17; and
- **Downgradient wells:** AD-3, AD-4C, and AD-16R.

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis report was prepared according to the background screening conducted in December 2017 that was approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting. The analysis was reviewed by Dr. Jim Loftis, Civil & Environmental Engineering professor emeritus at Colorado State University and Senior Advisor to Groundwater Stats Consulting.

The following CCR Detection Monitoring constituents were evaluated:

- **Appendix III Parameters**: boron, calcium, chloride, fluoride, pH, sulfate, and TDS

Time series plots for these parameters are provided for all wells and constituents; and are used to evaluate concentrations over time as well as for the purpose of updating statistical limits (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). Values in background which have been flagged as outliers may be seen in a lighter font and as a disconnected symbol on the graph. A summary of these values follows this letter (Figure C). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells.

During the background screening conducted in December 2017 data at all wells were evaluated for the following: 1) outliers; 2) trends; 3) most appropriate statistical method for Appendix III parameters based on site characteristics of groundwater data upgradient of the facility; and 4) eligibility of downgradient wells when intrawell statistical methods are recommended. Power curves were provided to demonstrate that the selected statistical methods for Appendix III parameters comply with the USEPA Unified Guidance recommendations as discussed below.

Summary of Statistical Method:

1) Intrawell prediction limits, combined with a 1-of-2 resample plan for boron, calcium, chloride, fluoride, pH, sulfate and TDS.

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are nondetects, a nonparametric test is utilized. While the false positive rate associated with the parametric limits is based on an annual 10% as recommended by the EPA Unified Guidance (2009), the false positive rate associated with the nonparametric limits is dependent upon the available background sample size, number of future comparisons, and verification resample plan. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% nondetects (USEPA Unified Guidance, 2009, Chapter 6).

- When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for nondetects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% nondetects.

Historical Summary of Background Screening – December 2017

Outlier Evaluation

Time series plots were used to identify suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective, in proposed background data. Suspected outliers at all wells for Appendix III parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits.

Tukey's outlier test noted a high value for chloride in well AD-16R, and this value was flagged in the database. A substitution of the most recent reporting limit was applied when varying detection limits existed in data. The results were submitted with the previous background screening report.

No true seasonal patterns were observed on the time series plots for any of the detected data; therefore, no deseasonalizing adjustments were made to the data. When seasonal patterns are observed, data may be deseasonalized so that the resulting limits will correctly account for the seasonality as a predictable pattern rather than random variation or a release. It was noted that for each constituent evaluated, the highest concentrations are reported in the upgradient wells.

While trends may be visual, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends. In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed concentrations were stable over time with no statistically significant increasing or decreasing trends, except for one decreasing trend for TDS in well AD-16R as may be seen on the Trend Test Summary table. This trend was relatively low in magnitude when compared to average concentrations; therefore, no adjustments were required.

Appendix III – Determination of Spatial Variation

The Analysis of Variance (ANOVA) is typically used to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying the most appropriate statistical approach. The ANOVA identified variation for all Appendix III parameters except for pH. Interwell tests, which compare downgradient well data to statistical limits constructed from pooled upgradient well data, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation and when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective.

All available data through September 2017 at each well were used to establish intrawell background limits for the parameters identified above based on a 1-of-2 resample plan that will be used for future comparisons. Future compliance measurements will be compared to these background limits during each subsequent semi-annual sampling event.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits will be necessary to accommodate these types of changes In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of an additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered to be a false positive result and, therefore, no further action is necessary. A summary table of the background prediction limits follows the previous letter.

Background Update - September 2019

Prior to updating background data, samples are re-evaluated for all wells for intrawell parameters and all upgradient wells for interwell parameters using Tukey's outlier test and visual screening on all historical data through May 2019. Tukey's outlier test noted high values for chloride in wells AD-1 and AD-16R; and for sulfate in well AD-17 that were flagged in the database, and may be seen on the Outlier Summary Table and accompanying graphs. A low value was flagged for chloride in well AD-1, but when Tukey's outlier test detects an outlier for the most recent sample, it will not be flagged in the event that the data precede a trend that is more representative of current concentrations. As mentioned above, flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. An updated summary of Tukey's test results and flagged outliers follows this letter.

For constituents requiring intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through September 2017 to the new compliance samples at each well through May 2019 to evaluate whether the groups are significantly different at the 99% confidence level. When no differences are identified, the background data may be updated with compliance data (Figure D). The only exception to this is sulfate in well AD-4C, which uses historical data through December 2018.

Statistically significant differences were found between the two groups for chloride in upgradient well AD-5. Typically, when the test concludes that the medians of the two groups are significantly different, particularly in the downgradient wells, the background are not updated to include the newer data but will be reconsidered in the future. However, because the differences for chloride in well AD-5 occurred in an upgradient well and more recent data are fairly similar to background and better represent the groundwater quality upgradient of the facility, the background data set was updated. A summary of these results follows this letter and the test results are included with the Mann Whitney test section at the end of this report. Additionally, a summary of well/constituent pairs using a truncated portion of their records follows this letter (Figure E).

Intrawell prediction limits using all historical data through May 2019, combined with a 1-of-2 resample plan, were constructed and a summary of the updated limits follows this letter (Figure F).

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Welsh BASP. If you have any questions or comments, please feel free to contact us.

For Groundwater Stats Consulting,

ACollins

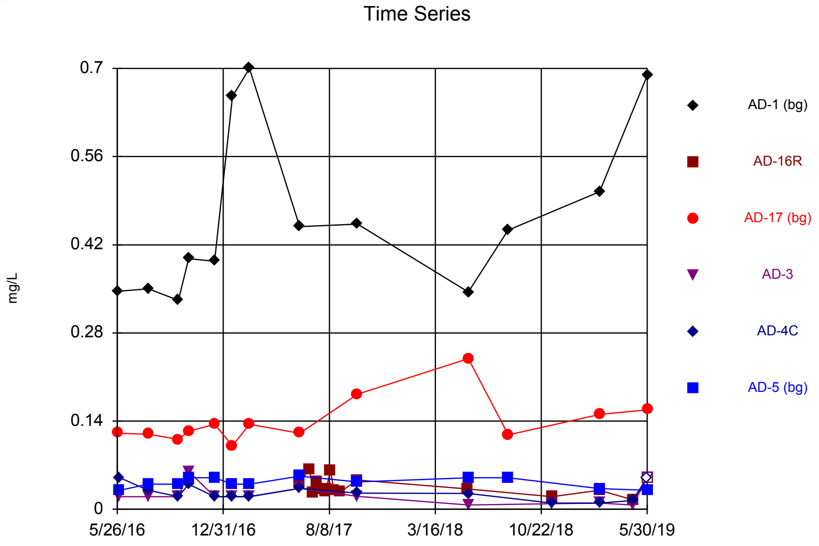
Andrew T. Collins
Groundwater Analyst

Kristina Rayner

Kristina L. Rayner
Groundwater Statistician

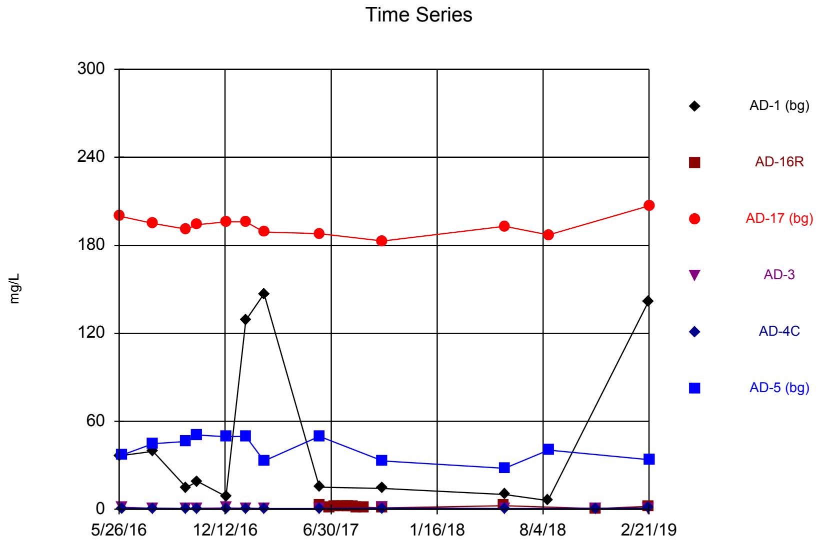
Figure A. Time Series

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



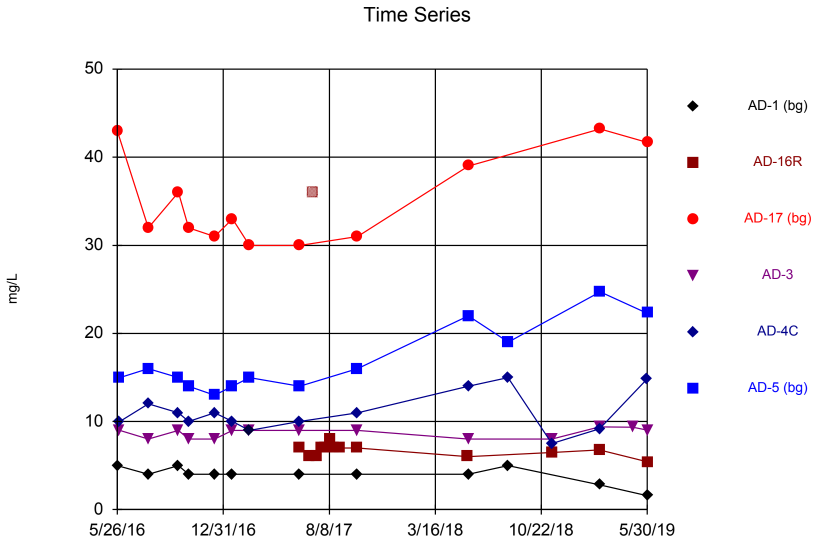
Constituent: Boron Analysis Run 11/7/2019 10:05 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



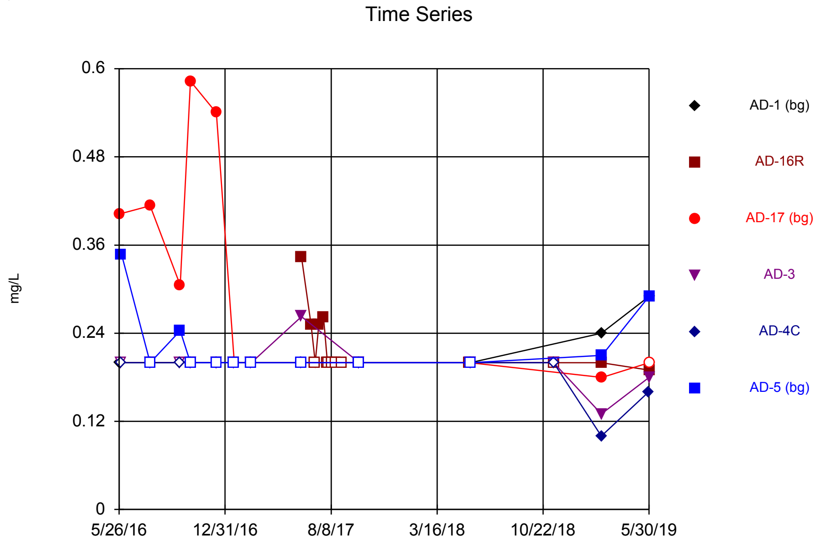
Constituent: Calcium Analysis Run 11/7/2019 10:05 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



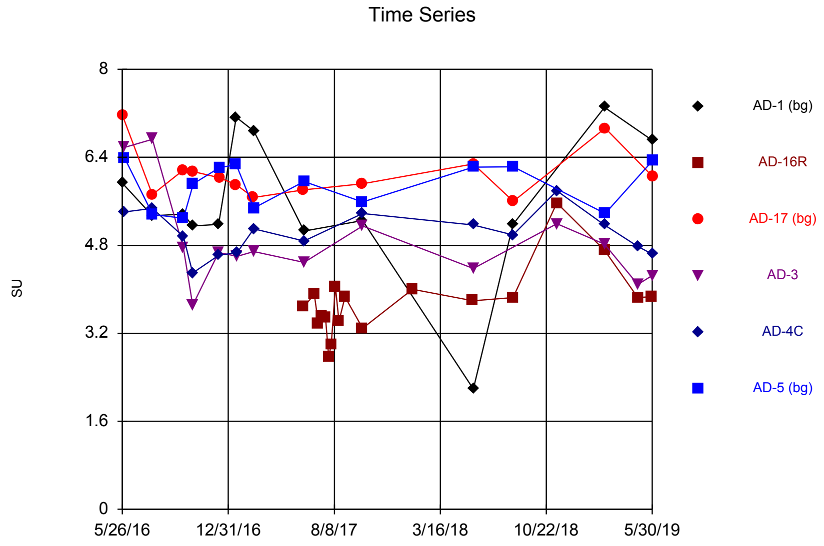
Constituent: Chloride Analysis Run 11/7/2019 10:05 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



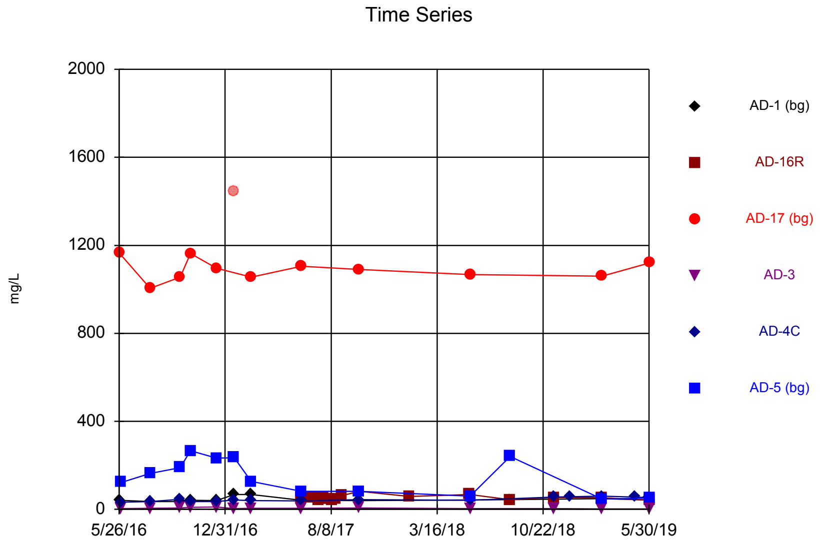
Constituent: Fluoride Analysis Run 11/7/2019 10:06 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



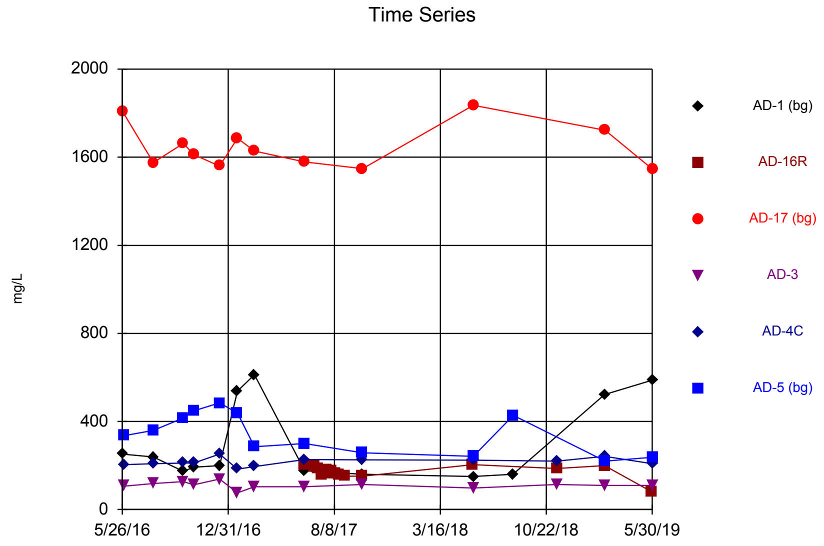
Constituent: pH, field   Analysis Run 11/7/2019 10:06 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Sulfate   Analysis Run 11/7/2019 10:06 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

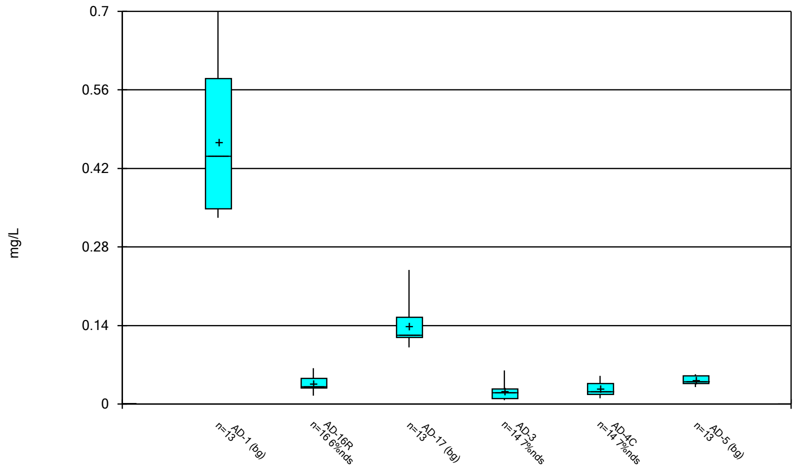


Constituent: Total Dissolved Solids   Analysis Run 11/7/2019 10:06 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Figure B. Box Plots

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

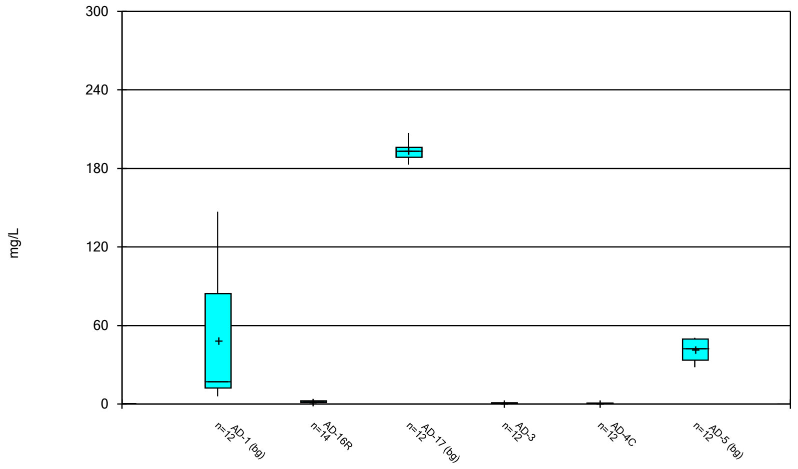
Box & Whiskers Plot



Constituent: Boron   Analysis Run 11/7/2019 10:06 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

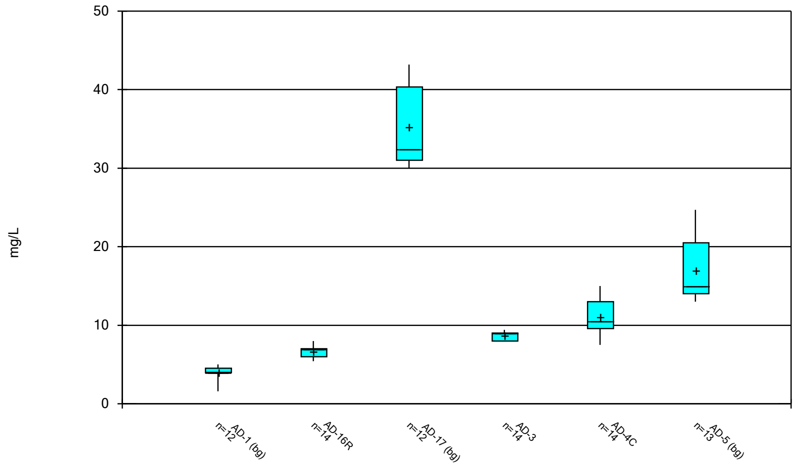
Box & Whiskers Plot



Constituent: Calcium   Analysis Run 11/7/2019 10:06 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

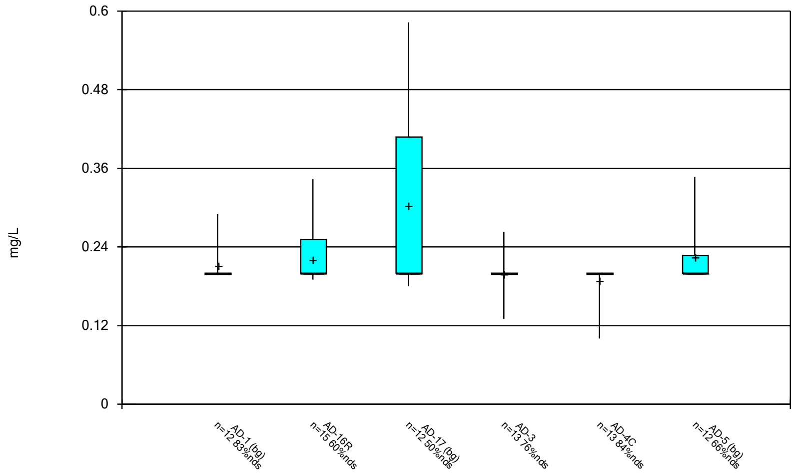
Box & Whiskers Plot



Constituent: Chloride   Analysis Run 11/7/2019 10:06 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

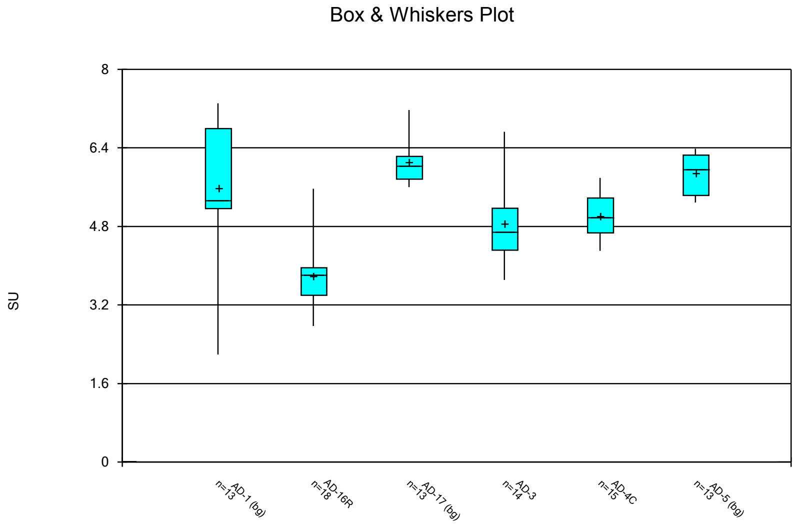
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Fluoride   Analysis Run 11/7/2019 10:06 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

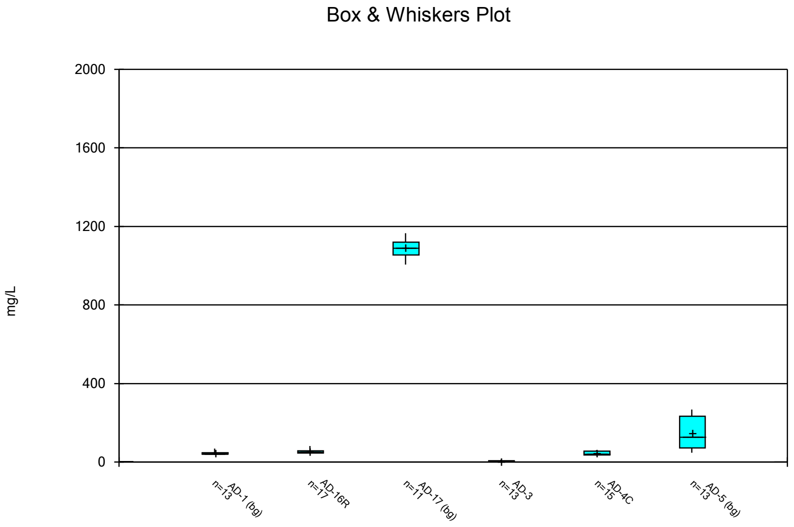
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: pH, field Analysis Run 11/7/2019 10:06 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

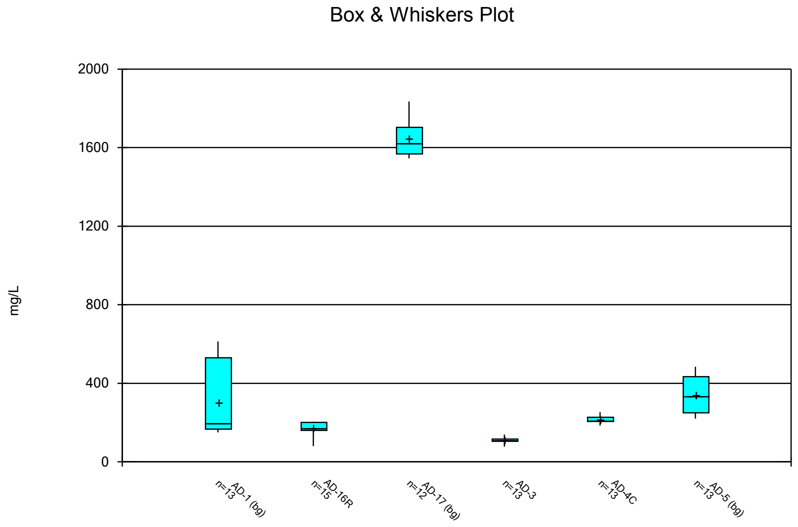
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Sulfate Analysis Run 11/7/2019 10:06 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids Analysis Run 11/7/2019 10:06 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Figure C. Outlier Summary

Welsh BASP   Client: Geosyntec   Data: Welsh BASP   Printed 11/7/2019, 10:05 AM

	AD-1 Chloride (mg/L)	AD-16R Chloride (mg/L)	AD-17 Sulfate (mg/L)
1/20/2017			1445 (o)
2/24/2017	9 (o)		
7/7/2017		36 (o)	

Figure D. Welch's t-test/Mann-Whitney - Significant Results

Welsh BASP Client: Geosyntec Data: Welsh BASP Printed 11/7/2019, 10:37 AM

Constituent	Well	Calc.	0.01	Method
Chloride (mg/L)	**AD-5 (bg)**	**2.816**	**Yes**	**Mann-W**

Figure D. Welch's t-test/Mann-Whitney - All Results

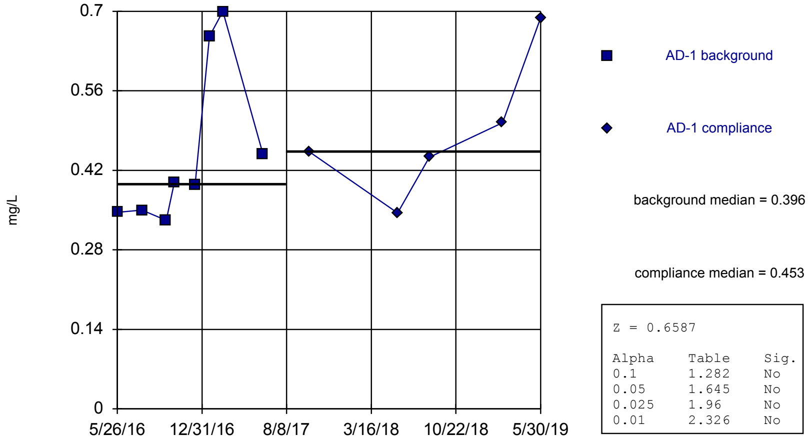
Welsh BASP Client: Geosyntec Data: Welsh BASP Printed 11/7/2019, 10:37 AM

Constituent	Well	Calc.	0.01	Method
Boron (mg/L)	AD-1 (bg)	0.6587	No	Mann-W
Boron (mg/L)	AD-16R	-0.7055	No	Mann-W
Boron (mg/L)	AD-17 (bg)	1.982	No	Mann-W
Boron (mg/L)	AD-3	-1.545	No	Mann-W
Boron (mg/L)	AD-4C	-1.111	No	Mann-W
Boron (mg/L)	AD-5 (bg)	-0.1495	No	Mann-W
Calcium (mg/L)	AD-1 (bg)	-1.274	No	Mann-W
Calcium (mg/L)	AD-16R	-0.7778	No	Mann-W
Calcium (mg/L)	AD-17 (bg)	-0.9358	No	Mann-W
Calcium (mg/L)	AD-3	0.08492	No	Mann-W
Calcium (mg/L)	AD-4C	0.4246	No	Mann-W
Calcium (mg/L)	AD-5 (bg)	-2.123	No	Mann-W
Chloride (mg/L)	AD-1 (bg)	-1.279	No	Mann-W
Chloride (mg/L)	AD-16R	-1.86	No	Mann-W
Chloride (mg/L)	AD-17 (bg)	1.366	No	Mann-W
Chloride (mg/L)	AD-3	1.102	No	Mann-W
Chloride (mg/L)	AD-4C	0.8524	No	Mann-W
Chloride (mg/L)	**AD-5 (bg)**	**2.816**	**Yes**	**Mann-W**
Fluoride (mg/L)	AD-1 (bg)	-2.219	No	Mann-W
Fluoride (mg/L)	AD-16R	-0.6218	No	Mann-W
Fluoride (mg/L)	AD-17 (bg)	-2.176	No	Mann-W
Fluoride (mg/L)	AD-3	-1.386	No	Mann-W
Fluoride (mg/L)	AD-4C	-1.978	No	Mann-W
Fluoride (mg/L)	AD-5 (bg)	-1.112	No	Mann-W
pH, field (SU)	AD-1 (bg)	-0.1466	No	Mann-W
pH, field (SU)	AD-16R	1.734	No	Mann-W
pH, field (SU)	AD-17 (bg)	0.366	No	Mann-W
pH, field (SU)	AD-3	-0.4518	No	Mann-W
pH, field (SU)	AD-4C	0.8687	No	Mann-W
pH, field (SU)	AD-5 (bg)	0.5123	No	Mann-W
Sulfate (mg/L)	AD-1 (bg)	0.8856	No	Mann-W
Sulfate (mg/L)	AD-16R	0.7355	No	Mann-W
Sulfate (mg/L)	AD-17 (bg)	-0.09471	No	Mann-W
Sulfate (mg/L)	AD-3	-1.843	No	Mann-W
Sulfate (mg/L)	AD-4C	2.095	No	Mann-W
Sulfate (mg/L)	AD-5 (bg)	-1.906	No	Mann-W
Total Dissolved Solids (mg/L)	AD-1 (bg)	-1.099	No	Mann-W
Total Dissolved Solids (mg/L)	AD-16R	0.1229	No	Mann-W
Total Dissolved Solids (mg/L)	AD-17 (bg)	-0.2548	No	Mann-W
Total Dissolved Solids (mg/L)	AD-3	-0.2205	No	Mann-W
Total Dissolved Solids (mg/L)	AD-4C	1.174	No	Mann-W
Total Dissolved Solids (mg/L)	AD-5 (bg)	-2.269	No	Mann-W

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-1 (bg)



background median = 0.396

compliance median = 0.453

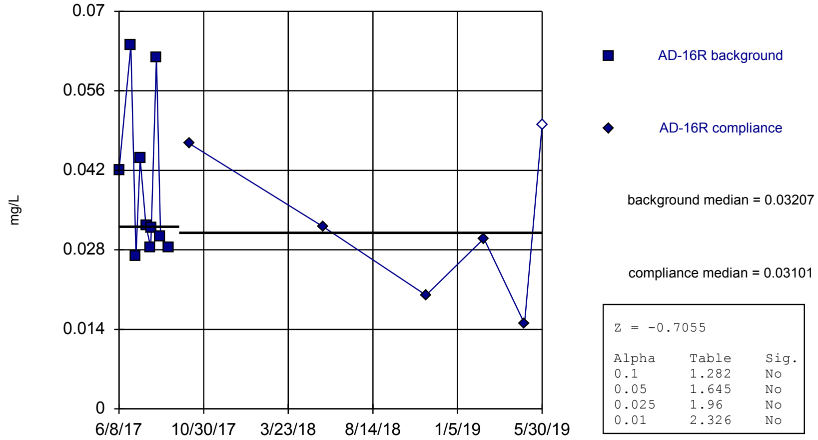
```
Z = 0.6587

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Boron   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-16R



background median = 0.03207

compliance median = 0.03101

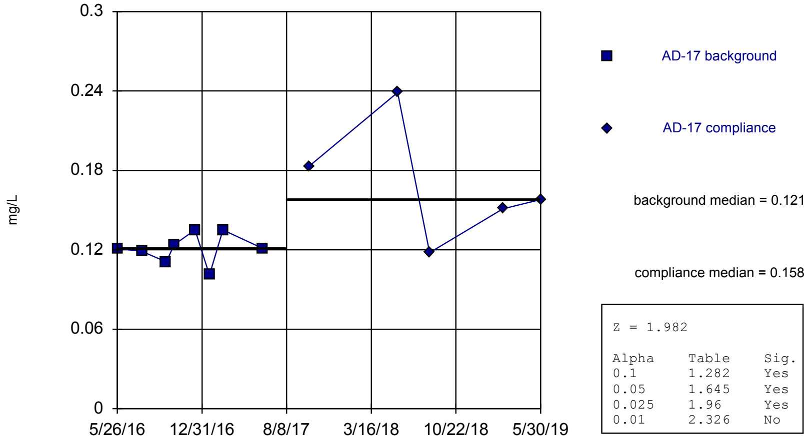
```
Z = -0.7055

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Boron   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-17 (bg)



background median = 0.121

compliance median = 0.158

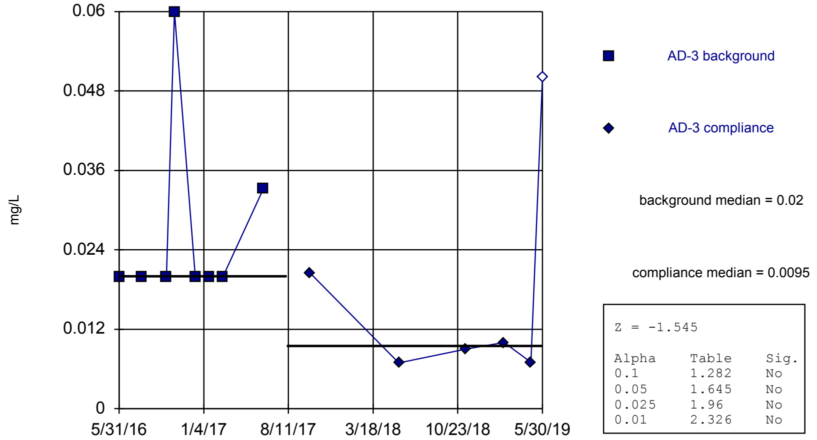
```
Z = 1.982

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     Yes
0.025     1.96      Yes
0.01      2.326     No
```

Constituent: Boron   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-3



background median = 0.02

compliance median = 0.0095

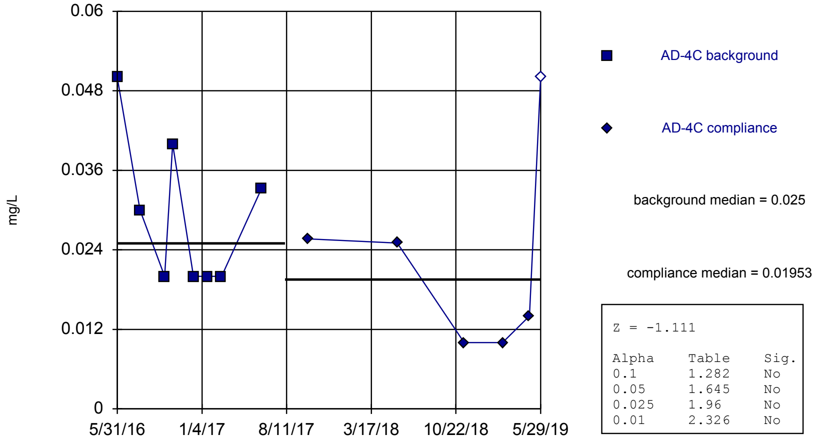
```
Z = -1.545

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Boron   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-4C



background median = 0.025

compliance median = 0.01953

Z = -1.111

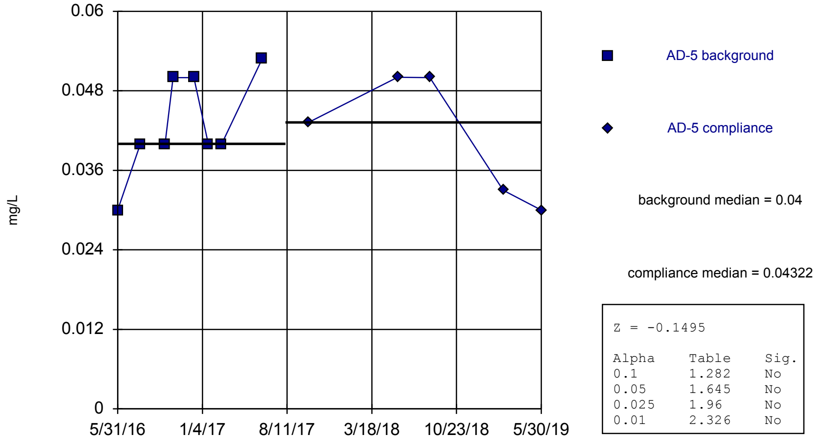
Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Boron   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-5 (bg)



background median = 0.04

compliance median = 0.04322

Z = -0.1495

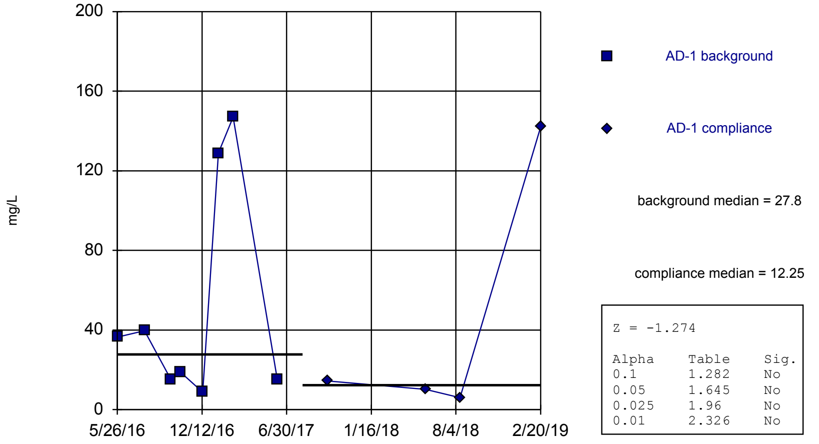
Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Boron   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-1 (bg)



background median = 27.8

compliance median = 12.25

Z = -1.274

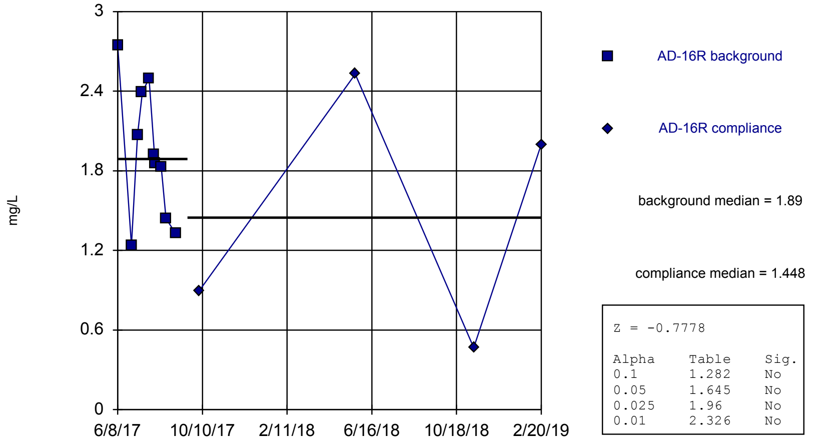
Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Calcium   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-16R



background median = 1.89

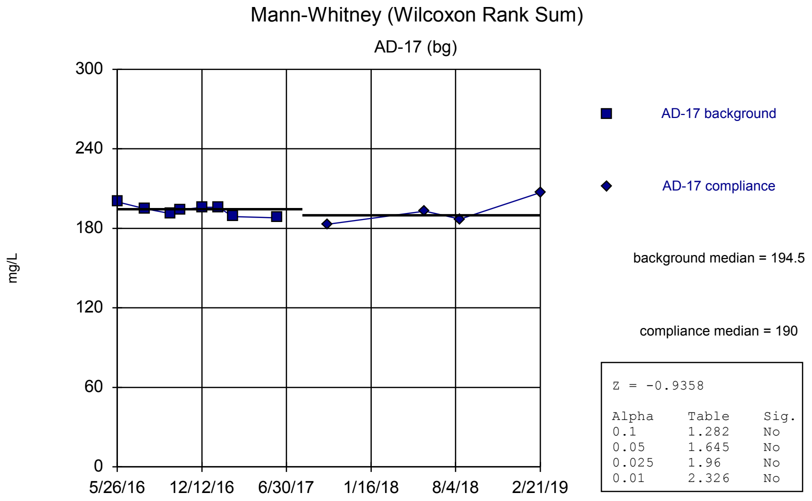
compliance median = 1.448

Z = -0.7778

Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Calcium   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



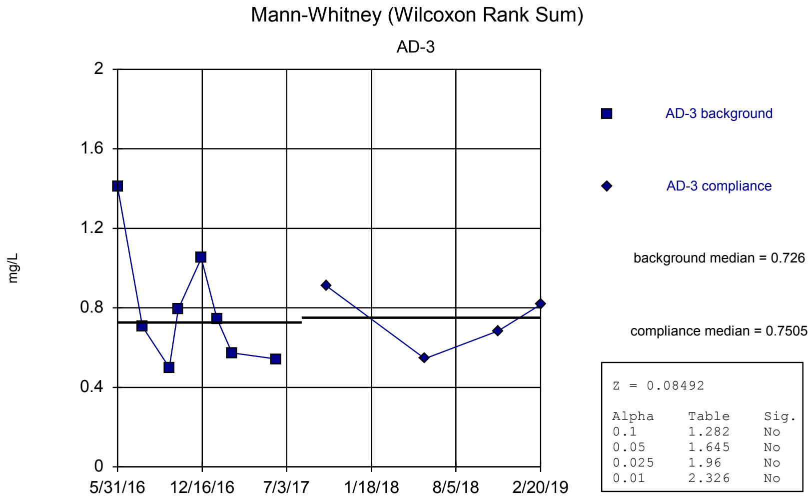
background median = 194.5

compliance median = 190

```
Z = -0.9358

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Calcium   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



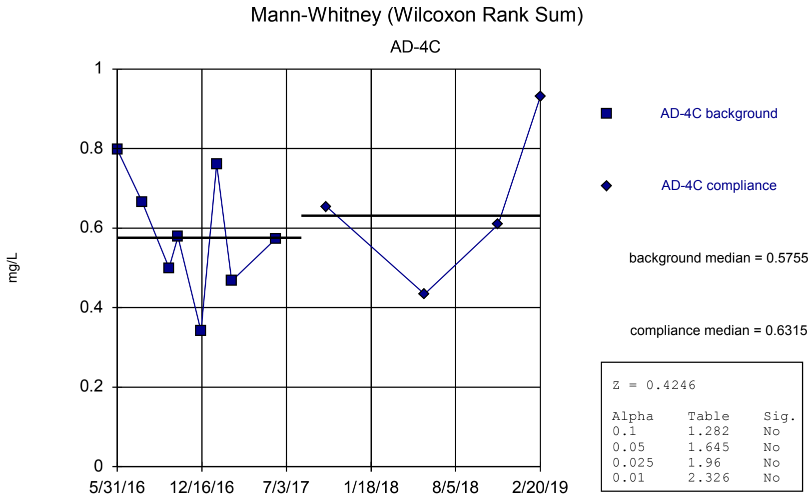
background median = 0.726

compliance median = 0.7505

```
Z = 0.08492

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Calcium   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



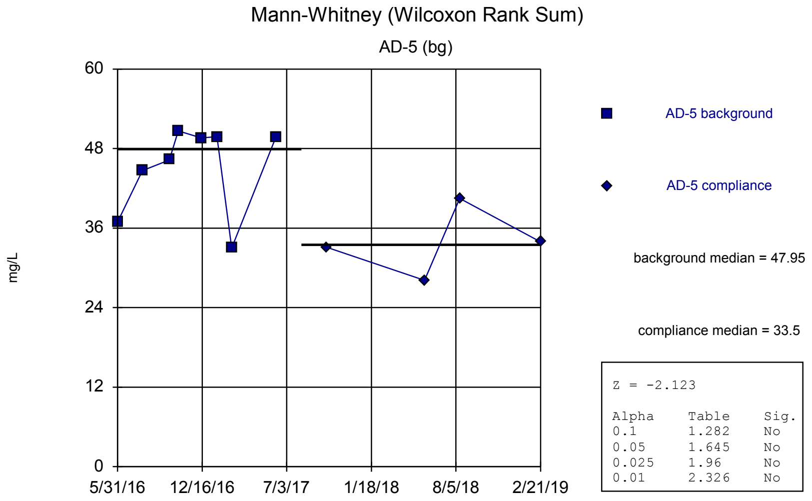
background median = 0.5755

compliance median = 0.6315

```
Z = 0.4246

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Calcium   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



background median = 47.95

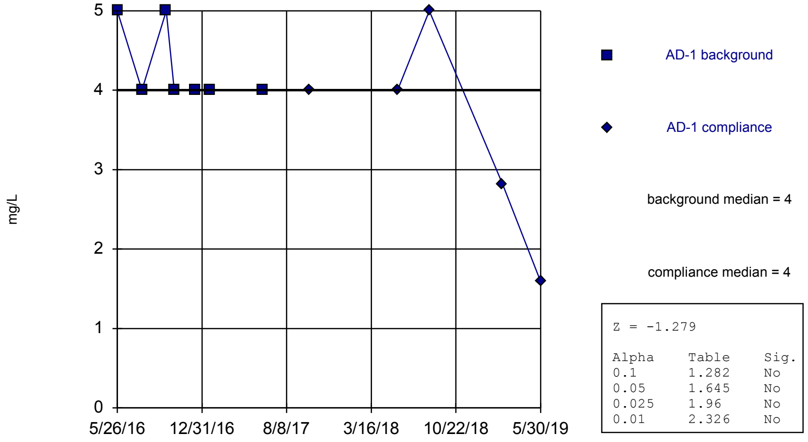
compliance median = 33.5

```
Z = -2.123

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Calcium   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Mann-Whitney (Wilcoxon Rank Sum)

AD-1 (bg)



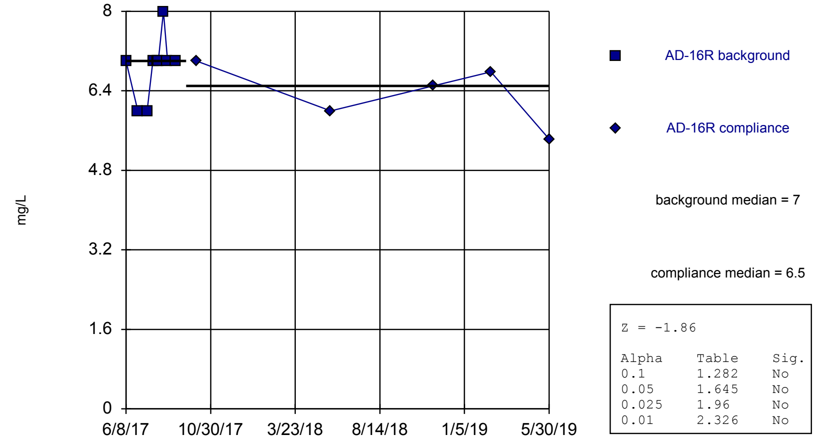
```
Z = -1.279

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Chloride   Analysis Run 11/7/2019 10:35 AM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Mann-Whitney (Wilcoxon Rank Sum)

AD-16R



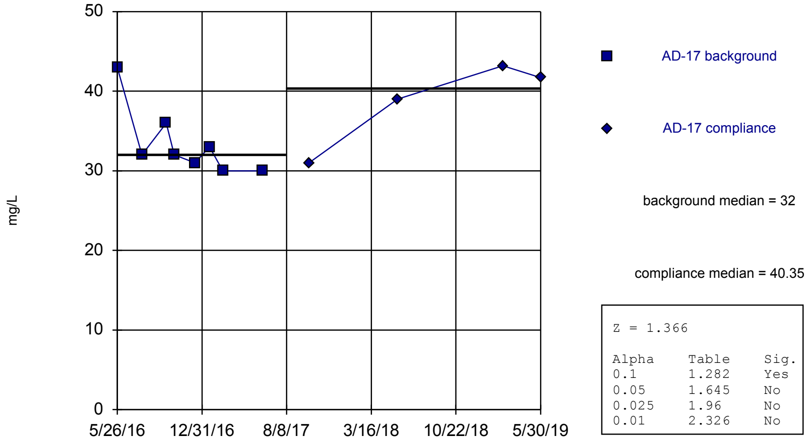
```
Z = -1.86

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Chloride   Analysis Run 11/7/2019 10:35 AM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Mann-Whitney (Wilcoxon Rank Sum)

AD-17 (bg)



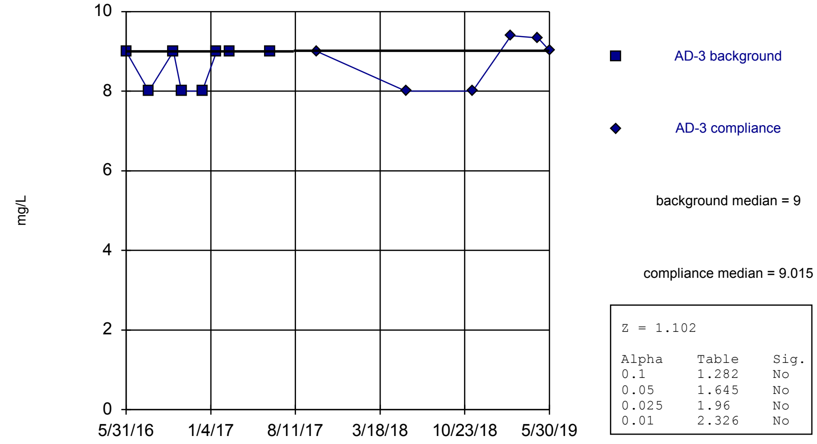
```
Z = 1.366

Alpha     Table     Sig.
0.1       1.282     Yes
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Chloride   Analysis Run 11/7/2019 10:35 AM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Mann-Whitney (Wilcoxon Rank Sum)

AD-3

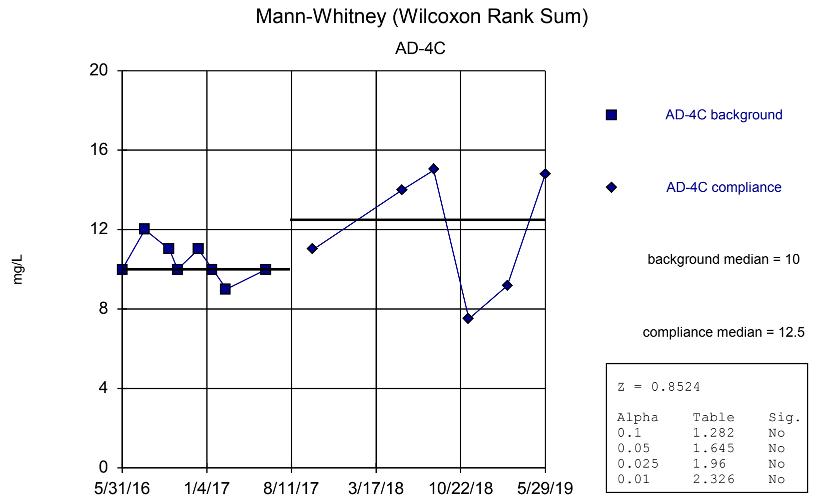


```
Z = 1.102

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

Constituent: Chloride   Analysis Run 11/7/2019 10:35 AM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

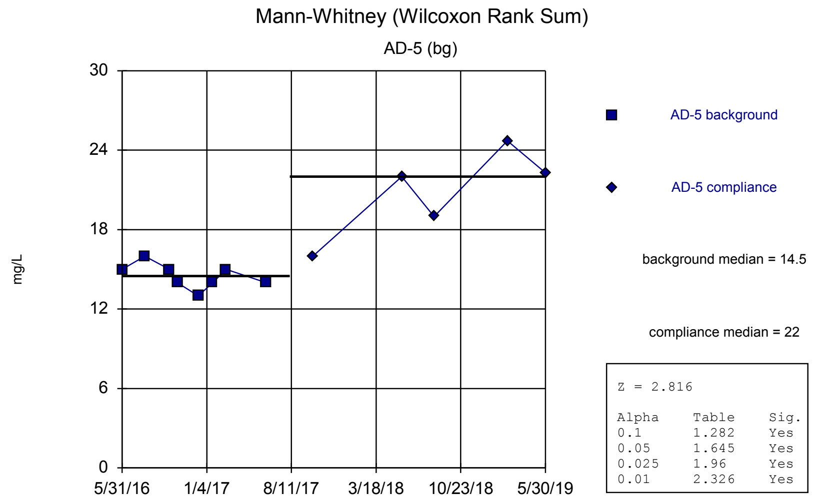
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Chloride Analysis Run 11/7/2019 10:35 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

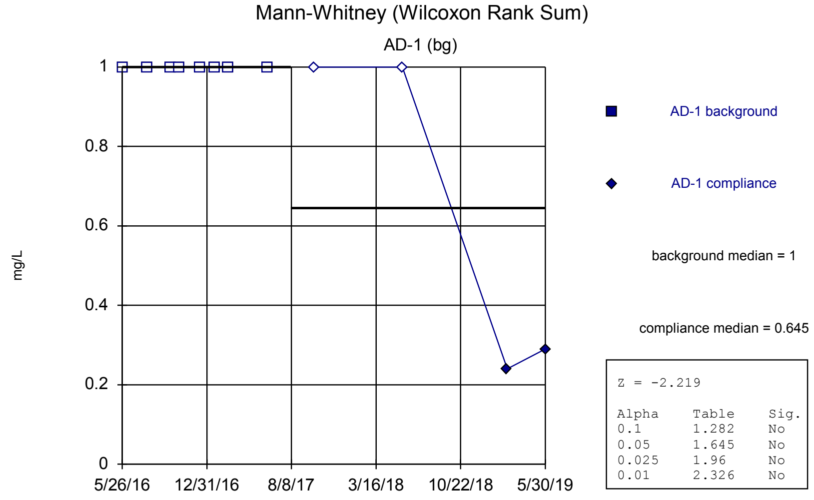


Constituent: Chloride Analysis Run 11/7/2019 10:35 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

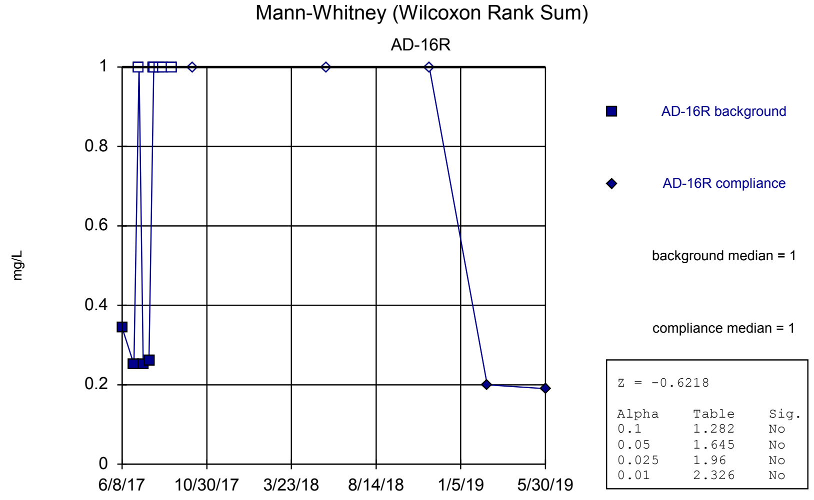


Constituent: Fluoride Analysis Run 11/7/2019 10:35 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

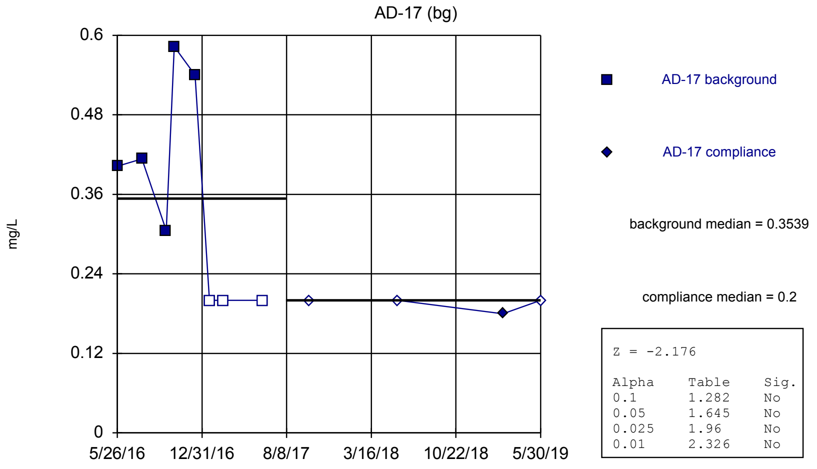


Constituent: Fluoride Analysis Run 11/7/2019 10:35 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)



background median = 0.3539

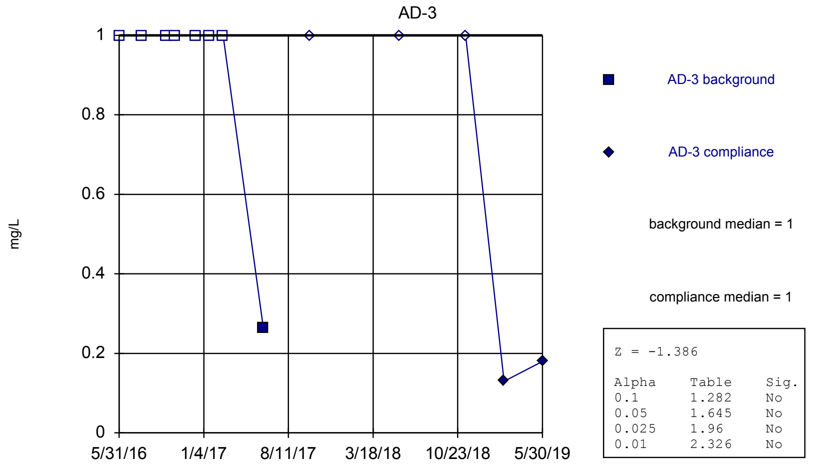
compliance median = 0.2

```
Z = -2.176

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Fluoride   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)



background median = 1

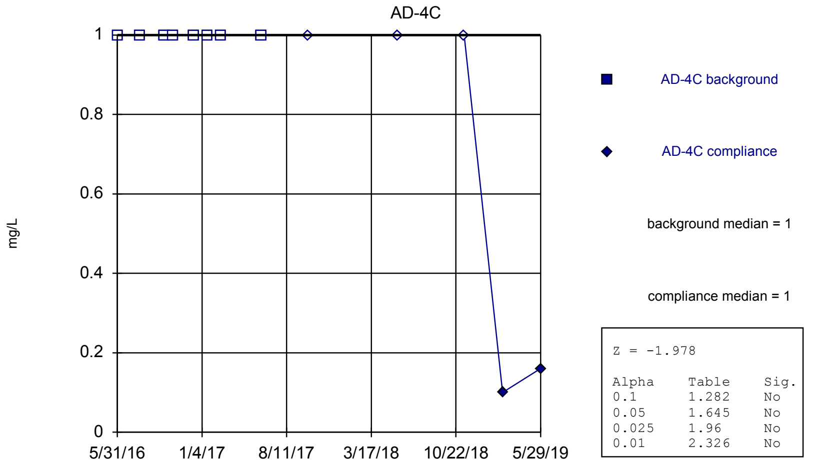
compliance median = 1

```
Z = -1.386

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Fluoride   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)



background median = 1

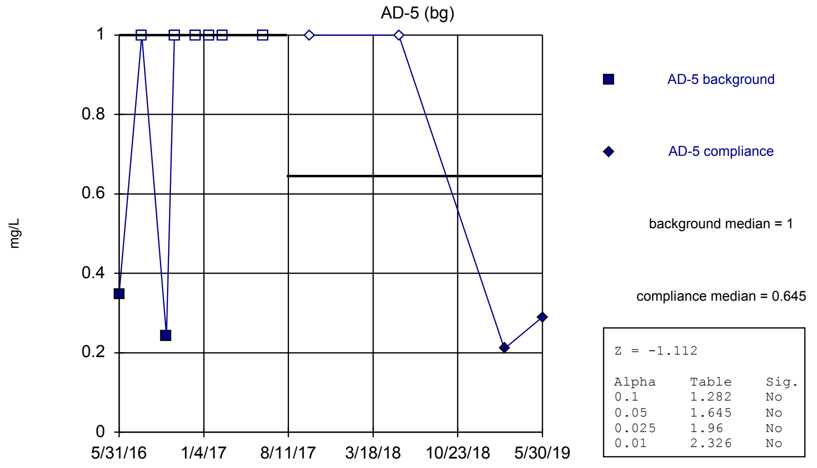
compliance median = 1

```
Z = -1.978

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Fluoride   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)



background median = 1

compliance median = 0.645

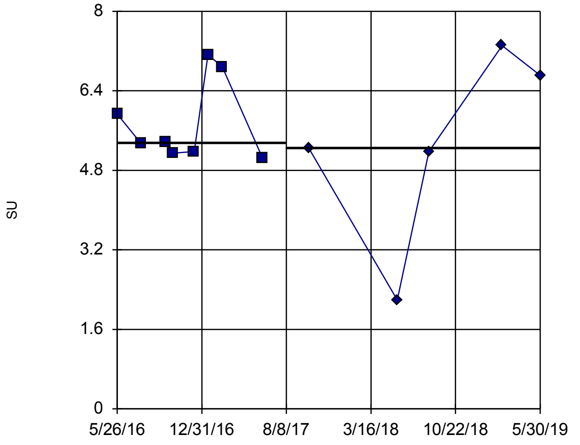
```
Z = -1.112

Alpha    Table    Sig.
0.1      1.282    No
0.05     1.645    No
0.025    1.96     No
0.01     2.326    No
```

Constituent: Fluoride   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-1 (bg)



background median = 5.355

compliance median = 5.25

```
Z = -0.1466 (two-tail)

Alpha    Table    Sig.
0.2      1.282    No
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

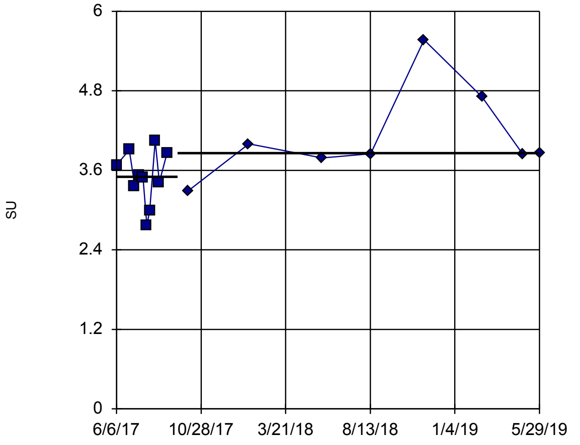
Constituent: pH, field   Analysis Run 11/7/2019 10:35 AM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-16R



background median = 3.505

compliance median = 3.86

```
Z = 1.734 (two-tail)

Alpha    Table    Sig.
0.2      1.282    Yes
0.1      1.645    Yes
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

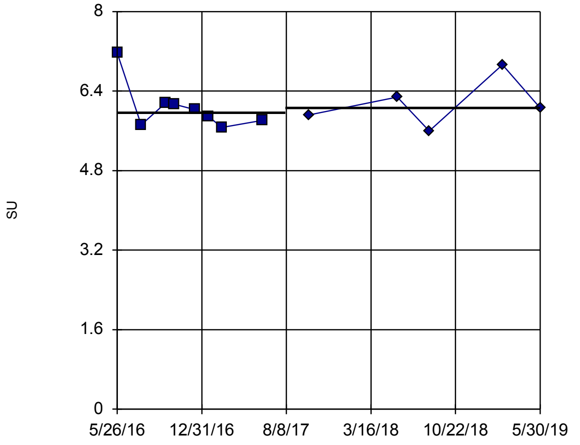
Constituent: pH, field   Analysis Run 11/7/2019 10:35 AM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-17 (bg)



background median = 5.965

compliance median = 6.06

```
Z = 0.366 (two-tail)

Alpha    Table    Sig.
0.2      1.282    No
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

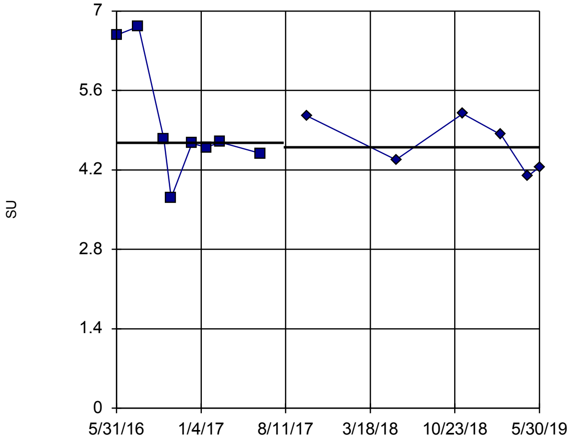
Constituent: pH, field   Analysis Run 11/7/2019 10:35 AM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-3



background median = 4.68

compliance median = 4.6

```
Z = -0.4518 (two-tail)

Alpha    Table    Sig.
0.2      1.282    No
0.1      1.645    No
0.05     1.96     No
0.02     2.326    No
0.01     2.576    No
```

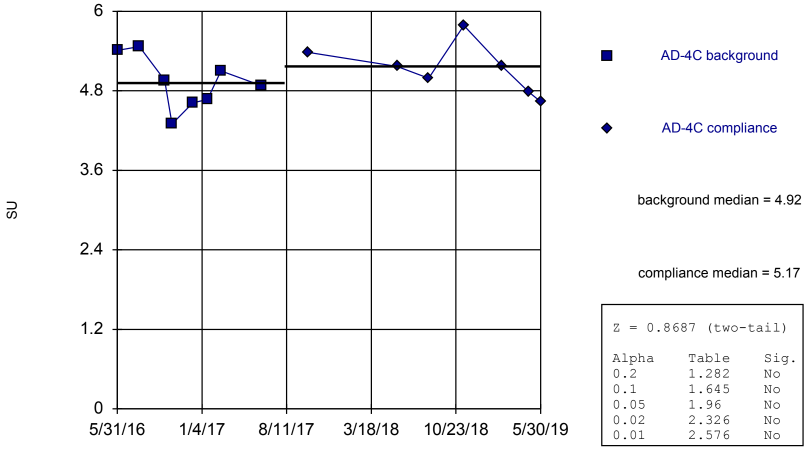
Constituent: pH, field   Analysis Run 11/7/2019 10:35 AM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-4C



background median = 4.92

compliance median = 5.17

```
Z = 0.8687 (two-tail)

Alpha     Table     Sig.
0.2       1.282     No
0.1       1.645     No
0.05      1.96      No
0.02      2.326     No
0.01      2.576     No
```

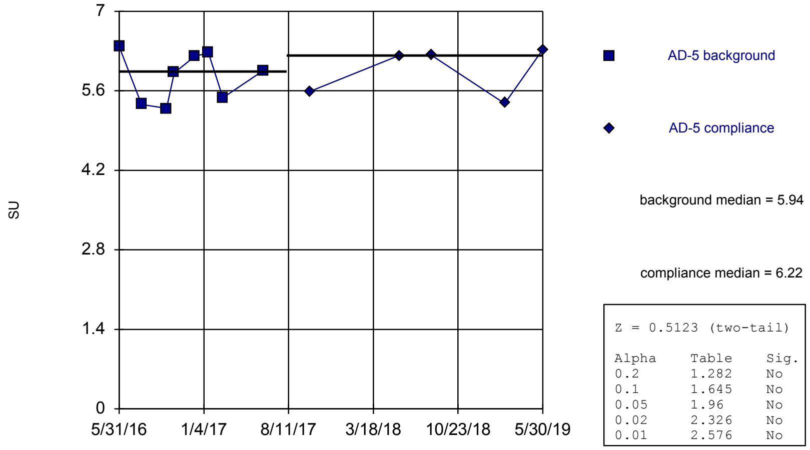
Constituent: pH, field   Analysis Run 11/7/2019 10:35 AM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-5 (bg)



background median = 5.94

compliance median = 6.22

```
Z = 0.5123 (two-tail)

Alpha     Table     Sig.
0.2       1.282     No
0.1       1.645     No
0.05      1.96      No
0.02      2.326     No
0.01      2.576     No
```

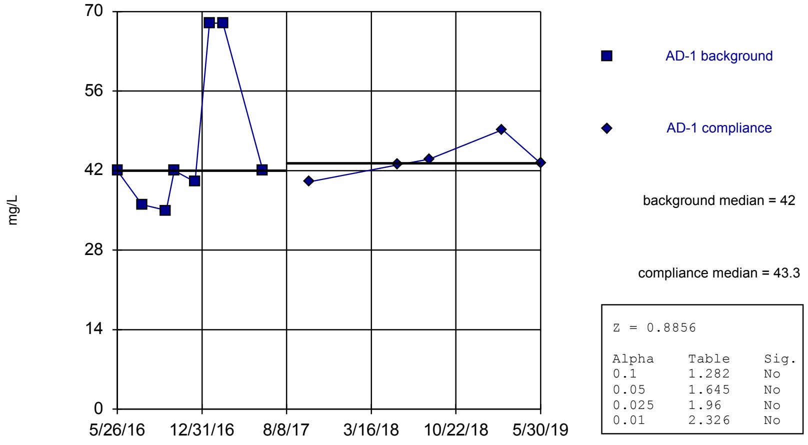
Constituent: pH, field   Analysis Run 11/7/2019 10:35 AM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-1 (bg)



background median = 42

compliance median = 43.3

```
Z = 0.8856

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

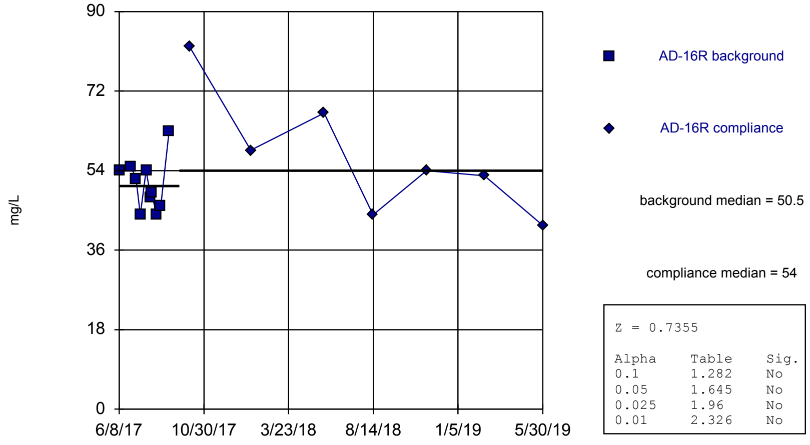
Constituent: Sulfate   Analysis Run 11/7/2019 10:35 AM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-16R



background median = 50.5

compliance median = 54

```
Z = 0.7355

Alpha     Table     Sig.
0.1       1.282     No
0.05      1.645     No
0.025     1.96      No
0.01      2.326     No
```

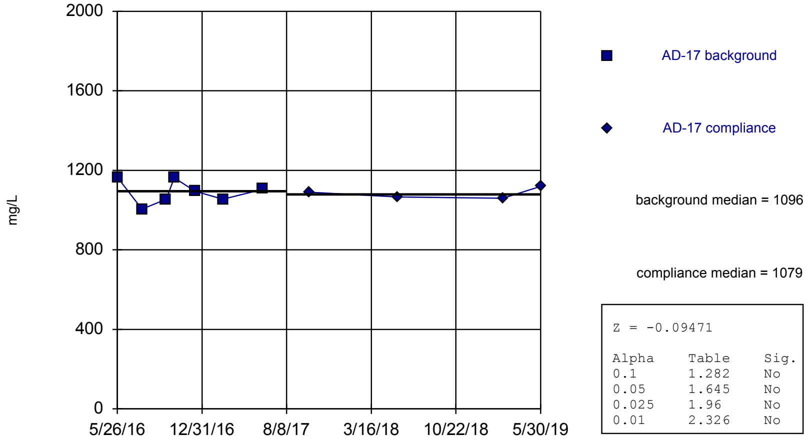
Constituent: Sulfate   Analysis Run 11/7/2019 10:35 AM

Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-17 (bg)



Z = -0.09471

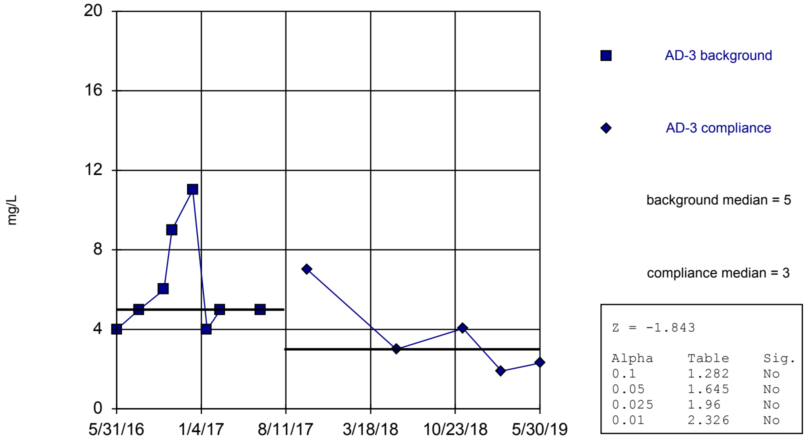
Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Sulfate   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-3



Z = -1.843

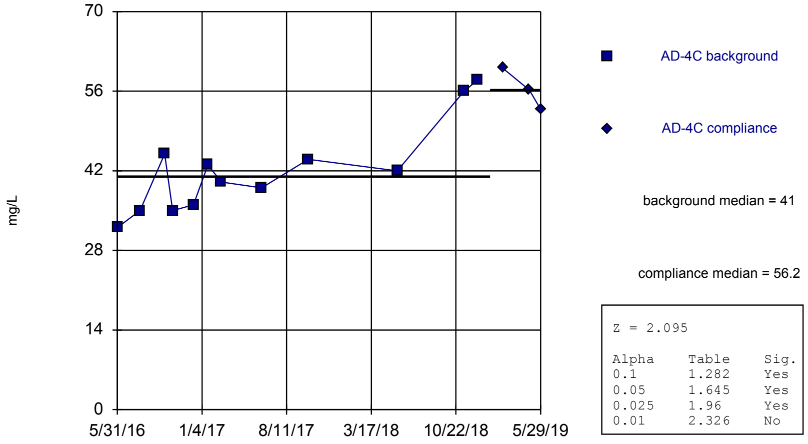
Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Sulfate   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-4C



Z = 2.095

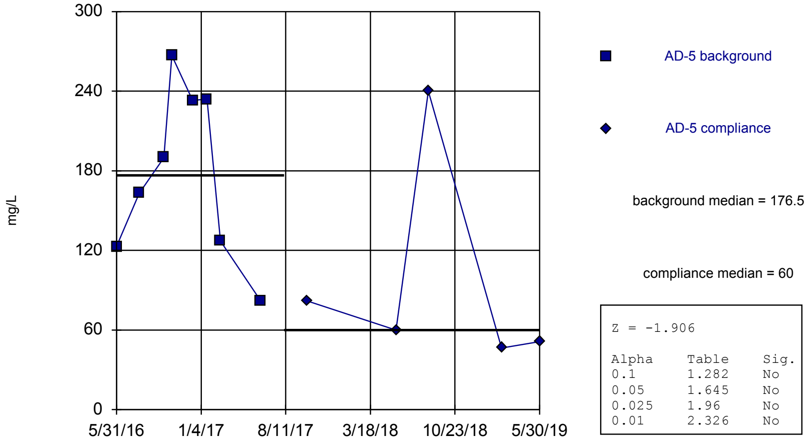
Alpha	Table	Sig.
0.1	1.282	Yes
0.05	1.645	Yes
0.025	1.96	Yes
0.01	2.326	No

Constituent: Sulfate   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-5 (bg)

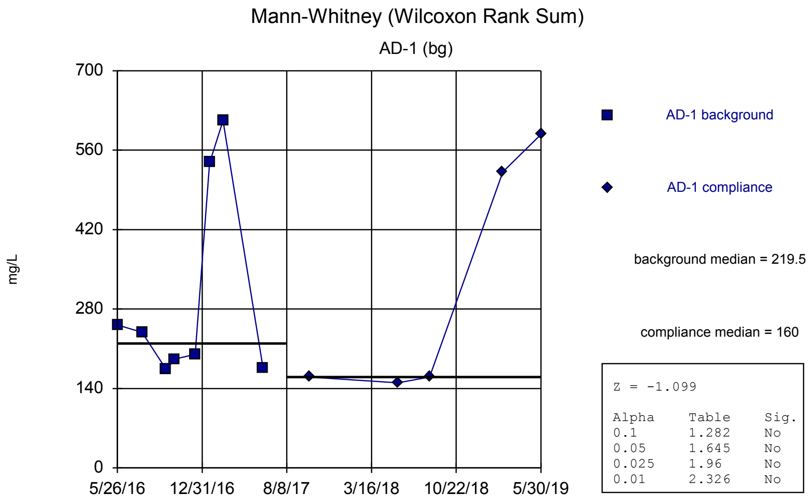


Z = -1.906

Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

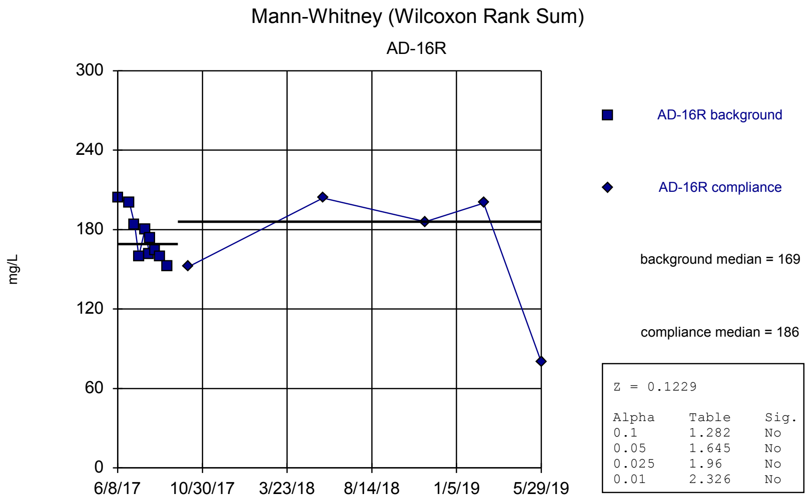
Constituent: Sulfate   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



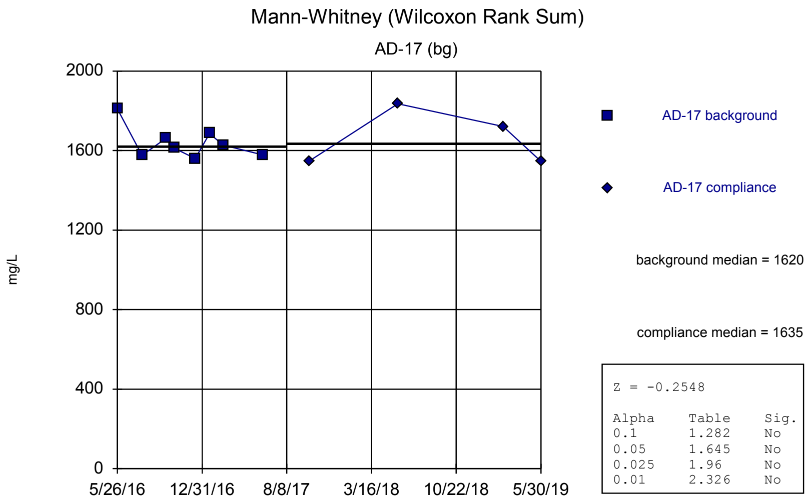
Constituent: Total Dissolved Solids Analysis Run 11/7/2019 10:35 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



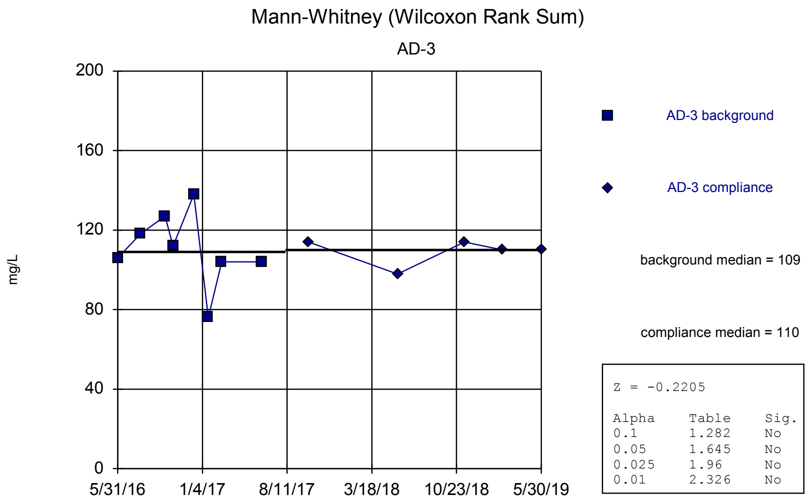
Constituent: Total Dissolved Solids Analysis Run 11/7/2019 10:35 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



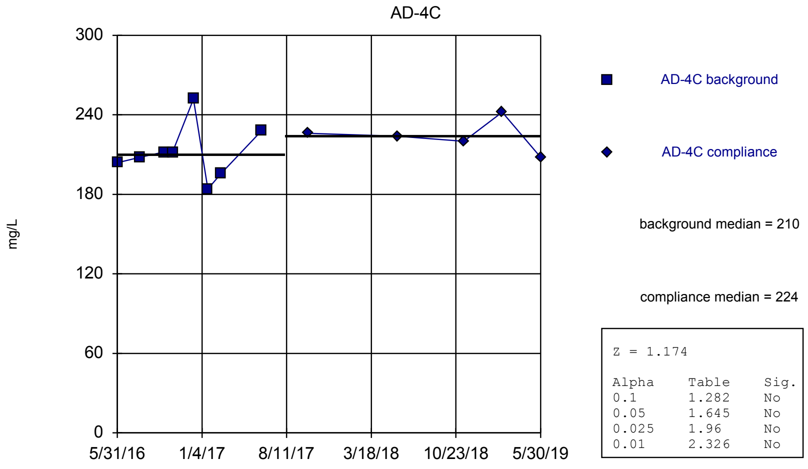
Constituent: Total Dissolved Solids Analysis Run 11/7/2019 10:35 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids Analysis Run 11/7/2019 10:35 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Mann-Whitney (Wilcoxon Rank Sum)

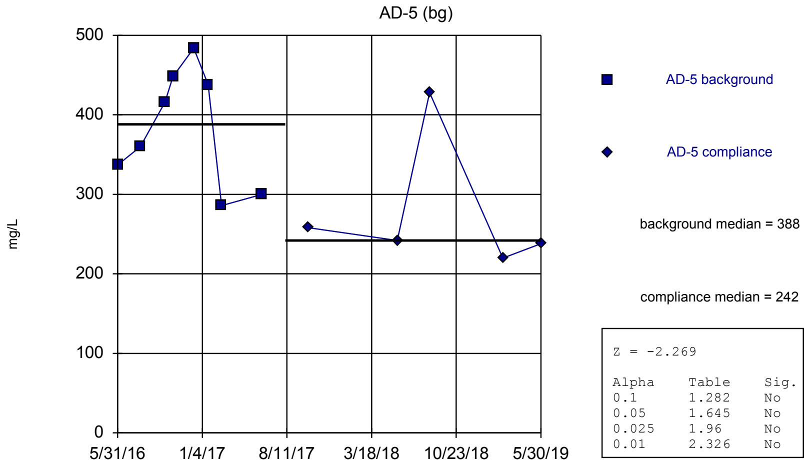


Z = 1.174

Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Total Dissolved Solids   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Mann-Whitney (Wilcoxon Rank Sum)



Z = -2.269

Alpha	Table	Sig.
0.1	1.282	No
0.05	1.645	No
0.025	1.96	No
0.01	2.326	No

Constituent: Total Dissolved Solids   Analysis Run 11/7/2019 10:35 AM
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Figure E. Date Ranges

Date: 11/7/2019 10:33 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sulfate (mg/L)
AD-4C background:5/26/2016-12/18/2018

Figure F. Intrawell Prediction Limit Summary Table - All Results

Welsh BASP Client: Geosyntec Data: Welsh BASP Printed 11/7/2019, 10:39 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron (mg/L)	AD-1	0.7429	n/a	n/a	1 future	n/a	13	0.4661	0.1333	0	None	No	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-16R	0.06376	n/a	n/a	1 future	n/a	16	0.03651	0.01384	6.25	None	No	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-17	0.2176	n/a	n/a	1 future	n/a	13	0.3711	0.0459	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-3	0.05798	n/a	n/a	1 future	n/a	14	0.1432	0.04783	7.143	None	sqrt(x)	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-4C	0.05294	n/a	n/a	1 future	n/a	14	0.02629	0.01306	7.143	None	No	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-5	0.05876	n/a	n/a	1 future	n/a	13	0.04224	0.007957	0	None	No	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-1	206	n/a	n/a	1 future	n/a	12	3.196	1.283	0	None	x^(1/3)	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-16R	3.149	n/a	n/a	1 future	n/a	14	1.802	0.66	0	None	No	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-17	206.7	n/a	n/a	1 future	n/a	12	193.3	6.384	0	None	No	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-3	1.319	n/a	n/a	1 future	n/a	12	0.773	0.2586	0	None	No	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-4C	0.9607	n/a	n/a	1 future	n/a	12	0.6093	0.1664	0	None	No	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-5	58.47	n/a	n/a	1 future	n/a	12	41.36	8.1	0	None	No	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-1	5.523	n/a	n/a	1 future	n/a	12	16.46	6.652	0	None	x^2	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-16R	8.015	n/a	n/a	1 future	n/a	14	6.694	0.6474	0	None	No	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-17	46.13	n/a	n/a	1 future	n/a	12	35.16	5.195	0	None	No	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-3	9.4	n/a	n/a	1 future	n/a	14	n/a	n/a	0	n/a	n/a	0.008612	NP Intra (normality) 1 of 2
Chloride (mg/L)	AD-4C	15.56	n/a	n/a	1 future	n/a	14	11.03	2.219	0	None	No	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-5	24.81	n/a	n/a	1 future	n/a	13	16.92	3.8	0	None	No	0.002505	Param Intra 1 of 2
Fluoride (mg/L)	AD-1	1	n/a	n/a	1 future	n/a	12	n/a	n/a	83.33	n/a	n/a	0.01077	NP Intra (NDs) 1 of 2
Fluoride (mg/L)	AD-16R	1	n/a	n/a	1 future	n/a	15	n/a	n/a	60	n/a	n/a	0.007533	NP Intra (NDs) 1 of 2
Fluoride (mg/L)	AD-17	0.583	n/a	n/a	1 future	n/a	12	n/a	n/a	50	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Fluoride (mg/L)	AD-3	1	n/a	n/a	1 future	n/a	13	n/a	n/a	76.92	n/a	n/a	0.009692	NP Intra (NDs) 1 of 2
Fluoride (mg/L)	AD-4C	1	n/a	n/a	1 future	n/a	13	n/a	n/a	84.62	n/a	n/a	0.009692	NP Intra (NDs) 1 of 2
Fluoride (mg/L)	AD-5	1	n/a	n/a	1 future	n/a	12	n/a	n/a	66.67	n/a	n/a	0.01077	NP Intra (NDs) 1 of 2
pH, field (SU)	AD-1	8.335	2.846	n/a	1 future	n/a	13	5.591	1.322	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-16R	4.977	2.578	n/a	1 future	n/a	18	3.778	0.6212	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-17	7.077	5.138	n/a	1 future	n/a	13	6.108	0.4667	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-3	6.604	3.124	n/a	1 future	n/a	14	4.864	0.8526	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-4C	5.809	4.235	n/a	1 future	n/a	15	5.022	0.3924	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-5	6.756	5.031	n/a	1 future	n/a	13	5.894	0.4153	0	None	No	0.001253	Param Intra 1 of 2
Sulfate (mg/L)	AD-1	68	n/a	n/a	1 future	n/a	13	n/a	n/a	0	n/a	n/a	0.009692	NP Intra (normality) 1 of 2
Sulfate (mg/L)	AD-16R	73.19	n/a	n/a	1 future	n/a	17	53.47	10.11	0	None	No	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-17	1194	n/a	n/a	1 future	n/a	11	1089	48.34	0	None	No	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-3	10.55	n/a	n/a	1 future	n/a	13	5.173	2.589	0	None	No	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-4C	63.73	n/a	n/a	1 future	n/a	15	44.94	9.37	0	None	No	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-5	311.7	n/a	n/a	1 future	n/a	13	146.1	79.77	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-1	612	n/a	n/a	1 future	n/a	13	n/a	n/a	0	n/a	n/a	0.009692	NP Intra (normality) 1 of 2
Total Dissolved Solids (mg/L)	AD-16R	221	n/a	n/a	1 future	n/a	15	30087	9358	0	None	x^2	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-17	1857	n/a	n/a	1 future	n/a	12	1647	99.38	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-3	140.4	n/a	n/a	1 future	n/a	13	110.1	14.61	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-4C	254.6	n/a	n/a	1 future	n/a	13	216.6	18.3	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-5	533.7	n/a	n/a	1 future	n/a	13	342.7	91.96	0	None	No	0.002505	Param Intra 1 of 2

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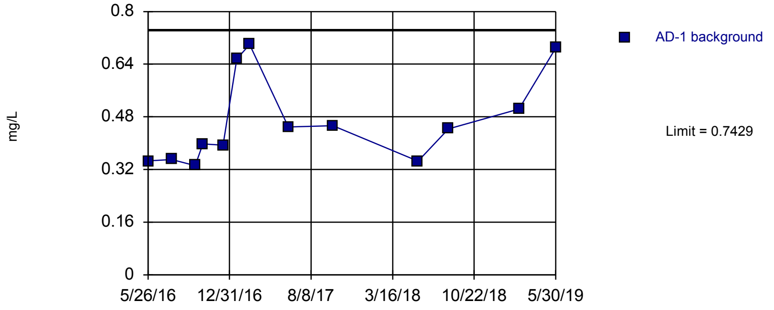
Prediction Limit

Intrawell Parametric, AD-1 (bg)



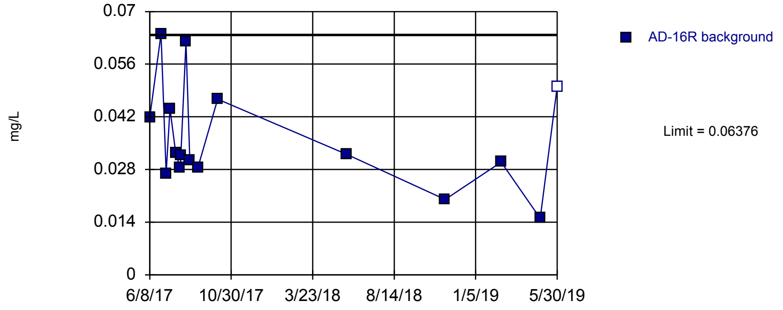
Background Data Summary: Mean=0.4661, Std. Dev.=0.1333, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8345, critical = 0.814. Kappa = 2.077 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-16R



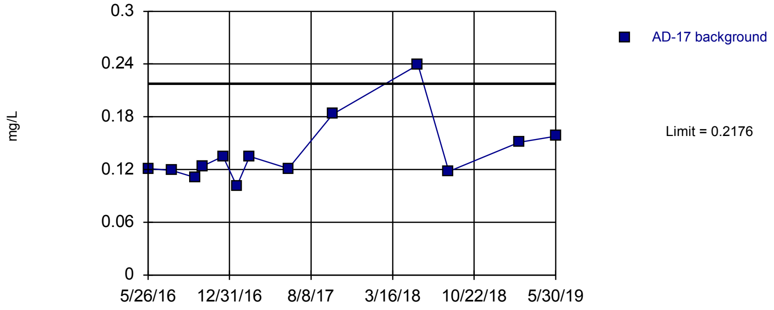
Background Data Summary: Mean=0.03651, Std. Dev.=0.01384, n=16, 6.25% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9241, critical = 0.844. Kappa = 1.97 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



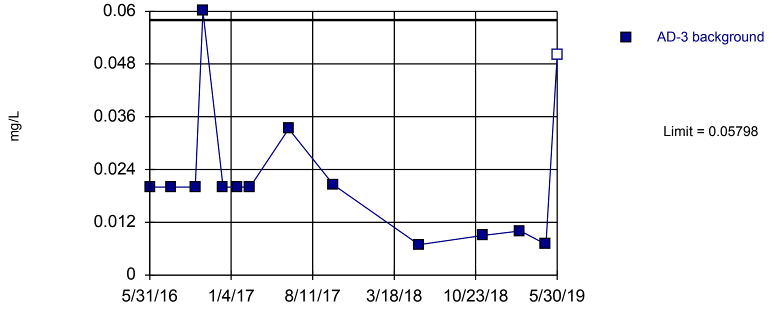
Background Data Summary (based on square root transformation): Mean=0.3711, Std. Dev.=0.0459, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8526, critical = 0.814. Kappa = 2.077 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-3



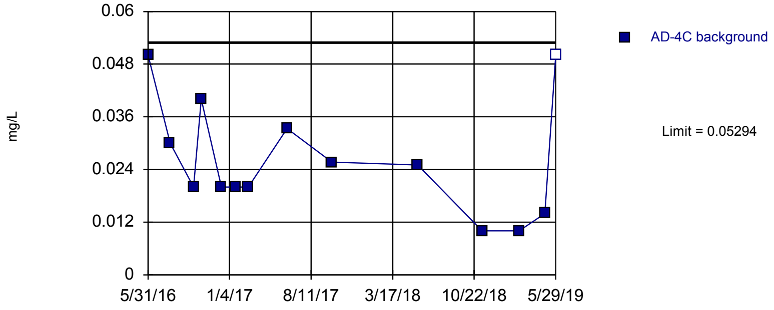
Background Data Summary (based on square root transformation): Mean=0.1432, Std. Dev.=0.04783, n=14, 7.143% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8693, critical = 0.825. Kappa = 2.041 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-4C



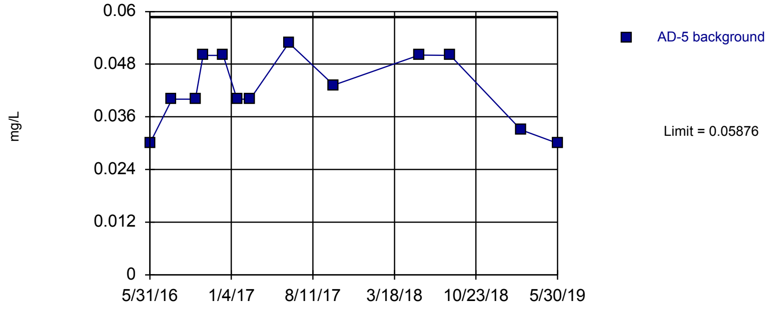
Background Data Summary: Mean=0.02629, Std. Dev.=0.01306, n=14, 7.143% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9069, critical = 0.825. Kappa = 2.041 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



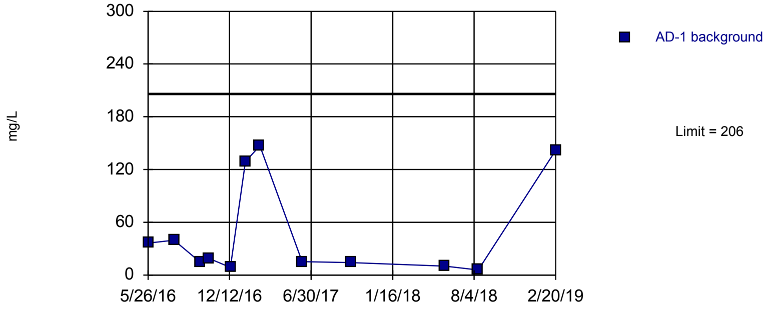
Background Data Summary: Mean=0.04224, Std. Dev.=0.007957, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8882, critical = 0.814. Kappa = 2.077 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



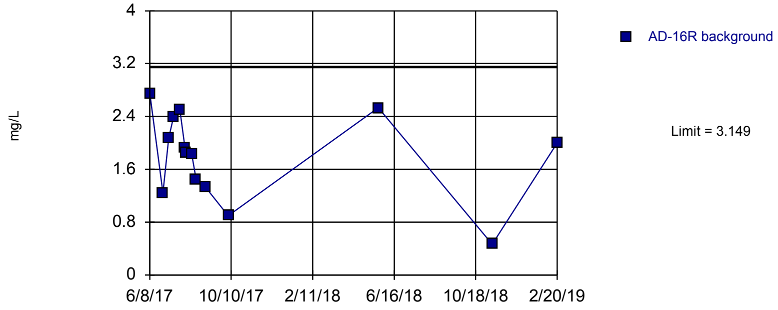
Background Data Summary (based on cube root transformation): Mean=3.196, Std. Dev.=1.283, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8246, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16R

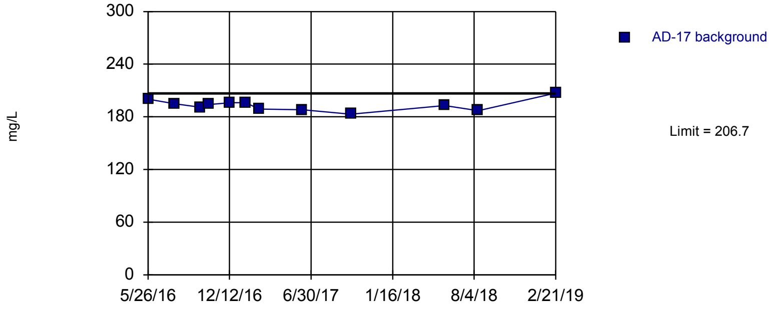


Background Data Summary: Mean=1.802, Std. Dev.=0.66, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9618, critical = 0.825. Kappa = 2.041 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-17 (bg)

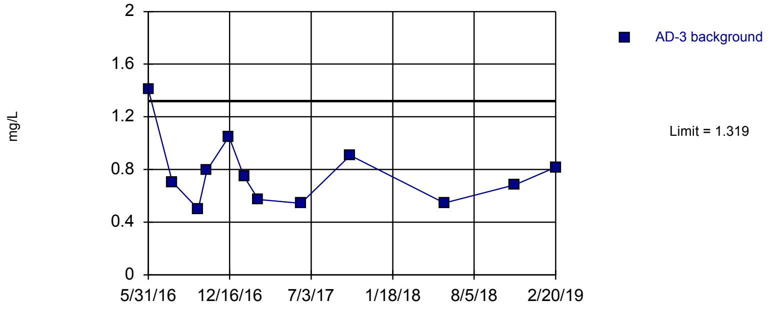


Background Data Summary: Mean=193.3, Std. Dev.=6.384, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9698, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-3

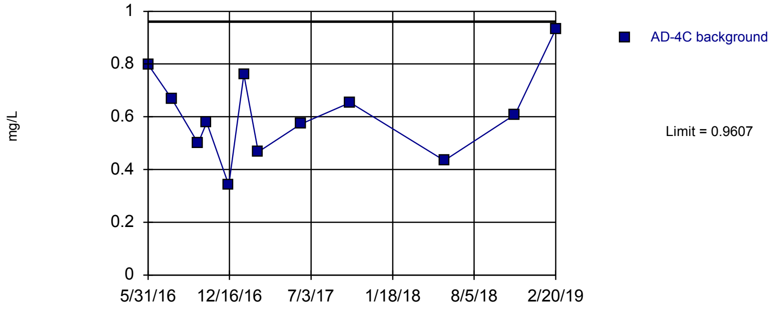


Background Data Summary: Mean=0.773, Std. Dev.=0.2586, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8744, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-4C

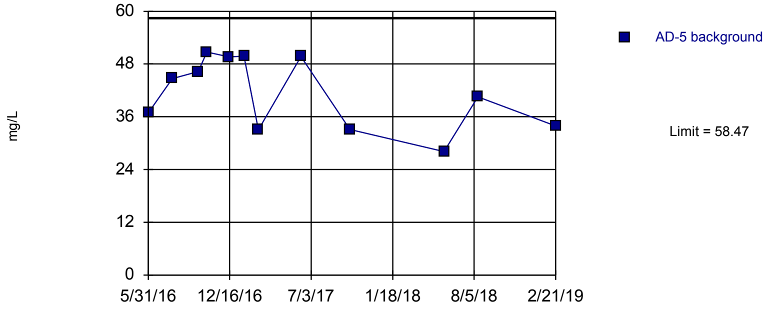


Background Data Summary: Mean=0.6093, Std. Dev.=0.1664, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9854, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-5 (bg)



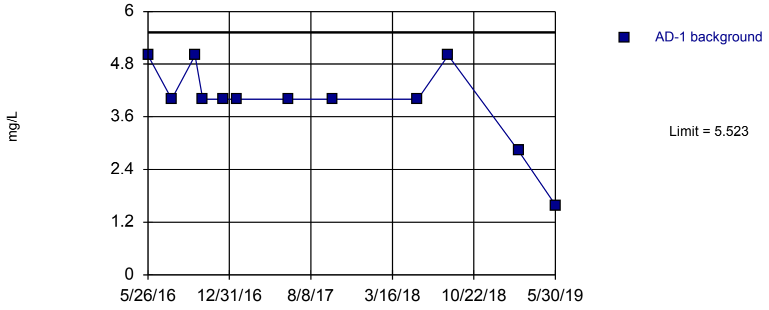
Background Data Summary: Mean=41.36, Std. Dev.=8.1, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8897, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



Background Data Summary (based on square transformation): Mean=16.46, Std. Dev.=6.652, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8287, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

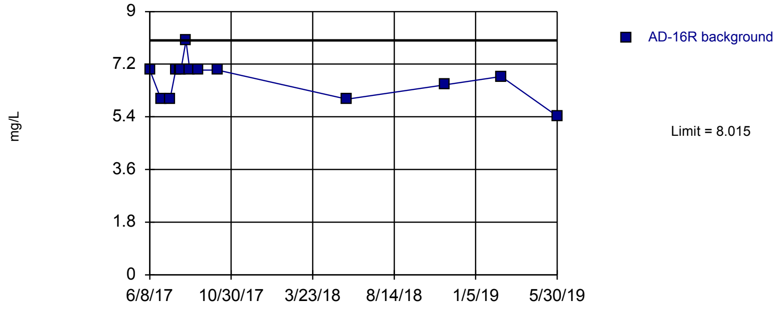
Constituent: Chloride Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16R



Background Data Summary: Mean=6.694, Std. Dev.=0.6474, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8766, critical = 0.825. Kappa = 2.041 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

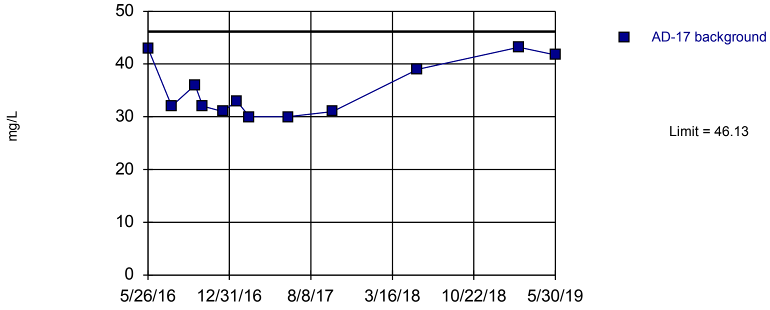
Constituent: Chloride Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



Background Data Summary: Mean=35.16, Std. Dev.=5.195, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8334, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

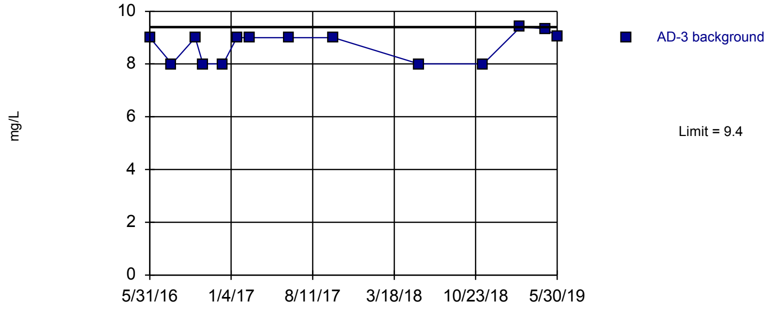
Constituent: Chloride Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, AD-3



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 14 background values. Well-constituent pair annual alpha = 0.01715. Individual comparison alpha = 0.008612 (1 of 2). Assumes 1 future value.

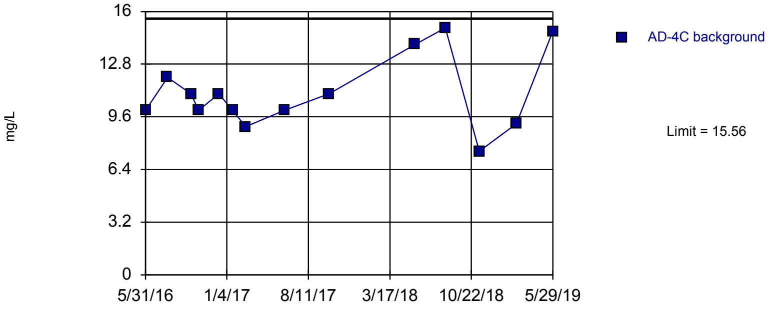
Constituent: Chloride Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-4C



Background Data Summary: Mean=11.03, Std. Dev.=2.219, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9097, critical = 0.825. Kappa = 2.041 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

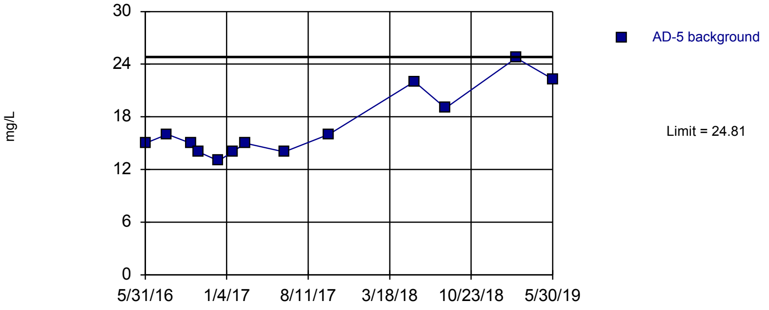
Constituent: Chloride Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



Background Data Summary: Mean=16.92, Std. Dev.=3.8, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8277, critical = 0.814. Kappa = 2.077 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride Analysis Run 11/7/2019 10:38 AM

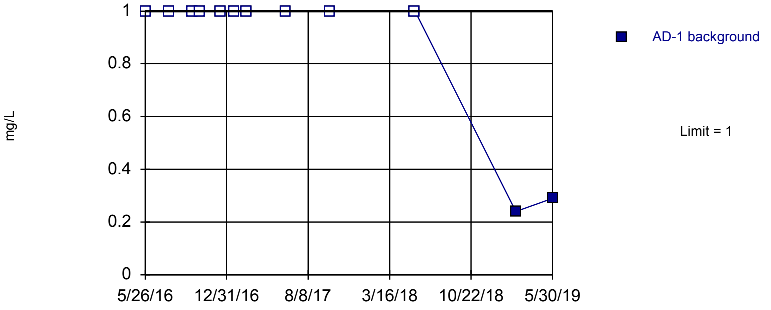
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-1 (bg)



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 12 background values. 83.33% NDs. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 11/7/2019 10:38 AM

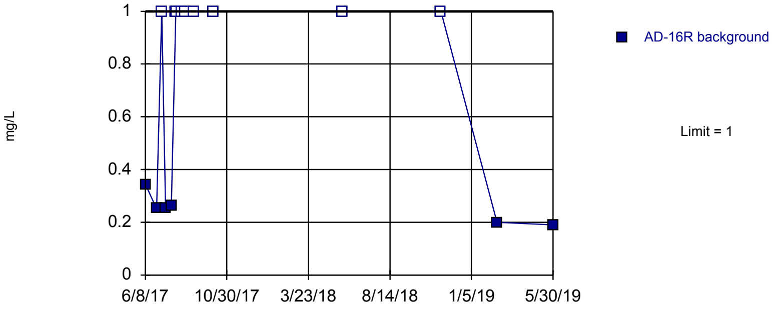
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-16R



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 15 background values. 60% NDs. Well-constituent pair annual alpha = 0.01501. Individual comparison alpha = 0.007533 (1 of 2). Assumes 1 future value.

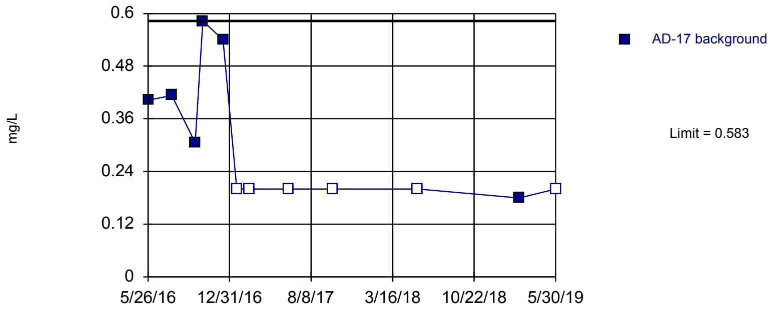
Constituent: Fluoride Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-17 (bg)



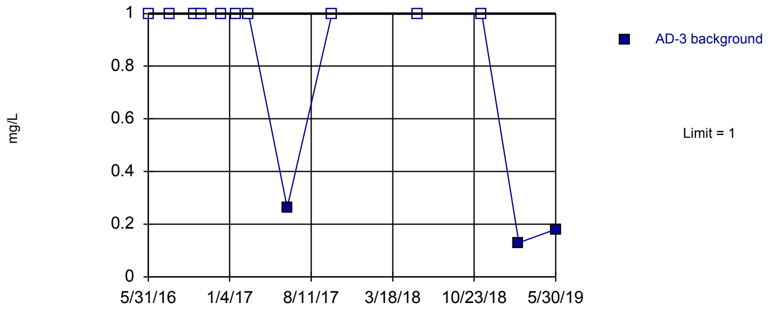
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. 50% NDs. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-3



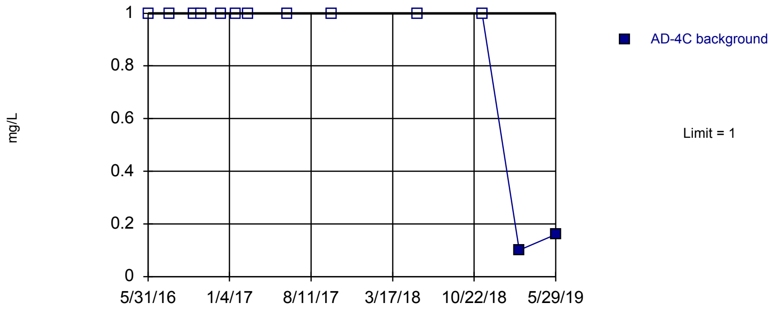
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 13 background values. 76.92% NDs. Well-constituent pair annual alpha = 0.01929. Individual comparison alpha = 0.009692 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-4C



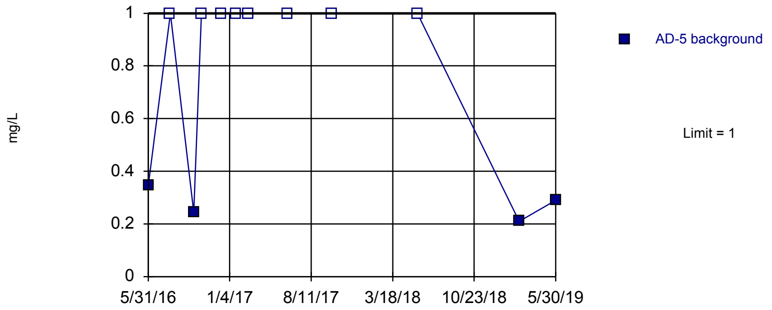
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 13 background values. 84.62% NDs. Well-constituent pair annual alpha = 0.01929. Individual comparison alpha = 0.009692 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-5 (bg)



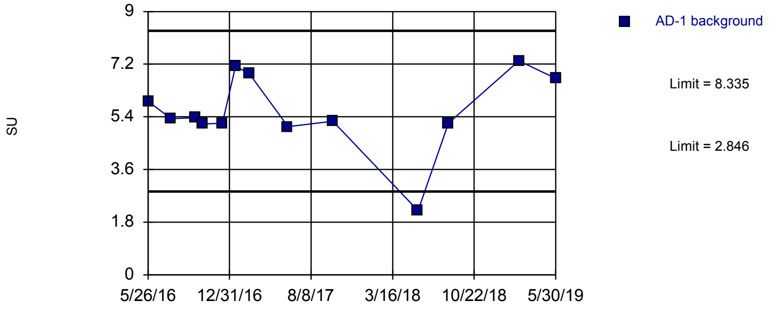
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 12 background values. 66.67% NDs. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



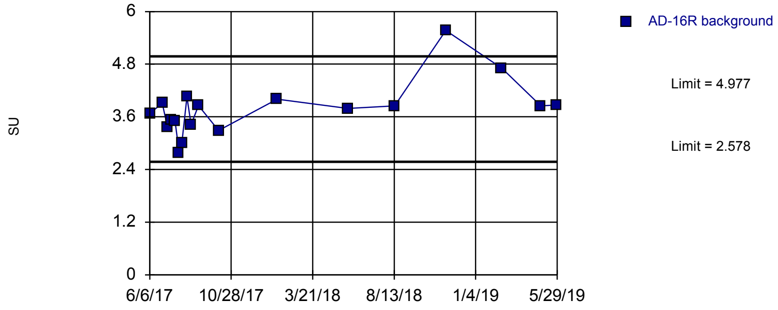
Background Data Summary: Mean=5.591, Std. Dev.=1.322, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8413, critical = 0.814. Kappa = 2.077 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16R



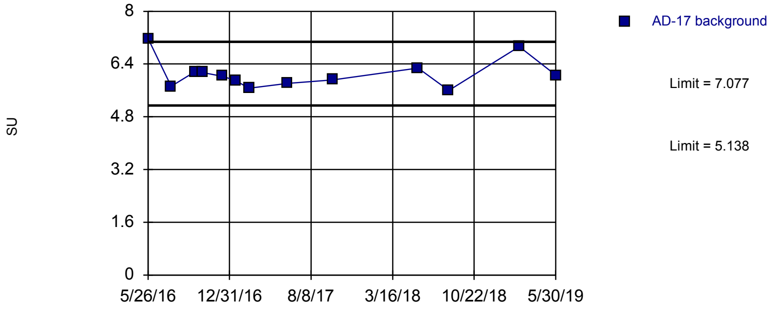
Background Data Summary: Mean=3.778, Std. Dev.=0.6212, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8834, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



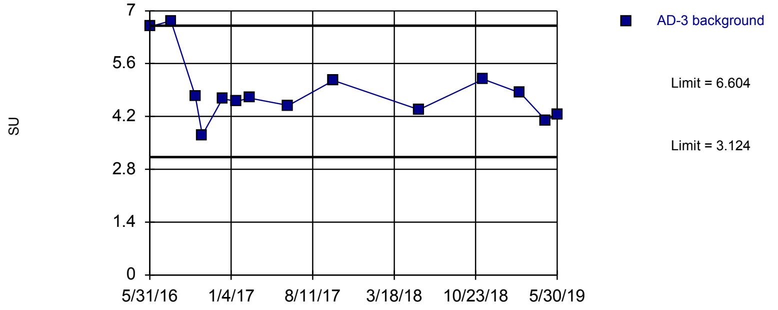
Background Data Summary: Mean=6.108, Std. Dev.=0.4667, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8501, critical = 0.814. Kappa = 2.077 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-3

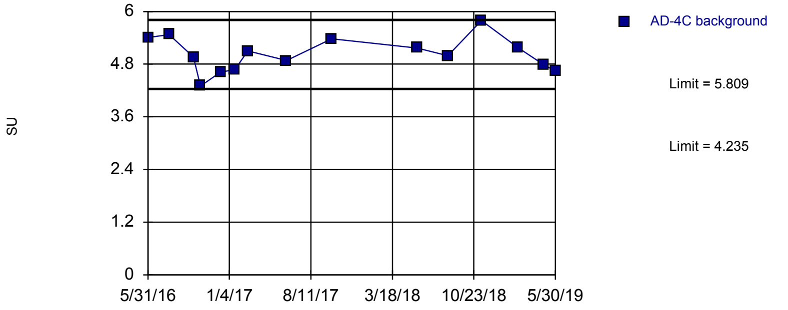


Background Data Summary: Mean=4.864, Std. Dev.=0.8526, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8501, critical = 0.825. Kappa = 2.041 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-4C



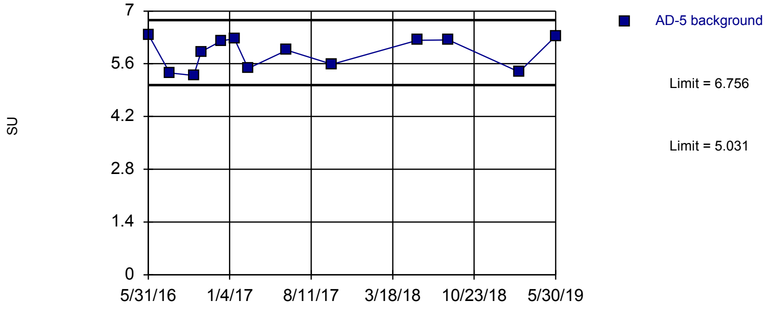
Background Data Summary: Mean=5.022, Std. Dev.=0.3924, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9865, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-5 (bg)



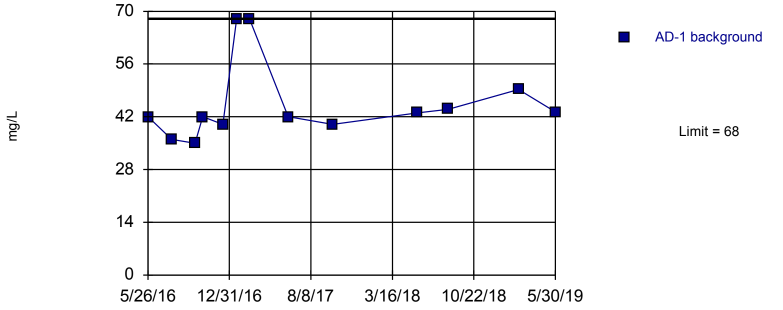
Background Data Summary: Mean=5.894, Std. Dev.=0.4153, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8601, critical = 0.814. Kappa = 2.077 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Non-parametric, AD-1 (bg)



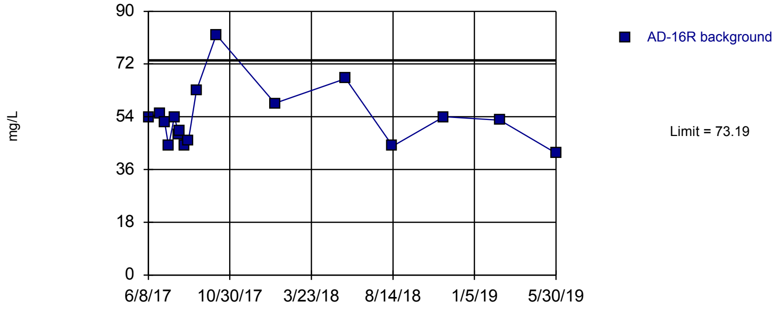
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 13 background values. Well-constituent pair annual alpha = 0.01929. Individual comparison alpha = 0.009692 (1 of 2). Assumes 1 future value.

Constituent: Sulfate Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-16R



Background Data Summary: Mean=53.47, Std. Dev.=10.11, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8735, critical = 0.851. Kappa = 1.951 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

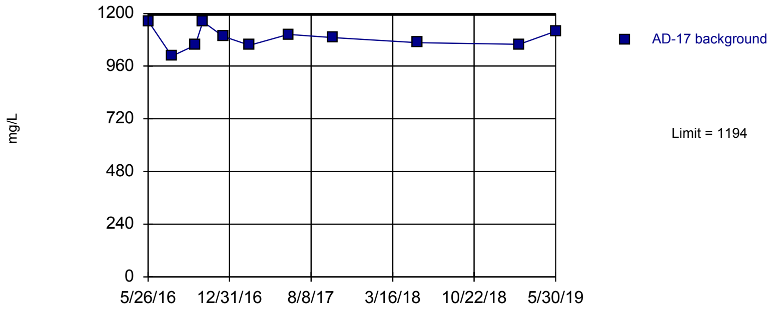
Constituent: Sulfate Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



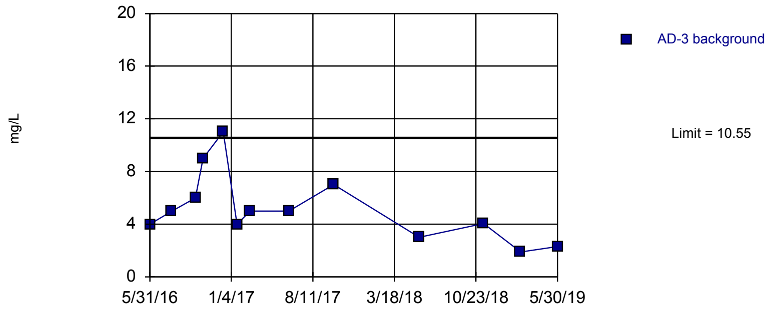
Background Data Summary: Mean=1089, Std. Dev.=48.34, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9517, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-3



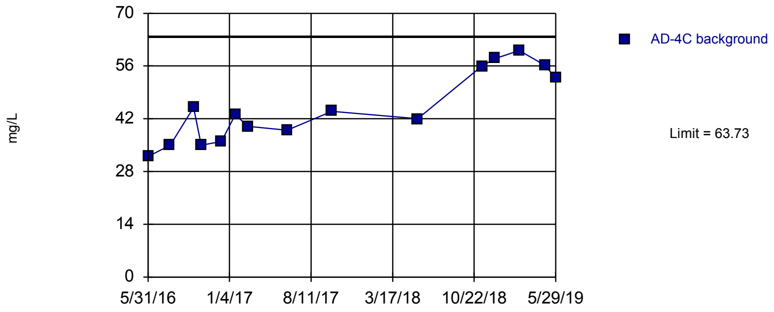
Background Data Summary: Mean=5.173, Std. Dev.=2.589, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9137, critical = 0.814. Kappa = 2.077 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-4C



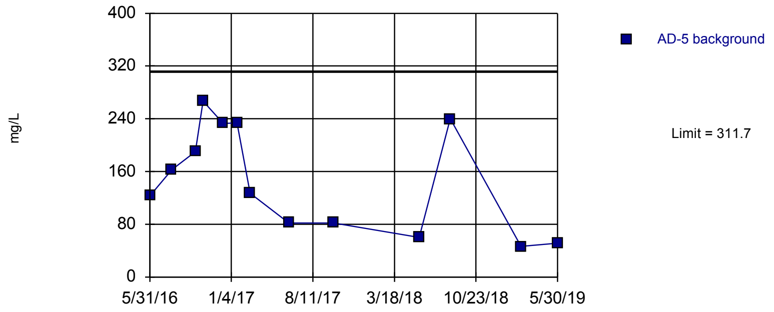
Background Data Summary: Mean=44.94, Std. Dev.=9.37, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9138, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)

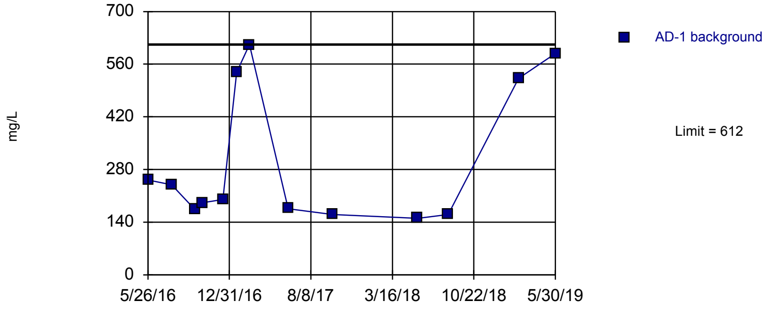


Background Data Summary: Mean=146.1, Std. Dev.=79.77, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9036, critical = 0.814. Kappa = 2.077 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 11/7/2019 10:38 AM
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Non-parametric, AD-1 (bg)



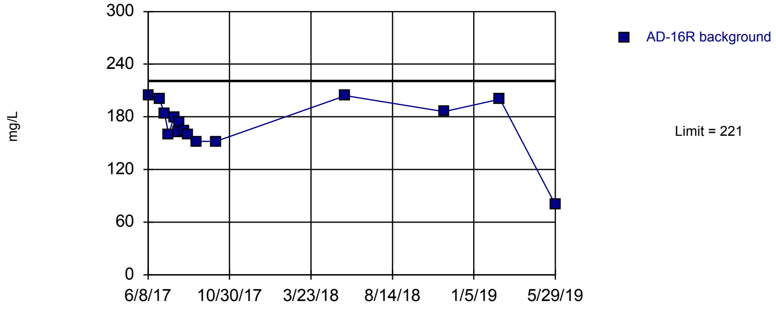
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 13 background values. Well-constituent pair annual alpha = 0.01929. Individual comparison alpha = 0.009692 (1 of 2). Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-16R



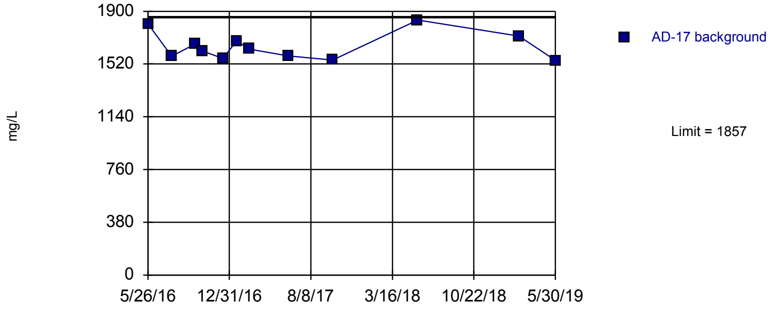
Background Data Summary (based on square transformation): Mean=30087, Std. Dev.=9358, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9045, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-17 (bg)



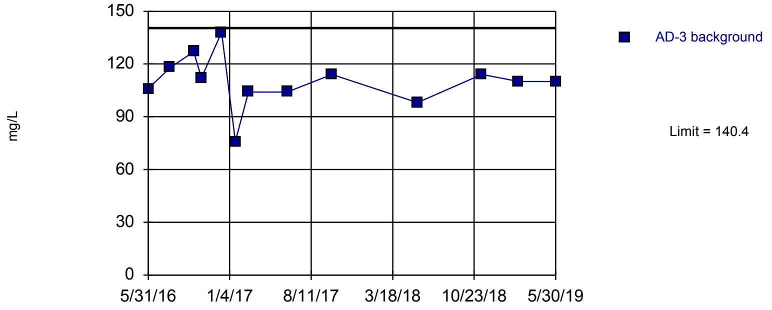
Background Data Summary: Mean=1647, Std. Dev.=99.38, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8827, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-3



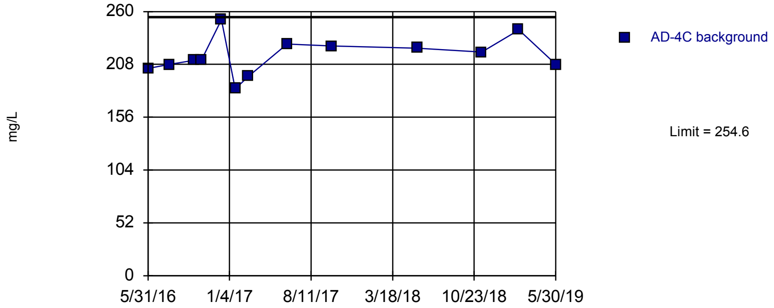
Background Data Summary: Mean=110.1, Std. Dev.=14.61, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9352, critical = 0.814. Kappa = 2.077 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-4C



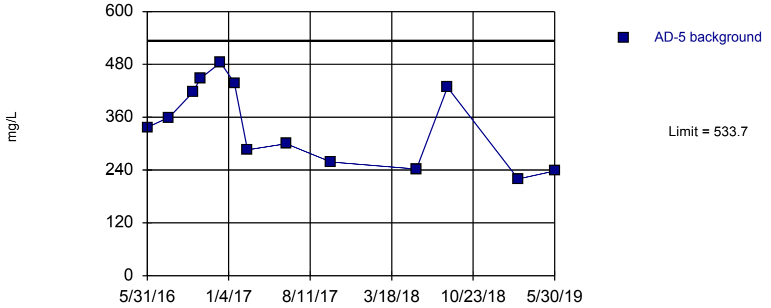
Background Data Summary: Mean=216.6, Std. Dev.=18.3, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9809, critical = 0.814. Kappa = 2.077 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-5 (bg)



Background Data Summary: Mean=342.7, Std. Dev.=91.96, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9173, critical = 0.814. Kappa = 2.077 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 11/7/2019 10:38 AM

Welsh BASP Client: Geosyntec Data: Welsh BASP

APPENDIX III

Alternate source demonstrations are included in this appendix. Alternate sources are sources or reasons that explain that statistically significant increases over background or statistically significant levels above the groundwater protection standard are not attributable to the CCR unit.

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

J. Robert Welsh Plant
Pittsburg, Texas

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

94 Chatham Lane
Suite 103
Columbus, Ohio 43221

January 7, 2019

CHA8462

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
BASP	Bottom Ash Storage Pond
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LPL	Lower Prediction Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

Eight to ten background monitoring events were conducted at the Welsh Bottom Ash Storage Pond (BASP), and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. Prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is concluded only if both samples in a series of two exceeds the UPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed. Following two detection monitoring events at the BASP, an SSI for chloride at well AD-4C was identified by intrawell analysis.

A summary of the detection monitoring analytical results and the calculated prediction limits to which they were compared is provided in Table 1.

1.1 CCR Rule Requirements

In accordance with the United States Environmental Protection Agency (USEPA) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments, Rule 40 CFR 257.94(e)(2) states the following:

> *The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report.*

Two detection monitoring events were conducted on May 23-24, 2018 and August 14, 2018 at the Welsh BASP to identify SSIs over background limits. The CCR Rule allows the owner or operator 90 days from the determination of an SSI to demonstrate that the SSI resulted from a source other than the regulated CCR unit, such as an error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

Pursuant to the Rule, Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report, which documents that the SSIs cited above should not be attributed to the Welsh BASP.

1.2 Demonstration of Alternative Sources

An evaluation was completed to assess possible alternative sources to which identified SSIs could be attributed. Alternative sources were identified amongst five types, based on methodology provided by EPRI (2017):

- ASD Type I: Sampling Causes;
- ASD Type II: Laboratory Causes;
- ASD Type III: Statistical Evaluation Causes;
- ASD Type IV: Natural Variation; and
- ASD Type V: Alternative Sources.

A demonstration was conducted to show that the increases in constituent concentrations were based on a Type IV cause and not by a release from the Welsh BASP.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The CCR Rule allows the owner or operator 90 days from the determination of an SSI to demonstrate that a source other than the CCR unit caused the SSI. Identified SSIs, evaluation methodology, and the proposed alternative source are described below.

2.1 Proposed Alternative Source

Initial review of site geochemistry, site historical data, and laboratory QA/QC did not identify ASDs due to Type I or Type II issues. A review of the statistical analyses did not identify any Type III issues. An initial review of site geochemistry revealed natural variation as a source of the observed chloride SSI at well AD-4C.

A site map showing well locations is presented in Figure 1. Groundwater flow beneath the BASP is typically to the southeast, as shown in Figure 2. Wells of interest to this ASD include AD-1, which lies upgradient of the BASP and downgradient wells AD-3 and AD-4C.

Figure 3 summarizes groundwater composition at the wells of interest using a Schoeller diagram. The Schoeller diagram shows that downgradient wells AD-4C and AD-3 are deficient in calcium, magnesium and bicarbonate (collectively known as hardness species), relative to AD-1. Contrary to the hardness species, the concentrations of sodium and chloride are identical between AD-1 and AD-4C. During two sampling events AD-1 groundwater is in equilibrium with calcite, a major mineral in limestone, whereas both AD-3 and AD-4C are significantly undersaturated based on the calculated saturation indices (Table 2). Both AD-3 and AD-4C strongly resemble storm water due to the near absence of calcium and magnesium (both were less than 1 mg/L during the sampling event).

AD-4C could be susceptible to surface water or rainwater intrusion due to its shallow construction. The filter pack extends to four feet below ground surface (ft bgs) and the screened interval is from 5-15 ft bgs (Arcadis, 2018). Figure 4 shows an inverse relationship between groundwater elevation and chloride concentration over time. These results suggest that as groundwater rises, likely due to infiltration from surface water, the chloride concentration in the groundwater is diluted. The groundwater elevation at AD-4C appears to be trending downwards since January 2017, with an increasing trend for chloride observed. Despite recent increases, the concentrations remain consistent with historical values at the well.

The second semi-annual detection monitoring event for 2018 was completed in November 2018, with a reported chloride concentration of 7.5 milligrams per liter (mg/L), which is below the UPL of 14 mg/L. The decline in chloride concentrations at AD-4C suggest that the SSI was due to a temporary variation in groundwater conditions and is an additional line of evidence that the chloride SSI should not be attributed to a release from the BASP.

2.2 Sampling Requirements

As the ASD described above supports the position that the identified SSIs are not due to a release from the Welsh BASP, the unit will remain in the detection monitoring program. Groundwater at the unit will be sampled for Appendix III parameters on a semi-annual basis.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and supports the position that the SSIs in Appendix III detection monitoring constituents are not due to a release from the Welsh BASP during the May and August 2018 sampling events. The identified SSI for chloride at well AD-4C was attributed to natural variation, and concentrations have since declined below the upper prediction limit. Therefore, no further action is warranted and the Welsh BASP will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in Attachment A.

SECTION 4

REFERENCES

Arcadis, 2018. Bottom Ash Storage Pond – CCR Groundwater Monitoring Well Network Evaluation. February 2018.

EPRI, 2017. Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Site. 3002010920. October

U.S. EPA, 2015. Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities (Final Rule). Fed. Reg. 80 FR 21301, pp. 21301-21501, 40 CFR Parts 257 and 261, April.

TABLES

Table 1: Detection Monitoring Data Evaluation
Welsh Plant - Bottom Ash Storage Pond

Parameter	Units	Description	AD-3	AD-4C		AD-16R	
			5/24/2018	5/24/2018	8/14/2018	5/23/2018	8/14/2018
Boron	mg/L	Intrawell Background Value (UPL)	0.0333	0.0571		0.0700	
		Detection Monitoring Data	0.0069 J	0.0251	--	0.0320	--
Calcium	mg/L	Intrawell Background Value (UPL)	1.541	0.962		3.069	
		Detection Monitoring Data	0.545	0.434	--	2.53	--
Chloride	mg/L	Intrawell Background Value (UPL)	9	12.6		8.3	
		Detection Monitoring Data	8	**14**	**15**	6	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1	1		1	
		Detection Monitoring Data	<0.083	<0.083	--	<0.083	--
pH	SU	Intrawell Background Value (UPL)	7.63	5.91		4.4	
		Intrawell Background Value (LPL)	2.43	3.95		2.61	
		Detection Monitoring Data	4.38	5.17	--	3.79	--
Sulfate	mg/L	Intrawell Background Value (UPL)	12.4	49.0		64.1	
		Detection Monitoring Data	3	42	--	**67**	44
TDS	mg/L	Intrawell Background Value (UPL)	156	263		214	
		Detection Monitoring Data	98	224	--	204	--

Notes

UPL: Upper prediction limit

LPL: Lower prediction limit

TDS: Total dissolved solids

J: Estimated value

<: Indicates the parameter was not detected

Bold values exceed the background value.

Background values are shaded gray.

--: sample was not collected

Table 2: Calculated Calcite Saturation Indices
Welsh Bottom Ash Storage Pond

Well ID	Date	Calcite ($CaCO_3$) Saturation Index
AD-1	10/21/2016	-3.12
	01/20/2017	0.22
	02/24/2017	0.19
	06/08/2017	-3.48
AD-3	10/21/2016	-6.37
	01/20/2017	-6.04
	02/24/2017	-6.04
	06/08/2017	-6.15
AD-4	10/21/2016	-5.97
	01/20/2017	-5.82
	02/24/2017	-5.73
	06/08/2017	-5.77

Notes:
Calculated SIs greater than -0.2 suggest saturation of the mineral and are shaded red in red text.

FIGURES

Monitoring Well Network

- Downgradient Sampling Location
- Background Sampling Location

Bottom Ash Storage Pond

Notes
- Monitoring well coordinates provided by AEP.
- Site features based on information avilable in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).

500 250 0 500
Feet

Site Layout
Bottom Ash Storage Pond

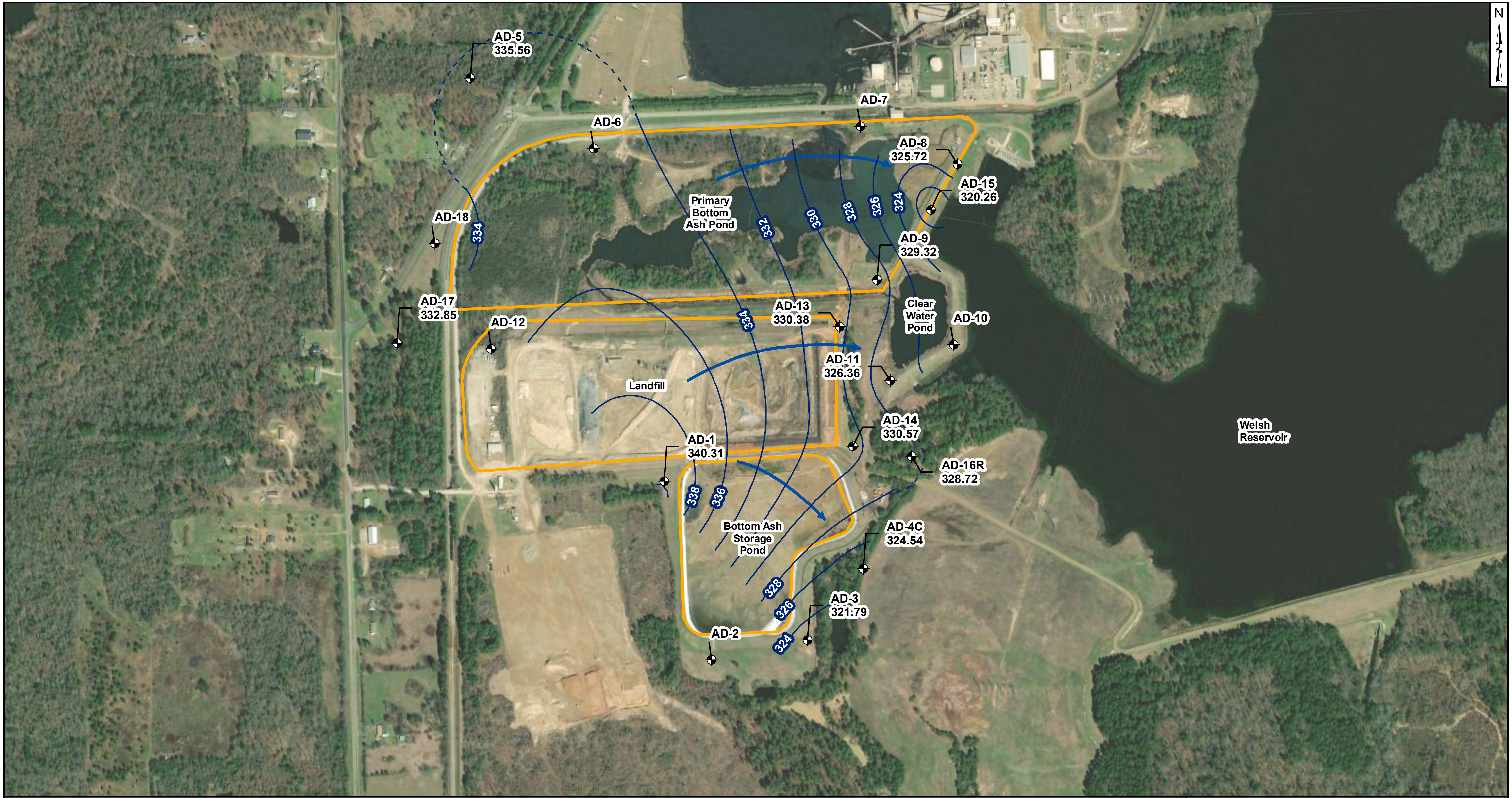
AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Columbus, Ohio
2018/01/26

Figure
1

C:\Users\mmuenich\Documents\local_projects\AEP_GIS\Welsh\MXDs\AEP-Welsh_BASP_Site_Layout.mxd. MMuenich. 1/26/2018. CHA8423/14/08.



Legend

- ⌖ Groundwater Monitoring Well
- → Approximate Groundwater Flow Direction
- — Groundwater Elevation Contour
- - - Inferred Groundwater Elevation Contour
- ▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on May 23, 2018) provided by AEP.
- Site features based on information avilable in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.
- Inferred groundwater contours were extrapolated from topgraphic and hydrographic information as well as previous monitoring events.
- AD-16 was replaced with AD-16R on 4/12/2017.
- Wells AD-2, -6, -7, -10 ,-12, and -18 were not gauged during the May 2018 sampling event.

750 375 0 750 Feet

Groundwater Potentiometric Map
May 2018

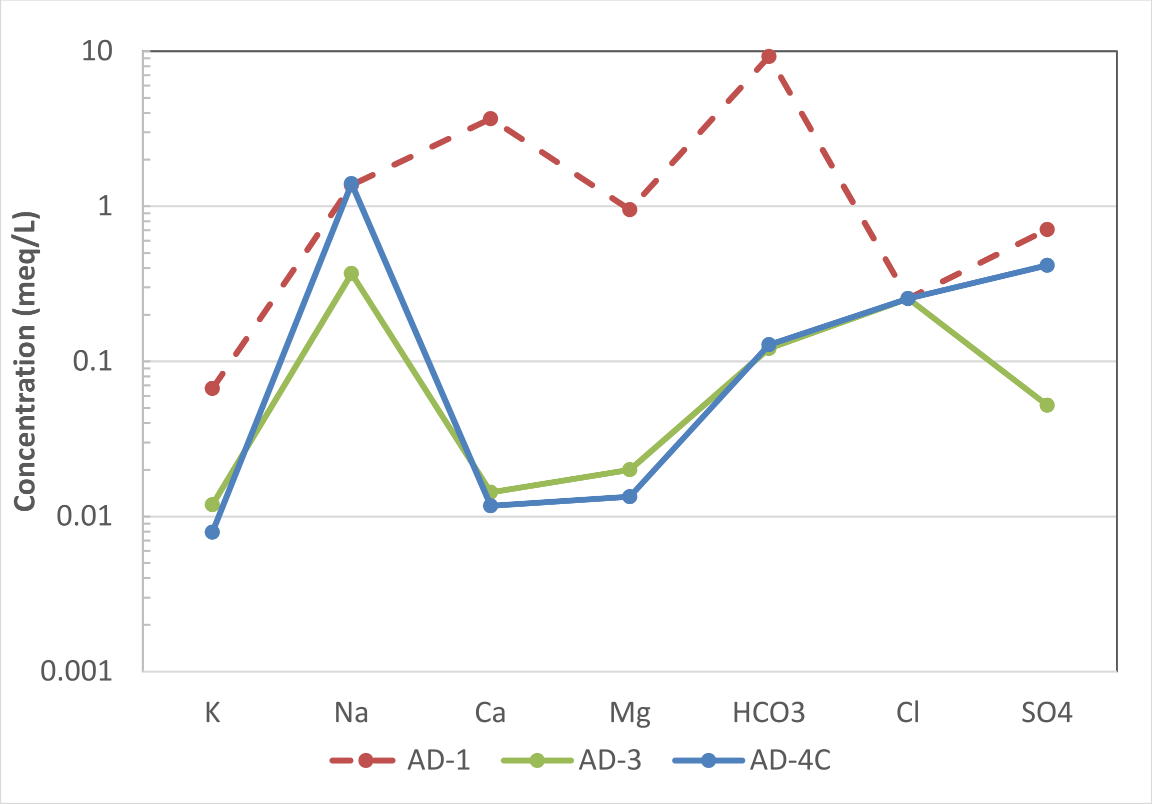
AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Figure
2

Columbus, Ohio | 2018/10/24

\\annarbor-01\data\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Welsh\2018\AEP-Welsh_GW_2018-05May.mxd. SKaroly. 10/24/2018. CHA8423/14/08.



Notes: Schoeller diagram for BASP upgradient well AD-1 and downgradient wells based on February 24, 2017 groundwater sampling event.

Schoeller Diagram

Welsh Bottom Ash Storage Pond

Geosyntec consultants

AMERICAN ELECTRIC POWER

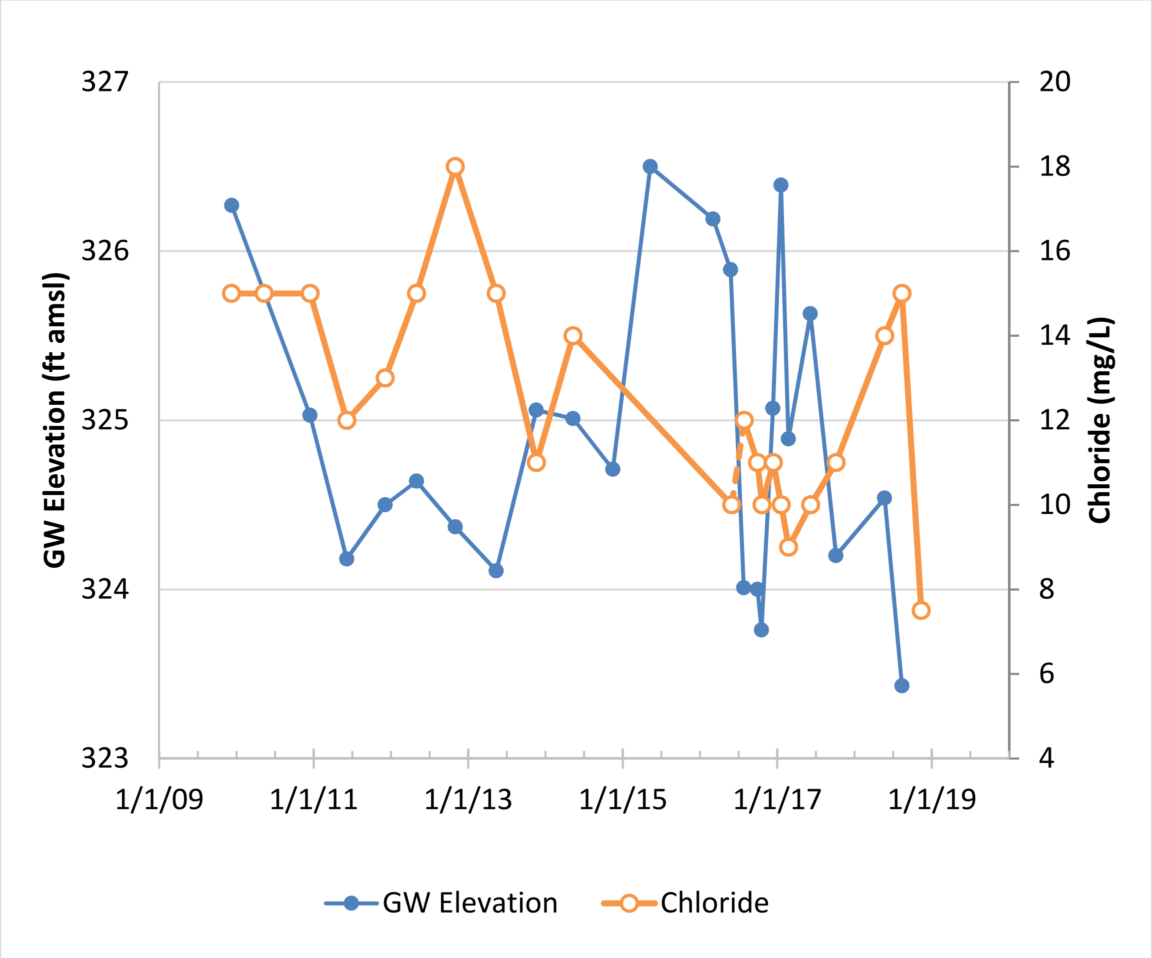
Figure

3

Columbus, Ohio

4-JAN-2019

internal info: path, date revised, author



Notes: Chloride data includes both historic data and data collected for CCR Rule compliance.

AD-4C Time Series Graph

Welsh Bottom Ash Storage Pond

Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure

4

Columbus, Ohio

4-JAN-2019

ATTACHMENT A

Certification by Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Welsh Bottom Ash Storage Pond CCR management area and that the requirements of 40 CFR 257.94(e)(2) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

DAVID ANTHONY MILLER
112498

David Anthony Miller
Signature

112498
License Number

TEXAS
Licensing State

01.07.19
Date

American Electric
Power Service
Corporation
Texas Registered
Engineering Firm No.
F-3341

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

J. Robert Welsh Plant
Bottom Ash Storage Pond
Pittsburg, Texas

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
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May 17, 2019

CHA8462

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LIST OF ACRONYMS AND ABBREVIATIONS

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ASD	Alternative Source Demonstration
BASP	Bottom Ash Storage Pond
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LPL	Lower Prediction Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

Eight to ten background monitoring events were conducted at the Welsh Bottom Ash Storage Pond (BASP). Upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. Prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is concluded only if both samples in a series of two exceeds the UPL and for pH exceeds the LPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

The second semi-annual detection monitoring event was performed in November 2018 (initial sampling event) and December 2018 (re-sampling event), and the results were compared to the calculated prediction limits. An SSI was identified for sulfate at well AD-4C by intrawell analysis. A summary of the detection monitoring analytical results and the calculated prediction limits to which they were compared is provided in Table 1.

1.1 CCR Rule Requirements

United States Environmental Protection Agency (USEPA) regulations regarding detection monitoring programs for coal combustion residuals (CCR) landfills and surface impoundments provide owners and operators with the option to make an alternative source demonstration (ASD) when an SSI is identified (40 CFR 257.94(e)(2)):

> *The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer… verifying the accuracy of the information in the report.*

Sulfate concentrations of 56 mg/L and 58 mg/L were reported for the sampling and re-sampling events on November 13, 2018 and December 18, 2018, respectively. Both concentrations exceeded the UPL value for sulfate of 49 mg/L. Pursuant to 40 CFR 257.94(e)(2) of the CCR Rule (40 CFR 257), Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report, which documents that the SSI for sulfate at AD-4C should not be attributed to the Welsh BASP.

1.2 Demonstration of Alternative Sources

An evaluation was completed to assess possible alternative sources to which the identified SSI could be attributed. Alternative sources were identified amongst five types, based on methodology provided by EPRI (2017):

- ASD Type I: Sampling Causes;
- ASD Type II: Laboratory Causes;
- ASD Type III: Statistical Evaluation Causes;
- ASD Type IV: Natural Variation; and
- ASD Type V: Alternative Sources.

A demonstration was conducted to show that the increases in constituent concentrations were based on either a Type IV or Type V cause and not by a release from the Welsh BASP.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The method used to assess possible alternative sources of the SSI for sulfate at AD-4C and the proposed alternative source are described below. In addition, the statistical revision of the background concentration for sulfate at AD-4C and the future sampling requirements for the Welsh BASP are presented.

2.1 Proposed Alternative Source

An initial review of field forms, site geochemistry, and laboratory QA/QC data did not identify alternative sources due to Type I or Type II issues. A review of the statistical analyses of the groundwater data for sulfate did not identify any Type III issues. However, a review of site geochemistry and historic operations revealed a change in chemistry at an upgradient well, due to either Type IV or Type V causes, as a potential source of the observed sulfate SSI at well AD-4C.

A site map showing the location of AD-4C and other network well locations is presented in Figure 1. Groundwater flow beneath the BASP is typically toward the southeast, as shown in Figure 2. The monitoring network includes background locations AD-1, AD-5, and AD-17 and compliance wells AD-3, AD-4C, and AD-16R.

The two exceedances for sulfate at AD-4C in November and December 2018 are shown in a time-series graph (Figure 3), where the dashed line represents the intrawell UPL for sulfate (49 mg/L). Overall, the concentration of sulfate appears to be increasing. Also shown are the sulfate concentrations at background well AD-1, which is the background well closest to AD-4C. The sulfate concentrations at AD-1 are commensurate with those of AD-4C in eight of the ten background monitoring events. In January and February 2017, sulfate at AD-1 was 68 mg/L, which was considerably higher than the other eight results for AD-1 as well as the results for AD-4C.

A Schoeller diagram was prepared for AD-1 to illustrate major constituent behavior for the four background sampling events where all data were available (Figure 4). Note that concentration units were converted to milli-equivalents per liter (meq/L), which allows the major cations and anions to be compared on a charge-equivalent basis. The rule of charge balance also requires that the sum of the major cations (potassium + sodium + calcium + magnesium) must be equal to the sum of the major anions (chloride + sulfate + bicarbonate + carbonate [if pH > 10]), when expressed in meq/L units. Calcium, magnesium and bicarbonate (collectively known as hardness species) were up to an order of magnitude higher in January and February 2017 compared to October 2016 and June 2017. In contrast, the concentration of sulfate increased approximately 50%, while sodium and chloride changed very little. Thus, while the sulfate concentration changed during these events, the magnitude of change in its concentration was much smaller than the charge in hardness species during the same time period.

A geochemical model (PHREEQC) was used to help explain the significance of species concentrations with respect to equilibrium with aquifer minerals. Calculated mineral saturation indices for calcite and gypsum for background well AD-1 and compliance wells AD-3 and AD-4C, which are located downgradient of AD-1, are presented in Table 2. Mineral saturation indices with a numerical value of zero (±0.2) indicate that the represented minerals are in equilibrium with the groundwater. Values less than -0.2 indicate undersaturation, implying that the represented minerals are not present in the aquifer. Model results show that AD-1 groundwater was in equilibrium with the mineral calcite ($CaCO_3$) during January and February 2017. However, the groundwater was undersaturated with respect to both calcite and gypsum in the October 2016 and June 2017 events. All AD-3 and AD-4C samples were significantly undersaturated with respect to calcite, as indicated by the large negative values in Table 2. Modeling results indicate that groundwater in wells AD-1, AD-3 and AD-4C is undersaturated with respect to gypsum ($CaSO_4 \cdot 2H_2O$) at all sampling events. Calcite crystals are known to precipitate and dissolve quickly as groundwater conditions either become conducive to calcite formation or disfavor it (Sanjuan and Girard, 1996). However, it is infeasible for the mineralogy of an entire aquifer to change in a matter of months. Therefore, the model results suggest that calcite is typically not present in the aquifer. The situation at AD-1, where the groundwater became saturated with respect to calcite in January and February 2017, appears to be transient and caused by a rapid increase in calcium and alkalinity, along with other subtle changes in composition (Figure 4). At other times (e.g., October 2016 and June 2017) the unidentified source of calcium and alkalinity is not active, and groundwater no longer appears to be in equilibrium with calcite.

Concentrations of sulfate at upgradient well AD-1 have been even higher in the past than the values observed in 2017 during the CCR Rule background monitoring period. Prior to establishing the groundwater monitoring network for the BASP, the Plant monitored wells AD-1 and AD-4C for sulfate and other groundwater constituents. Sulfate concentrations at AD-4C were typically around 25-30 mg/L between 2009 and 2014, which is lower than the concentrations observed during the background monitoring period (35-45 mg/L, as shown in Figure 3). Prior to 2009, sulfate concentrations at AD-1 were generally much higher and subject to significant upward swings, including a peak value of 616 mg/L sulfate on in June 2007 (Figure 5).

Sulfate concentrations are also high at other locations across the Site. Upgradient well AD-17, which is located further northwest from the BASP than AD-1, had sulfate concentrations above 1,000 mg/L for the entire background monitoring period (Figure 6). Groundwater samples collected from borings advanced in 2009 approximately 0.5 miles to the north of the BASP to evaluate background conditions identified a maximum sulfate concentration of 156 mg/L (Geosyntec, 2009). These results suggest either sulfate is naturally highly variable or groundwater concentrations are fluctuating in response to a variety of possible sources (such as site activities) across the site.

While the source of upgradient impacts to AD-1, and thus the increase in sulfate at AD-4C cannot be identified, it does not appear to be caused by a release from the pond. No other Appendix III species have a similar increase, which would be expected if there was a release (Figure 7). This includes several species which are more conservative than sulfate and have relatively higher concentrations in the pond water than in groundwater, such as potassium and sodium (Figure 8), suggesting that no mixing is occurring between the pond water and groundwater at AD-4C.

The recent SSI for sulfate at AD-4C is best attributed to variations in the groundwater chemistry that are observed at multiple locations. The source of the perturbations in groundwater is not known and could include either natural variability or plant activities, such as site construction or pond management, which could affect groundwater quality. Additionally, the lack of increase in other constituent concentrations suggests that the sulfate SSI should not be attributed to a release from the BASP.

2.2 Statistical Revision

When historical data is included with results collected under the CCR Rule, an upward trend is observed for sulfate at AD-4C (Figure 9). This trend may be representative of higher sulfate concentrations observed across the site, including at upgradient locations AD-1 and AD-17. As the increase in sulfate does not appear to be related to a release from the BASP, the background dataset was revised to include the four most recent sampling events (October 2017, 44 mg/L; May 2018, 42 mg/L; November 2018, 56 mg/L; December 2018, 58 mg/L). The intrawell UPL at AD-4C for sulfate was recalculated as 59.1 mg/L. This value will be used in detection monitoring events going forward until the background dataset is revised following the collection of at least four additional samples. The revised statistics are provided in Attachment A.

2.3 Sampling Requirements

As the ASD described above supports the position that the identified SSIs are not due to a release from the Welsh BASP, the unit will remain in the detection monitoring program. Groundwater at the unit will be sampled for Appendix III parameters on a semi-annual basis.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and supports the position that the SSIs in Appendix III detection monitoring constituents are not due to a release from the Welsh BASP during the November and December 2018 sampling events. The identified SSI for sulfate at well AD-4C was attributed to either natural variation or anthropogenic impacts, which may be related to the sulfate perturbation that was detected at AD-1. Therefore, no further action is warranted, and the Welsh BASP will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in Attachment B.

SECTION 4

REFERENCES

Arcadis, 2018. Bottom Ash Storage Pond – CCR Groundwater Monitoring Well Network Evaluation. February.

EPRI, 2017. Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites. 3002010920. October.

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TABLES

Table 1: Detection Monitoring Data Evaluation
Welsh Plant - Bottom Ash Storage Pond

Parameter	Units	Description	AD-3		AD-4C		AD-16R	
			11/13/2018	12/18/2018	11/13/2018	12/18/2018	11/13/2018	1/11/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.033		0.057		0.070	
		Detection Monitoring Result	0.009	-	0.01	-	0.02	-
Calcium	mg/L	Intrawell Background Value (UPL)	1.54		0.962		3.07	
		Detection Monitoring Result	0.684	-	0.609	-	0.467	-
Chloride	mg/L	Intrawell Background Value (UPL)	9.0		12.6		8.3	
		Detection Monitoring Result	8	-	7.5	-	6.5	-
Fluoride	mg/L	Intrawell Background Value (UPL)	1		1		1	
		Detection Monitoring Result	<0.083	-	<0.083	-	<0.083	-
pH	SU	Intrawell Background Value (UPL)	7.63		5.91		4.40	
		Intrawell Background Value (LPL)	2.43		3.95		2.61	
		Detection Monitoring Result	5.19	-	5.79	-	**5.57**	2.66
Sulfate	mg/L	Intrawell Background Value (UPL)	12.4		49.0		64.1	
		Detection Monitoring Result	4.05	-	**56**	**58**	54	-
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	156		263		214	
		Detection Monitoring Result	114	-	220	-	186	-

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

-: Not Sampled

Bold values exceed the background value.

Background values are shaded gray.

Based on a 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the calculated background

Table 2: Calculated Mineral Saturation Indices
Welsh Bottom Ash Storage Pond

Well ID	Sampling Date	Calcite	Gypsum
AD-1	1/20/2017	0.2	-1.6
	2/24/2017	0.2	-1.6
	6/8/2017	-3.5	-2.4
	10/21/2016	-3.1	-2.4
AD-3	1/20/2017	-6.0	-4.6
	2/24/2017	-6.0	-4.6
	6/8/2017	-6.2	-4.7
	10/21/2016	-6.4	-4.3
AD-4C	1/20/2017	-5.8	-3.7
	2/24/2017	-5.7	-3.9
	6/8/2017	-5.8	-3.8
	10/21/2016	-6.0	-3.9

Note:
Values between -0.2 and 0.2 indicate the mineral is in equilibrium with groundwater.
Results with values indicating equilibrium are highlighted in red.

FIGURES

Monitoring Well Network

- ⊕ Downgradient Sampling Location
- ⊕ Background Sampling Location

▭ Bottom Ash Storage Pond

Notes
- Monitoring well coordinates provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluation (Arcadis, 2016).

500 250 0 500
Feet

Site Layout
Bottom Ash Storage Pond

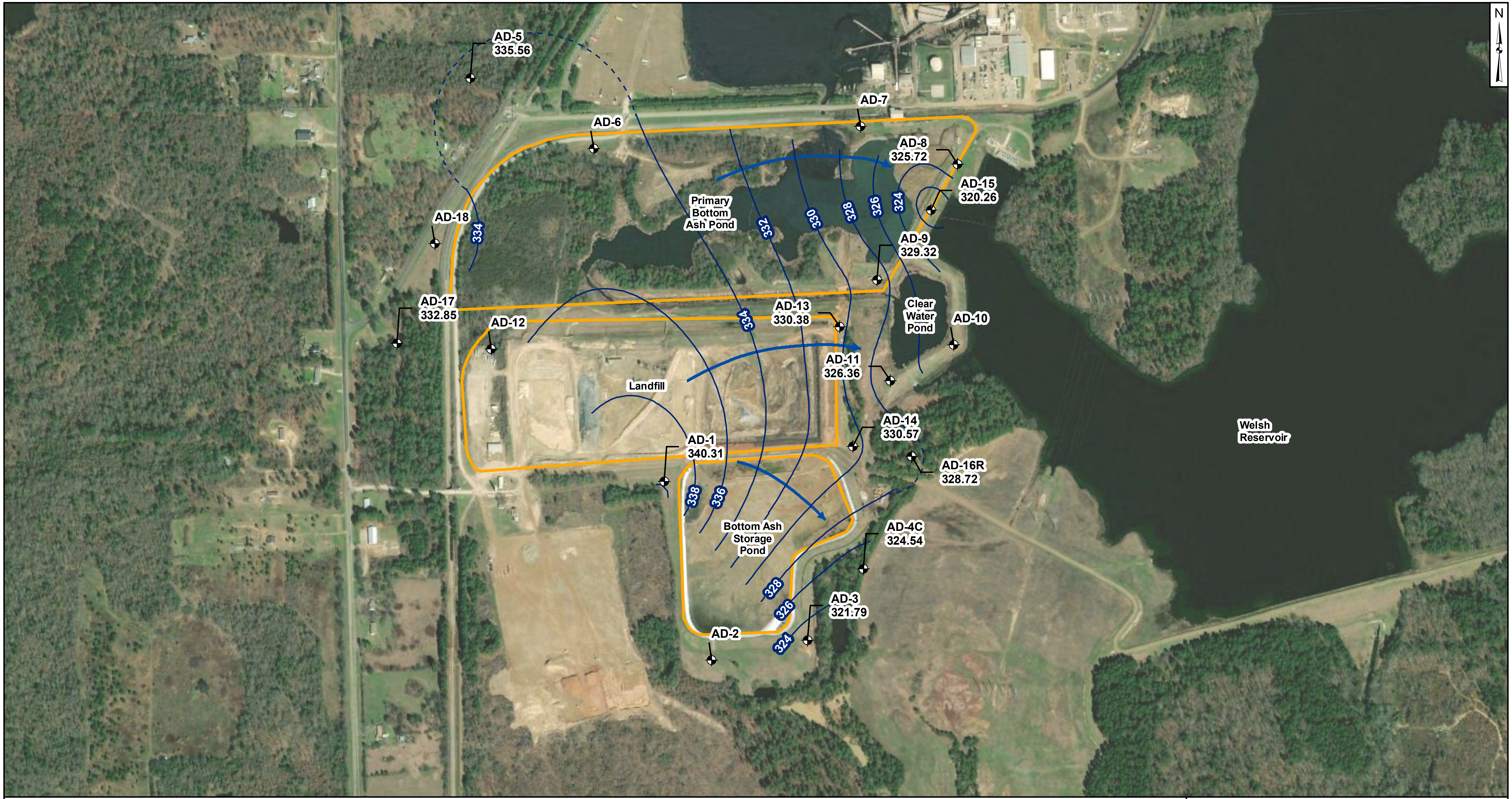
AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Columbus, Ohio
2018/01/26

Figure
1

C:\Users\mmuenich\Documents\local_projects\AEP_GIS\Welsh\MXDs\AEP-Welsh_BASP_Site_Layout.mxd. MMuenich. 1/26/2018. CHA8423/14/08.



Legend
- ⊕ Groundwater Monitoring Well
- ➡ Approximate Groundwater Flow Direction
- ── Groundwater Elevation Contour
- - - - Inferred Groundwater Elevation Contour
- ▭ CCR Units

Notes
- Monitoring well coordinates and water level data (collected on May 23, 2018) provided by AEP.
- Site features based on information avilable in CCR Groundwater Monitoring Well Network Evaluation (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.
- Inferred groundwater contours were extrapolated from topographic and hydrographic information as well as previous monitoring events.
- AD-16 was replaced with AD-16R on 4/12/2017.
- Wells AD-2, -6, -7, -10 ,-12, and -18 were not gauged during the May 2018 sampling event.

750 375 0 750
Feet

Groundwater Potentiometric Map
May 2018

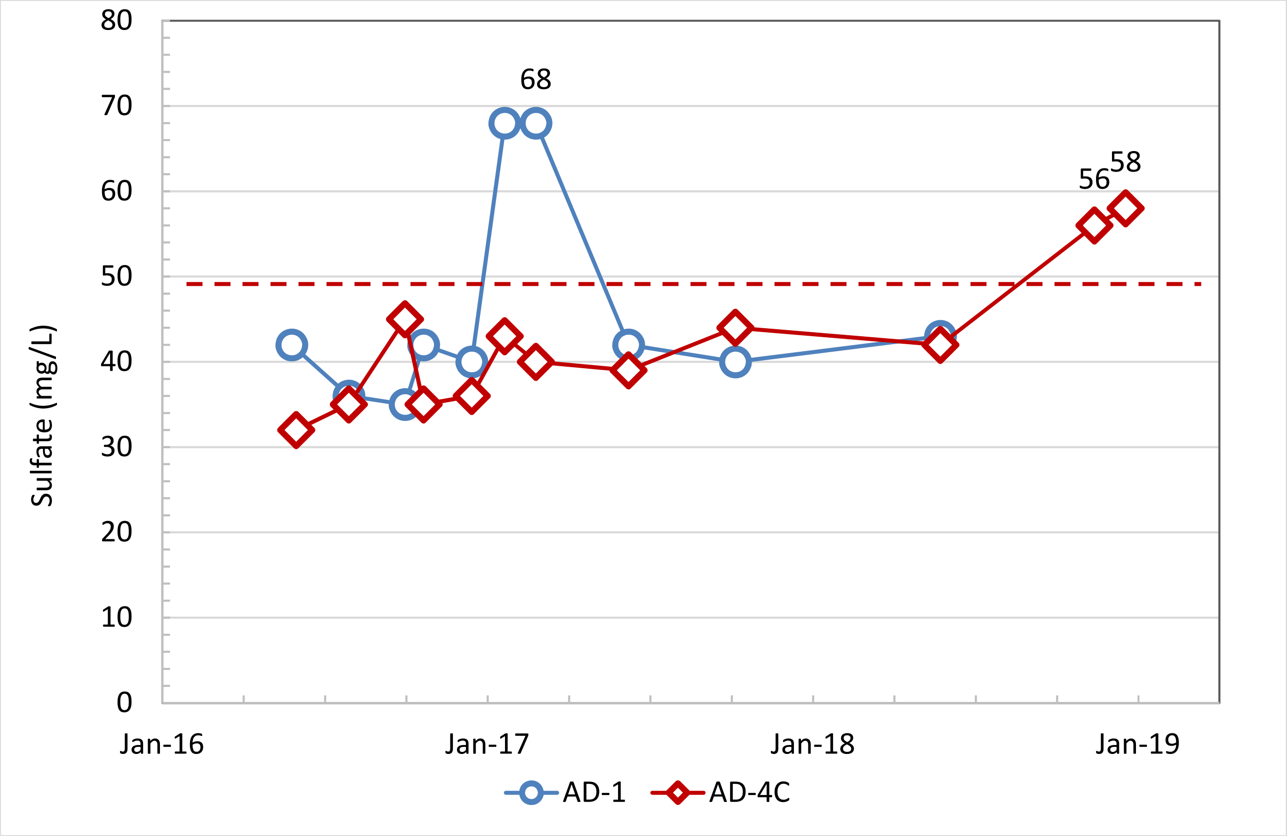
AEP Welsh Power Plant
Cason, Texas

Geosyntec consultants

Figure
2

Columbus, Ohio
2018/10/24

\\annarbor-01\data\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Welsh\2018\AEP-Welsh_GW_2018-05May.mxd. SKaroly. 10/24/2018. CHA8423/14/08.



Notes: Sulfate time series diagram for BASP upgradient well AD-1 and downgradient well AD-4C under the CCR Rule program. The dashed line represents the intrawell UPL for sulfate at AD-4C (49 mg/L).

Sulfate Time Series Graph

Welsh Bottom Ash Storage Pond

Geosyntec consultants

AMERICAN ELECTRIC POWER

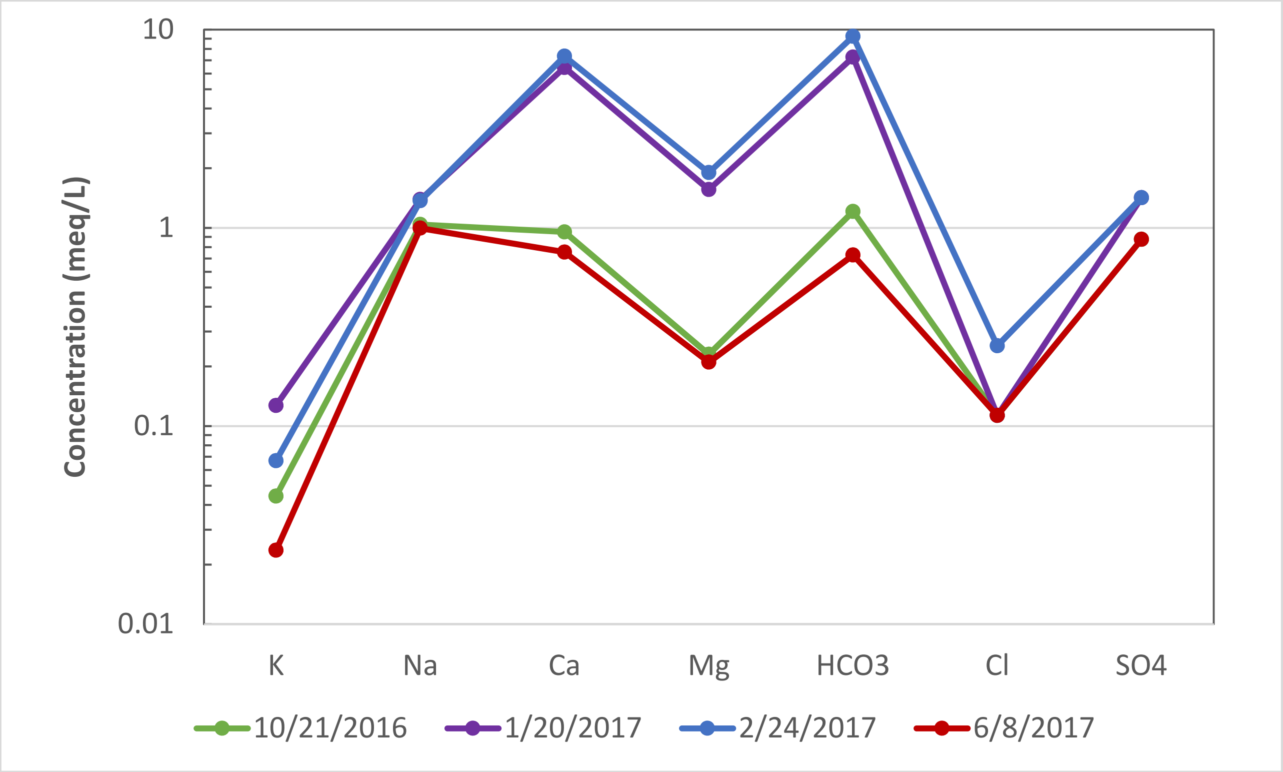
Figure

3

Columbus, Ohio

14-FEB-2019

internal info: path, date revised, author



Notes: Schoeller diagram for BASP upgradient well AD-1 for four groundwater sampling events where data for all major constituents was available.

AD-1 Schoeller Diagram

Welsh Bottom Ash Storage Pond

Geosyntec consultants

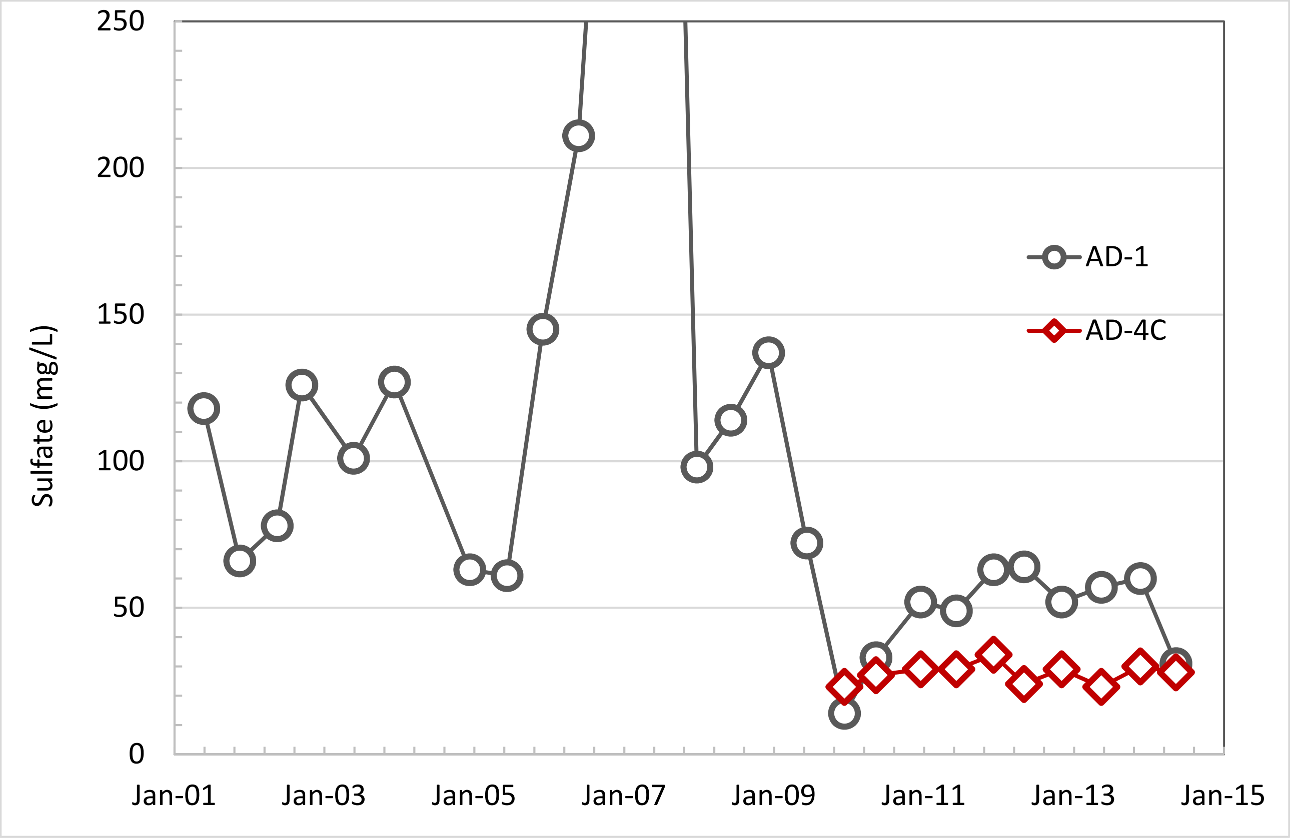
AMERICAN ELECTRIC POWER

Figure

4

Columbus, Ohio

4-JAN-2019



Notes: Concentrations of sulfate at AD-1 and AD-4C, based on samples that were collected for compliance with state regulations. Sulfate at AD-1 (off scale) was 616 mg/L on 6/13/2007.

Historical Sulfate Concentrations

Welsh Bottom Ash Storage Pond

Geosyntec consultants

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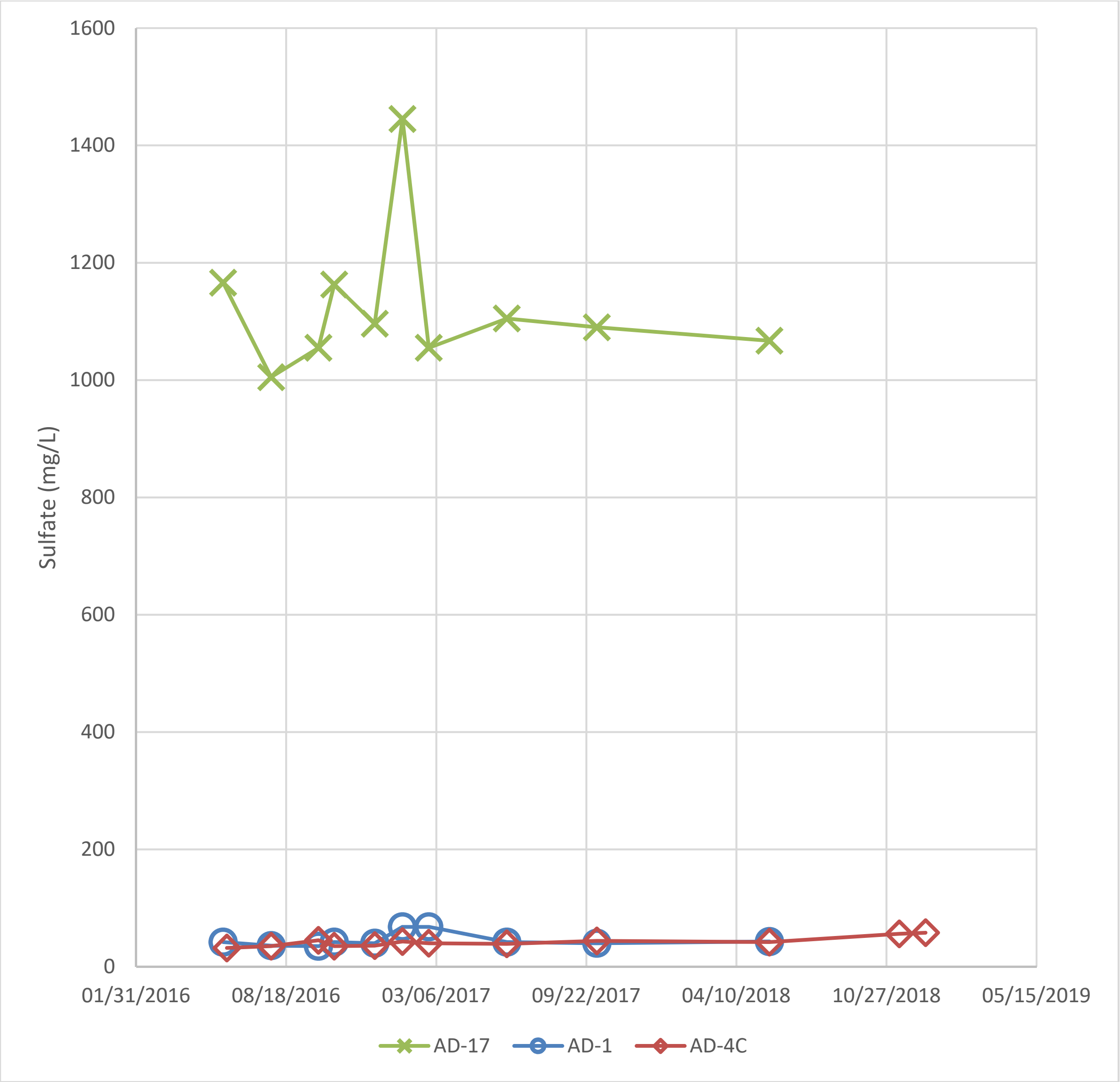
Figure

5

Columbus, Ohio

4-JAN-2019



Notes: Data were collected as part of the background monitoring period for the Federal CCR Rule.

AD-17 Sulfate Time Series Graph

Welsh Bottom Ash Storage Pond

Geosyntec consultants

AMERICAN ELECTRIC POWER

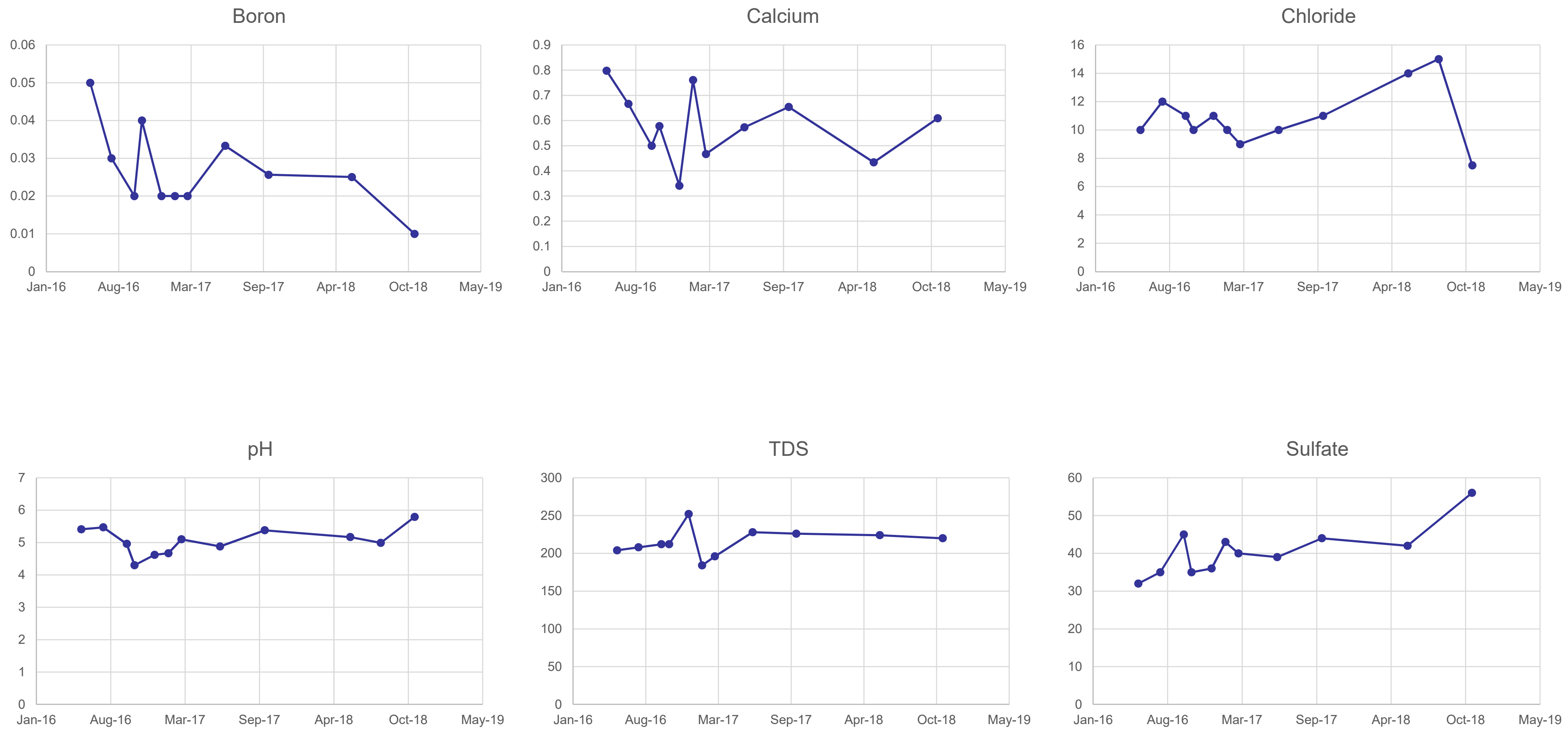
Figure

6

Columbus, Ohio

08-Apr-2019

internal info: path, date revised, author



Notes: Fluoride was not detected in any sample above the reporting limit of 0.083 mg/L. All parameters except pH reported as milligrams per liter (mg/L). pH reported as specific units (SU)

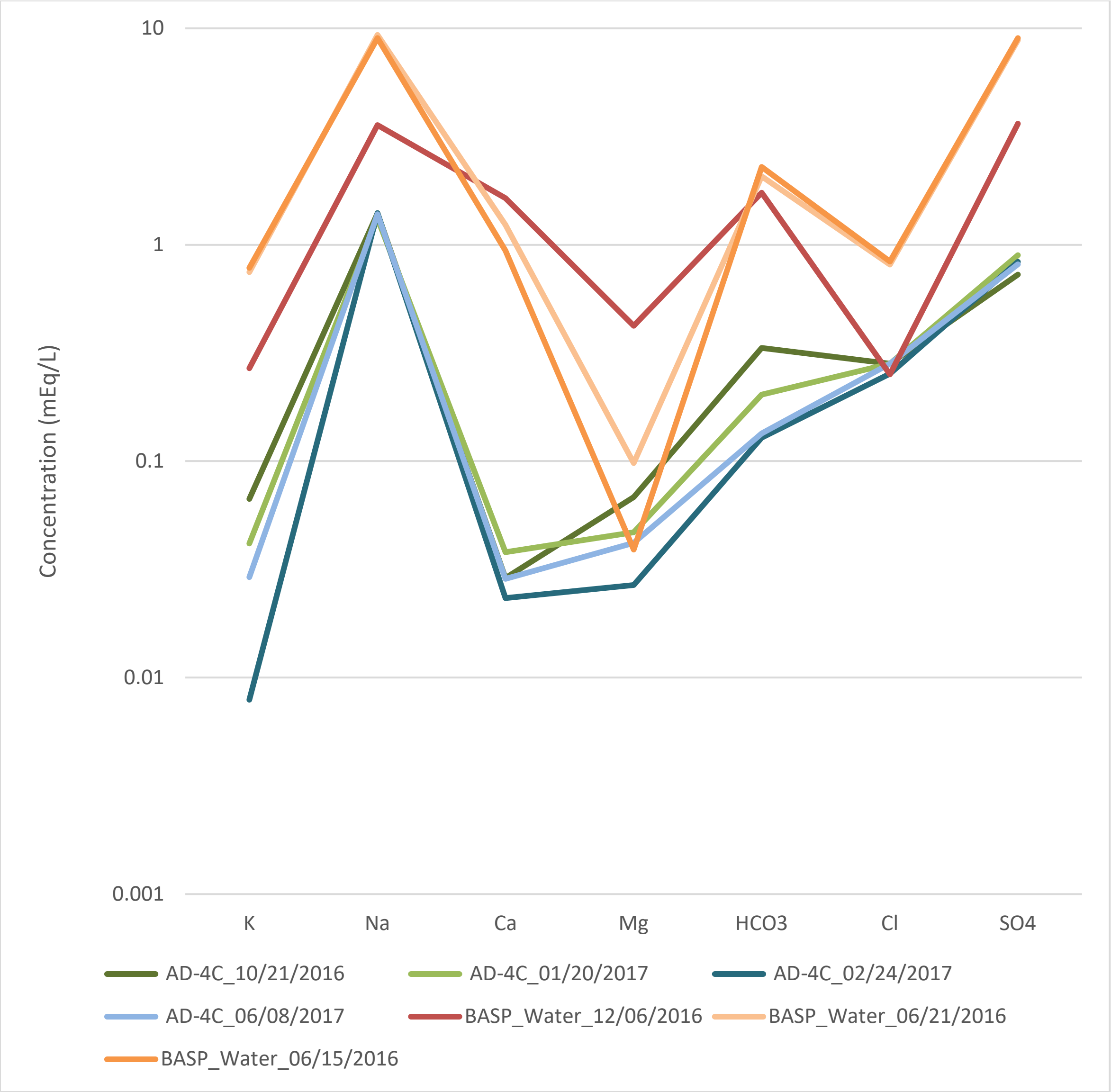
Appendix III Time Series Graphs

Welsh Bottom Ash Storage Pond

Geosyntec consultants

Figure
7

Columbus, OH | 11-Apr-2019



Notes: BASP water samples were collected as part of a water balance study (AECOM, 2017).

Pond Water Chemistry

Welsh Bottom Ash Storage Pond

Geosyntec consultants

AMERICAN ELECTRIC POWER

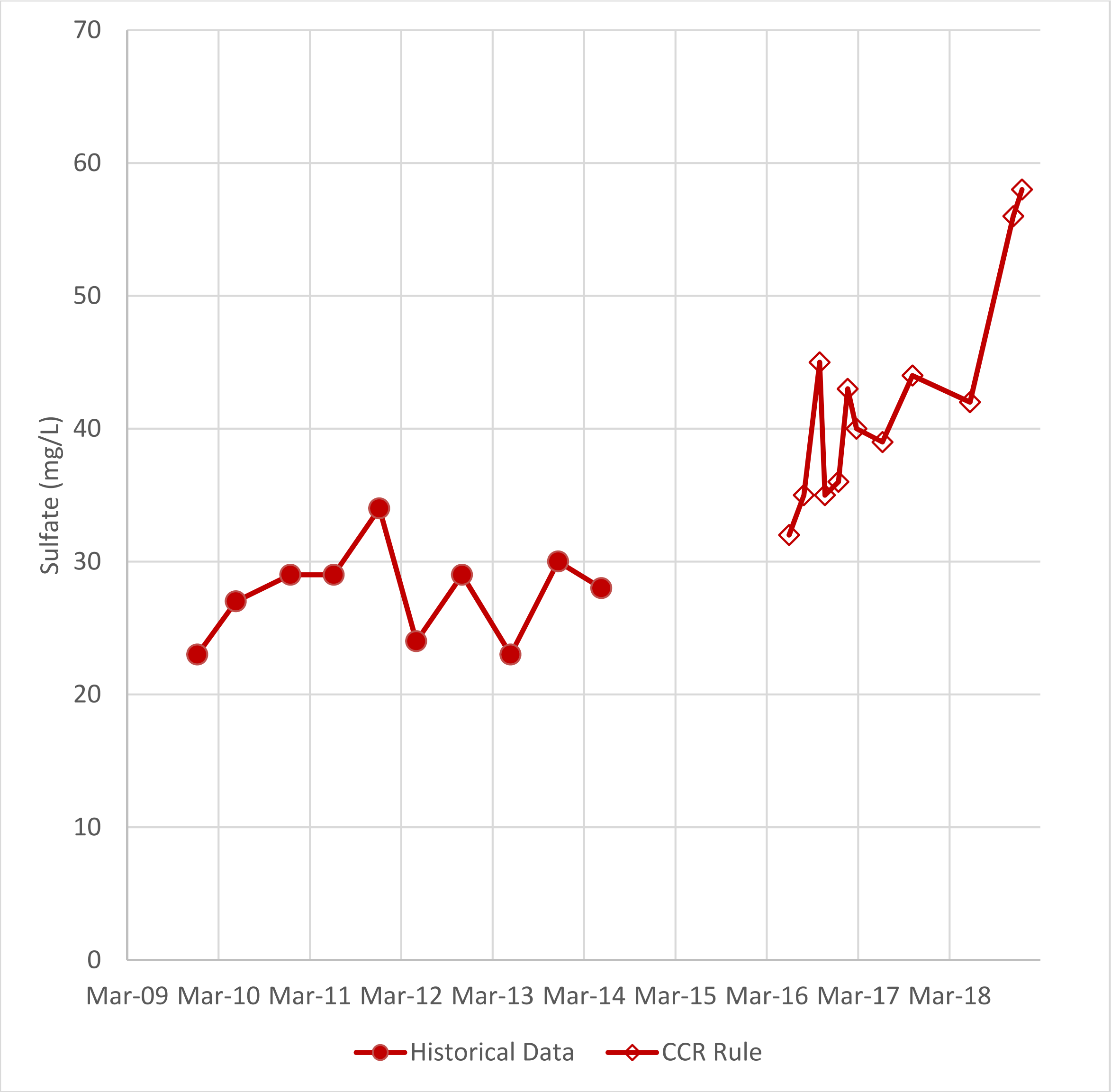
Figure

8

Columbus, Ohio

24-Apr-2019

internal info: path, date revised, author



Notes: Historical data were not collected under the CCR Rule.

AD-4C Sulfate Time Series Graph

Welsh Bottom Ash Storage Pond

Geosyntec consultants

AMERICAN ELECTRIC POWER

Columbus, Ohio

5-MAY-2019

Figure

9

internal info: path, date revised, author

ATTACHMENT A

Revised Statistical Analysis Output

Intrawell Prediction Limit Summary

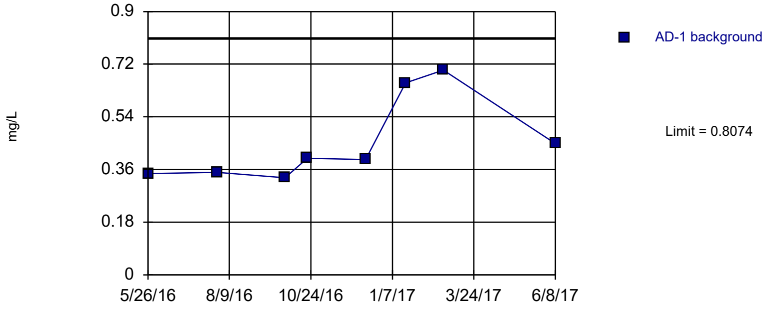
Welsh BASP Client: Geosyntec Data: Welsh BASP Printed 5/9/2019, 1:03 PM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron (mg/L)	AD-1	0.8074	n/a	8	0.4531	0.1441	0	None	No	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-5	0.06141	n/a	8	0.04285	0.00755	0	None	No	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-17	0.1488	n/a	8	0.1209	0.01137	0	None	No	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-3	0.03326	n/a	7	n/a	n/a	0	n/a	n/a	0.02765	NP Intra (normality) 1 of 2
Boron (mg/L)	AD-4C	0.05712	n/a	8	0.02916	0.01137	0	None	No	0.002505	Param Intra 1 of 2
Boron (mg/L)	AD-16R	0.07001	n/a	10	0.03904	0.01384	0	None	No	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-1	224.6	n/a	8	6.363	3.508	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-5	61.45	n/a	8	45.09	6.656	0	None	No	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-17	203.5	n/a	8	193.6	4.033	0	None	No	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-3	1.541	n/a	8	0.7903	0.3055	0	None	No	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-4C	0.9615	n/a	8	0.5855	0.153	0	None	No	0.002505	Param Intra 1 of 2
Calcium (mg/L)	AD-16R	3.069	n/a	10	1.933	0.5077	0	None	No	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-1	9	n/a	8	n/a	n/a	0	n/a	n/a	0.02144	NP Intra (normality) 1 of 2
Chloride (mg/L)	AD-5	16.78	n/a	8	14.5	0.9258	0	None	No	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-17	44.04	n/a	8	33.38	4.34	0	None	No	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-3	9	n/a	8	n/a	n/a	0	n/a	n/a	0.02144	NP Intra (normality) 1 of 2
Chloride (mg/L)	AD-4C	12.63	n/a	8	10.38	0.9161	0	None	No	0.002505	Param Intra 1 of 2
Chloride (mg/L)	AD-16R	8.3	n/a	9	6.889	0.6009	0	None	No	0.002505	Param Intra 1 of 2
Fluoride (mg/L)	AD-1	1	n/a	8	n/a	n/a	100	n/a	n/a	0.02144	NP Intra (NDs) 1 of 2
Fluoride (mg/L)	AD-5	1	n/a	8	n/a	n/a	75	n/a	n/a	0.02144	NP Intra (NDs) 1 of 2
Fluoride (mg/L)	AD-17	0.6953	n/a	8	0.4488	0.1003	37.5	Kaplan-Meier	No	0.002505	Param Intra 1 of 2
Fluoride (mg/L)	AD-3	1	n/a	8	n/a	n/a	87.5	n/a	n/a	0.02144	NP Intra (NDs) 1 of 2
Fluoride (mg/L)	AD-4C	1	n/a	8	n/a	n/a	100	n/a	n/a	0.02144	NP Intra (NDs) 1 of 2
Fluoride (mg/L)	AD-16R	1	n/a	10	n/a	n/a	60	n/a	n/a	0.01476	NP Intra (NDs) 1 of 2
pH, field (SU)	AD-1	7.766	3.744	8	5.755	0.8183	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-5	6.916	4.802	8	5.859	0.4299	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-17	7.253	4.899	8	6.076	0.4789	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-3	7.628	2.427	8	5.028	1.058	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-4C	5.907	3.945	8	4.926	0.3991	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-16R	4.402	2.612	10	3.507	0.3998	0	None	No	0.001253	Param Intra 1 of 2
Sulfate (mg/L)	AD-1	82.3	n/a	8	6.772	0.9358	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-5	336.4	n/a	8	177.4	64.69	0	None	No	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-17	1471	n/a	8	1136	136.3	0	None	No	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-3	12.35	n/a	8	6.125	2.532	0	None	No	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-4C	59.09	n/a	12	42.08	8.051	0	None	No	0.002505	Param Intra 1 of 2
Sulfate (mg/L)	AD-16R	64.14	n/a	10	50.9	5.915	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-1	784.8	n/a	8	16.71	4.598	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-5	563.5	n/a	8	383.6	73.17	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-17	1840	n/a	8	1639	81.77	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-3	156	n/a	8	110.6	18.45	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-4C	262.7	n/a	8	212	20.62	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-16R	213.7	n/a	10	174	17.74	0	None	No	0.002505	Param Intra 1 of 2

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



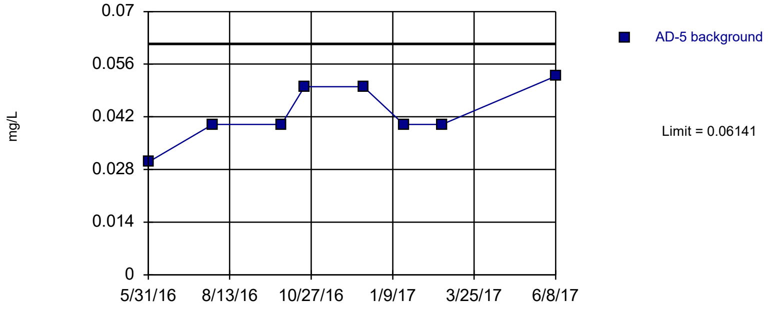
Background Data Summary: Mean=0.4531, Std. Dev.=0.1441, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7868, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 5/9/2019 1:00 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



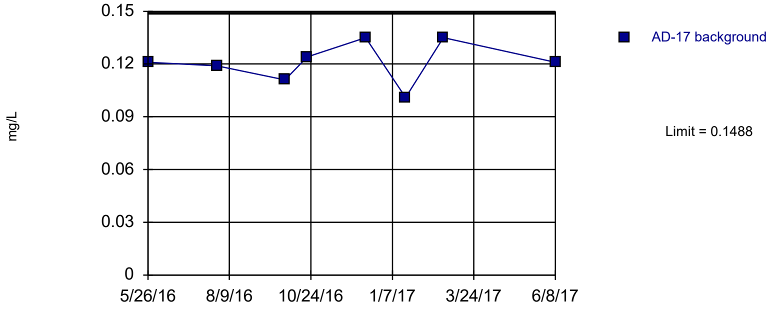
Background Data Summary: Mean=0.04285, Std. Dev.=0.00755, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8774, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 5/9/2019 1:00 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



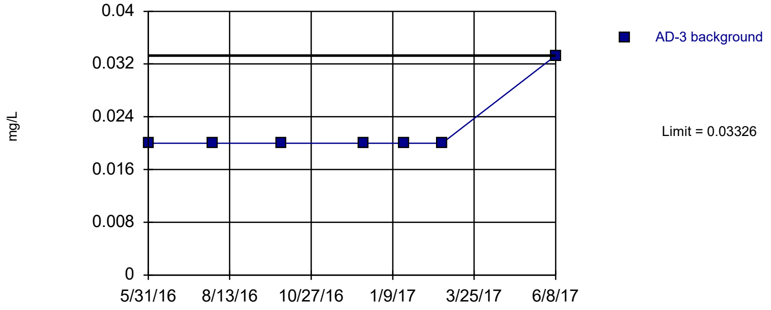
Background Data Summary: Mean=0.1209, Std. Dev.=0.01137, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9321, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 5/9/2019 1:00 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, AD-3



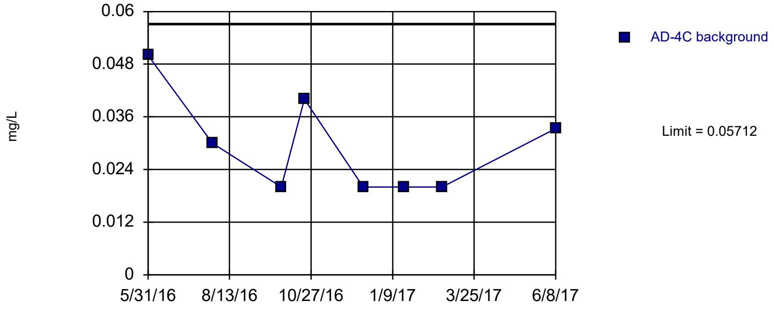
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 7 background values. Well-constituent pair annual alpha = 0.05455. Individual comparison alpha = 0.02765 (1 of 2). Assumes 1 future value.

Constituent: Boron Analysis Run 5/9/2019 1:00 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-4C



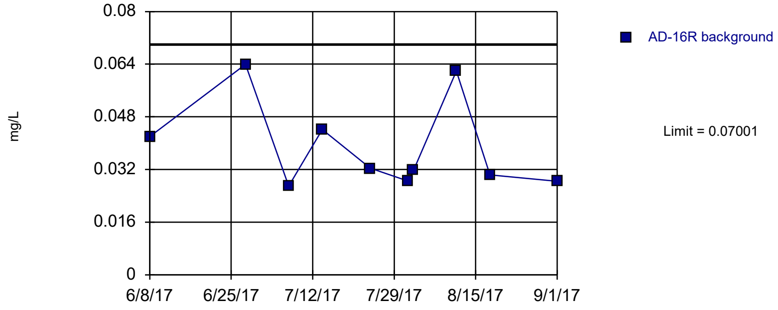
Background Data Summary: Mean=0.02916, Std. Dev.=0.01137, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8271, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 5/9/2019 1:00 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16R



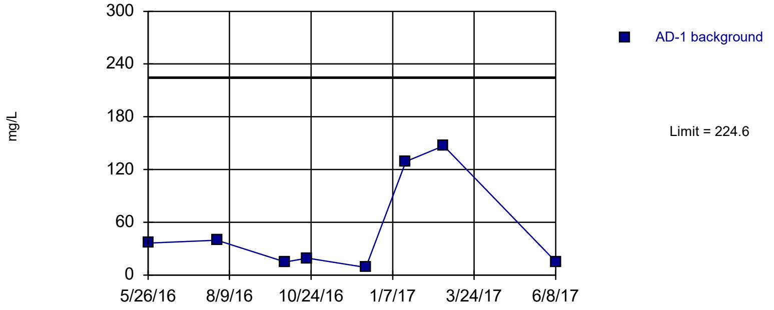
Background Data Summary: Mean=0.03904, Std. Dev.=0.01384, n=10. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7973, critical = 0.781. Kappa = 2.238 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron Analysis Run 5/9/2019 1:00 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



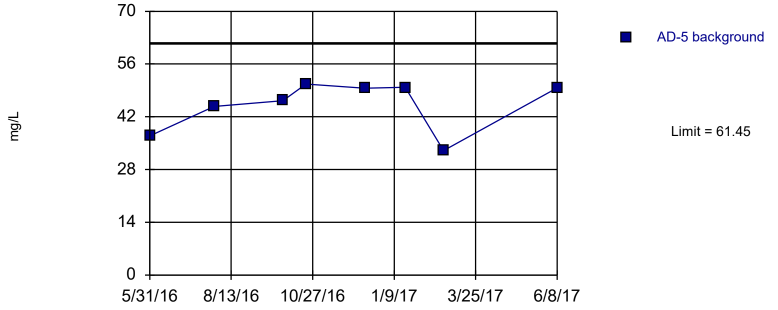
Background Data Summary (based on square root transformation): Mean=6.363, Std. Dev.=3.508, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8248, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 5/9/2019 1:00 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



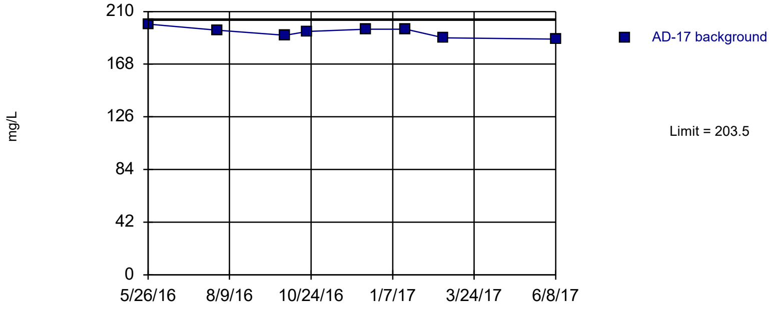
Background Data Summary: Mean=45.09, Std. Dev.=6.656, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8101, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 5/9/2019 1:00 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



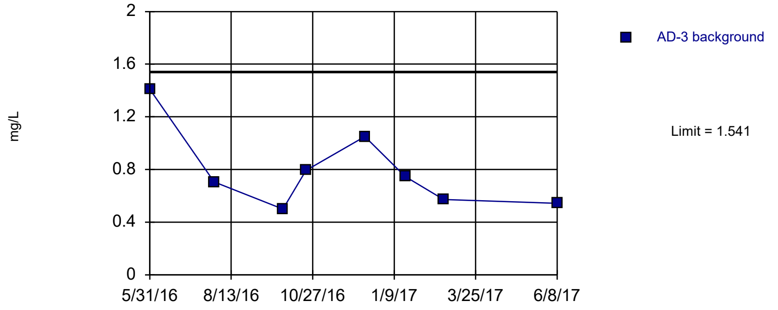
Background Data Summary: Mean=193.6, Std. Dev.=4.033, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9507, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 5/9/2019 1:00 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-3



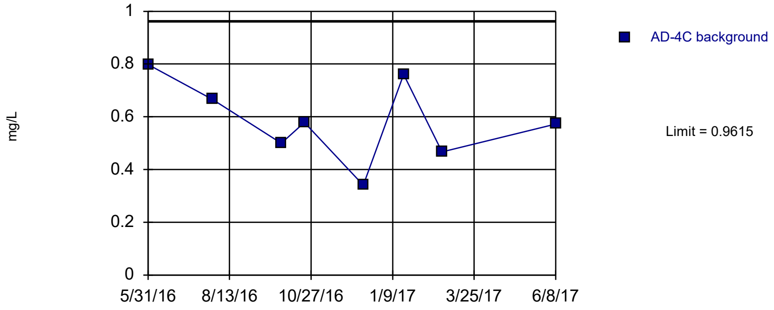
Background Data Summary: Mean=0.7903, Std. Dev.=0.3055, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8655, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 5/9/2019 1:00 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-4C



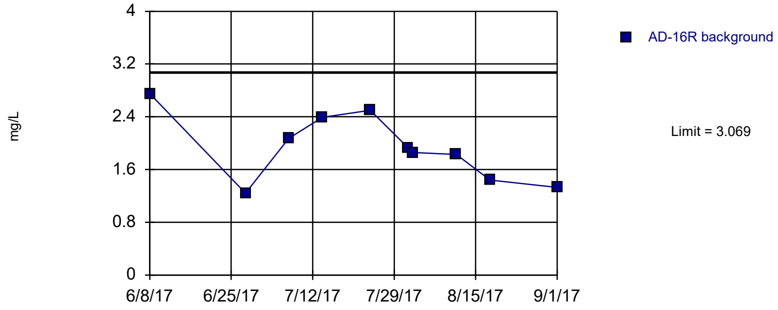
Background Data Summary: Mean=0.5855, Std. Dev.=0.153, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9711, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 5/9/2019 1:00 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16R



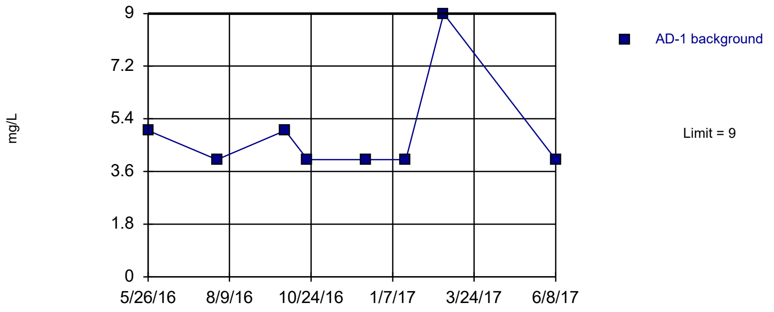
Background Data Summary: Mean=1.933, Std. Dev.=0.5077, n=10. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.953, critical = 0.781. Kappa = 2.238 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium Analysis Run 5/9/2019 1:00 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, AD-1 (bg)



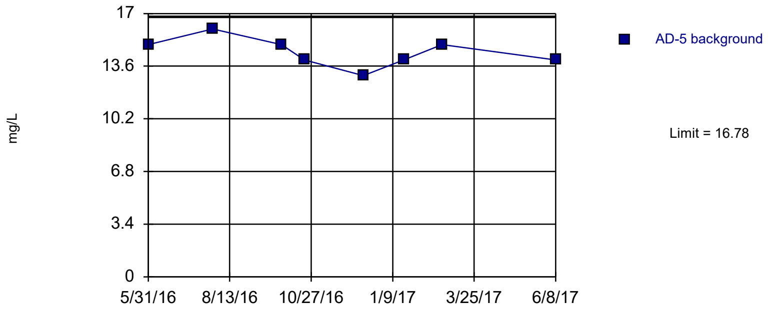
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2). Assumes 1 future value.

Constituent: Chloride   Analysis Run 5/9/2019 1:00 PM   View: PL's - Intrawell
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



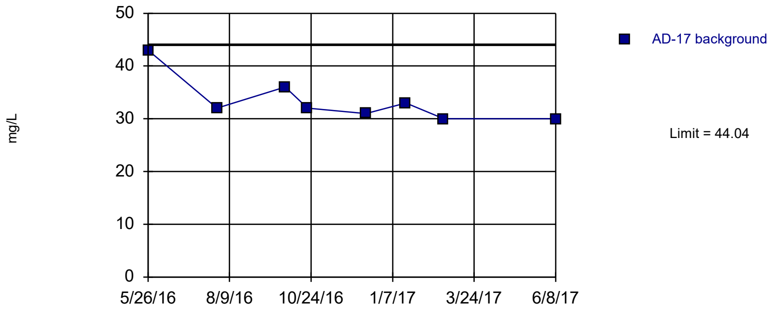
Background Data Summary: Mean=14.5, Std. Dev.=0.9258, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9302, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride   Analysis Run 5/9/2019 1:00 PM   View: PL's - Intrawell
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



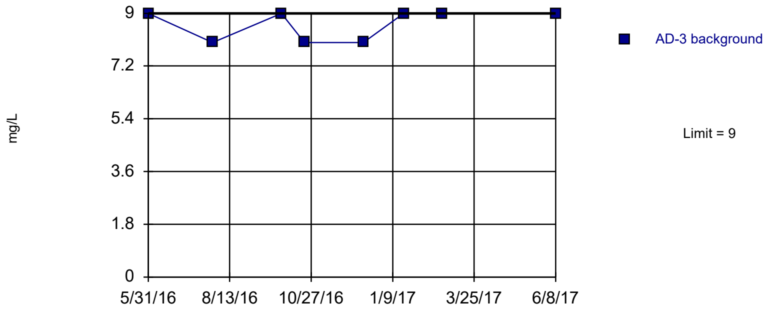
Background Data Summary: Mean=33.38, Std. Dev.=4.34, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7758, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride   Analysis Run 5/9/2019 1:00 PM   View: PL's - Intrawell
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, AD-3



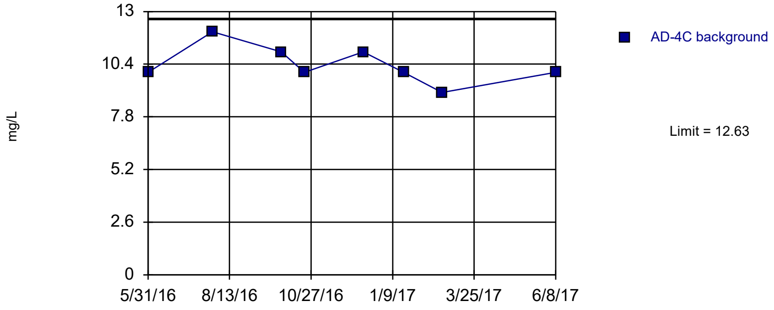
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2). Assumes 1 future value.

Constituent: Chloride   Analysis Run 5/9/2019 1:00 PM   View: PL's - Intrawell
Welsh BASP   Client: Geosyntec   Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-4C



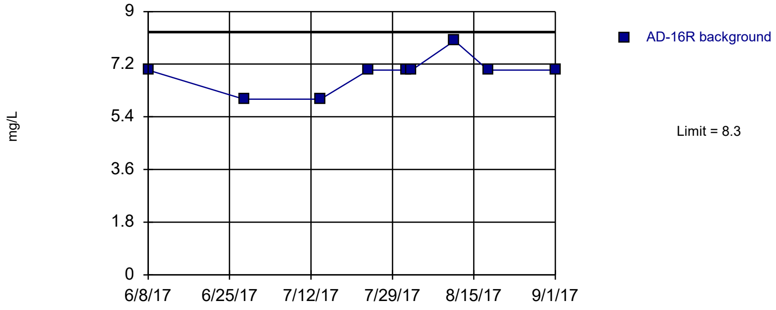
Background Data Summary: Mean=10.38, Std. Dev.=0.9161, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9054, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride Analysis Run 5/9/2019 1:00 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16R



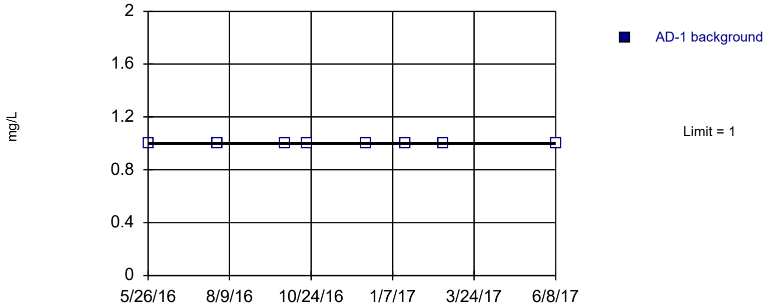
Background Data Summary: Mean=6.889, Std. Dev.=0.6009, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7809, critical = 0.764. Kappa = 2.348 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-1 (bg)



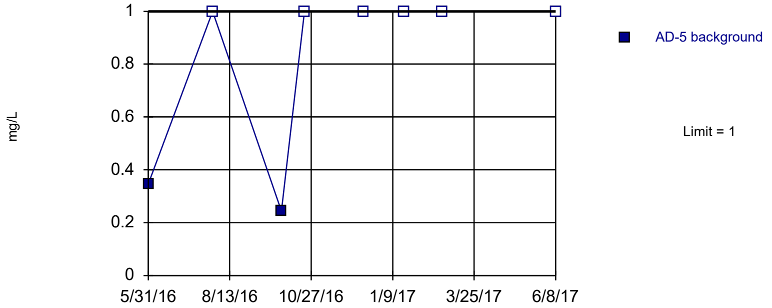
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 8) were censored; limit is most recent reporting limit. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-5 (bg)



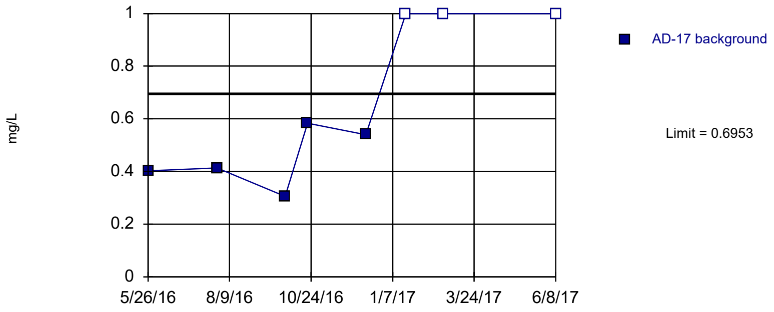
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 8 background values. 75% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-17 (bg)



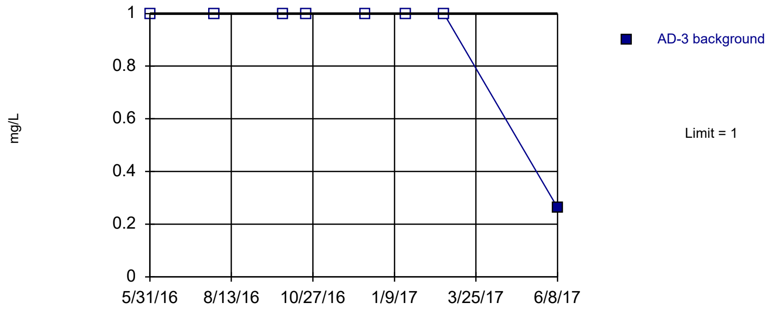
Background Data Summary (after Kaplan-Meier Adjustment): Mean=0.4488, Std. Dev.=0.1003, n=8, 37.5% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8226, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-3



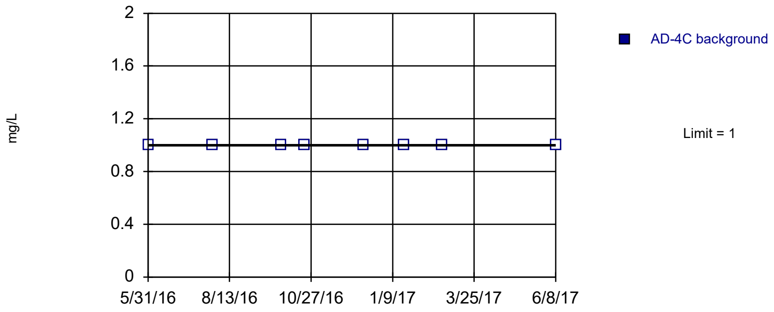
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 8 background values. 87.5% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-4C



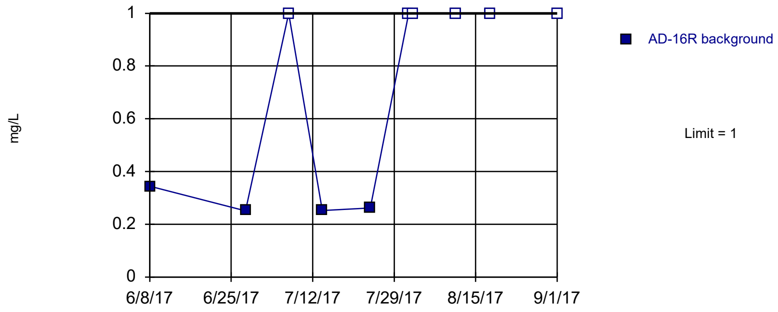
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 8) were censored; limit is most recent reporting limit. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, AD-16R



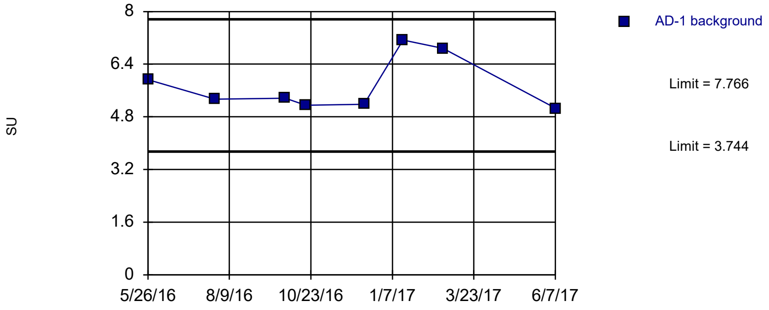
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 10 background values. 60% NDs. Well-constituent pair annual alpha = 0.0293. Individual comparison alpha = 0.01476 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



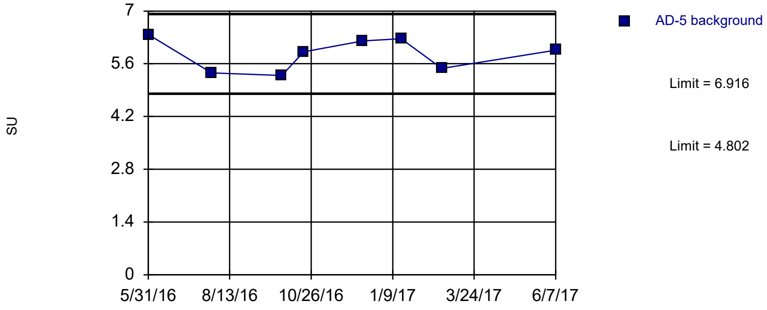
Background Data Summary: Mean=5.755, Std. Dev.=0.8183, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7968, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



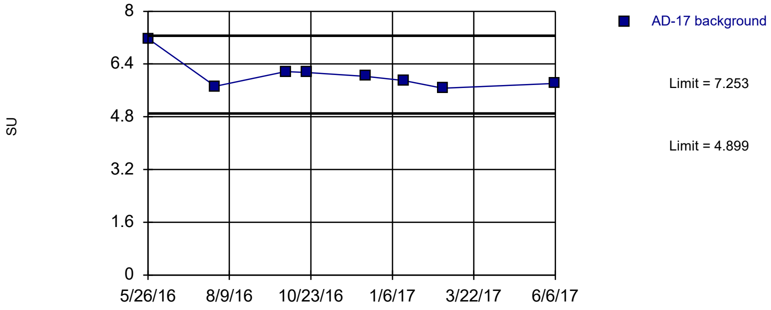
Background Data Summary: Mean=5.859, Std. Dev.=0.4299, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8966, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



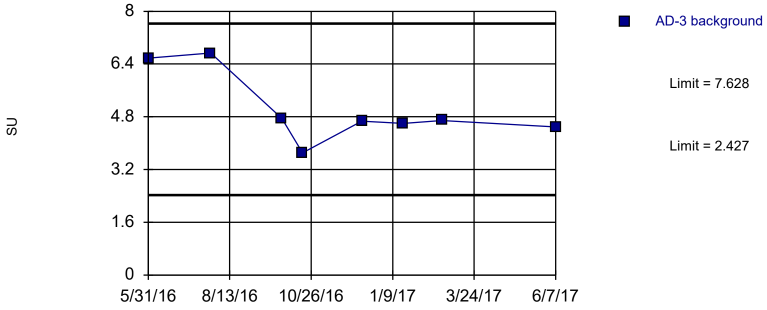
Background Data Summary: Mean=6.076, Std. Dev.=0.4789, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7745, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-3



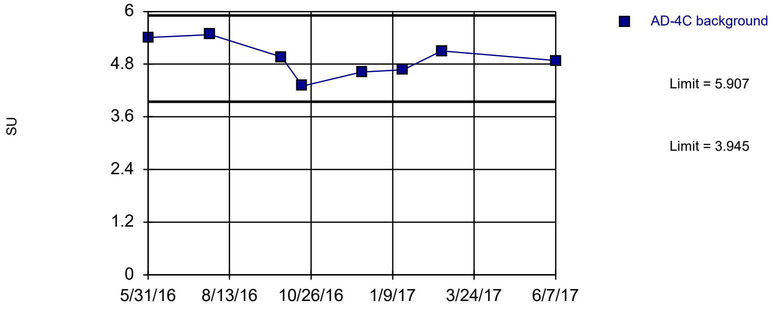
Background Data Summary: Mean=5.028, Std. Dev.=1.058, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8081, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-4C



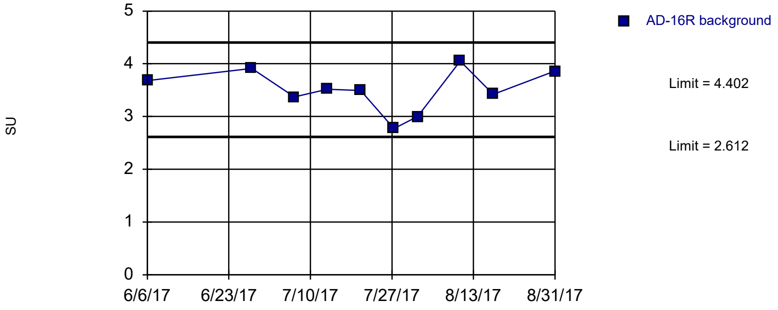
Background Data Summary: Mean=4.926, Std. Dev.=0.3991, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9655, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16R



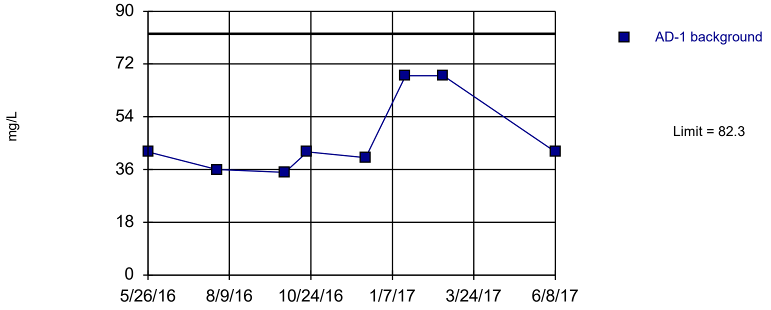
Background Data Summary: Mean=3.507, Std. Dev.=0.3998, n=10. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9547, critical = 0.781. Kappa = 2.238 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



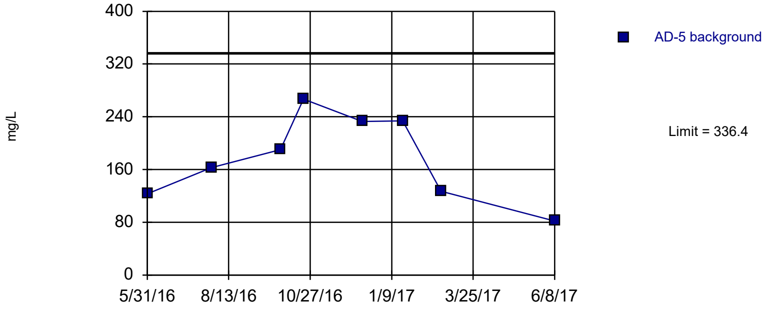
Background Data Summary (based on square root transformation): Mean=6.772, Std. Dev.=0.9358, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7528, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



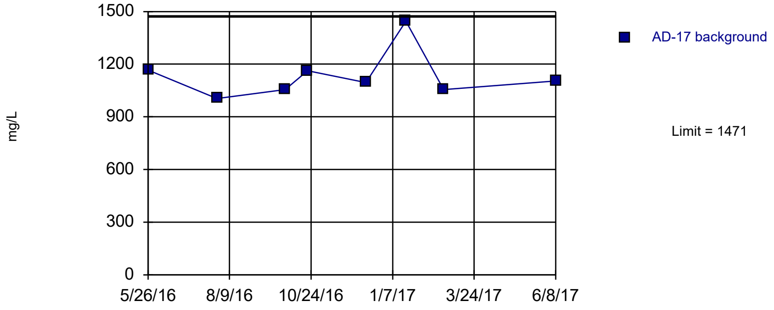
Background Data Summary: Mean=177.4, Std. Dev.=64.69, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.953, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



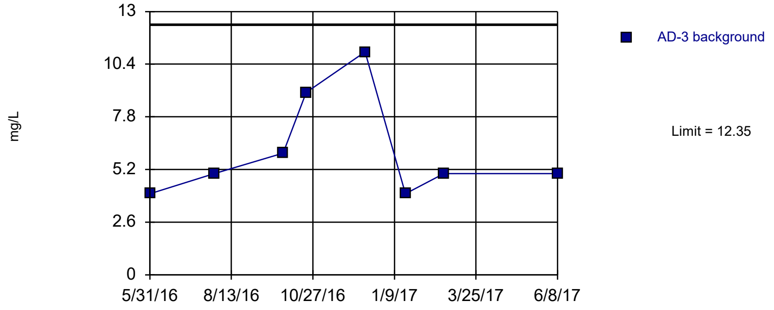
Background Data Summary: Mean=1136, Std. Dev.=136.3, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7916, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-3



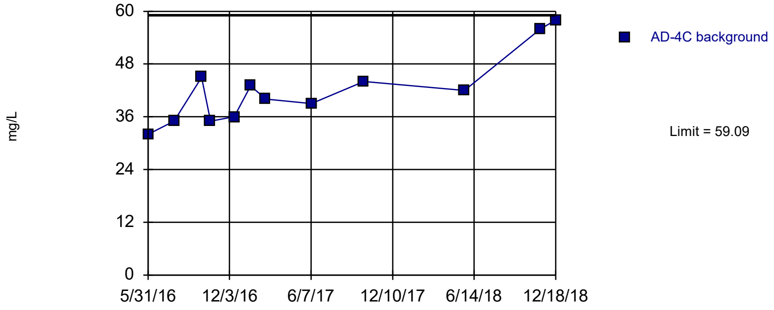
Background Data Summary: Mean=6.125, Std. Dev.=2.532, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8003, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-4C



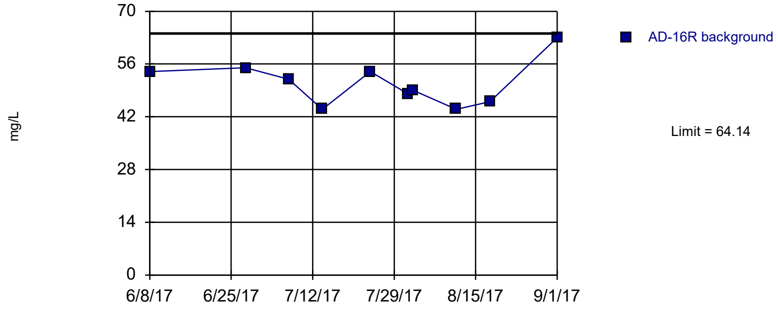
Background Data Summary: Mean=42.08, Std. Dev.=8.051, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8952, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16R



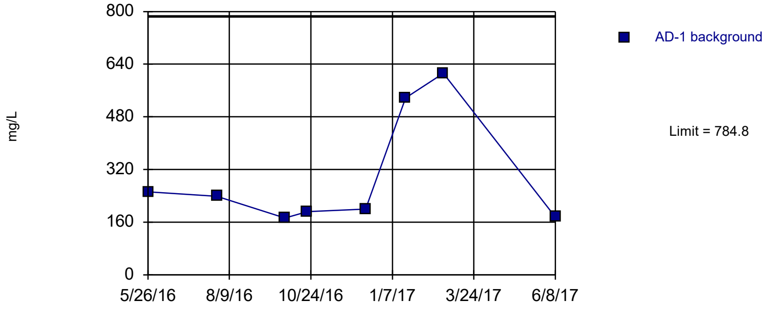
Background Data Summary: Mean=50.9, Std. Dev.=5.915, n=10. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9276, critical = 0.781. Kappa = 2.238 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



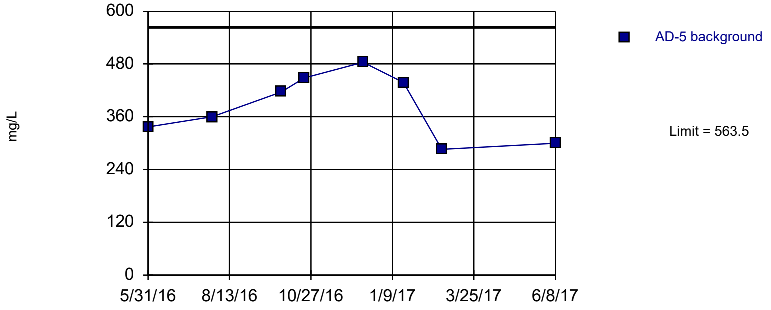
Background Data Summary (based on square root transformation): Mean=16.71, Std. Dev.=4.598, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.756, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



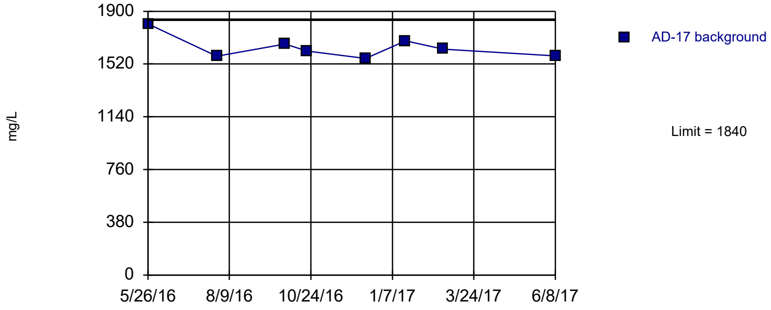
Background Data Summary: Mean=383.6, Std. Dev.=73.17, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.937, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



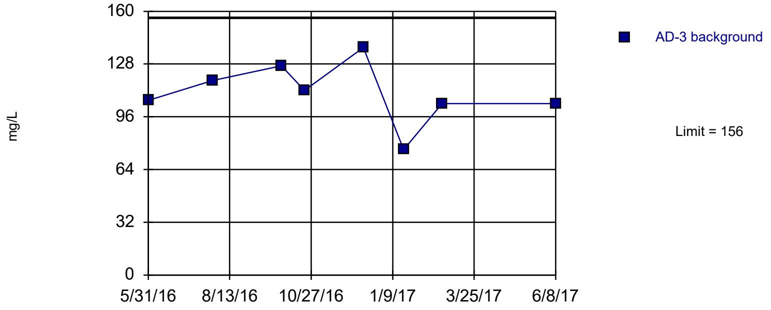
Background Data Summary: Mean=1639, Std. Dev.=81.77, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8702, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-3

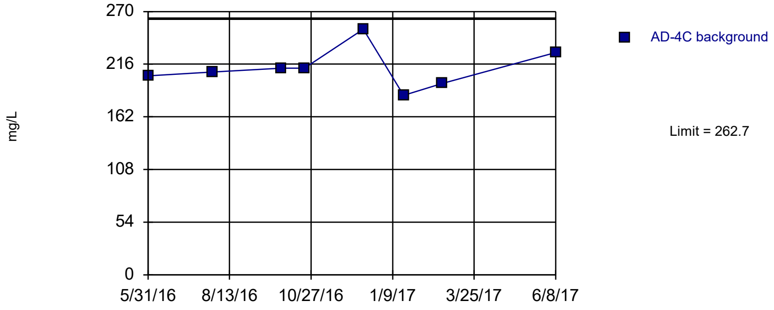


Background Data Summary: Mean=110.6, Std. Dev.=18.45, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9503, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-4C

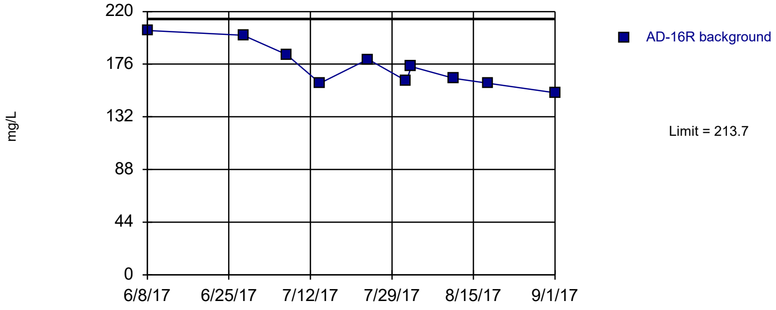


Background Data Summary: Mean=212, Std. Dev.=20.62, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9402, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

Prediction Limit

Intrawell Parametric, AD-16R



Background Data Summary: Mean=174, Std. Dev.=17.74, n=10. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9094, critical = 0.781. Kappa = 2.238 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/9/2019 1:01 PM View: PL's - Intrawell
Welsh BASP Client: Geosyntec Data: Welsh BASP

ATTACHMENT B
Certification by Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Welsh Bottom Ash Storage Pond CCR management area and that the requirements of 40 CFR 257.94(e)(2) have been met.

BETH ANN GROSS
79864

Beth Ann Gross
Printed Name of Licensed Professional Engineer

Beth Gross
Signature

Geosyntec Consultants
8217 Shoal Creek Blvd., Suite 200
Austin, TX 78757

Texas Registered Engineering Firm
No. F-1182

79864	Texas	5/17/2019
License Number	Licensing State	Date

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

J. Robert Welsh Plant
Bottom Ash Storage Pond
Pittsburg, Texas

Submitted to

AMERICAN
ELECTRIC
POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

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consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

August 22, 2019

CHA8462

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
BASP	Bottom Ash Storage Pond
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LPL	Lower Prediction Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

Eight to ten background monitoring events were conducted at the Welsh Bottom Ash Storage Pond (BASP). Upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. Prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is concluded only if both samples in a series of two exceeds the UPL and for pH exceeds the LPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

The first semi-annual detection monitoring event of 2019 was performed in February 2019 (initial sampling event) and April 2019 (re-sampling event), and the results were compared to the calculated prediction limits. An SSI was identified for chloride at well AD-3 by intrawell analysis. A summary of the detection monitoring analytical results and the calculated prediction limits to which they were compared is provided in Table 1.

1.1 CCR Rule Requirements

United States Environmental Protection Agency (U.S. EPA) regulations (USEPA, 2015) regarding detection monitoring programs for coal combustion residuals (CCR) landfills and surface impoundments provide owners and operators with the option to make an alternative source demonstration (ASD) when an SSI is identified (40 CFR 257.94(e)(2)):

> *The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer… verifying the accuracy of the information in the report.*

Chloride concentrations of 9.40 milligrams per liter (mg/L) and 9.34 mg/L were reported for the sampling and re-sampling events on February 20, 2019 and April 30, 2019, respectively. Both concentrations exceeded the UPL value for chloride of 9 mg/L. Pursuant to 40 CFR 257.94(e)(2) of the CCR Rule (40 CFR 257), Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report, which documents that the SSI for chloride at AD-3 should not be attributed to the Welsh BASP.

1.2 Demonstration of Alternative Sources

An evaluation was completed to assess possible alternative sources to which the identified SSI could be attributed. Alternative sources were identified amongst five types, based on methodology provided by EPRI (2017):

- ASD Type I: Sampling Causes;
- ASD Type II: Laboratory Causes;
- ASD Type III: Statistical Evaluation Causes;
- ASD Type IV: Natural Variation; and
- ASD Type V: Alternative Sources.

A demonstration was conducted to show that the increases in constituent concentrations were based on a Type II cause and not by a release from the Welsh BASP.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The method used to assess possible alternative sources of the SSI for chloride at AD-3 and the proposed alternative source are described below. In addition, the future sampling requirements for the Welsh BASP are presented.

2.1 Proposed Alternative Source

Initial review of field forms, site geochemistry, and site historical data did not identify alternative sources due to a Type I issue (sampling causes). Review of the laboratory results, however, identified a variation in the number of significant figures used in reported results that explains the SSI. This Type II issue is described below.

The eight samples collected from AD-3 during the background monitoring period were analyzed by AEP Analytical Chemistry Services in Shreveport, Louisiana using USEPA Method 300.0 and reported to the nearest 1 mg/L. Three background sample results for chloride were reported at 8 mg/L and five background results for chloride were 9 mg/L (Attachment A). Given the limited variability in the background dataset, the UPL for chloride at AD-3 was calculated non-parametrically as 9 mg/L, which is the highest value in the set of background data was used.

The samples for the first semi-annual detection monitoring event in 2019 were analyzed by AEP's Dolan Chemical Laboratory in Groveport, Ohio and reported to the nearest 0.01 mg/L. The initial and verification results for chloride were 9.40 mg/L and 9.34 mg/L respectively (Attachment B). These results are only above the UPL due to the additional significant figures provided by the laboratory. If the 2019 sample results had been reported to the same precision as the background samples, i.e., to the nearest 1 mg/L, they would be equal to the UPL and would not have triggered an SSI.

Furthermore, the detection monitoring samples were analyzed using USEPA Method 300.1, which prescribes ±15% variation as the quality control sample acceptance criteria (USEPA, 1999). Because both reported concentrations are within 15% (4.3% and 3.6% respectively) of the UPL, the differences observed are within acceptable variation in the analytical procedure.

Following completion of the first semi-annual CCR detection monitoring event, additional sampling was conducted at the BASP on May 30, 2019 for compliance with another regulatory program. The analysis was completed by AEP's Dolan Chemical Laboratory using USEPA Method 300.1. The reported chloride concentration for the sample from well AD-3 was 7.97 mg/L, which is below the UPL (Attachment C). Based on all results for AD-3 during the 2019 groundwater monitoring events, a positive trend is not demonstrated for chloride (Figure 1). Additionally, no other Appendix III exceedances were observed for AD-3 during the first semi-annual event of 2019. Thus, the observed chloride concentrations during the first semi-annual event are not considered indicative of a release from the BASP.

2.2 Sampling Requirements

The ASD described above supports the position that the identified SSI is not due to a release from the Welsh BASP. Therefore, the unit will remain in the detection monitoring. Groundwater at the unit will be sampled for Appendix III parameters on a semi-annual basis. In subsequent sampling events, results will be reported to the appropriate number of significant figures based on laboratory quality control protocols. As this detection monitoring event represent the fourth monitoring event since the initial background dataset was established, the results of the detection monitoring events will be compared to the existing background dataset and added to the dataset as appropriate and as recommended by the Unified Guidance (USEPA, 2009).

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and supports the position that the SSIs in Appendix III detection monitoring constituents are not due to a release from the Welsh BASP during the February and April 2019 sampling events. The identified SSI for chloride at well AD-3 was attributed to differences in laboratory reporting practices. Therefore, no further action is warranted, and the Welsh BASP will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in Attachment D.

SECTION 4

REFERENCES

EPRI, 2017. Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites. 3002010920. October.

Geosyntec, 2019. Alternative Source Demonstration Report – Federal CCR Rule. J. Robert Welsh Plant. January.

USEPA, 1999. Method 300.1 Determination of Inorganic Anions in Drinking Water by Ion Chromatography. Revision 1.0. Office of Research and Development. Cincinnati, OH.

USEPA, 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March 2009.

USEPA, 2015. Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities (Final Rule). Fed. Reg. 80 FR 21301, pp. 21301-21501, 40 CFR Parts 257 and 261, April.

TABLES

Table 1: Detection Monitoring Data Evaluation
Welsh Plant - Bottom Ash Storage Pond

Parameter	Units	Description	AD-3		AD-4C		AD-16R	
			2/20/2019	4/30/2019	2/20/2019	4/30/2019	2/20/2019	4/30/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.0333		0.0571		0.0700	
		Detection Monitoring Data	0.01 J	0.0070	0.01 J	0.0140	0.03 J	**0.0150**
Calcium	mg/L	Intrawell Background Value (UPL)	1.54		0.962		3.07	
		Detection Monitoring Data	0.817	--	0.931	--	2.00	-
Chloride	mg/L	Intrawell Background Value (UPL)	9		12.6		8.30	
		Detection Monitoring Data	**9.40**	**9.34**	9.18	--	6.78	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1.0		1.0		1.0	
		Detection Monitoring Data	0.13	--	0.10	--	0.20	--
pH	SU	Intrawell Background Value (UPL)	7.6		5.9		4.4	
		Intrawell Background Value (LPL)	2.4		3.9		2.6	
		Detection Monitoring Data	4.8	4.1	5.2	4.8	**4.7**	3.9
Sulfate	mg/L	Intrawell Background Value (UPL)	12.4		59.1		64.1	
		Detection Monitoring Data	1.90	--	**60.1**	56.2	52.8	--
TDS	mg/L	Intrawell Background Value (UPL)	156		263		214	
		Detection Monitoring Data	110	--	242	--	200	--

Notes

UPL: Upper prediction limit

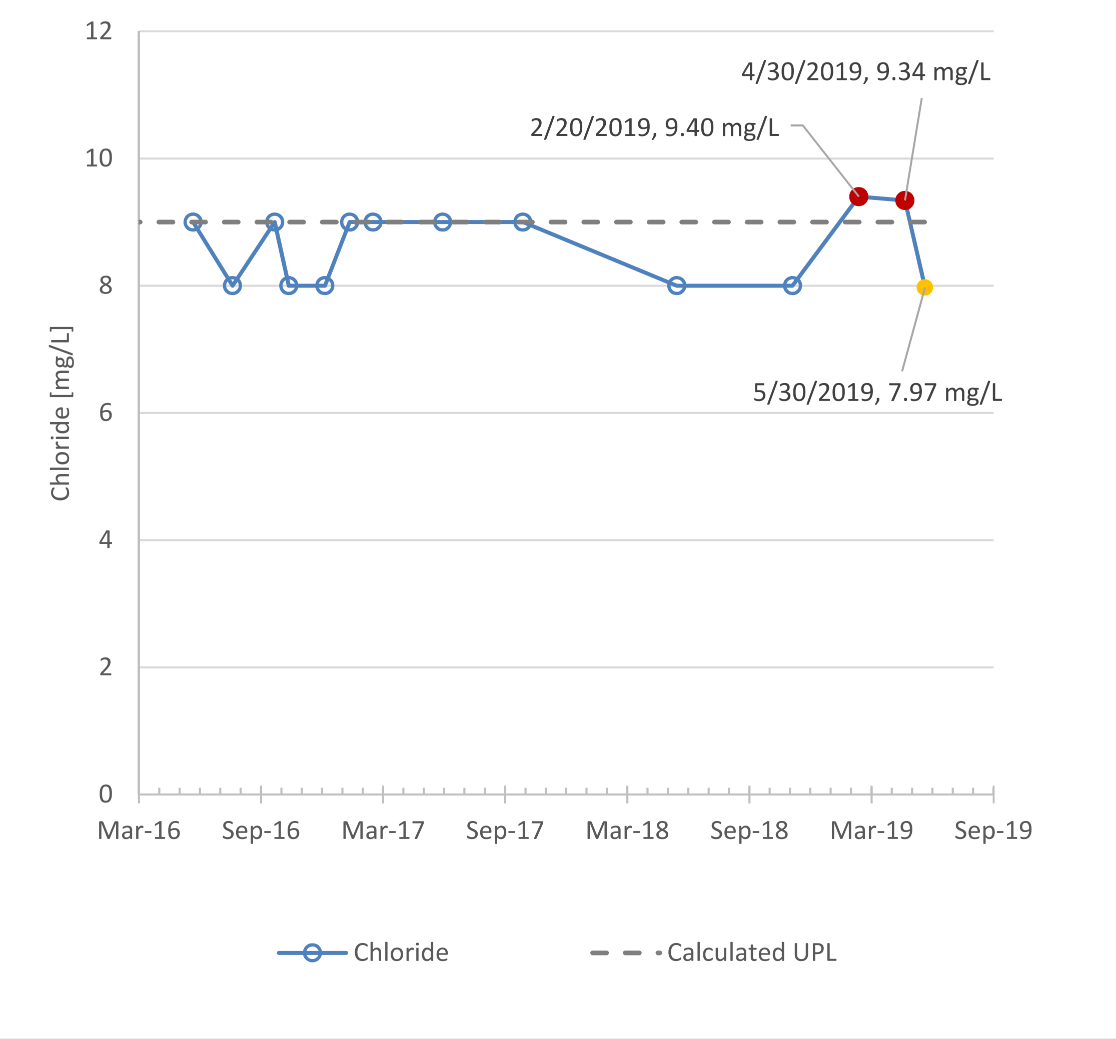
LPL: Lower prediction limit

TDS: Total dissolved solids

Bold values exceed the background value.

Background values are shaded gray.

FIGURES



Notes: Initial sampling for the first semi-annual detection monitoring event of 2019 occurred on 02/20/2019. Verification sampling for the first semi-annual event occurred on 04/30/2019. These events are shown with red symbols. Sampling for another program occurred on 5/30/2019 (yellow symbol). The upper prediction limit (UPL) was calculated using intrawell analyses.

Chloride Time Series Graph at AD-3

Welsh BASP

Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure

1

Columbus, Ohio

18-Jul-2019

internal info: path, date revised, author

ATTACHMENT A

Background Monitoring Data Laboratory Reports

502 North Allen Ave.
Shreveport, LA 71101
Phone: (318) 673-3802
Fax: (318) 673-3960

AEP ANALYTICAL CHEMISTRY SERVICES

Analysis Report

Report ID : 33094
Date Received: 06/01/2016

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
Phone: (318) 673-3816

Address: 502 N. Allen Avenue
Shreveport, LA 71101
Fax: (318) 673-3960

AEP Sample ID : 196453
Cust Sample ID:
Sample Desc.: AD- 3

Collected Date: 05/31/2016
Location: Welsh Power Plant CCR

By: MH
Matrix: Water

Metals (196453)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Antimony	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/06/2016 17:09		JDB
Arsenic	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/06/2016 17:09		JDB
Barium	0.053	mg/L	0.001	1	EPA 6010B 1996	07/06/2016 17:09		JDB
Beryllium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	07/06/2016 17:09		JDB
Boron	0.02	mg/L	0.01	1	EPA 6010B 1996	07/06/2016 17:09		JDB
Cadmium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	07/06/2016 17:09		JDB
Calcium	1.41	mg/L	0.01	1	EPA 6010B 1996	07/06/2016 17:09		JDB
Chromium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	07/06/2016 17:09		JDB
Cobalt	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/06/2016 17:09		JDB
Lead	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/06/2016 17:09		JDB
Lithium	0.01	mg/L	0.001	1	EPA 6010B 1996	07/06/2016 17:09		JDB
Mercury	0.00085	mg/L	0.000025	1	EPA 7470A 1994	06/17/2016 15:24		JDB
Molybdenum	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/06/2016 17:09		JDB
Selenium	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/06/2016 17:09		JDB
Thallium	< 0.002	mg/L	0.002	1	EPA 6010B 1996	07/06/2016 17:09		JDB

Water (196453)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Chloride	9	mg/L	1	1	EPA 300.0	06/01/2016 14:55		GB
Fluoride	< 1	mg/L	1	1	EPA 300.0	06/01/2016 14:55		GB
Solids, Total Dissolved (TDS)	106	mg/L	5	1	SM 2540 C-2011	06/02/2016 15:45		JTM
Sulfate	4	mg/L	1	1	EPA 300.0	06/01/2016 14:55		GB

AEP ANALYTICAL CHEMISTRY SERVICES

Analysis Report

502 North Allen Ave.
Shreveport, LA 71101
Phone: (318) 673-3802
Fax: (318) 673-3960

Report ID : 33451
Date Received: 07/29/2016

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
Phone: (318) 673-3816

Address: 502 N. Allen Avenue
Shreveport, LA 71101
Fax: (318) 673-3960

AEP Sample ID : 197834
Cust Sample ID:
Sample Desc.: AD-3

Collected Date: 07/27/2016
Location: Welsh Power Plant

By: MH/KM
Matrix: Water

Metals (197834)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Antimony	< 0.005	mg/L	0.005	1	EPA 6010B 1996	09/09/2016 10:09		JDB
Arsenic	< 0.005	mg/L	0.005	1	EPA 6010B 1996	09/09/2016 10:09		JDB
Barium	0.036	mg/L	0.001	1	EPA 6010B 1996	09/09/2016 10:09		JDB
Beryllium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	09/09/2016 10:09		JDB
Boron	0.02	mg/L	0.01	1	EPA 6010B 1996	09/09/2016 10:09		JDB
Cadmium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	09/09/2016 10:09		JDB
Calcium	0.706	mg/L	0.01	1	EPA 6010B 1996	09/09/2016 10:09		JDB
Chromium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	09/09/2016 10:09		JDB
Cobalt	< 0.005	mg/L	0.005	1	EPA 6010B 1996	09/09/2016 10:09		JDB
Lead	< 0.005	mg/L	0.005	1	EPA 6010B 1996	09/09/2016 10:09		JDB
Lithium	0.024	mg/L	0.001	1	EPA 6010B 1996	09/09/2016 10:09		JDB
Mercury	0.000589	mg/L	0.000025	1	EPA 7470A 1994	08/18/2016 12:22		JDB
Molybdenum	< 0.005	mg/L	0.005	1	EPA 6010B 1996	09/09/2016 10:09		JDB
Selenium	< 0.005	mg/L	0.005	1	EPA 6010B 1996	09/09/2016 10:09		JDB
Thallium	< 0.002	mg/L	0.002	1	EPA 6010B 1996	09/13/2016 17:50		JDB

Water (197834)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Chloride	8	mg/L	1	1	EPA 300.0	07/31/2016 11:43		GB
Fluoride	< 1	mg/L	1	1	EPA 300.0	07/31/2016 11:43		GB
Solids, Total Dissolved (TDS)	118	mg/L	5	1	SM 2540 C-2011	08/02/2016 16:15		JTM
Sulfate	5	mg/L	1	1	EPA 300.0	07/31/2016 11:43		GB

AEP ANALYTICAL CHEMISTRY SERVICES

Analysis Report

502 North Allen Ave.
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Phone: (318) 673-3802
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Report ID : 33888
Date Received: 09/30/2016

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
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Address: 502 N. Allen Avenue
Shreveport, LA 71101
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AEP Sample ID : 199549
Cust Sample ID:
Sample Desc.: AD-3

Collected Date: 09/30/2016
Location: Welsh P.S.

By: MH/KM
Matrix: Water

Metals (199549)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Antimony	< 0.005	mg/L	0.005	1	EPA 6010B 1996	10/26/2016 20:53		JDB
Arsenic	< 0.005	mg/L	0.005	1	EPA 6010B 1996	10/26/2016 20:53		JDB
Barium	0.043	mg/L	0.001	1	EPA 6010B 1996	10/26/2016 20:53		JDB
Beryllium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	10/26/2016 20:53		JDB
Boron	0.02	mg/L	0.01	1	EPA 6010B 1996	10/26/2016 20:53		JDB
Cadmium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	10/26/2016 20:53		JDB
Calcium	< 0.5	mg/L	0.5	1:50	EPA 6010B 1996	10/26/2016 17:28		JDB
Chromium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	10/26/2016 20:53		JDB
Cobalt	< 0.005	mg/L	0.005	1	EPA 6010B 1996	10/26/2016 20:53		JDB
Lead	< 0.005	mg/L	0.005	1	EPA 6010B 1996	10/26/2016 20:53		JDB
Lithium	0.019	mg/L	0.001	1	EPA 6010B 1996	10/26/2016 20:53		JDB
Mercury	0.00039	mg/L	0.000025	1	EPA 7470A 1994	10/06/2016 10:06		LNM
Molybdenum	< 0.005	mg/L	0.005	1	EPA 6010B 1996	10/26/2016 20:53		JDB
Selenium	< 0.005	mg/L	0.005	1	EPA 6010B 1996	10/26/2016 20:53		JDB
Thallium	< 0.002	mg/L	0.002	1	EPA 6010B 1996	10/26/2016 20:53		JDB

Water (199549)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Chloride	9	mg/L	1	1	EPA 300.0	10/05/2016 17:04		GB
Fluoride	< 1	mg/L	1	1	EPA 300.0	10/05/2016 17:04		GB
Solids, Total Dissolved (TDS)	127	mg/L	5	1	SM 2540 C-2011	10/03/2016 16:30		JTM
Sulfate	6	mg/L	1	1	EPA 300.0	10/05/2016 17:04		GB

AEP ANALYTICAL CHEMISTRY SERVICES

Analysis Report

Report ID : 34036
Date Received: 10/21/2016

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
Phone: (318) 673-3816

Address: 502 N. Allen Avenue
Shreveport, LA 71101
Fax: (318) 673-3960

AEP Sample ID : 200428
Cust Sample ID:
Sample Desc.: AD-3

Collected Date: 10/19/2016
Location: Welsh P.S.

By: MH/KM
Matrix: Water

Metals (200428)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Antimony	< 0.005	mg/L	0.005	1	EPA 6010B 1996	12/20/2016 1:25		JDB
Arsenic	< 0.005	mg/L	0.005	1	EPA 6010B 1996	12/20/2016 1:25		JDB
Barium	0.041	mg/L	0.001	1	EPA 6010B 1996	12/20/2016 1:25		JDB
Beryllium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	12/20/2016 1:25		JDB
Boron	0.06	mg/L	0.01	1	EPA 6010B 1996	12/20/2016 1:25		JDB
Cadmium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	12/20/2016 1:25		JDB
Calcium	0.794	mg/L	0.01	1	EPA 6010B 1996	12/20/2016 1:25		JDB
Chromium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	12/20/2016 1:25		JDB
Cobalt	< 0.005	mg/L	0.005	1	EPA 6010B 1996	12/20/2016 1:25		JDB
Lead	< 0.005	mg/L	0.005	1	EPA 6010B 1996	12/20/2016 1:25		JDB
Lithium	0.018	mg/L	0.001	1	EPA 6010B 1996	12/20/2016 1:25		JDB
Mercury	0.000351	mg/L	0.000025	1	EPA 7470A 1994	10/27/2016 10:57		LNM
Molybdenum	0.006	mg/L	0.005	1	EPA 6010B 1996	12/20/2016 1:25		JDB
Selenium	< 0.005	mg/L	0.005	1	EPA 6010B 1996	12/20/2016 1:25		JDB
Thallium	< 0.002	mg/L	0.002	1	EPA 6010B 1996	12/21/2016 21:04		JDB

Water (200428)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Chloride	8	mg/L	1	1	EPA 300.0	10/29/2016 22:09		GB
Fluoride	< 1	mg/L	1	1	EPA 300.0	10/29/2019 22:09		GB
Solids, Total Dissolved (TDS)	112	mg/L	5	1	SM 2540 C-2011	10/24/2016 16:30		JTM
Sulfate	9	mg/L	1	1	EPA 300.0	10/29/2016 22:09		GB

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AEP ANALYTICAL CHEMISTRY SERVICES

Analysis Report

Report ID : 34314
Date Received: 12/14/2016

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
Phone: (318) 673-3816

Address: 502 N. Allen Avenue
Shreveport, LA 71101
Fax: (318) 673-3960

AEP Sample ID : 202088
Cust Sample ID:
Sample Desc.: AD-3

Collected Date: 12/12/2016
Location: Welsh Power Plant

By: MH/KM
Matrix: Water

Metals (202088)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Antimony	< 0.005	mg/L	0.005	1	EPA 6010B 1996	01/31/2017 3:59		JDB
Arsenic	< 0.005	mg/L	0.005	1	EPA 6010B 1996	01/31/2017 3:59		JDB
Barium	0.045	mg/L	0.001	1	EPA 6010B 1996	01/31/2017 3:59		JDB
Beryllium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	01/31/2017 3:59		JDB
Boron	0.02	mg/L	0.01	1	EPA 6010B 1996	01/31/2017 3:59		JDB
Cadmium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	01/31/2017 3:59		JDB
Calcium	1.05	mg/L	0.01	1	EPA 6010B 1996	01/31/2017 3:59		JDB
Chromium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	01/31/2017 3:59		JDB
Cobalt	< 0.005	mg/L	0.005	1	EPA 6010B 1996	01/31/2017 3:59		JDB
Lead	< 0.005	mg/L	0.005	1	EPA 6010B 1996	01/31/2017 3:59		JDB
Lithium	0.017	mg/L	0.001	1	EPA 6010B 1996	01/31/2017 3:59		JDB
Mercury	0.000321	mg/L	0.000025	1	EPA 7470A 1994	12/28/2016 12:52		LNM
Molybdenum	< 0.005	mg/L	0.005	1	EPA 6010B 1996	01/31/2017 3:59		JDB
Selenium	< 0.005	mg/L	0.005	1	EPA 6010B 1996	01/31/2017 3:59		JDB
Thallium	< 0.002	mg/L	0.002	1	EPA 6010B 1996	01/31/2017 3:59		JDB

Water (202088)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Chloride	8	mg/L	1	1	EPA 300.0	12/21/2016 17:10		GB
Fluoride	< 1	mg/L	1	1	EPA 300.0	12/21/2016 17:10		GB
Solids, Total Dissolved (TDS)	138	mg/L	5	1	SM 2540 C-2011	12/18/2016 14:45		JTM
Sulfate	11	mg/L	1	1	EPA 300.0	12/21/2016 17:10		GB

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Shreveport, LA 71101
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AEP ANALYTICAL CHEMISTRY SERVICES

Analysis Report

Report ID : 34517
Date Received: 01/20/2017

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
Phone: (318) 673-3816

Address: 502 N. Allen Avenue
Shreveport, LA 71101
Fax: (318) 673-3960

AEP Sample ID : 202906
Cust Sample ID: AD-3
Sample Desc.:

Collected Date: 01/19/2017
Location: Welsh P.P.

By: MH
Matrix: Water

Metals (202906)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Antimony	< 0.005	mg/L	0.005	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Arsenic	< 0.005	mg/L	0.005	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Barium	0.041	mg/L	0.001	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Beryllium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Boron	0.02	mg/L	0.01	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Cadmium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Calcium	0.746	mg/L	0.01	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Chromium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Cobalt	< 0.005	mg/L	0.005	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Lead	< 0.005	mg/L	0.005	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Lithium	0.014	mg/L	0.001	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Magnesium	0.49	mg/L	0.01	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Mercury	0.000504	mg/L	0.000025	1	EPA 7470A 1994	01/24/2017 14:37		LNM
Molybdenum	< 0.005	mg/L	0.005	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Potassium	0.585	mg/L	0.01	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Selenium	< 0.005	mg/L	0.005	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Sodium	7.77	mg/L	0.01	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Strontium	0.013	mg/L	0.001	1	EPA 6010B 1996	02/11/2017 0:42		JDB
Thallium	< 0.002	mg/L	0.002	1	EPA 6010B 1996	02/11/2017 0:42		JDB

Water (202906)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Alkalinity, Total	< 5	mg/L	5	1	SM 2320 B-2011	01/24/2017 17:30		JID
Bromide	< 1.0	mg/L	1.0	1	EPA 300.0	01/27/2017 12:21		GB
Chloride	9	mg/L	1	1	EPA 300.0	01/27/2017 12:21		GB
Fluoride	< 1	mg/L	1	1	EPA 300.0	01/27/2017 12:21		GB
Solids, Total Dissolved (TDS)	76	mg/L	5	1	SM 2540 C-2011	01/21/2017 14:00		JID

AEP ANALYTICAL CHEMISTRY SERVICES

Analysis Report

**502 North Allen Ave.
Shreveport, LA 71101
Phone: (318) 673-3802
Fax: (318) 673-3960**

Report ID : 34799
Date Received: 02/24/2017

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
Phone: (318) 673-3816

Address: 502 N. Allen Avenue
Shreveport, LA 71101
Fax: (318) 673-3960

AEP Sample ID : 204458
Cust Sample ID: AD-3
Sample Desc.: Coal Combustion Residuals

Collected Date: 02/23/2017
Location: Welsh P.S.

By: MH
Matrix: Water

Metals (204458)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Antimony	< 0.005	mg/L	0.005	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Arsenic	< 0.005	mg/L	0.005	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Barium	0.037	mg/L	0.001	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Beryllium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Boron	0.02	mg/L	0.01	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Cadmium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Calcium	0.573	mg/L	0.01	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Chromium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Cobalt	< 0.005	mg/L	0.005	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Lead	< 0.005	mg/L	0.005	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Lithium	0.014	mg/L	0.001	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Magnesium	0.485	mg/L	0.01	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Mercury	0.000501	mg/L	0.000025	1	EPA 7470A 1994	03/01/2017 12:03	H1	LNM
Molybdenum	< 0.005	mg/L	0.005	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Potassium	0.464	mg/L	0.01	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Selenium	< 0.005	mg/L	0.005	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Sodium	8.45	mg/L	0.01	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Strontium	0.013	mg/L	0.001	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB
Thallium	< 0.002	mg/L	0.002	1	EPA 6010B 1996	03/01/2017 23:52	H1	JDB

Water (204458)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Alkalinity, Total	< 5	mg/L	5	1	SM 2320 B-2011	02/27/2017 9:56	H1	JID
Bromide	< 1.0	mg/L	1.0	1	EPA 300.0	02/28/2017 5:11	H1	GB
Chloride	9	mg/L	1	1	EPA 300.0	02/28/2017 5:11	H1	GB
Fluoride	< 1	mg/L	1	1	EPA 300.0	02/28/2017 5:11	H1	GB
Solids, Total Dissolved (TDS)	104	mg/L	5	1	SM 2540 C-2011	03/02/2017 9:00	H1	JKL

AEP ANALYTICAL CHEMISTRY SERVICES

Analysis Report

502 North Allen Ave.
Shreveport, LA 71101
Phone: (318) 673-3802
Fax: (318) 673-3960

Report ID : 35500
Date Received: 06/08/2017

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
Phone: (318) 673-3816

Address: 502 N. Allen Avenue
Shreveport, LA 71101
Fax: (318) 673-3960

AEP Sample ID : 207456
Cust Sample ID: AD-3
Sample Desc.: Coal Combustion Residuals (CCR)

Collected Date: 06/07/2017
Location: Welsh P.S.

By: MH
Matrix: Water

Metals (207456)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Antimony	< 0.00093	mg/L	0.00093	1	EPA 6010B 1996	07/20/2017 8:43		JDB
Arsenic	0.00191	mg/L	0.00105	1	EPA 6010B 1996	07/20/2017 8:43	J	JDB
Barium	0.038	mg/L	0.00015	1	EPA 6010B 1996	07/20/2017 8:43		JDB
Beryllium	0.00024	mg/L	0.00002	1	EPA 6010B 1996	07/20/2017 8:43	J	JDB
Boron	0.03326	mg/L	0.00028	1	EPA 6010B 1996	07/20/2017 8:43		JDB
Cadmium	0.00008	mg/L	0.00007	1	EPA 6010B 1996	07/20/2017 8:43	J	JDB
Calcium	0.543	mg/L	0.0096	1	EPA 6010B 1996	07/20/2017 8:43		JDB
Chromium	0.00075	mg/L	0.00023	1	EPA 6010B 1996	07/20/2017 8:43	J	JDB
Cobalt	0.00128	mg/L	0.00014	1	EPA 6010B 1996	07/20/2017 8:43	J	JDB
Lead	< 0.00068	mg/L	0.00068	1	EPA 6010B 1996	07/20/2017 8:43		JDB
Lithium	0.01503	mg/L	0.00013	1	EPA 6010B 1996	07/20/2017 8:43		JDB
Magnesium	0.489	mg/L	0.01	1	EPA 6010B 1996	07/20/2017 8:43		JDB
Mercury	0.000365	mg/L	0.000005	1	EPA 7470A 1994	06/23/2017 12:19		LNM
Molybdenum	< 0.00029	mg/L	0.00029	1	EPA 6010B 1996	07/20/2017 8:43		JDB
Potassium	0.532	mg/L	0.01	1	EPA 6010B 1996	07/20/2017 8:43		JDB
Selenium	< 0.00099	mg/L	0.00099	1	EPA 6010B 1996	07/20/2017 8:43		JDB
Sodium	8.27	mg/L	0.01	1	EPA 6010B 1996	07/20/2017 8:43		JDB
Strontium	0.012	mg/L	0.001	1	EPA 6010B 1996	07/20/2017 8:43		JDB
Thallium	< 0.00086	mg/L	0.00086	1	EPA 6010B 1996	07/20/2017 8:43		JDB

Water (207456)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Alkalinity, Total	< 5	mg/L	5	1	SM 2320 B-2011	06/12/2017 10:43		JID
Bromide	< 1.0	mg/L	1.0	1	EPA 300.0	06/21/2017 13:18		GB
Chloride	9	mg/L	0.219	1	EPA 300.0	06/21/2017 13:18		GB
Fluoride	0.2625	mg/L	0.083	1	EPA 300.0	06/21/2017 13:18	J	GB
Solids, Total Dissolved (TDS)	104	mg/L	2	1	SM 2540 C-2011	06/12/2017 16:30	L4	JAR

ATTACHMENT B

Detection Monitoring Event Laboratory Reports

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
T: 614-836-4221, Audinet 210-4221
F: 614-836-4168, Audinet 210-4168
http://aepenv/labs

Water Analysis

Location: Welsh PS ***Report Date: 2/28/2019***

AD-3

Sample Number: **190680-001** **Date Collected:** **02/20/2019 12:02** **Date Received:** **2/27/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Chloride, Cl	9.40	mg/L		0.04	0.01	CRJ	02/28/2019	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.13	mg/L		0.06	0.01	CRJ	02/28/2019	EPA 300.1-1997, Rev. 1.0
Sulfate, SO4	1.9	mg/L		0.4	0.06	CRJ	02/28/2019	EPA 300.1-1997, Rev. 1.0

AD-4C

Sample Number: **190680-002** **Date Collected:** **02/20/2019 11:13** **Date Received:** **2/27/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Chloride, Cl	9.18	mg/L		0.1	0.03	CRJ	02/27/2019	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.1	mg/L	J	0.2	0.04	CRJ	02/27/2019	EPA 300.1-1997, Rev. 1.0
Sulfate, SO4	60.1	mg/L		1	0.2	CRJ	02/27/2019	EPA 300.1-1997, Rev. 1.0

AD-16R

Sample Number: **190680-003** **Date Collected:** **02/20/2019 12:50** **Date Received:** **2/27/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Chloride, Cl	6.78	mg/L		0.1	0.03	CRJ	02/27/2019	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.20	mg/L		0.2	0.04	CRJ	02/27/2019	EPA 300.1-1997, Rev. 1.0
Sulfate, SO4	52.8	mg/L		1	0.2	CRJ	02/27/2019	EPA 300.1-1997, Rev. 1.0

Duplicate BASP

Sample Number: **190680-004** **Date Collected:** **02/20/2019 12:02** **Date Received:** **2/27/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Chloride, Cl	9.42	mg/L		0.04	0.01	CRJ	02/28/2019	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.13	mg/L		0.06	0.01	CRJ	02/28/2019	EPA 300.1-1997, Rev. 1.0
Sulfate, SO4	1.9	mg/L		0.4	0.06	CRJ	02/28/2019	EPA 300.1-1997, Rev. 1.0

Form REP-703
Rev. 1, 11/2013

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
T: 614-836-4221, Audinet 210-4221
F: 614-836-4168, Audinet 210-4168
http://aepenv/labs

Water Analysis

Location: Welsh PS ***Report Date: 6/3/2019***

AD-3

Sample Number: **191516-001** **Date Collected:** **04/30/2019 10:27** **Date Received:** **5/2/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.007	mg/L		0.005	0.0009	GES	05/21/2019 13:35	EPA 200.8-1994, Rev. 5.4
Chloride, Cl	9.34	mg/L		0.04	0.01	CRJ	05/15/2019 15:58	EPA 300.1-1997, Rev. 1.0

AD-4C

Sample Number: **191516-002** **Date Collected:** **04/30/2019 11:02** **Date Received:** **5/2/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.014	mg/L		0.005	0.0009	GES	05/21/2019 13:40	EPA 200.8-1994, Rev. 5.4
Sulfate, SO4	56.2	mg/L		1	0.2	CRJ	05/15/2019 16:21	EPA 300.1-1997, Rev. 1.0

AD-16R

Sample Number: **191516-003** **Date Collected:** **04/30/2019 11:32** **Date Received:** **5/2/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.015	mg/L		0.005	0.0009	GES	05/21/2019 15:20	EPA 200.8-1994, Rev. 5.4

AD-8

Sample Number: **191516-004** **Date Collected:** **04/30/2019 10:22** **Date Received:** **5/2/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	1.21	mg/L		0.005	0.0009	GES	05/21/2019 15:25	EPA 200.8-1994, Rev. 5.4

AD-9

Sample Number: **191516-005** **Date Collected:** **04/30/2019 10:57** **Date Received:** **5/2/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.070	mg/L		0.005	0.0009	GES	05/21/2019 15:30	EPA 200.8-1994, Rev. 5.4

AD-11

Sample Number: **191516-006** **Date Collected:** **04/30/2019 11:32** **Date Received:** **5/2/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	1.34	mg/L		0.005	0.0009	GES	05/21/2019 15:35	EPA 200.8-1994, Rev. 5.4

ATTACHMENT C

May 2019 Sampling Laboratory Report

Duplicate Background

Sample Number: **191926-005** **Date Collected:** **05/30/2019 10:32** **Date Received:** **6/4/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Chloride, Cl	1.50	mg/L		0.1	0.03	CRJ	06/17/2019 20:28	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.31	mg/L		0.2	0.04	CRJ	06/17/2019 20:28	EPA 300.1-1997, Rev. 1.0
Sulfate, SO4	43.1	mg/L		1	0.2	CRJ	06/17/2019 20:28	EPA 300.1-1997, Rev. 1.0

AD-3

Sample Number: **191926-006** **Date Collected:** **05/30/2019 11:49** **Date Received:** **6/4/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Chloride, Cl	7.97	mg/L		0.04	0.01	CRJ	06/17/2019 21:14	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.21	mg/L		0.06	0.01	CRJ	06/17/2019 21:14	EPA 300.1-1997, Rev. 1.0
Sulfate, SO4	2.6	mg/L		0.4	0.06	CRJ	06/17/2019 21:14	EPA 300.1-1997, Rev. 1.0

AD-4C

Sample Number: **191926-007** **Date Collected:** **05/30/2019 10:52** **Date Received:** **6/4/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Chloride, Cl	14.6	mg/L		0.04	0.01	CRJ	06/17/2019 21:37	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.15	mg/L		0.06	0.01	CRJ	06/17/2019 21:37	EPA 300.1-1997, Rev. 1.0
Sulfate, SO4	52.6	mg/L		0.4	0.06	CRJ	06/17/2019 21:37	EPA 300.1-1997, Rev. 1.0

AD-16R

Sample Number: **191926-008** **Date Collected:** **05/29/2019 12:37** **Date Received:** **6/4/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Chloride, Cl	5.29	mg/L		0.04	0.01	CRJ	06/17/2019 23:55	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.18	mg/L		0.06	0.01	CRJ	06/17/2019 23:55	EPA 300.1-1997, Rev. 1.0
Sulfate, SO4	41.6	mg/L		0.4	0.06	CRJ	06/17/2019 23:55	EPA 300.1-1997, Rev. 1.0

Duplicate BASP

Sample Number: **191926-009** **Date Collected:** **05/30/2019 10:52** **Date Received:** **6/4/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Chloride, Cl	14.6	mg/L		0.04	0.01	CRJ	06/18/2019 00:18	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.15	mg/L		0.06	0.01	CRJ	06/18/2019 00:18	EPA 300.1-1997, Rev. 1.0
Sulfate, SO4	52.8	mg/L		0.4	0.06	CRJ	06/18/2019 00:18	EPA 300.1-1997, Rev. 1.0

ATTACHMENT D

Certification by a Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Welsh Bottom Ash Storage Pond CCR management area and that the requirements of 40 CFR 257.94(e)(2) have been met.

BETH ANN GROSS
79864

Beth Ann Gross
Printed Name of Licensed Professional Engineer

Beth Ann Gross
Signature

Geosyntec Consultants
8217 Shoal Creek Blvd., Suite 200
Austin, TX 78757

Texas Registered Engineering Firm
No. F-1182

79864
License Number

Texas
Licensing State

9/2/19
Date

Annual Groundwater Monitoring Report

Southwestern Electric Power Company
J. Robert Welsh Power Plant

Landfill CCR Management Unit

1187 Country Road 4865
Titus County
Pittsburg, Texas

January 2020

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

SOUTHWESTERN ELECTRIC POWER COMPANY
An AEP Company
BOUNDLESS ENERGY

Page

Table of Contents

I. **Overview**

This *Annual Groundwater Monitoring Report* (Report) has been prepared to report the status of activities for the preceding year for an existing CCR unit at Southwestern Electric Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), Welsh Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31, 2020.

In general, the following activities were completed:

- Groundwater samples were collected and analyzed for Appendix III and Appendix IV constituents, as specified in 40 CFR 257.95 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan (2016)*;
- Semi-annual Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- No statistically significant levels (SSLs) were identified;
- Statistically significant increases (SSIs) remain without alternate source demonstrations, keeping the unit in assessment monitoring.
- Groundwater Monitoring Statistical Evaluation Reports to evaluate groundwater data were prepared in accordance with 40 CFR 257.93 and certified. The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance", USEPA, 2009).
- This CCR Unit remained in assessment monitoring throughout 2019.

The major components of this annual report, to the extent applicable at this time, are presented in sections that follow:

- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers;
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened;
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs is included in Appendix I;
- Statistical reports are located in Appendix II

- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring, in addition to identifying the constituents detected at a statistically significant increase over background concentrations (Appendix IV).
- Other information required to be included in the annual report such as alternate source demonstration or assessment of corrective measures, if applicable.

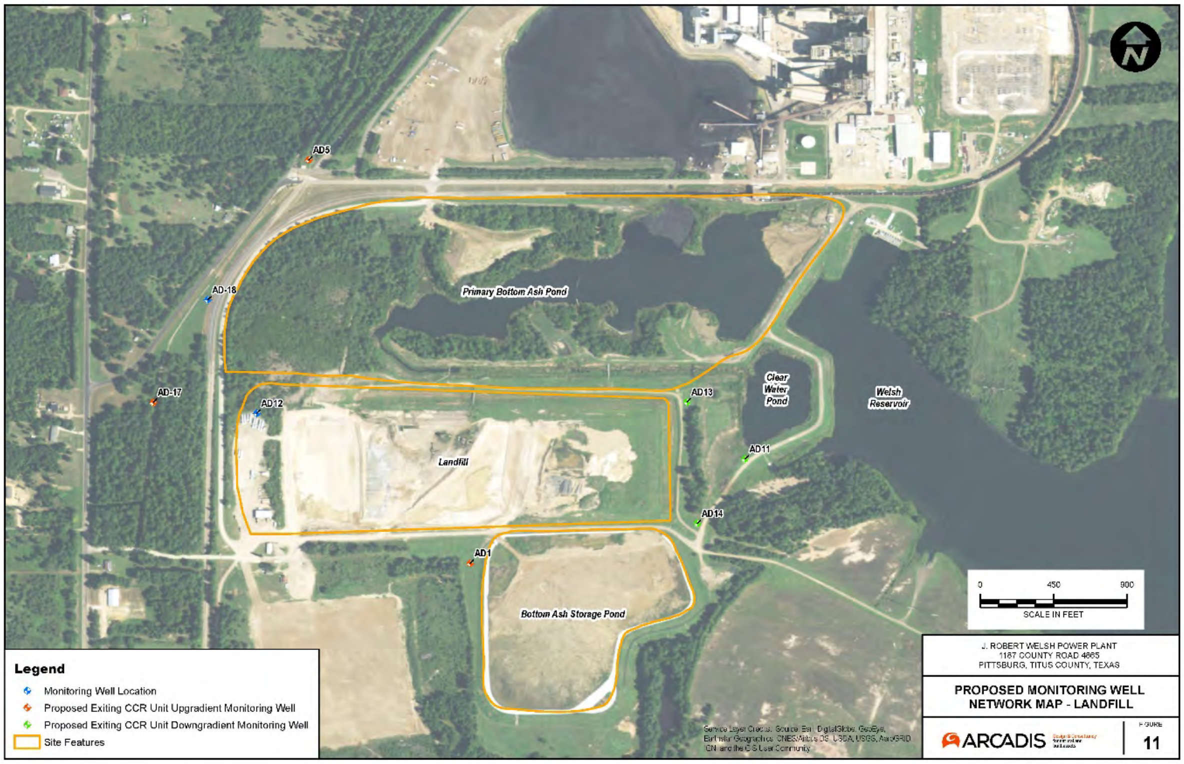
In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.

II. Groundwater Monitoring Well Locations and Identification Numbers

The figure that follows depicts the PE-certified groundwater monitoring network, the monitoring well locations and their corresponding identification numbers.

Landfill Monitoring Wells	
Up Gradient	Down Gradient
AD-1	AD-11
AD-5	AD-13
AD-17	AD-14

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\Dec2017Update\fig 11 - proposed wells_v2.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

III. Monitoring Wells Installed or Decommissioned

During 2019, no monitoring wells were installed or decommissioned during this time period.

IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction and Discussion

Appendix I contains tables showing the groundwater quality data obtained under 40 CFR 257.90 through 275.9. Static water elevation data from each monitoring event also are shown in Appendix I, along with the groundwater velocity, groundwater flow direction and potentiometric maps developed after each sampling event.

The sampling event conducted 5/30/19 satisfies the requirement of 257.95(b).

V. Statistical Evaluations completed in 2019

During the 2nd semi-annual 2018 event the following SSIs were determined:

- Boron concentrations exceeded the interwell UPL of 0.77 mg/L at AD-11 (1.84 mg/L), AD-13 (1.49 mg/L), and AD-14 (1.51 mg/L).
- Chloride concentrations exceeded the intrawell UPLs of 12.6 mg/L at AD-11 (15.0 mg/L) and 6.45 mg/L at AD-14 (12.00 mg/L).
- pH value was below the interwell LPL of 4.29 SU at AD-14 (4.27 SU).
- Sulfate concentration exceeded the intrawell UPL of 131 mg/L at AD-14 (204 mg/L).
- TDS concentration exceeded the intrawell UPL of 325 mg/L at AD-14 (384 mg/L).

SSLs were not determined for the landfill during 2nd semi-annual 2018 event.

During the 1st semi-annual 2019 event, the following SSIs were determined:

- Boron concentrations exceeded the interwell UPL of 0.775 mg/L at AD-11 (1.63 mg/L and 1.34 mg/L) and AD-14 (1.20 mg/L and 1.04 mg/L).

SSLs were not determined for the landfill during the 1st semi-annual 2019 event.

During the 2nd semi-annual 2019 event, the following SSIs were determined:

- Boron concentrations exceeded the interwell UPL of 0.700 mg/L at AD-11 (1.56 mg/L), AD-13 (0.780 mg/L), and AD-14 (1.25 mg/L).
- TDS concentration at AD-14 exceeded the intrawell UPL of 369 mg/L at AD-14 (440 mg/L).

SSLs were not determined for the landfill during the 2nd semi-annual 2019 event.

These SSIs cause the unit to remain in assessment monitoring.

The statistical reports completed in 2019 are found in Appendix II

VI. Alternate Source Demonstrations completed in 2019

No ASDs were conducted for the landfill's SSIs.

VII. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency

This unit remains in assessment monitoring.

VIII. Other Information Required

As required by the CCR assessment monitoring rules in 40 CFR 257.95 (b) and (d 1), sampling all CCR wells for the required Appendix III and IV parameters was completed in 2019. Statistical comparison of Appendix III and IV parameters to the GWPSs was completed in 2019.

IX. Description of Any Problems Encountered in 2019 and Actions Taken

No significant problems were encountered.

X. A Projection of Key Activities for the Upcoming Year

Key activities for 2020 include:

- Assessment monitoring will continue;
- Evaluation of the assessment monitoring results from a statistical analysis viewpoint, looking for SSIs as well as SSLs above GWPS;
- Responding to any new data received in light of CCR rule requirements;
- Preparation of the next annual groundwater report.

APPENDIX I

Tables follow, showing the groundwater monitoring data collected, the rate and direction of groundwater flow, and a summary showing the number of samples collected per monitoring well. The dates that the samples were collected also is shown.

Legend

- ⊕ Groundwater Monitoring Well
- → Approximate Groundwater Flow Direction
- — Groundwater Elevation Contour
- ▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on February 20-21, 2019) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.
- AD-16 was replaced with AD-16R on 4/12/2017.

500 250 0 500
Feet

Groundwater Potentiometric Map
February 2019

AEP Welsh Power Plant
Cason, Texas

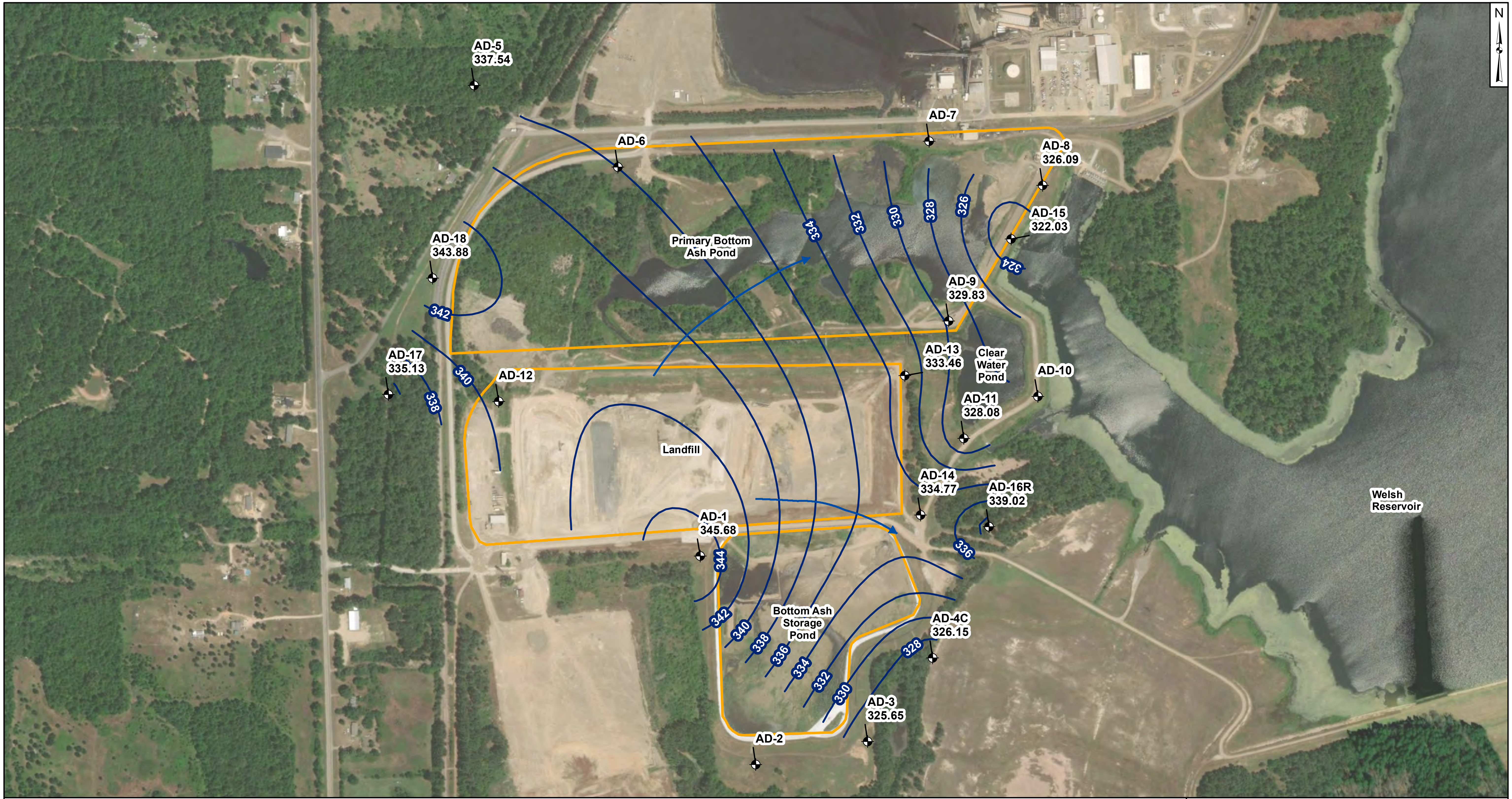
Geosyntec consultants

Columbus, Ohio

2020/01/22

Figure
1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Welsh\2019\AEP-Welsh_GW_2019-20Feb.mxd. ARevezzo. 1/22/2020. CHA8423/14/08.



Legend

- ⊕ Groundwater Monitoring Well
- → Approximate Groundwater Flow Direction
- — Groundwater Elevation Contour
- ▭ CCR Units

Notes

- Monitoring well coordinates and water level data (collected on May 29-30, 2019) provided by AEP.
- AD-10, AD-6, AD-7, AD-2, and AD-12 were not gauged during this event
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.
- AD-16 was replaced with AD-16R on 4/12/2017.

750 375 0 750 Feet

Groundwater Potentiometric Map
May 2019

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Figure
2

Columbus, Ohio
2019/12/12

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Legend
⊕ Groundwater Monitoring Well
→ Approximate Groundwater Flow Direction
— Groundwater Elevation Contour
- - - Groundwater Elevation Contour (Inferred)
▭ CCR Units

Notes
- Monitoring well coordinates and water level data (collected on July 23-24, 2019) provided by AEP.
-AD-12 and AD-6 were not gauged during this event.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016).
- Groundwater elevation units are feet above mean sea level.
- Inferred groundwater contours were ectrapolated from topographic and hydrographic information as well as previous monitoring events.

750 375 0 750
Feet

Groundwater Potentiometric Map
July 2019

AEP Welsh Power Plant
Cason, Texas

Geosyntec
consultants

Columbus, Ohio

2020/01/22

Figure
3

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Welsh\2019\AEP-Welsh_GW_2019-07July.mxd. ARevezzo. 1/22/2020. CHA8423/14/08.

Table 1: Residence Time Calculation Summary
Welsh Landfill

			2019-02		**2019-05**		**2019-07**	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	AD-5 [1]	2.0	1.5	40.2	2.4	25.4	2.1	29.2
	AD-11 [2]	2.0	5.3	11.4	7.4	8.2	4.4	13.9
	AD-13 [2]	0.0	2.5	24.7	4.8	12.8	3.8	15.8
	AD-14 [2]	0.0	3.5	17.2	1.9	32.2	1.9	32.9
	AD-1 [1]	2.0	2.7	22.4	5.3	11.5	4.1	14.9
	AD-17 [1]	2.0	8.9	6.9	4.7	13.0	3.5	17.5

Notes:

[1] - Upgradient Well

[2] - Downgradient Well

Table 1 - Groundwater Data Summary: AD-1
Welsh - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/26/2016	Background	0.346	36.5	5	<0.083 U	5.9	252	42
7/29/2016	Background	0.35	39.6	4	<0.083 U	5.3	239	36
9/30/2016	Background	0.332	15	5	<0.083 U	5.4	173	35
10/21/2016	Background	0.398	19.1	4	<0.083 U	5.2	192	42
12/14/2016	Background	0.394	8.74	4	<0.083 U	5.2	200	40
1/20/2017	Background	0.656	129	4	<0.083 U	7.1	538	68
2/24/2017	Background	0.7	147	9	<0.083 U	6.9	612	68
6/8/2017	Background	0.449	15.1	4	<0.083 U	5.1	176	42
10/6/2017	Detection	0.453	14.3	4	<0.083 U	5.3	160	40
5/24/2018	Assessment	0.345	10.2	4	<0.083 U	2.2	150	43
8/14/2018	Assessment	0.443	5.95	5	<0.083 U	5.2	160	44
2/20/2019	Assessment	0.504	142	2.82	0.24	7.3	522	49.2
5/30/2019	Assessment	0.689	138	1.59	0.29	6.7	588	43.3
7/24/2019	Assessment	0.644	62.7	2	0.106 J	6.0	180	58

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-1
Welsh - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/26/2016	Background	<0.93 U	1.39361 J	191	0.271453 J	0.213294 J	0.240267 J	1.15339 J	1.184	<0.083 U	<0.68 U	0.01	0.033	0.53149 J	1.74922 J	0.959865 J
7/29/2016	Background	<0.93 U	<1.05 U	191	0.315631 J	0.0940357 J	<0.23 U	0.615933 J	0.9952	<0.083 U	<0.68 U	0.019	0.00793 J	<0.29 U	1.81763 J	<0.86 U
9/30/2016	Background	<0.93 U	2.96797 J	141	0.382874 J	<0.07 U	5	0.850408 J	1.38	<0.083 U	3.38434 J	0.014	0.01773 J	<0.29 U	1.02629 J	<0.86 U
10/21/2016	Background	<0.93 U	<1.05 U	114	0.311247 J	<0.07 U	0.412131 J	0.649606 J	1.141	<0.083 U	<0.68 U	0.008	0.00534 J	1.39872 J	2.03168 J	1.25062 J
12/14/2016	Background	<0.93 U	<1.05 U	72	0.34133 J	<0.07 U	<0.23 U	0.424105 J	0.719	<0.083 U	<0.68 U	0.008	0.01521 J	<0.29 U	1.85825 J	<0.86 U
1/20/2017	Background	<0.93 U	<1.05 U	410	0.0366913 J	<0.07 U	<0.23 U	0.480125 J	3.009	<0.083 U	<0.68 U	0.000275956 J	<0.005 U	<0.29 U	4.04737 J	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	488	<0.02 U	<0.07 U	<0.23 U	0.765099 J	4.309	<0.083 U	<0.68 U	0.001	<0.005 U	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	1.14 J	93.46	0.37 J	<0.07 U	0.66 J	0.77 J	0.676	<0.083 U	<0.68 U	0.00902	0.007 J	<0.29 U	2.1 J	<0.86 U
5/24/2018	Assessment	3.17 J	<1.05 U	79.9	0.39 J	<0.07 U	<0.23 U	0.35 J	1.983	<0.083 U	<0.68 U	0.00814	0.006 J	<0.29 U	1.38 J	<0.86 U
8/14/2018	Assessment	0.03 J	0.21	63	0.482	0.02	- -	- -	1.102	<0.083 U	0.238	0.00708	0.013 J	0.210	1.7	0.03 J
2/20/2019	Assessment	0.16	0.46	457	0.09 J	0.01 J	0.306	0.399	3.159	0.24	0.124	0.00155	<0.005 U	1 J	0.7	<0.1 U
5/30/2019	Assessment	0.16	0.60	512	0.244	0.01 J	0.1 J	0.756	2.717	0.29	0.197	<0.009 U	<0.005 U	2.43	1.4	<0.1 U
7/24/2019	Assessment	0.08 J	0.39	245	0.54	0.02 J	0.1 J	0.789	1.819	0.106 J	0.1 J	0.00557	<0.005 U	2 J	3.4	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-5
Welsh - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	0.03	36.9	15	0.3469 J	6.4	337	123
7/29/2016	Background	0.04	44.7	16	<0.083 U	5.4	360	163
9/30/2016	Background	0.04	46.3	15	0.2436 J	5.3	416	190
10/21/2016	Background	0.05	50.7	14	<0.083 U	5.9	448	267
12/14/2016	Background	0.05	49.6	13	<0.083 U	6.2	484	233
1/20/2017	Background	0.04	49.8	14	<0.083 U	6.3	438	234
2/24/2017	Background	0.04	33	15	<0.083 U	5.5	286	127
6/8/2017	Background	0.05281	49.7	14	<0.083 U	6.0	300	82
10/6/2017	Detection	0.04322	33.1	16	<0.083 U	5.6	258	82
5/24/2018	Assessment	0.05007	28.1	22	<0.083 U	6.2	242	60
8/15/2018	Assessment	0.05	40.5	19	<0.083 U	6.2	428	240
2/21/2019	Assessment	0.033	33.9	24.7	0.21	5.4	220	46.5
5/30/2019	Assessment	0.03 J	30.0	22.3	0.29	6.3	238	51.3
7/24/2019	Assessment	0.04 J	41.1	18	0.112 J	6.3	354	90

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-5
Welsh - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	<0.93 U	<1.05 U	57	0.149801 J	0.0765156 J	0.555038 J	14	1.634	0.3469 J	<0.68 U	0.135	0.01135 J	<0.29 U	<0.99 U	<0.86 U
7/29/2016	Background	2.05116 J	2.90819 J	93	0.518653 J	0.502155 J	0.411466 J	15	4.75	<0.083 U	<0.68 U	0.191	0.01516 J	<0.29 U	1.08901 J	<0.86 U
9/30/2016	Background	<0.93 U	4.7609 J	87	0.251584 J	<0.07 U	0.90676 J	14	3.33	0.2436 J	<0.68 U	0.186	<0.005 U	<0.29 U	<0.99 U	<0.86 U
10/21/2016	Background	<0.93 U	<1.05 U	70	0.08781 J	0.107488 J	0.248085 J	9	2.319	<0.083 U	<0.68 U	0.225	<0.005 U	1.36984 J	<0.99 U	<0.86 U
12/14/2016	Background	<0.93 U	1.15381 J	53	0.164529 J	0.203546 J	0.747921 J	13	2.182	<0.083 U	<0.68 U	0.199	0.00802 J	<0.29 U	<0.99 U	<0.86 U
1/20/2017	Background	<0.93 U	<1.05 U	47	0.0574718 J	0.180502 J	<0.23 U	12	1.023	<0.083 U	<0.68 U	0.239	<0.005 U	<0.29 U	<0.99 U	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	42	0.0306858 J	<0.07 U	<0.23 U	13	1.788	<0.083 U	<0.68 U	0.166	<0.005 U	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	3.85 J	87.7	0.08 J	0.39 J	0.28 J	11.93	2.32	<0.083 U	<0.68 U	0.124	<0.005 U	<0.29 U	<0.99 U	<0.86 U
5/24/2018	Assessment	<0.93 U	<1.05 U	71.16	<0.02 U	0.23 J	0.8 J	14.24	1.946	<0.083 U	<0.68 U	0.121	<0.005 U	<0.29 U	<0.99 U	<0.86 U
8/15/2018	Assessment	0.01 J	1.69	63.7	0.055	0.008 J	0.072	11.4	0.316	<0.083 U	0.079	0.147	<0.005 U	0.13	0.08 J	<0.01 U
2/21/2019	Assessment	0.02 J	1.59	69.4	0.08 J	<0.01 U	0.432	8.58	1.267	0.21	0.147	0.0807	<0.005 U	<0.4 U	0.1 J	<0.1 U
5/30/2019	Assessment	<0.02 U	3.05	60.5	0.08 J	<0.01 U	0.06 J	11.8	1.431	0.29	0.05 J	0.104	0.006 J	<0.4 U	0.05 J	<0.1 U
7/24/2019	Assessment	<0.02 U	2.48	77.4	0.05 J	<0.01 U	0.05 J	8.38	2.533	0.112 J	<0.05 U	0.108	<0.005 U	<0.4 U	0.06 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-11
Welsh - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	2.47	8.47	9	2	5.2	388	518
7/29/2016	Background	2.83	8.88	10	2	3.8	1000	596
9/30/2016	Background	3.4	10.7	12	2	4.1	1065	683
10/21/2016	Background	3.77	8.78	11	3	3.7	1024	706
12/14/2016	Background	3.36	8.98	10	2	3.8	1044	548
1/20/2017	Background	2.81	10.3	11	2	4.4	1048	760
2/24/2017	Background	2.88	9.31	10	2	4.3	876	558
6/8/2017	Background	2.79	9.93	10	1.366	3.9	960	556
10/6/2017	Detection	2.58	6.99	10	<0.083 U	4.4	752	527
1/18/2018	Detection	1.9	- -	- -	- -	4.5	564	377
5/23/2018	Assessment	- -	- -	- -	<0.083 U	4.1	- -	- -
8/15/2018	Assessment	- -	- -	- -	<0.083 U	4.7	- -	- -
9/17/2018	Assessment	1.84	6.61	15	- -	- -	720	410
2/5/2019	Assessment	1.47	4.56	9.47	0.47	4.3	- -	225
2/21/2019	Assessment	1.63	19.1	9.23	0.41	4.9	542	306
4/30/2019	Assessment	1.34	7.53	- -	- -	5.3	- -	- -
5/29/2019	Assessment	1.40	5.78	6.96	0.47	4.2	680	367
7/23/2019	Assessment	1.56	7.19	6	0.338 J	4.5	700	342

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-11
Welsh - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	<0.93 U	<1.05 U	14	4	0.325877 J	3	26	1.773	2	<0.68 U	0.032	0.02258 J	<0.29 U	1.54658 J	<0.86 U
7/29/2016	Background	<0.93 U	<1.05 U	12	4	0.453906 J	0.581828 J	26	2.23	2	<0.68 U	0.047	0.00624 J	<0.29 U	1.63477 J	1.31673 J
9/30/2016	Background	<0.93 U	1.77308 J	52	5	0.579196 J	7	30	3.92	2	4.25302 J	0.047	0.01924 J	<0.29 U	2.09096 J	1.07034 J
10/21/2016	Background	<0.93 U	<1.05 U	20	5	0.515668 J	2	27	2.56	3	<0.68 U	0.047	0.0156 J	1.51918 J	<0.99 U	<0.86 U
12/14/2016	Background	<0.93 U	<1.05 U	13	4	0.366319 J	0.365212 J	25	1.569	2	<0.68 U	0.041	0.01212 J	<0.29 U	1.57203 J	<0.86 U
1/20/2017	Background	<0.93 U	<1.05 U	13	4	0.394925 J	0.749253 J	25	1.082	2	<0.68 U	0.046	<0.005 U	<0.29 U	<0.99 U	1.23139 J
2/24/2017	Background	<0.93 U	<1.05 U	19	4	0.430668 J	2	24	1.45	2	1.18289 J	0.035	0.01613 J	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	1.23 J	10.12	2.79	0.41 J	0.32 J	22.16	1.902	1.366	<0.68 U	0.03654	<0.005 U	<0.29 U	<0.99 U	<0.86 U
5/23/2018	Assessment	<0.93 U	2.6 J	16.27	0.89 J	0.18 J	0.8 J	8.63	1.912	<0.083 U	<0.68 U	0.01875	0.007 J	<0.29 U	1.34 J	46
8/15/2018	Assessment	0.02 J	1.05	11.9	1.18	0.37	0.257	15.3	2.568	<0.083 U	1.42	0.0175	<0.005 U	0.05 J	2.4	0.2
2/21/2019	Assessment	0.03 J	0.51	40.3	0.824	0.19	0.259	8.58	1.506	0.41	0.523	0.0157	<0.005 U	<0.4 U	1.5	0.1 J
5/29/2019	Assessment	<0.02 U	0.78	19.1	1.05	0.20	0.369	9.82	1.473	0.47	0.847	0.02 J	<0.005 U	<0.4 U	2.2	0.1 J
7/23/2019	Assessment	<0.02 U	0.59	16.4	0.987	0.24	0.413	10.5	2.246	0.338 J	0.976	0.0153	<0.005 U	<0.4 U	1.0	0.2 J

Notes:

µg/L: micrograms per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

- -: Not analyzed

pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-13
Welsh - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	1.19	8.02	12	0.4948 J	6.1	900	177
7/29/2016	Background	1.23	3.7	15	0.7416 J	4.5	404	187
9/30/2016	Background	1.37	2.7	17	0.6464 J	4.6	431	207
10/21/2016	Background	1.67	3.66	19	1.1263	4.3	482	226
12/14/2016	Background	1.96	3.77	18	0.4149 J	4.8	596	287
1/20/2017	Background	0.402	33.5	7	<0.083 U	5.4	222	90
2/24/2017	Background	1.27	10.3	13	<0.083 U	5.1	392	183
6/8/2017	Background	1.68	3.03	15	0.6679 J	4.2	494	244
10/6/2017	Detection	2.23	5.11	13	<0.083 U	4.6	564	345
1/18/2018	Detection	2.13	- -	- -	- -	4.7	588	383
5/23/2018	Assessment	- -	- -	- -	0.6534 J	4.5	- -	- -
8/14/2018	Assessment	- -	- -	- -	0.7442 J	4.8	- -	- -
9/17/2018	Assessment	1.49	10.1	18	- -	- -	620	316
2/5/2019	Assessment	0.656	5.85	5.43	0.39	4.5	- -	130
2/20/2019	Assessment	0.484	17.7	3.95	0.28	4.9	234	96.3
4/30/2019	Assessment	0.483	- -	- -	- -	4.9	- -	- -
5/30/2019	Assessment	0.477	9.88	3.60	0.53	5.2	196	94.0
7/23/2019	Assessment	0.78	6.16	5	0.169 J	4.8	334	146

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-13
Welsh - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	<0.93 U	<1.05 U	62	0.682114 J	<0.07 U	0.690428 J	4.11633 J	1.223	0.4948 J	<0.68 U	0.011	0.01797 J	<0.29 U	1.4772 J	<0.86 U
7/29/2016	Background	<0.93 U	<1.05 U	36	0.922975 J	0.0850015 J	<0.23 U	4.46011 J	1.601	0.7416 J	<0.68 U	0.026	0.00515 J	<0.29 U	2.00998 J	<0.86 U
9/30/2016	Background	<0.93 U	<1.05 U	40	0.827513 J	0.0965393 J	0.77177 J	4.59287 J	2.213	0.6464 J	<0.68 U	0.020	<0.005 U	<0.29 U	1.03137 J	<0.86 U
10/21/2016	Background	<0.93 U	<1.05 U	30	0.934335 J	0.0913657 J	0.581648 J	4.91926 J	3.662	1.1263	<0.68 U	0.022	<0.005 U	0.870491 J	1.03637 J	0.97358 J
12/14/2016	Background	<0.93 U	3.69546 J	51	1	0.185393 J	7	7	2.27	0.4149 J	1.09698 J	0.025	0.01565 J	0.353324 J	1.64297 J	<0.86 U
1/20/2017	Background	<0.93 U	6.00	112	0.198035 J	<0.07 U	4	1.76949 J	2.228	<0.083 U	2.72659 J	0.004	0.00673 J	<0.29 U	<0.99 U	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	41	0.612394 J	<0.07 U	<0.23 U	4.55541 J	1.556	<0.083 U	<0.68 U	0.015	<0.005 U	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	1.53 J	<1.05 U	17.12	0.89 J	0.14 J	<0.23 U	6.24	1.565	0.6679 J	<0.68 U	0.02082	<0.005 U	<0.29 U	1.03 J	<0.86 U
5/23/2018	Assessment	<0.93 U	<1.05 U	26.53	0.87 J	<0.07 U	0.73 J	9.37	2.16	0.6534 J	<0.68 U	0.0291	0.008 J	<0.29 U	<0.99 U	<0.86 U
8/14/2018	Assessment	0.03 J	1.37	16.9	0.971	0.31	0.503	13.1	4.037	0.7442 J	1	0.0321	<0.005 U	0.06 J	1.7	0.277
2/20/2019	Assessment	0.02 J	0.380	55.2	0.302	0.05	0.2 J	2.35	2.534	0.28	0.05 J	0.0094	<0.005 U	<0.4 U	0.4	<0.1 U
5/30/2019	Assessment	0.03 J	0.320	60.9	0.385	0.07	0.310	3.15	3.15	0.53	0.05 J	0.009 J	<0.005 U	<0.4 U	0.4	<0.1 U
7/23/2019	Assessment	0.02 J	0.370	23.6	0.443	0.09	0.283	3.82	1.748	0.169 J	0.204	0.0175	<0.005 U	<0.4 U	0.3	0.1 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-14
Welsh - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/31/2016	Background	1.28	2.88	4	<0.083 U	4.8	285	115
7/29/2016	Background	1.14	2.51	5	<0.083 U	4.2	267	111
9/30/2016	Background	1.14	1.19	5	<0.083 U	4.2	252	111
10/21/2016	Background	1.25	2.48	4	<0.083 U	3.9	276	118
12/14/2016	Background	1.25	2.41	5	<0.083 U	4.1	296	101
1/20/2017	Background	0.915	10.3	4	<0.083 U	6.1	254	92
2/24/2017	Background	1.06	9.48	4	<0.083 U	5.4	212	90
6/8/2017	Background	1.26	7.69	6	<0.083 U	4.8	256	108
10/6/2017	Detection	1.63	3.55	10	<0.083 U	4.6	288	143
1/18/2018	Detection	1.57	- -	6.43	- -	5.7	- -	- -
5/23/2018	Assessment	- -	- -	- -	<0.083 U	4.2	- -	- -
8/14/2018	Assessment	- -	- -	- -	<0.083 U	4.3	- -	- -
9/17/2018	Assessment	1.51	4.51	12	- -	- -	384	204
2/5/2019	Assessment	1.1	4.13	3.13	0.15	4.3	- -	99.9
2/20/2019	Assessment	1.2	10.3	2.2	0.14	4.3	236	90.4
4/30/2019	Assessment	1.04	- -	- -	- -	4.4	- -	- -
5/29/2019	Assessment	1.21	9.80	3.65	0.19	4.5	274	122
7/23/2019	Assessment	1.25	9.93	8	0.162 J	5.5	440	171

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-14
Welsh - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/31/2016	Background	<0.93 U	1.89384 J	31	0.65845 J	0.99504 J	0.536293 J	10	0.871	<0.083 U	<0.68 U	0.012	0.03	<0.29 U	2.91711 J	<0.86 U
7/29/2016	Background	<0.93 U	<1.05 U	84	0.653837 J	0.976466 J	1	9	1.487	<0.083 U	<0.68 U	0.024	0.02159 J	<0.29 U	1.93417 J	<0.86 U
9/30/2016	Background	<0.93 U	1.45308 J	30	0.473938 J	0.975306 J	0.775009 J	9	4.817	<0.083 U	<0.68 U	0.015	0.02217 J	<0.29 U	2.73939 J	<0.86 U
10/21/2016	Background	<0.93 U	<1.05 U	39	0.543258 J	1	0.640984 J	9	1.972	<0.083 U	<0.68 U	0.014	0.02024 J	0.49697 J	2.46916 J	<0.86 U
12/14/2016	Background	<0.93 U	<1.05 U	47	0.536415 J	1	1	9	1.271	<0.083 U	<0.68 U	0.013	0.037	<0.29 U	3.32013 J	<0.86 U
1/20/2017	Background	<0.93 U	<1.05 U	38	0.215525 J	0.226476 J	0.700394 J	2.91252 J	1.825	<0.083 U	<0.68 U	0.013	0.01863 J	<0.29 U	<0.99 U	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	42	0.286071 J	0.187588 J	<0.23 U	3.50056 J	0.512	<0.083 U	<0.68 U	0.012	0.01443 J	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	<1.05 U	44.83	0.38 J	0.67 J	1.27	6.78	1.138	<0.083 U	<0.68 U	0.0127	0.021 J	<0.29 U	2.61 J	<0.86 U
5/23/2018	Assessment	<0.93 U	<1.05 U	28.17	0.78 J	1.61	<0.23 U	14.34	1.601	<0.083 U	<0.68 U	0.0152	0.145	<0.29 U	3.62 J	<0.86 U
8/14/2018	Assessment	0.01 J	0.39	24	0.854	1.99	0.276	17.6	1.502	<0.083 U	0.174	0.011	0.181	0.03 J	3.7	0.242
2/20/2019	Assessment	0.03 J	0.34	41.2	0.387	0.35	0.247	4.37	1.172	0.14	0.09 J	0.0114	<0.005 U	<0.4 U	0.8	<0.1 U
5/29/2019	Assessment	0.03 J	0.4	44.8	0.556	0.81	0.2 J	7.82	1.946	0.19	0.137	0.02 J	0.181	<0.4 U	2	<0.1 U
7/23/2019	Assessment	<0.02 U	0.43	36.2	0.934	2.49	0.286	18.5	2.731	0.162 J	0.2	0.0155	0.123	<0.4 U	2.7	0.2 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AD-17
Welsh - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/26/2016	Background	0.121	200	43	0.4023 J	7.2	1810	1166
7/29/2016	Background	0.119	195	32	0.4135 J	5.7	1576	1005
9/30/2016	Background	0.111	191	36	0.3055 J	6.2	1663	1055
10/21/2016	Background	0.124	194	32	0.583 J	6.1	1612	1163
12/14/2016	Background	0.135	196	31	0.5399 J	6.0	1560	1096
1/20/2017	Background	0.101	196	33	<0.083 U	5.9	1686	1445
2/24/2017	Background	0.135	189	30	<0.083 U	5.7	1628	1055
6/8/2017	Background	0.121	188	30	<0.083 U	5.8	1578	1105
10/6/2017	Detection	0.183	183	31	<0.083 U	5.9	1548	1090
5/24/2018	Assessment	0.239	193	39	<0.083 U	6.3	1836	1067
8/15/2018	Assessment	0.118	187	40	<0.083 U	5.6	1748	1168
2/21/2019	Assessment	0.151	207	43.2	0.18	6.9	1722	1060
5/30/2019	Assessment	0.158	202	41.7	<0.04 U	6.1	1546	1120
7/24/2019	Assessment	0.113	216	37	0.085 J	6.0	1864	1127

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AD-17
Welsh - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/26/2016	Background	<0.93 U	1.37501 J	21	0.173275 J	2	1	63	1.525	0.4023 J	<0.68 U	0.37	0.032	<0.29 U	<0.99 U	<0.86 U
7/29/2016	Background	1.13716 J	<1.05 U	20	0.307264 J	4	1	68	2.78	0.4135 J	<0.68 U	0.374	0.02133 J	1.04115 J	4.56733 J	<0.86 U
9/30/2016	Background	<0.93 U	<1.05 U	31	0.175474 J	0.848199 J	3	58	2.358	0.3055 J	<0.68 U	0.354	<0.005 U	<0.29 U	<0.99 U	<0.86 U
10/21/2016	Background	<0.93 U	<1.05 U	34	0.200656 J	2	4	65	2.224	0.583 J	<0.68 U	0.394	<0.005 U	0.322249 J	3.34422 J	<0.86 U
12/14/2016	Background	<0.93 U	<1.05 U	17	0.0498325 J	3	0.816224 J	68	2.384	0.5399 J	<0.68 U	0.323	0.01485 J	<0.29 U	<0.99 U	<0.86 U
1/20/2017	Background	<0.93 U	<1.05 U	14	0.0319852 J	3	68	68	2.436	<0.083 U	<0.68 U	0.341	<0.005 U	<0.29 U	<0.99 U	<0.86 U
2/24/2017	Background	<0.93 U	<1.05 U	20	0.0665729 J	2	1	73	2.288	<0.083 U	<0.68 U	0.331	<0.005 U	<0.29 U	<0.99 U	<0.86 U
6/8/2017	Background	<0.93 U	<1.05 U	10.3	<0.02 U	6.06	<0.23 U	74.8	1.598	<0.083 U	<0.68 U	0.329	0.013 J	<0.29 U	<0.99 U	<0.86 U
5/24/2018	Assessment	<0.93 U	<1.05 U	9.65	<0.02 U	6.46	<0.23 U	71.73	1.939	<0.083 U	<0.68 U	0.308	<0.005 U	<0.29 U	<0.99 U	<0.86 U
8/15/2018	Assessment	0.02 J	1.83	12.8	0.069	0.25	0.604	43.5	2.35	<0.083 U	1.1	0.243	0.011 J	0.35	0.3	0.074
2/21/2019	Assessment	0.08 J	2.51	120	0.240	0.27	3.34	64.5	2.657	0.18	2.49	0.268	0.007 J	0.7 J	0.8	<0.1 U
5/30/2019	Assessment	<0.02 U	0.410	19.6	0.02 J	0.03 J	0.246	51.1	2.508	<0.04 U	0.03 J	0.341	<0.005 U	<0.4 U	0.06 J	<0.1 U
7/24/2019	Assessment	<0.02 U	1.07	14.3	0.13	0.03 J	0.228	57.7	3.45	0.085 J	0.263	0.283	<0.005 U	<0.4 U	0.1 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

APPENDIX II

Where applicable, show in this appendix the results from statistical analyses, and a description of the statistical analysis method chosen. These statistical analyses are to be conducted separately for each constituent in each monitoring well.

STATISTICAL ANALYSIS SUMMARY
LANDFILL
J. Robert Welsh Plant
Pittsburg, Texas

Submitted to

AMERICAN ELECTRIC POWER

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January 8, 2019

CHA8473

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LF	Landfill
LFB	Laboratory Fortified Blanks
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
QA	Quality Assurance
QC	Quality Control
RSL	Regional Screening Level
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Landfill (LF), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron, total dissolved solids (TDS), and sulfate at the LF. An alternate source was not identified at the time, so three assessment monitoring events were conducted at the LF in 2018, in accordance with 40 CFR 257.95.

Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at a statistically significant level (SSL) above the GWPS. No SSLs were identified, but Appendix III concentrations for boron, chloride, TDS, and sulfate remained above background. Thus, the unit will remain in assessment monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

LANDFILL EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, samples were collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(b) and 257.95(d)(1). Samples collected from background wells for the May and August 2018 sampling events were analyzed for both Appendix III and Appendix IV parameters, whereas samples collected from downgradient wells were analyzed for Appendix IV parameters only. Lead and molybdenum values for the August 2018 are not reported as they were not detected in any wells during the first event. Additional samples were collected from downgradient wells for Appendix III parameters in September 2018. A summary of data collected during assessment monitoring may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.5 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the LF were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained to meet the requirements of 40 CFR 257.95(b) and 257.95(d)(1) were screened for potential outliers. The reported chromium value of 0.068 milligrams per liter (mg/L) for the January 20, 2017 sampling event at background well AD-17 was removed as an outlier. The reported lithium value of 0.024 mg/L for the July 29, 2016 sampling event at compliance well AD-14 was also removed as an outlier.

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or regional screening level (RSL) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events. Tolerance limits were calculated parametrically with 95% coverage and 95% confidence for barium, beryllium, and combined radium. Non-parametric tolerance limits were calculated for arsenic, chromium, cobalt, lithium, mercury, molybdenum, and selenium due to apparent non-normal distributions; for antimony, fluoride, lead, and thallium due to a high non-detect frequency; and for cadmium due to both an apparent non-normal distribution and a high non-detect frequency. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

No SSLs were identified at the Welsh LF.

2.2.3 Evaluation of Potential Appendix III SSIs

The CCR rule allows CCR units to move from assessment monitoring to detection monitoring if all Appendix III and Appendix IV parameters were at or below background levels for two consecutive sampling events [40 CFR 257.95(e)]. Since no Appendix IV SSLs were identified, Appendix III results were analyzed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations.

Prediction limits were calculated for the Appendix III parameters to represent background values. As described in the January 2018 *Statistical Analysis Summary* report (Geosyntec, 2018), intrawell tests were used to evaluate potential SSIs for calcium, chloride, and pH, whereas interwell tests were used to evaluate potential SSIs for boron, fluoride, TDS, and sulfate.

Wells AD-1 and AD-17 were added to the monitoring well network following completion of the background statistics. Thus, the prediction limits were recalculated using both the background data from AD-1 and AD-17 and the data collected during the 2018 assessment monitoring events. Intrawell tests were selected for calcium, chloride, TDS, and sulfate, whereas interwell tests were selected for boron, fluoride and pH.

Data collected from each compliance well were compared to the prediction limits to evaluate SSIs. The results from this event and the prediction limits are summarized in Table 3. While the prediction limits were calculated assuming a 1-of-2 testing procedures, it was conservatively assumed that an SSI was identified if the initial sample exceeded either the lower prediction limit (LPL) or the upper prediction limit (UPL) based on results from previously unsuccessful alternative source demonstrations (ASDs). The following exceedances of the LPLs/UPLs were noted:

- Boron concentrations exceeded the interwell UPL of 0.77 mg/L at AD-11 (1.84 mg/L), AD-13 (1.49 mg/L), and AD-14 (1.51 mg/L).
- Chloride concentrations exceeded the intrawell UPLs of 12.6 mg/L at AD-11 (15.0 mg/L), and 6.45 mg/L at AD-14 (12.00 mg/L).
- The pH value was below the interwell LPL of 4.29 SU at AD-14 (4.27 SU).
- The sulfate concentration exceeded the intrawell UPL of 131 mg/L at AD-14 (204 mg/L).
- The TDS concentration exceeded the intrawell UPL of 325 mg/L at AD-14 (384 mg/L).

Based on these results, concentrations of Appendix III parameters exceeded background levels at compliance wells at the Welsh LF during assessment monitoring. As a result, the Welsh LF CCR unit will remain in assessment monitoring.

2.3 Conclusions

Three assessment monitoring events were conducted in 2018 in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the 2018 data. GWPSs were established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPS. No SSLs were identified.

The Appendix III results were evaluated to assess whether concentrations of Appendix III parameters exceeded background levels. The prediction limits were recalculated using data from additional background wells and the 2018 sampling events. Intrawell tests were used to evaluate for calcium, chloride, TDS, and sulfate exeedances, whereas interwell tests were used to evaluate for boron, fluoride and pH exceedances. Boron, chloride, pH, sulfate, and TDS results exceeded background levels.

Based on this evaluation, the Welsh LF CCR unit will remain in assessment monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Welsh Plant. January 2017.

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – Landfill, J. Robert Welsh Plant, Pittsburg, Texas. January 15, 2018.

TABLES

Table 1 – Groundwater Data Summary
Welsh – Landfill

Parameter	Unit	AD-1		AD-5		AD-11			AD-13			AD-14			AD-17	
		5/24/2018	**8/14/2018**	**5/24/2018**	**8/15/2018**	**5/23/2018**	**8/15/2018**	**9/17/2018**	**5/23/2018**	**8/14/2018**	**9/17/2018**	**5/23/2018**	**8/14/2018**	**9/17/2018**	**5/24/2018**	**8/15/2018**
Antimony	mg/L	0.00317 J	0.0000300 J	0.005 U	0.0000100 J	0.005 U	0.0000200 J	-	0.005 U	0.0000300 J	-	0.005 U	0.0000100 J	-	0.005 U	0.0000200 J
Arsenic	mg/L	0.005 U	0.000210	0.005 U	0.00169	0.00260 J	0.00105	-	0.005 U	0.00137	-	0.005 U	0.000390	-	0.005 U	0.00183
Barium	mg/L	0.0799	0.0630	0.0712	0.0637	0.0163	0.0119	-	0.0265	0.0169	-	0.0282	0.0240	-	0.00965	0.0128
Beryllium	mg/L	0.000390 J	0.000482	0.001 U	0.0000550	0.000890 J	0.00118	-	0.000870 J	0.000971	-	0.000780 J	0.000854	-	0.001 U	0.0000690
Boron	mg/L	0.345	0.443	0.0501	0.0500	-	-	1.84	-	-	1.49	-	-	1.51	0.239	0.118
Cadmium	mg/L	0.001 U	0.0000200	0.000230 J	0.00000800 J	0.000180 J	0.000370	-	0.001 U	0.000310	-	0.00161	0.00199	-	0.00646	0.000250
Calcium	mg/L	10.2	5.95	28.1	40.5	-	-	6.61	-	-	10.1	-	-	4.51	193	187
Chloride	mg/L	4.00	5.00	22.0	19.0	-	-	15.0	-	-	18.0	-	-	12.0	39.0	40.0
Chromium	mg/L	0.001 U	0.00016	0.000800 J	0.0000720	0.000800 J	0.000257	-	0.000730 J	0.000503	-	0.001 U	0.000276	-	0.001 U	0.000604
Cobalt	mg/L	0.000350 J	0.000797	0.0142	0.0114	0.00863	0.0153	-	0.00937	0.0131	-	0.0143	0.0176	-	0.0717	0.0435
Combined Radium	pCi/L	1.98	1.10	1.95	0.316	1.91	2.57	-	2.16	4.07*	-	1.60	1.50*	-	1.94	2.35
Fluoride	mg/L	1 U	1 U	1 U	1 U	1 U	1 U	-	0.653 J	0.7442 J	-	1 U	1 U	-	1 U	1 U
Lead	mg/L	0.005 U	NR	0.005 U	NR	0.005 U	0.00142	-	0.005 U	0.00100	-	0.005 U	0.000174	-	0.005 U	0.00110
Lithium	mg/L	0.00814	0.00708	0.121	0.147	0.0188	0.0175	-	0.0291	0.0321	-	0.0152	0.0110	-	0.308	0.243
Mercury	mg/L	0.00000600 J	0.0000130 J	0.000025 U	0.000025 U	0.00000700 J	0.000025 U	-	0.00000800 J	0.000025 U	-	0.000145	0.000181	-	0.000025 U	0.0000110 J
Molybdenum	mg/L	0.005 U	NR	0.005 U	NR	0.005 U	0.0000500 J	-	0.005 U	0.0000600 J	-	0.005 U	0.0000300 J	-	0.005 U	0.000350
Selenium	mg/L	0.00138 J	0.00170	0.005 U	0.0000800 J	0.00134 J	0.00240	-	0.005 U	0.00170	-	0.00362 J	0.00370	-	0.005 U	0.000300
Total Dissolved Solids	mg/L	150	160	242	428	-	-	720	-	-	620	-	-	384	1840	1750
Sulfate	mg/L	43.0	44.0	60.0	240	-	-	410	-	-	316	-	-	204	1070	1170
Thallium	mg/L	0.002 U	0.0000300 J	0.002 U	0.01 U	0.0460	0.000200	-	0.002 U	0.000277	-	0.002 U	0.000242	-	0.002 U	0.000074
pH	SU	2.19	5.18	6.22	6.23	4.05	4.73	-	4.52	4.82	-	4.17	4.27	-	6.28	5.60

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Parameter was not present in concentrations above the method detection limit and is reported as the reporting limit
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not sampled
NR: Values are not reported as this parameter was not detected during the May 2018 event at any wells
*Sample collected on 8/15/2018
The fluoride values collected in August 2018 were also used in Appendix III analyses.

Table 2: Groundwater Protection Standards
Welsh Plant - Landfill

Constituent Name	MCL	RSL	Background Limit
Antimony, Total (mg/L)	0.006		0.005
Arsenic, Total (mg/L)	0.01		0.005
Barium, Total (mg/L)	2		0.36
Beryllium, Total (mg/L)	0.004		0.00077
Cadmium, Total (mg/L)	0.005		0.0065
Chromium, Total (mg/L)	0.1		0.004
Cobalt, Total (mg/L)	n/a	0.006	0.075
Combined Radium, Total (pCi/L)	5		4.21
Fluoride, Total (mg/L)	4		1
Lead, Total (mg/L)	n/a	0.015	0.005
Lithium, Total (mg/L)	n/a	0.04	0.39
Mercury, Total (mg/L)	0.002		0.000033
Molybdenum, Total (mg/L)	n/a	0.1	0.005
Selenium, Total (mg/L)	0.05		0.005
Thallium, Total (mg/L)	0.002		0.002

Notes:

Grey cell indicates calculated UTL (Upper Tolerance Limit) is higher than MCL.

MCL = Maximum Contaminant Level

RSL = Regional Screening Level

Calculated UTL represents site-specific background values.

The higher of the calculated UTL or MCL/RSL is used as the GWPS.

Table 3: Appendix III Data Evaluation
Welsh Plant - Landfill

Parameter	Units	Description	AD-11	AD-13	AD-14
			9/17/2018	9/17/2018	9/17/2018
Boron	mg/L	Interwell Background Value (UPL)	0.77		
	mg/L	Assessment Monitoring Result	**1.84**	**1.49**	**1.51**
Calcium	mg/L	Intrawell Background Value (UPL)	11.4	38.5	13.9
	mg/L	Assessment Monitoring Result	6.61	10.1	4.51
Chloride	mg/L	Intrawell Background Value (UPL)	12.6	24.0	6.45
	mg/L	Assessment Monitoring Result	**15**	18	**12**
Fluoride	mg/L	Interwell Background Value (UPL)	1.0		
	mg/L	Assessment Monitoring Result	<0.083	0.744	<0.83
pH	SU	Interwell Background Value (UPL)	7.05		
	SU	Interwell Background Value (LPL)	4.29		
	SU	Assessment Monitoring Result	4.73	4.82	**4.27**
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	1224	974	325
	mg/L	Assessment Monitoring Result	720	620	**384**
Sulfate	mg/L	Intrawell Background Value (UPL)	833	342	131
	mg/L	Assessment Monitoring Result	410	316	**204**

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

Bold values exceed the background value.

Background values are shaded gray.

Fluoride and pH analyzed on 8/14-8/15/2018

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Welsh Landfill CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

112498
License Number

TEXAS
Licensing State

01.08.19
Date

DAVID ANTHONY MILLER
112498

American Electric Power
Service Corporation
Texas Registered Engineering
Firm No. F-3341

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

January 5, 2019

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Welsh Landfill
Assessment Monitoring Event 2018

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the statistical analysis of the September 2018 data for American Electric Power Inc.'s Welsh Landfill. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at the site for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** AD-1, AD-5, and AD-17; and
- **Downgradient wells:** AD-11, AD-13 and AD-14

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis was reviewed by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting.

The CCR program consists of the following constituents:

- **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS;

- **Appendix IV** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series and box plots for Appendix III and IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record (Figures A and B). Data were screened for trends and outliers during December 2017 and the results of those findings were submitted with that report. A summary of flagged values follows this report (Figure C). Values previously flagged as outliers may also be seen in a lighter font and disconnected symbol on the time series graphs. Since the original background screening, upgradient wells AD-1 and AD-17 were approved during 2018 for use as background wells at the Welsh Landfill. These data were previously evaluated during the November 2017 background screening as part of the Welsh PBAP monitoring well network, and no additional adjustments were required to the data sets. Data were, however, re-evaluated to determine the most appropriate statistical method, as described below, with the addition of the data from these upgradient wells.

Determination of Statistical Method

Appendix III – Determination of Spatial Variation

The Analysis of Variance (ANOVA) was used to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying the most appropriate statistical approach (Figure D). Interwell tests, which compare downgradient well data to statistical limits constructed from pooled upgradient well data, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation; when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter.

The ANOVA identified variation for the following Appendix III parameters: boron, calcium, chloride, sulfate and TDS suggesting intrawell methods should be considered. No differences were noted for fluoride and pH; therefore, these parameters are eligible for interwell prediction limits. Boron, calcium, chloride, sulfate and TDS data were further evaluated as described below for the appropriateness of intrawell testing to accommodate the groundwater quality. A summary table of the ANOVA results is included with the reports.

Appendix III - Statistical Limits

Intrawell limits constructed from carefully screened background data from within each well serve to provide statistical limits that are conservative (i.e. lower) from a regulatory perspective, and will rapidly identify a change in more recent compliance data from within a given well. This statistical method removes the element of variation from across wells and eliminates the chance of mistaking natural spatial variation for a release from the facility. Prior to performing intrawell prediction limits, several steps are required to reasonably demonstrate downgradient water quality does not have existing impacts from the practices of the facility.

Exploratory data analysis was used as a general comparison of concentrations in downgradient wells for all Appendix III parameters recommended for intrawell analyses to concentrations reported in the upgradient well. Upper tolerance limits are used in conjunction with confidence intervals to determine whether the estimated averages in downgradient wells are higher than observed levels upgradient of the facility. The upper tolerance limits were constructed to represent the extreme upper range of possible background levels at the site.

In cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to justify an intrawell approach. Such an assessment is beyond the scope of services provided by Groundwater Stats Consulting. When there is not an obvious explanation for observed concentration differences in downgradient wells relative to reported concentrations in the upgradient well, interwell prediction limits will initially be selected for the statistical method until further evidence shows that concentrations are due to natural variation rather than a result of the facility.

Parametric tolerance limits were constructed with a target of 99% confidence and 95% coverage using upgradient well data for each of the Appendix III parameters (Figure E). The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. As more data are collected, the background population is better represented and the confidence and coverage levels increase.

Confidence intervals were constructed on downgradient wells for each of the Appendix III parameters, using the tolerance limits discussed above, to determine intrawell eligibility (Figure F). When the entire confidence interval is above a background standard for a given parameter, interwell methods are initially recommended as the statistical method.

Therefore, only parameters with confidence intervals which did not exceed background standards are eligible for intrawell prediction limits.

Confidence intervals for the above parameters were found to be within their respective background limit for all parameters except boron. Therefore, intrawell methods are recommended for calcium, chloride, sulfate and TDS; and interwell methods are initially recommended for boron, fluoride and pH. As mentioned earlier, if a demonstration supports natural variation in groundwater, intrawell methods will be considered for all parameters.

All available data through June 2017 at each well were used to establish intrawell background limits for the parameters identified above based on a 1-of-2 resample plan that will be used for future comparisons (Figure G). Interwell prediction limits, combined with a 1-of-2 resample plan, were constructed from upgradient wells AD-1, AD-5 and AD-17 (Figure H). Downgradient measurements will be compared to these background limits during each subsequent semi-annual sampling event.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits will be necessary to accommodate these types of changes In the interwell case, newer data will be included in background when a minimum of 2 new samples are available. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

Evaluation of Appendix III Parameters

Interwell prediction limits combined with a 1-of-2 verification strategy were constructed for boron, fluoride, and pH. Intrawell limits combined with a 1-of-2 verification strategy were constructed for calcium, chloride, sulfate and TDS.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of one additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered a false positive result and, therefore, no further action is necessary.

When upgradient wells exceed their background limits, it may be an indication that groundwater is changing naturally upgradient of the facility. Concentrations will continue to be monitored over the next sampling events. The results of those findings may be found in the Prediction Limit Summary tables following this letter.

When a statistically significant increase is identified, the data are further evaluated using the Sen's Slope/Mann Kendall trend test to determine whether concentrations are statistically increasing, decreasing or stable (Figure I). Upgradient wells are included in the trend analyses to identify whether similar patters exist upgradient of the site which is an indication of natural variability in groundwater unrelated to practices at the site.

No statistically significant increasing or decreasing trends were found for any of the well/parameter pairs. A Trend Test summary table follows this letter.

Evaluation of Appendix IV Parameters

Parametric tolerance limits were used to calculate background limits from pooled upgradient well data for Appendix IV parameters with a target of 95% confidence and 95% coverage to determine the Alternate Contaminant Level (ACL) (Figure J). The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and Regional Screening Levels (RSLs) in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure K).

Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters using the highest limit of either the MCL, RSL, or ACL as discussed above (Figure L). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No confidence intervals exceedances were found for any of the downgradient wells. A summary of the confidence interval results follows this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Welsh Landfill. If you have any questions or comments, please feel free to contact me.

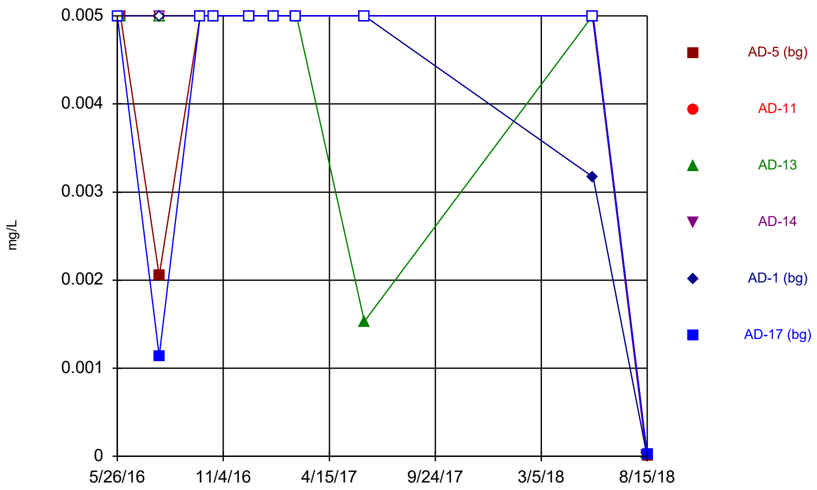
For Groundwater Stats Consulting,

Kristina Rayner

Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Antimony, total Analysis Run 12/24/2018 8:54 AM View: Descriptive
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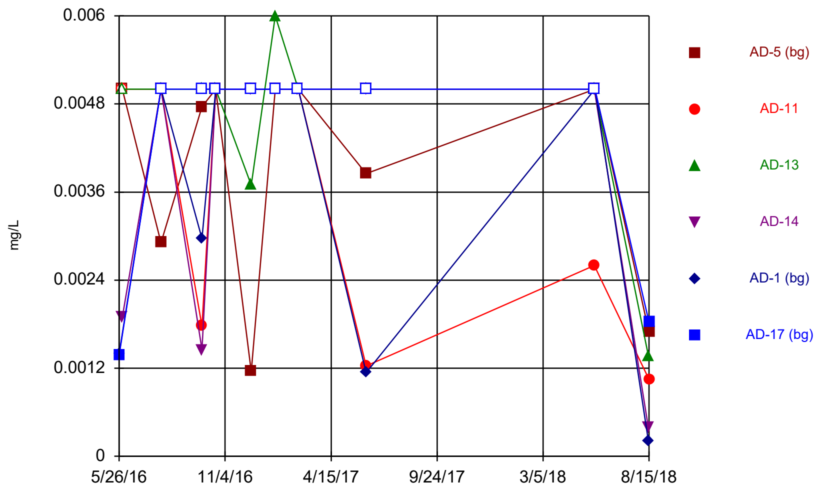

Constituent: Arsenic, total Analysis Run 12/24/2018 8:54 AM View: Descriptive
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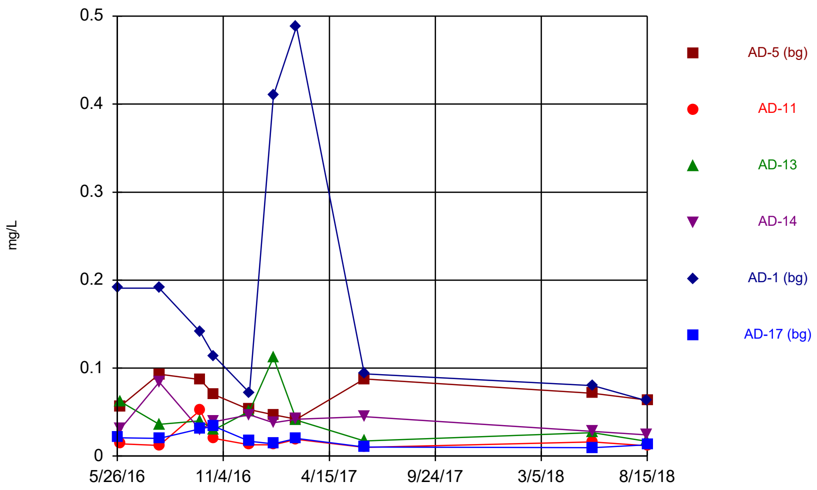

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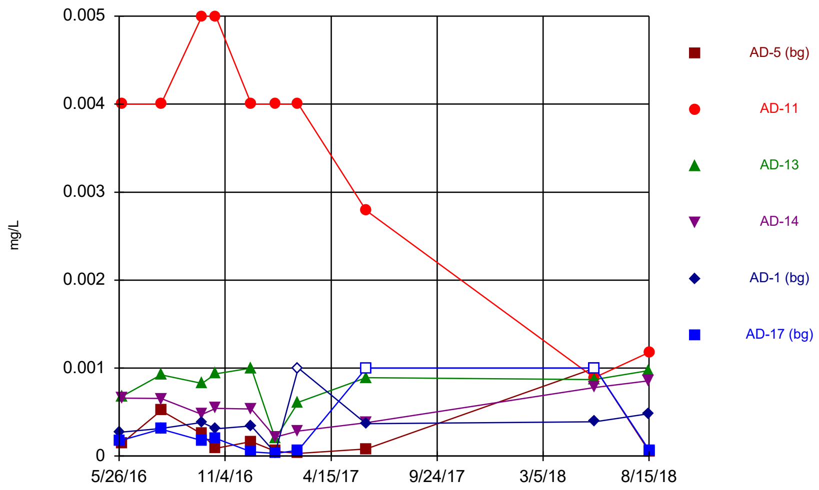

Constituent: Beryllium, total Analysis Run 12/24/2018 8:54 AM View: Descriptive
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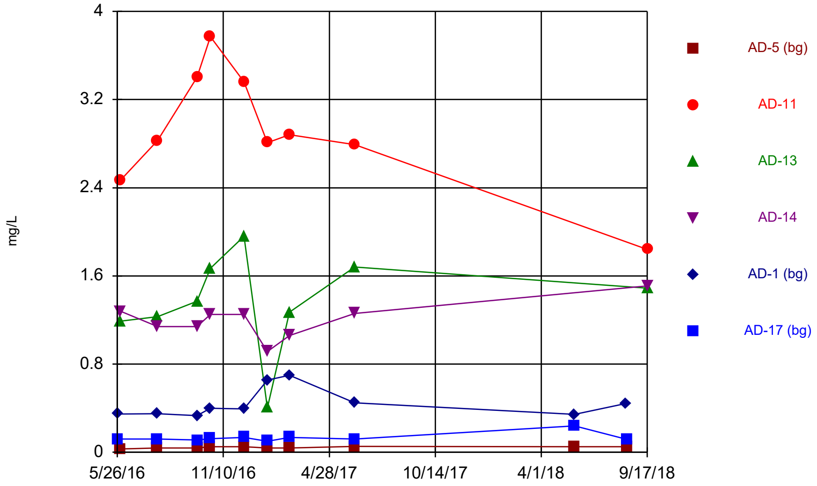

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Hollow symbols indicate censored values.

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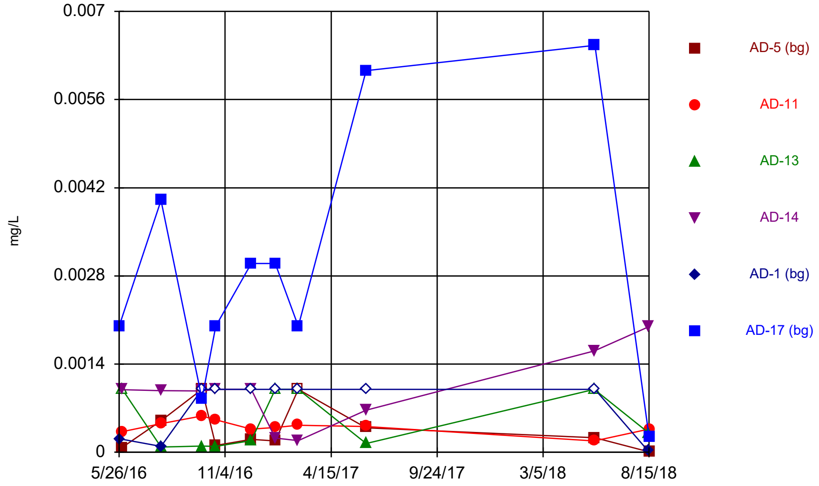

Constituent: Cadmium, total Analysis Run 12/24/2018 8:54 AM View: Descriptive
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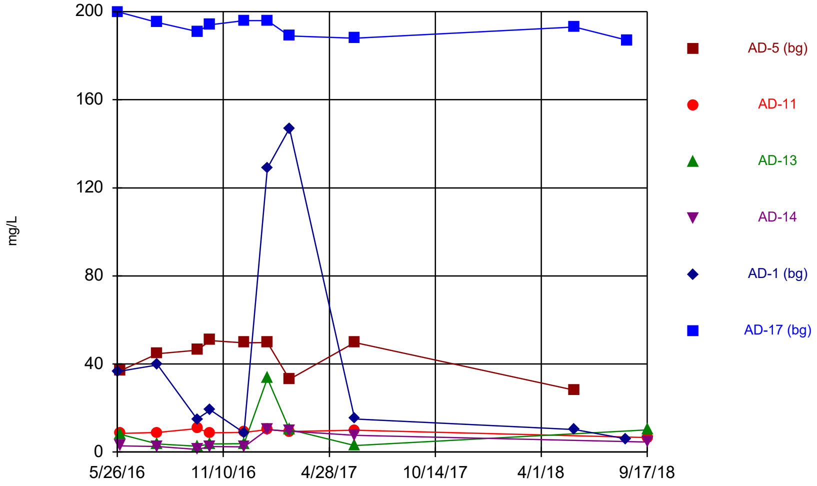
Time Series



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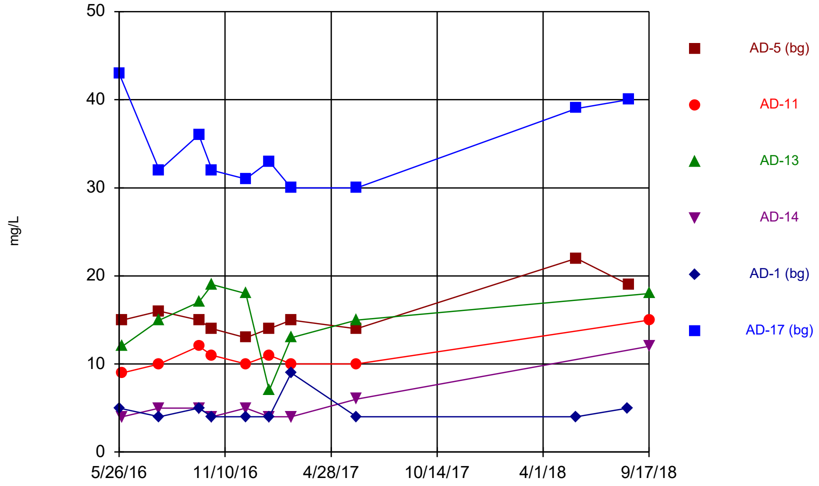
Time Series



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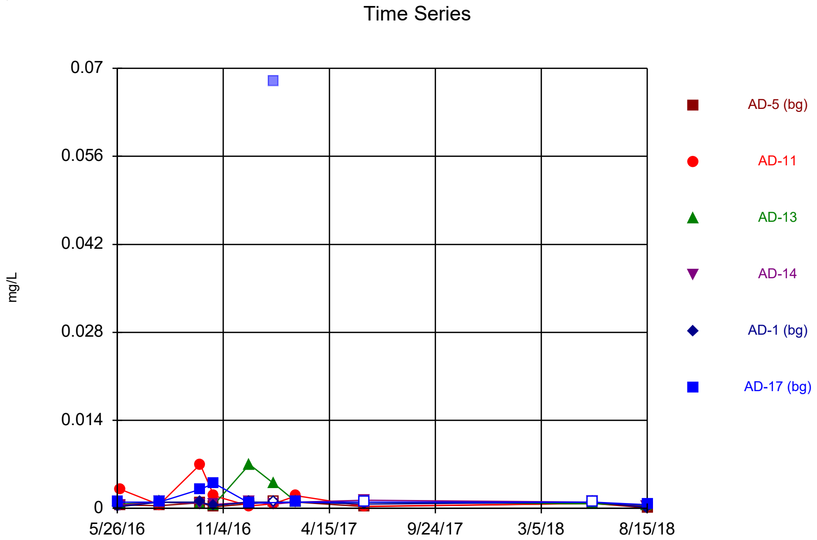
Hollow symbols indicate censored values.



Constituent: Chromium, total Analysis Run 12/24/2018 8:54 AM View: Descriptive
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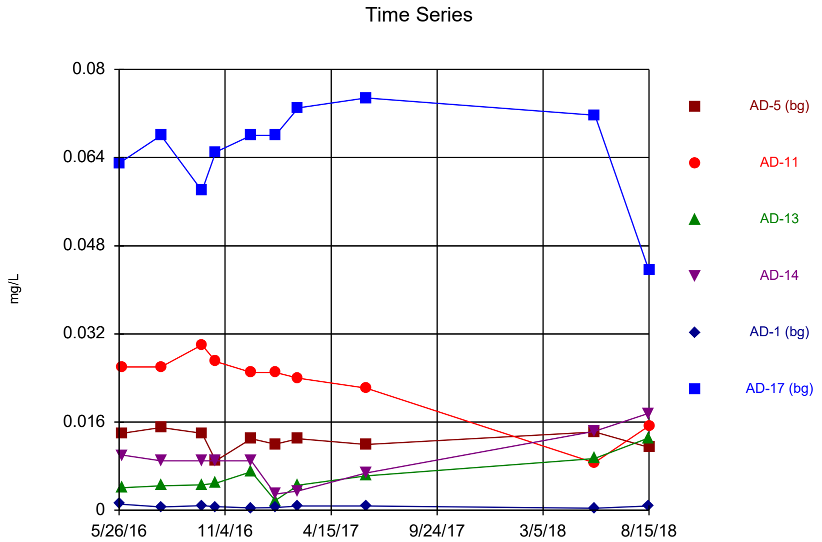

Constituent: Cobalt, total Analysis Run 12/24/2018 8:54 AM View: Descriptive
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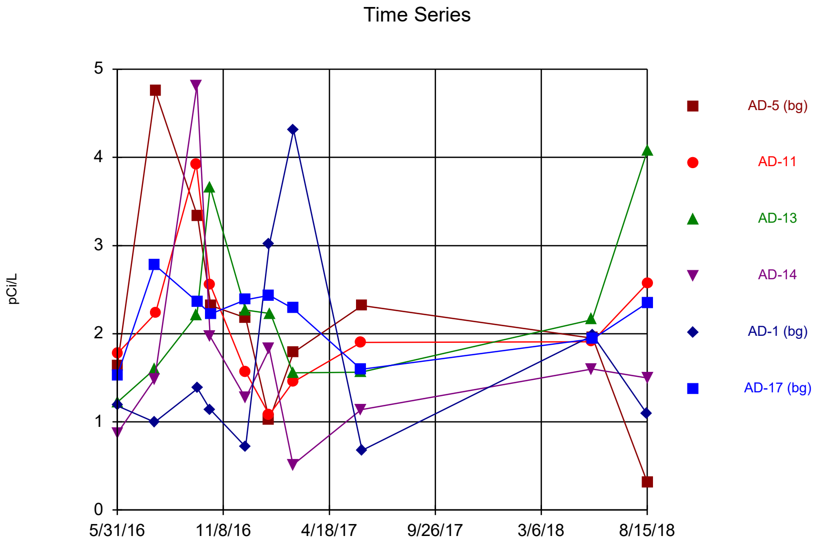
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Combined Radium 226 + 228 Analysis Run 12/24/2018 8:54 AM View: Descriptive
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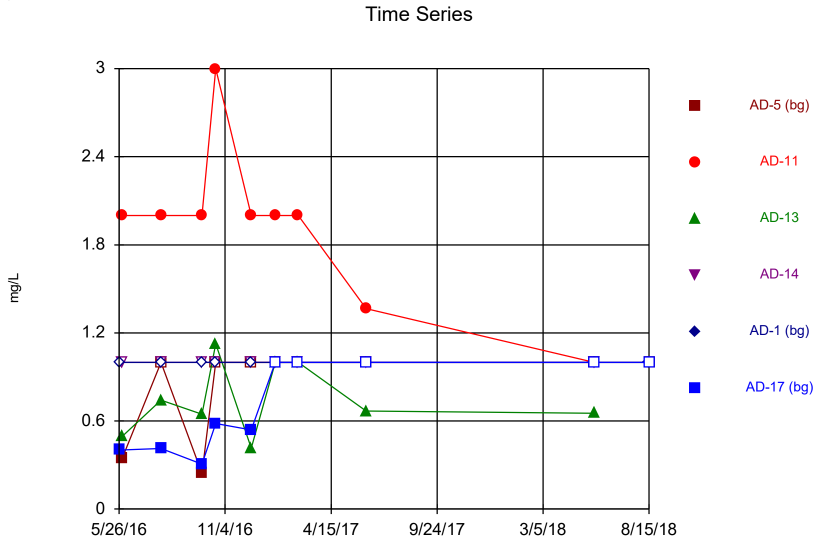
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Fluoride, total Analysis Run 12/24/2018 8:54 AM View: Descriptive
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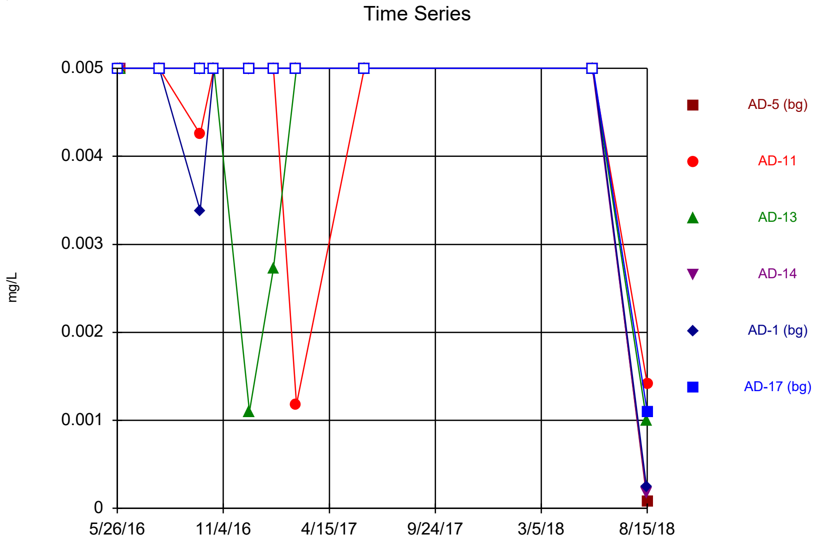
Hollow symbols indicate censored values.



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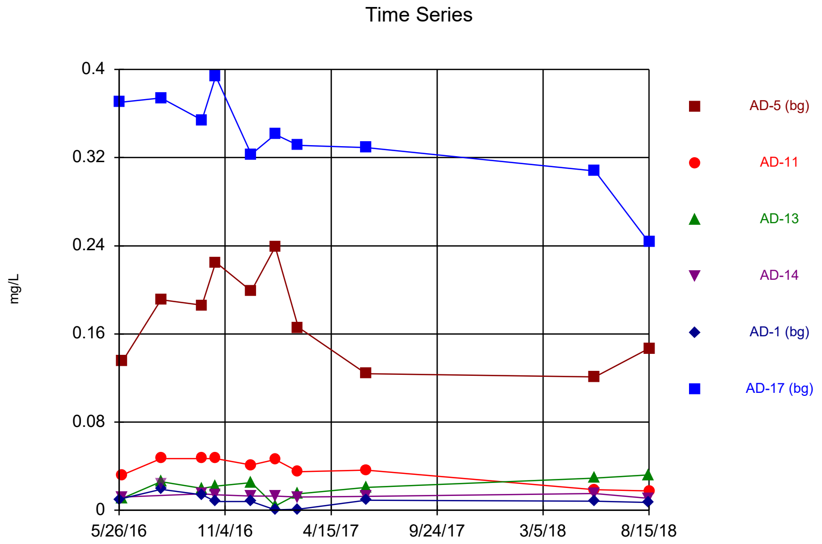
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



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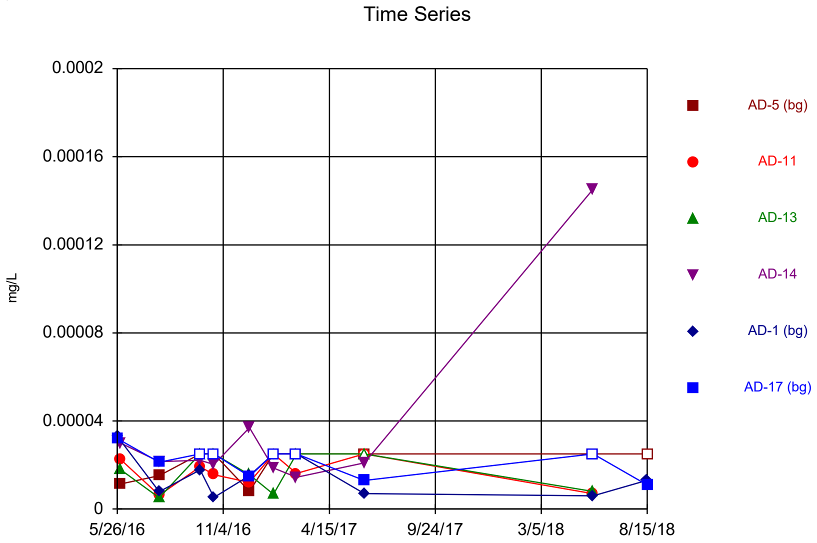
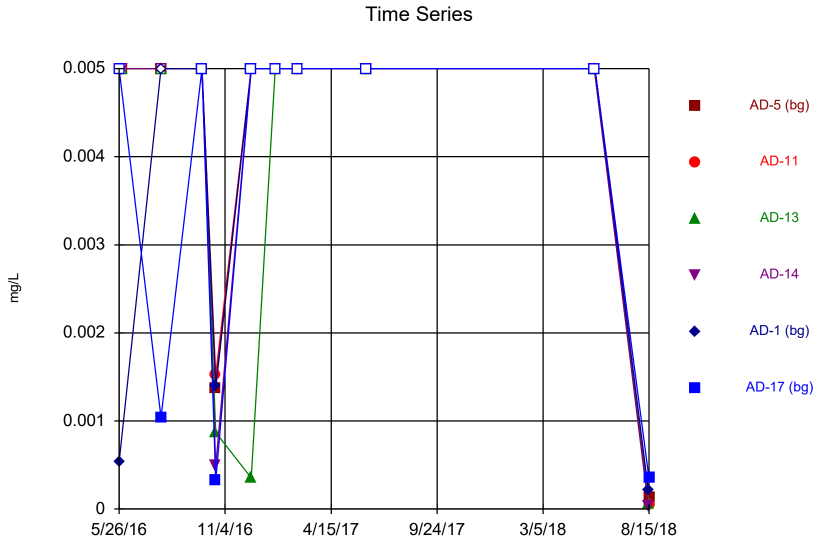
Hollow symbols indicate censored values.



Constituent: Mercury, total Analysis Run 12/24/2018 8:55 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

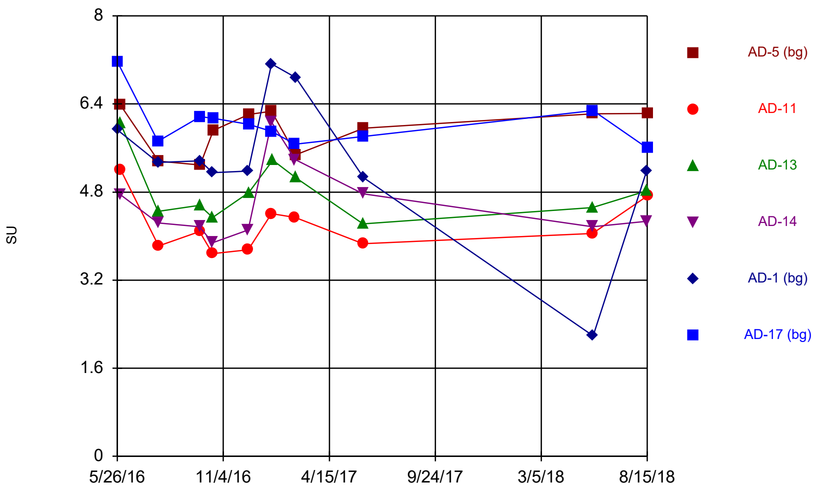
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Molybdenum, total Analysis Run 12/24/2018 8:55 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

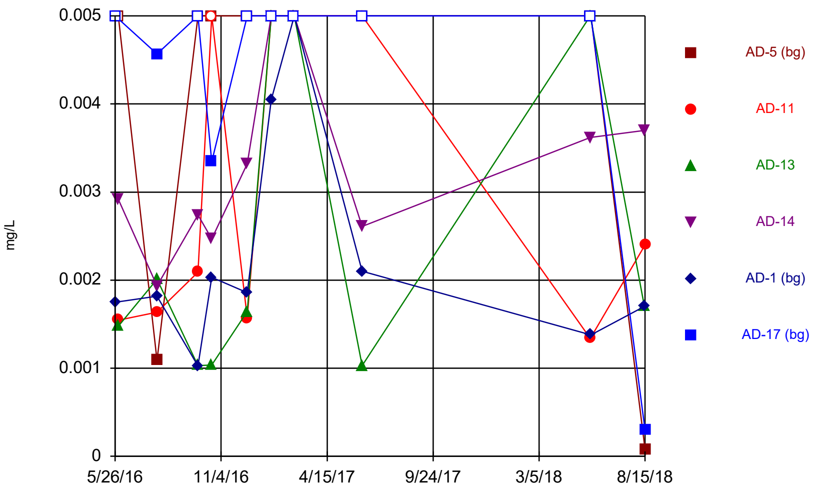
Time Series



Constituent: pH, field Analysis Run 12/24/2018 8:55 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

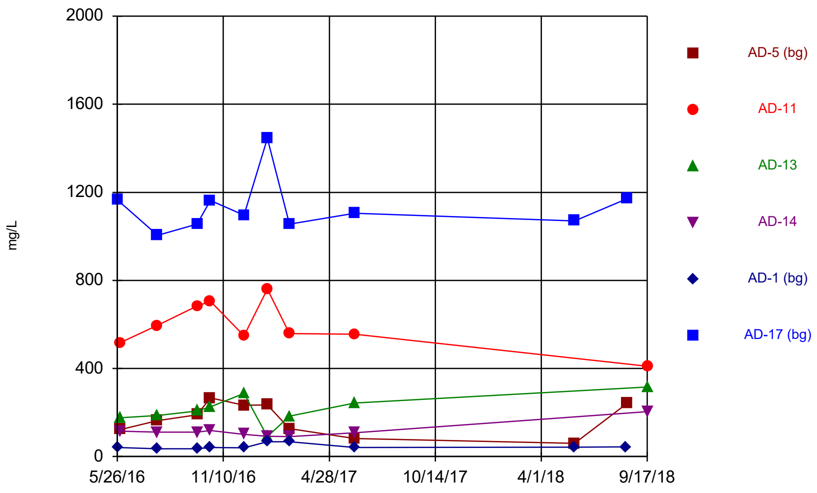
Time Series



Constituent: Selenium, total Analysis Run 12/24/2018 8:55 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

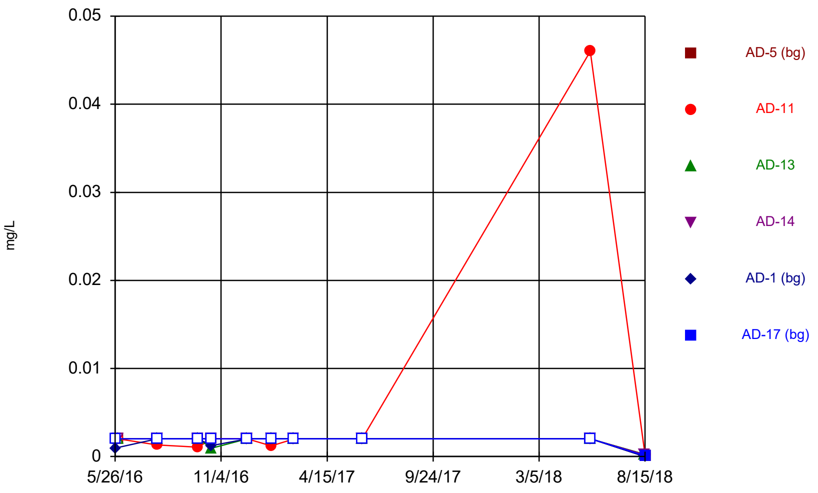
Time Series



Constituent: Sulfate, total Analysis Run 12/24/2018 8:55 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

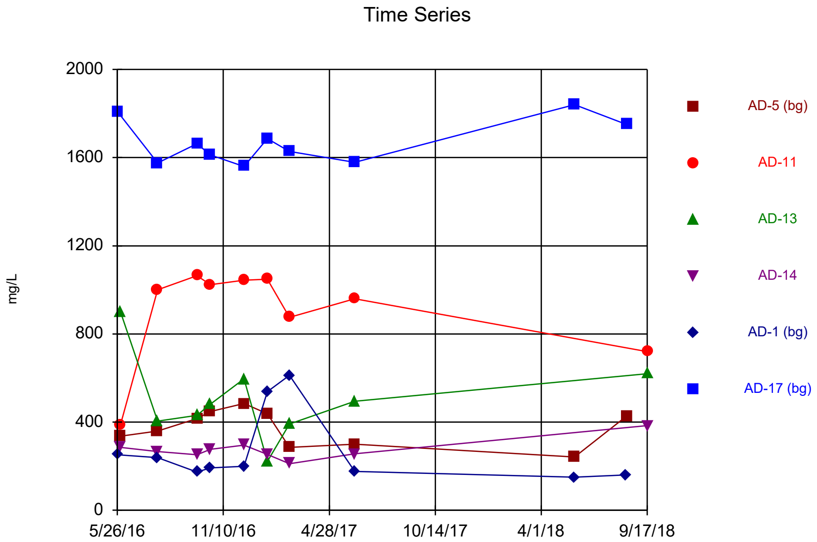
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Thallium, total Analysis Run 12/24/2018 8:55 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

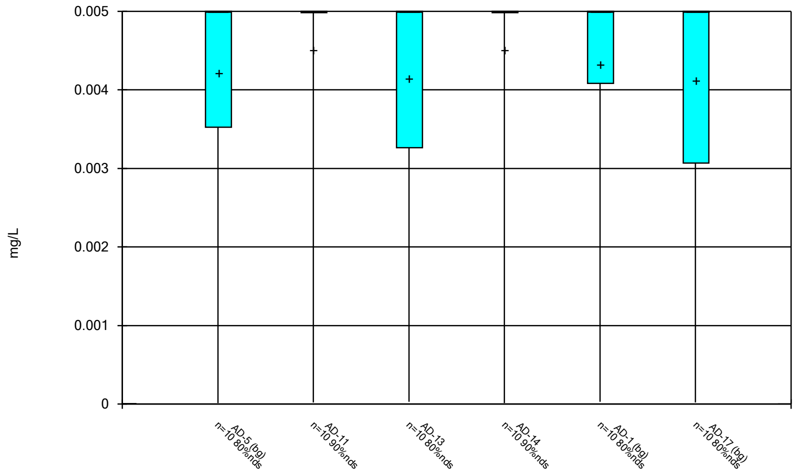
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids Analysis Run 12/24/2018 8:55 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

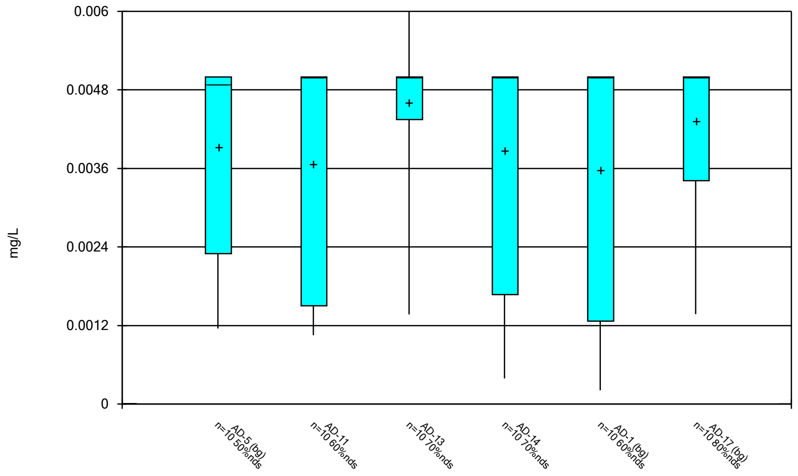
Box & Whiskers Plot



Constituent: Antimony, total Analysis Run 12/24/2018 8:56 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

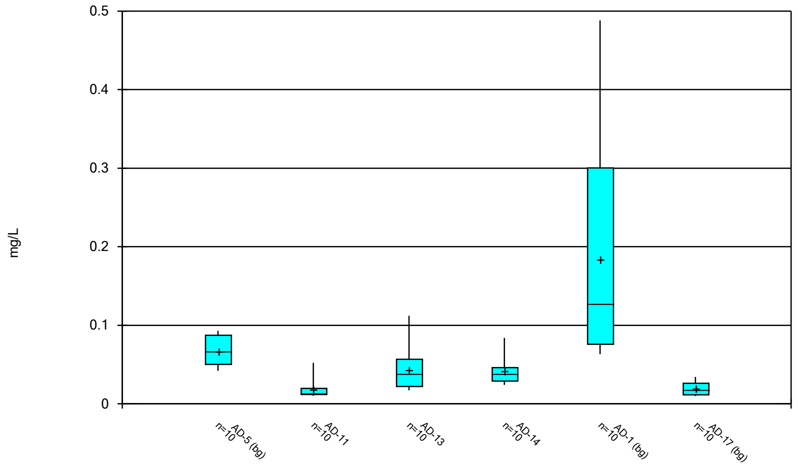
Box & Whiskers Plot



Constituent: Arsenic, total Analysis Run 12/24/2018 8:56 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

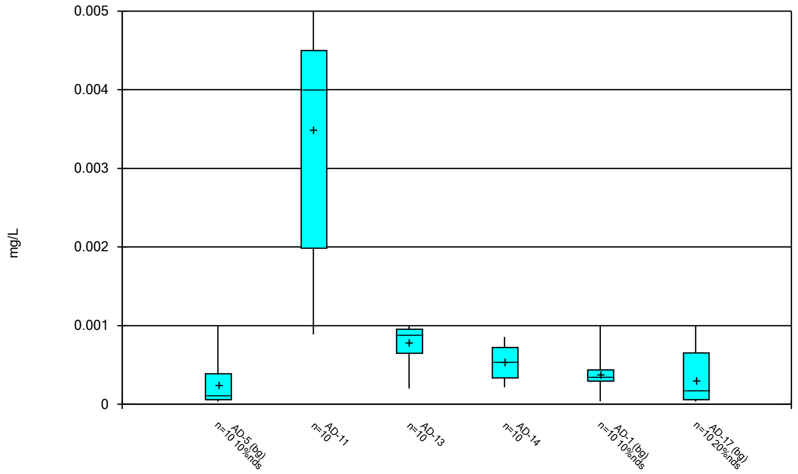
Box & Whiskers Plot



Constituent: Barium, total Analysis Run 12/24/2018 8:56 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

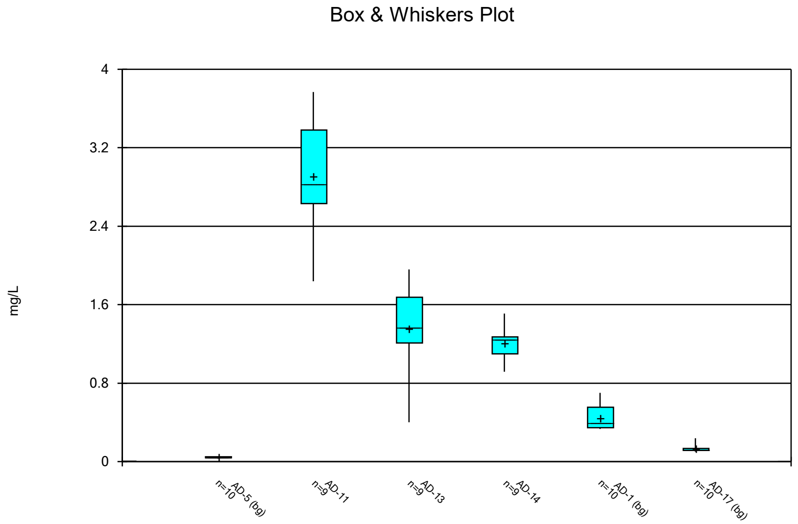
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



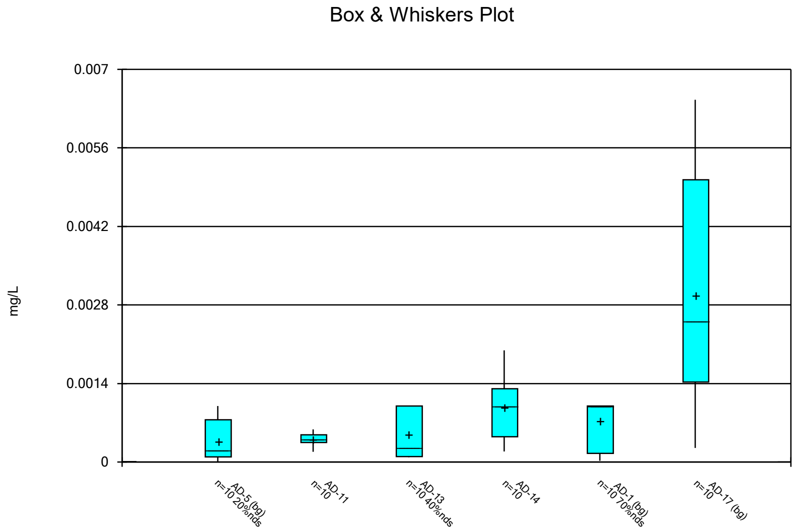
Constituent: Beryllium, total Analysis Run 12/24/2018 8:56 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



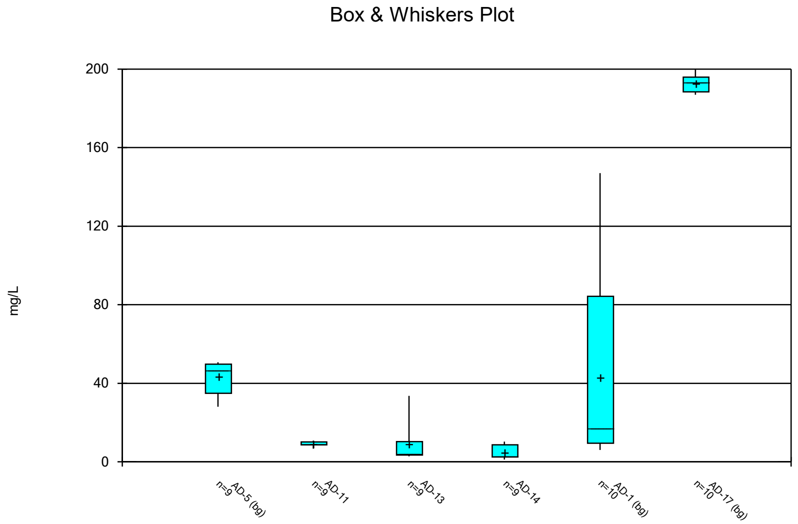
Constituent: Boron, total Analysis Run 12/24/2018 8:56 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



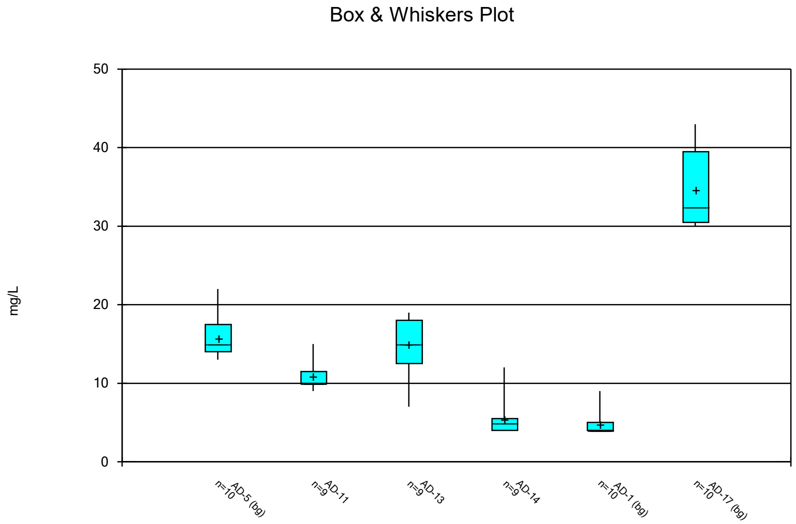
Constituent: Cadmium, total Analysis Run 12/24/2018 8:56 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Calcium, total Analysis Run 12/24/2018 8:56 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

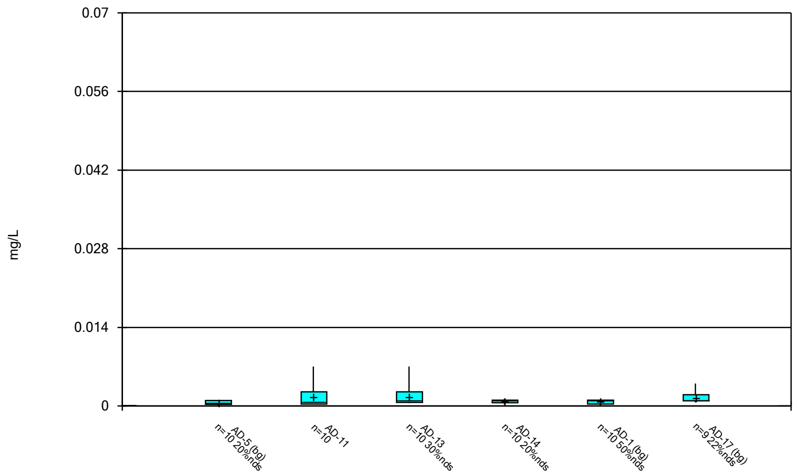
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Chloride, total Analysis Run 12/24/2018 8:56 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

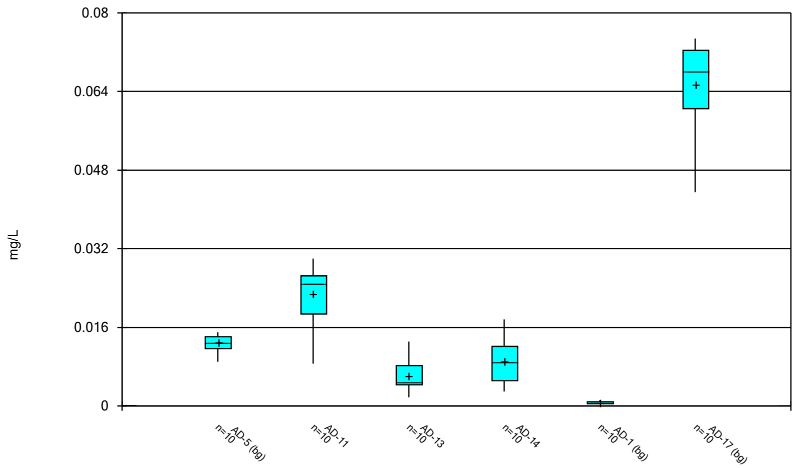
Box & Whiskers Plot



Constituent: Chromium, total Analysis Run 12/24/2018 8:56 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

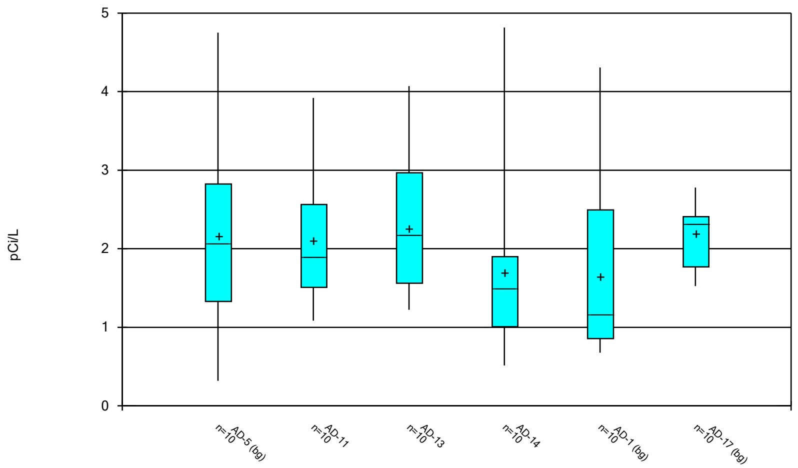
Box & Whiskers Plot



Constituent: Cobalt, total Analysis Run 12/24/2018 8:56 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

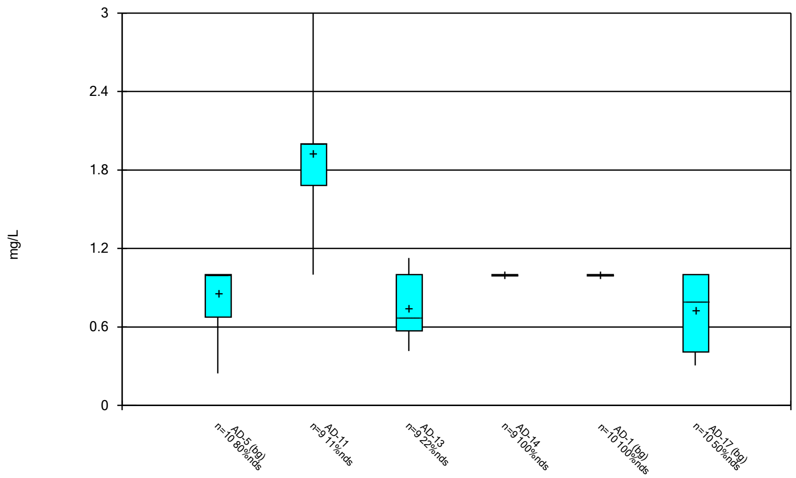
Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 12/24/2018 8:56 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

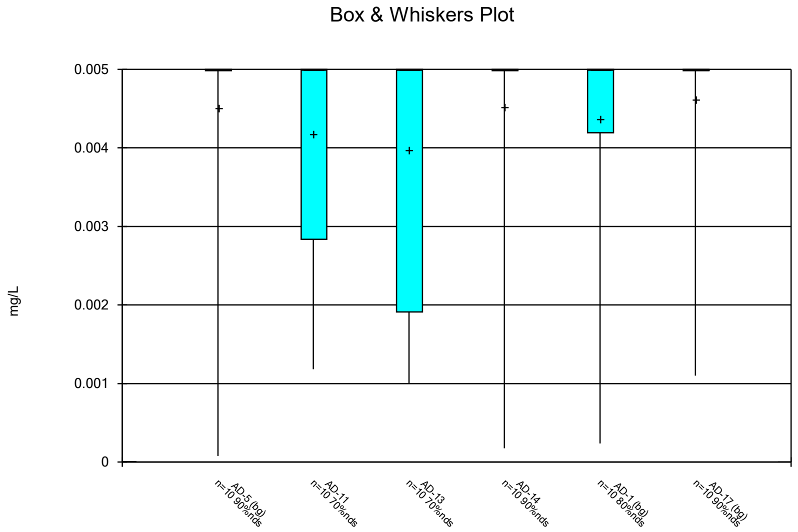
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



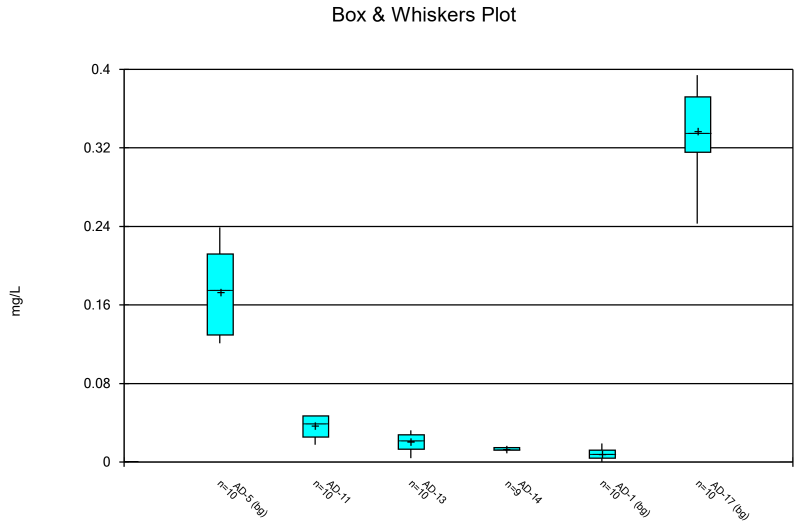
Constituent: Fluoride, total Analysis Run 12/24/2018 8:56 AM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



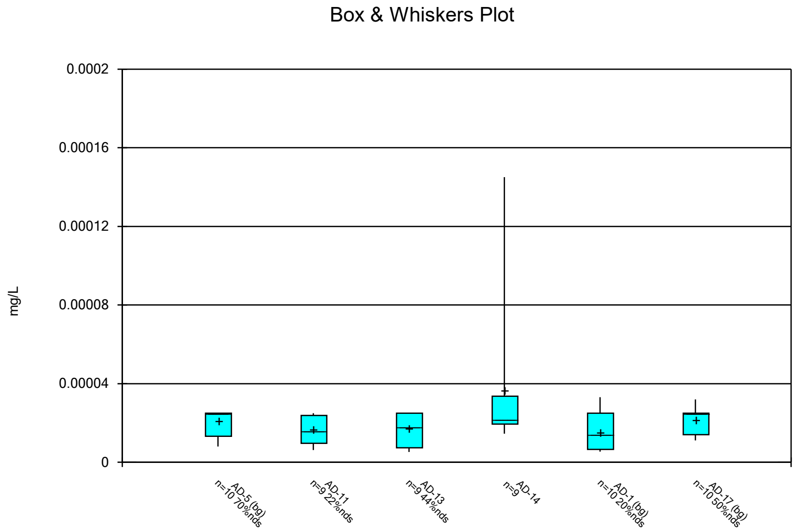
Constituent: Lead, total   Analysis Run 12/24/2018 8:56 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



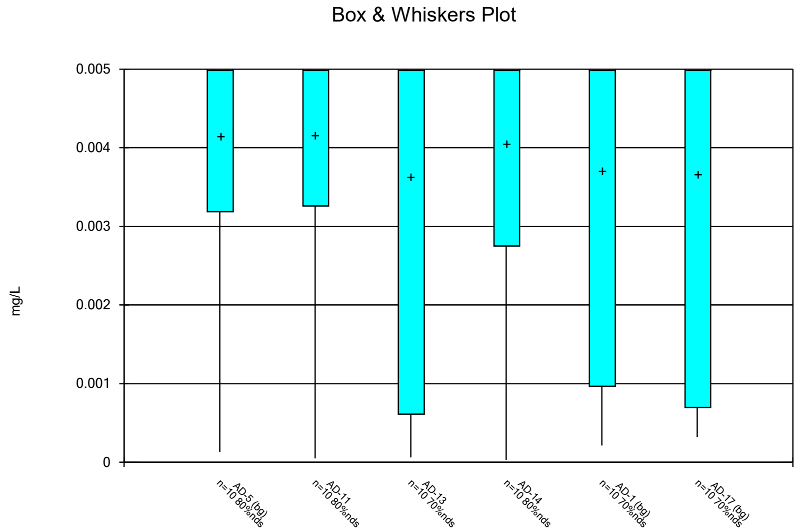
Constituent: Lithium, total   Analysis Run 12/24/2018 8:56 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Mercury, total   Analysis Run 12/24/2018 8:56 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

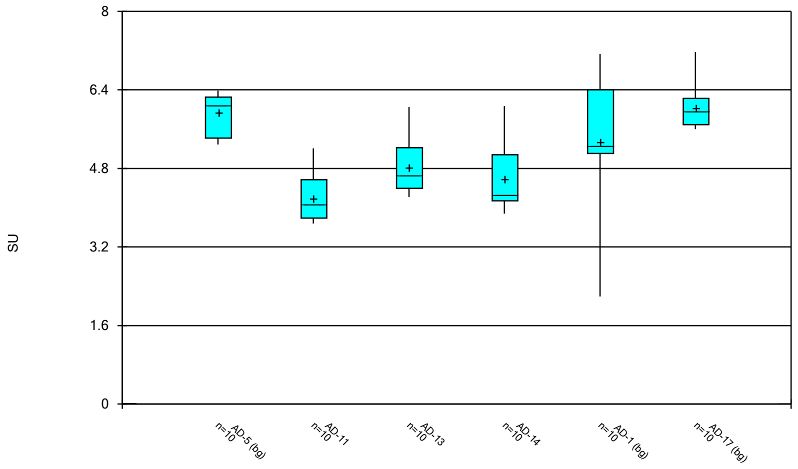
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Molybdenum, total   Analysis Run 12/24/2018 8:56 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

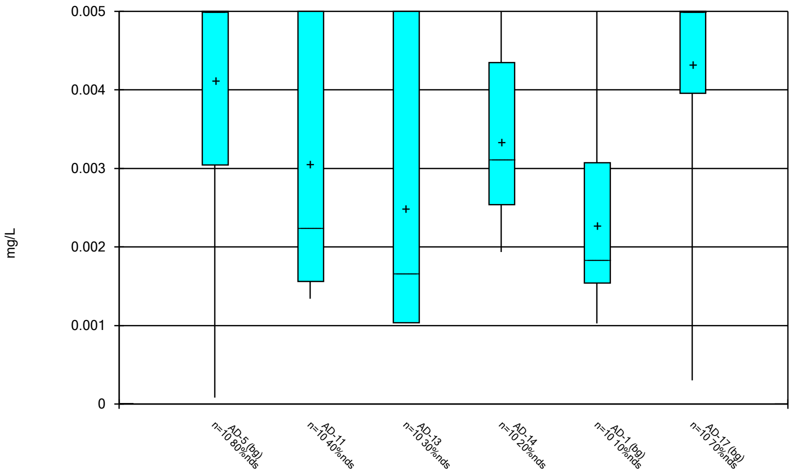
Box & Whiskers Plot



Constituent: pH, field   Analysis Run 12/24/2018 8:56 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

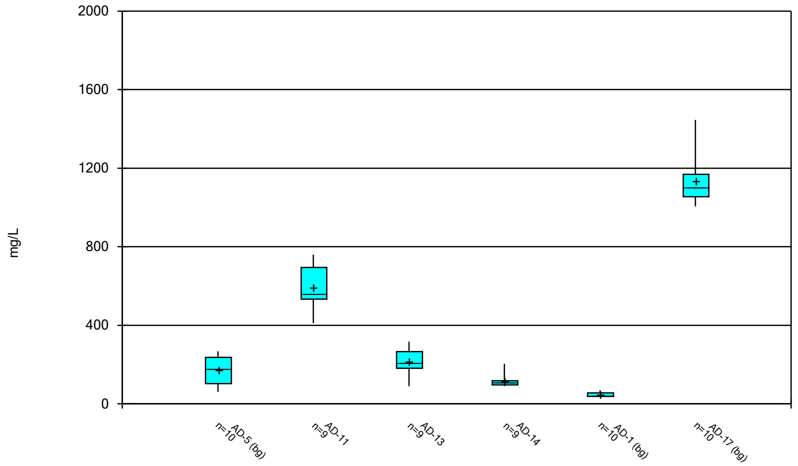
Box & Whiskers Plot



Constituent: Selenium, total   Analysis Run 12/24/2018 8:56 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

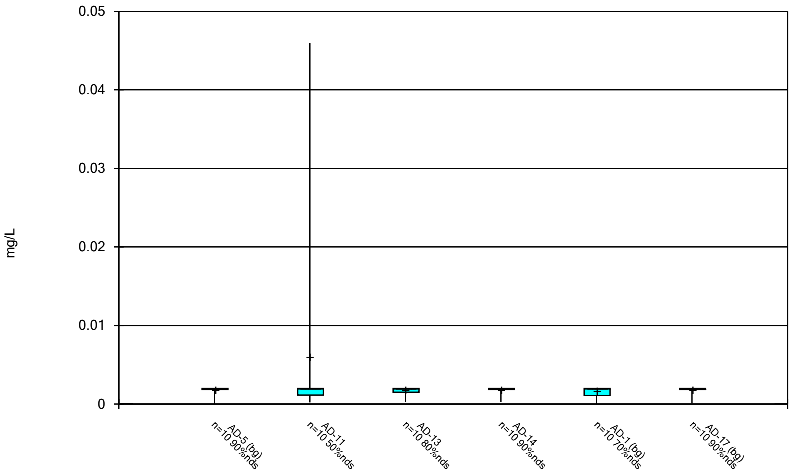
Box & Whiskers Plot



Constituent: Sulfate, total   Analysis Run 12/24/2018 8:56 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

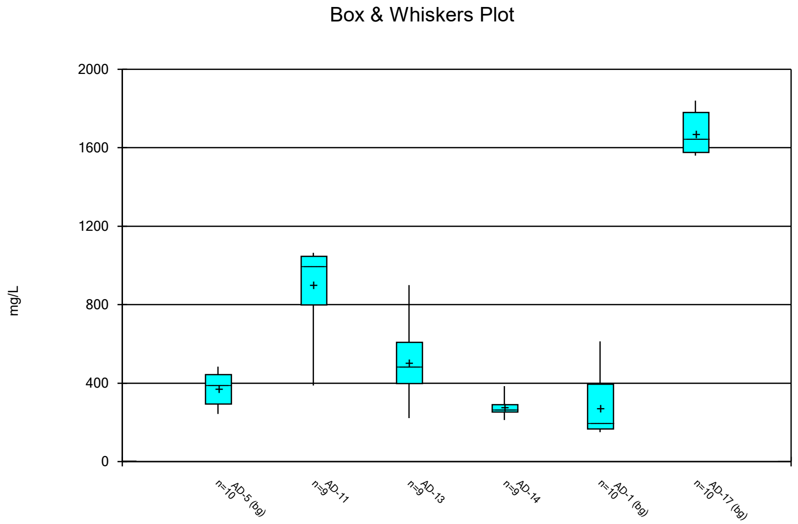
Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Thallium, total   Analysis Run 12/24/2018 8:57 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids   Analysis Run 12/24/2018 8:57 AM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Outlier Summary

Welsh LF   Client: Geosyntec   Data: Welsh LF   Printed 12/10/2018, 3:33 PM

	AD-17 Chromium, total (mg/L)	AD-14 Lithium, total (mg/L)
7/29/2016		0.024 (o)
1/20/2017	0.068 (O)	

Analysis of Variance

Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/24/2018, 8:59 AM

Constituent	Well	Calc.	Crit.	Sig.	Alpha	Transform	ANOVA Sig.	Alpha	Method
Boron, total (mg/L)	n/a	n/a	n/a	n/a	n/a	ln(x)	Yes	0.05	Param.
Calcium, total (mg/L)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	NP (normality)
Chloride, total (mg/L)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	NP (normality)
Fluoride, total (mg/L)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	NP (NDs)
pH, field (SU)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	NP (normality)
Sulfate, total (mg/L)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	NP (eq. var.)
Total Dissolved Solids (mg/L)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	NP (eq. var.)

Parametric ANOVA

Constituent: Boron, total Analysis Run 12/24/2018 8:59 AM View: ANOVA
Welsh LF Client: Geosyntec Data: Welsh LF

For observations made between 5/26/2016 and 8/15/2018 the parametric analysis of variance test (after natural log transformation) indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 248.8

Tabulated F statistic = 3.35 with 2 and 27 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	1.521	2	0.7604	8.064
Error Within Groups	2.546	27	0.09429	
Total	4.067	29		

The Shapiro Wilk normality test on the residuals passed after natural log transformation. Alpha = 0.01, calculated = 0.9013, critical = 0.9. Levene's Equality of Variance test passed. Calculated = 0.5384, tabulated = 3.35.

Non-Parametric ANOVA

Constituent: Calcium, total   Analysis Run 12/24/2018 8:59 AM   View: ANOVA
Welsh LF   Client: Geosyntec   Data: Welsh LF

For observations made between 5/26/2016 and 8/15/2018, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 20.41

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 1 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 20.41
Adjusted Kruskal-Wallis statistic (H') = 20.41

Non-Parametric ANOVA

Constituent: Chloride, total   Analysis Run 12/24/2018 8:59 AM   View: ANOVA
Welsh LF   Client: Geosyntec   Data: Welsh LF

For observations made between 5/26/2016 and 8/15/2018, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 26.09

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 6 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 25.81
Adjusted Kruskal-Wallis statistic (H') = 26.09

Non-Parametric ANOVA

Constituent: Fluoride, total Analysis Run 12/24/2018 8:59 AM View: ANOVA
Welsh LF Client: Geosyntec Data: Welsh LF

For observations made between 5/26/2016 and 8/15/2018, the non-parametric analysis of variance test indicates NO DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is less than or equal to the Chi-squared value, we conclude that no group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 5.92

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 1 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 3.254
Adjusted Kruskal-Wallis statistic (H') = 5.92

Non-Parametric ANOVA

Constituent: pH, field   Analysis Run 12/24/2018 8:59 AM   View: ANOVA
Welsh LF   Client: Geosyntec   Data: Welsh LF

For observations made between 5/26/2016 and 8/15/2018, the non-parametric analysis of variance test indicates NO DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is less than or equal to the Chi-squared value, we conclude that no group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 4.842

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 1 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 4.841
Adjusted Kruskal-Wallis statistic (H') = 4.842

Non-Parametric ANOVA

Constituent: Sulfate, total   Analysis Run 12/24/2018 8:59 AM   View: ANOVA
Welsh LF   Client: Geosyntec   Data: Welsh LF

For observations made between 5/26/2016 and 8/15/2018, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 25.33

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 3 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 25.3
Adjusted Kruskal-Wallis statistic (H') = 25.33

Non-Parametric ANOVA

Constituent: Total Dissolved Solids Analysis Run 12/24/2018 8:59 AM View: ANOVA
Welsh LF Client: Geosyntec Data: Welsh LF

For observations made between 5/26/2016 and 8/15/2018, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 21.53

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 0 groups of ties in the data, so no adjustment to the Kruskal-Wallis statistic (H) was necessary.

Upper Tolerance Limits - Appendix III

Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/10/2018, 4:12 PM

Constituent	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Calcium, total (mg/L)	200	n/a	29	n/a	n/a	0	n/a	n/a	0.2259	NP Inter(normality)
Chloride, total (mg/L)	43	n/a	30	n/a	n/a	0	n/a	n/a	0.2146	NP Inter(normality)
Fluoride, total (mg/L)	1	n/a	30	n/a	n/a	76.67	n/a	n/a	0.2146	NP Inter(NDs)
pH, field (SU)	7.672	3.051	30	34.08	8.719	0	None	x^2	0.01	Inter
Sulfate, total (mg/L)	1445	n/a	30	n/a	n/a	0	n/a	n/a	0.2146	NP Inter(normality)
Total Dissolved Solids (mg/L)	1840	n/a	30	n/a	n/a	0	n/a	n/a	0.2146	NP Inter(normality)
Boron, total (mg/L)	0.7	n/a	30	n/a	n/a	0	n/a	n/a	0.2146	NP Inter

Confidence Intervals Appendix III - Significant Results

Welsh LF   Client: Geosyntec   Data: Welsh LF   Printed 12/10/2018, 4:15 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Boron, total (mg/L)	**AD-11**	**3.451**	**2.36**	**0.7**	**Yes**	**9**	**0**	**No**	**0.01**	**Param.**
Boron, total (mg/L)	**AD-13**	**1.787**	**0.9379**	**0.7**	**Yes**	**9**	**0**	**No**	**0.01**	**Param.**
Boron, total (mg/L)	**AD-14**	**1.36**	**1.041**	**0.7**	**Yes**	**9**	**0**	**No**	**0.01**	**Param.**

Confidence Intervals Appendix III - All Results

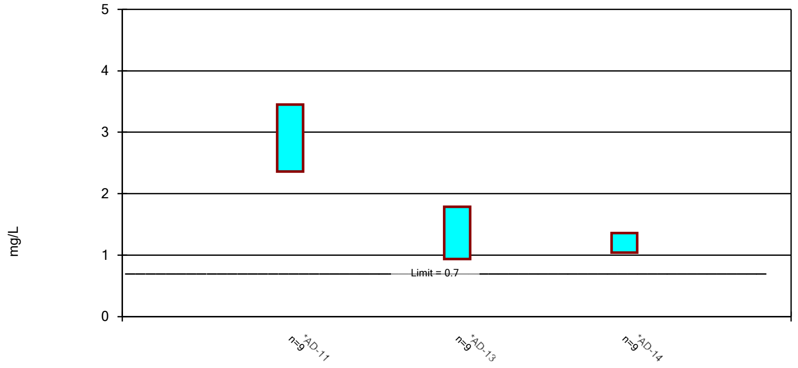
Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/10/2018, 4:15 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Boron, total (mg/L)	**AD-11**	**3.451**	**2.36**	**0.7**	**Yes**	**9**	**0**	**No**	**0.01**	**Param.**
Boron, total (mg/L)	**AD-13**	**1.787**	**0.9379**	**0.7**	**Yes**	**9**	**0**	**No**	**0.01**	**Param.**
Boron, total (mg/L)	**AD-14**	**1.36**	**1.041**	**0.7**	**Yes**	**9**	**0**	**No**	**0.01**	**Param.**
Calcium, total (mg/L)	AD-11	10.26	7.949	200	No	9	0	No	0.01	Param.
Calcium, total (mg/L)	AD-13	33.5	2.7	200	No	9	0	No	0.002	NP (normality)
Calcium, total (mg/L)	AD-14	7.913	1.793	200	No	9	0	sqrt(x)	0.01	Param.
Chloride, total (mg/L)	AD-11	15	9	43	No	9	0	No	0.002	NP (normality)
Chloride, total (mg/L)	AD-13	18.55	11.23	43	No	9	0	No	0.01	Param.
Chloride, total (mg/L)	AD-14	12	4	43	No	9	0	No	0.002	NP (normality)
Fluoride, total (mg/L)	AD-11	3	0.5	4	No	9	11.11	No	0.002	NP (normality)
Fluoride, total (mg/L)	AD-13	1.126	0.4149	4	No	9	22.22	No	0.002	NP (Cohens/xfrm)
Fluoride, total (mg/L)	AD-14	0.5	0.5	4	No	9	100	No	0.002	NP (NDs)
pH, field (SU)	AD-11	4.693	3.693	7.67	No	10	0	No	0.005	Param.
pH, field (SU)	AD-13	5.389	4.249	7.67	No	10	0	No	0.005	Param.
pH, field (SU)	AD-14	5.262	3.909	7.67	No	10	0	sqrt(x)	0.005	Param.
Sulfate, total (mg/L)	AD-11	696.6	489	1445	No	9	0	No	0.01	Param.
Sulfate, total (mg/L)	AD-13	277.1	148.9	1445	No	9	0	No	0.01	Param.
Sulfate, total (mg/L)	AD-14	204	90	1445	No	9	0	No	0.002	NP (normality)
Total Dissolved Solids (mg/L)	AD-11	1061	796.3	1840	No	9	0	x^4	0.01	Param.
Total Dissolved Solids (mg/L)	AD-13	687.3	321.8	1840	No	9	0	No	0.01	Param.
Total Dissolved Solids (mg/L)	AD-14	319.6	232.1	1840	No	9	0	sqrt(x)	0.01	Param.

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

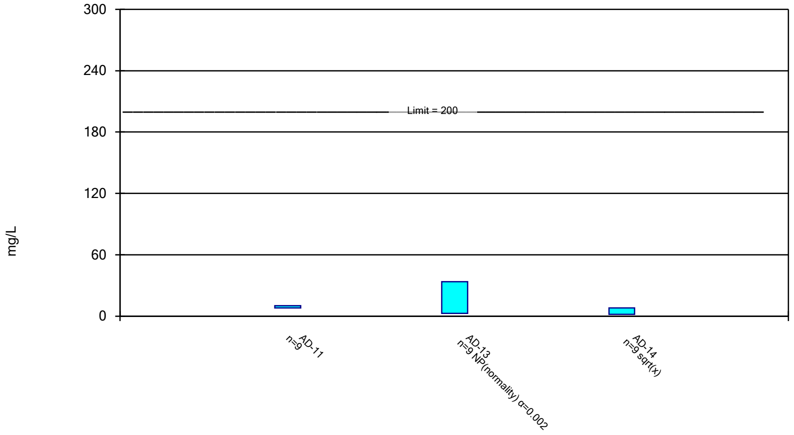


Constituent: Boron, total Analysis Run 12/10/2018 4:14 PM View: Confidence Intervals - App III
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

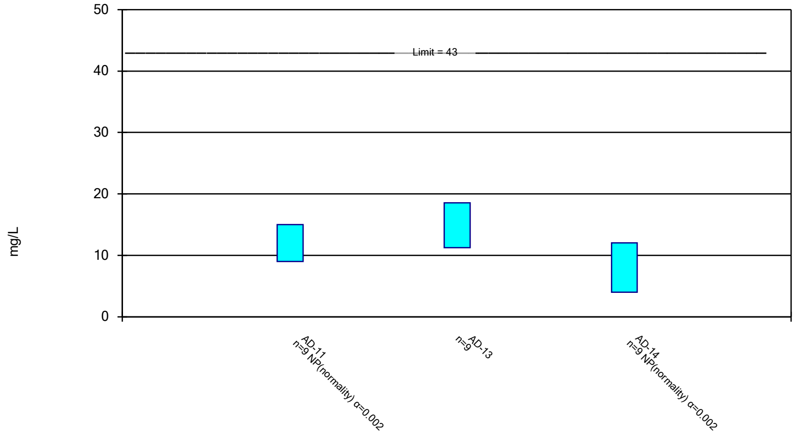


Constituent: Calcium, total Analysis Run 12/10/2018 4:14 PM View: Confidence Intervals - App III
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

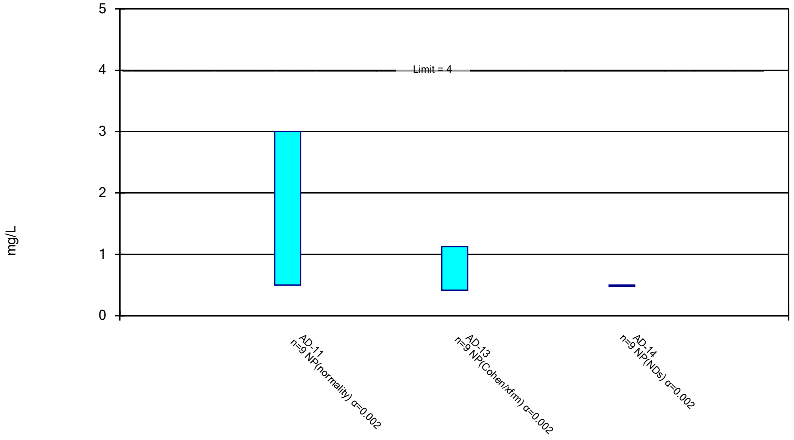


Constituent: Chloride, total Analysis Run 12/10/2018 4:14 PM View: Confidence Intervals - App III
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

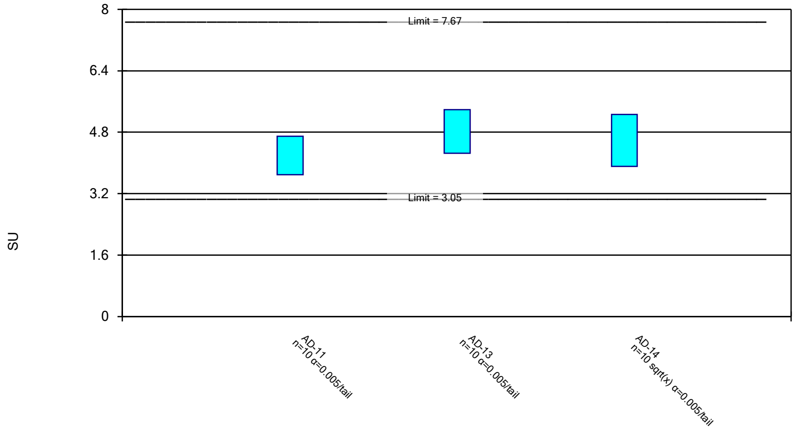


Constituent: Fluoride, total Analysis Run 12/10/2018 4:14 PM View: Confidence Intervals - App III
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Normality Test: Shapiro Wilk, alpha based on n.

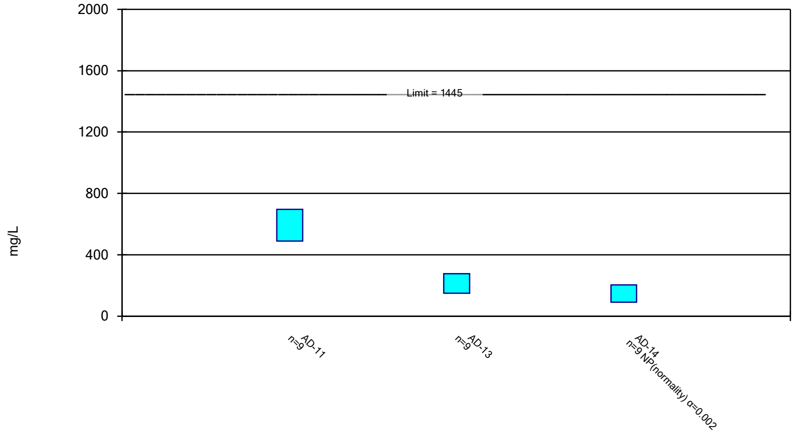


Constituent: pH, field   Analysis Run 12/10/2018 4:14 PM   View: Confidence Intervals - App III
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

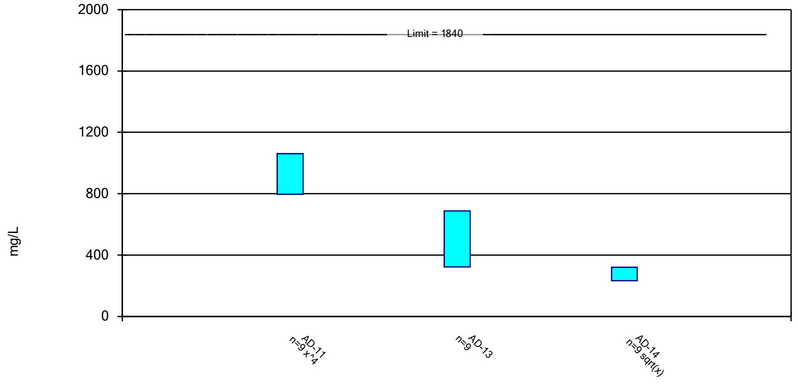


Constituent: Sulfate, total   Analysis Run 12/10/2018 4:14 PM   View: Confidence Intervals - App III
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Total Dissolved Solids   Analysis Run 12/10/2018 4:14 PM   View: Confidence Intervals - App III
Welsh LF   Client: Geosyntec   Data: Welsh LF

Intrawell Prediction Limit Summary Table - Significant Results

Welsh LF Client: Geosyntec Data: Welsh LF Printed 1/5/2019, 11:10 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Chloride, total (mg/L)	**AD-5**	**16.78**	**n/a**	**8/15/2018**	**19**	**Yes**	**8**	**14.5**	**0.9258**	**0**	**None**	**No**	**0.002505**	**Param Intra 1 of 2**
Chloride, total (mg/L)	**AD-11**	**12.63**	**n/a**	**9/17/2018**	**15**	**Yes**	**8**	**10.38**	**0.9161**	**0**	**None**	**No**	**0.002505**	**Param Intra 1 of 2**
Chloride, total (mg/L)	**AD-14**	**6.454**	**n/a**	**9/17/2018**	**12**	**Yes**	**8**	**4.625**	**0.744**	**0**	**None**	**No**	**0.002505**	**Param Intra 1 of 2**
Sulfate, total (mg/L)	**AD-14**	**131.3**	**n/a**	**9/17/2018**	**204**	**Yes**	**8**	**105.8**	**10.39**	**0**	**None**	**No**	**0.002505**	**Param Intra 1 of 2**
Total Dissolved Solids (mg/L)	**AD-14**	**325.3**	**n/a**	**9/17/2018**	**384**	**Yes**	**8**	**262.3**	**25.65**	**0**	**None**	**No**	**0.002505**	**Param Intra 1 of 2**

Intrawell Prediction Limit Summary Table - All Results

Welsh LF Client: Geosyntec Data: Welsh LF Printed 1/5/2019, 11:10 AM

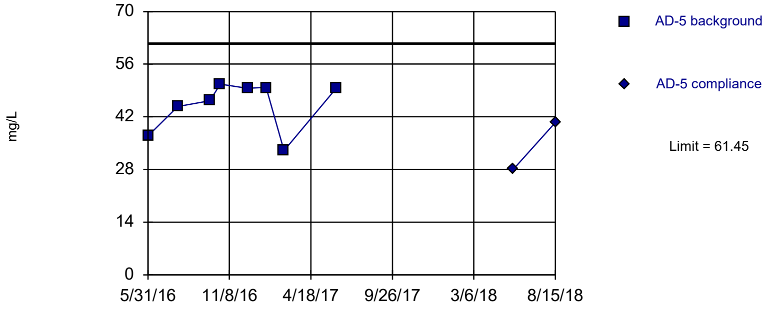
Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj	Transform	Alpha	Method
Calcium, total (mg/L)	AD-5	61.45	n/a	8/15/2018	40.5	No	8	45.09	6.656	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-11	11.39	n/a	9/17/2018	6.61	No	8	9.419	0.8002	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-13	38.48	n/a	9/17/2018	10.1	No	8	1.861	0.6165	0	None	x^(1/3)	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-14	13.85	n/a	9/17/2018	4.51	No	8	4.868	3.655	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-1	224.6	n/a	8/14/2018	5.95	No	8	6.363	3.508	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-17	203.5	n/a	8/15/2018	187	No	8	193.6	4.033	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	**AD-5**	**16.78**	**n/a**	**8/15/2018**	**19**	**Yes**	**8**	**14.5**	**0.9258**	**0**	**None**	**No**	**0.002505**	**Param Intra 1 of 2**
Chloride, total (mg/L)	**AD-11**	**12.63**	**n/a**	**9/17/2018**	**15**	**Yes**	**8**	**10.38**	**0.9161**	**0**	**None**	**No**	**0.002505**	**Param Intra 1 of 2**
Chloride, total (mg/L)	AD-13	23.97	n/a	9/17/2018	18	No	8	14.5	3.854	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	**AD-14**	**6.454**	**n/a**	**9/17/2018**	**12**	**Yes**	**8**	**4.625**	**0.744**	**0**	**None**	**No**	**0.002505**	**Param Intra 1 of 2**
Chloride, total (mg/L)	AD-1	9	n/a	8/14/2018	5	No	8	n/a	n/a	0	n/a	n/a	0.02144	NP Intra (normality) ...
Chloride, total (mg/L)	AD-17	44.04	n/a	8/15/2018	40	No	8	33.38	4.34	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-5	336.4	n/a	8/15/2018	240	No	8	177.4	64.69	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-11	833.3	n/a	9/17/2018	410	No	8	615.6	88.57	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-13	342	n/a	9/17/2018	316	No	8	200.1	57.71	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	**AD-14**	**131.3**	**n/a**	**9/17/2018**	**204**	**Yes**	**8**	**105.8**	**10.39**	**0**	**None**	**No**	**0.002505**	**Param Intra 1 of 2**
Sulfate, total (mg/L)	AD-1	82.3	n/a	8/14/2018	44	No	8	6.772	0.9358	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-17	1471	n/a	8/15/2018	1170	No	8	1136	136.3	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-5	563.5	n/a	8/15/2018	428	No	8	383.6	73.17	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-11	1224	n/a	9/17/2018	720	No	8	9.0e8	3.8e8	0	None	x^3	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-13	974.4	n/a	9/17/2018	620	No	8	490.1	197	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	**AD-14**	**325.3**	**n/a**	**9/17/2018**	**384**	**Yes**	**8**	**262.3**	**25.65**	**0**	**None**	**No**	**0.002505**	**Param Intra 1 of 2**
Total Dissolved Solids (mg/L)	AD-1	784.8	n/a	8/14/2018	160	No	8	16.71	4.598	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-17	1840	n/a	8/15/2018	1750	No	8	1639	81.77	0	None	No	0.002505	Param Intra 1 of 2

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=45.09, Std. Dev.=6.656, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8101, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

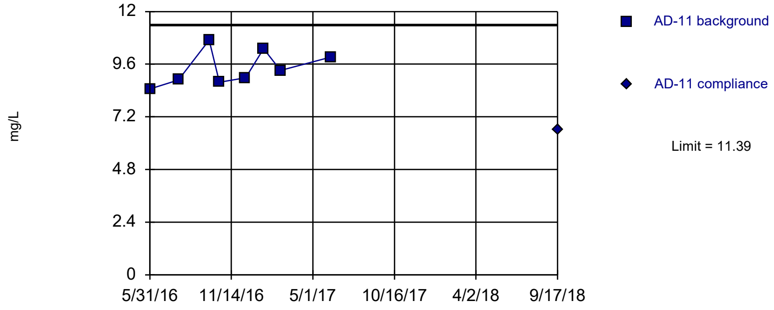
Constituent: Calcium, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=9.419, Std. Dev.=0.8002, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9212, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

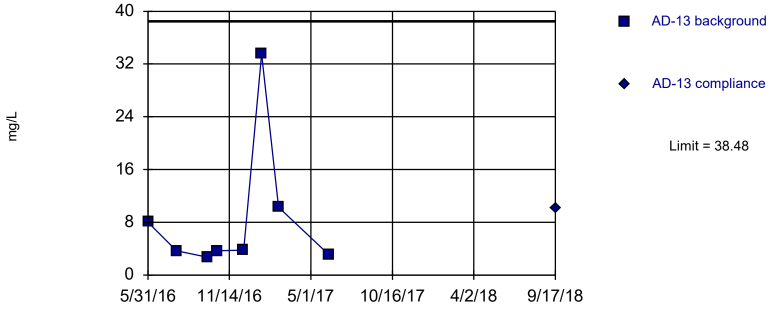
Constituent: Calcium, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on cube root transformation): Mean=1.861, Std. Dev.=0.6165, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7575, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

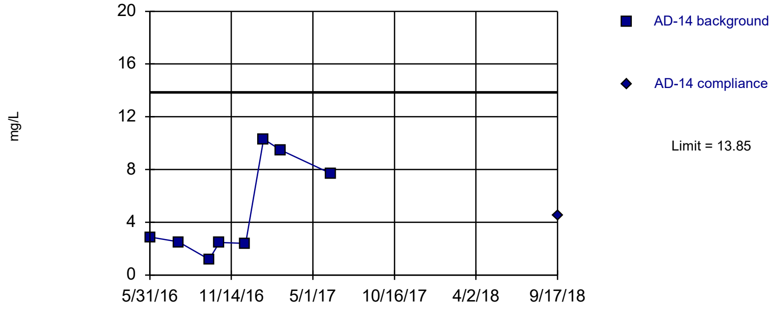
Constituent: Calcium, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=4.868, Std. Dev.=3.655, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8054, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

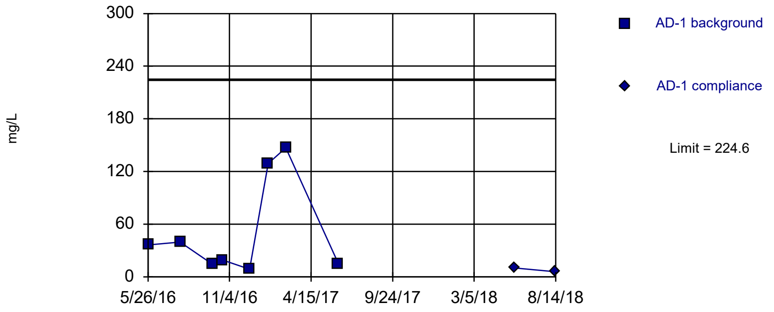
Constituent: Calcium, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on square root transformation): Mean=6.363, Std. Dev.=3.508, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8248, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

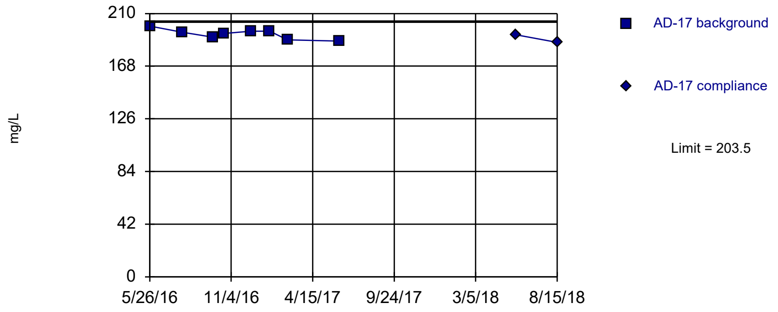
Constituent: Calcium, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=193.6, Std. Dev.=4.033, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9507, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

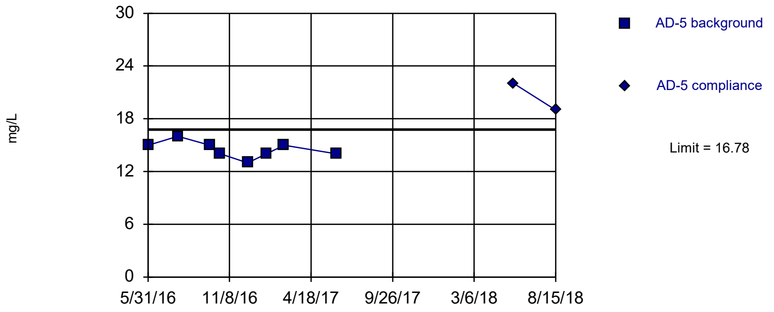
Constituent: Calcium, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=14.5, Std. Dev.=0.9258, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9302, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

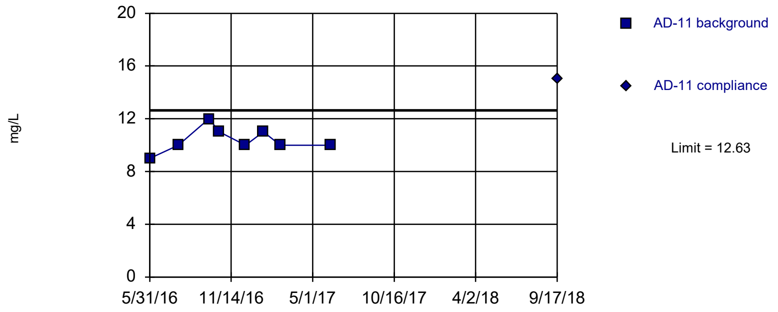
Constituent: Chloride, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=10.38, Std. Dev.=0.9161, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9054, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

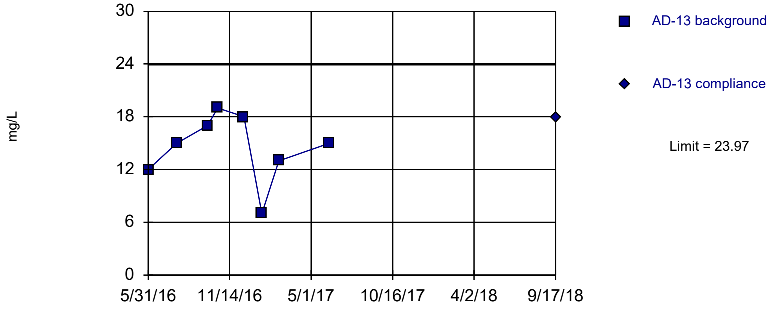
Constituent: Chloride, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=14.5, Std. Dev.=3.854, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9344, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

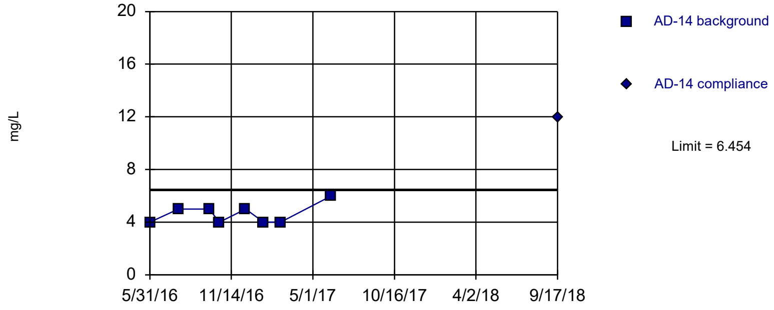
Constituent: Chloride, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=4.625, Std. Dev.=0.744, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7968, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

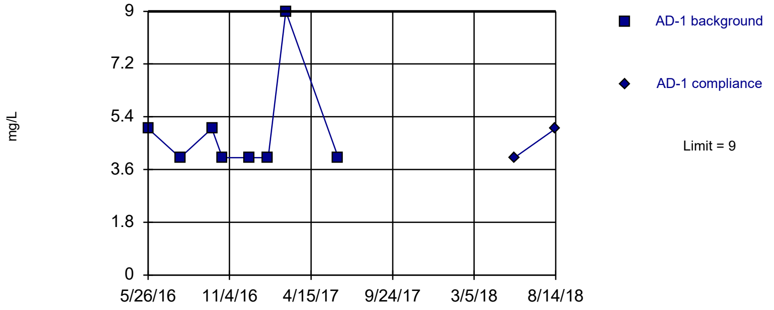
Constituent: Chloride, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

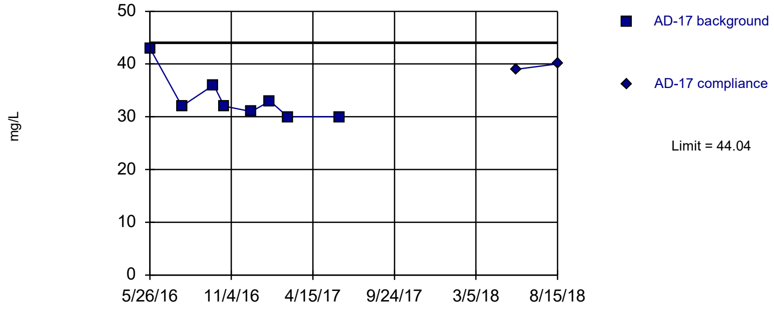
Constituent: Chloride, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=33.38, Std. Dev.=4.34, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7758, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

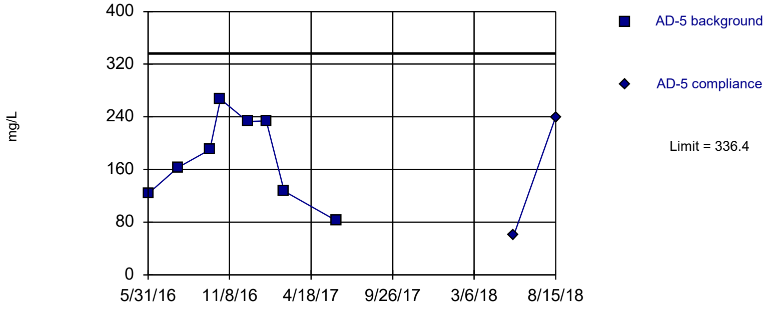
Constituent: Chloride, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=177.4, Std. Dev.=64.69, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.953, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

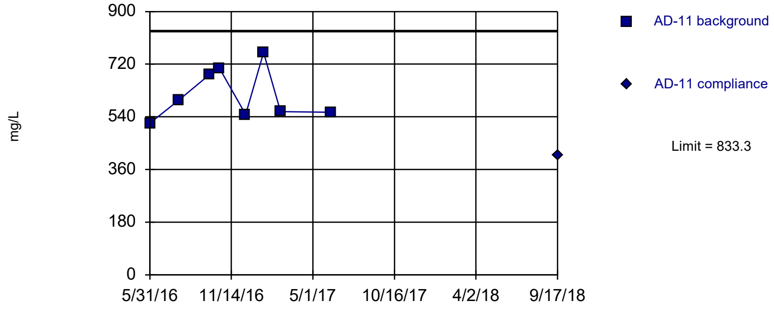
Constituent: Sulfate, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=615.6, Std. Dev.=88.57, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8871, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

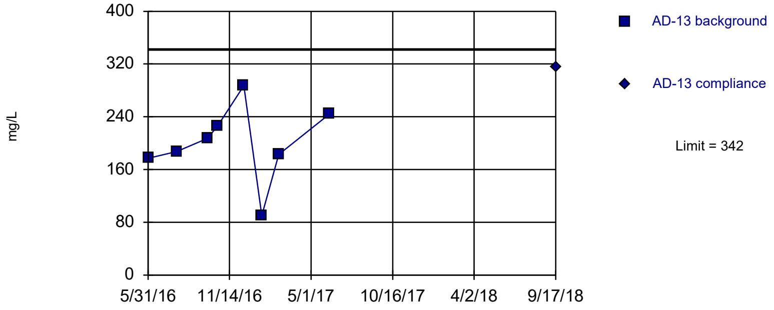
Constituent: Sulfate, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=200.1, Std. Dev.=57.71, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9527, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

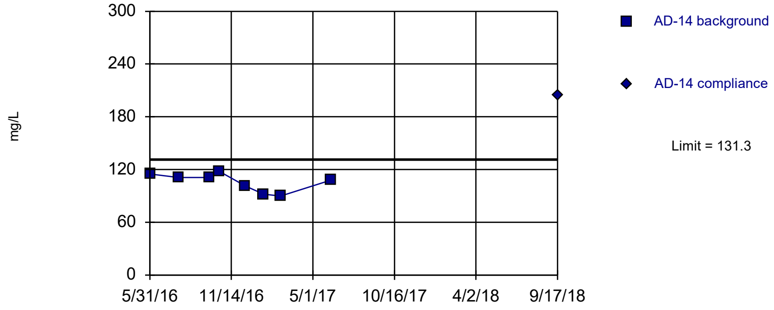
Constituent: Sulfate, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=105.8, Std. Dev.=10.39, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.904, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

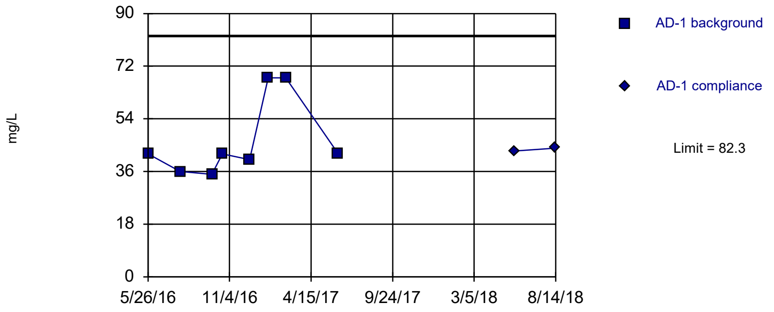
Constituent: Sulfate, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on square root transformation): Mean=6.772, Std. Dev.=0.9358, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7528, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

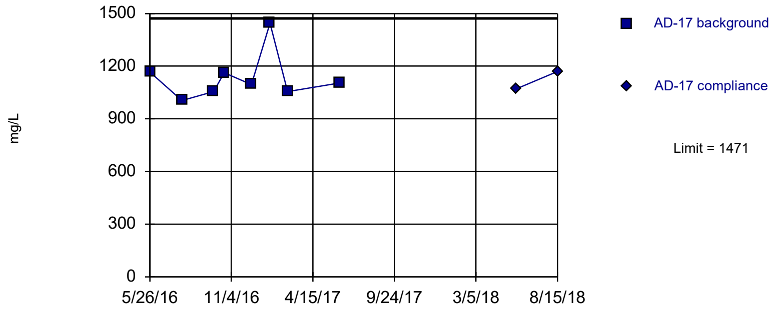
Constituent: Sulfate, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=1136, Std. Dev.=136.3, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7916, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

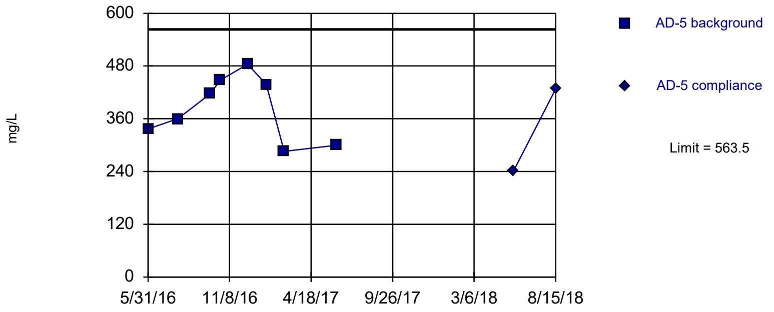
Constituent: Sulfate, total Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=383.6, Std. Dev.=73.17, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.937, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

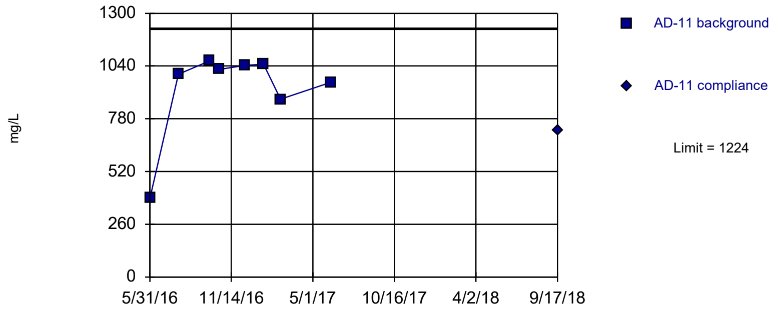
Constituent: Total Dissolved Solids Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on cube transformation): Mean=9.0e8, Std. Dev.=3.8e8, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.79, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

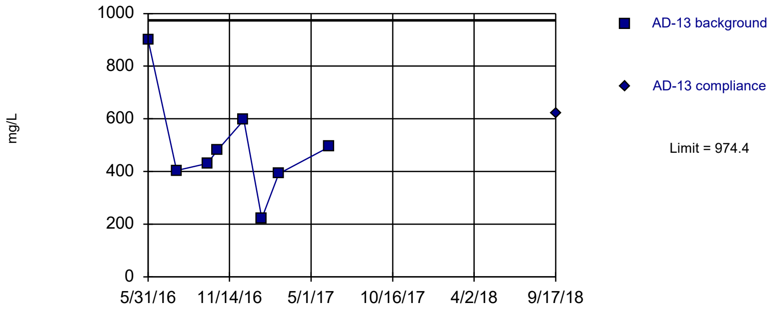
Constituent: Total Dissolved Solids Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=490.1, Std. Dev.=197, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.896, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

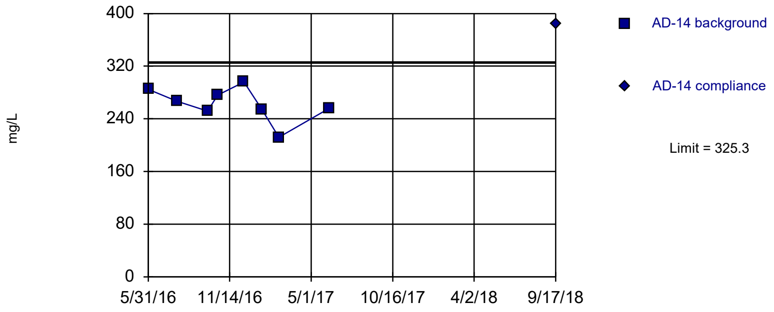
Constituent: Total Dissolved Solids Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=262.3, Std. Dev.=25.65, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9381, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

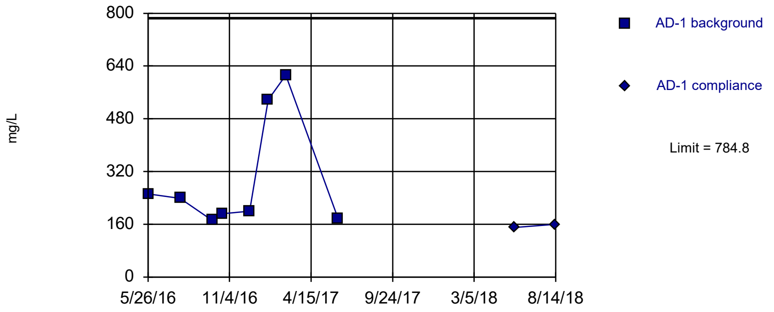
Constituent: Total Dissolved Solids Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on square root transformation): Mean=16.71, Std. Dev.=4.598, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.756, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

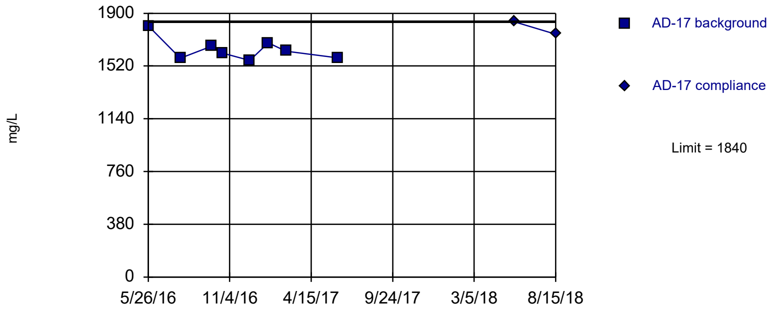
Constituent: Total Dissolved Solids Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=1639, Std. Dev.=81.77, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8702, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

Constituent: Total Dissolved Solids Analysis Run 1/5/2019 11:06 AM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Interwell Prediction Limit Summary Table - Significant Results

Welsh LF   Client: Geosyntec   Data: Welsh LF   Printed 1/5/2019, 11:13 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	**AD-11**	**0.765**	**n/a**	**9/17/2018**	**1.84**	**Yes**	**30**	**-2.011**	**0.9717**	**0**	**None**	**ln(x)**	**0.002505**	Param 1 of 2
Boron, total (mg/L)	**AD-13**	**0.765**	**n/a**	**9/17/2018**	**1.49**	**Yes**	**30**	**-2.011**	**0.9717**	**0**	**None**	**ln(x)**	**0.002505**	Param 1 of 2
Boron, total (mg/L)	**AD-14**	**0.765**	**n/a**	**9/17/2018**	**1.51**	**Yes**	**30**	**-2.011**	**0.9717**	**0**	**None**	**ln(x)**	**0.002505**	Param 1 of 2
pH, field (SU)	**AD-14**	**7.051**	**4.294**	**8/14/2018**	**4.27**	**Yes**	**30**	**34.08**	**8.719**	**0**	**None**	**x^2**	**0.001253**	Param 1 of 2

Interwell Prediction Limit Summary Table - All Results

Welsh LF Client: Geosyntec Data: Welsh LF Printed 1/5/2019, 11:13 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj	Transform	Alpha	Method
Boron, total (mg/L)	**AD-11**	**0.765**	**n/a**	**9/17/2018**	**1.84**	**Yes**	**30**	**-2.011**	**0.9717**	**0**	**None**	**ln(x)**	**0.002505**	Param 1 of 2
Boron, total (mg/L)	**AD-13**	**0.765**	**n/a**	**9/17/2018**	**1.49**	**Yes**	**30**	**-2.011**	**0.9717**	**0**	**None**	**ln(x)**	**0.002505**	Param 1 of 2
Boron, total (mg/L)	**AD-14**	**0.765**	**n/a**	**9/17/2018**	**1.51**	**Yes**	**30**	**-2.011**	**0.9717**	**0**	**None**	**ln(x)**	**0.002505**	Param 1 of 2
Fluoride, total (mg/L)	AD-11	1	n/a	8/15/2018	1ND	No	30	n/a	n/a	76.67	n/a	n/a	0.00197	NP (NDs) 1 of 2
Fluoride, total (mg/L)	AD-13	1	n/a	8/14/2018	0.7442	No	30	n/a	n/a	76.67	n/a	n/a	0.00197	NP (NDs) 1 of 2
Fluoride, total (mg/L)	AD-14	1	n/a	8/14/2018	1ND	No	30	n/a	n/a	76.67	n/a	n/a	0.00197	NP (NDs) 1 of 2
pH, field (SU)	AD-11	7.051	4.294	8/15/2018	4.73	No	30	34.08	8.719	0	None	x^2	0.001253	Param 1 of 2
pH, field (SU)	AD-13	7.051	4.294	8/14/2018	4.82	No	30	34.08	8.719	0	None	x^2	0.001253	Param 1 of 2
pH, field (SU)	**AD-14**	**7.051**	**4.294**	**8/14/2018**	**4.27**	**Yes**	**30**	**34.08**	**8.719**	**0**	**None**	**x^2**	**0.001253**	Param 1 of 2

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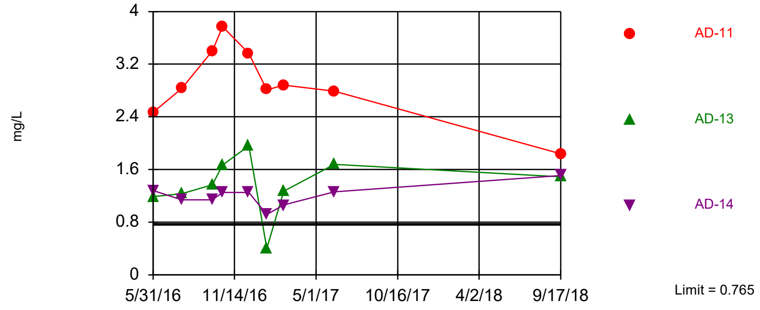
Exceeds Limit: AD-11, AD-13, AD-14

Prediction Limit

Interwell Parametric



Background Data Summary (based on natural log transformation): Mean=-2.011, Std. Dev.=0.9717, n=30. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9108, critical = 0.9. Kappa = 1.794 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.002505. Comparing 3 points to limit.

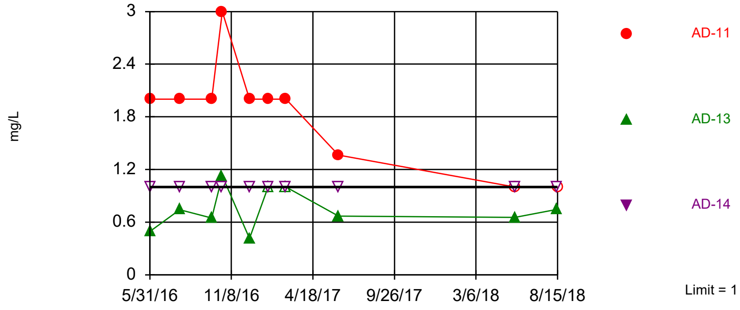
Constituent: Boron, total Analysis Run 1/5/2019 11:11 AM View: PL's - Interwell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 30 background values. 76.67% NDs. Annual per-constituent alpha = 0.01176. Individual comparison alpha = 0.00197 (1 of 2). Comparing 3 points to limit.

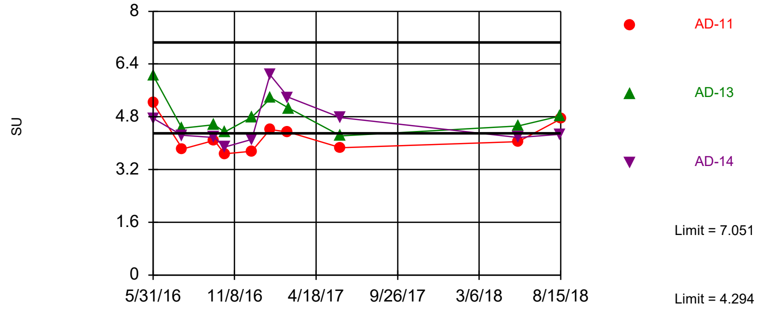
Constituent: Fluoride, total Analysis Run 1/5/2019 11:11 AM View: PL's - Interwell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limits: AD-14

Prediction Limit

Interwell Parametric



Background Data Summary (based on square transformation): Mean=34.08, Std. Dev.=8.719, n=30. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9102, critical = 0.9. Kappa = 1.794 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.001253. Comparing 3 points to limit.

Constituent: pH, field Analysis Run 1/5/2019 11:11 AM View: PL's - Interwell
Welsh LF Client: Geosyntec Data: Welsh LF

Prediction Limit

Constituent: Boron, total (mg/L) Analysis Run 1/5/2019 11:13 AM View: PL's - Interwell

Welsh LF Client: Geosyntec Data: Welsh LF

	AD-17 (bg)	AD-1 (bg)	AD-5 (bg)	AD-13	AD-11	AD-14
5/26/2016	0.121	0.346				
5/31/2016			0.03	1.19	2.47	1.28
7/29/2016	0.119	0.35	0.04	1.23	2.83	1.14
9/30/2016	0.111	0.332	0.04	1.37	3.4	1.14
10/21/2016	0.124	0.398	0.05	1.67	3.77	1.25
12/14/2016	0.135	0.394	0.05	1.96	3.36	1.25
1/20/2017	0.101	0.656	0.04	0.402	2.81	0.915
2/24/2017	0.135	0.7	0.04	1.27	2.88	1.06
6/8/2017	0.121	0.449	0.05281	1.68	2.79	1.26
5/24/2018	0.239	0.345	0.0501			
8/14/2018		0.443				
8/15/2018	0.118		0.05			
9/17/2018				1.49	1.84	1.51

Trend Test Summary Table - All Results (No Significant Results)

Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/11/2018, 5:00 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	AD-5 (bg)	0.005828	22	30	No	10	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-11	-0.295	-10	-25	No	9	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-13	0.1357	12	25	No	9	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-14	0.0183	4	25	No	9	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-1 (bg)	0.08093	15	30	No	10	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-17 (bg)	0.007399	7	30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-5 (bg)	0	5	30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-11	1.168	9	25	No	9	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-14	1.308	11	25	No	9	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-1 (bg)	0	-1	-30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-17 (bg)	-2.005	-5	-30	No	10	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-5 (bg)	0.1885	11	30	No	10	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-14	0.01464	2	30	No	10	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-1 (bg)	-0.4232	-14	-30	No	10	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-17 (bg)	-0.4462	-19	-30	No	10	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-5 (bg)	-14.86	-1	-30	No	10	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-14	-9.409	-7	-25	No	9	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-1 (bg)	2.401	19	30	No	10	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-17 (bg)	12.06	8	30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	AD-5 (bg)	-33.56	-5	-30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	AD-14	-3.767	0	25	No	9	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	AD-1 (bg)	-26.43	-13	-30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	AD-17 (bg)	40.84	7	30	No	10	0	n/a	n/a	0.01	NP

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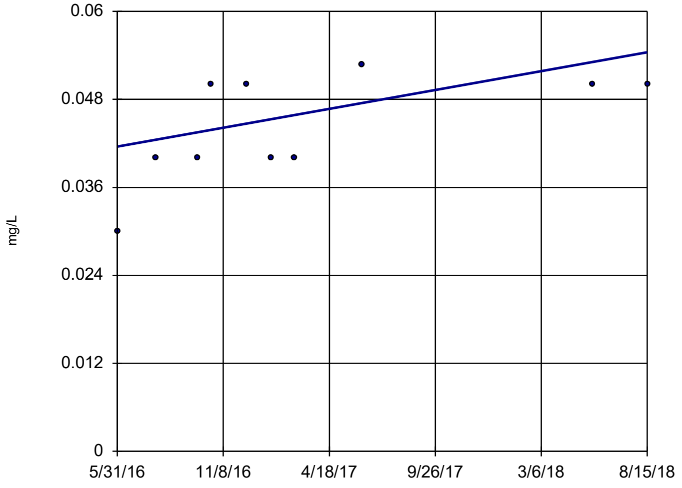
Sen's Slope Estimator

AD-5 (bg)



n = 10

Slope = 0.005828 units per year.

Mann-Kendall statistic = 22 critical = 30

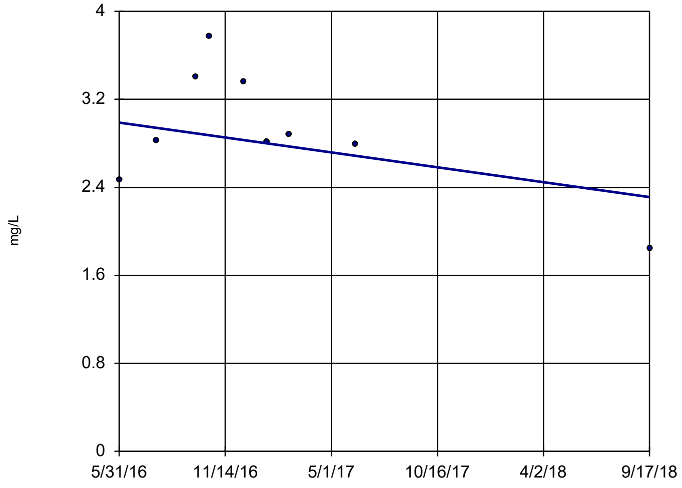
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-11



n = 9

Slope = -0.295 units per year.

Mann-Kendall statistic = -10 critical = -25

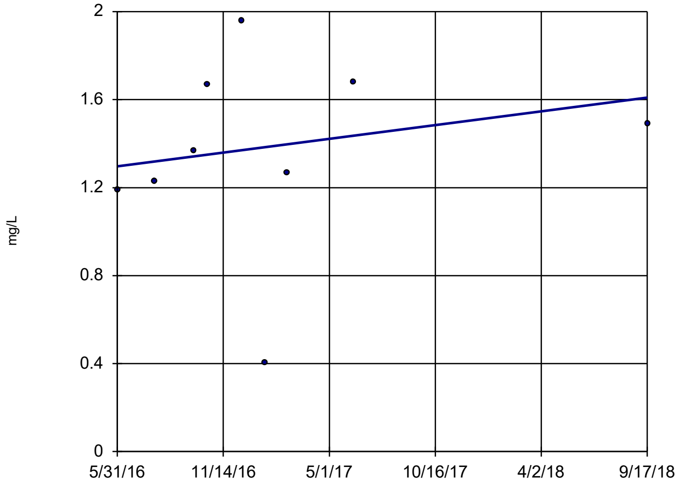
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-13



n = 9

Slope = 0.1357 units per year.

Mann-Kendall statistic = 12 critical = 25

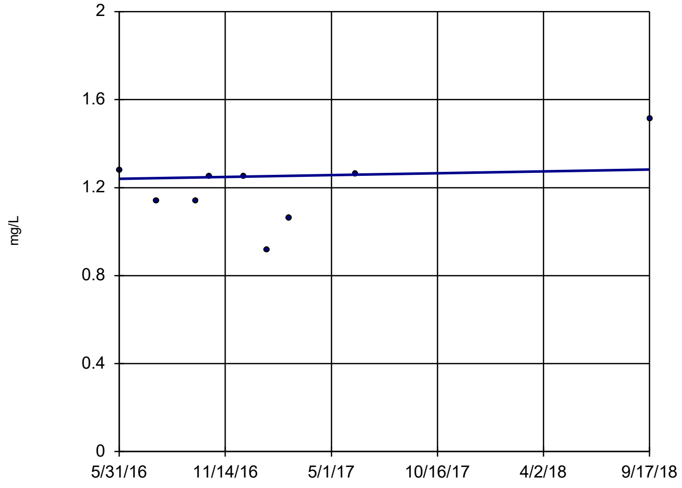
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-14



n = 9

Slope = 0.0183 units per year.

Mann-Kendall statistic = 4 critical = 25

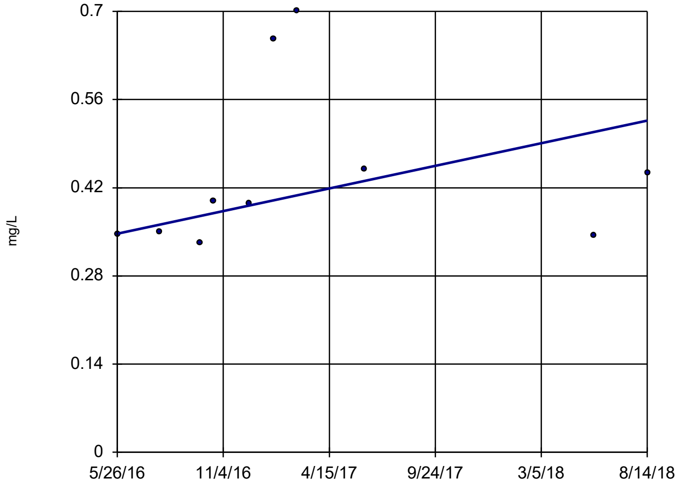
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-1 (bg)



n = 10

Slope = 0.08093
units per year.

Mann-Kendall
statistic = 15
critical = 30

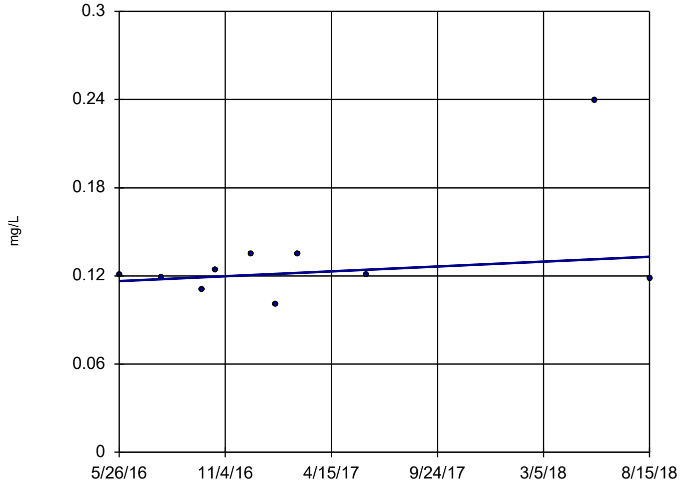
Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Boron, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-17 (bg)



n = 10

Slope = 0.007399
units per year.

Mann-Kendall
statistic = 7
critical = 30

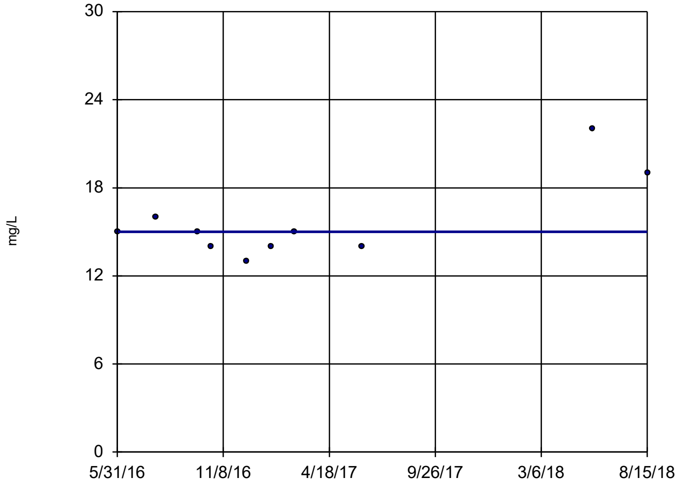
Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Boron, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-5 (bg)



n = 10

Slope = 0
units per year.

Mann-Kendall
statistic = 5
critical = 30

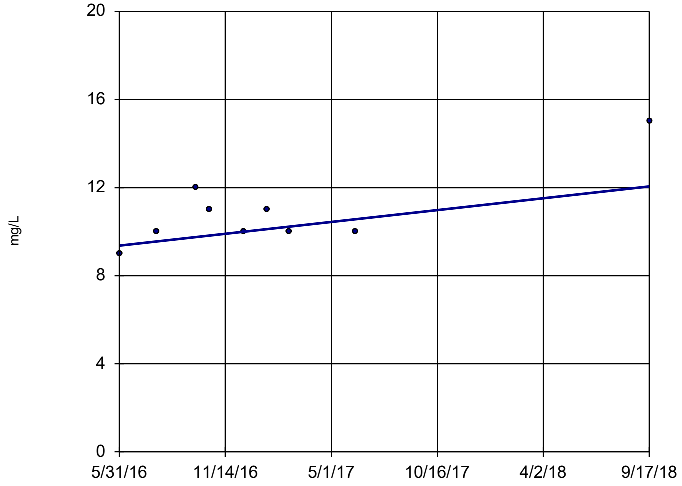
Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Chloride, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-11



n = 9

Slope = 1.168
units per year.

Mann-Kendall
statistic = 9
critical = 25

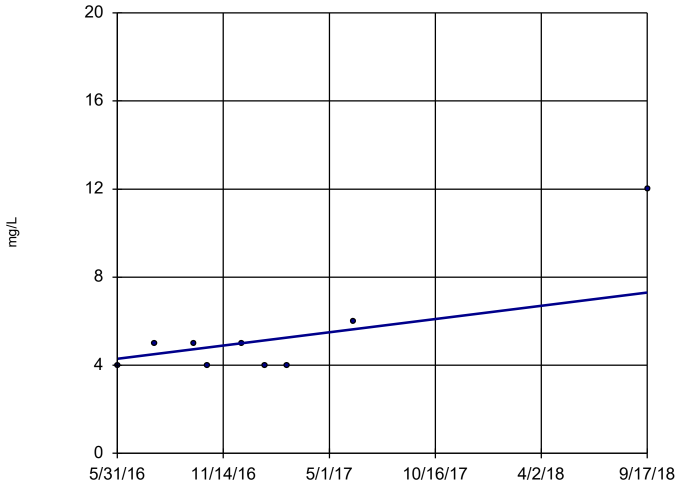
Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Chloride, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-14



n = 9

Slope = 1.308
units per year.

Mann-Kendall
statistic = 11
critical = 25

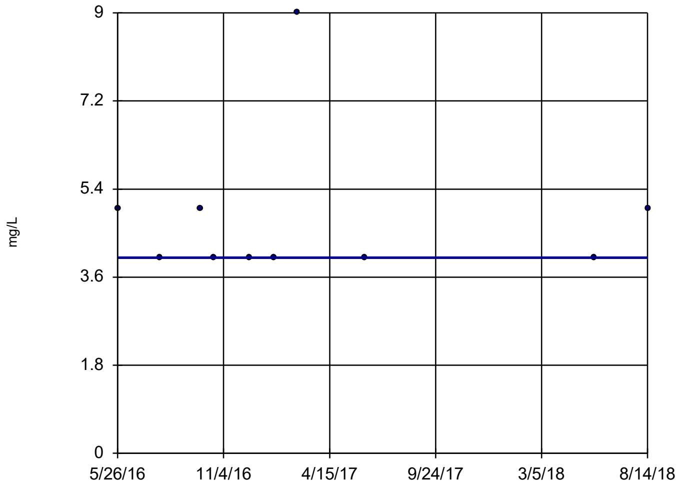
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Chloride, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-1 (bg)



n = 10

Slope = 0
units per year.

Mann-Kendall
statistic = -1
critical = -30

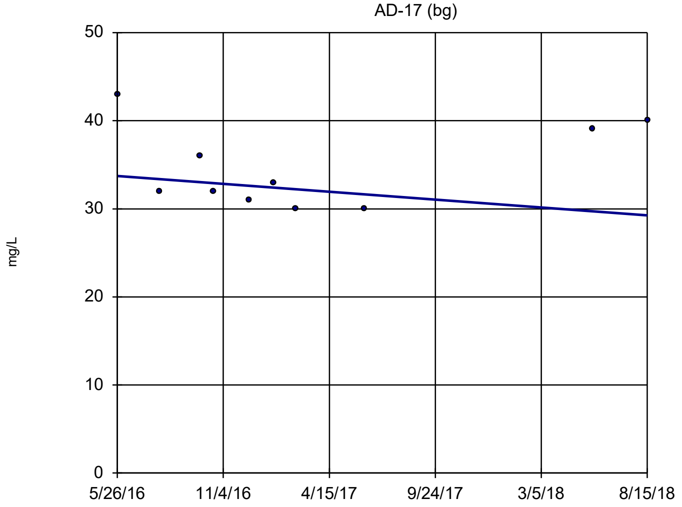
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Chloride, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-17 (bg)



n = 10

Slope = -2.005
units per year.

Mann-Kendall
statistic = -5
critical = -30

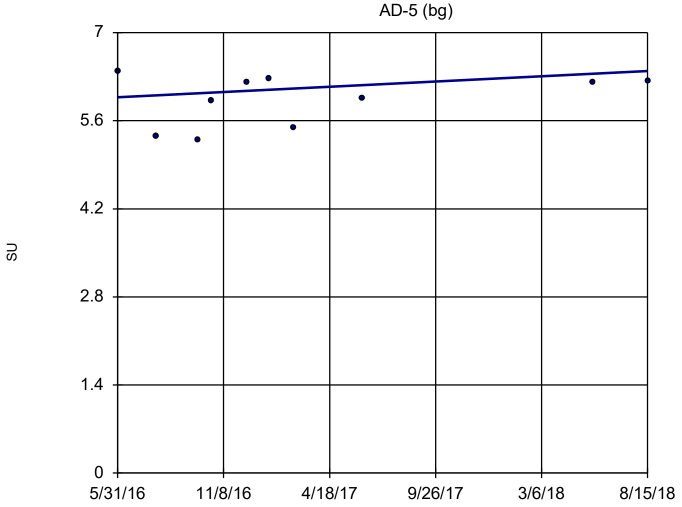
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Chloride, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-5 (bg)



n = 10

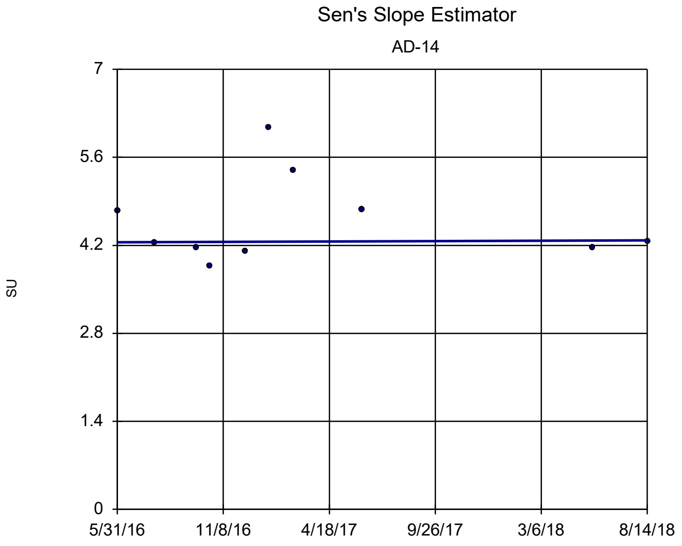
Slope = 0.1885
units per year.

Mann-Kendall
statistic = 11
critical = 30

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



n = 10

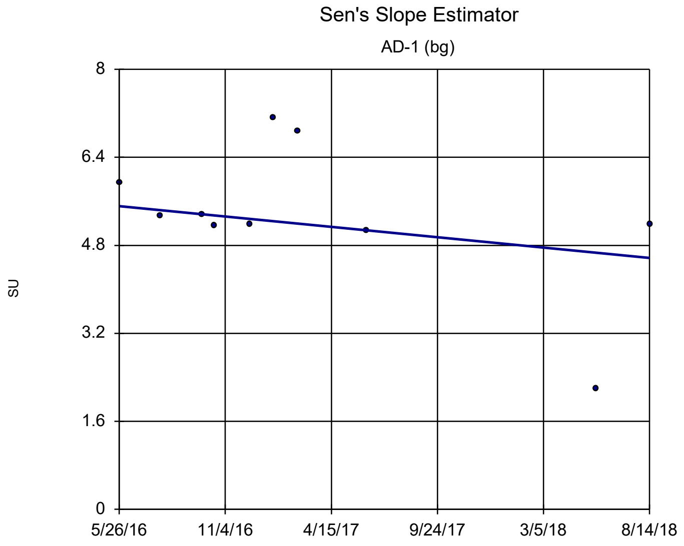
Slope = 0.01464 units per year.

Mann-Kendall statistic = 2 critical = 30

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



n = 10

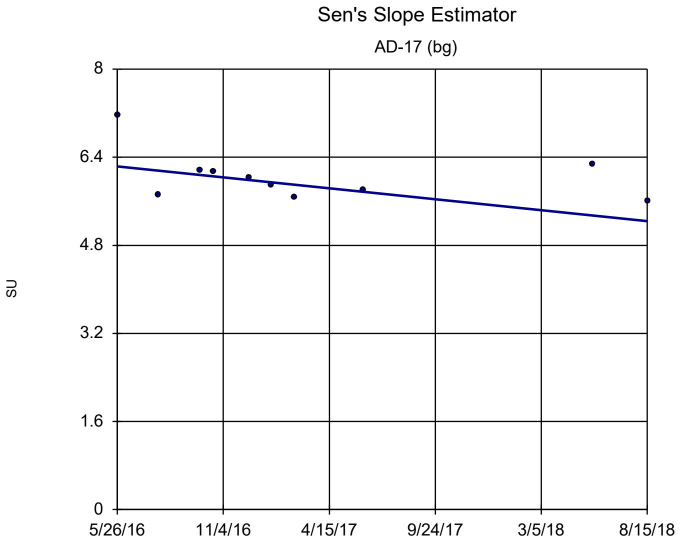
Slope = -0.4232 units per year.

Mann-Kendall statistic = -14 critical = -30

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



n = 10

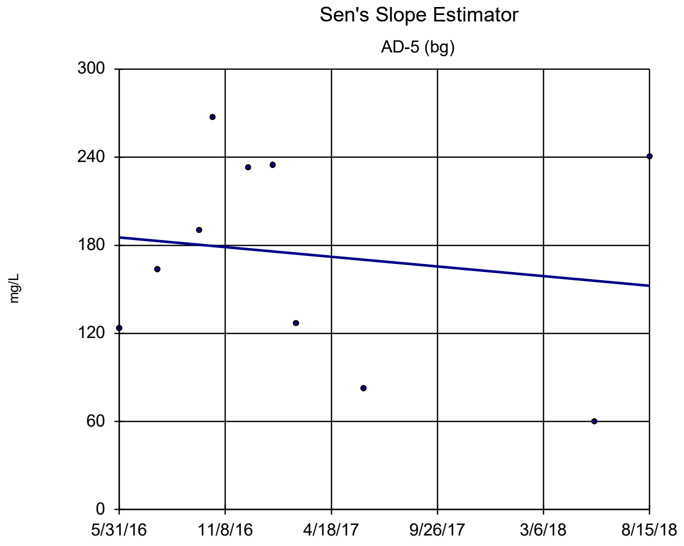
Slope = -0.4462 units per year.

Mann-Kendall statistic = -19 critical = -30

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG



n = 10

Slope = -14.86 units per year.

Mann-Kendall statistic = -1 critical = -30

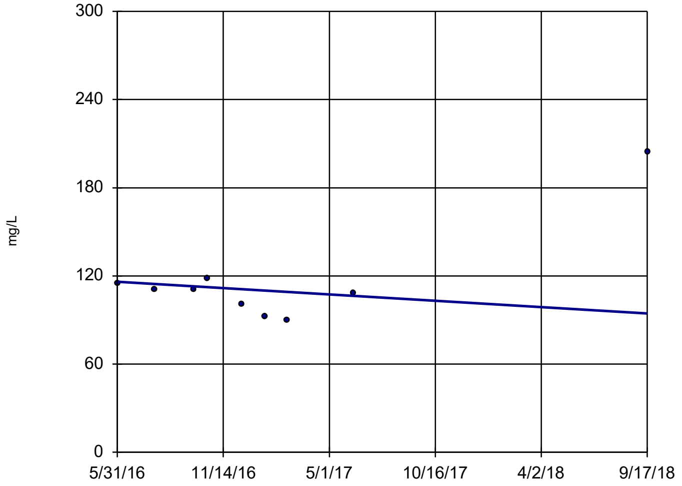
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Sulfate, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-14



n = 9

Slope = -9.409
units per year.

Mann-Kendall
statistic = -7
critical = -25

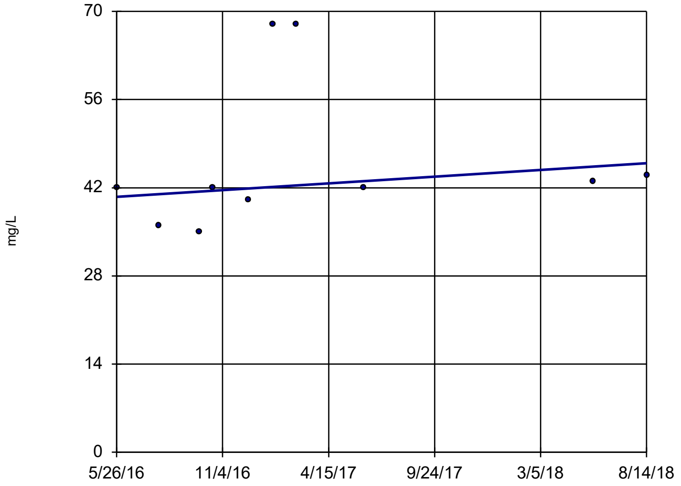
Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Sulfate, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-1 (bg)



n = 10

Slope = 2.401
units per year.

Mann-Kendall
statistic = 19
critical = 30

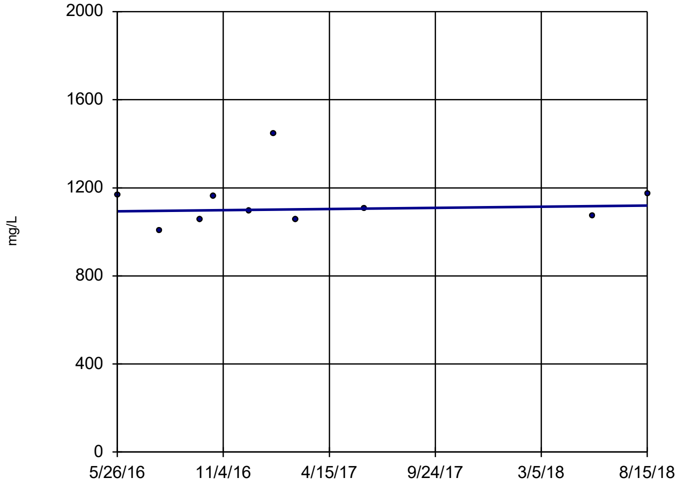
Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Sulfate, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-17 (bg)



n = 10

Slope = 12.06
units per year.

Mann-Kendall
statistic = 8
critical = 30

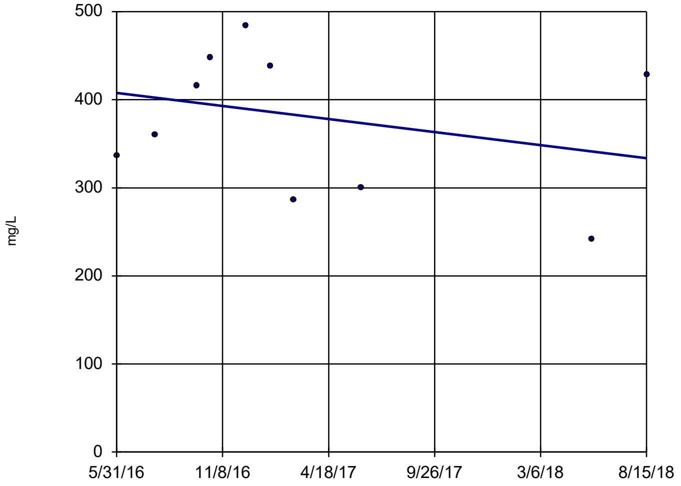
Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Sulfate, total Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-5 (bg)



n = 10

Slope = -33.56
units per year.

Mann-Kendall
statistic = -5
critical = -30

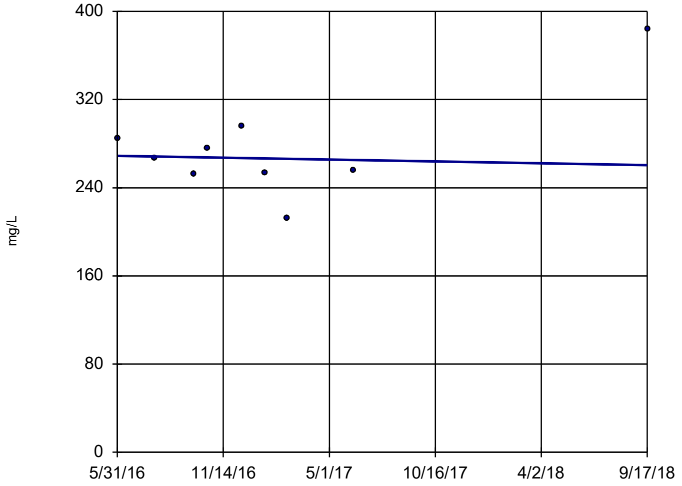
Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Total Dissolved Solids Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-14



n = 9

Slope = -3.767 units per year.

Mann-Kendall statistic = 0 critical = 25

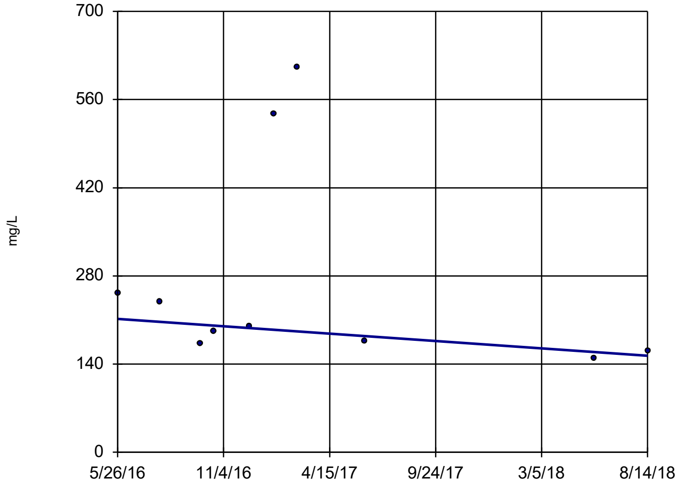
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-1 (bg)



n = 10

Slope = -26.43 units per year.

Mann-Kendall statistic = -13 critical = -30

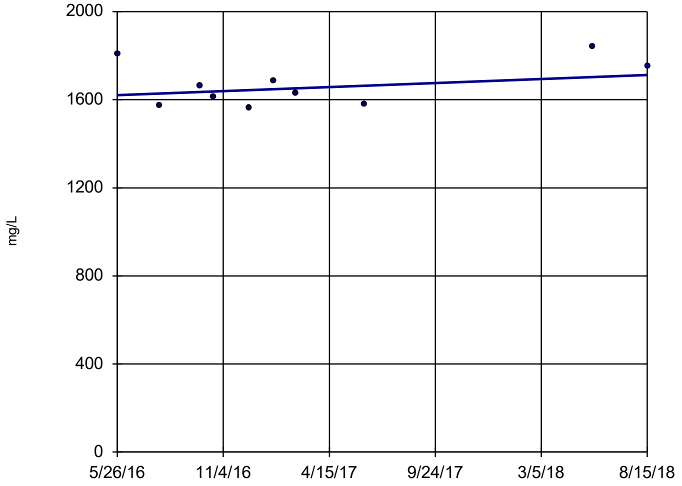
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-17 (bg)



n = 10

Slope = 40.84 units per year.

Mann-Kendall statistic = 7 critical = 30

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids Analysis Run 12/11/2018 4:59 AM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Upper Tolerance Limits - Appendix IV

Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/10/2018, 1:51 PM

Constituent	Upper Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony, total (mg/L)	0.005	30	n/a	n/a	80	n/a	n/a	0.2146	NP Inter(NDs)
Arsenic, total (mg/L)	0.005	30	n/a	n/a	63.33	n/a	n/a	0.2146	NP Inter(normality)
Barium, total (mg/L)	0.362	30	0.4014	0.1402	0	None	x^(1/3)	0.05	Inter
Beryllium, total (mg/L)	0.0007706	30	0.01454	0.005955	13.33	None	sqrt(x)	0.05	Inter
Cadmium, total (mg/L)	0.00646	30	n/a	n/a	30	n/a	n/a	0.2146	NP Inter(Cohens/xform)
Chromium, total (mg/L)	0.004	29	n/a	n/a	31.03	n/a	n/a	0.2259	NP Inter(normality)
Cobalt, total (mg/L)	0.0748	30	n/a	n/a	0	n/a	n/a	0.2146	NP Inter(normality)
Combined Radium 226 + 228 (pCi/L)	4.205	30	2	0.9933	0	None	No	0.05	Inter
Fluoride, total (mg/L)	1	30	n/a	n/a	76.67	n/a	n/a	0.2146	NP Inter(NDs)
Lead, total (mg/L)	0.005	30	n/a	n/a	86.67	n/a	n/a	0.2146	NP Inter(NDs)
Lithium, total (mg/L)	0.394	30	n/a	n/a	0	n/a	n/a	0.2146	NP Inter(normality)
Mercury, total (mg/L)	0.000033	30	n/a	n/a	46.67	n/a	n/a	0.2146	NP Inter(normality)
Molybdenum, total (mg/L)	0.005	30	n/a	n/a	73.33	n/a	n/a	0.2146	NP Inter(normality)
Selenium, total (mg/L)	0.005	30	n/a	n/a	53.33	n/a	n/a	0.2146	NP Inter(normality)
Thallium, total (mg/L)	0.002	30	n/a	n/a	83.33	n/a	n/a	0.2146	NP Inter(NDs)

Confidence Interval Summary Table - All Appendix IV (No Significant Results)

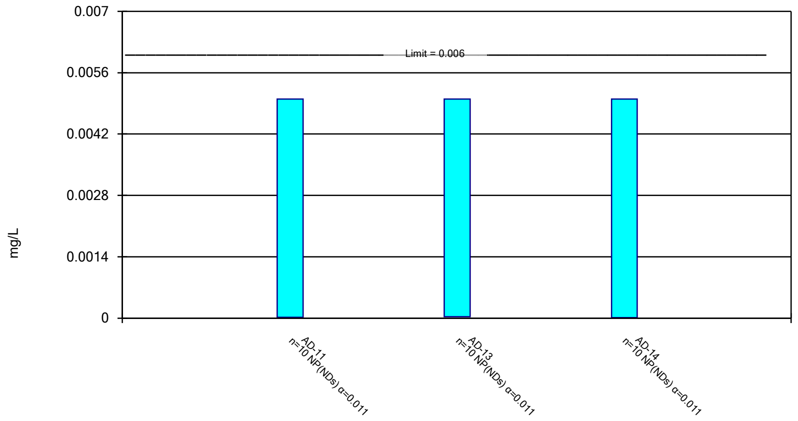
Welsh LF   Client: Geosyntec   Data: Welsh LF   Printed 1/5/2019, 11:18 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	AD-11	0.005	0.00002	0.006	No	10	90	No	0.011	NP (NDs)
Antimony, total (mg/L)	AD-13	0.005	0.00003	0.006	No	10	80	No	0.011	NP (NDs)
Antimony, total (mg/L)	AD-14	0.005	0.00001	0.006	No	10	90	No	0.011	NP (NDs)
Arsenic, total (mg/L)	AD-11	0.005	0.00105	0.01	No	10	60	No	0.011	NP (normality)
Arsenic, total (mg/L)	AD-13	0.005	0.00137	0.01	No	10	70	No	0.011	NP (normality)
Arsenic, total (mg/L)	AD-14	0.005	0.00039	0.01	No	10	70	No	0.011	NP (normality)
Barium, total (mg/L)	AD-11	0.02	0.01012	2	No	10	0	No	0.011	NP (normality)
Barium, total (mg/L)	AD-13	0.0645	0.02124	2	No	10	0	sqrt(x)	0.01	Param.
Barium, total (mg/L)	AD-14	0.05407	0.02723	2	No	10	0	sqrt(x)	0.01	Param.
Beryllium, total (mg/L)	AD-11	0.004635	0.002551	0.004	No	10	0	x^2	0.01	Param.
Beryllium, total (mg/L)	AD-13	0.0009722	0.0006411	0.004	No	10	0	x^2	0.01	Param.
Beryllium, total (mg/L)	AD-14	0.0007222	0.0003541	0.004	No	10	0	No	0.01	Param.
Cadmium, total (mg/L)	AD-11	0.0004992	0.0003061	0.005	No	10	0	No	0.01	Param.
Cadmium, total (mg/L)	AD-13	0.001	0.000085	0.005	No	10	40	No	0.011	NP (normality)
Cadmium, total (mg/L)	AD-14	0.001452	0.0004738	0.005	No	10	0	No	0.01	Param.
Chromium, total (mg/L)	AD-11	0.003028	0.0002928	0.1	No	10	0	sqrt(x)	0.01	Param.
Chromium, total (mg/L)	AD-13	0.004	0.000503	0.1	No	10	30	No	0.011	NP (normality)
Chromium, total (mg/L)	AD-14	0.001171	0.0005606	0.1	No	10	20	No	0.01	Param.
Cobalt, total (mg/L)	AD-11	0.02786	0.01857	0.075	No	10	0	x^2	0.01	Param.
Cobalt, total (mg/L)	AD-13	0.008863	0.003162	0.075	No	10	0	No	0.01	Param.
Cobalt, total (mg/L)	AD-14	0.01305	0.005173	0.075	No	10	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-11	2.806	1.388	5	No	10	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-13	3.082	1.427	5	No	10	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-14	2.552	0.8154	5	No	10	0	sqrt(x)	0.01	Param.
Fluoride, total (mg/L)	AD-11	2	0.083	4	No	10	20	No	0.011	NP (normality)
Fluoride, total (mg/L)	AD-13	0.8623	0.1958	4	No	10	20	No	0.01	Param.
Fluoride, total (mg/L)	AD-14	0.083	0.083	4	No	10	100	No	0.011	NP (NDs)
Lead, total (mg/L)	AD-11	0.005	0.001183	0.015	No	10	70	No	0.011	NP (normality)
Lead, total (mg/L)	AD-13	0.005	0.001	0.015	No	10	70	No	0.011	NP (normality)
Lead, total (mg/L)	AD-14	0.005	0.000174	0.015	No	10	90	No	0.011	NP (NDs)
Lithium, total (mg/L)	AD-11	0.04681	0.02675	0.39	No	10	0	No	0.01	Param.
Lithium, total (mg/L)	AD-13	0.02811	0.01289	0.39	No	10	0	No	0.01	Param.
Lithium, total (mg/L)	AD-14	0.01446	0.01174	0.39	No	9	0	No	0.01	Param.
Mercury, total (mg/L)	AD-11	0.00001756	0.000001904	0.002	No	10	30	No	0.01	Param.
Mercury, total (mg/L)	AD-13	0.00001565	0.000005	0.002	No	10	50	No	0.011	NP (normality)
Mercury, total (mg/L)	AD-14	0.000145	0.00001443	0.002	No	10	0	No	0.011	NP (normality)
Molybdenum, total (mg/L)	AD-11	0.005	0.00005	0.1	No	10	80	No	0.011	NP (NDs)
Molybdenum, total (mg/L)	AD-13	0.005	0.00006	0.1	No	10	70	No	0.011	NP (normality)
Molybdenum, total (mg/L)	AD-14	0.005	0.00003	0.1	No	10	80	No	0.011	NP (NDs)
Selenium, total (mg/L)	AD-11	0.005	0.00134	0.05	No	10	40	No	0.011	NP (normality)
Selenium, total (mg/L)	AD-13	0.005	0.00103	0.05	No	10	30	No	0.011	NP (normality)
Selenium, total (mg/L)	AD-14	0.00453	0.002362	0.05	No	10	20	No	0.01	Param.
Thallium, total (mg/L)	AD-11	0.002	0.0002	0.002	No	10	50	No	0.011	NP (normality)
Thallium, total (mg/L)	AD-13	0.002	0.000277	0.002	No	10	80	No	0.011	NP (NDs)
Thallium, total (mg/L)	AD-14	0.002	0.000242	0.002	No	10	90	No	0.011	NP (NDs)

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

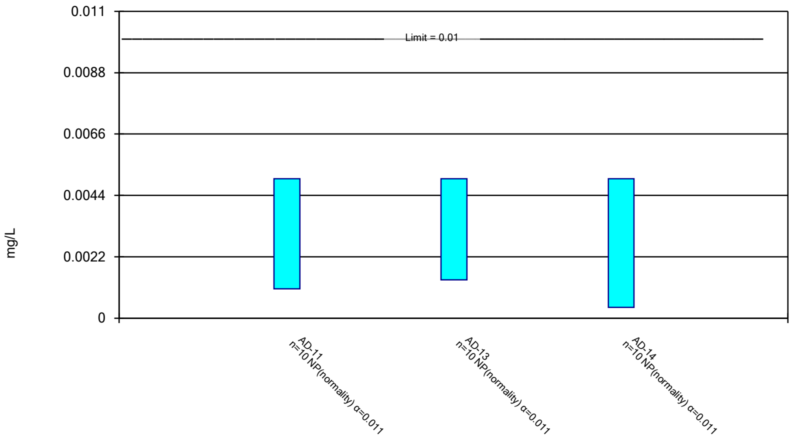


Constituent: Antimony, total   Analysis Run 1/5/2019 11:15 AM   View: Confidence Interval - App IV
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

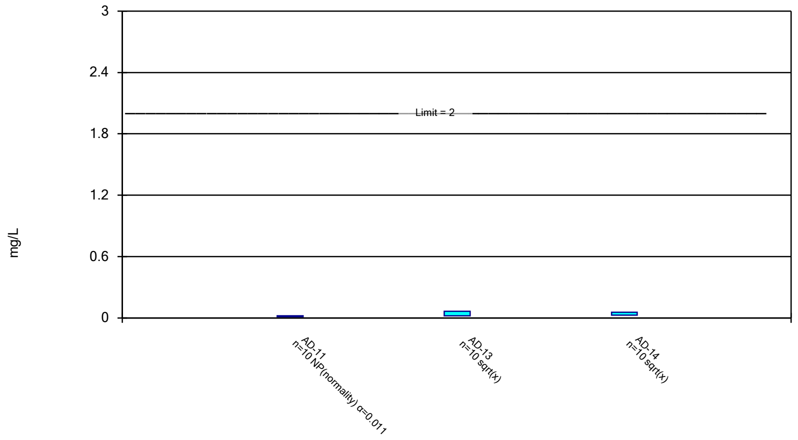


Constituent: Arsenic, total   Analysis Run 1/5/2019 11:15 AM   View: Confidence Interval - App IV
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

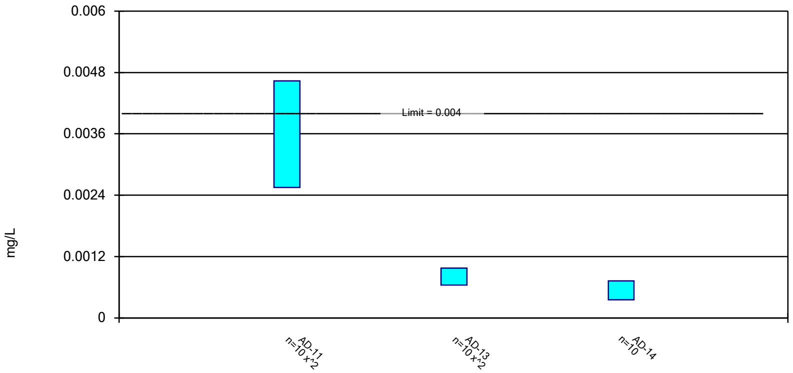


Constituent: Barium, total   Analysis Run 1/5/2019 11:15 AM   View: Confidence Interval - App IV
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

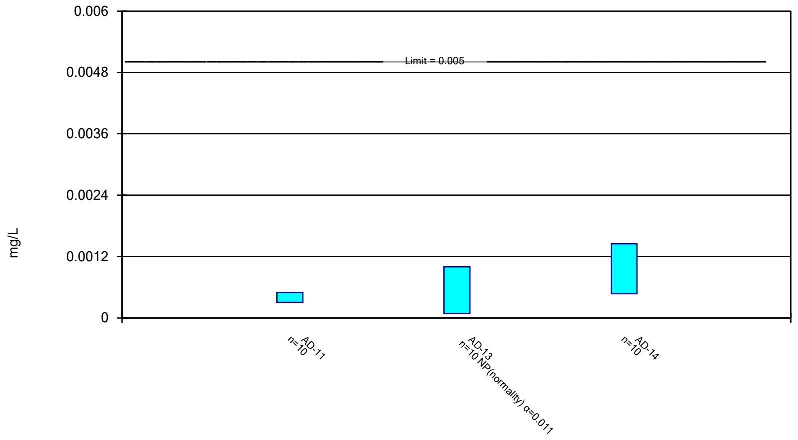


Constituent: Beryllium, total   Analysis Run 1/5/2019 11:15 AM   View: Confidence Interval - App IV
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

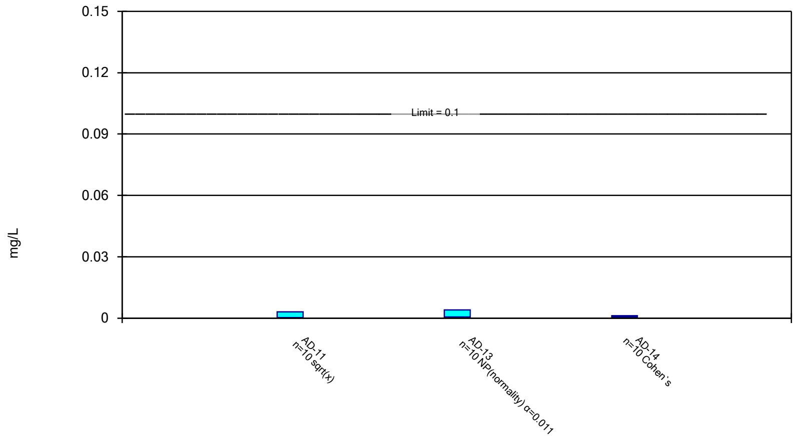


Constituent: Cadmium, total   Analysis Run 1/5/2019 11:16 AM   View: Confidence Interval - App IV
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

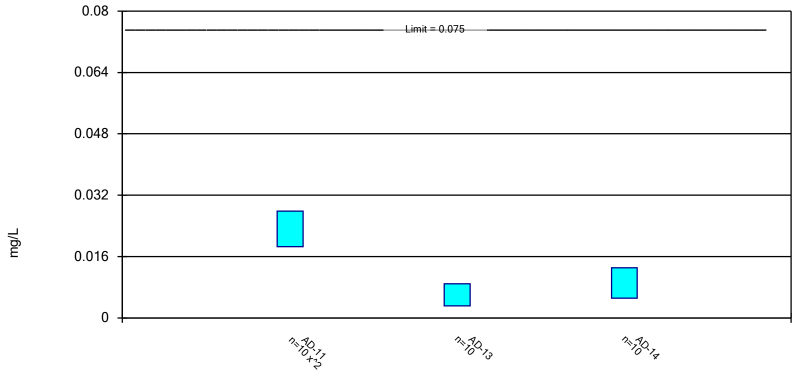


Constituent: Chromium, total   Analysis Run 1/5/2019 11:16 AM   View: Confidence Interval - App IV
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

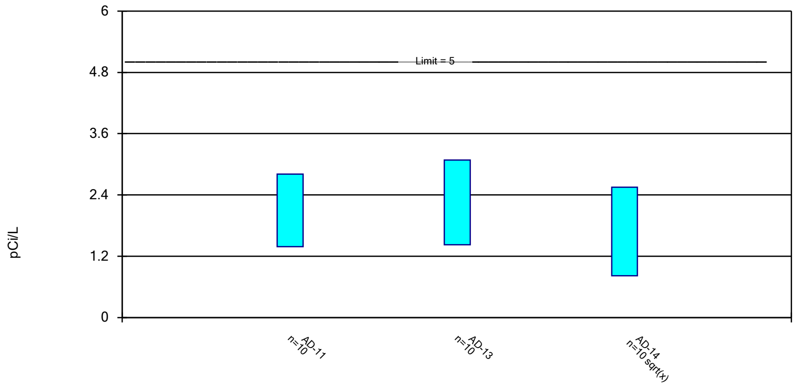


Constituent: Cobalt, total   Analysis Run 1/5/2019 11:16 AM   View: Confidence Interval - App IV
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

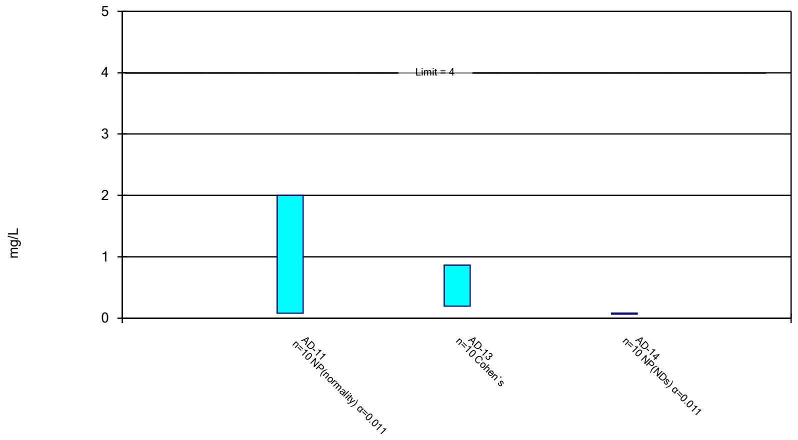


Constituent: Combined Radium 226 + 228   Analysis Run 1/5/2019 11:16 AM   View: Confidence Interval - A
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

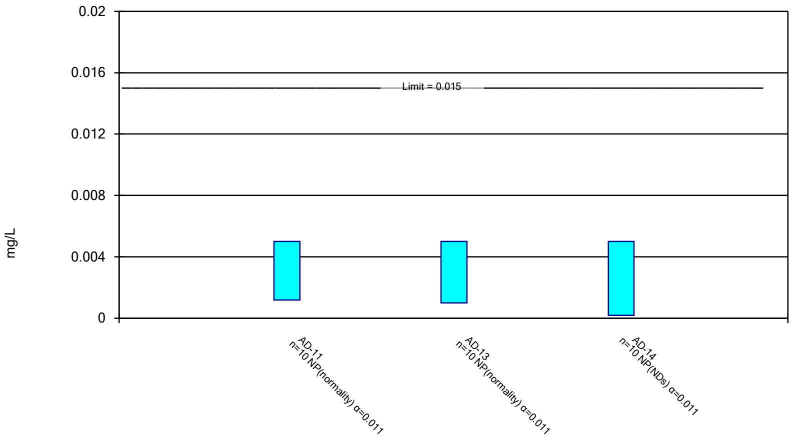


Constituent: Fluoride, total Analysis Run 1/5/2019 11:16 AM View: Confidence Interval - App IV
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

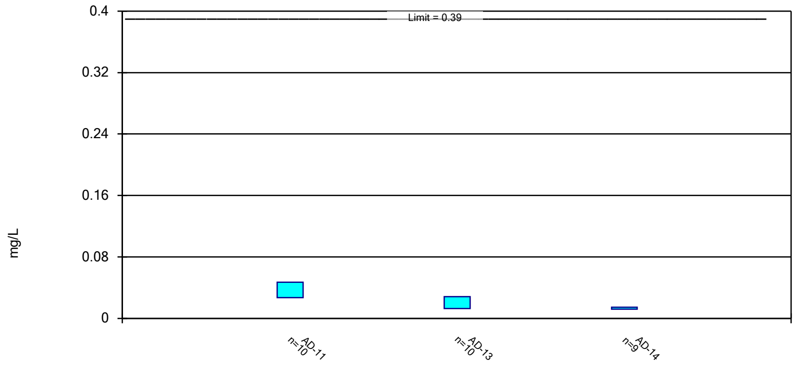


Constituent: Lead, total Analysis Run 1/5/2019 11:16 AM View: Confidence Interval - App IV
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

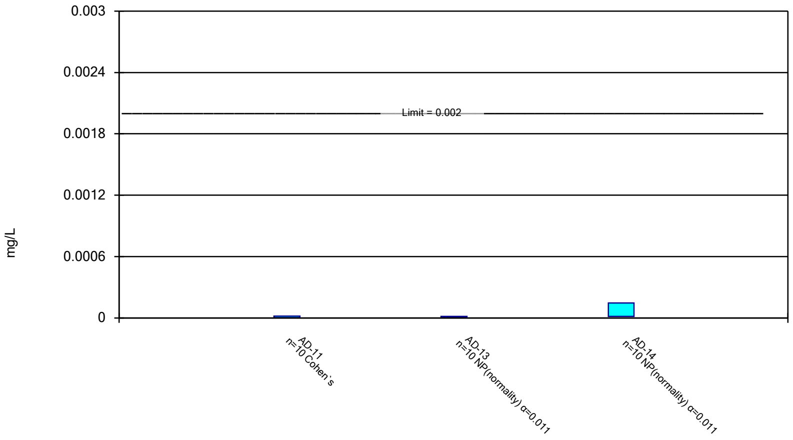


Constituent: Lithium, total Analysis Run 1/5/2019 11:16 AM View: Confidence Interval - App IV
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

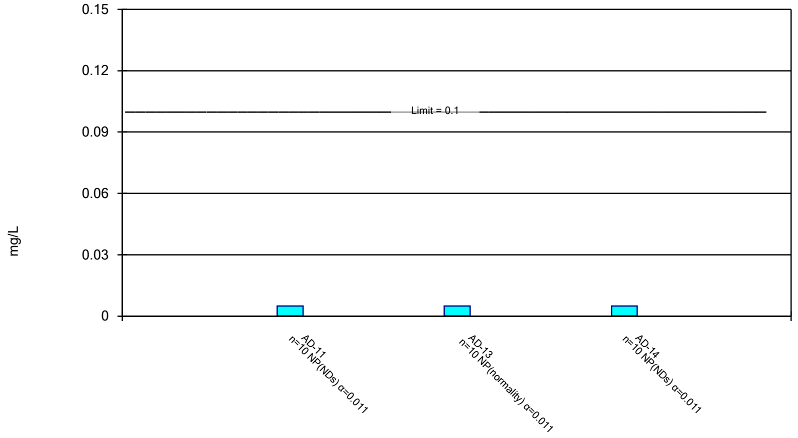


Constituent: Mercury, total Analysis Run 1/5/2019 11:16 AM View: Confidence Interval - App IV
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

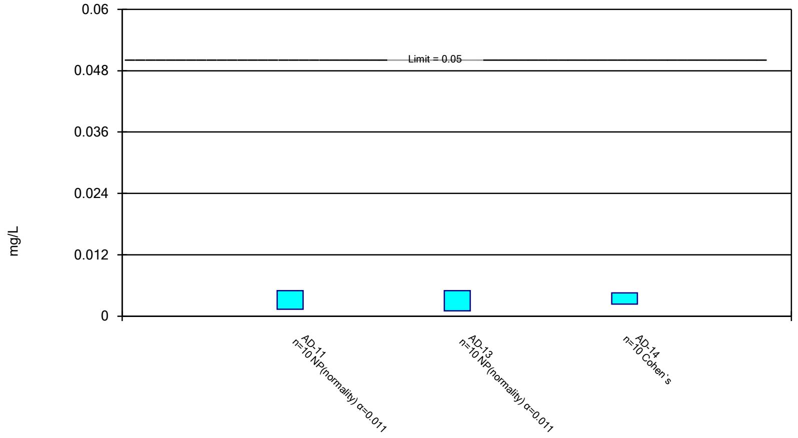


Constituent: Molybdenum, total Analysis Run 1/5/2019 11:16 AM View: Confidence Interval - App IV
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

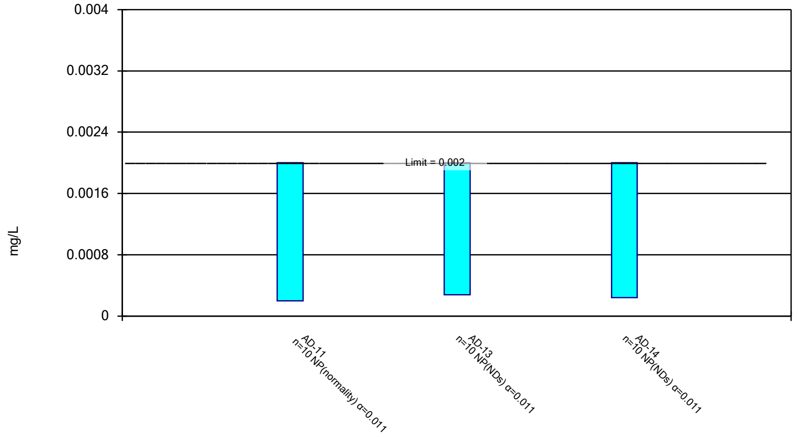


Constituent: Selenium, total Analysis Run 1/5/2019 11:16 AM View: Confidence Interval - App IV
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



Constituent: Thallium, total Analysis Run 1/5/2019 11:16 AM View: Confidence Interval - App IV
Welsh LF Client: Geosyntec Data: Welsh LF

STATISTICAL ANALYSIS SUMMARY
LANDFILL
J. Robert Welsh Plant
Pittsburg, Texas

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

July 9, 2019

CHA8473

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LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LF	Landfill
LFB	Laboratory Fortified Blanks
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
QA	Quality Assurance
QC	Quality Control
RSL	Regional Screening Level
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Landfill (LF), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron, total dissolved solids (TDS), and sulfate at the LF. An alternative source was not identified at the time, so two assessment monitoring events were conducted at the LF in 2018, in accordance with 40 CFR 257.95. No SSLs were identified during these events and the unit remained in assessment monitoring. A semi-annual assessment monitoring event was also completed in February 2019, with the results of the February 2019 event documented in this report.

Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were re-established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at a statistically significant level (SSL) above the GWPS. No SSLs were identified, but Appendix III concentrations for boron and calcium remained above background. Thus, either the unit will remain in assessment monitoring or an alternative source demonstration (ASD) will be conducted to evaluate if the unit can return to detection monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

LANDFILL EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, one set of samples was collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(d)(1). Samples from the February 2019 semi-annual sampling event were analyzed for the Appendix III and Appendix IV parameters. A summary of data collected during this assessment monitoring event may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.14 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the LF were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained to meet the requirements of 40 CFR 257.95(d)(1) were screened for potential outliers. No outliers were identified.

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in 40 CFR 257.95(h)(2) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events. Generally, tolerance limits were calculated parametrically with 95% coverage and 95% confidence. Non-parametric tolerance limits were calculated for antimony, arsenic, cobalt, fluoride, lithium, mercury, molybdenum, and selenium due to apparent non-normal distributions, for lead and thallium due to a high non-detect frequency, and for cadmium and chromium due to both apparent non-normal distributions and high non-detect frequencies. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

No SSLs were identified at the Welsh LF.

2.2.3 Evaluation of Potential Appendix III SSIs

The CCR rule allows CCR units to move from assessment monitoring to detection monitoring if all Appendix III and Appendix IV parameters were at or below background levels for two consecutive sampling events [40 CFR 257.95(e)]. Since no Appendix IV SSLs were identified, Appendix III results were analyzed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations.

Prediction limits were calculated for the Appendix III parameters to represent background values. As described in the January 2018 *Statistical Analysis Summary* report (Geosyntec, 2018), intrawell tests were used to evaluate potential SSIs for calcium, chloride, TDS, and sulfate, whereas interwell tests were used to evaluate potential SSIs for boron, fluoride, and pH.

Prediction limits for the interwell tests were recalculated using data collected during the February 2019 assessment monitoring event and another monitoring event also conducted in February 2019. Three data points (i.e., one sample from three background wells) were added to the background dataset for each interwell test. An additional three data points (i.e., one sample from three background wells) were added for boron, fluoride, and pH. New data were tested for outliers prior to being added to the background dataset. The updated prediction limits were calculated for a one-of-two retesting procedure, as during detection monitoring. The values of the updated prediction limits were similar to the values of the prediction limits calculated during detection monitoring. The revised interwell prediction limits were used to evaluate potential SSIs for boron, fluoride, and pH.

For the intrawell tests, limited data made it possible to add only one data point (i.e., one sample from each compliance well) to each background dataset. Because one sample result is insufficient to compare against the existing background dataset, the prediction limits were not updated for the intrawell tests at this time. The intrawell prediction limits calculated during detection monitoring were used to evaluate potential SSIs for calcium, chloride, sulfate, and TDS.

Data collected during the February 2019 assessment monitoring events from each compliance well were compared to the prediction limits to evaluate results above background values. Verification sampling was completed in April 2019. The results from this event and the prediction limits are summarized in Table 3. The following exceedances of the upper prediction limits (UPLs) were noted:

- Boron concentrations exceeded the interwell UPL of 0.775 mg/L at AD-11 (1.63 mg/L and 1.34 mg/L) and AD-14 (1.20 mg/L and 1.04 mg/L).

Based on these results, concentrations of Appendix III parameters exceeded background levels at compliance wells at the Welsh LF during assessment monitoring. As a result, the Welsh LF CCR unit will remain in assessment monitoring.

2.3 Conclusions

A semi-annual assessment monitoring event was conducted in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the February 2019 data. GWPSs were re-established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPS. No SSLs were identified.

The Appendix III results were evaluated to assess whether concentrations of Appendix III parameters exceeded background levels. Interwell tests were used to evaluate potential SSIs for boron, fluoride, and pH, and intrawell tests were used to evaluate potential SSIs for calcium, chloride, sulfate, and TDS. The prediction limits for the interwell tests were updated with additional data collected from the background wells. Prediction limits were recalculated using a one-of-two retesting procedure. The prediction limits calculated during detection monitoring were used for the intrawell tests. SSIs were identified for boron.

Based on this evaluation, either the Welsh LF CCR unit will remain in assessment monitoring or an ASD will be conducted to evaluate if the unit can return to detection monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Welsh Plant. January 2017.

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – Landfill, J. Robert Welsh Plant, Pittsburg, Texas. January 15, 2018.

TABLES

Table 1 - Groundwater Data Summary
Welsh - Landfill

Parameter	Unit	AD-1	AD-5	AD-11	AD-13	AD-14	AD-17
		2/20/2019	2/21/2019	2/21/2019	2/20/2019	2/20/2019	2/21/2019
Antimony	µg/L	0.160	0.0200 J	0.0300 J	0.0200 J	0.0300 J	0.0800 J
Arsenic	µg/L	0.460	1.59	0.510	0.380	0.340	2.51
Barium	µg/L	457	69.4	40.3	55.2	41.2	120
Beryllium	µg/L	0.0900 J	0.0800 J	0.824	0.302	0.387	0.240
Boron	mg/L	0.504	0.0330	1.63	0.484	1.20	0.151
Cadmium	µg/L	0.0100 J	0.0500 U	0.190	0.0500	0.350	0.270
Calcium	mg/L	142	33.9	19.1	17.7	10.3	207
Chloride	mg/L	2.82	24.7	9.23	3.95	2.20	43.2
Chromium	µg/L	0.306	0.432	0.259	0.200 J	0.247	3.34
Cobalt	µg/L	0.399	8.58	8.58	2.35	4.37	64.5
Combined Radium	pCi/L	3.16	1.27	1.51	2.53	1.17	2.66
Fluoride	mg/L	0.240	0.210	0.410	0.280	0.140	0.180
Lead	µg/L	0.124	0.147	0.523	0.0500 J	0.0900 J	2.49
Lithium	mg/L	0.00155	0.0807	0.0157	0.00940	0.0114	0.268
Mercury	mg/L	0.0000250 U	0.0000250 U	0.0000250 U	0.0000250 U	0.0000250 U	0.00000700 J
Molybdenum	µg/L	1.00 J	2.00 U	2.00 U	2.00 U	2.00 U	0.700 J
Selenium	µg/L	0.700	0.100 J	1.50	0.400	0.800	0.800
Total Dissolved Solids	mg/L	522	220	542	234	236	1720
Sulfate	mg/L	49.2	46.5	306	96.3	90.4	1060
Thallium	µg/L	0.500 U	0.500 U	0.100 J	0.500 U	0.500 U	0.500 U
pH	SU	7.31	5.38	4.85	4.86	4.28	6.93

Notes:

µg/L: micrograms per liter

mg/L: milligrams per liter

pCi/L: picocuries per liter

SU: standard unit

U: Non-detect value. For statistical analysis, parameters which were not detected were replaced with the reporting limit.

J: Estimated value. Parameter was detected in concentrations below the reporting limit.

Wells AD-1, AD-5, and AD-17 are background wells

Table 2: Groundwater Protection Standards
Welsh Plant - Landfill

Constituent Name	MCL	CCR Rule-Specified	Background Limit
Antimony, Total (mg/L)	0.006		0.005
Arsenic, Total (mg/L)	0.01		0.005
Barium, Total (mg/L)	2		0.58
Beryllium, Total (mg/L)	0.004		0.00070
Cadmium, Total (mg/L)	0.005		0.0065
Chromium, Total (mg/L)	0.1		0.004
Cobalt, Total (mg/L)	n/a	0.006	0.075
Combined Radium, Total (pCi/L)	5		4.18
Fluoride, Total (mg/L)	4		1
Lead, Total (mg/L)	n/a	0.015	0.005
Lithium, Total (mg/L)	n/a	0.04	0.39
Mercury, Total (mg/L)	0.002		0.000033
Molybdenum, Total (mg/L)	n/a	0.1	0.002
Selenium, Total (mg/L)	0.05		0.005
Thallium, Total (mg/L)	0.002		0.001

Notes:

Grey cell indicates calculated UTL (Upper Tolerance Limit) is higher than MCL.

MCL = Maximum Contaminant Level

Calculated UTL represents site-specific background values.

The higher of the calculated UTL or MCL/RSL is used as the GWPS.

Table 3: Detection Monitoring Data Evaluation
Welsh Plant - Landfill

Parameter	Units	Description	AD-11		AD-13		AD-14	
			2/21/2019	4/30/2019	2/20/2019	4/30/2019	2/20/2019	4/30/2019
Boron	mg/L	Interwell Background Value (UPL)	0.775					
		Detection Monitoring Result	**1.63**	**1.34**	0.484	0.483	**1.20**	**1.04**
Calcium	mg/L	Intrawell Background Value (UPL)	11.4		38.5		13.9	
		Detection Monitoring Result	**19.1**	7.53	17.7	--	10.3	--
Chloride	mg/L	Intrawell Background Value (UPL)	12.6		24.0		6.45	
		Detection Monitoring Result	9.23	--	3.95	--	2.2	--
Fluoride	mg/L	Interwell Background Value (UPL)	1.00					
		Detection Monitoring Result	0.41	--	0.28	--	0.14	--
pH	SU	Interwell Background Value (UPL)	7.2					
		Interwell Background Value (LPL)	4.3					
		Detection Monitoring Result	4.9	--	4.9	--	4.3	--
Sulfate	mg/L	Intrawell Background Value (UPL)	833		342		131	
		Detection Monitoring Result	306	--	96.3	--	90.4	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	1224		974		325	
		Detection Monitoring Result	542	--	234	--	236	--

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
*: Designates results for a duplicate sample
-: Not Sampled
Bold values exceed the background value.
Background values are shaded gray.
Based on a 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the calculated background value.

ATTACHMENT A
Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Welsh Landfill CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

DAVID ANTHONY MILLER
112498

David Anthony Miller
Signature

112498
License Number

TEXAS
Licensing State

07.09.19
Date

American Electric Power
Service Corporation
Texas Registered
Engineering Firm No.
F-3341

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

July 11, 2019

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Welsh Landfill
Assessment Monitoring Event – February 2019

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the statistical analysis of the February 2019 data for American Electric Power Inc.'s Welsh Landfill. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at the site for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** AD-1, AD-5, and AD-17; and
- **Downgradient wells:** AD-11, AD-13 and AD-14

Data were sent electronically, and the statistical analysis was conducted according to the Statistical Analysis Plan and screening evaluation prepared by GSC and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC.

The CCR program consists of the following constituents:

- **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS;
- **Appendix IV** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record (Figure A). Values previously flagged during the screening as outliers may be seen in a lighter font and disconnected symbol on the time series graphs. A summary of flagged values follows this letter (Figure B).

Evaluation of Appendix III Parameters

Interwell prediction limits, based on a 1-of-2 resample plan, were constructed to evaluate the following Appendix III Detection Monitoring parameters: boron, fluoride and TDS (Figure C). The statistical method selected for each parameter was determined based on the results of the evaluation performed in December 2017; and all proposed background data were screened for outliers and trends at that time. The findings of those reports were submitted with that analysis.

Interwell prediction limits utilize all upgradient well data for construction of statistical limits. During each sample event, upgradient well data are screened for any newly suspected outliers or obvious trending patterns using time series plots. All values flagged as outliers may be seen on the Outlier Summary report following this letter. No obvious trending patterns were observed in the upgradient wells.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of one additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered a false positive result and, therefore, no further action is necessary.

No prediction limits exceedances were noted except for boron in wells AD-11 and AD-14; and pH in well AD-14 which exceeded its lower limit.

When a statistically significant increase is identified, the data are further evaluated using the Sen's Slope/Mann Kendall trend test to determine whether concentrations are statistically increasing, decreasing or stable. Upgradient wells are included in the trend analyses to identify whether similar patterns exist upgradient of the site which is an indication of natural variability in groundwater unrelated to practices at the site. No statistically significant trends were noted (Figure D).

Evaluation of Appendix IV Parameters

Interwell Tolerance limits were used to calculate background limits from all available pooled upgradient well data for Appendix IV parameters to determine the Alternate Contaminant Level (ACL) for each constituent (Figure E). Background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits. Any flagged values may be seen on the Outlier Summary following this letter.

Parametric limits use a target of 95% confidence and 95% coverage. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and CCR-Rule specified levels in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure F).

Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters using the highest limit of either the MCL, CCR-rule specified, or ACL as discussed above (Figure G). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No confidence intervals exceedances were found for any of the downgradient wells. A summary of the confidence interval results follows this letter.

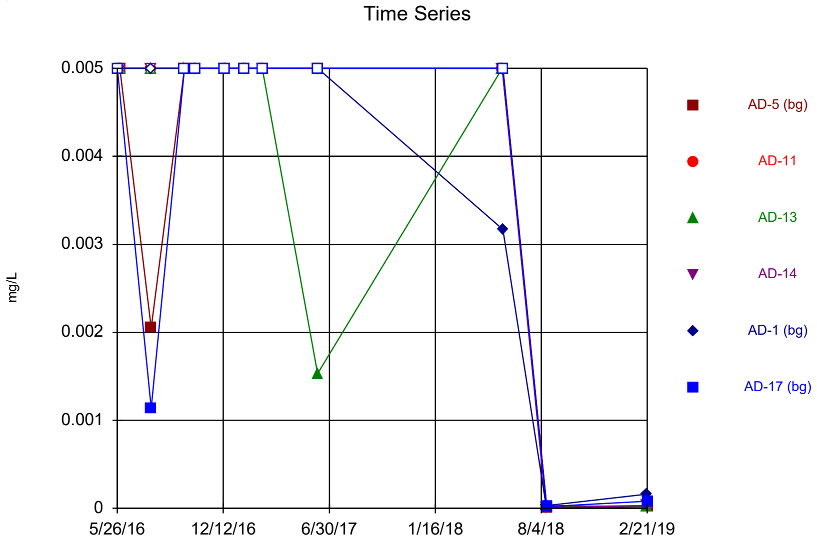
Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Welsh Landfill. If you have any questions or comments, please feel free to contact me.

For Groundwater Stats Consulting,

Kristina Rayner

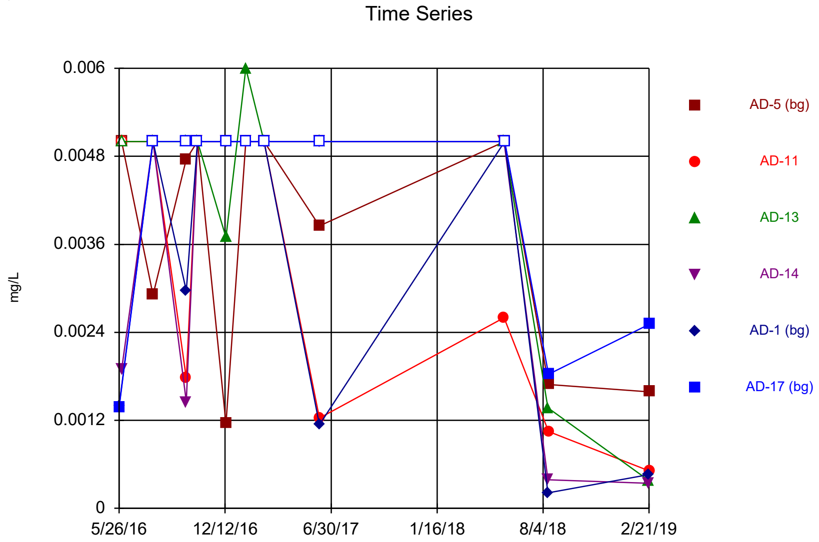
Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



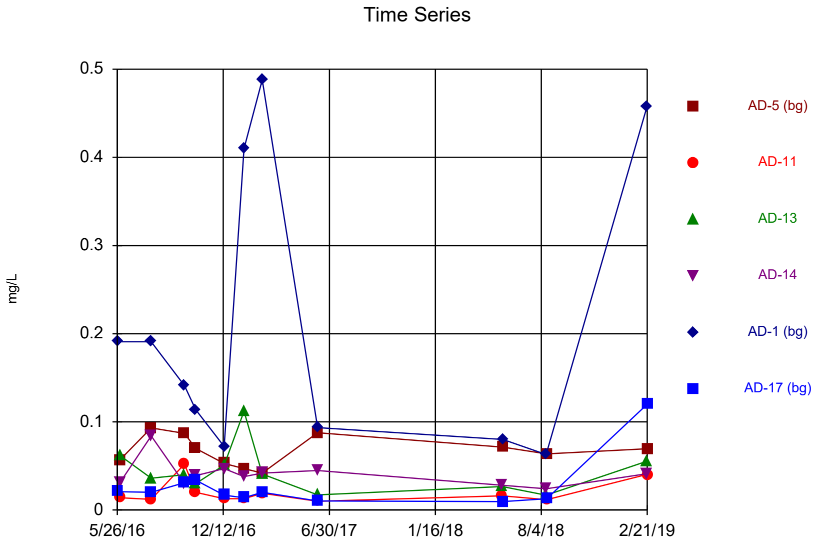
Constituent: Antimony, total   Analysis Run 6/24/2019 12:01 PM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



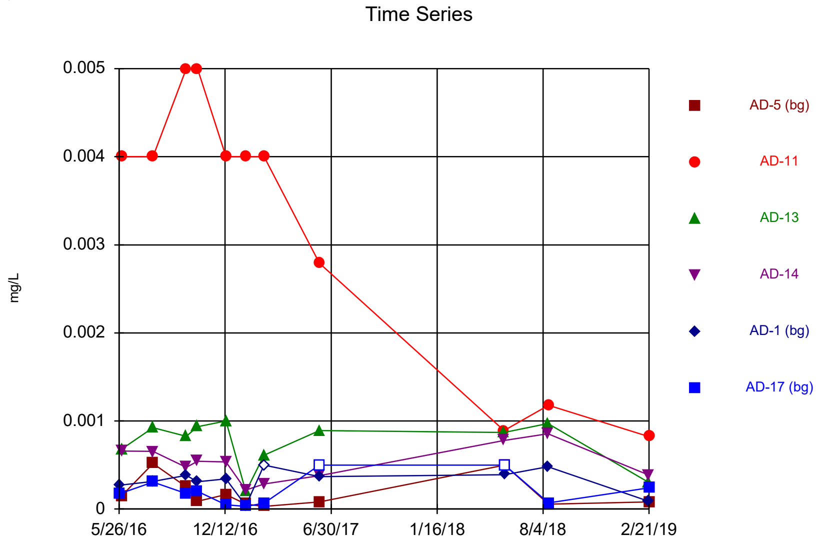
Constituent: Arsenic, total   Analysis Run 6/24/2019 12:01 PM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



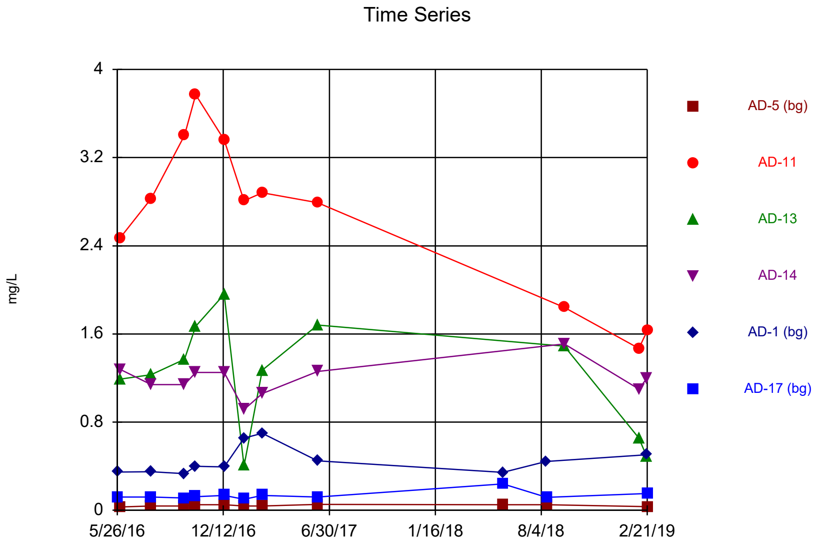
Constituent: Barium, total   Analysis Run 6/24/2019 12:01 PM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



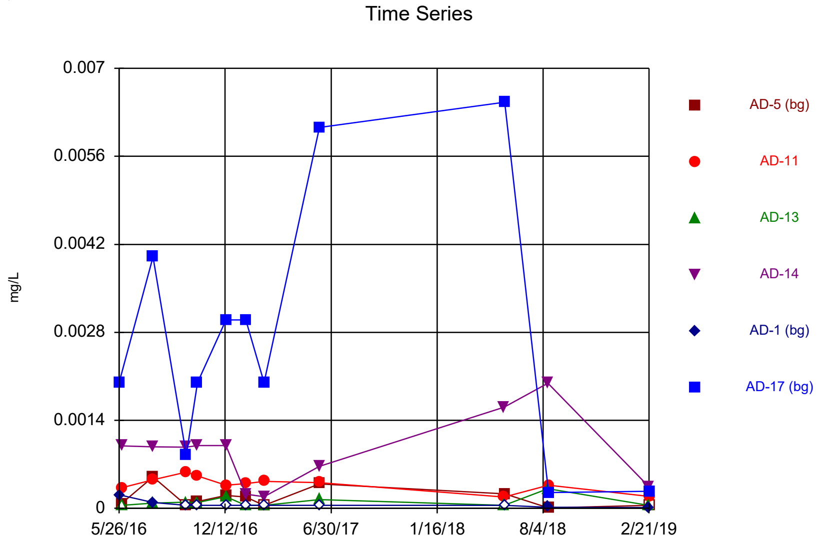
Constituent: Beryllium, total   Analysis Run 6/24/2019 12:01 PM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



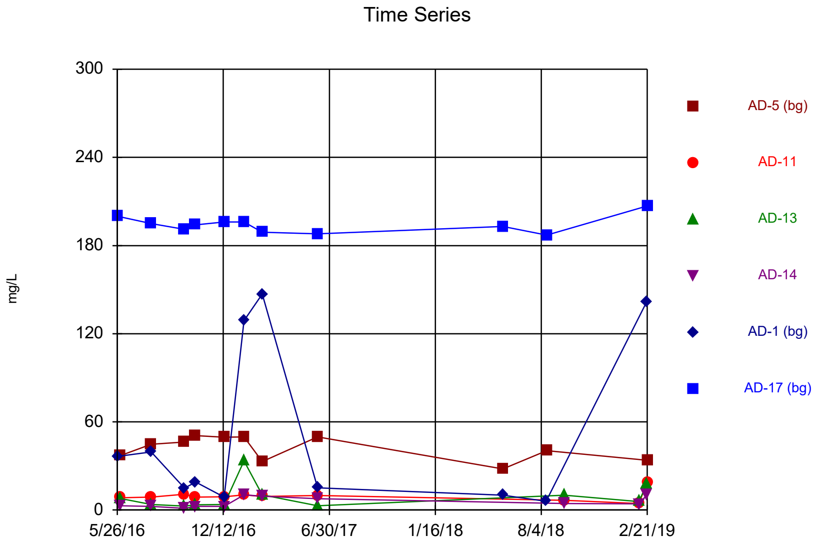
Constituent: Boron, total Analysis Run 6/24/2019 12:01 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



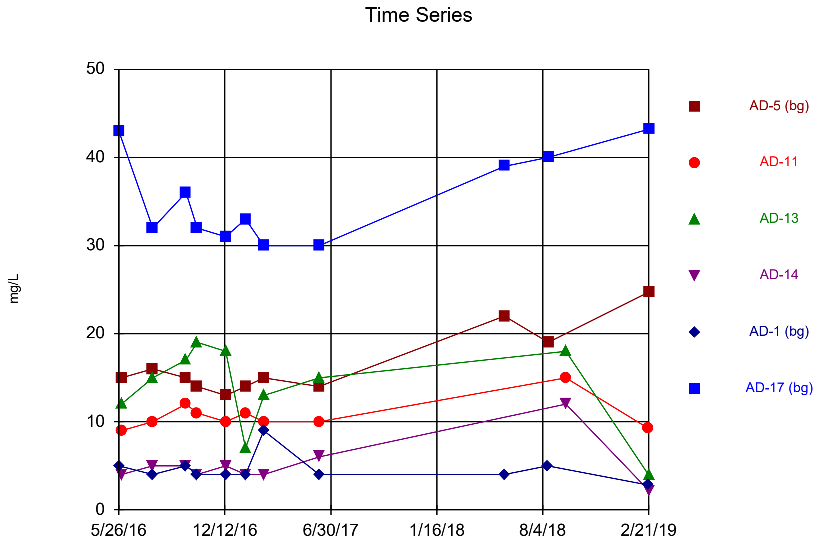
Constituent: Cadmium, total Analysis Run 6/24/2019 12:01 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



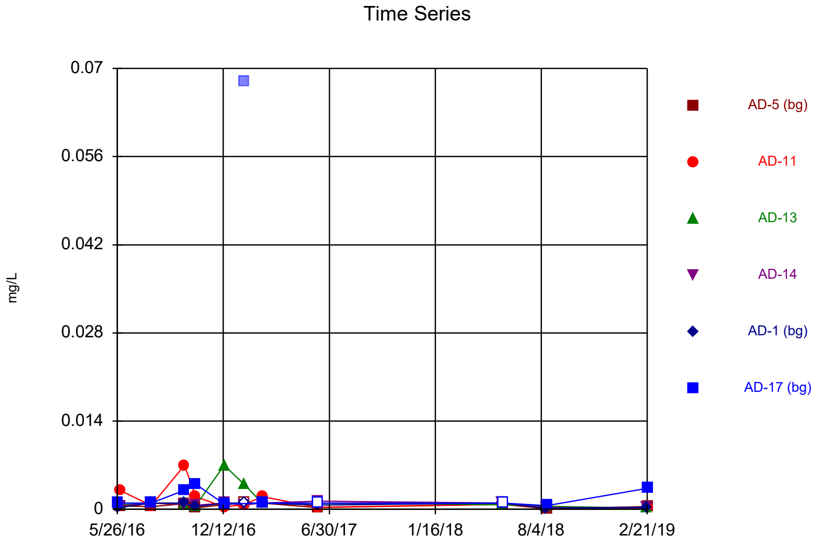
Constituent: Calcium, total Analysis Run 6/24/2019 12:01 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



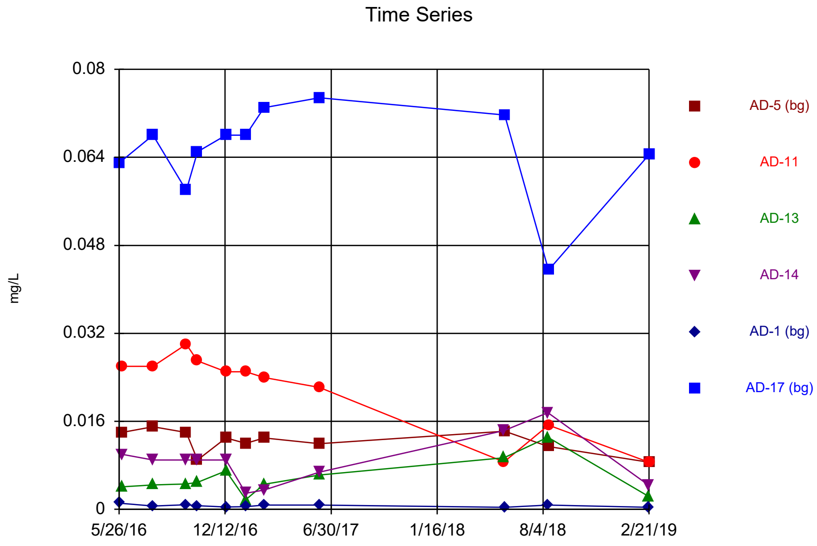
Constituent: Chloride, total Analysis Run 6/24/2019 12:01 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



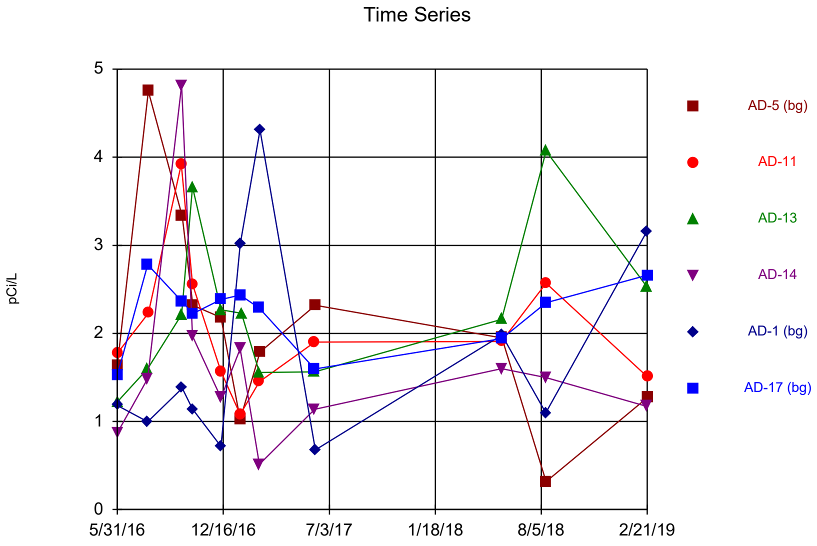
Constituent: Chromium, total Analysis Run 6/24/2019 12:01 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



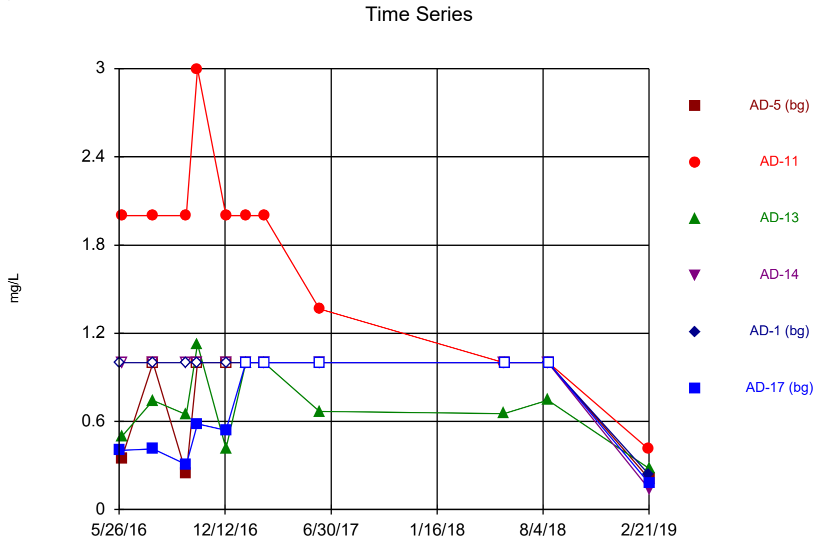
Constituent: Cobalt, total Analysis Run 6/24/2019 12:01 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Combined Radium 226 + 228 Analysis Run 6/24/2019 12:01 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

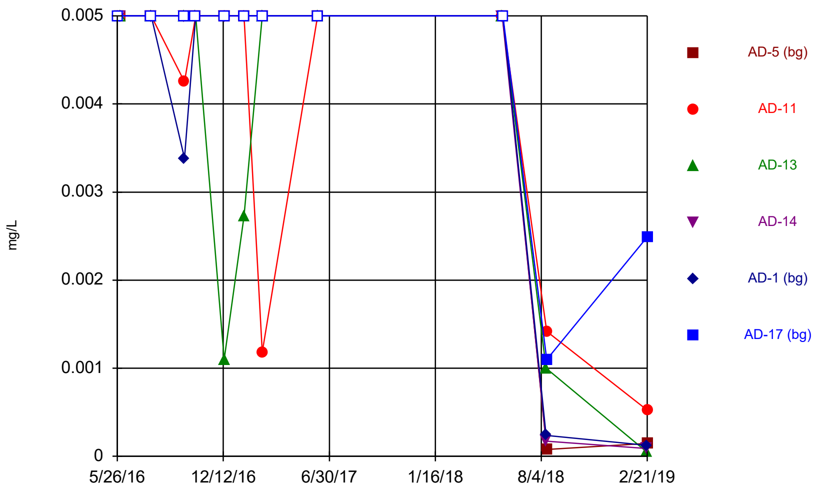
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Fluoride, total Analysis Run 6/24/2019 12:01 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

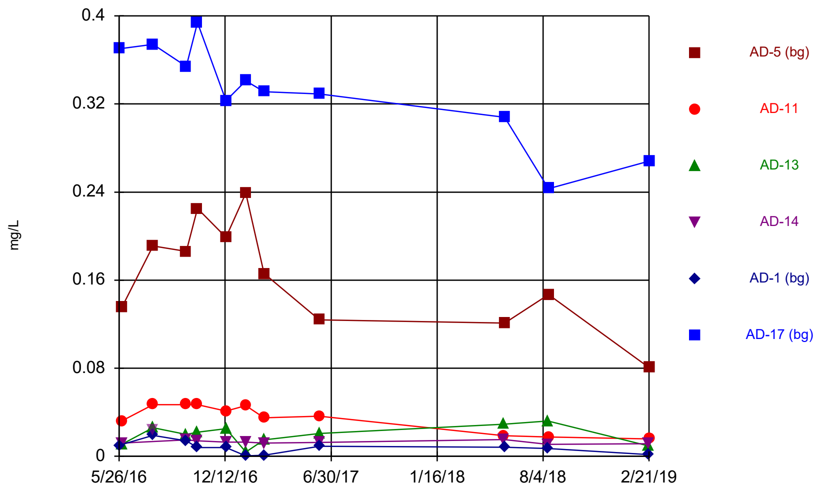
Time Series



Constituent: Lead, total   Analysis Run 6/24/2019 12:01 PM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

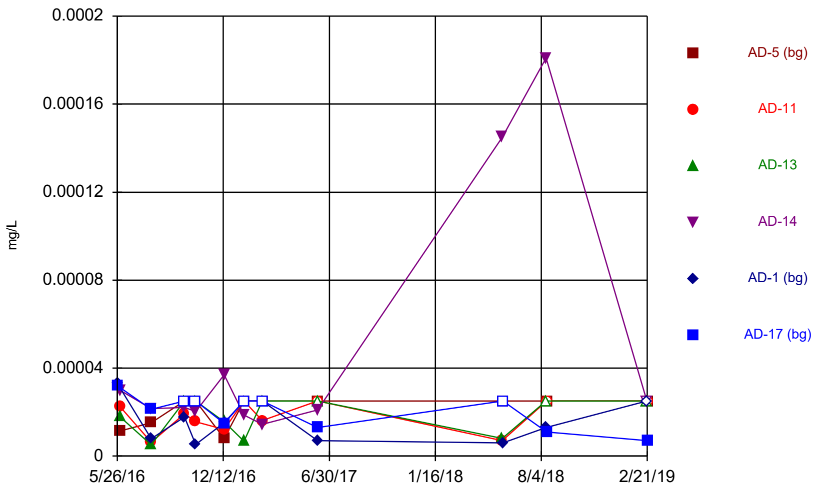
Time Series



Constituent: Lithium, total   Analysis Run 6/24/2019 12:01 PM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

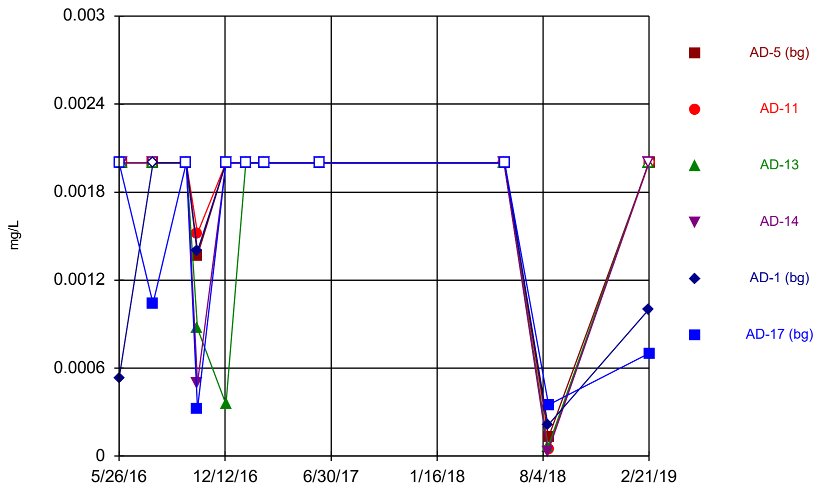
Time Series



Constituent: Mercury, total   Analysis Run 6/24/2019 12:01 PM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

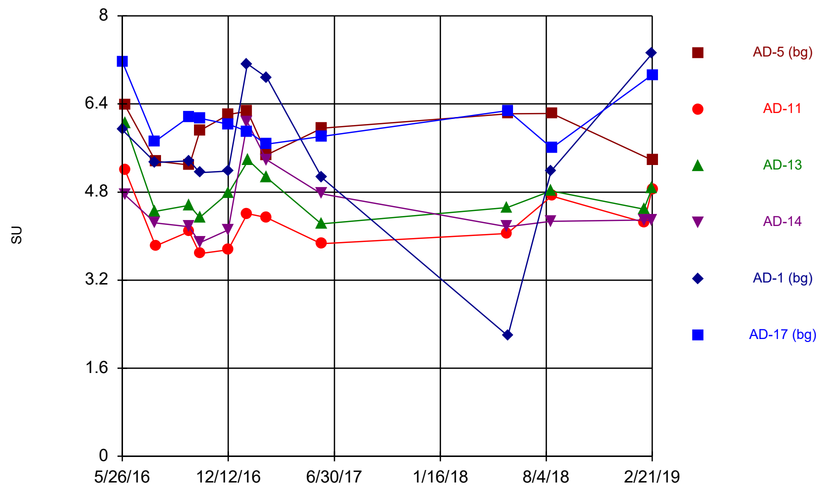
Time Series



Constituent: Molybdenum, total   Analysis Run 6/24/2019 12:01 PM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

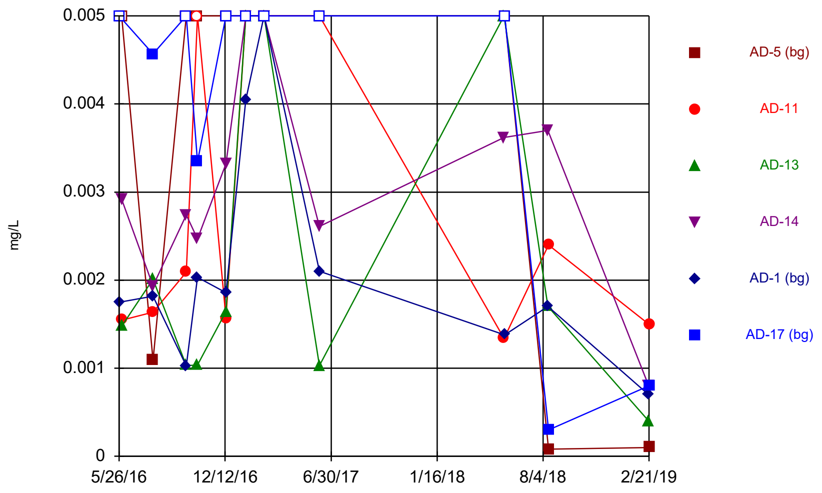
Time Series



Constituent: pH, field Analysis Run 6/24/2019 12:01 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

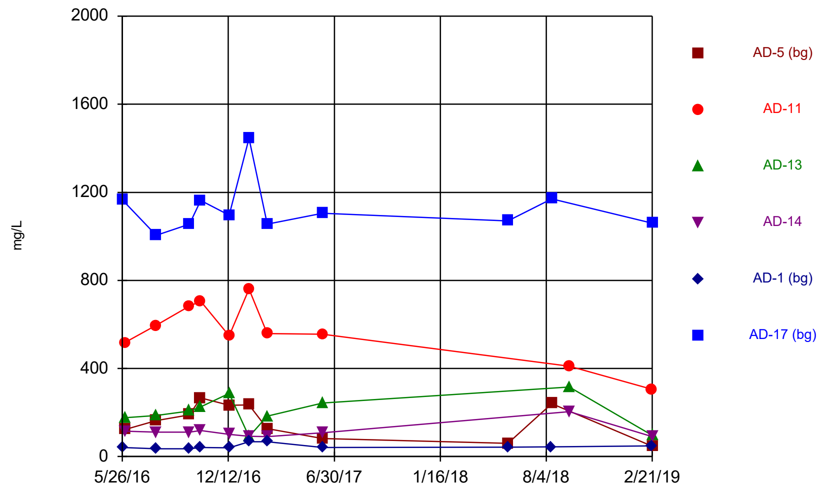
Time Series



Constituent: Selenium, total Analysis Run 6/24/2019 12:01 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

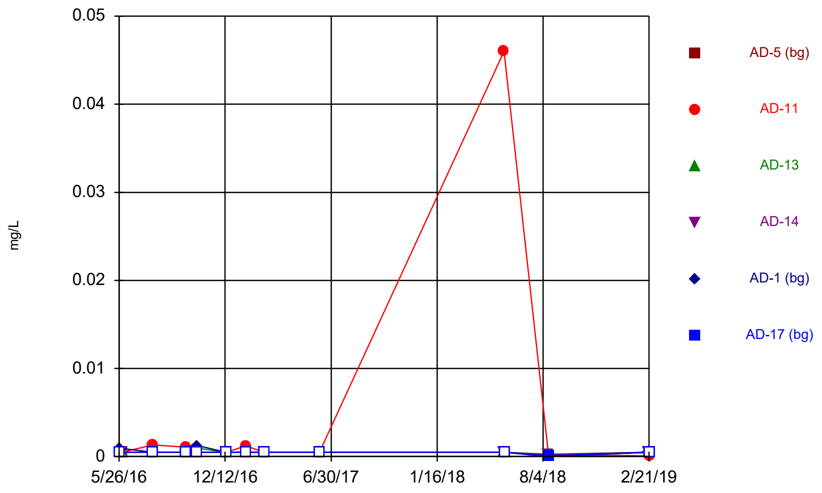
Time Series



Constituent: Sulfate, total Analysis Run 6/24/2019 12:01 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

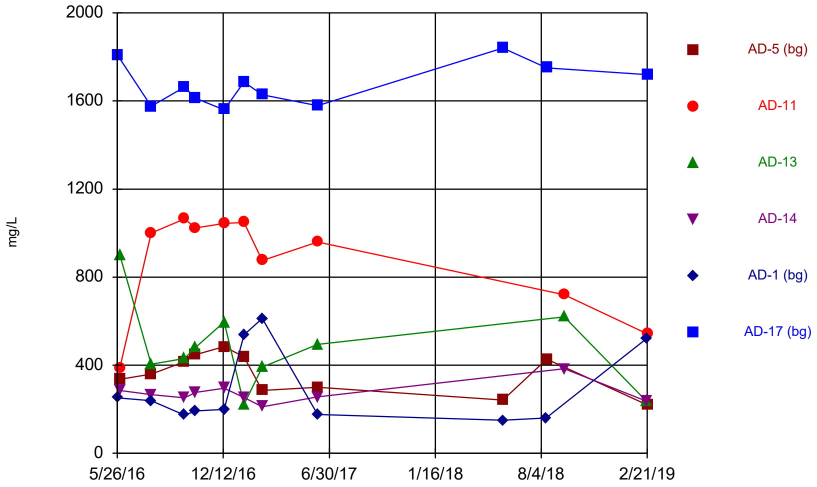
Time Series



Constituent: Thallium, total Analysis Run 6/24/2019 12:01 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Time Series



Constituent: Total Dissolved Solids Analysis Run 6/24/2019 12:01 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Outlier Summary

Welsh LF Client: Geosyntec Data: Welsh LF Printed 7/11/2019, 2:01 PM

	AD-17 Chromium, total (mg/L)	AD-14 Lithium, total (mg/L)
7/29/2016		0.024 (o)
1/20/2017	0.068 (O)	

Interwell Prediction Limit Summary - Significant Results

Welsh LF Client: Geosyntec Data: Welsh LF Printed 6/24/2019, 12:10 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	**AD-11**	**0.775**	**n/a**	**2/21/2019**	**1.63**	**Yes**	**33**	**-2.01**	**0.986**	**0**	**None**	**ln(x)**	**0.002505**	**Param Inter 1 of 2**
Boron, total (mg/L)	**AD-14**	**0.775**	**n/a**	**2/20/2019**	**1.2**	**Yes**	**33**	**-2.01**	**0.986**	**0**	**None**	**ln(x)**	**0.002505**	**Param Inter 1 of 2**
pH, field (SU)	**AD-14**	**7.177**	**4.285**	**2/20/2019**	**4.28**	**Yes**	**33**	**34.93**	**9.314**	**0**	**None**	**x^2**	**0.001253**	**Param Inter 1 of 2**

Interwell Prediction Limit Summary - All Results

Welsh LF   Client: Geosyntec   Data: Welsh LF   Printed 6/24/2019, 12:10 PM

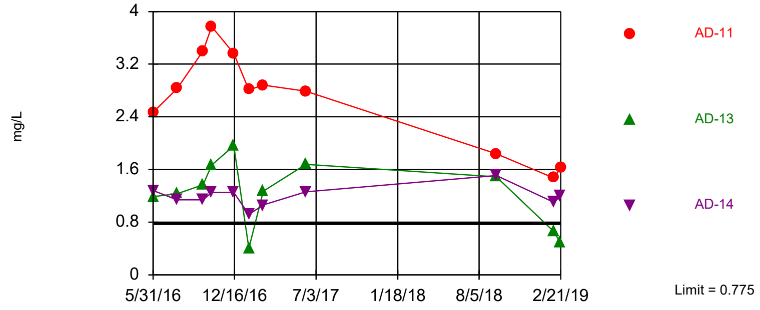
Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	**AD-11**	**0.775**	**n/a**	**2/21/2019**	**1.63**	**Yes**	**33**	**-2.01**	**0.986**	**0**	**None**	**ln(x)**	**0.002505**	**Param Inter 1 of 2**
Boron, total (mg/L)	AD-13	0.775	n/a	2/20/2019	0.484	No	33	-2.01	0.986	0	None	ln(x)	0.002505	Param Inter 1 of 2
Boron, total (mg/L)	**AD-14**	**0.775**	**n/a**	**2/20/2019**	**1.2**	**Yes**	**33**	**-2.01**	**0.986**	**0**	**None**	**ln(x)**	**0.002505**	**Param Inter 1 of 2**
Fluoride, total (mg/L)	AD-11	1	n/a	2/20/2019	0.41	No	33	n/a	n/a	69.7	n/a	n/a	0.001673	NP Inter (NDs) 1 of 2
Fluoride, total (mg/L)	AD-13	1	n/a	2/21/2019	0.28	No	33	n/a	n/a	69.7	n/a	n/a	0.001673	NP Inter (NDs) 1 of 2
Fluoride, total (mg/L)	AD-14	1	n/a	2/21/2019	0.14	No	33	n/a	n/a	69.7	n/a	n/a	0.001673	NP Inter (NDs) 1 of 2
pH, field (SU)	AD-11	7.177	4.285	2/21/2019	4.85	No	33	34.93	9.314	0	None	x^2	0.001253	Param Inter 1 of 2
pH, field (SU)	AD-13	7.177	4.285	2/20/2019	4.86	No	33	34.93	9.314	0	None	x^2	0.001253	Param Inter 1 of 2
pH, field (SU)	**AD-14**	**7.177**	**4.285**	**2/20/2019**	**4.28**	**Yes**	**33**	**34.93**	**9.314**	**0**	**None**	**x^2**	**0.001253**	**Param Inter 1 of 2**

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: AD-11, AD-14

Prediction Limit

Interwell Parametric



Background Data Summary (based on natural log transformation): Mean=-2.01, Std. Dev.=0.986, n=33. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9116, critical = 0.906. Kappa = 1.78 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.002505. Comparing 3 points to limit.

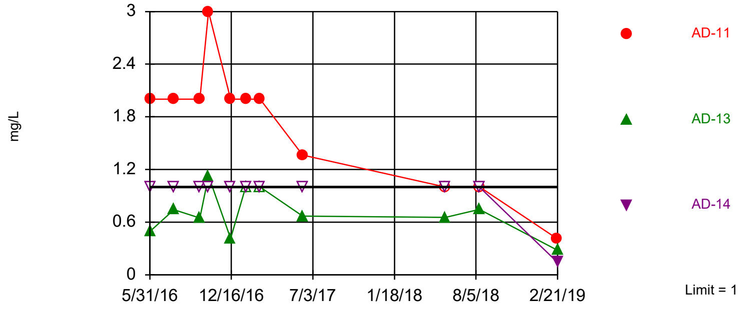
Constituent: Boron, total Analysis Run 6/24/2019 12:08 PM View: PL's - Interwell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 33 background values. 69.7% NDs. Annual per-constituent alpha = 0.009997. Individual comparison alpha = 0.001673 (1 of 2). Comparing 3 points to limit.

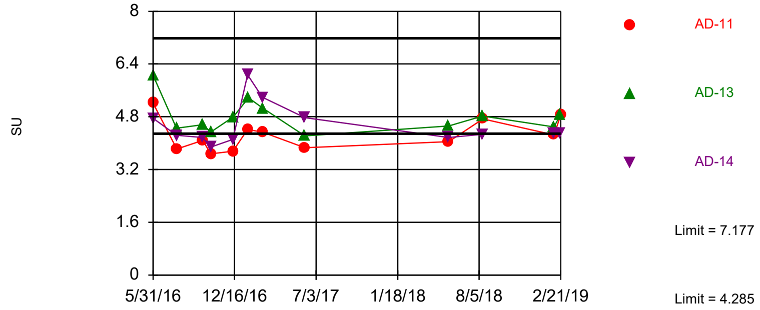
Constituent: Fluoride, total Analysis Run 6/24/2019 12:08 PM View: PL's - Interwell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limits: AD-14

Prediction Limit

Interwell Parametric



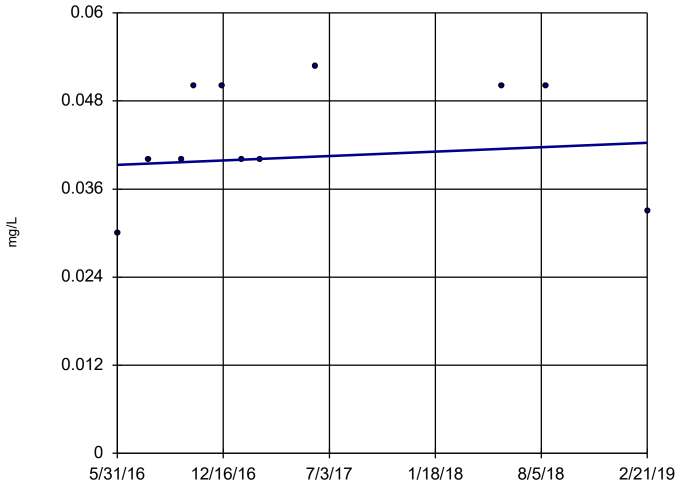
Background Data Summary (based on square transformation): Mean=34.93, Std. Dev.=9.314, n=33. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.927, critical = 0.906. Kappa = 1.78 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.001253. Comparing 3 points to limit.

Constituent: pH, field Analysis Run 6/24/2019 12:08 PM View: PL's - Interwell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-5 (bg)



n = 11

Slope = 0.001099
units per year.

Mann-Kendall
statistic = 14
critical = 34

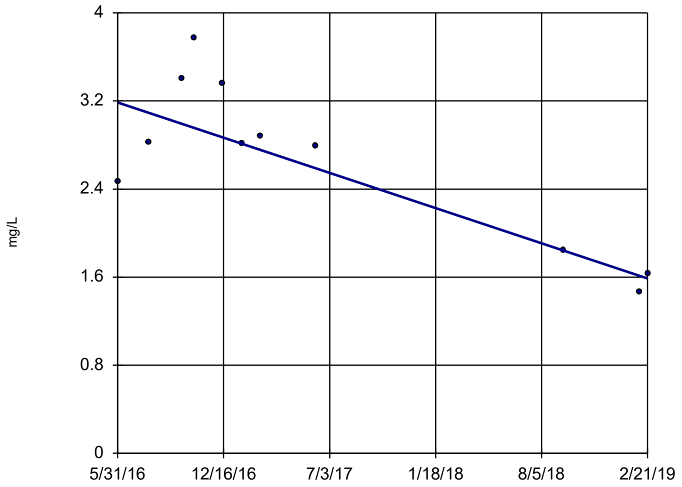
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 6/24/2019 12:12 PM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-11



n = 11

Slope = -0.5852
units per year.

Mann-Kendall
statistic = -27
critical = -34

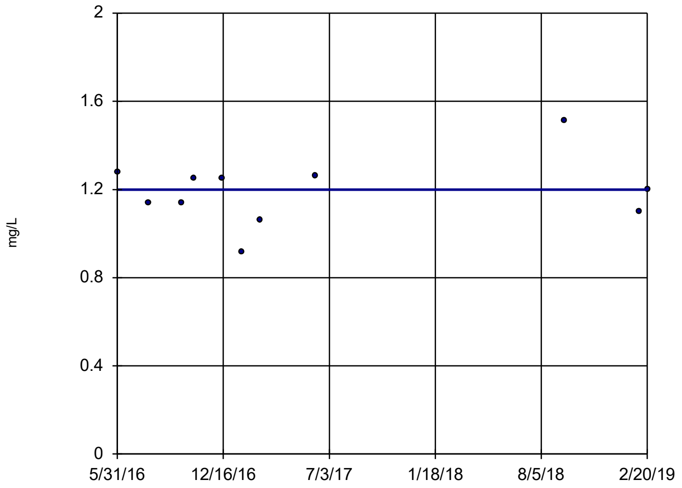
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 6/24/2019 12:12 PM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-14



n = 11

Slope = 0
units per year.

Mann-Kendall
statistic = -1
critical = -34

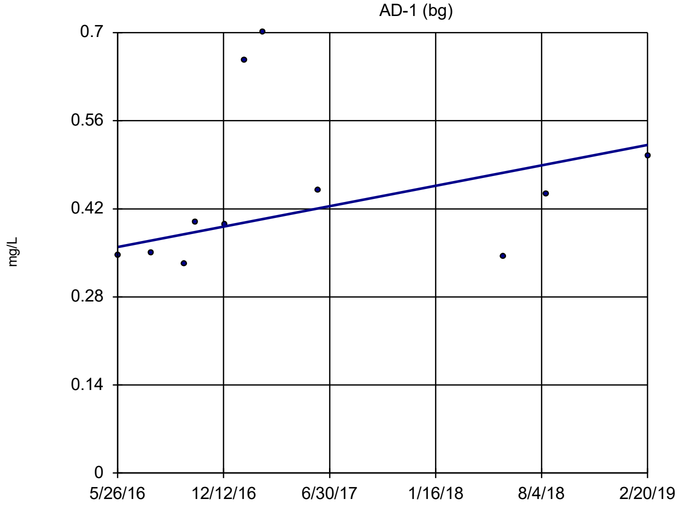
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 6/24/2019 12:12 PM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-1 (bg)



n = 11

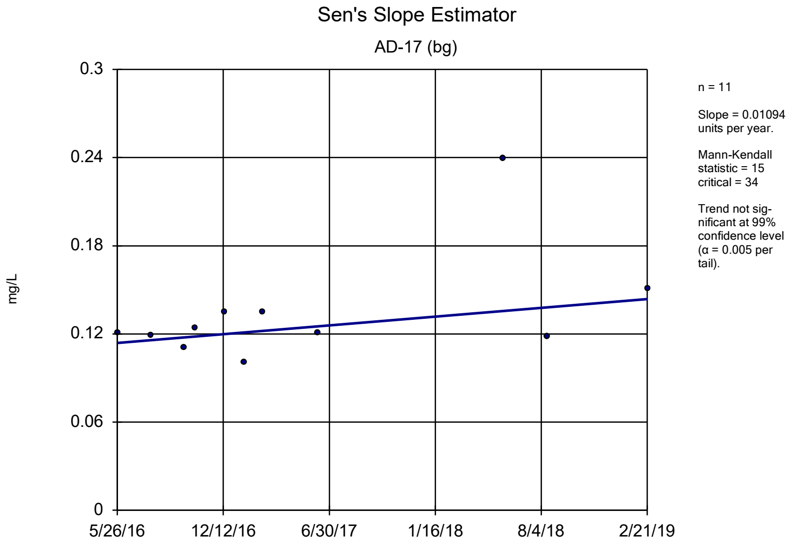
Slope = 0.05932
units per year.

Mann-Kendall
statistic = 21
critical = 34

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 6/24/2019 12:12 PM View: Trend Testing
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



n = 11

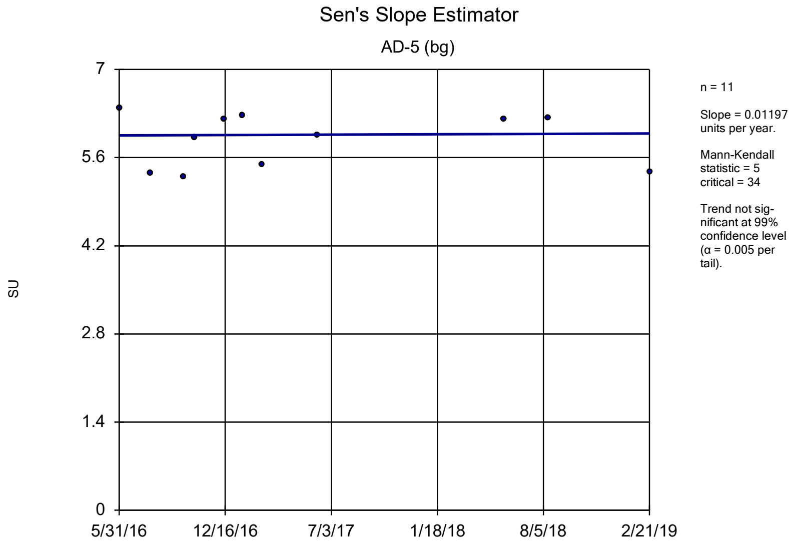
Slope = 0.01094 units per year.

Mann-Kendall statistic = 15 critical = 34

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total   Analysis Run 6/24/2019 12:12 PM   View: Trend Testing
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



n = 11

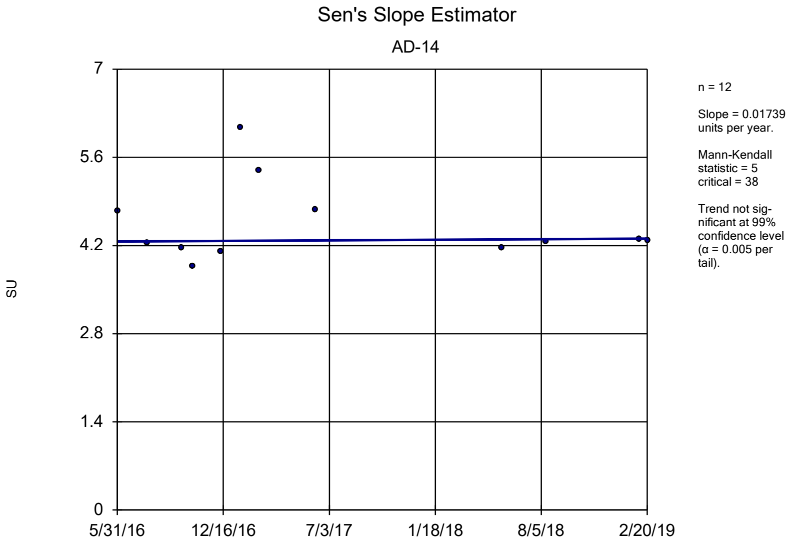
Slope = 0.01197 units per year.

Mann-Kendall statistic = 5 critical = 34

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field   Analysis Run 6/24/2019 12:12 PM   View: Trend Testing
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



n = 12

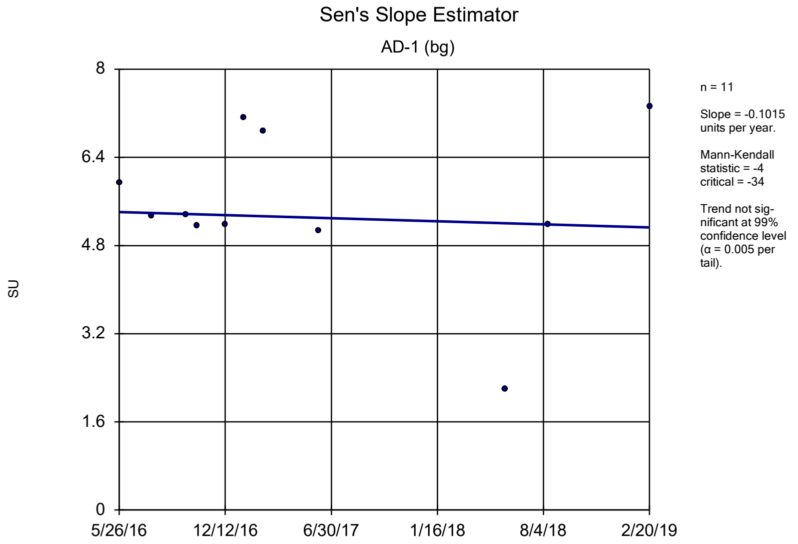
Slope = 0.01739 units per year.

Mann-Kendall statistic = 5 critical = 38

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field   Analysis Run 6/24/2019 12:12 PM   View: Trend Testing
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



n = 11

Slope = -0.1015 units per year.

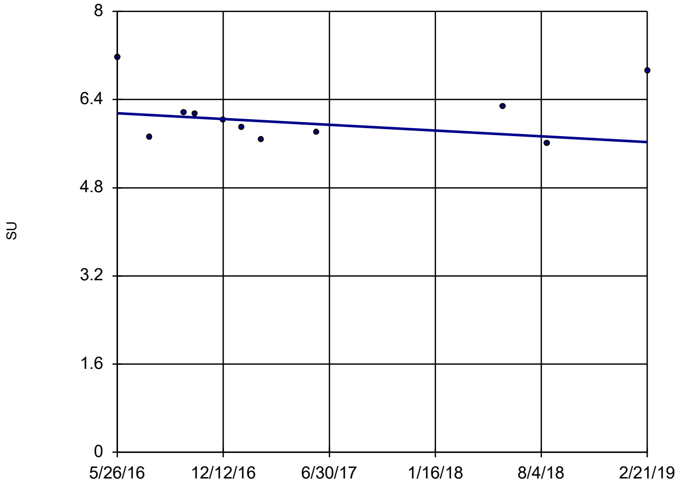
Mann-Kendall statistic = -4 critical = -34

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field   Analysis Run 6/24/2019 12:12 PM   View: Trend Testing
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sen's Slope Estimator

AD-17 (bg)



n = 11

Slope = -0.1904
units per year.

Mann-Kendall
statistic = -11
critical = -34

Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: pH, field   Analysis Run 6/24/2019 12:12 PM   View: Trend Testing
Welsh LF   Client: Geosyntec   Data: Welsh LF

Upper Tolerance Limits - Appendix IV

Welsh Landfill Client: Geosyntec Data: Welsh LF Printed 6/18/2019, 9:26 AM

Constituent	Upper Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony, total (mg/L)	0.005	33	n/a	n/a	72.73	n/a	n/a	0.184	NP Inter(normality)
Arsenic, total (mg/L)	0.005	33	n/a	n/a	57.58	n/a	n/a	0.184	NP Inter(normality)
Barium, total (mg/L)	0.5818	33	-2.809	1.037	0	None	ln(x)	0.05	Inter
Beryllium, total (mg/L)	0.0007276	33	0.01425	0.005818	12.12	None	sqrt(x)	0.05	Inter
Cadmium, total (mg/L)	0.00646	33	n/a	n/a	30.3	n/a	n/a	0.184	NP Inter(Cohens/x...
Chromium, total (mg/L)	0.004	32	n/a	n/a	28.13	n/a	n/a	0.1937	NP Inter(Cohens/x...
Cobalt, total (mg/L)	0.0748	33	n/a	n/a	0	n/a	n/a	0.184	NP Inter(normality)
Combined Radium 226 + 228 (pCi/L)	4.182	33	2.033	0.9825	0	None	No	0.05	Inter
Fluoride, total (mg/L)	1	33	n/a	n/a	69.7	n/a	n/a	0.184	NP Inter(normality)
Lead, total (mg/L)	0.005	33	n/a	n/a	78.79	n/a	n/a	0.184	NP Inter(NDs)
Lithium, total (mg/L)	0.394	33	n/a	n/a	0	n/a	n/a	0.184	NP Inter(normality)
Mercury, total (mg/L)	0.000033	33	n/a	n/a	48.48	n/a	n/a	0.184	NP Inter(normality)
Molybdenum, total (mg/L)	0.002	33	n/a	n/a	69.7	n/a	n/a	0.184	NP Inter(normality)
Selenium, total (mg/L)	0.005	33	n/a	n/a	48.48	n/a	n/a	0.184	NP Inter(normality)
Thallium, total (mg/L)	0.001251	33	n/a	n/a	84.85	n/a	n/a	0.184	NP Inter(NDs)

Confidence Intervals - All Appendix IV (No Significant Results)

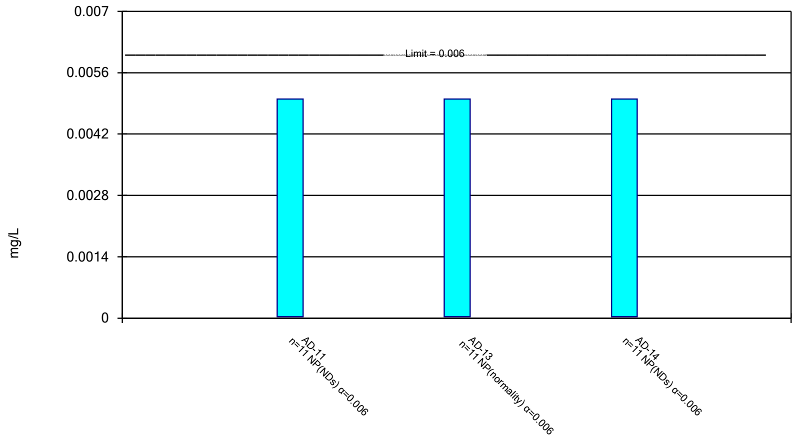
Welsh Landfill Client: Geosyntec Data: Welsh LF Printed 6/18/2019, 9:34 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	AD-11	0.005	0.00003	0.006	No	11	81.82	No	0.006	NP (NDs)
Antimony, total (mg/L)	AD-13	0.005	0.00003	0.006	No	11	72.73	No	0.006	NP (normality)
Antimony, total (mg/L)	AD-14	0.005	0.00003	0.006	No	11	81.82	No	0.006	NP (NDs)
Arsenic, total (mg/L)	AD-11	0.005	0.00105	0.01	No	11	54.55	No	0.006	NP (normality)
Arsenic, total (mg/L)	AD-13	0.005	0.00137	0.01	No	11	63.64	No	0.006	NP (normality)
Arsenic, total (mg/L)	AD-14	0.005	0.00039	0.01	No	11	63.64	No	0.006	NP (normality)
Barium, total (mg/L)	AD-11	0.0403	0.0119	2	No	11	0	No	0.006	NP (normality)
Barium, total (mg/L)	AD-13	0.0634	0.02381	2	No	11	0	sqrt(x)	0.01	Param.
Barium, total (mg/L)	AD-14	0.05248	0.02864	2	No	11	0	sqrt(x)	0.01	Param.
Beryllium, total (mg/L)	AD-11	0.004496	0.002314	0.004	No	11	0	x^2	0.01	Param.
Beryllium, total (mg/L)	AD-13	0.0009506	0.0005881	0.004	No	11	0	x^2	0.01	Param.
Beryllium, total (mg/L)	AD-14	0.0006918	0.000357	0.004	No	11	0	No	0.01	Param.
Cadmium, total (mg/L)	AD-11	0.0004842	0.0002825	0.0065	No	11	0	No	0.01	Param.
Cadmium, total (mg/L)	AD-13	0.0005	0.000085	0.0065	No	11	36.36	No	0.006	NP (Cohens/xfrm)
Cadmium, total (mg/L)	AD-14	0.001367	0.0004472	0.0065	No	11	0	No	0.01	Param.
Chromium, total (mg/L)	AD-11	0.002504	0.0003169	0.1	No	11	0	x^(1/3)	0.01	Param.
Chromium, total (mg/L)	AD-13	0.004	0.000503	0.1	No	11	27.27	No	0.006	NP (Cohens/xfrm)
Chromium, total (mg/L)	AD-14	0.001127	0.0004973	0.1	No	11	18.18	No	0.01	Param.
Cobalt, total (mg/L)	AD-11	0.02727	0.01701	0.075	No	11	0	x^2	0.01	Param.
Cobalt, total (mg/L)	AD-13	0.008368	0.002991	0.075	No	11	0	No	0.01	Param.
Cobalt, total (mg/L)	AD-14	0.01236	0.004993	0.075	No	11	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-11	2.689	1.398	5	No	11	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-13	3.016	1.543	5	No	11	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-14	2.333	0.8758	5	No	11	0	x^(1/3)	0.01	Param.
Fluoride, total (mg/L)	AD-11	2	0.083	4	No	11	18.18	No	0.006	NP (normality)
Fluoride, total (mg/L)	AD-13	0.8099	0.2031	4	No	11	18.18	No	0.01	Param.
Fluoride, total (mg/L)	AD-14	0.083	0.083	4	No	11	90.91	No	0.006	NP (NDs)
Lead, total (mg/L)	AD-11	0.005	0.001183	0.015	No	11	63.64	No	0.006	NP (normality)
Lead, total (mg/L)	AD-13	0.005	0.001	0.015	No	11	63.64	No	0.006	NP (normality)
Lead, total (mg/L)	AD-14	0.005	0.000174	0.015	No	11	81.82	No	0.006	NP (NDs)
Lithium, total (mg/L)	AD-11	0.04493	0.02632	0.39	No	11	0	x^2	0.01	Param.
Lithium, total (mg/L)	AD-13	0.02679	0.0122	0.39	No	11	0	No	0.01	Param.
Lithium, total (mg/L)	AD-14	0.01421	0.01165	0.39	No	10	0	No	0.01	Param.
Mercury, total (mg/L)	AD-11	0.00002919	0.00001196	0.002	No	11	36.36	No	0.01	Param.
Mercury, total (mg/L)	AD-13	0.000025	0.00000673	0.002	No	11	54.55	No	0.006	NP (normality)
Mercury, total (mg/L)	AD-14	0.000145	0.00001863	0.002	No	11	9.091	No	0.006	NP (normality)
Molybdenum, total (mg/L)	AD-11	0.002	0.001519	0.1	No	11	81.82	No	0.006	NP (NDs)
Molybdenum, total (mg/L)	AD-13	0.002	0.0003533	0.1	No	11	72.73	No	0.006	NP (normality)
Molybdenum, total (mg/L)	AD-14	0.002	0.000497	0.1	No	11	81.82	No	0.006	NP (NDs)
Selenium, total (mg/L)	AD-11	0.005	0.0015	0.05	No	11	36.36	No	0.006	NP (normality)
Selenium, total (mg/L)	AD-13	0.005	0.00103	0.05	No	11	27.27	No	0.006	NP (Cohens/xfrm)
Selenium, total (mg/L)	AD-14	0.004435	0.002023	0.05	No	11	18.18	No	0.01	Param.
Thallium, total (mg/L)	AD-11	0.001317	0.0002	0.002	No	11	45.45	No	0.006	NP (normality)
Thallium, total (mg/L)	AD-13	0.0005	0.0005	0.002	No	11	81.82	No	0.006	NP (NDs)
Thallium, total (mg/L)	AD-14	0.0005	0.0005	0.002	No	11	90.91	No	0.006	NP (NDs)

Sanitas™ v.9.6.16 Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



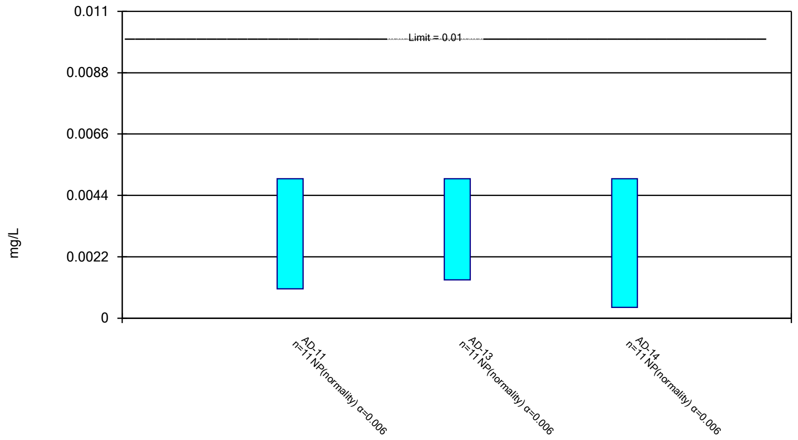
Constituent: Antimony, total Analysis Run 6/18/2019 9:32 AM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.16 Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



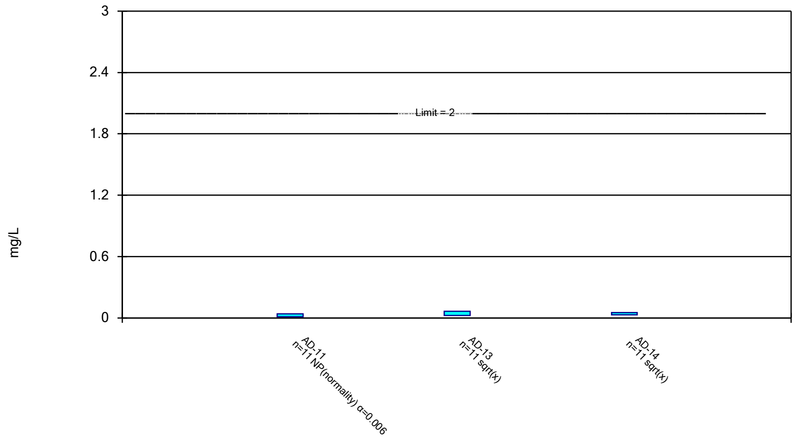
Constituent: Arsenic, total Analysis Run 6/18/2019 9:32 AM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.16 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



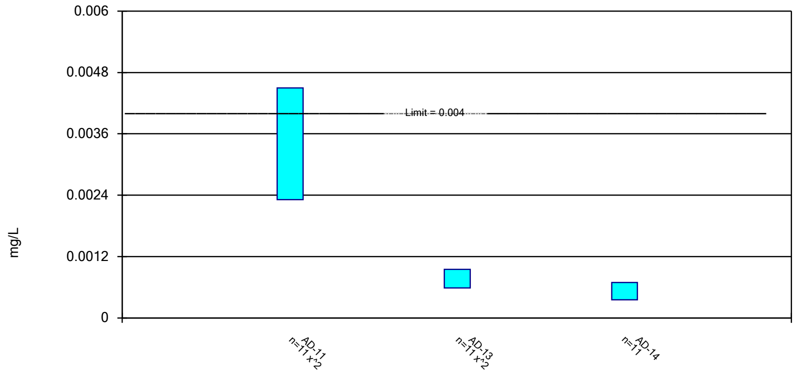
Constituent: Barium, total Analysis Run 6/18/2019 9:32 AM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.16 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

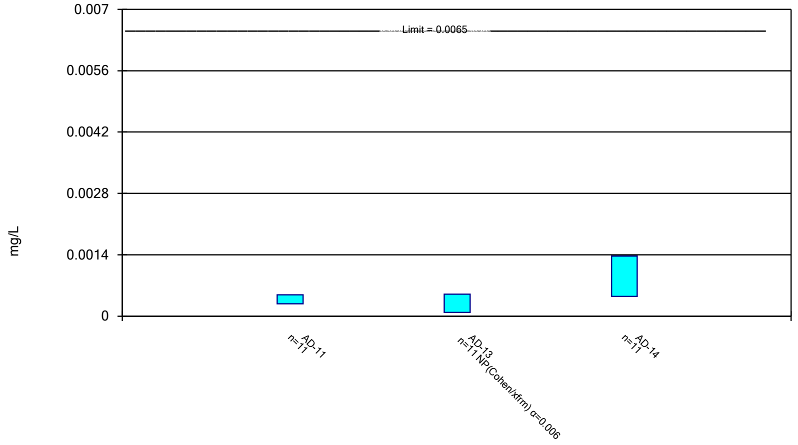


Constituent: Beryllium, total Analysis Run 6/18/2019 9:32 AM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

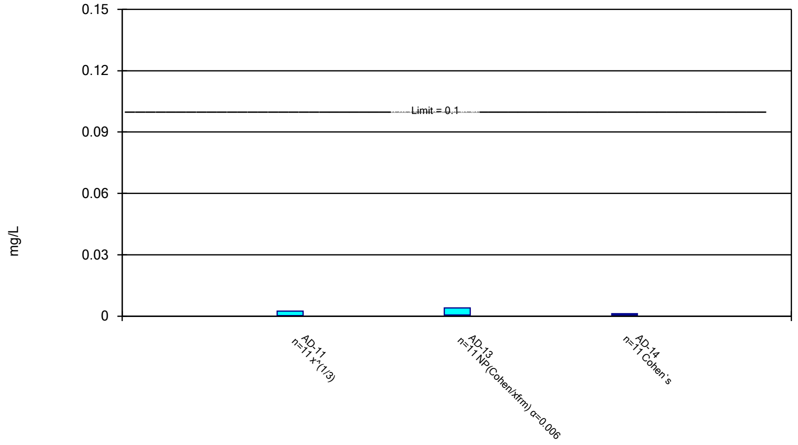


Constituent: Cadmium, total   Analysis Run 6/18/2019 9:32 AM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

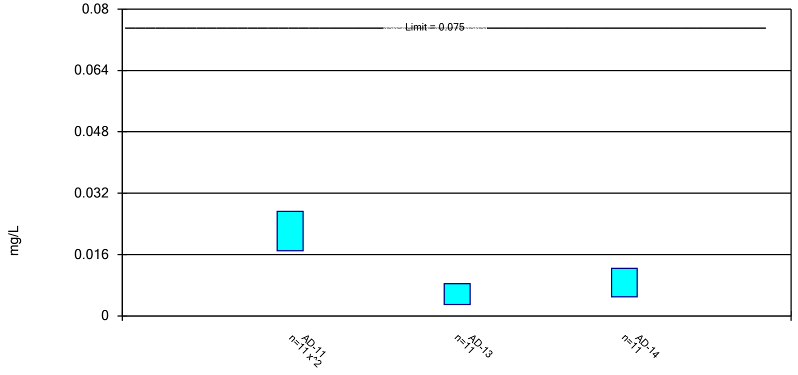


Constituent: Chromium, total   Analysis Run 6/18/2019 9:32 AM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

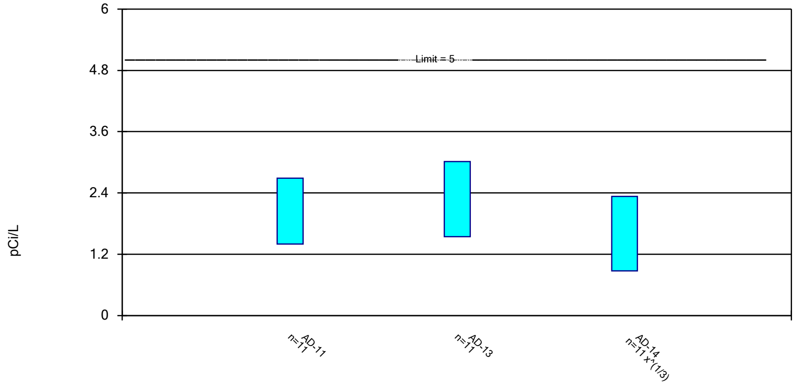


Constituent: Cobalt, total   Analysis Run 6/18/2019 9:32 AM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



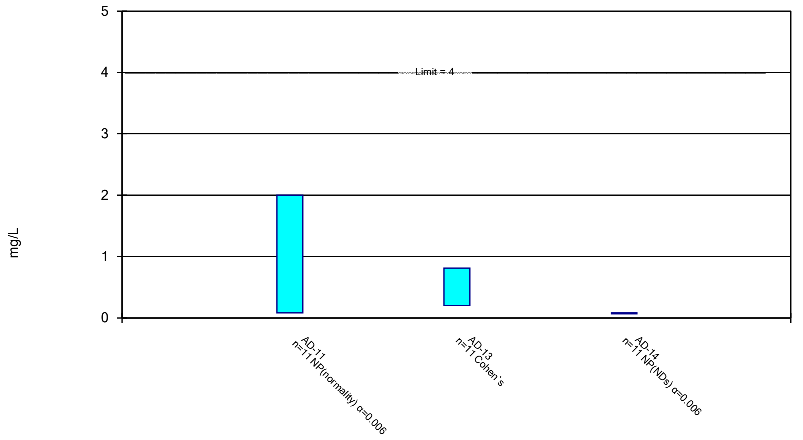
Constituent: Combined Radium 226 + 228   Analysis Run 6/18/2019 9:32 AM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.16 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

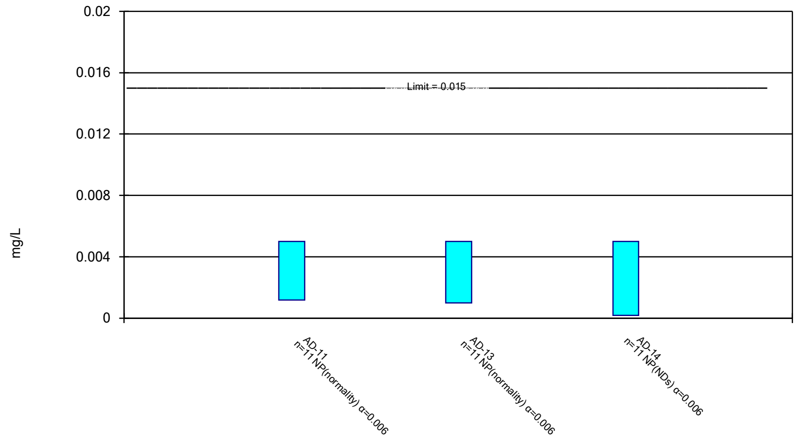


Constituent: Fluoride, total   Analysis Run 6/18/2019 9:32 AM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.16 Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

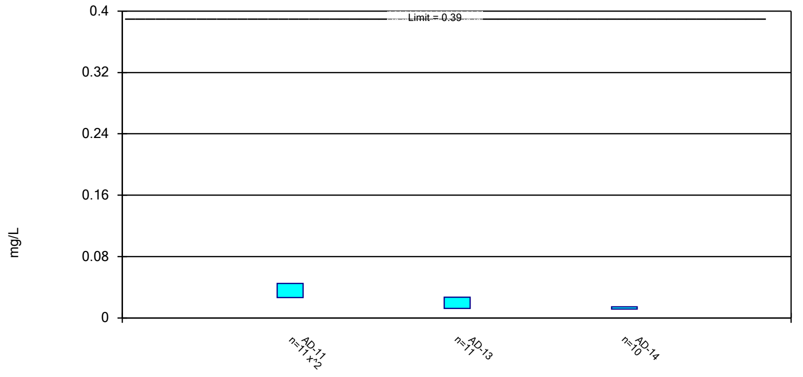


Constituent: Lead, total   Analysis Run 6/18/2019 9:32 AM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.16 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

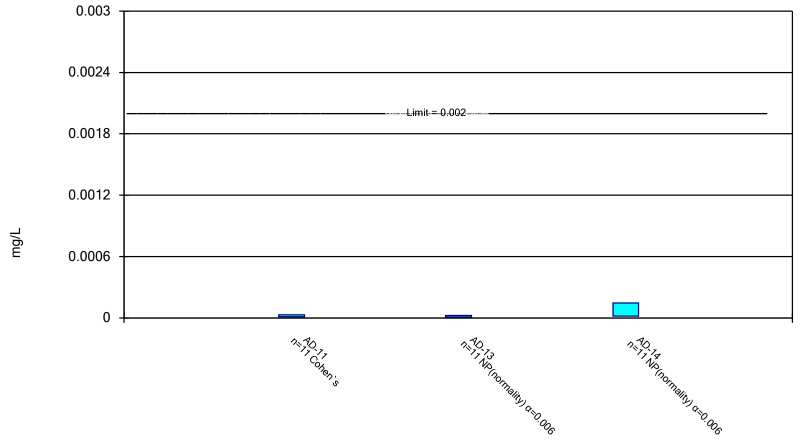


Constituent: Lithium, total   Analysis Run 6/18/2019 9:32 AM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.16 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

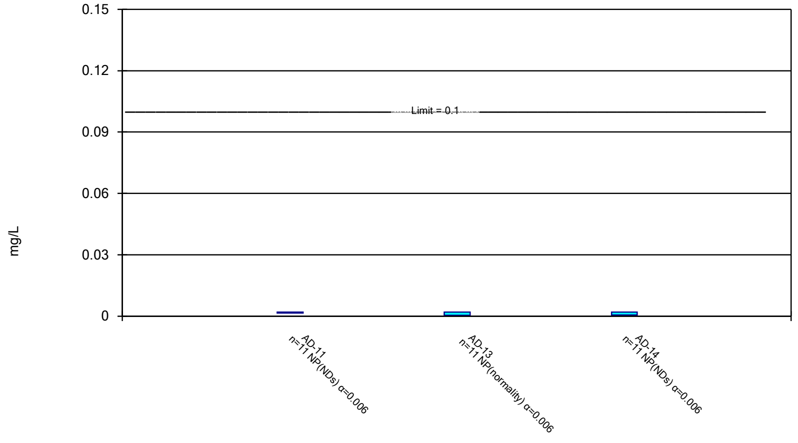


Constituent: Mercury, total   Analysis Run 6/18/2019 9:32 AM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.16 Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



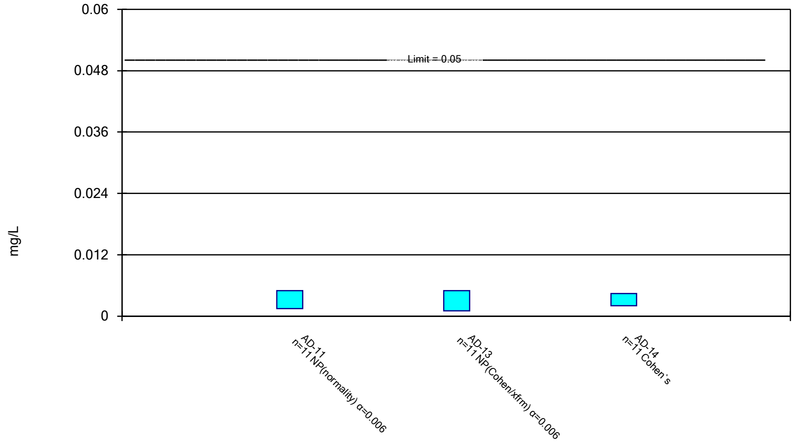
Constituent: Molybdenum, total   Analysis Run 6/18/2019 9:32 AM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.16 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



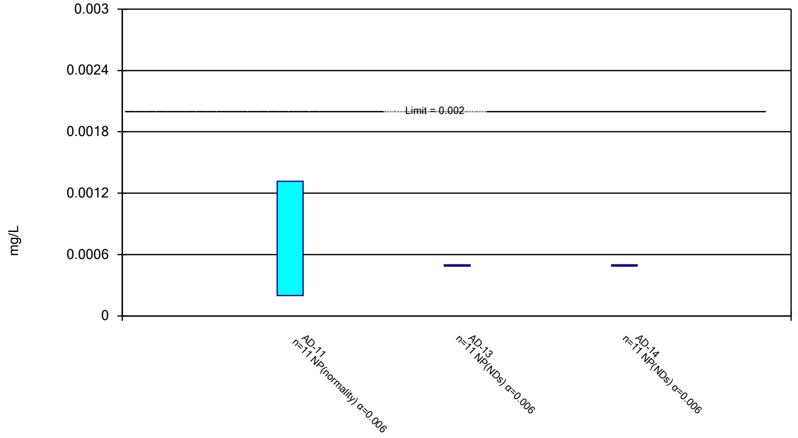
Constituent: Selenium, total   Analysis Run 6/18/2019 9:32 AM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.16 Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



Constituent: Thallium, total   Analysis Run 6/18/2019 9:33 AM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

STATISTICAL ANALYSIS SUMMARY
LANDFILL
J. Robert Welsh Plant
Pittsburg, Texas

Submitted to

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

December 16, 2019

CHA8473

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LF	Landfill
LFB	Laboratory Fortified Blanks
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Landfill (LF), an existing CCR unit at the Welsh Power Plant located in Pittsburg, Texas.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron, total dissolved solids (TDS), and sulfate at the LF. An alternative source was not identified at the time, so the LF has been in assessment monitoring since. Groundwater protection standards (GWPS) were set in accordance with 40 CFR 257.95(d)(2) and a statistical evaluation of the assessment monitoring data was conducted. During the most recent assessment monitoring event, completed in February 2019, no SSLs were identified during these events, and the unit remained in assessment monitoring. Two assessment monitoring events were conducted at the LF in May 2019 and July 2019, in accordance with 40 CFR 257.95(b) and (d), respectively. The results of these assessment events are documented in this report.

Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were re-established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at a statistically significant level (SSL) above the GWPS. No SSLs were identified.

Prediction limits were calculated for Appendix III parameters. When compared to the revised prediction limits, concentrations for boron and TDS remained above background. Thus, either the unit will remain in assessment monitoring or an alternative source demonstration (ASD) will be conducted to evaluate if the unit can return to detection monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

LANDFILL EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, two sets of samples were collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(b) (May 2019) and 257.95(d)(1) (July 2019). Samples from both sampling events were analyzed for the Appendix III and Appendix IV parameters. A summary of data collected during these assessment monitoring events may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.23 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the LF were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained in May and July 2019 were screened for potential outliers. No outliers were identified.

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in 40 CFR 257.95(h)(2) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events. Tolerance limits were calculated parametrically with 95% coverage and 95% confidence for barium, beryllium, and combined radium. Non-parametric tolerance limits were calculated for antimony, arsenic, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, and selenium due to apparent non-normal distributions and for thallium due to a high non-detect frequency. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

No SSLs were identified at the Welsh LF.

2.2.3 Establishment of Appendix III Prediction Limits

Upper prediction limits (UPL) were previously established for all Appendix III parameters following the background monitoring period (Geosyntec, 2018). Intrawell tests were used to evaluate potential SSIs for calcium, chloride, and pH, whereas interwell tests were used to evaluate potential SSIs for boron, fluoride, sulfate and TDS. While interwell prediction limits have been updated periodically during the assessment monitoring period as sufficient data became available, this represents the first update to the background dataset for parameters evaluated using intrawell tests.

Mann-Whitney (Wilcoxon rank-sum) tests were performed to determine whether the newer data are affected by a release from the LF. Because the interwell Appendix III limits and the Appendix IV GWPSs are based on data from upgradient wells which we would not expect to have been impacted by a release, these tests were used for intrawell Appendix III tests only. Mann-Whitney tests were used to compare the medians of historical data (May 2016 - June 2017) to the new compliance samples (October 2017 – February 2019) for calcium, chloride, and pH. Results were evaluated to determine if the medians of the two groups were similar at the 99% confidence level. Where no significant difference was found, the new compliance data were added to the background dataset. Where a statistically significant difference was found between the medians of the two groups, the data were reviewed to evaluate the cause of the difference and to determine if adding newer data to the background dataset, replacing the background dataset with the newer data, or continuing to use the existing background dataset was most appropriate. If the differences appeared to have been caused by a release, then the previous background dataset would have continued to be used.

The complete Mann-Whitney test results and a summary of the significant findings can be found in Appendix B. Significant differences were found between the two groups for chloride in upgradient well AD-5 at sulfate at downgradient well AD-11. However, because AD-5 is an upgradient monitoring well and more recent data are similar to background and better represent the groundwater quality upgradient of the facility, the background dataset was updated to include the compliance data for chloride at AD-5. Because concentrations for sulfate at downgradient well AD-11 are lower in the more recent sampling events, the background dataset was updated to include all available information, which will result in a more conservative prediction limit.

After the revised background set was established, a parametric or non-parametric analysis was selected based on the distribution of the data and the frequency of non-detect data. Estimated results less than the practical quantitation limit (PQL) – i.e., "J-flagged" data – were considered detections and the estimated results were used in the statistical analyses. Non-parametric analyses were selected for datasets with at least 50% non-detect data or datasets that could not be normalized. Parametric analyses were selected for datasets (either transformed or untransformed) that passed the Shapiro-Wilk / Shapiro-Francía test for normality. The Kaplan-Meier non-detect adjustment was applied to datasets with between 15% and 50% non-detect data. For datasets with fewer than 15% non-detect data, non-detect data were replaced with one half of the PQL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment B.

UPLs were updated using all the historical data through February 2019 to represent background values. LPLs were also updated for pH. The updated prediction limits are summarized in Table 3. Intrawell tests continued to be used to evaluate potential SSIs for calcium, chloride, TDS, and sulfate, whereas interwell tests continued to be used to evaluate potential SSIs for boron, fluoride, and pH. The UPLs were calculated for a one-of-two retesting procedure; i.e., if at least one sample in a series of two does not exceed the UPL, then it can be concluded that an SSI has not occurred. In practice, where the initial result did not exceed the UPL, a second sample was not collected. The retesting procedures allowed achieving an acceptably high statistical power to detect changes at downgradient wells for constituents evaluated using intrawell prediction limits.

2.2.4 Evaluation of Potential Appendix III SSIs

The CCR rule allows CCR units to move from assessment monitoring to detection monitoring if all Appendix III and Appendix IV parameters were at or below background levels for two consecutive sampling events [40 CFR 257.95(e)]. Since no Appendix IV SSLs were identified, Appendix III results were analyzed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations.

Data collected during the May 2019 and July 2019 assessment monitoring events from each compliance well were compared to the prediction limits to evaluate results above background values. The results from these events and the prediction limits are summarized in Table 4. The following exceedances of the upper prediction limits (UPLs) were noted:

- Boron concentrations exceeded the interwell UPL of 0.700 mg/L at AD-11 (1.56 mg/L), AD-13 (0.780 mg/L), and AD-14 (1.25 mg/L)

- The TDS concentration at AD-14 exceeded the intrawell UPL of 369 mg/L at AD-14 (440 mg/L).

The results from June 2019 each represent the initial sampling for a detection monitoring event. While the prediction limits were calculated assuming one-of-two testing procedures, it was conservatively assumed that an SSI was identified if the initial sample exceeded the UPL or was below the pH LPL during each event. Based on these results, concentrations of Appendix III parameters exceeded background levels at compliance wells at the Welsh LF during assessment monitoring.

2.3 Conclusions

A semi-annual assessment monitoring event was conducted in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the May and July 2019 data. GWPSs were re-established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPS. No SSLs were identified.

Revised prediction limits were calculated for Appendix III parameters. Intrawell tests were used to evaluate potential SSIs for calcium, chloride, TDS, and sulfate, whereas interwell tests were used to evaluate potential SSIs for boron, fluoride, and pH. Prediction limits were recalculated using a one-of-two retesting procedure. The Appendix III results were evaluated to assess whether concentrations of Appendix III parameters exceeded background levels. Boron and TDS results exceeded background levels.

Based on this evaluation, either the Welsh LF CCR unit will remain in assessment monitoring or an ASD will be conducted to evaluate if the unit can return to detection monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Welsh Plant. January 2017.

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – Landfill, J. Robert Welsh Plant, Pittsburg, Texas. January 15, 2018.

TABLES

Table 1 - Groundwater Data Summary
Welsh - Landfill

Component	Unit	AD-1		AD-5		AD-11		AD-13		AD-14		AD-17	
		5/30/2019	7/24/2019	5/30/2019	7/24/2019	5/29/2019	7/23/2019	5/30/2019	7/23/2019	5/29/2019	7/23/2019	5/30/2019	7/24/2019
Antimony	µg/L	0.160	0.080 J	0.100 U	0.100 U	0.100 U	0.100 U	0.030 J	0.020 J	0.030 J	0.100 U	0.100 U	0.100 U
Arsenic	µg/L	0.600	0.390	3.05	2.48	0.780	0.590	0.320	0.370	0.400	0.430	0.410	1.07
Barium	µg/L	512	245	60.5	77.4	19.1	16.4	60.9	23.6	44.8	36.2	19.6	14.3
Beryllium	µg/L	0.244	0.540	0.080 J	0.050 J	1.05	0.987	0.385	0.443	0.556	0.934	0.020 J	0.130
Boron	mg/L	0.689	0.644	0.030 J	0.040 J	1.40	1.56	0.477	0.780	1.21	1.25	0.158	0.113
Cadmium	µg/L	0.010 J	0.020 J	0.050 U	0.050 U	0.200	0.240	0.07	0.09	0.810	2.49	0.030 J	0.030 J
Calcium	mg/L	138	62.7	30.0	41.1	5.78	7.19	9.88	6.16	9.80	9.93	202	216
Chloride	mg/L	1.59	2.00	22.3	18.0	6.96	6.00	3.60	5.00	3.65	8.00	41.7	37.0
Chromium	µg/L	0.100 J	0.100 J	0.060 J	0.050 J	0.369	0.413	0.310	0.283	0.200 J	0.286	0.246	0.228
Cobalt	µg/L	0.756	0.789	11.8	8.38	9.82	10.5	3.15	3.82	7.82	18.5	51.1	57.7
Combined Radium	pCi/L	2.72	1.82	1.43	2.53	1.47	2.25	3.15	1.75	1.95	2.73	2.51	3.45
Fluoride	mg/L	0.290	0.106 J	0.290	0.112 J	0.470	0.338 J	0.530	0.169 J	0.190	0.162 J	0.200 U	0.085 J
Lead	µg/L	0.197	0.100 J	0.0500 J	0.200 U	0.847	0.976	0.050 J	0.204	0.137	0.200	0.030 J	0.263
Lithium	mg/L	0.030 U	0.006	0.104	0.108	0.020 J	0.015	0.009 J	0.018	0.020 J	0.016	0.341	0.283
Mercury	mg/L	0.0000250 U	0.0000250 U	0.00000600 J	0.0000250 U	0.0000250 U	0.0000250 U	0.0000250 U	0.0000250 U	0.000181	0.000123	0.0000250 U	0.0000250 U
Molybdenum	µg/L	2.43	2.00 J	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
Selenium	µg/L	1.40	3.40	0.050 J	0.060 J	2.20	1.00	0.400	0.300	2.00	2.70	0.060 J	0.100 J
Total Dissolved Solids	mg/L	588	180	238	354	680	700	196	334	274	440	1550	1860
Sulfate	mg/L	43.3	58.0	51.3	90.0	367	342	94.0	146	122	171	1120	1130
Thallium	µg/L	0.500 U	0.500 U	0.500 U	0.500 U	0.100 J	0.200 J	0.500 U	0.100 J	0.500 U	0.200 J	0.500 U	0.500 U
pH	SU	6.7	6.0	6.3	6.3	4.2	4.5	5.2	4.8	4.5	5.5	6.1	6.0

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Parameter was not present in concentrations above the method detection limit and is reported as the reporting limit
J: Estimated value. Parameter was detected in concentrations below the reporting limit

Table 2: Groundwater Protection Standards
Welsh Plant - Landfill

Constituent Name	MCL	CCR Rule-Specified	Calculated UTL
Antimony, Total (mg/L)	0.006		0.003
Arsenic, Total (mg/L)	0.01		0.005
Barium, Total (mg/L)	2		0.62
Beryllium, Total (mg/L)	0.004		0.00079
Cadmium, Total (mg/L)	0.005		0.0065
Chromium, Total (mg/L)	0.1		0.004
Cobalt, Total (mg/L)	n/a	0.006	0.075
Combined Radium, Total (pCi/L)	5		4.11
Fluoride, Total (mg/L)	4		0.583
Lead, Total (mg/L)	n/a	0.015	0.003
Lithium, Total (mg/L)	n/a	0.04	0.39
Mercury, Total (mg/L)	0.002		0.000033
Molybdenum, Total (mg/L)	n/a	0.1	0.002
Selenium, Total (mg/L)	0.05		0.005
Thallium, Total (mg/L)	0.002		0.001

Notes:

Grey cell indicates calculated UTL is higher than MCL or CCR Rule-specified value.

MCL = Maximum Contaminant Level

Calculated UTL (Upper Tolerance Limit) represents site-specific background values.

The higher of the calculated UTL or MCL/Rule-Specified Level is used as the GWPS.

Table 3: Revised Prediction Limits
Welsh Plant - Landfill

Parameter	Unit	Description	AD-11	AD-13	AD-14
Boron	mg/L	Interwell Background Value (UPL)	0.700		
Calcium	mg/L	Intrawell Background Value (UPL)	17.1	28.4	12.2
Chloride	mg/L	Intrawell Background Value (UPL)	14.3	24.0	11.5
Fluoride	mg/L	Interwell Background Value (UPL)	0.583		
pH	SU	Interwell Background Value (UPL)	7.1		
		Interwell Background Value (LPL)	4.3		
Sulfate	mg/L	Intrawell Background Value (UPL)	829	422	189
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	1330	881	369

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit

Table 4: Appendix III Data Summary
Welsh - Landfill

Parameter	Unit	Description	AD-11		AD-13		AD-14	
			5/29/2019*	7/23/2019	5/30/2019*	7/23/2019	5/29/2019*	7/23/2019
Boron	mg/L	Interwell Background Value (UPL)	0.700					
		Detection Monitoring Result	1.40	**1.56**	0.477	**0.780**	1.21	**1.25**
Calcium	mg/L	Intrawell Background Value (UPL)	17.1		28.4		12.2	
		Detection Monitoring Result	5.78	7.19	9.88	6.16	9.80	9.93
Chloride	mg/L	Intrawell Background Value (UPL)	14.3		24.0		11.5	
		Detection Monitoring Result	6.96	6.00	3.60	5.00	3.65	8.00
Fluoride	mg/L	Interwell Background Value (UPL)	0.583					
		Detection Monitoring Result	0.470	0.338	0.530	0.169	0.190	0.162
pH	SU	Interwell Background Value (UPL)	7.1					
		Interwell Background Value (LPL)	4.3					
		Detection Monitoring Result	4.2	4.5	5.2	4.8	4.5	5.5
Sulfate	mg/L	Intrawell Background Value (UPL)	829		422		189	
		Detection Monitoring Result	367	342	94.0	146	122	171
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	1330		881		369	
		Detection Monitoring Result	680	700	196	334	274	**440**

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
*257.95(b) results not used to determine SSI

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Welsh Landfill CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

DAVID ANTHONY MILLER
112498

112498

License Number

TEXAS

Licensing State

12.17.19

Date

American Electric Power
Service Corporation
Texas Registered
Engineering Firm No.
F-3341

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

December 8, 2019

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Welsh Landfill - Assessment Monitoring Event & Background Update 2019

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the statistical analysis and background update of groundwater data for American Electric Power Inc.'s Welsh Landfill. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at the site for the CCR program in 2016. Below is a list of the monitoring well network, as provided by Geosyntec Consultants. Note that originally the network included upgradient well AD-18; however, further research, reportedly, identified that this well was not providing adequate representation of the groundwater quality upgradient of this site and exhibited different chemical properties from the neighboring upgradient wells. Therefore, data from this well is no longer included in the statistical analysis.

- **Upgradient wells:** AD-1, AD-5, and AD-17
- **Downgradient wells:** AD-11, AD-13 and AD-14

Data were sent electronically, and the statistical analysis was reviewed by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC. The analysis was conducted according to the Statistical Analysis Plan prepared by GSC and approved by Dr. Cameron.

The CCR program consists of the following constituents:

- **Appendix III** (Detection Monitoring) - boron, calcium, chloride, fluoride, pH, sulfate, and TDS;
- **Appendix IV** (Assessment Monitoring) – antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells. Values flagged as outliers may be seen in the Outlier Summary following this letter (Figure C). These values are plotted in a lighter font and disconnected symbol on the time series graphs.

Summary of Statistical Method:

1) Intrawell prediction limits, combined with a 1-of-2 resample plan for calcium, chloride, sulfate and TDS; and
2) Interwell prediction limits combined with a 1-of-2 resample plan for boron, fluoride and pH.

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are nondetects, a nonparametric test is utilized. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% nondetects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for nondetects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean

and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% nondetects.

Summary of Background Screening Conducted December 2017

Appendix III – Determination of Spatial Variation

The Analysis of Variance (ANOVA) was used to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying the most appropriate statistical approach. Interwell tests, which compare downgradient well data to statistical limits constructed from pooled upgradient well data, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation; when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter.

The ANOVA identified variation for the following Appendix III parameters: boron, calcium, chloride, sulfate and TDS suggesting intrawell methods should be considered. No differences were noted for fluoride and pH; therefore, these parameters are eligible for interwell prediction limits. Boron, calcium, chloride, sulfate and TDS data were further evaluated as described below for the appropriateness of intrawell testing to accommodate the groundwater quality. A summary table of the ANOVA results was included with the reports.

Appendix III - Statistical Limits

Intrawell limits constructed from carefully screened background data from within each well serve to provide statistical limits that are conservative (i.e. lower) from a regulatory perspective, and will rapidly identify a change in more recent compliance data from within a given well. This statistical method removes the element of variation from across wells and eliminates the chance of mistaking natural spatial variation for a release from the facility. Prior to performing intrawell prediction limits, several steps are required to reasonably demonstrate downgradient water quality does not have existing impacts from the practices of the facility.

Exploratory data analysis was used as a general comparison of concentrations in downgradient wells for all Appendix III parameters recommended for intrawell analyses to concentrations reported in the upgradient well. Upper tolerance limits are used in conjunction with confidence intervals to determine whether the estimated averages in downgradient wells are higher than observed levels upgradient of the facility. The upper tolerance limits were constructed to represent the extreme upper range of possible background levels at the site.

In cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to justify an intrawell approach. Such an assessment is beyond the scope of services provided by Groundwater Stats Consulting. When there is not an obvious explanation for observed concentration differences in downgradient wells relative to reported concentrations in the upgradient well, interwell prediction limits will initially be selected for the statistical method until further evidence shows that concentrations are due to natural variation rather than a result of the facility.

Parametric tolerance limits were constructed with a target of 99% confidence and 95% coverage using upgradient well data for each of the Appendix III parameters. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. As more data are collected, the background population is better represented and the confidence and coverage levels increase.

Confidence intervals were constructed on downgradient wells for each of the Appendix III parameters, using the tolerance limits discussed above, to determine intrawell eligibility. When the entire confidence interval is above a background standard for a given parameter, interwell methods are initially recommended as the statistical method. Therefore, only parameters with confidence intervals which did not exceed background standards are eligible for intrawell prediction limits.

Confidence intervals for the above parameters were found to be within their respective background limit for all parameters except boron. Therefore, intrawell methods are recommended for calcium, chloride, sulfate and TDS; and interwell methods are initially recommended for boron, fluoride and pH. As mentioned earlier, if a demonstration supports natural variation in groundwater, intrawell methods will be considered for all parameters.

All available data through June 2017 at each well were used to establish intrawell background limits for the parameters identified above based on a 1-of-2 resample plan that will be used for future comparisons. Interwell prediction limits, combined with a 1-of-2 resample plan, were constructed from upgradient wells AD-1, AD-5 and AD-17.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits will be necessary to accommodate these types of changes In the interwell case, newer data will be included in background during each subsequent event after careful screening for new outliers. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

November 2019 - Background Update

Data were re-evaluated using Tukey’s outlier test and visual screening with the February 2019 samples. Boron, fluoride and pH are tested using interwell prediction limits and, therefore, pooled upgradient wells were tested for outliers for these constituents (Figure C). All other Appendix III parameters, which use intrawell prediction limits, were tested for outliers at each well (Figure C). Tukey’s test did not identify any outliers except for Chromium AD-13. The following values were not identified as outliers by Tukey’s test; However, these values were flagged as outliers in the database because they do not appear to represent the population at these wells: chromium, fluoride, and thallium in well AD-11.

For constituents requiring intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through June 2017 to the new compliance samples at each well through February 2019 to evaluate whether the groups are statistically different at the 99% confidence level, in which case background data may not be updated with more recent compliance data (Figure D). Statistically significant differences were found for chloride in upgradient well AD-5, with the median of the more recent group of data slightly higher than the background median. Additionally, a significant difference was noted for sulfate in downgradient well AD-11, with the median of the more recent group of data slightly lower than the background median.

Typically, when the test concludes that the medians of the two groups are significantly different, particularly in the downgradient wells, the background are not updated to include the newer data but will be reconsidered in the future. Chloride, however, was updated to include more recent data in upgradient well AD-5 as those data represent groundwater quality upgradient of the facility. In the case of sulfate, while concentrations have decreased over the entire record, background was updated to include all data through February 2019. In both cases, limited data are currently available but all data will be reevaluated during the next background update, and earlier measurements will be deselected if they no longer represent present-day groundwater quality. A summary of these results follows this letter and the test results are included with the Mann Whitney test section at the end of this report.

Intrawell prediction limits using all historical data reported through February 2019, combined with a 1-of-2 resample plan, were constructed and a summary of the updated limits follows this letter (Figure E).

The Sen's Slope/Mann Kendall trend test was used to evaluate data at upgradient wells for fluoride to identify statistically significant increasing or decreasing trends. The results of the trend analyses showed all data are consistent over time with no statistically significant increasing or decreasing trends (Figure F).

Interwell prediction limits, combined with a 1-of-2 resample plan, were updated using all available data from upgradient wells for the same time period for fluoride (Figure G). Interwell prediction limits pool upgradient well data to establish a background limit for an individual constituent. A summary table of the updated limits may be found following this letter in the Prediction Limit Summary Tables.

Evaluation of Appendix IV Parameters

Interwell Tolerance limits were used to calculate background limits from all available pooled upgradient well data for Appendix IV parameters to determine the Alternate Contaminant Level (ACL) for each constituent (Figure H). Background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits. Any flagged values may be seen on the Outlier Summary following this letter.

Parametric limits use a target of 95% confidence and 95% coverage. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and CCR-Rule specified levels in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure I).

Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters using the highest limit of either the MCL, CCR-rule specified, or ACL as discussed above (Figure J). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No confidence intervals exceedances were found for any of the downgradient wells. A summary of the confidence interval results follows this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Welsh Landfill. If you have any questions or comments, please feel free to contact me.

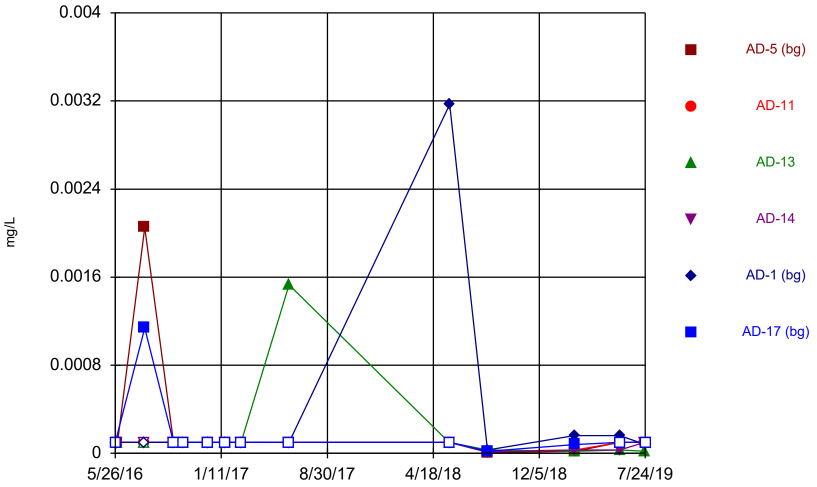
For Groundwater Stats Consulting,

Kristina Rayner

Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



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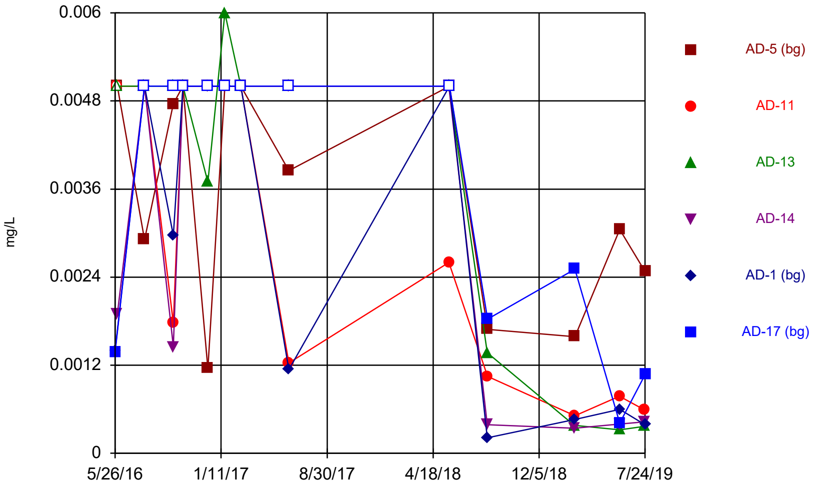
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



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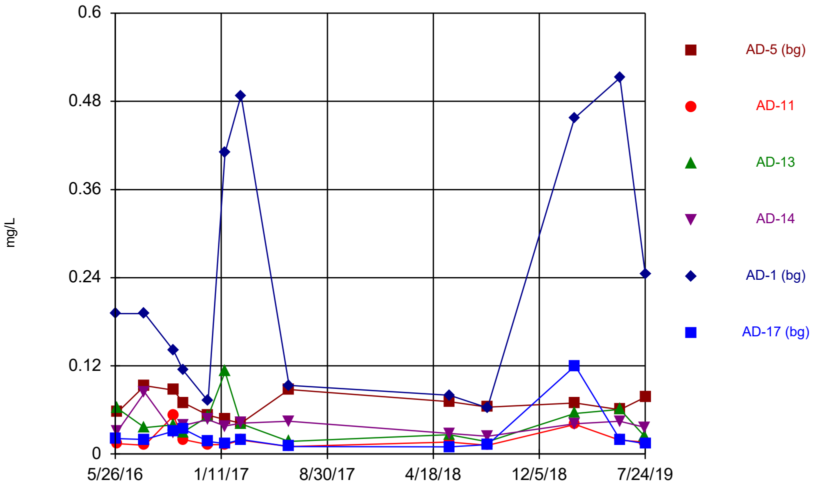
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Time Series



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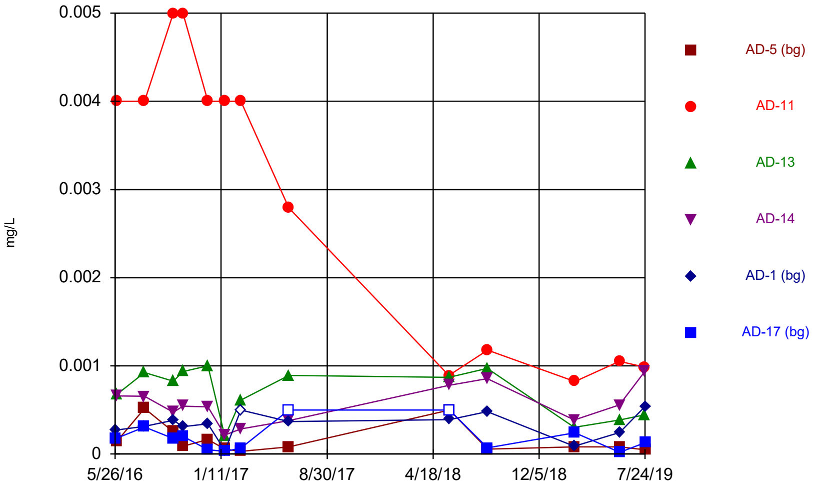
Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

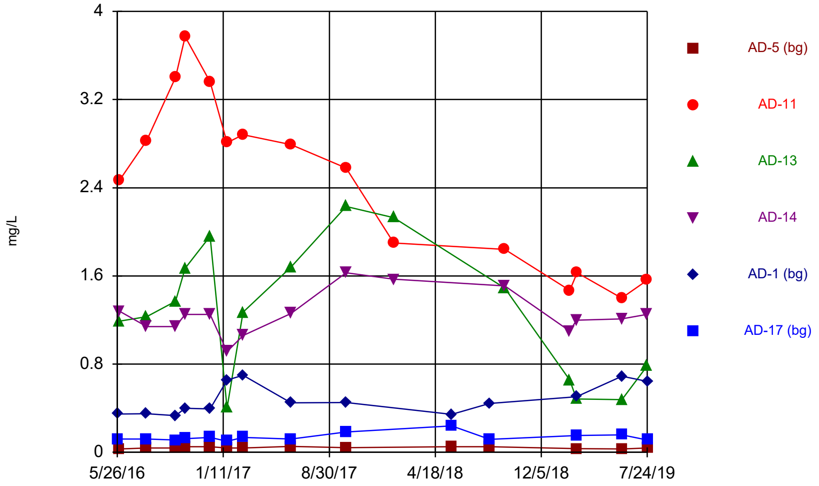
Time Series



Constituent: Beryllium, total Analysis Run 12/5/2019 12:32 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

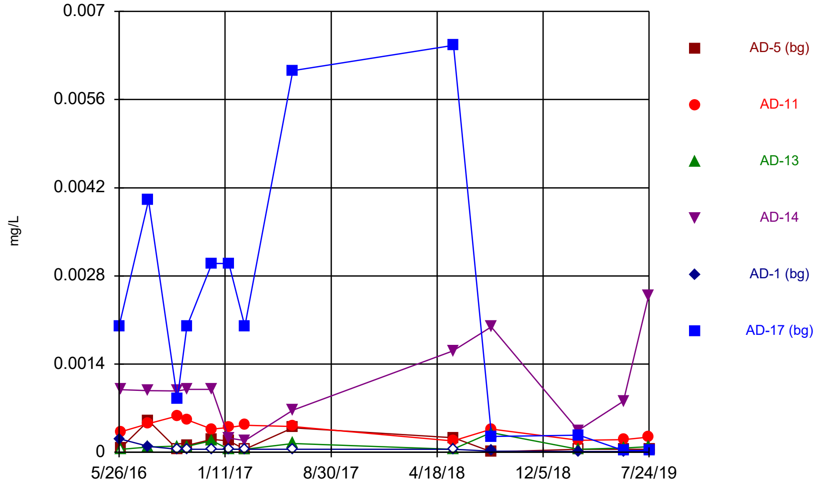
Time Series



Constituent: Boron, total Analysis Run 12/5/2019 12:32 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

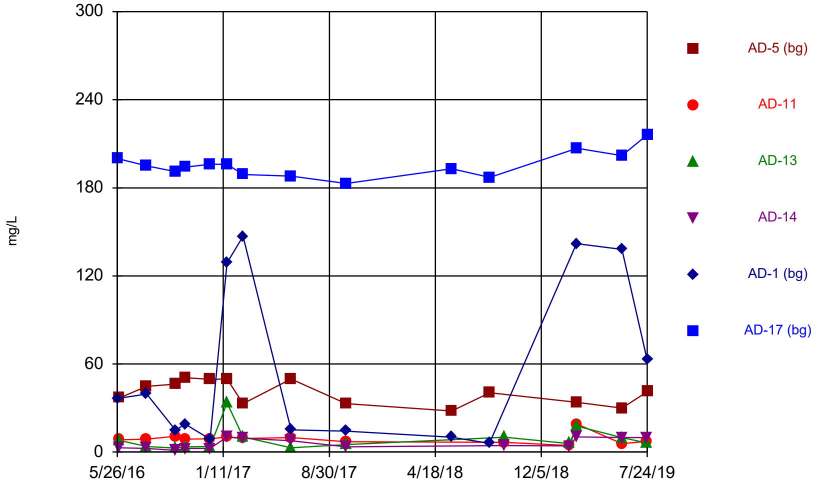
Time Series



Constituent: Cadmium, total Analysis Run 12/5/2019 12:32 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

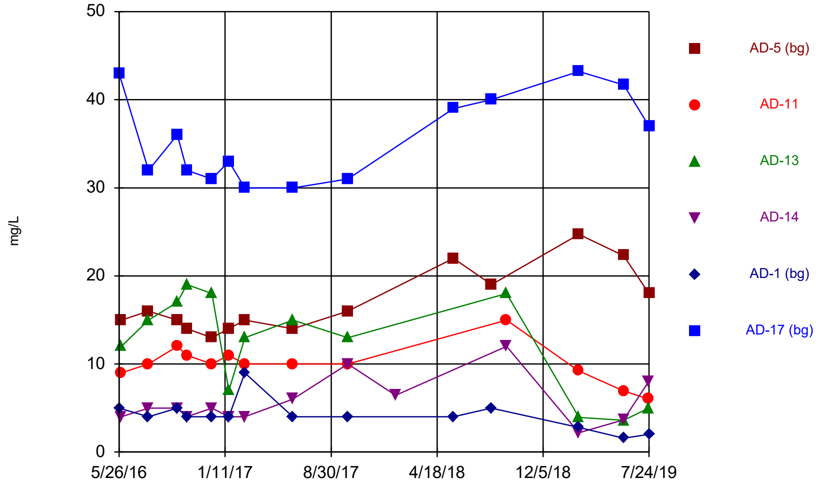
Time Series



Constituent: Calcium, total Analysis Run 12/5/2019 12:32 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

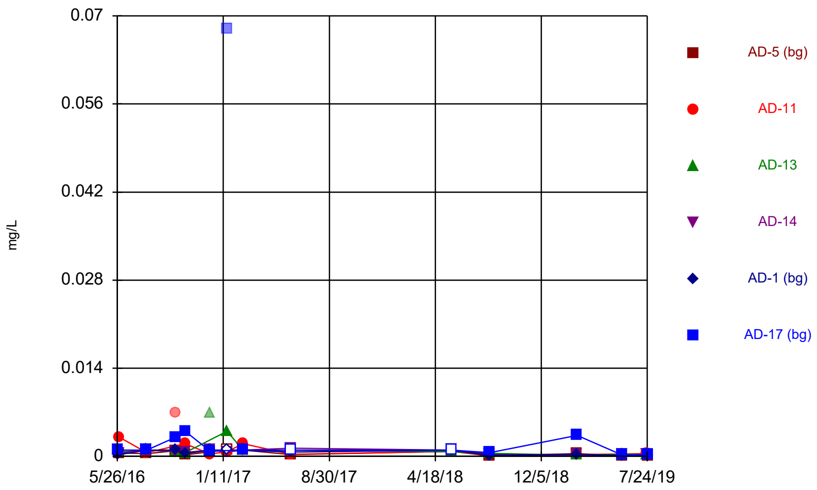
Time Series



Constituent: Chloride, total Analysis Run 12/5/2019 12:32 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

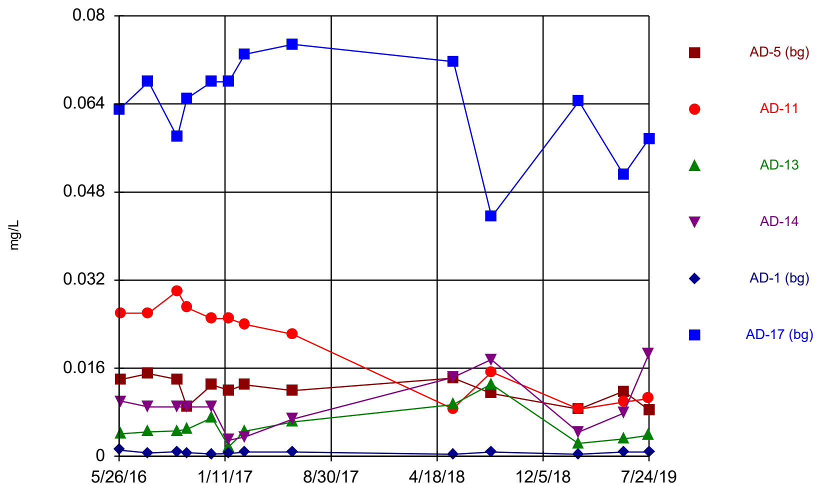
Time Series



Constituent: Chromium, total Analysis Run 12/5/2019 12:32 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

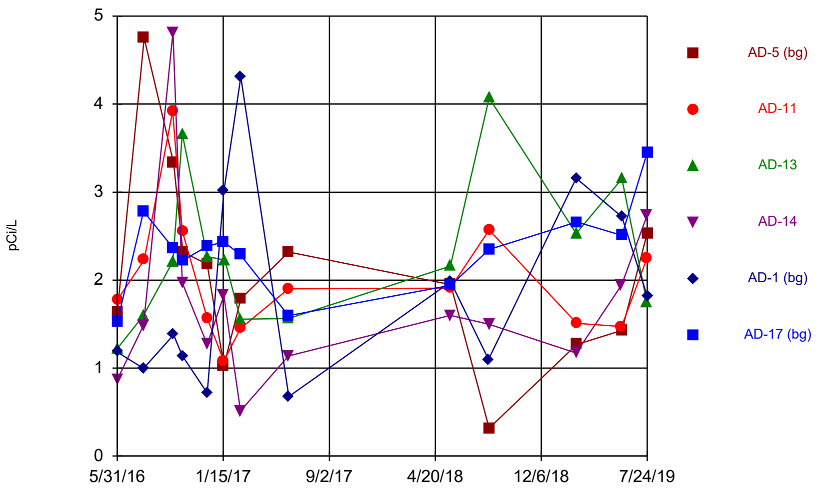
Time Series



Constituent: Cobalt, total Analysis Run 12/5/2019 12:32 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

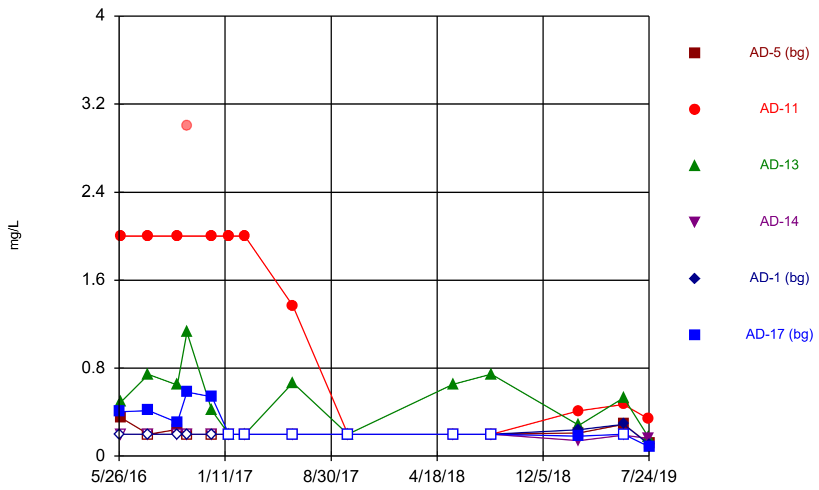
Time Series



Constituent: Combined Radium 226 + 228 Analysis Run 12/5/2019 12:32 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

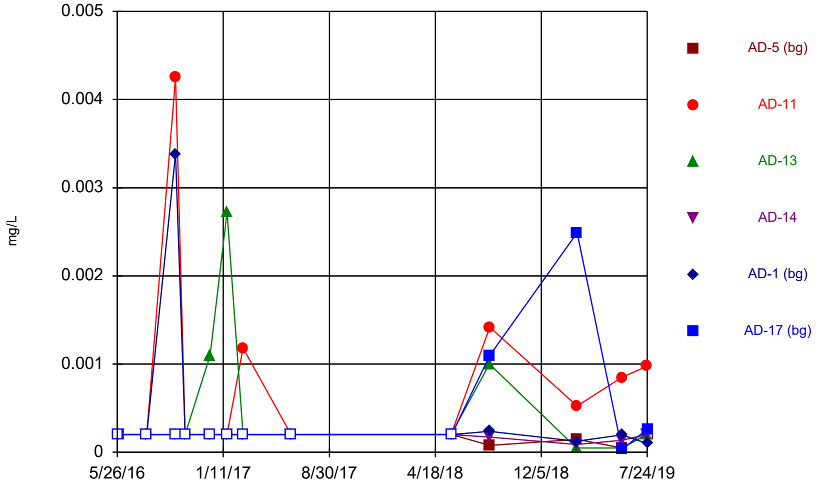
Time Series



Constituent: Fluoride, total Analysis Run 12/5/2019 12:32 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

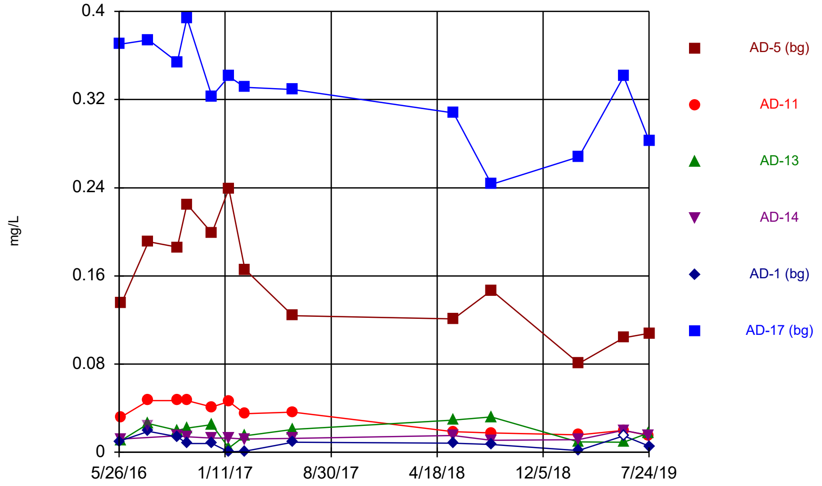
Time Series



Constituent: Lead, total   Analysis Run 12/5/2019 12:32 PM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

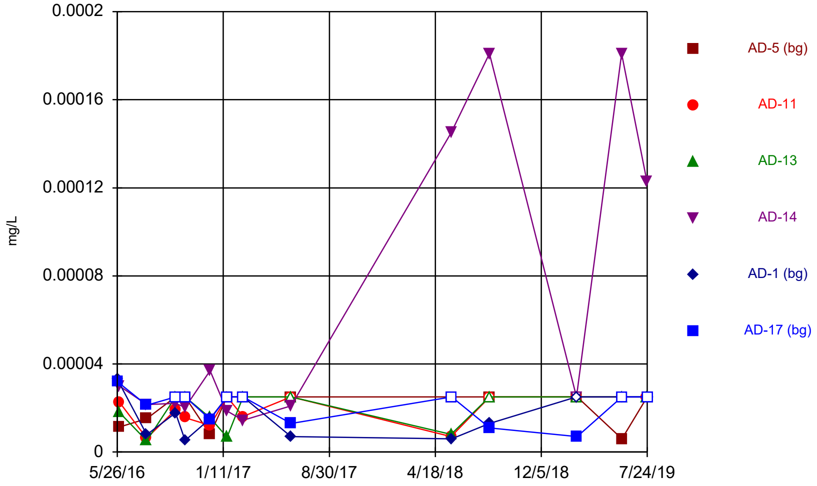
Time Series



Constituent: Lithium, total   Analysis Run 12/5/2019 12:32 PM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

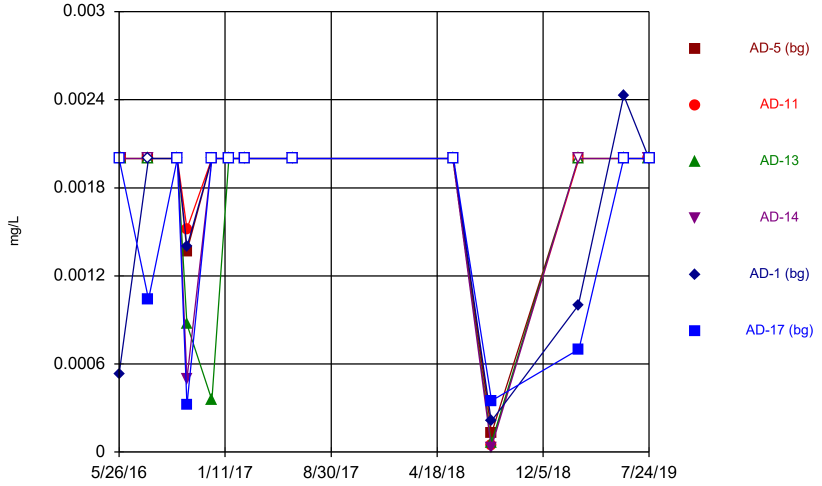
Time Series



Constituent: Mercury, total   Analysis Run 12/5/2019 12:32 PM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

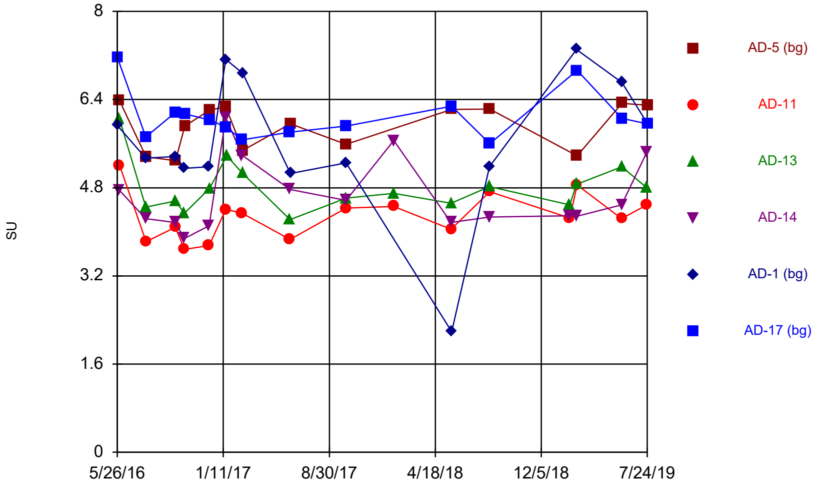
Time Series



Constituent: Molybdenum, total   Analysis Run 12/5/2019 12:32 PM   View: Descriptive
Welsh LF   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

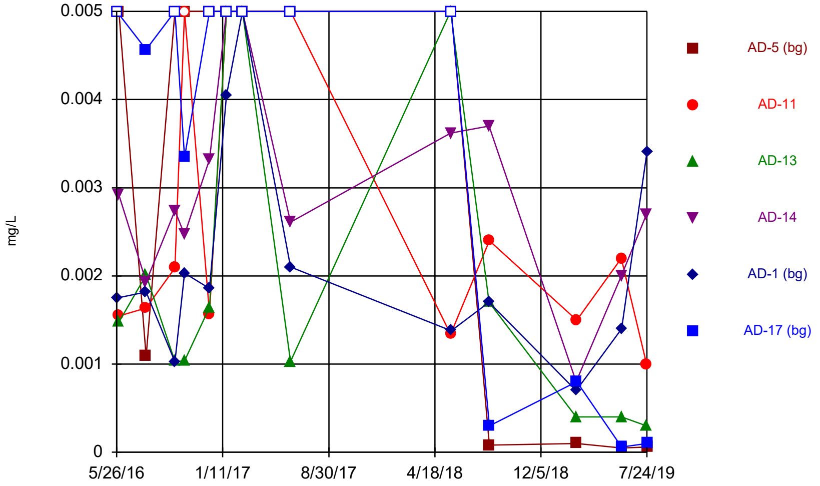
Time Series



Constituent: pH, field Analysis Run 12/5/2019 12:32 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

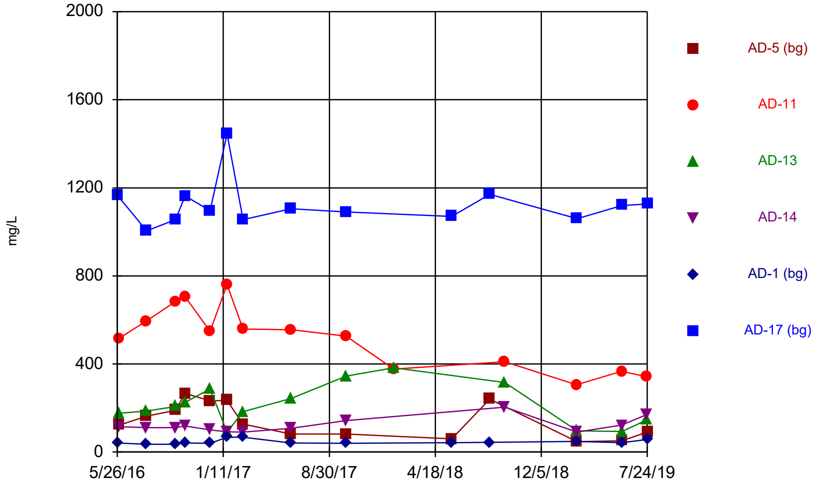
Time Series



Constituent: Selenium, total Analysis Run 12/5/2019 12:32 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

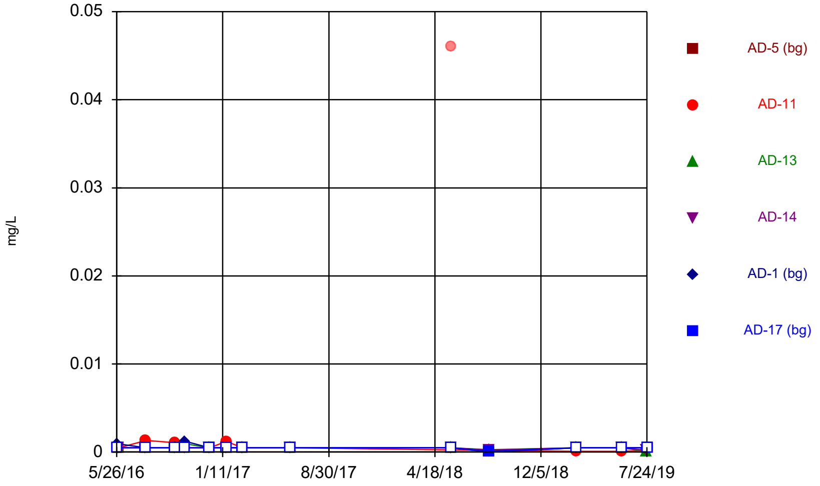
Time Series



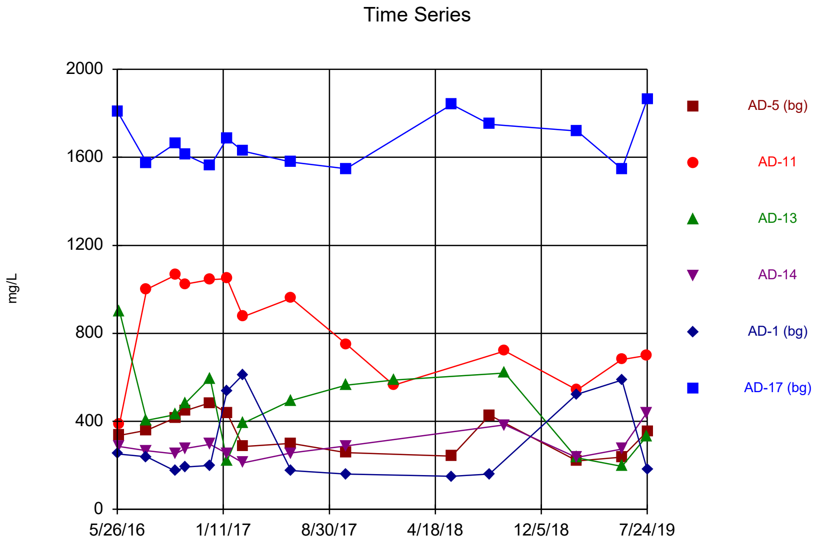
Constituent: Sulfate, total Analysis Run 12/5/2019 12:32 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series

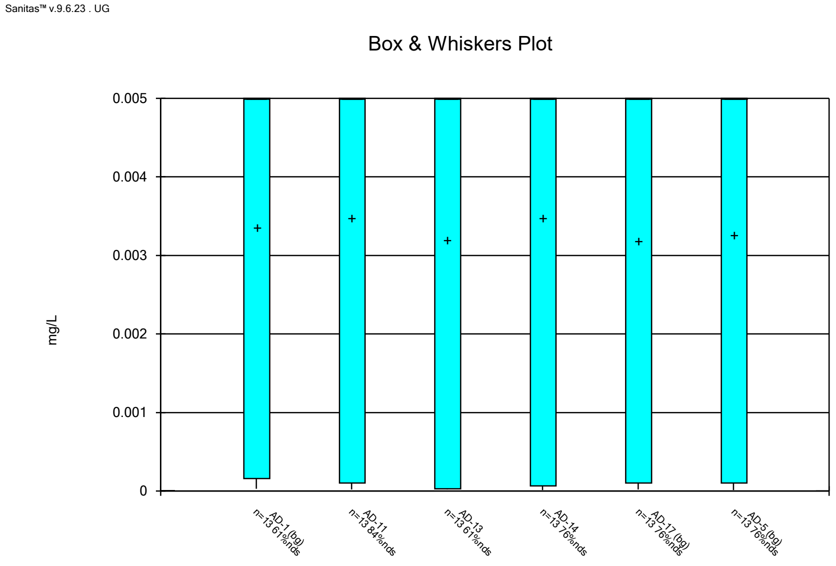


Constituent: Thallium, total Analysis Run 12/5/2019 12:32 PM View: Descriptive
Welsh LF Client: Geosyntec Data: Welsh LF



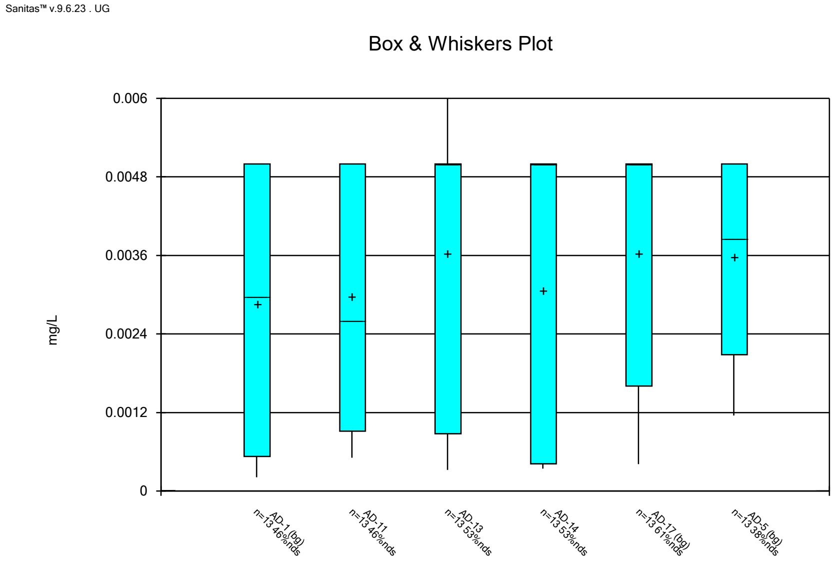
Constituent: Total Dissolved Solids   Analysis Run 12/5/2019 12:32 PM   View: Descriptive

Welsh LF   Client: Geosyntec   Data: Welsh LF



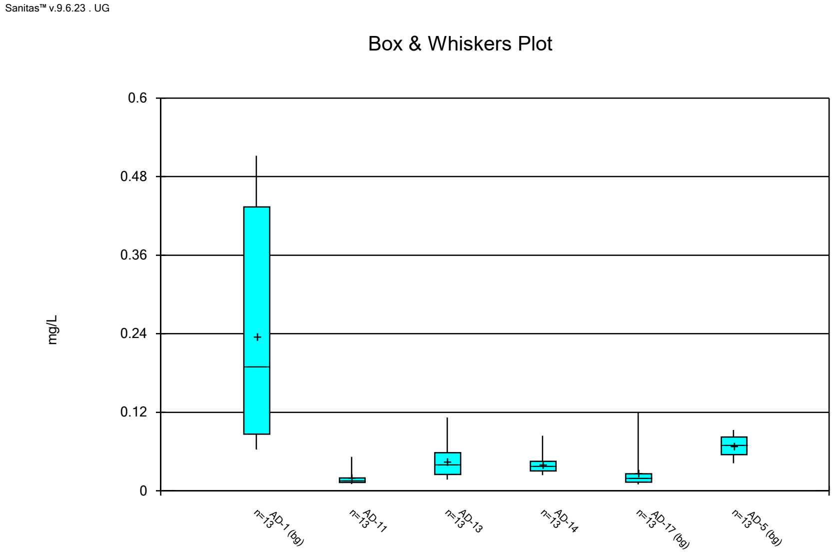
Constituent: Antimony, total   Analysis Run 11/22/2019 5:25 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF



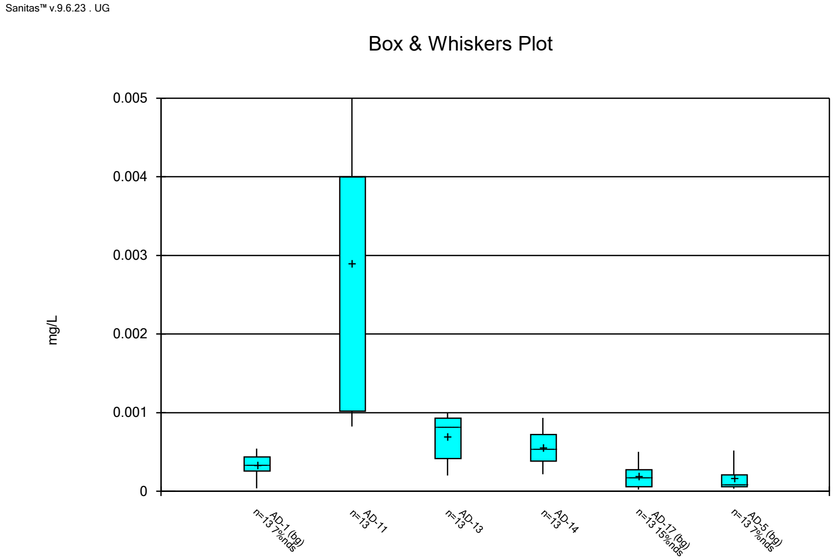
Constituent: Arsenic, total   Analysis Run 11/22/2019 5:25 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF



Constituent: Barium, total   Analysis Run 11/22/2019 5:25 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

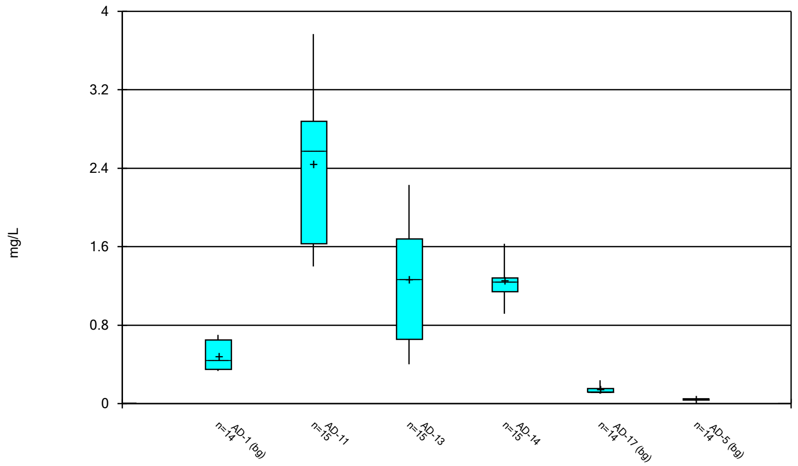


Constituent: Beryllium, total   Analysis Run 11/22/2019 5:25 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

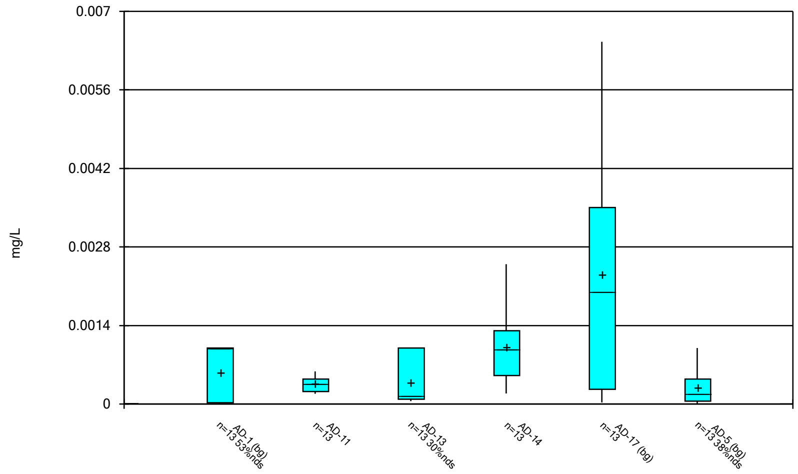


Constituent: Boron, total Analysis Run 11/22/2019 5:25 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

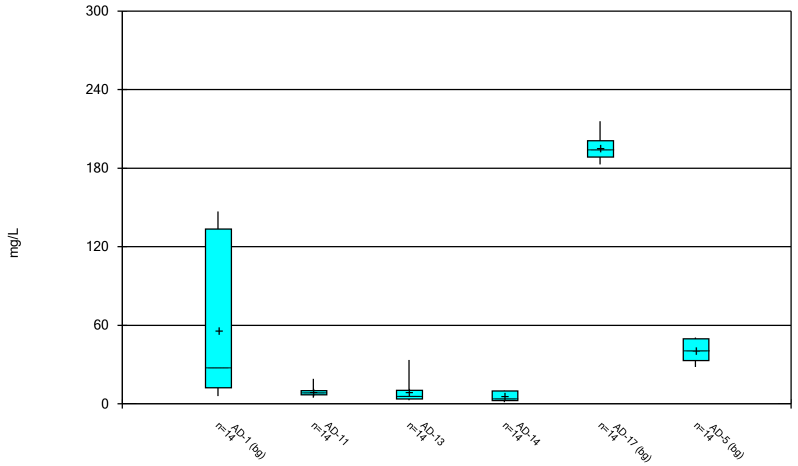


Constituent: Cadmium, total Analysis Run 11/22/2019 5:25 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

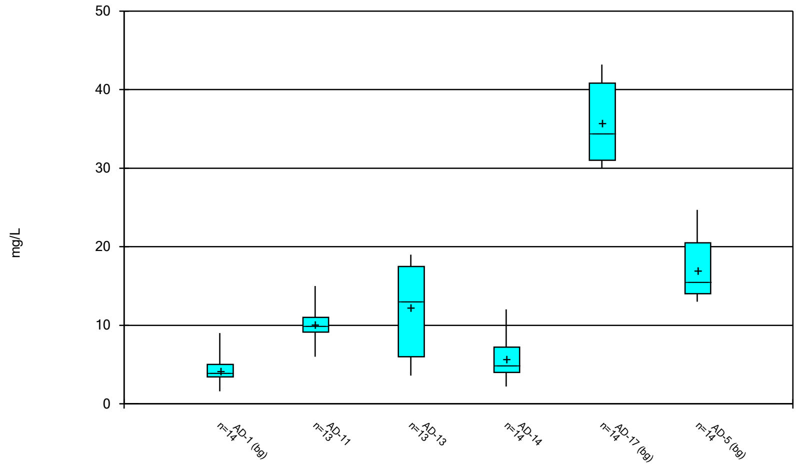


Constituent: Calcium, total Analysis Run 11/22/2019 5:25 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

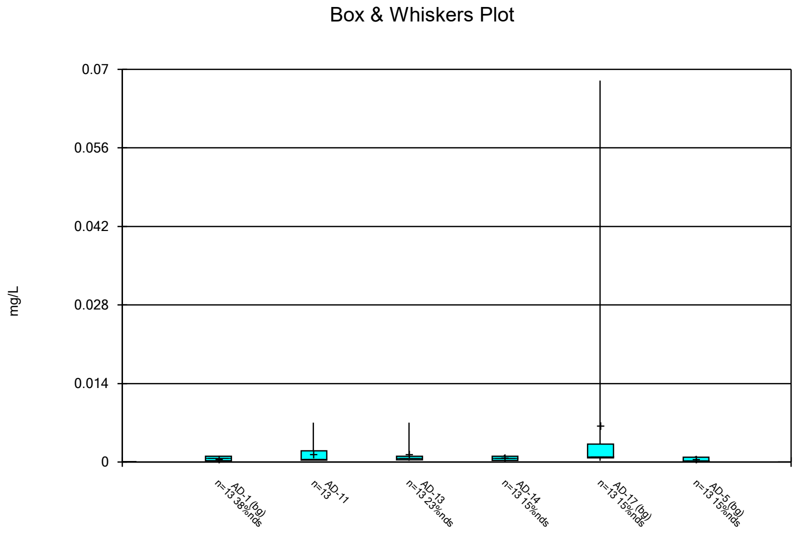
Box & Whiskers Plot



Constituent: Chloride, total Analysis Run 11/22/2019 5:25 PM

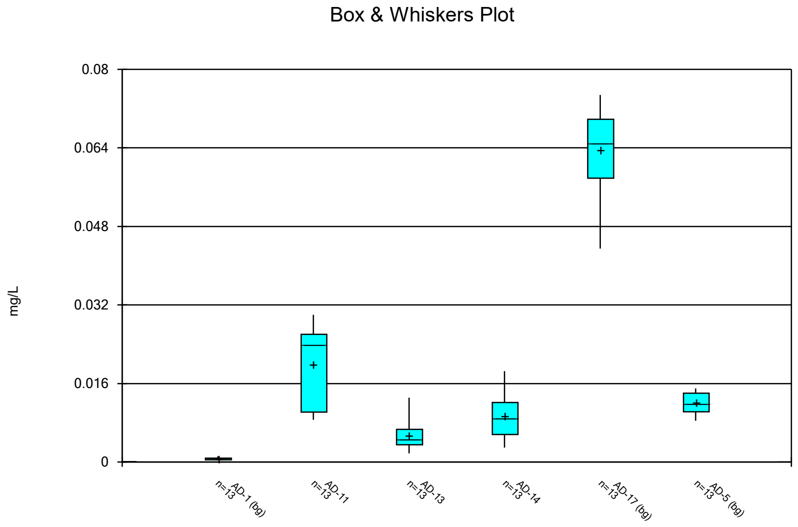
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG



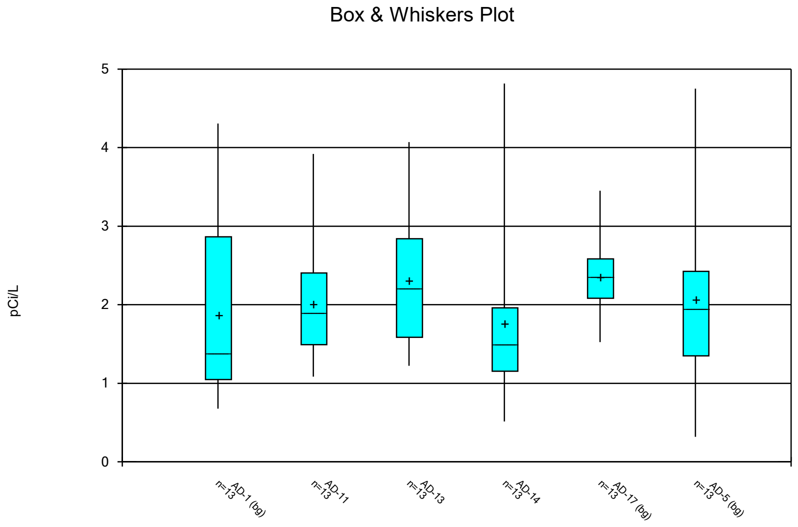
Constituent: Chromium, total   Analysis Run 11/22/2019 5:25 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG



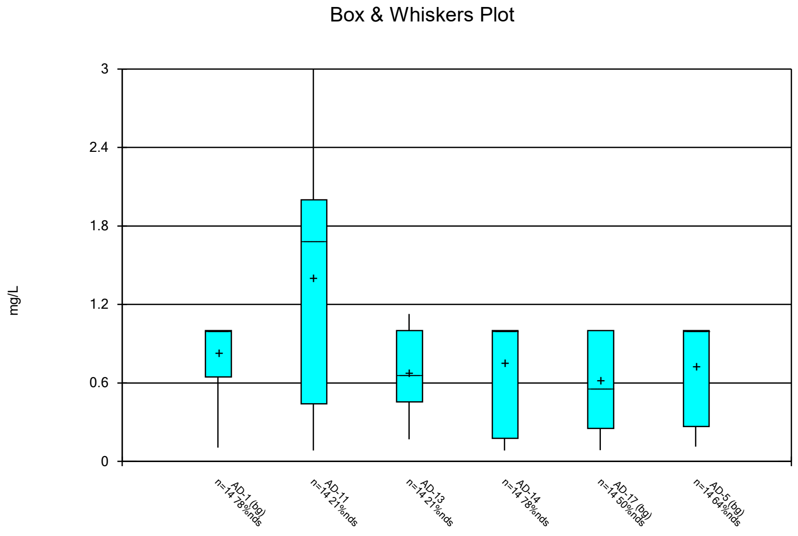
Constituent: Cobalt, total   Analysis Run 11/22/2019 5:25 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG



Constituent: Combined Radium 226 + 228   Analysis Run 11/22/2019 5:25 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

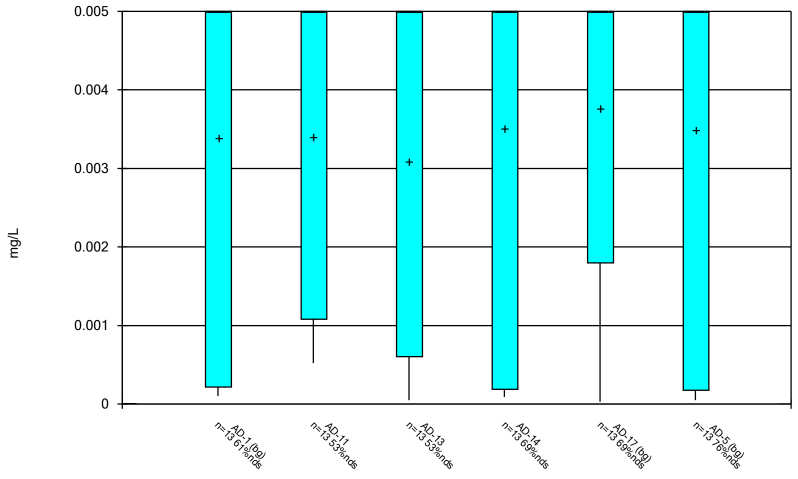
Sanitas™ v.9.6.23 . UG



Constituent: Fluoride, total   Analysis Run 11/22/2019 5:25 PM
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

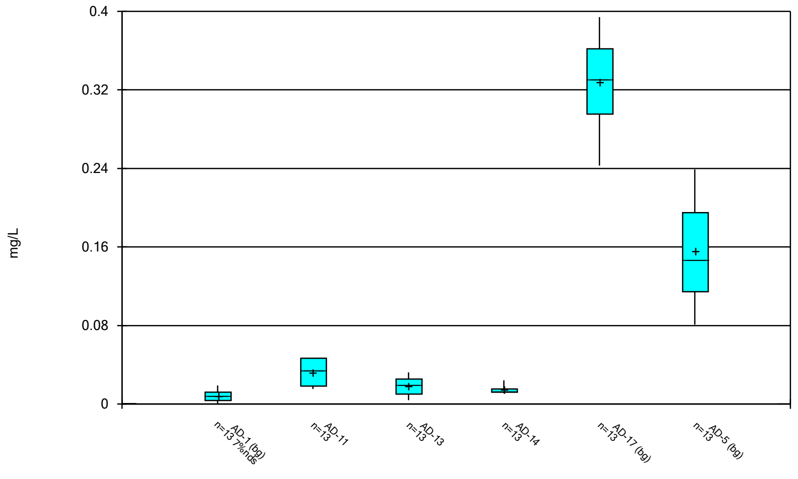


Constituent: Lead, total   Analysis Run 11/22/2019 5:25 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

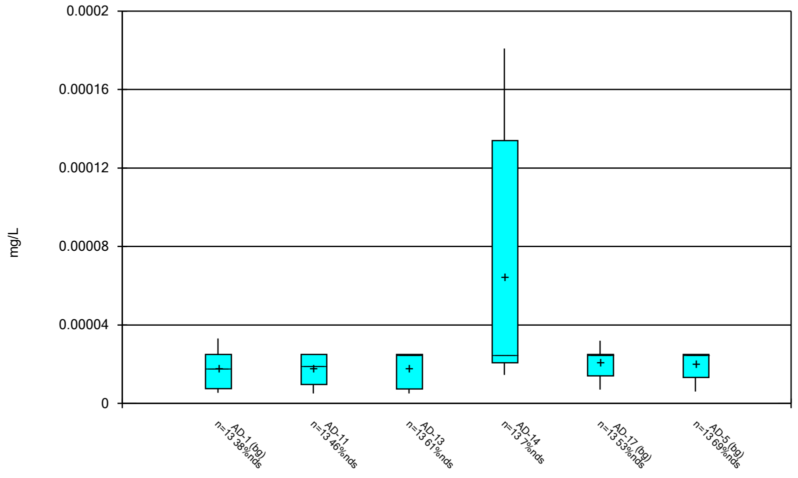


Constituent: Lithium, total   Analysis Run 11/22/2019 5:25 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Box & Whiskers Plot

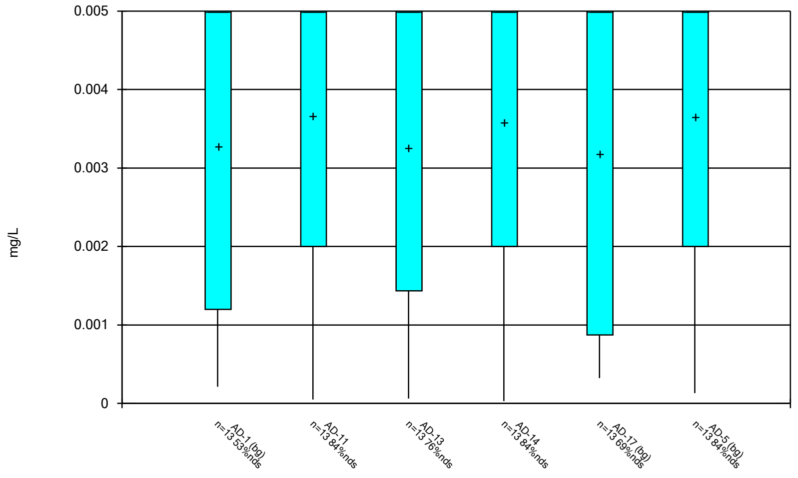


Constituent: Mercury, total   Analysis Run 11/22/2019 5:25 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

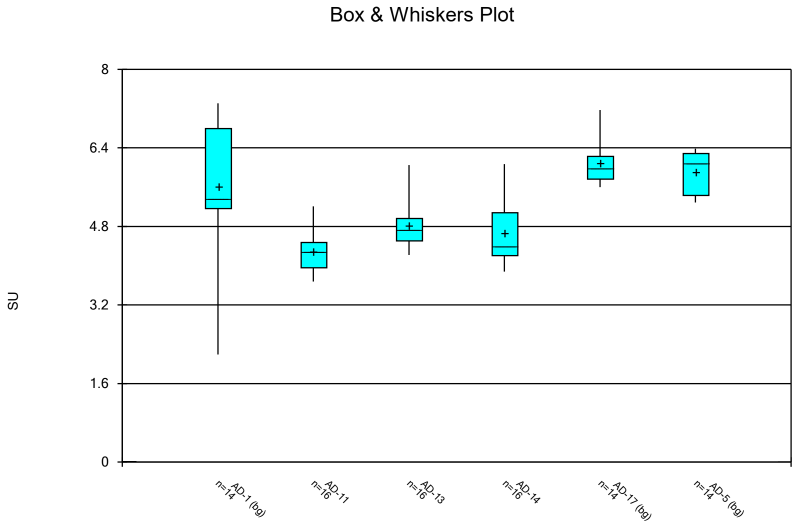
Box & Whiskers Plot



Constituent: Molybdenum, total   Analysis Run 11/22/2019 5:25 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

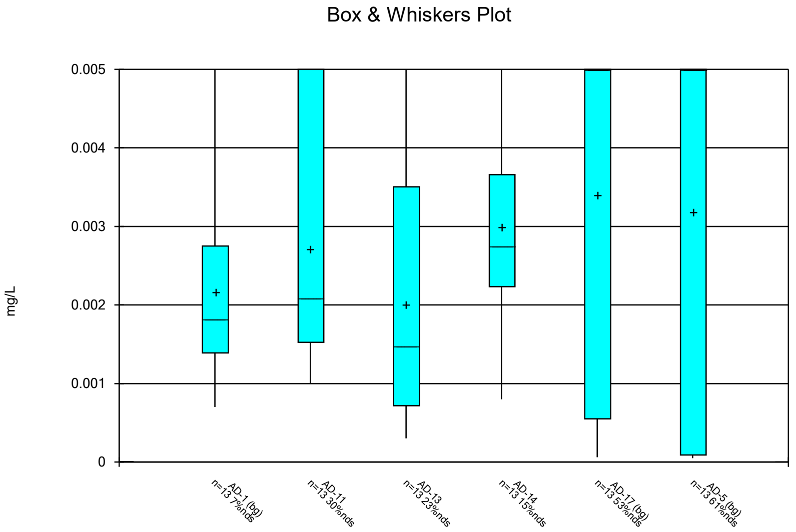
Sanitas™ v.9.6.23 . UG



Constituent: pH, field   Analysis Run 11/22/2019 5:25 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

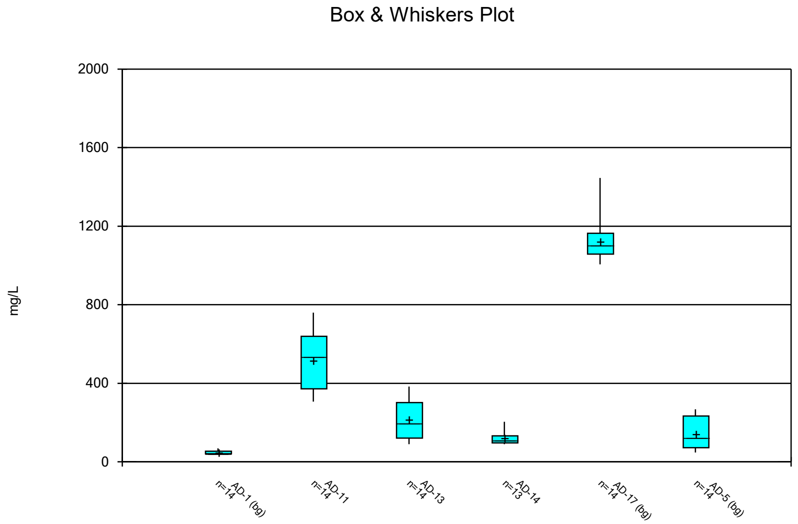
Sanitas™ v.9.6.23 . UG



Constituent: Selenium, total   Analysis Run 11/22/2019 5:25 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

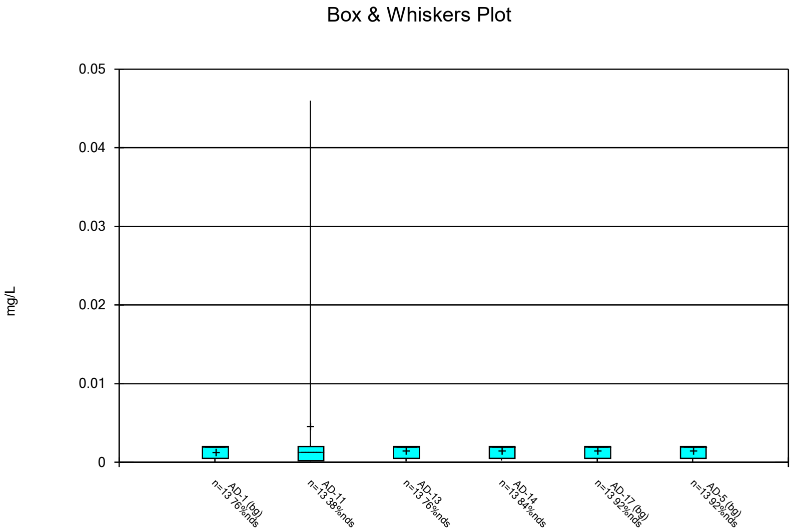
Sanitas™ v.9.6.23 . UG



Constituent: Sulfate, total   Analysis Run 11/22/2019 5:25 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

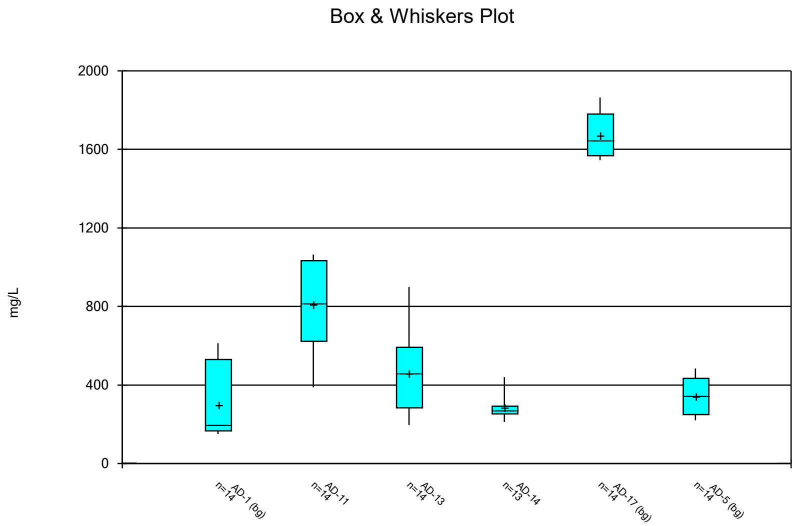
Sanitas™ v.9.6.23 . UG



Constituent: Thallium, total   Analysis Run 11/22/2019 5:25 PM

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG



Constituent: Total Dissolved Solids Analysis Run 11/22/2019 5:25 PM

Welsh Landfill Client: Geosyntec Data: Welsh LF

Outlier Summary

Welsh Landfill Client: Geosyntec Data: Welsh LF Printed 11/25/2019, 3:39 PM

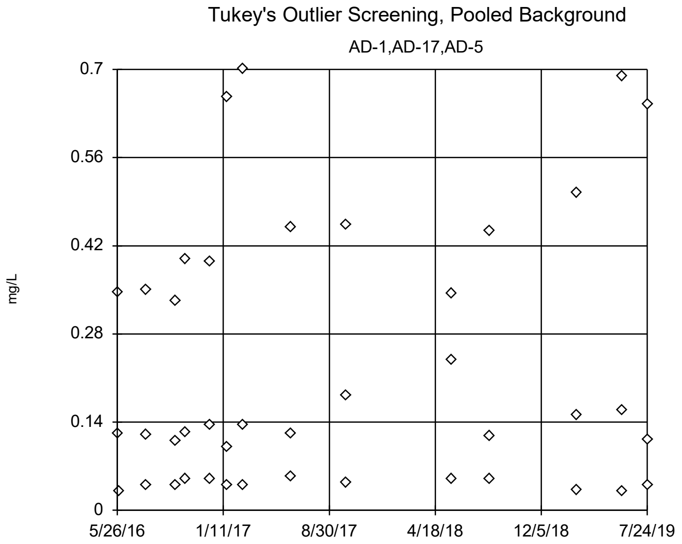
	AD-11 Chromium, total (mg/L)	AD-13 Chromium, total (mg/L)	AD-17 Chromium, total (mg/L)	AD-11 Fluoride, total (mg/L)	AD-14 Lithium, total (mg/L)	AD-11 Thallium, total (mg/L)
7/29/2016					0.024 (o)	
9/30/2016	0.007 (o)					
10/21/2016				3 (o)		
12/14/2016		0.007 (o)				
1/20/2017			0.068 (O)			
5/23/2018						0.046 (o)

Interwell Appendix III Outlier Analysis - All Results (No Significant)

Welsh Landfill   Client: Geosyntec   Data: Welsh LF   Printed 11/20/2019, 1:15 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	42	0.2196	0.2058	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	42	0.7273	0.3627	ln(x)	ShapiroWilk
pH, field (SU)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	42	5.879	0.8205	x^3	ShapiroWilk

Sanitas™ v.9.6.23 . UG



n = 42

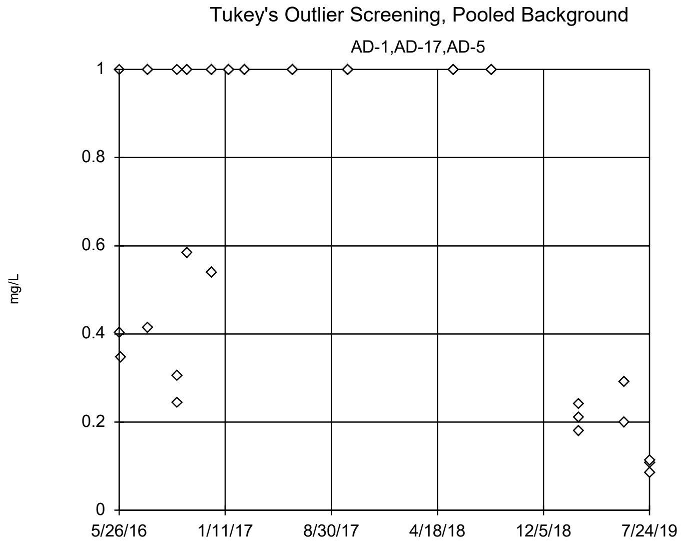
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 152.1, low cutoff = 0.000122, based on IQR multiplier of 3.

Constituent: Boron, total   Analysis Run 11/20/2019 1:14 PM   View: Interwell AIII
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG



n = 42

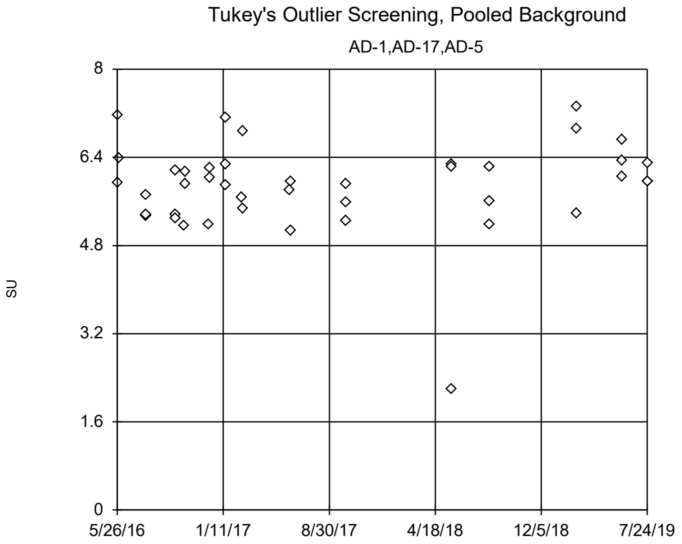
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 37.92, low cutoff = 0.007849, based on IQR multiplier of 3.

Constituent: Fluoride, total   Analysis Run 11/20/2019 1:14 PM   View: Interwell AIII
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG



n = 42

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 8.054, low cutoff = -4.934, based on IQR multiplier of 3.

Constituent: pH, field   Analysis Run 11/20/2019 1:14 PM   View: Interwell AIII
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Upgradient Appendix IV Outlier Analysis - All Results

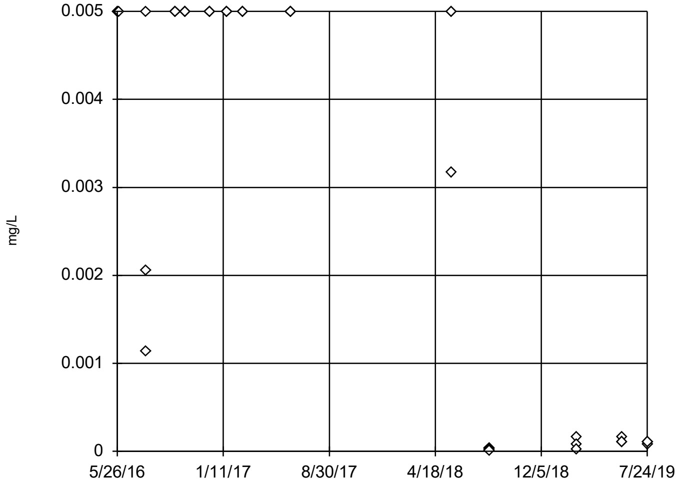
Welsh Landfill Client: Geosyntec Data: Welsh LF Printed 11/20/2019, 1:29 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony, total (mg/L)	AD-1,AD-1...	n/a	n/a	n/a w/com...	NP	NaN	39	0.003265	0.002294	unknown	ShapiroWilk
Arsenic, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.003355	0.001848	sqrt(x)	ShapiroWilk
Barium, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.1097	0.1337	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.000...	0.000171	x^(1/3)	ShapiroWilk
Cadmium, total (mg/L)	AD-1,AD-1...	n/a	n/a	n/a w/com...	NP	NaN	39	0.001055	0.001552	unknown	ShapiroWilk
Chromium, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	38	0.000...	0.00086	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.02542	0.02821	x^(1/3)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	2.091	0.9476	sqrt(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	42	0.7273	0.3627	ln(x)	ShapiroWilk
Lead, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.003549	0.002164	ln(x)	ShapiroWilk
Lithium, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.1639	0.1373	normal	ShapiroWilk
Mercury, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.000...	0.0000...	x^2	ShapiroWilk
Molybdenum, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.003371	0.001944	x^(1/3)	ShapiroWilk
Selenium, total (mg/L)	AD-1,AD-1...	No	n/a	n/a w/com...	NP	NaN	39	0.002917	0.002031	sqrt(x)	ShapiroWilk
Thallium, total (mg/L)	AD-1,AD-1...	n/a	n/a	n/a w/com...	NP	NaN	39	0.001457	0.00076	unknown	ShapiroWilk

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

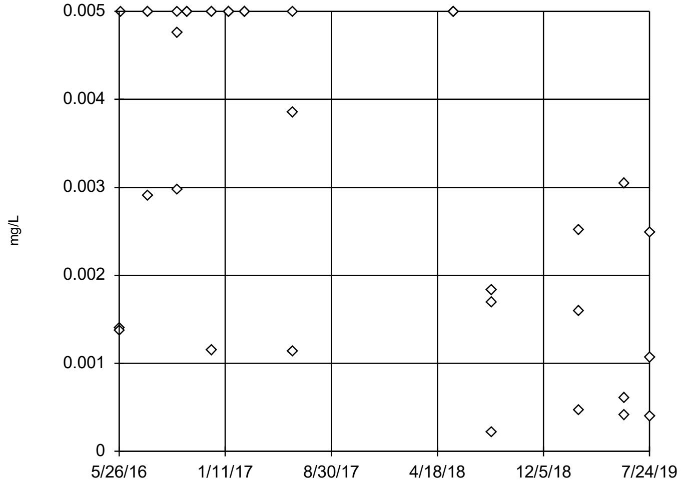
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Antimony, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

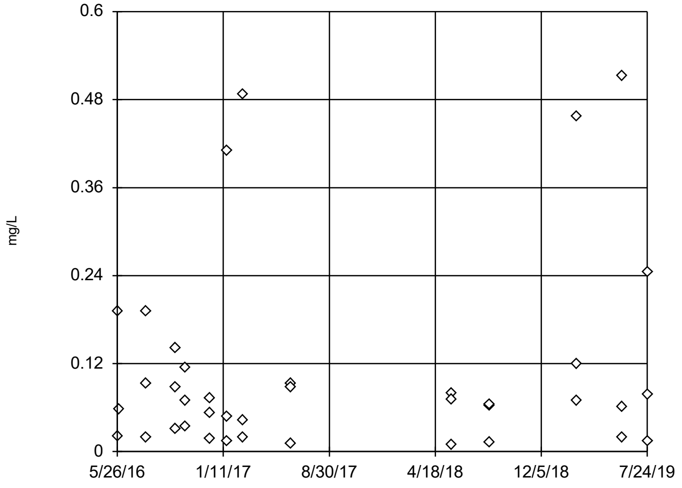
High cutoff = 0.02919, low cutoff = -0.003945, based on IQR multiplier of 3.

Constituent: Arsenic, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

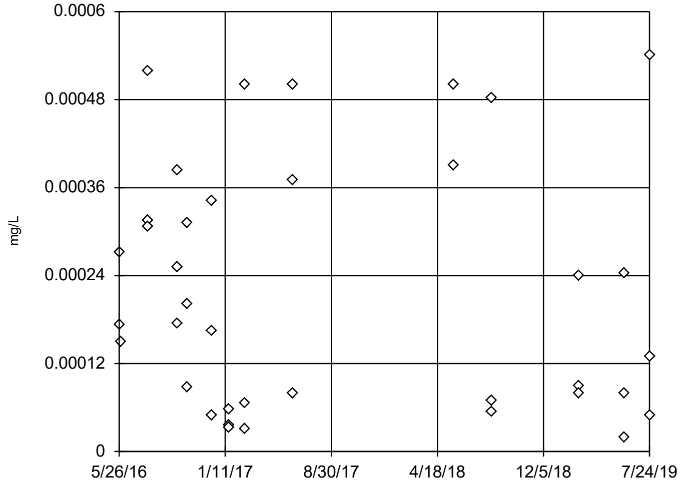
High cutoff = 18.24, low cutoff = 0.0001313, based on IQR multiplier of 3.

Constituent: Barium, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

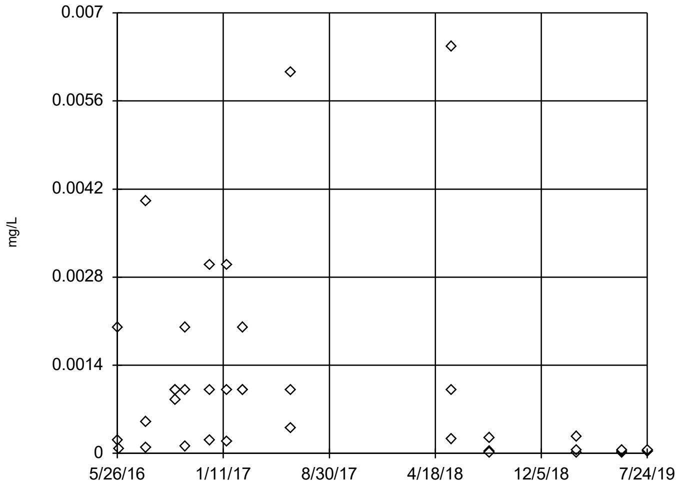
High cutoff = 0.00442, low cutoff = -0.0001351, based on IQR multiplier of 3.

Constituent: Beryllium, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because both the lower and upper quartiles represent reporting limits.

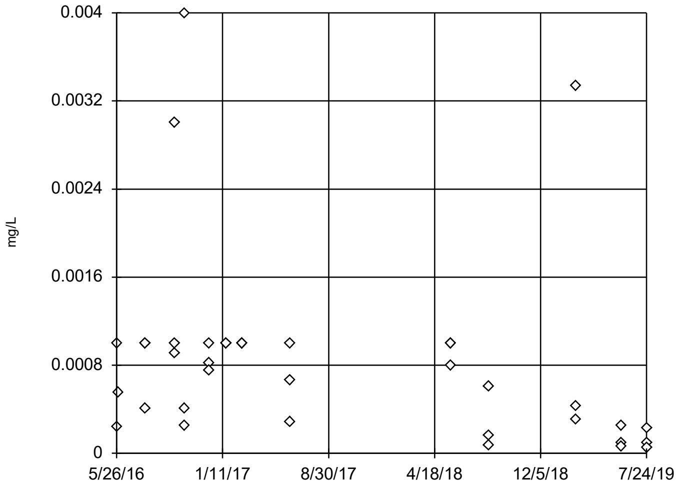
Constituent: Cadmium, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 38

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.06633, low cutoff = 0.000003725, based on IQR multiplier of 3.

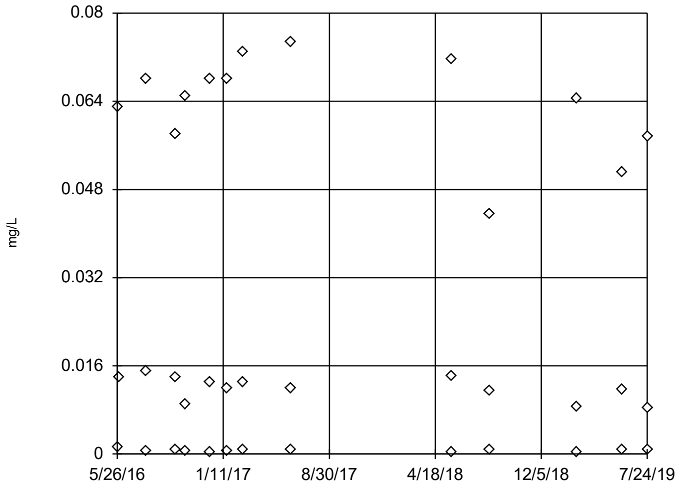
Constituent: Chromium, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2.054, low cutoff = -0.4961, based on IQR multiplier of 3.

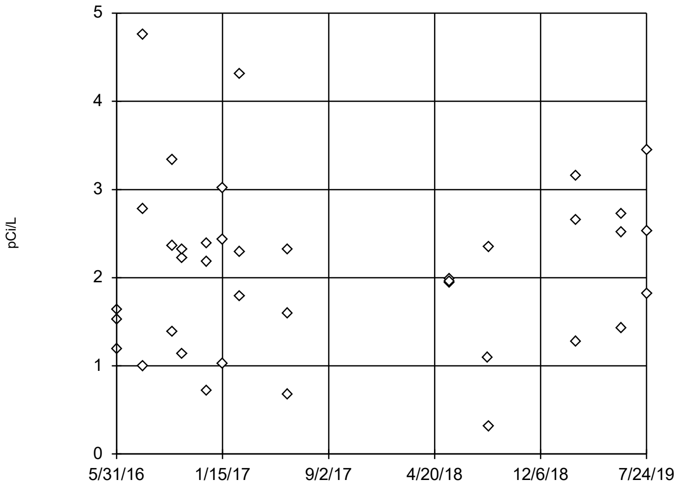
Constituent: Cobalt, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 8.077, low cutoff = -0.005728, based on IQR multiplier of 3.

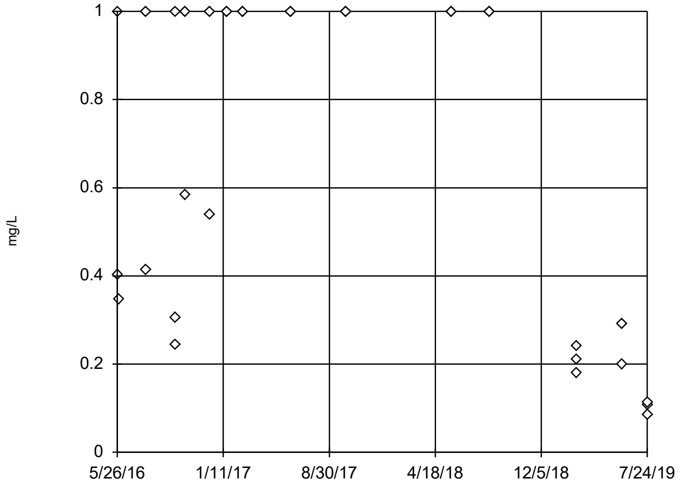
Constituent: Combined Radium 226 + 228   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 42

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

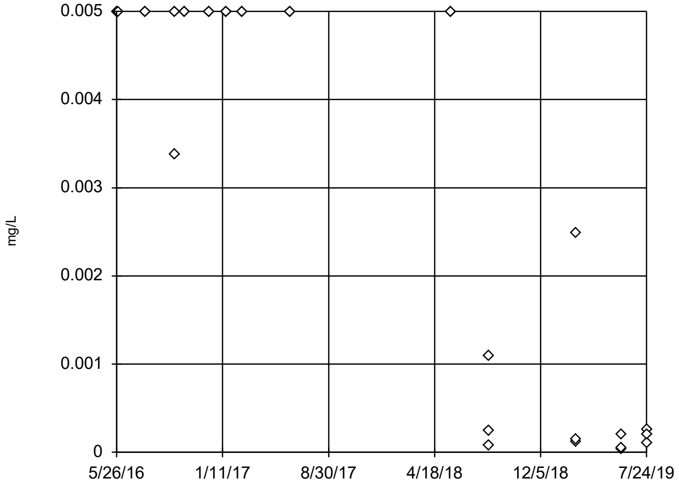
High cutoff = 37.92, low cutoff = 0.007849, based on IQR multiplier of 3.

Constituent: Fluoride, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

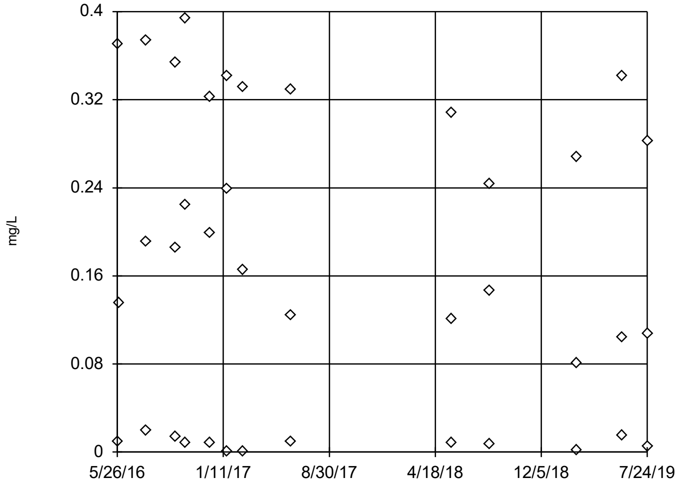
High cutoff = 34.36, low cutoff = 3.8e-8, based on IQR multiplier of 3.

Constituent: Lead, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

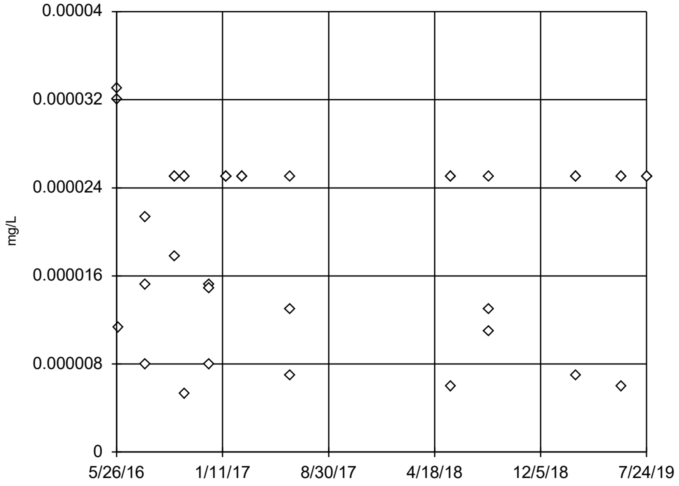
High cutoff = 1.202, low cutoff = -0.884, based on IQR multiplier of 3.

Constituent: Lithium, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

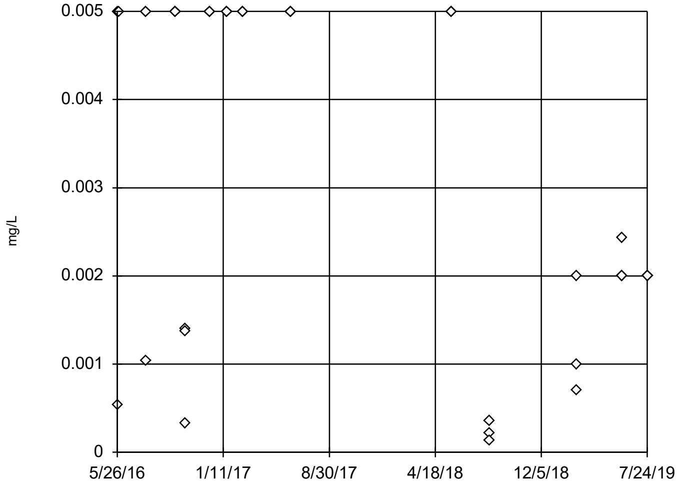
High cutoff = 0.00004464, low cutoff = -0.00003463, based on IQR multiplier of 3.

Constituent: Mercury, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

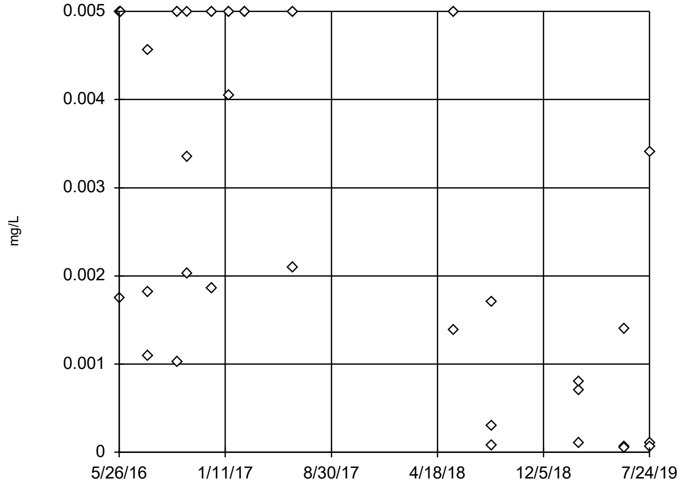
High cutoff = 0.04232, low cutoff = -0.000283, based on IQR multiplier of 3.

Constituent: Molybdenum, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

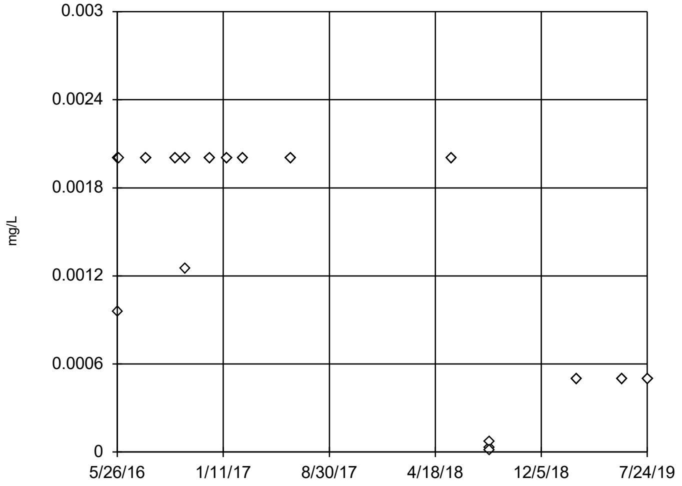
High cutoff = 0.03487, low cutoff = -0.007054, based on IQR multiplier of 3.

Constituent: Selenium, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-1,AD-17,AD-5



n = 39

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Thallium, total   Analysis Run 11/20/2019 1:28 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Intrawell Appendix III Outlier Analysis - All Results

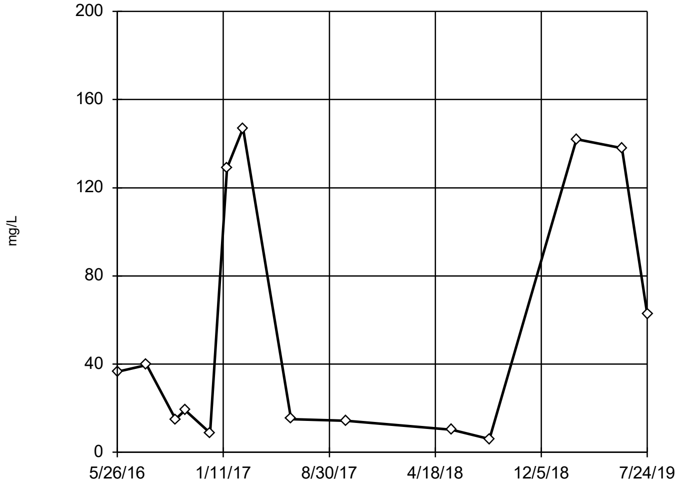
Welsh Landfill   Client: Geosyntec   Data: Welsh LF   Printed 11/20/2019, 1:27 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Calcium, total (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	14	55.94	56.65	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	14	8.97	3.408	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	14	8.82	8.193	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	14	5.797	3.544	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	14	195.5	8.645	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	14	40.53	8.044	x^(1/3)	ShapiroWilk
Chloride, total (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	14	4.172	1.727	x^(1/3)	ShapiroWilk
Chloride, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	13	10.01	2.195	sqrt(x)	ShapiroWilk
Chloride, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	13	12.27	5.586	x^2	ShapiroWilk
Chloride, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	14	5.663	2.683	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	14	35.64	4.965	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	14	17	3.662	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	14	46.46	10.67	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	14	518.1	141.8	normal	ShapiroWilk
Sulfate, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	14	213	93.58	sqrt(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	13	121.3	33.45	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	14	1123	104.3	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	14	142.1	78.09	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-1 (bg)	No	n/a	n/a	NP	NaN	14	295.9	180	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-11	No	n/a	n/a	NP	NaN	14	811.6	221.2	normal	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-13	No	n/a	n/a	NP	NaN	14	461.2	189.8	sqrt(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-14	No	n/a	n/a	NP	NaN	13	286.2	61.3	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-17 (bg)	No	n/a	n/a	NP	NaN	14	1670	111	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	AD-5 (bg)	No	n/a	n/a	NP	NaN	14	343.5	88.41	sqrt(x)	ShapiroWilk

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-1 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

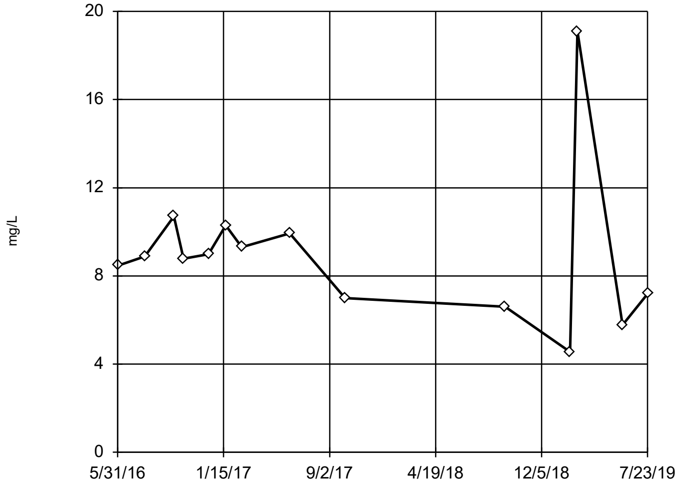
High cutoff = 179901, low cutoff = 0.008957, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

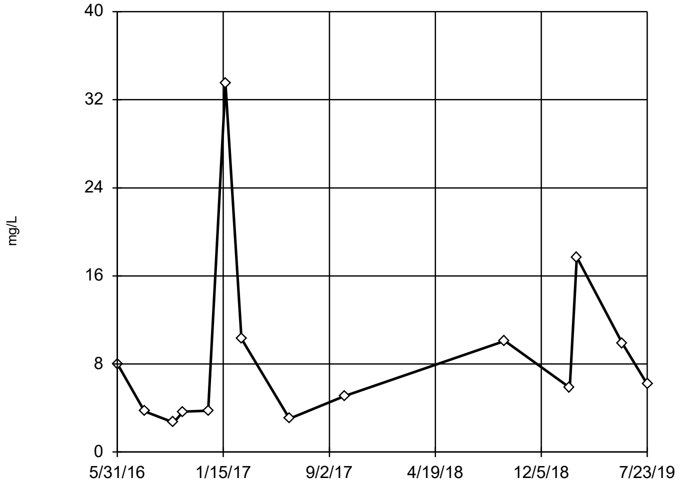
High cutoff = 33.31, low cutoff = 2.064, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

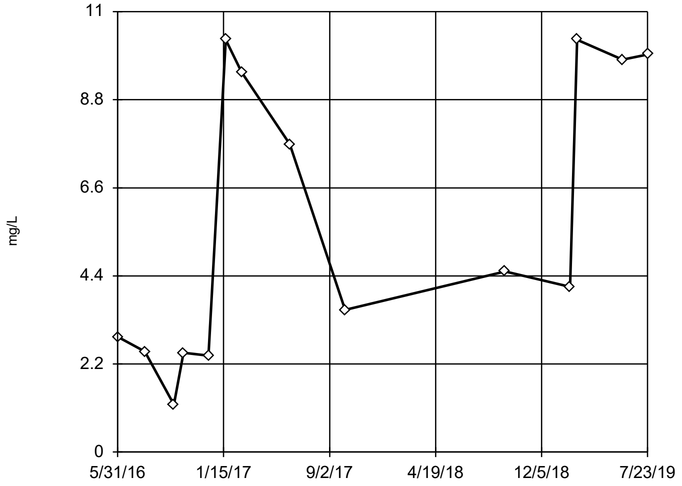
High cutoff = 217.2, low cutoff = 0.1728, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-14



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

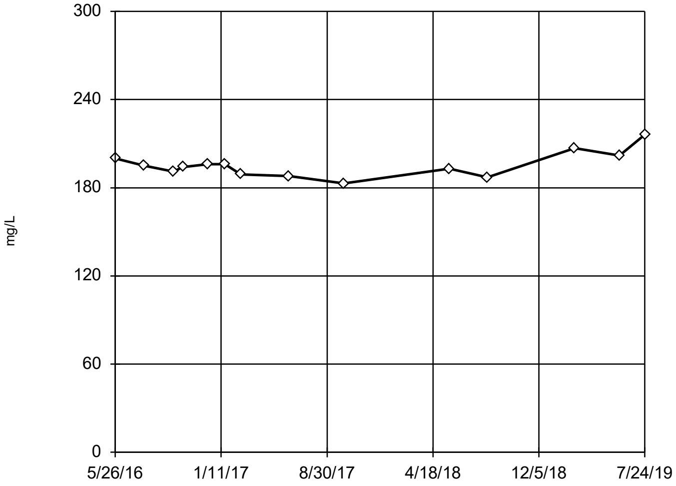
High cutoff = 609.8, low cutoff = 0.04036, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-17 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

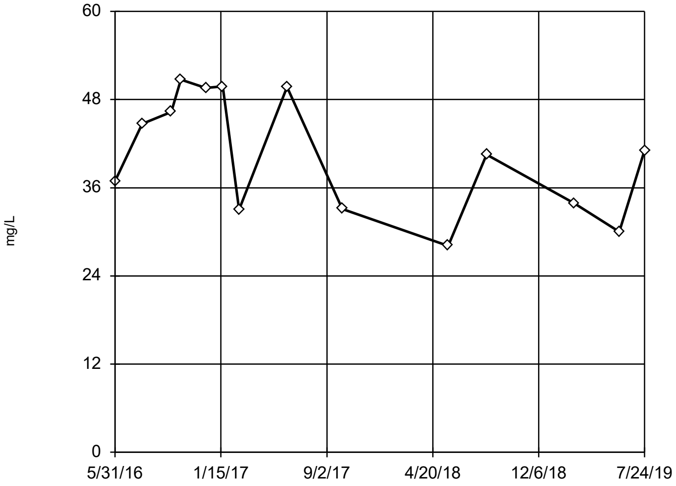
High cutoff = 243.7, low cutoff = 155.5, based on IQR multiplier of 3.

Constituent: Calcium, total   Analysis Run 11/20/2019 1:26 PM   View: Intrawell AIII
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-5 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

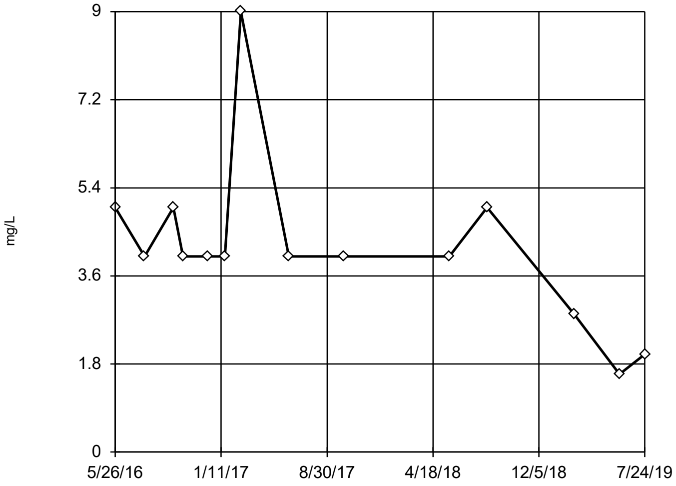
High cutoff = 130.6, low cutoff = 5.933, based on IQR multiplier of 3.

Constituent: Calcium, total   Analysis Run 11/20/2019 1:26 PM   View: Intrawell AIII
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-1 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

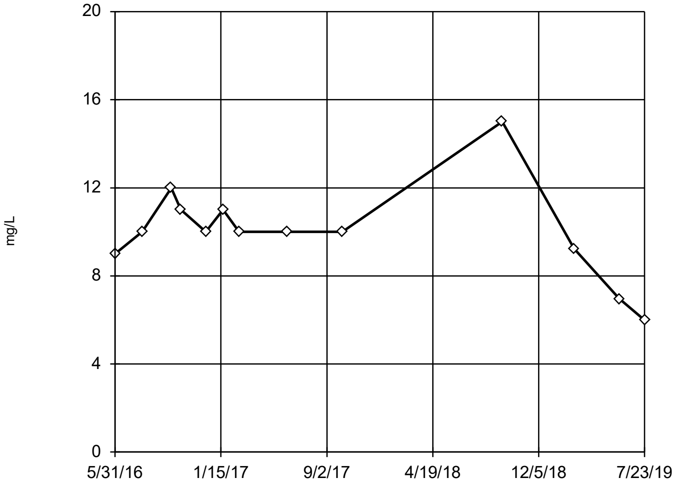
High cutoff = 12.81, low cutoff = 0.6596, based on IQR multiplier of 3.

Constituent: Chloride, total   Analysis Run 11/20/2019 1:26 PM   View: Intrawell AIII
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 13

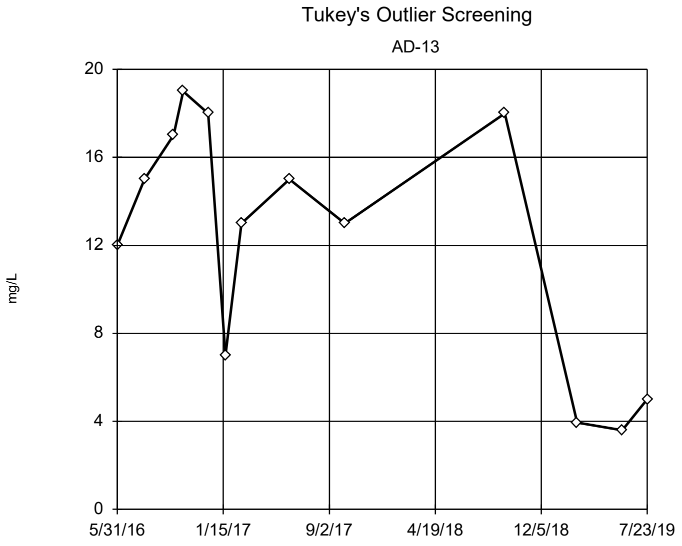
No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 17.72, low cutoff = 4.521, based on IQR multiplier of 3.

Constituent: Chloride, total   Analysis Run 11/20/2019 1:26 PM   View: Intrawell AIII
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG


Tukey's Outlier Screening

AD-13

n = 13

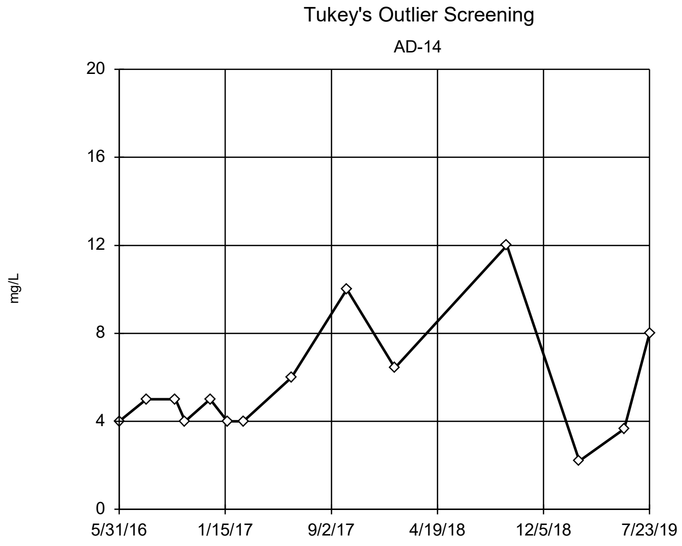
No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 33.39, low cutoff = -27.78, based on IQR multiplier of 3.

Constituent: Chloride, total   Analysis Run 11/20/2019 1:26 PM   View: Intrawell AIII
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG


Tukey's Outlier Screening

AD-14

n = 14

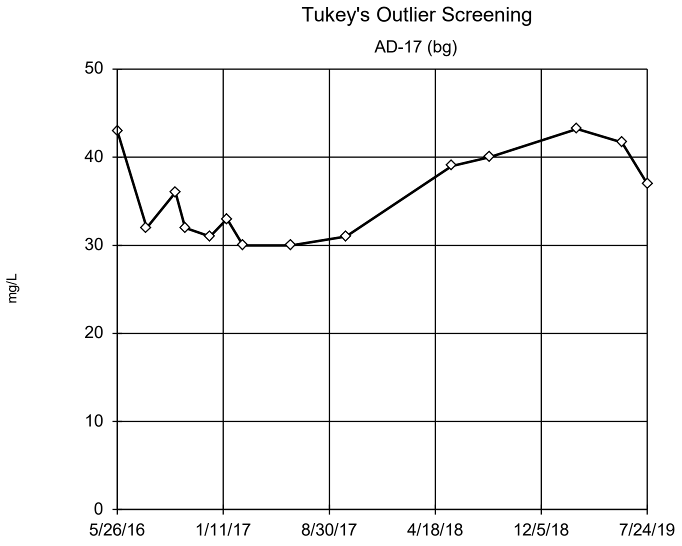
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 41.34, low cutoff = 0.6939, based on IQR multiplier of 3.

Constituent: Chloride, total   Analysis Run 11/20/2019 1:26 PM   View: Intrawell AIII
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG


Tukey's Outlier Screening

AD-17 (bg)

n = 14

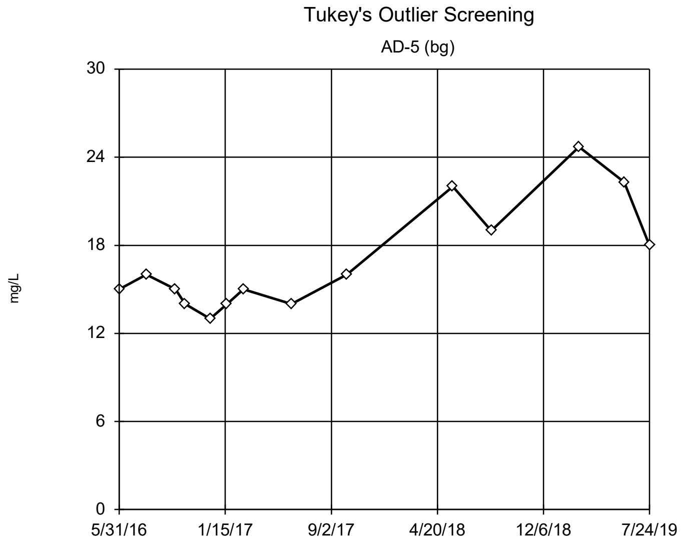
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 93.39, low cutoff = 13.56, based on IQR multiplier of 3.

Constituent: Chloride, total   Analysis Run 11/20/2019 1:26 PM   View: Intrawell AIII
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG


Tukey's Outlier Screening

AD-5 (bg)

n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

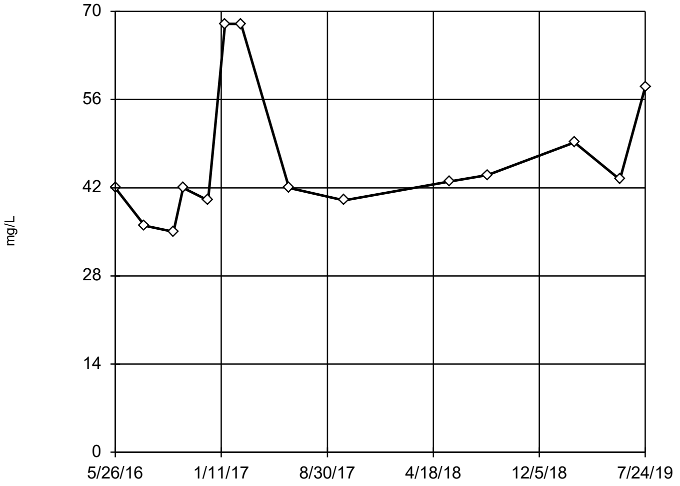
High cutoff = 63.67, low cutoff = 4.495, based on IQR multiplier of 3.

Constituent: Chloride, total   Analysis Run 11/20/2019 1:26 PM   View: Intrawell AIII
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-1 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

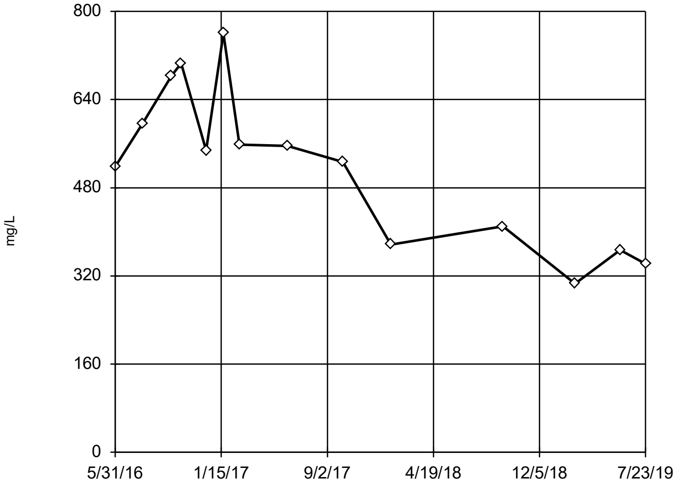
High cutoff = 127.2, low cutoff = 16.79, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 14

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

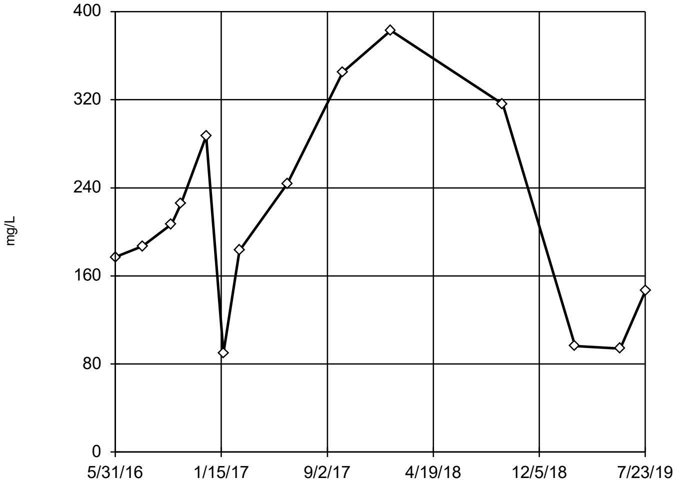
High cutoff = 1442, low cutoff = -430.5, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 14

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

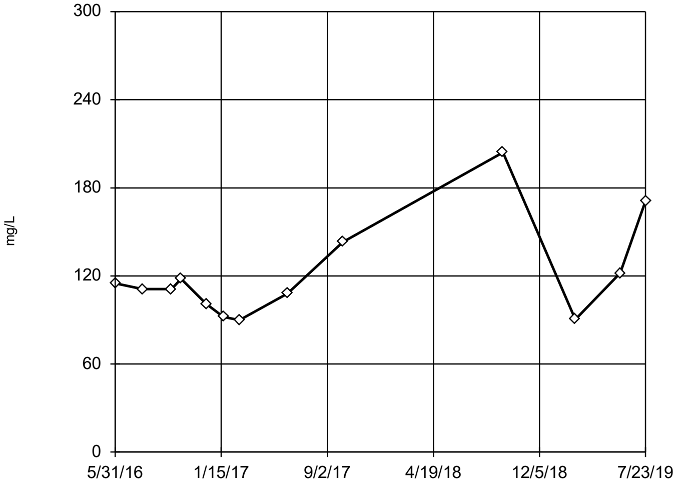
High cutoff = 1339, low cutoff = -68.62, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-14



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

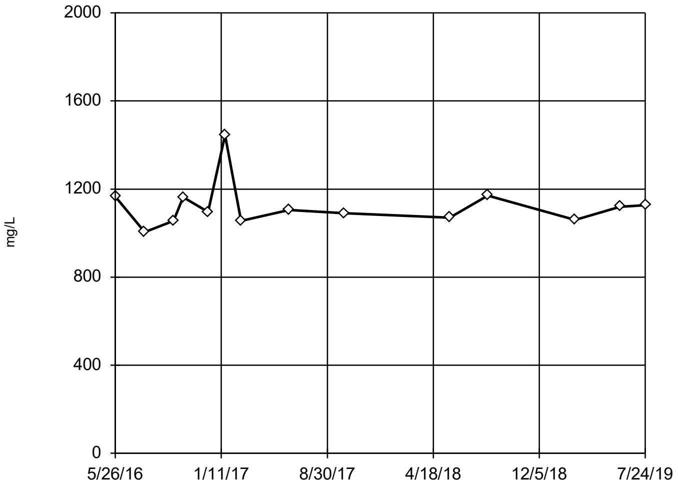
High cutoff = 339.8, low cutoff = 37.47, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-17 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

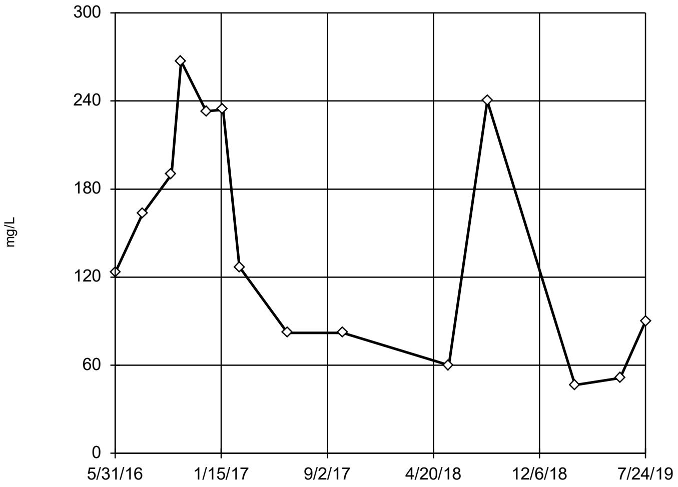
High cutoff = 1555, low cutoff = 792, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-5 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

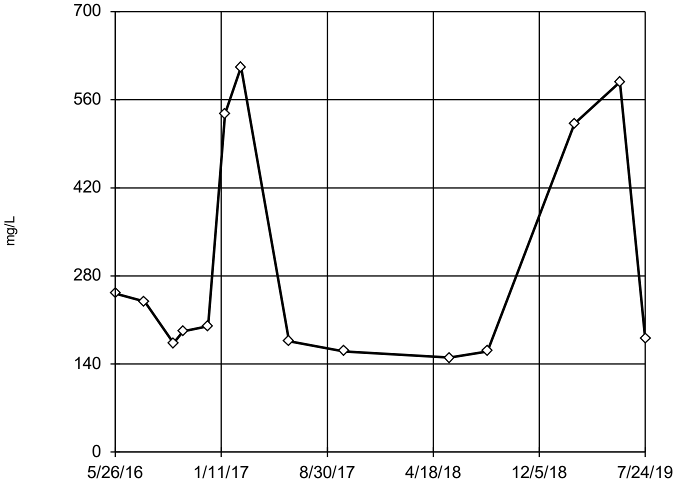
High cutoff = 8614, low cutoff = 1.901, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-1 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

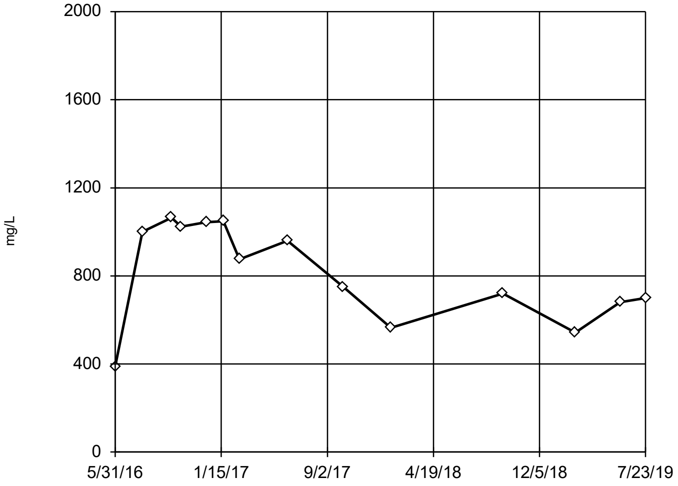
High cutoff = 17126, low cutoff = 5.148, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 14

No outliers found. Tukey's method selected by user.

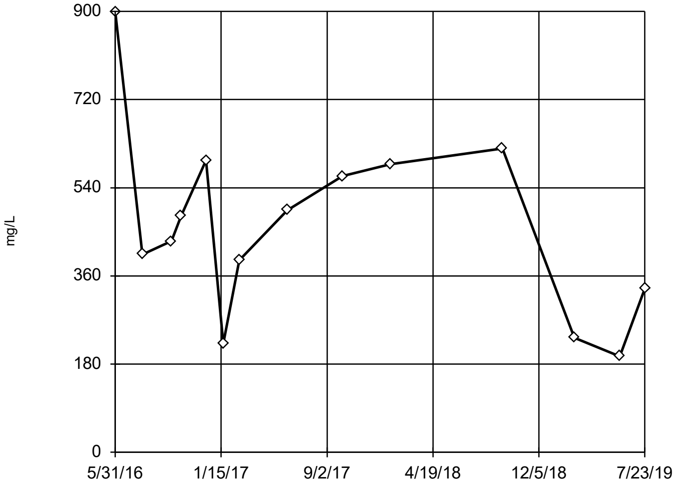
Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 2270, low cutoff = -614, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Tukey's Outlier Screening

AD-13



n = 14

No outliers found. Tukey's method selected by user.

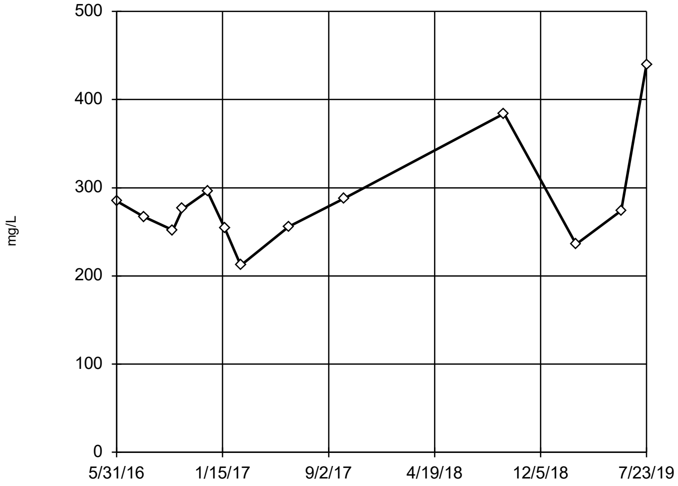
Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2206, low cutoff = -34.19, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Tukey's Outlier Screening

AD-14



n = 13

No outliers found. Tukey's method selected by user.

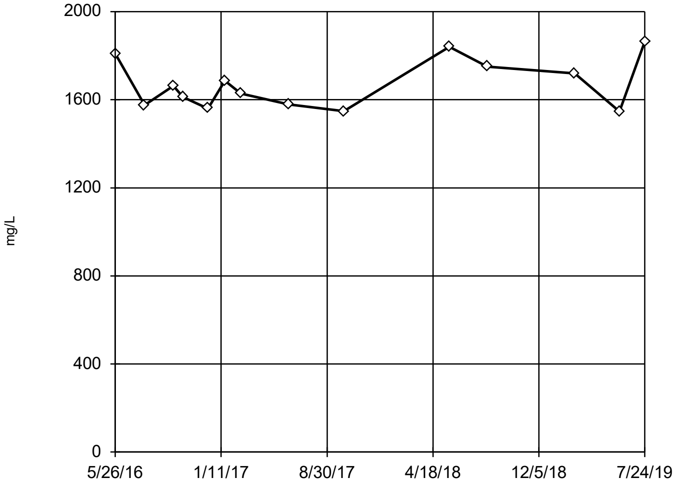
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 448.8, low cutoff = 164.6, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Tukey's Outlier Screening

AD-17 (bg)



n = 14

No outliers found. Tukey's method selected by user.

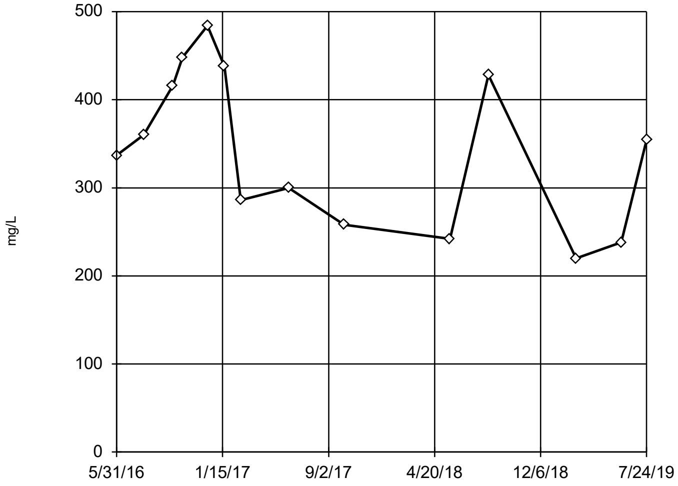
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2603, low cutoff = 1072, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Tukey's Outlier Screening

AD-5 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1282, low cutoff = 0.6602, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 11/20/2019 1:26 PM View: Intrawell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Downgradient Appendix IV Outlier Analysis - Significant Results

Welsh Landfill Client: Geosyntec Data: Welsh LF Printed 11/20/2019, 1:21 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Chromium, total (mg/L)	**AD-13**	**Yes**	**0.007**	**12/14/2016**	**NP**	**NaN**	**13**	**0.001275**	**0.00198**	**ln(x)**	**ShapiroWilk**

Downgradient Appendix IV Outlier Analysis - All Results

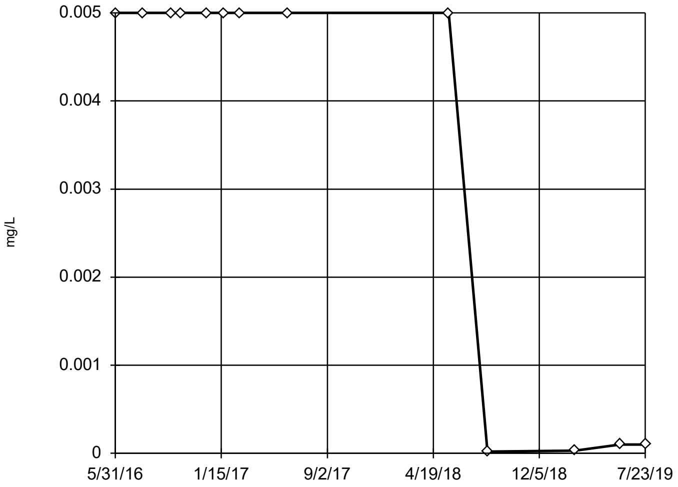
Welsh Landfill Client: Geosyntec Data: Welsh LF Printed 11/20/2019, 1:21 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony, total (mg/L)	AD-11	n/a	n/a	n/a	NP	NaN	13	0.003481	0.002372	unknown	ShapiroWilk
Antimony, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	13	0.003202	0.002398	sqrt(x)	ShapiroWilk
Antimony, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	13	0.003475	0.002382	ln(x)	ShapiroWilk
Arsenic, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	13	0.002964	0.002031	ln(x)	ShapiroWilk
Arsenic, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	13	0.003626	0.00216	x^3	ShapiroWilk
Arsenic, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	13	0.00307	0.002214	ln(x)	ShapiroWilk
Barium, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	13	0.01978	0.01233	ln(x)	ShapiroWilk
Barium, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	13	0.04402	0.02561	ln(x)	ShapiroWilk
Barium, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	13	0.04079	0.01479	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	13	0.002902	0.001665	x^2	ShapiroWilk
Beryllium, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	13	0.000...	0.0002788	x^3	ShapiroWilk
Beryllium, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	13	0.000...	0.0002155	sqrt(x)	ShapiroWilk
Cadmium, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	13	0.000...	0.0001266	normal	ShapiroWilk
Cadmium, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	13	0.000...	0.000192	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	13	0.001022	0.0006704	sqrt(x)	ShapiroWilk
Chromium, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	13	0.001393	0.001892	ln(x)	ShapiroWilk
Chromium, total (mg/L)	**AD-13**	**Yes**	**0.007**	**12/14/2016**	**NP**	**NaN**	**13**	**0.001275**	**0.00198**	**ln(x)**	**ShapiroWilk**
Chromium, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	13	0.000...	0.0003319	x^(1/3)	ShapiroWilk
Cobalt, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	13	0.01985	0.007995	x^4	ShapiroWilk
Cobalt, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	13	0.005342	0.003061	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	13	0.009368	0.004887	x^(1/3)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-11	No	n/a	n/a	NP	NaN	13	2.015	0.7276	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-13	No	n/a	n/a	NP	NaN	13	2.306	0.8584	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-14	No	n/a	n/a	NP	NaN	13	1.757	1.075	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	14	1.405	0.8659	normal	ShapiroWilk
Fluoride, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	14	0.6763	0.2861	normal	ShapiroWilk
Fluoride, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	14	0.7554	0.402	ln(x)	ShapiroWilk
Lead, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	13	0.0034	0.002003	ln(x)	ShapiroWilk
Lead, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	13	0.003087	0.002251	sqrt(x)	ShapiroWilk
Lead, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	13	0.003508	0.00233	ln(x)	ShapiroWilk
Lithium, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	13	0.03222	0.01308	normal	ShapiroWilk
Lithium, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	13	0.01853	0.008507	normal	ShapiroWilk
Lithium, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	12	0.01373	0.002473	ln(x)	ShapiroWilk
Mercury, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	13	0.000...	0.0000...	normal	ShapiroWilk
Mercury, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	13	0.000...	0.0000...	normal	ShapiroWilk
Mercury, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	13	0.000...	0.0000...	ln(x)	ShapiroWilk
Molybdenum, total (mg/L)	AD-11	n/a	n/a	n/a	NP	NaN	13	0.003659	0.001831	unknown	ShapiroWilk
Molybdenum, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	13	0.003253	0.002048	sqrt(x)	ShapiroWilk
Molybdenum, total (mg/L)	AD-14	n/a	n/a	n/a	NP	NaN	13	0.003579	0.001952	unknown	ShapiroWilk
Selenium, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	13	0.002714	0.001628	ln(x)	ShapiroWilk
Selenium, total (mg/L)	AD-13	No	n/a	n/a	NP	NaN	13	0.002002	0.001787	ln(x)	ShapiroWilk
Selenium, total (mg/L)	AD-14	No	n/a	n/a	NP	NaN	13	0.002985	0.001174	normal	ShapiroWilk
Thallium, total (mg/L)	AD-11	No	n/a	n/a	NP	NaN	13	0.004632	0.01246	ln(x)	ShapiroWilk
Thallium, total (mg/L)	AD-13	n/a	n/a	n/a	NP	NaN	13	0.001412	0.0007975	unknown	ShapiroWilk
Thallium, total (mg/L)	AD-14	n/a	n/a	n/a	NP	NaN	13	0.001496	0.0007917	unknown	ShapiroWilk

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because both the lower and upper quartiles represent reporting limits.

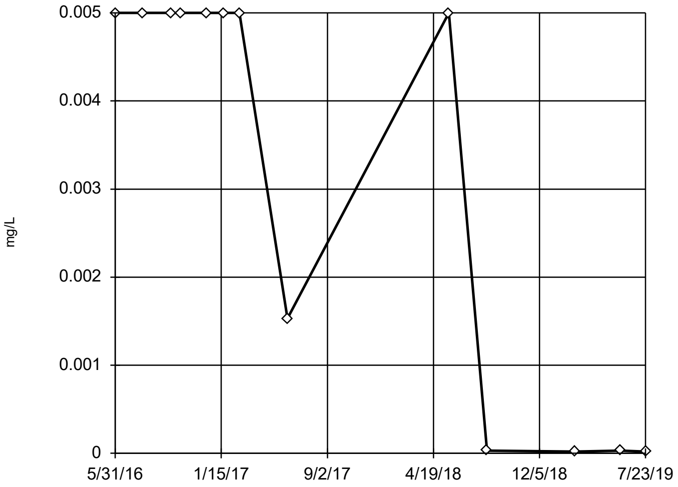
Constituent: Antimony, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 13

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.07097, low cutoff = -0.03618, based on IQR multiplier of 3.

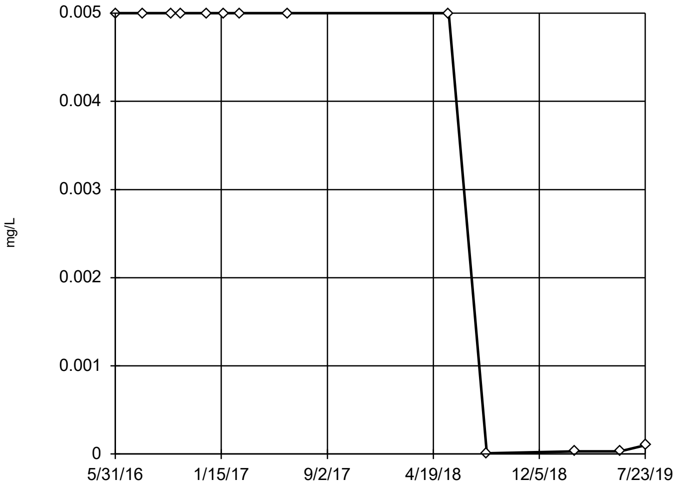
Constituent: Antimony, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-14



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 3804, low cutoff = 7.2e-11, based on IQR multiplier of 3.

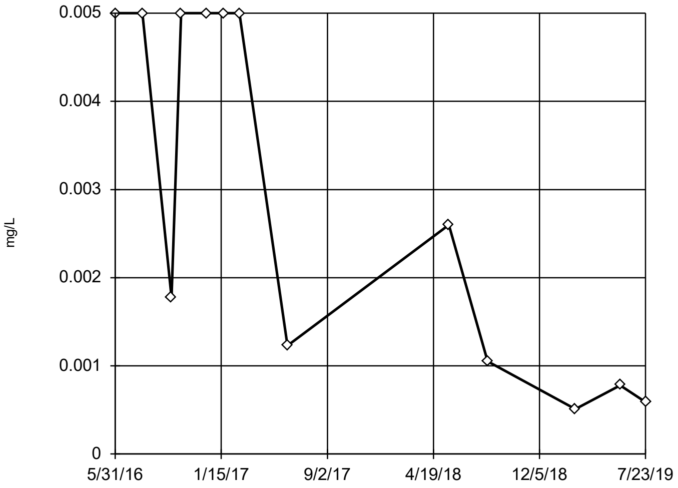
Constituent: Antimony, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.8432, low cutoff = 0.000005366, based on IQR multiplier of 3.

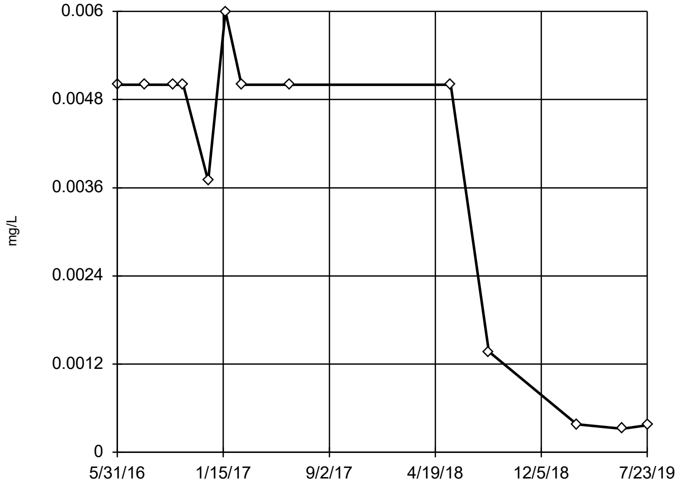
Constituent: Arsenic, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV

Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 13

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

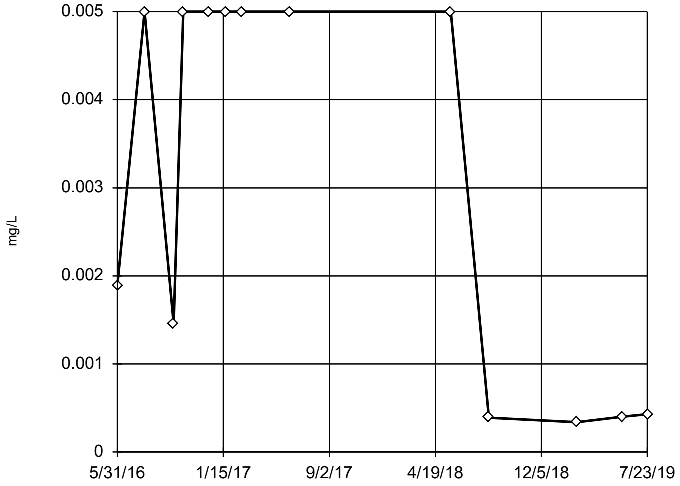
High cutoff = 0.007916, low cutoff = -0.007177, based on IQR multiplier of 3.

Constituent: Arsenic, total   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-14



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

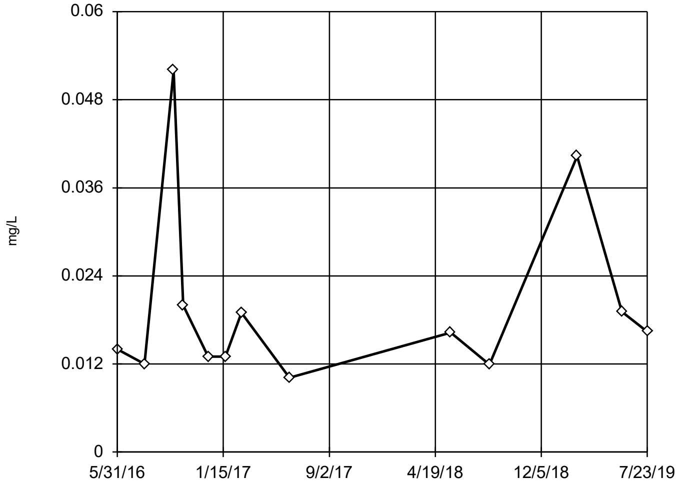
High cutoff = 8.762, low cutoff = 2.4e-7, based on IQR multiplier of 3.

Constituent: Arsenic, total   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

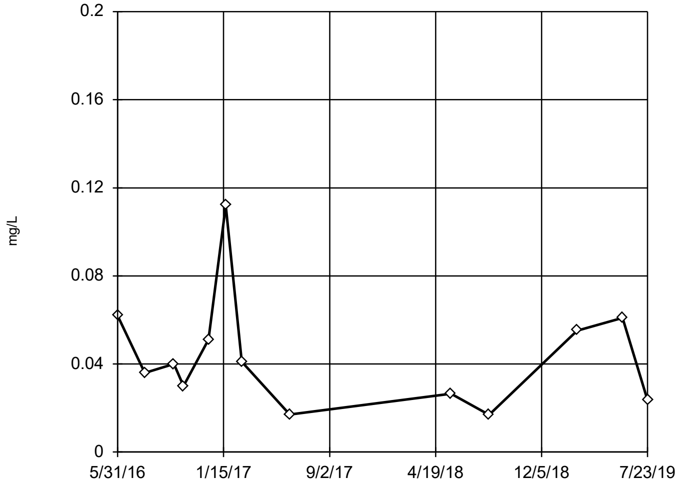
High cutoff = 0.07489, low cutoff = 0.00326, based on IQR multiplier of 3.

Constituent: Barium, total   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

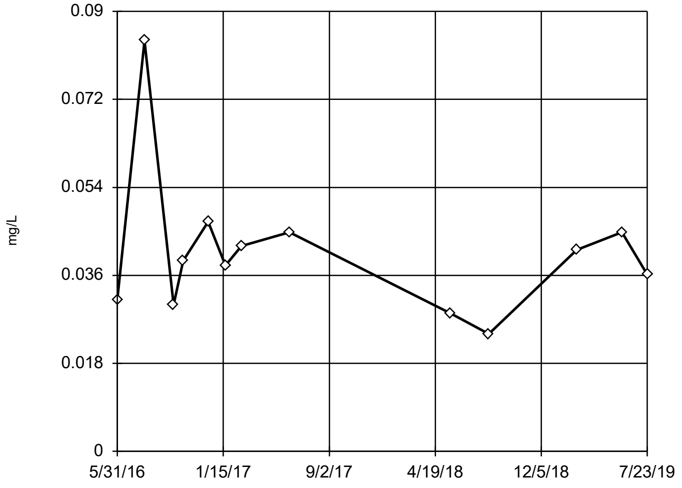
High cutoff = 0.7226, low cutoff = 0.002007, based on IQR multiplier of 3.

Constituent: Barium, total   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-14



n = 13

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

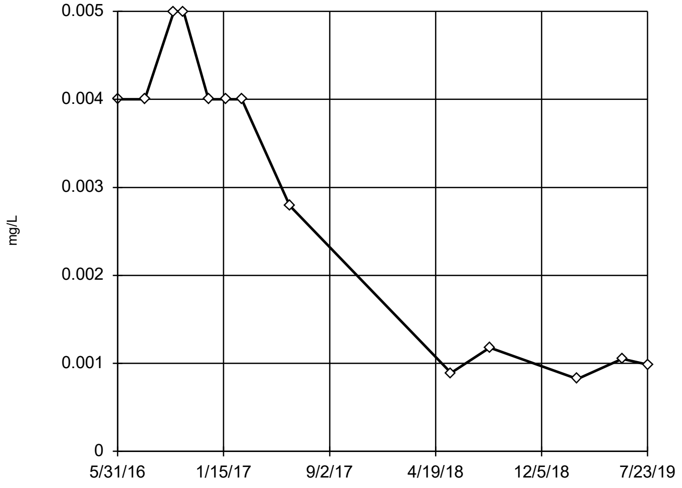
High cutoff = 0.1422, low cutoff = 0.009609, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 13

No outliers found.
Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

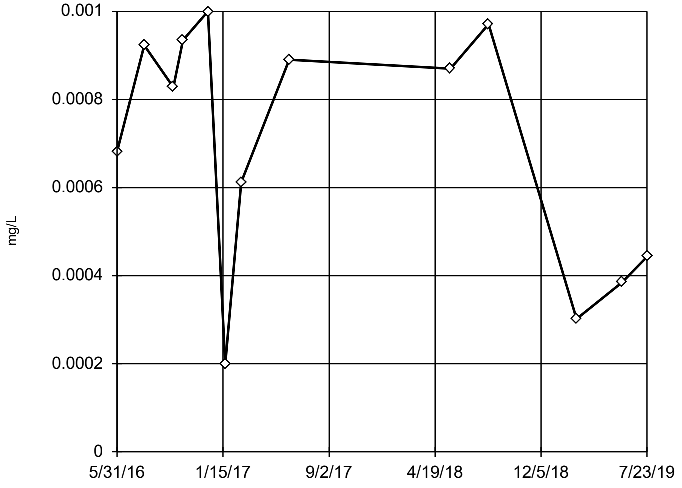
High cutoff = 0.007803, low cutoff = -0.006622, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 13

No outliers found.
Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

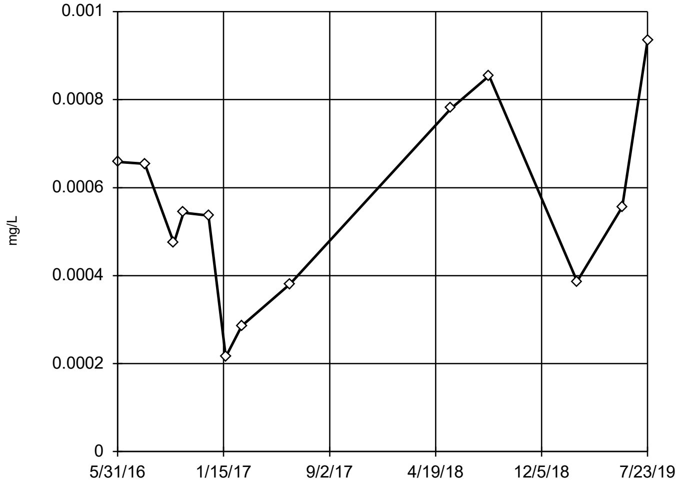
High cutoff = 0.00144, low cutoff = -0.001284, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-14



n = 13

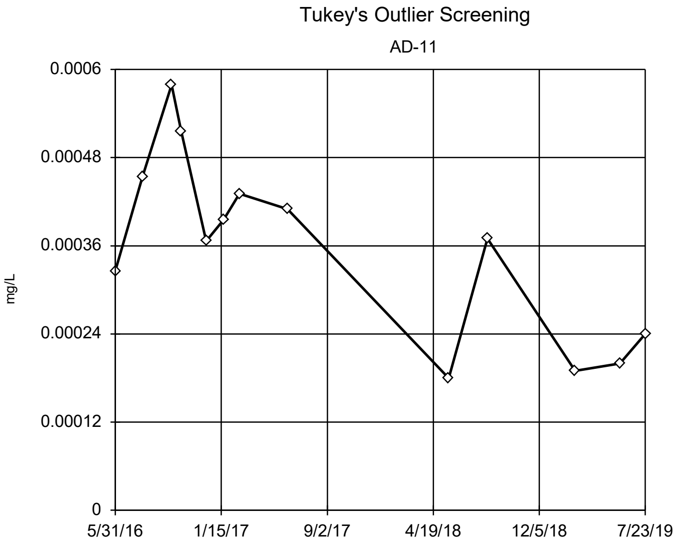
No outliers found.
Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.002345, low cutoff = -0.000004208, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG



n = 13

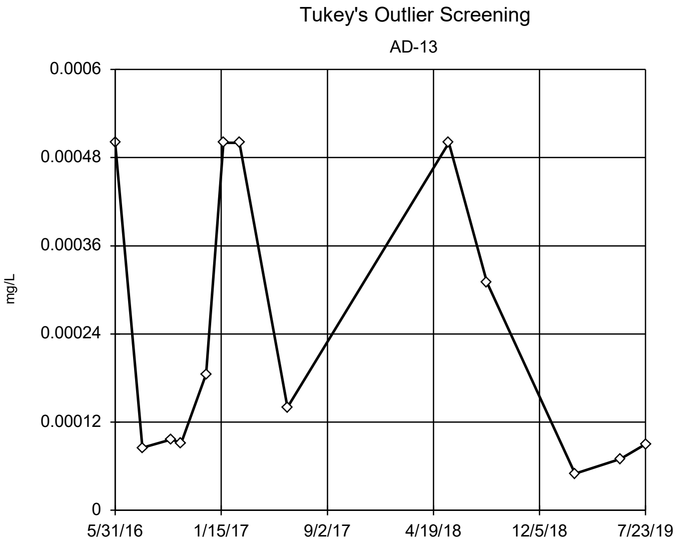
No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 0.001109, low cutoff = -0.0004469, based on IQR multiplier of 3.

Constituent: Cadmium, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG



n = 13

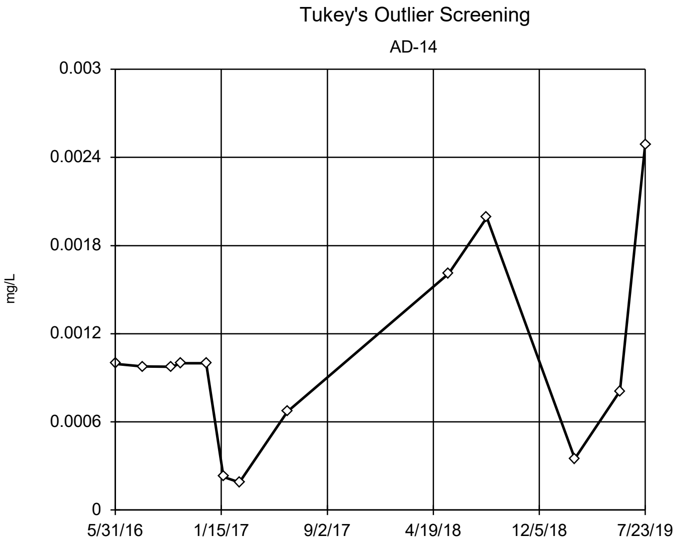
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.09341, low cutoff = 4.7e-7, based on IQR multiplier of 3.

Constituent: Cadmium, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG



n = 13

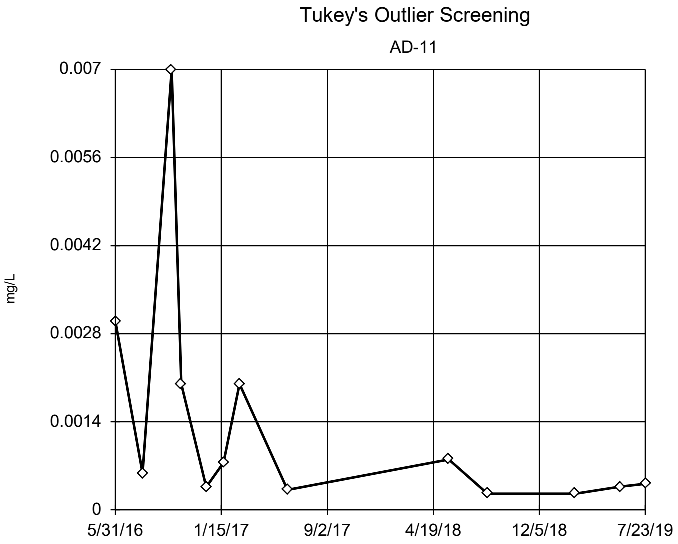
No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.005869, low cutoff = -0.0003399, based on IQR multiplier of 3.

Constituent: Cadmium, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

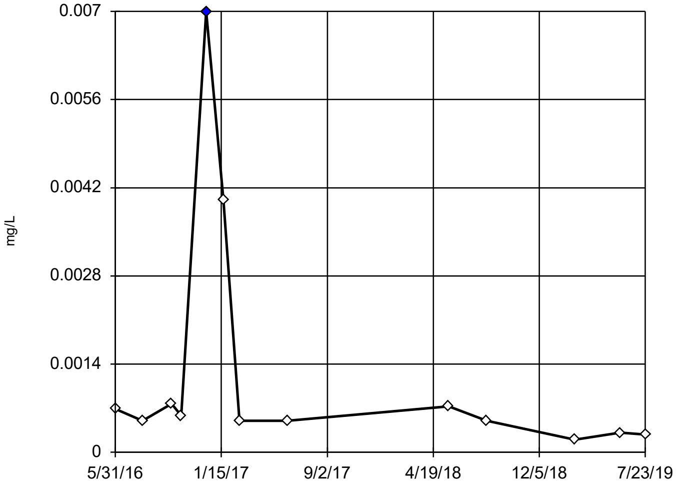
High cutoff = 0.4005, low cutoff = 0.000001707, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 13

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

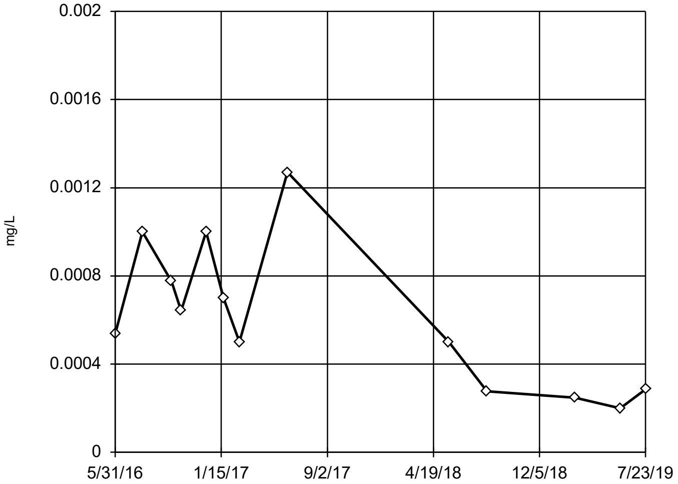
High cutoff = 0.005201, low cutoff = 0.00005681, based on IQR multiplier of 3.

Constituent: Chromium, total   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-14



n = 13

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

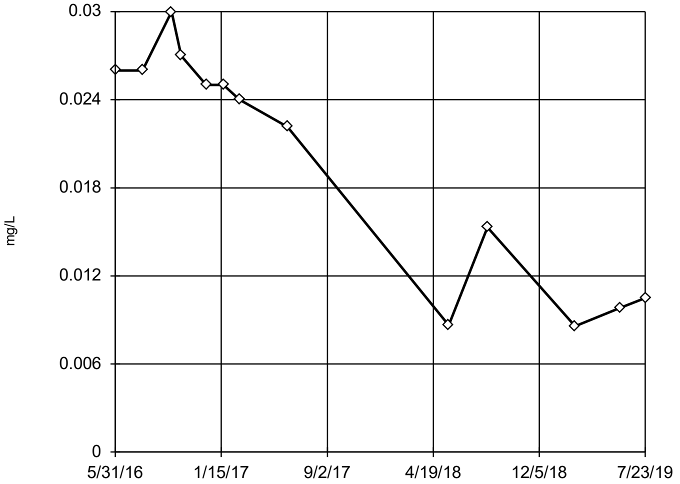
High cutoff = 0.006562, low cutoff = -0.00001716, based on IQR multiplier of 3.

Constituent: Chromium, total   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 13

No outliers found. Tukey's method selected by user.

Data were x^4 transformed to achieve best W statistic (graph shown in original units).

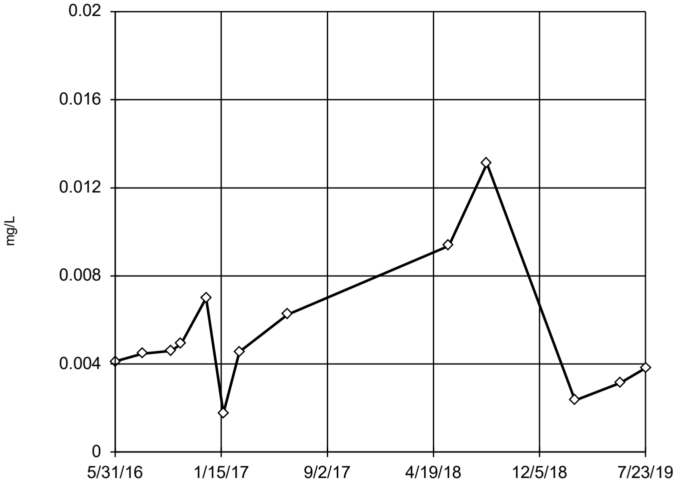
High cutoff = 0.03661, low cutoff = -0.03395, based on IQR multiplier of 3.

Constituent: Cobalt, total   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 13

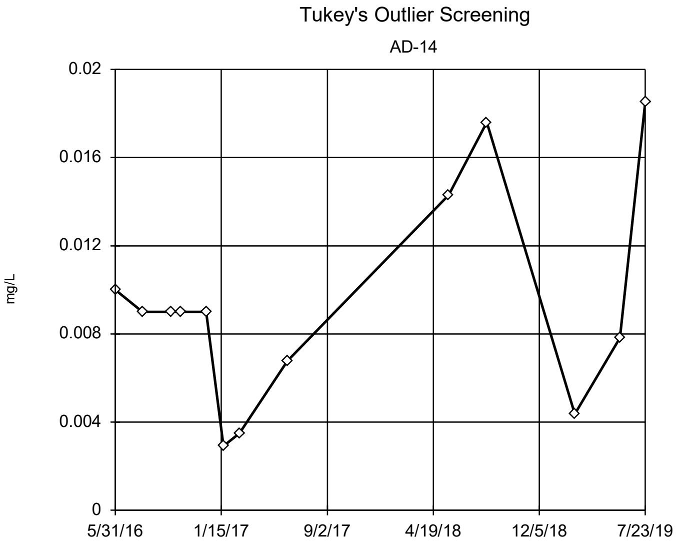
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.04571, low cutoff = 0.0005016, based on IQR multiplier of 3.

Constituent: Cobalt, total   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG



n = 13

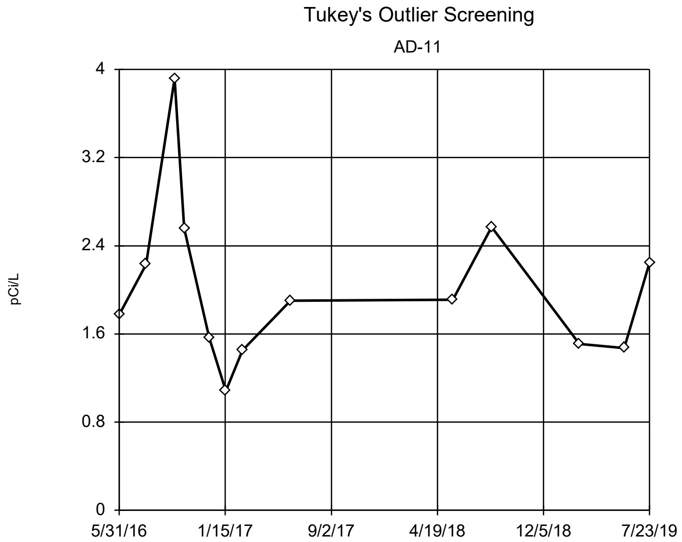
No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.05805, low cutoff = 0.000006095, based on IQR multiplier of 3.

Constituent: Cobalt, total   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG



n = 13

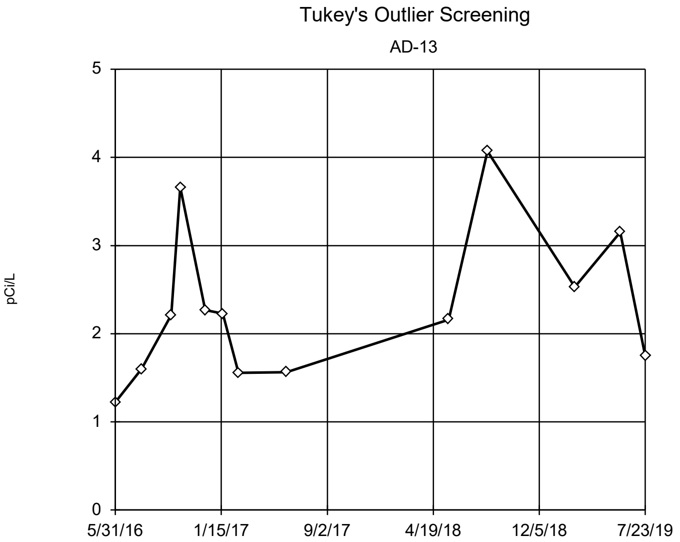
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 9.966, low cutoff = 0.3588, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG



n = 13

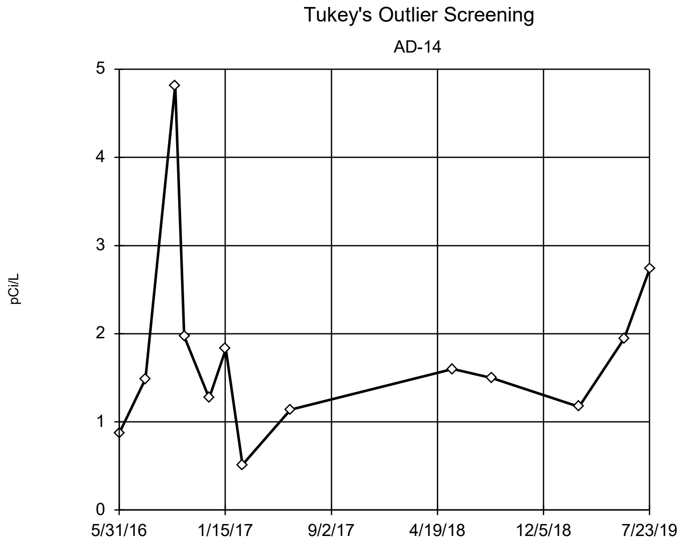
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 16.01, low cutoff = 0.279, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

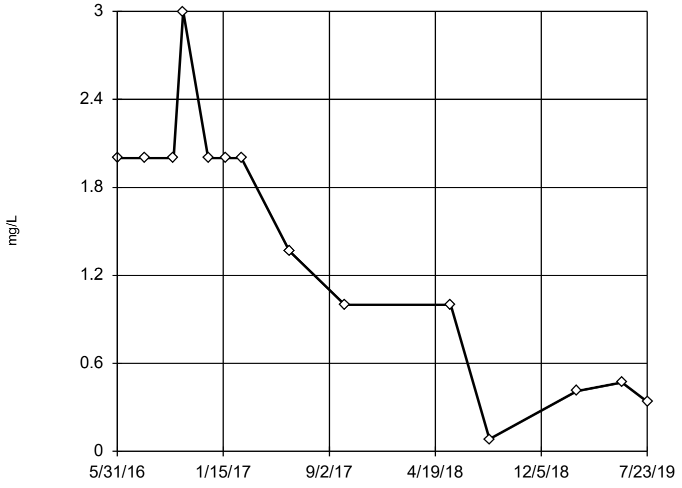
High cutoff = 9.585, low cutoff = 0.2358, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 14

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

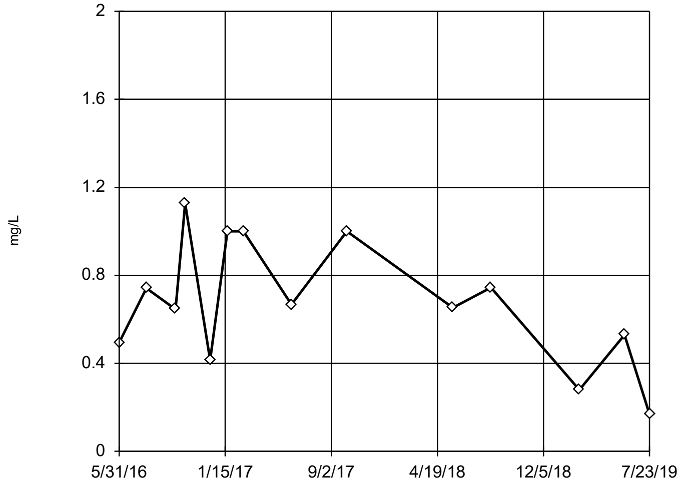
High cutoff = 6.68, low cutoff = -4.24, based on IQR multiplier of 3.

Constituent: Fluoride, total   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 14

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

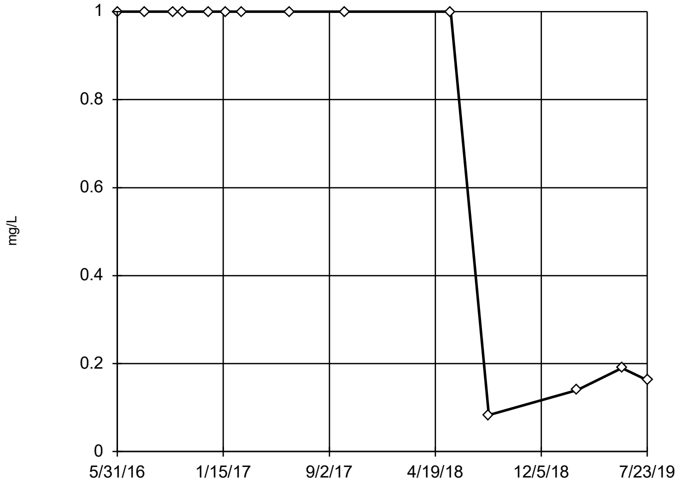
High cutoff = 2.635, low cutoff = -1.181, based on IQR multiplier of 3.

Constituent: Fluoride, total   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-14



n = 14

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

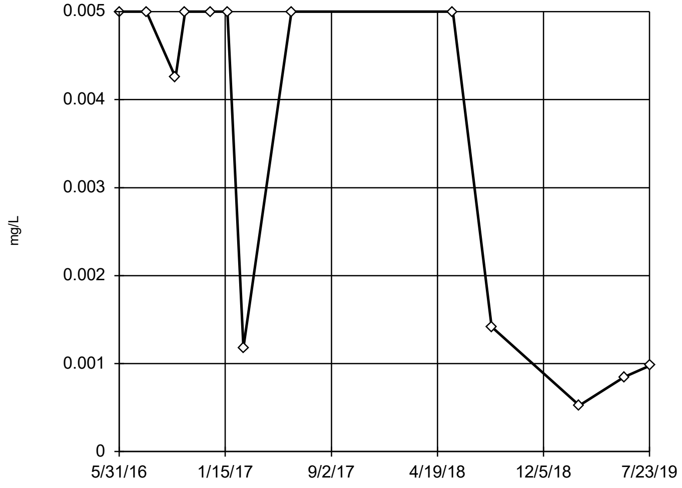
High cutoff = 185.2, low cutoff = 0.0009474, based on IQR multiplier of 3.

Constituent: Fluoride, total   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

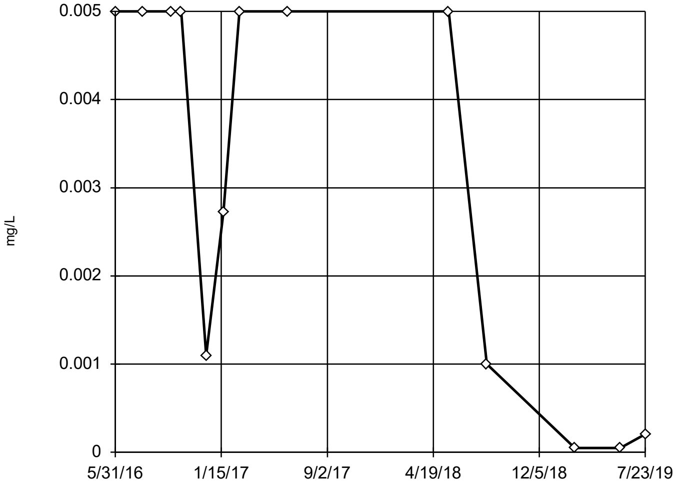
High cutoff = 0.5038, low cutoff = 0.00001066, based on IQR multiplier of 3.

Constituent: Lead, total   Analysis Run 11/20/2019 1:20 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 13

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

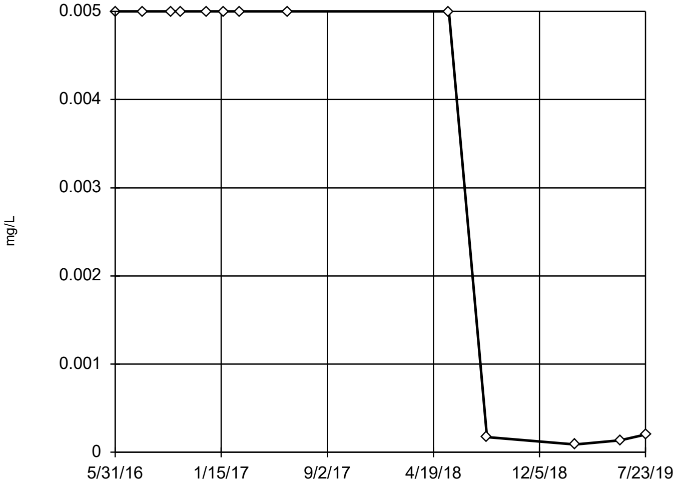
High cutoff = 0.04579, low cutoff = -0.01448, based on IQR multiplier of 3.

Constituent: Lead, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-14



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

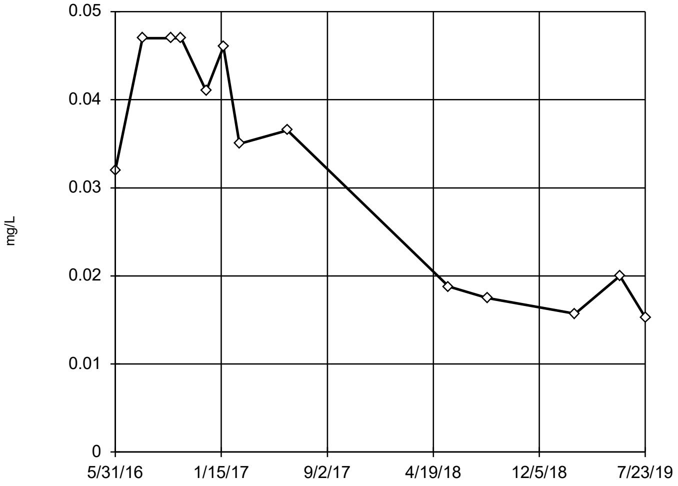
High cutoff = 96.27, low cutoff = 9.7e-9, based on IQR multiplier of 3.

Constituent: Lead, total Analysis Run 11/20/2019 1:20 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

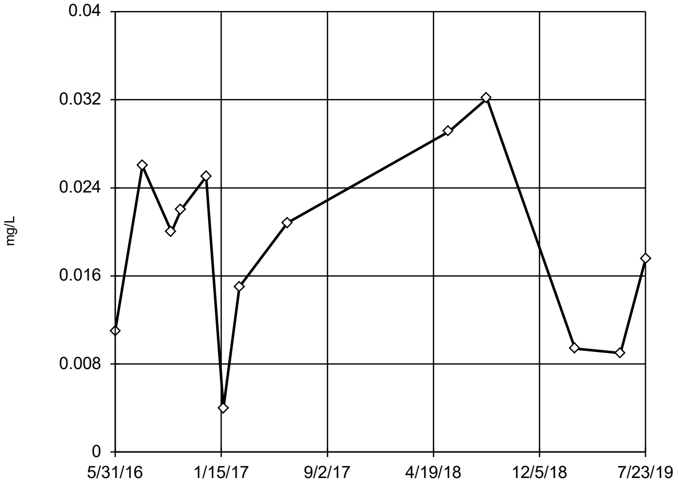
High cutoff = 0.1316, low cutoff = -0.0669, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 11/20/2019 1:21 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

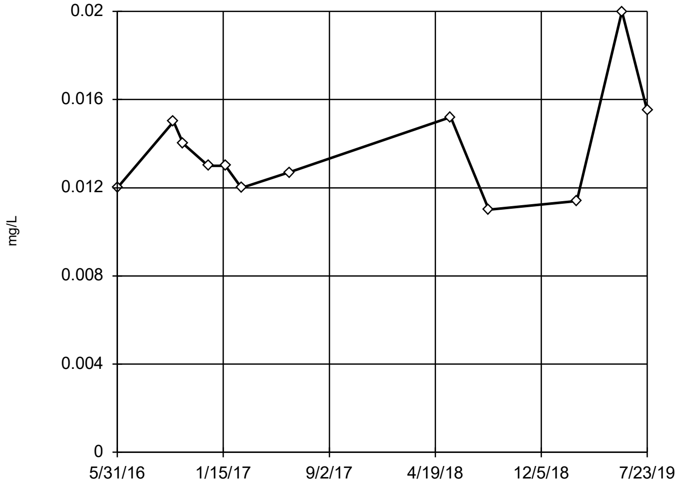
High cutoff = 0.0714, low cutoff = -0.0357, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 11/20/2019 1:21 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-14



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

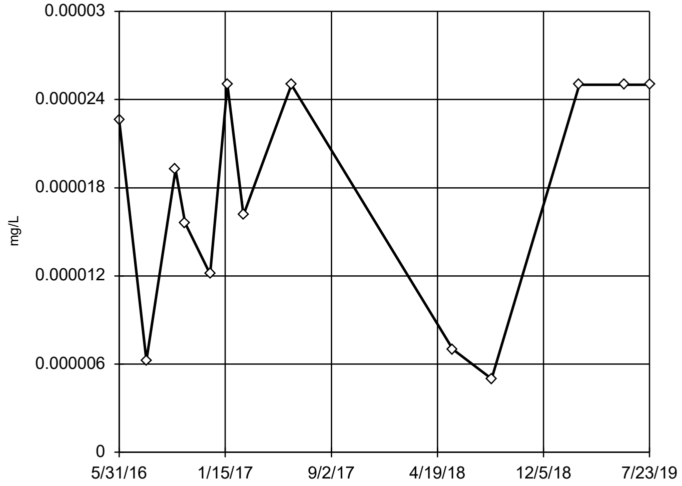
High cutoff = 0.03008, low cutoff = 0.006023, based on IQR multiplier of 3.

Constituent: Lithium, total   Analysis Run 11/20/2019 1:21 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

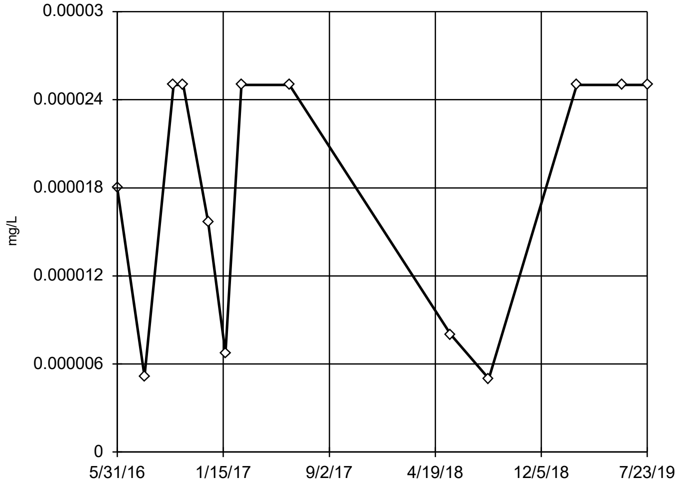
High cutoff = 0.00007132, low cutoff = -0.00003676, based on IQR multiplier of 3.

Constituent: Mercury, total   Analysis Run 11/20/2019 1:21 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

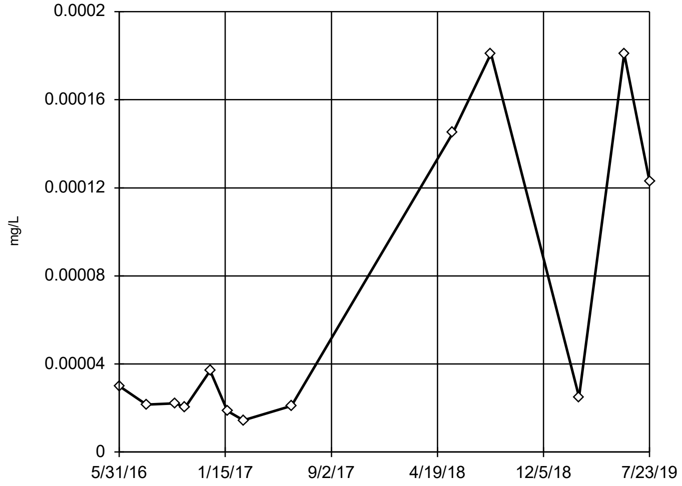
High cutoff = 0.0000779, low cutoff = -0.00004554, based on IQR multiplier of 3.

Constituent: Mercury, total   Analysis Run 11/20/2019 1:21 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-14



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

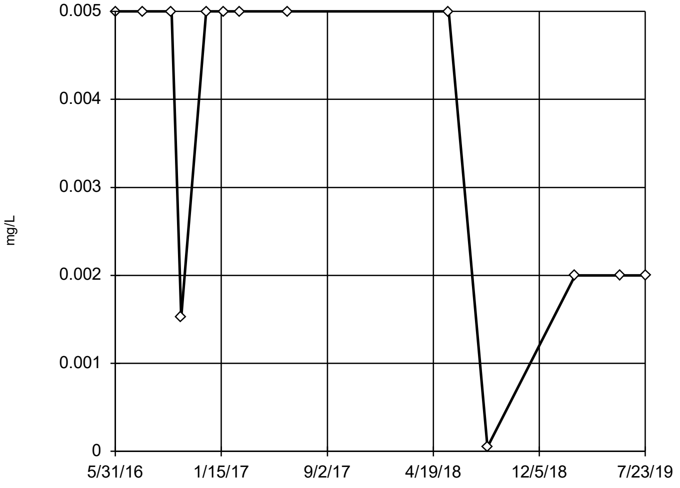
High cutoff = 0.0363, low cutoff = 7.6e-8, based on IQR multiplier of 3.

Constituent: Mercury, total   Analysis Run 11/20/2019 1:21 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

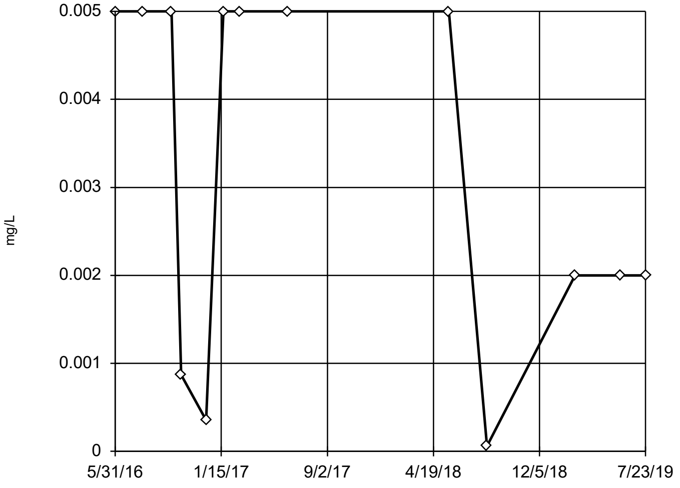
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Molybdenum, total   Analysis Run 11/20/2019 1:21 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 13

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

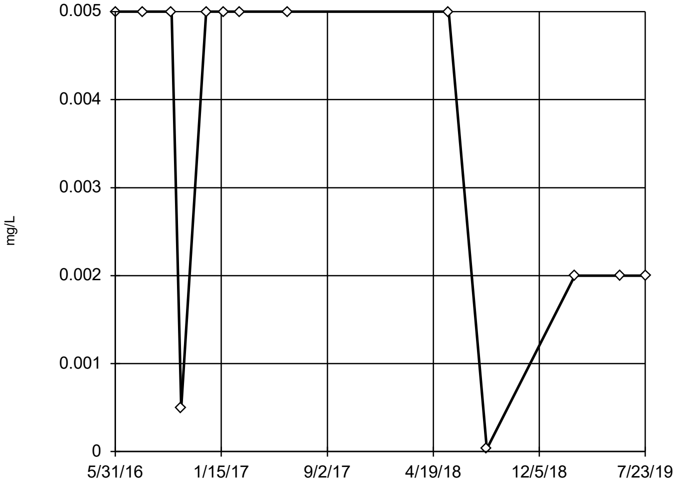
High cutoff = 0.02941, low cutoff = -0.004055, based on IQR multiplier of 3.

Constituent: Molybdenum, total   Analysis Run 11/20/2019 1:21 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-14



n = 13

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

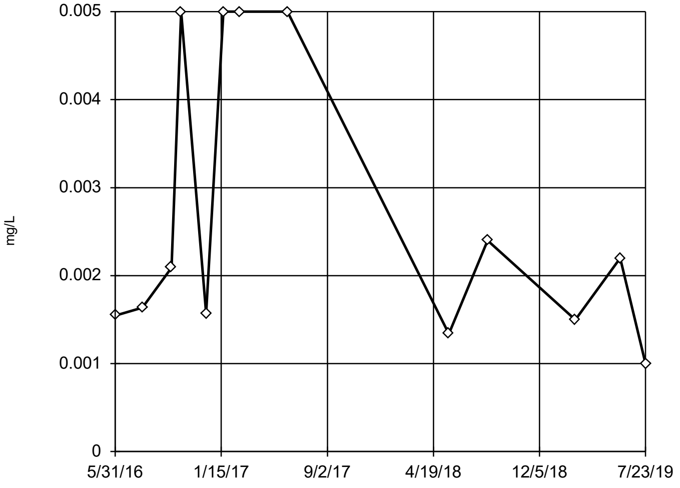
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Molybdenum, total   Analysis Run 11/20/2019 1:21 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

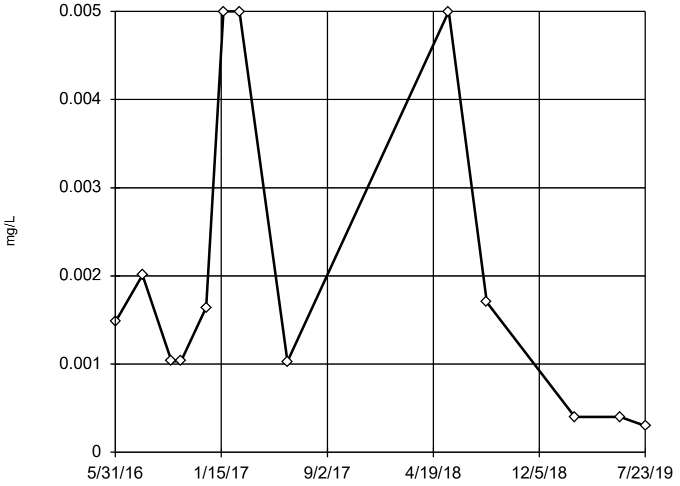
High cutoff = 0.1769, low cutoff = 0.00004305, based on IQR multiplier of 3.

Constituent: Selenium, total   Analysis Run 11/20/2019 1:21 PM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

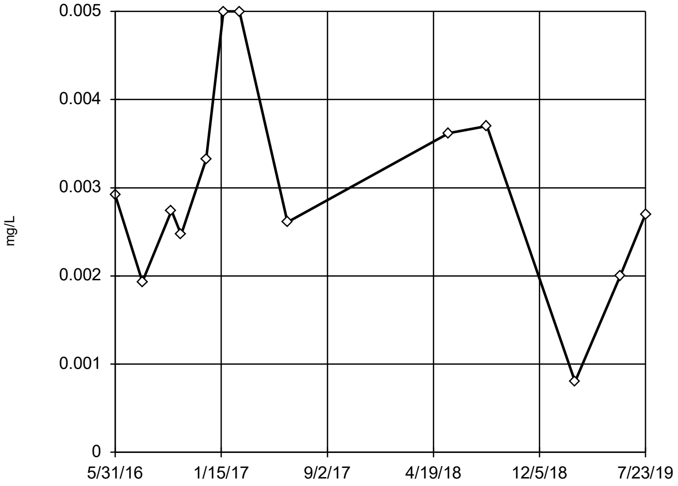
High cutoff = 0.3819, low cutoff = 0.000005328, based on IQR multiplier of 3.

Constituent: Selenium, total Analysis Run 11/20/2019 1:21 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-14



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

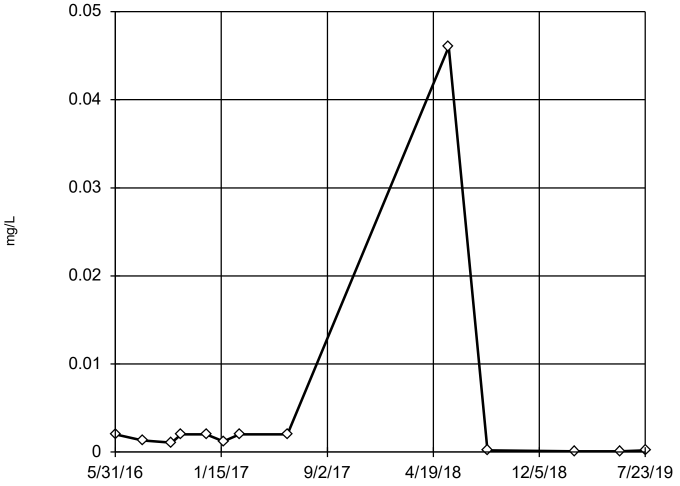
High cutoff = 0.007936, low cutoff = -0.002042, based on IQR multiplier of 3.

Constituent: Selenium, total Analysis Run 11/20/2019 1:21 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-11



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

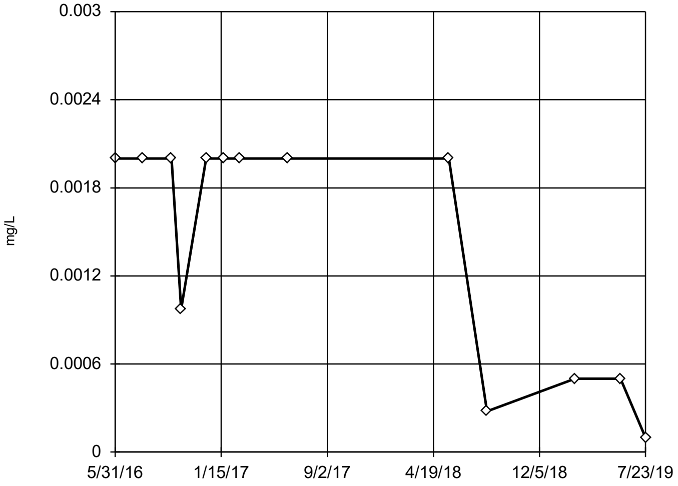
High cutoff = 2, low cutoff = 2.0e-7, based on IQR multiplier of 3.

Constituent: Thallium, total Analysis Run 11/20/2019 1:21 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-13



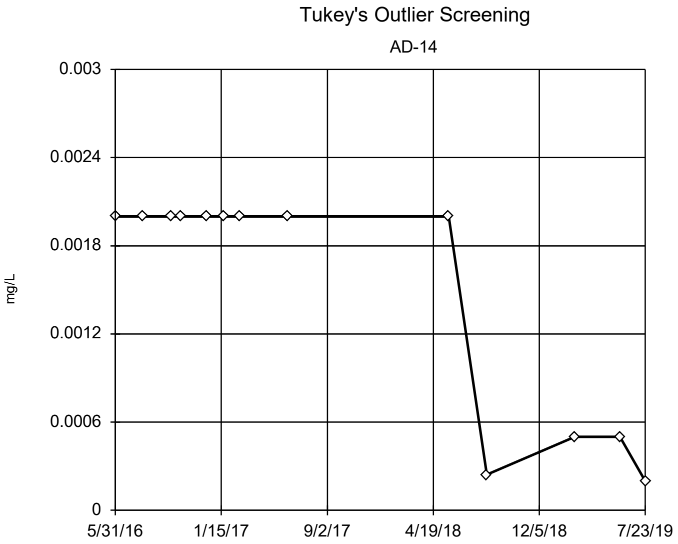
n = 13

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Thallium, total Analysis Run 11/20/2019 1:21 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF



n = 13

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Thallium, total Analysis Run 11/20/2019 1:21 PM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Mann-Whitney - Significant Results

Welsh LF   Client: Geosyntec   Data: Welsh LF   Printed 12/8/2019, 3:23 PM

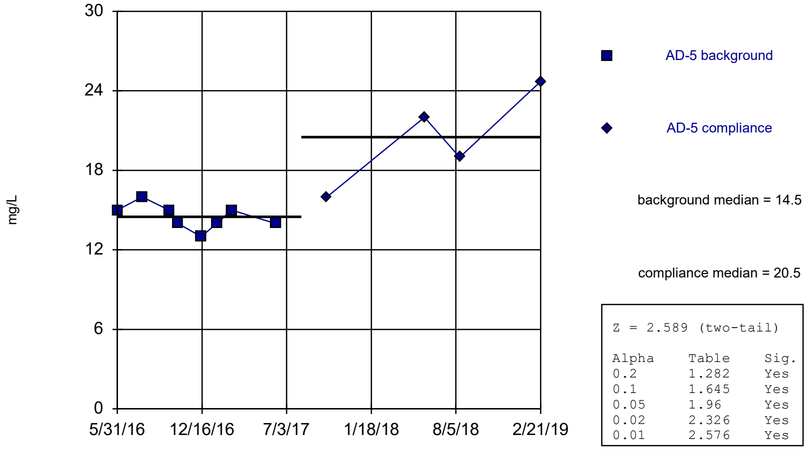
Constituent	Well	Calc.	0.01	Sig.	Method
Chloride, total (mg/L)	**AD-5 (bg)**	**2.589**	**Yes**	**Yes**	**Mann-W**
Sulfate, total (mg/L)	**AD-11**	**-2.633**	**Yes**	**Yes**	**Mann-W**

Mann-Whitney - All Results

Welsh LF   Client: Geosyntec   Data: Welsh LF   Printed 12/8/2019, 3:23 PM

Constituent	Well	Calc.	0.01	Sig.	Method
Calcium, total (mg/L)	AD-5 (bg)	-2.123	No	No	Mann-W
Calcium, total (mg/L)	AD-11	-1.444	No	No	Mann-W
Calcium, total (mg/L)	AD-13	1.104	No	No	Mann-W
Calcium, total (mg/L)	AD-14	1.021	No	No	Mann-W
Calcium, total (mg/L)	AD-1 (bg)	-1.274	No	No	Mann-W
Calcium, total (mg/L)	AD-17 (bg)	-0.9358	No	No	Mann-W
Chloride, total (mg/L)	**AD-5 (bg)**	**2.589**	**Yes**	**Yes**	**Mann-W**
Chloride, total (mg/L)	AD-11	-0.1073	No	No	Mann-W
Chloride, total (mg/L)	AD-13	-0.7194	No	No	Mann-W
Chloride, total (mg/L)	AD-14	1.306	No	No	Mann-W
Chloride, total (mg/L)	AD-1 (bg)	-1.051	No	No	Mann-W
Chloride, total (mg/L)	AD-17 (bg)	1.366	No	No	Mann-W
Sulfate, total (mg/L)	AD-5 (bg)	-1.531	No	No	Mann-W
Sulfate, total (mg/L)	**AD-11**	**-2.633**	**Yes**	**Yes**	**Mann-W**
Sulfate, total (mg/L)	AD-13	1.444	No	No	Mann-W
Sulfate, total (mg/L)	AD-14	0.9207	No	No	Mann-W
Sulfate, total (mg/L)	AD-1 (bg)	0.6866	No	No	Mann-W
Sulfate, total (mg/L)	AD-17 (bg)	-0.08507	No	No	Mann-W
Total Dissolved Solids (mg/L)	AD-5 (bg)	-1.953	No	No	Mann-W
Total Dissolved Solids (mg/L)	AD-11	-2.123	No	No	Mann-W
Total Dissolved Solids (mg/L)	AD-13	0.5944	No	No	Mann-W
Total Dissolved Solids (mg/L)	AD-14	0.7144	No	No	Mann-W
Total Dissolved Solids (mg/L)	AD-1 (bg)	-1.786	No	No	Mann-W
Total Dissolved Solids (mg/L)	AD-17 (bg)	0.9341	No	No	Mann-W

Mann-Whitney (Wilcoxon Rank Sum)

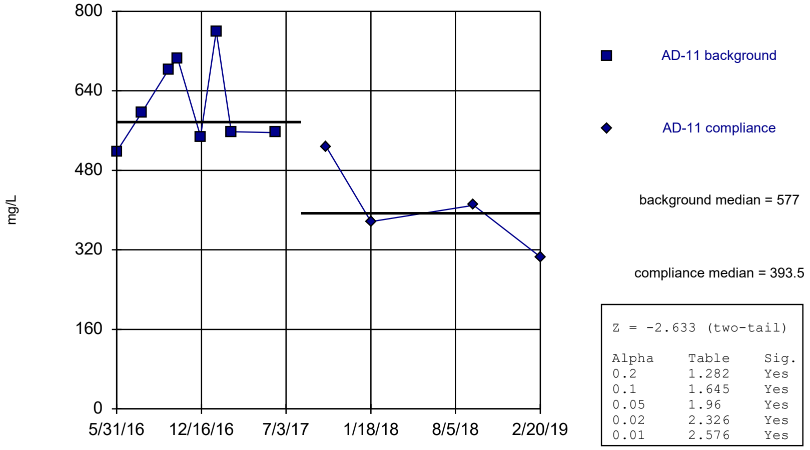


```
Z = 2.589 (two-tail)

Alpha     Table     Sig.
0.2       1.282     Yes
0.1       1.645     Yes
0.05      1.96      Yes
0.02      2.326     Yes
0.01      2.576     Yes
```

Constituent: Chloride, total   Analysis Run 12/8/2019 3:10 PM   View: Mann Whitney
Welsh LF   Client: Geosyntec   Data: Welsh LF

Mann-Whitney (Wilcoxon Rank Sum)



```
Z = -2.633 (two-tail)

Alpha     Table     Sig.
0.2       1.282     Yes
0.1       1.645     Yes
0.05      1.96      Yes
0.02      2.326     Yes
0.01      2.576     Yes
```

Constituent: Sulfate, total   Analysis Run 12/8/2019 3:10 PM   View: Mann Whitney
Welsh LF   Client: Geosyntec   Data: Welsh LF

Intrawell Prediction Limit Summary

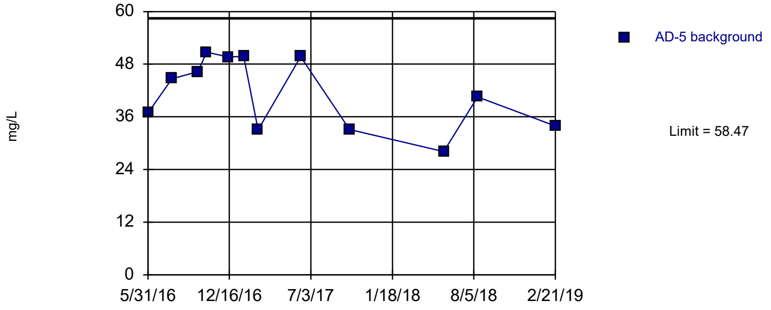
Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/8/2019, 3:34 PM

Constituent	Well	Upper Lim.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Calcium, total (mg/L)	AD-5	58.47	n/a	12	41.36	8.1	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-11	17.13	n/a	12	3.021	0.5295	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-13	28.43	n/a	12	2.755	1.22	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-14	12.23	n/a	12	5.119	3.367	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-1	206	n/a	12	3.196	1.283	0	None	x^(1/3)	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-17	206.7	n/a	12	193.3	6.384	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-5	24.25	n/a	12	4.039	0.4191	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-11	14.32	n/a	11	3.256	0.2425	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-13	24	n/a	11	13.72	4.724	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-14	11.47	n/a	12	5.636	2.764	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-1	9	n/a	12	n/a	n/a	0	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Chloride, total (mg/L)	AD-17	45.62	n/a	12	35.02	5.02	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-5	318.3	n/a	12	154	77.83	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-11	829.3	n/a	12	545.4	134.4	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-13	421.9	n/a	12	228.4	91.62	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-14	188.9	n/a	11	4.854	0.4062	0	None	x^(1/3)	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-1	70.37	n/a	12	3.801	0.2145	0	None	ln(x)	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-17	1445	n/a	12	n/a	n/a	0	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Total Dissolved Solids (mg/L)	AD-5	542	n/a	12	351.4	90.26	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-11	1326	n/a	12	831.9	233.8	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-13	880.8	n/a	12	493.9	183.2	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-14	369.2	n/a	11	273.3	44.1	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	AD-1	612	n/a	12	n/a	n/a	0	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Total Dissolved Solids (mg/L)	AD-17	1872	n/a	12	1664	98.5	0	None	No	0.002505	Param Intra 1 of 2

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



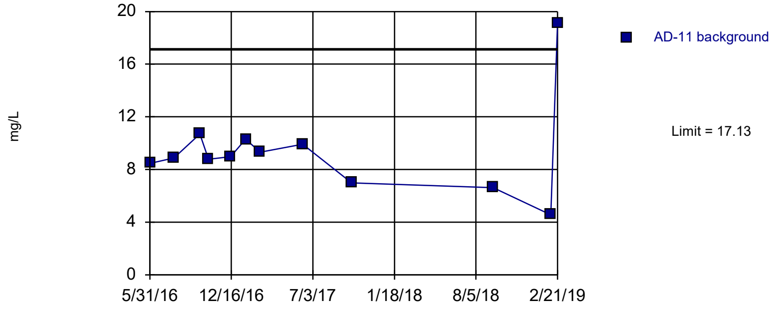
Background Data Summary: Mean=41.36, Std. Dev.=8.1, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8897, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-11



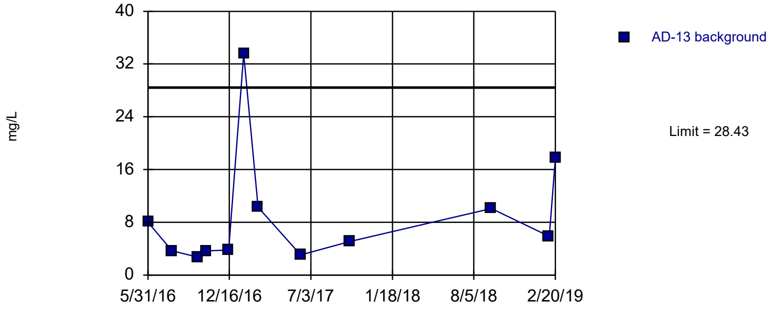
Background Data Summary (based on square root transformation): Mean=3.021, Std. Dev.=0.5295, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.868, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-13



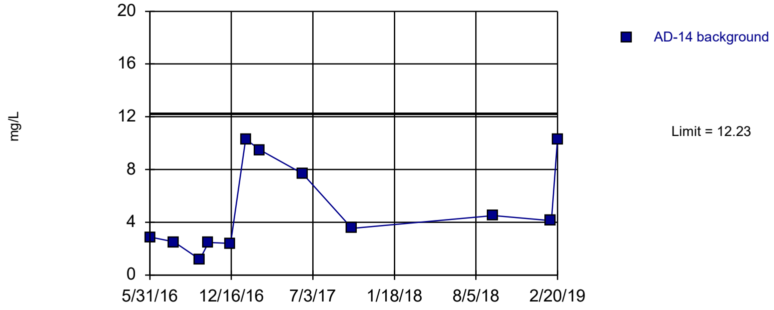
Background Data Summary (based on square root transformation): Mean=2.755, Std. Dev.=1.22, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8264, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-14



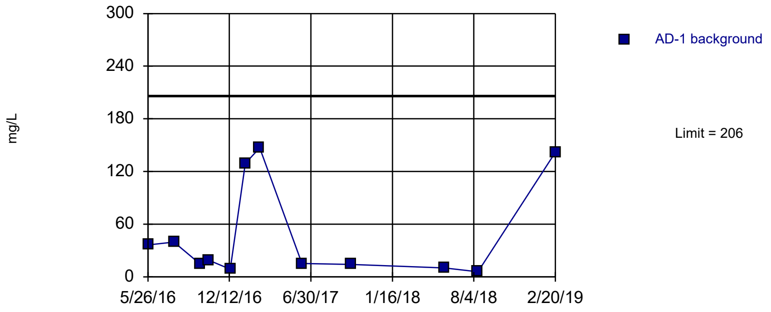
Background Data Summary: Mean=5.119, Std. Dev.=3.367, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8416, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



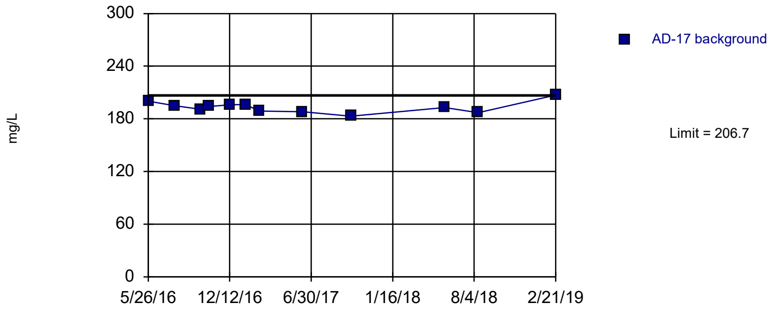
Background Data Summary (based on cube root transformation): Mean=3.196, Std. Dev.=1.283, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8246, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



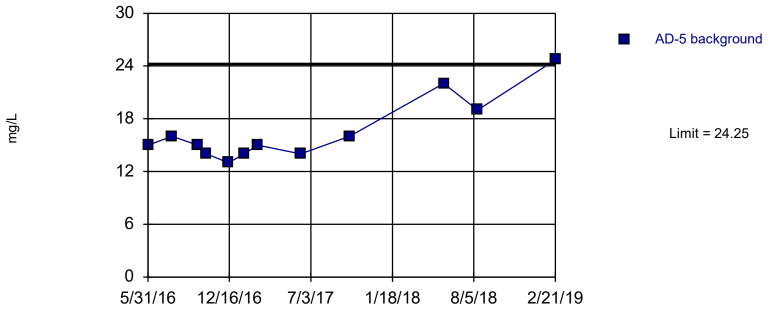
Background Data Summary: Mean=193.3, Std. Dev.=6.384, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9698, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



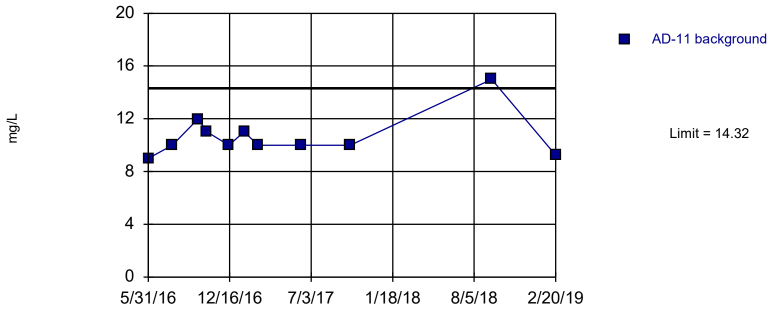
Background Data Summary (based on square root transformation): Mean=4.039, Std. Dev.=0.4191, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8217, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-11



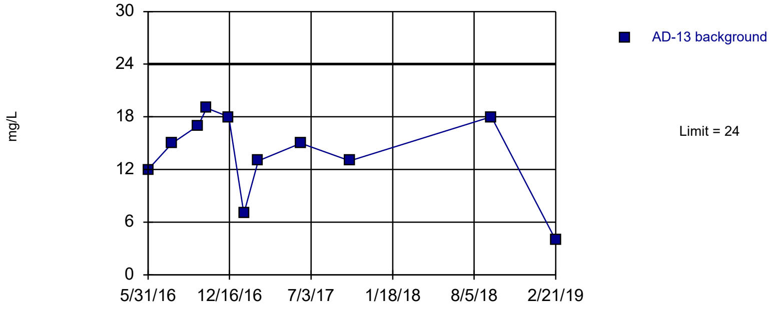
Background Data Summary (based on square root transformation): Mean=3.256, Std. Dev.=0.2425, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8026, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-13



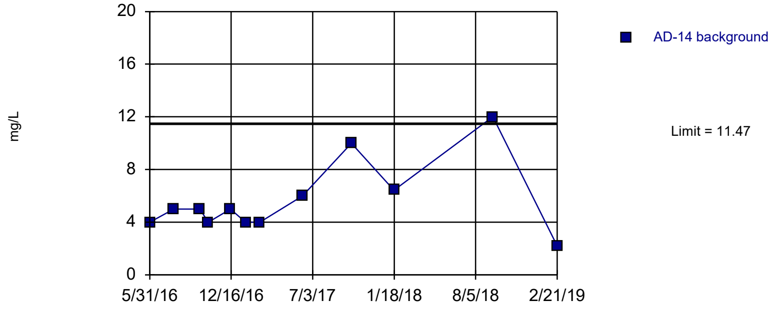
Background Data Summary: Mean=13.72, Std. Dev.=4.724, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8963, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-14



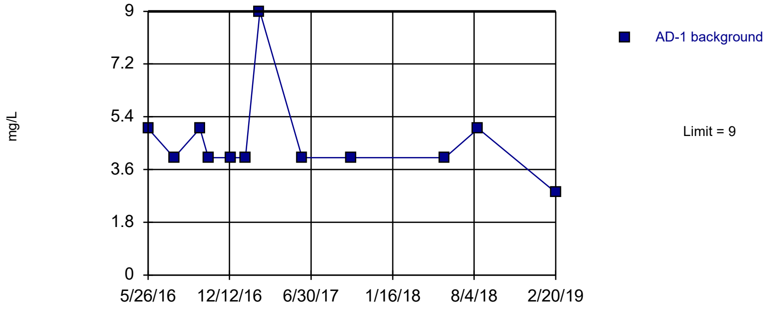
Background Data Summary: Mean=5.636, Std. Dev.=2.764, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8278, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, AD-1 (bg)



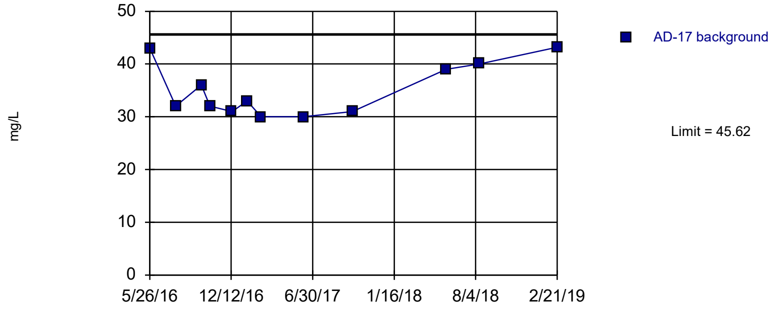
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



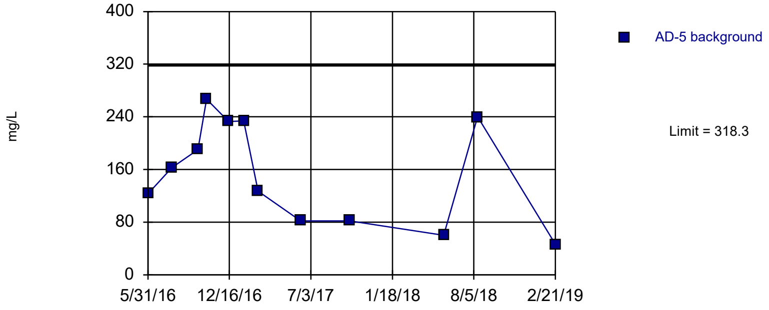
Background Data Summary: Mean=35.02, Std. Dev.=5.02, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8477, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



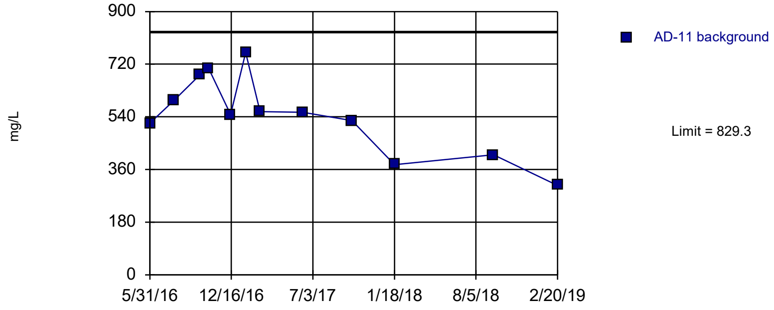
Background Data Summary: Mean=154, Std. Dev.=77.83, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.919, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-11



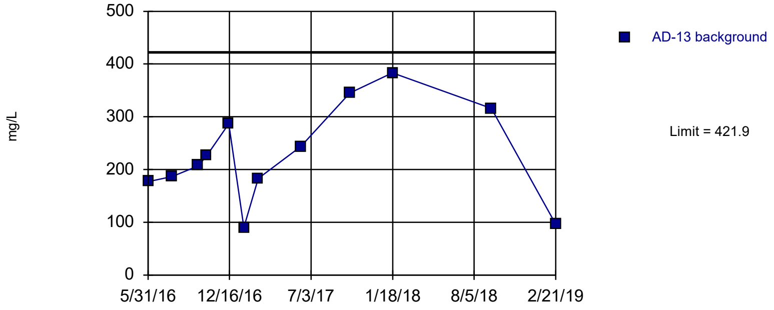
Background Data Summary: Mean=545.4, Std. Dev.=134.4, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9632, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-13



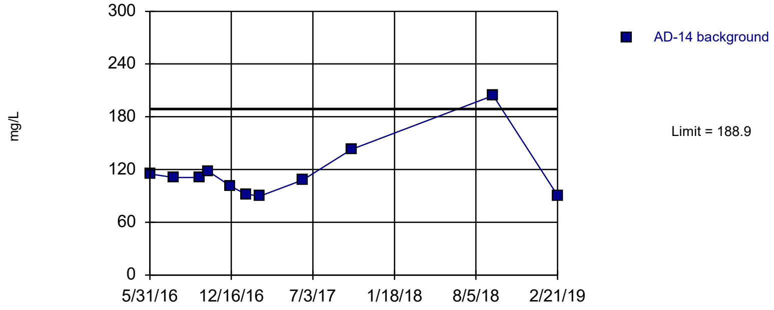
Background Data Summary: Mean=228.4, Std. Dev.=91.62, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9622, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-14



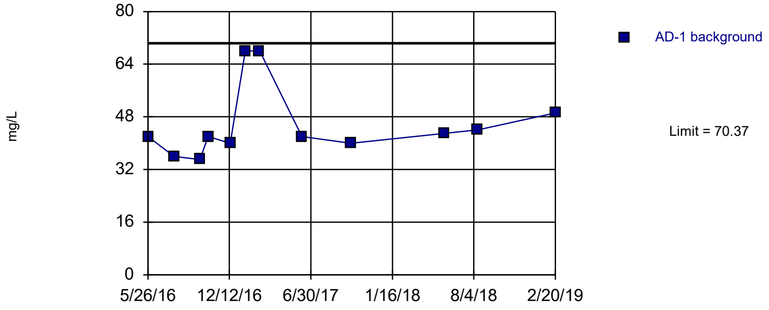
Background Data Summary (based on cube root transformation): Mean=4.854, Std. Dev.=0.4062, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8065, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-1 (bg)



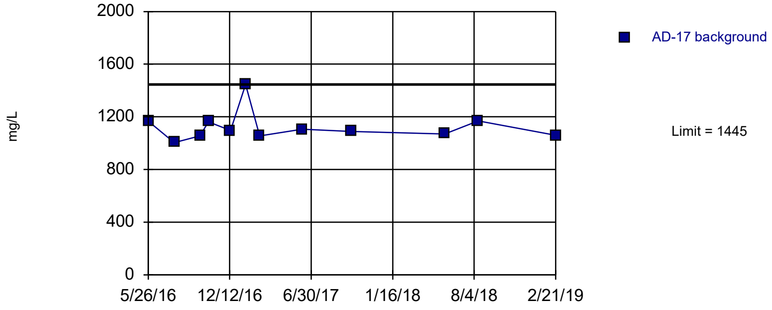
Background Data Summary (based on natural log transformation): Mean=3.801, Std. Dev.=0.2145, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.812, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, AD-17 (bg)



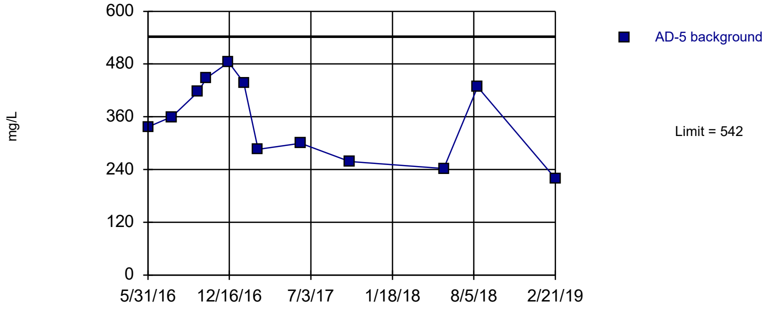
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-5 (bg)



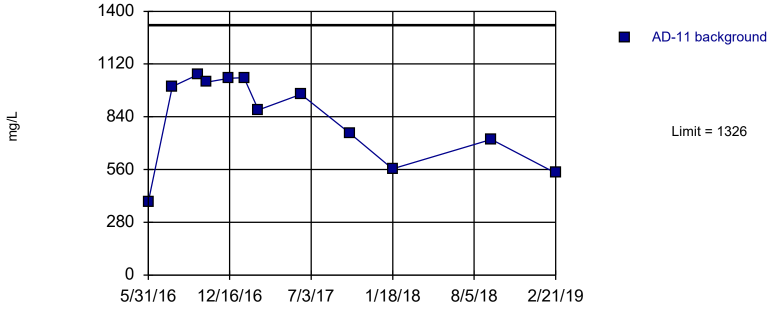
Background Data Summary: Mean=351.4, Std. Dev.=90.26, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9333, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-11



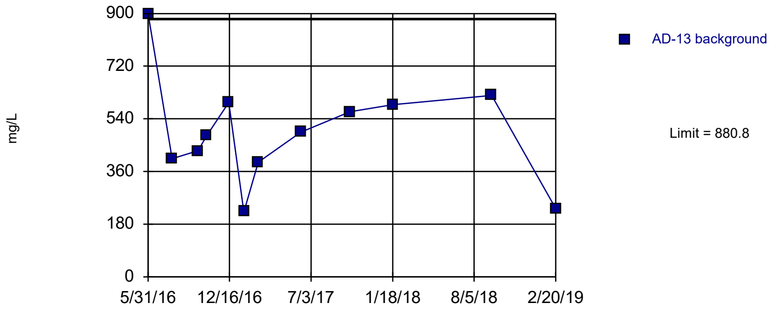
Background Data Summary: Mean=831.9, Std. Dev.=233.8, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8746, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-13



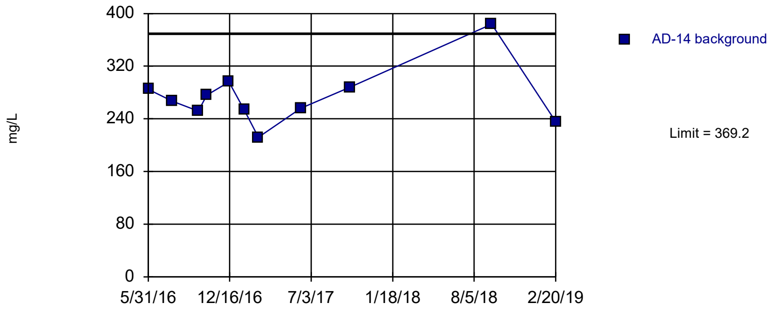
Background Data Summary: Mean=493.9, Std. Dev.=183.2, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9408, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-14



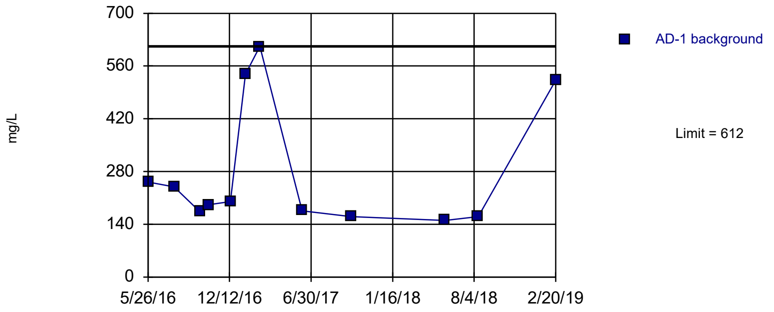
Background Data Summary: Mean=273.3, Std. Dev.=44.1, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8716, critical = 0.792. Kappa = 2.175 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, AD-1 (bg)



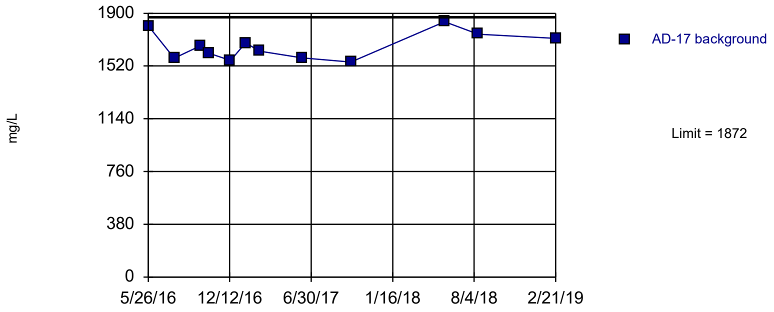
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-17 (bg)



Background Data Summary: Mean=1664, Std. Dev.=98.5, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9253, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

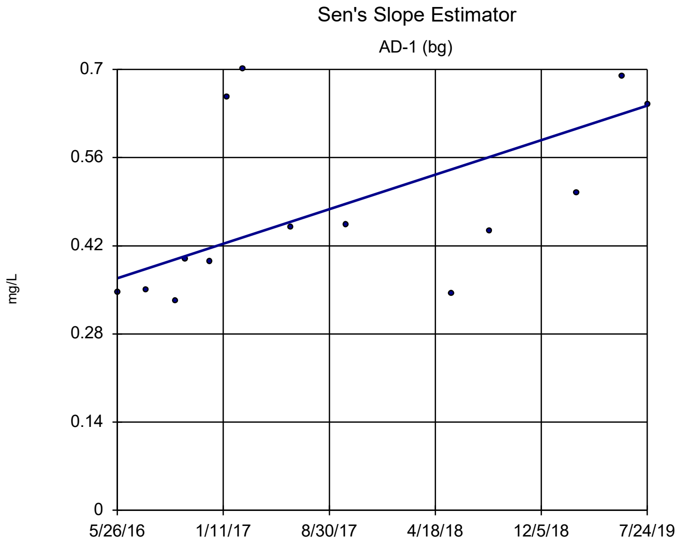
Constituent: Total Dissolved Solids Analysis Run 12/8/2019 3:31 PM View: PL's - Intrawell
Welsh LF Client: Geosyntec Data: Welsh LF

Trend Test Summary Table - All Results (No Significant)

Welsh Landfill   Client: Geosyntec   Data: Welsh LF   Printed 11/22/2019, 4:51 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	AD-1 (bg)	0.08662	41	48	No	14	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-17 (bg)	0.01085	21	48	No	14	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-5 (bg)	0	3	48	No	14	0	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-1 (bg)	0	-34	-48	No	14	78.57	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-17 (bg)	0	0	48	No	14	50	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-5 (bg)	0	-17	-48	No	14	64.29	n/a	n/a	0.01	NP
pH, field (SU)	AD-1 (bg)	0.01649	4	48	No	14	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-17 (bg)	-0.05848	-9	-48	No	14	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-5 (bg)	0.07449	23	48	No	14	0	n/a	n/a	0.01	NP

Sanitas™ v.9.6.23 . UG



n = 14

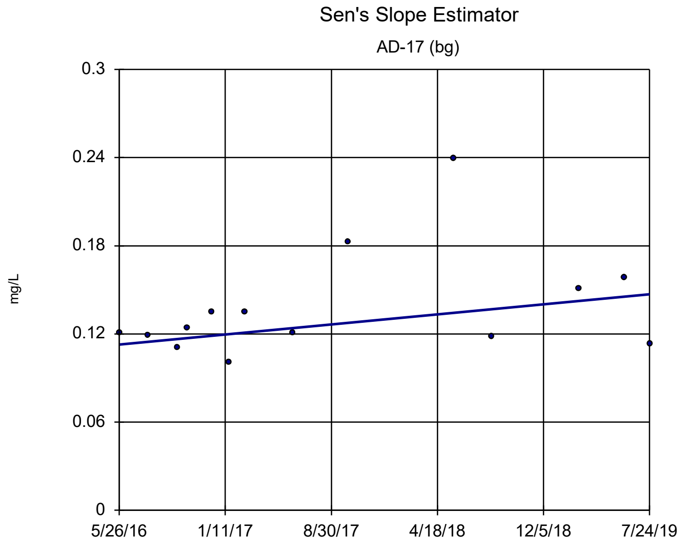
Slope = 0.08662
units per year.

Mann-Kendall
statistic = 41
critical = 48

Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Boron, total Analysis Run 11/22/2019 4:51 PM View: Interwell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG



n = 14

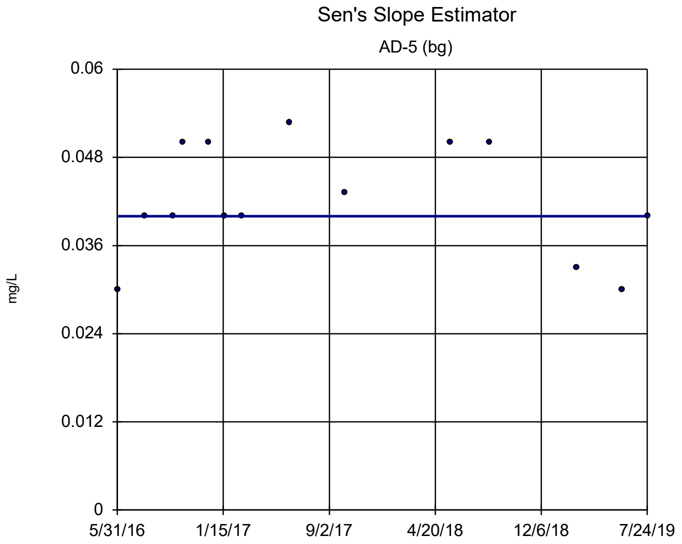
Slope = 0.01085
units per year.

Mann-Kendall
statistic = 21
critical = 48

Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Boron, total Analysis Run 11/22/2019 4:51 PM View: Interwell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG



n = 14

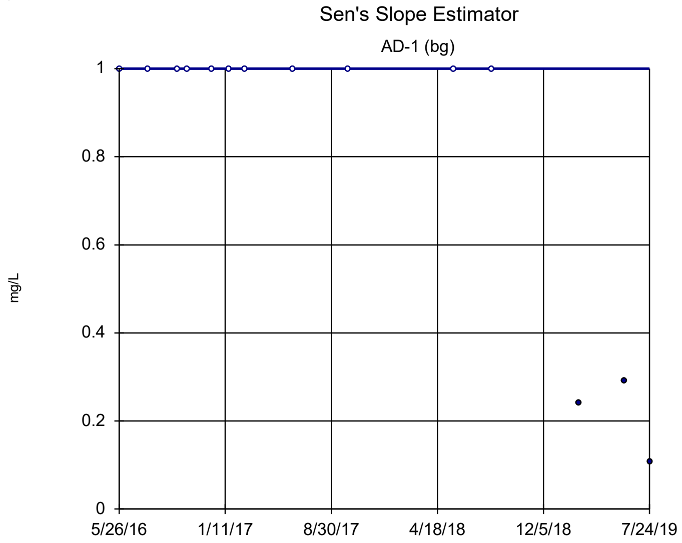
Slope = 0
units per year.

Mann-Kendall
statistic = 3
critical = 48

Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Boron, total Analysis Run 11/22/2019 4:51 PM View: Interwell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG
Hollow symbols indicate censored values.



n = 14

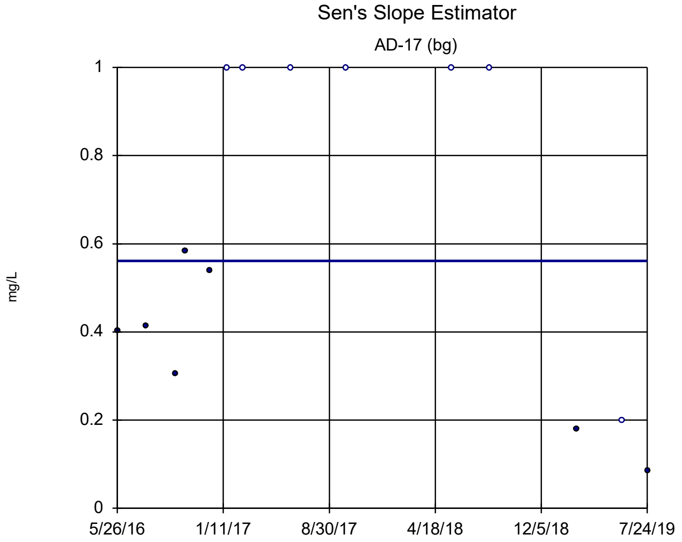
Slope = 0
units per year.

Mann-Kendall
statistic = -34
critical = -48

Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: Fluoride, total Analysis Run 11/22/2019 4:51 PM View: Interwell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG
Hollow symbols indicate censored values.



n = 14

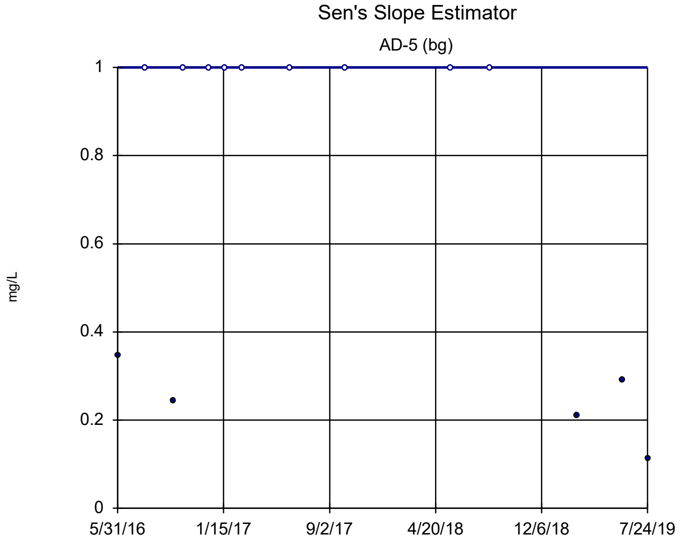
Slope = 0
units per year.

Mann-Kendall
statistic = 0
critical = 48

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Fluoride, total Analysis Run 11/22/2019 4:51 PM View: Interwell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG
Hollow symbols indicate censored values.



n = 14

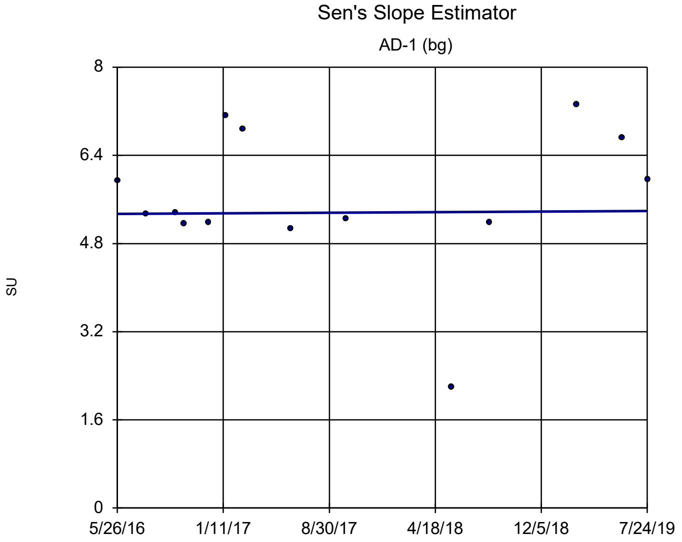
Slope = 0
units per year.

Mann-Kendall
statistic = -17
critical = -48

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Fluoride, total Analysis Run 11/22/2019 4:51 PM View: Interwell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG



n = 14

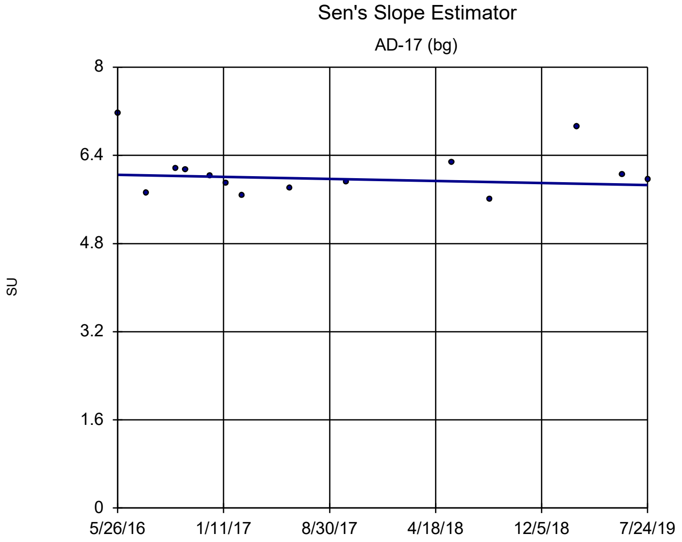
Slope = 0.01649
units per year.

Mann-Kendall
statistic = 4
critical = 48

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field Analysis Run 11/22/2019 4:51 PM View: Interwell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG



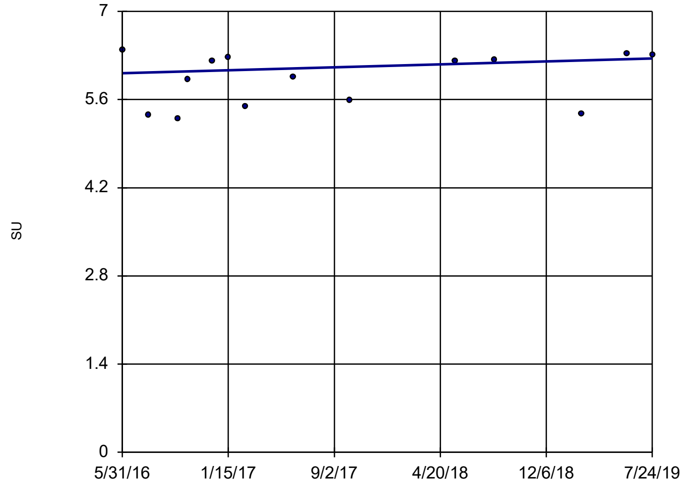
n = 14

Slope = -0.05848
units per year.

Mann-Kendall
statistic = -9
critical = -48

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field Analysis Run 11/22/2019 4:51 PM View: Interwell AIII
Welsh Landfill Client: Geosyntec Data: Welsh LF



Sen's Slope Estimator

AD-5 (bg)

n = 14

Slope = 0.07449
units per year.

Mann-Kendall
statistic = 23
critical = 48

Trend not significant at 99%
confidence level
(α = 0.005 per
tail).

Constituent: pH, field   Analysis Run 11/22/2019 4:51 PM   View: Interwell AIII

Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Interwell Prediction Limit Summary

Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/8/2019, 3:44 PM

Constituent	Well	Upper Lim.	Lower Lim.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	n/a	0.7	n/a	n/a	36	n/a	n/a	0	n/a	n/a	0.001409	NP Inter (normality) 1 of 2
Fluoride, total (mg/L)	n/a	0.583	n/a	n/a	42	n/a	n/a	64.29	n/a	n/a	0.001066	NP Inter (NDs) 1 of 2
pH, field (SU)	n/a	7.109	4.327	n/a	36	34.63	9.009	0	None	x^2	0.001253	Param Inter 1 of 2

Tolerance Limit Summary Table

Welsh LF Client: Geosyntec Data: Welsh LF Printed 12/5/2019, 12:30 PM

Constituent	Well	Upper Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony, total (mg/L)	n/a	0.00317	39	n/a	n/a	71.79	n/a	n/a	0.1353	NP Inter(normality)
Arsenic, total (mg/L)	n/a	0.005	39	n/a	n/a	48.72	n/a	n/a	0.1353	NP Inter(normality)
Barium, total (mg/L)	n/a	0.6226	39	-2.778	1.08	0	None	ln(x)	0.05	Inter
Beryllium, total (mg/L)	n/a	0.0007877	39	0.0565	0.0168	10.26	None	x^(1/3)	0.05	Inter
Cadmium, total (mg/L)	n/a	0.00646	39	n/a	n/a	30.77	n/a	n/a	0.1353	NP Inter(normality)
Chromium, total (mg/L)	n/a	0.004	38	n/a	n/a	23.68	n/a	n/a	0.1424	NP Inter(normality)
Cobalt, total (mg/L)	n/a	0.0748	39	n/a	n/a	0	n/a	n/a	0.1353	NP Inter(normality)
Combined Radium 226 + 228 (pCi/L)	n/a	4.113	39	2.091	0.9476	0	None	No	0.05	Inter
Fluoride, total (mg/L)	n/a	0.583	42	n/a	n/a	64.29	n/a	n/a	0.116	NP Inter(normality)
Lead, total (mg/L)	n/a	0.003384	39	n/a	n/a	69.23	n/a	n/a	0.1353	NP Inter(normality)
Lithium, total (mg/L)	n/a	0.394	39	n/a	n/a	2.564	n/a	n/a	0.1353	NP Inter(normality)
Mercury, total (mg/L)	n/a	0.000033	39	n/a	n/a	53.85	n/a	n/a	0.1353	NP Inter(normality)
Molybdenum, total (mg/L)	n/a	0.00243	39	n/a	n/a	69.23	n/a	n/a	0.1353	NP Inter(normality)
Selenium, total (mg/L)	n/a	0.005	39	n/a	n/a	41.03	n/a	n/a	0.1353	NP Inter(normality)
Thallium, total (mg/L)	n/a	0.001251	39	n/a	n/a	87.18	n/a	n/a	0.1353	NP Inter(NDs)

Confidence Interval Summary Table - All Results (No Significant)

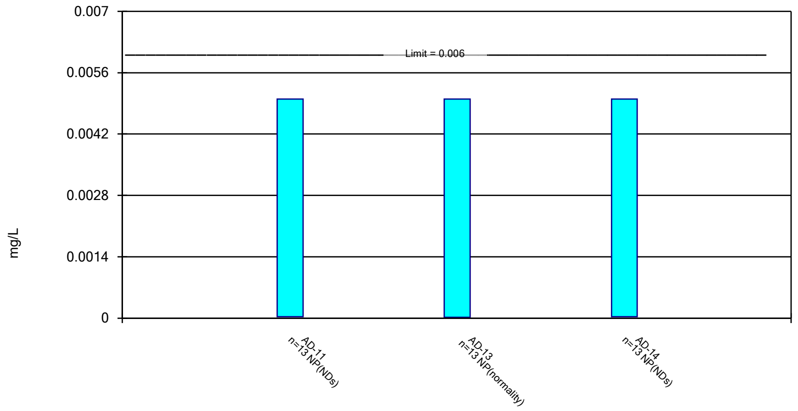
Welsh Landfill Client: Geosyntec Data: Welsh LF Printed 11/25/2019, 9:47 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	AD-11	0.005	0.00003	0.006	No	13	84.62	No	0.01	NP (NDs)
Antimony, total (mg/L)	AD-13	0.005	0.00002	0.006	No	13	61.54	No	0.01	NP (normality)
Antimony, total (mg/L)	AD-14	0.005	0.00003	0.006	No	13	76.92	No	0.01	NP (NDs)
Arsenic, total (mg/L)	AD-11	0.005	0.00059	0.01	No	13	46.15	No	0.01	NP (normality)
Arsenic, total (mg/L)	AD-13	0.006	0.00037	0.01	No	13	53.85	No	0.01	NP (normality)
Arsenic, total (mg/L)	AD-14	0.005	0.00039	0.01	No	13	53.85	No	0.01	NP (normality)
Barium, total (mg/L)	AD-11	0.0403	0.0119	2	No	13	0	No	0.01	NP (normality)
Barium, total (mg/L)	AD-13	0.05991	0.02574	2	No	13	0	sqrt(x)	0.01	Param.
Barium, total (mg/L)	AD-14	0.04972	0.03072	2	No	13	0	x^(1/3)	0.01	Param.
Beryllium, total (mg/L)	AD-11	0.005	0.00089	0.004	No	13	0	No	0.01	NP (normality)
Beryllium, total (mg/L)	AD-13	0.0009026	0.000488	0.004	No	13	0	No	0.01	Param.
Beryllium, total (mg/L)	AD-14	0.0007186	0.0003981	0.004	No	13	0	No	0.01	Param.
Cadmium, total (mg/L)	AD-11	0.0004523	0.000264	0.0065	No	13	0	No	0.01	Param.
Cadmium, total (mg/L)	AD-13	0.0005	0.00007	0.0065	No	13	30.77	No	0.01	NP (normality)
Cadmium, total (mg/L)	AD-14	0.00152	0.0005231	0.0065	No	13	0	No	0.01	Param.
Chromium, total (mg/L)	AD-11	0.001255	0.000329	0.1	No	12	0	ln(x)	0.01	Param.
Chromium, total (mg/L)	AD-13	0.0007718	0.000283	0.1	No	12	25	No	0.01	NP (normality)
Chromium, total (mg/L)	AD-14	0.001025	0.000423	0.1	No	13	15.38	No	0.01	Param.
Cobalt, total (mg/L)	AD-11	0.0259	0.01533	0.075	No	13	0	x^2	0.01	Param.
Cobalt, total (mg/L)	AD-13	0.007241	0.003164	0.075	No	13	0	sqrt(x)	0.01	Param.
Cobalt, total (mg/L)	AD-14	0.013	0.005734	0.075	No	13	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-11	2.556	1.474	5	No	13	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-13	2.944	1.668	5	No	13	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-14	2.395	1.022	5	No	13	0	sqrt(x)	0.01	Param.
Fluoride, total (mg/L)	AD-11	2	0.338	4	No	13	23.08	No	0.01	NP (normality)
Fluoride, total (mg/L)	AD-13	0.964	0.4729	4	No	14	21.43	No	0.01	Param.
Fluoride, total (mg/L)	AD-14	1	0.162	4	No	14	78.57	No	0.01	NP (NDs)
Lead, total (mg/L)	AD-11	0.005	0.000847	0.015	No	13	53.85	No	0.01	NP (normality)
Lead, total (mg/L)	AD-13	0.005	0.000204	0.015	No	13	53.85	No	0.01	NP (normality)
Lead, total (mg/L)	AD-14	0.005	0.000137	0.015	No	13	69.23	No	0.01	NP (normality)
Lithium, total (mg/L)	AD-11	0.047	0.0157	0.39	No	13	0	No	0.01	NP (normality)
Lithium, total (mg/L)	AD-13	0.02486	0.01221	0.39	No	13	0	No	0.01	Param.
Lithium, total (mg/L)	AD-14	0.01567	0.01179	0.39	No	12	0	No	0.01	Param.
Mercury, total (mg/L)	AD-11	0.000025	0.00000624	0.002	No	13	46.15	No	0.01	NP (normality)
Mercury, total (mg/L)	AD-13	0.000025	0.00000515	0.002	No	13	61.54	No	0.01	NP (normality)
Mercury, total (mg/L)	AD-14	0.000145	0.00001863	0.002	No	13	7.692	No	0.01	NP (normality)
Molybdenum, total (mg/L)	AD-11	0.005	0.001519	0.1	No	13	84.62	No	0.01	NP (NDs)
Molybdenum, total (mg/L)	AD-13	0.005	0.0003533	0.1	No	13	76.92	No	0.01	NP (NDs)
Molybdenum, total (mg/L)	AD-14	0.005	0.000497	0.1	No	13	84.62	No	0.01	NP (NDs)
Selenium, total (mg/L)	AD-11	0.005	0.00134	0.05	No	13	30.77	No	0.01	NP (normality)
Selenium, total (mg/L)	AD-13	0.005	0.0004	0.05	No	13	23.08	No	0.01	NP (Cohens/xfrm)
Selenium, total (mg/L)	AD-14	0.004072	0.002084	0.05	No	13	15.38	No	0.01	Param.
Thallium, total (mg/L)	AD-11	0.002	0.0001	0.002	No	12	41.67	No	0.01	NP (normality)
Thallium, total (mg/L)	AD-13	0.002	0.000277	0.002	No	13	76.92	No	0.01	NP (NDs)
Thallium, total (mg/L)	AD-14	0.002	0.000242	0.002	No	13	84.62	No	0.01	NP (NDs)

Sanitas™ v.9.6.23 . UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

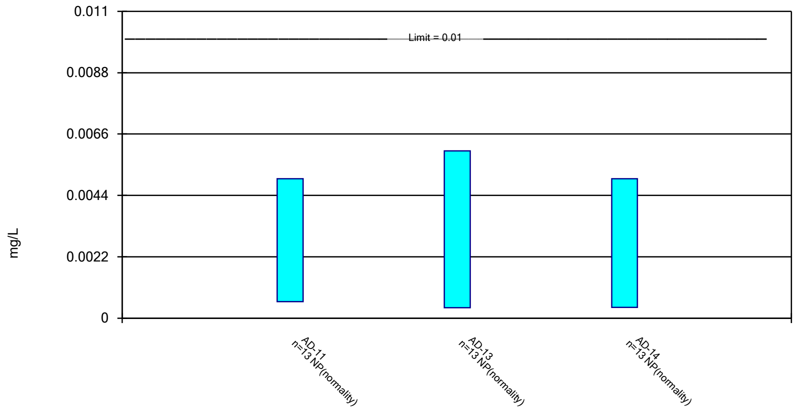


Constituent: Antimony, total   Analysis Run 11/25/2019 9:45 AM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

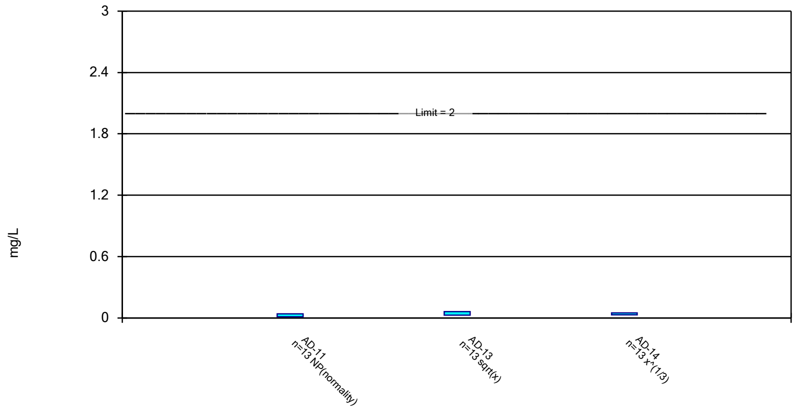


Constituent: Arsenic, total   Analysis Run 11/25/2019 9:45 AM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

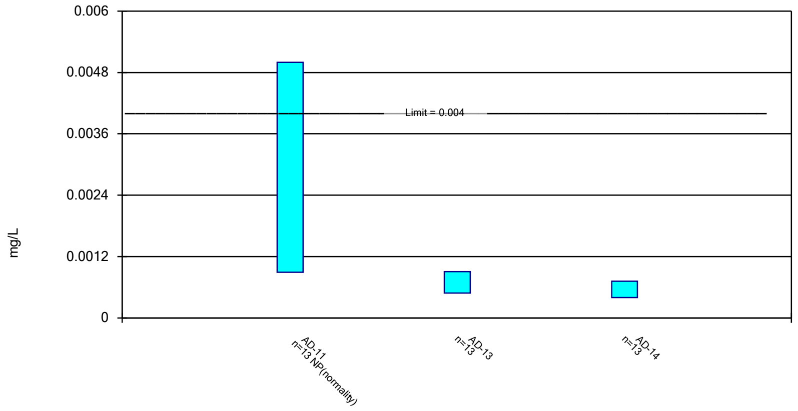


Constituent: Barium, total   Analysis Run 11/25/2019 9:45 AM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

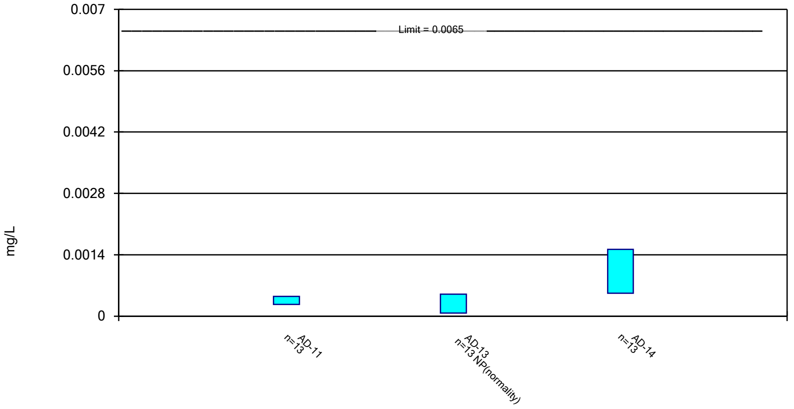


Constituent: Beryllium, total   Analysis Run 11/25/2019 9:45 AM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

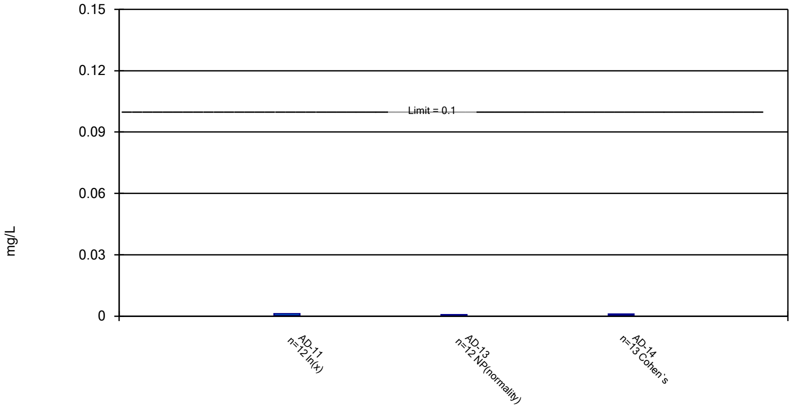


Constituent: Cadmium, total Analysis Run 11/25/2019 9:45 AM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

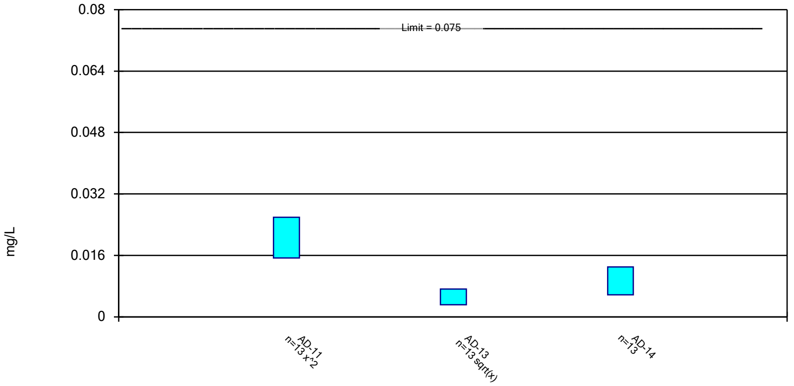


Constituent: Chromium, total Analysis Run 11/25/2019 9:45 AM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

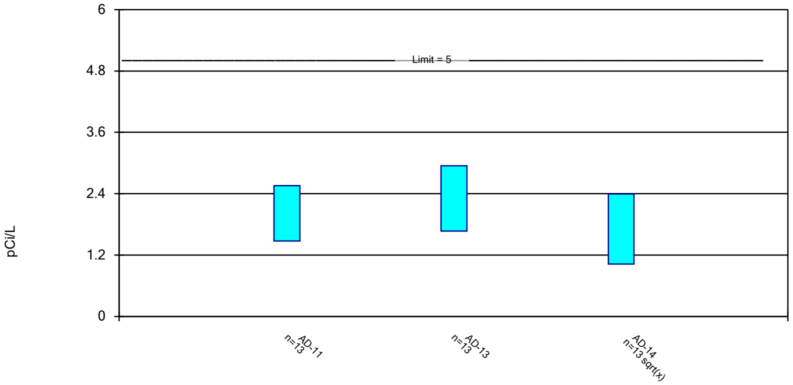


Constituent: Cobalt, total Analysis Run 11/25/2019 9:45 AM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

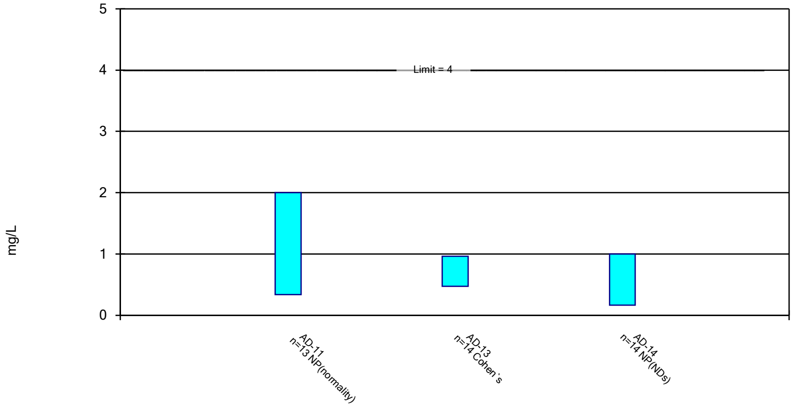


Constituent: Combined Radium 226 + 228 Analysis Run 11/25/2019 9:45 AM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

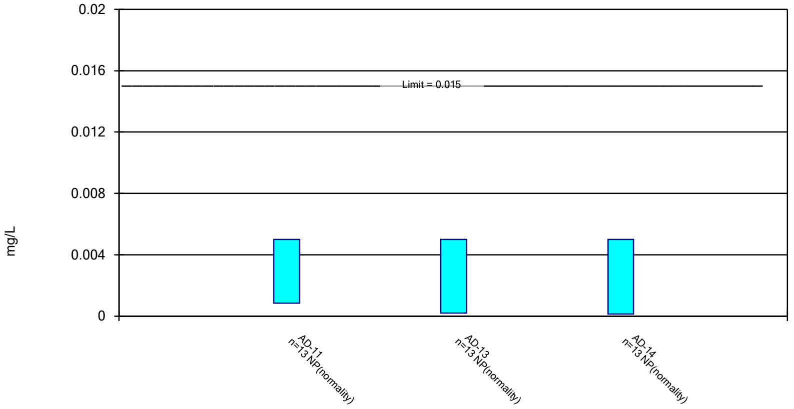


Constituent: Fluoride, total   Analysis Run 11/25/2019 9:45 AM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

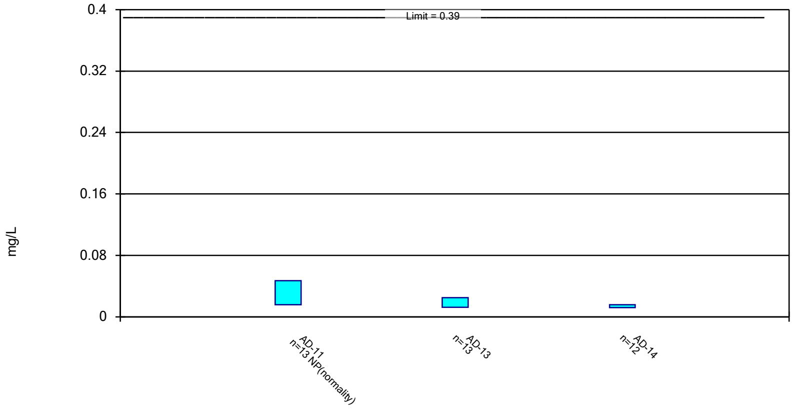


Constituent: Lead, total   Analysis Run 11/25/2019 9:45 AM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

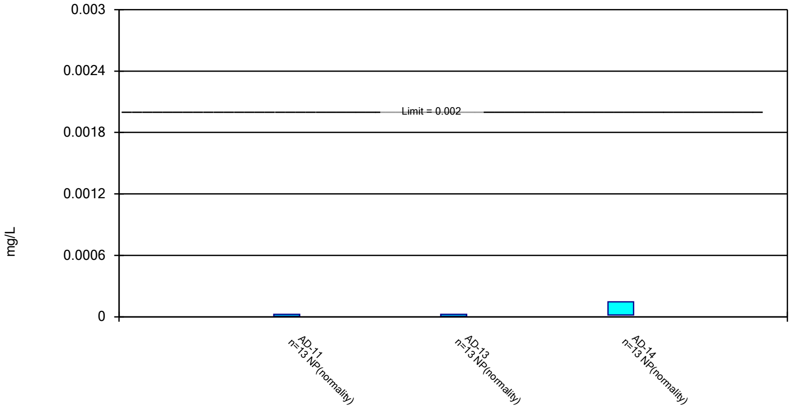


Constituent: Lithium, total   Analysis Run 11/25/2019 9:45 AM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

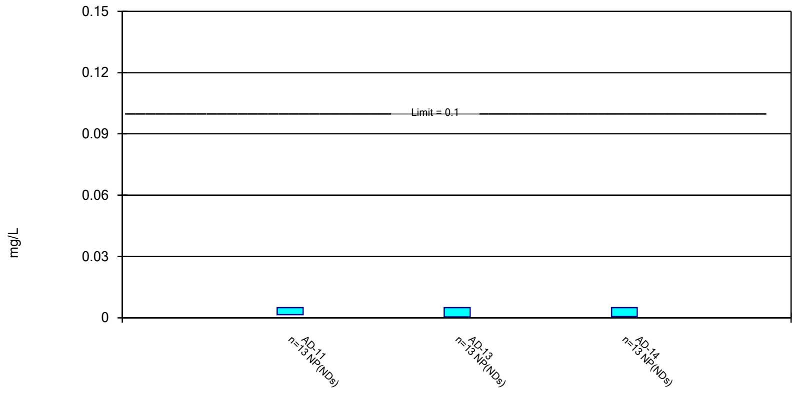


Constituent: Mercury, total   Analysis Run 11/25/2019 9:45 AM   View: Interwell AIV
Welsh Landfill   Client: Geosyntec   Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

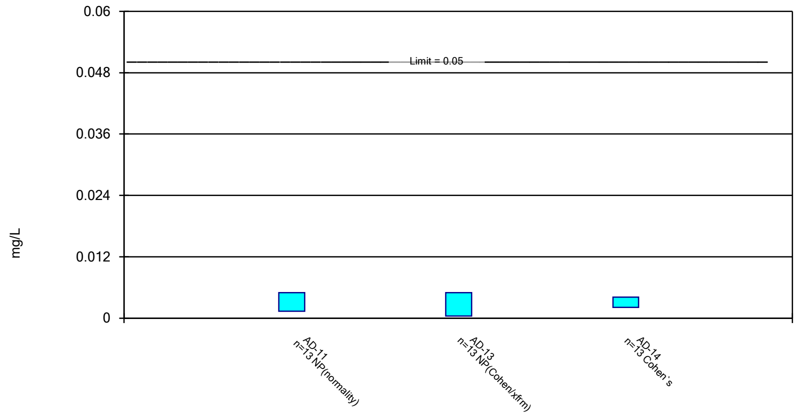


Constituent: Molybdenum, total Analysis Run 11/25/2019 9:45 AM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

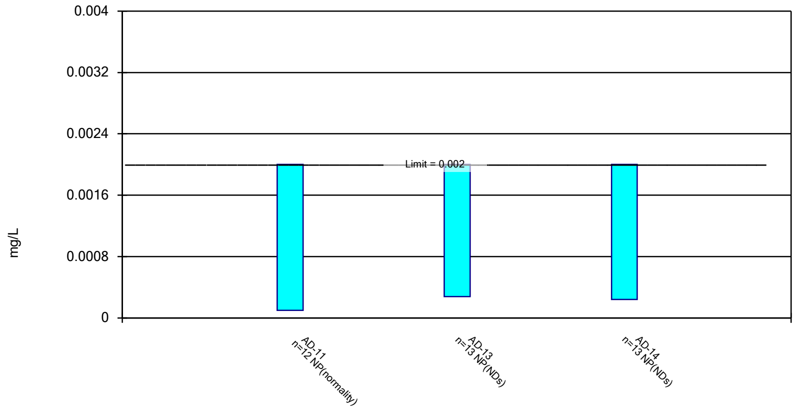


Constituent: Selenium, total Analysis Run 11/25/2019 9:45 AM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

Sanitas™ v.9.6.23 . UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Thallium, total Analysis Run 11/25/2019 9:45 AM View: Interwell AIV
Welsh Landfill Client: Geosyntec Data: Welsh LF

APPENDIX III

Alternate source demonstrations are included in this appendix. Alternate sources are sources or reasons that explain that statistically significant increases over background or statistically significant levels above the groundwater protection standard are not attributable to the CCR unit.

APPENDIX IV

Notices of groundwater monitoring programs are included in this appendix.

APPENDIX V- NA

Reports documenting monitoring well plugging and abandonment or well installation are included in the appendix.

Appendix D
Groundwater Monitoring Well Network Evaluation Reports

Infrastructure · Water · Environment · Buildings

Imagine the result

American Electric Power Service Corporation

Primary Bottom Ash Pond - CCR Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187 County Road 4865
Titus County
Pittsburg, Texas

August 22, 2017

ARCADIS

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

Kenneth Brandner

Kenneth Brandner, P.E., P.G.
Senior Project Engineer

Matthew J Lamb /KSB

Matthew J. Lamb
Project Manager

John Holm /DPL

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Primary Bottom Ash Pond - CCR Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187County Road 4865
Titus County
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Our Ref.:
OH015976.0011

Date:
August 22, 2017

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Acronyms and Abbreviation

AEP	American Electric Power Service Cooperation
amsl	above mean sea level
ARCADIS	ARCADIS U.S., Inc.
BAP	bottom ash pond
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
FAP	fly ash pond
FGD	flue gas desulfurization
ft	feet
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
PTI	Permit to Install
TDS	total dissolved solids

Primary Bottom Ash Pond - CCR
Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187 County Road 4865
Titus County
Pittsburg, Texas

1. Objective

This report was prepared by ARCADIS U.S., Inc. (ARCADIS) for American Electric Power Service Corporation (AEP) to assess the adequacy of the groundwater monitoring well network included in the Coal Combustion Residual (CCR) requirements, as specified in Code of Federal Regulations (CFR) 40 CFR 257.91, for the Primary Bottom Ash Pond (CCR Unit) at the AEP Generating Plant (Plant) located at 1187 County Road 4865 in Pittsburg, Titus County, Texas (**Figure 1**). One of the CCR requirements includes an evaluation of the adequacy of the groundwater monitoring well network to characterize groundwater quality up and down gradient of the CCR unit.

Three regulated CCR units associated with the Plant were identified for review, which include the Primary Bottom Ash Pond, landfill, and bottom ash storage pond (**Figure 2**). This report summarizes the evaluation of the groundwater monitoring well network in the uppermost aquifer at the Primary Bottom Ash Pond (Site).

This evaluation included a review of AEP-provided data associated with previously completed subsurface investigation activities in the vicinity of the Primary Bottom Ash Pond CCR unit, as well as publically-available geologic and hydrogeologic data. The following report also presents the current Conceptual Site Model based on all documents reviewed and will further describe the uppermost aquifer, include an evaluation of the adequacy of the existing monitoring well network, and provide recommendations for monitoring well augmentation, as necessary.

2. Background Information

The following section provides background information for the AEP Welsh Generating Plant Primary Bottom Ash Pond.

2.1 Facility Location Description

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The Primary Bottom Ash Pond CCR unit is located southwest of the Plant and directly west of the Welsh Reservoir (**Figures 1** and **2**).

2.2 Description of Primary Bottom Ash Pond CCR Unit

The following section will discuss the embankment configuration, area, volume, construction and operational history, and surface water control associated with the Primary Bottom Ash Pond.

2.2.1 Embankment Configuration

The Primary Bottom Ash Pond was placed into operation in approximately 1977, and is located in a topographically low area that had been an unnamed intermittent tributary of Swauano Creek prior to development of the Site. The Primary Bottom Ash Pond is bounded by natural ground surface (topographically higher areas) to the north and west, and embankment dikes to the south and east. These dikes are constructed of compacted sandy clay and clayey sand. The embankment dike south of the Primary Bottom Ash Pond includes a drainage canal that receives overflow (clear) water from the Primary Bottom Ash Pond. The water level in the Primary Bottom Ash Pond is controlled by a weir box which discharges into the drainage canal. The clear water in the drainage canal flows east and discharges into the clear water pond.

The Primary Bottom Ash Pond embankment is up to approximately 40 ft in height. Discussions of embankment configuration and timeline, including cross sections through the dikes, was provided in a previous report prepared by ETTL Engineers & Consultants Inc. in 2010 (ETTL, 2010).

2.2.2 Area/Volume

Per the *Hydraulic Analysis of Welsh Power Plant Ash Ponds Report,* dated December 2010 (Freese and Nichols, 2010), the bottom elevation of the Primary Bottom Ash Pond is 300 feet above mean sea level (amsl), the high level overflow weir box bottom elevation is 325 feet MSL, and the storage capacity of the Primary Bottom Ash Pond at elevation 325 feet amsl is 304.2 acre-ft (**Figure 3**).

2.2.3 Construction and Operational History

The AEP J. Robert Welsh Plant began operations in 1977 with three coal-fired generating units (Units 1, 2, and 3). Throughout the life of the generating plant, CCR materials (fly ash, bottom ash, economizer ash) have been generated. All of these byproducts were stored in the Primary Bottom Ash Pond and in the adjacent landfill that was constructed in the late 1970’s. In 2000, the 22-acre bottom ash storage pond was installed south of the landfill. The bottom ash storage pond was constructed with a 60-mil high-density polyethylene (HDPE) liner, and receives bottom ash and economizer ash dredged and sluiced from the Primary Bottom Ash Pond (**Figure 2**).

Presently bottom ash and economizer ash from the generating plant are sluiced to the Primary Bottom Ash Pond. Solids settle as the clear liquids flow through a drainage canal into the clear water pond (a non-CCR unit). Water in the clear water pond discharges through a weir box into a 36-inch-diameter pipe, and then into the Welsh Reservoir under Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ00018111000 (**Figure 3**).

2.2.4 Surface Water Control

Surface water flow within the Primary Bottom Ash Pond complex is controlled by a weir and emergency spillway located on the south side of the pond below the embankments. Pond elevation is maintained so that surface water flows through the weir box which has a bottom elevation of 325 feet amsl. The emergency spillway is 90 feet wide with a crest elevation of 334 feet amsl. Clear water flows through the weir (and occasionally the emergency spillway during heavy precipitation events) into a drainage canal along the south side of the pond. The drainage canal discharges into the clear water pond located directly southeast of the Primary Bottom Ash Pond (**Figure 3**).

The perimeter embankments on the south and east sides of the Primary Bottom Ash Pond are located at an approximate elevation of 340 feet amsl. Therefore the perimeter embankments have approximately six feet of freeboard above the emergency spillway.

2.3 Previous Investigations

The initial soils investigation for the site was provided in a 1973 report prepared by McClelland Engineers, Inc. entitled "*Soils Investigation, Welsh Power Plant, Cason, Texas*". This investigation included advancement of soil borings in the Primary Bottom Ash Pond area, and geotechnical soil testing to characterize the area encompassed by the Primary Bottom Ash Pond.

In 2001, five monitoring wells (AD-1 through AD-5) were installed in the area of the Primary Bottom Ash Pond and Bottom Ash Storage Pond to obtain hydrologic data for the uppermost water-bearing unit. Twelve additional monitoring wells (AD-4a, AD-4b, AD-4c, AD-6 through AD-14) were installed in the area of the Primary Bottom Ash Pond, Bottom Ash Storage Pond, and landfill by Eagle Environmental Services in 2009 to obtain more detailed hydrologic data for the uppermost water-bearing unit.

In 2010, ETTL prepared a report entitled "*Geotechnical Investigation, Welsh Power Station, Existing Ash Storage Ponds Embankment Investigation, Pittsburg, Texas*". The objective of this report was to evaluate the stability of the earthen embankments for the Primary Bottom Ash Pond and non-CCR clear water pond (aka "Secondary Ash Pond"). The principal finding of this investigation was that slope stability would be acceptable following a proposed repair to the embankment of the clear water pond. The repair of the embankment of the clear water pond was completed during September 2010.

In 2010, Freese and Nichols performed a *Hydraulic Analysis of the Welsh Power Plant Ash Ponds* (Freese and Nichols, 2010). The report concluded the spillways for the Primary Bottom Ash Pond, clear water pond, and are hydraulically adequate for the full range of storm events from the 10-year to the 100-year storm events.

In December 2015, Auckland Consulting further expanded the groundwater monitoring well system at the Plant by installation of monitoring wells AD-15 through AD-18 (Auckland Consulting, 2016). Monitoring well completion diagrams are provided in **Appendix A.**

2.4 Hydrogeologic Setting

The site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently southeast. The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966).

These features are further illustrated on five lines of cross section that were prepared through the Primary Bottom Ash Pond area, with three lines trending from west to east (A-A'; B-B'; C-C'), and the other two lines trending from north to south (D-D'; E-E'). The cross section location map is included as **Figure 3** and the lines of cross section are included as **Figure** 4 (A-A') through **Figure 8** (E-E').

2.4.1 Climate and Water Budget

The climate of Titus County, Texas is moist subhumid. The average January temperature is 45˚ Fahrenheit (F), and the average July temperature is 82.9˚F. The mean annual growing season is 228 days (Broom, 1965). Average annual precipitation (including liquid water equivalent from snowfall) is approximately 47 inches according to weatherdb.com.

2.4.2 Regional and Local Geologic Setting

The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966). The Recklaw Formation attains a thickness of approximately 110 feet in Titus County, and is underlain by the Eocene-age Carrizo Sand which consists of fine to coarse sand, silt, and clay (Broom, 1965). In the topographically low areas underling the Welsh Reservoir to the east of the Primary Bottom Ash Pond, Quarternary alluvial sediments associated with Swauano Creek are present (Flawn, 1966).

Detailed regional geologic characterization can be found in several published reports including Texas Water Commission Bulletin 6517 "*Ground-Water Resources of Camp, Franklin, Morris and Titus Counties, Texas*" (Broom, 1965), and The University of Texas at Austin Bureau of Economic Geology "*Geologic Atlas of Texas – Texarkana Sheet*" (Flawn, 1966).

Detailed regional and site geologic characterization can be found in the 2010 ETTL report entitled "*Geotechnical Investigation, Welsh Power Station, Existing Ash Storage Ponds Embankment Investigation, Pittsburg, Texas*" (ETTL, 2010).

2.4.3 Surface Water and Surface Water Groundwater Interactions

The Site is generally less than one-half mile from Swauano Creek, which was dammed near the southern end of the Site during plant development to form the Welsh Reservoir. Groundwater flow direction at the Site is generally from west to east, following surface topography towards the Welsh Reservoir. The Welsh Reservoir is likely a gaining surface water feature, and groundwater elevations on site are higher than the normal stage elevation of the Welsh Reservoir (approximately 320 feet amsl).

The Primary Bottom Ash Pond normal operating level is near the weir box which has a bottom elevation of 325 feet amsl. **Figure 9** and **Figure 10** are a potentiometric surface maps for the uppermost water bearing unit at the Site based on March 2016 water level data, and February 2017 water level data, respectively. Water level elevations in the Site monitoring wells are summarized on **Table 1**. As shown on **Figures 9** and **10**, shallow groundwater flow direction in the area of the Primary Bottom Ash Pond is in a general easterly direction toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.01 foot per foot.

2.4.4 Water Users

A water well inventory conducted by Banks Information Solutions showed one water well within a ½-mile radius of the Site (Banks, 2013). The water well is located on-site to the southwest (side gradient) of the Primary Bottom Ash Pond, and was installed for Southwestern Electric Company in 1974 with screens from 515 to 535 feet below ground surface, and plugged at a later date.

3. Groundwater Monitoring Well Network Evaluation

The existing monitoring well network present at the Site was evaluated to determine if any of the wells were viable for continued use as part of the groundwater monitoring well network or also retained as part of a larger groundwater hydraulic monitoring well network. The hydrogeologic conditions were also evaluated to determine if the uppermost aquifer unit has an effective well network. The evaluation was completed in accordance with 40 CFR 257.91 to have an established monitoring well network that effectively monitors the uppermost aquifer up gradient and down gradient of the Site. The up gradient wells represent background groundwater quality and the down gradient wells are to be placed down gradient of the CCR unit boundary to monitor water quality.

3.1 Hydrostratigraphic Units

3.1.1 Horizontal and Vertical Position Relative to CCR Unit

Geologic data from soil borings and monitoring wells installed at the Site show the uppermost aquifer in the area of the Primary Bottom Ash Pond is a fine to medium grained clayey and silty sand stratum with an average thickness of approximately 10 feet that is located between an elevation ranging from approximately 310 and 330 feet amsl (**Appendix A**). The base of the Primary Bottom Ash Pond ranges in elevation from approximately 330 feet amsl on the west to 300 feet amsl on the east. Therefore the uppermost aquifer appears to be in contact with the Primary Bottom Ash Pond and is further illustrated on cross section A-A' (**Figure 4)** and cross section D-D' (**Figure 7)**.

3.1.2 Overall Flow Conditions

Groundwater is recharged from regional precipitation infiltration and locally from ash pond use. The uppermost aquifer (clayey and silty sand) is expected to have a hydraulic conductivity of approximately 10^{-4} centimeters per second (Fetter, 1980). Based on the hydraulic conductivity and average saturated thickness (approximately 10 feet), the yield of the uppermost aquifer is anticipated to exceed the TCEQ non-useable (Class 3) limit of 150 gallons per day (TCEQ, 2010).

Available groundwater elevations are summarized on **Table 1** for 2011 through 2017. The most recent groundwater data set from February 2017 is depicted on **Figure 10**. The groundwater flow is generally easterly towards the Welsh Reservoir.

3.2 Uppermost Aquifer

3.2.1 CCR Rule Definition

Per 40 CFR 257.60(a), new CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (five ft) above the upper limit of the uppermost aquifer, or must demonstrate there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high conditions).

The CCR rule definitions for an aquifer and the uppermost aquifer as specified in 40 CFR 257.53 indicates an aquifer is a geologic formation capable of yielding usable quantities of groundwater to wells or springs while an uppermost aquifer is defined as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers, that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural groundwater surface to which the aquifer rises during the wet season.

3.2.1.1 Common Definitions

An aquifer is commonly defined as a geologic unit that stores and transmits water (readily or at sufficient flow rates) to supply wells and springs (USGS, 2015; Fetter, 2001). The uppermost aquifer is considered the first encountered aquifer nearest to the CCR unit.

3.2.2 Identified Onsite Hydrostratigraphic Unit

The identified on-Site hydrostratigraphic unit in the area of the Primary Bottom Ash Pond is the fine to medium grained clayey and silty sand stratum that has an average thickness of approximately 10 feet, and is located between an elevation ranging from approximately 310 and 330 feet amsl. This unit is not used locally for groundwater supply or industrial water use, but meets the TCEQ definition of a useable aquifer.

3.3 Review of Existing Monitoring Well Network

3.3.1 Overview

The Site was visited by ARCADIS and AEP personnel on August 20, 2015 to review existing well network conditions and locations. A well construction table that summarizes the location, ground surface elevation, borehole depth, installation date, and associated well construction details of the monitoring well network is included as **Table 2**. Photo documentation of the located wells during the August 20, 2015 site visit is provided in **Appendix B**.

Monitoring wells AD-5 through AD-9 were previously installed at the Site to monitor the uppermost aquifer (fine to medium grained clayey and silty sand stratum) associated with the Primary Bottom Ash Pond. As discussed above in Section 3.1.1, the uppermost aquifer below the Primary Bottom Ash Pond has an average thickness of approximately 10 feet, and is located between an elevation ranging from approximately 310 and 330 feet amsl. In addition to these five monitoring wells, one piezometer (B-2) was installed directly down gradient (east) of the Primary Bottom Ash Pond in 2009 as part of the ETTL geotechnical investigation of the Primary Bottom Ash Pond embankments (ETTL, 2010).

3.3.2 Gaps in Monitoring Network

As shown on Geologic Cross Sections A-A' (**Figure 4**) and C-C' (**Figure 6**), and the potentiometric surface maps on **Figures 9** and **10**, existing monitoring wells AD-1 and AD-5 are screened in the uppermost aquifer up gradient of the Primary Bottom Ash Pond, and existing monitoring wells AD-8 and AD-9 are screened in the uppermost aquifer down gradient (east) of the Primary Bottom Ash Pond. These four monitoring wells will be utilized as part of the groundwater monitoring system for the Primary Bottom Ash Pond.

Monitoring well AD-17 was completed in the uppermost aquifer southwest of the Primary Bottom Ash Pond during December 2015. As shown on the March 2016 potentiometric surface map (**Figure 9**) and February 2017 potentiometric surface map (**Figure 10**), monitoring well AD-17 is located west of a topographic and hydraulic ridge located on the southwest side of the Primary Bottom Ash Pond and Landfill. Therefore groundwater quality at monitoring well AD-17 is not affected by the Primary Bottom Ash Pond, and monitoring well AD-17 will be utilized as a hydraulically upgradient monitoring well to collect background water quality data. Monitoring well AD-18 is located on the north side of the topographic and hydraulic ridge, and is therefore hydraulically sidegradient relative to the Primary Bottom Ash Pond and Landfill, and will be utilized as a piezometer.

As shown on the soil boring log in **Appendix A** and Geologic Cross Section E-E' (**Figure 8**), piezometer B-2 is located down gradient of the Primary Bottom Ash Pond, but is screened in a clay stratum above the top of the uppermost aquifer. Therefore piezometer B-2 will not be utilized as part of the groundwater monitoring system for the Primary Bottom Ash Pond. This data gap was addressed by installation of new down gradient monitoring well AD-15 adjacent to piezometer B-2 during December 2015 as shown on **Figure 9** and **Figure 10**. With the addition of monitoring wells AD-15 and AD-17 during December 2015, there are no gaps remaining in the groundwater monitoring network for the Primary Bottom Ash Pond.

4. Recommended Monitoring Network and PE Certification

The recommended modifications to the existing groundwater monitoring well network are intended to meet specifications stated in 40 CFR 257.91. Recommended wells are further discussed with respect to location to the Primary Bottom Ash Pond (up gradient or down gradient), well depth, and well construction. The recommended network would provide an improved understanding of groundwater quality, hydraulics, and groundwater flow at the Primary Bottom Ash Pond.

4.1 Recommended Monitoring Well Network Distribution

A total of three down gradient well locations (existing monitoring wells AD-8, AD-9, and AD-15) and three up gradient well locations (existing monitoring wells AD-1, AD-5, and AD-17) are recommended to establish a groundwater quality monitoring well network for the Primary Bottom Ash Pond. In addition, existing monitoring wells AD-6, AD-7, and AD-18 may be utilized as piezometers to obtain additional groundwater flow direction and gradient data for the Primary Bottom Ash Pond.

4.1.1 Location

The recommended monitoring well network for groundwater quality of the uppermost aquifer at the Primary Bottom Ash Pond is summarized on **Table 3** and illustrated on **Figure 11.**

4.1.2 Depth

The screen depths for the monitoring wells recommended for inclusion in the monitoring network are within the shallow saturated sand stratum (uppermost aquifer) that averages approximately 10 feet in thickness, and ranges in elevation ranging from approximately 310 and 330 feet amsl as shown on Geologic Cross Sections A-A’ (**Figure 4**), C-C’ (**Figure 6**), and E-E’ (**Figure 8**). The screen elevations are presented in **Table 3**.

4.1.3 Well Construction

As discussed above in Section 3.3.2, the gap in the monitoring well network for the uppermost aquifer at the Primary Bottom Ash Pond was addressed by installation of monitoring wells AD-15 and AD-17 during December 2015. Monitoring wells AD-15 and AD-17 were installed by a Texas Department of Licensing and Regulation (TDLR)-

licensed water well driller. Well construction data for the monitoring well network are summarized on **Tables 2** and **3**, and the monitoring well completion diagrams are provided in **Appendix A**.

4.2 Professional Engineer's Certification

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the proposed groundwater monitoring system will be adequate to meet the requirements of 40 CFR Part 257.91.

Kenneth J. Brandner
Printed Name of Registered Professional Engineer

Kenneth Brand
Signature

KENNETH J. BRANDNER
69586

69586
Registration No.

Texas
Registration State

8-22-17
Date

5. References

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Tables

Table 1
Water Level Data
AEP J. Robert Welsh Power Plant - CCR Storage Areas
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Screen		Bottom of Screen		6/7/2011	12/6/2011	5/2/2012	11/1/2012	5/14/2013	11/19/2013	5/12/2014	11/16/2014	5/12/2015	3/4/2016	5/26/2016	7/27/2016	10/19/2016	12/12/2016	1/17/2017	2/23/2017
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																												
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57	338.46	334.92	337.88	337.18	337.43	336.73	338.03	337.64	340.82	342.83	344.89	342.89	341.23	340.58	341.18	339.74
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16	330.16	329.07	330.00	329.26	329.83	329.70	330.09	329.69	332.56	332.32	---	---	---	---	---	---
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10	323.81	323.19	323.99	323.29	323.77	323.98	324.12	323.28	325.58	325.12	324.59	323.70	323.47	323.78	325.04	324.92
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61	324.81	324.84	324.62	324.40	324.74	325.52	325.44	325.13	327.00	326.90	---	---	---	---	---	---
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19	325.01	324.19	325.24	322.90	324.86	324.68	325.64	325.34	327.19	327.12	---	---	---	---	---	---
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55	324.35	324.32	324.50	324.30	324.30	325.21	325.22	324.90	326.58	326.67	---	---	---	---	---	---
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15	324.18	324.50	324.64	324.37	324.11	325.06	325.01	324.71	326.50	326.19	325.89	324.01	323.76	325.07	326.39	324.89
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00	336.34	336.58	336.82	336.99	336.78	336.47	336.80	336.01	339.07	338.04	337.62	337.24	337.74	337.01	338.34	336.17
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31	333.04	333.02	332.83	333.02	333.11	332.81	333.11	332.81	333.38	334.00	---	---	---	---	---	---
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86	334.32	334.12	334.19	334.20	334.13	334.58	333.77	333.98	334.09	333.61	---	---	---	---	---	---
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53	325.41	324.09	325.69	325.15	325.79	325.75	325.98	325.77	326.05	325.70	325.68	325.05	325.29	325.92	326.76	324.27
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32	328.46	328.53	328.63	328.44	328.74	329.38	NM	330.18	329.98	329.74	329.28	329.53	328.92	329.31	330.50	328.05
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23	323.44	322.55	323.27	323.35	323.51	323.76	323.57	323.88	323.95	323.55	---	---	---	---	---	---
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61	327.99	328.37	327.82	327.93	327.94	328.13	328.20	327.97	328.96	328.13	328.39	328.14	327.87	328.20	328.90	328.25
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27	348.30	348.29	349.86	349.56	349.99	349.65	349.89	350.01	350.65	350.39	---	---	---	---	---	---
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12	332.36	332.24	333.09	332.26	332.68	333.25	333.35	332.01	337.58	334.76	334.54	332.93	332.39	332.84	334.54	331.83
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32	330.40	329.80	331.67	330.34	330.94	331.69	332.12	330.17	336.63	334.83	334.51	331.71	330.94	330.79	332.63	330.87
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71	---	---	---	---	---	---	---	---	---	322.14	321.93	321.28	321.42	321.71	321.64	322.81
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86	---	---	---	---	---	---	---	---	---	337.09	335.84	332.14	331.52	331.43	330.96	330.71
AD-16R(e)	33° 02' 49"	94° 50' 28.9"	350.55	353.49	27.0	4/12/17	Sch. 40 PVC	2	12.0	338.55	27.0	323.55	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99	---	---	---	---	---	---	---	---	---	334.64	334.26	334.30	334.45	334.64	334.05	333.94
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17	---	---	---	---	---	---	---	---	---	343.66	343.26	340.81	339.92	339.38	338.97	340.38
Piezometers																												
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

NM - Not measured.
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
(e) Monitoring well installed by ARCADIS on April 12, 2017 as a replacement for monitoring well AD-16.
Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through February 2017.

Table 2
Well Construction Details
AEP J. Robert Welsh Power Plant - CCR Units
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Filter Pack		Bottom of Filter Pack		Top of Screen		Bottom of Screen	
								Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl
<u>Monitoring Wells</u>															
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	25.0	1/11/2001	PVC	2	13	343	25	331	15.0	340.57	25.0	330.57
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	25.0	4/26/2001	PVC	2	12	332	25	319	15.0	329.16	25.0	319.16
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	17.0	4/26/2001	PVC	2	5	326	17	314	7.0	324.10	17.0	314.10
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	30.0	4/26/2001	PVC	2	16	325	30	311	19.0	321.61	29.0	311.61
AD-4a (a)	33.04527	94.84258	340.19	30.0	9/22/2009	PVC	2	17	323	30	310	20.0	320.19	30.0	310.19
AD-4b (a)	33.04531	94.84230	329.55	15.0	9/23/2009	PVC	2	4	326	15	315	5.0	324.55	15.0	314.55
AD-4c (a)	33.04507	94.84244	329.15	15.0	9/23/2009	PVC	2	4	325	15	314	5.0	324.15	15.0	314.15
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	30.0	1/11/2001	PVC	2	16	333	30	319	20.0	329.00	30.0	319.00
AD-6 (a)	33.05235	94.84757	343.31	33.0	9/23/2009	PVC	2	21	322	33	310	23.0	320.31	33.0	310.31
AD-7 (a)	33.05257	94.84219	347.86	38.0	9/24/2009	PVC	2	26	322	38	310	28.0	319.86	38.0	309.86
AD-8 (a)	33.05187	94.84026	337.53	29.0	9/21/2009	PVC	2	14	324	29	309	16.0	321.53	26.0	311.53
AD-9 (a)	33.04995	94.84196	340.32	35.0	9/21/2009	PVC	2	18	322	35	305	20.0	320.32	35.0	305.32
AD-10 (a)	33.04881	94.84047	340.23	35.0	9/22/2009	PVC	2	18	322	35	305	20.0	320.23	35.0	305.23
AD-11 (a)	33.04824	94.84177	339.61	20.0	9/22/2009	PVC	2	8	332	20	320	10.0	329.61	20.0	319.61
AD-12 (a)	33.04901	94.84977	366.27	30.0	9/24/2009	PVC	2	18	348	30	336	20.0	346.27	30.0	336.27
AD-13 (a)	33.04918	94.84275	344.12	20.0	9/22/2009	PVC	2	4	340	20	324	6.0	338.12	16.0	328.12
AD-14 (a)	33.04715	94.84256	342.32	19.0	9/22/2009	PVC	2	6	336	18	324	8.0	334.32	18.0	324.32
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	46.0	12/12/15	PVC	2	22	318	45.5	295	25.5	314.71	45.5	294.71
AD-16R	33° 02' 49"	94° 50' 29"	350.55	27.0	4/12/17	PVC	2	10	341	27	324	12.0	338.55	27.0	323.55
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	40.0	12/10/15	PVC	2	22	332	39	315	24.0	329.99	39.0	314.99
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	29.0	12/11/15	PVC	2	12	334	29	317	14.0	332.17	29.0	317.17
<u>Piezometers</u>															
B-2 (b)	33° 03.078'	94° 50.449'	339.7	50.0	10/28/2009	PVC	2	8	332	20	320	10.0	329.70	20.0	319.70
B-4 (b)	33° 03.011'	94° 50.462'	340.6	50.0	10/27/2009	PVC	2	8	333	18	323	8.0	332.60	18.0	322.60
B-5 (b)	33° 02.964'	94° 50.428'	340.0	50.0	10/27/2009	PVC	2	5	335	20	320	10.0	330.00	20.0	320.00
B-6 (b)	33° 02.912'	94° 50.462'	340.1	50.0	10/28/2009	PVC	2	4	336	22	318	12.0	328.10	22.0	318.10
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	21.0	12/10/15	PVC	2	9	342	21	330	11.0	339.86	21.0	329.86

General Notes:
Elevation in feet above mean sea level.

Footnotes:
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
Acronyms and Abbreviations:
NA = Data not available
ft = feet
bls = below land surface
msl = mean sea level

Table 3
Proposed Well Network
AEP J. Robert Welsh Power Plant - Primary Bottom Ash Pond
Pittsburg, Titus County, Texas

Well ID	Exisiting/ Proposed	Hydrostratigraphic Unit Target	Location Description		Screen Top Target Elevation(a) (ft amsl)	Screen Bottom Target Elevation(a) (ft amsl)	Screen Length (ft)	Comments
Upgradient								
AD-1	Existing	Uppermost Water-Bearing Unit	South of Primary Bottom Ash Pond	Upgradient	340.6	330.6	10	Existing well installed in 2001; well will be utilitzed to establish backgroud water quality
AD-5	Existing	Uppermost Water-Bearing Unit	NW of Primary Bottom Ash Pond	Upgradient	329.0	319.0	10	Existing well installed in 2001; well will be utilitzed to establish backgroud water quality
AD-17	Existing	Uppermost Water-Bearing Unit	SW of Primary Bottom Ash Pond	Upgradient	330.0	315.0	15	New monitoring well installed during December 2015 in uppermost shallow aquifer southwest of Primary Bottom Ash Pond - upgradient; well will be utilized to establish background water quality
Downgradient								
AD-8	Existing	Uppermost Water-Bearing Unit	E of Primary Bottom Ash Pond	Down gradient	321.5	311.5	10	Existing well installed in 2009; uppermost shallow aquifer adjacent to the Primary Bottom Ash Pond - downgradient
AD-9	Existing	Uppermost Water-Bearing Unit	E of Primary Bottom Ash Pond	Down gradient	320.3	305.3	15	Existing well installed in 2009; uppermost shallow aquifer adjacent to the Primary Bottom Ash Pond - downgradient
AD-15	Existing	Uppermost Water-Bearing Unit	E of Primary Bottom Ash Pond	Down gradient	314.7	294.7	20	New monitoring well installed during December 2015 in uppermost shallow aquifer adjacent to the Primary Bottom Ash Pond - downgradient
Piezometers								
AD-6	Existing	Uppermost Water-Bearing Unit	N of Primary Bottom Ash Pond	Side gradient	320.3	310.3	10	Existing well installed in 2009; and utilitzed to obtain water level data for uppermost water-bearing unit
AD-7	Existing	Uppermost Water-Bearing Unit	N of Primary Bottom Ash Pond	Side gradient	319.9	309.9	10	Existing well installed in 2009; and utilitzed to obtain water level data for uppermost water-bearing unit
AD-18	Existing	Uppermost Water-Bearing Unit	W of Primary Bottom Ash Pond	Side gradient	332.2	317.2	15	New well installed during December 2015 in uppermost shallow aquifer sidegradient of Primary Bottom Ash Pond; will be utilized to obtain water level data for uppermost water-bearing unit

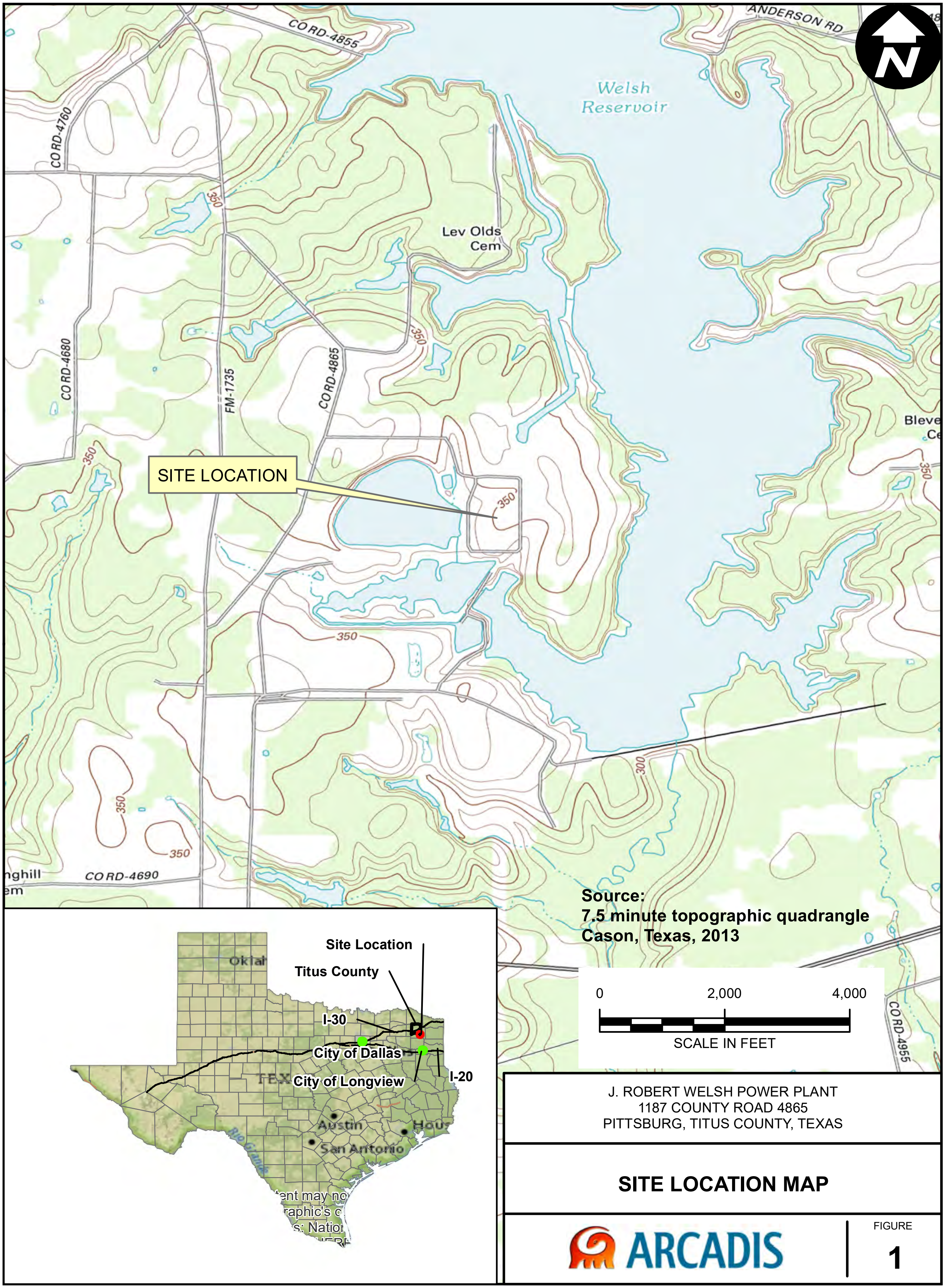
Footnotes:

a. Target elevations are an estimated range.

Acronyms and Abbreviations:

U=Upgradient
D=Downgradient
ft = feet
amsl = above mean sea level

Figures



Source:
7.5 minute topographic quadrangle
Cason, Texas, 2013

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

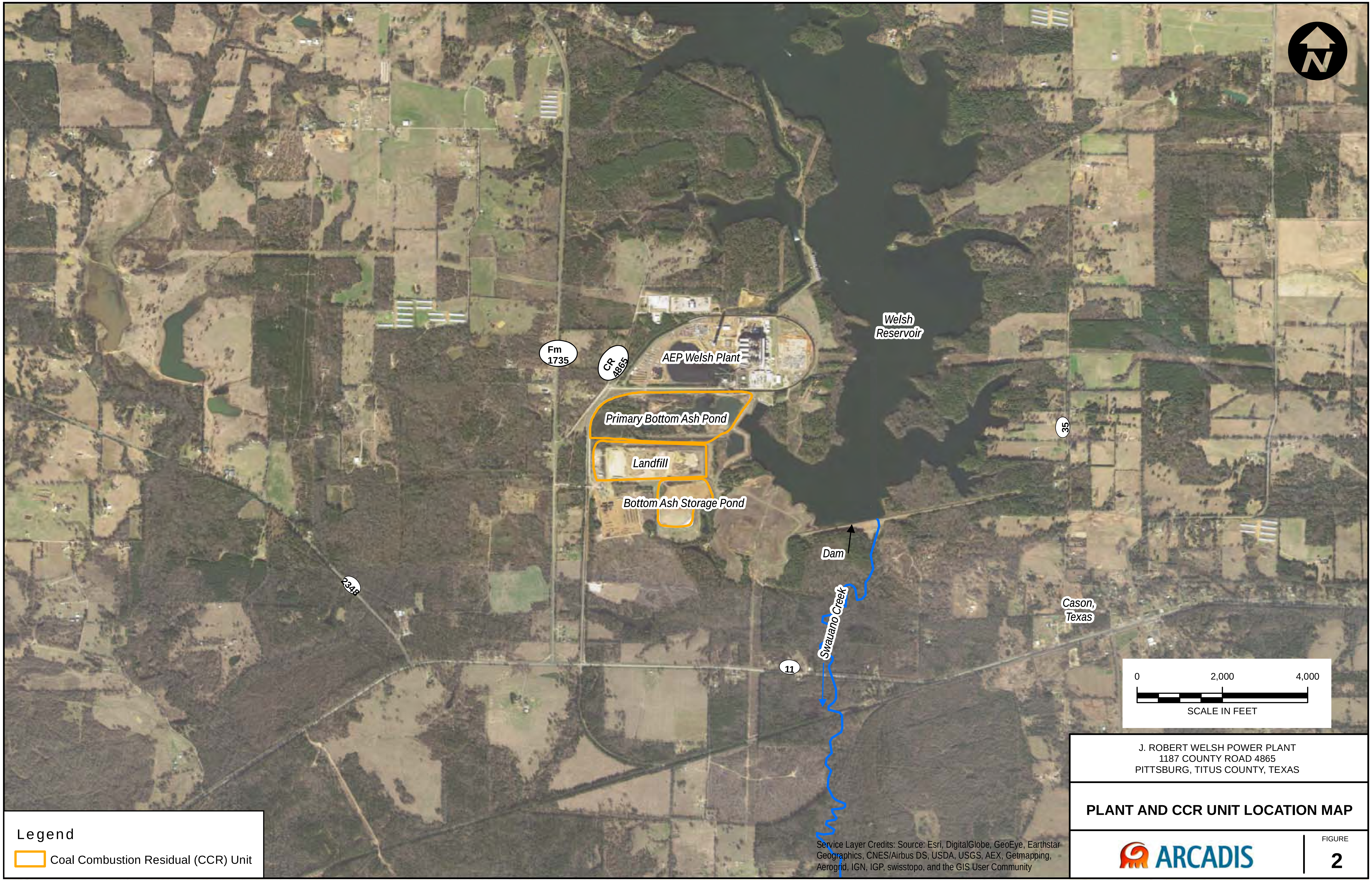
SITE LOCATION MAP

ARCADIS

FIGURE
1

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 1 - site map.mxd

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 2 - CCR location.mxd



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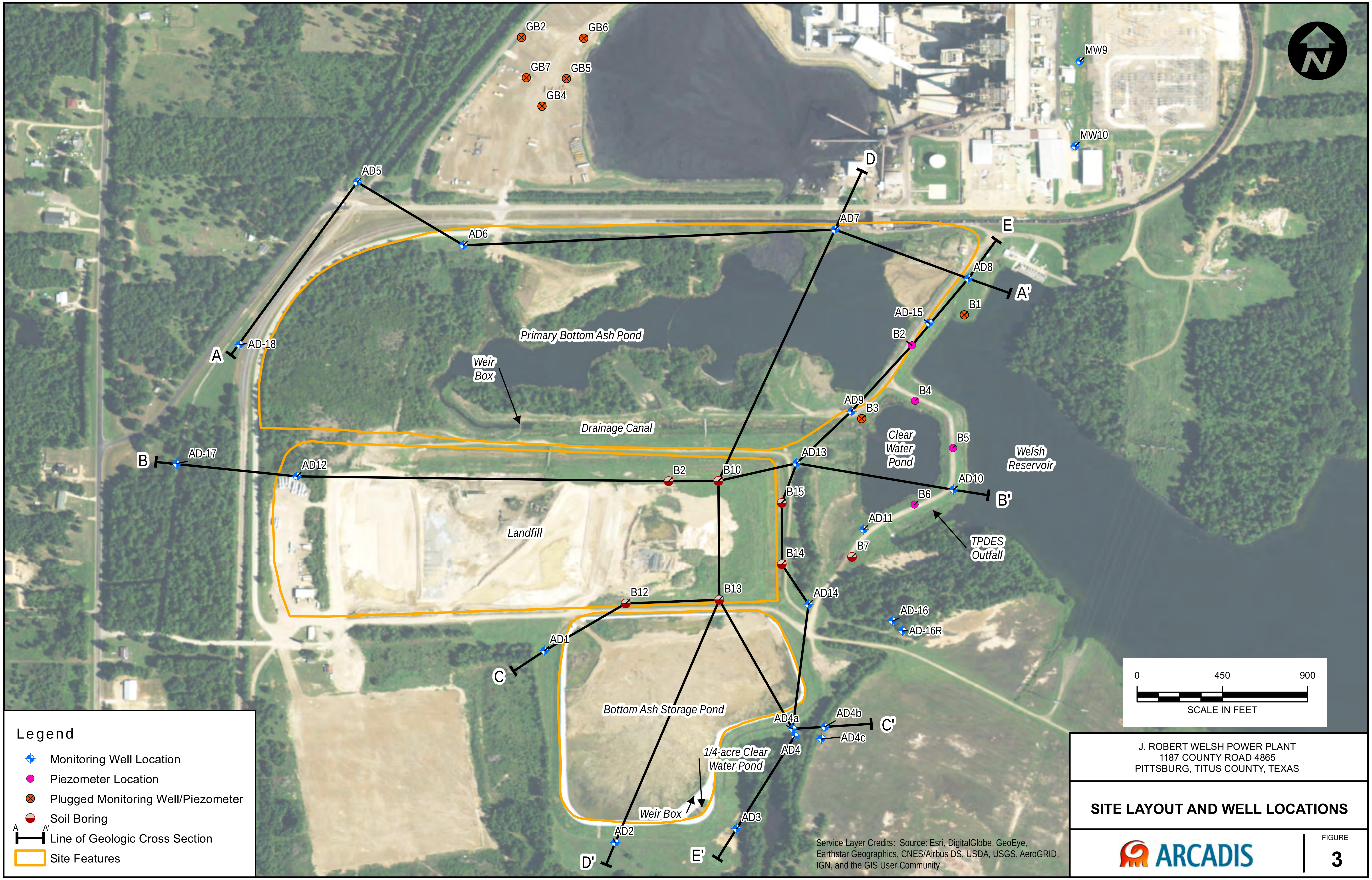
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PLANT AND CCR UNIT LOCATION MAP

ARCADIS

FIGURE
2



Legend

- 🔹 Monitoring Well Location
- ● Piezometer Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◓ Soil Boring
- A |—| A' Line of Geologic Cross Section
- ▭ Site Features

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LAYOUT AND WELL LOCATIONS

ARCADIS

FIGURE
3

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 3 - site layout.mxd

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond WELL Network Evaluation\Figures-Maps\Figure 4 Cross Section A-A'.dwg LAYOUT: MODEL SAVED: 8/26/2015 9:53 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE:
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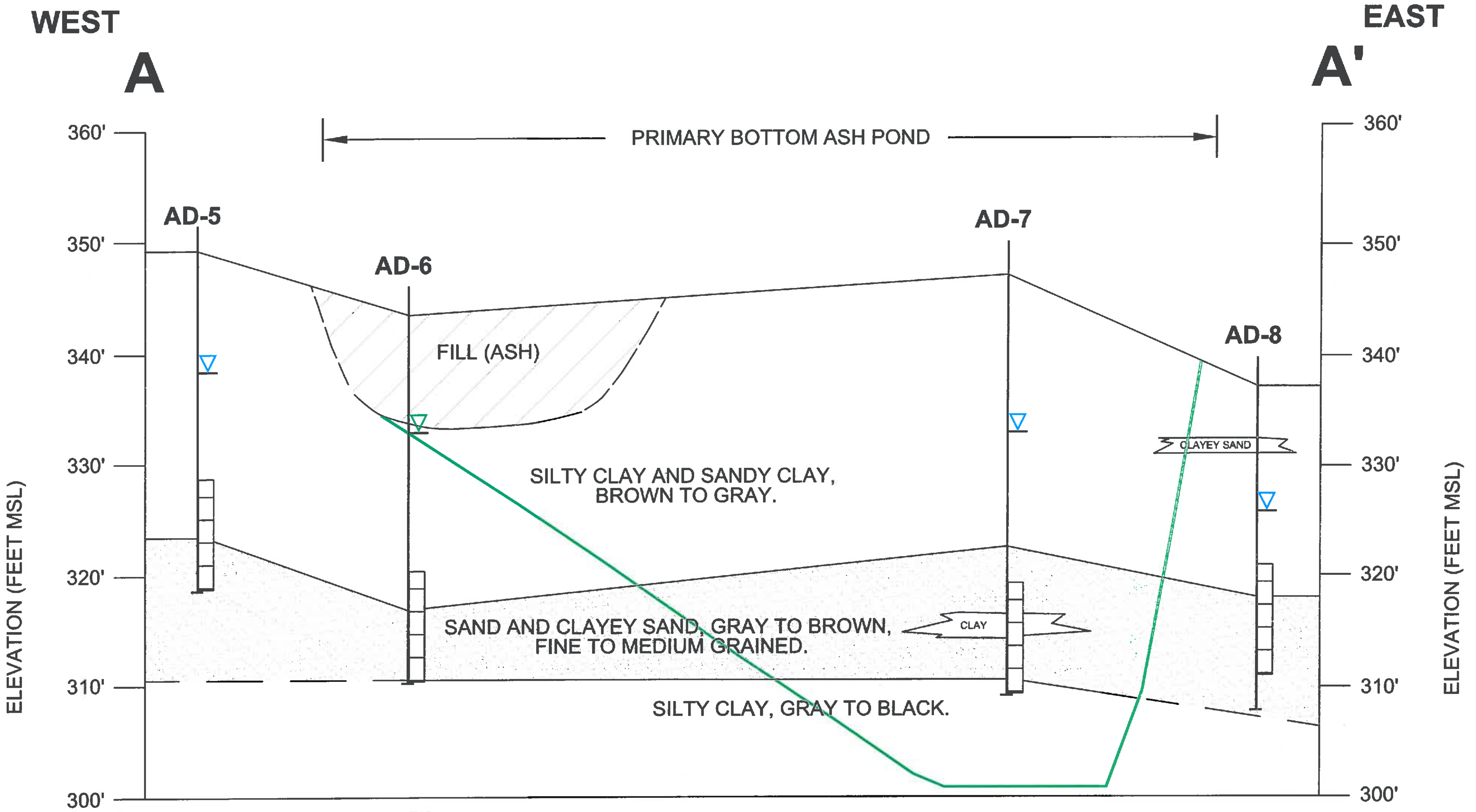


STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

8-22-17

0 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

⊟	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (5/12/15)
—	PROJECTED BASE OF ASH POND (SEE NOTE)

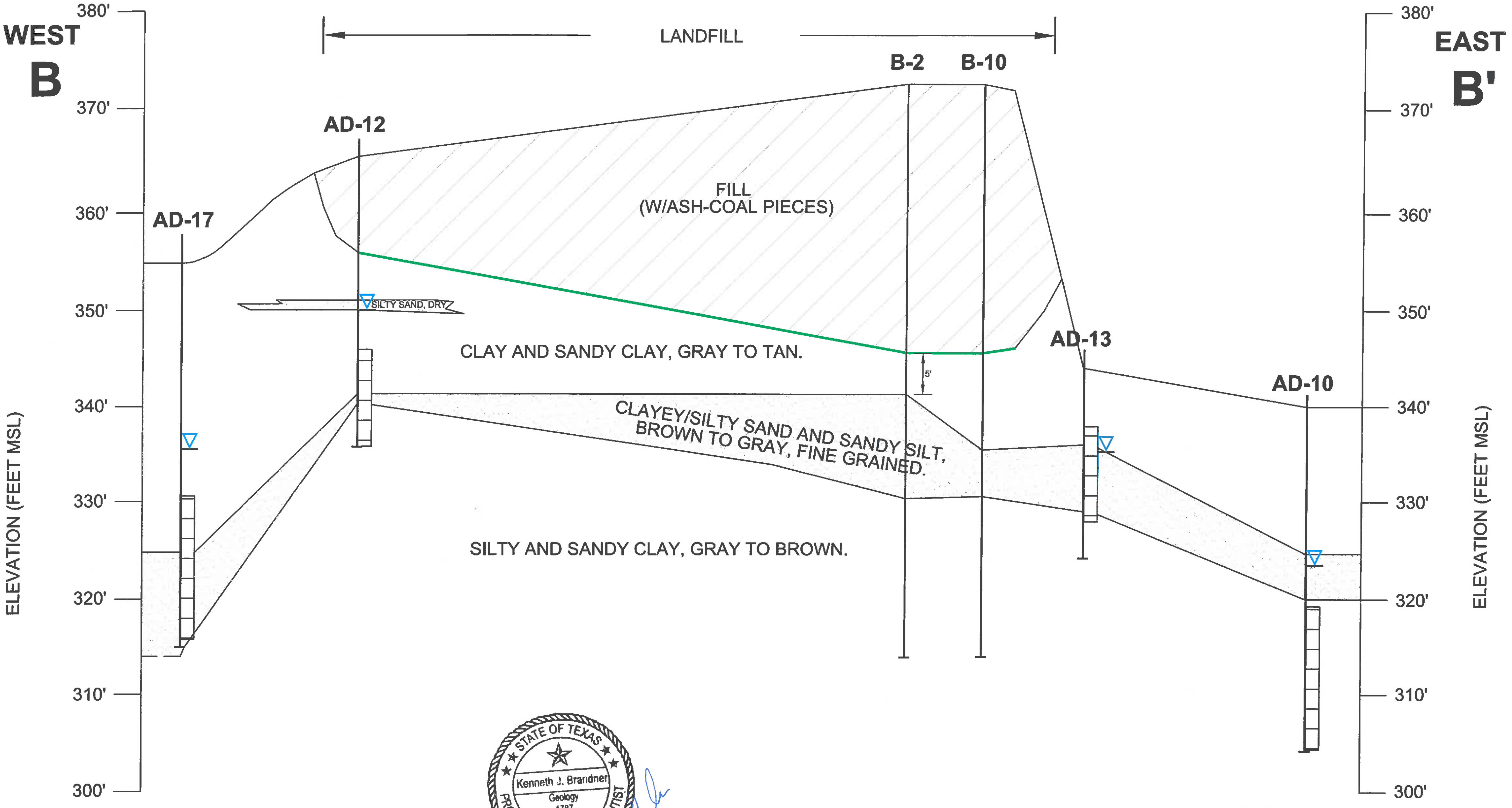
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION A - A'

ARCADIS

FIGURE
4

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 5 Cross Section B-B'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:41 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE: — PLOTTED: 3/11/2016 12:33 PM BY: LEASE, DIANA



Kenneth J. Brandner
Geology
1787

8-22-17

0 300'
HORIZONTAL SCALE

NOTE: BASE OF LANDFILL ELEVATION TAKEN FROM "WELSH POWER PLANT- UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12/3/76.

LEGEND

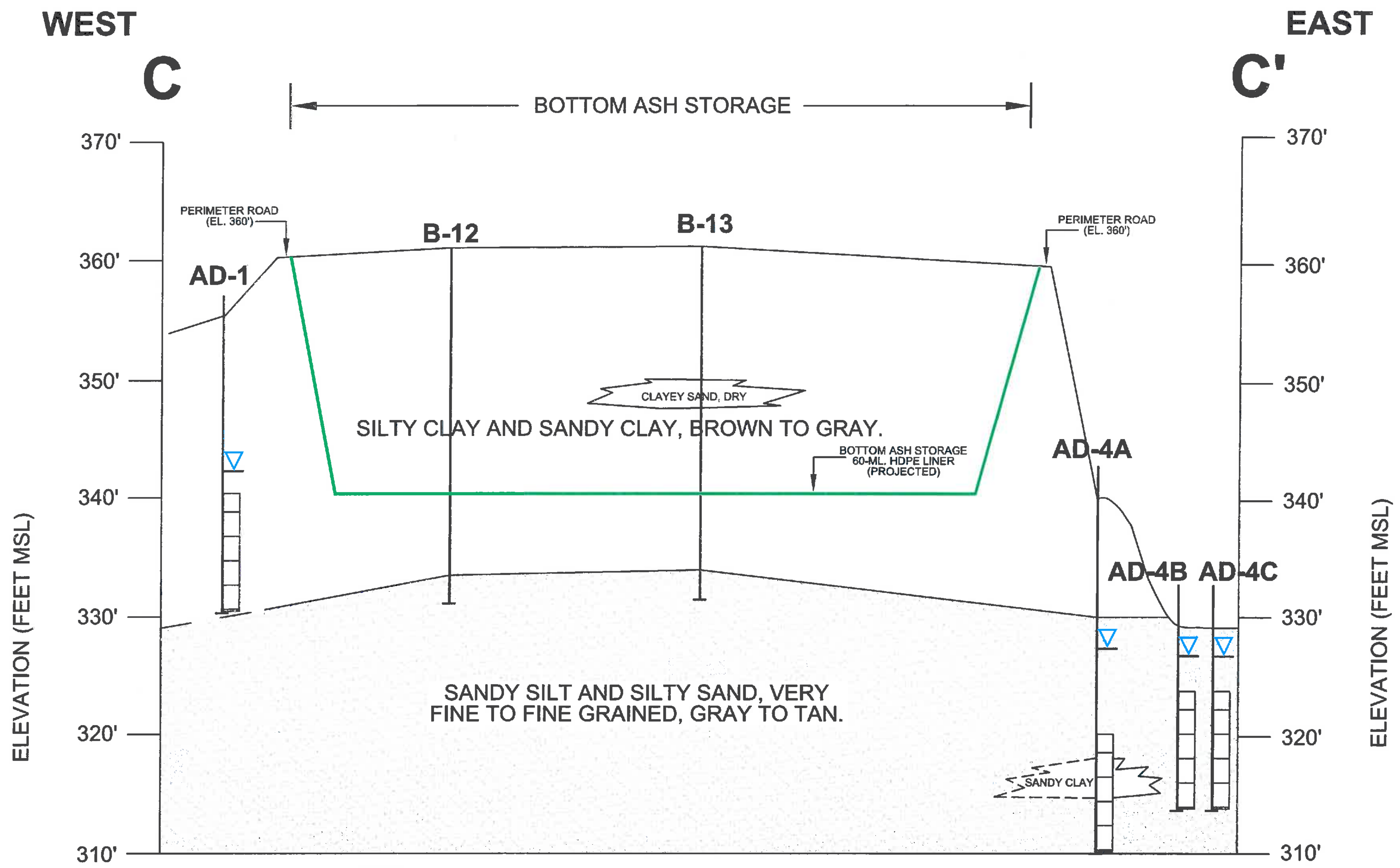
⊟	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
🟩	BASE OF LANDFILL (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION B - B'

ARCADIS

FIGURE
5



Kenneth J. Brandner
Geology
1787

8-22-17

0 200'
HORIZONTAL SCALE

NOTE: BASE OF BOTTOM ASH STORAGE HAS A 60-ML. HDPE LINER AT ELEVATION 340.0', TAKEN FROM FREESE AND NICHOLS "HYDRAULIC ANALYSIS OF WELSH POWER PLANT ASH PONDS, AMERICAN ELECTRIC POWER COMPANY", DATED DECEMBER 2010.

LEGEND

⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
C - C'

ARCADIS

FIGURE
6

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 6 Cross Section C-C'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:54 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: —
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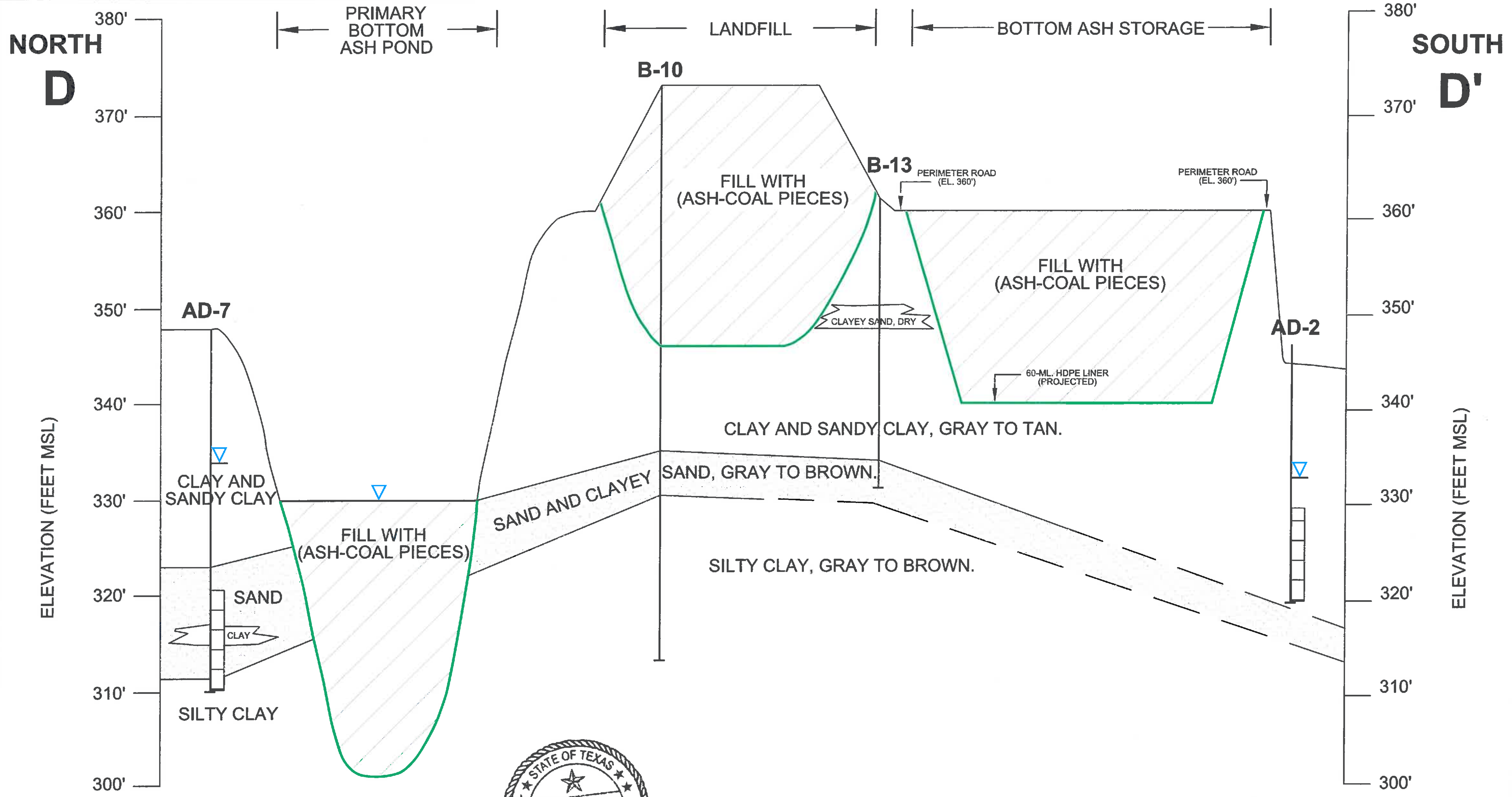

Kenneth J. Brandner
Geology
1787

8-22-17

0 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (5/12/15)
—	BASE OF CCR UNIT

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION D - D'

ARCADIS

FIGURE
7

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond WELL Network Evaluation\Figures-Maps\Figure 7 Cross Section D-D'.dwg LAYOUT: MODEL SAVED: 8/26/2015 10:07 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE:
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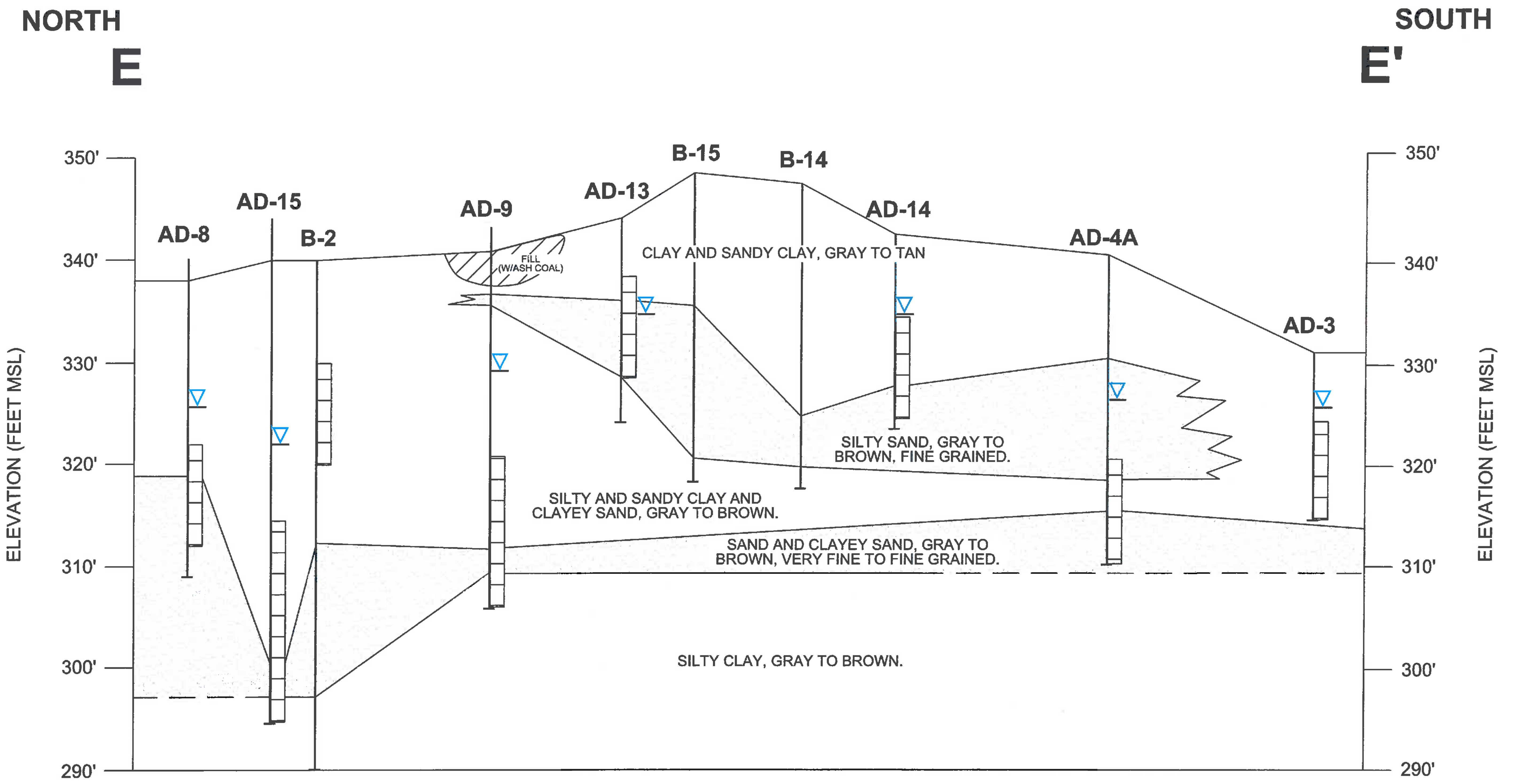

0 300'
HORIZONTAL SCALE

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

8-22-17

LEGEND

- ⌸ MONITORING WELL SCREENED INTERVAL
- ▽ WATER LEVEL IN MONITORING WELL (3/4/16)
- — PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION E - E'

ARCADIS

FIGURE
8

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 8 Cross Section E-E'.dwg LAYOUT: MODEL SAVED: 3/11/2016 12:06 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE:
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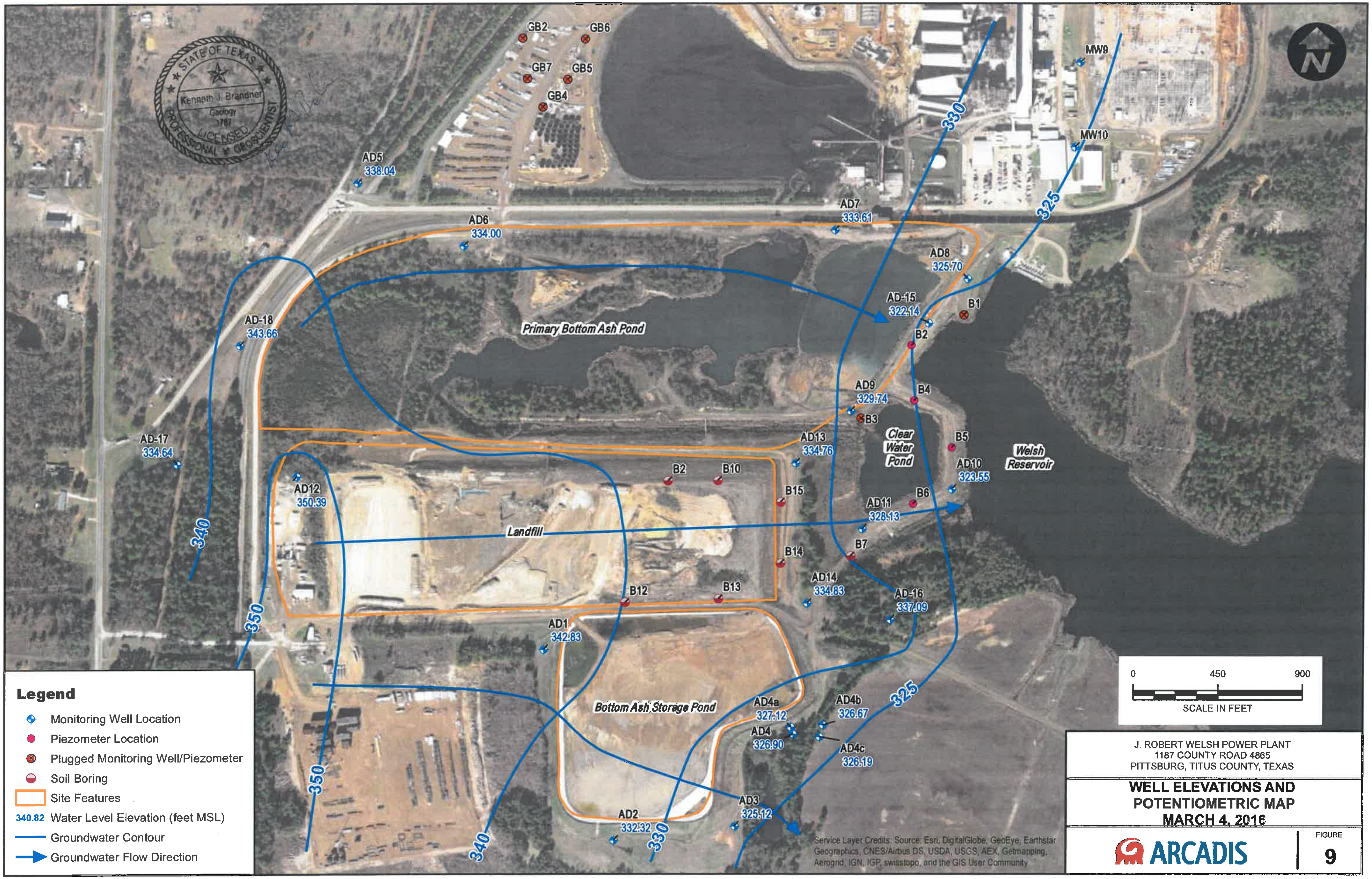


Kenneth J. Brandner
Geology
1787

Legend

- 🔹 Monitoring Well Location
- ● Piezometer Location
- ⊗ Plugged Monitoring Well/Piezometer
- ◓ Soil Boring
- ▭ Site Features
- 340.82 Water Level Elevation (feet MSL)
- — Groundwater Contour
- → Groundwater Flow Direction

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

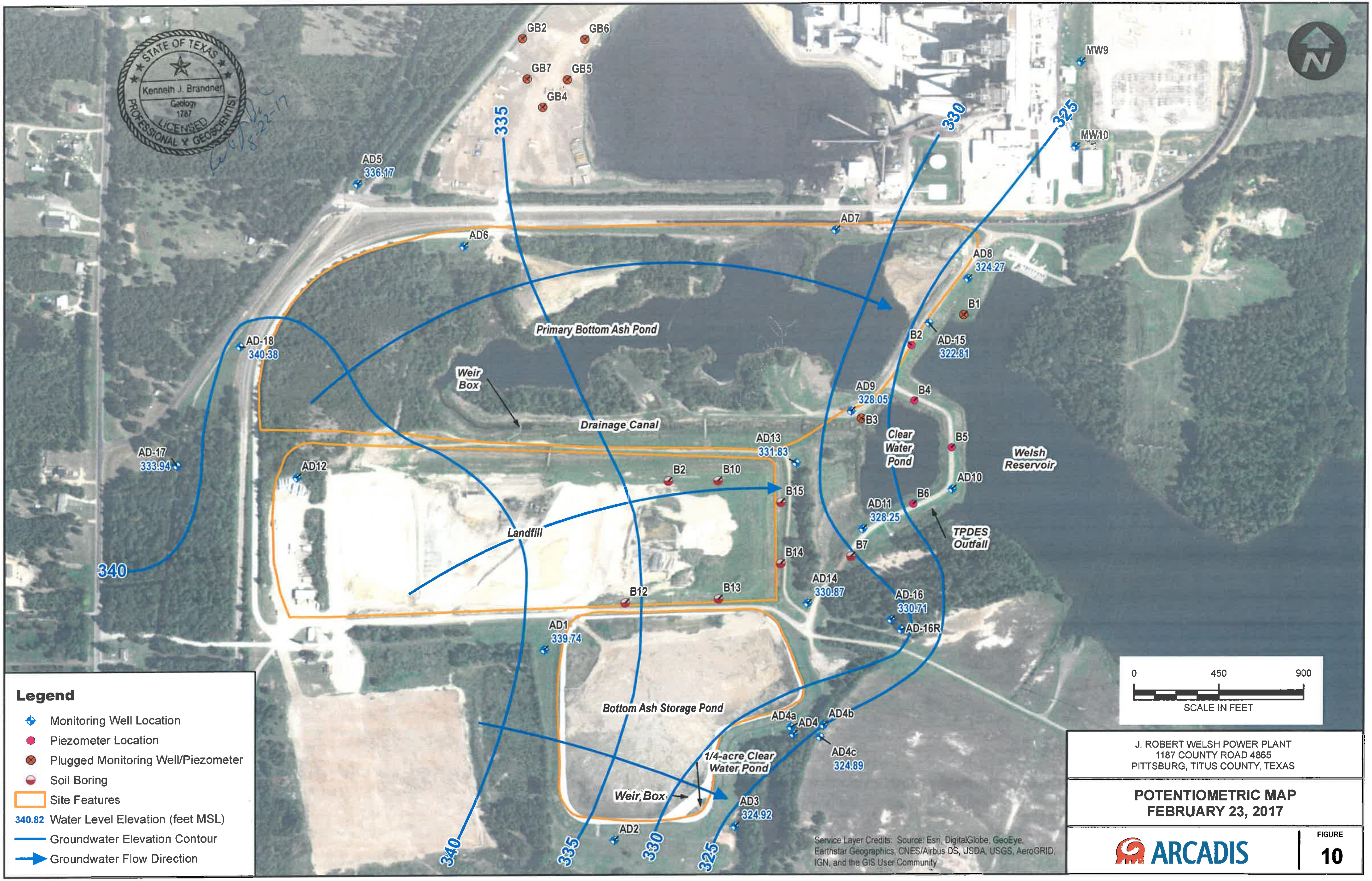
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

WELL ELEVATIONS AND POTENTIOMETRIC MAP MARCH 4, 2016

ARCADIS

FIGURE
9

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 9 - Mar2016_POT.mxd



Kenneth J. Brandner
1787
8-22-17

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

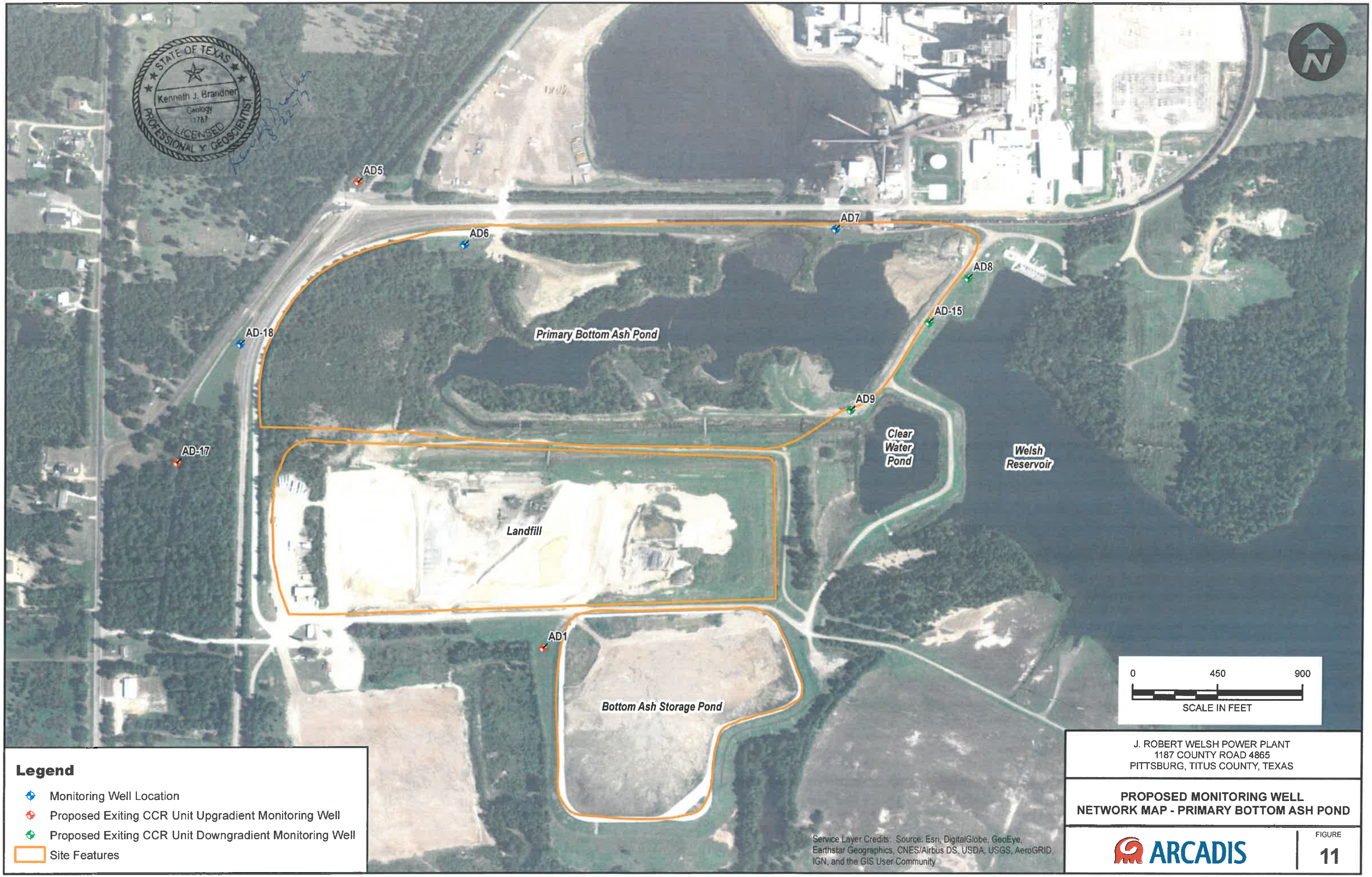
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

POTENTIOMETRIC MAP
FEBRUARY 23, 2017

ARCADIS

FIGURE
10

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 10 - Feb2017_POT.mxd



STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

Kenneth Brandner
08-22-17

Legend

- 🔵 Monitoring Well Location
- 🔴 Proposed Exiting CCR Unit Upgradient Monitoring Well
- 🟢 Proposed Exiting CCR Unit Downgradient Monitoring Well
- 🟧 Site Features

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PROPOSED MONITORING WELL NETWORK MAP - PRIMARY BOTTOM ASH POND

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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FIGURE
11

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Ash Pond report\fig 11 - proposed wells_v2.mxd

ARCADIS

Appendix A

Boring/Well Construction Logs

AD-1

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt.4, Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4
County ~~Camp~~ Titus

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'48"N
94°50'47"W
N

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ______

From (ft.)	To (ft.)	Description and color of formation material
0	25	gray silty clay with some hard red streaks

AP-1

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other ______
If Gravel Packed give interval ... from 13 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	sch 40
2	N	#10 slot screen	15	25	sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 13 ft. to 0 ft. No. of sacks used 6-50#
ft. to ______ ft. No. of sacks used ______
Method used bentonite
Cemented by ______
Distance to septic system field lines or other concentrated contamination ______ ft.
Method of verification of above distance ______

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 12'8" ft. below land surface Date 1-11-01
Artesian flow ______ gpm. Date ______

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc., ______ ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ______ (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS ______ (Street or RFD) (City) (State) (Zip)

(Signed) ______ (Licensed Well Driller) (Signed) ______ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-2

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS 33°02'37"N 94°50'44"W N↑

6) WELL LOG:
Date Drilling:
Started 4/26 2001
Completed 4/26 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	2	top soil
2	5	red & gray clay w/ silt
5	10	red & gray clay w/ silt
10	25	gray silty clay w/ tan streaks
		AP-2

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 12 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	Sch 40
2	N	#10 slot screen	15	25	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 12 ft. to +2 ft. No. of sacks used 5-50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) Gilbert M (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-3

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4
County ~~Camp~~ Titus

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'38"N
94°50'37"W
N↑

6) WELL LOG:
Date Drilling:
Started 4/26 2001
Completed 4/26 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	17

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ________

From (ft.)	To (ft.)	Description and color of formation material
0	12	gray silt clay w/tan streaks
12	15	very stiff gray/blood red clay
15	17	very stiff gray clay w/ red nodules and tan streaks

AP-3

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other ________
If Gravel Packed give interval ... from 5 ft. to 17 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	7	Sch 40
2	N	#10 slot screen	7	17	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 2 ft. to 5 ft. No. of sacks used 2 1/2 - 50*
________ ft. to ________ ft. No. of sacks used ________
Method used bentonite pellets
Cemented by ________
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance ________

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ________ ft. below land surface Date ________
Artesian flow ________ gpm. Date ________

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ________
Depth to pump bowls, cylinder, jet, etc., ________ ft.

14) WELL TESTS: NA
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ________ gpm with ________ ft. drawdown after ________ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ________ Depth of strata ________
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ________ (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS ________ (Street or RFD) (City) (State) (Zip)

(Signed) ________ (Licensed Well Driller) (Signed) ________ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-4

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'43"N
94°50'33"W
N↑

6) WELL LOG:
Date Drilling:
Started 4/26 19 2001
Completed 4/26 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	5	red silty clay with gray streaks
5 -	30	gray silty clay with red streaks

AD-4

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	19	Sch. 40
2	N	#10 slot screen	19	29	Sch. 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 2 ft. No. of sacks used 8-50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other NA
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete Items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4A**
TOTAL DEPTH:	**30'**
TOP OF CASING ELEV.:	**342.85 ft. NGVD**
GROUND SURFACE ELEV.:	**340.19 ft. NGVD**

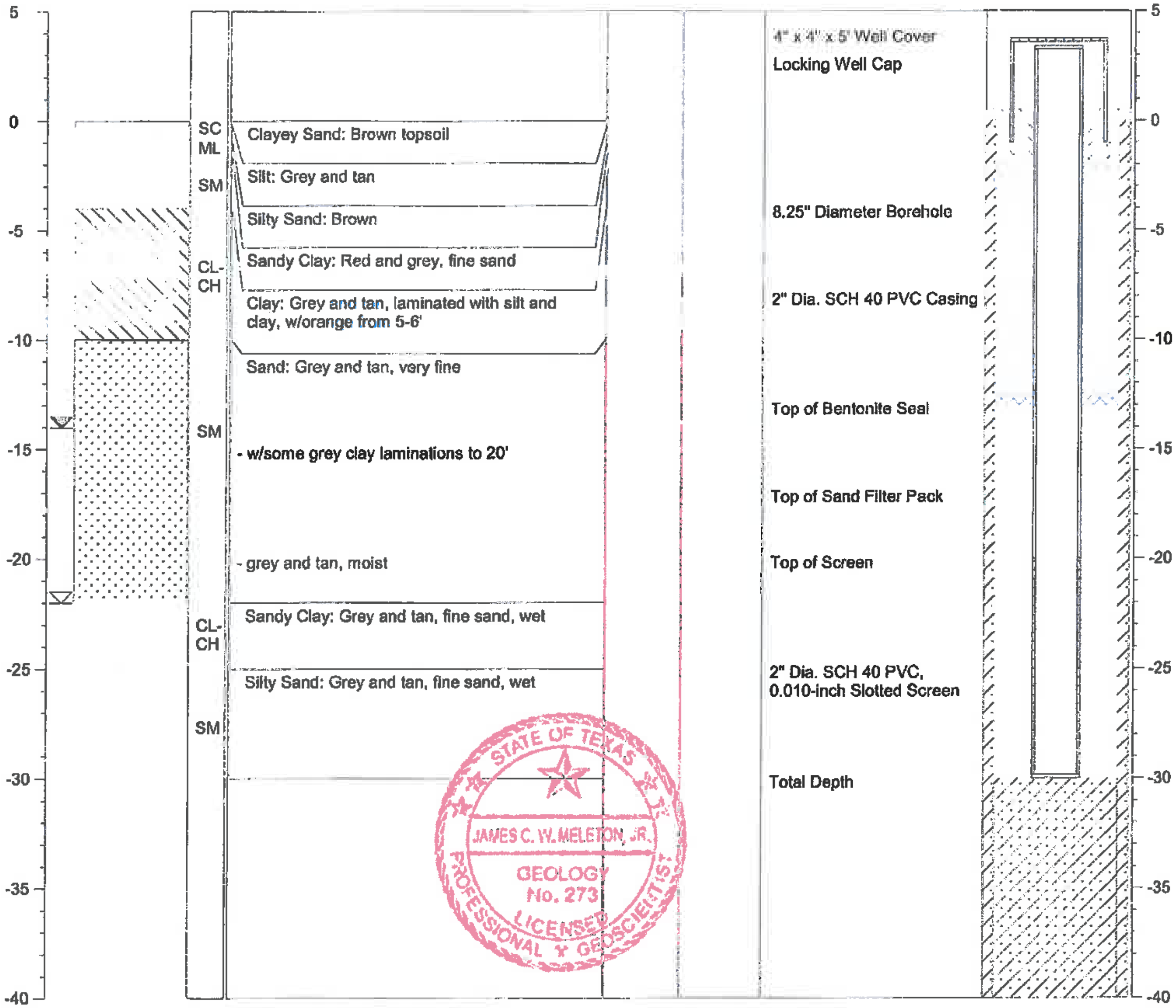
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04527**
Longitude: 94.84258

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Clayey Sand: Brown topsoil
Silt: Grey and tan
Silty Sand: Brown
Sandy Clay: Red and grey, fine sand
Clay: Grey and tan, laminated with silt and clay, w/orange from 5-6'
Sand: Grey and tan, very fine
- w/some grey clay laminations to 20'
- grey and tan, moist
Sandy Clay: Grey and tan, fine sand, wet
Silty Sand: Grey and tan, fine sand, wet

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

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OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4B**
TOTAL DEPTH:	**15'**
TOP OF CASING ELEV.:	**333.23 ft. NGVD**
GROUND SURFACE ELEV.:	**329.55 ft. NGVD**

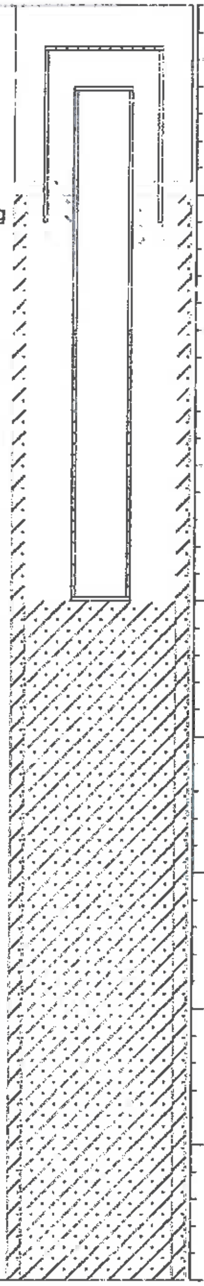
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.04531**
Longitude: 94.84230

▼ Water level during drilling
▽ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION
5							5
						4" x 4" x 6.5' Well Cover Locking Well Cap	
0			Silty Sand: Grey and tan, fine, moist			2" Dia. SCH 40 PVC Casing	0
						Top of Bentonite Seal	
▼							
						Top of Sand Filter Pack Top of Screen	
-5							-5
▽		SM	- wet				
						8.25" Diameter Borehole	
-10							-10
						2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen	
-15						Total Depth	-15
-20							-20
-25							-25
-30							-30
-35							-35
-40							-40



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SOIL BORING LOG

BORING/WELL NO.:	**AD-4C**
TOTAL DEPTH:	**15'**
TOP OF CASING ELEV.:	**333.28 ft. NGVD**
GROUND SURFACE ELEV.:	**329.15 ft. NGVD**

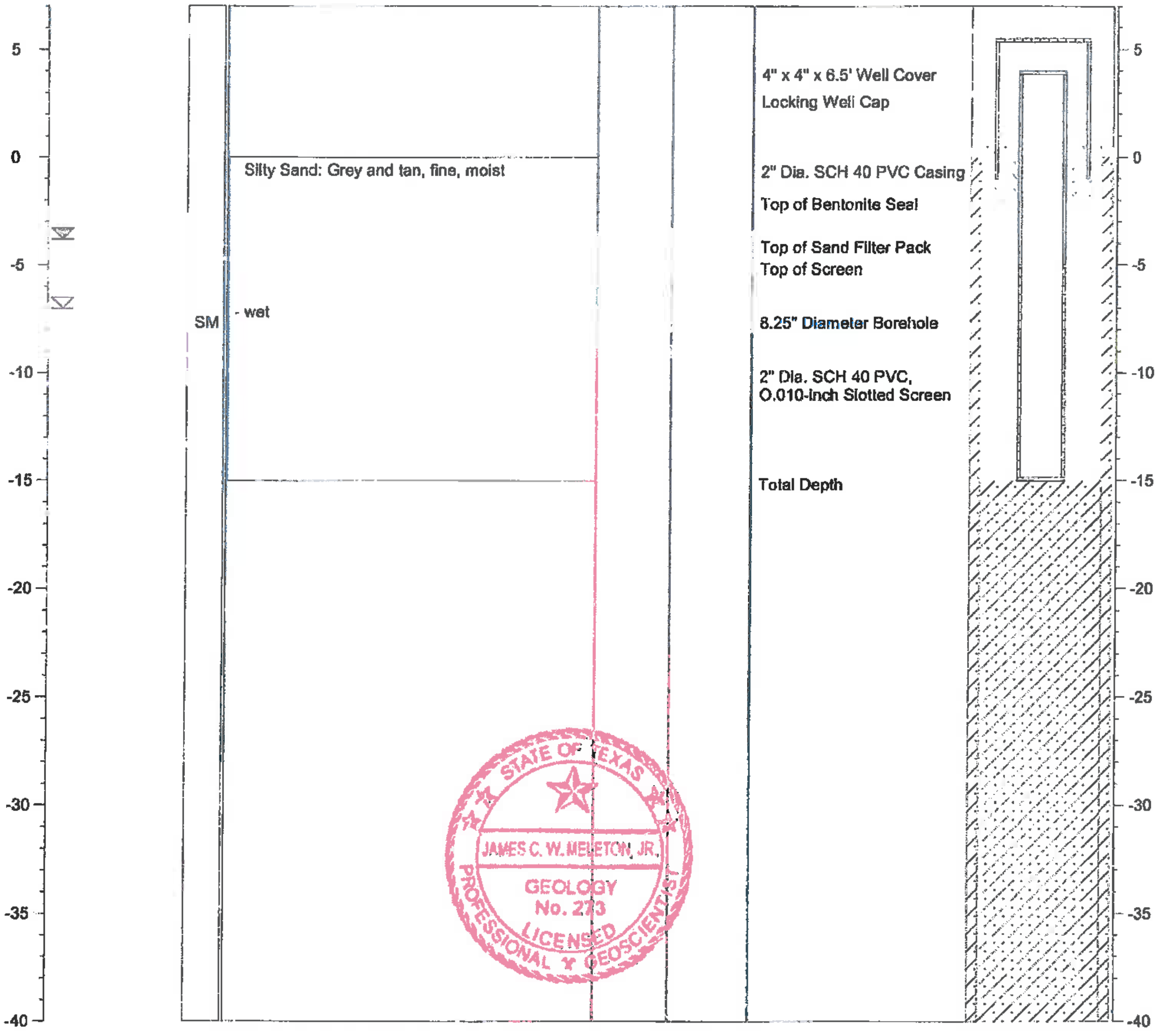
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.04507**
Longitude: 94.84244

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Silty Sand: Grey and tan, fine, moist

- wet

4" x 4" x 6.5' Well Cover
Locking Well Cap
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
8.25" Diameter Borehole
2" Dia. SCH 40 PVC,
0.010-Inch Slotted Screen
Total Depth

STATE OF TEXAS
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AD-5

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt.4, Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) 33°03'13"N 94°51'00"W N

6) WELL LOG: Date Drilling: Started 1-11 19 2001 Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	10	red & gray clay with orange streaks
10	20	gray/black clay with tan clay
20	25	stiff clay with lignite streak
25	30	fine gray sand

AP-5

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other

If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	risor	+2	20	Sch 40
2	N	#10 slot screen	20	30	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]

Cemented from 16 ft. to 0 ft. No. of sacks used

ft. to ft. No. of sacks used

Method used bentonite

Cemented by

Distance to septic system field lines or other concentrated contamination ft.

Method of verification of above distance

✓10) SURFACE COMPLETION

☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]

☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]

☐ Pitless Adapter Used [Rule 338.44(3)(b)]

☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:

Static level 11'9" ft. below land surface Date 1-11-01

Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: ☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other

Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated

Yield: gpm with ft. drawdown after hrs.

✓15) WATER QUALITY:

Did you knowingly penetrate any strata which contained undesirable constituents?

☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"

Type of water? Depth of strata

Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

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ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.: **AD-6**
TOTAL DEPTH: **33'**
TOP OF CASING ELEV.: **346.33 ft. NGVD**
GROUND SURFACE ELEV.: **343.31 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

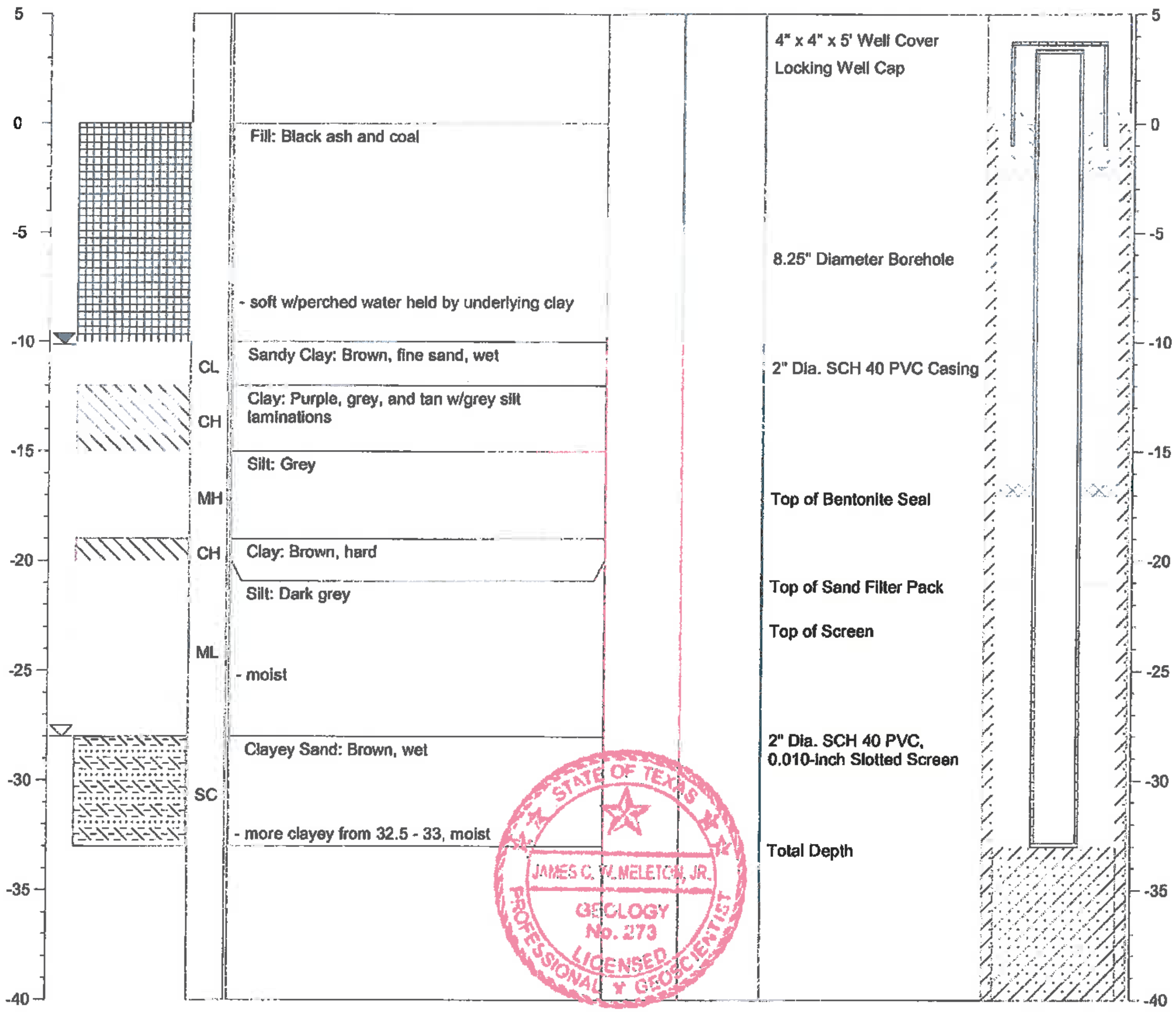
DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/23/09**

NOTES: **Latitude: 33.05235**
Longitude: 94.84757

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Fill: Black ash and coal
- soft w/perched water held by underlying clay

Sandy Clay: Brown, fine sand, wet

Clay: Purple, grey, and tan w/grey silt laminations

Silt: Grey

Clay: Brown, hard

Silt: Dark grey
- moist

Clayey Sand: Brown, wet
- more clayey from 32.5 - 33, moist

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SOIL BORING LOG

BORING/WELL NO.: **AD-7**
TOTAL DEPTH: **38'**
TOP OF CASING ELEV.: **350.82 ft. NGVD**
GROUND SURFACE ELEV.: **347.86 ft. NGVD**

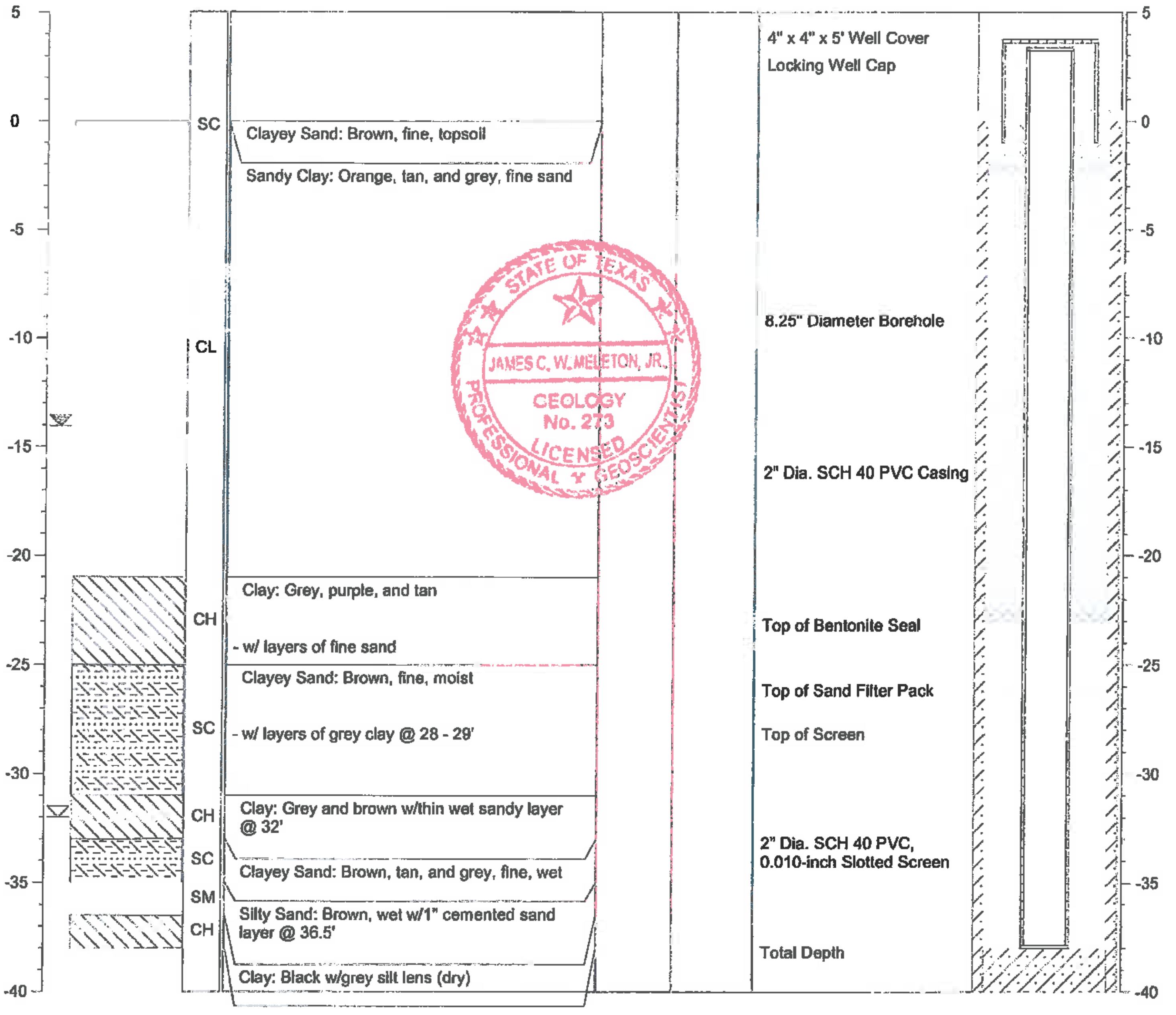
CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/24/09**

NOTES: **Latitude: 33.05257**
Longitude: 94.84219

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, fine, topsoil
CL	Sandy Clay: Orange, tan, and grey, fine sand
CH	Clay: Grey, purple, and tan - w/ layers of fine sand
SC	Clayey Sand: Brown, fine, moist - w/ layers of grey clay @ 28 - 29'
CH	Clay: Grey and brown w/thin wet sandy layer @ 32'
SC	Clayey Sand: Brown, tan, and grey, fine, wet
SM	Silty Sand: Brown, wet w/1" cemented sand layer @ 36.5'
CH	Clay: Black w/grey silt lens (dry)

CORE RECOVERY (Percent)

PID (ppm)

WELL DESCRIPTION

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

WELL CONSTRUCTION

STATE OF TEXAS
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SOIL BORING LOG

BORING/WELL NO.:	**AD-8**
TOTAL DEPTH:	**29'**
TOP OF CASING ELEV.:	**340.01 ft. NGVD**
GROUND SURFACE ELEV.:	**337.53 ft. NGVD**

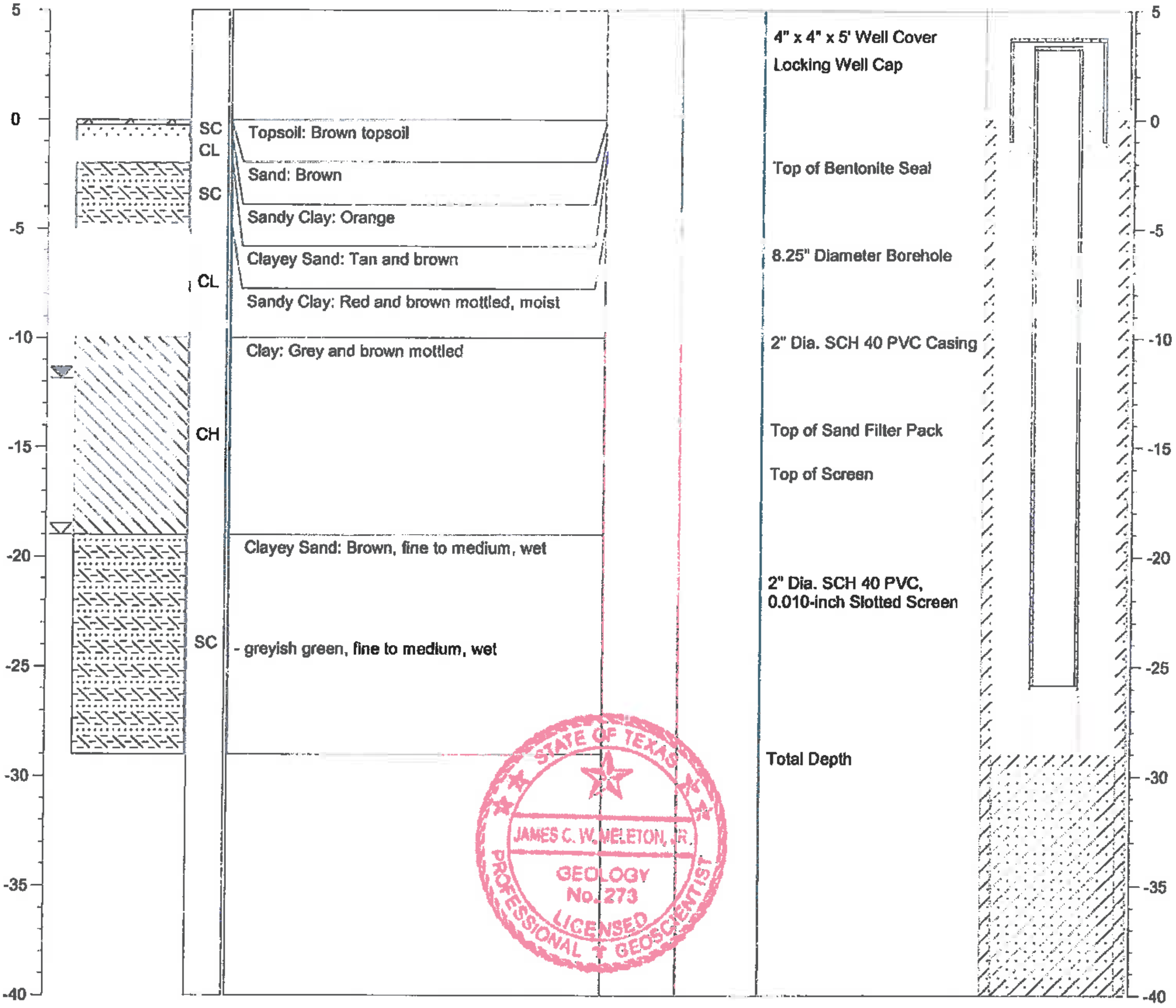
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/21/09**

NOTES: **Latitude: 33.05187**
Longitude: 94.84026

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Topsoil: Brown topsoil

Sand: Brown

Sandy Clay: Orange

Clayey Sand: Tan and brown

Sandy Clay: Red and brown mottled, moist

Clay: Grey and brown mottled

Clayey Sand: Brown, fine to medium, wet

- greyish green, fine to medium, wet

4" x 4" x 5' Well Cover

Locking Well Cap

Top of Bentonite Seal

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC,
0.010-inch Slotted Screen

Total Depth

STATE OF TEXAS
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SOIL BORING LOG

BORING/WELL NO.:	**AD-9**
TOTAL DEPTH:	**35'**
TOP OF CASING ELEV.:	**343.09 ft. NGVD**
GROUND SURFACE ELEV.:	**340.32 ft. NGVD**

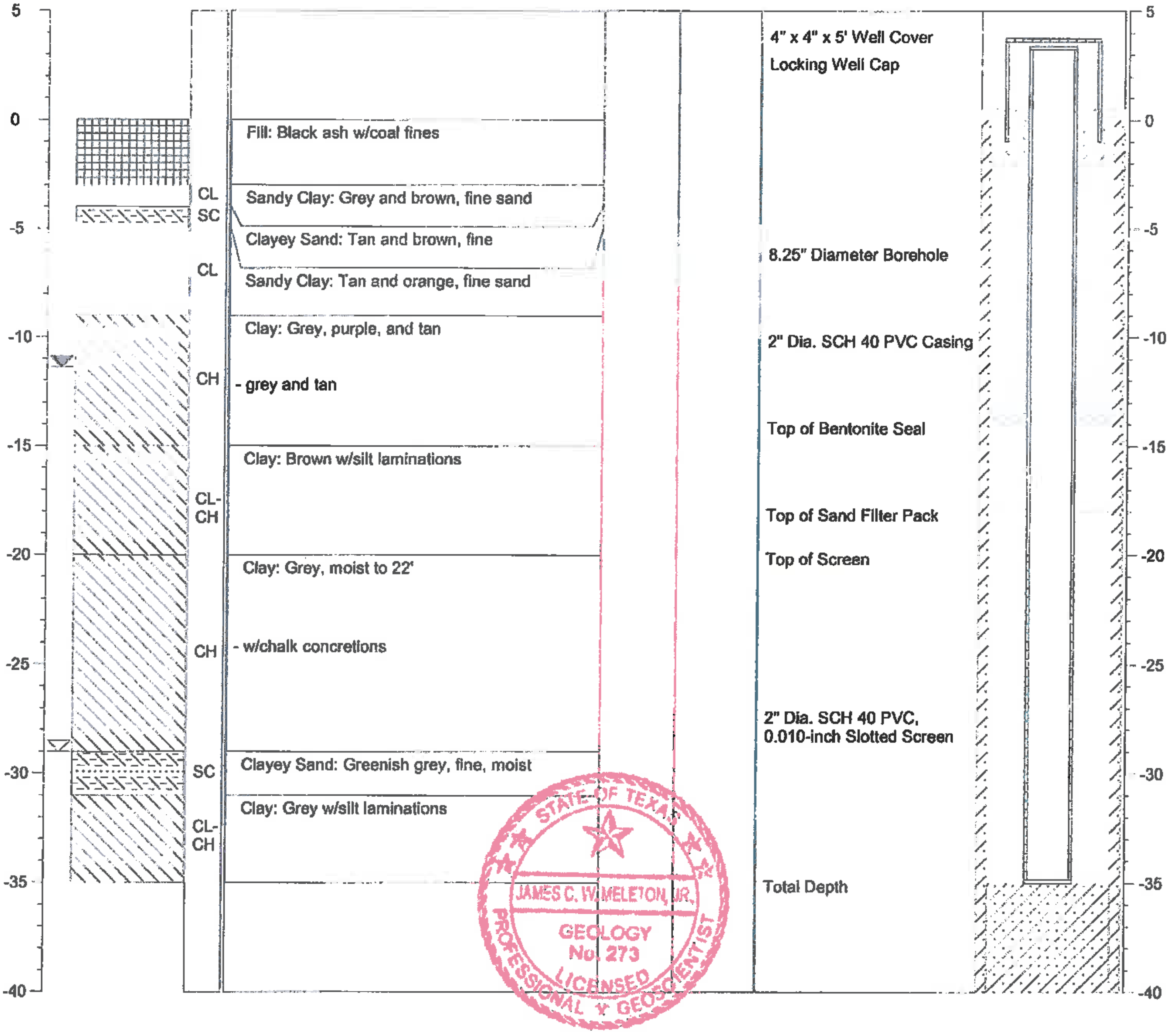
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/21/09**

NOTES: **Latitude: 33.04995**
Longitude: 94.84196

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
	Fill: Black ash w/coal fines
CL	Sandy Clay: Grey and brown, fine sand
SC	Clayey Sand: Tan and brown, fine
CL	Sandy Clay: Tan and orange, fine sand
CH	Clay: Grey, purple, and tan - grey and tan
CL-CH	Clay: Brown w/silt laminations
CH	Clay: Grey, moist to 22' - w/chalk concretions
SC	Clayey Sand: Greenish grey, fine, moist
CL-CH	Clay: Grey w/silt laminations

WELL DESCRIPTION:
4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.: **AD-10**
TOTAL DEPTH: **35'**
TOP OF CASING ELEV.: **343.01 ft. NGVD**
GROUND SURFACE ELEV.: **340.23 ft. NGVD**

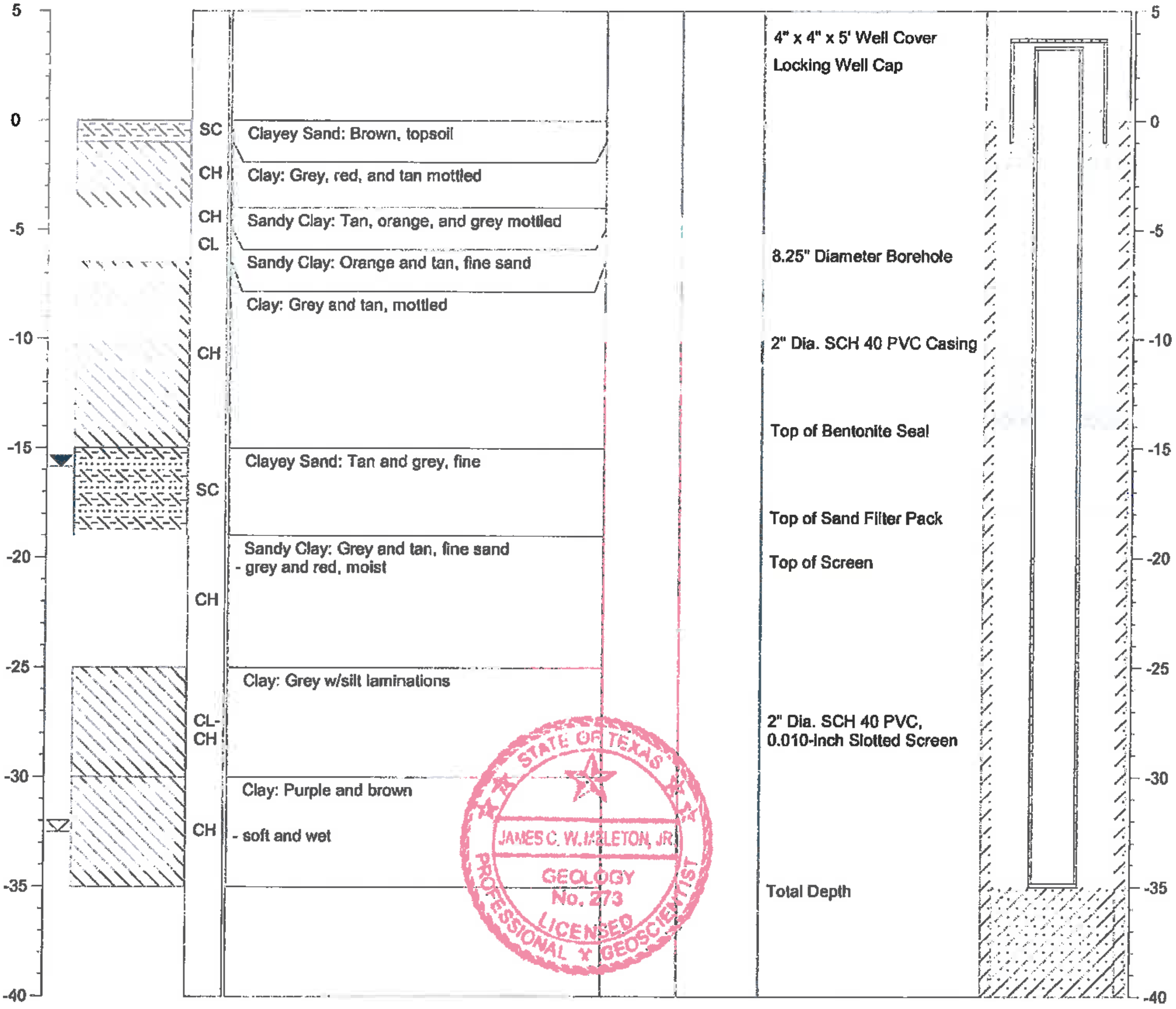
CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/22/09**

NOTES: **Latitude: 33.04881**
Longitude: 94.84047

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION
5						4" x 4" x 5' Well Cover Locking Well Cap	
0		SC	Clayey Sand: Brown, topsoil				
		CH	Clay: Grey, red, and tan mottled				
-5		CH	Sandy Clay: Tan, orange, and grey mottled				
		CL	Sandy Clay: Orange and tan, fine sand			8.25" Diameter Borehole	
-10		CH	Clay: Grey and tan, mottled			2" Dia. SCH 40 PVC Casing Top of Bentonite Seal	
-15		SC	Clayey Sand: Tan and grey, fine			Top of Sand Filter Pack	
-20		CH	Sandy Clay: Grey and tan, fine sand - grey and red, moist			Top of Screen	
-25		CL-CH	Clay: Grey w/silt laminations			2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen	
-30		CH	Clay: Purple and brown - soft and wet				
-35						Total Depth	
-40							

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ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-11**
TOTAL DEPTH:	**20'**
TOP OF CASING ELEV.:	**342.18 ft. NGVD**
GROUND SURFACE ELEV.:	**339.61 ft. NGVD**

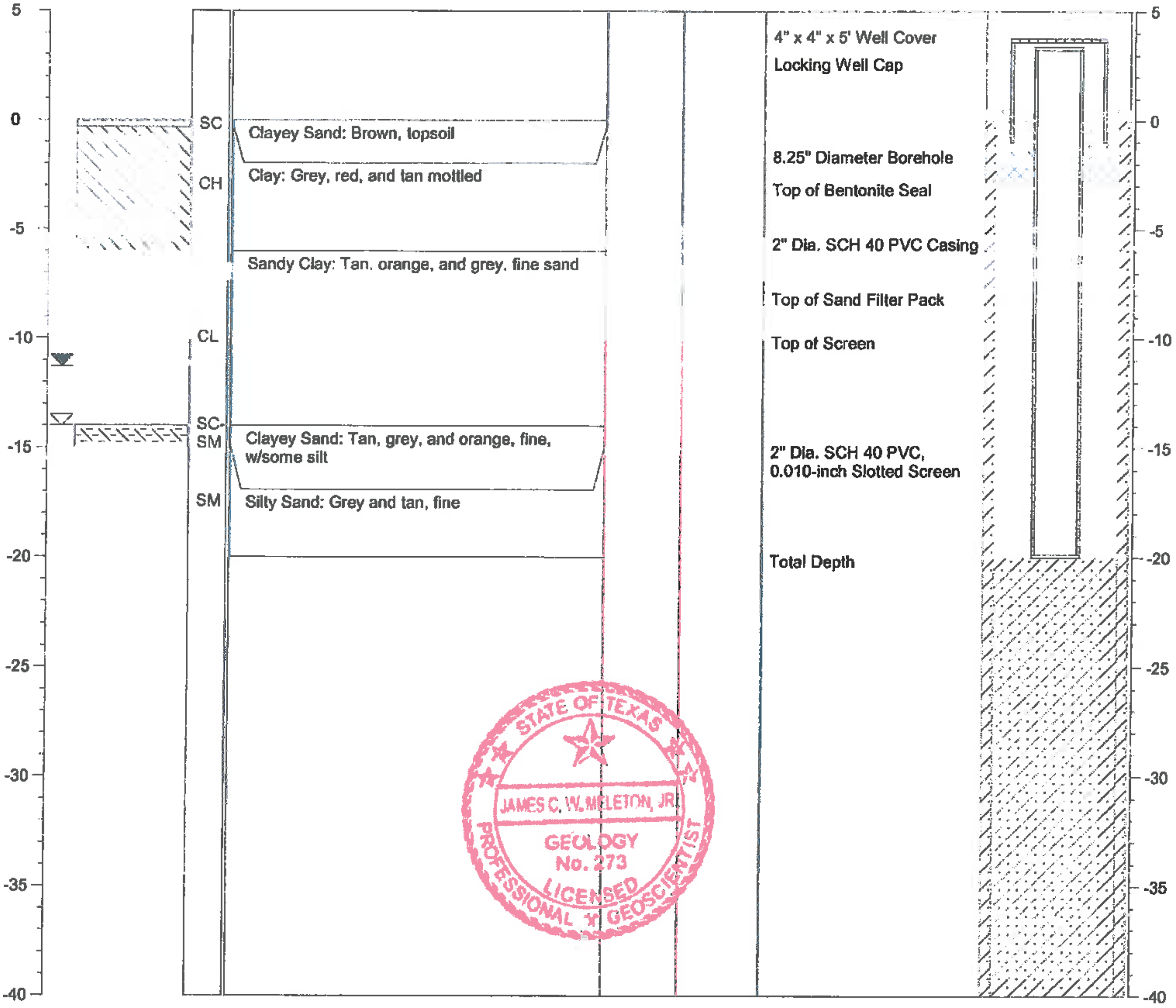
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04824**
Longitude: 94.84177

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, topsoil
CH	Clay: Grey, red, and tan mottled
	Sandy Clay: Tan, orange, and grey, fine sand
CL	
SC-SM	Clayey Sand: Tan, grey, and orange, fine, w/some silt
SM	Silty Sand: Grey and tan, fine

WELL DESCRIPTION:
4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
Top of Bentonite Seal
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

JAMES C. W. MELETON, JR.
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No. 273

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ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.: **AD-12**
TOTAL DEPTH: **30'**
TOP OF CASING ELEV.: **369.33 ft. NGVD**
GROUND SURFACE ELEV.: **366.27 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

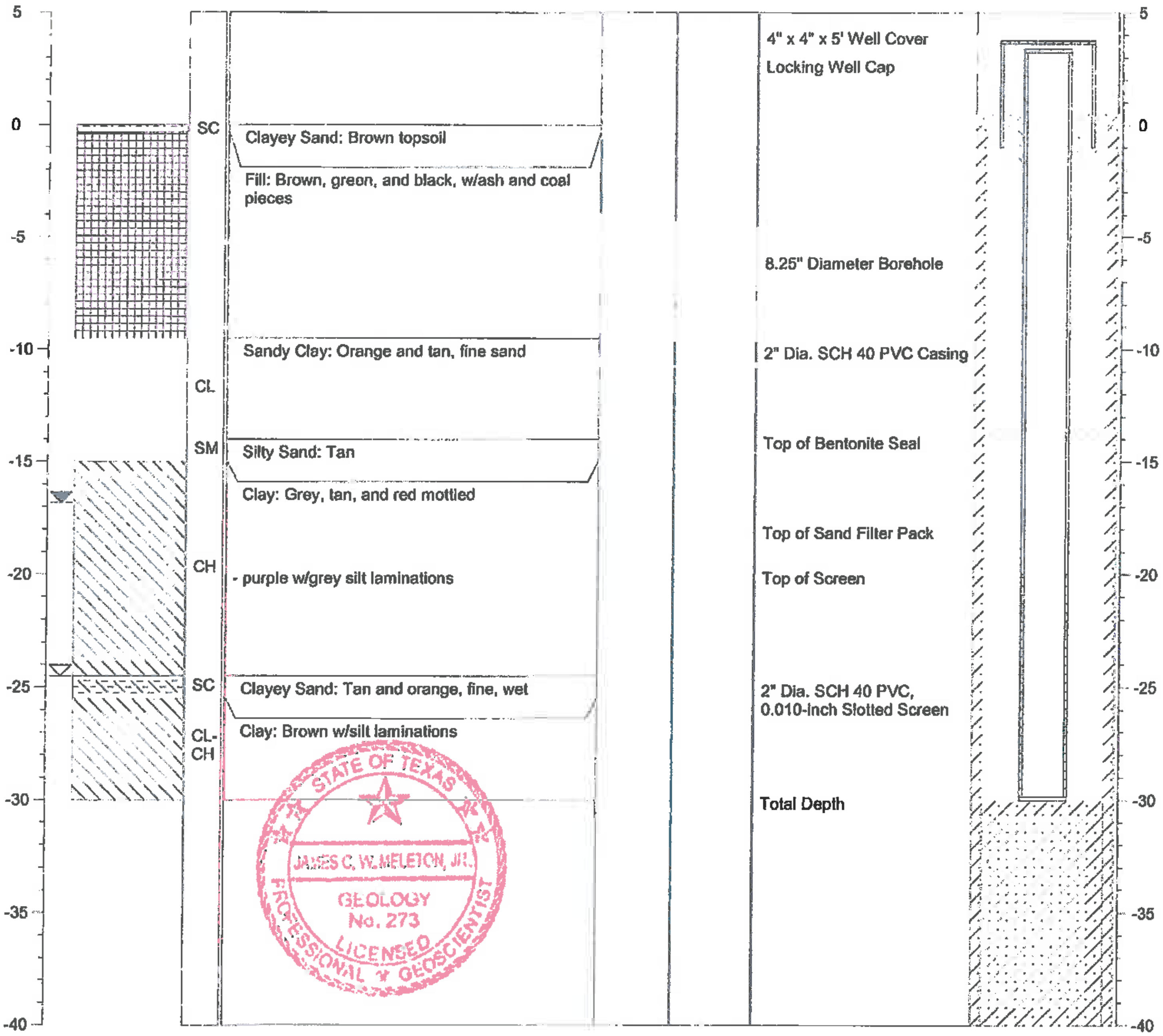
DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/24/09**

NOTES: **Latitude: 33.04901**
Longitude: 94.84977

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

EAGLE
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-13**
TOTAL DEPTH:	**20'**
TOP OF CASING ELEV.:	**347.00 ft. NGVD**
GROUND SURFACE ELEV.:	**344.12 ft. NGVD**

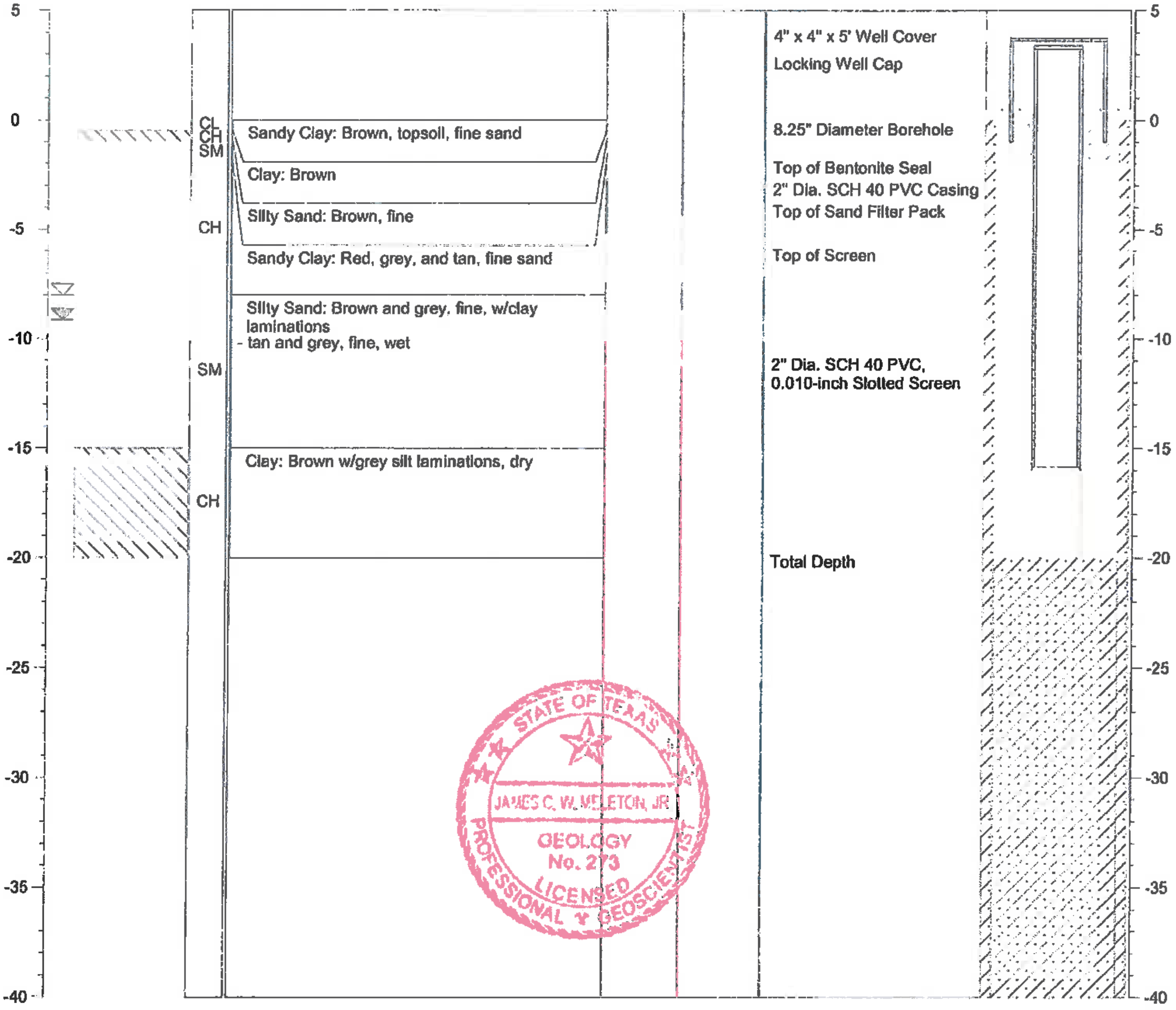
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04918**
Longitude: 94.84275

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Sandy Clay: Brown, topsoil, fine sand

Clay: Brown

Silty Sand: Brown, fine

Sandy Clay: Red, grey, and tan, fine sand

Silty Sand: Brown and grey, fine, w/clay laminations
- tan and grey, fine, wet

Clay: Brown w/grey silt laminations, dry

4" x 4" x 5' Well Cover

Locking Well Cap

8.25" Diameter Borehole

Top of Bentonite Seal

2" Dia. SCH 40 PVC Casing

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen

Total Depth

STATE OF TEXAS
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E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

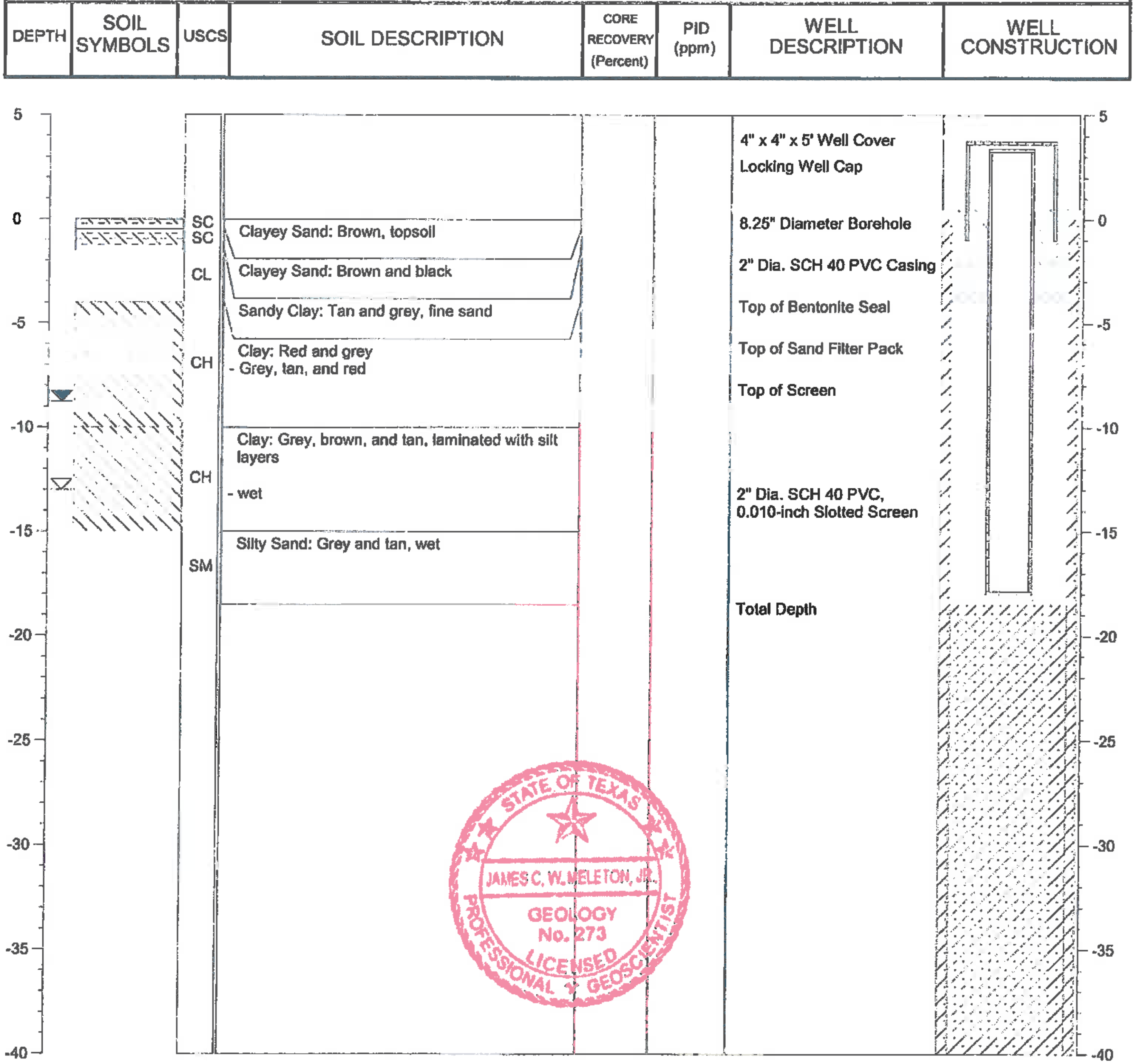
BORING/WELL NO.:	**AD-14**
TOTAL DEPTH:	**18.5'**
TOP OF CASING ELEV.:	**345.43 ft. NGVD**
GROUND SURFACE ELEV.:	**342.32 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04715**
Longitude: 94.84256

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



STATE OF TEXAS
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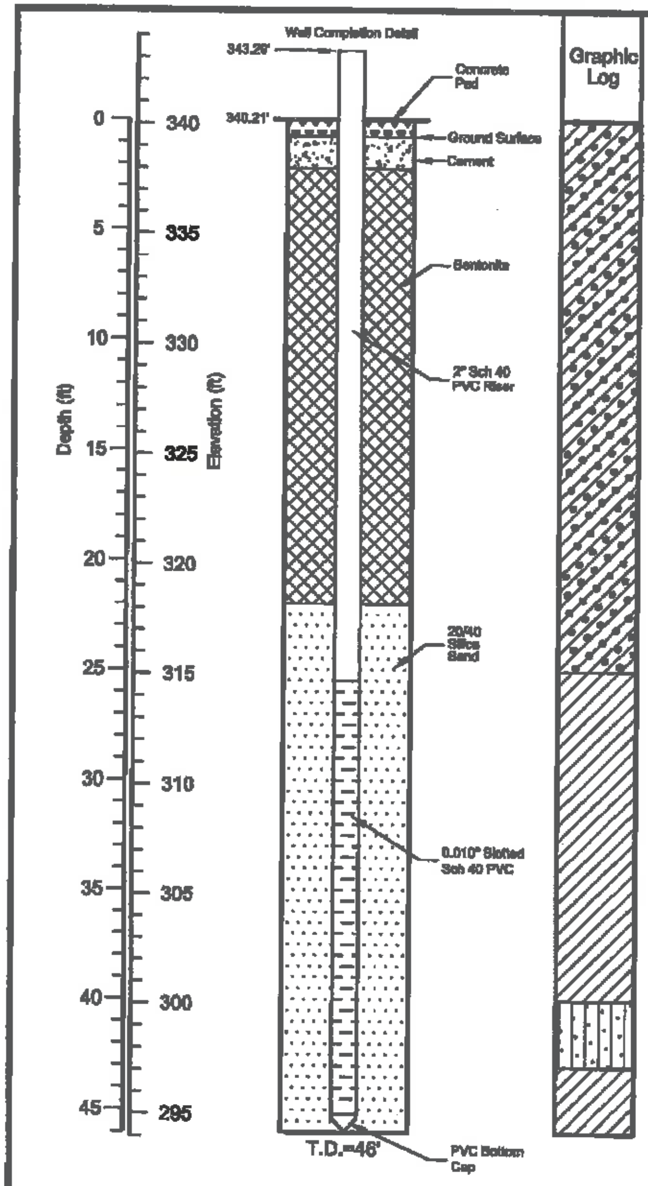


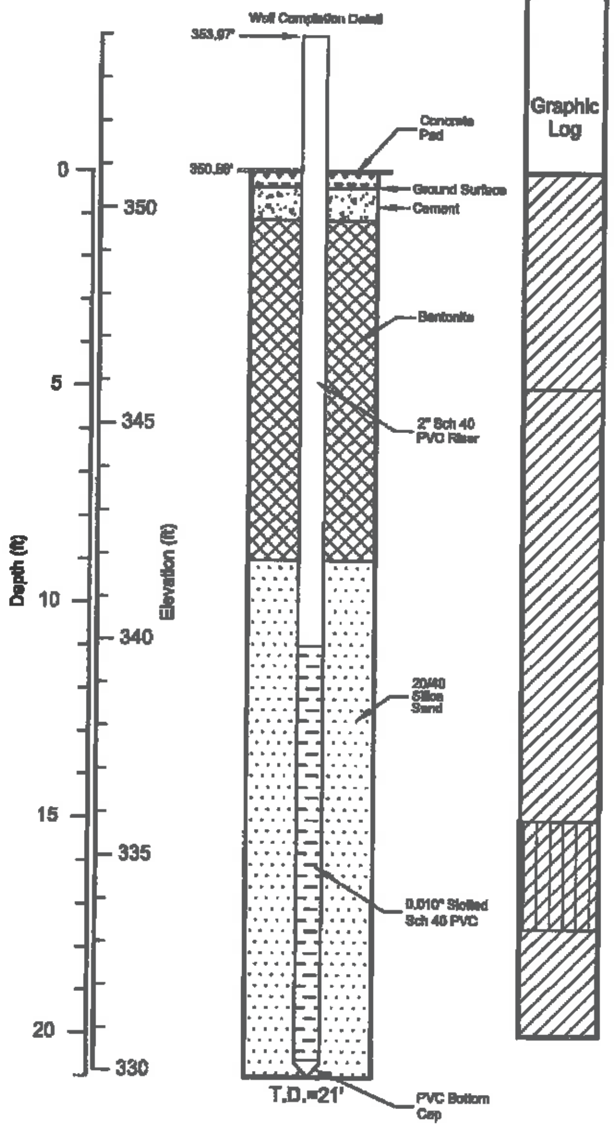
PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		SC	Clayey SAND: reddish brown					
					16	48	37	18	19
				- 2" lense of brown sand					
				- 3" lense of brown sand					
	Direct Push		CL	Sandy Lean CLAY: reddish brown, very moist					
				- less moisture					
					22	51	36	19	17
			SM	Silty SAND: light brown & light gray, wet.	27	24	26	NP	-
			CL	Lean CLAY: orangish brown & light gray, mottled, with sand	26	94	45	21	24

STEVEN R. WEMPLE
2176
1-22-16

WEST DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahatchie, Texas 75165

DATE: 12/12/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-15
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/12/15	DRAWN BY: HDS	PROJECT NO.: —
			SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	Description Interva (feet bgs)	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0–5		Direct Push		CL	Lean CLAY w/ Sand: light brown & light gray - orangish brown, with silt	16	82	26	16	10
5–15				CL	Lean CLAY w/ Sand: orangish-brown & light gray	22	68	31	19	12
15–				CL-ML	Silty CLAY: orange w/ brown, wet	30	69	27	20	7
–20				CL	Sandy, Lean CLAY: brown w/ orange, stiff	26	66	46	26	20

STEVEN R. WEMPLE
SOIL SCIENCE
LICENSE NUMBER 2176
1-22-16

West DRILLING environmental & geotechnical
WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/10/15
Drilling Method: H.S.A.
Bit Diameter: 7.25"
Depth to Water: –

Logged by: Robert Williams, PE
Driller: Robert Williams
Date Completed: 12/10/15
Depth to Product: NA

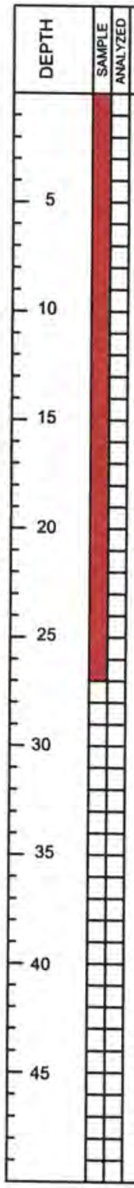
Welsh Power Station
Pittsburg, Texas
DRAWN BY: HDS
CHECKED BY: SRW

Log of Boring AD-16

PROJECT NO.: —
SCALE: AS SHOWN
FILE NAME: JR Welsh Power Plant LOGS.dwg

WELL LOG

DEPTH	SAMPLE	ANALYZED	TYPE	ORGANIC VAPOR (ppm)
0-27	▮		SS SS SS SS SS SS SS SS SS SS SS SS SS	



SAMPLE DESCRIPTION

(0-15') SILTY CLAY (CL), BROWN TO ORANGE-BROWN, STIFF, DRY.

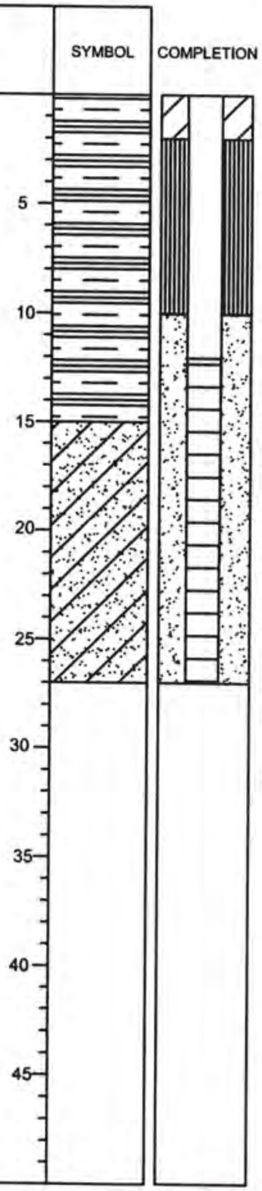
(15-18') SILTY CLAY AND SANDY CLAY, ORANGE-BROWN TO LIGHT GRAY, MOIST.

(18-27') SILTY CLAY AND SANDY CLAY, DARK BROWN TO GRAY, MOIST TO WET.

TOTAL DEPTH = 27' BGS

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

Kenneth J. Brandner
4-12-17



AD-16R
WELL

AEP
CLIENT

BOTTOM ASH STORAGE POND
PROJECT

WELSH POWER PLANT
LOCATION

4/12/17
DATE

HSA
DRILLING METHOD

2" PVC, 2' AGL-12' BGL
CASING

2" PVC, 12'-27' BGS
SCREEN

0-2' BGS
CEMENT

2-10' BGS
BENTONITE

10-27' BGS
SAND PACK

350.55' / 353.49'
GROUND ELEV. / TOP OF CASING ELEV.

CT - CUTTINGS
SB - SPLIT BARREL(5')
SS - SPLIT SPOON(2')

▽ HC LEVEL
▼ WATER LEVEL

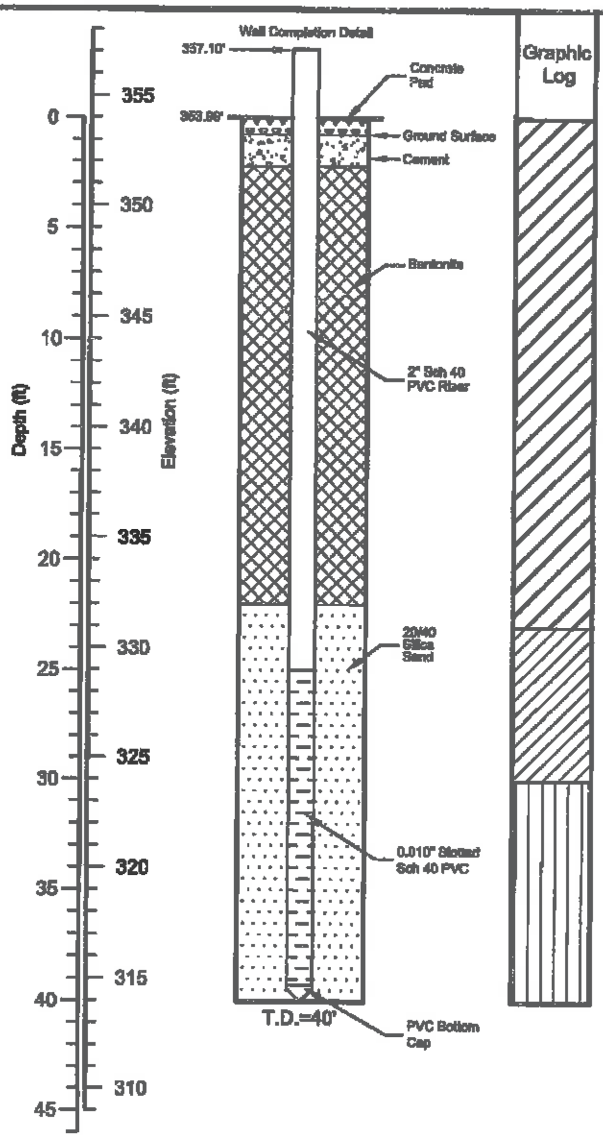
░ SAND
▤ SILT
▤ CLAY

▨ FILL/CONCRETE
▥ BENTONITE
⁘ GRAVEL

START: FINISH:

PAGE 1 OF 1

ARCADIS Design & Consultancy for natural and built assets
711 N. CARANCAHUA, #1080
CORPUS CHRISTI, TEXAS 78401
TEL: (361) 883-1353 FAX: (361) 883-7565



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0		Direct Push		CH	Fat CLAY: reddish-brown					
5					- light gray to light brown, reddish brown w/ Sand and gravel lenses	24	97	83	30	53
10					- light brown					
15					- brown Sand lenses, wet					
20					- gray, w/ some Silt	18	90	53	25	28
25		Direct Push		CL	Lean CLAY with Sand: gray	22	81	43	22	21
30				ML	Sandy SILT: gray	23	63	26	NP	-
35										
40										

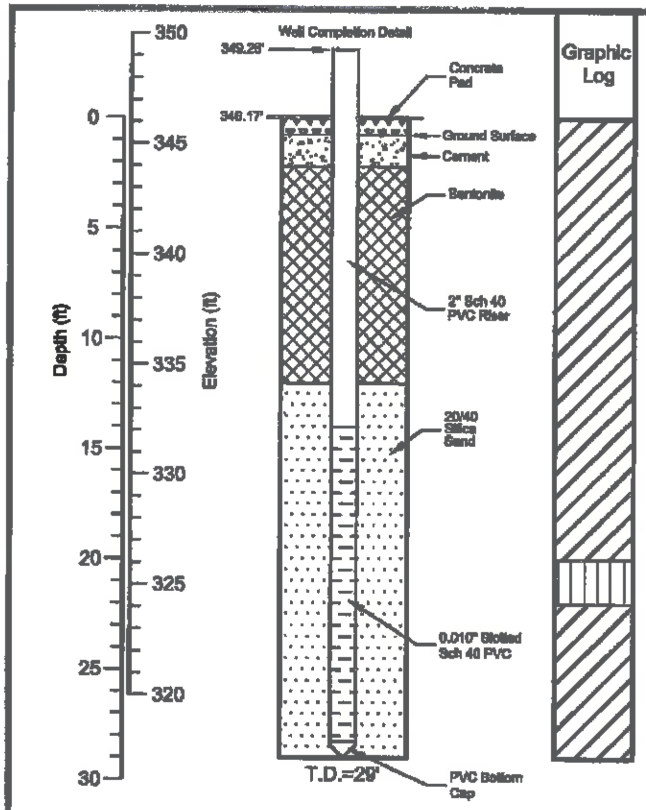
STEVEN R. WEMPLE
SOIL SCIENCE
LICENSE NUMBER 2176

1/22/16

west DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahatchie, Texas 75165

DATE: 12/10/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-17
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: —
			SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0–20		Direct Push		CH	Fat CLAY: light brown & light gray, sandy - reddish brown and light gray, with Sand - gray with silt - gray, stiff	19	88	50	24	26
20–22				ML	SILT: gray, with Clay and Sand, wet	29	86	26	NP	-
22–29				CH	Fat CLAY: light gray, silty w/ Sand, very stiff	20	85	50	23	27

STEVEN R. WEMPLE
2176

1-22-21

West DRILLING environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/11/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-18
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: — SCALE: AS SHOWN
Depth to Water: –	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 1 of 2

Date(s) Drilled **July 23, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **37 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **367 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Bentonite Chips**	Location **On the Northern edge of proposed chemical pond along the screening berm.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
367	0					Other		Black COAL, a few fine roots and organics.						
			ST											Shelby tube pulled black COAL
			SS	10										SPT 4, 5, 5, 5. 24" recovered
362	5		SS	11	Soft to Firm	SC		Reddish Brown fine SAND, little clay, trace silt, Dry. Natural Ground.						SPT 4, 5, 6, 7. 24" recovered
			SS	11	Soft	SM		Reddish brown fine SAND with silt, trace clay. Vertical sand seams in sample, Dry.						SPT 3, 5, 6, 8. 24" recovered.
357	10		ST						23.6	[illegible]	48.9	5.4E-07		Shelby tube sample, 18" recovered.
					Soft	SC		Reddish brown well graded fine SAND, trace silt and clay. Damp.						SPT 5, 6, 6, 9. 24" recovered
			SS	12	Firm	CL		Greyish red CLAY, little sand, horizontal sand seams, Dry.						
					Soft	SC		Brownish red fine SAND, little clay, Damp.						SPT 7, 6, 7, 9. 24" recovered.
			SS	13	Firm	SC-CL		Four-inch CLAY seam, little fine sand.						
					Firm	CL		Reddish grey CLAY, little sand, oxidized iron ore. Dry						
352	15				Soft	SM		Brownish red fine SAND, trace clay, thin clay seams. Moist.						SPT 8, 9, 9, 9. 24" recovered.
			SS	18					17.74	14	40.1			
			ST						16.25	NP	28.9	3.6E-05		Shelby tube samples look like SC. 17" recovered.
														SPT 9, 8, 9, 11. 24 inches recovered.
347	20		SS	17	Soft	Other		Iron oxidized material						
					Soft	SC		Brownish red fine SAND, little clay. Moist.						SPT 5, 7, 8, 50/2. 21" recovered
			SS	15										
			SS	50	Soft	CL		Dark grey CLAY, little fine sand, Wet.						SPT 50/3".
					Very Hard	SP		Dark grey-black cemented SAND, little clay. Wet. Driller comments that cemented sand terminates at 25.5 feet.						
342	25													SPT 11, 13, 14, 16. 24" recovered.
			SS	27	Soft to Firm	SC		Dark grey fine SAND, little clay. Moist. Soft sand with lenses of firm clay.						
					Hard	CL		Dark grey CLAY, little sand, Dry.						
					Soft	SC		Dark grey-black fine SAND, little clay, Wet. Encountered water but water rose to 19 feet after 15 min break.						SPT 11, 16, 30, 14. 24" recovered.
			SS	46										
			SS	37										SPT 11, 15, 22, 25. 24" recovered.
337	30				Hard	CL								

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
337	30	▨	SS	37	Hard	CL	▨	Dark grey CLAY, little fine sand, occasional horizontal sand seams. Wet. (cont.)						SPT 11, 15, 22, 25. 24" recovered.
		▨	SS	29	Soft	ML	▥	Dark grey-black fine SAND, with clay, frequent hard clay lenses (1-3"), Wet.	26.37	NP	57.5			SPT 6, 11, 18, 24. 24 recovered.
332	35		SS	34	Hard	CL	▨	Black CLAY, trace to little fine sand, trace silt. Dry						SPT 9, 16, 18, 23. 24" recovered.
								Bottom of Boring at 37 feet bgs						
327	40													
322	45													
317	50													
312	55													
307	60													
302	65													

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-02

Sheet 1 of 1

Date(s) Drilled **August 14, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **364.56 feet MSL**
Groundwater Level and Date Measured **21.53 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Western edge of proposed chemical pond near perimeter fence.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
364.6	0				Soft	Other		Coal						
					Soft	CL		Greyish brown CLAY, with little silt, little sand, damp.						SPT 2, 2, 2. 12" recovered.
			SS	4										
			SS	13										SPT 4, 7, 6, 12.
359.6	5		ST											Shelby Tube Sample
					Firm	CH		Brownish tan CLAY with silt, little sand, Damp. Occasional sand and iron ore.						SPT 8, 12, 17, 21
			SS	29					23.71	38	77.3			
			SS	80										SPT 20, 30, 50/5. 17" recovered
354.6	10				Soft	SC		Red-orange fine SAND, little clay, damp. Occasional iron ore.						SPT 15, 20, 24, 31. 18" recovered.
					Soft	CL		Brownish tan CLAY, little silt, little sand, Damp.						
			SS	44	Soft	SM		Red-orange fine SAND, little clay, Damp.						
														SPT 11, 12, 9, 32.
			SS	21					20.35	NP	33.5			
														SPT 6, 6, 12, 6.
349.6	15		SS	18	Soft	SM-SC		Light brown fine SAND, with little silt, little sand, Damp.						
					Firm	CL		Black CLAY, with fine sand, Wet.						SPT 12, 25, 50/5.
			SS	75	Soft	SM-SC		Dark red fine SAND, little clay, little silt, Wet.						
					Soft-Firm	SC		Dark grey fine SAND, little clay, Wet. Occasional clay seams.						SPT 9, 16, 12, 15.
			SS	28										
344.6	20													SPT 9, 17, 21, 27.
			SS	38	Firm	SC		Frequent clay lenses. 8/11/09	22.55	13	36.6			
														SPT 22, 35, 50/4".
			SS	65										
														SPT 10, 15, 18, 26.
339.6	25		SS	33										
					Soft	SC		Less clay lenses, Wet.						SPT 12, 27, 37, 50/5".
			SS	64										
														SPT 19, 24, 21, 50/5".
			SS	44										
					Hard	CL		Dark grey CLAY, little sand, trace silt, Wet.						
334.6	30													

Figure

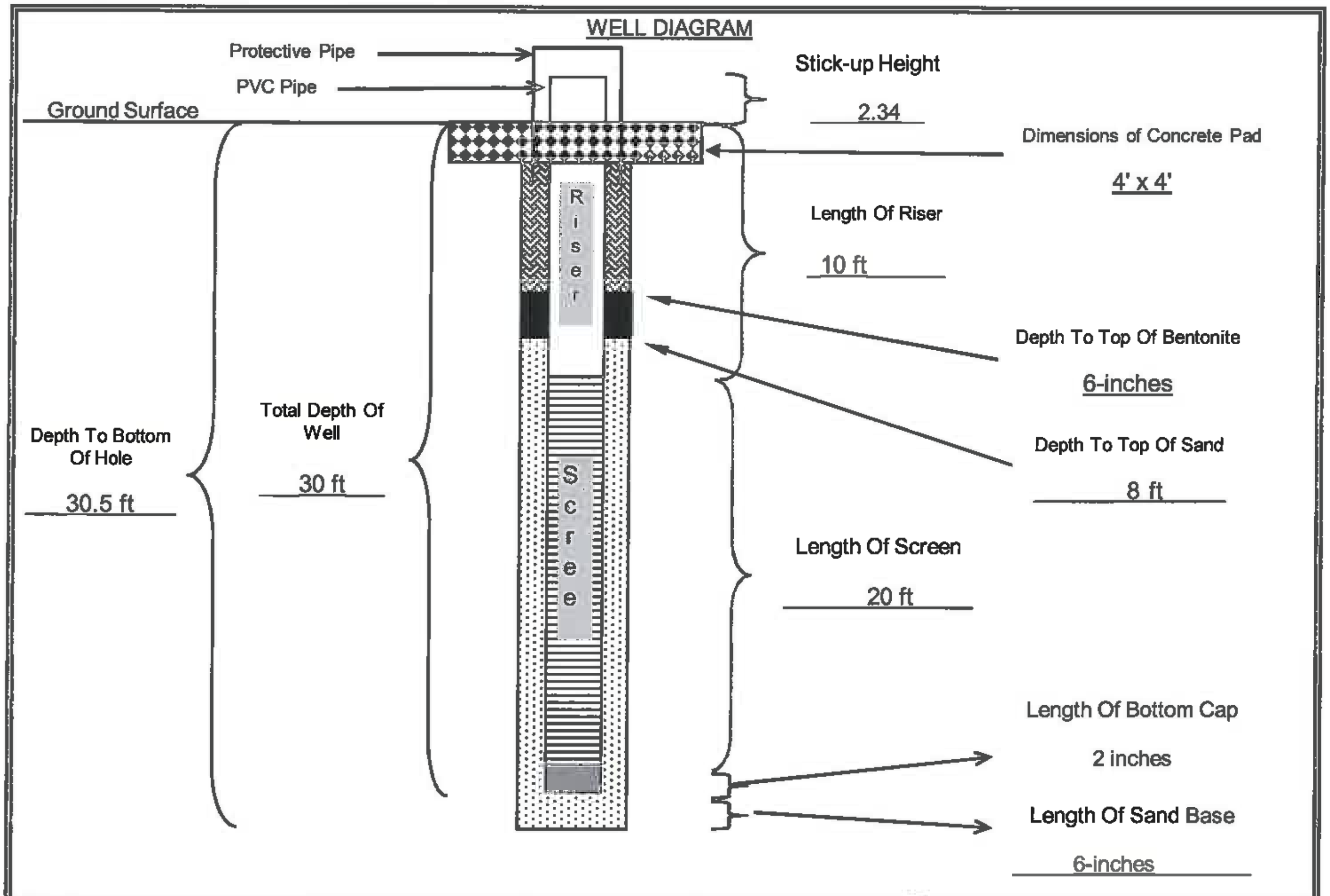
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL LOCATION:
WELL NO.: GB-02
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION:	364.56 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	354.56 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	334.06 (ft, msl)	CEMENT TYPE:	Not used-sealed with bentonite chips
NORTHING: 747.0223	EASTING: -2442.888	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	4 bags lbs
RISER DIAMETER:	2 (in) Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 20 (ft)	AMOUNT SAND USED:	13 bags lbs
BOREHOLE DIAMETER:	8 (in)	STATIC WATER:	21.53 depth from TOC
DRILLING TECHNIQUE:	Hollow stem Size: (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



▨	Cement/Bentonite Grout	░	Sand Pack	▦	Neat Concrete	■	Bentonite	▩	Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: August 7th, 2009
OBSERVED BY: Kush Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 1 of 2

Date(s) Drilled **August 7, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **31 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **359.91 feet MSL**
Groundwater Level and Date Measured **21.89 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Southwest corner of proposed chemical pond near screening pile.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
359.9	0				Soft	Other		Coal						
354.9	5				Soft	CH		Shelby Tube						Shelby tube sample.
			ST							43	96.1			
					Firm	CH		Light brown-grey CLAY, little silt, occasional sand seams (fine), Damp.						SPT 29, 22, 19, 21.
			SS	41					24.04	29	90.4			
					Soft	CH		Brownish dark grey CLAY, trace sand, trace silt, Wet.						SPT 6, 12, 15, 20.
349.9	10		SS	27										
					Soft	SC		Dark orange red SAND, little clay, trace silt, Wet. Occasional clay seam (dark grey).						SPT 17, 29, 24, 25.
			SS	53										
					Soft	SC		Clay lenses.						SPT 7, 15, 17, 40.
			SS	32										
344.9	15													SPT 9, 17, 30, 20.
			SS	47	Soft	SC		Clay lense						
					Soft	SC		Dark grey fine SAND with clay, occasional clay lense, Wet.						SPT 11, 50/4".
					Firm	CL		Dark grey CLAY, little fine sand, Wet.						
			SS	50										
					Soft	SC		Dark grey fine SAND, little clay, occasional clay seam, iron ore, Wet.						SPT 11, 27, 17, 21.
339.9	20		SS	44										
								8/11/09 ▼						
334.9	25													SPT 27, 40, 50/4".
			SS	90										
					Firm	SC		Dark grey clay lense						SPT 11, 15, 40, 50/3".
			SS	55										
														SPT 17, 50/5.5".
			SS	55										
329.9	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
329.9	30	▨	SS	55	Hard	CL	▨	Dark gray CLAY, trace silt, trace fine sand.						SPT 17, 50/5.5".
								Bottom of Boring at 31 feet bgs						
324.9	35													
319.9	40													
314.9	45													
309.9	50													
304.9	55													
299.9	60													
294.9	65													

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

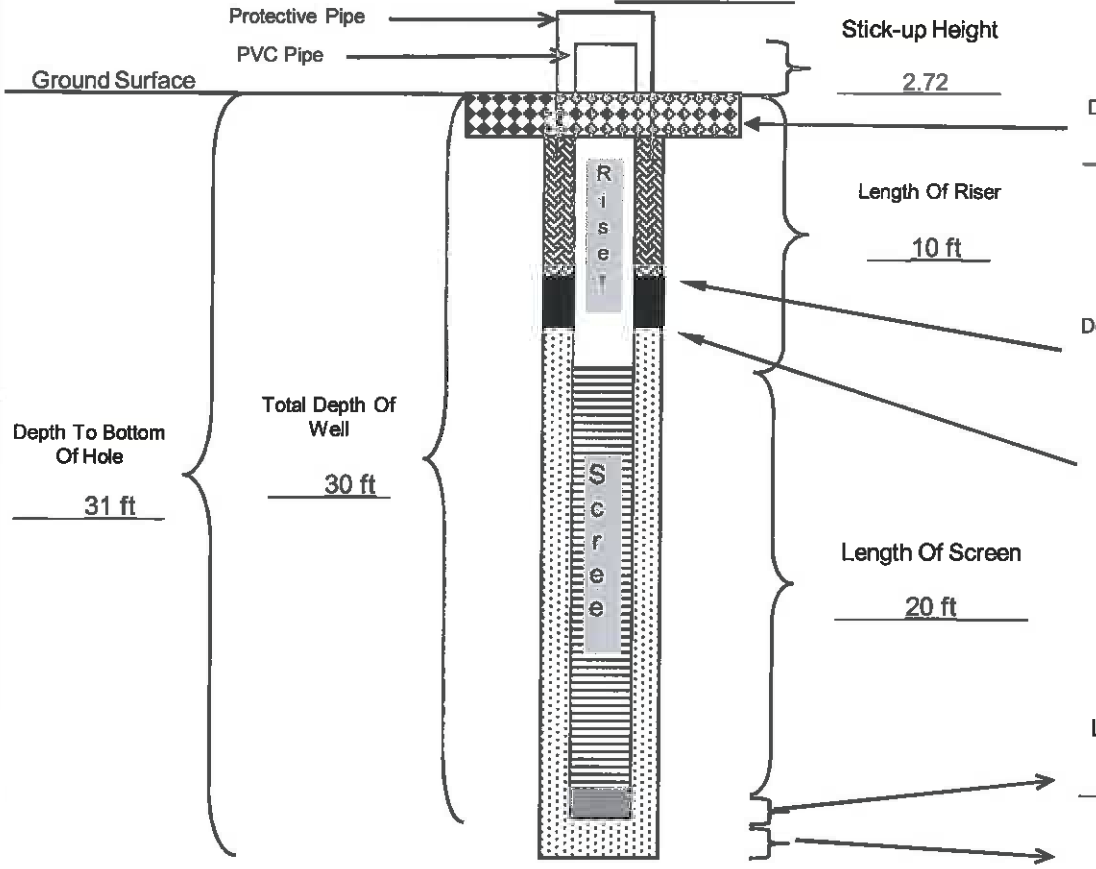
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL NO.: GB-03
WELL LOCATION:
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 359.57 (ft, msl)
TOP OF SCREEN ELEVATION: 349.57 (ft, msl)
BOTTOM OF WELL ELEVATION: 328.57 (ft, msl)
NORTHING: 460.5803 EASTING: -2507.6332
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 8 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 8 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE: None used-sealed with bentonite chips
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 4 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 12 bags lbs
STATIC WATER: 21.89 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.72
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 1 ft
Total Depth Of Well: 30 ft
Depth To Bottom Of Hole: 31 ft

▨	Cement/Bentonite Grout	░	Sand Pack	▦	Neat Concrete	■	Bentonite	▩	Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: 7-Aug-09
OBSERVED BY: Kush S. Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **34 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.22 feet MSL**
Groundwater Level and Date Measured **20.54 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Southeast corner of proposed chemical evaportation pond. Located in a grassy field.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
357.2	0	▨	SS	9	Soft	SM-SC	Reddish brown fine SAND, little silt, trace clay, damp.					SPT 1, 3, 6, 6. 24" recovered.
					Soft	Other	COAL					
					Firm	SC	Brownish red SAND, little clay, trace silt. Damp.					
		▨	SS	8	Firm	CL	Reddish pink CLAY, some fine sand, Dry.	24.49	47	90.2		SPT 4, 4, 4, 4. 24" recovered.
		▨	SS	14	Soft	Other	Oxidized SAND and clay with iron ore.					SPT 5, 6, 8, 4. 18" recovered.
352.2	5				Soft	CH	Light reddish brown CLAY and sand mixture, Dry.					
		☒	ST		Soft	SC	Reddish brown SAND, little clay, Dry.	28.4	38	61.1	7.7E-09	12" Shelby tube. 9" recovered.
		▨	SS	17	Firm	CH	Light brownish tan CLAY, little sand, occasional sand seams, Dry.					SPT 3, 4, 13, 15. 27" recovered.
347.2	10											
342.2	15	▨	SS	10	Soft	SC	Red/yellowish brown SAND, some clay, Wet.	6.95	14	47		SPT 3, 7, 3, 15. 24" recovered.
					Firm	SC	Occasional clay lenses.					
337.2	20	☒	ST				8/11/09 ▼					Shelby tube. 12" driven 0" pulled. Gravel material encountered.
		▨	SS	19	Soft to Firm	SM	Black to dark grey fine/med SAND, little clay, occasional clay lenses, Wet.					SPT 7, 10, 9, 13. 24" recovered.
332.2	25	▨	SS	74	Soft	SM	Well graded light grey fine/med SAND, trace silt, Wet.	22.29	NP	13.5		SPT 17, 24, 50/5.5". 19" recovered.
					Firm	CL	Dark grey clay lense, Wet.					
					Firm	SM-SC	Well graded light grey fine/med SAND, trace silt, Wet.					
327.2	30											

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.2	30	☒	ST		Hard	ML	▥	Dark grey CLAY, little sand, Wet.					░	12" Shelby tube. Bent shelby tube.
		☒	ST						21.3	NP	84.2	2.0E-08	░	12" Shelby tube.
		▨			Hard	CL	▨	Dark grey CLAY, trace sand, Wet.					░	SPT 15, 19, 19, 25. 24" recovered.
		▨	SS	38					25.44	18	92.5		░	
								Bottom of Boring at 34 feet bgs						
322.2	35													
317.2	40													
312.2	45													
307.2	50													
302.2	55													
297.2	60													
292.2	65													

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

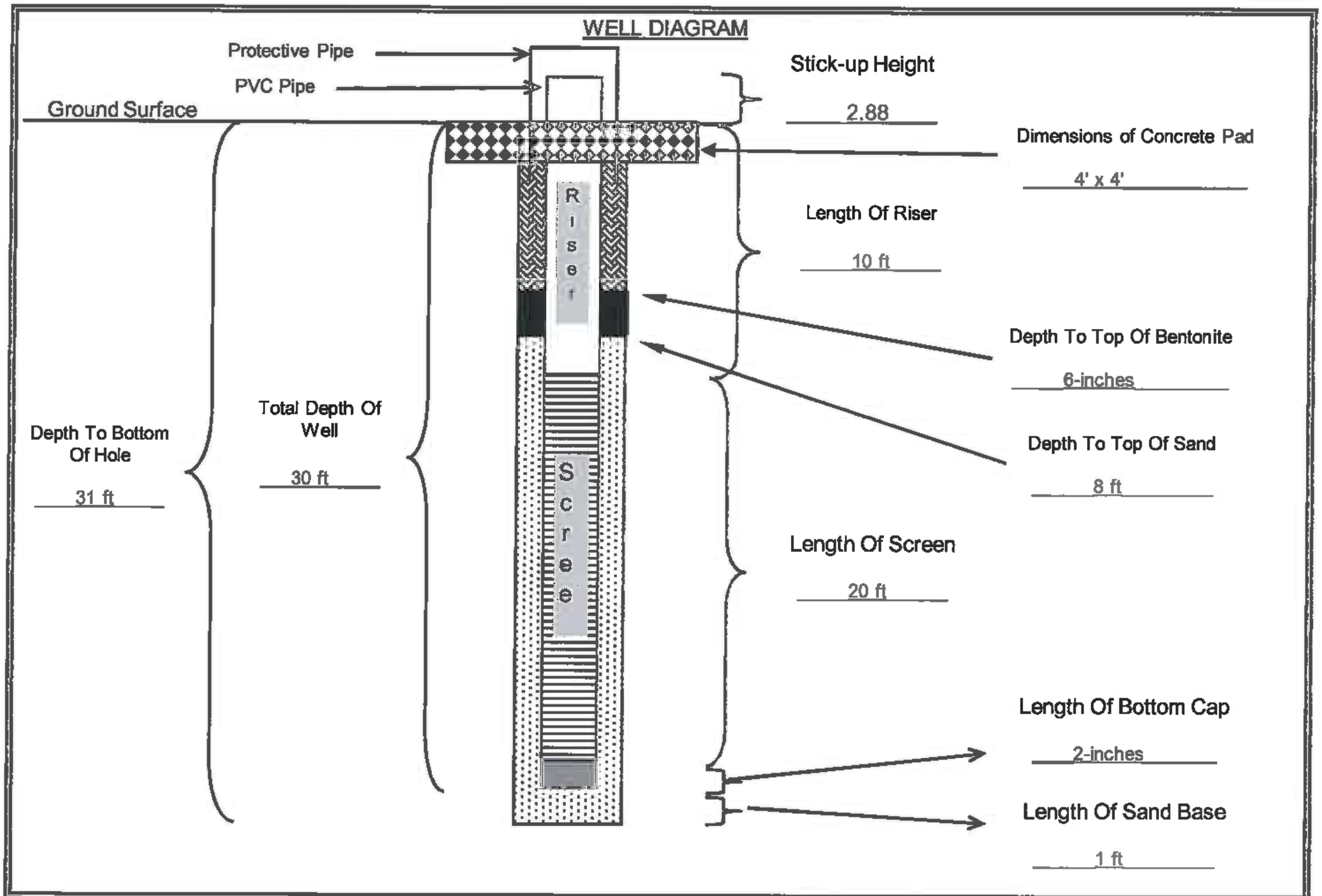
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 24-Jul-09
WELL LOCATION:
WELL NO.: **GB-04**
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.22 (ft, msl)
TOP OF SCREEN ELEVATION: 347.22 (ft, msl)
BOTTOM OF WELL ELEVATION: 326.22 (ft, msl)
NORTHING: -384.9666 EASTING: -2353.7375
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 6.75 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 6.75 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 3 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 20.54 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: 24-Jul-09
OBSERVED BY: Kush S. Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 1 of 2

Date(s) Drilled	**July 24, 2009**	Logged By	**Kush S. Chohan**	Checked By	
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type		Total Depth of Borehole	**30.5 feet bgs**
Drill Rig Type	**Mobil B61**	Drilling Contractor	**Total Support Services**	Approximate Surface Elevation	**357.49 feet MSL**
Groundwater Level and Date Measured	**15.3 feet measured on 8-11-09**	Sampling Method(s)	**SPT, Tube**	Hammer Data	**140 lb, 30 in drop, Auto-hammer**
Borehole Backfill	**Well Completion**	Location	**Eastern edge of proposed chemical evaporation pond.**		

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
357.5	0				Soft	SW-SM		Dark fine SAND with brown organic material and roots.						SPT 2, 2, 5, 5. 24" recovered
			SS	7	Firm	CH		Dark red/grey CLAY, trace silt. Dry.	23.37	44	68.6			
			SS	11								7E-07		SPT 4, 4, 7, 9. 24" recovered.
352.5	5		SS	14										SPT 5, 6, 8, 13. 24 recovered
						CH		↓ Trace of sand						
			ST		Soft	CH		Dark red fine SAND, trace clay, Damp.	16.5	41	73.8	3.2E-08		Shelby tube. Pushed 12 recovered 9".
			SS	18	Firm	CH		〉 Light tan CLAY, trace sand, Dry.						SPT 5, 7, 11, 11. 24" recovered.
					Soft	SC		Dark red SAND, trace of CLAY, Damp.						
					Firm	CL		Light tan CLAY, trace fine sand, Dry.						
					Soft	SC		Dark red SAND, little clay, frequent clay seams, Damp						SPT 6, 7, 11, 14. 24" recovered.
347.5	10		SS	18										
						SC		↓ Frequent clay seams						SPT 11, 22, 13, 14. 24" recovered.
			SS	35	Soft	SC		Red/orange fine SAND, trace clay, trace coarse sand, poorly sorted, Moist.						
			SS	77										SPT 17, 27, 50/5". 17" recovered.
					Firm	CL		Brownish grey CLAY, trace sand, Moist.						
					Soft	SC		Tanish grey fine SAND, some clay, Wet.						
342.5	15		ST					8-11-09 ▼	19.9	13	35.7	6.6E-07		Shelby tube. Pushed 12" recovered 9".
			SS	23					27.98	NP	32.3			SPT 11, 13, 10, 14. 24" recovered.
					Soft	SM		Dark grey coarse SAND/GRAVEL mix, some fine sand, trace clay, Wet.						
					Soft	SM-SC		Red fine SAND, trace clay, Moist. cemented. Moist.						SPT 7, 8, 11, 13. 24" recovered.
			SS	19										
					Firm	SC		Black fine SAND, occasional clay, Wet.						
337.5	20													SPT 8, 10, 12, 15. 24" recovered.
					Firm	CL		〉 Dark grey CLAY, little sand, Wet.						
					Firm	SM		Black fine SAND, some medium sand, some clay, Wet.						
			SS	22					32.23	NP	35.5			
					Firm	CL		〉 Dark grey CLAY, little sand, Wet.						
					Firm	SM		Black fine SAND, some medium sand, some clay, Wet.						
														SPT 6, 11, 17, 21. 24" recovered.
			SS	26	Firm	SM		↓ Frequent clay seams						
					Firm	SM		↓ Frequent clay seams.						
			ST											Shelby tube. 12" driven 0 recovered.
332.5	25													SPT 15, 19, 21, 27. 24" recovered.
			SS	40	Hard	CL		Dark grey CLAY, trace of sand, Dry.						
														SPT 10, 11, 11, 50/5". 23" recovered.
			SS	22										
					Very Hard	CL		↓ Dark grey CLAY, frequent iron stone/ore. Rig chatter driller comments						
			ST						24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
327.5	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.5	30	☒	ST		Hard	CL	▨	Dark grey CLAY, trace of sand, Dry. (cont.)	24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
								Bottom of Boring at 30.5 feet bgs						
322.5	35													
317.5	40													
312.5	45													
307.5	50													
302.5	55													
297.5	60													
292.5	65													

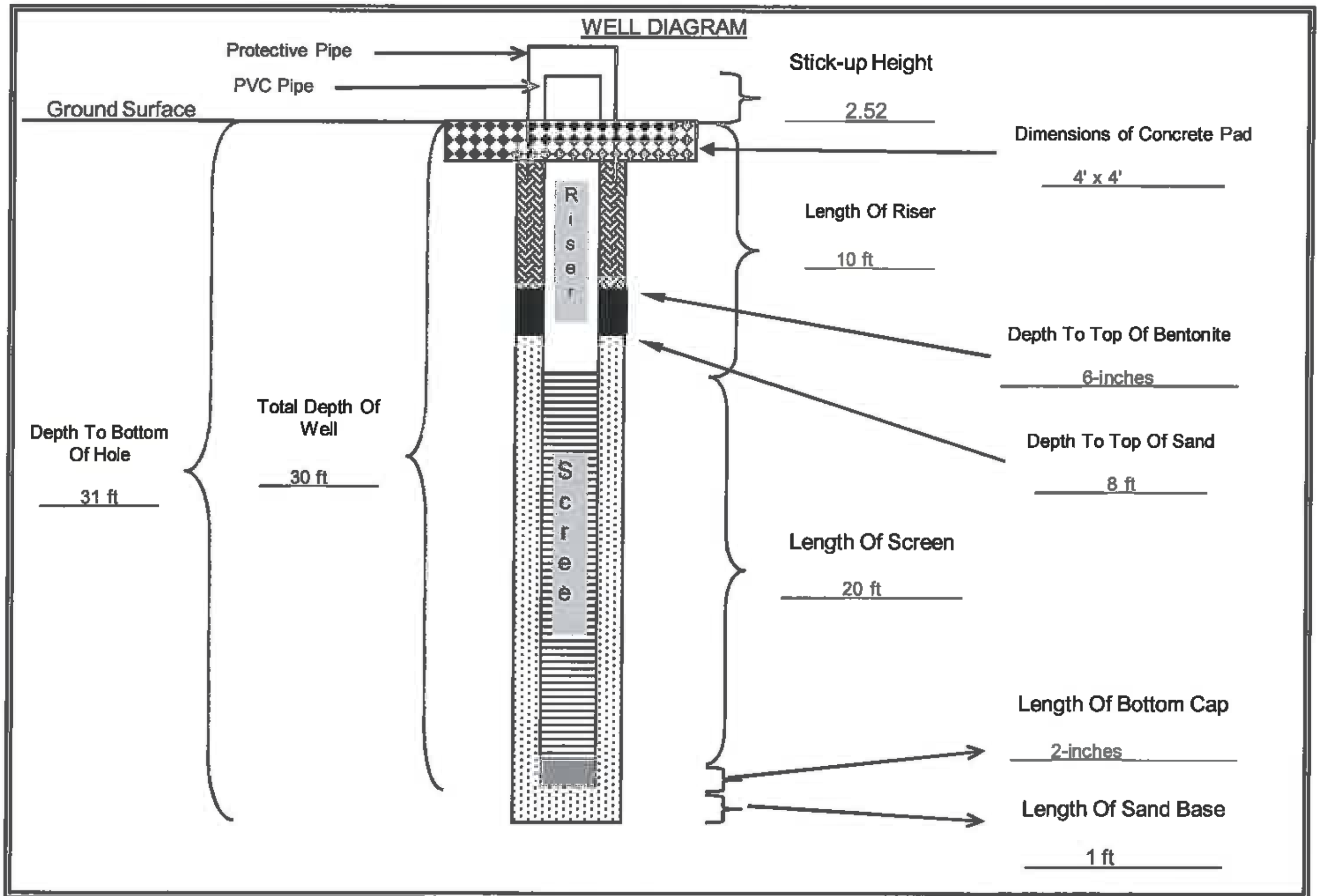
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: August 6 2009
WELL LOCATION:
WELL NO.: GB-05
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION:	357.49 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	347.49 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	326.49 (ft, msl)	CEMENT TYPE:	
NORTHING: 529.1865	EASTING: -2243.9973	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	3 bags lbs
RISER DIAMETER:	2 (in) Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 20 (ft)	AMOUNT SAND USED:	7 bags lbs
BOREHOLE DIAMETER:	8 (in)	STATIC WATER:	17.33 depth from TOC
DRILLING TECHNIQUE:	Hollow Stem Size: 8 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.52

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 10 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 8 ft

Length Of Screen: 20 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 1 ft

Total Depth Of Well: 30 ft

Depth To Bottom Of Hole: 31 ft

▨	Cement/Bentonite Grout	░	Sand Pack	▦	Neat Concrete	■	Bentonite	▩	Bottom Cap

QA/QC	INSTALLED BY:	Total Support Services	OBSERVED BY:	Kush Chohan
	DATE:	6-Aug-09	CHECKED BY:	DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-06

Sheet 1 of 1

Date(s) Drilled **7/23/2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.41 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube, Other**	Hammer Data **140 lb, 30 in drop, auto hammer**
Borehole Backfill **Well Completion**	Location **Northeast corner of proposed chemical pond in the middle of open grass field.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
357.4	0				Soft	SP		Greyish brown fine SAND with trace fines. Organic material (roots).						Hand Auger
			HA		Soft	SP-SM		Greyish red fine SAND, little silt. Poorly sorted, less organic material.						
					Soft	SM		Greyish red fine SAND, with little silt and clay. Dry.						
					Soft			Tanish grey fine SAND, trace silt and clay, frequent iron oxide, frequent discoloration.						SPT 4, 7, 7. 16" recovered
			SS	14	Firm	CL		Red light brown CLAY, little sand, trace silt, Dry.	12.74	34	67.9			
352.4	5													SPT 3, 5, 6, 8. 20" recovered
			SS	11	Soft	SC		Dark reddish brown fine SAND, little clay.						
					Soft	CL		Light grey CLAY, little sand, trace silt. Dry.						
					Soft	SC		Reddish brown fine SAND, trace clay, trace silt. Occansional clay seams. Damp.						SPT 3, 5, 7, 7. 24" recovered
			SS	12					17.65	NP	43.2			
					Soft	CL		Light grey CLAY, little fine sand						
			SS		Soft to Firm	SC		Brownish red fine SAND, little to some clay, some cementation, Damp.						24" driven, 15" recovered.
347.4	10													
			SS	19										SPT 8, 9, 10, 10. 24" recovered.
					Soft to Firm	CL		Brown CLAY, little fine sand, frequent brown sand-clay mixture with iron ore oxide.						
			ST						22.9	21	43.2	6.0e-07		Shelby Tube. 24" driven/16" recovered
342.4	15				Firm	CL		Dark redish brown CLAY, little fine sand, Damp. 8/11/09 ▼						
			SS	40	Firm	SC		Dark reddish brown SAND, little to some clay, Moist.						SPT 15, 10, 22, 30. 24" recovered
					Firm	CL		Black CLAY, little fine sand, Wet.						
			SS	22	Firm	SW		Black fine SAND, trace clay, trace med sand, Wet.						SPT 2, 8, 14, 10. 24" recovered
					Firm	CL		Black CLAY, trace fine sand, trace silt, Wet.						SPT 5, 8, 22, 50/4". 22 recovered.
						SC		Black fine SAND, little clay, Wet.						
337.4	20		SS	30	Firm	CL		Black CLAY, trace sand, trace silt. Wet.						
					Firm	SC		Black fine SAND, trace to little clay, Wet. Occansional black clay seams.						SPT 10, 11, 23, 33. 24" recovered
			SS	34	Firm	SP-SC		Black fine SAND, with little clay, trace med sand, Wet.						
						SW-SC		Grading to med SAND, Wet.						SPT 11, 16, 16, 24. 24" recovered.
			SS	36										
332.4	25													SPT 9, 11, 12, 22. 24" recovered.
			SS	23	Firm	SW-SC		Occasional CLAY lenses, Wet.						
					Firm	SC		Black fine SAND, little med sand and clay, Wet.						SPT 7, 15, 25, 50/3". 21 recovered.
			SS	40	Hard	CL		Dark grey CLAY, little sand, little silt, Dry.						
			ST					Bottom of Boring at 30 feet bgs		19	45.1			Shelby tube. 12" driven-8" recovered.
327.4	30													

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

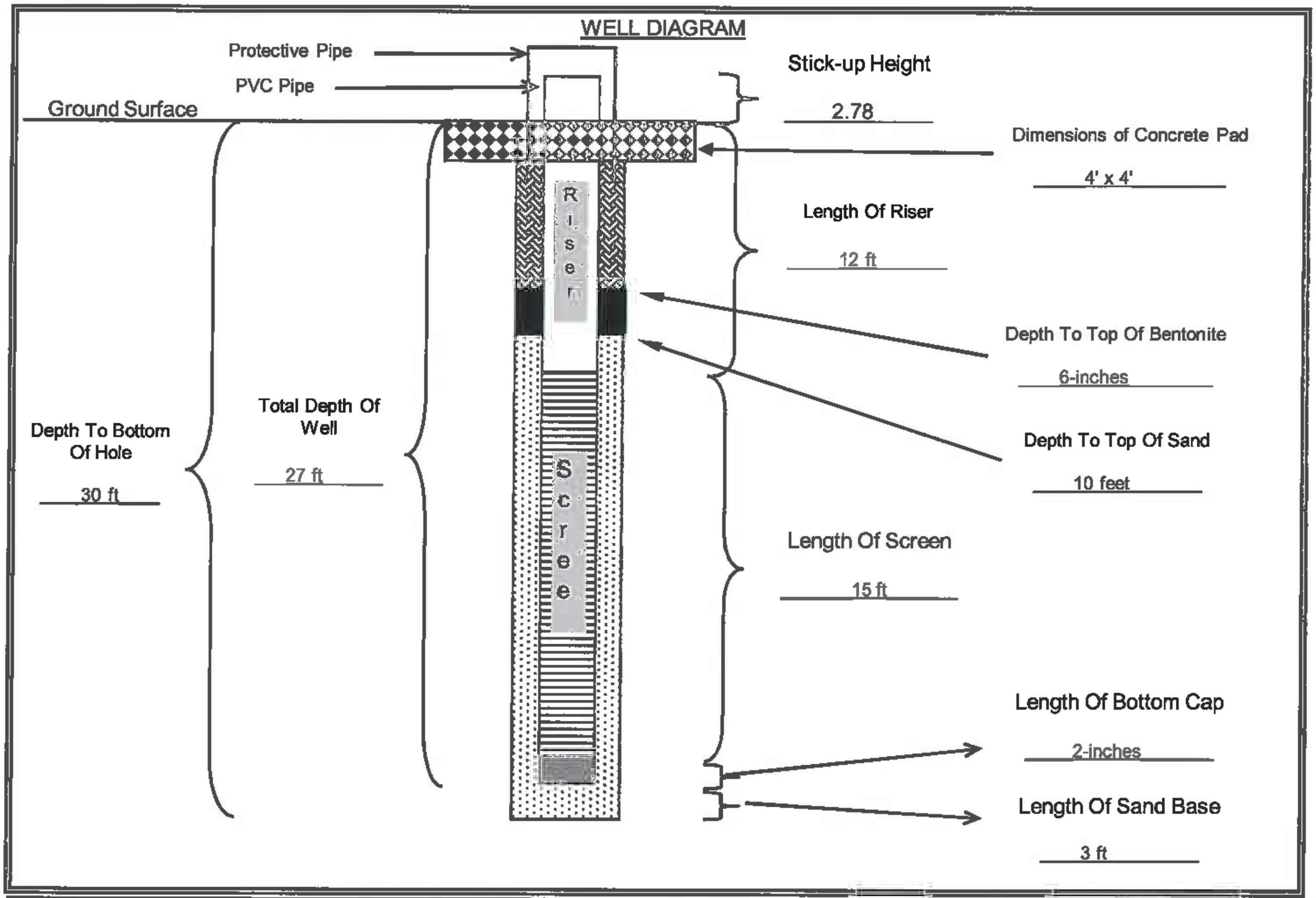
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 23-Jul-09
WELL LOCATION:
WELL NO.: **GB-06**
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.41 (ft, msl)
TOP OF SCREEN ELEVATION: 345.41 (ft, msl)
BOTTOM OF WELL ELEVATION: 327.41 (ft, msl)
NORTHING: 740.4893 EASTING: -2166.134
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 12 (ft)
SCREEN DIAMETER: 2 (in) Length: 15 (ft)
BOREHOLE DIAMETER: 6.75 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 6.75 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 2.5 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 15.3 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.78
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 12 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 10 feet
Length Of Screen: 15 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 3 ft
Depth To Bottom Of Hole: 30 ft
Total Depth Of Well: 27 ft

▨ Cement/Bentonite Grout	░ Sand Pack	▦ Neat Concrete	■ Bentonite	▩ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
OBSERVED BY: Kush Chohan
DATE: 23-Jul-09
CHECKED BY:
DATE:

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

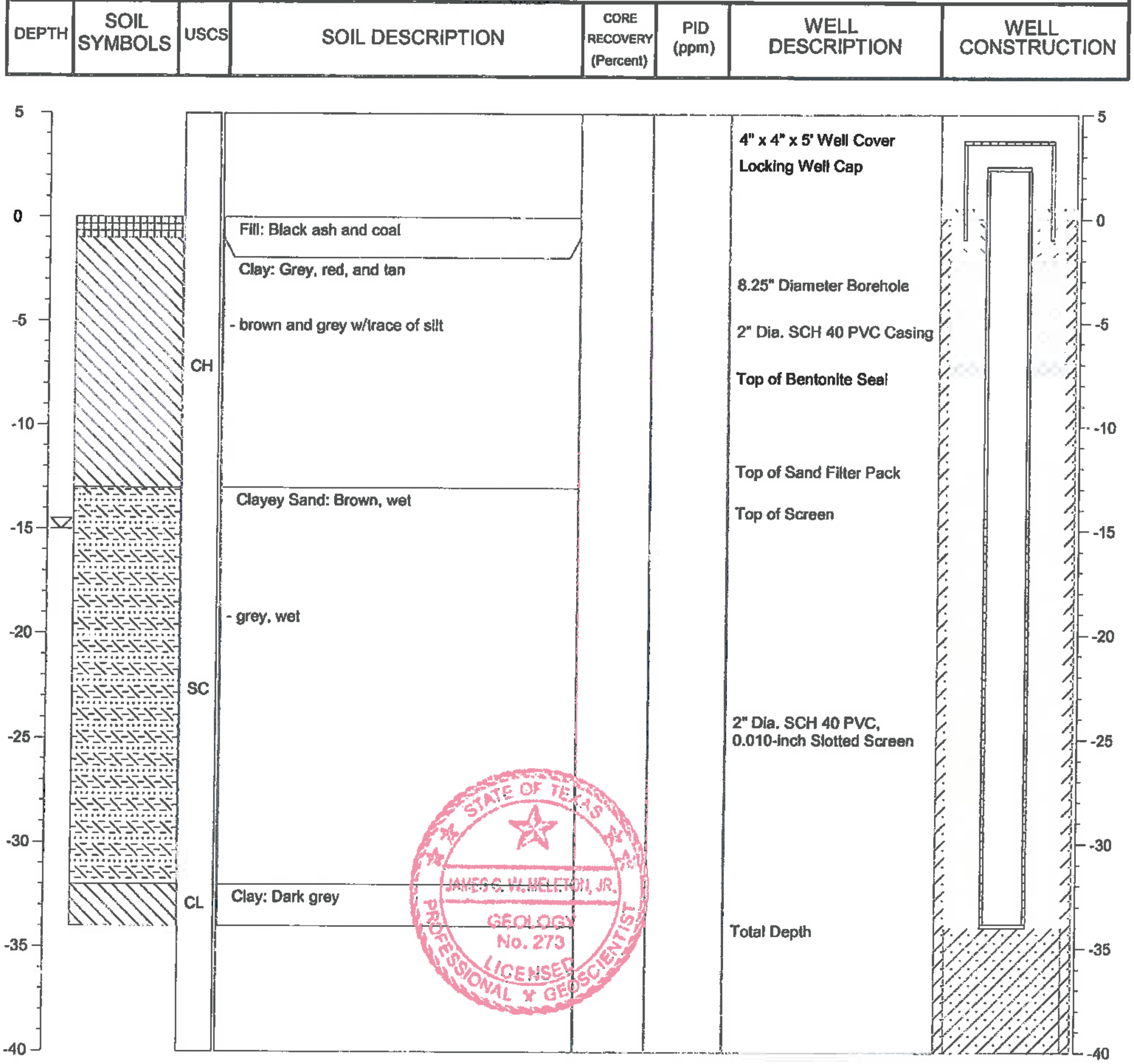
BORING/WELL NO.:	**GB-07/MW-7**
TOTAL DEPTH:	**34'**
TOP OF CASING ELEV.:	**362.75 ft. NGVD**
GROUND SURFACE ELEV.:	**360.20 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Metal Cleaning Waste Pond**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0120**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**12/1/09**

NOTES: **Latitude: 33.05455**
Longitude: 94.84674

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-1

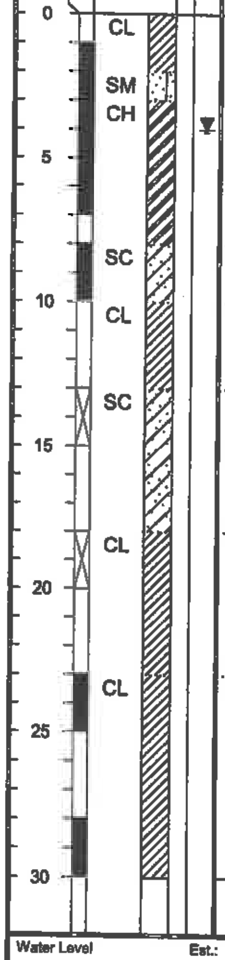
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

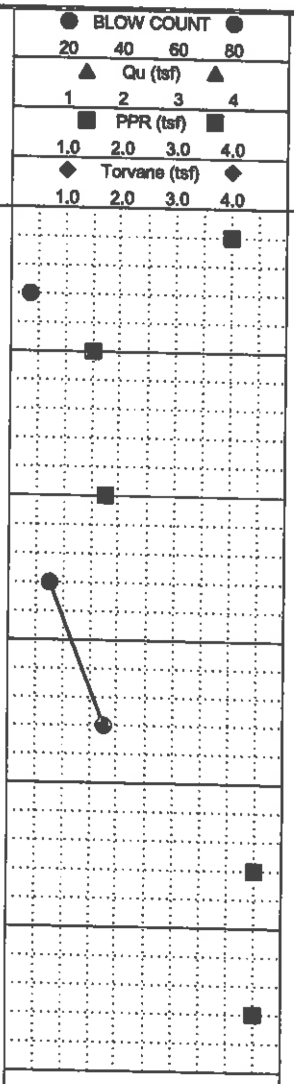
BORING TYPE: Flight Auger

DATE 10/27/09

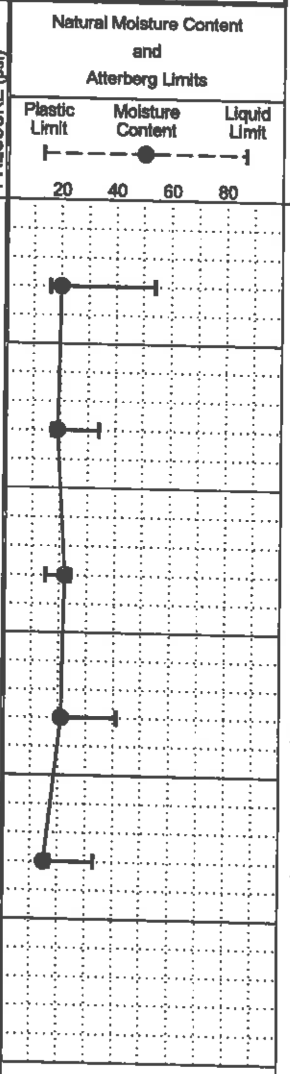
SURFACE ELEVATION 324.1



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; brownish orange	P=4.0 SF						
SM	SILTY SAND(SM) tannish orange	N=7						
CH	SANDY FAT CLAY(CH) medium stiff; tannish orange		20	54	16	38	63	+40Sieve=10%, +4 Sieve=1%
	–stiff	P=1.5						
SC	CLAYEY SAND(SC) medium dense; tannish orange; with clay seams	P=1.75	19	34	17	17	32	+40 Sieve=7%, +4 Sieve=3%
CL	SANDY LEAN CLAY(CL) stiff; orange							
SC	CLAYEY SAND(SC) medium dense; orange; saturated; with iron oxide cemented sandstone rock	N=15	22	24	15	9	19	+40Sieve=35%, +4 Sieve=22%
CL	LEAN CLAY WITH SAND(CL) hard; dark gray; with clay seams	N=35	21	41	21	20	75	+40 Sieve=2%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; dark brown	P=4.5+	15	33	17	16	52	+40 Sieve=1%, +4 Sieve=0%
	–grayish brown; laminated with silt	P=4.5+						
	Bottom of Boring @ 30'							



DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 5' while drilling. Water level @ 4' and open to 30' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.090', W 94°50.417'

Piezometer B-2

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

PROJECT: Welsh Power Plant
Pittsburgh, Texas

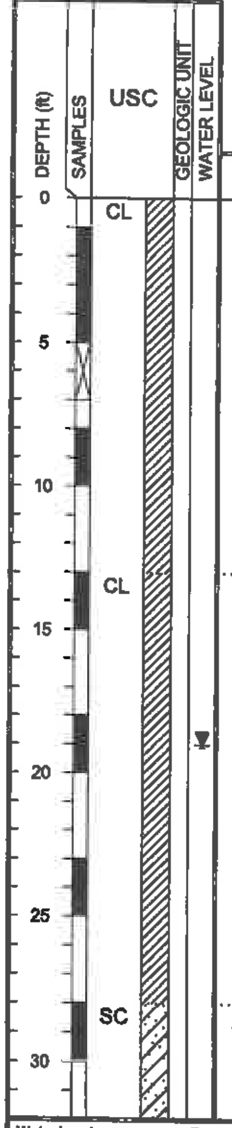
PROJECT NO.: G3242-09

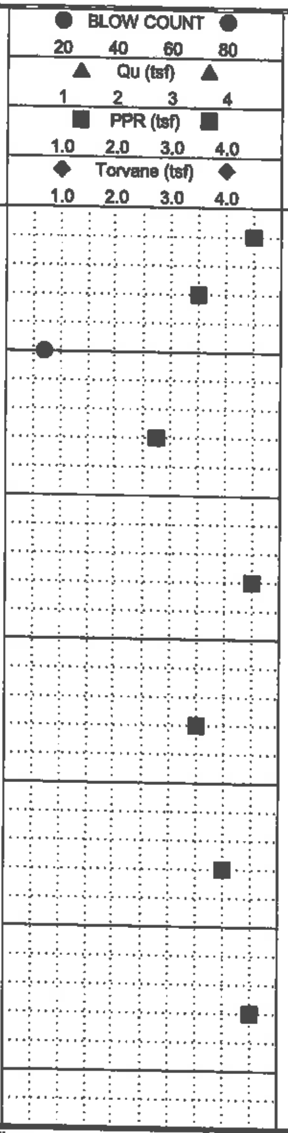
BORING TYPE: Flight Auger

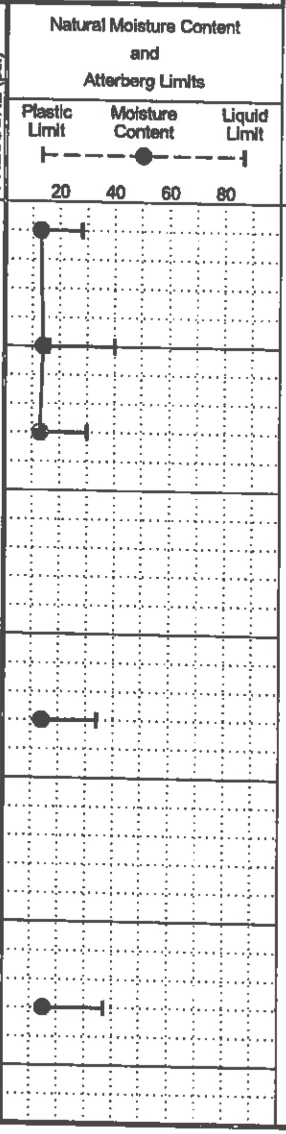
DATE 10/28/09

SURFACE ELEVATION 339.7

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+					13	28	14	14	61	+40 Sieve=3%, +4 Sieve=0%
	--very stiff	P=3.5										
	--stiff	N=14					14	40	16	24	65	+40 Sieve=0%, +4 Sieve=0%
	--very stiff; reddish brown	P=2.75					13	30	14	16	58	+40 Sieve=0%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+										
	--very stiff	P=3.5					14	34	15	19	54	+40 Sieve=0%, +4 Sieve=0%
		P=4.0										
SC	CLAYEY SAND(SC) medium dense; tan, red, and gray	P=4.5					15	37	16	21	47	+40 Sieve=5%, +4 Sieve=3%







Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

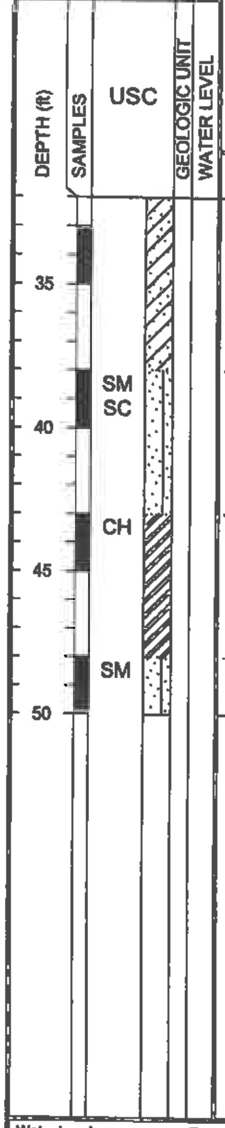
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

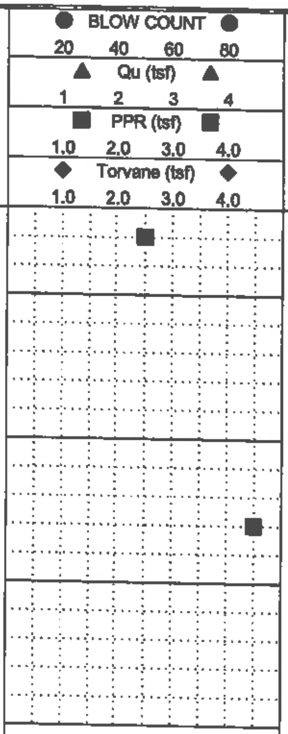
BORING TYPE: Flight Auger

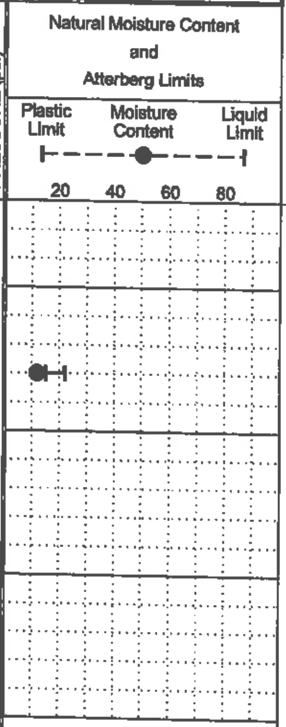
DATE 10/28/09

SURFACE ELEVATION 339.7



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	--red and tan	P=2.5										
SM SC	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated	SF					12	22	15	7	48	+40 Sieve=0%, +4 Sieve=0%
CH	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams	P=4.5+										
SM	SILTY SAND(SM) black and gray	SF										
	Bottom of Boring @ 50'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

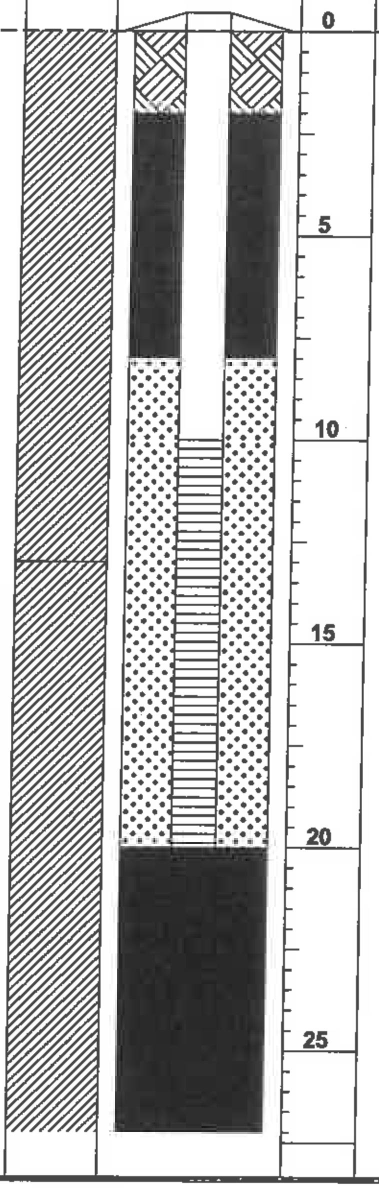
Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

Piezometer B-2

ENVIRONMENTAL LOG

Client: Welsh Power Plant	**Well No.** B-2
	Location Pittsburg, Texas
Project No: G3242-095 **Phase** **Task**	**Surface Elev.** **Page** 1 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
						T.O.C. Elev.
0	Ground Surface				0	
	SANDY LEAN CLAY(CL) hard; red and tan					
	–very stiff					
5	–stiff				5	
	–very stiff; reddish brown					
10					10	
	SANDY LEAN CLAY(CL) hard; red and tan					
15					15	
	–very stiff					
20					20	
25					25	



Continued Next Page

Driller Doug Hinds
Logged By James Griffith
Drilling Started 10/28/09
Drilling Completed 10/28/09
Construction Completed
Development Completed
Type of Well

Drilling Method Soild Stem Auger
Borehole Diameter 6.5"
Well Casing 2.0" **Dia.** 0.0' **to** 10.0'
Casing Type PVC
Well Screen 2.0" **Dia.** 10.0' **to** 20.0'
Screen Type Slotted
Slot Size 0.010"
Grout Type Bentonite

Bentonite Seal 2-8' & 20-50'
Filter Pack Qty. 8-20'
Filter Pack Type 20/40 Sand
Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

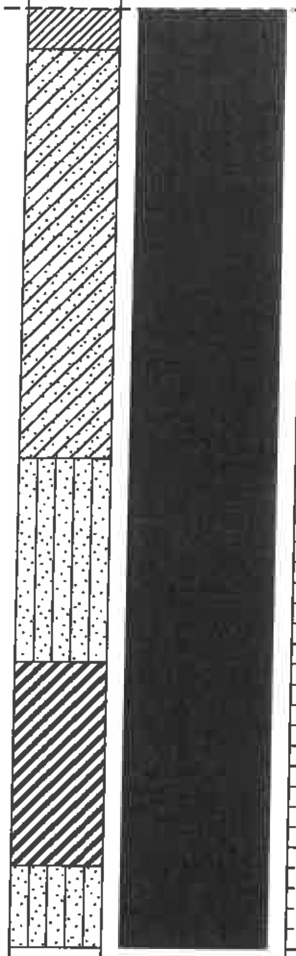
Well No. B-2

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		CLAYEY SAND(SC) medium dense; tan, red, and gray					
30						30	
		--red and tan					
35						35	
		SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated					
40						40	
		FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams					
45						45	
		SILTY SAND(SM) black and gray					
50						50	
		Bottom of Boring @ 50'					
55							
60							



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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

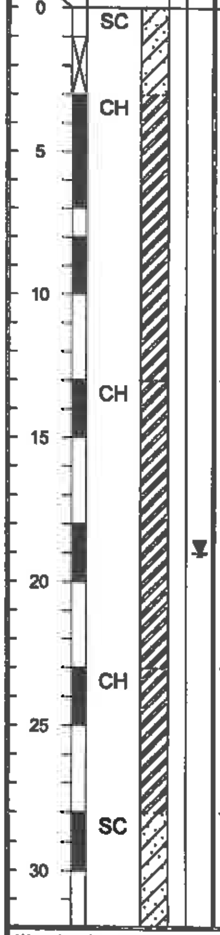
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

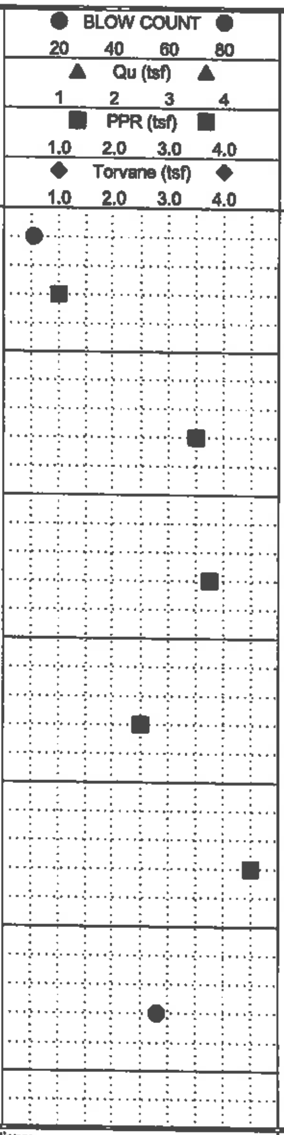
DATE 10/27/09

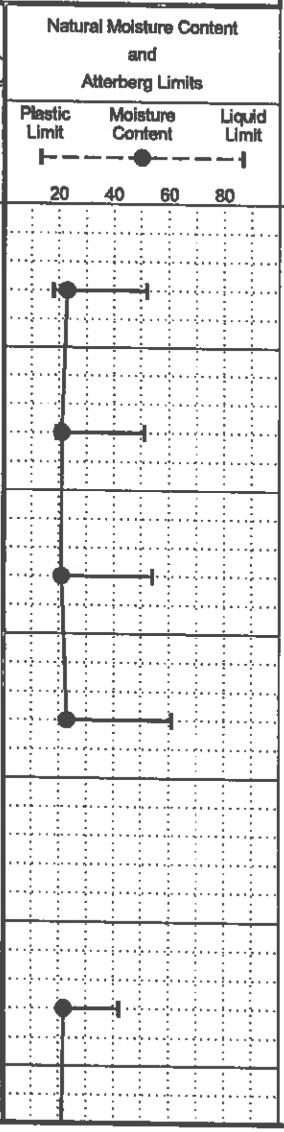
SURFACE ELEVATION 339.6



MATERIAL DESCRIPTION

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	CLAYEY SAND(SC) medium dense; gray and red	N=11										
CH	FAT CLAY(CH) stiff; red and tan; with sand seams	P=1.0					23	52	18	34	87	+40 Sieve=3%, +4 Sieve=0%
	--very stiff	P=3.5					21	51	19	32	86	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) very stiff; brown; with ferric joints	P=3.75					21	54	20	34	85	+40Sieve=10%, +4 Sieve=1%
	--red and tan; layered; with ferric seams	P=2.5					23	61	24	37	81	+40Sieve=11%, +4 Sieve=0%
CH	FAT CLAY(CH) hard; gray; with sand seams	P=4.5+										
SC	CLAYEY SAND(SC) very dense; gray; with sand seams	N=56					22	42	22	20	35	+40 Sieve=1%, +4 Sieve=0%





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

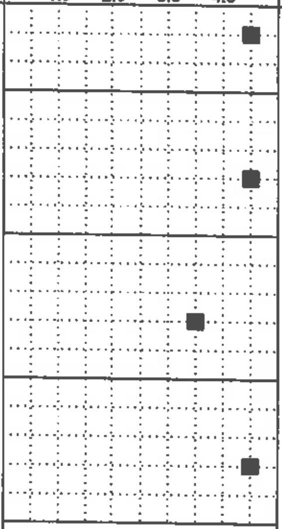
BORING TYPE: Flight Auger

DATE 10/27/09

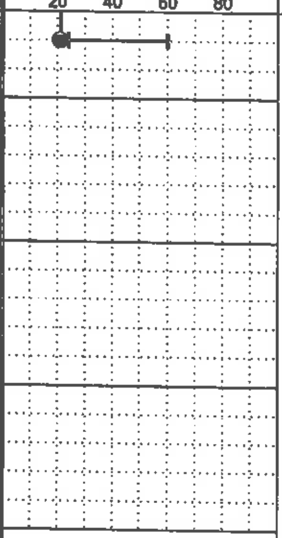
SURFACE ELEVATION 339.6

DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35		CH			FAT CLAY(CH) hard; brown; layered and with sand seams	P=4.5+					21	60	24	36	95	+40 Sieve=1%, +4 Sieve=0%
40					--gray and green	P=4.5+										
45		CL			SANDY LEAN CLAY(CL) very stiff; gray and dark green; layered; with sand seams	P=3.5										
50		CH			FAT CLAY(CH) hard; gray and dark green; layered; with silt seams	P=4.5+										
					Bottom of Boring @ 50'											

● BLOW COUNT ● 20 40 60 80
▲ Qu (tsf) ▲ 1 2 3 4
■ PPR (tsf) ■ 1.0 2.0 3.0 4.0
◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0



Natural Moisture Content and Atterberg Limits
Plastic Limit ├ - - - ● - - - ┤ Liquid Limit
Moisture Content
20 40 60 80



Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

Piezometer B-4

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

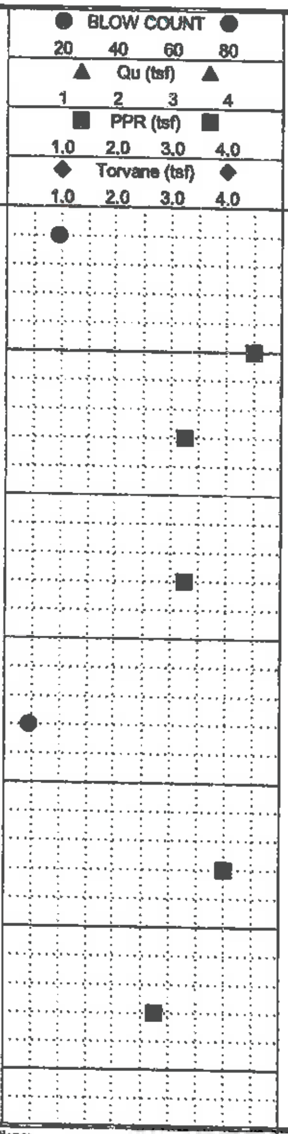
PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

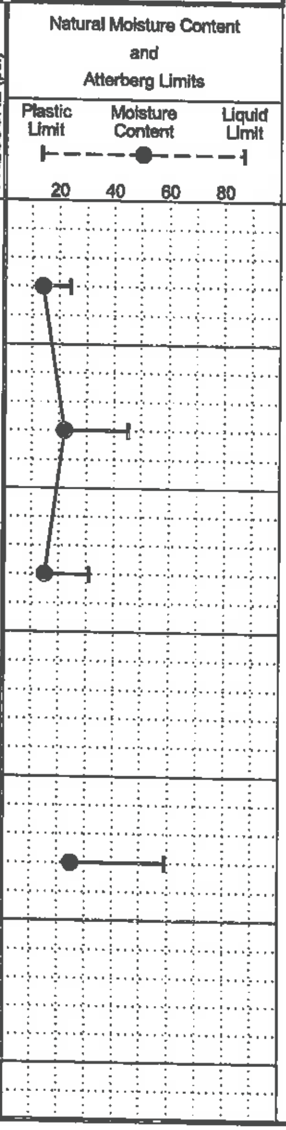
DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	SM		SILTY SAND(SM) medium dense; tan; with gravel	N=19						
	CL		SANDY LEAN CLAY(CL) dark brown	SF						
5			--tannish orange		14	24	15	9	59	+40 Sieve=1%, +4 Sieve=0%
			--hard; orangish tan	P=4.5						
				P=3.25	22	45	21	24	94	+40 Sieve=2%, +4 Sieve=0%
10			--very stiff; white							
	SC		CLAYEY SAND(SC) medium dense; tan --orangish gray; with sand seams	P=3.25	15	31	15	16	40	+40 Sieve=1%, +4 Sieve=0%
15										
	CL	▼	SANDY LEAN CLAY(CL) stiff; orangish tan	N=9						
20										
	CH		FAT CLAY(CH) very stiff; orangish tan; with ferric seams	P=4.0	25	59	24	35	88	+40 Sieve=4%, +4 Sieve=0%
25										
			--tannish brown; with iron ore seams	P=2.75						
30										



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

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LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

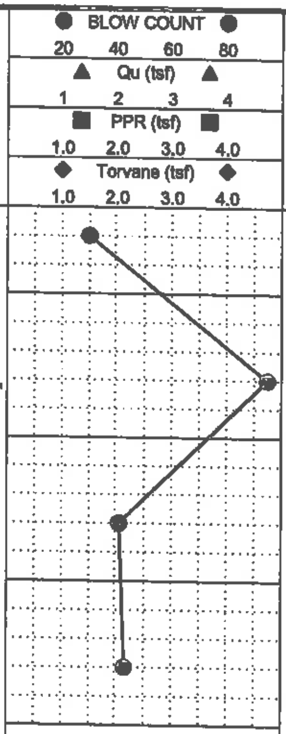
PROJECT NO.: G3242-09

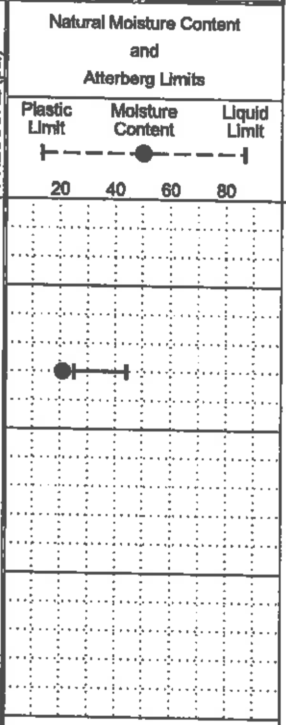
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	☒				–hard; light gray; layered and with silt seams	N=30										
40	☒	CL			LEAN CLAY(CL) hard; light gray; layered and with silt seams	N=50/5.75"					21	44	25	19	93	+40 Sieve=1%, +4 Sieve=0%
45	☒				–light gray	N=41										
50	☒				–layered and with sand seams; with lignite	N=43										
					Bottom of Boring @ 50'											





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

Piezometer B-4

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-4

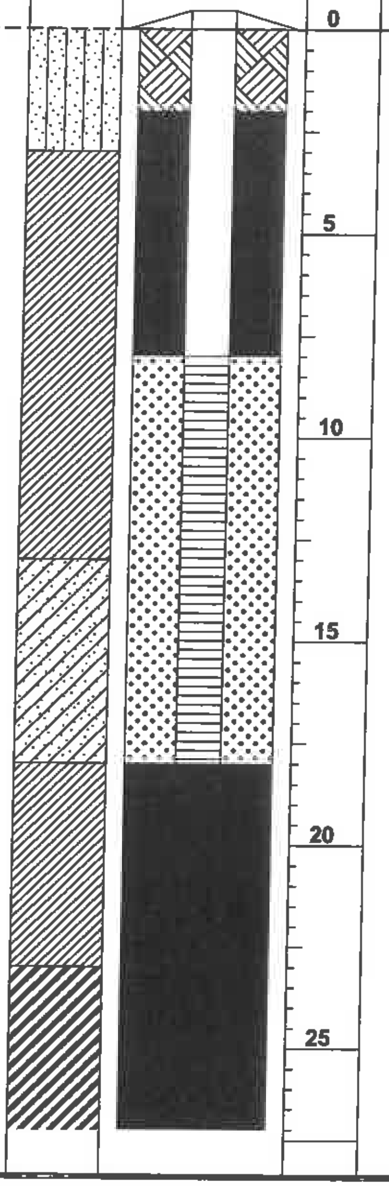
Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description
0		Ground Surface
		SILTY SAND(SM) medium dense; tan; with gravel
		SANDY LEAN CLAY(CL) dark brown
		–tannish orange
5		–hard; orangish tan
10		–very stiff; white
		CLAYEY SAND(SC) medium dense; tan
15		–orangish gray; with sand seams
		SANDY LEAN CLAY(CL) stiff; orangish tan
20		
		FAT CLAY(CH) very stiff; orangish tan; with ferric seams
25		

Continued Next Page



Well Construction Details

T.O.C. Elev.

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 8.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 8.0' **to** 18.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-8' & 18-50'

Filter Pack Qty. 6-18'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

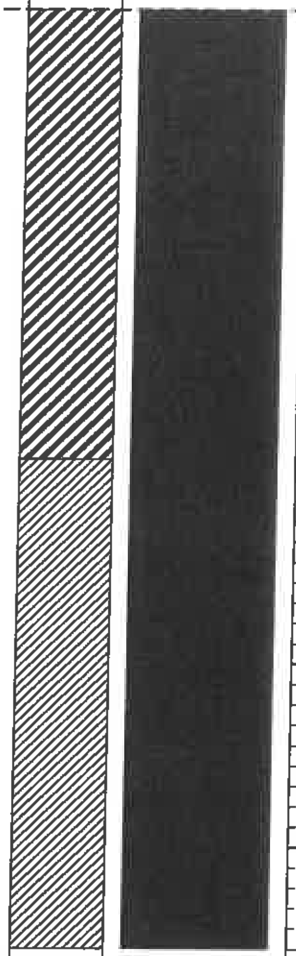
Well No. B-4

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		--tannish brown; with iron ore seams					
30						30	
		--hard; light gray; layered and with silt seams					
35						35	
		LEAN CLAY(CL) hard; light gray; layered and with silt seams					
40						40	
		--light gray					
45						45	
		--layered and with sand seams; with lignite					
50						50	
		Bottom of Boring @ 50'					
55							
60							



Piezometer B-5

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

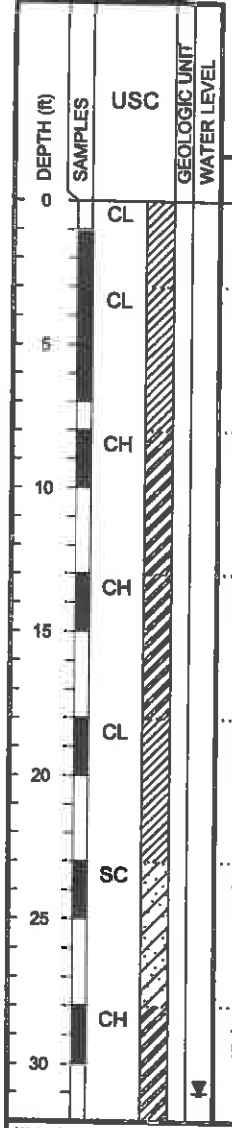
PROJECT NO.: G3242-09

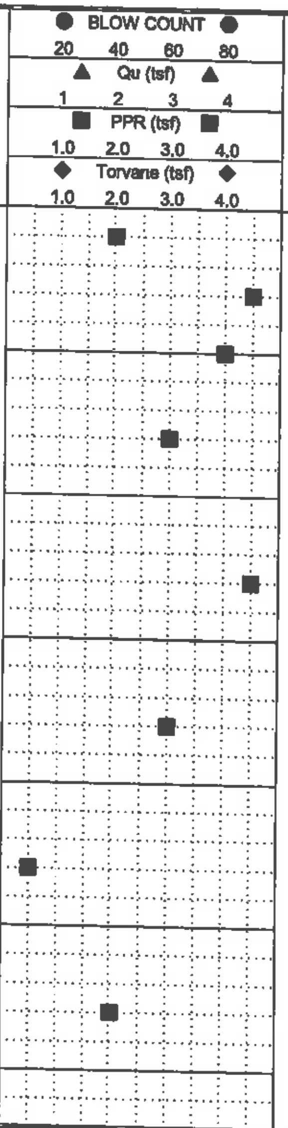
BORING TYPE: Flight Auger

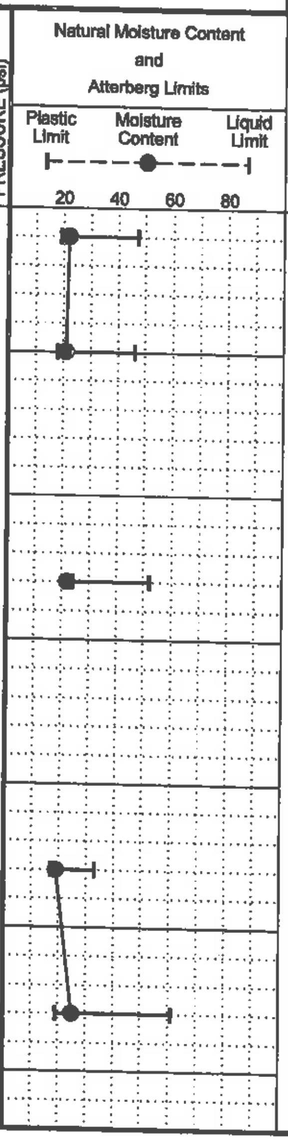
DATE 10/27/09

SURFACE ELEVATION 340.0

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) stiff; red and tan	P=2.0					22	47	19	28	81	+40 Sieve=9%, +4 Sieve=3%
CL	LEAN CLAY(CL) hard; red and tan	P=4.5+										
	–very stiff	P=4.0					21	46	18	28	94	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY(CL) very stiff; brown and tan	P=3.0										
CH	FAT CLAY WITH SAND(CH) hard; red and tan	P=4.5+					22	52	24	28	88	+40 Sieve=3%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams	P=3.0										
SC	CLAYEY SAND(SC) very loose; tan, red, and gray	P=0.5					19	33	17	16	44	+40 Sieve=1%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) stiff; red and gray	P=2.0					25	61	19	42	83	+40 Sieve=5%, +4 Sieve=3%







Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

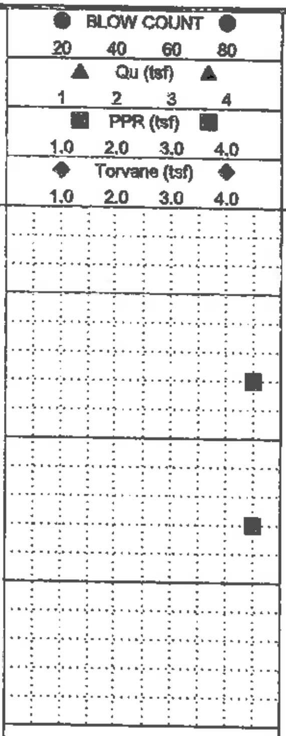
PROJECT NO.: G3242-09

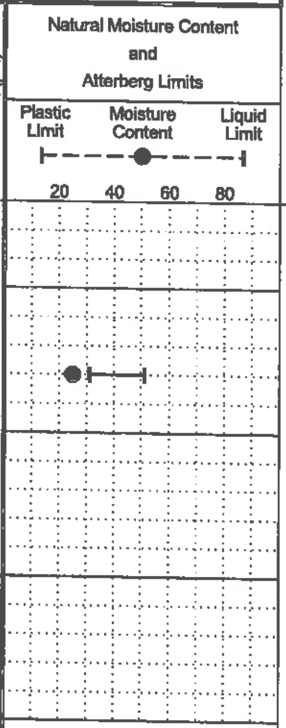
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	SC	<u>SILTY CLAYEY SAND</u>(SC) gray and red; saturated	SF										
40	CH	<u>FAT CLAY</u>(CH) hard; red and gray; with sand seams	P=4.5+					25	51	31	20	87	+40 Sieve=6%, +4 Sieve=0%
45		–gray, tan, and red; with sand seams	P=4.5+										
50	SM SC	<u>SILTY SAND</u>(SM-SC) red and gray	SF										
		Bottom of Boring @ 50'											





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

Piezometer B-5

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-5

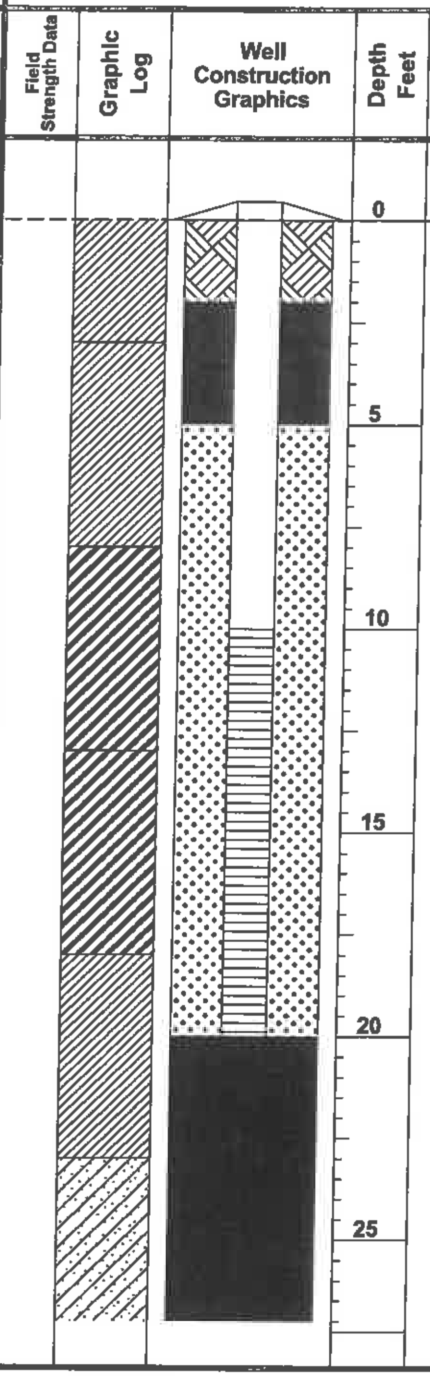
Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description
0		Ground Surface
		LEAN CLAY WITH SAND(CL) stiff; red and tan
		LEAN CLAY(CL) hard; red and tan
5		--very stiff
		FAT CLAY(CL) very stiff; brown and tan
10		
		FAT CLAY WITH SAND(CH) hard; red and tan
15		
		SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams
20		
		CLAYEY SAND(SC) very loose; tan, red, and gray
25		

Continued Next Page



Well Construction Details

T.O.C. Elev.

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-5' & 20-50'

Filter Pack Qty. 5-20'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ETTL Engineers & Consultants Inc.

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

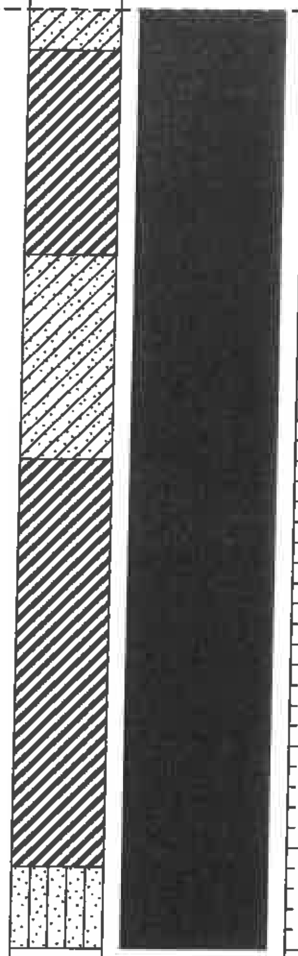
Well No. B-5

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		FAT CLAY WITH SAND(CH) stiff; red and gray					
30						30	
		SILTY CLAYEY SAND(SC) gray and red; saturated					
35						35	
		FAT CLAY(CH) hard; red and gray; with sand seams					
40						40	
		–gray, tan, and red; with sand seams					
45						45	
		SILTY SAND(SM-SC) red and gray					
50						50	
		Bottom of Boring @ 50'					
55							
60							



ETTL Engineers & Consultants Inc.

Piezometer B-6

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

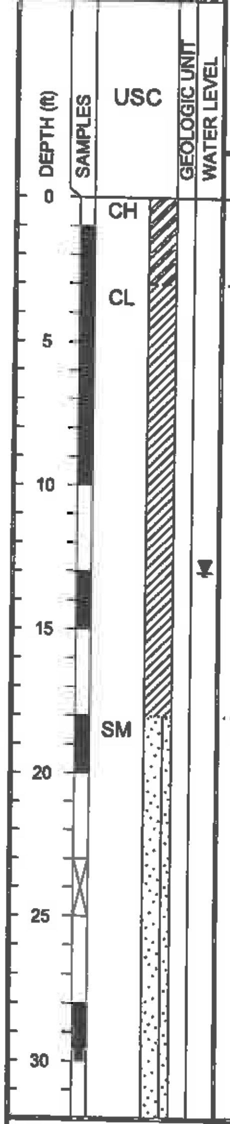
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

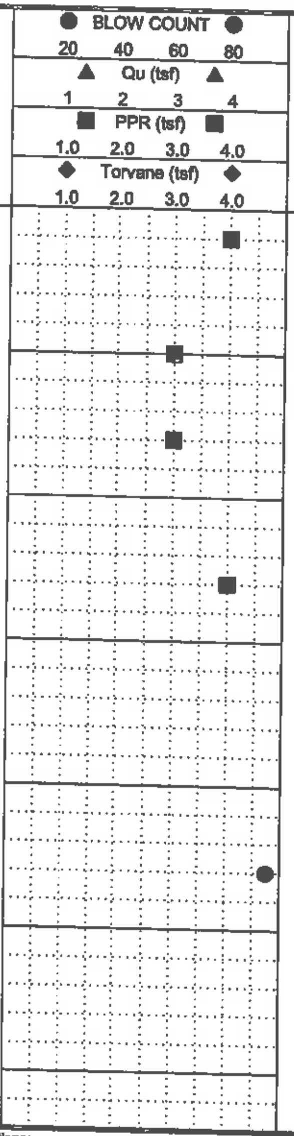
DATE 10/27/09

SURFACE ELEVATION 340.1

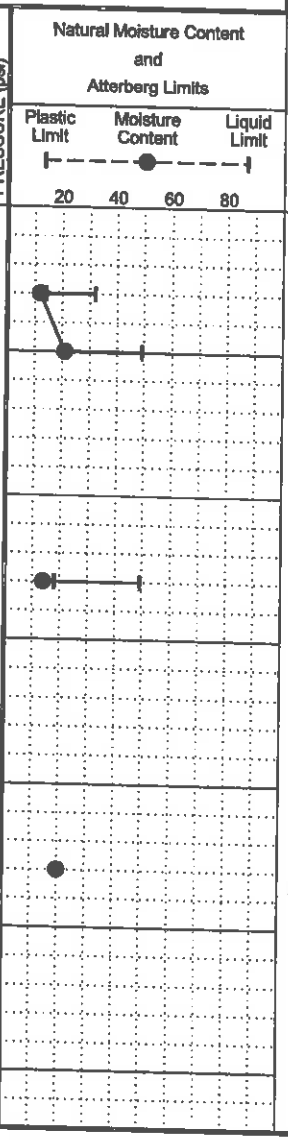


MATERIAL DESCRIPTION

MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
FAT CLAY(CH) very stiff; red and gray; with ferric seams	P=4.0						
SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+	12	32	14	18	60	+40 Sieve=0%, +4 Sieve=0%
		21	49	20	29	93	+40 Sieve=2%, +4 Sieve=0%
–very stiff; red, gray, and brown; with gravel	P=3.0						
–with sand seams	P=3.0						
	P=4.0	14	49	18	31	65	+40 Sieve=0%, +4 Sieve=0%
SILTY SAND(SM) gray; saturated	P=3.0						
–very dense; gray and red	N=50/5.25"	20				18	+40 Sieve=0%, +4 Sieve=0%
	SF						



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
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LOG OF BORING B-6

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
33	CH	FAT CLAY(CH) hard; brown; with sand seams	P=4.5+						
38			P=4.5+	22	68	24	44	95	+40 Sieve=0%, +4 Sieve=0%
43		--dark green	P=4.5+						
48	CL	LEAN CLAY(CL) hard; dark green; laminated with lignite	P=4.5+						
50		Bottom of Boring @ 50'							

Columns also shown: SAMPLES; GEOLOGIC UNIT; WATER LEVEL; ● BLOW COUNT ● 20 40 60 80; ▲ Qu (tsf) ▲ 1 2 3 4; ■ PPR (tsf) ■ 1.0 2.0 3.0 4.0; ◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0; DRY DENSITY (pcf); COMPRESSIVE STRENGTH (tsf); FAILURE STRAIN (%); CONFINING PRESSURE (psi); Natural Moisture Content and Atterberg Limits: Plastic Limit ⊢ - - - ● - - - ⊣ Moisture Content, Liquid Limit, 20 40 60 80; ATTERBERG LIMITS(%)

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

Piezometer B-6

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

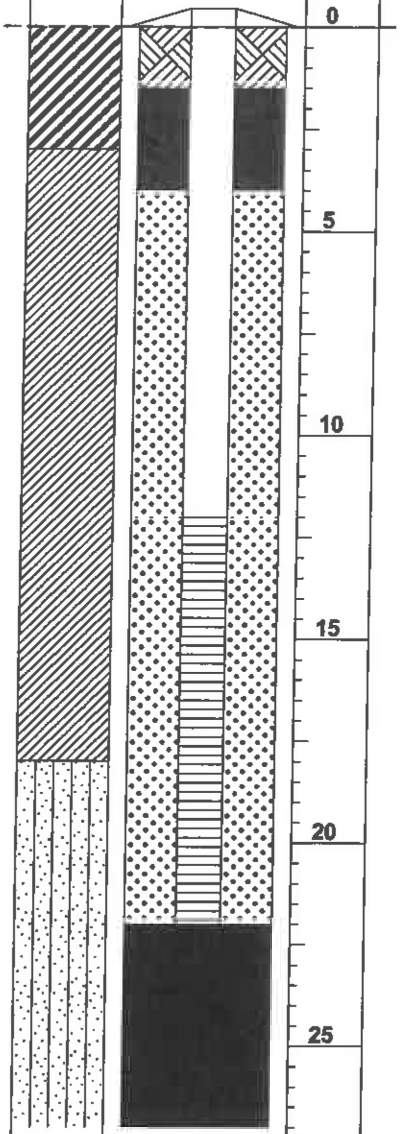
Well No. B-6

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		FAT CLAY(CH) very stiff; red and gray; with ferric seams					
		SANDY LEAN CLAY(CL) hard; red and tan					
5						5	
		–very stiff; red, gray, and brown; with gravel					
		–with sand seams					
10						10	
15						15	
		SILTY SAND(SM) gray; saturated					
20						20	
		–very dense; gray and red					
25						25	



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/28/09

Drilling Completed 10/28/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 12.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 12.0' **to** 22.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 1.5-4' & 22-50'

Filter Pack Qty. 4-22'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

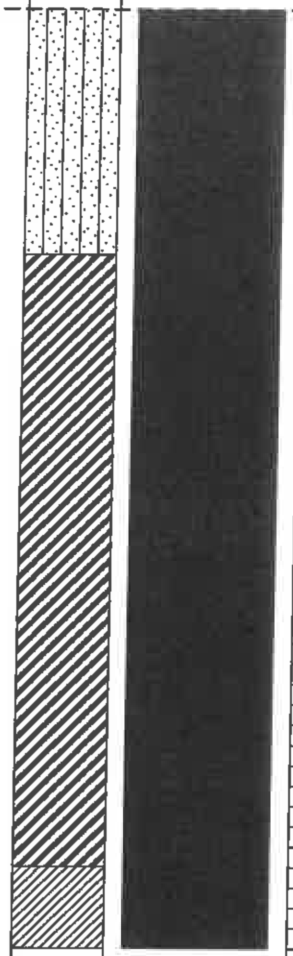
Well No. B-6

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
30						30	
		FAT CLAY(CH) hard; brown; with sand seams					
35						35	
40						40	
		–dark green					
45						45	
		LEAN CLAY(CL) hard; dark green; laminated with lignite					
50		Bottom of Boring @ 50'				50	
55							
60							



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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-7

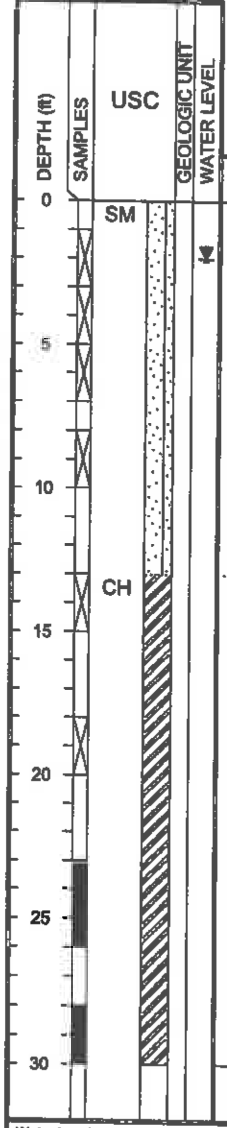
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

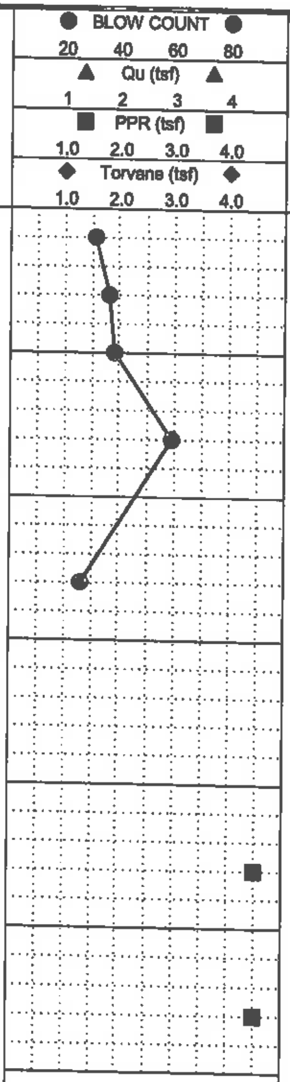
BORING TYPE: Flight Auger

DATE 10/27/09

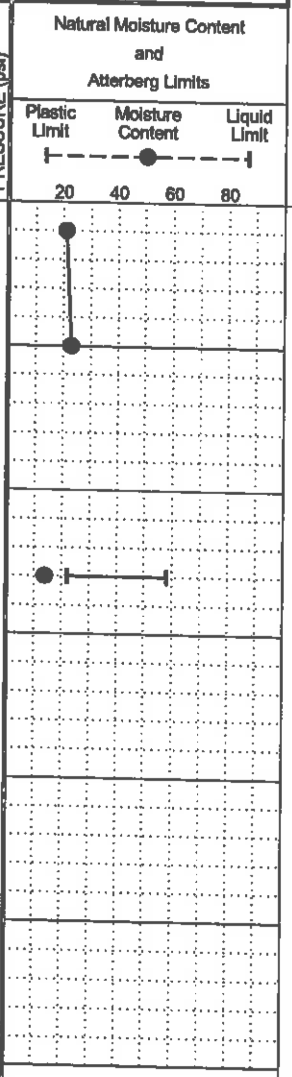
SURFACE ELEVATION 340.4



USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SM	▼	SILTY SAND(SM) dense; tan	N=31	21				21	+40 Sieve=0%, +4 Sieve=0%
			N=36						
		--gray; saturated	N=38	23				15	+40 Sieve=0%, +4 Sieve=0%
		--very dense	N=59						
CH		FAT CLAY(CH) very stiff; dark gray; with silt and ferric seams	N=26	14	58	22	36	98	+40 Sieve=0%, +4 Sieve=0%
		--hard; gray and black; with trace of lignite	P=4.5+						
		--gray							
			P=4.5+						
		Bottom of Boring @ 30'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 4' while drilling. Water level @ 2' and open to 7' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.898', W 94°50.519'

Landfill Boring B-2

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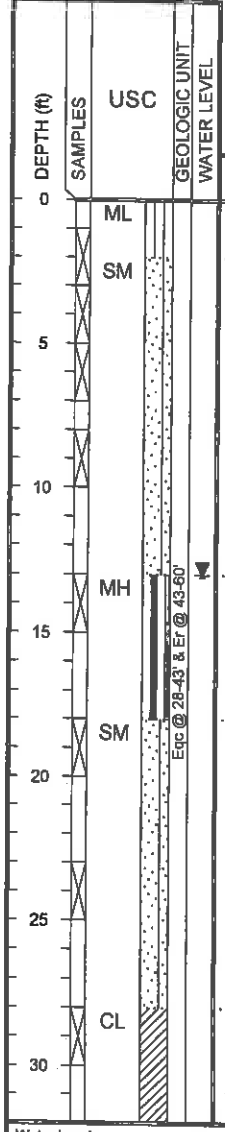
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

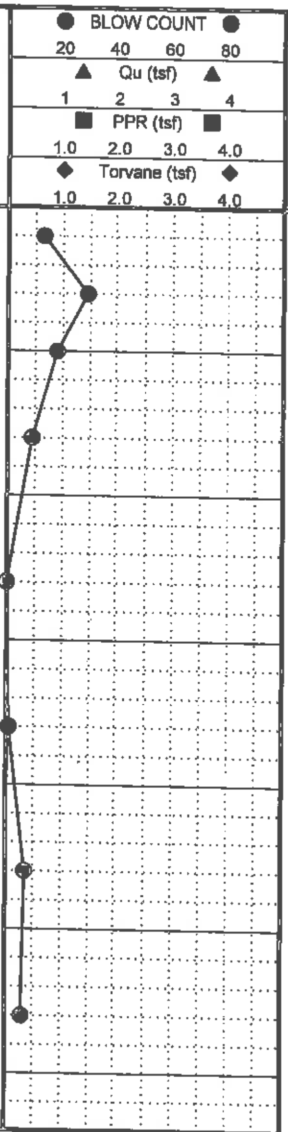
LOG OF BORING B-2

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas
DRILL RIG: B-61 HDX
PROJECT NO.: G4207-146
BORING TYPE: Rotary Wash/Flight Auger

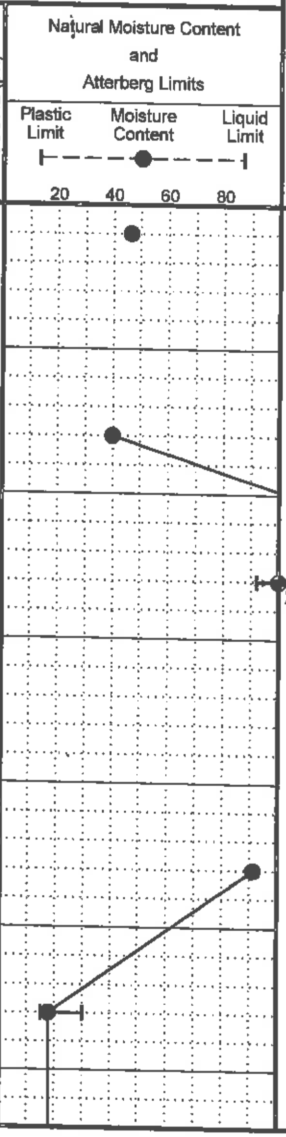
DATE 10/8/14
SURFACE ELEVATION 373.8



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
ML SM	ASH (SILT WITH GRAVEL(ML)) medium dense; light grayish brown; with coarse-grained sand and lightly cemented gravel pieces; dry	N=13	46				59	+40 Sieve=27% +4 Sieve=16%
		N=29						
	ASH (SILTY SAND(SM)) medium dense; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces	N=18						
	--loose; moist	N=9	40				40	+40 Sieve=19% +4 Sieve=2%
MH	ASH (ELASTIC SILT(MH)) very loose; black; with fine-grained sand and lightly cemented gravel pieces; saturated	N=0	200	134	92	42	100	+40 Sieve=0% +4 Sieve=0%
SM	ASH (SILTY SAND(SM)) very loose; dark brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=1						
	--loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7	91				61	+40 Sieve=11% +4 Sieve=1%
CL	SANDY LEAN CLAY(CL) medium stiff; dark brown and black; with fine-grained sand and cemented gravel pieces; saturated	N=6	18	30	15	15	63	+40 Sieve=1% +4 Sieve=0%



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbrevations:
- N - SPT Data (Blows/Ft)
- P - Pocket Penetrometer (tsf)
- T - Torvane (tsf)
- L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

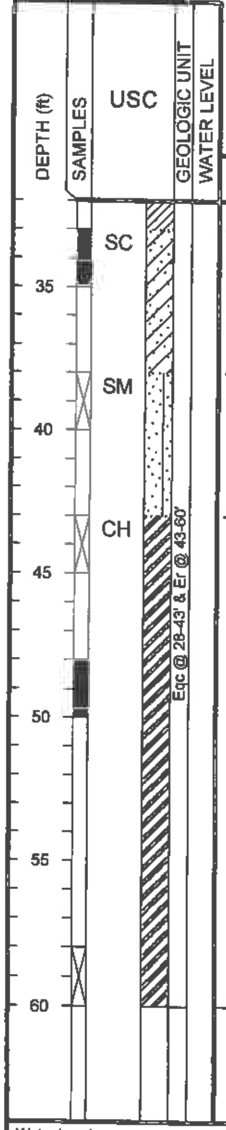
PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

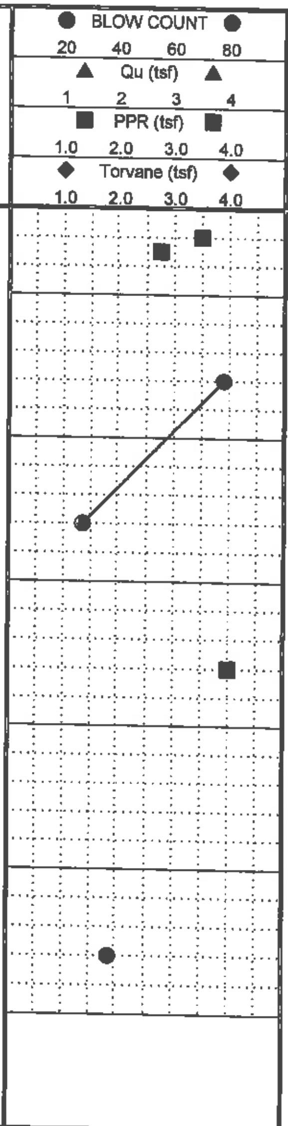
BORING TYPE: Rotary Wash/Flight Auger

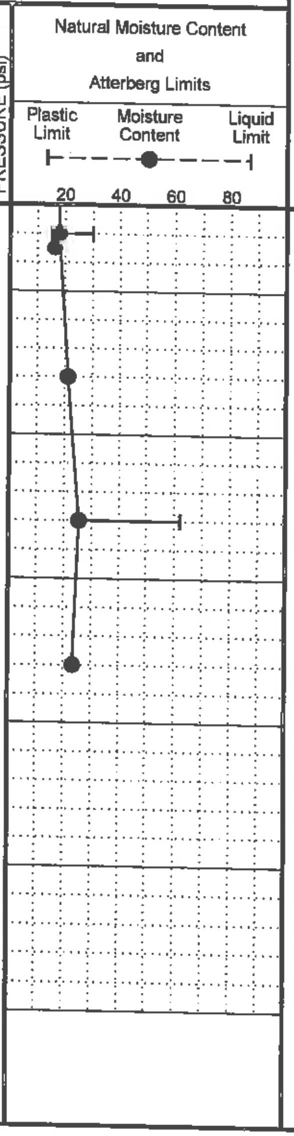
DATE 10/8/14

SURFACE ELEVATION 373.8



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	CLAYEY SAND(SC) dense; light brown, light gray and reddish brown; moist; with fine-grained sand; mottled	P=3.5 P=2.75	110	1.39	4.3	21	18 16	30	15	15	39	+40 Sieve=0% +4 Sieve=0%
SM	SILTY SAND(SM) very dense; light brown, yellowish brown and light gray; moist; mottled; with fine-grained sand	N=78					21				24	+40 Sieve=0% +4 Sieve=0%
CH	FAT CLAY(CH) very stiff; dark brown and light brown; moist; with sand seams; laminated	N=27					25	62	26	36	96	+40 Sieve=2% +4 Sieve=0%
	--dark brown with light gray; moist; with silt seams	P=4.0	98				24					
	--hard; dark brown; moist	N=37										
	Bottom of Boring @ 60'											





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill boring B-10

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

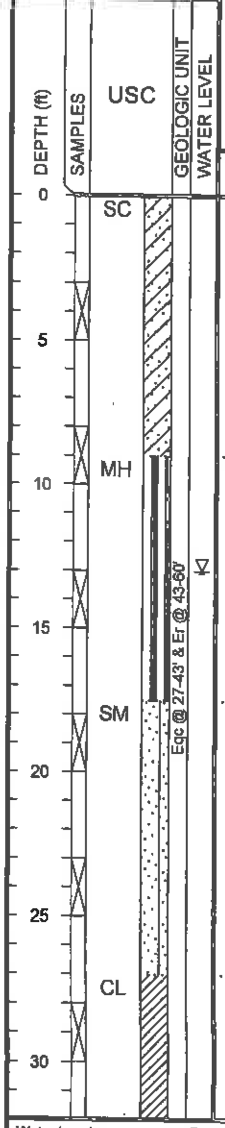
DRILL RIG: B-61 HDX

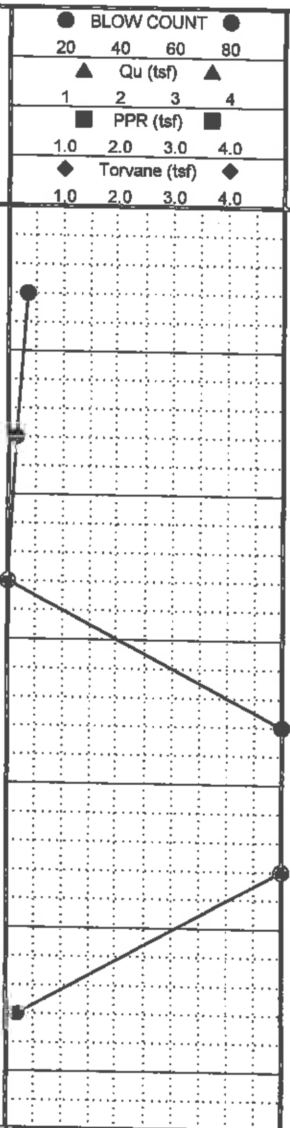
PROJECT NO.: G4207-146

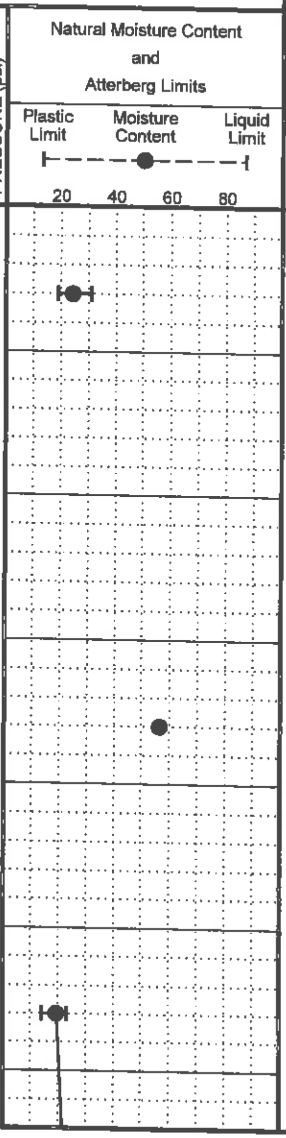
BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14

SURFACE ELEVATION 373.2







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	ASH (CLAYEY SAND(SC)) loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7					24	31	19	12	41	+40 Sieve=21% +4 Sieve=11%
MH	ASH (ELASTIC SILT(MH)) very loose; black; moist	N=3										
	--wet	N=0										
SM	ASH (SILTY SAND WITH GRAVEL(SM)) very dense; light brown and dark brown; with lightly cemented gravel pieces and coarse-grained sand; moist; cemented layer from 17.5' to 21'	N=50/1"					56				14	+40 Sieve=71% +4 Sieve=28%
	--cemented layer from 23' to 27'	N=50/4"										
CL	SANDY LEAN CLAY(CL) medium stiff; grayish brown and yellowish brown; saturated; mottled	N=4					19	23	14	9	57	+40 Sieve=1% +4 Sieve=0%

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

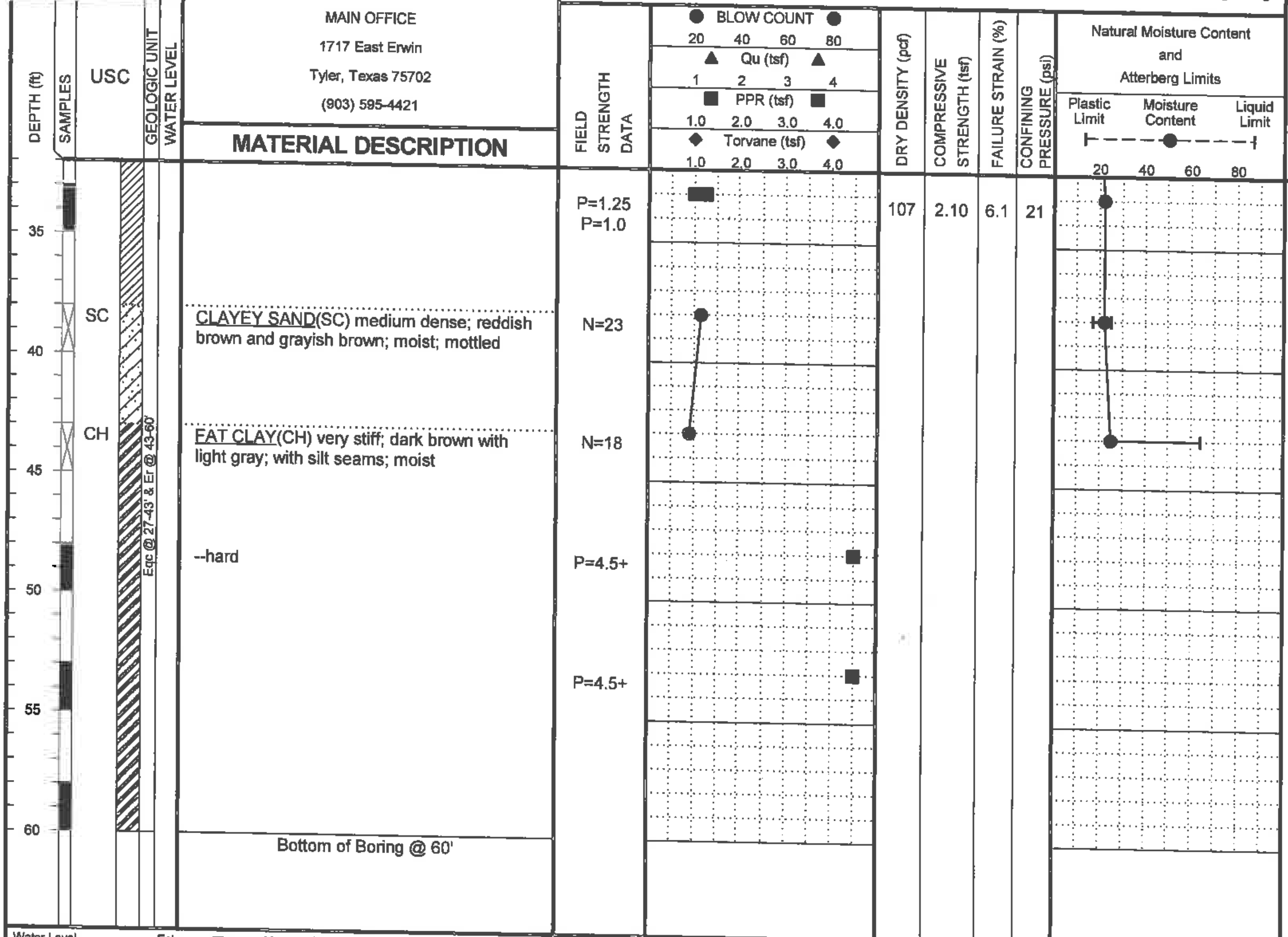
PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14

SURFACE ELEVATION 373.2



DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35			P=1.25 P=1.0	107	2.10	6.1	21	22					
40	SC	CLAYEY SAND(SC) medium dense; reddish brown and grayish brown; moist; mottled	N=23					22	25	17	8	27	+40 Sieve=3% +4 Sieve=0%
45	CH	FAT CLAY(CH) very stiff; dark brown with light gray; with silt seams; moist	N=18					25	64	24	40	90	+40 Sieve=7% +4 Sieve=0%
50		--hard	P=4.5+										
55			P=4.5+										
60		Bottom of Boring @ 60'											

Water Level Est.: ▽ Measured: ▼ Parched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill Boring B-12

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-12

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

DRILL RIG:

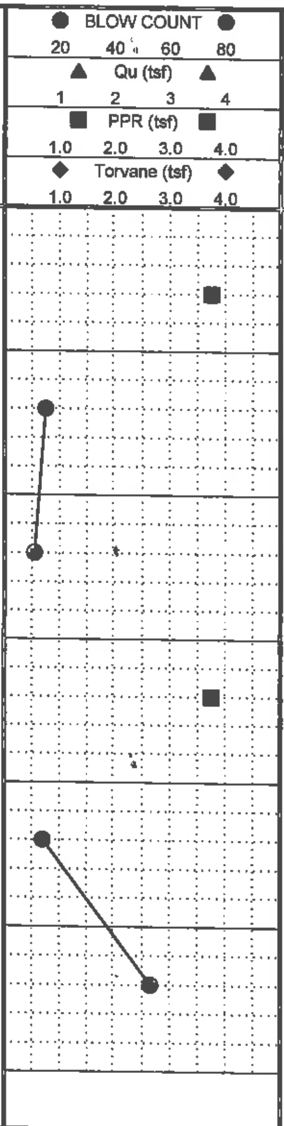
PROJECT NO.: G4207-146

BORING TYPE: Flight Auger

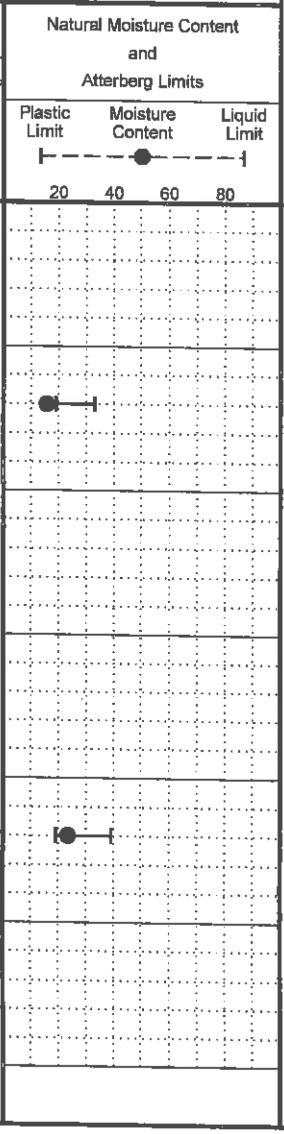
DATE 10/15/14

SURFACE ELEVATION 361.7

DEPTH (ft)	USC	GEOLOGIC UNIT	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	Egc	LEAN CLAY WITH SAND(CL) stiff; light gray and reddish brown; moist; mottled	P=3.75						
5	CL		SANDY LEAN CLAY(CL) stiff; light brown, light gray and reddish brown; moist; mottled	N=15	16	33	19	14	58	+40 Sieve=1% +4 Sieve=0%
10			--grayish brown and brown; moist	N=11						
15	CH		FAT CLAY WITH SAND(CH) stiff; light gray and reddish brown; moist; mottled; with ferric seams	P=3.75						
20	CL		LEAN CLAY(CL) stiff; light gray and brownish gray; moist; layered with silt	N=14	24	39	19	20	93	+40 Sieve=1% +4 Sieve=0%
25	ML		SILT WITH SAND(ML) very dense; light brown and yellowish brown; moist; with clay seams	N=53						
30			Bottom of Boring @ 30'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 27' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04713°, W94.84486°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Land Fill Boring B-13

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1717 East Erwin
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(903) 595-4421

LOG OF BORING B-13

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

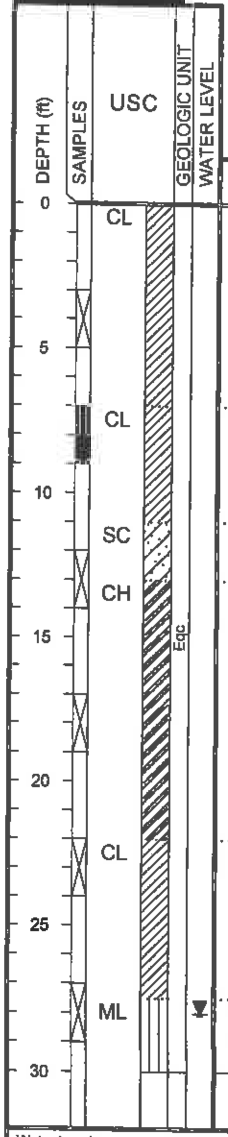
DRILL RIG:

PROJECT NO.: G4207-146

BORING TYPE: Flight Auger

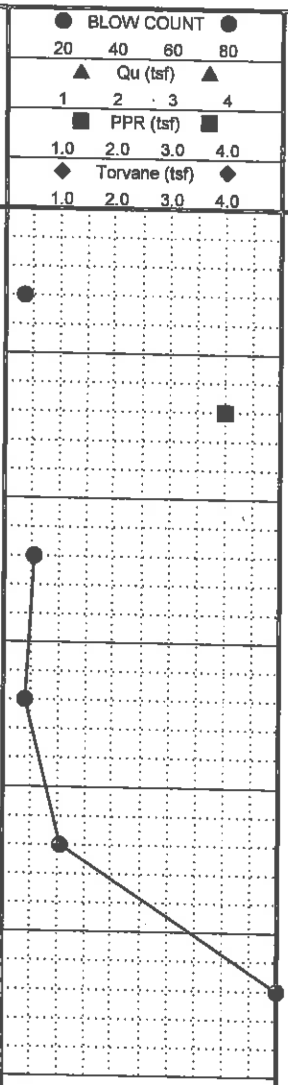
DATE 10/15/14

SURFACE ELEVATION 361.4

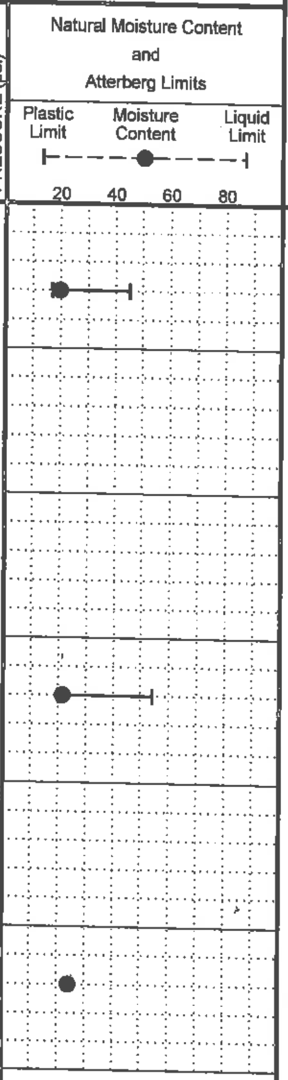


MATERIAL DESCRIPTION

USC	Material Description	Field Strength Data	Moisture Content (%)	LL	PL	PI	Minus #200 Sieve (%)	Other Tests Performed (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) medium stiff; reddish brown with light gray; moist	N=7	20	45	17	28	76	+40 Sieve=1% +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) very stiff; light brown, gray and reddish brown; moist; mottled	P=4.0						
SC	CLAYEY SAND(SC) medium dense; grayish brown; moist							
CH	FAT CLAY WITH SAND(CH) medium stiff; reddish brown and light gray; moist; mottled	N=11						
		N=8	22	54	20	34	79	+40 Sieve=1% +4 Sieve=0%
CL	LEAN CLAY(CL) very stiff; light gray and grayish brown; moist; layered with silt	N=21						
ML	SILT WITH SAND(ML) very dense; light gray and yellowish brown; wet; with clay seams	N=50/5"	24				80	+40 Sieve=0% +4 Sieve=0%
	Bottom of Boring @ 30'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 28' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.047160°, W94.84384°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-14

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-14

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

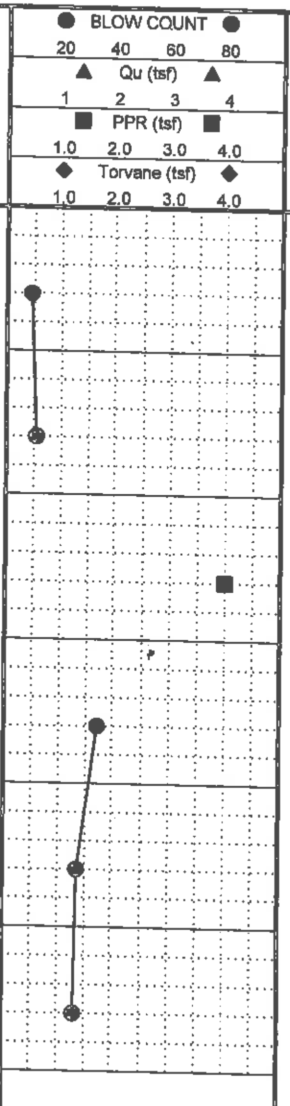
DRILL RIG:

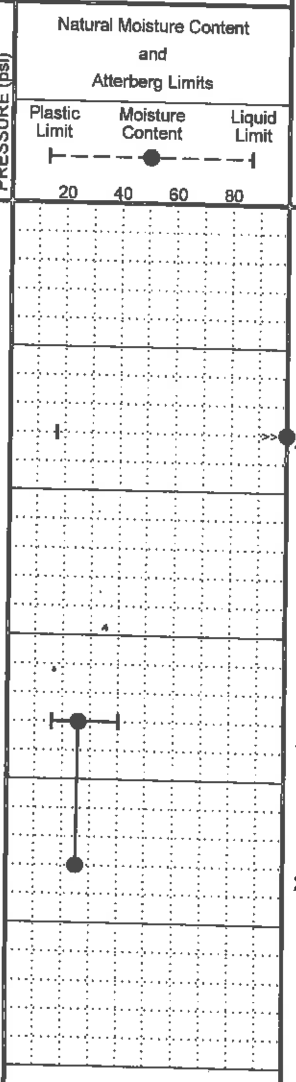
BORING TYPE: Flight Auger

DATE 10/14/14

SURFACE ELEVATION 347.2

DEPTH (ft)	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	Eqc @ 0-28' & Er @ 28-30'		<u>SANDY LEAN CLAY</u>(CL) medium stiff; yellowish brown with reddish brown; dry; with clay seams	N=9										
	ML			<u>SANDY SILT</u>(ML) medium dense; grayish brown; moist; with clay seams	N=11					108	17	17	NP	68	+40 Sieve=1% +4 Sieve=1%
	CL			<u>SANDY LEAN CLAY</u>(CL) very stiff; light gray and gray; moist	P=4.0										
			▼	--light gray and grayish brown; moist; layered with silt	N=34					26	40	16	24	67	+40 Sieve=1% +4 Sieve=0%
	SP SM			<u>POORLY GRADED SAND WITH SILT</u>(SP-SM) medium dense; yellowish brown, light gray and reddish brown; wet	N=27					25				10	+40 Sieve=0% +4 Sieve=0%
30	CL			<u>LEAN CLAY</u>(CL) very stiff; dark brown; moist; with silt partings	N=26										
				Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 23' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04774°, W94.84290°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-15

ETTL
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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-15

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

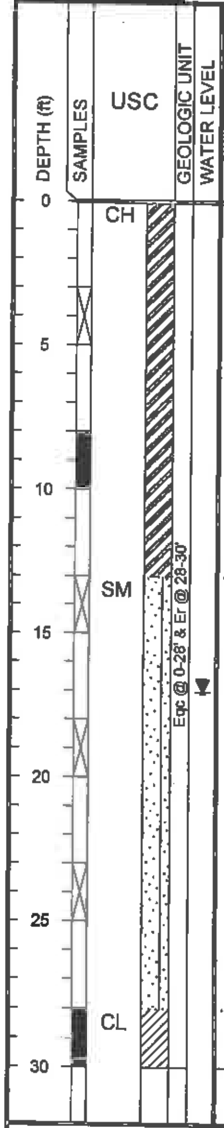
DRILL RIG:

PROJECT NO.: G4207-146

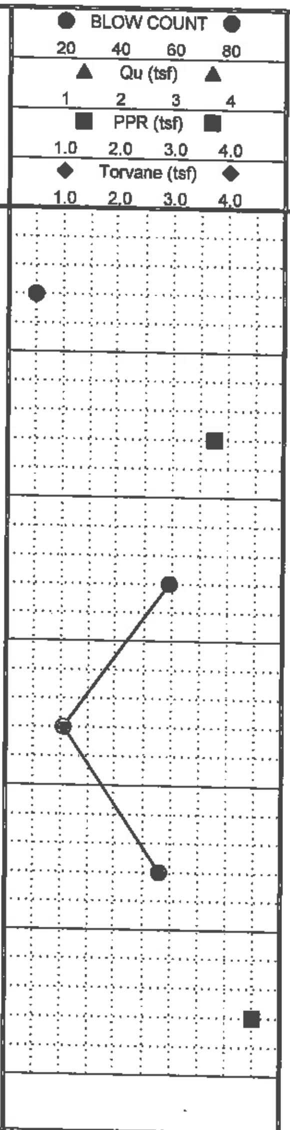
BORING TYPE: Flight Auger

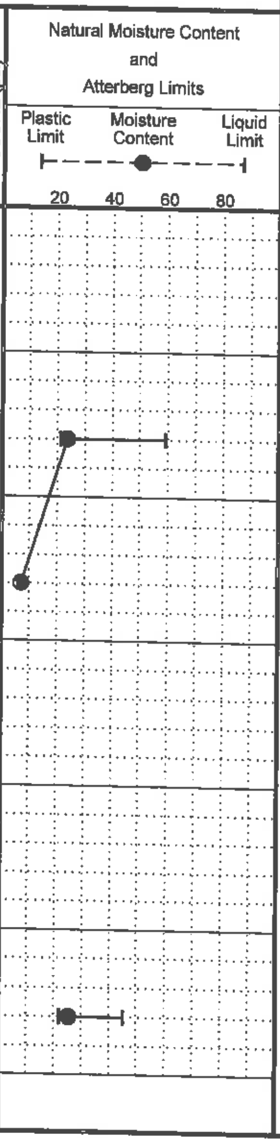
DATE 10/14/14

SURFACE ELEVATION 348.2



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY(CH) stiff; reddish brown and light gray; moist; mottled	N=10										
	--very stiff; light gray, grayish brown and reddish brown; moist; layered	P=3.75					24	59	21	38	85	+40 Sieve=0% +4 Sieve=0%
SM	SILTY SAND(SM) very dense; light brown; dry	N=59					7				12	+40 Sieve=0% +4 Sieve=0%
	--medium dense; wet	N=21										
	--very dense	N=56										
CL	LEAN CLAY(CL) hard; dark brown; moist; with silt partings	P=4.5					25	45	22	23	92	+40 Sieve=0% +4 Sieve=0%
	Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 19' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04857°, W94.84286°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

ARCADIS

Appendix B

Photographic Log

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 1

Date: 8/20/2015

Direction Photo Taken:

North

Description:
Staging area west of landfill.

P8200493

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 2

Date: 8/20/2015

Direction Photo Taken:

South Southeast

Description:

Potential wetland on the top (west) end of the Primary Ash Pond.

P8200495

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 3	**Date:** 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Ditch between road and railway west of landfill, this ditch would be non-jurisdictional.

P8200497

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 4	**Date:** 8/20/2015

Direction Photo Taken:

Northeast

Description:

Ground Water Monitoring Well AD-12 near northwest end of landfill.

P8200501

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – J. ROBERT WELSH POWER PLANT	PITTSBURG, TITUS COUNTY, TEXAS	OK001625.0001

Photo No. 5

Date: 8/20/2015

Direction Photo Taken:

East Northeast

Description:

View of plant from top of landfill. Primary ash pond is within the wooded area on left.

P8200506

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – J. ROBERT WELSH POWER PLANT	PITTSBURG, TITUS COUNTY, TEXAS	OK001625.0001

Photo No. 6

Date: 8/20/2015

Direction Photo Taken:

East Northeast

Description:

Drainage canal that drains from primary ash pond to clear water pond.

P8200510

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 7

Date: 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Vegetated strip between landfill and road. This would be isolated due to lack of connectivity.

P8200521

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 8

Date: 8/20/2015

Direction Photo Taken:

North

Description:

Dike between landfill and primary ash pond. Facility in the background.

P8200522

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 9

Date: 8/20/2015

Direction Photo Taken:

West

Description:

Vegetated strip between landfill and road. This area would be isolated due to lack of connectivity.

P8200527

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 10

Date: 8/20/2015

Direction Photo Taken:

North Northeast

Description:

Road east of landfill running toward facility and clear water pond.

P8200530

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 11

Date: 8/20/2015

Direction Photo Taken:

South

Description:

Top of landfill.

P8200534

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 12

Date: 8/20/2015

Direction Photo Taken:

Southeast

Description:

View of lined bottom ash storage pond.

P8200538

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 13

Date: 8/20/2015

Direction Photo Taken:

Southeast

Description:

Lined bottom ash storage pond.

P8200545

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 14

Date: 8/20/2015

Direction Photo Taken:

South

Description:

Southside of lined bottom ash storage pond.

P8200547

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 15

Date: 8/20/2015

Direction Photo Taken:

West

Description:

East side of lined bottom ash storage pond.

P8200560

ARCADIS **PHOTOGRAPHIC LOG**

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 16

Date: 8/20/2015

Direction Photo Taken:

North

Description:

Upland with pine and ground water monitoring well AD-2 south of lined bottom ash storage pond.

P8200563

ARCADIS **PHOTOGRAPHIC LOG**

Project Name:	Location:	Project No.
AEP – J. ROBERT WELSH POWER PLANT	PITTSBURG, TITUS COUNTY, TEXAS	OK001625.0001

Photo No.	Date:
17	8/20/2015

Direction Photo Taken:

Description:

Outflow of water from plant into the northeast portion of the Primary Ash Pond.

P8200577

ARCADIS **PHOTOGRAPHIC LOG**

Project Name:	Location:	Project No.
AEP – J. ROBERT WELSH POWER PLANT	PITTSBURG, TITUS COUNTY, TEXAS	OK001625.0001

Photo No.	Date:
18	8/20/2015

Direction Photo Taken:

South Southwest

Description:

Northeast portion of primary ash pond, view facing south-southwest.

P8200578

Imagine the result

American Electric Power Service Corporation

Bottom Ash Storage Pond - CCR Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187 County Road 4865
Titus County
Pittsburg, Texas

February 5, 2018

ARCADIS

Bottom Ash Storage Pond - CCR Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187County Road 4865
Titus County
Pittsburg, Texas

Prepared for:
AEP

Prepared by:
ARCADIS U.S., Inc.
100 E Campus View Blvd
Suite 200
Columbus
Ohio 43235-1447
Tel 614 985 9100
Fax 614 985 9170

Our Ref.:
OH015976.0011

Date:
February 5, 2018

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

Kenneth Brandner

Kenneth Brandner, P.E., P.G.
Senior Project Engineer

Matthew J. Lamb /KJB

Matthew J. Lamb
Project Manager

John Holm /DPL

John Holm, P.E.
Professional Engineer

Tables

Figures

Appendices

Acronyms and Abbreviation

AEP	American Electric Power Service Cooperation
amsl	above mean sea level
ARCADIS	ARCADIS U.S., Inc.
BAP	bottom ash pond
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
FAP	fly ash pond
FGD	flue gas desulfurization
ft	feet
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
PTI	Permit to Install
TDS	total dissolved solids

1. Objective

This report was prepared by ARCADIS U.S., Inc. (ARCADIS) for American Electric Power Service Corporation (AEP) to assess the adequacy of the groundwater monitoring well network included in the Coal Combustion Residual (CCR) requirements, as specified in Code of Federal Regulations (CFR) 40 CFR 257.91, for the Bottom Ash Storage Pond (CCR Unit) at the AEP Generating Plant (Plant) located at 1187 County Road 4865 in Pittsburg, Titus County, Texas (**Figure 1**). The CCR requirements include an evaluation of the adequacy of the groundwater monitoring well network to characterize groundwater quality up and down gradient of the CCR unit.

Three regulated CCR units associated with the Plant were identified for review, which include the primary bottom ash pond, landfill, and Bottom Ash Storage Pond (**Figure 2**). This report summarizes the evaluation of the groundwater monitoring well network in the uppermost aquifer at the Bottom Ash Storage Pond (Site).

This evaluation included a review of AEP-provided data associated with previously completed subsurface investigation activities in the vicinity of the Bottom Ash Storage Pond CCR unit, as well as publicly-available geologic and hydrogeologic data. This report also presents the current Conceptual Site Model based on all documents reviewed and will further describe the uppermost aquifer, include an evaluation of the adequacy of the existing monitoring well network, and provide recommendations for monitoring well augmentation, as necessary.

2. Background Information

The following section provides background information for the AEP J. Robert Welsh Generating Plant (Welsh Plant) Bottom Ash Storage Pond.

2.1 Facility Location Description

The AEP Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The Bottom Ash Storage Pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir (**Figures 1** and **2**).

2.2 Description of Bottom Ash Storage Pond CCR Unit

The following section will discuss the embankment configuration, area, volume, construction and operational history, and surface water control associated with the Bottom Ash Storage Pond.

2.2.1 Embankment Configuration

The Bottom Ash Storage Pond was placed into operation in 2000, and is located in the southern portion of the Plant. The Bottom Ash Storage Pond embankments are approximately 20 feet in height and are constructed of compacted clay on a 3:1 slope (3 feet horizontal, 1 foot vertical). The elevation at the base of the embankment is approximately 340 feet amsl, and the elevation at the top of the embankment around the perimeter of the Bottom Ash Storage Pond is approximately 360 feet amsl (Southwestern Electric Power Company, 2000).

2.2.2 Area/Volume

The Bottom Ash Storage Pond is 22 acres in size. Per the *Hydraulic Analysis of Welsh Power Plant Ash Ponds Report,* dated December 2010 (Freese and Nichols, 2010), the principal spillway for the Bottom Ash Storage Pond is located near the southeast corner of the pond and consists primarily of an 18 inch drain at elevation 350.5 feet amsl and also of a 40-foot-long broad-crested weir with a crest elevation of 355 feet amsl. The emergency spillway is an 8-foot-wide weir with a rock rip-rap discharge chute located along the southern embankment at an elevation of 358 feet amsl. The storage capacity of the Bottom Ash Storage Pond at elevation 358 feet amsl is 86.50 acre-ft (Freese and Nichols, 2010).

2.2.3 Construction and Operational History

The AEP J. Robert Welsh Plant began operations in approximately 1977 with three coal-fired generating units (Units 1, 2, and 3). Throughout the life of the generating plant, CCR materials (fly ash, bottom ash, economizer ash) have been generated. All of these byproducts were stored in the primary bottom ash pond and in the adjacent landfill that was constructed in the late 1970's. In 2000, the 22-acre Bottom Ash Storage Pond was installed south of the landfill. The Bottom Ash Storage Pond was constructed with a 60-mil high-density polyethylene (HDPE) liner, and receives bottom ash and economizer ash dredged and sluiced from the primary bottom ash pond (**Figure 2**).

The Bottom Ash Storage Pond 60-mil HDPE liner is located at the base of the Bottom Ash Storage Pond at an elevation of 340 feet amsl. The liner also extends along the base of the Bottom Ash Storage Pond sidewalls and is keyed into the top of the Bottom Ash Storage Pond earthen embankment at an elevation of 360 feet amsl (Southwestern Electric Power Company, 2000).

The southeast corner of the Bottom Ash Storage Pond contains an approximate ¼-acre clear water pond with a base elevation of 347 feet amsl (**Figure 3**). The clear water pond receives clear water primarily through an 18 inch drain and then through an overflow structure from the main part of the Bottom Ash Storage Pond through the 40-foot-long broad-crested weir discussed above in Section 2.2.2. Water in the ¼-acre clear water pond at the southeast corner of the Bottom Ash Storage Pond discharges through a 30-inch-diameter pipe into the primary bottom ash pond system.

2.2.4 Surface Water Control

Surface water flow within the Bottom Ash Storage Pond is primarily controlled by an 18 inch drain and then by a weir located on the southeast side of the pond below the embankments. The pond elevation is maintained so that surface water flows through the drain pipe at invert elevation 350.5 amsl or weir which has a crest elevation of 355 feet amsl. Clear water flows through the weir into the ¼-acre clear water pond at the southeast corner of the Bottom Ash Storage Pond, then discharges through a 30-inch-diameter pipe into the primary bottom ash pond (**Figure 3**).

The emergency spillway for the Bottom Ash Storage Pond is located along the southern embankment, and is 8 feet wide with a crest elevation of 358 feet amsl. The perimeter embankments of the Bottom Ash Storage Pond are located at an elevation of

360 feet amsl. Therefore the perimeter embankments have approximately five feet of freeboard above the clear water discharge weir, and approximately two feet of freeboard above the emergency spillway.

2.3 Previous Investigations

The initial soils investigation for the site was provided in a 1973 report prepared by McClelland Engineers, Inc. entitled "*Soils Investigation, Welsh Power Plant, Cason, Texas*". This investigation included advancement of soil borings in the primary bottom ash pond area, and geotechnical soil testing to characterize the area encompassed by the primary bottom ash pond.

In 2000, Maxim Technologies prepared a report entitled "*Subsurface Exploration for Ash Storage Area, Phase II, Welsh Power Plant, Cason, Texas*". This report evaluated the geotechnical properties of the soils below the Bottom Ash Storage Pond.

In 2000, an HDPE liner installation report was prepared by Alliance Incorporated. This report provided details regarding installation of the 60-mil HDPE liner on the bottom of the Bottom Ash Storage Pond.

In 2001, five monitoring wells (AD-1 through AD-5) were installed in the area of the primary bottom ash pond and Bottom Ash Storage Pond to obtain hydrologic data for the uppermost water-bearing unit. Twelve additional monitoring wells (AD-4a, AD-4b, AD-4c, AD-6 through AD-14) were installed in the area of the primary bottom ash pond, Bottom Ash Storage Pond, and landfill by Eagle Environmental Services in 2009 to obtain more detailed hydrologic data for the uppermost water-bearing unit.

In 2010, Freese and Nichols performed a *Hydraulic Analysis of the Welsh Power Plant Ash Ponds* (Freese and Nichols, 2010). The report concluded the spillways for the primary bottom ash pond, clear water pond, and Bottom Ash Storage Pond are hydraulically adequate for the full range of storm events from the 10-year to the 100-year storm events.

In December 2015, Auckland Consulting further expanded the groundwater monitoring well system at the Plant by installation of monitoring wells AD-15 through AD-18 (Auckland Consulting, 2016). In April 2017, ARCADIS installed monitoring well AD-16R as a replacement for monitoring well AD-16, which was nearly dry following drilling. Monitoring well completion diagrams are provided in **Appendix A.**

2.4 Hydrogeologic Setting

The site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently southeast. The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966).

These features are further illustrated on five lines of cross section that were prepared through the Bottom Ash Storage Pond area, with three lines trending from west to east (A-A'; B-B'; C-C'), and the other two lines trending from north to south (D-D'; E-E'). The cross section location map is included as **Figure 3** and the lines of cross section are included as **Figure** 4 (A-A') through **Figure 8** (E-E').

2.4.1 Climate and Water Budget

The climate of Titus County, Texas is moist subhumid. The normal January temperature is 45˚Fahrenheit (F), and the normal July temperature is 82.9˚F. The mean annual growing season is 228 days (Broom, 1965). Average annual precipitation (including liquid water equivalent from snowfall) is approximately 47 inches according to weatherdb.com.

2.4.2 Regional and Local Geologic Setting

The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966). The Recklaw Formation attains a thickness of approximately 110 feet in Titus County, and is underlain by the Eocene-age Carrizo Sand which consists of fine to coarse sand, silt, and clay (Broom, 1965). In the topographically low areas underling the Welsh Reservoir to the east of the Bottom Ash Storage Pond, Quarternary alluvial sediments associated with Swauano Creek are present (Flawn, 1966).

Detailed regional geologic characterization can be found in several published reports including Texas Water Commission Bulletin 6517 "*Ground-Water Resources of Camp, Franklin, Morris and Titus Counties, Texas*" (Broom, 1965), and The University of Texas at Austin Bureau of Economic Geology "*Geologic Atlas of Texas – Texarkana Sheet*" (Flawn, 1966).

Detailed regional and site geologic characterization can be found in the 2010 ETTL report entitled "*Geotechnical Investigation, Welsh Power Station, Existing Ash Storage Ponds Embankment Investigation, Pittsburg, Texas*" (ETTL, 2010).

2.4.3 Surface Water and Surface Water Groundwater Interactions

The Site is generally less than one-half mile from Swauano Creek, which was dammed near the southern end of the Site during plant development to form the Welsh Reservoir. Groundwater flow direction at the Site is generally from west to east, following surface topography towards the Welsh Reservoir. The Welsh Reservoir is likely a gaining surface water feature, and groundwater elevations on site are higher than the normal stage elevation of the Welsh Reservoir (approximately 320 feet amsl).

The Bottom Ash Storage Pond normal operating level is near the clear water overflow weir which has a crest elevation of 355 feet amsl. **Figure 9** and **Figure 10** are potentiometric surface maps for the uppermost aquifer at the Site based on March 2016 and February 2017 water level data, respectively. Water level elevations in the Site monitoring wells are summarized on **Table 1**. As shown on **Figures 9** and **10**, shallow groundwater flow direction in the area of the Bottom Ash Storage Pond is east-southeasterly toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.01 foot per foot.

2.4.4 Water Users

A water well inventory conducted by Banks Information Solutions showed one water well within a ½-mile radius of the Site (Banks, 2013). The water well is located on-site to the southwest (sidegradient) of the primary bottom ash pond, and was installed for Southwestern Electric Company in 1974 with screens from 515 to 535 feet below ground surface, and plugged at a later date.

3. Groundwater Monitoring Well Network Evaluation

The existing monitoring well network present at the Site was evaluated to determine if any of the wells were viable for continued use as part of the groundwater monitoring well network or also retained as part of a larger groundwater hydraulic monitoring well network. The hydrogeologic conditions were also evaluated to determine if the uppermost aquifer unit has an effective well network. The evaluation was completed in accordance with 40 CFR 257.91 to have an established monitoring well network that effectively monitors the uppermost aquifer upgradient and down gradient of the Site. The upgradient wells represent background groundwater quality and the down gradient wells are to be placed down gradient of the CCR unit boundary to monitor water quality.

3.1 Hydrostratigraphic Units

3.1.1 Horizontal and Vertical Position Relative to CCR Unit

Geologic data from soil borings and monitoring wells installed at the Site show the uppermost aquifer in the area of the Bottom Ash Storage Pond is a very fine to fine grained silty sand and sandy silt stratum with an average thickness of approximately 12 feet that is located between an elevation of approximately 320 and 332 feet amsl (**Appendix A**). The base of the Bottom Ash Storage Pond is at an elevation of 340 feet amsl. Therefore the separation distance between the uppermost aquifer and the base of the Bottom Ash Storage Pond is approximately 8 feet. This separation distance is further illustrated on cross section C-C’ (**Figure 6)** and cross section D-D’ (**Figure 7)**.

3.1.2 Overall Flow Conditions

Groundwater is recharged from regional precipitation infiltration. The uppermost aquifer (silty sand) is expected to have a hydraulic conductivity of approximately 10^{-4} centimeters per second (Fetter, 1980). Based on the hydraulic conductivity and saturated thickness (approximately 12 feet), the yield of the uppermost aquifer is anticipated to exceed the TCEQ non-useable (Class 3) limit of 150 gallons per day (TCEQ, 2010).

Available groundwater elevations are summarized on **Table 1** for 2011 through 2017. The most recent comprehensive groundwater data set from February 2017 is depicted on **Figure 10**. The groundwater flow is generally easterly towards the Welsh Reservoir.

3.2 Uppermost Aquifer

3.2.1 CCR Rule Definition

The CCR rule definitions for an aquifer and the uppermost aquifer as specified in 40 CFR 257.53 indicates an aquifer is a geologic formation capable of yielding usable quantities of groundwater to wells or springs while an uppermost aquifer is defined as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers, that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural groundwater surface to which the aquifer rises during the wet season.

3.2.1.1 Common Definitions

An aquifer is commonly defined as a geologic unit that stores and transmits water (readily or at sufficient flow rates) to supply wells and springs (USGS, 2015; Fetter, 2001). The uppermost aquifer is considered the first encountered aquifer nearest to the CCR unit.

3.2.2 Identified Onsite Hydrostratigraphic Unit

The identified on-Site hydrostratigraphic unit in the area of the Bottom Ash Storage Pond is the very fine to fine grained silty sand and sandy silt stratum that is located between an elevation of approximately 320 and 332 feet amsl. This unit is not used locally for groundwater supply or industrial water use, but meets the TCEQ definition of a useable aquifer.

3.3 Review of Existing Monitoring Well Network

3.3.1 Overview

The Site was visited by ARCADIS and AEP personnel on August 20, 2015 to review existing well network conditions and locations. A well construction table that summarizes the location, ground surface elevation, borehole depth, installation date, and associated well construction details of the monitoring well network is included as **Table 2**. Photo documentation of the located wells during the August 20, 2015 site visit is provided in **Appendix B**.

Monitoring wells AD-1 through AD-4, AD-4a, AD-4b, and AD-4c were previously installed at the Site to monitor the uppermost aquifer (very fine to fine grained silty sand and sandy silt stratum) associated with the Bottom Ash Storage Pond. As discussed above in Section 3.1.1, the aquifer below the Bottom Ash Storage Pond is approximately 12 feet thick and is located between an elevation of approximately 320 and 332 feet amsl.

3.3.2 Gaps in Monitoring Network

As shown on Geologic Cross Sections A-A’ (**Figure 4**) and C-C’ (**Figure 6**), existing monitoring wells AD-5 and AD-1 are screened at the top of the uppermost aquifer up gradient (northwest) of the Bottom Ash Storage Pond, and existing monitoring wells AD-4a, AD-4b, and AD4c are screened in the uppermost aquifer down gradient (east) of the Bottom Ash Storage Pond. Existing monitoring wells AD-1 and AD-5 will be utilized as the upgradient monitoring wells for the Bottom Ash Storage Pond. Monitoring well AD-17, installed northwest (upgradient) of the Bottom Ash Storage Pond during December 2015, will also be utilized as an upgradient monitoring well for the Bottom Ash Storage Pond.

Existing monitoring well AD-3, located east of the Bottom Ash Storage Pond, will be utilized as a down gradient monitoring well for the Bottom Ash Storage Pond. Existing monitoring wells AD-4, AD-4a, AD-4b, and AD-4c are located in close proximity to each other, and as shown on **Figure 9**, monitoring well AD-4c is the furthest down gradient of these four monitoring wells. Therefore monitoring well AD-4c will be utilized as a down gradient monitoring well for the Bottom Ash Storage Pond.

As shown on **Figures 9** and **10**, existing monitoring well AD-14 is located east of the northeast corner of the Bottom Ash Storage Pond. However, due to the close proximity of the landfill CCR unit directly north of the Bottom Ash Storage Pond, groundwater at monitoring well AD-14 could be affected by the landfill. Therefore monitoring well AD-14 will not be utilized as part of the groundwater monitoring system for the Bottom Ash Storage Pond. This data gap was addressed by installation of new monitoring well AD-16 during December 2015 east (down gradient) of the Bottom Ash Storage Pond as shown on **Figure 9** and **Figure 10**. However, monitoring well AD-16 was nearly dry following drilling. Therefore monitoring well AD-16 was replaced with monitoring well AD-16R during April 2017. With the addition of monitoring wells AD-16R and AD-17, there are no gaps remaining in the groundwater monitoring network for the Bottom Ash Storage Pond.

4. Recommended Monitoring Network and PE Certification

The recommended existing groundwater monitoring well network is intended to meet specifications stated in 40 CFR 257.91. Recommended wells are further discussed with respect to location to the Bottom Ash Storage Pond (upgradient or down gradient), well depth, and well construction. The recommended network would provide an improved understanding of groundwater quality, hydraulics, and groundwater flow at the Bottom Ash Storage Pond.

4.1 Recommended Monitoring Well Network Distribution

Three upgradient well locations (existing monitoring wells AD-1, AD-5, and AD-17) and three down gradient well locations (existing monitoring wells AD-3, AD-4c, and AD-16R) are recommended to establish a groundwater quality monitoring well network for the Bottom Ash Storage Pond. In addition, existing monitoring wells AD-2, AD-4, AD-4a, AD-4b, and AD-16 may be utilized as piezometers to obtain additional groundwater flow direction and gradient data for the Bottom Ash Storage Pond.

4.1.1 Location

The recommended monitoring well network for groundwater quality of the uppermost aquifer at the Bottom Ash Storage Pond is summarized on **Table 3** and illustrated on **Figure 11.**

4.1.2 Depth

The screen depths for the monitoring wells recommended for inclusion in the monitoring network are within the shallow saturated sand stratum (uppermost aquifer) that occurs between an elevation of approximately 320 and 332 feet amsl as shown on Geologic Cross Sections C-C’ (**Figure 6**) and D-D’ (**Figure 7**). The screen elevations are presented in **Table 3**.

4.1.3 Well Construction

As discussed above in Section 3.3.2, the gap in the monitoring well network for the uppermost aquifer at the Bottom Ash Storage Pond was addressed by installation of monitoring wells AD-16R and AD-17. Monitoring wells AD-16R and AD-17 were installed by a Texas Department of Licensing and Regulation (TDLR)-licensed water well driller. Well construction data for the monitoring well network are summarized on **Tables 2** and **3**, and the monitoring well completion diagrams are provided in **Appendix A**.

4.2 Professional Engineer's Certification

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the proposed groundwater monitoring system will be adequate to meet the requirements of 40 CFR Part 257.91.

Kenneth J. Brandner
Printed Name of Registered Professional Engineer

Signature

KENNETH J. BRANDNER
69586

69586	TX	2-5-18
Registration No.	Registration State	Date

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Tables

Table 1
Water Level Data
AEP J. Robert Welsh Power Plant - CCR Storage Areas
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Screen		Bottom of Screen		6/7/2011	12/6/2011	5/2/2012	11/1/2012	5/14/2013	11/19/2013	5/12/2014	11/16/2014	5/12/2015	3/4/2016	5/26/2016	7/27/2016	10/19/2016	12/12/2016	1/17/2017	2/23/2017
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																												
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57	338.46	334.92	337.88	337.18	337.43	336.73	338.03	337.64	340.82	342.83	344.89	342.89	341.23	340.58	341.18	339.74
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16	330.16	329.07	330.00	329.26	329.83	329.70	330.09	329.69	332.56	332.32	---	---	---	---	---	---
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10	323.81	323.19	323.99	323.29	323.77	323.98	324.12	323.28	325.58	325.12	324.59	323.70	323.47	323.78	325.04	324.92
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61	324.81	324.84	324.62	324.40	324.74	325.52	325.44	325.13	327.00	326.90	---	---	---	---	---	---
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19	325.01	324.19	325.24	322.90	324.86	324.68	325.64	325.34	327.19	327.12	---	---	---	---	---	---
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55	324.35	324.32	324.50	324.30	324.30	325.21	325.22	324.90	326.58	326.67	---	---	---	---	---	---
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15	324.18	324.50	324.64	324.37	324.11	325.06	325.01	324.71	326.50	326.19	325.89	324.01	323.76	325.07	326.39	324.89
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00	336.34	336.58	336.82	336.99	336.78	336.47	336.80	336.01	339.07	338.04	337.62	337.24	337.74	337.01	338.34	336.17
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31	333.04	333.02	332.83	333.02	333.11	332.81	333.11	332.81	333.38	334.00	---	---	---	---	---	---
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86	334.32	334.12	334.19	334.20	334.13	334.58	333.77	333.98	334.09	333.61	---	---	---	---	---	---
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53	325.41	324.09	325.69	325.15	325.79	325.75	325.98	325.77	326.05	325.70	325.68	325.05	325.29	325.92	326.76	324.27
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32	328.46	328.53	328.63	328.44	328.74	329.38	NM	330.18	329.98	329.74	329.28	329.53	328.92	329.31	330.50	328.05
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23	323.44	322.55	323.27	323.35	323.51	323.76	323.57	323.88	323.95	323.55	---	---	---	---	---	---
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61	327.99	328.37	327.82	327.93	327.94	328.13	328.20	327.97	328.96	328.13	328.39	328.14	327.87	328.20	328.90	328.25
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27	348.30	348.29	349.86	349.56	349.99	349.65	349.89	350.01	350.65	350.39	---	---	---	---	---	---
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12	332.36	332.24	333.09	332.26	332.68	333.25	333.35	332.01	337.58	334.76	334.54	332.93	332.39	332.84	334.54	331.83
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32	330.40	329.80	331.67	330.34	330.94	331.69	332.12	330.17	336.63	334.83	334.51	331.71	330.94	330.79	332.63	330.87
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71	---	---	---	---	---	---	---	---	---	322.14	321.93	321.28	321.42	321.71	321.64	322.81
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86	---	---	---	---	---	---	---	---	---	337.09	335.84	332.14	331.52	331.43	330.96	330.71
AD-16R(e)	33° 02' 49"	94° 50' 28.9"	350.55	353.49	27.0	4/12/17	Sch. 40 PVC	2	12.0	338.55	27.0	323.55	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99	---	---	---	---	---	---	---	---	---	334.64	334.26	334.30	334.45	334.64	334.05	333.94
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17	---	---	---	---	---	---	---	---	---	343.66	343.26	340.81	339.92	339.38	338.97	340.38
Piezometers																												
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

NM - Not measured.
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
(e) Monitoring well installed by ARCADIS on April 12, 2017 as a replacement for monitoring well AD-16.
Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through February 2017.

Table 2
Well Construction Details
AEP J. Robert Welsh Power Plant - CCR Units
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Filter Pack		Bottom of Filter Pack		Top of Screen		Bottom of Screen	
								Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl
Monitoring Wells															
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	25.0	1/11/2001	PVC	2	13	343	25	331	15.0	340.57	25.0	330.57
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	25.0	4/26/2001	PVC	2	12	332	25	319	15.0	329.16	25.0	319.16
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	17.0	4/26/2001	PVC	2	5	326	17	314	7.0	324.10	17.0	314.10
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	30.0	4/26/2001	PVC	2	16	325	30	311	19.0	321.61	29.0	311.61
AD-4a (a)	33.04527	94.84258	340.19	30.0	9/22/2009	PVC	2	17	323	30	310	20.0	320.19	30.0	310.19
AD-4b (a)	33.04531	94.84230	329.55	15.0	9/23/2009	PVC	2	4	326	15	315	5.0	324.55	15.0	314.55
AD-4c (a)	33.04507	94.84244	329.15	15.0	9/23/2009	PVC	2	4	325	15	314	5.0	324.15	15.0	314.15
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	30.0	1/11/2001	PVC	2	16	333	30	319	20.0	329.00	30.0	319.00
AD-6 (a)	33.05235	94.84757	343.31	33.0	9/23/2009	PVC	2	21	322	33	310	23.0	320.31	33.0	310.31
AD-7 (a)	33.05257	94.84219	347.86	38.0	9/24/2009	PVC	2	26	322	38	310	28.0	319.86	38.0	309.86
AD-8 (a)	33.05187	94.84026	337.53	29.0	9/21/2009	PVC	2	14	324	29	309	16.0	321.53	26.0	311.53
AD-9 (a)	33.04995	94.84196	340.32	35.0	9/21/2009	PVC	2	18	322	35	305	20.0	320.32	35.0	305.32
AD-10 (a)	33.04881	94.84047	340.23	35.0	9/22/2009	PVC	2	18	322	35	305	20.0	320.23	35.0	305.23
AD-11 (a)	33.04824	94.84177	339.61	20.0	9/22/2009	PVC	2	8	332	20	320	10.0	329.61	20.0	319.61
AD-12 (a)	33.04901	94.84977	366.27	30.0	9/24/2009	PVC	2	18	348	30	336	20.0	346.27	30.0	336.27
AD-13 (a)	33.04918	94.84275	344.12	20.0	9/22/2009	PVC	2	4	340	20	324	6.0	338.12	16.0	328.12
AD-14 (a)	33.04715	94.84256	342.32	19.0	9/22/2009	PVC	2	6	336	18	324	8.0	334.32	18.0	324.32
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	46.0	12/12/15	PVC	2	22	318	45.5	295	25.5	314.71	45.5	294.71
AD-16R	33° 02' 49"	94° 50' 29"	350.55	27.0	4/12/17	PVC	2	10	341	27	324	12.0	338.55	27.0	323.55
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	40.0	12/10/15	PVC	2	22	332	39	315	24.0	329.99	39.0	314.99
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	29.0	12/11/15	PVC	2	12	334	29	317	14.0	332.17	29.0	317.17
Piezometers															
B-2 (b)	33° 03.078'	94° 50.449'	339.7	50.0	10/28/2009	PVC	2	8	332	20	320	10.0	329.70	20.0	319.70
B-4 (b)	33° 03.011'	94° 50.462'	340.6	50.0	10/27/2009	PVC	2	8	333	18	323	8.0	332.60	18.0	322.60
B-5 (b)	33° 02.964'	94° 50.428'	340.0	50.0	10/27/2009	PVC	2	5	335	20	320	10.0	330.00	20.0	320.00
B-6 (b)	33° 02.912'	94° 50.462'	340.1	50.0	10/28/2009	PVC	2	4	336	22	318	12.0	328.10	22.0	318.10
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	21.0	12/10/15	PVC	2	9	342	21	330	11.0	339.86	21.0	329.86

General Notes:
Elevation in feet above mean sea level.

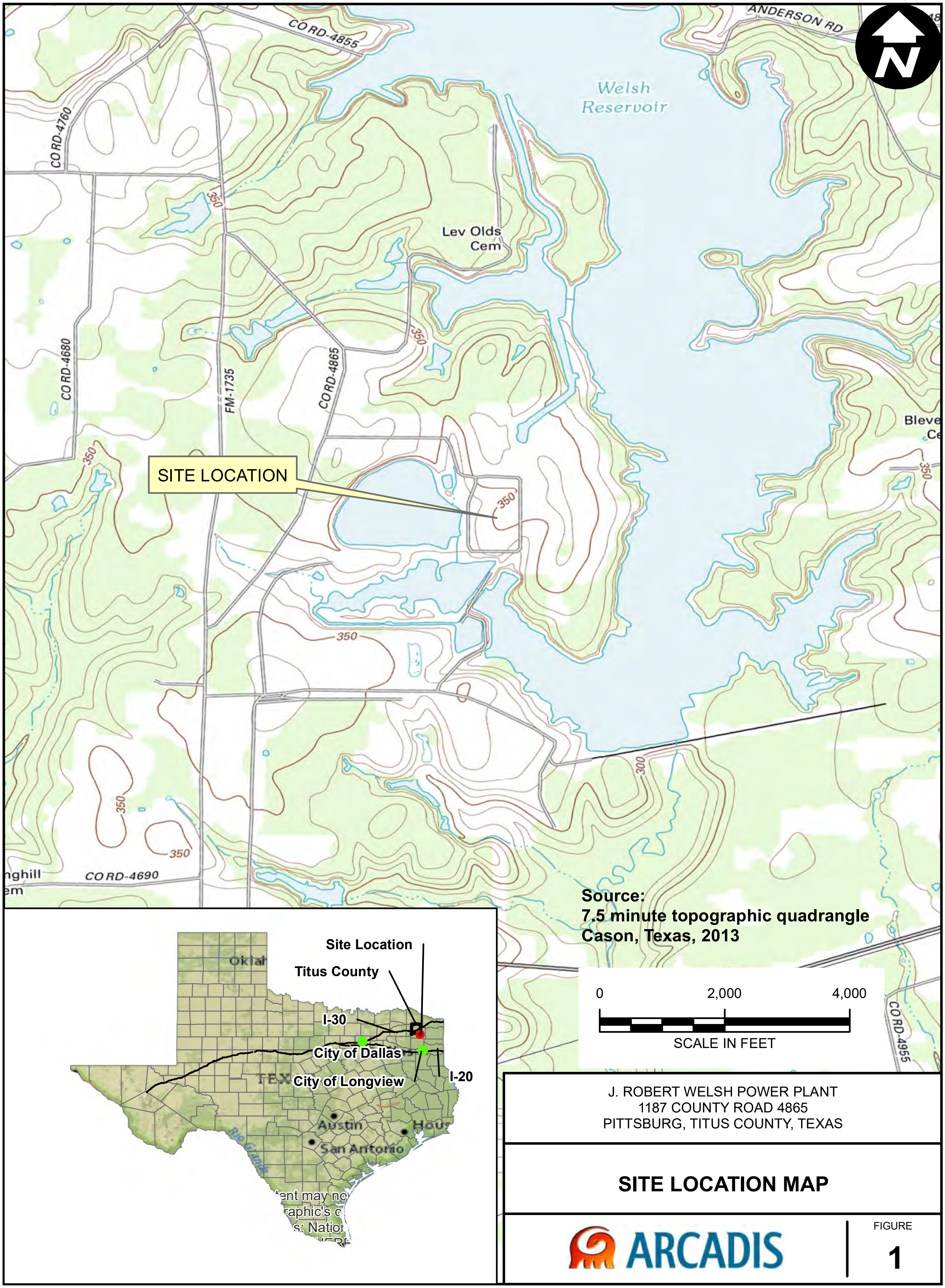
Footnotes:
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
Acronyms and Abbreviations:
NA = Data not available
ft = feet
bls = below land surface
msl = mean sea level

Table 3
Proposed Well Network
AEP J. Robert Welsh Power Plant - Bottom Ash Storage Pond
Pittsburg, Titus County, Texas

Well ID	Exisiting/ Proposed	Hydrostratigraphic Unit Target	Location Description		Screen Top Elevation (ft amsl)	Screen Bottom Elevation (ft amsl)	Screen Length (ft)	Comments
Upgradient								
AD-1	Existing	Uppermost Water-Bearing Unit	West of Bottom Ash Storage Pond	Upgradient	340.6	330.6	10	Existing well installed in 2001; well will be utilitzed to establish backgroud water quality
AD-5	Existing	Uppermost Water-Bearing Unit	NW of Bottom Ash Storage Pond	Upgradient	329.0	319.0	10	Existing well installed in 2001; well will be utilitzed to establish backgroud water quality
AD-17	Existing	Uppermost Water-Bearing Unit	NW of Bottom Ash Storage Pond	Upgradient	330.0	315.0	15	New monitoring well installed during December 2015 in uppermost shallow aquifer northwest of Bottom Ash Storage Pond - upgradient; well will be utilized to establish background water quality
Downgradient								
AD-3	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	324.1	314.1	10	Existing well installed in 2001; uppermost shallow aquifer adjacent to the bottom ash storage pond - downgradient
AD-4c	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	324.2	314.2	10	Existing well installed in 2009; uppermost shallow aquifer adjacent to the bottom ash storage pond - downgradient
AD-16R	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	338.6	323.6	15	New monitoring well installed during April 2017 in uppermost shallow aquifer adjacent to the bottom ash storage pond - downgradient
Piezometers								
AD-2	Existing	Uppermost Water-Bearing Unit	South of Bottom Ash Storage Pond	Side gradient	329.2	319.2	10	Existing well installed in 2001; and utilitzed to obtain water level data for uppermost water-bearing unit
AD-4	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	321.6	311.6	10	Existing well installed in 2001; and utilitzed to obtain water level data for uppermost water-bearing unit
AD-4a	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	320.2	310.2	10	Existing well installed in 2009; and utilitzed to obtain water level data for uppermost water-bearing unit
AD-4b	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	324.6	314.6	10	Existing well installed in 2009; and utilitzed to obtain water level data for uppermost water-bearing unit
AD-16	Existing	Uppermost Water-Bearing Unit	East of Bottom Ash Storage Pond	Down gradient	339.9	329.9	10	New piezometer installed during December 2015 in uppermost shallow aquifer adjacent to the bottom ash storage pond - downgradient

Acronyms and Abbreviations:
U=Upgradient
D=Downgradient
ft = feet
amsl = above mean sea level

Figures



Source:
7.5 minute topographic quadrangle
Cason, Texas, 2013

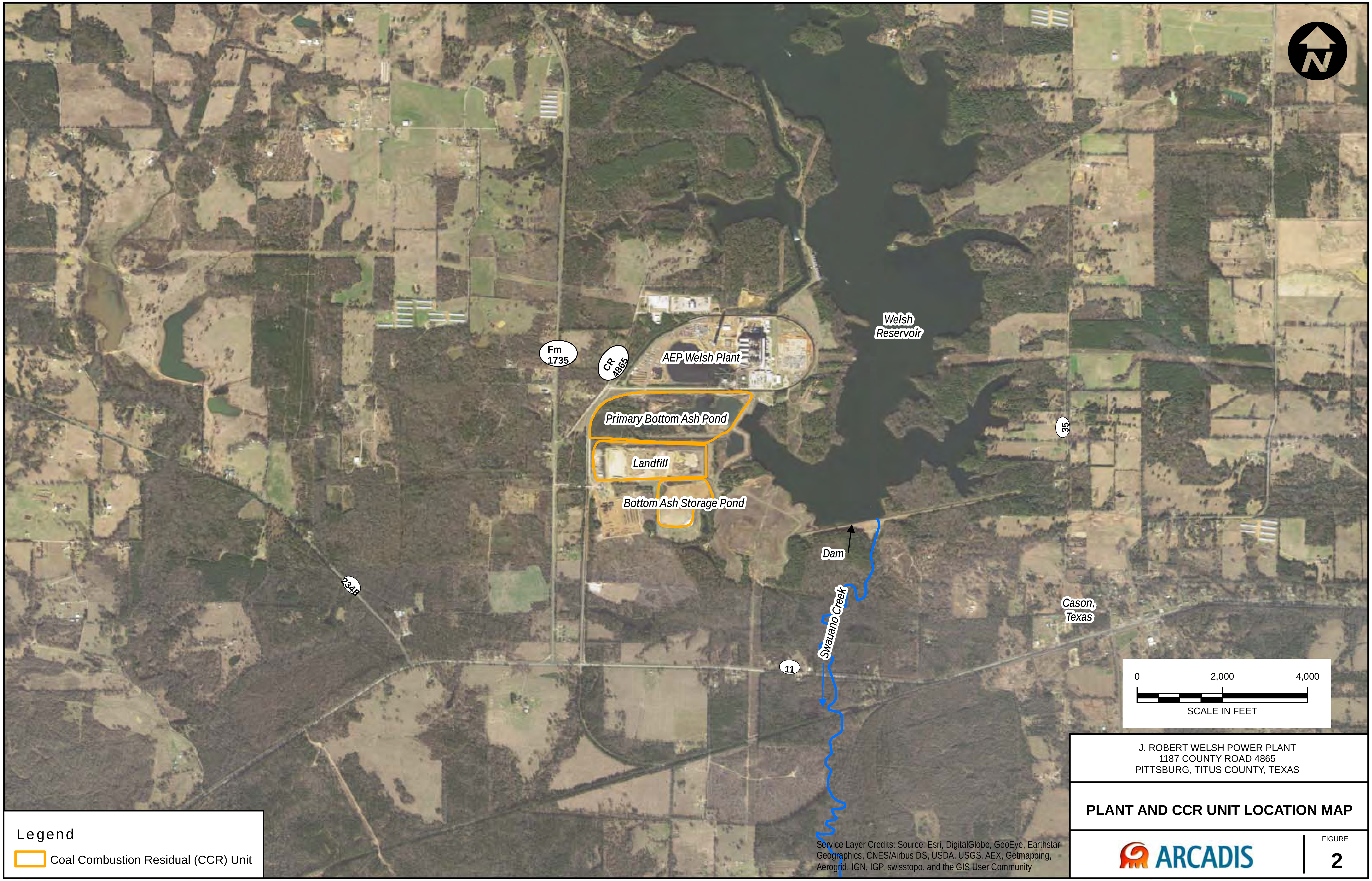
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LOCATION MAP

ARCADIS

FIGURE
1

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 1 - site map.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

🟧 Coal Combustion Residual (CCR) Unit

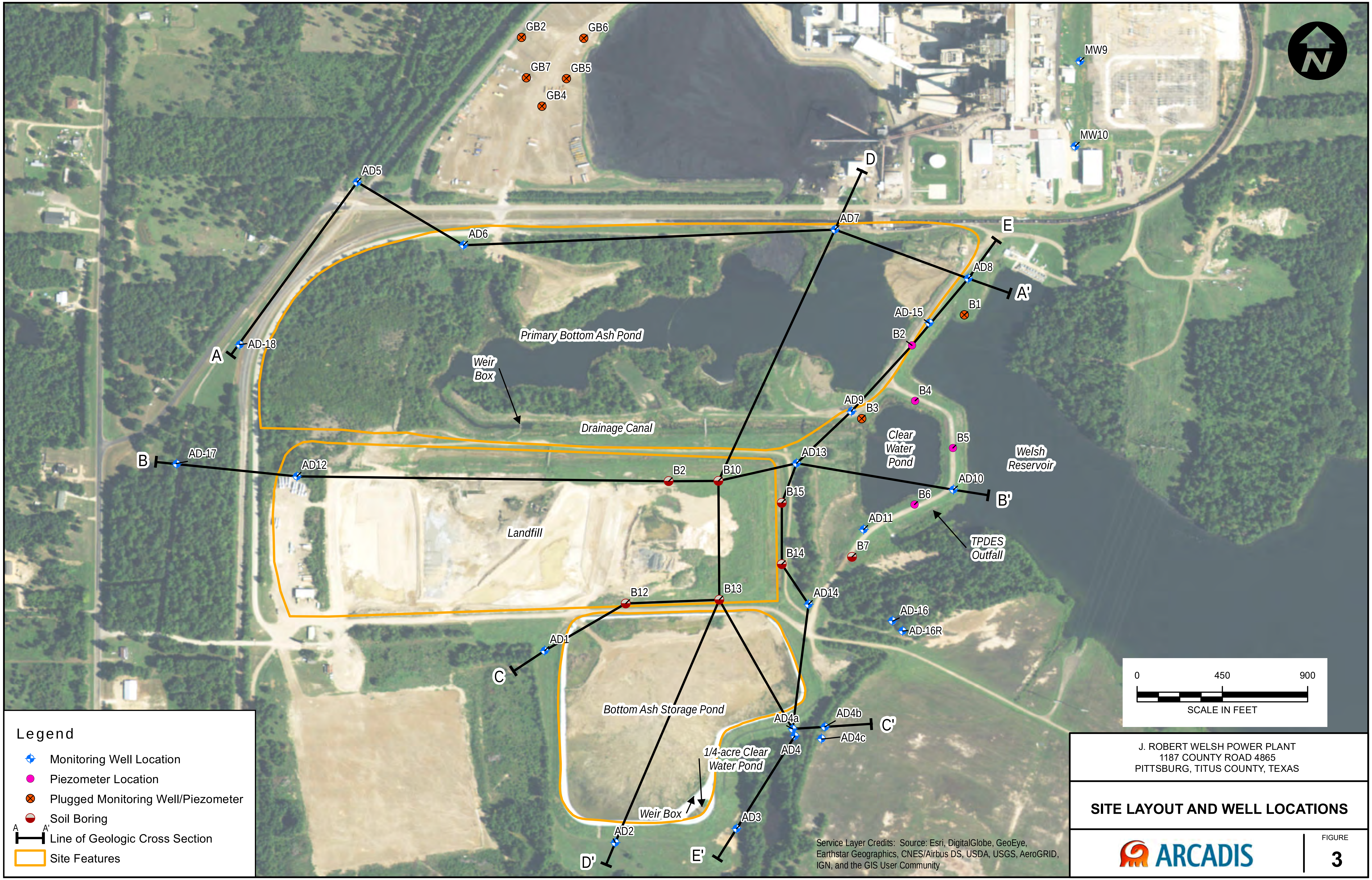
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PLANT AND CCR UNIT LOCATION MAP

ARCADIS

FIGURE
2

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 2 - CCR location.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

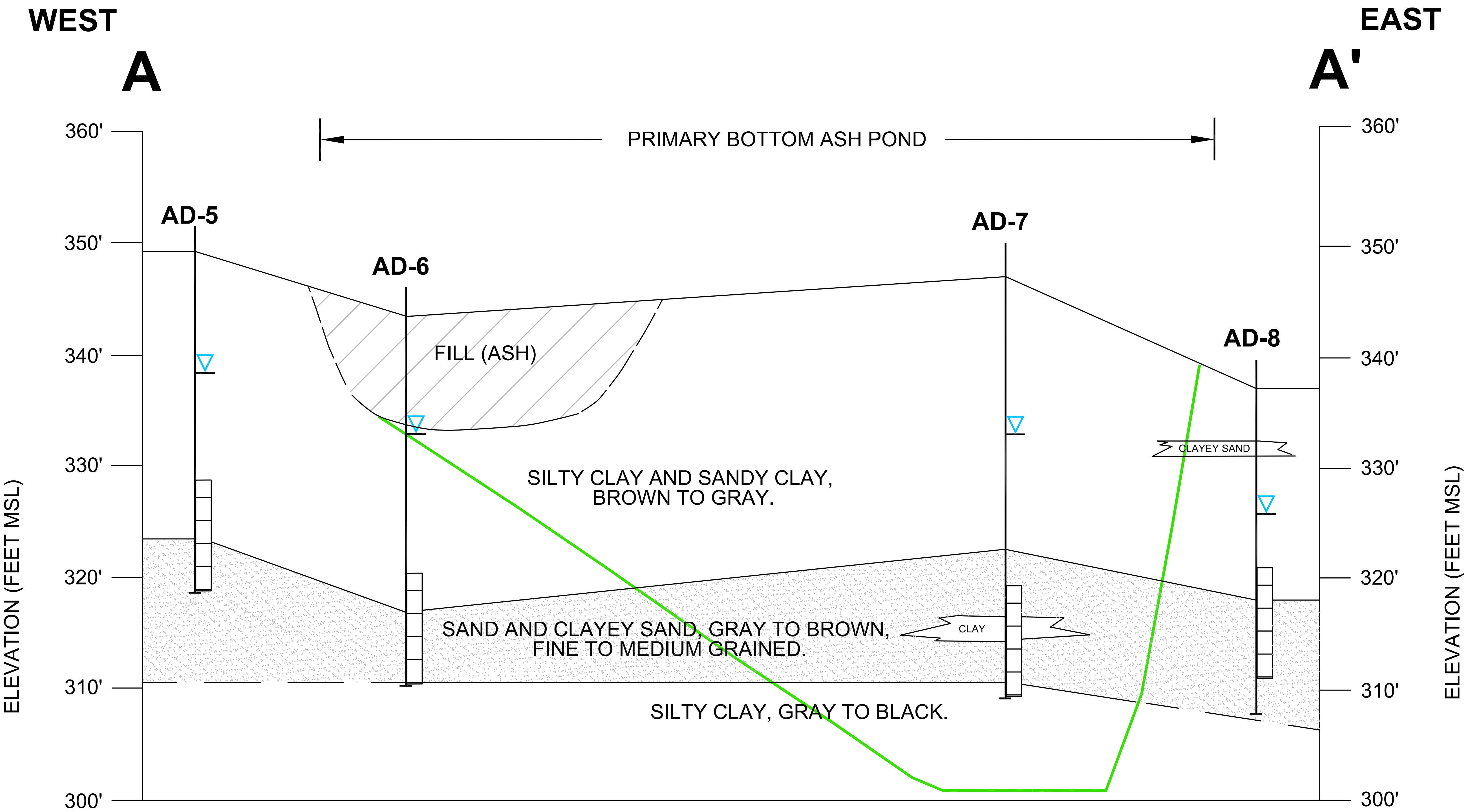
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LAYOUT AND WELL LOCATIONS

ARCADIS

FIGURE
3

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 3 - site layout.mxd



0 ▬▬ 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

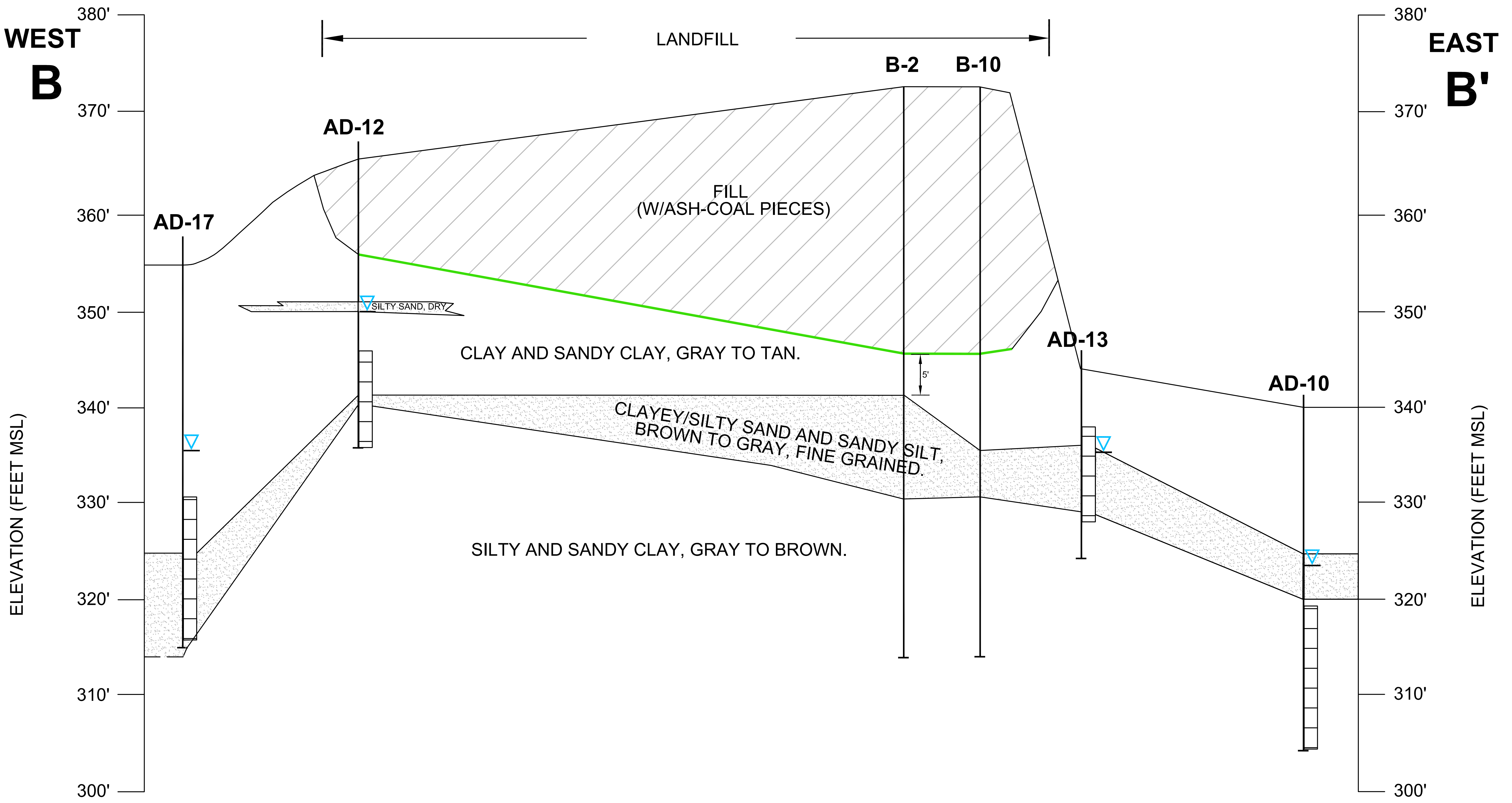
⊟	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (5/12/15)
—	PROJECTED BASE OF ASH POND (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION A - A'

ARCADIS

FIGURE
4



0 ▬▭ 300'
HORIZONTAL SCALE

NOTE: BASE OF LANDFILL ELEVATION TAKEN FROM "WELSH POWER PLANT- UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12/3/76.

LEGEND

- ▤ MONITORING WELL SCREENED INTERVAL
- ▽ WATER LEVEL IN MONITORING WELL (3/4/16)
- 🟩 BASE OF LANDFILL (SEE NOTE)

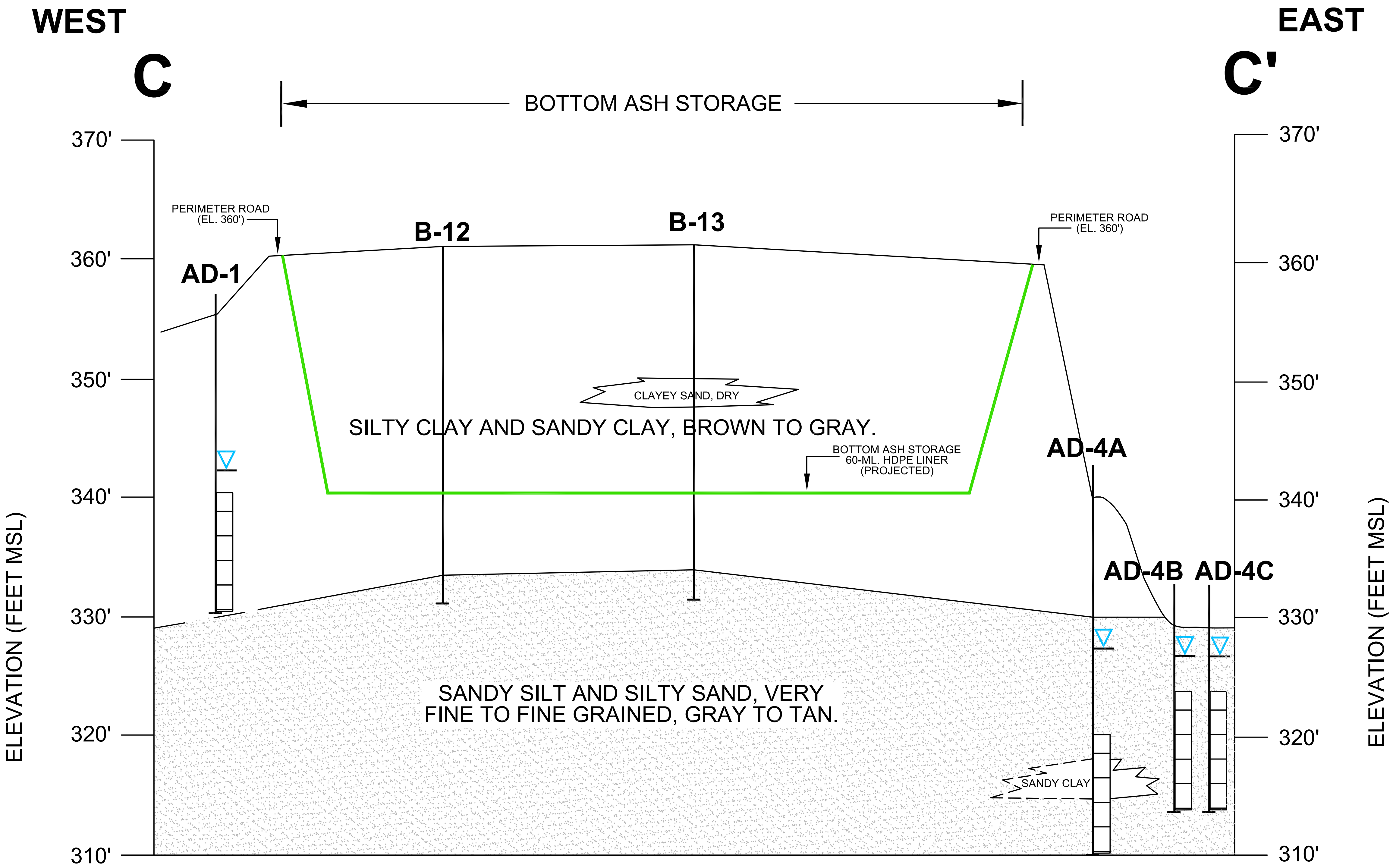
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
B - B'

ARCADIS

FIGURE
5

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 5 Cross Section B-B'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:41 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE:
---- PLOTTED: 3/11/2016 12:33 PM BY: LEASE, DIANA



0 200'
HORIZONTAL SCALE

NOTE: BASE OF BOTTOM ASH STORAGE HAS A 60-ML. HDPE LINER AT ELEVATION 340.0' , TAKEN FROM FREESE AND NICHOLS "HYDRAULIC ANALYSIS OF WELSH POWER PLANT ASH PONDS, AMERICAN ELECTRIC POWER COMPANY", DATED DECEMBER 2010.

LEGEND

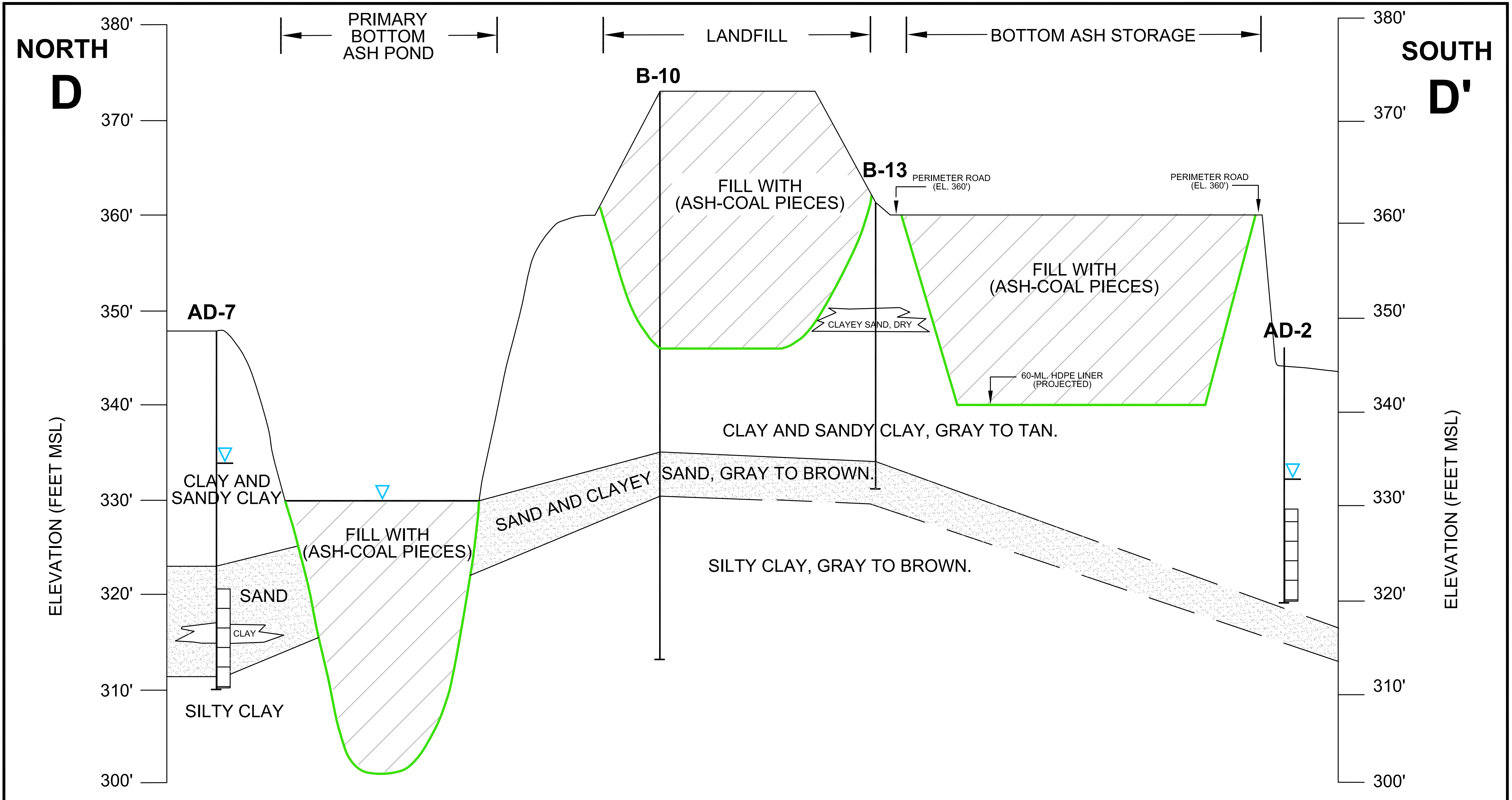
▯	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
🟩	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
C - C'

ARCADIS

FIGURE
6



0 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

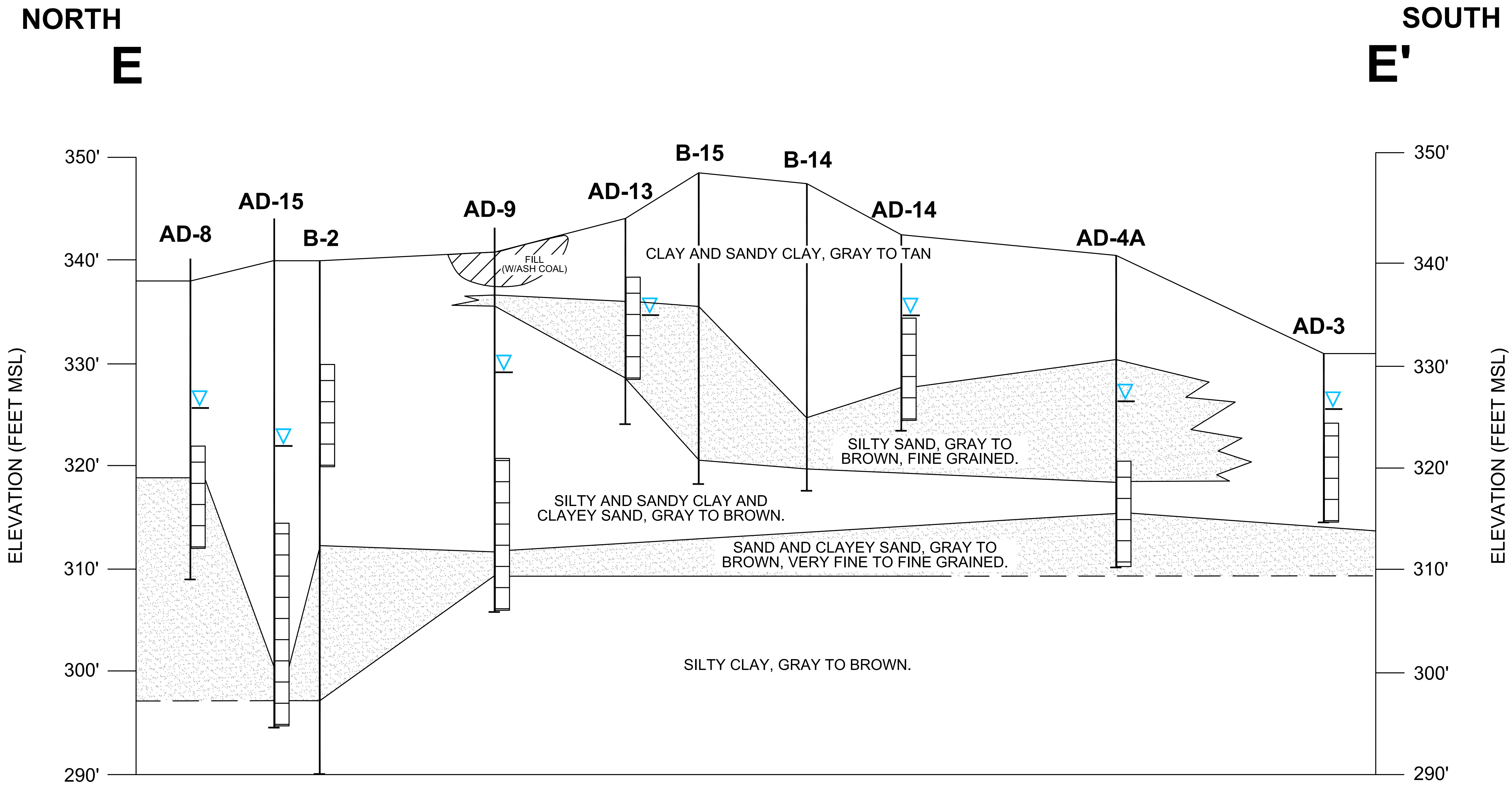
- ▤ MONITORING WELL SCREENED INTERVAL
- ▽ WATER LEVEL IN MONITORING WELL (5/12/15)
- 🟩 BASE OF CCR UNIT

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
D - D'

ARCADIS

FIGURE
7



0 ▬▬ 300'
HORIZONTAL SCALE

LEGEND

⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
—	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
E - E'

ARCADIS

FIGURE
8

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

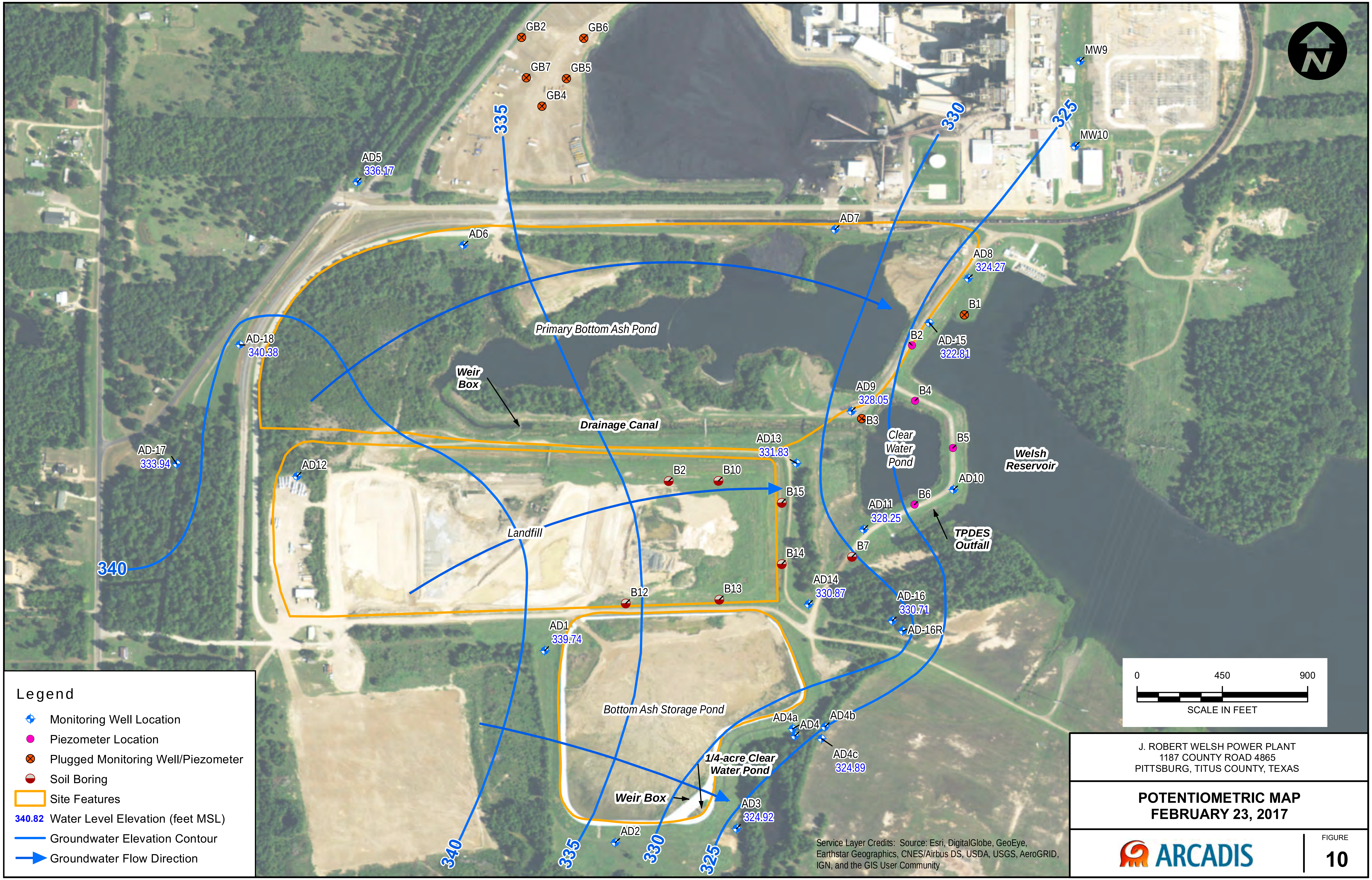
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

WELL ELEVATIONS AND POTENTIOMETRIC MAP MARCH 4, 2016

ARCADIS

FIGURE
9

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 9 - Mar2016_POT.mxd



Legend

- Monitoring Well Location
- Piezometer Location
- Plugged Monitoring Well/Piezometer
- Soil Boring
- Site Features
- **340.82** Water Level Elevation (feet MSL)
- Groundwater Elevation Contour
- Groundwater Flow Direction

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

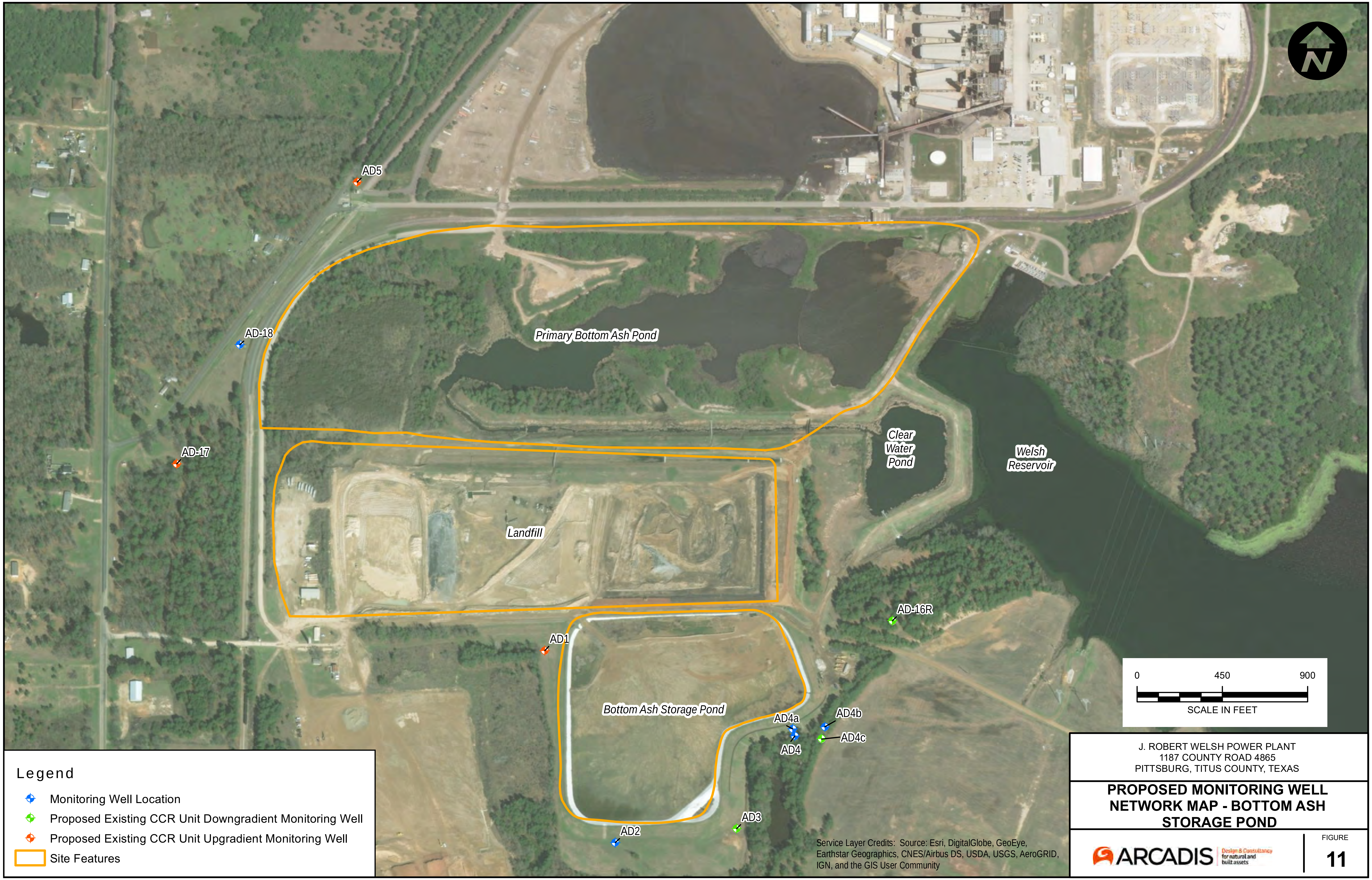
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

POTENTIOMETRIC MAP
FEBRUARY 23, 2017

ARCADIS

FIGURE
10

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 10 - Feb2017_POT.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PROPOSED MONITORING WELL NETWORK MAP - BOTTOM ASH STORAGE POND

ARCADIS Design & Consultancy for natural and built assets

FIGURE
11

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Bottom Ash Storage\fig 11 - proposed wells.mxd

ARCADIS

Appendix A

Boring/Well Construction Logs

AD-1

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt.4, Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4
County ~~Camp~~ Titus

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic
☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'48"N
94°50'47"W

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven
☐ Air Rotary ☐ Mud Rotary ☒ Bored
☐ Air Hammer ☐ Cable Tool ☐ Jetted
☐ Other ______

From (ft.)	To (ft.)	Description and color of formation material
0	25	gray silty Clay with some hard red streaks
		AP-1

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall
☐ Underreamed ☒ Gravel Packed ☐ Other ______
If Gravel Packed give interval ... from 13 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	sch 40
2	N	#10 slot screen	15	25	sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 13 ft. to 0 ft. No. of sacks used 6-50#
______ ft. to ______ ft. No. of sacks used ______
Method used bentonite
Cemented by ______
Distance to septic system field lines or other concentrated contamination ______ ft.
Method of verification of above distance ______

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 12'8" ft. below land surface Date 1-11-01
Artesian flow ______ gpm. Date ______

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc., ______ ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ______ (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS ______ (Street or RFD) (City) (State) (Zip)

(Signed) ______ (Licensed Well Driller) (Signed) ______ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-2

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'37"N
94°50'44"W
N↑

6) WELL LOG:
Date Drilling:
Started 4/26 19 2001
Completed 4/26 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	2	top soil
2	5	red & gray clay w/ silt
5	10	red & gray clay w/ silt
10	25	gray silty clay w/ tan streaks
		AP-2

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 12 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	Sch 40
2	N	#10 slot screen	15	25	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 12 ft. to +2 ft. No. of sacks used 5-50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) Gilbert M. (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-3

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'38"N
94°50'37"W
N

6) WELL LOG:
Date Drilling:
Started 4/26 2001
Completed 4/26 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	17

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	12	gray silty clay w/ tan streaks
12	15	very stiff gray/blood red clay
15	17	very stiff gray clay w/ red nodules and tan streaks

AP-3

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 5 ft. to 17 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Casting Screen
			From	To	
2	N	riser	+2	7	Sch 40
2	N	#10 slot screen	7	17	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 2 ft. to 5 ft. No. of sacks used 2 1/2 - 50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-4

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33° 02' 43" N
94° 50' 33" W

6) WELL LOG:
Date Drilling:
Started 4/26 ~~19~~ 2001
Completed 4/26 ~~19~~ 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	5	red silty clay with gray streaks
5 -	30	gray silty clay with red streaks

AD-4

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	19	Sch 40
2	N	#10 slot screen	19	29	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 2 ft. No. of sacks used 8-50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other NA
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete Items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4A**
TOTAL DEPTH:	**30'**
TOP OF CASING ELEV.:	**342.85 ft. NGVD**
GROUND SURFACE ELEV.:	**340.19 ft. NGVD**

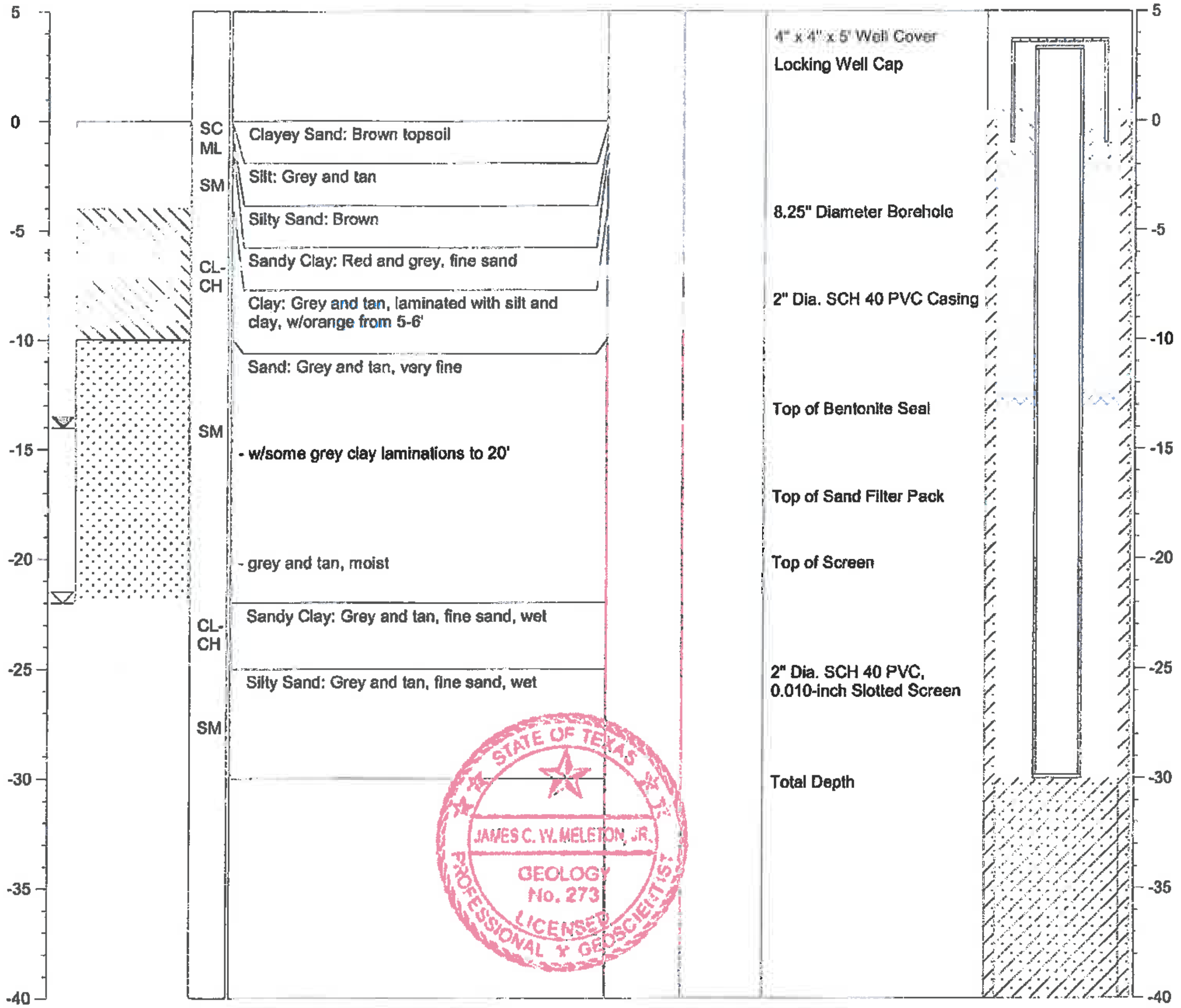
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04527**
Longitude: 94.84258

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown topsoil
ML	Silt: Grey and tan
SM	Silty Sand: Brown
CL-CH	Sandy Clay: Red and grey, fine sand
	Clay: Grey and tan, laminated with silt and clay, w/orange from 5-6'
SM	Sand: Grey and tan, very fine - w/some grey clay laminations to 20' - grey and tan, moist
CL-CH	Sandy Clay: Grey and tan, fine sand, wet
SM	Silty Sand: Grey and tan, fine sand, wet

WELL DESCRIPTION:
4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED PROFESSIONAL GEOSCIENTIST

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ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.: **AD-4B**
TOTAL DEPTH: **15'**
TOP OF CASING ELEV.: **333.23 ft. NGVD**
GROUND SURFACE ELEV.: **329.55 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

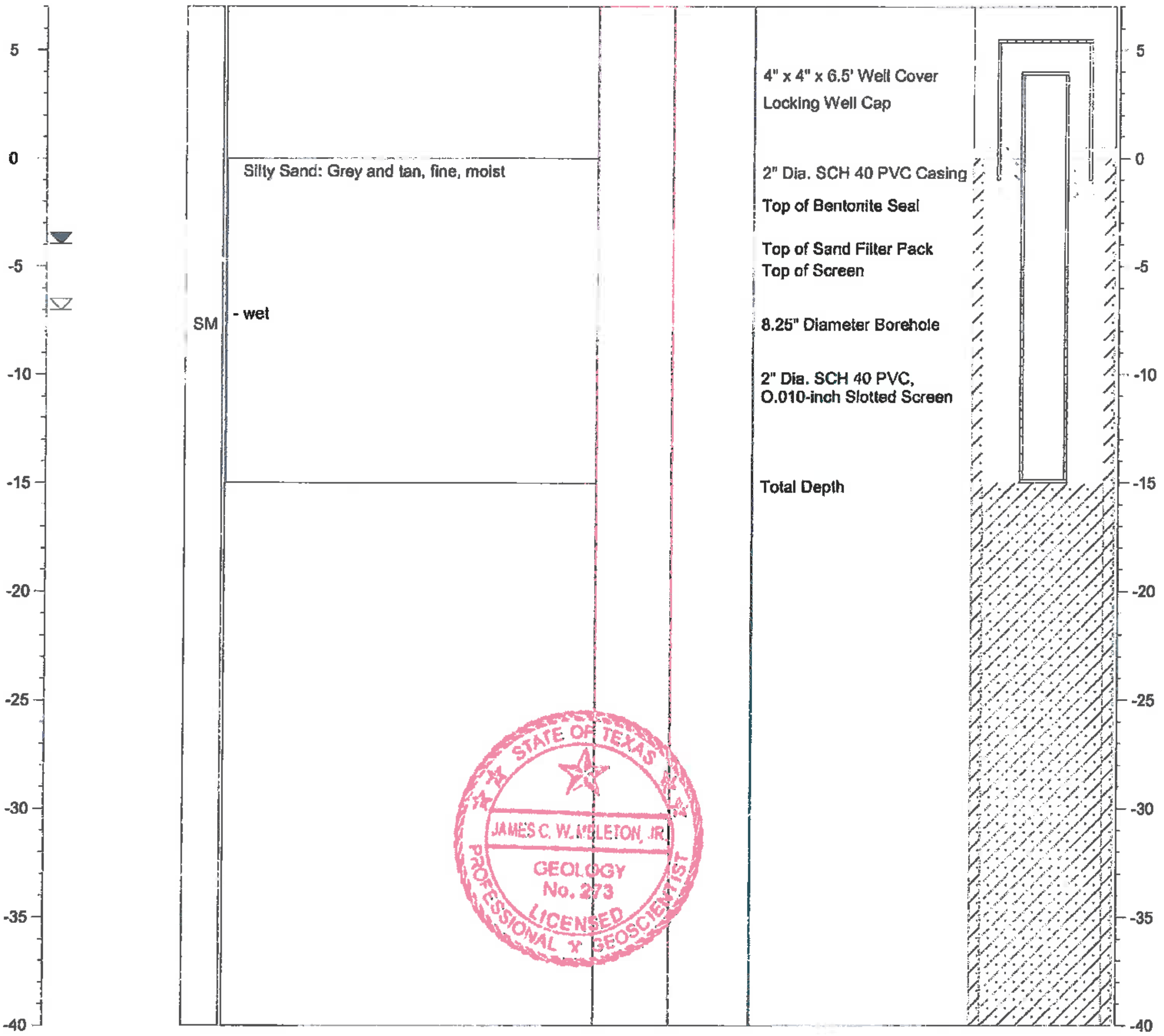
DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/23/09**

NOTES: **Latitude: 33.04531**
Longitude: 94.84230

▼ Water level during drilling
▽ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
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PROFESSIONAL GEOSCIENTIST

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ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4C**
TOTAL DEPTH:	**15'**
TOP OF CASING ELEV.:	**333.28 ft. NGVD**
GROUND SURFACE ELEV.:	**329.15 ft. NGVD**

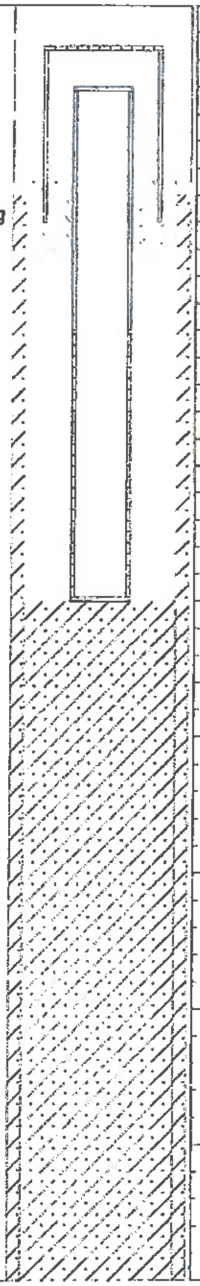
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.04507**
Longitude: 94.84244

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION
5						4" x 4" x 6.5' Well Cover Locking Well Cap	
0			Silty Sand: Grey and tan, fine, moist			2" Dia. SCH 40 PVC Casing Top of Bentonite Seal	
-5						Top of Sand Filter Pack Top of Screen	
		SM	- wet			8.25" Diameter Borehole	
-10						2" Dia. SCH 40 PVC, 0.010-Inch Slotted Screen	
-15						Total Depth	
-20							
-25							
-30							
-35							
-40							



STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

AD-5

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt.4, Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic
☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) 33°03'13"N
94°51'00"W
N↑

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8¼	Surface	30

7) DRILLING METHOD (Check): ☐ Driven
☐ Air Rotary ☐ Mud Rotary ☒ Bored
☐ Air Hammer ☐ Cable Tool ☐ Jetted
☐ Other ______

From (ft.)	To (ft.)	Description and color of formation material
0	10	red & gray clay with orange streaks
10	20	gray/black clay with tan clay
20	25	stiff clay with lignite streak
25	30	fine gray sand

AP-5

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall
☐ Underreamed ☒ Gravel Packed ☐ Other ______
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	risor	+2	20	Sch 40
2	N	#10 slot screen	20	30	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 0 ft. No. of sacks used ______
______ ft. to ______ ft. No. of sacks used ______
Method used bentonite
Cemented by ______
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance ______

✓10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 11'9" ft. below land surface Date 1-11-01
Artesian flow ______ gpm. Date ______

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc., ______ ft.

14) WELL TESTS:
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.

✓15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ______ (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS ______ (Street or RFD) (City) (State) (Zip)

(Signed) ______ (Licensed Well Driller) (Signed) ______ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.: **AD-6**
TOTAL DEPTH: **33'**
TOP OF CASING ELEV.: **346.33 ft. NGVD**
GROUND SURFACE ELEV.: **343.31 ft. NGVD**

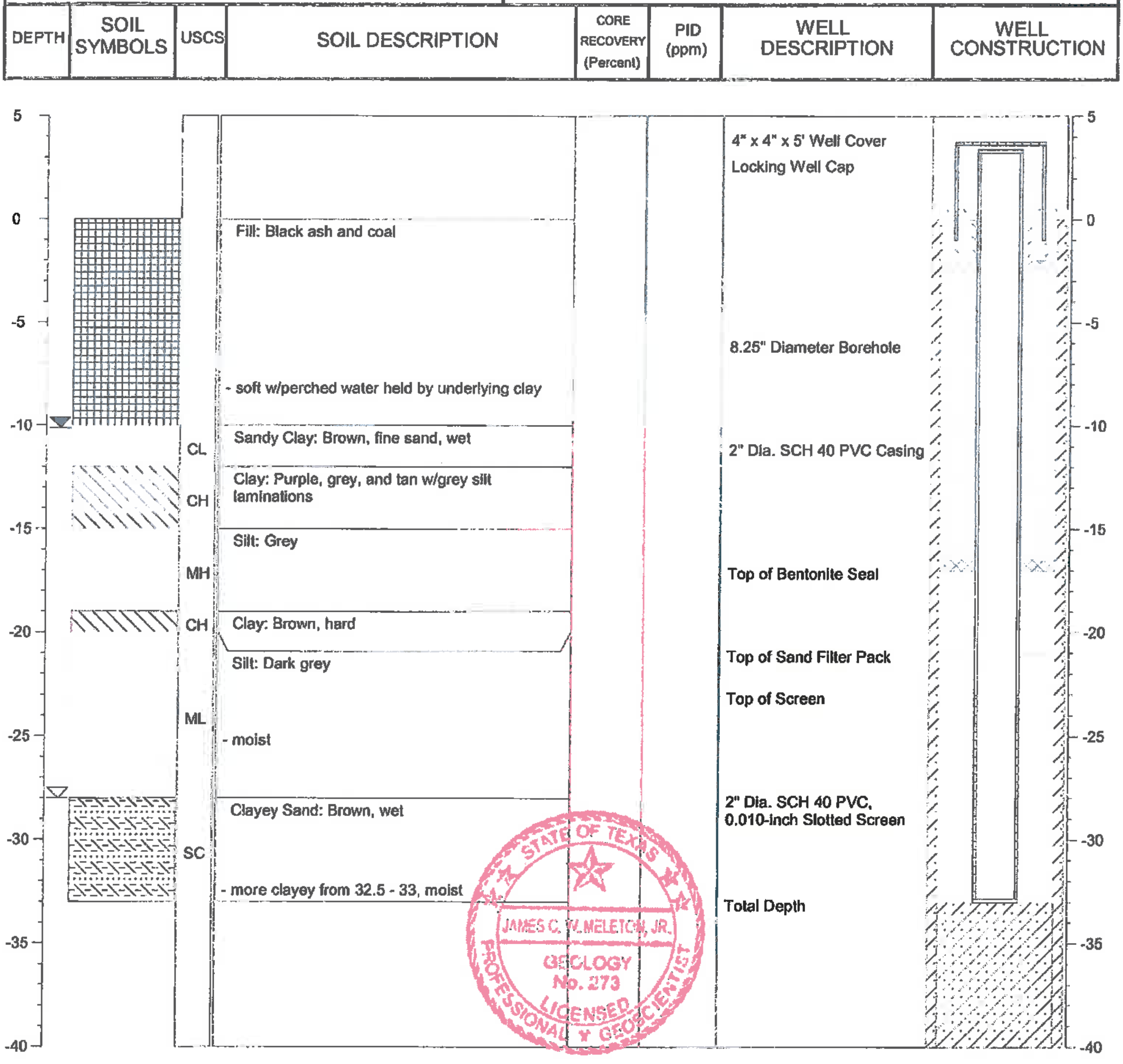
CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/23/09**

NOTES: **Latitude: 33.05235**
Longitude: 94.84757

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



Fill: Black ash and coal
- soft w/perched water held by underlying clay
Sandy Clay: Brown, fine sand, wet
Clay: Purple, grey, and tan w/grey silt laminations
Silt: Grey
Clay: Brown, hard
Silt: Dark grey
- moist
Clayey Sand: Brown, wet
- more clayey from 32.5 - 33, moist

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
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PROFESSIONAL GEOSCIENTIST

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ENVIRONMENTAL SERVICES OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.:	**AD-7**
TOTAL DEPTH:	**38'**
TOP OF CASING ELEV.:	**350.82 ft. NGVD**
GROUND SURFACE ELEV.:	**347.86 ft. NGVD**

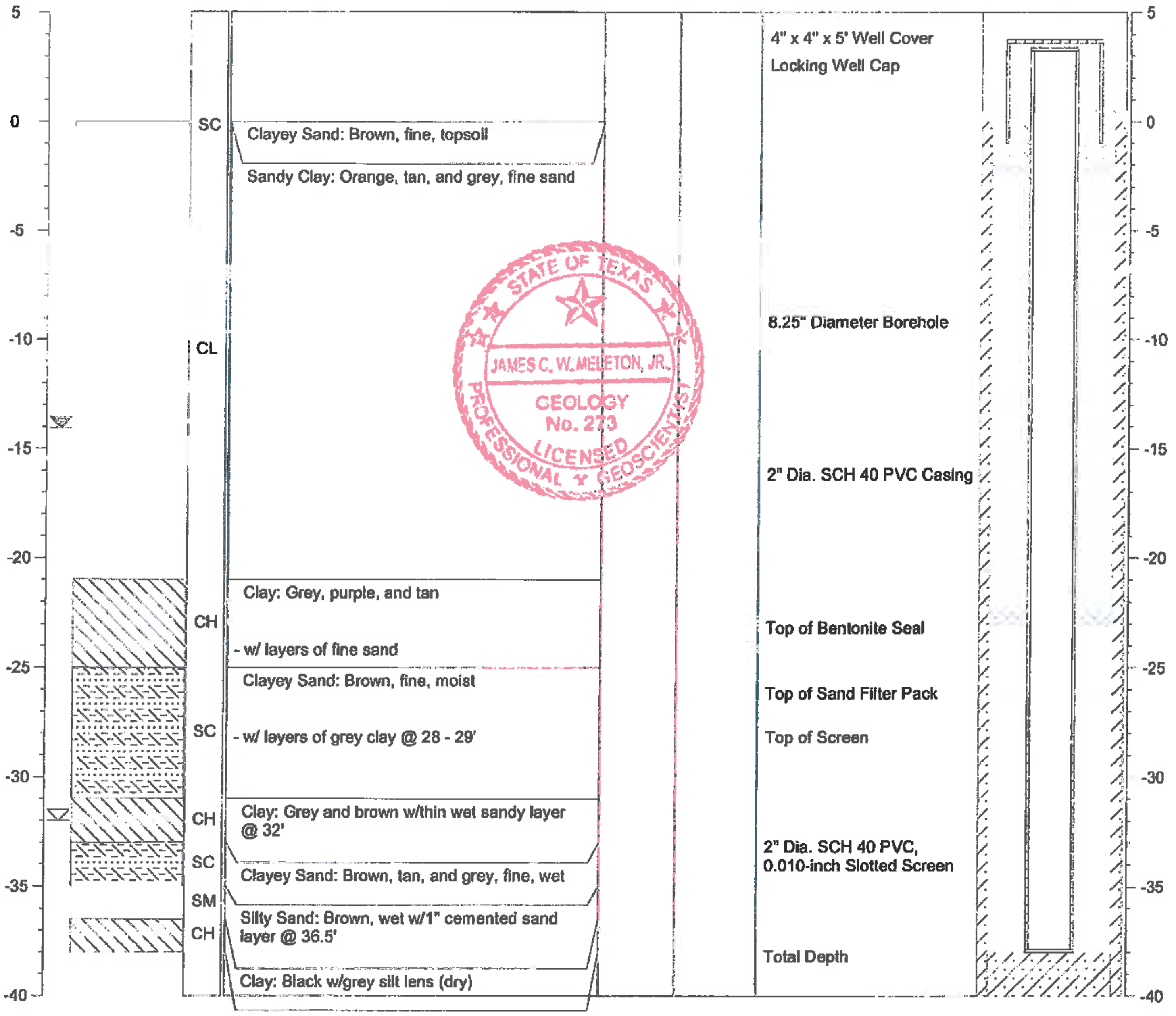
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/24/09**

NOTES: **Latitude: 33.05257**
Longitude: 94.84219

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



SC Clayey Sand: Brown, fine, topsoil

CL Sandy Clay: Orange, tan, and grey, fine sand

CH Clay: Grey, purple, and tan
- w/ layers of fine sand

SC Clayey Sand: Brown, fine, moist
- w/ layers of grey clay @ 28 - 29'

CH Clay: Grey and brown w/thin wet sandy layer @ 32'

SC Clayey Sand: Brown, tan, and grey, fine, wet

SM Silty Sand: Brown, wet w/1" cemented sand layer @ 36.5'

CH Clay: Black w/grey silt lens (dry)

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

JAMES C. W. MELETON, JR.
GEOLOGY No. 273

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-8**
TOTAL DEPTH:	**29'**
TOP OF CASING ELEV.:	**340.01 ft. NGVD**
GROUND SURFACE ELEV.:	**337.53 ft. NGVD**

CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

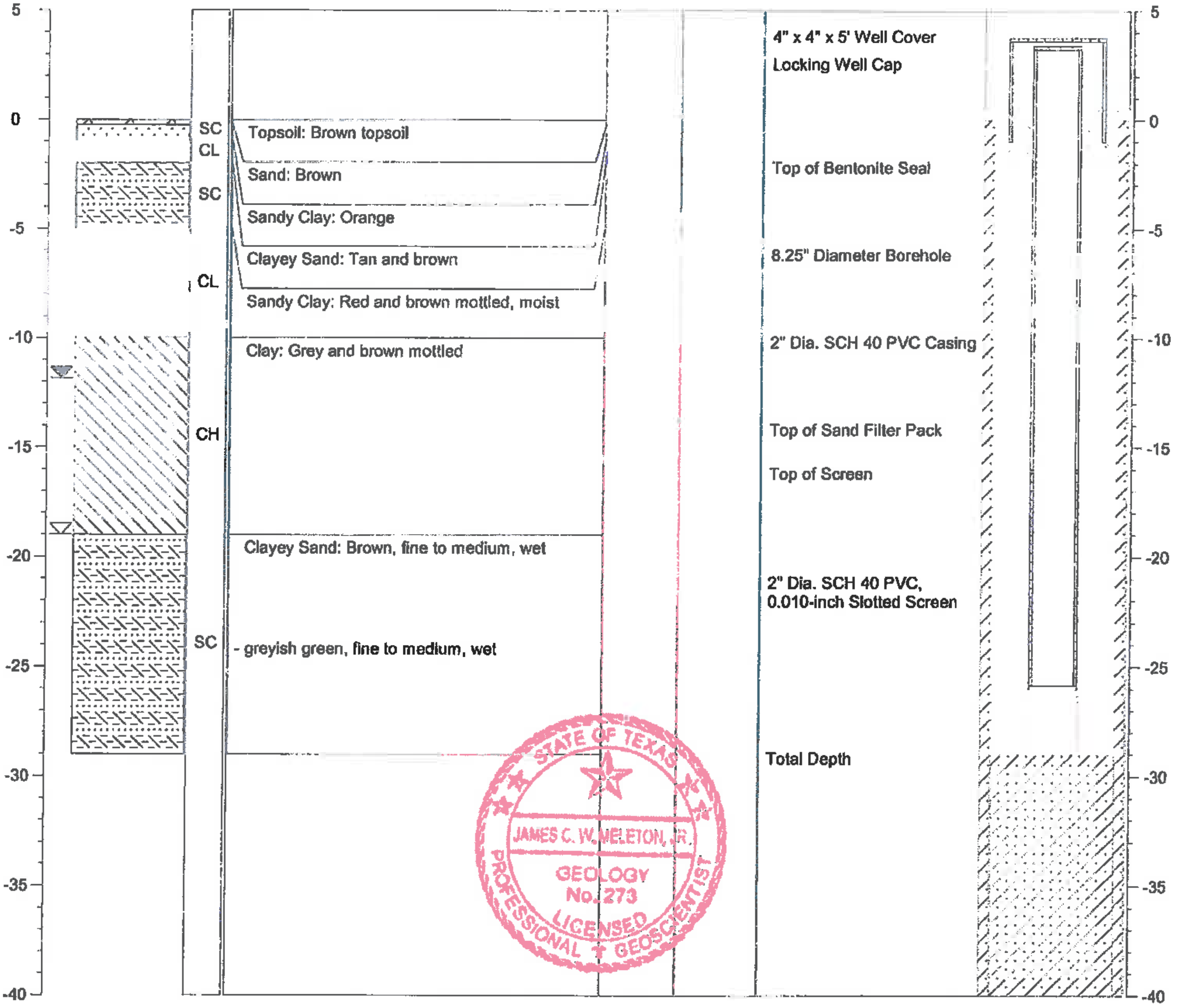
DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/21/09**

NOTES: **Latitude: 33.05187**
Longitude: 94.84026

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Topsoil: Brown topsoil

Sand: Brown

Sandy Clay: Orange

Clayey Sand: Tan and brown

Sandy Clay: Red and brown mottled, moist

Clay: Grey and brown mottled

Clayey Sand: Brown, fine to medium, wet

- greyish green, fine to medium, wet

4" x 4" x 5' Well Cover

Locking Well Cap

Top of Bentonite Seal

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen

Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

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OF SHREVEPORT, INC

SOIL BORING LOG

BORING/WELL NO.:	**AD-9**
TOTAL DEPTH:	**35'**
TOP OF CASING ELEV.:	**343.09 ft. NGVD**
GROUND SURFACE ELEV.:	**340.32 ft. NGVD**

CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

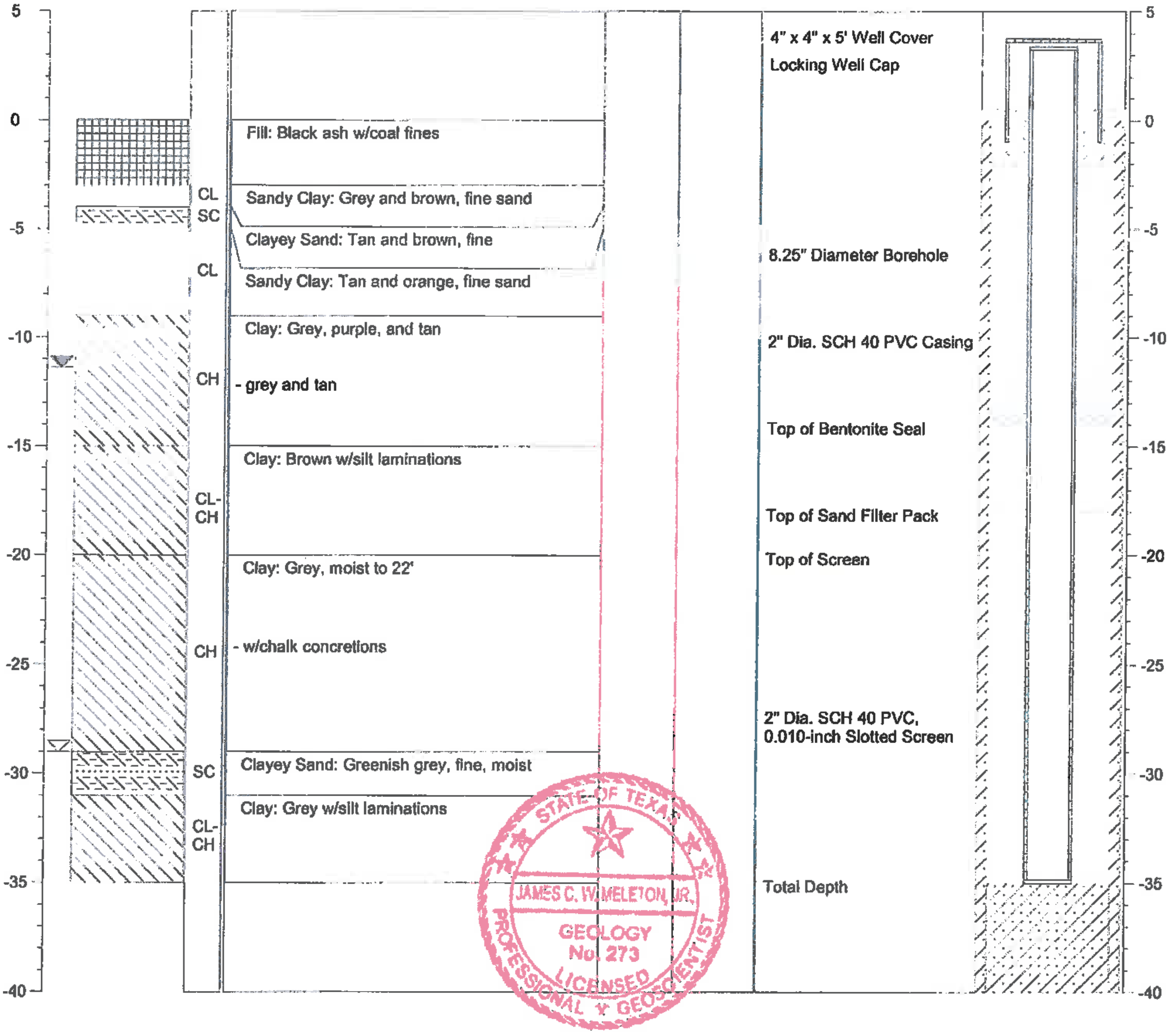
DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/21/09**

NOTES: **Latitude: 33.04995**
Longitude: 94.84196

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
	Fill: Black ash w/coal fines
CL	Sandy Clay: Grey and brown, fine sand
SC	Clayey Sand: Tan and brown, fine
CL	Sandy Clay: Tan and orange, fine sand
CH	Clay: Grey, purple, and tan - grey and tan
CL-CH	Clay: Brown w/silt laminations
CH	Clay: Grey, moist to 22' - w/chalk concretions
SC	Clayey Sand: Greenish grey, fine, moist
CL-CH	Clay: Grey w/silt laminations

WELL DESCRIPTION:

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

BORING/WELL NO.:	**AD-10**
TOTAL DEPTH:	**35'**
TOP OF CASING ELEV.:	**343.01 ft. NGVD**
GROUND SURFACE ELEV.:	**340.23 ft. NGVD**

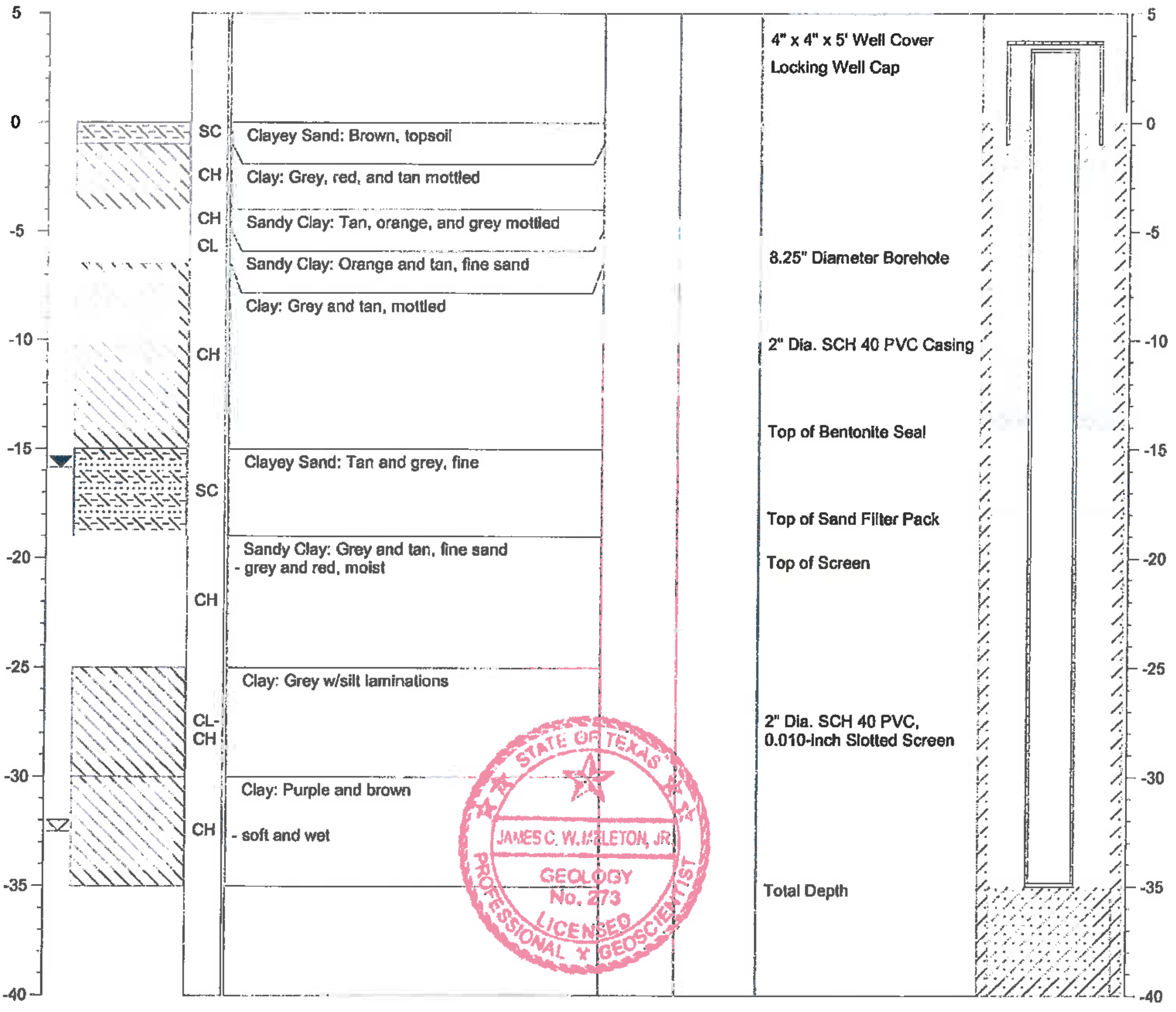
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04881**
Longitude: 94.84047

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, topsoil
CH	Clay: Grey, red, and tan mottled
CH	Sandy Clay: Tan, orange, and grey mottled
CL	Sandy Clay: Orange and tan, fine sand
CH	Clay: Grey and tan, mottled
SC	Clayey Sand: Tan and grey, fine
CH	Sandy Clay: Grey and tan, fine sand - grey and red, moist
CL-CH	Clay: Grey w/silt laminations
CH	Clay: Purple and brown - soft and wet

WELL DESCRIPTION:
4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

BORING/WELL NO.: **AD-11**
TOTAL DEPTH: **20'**
TOP OF CASING ELEV.: **342.18 ft. NGVD**
GROUND SURFACE ELEV.: **339.61 ft. NGVD**

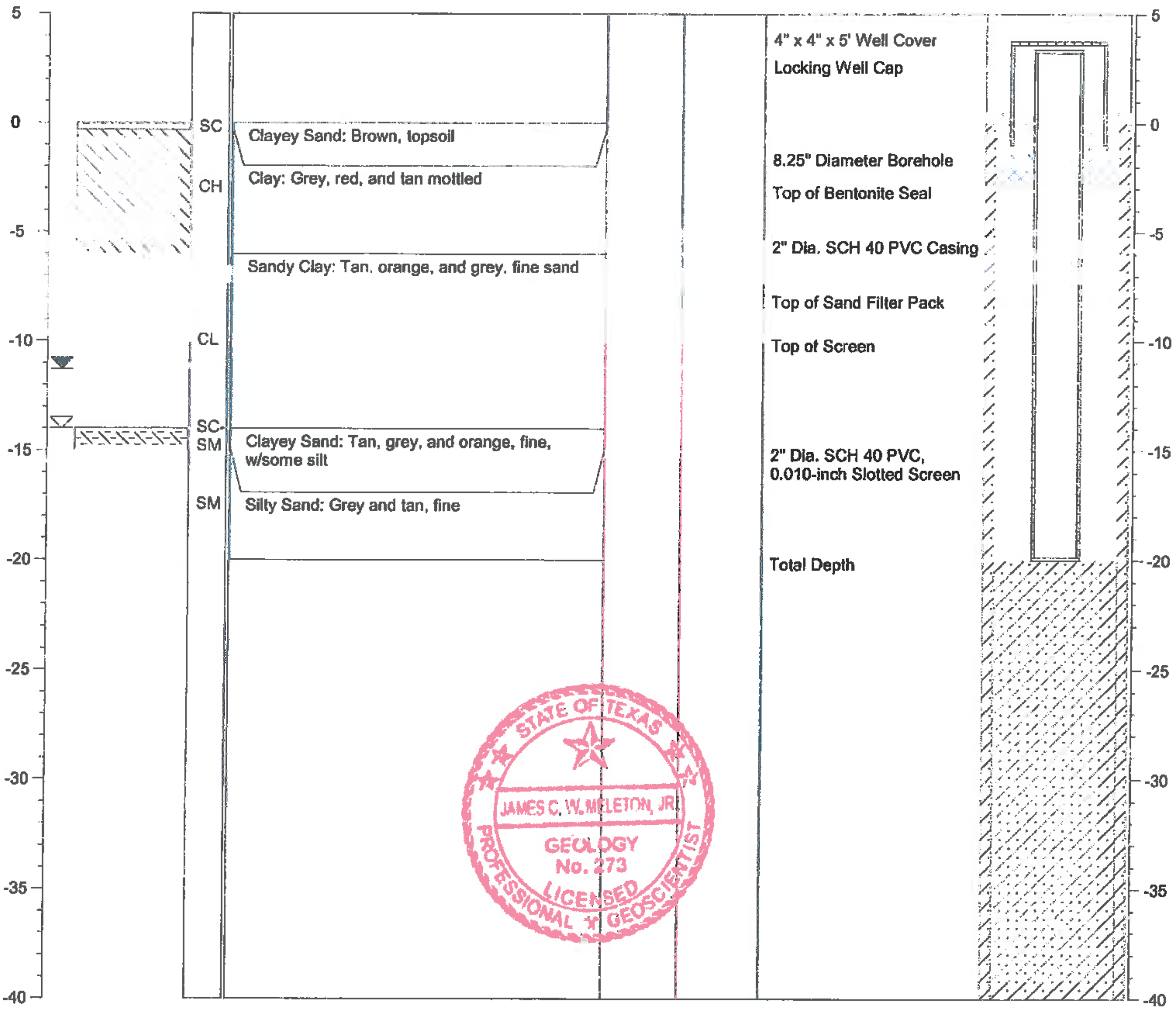
CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/22/09**

NOTES: **Latitude: 33.04824**
Longitude: 94.84177

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1



DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)
		SC	Clayey Sand: Brown, topsoil		
		CH	Clay: Grey, red, and tan mottled		
		CL	Sandy Clay: Tan, orange, and grey, fine sand		
		SC-SM	Clayey Sand: Tan, grey, and orange, fine, w/some silt		
		SM	Silty Sand: Grey and tan, fine		

WELL DESCRIPTION
4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
Top of Bentonite Seal
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

WELL CONSTRUCTION

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SOIL BORING LOG

BORING/WELL NO.: **AD-12**
TOTAL DEPTH: **30'**
TOP OF CASING ELEV.: **369.33 ft. NGVD**
GROUND SURFACE ELEV.: **366.27 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

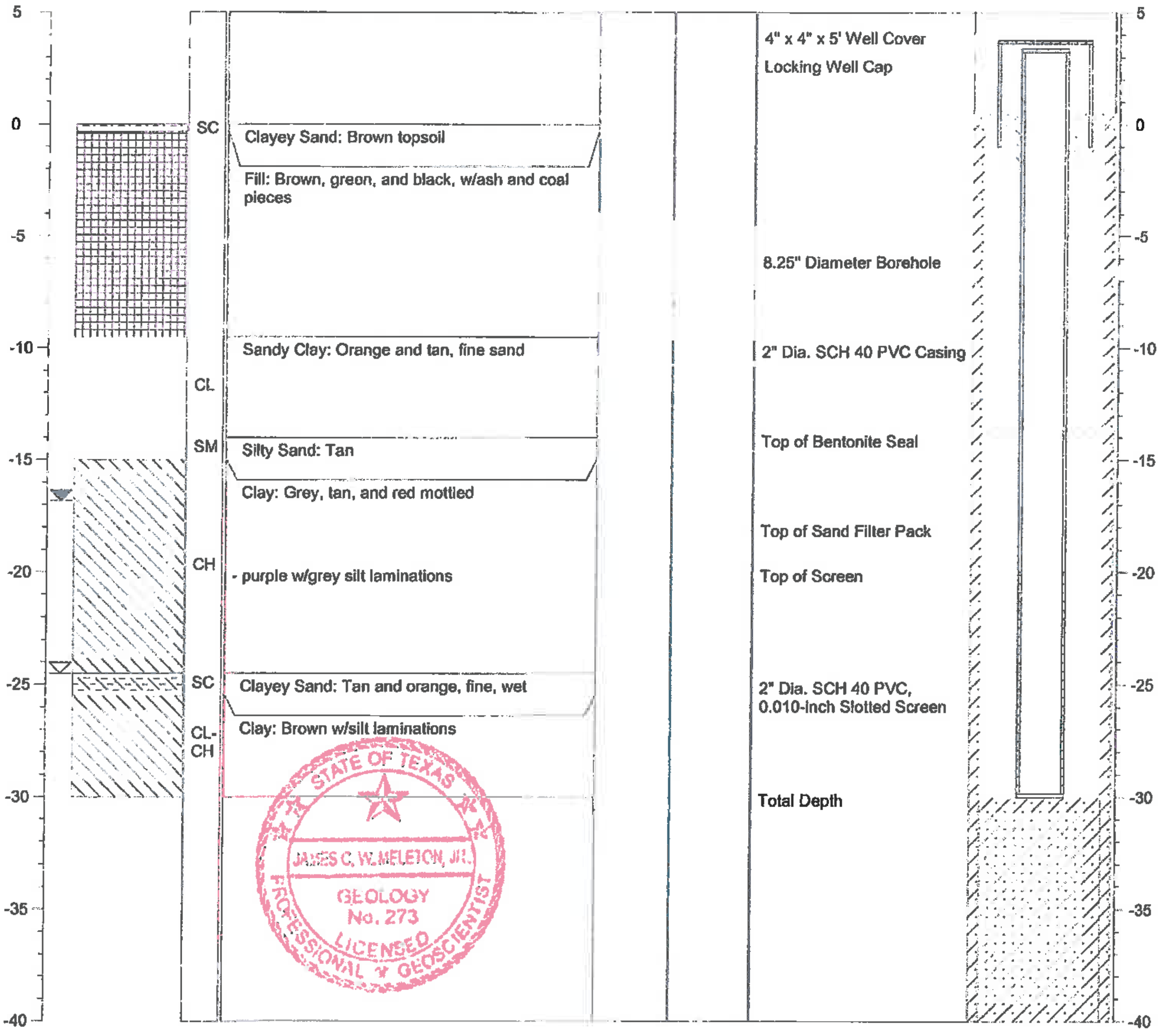
DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/24/09**

NOTES: **Latitude: 33.04901**
Longitude: 94.84977

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown topsoil
	Fill: Brown, green, and black, w/ash and coal pieces
CL	Sandy Clay: Orange and tan, fine sand
SM	Silty Sand: Tan
CH	Clay: Grey, tan, and red mottled - purple w/grey silt laminations
SC	Clayey Sand: Tan and orange, fine, wet
CL-CH	Clay: Brown w/silt laminations

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

BORING/WELL NO.:	**AD-13**
TOTAL DEPTH:	**20'**
TOP OF CASING ELEV.:	**347.00 ft. NGVD**
GROUND SURFACE ELEV.:	**344.12 ft. NGVD**

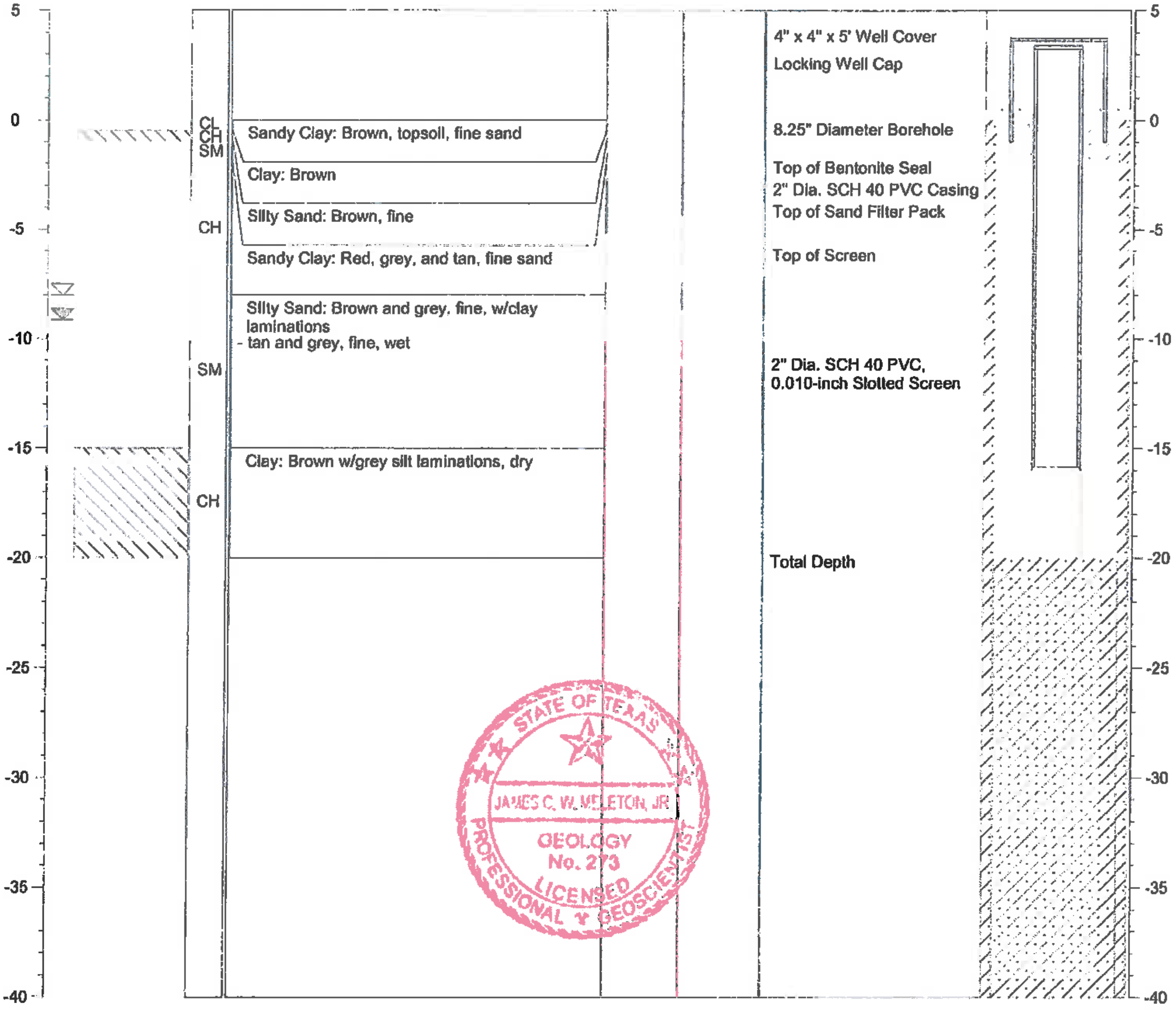
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04918**
Longitude: 94.84275

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Sandy Clay: Brown, topsoil, fine sand

Clay: Brown

Silty Sand: Brown, fine

Sandy Clay: Red, grey, and tan, fine sand

Silty Sand: Brown and grey, fine, w/clay laminations
- tan and grey, fine, wet

Clay: Brown w/grey silt laminations, dry

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
Top of Bentonite Seal
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

BORING/WELL NO.:	**AD-14**
TOTAL DEPTH:	**18.5'**
TOP OF CASING ELEV.:	**345.43 ft. NGVD**
GROUND SURFACE ELEV.:	**342.32 ft. NGVD**

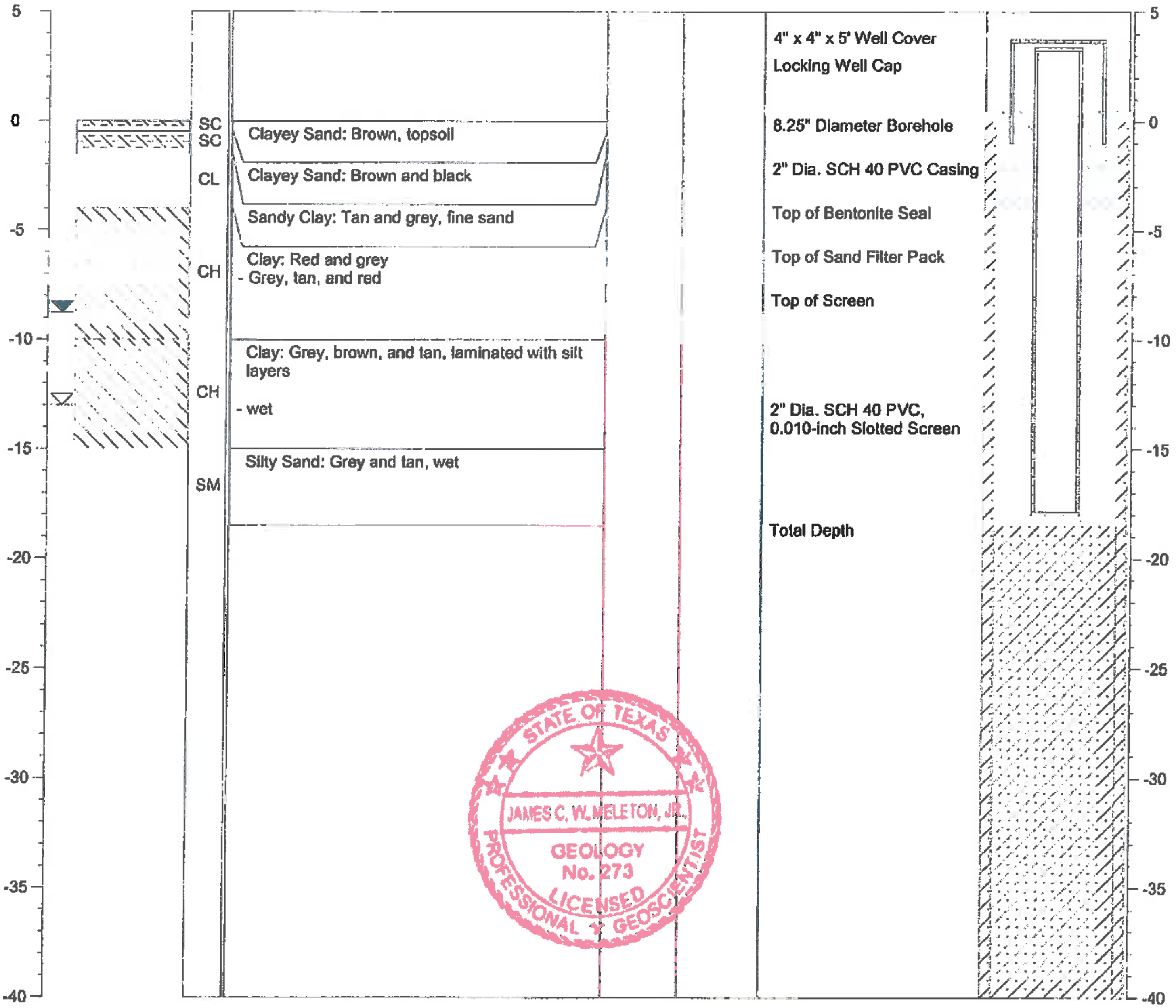
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04715**
Longitude: 94.84256

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, topsoil
SC	Clayey Sand: Brown and black
CL	Sandy Clay: Tan and grey, fine sand
CH	Clay: Red and grey - Grey, tan, and red
CH	Clay: Grey, brown, and tan, laminated with silt layers - wet
SM	Silty Sand: Grey and tan, wet

WELL DESCRIPTION:
4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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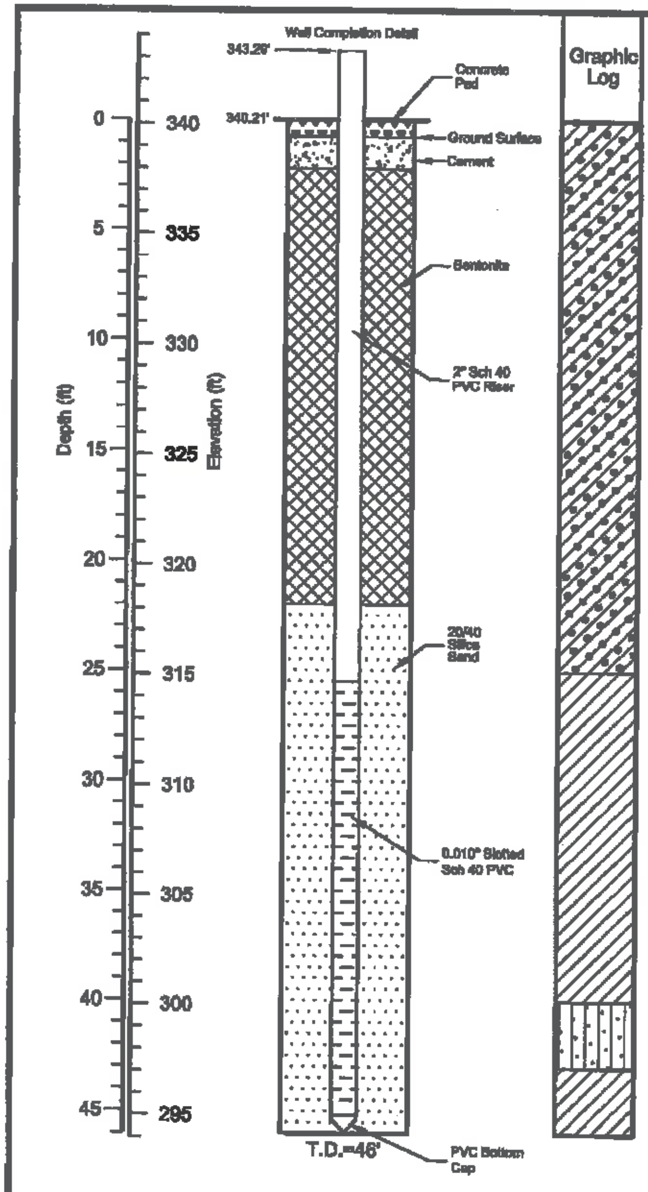


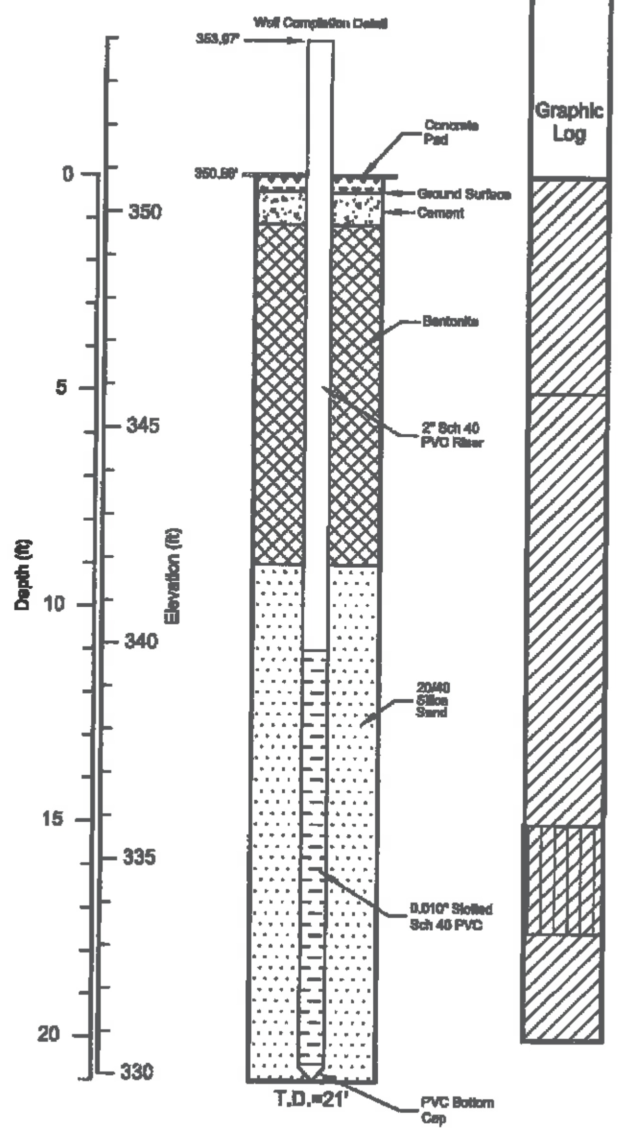
Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0–25		Direct Push		SC	Clayey SAND: reddish brown					
12						16	48	37	18	19
16					- 2" lense of brown sand					
21					- 3" lense of brown sand					
25–40		Direct Push		CL	Sandy Lean CLAY: reddish brown, very moist					
31					- less moisture					
33						22	51	36	19	17
40–43				SM	Silty SAND: light brown & light gray, wet.	27	24	26	NP	-
43–45				CL	Lean CLAY: orangish brown & light gray, mottled, with sand	26	94	45	21	24

STEVEN R. WEMPLE
2176
1-22-16

west DRILLING environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/12/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-15
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/12/15	DRAWN BY: HDS	PROJECT NO.: — / SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	Description Interva (feet bgs)	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0–5		Direct Push		CL	Lean CLAY w/ Sand: light brown & light gray - orangish brown, with silt	16	82	26	16	10
5–15				CL	Lean CLAY w/ Sand: orangish-brown & light gray	22	88	31	19	12
15				CL-ML	Silty CLAY: orange w/ brown, wet	30	89	27	20	7
20				CL	Sandy, Lean CLAY: brown w/ orange, stiff	26	66	46	26	20

STEVEN R. WEMPLE
SOIL SCIENCE
LICENSE NUMBER 2176

1-22-16

West
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WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

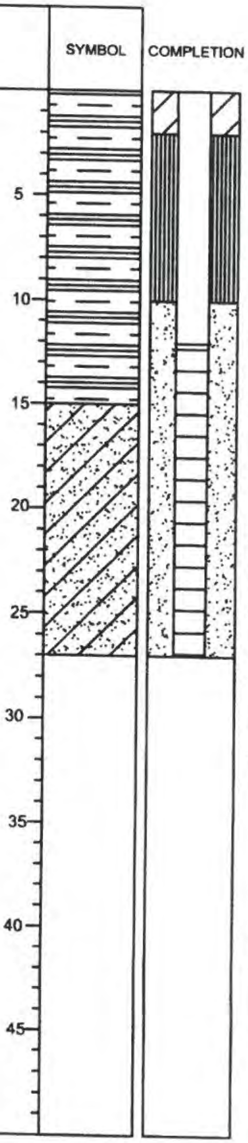
DATE: 12/10/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-16
Drilling Method: H.S.A.	Driller: Robert Williams	DRAWN BY: HDS	PROJECT NO.: —
Bit Diameter: 7.25"	Date Completed: 12/10/15	CHECKED BY: SRW	SCALE: AS SHOWN
Depth to Water: –	Depth to Product: NA		FILE NAME: JR Welsh Power Plant LOGS.dwg

WELL LOG

DEPTH	SAMPLE ANALYZED	TYPE	ORGANIC VAPOR (ppm)	SAMPLE DESCRIPTION
		SS		(0-15') SILTY CLAY (CL), BROWN TO ORANGE-BROWN, STIFF, DRY.
		SS		
5		SS		
		SS		
10		SS		
		SS		
15		SS		(15-18') SILTY CLAY AND SANDY CLAY, ORANGE-BROWN TO LIGHT GRAY, MOIST.
		SS		(18-27') SILTY CLAY AND SANDY CLAY, DARK BROWN TO GRAY, MOIST TO WET.
20		SS		
		SS		
		SS		
25		SS		
		SS		TOTAL DEPTH = 27' BGS
30				
35				
40				
45				

Kenneth Brandner
Geology
1787

4-27-17



AD-16R
WELL

AEP
CLIENT

BOTTOM ASH STORAGE POND
PROJECT

WELSH POWER PLANT
LOCATION

4/12/17
DATE

HSA
DRILLING METHOD

2" PVC, 2' AGL-12' BGL
CASING

2" PVC, 12'-27' BGS
SCREEN

0-2' BGS
CEMENT

2-10' BGS
BENTONITE

10-27' BGS
SAND PACK

350.55' / 353.49'
GROUND ELEV. / TOP OF CASING ELEV.

CT - CUTTINGS
SB - SPLIT BARREL(5')
SS - SPLIT SPOON(2')

▽ HC LEVEL
▼ WATER LEVEL

░ SAND
▤ SILT
▤ CLAY
▨ FILL/CONCRETE
▥ BENTONITE
⁂ GRAVEL

START: FINISH:

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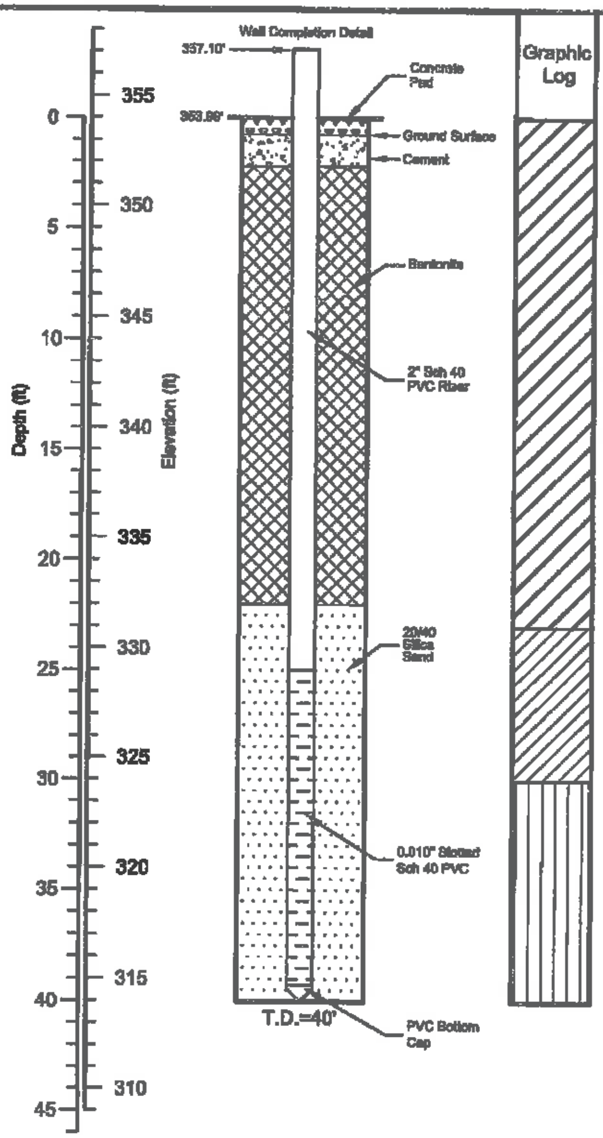
CORPUS CHRISTI, TEXAS 78401
TEL: (361) 883-1353 FAX: (361) 883-7565



PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		CH	Fat CLAY: reddish-brown					
				- light gray to light brown, reddish brown w/ Sand and gravel lenses	24	97	83	30	53
				- light brown					
				- brown Sand lenses, wet					
				- gray, w/ some Silt	18	90	53	25	28
	Direct Push		CL	Lean CLAY with Sand: gray	22	81	43	22	21
			ML	Sandy SILT: gray	23	63	26	NP	-

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40

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LICENSE NUMBER 2176
1/22/16

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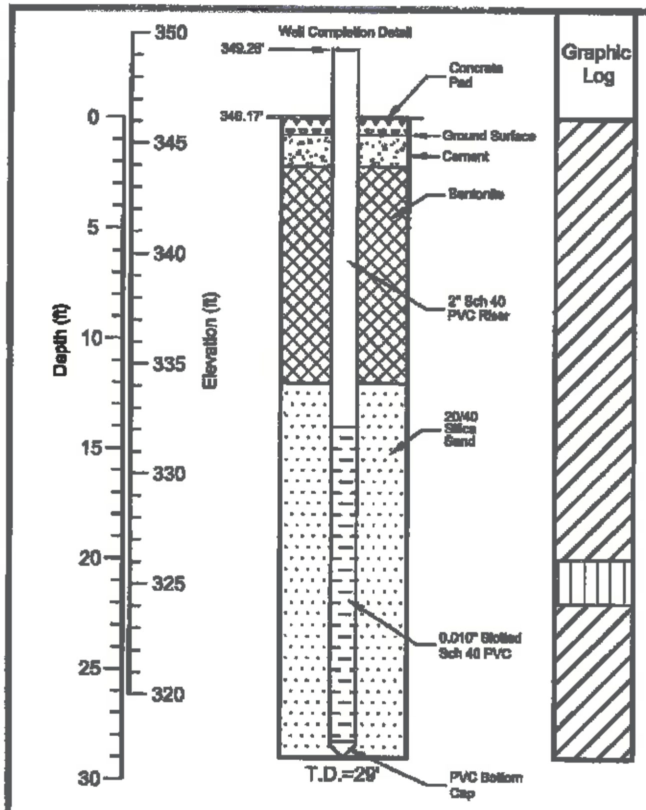
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/10/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-17
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: —
			SCALE: AS SHOWN
Depth to Water: –	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0		Direct Push		CH	Fat CLAY: light brown & light gray, sandy					
5					- reddish brown and light gray, with Sand					
10						19	88	50	24	26
15					- gray with silt					
					- gray, stiff					
20				ML	SILT: gray, with Clay and Sand, wet	29	86	26	NP	-
				CH	Fat CLAY: light gray, silty w/ Sand, very stiff	20	85	50	23	27
25										
30										

STEVEN R. WEMPLE
2176
1-22-21

west
DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/11/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-18
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: — / SCALE: AS SHOWN
Depth to Water: –	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 1 of 2

Date(s) Drilled **July 23, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **37 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **367 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Bentonite Chips**	Location **On the Northern edge of proposed chemical pond along the screening berm.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
367	0					Other	▤	Black COAL, a few fine roots and organics.						
		☒	ST											Shelby tube pulled black COAL
		▨	SS	10										SPT 4, 5, 5, 5. 24" recovered
362	5													
		▨	SS	11	Soft to Firm	SC	▨	Reddish Brown fine SAND, little clay, trace silt, Dry. Natural Ground.						SPT 4, 5, 6, 7. 24" recovered
			SS	11	Soft	SM	▥	Reddish brown fine SAND with silt, trace clay. Vertical sand seams in sample, Dry.						SPT 3, 5, 6, 8. 24" recovered.
357	10	☒	ST						23.6	[illegible]	48.9	5.4E-07		Shelby tube sample, 18" recovered.
					Soft	SC	▨	Reddish brown well graded fine SAND, trace silt and clay. Damp.						
		▨	SS	12	Firm	CL	▨	Greyish red CLAY, little sand, horizontal sand seams, Dry.						SPT 5, 6, 6, 9. 24" recovered
		▨			Soft	SC	▨	Brownish red fine SAND, little clay, Damp.						SPT 7, 6, 7, 9. 24" recovered.
			SS	13	Firm	SC-CL		〉 Four-inch CLAY seam, little fine sand.						
					Firm	CL	▨	Reddish grey CLAY, little sand, oxidized iron ore. Dry						
352	15	▨			Soft	SM	▥	Brownish red fine SAND, trace clay, thin clay seams. Moist.						SPT 8, 9, 9, 9. 24" recovered.
			SS	16					17.74	14	40.1			
		☒	ST						16.25	NP	28.9	3.6E-05		Shelby tube samples look like SC. 17" recovered.
		▨												SPT 9, 8, 9, 11. 24 Inches recovered.
347	20		SS	17	Soft	Other	▤	〉 Iron oxidized material						
					Soft	SC	▨	Brownish red fine SAND, little clay. Moist.						
		▨	SS	15										SPT 5, 7, 8, 50/2. 21" recovered
		■	SS	50	Soft	CL	▨	Dark grey CLAY, little fine sand, Wet.						SPT 50/3".
					Very Hard	SP	░	Dark grey-black cemented SAND, little clay. Wet. Driller comments that cemented sand terminates at 25.5 feet.						
342	25													
		▨	SS	27	Soft to Firm	SC	▨	Dark grey fine SAND, little clay. Moist. Soft sand with lenses of firm clay.						SPT 11, 13, 14, 16. 24" recovered.
					Hard	CL		I Dark grey CLAY, little sand, Dry.						
		▨	SS	46	Soft	SC	▨	Dark grey-black fine SAND, little clay, Wet. Encountered water but water rose to 19 feet after 15 min break.						SPT 11, 16, 30, 14. 24" recovered.
		▨	SS	37										SPT 11, 15, 22, 25. 24" recovered.
337	30				Hard	CL								

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
337	30	▨	SS	37	Hard	CL	▨	Dark grey CLAY, little fine sand, occasional horizontal sand seams. Wet. (cont.)						SPT 11, 15, 22, 25. 24" recovered.
		▨	SS	29	Soft	ML	▥	Dark grey-black fine SAND, with clay, frequent hard clay lenses (1-3"), Wet.	26.37	NP	57.5			SPT 6, 11, 18, 24. 24 recovered.
332	35		SS	34	Hard	CL	▨	Black CLAY, trace to little fine sand, trace silt. Dry						SPT 9, 16, 18, 23. 24" recovered.
								Bottom of Boring at 37 feet bgs						
327	40													
322	45													
317	50													
312	55													
307	60													
302	65													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

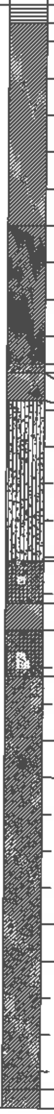
Log of Boring GB-02

Sheet 1 of 1

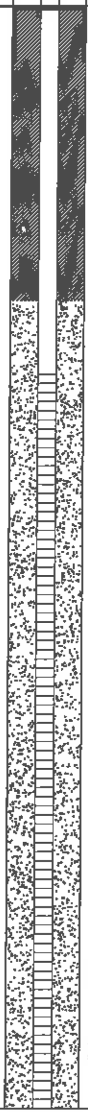
Date(s) Drilled **August 14, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **364.56 feet MSL**
Groundwater Level and Date Measured **21.53 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Western edge of proposed chemical pond near perimeter fence.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
364.6	0				Soft	Other	Coal					
					Soft	CL	Greyish brown CLAY, with little silt, little sand, damp.					
		■	SS	4								SPT 2, 2, 2. 12" recovered.
		▨	SS	13								SPT 4, 7, 6, 12.
359.6	5	☒	ST									Shelby Tube Sample
					Firm	CH	Brownish tan CLAY with silt, little sand, Damp. Occasional sand and iron ore.					
		▨	SS	29				23.71	36	77.3		SPT 8, 12, 17, 21
		▨	SS	80								SPT 20, 30, 50/5. 17" recovered
354.6	10				Soft	SC	Red-orange fine SAND, little clay, damp. Occasional iron ore.					
					Soft	CL	Brownish tan CLAY, little silt, little sand, Damp.					
		▨	SS	44	Soft	SM	Red-orange fine SAND, little clay, Damp.					SPT 15, 20, 24, 31. 18" recovered.
		▨	SS	21				20.35	NP	33.5		SPT 11, 12, 9, 32.
349.6	15	▨	SS	18								SPT 6, 6, 12, 6.
					Soft	SM-SC	Light brown fine SAND, with little silt, little sand, Damp.					
					Firm	CL	Black CLAY, with fine sand, Wet.					
		▨	SS	75	Soft	SM-SC	Dark red fine SAND, little clay, little silt, Wet.					SPT 12, 25, 50/5.
					Soft-Firm	SC	Dark grey fine SAND, little clay, Wet. Occasional clay seams.					
		▨	SS	28								SPT 9, 16, 12, 15.
344.6	20											
		▨	SS	38	Firm	SC	Frequent clay lenses.	22.55	13	36.6		SPT 9, 17, 21, 27.
							8/11/09 ▼					
		▨	SS	65								SPT 22, 35, 50/4".
339.6	25	▨	SS	33								SPT 10, 15, 18, 28.
					Soft	SC	Less clay lenses, Wet.					
		▨	SS	64								SPT 12, 27, 37, 50/5".
		▨	SS	44								SPT 19, 24, 21, 50/5".
					Hard	CL	Dark grey CLAY, little trace silt, Wet. Bottom of Boring at 30 feet bgs					
334.6	30											

Graphic Log



Well Log



Figure

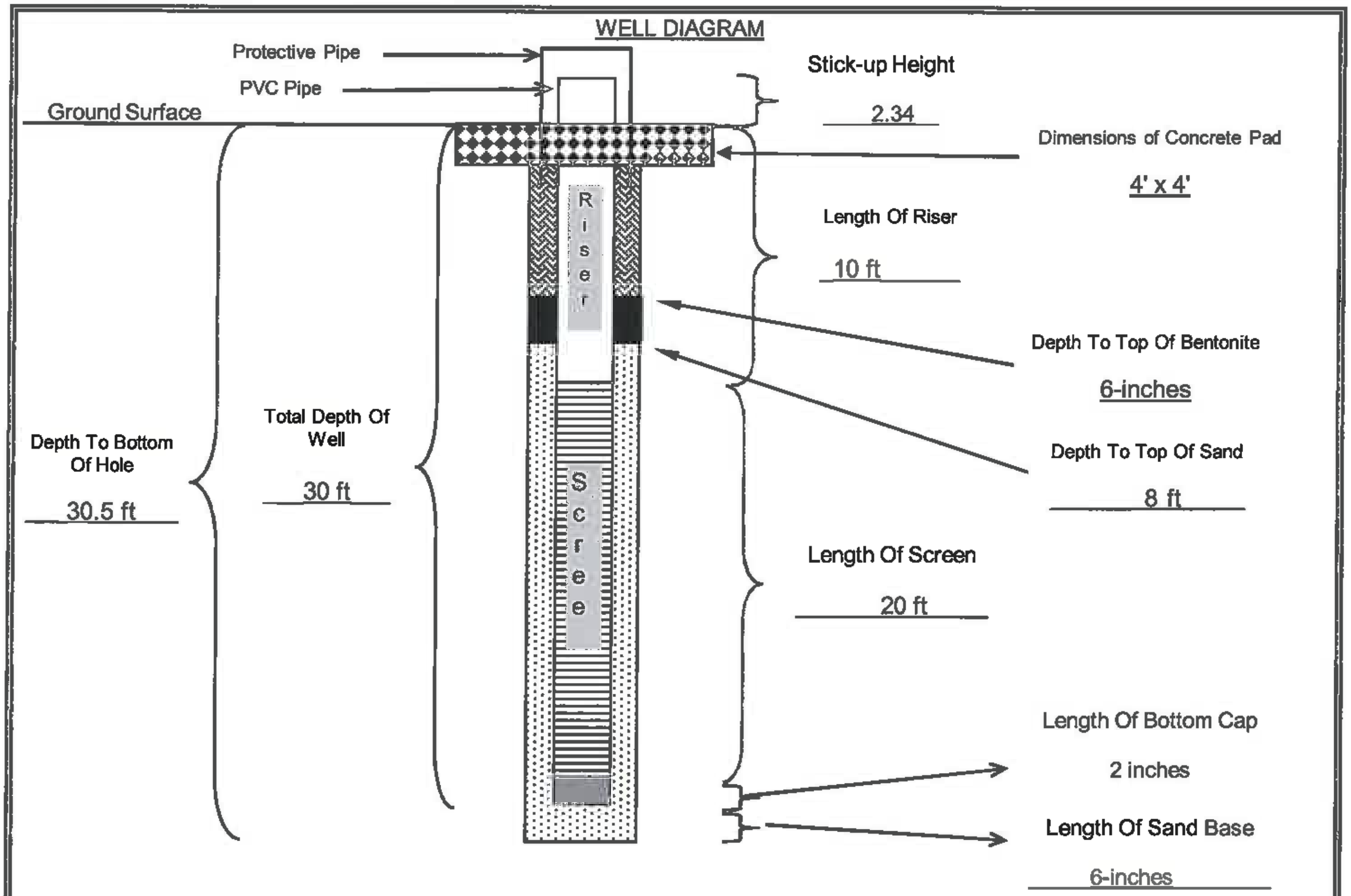
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL NO.: GB-02
WELL LOCATION:
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION:	364.56	(ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	354.56	(ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	334.06	(ft, msl)	CEMENT TYPE:	Not used-sealed with bentonite chips
NORTHING: 747.0223	EASTING: -2442.888		CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC		SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:			SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC		DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:			AMOUNT BENTONITE USED:	4 bags lbs
RISER DIAMETER:	2 (in)	Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in)	Length: 20 (ft)	AMOUNT SAND USED:	13 bags lbs
BOREHOLE DIAMETER:	8	(in)	STATIC WATER:	21.53 depth from TOC
DRILLING TECHNIQUE:	Hollow stem	Size: (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.34
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2 inches
Length Of Sand Base: 6-inches
Depth To Bottom Of Hole: 30.5 ft
Total Depth Of Well: 30 ft

▩ Cement/Bentonite Grout ⁙ Sand Pack ▦ Neat Concrete ■ Bentonite ▨ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
OBSERVED BY: Kush Chohan
DATE: August 7th, 2009
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 1 of 2

Date(s) Drilled **August 7, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **31 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **359.91 feet MSL**
Groundwater Level and Date Measured **21.89 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Southwest corner of proposed chemical pond near screening pile.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
359.9	0				Soft	Other		Coal						
354.9	5				Soft	CH		Shelby Tube						Shelby tube sample.
			ST							43	96.1			
					Firm	CH		Light brown-grey CLAY, little silt, occasional sand seams (fine), Damp.						SPT 29, 22, 19, 21.
			SS	41					24.04	29	90.4			
					Soft	CH		Brownish dark grey CLAY, trace sand, trace silt, Wet.						SPT 6, 12, 15, 20.
349.9	10		SS	27										
														SPT 17, 29, 24, 25.
			SS	53	Soft	SC		Dark orange red SAND, little clay, trace silt, Wet. Occasional clay seam (dark grey).						
					Soft	SC		Clay lenses.						SPT 7, 15, 17, 40.
			SS	32										
344.9	15													SPT 9, 17, 30, 20.
			SS	47	Soft	SC		Clay lense						
					Soft	SC		Dark grey fine SAND with clay, occasional clay lense, Wet.						SPT 11, 50/4".
			SS	50	Firm	CL		Dark grey CLAY, little fine sand, Wet.						
					Soft	SC		Dark grey fine SAND, little clay, occasional clay seam, iron ore, Wet.						SPT 11, 27, 17, 21.
339.9	20		SS	44										
								8/11/09						
334.9	25													SPT 27, 40, 50/4".
			SS	90										
					Firm	SC		Dark grey clay lense						SPT 11, 15, 40, 50/3".
			SS	55										
			SS	55										SPT 17, 50/5.5".
329.9	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
329.9	30	▨	SS	55	Hard	CL	▨	Dark gray CLAY, trace silt, trace fine sand.						SPT 17, 50/5.5".
								Bottom of Boring at 31 feet bgs						
324.9	35													
319.9	40													
314.9	45													
309.9	50													
304.9	55													
299.9	60													
294.9	65													

Figure

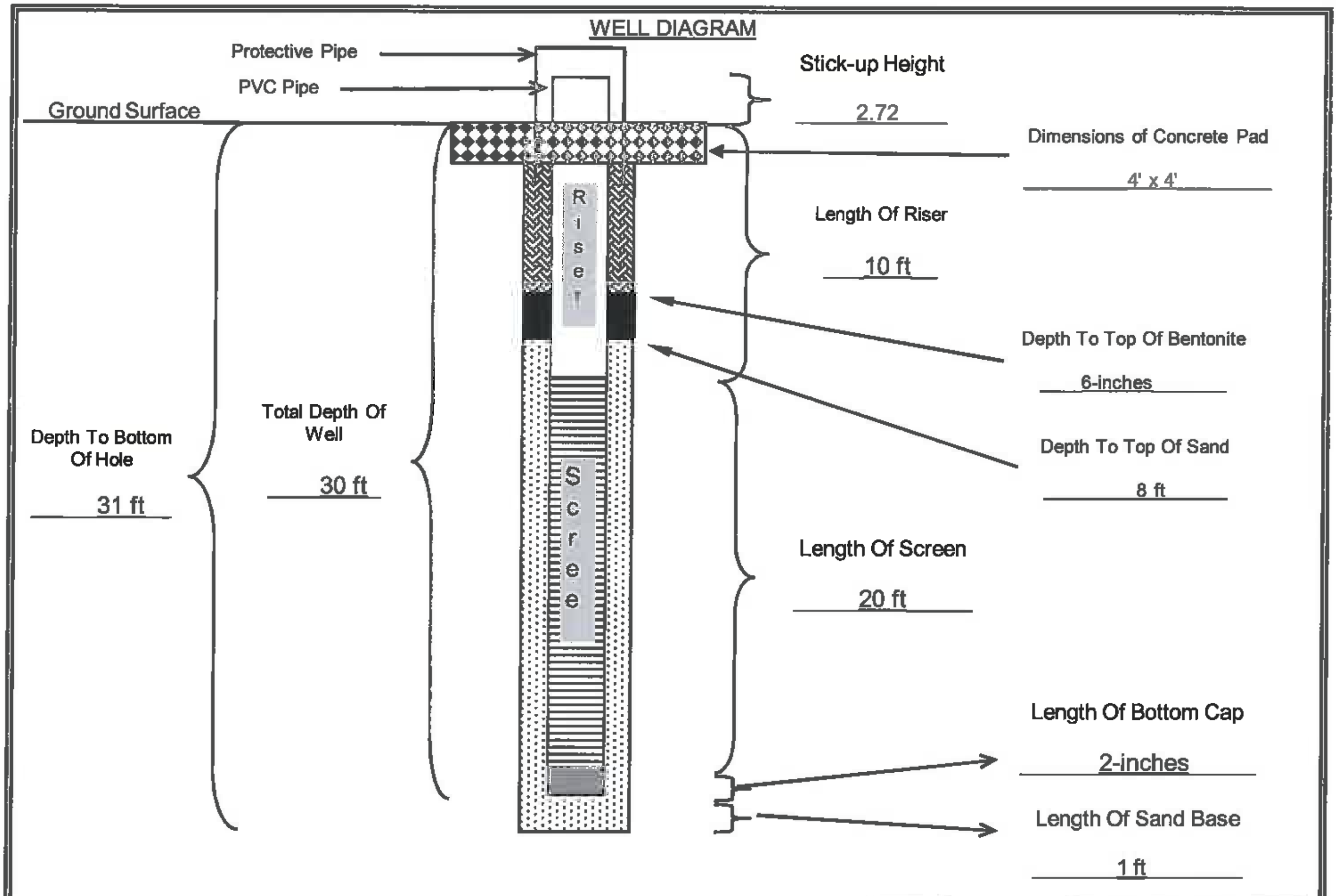
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME:	AEP Welsh Power Plant		
JOB NO.:	TXL0064		
DATE/TIME:	8/7/2009	WELL NO.:	GB-03
WELL LOCATION:		FIELD REP:	Kush Chohan

GROUND SURFACE ELEVATION:	359.57 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	349.57 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	328.57 (ft, msl)	CEMENT TYPE:	None used-sealed with bentonite chips
NORTHING: 460.5803	EASTING: -2507.6332	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	4 bags lbs
RISER DIAMETER:	2 (in) Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 20 (ft)	AMOUNT SAND USED:	12 bags lbs
BOREHOLE DIAMETER:	8 (in)	STATIC WATER:	21.89 depth from TOC
DRILLING TECHNIQUE:	Hollow Stem Size: 8 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.72

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 10 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 8 ft

Length Of Screen: 20 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 1 ft

Total Depth Of Well: 30 ft

Depth To Bottom Of Hole: 31 ft

▩	Cement/Bentonite Grout	░	Sand Pack	▦	Neat Concrete	■	Bentonite	▨	Bottom Cap

QA/QC INSTALLED BY:	Total Support Services	OBSERVED BY:	Kush S. Chohan
DATE:	7-Aug-09	CHECKED BY:	DATE:

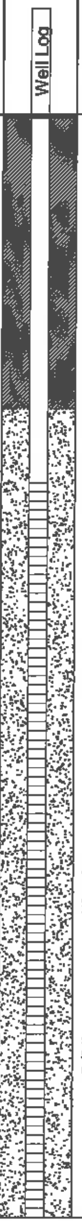
Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 1 of 2

Date(s) Drilled	**July 24, 2009**	Logged By	**Kush S. Chohan**	Checked By	
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type		Total Depth of Borehole	**34 feet bgs**
Drill Rig Type	**Mobil B61**	Drilling Contractor	**Total Support Services**	Approximate Surface Elevation	**357.22 feet MSL**
Groundwater Level and Date Measured	**20.54 feet measured on 8/11/09**	Sampling Method(s)	**SPT, Tube**	Hammer Data	**140 lb, 30 in drop, Auto-hammer**
Borehole Backfill	**Well Completion**	Location	**Southeast corner of proposed chemical evaportation pond. Located in a grassy field.**		

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
357.2	0				Soft	SM-SC	Reddish brown fine SAND, little silt, trace clay, damp.					SPT 1, 3, 6, 6. 24" recovered.
			SS	9	Soft	Other	COAL					
					Firm	SC	Brownish red SAND, little clay, trace silt. Damp.					
					Firm	CL	Reddish pink CLAY, some fine sand, Dry.					SPT 4, 4, 4, 4. 24" recovered.
			SS	8				24.49	47	90.2		
												SPT 5, 6, 8, 4. 18" recovered.
					Soft	Other	Oxidized SAND and clay with iron ore.					
352.2	5		SS	14	Soft	CH	Light reddish brown CLAY and sand mixture, Dry.					
					Soft	SC	Reddish brown SAND, little clay, Dry.					
			ST					28.4	38	61.1	7.7E-09	12" Shelby tube. 9" recovered.
					Firm	CH	Light brownish tan CLAY, little sand, occasional sand seams, Dry.					SPT 3, 4, 13, 15. 27" recovered.
			SS	17								
347.2	10											
342.2	15				Soft	SC	Red/yellowish brown SAND, some clay, Wet.					SPT 3, 7, 3, 15. 24" recovered.
			SS	10				6.95	14	47		
					Firm	SC	Occasional clay lenses.					
337.2	20		ST				8/11/09					Shelby tube. 12" driven 0" pulled. Gravel material encountered.
					Soft to Firm	SM	Black to dark grey fine/med SAND, little clay, occasional clay lenses, Wet.					SPT 7, 10, 9, 13. 24" recovered.
			SS	19								
332.2	25				Soft	SM	Well graded light grey fine/med SAND, trace silt, Wet.					SPT 17, 24, 50/5.5". 19" recovered.
			SS	74				22.29	NP	13.5		
					Firm	CL	Dark grey clay lense, Wet.					
					Firm	SM-SC	Well graded light grey fine/med SAND, trace silt, Wet.					
327.2	30											



Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.2	30	☒	ST		Hard	ML	▥	Dark grey CLAY, little sand, Wet.						12" Shelby tube. Bent shelby tube.
		☒	ST						21.3	NP	84.2	2.0E-08		12" Shelby tube.
		▨	SS	38	Hard	CL	▨	Dark grey CLAY, trace sand, Wet.	25.44	18	92.5			SPT 15, 19, 19, 25. 24" recovered.
								Bottom of Boring at 34 feet bgs						
322.2	35													
317.2	40													
312.2	45													
307.2	50													
302.2	55													
297.2	60													
292.2	65													

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

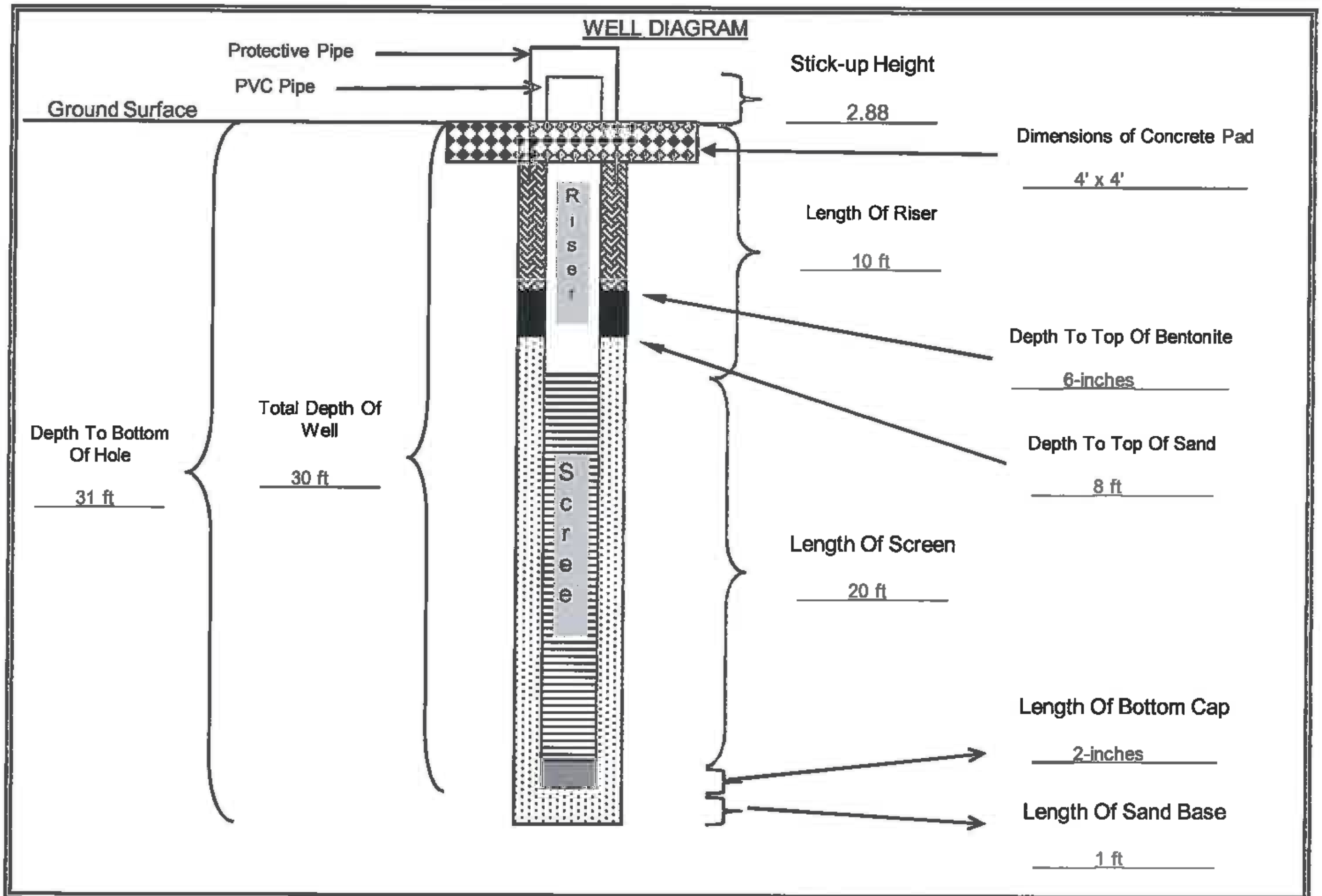
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 24-Jul-09
WELL LOCATION:
WELL NO.: GB-04
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.22 (ft, msl)
TOP OF SCREEN ELEVATION: 347.22 (ft, msl)
BOTTOM OF WELL ELEVATION: 326.22 (ft, msl)
NORTHING: -384.9666 EASTING: -2353.7375
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 10 (ft)
SCREEN DIAMETER: 2 (in) Length: 20 (ft)
BOREHOLE DIAMETER: 6.75 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 6.75 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 3 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 20.54 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height: 2.88
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 1 ft
Total Depth Of Well: 30 ft
Depth To Bottom Of Hole: 31 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: 24-Jul-09
OBSERVED BY: Kush S. Chohan
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30.5 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.49 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8-11-09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Eastern edge of proposed chemical evaporation pond.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
357.5	0				Soft	SW-SM		Dark fine SAND with brown organic material and roots.						SPT 2, 2, 5, 5. 24" recovered
			SS	7	Firm	CH		Dark red/grey CLAY, trace silt. Dry.	23.37	44	68.6			
			SS	11								7E-07		SPT 4, 4, 7, 9. 24" recovered.
352.5	5		SS	14										SPT 5, 6, 8, 13. 24 recovered
						CH		↓ Trace of sand						
			ST		Soft	CH		Dark red fine SAND, trace clay, Damp.	16.5	41	73.8	3.2E-08		Shelby tube. Pushed 12 recovered 9".
			SS	18	Firm	CH		) Light tan CLAY, trace sand, Dry.						SPT 5, 7, 11, 11. 24" recovered.
					Soft	SC		Dark red SAND, trace of CLAY, Damp.						
					Firm	CL		Light tan CLAY, trace fine sand, Dry.						
					Soft	SC		Dark red SAND, little clay, frequent clay seams, Damp						SPT 6, 7, 11, 14. 24" recovered.
347.5	10		SS	18										
						SC		↓ Frequent clay seams						SPT 11, 22, 13, 14. 24" recovered.
			SS	35	Soft	SC		Red/orange fine SAND, trace clay, trace coarse sand, poorly sorted, Moist.						
			SS	77										SPT 17, 27, 50/5". 17" recovered.
					Firm	CL		Brownish grey CLAY, trace sand, Moist.						
					Soft	SC		Tanish grey fine SAND, some clay, Wet.						
342.5	15													
			ST					8-11-09 ▼	19.9	13	35.7	6.6E-07		Shelby tube. Pushed 12" recovered 9".
			SS	23					27.98	NP	32.3			SPT 11, 13, 10, 14. 24" recovered.
					Soft	SM		Dark grey coarse SAND/GRAVEL mix, some fine sand, trace clay, Wet.						
					Soft	SM-SC		Red fine SAND, trace clay, Moist. cemented. Moist.						SPT 7, 8, 11, 13. 24" recovered.
			SS	19										
					Firm	SC		Black fine SAND, occasional clay, Wet.						
337.5	20													SPT 6, 10, 12, 15. 24" recovered.
					Firm	CL		) Dark grey CLAY, little sand, Wet.						
					Firm	SM		Black fine SAND, some medium sand, some clay, Wet.						
			SS	22					32.23	NP	35.5			
					Firm	CL		) Dark grey CLAY, little sand, Wet.						
					Firm	SM		Black fine SAND, some medium sand, some clay, Wet.						
			SS	26	Firm	SM		↓ Frequent clay seams						SPT 6, 11, 17, 21. 24" recovered.
					Firm	SM		↓ Frequent clay seams.						
			ST											Shelby tube. 12" driven 0 recovered.
332.5	25													SPT 15, 19, 21, 27. 24" recovered.
			SS	40	Hard	CL		Dark grey CLAY, trace of sand, Dry.						
			SS	22										SPT 10, 11, 11, 50/5". 23" recovered.
					Very Hard	CL		↓ Dark grey CLAY, frequent iron stone/ore. Rig chatter driller comments						
			ST						24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
327.5	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.5	30	⊠	ST		Hard	CL	▨	Dark grey CLAY, trace of sand, Dry. (cont.)	24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
								Bottom of Boring at 30.5 feet bgs						
322.5	35													
317.5	40													
312.5	45													
307.5	50													
302.5	55													
297.5	60													
292.5	65													

Figure

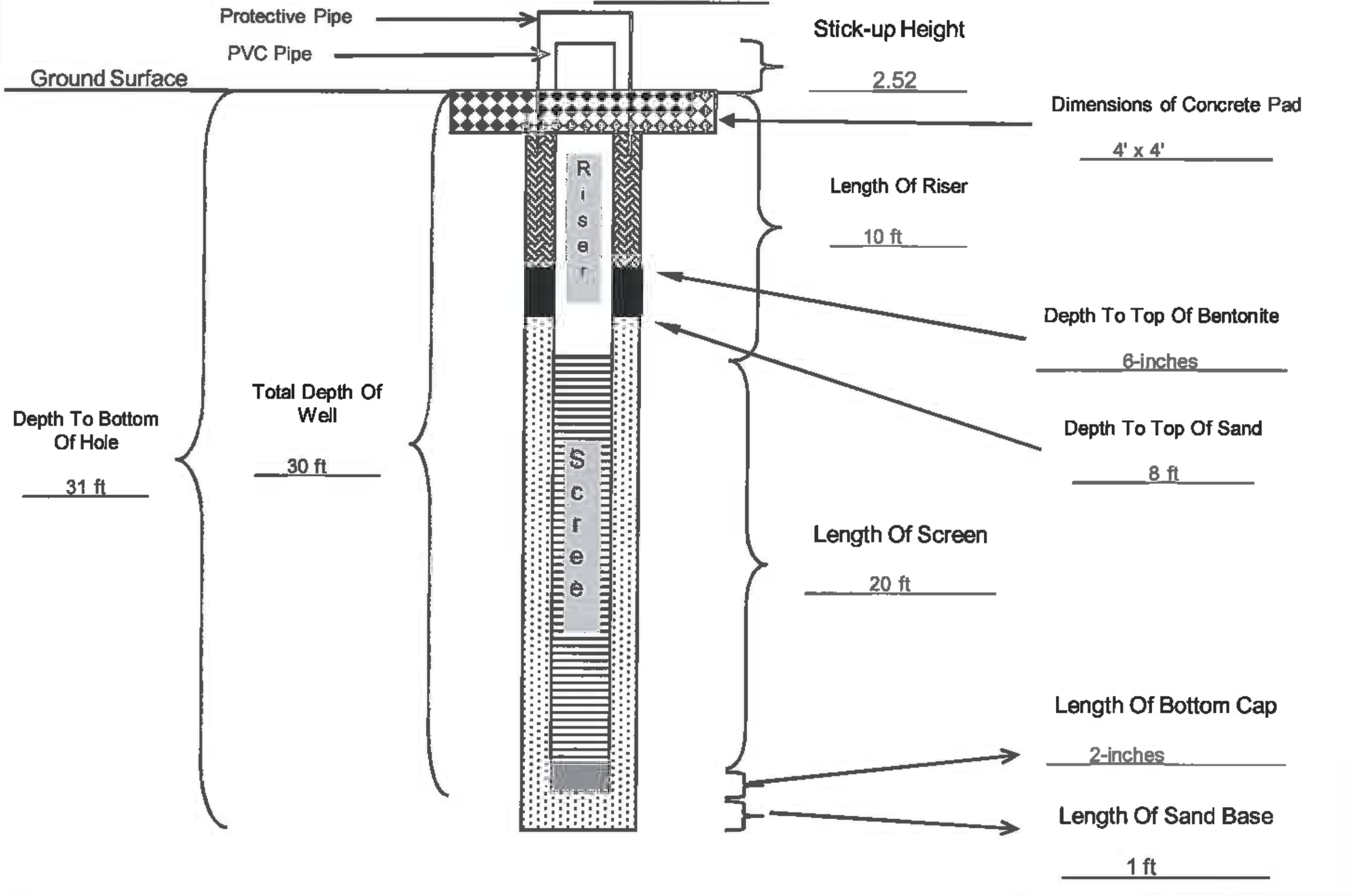
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME:	AEP Welsh Power Plant		
JOB NO.:	TXL0064		
DATE/TIME:	August 6 2009	WELL NO.:	GB-05
WELL LOCATION:		FIELD REP:	Kush Chohan

GROUND SURFACE ELEVATION:	357.49 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	347.49 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	326.49 (ft, msl)	CEMENT TYPE:	
NORTHING: 529.1865	EASTING: -2243.9973	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	3 bags lbs
RISER DIAMETER:	2 (in) Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 20 (ft)	AMOUNT SAND USED:	7 bags lbs
BOREHOLE DIAMETER:	8 (in)	STATIC WATER:	17.33 depth from TOC
DRILLING TECHNIQUE:	Hollow Stem Size: 8 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.52

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 10 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 8 ft

Length Of Screen: 20 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 1 ft

Depth To Bottom Of Hole: 31 ft

Total Depth Of Well: 30 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

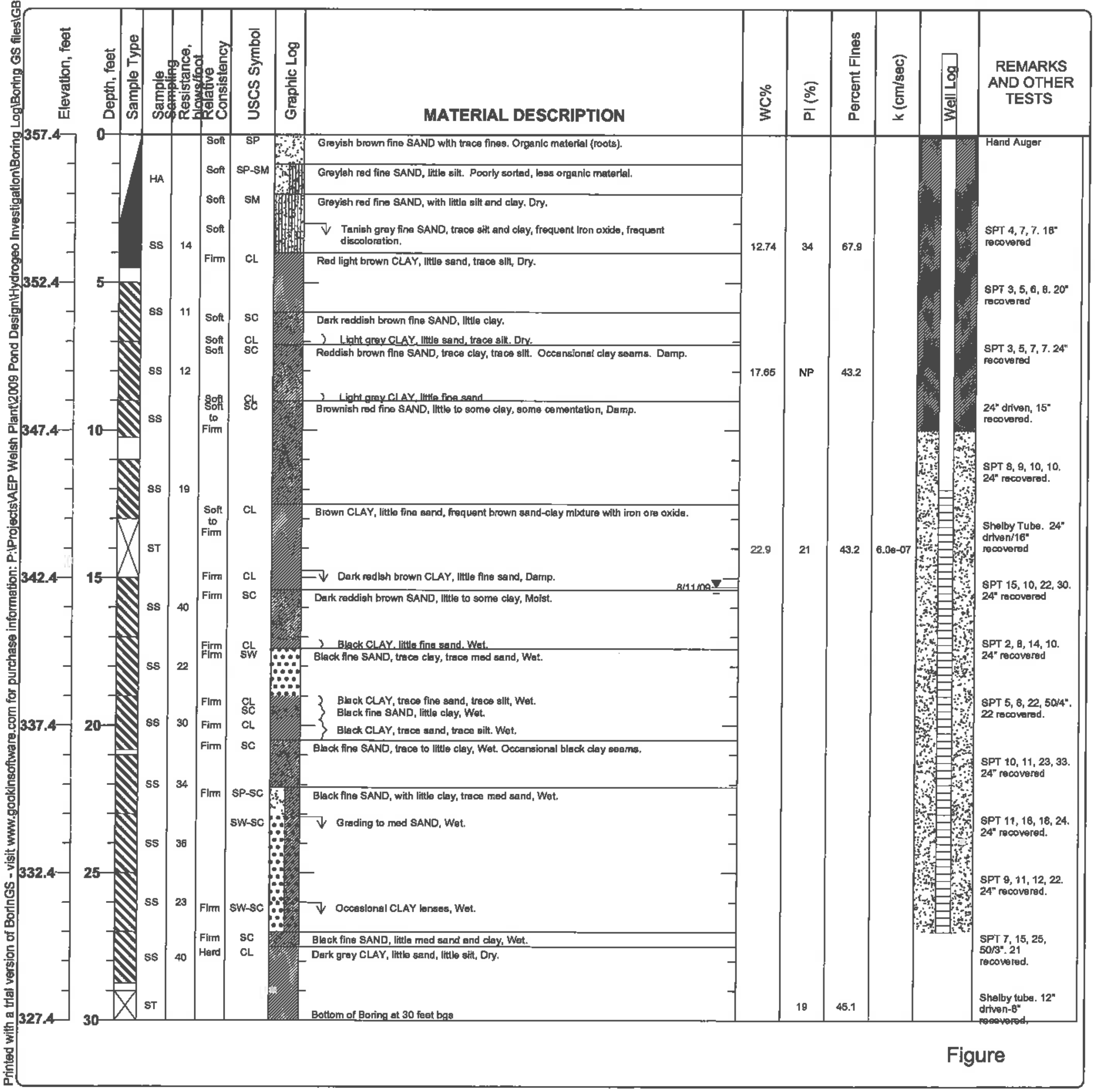
QA/QC INSTALLED BY:	Total Support Services	OBSERVED BY:	Kush Chohan
DATE:	6-Aug-09	CHECKED BY:	DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-06

Sheet 1 of 1

Date(s) Drilled **7/23/2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.41 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube, Other**	Hammer Data **140 lb, 30 in drop, auto hammer**
Borehole Backfill **Well Completion**	Location **Northeast corner of proposed chemical pond in the middle of open grass field.**	



Elevation, feet	Depth, feet	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
357.4	0			Soft	SP	Greyish brown fine SAND with trace fines. Organic material (roots).					Hand Auger
		HA		Soft	SP-SM	Greyish red fine SAND, little silt. Poorly sorted, less organic material.					
				Soft	SM	Greyish red fine SAND, with little silt and clay. Dry.					
				Soft		Tanish grey fine SAND, trace silt and clay, frequent iron oxide, frequent discoloration.					SPT 4, 7, 7. 16" recovered
		SS	14				12.74	34	67.9		
				Firm	CL	Red light brown CLAY, little sand, trace silt, Dry.					
352.4	5										SPT 3, 5, 6, 8. 20" recovered
		SS	11	Soft	SC	Dark reddish brown fine SAND, little clay.					
				Soft	CL	Light grey CLAY, little sand, trace silt. Dry.					
				Soft	SC	Reddish brown fine SAND, trace clay, trace silt. Occasional clay seams. Damp.					SPT 3, 5, 7, 7. 24" recovered
		SS	12				17.65	NP	43.2		
				Soft	CL	Light grey CLAY, little fine sand					
		SS		Soft to Firm	SC	Brownish red fine SAND, little to some clay, some cementation, Damp.					24" driven, 15" recovered.
347.4	10										
											SPT 8, 9, 10, 10. 24" recovered.
		SS	19								
				Soft to Firm	CL	Brown CLAY, little fine sand, frequent brown sand-clay mixture with iron ore oxide.					Shelby Tube. 24" driven/16" recovered
		ST					22.9	21	43.2	6.0e-07	
342.4	15			Firm	CL	Dark redish brown CLAY, little fine sand, Damp. 8/11/09 ▼					SPT 15, 10, 22, 30. 24" recovered
				Firm	SC	Dark reddish brown SAND, little to some clay, Moist.					
		SS	40								
				Firm	CL	Black CLAY, little fine sand, Wet.					SPT 2, 8, 14, 10. 24" recovered
				Firm	SW	Black fine SAND, trace clay, trace med sand, Wet.					
		SS	22								
				Firm	CL	Black CLAY, trace fine sand, trace silt, Wet.					SPT 5, 8, 22, 50/4". 22 recovered.
					SC	Black fine SAND, little clay, Wet.					
337.4	20	SS	30	Firm	CL	Black CLAY, trace sand, trace silt. Wet.					
				Firm	SC	Black fine SAND, trace to little clay, Wet. Occasional black clay seams.					SPT 10, 11, 23, 33. 24" recovered
		SS	34								
				Firm	SP-SC	Black fine SAND, with little clay, trace med sand, Wet.					SPT 11, 16, 16, 24. 24" recovered.
					SW-SC	Grading to med SAND, Wet.					
		SS	36								
332.4	25										SPT 9, 11, 12, 22. 24" recovered.
		SS	23	Firm	SW-SC	Occasional CLAY lenses, Wet.					
				Firm	SC	Black fine SAND, little med sand and clay, Wet.					SPT 7, 15, 25, 50/3". 21 recovered.
		SS	40	Hard	CL	Dark grey CLAY, little sand, little silt, Dry.					
		ST									Shelby tube. 12" driven-8" recovered.
327.4	30					Bottom of Boring at 30 feet bgs		19	45.1		

Figure

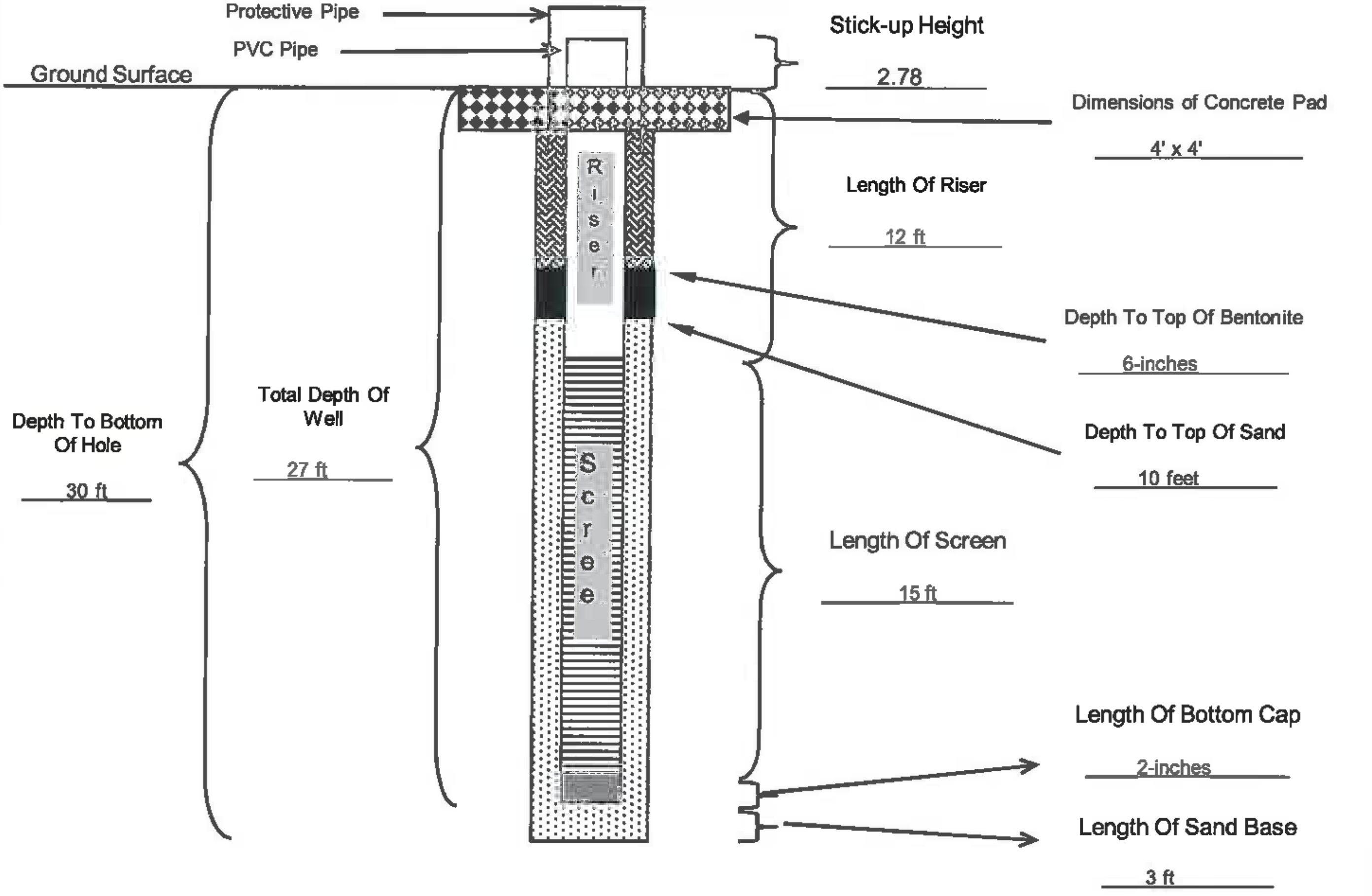
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME:	AEP Welsh Power Plant		
JOB NO.:	TXL0064	WELL NO.:	GB-06
DATE/TIME:	23-Jul-09		
WELL LOCATION:		FIELD REP:	Kush Chohan

GROUND SURFACE ELEVATION:	357.41 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	345.41 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	327.41 (ft, msl)	CEMENT TYPE:	
NORTHING: 740.4893	EASTING: -2166.134	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	2.5 bags lbs
RISER DIAMETER:	2 (in) Length: 12 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 15 (ft)	AMOUNT SAND USED:	7 bags lbs
BOREHOLE DIAMETER:	6.75 (in)	STATIC WATER:	15.3 depth from TOC
DRILLING TECHNIQUE:	Hollow Stem Size: 6.75 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.78

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 12 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 10 feet

Length Of Screen: 15 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 3 ft

Depth To Bottom Of Hole: 30 ft

Total Depth Of Well: 27 ft

▨	Cement/Bentonite Grout	░	Sand Pack	▦	Neat Concrete	■	Bentonite	▩	Bottom Cap

QA/QC	INSTALLED BY:	Total Support Services	OBSERVED BY:	Kush Chohan
	DATE:	23-Jul-09	CHECKED BY:	DATE:

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**GB-07/MW-7**
TOTAL DEPTH:	**34'**
TOP OF CASING ELEV.:	**362.75 ft. NGVD**
GROUND SURFACE ELEV.:	**360.20 ft. NGVD**

CLIENT:	**AEP**
PROJECT:	**Metal Cleaning Waste Pond**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0120**
LOGGED BY:	**James Meleton, Jr.**

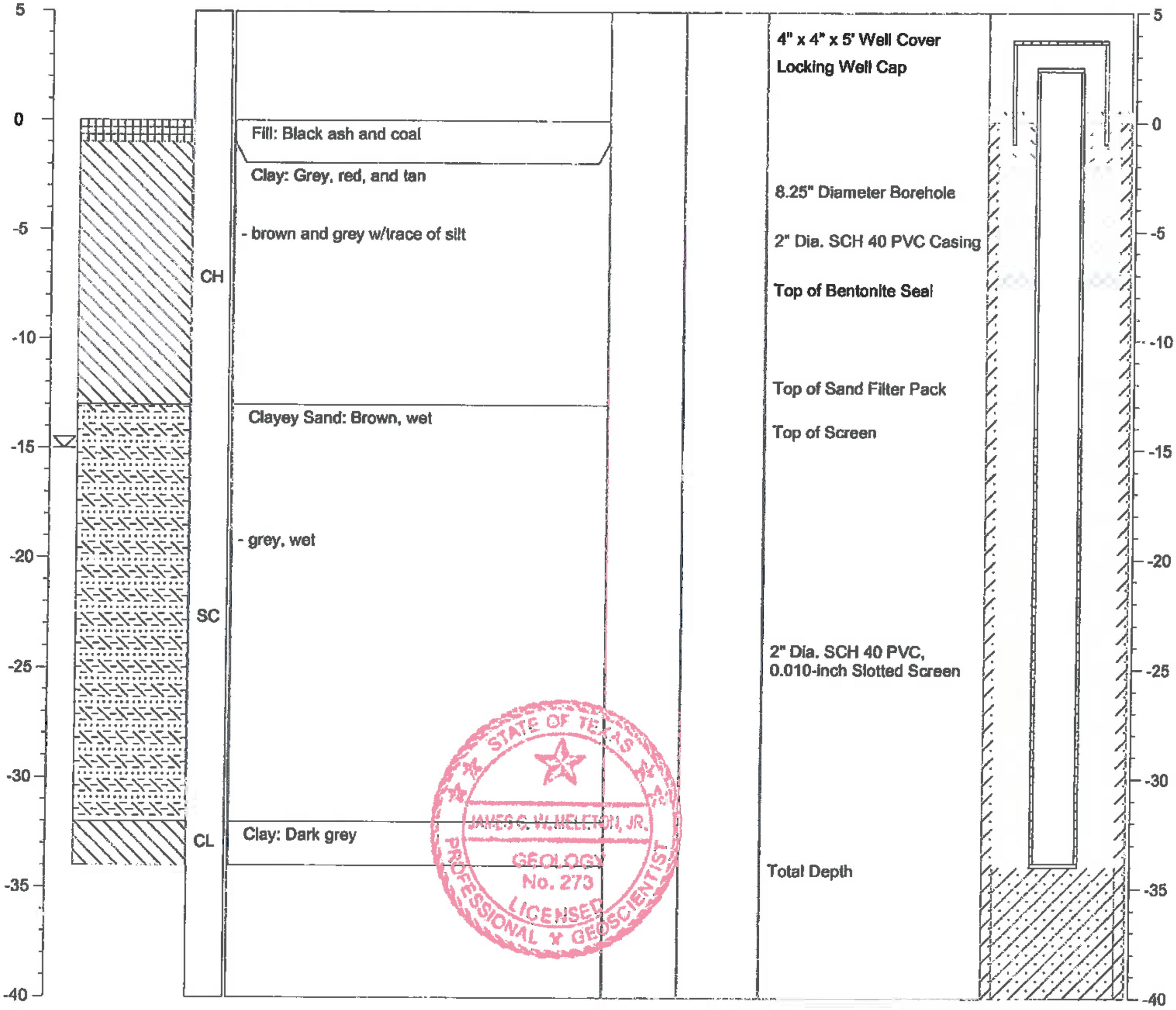
DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**12/1/09**

NOTES: **Latitude: 33.05455**
Longitude: 94.84674

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Fill: Black ash and coal

Clay: Grey, red, and tan

- brown and grey w/trace of silt

Clayey Sand: Brown, wet

- grey, wet

Clay: Dark grey

4" x 4" x 5' Well Cover

Locking Well Cap

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Bentonite Seal

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen

Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-1

PROJECT: Welsh Power Plant
Pittsburgh, Texas

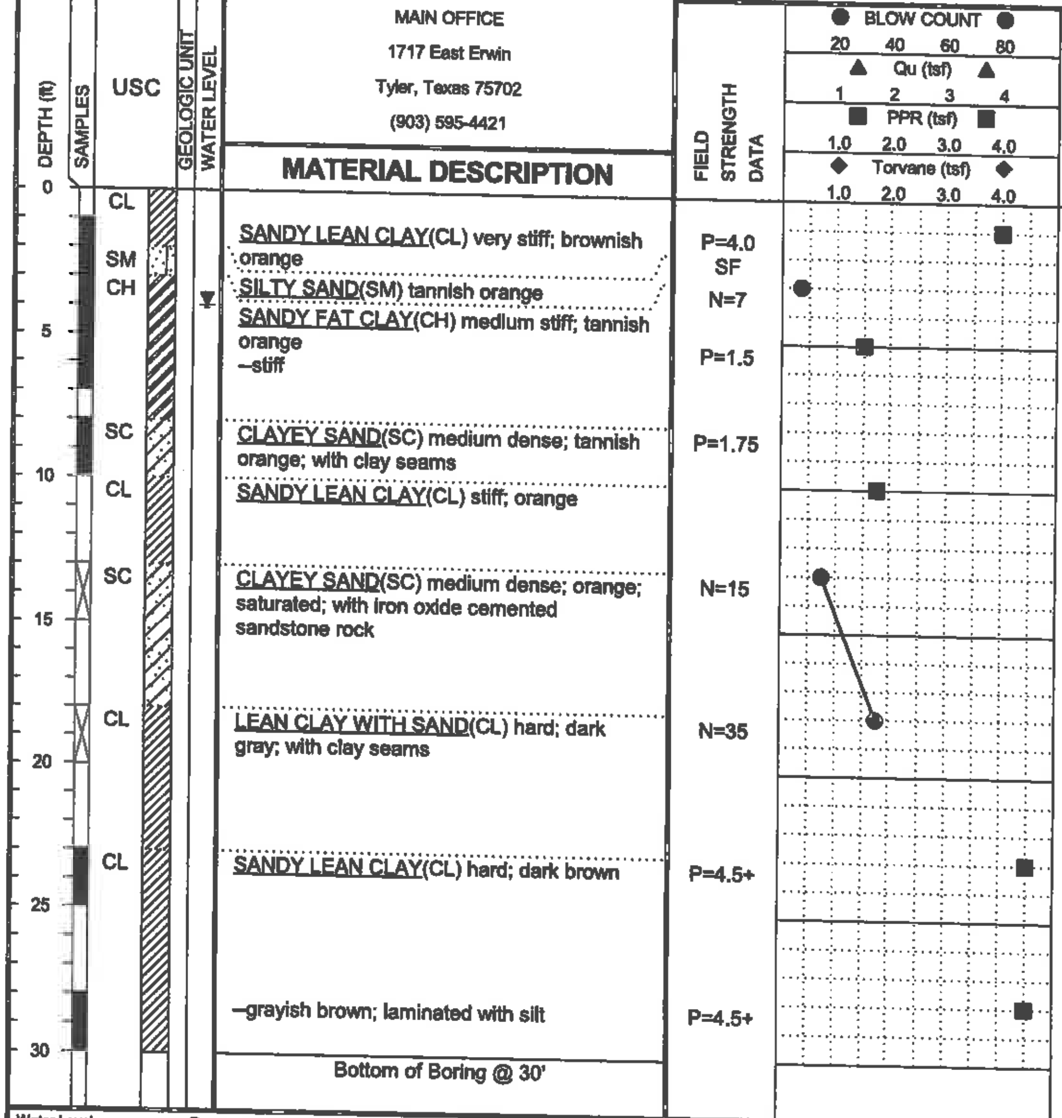
PROJECT NO.: G3242-09

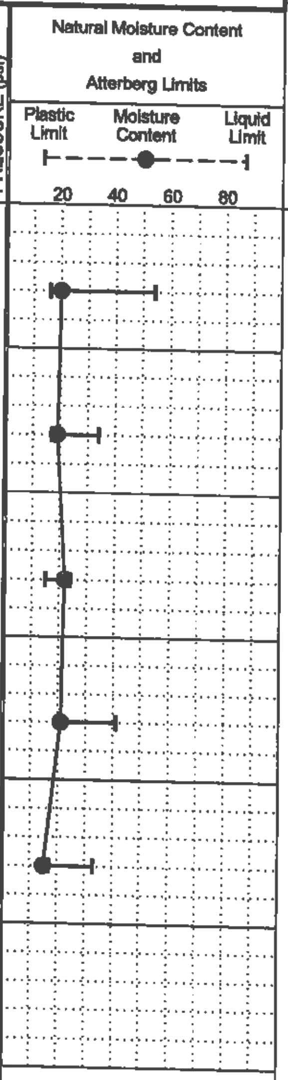
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 324.1

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; brownish orange	P=4.0 SF										
SM	SILTY SAND(SM) tannish orange	N=7										
CH	SANDY FAT CLAY(CH) medium stiff; tannish orange						20	54	16	38	63	+40Sieve=10%, +4 Sieve=1%
	–stiff	P=1.5										
SC	CLAYEY SAND(SC) medium dense; tannish orange; with clay seams	P=1.75					19	34	17	17	32	+40 Sieve=7%, +4 Sieve=3%
CL	SANDY LEAN CLAY(CL) stiff; orange											
SC	CLAYEY SAND(SC) medium dense; orange; saturated; with iron oxide cemented sandstone rock	N=15					22	24	15	9	19	+40Sieve=35%, +4 Sieve=22%
CL	LEAN CLAY WITH SAND(CL) hard; dark gray; with clay seams	N=35					21	41	21	20	75	+40 Sieve=2%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; dark brown	P=4.5+					15	33	17	16	52	+40 Sieve=1%, +4 Sieve=0%
	–grayish brown; laminated with silt	P=4.5+										
	Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 5' while drilling. Water level @ 4' and open to 30' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.090', W 94°50.417'

Piezometer B-2

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

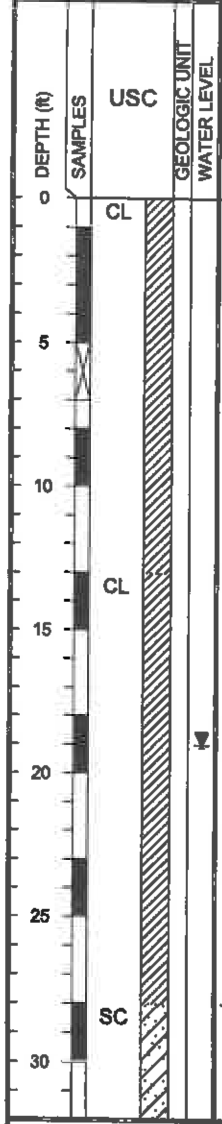
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

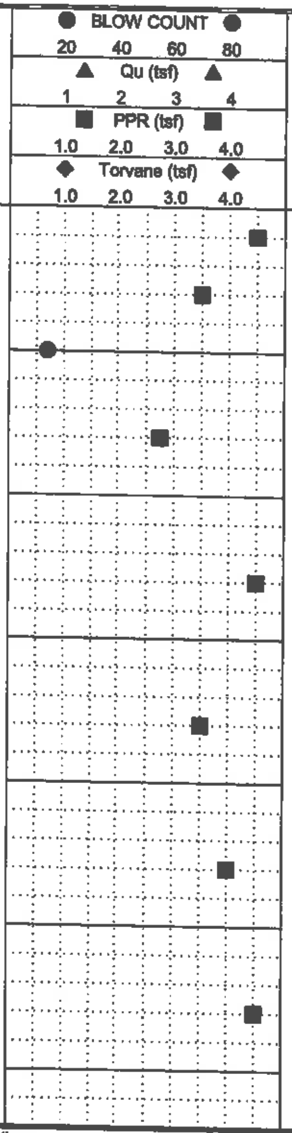
BORING TYPE: Flight Auger

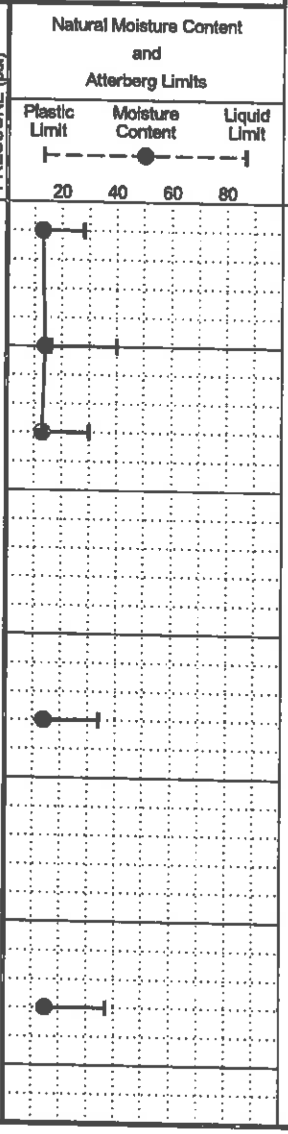
DATE 10/28/09

SURFACE ELEVATION 339.7



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+					13	28	14	14	61	+40 Sieve=3%, +4 Sieve=0%
	–very stiff	P=3.5										
	–stiff	N=14					14	40	16	24	65	+40 Sieve=0%, +4 Sieve=0%
	–very stiff; reddish brown	P=2.75					13	30	14	16	58	+40 Sieve=0%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+										
	–very stiff	P=3.5					14	34	15	19	54	+40 Sieve=0%, +4 Sieve=0%
		P=4.0										
SC	CLAYEY SAND(SC) medium dense; tan, red, and gray	P=4.5					15	37	16	21	47	+40 Sieve=5%, +4 Sieve=3%





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

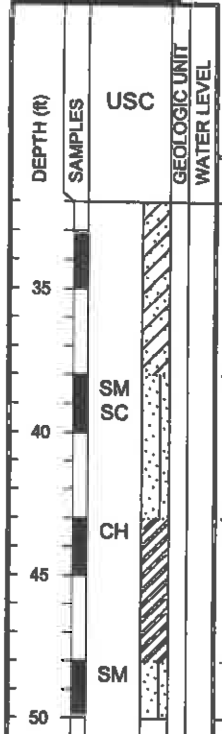
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

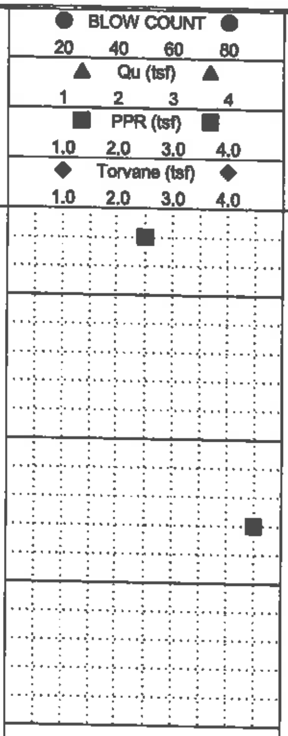
BORING TYPE: Flight Auger

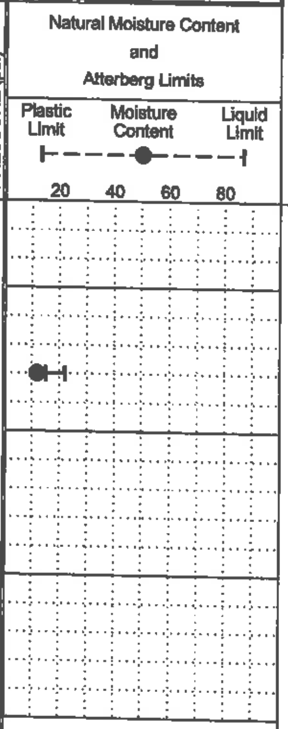
DATE 10/28/09

SURFACE ELEVATION 339.7



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
--red and tan	P=2.5										
SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated	SF					12	22	15	7	48	+40 Sieve=0%, +4 Sieve=0%
FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams	P=4.5+										
SILTY SAND(SM) black and gray	SF										
Bottom of Boring @ 50'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

Piezometer B-2

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-2

Location Pittsburg, Texas

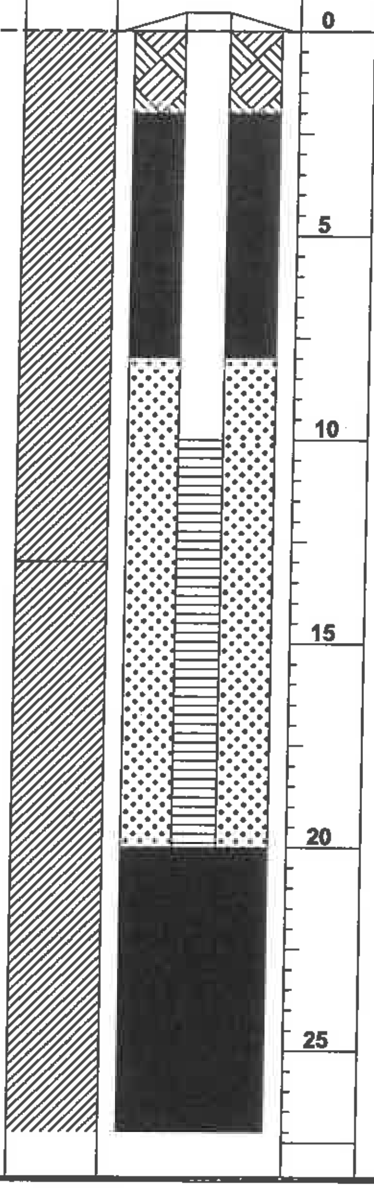
Surface Elev.

Page 1 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description
0	Ground Surface
	SANDY LEAN CLAY(CL) hard; red and tan
	—very stiff
5	--stiff
	—very stiff; reddish brown
10	
	SANDY LEAN CLAY(CL) hard; red and tan
15	
	—very stiff
20	
25	

Field Strength Data | **Graphic Log** | **Well Construction Graphics** | **Depth Feet** | **Well Construction Details**

T.O.C. Elev.



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/28/09

Drilling Completed 10/28/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-8' & 20-50'

Filter Pack Qty. 8-20'

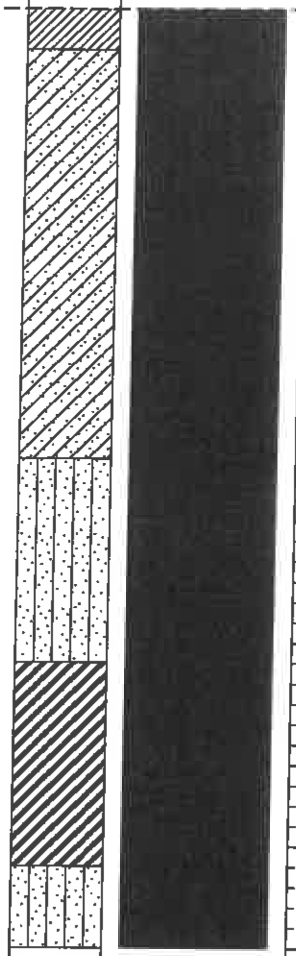
Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**
Well No. B-2
Location Pittsburg, Texas
Surface Elev.
Page 2 **of** 2



Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		CLAYEY SAND(SC) medium dense; tan, red, and gray					
30						30	
		--red and tan					
35						35	
		SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated					
40						40	
		FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams					
45						45	
		SILTY SAND(SM) black and gray					
50		Bottom of Boring @ 50'				50	
55							
60							

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	CLAYEY SAND(SC) medium dense; gray and red	N=11										
CH	FAT CLAY(CH) stiff; red and tan; with sand seams	P=1.0					23	52	18	34	87	+40 Sieve=3%, +4 Sieve=0%
	–very stiff	P=3.5					21	51	19	32	86	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) very stiff; brown; with ferric joints	P=3.75					21	54	20	34	85	+40Sieve=10%, +4 Sieve=1%
	–red and tan; layered; with ferric seams	P=2.5					23	61	24	37	81	+40Sieve=11%, +4 Sieve=0%
CH	FAT CLAY(CH) hard; gray; with sand seams	P=4.5+										
SC	CLAYEY SAND(SC) very dense; gray; with sand seams	N=56					22	42	22	20	35	+40 Sieve=1%, +4 Sieve=0%

DEPTH (ft): 0, 5, 10, 15, 20, 25, 30

BLOW COUNT 20 40 60 80 · Qu (tsf) 1 2 3 4 · PPR (tsf) 1.0 2.0 3.0 4.0 · Torvane (tsf) 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit · 20 40 60 80

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

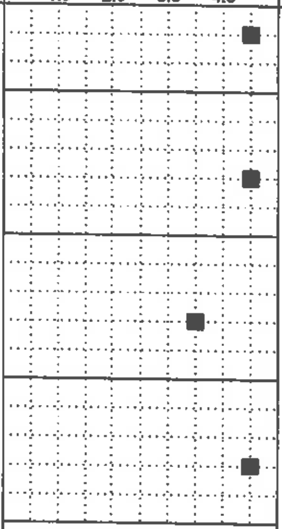
DATE 10/27/09

SURFACE ELEVATION 339.6

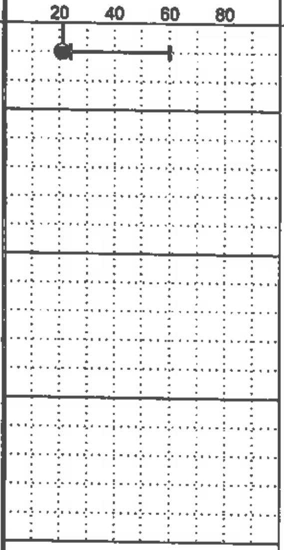
DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	CH	FAT CLAY(CH) hard; brown; layered and with sand seams	P=4.5+	21	60	24	36	95	+40 Sieve=1%, +4 Sieve=0%
40		—gray and green	P=4.5+						
45	CL	SANDY LEAN CLAY(CL) very stiff; gray and dark green; layered; with sand seams	P=3.5						
50	CH	FAT CLAY(CH) hard; gray and dark green; layered; with silt seams	P=4.5+						
		Bottom of Boring @ 50'							

SAMPLES | GEOLOGIC UNIT | WATER LEVEL | DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)

● BLOW COUNT ●
20 40 60 80
▲ Qu (tsf) ▲
1 2 3 4
■ PPR (tsf) ■
1.0 2.0 3.0 4.0
◆ Torvane (tsf) ◆
1.0 2.0 3.0 4.0



Natural Moisture Content
and
Atterberg Limits
Plastic Limit ├----● Moisture Content----┤ Liquid Limit



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

Piezometer B-4

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

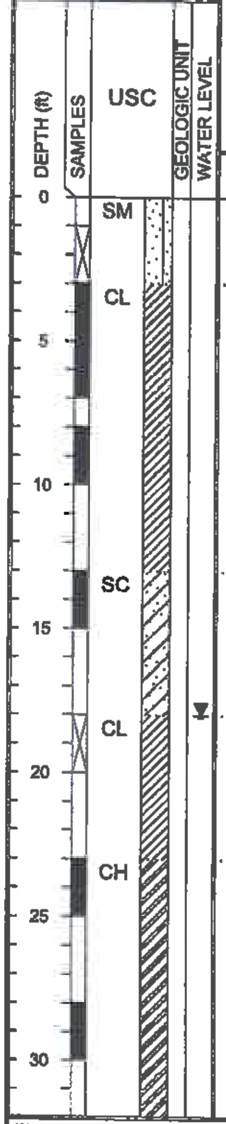
PROJECT: Welsh Power Plant
Pittsburgh, Texas

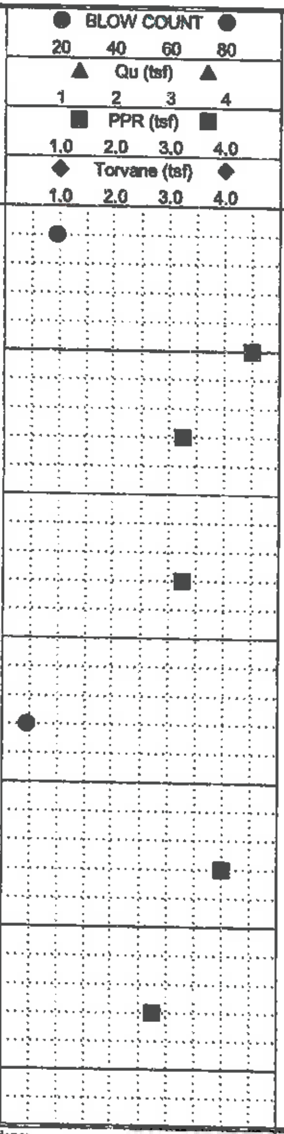
PROJECT NO.: G3242-09

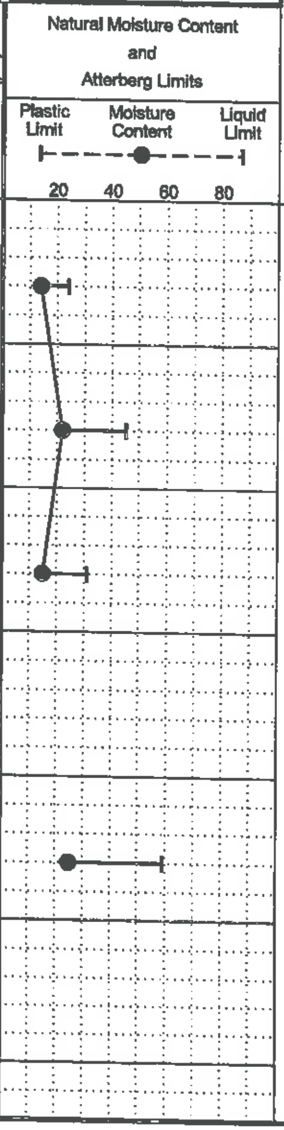
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SM	SILTY SAND(SM) medium dense; tan; with gravel	N=19										
CL	SANDY LEAN CLAY(CL) dark brown	SF										
	—tannish orange						14	24	15	9	59	+40 Sieve=1%, +4 Sieve=0%
	—hard; orangish tan	P=4.5										
		P=3.25					22	45	21	24	94	+40 Sieve=2%, +4 Sieve=0%
	—very stiff; white											
SC	CLAYEY SAND(SC) medium dense; tan	P=3.25										
	—orangish gray; with sand seams						15	31	15	16	40	+40 Sieve=1%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) stiff; orangish tan	N=9										
CH	FAT CLAY(CH) very stiff; orangish tan; with ferric seams	P=4.0					25	59	24	35	88	+40 Sieve=4%, +4 Sieve=0%
	—tannish brown; with iron ore seams	P=2.75										

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

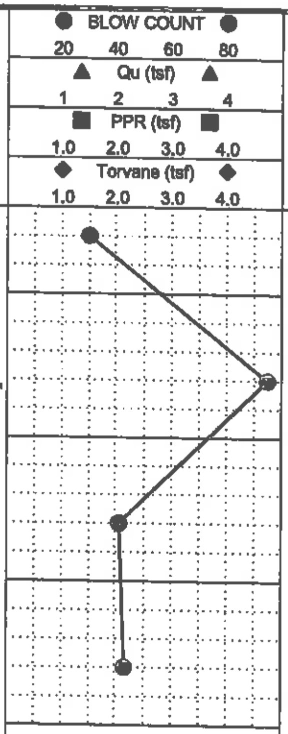
PROJECT NO.: G3242-09

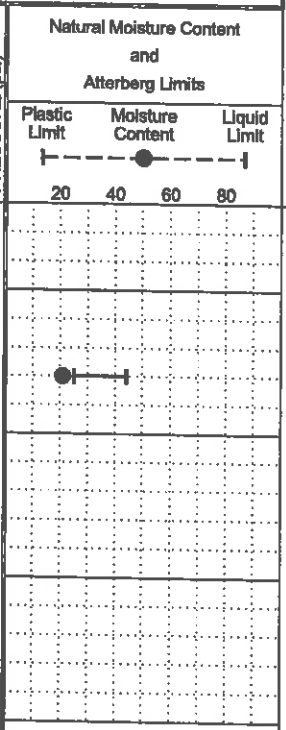
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	☒				–hard; light gray; layered and with silt seams	N=30										
40	☒	CL			LEAN CLAY(CL) hard; light gray; layered and with silt seams	N=50/5.75"					21	44	25	19	93	+40 Sieve=1%, +4 Sieve=0%
45	☒				–light gray	N=41										
50	☒				–layered and with sand seams; with lignite	N=43										
					Bottom of Boring @ 50'											





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

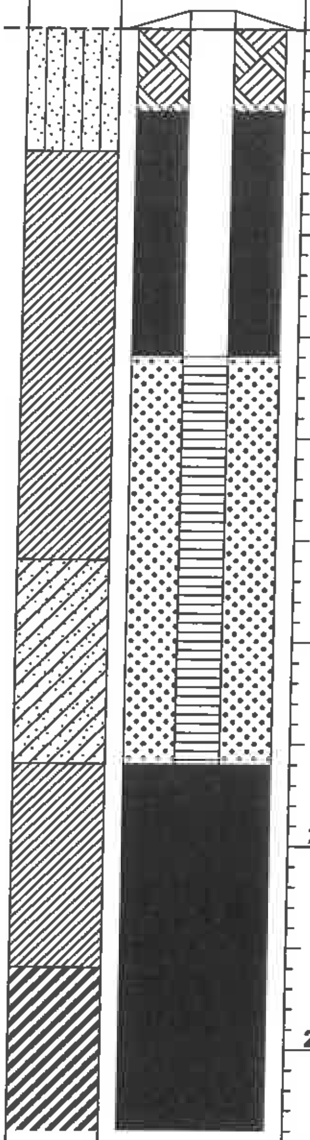
Piezometer B-4

ENVIRONMENTAL LOG

Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**

Well No. B-4
Location Pittsburg, Texas
Surface Elev.
Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		SILTY SAND(SM) medium dense; tan; with gravel					
		SANDY LEAN CLAY(CL) dark brown					
		–tannish orange					
5		–hard; orangish tan				5	
10		–very stiff; white				10	
		CLAYEY SAND(SC) medium dense; tan					
15		–orangish gray; with sand seams				15	
		SANDY LEAN CLAY(CL) stiff; orangish tan					
20						20	
		FAT CLAY(CH) very stiff; orangish tan; with ferric seams					
25						25	



Continued Next Page

Driller Doug Hinds
Logged By James Griffith
Drilling Started 10/27/09
Drilling Completed 10/27/09
Construction Completed
Development Completed
Type of Well

Drilling Method Soild Stem Auger
Borehole Diameter 6.5"
Well Casing 2.0" **Dia.** 0.0' **to** 8.0'
Casing Type PVC
Well Screen 2.0" **Dia.** 8.0' **to** 18.0'
Screen Type Slotted
Slot Size 0.010"
Grout Type Bentonite

Bentonite Seal 2-8' & 18-50'
Filter Pack Qty. 6-18'
Filter Pack Type 20/40 Sand
Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

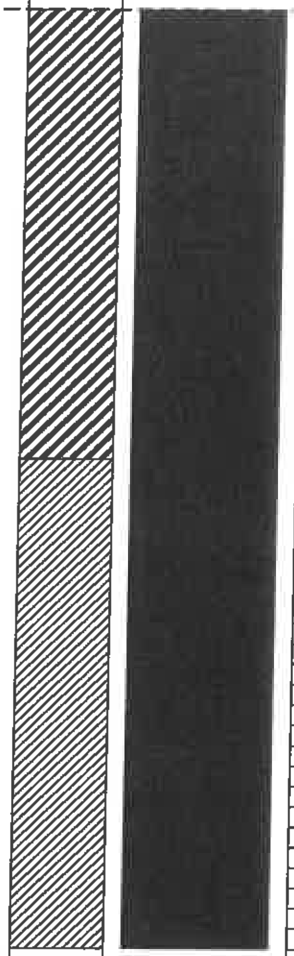
Well No. B-4

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		--tannish brown; with iron ore seams					
30						30	
		--hard; light gray; layered and with silt seams					
35						35	
		LEAN CLAY(CL) hard; light gray; layered and with silt seams					
40						40	
		--light gray					
45						45	
		--layered and with sand seams; with lignite					
50						50	
		Bottom of Boring @ 50'					
55							
60							



ETTL Engineers & Consultants Inc.

Piezometer B-5

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

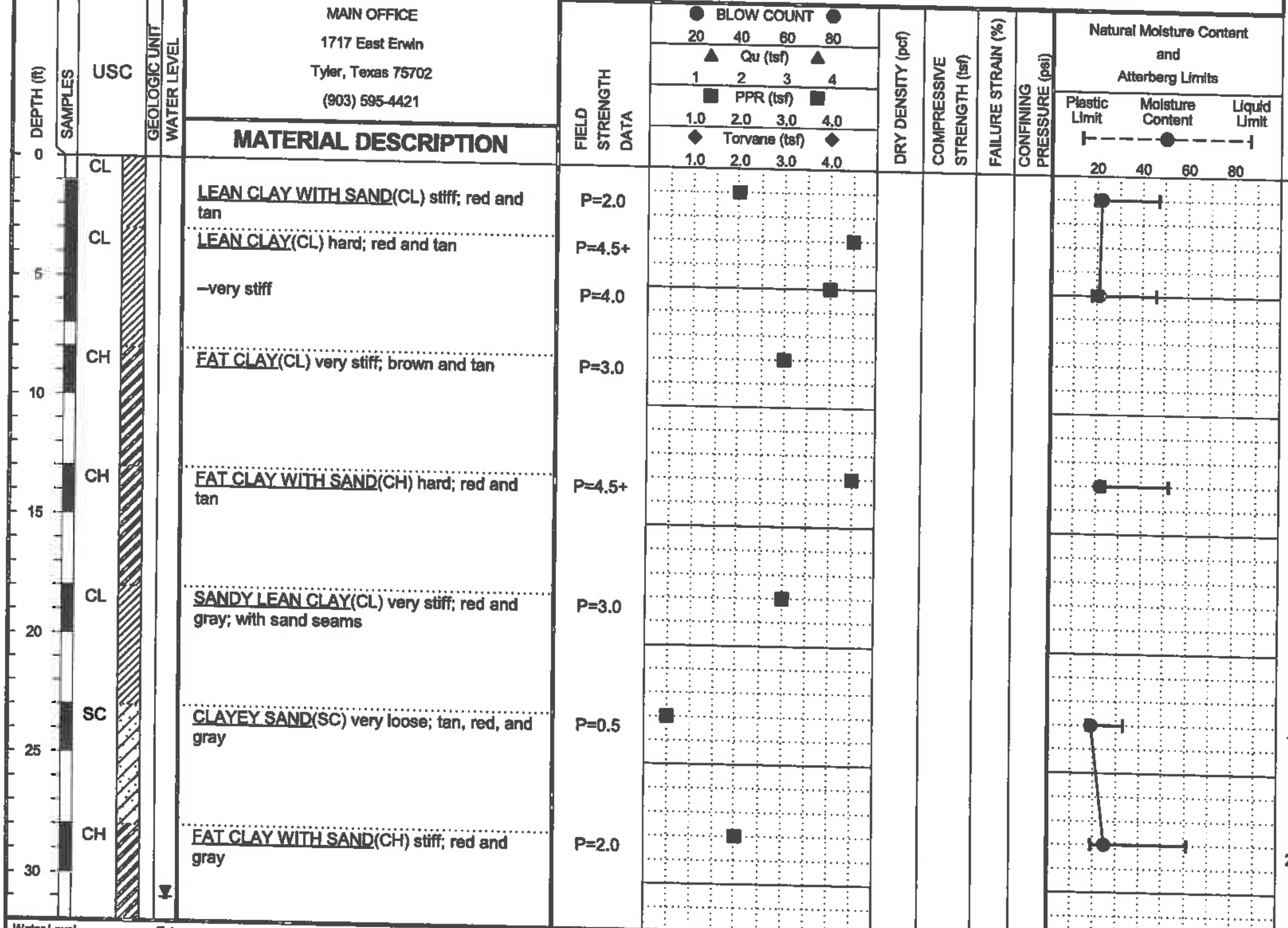
PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) stiff; red and tan	P=2.0	22	47	19	28	81	+40 Sieve=9%, +4 Sieve=3%
CL	LEAN CLAY(CL) hard; red and tan	P=4.5+						
	–very stiff	P=4.0	21	46	18	28	94	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY(CL) very stiff; brown and tan	P=3.0						
CH	FAT CLAY WITH SAND(CH) hard; red and tan	P=4.5+	22	52	24	28	88	+40 Sieve=3%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams	P=3.0						
SC	CLAYEY SAND(SC) very loose; tan, red, and gray	P=0.5	19	33	17	16	44	+40 Sieve=1%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) stiff; red and gray	P=2.0	25	61	19	42	83	+40 Sieve=5%, +4 Sieve=3%



Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

LOG OF BORING B-5

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

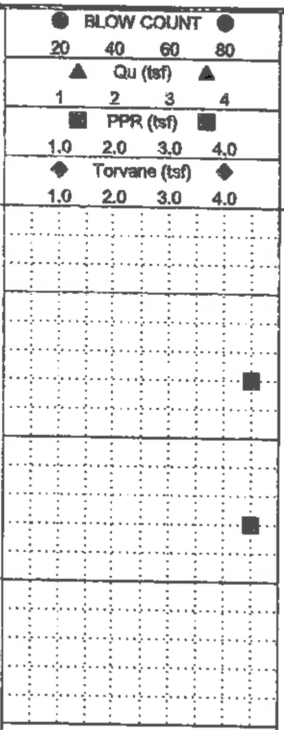
PROJECT NO.: G3242-09

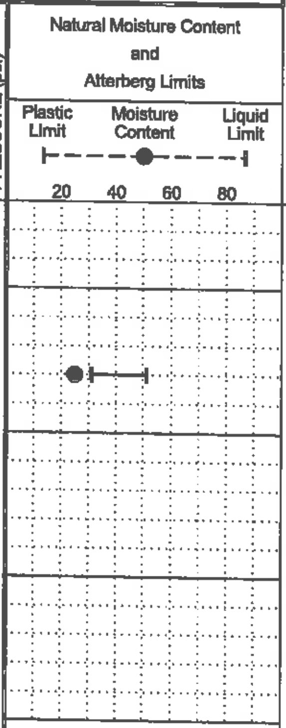
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	SC	SILTY CLAYEY SAND(SC) gray and red; saturated	SF										
40	CH	FAT CLAY(CH) hard; red and gray; with sand seams	P=4.5+					25	51	31	20	87	+40 Sieve=6%, +4 Sieve=0%
45		–gray, tan, and red; with sand seams	P=4.5+										
50	SM SC	SILTY SAND(SM-SC) red and gray	SF										
		Bottom of Boring @ 50'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

Rezoneker B-5

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-5

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description
0		Ground Surface
		LEAN CLAY WITH SAND(CL) stiff; red and tan
		LEAN CLAY(CL) hard; red and tan
5		--very stiff
		FAT CLAY(CL) very stiff; brown and tan
10		
		FAT CLAY WITH SAND(CH) hard; red and tan
15		
		SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams
20		
		CLAYEY SAND(SC) very loose; tan, red, and gray
25		

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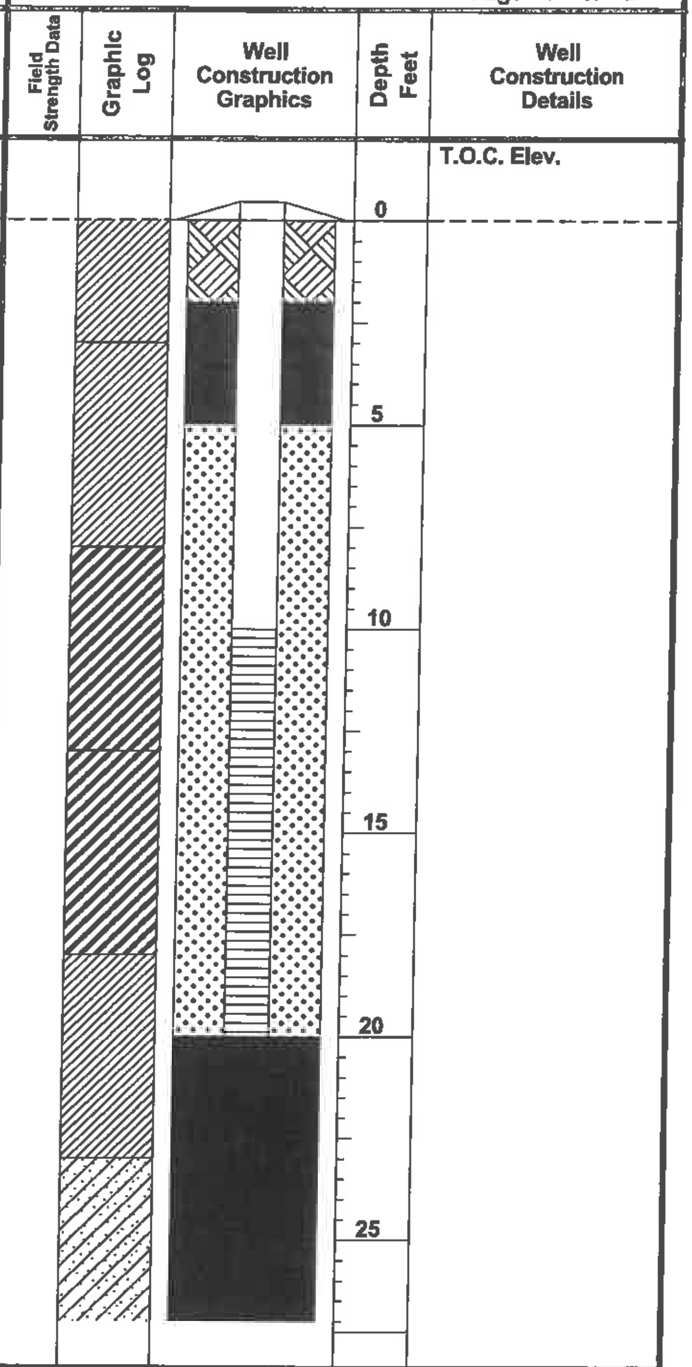


Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-5' & 20-50'

Filter Pack Qty. 5-20'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-5

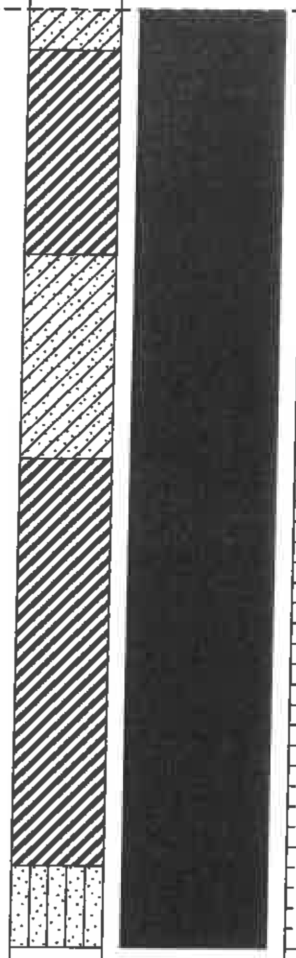
Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details

Continued from previous page



FAT CLAY WITH SAND(CH) stiff; red and gray

30

SILTY CLAYEY SAND(SC) gray and red; saturated

35

FAT CLAY(CH) hard; red and gray; with sand seams

40

–gray, tan, and red; with sand seams

45

SILTY SAND(SM-SC) red and gray

50

Bottom of Boring @ 50'

55

60

Piezometer B-6

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

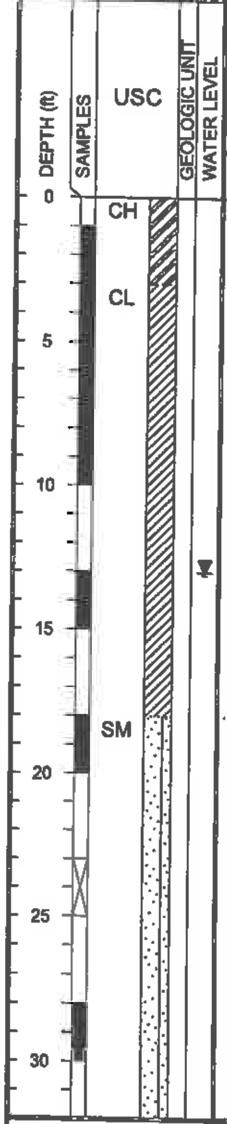
PROJECT: Welsh Power Plant
Pittsburgh, Texas

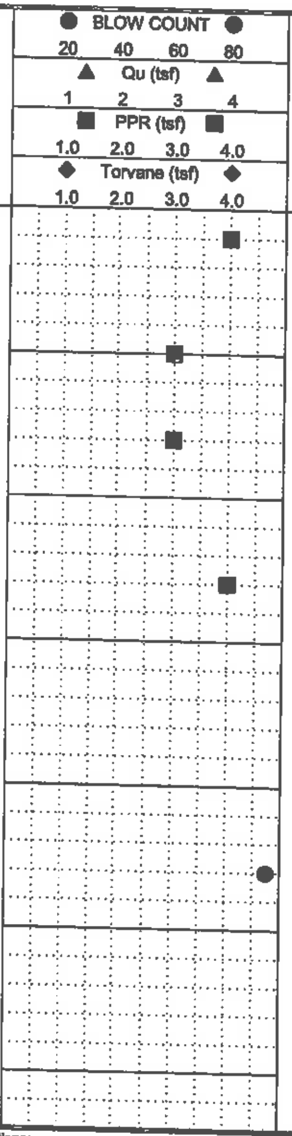
PROJECT NO.: G3242-09

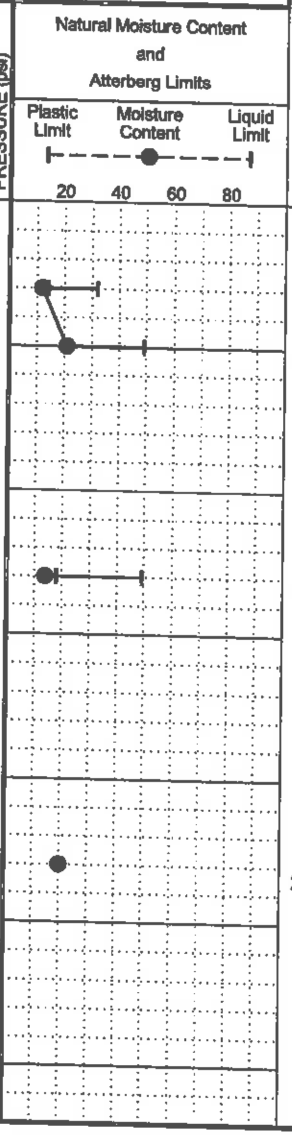
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1







MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
FAT CLAY(CH) very stiff; red and gray; with ferric seams	P=4.0										
SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+					12	32	14	18	60	+40 Sieve=0%, +4 Sieve=0%
	P=3.0					21	49	20	29	93	+40 Sieve=2%, +4 Sieve=0%
–very stiff; red, gray, and brown; with gravel –with sand seams	P=3.0										
	P=4.0					14	49	18	31	65	+40 Sieve=0%, +4 Sieve=0%
SILTY SAND(SM) gray; saturated	P=3.0										
–very dense; gray and red	N=50/5.25"					20				18	+40 Sieve=0%, +4 Sieve=0%
	SF										

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

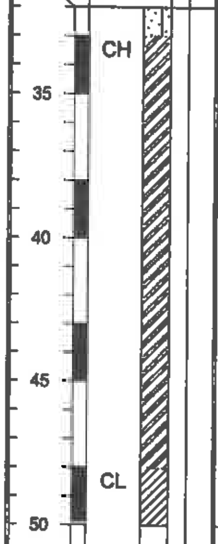
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

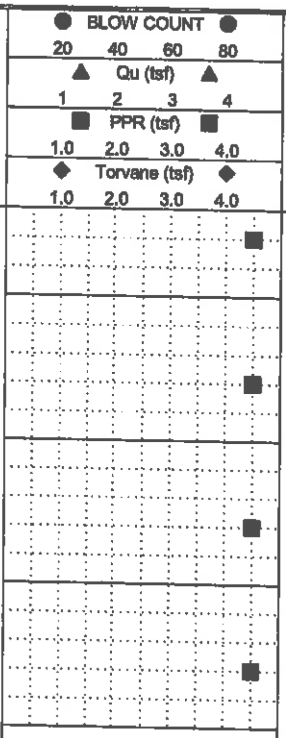
BORING TYPE: Flight Auger

DATE 10/27/09

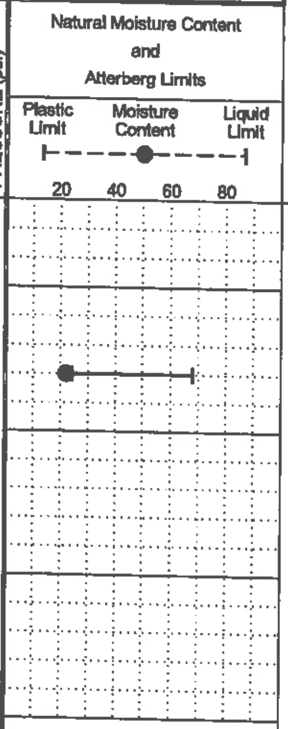
SURFACE ELEVATION 340.1



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY(CH) hard; brown; with sand seams	P=4.5+						
		P=4.5+	22	68	24	44	95	+40 Sieve=0%, +4 Sieve=0%
	--dark green	P=4.5+						
CL	LEAN CLAY(CL) hard; dark green; laminated with lignite	P=4.5+						
	Bottom of Boring @ 50'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

Piezometer B-6

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

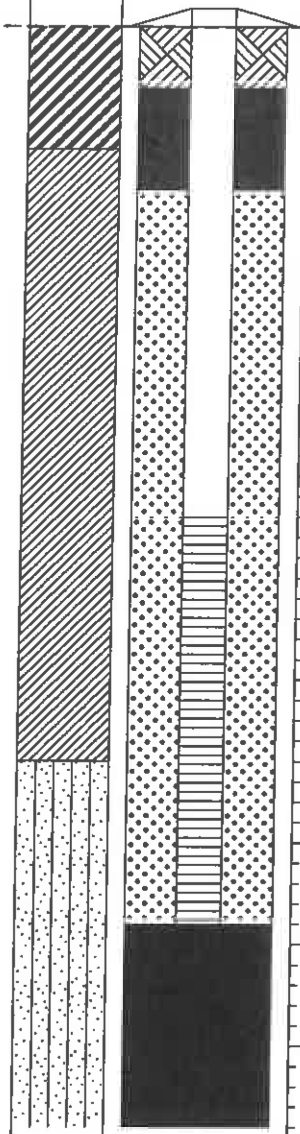
Well No. B-6

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		FAT CLAY(CH) very stiff; red and gray; with ferric seams					
		SANDY LEAN CLAY(CL) hard; red and tan					
5						5	
		–very stiff; red, gray, and brown; with gravel					
		–with sand seams					
10						10	
15						15	
		SILTY SAND(SM) gray; saturated					
20						20	
		–very dense; gray and red					
25						25	



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/28/09

Drilling Completed 10/28/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 12.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 12.0' **to** 22.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 1.5-4' & 22-50'

Filter Pack Qty. 4-22'

Filter Pack Type 20/40 Sand

Static Water Level

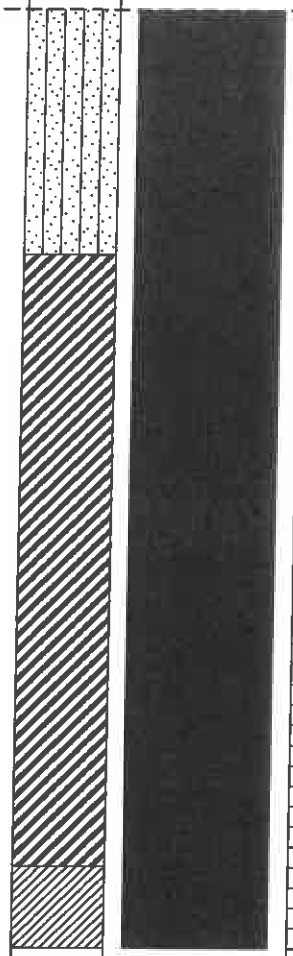
Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**

Well No. B-6
Location Pittsburg, Texas
Surface Elev.
Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
30						30	
		FAT CLAY(CH) hard; brown; with sand seams					
35						35	
40						40	
		--dark green					
45						45	
		LEAN CLAY(CL) hard; dark green; laminated with lignite					
50						50	
		Bottom of Boring @ 50'					
55							
60							



LOG OF BORING B-7

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

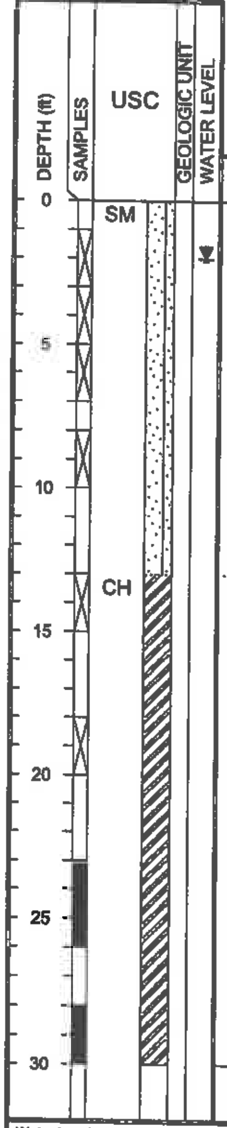
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

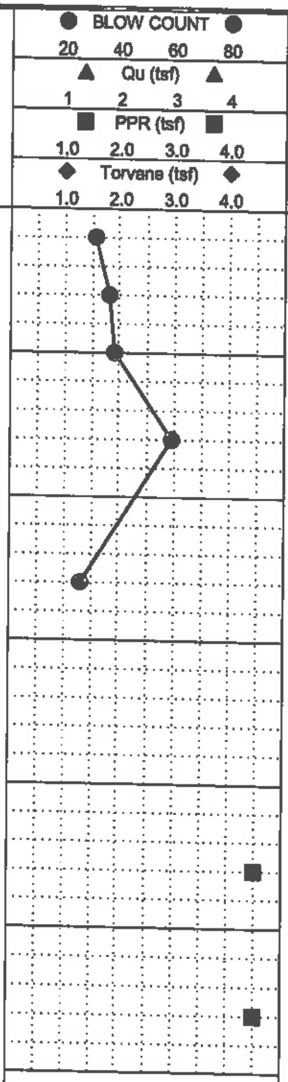
BORING TYPE: Flight Auger

DATE 10/27/09

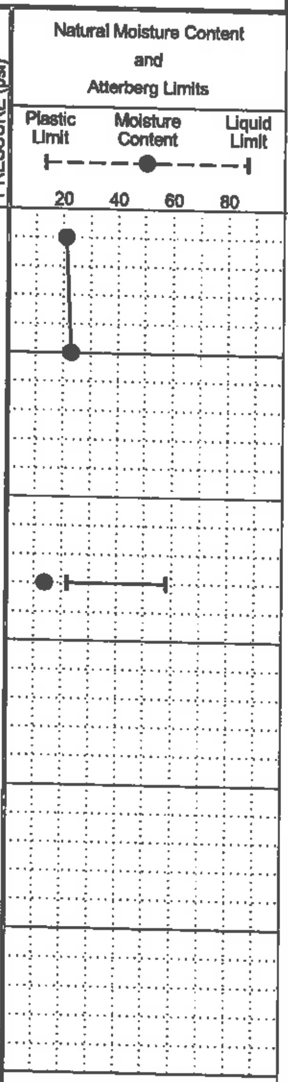
SURFACE ELEVATION 340.4



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SILTY SAND(SM) dense; tan	N=31	21				21	+40 Sieve=0%, +4 Sieve=0%
	N=36						
--gray; saturated	N=38	23				15	+40 Sieve=0%, +4 Sieve=0%
--very dense	N=59						
FAT CLAY(CH) very stiff; dark gray; with silt and ferric seams	N=26	14	58	22	36	98	+40 Sieve=0%, +4 Sieve=0%
--hard; gray and black; with trace of lignite	P=4.5+						
--gray							
	P=4.5+						
Bottom of Boring @ 30'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 4' while drilling. Water level @ 2' and open to 7' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.898', W 94°50.519'

Landfill Boring B-2

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

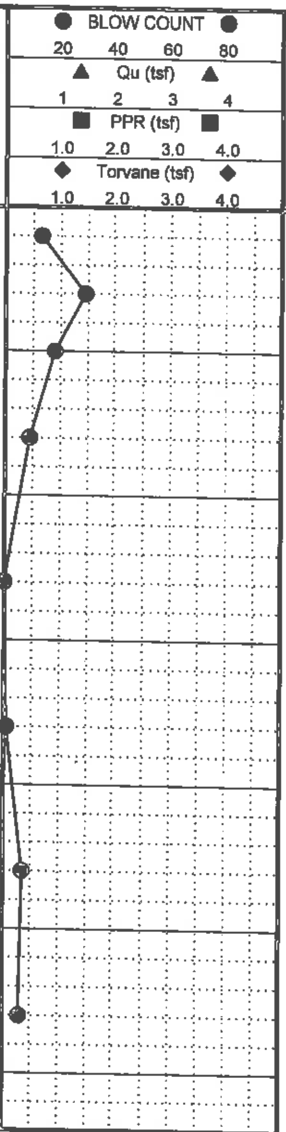
DRILL RIG: B-61 HDX

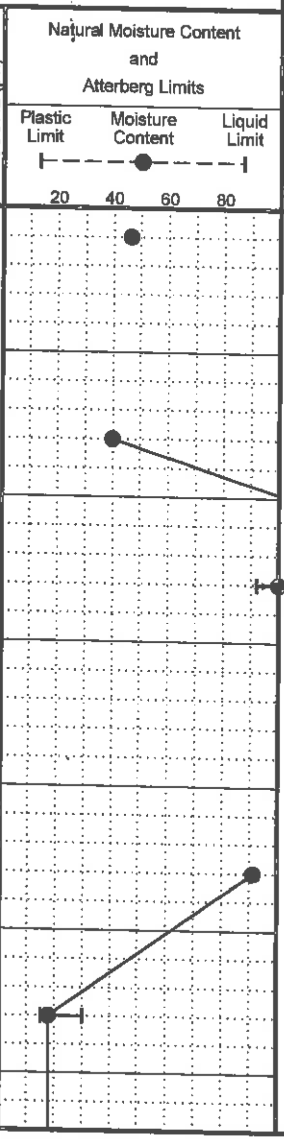
PROJECT NO.: G4207-146

BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14

SURFACE ELEVATION 373.8





DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	☒	ML SM	Eqc @ 28-43' & Er @ 43-60'		ASH (SILT WITH GRAVEL(ML)) medium dense; light grayish brown; with coarse-grained sand and lightly cemented gravel pieces; dry	N=13					46				59	+40 Sieve=27% +4 Sieve=16%
	☒					N=29										
5	☒				ASH (SILTY SAND(SM)) medium dense; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces	N=18										
10	☒				--loose; moist	N=9					40				40	+40 Sieve=19% +4 Sieve=2%
15	☒	MH		▼	ASH (ELASTIC SILT(MH)) very loose; black; with fine-grained sand and lightly cemented gravel pieces; saturated	N=0					200	134	92	42	100	+40 Sieve=0% +4 Sieve=0%
20	☒	SM			ASH (SILTY SAND(SM)) very loose; dark brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=1										
25	☒				--loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7					91				61	+40 Sieve=11% +4 Sieve=1%
30	☒	CL			SANDY LEAN CLAY(CL) medium stiff; dark brown and black; with fine-grained sand and cemented gravel pieces; saturated	N=6					18	30	15	15	63	+40 Sieve=1% +4 Sieve=0%

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

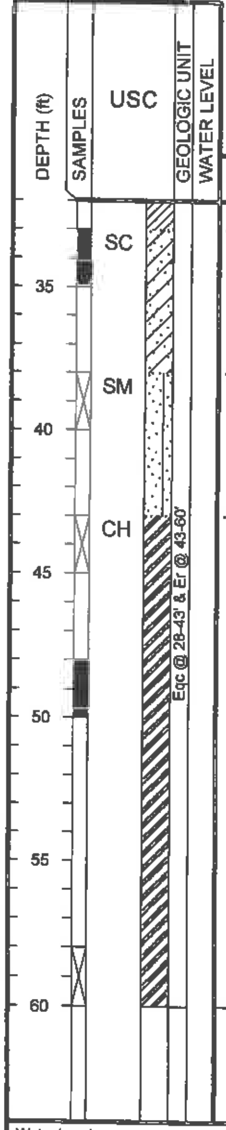
DRILL RIG: B-61 HDX

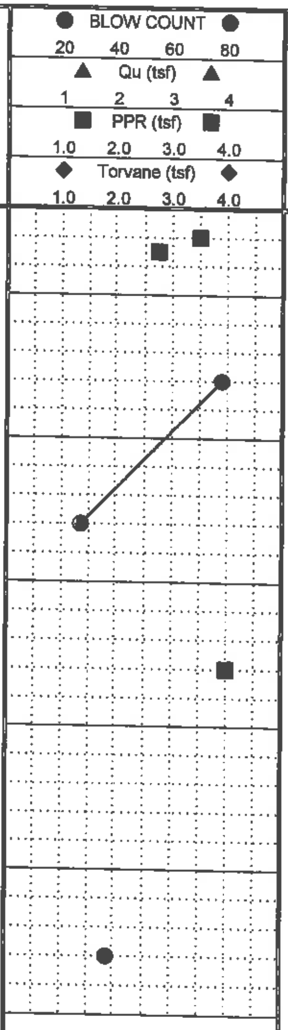
PROJECT NO.: G4207-146

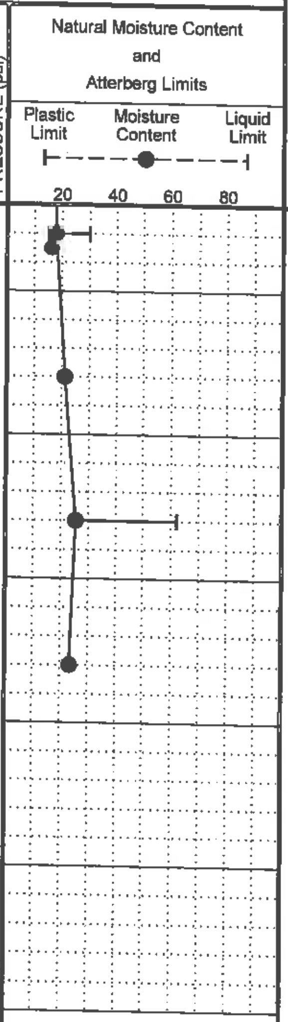
BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14

SURFACE ELEVATION 373.8







MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CLAYEY SAND(SC) dense; light brown, light gray and reddish brown; moist; with fine-grained sand; mottled	P=3.5 P=2.75	110	1.39	4.3	21	18 16	30	15	15	39	+40 Sieve=0% +4 Sieve=0%
SILTY SAND(SM) very dense; light brown, yellowish brown and light gray; moist; mottled; with fine-grained sand	N=78					21				24	+40 Sieve=0% +4 Sieve=0%
FAT CLAY(CH) very stiff; dark brown and light brown; moist; with sand seams; laminated	N=27					25	62	26	36	96	+40 Sieve=2% +4 Sieve=0%
--dark brown with light gray; moist; with silt seams	P=4.0	98				24					
--hard; dark brown; moist	N=37										
Bottom of Boring @ 60'											

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill boring B-10

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

BORING TYPE: Rotary Wash/Flight Auger

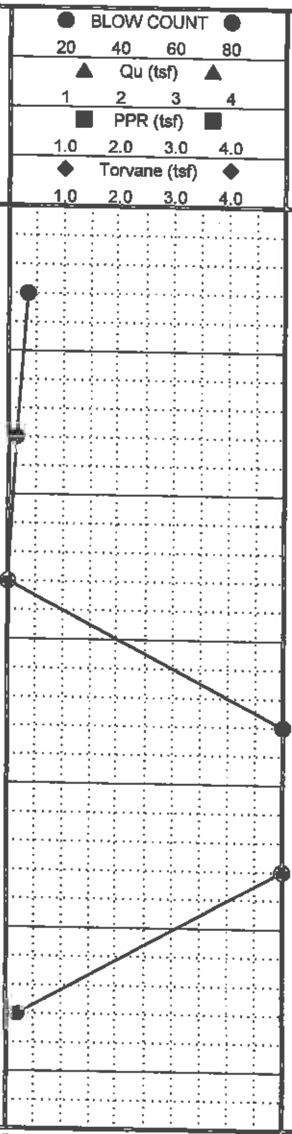
DATE 10/8/14

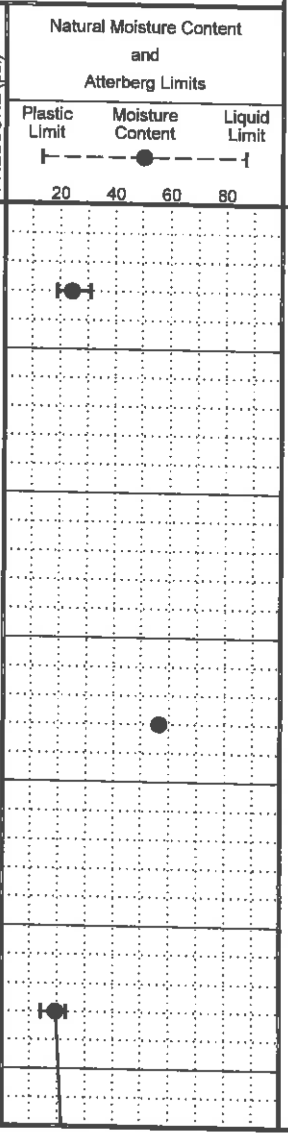
SURFACE ELEVATION 373.2

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0–9	SC	ASH (CLAYEY SAND(SC)) loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7					24	31	19	12	41	+40 Sieve=21% +4 Sieve=11%
9–17.5	MH	ASH (ELASTIC SILT(MH)) very loose; black; moist	N=3										
		--wet	N=0										
17.5–27	SM	ASH (SILTY SAND WITH GRAVEL(SM)) very dense; light brown and dark brown; with lightly cemented gravel pieces and coarse-grained sand; moist; cemented layer from 17.5' to 21'	N=50/1"					56				14	+40 Sieve=71% +4 Sieve=28%
		--cemented layer from 23' to 27'	N=50/4"										
27–	CL	SANDY LEAN CLAY(CL) medium stiff; grayish brown and yellowish brown; saturated; mottled	N=4					19	23	14	9	57	+40 Sieve=1% +4 Sieve=0%

GEOLOGIC UNIT: Egc @ 27-43' & Er @ 43-60'

WATER LEVEL: ▽ at 13'





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

ETTL
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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

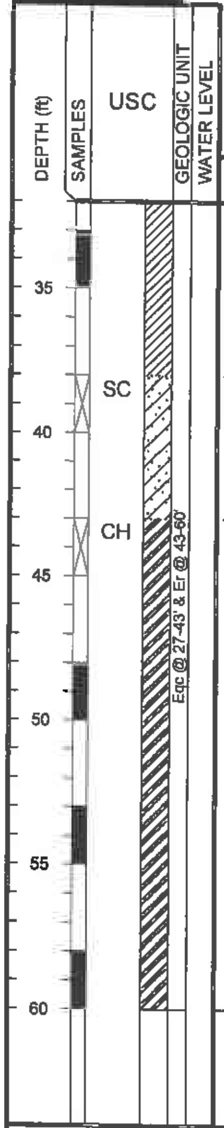
PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

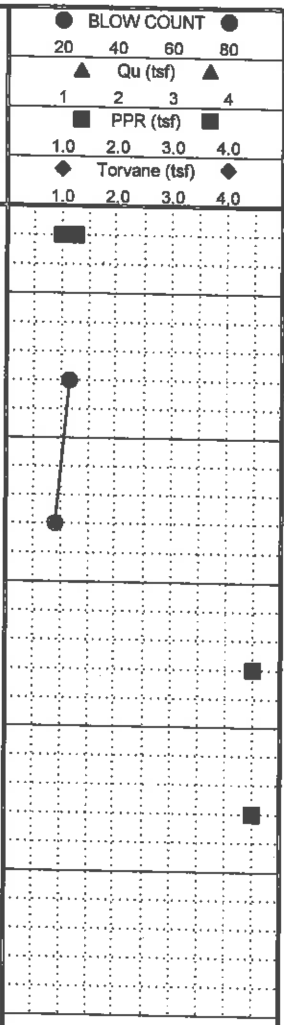
BORING TYPE: Rotary Wash/Flight Auger

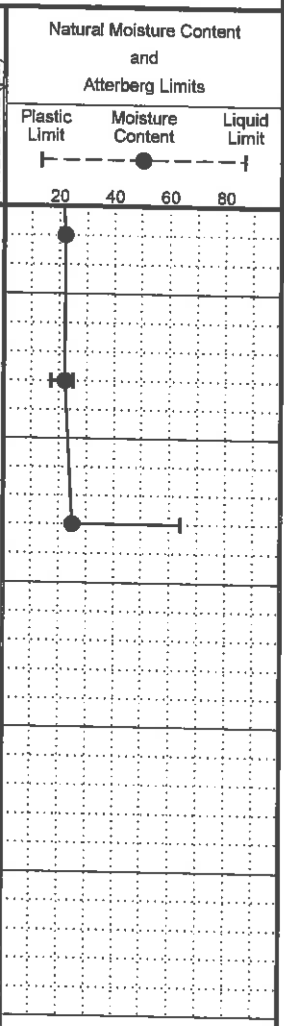
DATE 10/8/14

SURFACE ELEVATION 373.2



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	P=1.25 P=1.0	107	2.10	6.1	21	22					
CLAYEY SAND(SC) medium dense; reddish brown and grayish brown; moist; mottled	N=23					22	25	17	8	27	+40 Sieve=3% +4 Sieve=0%
FAT CLAY(CH) very stiff; dark brown with light gray; with silt seams; moist	N=18					25	64	24	40	90	+40 Sieve=7% +4 Sieve=0%
--hard	P=4.5+										
	P=4.5+										
Bottom of Boring @ 60'											





Water Level Est.: ▽ Measured: ▼ Parched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill Boring B-12

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-12

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

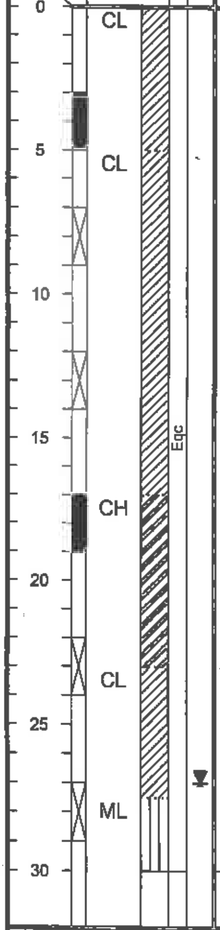
DRILL RIG:

PROJECT NO.: G4207-146

BORING TYPE: Flight Auger

DATE 10/15/14

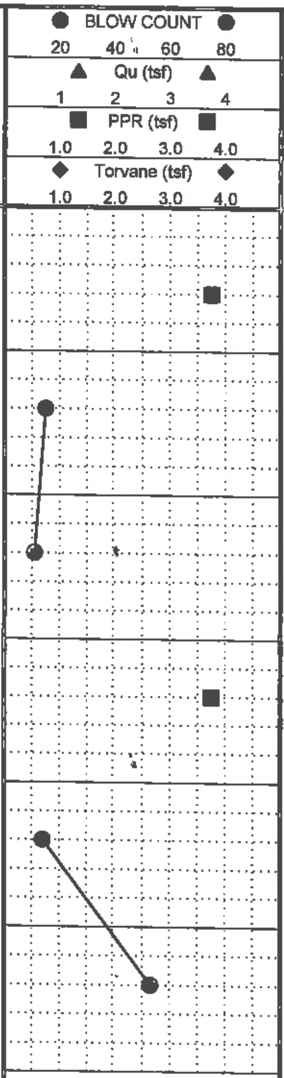
SURFACE ELEVATION 361.7



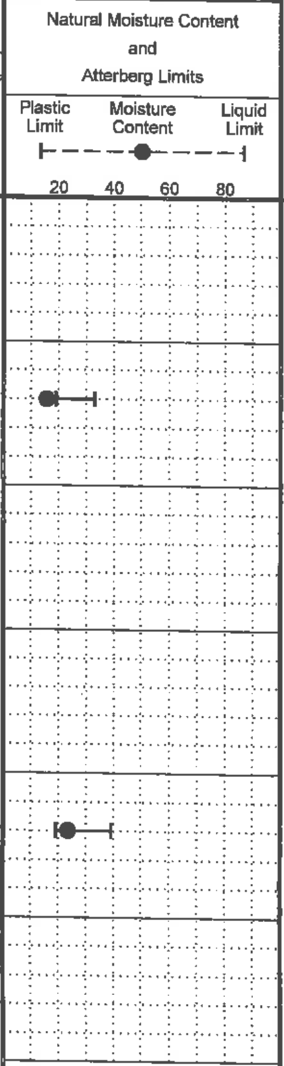
MATERIAL DESCRIPTION

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) stiff; light gray and reddish brown; moist; mottled	P=3.75						
CL	SANDY LEAN CLAY(CL) stiff; light brown, light gray and reddish brown; moist; mottled	N=15	16	33	19	14	58	+40 Sieve=1% +4 Sieve=0%
	--grayish brown and brown; moist	N=11						
CH	FAT CLAY WITH SAND(CH) stiff; light gray and reddish brown; moist; mottled; with ferric seams	P=3.75						
CL	LEAN CLAY(CL) stiff; light gray and brownish gray; moist; layered with silt	N=14	24	39	19	20	93	+40 Sieve=1% +4 Sieve=0%
ML	SILT WITH SAND(ML) very dense; light brown and yellowish brown; moist; with clay seams	N=53						

Bottom of Boring @ 30'



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 27' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04713°, W94.84486°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Land Fill Boring B-13

LOG OF BORING B-13

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

DRILL RIG:

PROJECT NO.: G4207-146

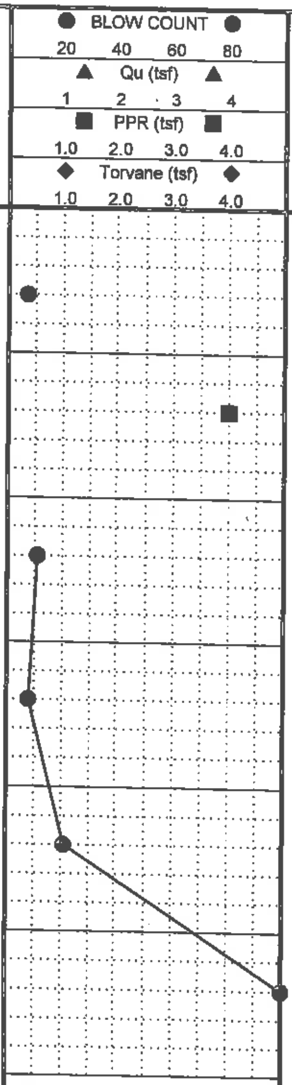
BORING TYPE: Flight Auger

DATE 10/15/14

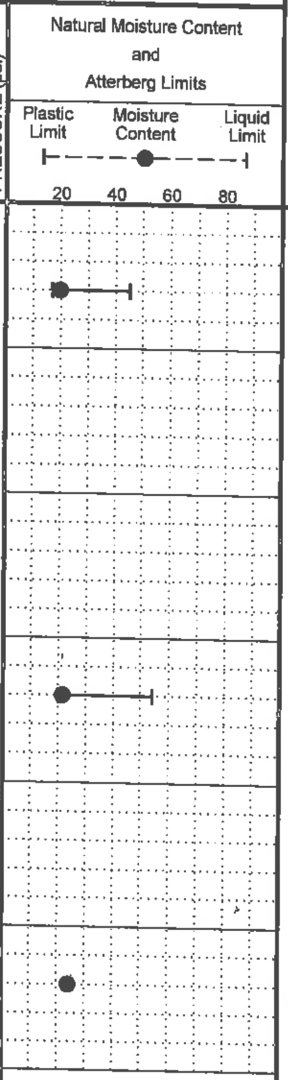
SURFACE ELEVATION 361.4

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	LEAN CLAY WITH SAND(CL) medium stiff; reddish brown with light gray; moist	N=7	20	45	17	28	76	+40 Sieve=1% +4 Sieve=0%
7	CL	SANDY LEAN CLAY(CL) very stiff; light brown, gray and reddish brown; moist; mottled	P=4.0						
11	SC	CLAYEY SAND(SC) medium dense; grayish brown; moist	N=11						
13	CH	FAT CLAY WITH SAND(CH) medium stiff; reddish brown and light gray; moist; mottled	N=8	22	54	20	34	79	+40 Sieve=1% +4 Sieve=0%
22	CL	LEAN CLAY(CL) very stiff; light gray and grayish brown; moist; layered with silt	N=21						
27	ML	SILT WITH SAND(ML) very dense; light gray and yellowish brown; wet; with clay seams	N=50/5"	24				80	+40 Sieve=0% +4 Sieve=0%
30		Bottom of Boring @ 30'							

GEOLOGIC UNIT: Eqc



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 28' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.047160°, W94.84384°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-14

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-14

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

DRILL RIG:

PROJECT NO.: G4207-146

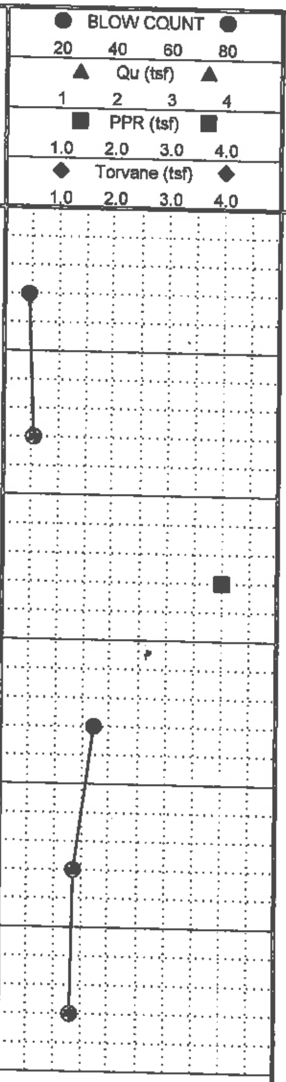
BORING TYPE: Flight Auger

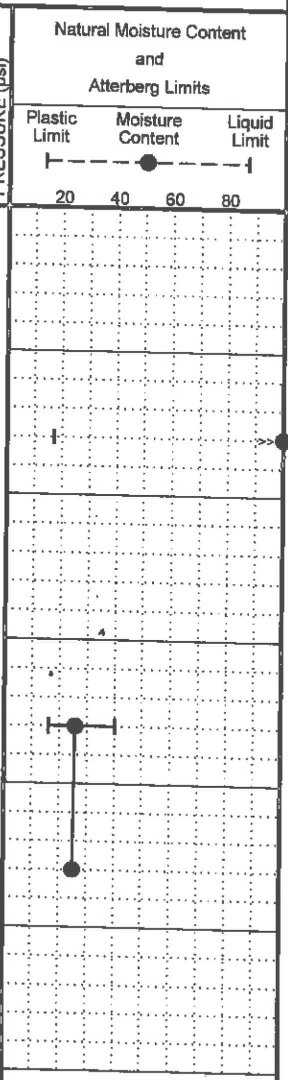
DATE 10/14/14

SURFACE ELEVATION 347.2

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	SANDY LEAN CLAY(CL) medium stiff; yellowish brown with reddish brown; dry; with clay seams	N=9										
	ML	SANDY SILT(ML) medium dense; grayish brown; moist; with clay seams	N=11					108	17	17	NP	68	+40 Sieve=1% +4 Sieve=1%
	CL	SANDY LEAN CLAY(CL) very stiff; light gray and gray; moist	P=4.0										
		–light gray and grayish brown; moist; layered with silt	N=34					26	40	16	24	67	+40 Sieve=1% +4 Sieve=0%
	SP SM	POORLY GRADED SAND WITH SILT(SP-SM) medium dense; yellowish brown, light gray and reddish brown; wet	N=27					25				10	+40 Sieve=0% +4 Sieve=0%
30	CL	LEAN CLAY(CL) very stiff; dark brown; moist; with silt partings	N=26										
		Bottom of Boring @ 30'											

Geologic unit: Eqc @ 0-28' & Er @ 28-30'





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 23' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04774°, W94.84290°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-15

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-15

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

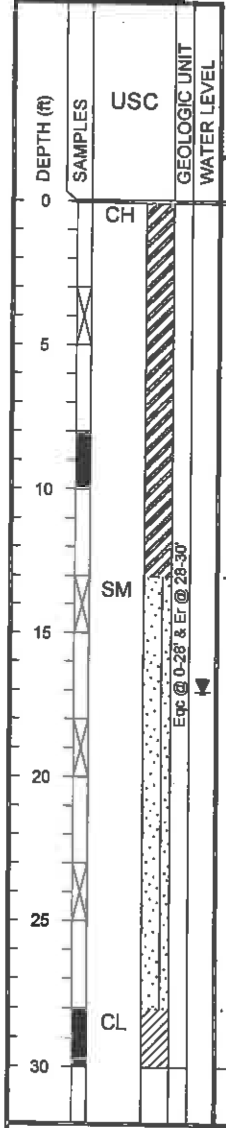
PROJECT NO.: G4207-146

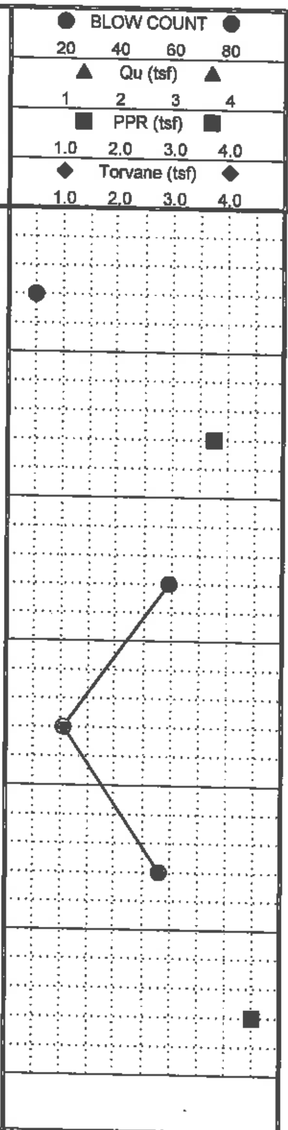
DRILL RIG:

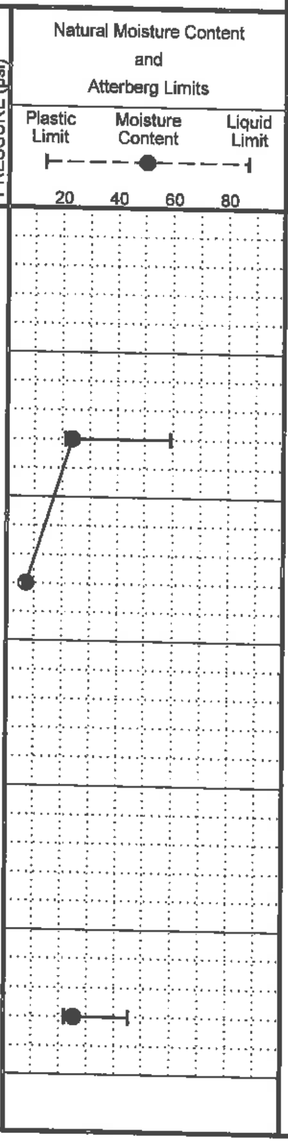
BORING TYPE: Flight Auger

DATE 10/14/14

SURFACE ELEVATION 348.2







MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
FAT CLAY(CH) stiff; reddish brown and light gray; moist; mottled	N=10										
--very stiff; light gray, grayish brown and reddish brown; moist; layered	P=3.75					24	59	21	38	85	+40 Sieve=0% +4 Sieve=0%
SILTY SAND(SM) very dense; light brown; dry	N=59					7				12	+40 Sieve=0% +4 Sieve=0%
--medium dense; wet	N=21										
--very dense	N=56										
LEAN CLAY(CL) hard; dark brown; moist; with silt partings	P=4.5					25	45	22	23	92	+40 Sieve=0% +4 Sieve=0%
Bottom of Boring @ 30'											

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 19' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04857°, W94.84286°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

ARCADIS

Appendix B

Photographic Log

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 1

Date: 8/20/2015

Direction Photo Taken:

North

Description:
Staging area west of landfill.

P8200493

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 2

Date: 8/20/2015

Direction Photo Taken:

South Southeast

Description:

Potential wetland on the top (west) end of the Primary Ash Pond.

P8200495

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – J. ROBERT WELSH POWER PLANT	PITTSBURG, TITUS COUNTY, TEXAS	OK001625.0001

Photo No. 3

Date: 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Ditch between road and railway west of landfill, this ditch would be non-jurisdictional.

P8200497

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – J. ROBERT WELSH POWER PLANT	PITTSBURG, TITUS COUNTY, TEXAS	OK001625.0001

Photo No. 4

Date: 8/20/2015

Direction Photo Taken:

Northeast

Description:

Ground Water Monitoring Well AD-12 near northwest end of landfill.

P8200501

ARCADIS

PHOTOGRAPHIC LOG

Project Name:

AEP – J. ROBERT WELSH POWER PLANT

Location:

PITTSBURG, TITUS COUNTY, TEXAS

Project No.

OK001625.0001

Photo No.

5

Date:

8/20/2015

Direction Photo Taken:

East Northeast

Description:

View of plant from top of landfill. Primary ash pond is within the wooded area on left.

P8200506

ARCADIS

PHOTOGRAPHIC LOG

Project Name:

AEP – J. ROBERT WELSH POWER PLANT

Location:

PITTSBURG, TITUS COUNTY, TEXAS

Project No.

OK001625.0001

Photo No.

6

Date:

8/20/2015

Direction Photo Taken:

East Northeast

Description:

Drainage canal that drains from primary ash pond to clear water pond.

P8200510

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 7

Date: 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Vegetated strip between landfill and road. This would be isolated due to lack of connectivity.

P8200521

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 8

Date: 8/20/2015

Direction Photo Taken:

North

Description:

Dike between landfill and primary ash pond. Facility in the background.

P8200522

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 9

Date: 8/20/2015

Direction Photo Taken:

West

Description:

Vegetated strip between landfill and road. This area would be isolated due to lack of connectivity.

P8200527

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 10

Date: 8/20/2015

Direction Photo Taken:

North Northeast

Description:

Road east of landfill running toward facility and clear water pond.

P8200530

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **11**	**Date:** 8/20/2015

Direction Photo Taken:

South

Description:

Top of landfill.

P8200534

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **12**	**Date:** 8/20/2015

Direction Photo Taken:

Southeast

Description:

View of lined bottom ash storage pond.

P8200538

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 13

Date: 8/20/2015

Direction Photo Taken:

Southeast

Description:

Lined bottom ash storage pond.

P8200545

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 14

Date: 8/20/2015

Direction Photo Taken:

South

Description:

Southside of lined bottom ash storage pond.

P8200547

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 15

Date: 8/20/2015

Direction Photo Taken:

West

Description:

East side of lined bottom ash storage pond.

P8200560

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 16

Date: 8/20/2015

Direction Photo Taken:

North

Description:

Upland with pine and ground water monitoring well AD-2 south of lined bottom ash storage pond.

P8200563

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 17

Date: 8/20/2015

Direction Photo Taken:

Description:

Outflow of water from plant into the northeast portion of the Primary Ash Pond.

P8200577

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 18

Date: 8/20/2015

Direction Photo Taken:

South Southwest

Description:

Northeast portion of primary ash pond, view facing south-southwest.

P8200578

American Electric Power Service Corporation

Landfill - CCR Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187 County Road 4865
Titus County
Pittsburg, Texas

February 5, 2018

ARCADIS

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

Kenneth J Brandner

Kenneth Brandner, P.E., P.G.
Senior Project Engineer

Matthew J. Lamb / KJB

Matthew J. Lamb
Project Manager

John Holm / DPL

John Holm, P.E.
Professional Engineer

Landfill - CCR Groundwater Monitoring Well Network Evaluation

J. Robert Welsh Power Plant
1187County Road 4865
Titus County
Pittsburg, Texas

Prepared for:
AEP

Prepared by:
ARCADIS U.S., Inc.
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Tel 614 985 9100
Fax 614 985 9170

Our Ref.:
OH015976.0011

Date:
February 5, 2018

Tables

Figures

Appendices

Acronyms and Abbreviation

AEP	American Electric Power Service Cooperation
amsl	above mean sea level
ARCADIS	ARCADIS U.S., Inc.
BAP	bottom ash pond
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
FAP	fly ash pond
FGD	flue gas desulfurization
ft	feet
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
PTI	Permit to Install
TDS	total dissolved solids

1. Objective

This report was prepared by ARCADIS U.S., Inc. (ARCADIS) for American Electric Power Service Corporation (AEP) to assess the adequacy of the groundwater monitoring well network included in the Coal Combustion Residual (CCR) requirements, as specified in Code of Federal Regulations (CFR) 40 CFR 257.91, for the existing landfill (CCR Unit) at the AEP J. Robert Welsh Generating Plant (Plant) located at 1187 County Road 4865 in Pittsburg, Titus County, Texas (**Figure 1**). The CCR requirements include an evaluation of the adequacy of the groundwater monitoring well network to characterize groundwater quality up and down gradient of the CCR unit.

Three regulated CCR units associated with the Plant were identified for review, which include the primary bottom ash pond, existing landfill, and bottom ash storage pond (**Figure 2**). This report summarizes the evaluation of the groundwater monitoring well network in the uppermost aquifer at the existing landfill (landfill). The evaluation of location restriction criteria is not included in this report and will be completed under separate cover.

This evaluation included a review of AEP-provided data associated with previously completed subsurface investigation activities in the vicinity of the landfill CCR unit, as well as publicly-available geologic and hydrogeologic data. This report also presents the current Conceptual Site Model based on all documents reviewed and will further describe the uppermost aquifer, include an evaluation of the adequacy of the existing monitoring well network, and provide recommendations for monitoring well augmentation, as necessary.

2. Background Information

This section provides background information for the AEP Welsh Generating Plant landfill.

2.1 Facility Location Description

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The landfill CCR unit is located approximately 2,000 feet southwest of the Plant generating units, directly south of the primary bottom ash pond CCR unit, and approximately 800 feet west of the Welsh Reservoir (**Figures 1** and **2**).

2.2 Description of Landfill CCR Unit

The following section will discuss the embankment configuration, area, volume, construction and operational history, and surface water control associated with the landfill.

2.2.1 Embankment Configuration

The landfill was placed into operation in approximately 1977, and is located in a topographically high area south of the primary bottom ash pond. The landfill is approximately 40 acres in size, and is located directly above native clayey soils. The base of the landfill ranges in elevation from approximately 355 feet amsl on the west side to 345 feet amsl on the east side. These landfill base elevations were confirmed by soil borings installed through the landfill in 2014 (ETTL, 2015).

The western two thirds of the landfill is used as a temporary storage and processing area for marketable CCR that is sold for beneficial reuse including road base material. The eastern third of the landfill is an approximate 13-acre active ash disposal area where ash is placed above the base of the landfill to a top surface elevation that currently ranges from approximately 364 to 380 feet amsl.

Ash material had previously been placed into the landfill against an earthen embankment with 2:1 side slopes (2 feet horizontal, 1 foot vertical). However, to reduce the potential for slope failure, the side slopes of the landfill embankment were re-graded to 3:1 (3 feet horizontal, 1 foot vertical) in 2010.

2.2.2 Area/Volume

The landfill occupies an area of approximately 40 acres. A capacity analysis of the landfill was conducted by AEP in 2008 (AEP, 2008). The capacity analysis concluded the landfill has a maximum ash storage capacity of approximately 1,770,000 cubic yards beyond April 2008. Based on soil borings installed through the landfill (ETTL, 2015), the maximum ash thickness is approximately 33 feet, and the average ash thickness within the 40-acre landfill is approximately 20 feet. This corresponds to a current ash volume of approximately 800 acre-feet (1,290,000 cubic yards).

2.2.3 Construction and Operational History

The AEP J. Robert Welsh Plant began operations in 1977 with three coal-fired generating units (Units 1, 2, and 3). Throughout the life of the generating plant, CCR materials (fly ash, bottom ash, economizer ash) have been generated. All of these byproducts were stored in the primary bottom ash pond and in the landfill that was constructed in the late 1970's. In 2000, the 22-acre bottom ash storage pond was installed south of the landfill (**Figure 3**).

The landfill received fly ash, bottom ash, and economizer ash from the generating plant. The ash was sluiced to the landfill between approximately 1982 and 2000. Currently, dry ash is trucked to the landfill. The landfill is also utilized for disposal of ash dredged from the bottom ash storage pond that was constructed in 2000. The ash is currently stored in the eastern third of the landfill, and the western two thirds of the landfill is currently used as a temporary storage and processing area for marketable ash material that is sold for beneficial reuse, loaded into trucks, and transported offsite for reuse (highway road base, etc.).

2.2.4 Surface Water Control

Surface water flow within the landfill is controlled by drainage ditches at the north and east toes of the landfill. Surface water in the drainage ditches flows to a culvert at the northeast corner of the landfill, then discharges into the primary ash pond directly north of the landfill.

2.3 Previous Investigations

The initial soils investigation for the site was provided in a 1973 report prepared by McClelland Engineers, Inc. entitled "*Soils Investigation, Welsh Power Plant, Cason,* *Texas*". This investigation included advancement of soil borings in the primary bottom ash pond area, and geotechnical soil testing to characterize the area encompassed by the primary bottom ash pond.

In 2001, five monitoring wells (AD-1 through AD-5) were installed in the area of the primary bottom ash pond and bottom ash storage pond to obtain hydrologic data for the uppermost water-bearing unit. Twelve additional monitoring wells (AD-4a, AD-4b, AD-4c, AD-6 through AD-14) were installed in the area of the primary bottom ash pond, bottom ash storage pond, and landfill by Eagle Environmental Services in 2009 to obtain more detailed hydrologic data for the uppermost water-bearing unit. Monitoring well completion diagrams are provided in **Appendix A.**

In 2015, ETTL conducted a *Geotechnical Investigation* of the Landfill (ETTL, 2015). The report concluded the risk of slope failure due to liquefaction is very low, and recommended regrading of the top surface of the existing ash at the southeast corner of the landfill to eliminate ponding of surface water. The report also recommended dredged ash be spread out to drain water prior to placement in the landfill, emplacement of a 3-foot-thick clay cap on the existing side slopes in the eastern third of the landfill on a 3:1 slope (3 feet horizontal, 1 foot vertical), and improve drainage along the toe of the eastern third of the landfill using either horizontal drains at the toe of the slope or trenches containing perforated pipe with a geotextile cover.

In December 2015, Auckland Consulting further expanded the groundwater monitoring well system at the Plant by installation of monitoring wells AD-15 through AD-18 (Auckland Consulting, 2016). Monitoring well completion diagrams are provided in **Appendix A.**

2.4 Hydrogeologic Setting

The site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently southeast. The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966).

These features are further illustrated on five lines of cross section that were prepared through the landfill area, with three lines trending from west to east (A-A'; B-B'; C-C'), and the other two lines trending from north to south (D-D'; E-E'). The cross section location map is included as **Figure 3** and the lines of cross section are included as **Figure** 4 (A-A') through **Figure 8** (E-E').

2.4.1 Climate and Water Budget

The climate of Titus County, Texas is moist subhumid. The average January temperature is 45˚ Fahrenheit (F), and the average July temperature is 82.9˚F. The mean annual growing season is 228 days (Broom, 1965). Average annual precipitation (including liquid water equivalent from snowfall) is approximately 47 inches according to weatherdb.com.

2.4.2 Regional and Local Geologic Setting

The Site is located on the outcrop of the Eocene-age Recklaw Formation, which consists of very fine to fine grained sand and clay (Flawn, 1966). The Recklaw Formation attains a thickness of approximately 110 feet in Titus County, and is underlain by the Eocene-age Carrizo Sand which consists of fine to coarse sand, silt, and clay (Broom, 1965). In the topographically low areas underling the Welsh Reservoir to the east of the landfill, Quarternary alluvial sediments associated with Swauano Creek are present (Flawn, 1966).

Detailed regional geologic characterization can be found in several published reports including Texas Water Commission Bulletin 6517 "*Ground-Water Resources of Camp, Franklin, Morris and Titus Counties, Texas*" (Broom, 1965), and The University of Texas at Austin Bureau of Economic Geology "*Geologic Atlas of Texas – Texarkana Sheet*" (Flawn, 1966).

Detailed regional and site geologic characterization can be found in the 2015 ETTL report entitled "*Geotechnical Investigation, Phase 1 Landfill Seepage Evaluation and Vertical Expansion, Pittsburg, Texas"* (ETTL, 2015).

2.4.3 Surface Water and Surface Water Groundwater Interactions

The Site is generally less than one-half mile from Swauano Creek, which was dammed near the southern end of the site during plant development to form the Welsh Reservoir. Groundwater flow direction at the Site is generally from west to east, following surface topography towards the Welsh Reservoir. The Welsh Reservoir is likely a gaining surface water feature, and groundwater elevations on site are higher than the normal stage elevation of the Welsh Reservoir (approximately 320 feet amsl).

Figure 9 and **Figure 10** are potentiometric surface maps for the uppermost aquifer at the Site based on March 2016 and February 2017 water level data, respectively. Water level elevations in the Site monitoring wells are summarized on **Table 1**. As shown on **Figures 9** and **10**, a hydraulic ridge is present in the uppermost aquifer in the area of monitoring well AD-12 at the west end of the landfill. Shallow groundwater flow often follows surface topography, and the hydraulic ridge location corresponds to a topographically high area of the Site. Shallow groundwater flow direction at the landfill is northeasterly to easterly toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.01 foot per foot. Shallow groundwater flow directly west of the landfill in the area of monitoring well AD-17 is westerly toward a topographically low-lying area west of monitoring well AD-17.

2.4.4 Water Users

A water well inventory conducted by Banks Information Solutions showed one water well within a ½-mile radius of the Site (Banks, 2013). The water well is located on-site to the northwest (up gradient) of the landfill, and was installed for Southwestern Electric Company in 1974 with screens from 515 to 535 feet below ground surface, and plugged at a later date.

3. Groundwater Monitoring Well Network Evaluation

The existing monitoring well network present at the Site was evaluated to determine if any of the wells were viable for continued use as part of the groundwater monitoring well network or also retained as part of a larger groundwater hydraulic monitoring well network. The hydrogeologic conditions were also evaluated to determine if the uppermost aquifer unit has an effective well network. The evaluation was completed in accordance with 40 CFR 257.91 to have an established monitoring well network that effectively monitors the uppermost aquifer upgradient and down gradient of the Site. The upgradient wells represent background groundwater quality and the down gradient wells are to be placed down gradient of the CCR unit boundary to monitor water quality.

3.1 Hydrostratigraphic Units

3.1.1 Horizontal and Vertical Position Relative to CCR Unit

Geologic data from soil borings and monitoring wells installed at the site show the uppermost aquifer in the area of the landfill is a very fine to fine grained clayey and silty sand stratum with an average thickness of approximately 10 feet that is located between an average elevation of approximately 325 and 335 feet amsl (**Appendix A**). The base of the landfill is at an elevation of approximately 345 to 355 feet amsl. This separation distance is further illustrated on cross section B-B’ (**Figure 5)** and cross section D-D’ (**Figure 7)**.

3.1.2 Overall Flow Conditions

Groundwater is recharged from regional precipitation infiltration and locally from ash pond use. The uppermost aquifer (clayey and silty sand) is expected to have a hydraulic conductivity of approximately 10^{-4} centimeters per second (Fetter, 1980). Based on the hydraulic conductivity and saturated thickness (approximately 10 feet), the yield of the uppermost aquifer is anticipated to exceed the TCEQ non-useable (Class 3) limit of 150 gallons per day (TCEQ, 2010).

Available groundwater elevations are summarized on **Table 1** for 2011 through 2017. The most recent comprehensive groundwater data set from February 2017 is depicted on **Figure 10**. A hydraulic ridge is present in the uppermost aquifer in the area of monitoring well AD-12 at the west end of the landfill. The hydraulic ridge extends northerly from AD-12 toward monitoring well AD-18, which is located hydraulically sidegradient of the landfill. Shallow groundwater flow direction at the landfill is easterly toward the Welsh Reservoir at an average hydraulic gradient of approximately 0.01 foot per foot. Shallow groundwater flow directly west of the landfill in the area of monitoring well AD-17 is westerly toward a topographically low-lying area west of monitoring well AD-17.

3.2 Uppermost Aquifer

3.2.1 CCR Rule Definition

The CCR rule definitions for an aquifer and the uppermost aquifer as specified in 40 CFR 257.53 indicates an aquifer is a geologic formation capable of yielding usable quantities of groundwater to wells or springs while an uppermost aquifer is defined as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers, that are hydraulically interconnected with this aquifer within the facility’s property boundary. Upper limit is measured at a point nearest to the natural groundwater surface to which the aquifer rises during the wet season.

3.2.1.1 Common Definitions

An aquifer is commonly defined as a geologic unit that stores and transmits water (readily or at sufficient flow rates) to supply wells and springs (USGS, 2015; Fetter, 2001). The uppermost aquifer is considered the first encountered aquifer below the CCR unit.

3.2.2 Identified Onsite Hydrostratigraphic Unit

The identified on-Site hydrostratigraphic unit in the area of the landfill is the very fine to fine grained clayey and silty sand stratum that is located between an elevation of approximately 325 and 335 feet amsl. This unit is not used locally for groundwater supply or industrial water use, but meets the TCEQ definition of a useable aquifer.

3.3 Review of Existing Monitoring Well Network

3.3.1 Overview

The Site was visited by ARCADIS and AEP personnel on August 20, 2015 to review existing well network conditions and locations. A well construction table that summarizes the location, ground surface elevation, borehole depth, installation date, and associated well construction details of the monitoring well network is included as **Table 2**. Photo documentation of the located wells during the August 20, 2015 site visit is provided in **Appendix B**.

Monitoring wells AD-11 through AD-14 were previously installed at the Site to monitor the uppermost aquifer (very fine to fine grained clayey and silty sand stratum) associated with the landfill. As discussed above in Section 3.1.1, the uppermost aquifer below the landfill is approximately 10 feet thick and is located between an elevation of approximately 325 and 335 feet amsl. In addition to these four monitoring wells, several soil borings were installed through the landfill as part of the ETTL geotechnical investigation of the landfill embankments (ETTL, 2015). These soil borings confirmed the presence of the uppermost aquifer beneath the landfill between an average elevation of approximately 325 and 335 feet amsl.

3.3.2 Gaps in Monitoring Network

As shown on the monitoring well completion diagrams in **Appendix A** and Geologic Cross Sections B-B’ (**Figure 5**) and E-E’ (**Figure 8**), existing monitoring wells AD-11, AD-13, and AD-14 are screened in the uppermost aquifer down gradient (east) of the landfill. These three monitoring wells will be utilized as down gradient monitoring wells for the landfill groundwater monitoring system. Existing monitoring wells AD-1 and AD-5 are screened in the uppermost aquifer south and north, respectively, of the landfill. As shown on **Figures 9** and **10**, the groundwater flow path at the landfill is easterly toward the Welsh Reservoir, and monitoring wells AD-1 and AD-5 are not within this groundwater flow path. Therefore, monitoring wells AD-1 and AD-5 will be utilized as background (upgradient) monitoring wells to collect background water quality data for the landfill.

As shown on **Figure 3** and Geologic Cross Section B-B’ (**Figure 5**), existing monitoring well AD-12 is located in the upgradient (west) portion of the landfill, but is located within the landfill boundaries as confirmed by the presence of ash material in the uppermost 10 feet of the boring. Therefore, due to the presence of ash material at the AD-12 location, this monitoring well will not be utilized as an upgradient monitoring well. This data gap was addressed by installation of new monitoring wells AD-17 and AD-18 outside of the landfill boundary approximately 500 feet west and 700 feet northwest, respectively, of monitoring well AD-12. As shown on **Figures 9** and **10**, monitoring well AD-17 is located west of the hydraulic ridge along the western boundary of the landfill that extends north toward monitoring well AD-18. Therefore, monitoring well AD-17 will be utilized as a background (upgradient) monitoring well for the landfill groundwater monitoring system. Monitoring well AD-18 is located along the hydraulic ridge in uppermost aquifer in the western portion of the Site, and is therefore side gradient of the landfill. Therefore, monitoring well MW-18 may be utilized as a piezometer to obtain water level data for the uppermost aquifer. With the addition of monitoring wells AD-17 and AD-18 during December 2015, there are no data gaps remaining in the groundwater monitoring system for the landfill.

4. Recommended Monitoring Network and PE Certification

The recommended modifications to the existing groundwater monitoring well network are intended to meet specifications stated in 40 CFR 257.91. Recommended wells are further discussed with respect to location to the landfill (upgradient or down gradient), well depth, and well construction. The recommended network would provide an improved understanding of groundwater quality, hydraulics, and groundwater flow at the landfill.

4.1 Recommended Monitoring Well Network Distribution

A total of three down gradient well locations (existing monitoring wells AD-11, AD-13 and AD-14) and three upgradient well locations (existing monitoring wells AD-1, AD-5 and AD-17) are recommended to establish a groundwater quality monitoring well network for the landfill. In addition, existing monitoring wells AD-12 and AD-18 may be utilized as piezometers to obtain additional groundwater flow direction and gradient data for the landfill.

4.1.1 Location

The recommended monitoring well network for groundwater quality of the uppermost aquifer at the landfill is summarized on **Table 3** and illustrated on **Figure 11.**

4.1.2 Depth

The screen depths for the monitoring wells recommended for inclusion in the monitoring network are within the shallow saturated sand stratum (uppermost aquifer) that occurs beneath the landfill between an average elevation of approximately 325 and 335 feet amsl. The screen elevations are presented in **Table 3**.

4.1.3 Well Construction

As discussed above in Section 3.3.2, the gap in the monitoring well network for the uppermost aquifer beneath the landfill was addressed by installation of monitoring wells AD-17 and AD-18 during December 2015. Monitoring wells AD-17 and AD-18 were installed by a Texas Department of Licensing and Regulation (TDLR)-licensed water well driller. Well construction data for the monitoring well network are summarized on **Tables 2** and **3**, and the monitoring well completion diagrams are provided in **Appendix A**.

4.2 Professional Engineer's Certification

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the proposed groundwater monitoring system will be adequate to meet the requirements of 40 CFR Part 257.91.

Kenneth J. Brandner
Printed Name of Registered Professional Engineer

Signature

KENNETH J. BRANDNER
69586

69586
Registration No.

TX
Registration State

2-5-18
Date

5. References

AEP. 2015. Soil Boring Logs AD-1 through AD-14.

Auckland Consulting LLC, “Monitoring Well Installation – 2015, Welsh Generating Station, Pittsburg, Texas”, January 26, 2016.

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Tables

Table 1
Water Level Data
AEP J. Robert Welsh Power Plant - CCR Storage Areas
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Screen		Bottom of Screen		6/7/2011	12/6/2011	5/2/2012	11/1/2012	5/14/2013	11/19/2013	5/12/2014	11/16/2014	5/12/2015	3/4/2016	5/26/2016	7/27/2016	10/19/2016	12/12/2016	1/17/2017	2/23/2017
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																												
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	357.57	25.0	1/11/01	Sch. 40 PVC	2	15.0	340.57	25.0	330.57	338.46	334.92	337.88	337.18	337.43	336.73	338.03	337.64	340.82	342.83	344.89	342.89	341.23	340.58	341.18	339.74
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	346.16	25.0	4/26/01	Sch. 40 PVC	2	15.0	329.16	25.0	319.16	330.16	329.07	330.00	329.26	329.83	329.70	330.09	329.69	332.56	332.32	---	---	---	---	---	---
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	333.10	17.0	4/26/01	Sch. 40 PVC	2	7.0	324.10	17.0	314.10	323.81	323.19	323.99	323.29	323.77	323.98	324.12	323.28	325.58	325.12	324.59	323.70	323.47	323.78	325.04	324.92
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	342.61	30.0	4/26/01	Sch. 40 PVC	2	19.0	321.61	29.0	311.61	324.81	324.84	324.62	324.40	324.74	325.52	325.44	325.13	327.00	326.90	---	---	---	---	---	---
AD-4a (a)	33.04527	94.84258	340.19	342.85	30.0	9/22/09	Sch. 40 PVC	2	20.0	320.19	30.0	310.19	325.01	324.19	325.24	322.90	324.86	324.68	325.64	325.34	327.19	327.12	---	---	---	---	---	---
AD-4b (a)	33.04531	94.84230	329.55	333.23	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.55	15.0	314.55	324.35	324.32	324.50	324.30	324.30	325.21	325.22	324.90	326.58	326.67	---	---	---	---	---	---
AD-4c (a)	33.04507	94.84244	329.15	333.28	15.0	9/23/09	Sch. 40 PVC	2	5.0	324.15	15.0	314.15	324.18	324.50	324.64	324.37	324.11	325.06	325.01	324.71	326.50	326.19	325.89	324.01	323.76	325.07	326.39	324.89
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	351.00	30.0	1/11/01	Sch. 40 PVC	2	20.0	329.00	30.0	319.00	336.34	336.58	336.82	336.99	336.78	336.47	336.80	336.01	339.07	338.04	337.62	337.24	337.74	337.01	338.34	336.17
AD-6 (a)	33.05235	94.84757	343.31	346.33	33.0	9/23/09	Sch. 40 PVC	2	23.0	320.31	33.0	310.31	333.04	333.02	332.83	333.02	333.11	332.81	333.11	332.81	333.38	334.00	---	---	---	---	---	---
AD-7 (a)	33.05257	94.84219	347.86	350.82	38.0	9/24/09	Sch. 40 PVC	2	28.0	319.86	38.0	309.86	334.32	334.12	334.19	334.20	334.13	334.58	333.77	333.98	334.09	333.61	---	---	---	---	---	---
AD-8 (a)	33.05187	94.84026	337.53	340.01	29.0	9/21/09	Sch. 40 PVC	2	16.0	321.53	26.0	311.53	325.41	324.09	325.69	325.15	325.79	325.75	325.98	325.77	326.05	325.70	325.68	325.05	325.29	325.92	326.76	324.27
AD-9 (a)	33.04995	94.84196	340.32	343.09	35.0	9/21/09	Sch. 40 PVC	2	20.0	320.32	35.0	305.32	328.46	328.53	328.63	328.44	328.74	329.38	NM	330.18	329.98	329.74	329.28	329.53	328.92	329.31	330.50	328.05
AD-10 (a)	33.04881	94.84047	340.23	343.01	35.0	9/22/09	Sch. 40 PVC	2	20.0	320.23	35.0	305.23	323.44	322.55	323.27	323.35	323.51	323.76	323.57	323.88	323.95	323.55	---	---	---	---	---	---
AD-11 (a)	33.04824	94.84177	339.61	342.18	20.0	9/22/09	Sch. 40 PVC	2	10.0	329.61	20.0	319.61	327.99	328.37	327.82	327.93	327.94	328.13	328.20	327.97	328.96	328.13	328.39	328.14	327.87	328.20	328.90	328.25
AD-12 (a)	33.04901	94.84977	366.27	369.33	30.0	9/24/09	Sch. 40 PVC	2	20.0	346.27	30.0	336.27	348.30	348.29	349.86	349.56	349.99	349.65	349.89	350.01	350.65	350.39	---	---	---	---	---	---
AD-13 (a)	33.04918	94.84275	344.12	347.00	20.0	9/22/09	Sch. 40 PVC	2	6.0	338.12	16.0	328.12	332.36	332.24	333.09	332.26	332.68	333.25	333.35	332.01	337.58	334.76	334.54	332.93	332.39	332.84	334.54	331.83
AD-14 (a)	33.04715	94.84256	342.32	345.43	19.0	9/22/09	Sch. 40 PVC	2	8.0	334.32	18.0	324.32	330.40	329.80	331.67	330.34	330.94	331.69	332.12	330.17	336.63	334.83	334.51	331.71	330.94	330.79	332.63	330.87
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	343.29	46.0	12/12/15	Sch. 40 PVC	2	25.5	314.71	45.5	294.71	---	---	---	---	---	---	---	---	---	322.14	321.93	321.28	321.42	321.71	321.64	322.81
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	353.97	21.0	12/10/15	Sch. 40 PVC	2	11.0	339.86	21.0	329.86	---	---	---	---	---	---	---	---	---	337.09	335.84	332.14	331.52	331.43	330.96	330.71
AD-16R(e)	33° 02' 49"	94° 50' 28.9"	350.55	353.49	27.0	4/12/17	Sch. 40 PVC	2	12.0	338.55	27.0	323.55	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	357.10	40.0	12/10/15	Sch. 40 PVC	2	24.0	329.99	39.0	314.99	---	---	---	---	---	---	---	---	---	334.64	334.26	334.30	334.45	334.64	334.05	333.94
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	349.28	29.0	12/11/15	Sch. 40 PVC	2	14.0	332.17	29.0	317.17	---	---	---	---	---	---	---	---	---	343.66	343.26	340.81	339.92	339.38	338.97	340.38
Piezometers																												
B-2 (b)	33° 03.078'	94° 50.449'	339.7	339.7	50.0	10/28/09	Sch. 40 PVC	2	10.0	329.70	20.0	319.70	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-4 (b)	33° 03.011'	94° 50.462'	340.6	340.6	50.0	10/27/09	Sch. 40 PVC	2	8.0	332.60	18.0	322.60	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-5 (b)	33° 02.964'	94° 50.428'	340.0	340.0	50.0	10/27/09	Sch. 40 PVC	2	10.0	330.00	20.0	320.00	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
B-6 (b)	33° 02.912'	94° 50.462'	340.1	340.1	50.0	10/28/09	Sch. 40 PVC	2	12.0	328.10	22.0	318.10	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

NM - Not measured.
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.
(e) Monitoring well installed by ARCADIS on April 12, 2017 as a replacement for monitoring well AD-16.
Groundwater Elevation Source: AEP, Shallow Groundwater Data Summary through February 2017.

Table 2
Well Construction Details
AEP J. Robert Welsh Power Plant - CCR Units
Pittsburg, Titus County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Filter Pack		Bottom of Filter Pack		Top of Screen		Bottom of Screen	
								Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl
Monitoring Wells															
AD-1 (c)	33° 02' 48"	94° 50' 47"	355.57	25.0	1/11/2001	PVC	2	13	343	25	331	15.0	340.57	25.0	330.57
AD-2 (c)	33° 02' 37"	94° 50' 44"	344.16	25.0	4/26/2001	PVC	2	12	332	25	319	15.0	329.16	25.0	319.16
AD-3 (c)	33° 02' 38"	94° 50' 37"	331.10	17.0	4/26/2001	PVC	2	5	326	17	314	7.0	324.10	17.0	314.10
AD-4 (c)	33° 02' 43"	94° 50' 33"	340.61	30.0	4/26/2001	PVC	2	16	325	30	311	19.0	321.61	29.0	311.61
AD-4a (a)	33.04527	94.84258	340.19	30.0	9/22/2009	PVC	2	17	323	30	310	20.0	320.19	30.0	310.19
AD-4b (a)	33.04531	94.84230	329.55	15.0	9/23/2009	PVC	2	4	326	15	315	5.0	324.55	15.0	314.55
AD-4c (a)	33.04507	94.84244	329.15	15.0	9/23/2009	PVC	2	4	325	15	314	5.0	324.15	15.0	314.15
AD-5 (c)	33° 03' 13"	94° 51' 00"	349.00	30.0	1/11/2001	PVC	2	16	333	30	319	20.0	329.00	30.0	319.00
AD-6 (a)	33.05235	94.84757	343.31	33.0	9/23/2009	PVC	2	21	322	33	310	23.0	320.31	33.0	310.31
AD-7 (a)	33.05257	94.84219	347.86	38.0	9/24/2009	PVC	2	26	322	38	310	28.0	319.86	38.0	309.86
AD-8 (a)	33.05187	94.84026	337.53	29.0	9/21/2009	PVC	2	14	324	29	309	16.0	321.53	26.0	311.53
AD-9 (a)	33.04995	94.84196	340.32	35.0	9/21/2009	PVC	2	18	322	35	305	20.0	320.32	35.0	305.32
AD-10 (a)	33.04881	94.84047	340.23	35.0	9/22/2009	PVC	2	18	322	35	305	20.0	320.23	35.0	305.23
AD-11 (a)	33.04824	94.84177	339.61	20.0	9/22/2009	PVC	2	8	332	20	320	10.0	329.61	20.0	319.61
AD-12 (a)	33.04901	94.84977	366.27	30.0	9/24/2009	PVC	2	18	348	30	336	20.0	346.27	30.0	336.27
AD-13 (a)	33.04918	94.84275	344.12	20.0	9/22/2009	PVC	2	4	340	20	324	6.0	338.12	16.0	328.12
AD-14 (a)	33.04715	94.84256	342.32	19.0	9/22/2009	PVC	2	6	336	18	324	8.0	334.32	18.0	324.32
AD-15 (d)	33° 03' 04"	94° 50' 27"	340.21	46.0	12/12/15	PVC	2	22	318	45.5	295	25.5	314.71	45.5	294.71
AD-16R	33° 02' 49"	94° 50' 29"	350.55	27.0	4/12/17	PVC	2	10	341	27	324	12.0	338.55	27.0	323.55
AD-17 (d)	33° 02' 57"	94° 51' 06"	353.99	40.0	12/10/15	PVC	2	22	332	39	315	24.0	329.99	39.0	314.99
AD-18 (d)	33° 03' 03"	94° 51' 03"	346.17	29.0	12/11/15	PVC	2	12	334	29	317	14.0	332.17	29.0	317.17
Piezometers															
B-2 (b)	33° 03.078'	94° 50.449'	339.7	50.0	10/28/2009	PVC	2	8	332	20	320	10.0	329.70	20.0	319.70
B-4 (b)	33° 03.011'	94° 50.462'	340.6	50.0	10/27/2009	PVC	2	8	333	18	323	8.0	332.60	18.0	322.60
B-5 (b)	33° 02.964'	94° 50.428'	340.0	50.0	10/27/2009	PVC	2	5	335	20	320	10.0	330.00	20.0	320.00
B-6 (b)	33° 02.912'	94° 50.462'	340.1	50.0	10/28/2009	PVC	2	4	336	22	318	12.0	328.10	22.0	318.10
AD-16 (d)	33° 02' 49"	94° 50' 29"	350.86	21.0	12/10/15	PVC	2	9	342	21	330	11.0	339.86	21.0	329.86

General Notes:
Elevation in feet above mean sea level.

Footnotes:
(a) Source: Eagle Environmental Services Well Logs (2009).
(b) Source: ETTL Engineers & Consultants Inc. (June 21, 2010).
(c) Source: Southwest Electric Power, State of Texas Well Report (2001).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-15 through AD-18 installed during December 2015.

Acronyms and Abbreviations:
NA = Data not available
ft = feet
bls = below land surface
msl = mean sea level

Table 3
Proposed Well Network
AEP J. Robert Welsh Power Plant - Landfill
Pittsburg, Titus County, Texas

Well ID	Exisiting/ Proposed	Hydrostratigraphic Unit Target	Location Description		Screen Top Target Elevation[(a)] (ft amsl)	Screen Bottom Target Elevation[(a)] (ft amsl)	Screen Length (ft)	Comments
Upgradient								
AD-1	Existing	Uppermost Water-Bearing Unit	South of Landfill	Upgradient	340.6	330.6	10	Existing well installed in 2001; well will be utilitzed to establish backgroud water quality
AD-5	Existing	Uppermost Water-Bearing Unit	NW of Landfill	Upgradient	329.0	319.0	10	Existing well installed in 2001; well will be utilitzed to establish backgroud water quality
AD-17	Existing	Uppermost Water-Bearing Unit	West of Landfill	Upgradient	330.0	315.0	15	New monitoring well installed during December 2015 in uppermost shallow aquifer west of Landfill - upgradient; well will be utilized to establish background water quality
Downgradient								
AD-11	Existing	Uppermost Water-Bearing Unit	East of Landfill	Down gradient	329.6	319.6	10	Existing well installed in 2009; uppermost shallow aquifer adjacent to the landfill - downgradient
AD-13	Existing	Uppermost Water-Bearing Unit	East of Landfill	Down gradient	338.1	328.1	10	Existing well installed in 2009; uppermost shallow aquifer adjacent to the landfill - downgradient
AD-14	Existing	Uppermost Water-Bearing Unit	East of Landfill	Down gradient	334.3	324.3	10	Existing well installed in 2009; uppermost shallow aquifer adjacent to the landfill - downgradient
Piezometers								
AD-12	Existing	Uppermost Water-Bearing Unit	Within Landfill Boundary	Upgradient	346.3	336.3	10	Existing well installed in 2009; and utilitzed to obtain water level data for uppermost water-bearing unit
AD-18	Existing	Uppermost Water-Bearing Unit	NW of Landfill	Side gradient	332.2	317.2	15	New monitoring well installed during December 2015 in uppermost shallow aquifer sidegradient of Landfill: will be utilized to obtain water level data for uppermost water-bearing unit.

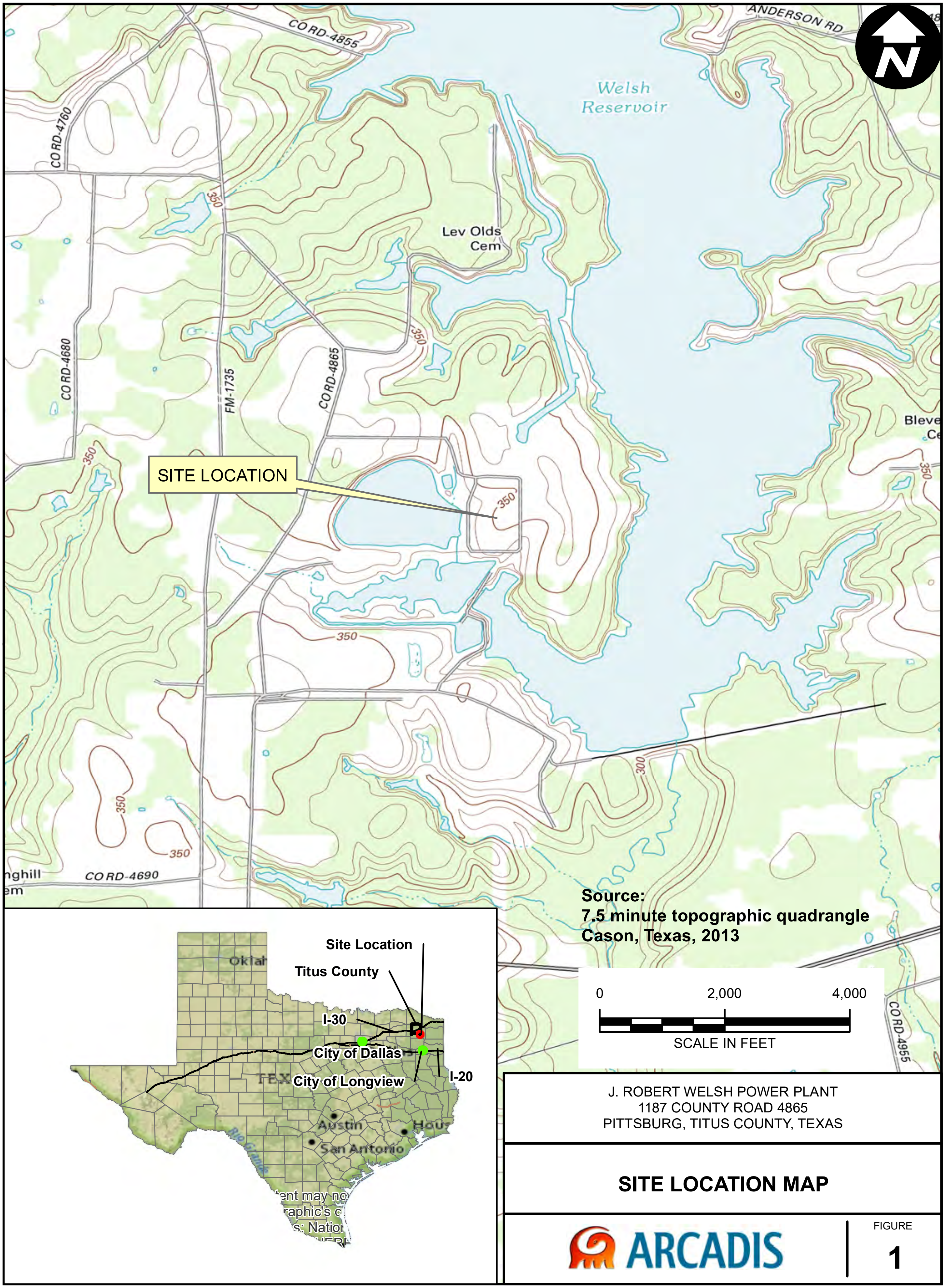
Footnotes:

a. Target elevations are an estimated range.

Acronyms and Abbreviations:

U=Upgradient
D=Downgradient
ft = feet
amsl = above mean sea level

Figures



Source:
7.5 minute topographic quadrangle
Cason, Texas, 2013

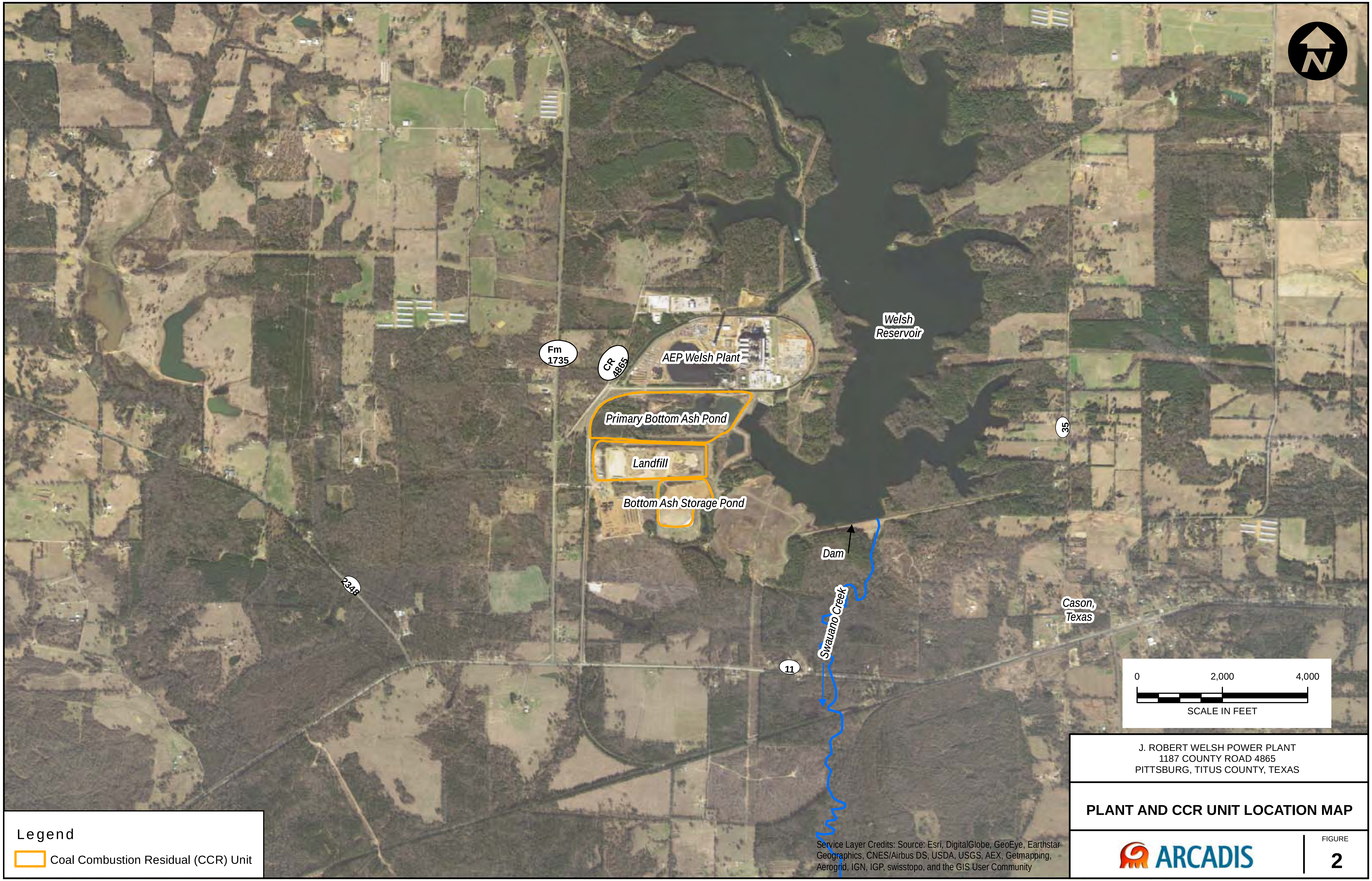
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LOCATION MAP

ARCADIS

FIGURE
1

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 1 - site map.mxd



Legend

▭ Coal Combustion Residual (CCR) Unit

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

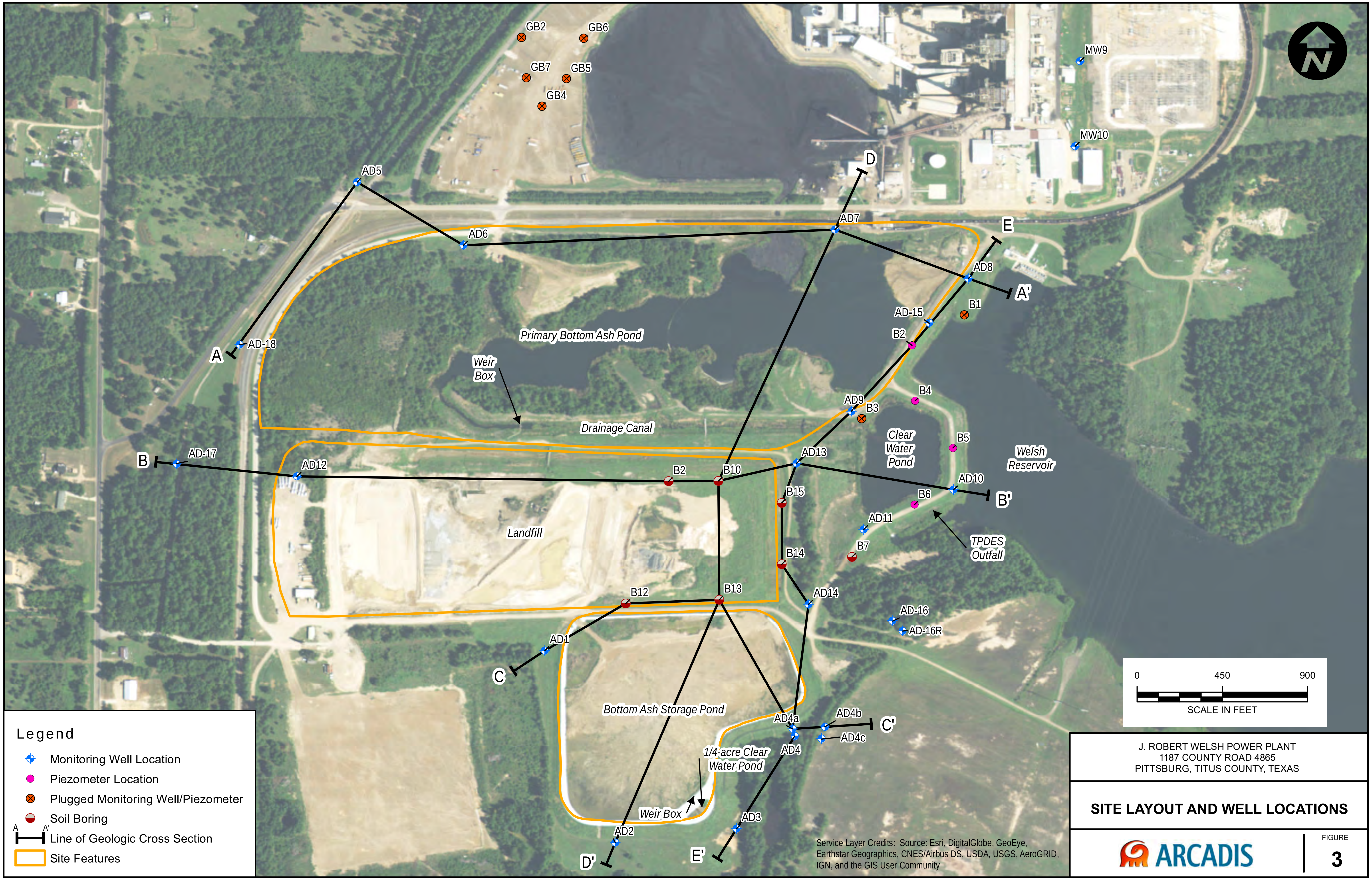
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PLANT AND CCR UNIT LOCATION MAP

ARCADIS

FIGURE
2

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 2 - CCR location.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

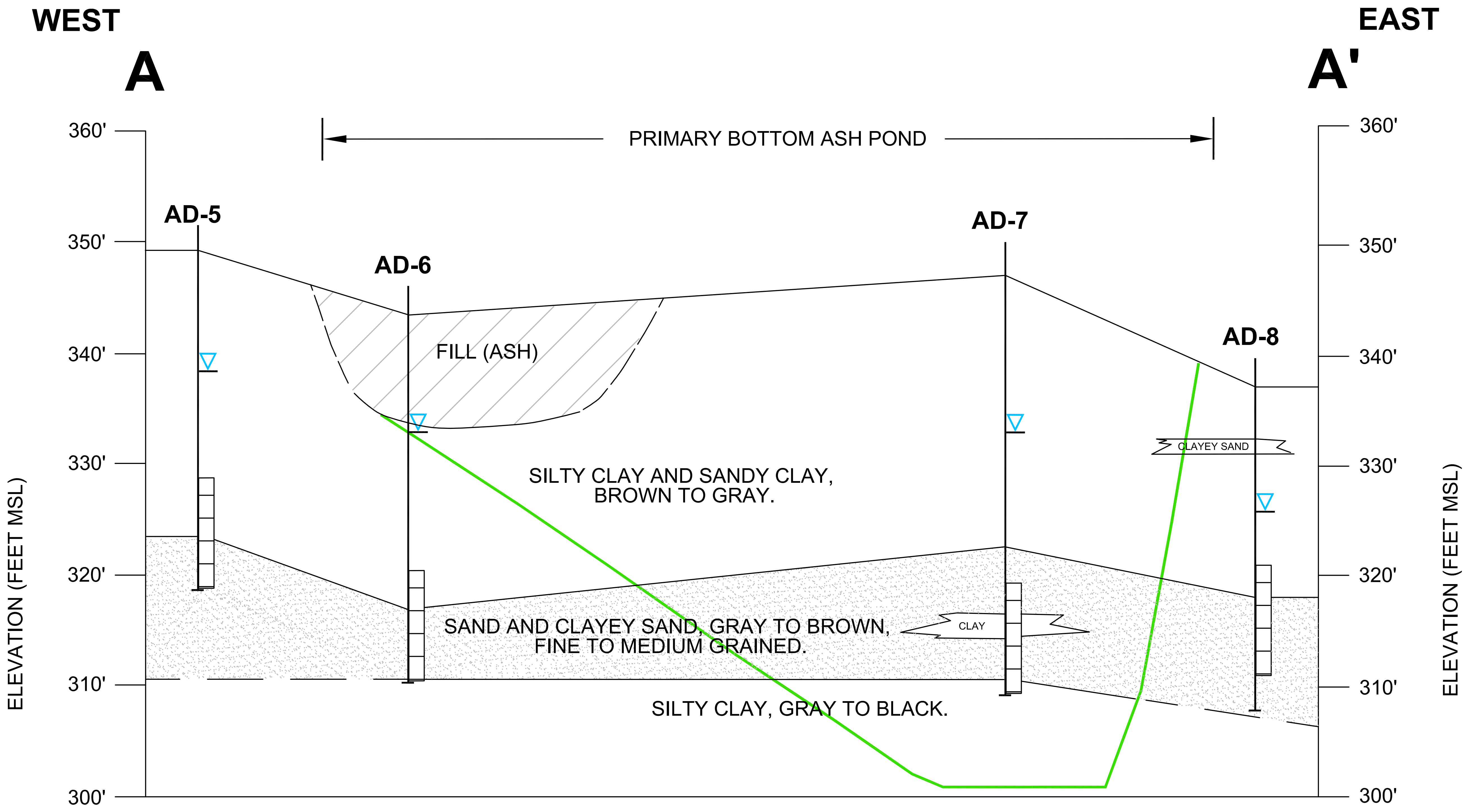
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

SITE LAYOUT AND WELL LOCATIONS

ARCADIS

FIGURE
3

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 3 - site layout.mxd



0 ▬▬ 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

⌸	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (5/12/15)
▬	PROJECTED BASE OF ASH POND (SEE NOTE)

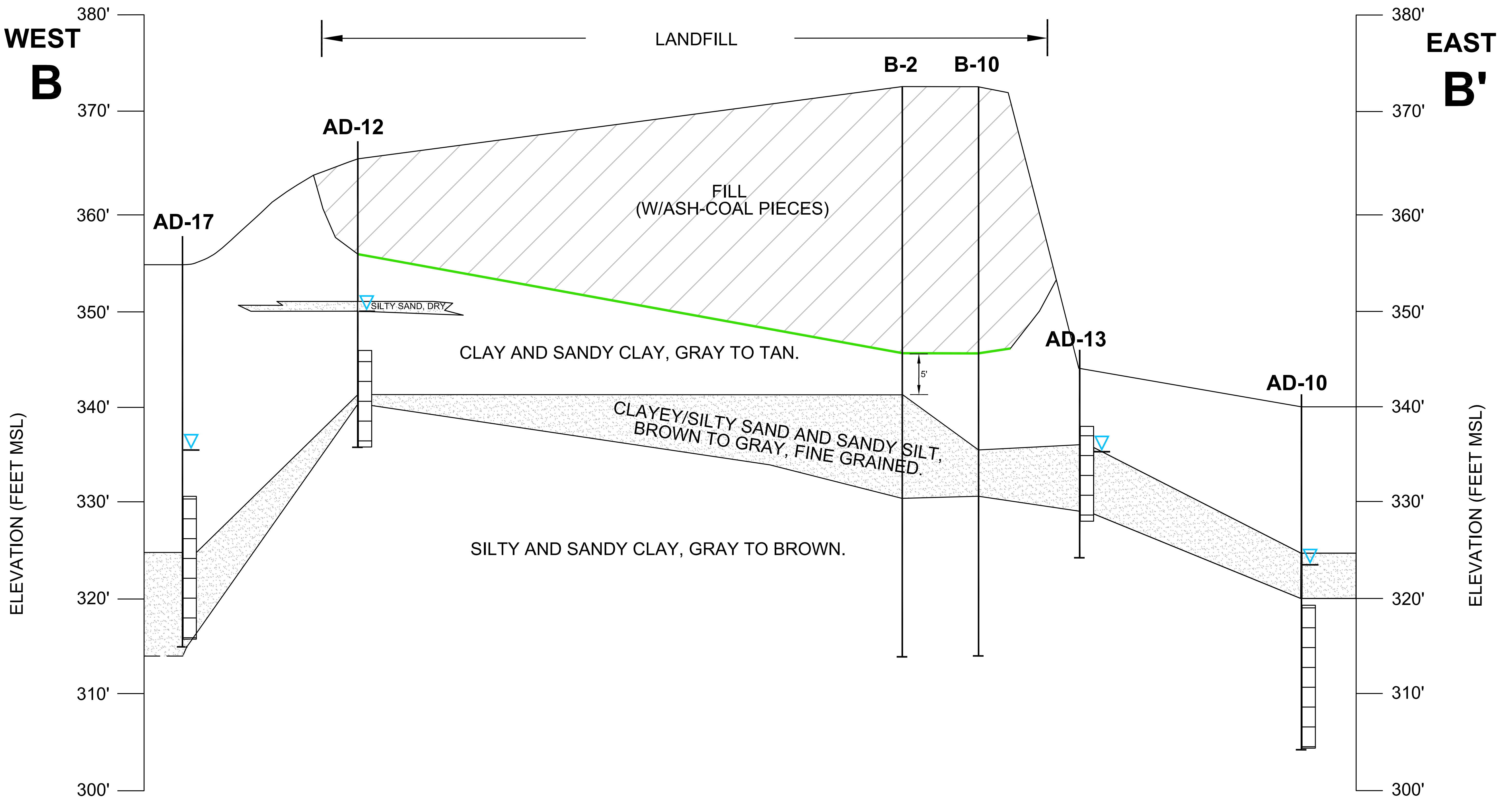
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
A - A'

ARCADIS

FIGURE
4

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond WELL Network Evaluation\Figures-Maps\Figure 4 Cross Section A-A'.dwg LAYOUT: MODEL SAVED: 8/26/2015 9:53 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE:
---- PLOTTED: 6/23/2016 10:35 AM BY: LEASE, DIANA



0 ▬▬▭ 300'
HORIZONTAL SCALE

NOTE: BASE OF LANDFILL ELEVATION TAKEN FROM "WELSH POWER PLANT- UNIT 1 FLY ASH STORAGE AREA PHASE I" DRAWING ID WEPX-88, DATED 12/3/76.

LEGEND

⊟	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
🟩	BASE OF LANDFILL (SEE NOTE)

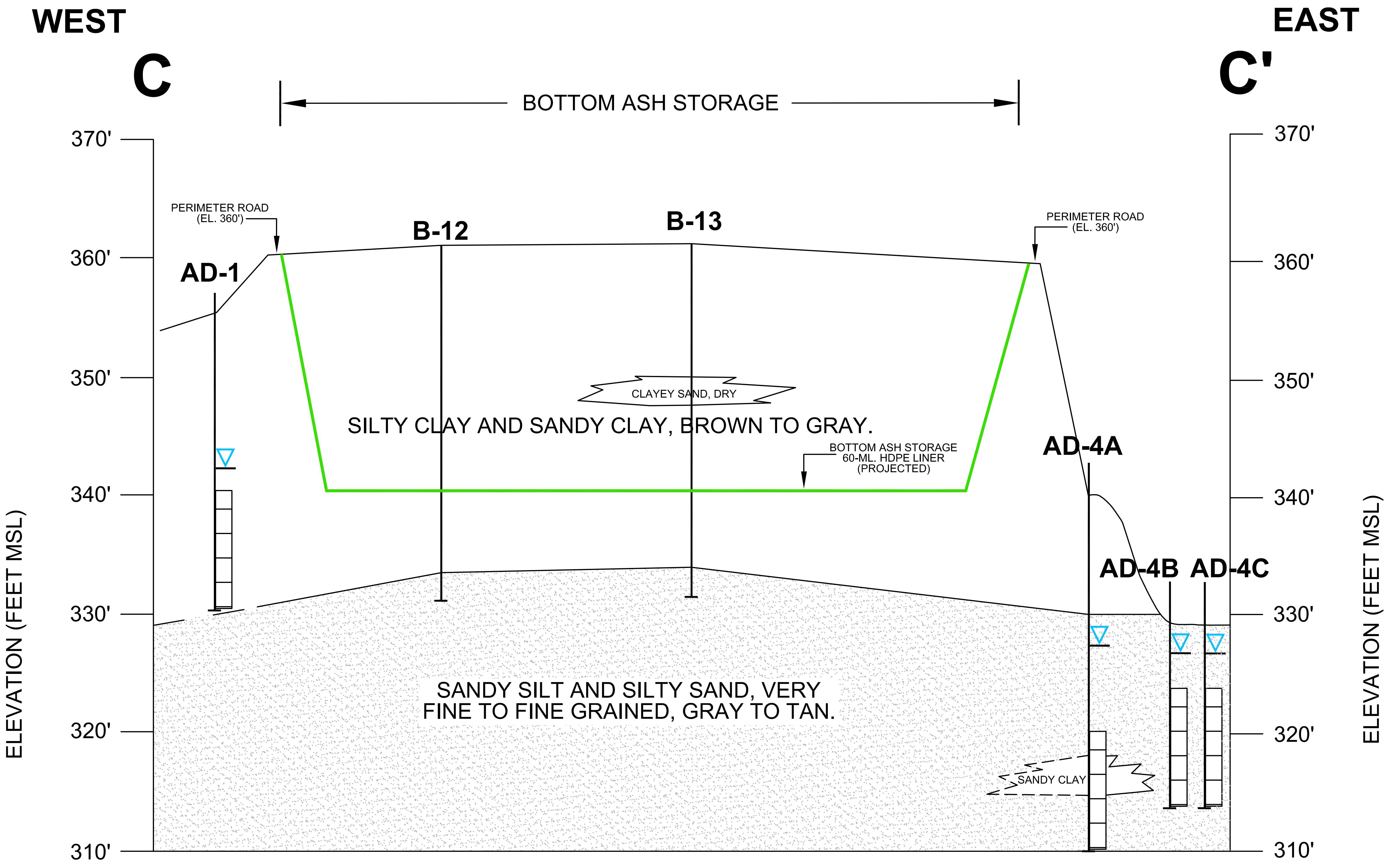
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
B - B'

ARCADIS

FIGURE
5

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 5 Cross Section B-B'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:41 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ----
PLOTTED: 3/11/2016 12:33 PM BY: LEASE, DIANA



0 200'
HORIZONTAL SCALE

NOTE: BASE OF BOTTOM ASH STORAGE HAS A 60-ML. HDPE LINER AT ELEVATION 340.0' , TAKEN FROM FREESE AND NICHOLS "HYDRAULIC ANALYSIS OF WELSH POWER PLANT ASH PONDS, AMERICAN ELECTRIC POWER COMPANY", DATED DECEMBER 2010.

LEGEND

▭	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (3/4/16)
🟩	PROJECTED BASE OF ASH STORAGE (SEE NOTE)

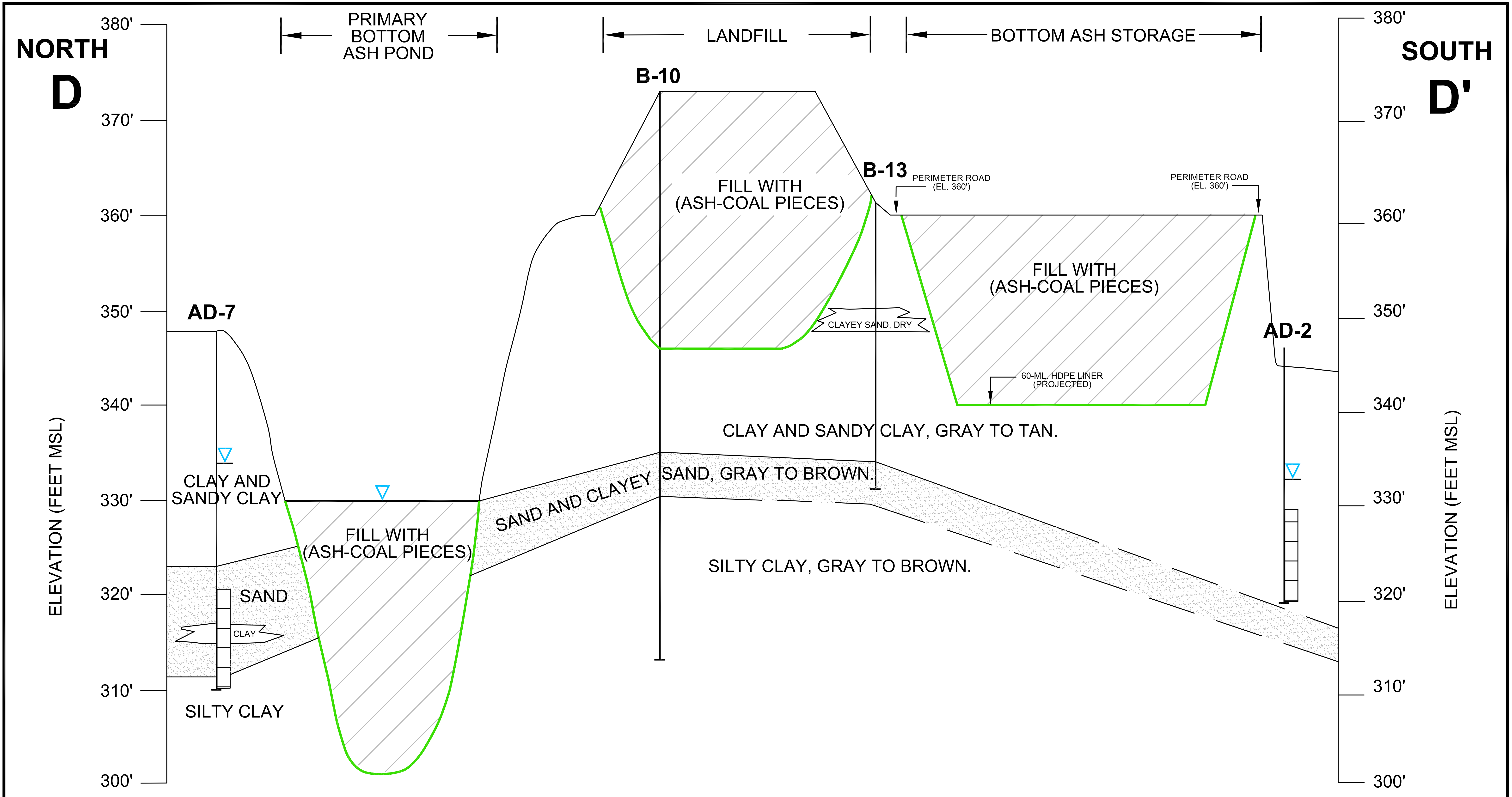
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION C - C'

ARCADIS

FIGURE
6

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 6 Cross Section C-C'.dwg LAYOUT: MODEL SAVED: 3/11/2016 10:54 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: ----
PLOTSTYLETABLE: ---- PLOTTED: 3/11/2016 12:36 PM BY: LEASE, DIANA



0 300'
HORIZONTAL SCALE

NOTE: BASE OF PRIMARY BOTTOM ASH POND TAKEN FROM "WELSH POWER PLANT-UNIT 1 FLY ASH STORAGE AREA PHASE I " DRAWING ID WEPX-88, DATED 12-3-76; AND U.S. GEOLOGICAL SURVEY 7 1/2 MINUTE SERIES TOPOGRAPHIC MAP, CASON, TX QUADRANGLE, 1964 (PHOTO REVISED 1980).

LEGEND

⊟	MONITORING WELL SCREENED INTERVAL
▽	WATER LEVEL IN MONITORING WELL (5/12/15)
🟩	BASE OF CCR UNIT

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION D - D'

ARCADIS

FIGURE
7

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond WELL Network Evaluation\Figures-Maps\Figure 7 Cross Section D-D'.dwg LAYOUT: MODEL SAVED: 8/26/2015 10:07 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE:
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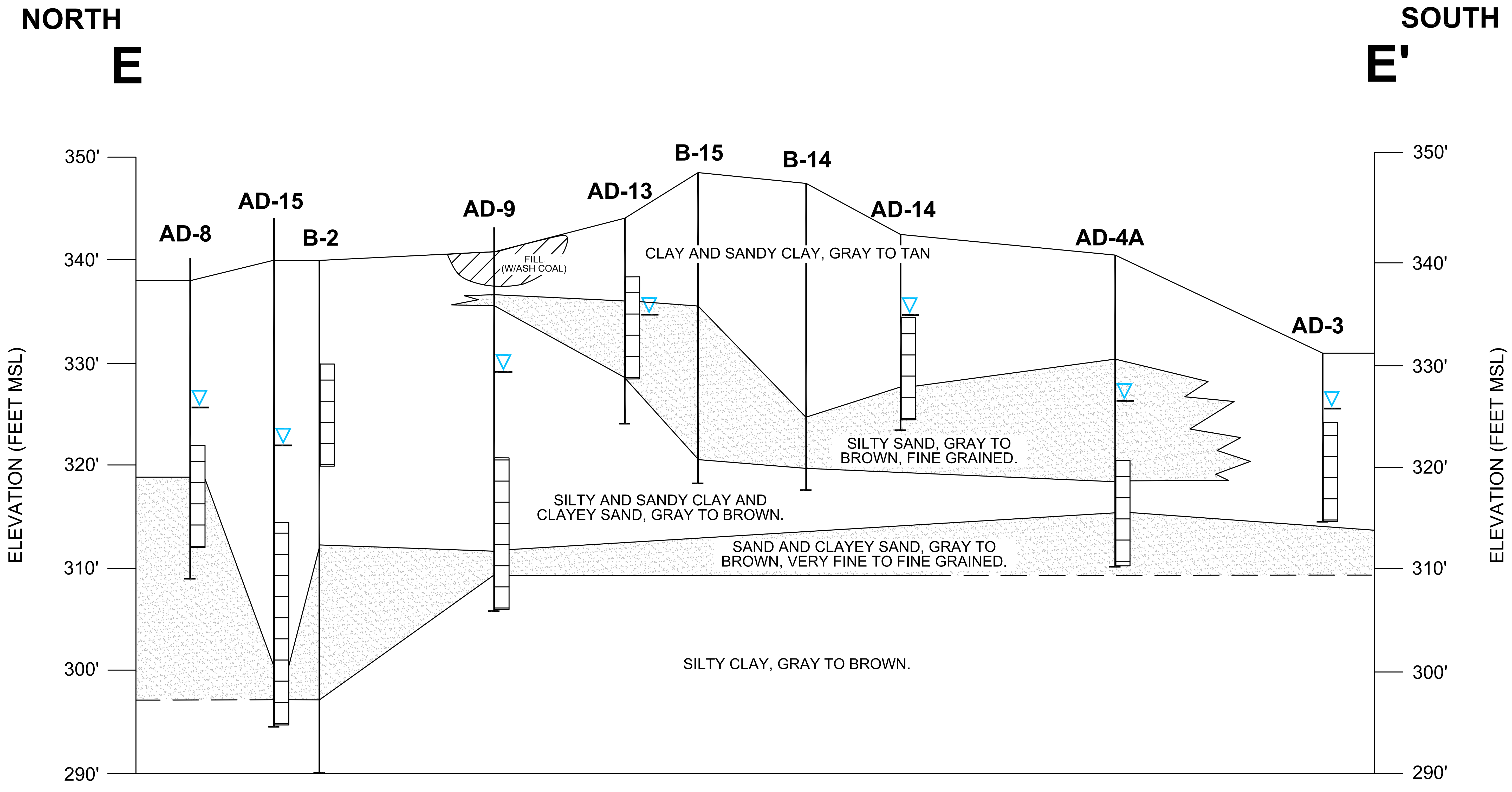


0 300'
HORIZONTAL SCALE

LEGEND

- ▤ MONITORING WELL SCREENED INTERVAL
- ▽ WATER LEVEL IN MONITORING WELL (3/4/16)
- — PROJECTED BASE OF ASH STORAGE (SEE NOTE)

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

CROSS SECTION
E - E'

ARCADIS

FIGURE
8

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Welsh Power Plant\2016 Final Reports\Primary Ash Pond Location Restriction Report\Figures-Maps\Figure 8 Cross Section E-E'.dwg LAYOUT: MODEL SAVED: 3/11/2016 12:06 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE:
---- PLOTTED: 3/11/2016 12:52 PM BY: LEASE, DIANA

Legend

- Monitoring Well Location
- Piezometer Location
- Plugged Monitoring Well/Piezometer
- Soil Boring
- Site Features
- 340.82 Water Level Elevation (feet MSL)
- Groundwater Contour
- Groundwater Flow Direction

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

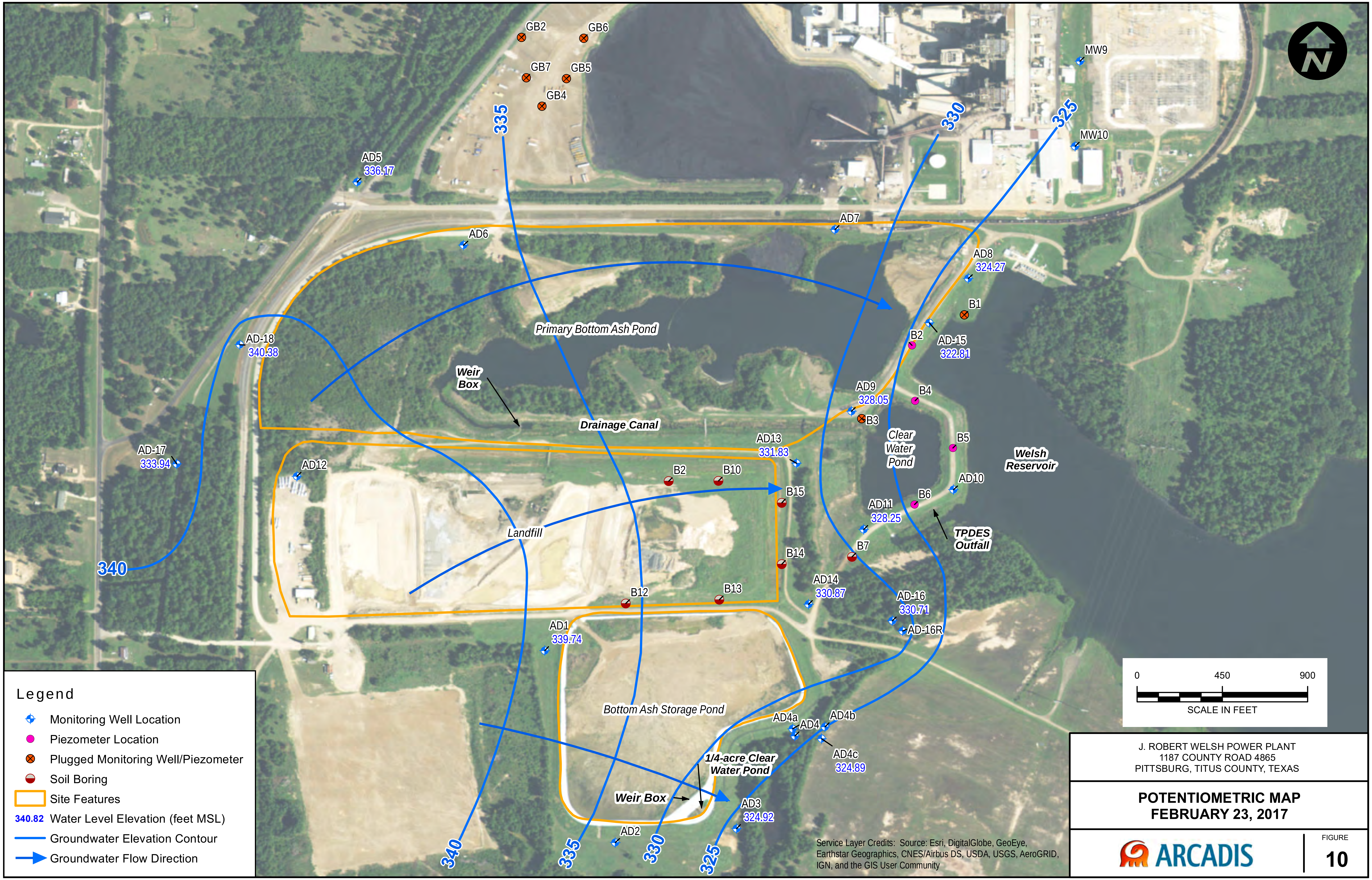
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

WELL ELEVATIONS AND POTENTIOMETRIC MAP MARCH 4, 2016

ARCADIS

FIGURE
9

Document Path: Z:\GISPROJECTS_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 9 - Mar2016_POT.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

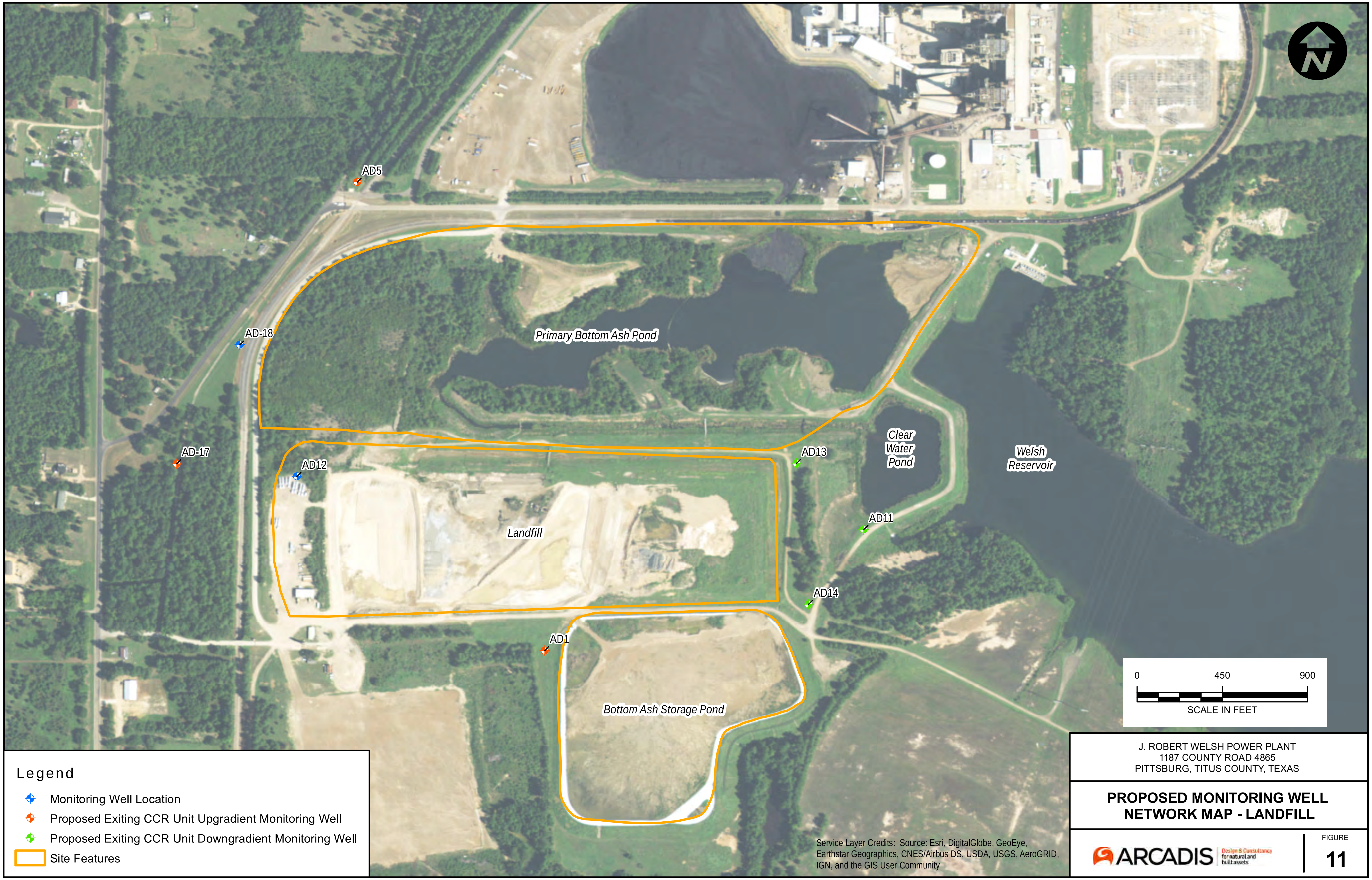
J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

POTENTIOMETRIC MAP
FEBRUARY 23, 2017

ARCADIS

FIGURE
10

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\fig 10 - Feb2017_POT.mxd



Legend

- Monitoring Well Location
- Proposed Exiting CCR Unit Upgradient Monitoring Well
- Proposed Exiting CCR Unit Downgradient Monitoring Well
- 🟧 Site Features

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J. ROBERT WELSH POWER PLANT
1187 COUNTY ROAD 4865
PITTSBURG, TITUS COUNTY, TEXAS

PROPOSED MONITORING WELL NETWORK MAP - LANDFILL

ARCADIS Design & Consultancy for natural and built assets

FIGURE
11

Document Path: Z:\GISProjects_ENV\AEP\Welsh Plant\MXD\Landfill report\Dec2017Update\fig 11 - proposed wells_v2.mxd

ARCADIS

Boring/Well Construction Logs

AD-1

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4, Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'48"N
94°50'47"W
N

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ____

From (ft.)	To (ft.)	Description and color of formation material
0	25	gray silty clay with some hard red streaks

AP-1

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other ____
If Gravel Packed give interval ... from 13 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	sch 40
2	N	#10 slot screen	15	25	sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 13 ft. to 0 ft. No. of sacks used 6-50#
____ ft. to ____ ft. No. of sacks used ____
Method used bentonite
Cemented by ____
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance ____

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 12'8" ft. below land surface Date 1-11-01
Artesian flow ____ gpm. Date ____

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other ____
Depth to pump bowls, cylinder, jet, etc., ____ ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: ____ gpm with ____ ft. drawdown after ____ hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ____ (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS ____ (Street or RFD) (City) (State) (Zip)

(Signed) Gilbert M. [illegible] (Licensed Well Driller) (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-2

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

County ~~Camp~~ Titus

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell

If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'37"N
94°50'44"W
N

6) WELL LOG:
Date Drilling:
Started 4/26 ~~19~~ 2001
Completed 4/26 ~~19~~ 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	25

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	2	top soil
2	5	red & gray clay w/ silt
5	10	red & gray clay w/ silt
10	25	gray silty clay w/ tan streaks
		AP-2

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other

If Gravel Packed give interval ... from 12 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	15	Sch. 40
2	N	#10 slot screen	15	25	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]

Cemented from 12 ft. to ~~4~~ 2 ft. No. of sacks used 5-50#

ft. to ft. No. of sacks used

Method used bentonite pellets

Cemented by

Distance to septic system field lines or other concentrated contamination ft.

Method of verification of above distance

10) SURFACE COMPLETION

☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]

☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]

☐ Pitless Adapter Used [Rule 338.44(3)(b)]

☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:

Static level ft. below land surface Date

Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA

☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder

☐ Other

Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA

Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated

Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:

Did you knowingly penetrate any strata which contained undesirable constituents?

☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"

Type of water? Depth of strata

Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX-52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) Gilbert M (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-3

Please use black ink.

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'38"N
94°50'37"W
N↑

6) WELL LOG:
Date Drilling:
Started 4/26 2001
Completed 4/26 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	17

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	12	gray silty clay w/tan streaks
12	15	very stiff gray/blood red clay
15	17	very stiff gray clay w/ red nodules and tan streaks

AP-3

(*Use reverse side if necessary*)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 5 ft. to 17 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Casting Screen
			From	To	
2	N	riser	+2	7	Sch 40
2	N	#10 slot screen	7	17	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 2 ft. to 5 ft. No. of sacks used 2 1/2 - 50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP: NA
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

AD-4

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Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt. 4, Box 221 (Street or RFD) Pittsburg (City) Tx (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt. 4 Box 221 (Street, RFD or other) Pittsburg (City) Tx (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) GPS
33°02'43"N
94°50'33"W
N

6) WELL LOG:
Date Drilling:
Started 4/26 19 2001
Completed 4/26 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/4	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	5	red silty clay with gray streaks
5 -	30	gray silty clay with red streaks
		AD-4

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	19	Sch 40
2	N	#10 Slot Screen	19	29	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 2 ft. No. of sacks used 8-50#
ft. to ft. No. of sacks used
Method used bentonite pellets
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level ft. below land surface Date
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other NA
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS: NA
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print)
WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller)
(Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

E·A·G·L·E
ENVIRONMENTAL SERVICES OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4A**
TOTAL DEPTH:	**30'**
TOP OF CASING ELEV.:	**342.85 ft. NGVD**
GROUND SURFACE ELEV.:	**340.19 ft. NGVD**

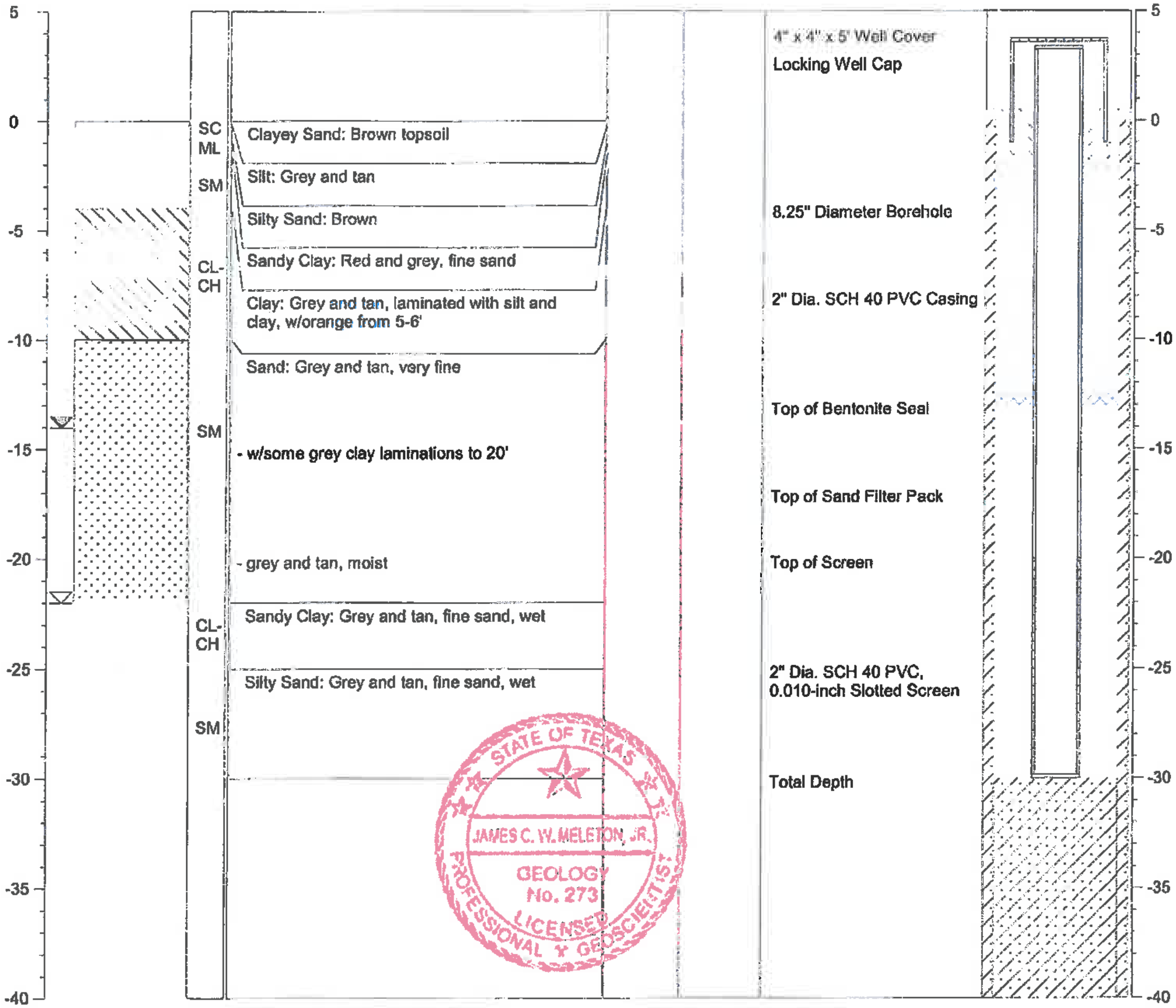
CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04527**
Longitude: 94.84258

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown topsoil
ML	Silt: Grey and tan
SM	Silty Sand: Brown
CL-CH	Sandy Clay: Red and grey, fine sand
	Clay: Grey and tan, laminated with silt and clay, w/orange from 5-6'
SM	Sand: Grey and tan, very fine - w/some grey clay laminations to 20' - grey and tan, moist
CL-CH	Sandy Clay: Grey and tan, fine sand, wet
SM	Silty Sand: Grey and tan, fine sand, wet

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

STATE OF TEXAS
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GEOLOGY
No. 273
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PROFESSIONAL GEOSCIENTIST

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	**AD-4B**
TOTAL DEPTH:	**15'**
TOP OF CASING ELEV.:	**333.23 ft. NGVD**
GROUND SURFACE ELEV.:	**329.55 ft. NGVD**

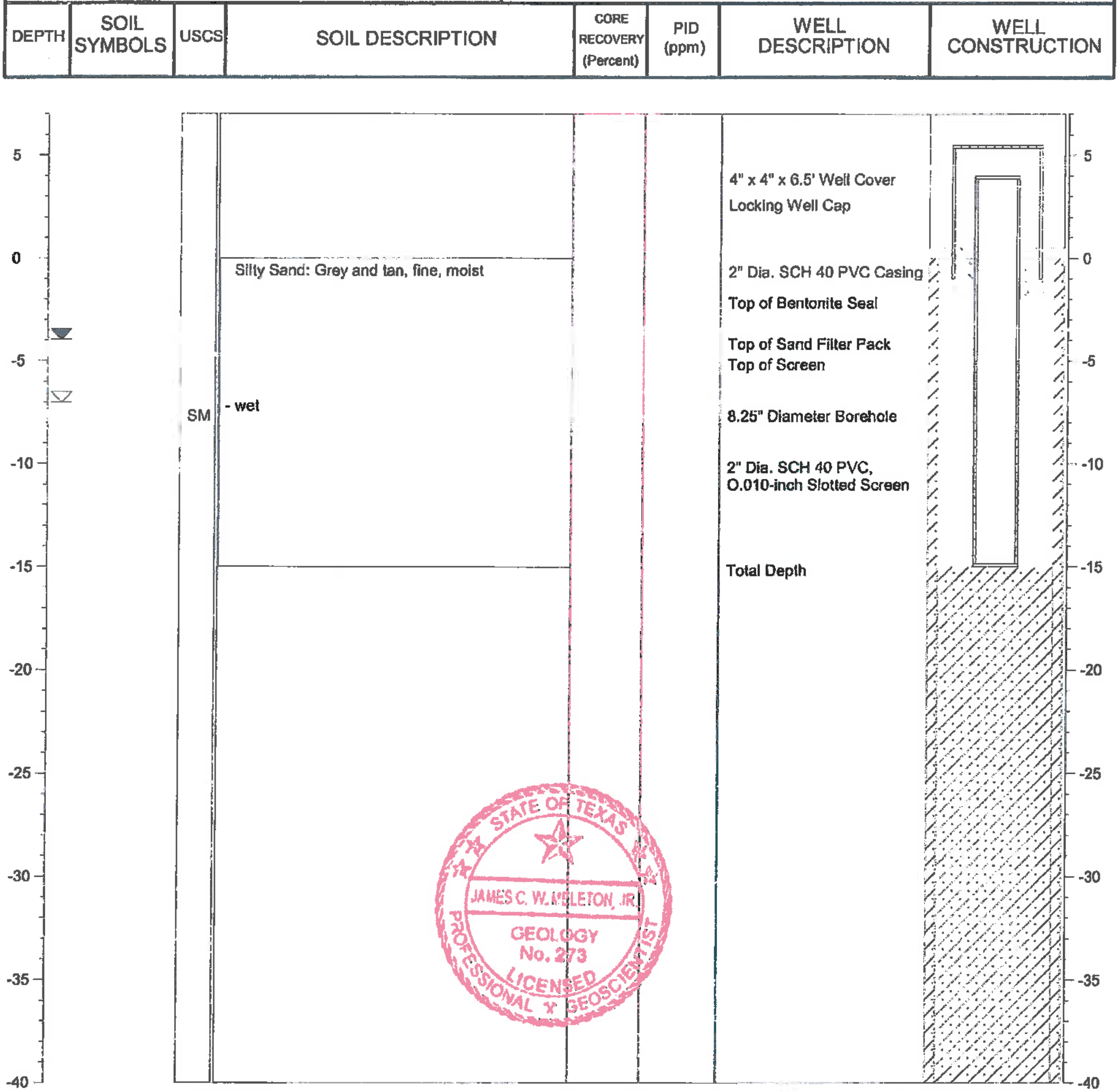
CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.04531**
Longitude: 94.84230

▼ Water level during drilling
▽ Water level in completed well

Page 1 of 1



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SOIL BORING LOG

BORING/WELL NO.:	**AD-4C**
TOTAL DEPTH:	**15'**
TOP OF CASING ELEV.:	**333.28 ft. NGVD**
GROUND SURFACE ELEV.:	**329.15 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.04507**
Longitude: 94.84244

▽ Water level during drilling
▼ Water level in completed well

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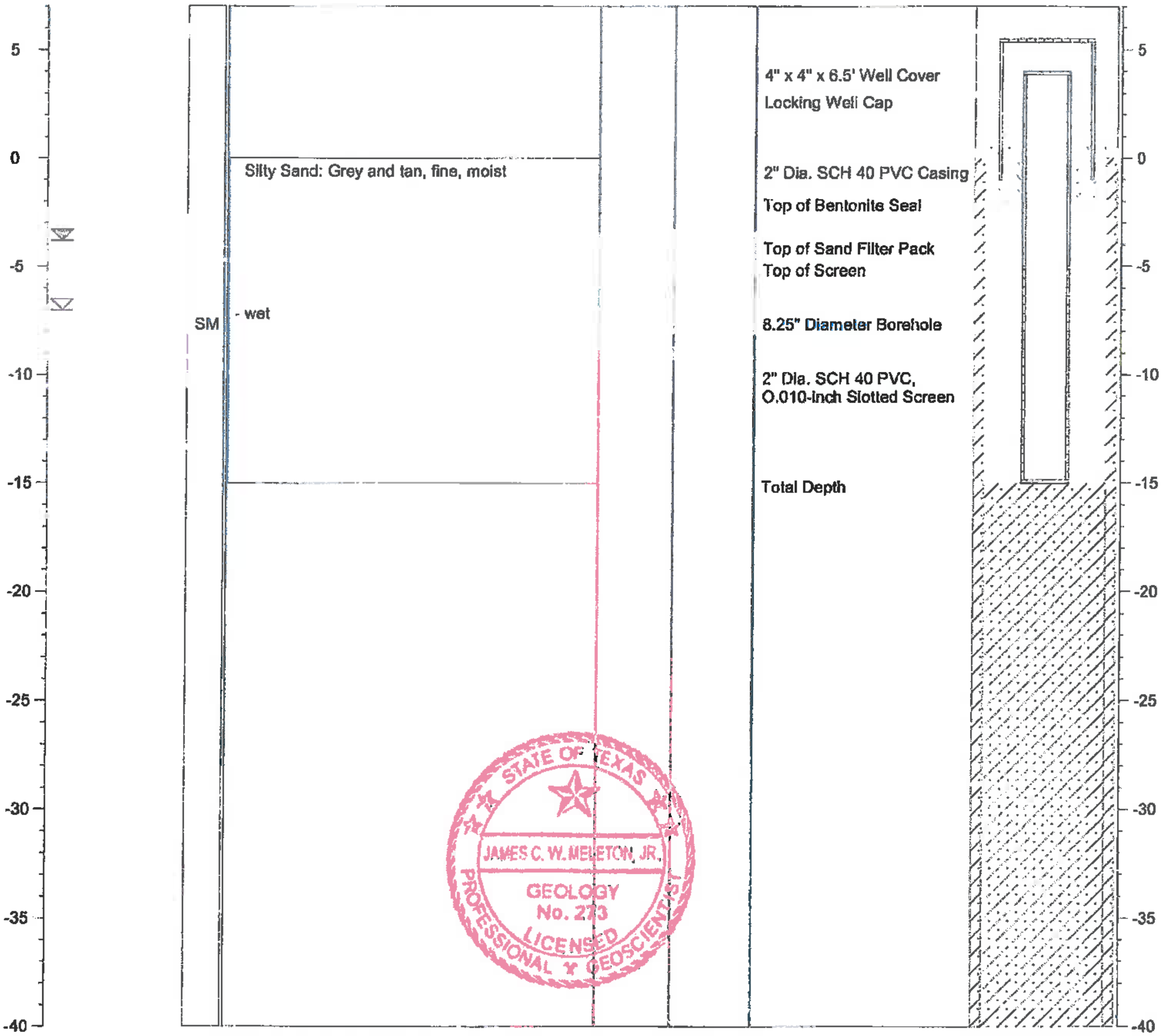
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



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AD-5

Send original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Southwestern Electric Power (Name) ADDRESS Rt.4, Box 221 (Street or RFD) Pittsburg (City) TX (State) 75686 (Zip)

2) ADDRESS OF WELL: County ~~Camp~~ Titus Rt.4, Box 221 (Street, RFD or other) Pittsburg (City) TX (State) 75686 (Zip) GRID # 16-58-4

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☐ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) 33°03'13"N
94°51'00"W
N↑

6) WELL LOG:
Date Drilling:
Started 1-11 19 2001
Completed 1-11 19 2001

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8¼	Surface	30

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☐ Mud Rotary ☒ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	10	red & gray clay with orange streaks
10	20	gray/black clay with tan clay
20	25	stiff clay with lignite streak
25	30	fine gray sand

AP-5

(Use reverse side if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 16 ft. to 30 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
2	N	riser	+2	20	Sch 40
2	N	#10 slot screen	20	30	Sch 40

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 16 ft. to 0 ft. No. of sacks used
ft. to ft. No. of sacks used
Method used bentonite
Cemented by
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

✓10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 11'9" ft. below land surface Date 1-11-01
Artesian flow gpm. Date

12) PACKERS: NA Type Depth

13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., ft.

14) WELL TESTS:
Type test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: gpm with ft. drawdown after hrs.

✓15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME (Type or print) WELL DRILLER'S LICENSE NO. TX 52694-M

ADDRESS (Street or RFD) (City) (State) (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 11-01-94)

Send one (1) copy each to: TNRCC, DRILLER, WELL OWNER

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SOIL BORING LOG

BORING/WELL NO.:	**AD-6**
TOTAL DEPTH:	**33'**
TOP OF CASING ELEV.:	**346.33 ft. NGVD**
GROUND SURFACE ELEV.:	**343.31 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/23/09**

NOTES: **Latitude: 33.05235**
Longitude: 94.84757

▽ Water level during drilling
▼ Water level in completed well

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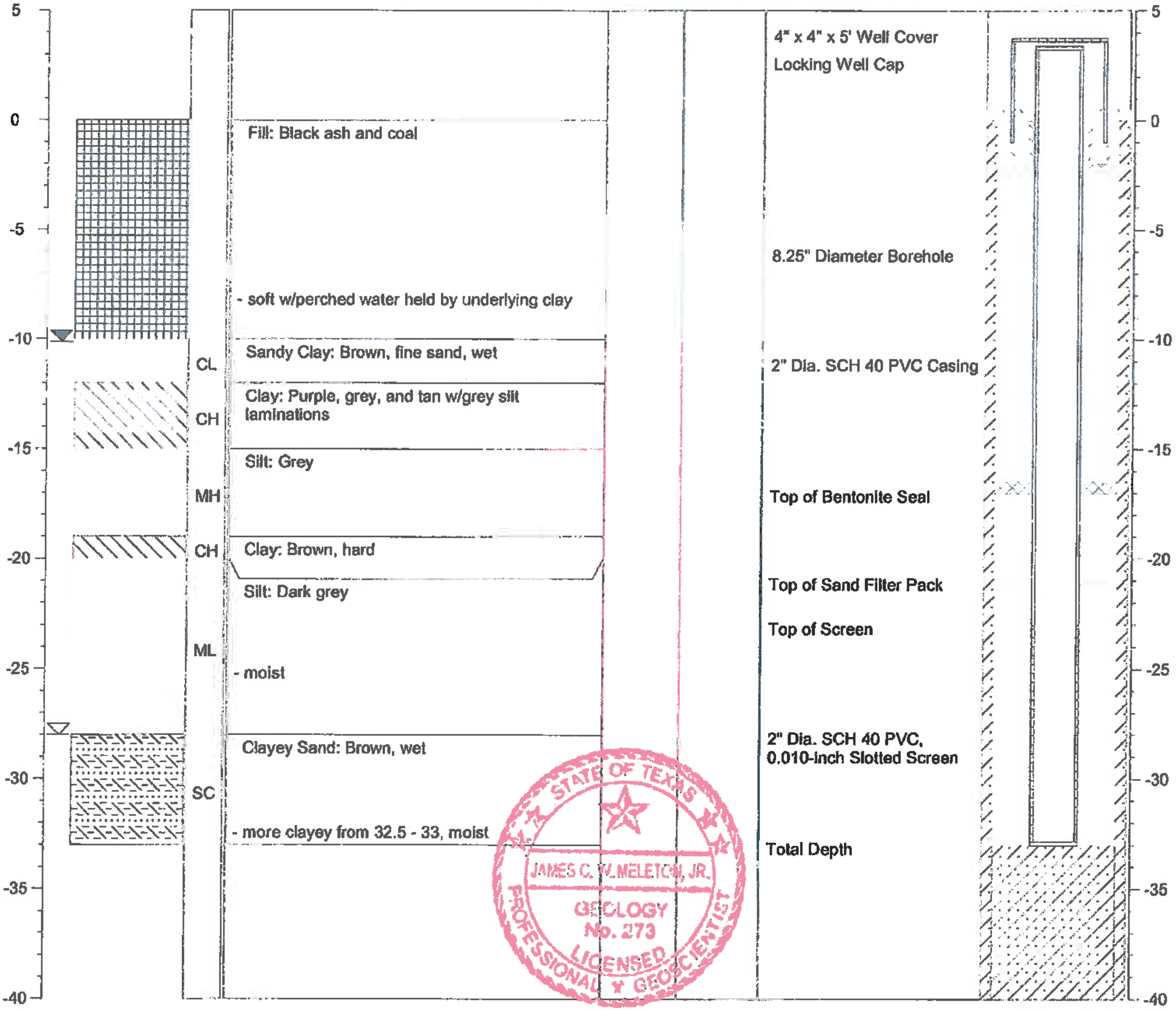
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Fill: Black ash and coal

- soft w/perched water held by underlying clay

Sandy Clay: Brown, fine sand, wet

Clay: Purple, grey, and tan w/grey silt laminations

Silt: Grey

Clay: Brown, hard

Silt: Dark grey

- moist

Clayey Sand: Brown, wet

- more clayey from 32.5 - 33, moist

4" x 4" x 5' Well Cover
Locking Well Cap

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Bentonite Seal

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen

Total Depth

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SOIL BORING LOG

BORING/WELL NO.: **AD-7**
TOTAL DEPTH: **38'**
TOP OF CASING ELEV.: **350.82 ft. NGVD**
GROUND SURFACE ELEV.: **347.86 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

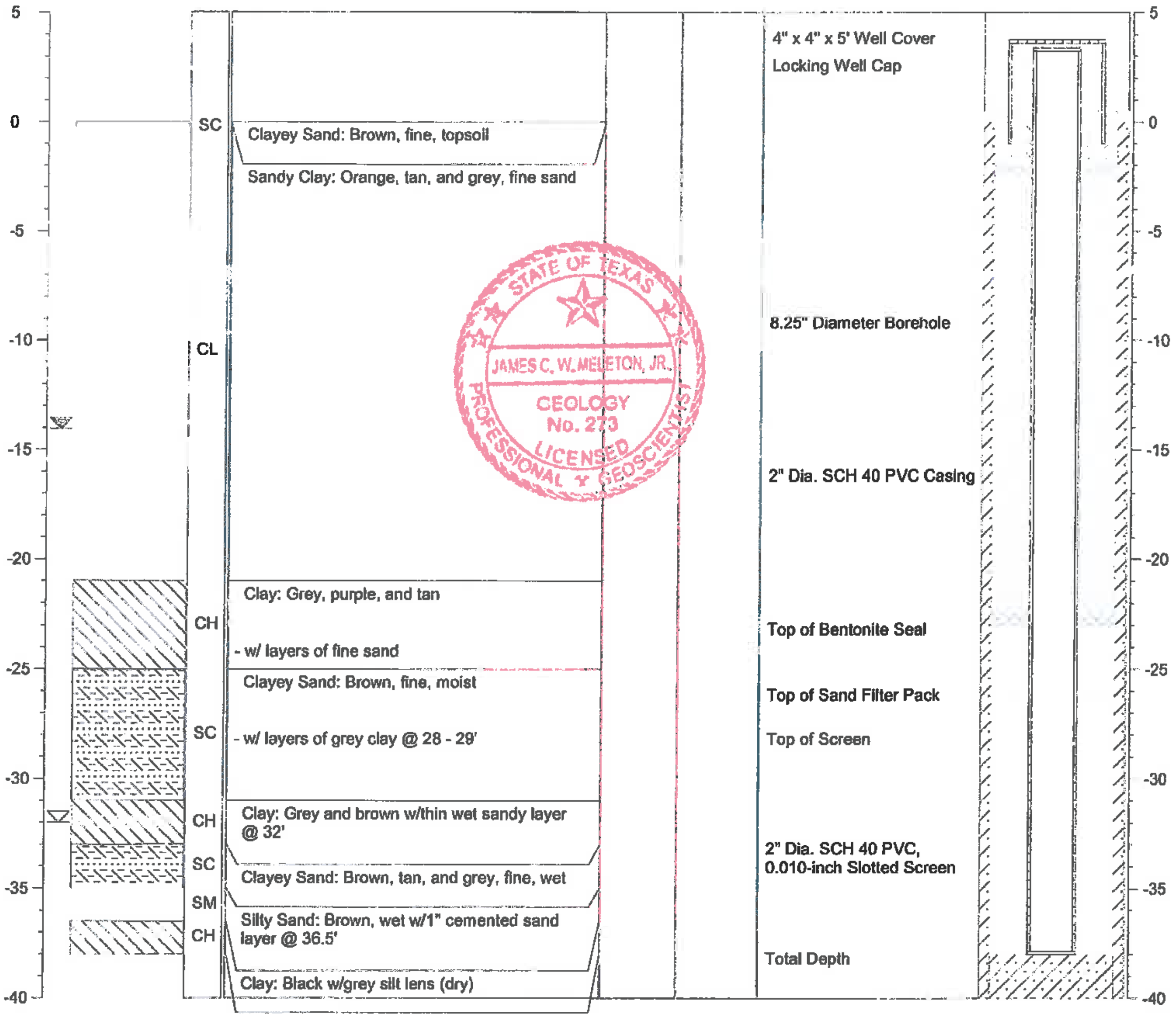
DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/24/09**

NOTES: **Latitude: 33.05257**
Longitude: 94.84219

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, fine, topsoil
CL	Sandy Clay: Orange, tan, and grey, fine sand
CH	Clay: Grey, purple, and tan - w/ layers of fine sand
SC	Clayey Sand: Brown, fine, moist - w/ layers of grey clay @ 28 - 29'
CH	Clay: Grey and brown w/thin wet sandy layer @ 32'
SC	Clayey Sand: Brown, tan, and grey, fine, wet
SM	Silty Sand: Brown, wet w/1" cemented sand layer @ 36.5'
CH	Clay: Black w/grey silt lens (dry)

WELL DESCRIPTION:
4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

BORING/WELL NO.:	**AD-8**
TOTAL DEPTH:	**29'**
TOP OF CASING ELEV.:	**340.01 ft. NGVD**
GROUND SURFACE ELEV.:	**337.53 ft. NGVD**

CLIENT:	**AEP**
PROJECT:	**Ash Disposal Area**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0109**
LOGGED BY:	**James Meleton, Jr.**

DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**9/21/09**

NOTES: **Latitude: 33.05187**
Longitude: 94.84026

▽ Water level during drilling
▼ Water level in completed well

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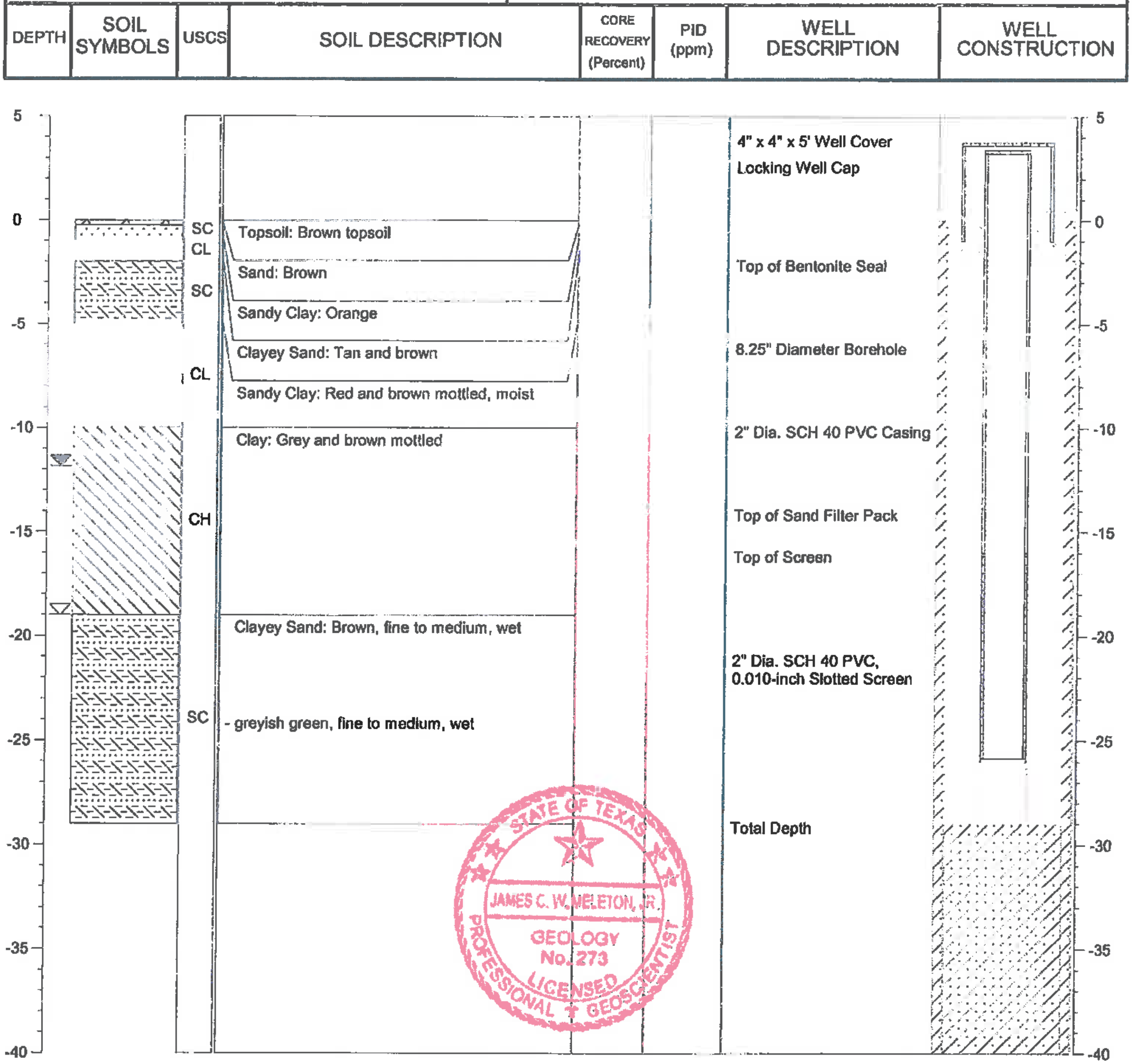

Topsoil: Brown topsoil
Sand: Brown
Sandy Clay: Orange
Clayey Sand: Tan and brown
Sandy Clay: Red and brown mottled, moist
Clay: Grey and brown mottled
Clayey Sand: Brown, fine to medium, wet
- greyish green, fine to medium, wet

4" x 4" x 5' Well Cover
Locking Well Cap
Top of Bentonite Seal
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

BORING/WELL NO.: **AD-9**
TOTAL DEPTH: **35'**
TOP OF CASING ELEV.: **343.09 ft. NGVD**
GROUND SURFACE ELEV.: **340.32 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/21/09**

NOTES: **Latitude: 33.04995**
Longitude: 94.84196

▽ Water level during drilling
▼ Water level in completed well

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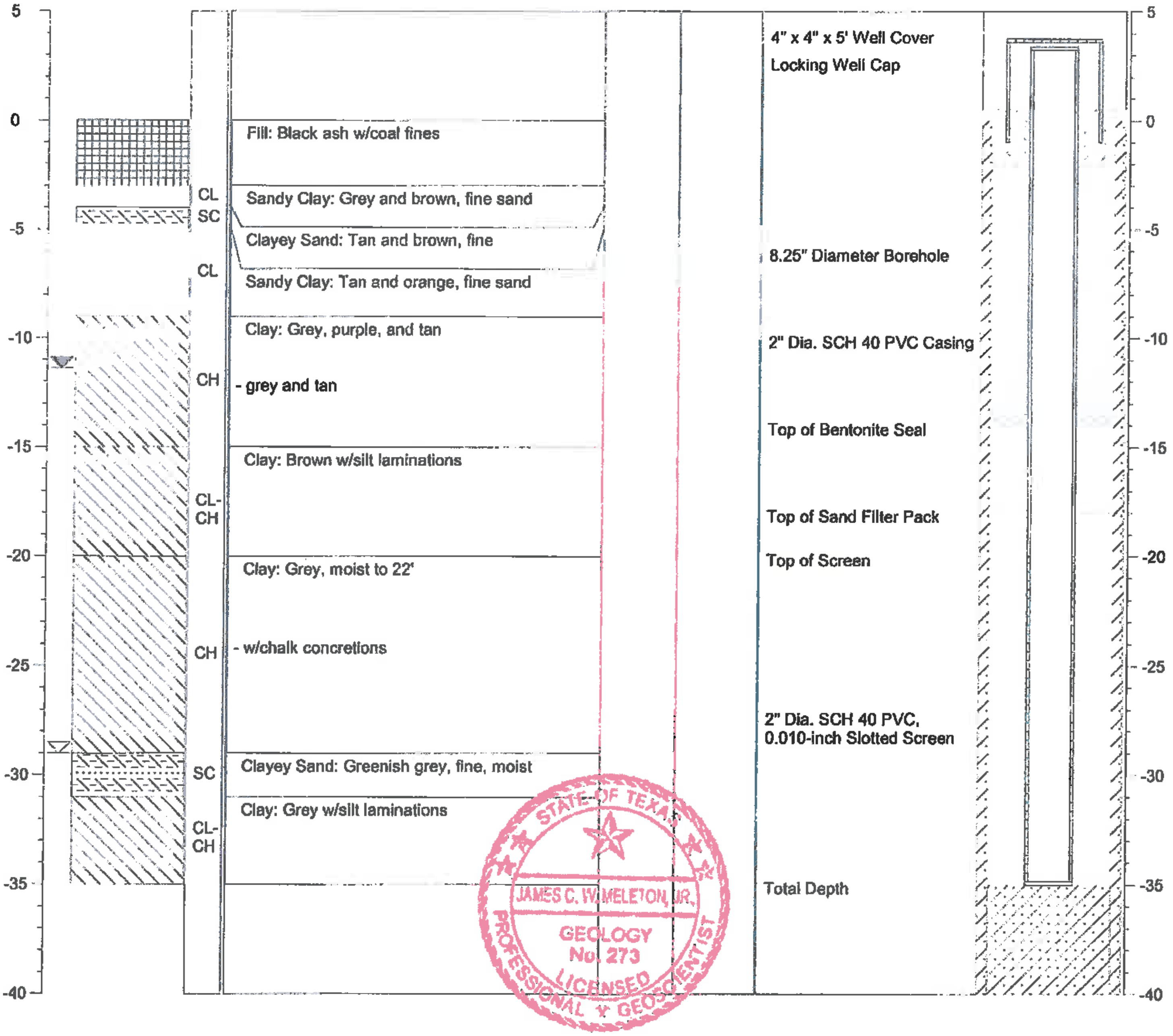
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



USCS	SOIL DESCRIPTION
	Fill: Black ash w/coal fines
CL	Sandy Clay: Grey and brown, fine sand
SC	Clayey Sand: Tan and brown, fine
CL	Sandy Clay: Tan and orange, fine sand
CH	Clay: Grey, purple, and tan - grey and tan
CL-CH	Clay: Brown w/silt laminations
CH	Clay: Grey, moist to 22' - w/chalk concretions
SC	Clayey Sand: Greenish grey, fine, moist
CL-CH	Clay: Grey w/silt laminations

WELL DESCRIPTION:

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
2" Dia. SCH 40 PVC Casing
Top of Bentonite Seal
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

BORING/WELL NO.:	**AD-10**
TOTAL DEPTH:	**35'**
TOP OF CASING ELEV.:	**343.01 ft. NGVD**
GROUND SURFACE ELEV.:	**340.23 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04881**
Longitude: 94.84047

▽ Water level during drilling
▼ Water level in completed well

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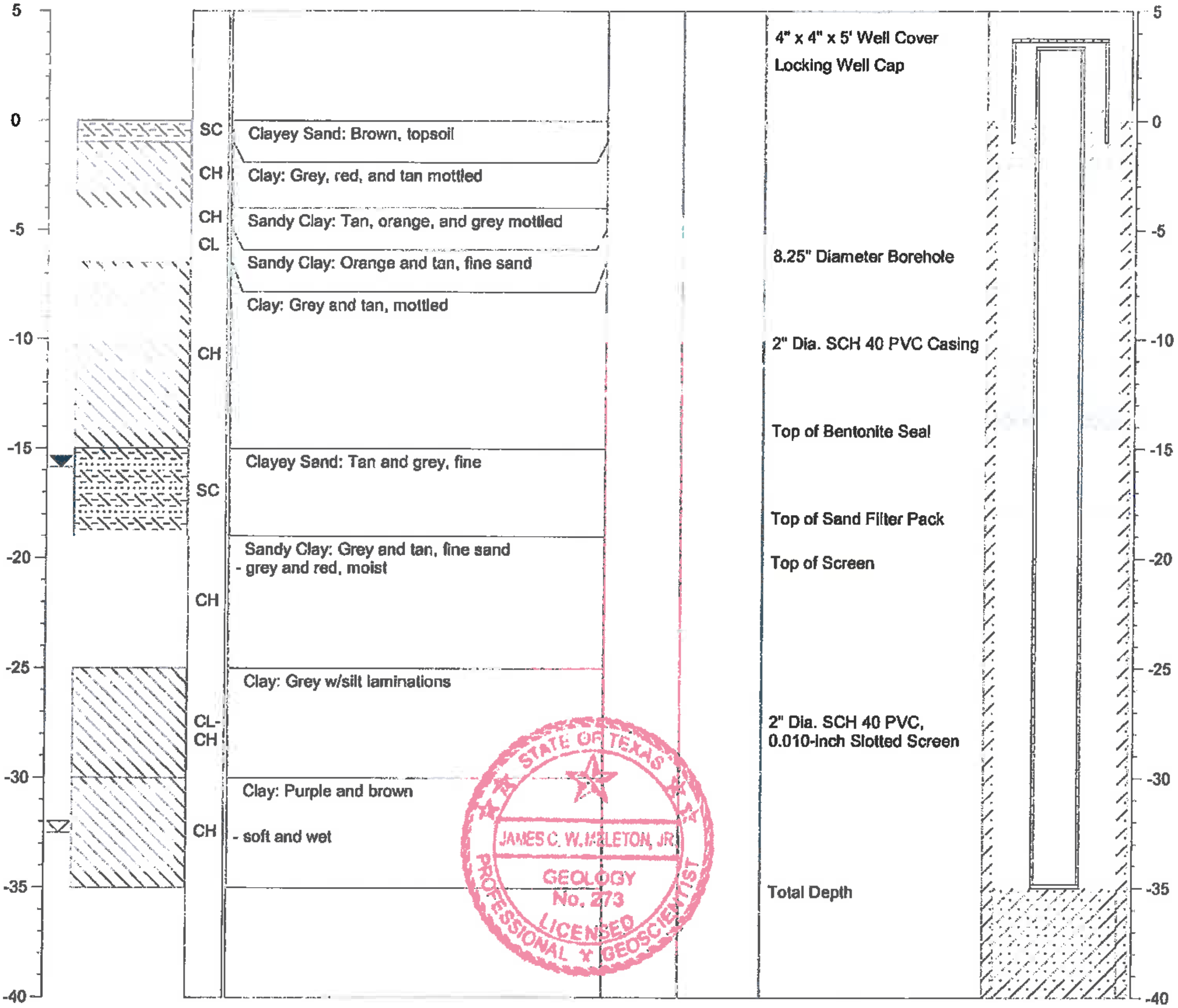
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



SC Clayey Sand: Brown, topsoil

CH Clay: Grey, red, and tan mottled

CH Sandy Clay: Tan, orange, and grey mottled

CL Sandy Clay: Orange and tan, fine sand

CH Clay: Grey and tan, mottled

SC Clayey Sand: Tan and grey, fine

CH Sandy Clay: Grey and tan, fine sand
- grey and red, moist

CL-CH Clay: Grey w/silt laminations

CH Clay: Purple and brown
- soft and wet

4" x 4" x 5' Well Cover
Locking Well Cap

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Bentonite Seal

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC,
0.010-inch Slotted Screen

Total Depth

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SOIL BORING LOG

BORING/WELL NO.: **AD-11**
TOTAL DEPTH: **20'**
TOP OF CASING ELEV.: **342.18 ft. NGVD**
GROUND SURFACE ELEV.: **339.61 ft. NGVD**

CLIENT: **AEP**
PROJECT: **Ash Disposal Area**
SITE LOCATION: **Welsh Power Plant**
PROJECT NO.: **S-08-0109**
LOGGED BY: **James Meleton, Jr.**

DRILLING CO.: **WEST Drilling**
DRILLER: **Tom McCullough**
METHOD OF DRILLING: **Hollow-stem Auger**
SAMPLING METHODS: **Split-spoon**
DATE DRILLED: **9/22/09**

NOTES: **Latitude: 33.04824**
Longitude: 94.84177

▽ Water level during drilling
▼ Water level in completed well

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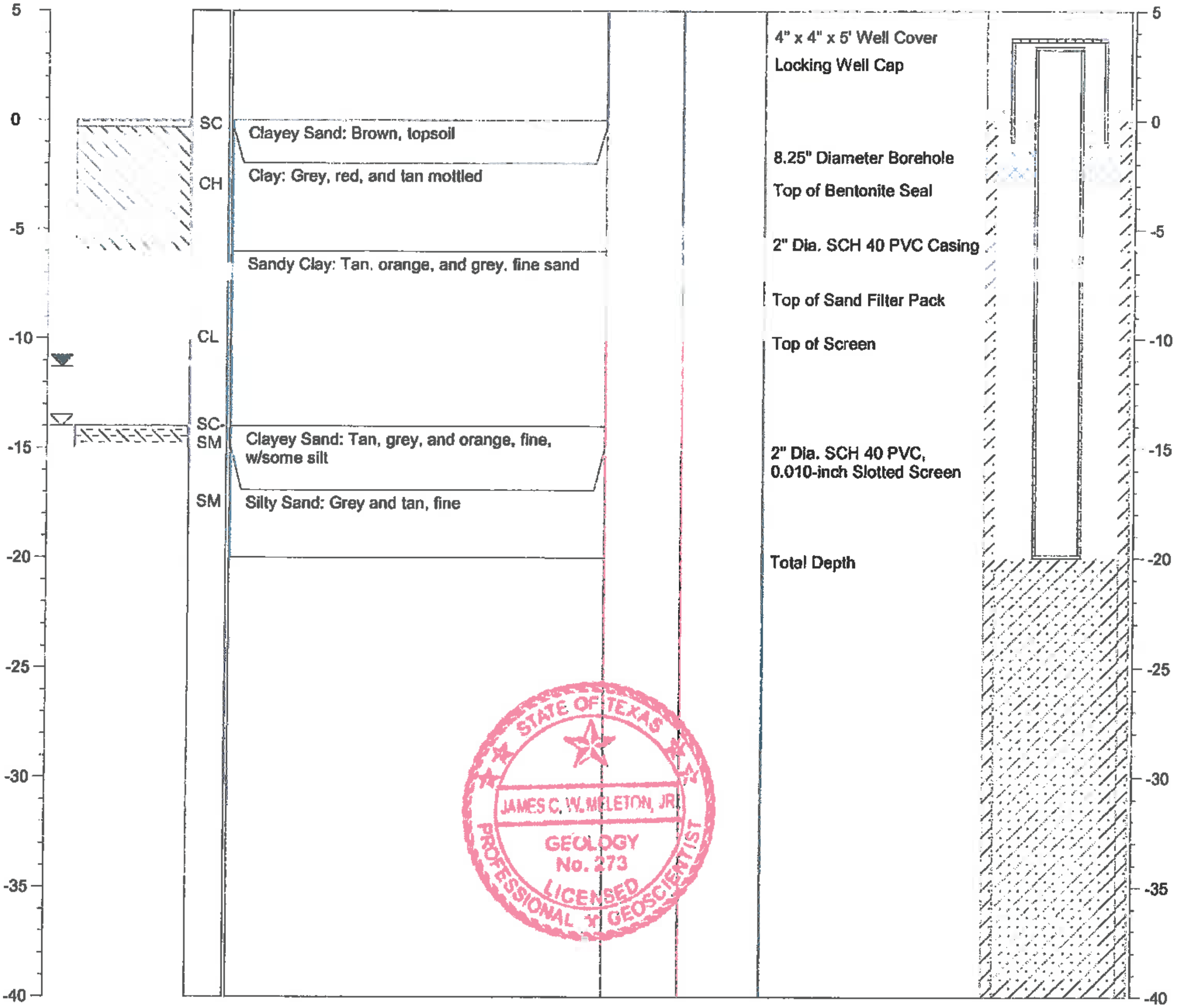
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



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SOIL BORING LOG

BORING/WELL NO.:	**AD-12**
TOTAL DEPTH:	**30'**
TOP OF CASING ELEV.:	**369.33 ft. NGVD**
GROUND SURFACE ELEV.:	**366.27 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/24/09**

NOTES: **Latitude: 33.04901**
Longitude: 94.84977

▽ Water level during drilling
▼ Water level in completed well

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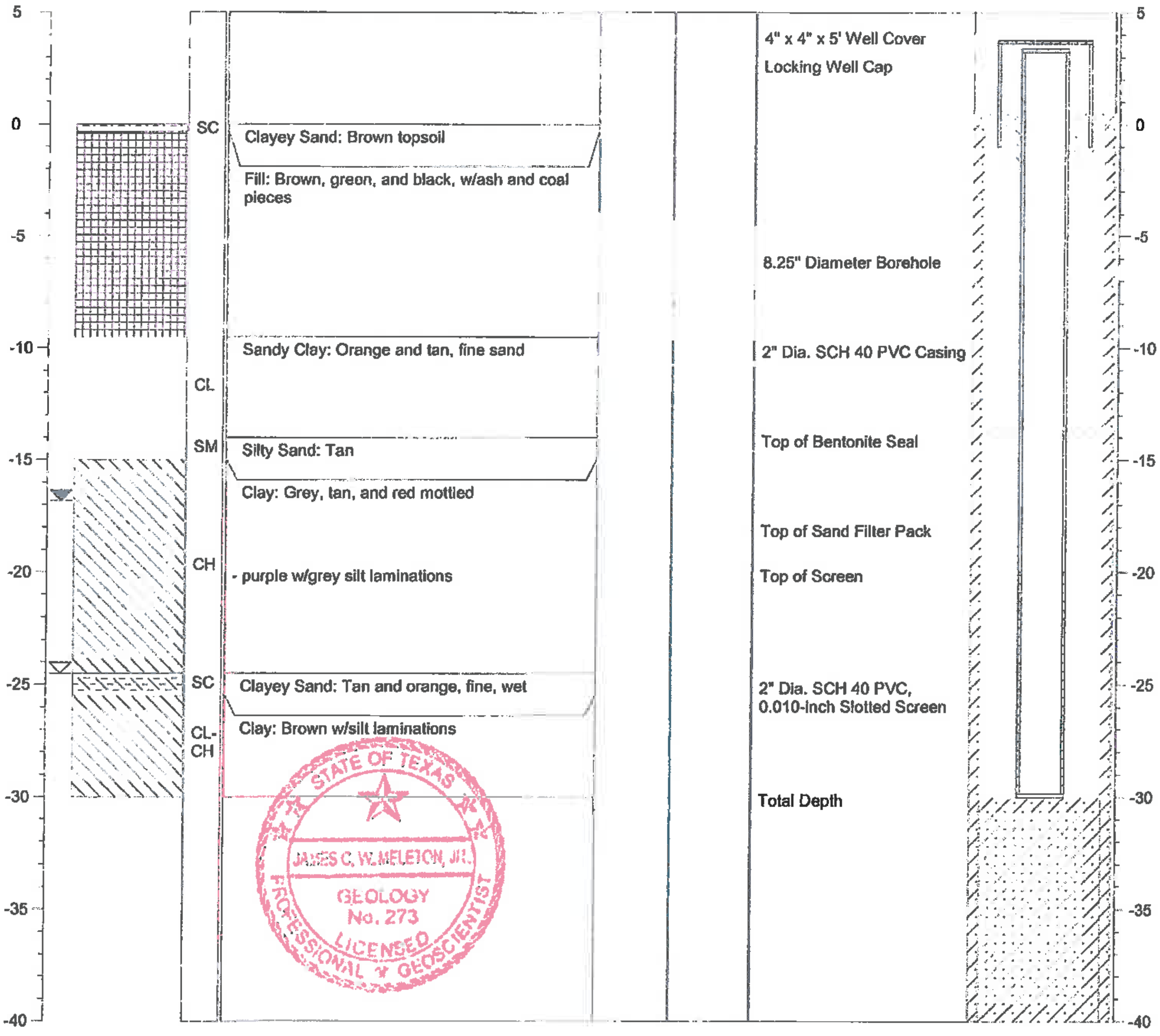
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Clayey Sand: Brown topsoil

Fill: Brown, green, and black, w/ash and coal pieces

Sandy Clay: Orange and tan, fine sand

Silty Sand: Tan

Clay: Grey, tan, and red mottled

- purple w/grey silt laminations

Clayey Sand: Tan and orange, fine, wet

Clay: Brown w/silt laminations

4" x 4" x 5' Well Cover

Locking Well Cap

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Bentonite Seal

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC,
0.010-inch Slotted Screen

Total Depth

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SOIL BORING LOG

BORING/WELL NO.:	**AD-13**
TOTAL DEPTH:	**20'**
TOP OF CASING ELEV.:	**347.00 ft. NGVD**
GROUND SURFACE ELEV.:	**344.12 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04918**
Longitude: 94.84275

▽ Water level during drilling
▼ Water level in completed well

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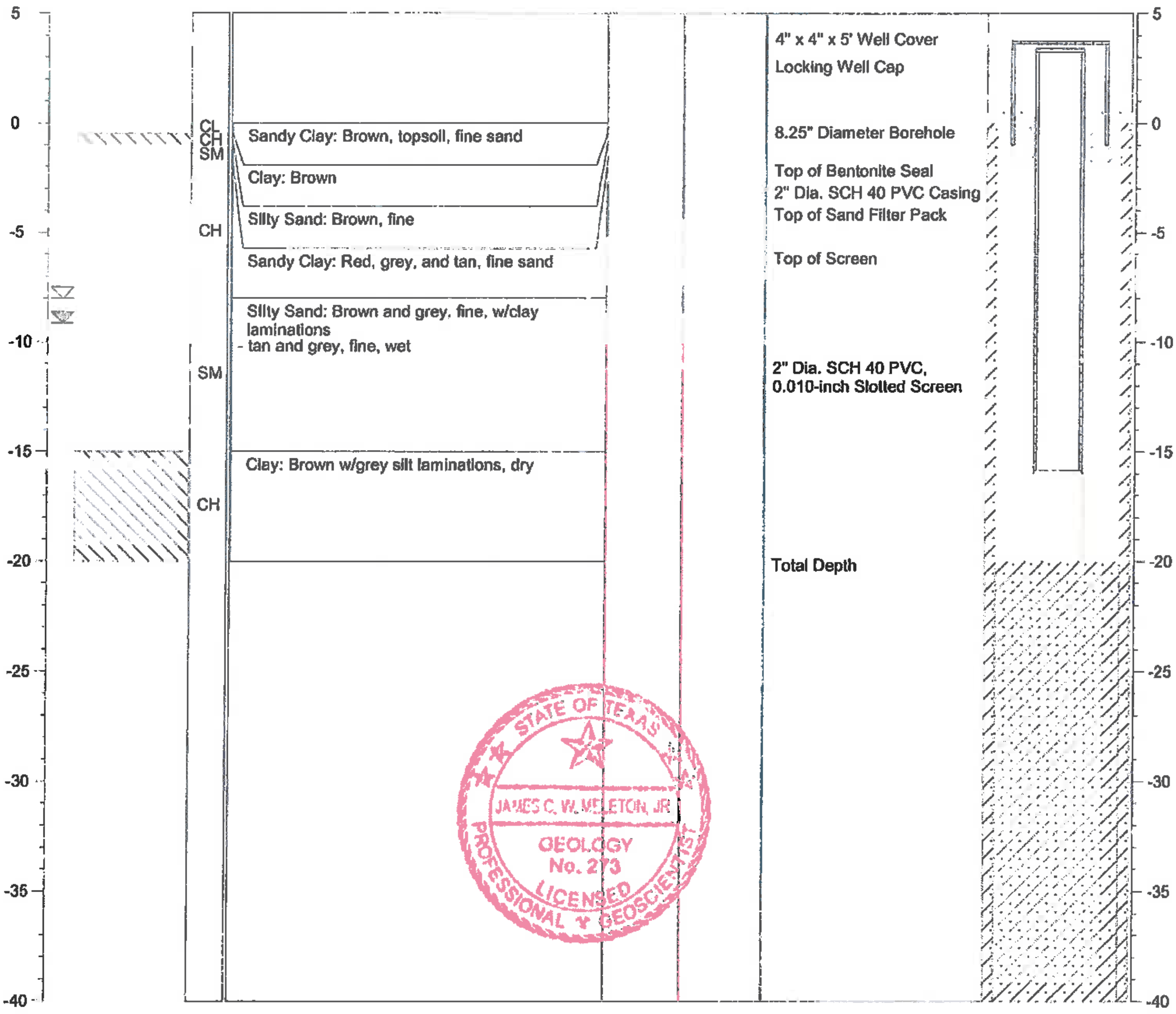
DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Sandy Clay: Brown, topsoil, fine sand

Clay: Brown

Silty Sand: Brown, fine

Sandy Clay: Red, grey, and tan, fine sand

Silty Sand: Brown and grey, fine, w/clay laminations
- tan and grey, fine, wet

Clay: Brown w/grey silt laminations, dry

4" x 4" x 5' Well Cover
Locking Well Cap
8.25" Diameter Borehole
Top of Bentonite Seal
2" Dia. SCH 40 PVC Casing
Top of Sand Filter Pack
Top of Screen
2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
Total Depth

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SOIL BORING LOG

BORING/WELL NO.:	**AD-14**
TOTAL DEPTH:	**18.5'**
TOP OF CASING ELEV.:	**345.43 ft. NGVD**
GROUND SURFACE ELEV.:	**342.32 ft. NGVD**

CLIENT:	**AEP**	DRILLING CO.:	**WEST Drilling**
PROJECT:	**Ash Disposal Area**	DRILLER:	**Tom McCullough**
SITE LOCATION:	**Welsh Power Plant**	METHOD OF DRILLING:	**Hollow-stem Auger**
PROJECT NO.:	**S-08-0109**	SAMPLING METHODS:	**Split-spoon**
LOGGED BY:	**James Meleton, Jr.**	DATE DRILLED:	**9/22/09**

NOTES: **Latitude: 33.04715**
Longitude: 94.84256

▽ Water level during drilling
▼ Water level in completed well

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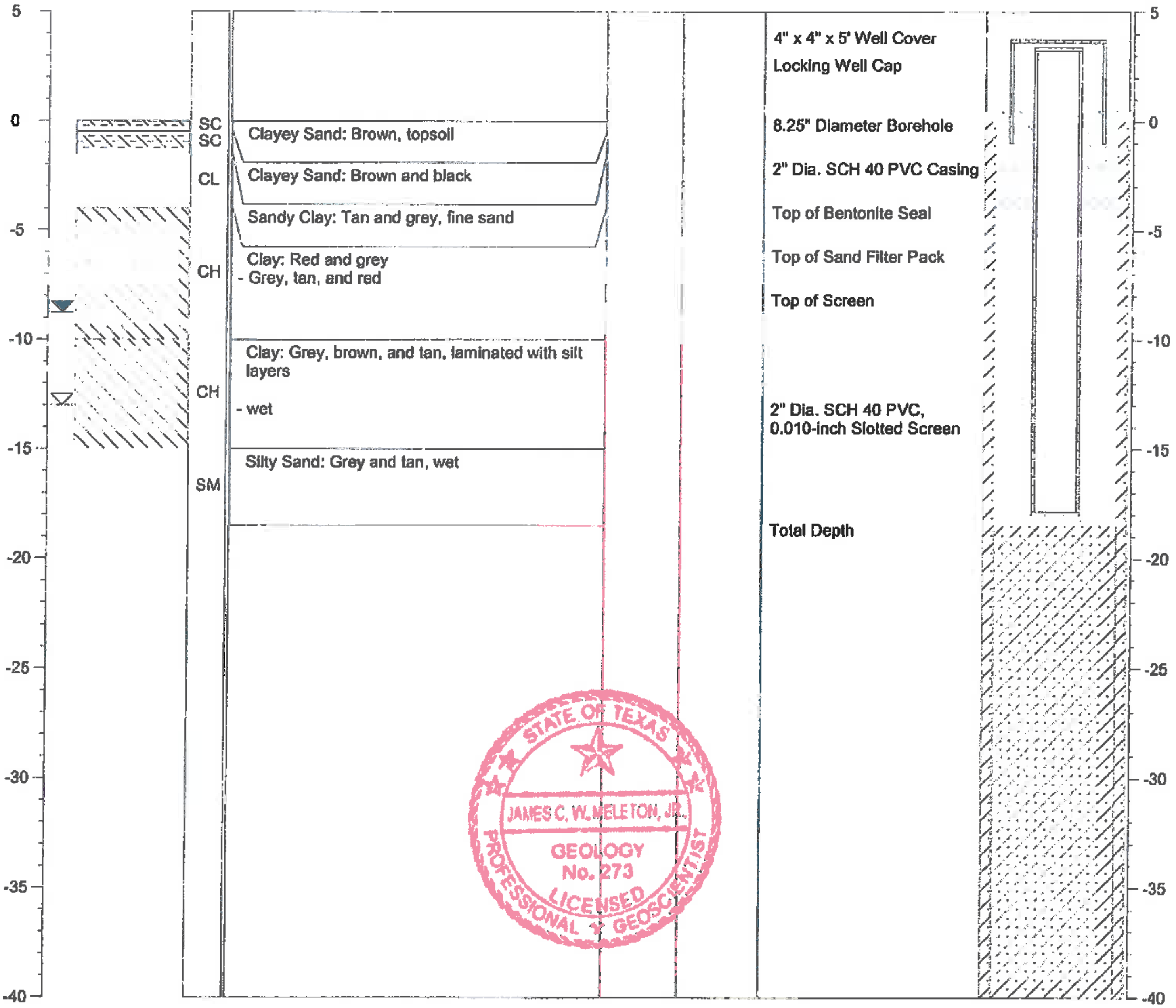

USCS	SOIL DESCRIPTION
SC	Clayey Sand: Brown, topsoil
SC	Clayey Sand: Brown and black
CL	Sandy Clay: Tan and grey, fine sand
CH	Clay: Red and grey - Grey, tan, and red
CH	Clay: Grey, brown, and tan, laminated with silt layers - wet
SM	Silty Sand: Grey and tan, wet

WELL DESCRIPTION
- 4" x 4" x 5' Well Cover
- Locking Well Cap
- 8.25" Diameter Borehole
- 2" Dia. SCH 40 PVC Casing
- Top of Bentonite Seal
- Top of Sand Filter Pack
- Top of Screen
- 2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen
- Total Depth

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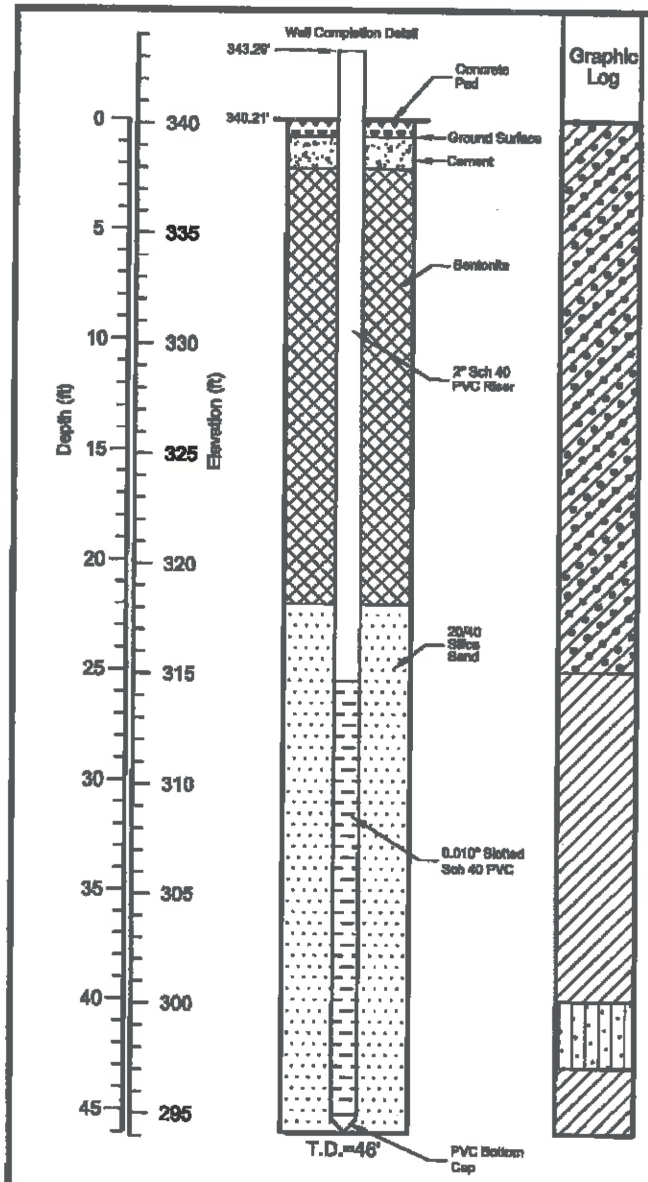
GEOLOGY
No. 273
PROFESSIONAL LICENSED GEOSCIENTIST



PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		SC	Clayey SAND: reddish brown					
					16	48	37	18	19
				- 2" lense of brown sand					
				- 3" lense of brown sand					
	Direct Push		CL	Sandy Lean CLAY: reddish brown, very moist					
				- less moisture					
					22	51	36	19	17
			SM	Silty SAND: light brown & light gray, wet.	27	24	26	NP	-
			CL	Lean CLAY: orangish brown & light gray, mottled, with sand	26	94	45	21	24

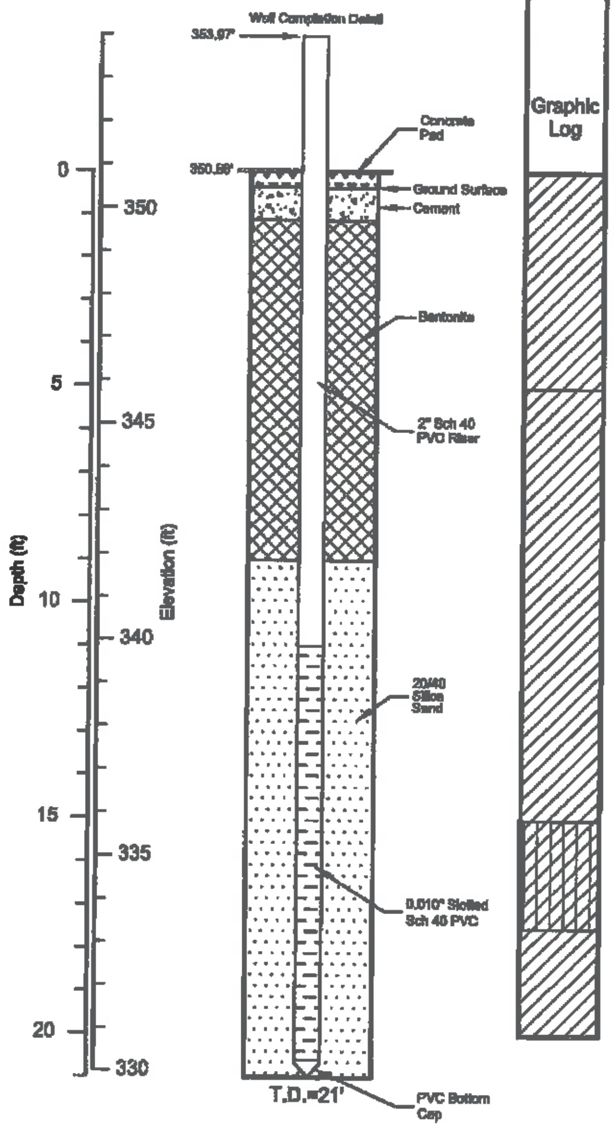
STEVEN R. WEMPLE
2716

1-22-16

west
DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/12/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-15
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/12/15	DRAWN BY: HDS	PROJECT NO.: — SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



PID Reading (ppm)	Sampling Device	Sample Interval	Description Interva (feet bgs)	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		CL	Lean CLAY w/ Sand: light brown & light gray - orangish brown, with silt	16	82	26	16	10
			CL	Lean CLAY w/ Sand: orangish-brown & light gray	22	88	31	19	12
			CL-ML	Silty CLAY: orange w/ brown, wet	30	69	27	20	7
			CL	Sandy, Lean CLAY: brown w/ orange, stiff	26	86	46	26	20

STEVEN R. WEMPLE
SOIL SCIENCE
LICENSE NUMBER
2176

1-22-16

west DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/10/15
Drilling Method: H.S.A.
Bit Diameter: 7.25"
Depth to Water: –

Logged by: Robert Williams, PE
Driller: Robert Williams
Date Completed: 12/10/15
Depth to Product: NA

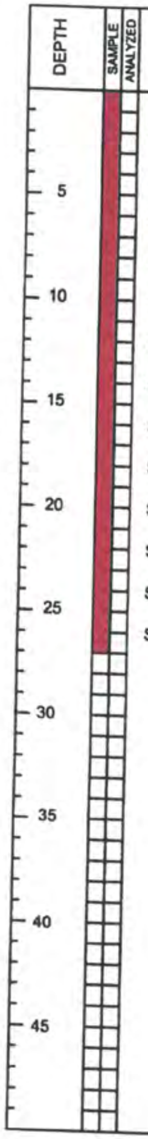
Welsh Power Station
Pittsburg, Texas

DRAWN BY: HDS
CHECKED BY: SRW

Log of Boring AD-16

PROJECT NO.: —
SCALE: AS SHOWN
FILE NAME: JR Welsh Power Plant LOGS.dwg

WELL LOG



TYPE: SS, SS, SS, SS, SS, SS, SS, SS, SS, SS, SS, SS, SS

ORGANIC VAPOR (ppm)

SAMPLE DESCRIPTION

(0-15') SILTY CLAY (CL), BROWN TO ORANGE-BROWN, STIFF, DRY.

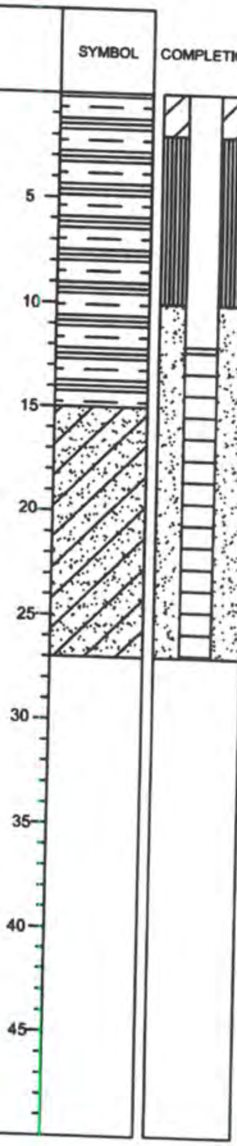
(15-18') SILTY CLAY AND SANDY CLAY, ORANGE-BROWN TO LIGHT GRAY, MOIST.

(18-27') SILTY CLAY AND SANDY CLAY, DARK BROWN TO GRAY, MOIST TO WET.

TOTAL DEPTH = 27' BGS

Kenneth J. Brandner
Geology
1787

4-12-17



AD-16R
WELL

AEP
CLIENT

BOTTOM ASH STORAGE POND
PROJECT

WELSH POWER PLANT
LOCATION

4/12/17
DATE

HSA
DRILLING METHOD

2" PVC, 2' AGL-12' BGL
CASING

2" PVC, 12'-27' BGS
SCREEN

0-2' BGS
CEMENT

2-10' BGS
BENTONITE

10-27' BGS
SAND PACK

350.55' / 353.49'
GROUND ELEV. / TOP OF CASING ELEV.

CT - CUTTINGS
SB - SPLIT BARREL(5')
SS - SPLIT SPOON(2')

▽ HC LEVEL
▼ WATER LEVEL

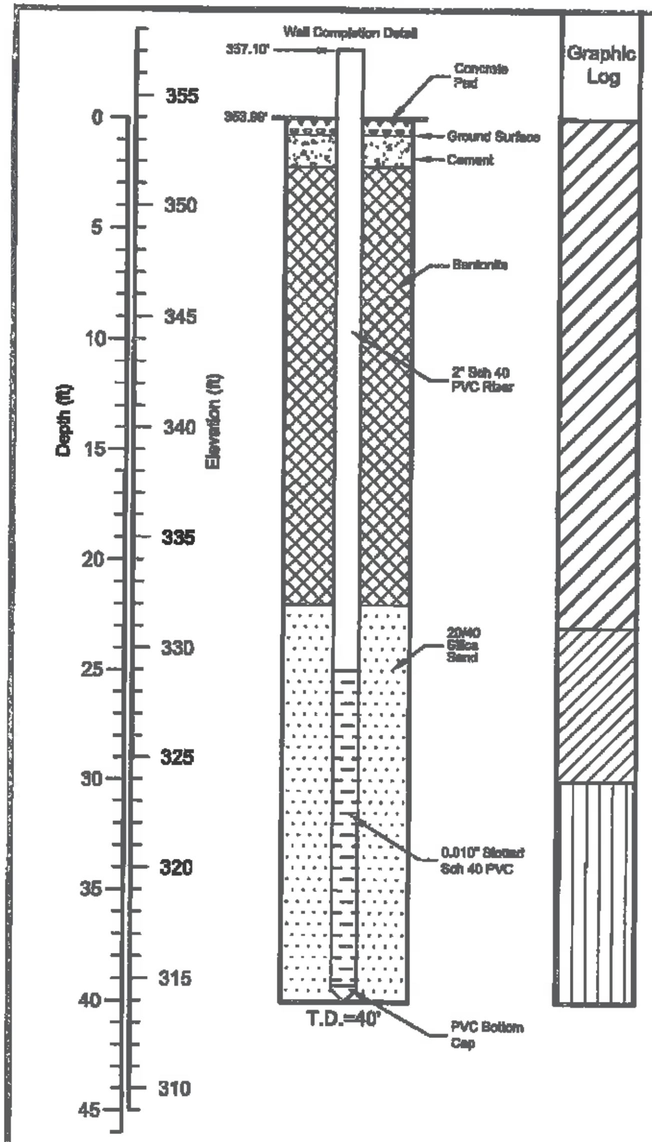
▨ SAND
▨ SILT
▨ CLAY
▨ FILL/CONCRETE
▨ BENTONITE
▨ GRAVEL

START: FINISH:

PAGE 1 OF 1

ARCADIS Design & Consultancy for natural and built assets

711 N. CARANCAHUA, #1080
CORPUS CHRISTI, TEXAS 78401
TEL: (361) 883-1353 FAX: (361) 883-7565



PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
	Direct Push		CH	Fat CLAY: reddish-brown					
				- light gray to light brown, reddish brown w/ Sand and gravel lenses	24	97	83	30	53
				- light brown					
				- brown Sand lenses, wet					
				- gray, w/ some Silt	18	90	53	25	28
	Direct Push		CL	Lean CLAY with Sand: gray	22	81	43	22	21
			ML	Sandy SILT: gray	23	63	26	NP	-

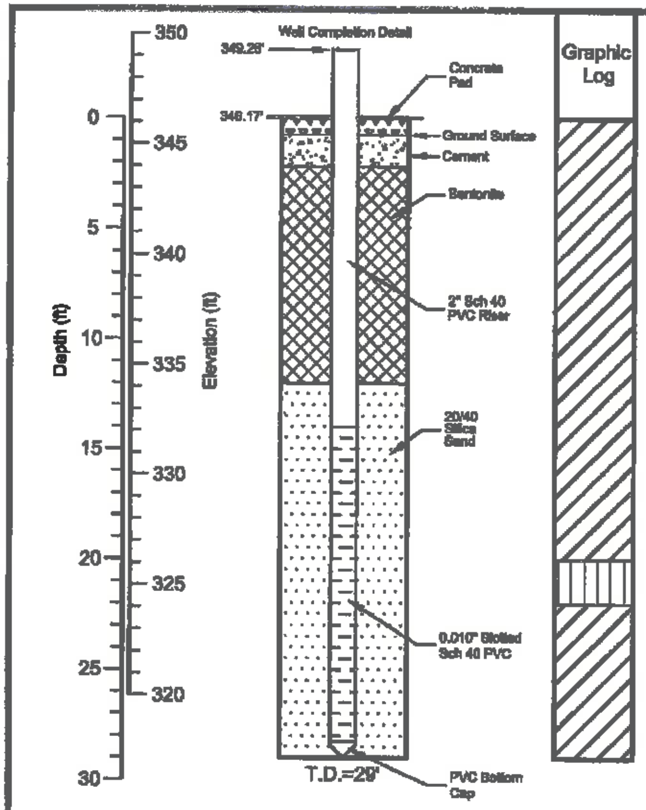
STEVEN R. WEMPLE
2176

1/22/16

west
DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahatchie, Texas 75165

DATE: 12/10/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-17
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: —
			SCALE: AS SHOWN
Depth to Water: —	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg



Depth (ft)	PID Reading (ppm)	Sampling Device	Sample Interval	USCS	Comments and Lithology	Percent Moisture	Percent Fines	Liquid Limit	Plastic Limit	Plastic Index
0		Direct Push		CH	Fat CLAY: light brown & light gray, sandy					
5					- reddish brown and light gray, with Sand					
10						19	88	50	24	26
15					- gray with silt					
					- gray, stiff					
20				ML	SILT: gray, with Clay and Sand, wet	29	86	26	NP	-
				CH	Fat CLAY: light gray, silty w/ Sand, very stiff					
25						20	85	50	23	27
30										

STEVEN R. WEMPLE
LICENSE NUMBER 2176

1-22-21

WEST DRILLING
environmental & geotechnical

WEST Drilling, Inc.
101 Industrial Drive
Waxahachie, Texas 75165

DATE: 12/11/15	Logged by: Robert Williams, PE	Welsh Power Station Pittsburg, Texas	Log of Boring AD-18
Drilling Method: H.S.A.	Driller: Robert Williams		
Bit Diameter: 7.25"	Date Completed: 12/11/15	DRAWN BY: HDS	PROJECT NO.: —
			SCALE: AS SHOWN
Depth to Water: –	Depth to Product: NA	CHECKED BY: SRW	FILE NAME: JR Welsh Power Plant LOGS.dwg

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 1 of 2

Date(s) Drilled **July 23, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **37 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **367 feet MSL**
Groundwater Level and Date Measured	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Bentonite Chips**	Location **On the Northern edge of proposed chemical pond along the screening berm.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
367	0					Other		Black COAL, a few fine roots and organics.						
			ST											Shelby tube pulled black COAL
			SS	10										SPT 4, 5, 5, 5. 24" recovered
362	5				Soft to Firm	SC		Reddish Brown fine SAND, little clay, trace silt, Dry. Natural Ground.						
			SS	11										SPT 4, 5, 6, 7. 24" recovered
					Soft	SM		Reddish brown fine SAND with silt, trace clay. Vertical sand seams in sample, Dry.						
			SS	11										SPT 3, 5, 6, 6. 24" recovered.
357	10		ST						23.6	[illegible]	48.9	5.4E-07		Shelby tube sample, 18" recovered.
					Soft	SC		Reddish brown well graded fine SAND, trace silt and clay. Damp.						
			SS	12	Firm	CL		Greyish red CLAY, little sand, horizontal sand seams, Dry.						SPT 5, 6, 6, 9. 24" recovered
					Soft	SC		Brownish red fine SAND, little clay, Damp.						SPT 7, 6, 7, 9. 24" recovered.
			SS	13	Firm	SC-CL		) Four-inch CLAY seam, little fine sand.						
					Firm	CL		Reddish grey CLAY, little sand, oxidized iron ore. Dry						
352	15				Soft	SM		Brownish red fine SAND, trace clay, thin clay seams. Moist.						SPT 8, 9, 9, 9. 24" recovered.
			SS	18					17.74	14	40.1			
			ST						16.25	NP	28.9	3.6E-05		Shelby tube samples look like SC. 17" recovered.
347	20		SS	17	Soft	Other		) Iron oxidized material						SPT 9, 8, 9, 11. 24 inches recovered.
					Soft	SC		Brownish red fine SAND, little clay. Moist.						
			SS	15										SPT 5, 7, 8, 50/2. 21" recovered
			SS	50	Soft	CL		Dark grey CLAY, little fine sand, Wet.						SPT 50/3".
					Very Hard	SP		Dark grey-black cemented SAND, little clay. Wet. Driller comments that cemented sand terminates at 25.5 feet.						
342	25													
			SS	27	Soft to Firm	SC		Dark grey fine SAND, little clay. Moist. Soft sand with lenses of firm clay.						SPT 11, 13, 14, 16. 24" recovered.
					Hard	CL		I Dark grey CLAY, little sand, Dry.						
					Soft	SC		Dark grey-black fine SAND, little clay, Wet. Encountered water but water rose to 19 feet after 15 min break.						SPT 11, 16, 30, 14. 24" recovered.
			SS	46										
			SS	37										SPT 11, 15, 22, 25. 24" recovered.
337	30				Hard	CL								

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, TX
Project Number: TXL0064

Log of Boring GB-1

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
337	30	▨	SS	37	Hard	CL	▨	Dark grey CLAY, little fine sand, occasional horizontal sand seams. Wet. (cont.)						SPT 11, 15, 22, 25. 24" recovered.
		▨	SS	29	Soft	ML	▥	Dark grey-black fine SAND, with clay, frequent hard clay lenses (1-3"), Wet.	26.37	NP	57.5			SPT 6, 11, 18, 24. 24 recovered.
332	35		SS	34	Hard	CL	▨	Black CLAY, trace to little fine sand, trace silt. Dry						SPT 9, 16, 18, 23. 24" recovered.
								Bottom of Boring at 37 feet bgs						
327	40													
322	45													
317	50													
312	55													
307	60													
302	65													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-02

Sheet 1 of 1

Date(s) Drilled **August 14, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **364.56 feet MSL**
Groundwater Level and Date Measured **21.53 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Western edge of proposed chemical pond near perimeter fence.**	

Elevation, feet	Depth, feet	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
364.6	0			Soft	Other	Coal					
				Soft	CL	Greyish brown CLAY, with little silt, little sand, damp.					
		SS	4								SPT 2, 2, 2. 12" recovered.
		SS	13								SPT 4, 7, 6, 12.
359.6	5	ST									Shelby Tube Sample
				Firm	CH	Brownish tan CLAY with silt, little sand, Damp. Occasional sand and iron ore.					SPT 8, 12, 17, 21
		SS	29				23.71	38	77.3		
		SS	80								SPT 20, 30, 50/5. 17" recovered
354.6	10			Soft	SC	Red-orange fine SAND, little clay, damp. Occasional iron ore.					SPT 15, 20, 24, 31. 18" recovered.
				Soft	CL	Brownish tan CLAY, little silt, little sand, Damp.					
		SS	44	Soft	SM	Red-orange fine SAND, little clay, Damp.					SPT 11, 12, 9, 32.
		SS	21				20.35	NP	33.5		SPT 6, 6, 12, 6.
349.6	15	SS	18	Soft	SM-SC	Light brown fine SAND, with little silt, little sand, Damp.					SPT 12, 25, 50/5.
				Firm	CL	Black CLAY, with fine sand, Wet.					
		SS	75	Soft	SM-SC	Dark red fine SAND, little clay, little silt, Wet.					SPT 9, 16, 12, 15.
				Soft-Firm	SC	Dark grey fine SAND, little clay, Wet. Occasional clay seams.					
		SS	28								
344.6	20										SPT 9, 17, 21, 27.
		SS	38	Firm	SC	Frequent clay lenses.	22.55	13	36.6		
						8/11/09 ▼					SPT 22, 35, 50/4".
		SS	65								SPT 10, 15, 18, 28.
339.6	25	SS	33								
				Soft	SC	Less clay lenses, Wet.					SPT 12, 27, 37, 50/5".
		SS	64								SPT 19, 24, 21, 50/5".
		SS	44								
				Hard	CL	Dark grey CLAY, [illegible] trace silt, Wet. Bottom of Boring at 30 feet bgs					
334.6	30										

Figure

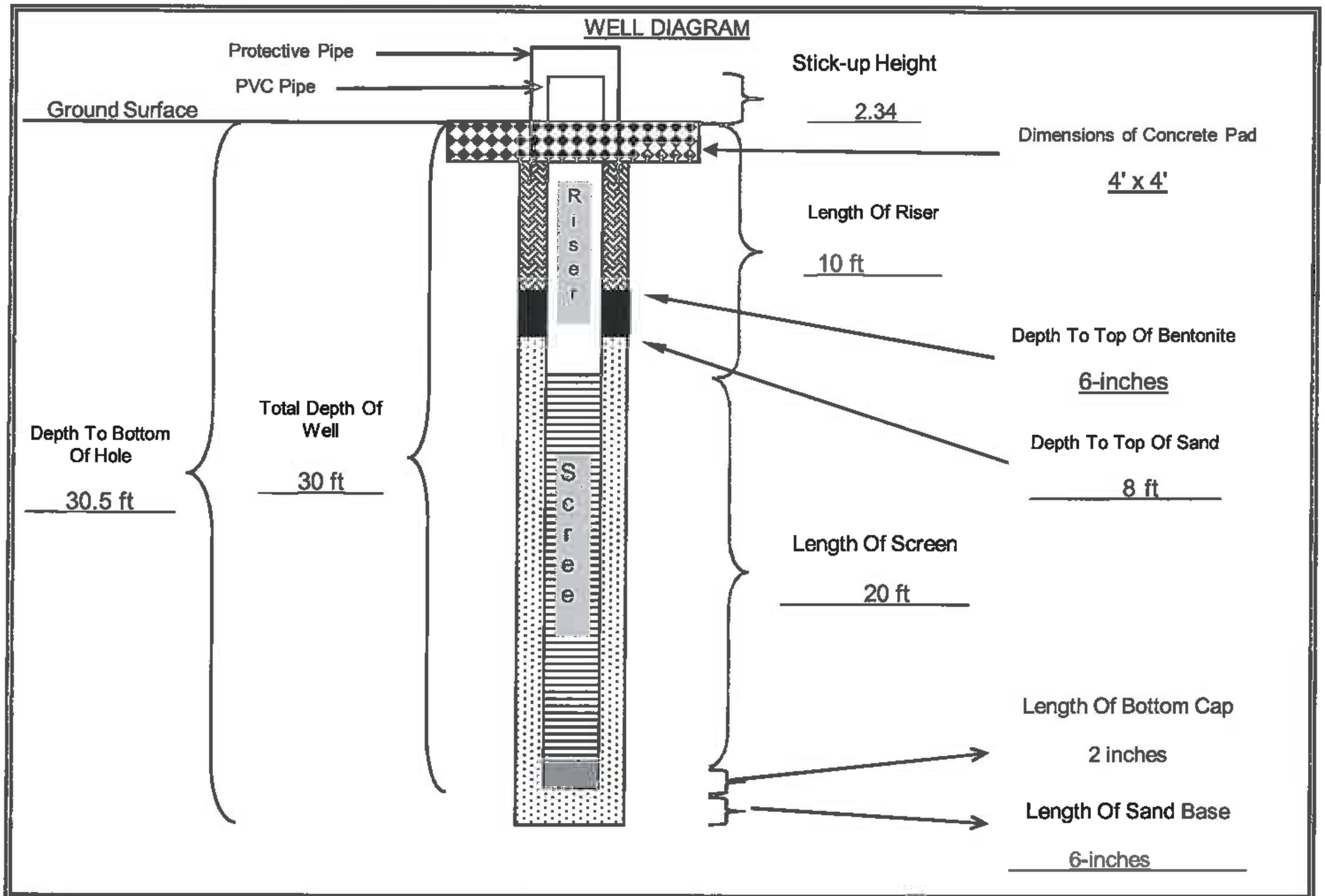
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME:	AEP Welsh Power Plant		
JOB NO.:	TXL0064		**GB-02**
DATE/TIME:	8/7/2009	WELL NO.:	
WELL LOCATION:		FIELD REP:	Kush Chohan

GROUND SURFACE ELEVATION:	364.56 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	354.56 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	334.06 (ft, msl)	CEMENT TYPE:	Not used-sealed with bentonite chips
NORTHING: 747.0223	EASTING: -2442.888	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	4 bags lbs
RISER DIAMETER:	2 (in) Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 20 (ft)	AMOUNT SAND USED:	13 bags lbs
BOREHOLE DIAMETER:	8 (in)	STATIC WATER:	21.53 depth from TOC
DRILLING TECHNIQUE:	Hollow stem Size: (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height 2.34

Dimensions of Concrete Pad 4' x 4'

Length Of Riser 10 ft

Depth To Top Of Bentonite 6-inches

Depth To Top Of Sand 8 ft

Depth To Bottom Of Hole 30.5 ft

Total Depth Of Well 30 ft

Length Of Screen 20 ft

Length Of Bottom Cap 2 inches

Length Of Sand Base 6-inches

▨ Cement/Bentonite Grout	░ Sand Pack	▦ Neat Concrete	■ Bentonite	▩ Bottom Cap

QA/QC INSTALLED BY:	Total Support Services	OBSERVED BY:	Kush Chohan
DATE:	August 7th, 2009	CHECKED BY:	DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 1 of 2

Date(s) Drilled **August 7, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **31 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **359.91 feet MSL**
Groundwater Level and Date Measured **21.89 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, rope & cathead**
Borehole Backfill **Well Completion**	Location **Southwest corner of proposed chemical pond near screening pile.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
359.9	0				Soft	Other		Coal						
354.9	5				Soft	CH		Shelby Tube						Shelby tube sample.
			ST							43	96.1			
					Firm	CH		Light brown-grey CLAY, little silt, occasional sand seams (fine), Damp.						SPT 29, 22, 19, 21.
			SS	41					24.04	29	90.4			
					Soft	CH		Brownish dark grey CLAY, trace sand, trace silt, Wet.						SPT 6, 12, 15, 20.
349.9	10		SS	27										
														SPT 17, 29, 24, 25.
					Soft	SC		Dark orange red SAND, little clay, trace silt, Wet. Occasional clay seam (dark grey).						
			SS	53										
					Soft	SC		Clay lenses.						SPT 7, 15, 17, 40.
			SS	32										
344.9	15													SPT 9, 17, 30, 20.
			SS	47	Soft	SC		Clay lense						
					Soft	SC		Dark grey fine SAND with clay, occasional clay lense, Wet.						SPT 11, 50/4".
			SS	50	Firm	CL		Dark grey CLAY, little fine sand, Wet.						
					Soft	SC		Dark grey fine SAND, little clay, occasional clay seam, iron ore, Wet.						SPT 11, 27, 17, 21.
339.9	20		SS	44										
								8/11/09 ▼						
334.9	25													SPT 27, 40, 50/4".
			SS	90										
					Firm	SC		Dark grey clay lense						SPT 11, 15, 40, 50/3".
			SS	55										
			SS	55										SPT 17, 50/5.5".
329.9	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-03

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
329.9	30	▨	SS	55	Hard	CL	▨	Dark gray CLAY, trace silt, trace fine sand.						SPT 17, 50/5.5".
								Bottom of Boring at 31 feet bgs						
324.9	35													
319.9	40													
314.9	45													
309.9	50													
304.9	55													
299.9	60													
294.9	65													

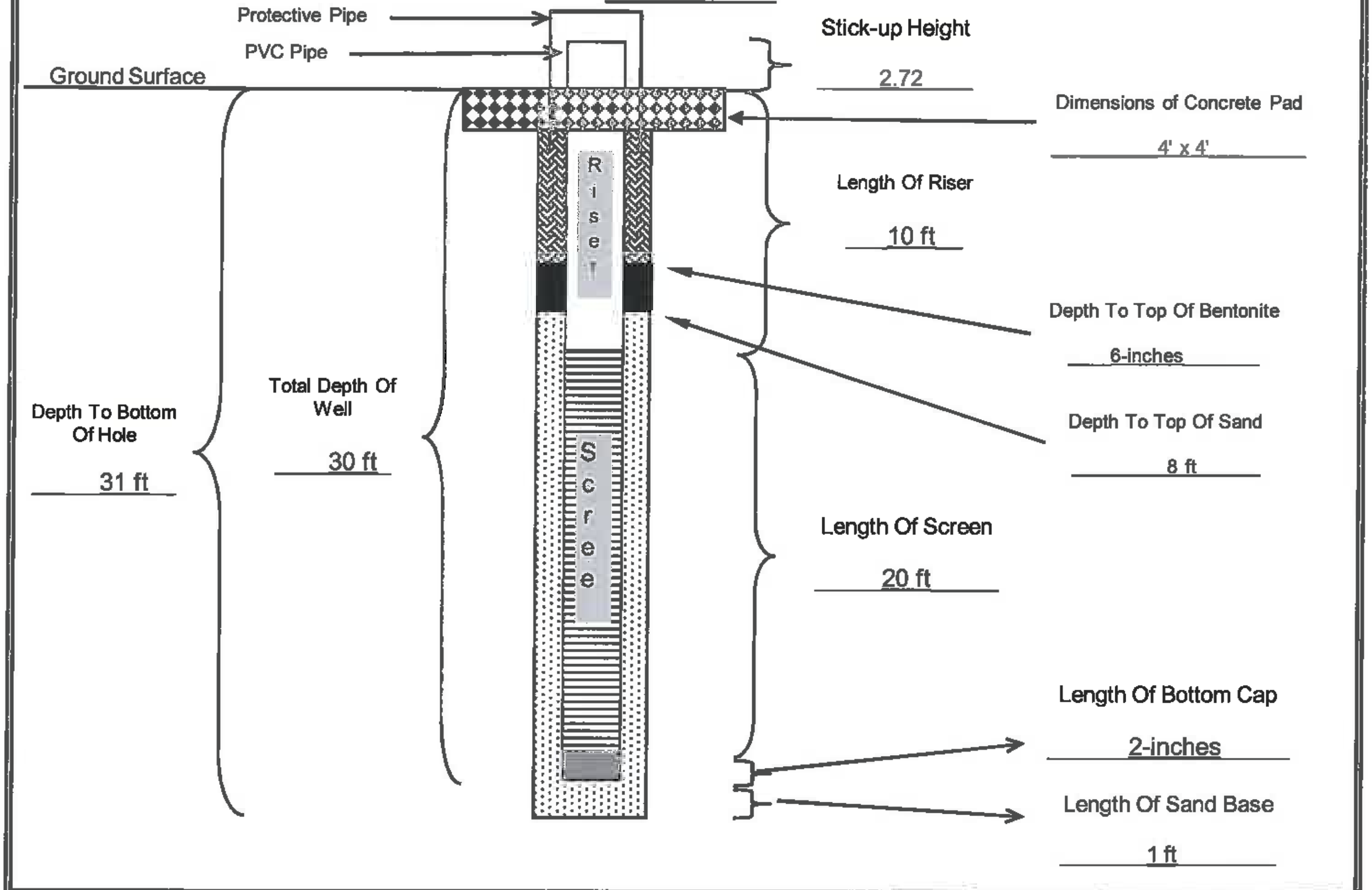
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 8/7/2009
WELL NO.: GB-03
WELL LOCATION:
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 359.57 (ft, msl) BENTONITE TYPE: Western Bentonite
TOP OF SCREEN ELEVATION: 349.57 (ft, msl) MANUFACTURER: PDS
BOTTOM OF WELL ELEVATION: 328.57 (ft, msl) CEMENT TYPE: None used-sealed with bentonite chips
NORTHING: 460.5803 EASTING: -2507.6332 CEMENT MANUFACTURER:
SCREEN MATERIAL: PVC SAND PACK TYPE AND SIZE: Silica 20/40
SCREEN MANUFACTURER: SAND MANUFACTURER: Uninum
RISER MATERIAL: PVC DRILLING CONTRACTOR: Total Support Services
RISER MANUFACTURER: AMOUNT BENTONITE USED: 4 bags lbs
RISER DIAMETER: 2 (in) Length: 10 (ft) AMOUNT CEMENT USED: bags lbs
SCREEN DIAMETER: 2 (in) Length: 20 (ft) AMOUNT SAND USED: 12 bags lbs
BOREHOLE DIAMETER: 8 (in) STATIC WATER: 21.89 depth from TOC
DRILLING TECHNIQUE: Hollow Stem Size: 8 (in) ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



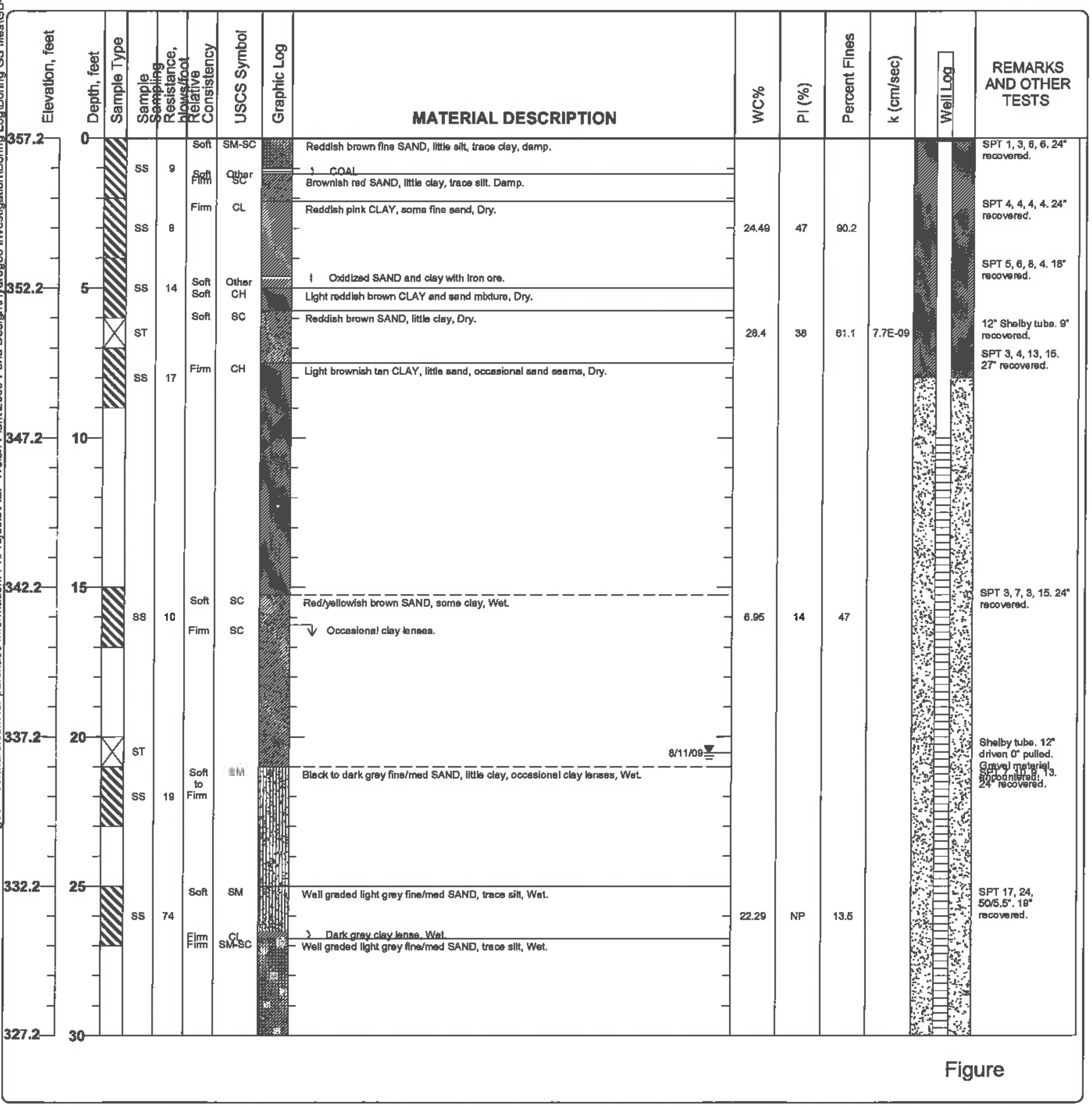
Stick-up Height: 2.72
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 1 ft
Depth To Bottom Of Hole: 31 ft
Total Depth Of Well: 30 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services OBSERVED BY: Kush S. Chohan
DATE: 7-Aug-09 CHECKED BY: DATE:

Project: AEP Welsh Power Plant **Project Location: Cason, Texas** **Project Number: TXL0064**	**Log of Boring GB-04** Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **34 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.22 feet MSL**
Groundwater Level and Date Measured **20.54 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Southeast corner of proposed chemical evaportation pond. Located in a grassy field.**	



Elevation, feet	Depth, feet	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	REMARKS AND OTHER TESTS
357.2	0			Soft	SM-SC	Reddish brown fine SAND, little silt, trace clay, damp.					SPT 1, 3, 6, 6. 24" recovered.
		SS	9	Soft	Other	COAL					
				Firm	SC	Brownish red SAND, little clay, trace silt. Damp.					
				Firm	CL	Reddish pink CLAY, some fine sand, Dry.					SPT 4, 4, 4, 4. 24" recovered.
		SS	8				24.49	47	90.2		
				Soft	Other	Oxidized SAND and clay with iron ore.					SPT 5, 6, 8, 4. 18" recovered.
352.2	5	SS	14	Soft	CH	Light reddish brown CLAY and sand mixture, Dry.					
				Soft	SC	Reddish brown SAND, little clay, Dry.					
		ST					28.4	36	61.1	7.7E-09	12" Shelby tube. 9" recovered.
		SS	17	Firm	CH	Light brownish tan CLAY, little sand, occasional sand seams, Dry.					SPT 3, 4, 13, 15. 27" recovered.
347.2	10										
342.2	15			Soft	SC	Red/yellowish brown SAND, some clay, Wet.					SPT 3, 7, 3, 15. 24" recovered.
		SS	10				6.95	14	47		
				Firm	SC	Occasional clay lenses.					
337.2	20	ST				8/11/09					Shelby tube. 12" driven 0" pulled. Gravel material encountered.
				Soft to Firm	SM	Black to dark grey fine/med SAND, little clay, occasional clay lenses, Wet.					SPT 7, 10, 9, 13. 24" recovered.
		SS	19								
332.2	25			Soft	SM	Well graded light grey fine/med SAND, trace silt, Wet.					SPT 17, 24, 50/5.5". 18" recovered.
		SS	74				22.29	NP	13.5		
				Firm	CL	Dark grey clay lense, Wet.					
				Firm	SM-SC	Well graded light grey fine/med SAND, trace silt, Wet.					
327.2	30										

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-04

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.2	30	☒	ST		Hard	ML	▥	Dark grey CLAY, little sand, Wet.						12" Shelby tube. Bent shelby tube.
		☒	ST				▥		21.3	NP	84.2	2.0E-08		12" Shelby tube.
		▨	SS	38	Hard	CL	▨	Dark grey CLAY, trace sand, Wet.	25.44	18	92.5			SPT 15, 19, 19, 25. 24" recovered.
								Bottom of Boring at 34 feet bgs						
322.2	35													
317.2	40													
312.2	45													
307.2	50													
302.2	55													
297.2	60													
292.2	65													

Figure

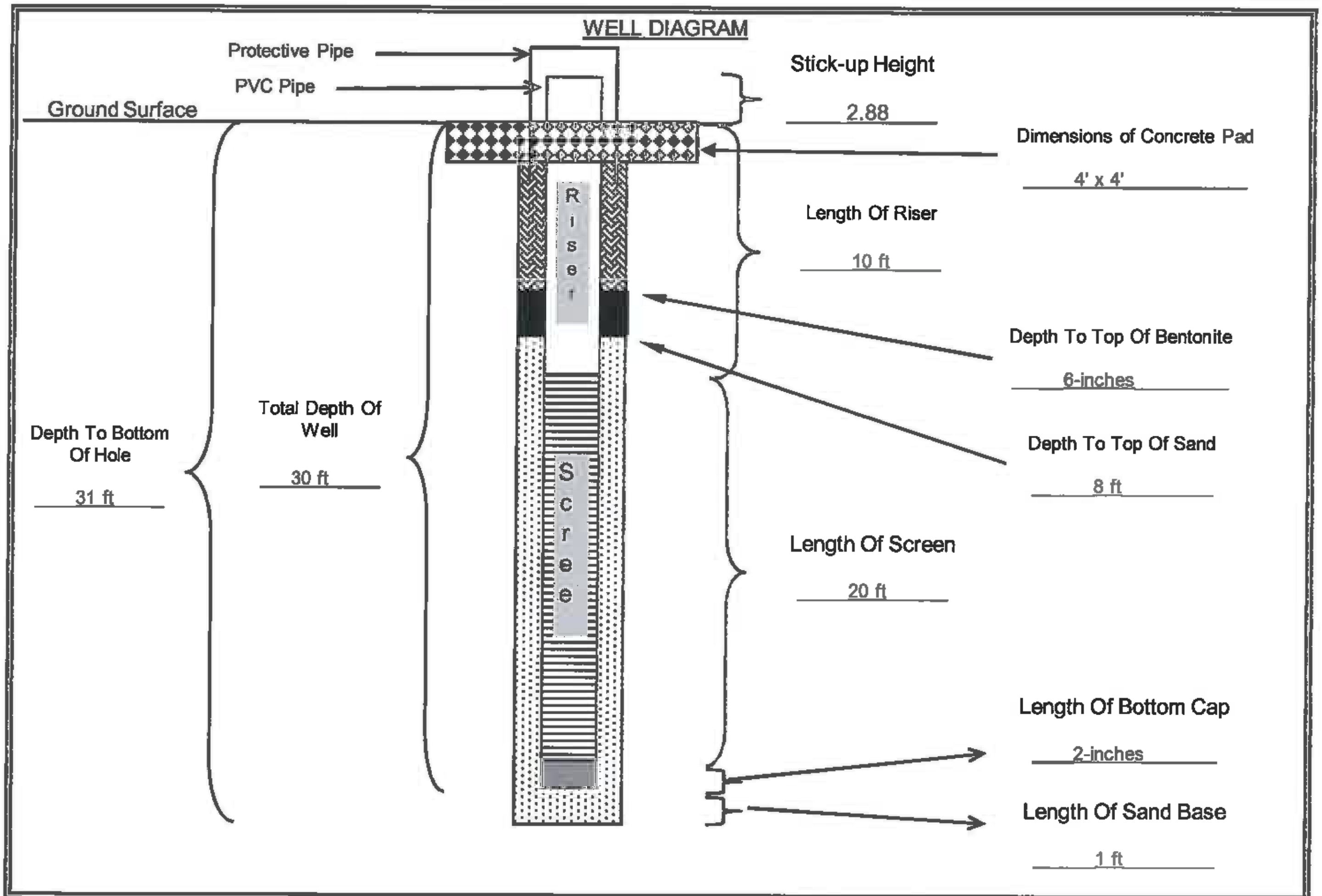
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec
consultants

JOB NAME:	AEP Welsh Power Plant		
JOB NO.:	TXL0064		
DATE/TIME:	24-Jul-09	WELL NO.:	GB-04
WELL LOCATION:		FIELD REP:	Kush Chohan

GROUND SURFACE ELEVATION:	357.22 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	347.22 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	326.22 (ft, msl)	CEMENT TYPE:	
NORTHING: -384.9666	EASTING: -2353.7375	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	3 bags lbs
RISER DIAMETER:	2 (in) Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER:	2 (in) Length: 20 (ft)	AMOUNT SAND USED:	7 bags lbs
BOREHOLE DIAMETER:	6.75 (in)	STATIC WATER:	20.54 depth from TOC
DRILLING TECHNIQUE:	Hollow Stem Size: 6.75 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.88

Dimensions of Concrete Pad: 4' x 4'

Length Of Riser: 10 ft

Depth To Top Of Bentonite: 6-inches

Depth To Top Of Sand: 8 ft

Length Of Screen: 20 ft

Length Of Bottom Cap: 2-inches

Length Of Sand Base: 1 ft

Depth To Bottom Of Hole: 31 ft

Total Depth Of Well: 30 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▒ Bottom Cap

QA/QC INSTALLED BY:	Total Support Services	OBSERVED BY:	Kush S. Chohan
DATE:	24-Jul-09	CHECKED BY:	DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 1 of 2

Date(s) Drilled **July 24, 2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30.5 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.49 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8-11-09**	Sampling Method(s) **SPT, Tube**	Hammer Data **140 lb, 30 in drop, Auto-hammer**
Borehole Backfill **Well Completion**	Location **Eastern edge of proposed chemical evaporation pond.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
357.5	0				Soft	SW-SM		Dark fine SAND with brown organic material and roots.						SPT 2, 2, 5, 5. 24" recovered
			SS	7	Firm	CH		Dark red/grey CLAY, trace silt. Dry.	23.37	44	68.6			
														SPT 4, 4, 7, 9. 24" recovered.
			SS	11								7E-07		
														SPT 5, 6, 8, 13. 24 recovered
352.5	5		SS	14										
						CH		Trace of sand						
			ST		Soft	CH		Dark red fine SAND, trace clay, Damp.	16.5	41	73.8	3.2E-08		Shelby tube. Pushed 12 recovered 9".
														SPT 5, 7, 11, 11. 24" recovered.
			SS	18	Firm	CH		Light tan CLAY, trace sand, Dry.						
					Soft	SC		Dark red SAND, trace of CLAY, Damp.						
					Firm	CL		Light tan CLAY, trace fine sand, Dry.						
					Soft	SC		Dark red SAND, little clay, frequent clay seams, Damp						SPT 6, 7, 11, 14. 24" recovered.
347.5	10		SS	18										
						SC		Frequent clay seams						SPT 11, 22, 13, 14. 24" recovered.
			SS	35	Soft	SC		Red/orange fine SAND, trace clay, trace coarse sand, poorly sorted, Moist.						
														SPT 17, 27, 50/5". 17" recovered.
			SS	77	Firm	CL		Brownish grey CLAY, trace sand, Moist.						
					Soft	SC		Tanish grey fine SAND, some clay, Wet.						
342.5	15													
			ST					8-11-09 ▼	19.9	13	35.7	6.6E-07		Shelby tube. Pushed 12" recovered 9".
														SPT 11, 13, 10, 14. 24" recovered.
			SS	23					27.98	NP	32.3			
					Soft	SM		Dark grey coarse SAND/GRAVEL mix, some fine sand, trace clay, Wet.						
					Soft	SM-SC		Red fine SAND, trace clay, Moist. cemented. Moist.						SPT 7, 8, 11, 13. 24" recovered.
			SS	19										
					Firm	SC		Black fine SAND, occasional clay, Wet.						
337.5	20													
					Firm	CL		Dark grey CLAY, little sand, Wet.						SPT 8, 10, 12, 15. 24" recovered.
			SS	22	Firm	SM		Black fine SAND, some medium sand, some clay, Wet.	32.23	NP	35.5			
					Firm	CL		Dark grey CLAY, little sand, Wet.						
					Firm	SM		Black fine SAND, some medium sand, some clay, Wet.						
														SPT 6, 11, 17, 21. 24" recovered.
			SS	28	Firm	SM		Frequent clay seams						
					Firm	SM		Frequent clay seams.						
			ST											Shelby tube. 12" driven 0 recovered.
332.5	25													SPT 15, 19, 21, 27. 24" recovered.
			SS	40	Hard	CL		Dark grey CLAY, trace of sand, Dry.						
														SPT 10, 11, 11, 50/5". 23" recovered.
			SS	22										
					Very Hard	CL		Dark grey CLAY, frequent Iron stone/ore. Rig chatter driller comments						
			ST						24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
327.5	30													

Figure

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-05

Sheet 2 of 2

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
327.5	30	☒	ST		Hard	CL	▨	Dark grey CLAY, trace of sand, Dry. (cont.)	24.9	15	75.0	1.0E-07		Shelby tube. 12" driven 9" recovered.
								Bottom of Boring at 30.5 feet bgs						
322.5	35													
317.5	40													
312.5	45													
307.5	50													
302.5	55													
297.5	60													
292.5	65													

Figure

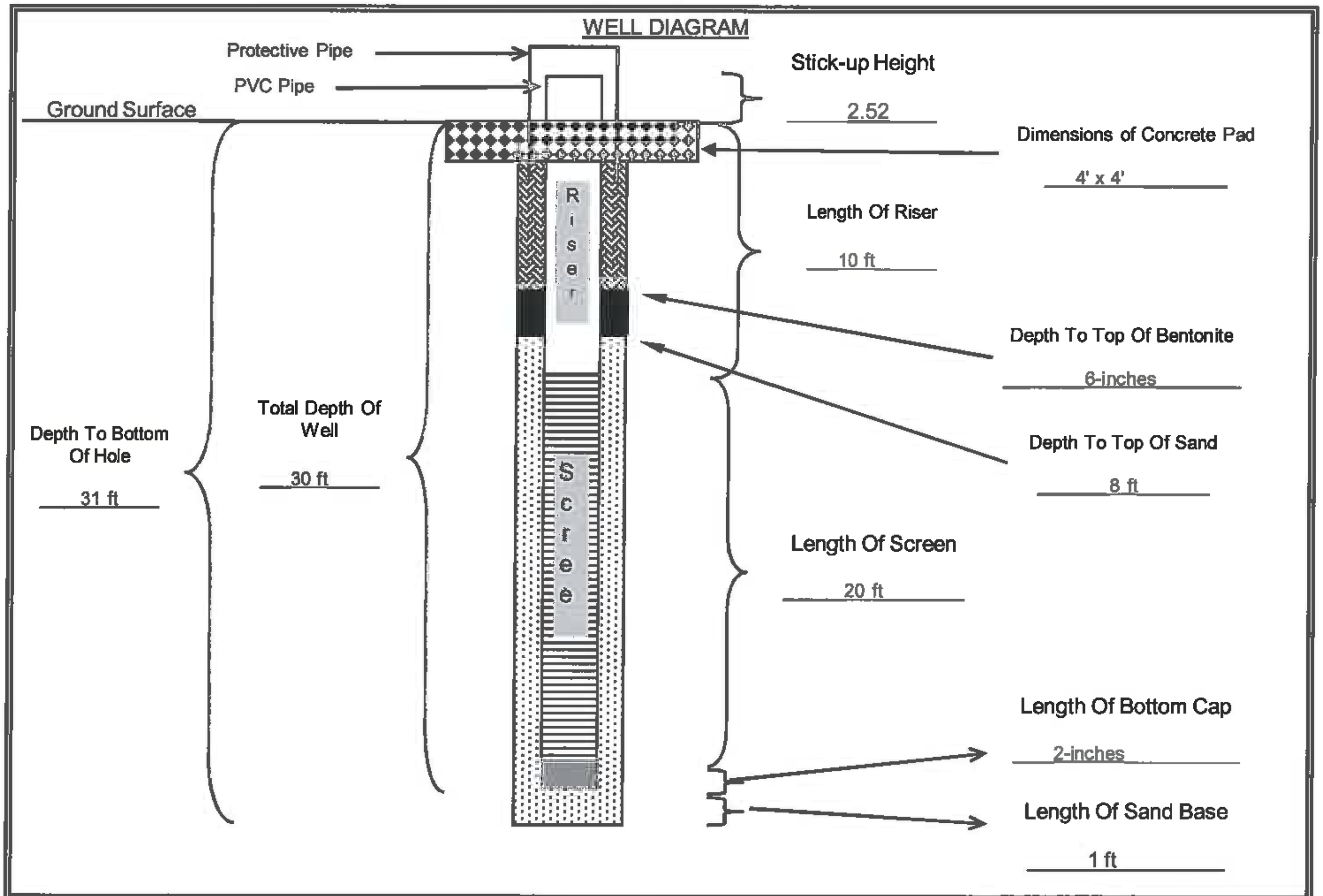
WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: August 6 2009
WELL NO.: GB-05
WELL LOCATION:
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION:	357.49 (ft, msl)	BENTONITE TYPE:	Western Bentonite
TOP OF SCREEN ELEVATION:	347.49 (ft, msl)	MANUFACTURER:	PDS
BOTTOM OF WELL ELEVATION:	326.49 (ft, msl)	CEMENT TYPE:	
NORTHING: 529.1865	EASTING: -2243.9973	CEMENT MANUFACTURER:	
SCREEN MATERIAL:	PVC	SAND PACK TYPE AND SIZE:	Silica 20/40
SCREEN MANUFACTURER:		SAND MANUFACTURER:	Uninum
RISER MATERIAL:	PVC	DRILLING CONTRACTOR:	Total Support Services
RISER MANUFACTURER:		AMOUNT BENTONITE USED:	3 bags lbs
RISER DIAMETER: 2 (in)	Length: 10 (ft)	AMOUNT CEMENT USED:	bags lbs
SCREEN DIAMETER: 2 (in)	Length: 20 (ft)	AMOUNT SAND USED:	7 bags lbs
BOREHOLE DIAMETER:	8 (in)	STATIC WATER:	17.33 depth from TOC
DRILLING TECHNIQUE: Hollow Stem	Size: 8 (in)	ENCOUNTERED WATER:	depth from ground

WELL DIAGRAM



Stick-up Height: 2.52
Dimensions of Concrete Pad: 4' x 4'
Length Of Riser: 10 ft
Depth To Top Of Bentonite: 6-inches
Depth To Top Of Sand: 8 ft
Length Of Screen: 20 ft
Length Of Bottom Cap: 2-inches
Length Of Sand Base: 1 ft
Total Depth Of Well: 30 ft
Depth To Bottom Of Hole: 31 ft

▨ Cement/Bentonite Grout ░ Sand Pack ▦ Neat Concrete ■ Bentonite ▩ Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
OBSERVED BY: Kush Chohan
DATE: 6-Aug-09
CHECKED BY:
DATE:

Project: AEP Welsh Power Plant
Project Location: Cason, Texas
Project Number: TXL0064

Log of Boring GB-06

Sheet 1 of 1

Date(s) Drilled **7/23/2009**	Logged By **Kush S. Chohan**	Checked By
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type	Total Depth of Borehole **30 feet bgs**
Drill Rig Type **Mobil B61**	Drilling Contractor **Total Support Services**	Approximate Surface Elevation **357.41 feet MSL**
Groundwater Level and Date Measured **15.3 feet measured on 8/11/09**	Sampling Method(s) **SPT, Tube, Other**	Hammer Data **140 lb, 30 in drop, auto hammer**
Borehole Backfill **Well Completion**	Location **Northeast corner of proposed chemical pond in the middle of open grass field.**	

Elevation, feet	Depth, feet	Sample Type	Sample	Sampling Resistance, blows/foot	Relative Consistency	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	WC%	PI (%)	Percent Fines	k (cm/sec)	Well Log	REMARKS AND OTHER TESTS
357.4	0				Soft	SP		Greyish brown fine SAND with trace fines. Organic material (roots).						Hand Auger
			HA		Soft	SP-SM		Greyish red fine SAND, little silt. Poorly sorted, less organic material.						
					Soft	SM		Greyish red fine SAND, with little silt and clay. Dry.						
			SS	14	Soft			Tanish grey fine SAND, trace silt and clay, frequent iron oxide, frequent discoloration.	12.74	34	67.9			SPT 4, 7, 7. 16" recovered
					Firm	CL		Red light brown CLAY, little sand, trace silt, Dry.						
352.4	5													SPT 3, 5, 6, 8. 20" recovered
			SS	11	Soft	SC		Dark reddish brown fine SAND, little clay.						
					Soft	CL		Light grey CLAY, little sand, trace silt. Dry.						
					Soft	SC		Reddish brown fine SAND, trace clay, trace silt. Occasional clay seams. Damp.						SPT 3, 5, 7, 7. 24" recovered
			SS	12					17.65	NP	43.2			
					Soft	CL		Light grey CLAY, little fine sand						
			SS		Soft to Firm	SC		Brownish red fine SAND, little to some clay, some cementation, Damp.						24" driven, 15" recovered.
347.4	10													
			SS	19										SPT 8, 9, 10, 10. 24" recovered.
					Soft to Firm	CL		Brown CLAY, little fine sand, frequent brown sand-clay mixture with iron ore oxide.						Shelby Tube. 24" driven/16" recovered
			ST						22.9	21	43.2	6.0e-07		
342.4	15				Firm	CL		Dark redish brown CLAY, little fine sand, Damp. 8/11/09 ▼						SPT 15, 10, 22, 30. 24" recovered
					Firm	SC		Dark reddish brown SAND, little to some clay, Moist.						
			SS	40										
					Firm	CL		Black CLAY, little fine sand, Wet.						
					Firm	SW		Black fine SAND, trace clay, trace med sand, Wet.						SPT 2, 8, 14, 10. 24" recovered
			SS	22										
					Firm	CL		Black CLAY, trace fine sand, trace silt, Wet.						SPT 5, 8, 22, 50/4". 22 recovered.
						SC		Black fine SAND, little clay, Wet.						
337.4	20		SS	30	Firm	CL		Black CLAY, trace sand, trace silt. Wet.						
					Firm	SC		Black fine SAND, trace to little clay, Wet. Occasional black clay seams.						SPT 10, 11, 23, 33. 24" recovered
			SS	34	Firm	SP-SC		Black fine SAND, with little clay, trace med sand, Wet.						
						SW-SC		Grading to med SAND, Wet.						SPT 11, 16, 16, 24. 24" recovered.
			SS	36										
332.4	25													SPT 9, 11, 12, 22. 24" recovered.
			SS	23	Firm	SW-SC		Occasional CLAY lenses, Wet.						
					Firm	SC		Black fine SAND, little med sand and clay, Wet.						SPT 7, 15, 25, 50/3". 21 recovered.
			SS	40	Hard	CL		Dark grey CLAY, little sand, little silt, Dry.						
			ST							19	45.1			Shelby tube. 12" driven-8" recovered.
327.4	30							Bottom of Boring at 30 feet bgs						

Figure

WELL CONSTRUCTION DIAGRAM - EPA TYPE II WELL (STICK-UP)

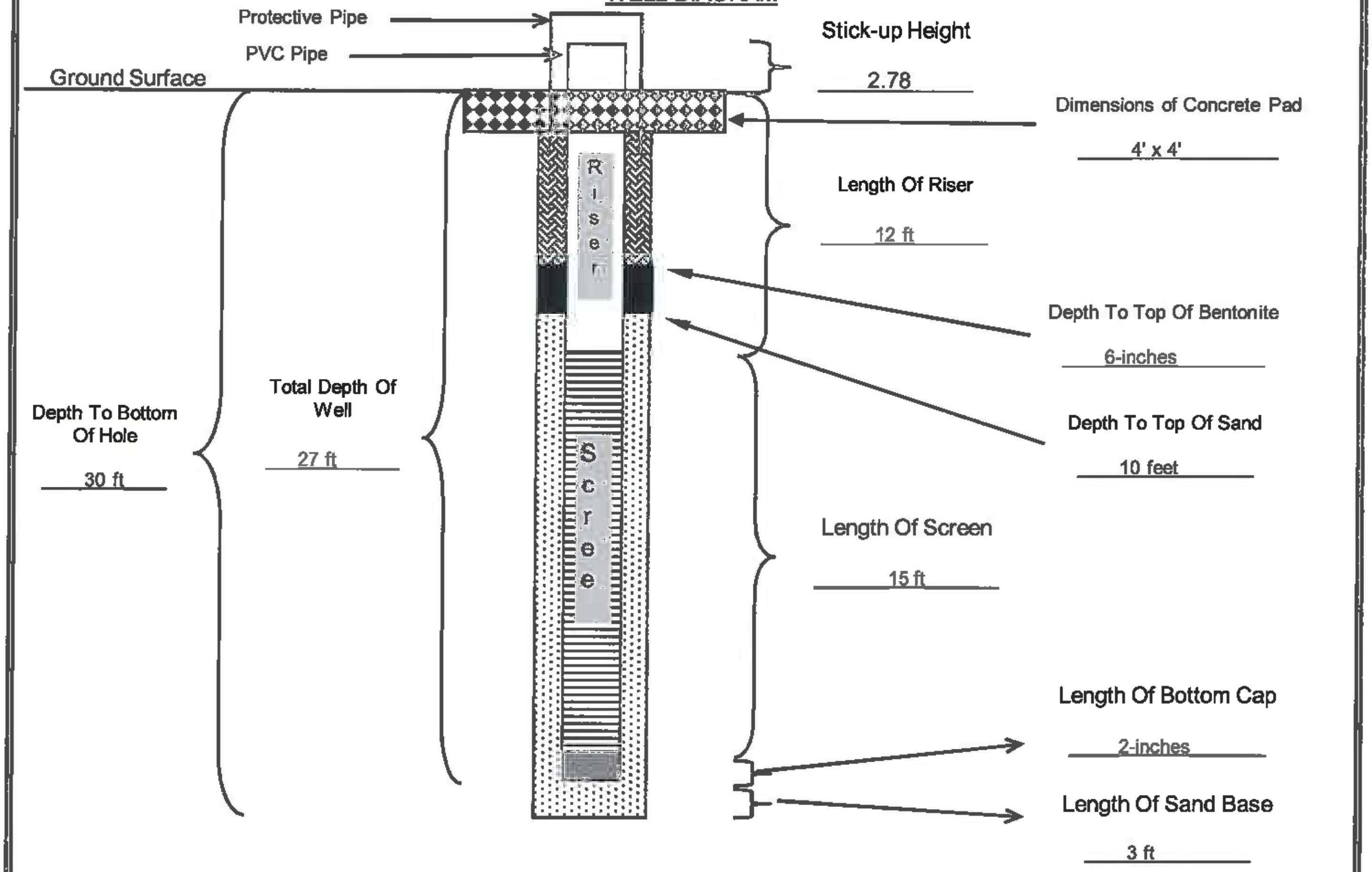
Geosyntec consultants

JOB NAME: AEP Welsh Power Plant
JOB NO.: TXL0064
DATE/TIME: 23-Jul-09
WELL LOCATION:
WELL NO.: **GB-06**
FIELD REP: Kush Chohan

GROUND SURFACE ELEVATION: 357.41 (ft, msl)
TOP OF SCREEN ELEVATION: 345.41 (ft, msl)
BOTTOM OF WELL ELEVATION: 327.41 (ft, msl)
NORTHING: 740.4893 EASTING: -2166.134
SCREEN MATERIAL: PVC
SCREEN MANUFACTURER:
RISER MATERIAL: PVC
RISER MANUFACTURER:
RISER DIAMETER: 2 (in) Length: 12 (ft)
SCREEN DIAMETER: 2 (in) Length: 15 (ft)
BOREHOLE DIAMETER: 6.75 (in)
DRILLING TECHNIQUE: Hollow Stem Size: 6.75 (in)

BENTONITE TYPE: Western Bentonite
MANUFACTURER: PDS
CEMENT TYPE:
CEMENT MANUFACTURER:
SAND PACK TYPE AND SIZE: Silica 20/40
SAND MANUFACTURER: Uninum
DRILLING CONTRACTOR: Total Support Services
AMOUNT BENTONITE USED: 2.5 bags lbs
AMOUNT CEMENT USED: bags lbs
AMOUNT SAND USED: 7 bags lbs
STATIC WATER: 15.3 depth from TOC
ENCOUNTERED WATER: depth from ground

WELL DIAGRAM



Stick-up Height 2.78
Dimensions of Concrete Pad 4' x 4'
Length Of Riser 12 ft
Depth To Top Of Bentonite 6-inches
Depth To Top Of Sand 10 feet
Length Of Screen 15 ft
Length Of Bottom Cap 2-inches
Length Of Sand Base 3 ft
Depth To Bottom Of Hole 30 ft
Total Depth Of Well 27 ft

▨	Cement/Bentonite Grout	░	Sand Pack	▦	Neat Concrete	■	Bentonite	▩	Bottom Cap

QA/QC
INSTALLED BY: Total Support Services
DATE: 23-Jul-09
OBSERVED BY: Kush Chohan
CHECKED BY:
DATE:

E·A·G·L·E
ENVIRONMENTAL SERVICES
OF SHREVEPORT, INC.

SOIL BORING LOG

BORING/WELL NO.:	GB-07/MW-7
TOTAL DEPTH:	34'
TOP OF CASING ELEV.:	362.75 ft. NGVD
GROUND SURFACE ELEV.:	360.20 ft. NGVD

CLIENT:	**AEP**
PROJECT:	**Metal Cleaning Waste Pond**
SITE LOCATION:	**Welsh Power Plant**
PROJECT NO.:	**S-08-0120**
LOGGED BY:	**James Meleton, Jr.**

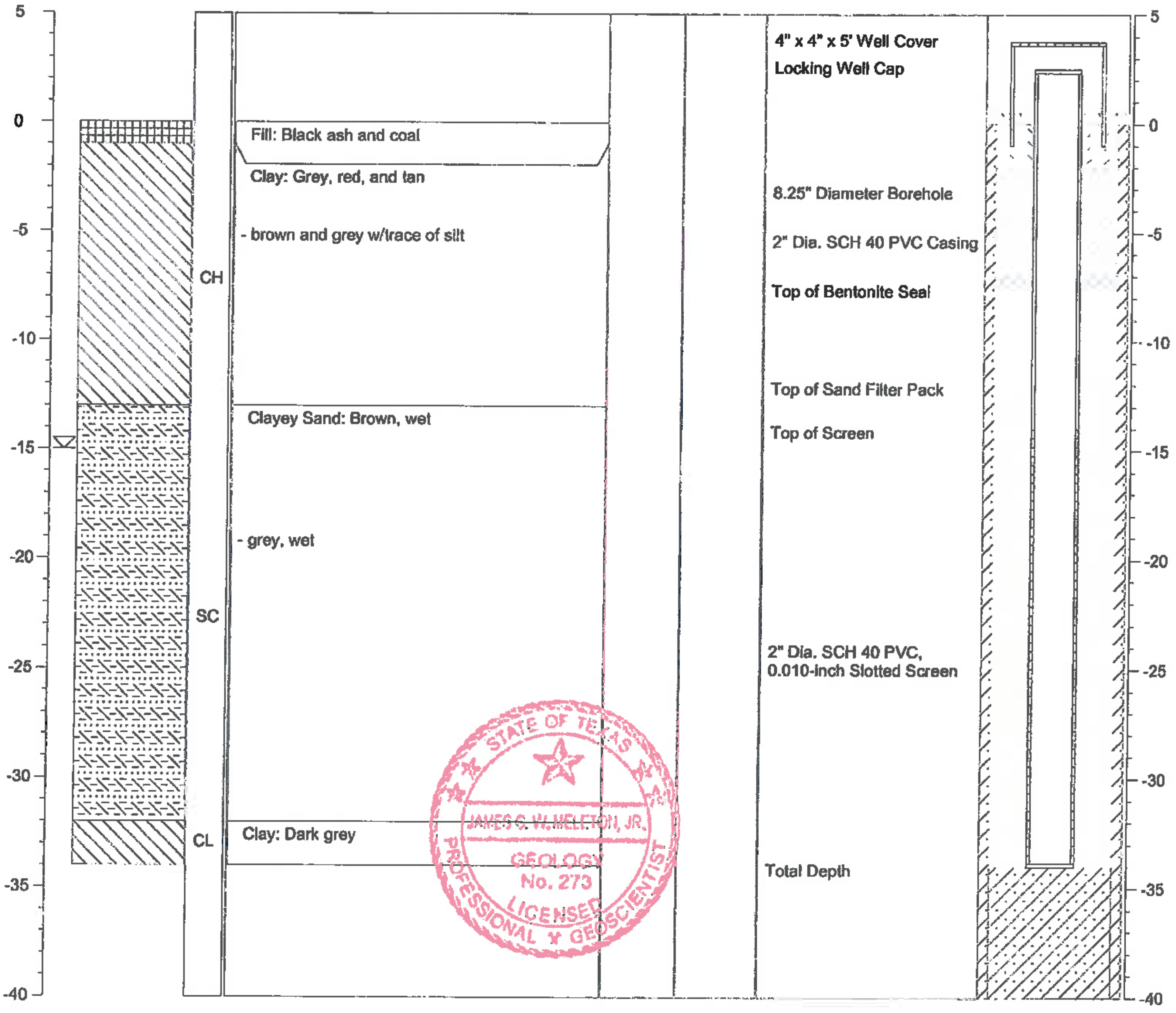
DRILLING CO.:	**WEST Drilling**
DRILLER:	**Tom McCullough**
METHOD OF DRILLING:	**Hollow-stem Auger**
SAMPLING METHODS:	**Split-spoon**
DATE DRILLED:	**12/1/09**

NOTES: **Latitude: 33.05455**
Longitude: 94.84674

▽ Water level during drilling
▼ Water level in completed well

Page 1 of 1

DEPTH	SOIL SYMBOLS	USCS	SOIL DESCRIPTION	CORE RECOVERY (Percent)	PID (ppm)	WELL DESCRIPTION	WELL CONSTRUCTION



Fill: Black ash and coal

Clay: Grey, red, and tan

- brown and grey w/trace of silt

Clayey Sand: Brown, wet

- grey, wet

Clay: Dark grey

4" x 4" x 5' Well Cover

Locking Well Cap

8.25" Diameter Borehole

2" Dia. SCH 40 PVC Casing

Top of Bentonite Seal

Top of Sand Filter Pack

Top of Screen

2" Dia. SCH 40 PVC, 0.010-inch Slotted Screen

Total Depth

STATE OF TEXAS
JAMES C. W. MELETON, JR.
GEOLOGY
No. 273
LICENSED
PROFESSIONAL GEOSCIENTIST

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-1

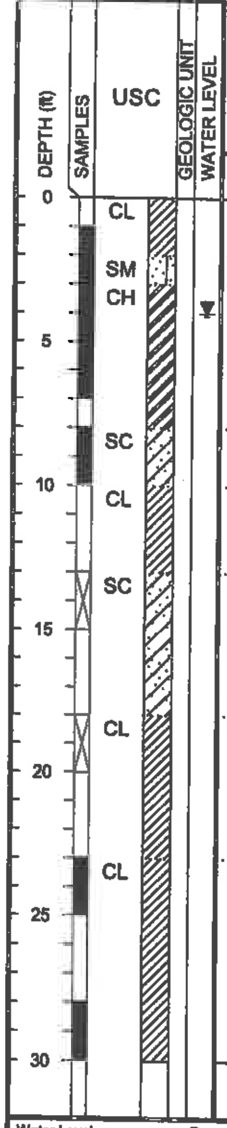
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

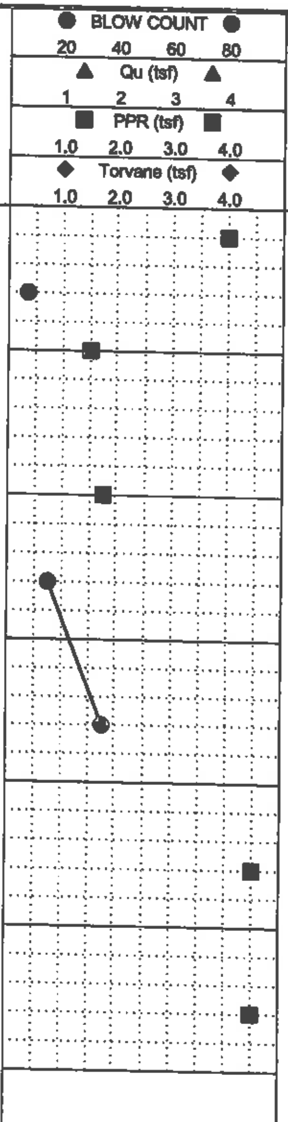
DATE 10/27/09

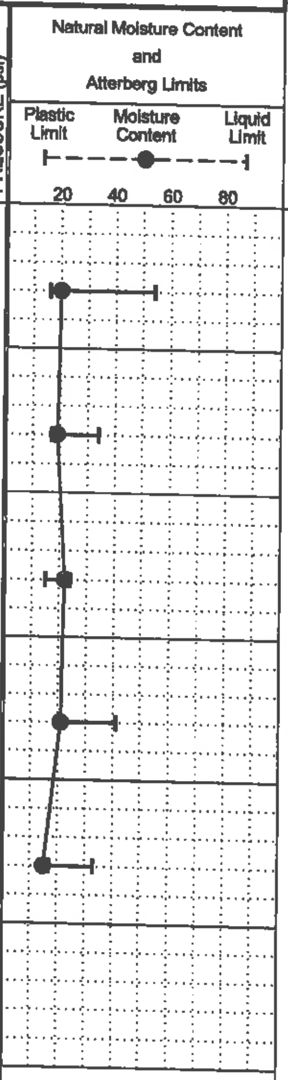
SURFACE ELEVATION 324.1



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; brownish orange	P=4.0 SF						
SM	SILTY SAND(SM) tannish orange	N=7						
CH	SANDY FAT CLAY(CH) medium stiff; tannish orange		20	54	16	38	63	+40Sieve=10%, +4 Sieve=1%
	–stiff	P=1.5						
SC	CLAYEY SAND(SC) medium dense; tannish orange; with clay seams	P=1.75	19	34	17	17	32	+40 Sieve=7%, +4 Sieve=3%
CL	SANDY LEAN CLAY(CL) stiff; orange							
SC	CLAYEY SAND(SC) medium dense; orange; saturated; with iron oxide cemented sandstone rock	N=15	22	24	15	9	19	+40Sieve=35%, +4 Sieve=22%
CL	LEAN CLAY WITH SAND(CL) hard; dark gray; with clay seams	N=35	21	41	21	20	75	+40 Sieve=2%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; dark brown	P=4.5+	15	33	17	16	52	+40 Sieve=1%, +4 Sieve=0%
	–grayish brown; laminated with silt	P=4.5+						
	Bottom of Boring @ 30'							

DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)





Water Level Est.: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 5' while drilling. Water level @ 4' and open to 30' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.090', W 94°50.417'

Piezometer B-2

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

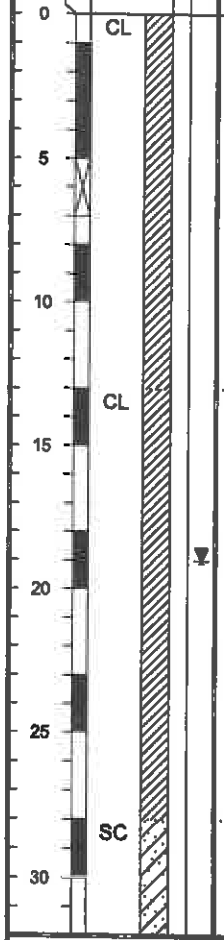
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

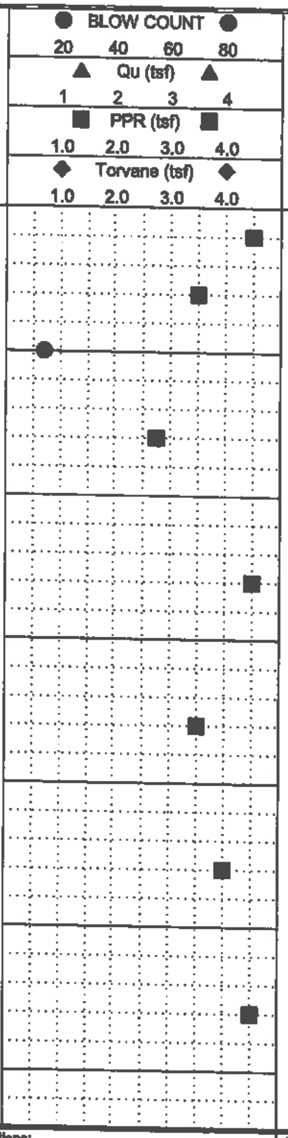
BORING TYPE: Flight Auger

DATE 10/28/09

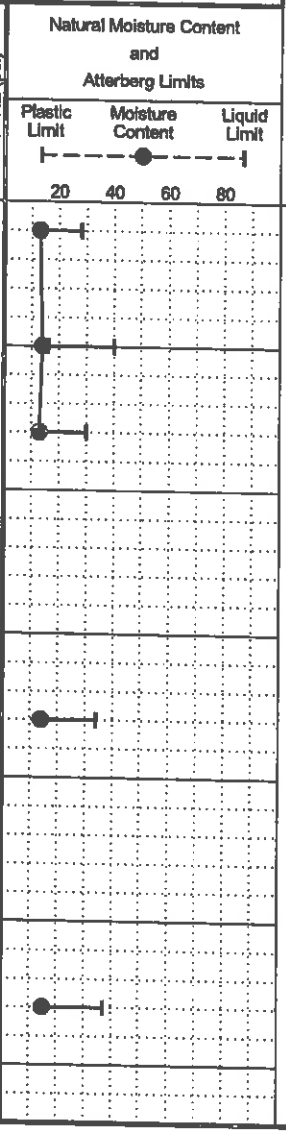
SURFACE ELEVATION 339.7



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+	13	28	14	14	61	+40 Sieve=3%, +4 Sieve=0%
	--very stiff	P=3.5						
	--stiff	N=14	14	40	16	24	65	+40 Sieve=0%, +4 Sieve=0%
	--very stiff; reddish brown	P=2.75	13	30	14	16	58	+40 Sieve=0%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+						
	--very stiff	P=3.5	14	34	15	19	54	+40 Sieve=0%, +4 Sieve=0%
		P=4.0						
SC	CLAYEY SAND(SC) medium dense; tan, red, and gray	P=4.5	15	37	16	21	47	+40 Sieve=5%, +4 Sieve=3%



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



ATTERBERG LIMITS(%)

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2

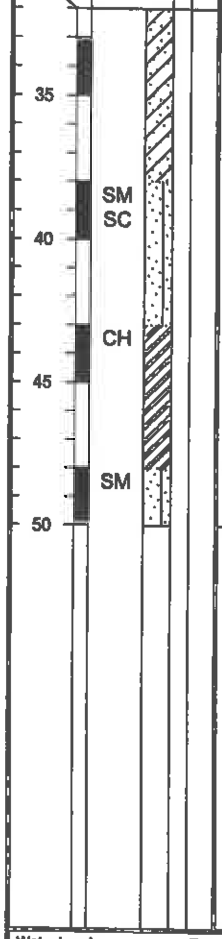
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

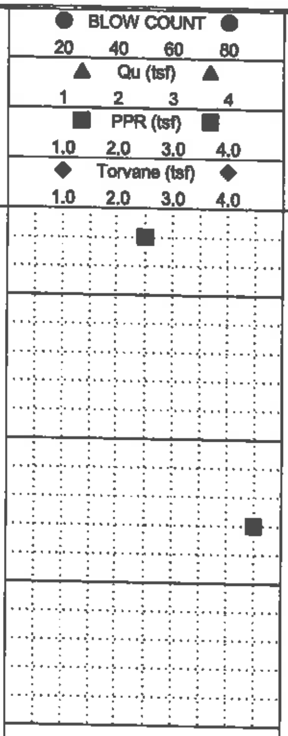
DATE 10/28/09

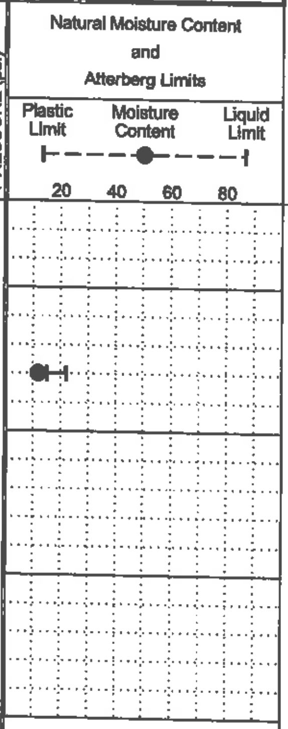
SURFACE ELEVATION 339.7



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	--red and tan	P=2.5										
SM SC	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated	SF					12	22	15	7	48	+40 Sieve=0%, +4 Sieve=0%
CH	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams	P=4.5+										
SM	SILTY SAND(SM) black and gray	SF										

Bottom of Boring @ 50'





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

Piezometer B-2

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

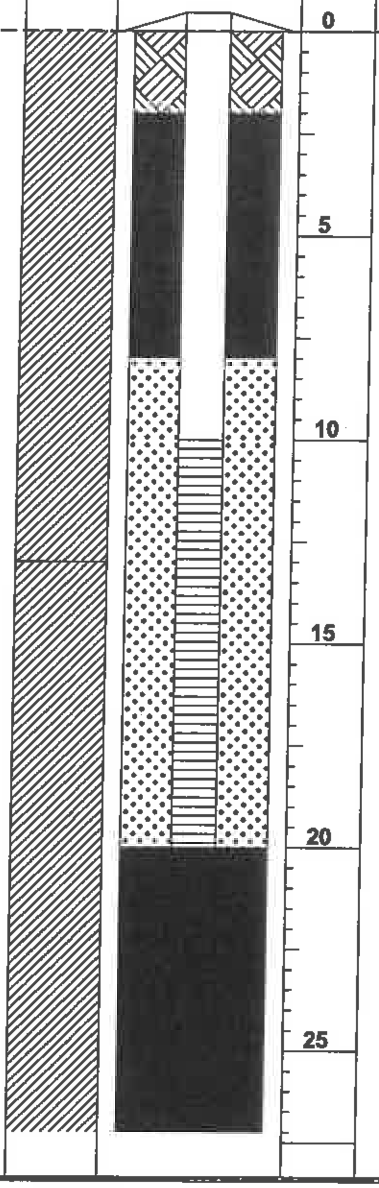
Well No. B-2

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		SANDY LEAN CLAY(CL) hard; red and tan					
		–very stiff					
5		–stiff				5	
		–very stiff; reddish brown					
10						10	
		SANDY LEAN CLAY(CL) hard; red and tan					
15						15	
		–very stiff					
20						20	
25						25	



Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/28/09

Drilling Completed 10/28/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-8' & 20-50'

Filter Pack Qty. 8-20'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

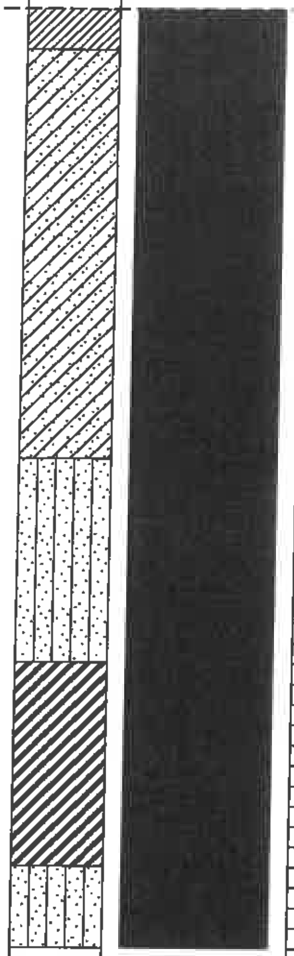
Well No. B-2

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
	CLAYEY SAND(SC) medium dense; tan, red, and gray					
30					30	
	--red and tan					
35					35	
	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated					
40					40	
	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams					
45					45	
	SILTY SAND(SM) black and gray					
50					50	
	Bottom of Boring @ 50'					
55						
60						



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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

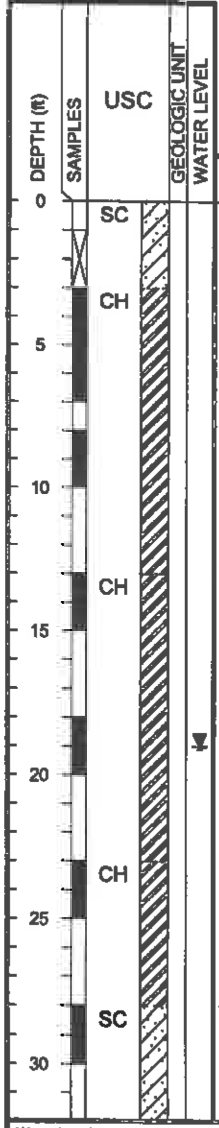
PROJECT: Welsh Power Plant
Pittsburgh, Texas

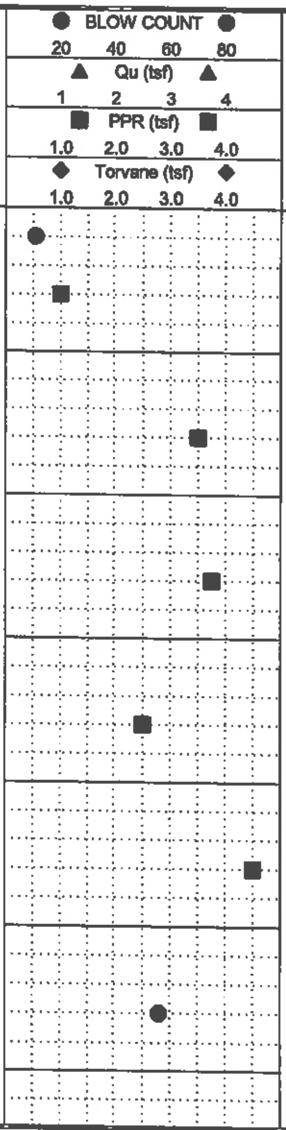
PROJECT NO.: G3242-09

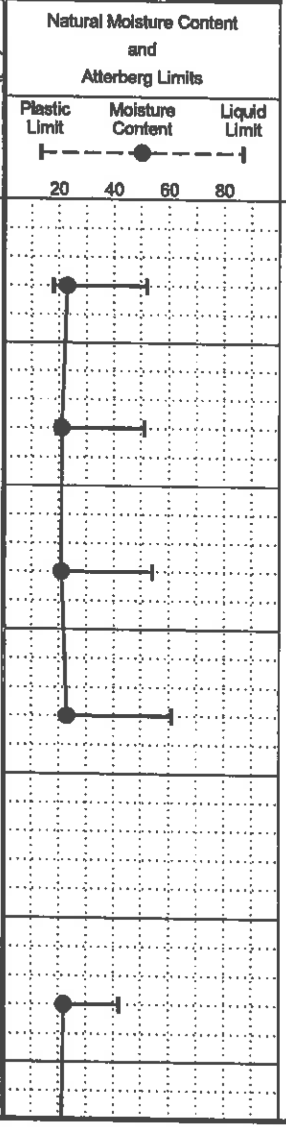
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6







USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC		CLAYEY SAND(SC) medium dense; gray and red	N=11										
CH		FAT CLAY(CH) stiff; red and tan; with sand seams	P=1.0					23	52	18	34	87	+40 Sieve=3%, +4 Sieve=0%
		--very stiff	P=3.5					21	51	19	32	86	+40 Sieve=3%, +4 Sieve=0%
CH		FAT CLAY WITH SAND(CH) very stiff; brown; with ferric joints	P=3.75					21	54	20	34	85	+40Sieve=10%, +4 Sieve=1%
	▼	--red and tan; layered; with ferric seams	P=2.5					23	61	24	37	81	+40Sieve=11%, +4 Sieve=0%
CH		FAT CLAY(CH) hard; gray; with sand seams	P=4.5+										
SC		CLAYEY SAND(SC) very dense; gray; with sand seams	N=56					22	42	22	20	35	+40 Sieve=1%, +4 Sieve=0%

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6

DEPTH (ft)	SAMPLES	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	▇	CH	FAT CLAY(CH) hard; brown; layered and with sand seams	P=4.5+					21	60	24	36	95	+40 Sieve=1%, +4 Sieve=0%
40	▇		--gray and green	P=4.5+										
45	▇	CL	SANDY LEAN CLAY(CL) very stiff; gray and dark green; layered; with sand seams	P=3.5										
50	▇	CH	FAT CLAY(CH) hard; gray and dark green; layered; with silt seams	P=4.5+										
			Bottom of Boring @ 50'											

● BLOW COUNT ● 20 40 60 80
▲ Qu (tsf) ▲ 1 2 3 4
■ PPR (tsf) ■ 1.0 2.0 3.0 4.0
◆ Torvane (tsf) ◆ 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits
Plastic Limit ⊢ - - - ● - - - ⊣ Liquid Limit
Moisture Content
20 40 60 80

GEOLOGIC UNIT
WATER LEVEL

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

Piezometer B-4

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

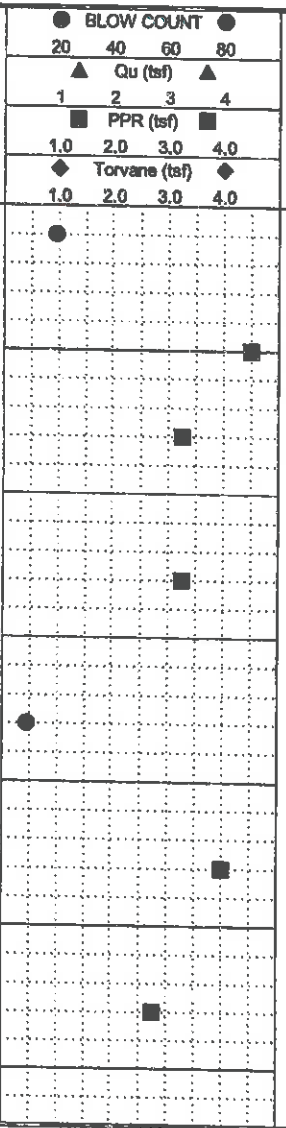
PROJECT NO.: G3242-09

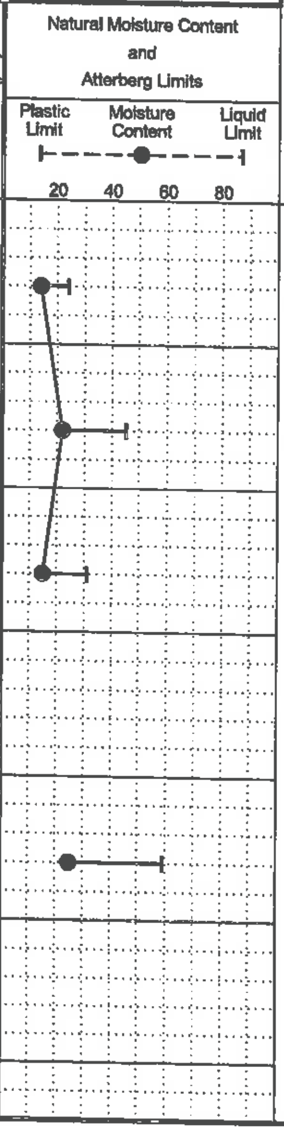
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	SM		SILTY SAND(SM) medium dense; tan; with gravel	N=19										
	CL		SANDY LEAN CLAY(CL) dark brown –tannish orange	SF					14	24	15	9	59	+40 Sieve=1%, +4 Sieve=0%
5			–hard; orangish tan	P=4.5										
				P=3.25					22	45	21	24	94	+40 Sieve=2%, +4 Sieve=0%
10			–very stiff; white											
	SC		CLAYEY SAND(SC) medium dense; tan –orangish gray; with sand seams	P=3.25					15	31	15	16	40	+40 Sieve=1%, +4 Sieve=0%
15														
	CL	▼	SANDY LEAN CLAY(CL) stiff; orangish tan	N=9										
20														
	CH		FAT CLAY(CH) very stiff; orangish tan; with ferric seams	P=4.0					25	59	24	35	88	+40 Sieve=4%, +4 Sieve=0%
25														
			–tannish brown; with iron ore seams	P=2.75										
30														





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

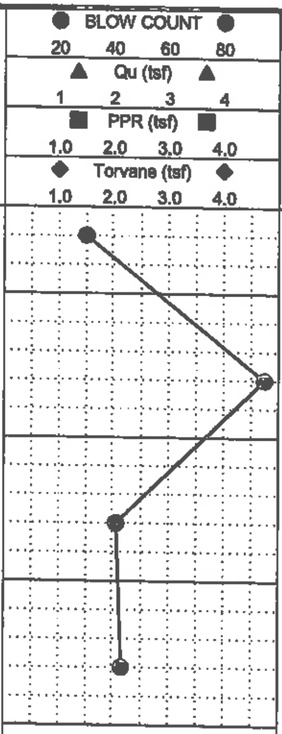
PROJECT NO.: G3242-09

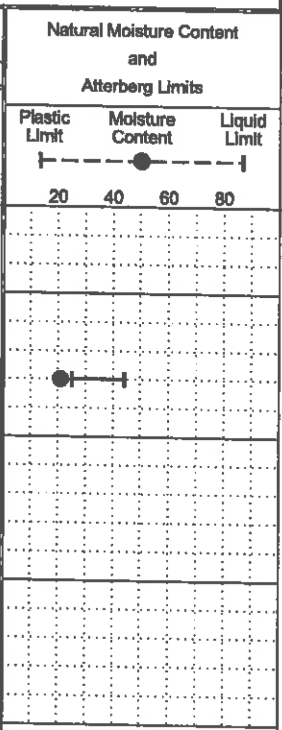
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	SAMPLES	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	☒	CL	–hard; light gray; layered and with silt seams	N=30										
40	☒		LEAN CLAY(CL) hard; light gray; layered and with silt seams	N=50/5.75"					21	44	25	19	93	+40 Sieve=1%, +4 Sieve=0%
45	☒		–light gray	N=41										
50	☒		–layered and with sand seams; with lignite	N=43										
			Bottom of Boring @ 50'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

Piezometer B-4

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-4

Location Pittsburg, Texas

Surface Elev.

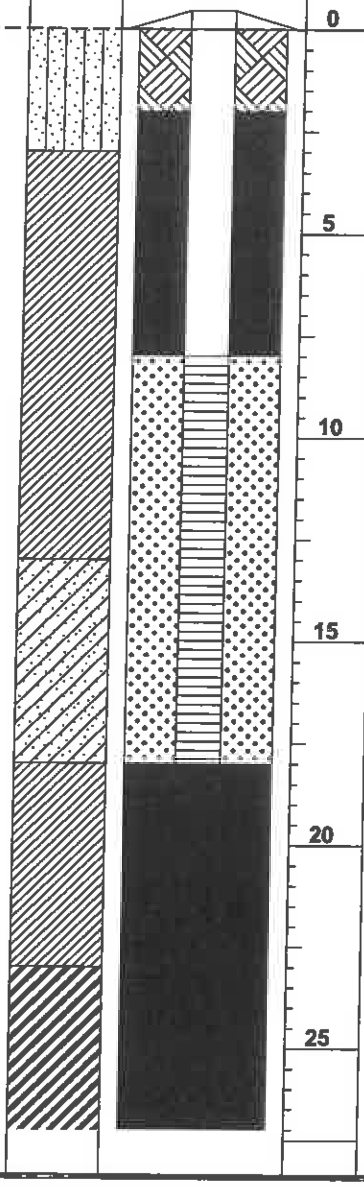
Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description
0		Ground Surface
		SILTY SAND(SM) medium dense; tan; with gravel
		SANDY LEAN CLAY(CL) dark brown
		–tannish orange
5		–hard; orangish tan
10		–very stiff; white
		CLAYEY SAND(SC) medium dense; tan
15		–orangish gray; with sand seams
		SANDY LEAN CLAY(CL) stiff; orangish tan
20		
		FAT CLAY(CH) very stiff; orangish tan; with ferric seams
25		

Continued Next Page

Field Strength Data | **Graphic Log** | **Well Construction Graphics** | **Depth Feet** | **Well Construction Details**

T.O.C. Elev.



Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 8.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 8.0' **to** 18.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-8' & 18-50'

Filter Pack Qty. 6-18'

Filter Pack Type 20/40 Sand

Static Water Level

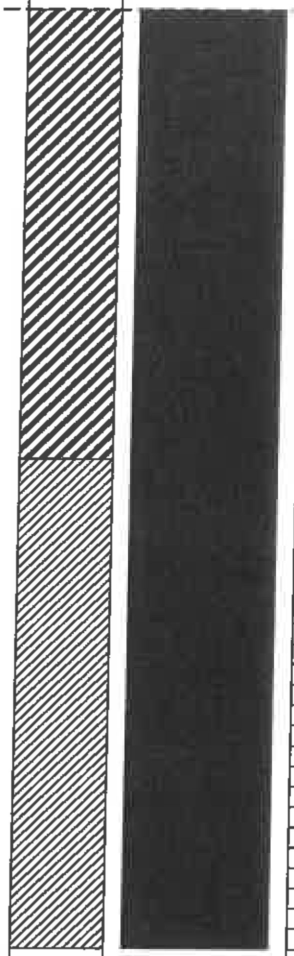
Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**

Well No. B-4
Location Pittsburg, Texas
Surface Elev.
Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		--tannish brown; with iron ore seams					
30						30	
		--hard; light gray; layered and with silt seams					
35						35	
		LEAN CLAY(CL) hard; light gray; layered and with silt seams					
40						40	
		--light gray					
45						45	
		--layered and with sand seams; with lignite					
50						50	
		Bottom of Boring @ 50'					
55							
60							



Piezometer B-5

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

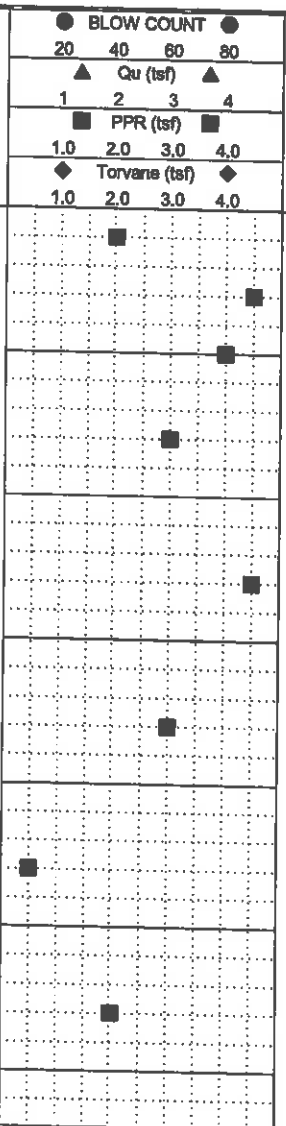
SURFACE ELEVATION 340.0

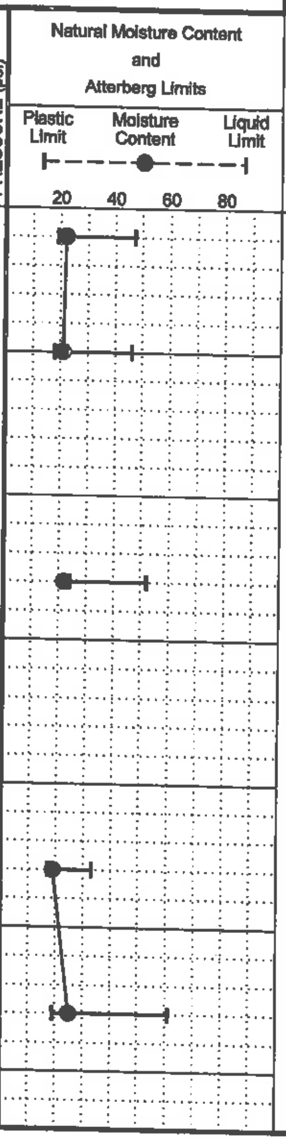
USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) stiff; red and tan	P=2.0	22	47	19	28	81	+40 Sieve=9%, +4 Sieve=3%
CL	LEAN CLAY(CL) hard; red and tan	P=4.5+						
	–very stiff	P=4.0	21	46	18	28	94	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY(CL) very stiff; brown and tan	P=3.0						
CH	FAT CLAY WITH SAND(CH) hard; red and tan	P=4.5+	22	52	24	28	88	+40 Sieve=3%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams	P=3.0						
SC	CLAYEY SAND(SC) very loose; tan, red, and gray	P=0.5	19	33	17	16	44	+40 Sieve=1%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) stiff; red and gray	P=2.0	25	61	19	42	83	+40 Sieve=5%, +4 Sieve=3%

DEPTH (ft): 0, 5, 10, 15, 20, 25, 30

SAMPLES | GEOLOGIC UNIT | WATER LEVEL

DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)





Water Level Est.: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

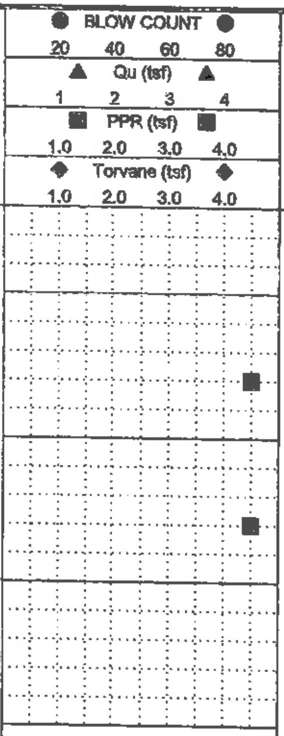
PROJECT NO.: G3242-09

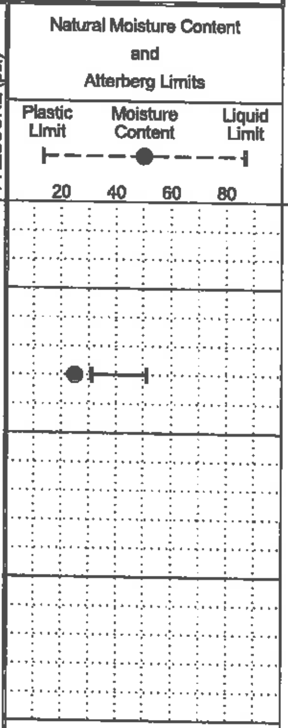
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
33–35	SC	SILTY CLAYEY SAND(SC) gray and red; saturated	SF										
38–40	CH	FAT CLAY(CH) hard; red and gray; with sand seams	P=4.5+					25	51	31	20	87	+40 Sieve=6%, +4 Sieve=0%
43–45		–gray, tan, and red; with sand seams	P=4.5+										
48–50	SM SC	SILTY SAND(SM-SC) red and gray	SF										
50		Bottom of Boring @ 50'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

Piezometer B-5

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

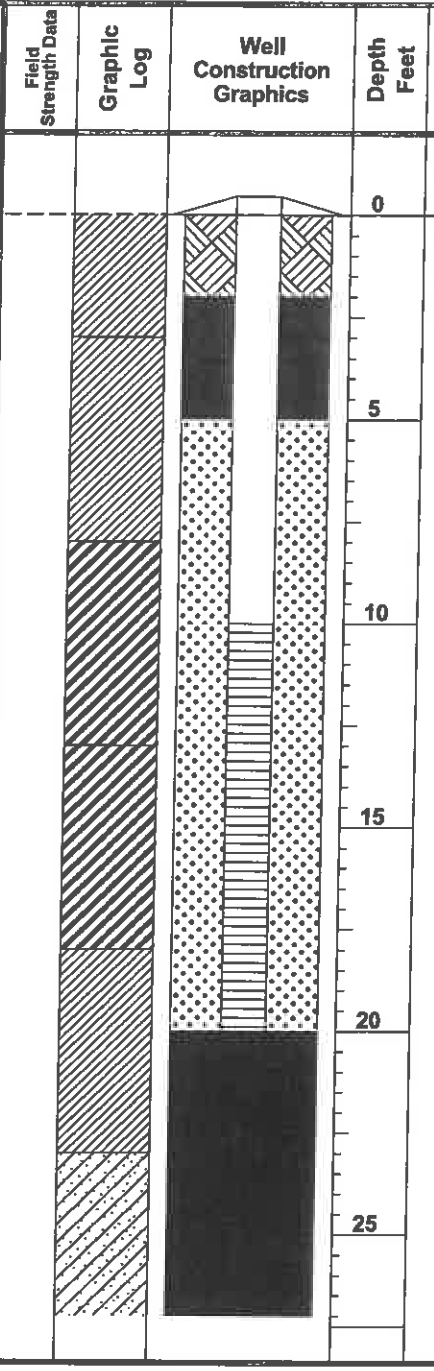
Well No. B-5

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description
0		Ground Surface
		LEAN CLAY WITH SAND(CL) stiff; red and tan
		LEAN CLAY(CL) hard; red and tan
5		--very stiff
		FAT CLAY(CL) very stiff; brown and tan
10		
		FAT CLAY WITH SAND(CH) hard; red and tan
15		
		SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams
20		
		CLAYEY SAND(SC) very loose; tan, red, and gray
25		



Well Construction Details

T.O.C. Elev.

Continued Next Page

Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-5' & 20-50'

Filter Pack Qty. 5-20'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

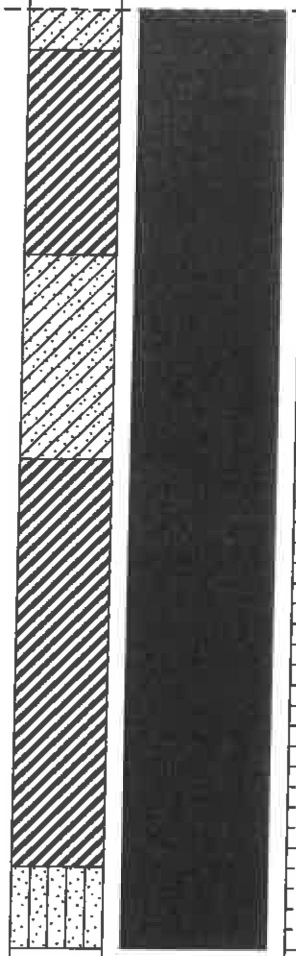
Well No. B-5

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
	FAT CLAY WITH SAND(CH) stiff; red and gray					
30					30	
	SILTY CLAYEY SAND(SC) gray and red; saturated					
35					35	
	FAT CLAY(CH) hard; red and gray; with sand seams					
40					40	
	–gray, tan, and red; with sand seams					
45					45	
	SILTY SAND(SM-SC) red and gray					
50	Bottom of Boring @ 50'				50	
55						
60						



ETTL Engineers & Consultants Inc.

Piezometer B-6

**ETTL
ENGINEERS &
CONSULTANTS**

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

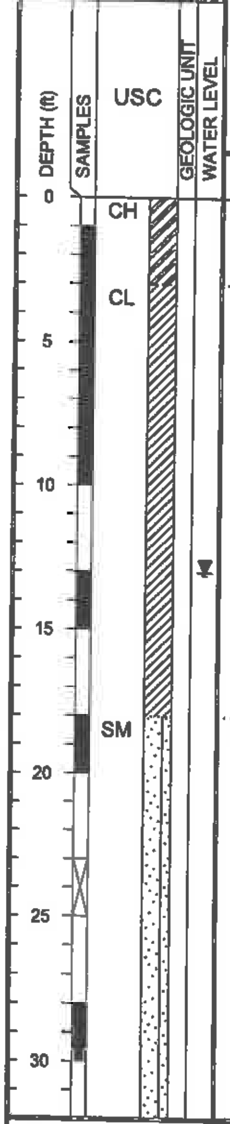
PROJECT: Welsh Power Plant
Pittsburgh, Texas

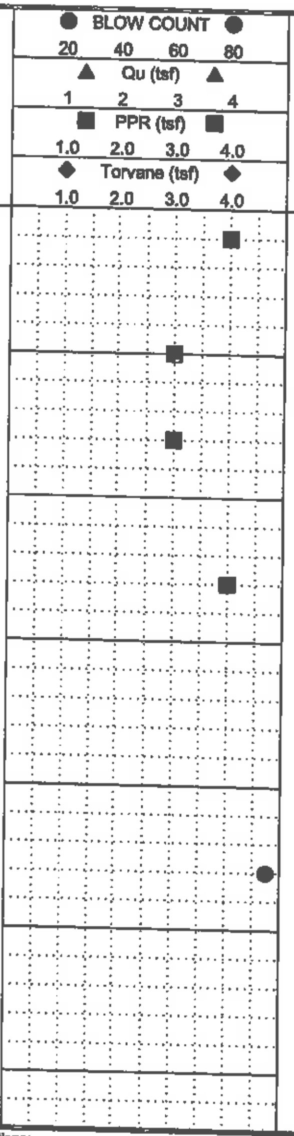
PROJECT NO.: G3242-09

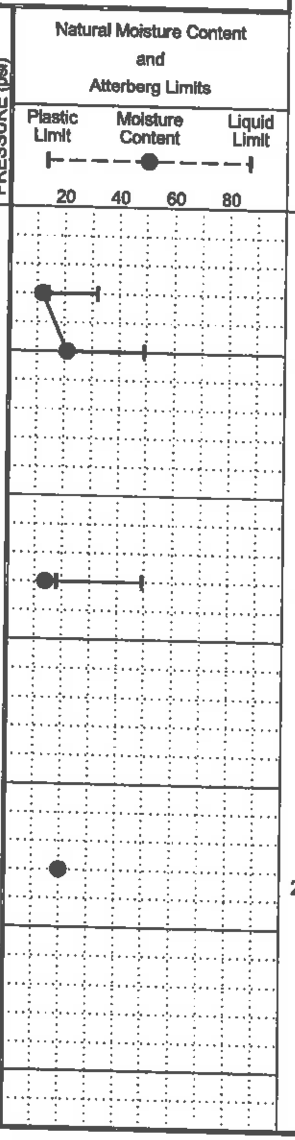
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1







MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
FAT CLAY(CH) very stiff; red and gray; with ferric seams	P=4.0										
SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+					12	32	14	18	60	+40 Sieve=0%, +4 Sieve=0%
–very stiff; red, gray, and brown; with gravel	P=3.0					21	49	20	29	93	+40 Sieve=2%, +4 Sieve=0%
–with sand seams	P=3.0										
	P=4.0					14	49	18	31	65	+40 Sieve=0%, +4 Sieve=0%
SILTY SAND(SM) gray; saturated	P=3.0										
–very dense; gray and red	N=50/5.25"					20				18	+40 Sieve=0%, +4 Sieve=0%
	SF										

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

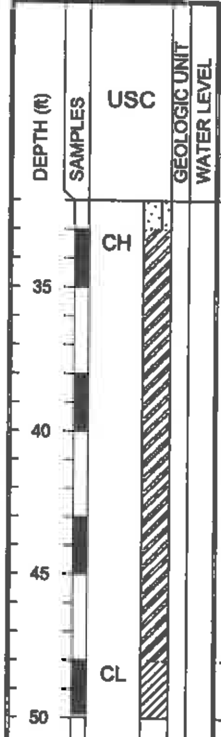
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

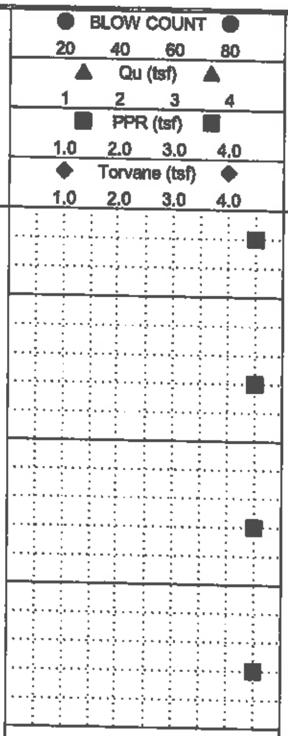
BORING TYPE: Flight Auger

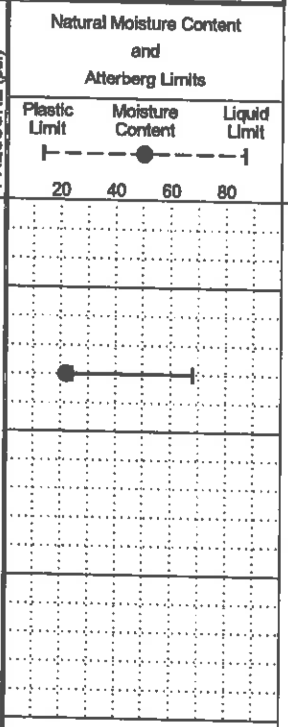
DATE 10/27/09

SURFACE ELEVATION 340.1



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY(CH) hard; brown; with sand seams	P=4.5+										
		P=4.5+					22	68	24	44	95	+40 Sieve=0%, +4 Sieve=0%
	--dark green	P=4.5+										
CL	LEAN CLAY(CL) hard; dark green; laminated with lignite	P=4.5+										
	Bottom of Boring @ 50'											





Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

Piezometer B-6

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

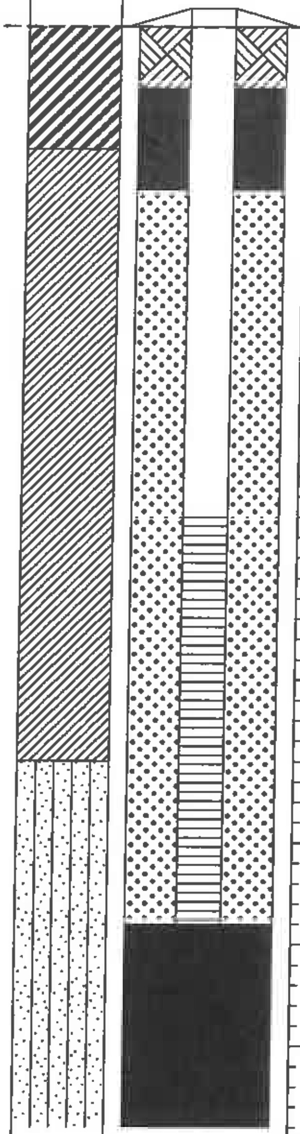
Well No. B-6

Location Pittsburg, Texas

Surface Elev.

Page 1 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		FAT CLAY(CH) very stiff; red and gray; with ferric seams					
		SANDY LEAN CLAY(CL) hard; red and tan					
5						5	
		–very stiff; red, gray, and brown; with gravel					
		–with sand seams					
10						10	
15						15	
		SILTY SAND(SM) gray; saturated					
20						20	
		–very dense; gray and red					
25						25	



Continued Next Page

Driller Doug Hinds	**Drilling Method** Soild Stem Auger	**Bentonite Seal** 1.5-4' & 22-50'
Logged By James Griffith	**Borehole Diameter** 6.5"	**Filter Pack Qty.** 4-22'
Drilling Started 10/28/09	**Well Casing** 2.0" **Dia.** 0.0' **to** 12.0'	**Filter Pack Type** 20/40 Sand
Drilling Completed 10/28/09	**Casing Type** PVC	**Static Water Level**
Construction Completed	**Well Screen** 2.0" **Dia.** 12.0' **to** 22.0'	
Development Completed	**Screen Type** Slotted	**Notes:**
Type of Well	**Slot Size** 0.010"	
	Grout Type Bentonite	

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

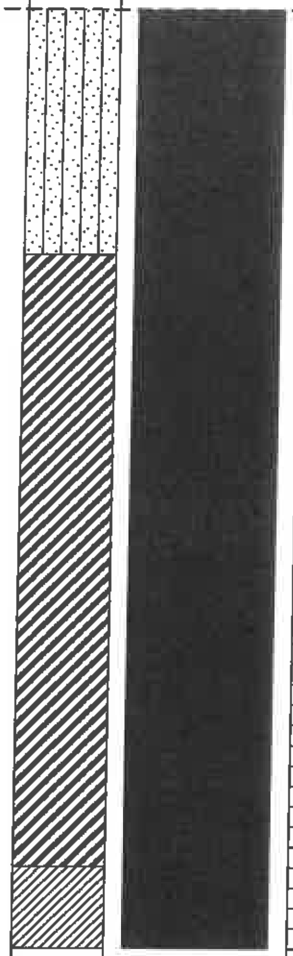
Well No. B-6

Location Pittsburg, Texas

Surface Elev.

Page 2 **of** 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
30						30	
		<u>FAT CLAY</u>(CH) hard; brown; with sand seams					
35						35	
40						40	
		--dark green					
45						45	
		<u>LEAN CLAY</u>(CL) hard; dark green; laminated with lignite					
50		Bottom of Boring @ 50'				50	
55							
60							



LOG OF BORING B-7

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

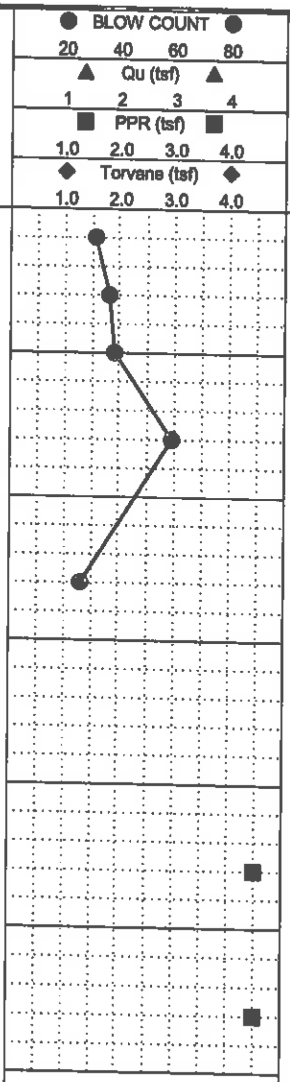
PROJECT NO.: G3242-09

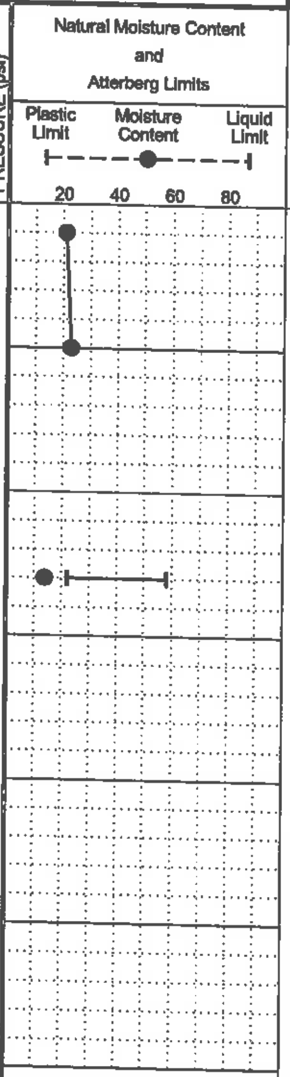
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.4

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	SM	▼	SILTY SAND(SM) dense; tan	N=31					21				21	+40 Sieve=0%, +4 Sieve=0%
				N=36										
5			--gray; saturated	N=38					23				15	+40 Sieve=0%, +4 Sieve=0%
			--very dense	N=59										
10														
	CH		FAT CLAY(CH) very stiff; dark gray; with silt and ferric seams	N=26					14	58	22	36	98	+40 Sieve=0%, +4 Sieve=0%
15														
20														
			--hard; gray and black; with trace of lignite	P=4.5+										
25			--gray											
				P=4.5+										
30			Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 4' while drilling. Water level @ 2' and open to 7' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.898', W 94°50.519'

Landfill Boring B-2

LOG OF BORING B-2

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ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

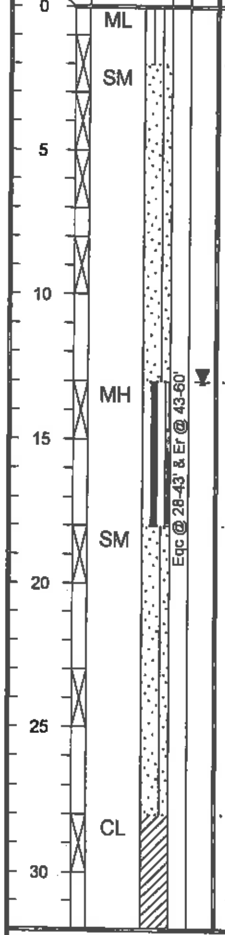
PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

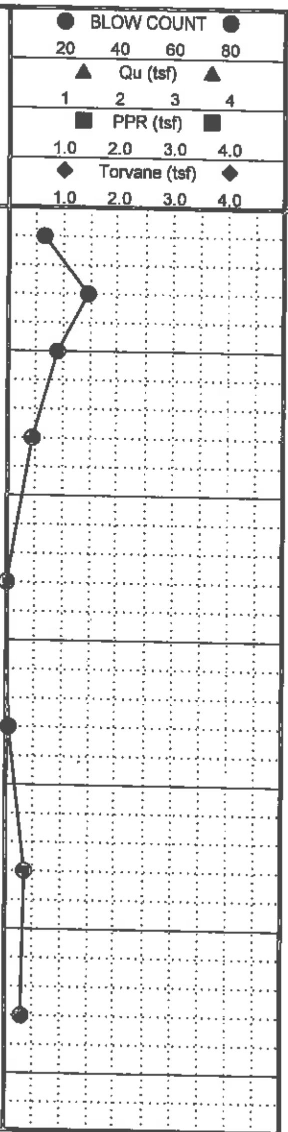
BORING TYPE: Rotary Wash/Flight Auger

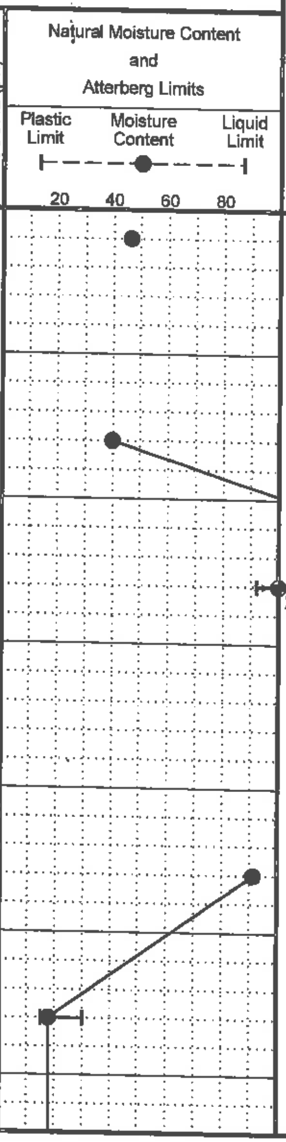
DATE 10/8/14

SURFACE ELEVATION 373.8



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
ML	ASH (SILT WITH GRAVEL(ML)) medium dense; light grayish brown; with coarse-grained sand and lightly cemented gravel pieces; dry	N=13					46				59	+40 Sieve=27% +4 Sieve=16%
SM	ASH (SILTY SAND(SM)) medium dense; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces	N=29										
		N=18										
	--loose; moist	N=9					40				40	+40 Sieve=19% +4 Sieve=2%
MH	ASH (ELASTIC SILT(MH)) very loose; black; with fine-grained sand and lightly cemented gravel pieces; saturated	N=0					200	134	92	42	100	+40 Sieve=0% +4 Sieve=0%
SM	ASH (SILTY SAND(SM)) very loose; dark brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=1										
	--loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7					91				61	+40 Sieve=11% +4 Sieve=1%
CL	SANDY LEAN CLAY(CL) medium stiff; dark brown and black; with fine-grained sand and cemented gravel pieces; saturated	N=6					18	30	15	15	63	+40 Sieve=1% +4 Sieve=0%





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-2 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

DRILL RIG: B-61 HDX

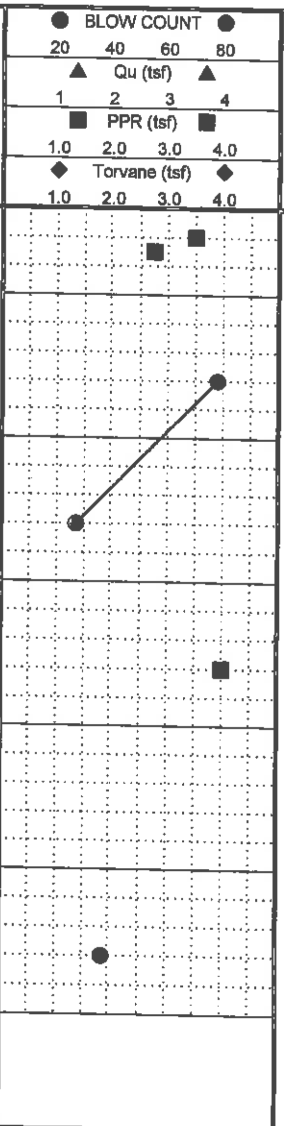
PROJECT NO.: G4207-146

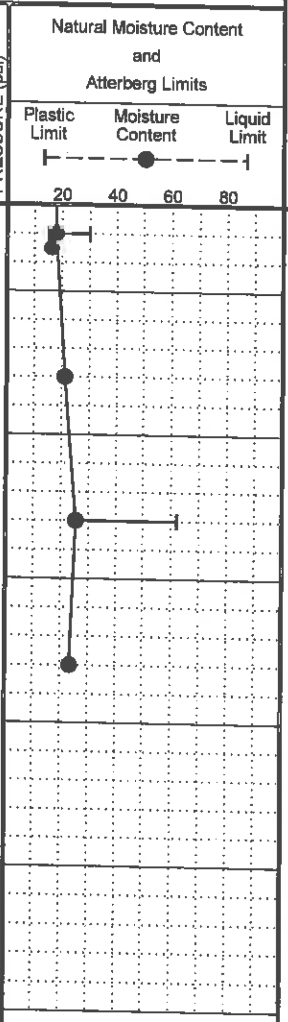
BORING TYPE: Rotary Wash/Flight Auger

DATE 10/8/14

SURFACE ELEVATION 373.8

DEPTH (ft)	USC	GEOLOGIC UNIT	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	SC	Eqc @ 28-43' & Er @ 43-60'	CLAYEY SAND(SC) dense; light brown, light gray and reddish brown; moist; with fine-grained sand; mottled	P=3.5 P=2.75	110	1.39	4.3	21	18 16	30	15	15	39	+40 Sieve=0% +4 Sieve=0%
40	SM		SILTY SAND(SM) very dense; light brown, yellowish brown and light gray; moist; mottled; with fine-grained sand	N=78					21				24	+40 Sieve=0% +4 Sieve=0%
45	CH		FAT CLAY(CH) very stiff; dark brown and light brown; moist; with sand seams; laminated	N=27					25	62	26	36	96	+40 Sieve=2% +4 Sieve=0%
50			--dark brown with light gray; moist; with silt seams	P=4.0	98				24					
55														
60			--hard; dark brown; moist	N=37										
			Bottom of Boring @ 60'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 13'.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04890°, W94.84451°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill boring B-10

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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

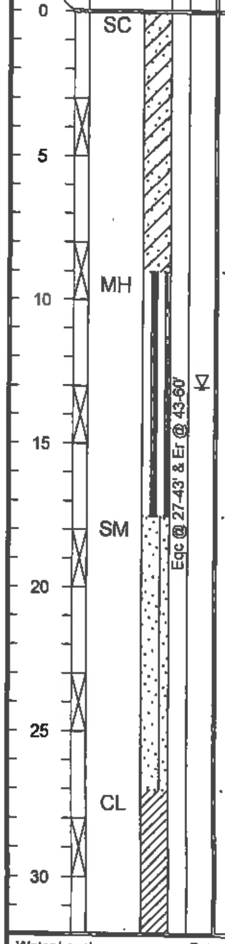
PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

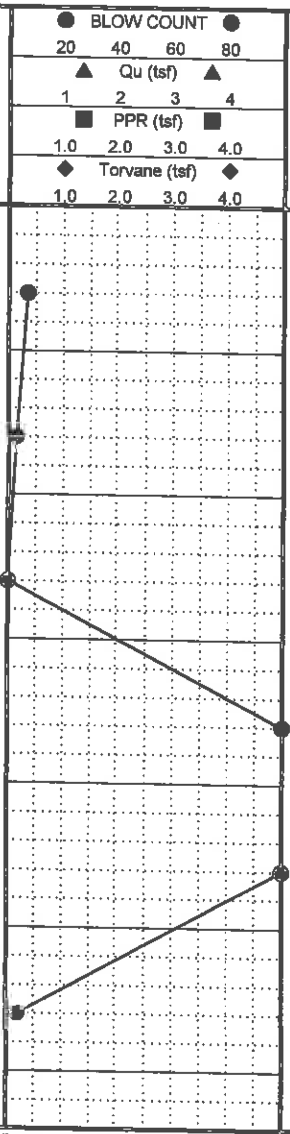
BORING TYPE: Rotary Wash/Flight Auger

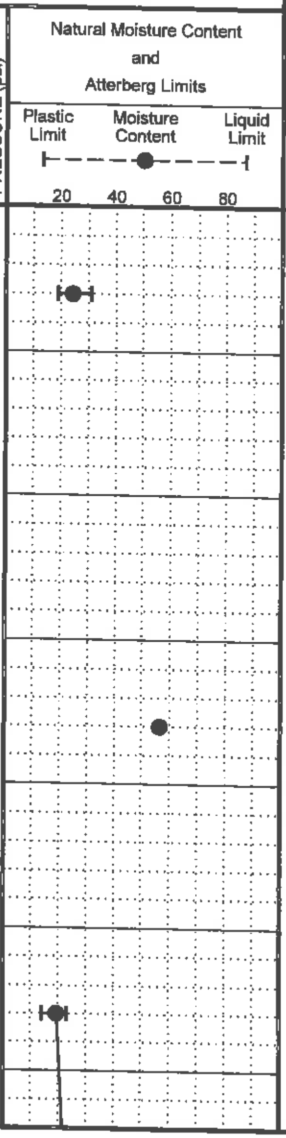
DATE 10/8/14

SURFACE ELEVATION 373.2



DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0–9	SC	ASH (CLAYEY SAND(SC)) loose; dark brown and light brown; with coarse-grained sand and lightly cemented gravel pieces; moist	N=7					24	31	19	12	41	+40 Sieve=21% +4 Sieve=11%
			N=3										
9–17.5	MH	ASH (ELASTIC SILT(MH)) very loose; black; moist											
		--wet	N=0										
17.5–27	SM	ASH (SILTY SAND WITH GRAVEL(SM)) very dense; light brown and dark brown; with lightly cemented gravel pieces and coarse-grained sand; moist; cemented layer from 17.5' to 21'	N=50/1"					56				14	+40 Sieve=71% +4 Sieve=28%
		--cemented layer from 23' to 27'	N=50/4"										
27–	CL	SANDY LEAN CLAY(CL) medium stiff; grayish brown and yellowish brown; saturated; mottled	N=4					19	23	14	9	57	+40 Sieve=1% +4 Sieve=0%





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-10 (cont.)

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

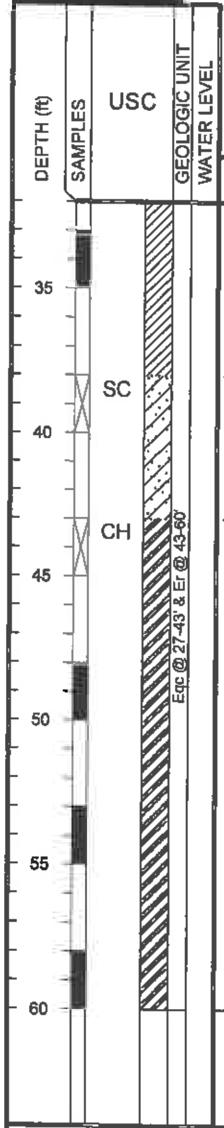
PROJECT NO.: G4207-146

DRILL RIG: B-61 HDX

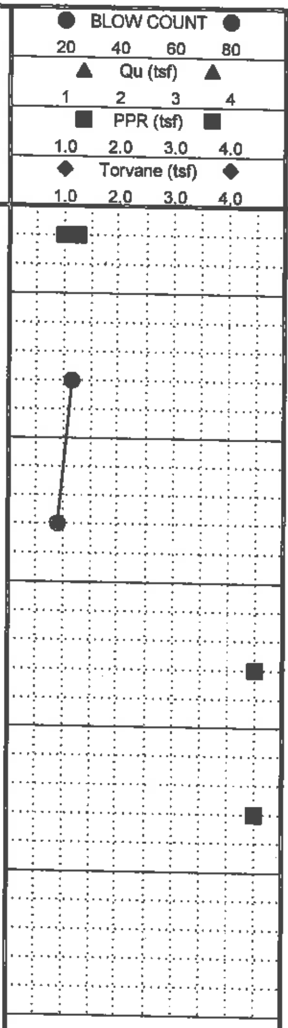
BORING TYPE: Rotary Wash/Flight Auger

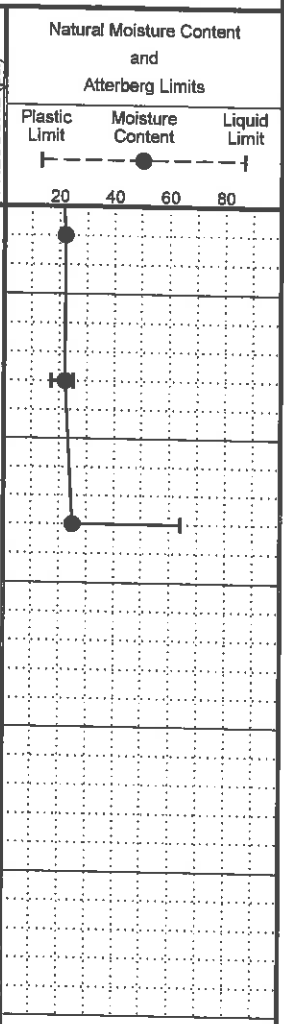
DATE 10/8/14

SURFACE ELEVATION 373.2



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
		P=1.25 P=1.0	107	2.10	6.1	21	22					
SC	CLAYEY SAND(SC) medium dense; reddish brown and grayish brown; moist; mottled	N=23					22	25	17	8	27	+40 Sieve=3% +4 Sieve=0%
CH	FAT CLAY(CH) very stiff; dark brown with light gray; with silt seams; moist	N=18					25	64	24	40	90	+40 Sieve=7% +4 Sieve=0%
	--hard	P=4.5+										
		P=4.5+										
	Bottom of Boring @ 60'											





Water Level Est.: ▽ Measured: ▼ Parched: ▼

Water Observations: Seepage @ 13' while drilling.

Key to Abbrevations:
- N - SPT Data (Blows/Ft)
- P - Pocket Penetrometer (tsf)
- T - Torvane (tsf)
- L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04895°, W94.84390°

Driller: Tommy Cook

Logger: B.Hobbs/O.Sanderson

Landfill Boring B-12

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-12

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

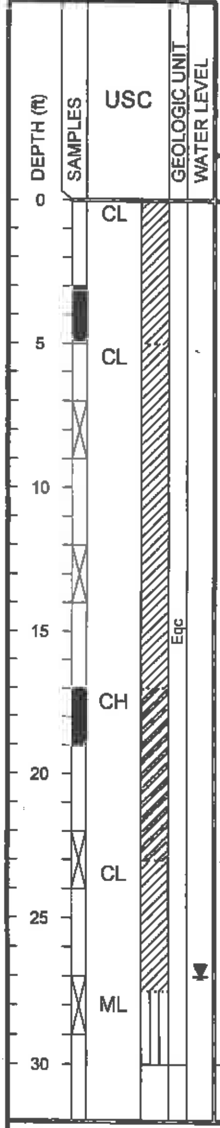
DRILL RIG:

PROJECT NO.: G4207-146

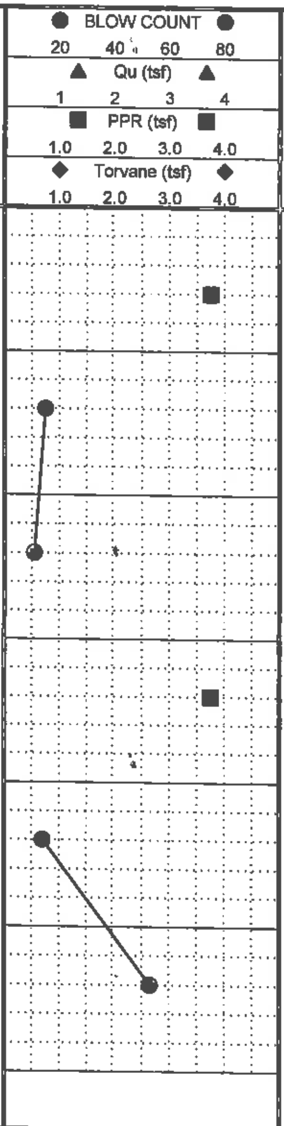
BORING TYPE: Flight Auger

DATE 10/15/14

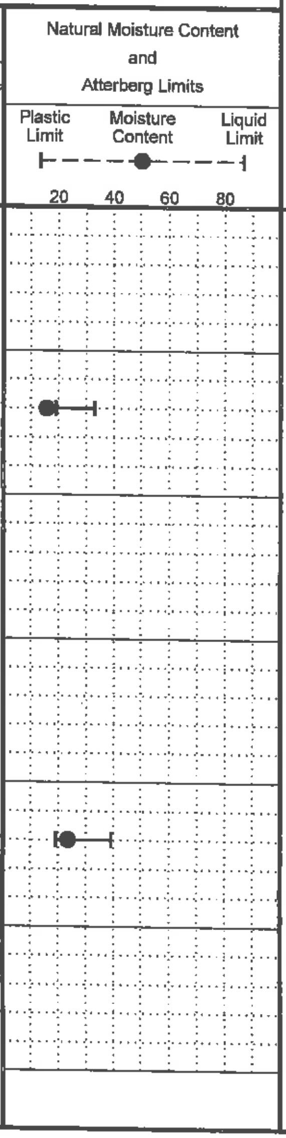
SURFACE ELEVATION 361.7



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) stiff; light gray and reddish brown; moist; mottled	P=3.75						
CL	SANDY LEAN CLAY(CL) stiff; light brown, light gray and reddish brown; moist; mottled	N=15	16	33	19	14	58	+40 Sieve=1% +4 Sieve=0%
	--grayish brown and brown; moist	N=11						
CH	FAT CLAY WITH SAND(CH) stiff; light gray and reddish brown; moist; mottled; with ferric seams	P=3.75						
CL	LEAN CLAY(CL) stiff; light gray and brownish gray; moist; layered with silt	N=14	24	39	19	20	93	+40 Sieve=1% +4 Sieve=0%
ML	SILT WITH SAND(ML) very dense; light brown and yellowish brown; moist; with clay seams	N=53						
	Bottom of Boring @ 30'							



DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 27' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04713°, W94.84486°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-13

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-13

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

DRILL RIG:

PROJECT NO.: G4207-146

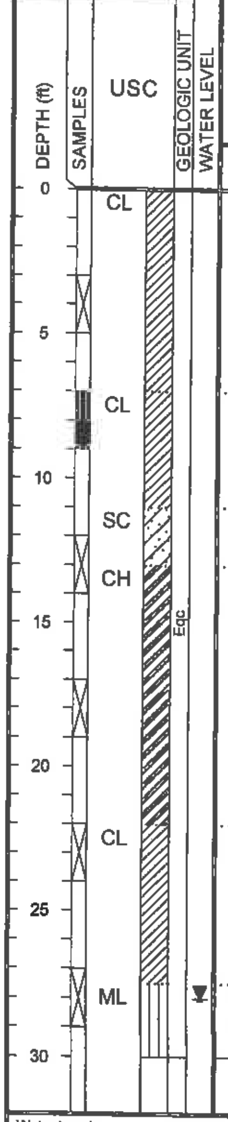
BORING TYPE: Flight Auger

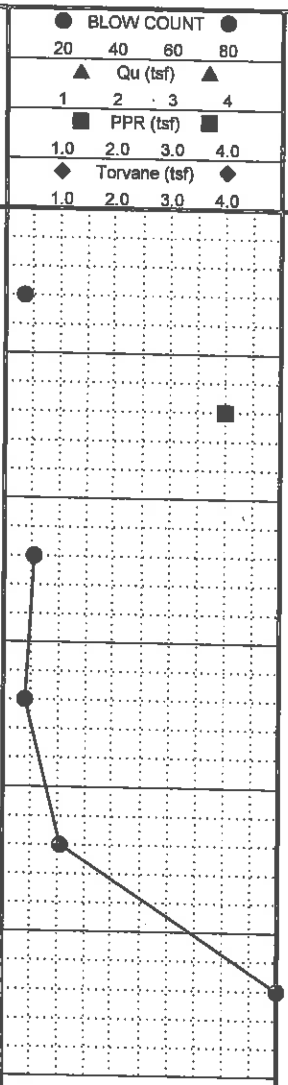
DATE 10/15/14

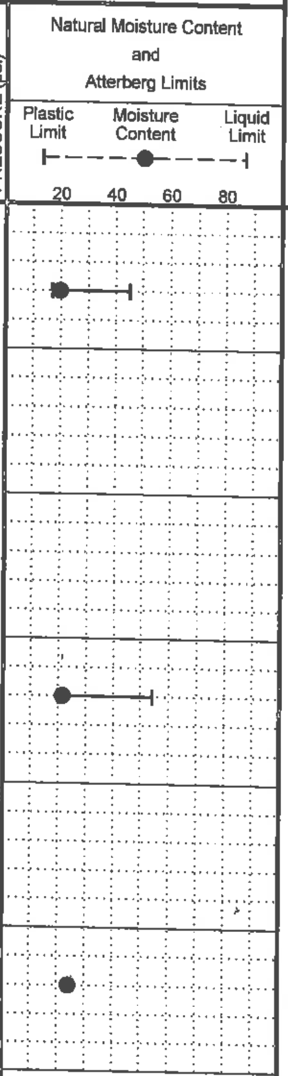
SURFACE ELEVATION 361.4

MATERIAL DESCRIPTION

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) medium stiff; reddish brown with light gray; moist	N=7					20	45	17	28	76	+40 Sieve=1% +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) very stiff; light brown, gray and reddish brown; moist; mottled	P=4.0										
SC	CLAYEY SAND(SC) medium dense; grayish brown; moist	N=11										
CH	FAT CLAY WITH SAND(CH) medium stiff; reddish brown and light gray; moist; mottled	N=8					22	54	20	34	79	+40 Sieve=1% +4 Sieve=0%
CL	LEAN CLAY(CL) very stiff; light gray and grayish brown; moist; layered with silt	N=21										
ML	SILT WITH SAND(ML) very dense; light gray and yellowish brown; wet; with clay seams	N=50/5"					24				80	+40 Sieve=0% +4 Sieve=0%
	Bottom of Boring @ 30'											







Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 28' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.047160°, W94.84384°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

Landfill Boring B-14

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-14

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

PROJECT NO.: G4207-146

DRILL RIG:

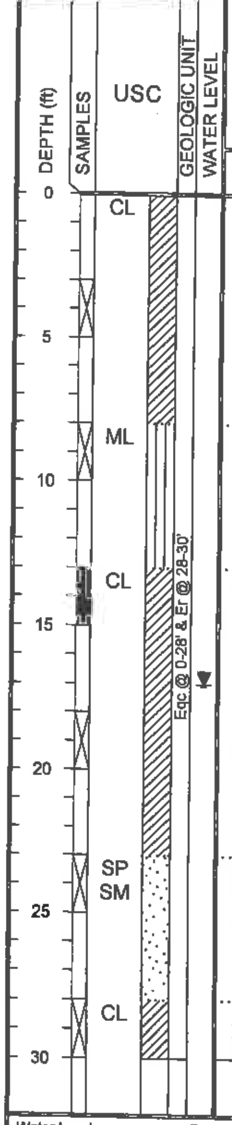
BORING TYPE: Flight Auger

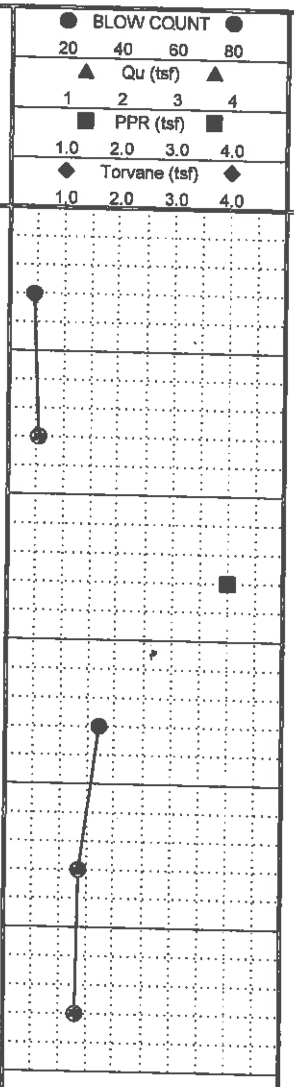
DATE 10/14/14

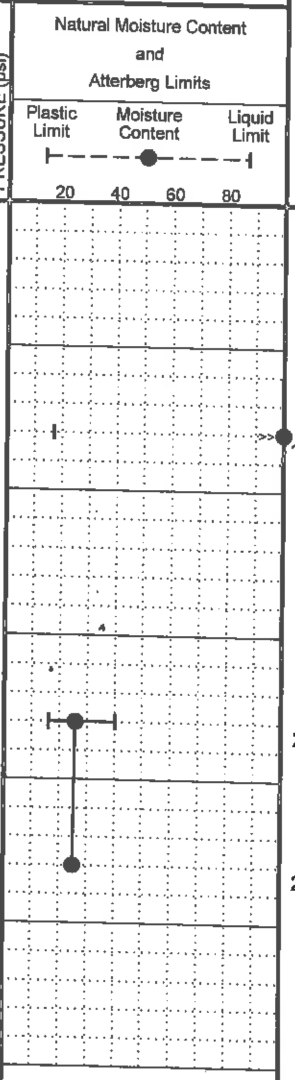
SURFACE ELEVATION 347.2

Geologic Unit: Eqc @ 0-28' & Er @ 28-30'

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) medium stiff; yellowish brown with reddish brown; dry; with clay seams	N=9						
ML	SANDY SILT(ML) medium dense; grayish brown; moist; with clay seams	N=11	108	17	17	NP	68	+40 Sieve=1% +4 Sieve=1%
CL	SANDY LEAN CLAY(CL) very stiff; light gray and gray; moist	P=4.0						
	--light gray and grayish brown; moist; layered with silt	N=34	26	40	16	24	67	+40 Sieve=1% +4 Sieve=0%
SP SM	POORLY GRADED SAND WITH SILT(SP-SM) medium dense; yellowish brown, light gray and reddish brown; wet	N=27	25				10	+40 Sieve=0% +4 Sieve=0%
CL	LEAN CLAY(CL) very stiff; dark brown; moist; with silt partings	N=26						
	Bottom of Boring @ 30'							







Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 23' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates:	Driller:	Logger:
N33.04774°, W94.84290°	Lewis Drilling, Inc.	O.Sanderson

Landfill Boring B-15

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-15

PROJECT: Phase 1 Fly Ash Storage Area Embankment Seepage & Vertical Expansion Invest.
Welsh Power Station - Cason, Texas

DRILL RIG:

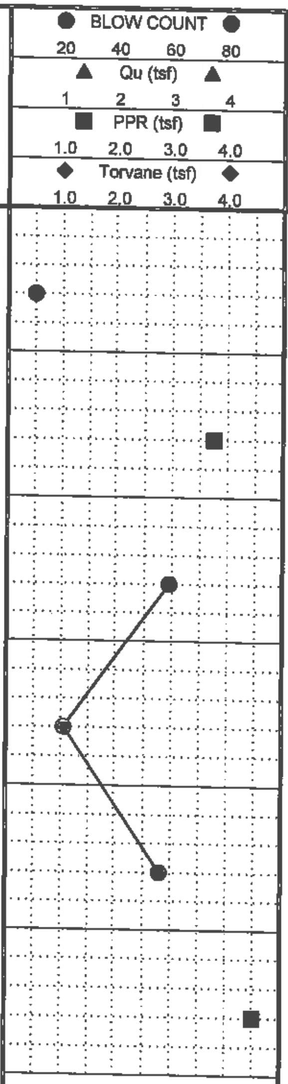
PROJECT NO.: G4207-146

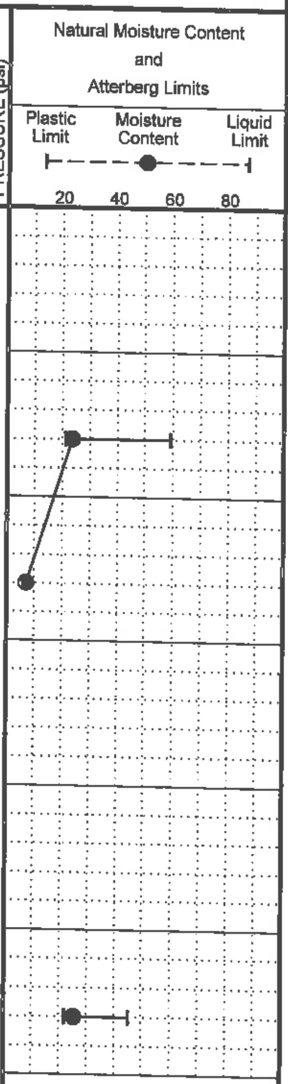
BORING TYPE: Flight Auger

DATE 10/14/14

SURFACE ELEVATION 348.2

DEPTH (ft)	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CH	Eqc @ 0-28' & Er @ 28-30'		FAT CLAY(CH) stiff; reddish brown and light gray; moist; mottled	N=10										
10				--very stiff; light gray, grayish brown and reddish brown; moist; layered	P=3.75					24	59	21	38	85	+40 Sieve=0% +4 Sieve=0%
15	SM			SILTY SAND(SM) very dense; light brown; dry	N=59					7				12	+40 Sieve=0% +4 Sieve=0%
			▼	--medium dense; wet	N=21										
20				--very dense	N=56										
25	CL			LEAN CLAY(CL) hard; dark brown; moist; with silt partings	P=4.5					25	45	22	23	92	+40 Sieve=0% +4 Sieve=0%
30				Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 17' and caved to 19' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N33.04857°, W94.84286°

Driller: Lewis Drilling, Inc.

Logger: O.Sanderson

ARCADIS

Appendix B

Photographic Log

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No.
1

Date:
8/20/2015

Direction Photo Taken:

North

Description:
Staging area west of landfill.

P8200493

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No.
2

Date:
8/20/2015

Direction Photo Taken:

South Southeast

Description:

Potential wetland on the top (west) end of the Primary Ash Pond.

P8200495

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No. 3

Date: 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Ditch between road and railway west of landfill, this ditch would be non-jurisdictional.

P8200497

ARCADIS

PHOTOGRAPHIC LOG

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No. 4

Date: 8/20/2015

Direction Photo Taken:

Northeast

Description:

Ground Water Monitoring Well AD-12 near northwest end of landfill.

P8200501

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **5**	**Date:** 8/20/2015

Direction Photo Taken:

East Northeast

Description:

View of plant from top of landfill. Primary ash pond is within the wooded area on left.

P8200506

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. **6**	**Date:** 8/20/2015

Direction Photo Taken:

East Northeast

Description:

Drainage canal that drains from primary ash pond to clear water pond.

P8200510

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 7

Date: 8/20/2015

Direction Photo Taken:

West Northwest

Description:

Vegetated strip between landfill and road. This would be isolated due to lack of connectivity.

P8200521

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 8

Date: 8/20/2015

Direction Photo Taken:

North

Description:

Dike between landfill and primary ash pond. Facility in the background.

P8200522

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 9

Date: 8/20/2015

Direction Photo Taken:

West

Description:

Vegetated strip between landfill and road. This area would be isolated due to lack of connectivity.

P8200527

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 10

Date: 8/20/2015

Direction Photo Taken:

North Northeast

Description:

Road east of landfill running toward facility and clear water pond.

P8200530

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 11

Date: 8/20/2015

Direction Photo Taken:

South

Description:

Top of landfill.

P8200534

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 12

Date: 8/20/2015

Direction Photo Taken:

Southeast

Description:

View of lined bottom ash storage pond.

P8200538

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 13	**Date:** 8/20/2015

Direction Photo Taken:

Southeast

Description:

Lined bottom ash storage pond.

P8200545

ARCADIS

PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 14	**Date:** 8/20/2015

Direction Photo Taken:

South

Description:

Southside of lined bottom ash storage pond.

P8200547

ARCADIS PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 15

Date: 8/20/2015

Direction Photo Taken:

West

Description:

East side of lined bottom ash storage pond.

P8200560

ARCADIS PHOTOGRAPHIC LOG

Project Name: AEP – J. ROBERT WELSH POWER PLANT	**Location:** PITTSBURG, TITUS COUNTY, TEXAS	**Project No.** OK001625.0001

Photo No. 16

Date: 8/20/2015

Direction Photo Taken:

North

Description:

Upland with pine and ground water monitoring well AD-2 south of lined bottom ash storage pond.

P8200563

ARCADIS **PHOTOGRAPHIC LOG**

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No. 17

Date: 8/20/2015

Direction Photo Taken:

Description:

Outflow of water from plant into the northeast portion of the Primary Ash Pond.

P8200577

ARCADIS **PHOTOGRAPHIC LOG**

Project Name:
AEP – J. ROBERT WELSH POWER PLANT

Location:
PITTSBURG, TITUS COUNTY, TEXAS

Project No.
OK001625.0001

Photo No. 18

Date: 8/20/2015

Direction Photo Taken:

South Southwest

Description:

Northeast portion of primary ash pond, view facing south-southwest.

P8200578

Appendix E

The Most Recent Structural Stability Assessment

Required at 40 CFR §257.73(d)

STRUCTURAL STABILITY ASSESSMENT

CFR 257.73(d)

Primary Bottom Ash Pond

Welsh Plant
Pittsburg, Texas

October, 2016

Prepared for: Southwest Electric Power Company (SWEPCO) – Welsh Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

Document No. GERS-16-132

Structural Stability Assessment
CFR 257.73(d)
Welsh Plant
Primary Bottom Ash Pond

PREPARED BY	Brett A. Dreger Brett A. Dreger, P.E.	DATE	10/12/2016
REVIEWED BY	Shah S. Baig, P.E.	DATE	10-13-16
APPROVED BY	Gary F. Zych Gary Zych, P.E. Manager – AEP Geotechnical Engineering	DATE	10/13/2016

American Electric Power Service Corporation
Texas Registered Engineering Firm
No. F-3341

10-13-2016

SHAHRIYAR S. BAIG
98172
LICENSED PROFESSIONAL ENGINEER

I certify to the best of my knowledge, information and belief that the information contained in this structural stability assessment meets the requirements of 40 CFR 257.73(d)

Table of CONTENTS

1.0 OBJECTIVE 257.73(d)

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CFR 257.73(d) and document whether the design, construction, operations, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices. This is the initial assessment as per the Rule.

2.0 NAME AND DESCRIPTION OF CCR SURFACE IMPOUNDMENT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash pond and the Bottom Ash Storage pond. This report addresses the closure plan for the Primary Bottom Ash Pond. The Primary Bottom Ash pond CCR unit is located southwest of the Plant and directly west of the Welsh Reservoir.

The Primary Bottom Ash pond is bounded by natural ground surface (topographically higher areas) to the north and west, and embankment dikes to the south and east. The elevation at the top of embankment along the crest area is approximately 340.0 feet above msl. Presently, economizer ash from the generating plant is sluiced to the Primary Bottom Ash pond. On occasion, bottom ash is sluiced to the Primary Bottom Ash pond.

3.0 STABLE FOUNDATION AND ABUTMENTS 257.73(d)(1)(i)

[Was the facility designed for and constructed on stable foundations and abutments? Describe any foundation improvements required as part of construction.]

The foundaion materials for the Primary Bottom Ash Pond embankment consist primarily of stiff to hard lean clay (CL) and fat clay (CH) with intermittent layers of medium dense to very dense clayey sand (SC) and silty sand (SM). There is a thick layer of very dense silty sand (SM) which is apparently the native surficial soils near the previous creek bed. Atterberg Plasticity Indices of the tested soils ranged between a low of 9 to a high of 44. Based on the subsurface investigation and engineering properties of the subsurface soils, it is concluded that the Primary Bottom Ash Pond dikes are supported on a stable foundation base.

Operation of the impoundment is performed so as to not adversely affect the foundation and abutments. As required by the CCR rules the Bottom Ash Pond Complex is inspected at least every 7 days by a qualified person. Also as a requirement of the CCR rules, the impoundment is also inspected annually by a professional engineer. Maintenance items are addressed as they are discovered as a part of those inspections.

4.0 SLOPE PROTECTION 257.73(D)(1)(II)

[DESCRIBE THE SLOPE PROTECTION MEASURES ON THE UPSTREAM AND DOWNSTREAM SLOPES.]

The primary bottom ash pond unit has been constructed with a layer of bottom ash on the interior slope of the ash pond and limited riprap on the interior slopes of random areas that require slope protection from erosion and wave action. The exterior slopes consist of vegetative cover on the upper half of the slope while the lower half of the slope is protected by large rip rap for armor protection. Any erosion that may occur is repaired within a timely period.

5.0 EMBANKMENT CONSTRUCTION 257.73 (d)(1)(iii)

[Describe the specifications for compaction and/or recent boring to give a relative comparison of density.]

The Primary Bottom Ash Pond embankment is constructed of compacted earth fill. The source and type of soils used for earth fill is unknown. However, AEP contracted with ETTL Engineers & Consultants Inc. of Tyler, Texas to perform a Geotechnical Investigation of Existing Ash Storage Ponds Embankments on June 21, 2010. The evaluation of the existing earthen embankments consisted of slope stability and seepage analyses for the embankments. The evaluation was performed using information obtained from soil borings located on the crest and outside toe of the embankments. The embankment for the Primary bottom Ash Pond was investigated. Three borings were drilled to 50 feet depth at the crest of the embankment (Appendix C). The fill material in the containment berm consists primarily of stiff to hard lean clay (CL), fat clay (CH) and medium dense clayey sand (SC) overlying the native soils which consist primarily of stiff to hard lean clay (CL) and fat clay (CH) with intermittent layers of medium dense to very dense clayey sand (SC) and silty sand (SM). Atterberg Plasticity Indices of the tested soils ranged between a low of 9 to a high 44. Based on the slope stability evaluation and the engineering properties of the subsurface soils, it is concluded that the Primary Bottom Ash Pond embankments are adequately constructed.

6.0 VEGETATION CONTROL 257.73 (d)(1)(iv)

[Describe the maintenance plan for vegetative cover.]

The vegetative slopes/areas are mowed to facilitate inspections and maintain the growth of the vegetative layer; and prevent the growth of woody vegetation.

7.0 SPILLWAY SYSTEM 257.73(d)(1)(v)

[Describe the spillway system and its capacity to pass the Inflow Design Flood as per its Hazard Classification.]

Hydrology and Hydraulic Analysis which includes calculations for each spillway structure are included in Inflow Design Flood Control Plan. The Inflow Design Flood for the Primary Bottom Ash Pond is the 100-year storm event.

The principal spillway weir box for the Primary Ash Pond is located in the canal connecting the Primary and Secondary Ash Ponds. The Primary Pond receives effluent from the ash sluice lines that transport the ash slurry on the east side of the pond. The ash settles, and the decant water flows to a 48-inch wide concrete weir box and into the Secondary Pond via an approximate 1,950-foot long discharge canal which originates at the southwest corner of the

Primary Pond. The weir box has a minimum crest elevation of 325.0 feet, and flows through the weir box are controlled by installing 12-inch stop logs that are 55 inches long. Flows are conveyed through the weir box by a sheet piling wall installed across the discharge canal, on either side of the weir box. The Primary Pond has a 90-foot wide earthen emergency spillway on the south side of the pond; the spillway crest elevation is 334.0 feet. The emergency spillway overflows from the Primary Pond directly into the discharge canal at approximate midpoint of the discharge canal. Based on the Hydrology and Hydraulic analysis the Primary Bottom Ash Storage pond spillway system can handle the 100-year storm event.

8.0 BURIED HYDRAULIC STRUCTURES 257.73 (d)(1)(vi)

[Describe the condition of the sections of any hydraulic structure that in buried beneath and/or in the embankment.]

There are no pipes that are part of the spillway system that are buried within or beneath the embankment.

9.0 SUDDEN DRAWDOWN 257.73 (d)(1)(vii)

[If the downstream slope is susceptible to inundation, discuss the stability due to a sudden drawdown.]

The downslope is partially inundated by the Swauano Creek reservoir. The reservoir is used to supply the power plant with a source of water for operations. The service spillway is a concrete morning glory drop inlet with a concrete conduit through the dam. It has a low level drain pipe (18-inch diameter) located at the bottom of the drop inlet and discharges into the concrete conduit. The emergency spillway is a broad-crested earthen spillway located in the right abutment of the dam. The service spillway overflow section is only activated during large precipitation events and the emergency spillway section has never been activated since the construction of the dam. The water level of the lake is also maintained via a make-up water line from a nearby reservoir that keeps the reservoir near normal pool levels. The water intake for the plant operations is maintained via pumps. In general, the reservoir area and volume is large compared to the intake pump capacity of the plant. Therefore, since the water level in the lake cannot increase or decrease significantly in a rapid manner, the condition for a sudden drawdown of the reservoir is not feasible.

STRUCTURAL STABILITY ASSESSMENT

CFR 257.73(d)

Bottom Ash Storage Pond

Welsh Plant
Pittsburg, Texas

October, 2016

Prepared for: Southwest Electric Power Company (SWEPCO) – Welsh Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

Document No. GERS-16-133

Structural Stability Assessment
CFR 257.73(d)
Welsh Plant
Bottom Ash Storage Pond

PREPARED BY Brett A. Dreger DATE 10/12/2016
Brett A. Dreger, P.E.

REVIEWED BY DATE 10-13-16
Shah S. Baig, P.E.

APPROVED BY Gary F. Zych DATE 10/13/2016
Gary Zych, P.E.
Manager – AEP Geotechnical Engineering

American Electric Power Service Corporation
Texas Registered Engineering Firm No. F-3341

10-13-2016
SHAHRIYAR S. BAIG
92172
Shah Baig

I certify to the best of my knowledge, information and belief that the information contained in this structural stability assessment meets the requirements of 40 CFR 257.73(d)

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1.0 OBJECTIVE 257.73(d)

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CFR 257.73(d) and document whether the design, construction, operations, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices. This is the initial assessment as per the Rule.

2.0 NAME AND DESCRIPTION OF CCR SURFACE IMPOUNDMENT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash Pond and the Bottom Ash Storage pond. This report addresses the Bottom Ash Storage Pond. The Bottom Ash Storage Pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir.

The Bottom Ash Storage Pond embankments are approximately 20 feet in height and are constructed on a 3:1 slope (3 feet horizontal, 1 foot vertical). The elevation at the base of the embankment is approximately 340 feet above msl, and the elevation at the top of the embankment around the perimeter of the Bottom Ash Storage Pond is approximately 360 feet above msl. Presently a combination of economizer ash, bottom ash and some fly ash is sluiced to the bottom ash storage pond from the primary bottom ash pond.

3.0 STABLE FOUNDATION AND ABUTMENTS 257.73(d)(1)(i)

[Was the facility designed for and constructed on stable foundations and abutments? Describe any foundation improvements required as part of construction.]

Native coarse grained (or sandy) material underlying the Bottom Ash Pond generally consists of medium dense to very dense silty sand (SM), clayey sand (SC) and silt (ML) and fine grained (clayey) material consist of medium stiff to hard lean clay and fat clay (CL and CH) soils. Based on the subsurface investigation and engineering properties of the subsurface soils, it is concluded that the Bottom Ash Storage Pond dikes are supported on a stable foundation base.

Operation of the impoundment is performed so as to not adversely affect the foundation and abutments. As required by the CCR rules the Bottom Ash Pond Complex is inspected at least every 7 days by a qualified person. Also as a requirement of the CCR rules, the impoundment is also inspected annually by a professional engineer. Maintenance items are addressed as they are discovered as a part of those inspections.

4.0 SLOPE PROTECTION 257.73(D)(1)(II)

[DESCRIBE THE SLOPE PROTECTION MEASURES ON THE UPSTREAM AND DOWNSTREAM SLOPES.]

The bottom ash storage pond interior has been constructed with a geomembrane liner. The impoundment's storage area is lined with a 60 mil HDPE liner. The geomembrane extends all the way to the crest of the interior slope to protect areas that require protection from erosion and wave action. The exterior slopes consist of vegetative cover. Any erosion that may occur is repaired within a timely period.

5.0 EMBANKMENT CONSTRUCTION 257.73 (d)(1)(iii)

[Describe the specifications for compaction and/or recent boring to give a relative comparison of density.]

The Bottom Ash Storage Pond embankment is constructed of compacted earth fill. The source and type of soils used for earth fill is unknown. However, AEP contracted with Auckland Consulting, Inc. of Tyler, Texas to perform a Geotechnical Investigation of Existing Bottom Ash Storage Pond Embankments in 2016. The evaluation of the existing earthen embankments consisted of slope stability and seepage analyses for the embankments. The evaluation was performed using information obtained from soil borings drilled on the crest and outside toe of the embankments. The embankments for the Bottom Ash Storage were investigated. The subsurface exploration of the embankment consisted of advancing a total of seven (7) borings located in potentially critical areas of the embankment. Four (4) borings (Boring Nos. 2 through 5) were completed along the embankment crest with termination depths ranging from approximately 40 to 50 feet. Three (3) borings (Boring Nos. 6 through 8) were completed along the embankment toe and were advanced to termination depths of approximately 40 feet.

Based on subsurface soils and field sampling and testing, the existing embankment is primarily lean clay (CL) with existing side slopes (upstream and downstream) of approximately 3:1 (H:V). Based on the slope stability evaluation and the engineering properties of the subsurface soils, it is concluded that the Bottom Ash Storage Pond embankments are adequately constructed.

6.0 VEGETATION CONTROL 257.73 (d)(1)(iv)

[Describe the maintenance plan for vegetative cover.]

The vegetative slopes/areas are mowed to facilitate inspections and maintain the growth of the vegetative layer; and prevent the growth of woody vegetation.

7.0 SPILLWAY SYSTEM 257.73(d)(1)(v)

[Describe the spillway system and its capacity to pass the Inflow Design Flood as per its Hazard Classification.]

Hydrology and Hydraulic Analysis which includes calculations for each spillway structure are included in Inflow Design Flood Control Plan. The Inflow Design Flood for the Bottom Ash Storage Pond is the 100-year storm event.

The principal spillway for the Bottom Ash Pond is a 40-foot long broad-crested weir with 6:1 side slopes and crest at elevation 355.0 ft-msl. However, this spillway does not act as the hydraulic control for the Bottom Ash Storage Pond. Discharges from the Bottom Ash Storage Pond are initially controlled by an 18-inch HDPE pipe with an invert elevation of 350.5 feet penetrating the 40 foot wide interior spillway, and then by a 30-inch HDPE pipe with an invert elevation of 350.0 feet located in the sump area; flows through this pipe are directed back to Primary Pond. The Bottom Ash Storage Pond has an 8-foot wide emergency spillway with a crest elevation of 358.0 feet. The emergency spillway channel is lined with rock riprap and discharges into an unnamed tributary of Swauano Creek just upstream of the south end of the Welsh Reservoir emergency spillway. Based on the Hydrology and Hydraulic analysis the bottom ash storage pond spillway system can handle the 100-year storm event.

8.0 BURIED HYDRAULIC STRUCTURES 257.73 (d)(1)(vi)

[Describe the condition of the sections of any hydraulic structure that in buried beneath and/or in the embankment.]

The 30-inch diameter HDPE discharge pipe for the principal spillway area extends through the top portion of the embankment of the bottom ash pond. The elevation of the pipe through the embankment is equal to the normal operating pool level of the pond. Once the pipe exits the embankment, it runs along the outside slope area until it reaches its discharge point. Based on examination of the exposed areas of the pipe along the outside slope area, the pipe appears to be in satisfactory condition.

9.0 SUDDEN DRAWDOWN 257.73 (d)(1)(vii)

[If the downstream slope is susceptible to inundation, discuss the stability due to a sudden drawdown.]

The downstream slope of the Bottom Ash dikes will not be inundated from any adjacent water bodies.

Appendix F

The Most Recent Safety Factor Assessment

Required at 40 CFR §257.73(e)

Initial Safety Factor Assessment – Primary Bottom Ash Pond

Welsh Power Generating Station
Pittsburgh, Texas

Auckland Project No. 2015-008A (Revision No. 2)
January 14, 2016

Prepared For:

American Electric Power Company
1 Riverside Plaza
Columbus, Ohio 43215

Prepared By:

Auckland Consulting, LLC
Jacksonville, Texas

TBPE Firm Registration No. F-16721
Expires 2/29/2016

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Appendix

1.0 Introduction and Embankment Information

1.1 Introduction

The following report and evaluation provides the Initial Safety Factor Assessment of the Primary Ash Pond, an existing CCR impoundment (as defined by 40 CFR §257.2) located at the Welsh Power Station near Pittsburgh, Texas. In accordance with 40 CFR §257.73(e)(1)(i) through (iv) this initial assessment provides field and laboratory data, model outputs (detailing multiple stability conditions) and summary of safety factors for the Primary Ash Pond. In accordance with 40 CFR §257.73(e)(2) this report provides the Initial Safety Factor Assessment certification for the Primary Ash Pond.

1.2 Referenced Information and Data

Soils data, comprised of field and laboratory testing, utilized in the preparation of this assessment were completed by ETTL Engineers and Consultants, Inc. and documented in the report *Welsh Power Station, Existing Ash Storage Pond Embankment Investigation, Pittsburg, Texas* dated June 21, 2010. Based on a review of the provided field and laboratory data, it appears to be accurate and appropriate for use in the initial structural stability assessment of the Primary Ash Pond [40 CFR §257.73(e)(1)]. Furthermore, based on a recent site visit (October 2015), no modifications or elevation alterations have been made to the embankment since the referenced investigation. No additional field or laboratory activities were conducted. Soil data utilized in this evaluation is provided in the Appendix of this report.

The impoundment pool elevation data cited herein were provided in a separate hydrology and hydraulic (H&H) analysis report completed by Freese and Nichols titled *Hydraulic Analysis of Welsh Power Plant Ash Ponds* dated December 29, 2010 (not included herein). The referenced report generally meets the demonstration requirements of 40 CFR §257.82(a).

Embankment profile dimensions and elevations were determined by using existing information provided by the client. This information is also included in the Appendix of this report.

1.3 Embankment Evaluation Criteria

Based on information provided by the client, the existing embankment is constructed of lean clay (CL) and fat clay (CH) with existing side slopes (both up- and downstream) of approximately 2.5:1 (H:V), maximum embankment height of 35 feet (downstream) and top of dam elevation of 340.0 feet MSL. The crest width of the embankment is approximately 50 feet. An embankment cutoff key (key trench) extends below the core structure approximately five (5) feet and has an approximate bottom width of 20 feet.

The downstream toe of the Primary Ash Pond extends below the impounded water level of the adjacent Welsh Reservoir. Based on information provided by the client, the normal pool elevation for the Welsh Reservoir is approximately 320.0 feet (MSL). Reservoir levels are monitored and adjusted as needed to maintain a constant pool elevation of approximately 320.0 feet (MSL). Based on the active management and control of the Welsh Reservoir pool elevation, the downstream toe of the Primary Ash Pond should not be subject to sudden or rapid drawdown conditions, notwithstanding a catastrophic failure of or uncontrolled release from the Welsh Reservoir. Regardless, the sudden drawdown of the Welsh Reservoir along the downstream slope of the Primary Ash Pond is modeled herein (40 CFR §257.73(d)(1)(A)(3)(vii).

In accordance with 40 CFR §257.73(e)(1)(i) and (ii), the maximum storage pool elevation for the Primary Ash Pond as determined by the 25-year, 24-hour storm event is 329.35 feet (MSL). For the purposes of this evaluation, the maximum storage pool elevation of 330.0 feet (MSL) was utilized. Likewise the maximum (or flood) surcharge loading elevation as determined by the 100-year, 24-hour event is 330.80 feet (MSL), for this evaluation a maximum surcharge loading elevation of 331.0 feet (MSL) was utilized. Storage pool elevations were determined in accordance with 40 CFR §257.82(a).

2.0 Slope Stability Analyses

2.1 General

Soil parameters used for stability analyses of the existing embankment are based on findings of previous laboratory and field testing programs. The probable failure planes were analyzed using the analytical slope stability software, SLIDE by Rocscience, Inc. Methods of evaluation used in SLIDE are considered to be limited equilibrium methods of analysis, where each individual shear plane is evaluated to determine the resulting shear stress at the point of failure. For the purposes of this evaluation the Bishop Method of analysis, which analyzes circular failure planes through the slope was utilized.

Per 40 CFR §257.73(e)(1)(i) through (iii), four (4) modeled scenarios (presented below) were utilized to evaluate the stability of the existing embankment: steady state seepage (long term) condition under maximum storage pool, steady state seepage (long term) condition under maximum surcharge pool, steady state seepage condition with seismic loading under maximum storage pool conditions, and rapid drawdown (of the inundated downstream slope). The following minimum factors of safety (FS) and soil stress parameters were utilized in modeling. Minimum factors of safety are based on demonstration requirements provided in 40 CFR §257.73(e)(1) and guidance provided by the United States Army Corps of Engineers (USACE).

Summary of Embankment Condition and Factor of Safety		
Embankment Condition	**Soil Parameters**	**Minimum Factor of Safety**
Steady State Seepage – Maximum Pool	Effective Stress	1.50
Steady State Seepage – Surcharge Pool	Effective Stress	1.40
Steady State Seepage (Seismic) – Maximum Pool	Total Stress	1.00
Rapid Drawdown – Downstream Slope	Effective and Total Stress	1.20
NOTE: Minimum factors of safety based on demonstration requirements provided in 40 CFR §257.82 (e)(1). Minimum factor of safety for Rapid Drawdown based on guidance provided by the United States Army Corps of Engineers (USACE).		

For evaluation of steady state seepage (long term) conditions with seismic, peak ground acceleration for this location was obtained from the USGS National Seismic Hazard Mapping Project (http://earthquake.usgs.gov/hazards). Based on the seismic survey data, the anticipated site specific peak ground acceleration (PGA) of 0.06g (acceleration at rock sites) for two (2) percent probability of exceedance in 50 years (40 CFR Part 257, Preamble page 21384). Correcting for acceleration at soft soil sites (Seismic Site Classification D) yields an estimated PGA of 0.13g. The seismic coefficient (k) used for pseudo static analysis is determined by reducing the estimated PGA by 50% yielding a seismic coefficient of 0.065g.

2.2 Liquefaction Assessment

Liquefaction of soils occurs when horizontal shearing stresses exceed the strength of existing loose, saturated sand. This sudden loss of shear strength and subsequent soil structure is typically associated with earthquake-induced horizontal movement. Recent engineering publications[1] provide criteria to assess liquefaction potential of sands (little to no fines) and clayey soils of low plasticity (e.g. clayey sands, silts). These criteria indicate that water content of fine-grained or cohesive soils needs to be high (≥ 0.85 *Liquid Limit [LL]), a clay fine content (defined as grains smaller than 0.002 mm) of less than 10 percent (< 10%), and relatively low soil density (assessed in terms of SPT blow counts). In addition, the accepted minimum seismic threshold acceleration to cause liquefaction in loose sands is 0.10g, the anticipated site specific PGA for this site is 0.06g.

Native fine grained (or cohesive) material underlying the Primary Ash Pond generally consist of medium stiff to hard lean clay and fat clay (CL and CH) soils and coarse grained (or sandy) material consist of medium dense to very dense clayey sand (SC), silty sand (SM) and silty clayey sand (SC-SM) soils. Based on these soil characteristics and that the Primary Ash Pond is located in a zone of low peak ground acceleration (PGA), the risk of

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[1] Seed, R.B., et al, Recent Advances in Soil Liquefaction Engineering: A Unified and Consistent Framework, 26th Annual ASCE Los Angeles Spring Seminar, April 2003

either embankment or underlying soils liquefying are negligible [40 CFR §257.73(e)(1)(iv)].

2.3 Embankment and Foundation Stratigraphy

The models developed for this evaluation are based on the existing embankment geometry, results of field and laboratory testing and hydrologic site information provided by the client. Selection of the critical slope section was based on both height and subsurface sensitivity to loading. The following tables provide a summary of soil parameters used for these analyses. Specific soil parameters used for each model are presented in the Appendix.

Summary of Long Term, Total Stress Soil Parameters:

Material Type	Unit Weight (pcf)	Consolidated-Undrained Cohesion (psf)	Consolidated-Undrained Angle of Internal Friction (degrees)
Embankment Fill	125	570	12
Clayey Sand (SC)	130	360	10
Silty Sand (SM)	125	0	30
Fat Clay (CH)	130	320	19

NOTE: Properties used for Steady State Seepage with Seismic and Rapid Drawdown analyses.

Summary of Long Term, Effective Stress Soil Parameters

Material Type	Unit Weight (pcf)	Consolidated-Drained Cohesion (psf)	Consolidated-Drained Angle of Internal Friction (degrees)
Embankment Fill	125	310	23
Clayey Sand (SC)	130	320	15
Silty Sand (SM)	125	0	30
Fat Clay (CH)	130	300	28

NOTE: Properties used for Steady State Seepage and Rapid Drawdown analyses. Consolidated-drained conditions determined based on pore pressure measurements made during Consolidated-Undrained (CU) triaxial testing.

2.4 Seepage Analysis Parameters

The analysis of embankment seepage is based on laboratory results and estimated values for permeability for various embankment and native foundation soils. These soil parameters were utilized in the models to establish a long term steady state condition and corresponding phreatic surface in the embankment. Hydraulic conductivity test results are provided in the Appendix. Hydraulic conductivity properties utilized in the seepage analysis are provided in the below table.

Hydraulic Conductivity of Embankment Soils	
Material Type	**Permeability (ft/sec)**
Embankment Fill	1×10^{-9}
Clayey Sand (SC)	1×10^{-7}
Silty Sand (SM)	1×10^{-5}
Fat Clay (CH)	1×10^{-8}

2.5 Stability Analysis Results

The following table provides the results of the stability analysis for each of the conditions cited herein, as required by 40 CFR §257.73(e)(1)(i) through (iii). The graphical representations of each analysis are included in the Appendix.

Summary of Stability Analyses – Safety Factors		
Modeled Condition	**Factor of Safety**	
	Actual	**Minimum**
Steady State Seepage – Maximum Pool	1.51	1.50
Steady State Seepage – Surcharge Pool	1.51	1.40
Steady State Seepage with Seismic – Maximum Pool	1.07	1.00
Rapid Drawdown – Downstream Slope	1.21	1.20

Based on the findings of this analysis, the evaluated embankment appears to be stable under the modeled conditions and demonstrate the minimum safety factors, as required by 40 CFR §257.73(e)(1)(i) through (iii).

3.0 Report Limitations

This report has been prepared for the exclusive use of our client for the specific application to the project discussed and has been prepared in accordance with the generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. The analyses contained in the report are based on the data obtained from the referenced soil borings performed within the project site. This report does not reflect variations that may occur between borings or across the site. Soil borings do not necessarily reflect strata variations that may exist at other locations within the project site.

4.0 Initial Structural Stability Assessment Certification

By means of this certification, (i) I have reviewed the requirements of 40 CFR §257.73(e)(1) – *Periodic Safety Factor Assessments*, (ii) I or my agent has visited and examined the facility, (iii) the referenced data used in this evaluation to the best of my knowledge appears correct and appropriate for use, (iv) and this Initial Safety Factor Assessment for the Primary Ash Pond (Welsh Power Station) has been prepared to the best of my knowledge in accordance with §257.73(e)(1).

By: ______________________________

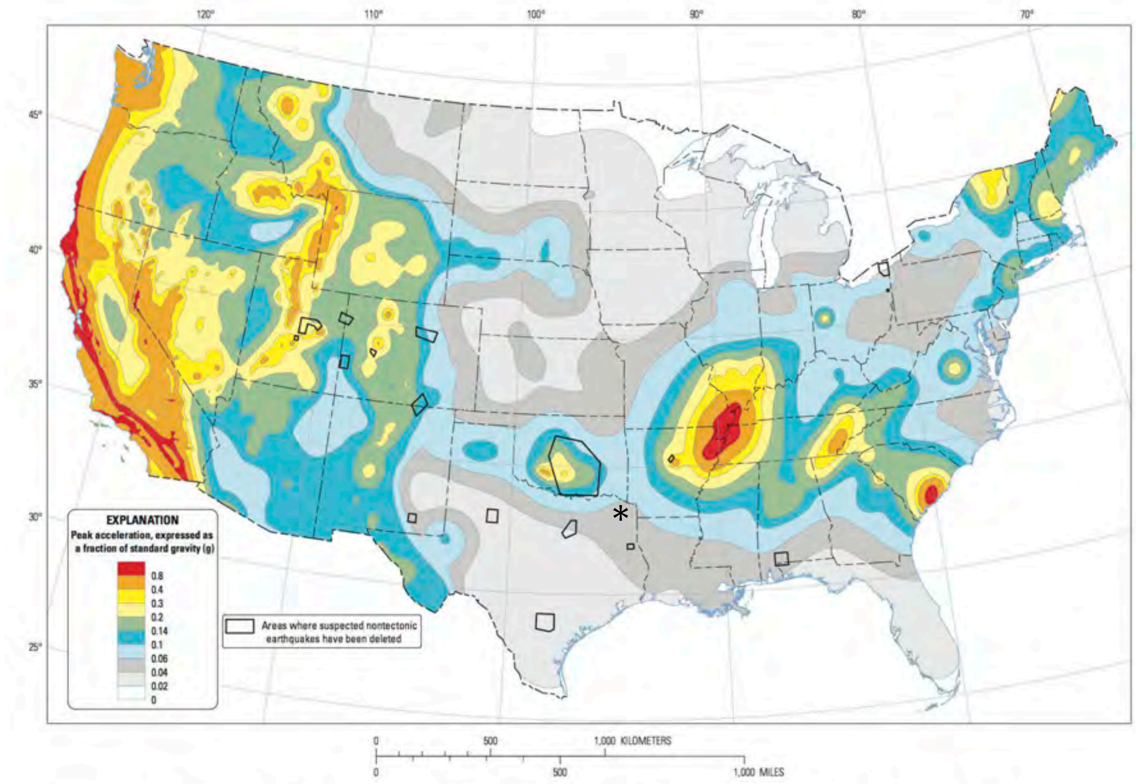
Dated: January 14, 2016

JOHN J. TAYNTOR
99202

TBPE Firm Registration No. F-16721
Expires 2/29/2016

Appendix

Stability Analyses
Reference Data



Two-percent probability of exceedance in 50 years map of peak ground acceleration

* Approximate location of Welsh Power Generating Station

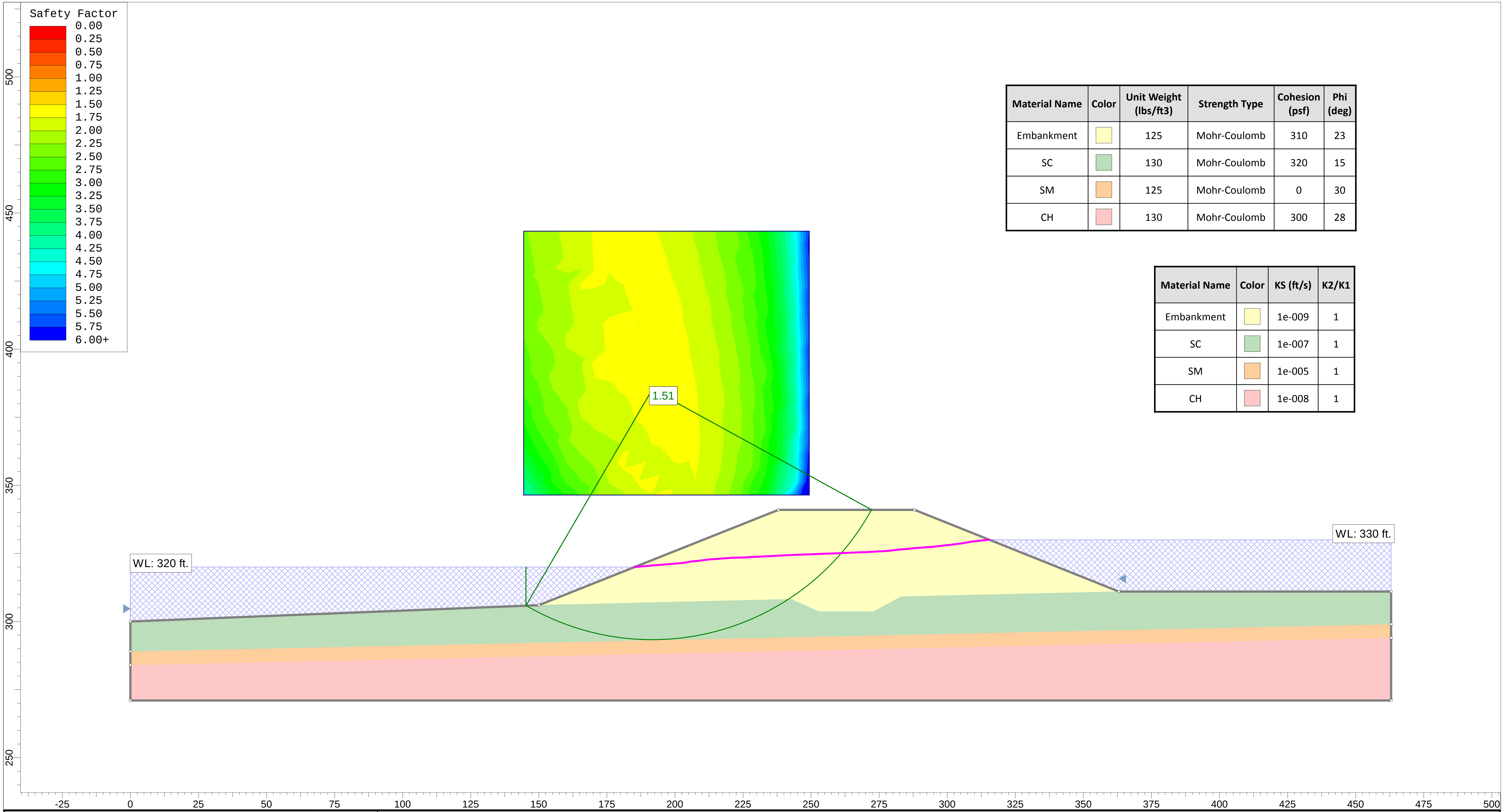
Provided by USGS National Seismic Hazard Mapping Project.

Seismic Probability Map

Scale: N/A

Auckland Project No. 2015-008A

Welsh Power Generating Station
Initial Safety Factor Assessment - Primary Ash Pond
Pittsburgh, Texas



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	Mohr-Coulomb	310	23
SC	🟩	130	Mohr-Coulomb	320	15
SM	🟧	125	Mohr-Coulomb	0	30
CH	🟥	130	Mohr-Coulomb	300	28

Material Name	Color	KS (ft/s)	K2/K1
Embankment	🟨	1e-009	1
SC	🟩	1e-007	1
SM	🟧	1e-005	1
CH	🟥	1e-008	1

Auckland Consulting LLC
PO Box 8155
Jacksonville, Texas 75766

SLIDEINTERPRET 6.036

Project
Welsh Power Station - Primary Ash Pond

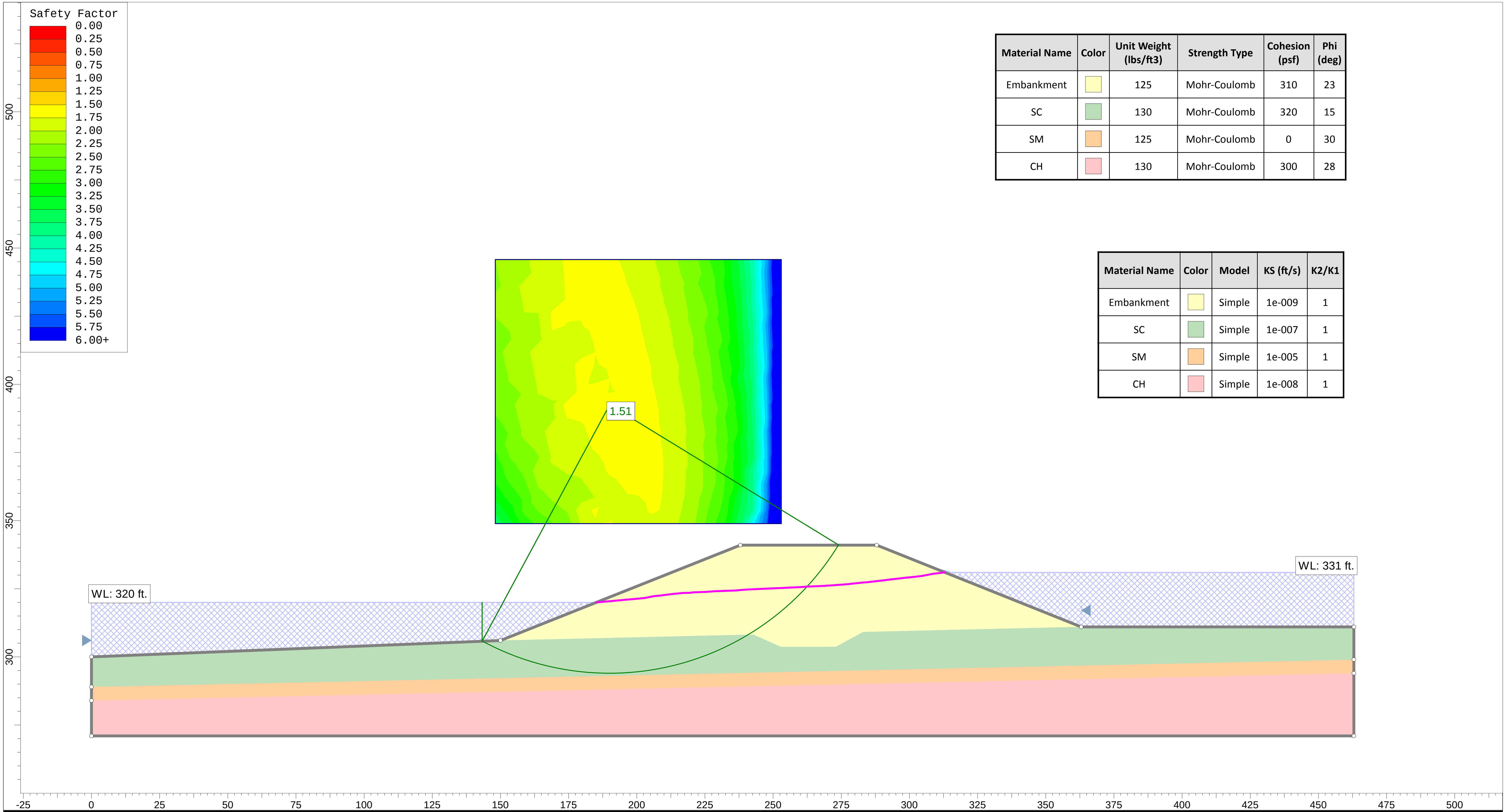
Analysis Description
Maximum Storage Pool at Normal Reservior Pool

Drawn By
JJT

Company

Date
12/2/2015

File Name
Primary_SSS_normal_25yr pool_Rev1.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	Mohr-Coulomb	310	23
SC	🟩	130	Mohr-Coulomb	320	15
SM	🟧	125	Mohr-Coulomb	0	30
CH	🟥	130	Mohr-Coulomb	300	28

Material Name	Color	Model	KS (ft/s)	K2/K1
Embankment	🟨	Simple	1e-009	1
SC	🟩	Simple	1e-007	1
SM	🟧	Simple	1e-005	1
CH	🟥	Simple	1e-008	1

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SLIDEINTERPRET 6.036

Project
Welsh Power Station - Primary Ash Pond

Analysis Description
Maximum Surcharge Pool at Normal Reservior Pool

Drawn By
JJT

Company

Date
12/2/2015

File Name
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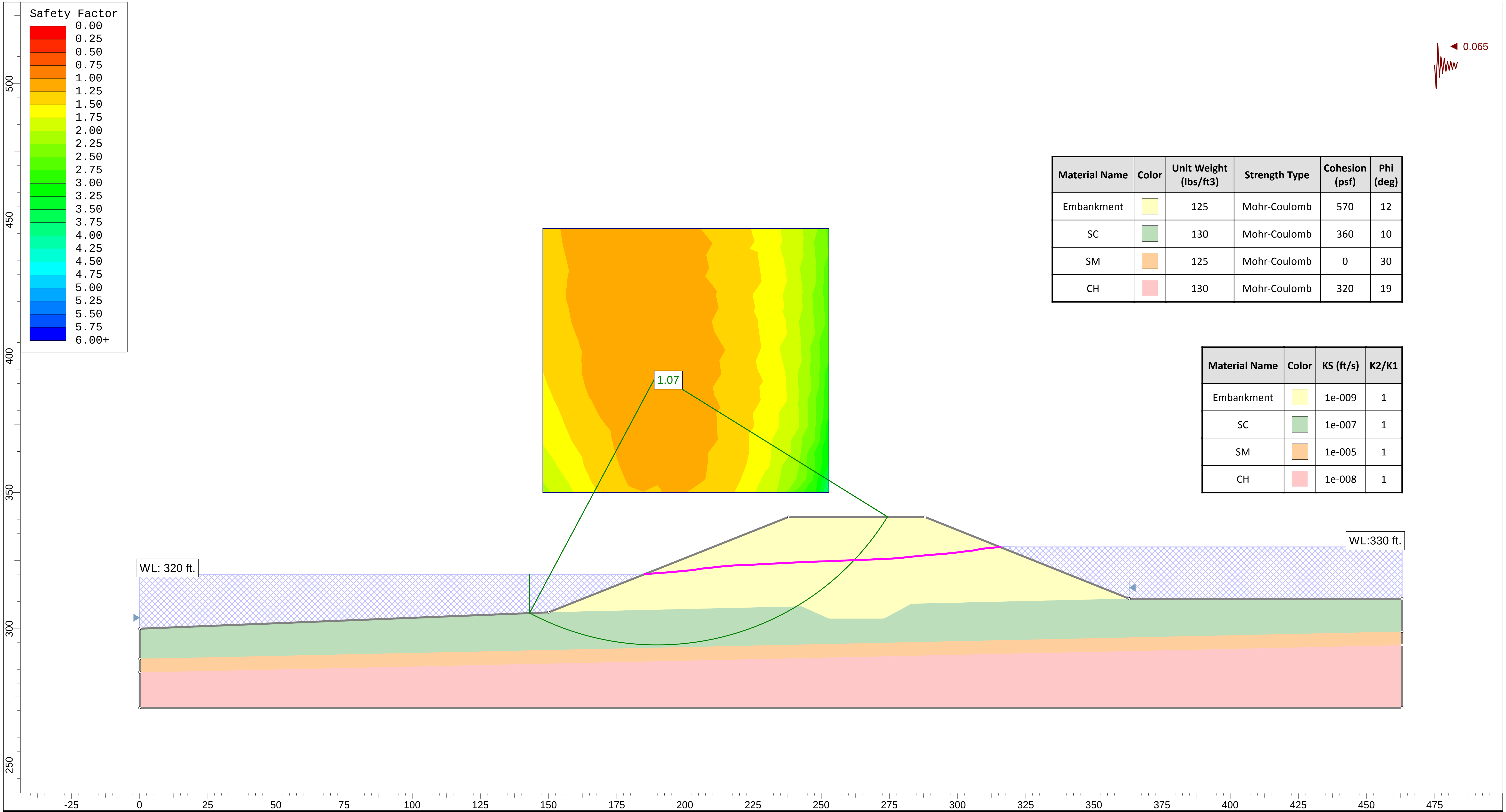

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	Mohr-Coulomb	570	12
SC	🟩	130	Mohr-Coulomb	360	10
SM	🟧	125	Mohr-Coulomb	0	30
CH	🟥	130	Mohr-Coulomb	320	19

Material Name	Color	KS (ft/s)	K2/K1
Embankment	🟨	1e-009	1
SC	🟩	1e-007	1
SM	🟧	1e-005	1
CH	🟥	1e-008	1

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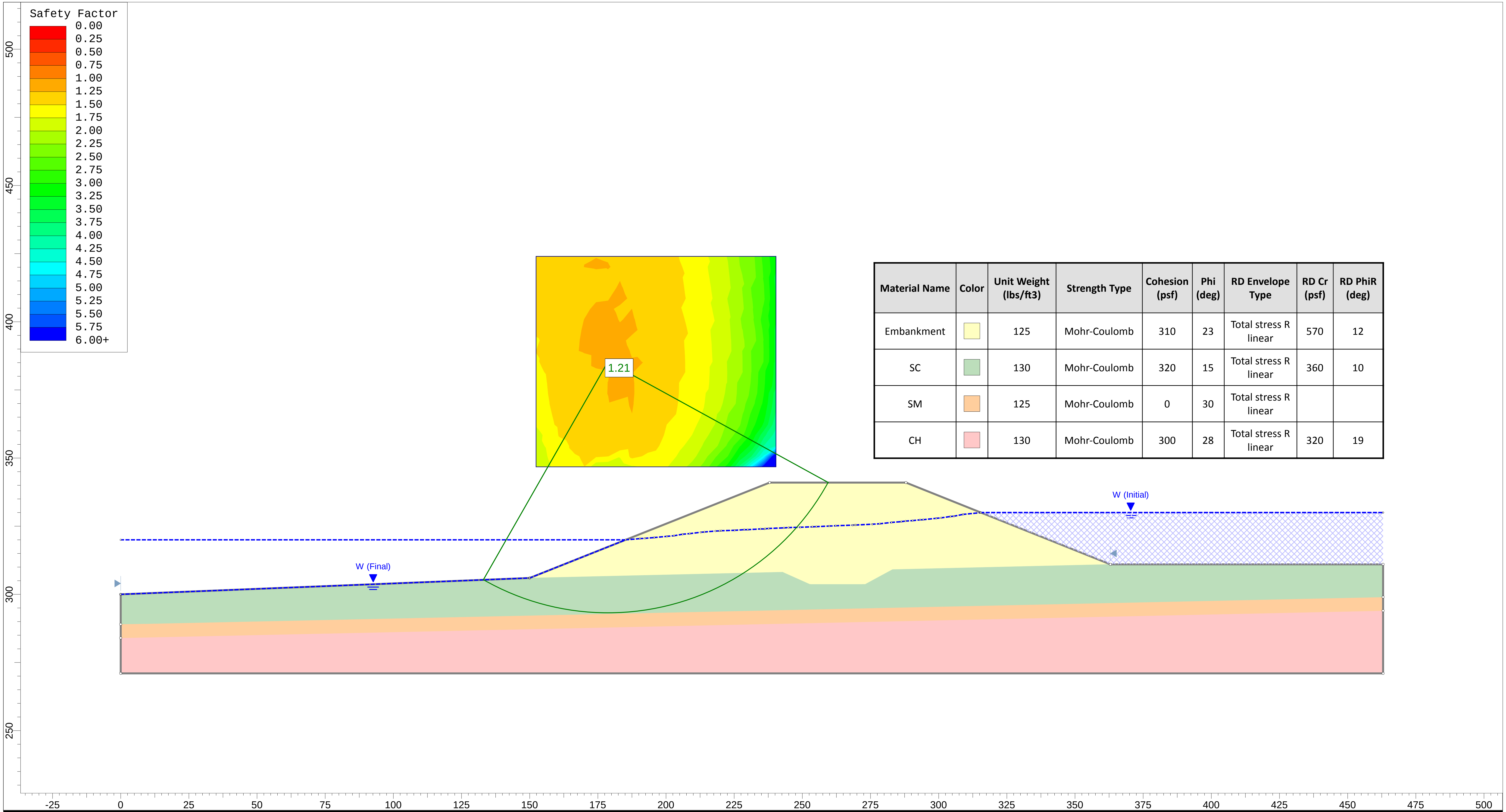
SLIDEINTERPRET 6.036

Project Welsh Power Station - Primary Ash Pond	
Analysis Description Maximum Storage Pool at Normal Reservior Pool, Seismic Analysis	
Drawn By JJT	*Company*
Date 12/23/2015	*File Name* Primary_SSS_seismic_25yr pool.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	RD Envelope Type	RD Cr (psf)	RD PhiR (deg)
Embankment	🟨	125	Mohr-Coulomb	310	23	Total stress R linear	570	12
SC	🟩	130	Mohr-Coulomb	320	15	Total stress R linear	360	10
SM	🟧	125	Mohr-Coulomb	0	30	Total stress R linear		
CH	🟥	130	Mohr-Coulomb	300	28	Total stress R linear	320	19

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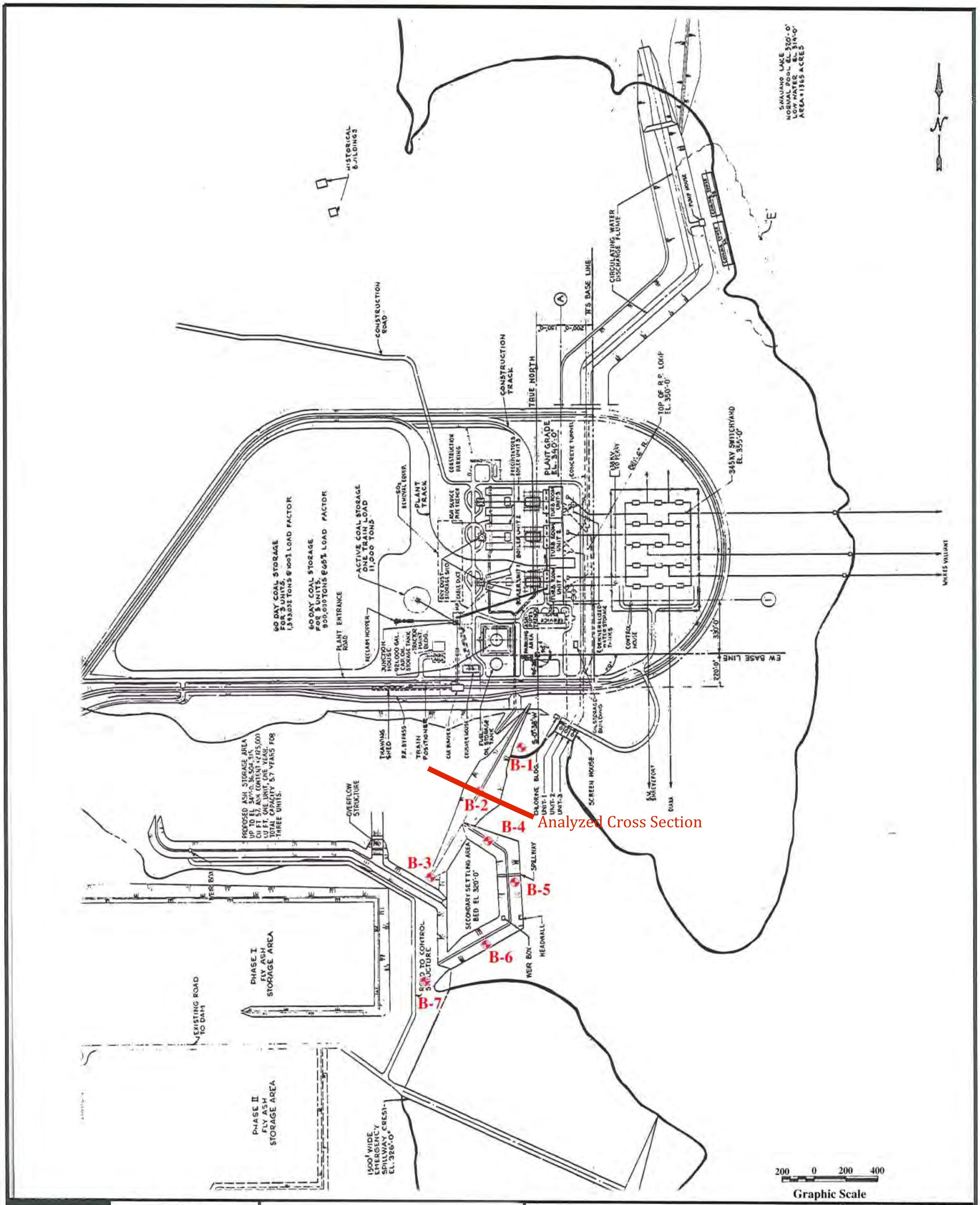
SLIDEINTERPRET 6.036

Project	Welsh Power Station - Primary Ash Pond
Analysis Description	Maximum Storage Pool with Rapid Drawdown of Reservior Pool
Drawn By	JJT
Company	
Date	12/2/2015
File Name	Primary_RD Res_normal_25yr pool.slim



ETTL ENGINEERS & CONSULTANTS
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Tyler, Texas 75702
(903) 595-4421

WELSH POWER PLANT
PITTSBURGH, TEXAS

PLATE 1 - PLAN OF BORINGS

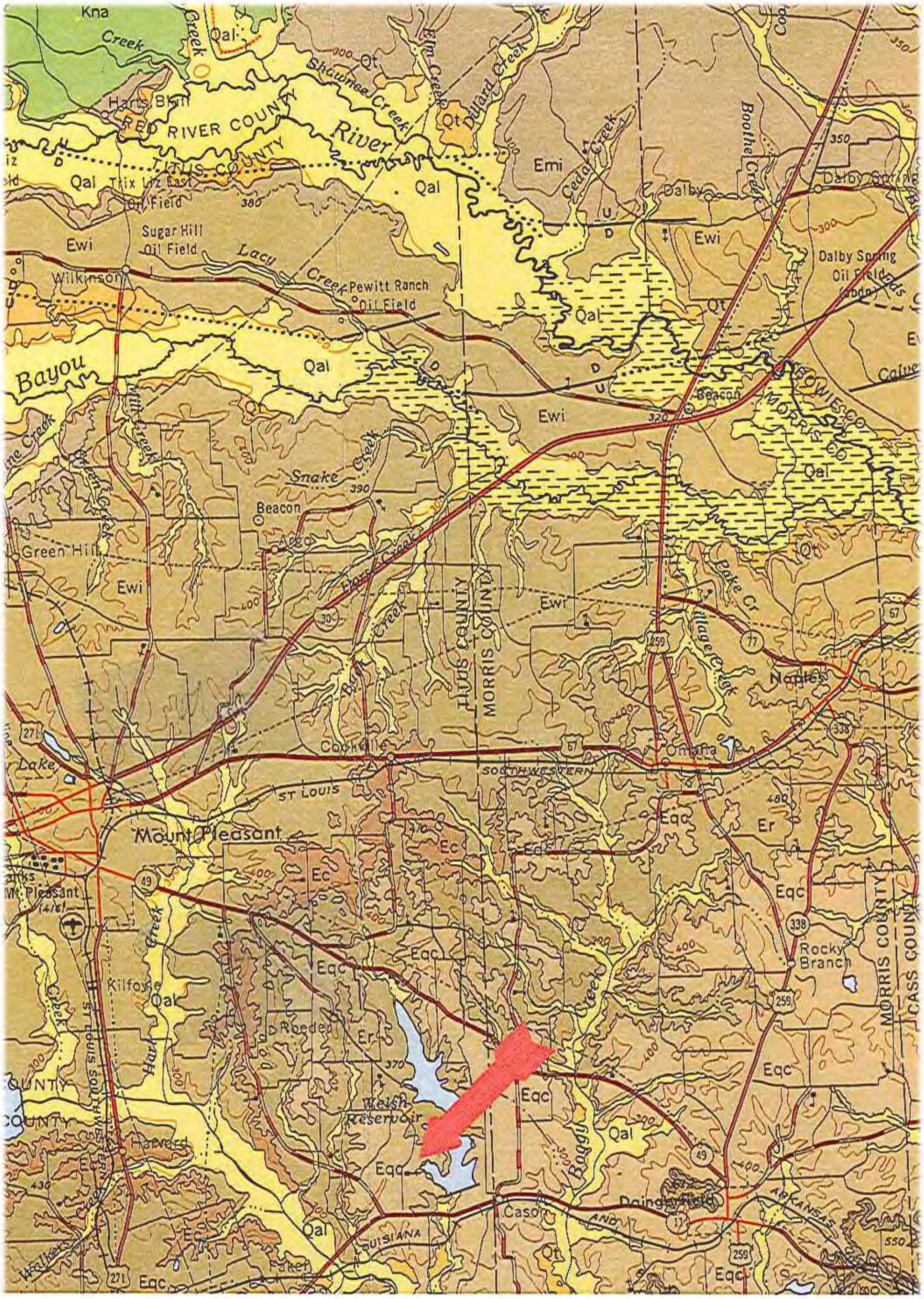
JOB NO.: G3242-095

DATE: JAN. 2010

SCALE: AS SHOWN

APPROVED BY:

DRAWN BY: K.C.R.



EXPLANATION

SEDIMENTARY ROCKS

QUATERNARY

Recent

Qal

Alluvium

Flood-plain deposits

Pleistocene

Qt

Fluviatile terrace deposits undivided

TERTIARY

Eocene

Etg / Es

Sparta Sand

Quartz sand, fine to medium grained, light gray to brownish gray, slightly cohesive from silt and clay matrix, massive, locally cross-bedded, interbeds of sandy clay more abundant upward, locally carbonaceous; weathers various shades of light gray, at base hard, brown, ferruginous sandstone; lower part 170± feet thick, upper part absent. Locally includes Tyler Greensand Member, Etg, quartz-glauconite greensand, grayish green, massive, locally cross-bedded; weathers dark reddish brown, abundant ironstone concretions

Ew

Weches Formation

Glauconite and quartz sand, grayish green to grayish olive green, thin bedded, locally cross-bedded to lenticular, clay interbeds light brown to moderate light gray, silty, muscovitic, thin bedded; weathers moderate to dark reddish brown, locally forms limonitic and sideritic iron ore and clay ironstone concretions; marine megafossils in southern part; 35± feet thick, range 0–70 feet

Eqc

Queen City Sand

Quartz sand, fine grained to locally medium grained, light gray to brownish gray, locally carbonaceous, and clay, gray to brown, silty, slightly lignitic, sand most abundant to west; weathers red and white mottled, ironstone concretions and ledges common; local beds of glauconite-quartz greensand, cross-bedded, weathers to ferruginous ledges and rubble; 100–400 feet thick, thins southeastward

Er

Reklaw Formation

Upper 100± feet, clay, brownish black to brownish gray, silty, muscovitic, carbonaceous, laminated, interbeds of moderate reddish-brown clay; weathers light brown, ironstone concretions common; a few marine fossils. Lower 15± feet, quartz sand, fine to very fine grained, grayish green, glauconitic, argillaceous, massive, locally cross-bedded; weathers moderate brown to dark yellowish orange with clay ironstone ledges and rubble; fossils, clay ironstone, and clay decrease northward

Ec

Carrizo Sand

Upper part, very fine sand, silt, clayey silt, silty clay, medium to dark gray, carbonaceous; weathers moderate yellowish brown to dark reddish brown, indurated ledges of dark brownish-gray ironstone common. Lower part, quartz sand, fine to medium grained, light brownish gray, weakly cohesive, massive, locally cross-bedded; weathers light gray to various shades of red. Thickness 20–100 feet

Ewi

Wilcox Group undivided

Mostly silty and sandy clay, various shades of gray, local beds of clay, lignite, silt, and quartz sand, in part carbonaceous, laminated to massive, locally cross-bedded, weathers to various shades of gray, brown, yellow, and red. Calcareous siltstone and ironstone concretions common; abundant plant fossils, a few marine fossils in southeastern part; 500–1,000 feet thick.

E

Eocene rocks undivided

Reklaw Formation, Carrizo Sand, Wilcox Group, and Midway Group on Brooks dome, not separately shown

Ewp

Wills Point Formation

Clay, medium bluish gray, greenish gray, grayish green, brownish gray, silt increases upward, laminated to locally massive, glauconitic near base, rough calcareous siltstone concretions common in upper part, locally lignitic in upper part, thin bed of fossilic limestone near middle; weathers medium gray to yellowish gray; fossiliferous; 300± feet thick

Ek

Kincaid Formation

Clay, medium gray to dark gray, greenish gray, brownish gray, glauconitic, calcareous, selenitic, locally silty or sandy, locally phosphatic near base, thin beds of limestone in upper part, gray, hard, detrital; weathers medium gray; fossiliferous; 180± feet thick

CRETACEOUS

Upper Cretaceous

Kke

Kemp Clay

Clay, dark gray to bluish gray, calcareous, silty, glauconitic, calcareous concretions common; weathers dark greenish gray and black; upper part only crops out

Ku

Upper Cretaceous rocks undivided

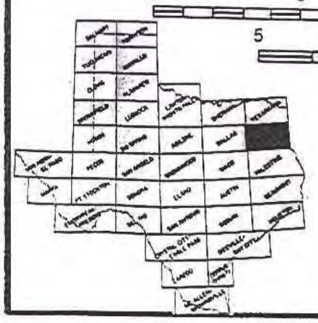
Navarro Group, Taylor Group, and Austin Chalk on Brooks dome not separately shown

Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 Nautical Miles



CONTOUR INTERVAL 100 FEET
WITH SUPPLEMENTARY CONTOURS AT 50 FOOT INTERVALS

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SITE SURFACE GEOLOGY

JOB No.: G3242-09	
DATE: 1975	
SCALE: 1:250,000	

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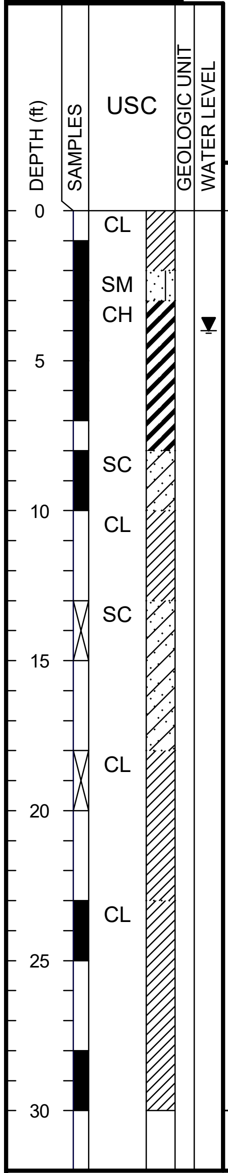
LOG OF BORING B-1

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

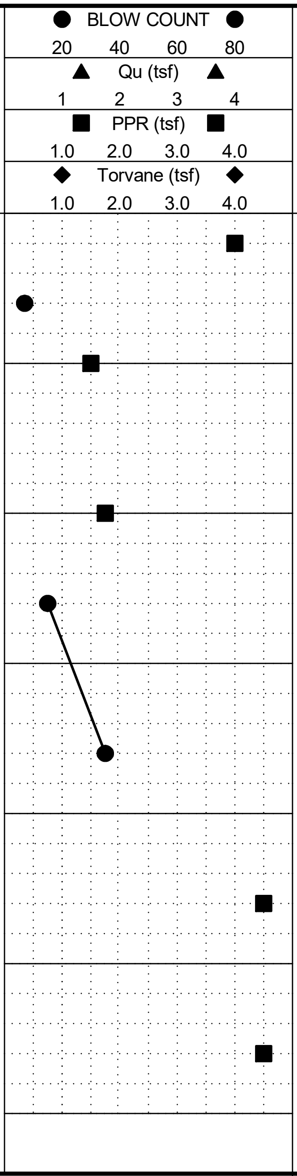
SURFACE ELEVATION 324.1

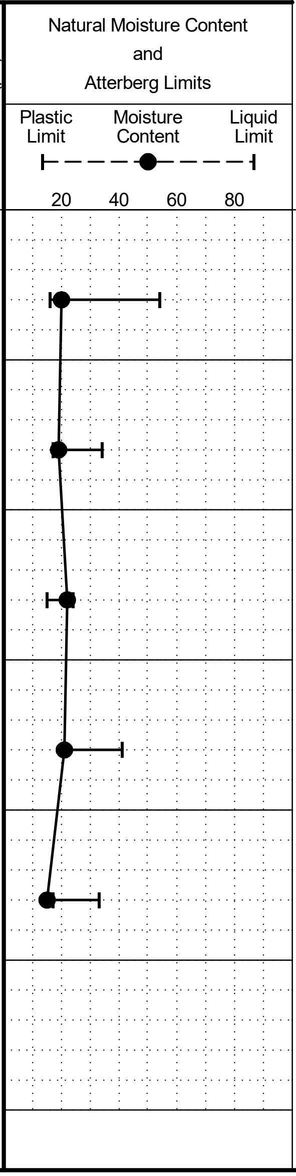


MATERIAL DESCRIPTION

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; brownish orange	P=4.0 SF										
SM	SILTY SAND(SM) tannish orange	N=7					20	54	16	38	63	+40Sieve=10%, +4 Sieve=1%
CH	SANDY FAT CLAY(CH) medium stiff; tannish orange --stiff	P=1.5										
SC	CLAYEY SAND(SC) medium dense; tannish orange; with clay seams	P=1.75					19	34	17	17	32	+40 Sieve=7%, +4 Sieve=3%
CL	SANDY LEAN CLAY(CL) stiff; orange											
SC	CLAYEY SAND(SC) medium dense; orange; saturated; with iron oxide cemented sandstone rock	N=15					22	24	15	9	19	+40Sieve=35%, +4 Sieve=22%
CL	LEAN CLAY WITH SAND(CL) hard; dark gray; with clay seams	N=35					21	41	21	20	75	+40 Sieve=2%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; dark brown	P=4.5+					15	33	17	16	52	+40 Sieve=1%, +4 Sieve=0%
	--grayish brown; laminated with silt	P=4.5+										

Bottom of Boring @ 30'





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 5' while drilling. Water level @ 4' and open to 30' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.090', W 94°50.417'

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LOG OF BORING B-2

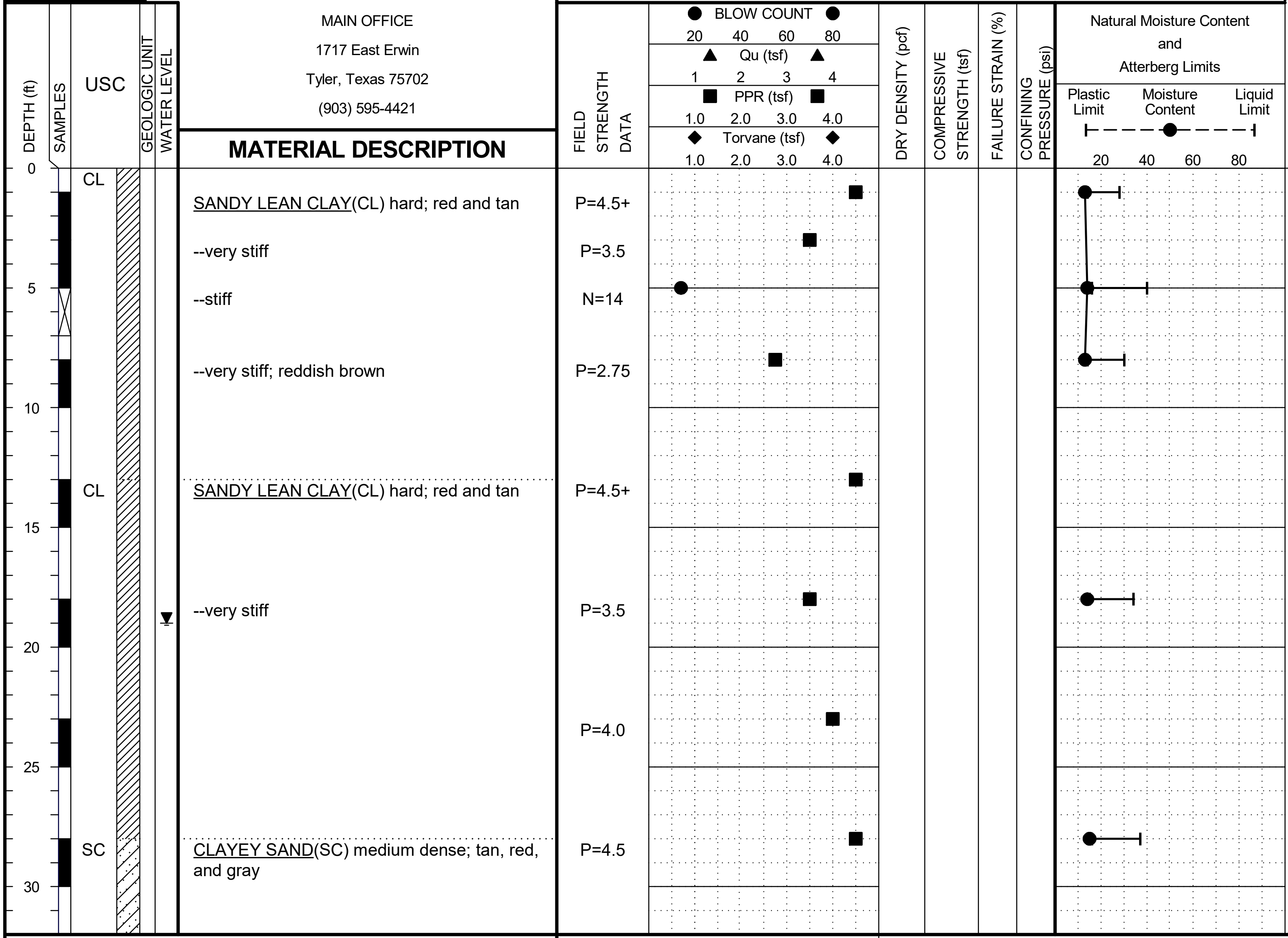
PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7

USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL		SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+	13	28	14	14	61	+40 Sieve=3%, +4 Sieve=0%
		--very stiff	P=3.5						
		--stiff	N=14	14	40	16	24	65	+40 Sieve=0%, +4 Sieve=0%
		--very stiff; reddish brown	P=2.75	13	30	14	16	58	+40 Sieve=0%, +4 Sieve=0%
CL		SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+						
	▼	--very stiff	P=3.5	14	34	15	19	54	+40 Sieve=0%, +4 Sieve=0%
			P=4.0						
SC		CLAYEY SAND(SC) medium dense; tan, red, and gray	P=4.5	15	37	16	21	47	+40 Sieve=5%, +4 Sieve=3%



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

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LOG OF BORING B-2

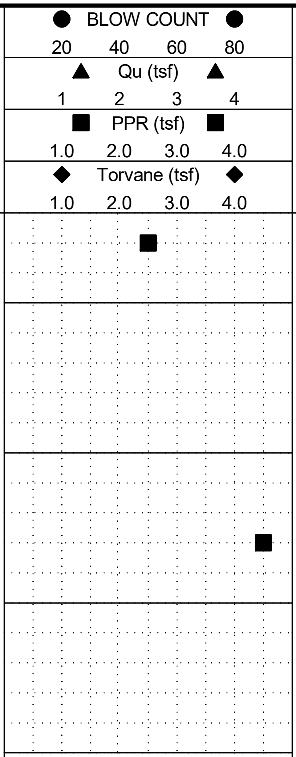
PROJECT: Welsh Power Plant
Pittsburgh, Texas

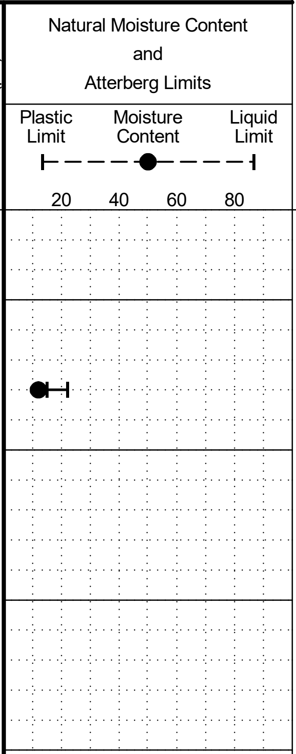
PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35		--red and tan	P=2.5						
40	SM SC	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated	SF	12	22	15	7	48	+40 Sieve=0%, +4 Sieve=0%
45	CH	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams	P=4.5+						
50	SM	SILTY SAND(SM) black and gray	SF						
		Bottom of Boring @ 50'							





Water Level Est.: ▽ Measured: ▼ Perched: ▽

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes: GPS Coordinates: N 33°03.078', W 94°50.449'

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LOG OF BORING B-3

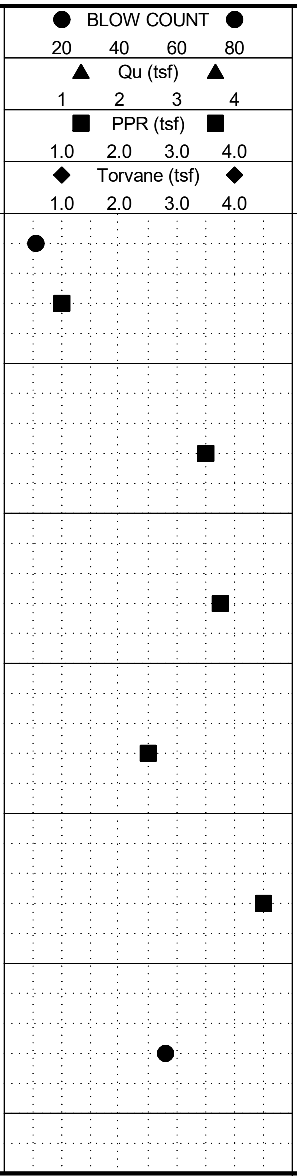
PROJECT: Welsh Power Plant
Pittsburgh, Texas

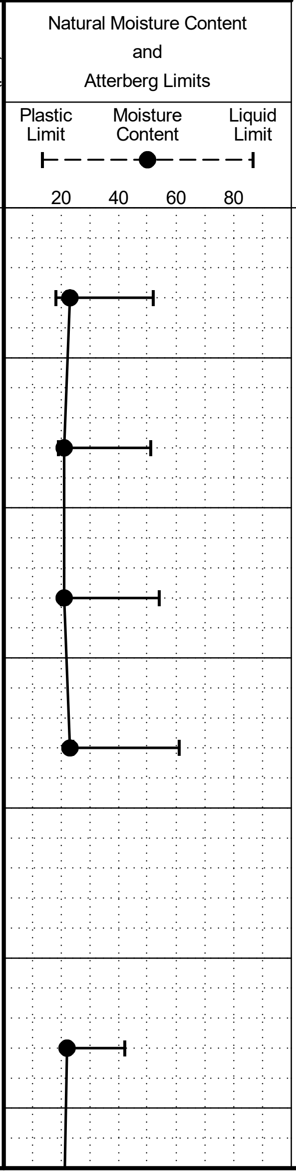
PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6





USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	CLAYEY SAND(SC) medium dense; gray and red	N=11						
CH	FAT CLAY(CH) stiff; red and tan; with sand seams	P=1.0	23	52	18	34	87	+40 Sieve=3%, +4 Sieve=0%
	--very stiff	P=3.5	21	51	19	32	86	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) very stiff; brown; with ferric joints	P=3.75	21	54	20	34	85	+40Sieve=10%, +4 Sieve=1%
	--red and tan; layered; with ferric seams	P=2.5	23	61	24	37	81	+40Sieve=11%, +4 Sieve=0%
CH	FAT CLAY(CH) hard; gray; with sand seams	P=4.5+						
SC	CLAYEY SAND(SC) very dense; gray; with sand seams	N=56	22	42	22	20	35	+40 Sieve=1%, +4 Sieve=0%

DEPTH (ft): 0, 5, 10, 15, 20, 25, 30

Columns also headed: SAMPLES, GEOLOGIC UNIT, WATER LEVEL, DRY DENSITY (pcf), COMPRESSIVE STRENGTH (tsf), FAILURE STRAIN (%), CONFINING PRESSURE (psi)

Water Level Est.: ∇ Measured: ▼ Perched: ∇

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

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LOG OF BORING B-3

PROJECT: Welsh Power Plant
Pittsburgh, Texas

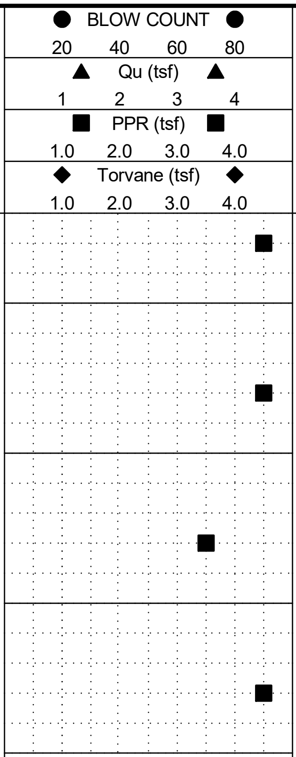
PROJECT NO.: G3242-09

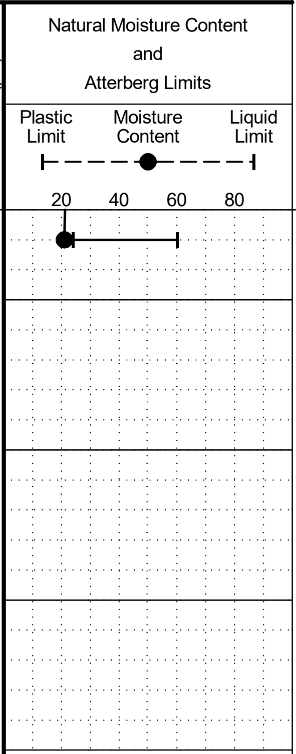
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
33	CH	FAT CLAY(CH) hard; brown; layered and with sand seams	P=4.5+	21	60	24	36	95	+40 Sieve=1%, +4 Sieve=0%
38		--gray and green	P=4.5+						
43	CL	SANDY LEAN CLAY(CL) very stiff; gray and dark green; layered; with sand seams	P=3.5						
48	CH	FAT CLAY(CH) hard; gray and dark green; layered; with silt seams	P=4.5+						
50		Bottom of Boring @ 50'							




Natural Moisture Content and Atterberg Limits

DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
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Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

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LOG OF BORING B-4

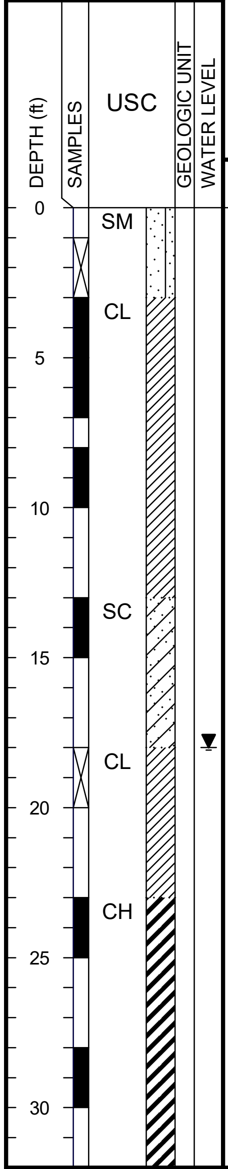
PROJECT: Welsh Power Plant
Pittsburgh, Texas

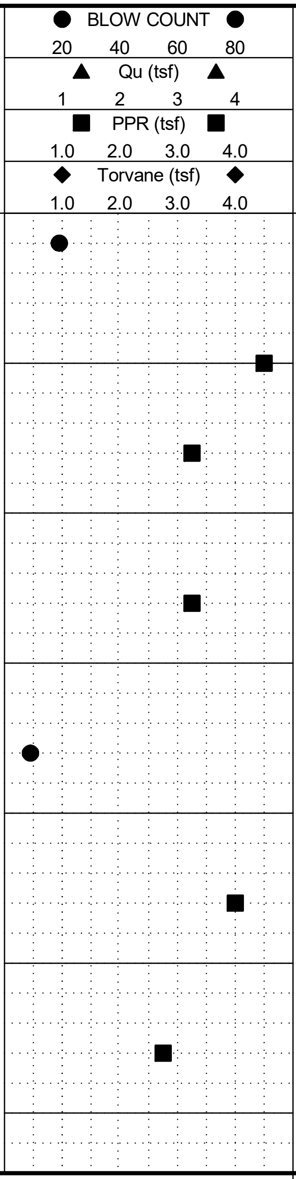
PROJECT NO.: G3242-09

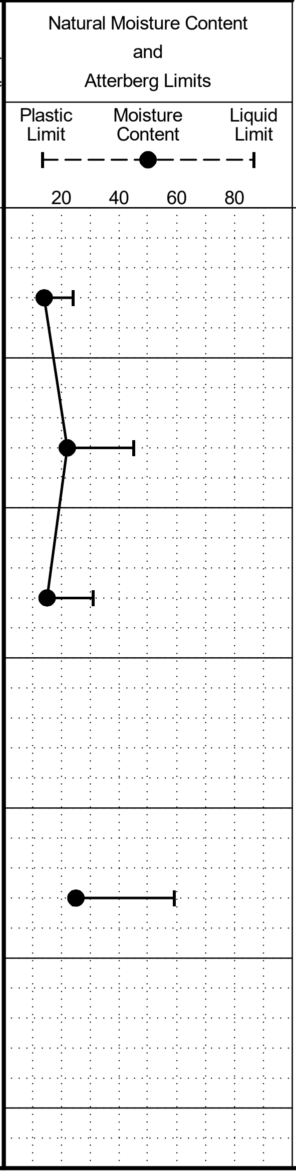
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SM	SILTY SAND(SM) medium dense; tan; with gravel	N=19										
CL	SANDY LEAN CLAY(CL) dark brown	SF					14	24	15	9	59	+40 Sieve=1%, +4 Sieve=0%
	--tannish orange											
	--hard; orangish tan	P=4.5										
		P=3.25					22	45	21	24	94	+40 Sieve=2%, +4 Sieve=0%
	--very stiff; white											
SC	CLAYEY SAND(SC) medium dense; tan	P=3.25					15	31	15	16	40	+40 Sieve=1%, +4 Sieve=0%
	--orangish gray; with sand seams											
CL	SANDY LEAN CLAY(CL) stiff; orangish tan	N=9										
CH	FAT CLAY(CH) very stiff; orangish tan; with ferric seams	P=4.0					25	59	24	35	88	+40 Sieve=4%, +4 Sieve=0%
	--tannish brown; with iron ore seams	P=2.75										

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

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LOG OF BORING B-4

PROJECT: Welsh Power Plant
Pittsburgh, Texas

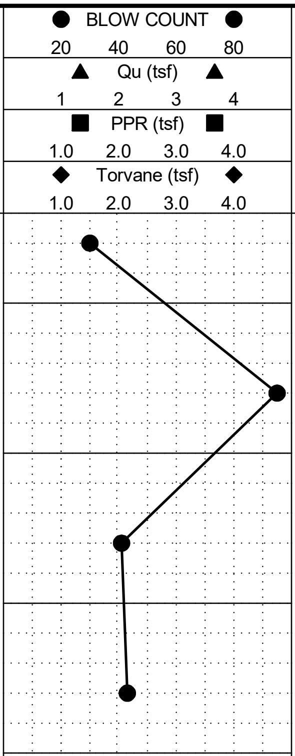
PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

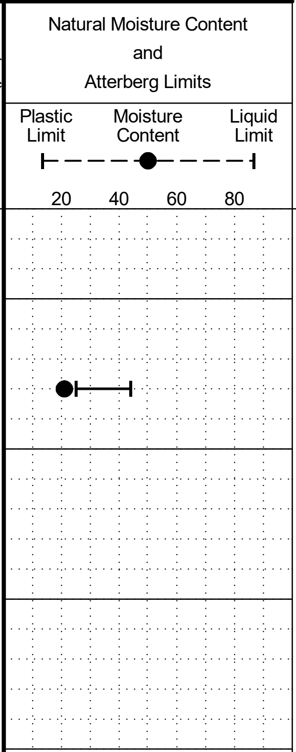
DATE 10/27/09

SURFACE ELEVATION 340.6

MATERIAL DESCRIPTION

DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
					--hard; light gray; layered and with silt seams	N=30										
35																
		CL			LEAN CLAY(CL) hard; light gray; layered and with silt seams	N=50/5.75"					21	44	25	19	93	+40 Sieve=1%, +4 Sieve=0%
40																
					--light gray	N=41										
45																
					--layered and with sand seams; with lignite	N=43										
50					Bottom of Boring @ 50'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

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LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

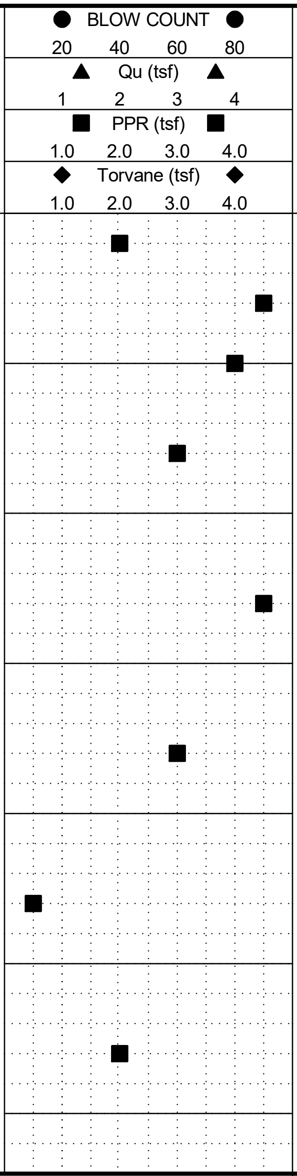
PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

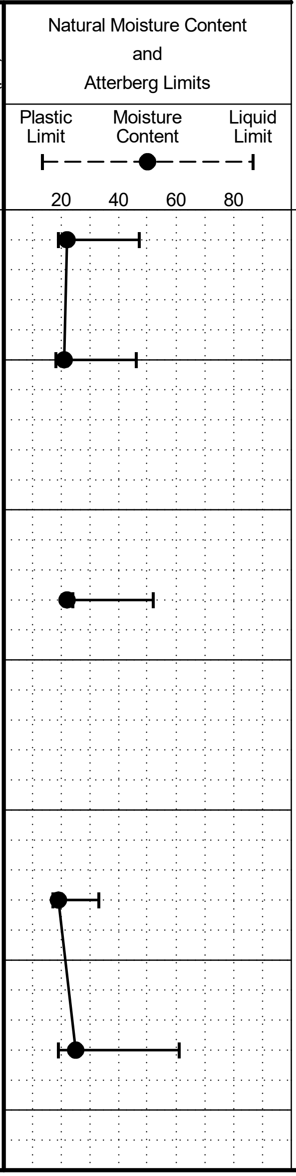
DATE 10/27/09

SURFACE ELEVATION 340.0

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY WITH SAND(CL) stiff; red and tan	P=2.0	22	47	19	28	81	+40 Sieve=9%, +4 Sieve=3%
CL	LEAN CLAY(CL) hard; red and tan	P=4.5+						
	--very stiff	P=4.0	21	46	18	28	94	+40 Sieve=3%, +4 Sieve=0%
CH	FAT CLAY(CL) very stiff; brown and tan	P=3.0						
CH	FAT CLAY WITH SAND(CH) hard; red and tan	P=4.5+	22	52	24	28	88	+40 Sieve=3%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams	P=3.0						
SC	CLAYEY SAND(SC) very loose; tan, red, and gray	P=0.5	19	33	17	16	44	+40 Sieve=1%, +4 Sieve=0%
CH	FAT CLAY WITH SAND(CH) stiff; red and gray	P=2.0	25	61	19	42	83	+40 Sieve=5%, +4 Sieve=3%



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

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LOG OF BORING B-5

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
33–35	SC	SILTY CLAYEY SAND(SC) gray and red; saturated	SF						
38–40	CH	FAT CLAY(CH) hard; red and gray; with sand seams	P=4.5+	25	51	31	20	87	+40 Sieve=6%, +4 Sieve=0%
43–45		--gray, tan, and red; with sand seams	P=4.5+						
48–50	SM SC	SILTY SAND(SM-SC) red and gray	SF						
50		Bottom of Boring @ 50'							

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

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LOG OF BORING B-6

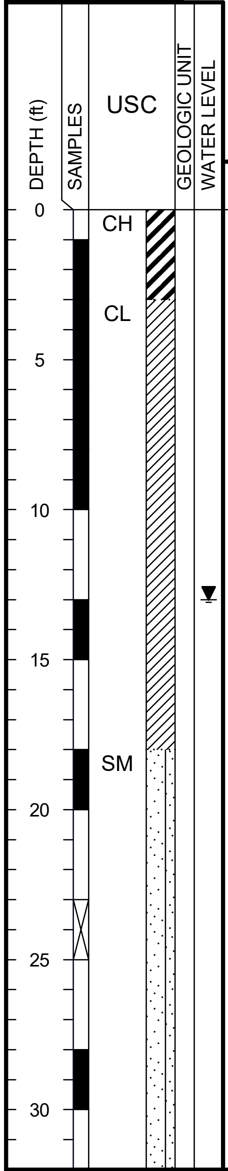
PROJECT: Welsh Power Plant
Pittsburgh, Texas

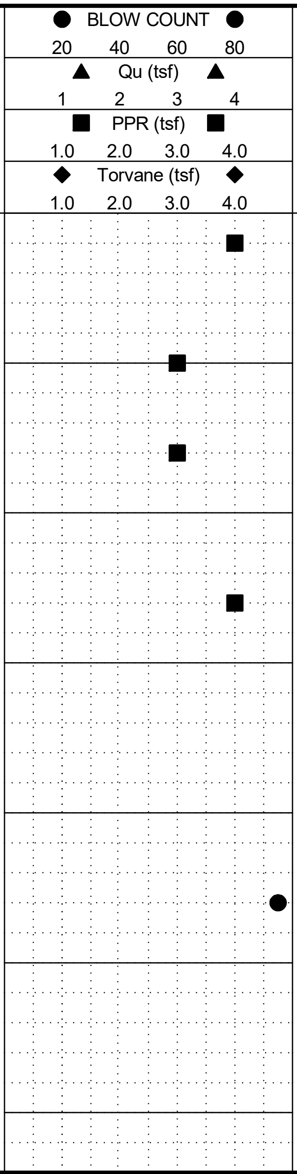
PROJECT NO.: G3242-09

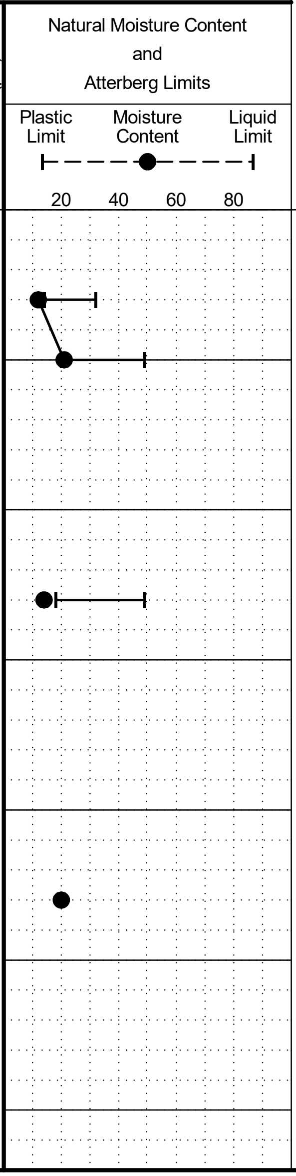
BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	<u>FAT CLAY</u>(CH) very stiff; red and gray; with ferric seams	P=4.0										
CL	<u>SANDY LEAN CLAY</u>(CL) hard; red and tan	P=4.5+					12	32	14	18	60	+40 Sieve=0%, +4 Sieve=0%
							21	49	20	29	93	+40 Sieve=2%, +4 Sieve=0%
		P=3.0										
	--very stiff; red, gray, and brown; with gravel --with sand seams	P=3.0										
		P=4.0					14	49	18	31	65	+40 Sieve=0%, +4 Sieve=0%
SM	<u>SILTY SAND</u>(SM) gray; saturated	P=3.0										
	--very dense; gray and red	N=50/5.25"					20				18	+40 Sieve=0%, +4 Sieve=0%
		SF										

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-6

PROJECT: Welsh Power Plant
Pittsburgh, Texas

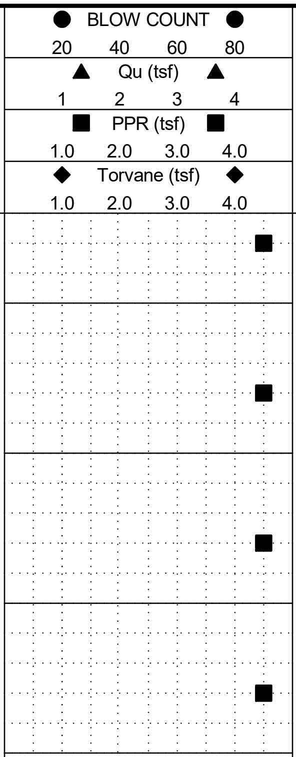
PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

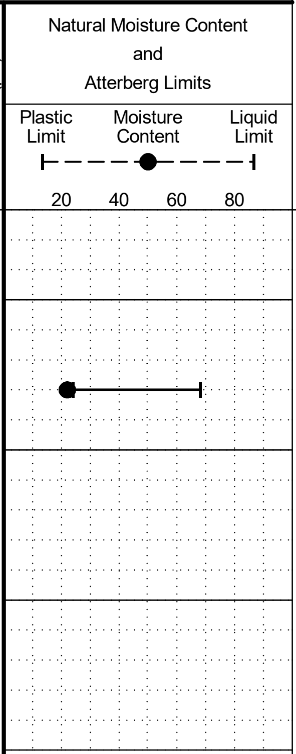
DATE 10/27/09

SURFACE ELEVATION 340.1

MATERIAL DESCRIPTION

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	CH	FAT CLAY(CH) hard; brown; with sand seams	P=4.5+						
35									
			P=4.5+	22	68	24	44	95	+40 Sieve=0%, +4 Sieve=0%
40									
		--dark green	P=4.5+						
45									
	CL	LEAN CLAY(CL) hard; dark green; laminated with lignite	P=4.5+						
50		Bottom of Boring @ 50'							





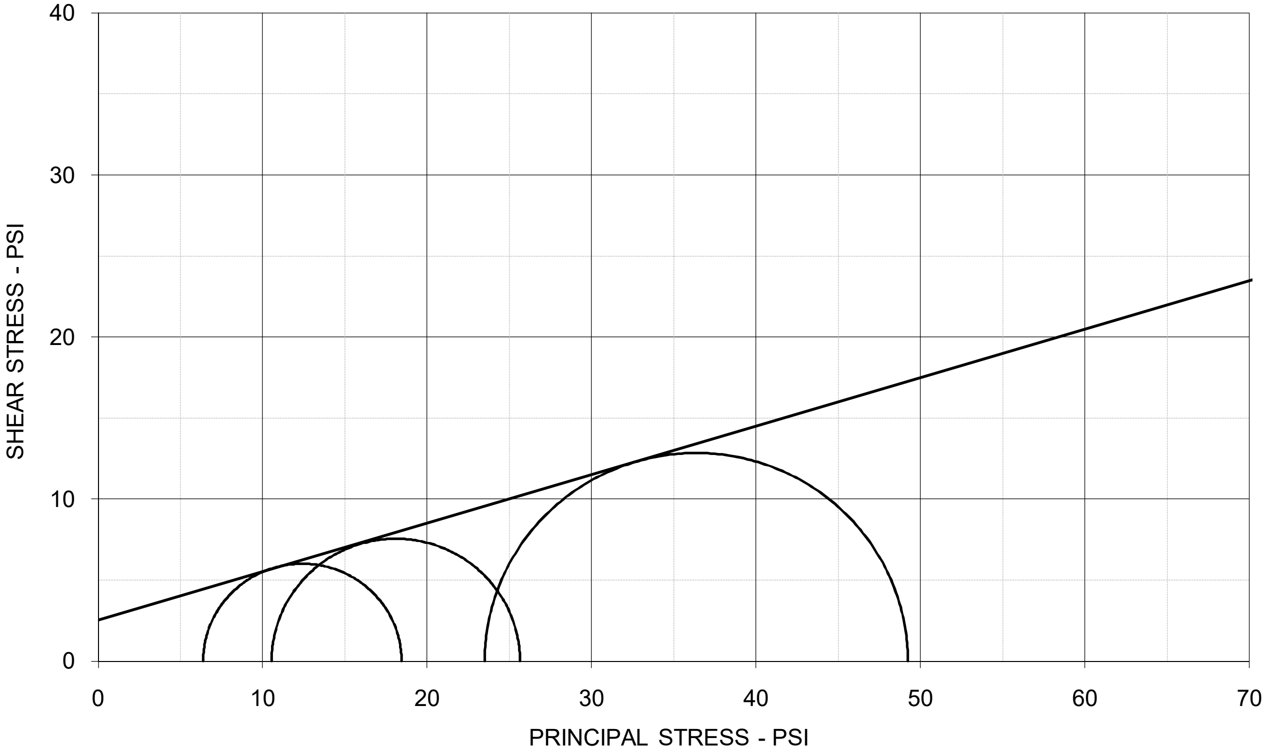
Water Level Est.: ∇ Measured: ▼ Perched: ⊻

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

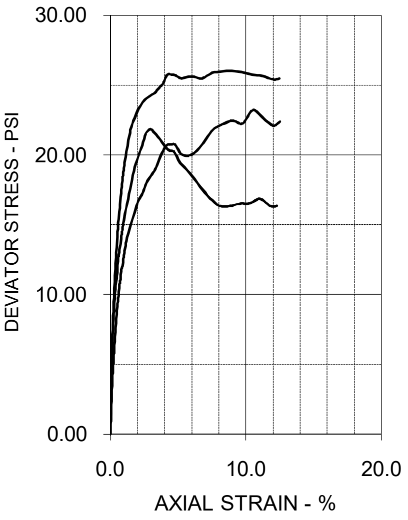
Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ ' =	16.7 deg	c' =	2.5 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	23.9	24.1	26.5	
Dry Density - pcf	102.5	100.6	99.0	
Diameter - inches	2.01	2.00	2.01	
Height - inches	4.00	3.92	3.98	
AT TEST				
Final Moisture - %	25.4	24.3	25.0	
Dry Density - pcf	102.7	102.4	101.9	
Calculated Diameter (in.)	2.01	1.98	1.99	
Height - inches	4.02	3.87	3.92	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.03	15.08	25.71	
Total Pore Pressure - psi	53.6	59.4	66.5	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.9	0.9	4.8	
σ_1' Failure - psi	18.43	25.64	49.23	
σ_3' Failure - psi	6.40	10.56	23.52	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP

SAMPLE TYPE: Shelby Tube Sample

DESCRIPTION: Tan & Gray Clay & w/ some Ferric Joints

Sampled on Site, B-1 5' to 10' deep

ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve

LL: PL: PI: Percent -200:

REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

G 3242-095, B-1 5'-10' Welsh

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds

LOCATION: Pittsburg, Texas

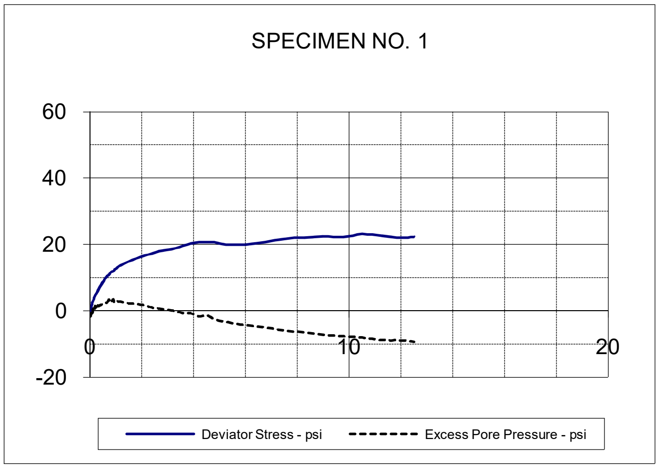
PROJECT NO: G 3242 - 095

CLIENT:

December 2009

ETTL ENGINEERS & CONSULTANTS

PLATE: B.1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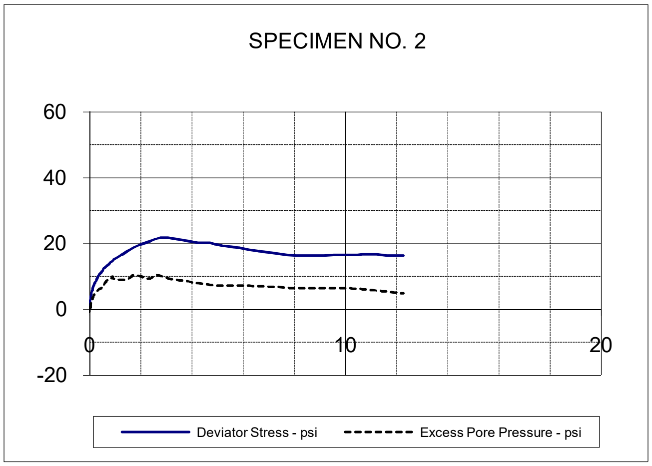
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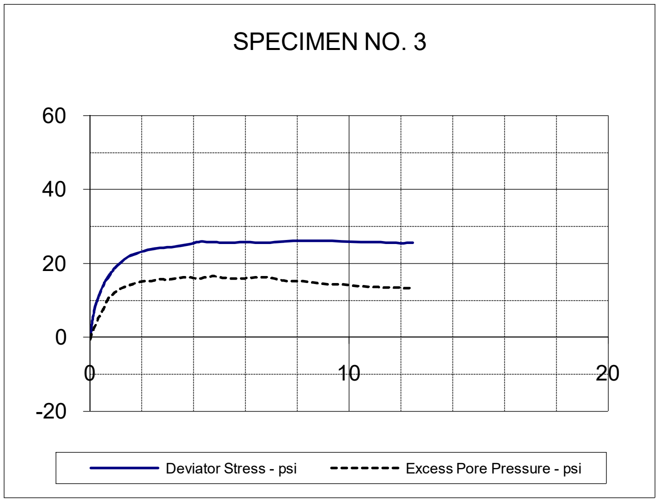
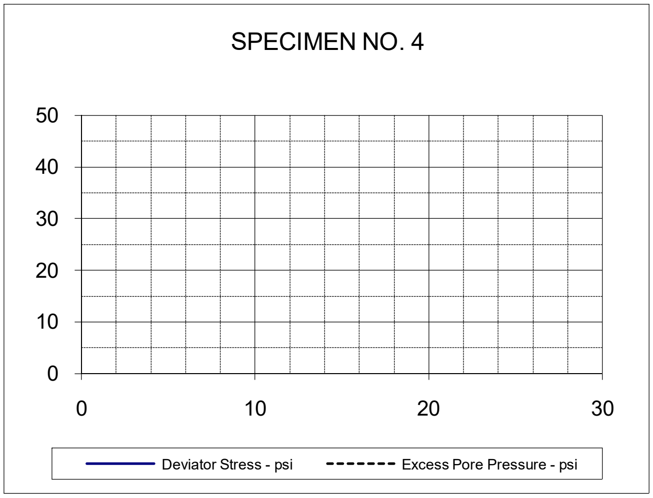

SPECIMEN NO. 3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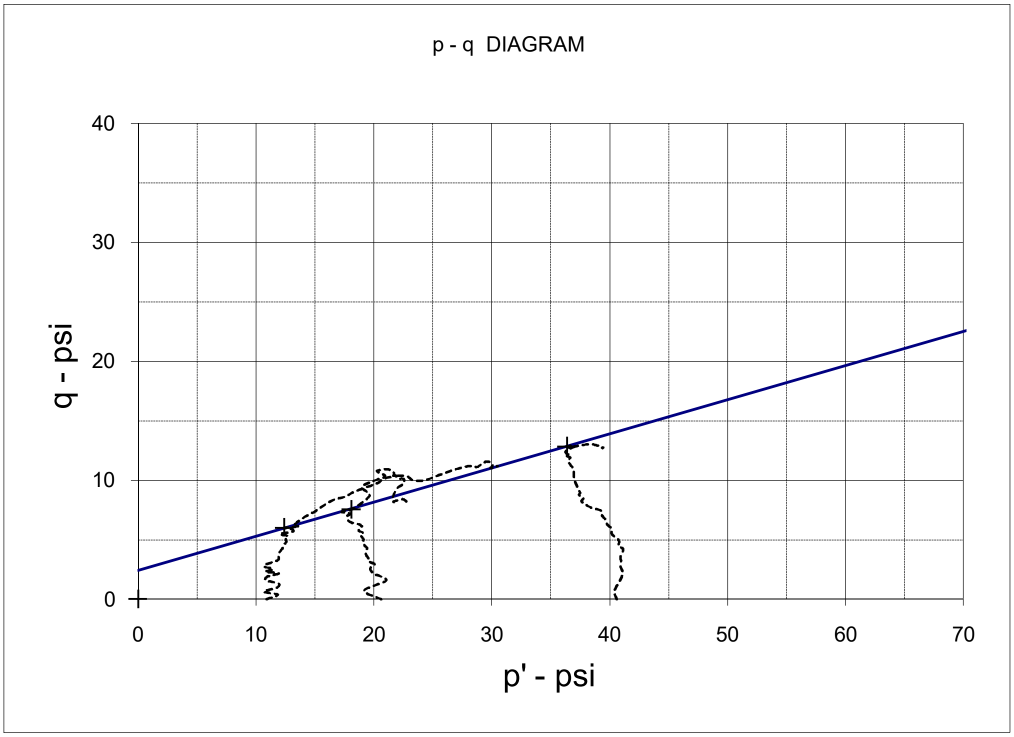
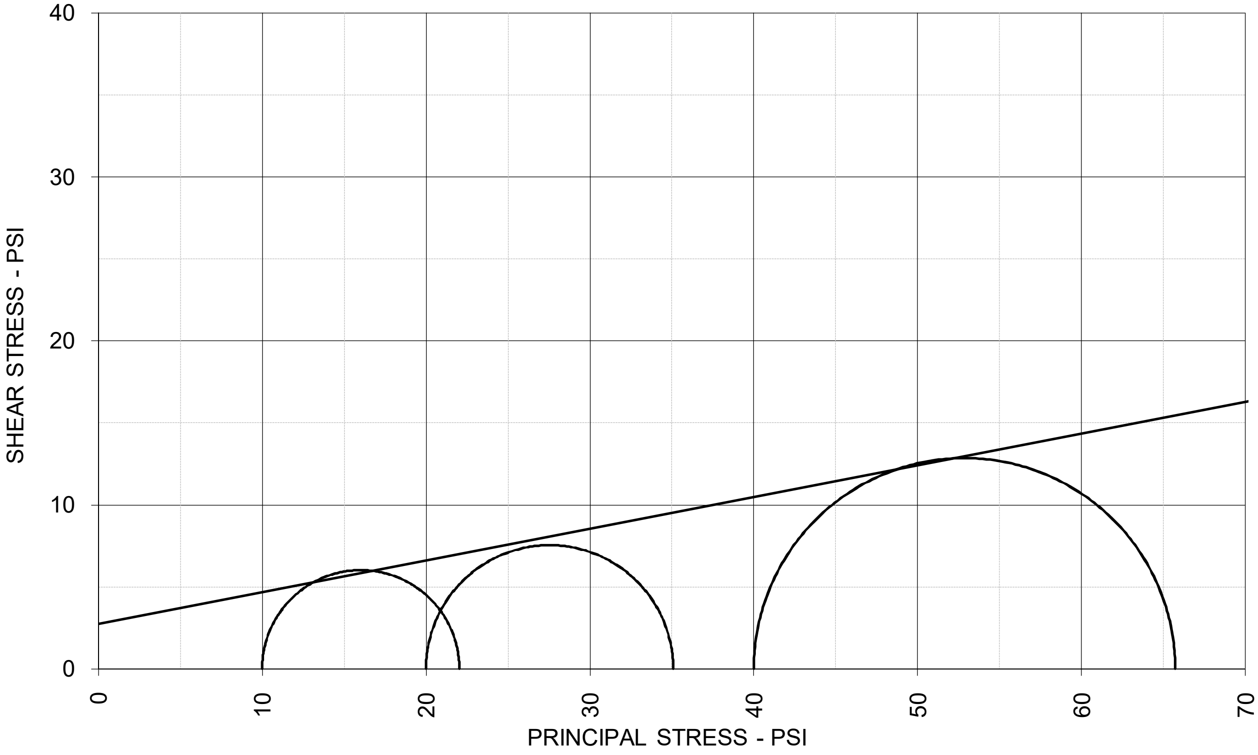

p - q DIAGRAM

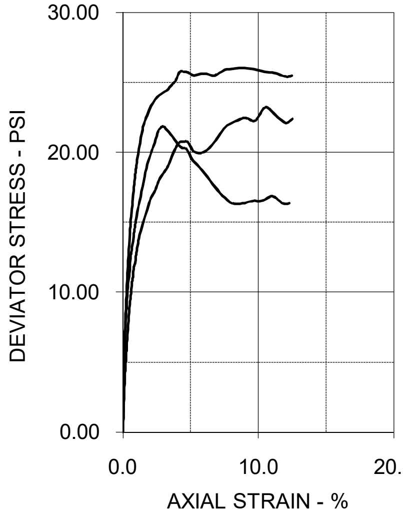
EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	α (deg) = 16.0	a (psi) = 2.4
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3242 - 095		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Tan & Gray Clay & w/ some Ferric Joints			

G 3242-095, B-1 5'-10' Welsh

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 10.9 deg	c = 2.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	23.9	24.1	26.5	
Dry Density - pcf	102.5	100.6	99.0	
Diameter - inches	2.01	2.00	2.01	
Height - inches	4.00	3.92	3.98	
AT TEST				
Final Moisture - %	25.4	24.3	25.0	
Dry Density - pcf	102.7	102.4	101.9	
Calculated Diameter (in.)	2.01	1.98	1.99	
Height - inches	4.02	3.87	3.92	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.03	15.08	25.71	
Total Pore Pressure - psi	53.6	59.4	66.5	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.9	0.9	4.8	
σ_1 Failure - psi	22.03	35.08	65.71	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Tan & Gray Clay & w/ some Ferric Joints
Sampled on Site, B-1 5' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

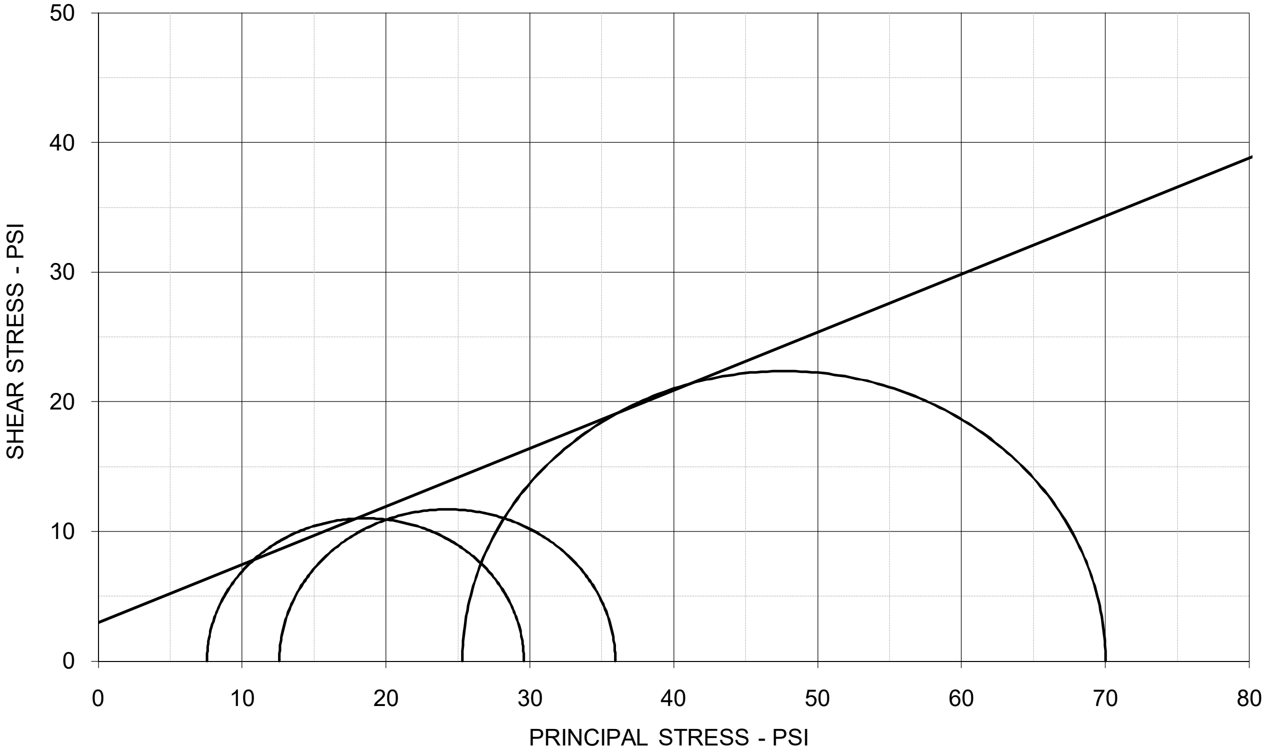
PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

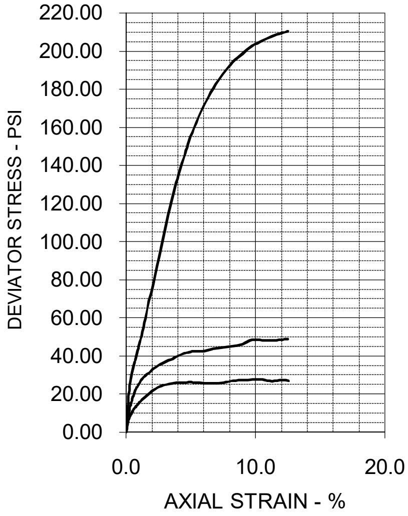
ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ ' = 24.1 deg	c' = 2.9 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	14.4	23.6	13.0	
Dry Density - pcf	114.9	100.1	122.2	
Diameter - inches	2.01	2.02	2.00	
Height - inches	4.00	4.00	4.02	
AT TEST				
Final Moisture - %	18.7	24.4	13.2	
Dry Density - pcf	115.2	101.7	123.3	
Calculated Diameter (in.)	2.00	2.01	1.99	
Height - inches	3.99	3.97	3.98	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	22.03	23.38	44.72	
Total Pore Pressure - psi	52.5	57.4	64.7	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.7	2.4	1.0	
σ_1' Failure - psi	29.58	35.95	70.02	
σ_3' Failure - psi	7.55	12.57	25.30	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Reddish Brown Sandy Lean Clay
Sampled on Site, B-2 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve
G 3242-095, B-2 8'-10' Welsh

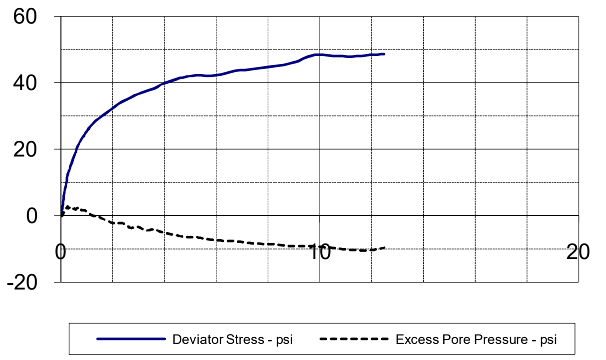
PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

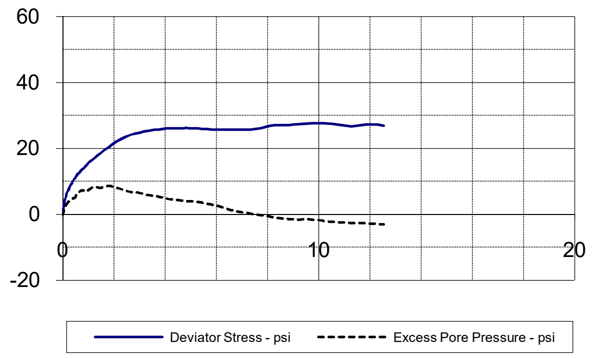
ETTL ENGINEERS & CONSULTANTS

PLATE: B.1

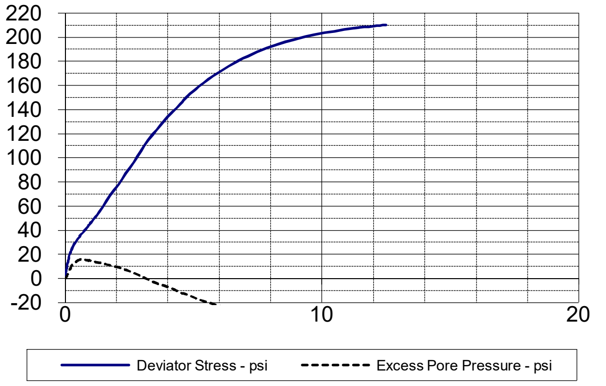
SPECIMEN NO. 1



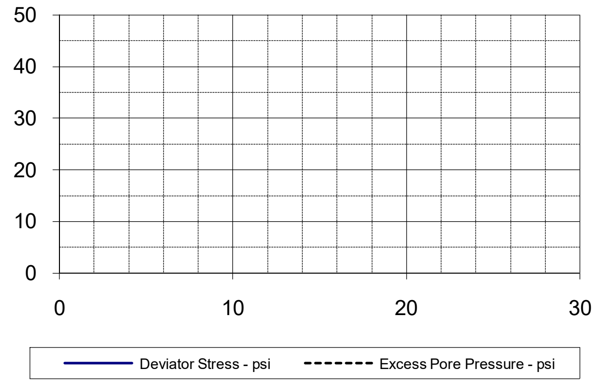
SPECIMEN NO. 2



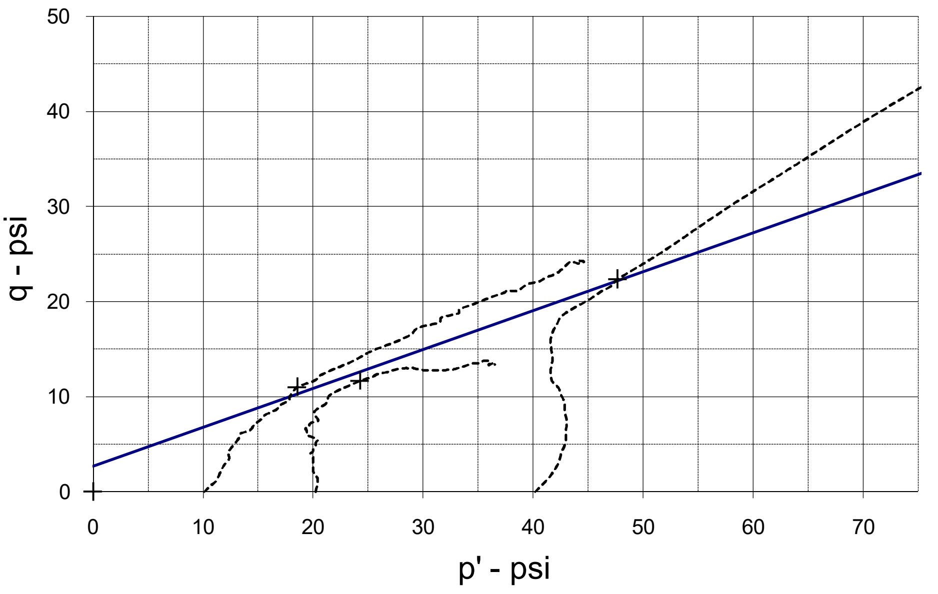
SPECIMEN NO. 3



SPECIMEN NO. 4



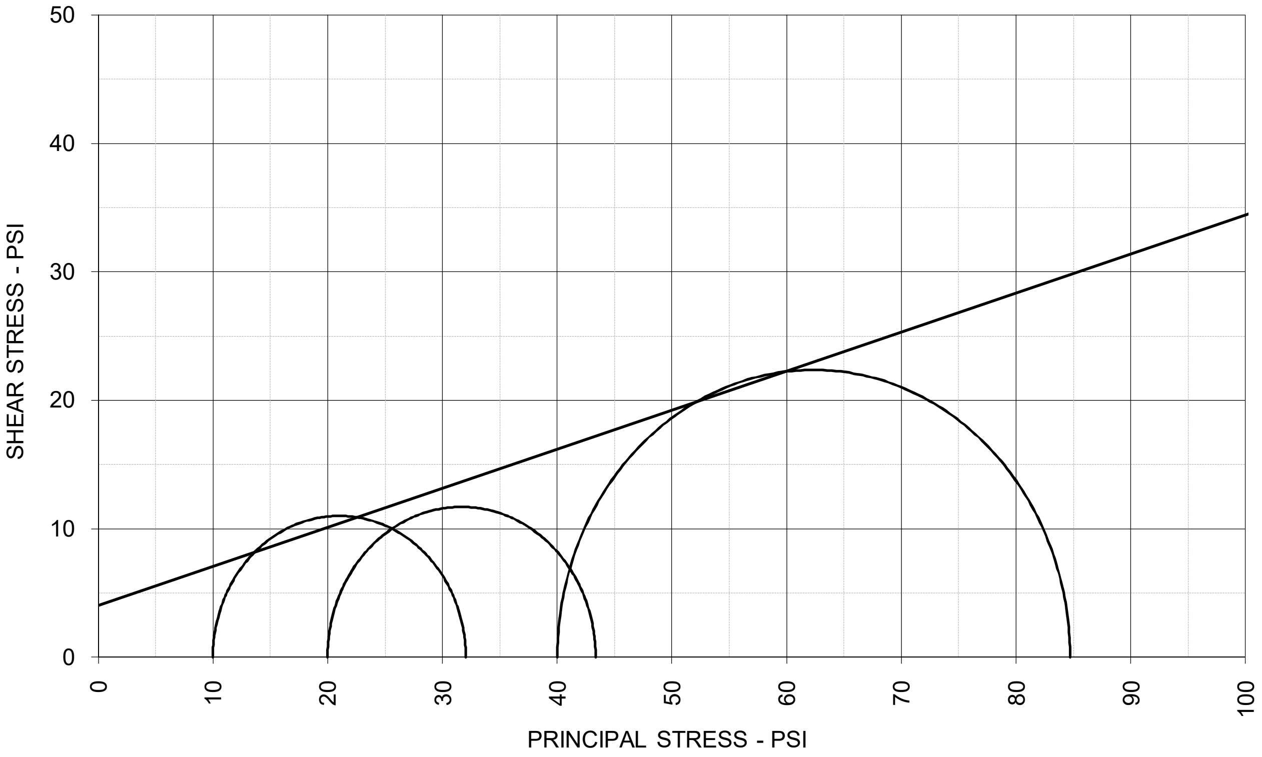
p - q DIAGRAM



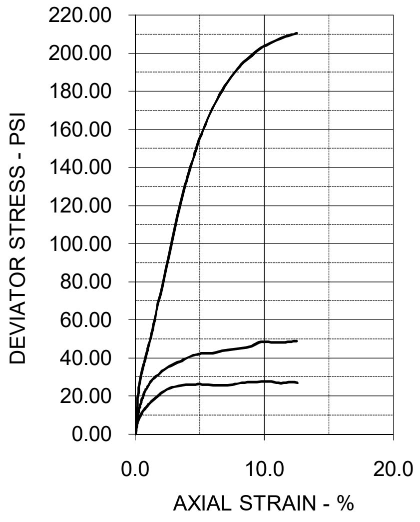
EFFECTIVE STRESS PARAMETERS	R^2 = 0.98	α (deg) = 22.3	a (psi) = 2.7
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3242 - 095		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Reddish Brown Sandy Lean Clay			

G 3242-095, B-2 8'-10' Welsh

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	φ = 16.9 deg	c = 4.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	14.4	23.6	13.0	
Dry Density - pcf	114.9	100.1	122.2	
Diameter - inches	2.01	2.02	2.00	
Height - inches	4.00	4.00	4.02	
AT TEST				
Final Moisture - %	18.7	24.4	13.2	
Dry Density - pcf	115.2	101.7	123.3	
Calculated Diameter (in.)	2.00	2.01	1.99	
Height - inches	3.99	3.97	3.98	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	22.03	23.38	44.72	
Total Pore Pressure - psi	52.5	57.4	64.7	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.7	2.4	1.0	
σ_1 Failure - psi	32.03	43.38	84.72	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP

SAMPLE TYPE: Shelby Tube Sample

DESCRIPTION: Reddish Brown Sandy Lean Clay

Sampled on Site, B-2 8' to 10' deep

ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve

LL: PL: PI: Percent -200:

REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds

LOCATION: Pittsburg, Texas

PROJECT NO: G 3242 - 095

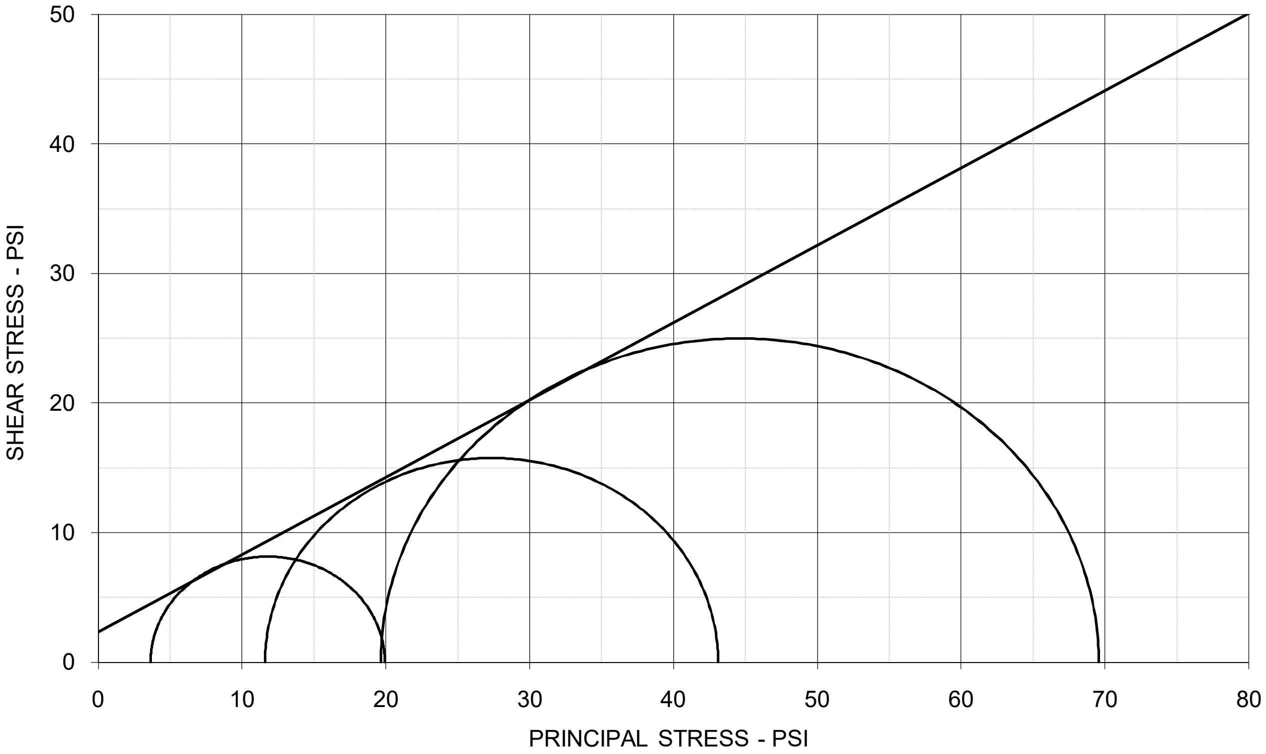
CLIENT:

December 2009

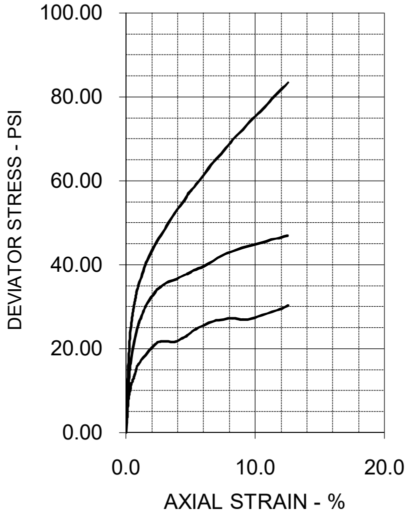
ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ ' =	30.8 deg	c' =	2.3 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	20.5	17.7	16.0	
Dry Density - pcf	106.7	111.3	117.2	
Diameter - inches	2.00	1.99	1.98	
Height - inches	3.99	3.98	4.00	
AT TEST				
Final Moisture - %	27.8	18.6	16.3	
Dry Density - pcf	106.8	112.4	118.7	
Calculated Diameter (in.)	2.00	1.99	1.97	
Height - inches	3.98	3.97	3.96	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	16.30	31.51	49.94	
Total Pore Pressure - psi	56.4	58.4	70.4	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.0	1.8	3.3	
σ_1' Failure - psi	19.94	43.12	69.59	
σ_3' Failure - psi	3.64	11.61	19.65	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Tan, Brown, Gray & Red Clayey Sand
Sampled on Site, B-2 28' to 30' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

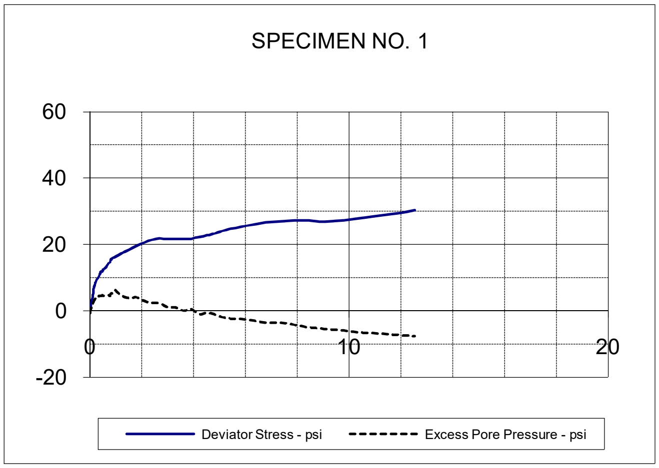
PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

ETTL ENGINEERS & CONSULTANTS

PLATE: B.1

G 3242-095, B-2 28'-30' Welsh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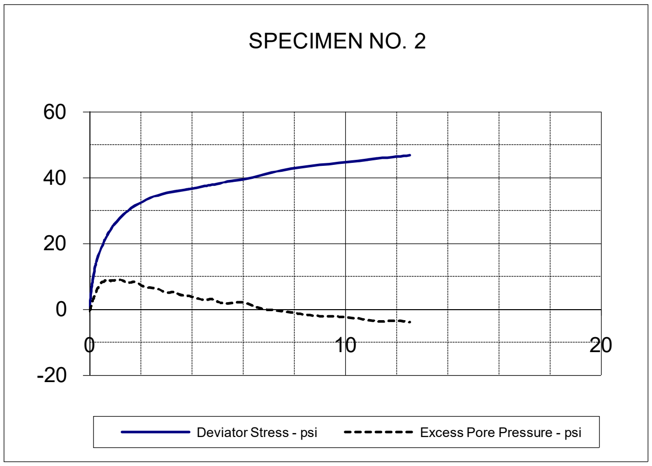
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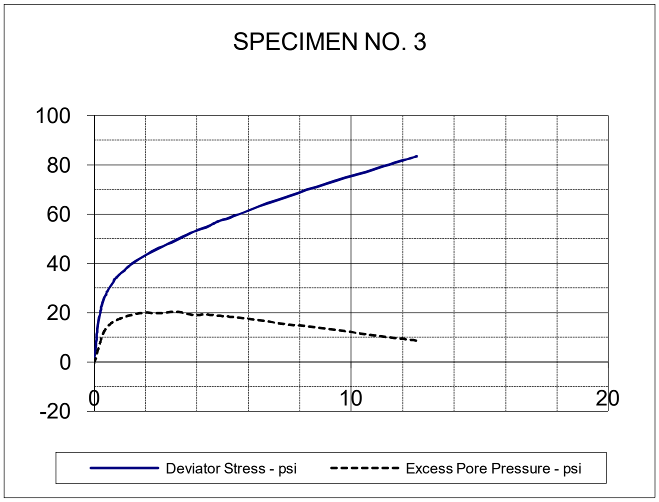
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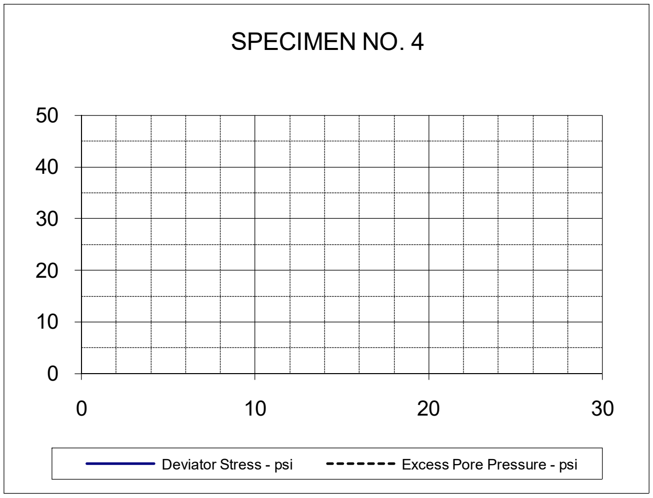
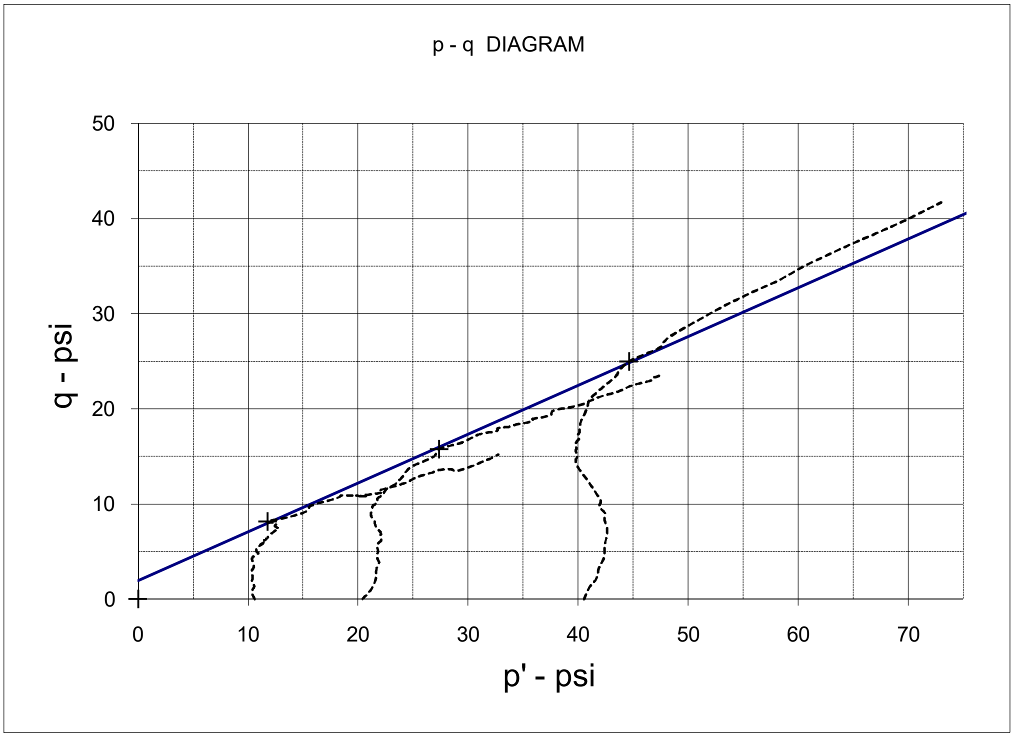

SPECIMEN NO. 4

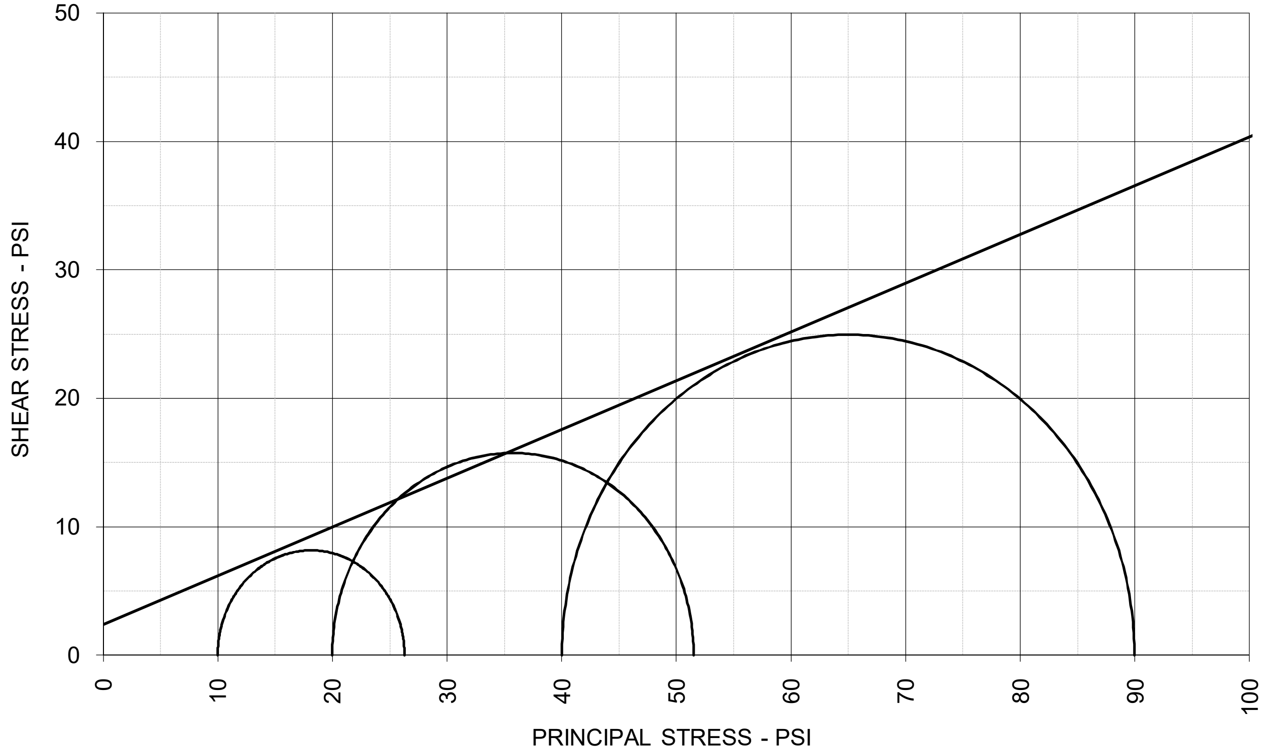

p - q DIAGRAM

EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	α (deg) = 27.1	a (psi) = 2.0

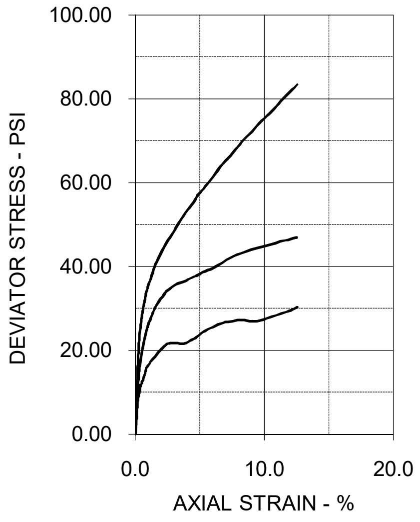
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds	TYPE OF TEST & NO: CU with PP
PROJECT NO: G 3242 - 095	**ETTL ENGINEERS & CONSULTANTS**
DESCRIPTION: Tan, Brown, Gray & Red Clayey Sand	PLATE: B.2

G 3242-095, B-2 28'-30' Welsh

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	φ = 20.8 deg	c = 2.4 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	20.5	17.7	16.0	
Dry Density - pcf	106.7	111.3	117.2	
Diameter - inches	2.00	1.99	1.98	
Height - inches	3.99	3.98	4.00	
AT TEST				
Final Moisture - %	27.8	18.6	16.3	
Dry Density - pcf	106.8	112.4	118.7	
Calculated Diameter (in.)	2.00	1.99	1.97	
Height - inches	3.98	3.97	3.96	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	16.30	31.51	49.94	
Total Pore Pressure - psi	56.4	58.4	70.4	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.0	1.8	3.3	
σ_1 Failure - psi	26.30	51.51	89.94	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Tan, Brown, Gray & Red Clayey Sand
Sampled on Site, B-2 28' to 30' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

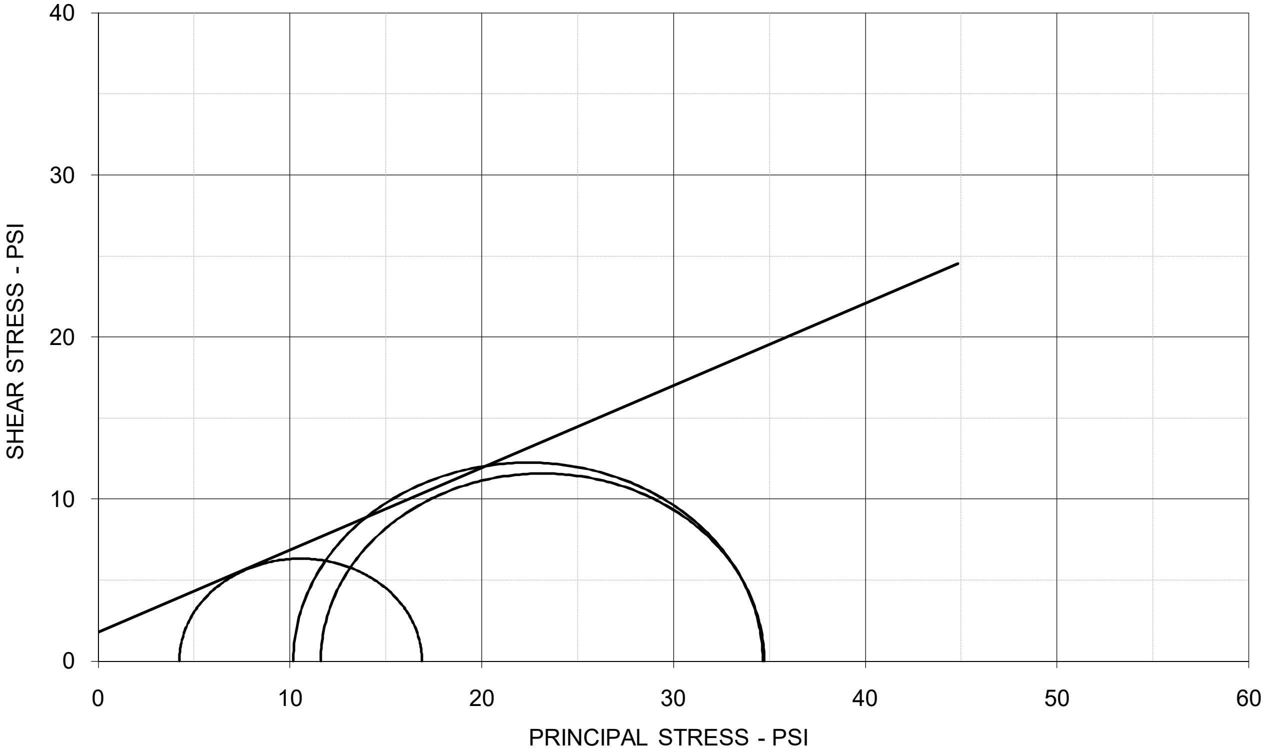
PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

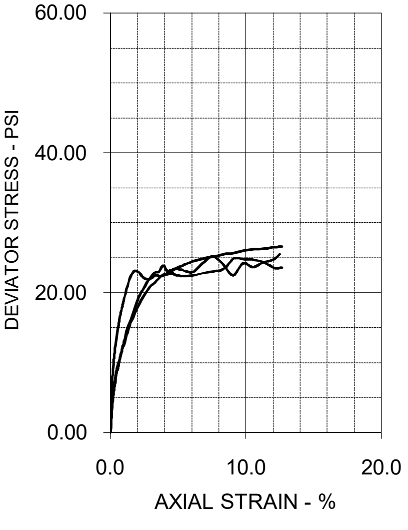
ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ ' =	26.9 deg	c' =	1.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	24.0	23.2	20.1	
Dry Density - pcf	98.6	102.2	104.5	
Diameter - inches	2.01	2.02	2.00	
Height - inches	3.97	4.01	4.01	
AT TEST				
Final Moisture - %	26.5	24.8	24.2	
Dry Density - pcf	99.5	103.0	105.7	
Calculated Diameter (in.)	2.01	2.02	2.00	
Height - inches	3.99	4.01	4.03	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.64	23.13	24.50	
Total Pore Pressure - psi	55.7	58.4	79.8	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.0	1.8	6.1	
σ_1' Failure - psi	16.87	34.74	34.66	
σ_3' Failure - psi	4.23	11.61	10.16	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Gray, Brown & Tan Fat Clay w/ Ferric Seams
Sampled on Site, B-5 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

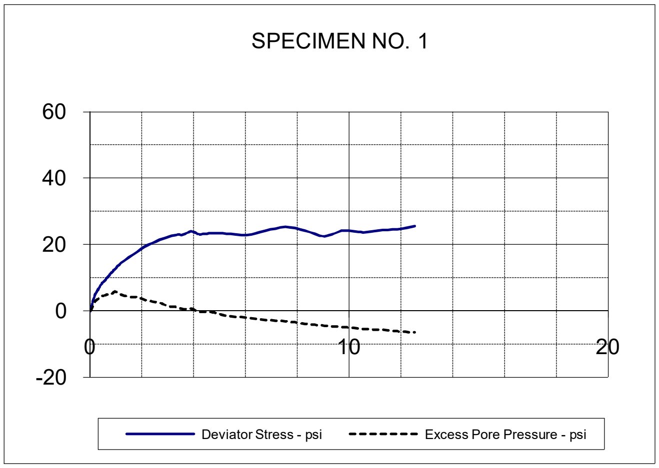
PROJECT INFORMATION

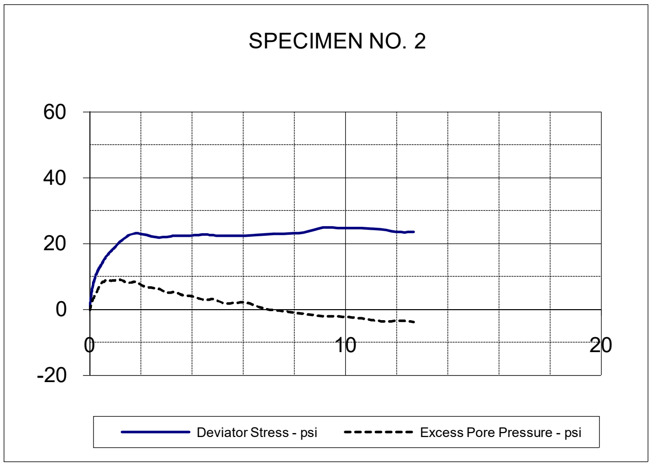
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

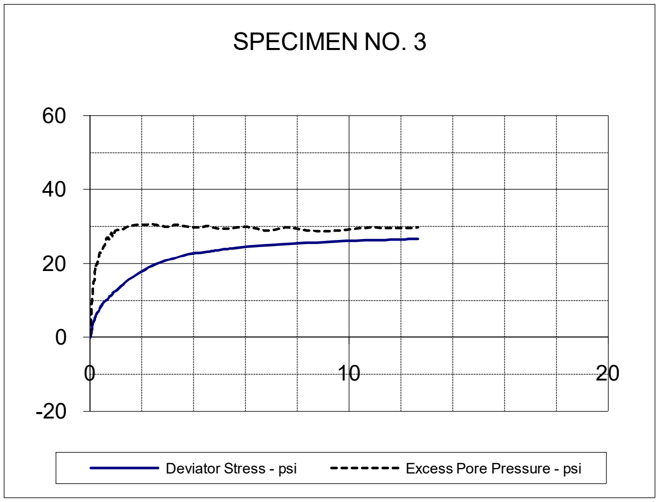
ETTL ENGINEERS & CONSULTANTS

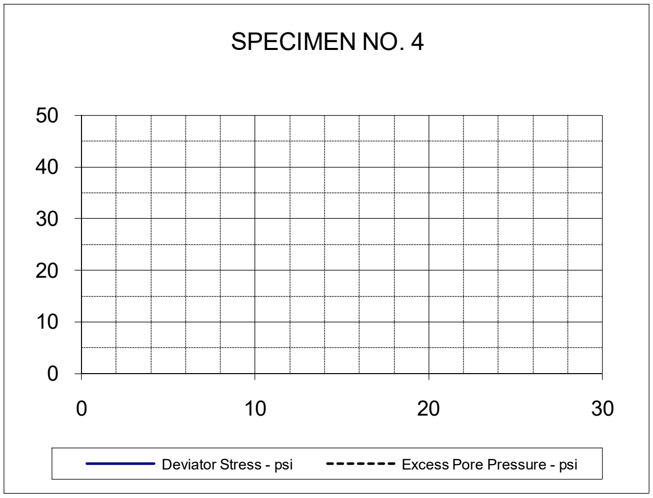
PLATE: B.1

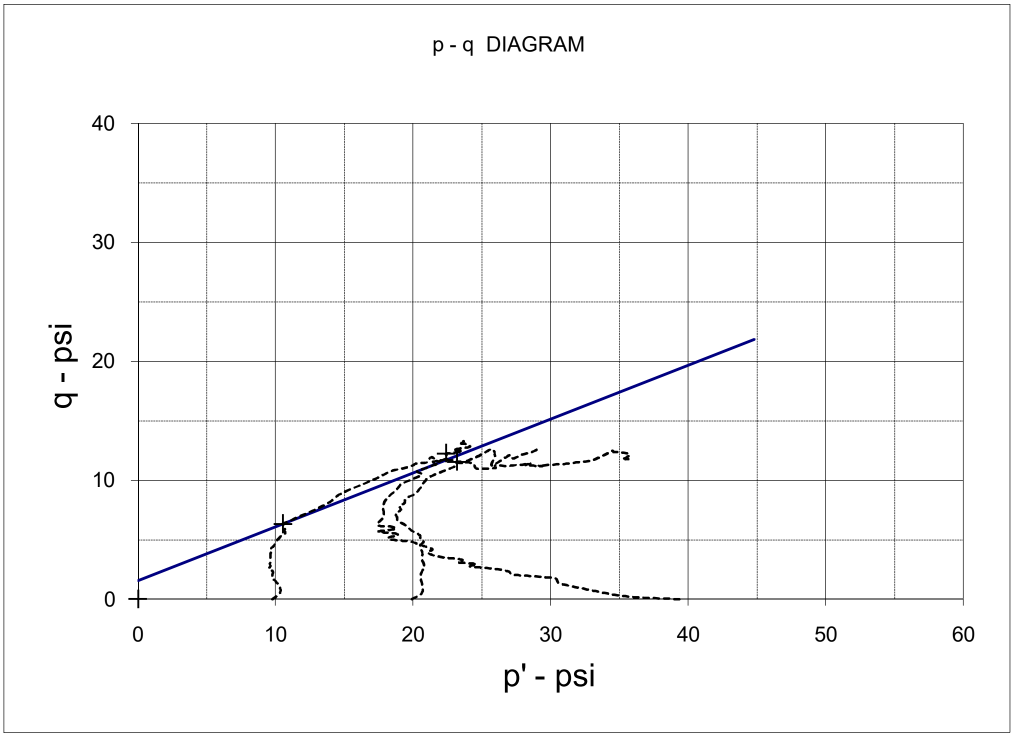
G 3242-095, B-5 8'-10' Welsh







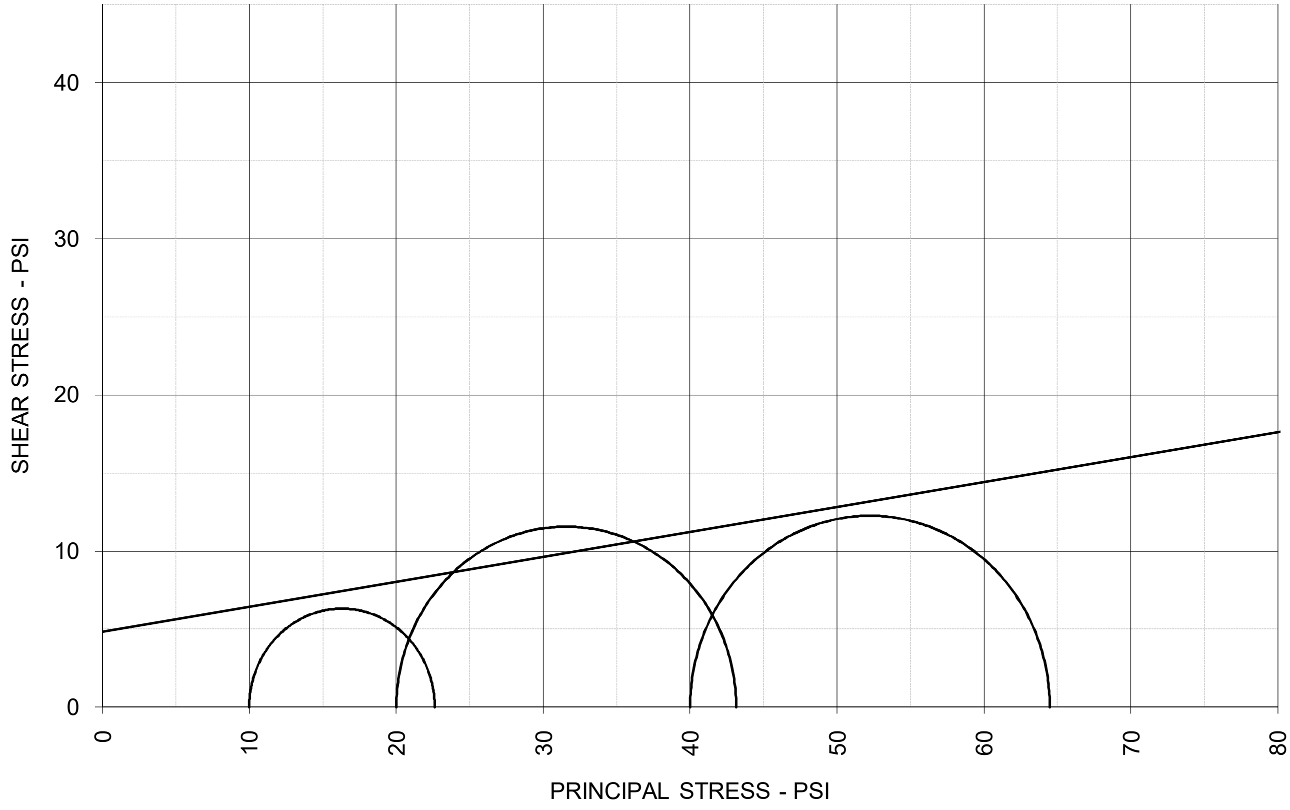




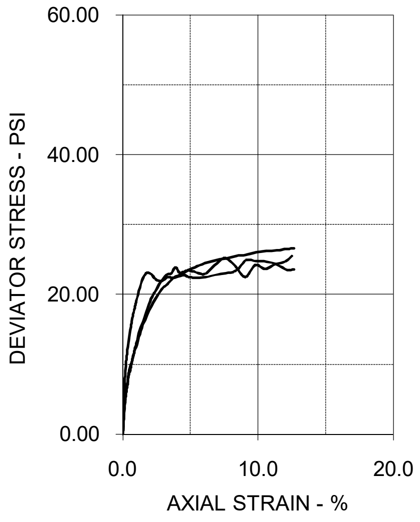
EFFECTIVE STRESS PARAMETERS	R^2 = 0.97	α (deg) = 24.3	a (psi) = 1.6
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3242 - 095		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Gray, Brown & Tan Fat Clay w/ Ferric Seams			

G 3242-095, B-5 8'-10' Welsh

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	φ = 9.1 deg	c = 4.9 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	24.0	23.2	20.1	
Dry Density - pcf	98.6	102.2	104.5	
Diameter - inches	2.01	2.02	2.00	
Height - inches	3.97	4.01	4.01	
AT TEST				
Final Moisture - %	26.5	24.8	24.2	
Dry Density - pcf	99.5	103.0	105.7	
Calculated Diameter (in.)	2.01	2.02	2.00	
Height - inches	3.99	4.01	4.03	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.64	23.13	24.50	
Total Pore Pressure - psi	55.7	58.4	79.8	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.0	1.8	6.1	
σ_1 Failure - psi	22.64	43.13	64.50	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Gray, Brown & Tan Fat Clay w/ Ferric Seams
Sampled on Site, B-5 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

ETTL ENGINEERS & CONSULTANTS PLATE: B.3

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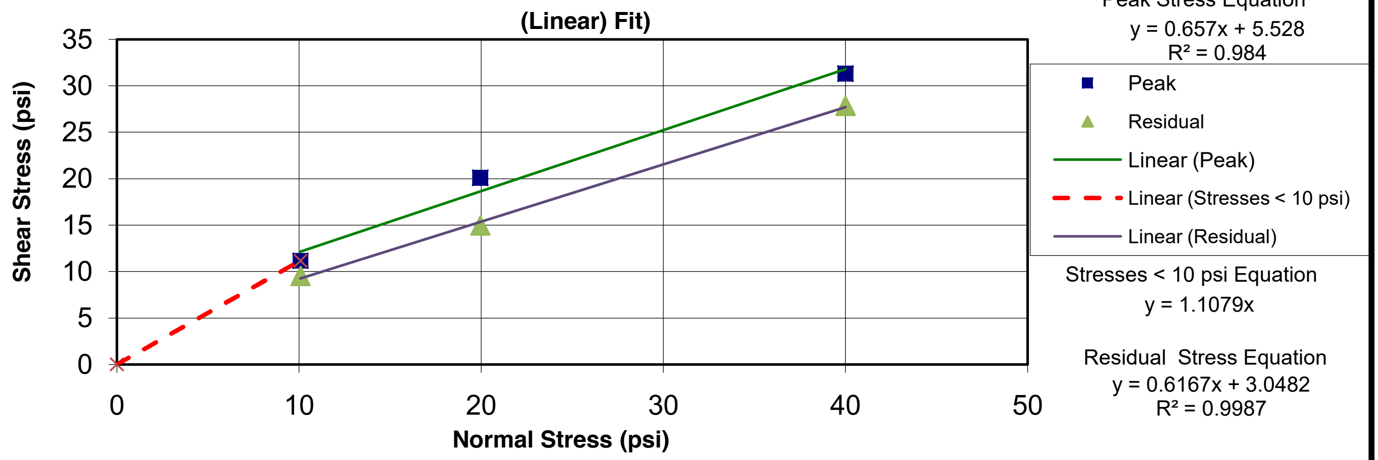
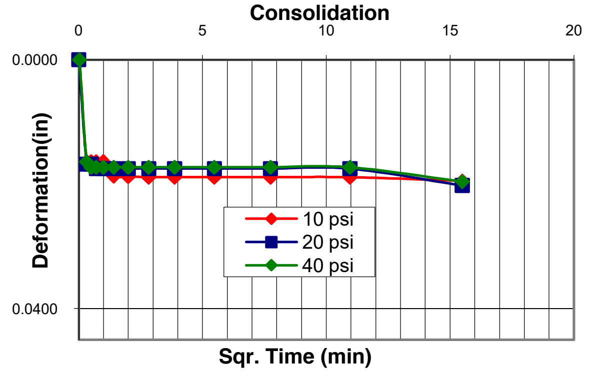
ASTM 3080 Direct Shear Test Report

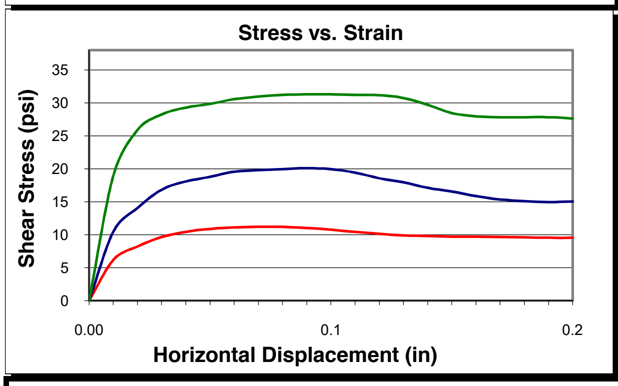


Peak Stress Equation
y = 0.657x + 5.528
R² = 0.984

Stresses < 10 psi Equation
y = 1.1079x

Residual Stress Equation
y = 0.6167x + 3.0482
R² = 0.9987





Peak Strength Parameters

	Peak		Residual	
Friction Angle	33.3 (deg)		31.63 (deg)	
Cohesion	5.53 (psi)	796.0 (psf)	3.05 (psi)	438.9 (psf)
Friction Angle Stresses < 10psi			47.91	(deg)
Specimen Number		1	2	3
Initial				
Moisture Content - %		22.5%	23.5%	23.2%
Dry Density- lb/ft^3		103.8	100.3	101.8
Height-inches		1.008	1.008	1.008
Diameter- inches		2.50	2.50	2.50
Final				
Moisture Content - %		23.1%	25.4%	23.5%
Dry Density- lb/ft^3		103.8	100.9	102.0
Height after shear-(inches)		1.009	1.006	1.006
Height after consolidation (inches)		0.989	0.988	0.988
Normal Stress-(psi)		10	20	40
Peak Failure Stress-(psi)		11.17	20.09	31.31
Residual Failure Stress-(psi)		9.52	14.96	27.84
Strain Rate - (inches/min)		0.0033	0.0033	0.0033

Project Information

Project :	Welsh power Plant Embankments	LL	PL	PI
Client:	AEP	-	-	NP
Material Origin:	, TX			
Material Description:	Dark Red Silty Sand	-200%	18	

Job No:	G 3241-095	**Technician:**	Owen Sanderson	**Remarks**
Boring No:	B-6	**Sample Type:**	Shelby Tube	When Calculating stresses < 10 psi: use appropriate Equation above (assuming no Cohesion)
Depth:	28'-31'	**Sampling method:**	Shelby Tube	
Date:	November 24, 2009	**Testing Device:**	Soiltest B-124BY 2.5 in. round	

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas
Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084
Project No. : G 3242-095 Permometer Data

Boring No.:	B-2	a_p =	0.031416 cm^2			**Set Mercury to Pipet Rp at beginning**	Equilibrium	1.7	cm^3
Sample:		a_a =	0.767120 cm^2				Pipet **Rp**	**6.7**	cm^3
Depth (ft):	13'-15'	M_1 =	0.030180	C =	0.000444308		Annulus **Ra**	1.5	cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671				

Material Description : Red & Tan Sandy Lean Clay

SAMPLE DATA

Wet Wt. sample + ring or tare :			602.32	g
Tare or ring Wt. :			0.0	g
Wet Wt: of Sample :			602.32	g
Diameter :	2.73	in	6.94	cm^2
Length :	2.76	in	7.02	cm
Area:	5.87	in^2	37.85	cm^2
Volume :	16.21	in^3	265.71	cm^3
Unit Wt.(wet):	**141.45**	pcf	**2.27**	g/cm^3
Unit Wt.(dry):	**125.06**	pcf	**2.00**	g/cm^3

	Before Test		After Test
Tare No.:	T-16	Tare No.:	T-1
Wet Wt.+tare:	292.51	Wet Wt.+tare:	746.56
Dry Wt.+tare:	276.22	Dry Wt.+tare:	683.49
Tare Wt:	151.95	Tare Wt:	217.27
Dry Wt.:	124.27	Dry Wt.:	466.22
Water Wt.:	16.29	Water Wt.:	63.07
% moist.:	**13.1**	% moist.:	**13.5**

Assumed Specific Gravity: **2.65** Max Dry Density(pcf) = 125.1105 OMC = 13.108554
% of max = 100.0 +/- OMC = 0.00
Calculated % saturation: 111.02 Void ratio (e) = **0.32** Porosity (n)= **0.24**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.26

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	1680	6	0.6588251	23.5	0.920	3.47E-08	9.84E-05	
12/28/2009	2280	5.9	0.7588251	23.5	0.920	2.98E-08	8.44E-05	
12/28/2009	3180	5.7	0.9588251	23.5	0.920	2.76E-08	7.83E-05	
12/28/2009	4140	5.55	1.1088251	23.5	0.920	2.50E-08	7.09E-05	

SUMMARY

ka = 2.93E-08 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	3.47E-08	cm/sec	18.5	%
k2 =	2.98E-08	cm/sec	1.7	%
k3 =	2.76E-08	cm/sec	5.6	%
k4 =	2.50E-08	cm/sec	14.6	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**2.93E-08**	cm/sec	**8.30E-05**	ft/day
Void Ratio	e =	**0.32**			
Porosity	n =	**0.24**			
Bulk Density	γ =	**2.27**	g/cm^3	**141.5**	pcf
Water Content	W =	**0.26**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**3.00E-13**	cm^2	(at 20 deg C)	

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas
Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084
Project No. : G 3242-095

Permometer Data

Boring No.:	B-2	a_p =	0.031416 cm^2			**Set Mercury to Pipet Rp at beginning**	Equilibrium	1.7	cm^3
Sample:		a_a =	0.767120 cm^2				Pipet **Rp**	**6.7**	cm^3
Depth (ft):	33'-35'	M_1 =	0.030180	C =	0.000433922		Annulus **Ra**	1.5	cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671				

Material Description : Red & Tan Clayey Sand

SAMPLE DATA

Wet Wt. sample + ring or tare :			553.04	g
Tare or ring Wt. :			0.0	g
Wet Wt: of Sample :			553.04	g
Diameter :	2.76	in	7.01	cm^2
Length :	2.75	in	6.98	cm
Area:	5.97	in^2	38.54	cm^2
Volume :	16.42	in^3	269.13	cm^3
Unit Wt.(wet):	**128.23**	pcf	**2.05**	g/cm^3
Unit Wt.(dry):	**107.70**	pcf	**1.73**	g/cm^3

	Before Test		After Test
Tare No.:	T-21	Tare No.:	T-13
Wet Wt.+tare:	553.04	Wet Wt.+tare:	784.01
Dry Wt.+tare:	464.50	Dry Wt.+tare:	684.19
Tare Wt:	0.00	Tare Wt:	219.69
Dry Wt.:	464.5	Dry Wt.:	464.5
Water Wt.:	88.54	Water Wt.:	99.82
% moist.:	**19.1**	% moist.:	**21.5**

Assumed Specific Gravity: **2.73** Max Dry Density(pcf) = 107.7462 OMC = 19.0613563
% of max = 100.0 +/- OMC = 0.00
Calculated % saturation: 100.72 Void ratio (e) = **0.58** Porosity (n)= **0.37**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.31

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	1580	5.4	1.2588251	23.5	0.920	7.40E-08	2.10E-04	
12/28/2009	2310	5	1.6588251	23.5	0.920	7.04E-08	2.00E-04	
12/28/2009	2535	4.9	1.7588251	23.5	0.920	6.90E-08	1.96E-04	
12/28/2009	2775	4.8	1.8588251	23.5	0.920	6.76E-08	1.92E-04	

SUMMARY

ka = 7.03E-08 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	7.40E-08	cm/sec	5.3	%
k2 =	7.04E-08	cm/sec	0.2	%
k3 =	6.90E-08	cm/sec	1.8	%
k4 =	6.76E-08	cm/sec	3.8	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**7.03E-08**	cm/sec	**1.99E-04**	ft/day
Void Ratio	e =	**0.58**			
Porosity	n =	**0.37**			
Bulk Density	γ =	**2.05**	g/cm^3	**128.2**	pcf
Water Content	W =	**0.33**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**7.20E-13**	cm^2	(at 20 deg C)	

Robert Duke, P.E.

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas
Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084
Project No. : G 3242-095

Permometer Data

Boring No.:	B-3	a_p =	0.031416 cm^2			Set Mercury to Pipet Rp at beginning	Equilibrium	1.7 cm^3
Sample:		a_a =	0.767120 cm^2				Pipet **Rp**	**6.7** cm^3
Depth (ft):	8'-10'	M_1 =	0.030180	C =	0.000431052		Annulus **Ra**	1.5 cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671			

Material Description : Red & Tan Fat Clay

SAMPLE DATA

Wet Wt. sample + ring or tare :			559.11	g				
Tare or ring Wt. :			0.0	g		Before Test		After Test
Wet Wt: of Sample :			559.11	g	Tare No.:	T-23	Tare No.:	T-3
Diameter :	2.75	in	6.99	cm^2	Wet Wt.+tare:	166.09	Wet Wt.+tare:	783.53
Length :	2.72	in	6.90	cm	Dry Wt.+tare:	162.69	Dry Wt.+tare:	700.67
Area:	5.94	in^2	38.32	cm^2	Tare Wt:	140.30	Tare Wt:	220.71
Volume :	16.13	in^3	264.26	cm^3	Dry Wt.:	22.39	Dry Wt.:	479.96
Unit Wt.(wet):	**132.02**	pcf	**2.12**	g/cm^3	Water Wt.:	3.4	Water Wt.:	82.86
Unit Wt.(dry):	**114.62**	pcf	**1.84**	g/cm^3	% moist.:	**15.2**	% moist.:	**17.3**

Assumed Specific Gravity: **2.68** Max Dry Density(pcf) = 114.6685 OMC = 15.1853506
% of max = 100.0 +/- OMC = 0.00
Calculated % saturation: 100.64 Void ratio (e) = **0.46** Porosity (n)= **0.31**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.43

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	1476	5.4	1.258825	23.5	0.920	7.87E-08	2.23E-04	
12/28/2009	2205	5	1.658825	23.5	0.920	7.33E-08	2.08E-04	
12/28/2009	2370	4.9	1.758825	23.5	0.920	7.33E-08	2.08E-04	
12/28/2009	2580	4.8	1.858825	23.5	0.920	7.22E-08	2.05E-04	

SUMMARY

ka = 7.44E-08 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	7.87E-08	cm/sec	5.8	%
k2 =	7.33E-08	cm/sec	1.5	%
k3 =	7.33E-08	cm/sec	1.4	%
k4 =	7.22E-08	cm/sec	2.9	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**7.44E-08**	cm/sec	**2.11E-04**	ft/day
Void Ratio	e =	**0.46**			
Porosity	n =	**0.31**			
Bulk Density	γ =	**2.12**	g/cm^3	**132.0**	pcf
Water Content	W =	**0.28**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**7.62E-13**	cm^2	(at 20 deg C)	

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas

Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084

Project No. : G 3242-095

Permometer Data

Boring No.:	B-4	a_p =	0.031416 cm^2		**Set Mercury to Pipet Rp at beginning**	Equilibrium	1.7 cm^3
Sample:		a_a =	0.767120 cm^2			Pipet **Rp**	**6.7** cm^3
Depth (ft):	8'-10'	M_1 =	0.030180	C =	0.000429664	Annulus **Ra**	1.5 cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671		

Material Description : Dark Brown Sandy Lean Clay

SAMPLE DATA

Wet Wt. sample + ring or tare : 531.96 g

Tare or ring Wt. : 0.0 g

Wet Wt: of Sample : 531.96 g

						Before Test		After Test
					Tare No.:	T-24	Tare No.:	T-6
Diameter :	2.76	in	7.01	cm^2	Wet Wt.+tare:	230.01	Wet Wt.+tare:	759.40
Length :	2.72	in	6.92	cm	Dry Wt.+tare:	207.52	Dry Wt.+tare:	648.84
Area:	5.98	in^2	38.57	cm^2	Tare Wt:	112.35	Tare Wt:	217.34
Volume :	16.29	in^3	266.87	cm^3	Dry Wt.:	95.17	Dry Wt.:	431.5
Unit Wt.(wet):	**124.38**	pcf	**1.99**	g/cm^3	Water Wt.:	22.49	Water Wt.:	110.56
Unit Wt.(dry):	**100.61**	pcf	**1.61**	g/cm^3	% moist.:	**23.6**	% moist.:	**25.6**

Assumed Specific Gravity: **2.72** Max Dry Density(pcf) = 100.6512 OMC = 23.6313964

% of max = 100.0 +/- OMC = 0.00

Calculated % saturation: 101.32 Void ratio (e) = **0.69** Porosity (n)= **0.41**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.40

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	2280	6.1	0.558825	23.5	0.920	2.07E-08	5.88E-05	
12/28/2009	2940	6	0.658825	23.5	0.920	1.92E-08	5.44E-05	
12/28/2009	3660	5.9	0.758825	23.5	0.920	1.79E-08	5.09E-05	
12/28/2009	4200	5.84	0.818825	23.5	0.920	1.70E-08	4.82E-05	

SUMMARY

ka = 1.87E-08 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	2.07E-08	cm/sec	10.8	%
k2 =	1.92E-08	cm/sec	2.5	%
k3 =	1.79E-08	cm/sec	4.1	%
k4 =	1.70E-08	cm/sec	9.2	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**1.87E-08**	cm/sec	**5.30E-05**	ft/day
Void Ratio	e =	**0.69**			
Porosity	n =	**0.41**			
Bulk Density	γ =	**1.99**	g/cm^3	**124.4**	pcf
Water Content	W =	**0.38**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**1.92E-13**	cm^2	(at 20 deg C)	

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas
Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084
Project No. : G 3242-095 Permometer Data

Boring No.:	B-5	a_p =	0.031416 cm^2		Set Mercury to Pipet Rp at beginning	Equilibrium	1.7	cm^3
Sample:		a_a =	0.767120 cm^2			Pipet **Rp**	**6.7**	cm^3
Depth (ft):	23'-25'	M_1 =	0.030180	C =	0.00043565	Annulus **Ra**	1.5	cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671			

Material Description : Orangish Tan Fat Clay

SAMPLE DATA

Wet Wt. sample + ring or tare : 532.37 g
Tare or ring Wt. : 0.0 g
Wet Wt: of Sample : 532.37 g

Diameter :	2.74 in	6.97	cm^2
Length :	2.73 in	6.94	cm
Area:	5.91 in^2	38.15	cm^2
Volume :	16.16 in^3	264.75	cm^3
Unit Wt.(wet):	**125.48** pcf	**2.01**	g/cm^3
Unit Wt.(dry):	**103.94** pcf	**1.67**	g/cm^3

Before Test		After Test	
Tare No.:	T-25	Tare No.:	T-9
Wet Wt.+tare:	532.37	Wet Wt.+tare:	765.78
Dry Wt.+tare:	441.00	Dry Wt.+tare:	661.51
Tare Wt:	0.00	Tare Wt:	220.51
Dry Wt.:	441	Dry Wt.:	441
Water Wt.:	91.37	Water Wt.:	104.27
% moist.:	**20.7**	% moist.:	**23.6**

Assumed Specific Gravity: **2.72** Max Dry Density(pcf) = 103.9846 OMC = 20.7188209
% of max = 100.0 +/- OMC = 0.00
Calculated % saturation: 101.48 Void ratio (e) = **0.63** Porosity (n)= **0.39**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.37

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	212	5.5	1.158825	23.5	0.920	5.03E-07	1.43E-03	
12/28/2009	237	5.4	1.258825	23.5	0.920	4.95E-07	1.40E-03	
12/28/2009	259	5.3	1.358825	23.5	0.920	4.96E-07	1.41E-03	
12/28/2009	289	5.2	1.458825	23.5	0.920	4.83E-07	1.37E-03	

SUMMARY

ka = 4.95E-07 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	5.03E-07	cm/sec	1.8	%
k2 =	4.95E-07	cm/sec	0.2	%
k3 =	4.96E-07	cm/sec	0.3	%
k4 =	4.83E-07	cm/sec	2.2	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**4.95E-07**	cm/sec	**1.40E-03**	ft/day
Void Ratio	e =	**0.63**			
Porosity	n =	**0.39**			
Bulk Density	γ =	**2.01**	g/cm^3	**125.5**	pcf
Water Content	W =	**0.35**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**5.07E-12**	cm^2	(at 20 deg C)	

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas
Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084
Project No. : G 3242-095

Permometer Data

Boring No.:	B-6	a_p =	0.031416 cm^2			Set Mercury to Pipet Rp at beginning	Equilibrium	1.7 cm^3
Sample:		a_a =	0.767120 cm^2				Pipet **Rp**	**6.7** cm^3
Depth (ft):	28'-30'	M_1 =	0.030180	C =	0.000408156		Annulus **Ra**	1.5 cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671			

Material Description : Gray Silty Sand

SAMPLE DATA

Wet Wt. sample + ring or tare :			457.40	g					
Tare or ring Wt. :			0.0	g		Before Test		After Test	
Wet Wt: of Sample :			457.40	g	Tare No.:	T-5	Tare No.:	T-10
Diameter :	2.69	in	6.83	cm^2	Wet Wt.+tare:	355.86	Wet Wt.+tare:	661.49
Length :	2.46	in	6.24	cm	Dry Wt.+tare:	328.36	Dry Wt.+tare:	581.76
Area:	5.68	in^2	36.64	cm^2	Tare Wt:	218.80	Tare Wt:	221.13
Volume :	13.96	in^3	228.75	cm^3	Dry Wt.:	109.56	Dry Wt.:	360.63
Unit Wt.(wet):	**124.77**	pcf	**2.00**	g/cm^3	Water Wt.:	27.5	Water Wt.:	79.73
Unit Wt.(dry):	**99.74**	pcf	**1.60**	g/cm^3	% moist.:	**25.1**	% moist.:	**22.1**

Assumed Specific Gravity: **2.55** Max Dry Density(pcf) = 99.78226 OMC = 25.1004016
% of max = 100.0 +/- OMC = 0.00
Calculated % saturation: 94.57 Void ratio (e) = **0.60** Porosity (n)= **0.37**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 10.42

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	7	4	2.658825	23.5	0.920	4.12E-05	1.17E-01	
12/28/2009	9	3.5	3.158825	23.5	0.920	4.23E-05	1.20E-01	
12/28/2009	11	3	3.658825	23.5	0.920	4.57E-05	1.30E-01	
12/28/2009	16	2.5	4.158825	23.5	0.920	4.28E-05	1.21E-01	

SUMMARY

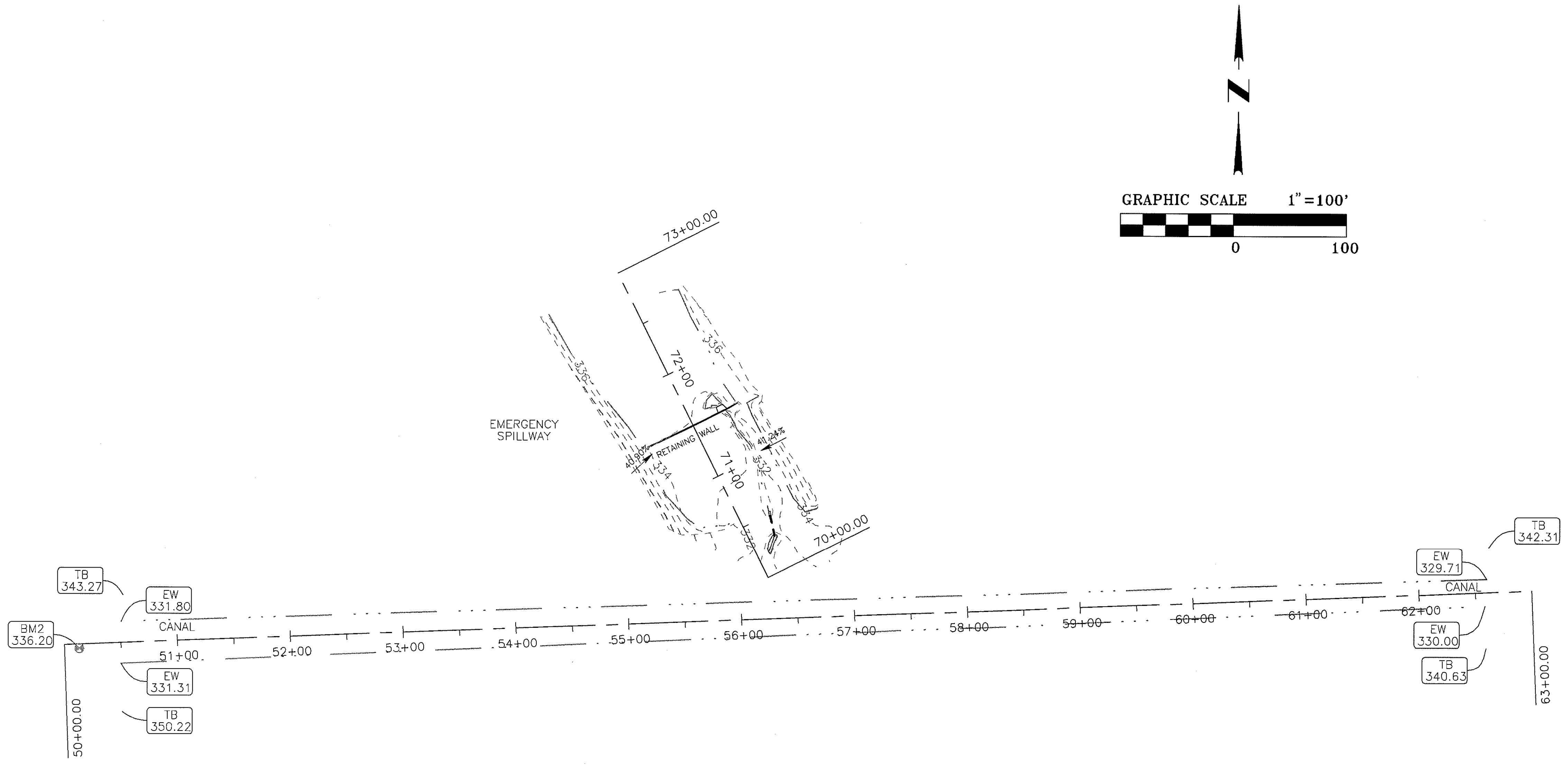
ka = 4.30E-05 cm/sec Acceptance criteria = 25 %

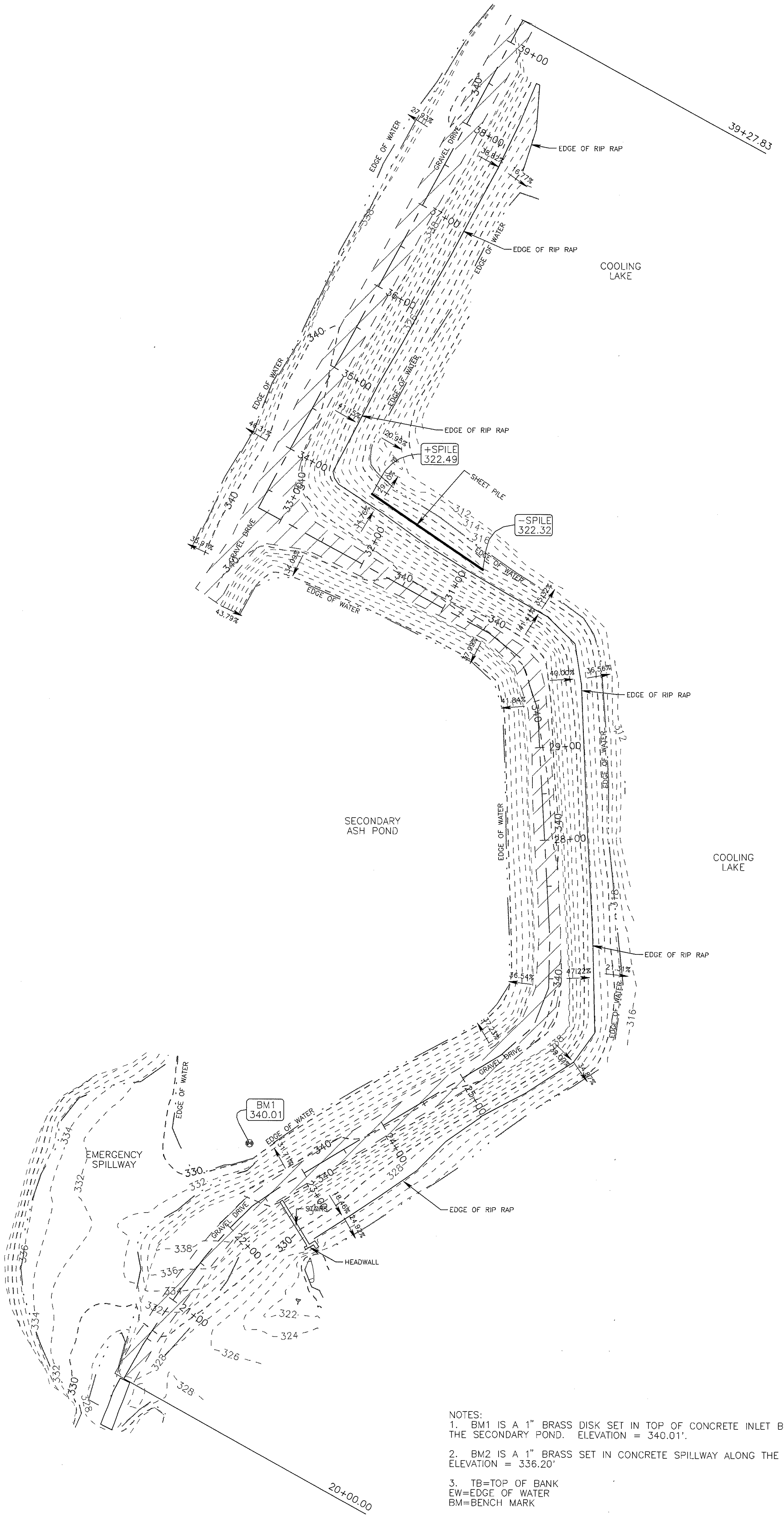
ki			Vm	
k1 =	4.12E-05	cm/sec	4.2	%
k2 =	4.23E-05	cm/sec	1.7	%
k3 =	4.57E-05	cm/sec	6.3	%
k4 =	4.28E-05	cm/sec	0.4	%

$$V_m = \frac{|k_a - k_i|}{k_a} \times 100$$

Hydraulic conductivity	k =	**4.30E-05**	cm/sec	**1.22E-01**	ft/day
Void Ratio	e =	**0.60**			
Porosity	n =	**0.37**			
Bulk Density	γ =	**2.00**	g/cm^3	**124.8**	pcf
Water Content	W =	**0.40**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**4.41E-10**	cm^2	(at 20 deg C)	

Robert Duke, P.E.





NOTES:
1. BM1 IS A 1" BRASS DISK SET IN TOP OF CONCRETE INLET BOX FOR THE SECONDARY POND. ELEVATION = 340.01'.

2. BM2 IS A 1" BRASS SET IN CONCRETE SPILLWAY ALONG THE CANAL. ELEVATION = 336.20'

3. TB=TOP OF BANK
EW=EDGE OF WATER
BM=BENCH MARK

4. CONTOURS ARE ARE 2.0' APART.

5. LAKE ELEVATION PER WELSH POWER PLANT ON NOVEMBER 18, 2010 WAS 317.57 FEET MSL.

SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON NOVEMBER 18, 2010, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: NOVEMBER 23, 2010
REVISED: DECEMBER 6, 2010

MIKE GARDNER
#5760

TOPOGRAPHIC SURVEY

DIKE'S AT WELSH POWER PLANT
FOR: GREG CARTER

Date	Revision/Description
12/6/10	ADDED LAKE LEVEL NOTE
12/6/10	ADDED CROSS SECTION SHEETS

Drawn By	Checked By	Project No.	Dwg. Date
MG	DW	104021	11/19/10

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TBPE NO. 354

File No.
Sheet No. 1

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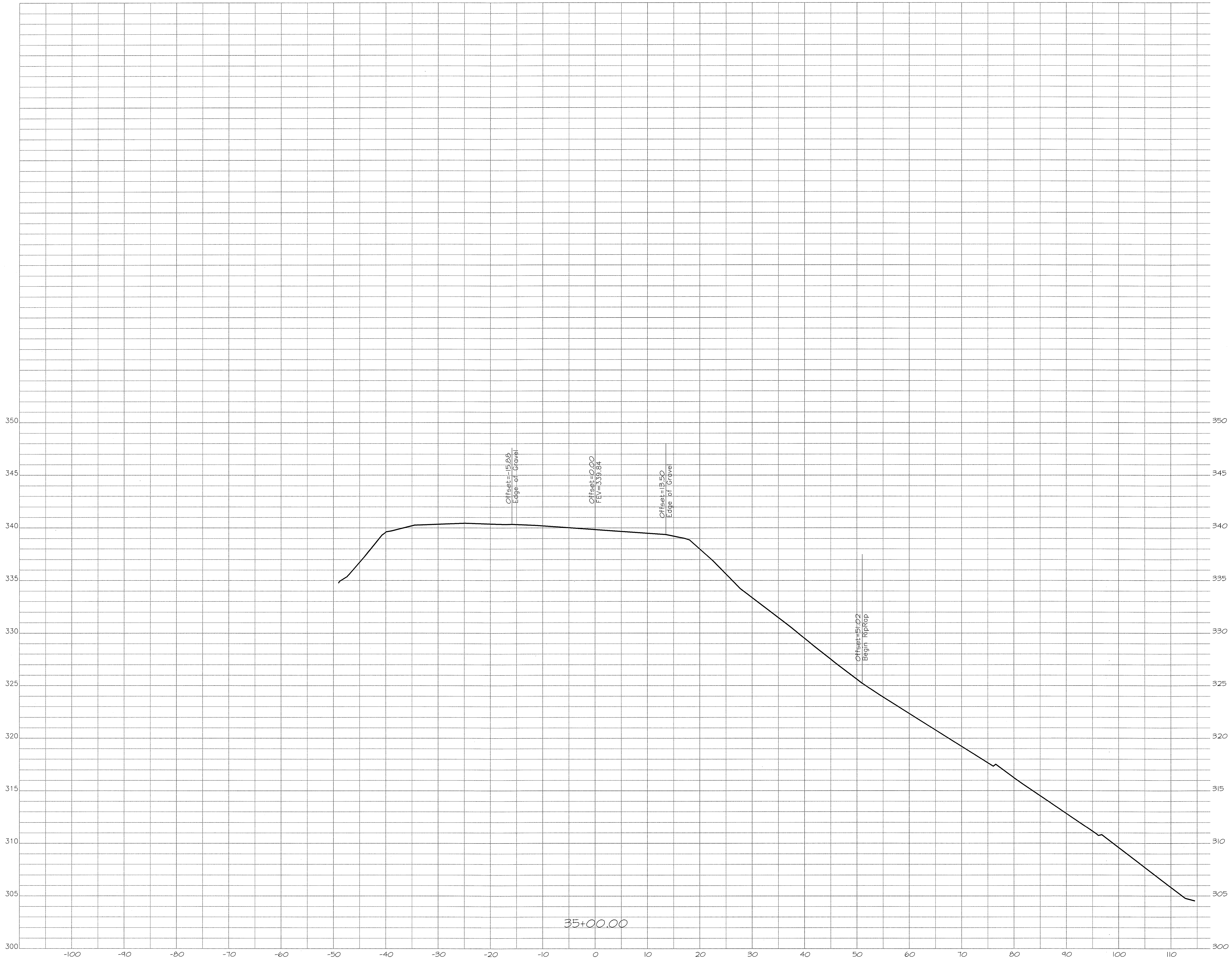
HORIZONTAL SCALE - 1"=10'
VERTICAL SCALE - 1"=5'



SURVEYOR CERTIFICATE:

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MIKE GARDNER
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NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: NOVEMBER 23, 2010
REVISED: DECEMBER 6, 2010

MIKE GARDNER
#5760

CROSS SECTIONS
ASH POND BERM

DIKE'S AT WELSH POWER PLANT
FOR: GREG CARTER

Date	Revision/Description

Drawn By	Checked By	Project No.	Dwg. Date
J.B.D.	M.G.	104021	12/6/2010

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TBPE NO. 354

File No.	Sheet No.
	5

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Mon. Dec 6, 2010 11:24AM

Initial Safety Factor Assessment – Bottom Ash Pond
Welsh Power Plant
Pittsburg, Texas

Auckland Project No. 2016-007
August 30, 2016

Prepared For:

American Electric Power Company
1 Riverside Plaza
Columbus, Ohio 43215

Prepared By:

Auckland Consulting, LLC
Jacksonville, Texas

TBPE Firm Registration No. F-16721
Expires 2/29/2017

Table of Contents

Appendix

1.0 Introduction and Embankment Information

1.1 Introduction

The following report and evaluation provides the Initial Safety Factor Assessment of the Bottom Ash Pond, an existing CCR impoundment (as defined by 40 CFR §257.2) located at the Welsh Power Plant near Pittsburg, Texas. In accordance with 40 CFR §257.73(e)(1)(i) through (iv) this initial assessment provides field and laboratory data, model outputs (detailing multiple stability conditions) and summary of safety factors for the Bottom Ash Pond. In accordance with 40 CFR §257.73(e)(2) this report provides the Initial Safety Factor Assessment certification for the Bottom Ash Pond.

1.2 Referenced Information and Data

The impoundment pool elevation data cited herein were provided in a separate hydrology and hydraulic (H&H) analysis report completed by Freese and Nichols titled *Hydraulic Analysis of Welsh Power Plant Ash Ponds* dated December 29, 2010 (not included herein). The referenced report generally meets the demonstration requirements of 40 CFR §257.82(a).

Embankment profile dimensions and elevations were determined by using existing information provided by the client. This information is included in the Appendix of this report.

1.3 Embankment Evaluation Criteria

Based on information provided and collected, the existing embankment is primarily lean clay (CL) with existing side slopes (both up- and downstream) of approximately 3:1 (H:V), maximum embankment height of approximately 34 feet (downstream) and top of dam elevation of 360.0 feet MSL. The downstream slope of the embankment is constructed with a 12-foot wide bench (vertical position on the slope varies along the embankment) that supports a 30-inch HDPE decant pipe. To account for the potential loading of the decant pipe, a surcharge load of 150 psf was applied to the bench. The crest width of the embankment is approximately 12 feet. The impoundment's storage area (side slopes and bottom) is lined with a 60-mil HDPE liner. The critical section for the embankment was determined to occur in the vicinity of Boring No. 4, as depicted on the Plan of Borings.

It is our understanding that the maximum storage elevation of impounded CCR material is 355.0 feet (MSL); however, the facility is managed to maintain an ash level less than this maximum level. The downstream toe of the Bottom Ash Pond is not adjacent to other water bodies that may inundate the downstream slope (or toe) and therefore not subject to 40 CFR §257.73(d)(1)(A)(3)(vii).

In accordance with 40 CFR §257.73(e)(1)(i) and (ii), the maximum storage pool elevation for the Bottom Ash Pond as determined by the 25-year, 24-hour storm event is 355.62 feet (MSL). For the purposes of this evaluation, the maximum storage pool elevation of 356.0 feet (MSL) was utilized. Likewise, the maximum (or flood) surcharge loading elevation as determined by the 100-year, 24-hour event is 355.76 feet (MSL), for this evaluation a maximum surcharge loading elevation of 356.0 feet (MSL) was utilized. Storage pool elevations were determined in accordance with 40 CFR §257.82(a).

2.0 Field and Laboratory Testing

2.1 Field Activities

The subsurface exploration of the embankment consisted of advancing a total of seven (7) borings located in potentially critical areas of the embankment. Four (4) borings (Boring Nos. 2 through 5) were completed along the embankment crest with termination depths ranging from approximately 40 to 50 feet. Three (3) borings (Boring Nos. 6 through 8) were completed along the embankment toe and were advanced to termination depths of approximately 40 feet. Boring No. 1 was not accessible by drilling equipment and therefore not completed. Borings were located in the field as shown on the Plan of Borings included in the Appendix of this report.

Drilling Methods. Field operations were performed in general accordance with ASTM procedures or similar accepted practices. Soil borings were drilled using a track mounted Geoprobe drilling rig equipped with a rotary head and continuous augers. The use of mud rotary or rotary wash was not necessary.

Soil Sampling. Sample intervals were semi-continuous in the upper 10 feet of each boring and five (5) foot intervals thereafter, unless otherwise directed by the onsite engineer. Split-spoon (Standard Penetration Test, SPT) or disturbed samples were collected in general accordance with ASTM Standard Method D 1586. Relatively undisturbed soil samples were collected in general accordance with ASTM D 1587 and extruded in the field and sealed in plastic to protect against moisture loss. Soil shear strengths were determined by using a calibrated hand penetrometer on undisturbed samples.

The collected samples were subsequently examined and selected for laboratory testing by a geotechnical engineer.

Boring Logs. The general subsurface soil and groundwater conditions encountered during field activities are presented on boring logs attached in the Appendix of this report. Information on the boring logs includes groundwater levels, laboratory test data, penetration resistance and soil classifications based on the Unified Soil Classification System (USCS).

Groundwater Level Measurements. Groundwater level observations completed during field activities are noted on the boring logs attached in the Appendix of this report.

2.2 Laboratory Testing Program

Laboratory testing was conducted on selected samples to assist in the classification of the soils encountered and to evaluate the physical and engineering properties of subsurface soils. Laboratory test results are presented on the boring logs included in the Appendix. Laboratory tests were performed in general accordance with ASTM procedures cited in the table below.

Laboratory Test	Test Designation
Atterberg Liquid Limit and Plastic Limit Determination	ASTM D 4318
Percentage Soil Passing No. 200 Sieve	ASTM D 1140
Moisture Content Determination	ASTM D 2216
Particle Size Analysis of Soils	ASTM D 422
Unconsolidated Undrained (UU) Triaxial Compression	ASTM D 2850
Hydraulic Conductivity	ASTM D 5084
Consolidated Undrained (CU) Triaxial Compression	ASTM D 4767
Direct Shear of Soils Under Consolidated Drain Conditions	ASTM D 3080

Soil samples not utilized in laboratory testing will be retained for approximately 30 days from the report issuance date and then disposed, unless specifically requested in writing from the client.

3.0 Slope Stability Analyses

3.1 General

Soil parameters used for stability analyses of the existing embankment are based on findings of the completed laboratory and field testing programs and previous assessments completed as the Welsh Power Plant. The probable failure planes were analyzed using the analytical slope stability software, SLIDE by Rocscience, Inc. Methods of evaluation used in SLIDE are considered to be limited equilibrium methods of analysis, where each individual shear plane is evaluated to determine the resulting shear stress at the point of failure. For the purposes of this evaluation the Bishop Method of analysis, which analyzes circular failure planes through the slope was utilized.

Per 40 CFR §257.73(e)(1)(i) through (iii), three (3) modeled scenarios (presented below) were utilized to evaluate the stability of the existing embankment: steady state seepage (long term) condition under maximum storage pool, steady state seepage (long term) condition under maximum surcharge pool, and steady state seepage condition with seismic loading under maximum storage pool conditions. The following minimum factors of safety (FS) and soil stress parameters were utilized in modeling. Minimum factors of safety are based on demonstration requirements provided in 40 CFR §257.73(e)(1).

Summary of Embankment Condition and Factor of Safety		
Embankment Condition	**Soil Parameters**	**Minimum Factor of Safety**
Steady State Seepage – Maximum Pool	Effective Stress	1.50
Steady State Seepage – Surcharge Pool	Effective Stress	1.40
Steady State Seepage (Seismic) – Maximum Pool	Total Stress	1.00
NOTE: Minimum factors of safety based on demonstration requirements provided in 40 CFR §257.82 (e)(1).		

For evaluation of steady state seepage (long term) conditions with seismic, peak ground acceleration for this location was obtained from the USGS National Seismic Hazard Mapping Project (http://earthquake.usgs.gov/hazards). Based on the seismic survey data, the anticipated site specific peak ground acceleration (PGA) of 0.06g (acceleration at rock sites) for two (2) percent probability of exceedance in 50 years (40 CFR Part 257, Preamble page 21384). Correcting for acceleration at soft soil sites (Seismic Site Classification D) yields an estimated PGA of 0.13g. The seismic coefficient (k) used for pseudo static analysis is determined by reducing the estimated PGA by 50% yielding a seismic coefficient of 0.065g.

3.2 Liquefaction Assessment

Liquefaction of soils occurs when horizontal shearing stresses exceed the strength of existing loose, saturated sand. This sudden loss of shear strength and subsequent soil structure is typically associated with earthquake-induced horizontal movement. Recent engineering publications[1] provide criteria to assess liquefaction potential of sands (little to no fines) and clayey soils of low plasticity (e.g. clayey sands, silts). These criteria indicate that water content of fine-grained or cohesive soils needs to be high (≥ 0.85 *Liquid Limit [LL]), a clay fine content (defined as grains smaller than 0.002 mm) of less than 10 percent (< 10%), and relatively low soil density (assessed in terms of SPT blow counts). In addition, the accepted minimum seismic threshold acceleration to cause liquefaction in loose sands is 0.10g, the anticipated site specific PGA for this site is 0.06g.

Native coarse grained (or sandy) material underlying the Bottom Ash Pond generally consist of medium dense to very dense silty sand (SM), clayey sand (SC) and silt (ML) and fine grained (or clayey) material consist of medium stiff to hard lean clay and fat clay (CL and CH) soils. Based on these soil characteristics and that the Bottom Ash Pond is located in

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[1] Seed, R.B., et al, Recent Advances in Soil Liquefaction Engineering: A Unified and Consistent Framework, 26th Annual ASCE Los Angeles Spring Seminar, April 2003

a zone of low peak ground acceleration (PGA), the risk of either embankment or underlying soils liquefying are negligible [40 CFR §257.73(e)(1)(iv)].

3.3 Embankment and Foundation Stratigraphy

The models developed for this evaluation are based on the existing embankment geometry, results of field and laboratory testing and hydrologic site information provided by the client. Selection of the critical slope section was based on both height and subsurface sensitivity to loading. The following tables provide a summary of soil parameters used for these analyses. Specific soil parameters used for each model are presented in the Appendix.

Summary of Long Term, Total Stress Soil Parameters:

Material Type	Unit Weight (pcf)	Consolidated-Undrained Cohesion (psf)	Consolidated-Undrained Angle of Internal Friction (degrees)
Embankment Fill	125	250	28
Silty, Clayey Sand (SM_SC)	120	225	20
Silty Sand (SM)	120	0	30
Native Fat and Lean Clay (CH_CL)	125	450	14
Ash	100	0	30

NOTE: Properties used for Steady State Seepage with Seismic analyses.

Summary of Long Term, Effective Stress Soil Parameters

Material Type	Unit Weight (pcf)	Consolidated-Drained Cohesion (psf)	Consolidated-Drained Angle of Internal Friction (degrees)
Embankment Fill	125	150	32
Silty, Clayey Sand (SM_SC)	120	0	34
Silty Sand (SM)	120	0	36
Native Fat and Lean Clay (CH_CL)	125	300	22
Ash	100	0	30

NOTE: Properties used for Steady State Seepage analyses. Consolidated-drained conditions determined based on pore pressure measurements made during Consolidated-Undrained (CU) triaxial testing.

The HDPE liner was modeled at the interface of the slope and the ash pond, a nominal strength of 50 psf was assumed for the liner material.

3.4 Seepage Analysis Parameters

The observed groundwater levels while drilling through the embankment (approximate groundwater elevation of 30 to 34 feet, below the crest) correspond with those groundwater elevations encountered while drilling adjacent to the embankment toe (approximately groundwater elevation six [6] feet, below existing grade). No elevated groundwater seepage or groundwater levels were observed in boreholes completed in the embankment that would indicate a prolific and defined phreatic surface in the embankment.

Therefore, based on the available information it appears that the existing impermeable liner has precluded the development of a phreatic surface (internal groundwater elevation) within the embankment. Though the probability of a phreatic surface developing in the embankment is considered low, it is however possible, and therefore was modeled as part of the structural assessment.

The analysis of embankment seepage is based on laboratory results and estimated values for permeability for various embankment and native foundation soils. These soil parameters were utilized in the models to establish a long term steady state condition and corresponding phreatic surface in the embankment. Hydraulic conductivity test results are provided in the Appendix. Hydraulic conductivity properties utilized in the seepage analysis are provided in the below table.

Hydraulic Conductivity of Embankment Soils

Material Type	Permeability (ft/sec)
Embankment Fill	1×10^{-8}
Silty, Clayey Sand (SM_SC)	1×10^{-5}
Silty Sand (SM)	1×10^{-5}
Native Fat and Lean Clay (CH_CL)	1×10^{-8}
Ash	1×10^{-4}

The HDPE liner is assumed to be impermeable; therefore a very low permeability value of $1\text{x}10^{-20}$ ft/sec was utilized.

3.5 Stability Analysis Results

The following table provides the results of the stability analysis for each of the conditions cited herein, as required by 40 CFR §257.73(e)(1)(i) through (iii). The graphical representations of each analysis are included in the Appendix.

Summary of Stability Analyses – Safety Factors

Modeled Condition	Factor of Safety	
	Actual	Minimum
Steady State Seepage – Maximum Pool	2.60	1.50
Steady State Seepage – Surcharge Pool	2.60	1.40
Steady State Seepage with Seismic – Maximum Pool	1.60	1.00

Summary of Stability Analyses– Safety Factors
(Potential Phreatic Surface)

Modeled Condition	Factor of Safety	
	Actual	Minimum
Steady State Seepage – Maximum Pool	1.78	1.50
Steady State Seepage – Surcharge Pool	1.78	1.40
Steady State Seepage with Seismic – Maximum Pool	1.31	1.00

Based on the findings of this analysis, the evaluated embankment appears to be stable under both modeled conditions (existing conditions and potential phreatic surface) and demonstrate the minimum safety factors, as required by 40 CFR §257.73(e)(1)(i) through (iii).

4.0 Report Limitations

This report has been prepared for the exclusive use of our client for the specific application to the project discussed and has been prepared in accordance with the generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. The analyses contained in the report are based on the data obtained from the soil

borings performed within the project site. This report does not reflect variations that may occur between borings or across the site. Soil borings do not necessarily reflect strata variations that may exist at other locations within the project site.

5.0 Initial Structural Stability Assessment Certification

By means of this certification, (i) I have reviewed the requirements of 40 CFR §257.73(e)(1) – *Periodic Safety Factor Assessments*, (ii) I or my agent has visited and examined the facility, (iii) the referenced data used in this evaluation to the best of my knowledge appears correct and appropriate for use, (iv) and this Initial Safety Factor Assessment for the Bottom Ash Pond (Welsh Power Plant) has been prepared to the best of my knowledge in accordance with §257.73(e)(1).

By: ________________________________

Dated: August 30, 2016

JOHN J. TAYNTOR
99202

TBPE Firm Registration No. F-16721
Expires 2/28/2017

Appendix

Stability Analyses
Reference Data

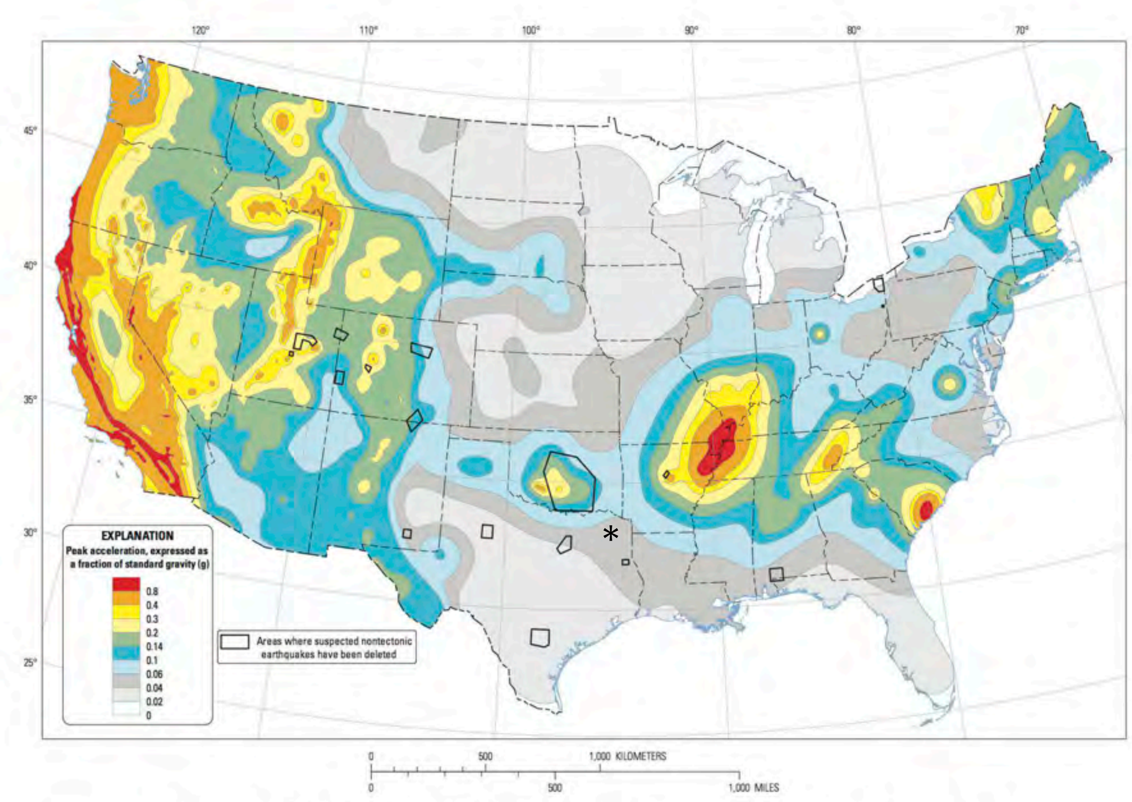
Aerial image provided by Google Earth.

Soil Boring Location Plan

Scale: N/A

Auckland Project No. 2016-007

Welsh Power Plant
Initial Safety Factor Assessment - Bottom Ash Pond
Pittsburg, Texas



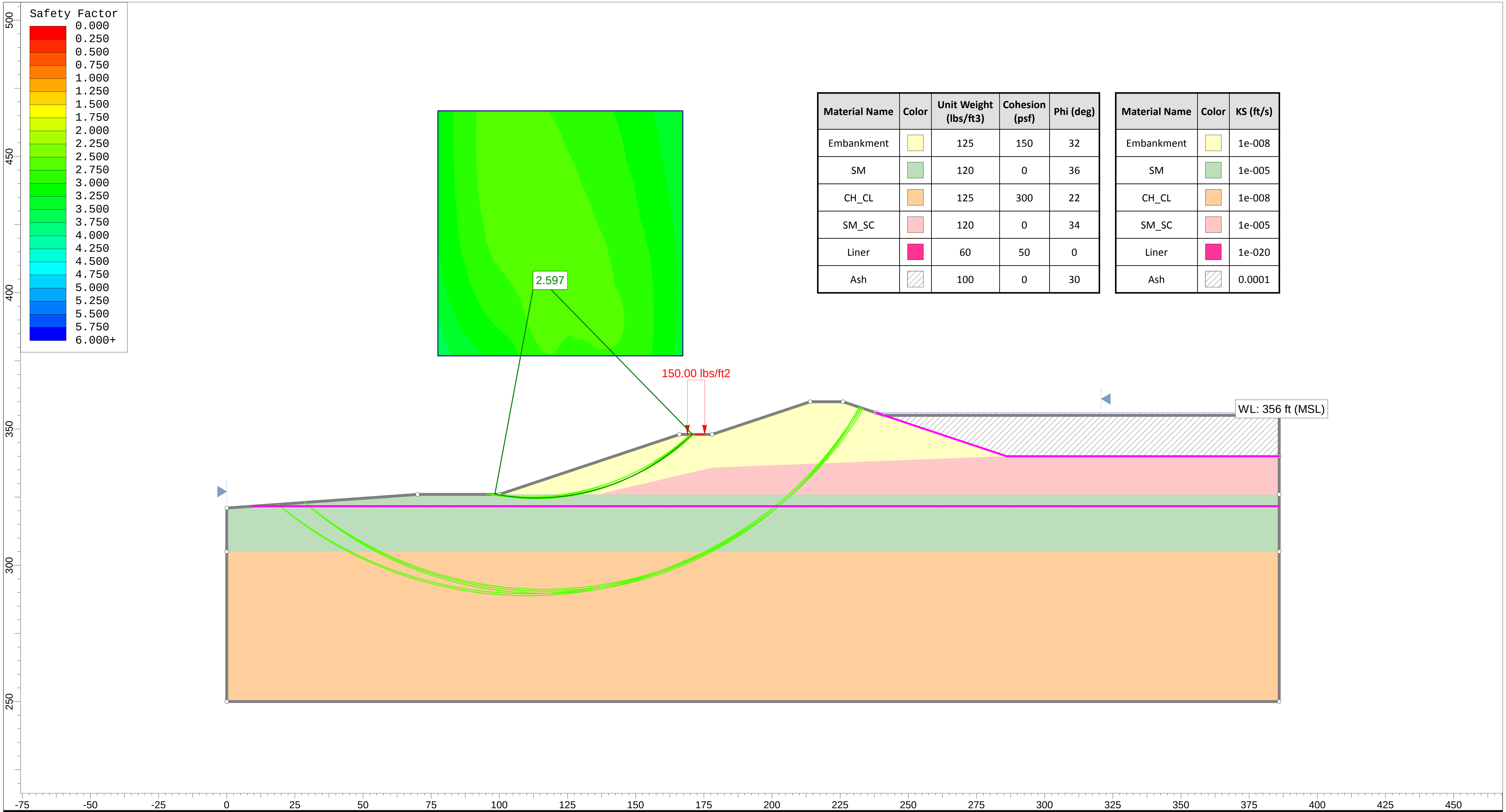
Two-percent probability of exceedance in 50 years map of peak ground acceleration

* Approximate location of Welsh Power Plant

Provided by USGS National Seismic Hazard Mapping Project.

Seismic Probability Map

Scale: N/A	**Welsh Power Plant** **Initial Safety Factor Assessment - Bottom Ash Pond** **Pittsburg, Texas**
Auckland Project No. 2016-007	



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	150	32
SM	🟩	120	0	36
CH_CL	🟧	125	300	22
SM_SC	🟥	120	0	34
Liner	🟥	60	50	0
Ash	▨	100	0	30

Material Name	Color	KS (ft/s)
Embankment	🟨	1e-008
SM	🟩	1e-005
CH_CL	🟧	1e-008
SM_SC	🟥	1e-005
Liner	🟥	1e-020
Ash	▨	0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project
Welsh Power Station - Bottom Ash Pond

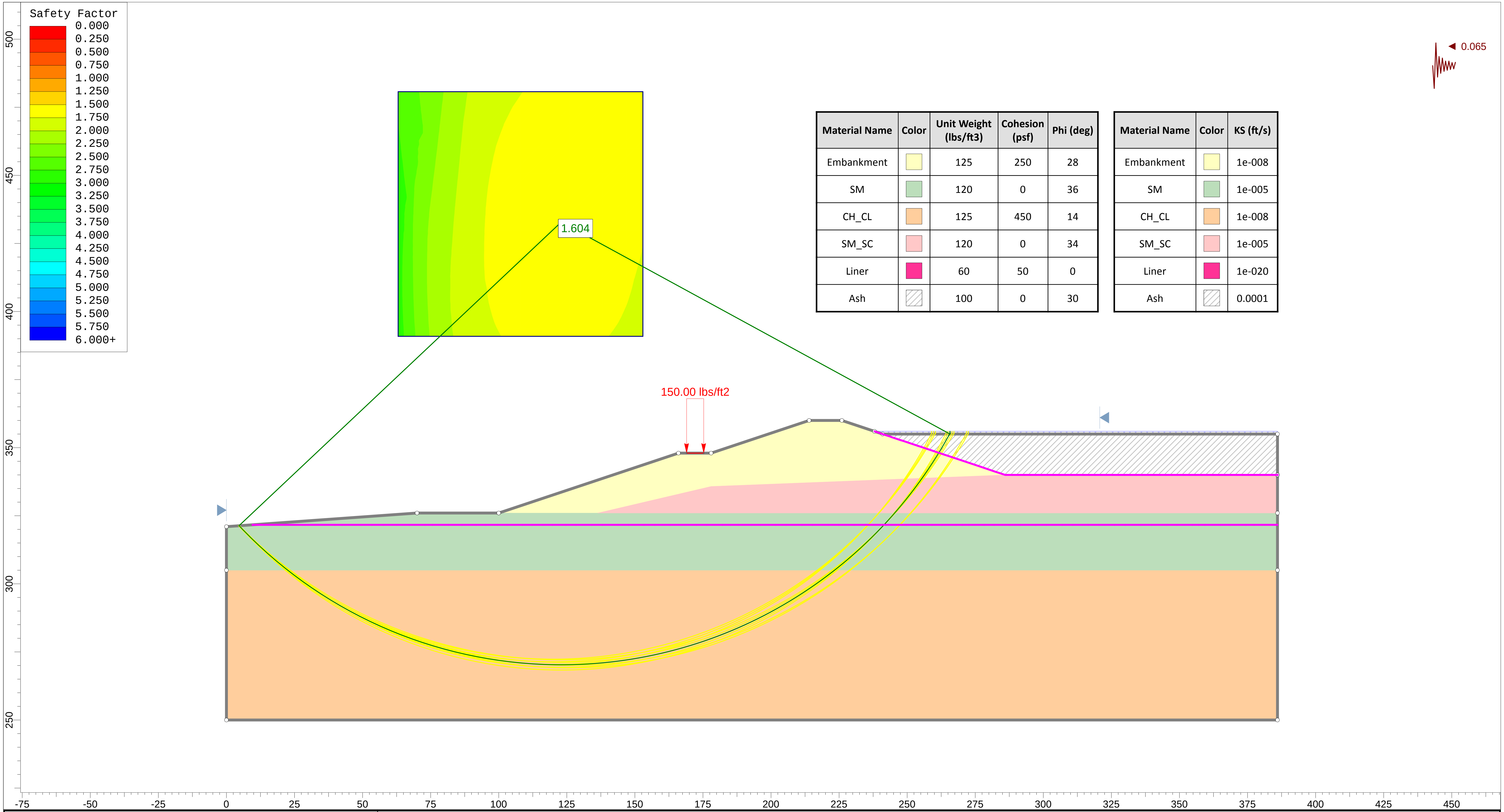
Analysis Description
Steady State Seepage at Maximum and Surcharge Pool

Drawn By
JJT

Company
Auckland

Date
7/11/2016, 3:30:13 PM

File Name
Winston_SS.slim



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	250	28
SM	🟩	120	0	36
CH_CL	🟧	125	450	14
SM_SC	🟥	120	0	34
Liner	🟪	60	50	0
Ash	▨	100	0	30

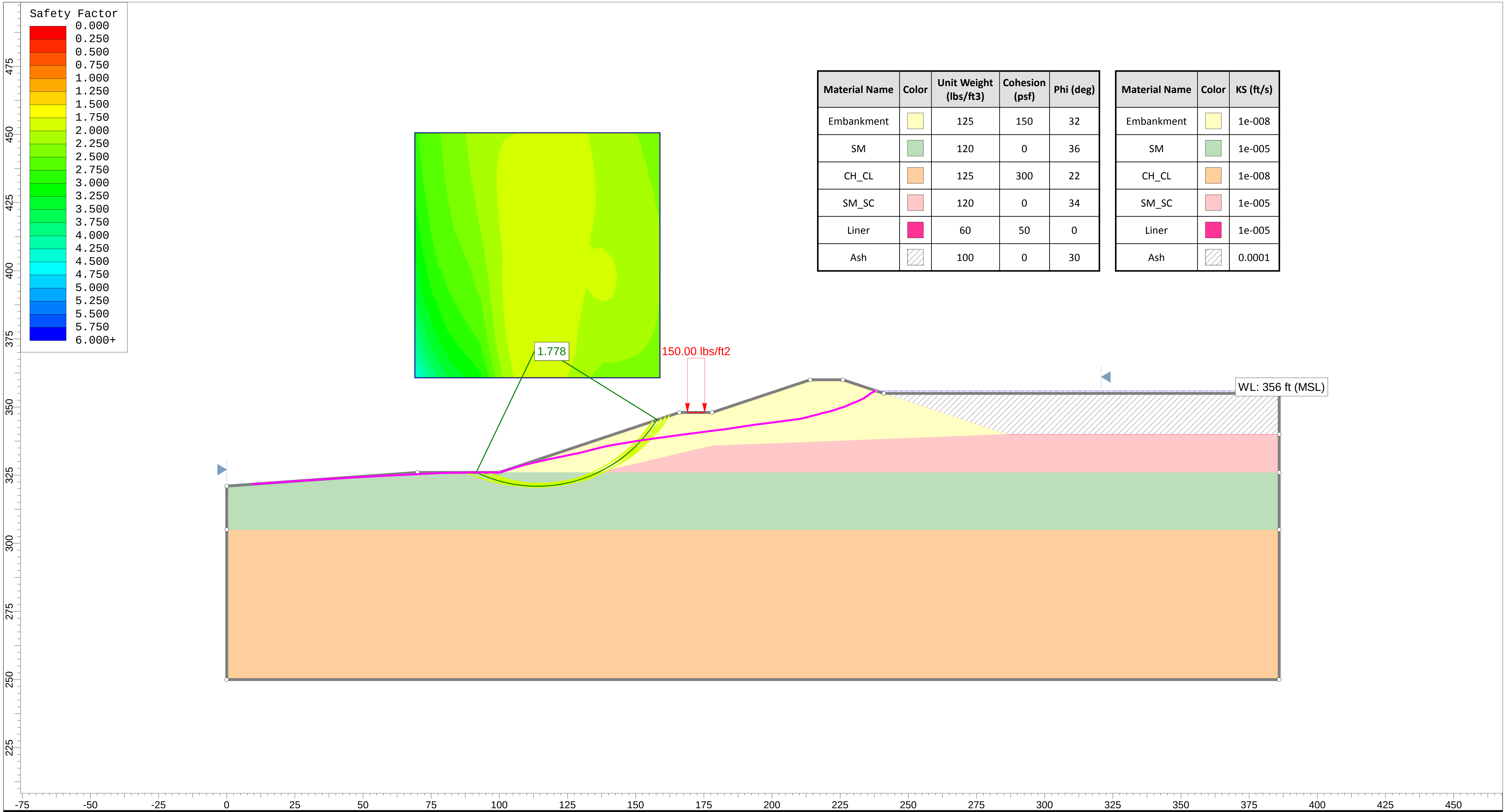
Material Name	Color	KS (ft/s)
Embankment	🟨	1e-008
SM	🟩	1e-005
CH_CL	🟧	1e-008
SM_SC	🟥	1e-005
Liner	🟪	1e-020
Ash	▨	0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project	Welsh Power Station - Bottom Ash Pond
Analysis Description	Steady State Seepage at Maximum and Surcharge Pool, Seismic Analysis

Drawn By	JJT	*Company*	Auckland
Date	7/11/2016, 3:30:13 PM	*File Name*	Winston_SSS.slim



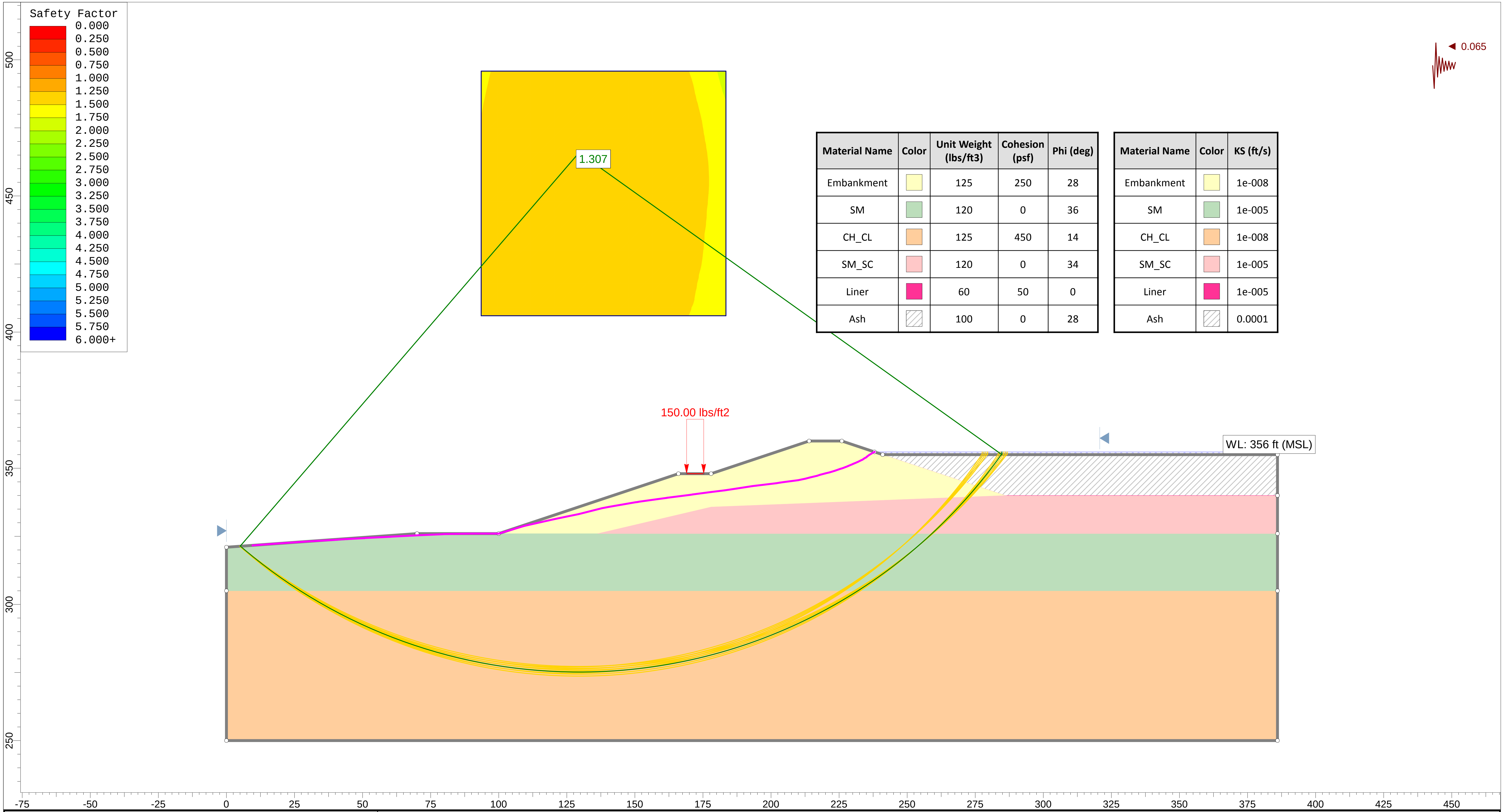
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment	🟨	125	150	32
SM	🟩	120	0	36
CH_CL	🟧	125	300	22
SM_SC	🟥	120	0	34
Liner	🟥	60	50	0
Ash	▨	100	0	30

Material Name	Color	KS (ft/s)
Embankment	🟨	1e-008
SM	🟩	1e-005
CH_CL	🟧	1e-008
SM_SC	🟥	1e-005
Liner	🟥	1e-005
Ash	▨	0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project	Welsh Power Station - Bottom Ash Pond
Analysis Description	Steady State Seepage at Maximum and Surcharge Pool (assumed phreatic surface)
Drawn By	JJT
Company	Auckland
Date	7/11/2016, 3:30:13 PM
File Name	Winston_SS_L.slim



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment	■	125	250	28
SM	■	120	0	36
CH_CL	■	125	450	14
SM_SC	■	120	0	34
Liner	■	60	50	0
Ash	▨	100	0	28

Material Name	Color	KS (ft/s)
Embankment	■	1e-008
SM	■	1e-005
CH_CL	■	1e-008
SM_SC	■	1e-005
Liner	■	1e-005
Ash	▨	0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

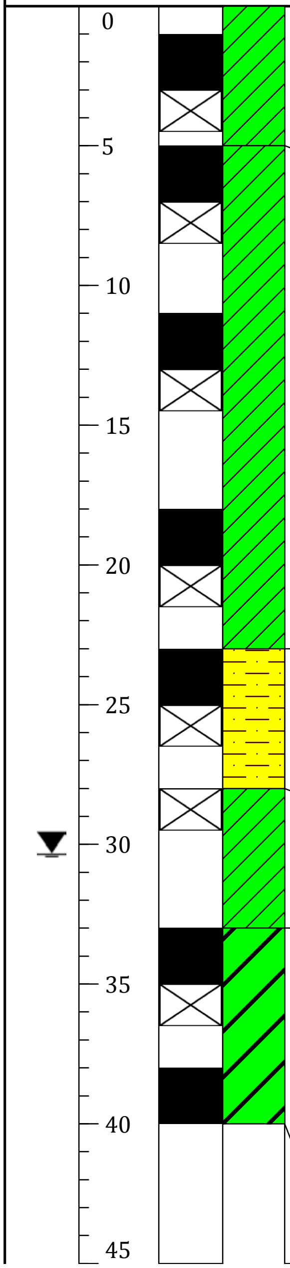
Project	Welsh Power Station - Bottom Ash Pond
Analysis Description	Steady State Seepage at Maximum and Surcharge Pool, Seismic Analysis (assumed phreatic surface)
Drawn By	JJT
Company	Auckland
Date	7/11/2016, 3:30:13 PM
File Name	Winston_SSS_L.slim

Auckland Consulting LLC

LOG OF BORING B2

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 05/19/2016

GPS Coordinates: N33° 02' 38.1" W94° 50' 42.3"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Very Stiff, light gray, red and tan, Sandy Lean Clay (CL), mottled, interbedded sand seams		4.0		57	23	35	18	17	
- medium stiff, mottled	8								
Stiff, tan with gray and red, Sandy Lean Clay (CL), mottled		N/A							
	14			64	23	34	22	12	
- very stiff, between 11 to 18 ft		3.0	2.5	61	16	36	17	19	114
	15								
- hard, between 18 to 20 ft		4.5+							114
- stiff, below 20 ft	15			66	18	38	19	19	
Medium Dense, light gray with tan, Silt with Sand (ML), with few clay		N/A							
	19			73	17				
- medium stiff									
	40								
Hard, light gray with tan, Lean Clay (CL), interbedded sand seams									
Very Stiff, light gray with tan, Fat Clay (CH), interbedded sand seams		3.0		98	30	63	31	32	92
	18								
- dark gray, tan and red, with sand inclusions and ferrous partings below 38 ft		3.0							
Boring terminated at 40 feet.									

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 30 ft during drilling. Water level at 30 feet upon completion. Boring caved to 32 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B3

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 05/18/2016

GPS Coordinates: N33° 02' 39.2" W94° 50' 38.1"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0	☒	Stiff, red, tan and gray, Sandy Lean Clay (CL), mottled	9								
		■			3.0		59	17	33	16	17	113
	5	☒	- with interbedded sand seams	13								
		■			1.5		67	18	39	21	18	111
	10	☒	- very stiff, tan, gray with red below 10 ft	18								
		☒		16								
	15		Very Stiff, red, brown, tan with gray, Lean Clay with Sand (CL), mottled, with interbedded sand seams									
		☒			4.0	2.2	71	18	42	20	22	109
	20	☒	- clay with silt and organics (wood debris) at 18 ft	26			61	13				
		☒		30			70	19				
	25		Medium Dense, gray, Sandy Silt (ML), few organics (wood debris), few clay inclusions									
		■	Very Stiff, tan, red and gray, Sandy Lean Clay (CL), mottled with silt		N/A		52	12	29	21	8	
▽	30	☒		16								
▼		☒	Medium Dense, light gray and red, Sandy Silt (ML), mottled, few clay inclusions	19			91	29	36	24	12	
	35		Very Stiff, tan, orange and red, Lean Clay (CL), mottled, laminated									
		■			N/A							
	40	☒	Light gray, tan and red, Sandy Silt (ML), mottled, few clay inclusions	35			70	24				
		☒	Hard, tan, gray with orange, Sandy Lean Clay (CL) with trace silt, mottled, laminated	34								
	45		Very Stiff, gray, Fat Clay (CH), laminated									
		☒		29			98	27	53	25	28	
	50		Boring terminated at 50 feet.									
	55											

Additional Information/Comments:

Logger: R. Pierson

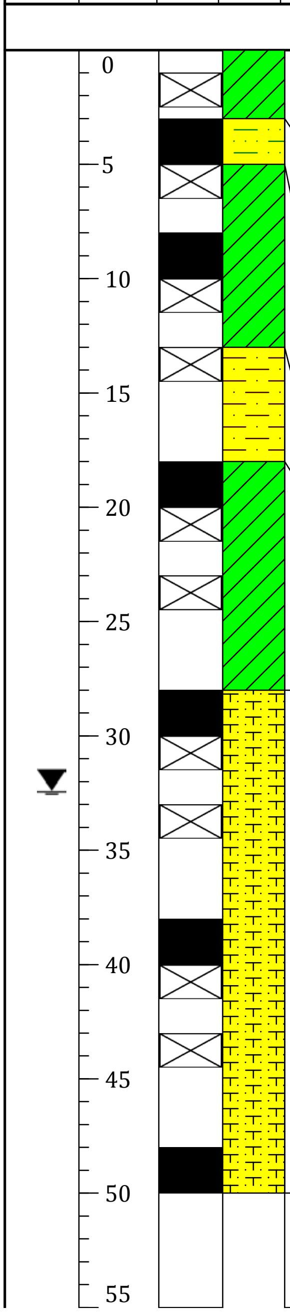
Notes/Comments: Seepage encountered at 30 ft during drilling. Water level at 33 feet upon completion. Boring caved to 40 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B4

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 06/08/2016

GPS Coordinates: N33° 02' 43.1" W94° 50' 37.1"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Stiff, red, brown with gray, Sandy Lean Clay (CL), mottled	9			63	14	38	18	20	
		3.5		44	19	42	25	17	109
Medium Dense, light gray, red and brown, Clayey Sand (SC), mottled, laminated	15								
Very Stiff, light gray, tan and brown, Sandy Lean Clay (CL), mottled, slickensided		3.5		66	16	33	20	13	
	12								
- stiff, light gray, red and tan, with silt and sand seams below 10 ft	13			62	18				
Medium Dense, light gray and brown, Sandy Silt (ML), mottled, few clay inclusions									
		3.0		55	17	38	20	18	
Very Stiff, brown, gray and red, Sandy Lean Clay (CL), mottled	18								
	10								
- stiff below 23 ft									
Dense, brown, light gray and red, Silty Sand (SM)		N/A		43	16	NP	NP	NP	
	37								
- brown with red, some clay between 30 to 33 ft	46			30	30	NP	NP	NP	
- very dense, light gray with tan below 33 ft									
		N/A							116
	48								
	48								
		N/A		26	19	NP	NP	NP	
Boring terminated at 50 feet.									

Additional Information/Comments:

Logger: R. Pierson

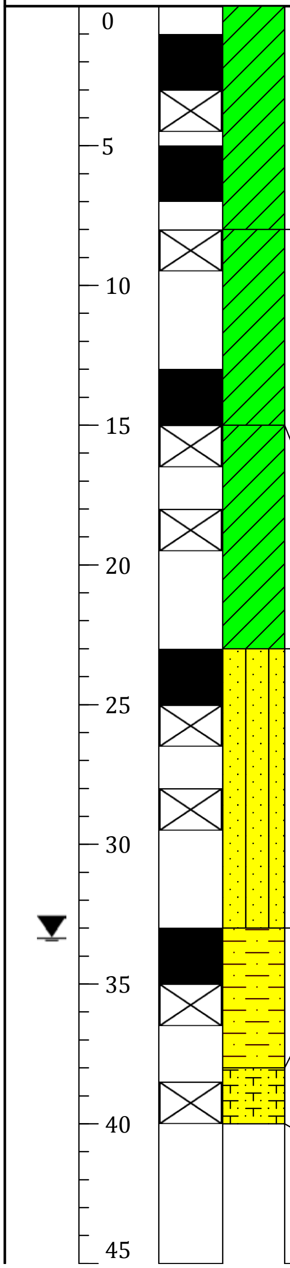
Notes/Comments: Seepage encountered at 32 ft during drilling. Water level at 32 feet upon completion. Boring caved to 40 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B5

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 06/08/2016

GPS Coordinates: N33° 02' 45.0" W94° 50' 33.4"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Stiff, red, gray and brown, Sandy Lean Clay (CL), mottled		2.0		54	20	40	18	22	
	11								
- very stiff with sand lenses below 5 ft		2.5		60	17	44	20	24	119
	16								
Very Stiff, light gray and brown, Lean Clay with Sand (CL), mottled									
- stiff with sand and organics (root and wood debris) below 13 ft		2.0		79	18	35	17	18	110
	23			62	12	30	16	14	
Very Stiff, light brown with gray, Sandy Lean Clay (CL), with few organics (root debris)									
	6								
- medium stiff, silt with sand below 18 ft									
Medium Dense, light brown, tan with gray, Silty Clayey Sand (SC-SM), mottled, with organics (root debris) between 23 to 25 ft		N/A		47	10	31	23	8	
	26								
- very dense below 28 ft	34			44	20				
Very Dense, light gray with tan, Silt (ML)		N/A		91	27	NP	NP	NP	96
- sandy silt below 35 ft	68								
Very Dense, light gray with tan, Silty Sand (SM)	96			21	28				
Boring terminated at 40 feet.									

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 33 ft during drilling. Water level at 33 feet upon completion. Boring caved to 38 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B6

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 05/17/2016

GPS Coordinates: N33° 02' 43.0" W94° 50' 34.1"
Surface Elevation: 332 ft, MSL (approx)
Drilling Method: Dry Auger

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0	☒	Medium Dense, red, tan and brown, Silt with Sand (ML), mottled	16								
		☒	- with gray	23			73	19	NP	NP	NP	
▼	5	■	Medium Dense, tan, gray and brown, Silty Sand (SM), mottled		N/A							
▽		☒	- tan and gray below 8 ft	24			45	26	NP	NP	NP	
	10											
		☒	- very dense between 13 and 30 ft	57								
	15											
		☒		51			47	27				
	20											
		☒	- few clay inclusions below 23 ft	73								
	25											
		■			N/A		36	29	NP	NP	NP	122
	30	☒	- dense with few clay inclusions between 30 and 33 ft	34								
		☒	- very dense below 33 ft	79								
	35											
		☒	Medium Dense, dark gray, tan and red, Clayey Sand (SC), few silt, trace gypsum	27			39	25	47	21	26	
	40		Boring terminated at 40 feet.									
	45											

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 8 ft during drilling. Water level at 6 feet upon completion. Boring caved to 15 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B7

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 05/17/2016

GPS Coordinates: N33° 02' 40.8" W94° 50' 36.5"
Surface Elevation: 328 ft, MSL (approx)
Drilling Method: Dry Auger

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0	☒	🟨	Loose, red, brown and tan, Clayey Sand (SC), few organics	8								
		☒	🟨	- medium dense, gray and tan below 3 ft	26			40	22				
	5	☒	🟨	Dense, tan, gray and red, Silty Sand (SM)	32			31	24	NP	NP	NP	
▼ ▽			🟨										
		☒	🟨		47								
	10		🟨										
		■	🟨	- light gray with tan, with few clay inclusions between 13 and 18 ft		N/A		31	26	NP	NP	NP	100
	15		🟨										
		☒	🟨	- medium dense below 18 ft	30								
	20		🟨										
		☒	🟩	Medium Stiff, tan, orange and brown, Fat Clay (CH), laminated with gypsum	5			92	31	55	22	33	
	25		🟩										
		■	🟩			N/A							
	30	☒	🟩	- very stiff below 30 ft	29								
		☒	🟩	Hard, dark gray and gray, Lean Clay with Sand (CL), laminated with gypsum	57			73	23	33	18	15	
	35		🟩										
		☒	🟩		36								
	40			Boring terminated at 40 feet.									
	45												

Additional Information/Comments:

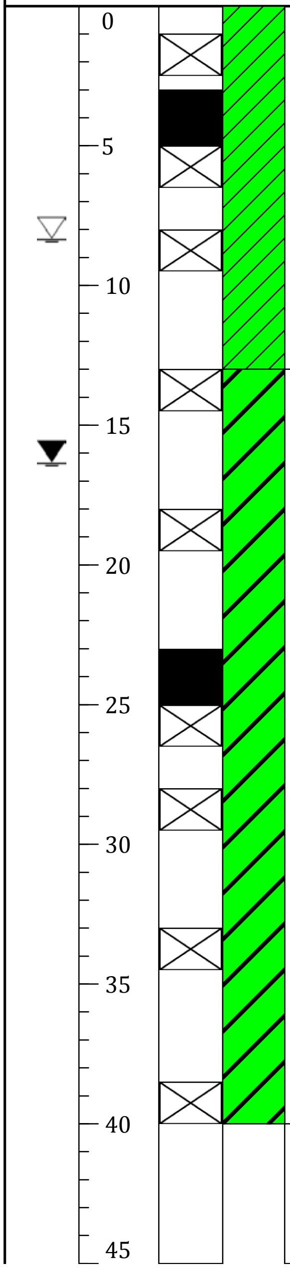
Logger: R. Pierson
Notes/Comments: Seepage encountered at 7 ft during drilling. Water level at 6 feet upon completion.
Boring caved to 35 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B8

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease
Project No.: 2016-007
Drill Date(s): 05/18/2016

GPS Coordinates: N33° 02' 37.8" W94° 50' 38.0"
Surface Elevation: 338 ft, MSL (approx)
Drilling Method: Dry Auger



Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
Stiff, gray, red and tan, Sandy Lean Clay (CL), mottled	12								
		4.5+	1.8	51	18	33	18	15	115
- very stiff between 5 and 8 ft	22								
- stiff, gray and light brown, mottled with interbedded sand seams below 8 ft	11			57	23				
Stiff, light brown and gray, Fat Clay (CH), laminated, few ferrous partings	13								
- very stiff, dark gray with brown, gypsum below 18 ft	28			60	25	58	32	26	
- laminated with gypsum, interbedded sand seams below 23 ft		2.5							
	22								
	30			88	19	63	32	31	
- hard below 33 ft	38								
	34			85	29				
Boring terminated at 40 feet.									

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 8 ft during drilling. Water level at 16 feet upon completion.
Boring caved to 26 feet. N/A: Not Attempted

Boring Log Terms and Symbols

Symbols and Sampler Types

■	Thin-walled Tube (Shelby Tube)
☒	Standard Penetration Test (SPT)
◩	Auger Sample
⧗	Texas Cone Penetration Test (TCP)
▼	Observed Static-Water Level
▽	Observed Free Water (Seepage)

Soil Consistency and Structure

Strength of Fine Grained Soils		
Consistency	**SPT (Blows/ft)**	**UCS (tsf)**
Very Soft	< 2	< 0.25
Soft	2 – 4	0.25 – 0.5
Medium Stiff	4 – 8	0.5 – 1.0
Stiff	8 – 15	1.0 – 2.0
Very Stiff	15 – 30	2.0 – 4.0
Hard	> 30	> 4.0

Density of Coarse Grained Soils		
Consistency	**SPT (Blows/ft)**	**TCP (Blows/ft)**
Very Loose	0 – 4	< 8
Loose	5 – 10	9 – 20
Medium Dense	11 – 30	21 – 60
Dense	31 – 50	61 -100
Very Dense	> 50	> 100

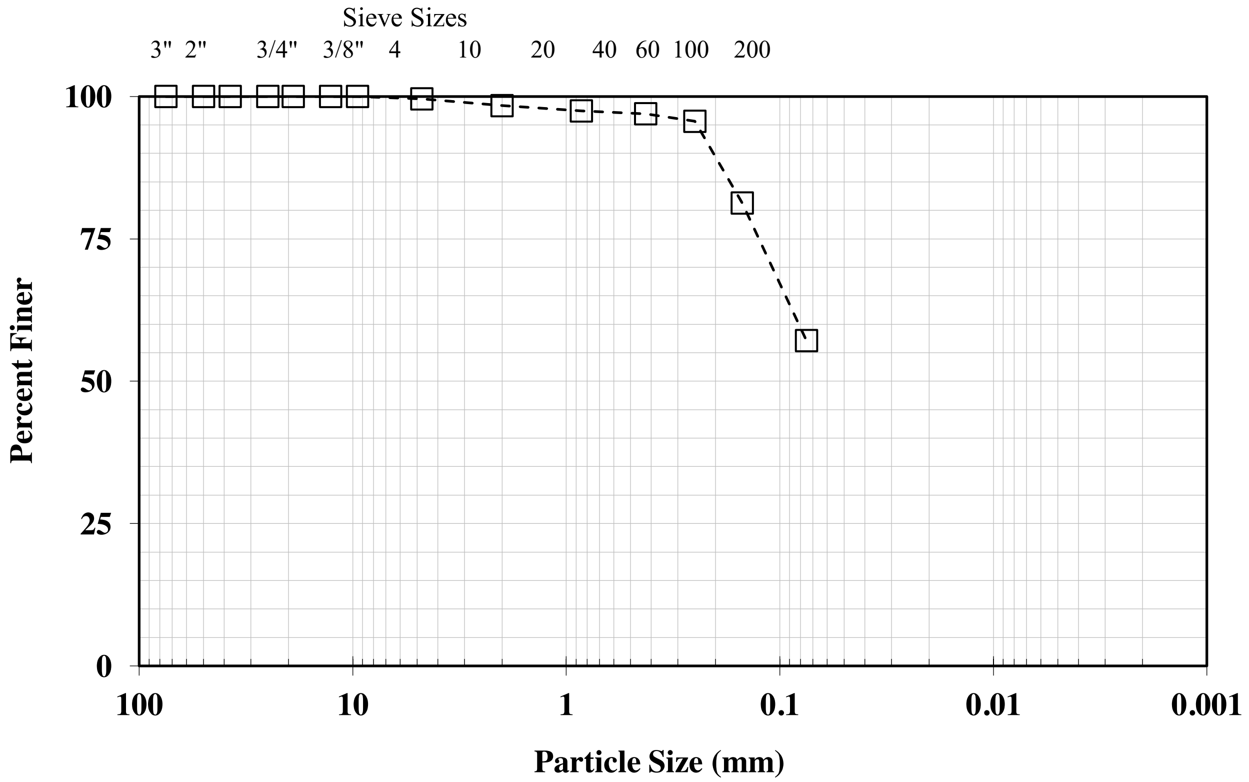
Soil Structure - Description	
Description	**Explanation**
Laminated	Alternating layers of varying material or color.
Slickensided	Fractured polished planes, little resistance to fracturing
Blocky	Cohesive soil that can be broken into small angular pieces.
Lensed	Inclusion of small pockets of different soils
Homogeneous	Same appearance and color throughout

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2 1-3

TRI Log#: 20888.1
Test Method: ASTM D422



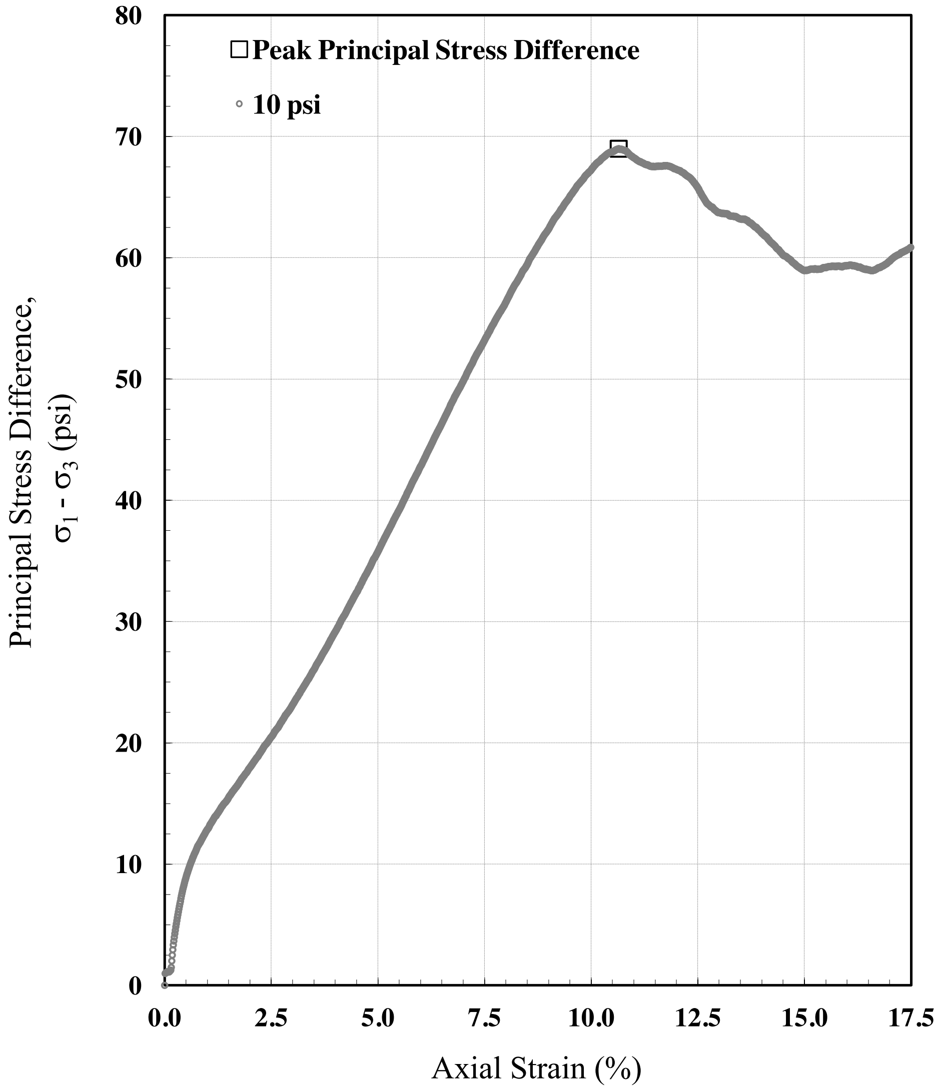
Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	99.6
No. 10 (2.00 mm)	98.4
No. 20 (0.841 mm)	97.5
No. 40 (0.420 mm)	97.0
No. 60 (0.250 mm)	95.6
No. 100 (0.149 mm)	81.3
No. 200 (0.074 mm)	57.1
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

USCS Classification (ASTM D2487)	Sandy lean clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	23.0
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	35
	Plastic Limit	18
	Plastic Index	17
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Unconsolidated-Undrained (Q) Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D2850
Sample:	B2: 11-13		



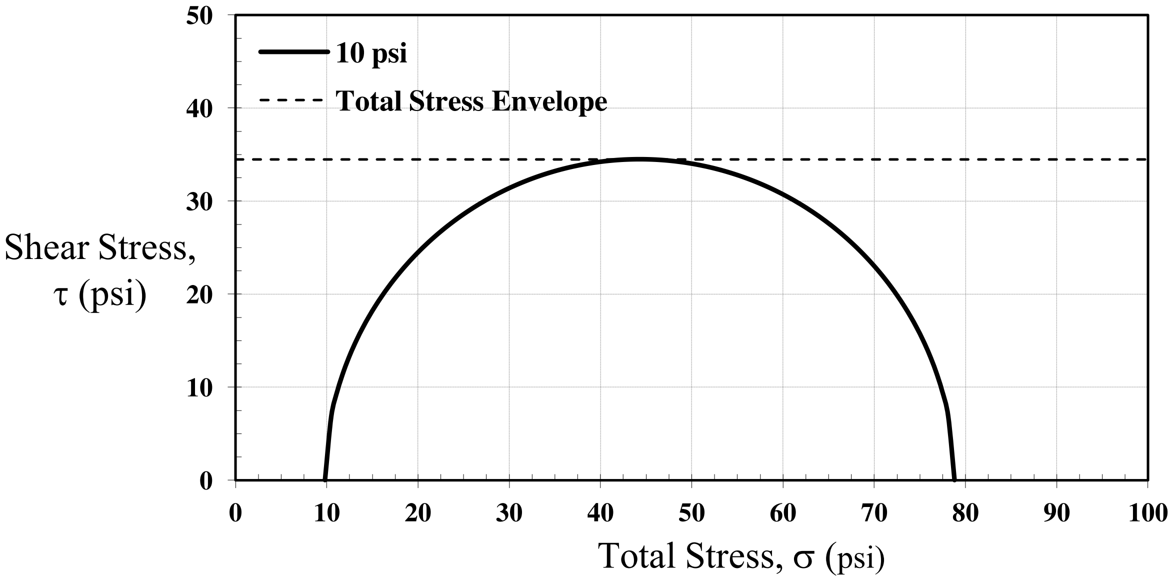
Test Parameters	
Minor Principal Stress (psi)	10.0
Rate of Strain (%/hr)	60

Initial Properties	
Avg. Diameter (in)	2.84
Avg. Height (in)	5.61
Avg. Water Content (%)	15.5
Bulk Density (pcf)	132.1
Dry Density (pcf)	114.4
Saturation (%)	92.0
Void Ratio	0.45
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	10.6
Minor Total Stress (psi)	10.0
Major Total Stress (psi)	79.0
Principal Stress Diff. (psi)	69.0

Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	34.5
S_u / σ_3	3.4

Note: The Mohr failure envelope was taken as a horizontal straight line. It should, however, be noted that the specimen was partially saturated.



Jeffrey A. Kuhn , Ph.D., P.E., 6/30/2016

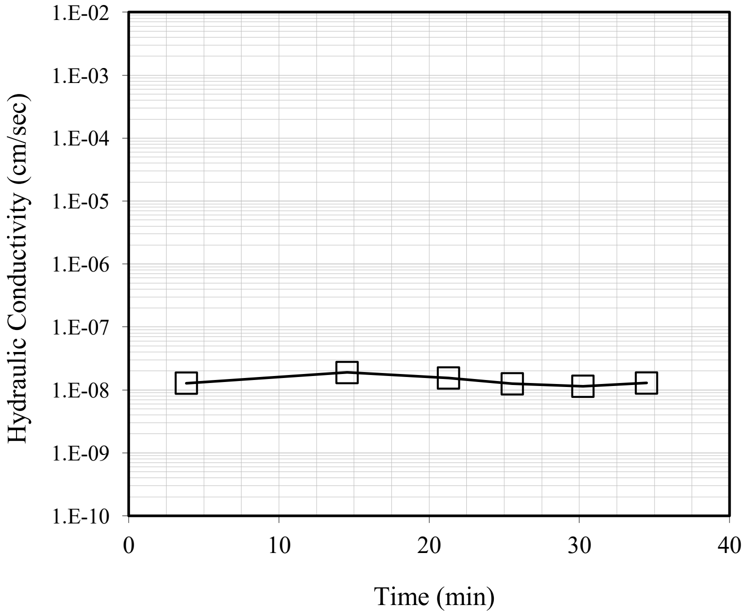
Analysis & Quality Review/Date

Laboratory Staff: LC

Hydraulic Conductivity

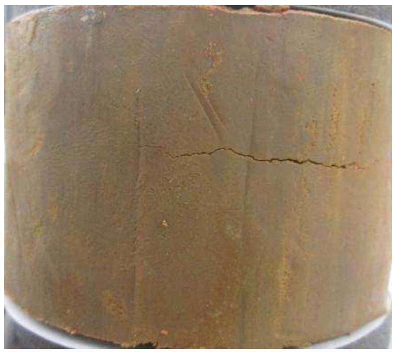
Client:	Auckland Consulting LLC
Project:	Winston Pond
Sample ID:	B2: 18-20

TRI Log #:	20888
Test Method:	ASTM D5084 Method F



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.82
Height (in)	1.81
Initial Mass (g)	389.6
Sample Area (in^2)	6.25
Water Content (%)	15.5
Total Unit Weight (pcf)	131.4
Dry Unit Weight (pcf)	113.8
Specific Gravity (Assumed)	2.65
Degree of Saturation	90.4
Void Ratio	0.45
Porosity	0.31
1 Pore Volume (cc)	57.7
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.96

Specimen Image



Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
21.3	1.5E-08
25.5	1.3E-08
30.2	1.1E-08
34.5	1.3E-08
Average, Last 2 Readings	**1.2E-08**

Note: Permeation measurements were made with a mercury U-tube.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016

Analysis & Quality Review/Date

Testing Performed By: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2: 33-35

TRI Log #: 20888
Test Method: ASTM D4767 Mod

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	14.2	28.3	42.5
Initial Specimen Properties			
Avg. Diameter (in)	2.05	2.05	2.05
Avg. Height (in)	4.33	4.33	4.33
Avg. Water Content (%)	30.8	-	-
Bulk Density (pcf)	119.7	119.7	119.7
Dry Density (pcf)	91.5	-	-
Saturation (%)	98.8	-	-
Void Ratio, n	0.84	0.84	0.84
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	79.7	80.0	80.2
B-Value, End of Saturation	0.96	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.82	0.82	0.82
Area (in^2)	3.28	3.28	3.28

Shear / Post-Shear			
Avg. Water Content (%)	-	-	29.7
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	1.0	1.5	1.9
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	5.6	11.9	20.5
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	15.8	25.5	34.0
Pore Water Pressure, Δu_f (psi)	-	-	-	9.8	17.2	22.6
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	21.4	37.4	54.5
Effective Friction Angle (degrees)	-			22.1		
Effective Cohesion (psi)	-			3.3		

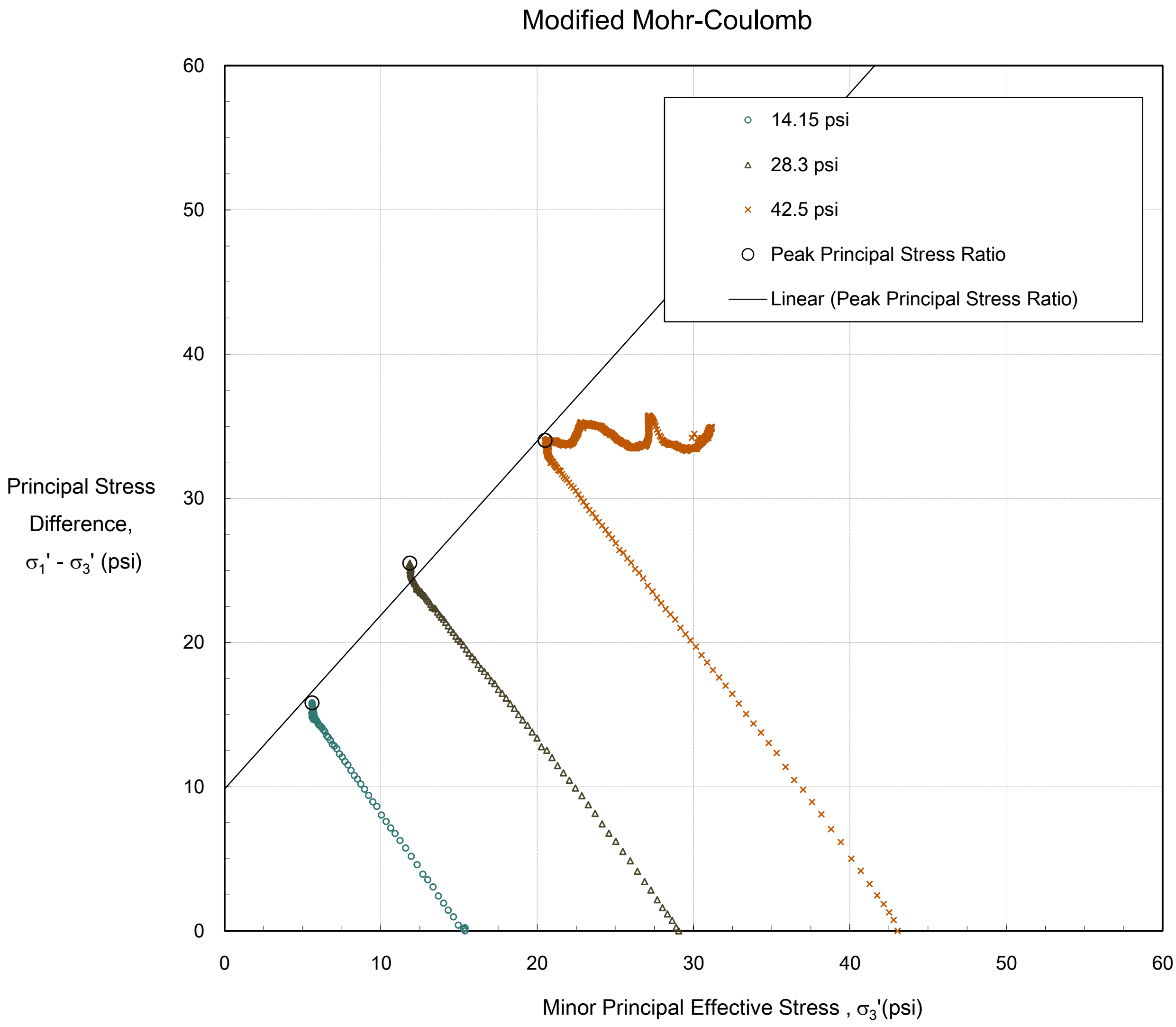
R-Envelope, "Total" Stress		
Friction Angle (deg)	-	14.3
Cohesion (psi)	-	2.3

Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/12/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

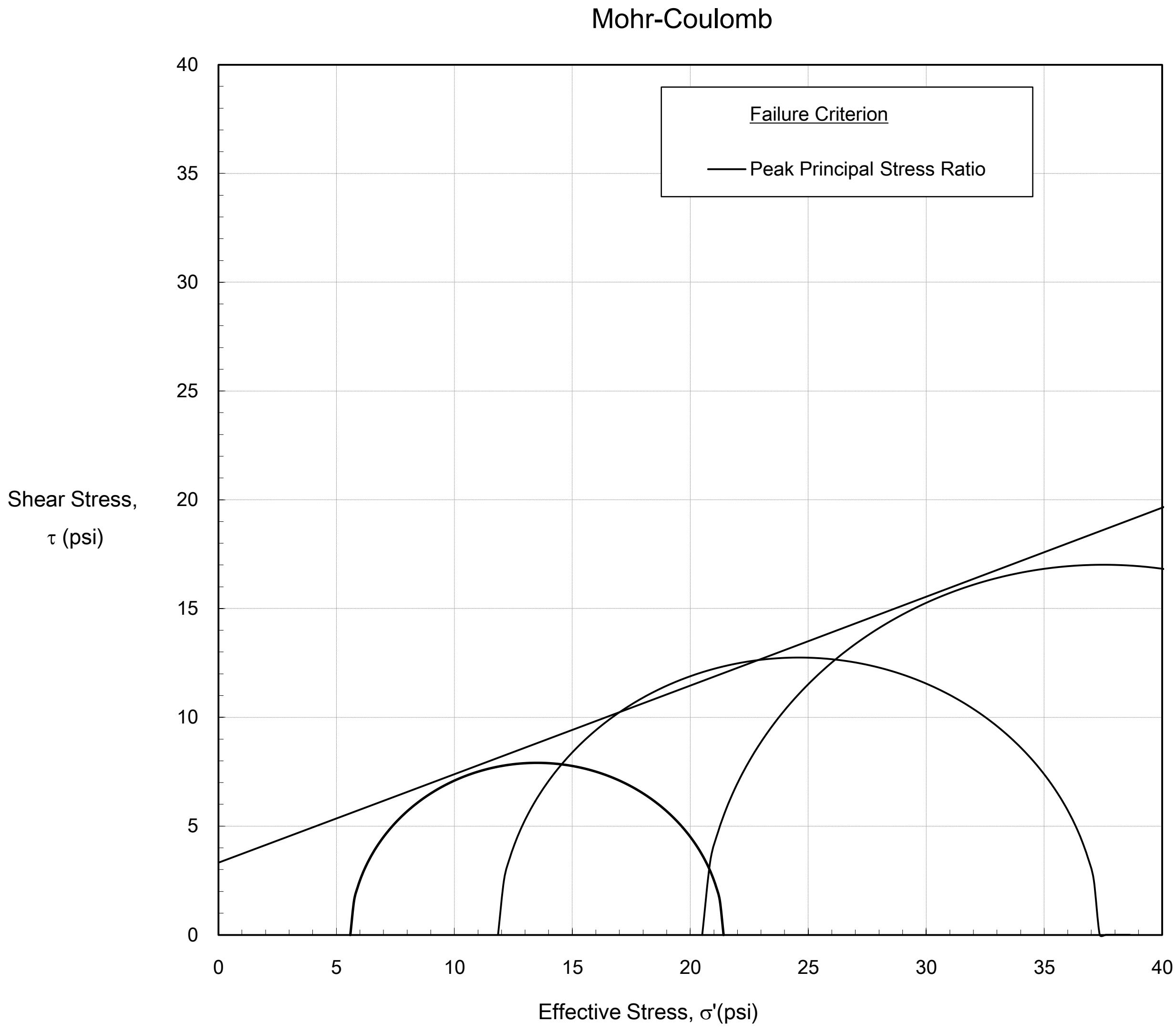
Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B2: 33-35		



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	22.1
Effective Cohesion (psi)	-	3.3

Multi-Stage Consolidated-Undrained Triaxial Compression

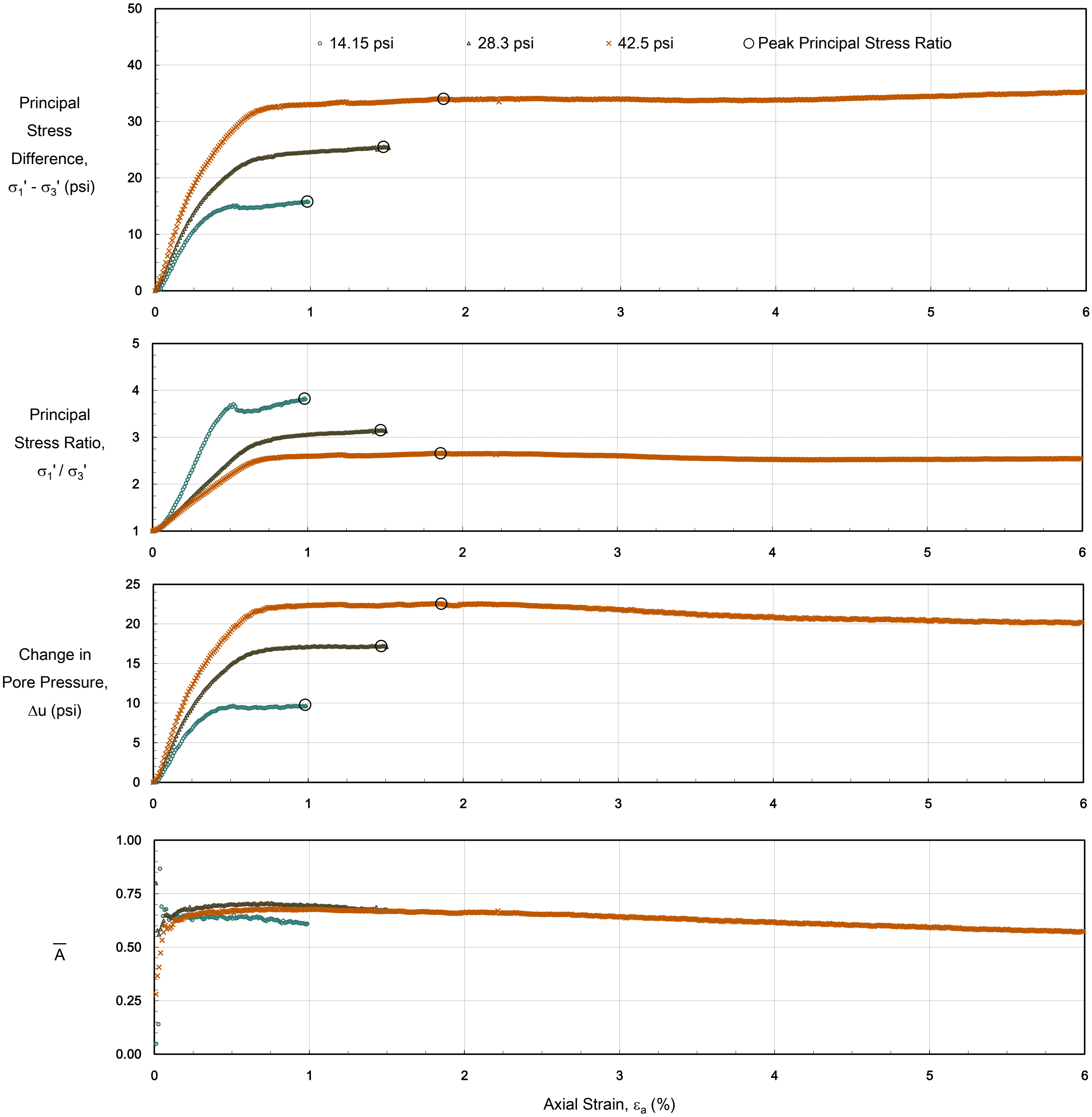
Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B2: 33-35		



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	22.1
Effective Cohesion (psi)	-	3.3

Multi-Stage Consolidated-Undrained Triaxial Compression

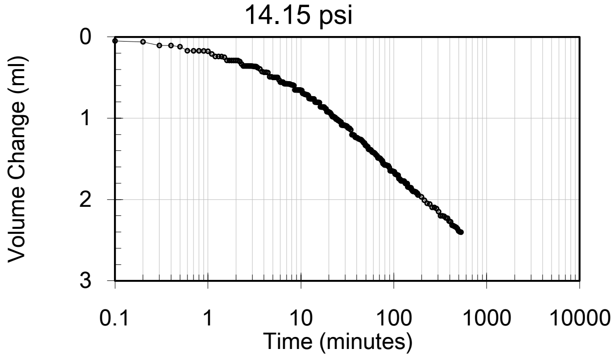
Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B2: 33-35		

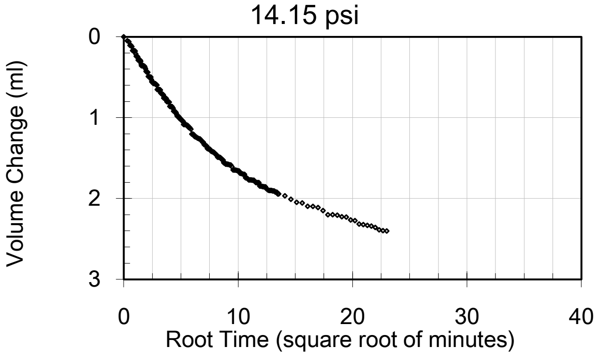


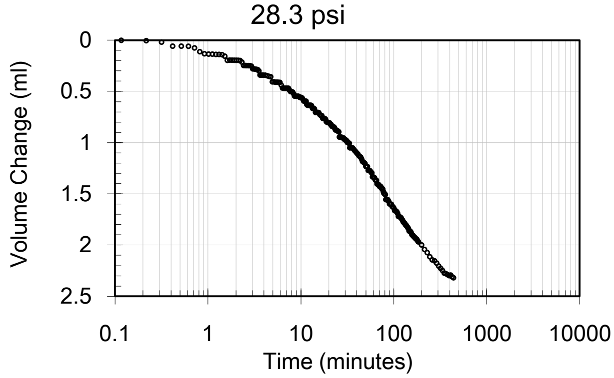
Multi-Stage Consolidated-Undrained Triaxial Compression

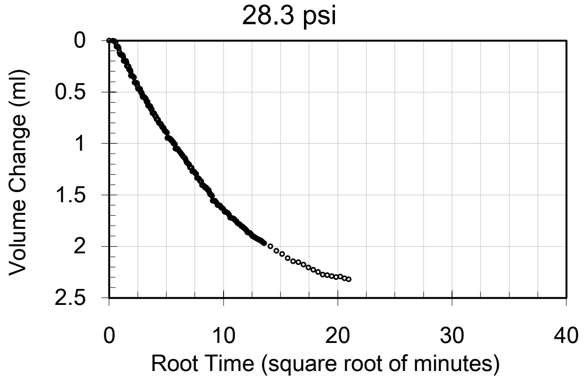
Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B2: 33-35		

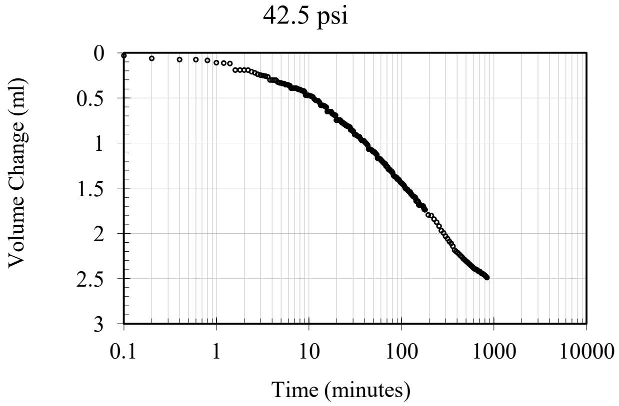
Consolidation

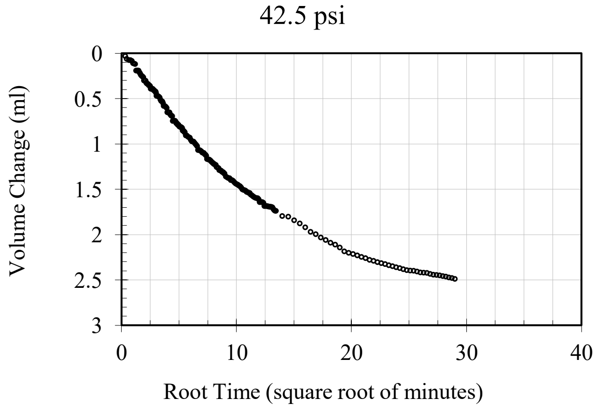








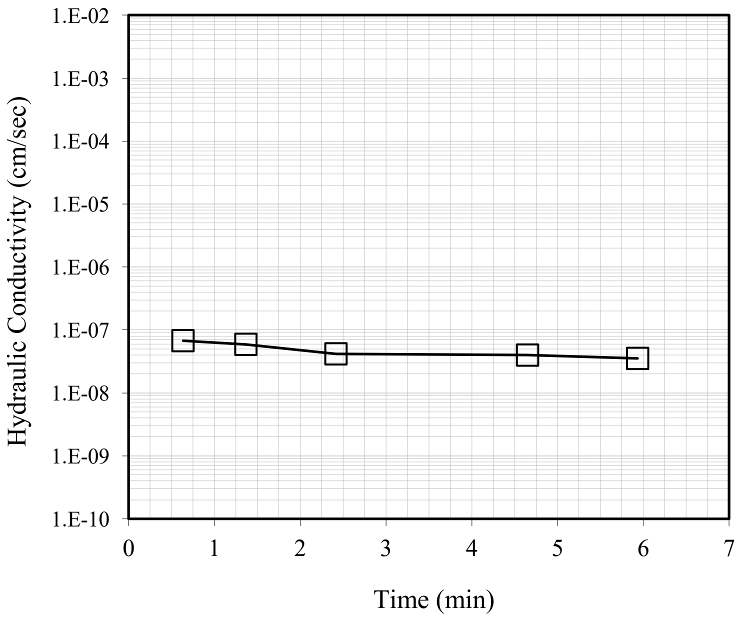




Hydraulic Conductivity

Client:	Auckland Consulting LLC
Project:	Winston Pond
Sample ID:	B3: 3-5

TRI Log #:	20888
Test Method:	ASTM D5084 Method F



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.83
Height (in)	1.59
Initial Mass (g)	341.8
Sample Area (in^2)	6.28
Water Content (%)	15.9
Total Unit Weight (pcf)	130.4
Dry Unit Weight (pcf)	112.6
Specific Gravity (Assumed)	2.65
Degree of Saturation	89.6
Void Ratio	0.47
Porosity	0.32
1 Pore Volume (cc)	52.2
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.96

Specimen Image

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
1.4	5.9E-08
2.4	4.2E-08
4.6	4.0E-08
5.9	3.5E-08
Average, Last 2 Readings	**3.8E-08**

Note: Permeation measurements were made with a mercury U-tube.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016

Analysis & Quality Review/Date

Testing Performed By: SOC & LC

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

TRI Log #: 20888
Test Method: ASTM D4767 Mod

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	3.8	7.5	15.0
Initial Specimen Properties			
Avg. Diameter (in)	2.05	2.05	2.05
Avg. Height (in)	4.46	4.46	4.46
Avg. Water Content (%)	17.8	-	-
Bulk Density (pcf)	130.1	130.1	130.1
Dry Density (pcf)	110.5	-	-
Saturation (%)	91.3	-	-
Void Ratio, n	0.53	0.53	0.53
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	81.1	81.1	81.1
B-Value, End of Saturation	1.00	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.51	0.51	0.51
Area (in^2)	3.27	3.27	3.26

Shear / Post-Shear			
Avg. Water Content (%)	-	-	19.9
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	1.0	0.8	2.7
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	2.2	4.4	10.1
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	7.0	11.6	28.5
Pore Water Pressure, Δu_f (psi)	-	-	-	1.6	3.1	4.9
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	9.2	16.0	38.6
Effective Friction Angle (degrees)	-			35.1		
Effective Cohesion (psi)	-			0.1		

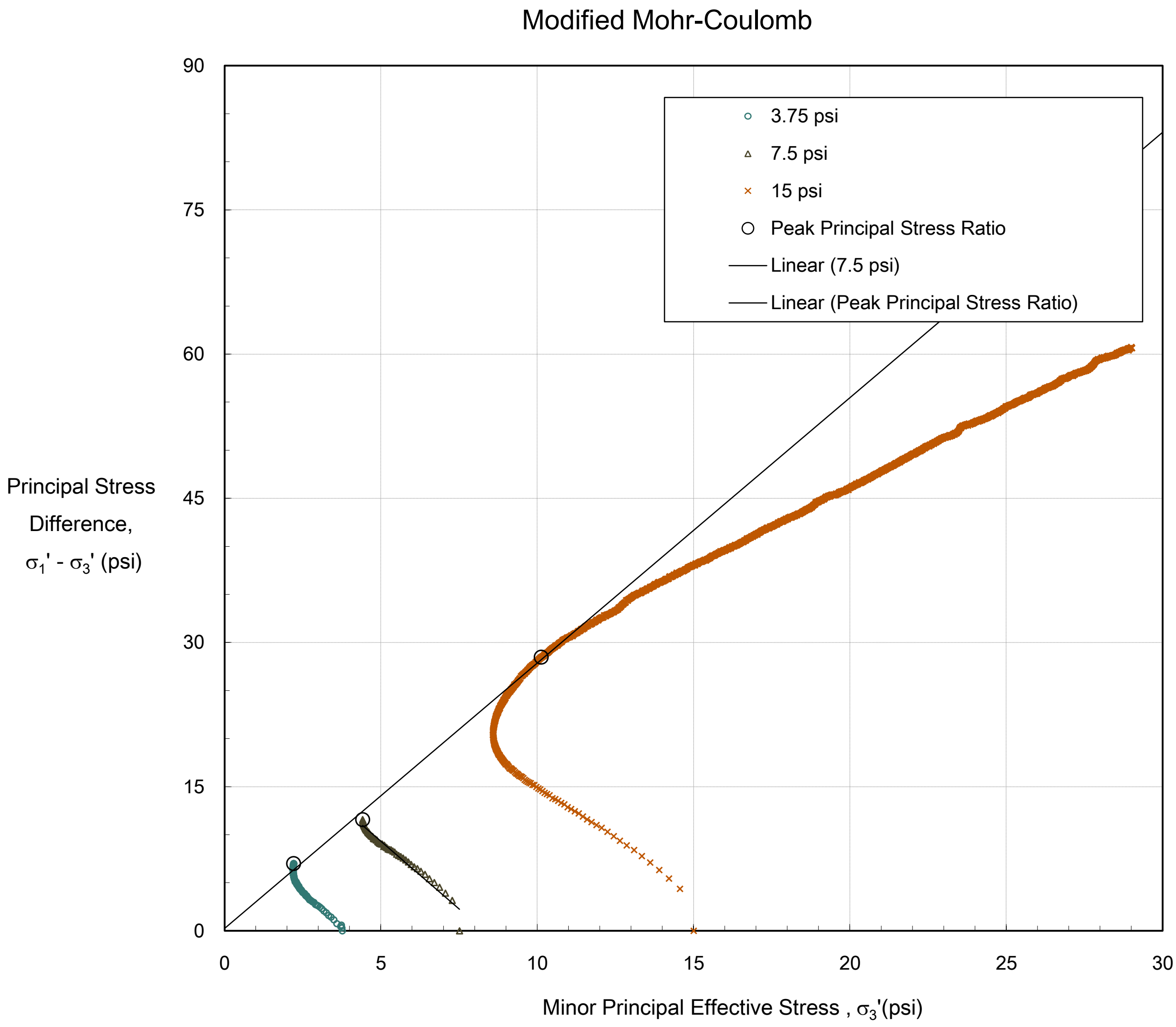
R-Envelope, "Total" Stress		
Friction Angle (deg)	-	28.5
Cohesion (psi)	-	0 (Forced)

Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/13/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B3: 8-10		

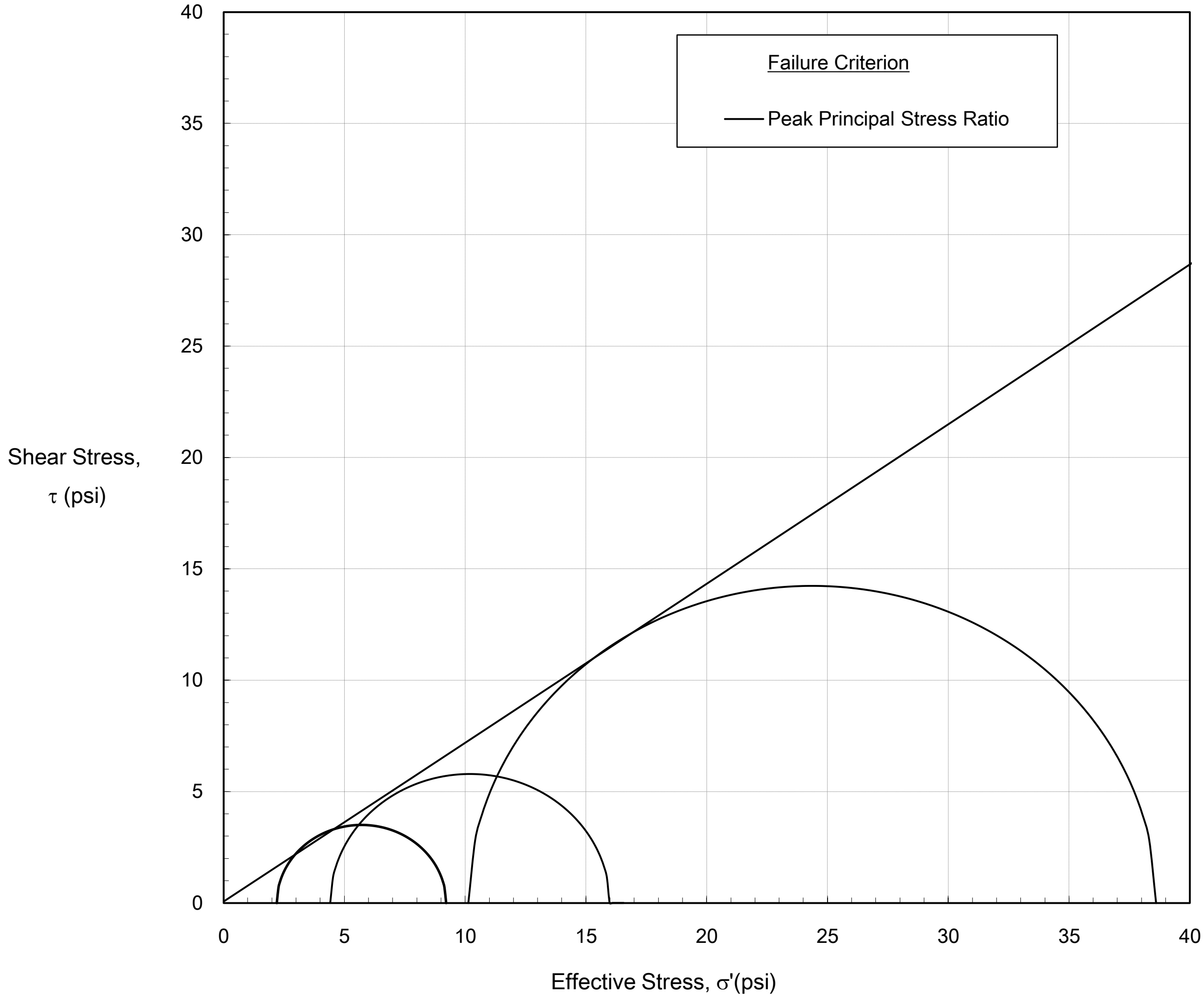


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	35.1
Effective Cohesion (psi)	-	0.1

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B3: 8-10		

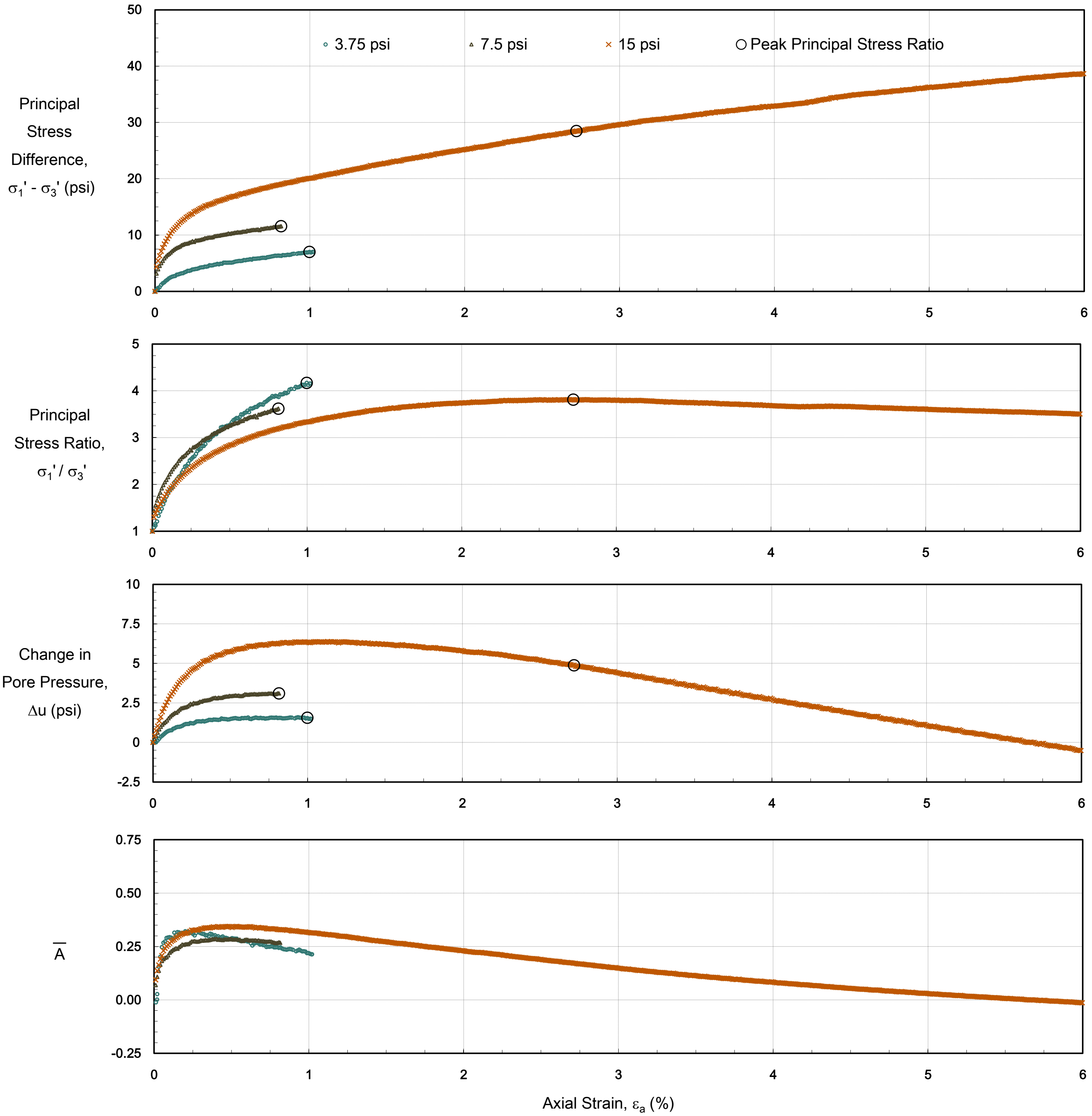
Mohr-Coulomb



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	35.1
Effective Cohesion (psi)	-	0.1

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B3: 8-10		

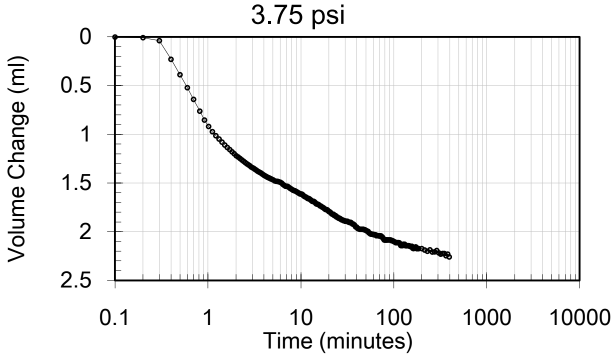


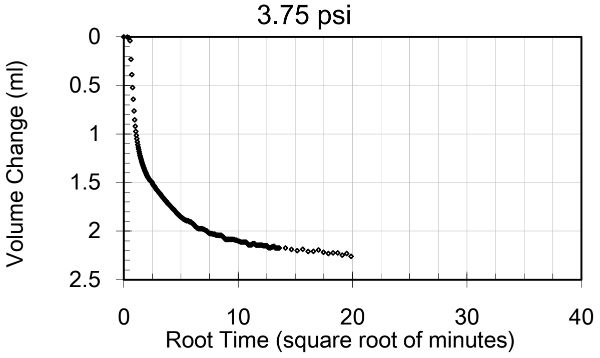
Multi-Stage Consolidated-Undrained Triaxial Compression

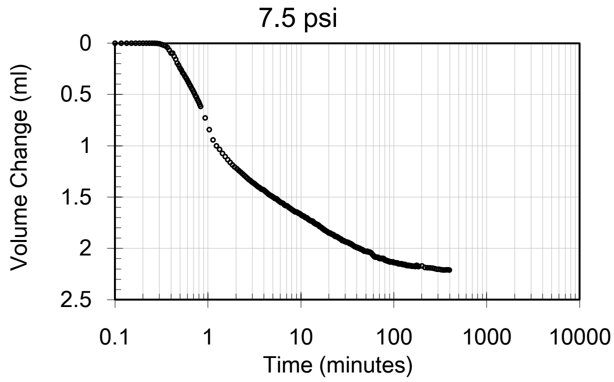
Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

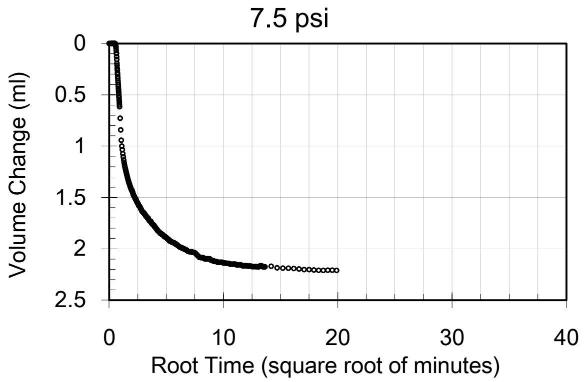
TRI Log #: 20888
Test Method: ASTM D4767 Mod

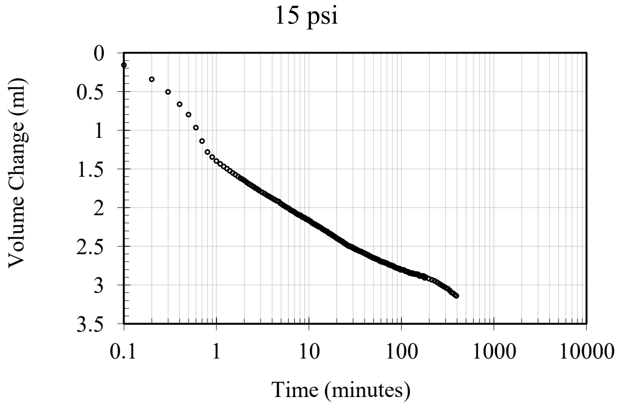
Consolidation

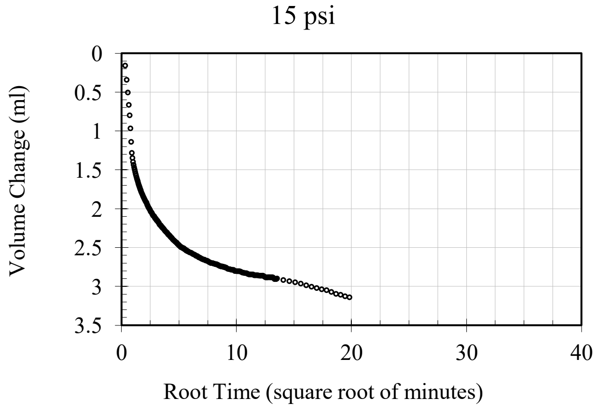








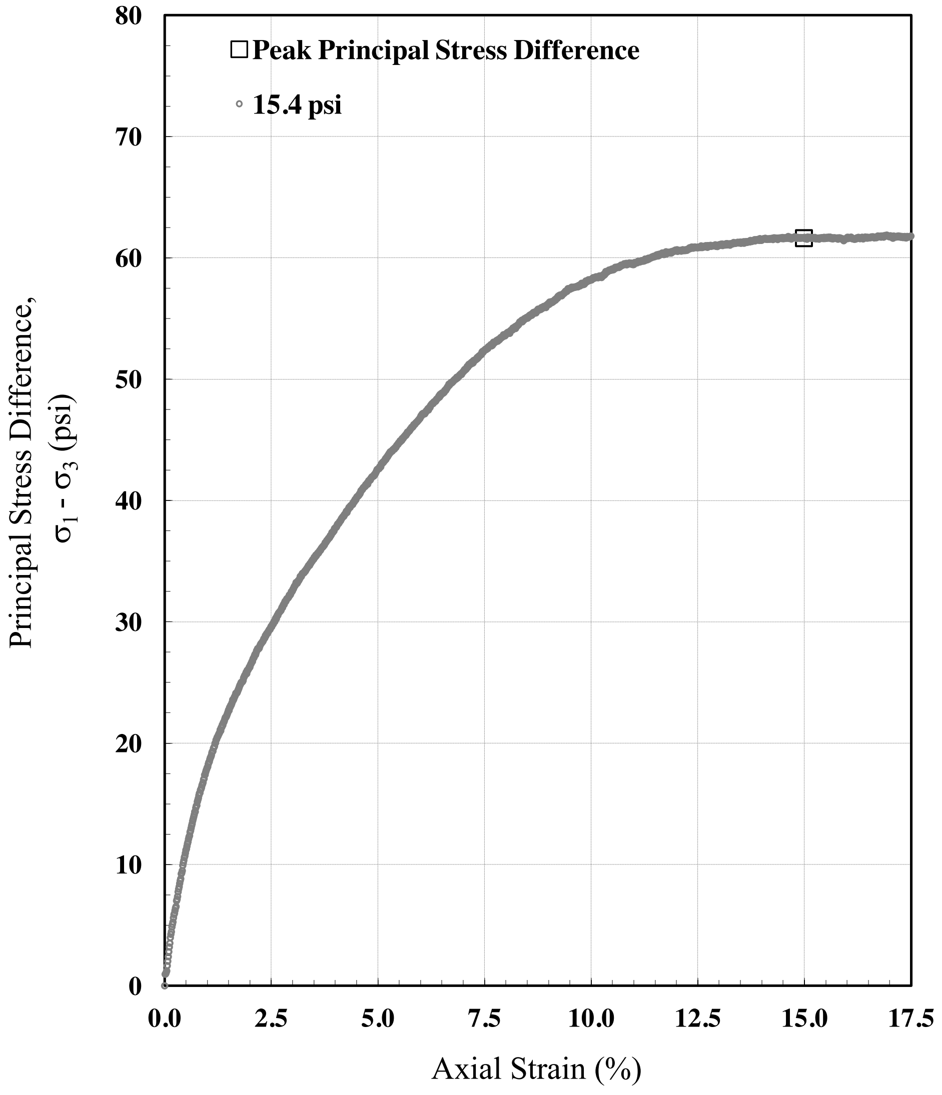




Unconsolidated-Undrained (Q) Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 18-19

TRI Log #: 20888
Test Method: ASTM D2850



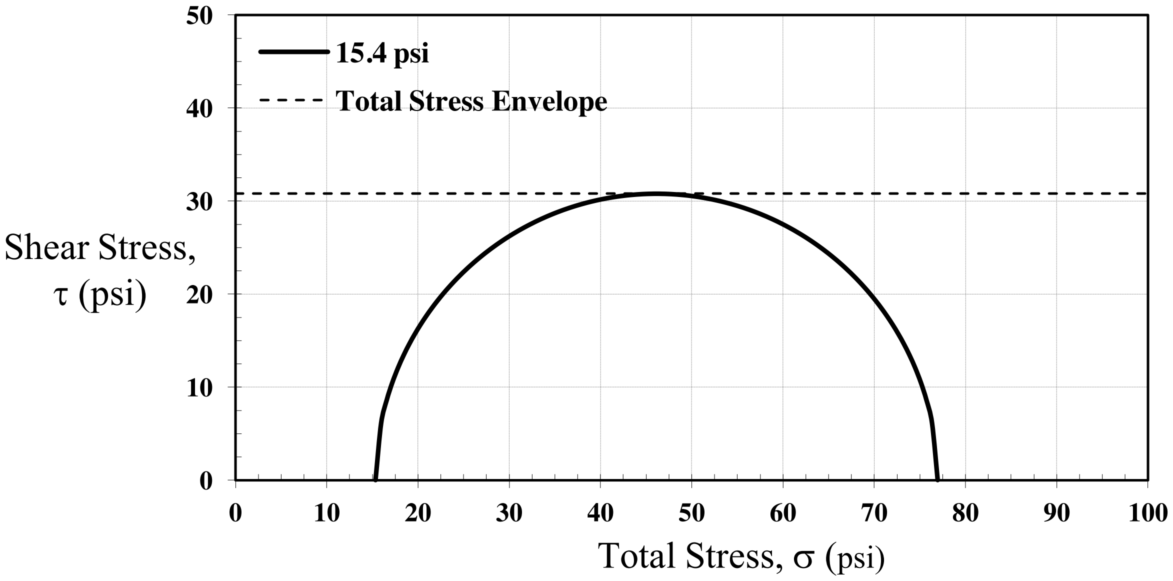
Test Parameters	
Minor Principal Stress (psi)	15.4
Rate of Strain (%/hr)	60

Initial Properties	
Avg. Diameter (in)	1.31
Avg. Height (in)	2.55
Avg. Water Content (%)	18.6
Bulk Density (pcf)	129.6
Dry Density (pcf)	109.2
Saturation (%)	95.9
Void Ratio	0.51
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	15.0
Minor Total Stress (psi)	15.4
Major Total Stress (psi)	77.0
Principal Stress Diff. (psi)	61.6

Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	30.8
S_u / σ_3	2.0

Note: The Mohr failure envelope was taken as a horizontal straight line. It should, however, be noted that the specimen was partially saturated.



Jeffrey A. Kuhn , Ph.D., P.E., 6/30/2016

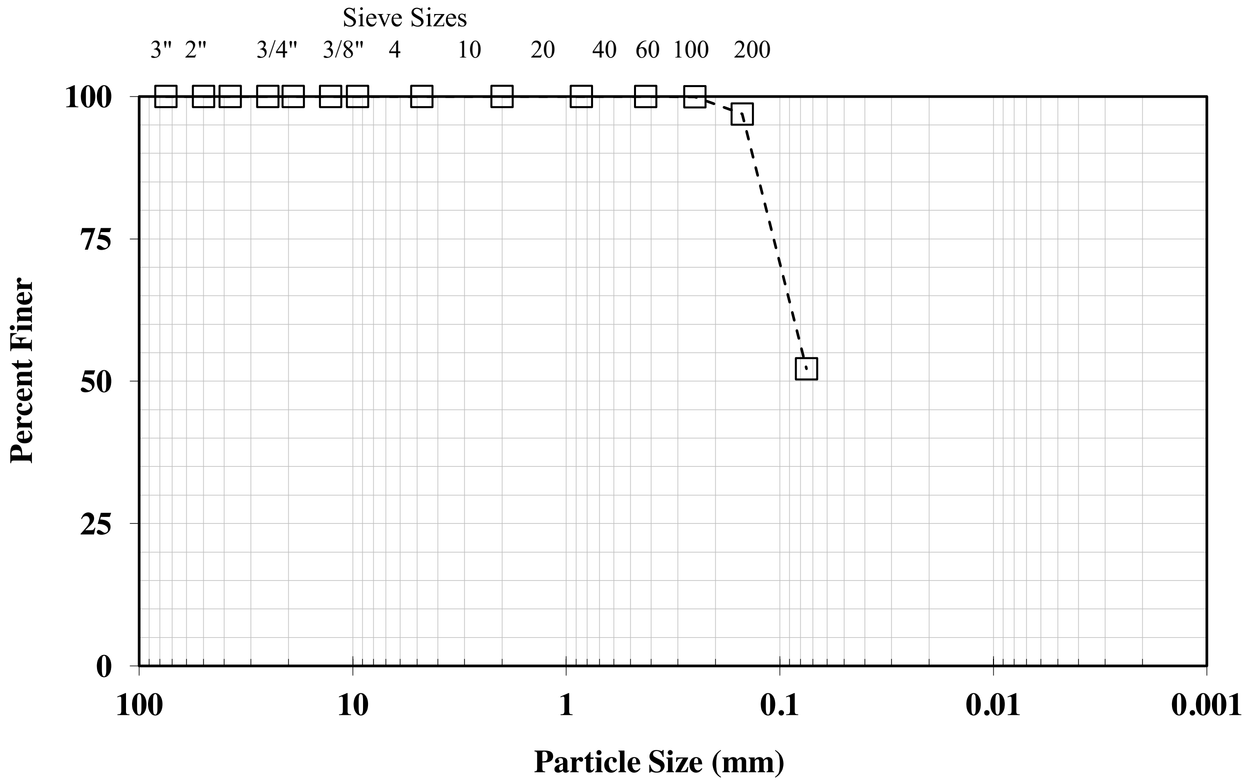
Analysis & Quality Review/Date

Laboratory Staff: LC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3 28-30

TRI Log#: 20888.13
Test Method: ASTM D422



Sieve Analysis		
Sieve Size		Percent Passing
3 in.	(76.2 mm)	100.0
2 in.	(50.8 mm)	100.0
1.5 in.	(38.1 mm)	100.0
1 in.	(25.4 mm)	100.0
3/4 in.	(19.0 mm)	100.0
1/2 in.	(12.7 mm)	100.0
3/8 in.	(9.51 mm)	100.0
No. 4	(4.76 mm)	100.0
No. 10	(2.00 mm)	100.0
No. 20	(0.841 mm)	100.0
No. 40	(0.420 mm)	100.0
No. 60	(0.250 mm)	99.9
No. 100	(0.149 mm)	96.9
No. 200	(0.074 mm)	52.2

Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

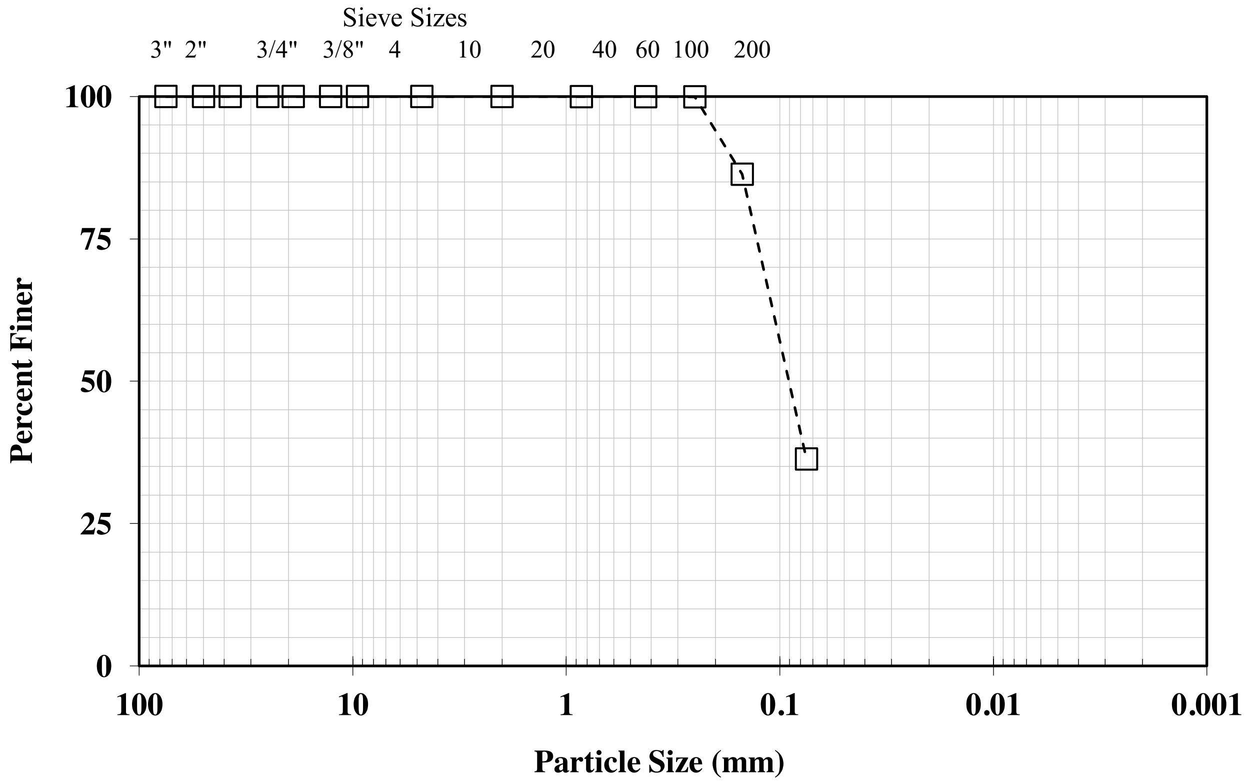
USCS Classification (ASTM D2487)	Sandy lean clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	11.9
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	29
	Plastic Limit	21
	Plastic Index	8
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B6: 28-30

TRI Log#: 20888.20
Test Method: ASTM D422



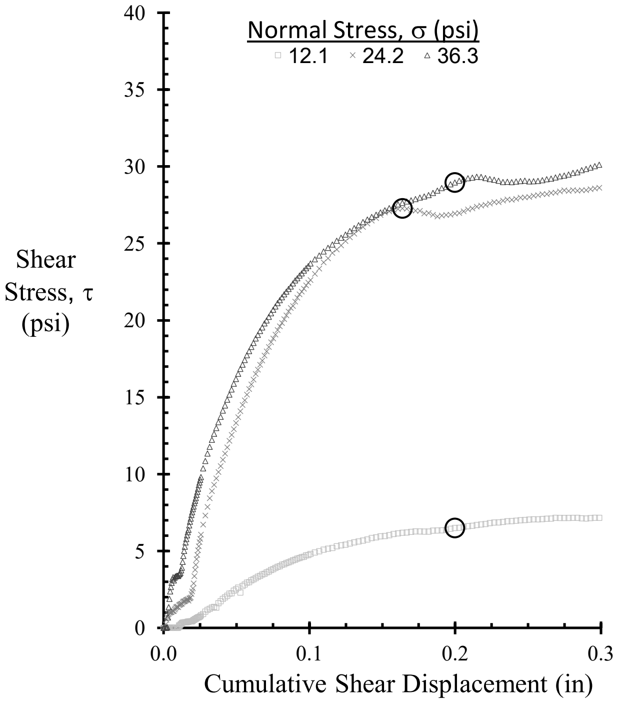
Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (0.841 mm)	100.0
No. 40 (0.420 mm)	100.0
No. 60 (0.250 mm)	99.9
No. 100 (0.149 mm)	86.3
No. 200 (0.074 mm)	36.3
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

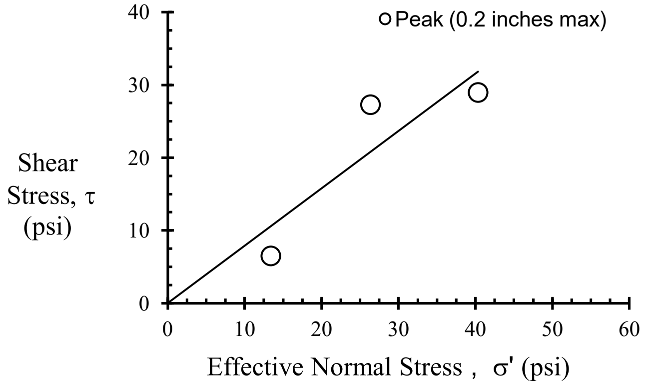
USCS Classification (ASTM D2487)	Silty sand (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	28.9
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	25
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

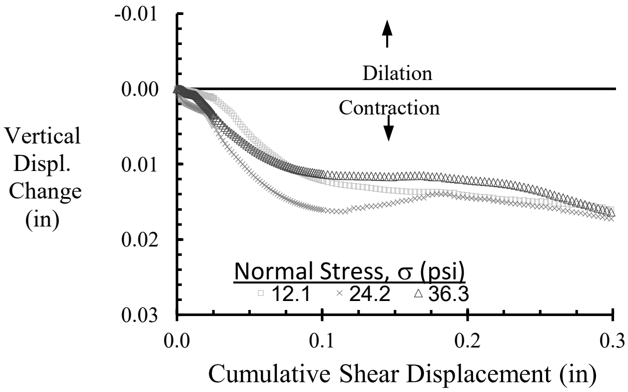
Direct Shear of Soil Under Consolidated-Drained Conditions

Client:	Auckland Consulting LLC	TRI Log#:	20888
Project:	Winston Pond	Test Method:	ASTM D 3080
Sample:	B6: 28-30		





Note: Area Correction Has Been Applied



	Sample Number	1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	29.9	27.7	28.8
	Saturation, %	225.9	223.9	225.0
	Dry Density, pcf	122.4	124.5	123.4
	Void Ratio	0.35	0.33	0.34
Post Consol	Height, in (prior to shear)	0.94	0.96	0.97
	Final Water Content, %	25.5	21.5	21.9
	Dry Density, pcf	130.9	129.3	126.6
	Void Ratio	0.26	0.28	0.31
Displacement rate (in/min)		2.0E-03	2.0E-03	2.0E-03
Peak (0.2 inches)	Normal Stress, σ' (psi)	13.40	26.36	40.34
	Shear Stress, τ (psi)	6.50	27.28	28.96
	Displacement (in)	0.20	0.16	0.20
	ϕ'_d, degrees	38.3		
	c'_d, psi	0 (Forced)		

Note: The loose sample was tamped in place. A specific gravity of 2.65 was assumed for weight-volume calculations.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/16

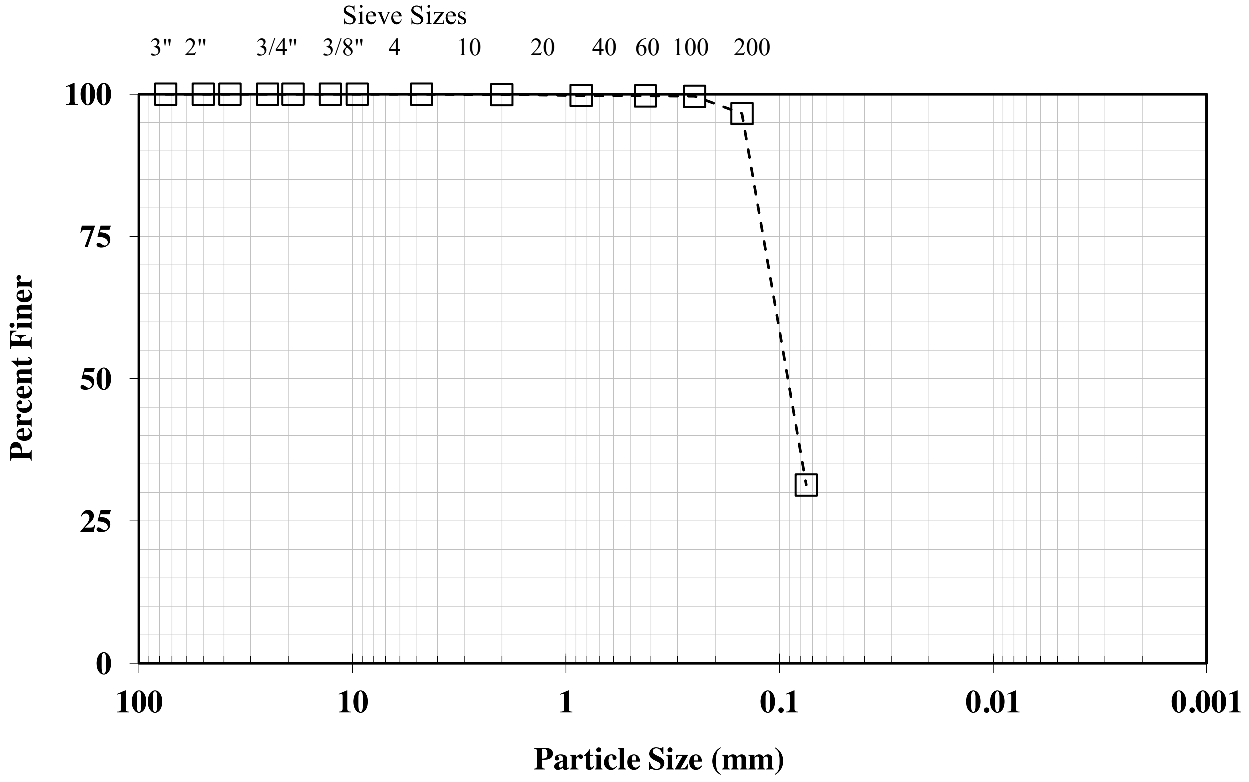
Analysis & Quality Review/Date

Test Performed By: LC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B7 13-15

TRI Log#: 20888.24
Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	99.9
No. 20 (0.841 mm)	99.8
No. 40 (0.420 mm)	99.7
No. 60 (0.250 mm)	99.6
No. 100 (0.149 mm)	96.6
No. 200 (0.074 mm)	31.3
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

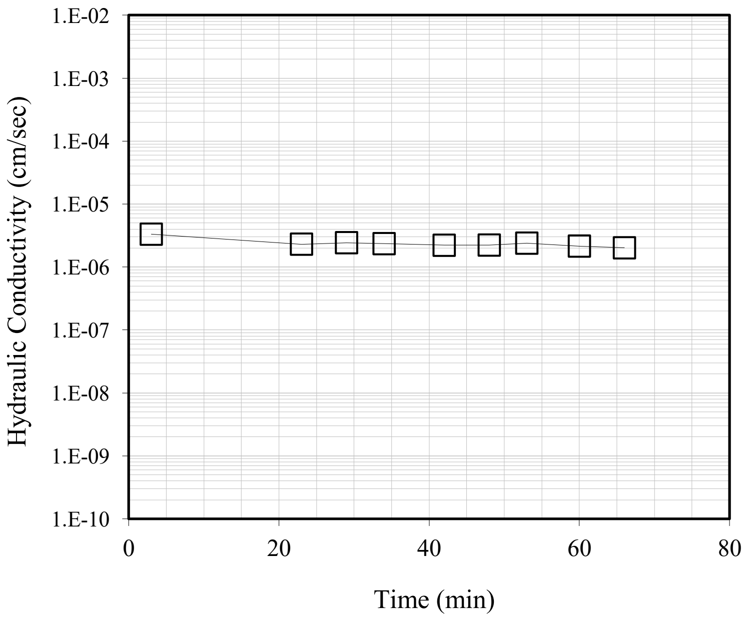
USCS Classification (ASTM D2487)	Silty sand (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	25.6
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	24
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Hydraulic Conductivity

Client:	Auckland Consulting LLC
Project:	Winston Pond
Sample ID:	B7: 13-15

TRI Log #:	20888
Test Method:	ASTM D5084 Method C



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.80
Height (in)	2.21
Initial Mass (g)	444.2
Sample Area (in^2)	6.16
Water Content (%)	24.5
Total Unit Weight (pcf)	124.3
Dry Unit Weight (pcf)	99.9
Specific Gravity (Assumed)	2.65
Degree of Saturation	99.0
Void Ratio	0.66
Porosity	0.40
1 Pore Volume (cc)	88.3
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.99

Specimen Image

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
48.0	2.2E-06
53.0	2.4E-06
60.0	2.2E-06
66.0	2.0E-06
Average, Last 4 Readings	**2.2E-06**

Note: Permeation measurements were made with a mercury U-tube.

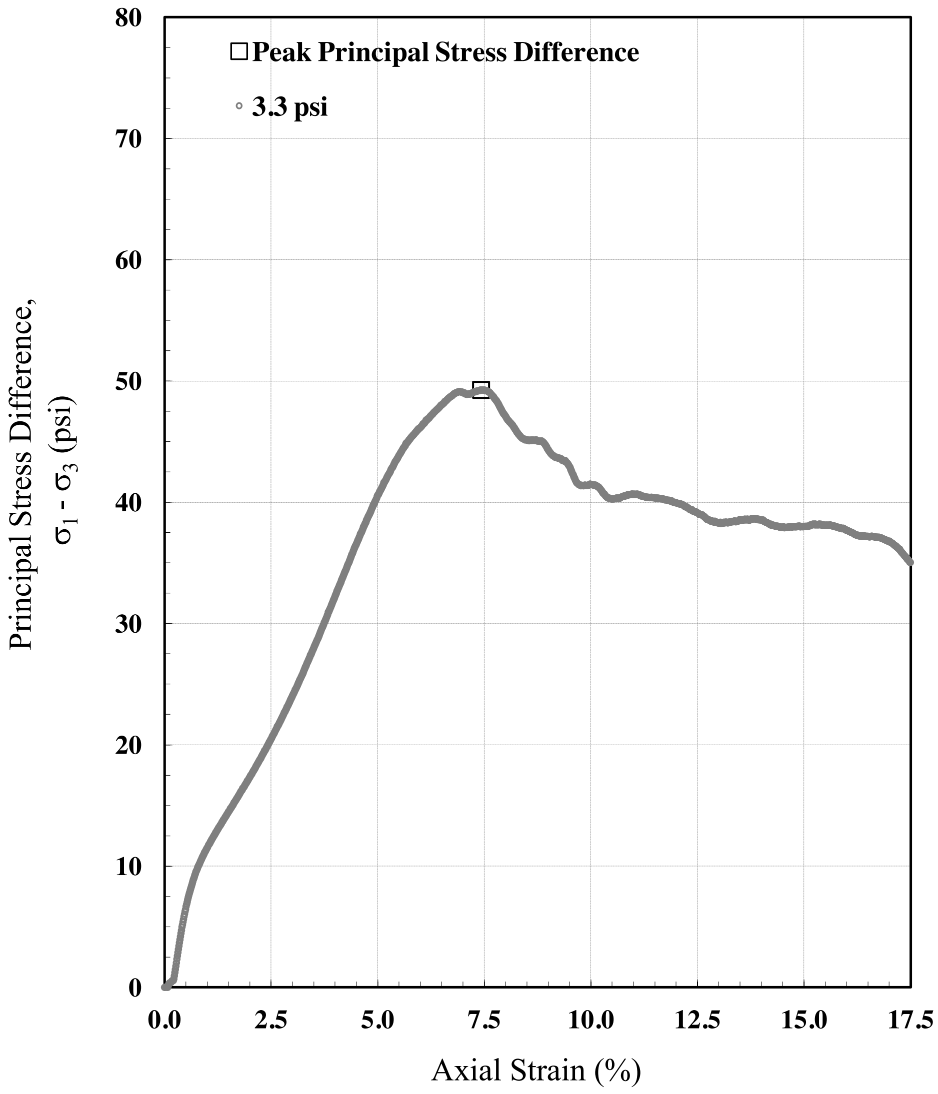
Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016

Analysis & Quality Review/Date

Testing Performed By: SOC & LC

Unconsolidated-Undrained (Q) Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	20888
Project:	Winston Pond	Test Method:	ASTM D2850
Sample:	B8: 3-5		



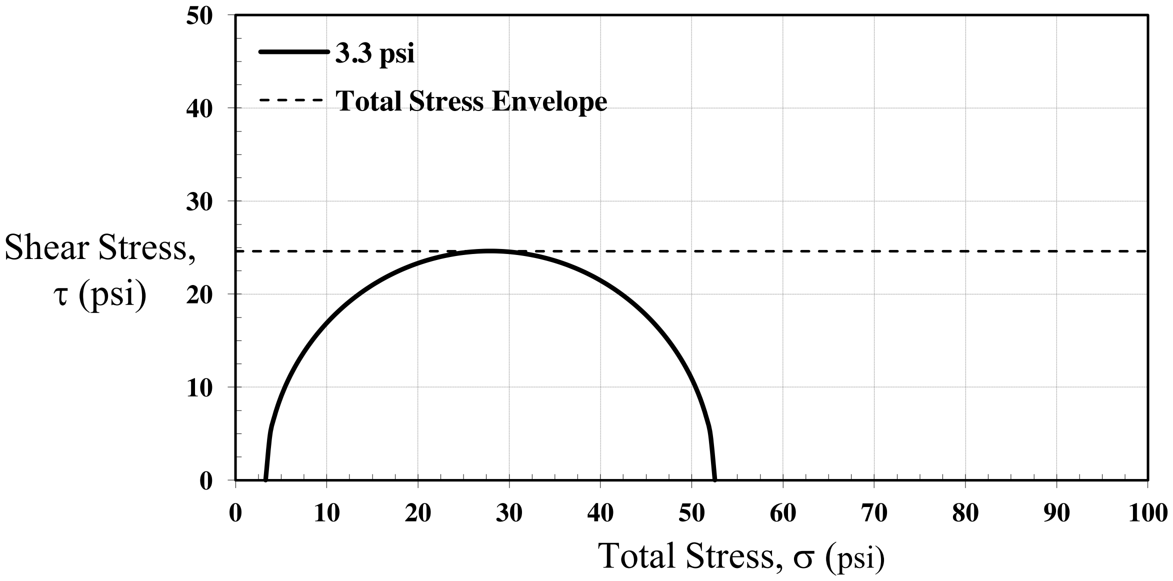
Test Parameters	
Minor Principal Stress (psi)	3.3
Rate of Strain (%/hr)	60

Initial Properties	
Avg. Diameter (in)	2.80
Avg. Height (in)	5.60
Avg. Water Content (%)	15.2
Bulk Density (pcf)	132.9
Dry Density (pcf)	115.4
Saturation (%)	92.8
Void Ratio	0.43
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	7.4
Minor Total Stress (psi)	3.3
Major Total Stress (psi)	52.6
Principal Stress Diff. (psi)	49.3

Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	24.6
S_u / σ_3	7.5

Note: The Mohr failure envelope was taken as a horizontal straight line. It should, however, be noted that the specimen was partially saturated.

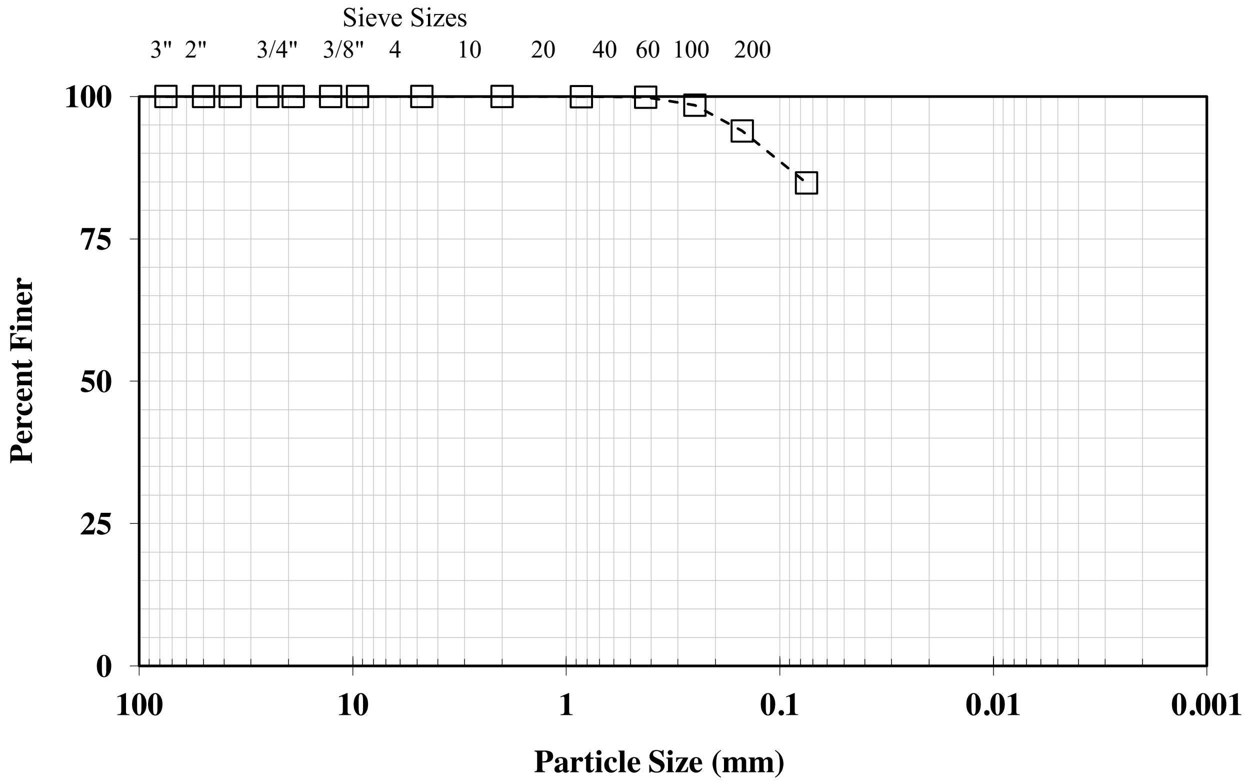


Jeffrey A. Kuhn , Ph.D., P.E., 6/30/2016
Analysis & Quality Review/Date
Laboratory Staff: LC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B8 38-40

TRI Log#: 20888.32
Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (0.841 mm)	100.0
No. 40 (0.420 mm)	99.9
No. 60 (0.250 mm)	98.5
No. 100 (0.149 mm)	93.9
No. 200 (0.074 mm)	84.8
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

USCS Classification (ASTM D2487)	- -	
As-Received Moisture Content (%)	(ASTM D2216)	28.8
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	- -
	Plastic Limit	- -
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (3-5)

TRI Log #: 21381
Test Method: ASTM D4767 Mod

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	5.0	10.0	15.0
Initial Specimen Properties			
Avg. Diameter (in)	1.95	1.96	1.97
Avg. Height (in)	4.39	4.33	4.24
Avg. Water Content (%)	18.1	-	-
Bulk Density (pcf)	128.7	129.5	130.6
Dry Density (pcf)	109.0	-	-
Saturation (%)	89.4	-	-
Void Ratio, n	0.55	0.54	0.52
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	81.0	80.9	80.9
B-Value, End of Saturation	0.97	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.54	0.52	0.51
Area (in^2)	2.98	3.00	3.04

Shear / Post-Shear			
Avg. Water Content (%)	-	-	20.6
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	0.8	1.3	1.6
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	2.7	6.1	11.1
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	9.1	16.6	25.8
Pore Water Pressure, Δu_f (psi)	-	-	-	2.5	4.2	4.2
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	11.8	22.7	36.9
Effective Friction Angle (degrees)	-			29.9		
Effective Cohesion (psi)	-			1.2		

R-Envelope, "Total" Stress		
Friction Angle (deg)	-	26.9
Cohesion (psi)	-	0.1

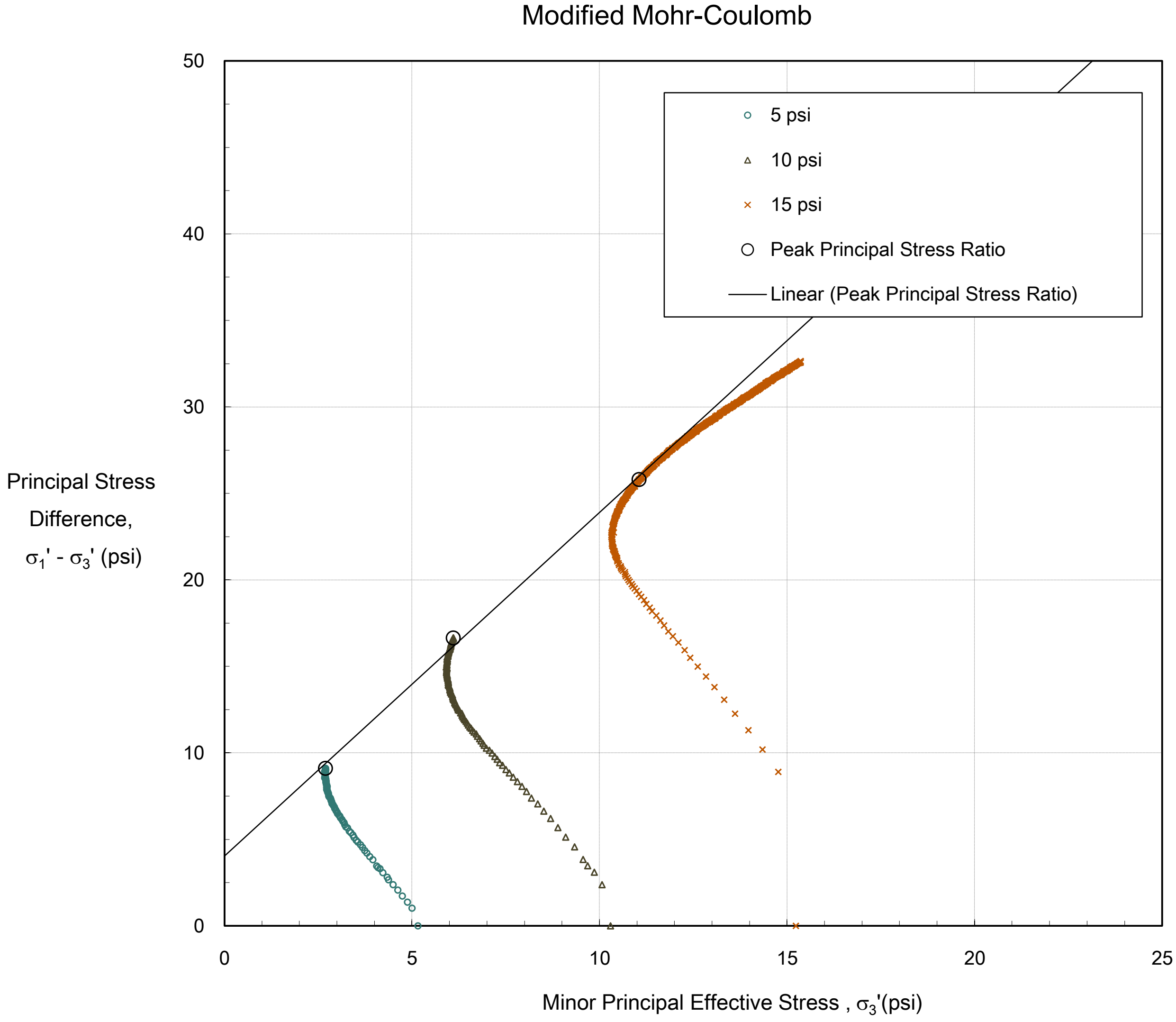
Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/12/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (3-5)

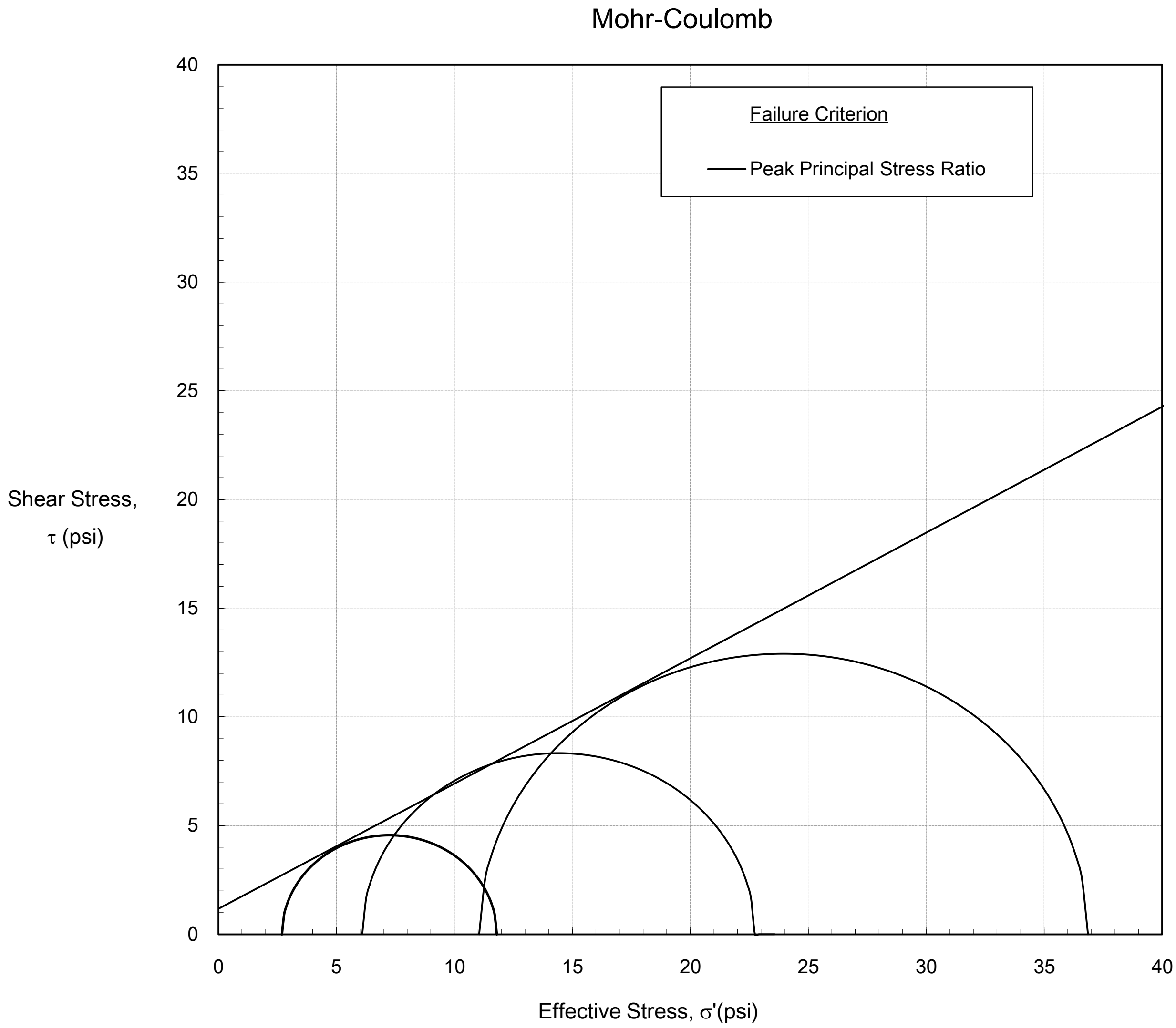
TRI Log #: 21381
Test Method: ASTM D4767 Mod



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	29.9
Effective Cohesion (psi)	-	1.2

Multi-Stage Consolidated-Undrained Triaxial Compression

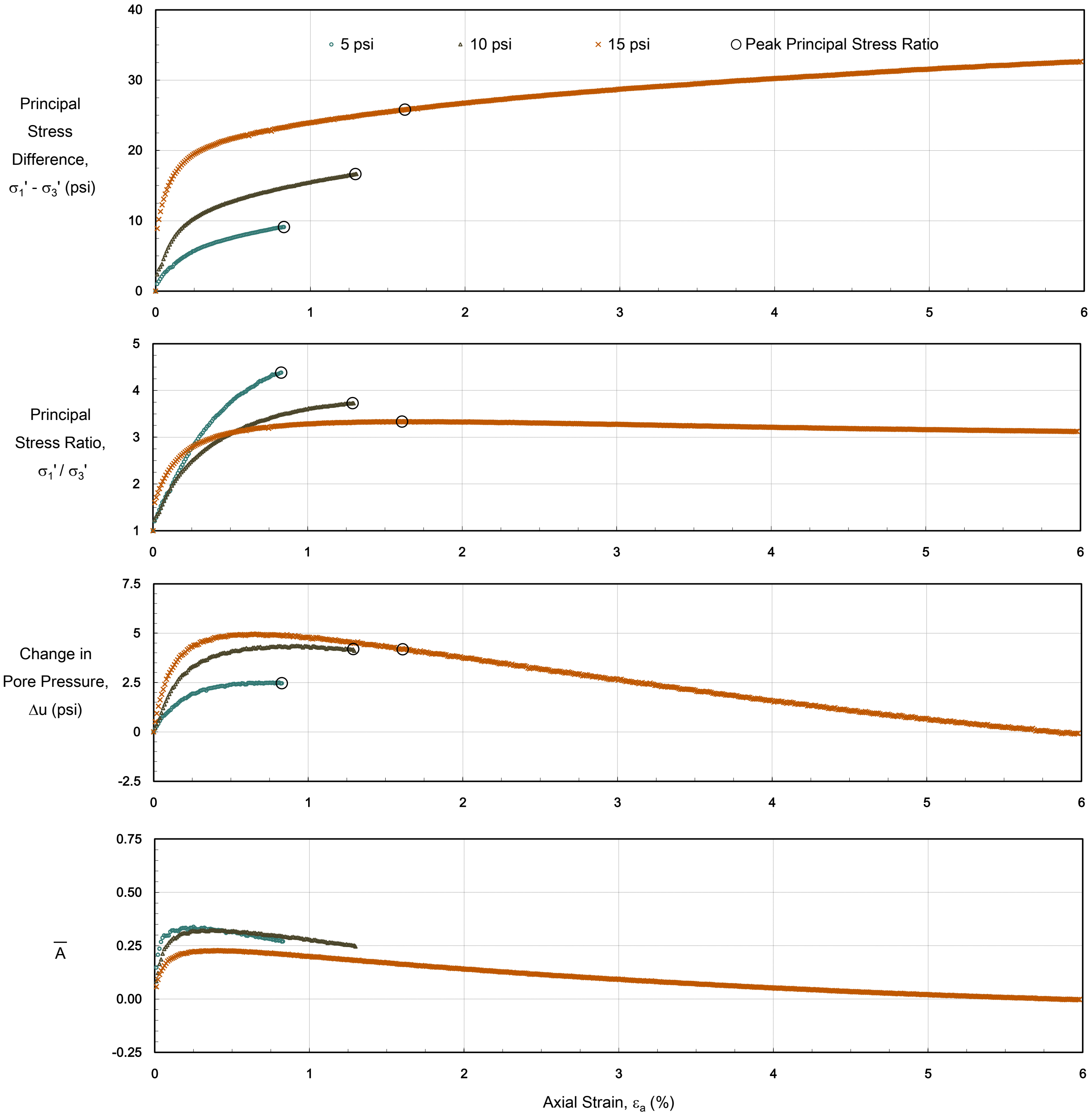
Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-4 (3-5)		



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	29.9
Effective Cohesion (psi)	-	1.2

Multi-Stage Consolidated-Undrained Triaxial Compression

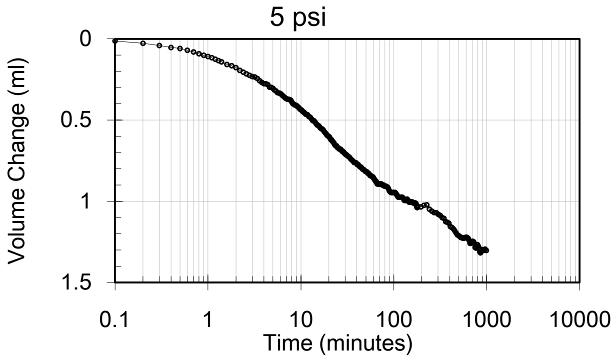
Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-4 (3-5)		

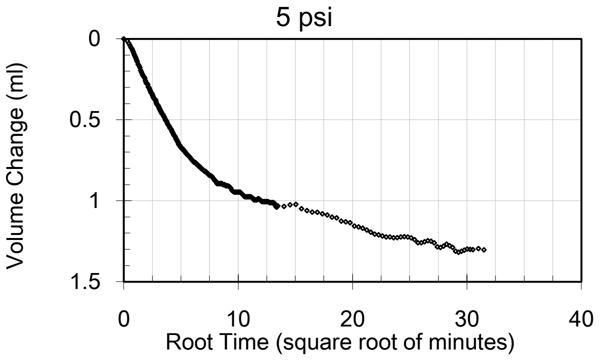


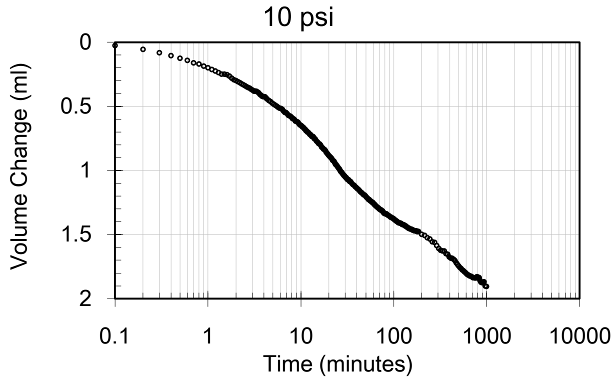
Multi-Stage Consolidated-Undrained Triaxial Compression

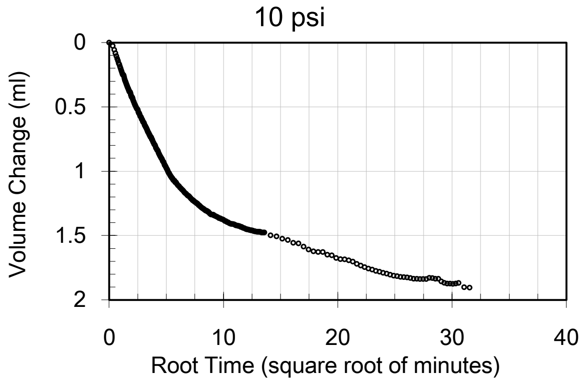
Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-4 (3-5)		

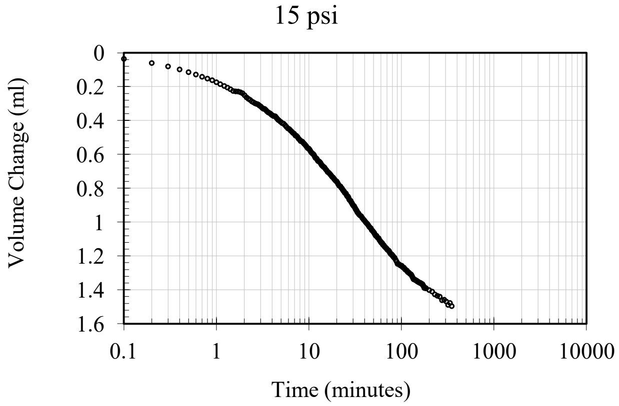
Consolidation

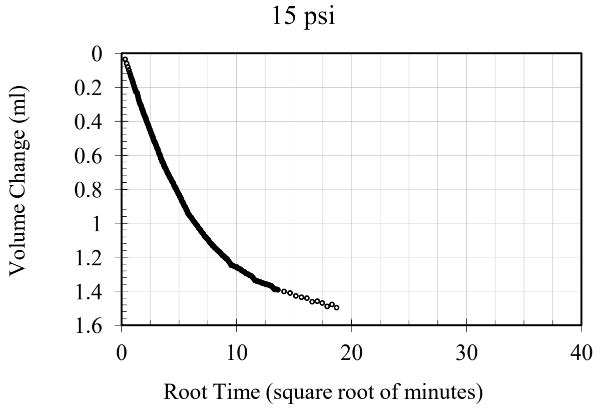








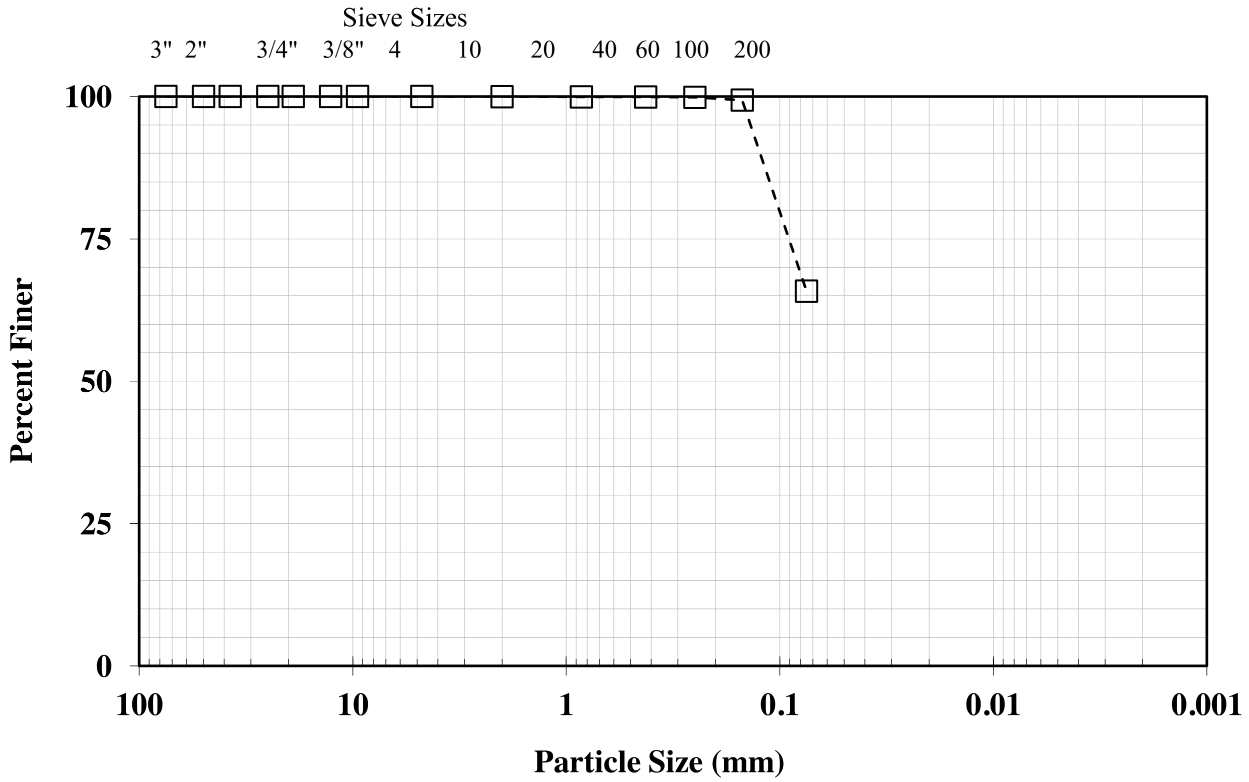




Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (8-10)

TRI Log#: 21381.3
Test Method: ASTM D422



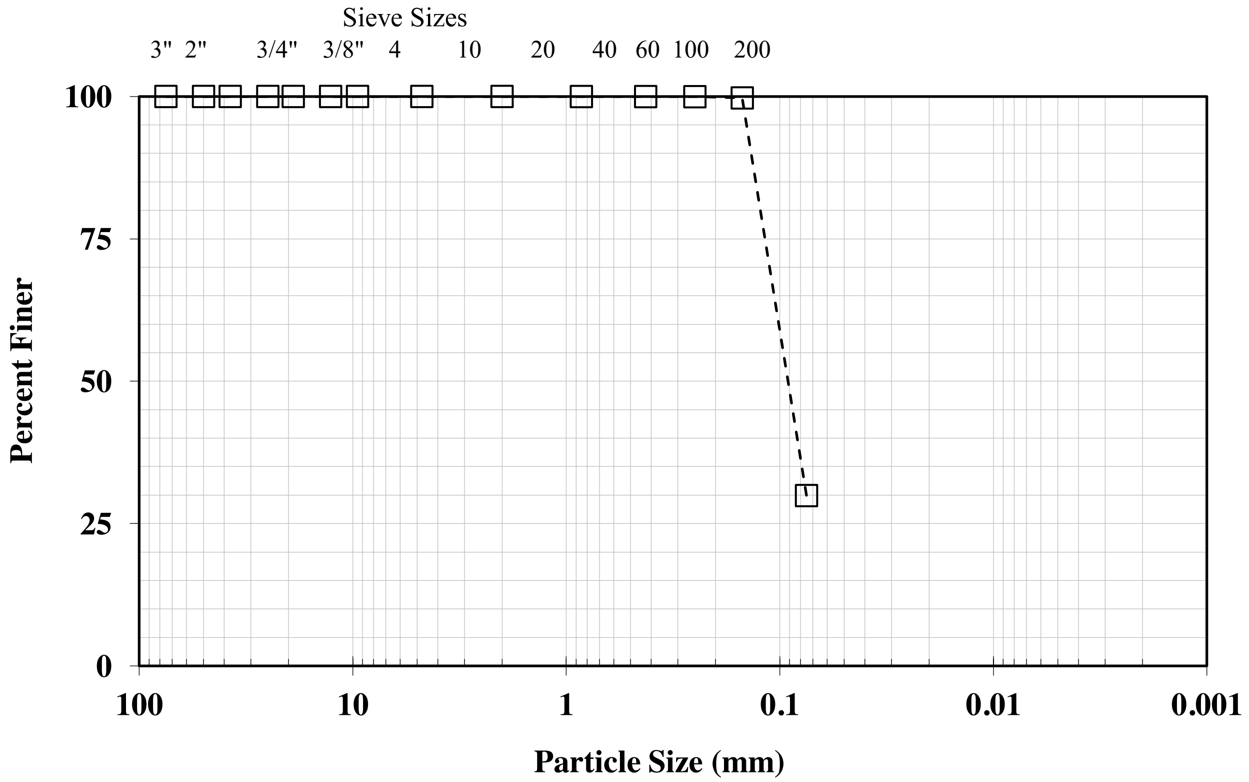
Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (0.841 mm)	99.9
No. 40 (0.420 mm)	99.9
No. 60 (0.250 mm)	99.8
No. 100 (0.149 mm)	99.4
No. 200 (0.074 mm)	65.8
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

USCS Classification (ASTM D2487)	Sandy lean clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	16.3
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	33
	Plastic Limit	20
	Plastic Index	13
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Particle Size Analysis for Soils

Client:	Auckland Consulting LLC	TRI Log#: 21381.7
Project:	Winston Pond	Test Method: ASTM D422
Sample:	B-4 (33-35)	



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	100.0
No. 10 (2.00 mm)	100.0
No. 20 (0.841 mm)	100.0
No. 40 (0.420 mm)	100.0
No. 60 (0.250 mm)	100.0
No. 100 (0.149 mm)	99.7
No. 200 (0.074 mm)	29.9
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

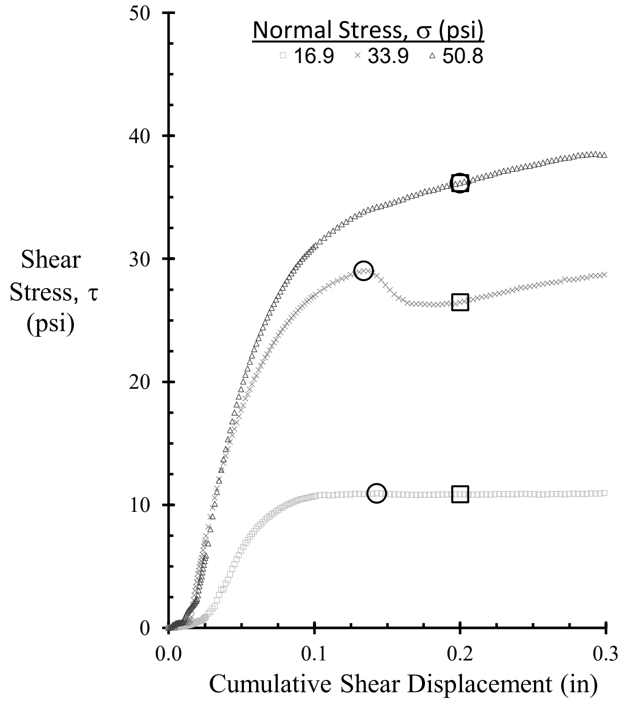
USCS Classification (ASTM D2487)	Silty sand (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	29.6
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	26
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

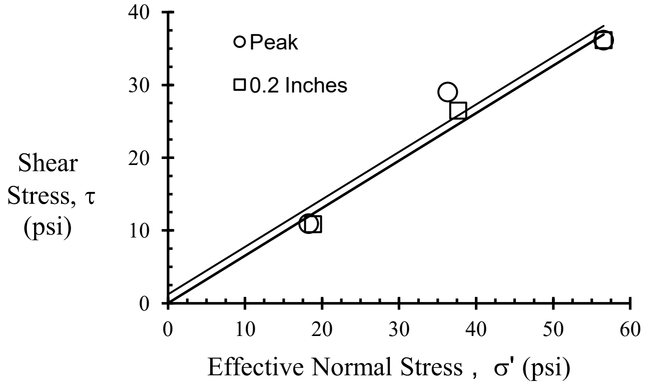
Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

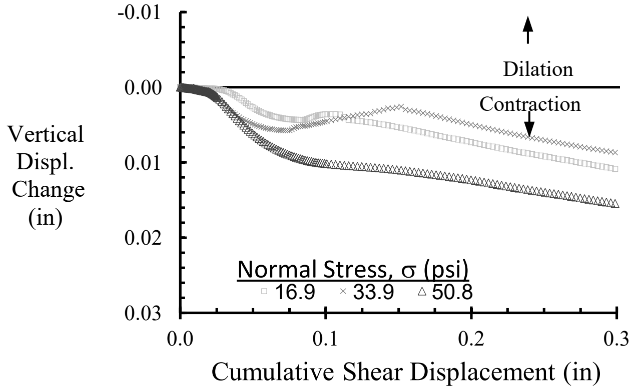
Direct Shear of Soil Under Consolidated-Drained Conditions

Client:	Auckland Consulting LLC	TRI Log#:	21381
Project:	Winston Pond	Test Method:	ASTM D 3080
Sample:	B-4 (38-40)		





Note: Area Correction Has Been Applied



	Sample Number	1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	24.7	24.9	24.9
	Saturation, %	155.9	156.2	156.2
	Dry Density, pcf	116.4	116.3	116.3
	Void Ratio	0.42	0.42	0.42
Post Consol	Height, in (prior to shear)	1.00	1.00	0.99
	Final Water Content, %	23.9	25.0	23.6
	Dry Density, pcf	116.9	116.5	117.2
	Void Ratio	0.41	0.42	0.41
Displacement rate (in/min)		2.0E-03	2.0E-03	2.0E-03
Peak	Normal Stress, σ' (psi)	18.26	36.30	56.54
	Shear Stress, τ (psi)	10.94	29.03	36.15
	Displacement (in)	0.14	0.13	0.20
	ϕ'_d, degrees	33.1		
	c'_d, psi	1.2		
Post-Peak	Normal Stress, σ' (psi)	18.83	37.66	56.54
	Shear Stress, τ (psi)	10.87	26.47	36.15
	Displacement (in)	0.20	0.20	0.20
	ϕ'_d, degrees	33.1		
	c'_d, psi	0 (Forced)		

Note: The loose sample was tamped in place. A specific gravity of 2.65 was assumed for weight-volume calculations.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/16

Analysis & Quality Review/Date

Test Performed By: LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-5 (5-7)		

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	5.0	10.0	15.0
Initial Specimen Properties			
Avg. Diameter (in)	1.85	1.85	1.87
Avg. Height (in)	4.51	4.44	4.35
Avg. Water Content (%)	17.6	-	-
Bulk Density (pcf)	139.6	141.0	142.1
Dry Density (pcf)	118.7	-	-
Saturation (%)	100.0	-	-
Void Ratio, n	0.42	0.41	0.40
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	80.7	80.8	81.5
B-Value, End of Saturation	0.94	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.41	0.40	0.38
Area (in^2)	2.67	2.68	2.72

Shear / Post-Shear			
Avg. Water Content (%)	-	-	19.1
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	0.6	1.3	1.4
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	4.3	5.6	9.9
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	9.2	11.7	23.4
Pore Water Pressure, Δu_f (psi)	-	-	-	0.7	2.8	3.4
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	13.5	17.3	33.3
Effective Friction Angle (degrees)	-			32.3		
Effective Cohesion (psi)	-			0 (Forced)		

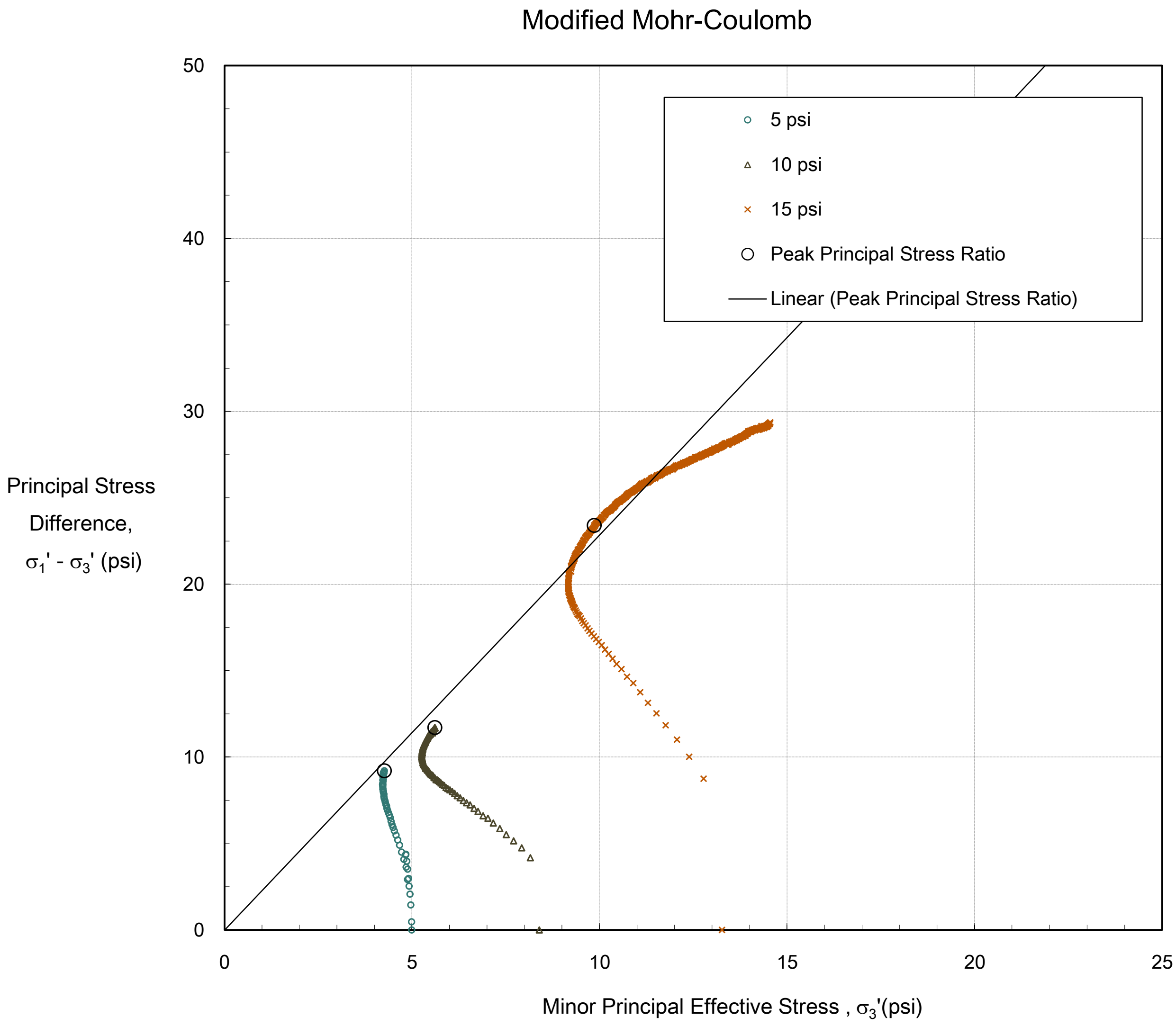
R-Envelope, "Total" Stress		
Friction Angle (deg)	-	27.1
Cohesion (psi)	-	0 (Forced)

Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/12/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-5 (5-7)		

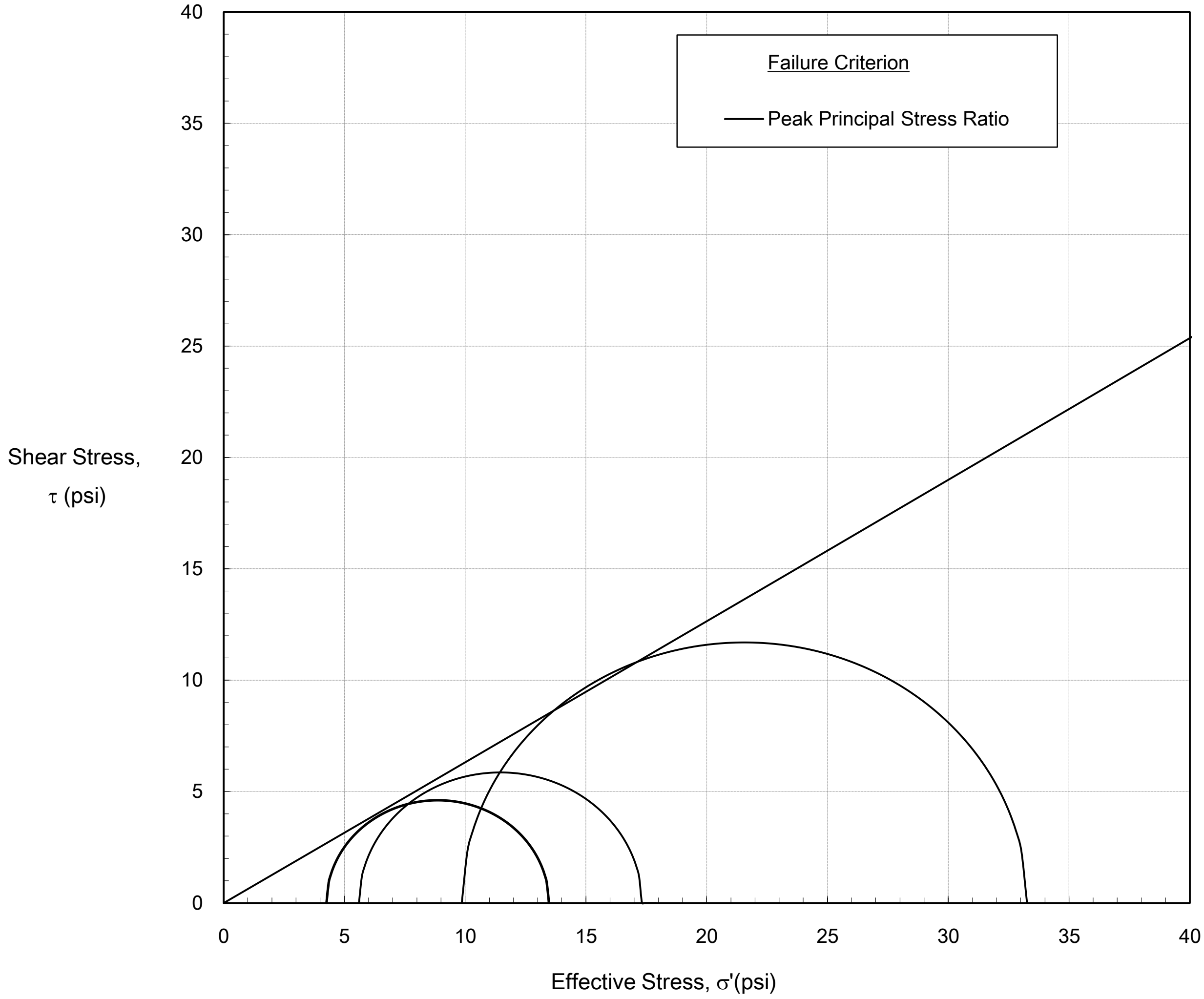


Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	32.3
Effective Cohesion (psi)	-	0 (Forced)

Multi-Stage Consolidated-Undrained Triaxial Compression

Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-5 (5-7)		

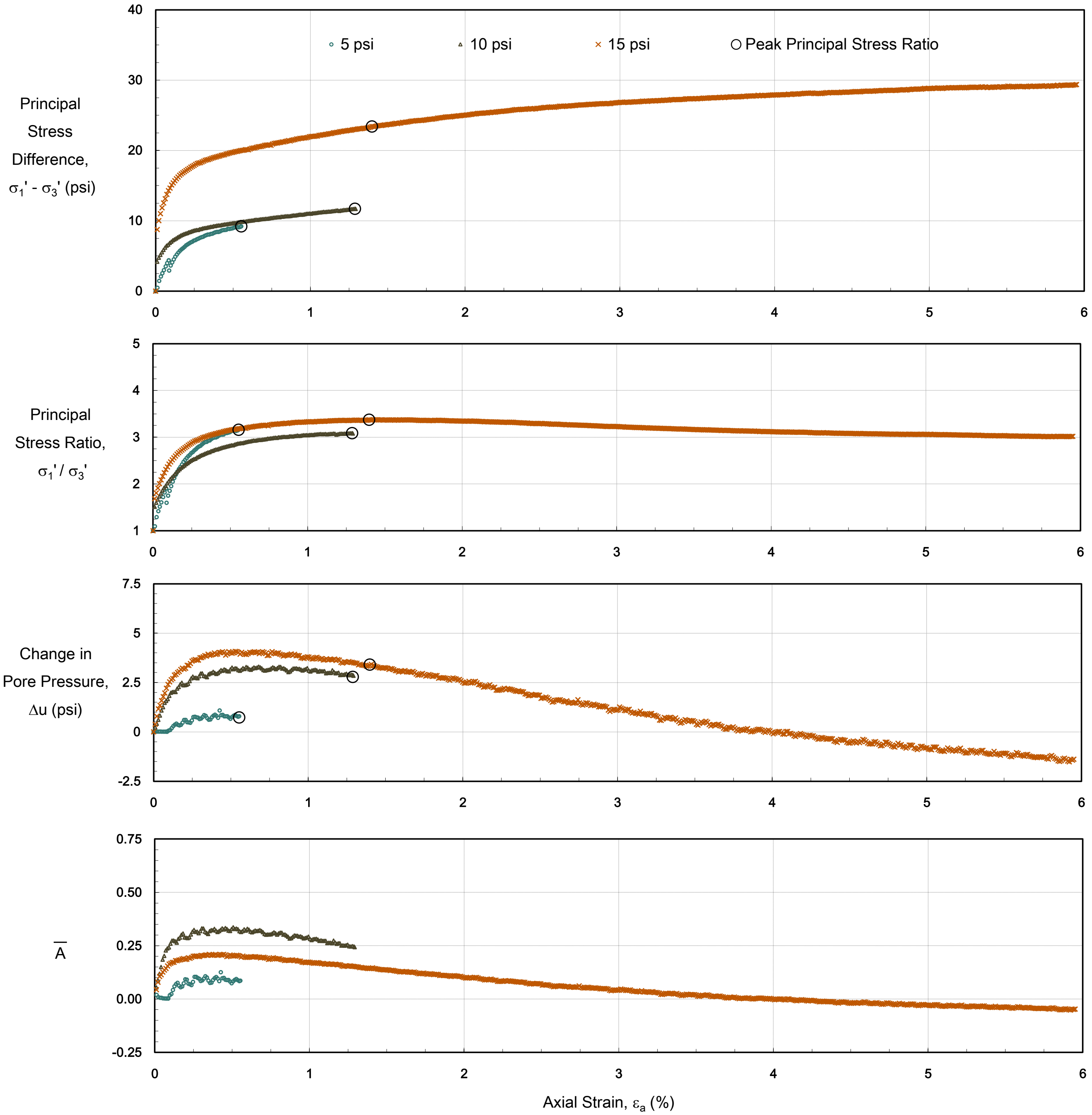
Mohr-Coulomb



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	32.3
Effective Cohesion (psi)	-	0 (Forced)

Multi-Stage Consolidated-Undrained Triaxial Compression

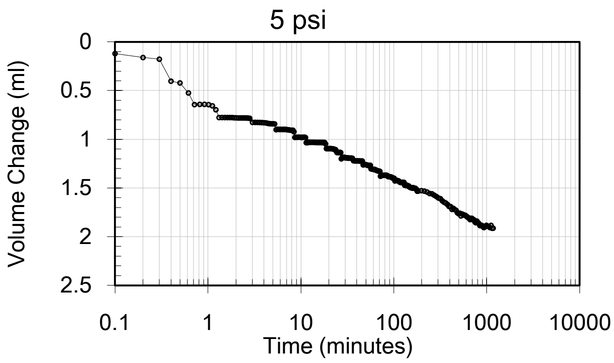
Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-5 (5-7)		

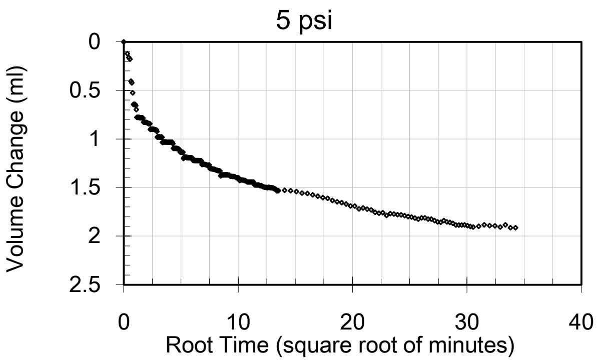


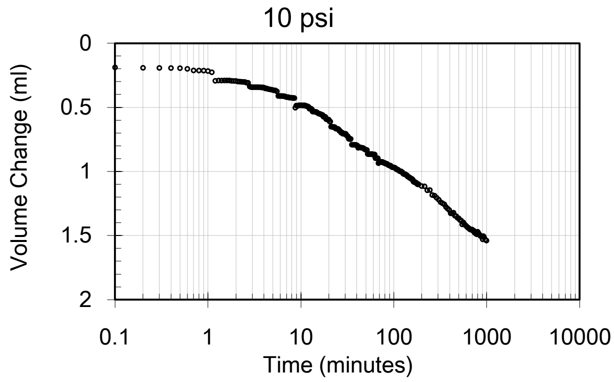
Multi-Stage Consolidated-Undrained Triaxial Compression

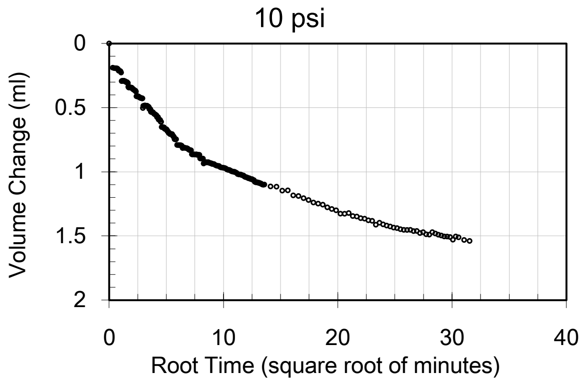
Client:	Auckland Consulting LLC	TRI Log #:	21381
Project:	Winston Pond	Test Method:	ASTM D4767 Mod
Sample:	B-5 (5-7)		

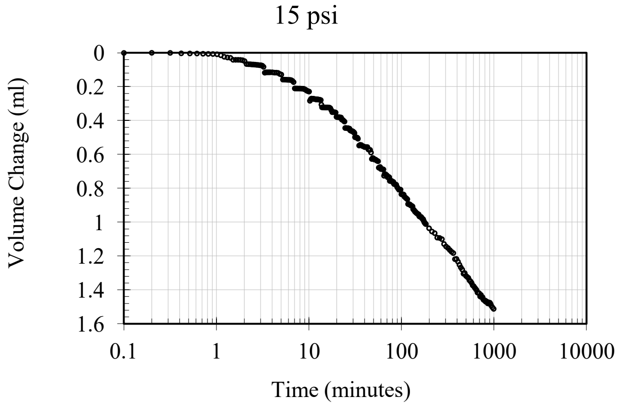
Consolidation

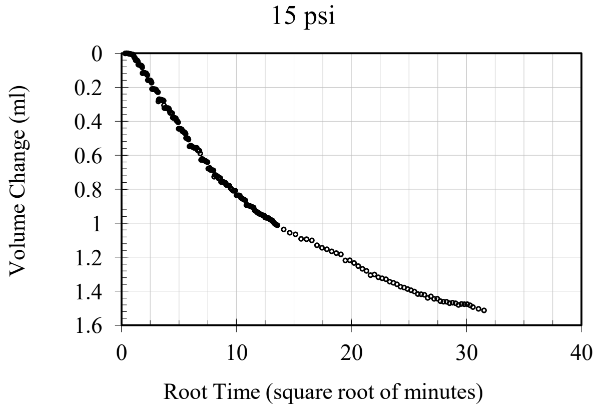






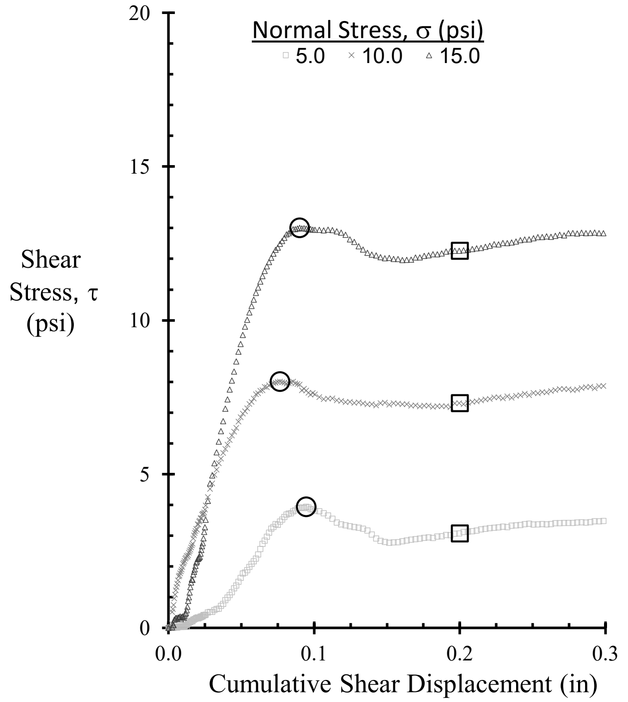


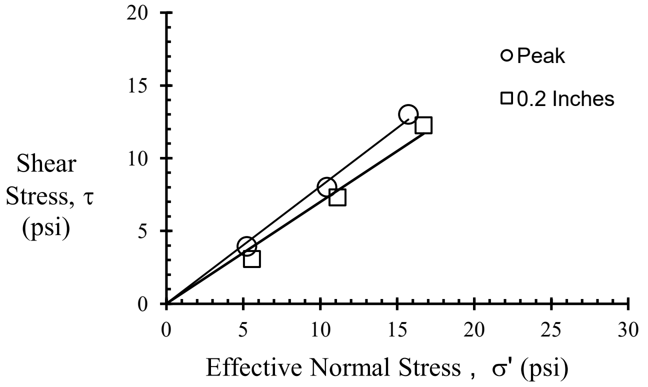




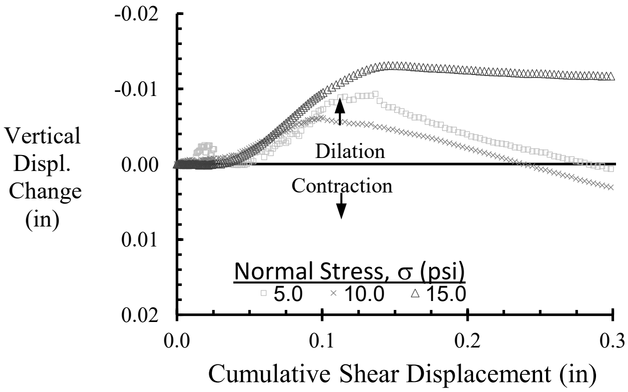
Direct Shear of Soil Under Consolidated-Drained Conditions

Client:	Auckland Consulting LLC	TRI Log#:	21381
Project:	Winston Pond	Test Method:	ASTM D 3080
Sample:	B-5 (13-15)		





Note: Area Correction Has Been Applied



	Sample Number	1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	16.9	16.0	15.6
	Saturation, %	83.9	83.6	89.1
	Dry Density, pcf	107.9	109.7	112.9
	Void Ratio	0.53	0.51	0.46
Post Consol	Height, in (prior to shear)	1.00	1.00	1.00
	Final Water Content, %	21.1	20.9	19.2
	Dry Density, pcf	108.0	109.9	113.3
	Void Ratio	0.53	0.50	0.46
Displacement rate (in/min)		6.0E-04	6.0E-04	6.0E-04
Peak	Normal Stress, σ' (psi)	5.23	10.43	15.72
	Shear Stress, τ (psi)	3.94	8.01	13.01
	Displacement (in)	0.09	0.08	0.09
	ϕ'_d, degrees	38.8		
	c'_d, psi	0 (Forced)		
Post-Peak	Normal Stress, σ' (psi)	5.56	11.12	16.70
	Shear Stress, τ (psi)	3.07	7.31	12.26
	Displacement (in)	0.20	0.20	0.20
	ϕ'_d, degrees	35.0		
	c'_d, psi	0 (Forced)		

Note: The undisturbed soil samples were extruded and trimmed using a trimming turntable. A specific gravity of 2.65 was assumed for weight-volume calculations.

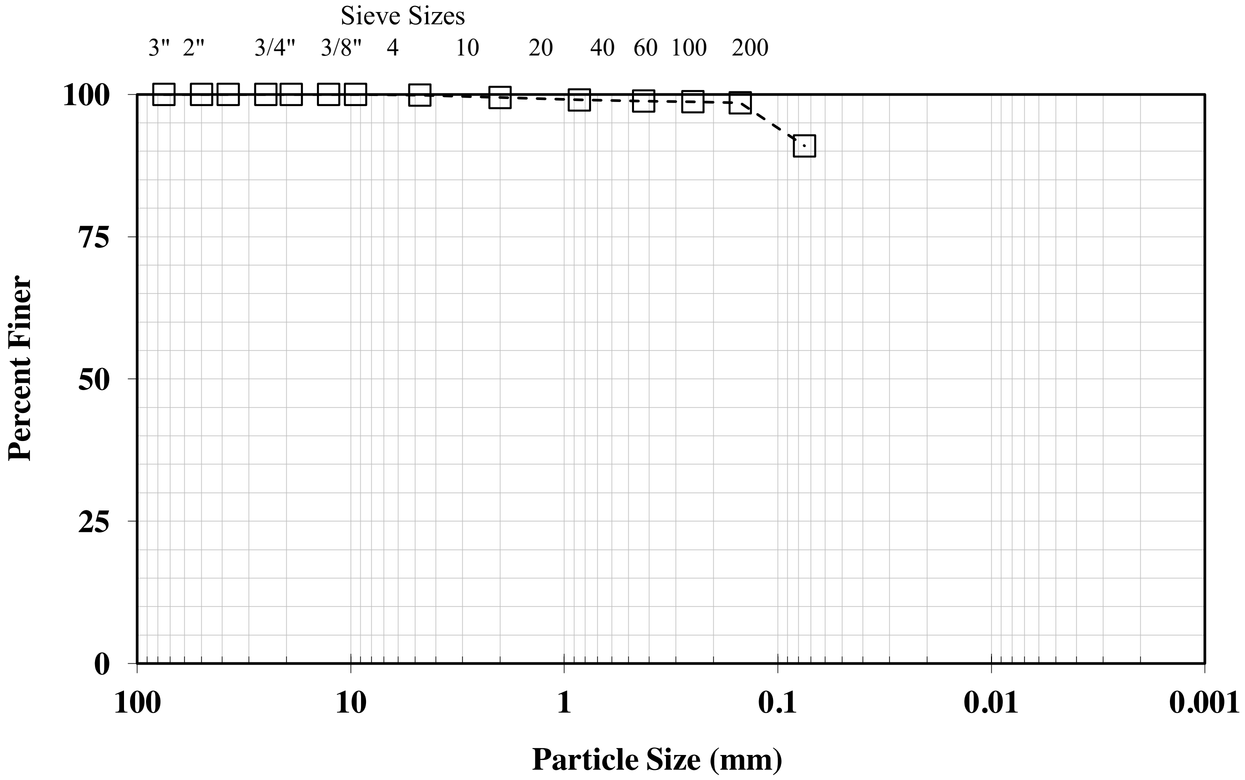
Jeffrey A. Kuhn, Ph.D., P.E., 6/30/16

Analysis & Quality Review/Date

Test Performed By: LC

Particle Size Analysis for Soils

Client:	Auckland Consulting LLC	TRI Log#: 21381.16
Project:	Winston Pond	Test Method: ASTM D422
Sample:	B-5 (33-35)	



Sieve Analysis	
Sieve Size	**Percent Passing**
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	99.9
No. 10 (2.00 mm)	99.5
No. 20 (0.841 mm)	99.0
No. 40 (0.420 mm)	98.8
No. 60 (0.250 mm)	98.7
No. 100 (0.149 mm)	98.5
No. 200 (0.074 mm)	90.9
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

USCS Classification (ASTM D2487)	Silt (ML)	
As-Received Moisture Content (%)	(ASTM D2216)	27.1
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	28
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

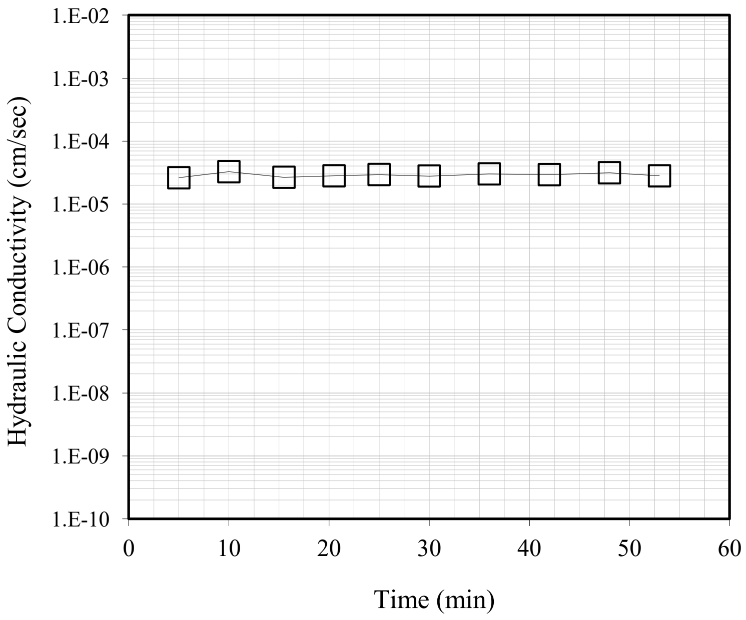
Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
AUSTIN, TX - USA | ANAHEIM, CA - USA | ANDERSON, SC - USA | GOLD COAST - AUSTRALIA | SUZHOU - CHINA

Hydraulic Conductivity

Client: Auckland Consulting LLC
Project: Winston Pond
Sample ID: B-5: (33-35)

TRI Log #: 21381
Test Method: ASTM D5084 Method C



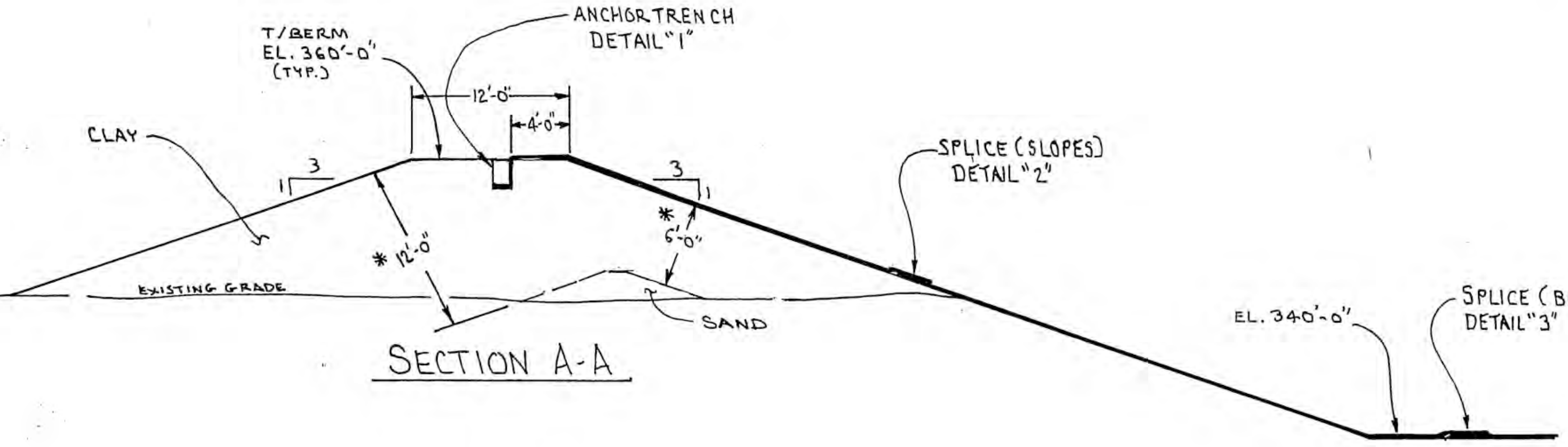
Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.80
Height (in)	2.55
Initial Mass (g)	500.5
Sample Area (in^2)	6.16
Water Content (%)	26.4
Total Unit Weight (pcf)	121.4
Dry Unit Weight (pcf)	96.1
Specific Gravity (Assumed)	2.65
Degree of Saturation	96.9
Void Ratio	0.72
Porosity	0.42
1 Pore Volume (cc)	107.8
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.99

Specimen Image

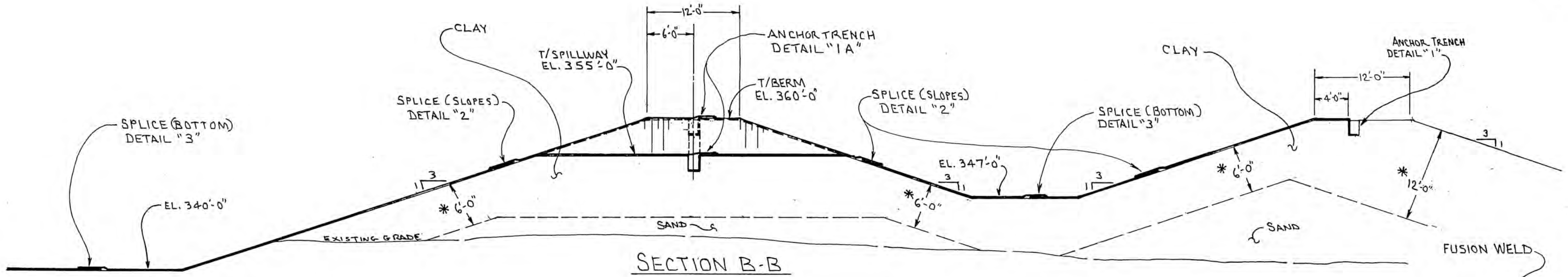
Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
36.0	3.0E-05
42.0	2.9E-05
48.0	3.1E-05
53.0	2.8E-05
Average, Last 4 Readings	**3.0E-05**

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Analysis & Quality Review/Date
Testing Performed By: SOC & LC

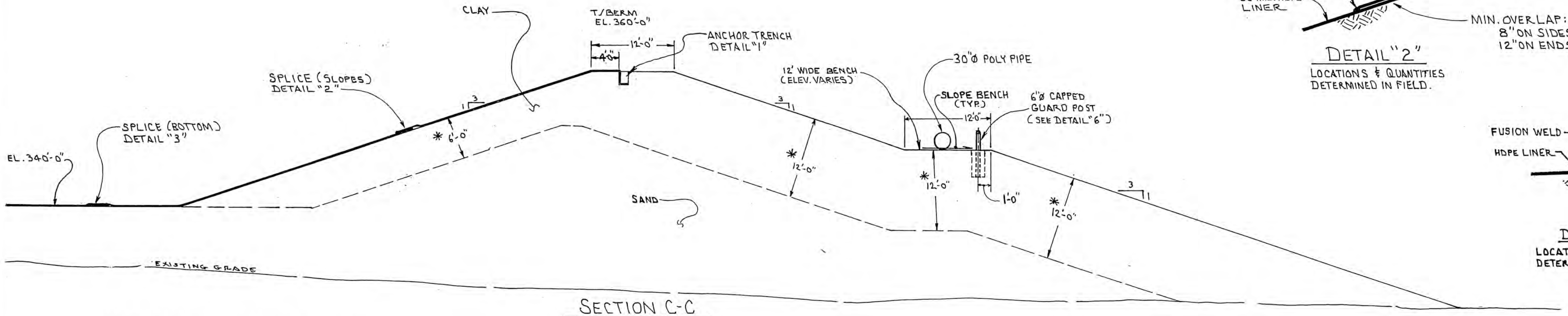
✱ - NOTE- THESE DIMENSIONS ARE SUBJECT TO ADJUSTMENT DEPENDING ON THE SAND / CLAY BALANCE VS. HAUL DISTANCE ON PROJECT.



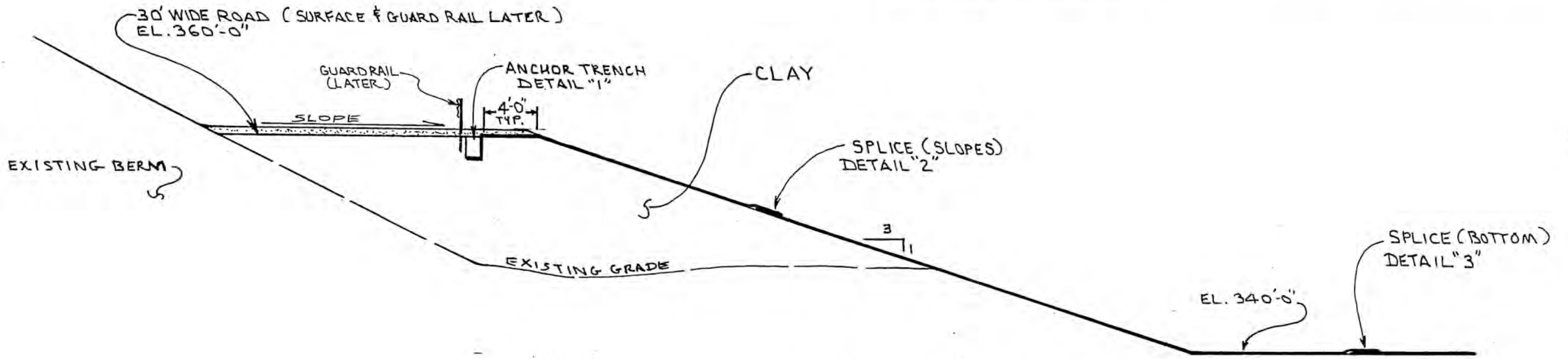
SECTION A-A



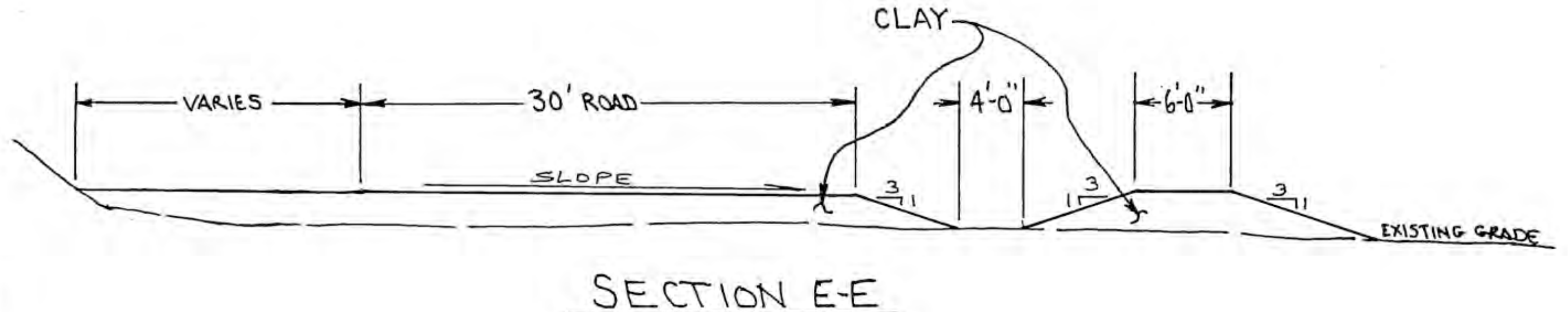
SECTION B-B



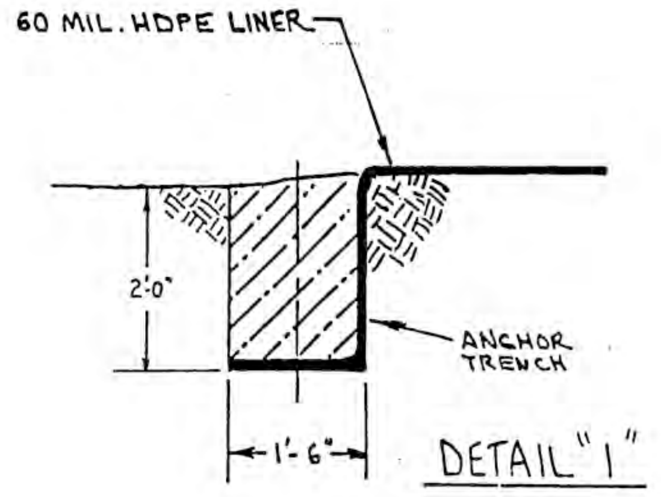
SECTION C-C



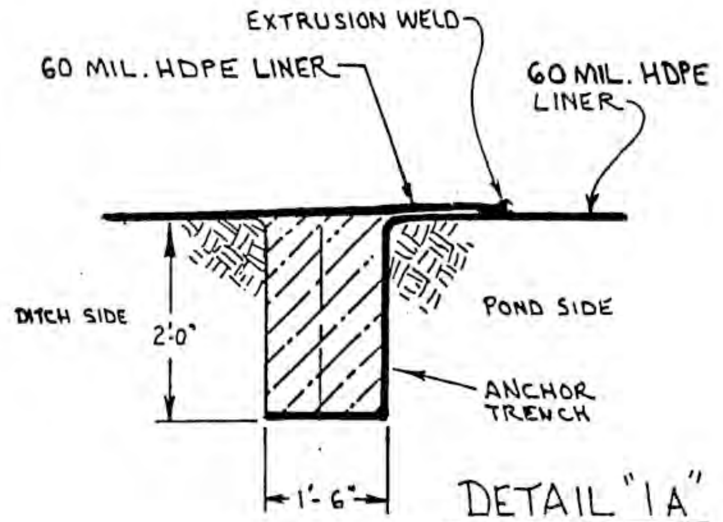
SECTION D-D



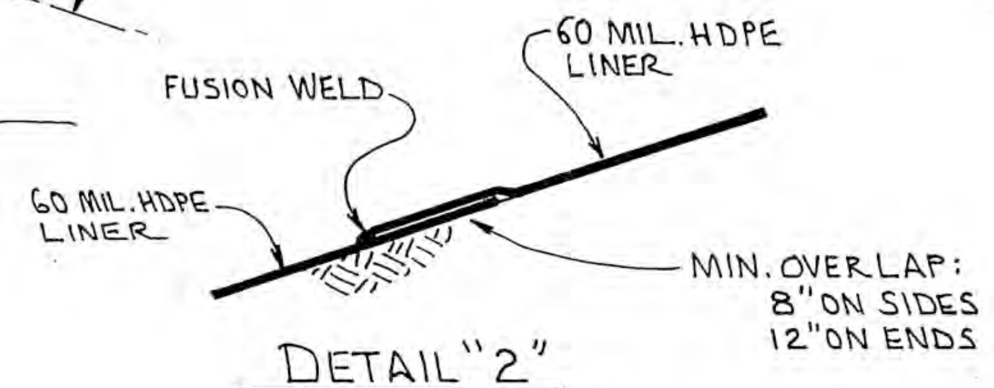
SECTION E-E



DETAIL "1"

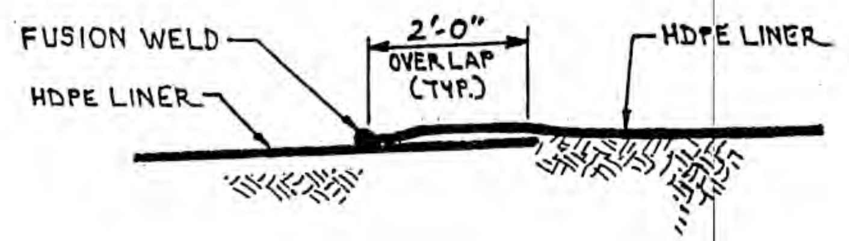


DETAIL "1A"



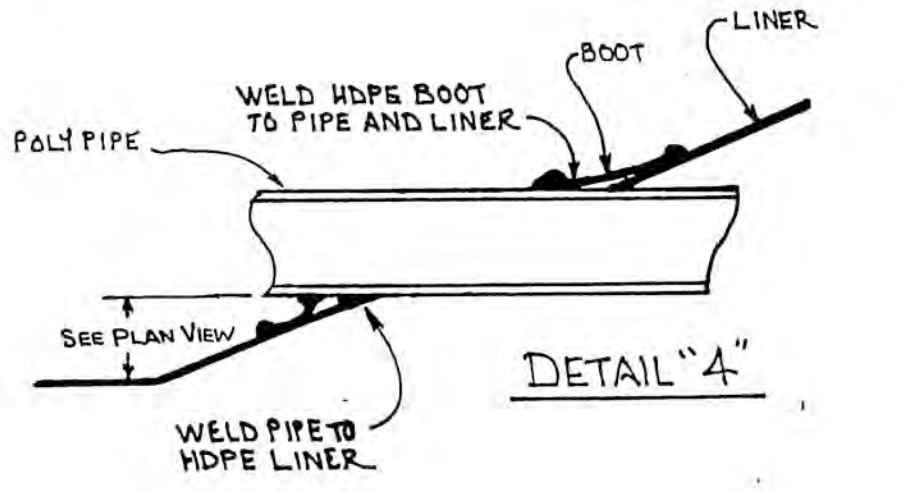
DETAIL "2"

LOCATIONS & QUANTITIES
DETERMINED IN FIELD.

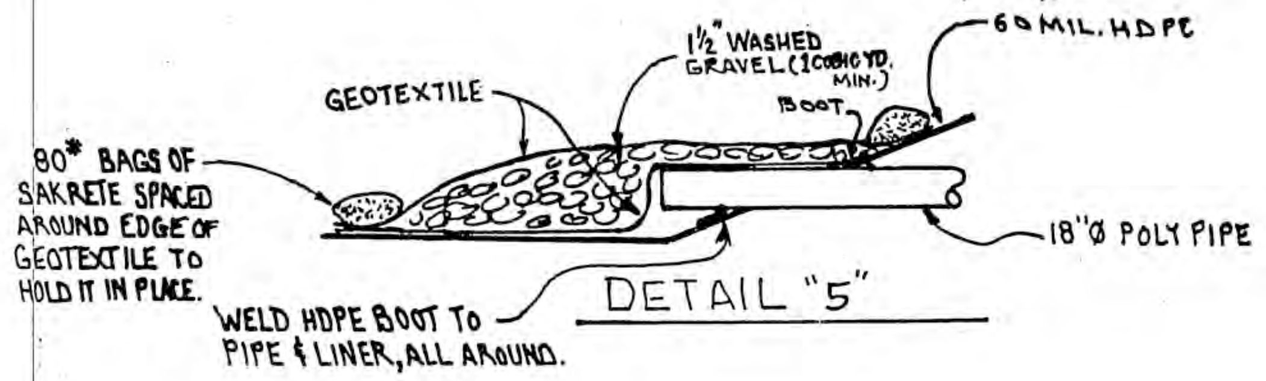


DETAIL "3"

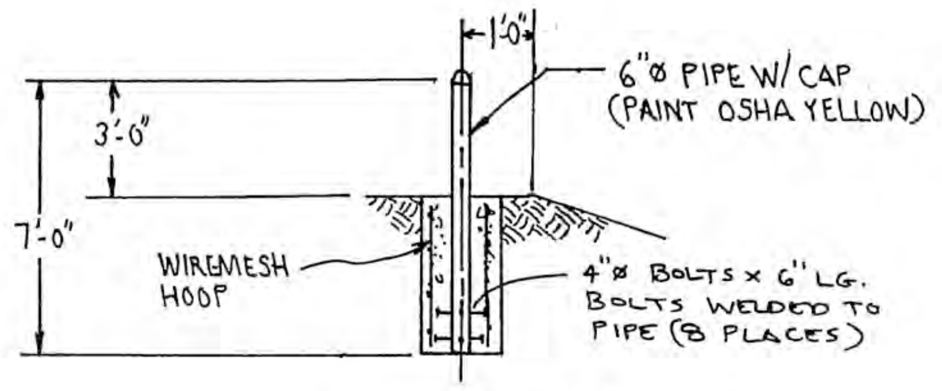
LOCATIONS & QUANTITIES
DETERMINED IN FIELD



DETAIL "4"

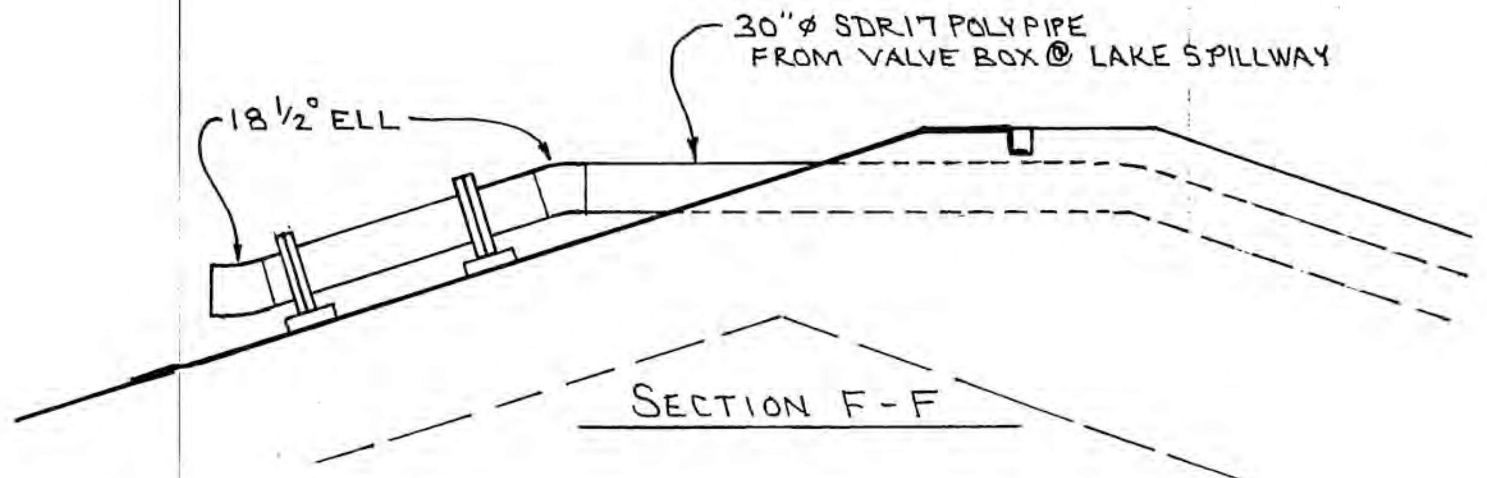


DETAIL "5"



DETAIL "6"

50' ON CENTERS
(20 REQUIRED)



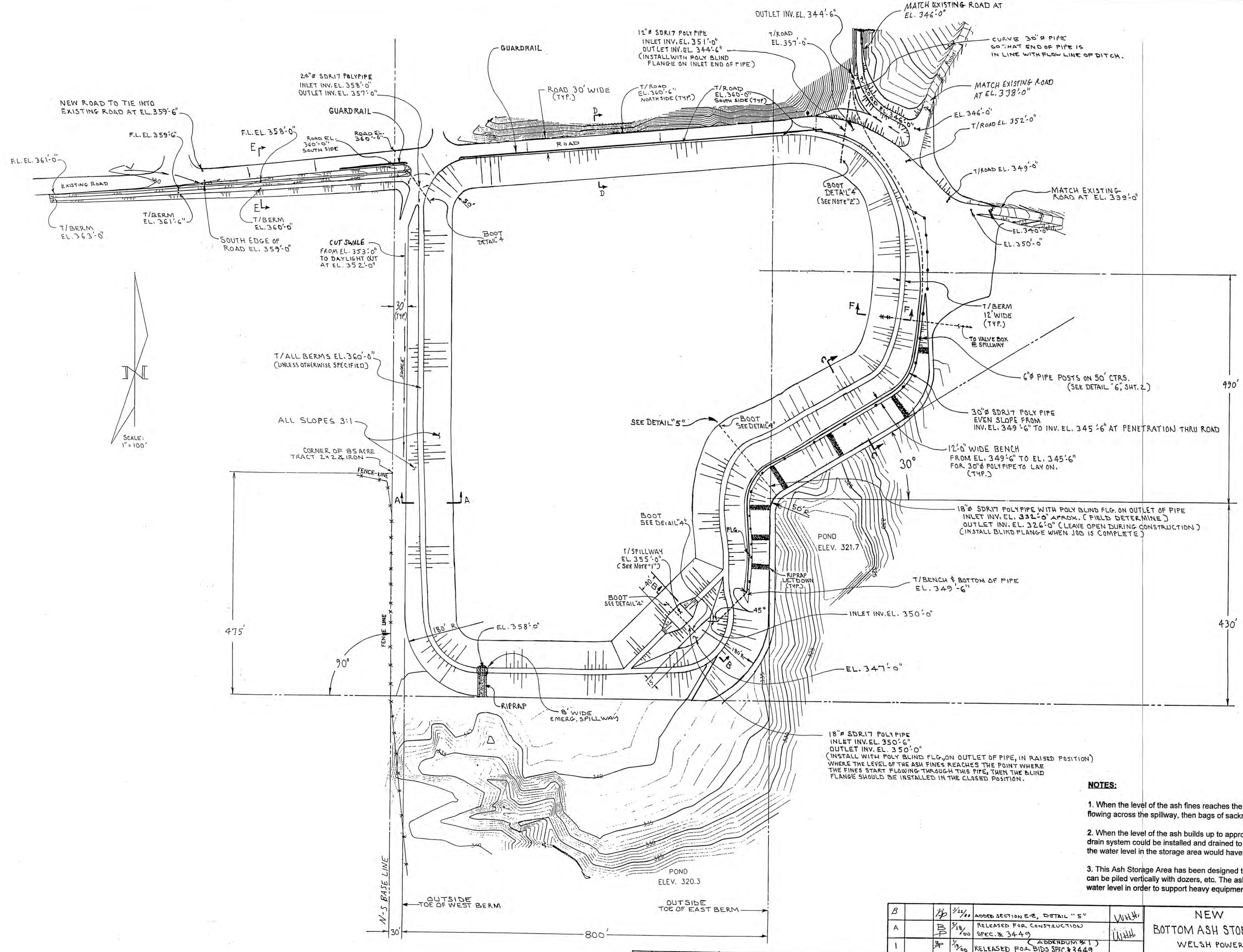
SECTION F-F

REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	10/29/00	AS BUILT	
A		BP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHA
1		BP	3/13/00	(ADDENDUM #1) RELEASED FOR BIDS SPEC. # 3449	
		BP	3/10/00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

	DEPT.
	DIV.
APPROVED	
DRWN. BY: BP	DATE: 3-10-00
SCALE: AS SHOWN	W.O.
SH. 2 OF 2	DRWG. NO. WEPX- 335



NOTES:

1. When the level of the ash fines reaches the point where the fines start flowing across the spillway, then bags of sackrete can be installed to raise the spillway elevation.

2. When the level of the ash builds up to approx. elev. 355 along the north and east sides, a french drain system could be installed and drained to this outlet to help hold the water table down. Of course the water level in the storage area would have to be at elev. 351 or above for the french drain to function.

3. This Ash Storage Area has been designed to hold the water level as low as possible so the ash can be piled vertically with dozers, etc. The ash level needs to be approx. 4 ft. to 5 ft. above the water level in order to support heavy equipment.

REV.	W.O.	BY	DATE	SUBJECT	APPROVED
C		BP	10-29-00	AS BUILT	

REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		Bp	7/22/00	ADDED SECTION E-E, DETAIL "5"	WHH
A		BP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHH
1		Bp	4/13/00	RELEASED FOR BIDS SPEC. # 3449 (ADDENDUM # 1)	
		BP	3-10-00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

DEPT.
DIV.
APPROVED
DRWN. BY: Bp
DATE: 3-10-00
SCALE: 1" = 100'
W.O.
SH. 1 of 2
DRWG. NO. WEPX-335

5.3 – TCEQ New Cease Receipt of Waste and Initiation of Closure Deadline for Coal Combustion Residual Unit, Primary Ash Pond and Ash Storage Pond, October 2020

Jon Niermann, *Chairman*
Emily Lindley, *Commissioner*
Bobby Janecka, *Commissioner*
Toby Baker, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

October 30, 2020

Mr. David A. Miller, P.E.
Director, Land Environment & Remediation Services
Environmental Services Division
American Electric Power
1 Riverside Plaza
Columbus, Ohio 43215

Re: New Cease Receipt of Waste and Initiation of Closure Deadline for Coal Combustion Residual Unit
AEP Southwestern Electric Power Company – Pittsburg, Titus County
Industrial Solid Waste Registration No. 31086
Welsh Power Plant
RN100213370/CN600126767

Dear Mr. Miller:

The Industrial and Hazardous Waste (I&HW) Permits Section of the Texas Commission on Environmental Quality (TCEQ) received your request for an extension to cease receipt of Coal Combustion Residuals (CCR) waste and initiate of closure activities. The request was dated and received on October 23, 2020.

The TCEQ acknowledges your request to extend the receipt of CCR waste and the initiation of closure activities until April 11, 2021, in compliance with the U.S. Environmental Protection Agency's (EPA) new Title 40 Code of Federal Regulations (40 CFR) §257.101(a)(1) or new 40 CFR §257.101(b)(1)(i). Your request may be extended further, upon a successful demonstration, approved by the EPA under new 40 CFR §257.103(f), of site-specific alternative deadlines to initiate closure. You must submit documentation of the initial EPA request and EPA's final decision to the TCEQ; and you must maintain records adequate to document your compliance with the site-specific deadline approved by the EPA. Please submit the EPA-related documents to IHWPER@tceq.texas.gov.

This extension applies to the following units:

- TCEQ WMU No. 004 – Primary Ash Pond; and
- TCEQ WMU No. 014 – Ash Storage Pond;

Please continue to keep the TCEQ updated as conditions change. You may contact me at (512) 239-2331 or via email at charly.fritz@tceq.texas.gov.

Sincerely,

Charly Fritz

Charly Fritz, Deputy Director
Waste Permits Division

CF/FR/tw

cc: Mr. Brian D Newton, Manager, American Electric Power

5.4 – Closure Plan, Bottom Ash Storage Pond, February 2021

CLOSURE PLAN

CCR 257.102(b)

Bottom Ash Storage Pond

Welsh Power Plant
Pittsburg, Texas

October 2016
Revised February 2021

Prepared for : Southwest Electric Power Company - Welsh Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

CLOSURE PLAN
CCR 257.102(b)
WELSH POWER PLANT
BOTTOM ASH STORAGE POND

PREPARED BY Gary F. Zych DATE 2/11/2021
Gary F. Zych, P.E.

REVIEWED BY Arthur W. Rentzsch DATE 02/11/2021
Arthur W. Rentzsch

APPROVED BY Gary F. Zych DATE 2/11/2021
Gary F. Zych, P.E.
Section Manager – AEPSC Geotechnical Engineering

American Electric Power
Service Corporation
Texas Registered
Engineering Firm No.
F-3341

Gary F. Zych
STATE OF TEXAS
GARY F. ZYCH
127152
LICENSED
PROFESSIONAL ENGINEER
2/11/2021

I certify to the best of my knowledge, information, and belief that the information contained in this closure plan meets the requirements of 40 CFR § 257.102

Table of CONTENTS

1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CCR 257.102(b) for Closure Plans of Existing CCR Surface Impoundments

2.0 DESCRIPTION OF THE CCR UNIT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. It is owned and operated by Southwest Electric Power Company (SWEPCO). The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash pond (PBAP) and the Bottom Ash Storage pond. This report addresses the closure plan for the Bottom Ash Storage Pond (BASP). The Bottom Ash Storage pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir.

In 2000, the 22-acre Bottom Ash Storage Pond was constructed south of the landfill. The Bottom Ash Storage Pond receives bottom ash and economizer ash dredged from the primary bottom ash pond and non-CCR flows.

3.0 DESCRIPTION OF CLOSURE PLAN 257.102(b)(1)(i)

[A narrative description of how the CCR unit will be closed in accordance with this section]

The Welsh Bottom Ash Storage Pond will be closed by removal.

4.0 CLOSURE BY REMOVAL 257.102 (b)(1)(ii)

[If closure of the CCR unit will be accomplished through removal of CCR from the CCR unit, a description of the procedures to remove the CCR and decontaminate the CCR unit in accordance with paragraph (c) of this section.]

Closure will include removal of all CCR from the CCR unit. The removal of all CCR unit will be accomplished by mechanical means. The CCR material will be either hauled and placed at the onsite CCR landfill or hauled offsite for beneficial reuse.

The geomembrane liner in the pond will be removed and disposed at an approved off-site landfill. After the liner is removed, 12 inches of bottom soil will be removed as part of the closure of the CCR surface impoundment.

A 3rd party QAQC consultant will verify the removal of the CCR material and soil.

4.1 CLOSURE PERFORMANCE STANDARDS 257.102 (c)

[An owner or operator may elect to close a CCR unit by removing and decontaminating all areas affected by releases from the CCR unit. CCR removal and decontamination of the CCR unit are complete when constituent concentrations throughout the CCR unit and any areas affected by releases from the CCR unit have been removed and groundwater monitoring concentrations do

not exceed the groundwater protection standard established pursuant to §257.95(h) for constituents listed in appendix IV to this part.]

Closure of the CCR unit will be completed when all CCR materials in the unit and any soils affected by releases from the CCR unit have been removed, and groundwater monitoring demonstrates that all concentrations of constituents are below background values using the statistical procedures in §257.93(g) for two consecutive sampling events.

5.0 ESTIMATE OF MAXIMUM CCR VOLUME 257.102 (b)(1)(iv)

[An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit.]

The estimated maximum CCR volume on-site is 500,000 cubic yards in the Bottom Ash Storage Pond.

6.0 ESTIMATE OF LARGEST AREA OF CCR REQUIRING COVER 257.102 (b)(1)(v)

[An estimate of the largest area of CCR unit ever requiring a final cover

This pond will be closed by removal of CCR materials as such this section is not applicable.

7.0 CLOSURE SCHEDULE 257.102(b)(1)(vi)

[A schedule for completing all activities necessary to satisfy the closure criteria in the section, including an estimate of the year in which all closure activities for the CCR unit will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR unit, including identification of major milestones such as coordinating with and obtaining necessary approvals and permits from other agencies, the dewatering and stabilization phases of the CCR surface impoundment closure, or installation of the final cover system, and the estimated timeframes to complete each step or phase of the CCR unit closure.

The following table presents milestone activities and schedule to complete the closure of the BASP.

Cease sluicing CCR from PBAP and miscellaneous non-CCR wastewater streams to BASP	April 11, 2021
Commence Closure by submitting the Request for proposal for closure design	No later than April 11, 2021
Engineering/design schedule based on proposals	To be determined later
Construction schedule based on proposals	To be determined later
Completion of closure	No later than April 11, 2026

5.5 – Notice of Intent to Close a CCR Unit, Bottom Ash Storage Pond, June 2021

Notification of Intent to Close a CCR Unit
April 6, 2021 Revision 0
June 1, 2021 Revision 1

June 1, 2021
Notice of Intent to Close a CCR Unit
Welsh Power Plant
Bottom Ash Storage Pond

As required by 40 CFR §257.102(g), this is notification that on April 06, 2021, the Welsh Power Plant, Bottom Ash Storage Pond ceased receipt of coal combustion residuals (CCR) and non-CCR wastestreams and commenced closure by removal for this CCR Unit in accordance with the certified closure plan.

As required by 40 CFR §257.101(a)(2), this CCR surface impoundment is closing under the requirements of 40 CFR §257.101(a)(1).

Record of Plan

Revision Number	Date	Revision Description
0	04-06-2021	Initial
1	06-01-2021	Added statement that unit was closing in according to 40 CFR §257.101(a)(1) as required by 40 CFR §257.101(a)(2)

5.6 – Closure Plan, Landfill Area, October 2016

CLOSURE PLAN

CCR 257.102(b)

Landfill Area

Welsh Power Plant
Pittsburg, Texas

October, 2016

Prepared for : Southwest Electric Power Company – Welsh Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

GERS – 16 – 097

CLOSURE PLAN
CCR 257.102(b)
WELSH POWER PLANT
LANDFILL AREA

PREPARED BY Brett A. Dreger DATE 9/20/2016
Brett A. Dreger, P.E.

REVIEWED BY DATE 9-28-16
Shahriyar S. Baig, P.E.

APPROVED BY Gary F. Zych DATE 9/29/2016
Gary F. Zych, P.E.
Department Manager – AEP Geotechnical Engineering

American Electric
Power Service
Corporation
Texas Registered
Engineering Firm No.
F-3341

09-30-2016
SHAHRIYAR S. BAIG
92172

I certify to the best of my knowledge, information, and belief that the information contained in this closure plan meets the requirements of 40 CFR § 257.102

I certify to the best of my knowledge, information and belief that design of the final cover system as described in this closure plan meets the requirements of 40 CFR § 257.102.

Table of CONTENTS

1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CCR 257.102(b) for Closure Plans of Existing CCR Units.

2.0 DESCRIPTION OF THE CCR UNIT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. It is owned and operated by Southwest Electric Power Company (SWEPCO). The facility operates a landfill for the disposal of CCR materials.

The Welsh Landfill is a Class 2, Industrial Solid Waste Facility per the Texas Commission on Environmental Quality, Industrial Solid Waste Management Technical Guideline No. 3.

3.0 DESCRIPTION OF CLOSURE PLAN 257.102(b)(1)(i)

[A narrative description of how the CCR unit will be closed in accordance with this section]

The Welsh Landfill Area will be closed by closure in place. The closure will consist of re-grading the existing onsite materials and the installation of an impermeable cap with vegetative cover. The existing surface will be graded to achieve a gently sloping surface to promote surface water runoff. The re-graded surface will be covered with 3-ft of re-compacted clay soil material with a permeability of 1X10-7 or less and 18-inches of vegetative soil cover that is capable of sustaining native plant growth. The surface soil will be seeded and mulched to promote the growth of a vegetative cover.

4.0 CLOSURE IN PLACE 257.102 (b)(1)(iii)

[If closure of the CCR unit will be accomplished by leaving the CCR in place, a description of the final cover system, designed in accordance with paragraph(d) of this section, and the methods and procedures to be used to install the final cover. The closure plan must also discuss how the final cover system will achieve the performance standards specified in paragraph (d) of this section.]

The final cover system will consist of 3-ft of re-compacted clay soil material with a permeability of $1X10^{-7}$ cm/sec or less and 18-inches of vegetative soil cover that is capable of sustaining native plant growth. The final cover will be seeded and mulched to promote growth of a vegetative cover. The final cover slope will be a minimum of 2% and will convey water to a TPDES permitted outfall.

4.1 CLOSURE PERFORMANCE STANDARDS 257.102 (d)(1)

4.1.1 SECTION 257.102(d)(1)(i)

[Control, minimize or eliminate, the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.]

The final cover system will cover the CCR material and will have a permeability that is less than or equal to the permeability of the natural subsoils and is no greater than 1×10^{-5} cm/sec.

4.1.2 SECTION 257.102(d)(1)(ii)

[Preclude the probability of future impoundment of water, sediment, or slurry.]

The final surface areas will be graded to a minimum slope 2% to prevent the ponding of surface runoff. Drainage features will be designed to have positive drainage.

4.1.3 SECTION 257.102(d)(1)(iii)

[Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period.]

The final cover system will be gently graded with a minimum of 2% slope. The final configuration of the impoundment will meet the stability requirements to prevent the sloughing or movement of the final cover system during the closure and post-closure care period.

4.1.4 SECTION 257.102(d)(1)(iv)

[Minimize the need for further maintenance of the CCR unit.]

The landfill facility will be vegetated to prevent erosion. Maintenance of the final cover system will include mowing.

4.1.5 SECTION 257.102(d)(1)(v)

[Be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.]

The CCR unit will be closed in a timeframe consistent with recognized and generally accepted good engineering practices. As the fill reaches the approved final grades, periodic closure activities may occur.

4.2 DRAINING AND STABILIZING OF THE SURFACE IMPOUNDMENT 257.102(d)(2)

This section is not applicable to a landfill.

4.3 FINAL COVER SYSTEM 257.102 (d)(3)

[If a CCR unit is closed by leaving CCR in place, the owner or operator must install a final cover system that is designed to minimize infiltration and erosion , and at a minimum, meets the requirements of paragraph (d)(3)(i) of this section, or the requirements of the alternative final cover system specified in paragraph (d)(3)(ii) of this section.

The final cover system must be designed and constructed to meet the criteria in paragraphs (d)(3)(i)(A) through (D) of this section. The design of the final cover system must be included in the written closure plan.]

The final cover system will consist of 3-ft of re-compacted clay soil material with a permeability of $1X10^{-7}$ cm/sec or less and 18-inches of vegetative soil cover that is capable of sustaining native plant growth. The final cover will be seeded and mulched to promote growth of a vegetative cover. The final cover slope will be a minimum of 2% and will convey water to a TPDES permitted outfall. The final cover slope will be a minimum of 2% to accommodate settling and subsidence.

5.0 ESTIMATE OF MAXIMUM CCR VOLUME 257.102 (b)(1)(iv)

[An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit.]

The estimated maximum CCR volume on-site is 2,740,000 Cubic Yards for the Landfill Area.

6.0 ESTIMATE OF LARGEST AREA OF CCR REQUIRING COVER 257.102 (b)(1)(v)

[An estimate of the largest area of CCR unit ever requiring a final cover

The largest area of the CCR unit requiring a final cover is 40 acres for the Landfill Area.

7.0 CLOSURE SCHEDULE 257.102(b)(1)(vi)

[A schedule for completing all activities necessary to satisfy the closure criteria in the section, including an estimate of the year in which all closure activities for the CCR unit will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR unit, including identification of major milestones such as coordinating with and obtaining necessary approvals and permits from other agencies, the dewatering and stabilization phases of the CCR surface impoundment closure, or installation of the final cover system, and the estimated timeframes to complete each step or phase of the CCR unit closure.

At this time there are currently no plans to close this CCR unit. Once the CCR unit requires closure a schedule to satisfy this section will be prepared.

ATTACHMENT 6

Post-Closure Plans

30 TAC §352.301 – Closure and Post-Closure Care Application Submittal

PBAP – Post-Closure Care Plan- NA (closure by removal)

BASP – Post-Closure Care Plan- NA (closure by removal)

Landfill – Post-Closure Care Plan

6.1 – Post Closure Plan, Primary Bottom Ash Pond, November 2021

POST CLOSURE PLAN
CFR 257.104(d)
WELSH POWER PLANT
PRIMARY BOTTOM ASH POND

The Written Closure Plan for the subject pond was revised in November 2020. The CCR surface impoundment will be closed by removal in accordance with CFR 257.102(c) – Closure by Removal. As such, a Post Closure Plan is not required for the facility as noted in CFR 257.104(a)(2).

The initial Post Closure Plan prepared in 2016 is no longer valid.

I certify to the best of my knowledge, information, and belief that the information contained above meets the requirements of 40 CFR § 257.104.

Gary F. Zych

GARY F. ZYCH
127152

11/30/2021

Gary F. Zych, P.E.
Manger – Geotechnical Engineering Section
American Electric Power Service Corporation

American Electric Power Service Corporation
Texas Registered Engineering Firm No. F-3341

6.2 – Post Closure Plan, Bottom Ash Storage Pond, November 2021

POST CLOSURE PLAN
CFR 257.104(d)
WELSH POWER PLANT
BOTTOM ASH STORAGE POND

The Written Closure Plan for the subject pond was revised in November 2020. The CCR surface impoundment will be closed by removal in accordance with CFR 257.102(c) – Closure by Removal. As such, a Post Closure Plan is not required for the facility as noted in CFR 257.104(a)(2).

The initial Post Closure Plan prepared in 2016 is no longer valid.

I certify to the best of my knowledge, information, and belief that the information contained above meets the requirements of 40 CFR § 257.104.

Gary F. Zych

Gary F. Zych, P.E.
Manger – Geotechnical Engineering Section
American Electric Power Service Corporation

GARY F. ZYCH
127152

11/30/2021

American Electric Power Service Corporation
Texas Registered Engineering Firm No. F-3341

6.3 – Post Closure Plan, Landfill, October 2016

POST CLOSURE PLAN

CFR 257.104(d)

Landfill

Welsh Power Plant
Pittsburg, Texas

October, 2016

Prepared for : Southwest Electric Power Company – Welsh Power Plant

Pittsburg, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

GERS – 16 – 100

POST CLOSURE PLAN
CFR 257.104(d)
WELSH PLANT
LANDFILL

PREPARED BY Brett A. Dreger DATE 9/23/2016
Brett A. Dreger, P.E.

REVIEWED BY DATE 9-23-2016
Shah Baig, P.E.

APPROVED BY Gary F. Zych DATE 9/25/2016
Gary F. Zych, P.E.
Manager – AEP Geotechnical Engineering

American Electric Power
Service Corporation
Texas Registered
Engineering Firm No.
F-3341

09-23-2016
SHAHRIYAR S. BAIG
92172

I certify to the best of my knowledge, information, and belief that the information contained in this post closure plan meets the requirements of 40 CFR § 257.104

Table of CONTENTS

1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CFR 257.104(d) for Post Closure Plans of CCR units.

2.0 DESCRIPTION OF THE CCR IMPOUNDMENT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. It is owned and operated by American Electric Power (AEP) and Southwest Electric Power Company (SWEPCO). The facility operates a landfill for the disposal of CCR materials.

The Welsh Landfill is a Class 2, Industrial Solid Waste Facility per the Texas Commission on Environmental Quality, Industrial Solid Waste Management Technical Guideline No. 3.

3.0 DESCRIPTION OF POST CLOSURE PLAN 257.104(d)(1)(i)

[A description of the monitoring and maintenance activities required in paragraph (b) of this section for the CCR unit, and the frequency at which these activities will be performed.]

3.1 SECTION 257.104(b)(1)

[Maintaining the integrity and effectiveness of the final cover system including making repairs to the final cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the final cover.]

Inspections are performed for the items noted below. The inspection frequencies are scheduled to properly detect any issues so that repairs can be performed before significant harm occurs.

- Embankment: The entire waste embankment, including top surface and side-slopes, will be inspected for slides, settlement, subsidence, displacement, and cover condition (see below).
- Soil Dike: The soil dike will be inspected for slides, displacement, seepage, and erosion.
- Cover: The final cover will be inspected for erosion and for the condition of the vegetated cover, i.e., gaps in vegetation or presence of undesirable trees or brush. The integrity of the cover drainage system will also be inspected.
- Final Cover Surface: The Final Cover surface will be inspected for any ponding of water or flat areas. Due to the design contours required to achieve the final cap grade, special attention will be focused to ensure that no settlement, subsidence, erosion, depressions or flat areas exist and that no water is allowed to pond above the cap system.
- Surface Drainage System: The surface drainage system, including channels, culverts, slope drains, etc., will be inspected for erosion, integrity of channel lining, ponding, and accumulated sediment.

Maintenance during the post-closure care period will be performed as discussed below, based upon the facility inspections described above.

- Erosion Damage Repair: Any areas exhibiting erosion will be repaired by replacing and compacting the material in-kind to design grade/specifications, and reseeding the area to the specifications. Applications of additional fertilizer, selective herbicides, rodent control measures, etc. will be implemented as necessary. In the selection of fertilizers and herbicides, ensure their use will not impact the groundwater negatively. Follow-up monitoring of the repaired area will be conducted to ascertain the integrity of the repair.
- Settlement, Subsidence, Displacement: Any areas at the closed site exhibiting evidence of settlement, subsidence, or displacement will be examined to determine the cause of the movement. If backfilling or placing additional fill material is needed to maintain the integrity of the closed structure, it will be performed in accordance with the site/closure specifications, including seeding. If the condition reoccurs or persists, or if the severity of the condition initially is judged to warrant it, a detailed investigation of the cause will be performed and remedial action will be performed. Similarly, any areas of the soil dike exhibiting sliding, displacement, or seepage will be investigated. Repairs will be made as necessary. Follow-up monitoring of the area will be performed to ascertain that the problem has been corrected.
- Closure Cap Surface: Any areas that show signs of ponding water or flat contours will be examined and rectified. Due to the design contours required to achieve the final cap grade, special attention will be focused on the cap surface to ensure that any areas that hold water are re-graded to promote drainage, re-seeded to promote vegetative growth, and maintained to ensure that the ponding of water does not persist.
- Surface Water Drainage System: The channel linings are designed to withstand the design velocities. Maintenance of the surface water drainage system will consist of removing sediment and/or undesirable vegetation from the surface water runoff control system (channels and culverts) as required. Eroded areas will be repaired by back-filling and reseeding according to the specifications. Damage to culverts will be repaired; structure replacement will be performed if needed.

3.1 SECTION 257.104(b)(3)

[Maintaining the groundwater monitoring system and monitoring the groundwater in accordance with the requirements of §257.90 through 257.98.]

The groundwater monitoring system will be inspected for the general integrity of the wells, well casings and well protective casings. Any damaged portions of the monitoring wells and/or their protective casings will be replaced in-kind.

Monitoring the groundwater will be in accordance with the groundwater monitoring plan for this facility and in accordance with the requirements of §§257.90 through 257.98.

4.0 POST-CLOSURE CONTACT 257.104 (d)(1)(ii)

[The name, address, telephone number and email address of the person or office to contact about the facility during the post-closure care period.]

The name, address, and telephone number of the person to contact about the Facility during the post closure period shall be provided upon notice of closure.

5.0 POST-CLOSURE PLANNED USE 257.104 (d)(1)(iii)

[A description of the planned uses of the property during the post-closure period. Post-closure use of the property shall not disturb the integrity of the final cover, liner(s), or any other component of the containment system, or the function of the monitoring systems unless necessary to comply with the requirements in this subpart…]

The post-closure use of the property will be undisturbed vacant land space. The only activities occurring on the closed CCR unit will be related to the Post-Closure care activities. All other activities will be prohibited.

ATTACHMENT 7

Post-Closure Care Cost Estimate for Landfill

WELSH PLANT - LANDFILL (ASH#1) Revised GES 7/3/2018

POST CLOSURE CARE ESTIMATE - ANNUAL MONITORING & MAINTENANCE

Post Closure Care Period: 30 years

Landfill Area constructed: 40 ac 40

			Value	Unit	Unit Price	Cost	
1.0 Ground Water Monitoring:							
1.1 Total Number of Monitoring Wells			6	Each			
1.2 Total Number of Samples per Year	frequency of sampling	3	18	EA/YR			
1.3 Cost of Sampling				$	$475	$8,550	
1.4 Laboratory testing of samples				$	$350	$6,300	
1.5 Statistical review and reporting		3		$	$2,500	$7,500	
Total Costs for Ground Water Monitoring				**$**		**$22,350**	
2.0 Leachate Monitoring							
2.1 Total Number of Samples per year	quarterly sampling		4	EA/YR			
2.2 Unit Cost per Sample				$/EA	$1,000		
Total Costs for Leachate Monitoring	**not required**			**$**		**$4,000**	
3.0 Surface Water Monitoring							
3.1 Total Number of Samples per year	collected with Leachate monitoring		2	EA/YR			
3.2 Unit Cost per Sample				$/EA	$1,000		
3.3 Total Monitoring Costs				$		**$2,000**	
4.0 O&M of Leachate Collection and Treatment System							
4.1 Inspection & Flushing of Collection and Conveyance Pipes	annual flushing	crew $2000/day	5	days	$2,000	$10,000	
4.2 Inspection & Cleaning of Sumps/Manholes	annual visual inspection		0	LS			
4.3 Repair/Replacement of Sump and Conveyance Piping				LS			
4.4 Amount of Leachate Generated from HELP Model				Gallons/YR			
4.5 Leachate Disposal Cost	assume no disposal cost			$/Gallon			
4.6 Total Annual Leachate Disposal Cost				$			
4.7 Annual Pump Electricity Costs				$/YR/pump			
Total Costs for O&M Leachate System				**$**		**$10,000**	**only every other year**
5.0 O&M Ground Water Monitoring Wells							
5.1 Inspection & Maintenance:	part of sample collection time		2	Each	$1,000	$2,000	
5.2 Repair of Monitoring Wells			0	Each	$2,500	$0	
Total Costs for Ground Water Monitoring Wells						**$2,000**	
6.0 Maintenance of Cover System:							
6.1 Mowing Frequency per Year			2	Each			
6.2 Unit Cost per mowing				$/ac	$50		
6.3 Total Mowing Costs:				$		$4,000	
6.4 Area to be Reseeded:	1% of seeded cap area		0	SY			
6.5 Reseeding Unit Costs:				$/SY	$0.50		
6.6 Total Reseeding Costs:				$		$0	
6.7 Cap Repairs per Year	24 hrs/yr @ $500/hr		24	HR			
6.8 Cap Repair Unit Costs				$/SY	$500.00		
6.9 Total Cap Repair Costs:				$		$12,000	
Total Costs for Maintenance of Cover System:	other maintenance in 4.0			$		**$16,000**	
7.0 O&M of Surface Water Management System							
7.1 Inspection & Routine Maintenance	Included in 5.0 above		4	Each	$0	$0	
7.2 Conveyance Ditch/Piping Cleaning & Repair	part of maintenance above		0	LS	$15,000	$0	
7.3 Outlet Cleaning & Repair			0	LS	$1,000	$0	
Total Costs for O&M of Surface Water System				$		**$0**	
8.0 O&M of Access Control Structures:							
8.1 Inspection & Routine Maintenance	Included in 5.0 above		4	Each	$0	$0	
8.2 Fence, Gate & Sign Repair	no fencing at project		0	LS	$1,000	$0	
8.3 Roadway Maintenance	part of maintenance above		0	LS	$2,000	$0	
Total Costs for O&M of Access Control Structures				$		**$0**	
9.0 Vector and Rodent Control:							
9.1 Vector and Rodent Control	part of maintenance above		1	LS/Year	$0	**$0**	
10.0 Inspections:							
10.1 Annual engineering Inspections	based on current contracts		1	Each/YR	$20,000	$20,000	
10.2 Benchmark Inspection	Included in 10.1 above		1	Each/YR	$0	$0	
10.3 Security Inspections	Included in 10.1 above		4	Each/YR	$0	$0	
Total Costs for Inspections						**$20,000**	
	part of sampling and maintenance.						
11.0 Final Closure							
11.1 Mobilization/Demobilization			1	LS	$0	$0	
11.2 Engineering Fees & Reports			1	LS	$0	$0	
11.3 Survey & Deed Notation			1	LS	$0	$0	

11.4 Closure Certification	1	LS	$0	$0
Total Costs for Final Closure				**$0**
TOTAL ANNUAL POST CLOSURE CARE COSTS:				**$76,350**
Non-annual Post Closure Care Costs:				
Replacement of Groundwater Monitoring Wells	6	Each	$15,000	$90,000
Plugging of Monitoring Wells	6	each	$3,000	$18,000
Total Costs for Non-annual Post Closure Costs:				$108,000
TOTAL POST CLOSURE CARE DIRECT COSTS: (30 years)				$2,398,500
TOTAL POST CLOSURE LANDFILL MONITORING & MAINTENANCE COSTS				$2,398,500