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American Electric Power Service Corporation

Landfill - 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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Landfill - CCR Groundwater Monitoring Well Network Evaluation

H.W. Pirkey Power Plant
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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 Landfill 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 Landfill. 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 Landfill 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 Landfill.

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 Landfill CCR unit is located in the southwestern portion of the Plant, and approximately 400 feet west of Brandy Branch 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 constructed in the southwestern portion of the Plant, and as shown on the U.S. Geological Survey 1983 topographic map (**Figure 1**), the southwestern portion of the Plant contained an unnamed intermittent tributary of Hatley Creek prior to Landfill construction in 1984. The Landfill was constructed within the unnamed tributary creek which had a bottom elevation ranging from approximately 290 feet amsl on the south side of the Landfill to 300 feet amsl on the north side of the Landfill. The native soil sidewalls of the tributary creek at the Landfill location have a maximum elevation of approximately 355 feet amsl. Therefore, as shown on Geologic Cross Section C-C' (**Figure 6**), the Landfill is partially incised within the tributary creek, and the tributary creek native soil sidewalls serve as a natural embankment for the lower portion of the Landfill.

The original Landfill design included emplacement of CCR materials in the Landfill with 3:1 slopes (3 feet horizontal, 1 foot vertical) with an approximate 10 foot wide bench for every 20 foot vertical rise of CCR material (VFL Technology Corporation, 1984). In addition to the Landfill CCR material embankments, earthen embankments are present around portions of the Landfill to control storm water flow.

2.2.2 Area/Volume

The Landfill is approximately 130 acres in size and was designed to receive 12,207,000 cubic yards (7,566 acre feet) of CCR materials including fly ash, bottom ash, economizer ash, and stabilized FGD sludge (VFL Technology Corporation, 1984).

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, stabilized FGD sludge) have been generated. The CCR materials that are not taken offsite for beneficial reuse are disposed of in the Landfill. The Landfill was constructed in several phases beginning with the northeast portion (Phase 1) in 1984. The Landfill was expanded (east-central portion) in 1985 and 1987. The Landfill was subsequently expanded to the west and south during the 1990's, including construction of the Landfill Stormwater Runoff Pond (non-CCR unit) directly south of the Landfill in 1993 and 1994.

In 2005, ETTL conducted a geotechnical evaluation of the Landfill and Landfill Stormwater Runoff Pond, including installation 30 soil borings, ten cone penetration test (CPT) borings, and geotechnical testing of soil samples. The Landfill was further expanded to the west between 2005 and 2015 to its current size of approximately 130 acres as shown on **Figure 3**.

2.2.4 Surface Water Control

Surface water in the area of the Landfill flows in a general southerly direction to the Landfill Stormwater Runoff Pond located directly south of the Landfill. The Landfill Stormwater Runoff Pond, which is approximately 16 acres in size, also receives Landfill leachate that is gravity drained from the Landfill via underground lateral perforated pipes and permeable bottom ash materials that were installed above portions of the Landfill liner.

2.3 Previous Investigations

The initial soils investigation and design of the Plant 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, including the Landfill Area.

A soils investigation of the Landfill was conducted by Southwestern Laboratories in 1984. The investigation included installation of 45 soil borings and geotechnical analyses of soil samples. The report recommended installation of three feet of compacted clay as the bottom liner for the Landfill (Southwestern Laboratories, July 1984).

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An engineering design report for the Landfill was prepared by VFL Technology Corporation in 1984. The Landfill design included a bottom compacted clay liner three feet in thickness, and Landfill side slopes of 3:1 (VFL Technology Corporation, 1984).

In 1985, Southwestern Laboratories conducted a geotechnical evaluation of the clay liner that was installed at the base of the Landfill, including installation of four soil borings and permeability testing of soil samples. The report concluded the clay liner was three feet thick with a permeability less than 1×10^{-7} centimeters per second (cm/sec) (Southwestern Laboratories, 1985).

In 1993, Alliance Inc. conducted a geotechnical investigation of the clay liner installed at the base of the Landfill following a Landfill expansion phase in 1993. The report concluded the clay liner was three feet or more in thickness, and the clay liner met the permeability specifications of $<1 \times 10^{-7}$ cm/sec (Alliance Inc., 1993).

In 1995, Central and South West Services prepared design specifications for Landfill expansion to the west and south. The design specifications included a geosynthetic clay liner overlain by a 0.060-inch (60 mil) HDPE liner (Central and South West Services, 1995).

In 2005, ETTL conducted a geotechnical evaluation of the Landfill and Landfill Stormwater Runoff Pond, including installation 30 soil borings, ten CPT borings, and geotechnical testing of soil samples. The geotechnical data was obtained to design Landfill expansions in 2005 through 2007.

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, March 2011).

In 2012, Apex Geoscience conducted a geotechnical investigation for Landfill expansion activities planned at the western portion of the Landfill where surface lignite mining operations had previously been conducted to a depth of 50 to 100 feet using a dragline, and the spoils (reclaimed soil) were returned to the excavation. The report concluded the Landfill embankments would be stable with side slopes of 3:1 (Apex Geoscience, 2013).

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 Site in the area of the Landfill Stormwater Runoff Pond. The Carrizo Sand consists of fine to medium grained sand interbedded with silt and clay, and attains a thickness of up to approximately 100 feet in Harrison County, Texas (Broom, 1966). As shown on Geologic Cross Sections C-C' (**Figure 6**) and D-D' (**Figure 7**), a thick sand stratum is located below and adjacent to the Landfill between an elevation of approximately 270 feet and 330 feet amsl. This sand stratum likely corresponds to the Carrizo Sand based on geologic maps of the Site area (Broom, 1966; Flawn, 1965).

The Carrizo Sand is underlain by the Eocene-age Wilcox Formation, which outcrops in topographically low areas near the Sabine River to the south and southeast of the Plant (Flawn, 1965). The Wilcox Formation consists of interbedded sand and clay with seams of lignite, and attains a thickness of approximately 700 feet (Broom, 1966). As shown on Geologic Cross Section D-D' (**Figure 7**), a lignite seam was encountered below an elevation of approximately 270 feet amsl during drilling of monitoring well AD-24 at the south end of the Site. This lignite seam likely corresponds to the top of the Wilcox Formation based on geologic maps of the Site area (Broom, 1966; Flawn, 1965).

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

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).

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2.4.2 Regional and Local Geologic Setting

The central and northern portions of the Plant 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 where the Landfill and Landfill Stormwater Runoff Pond are located (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 Landfill area is south to southwesterly at an average hydraulic gradient of approximately 0.01 foot per foot.

The Landfill is located approximately 400 feet west 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 Landfill area does not discharge into Brandy Branch Reservoir. Brandy Branch Reservoir likely recharges the uppermost aquifer in the southern portion of the Site, where the pool level in the Reservoir (340 feet amsl) is higher than water level elevations in monitoring wells located southwest (downslope) of the Reservoir.

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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 directly east of the Landfill in 2004 by Bennett Drilling for use as a rig supply well. The water well was screened from 330 to 426 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 directly south of the Landfill by Amoco Production Company in 1991 for use as an oil field rig supply well. The water well was screened from 163 to 243 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 third closest water well was reportedly drilled approximately 200 feet southwest of the Landfill by Matador Operating in 2000 for use as an industrial well. The water well was screened from 340 to 420 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 (upgradient) of the Pirkey Power Plant.

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 Landfill Area is a very fine to fine grained clayey and silty sand stratum located below and adjacent to the Landfill between an elevation of approximately 270 feet and 330 feet amsl (**Appendix A**). The location of the uppermost water bearing unit relative to the Landfill is shown cross section C-C' (**Figure 6)** and cross section D-D' (**Figure 7)**. As shown on **Figures 6** and **7**, several clay interbeds are present within the sand stratum, but the clay interbeds are discontinuous, indicating the entire saturated thickness of the sand stratum between approximately 270 feet and 330 feet amsl is in hydraulic communication and represents the uppermost aquifer.

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 in the Landfill area (up to 60 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 elevation data set from January 20, 2016 is depicted on **Figure 9**. The groundwater flow direction in the Landfill area is south to southwesterly towards Hatley Creek, which is located approximately one mile west of the Site.

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 Site hydrostratigraphic unit in the Landfill area is the clayey and silty sand stratum that is located between an elevation of approximately 270 and 330 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 **Table 2**. Photo documentation of the located wells during the August 19, 2015 site visit is provided in **Appendix B**.

Monitoring wells AD-8, AD-12, AD-16, AD-23, AD-24, AD-25, AD-26, and AD-27 were previously installed at the Site to monitor the uppermost aquifer (clayey and silty sand stratum) associated with the Landfill. As discussed above in Section 3.1.1, the uppermost aquifer below and adjacent to the Landfill is up to 60 feet thick and is located between an elevation of approximately 270 and 330 feet amsl.

3.3.2 Gaps in Monitoring Network

As shown on **Figure 9**, shallow groundwater flow direction in the Landfill area is south to southwesterly. Four existing monitoring wells (AD-8, AD-12, AD-16, and AD-27) are located up gradient north and northeast of the Landfill and will be utilized as up gradient monitoring wells for the Landfill.

As shown on **Figure 9**, one existing monitoring well (AD-23) was located downgradient (south) of the Landfill during the August 19, 2015 site visit, and three downgradient monitoring wells are required to monitor groundwater quality downgradient of a CCR unit. Existing monitoring wells AD-25 and AD-26 are located west (side gradient) of the Landfill and are therefore not suitable for use as downgradient monitoring wells. This data gap was addressed by installation of new downgradient monitoring wells AD-34 and AD-35 during December 2015 as shown on **Figure 9** and **Figure 10**. With the addition of monitoring wells AD-34 on the southwest side of the Landfill and AD-35 on the south side of the Landfill, there are no gaps remaining in the groundwater monitoring network for the Landfill.

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 Landfill (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 Landfill.

4.1 Recommended Monitoring Well Network Distribution

Four up gradient well locations (existing monitoring wells AD-8, AD-12, AD-16, and AD-27) and three downgradient well locations (existing monitoring wells AD-23, AD-34, and AD-35) are recommended to establish a groundwater quality monitoring well network for the Landfill. In addition, existing side gradient monitoring wells AD-25 and AD-26 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 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 270 and 330 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 Landfill was addressed by installation of monitoring wells AD-34 and AD-35 during December 2015. Monitoring wells AD-34 and AD-35 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

Kenneth 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 - Landfill
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-8	Exisiting	Uppermost Water-Bearing Unit	Northeast of Landfill	Upgradient	336.9	321.9	15	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-16	Exisiting	Uppermost Water-Bearing Unit	North of Landfill	Upgradient	341.8	321.8	20	Existing well installed in 2010; well will be utilitzed to establish backgroud water quality
AD-27	Existing	Uppermost Water-Bearing Unit	Northwest of Landfill	Upgradient	332.3	312.3	20	Existing well installed in 2010; well will be utilitzed to establish backgroud water quality
Downgradient								
AD-23	Existing	Uppermost Water-Bearing Unit	South of Landfill	Down gradient	331.7	311.7	20	Existing well installed in 2010; uppermost shallow aquifer adjacent to Landfill - downgradient
AD-34	Existing	Uppermost Water-Bearing Unit	Southwest of Landfill	Down gradient	294.6	279.6	15	New monitoring well installed during December 2015 in uppermost shallow aquifer adjacent to Landfill - downgradient.
AD-35	Existing	Uppermost Water-Bearing Unit	South of Landfill	Down gradient	313.0	298.0	15	New monitoring well installed during December 2015 in uppermost shallow aquifer adjacent to Landfill - downgradient.
Piezometers								
AD-25	Existing	Uppermost Water-Bearing Unit	West of Landfill	Side gradient	324.2	304.2	20	Existing well installed in 2010; uppermost shallow aquifer adjacent to Landfill - side gradient
AD-26	Existing	Uppermost Water-Bearing Unit	West of Landfill	Side gradient	332.4	302.4	30	Existing well installed in 2010; uppermost shallow aquifer adjacent to Landfill - side gradient

Footnotes:
a. Target elevations are an estimated range.
b. Ground surface elevation at proposed monitoring well location is approximately 310 feet amsl.
Acronyms and Abbreviations:
U=Upgradient
D=Downgradient
ft = feet
amsl = above mean sea level

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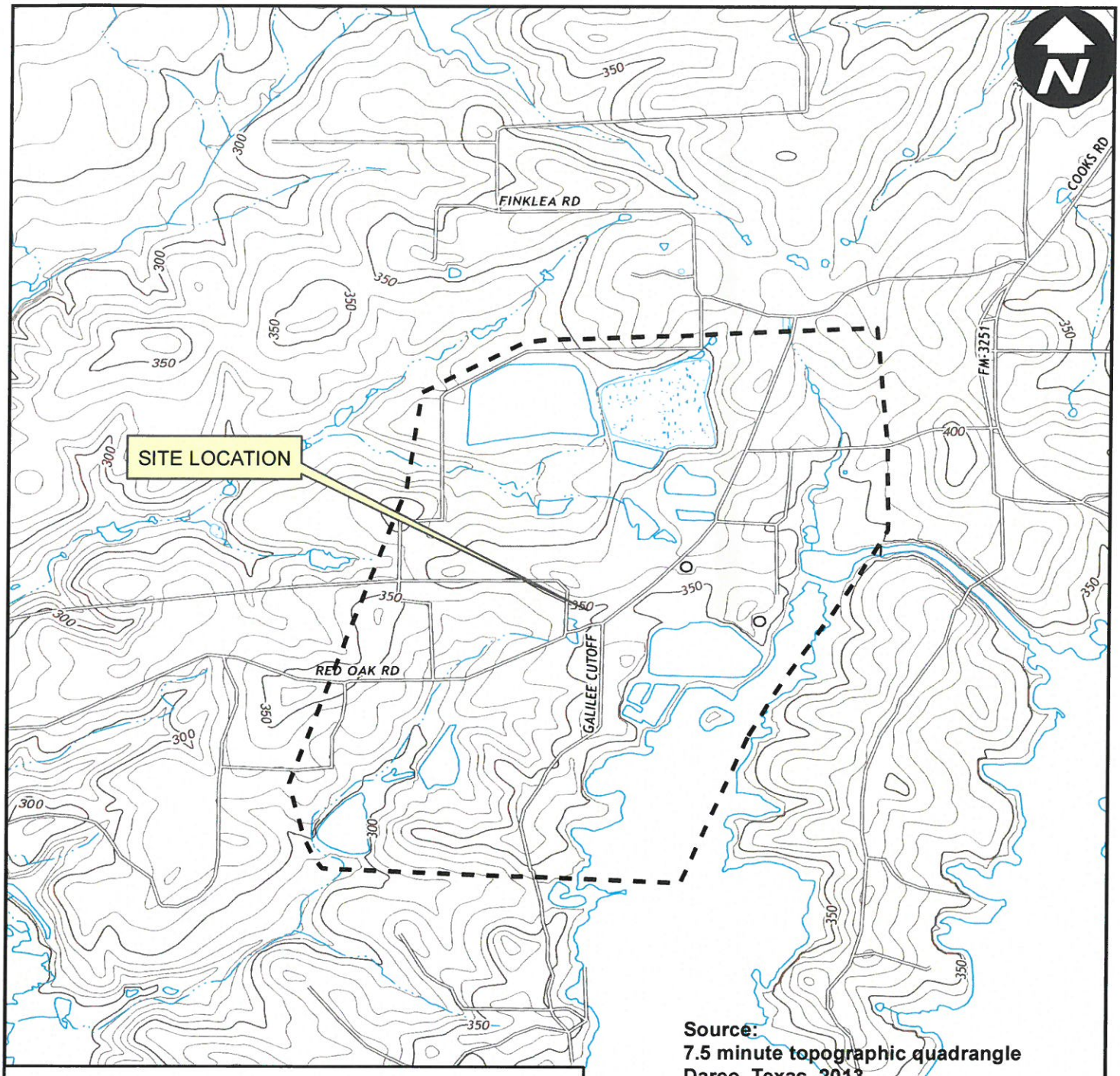
Figures



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

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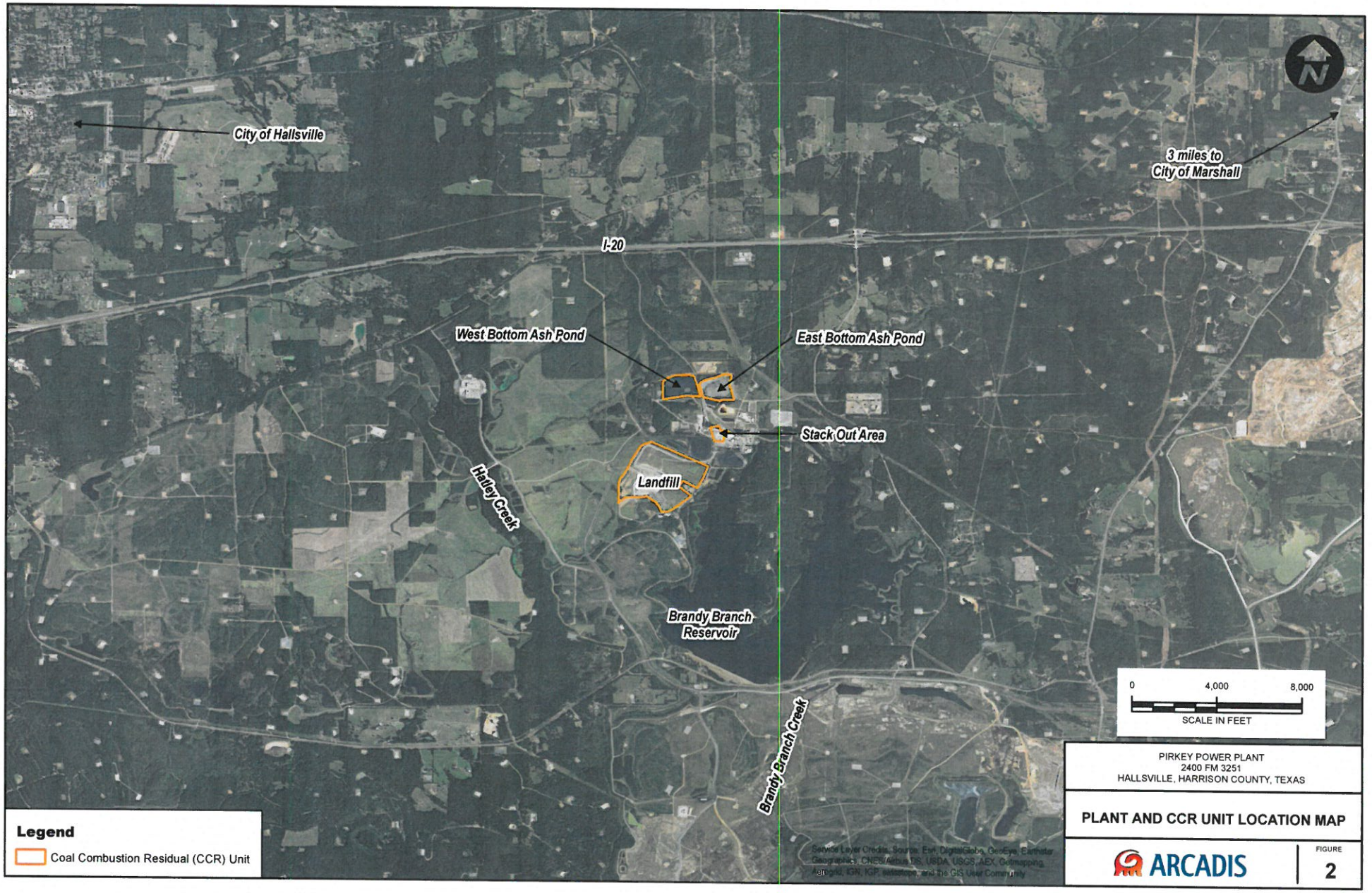
FIGURE
1

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



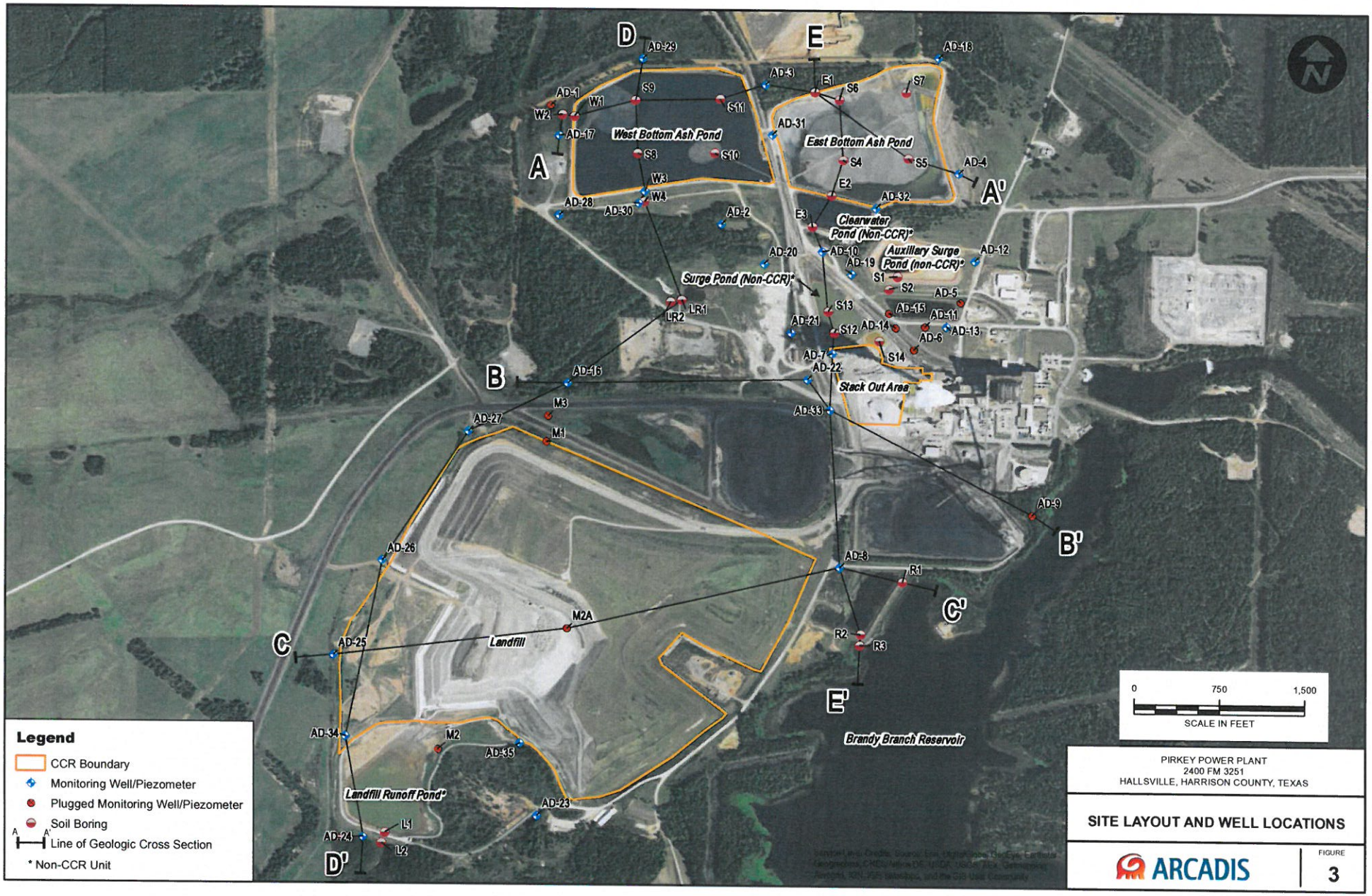
Document Path: Z:\GIS\PROJECTS\L_ENV\AEP\Pirkey Plant\MXD\Figure 2 - Plant and CCR Unit Location Map.mxd

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

PLANT AND CCR UNIT LOCATION MAP

ARCADIS

FIGURE
2



Legend

- CCR Boundary
- Monitoring Well/Piezometer
- Plugged Monitoring Well/Piezometer
- Soil Boring
- A — A' Line of Geologic Cross Section
- * Non-CCR Unit

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

SITE LAYOUT AND WELL LOCATIONS

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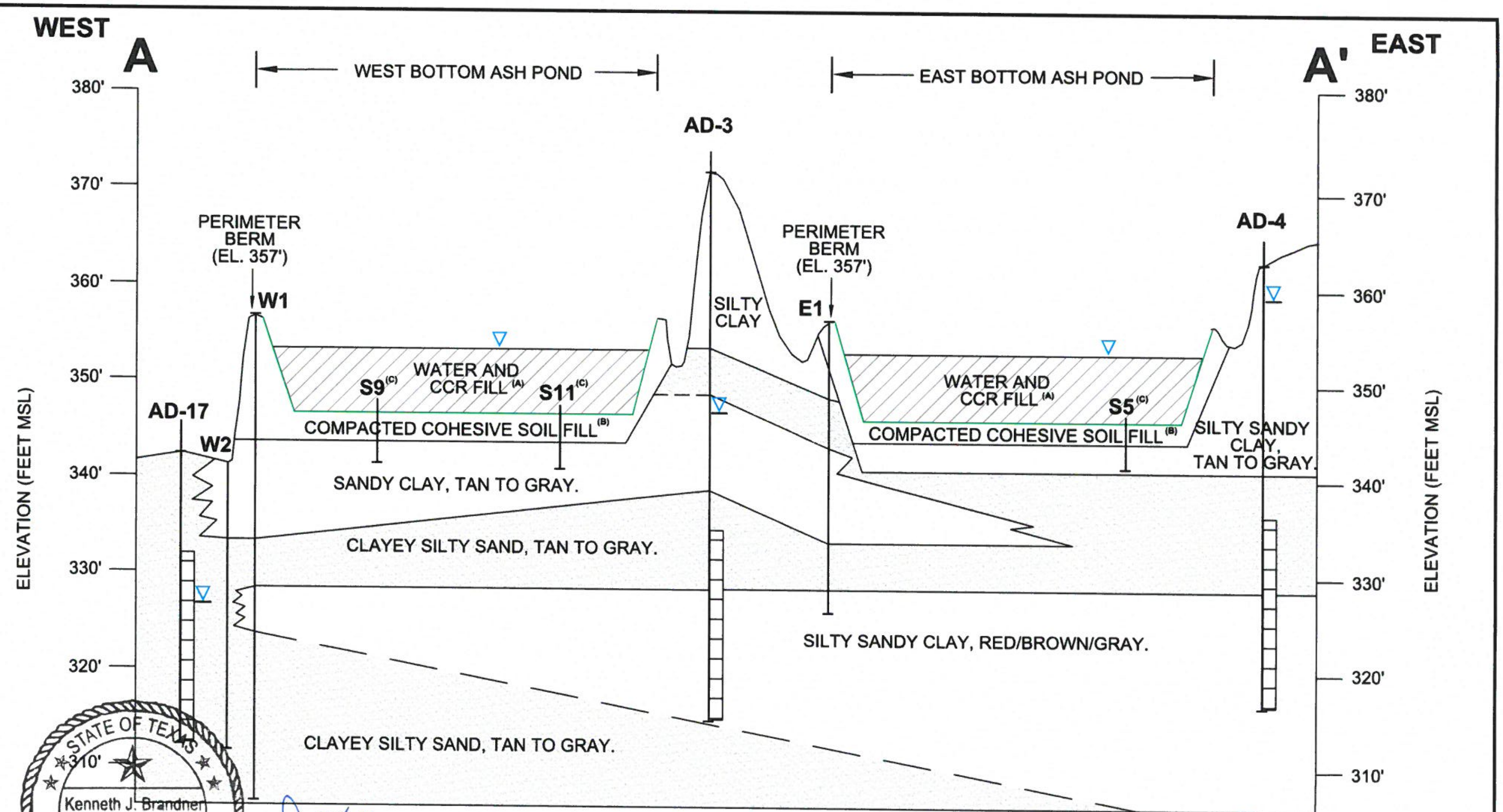
FIGURE 3

Document Path: Z:\GIS\PROJECTS_ENVIAE\Pirkey Plant\MXD\[Figure 3 - Site Layout and Well Locations.mxd



LEGEND

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

0 — 300'
HORIZONTAL SCALE

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'

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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: —
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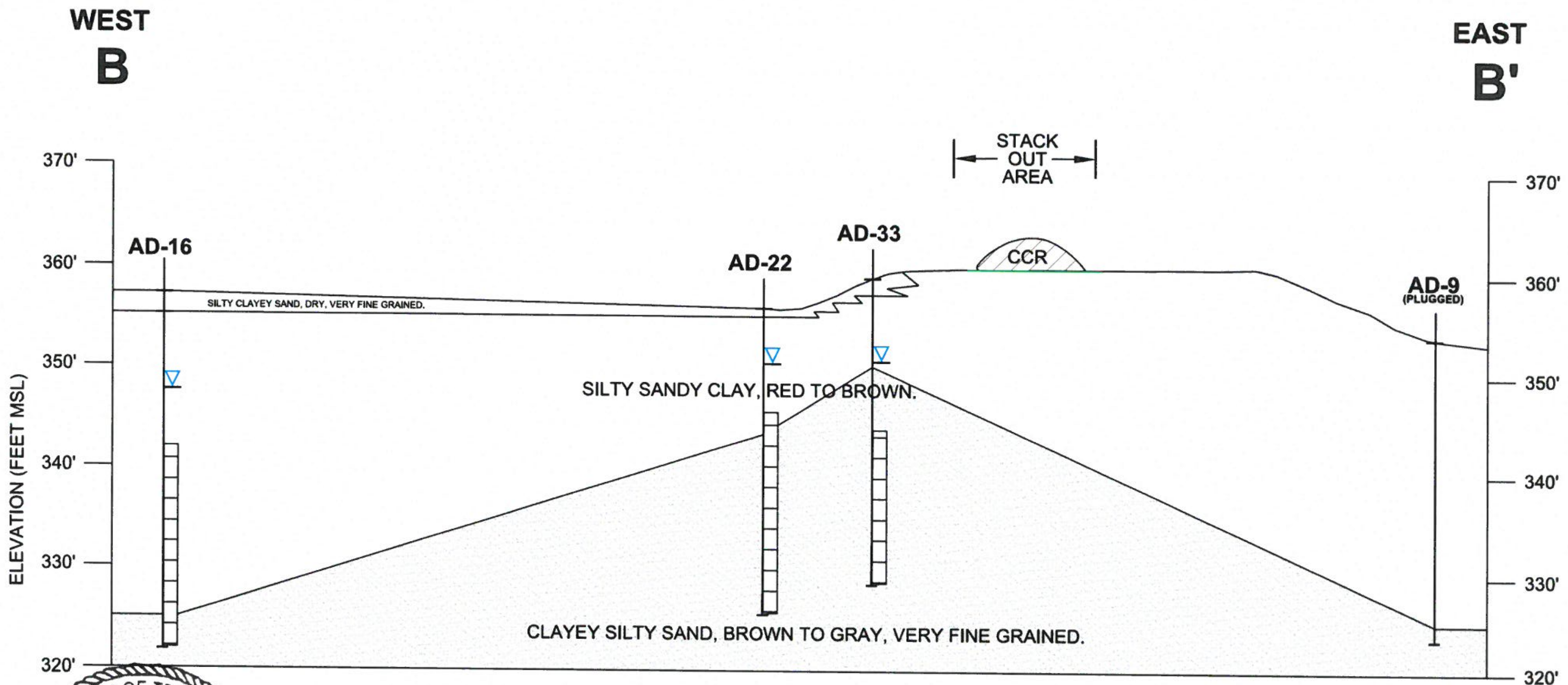

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1787
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5-25-16

0 300'
HORIZONTAL SCALE

LEGEND

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

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'

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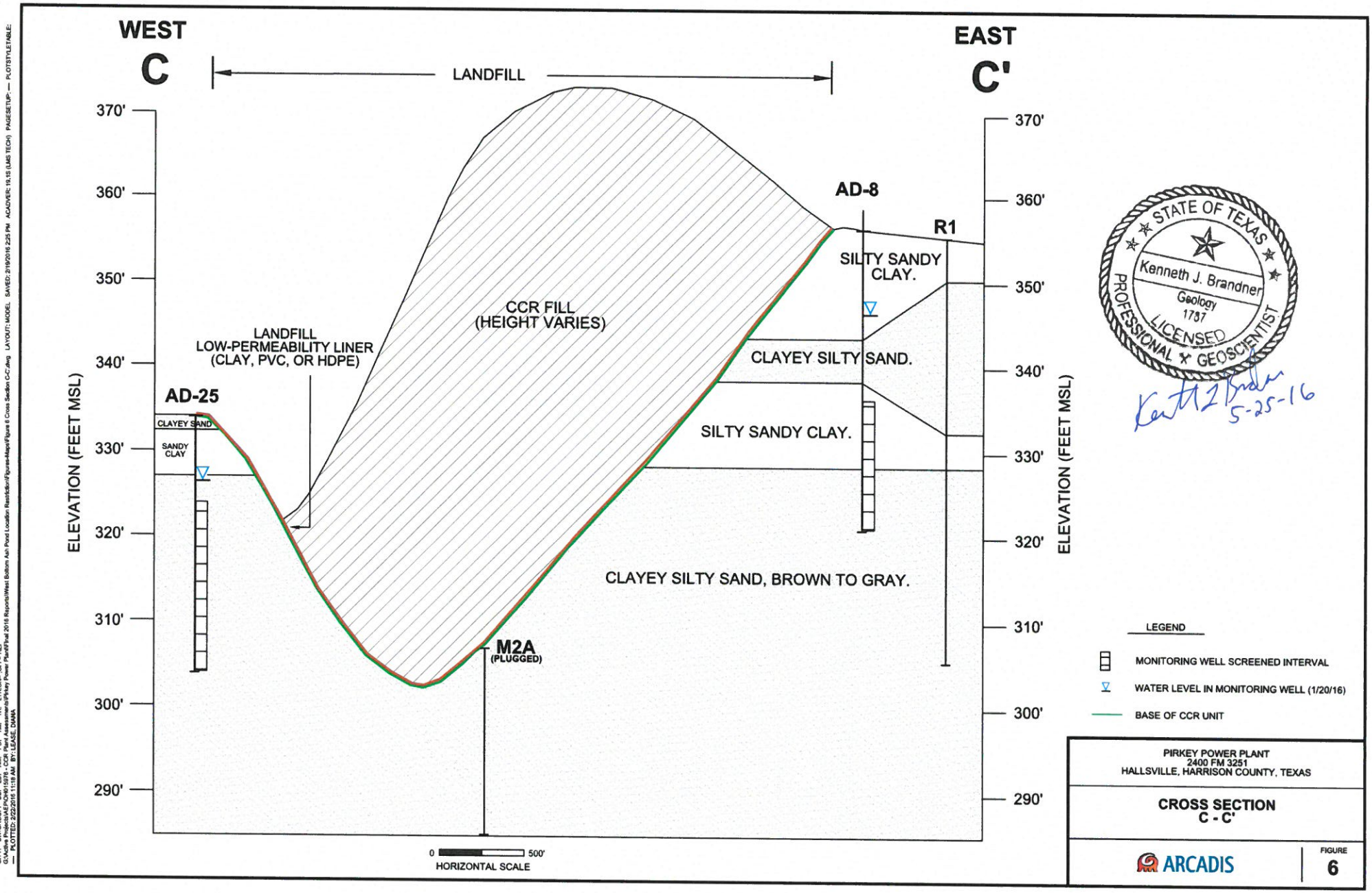
FIGURE
5



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

CROSS SECTION
C - C'

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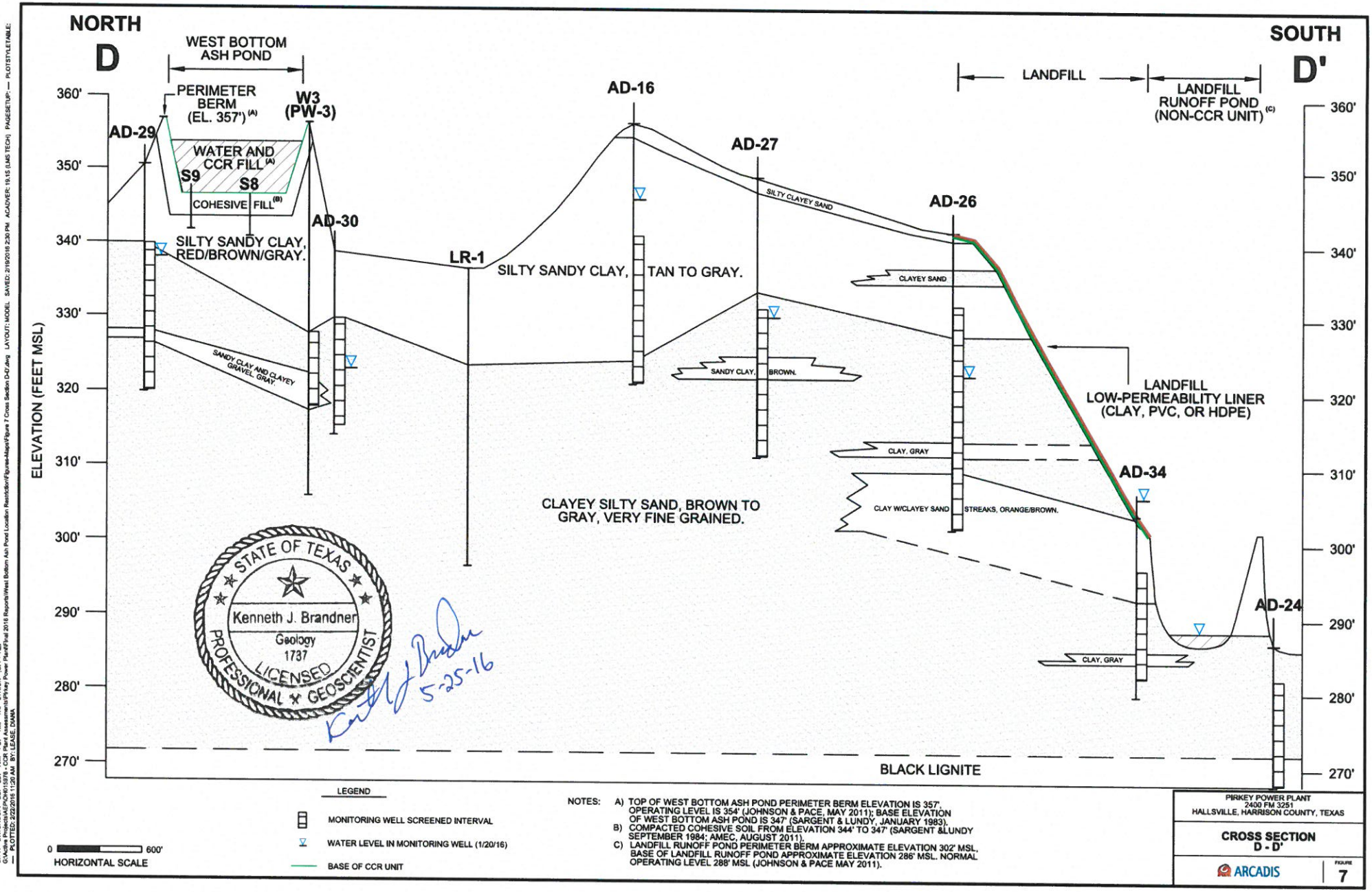
FIGURE
6



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5-25-16

LEGEND

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

0 600'
HORIZONTAL SCALE

NOTES:

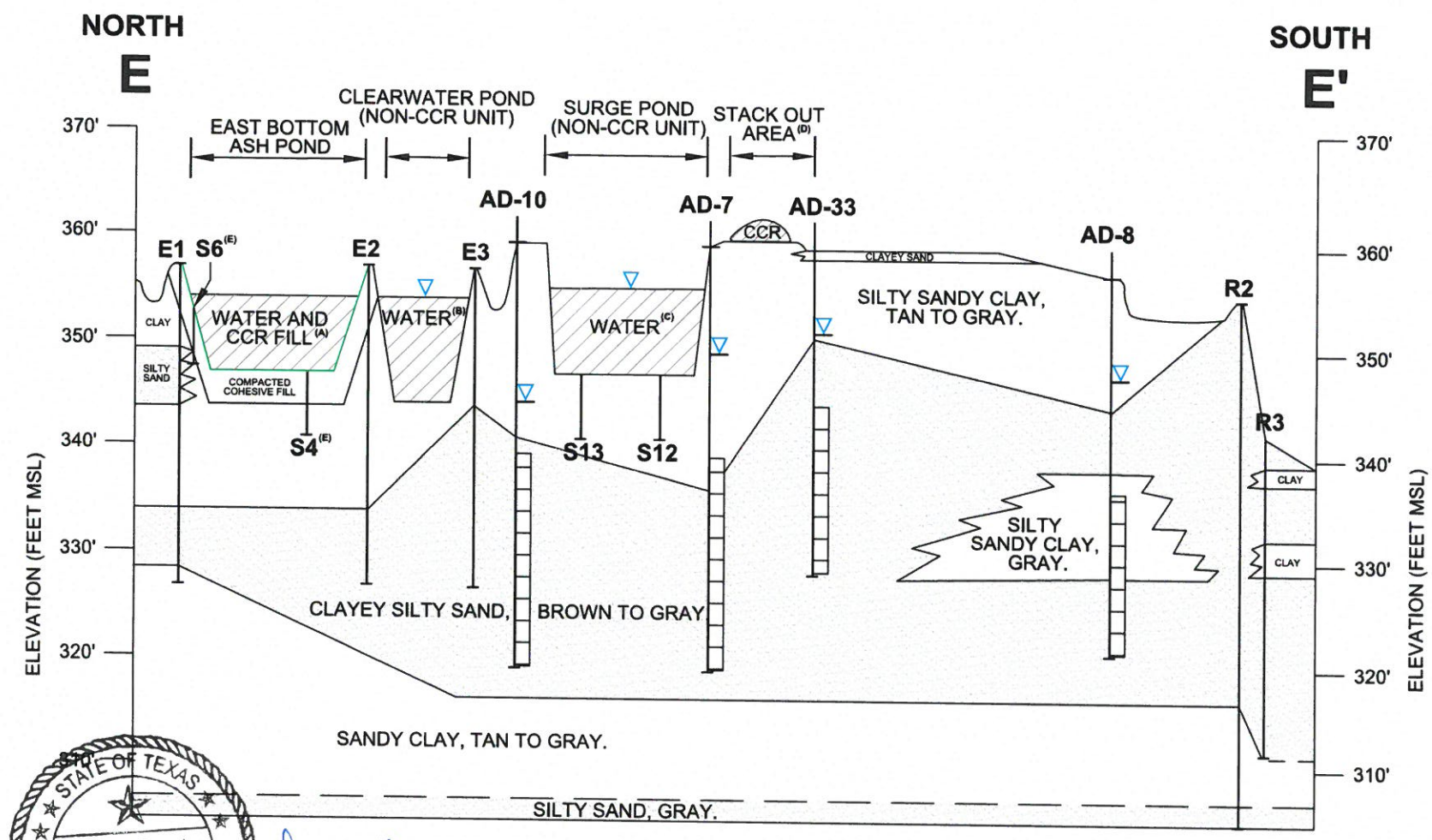
A) TOP OF WEST BOTTOM ASH POND PERIMETER BERM ELEVATION IS 357'. OPERATING LEVEL IS 354' (JOHNSON & PACE, MAY 2011); BASE ELEVATION OF WEST BOTTOM ASH POND IS 347' (SARGENT & LUNDY, JANUARY 1983).
B) COMPACTED COHESIVE SOIL FROM ELEVATION 344' TO 347' (SARGENT &LUNDY SEPTEMBER 1984; AMEC, AUGUST 2011).
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).

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

CROSS SECTION D - D'

ARCADIS

FIGURE 7



STATE OF TEXAS
Kenneth J. Brandner
Geology
1737
LICENSED
PROFESSIONAL GEOSCIENTIST

5-25-16

LEGEND

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

0 500'
HORIZONTAL SCALE

NOTES:

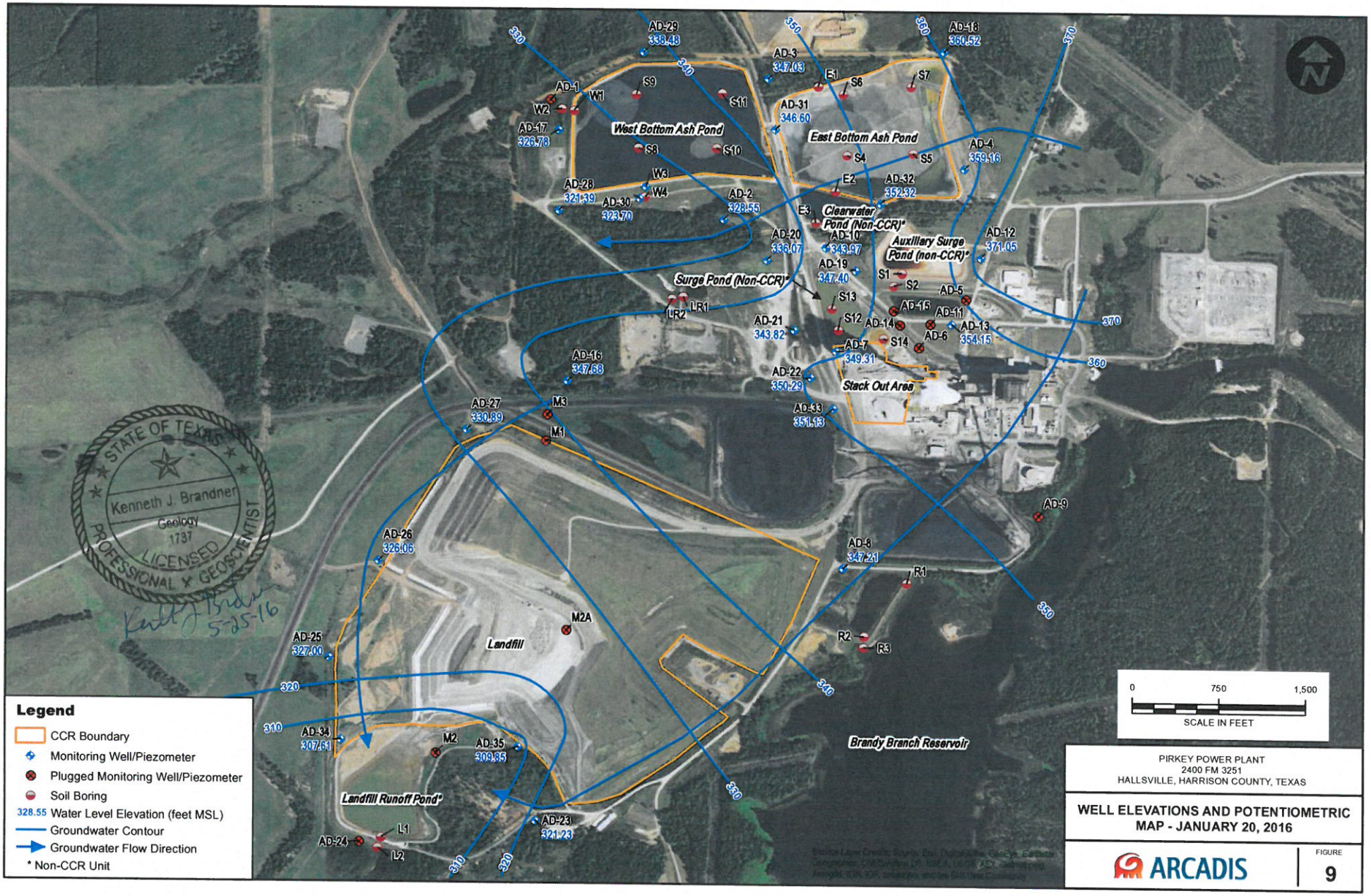
A) TOP OF EAST BOTTOM ASH POND PERIMETER BERM ELEVATION IS 357'. OPERATING LEVEL IS 354' (JOHNSON & PACE, MAY 2011); BASE ELEVATION OF EAST BOTTOM ASH POND IS 347' (SARGENT & LUNDY, JANUARY 1983).
B) TOP OF CLEARWATER POND PERIMETER BERM ELEVATION IS 357',OPERATING LEVEL IS 354' (JOHNSON & PACE, MAY 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



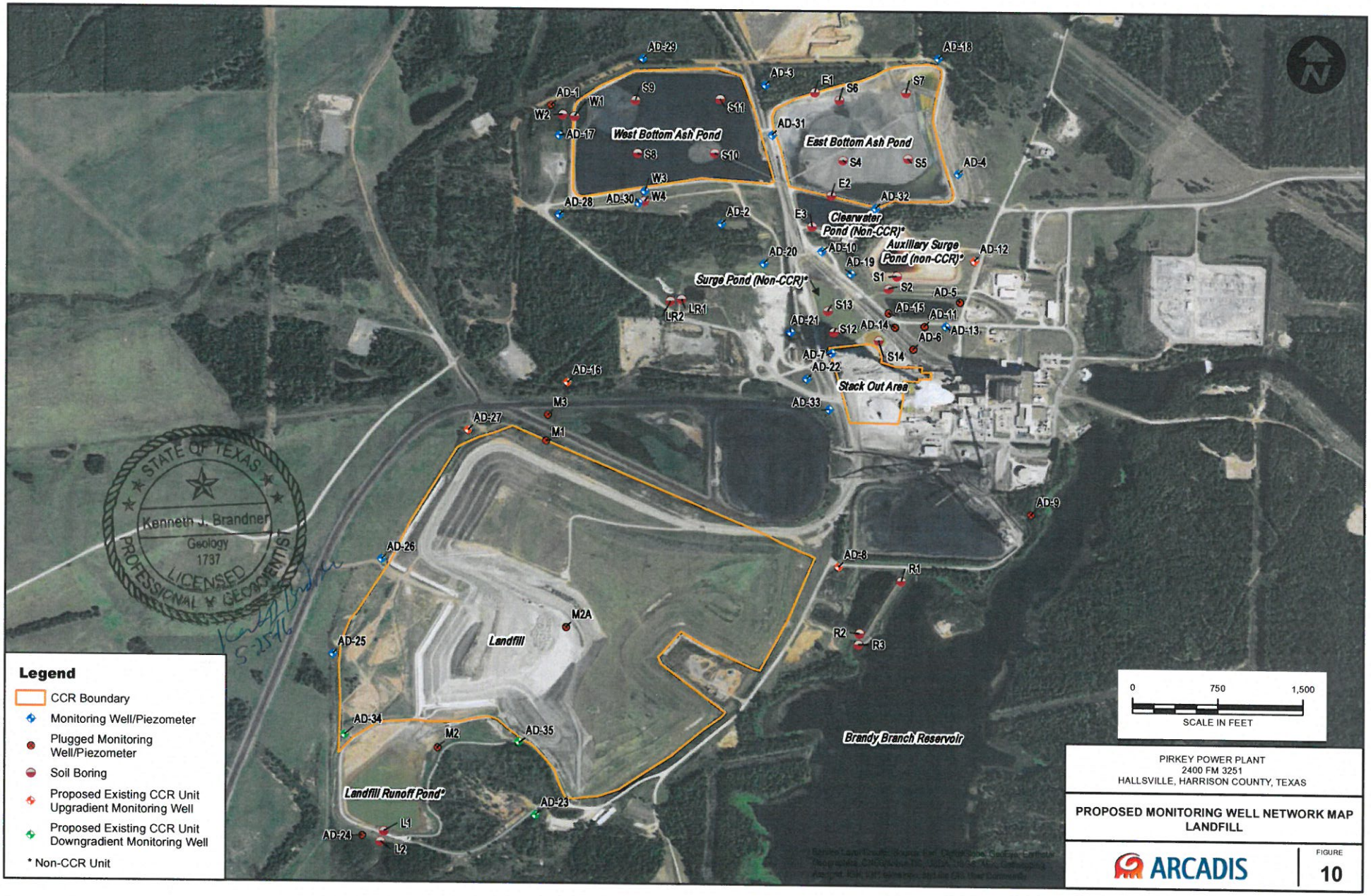
PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS

WELL ELEVATIONS AND POTENTIOMETRIC MAP - JANUARY 20, 2016

ARCADIS

FIGURE 9

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



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

PROPOSED MONITORING WELL NETWORK MAP
LANDFILL

ARCADIS

FIGURE
10

Document Path: Z:\GIS\PROJECTS_ENVAEP\Pirkey Plant\MXD\Figure 10 - Proposed Well Network - Landfill.mxd

ARCADIS

Appendix A

Boring/Well Construction Logs

832964

LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: MW-8
LOCATION: Hallsville

Date: 10-4-83 Type: Auger Ground Elevation:

Legend: ■ Sample X Penetration ▼ Water

Depth, Feet	Symbol	Sample	Description of Stratum
5			Stiff tan silty sandy clay w/iron ore
10			Stiff tan and grey silty sandy clay w/iron ore
15			Firm tan and grey clayey silty sand
20			Medium tan and grey very silty sandy clay w/iron ore
25			Very stiff grey silty clay lenses
30			43-7=5½" 50 B/5½"
35			Very dense tan and grey silty sand 50 B/5½"
40			Bottom of boring at 35 feet.
45			
50			

832964

LOG OF BORING

PROJECT: Monitor Wells at Metal Cleaning Waste Pond BORING NO.: MW-12
CLIENT: Southwestern Electric Power Company LOCATION: Hallsville, TX

Date: 1/30/86 Type: Rotary N 6+13.25; W-6+90.36
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-16

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: 12/30/2010

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

LATTITUDE: N 32°27.680' Datum: WGS-84 WELL LOCATION: North of Mine Haul Road
LONGITUDE: W94°29.642'

DEPTH (FEET)	PID (PPM)	SAMPLE INTERVAL	WELL LOG AND COMPLETION DETAILS	USCS CODE	SOIL DESCRIPTION AND COMMENTS	Odor	Moisture
1 2				0-2 SM	Silty sand, very fine grained, light brown	None	Dry
3 4 5 6 7 8				2-8 CL	Sandy clay, yellowish brown, reddish brown -some iron oxide concretions at 2.5' -light gray at 5'	None	Dry
9 10				8-10 CL	Clay, red, light yellowish brown, gray, fat, hard, some very fine laminated sand seams	None	Dry
11				10-11 CL	Sandy clay, red, light gray, yellowish brown, stiff to hard	None	Dry
12 13 14				11-14.25 CL	Clay, yellowish brown, some sand, reddish brown, light gray, hard -clayey sand seam at 14-14.25', yellowish brown, light gray	None	Dry Moist
15 16 17 18				14.25-18 CL	Sandy clay, red, light gray, gray, very thin sand lenses interbedded in clay	None	Moist to V. Moist
19 20 21 22 23 24 25 26 27 28 29 30 31 32			▽	18-29.5 CL	Clay, reddish gray, light gray, yellowish brown, hard, gray -2" reddish brown iron oxide cemented sand laminations at 19.75' -very moist, 1" gravelly sand lense, very fine gypsum crystals at 21' -sandy 22', 22.5', 24' -gray, yellowish brown at 24-24.5' - dark gray, very fine gypsum crystals, trace sand, hard, dry, at 25'	None	Moist V. Moist Dry
33 34 35				32-35 SC	Clayey sand, greenish gray, light gray, some very fine gypsum crystals, dense	None	Moist
36 37 38 39 40					Boring Terminated at 35'		

Cement Bentonite Filter Sand ▽ Water Level

Apex geoscience inc.

Total Depth: 35 feet
Filter Sand (Size/Interval): 13-35'
Grout (Type/Interval): Grout from 0-2'; Bentonite from 2-13'
Surface Completion ☐ Flush ■ Above Ground

Riser Interval: +3 (ags)-15'
Screen Interval: 15-35'
Water level: 23.37'
Above Ground 3'

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

APEX PROJECT NO.: 110-089 ☐ BORING BORING NUMBER: ____ ■ MONITOR WELL MONITOR WELL NUMBER: AD-23

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: 12/15/2010

PREPARED BY: David Bedford LOGGED BY: David Bedford

LATITUDE: N 32°27'03.3" Datum: WGS-84 WELL LOCATION: ____
LONGITUDE: W94°29'41.3"

DEPTH (FEET)	PID (PPM)	SAMPLE INTERVAL	WELL LOG AND COMPLETION DETAILS	USCS CODE	SOIL DESCRIPTION AND COMMENTS	Odor	Moisture
1-9				SC	Clayey sand, brown, with yellowish brown and orangish brown laminations, very fine grained, very silty, few light gray clay streaks	None	Moist
10-14				ML	Siltstone with light gray clay streaks, light gray with orangish brown streaks, few small iron ore pebbles	None	Moist
15-20				SM	Sand, light gray with orangish brown streaks, very silty, very fine grained, few clay laminations	None	Slightly Moist
21-27				ML	Siltstone, light gray with orangish brown streaks	None None	Very Moist V. Moist
28-30				SM	Sand, light brown mottled with orangish brown, very fine grained, very silty	None	Wet
31-32			▽	SC	Slightly sandy clay, orangish brown mottle with orangish brown, silty, very fine grained (30-31.5')	None	Moist
33-35				CL	Lean clay, dense, small sandy streaks, dark gray, very fine grained (31.5-35')	None	Moist
36-40					Boring Terminated at 35'		

Cement Bentonite Filter Sand Water Level

Apex geoscience inc.

Total Depth: 35 feet
Filter Sand (Size/Interval): 13-35'
Grout (Type/Interval): Grout from 0-2'; Bentonite from 2-13'
Surface Completion: Flush ■

Riser Interval: +3 (ags)-15'
Screen Interval: 15-35'
Water level: 30.83
Above Ground: 3'

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

APEX PROJECT NO.: 110-089 ☐ BORING BORING NUMBER: ____ ■ MONITOR WELL MONITOR WELL NUMBER: AD-24

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: 12/27/2010

PREPARED BY: Jeff Sammons LOGGED BY: Jeff Sammons

LATTITUDE: N 32°27.024' Datum: WGS-84 WELL LOCATION: South of LF pond dam
LONGITUDE: W94°29.940'

DEPTH (FEET)	PID (PPM)	SAMPLE INTERVAL	WELL LOG AND COMPLETION DETAILS	USCS CODE	SOIL DESCRIPTION AND COMMENTS	Odor	Moisture
1 2			0-1.5	SM	Silty sand, very fine grained, some clay, brown and reddish brown, medium dense	None	Moist
3 4 5 6			1.5-6.5	SC	Clayey sand, silty, gray, yellowish brown, reddish brown, very fine grained, dense -some iron oxide concretions and gravel at 5-6', trace organic matter at 6', gray, dark gray, reddish brown, loose to med. dense	None	Dry Moist
7 8 9 10 11 12 13 14 15 16			6.5-16	SM	Silty sand, very fine grained, red, loose, trace clay -some gravel at 10' -hard cemented sandstone with iron oxide at 11' - some clay at 15-16', medium dense, gray, dark gray	None	Saturated Moist
17 18 19 20			16-20	Lignite	Lignite, black, loose, saturated at 16-17' - medium dense, moist at 17-20'	None	Saturated
21 22 23 24 25 26 27 28 29 30					Boring Terminated @ 20'		

Cement Bentonite Filter Sand ▽ Water Level

Apex geoscience inc.

Total Depth: 20 feet
Filter Sand (Size/Interval): 3-20'
Grout (Type/Interval): Grout from 0-2'; Bentonite from 2-3'
Surface Completion ☐ Flush ■ Above Ground

Riser Interval: +3 (ags)-5'
Screen Interval: 5-20'
Water level: 8.4
3'

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

APEX PROJECT NO.: 110-089 ☐ BORING BORING NUMBER: ____ ■ MONITOR WELL MONITOR WELL NUMBER: AD-25

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: 12/14/2010

PREPARED BY: David Bedford LOGGED BY: David Bedford

LATTITUDE: N 32°27'17.2" Datum: WGS-84 WELL LOCATION: S. of Diesel ASTs
LONGITUDE: W94°29'59.1"

DEPTH (FEET)	PID (PPM)	SAMPLE INTERVAL	WELL LOG AND COMPLETION DETAILS	USCS CODE	SOIL DESCRIPTION AND COMMENTS	Odor	Moisture
1			0-1.5	SC	Clayey sand, brown, silty, very fine grained, moist	None	Moist
2			1.5-7	CH	Fat sandy clay, orangish brown, very fine grained, moist	None	Moist
3							
4							
5							
6							
7							
8			7-30	SC	Clayey sand, orangish brown mottled with dark gray, very fine grained, few light gray clay inclusions	None	Moist
9							
10							
11							
12							
13							
14		▽			Wet @ 14'		Wet
15							
16					15-20' - few pieces of dark gray cystalline rock		
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31					Boring Terminated at 30'		
32							
33							
34							
35							

Cement Bentonite Filter Sand ▽ Water Level

Apex geoscience inc.

Total Depth: 30 feet
Filter Sand (Size/Interval): 8-30'
Grout (Type/Interval): Grout from 0-2'; Bentonite from 2-8'
Surface Completion ☐ Flush ■ Above Ground

Riser Interval: +3 (ags)-10'
Screen Interval: 10-30'
Water level: 12.69'
3'

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

APEX PROJECT NO.: 110-089 ☐ BORING BORING NUMBER: ____ ■ MONITOR WELL MONITOR WELL NUMBER: AD-26

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: 12/14/2010

PREPARED BY: David Bedford LOGGED BY: David Bedford

LATTITUDE: N 32°27'25.3" Datum: WGS-84 WELL LOCATION: By silt fence and plastic lined trench
LONGITUDE: W94°29'54.8"

DEPTH (FEET)	PID (PPM)	SAMPLE INTERVAL	WELL LOG AND COMPLETION DETAILS	USCS CODE	SOIL DESCRIPTION AND COMMENTS	Odor	Moisture
1				0-1 SC	Slightly clayey sand, light brown, very fine grained, silty	None	Moist
2				1-3 CL	Sandy clay, lean, very fine grained, reddish brown	None	Moist
3							
4				3-5 CL	Lean, slightly sandy clay with clayey sand streaks, orangish brown, small coal pieces, very fine grained	None	Moist
5							
6				5-7 SC	Clayey sand, orangish brown, very fine grained, brown clay inclusions	None	Moist
7							
8				7-14 CL	Lean clay, orangish brown mottled with brown/light gray clayey sand streaks, very fine grained, few coal pieces	None	Moist
9							
10							
11							
12							
13							
14							
15				14-28 SC	Clayey sand, dark brown with orangish brown streaks, very fine grained, coal pieces	None	Slightly Wet
16							
17							
18							
19							
20			▽				
21					20-22' - Large clay inclusions, brown		Wet
22							
23							Very Moist
24							
25							
26					Wet from 25-26'		
27							
28							
29				28-30 CL	Lean clay, light gray with orangish brown streaks, few small sandy streaks, very fine grained	None	V. Moist
30							
31				30-32 SC	Clayey sand, light black, very fine grained, small pieces mica Wet from 30-30.5'	None	Wet Moist
32							
33				32-40 CL	Lean clay, orangish brown, small clayey sand streaks, very fine grained, brown streaks	None	Moist
34							
35							Slightly Wet
36							
37							
38							
39							
40							
					Boring Terminated at 40'		

Cement Bentonite Filter Sand ▽ Water Level

Apex geoscience inc.

Total Depth: 40 feet
Filter Sand (Size/Interval): 8-40'
Grout (Type/Interval): Grout from 0-2', Bentonite from 2-8'
Surface Completion ☐ Flush ■ Above Ground

Riser Interval: +3 (ags)-10'
Screen Interval: 10-40'
Water level: 19.45'
3'

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

APEX PROJECT NO.: 110-089 ☐ BORING BORING NUMBER: ____ ■ MONITOR WELL MONITOR WELL NUMBER: AD-27

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: 12/15/2010

PREPARED BY: David Bedford LOGGED BY: David Bedford

LATTITUDE: N 32°27'36.8" Datum: WGS-84 WELL LOCATION: By corner lined ditch
LONGITUDE: W94°29'47.3"

DEPTH (FEET)	PID (PPM)	SAMPLE INTERVAL	WELL LOG AND COMPLETION DETAILS	USCS CODE	SOIL DESCRIPTION AND COMMENTS	Odor	Moisture
1 2			0-2	SC	Clayey sand, orangish brown with dark gray laminations, very fine grained	None	Slightly Moist
3 4 5 6 7 8 9 10 11 12 13 14 15			2-15.5	CL	Lean clay, dense, few thin sandy streaks, reddish orange, very fine grained, mottled with light brownish gray Orange to brown with orangish brown streaks, at 10' becomes brittle	None	Slightly Moist
16 17 18 19 20 21 22 23			15.5-23	SC	Clayey sand, greenish brown with orangish brown streaks, few thin tan clay streaks, very fine grained	None	Moist
24			23-24	SM	Sand, orangish brown, silty, very fine grained	None	Wet
25 26 27		▽	24-27	CH	Fat clay, brown with orangish brown streaks, many sandy streaks, very fine grained	None	Very Moist
28 29 30			27-30	SM	Sand, greenish gray with orangish brown streaks, very fine to fine grained, wet	None	Wet
31 32 33 34 35 36 37			30-37.5	SC	Clayey sand with clay streaks, light greenish black, very fine grained Wet red brittle shale from 35-35.2	None	Slightly Wet
38 39 40					Boring Terminated at 37.5'		

Cement Bentonite Filter Sand ▽ Water Level

Apex geoscience inc.

Total Depth: 40 feet Riser Interval: +3 (ags)-17.5'
Filter Sand (Size/Interval): 15.5-37.5' Screen Interval: 17.5-37.5'
Grout (Type/Interval): Grout from 0-2'; Bentonite from 2-15.5' Water level: 26.73'
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-34

PROJECT INFORMATION

PROJECT:	Pirkey Power Plant
PROJECT NO.:	I-84-1021
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:	307.61 (Top of Casing)
HOLE DIAMETER:	8.25"
LATITUDE	32 27' 10.13" LONGITUDE 94 29' 57.93"

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

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

TBPG No. 50027

DESCRIPTION	USCS	DEPTH	SAMPLE	% MOISTURE	% FINES	LL	PL	PI
CLAYEY SAND: very fine to fine sand, some silt, reddish brownish, light reddish brown, light gray, moist	SC	0						
FAT CLAY: trace sand and silt, some iron oxide concretions, dark reddish brown, reddish brown, and and light gray, moist - some silt and very fine to fine sand at 5', light gray, light reddish brown, and light yellowish brown, moist to very moist	CH	2–5	31	89	63	23	40	
SANDY LEAN CLAY: some very fine to fine sand, dark gray, moist - reddish brown, dark reddish brown, dark gray, light gray at 10' to 12.5'	CL	6–12	23	64	26	18	8	
SILTY SAND: very fine to fine sand, some clay, gray and dark gray, saturated - increasing clay content with depth	SM	13–16	22	29	25	NP	-	
FAT CLAY: trace sand and silt, gray, moist	CH	19–20						
CLAYEY SAND: fine to very fine sand, dark gray, moist to very moist	SC	21–25	23	90	55	27	28	

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-35

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.:	50089
RIG TYPE:	Geoprobe 3230DT
METHOD OF DRILLING:	Hollow Stem Auger
SAMPLING METHODS:	Split Core
SURFACE ELEVATION:	318.95 (Top of Casing)
HOLE DIAMETER:	8.25"
LATITUDE	32 27' 9.64"
LONGITUDE	94 29' 42.74"

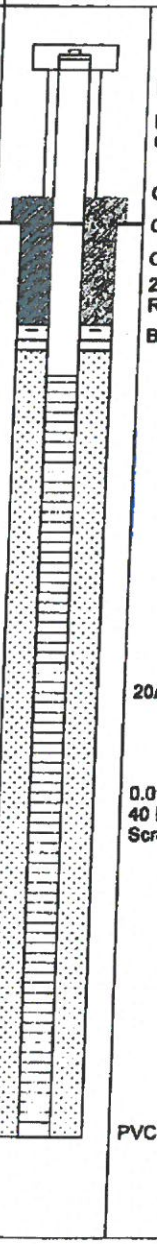
STATE OF TEXAS — JDS 1-21-16 — JEFFREY D. SAMMONS — GEOLOGY #10070 — LICENSED PROFESSIONAL GEOSCIENTIST

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

TBPG No. 50027

DESCRIPTION	USCS	% MOISTURE	% FINES	LL	PL	PI
CLAYEY SAND: very fine to fine sand, some iron ore gravel, reddish brownish, dark reddish brown, yellowish brown, gray, moist	SC	13	46	32	15	17
SILTY SAND: very fine to fine sand, trace clay, trace iron ore gravel, light reddish brown, moist, increasing moisture content with depth	SM	12	26	16	NP	
- saturated at 10' to 11'						
CLAYEY SAND: very fine to fine sand, trace iron ore gravel, light reddish brown, very moist - thin seams of saturated very fine sand with trace of clay at 12.25' to 12.5' - light reddish brown and light gray, moist to very moist at 12.5' to 15'	SC	19	33	31	18	13
LEAN CLAY: interbedded clays and silts with laminations of very fine sand, light gray, gray and light reddish brown, moist to very moist	CL	21	93	34	20	14
- thin lenses of very moist very fine sand and partially cemented very fine sand at 17.5' and 18', reddish brown						

WELL CONSTRUCTION



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

LOG OF BORING

852164
PROJECT: Monitoring Well Instllation
CLIENT: Southwestern Electric Power Company
BORING NO.: M-1
LOCATION: Hallsville, TX
S 12+32.79; W 35+34.55
Date: 1/29/86 Type: Rotary
Ground Elevation: 337.67

Legend:
■ Sample X Penetration ▼ Water

Depth, Feet	Symbol	Sample	Description of Stratum
5			Brown and tan sandy clay
10			Brown and tan sandy clay w/iron ore
15			Brown and tan sandy clay w/iron ore
20			Gray silty sand
25			Gray silty sand
30			Gray silty sand
35			Bottom of Boring at 30 feet. Water encountered at 10 feet.
40			
45			
50			

SOUTHWESTERN LABORATORIES

852164

LOG OF BORING

PROJECT: Monitoring Well Installation
CLIENT: Southwestern Electric Power Company

BORING NO.: MW-2
LOCATION: Hallsville, TX
S 38+86.22; W 45+76.41

Date: 1/29/86 Type: Rotary Ground Elevation: 302.19

Legend: ■ Sample X Penetration ▼ Water

Depth, Feet	Symbol	Sample	Description of Stratum
5			Brown silty sand w/iron ore
10			Brown silty sand w/iron ore
15			Brown and gray silty sand
20			Gray silty sand
25			Gray silty sand
30			Bottom of Boring at 27 feet. Water encountered at 11 feet.
35			
40			
45			
50			

SOUTHWESTERN LABORATORIES

LOG OF BORING

852164
PROJECT: Sludge Disposal Area
CLIENT: Southwestern Electric Power Company

BORING NO.: M. 2A
LOCATION: Hallsville, TX

Date: 6/20/85 Type: Auger Ground Elevation: 308.40

Legend: ■ Sample X Penetration

Plant Site Coordinates: South S 27+55.45 West W 36+47.44

▼ Water

Depth, Feet	Symbol	Sample	Description of Stratum
0			Red-brown clayey sand
10			Gravel
15			Gray clayey silty sand
20			Gray silty sand
25			Bottom of Boring at 22 feet. Water encountered at 12 feet. Bottom of Casing at 22 feet. Screen length 15 feet.
30			
35			
40			
45			
50			

SOUTHWESTERN LABORATORIES

Log of Boring

Number: M-3

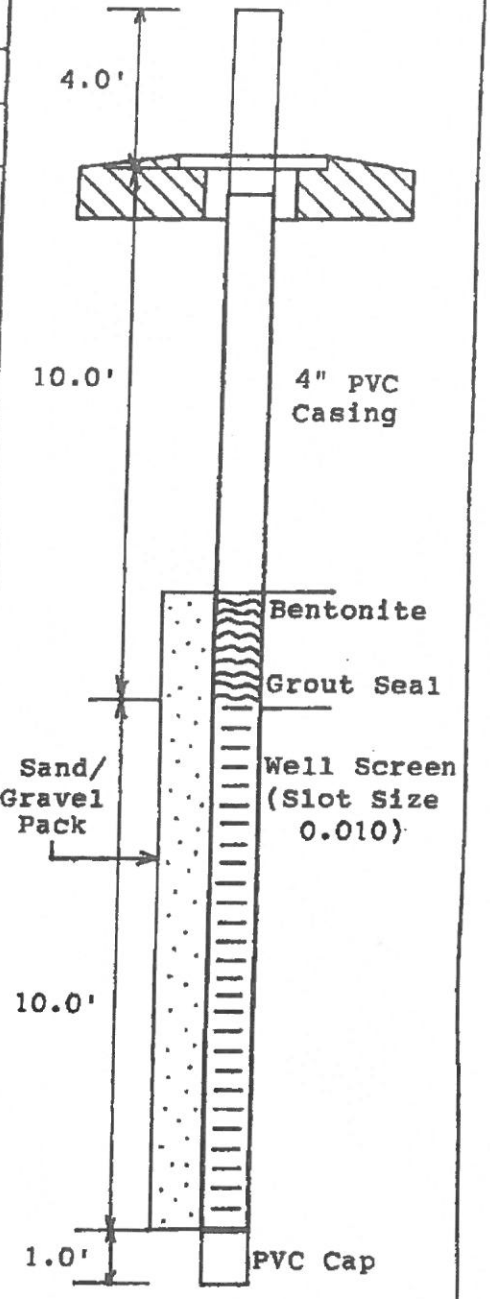
Location: Harrison Co., miles SW Marshall City Ha

Project: New Monitor Well Installation, H.W. Pirkey Power Plant

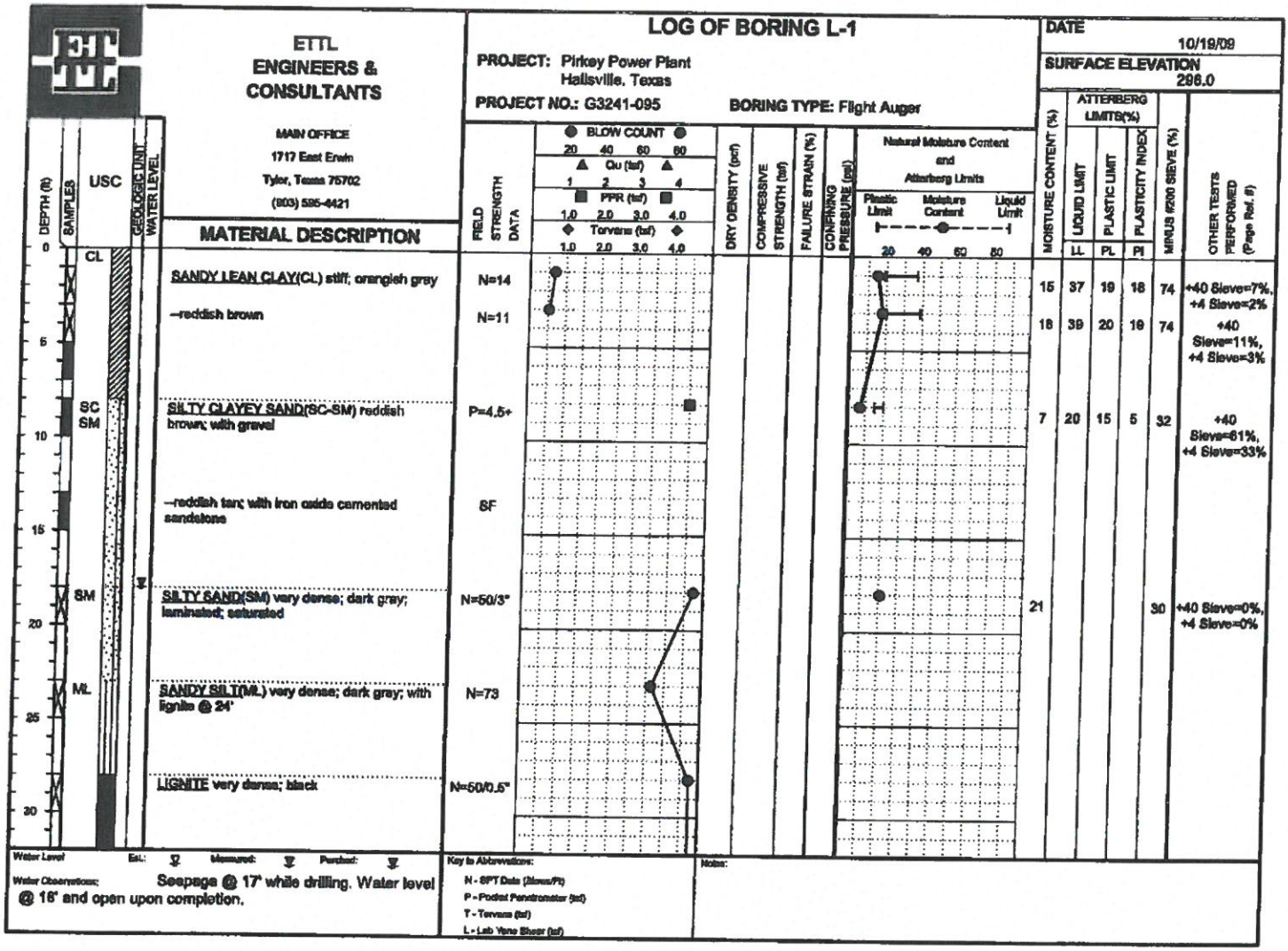
Type: Groundwater Monitor Well

Surface Elevation: 275.0'

Depth	Stratum Description
0	Sod
	Brown Silty Clay
5	Brown Silty Sandy Clay
	Red & Gray Silty Clay
10	
15	Lignite
	Tan Silty Sandy Clay
20	
25	



Completion Depth	Date	Water Observations
20'	7-1-93	Water Encountered at 10.0'



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Tyler, Texas 75702
(903) 595-4421

LOG OF BORING L-1

PROJECT: Pirkey Power Plant
Hallsville, Texas

PROJECT NO.: G3241-095 **BORING TYPE:** Flight Auger

DATE 10/19/09

SURFACE ELEVATION 296.0

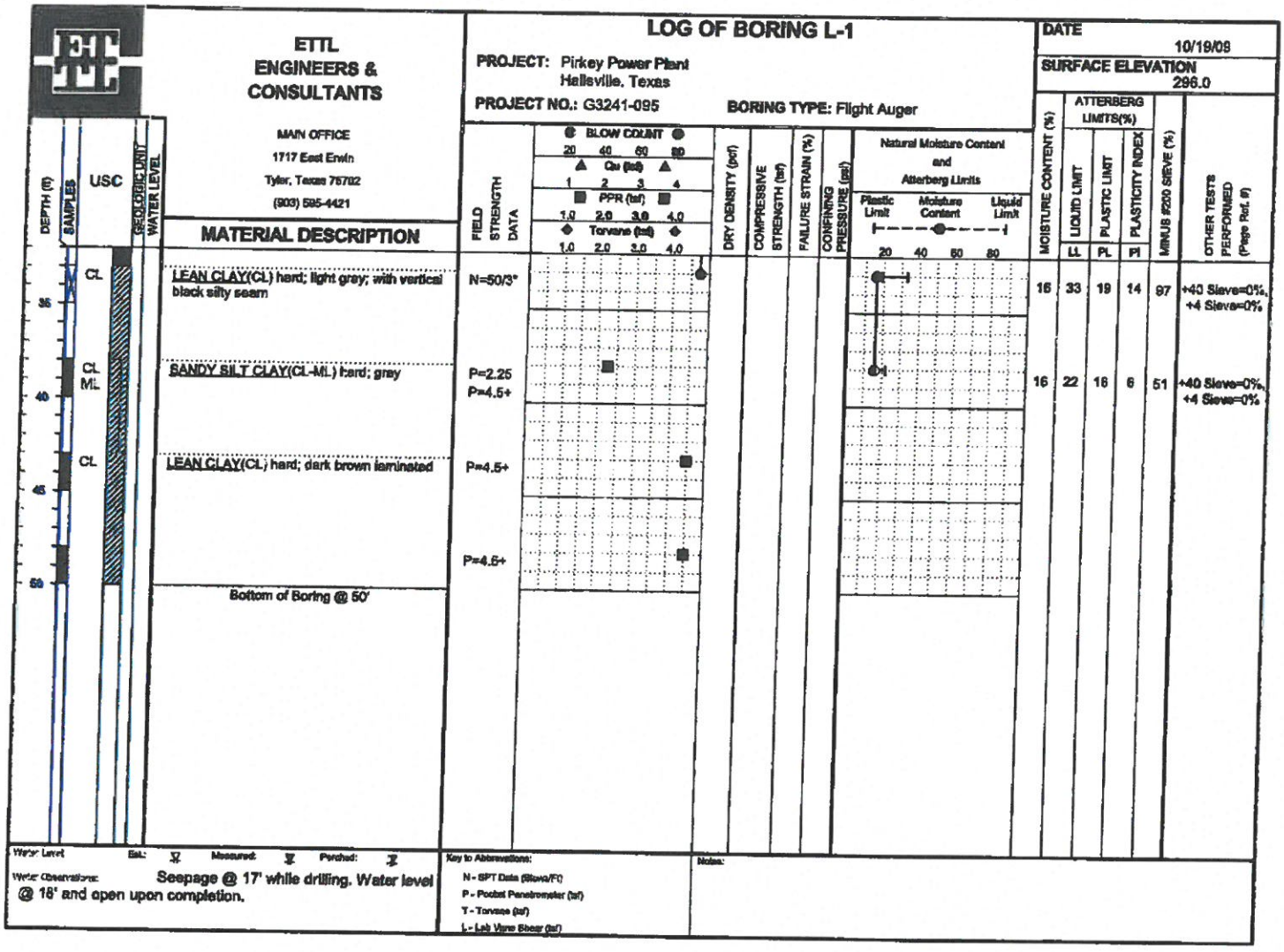
DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0		CL			SANDY LEAN CLAY(CL) stiff; orangish gray	N=14	15	37	19	18	74	+40 Sieve=7%, +4 Sieve=2%
5					--reddish brown	N=11	18	39	20	19	74	+40 Sieve=11%, +4 Sieve=3%
10		SC SM			SILTY CLAYEY SAND(SC-SM) reddish brown; with gravel	P=4.5+	7	20	15	5	32	+40 Sieve=61%, +4 Sieve=33%
15					--reddish tan; with iron oxide cemented sandstone	SF						
20		SM			SILTY SAND(SM) very dense; dark gray; laminated; saturated	N=50/3"	21				30	+40 Sieve=0%, +4 Sieve=0%
25		ML			SANDY SILT(ML) very dense; dark gray; with lignite @ 24'	N=73						
30					LIGNITE very dense; black	N=50/0.5"						

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

Water Observations: Seepage @ 17' while drilling. Water level @ 16' 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:



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LOG OF BORING L-1

PROJECT: Pirkey Power Plant
Hallsville, Texas

PROJECT NO.: G3241-095

BORING TYPE: Flight Auger

DATE: 10/19/09

SURFACE ELEVATION: 296.0

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		CL			LEAN CLAY(CL) hard; light gray; with vertical black silty seam	N=50/3"					16	33	19	14	97	+40 Sieve=0%, +4 Sieve=0%
40		CL ML			SANDY SILT CLAY(CL-ML) hard; gray	P=2.25 P=4.5+					16	22	16	6	51	+40 Sieve=0%, +4 Sieve=0%
45		CL			LEAN CLAY(CL) hard; dark brown laminated	P=4.5+										
50					Bottom of Boring @ 50'	P=4.5+										

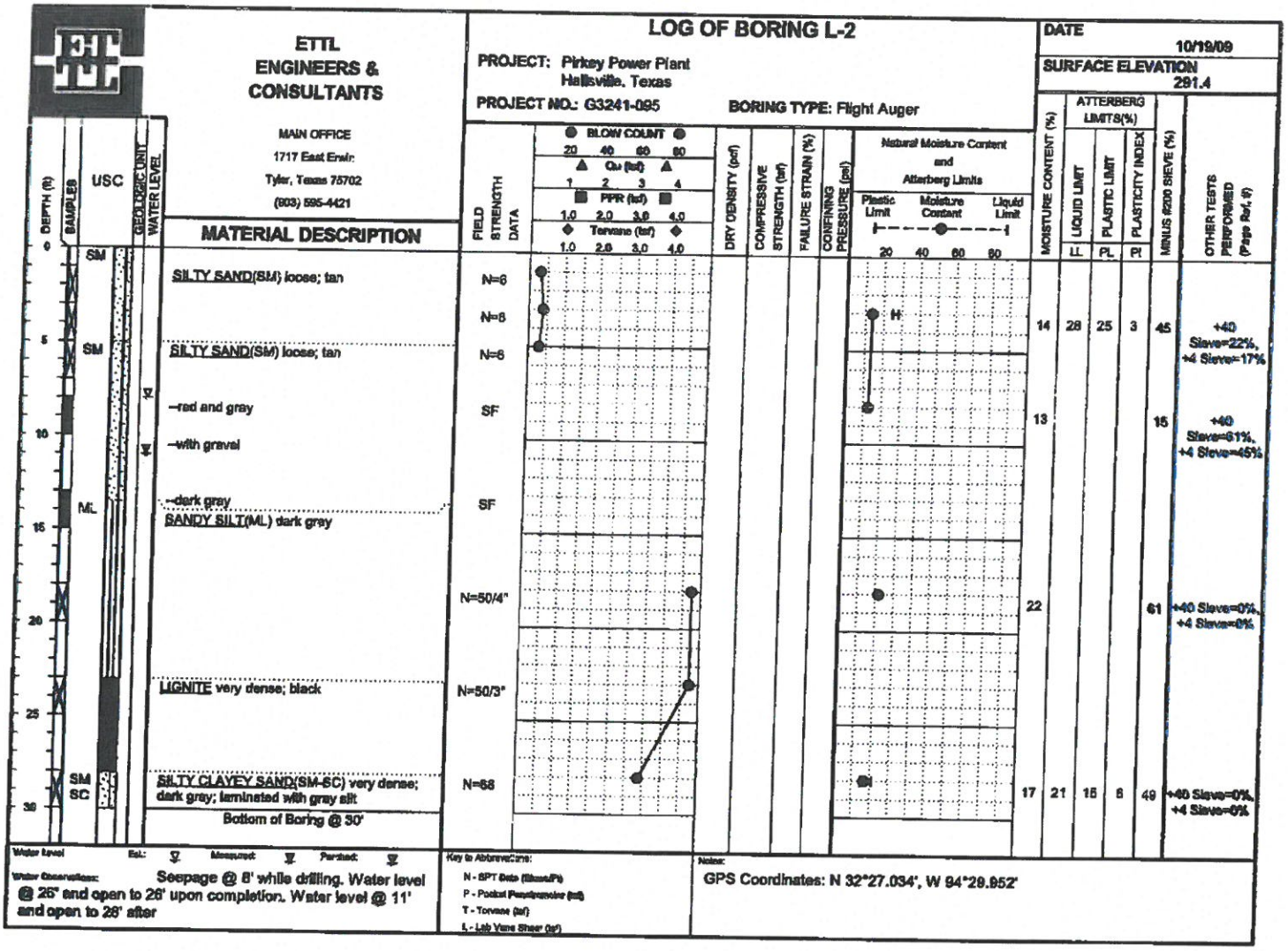
Natural Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit (20 40 60 80)

Water Level: Est.: Measured: Perched:

Water Observations: Seepage @ 17' while drilling. Water level @ 18' 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: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MAIN OFFICE
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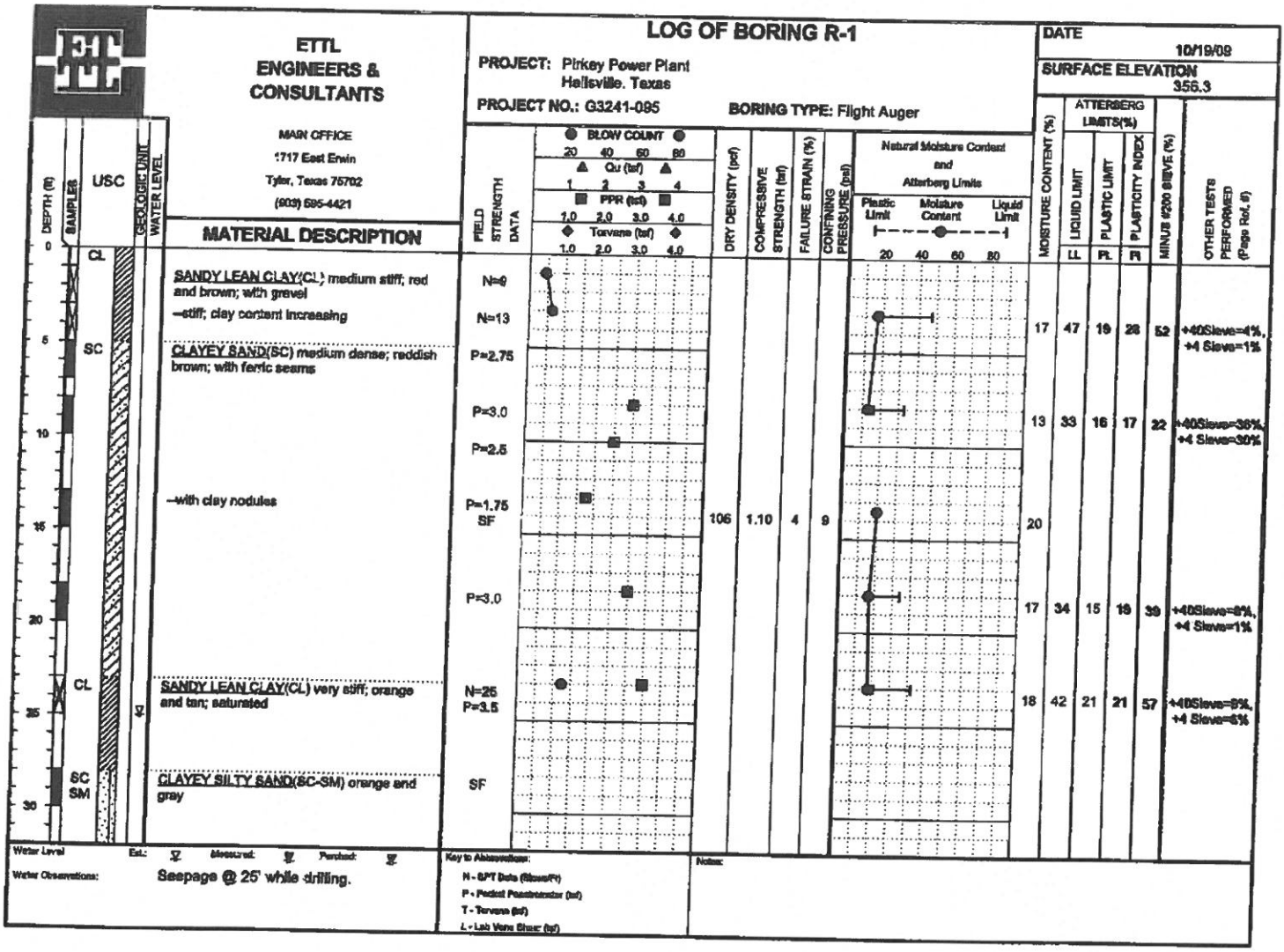
LOG OF BORING L-2
PROJECT: Pirkey Power Plant
Hallsville, Texas
PROJECT NO.: G3241-095
BORING TYPE: Flight Auger
DATE
10/19/09
SURFACE ELEVATION
291.4
MATERIAL DESCRIPTION
SILTY SAND(SM) loose; tan
SILTY SAND(SM) loose; tan
--red and gray
--with gravel
--dark gray
SANDY SILT(ML) dark gray
LIGNITE very dense; black
SILTY CLAYEY SAND(SM-SC) very dense; dark gray; laminated with gray silt
Bottom of Boring @ 30'
N=6
N=8
N=6
SF
SF
N=50/4"
N=50/3"
N=68
Natural Moisture Content and Atterberg Limits
Plastic Limit
Moisture Content
Liquid Limit
14
13
22
17
28
21
25
15
3
8
45
15
61
49
+40 Sieve=22%, +4 Sieve=17%
+40 Sieve=61%, +4 Sieve=45%
+40 Sieve=0%, +4 Sieve=0%
+40 Sieve=0%, +4 Sieve=0%
Seepage @ 8' while drilling. Water level @ 26' and open to 26' upon completion. Water level @ 11' and open to 26' after
GPS Coordinates: N 32°27.034', W 94°29.952'



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LOG OF BORING R-1

PROJECT: Pirkey Power Plant
Hallsville, Texas

PROJECT NO.: G3241-095

BORING TYPE: Flight Auger

DATE: 10/19/09

SURFACE ELEVATION: 356.3

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(%) LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0		CL			SANDY LEAN CLAY(CL) medium stiff; red and brown; with gravel	N=9										
					—stiff; clay content increasing	N=13					17	47	19	28	52	+40Sieve=4%, +4 Sieve=1%
5		SC			CLAYEY SAND(SC) medium dense; reddish brown; with ferric seams	P=2.75										
						P=3.0					13	33	16	17	22	+40Sieve=36%, +4 Sieve=30%
10						P=2.5										
					—with clay nodules	P=1.75										
15						SF	106	1.10	4	9	20					
						P=3.0					17	34	15	19	39	+40Sieve=8%, +4 Sieve=1%
20																
		CL			SANDY LEAN CLAY(CL) very stiff; orange and tan; saturated	N=25					18	42	21	21	57	+40Sieve=8%, +4 Sieve=6%
25				▽		P=3.5										
		SC SM			CLAYEY SILTY SAND(SC-SM) orange and gray	SF										
30																

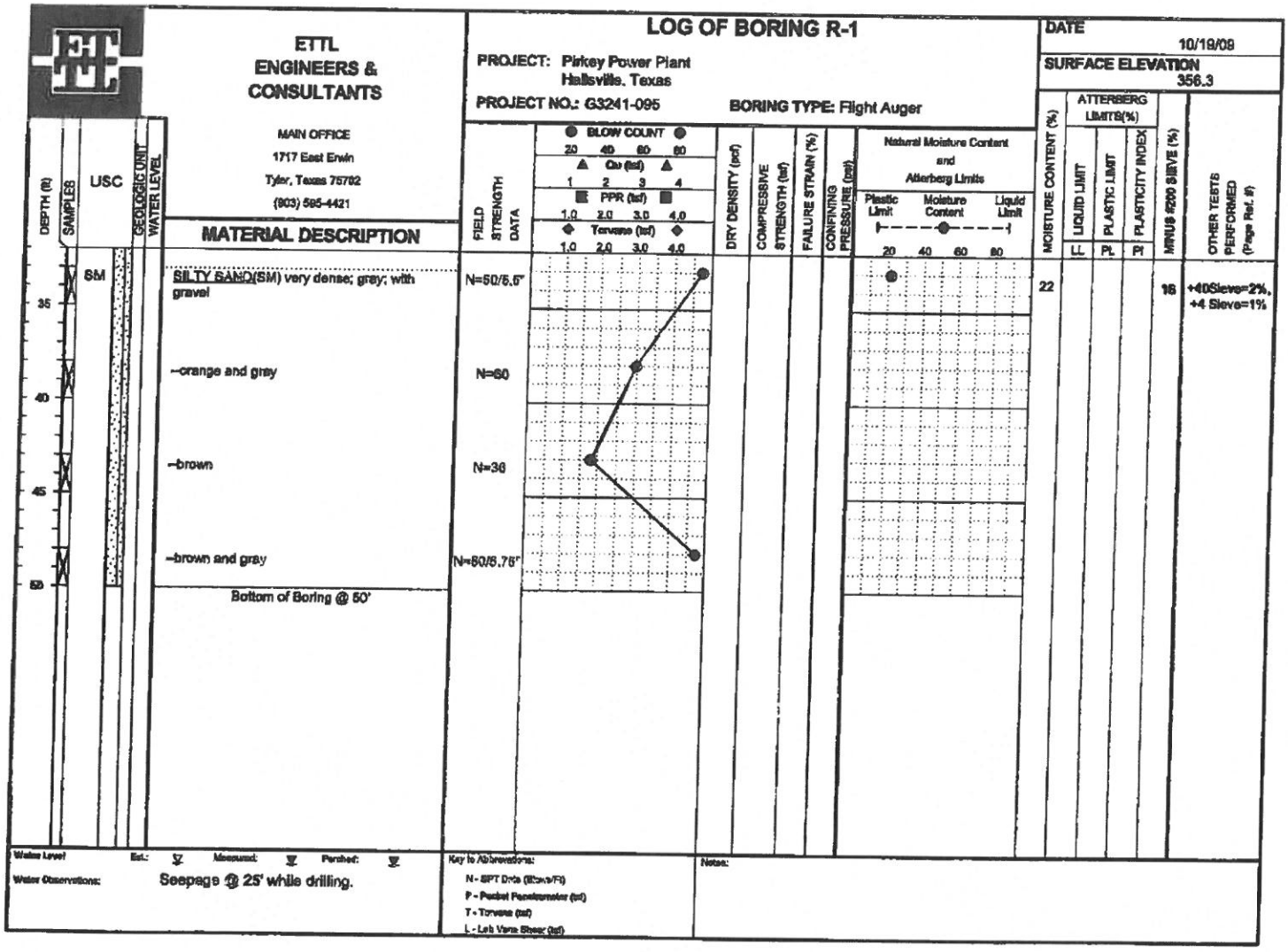
Natural Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit (20 40 60 80)

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

Water Observations: Seepage @ 25' while drilling.

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

Notes:



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LOG OF BORING R-1

PROJECT: Pirkey Power Plant
Hallsville, Texas

PROJECT NO.: G3241-095

BORING TYPE: Flight Auger

DATE: 10/19/09

SURFACE ELEVATION: 356.3

DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (tsf)	Natural Moisture Content and Atterberg Limits	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35		SM			SILTY SAND(SM) very dense; gray; with gravel	N=50/5.5"						22				16	+40Sieve=2%, +4 Sieve=1%
40					–orange and gray	N=60											
45					–brown	N=36											
50					–brown and gray	N=50/5.75"											
					Bottom of Boring @ 50'												

BLOW COUNT: 20 40 60 80
Cu (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 @ 25' while drilling.

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

Notes:

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LOG OF BORING R-2

PROJECT: Pirkey Power Plant
Hallsville, Texas

PROJECT NO.: G3241-095 **BORING TYPE:** Flight Auger

DATE 10/19/09

SURFACE ELEVATION 355.1

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. #)
0	SC	CLAYEY SAND(SC) medium dense; reddish tan; with gravel	P=4.5+	13	38	17	21	44	+40Sieve=6%, +4 Sieve=2%
			P=4.5+						
5		--red and orangish gray; with clay lenses	P=4.5	14	38	17	21	41	+40Sieve=9%, +4 Sieve=3%
		--gravelly and ferric seams	P=2.0	18	36	18	18	44	+40Sieve=12%, +4 Sieve=5%
10			P=3.5						
		--orange and red	P=3.0						
15									
			P=4.0						
20									
		--red and tan	P=4.5+	17	43	18	25	42	+40Sieve=6%, +4 Sieve=0%
25									
		--red and orange	P=4.0						
30									

Field strength data 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

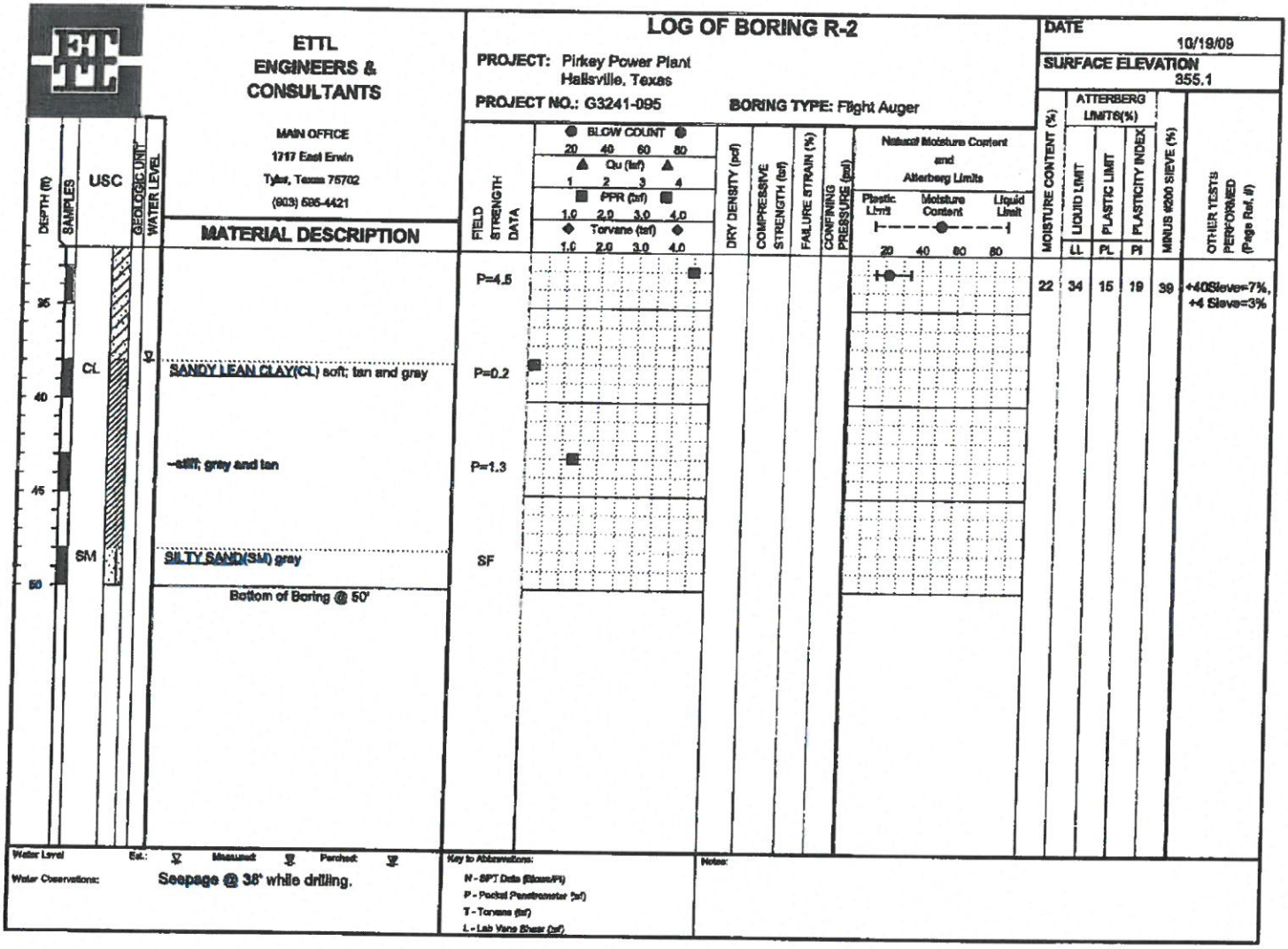
Other columns: DRY DENSITY (pcf); COMPRESSIVE STRENGTH (tsf); FAILURE STRAIN (%); CONFINING PRESSURE (psi); Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 20 40 60 80

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

Water Observations: Seepage @ 38' while drilling.

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

Notes: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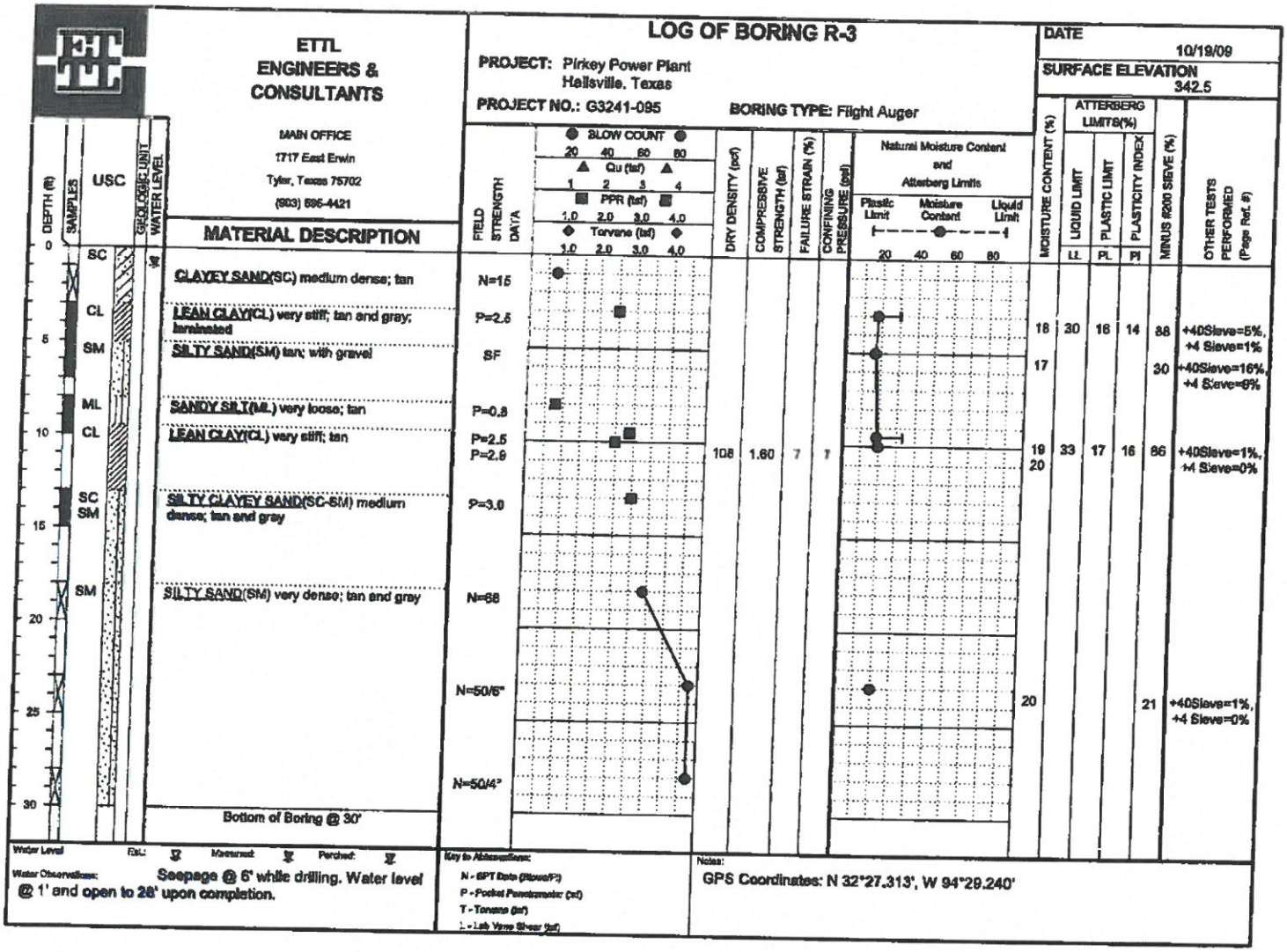
LOG OF BORING R-2
PROJECT: Pirkey Power Plant
Hallsville, Texas
PROJECT NO.: G3241-095
BORING TYPE: Flight Auger
DATE
10/19/09
SURFACE ELEVATION
355.1
DEPTH (ft)
SAMPLES
USC
GEOLOGIC UNIT
WATER LEVEL
MATERIAL DESCRIPTION
FIELD STRENGTH DATA
BLOW COUNT
Qu (tsf)
PPR (tsf)
Torvane (tsf)
DRY DENSITY (pcf)
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. #)
35
40
45
50
CL
SM
SANDY LEAN CLAY(CL) soft; tan and gray
--stiff; gray and tan
SILTY SAND(SM) gray
Bottom of Boring @ 50'
P=4.5
P=0.2
P=1.3
SF
22
34
15
19
39
+40Sieve=7%,
+4 Sieve=3%
Water Level
Est.:
Measured
Perched
Water Observations:
Seepage @ 38' while drilling.
Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)
Notes: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Tyler, Texas 75702
(903) 595-4421
LOG OF BORING R-3
PROJECT: Pirkey Power Plant
Hallsville, Texas
PROJECT NO.: G3241-095
BORING TYPE: Flight Auger
DATE
10/19/09
SURFACE ELEVATION
342.5
MATERIAL DESCRIPTION
CLAYEY SAND(SC) medium dense; tan
LEAN CLAY(CL) very stiff; tan and gray; laminated
SILTY SAND(SM) tan; with gravel
SANDY SILT(ML) very loose; tan
LEAN CLAY(CL) very stiff; tan
SILTY CLAYEY SAND(SC-SM) medium dense; tan and gray
SILTY SAND(SM) very dense; tan and gray
Bottom of Boring @ 30'
SLOW COUNT
Qu (tsf)
PPR (tsf)
Torvane (tsf)
Natural Moisture Content and Atterberg Limits
Plastic Limit
Moisture Content
Liquid Limit
N=15
P=2.5
SF
P=0.8
P=2.5
P=2.0
P=3.0
N=68
N=50/6"
N=50/4"
108
1.60
7
7
18
17
19
20
20
30
33
17
16
86
20
21
+40Sieve=5%, +4 Sieve=1%
+40Sieve=16%, +4 Sieve=6%
+40Sieve=1%, +4 Sieve=0%
+40Sieve=1%, +4 Sieve=0%
Water Level
Water Observations:
Seepage @ 6' while drilling. Water level @ 1' and open to 28' 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 32°27.313', W 94°29.240'

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:

P8190454
Upland drainage area along southeastern side of Landfill.

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:

South

Description:

P8190467
Lining for new landfill expansion cell

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:

East Northeast

Description:

P8190470
Lining for new landfill expansion cell

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:

East Northeast

Description:

P8190475
Upland ditch on east side of landfill.