

**American Electric Power Service
Corporation**

**Landfill - CCR Groundwater
Monitoring Well Network
Evaluation (Updated October 2018)**

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

October 25, 2018

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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

1. Objective

This update report was prepared by ARCADIS U.S., Inc. (ARCADIS) for American Electric Power Service Corporation (AEP) to provide an updated assessment 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 Landfill CCR Unit at the Plant is currently 130 acres in size. As shown on **Figure 2**, the Landfill will be expanded laterally to the south beginning in 2018 (2018 Lateral Expansion). The 2018 Lateral Expansion will be approximately 15 acres in size, and during Lateral Expansion construction activities one of the existing downgradient monitoring wells (monitoring well AD-35) will be plugged and replaced with new monitoring well AD-36.

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 provides an updated evaluation of the groundwater monitoring well network in the uppermost aquifer at the Landfill, including the 2018 Lateral Expansion. The updated evaluation of the location restriction criteria for the Landfill 2018 Lateral Expansion 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, including the 2018 Lateral Expansion area, as well as publicly-available geologic and hydrogeologic data. The following report also presents the current Conceptual Site Model based on all documents reviewed and will further describe the uppermost aquifer, include an evaluation of the adequacy of the existing monitoring well network, and provide recommendations for monitoring well augmentation, as necessary.

2. Background Information

The following section provides background information for the AEP 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 existing Landfill CCR unit is currently approximately 130 acres in size and is located in the southern portion of the Plant. The 2018 Landfill Lateral Expansion will cover approximately 15 acres directly south of the existing Landfill (**Figures 2 and 3**). Following completion of the 2018 Lateral Expansion, the Landfill will be approximately 145 acres in size.

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.

The 2018 Landfill Lateral Expansion will cover approximately 15 acres directly south of the existing Landfill. In 2016, Auckland Consulting conducted a stability assessment of the 2018 Lateral Expansion area and concluded the embankments would be stable on slopes no steeper than 3:1 (Auckland, November 2016). The 2016 Auckland Consulting

report stated the northern and eastern extents of the 2018 Lateral Expansion will be constructed contiguous to the existing Landfill disposal area, and ash disposal will be completed in multiple lifts, each with an approximate height of 20 feet, integrated with safety benches, and maximum side slopes of 3:1 to a maximum waste height of 120 feet.

2.2.2 Area/Volume

The existing 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). The design capacity of the CCR materials to be placed within the 2018 Lateral Expansion is approximately 2,200,000 cubic yards.

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**.

The 2018 Landfill Lateral Expansion design includes emplacement of up to 120 feet of CCR materials with maximum side slopes of 3:1 above the Landfill liner system which will consist of a 60-mil HDPE top liner underlain by a 2-foot-thick compacted clay bottom liner. Prior to installation of the liner system, approximately 10 to 15 feet of cut into the existing soils will occur along the topographically higher southern portion of the Lateral Expansion, and emplacement of these soils (clayey sands, silty clayey sand and/or lean clays) as fill materials below the liner system in the topographically lower central and northern portions of the Lateral Expansion. As detailed below in Section 3.3.2, during Lateral Expansion construction activities, existing downgradient monitoring well AD-35, located within the Lateral Expansion construction zone, will be plugged and replaced with a new monitoring well (AD-36) located directly downgradient of the Lateral Expansion area.

2.2.4 Surface Water Control

Surface water in the area of the existing Landfill flows in a general southerly direction to the Landfill Stormwater Runoff Pond located directly southwest of the existing Landfill. Surface water in the area of the 2018 Landfill Lateral Expansion flows in a general westerly direction to the Landfill Stormwater Runoff Pond. The Landfill Stormwater Runoff Pond, which is approximately 16 acres in size, also receives (1) Landfill leachate that is gravity drained from the existing Landfill via underground lateral perforated pipes and permeable bottom ash materials that were installed above portions of the existing Landfill liner, (2) Landfill leachate that will gravity drain via underground lateral perforated pipes that will be installed above the 2018 Landfill Lateral Expansion liner system, and (3) shallow groundwater that will gravity drain via underground lateral perforated HDPE underdrain pipes that will be installed in permeable bottom ash materials approximately seven feet below the 60-mil HDPE liner of the 2018 Landfill Lateral Expansion.

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).

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, E TTL 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).

In 2016, Auckland Consulting conducted a geotechnical evaluation of the 2018 Landfill Lateral Expansion area, including installation of eight soil borings (B1 through B8) with total depths ranging from 40 to 62 feet below ground surface (bgl). Soil boring locations are shown on **Figure 11**, and copies of the soil boring logs are provided in **Appendix C**. Based on the results of the 2016 geotechnical evaluation, including slope stability modeling and settlement analysis, Auckland Consulting concluded the 2018 Landfill Lateral Expansion will be structurally stable with maximum side slopes of 3:1 to a maximum disposal height of 120 feet (Auckland, November 2016).

In 2018, Auckland Consulting installed seven piezometers (PZ-1 through PZ-7) within the 2018 Landfill Lateral Expansion area to obtain detailed depth to groundwater and groundwater flow direction data prior to construction of the Lateral Expansion. The piezometers were completed in the uppermost water-bearing unit with total depths ranging from 14 to 20 feet bgl. Piezometer locations are shown on **Figure 11**, and piezometer completion data is provided in **Appendix C**

2.4 Hydrogeologic Setting

2.4.1 General

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 existing 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').

2.4.2 2018 Landfill Lateral Expansion Area

Based on the hydrogeologic data obtained from soil borings, monitoring wells, and piezometers installed in the 2018 Landfill Lateral Expansion area, three lines of cross section were prepared through the 2018 Landfill Lateral Expansion area. The cross section location map is included as **Figure 11** and the lines of cross section are included as **Figure 12** (F-F'), **Figure 13** (G-G'), and **Figure 14** (H-H').

As shown on **Figures 12** through **14**, a reddish-brown to gray clayey and silty sand stratum is located below the Lateral Expansion area between an elevation of

approximately 280 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).

As shown on **Figures 12** through **14**, a clay stratum with an average thickness of approximately 10 feet is located below the sand stratum, and a lignite seam is present below the clay stratum at an elevation of approximately 270 feet amsl. As discussed above in Section 2.4.1, this lignite seam likely corresponds to the top of the Wilcox Formation based on geologic maps of the Site area (Broom, 1966; Flawn, 1965).

2.4.3 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).

2.4.4 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 existing Landfill, 2018 Landfill Lateral Expansion, 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 E TTL report entitled “*Geotechnical Investigation, Pirkey Power Station, Existing Ash, Surge, Lignite and Limestone Runoff, and Landfill Stormwater Ponds Embankment Investigation, Hallsville, Texas*” (E TTL, 2010).

2.4.5 Surface Water and Surface Water Groundwater Interactions

Figures 9 and **10** are potentiometric surface maps based on January 2016 and August 2017 water level data, respectively, 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 **Figures 9** and **10**, shallow groundwater flow direction in the Landfill area is 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 **Figures 9 and 10**, 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 water bearing unit 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.

Figure 15 is a current potentiometric surface map for the uppermost water-bearing unit in the 2018 Landfill Lateral Expansion area, and water level elevations for the 2018 Landfill Lateral Expansion area piezometers are summarized on **Table 2**. As shown on **Figure 15**, shallow groundwater flow direction in the 2018 Landfill Lateral Expansion area is westerly toward the Landfill Stormwater Runoff Pond at a hydraulic gradient of approximately 0.02 foot per foot. Water level elevations in the 2018 Landfill Lateral Expansion area piezometers are higher than the surface water elevation of the Landfill Stormwater Runoff Pond (approximately 298 feet amsl), which indicates shallow groundwater in the 2018 Landfill Lateral Expansion area discharges into the Landfill Stormwater Runoff Pond.

2.4.6 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 existing Landfill Area is a very fine to fine grained clayey and silty sand stratum located below and adjacent to the existing 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 existing Landfill is shown on cross section C-C' (**Figure 6**) and cross section D-D' (**Figure 7**).

The location of the uppermost water bearing unit relative to the 2018 Landfill Lateral Expansion is shown on cross section F-F' (**Figure 12**), cross section G-G' (**Figure 13**), and H-H' (**Figure 14**). As shown on these geologic cross sections, the uppermost aquifer in the Landfill Lateral Expansion area is a clayey and silty sand stratum located between an elevation of approximately 280 feet and 330 feet amsl. 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 280 feet and 330 feet amsl in the Lateral Expansion area 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).

Groundwater elevations from the plant monitoring wells are summarized on **Table 1**. The plant-wide comprehensive groundwater elevation data set from August 24, 2017 is depicted on **Figure 10**. 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.

Current groundwater elevations in the Landfill 2018 Lateral Expansion area are summarized on **Table 2**, and a June 22, 2018 piezometric surface map is depicted on **Figure 15**. As shown on **Figure 15**, shallow groundwater flow direction in the 2018 Landfill Lateral Expansion area is westerly toward the Landfill Stormwater Runoff Pond at a hydraulic gradient of approximately 0.02 foot per foot. Water level elevations in the 2018 Landfill Lateral Expansion area piezometers are higher than the surface water elevation of the Landfill Stormwater Runoff Pond (approximately 298 feet amsl), which indicates shallow groundwater in the 2018 Landfill Lateral Expansion area discharges into the Landfill Stormwater Runoff Pond.

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 3. 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, AD-27, AD-34, and AD-35 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 existing Landfill is up to 60 feet thick and is located between an elevation of approximately 270 and 330 feet amsl. The uppermost aquifer below the Landfill Lateral Expansion area is located between an elevation of approximately 280 and 330 feet amsl.

3.3.2 Gaps in Monitoring Network

As shown on **Figure 10**, shallow groundwater flow direction in the existing 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 10**, three existing monitoring wells (AD-23, AD-34, and AD-35) are located downgradient (south) of the Landfill and are currently utilized to monitor groundwater quality downgradient of the Landfill CCR unit. However, monitoring well MW-35 is located within the footprint of the proposed 2018 Landfill Lateral Expansion and will be plugged by a Texas Department of Licensing and Regulation (TDLR) licensed water well driller. This data gap will be addressed by installation of new downgradient monitoring well AD-36. As shown on **Figure 16**, monitoring well AD-36 will be located on the west (downgradient) side of the 2018 Landfill Lateral Expansion. With the addition of monitoring well AD-36 as a replacement for monitoring well AD-35, there will be no gaps in the groundwater monitoring network for the Landfill.

4. Recommended Monitoring Network and PE Certification

The recommended 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 currently utilized as the groundwater quality monitoring well network for the Landfill. During the 2018 Landfill Lateral Expansion construction activities, monitoring well AD-35 will be plugged and replaced with a new monitoring well (AD-36) to be installed directly west (downgradient) of the Lateral Expansion. 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 4** and illustrated on **Figure 16**.

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 in the existing Landfill area, and between an elevation of approximately 280 and 330 feet amsl in the Landfill Lateral Expansion area, as shown on Geologic Cross Sections C-C' (**Figure 6**), D-D' (**Figure 7**), F-F' (**Figure 12**), G-G' (**Figure 13**), and H-H' (**Figure 14**). The screen elevations are presented in **Table 4**.

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 following plugging of monitoring well AD-35 will be addressed by installation of new monitoring well AD-36. Monitoring wells AD-35 will be plugged and monitoring well AD-36 will be installed by a TDLR-licensed water well driller. Well construction data for the monitoring well network are summarized on **Tables 3** and **4**, and the monitoring well completion diagrams for the existing monitoring wells are provided in **Appendix A**.

4.2 Professional Engineer's Certification

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the proposed groundwater monitoring system for the Landfill CCR unit will be adequate to meet the requirements of 40 CFR Part 257.91.

Kenneth J. Brandner

Printed Name of Registered Professional Engineer

Kenneth J Brandner

Signature

69586

Registration No.

Texas

Registration State

10-25-18

Date



5. References

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Tables

**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	1/12/2017	3/1/2017	4/11/2017	8/24/2017	
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
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	327.65	327.96	329.09	327.63	
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	344.19	345.53	345.53	343.49	
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	353.27	355.38	356.62	353.58	
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	347.04	347.96	347.87	347.40	
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	345.74	346.00	345.81	346.31	
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	365.11	368.79	372.97	367.68	
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	352.01	352.81	352.68	352.62	
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	343.09	344.54	344.69	342.71	
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	324.70	326.27	326.27	324.18	
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	357.06	359.21	358.63	358.23	
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	347.20	348.52	348.45	347.37	
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	320.99	321.00	320.85	320.77	
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	330.04	331.59	331.24	330.05	
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	320.27	320.51	320.69	320.07	
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	322.23	322.85	322.88	322.04	
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	343.78	344.53	344.58	343.57	
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	347.44	348.44	349.09	349.73	
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	348.56	349.32	349.25	349.31	
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	307.61	307.61	307.61	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	310.42	310.82	311.27	310.28	
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	---	---	---	---	---	---	---	---	---	---	---	---	---	

(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) Source: 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.
 --- Not Measured

Table 2
Piezometer Water Level Data - 2018 Landfill Lateral Expansion Area
AEP Pirkey Power Plant
Hallsville, Harrison County, Texas

Piezometer Completion Information

Piezometer ID:	<u>PZ1</u>	<u>PZ2</u>	<u>PZ3</u>	<u>PZ4</u>	<u>PZ5</u>	<u>PZ6</u>	<u>PZ7</u>	<u>AD-23</u>	<u>AD-35</u>
Northing	6871372.73	6871442.96	6871218.9	6871018.52	6870962.73	6870939.86	6871250.41		
Easting	3203056.63	3203345.4	3203322.02	3203009.98	3203281.7	3203544.92	3202996.36		
Screen length	10	10	10	10	10	10	10	20	15
TD (from GS)	14	14	14	14	20	20	14	37.44	18
Sand pack, top (from GS)	3	3	3	3	8	8	3		
Elev, GS								346.72	334.15
Elev, TOC	308.85	312.74	307.35	311.53	328.3	328.78	303.73	350.1	318.95

Piezometer Depth to Water Measurements (feet) below TOC

<u>Date</u>	<u>PZ1</u>	<u>PZ2</u>	<u>PZ3</u>	<u>PZ4</u>	<u>PZ5</u>	<u>PZ6</u>	<u>PZ7</u>	<u>AD-23</u>	<u>AD-35</u>
6/20/2018	9.98	9.99	4.29	8.66	20.47	13.23	2.84		
6/21/2018	9.99	9.95	4.07	8.37	20.47	13.24	2.75	29.4	7.95
6/22/2018	9.99	9.91	3.98	8.31	20.47	13.25	2.76	29.42	7.92
6/29/2018	10.01	10.1	4.34	8.85	20.63	13.4	2.98	29.39	8.14
7/6/2018	10.02	10.23	4.45	8.92	20.75	13.52	3.21	29.43	8.23

Piezometer Potentiometric Surface (Water Table) Elevations (feet AMSL)

<u>Date</u>	<u>PZ1</u>	<u>PZ2</u>	<u>PZ3</u>	<u>PZ4</u>	<u>PZ5</u>	<u>PZ6</u>	<u>PZ7</u>	<u>AD-23</u>	<u>AD-35</u>
6/20/2018	298.87	302.75	303.06	302.87	307.83	315.55	300.89		
6/21/2018	298.86	302.79	303.28	303.16	307.83	315.54	300.98	320.70	311.00
6/22/2018	298.86	302.83	303.37	303.22	307.83	315.53	300.97	320.68	311.03
6/29/2018	298.84	302.64	303.01	302.68	307.67	315.38	300.75	320.71	310.81
7/6/2018	298.83	302.51	302.9	302.61	307.55	315.26	300.52	320.67	310.72

Legend

GS	Ground surface	TOC	Top of piezometer casing
TD	Total depth	AMSL	Above mean sea level

**Table 3
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) Source: EETL (October 2010).
(d) Source: Auckland Consulting LLC (January 26, 2016).

Acronyms and Abbreviations:
NA = Data not available
ft = feet
bls = below land surface
msl = mean sea level

**Table 4
Proposed Well Network
AEP Pirkey Power Plant - Landfill
Hallsville, Harrison County, Texas**

Well ID	Existing/ 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	Existing	Uppermost Water-Bearing Unit	Northeast of Landfill	Upgradient	336.9	321.9	15	Existing well installed in 1983; well will be utilized to establish background water quality
AD-12	Existing	Uppermost Water-Bearing Unit	Northeast of Stack Out Area	Upgradient	347.8	327.8	20	Existing well installed in 1986; well will be utilized to establish background water quality
AD-16	Existing	Uppermost Water-Bearing Unit	North of Landfill	Upgradient	341.8	321.8	20	Existing well installed in 2010; well will be utilized to establish background 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 utilized to establish background 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	Existing monitoring well installed during December 2015 in uppermost shallow aquifer adjacent to Landfill - downgradient.
AD-35	Existing (to be plugged and replaced with AD-36 in 2018)	Uppermost Water-Bearing Unit	South of Landfill	Down gradient	313.0	298.0	15	Existing monitoring well installed during December 2015 in uppermost shallow aquifer adjacent to Landfill - downgradient. Will be plugged during Landfill 2018 Lateral Expansion construction and replaced with AD-36.
AD-36	Proposed	Uppermost Water-Bearing Unit	South of Existing Landfill, West of 2018 Lateral Expansion	Down gradient	304 ^(b)	294.0	10	Proposed monitoring well tentatively scheduled to be installed during 4th quarter 2018 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

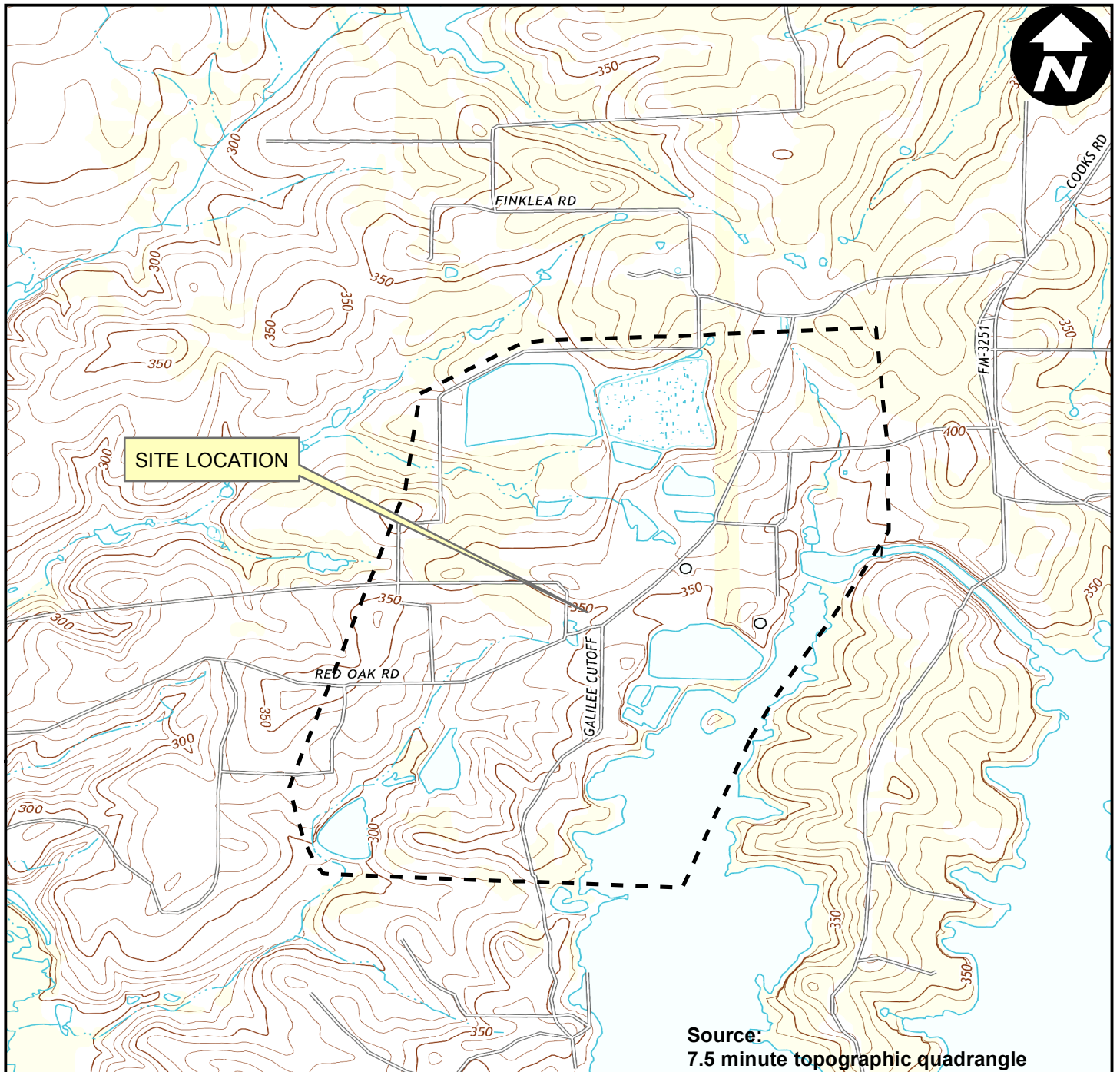
Footnotes:

- a. Target elevations are an estimated range.
- b. Ground surface elevation at proposed monitoring well location is approximately 308 feet amsl.

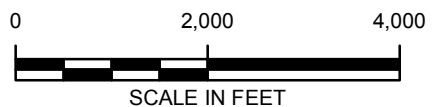
Acronyms and Abbreviations:

- U=Upgradient
- D=Downgradient
- ft = feet
- amsl = above mean sea level

Figures



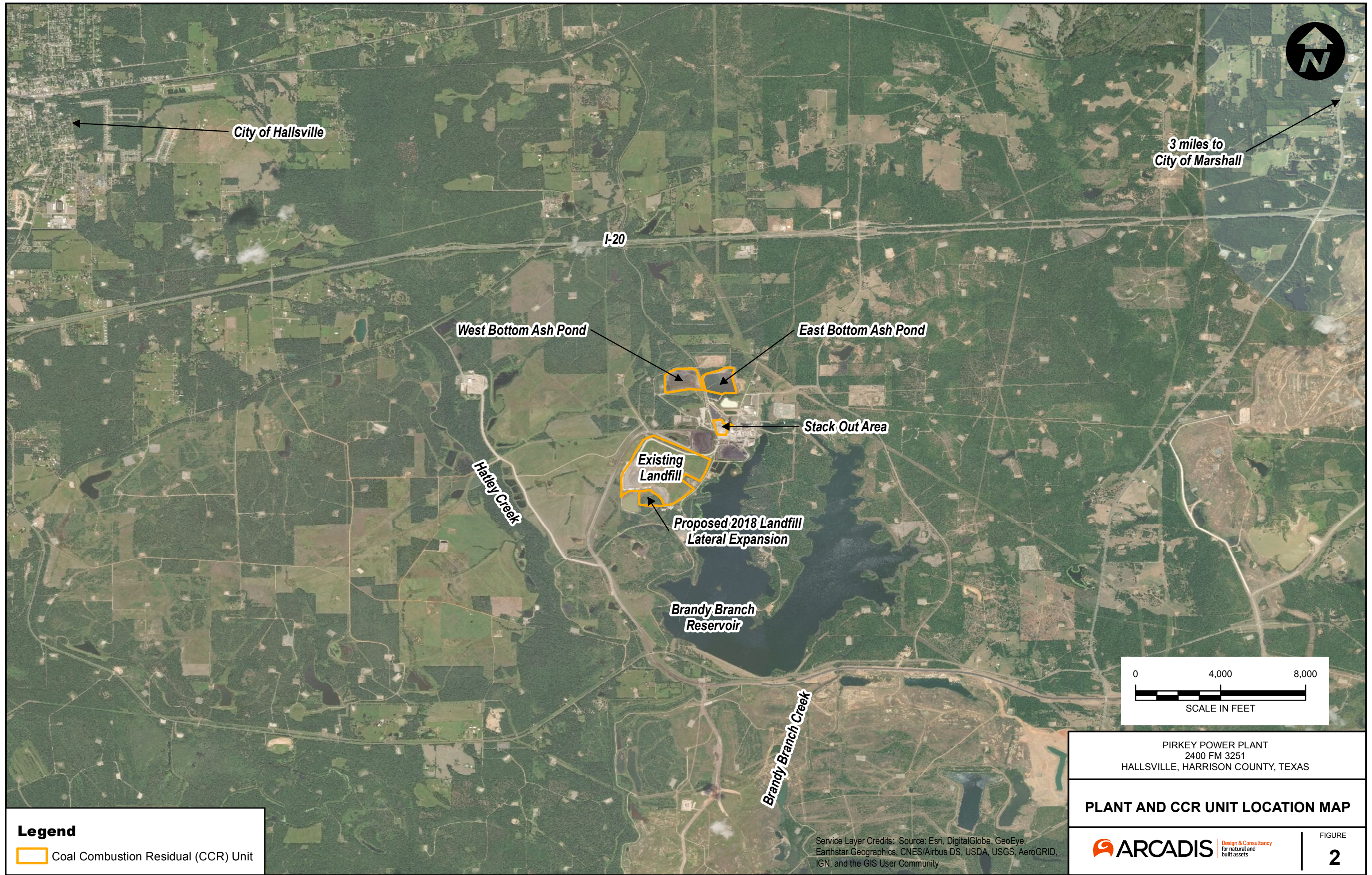
Source:
7.5 minute topographic quadrangle
Darco, Texas, 2013
Easton, Texas, 2013




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

SITE LOCATION MAP





Legend

 Coal Combustion Residual (CCR) Unit

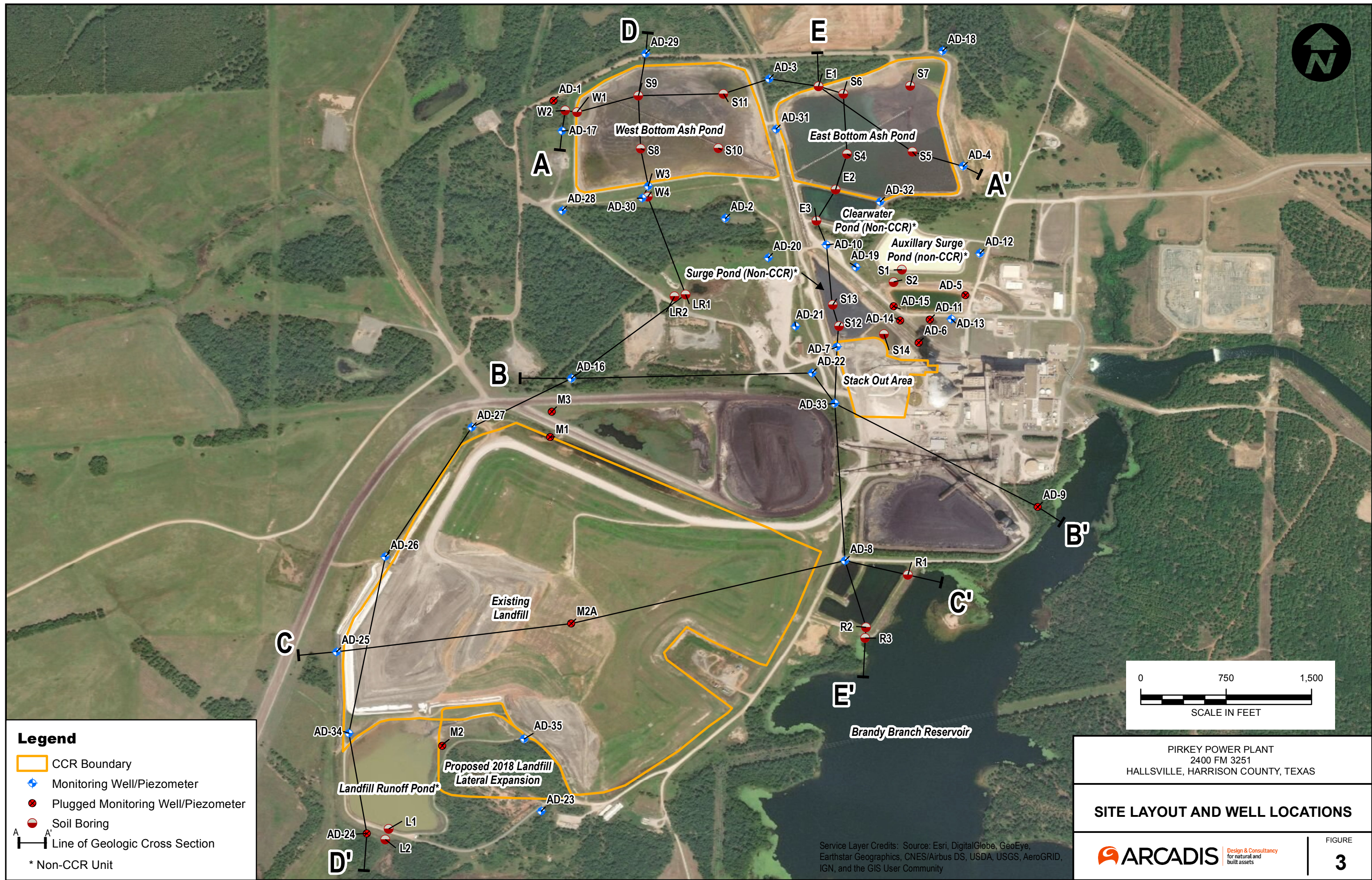
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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

PLANT AND CCR UNIT LOCATION MAP

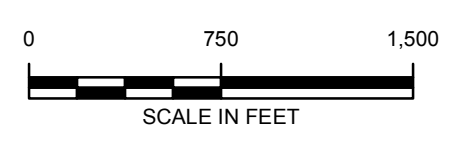
 **ARCADIS** Design & Consultancy
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FIGURE
2



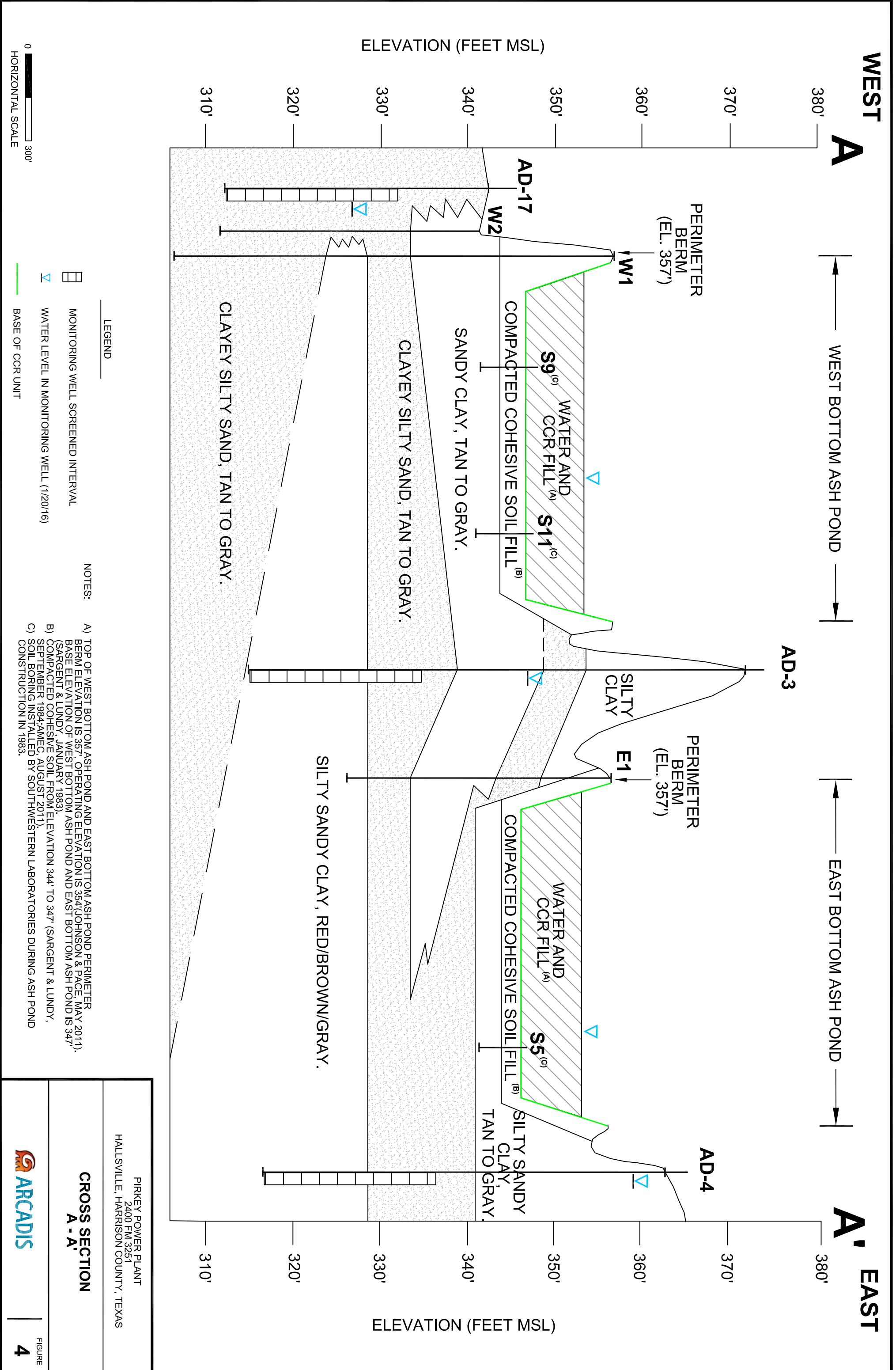
Legend

- CCR Boundary
- + Monitoring Well/Piezometer
- Plugged Monitoring Well/Piezometer
- Soil Boring
- | Line of Geologic Cross Section
- * Non-CCR Unit

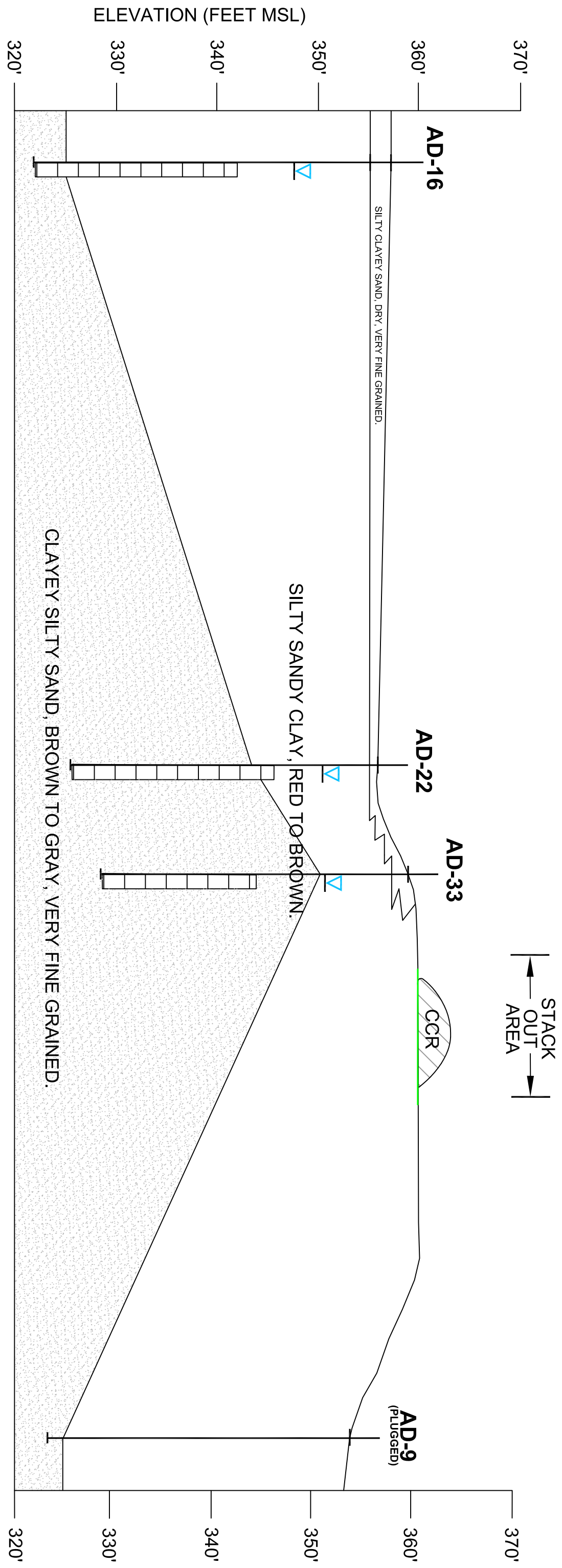


PIRKEY POWER PLANT 2400 FM 3251 HALLSVILLE, HARRISON COUNTY, TEXAS	
SITE LAYOUT AND WELL LOCATIONS	
ARCADIS <small>Design & Consultancy for natural and built assets</small>	FIGURE 3




Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



WEST
B **EAST**
B'



LEGEND

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

NOTES:

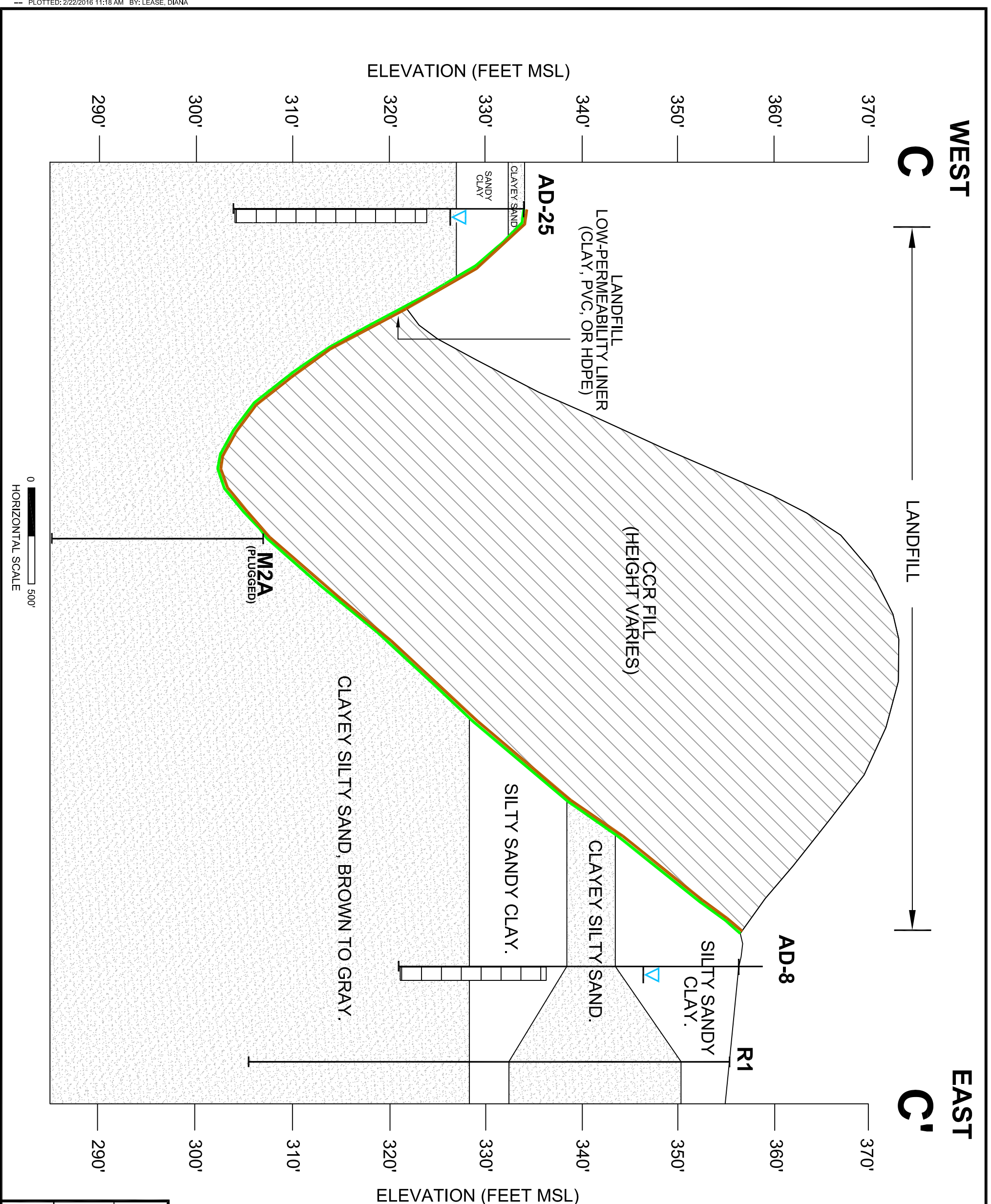
- A) BASE OF STACK OUT AREA CCR UNIT LOCATED AT GRADE, ELEVATION TAKEN FROM MAY 2012 AND JUNE 23, 2015 TOPOGRAPHIC SURVEYS BY BEACON AVIATION.
- B) ELEVATION OF CCR MATERIAL ABOVE STACK OUT AREA VARIES.



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

CROSS SECTION
B - B'





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

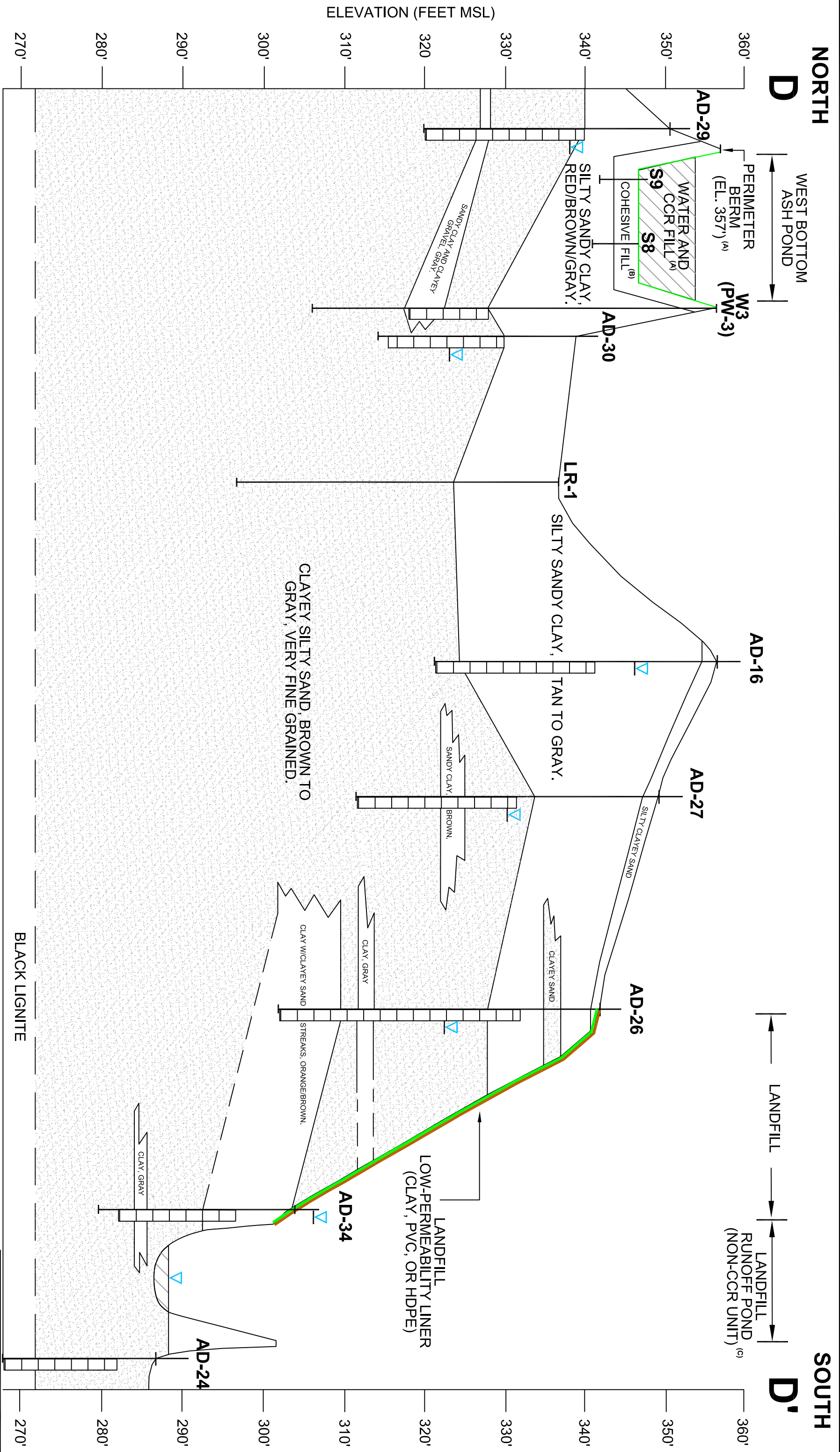
CROSS SECTION
 C - C'

LEGEND

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

ARCADIS

FIGURE **6**



NORTH

SOUTH

D

D'

WEST BOTTOM ASH POND

PERIMETER BERM (EL. 357)^(A)

W3 (PW-3)

WATER AND CCR FILL^(A)

S9

S8

COHESIVE FILL^(B)

SILTY SANDY CLAY, RED/BROWN/GRAY.

AD-29

AD-30

LR-1

SILTY SANDY CLAY, TAN TO GRAY.

AD-16

AD-27

AD-26

CLAYEY SILTY SAND, BROWN TO GRAY, VERY FINE GRAINED.

LANDFILL PERMEABILITY LINER (CLAY, PVC, OR HDPE)

AD-34

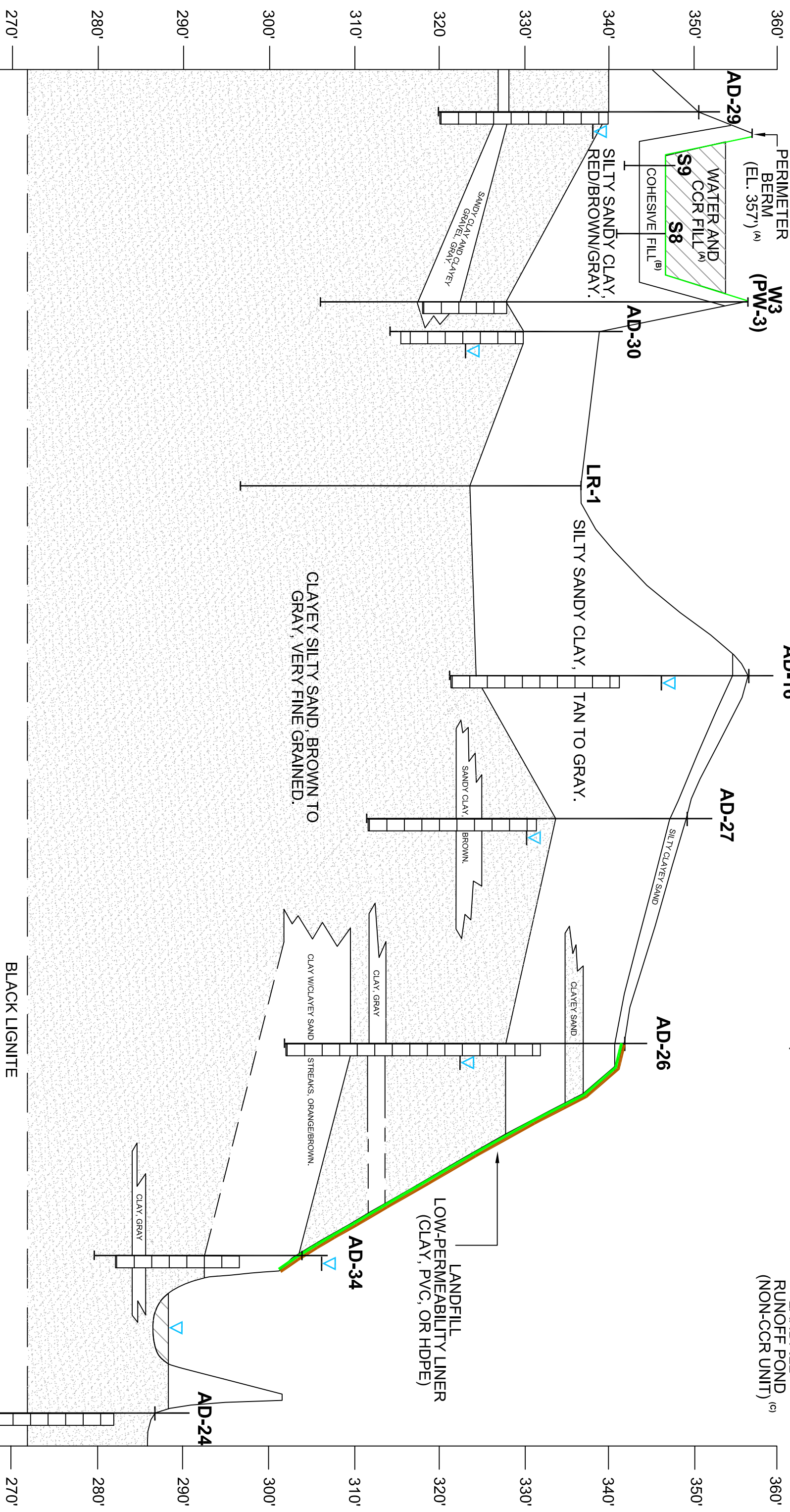
AD-24

BLACK LIGNITE

LANDFILL RUNOFF POND (NON-CCR UNIT)^(C)

LANDFILL

ELEVATION (FEET MSL)



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

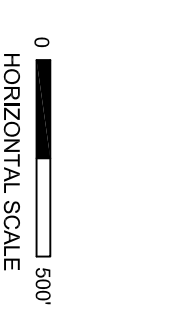
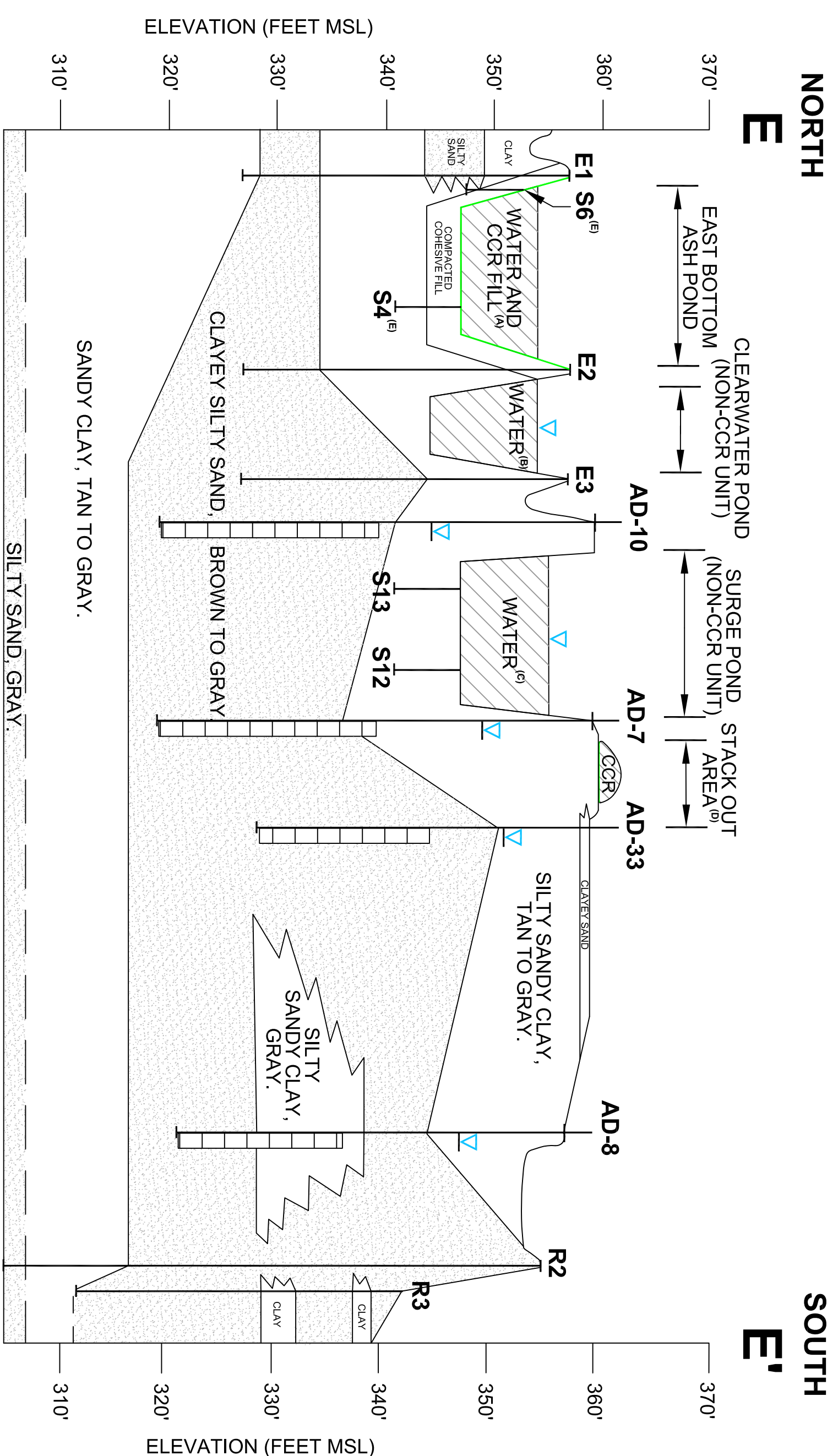
- NOTES:**
- A) TOP OF WEST BOTTOM ASH POND PERIMETER BERM ELEVATION IS 357', OPERATING LEVEL IS 354' (JOHNSON & PACE, MAY 2011); BASE ELEVATION OF WEST BOTTOM ASH POND IS 347' (SARGENT & LUNDY, JANUARY 1983).
 - B) COMPACTED COHESIVE SOIL FROM ELEVATION 344' TO 347' (SARGENT & LUNDY SEPTEMBER 1984; 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 5251
 HALLSVILLE, HARRISON COUNTY, TEXAS

CROSS SECTION D-D'

FIGURE 7

ARCADIS



LEGEND

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

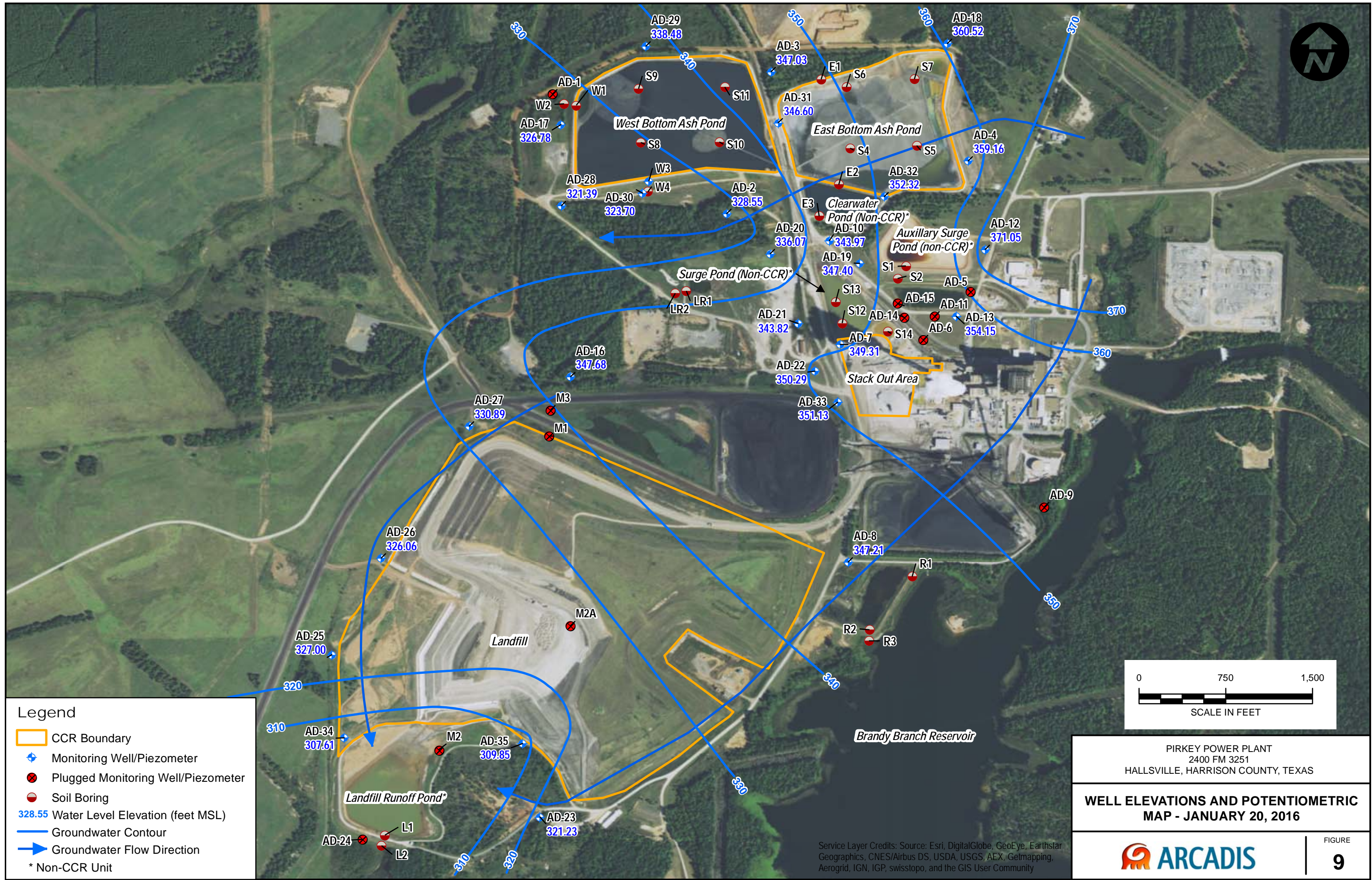
NOTES:

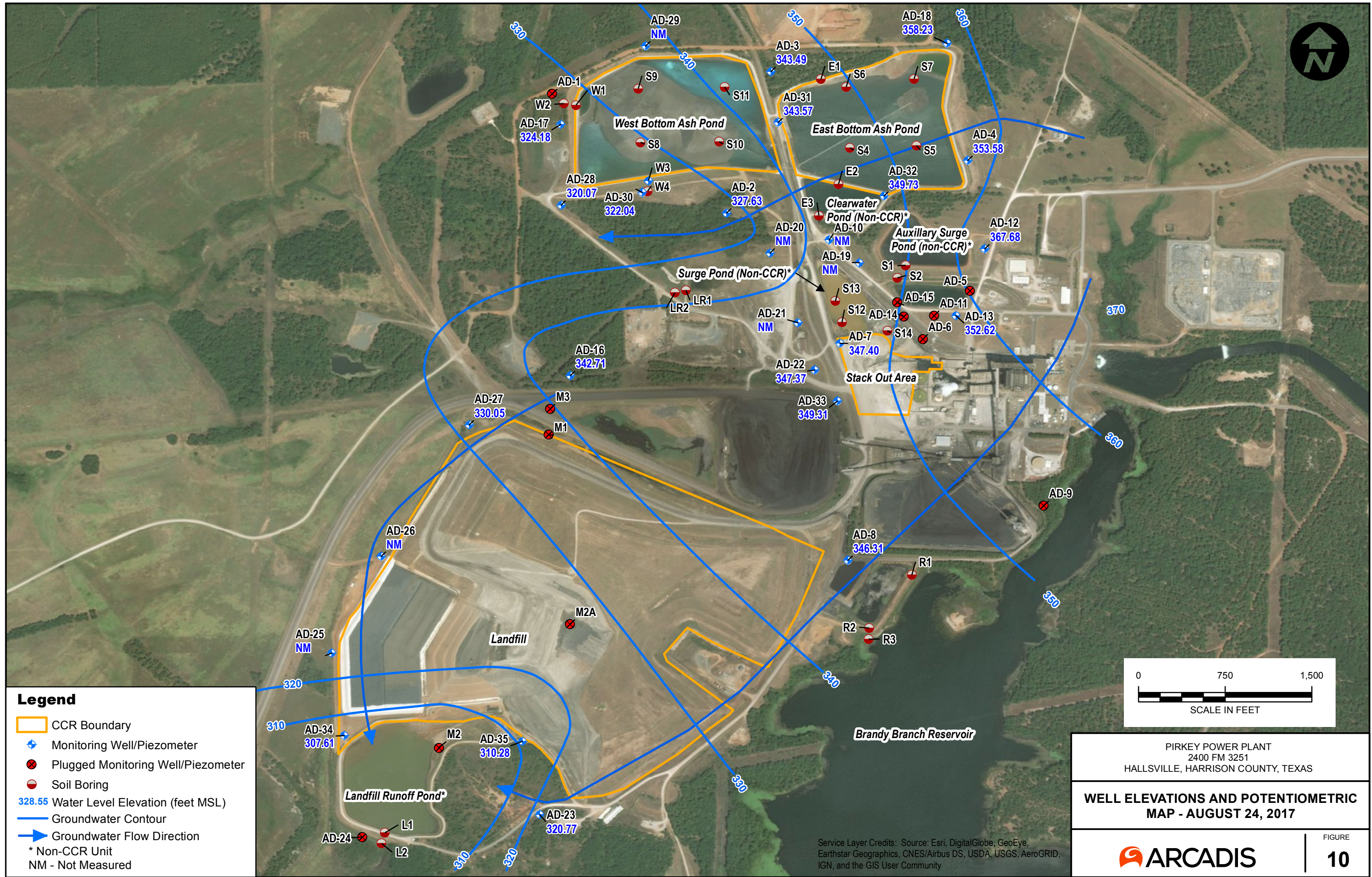
- A) TOP OF EAST BOTTOM ASH POND PERIMETER BERM ELEVATION IS 357', OPERATING LEVEL IS 354' (JOHNSON & PACE, MAY 2011); BASE ELEVATION OF EAST BOTTOM ASH POND IS 347' (SARGENT & LUNDY, JANUARY 1983).
- B) TOP OF CLEARWATER POND PERIMETER BERM ELEVATION IS 357', OPERATING LEVEL IS 354' (JOHNSON & PACE,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

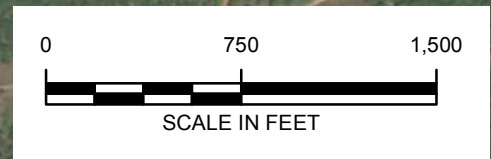






Legend

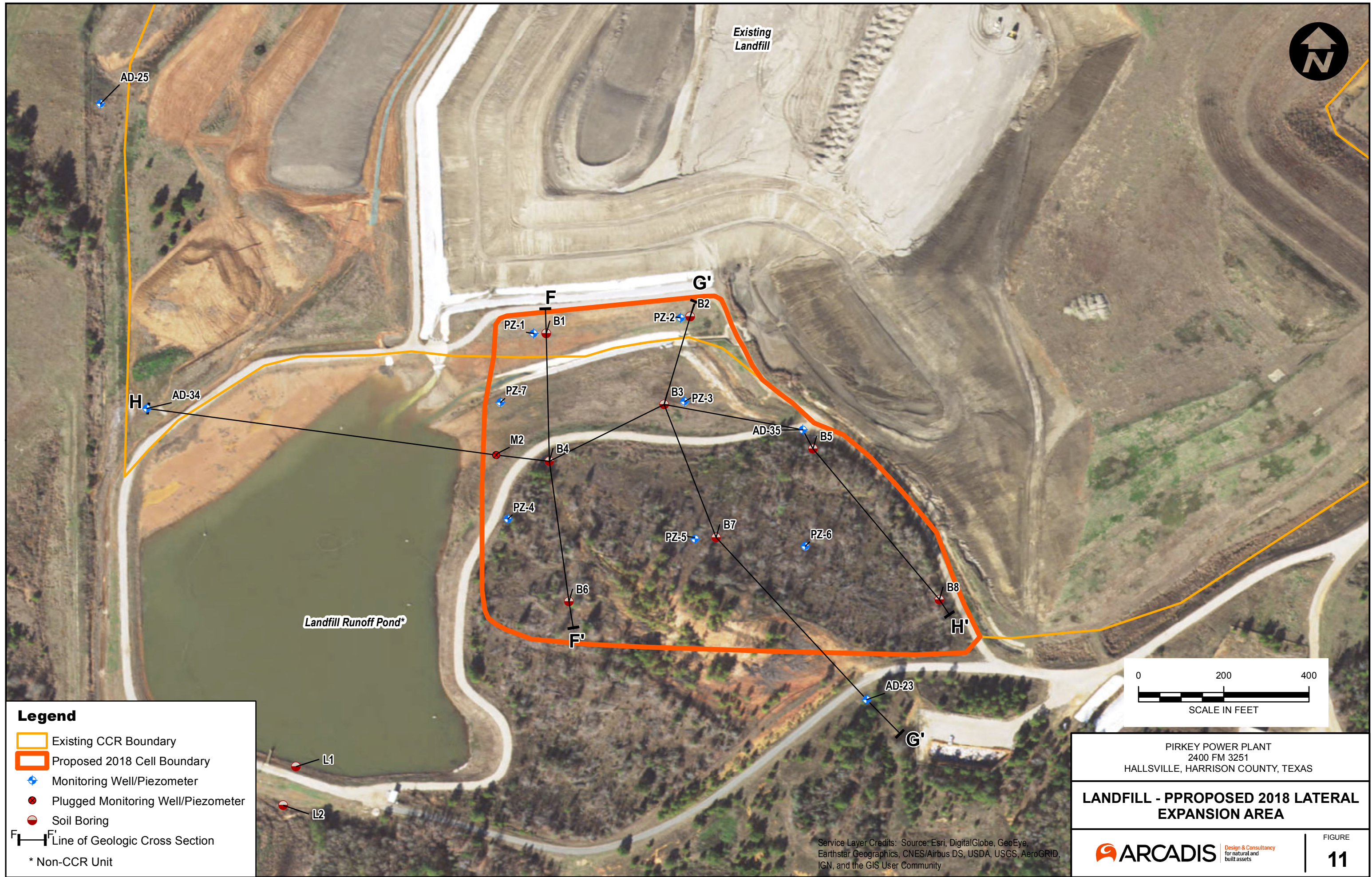
- CCR Boundary
- ◆ Monitoring Well/Piezometer
- ⊗ Plugged Monitoring Well/Piezometer
- Soil Boring
- 328.55 Water Level Elevation (feet MSL)
- Groundwater Contour
- ➔ Groundwater Flow Direction
- * Non-CCR Unit
- NM - Not Measured



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

**WELL ELEVATIONS AND POTENTIOMETRIC
MAP - AUGUST 24, 2017**

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

- Existing CCR Boundary
- Proposed 2018 Cell Boundary
- ◆ Monitoring Well/Piezometer
- Plugged Monitoring Well/Piezometer
- Soil Boring
- Line of Geologic Cross Section

* Non-CCR Unit

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

LANDFILL - PPROPOSED 2018 LATERAL EXPANSION AREA

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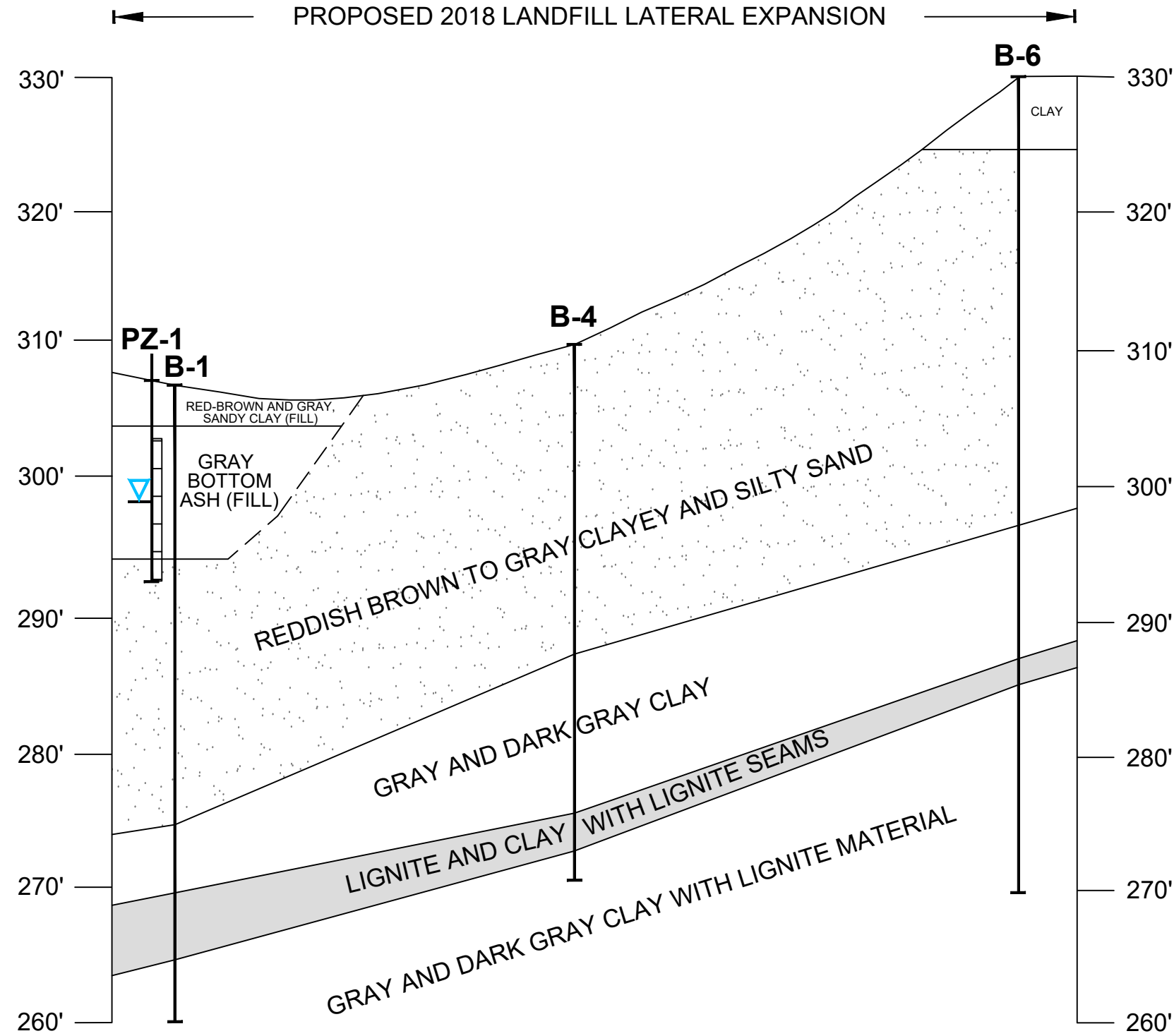
FIGURE
11

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

CITY: DIV/GROUP: DB: LD: AM: PD: TM: TR: LYRON-OFF=REF*
 G:\Active Projects\AEP\TX015976.0003 - Pirkey Landfill Expansion\Landfill Expansion Location Restriction Report\Figures\Maps\Figure 12 Cross-Section F-F.dwg LAYOUT: MODEL: SAVED: 9/19/2018 3:27 PM ACADVER: 20.1S (LMS TECH) PAGESETUP: --- PLOTTED: 9/19/2018 4:40 PM
 BY: LEASE, DIANA

NORTH
F

SOUTH
F'



ELEVATION (FEET MSL)

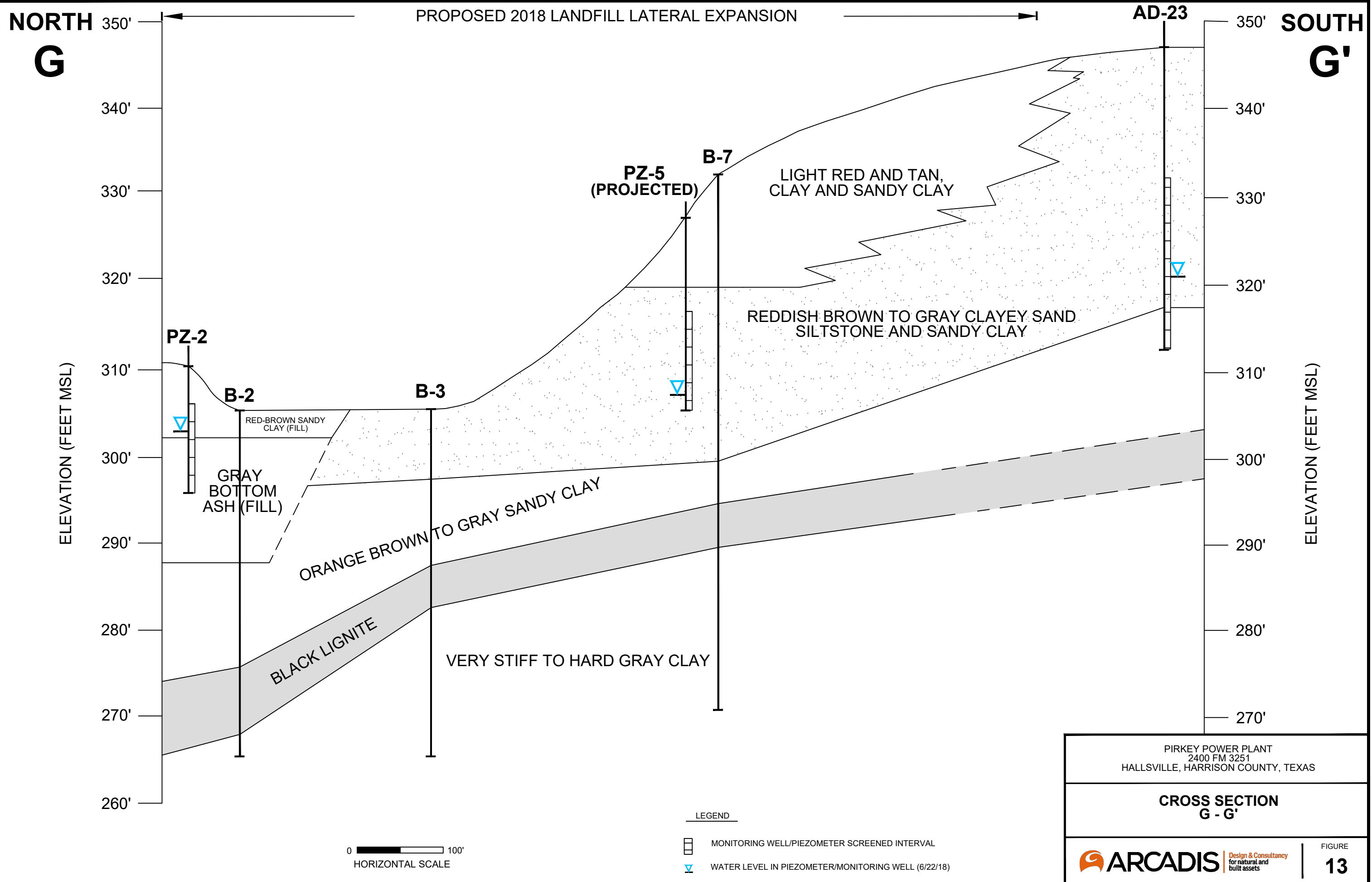
ELEVATION (FEET MSL)



- LEGEND
- MONITORING WELL /PIEZOMETER SCREENED INTERVAL
 - WATER LEVEL IN PIEZOMETER/MONITORING WELL (6/22/18)

PIRKEY POWER PLANT 2400 FM 3251 HALLSVILLE, HARRISON COUNTY, TEXAS	
CROSS SECTION F - F'	
	Design & Consultancy for natural and built assets
FIGURE 12	

CITY: DIV/GROUP: DB: LD: AM: PD: TM: LYNON="OFF=REF"
 G:\Active Projects\AEP\TX\15976.0003 - Pirkey Landfill Expansion\Landfill Expansion Location Restriction Report\Figures-Maps\Figure 13 Cross Sec G-G'.dwg ACADVER: 20.1S (LMS TECH) PAGES: 10 PLOT: 9/20/2018 2:28 PM BY: LEASE, DIANA



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

CROSS SECTION G - G'

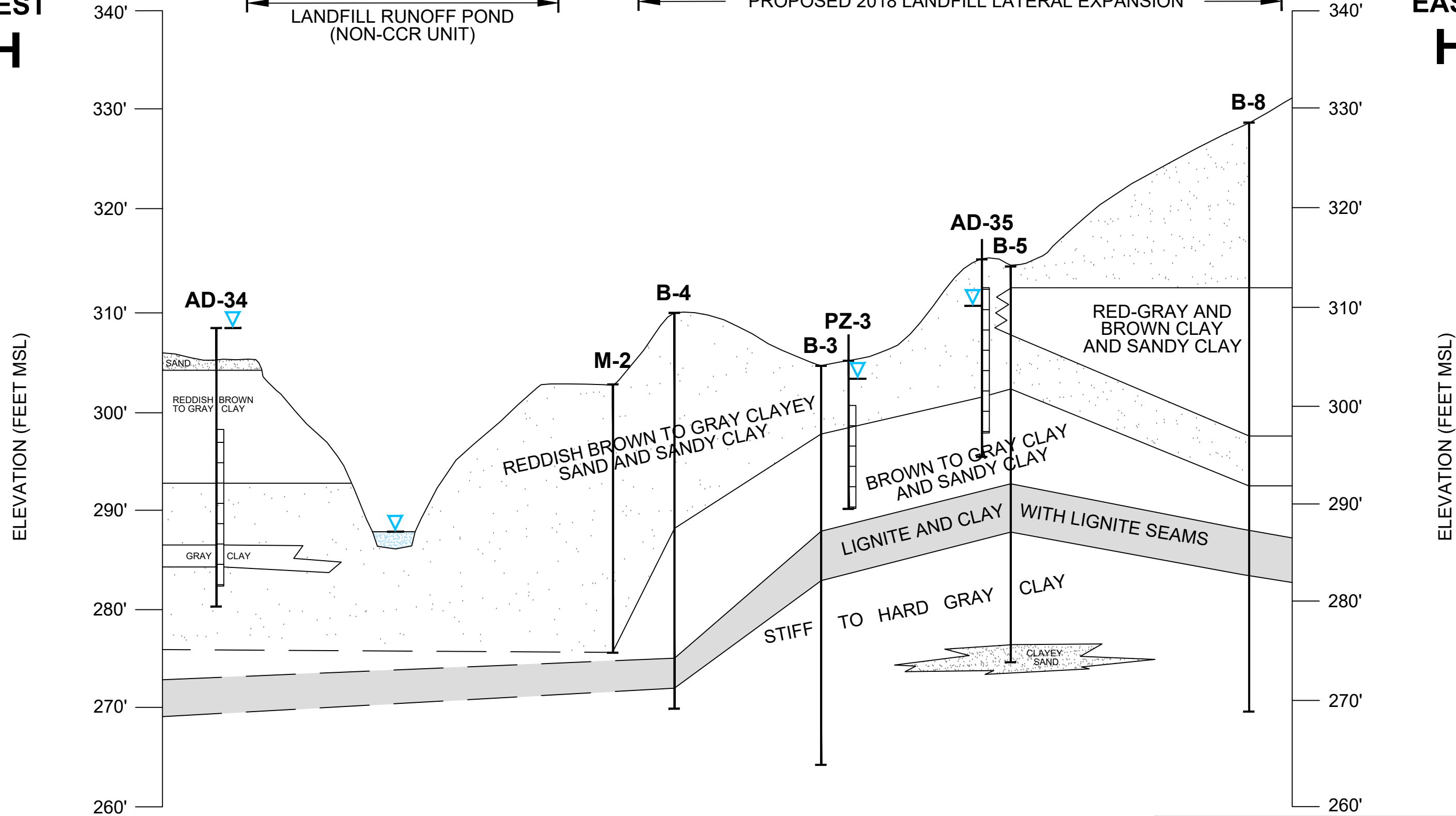
ARCADIS Design & Consultancy
 for natural and built assets

FIGURE
13



CITY: DIV/GROUP: DB: LD: AM: PD: TM: LYNONE"OFF=REF" G:\Active Projects\AEP17X015976.0003 - Pirkey Landfill Expansion\Landfill Expansion Location Restriction Report\Figures-Maps\Figure 14 Cross Sec H-H'.dwg LAYOUT: MODEL: LMS TECH: 20.1S (LMS TECH) PAGESETUP: PLOTSTYLETABLE: PLOTTED: 9/19/2018 4:52 PM BY: LEASE, DIANA

**WEST
H**

**EAST
H'**



LEGEND

-  MONITORING WELL/PIEZOMETER SCREENED INTERVAL
-  WATER LEVEL IN PIEZOMETER/MONITORING WELL (6/22/18)

NOTE: 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
 H - H'**


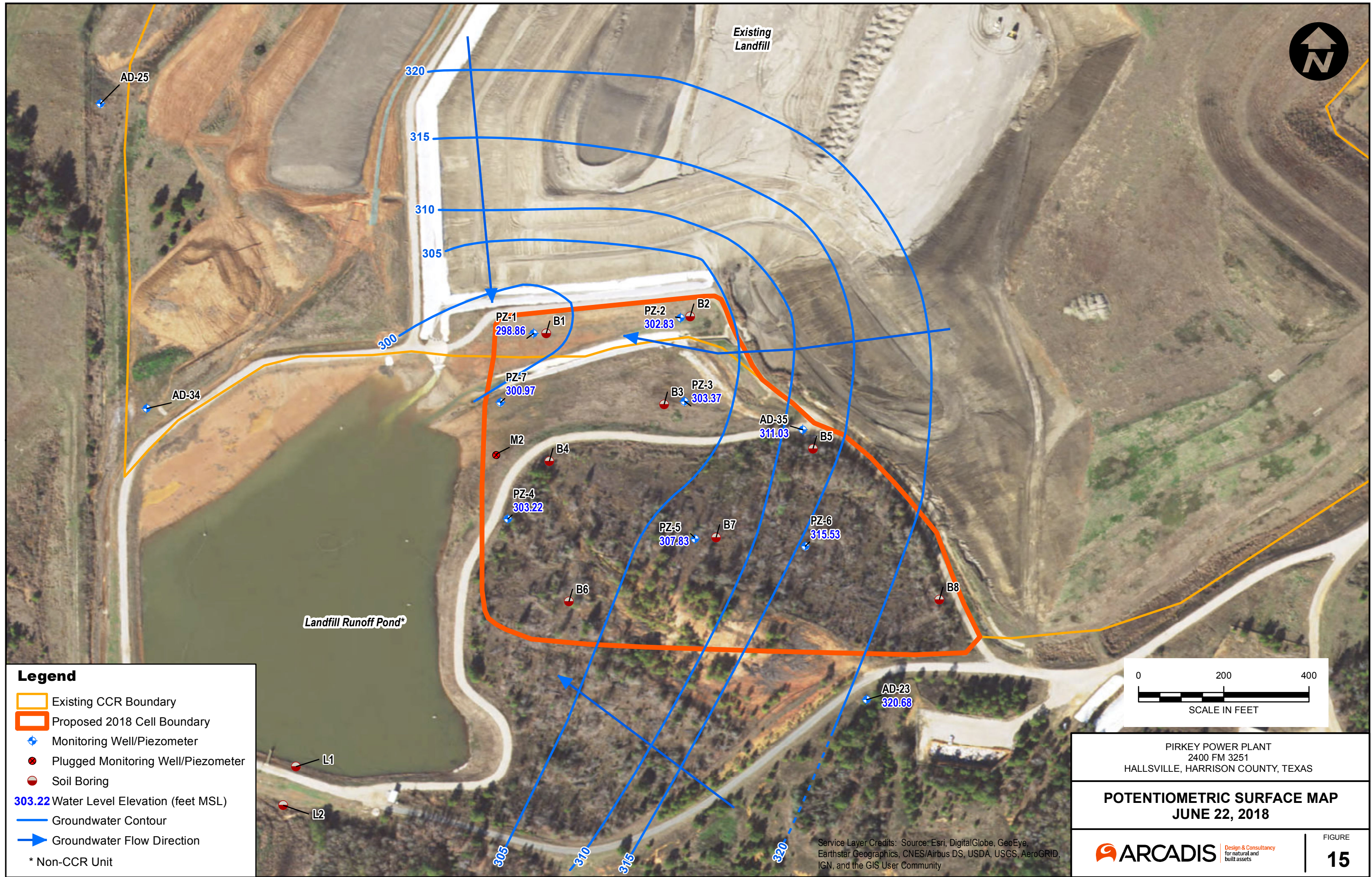
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FIGURE
14



Legend

- Existing CCR Boundary
- Proposed 2018 Cell Boundary
- ◆ Monitoring Well/Piezometer
- Plugged Monitoring Well/Piezometer
- Soil Boring
- 303.22 Water Level Elevation (feet MSL)
- Groundwater Contour
- Groundwater Flow Direction
- * Non-CCR Unit

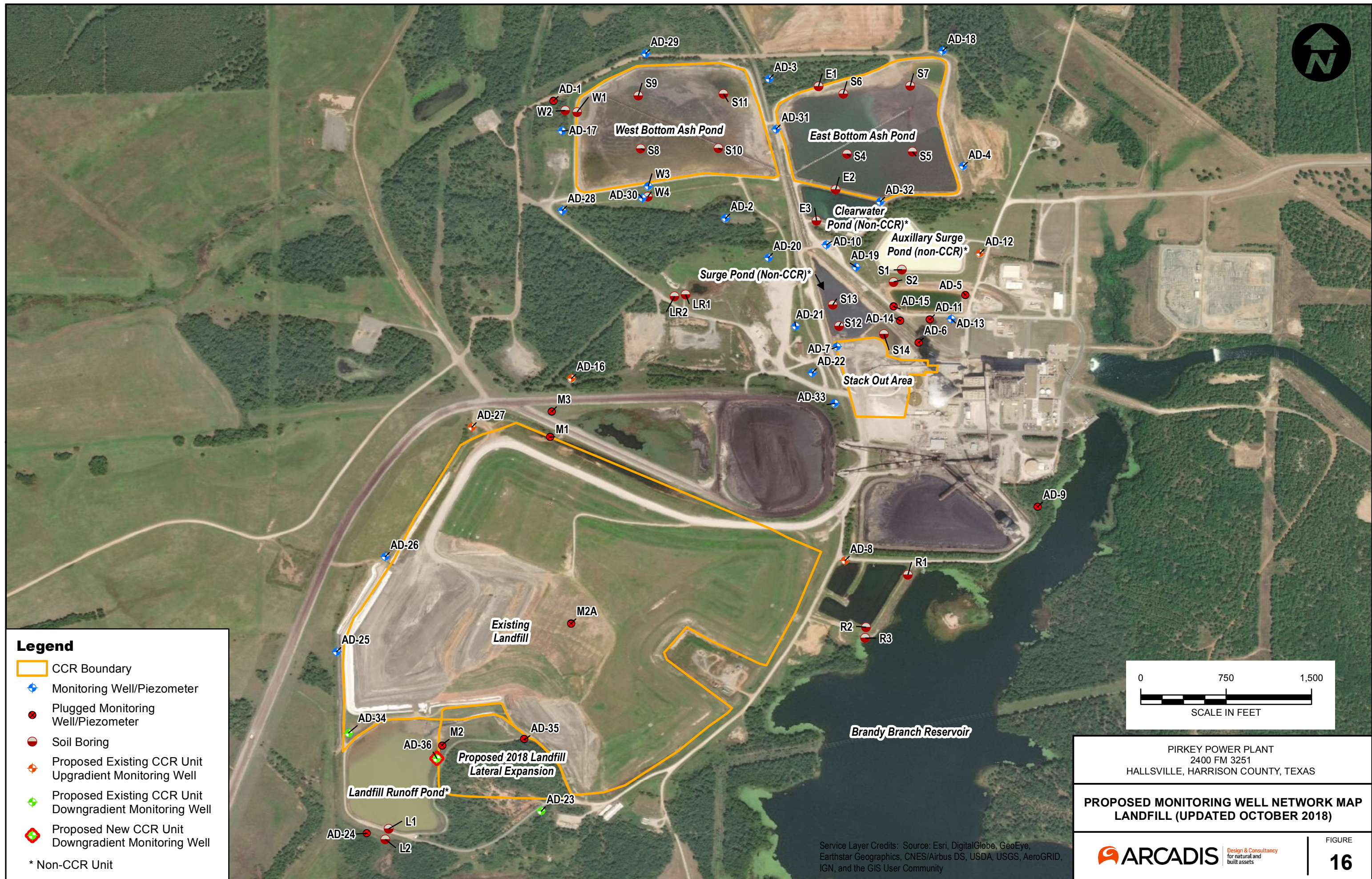
PIRKEY POWER PLANT
 2400 FM 3251
 HALLSVILLE, HARRISON COUNTY, TEXAS

POTENTIOMETRIC SURFACE MAP
JUNE 22, 2018

Design & Consultancy
for natural and
built assets

FIGURE
15

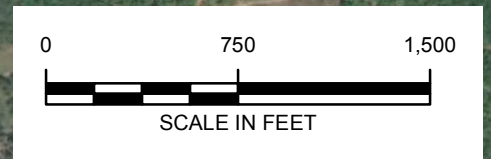
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



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
- ◆ Proposed New CCR Unit Downgradient Monitoring Well

* Non-CCR Unit



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

**PROPOSED MONITORING WELL NETWORK MAP
 LANDFILL (UPDATED OCTOBER 2018)**

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Appendix A

Boring/Well Construction Logs

832964

LOG OF BORING

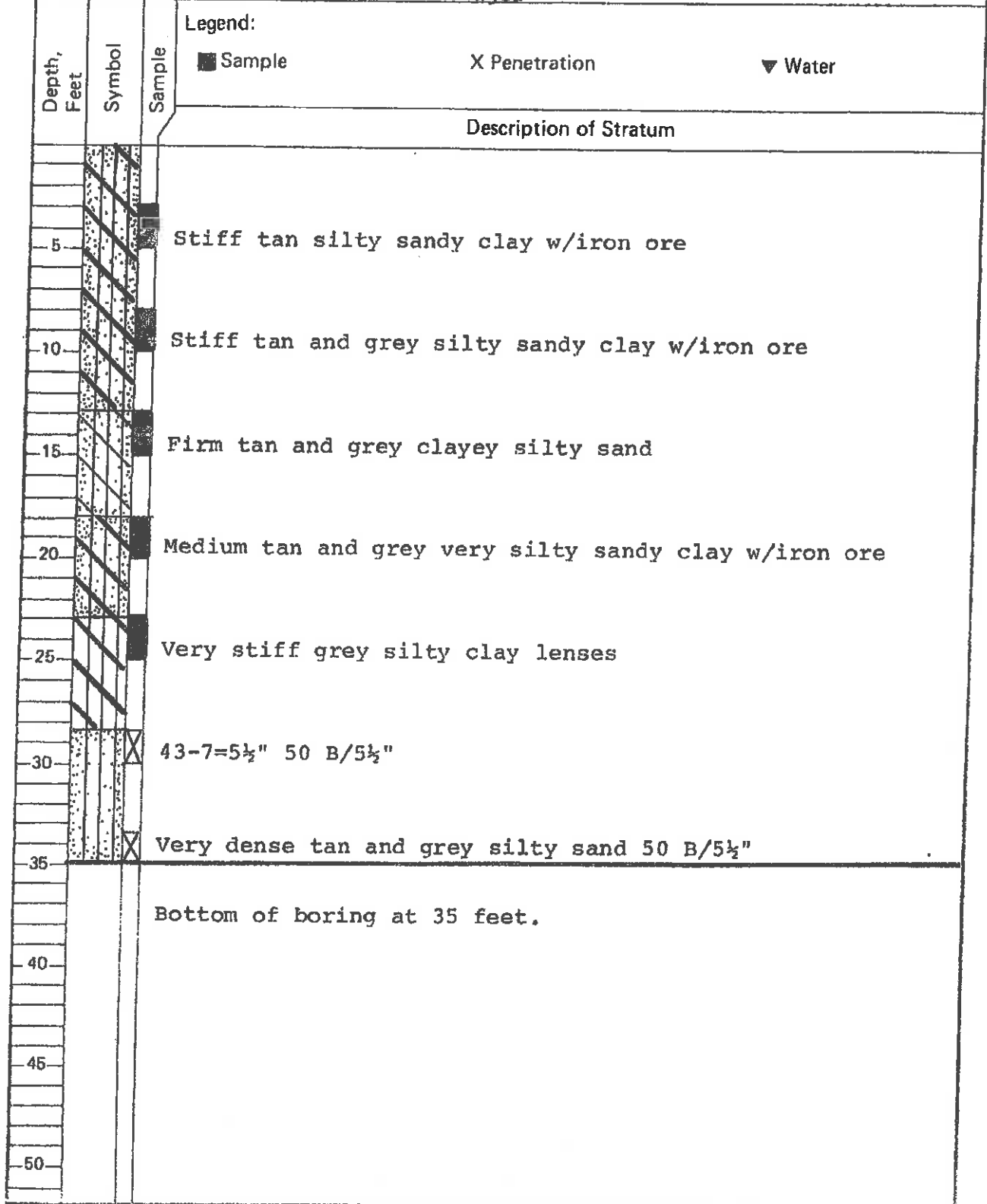
PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: MW-8
LOCATION: Hallsville

Date: 10-4-83

Type: Auger

Ground Elevation:



APEX PROJECT NO.: 110-089 **BORING** **MONITOR WELL**
BORING NUMBER: _____ **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
LATITUDE: 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				0-2	SM	Silty sand, very fine grained, light brown	None	Dry	
2				2-8	CL	Sandy clay, yellowish brown, reddish brown -some iron oxide concretions at 2.5' -light gray at 5'	None	Dry	
3				8-10	CL	Clay, red, light yellowish brown, gray, fat, hard, some very fine laminated sand seams	None	Dry	
4				10-11	CL	Sandy clay, red, light gray, yellowish brown, stiff to hard	None	Dry	
5				11-14.25	CL	Clay, yellowish brown, some sand, reddish brown, light gray, hard	None	Dry	
6				14.25-18	CL	-clayey sand seam at 14-14.25', yellowish brown, light gray Sandy clay, red, light gray, gray, very thin sand lenses interbedded in clay	None	Moist V. Moist	
7				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'	None	Moist V. Moist	
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33					32-35	SC	Clayey sand, greenish gray, light gray, some very fine gypsum crystals, dense	None	Moist
34									
35									
36									
37									
38									
39									
40									

Cement Bentonite Filler Sand Water Level

Apex geoscience inc.
 Total Depth: 35 feet Riser Interval: +3 (ags)-15'
 Filter Sand (Size/Interval): 13-35' Screen Interval: 15-35'
 Grout (Type/Interval): Grout from 0-2'; Bentonite from 2-13' Water level: 23.37'
 Surface Completion Flush Above Ground 3'

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

APEX PROJECT NO.: <u>110-089</u>	<input type="checkbox"/> BORING	<input checked="" type="checkbox"/> MONITOR WELL	
BORING NUMBER: _____	MONITOR WELL NUMBER: _____		<u>AD-25</u>
FACILITY NAME: <u>AEP- Pirkey Power Plant</u>		FACILITY ID NO.: <u>N/A</u>	
FACILITY ADDRESS: <u>Hallsville, Texas</u>			
DRILLING COMPANY/METHOD/RIG: <u>Apex Geoscience Inc. / Hollow-stem Augers/ CME-55 Track Rig</u>			
DRILLER: <u>Ed Wilson, Apex Geoscience Inc.</u>		COMPLETION DATE: <u>12/14/2010</u>	
PREPARED BY: <u>David Bedford</u>		LOGGED BY: <u>David Bedford</u>	
LATITUDE: <u>N 32°27'17.2"</u>		Datum: <u>WGS-84</u>	
LONGITUDE: <u>W94°29'59.1"</u>		WELL LOCATION: <u>S. of Diesel ASTs</u>	

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 crystalline rock		
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32						Boring Terminated at 30'		
33								
34								
35								



Cement
 Bentonite
 Filter Sand
 Water Level

	Total Depth: <u>30 feet</u>	Riser Interval: <u>+3 (ags)-10'</u>	
	Filter Sand (Size/Interval): <u>8-30'</u>	Screen Interval: <u>10-30'</u>	
	Grout (Type/Interval): <u>Grout from 0-2'; Bentonite from 2-8'</u>	Water level: <u>12.69'</u>	
	Surface Completion <input type="checkbox"/> Flush <input checked="" type="checkbox"/> Above Ground		<u>3'</u>

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

Boring Logs_110-089, AD-25

BORING MONITOR WELL
 APEX PROJECT NO.: 110-089 BORING NUMBER: _____ 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
 LATITUDE: 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			▽				Wet
21							
22					20-22' - Large clay inclusions, brown		Very Moist
23							
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	None	Wet
32					Wet from 30-30.5'		Moist
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



Total Depth: 40 feet Riser Interval: +3 (ags)-10'
 Filter Sand (Size/Interval): 8-40' Screen Interval: 10-40'
 Grout (Type/Interval): Grout from 0-2'; Bentonite from 2-8' Water level: 19.45'
 Surface Completion Flush Above Ground 3'

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

BORING MONITOR WELL
 APEX PROJECT NO.: 110-089 BORING NUMBER: _____ 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
 LATITUDE: 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				0-2	SC	Clayey sand, orangish brown with dark gray laminations, very fine grained	None	Slightly Moist
2				2-15.5	CL	Lean clay, dense, few thin sandy streaks, reddish orange, very fine grained, mottled with light brownish gray	None	Slightly Moist
3								
4								
5								
6								
7								
8								
9								
10								
11								
12						Orange to brown with orangish brown streaks, at 10' becomes brittle		
13								
14								
15								
16				15.5-23	SC	Clayey sand, greenish brown with orangish brown streaks, few thin tan clay streaks, very fine grained	None	Moist
17								
18								
19								
20								
21								
22								
23								
24				23-24	SM	Sand, orangish brown, silty, very fine grained	None	Wet
25				24-27	CH	Fat clay, brown with orangish brown streaks, many sandy streaks, very fine grained	None	Very Moist
26								
27			▽					
28				27-30	SM	Sand, greenish gray with orangish brown streaks, very fine to fine grained, wet	None	Wet
29								
30								
31				30-37.5	SC	Clayey sand with clay streaks, light greenish black, very fine grained	None	Slightly Wet
32								
33								
34								
35								
36						Wet red brittle shale from 35-35.2		
37								
38								
39						Boring Terminated at 37.5'		
40								

Cement
 Bentonite
 Filter Sand
 Water Level

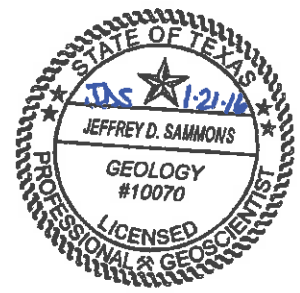
Apex geoscience inc.
 Total Depth: 40 feet Riser Interval: +3 (ags)-17.5'
 Filter Sand (Size/Interval): 15.5-37.5' Screen Interval: 17.5-37.5'
 Grout (Type/Interval): Grout from 0-2'; Bentonite from 2-15.5' Water Level: 26.73'
 Surface Completion Flush Above Ground 3'

Note: This log is not to be used separate from this report.
 Boring Log_110-089, AD-27



Monitor Well

Monitor Well No.: AD-34



PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	Pirkey Power Plant	DRILLER:	Buford Collier
PROJECT NO.:	I-04-1021	DRILLER'S LICENSE NO.:	60089
LOGGED BY:	Jeffrey D. Sammons, P.G.	RIG TYPE:	Geoprobe 3230DT
SUPERVISING PG:	Jeffrey D. Sammons, P.G.	METHOD OF DRILLING:	Hollow Stem Auger
COMPLETION:	12/11/2015	SAMPLING METHODS:	Split Core
DEVELOPMENT:	12/16/2015	SURFACE ELEVATION:	307.61 (Top of Casing)
SITE LOCATION:	2400 FM 3251, Hallsville, Texas	HOLE DIAMETER:	8.26"
WELL OWNER:	AEP	LATITUDE	32 27' 10.13"
		LONGITUDE	94 29' 57.93"

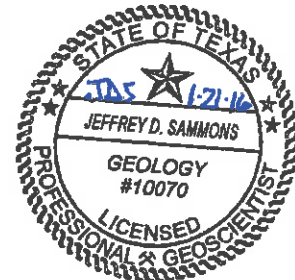
Water Level Upon Installation
 Water Level at Time of Drilling
 Geotechnical Lab Sample
 TBPB No. 50027

DESCRIPTION	USCS	SOIL SYMBOLS	DEPTH	WATER LEVEL	SAMPLE	% MOISTURE	% FINES	LL	PL	PI	WELL CONSTRUCTION
			4								<p>Locking Well Casing Cover</p> <p>Locking Well Cap</p> <p>Protective Well Casing</p> <p>Concrete Pad</p> <p>Ground Surface</p> <p>Cement</p> <p>Bentonite</p> <p>2" Sch. 40 PVC Riser</p> <p>20/40 Silica Sand</p> <p>0.010" Slotted Sch. 40 PVC Well Screen</p> <p>PVC Bottom Cap</p>
			3								
			2								
			1								
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	CH		2			31	89	63	23	40	
- some silt and very fine to fine sand at 5', light gray, light reddish brown, and light yellowish brown, moist to very moist			4								
SANDY LEAN CLAY: some very fine to fine sand, dark gray, moist	CL		6								
- reddish brown, dark reddish brown, dark gray, light gray at 10' to 12.5'			10								
			12			23	64	26	18	8	
SILTY SAND: very fine to fine sand, some clay, gray and dark gray, saturated	SM		13								
			15								
- increasing clay content with depth			16			22	29	25	NP	-	
			17								
			18								
FAT CLAY: trace sand and silt, gray, moist	CH		19								
			20								
			21			23	90	55	27	28	
CLAYEY SAND: fine to very fine sand, dark gray, moist to very moist	SC		22								
			23								
			24								
			25								



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"

Water Level Upon Installation
 Water Level at Time of Drilling
 Geotechnical Lab Sample
 TBPB No. 50027

DESCRIPTION	USCS	SOIL SYMBOLS	DEPTH	WATER LEVEL	SAMPLE	% MOISTURE	% FINES	LL	PL	PI	WELL CONSTRUCTION
			4								Locking Well Casing Cover
			3								Locking Well Cap
			2								Protective Well Casing
			1								Concrete Pad
CLAYEY SAND: very fine to fine sand, some iron ore gravel, reddish brownish, dark reddish brown, yellowish brown, gray, moist	SC	[Diagonal Hatching]	0								Ground Surface
			-1								Cement
			-2								2" Sch. 40 PVC Riser
SILTY SAND: very fine to fine sand, trace clay, trace iron ore gravel, light reddish brown, moist, increasing moisture content with depth	SM	[Dotted]	2		13	46	32	15	17		Bentonite
			3								
			4								
			5		12	26	16	NP			
			6								
			7								
			8								
			9								
- saturated at 10' to 11'			10								20/40 Silica Sand
			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	[Diagonal Hatching]	12		19	33	31	18	13		0.010" Slotted Sch. 40 PVC Well Screen
			13								
			14								
			15								
LEAN CLAY: interbedded clays and silts with laminations of very fine sand, light gray, gray and light reddish brown, moist to very moist	CL	[Diagonal Hatching]	15								
			16								
			17		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			18								PVC Bottom Cap
			19								
			20								

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 Installation
 CLIENT: Southwestern Electric Power Company

BORING NO.: M-1
 LOCATION: Hallsville, TX
 S 12+32.79; W 35+34.55
 Ground Elevation: 337.67

Date: 1/29/86 Type: Rotary

Depth, Feet	Symbol	Sample	Description of Stratum
Legend: ■ Sample X Penetration ▼ Water			
5	[Diagonal Hatching]	[Black Square]	Brown and tan sandy clay
10	[Diagonal Hatching]	[Black Square]	Brown and tan sandy clay w/iron ore
15	[Diagonal Hatching]	[Black Square]	Brown and tan sandy clay w/iron ore
20	[Vertical Lines]	[Black Square]	Gray silty sand
25	[Vertical Lines]	[Black Square]	Gray silty sand
30	[Vertical Lines]	[Black Square]	Gray silty sand
35			Bottom of Boring at 30 feet. Water encountered at 10 feet.
40			
45			
50			
55			

LOG OF BORING

852164
 PROJECT: Monitoring Well Installation
 CLIENT: Southwestern Electric Power Company
 Date: 1/29/86 Type: Rotary

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

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: Plant Site Coordinates: South West
■ Sample X Penetration

S 27+55.45
W 36+47.44
▼ Water

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

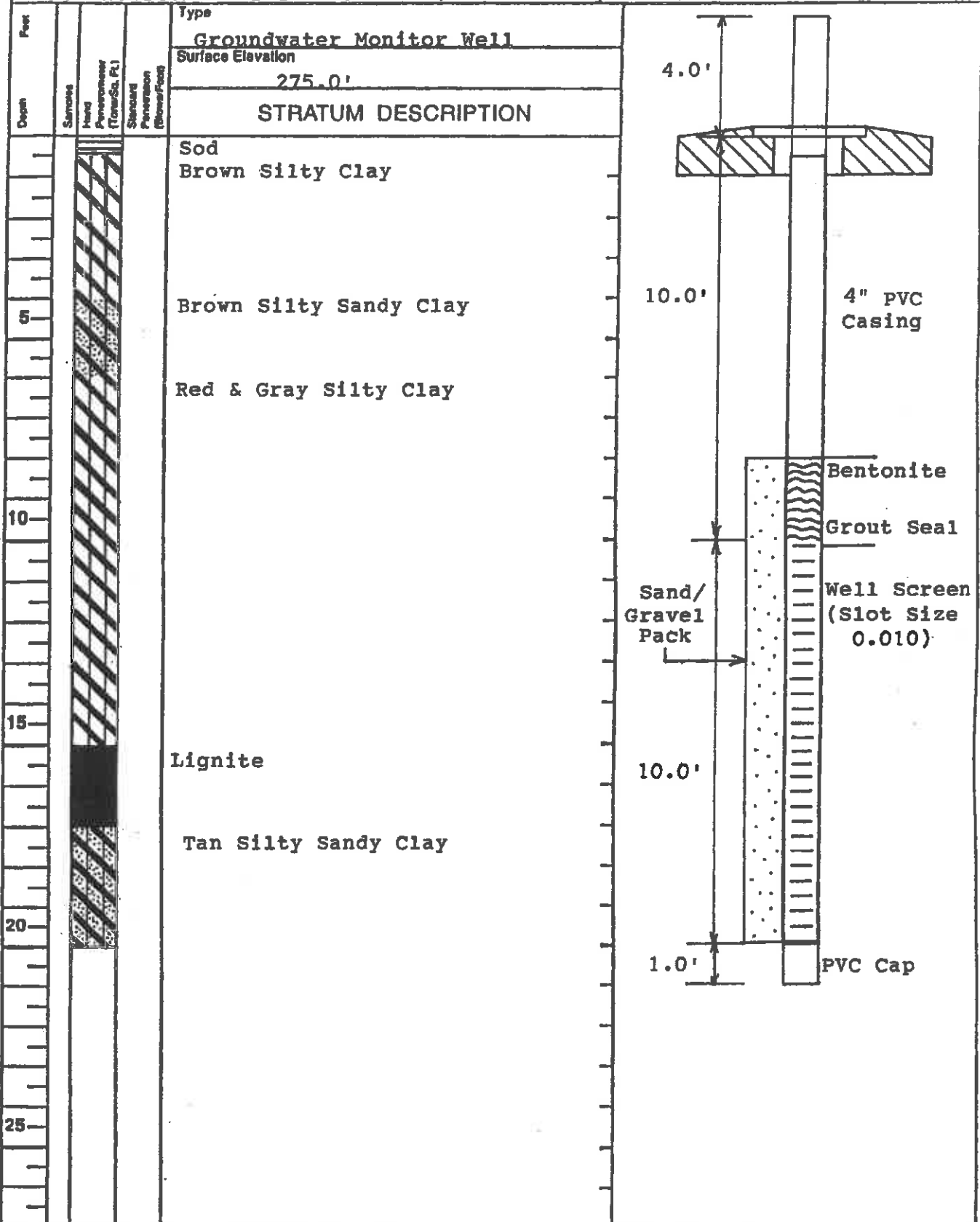
Log of Boring

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'

STRATUM DESCRIPTION

Sod
Brown Silty Clay

Brown Silty Sandy Clay

Red & Gray Silty Clay

Lignite

Tan Silty Sandy Clay

4.0'

10.0'

10.0'

1.0'

4" PVC Casing

Bentonite

Grout Seal

Well Screen
(Slot Size 0.010)

Sand/
Gravel
Pack

PVC Cap

Completion Depth
20'

Date
7-1-93

Water Observations
Water Encountered at 10.0'



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LOG OF BORING L-1

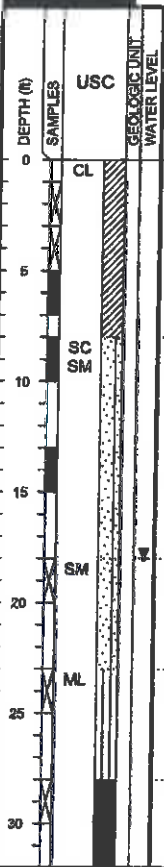
PROJECT: Pirkey Power Plant
Hallsville, Texas

PROJECT NO.: G3241-095

BORING TYPE: Flight Auger

DATE: 10/19/09

SURFACE ELEVATION: 298.0



MATERIAL DESCRIPTION

SANDY LEAN CLAY (CL) stiff, orangish gray
-reddish brown

SILTY CLAYEY SAND (SC-SM) reddish brown; with gravel

-reddish tan; with iron oxide cemented sandstone

SILTY SAND (SM) very dense; dark gray; laminated; saturated

SANDY SILT (ML) very dense; dark gray; with lignite @ 24'

LIGNITE very dense; black

FIELD STRENGTH DATA	BLOW COUNT		DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psf)	Natural Moisture Content and Atterberg Limits			MOISTURE CONTENT (%)				OTHER TESTS PERFORMED (Page Ref. #)	
	20	40					60	80	Plastic Limit	Moisture Content	Liquid Limit	LL	PL		PI
N=14	●						●			15	37	19	18	74	+40 Sieve=7%, +4 Sieve=2%
N=11	●						●			18	39	20	19	74	
P=4,5+							●			7	20	15	5	32	+40 Sieve=11%, +4 Sieve=3%
SF															
N=50/3"							●			21				30	+40 Sieve=0%, +4 Sieve=0%
N=73							●								
N=50/0.5"							●								

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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LOG OF BORING L-1

PROJECT: Pirkey Power Plant
Hallsville, Texas

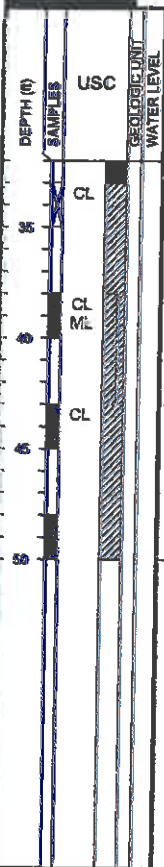
PROJECT NO.: G3241-095

BORING TYPE: Flight Auger

DATE

10/19/08

SURFACE ELEVATION
286.0



MATERIAL DESCRIPTION	
0 - 17'	LEAN CLAY (CL) hard; light gray; with vertical black silty seam
17 - 45'	SANDY SILT CLAY (CL-ML) hard; gray
45 - 50'	LEAN CLAY (CL) hard; dark brown laminated
Bottom of Boring @ 50'	

FIELD STRENGTH DATA	BLOW COUNT				DRY DENSITY (pcf)	COMPRESSION STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psf)	Natural Moisture Content and Atterberg Limits			MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	1	2	3	4					Plastic Limit	Moisture Content	Liquid Limit						
N=50/3*	20	40	60	80					~45	~33	~19	~14	~97				+40 Sieve=0%, +4 Sieve=0%
P=2.25 P=4.5+									~45	~22	~16	~6	~51				+40 Sieve=0%, +4 Sieve=0%
P=4.5+									~45								
P=4.5+									~45								

MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
~45	~33	~19	~14	~97	+40 Sieve=0%, +4 Sieve=0%
~45	~22	~16	~6	~51	+40 Sieve=0%, +4 Sieve=0%

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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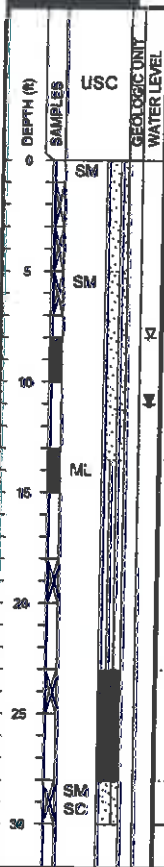
LOG OF BORING L-2

PROJECT: Pirkey Power Plant
Hallsville, Texas
PROJECT NO.: G3241-095

BORING TYPE: Flight Auger

DATE: 10/19/09

SURFACE ELEVATION: 291.4



MATERIAL DESCRIPTION	
0 - 4	SILTY SAND(SM) loose; tan
4 - 11	SILTY SAND(SM) loose; tan --red and gray --with gravel
11 - 24	SANDY SILT(ML) dark gray --dark gray
24 - 26	LIGNITE very dense; black
26 - 30	SILTY CLAYEY SAND(SM-SC) very dense; dark gray; laminated with gray silt

FIELD STRENGTH DATA	BLOW COUNT				DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psf)	Natural Moisture Content and Atterberg Limits			MOISTURE CONTENT (%)	ATTERBERG LIMITS (%)			OTHER TESTS PERFORMED (Page Ref. #)	
	20	40	60	80					Plastic Limit	Moisture Content	Liquid Limit		LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
N=6	●																
N=8	●											14	28	25	3	45	+40 Sieve=22%, +4 Sieve=17%
N=6	●											13				15	+40 Sieve=61%, +4 Sieve=45%
SF																	
SF																	
N=50/4"												22				61	+40 Sieve=0%, +4 Sieve=0%
N=50/3"																	
N=68												17	21	15	8	49	+40 Sieve=0%, +4 Sieve=0%

Water Level: Est. Measured Perched
 Water Observations: Seepage @ 8' while drilling. Water level @ 26' and open to 26' upon completion. Water level @ 11' and open to 28' after

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

Notes: GPS Coordinates: N 32°27.034', W 94°29.952'



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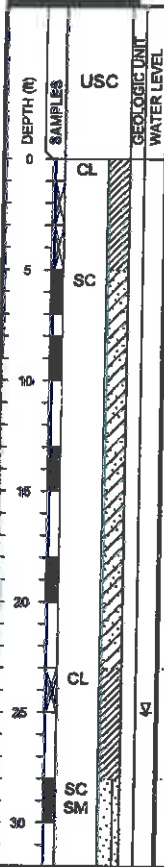
LOG OF BORING R-1

PROJECT: Pirkey Power Plant
Hallsville, Texas
PROJECT NO.: G3241-095

BORING TYPE: Flight Auger

DATE: 10/19/09

SURFACE ELEVATION: 356.3



MATERIAL DESCRIPTION

SANDY LEAN CLAY (CL) medium stiff; red and brown; with gravel
-stiff; clay content increasing

CLAYEY SAND (SC) medium dense; reddish brown; with ferric seams

-with clay nodules

SANDY LEAN CLAY (CL) very stiff; orange and tan; saturated

CLAYEY SILTY SAND (SC-SM) orange and gray

FIELD STRENGTH DATA	BLOW COUNT		DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	Natural Moisture Content and Atterberg Limits			MOISTURE CONTENT (%)	ATTERBERG LIMITS (%)			OTHER TESTS PERFORMED (Page Ref. #)	
	20	40				60	80	Plastic Limit		Moisture Content	Liquid Limit	LL		PL
N=9	1	2	3	4										
N=13	1	2	3	4					17	47	16	28	52	+40 Sieve=4%, +4 Sieve=1%
P=2.75														
P=3.0									13	33	16	17	22	+40 Sieve=36%, +4 Sieve=30%
P=2.5														
P=1.75 SF						106	1.10	4	9	20				
P=3.0									17	34	15	19	39	+40 Sieve=8%, +4 Sieve=1%
N=25 P=3.5									18	42	21	21	57	+40 Sieve=8%, +4 Sieve=6%
SF														

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

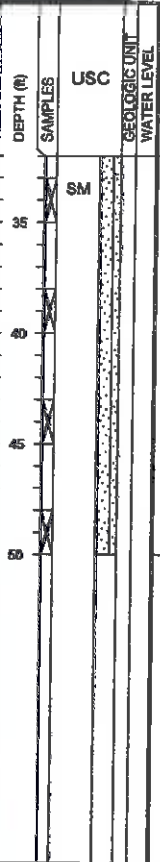
PROJECT: Pirkey Power Plant
Hallsville, Texas

PROJECT NO.: G3241-095

BORING TYPE: Flight Auger

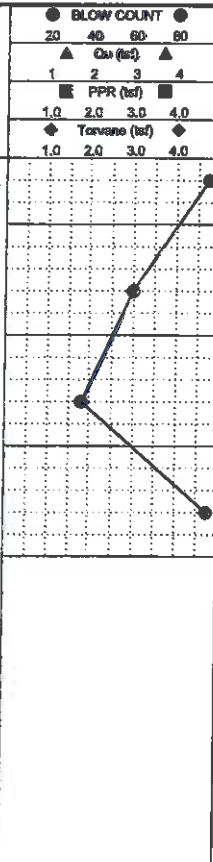
DATE: 10/19/08

SURFACE ELEVATION
356.3



MATERIAL DESCRIPTION	
SM	SILTY SAND(SM) very dense; gray; with gravel
	-orange and gray
	-brown
	-brown and gray
Bottom of Boring @ 50'	

FIELD STRENGTH DATA
N=50/5.5'
N=60
N=36
N=50/5.75'



DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (tsf)	Natural Moisture Content and Atterberg Limits		
				Plastic Limit	Moisture Content	Liquid Limit

MOISTURE CONTENT (%)	ATTERBERG LIMITS (%)			MINIUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	LL	PL	PI		
22				16	+40 Sieve=2%, +4 Sieve=1%

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:



**ETTL
ENGINEERS &
CONSULTANTS**

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 695-4421

LOG OF BORING R-2

PROJECT: Pirkey Power Plant
Haltsville, Texas

PROJECT NO.: G3241-095

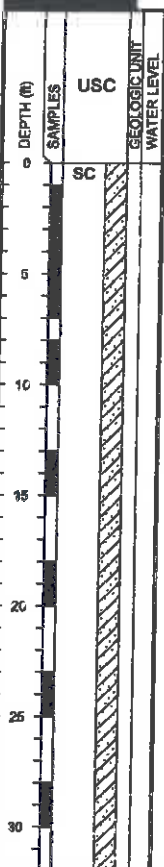
BORING TYPE: Flight Auger

DATE

10/19/09

SURFACE ELEVATION

355.1



MATERIAL DESCRIPTION

CLAYEY SAND(SC) medium dense; reddish tan; with gravel

-red and orangish gray; with clay lenses

-gravelly and ferric seams

-orange and red

-red and tan

-red and orange


FIELD STRENGTH DATA	BLOW COUNT				DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psf)	Natural Moisture Content and Atterberg Limits			MOISTURE CONTENT (%)	ATTERBERG LIMITS (%)			OTHER TESTS PERFORMED (Page Ref. #)
	20	40	60	80					Plastic Limit	Moisture Content	Liquid Limit		LL	PL	PI	
P=4.5+									13	38	17	21	44	+40 Sieve=6%, +4 Sieve=2%		
P=4.5+									14	38	17	21	41	+40 Sieve=8%, +4 Sieve=3%		
P=2.0									18	36	18	18	44	+40 Sieve=12%, +4 Sieve=5%		
P=3.5																
P=3.0																
P=4.0																
P=4.5+									17	43	18	25	42	+40 Sieve=6%, +4 Sieve=0%		
P=4.0																

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:

 ETTL ENGINEERS & CONSULTANTS		LOG OF BORING R-2						DATE 10/19/09																	
		PROJECT: Pirkey Power Plant Hallsville, Texas PROJECT NO.: G3241-095			BORING TYPE: Flight Auger			SURFACE ELEVATION 355.1																	
MAIN OFFICE 1717 East Erwin Tyler, Texas 75702 (903) 595-4421		MATERIAL DESCRIPTION		FIELD STRENGTH DATA		DRY DENSITY (pcf)		COMPRESSION STRENGTH (tsf)		FAILURE STRAIN (%)		CONFINING PRESSURE (psf)		Natural Moisture Content and Atterberg Limits		MOISTURE CONTENT (%)		ATTERBERG LIMITS (%)		PLASTICITY INDEX		MINUS #200 SIEVE (%)		OTHER TESTS PERFORMED (Page Ref. #)	
DEPTH (ft)	SAMPLES	USC	GEOLOGIC UNIT	WATER LEVEL	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSION STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psf)	Natural Moisture Content and Atterberg Limits	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%)	PLASTICITY INDEX	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)										
35					P=4.5					22	34	15	19	39	+40Sieve=7%, +4 Sieve=3%										
38			CL		P=0.2																				
40																									
45					P=1.3																				
50			SM		SF																				
				Bottom of Boring @ 50'																					

Water Level: Rel: Measured Perched
 Water Observations: Seepage @ 38" while drilling.

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

Notes:



**ETTL
ENGINEERS &
CONSULTANTS**

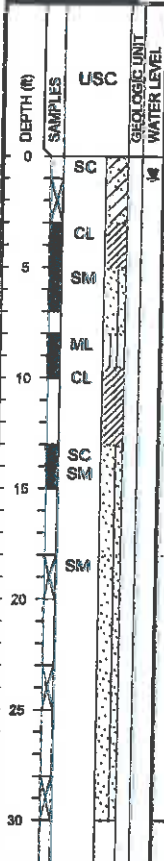
MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 696-4421

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

0 - 1.5	CLAYEY SAND(SC) medium dense; tan
1.5 - 3.0	LEAN CLAY(CL) very stiff; tan and gray; laminated
3.0 - 4.5	SILTY SAND(SM) tan; with gravel
4.5 - 6.0	SANDY SILT(ML) very loose; tan
6.0 - 7.5	LEAN CLAY(CL) very stiff; tan
7.5 - 10.0	SILTY CLAYEY SAND(SC-SM) medium dense; tan and gray
10.0 - 30.0	SILTY SAND(SM) very dense; tan and gray

Bottom of Boring @ 30'

FIELD STRENGTH DATA	SLOW COUNT				DRY DENSITY (pcf)	COMPRESSION STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psf)	Natural Moisture Content and Atterberg Limits			MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	1	2	3	4					Plastic Limit	Moisture Content	Liquid Limit						
N=15	●																
P=2.5			■									18	30	16	14	88	+40 Sieve=5%, +4 Sieve=1%
SF												17				30	+40 Sieve=16%, +4 Sieve=9%
P=0.8	■											19	33	17	16	86	+40 Sieve=1%, +4 Sieve=0%
P=2.5 P=2.9			■		108	1.80	7	7				20					
P=3.0			■														
N=68				●													
N=50/6"				●								20				21	+40 Sieve=1%, +4 Sieve=0%
N=50/4"				●													

Water Level Est.: Measured: Perched:


Water Observations: Seepage @ 6' while drilling. Water level @ 1' and open to 26' 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'



Appendix B

Photographic Log

Project Name: AEP – Pirkey Power Plant		Location: Hallsville, Harrison County, Texas	Project No. OH015976.0001
Photo No. 1	Date: 8/19/2015		
Direction Photo Taken: South			
Description: P8190454 Upland drainage area along southeastern side of Landfill.			

 ARCADIS		PHOTOGRAPHIC LOG	
Project Name: AEP – Pirkey Power Plant		Location: Hallsville, Harrison County, Texas	Project No. OH015976.0001
Photo No. 2	Date: 8/19/2015		
Direction Photo Taken: South			
Description: P8190467 Lining for new landfill expansion cell			

Project Name: AEP – Pirkey Power Plant		Location: Hallsville, Harrison County, Texas	Project No. OH015976.0001
Photo No. 3	Date: 8/19/2015		
Direction Photo Taken: East Northeast			
Description: P8190470 Lining for new landfill expansion cell			

 ARCADIS		PHOTOGRAPHIC LOG	
Project Name: AEP – Pirkey Power Plant		Location: Hallsville, Harrison County, Texas	Project No. OH015976.0001
Photo No. 4	Date: 8/19/2015		
Direction Photo Taken: East Northeast			
Description: P8190475 Upland ditch on east side of landfill.			

Appendix C

Soil Boring Logs and Piezometers -
2018 Landfill Lateral Expansion Area



Project Name: Pirkey - 2019 Landfill Expansion

Project Location: Hallsville, Texas

Drilling Contractor: C&S Lease

Project No.: 2016-011

Drill Date(s): 09/07/2016

GPS Coordinates: N32° 27' 12.0" W94° 29' 48.6"

Surface Elevation: N/A

Drilling Method: HSA

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0			Medium Stiff, red, brown and gray, Sandy Lean Clay (CL), mottled, few gravel	8			52	16	39	13	26	
	5			Gray, Bottom Ash	13	N/A		15					64
	10				6								
	15			Very Loose, brown, gray and red, Silty Clayey Sand (SC-SM), mottled, with organics (roots)	3			49	24	22	16	6	
	20			- red, tan and gray at 18 ft	1								
	25			Very Loose, light gray, red and tan, Silty Sand (SM), mottled	1	N/A		36	19	NP	NP	NP	
	30			- loose, few clay below 28 ft	10			31	19				
	35			Very Stiff, dark gray and gray, Sandy Lean Clay (CL)	24			55	21	29	13	16	
	40			Black, Lignite	50/2								
	45			Hard, dark gray and gray, Lean Clay (CL), laminated, few lignitic material	61			97	20	38	20	18	105
	50			Boring terminated at 47 feet.		4.5							

Additional Information/Comments:

Logger: D. Diduch

Notes/Comments: Seepage encountered at 8 ft during drilling. Water level at 8 feet upon completion.

N/A: Not Attempted



Project Name: Pirkey - 2019 Landfill Expansion
 Project Location: Hallsville, Texas
 Drilling Contractor: C&S Lease

Project No.: 2016-011
 Drill Date(s): 09/06/2016

GPS Coordinates: N32° 27' 12.3" W94° 29' 45.3"
 Surface Elevation: N/A
 Drilling Method: HSA

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
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	0			Very Stiff, red and brown, Sandy Lean Clay (CL), mottled, few gravel		2.5		57	18	30	12	18	
	5			Gray, Bottom Ash	4								
					3								
	10				1								
					2								
	15												
	20			Soft, dark gray, Sandy Lean Clay (CL)		0.5		62	20	34	13	21	91
	25			- very soft below 23 ft	1								
	30			Very Stiff, dark gray and gray, Sandy Silty Clay (CL-ML), with lignitic material		3.0		50	15	20	16	4	117
				Black, Lignite	50/3								
	35				50/3								
	40			Hard, gray and dark gray, Lean Clay (CL), laminated, trace gypsum	44			95	22	38	17	21	
				Boring terminated at 40 feet.									
	45												
	50												

Additional Information/Comments:

Logger: D. Diduch

Notes/Comments: Seepage encountered at 8 ft during drilling. Water level at 8 feet upon completion.

N/A: Not Attempted



Project Name: Pirkey - 2019 Landfill Expansion
 Project Location: Hallsville, Texas
 Drilling Contractor: C&S Lease

Project No.: 2016-011
 Drill Date(s): 09/08/2016

GPS Coordinates: N32° 27' 10.3" W94° 29' 45.9"
 Surface Elevation: N/A
 Drilling Method: HSA

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
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	0			Soft, brown, tan and red, Sandy Silty Clay (CL-ML), mottled, with few organics		N/A							
	5				4	N/A		53	19	20	15	5	
						N/A							
	10			Very Stiff, brown and gray, Lean Clay with Sand (CL), mottled, laminated	24			77	19	29	17	12	
	15			- stiff below 13 ft		1.5		75	22	31	17	14	103
	20			Black, Lignite	50/3.75								
	25			Hard, gray, Lean Clay (CL), mottled, laminated, few lignitic material	55								
	30			- very stiff between 28 ft and 30 ft - hard below 30 ft		2.5		99	17	38	18	20	117
	35			- attempted, no recovery		N/A							
	35			Very Stiff, gray, Fat Clay (CH), mottled, laminated, trace gypsum	27			97	23	51	17	34	
	40				26								
				Boring terminated at 40 feet.									
	45												
	50												

Additional Information/Comments:

Logger: D. Diduch

Notes/Comments: Seepage encountered at 5 ft during drilling. Water level at 5 feet upon completion.

N/A: Not Attempted



Project Name: Pirkey - 2019 Landfill Expansion
 Project Location: Hallsville, Texas
 Drilling Contractor: C&S Lease

Project No.: 2016-011
 Drill Date(s): 09/12/2016

GPS Coordinates: N32° 27' 9.0" W94° 29' 48.6"
 Surface Elevation: N/A
 Drilling Method: HSA

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0			Very Loose, reddish brown, Clayey Sand (SC), mottled	2								
	5			- medium dense between 3 ft and 10 ft - few gravel below 5 ft	15	3.5		27	14	23	14	9	
	10			- loose between 10 ft and 15 ft	5	2.5		49	18	28	13	15	115
	15			- medium dense between 15 ft and 18 ft	27	0.5		49	20	29	15	14	
	20			- very dense below 18 ft	60								
	25			Hard, gray and dark gray, Lean Clay (CL), mottled, laminated	32								
	30			- very stiff at 28 ft	17			88	22	45	16	29	
	35			- attempted, no recovery		N/A							
	35			Very Dense, gray and tan, Silty Sand (SM), with lignitic material	50/2								
	40			Hard, gray, dark gray and black, Lean Clay (CL), mottled, with lignitic material	95/11								
	40			Boring terminated at 40 feet.									

Additional Information/Comments:

Logger: D. Diduch

Notes/Comments: Seepage encountered at 10 ft during drilling. Water level at 10 feet upon completion.

N/A: Not Attempted



Project Name: Pirkey - 2019 Landfill Expansion

Project Location: Hallsville, Texas

Drilling Contractor: C&S Lease

Project No.: 2016-011

Drill Date(s): 09/09/2016

GPS Coordinates: N32° 27' 9.2" W94° 29' 42.4"

Surface Elevation: N/A

Drilling Method: HSA

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0			Loose, reddish brown, Clayey Sand (SC), mottled	8								
	5			Very Stiff, red and brown, Sandy Lean Clay (CL), mottled, few gravel	19	4.0	6.6	51	16	34	14	20	116
	10			Dense, red, tan and brown, Clayey Sand (SC), mottled	34	4.0		40	20				
	15			Very Stiff, gray and tan, Lean Clay (CL), mottled, laminated	17			96	21	41	16	25	
	20			Very Stiff, gray and dark gray, Lean Clay with Sand (CL), mottled	38	3.0		55	18	29	17	12	
	25			Black, Lignite	50/6								
	30			Hard, gray and dark gray, Lean Clay (CL), mottled, laminated	39	4.0		99	21				
	35			- very stiff at 33 ft	24								
	40			Medium Dense, gray and dark gray, Clayey Sand (SC)	27	2.5		45	27	36	16	20	
	45			Boring terminated at 42 feet.									
	50												

Additional Information/Comments:

Logger: D. Diduch

Notes/Comments: Seepage encountered at 13 ft during drilling. Water level at 13 feet upon completion.

N/A: Not Attempted



Project Name: Pirkey - 2019 Landfill Expansion
 Project Location: Hallsville, Texas
 Drilling Contractor: C&S Lease

Project No.: 2016-011
 Drill Date(s): 09/16/2016

GPS Coordinates: N32° 27' 5.7" W94° 29' 48.0"
 Surface Elevation: N/A
 Drilling Method: HSA

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0			Very Stiff, red and brown, Sandy Fat Clay (CH), mottled	17			55	19	61	25	36	
	5			Medium Dense, light red, tan and brown, Silty Clayey Sand (SC-SM), mottled	28	4.5		48	11				
	10			- tan, light red and gray below 8 ft, with few gravel between 8 ft and 10 ft	19	3.5							
	15			Very Dense, tan, light red and gray, Silty Sand (SM), mottled	88/10	2.5		33	12	19	15	4	
	20			- dense between 18 ft and 23 ft	42								
	25			- medium dense between 23 ft and 28 ft	28								
	30			- very dense below 28 ft	85/11			17	22	NP	NP	NP	
	35			Hard, gray and dark gray, Lean Clay (CL), mottled, laminated	72								
	40			- little recovery, few sand between 38 ft and 40 ft	48	N/A		97	22	42	17	25	
	45			- gray, dark gray and black, with lignitic material, laminated between 43 ft and 45 ft	50/3								
	50				40								
	55				60								
	60				40			98	19	42	17	25	
	65			Boring terminated at 60 feet.									

Additional Information/Comments:

Logger: D. Diduch

Notes/Comments: Seepage encountered at 28 ft during drilling. Water level at 28 feet upon completion.

N/A: Not Attempted



Project Name: Pirkey - 2019 Landfill Expansion

Project Location: Hallsville, Texas

Drilling Contractor: C&S Lease

Project No.: 2016-011

Drill Date(s): 09/14/2016

GPS Coordinates: N32° 27' 7.1" W94° 29' 44.6"

Surface Elevation: N/A

Drilling Method: HSA

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0			Stiff, light red and tan, Sandy Lean Clay (CL), mottled	13			51	19				
	5			Very Stiff, light tan, red and brown, Lean Clay (CL), mottled	20	N/A		85	17	29	14	15	
	10				21	N/A							
	15			Very Dense, light gray, Silty Sand (SM)	87/10	N/A		45	10	NP	NP	NP	
	20			Very Dense, red, brown and gray, Silty Sand (SM)	60								
	25				84/11			18	21				
	30				50/2								
	35			Hard, gray and dark gray, Lean Clay (CL), mottled, laminated	40								
	40			Black, Lignite	50/5								
	45			Hard, dark gray, Lean Clay (CL), mottled, laminated, trace gypsum	81								
	50				64								
	55				35			95	18	43	17	26	
	60			- attempted, no recovery		N/A							
	65			Boring terminated at 62 feet.	77								

Additional Information/Comments:

Logger: D. Diduch

Notes/Comments: Seepage encountered at 28 ft during drilling. Water level at 28 feet upon completion.

N/A: Not Attempted



Project Name: Pirkey - 2019 Landfill Expansion
 Project Location: Hallsville, Texas
 Drilling Contractor: C&S Lease

Project No.: 2016-011
 Drill Date(s): 09/13/2016

GPS Coordinates: N32° 27' 5.7" W94° 29' 39.6"
 Surface Elevation: N/A
 Drilling Method: HSA

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
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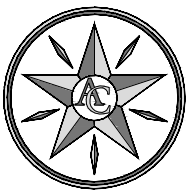
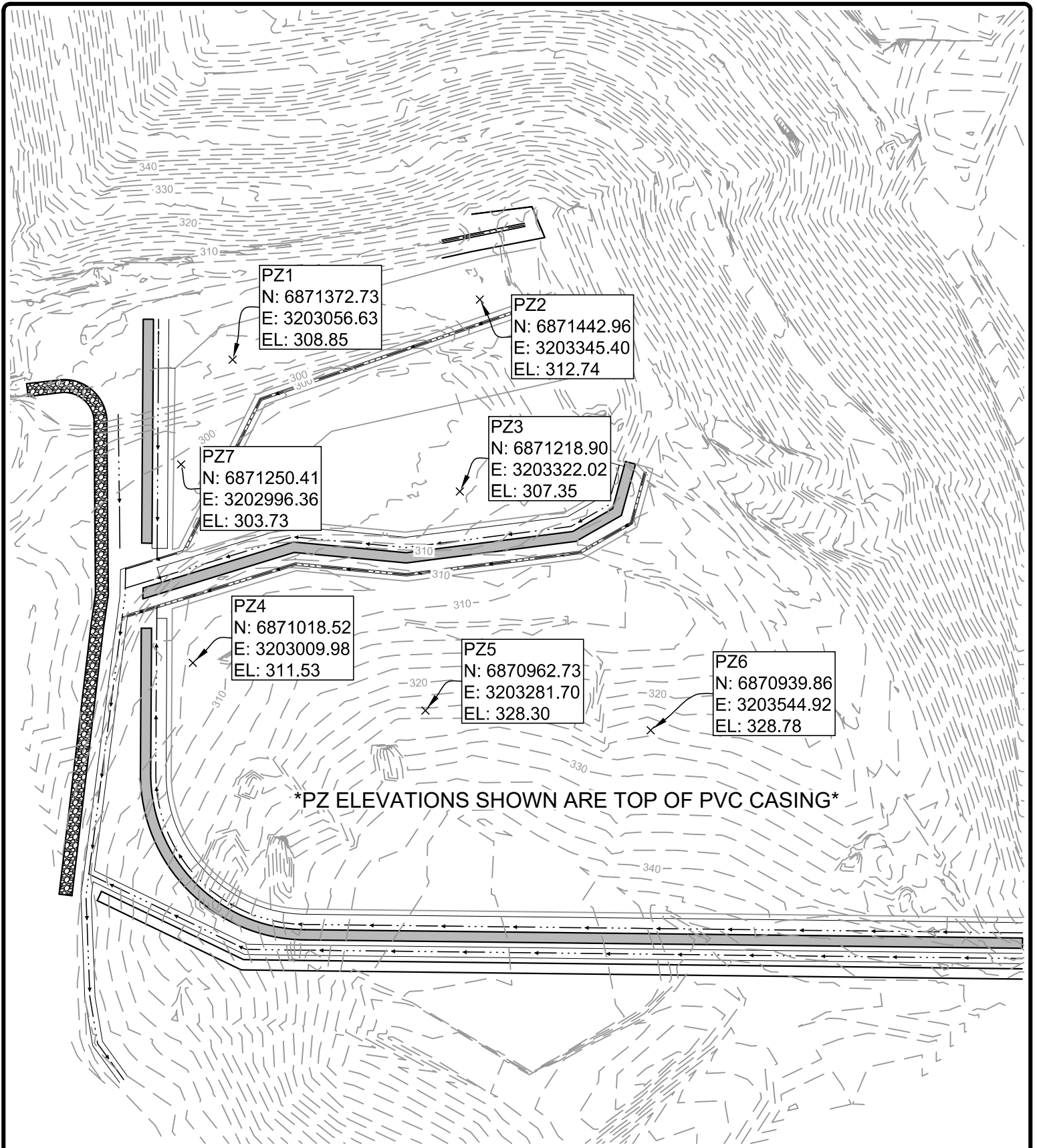
	0			Loose, red, tan, and brown, Clayey Sand (SC)	6								
	5				7	2.0		39	13	19	12	7	
	10			- medium dense, light gray, red and tan below 8 ft	18	N/A		37	23				
	15				15								
	20			Very Stiff, gray and brown, Lean Clay (CL), mottled, laminated	22			91	25	42	16	26	
	25			- hard below 23 ft	79								
	30				79/11								
	35			Very Dense, dark gray, Silty Sand (SM)	76/11			43	30	NP	NP	NP	
	40			Very Stiff, gray and dark gray, Lean Clay (CL), mottled, laminated	21			97	23				
	45			Stiff, gray and dark gray, Sandy Lean Clay (CL), mottled, with occasional lignitic seams	22	1.5		59	25	33	18	15	93
	50			- attempted, no recovery		N/A							
	55				16			48	30				
	60			- laminated at 58 ft	22								
	60			Boring terminated at 60 feet.	29			62	25	44	21	23	
	65												

Additional Information/Comments:

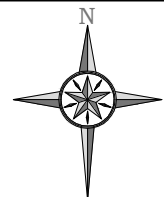
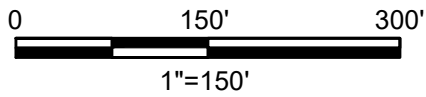
Logger: D. Diduch

Notes/Comments: Seepage encountered at 13 ft during drilling. Water level at 13 feet upon completion.

N/A: Not Attempted



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 www.akron-consulting.com



PZ WELL
 AS-BUILT
 LOCATIONS

STATE OF TEXAS WELL REPORT for Tracking #482280

Owner: American Electric Power Company	Owner Well #: PZ-1
Address: 502 N. Allen Street Shreveport, LA 71101	Grid #: 35-37-4
Well Location: 2400 Farm Road Hallsville, TX 75650	Latitude: 32° 27' 11.79" N
Well County: Harrison	Longitude: 094° 29' 48.1" W
	Elevation: No Data

Type of Work: New Well	Proposed Use: Piezometer
-------------------------------	---------------------------------

Drilling Start Date: **6/14/2018** Drilling End Date: **6/14/2018**

	Diameter (in.)	Top Depth (ft.)	Bottom Depth (ft.)
Borehole:	8.25	0	14

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

	Top Depth (ft.)	Bottom Depth (ft.)	Filter Material	Size
Filter Pack Intervals:	3	14	Sand	20/40

	Top Depth (ft.)	Bottom Depth (ft.)	Description (number of sacks & material)
Annular Seal Data:	0	1	Cement 1 Bags/Sacks
	1	3	Bentonite 2 Bags/Sacks

Seal Method: **Poured**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Alternative Procedure Used**

Surface Completion by Driller

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:	<i>Strata Depth (ft.)</i>	<i>Water Type</i>
	No Data	No Data

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **C&S Lease**
1873 FM 1252 E
Kilgore, TX 75663

Driller Name: **Buford E. Collier** License Number: **50089**

Apprentice Name: **Michael Aaron Dodson** Apprentice Number: **59693**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Casing:
BLANK PIPE & WELL SCREEN DATA

<i>Top (ft.)</i>	<i>Bottom (ft.)</i>	<i>Description</i>
0	5	Red Soft Clay
5	10	Very Soft Red/Grey Clay
10	14	Very Soft Brown Sandy Clay

<i>Dia (in.)</i>	<i>Type</i>	<i>Material</i>	<i>Sch./Gage</i>	<i>Top (ft.)</i>	<i>Bottom (ft.)</i>
2	Riser	New Plastic (PVC)	40	0	4
2	Screen	New Plastic (PVC)	40 0.010	4	14

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #482283

Owner:	American Electric Power Company	Owner Well #:	PZ-2
Address:	502 N. Allen Street Shreveport, LA 71101	Grid #:	35-37-4
Well Location:	2400 Farm Road Hallsville, TX 75650	Latitude:	32° 27' 12.36" N
Well County:	Harrison	Longitude:	094° 29' 44.64" W
		Elevation:	No Data
Type of Work:	New Well	Proposed Use:	Piezometer

Drilling Start Date: **6/14/2018** Drilling End Date: **6/14/2018**

	<i>Diameter (in.)</i>	<i>Top Depth (ft.)</i>	<i>Bottom Depth (ft.)</i>
Borehole:	8.25	0	14

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

	<i>Top Depth (ft.)</i>	<i>Bottom Depth (ft.)</i>	<i>Filter Material</i>	<i>Size</i>
Filter Pack Intervals:	3	14	Sand	20/40

	<i>Top Depth (ft.)</i>	<i>Bottom Depth (ft.)</i>	<i>Description (number of sacks & material)</i>
Annular Seal Data:	0	1	Cement 1 Bags/Sacks
	1	3	Bentonite 2 Bags/Sacks

Seal Method: **Poured**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Alternative Procedure Used**

Surface Completion by Driller

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:	<i>Strata Depth (ft.)</i>	<i>Water Type</i>
	No Data	No Data

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **C&S Lease**
1873 FM 1252 E
Kilgore, TX 75663

Driller Name: **Buford E. Collier** License Number: **50089**

Apprentice Name: **Michael Aaron Dodson** Apprentice Number: **59693**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Casing:
BLANK PIPE & WELL SCREEN DATA

<i>Top (ft.)</i>	<i>Bottom (ft.)</i>	<i>Description</i>
0	5	Red Soft Clay
5	10	Very Soft Red/Grey Clay
10	14	Very Soft Brown Sandy Clay

<i>Dia (in.)</i>	<i>Type</i>	<i>Material</i>	<i>Sch./Gage</i>	<i>Top (ft.)</i>	<i>Bottom (ft.)</i>
2	Riser	New Plastic (PVC)	40	0	4
2	Screen	New Plastic (PVC)	40 0.010	4	14

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Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #482286

Owner: American Electric Power Company	Owner Well #: PZ-3
Address: 502 N. Allen Street Shreveport, LA 71101	Grid #: 35-37-4
Well Location: 2400 Farm Road Hallsville, TX 75650	Latitude: 32° 27' 10.18" N
Well County: Harrison	Longitude: 094° 29' 45.15" W
	Elevation: No Data
Type of Work: New Well	Proposed Use: Piezometer

Drilling Start Date: **6/14/2018** Drilling End Date: **6/14/2018**

	Diameter (in.)	Top Depth (ft.)	Bottom Depth (ft.)
Borehole:	8.25	0	14

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

	Top Depth (ft.)	Bottom Depth (ft.)	Filter Material	Size
Filter Pack Intervals:	3	14	Sand	20/40

	Top Depth (ft.)	Bottom Depth (ft.)	Description (number of sacks & material)
Annular Seal Data:	0	1	Cement 1 Bags/Sacks
	1	3	Bentonite 2 Bags/Sacks

Seal Method: **Poured**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Alternative Procedure Used**

Surface Completion by Driller

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:	<i>Strata Depth (ft.)</i>	<i>Water Type</i>
	No Data	No Data

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **C&S Lease**
1873 FM 1252 E
Kilgore, TX 75663

Driller Name: **Buford E. Collier** License Number: **50089**

Apprentice Name: **Michael Aaron Dodson** Apprentice Number: **59693**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Casing:
BLANK PIPE & WELL SCREEN DATA

<i>Top (ft.)</i>	<i>Bottom (ft.)</i>	<i>Description</i>
0	5	Red Soft Clay
5	10	Very Soft Red/Grey Clay
10	14	Very Soft Brown Sandy Clay

<i>Dia (in.)</i>	<i>Type</i>	<i>Material</i>	<i>Sch./Gage</i>	<i>Top (ft.)</i>	<i>Bottom (ft.)</i>
2	Riser	New Plastic (PVC)	40	0	4
2	Screen	New Plastic (PVC)	40 0.010	4	14

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #482290

Owner: American Electric Power Company	Owner Well #: PZ-4
Address: 502 N. Allen Street Shreveport, LA 71101	Grid #: 35-37-4
Well Location: 2400 Farm Road Hallsville, TX 75650	Latitude: 32° 27' 08.3" N
Well County: Harrison	Longitude: 094° 29' 48.73" W
	Elevation: No Data
Type of Work: New Well	
Proposed Use: Piezometer	

Drilling Start Date: **6/15/2018** Drilling End Date: **6/15/2018**

	Diameter (in.)	Top Depth (ft.)	Bottom Depth (ft.)
Borehole:	8.25	0	14

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

	Top Depth (ft.)	Bottom Depth (ft.)	Filter Material	Size
Filter Pack Intervals:	3	14	Sand	20/40

	Top Depth (ft.)	Bottom Depth (ft.)	Description (number of sacks & material)
Annular Seal Data:	0	1	Cement 1 Bags/Sacks
	1	3	Bentonite 2 Bags/Sacks

Seal Method: **Poured**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Alternative Procedure Used**

Surface Completion by Driller

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:	<i>Strata Depth (ft.)</i>	<i>Water Type</i>
	No Data	No Data

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **C&S Lease**
1873 FM 1252 E
Kilgore, TX 75663

Driller Name: **Buford E. Collier** License Number: **50089**

Apprentice Name: **Michael Aaron Dodson** Apprentice Number: **59693**

Comments: **No Data**

Lithology:
 DESCRIPTION & COLOR OF FORMATION MATERIAL

Casing:
 BLANK PIPE & WELL SCREEN DATA

<i>Top (ft.)</i>	<i>Bottom (ft.)</i>	<i>Description</i>
0	5	Red Soft Clay
5	10	Very Soft Red/Grey Clay
10	14	Very Soft Brown Sandy Clay

<i>Dia (in.)</i>	<i>Type</i>	<i>Material</i>	<i>Sch./Gage</i>	<i>Top (ft.)</i>	<i>Bottom (ft.)</i>
2	Riser	New Plastic (PVC)	40	0	4
2	Screen	New Plastic (PVC)	40 0.010	4	14

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P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #482295

Owner: American Electric Power Company	Owner Well #: PZ-5
Address: 502 N. Allen Street Shreveport, LA 71101	Grid #: 35-37-4
Well Location: 2400 Farm Road Hallsville, TX 75650	Latitude: 32° 27' 07.7" N
Well County: Harrison	Longitude: 094° 29' 45.72" W
	Elevation: No Data
<hr/>	
Type of Work: New Well	Proposed Use: Piezometer

Drilling Start Date: **6/15/2018** Drilling End Date: **6/15/2018**

	Diameter (in.)	Top Depth (ft.)	Bottom Depth (ft.)
Borehole:	8.25	0	20

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

	Top Depth (ft.)	Bottom Depth (ft.)	Filter Material	Size
Filter Pack Intervals:	8	20	Sand	20/40

	Top Depth (ft.)	Bottom Depth (ft.)	Description (number of sacks & material)
Annular Seal Data:	0	1	Cement 1 Bags/Sacks
	1	8	Bentonite 4 Bags/Sacks

Seal Method: **Poured**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Alternative Procedure Used**

Surface Completion by Driller

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:	<i>Strata Depth (ft.)</i>	<i>Water Type</i>
	No Data	No Data

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **C&S Lease**
1873 FM 1252 E
Kilgore, TX 75663

Driller Name: **Buford E. Collier** License Number: **50089**

Apprentice Name: **Michael Aaron Dodson** Apprentice Number: **59693**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Casing:
BLANK PIPE & WELL SCREEN DATA

<i>Top (ft.)</i>	<i>Bottom (ft.)</i>	<i>Description</i>
0	5	Red Soft Sandy Clay
5	10	Very Soft Red/Brown Clay
10	15	Very Soft Red/Tan Sandy Clay
15	20	Tan/Red Silty Sand

<i>Dia (in.)</i>	<i>Type</i>	<i>Material</i>	<i>Sch./Gage</i>	<i>Top (ft.)</i>	<i>Bottom (ft.)</i>
2	Riser	New Plastic (PVC)	40	0	10
2	Screen	New Plastic (PVC)	40 0.010	10	20

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P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #482297

Owner: American Electric Power Company	Owner Well #: PZ-6
Address: 502 N. Allen Street Shreveport, LA 71101	Grid #: 35-37-4
Well Location: 2400 Farm Road Hallsville, TX 75650	Latitude: 32° 27' 07.69" N
Well County: Harrison	Longitude: 094° 29' 42.56" W
	Elevation: No Data
Type of Work: New Well	
Proposed Use: Piezometer	

Drilling Start Date: **6/15/2018** Drilling End Date: **6/15/2018**

	Diameter (in.)	Top Depth (ft.)	Bottom Depth (ft.)
Borehole:	8.25	0	20

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

	Top Depth (ft.)	Bottom Depth (ft.)	Filter Material	Size
Filter Pack Intervals:	8	20	Sand	20/40

	Top Depth (ft.)	Bottom Depth (ft.)	Description (number of sacks & material)
Annular Seal Data:	0	1	Cement 1 Bags/Sacks
	1	8	Bentonite 4 Bags/Sacks

Seal Method: **Poured**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Alternative Procedure Used**

Surface Completion by Driller

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:	<i>Strata Depth (ft.)</i>	<i>Water Type</i>
	No Data	No Data

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **C&S Lease**
1873 FM 1252 E
Kilgore, TX 75663

Driller Name: **Buford E. Collier** License Number: **50089**

Apprentice Name: **Michael Aaron Dodson** Apprentice Number: **59693**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Casing:
BLANK PIPE & WELL SCREEN DATA

<i>Top (ft.)</i>	<i>Bottom (ft.)</i>	<i>Description</i>
0	5	Red Soft Sandy Clay
5	10	Very Soft Red/Brown Clay
10	15	Very Soft Red/Tan Sandy Clay
15	20	Tan/Red Silty Sand

<i>Dia (in.)</i>	<i>Type</i>	<i>Material</i>	<i>Sch./Gage</i>	<i>Top (ft.)</i>	<i>Bottom (ft.)</i>
2	Riser	New Plastic (PVC)	40	0	10
2	Screen	New Plastic (PVC)	40 0.010	10	20

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Austin, TX 78711
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STATE OF TEXAS WELL REPORT for Tracking #482288

Owner: **American Electric Power Company** Owner Well #: **PZ-7**
Address: **502 N. Allen Street** Grid #: **35-37-4**
Shreveport, LA 71101
Well Location: **2400 Farm Road** Latitude: **32° 27' 10.81" N**
Hallsville, TX 75650 Longitude: **094° 29' 48.7" W**
Well County: **Harrison** Elevation: **No Data**

Type of Work: **New Well** Proposed Use: **Piezometer**

Drilling Start Date: **6/14/2018** Drilling End Date: **6/14/2018**

	<i>Diameter (in.)</i>	<i>Top Depth (ft.)</i>	<i>Bottom Depth (ft.)</i>
Borehole:	8.25	0	14

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

	<i>Top Depth (ft.)</i>	<i>Bottom Depth (ft.)</i>	<i>Filter Material</i>	<i>Size</i>
Filter Pack Intervals:	3	14	Sand	20/40

	<i>Top Depth (ft.)</i>	<i>Bottom Depth (ft.)</i>	<i>Description (number of sacks & material)</i>
Annular Seal Data:	0	1	Cement 1 Bags/Sacks
	1	3	Bentonite 2 Bags/Sacks

Seal Method: **Poured**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Alternative Procedure Used**

Surface Completion by Driller

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:	<i>Strata Depth (ft.)</i>	<i>Water Type</i>
	No Data	No Data

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **C&S Lease**
1873 FM 1252 E
Kilgore, TX 75663

Driller Name: **Buford E. Collier** License Number: **50089**

Apprentice Name: **Michael Aaron Dodson** Apprentice Number: **59693**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Casing:
BLANK PIPE & WELL SCREEN DATA

<i>Top (ft.)</i>	<i>Bottom (ft.)</i>	<i>Description</i>
0	5	Red Soft Clay
5	10	Very Soft Red/Grey Clay
10	14	Very Soft Brown Sandy Clay

<i>Dia (in.)</i>	<i>Type</i>	<i>Material</i>	<i>Sch./Gage</i>	<i>Top (ft.)</i>	<i>Bottom (ft.)</i>
2	Riser	New Plastic (PVC)	40	0	4
2	Screen	New Plastic (PVC)	40 0.010	4	14

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