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American Electric Power Service Corporation

East Bottom Ash Pond - CCR Groundwater Monitoring Well Network Evaluation

H.W. Pirkey Power Plant
2400 FM 3251
Harrison County
Hallsville, Texas

May 25, 2016

ARCADIS

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2400 FM 3251
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Hallsville, Texas

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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

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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 East Bottom Ash Pond (BAP) CCR Unit at the AEP H.W. Pirkey Generating Plant (Plant) located at 2400 FM 3251 in Hallsville, Harrison 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 and isolated from 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 zone, or in an unstable area.

Four regulated CCR units associated with the Plant were identified for review, which include the West BAP, East BAP, Stack Out Area, and Landfill (**Figure 2**). This report summarizes the evaluation of the groundwater monitoring well network in the uppermost aquifer at the East BAP (Site). The evaluation of the 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 East BAP 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.

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2. Background Information

The following section provides background information for the AEP H.W. Pirkey Generating Plant East BAP.

2.1 Facility Location Description

The AEP H.W. Pirkey Plant is located in southern Harrison County, approximately 5 miles southeast of Hallsville, Texas, and approximately 8 miles southwest of Marshall, Texas. The East BAP CCR unit is located at the north end of the Plant and approximately 2,000 feet north-northwest of Brandy Branch Reservoir (**Figures 1** and **2**).

2.2 Description of East BAP CCR Unit

The following section will discuss the embankment configuration, area, volume, construction and operational history, and surface water control associated with the East BAP.

2.2.1 Embankment Configuration

The East BAP is partially incised into native soils with an embankment height of approximately 4 feet (AMEC, 2011). The East BAP embankments are constructed of compacted clay on a 3:1 slope (3 feet horizontal, 1 foot vertical) (Sargent & Lundy, 1983). The elevation of the top of the embankment around the perimeter of the East BAP is approximately 357 feet amsl, and the normal operating level is approximately 354 feet amsl (Johnson & Pace, May 2011). The interior bottom elevation of the East BAP is approximately 347 feet amsl (Sargent & Lundy, 1983; Johnson & Pace, June 2011).

2.2.2 Area/Volume

The East BAP is approximately 31.5 acres in size. The design maximum ash storage capacity of the East BAP is 188 acre feet (Sargent & Lundy, 1983). Johnson & Pace calculated the East BAP ash storage capacity in 2011 at 161 acre feet at an elevation of 355 feet amsl (maximum operating level) (Johnson & Pace, June 2011).

2.2.3 Construction and Operational History

The H.W. Pirkey Power Plant was constructed in 1983 and 1984, and began operation in 1985. Throughout the life of the Plant, CCR materials (fly ash, bottom ash, economizer ash, flue gas desulfurization sludge) have been generated. The East BAP,

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which was placed into operation in 1985, receives bottom ash and economizer ash sluiced from the power plant boiler (**Figure 3**). Clear water overflow from the East BAP discharges into the Clearwater Pond located directly south of the East BAP. Bottom ash and economizer ash are periodically excavated from the East BAP and hauled by truck to either the on-site landfill for disposal, or sold for offsite beneficial re-use.

The base of the East BAP was constructed in 1983 with a compacted clay liner (Sargent & Lundy, 1983). Following installation of the compacted clay liner, soil borings S-4 through S-7 were advanced below the base of the East BAP to total depths of six feet in September 1983 (Southwestern Laboratories, 1984). The lithologic data from soil borings S-4 through S-7 confirm at least six feet of clay is present below the base of the East BAP (Sargent & Lundy, 1984).

2.2.4 Surface Water Control

Surface water elevation in the East BAP is controlled by a weir box and a manually operated gate valve on a 36-inch-diameter discharge pipe at the southwest corner of the pond. Clear water overflow from the East BAP discharges through the 36-inch-diameter pipe into the 2.7- acre Clearwater Pond located directly south of the East BAP (**Figure 3**). Water in the Clearwater Pond is pumped (re-circulated) back into the boiler ash hopper.

2.3 Previous Investigations

The initial soils investigation and design of the East BAP was provided in a January 31, 1983 report prepared by Sargent & Lundy entitled "*Henry W. Pirkey Power Plant, Design Summary for Lignite Storage Area and Wastewater Pond Facilities*". This investigation included advancement of soil borings throughout the Plant, and design of the East BAP. As discussed above in Section 2.2.3, the design included installation of a clay liner below the East BAP.

In September-October 1983, Southwestern Laboratories conducted a soil investigation at the Plant, including advancement of four soil borings (S-4 through S-7) below the East BAP (Southwestern Laboratories, 1984).

In 1984, Sargent & Lundy conducted an evaluation of the East BAP. This report included evaluation of soil sample geotechnical data, and concluded a low-permeability clay liner was present below the East BAP (Sargent & Lundy, 1984).

In 2009, ETTL Engineers & Consultants (ETTL) conducted a geotechnical investigation of the East BAP earthen embankment. The investigation included installation of two soil borings through the embankment (E1, E2), completion of the soil borings as

piezometers PE-1 and PE-2, respectively, and collection of soil samples for geotechnical analyses. The report concluded the embankment was stable and the existing embankment slopes were acceptable if conditions are maintained (ETTL, 2010). The conditions to be maintained included embankment protection from erosion (vegetative cover), removal of brush and trees two feet or more in height, and control of animal burrowing.

In 2010 and January 2011, Apex Geoscience expanded the groundwater monitoring well system at the Plant, including installation of monitoring wells AD-16 through AD-29. Apex Geoscience also conducted video surveillance of the existing monitoring wells and plugged monitoring wells MW-1, MW-5, MW-6, MW-9, MW-11, MW-14, MW-15, M-2, and M-3 (Apex Geoscience, 2011).

In 2011, Johnson & Pace performed a hydraulic analysis of the East BAP for a 10-year, 24-hour rainfall event in accordance with the TCEQ TPDES permit design criteria. The report concluded the storage capacity of the East BAP is hydraulically adequate (Johnson & Pace, May 2011).

In December 2015, Auckland Consulting further expanded the groundwater monitoring well system at the Plant, including installation of six monitoring wells (AD-30 through AD-35) (Auckland Consulting, 2016).

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 central and northern portions of the Plant are located on the outcrop of the Eocene-age Recklaw Formation. The Recklaw Formation consists predominantly of clay and fine grained sand, and attains a maximum thickness of approximately 100 feet (Broom, 1966).

The Recklaw Formation is underlain by the Eocene-age Carrizo Sand, which outcrops in the topographically low southern portion of the Plant. The Carrizo Sand consists of fine to medium grained sand interbedded with silt and clay, and attains a thickness of approximately 100 feet (Broom, 1966).

These features are further illustrated on five lines of cross section that were prepared through the East BAP 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').

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2.4.1 Climate and Water Budget

Average temperatures in Harrison County, Texas range from 47.1° Fahrenheit (F) in January to 83.8°F in July, and the mean annual growing season is 238 days. Average annual precipitation (including liquid water equivalent from snowfall) is approximately 47 inches (Broom, 1966).

2.4.2 Regional and Local Geologic Setting

The central and northern portions of the Plant, including the East BAP, are located on the outcrop of the Eocene-age Recklaw Formation. The Recklaw Formation is underlain by the Eocene-age Carrizo Sand, which outcrops in the topographically low southern end of the Plant (Broom, 1966; Flawn, 1965).

Detailed regional geologic characterization can be found in several published reports including Texas Water Development Report 27 "*Ground-Water Resources of Harrison County, Texas*" (Broom, 1966), The University of Texas at Austin Bureau of Economic Geology "*Geologic Atlas of Texas – Tyler Sheet*" (Flawn, 1965), and U.S. Geological Survey Open-File Report 88-450K "*Petroleum Geology and the Distribution of Conventional Crude Oil, Natural Gas, and Natural Gas Liquids, East Texas Basin*" (USGS, 1988).

Detailed regional and site geologic characterization can also be found in the 2010 ETTL report entitled "*Geotechnical Investigation, Pirkey Power Station, Existing Ash, Surge, Lignite and Limestone Runoff, and Landfill Stormwater Ponds Embankment Investigation, Hallsville, Texas*" (ETTL, 2010).

2.4.3 Surface Water and Surface Water Groundwater Interactions

Figure 9 is a potentiometric surface map based on January 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 East BAP is west-southwesterly at an average hydraulic gradient of approximately 0.01 foot per foot.

The East BAP is located approximately 2,000 feet north-northwest of Brandy Branch Reservoir, which was dammed during Plant construction in the 1980's. The normal pool level of Brandy Branch Reservoir is approximately 340 feet amsl. As shown on **Figure 9**, shallow groundwater flow direction at the Site generally follows surface topography to the west and southwest toward Hatley Creek, which is located in a topographically low area approximately one mile west of the Site. Therefore shallow

groundwater in the area of the East BAP does not discharge into Brandy Branch Reservoir.

2.4.4 Water Users

A water well inventory conducted by Banks Information Solutions showed 12 water wells had been drilled within a ½-mile radius of the Site (Banks, 2015). The nearest water well was reportedly drilled approximately 500 feet south (side gradient) of the East BAP in 2004 by Bennett Drilling for use as a rig supply well. The water well was screened from 350 to 430 feet below ground surface, therefore this water well is completed in a deeper water bearing unit relative to the uppermost water-bearing unit at the Site.

The second closest water well was reportedly drilled approximately ¼-mile southwest (downgradient) of the East BAP for NFR Energy in 2008 for use as a rig supply well. The water well was screened from 250 to 310 feet below ground surface, therefore this water well is completed in a deeper water bearing unit relative to the uppermost water-bearing unit at the Site.

All of the water wells identified within a ½-mile radius of the Site were drilled to total depths of 160 feet or deeper except one water well (Well ID: 35-37-4E) that was drilled to a total depth of 55 feet in 1982. This water well was completed with concrete tile from the surface to total depth, and is located approximately ¼-mile east (up gradient) of the Pirkey Power Plant.

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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, piezometers, and monitoring wells installed at the Site show the uppermost aquifer in the area of the East BAP is a very fine to fine grained clayey and silty sand stratum with an average thickness of approximately 15 feet that is located between an elevation of approximately 325 and 340 feet amsl (**Appendix A**). The base of the East BAP is at an elevation of 347 feet amsl. Therefore the separation distance between the uppermost aquifer and the base of the East BAP is approximately seven feet. This separation distance is further illustrated on cross section A-A' (**Figure 4)** and cross section E-E' (**Figure 8)**.

3.1.2 Overall Flow Conditions

Groundwater is recharged from regional precipitation infiltration. 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 15 feet), the yield of the uppermost aqufier 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 January 20, 2016 is depicted on **Figure 9**. The groundwater flow is west-southwesterly towards Hatley Creek, which is located approximately one mile west of the Site.

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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 Site hydrostratigraphic unit in the area of the East BAP is the clayey and silty sand stratum that is located between an elevation of approximately 325 and 340 feet amsl.

3.3 Review of Existing Monitoring Well Network

3.3.1 Overview

The Site was visited by ARCADIS and AEP personnel on August 19, 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

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Table 2. Photo documentation of the located wells during the August 19, 2015 site visit is provided in **Appendix B**.

Monitoring wells AD-2, AD-3, AD-4, AD-12, and AD-18 were previously installed at the Site to monitor the uppermost aquifer (clayey and silty sand stratum) associated with the East BAP. As discussed above in Section 3.1.1, the uppermost aquifer below the East BAP is approximately 15 feet thick and is located between an elevation of approximately 325 and 340 feet amsl.

3.3.2 Gaps in Monitoring Network

As shown on Geologic Cross Section A-A' (**Figure 4**), existing monitoring well AD-4 is screened in the uppermost aquifer upgradient (east) of the East BAP, and existing monitoring well AD-3 is screened in the uppermost aquifer sidegradient (northwest) of the East BAP. Existing monitoring wells AD-4, AD-12 and AD-18 (also located east of the East BAP) will be utilized as upgradient monitoring wells for the East BAP. Existing monitoring well AD-2, located west-southwest of the East BAP, will be utilized as a downgradient monitoring well for the East BAP.

As shown on **Figure 9**, shallow groundwater flow direction in the area of the East BAP is west-southwesterly. One existing monitoring well (AD-2) was located hydraulically downgradient of the East BAP during the August 19, 2015 site visit, and three downgradient monitoring wells are required to monitor groundwater quality downgradient of a CCR unit. This data gap was addressed by installation of new downgradient monitoring wells AD-31 and AD-32 during December 2015 as shown on **Figure 9** and **10**. With the addition of monitoring wells AD-31 on the west side of the East BAP and AD-32 on the south central side of the East BAP, there are no gaps remaining in the groundwater monitoring network for the East BAP.

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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 East BAP (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 East BAP.

4.1 Recommended Monitoring Well Network Distribution

Three up gradient well locations (existing monitoring wells AD-4, AD-12, and AD-18) and three down gradient well locations (existing monitoring wells AD-2, AD-31, and AD-32) are recommended to establish a groundwater quality monitoring well network for the East BAP. In addition, existing sidegradient monitoring well AD-3 may be utilized as a piezometer to obtain additional groundwater flow direction and gradient data for the East BAP.

4.1.1 Location

The recommended monitoring well network for groundwater quality of the uppermost aquifer at the East BAP 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 325 and 340 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 East BAP was addressed by installation of monitoring wells AD-31 and AD-32 during December 2015. Monitoring wells AD-31 and AD-32 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**.

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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

Kent J Brandner

Signature

69586	Texas	5-25-16
Registration No.	Registration State	Date

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Tables

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Table 1
Water Level Data
AEP Pirkey Power Plant - CCR Storage Areas
Hallsville, Harrison County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation[a]	Top of Casing Elevation[a]	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Screen[b]		Bottom of Screen[b]		4/13/2011	12/15/2011	6/20/2012	1/23/2013	7/7/2013	1/22/2014	7/9/2014	1/28/2015	1/20/2016
									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
Monitoring Wells																					
MW-2/AD-2	32° 27' 54.753"	94° 29' 25.282"	341.25	344.04	40	10/7/83	Sch. 40 PVC	4	20	321.25	40	301.25	326.90	327.12	327.17	327.26	326.62	327.70	327.19	328.62	328.55
MW-3/AD-3	32° 28' 6.829"	94° 29' 21.498"	372.76	375.30	57	11/4/83	Sch. 40 PVC	4	37	335.76	57	315.76	342.95	341.59	343.70	341.10	343.27	341.42	343.96	345.01	347.03
MW-4/AD-4	32° 27' 59.247"	94° 29' 4.692"	363.69	366.79	46	10/10/83	Sch. 40 PVC	4	26	337.69	46	317.69	351.45	351.24	352.44	354.42	349.22	355.58	353.33	359.00	359.16
MW-7/AD-7	32° 27' 43.611"	94° 29' 15.611"	359.61	362.79	40	10/3/83	Sch. 40 PVC	4	20	339.61	40	319.61	344.34	343.75	344.15	344.90	343.35	346.61	346.23	349.17	349.31
MW-8/AD-8	32° 27' 25.095"	94° 29' 14.925"	356.92	359.84	35	10/4/83	Sch. 40 PVC	4	20	336.92	35	321.92	341.65	340.29	341.65	340.72	341.25	341.67	343.36	344.03	347.21
MW-10/AD-10	32° 27' 52.446"	94° 29' 16.545"	359.48	362.21	40	10/10/83	Sch. 40 PVC	4	20	339.48	40	319.48	342.03	341.90	342.19	341.41	339.85	342.27	342.22	344.39	343.97
MW-12/AD-12	32° 27' 51.702"	94° 29' 3.238"	378.84	381.99	51	1/30/86	Sch. 40 PVC	4	31	347.84	51	327.84	358.95	357.99	359.33	368.07	357.41	369.97	367.04	372.75	371.05
MW-13/AD-13	32° 27' 46.002"	94° 29' 5.71"	361.98	364.76	40.5	2/23/88	Sch. 40 PVC	4	30.5	331.48	40.5	321.48	349.46	348.91	349.52	350.81	348.61	351.97	351.29	354.47	354.15
AD-16	32° 27' 40.871"	94° 29' 38.637"	356.81	360.05	35	12/30/10	Sch. 40 PVC	2	15.0	341.81	35.0	321.81	338.08	335.50	337.58	335.43	336.67	339.53	340.84	343.34	347.68
AD-17	32° 28' 2.315"	94° 29' 39.45"	342.65	346.09	30	12/30/10	Sch. 40 PVC	2	10.0	332.65	30.0	312.65	322.66	322.29	323.31	323.51	323.06	325.19	324.15	328.42	326.78
AD-18	32° 28' 9.245"	94° 29' 6.469"	360.48	363.42	25	1/3/11	Sch. 40 PVC	2	15.0	345.48	25.0	335.48	355.53	351.54	357.21	355.47	357.23	360.03	358.06	359.88	360.52
AD-19	32° 27' 50.512"	94° 29' 13.973"	359.50	362.82	30	12/30/10	Sch. 40 PVC	2	10.0	349.50	30.0	329.50	344.07	343.58	344.29	344.62	342.60	345.11	345.76	347.92	347.40
AD-20	32° 27' 51.346"	94° 29' 21.576"	352.30	355.79	35	12/28/10	Sch. 40 PVC	2	15.0	337.30	35.0	317.30	334.50	334.63	334.69	334.78	333.38	335.38	334.87	336.88	336.07
AD-21	32° 27' 45.403"	94° 29' 19.195"	347.23	350.72	30	12/27/10	Sch. 40 PVC	2	10.0	337.23	30.0	317.23	340.43	340.02	340.22	341.57	339.16	342.36	341.67	345.45	343.82
AD-22	32° 27' 41.349"	94° 29' 17.779"	355.57	358.51	30	12/16/10	Sch. 40 PVC	2	10.0	345.57	30.0	325.57	343.64	343.16	343.74	344.83	342.90	346.49	345.77	350.24	350.29
AD-23	32° 27' 3.384"	94° 29' 41.258"	346.72	350.10	35	12/15/10	Sch. 40 PVC	2	15.0	331.72	35.0	311.72	319.65	318.94	319.29	318.66	318.87	319.80	319.79	319.84	321.23
AD-24	32° 27' 1.455"	94° 29' 56.388"	287.68	291.14	20	12/27/10	Sch. 40 PVC	2	5.0	282.68	20.0	267.68	282.92	284.29	285.10	285.63	285.06	288.30	287.10	288.56	---
AD-25	32° 27' 17.187"	94° 29' 58.998"	334.15	337.09	30	12/14/10	Sch. 40 PVC	2	10.0	324.15	30.0	304.15	324.51	321.90	323.14	321.94	322.15	322.56	324.24	326.42	327.00
AD-26	32° 27' 25.426"	94° 29' 54.775"	342.41	345.25	40	12/14/10	Sch. 40 PVC	2	10.0	332.41	40.0	302.41	324.53	323.77	323.62	322.32	322.09	323.24	322.51	323.04	326.06
AD-27	32° 27' 36.66"	94° 29' 47.272"	349.83	352.62	37.5	12/15/10	Sch. 40 PVC	2	17.5	332.33	37.5	312.33	325.82	324.54	326.13	325.39	325.35	326.39	327.91	329.69	330.89
AD-28	32° 27' 55.439"	94° 29' 39.418"	335.92	339.40	40	12/28/10	Sch. 40 PVC	2	15.0	320.92	35.0	300.92	319.67	319.16	319.92	320.21	319.69	320.65	320.22	322.16	321.39
AD-29	32° 28' 8.271"	94° 29' 31.939"	350.21	353.37	30	1/3/11	Sch. 40 PVC	2	10.0	340.21	30.0	320.21	334.68	333.37	334.74	337.47	336.84	338.55	335.85	340.57	338.48
AD-30[d]	32° 27' 56.49"	94° 29' 32.53"	339.04	342.02	25	12/8/15	Sch. 40 PVC	2	10.0	329.04	25.0	314.04	---	---	---	---	---	---	---	---	323.70
AD-31[d]	32° 28' 02.48"	94° 29' 20.90"	357.75	360.75	35	12/8/15	Sch. 40 PVC	2	20.0	337.75	35.0	322.75	---	---	---	---	---	---	---	---	346.60
AD-32[d]	32° 27' 56.20"	94° 29' 11.86"	357.23	359.18	33	12/11/15	Sch. 40 PVC	2	13.0	344.23	33.0	324.23	---	---	---	---	---	---	---	---	352.32
AD-33[d]	32° 27' 38.70"	94° 29' 15.82"	359.30	362.37	30	12/11/15	Sch. 40 PVC	2	15.0	344.30	30.0	329.30	---	---	---	---	---	---	---	---	351.13
AD-34[d]	32° 27' 10.13"	94° 29' 57.93"	304.64	307.61	25	12/11/15	Sch. 40 PVC	2	10.0	294.64	25.0	279.64	---	---	---	---	---	---	---	---	307.61
AD-35[d]	32° 27' 09.64"	94° 29' 42.74"	316.01	318.95	20	12/11/15	Sch. 40 PVC	2	3.0	313.01	18.0	298.01	---	---	---	---	---	---	---	---	309.85
Piezometers[c]																					
W-3 (PW-3)	32° 27' 57.6"	94° 29' 31.8"	356.30	356.30	38	10/20/09	Sch. 40 PVC	2	28.0	328.30	38.0	318.30	NM	NM	NM	NM	NM	NM	NM	NM	NM

(a) Source: Apex Geoscience Inc. (March 23, 2011).
(b) Screen length and screened intervals for AD-2 through AD-12 estimated from video surveillance (Apex Geoscience Inc., March 23, 2011).
(c) Souce: EETL (October 2010).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-30 through AD-35 installed during December 2015.
Groundwater Elevation Source: AEP, Pirkey Monitoring Well Groundwater Elevations through January 2015.
NM - Not Measured

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Table 2
Well Construction Details
AEP Pirkey Power Plant - CCR Units
Hallsville, Harrison County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation[a]	Top of Casing Elevation[a]	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Filter Pack		Bottom of Filter Pack		Top of Screen[b]		Bottom of Screen[b]	
									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																
MW-2/AD-2	32° 27' 54.753"	94° 29' 25.282"	341.25	344.04	40	10/7/83	Sch. 40 PVC	4	18	323	40	301	20	321.25	40	301.25
MW-3/AD-3	32° 28' 6.829"	94° 29' 21.498"	372.76	375.30	57	11/4/83	Sch. 40 PVC	4	35	338	57	316	37	335.76	57	315.76
MW-4/AD-4	32° 27' 59.247"	94° 29' 4.692"	363.69	366.79	46	10/10/83	Sch. 40 PVC	4	24	340	46	318	26	337.69	46	317.69
MW-7/AD-7	32° 27' 43.611"	94° 29' 15.611"	359.61	362.79	40	10/3/83	Sch. 40 PVC	4	18	342	40	320	20	339.61	40	319.61
MW-8/AD-8	32° 27' 25.095"	94° 29' 14.925"	356.92	359.84	35	10/4/83	Sch. 40 PVC	4	18	339	35	322	20	336.92	35	321.92
MW-10/AD-10	32° 27' 52.446"	94° 29' 16.545"	359.48	362.21	40	10/10/83	Sch. 40 PVC	4	18	341	40	319	20	339.48	40	319.48
MW-12/AD-12	32° 27' 51.702"	94° 29' 3.238"	378.84	381.99	51	1/30/86	Sch. 40 PVC	4	29	350	51	328	31	347.84	51	327.84
MW-13/AD-13	32° 27' 46.002"	94° 29' 5.71"	361.98	364.76	40.5	2/23/88	Sch. 40 PVC	4	17.5	344.5	40.5	321.5	30.5	331.48	40.5	321.48
AD-16	32° 27' 40.871"	94° 29' 38.637"	356.81	360.05	35	12/30/10	Sch. 40 PVC	2	13	344	35	322	15.0	341.81	35.0	321.81
AD-17	32° 28' 2.315"	94° 29' 39.45"	342.65	346.09	30	12/30/10	Sch. 40 PVC	2	8	335	30	313	10.0	332.65	30.0	312.65
AD-18	32° 28' 9.245"	94° 29' 6.469"	360.48	363.42	25	1/3/11	Sch. 40 PVC	2	13	347	25	335	15.0	345.48	25.0	335.48
AD-19	32° 27' 50.512"	94° 29' 13.973"	359.50	362.82	30	12/30/10	Sch. 40 PVC	2	8	352	30	330	10.0	349.50	30.0	329.50
AD-20	32° 27' 51.346"	94° 29' 21.576"	352.30	355.79	35	12/28/10	Sch. 40 PVC	2	13	339	35	317	15.0	337.30	35.0	317.30
AD-21	32° 27' 45.403"	94° 29' 19.195"	347.23	350.72	30	12/27/10	Sch. 40 PVC	2	8	339	30	317	10.0	337.23	30.0	317.23
AD-22	32° 27' 41.349"	94° 29' 17.779"	355.57	358.51	30	12/16/10	Sch. 40 PVC	2	8	348	30	326	10.0	345.57	30.0	325.57
AD-23	32° 27' 3.384"	94° 29' 41.258"	346.72	350.10	35	12/15/10	Sch. 40 PVC	2	13	334	35	312	15.0	331.72	35.0	311.72
AD-24	32° 27' 1.455"	94° 29' 56.388"	287.68	291.14	20	12/27/10	Sch. 40 PVC	2	3	285	20	268	5.0	282.68	20.0	267.68
AD-25	32° 27' 17.187"	94° 29' 58.998"	334.15	337.09	30	12/14/10	Sch. 40 PVC	2	8	326	30	304	10.0	324.15	30.0	304.15
AD-26	32° 27' 25.426"	94° 29' 54.775"	342.41	345.25	40	12/14/10	Sch. 40 PVC	2	8	334	40	302	10.0	332.41	40.0	302.41
AD-27	32° 27' 36.66"	94° 29' 47.272"	349.83	352.62	37.5	12/15/10	Sch. 40 PVC	2	15.5	334.3	37.5	312.3	17.5	332.33	37.5	312.33
AD-28	32° 27' 55.439"	94° 29' 39.418"	335.92	339.40	40	12/28/10	Sch. 40 PVC	2	13	323	35	301	15.0	320.92	35.0	300.92
AD-29	32° 28' 8.271"	94° 29' 31.939"	350.21	353.37	30	1/3/11	Sch. 40 PVC	2	8	342	30	320	10.0	340.21	30.0	320.21
AD-30[d]	32° 27' 56.49"	94° 29' 32.53"	339.04	342.02	25	12/8/15	Sch. 40 PVC	2	8	331	25	314	10.0	329.04	25.0	314.04
AD-31[d]	32° 28' 02.48"	94° 29' 20.90"	357.75	360.75	35	12/8/15	Sch. 40 PVC	2	18	340	35	323	20.0	337.75	35.0	322.75
AD-32[d]	32° 27' 56.20"	94° 29' 11.86"	357.23	359.18	33	12/11/15	Sch. 40 PVC	2	11	346	33	324	13.0	344.23	33.0	324.23
AD-33[d]	32° 27' 38.70"	94° 29' 15.82"	359.30	362.37	30	12/11/15	Sch. 40 PVC	2	12	347	30	329	15.0	344.30	30.0	329.30
AD-34[d]	32° 27' 10.13"	94° 29' 57.93"	304.64	307.61	25	12/11/15	Sch. 40 PVC	2	8	297	25	280	10.0	294.64	25.0	279.64
AD-35[d]	32° 27' 09.64"	94° 29' 42.74"	316.01	318.95	20	12/11/15	Sch. 40 PVC	2	2.5	313.5	20	296	3.0	313.01	18.0	298.01
Piezometers[c]																
W-3 (PW-3)	32° 27' 57.6"	94° 29' 31.8"	356.30	356.30	38	10/20/09	Sch. 40 PVC	2	26	330	38	318	28.0	328.30	38.0	318.30

General Note:
Elevations in feet above mean sea level.

Footnotes:
(a) Source: Apex Geoscience Inc. (March 23, 2011).
(b) Screen length and screened intervals for AD-2 through AD-12 estimated from video surveillance (Apex Geoscience Inc., March 23, 2011). Top of sand pack estimated 2 feet above top of screened interval.
(c) Souce: EETL (October 2010).
(d) Source: Aukland Consulting LLC (January 26, 2016).
Acronyms and Abbreviations:
NA = Data not available
ft = feet
bls = below land surface
msl = mean sea level

Table 3
Proposed Well Network
AEP Pirkey Power Plant - East Bottom Ash Pond
Hallsville, Harrison 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-4	Exisiting	Uppermost Water-Bearing Unit	East of East Bottom Ash Pond	Upgradient	337.7	317.7	20	Existing well installed in 1983; well will be utilitzed to establish backgroud water quality
AD-12	Exisiting	Uppermost Water-Bearing Unit	Northeast of Stack Out Area	Upgradient	347.8	327.8	20	Existing well installed in 1986; well will be utilitzed to establish backgroud water quality
AD-18	Exisiting	Uppermost Water-Bearing Unit	East of East Bottom Ash Pond	Upgradient	345.5	335.5	10	Existing well installed in 2011; well will be utilitzed to establish backgroud water quality
Downgradient								
AD-2	Existing	Uppermost Water-Bearing Unit	West-Southwest of East Bottom Ash Pond	Down gradient	321.3	301.3	20	Existing well installed in 1983; uppermost shallow aquifer adjacent to the East Bottom Ash Pond - downgradient
AD-31	Existing	Uppermost Water-Bearing Unit	West of East Bottom Ash Pond	Down gradient	337.8	322.8	15	New monitoring well installed during December 2015 in uppermost shallow aquifer adjacent to the East Bottom Ash Pond - downgradient
AD-32	Existing	Uppermost Water-Bearing Unit	South of East Bottom Ash Pond	Down gradient	344.2	324.2	20	New monitoring well installed during December 2015 in uppermost shallow aquifer adjacent to the East Bottom Ash Pond - downgradient
Piezometers								
AD-3	Exisiting	Uppermost Water-Bearing Unit	Northwest of East Bottom Ash Pond	Side gradient	335.8	315.8	20	Existing well installed in 2011; 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

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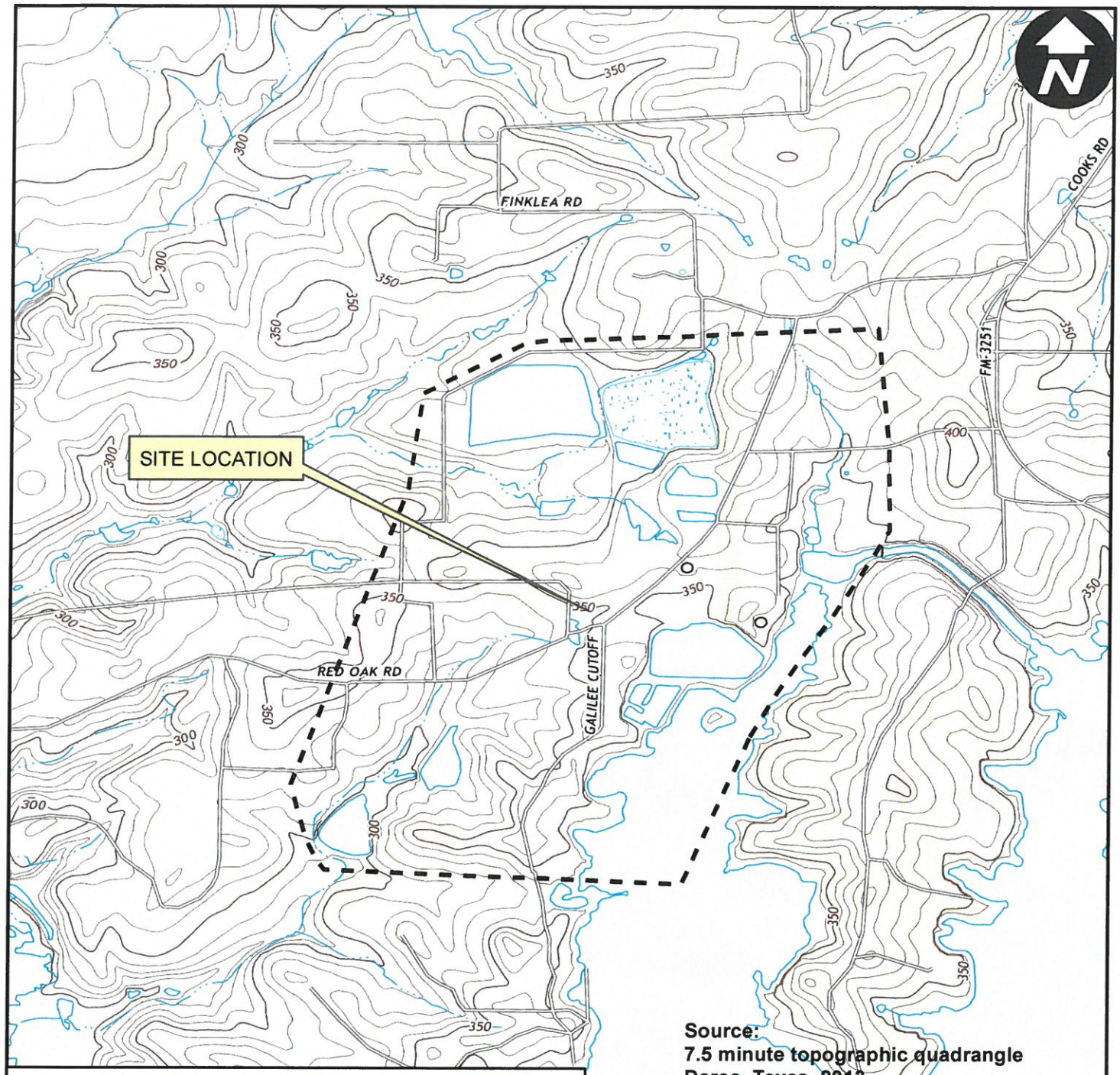
Figures



Source:
7.5 minute topographic quadrangle
Darco, Texas, 2013
Easton, Texas, 2013

0 2,000 4,000

SCALE IN FEET

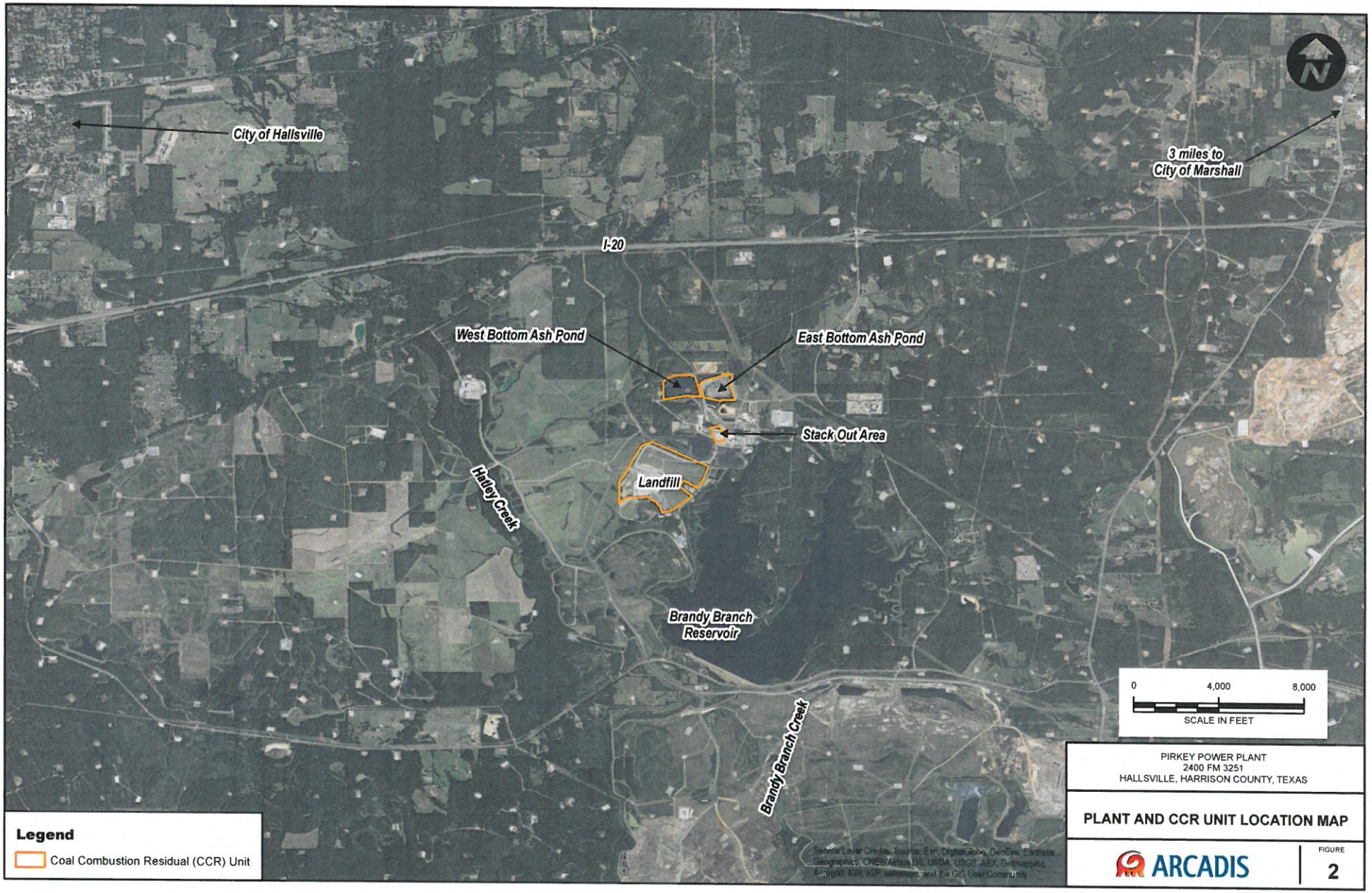
PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS

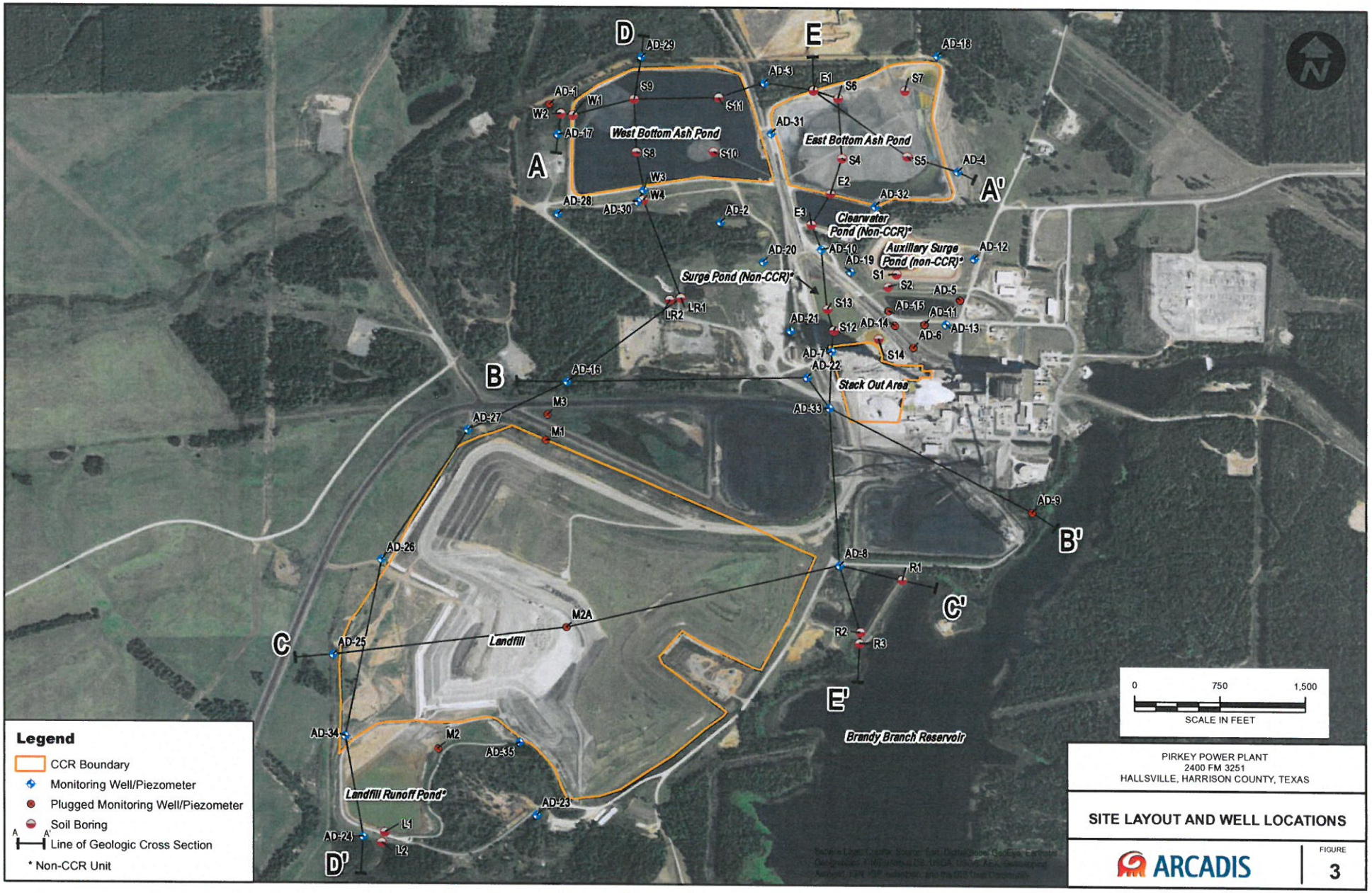
SITE LOCATION MAP

ARCADIS

FIGURE 1

Document Path: Z:\GISPROJECTS_ENVAEP\Pirkey Plant\MXD\Figure 1 - Site Location Map.mxd


City of Hallsville
3 miles to City of Marshall
I-20
West Bottom Ash Pond
East Bottom Ash Pond
Stack Out Area
Landfill
Hatley Creek
Brandy Branch Reservoir
Brandy Branch Creek
N
0
4,000
8,000
SCALE IN FEET
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
PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS
PLANT AND CCR UNIT LOCATION MAP
ARCADIS
FIGURE
2
Document Path: Z:\GIS\PROJECTS_ENV\AEP\Pirkey Plant\MXD\Figure 2 - Plant and CCR Unit Location Map.mxd



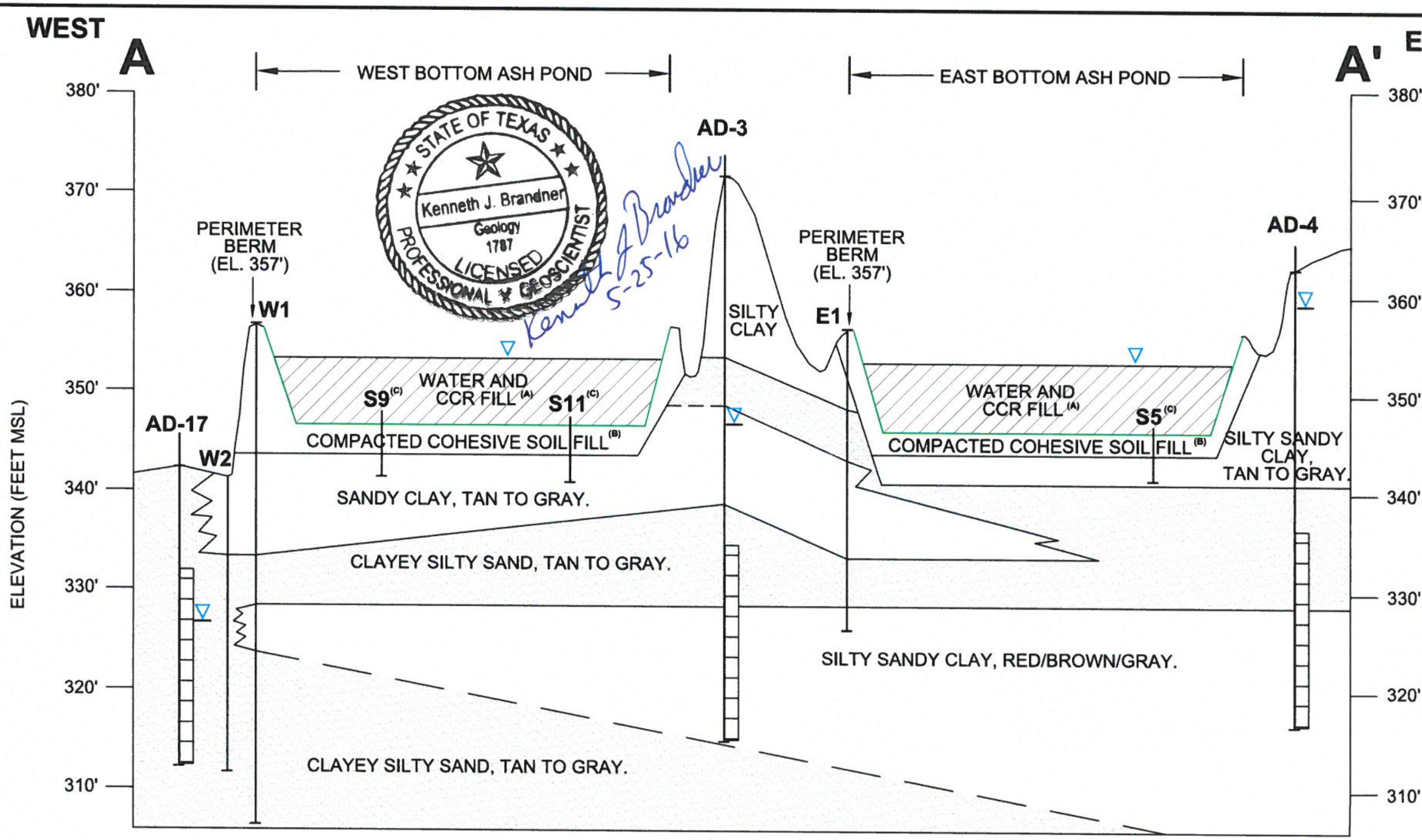
Document Path: Z:\GIS\PROJECTS_ENVAE\PVPirkey Plant\MXD\Figure 3 - Site Layout and Well Locations.mxd

PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS

SITE LAYOUT AND WELL LOCATIONS

ARCADIS

FIGURE
3



0 300'
HORIZONTAL SCALE

LEGEND

- MONITORING WELL SCREENED INTERVAL
- WATER LEVEL IN MONITORING WELL (1/20/16)
- BASE OF CCR UNIT

NOTES:

A) TOP OF WEST BOTTOM ASH POND AND EAST BOTTOM ASH POND PERIMETER BERM ELEVATION IS 357'. OPERATING ELEVATION IS 354'(JOHNSON & PACE, MAY 2011). BASE ELEVATION OF WEST BOTTOM ASH POND AND EAST BOTTOM ASH POND IS 347' (SARGENT & LUNDY, JANUARY 1983).
B) COMPACTED COHESIVE SOIL FROM ELEVATION 344' TO 347' (SARGENT & LUNDY, SEPTEMBER 1984;AMEC, AUGUST 2011).
C) SOIL BORING INSTALLED BY SOUTHWESTERN LABORATORIES DURING ASH POND CONSTRUCTION IN 1983.

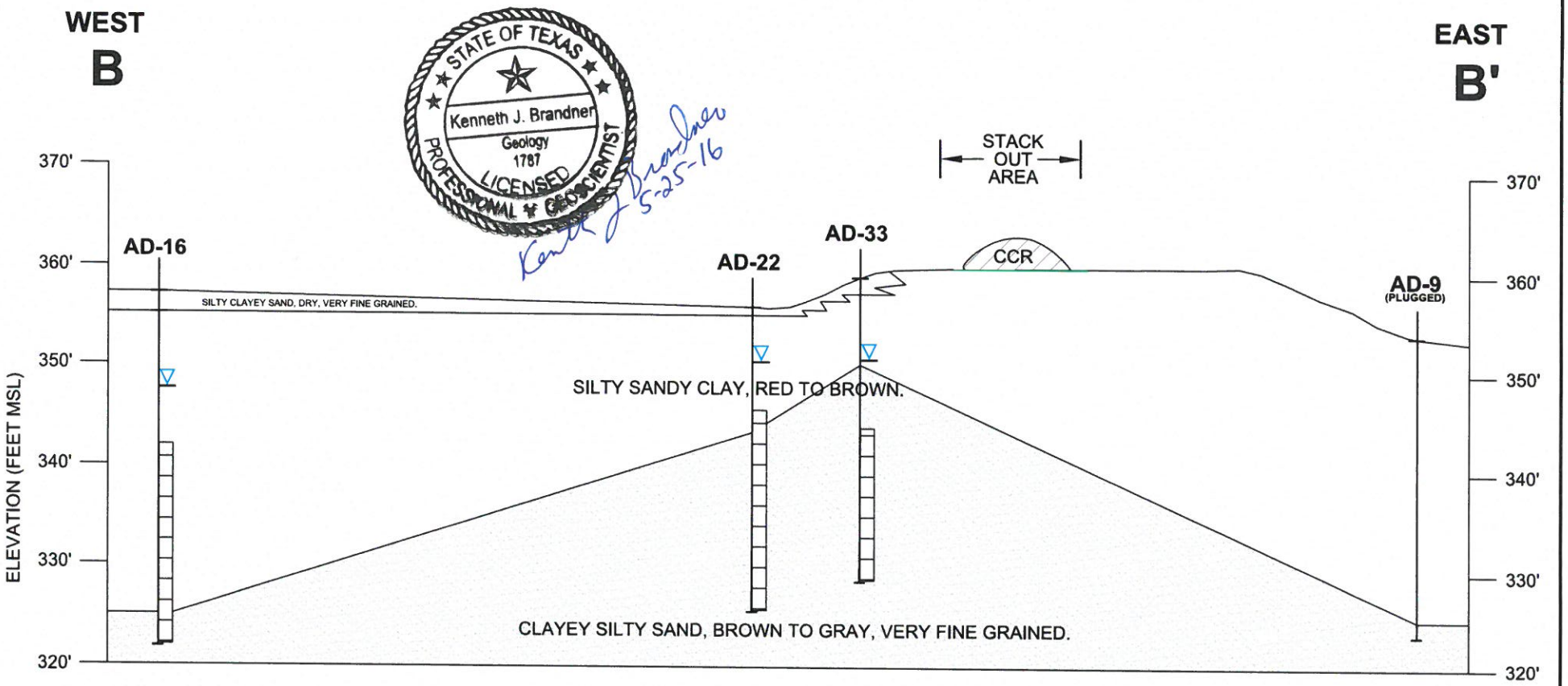
PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS

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\Pirkey Power Plant\Final 2016 Reports\West Bottom Ash Pond Location Restriction\Figures-Maps\Figure 4 Cross Section A-A'.dwg LAYOUT: MODEL SAVED: 2/19/2016 2:18 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE: — PLOTTED: 2/22/2016 11:17 AM BY: LEASE, DIANA



LEGEND

- MONITORING WELL SCREENED INTERVAL
- WATER LEVEL IN MONITORING WELL (1/20/16)
- BASE OF CCR UNIT

0 300'
HORIZONTAL SCALE

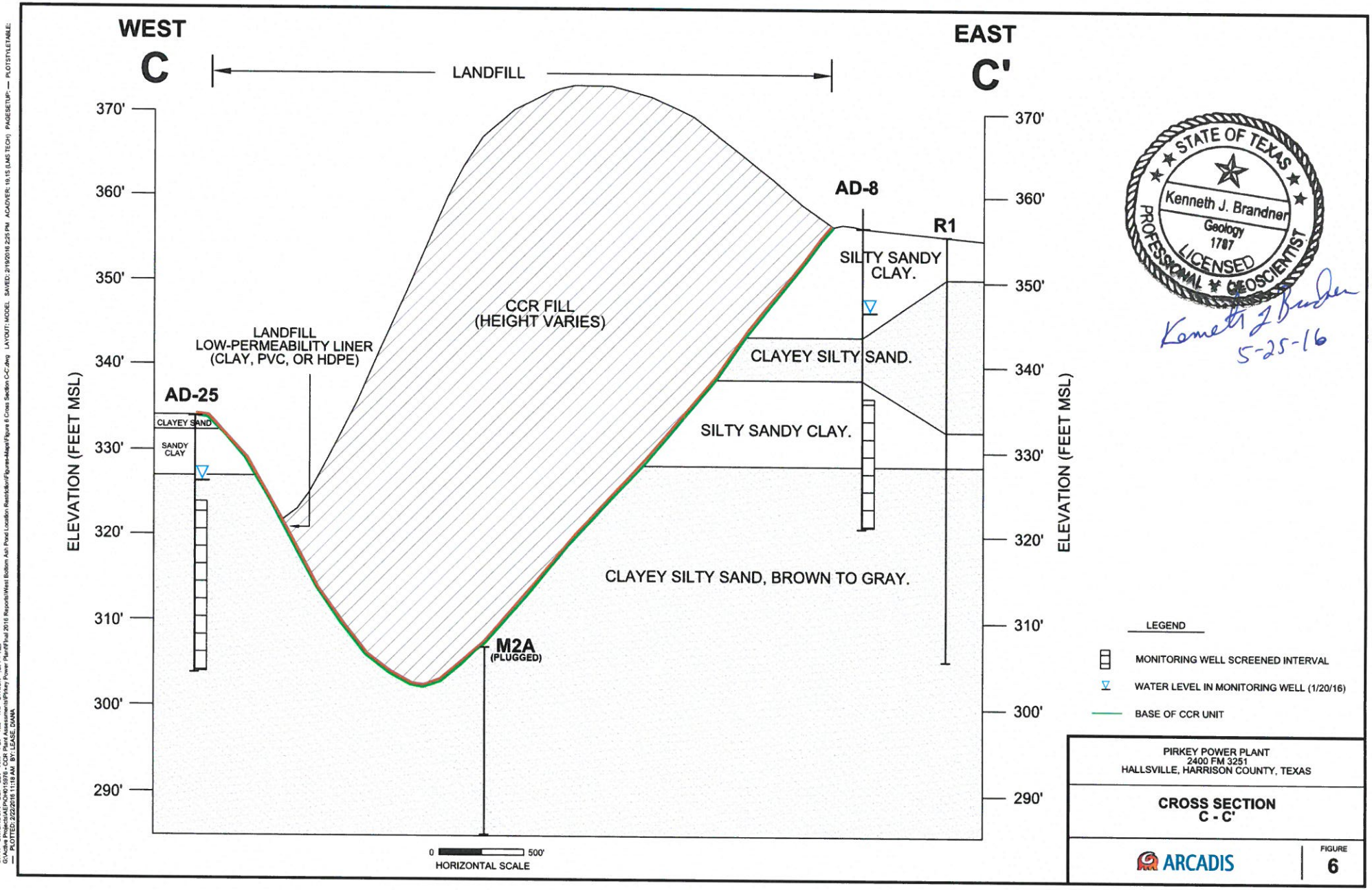
NOTES:
A) BASE OF STACK OUT AREA CCR UNIT LOCATED AT GRADE. ELEVATION TAKEN FROM MAY 2012 AND JUNE 23, 2015 TOPOGRAPHIC SURVEYS BY BEACON AVIATION.
B) ELEVATION OF CCR MATERIAL ABOVE STACK OUT AREA VARIES.

PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS

CROSS SECTION
B - B'

ARCADIS

FIGURE
5



STATE OF TEXAS
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1787
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PROFESSIONAL GEOSCIENTIST

Kenneth J Brandner
5-25-16

PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS

CROSS SECTION
C - C'

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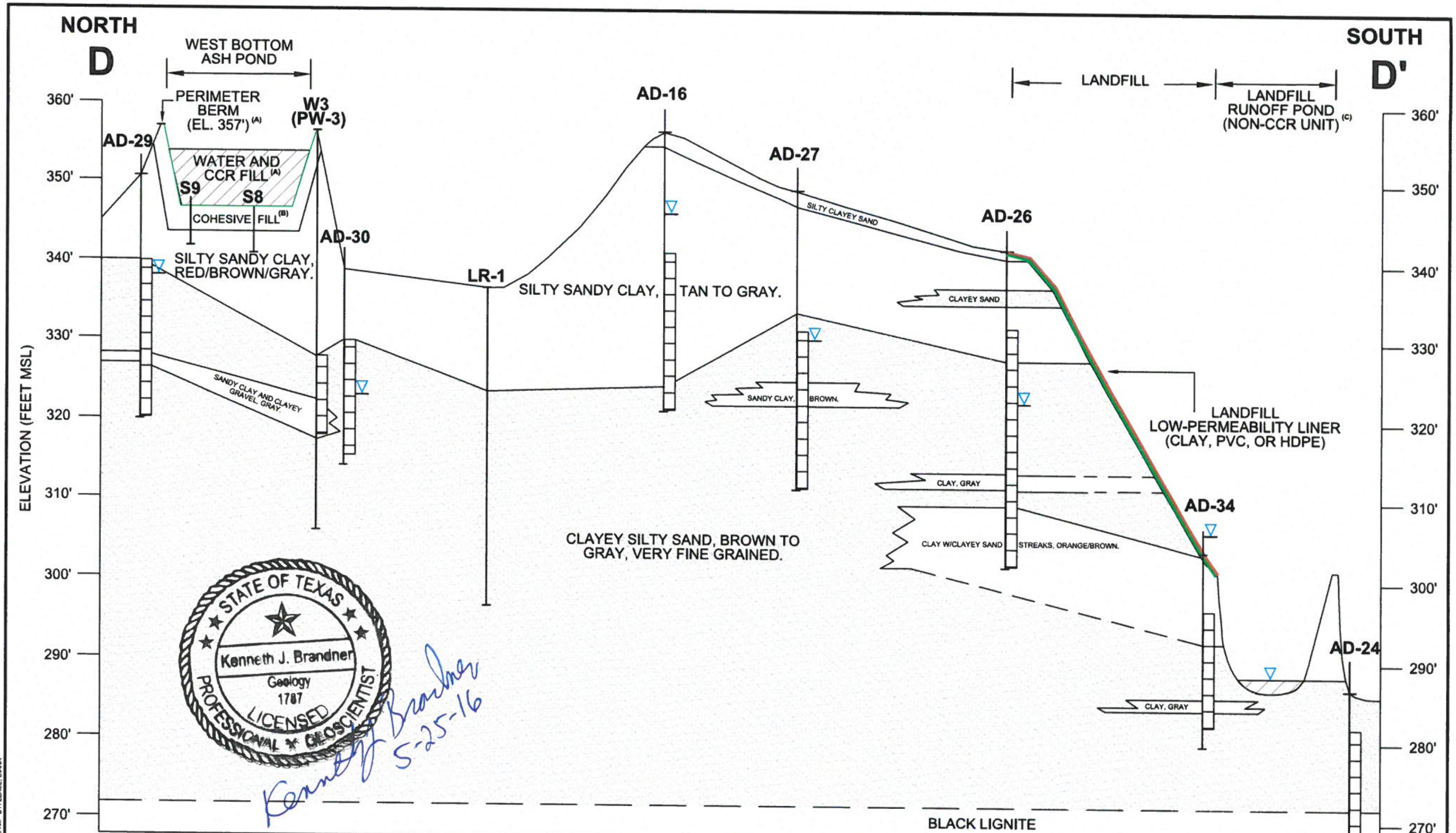
FIGURE
6



LEGEND

MONITORING WELL SCREENED INTERVAL

WATER LEVEL IN MONITORING WELL (1/20/16)

BASE OF CCR UNIT

0 600'
HORIZONTAL SCALE

NOTES:
A) TOP OF WEST BOTTOM ASH POND PERIMETER BERM ELEVATION IS 357', OPERATING LEVEL IS 354' (JOHNSON & PACE, MAY 2011); BASE ELEVATION OF WEST BOTTOM ASH POND IS 347' (SARGENT & LUNDY, JANUARY 1983).
B) COMPACTED COHESIVE SOIL FROM ELEVATION 344' TO 347' (SARGENT &LUNDY SEPTEMBER 1984; AMEC, AUGUST 2011).
C) LANDFILL RUNOFF POND PERIMETER BERM APPROXIMATE ELEVATION 302' MSL, BASE OF LANDFILL RUNOFF POND APPROXIMATE ELEVATION 286' MSL. NORMAL OPERATING LEVEL 288' MSL (JOHNSON & PACE MAY 2011).

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PIRKEY POWER PLANT
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HALLSVILLE, HARRISON COUNTY, TEXAS

CROSS SECTION
D - D'

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FIGURE
7

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYR:ON=*;OFF=*REF*
G:\Active Projects\AEP\OH015976 - CCR Plant Assessments\Pirkey Power Plant\Final 2016 Reports\West Bottom Ash Pond Location Restriction\Figures-Maps\Figure 7 Cross Section D-D'.dwg LAYOUT: MODEL SAVED: 2/19/2016 2:30 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE: —
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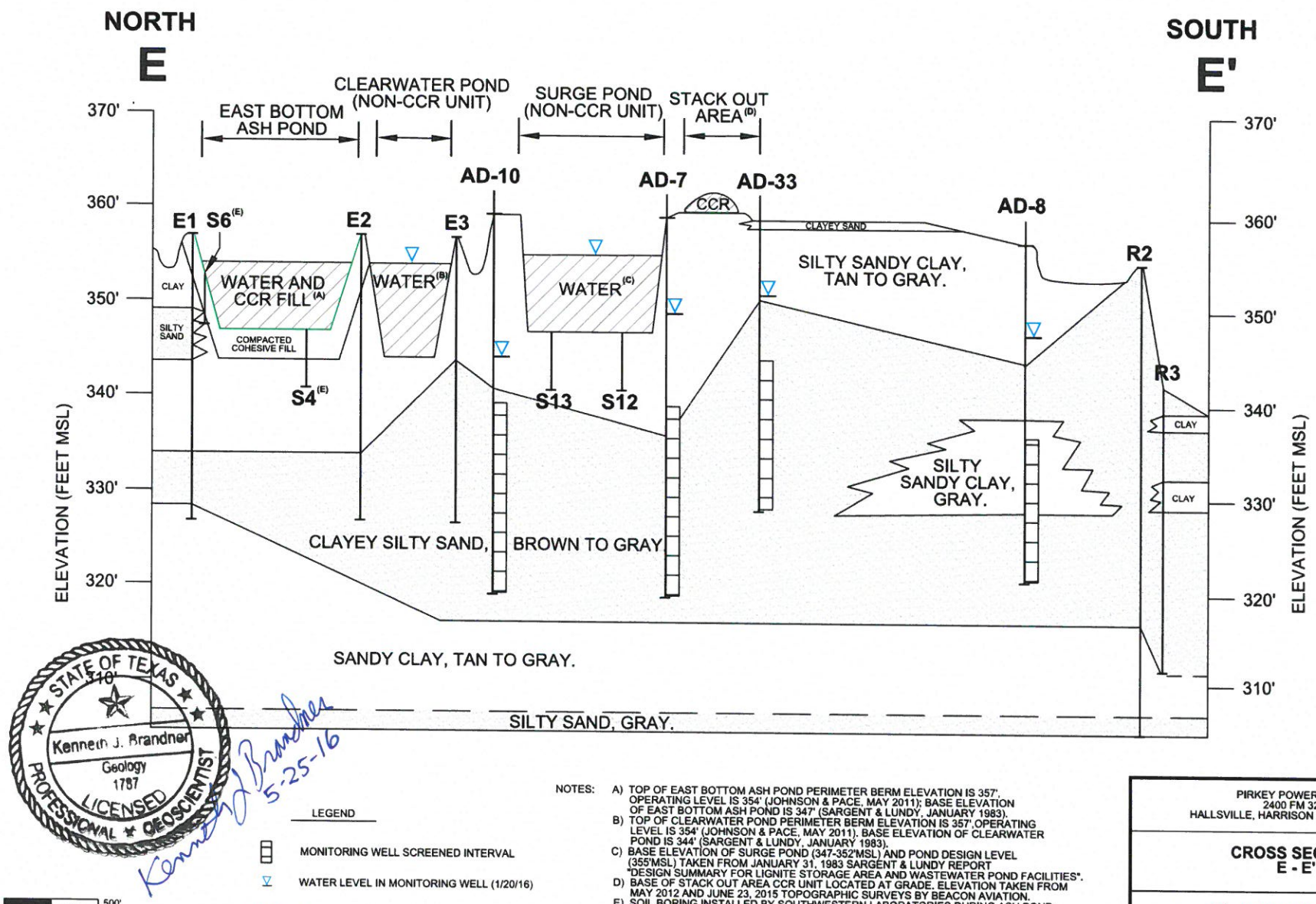

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PROFESSIONAL GEOSCIENTIST
5-25-16

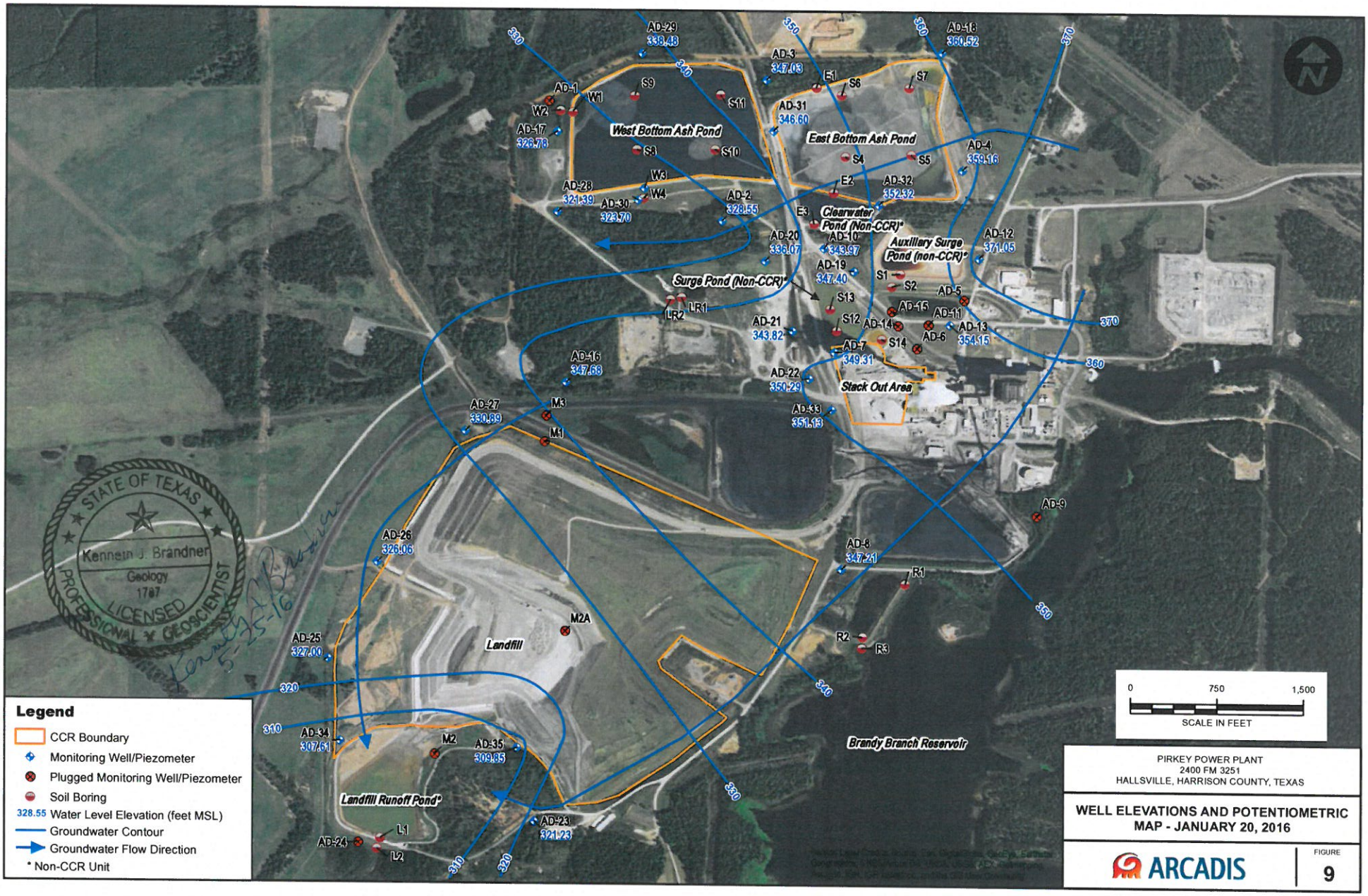
NOTES:
A) TOP OF EAST BOTTOM ASH POND PERIMETER BERM ELEVATION IS 357', OPERATING LEVEL IS 354' (JOHNSON & PACE, MAY 2011); BASE ELEVATION OF EAST BOTTOM ASH POND IS 347' (SARGENT & LUNDY, JANUARY 1983).
B) TOP OF CLEARWATER POND PERIMETER BERM ELEVATION IS 357',OPERATING LEVEL IS 354' (JOHNSON & PACE, MAY 2011). BASE ELEVATION OF CLEARWATER POND IS 344' (SARGENT & LUNDY, JANUARY 1983).
C) BASE ELEVATION OF SURGE POND (347-352'MSL) AND POND DESIGN LEVEL (355'MSL) TAKEN FROM JANUARY 31, 1983 SARGENT & LUNDY REPORT "DESIGN SUMMARY FOR LIGNITE STORAGE AREA AND WASTEWATER POND FACILITIES".
D) BASE OF STACK OUT AREA CCR UNIT LOCATED AT GRADE. ELEVATION TAKEN FROM MAY 2012 AND JUNE 23, 2015 TOPOGRAPHIC SURVEYS BY BEACON AVIATION.
E) SOIL BORING INSTALLED BY SOUTHWESTERN LABORATORIES DURING ASH POND CONSTRUCTION IN 1983.

PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS

CROSS SECTION
E - E'

ARCADIS

FIGURE
8



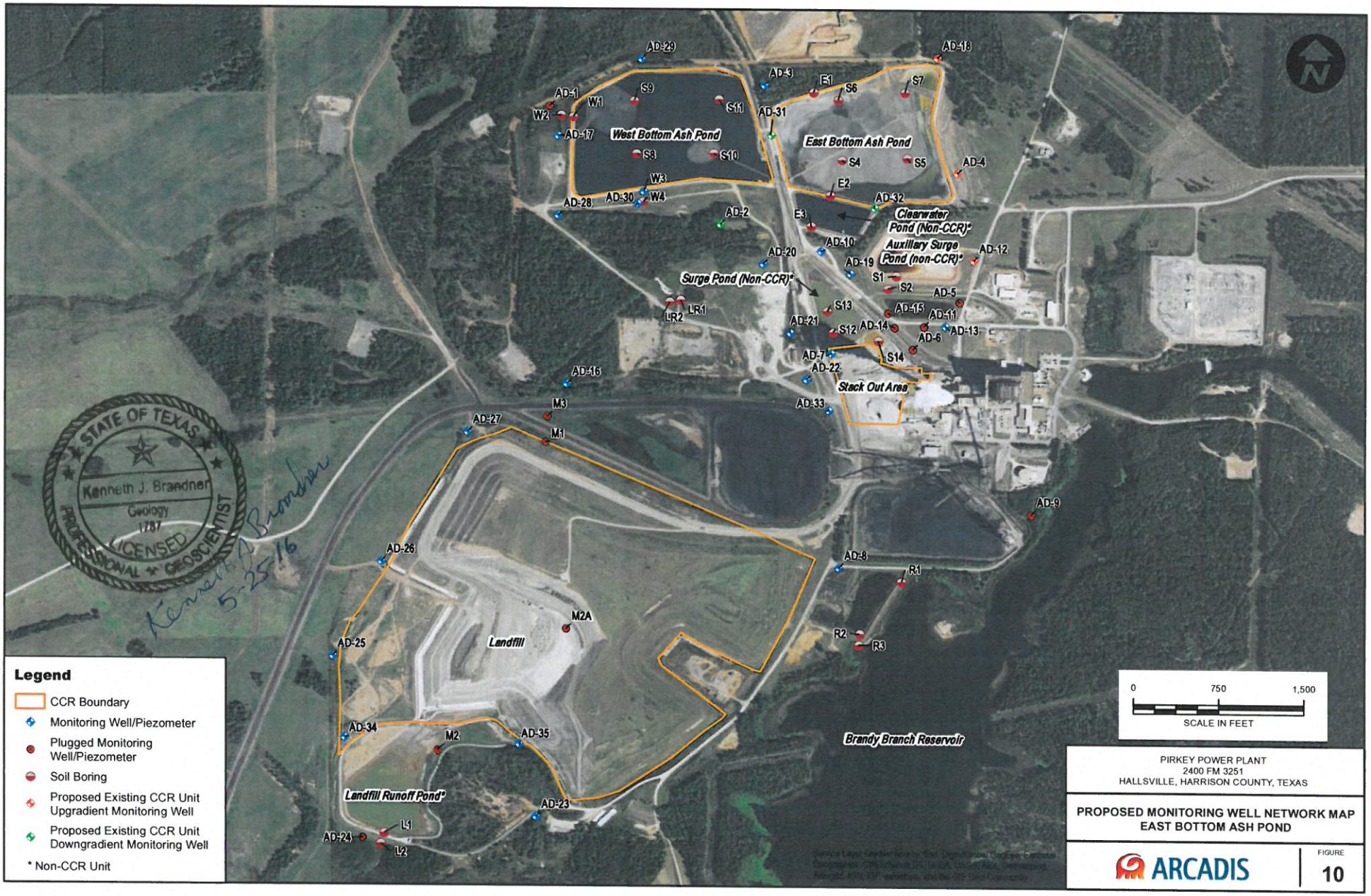
PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS

WELL ELEVATIONS AND POTENTIOMETRIC MAP - JANUARY 20, 2016

ARCADIS

FIGURE 9

Document Path: Z:\GIS\PROJECTS_ENVAE\Pirkey Plant\MXD\Figure 9 - Well Elevations and Potentiometric Map - January 20, 2016.mxd



Legend

- CCR Boundary
- Monitoring Well/Piezometer
- Plugged Monitoring Well/Piezometer
- Soil Boring
- Proposed Existing CCR Unit Upgradient Monitoring Well
- Proposed Existing CCR Unit Downgradient Monitoring Well

* Non-CCR Unit

STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST
Kenneth J. Brandner
5-25-16

PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS

PROPOSED MONITORING WELL NETWORK MAP
EAST BOTTOM ASH POND

ARCADIS

FIGURE
10

Document Path: Z:\GIS\PROJECTS_ENV\AEP\Pirkey Plant\MXD\Figure 10 - Proposed Well Network - East Bottom Ash Pond.mxd

ARCADIS

Appendix A

Boring/Well Construction Logs

832964

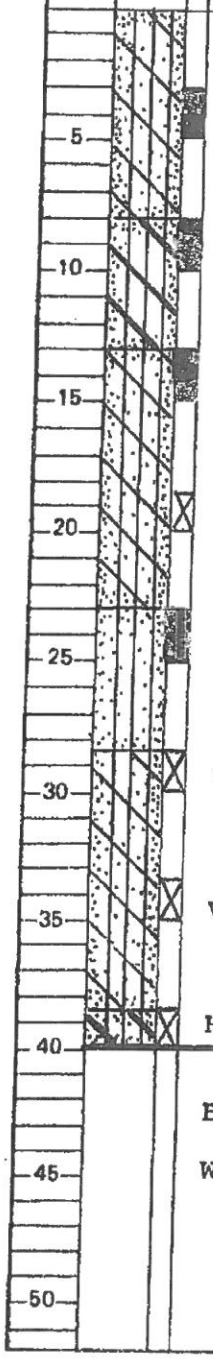
LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: MW-2
LOCATION: Hallsville

Date: 10-7-83 Type: Auger Ground Elevation:

Legend: ■ Sample X Penetration ▼ Water



Description of Stratum
Firm tan clayey silty sand
Medium tan and grey very sandy silty clay
Dense tan and grey clayey silty sand
Dense tan clayey silty sand 10-15-16 31 B/F
Dense tan silty sand
Very dense grey clayey silty sand 15-35=12" 50 B/F
Very dense grey clayey silty sand 21-29=9" 50 B/9"
Hard grey sandy silty clay 20-30=12" 50 B/F
Bottom of boring at 40 feet.
Water encountered at 25 feet.

832964

LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: MW-3
LOCATION: Hallsville, TX

Date: 11-4-83 Type: Auger Ground Elevation:

Legend: ■ Sample X Penetration ▼ Water

Depth, Feet	Symbol	Sample	Description of Stratum
5			Stiff red, brown and grey sandy silty clay
10			Stiff red, tan and grey silty clay lenses w/iron ore
15			Stiff brown and grey sandy silty clay
20			Firm brown and grey sand w/clay lenses
25			Stiff brown and grey clay
30			Stiff brown and grey clay w/silt lenses
35			Firm grey clayey silty sand
40			
45			Hard grey clay w/silty sand lenses 43-7=6" 50 B/6"
50			Hard brown and grey silty sandy clay 21-29=12" 50 B/F

832964

LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: MW-3
LOCATION: Hallsville, TX

Date: 11-4-83 Type: Auger Ground Elevation:

Legend: ■ Sample × Penetration ▼ Water

Depth, Feet	Symbol	Sample	Description of Stratum
55			Hard grey silty sandy clay 28-22=10" 50 B/10"
			Bottom of boring at 57 feet.
			Water encountered at 42 feet.
60			
65			
70			
75			
80			
85			
90			
95			
100			

SOUTHWESTERN LABORATORIES

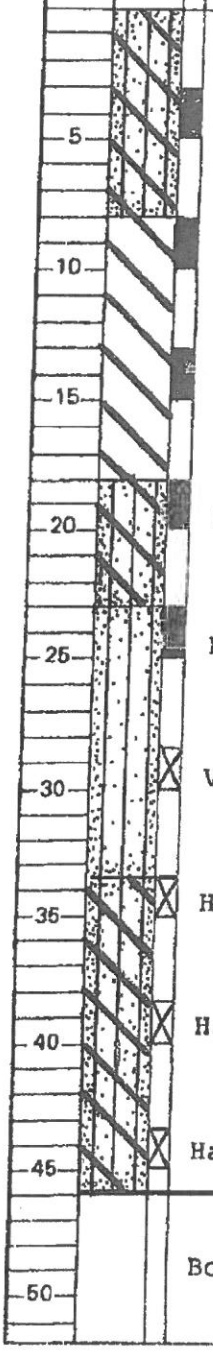
832964

LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: MW-4
LOCATION: Hallsville

Date: 10-10-83 Type: Auger Ground Elevation:



Legend:
■ Sample X Penetration ▼ Water

Description of Stratum
Stiff tan and grey silty sandy clay w/iron ore
Very stiff tan and grey clay
Very stiff tan and grey clay w/iron ore seam
Stiff tan and grey silty sandy clay lenses
Firm grey silty sand
Very dense grey silty sand 30-20=12" 50 B/F
Hard grey silty sandy clay 30-20=8" 50 B/8"
Hard grey silty sandy clay 25-25=8" 50 B/8"
Hard grey silty sandy clay 25-25=10½" 50 B/10½"
Bottom of boring at 46 feet.

832964

LOG OF BORING

PROJECT: Monitor Wells at Metal Cleaning Waste Pond BORING NO.: MW-12
CLIENT: Southwestern Electric Power Company LOCATION: Hallsville, TX
N 6+13.25; W-6+90.36
Date: 1/30/86 Type: Rotary Ground Elevation: 378.41

Legend: ■ Sample X Penetration ▼ Water

Depth, Feet	Symbol	Sample	Description of Stratum
5			Brown and tan sandy clay
10			Brown, tan and gray sandy clay
15			Tan and gray sandy clay
20			Brown and tan sandy clay
25			Gray and tan sandy clay
30			Brown and gray clay
35			Brown and gray clay
40			Gray silty sand
45			Gray silty sand
50			Gray silty sand

Water encountered at 27.5 feet.
Bottom of Boring at 51 feet.

SOUTHWESTERN LABORATORIES

APEX PROJECT NO.: 110-089 ☐ BORING BORING NUMBER: ____ ■ MONITOR WELL MONITOR WELL NUMBER: AD-18

FACILITY NAME: AEP- Pirkey Power Plant FACILITY ID NO.: N/A

FACILITY ADDRESS: Hallsville, Texas

DRILLING COMPANY/METHOD/RIG: Apex Geoscience Inc. / Hollow-stem Augers/ CME-55 Track Rig

DRILLER: Ed Wilson, Apex Geoscience Inc. COMPLETION DATE: 1/3/2011

PREPARED BY: Jeff Sammons LOGGED BY: Matt Lyon/Jeff Sammons

LATITUDE: N 32°28.154' Datum: WGS-84 WELL LOCATION: Northeast of Bottom Ash Pond #1
LONGITUDE: W94°29.108'

DEPTH (FEET)	PID (PPM)	SAMPLE INTERVAL	WELL LOG AND COMPLETION DETAILS	USCS CODE	SOIL DESCRIPTION AND COMMENTS	Odor	Moisture
1-7				0-7	SM	Sandy Silt, some clay, very fine grained, gray, light brown, light brownish red, yellowish brown	None	Dry
8-16				7-16	CL	Clay, some sand, light gray, reddish gray, stiff, yellowish brown -iron oxide fracture at 9.5'	None	Dry
						-increasing sand content at 14', thin lenses of iron-oxide cemented sand at 14.5', 15', 15.5', stiff		Moist
17-25			▽	16-25	SM	Silty sand, some clay, gray, yellowish brown, dense, abundant gypsum crystals, abundant iron oxide cemented sandstone gravel in layers, saturated 19-21'	None None	Moist to V. Moist Saturated
						-dark gray at 21' -clayey at 21-23'	None	
						-greenish gray, trace clay, at 23'	None	
						-clay lense, hard, dry, (shale), at 24.5-25'	None	Dry
26-40						Boring Terminated at 25'		

Cement Bentonite Filter Sand ▽ Water Level

Apex geoscience inc.

Total Depth: 25 feet Riser Interval: +3 (ags)-15'
Filter Sand (Size/Interval): 13-25' Screen Interval: 15-25'
Grout (Type/Interval): Grout from 0-2', Bentonite from 2-13' Water level:
Surface Completion ☐ Flush ■ Above Ground 3'

Note: This log is not to be used separate from this report.

Hydrex ENVIRONMENTAL, INC.

Monitor Well

Monitor Well No.: AD-31

PROJECT INFORMATION

PROJECT:	Pirkey Power Plant
PROJECT NO.:	I-04-1021
LOGGED BY:	Jeffrey D. Sammons, P.G.
SUPERVISING PG:	Jeffrey D. Sammons, P.G.
COMPLETION:	12/08/2015
DEVELOPMENT:	12/16/2015
SITE LOCATION:	2400 FM 3251, Hallsville, Texas
WELL OWNER:	AEP

DRILLING INFORMATION

DRILLER:	Buford Collier
DRILLER'S LICENSE NO.:	50089
RIG TYPE:	Geoprobe 3230DT
METHOD OF DRILLING:	Hollow Stem Auger
SAMPLING METHODS:	Split Core
SURFACE ELEVATION:	360.76 (Top of Casing)
HOLE DIAMETER:	8.25"
LATITUDE	32 28' 2.48"
LONGITUDE	94 29' 20.90"

STATE OF TEXAS — JEFFREY D. SAMMONS — GEOLOGY #10070 — LICENSED PROFESSIONAL GEOSCIENTIST — 1-21-16

Water Level Upon Installation ▽ Water Level at Time of Drilling ■ Geotechnical Lab Sample

TBPG No. 50027

DESCRIPTION	USCS	% MOISTURE	% FINES	LL	PL	PI
SANDY CLAY AND GRAVEL: dark reddish brown, moist	CH					
FAT CLAY WITH SAND: some laminations of very fine to fine sand, reddish brown and light gray	CH	22	81	51	15	36
FAT CLAY: some silt with trace very fine to fine sand laminations, reddish brown, yellowish brown and light gray	CH					
- light gray with laminations of light reddish brown silt and very fine sand at 11'		28	95	68	31	37
CLAYEY SAND: very fine to fine sand, light reddish brown and light gray, very moist to saturated	SC					
- dark gray and gray clay with thin seams of light reddish brown very fine sand at 22' to 23'		26	44	36	21	15
SILTY SAND: fine to very fine sand, some clay lenses and thin layers of partially cemented sandstone, gray and dark gray with light reddish brown, very moist to saturated	SM					
- dark gray and reddiswh brown at 29', saturated						
- trace clay, light brown at 30'		24	5	24	NP	
CLAYEY SAND: very fine sand, dark gray, very moist to saturated	SC					

WELL CONSTRUCTION

- Locking Well Casing Cover
- Locking Well Cap
- Protective Well Casing
- Concrete Pad
- Ground Surface
- Cement
- Bentonite
- 2" Sch. 40 PVC Riser
- 20/40 Silica Sand
- 0.010" Slotted Sch. 40 PVC Well Screen
- PVC Bottom Cap

NOTES: This log should not be used separately from the original report. Not all USCS descriptors were laboratory verified.

Hydrex ENVIRONMENTAL, INC.

Monitor Well

Monitor Well No.: AD-32

PROJECT INFORMATION

PROJECT:	Pirkey Power Plant
PROJECT NO.:	I-04-1021
LOGGED BY:	Jeffrey D. Sammons, P.G.
SUPERVISING PG:	Jeffrey D. Sammons, P.G.
COMPLETION:	12/11/2015
DEVELOPMENT:	12/16/2015
SITE LOCATION:	2400 FM 3251, Hallsville, Texas
WELL OWNER:	AEP

DRILLING INFORMATION

DRILLER:	Buford Collier
DRILLER'S LICENSE NO.:	60089
RIG TYPE:	Geoprobe 3230DT
METHOD OF DRILLING:	Hollow Stem Auger
SAMPLING METHODS:	Split Core
SURFACE ELEVATION:	359.18 (Top of Casing)
HOLE DIAMETER:	8.25"
LATITUDE	32 27' 66.20" LONGITUDE 94 29' 11.86"

STATE OF TEXAS — JEFFREY D. SAMMONS — GEOLOGY #10070 — LICENSED PROFESSIONAL GEOSCIENTIST — JDS 1-21-16

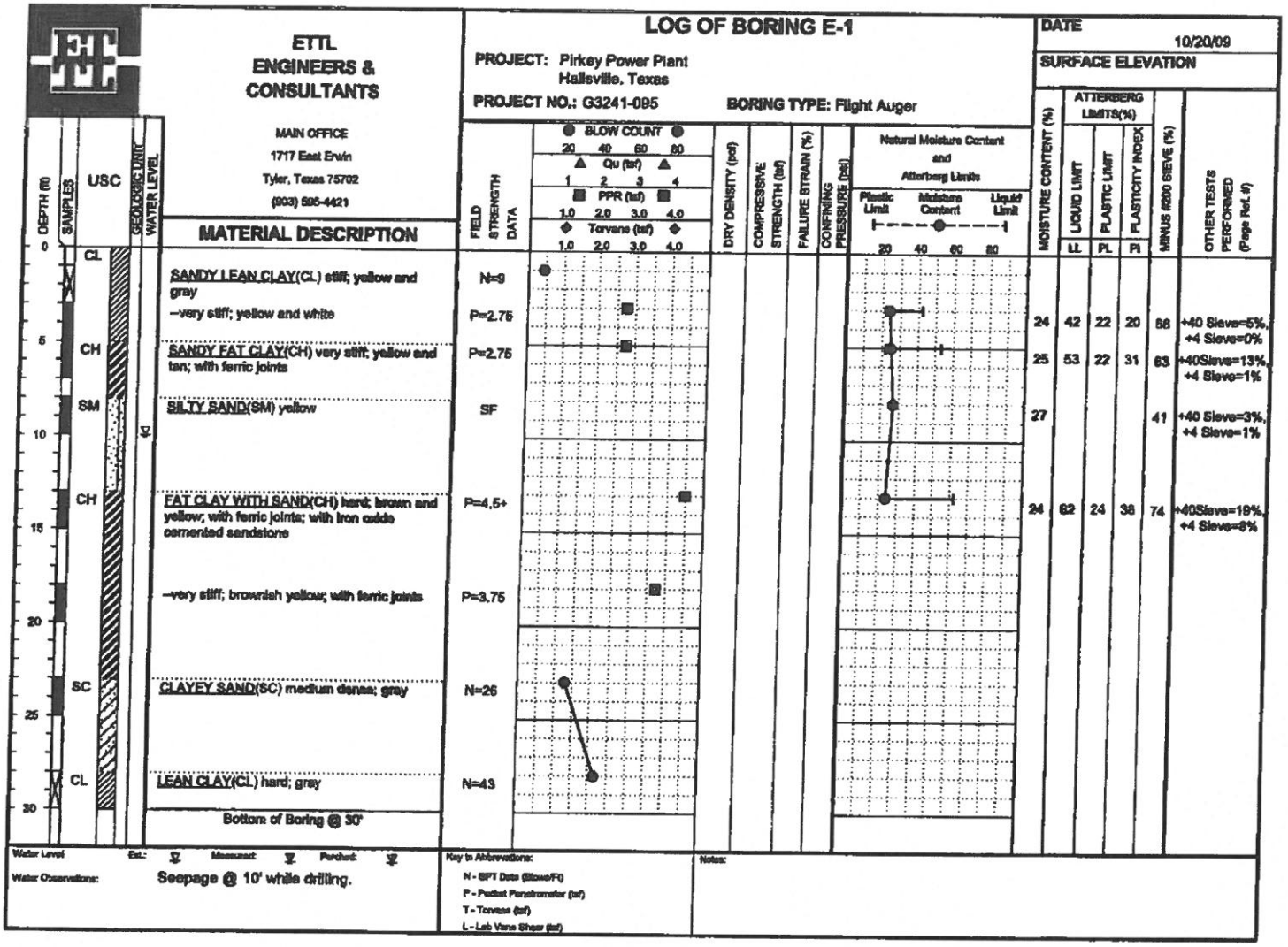
▼ Water Level Upon Installation ▽ Water Level at Time of Drilling ■ Geotechnical Lab Sample TBPG No. 50027

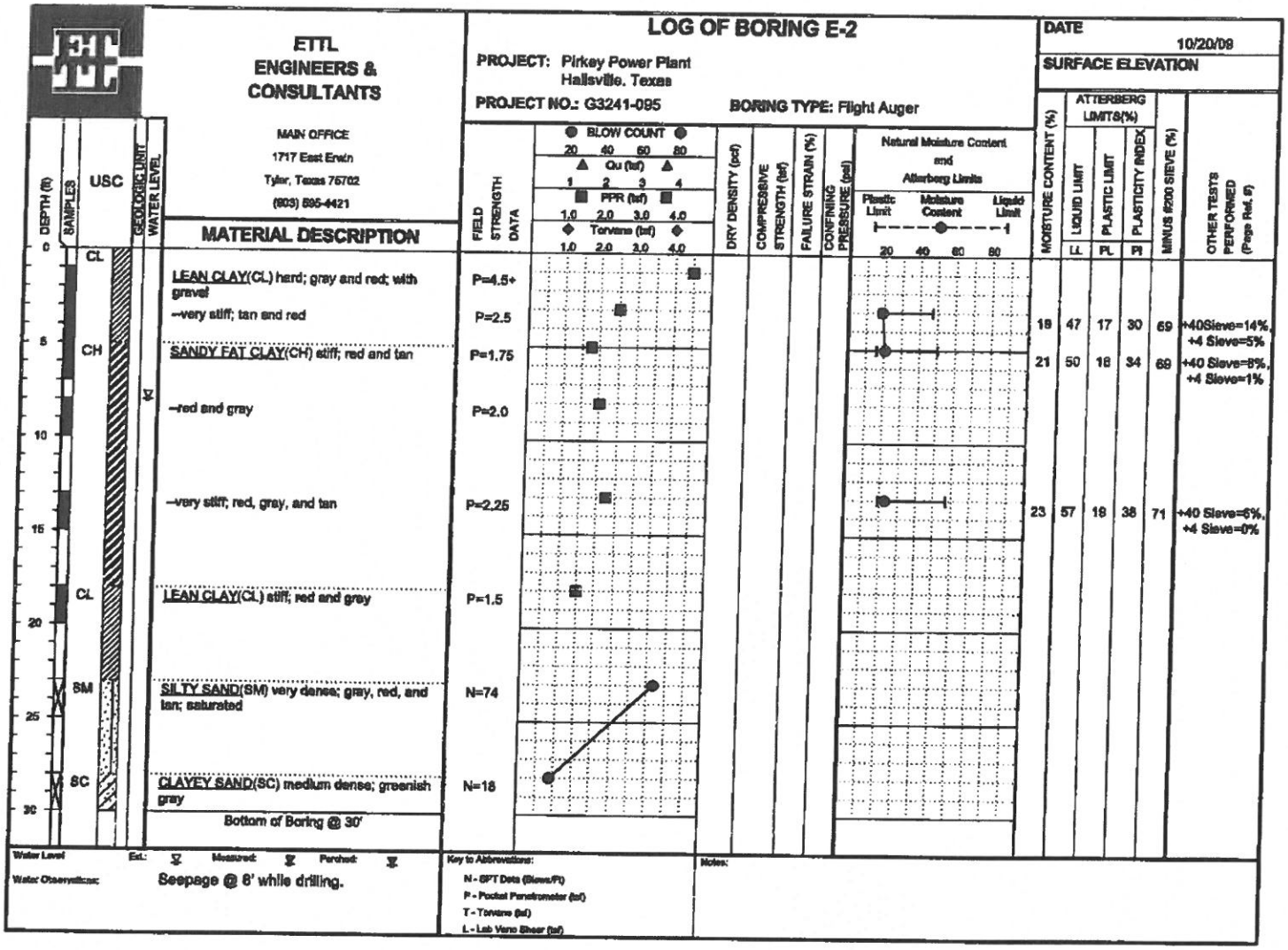
DESCRIPTION	USCS	SAMPLE	% MOISTURE	% FINES	LL	PL	PI
CLAYEY SAND: very fine to fine sand, dark reddish brown, moist - interbeds of sand and clay, yellowish brown and light gray at 1' - reddish brown and light gray at 2' - light gray and yellowish brown at 4', - grayish brown and light gray at 6' - grayish brown, light gray, and reddish brown at 7'	SC		25	46	35	22	13
			26	44	37	20	17
SANDY LEAN CLAY: some gravel seams and thin interbeds of cemented sand, light yellowish brown and light gray, moist to saturated within gravel seams - some iron ore gravel at 16', very moist to saturated	CL		28	54	37	22	15
SILTY SAND: very fine to fine sand, trace clay, brownish gray and dark brownish gray, saturated - reddish brown and brown at 20'	SM						
SANDY LEAN CLAY: gray and dark gray, very moist	CL		26	51	37	24	13
CLAYEY SAND: fine to very fine sand, gray and dark gray, very moist to saturated	SC		26	47	41	22	19
SANDY LEAN CLAY: gray and dark gray, very moist	CL		26	59	35	21	14

WELL CONSTRUCTION

- Locking Well Casing Cover
- Locking Well Cap
- Protective Well Casing
- Concrete Pad
- Ground Surface
- Cement
- Bentonite
- 2" Sch. 40 PVC Riser
- 20/40 Silica Sand
- 0.010" Slotted Sch. 40 PVC Well Screen
- PVC Bottom Cap

NOTES: This log should not be used separately from the original report. Not all USCS descriptors were laboratory verified.


ETTL
ENGINEERS &
CONSULTANTS
MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421
LOG OF BORING E-1
PROJECT: Pirkey Power Plant
Hallsville, Texas
PROJECT NO.: G3241-095
BORING TYPE: Flight Auger
DATE
10/20/09
SURFACE ELEVATION
DEPTH (ft)
SAMPLES
USC
GEOLOGIC UNIT
WATER LEVEL
MATERIAL DESCRIPTION
FIELD STRENGTH DATA
BLOW COUNT
Qu (tsf)
PPR (tsf)
Torvane (tsf)
DRY DENSITY (pcf)
COMPRESSIVE STRENGTH (tsf)
FAILURE STRAIN (%)
CONFINING PRESSURE (psi)
Natural Moisture Content and Atterberg Limits
Plastic Limit
Moisture Content
Liquid Limit
MOISTURE CONTENT (%)
ATTERBERG LIMITS(%)
LIQUID LIMIT
PLASTIC LIMIT
PLASTICITY INDEX
MINUS #200 SIEVE (%)
OTHER TESTS PERFORMED (Page Ref. #)
CL
SANDY LEAN CLAY(CL) stiff; yellow and gray
N=9
--very stiff; yellow and white
P=2.75
CH
SANDY FAT CLAY(CH) very stiff; yellow and tan; with ferric joints
P=2.75
SM
SILTY SAND(SM) yellow
SF
24 42 22 20 56 +40 Sieve=5%, +4 Sieve=0%
25 53 22 31 63 +40Sieve=13%, +4 Sieve=1%
27 41 +40 Sieve=3%, +4 Sieve=1%
CH
FAT CLAY WITH SAND(CH) hard; brown and yellow; with ferric joints; with iron oxide cemented sandstone
P=4.5+
24 62 24 38 74 +40Sieve=19%, +4 Sieve=8%
--very stiff; brownish yellow; with ferric joints
P=3.75
SC
CLAYEY SAND(SC) medium dense; gray
N=26
CL
LEAN CLAY(CL) hard; gray
N=43
Bottom of Boring @ 30'
Water Level
Est.:
Measured:
Perched:
Water Observations:
Seepage @ 10' while drilling.
Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)
Notes:


ETTL
ENGINEERS &
CONSULTANTS
MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421
LOG OF BORING E-2
PROJECT: Pirkey Power Plant
Hallsville, Texas
PROJECT NO.: G3241-095
BORING TYPE: Flight Auger
DATE
10/20/09
SURFACE ELEVATION
DEPTH (ft)
SAMPLES
USC
GEOLOGIC UNIT
WATER LEVEL
MATERIAL DESCRIPTION
FIELD STRENGTH DATA
BLOW COUNT
Qu (tsf)
PPR (tsf)
Torvane (tsf)
DRY DENSITY (pcf)
COMPRESSIVE STRENGTH (tsf)
FAILURE STRAIN (%)
CONFINING PRESSURE (psi)
Natural Moisture Content and Atterberg Limits
Plastic Limit
Moisture Content
Liquid Limit
MOISTURE CONTENT (%)
ATTERBERG LIMITS(%)
LIQUID LIMIT
PLASTIC LIMIT
PLASTICITY INDEX
MINUS #200 SIEVE (%)
OTHER TESTS PERFORMED (Page Ref. #)
LEAN CLAY(CL) hard; gray and red; with gravel
--very stiff; tan and red
SANDY FAT CLAY(CH) stiff; red and tan
--red and gray
--very stiff; red, gray, and tan
LEAN CLAY(CL) stiff; red and gray
SILTY SAND(SM) very dense; gray, red, and tan; saturated
CLAYEY SAND(SC) medium dense; greenish gray
Bottom of Boring @ 30'
P=4.5+
P=2.5
P=1.75
P=2.0
P=2.25
P=1.5
N=74
N=18
18 47 17 30 69 +40Sieve=14%, +4 Sieve=5%
21 50 18 34 69 +40 Sieve=8%, +4 Sieve=1%
23 57 19 38 71 +40 Sieve=6%, +4 Sieve=0%
Water Level
Est.
Measured:
Perched:
Water Observations:
Seepage @ 6' while drilling.
Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)
Notes:

832964

LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: S-4
LOCATION: Hallsville,TX

Date: 9-14-83 Type: Ground Elevation: 347.3

Legend: ■ Sample X Penetration ▼ Water

Depth, Feet	Symbol	Sample	Description of Stratum
5			Red and grey sandy silty clay Red and grey sandy silty clay Red and grey sandy silty clay w/iron ore
10			Bottom of boring at 6 feet. No water encountered.
15			
20			
25			
30			
35			
40			
45			
50			

SOUTHWESTERN LABORATORIES

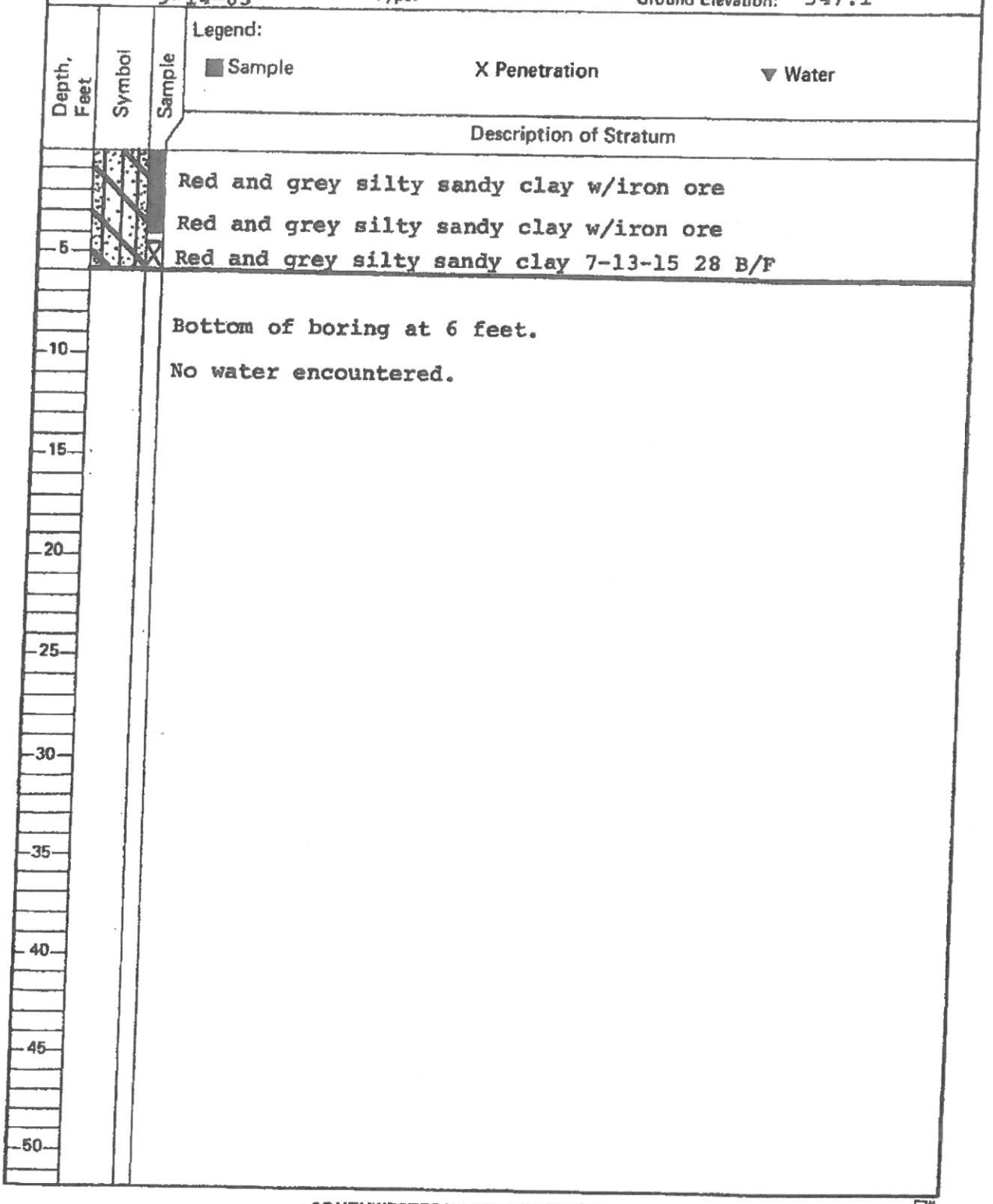
832964

LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: S-5
LOCATION: Hallsville, TX

Date: 9-14-83 Type: Ground Elevation: 347.1



SOUTHWESTERN LABORATORIES

832964

LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: S-6
LOCATION: Hallsville, TX

Date: 9-14-83 Type: Ground Elevation: 353.6

Legend: ■ Sample X Penetration ▼ Water

Depth, Feet	Symbol	Sample	Description of Stratum
5			Red and grey silty clay lenses w/iron ore Red and grey silty sandy clay w/iron ore Red and grey silty clay
10			Bottom of boring at 6 feet. No water encountered.
15			
20			
25			
30			
35			
40			
45			
50			

SOUTHWESTERN LABORATORIES

832964

LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: S-7
LOCATION: Hallsville, TX

Date: 9-14-83 Type: Ground Elevation: 346.9

Legend: ■ Sample X Penetration ▼ Water

Depth, Feet	Symbol	Sample	Description of Stratum
			Red, brown and grey silty clay
			Red, brown and grey silty clay w/silt lenses and iron ore
5			Red, brown and grey silty sandy clay
			Bottom of boring at 6 feet.
			No water encountered.
10			
15			
20			
25			
30			
35			
40			
45			
50			

SOUTHWESTERN LABORATORIES

ARCADIS

Appendix B

Photographic Log

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – Pirkey Power Plant	Hallsville, Harrison County, Texas	OH015976.0001

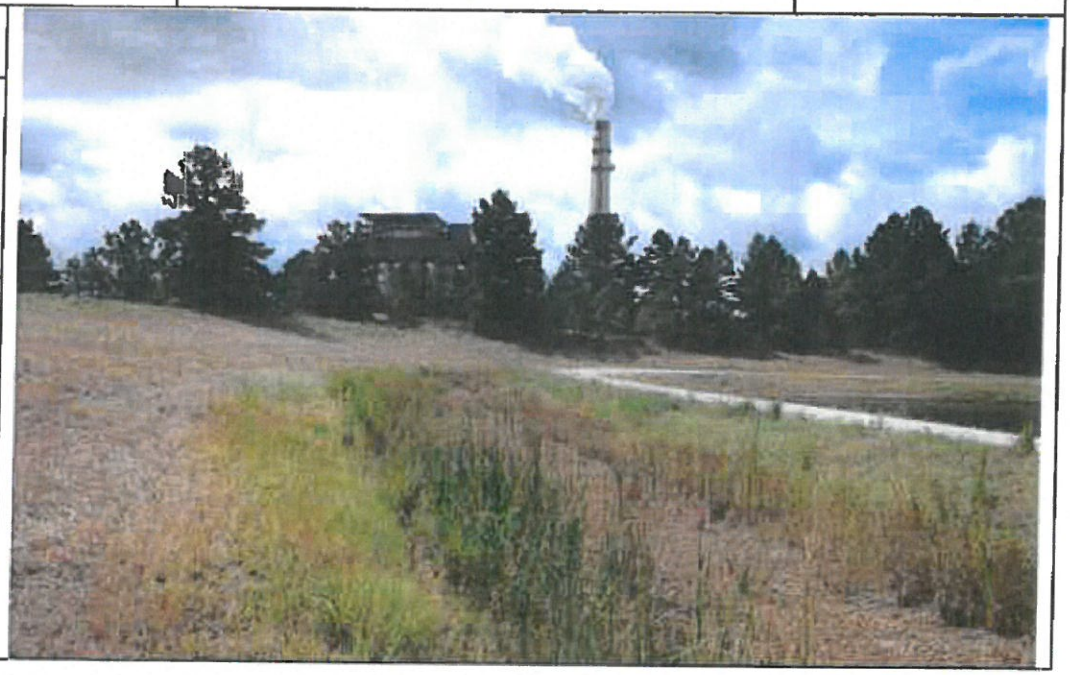
Photo No.	Date:
1	8/19/2015

Direction Photo Taken:

South

Description:

P8190374
Vegetative strip adjacent to East Ash Pond. Under new rule this potential wetland is likely non-jurisdictional.



ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – Pirkey Power Plant	Hallsville, Harrison County, Texas	OH015976.0001

Photo No.	Date:
2	8/19/2015

Direction Photo Taken:

Description:

P8190372
AD- 4 Ground water monitoring well. East Bottom Ash Pond embankment in background.

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – Pirkey Power Plant	Hallsville, Harrison County, Texas	OH015976.0001

Photo No.	Date:
3	8/19/2015

Direction Photo Taken:

South

Description:

P8190378
View across East and West Botton Ash Pond.

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – Pirkey Power Plant	Hallsville, Harrison County, Texas	OH015976.0001

Photo No.	Date:
4	8/19/2015

Direction Photo Taken:

Southeast

Description:

P8190379
Road side ditch, not considered a wetland, due to lack of hydric vegetation and connectivity.

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – Pirkey Power Plant	Hallsville, Harrison County, Texas	OH015976.0001

Photo No.	Date:
5	8/19/2015

Direction Photo Taken:

North

Description:

P8190380
AD-18 Ground water monitoring well.

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – Pirkey Power Plant	Hallsville, Harrison County, Texas	OH015976.0001

Photo No.	Date:
6	8/19/2015

Direction Photo Taken:

North

Description:

P8190381
AD-18 Ground water monitoring well.