Pirkey Power Plant
East Bottom Ash Pond
Alternate Source Demonstration

The Pirkey East Bottom Ash Pond initiated an assessment monitoring program in accordance with 40 CFR 257.95 on April 3, 2018. Groundwater protection standards (GWPS) were set in accordance with 257.95(d)(2) and a statistical evaluation of the assessment monitoring data was conducted. The statistical evaluation revealed an exceedance of the cobalt GWPS and the lithium GWPS on December 26, 2018. A successful alternate source demonstration for cobalt was certified on April 25, 2019. An alternate source demonstration for lithium is attached. These two alternate source demonstrations explain all exceedances at the East Bottom Ash Pond. The East Bottom Ash Pond will remain in assessment monitoring.

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

H.W. Pirkey Power Plant
East Bottom Ash Pond
Hallsville, Texas

Submitted to

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July 22, 2019

CHA8462

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ATTACHMENTS

LIST OF ACRONYMS

AEP	American Electric Power
ASL	Alternate Screening Level
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
DPT	Direct Push Technology
EBAP	East Bottom Ash Pond
EDS	Energy Dispersive Spectroscopic Analyzer
EPRI	Electric Power Research Institute
GSC	Groundwater Stats Consulting, LLC
GWPS	Groundwater Protection Standard
HSA	Hollow Stem Auger
LCL	Lower Confidence Limit
LOI	Loss on Ignition
MCL	Maximum Contaminant Level
NTU	Nephelometric Turbidity Unit
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
SEM	Scanning Electron Microscope
SSL	Statistically Significant Level
TSS	Total Suspended Solids
UTL	Upper Tolerance Limit
USEPA	United States Environmental Protection Agency
USCS	Unified Soil Classification System
VAP	Vertical Aquifer Profiling
WBAP	West Bottom Ash Pond
XRD	X-Ray Diffraction

SECTION 1

INTRODUCTION AND SUMMARY

The H.W. Pirkey Plant, located in Hallsville, Texas, has four regulated coal combustion residuals (CCR) storage units, including the East Bottom Ash Pond (EBAP, **Figure 1**). In 2018, two assessment monitoring events were conducted at the EBAP in accordance with 40 CFR 257.95. The monitoring data were submitted to Groundwater Stats Consulting, LLC (GSC) for statistical analysis. Groundwater protection standards (GWPSs) were established for each Appendix IV parameter in accordance with the statistical analysis plan developed for the facility (AEP, 2017) and United States Environmental Protection Agency's (USEPA) *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (Unified Guidance; USEPA, 2009). The GWPS for each parameter was established as the greater of the background concentration and the maximum contaminant level (MCL) or alternate screening level (ASL) provided in 40 CFR 257.95(h)(2). To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events.

Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at statistically significant levels (SSLs) above the GWPSs. An SSL was concluded if the lower confidence limit (LCL) of a parameter exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). The following SSLs were identified at the Pirkey EBAP:

- LCLs for lithium exceeded the GWPS of 0.051 mg/L at AD-31 (0.0556 mg/L) and AD-32 (0.0722 mg/L); and

- LCLs for cobalt exceeded the GWPS of 0.0094 mg/L at AD-2 (0.010 mg/L), AD-31 (0.00949 mg/L), and AD-32 (0.0353 mg/L).

No other SSLs were identified (Geosyntec, 2018).

1.1 CCR Rule Requirements

United States Environmental Protection Agency (USEPA) regulations regarding assessment monitoring programs for coal combustion residuals (CCR) landfills and surface impoundments provide owners and operators with the option to make an alternative source demonstration when an SSL is identified (40 CFR 257.95(g)(3)(ii)). An owner or operator may:

> *Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a*

> *qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section….*

Pursuant to 40 CFR 257.95(g)(3)(ii), Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report to document that the SSLs identified for lithium should not be attributed to the EBAP. An alternative source for cobalt at wells AD-2, AD-31, and AD-32 was previously identified and documented in an ASD (Geosyntec, 2019).

1.2 Demonstration of Alternative Sources

An evaluation was completed to assess possible alternative sources to which the identified SSL could be attributed. Alternative sources were identified amongst five types, based on methodology provided by EPRI (2017):

- ASD Type I: Sampling Causes;
- ASD Type II: Laboratory Causes;
- ASD Type III: Statistical Evaluation Causes;
- ASD Type IV: Natural Variation; and
- ASD Type V: Alternative Sources.

A demonstration was conducted to show that the SSLs identified for lithium were based on a Type IV cause and not by a release from the Pirkey EBAP.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The Federal CCR Rule allows the owner or operator 90 days from the determination of an SSL to demonstrate that a source other than the CCR unit caused the SSL. The methodology used to evaluate the SSLs identified for lithium and the proposed alternative source are described below.

2.1 Alternative Source for Lithium

Initial review of site geochemistry, site historical data, and laboratory quality assurance/quality control (QA/QC) data did not identify alternative sources due to Type I (sampling), Type II (laboratory), or Type III (statistical evaluation) issues. As described below, the SSLs for lithium have been attributed to natural variation associated with the underlying geology, which is a Type IV issue.

Lithium concentrations vary spatially across the Site and do not necessarily appear correlated with the locations of CCR units or other Plant operations in general. While AD-31 and AD-32 have higher lithium concentrations than the upgradient wells in the EBAP network (i.e., AD-4, AD-12, and AD-18), upgradient as well as downgradient wells having similar or higher concentrations of lithium were observed within the networks for other CCR units at the Site (**Table 1**). Additionally, a boring advanced in November 2018 immediately upgradient of the EBAP (SB-01/AD-40) (**Figure 1**) revealed a strong dependence of lithium concentration with elevation, as groundwater collected at shallow intervals had low lithium concentrations e.g., (0.0207 mg/L at 30-40 feet below ground surface [ft bgs]) and groundwater collected at deeper intervals had elevated lithium concentrations (e.g., 0.0844 mg/L at 90-100 ft bgs).

These results suggest that lithium concentrations in groundwater at the site have variability in both their lateral and vertical distribution across the Site. In addition to variable lithium concentrations, it was noted that the recorded turbidity at each groundwater monitoring well is typically above the recommended maximum value of 10 nephelometric turbidity units (NTU) during groundwater sampling (**Table 1**). The recorded turbidity of samples collected during the background monitoring period was occasionally above 400 NTU, and some readings noted that the turbidity saturated the field instrument (~1000 NTU). Based on these observations, additional field work was completed to better understand the spatial distribution of lithium and its relationship to turbidity. The additional field investigation was conducted in May 2019.

2.1.1 May 2019 Field Investigation

Geosyntec advanced three borings upgradient of the EBAP between May 7 and 17, 2019 (**Figure 2**) to collect groundwater chemistry data at locations sufficiently far upgradient to completely avoid all known (present and historical) Plant activities. One shallow boring, B-1, was advanced to 36 ft bgs on a parcel owned by AEP approximately 2,000 feet to the north. Two deep borings, B-2 and B-3, were advanced to refusal at 93 and 97 ft bgs, respectively, in locations closer to the plant, but upgradient of the EBAP. Permanent wells were installed at locations B-2 and B-3 for ongoing monitoring.

Prior to boring installation, all borings locations were hand-augured to five ft bgs to check for presence of utilities. A Geoprobe® drilling rig with 2" Direct Push Technology (DPT) was used to log and sample the shallow B-1 boring and the shallow intervals of borings B-2 and B-3. Upon refusal with the DPT rig, a truck-mounted 8" hollow stem auger (HSA) drilling rig with a continuous sampler was used to log and sample borings B-2 and B-3 below DPT refusal depth. Soils were logged continuously from the surface using the Unified Soil Classification System (USCS). Boring logs are provided in **Attachment A**. Both soil and groundwater sampling were conducted at each of the three borings. Boring B-1 was not used for a permanent well and was backfilled to the surface with Portland cement and bentonite.

2.1.1.1 Soil Sampling

The onsite hydrostratigraphic unit for the EBAP was identified as the clayey and silty sand stratum located between an elevation of approximately 325 and 340 feet above mean sea level (Arcadis, 2016). This unit is within the Reklaw Formation, which consists predominantly of clay and fine-grained sand and is underlain by the Eocene-age Carrizo Sand. The presence of lignite in the area is well-documented (Broom and Myers, 1966; ETTL, 2010). Geosyntec collected nine additional soil samples to better understand the distribution of lithium in soils in upgradient locations and with depth.

One soil sample at boring B-1, five samples at B-2 (including a sample of coal/lignite material found within the stratigraphic column), and three samples at boring B-3 were collected for total metals analysis via EPA Method 6010. Soil samples were collected just above the groundwater table, at the base of the deep borings, and at intervals of interest. The depths and rationale for each sample collected are summarized in **Table 2**. Except for the coal fragments collected in boring B-2 at 81.5 ft bgs, soil samples represent composite samples of the indicated depth interval.

Lithium concentrations of soil samples collected during the May 2019 field investigation varied from 2.59 mg/kg (B-3, 19.5-20.5 ft bgs) to 13.1 mg/kg (B-2, 87-88 ft bgs), which generally is consistent with soils previously sampled around the site. Results of the coal fragments from 81.5 ft bgs in boring B-2 indicated that the coal contained 4.32 mg/kg lithium. This is comparable to the lithium concentrations of the shallower (< 20 ft bgs) soil samples, which averaged 4.1 mg/kg (n=5), and less than the average concentrations observed in the co-located deeper lithology of 10.54 mg/kg (n=3). Lower lithium in shallower soil intervals could indicate weathering has mobilized lithium from those intervals.

2.1.1.2 Groundwater Sampling

Borings B-2 and B-3 were sampled via vertical aquifer profiling (VAP) techniques, in which multiple temporary well screens were set at the varying depth intervals of interest. Generally, a sample was taken after encountering the water table, followed by subsequent attempts to collect additional samples at ten-foot intervals. Shallow groundwater samples (< 24 ft bgs) were collected from temporary drop screens installed via DPT in offsets from the originally logged location. Two sampling depths were attempted using DPT in borings B-2 and B-3, one at the water table and one ten feet below the water table. In both borings, only the shallower water-table interval produced enough water to sample due to clayey lithology below the water table. One shallow groundwater grab sample was collected at boring B-1 using DPT and temporary well screen methodology.

Following DPT refusal, VAP samples were collected from the same HSA borehole being logged and soil-sampled at borings B-2 and B-3. After removing the HSA continuous sampler, a four-inch diameter polyvinyl chloride (PVC) casing with a five-foot long well screen were temporarily installed through the HSA tooling, and the augers were retracted to expose the well screen to the formation. Following sampling, the well casing and screen was removed and decontaminated, and drilling resumed for another ten feet. Four samples from boring B-2 and six samples from boring B-3 were collected using the HSA VAP methodology. Five-foot intervals in boring B-2 at 68-73 and 88-93 ft bgs and boring B-3 at 92.5-97.5 bgs did not produce enough water to collect a sample due to clay lithology. **Table 3** summarizes the groundwater samples collected in May 2019.

Groundwater VAP sampling was generally completed using a modified low-flow methodology. When possible, flow rates below 500 ml/min were used during purging, and drawdown was monitored. Geochemical parameters and turbidity were monitored, though stability was not observed during purging the temporary well screens. Wells were purged for a minimum of 20 minutes prior to sampling. However, turbidity remained visibly high at all sampling intervals prior to sample collection.

Groundwater VAP samples were sent to the lab on ice for quick turn-around analysis of total lithium concentrations via EPA Method 6010. Due to the high turbidity in the total lithium samples, extra sample volume was collected in an unpreserved one-liter plastic sample bottle for lab filtration using a 0.45-µm filter and analysis of dissolved lithium. Groundwater samples were also analyzed a full scan of metals, total dissolved solids, major anions, and alkalinity.

Total (unfiltered) lithium concentrations varied from 45 µg/L to 1,140 µg/L (**Table 3**). Lithium concentrations in the lab filtered samples varied from 6 µg/L to 105 µg/L. The lab filtered results were generally lower than the total lithium results, suggesting a correlation between turbidity and lithium concentration. Select total lithium concentrations were higher than previously observed at the Site. This is likely due to the fact that the samples were collected without a developed filter pack and with elevated turbidity. Additional groundwater results are available in **Attachment B**. Total metals data for parameters other than lithium are not available for samples from B-2 as they were analyzed using incorrect laboratory techniques.

2.1.1.3 Permanent Well Sampling

Permanent wells were installed at boring B-2 and B-3, with the screened interval based on VAP sampling results. The HSA drilling rig was used to install a well screen at 38 to 48 ft bgs at boring B-2 and 29 to 34 ft bgs at boring B-3. These elevations are consistent with the screened elevations at AD-31 and AD-32. Well construction diagrams are available in **Attachment C**. Wells were installed per state regulations and certified by a Texas licensed driller. After an appropriate set-up time for the bentonite seal, the wells were developed with a Proactive Typhoon pump until turbidity and geochemical parameters stabilized (**Attachment D**). Following well development, both new permanent wells were sampled using low-flow methodology (**Attachment E**).

Total lithium concentrations in permanent wells B-2 and B-3 were measured at 0.053 mg/l and 0.061 mg/l, respectively (**Figure 3**). These concentrations are slightly above the GWPS of 0.051 mg/L. Because these wells were installed at upgradient locations unimpacted by Site activities, they suggest that lithium concentrations above the GWPS are located in the vicinity of the EBAP, but not necessarily related to the prevailing groundwater flow direction. Samples were also collected from AD-31 and AD-32 using low-flow methodology, with special effort taken to purge the well until turbidity was below 10 NTU (**Attachment E**). The reported lithium concentrations for these samples were near or below the lowest value observed during monitoring at these locations to date (**Figure 4**). While not a direct correlation, these results suggest that elevated turbidity may be associated with higher lithium concentrations.

2.1.1.4 Investigation of Suspended Solids

It was noted during VAP and permanent well sampling that lithium is biased toward higher concentrations when samples are very turbid. Therefore, an additional investigation was conducted to evaluate the suspended matter and determine whether it could be serving as a background source of lithium. Unpreserved groundwater samples from intervals VAP-B3-(40-45) and VAP-B3-(50-55) were processed to separate the particulate from the groundwater. Aliquots of each sample were centrifuged at approximately 700 Relative Centrifugal Force for five minutes. The supernatant was then decanted, and the solid pellet was transferred to a small glass vial for chemical analysis. The supernatant had a yellowish color, suggesting that especially fine particulate remained in suspension, but accounted for very little mass.

In addition to the centrifuged material from VAP-B3-(40-45), a sample of the bulk soil from interval B2-(19-20) was submitted for analysis by X-ray diffraction (XRD). XRD is commonly used to identify and quantify crystalline solids among an assemblage of solids. Solids that are amorphous (non-crystalline), such as humic substances and other organic matter, cannot be detected with compositional specificity by XRD.

Results of the XRD analysis indicate the presence of common soil minerals (**Table 4**). The bulk soil [B-2-(19-20)] contained a higher fraction of quartz (67%), which is typical of an unconsolidated sandy aquifer. Soil in this depth interval also contained several percent by weight of clay minerals, including kaolinite, chlorite, illite and smectite. Goethite (a mineral composed of iron(III) hydroxide) comprises 2% of the sample and a form of amorphous (non-crystalline) matter makes up approximately 7% of the sample.

The centrifuged sample [VAP-B3-(40-45)] contained less quartz (15%), a higher fraction of clay minerals (42% kaolinite, 4% chlorite, 6% illite and 12% smectite), and 15% (roughly estimated) amorphous matter. According to the XRD results, this soil fraction contains 2% hematite, an iron(III) oxide (Fe_2O_3) and 3% pyrite.

Sulfur and iron were among the elements identified in the VAP-B3-(50-55) centrifuged solid material sample by scanning electron microscopy (SEM) using an energy dispersive spectroscopic analyzer (EDS). Results, reported as weight percent oxides and sulfide in **Table 5**, show 3.4% FeS_2 and 2.8% Fe_2O_3. While these results express chemical composition rather than mineralogy, it is reasonable to infer that FeS_2 represents pyrite and Fe_2O_3 represents hematite (Fe_2O_3) and goethite ($Fe_2O_3 \cdot H_2O$) based on the XRD results. Silica, aluminum and potassium oxides correspond to the quartz and clay minerals identified in **Table 4**.

The abundance of smectite in both XRD samples bears consideration. Smectite is a group name for certain clay minerals with a 2:1 silicate structure which form crystals that are typically sub-micrometer in size. Common types of smectite include montmorillonite and beidellite, but a lithium-bearing form called hectorite is also well known (USGS, 2001). Smectites have among the highest cation-exchange capacities of all clay minerals: their interlayer regions can sorb roughly 100 milli-equivalents of cation charge per 100 grams of clay (100 meq/100 g). Exchangeable metals often include calcium and sodium, but almost all metals with +1 or +2 charge are potential exchange species. The SEM/EDS results also confirm that aluminum and silicon are major constituents, which supports the XRD finding that clays are the predominant mineral in suspension. The presence of potassium also helps confirm the presence of illite (mica), which was identified by XRD.

It is noteworthy that the centrifuged solid material had a higher fraction of amorphous (non-crystalline) material, which could include organic solids. Moreover, this amorphous material may be what contains the abundance of clay minerals. While the XRD results are inconclusive, one possibility is that the amorphous material is lignite and the clays are associated with its mineral fraction.

Because XRD cannot identify if lithium is present within a sample, the centrifuged solid material was submitted for total metals analysis. An additional sample of suspended matter from VAP interval B3-(50-55) was also submitted for metals analysis, as it had the highest total lithium of all the VAP samples that were collected. Lithium was detected in B3-(50-55) and B3-(40-45) (**Table 6**) at concentrations comparable to lithium in the bulk soil (**Table 2**). These results provide evidence that the particulates captured during groundwater sampling contain lithium.

Metals in a lignite sample from the nearby surficial mine were compared to concentrations in the suspended matter (**Figure 5)**. The concentrations of lithium and other constituents are similar, suggesting that some fraction of the suspended solids consists of degraded lignite. Thin seams of lignite were noted in boring logs at the depth most monitoring wells at the Site were installed (**Attachment A**).

Loss on ignition (LOI) testing was completed to quantify mass loss after heating the sample to 550°C in an oxygen-rich environment, which allows for measurement of the combustible carbon and loss of semi-volatile constituents. Centrifuged solid material from both the VAP B3-(40-45) and B3-(50-55) fraction were air-dried in pre-weighed pans to 103˚C to remove excess water from the samples. The samples were weighed again and then heated to 550˚C until the mass of the fraction was steady, signifying complete combustion of the volatile fraction. The B3-(40-45) sample had a volatile fraction of 13.1%, and the B3-(50-55) sample had a volatile fraction of 11.4% of the total mass, respectively. These fractions are believed to represent organic compounds, such as lignite. The volatile fraction in the 40-45 ft sample (13.1%) is in good agreement with the determination of 15% amorphous matter by XRD (**Table 4**). By difference, the solid fractions consist of 87-89% refractory minerals including clays, metal oxides, and pyrite. Because lignite typically contains ~20 % hydrocarbons (plus oxygen and nitrogen), and only 6-19% mineral matter (Ghassemi, 2001), the results of the LOI tests suggest that most of the organic fraction of the lignite has been lost to degradation, primarily leaving the mineral fraction in place of the original lignite deposit.

Based on chemical analysis of the two solid samples, the iron content is 1.1% for B-2 and 2.6% for B-3, which is comparable to the amount of iron in the lignite sample (1.4%) from the Plant (**Table 6**). While some of the iron is associated with the oxidized iron minerals, goethite and hematite, which were detected by XRD (**Table 4**), some iron is likely present in pyrite as well. As noted above, pyrite was detected by XRD in the particulate sample (B-3) and iron and sulfur were both detected in the particulate by SEM/EDS, but the results were not quantified.

Together with the evidence presented for pyrite in the suspended solids and in locally-mined lignite, the solid phase results support the proposed alternative source for lithium, which is naturally suspended matter that likely originates from lignite and is ubiquitous in the shallow aquifer.

The total metal concentrations in the centrifuged solid material samples and the total groundwater concentrations were used to calculated partition coefficients values (K_d) for multiple constituents, including lithium. The calculated K_d values were comparable to literature K_d values reported for organic-rich soil media such as bogs and peats (**Table 7**) (Sheppard et al, 2009; 2011). Additionally, total suspended solids (TSS) concentrations were calculated using the solids and groundwater concentrations and compared to TSS concentration measured using gravimetric techniques (**Table 7**). These values were also comparable, providing further evidence that lithium behavior at the site is similar to its adsorption and mobility at other organic-rich sites described in the literature.

2.1.2 Proposed Mechanism for Lithium Transport in Groundwater

Based on the chemistry results, it is proposed that lithium is associated with clay minerals that make up the mineral fraction of lignite, which is deposited in thin beds at various depths within the aquifer. Clay particles which remain suspended due to their association with the lignite matrix are the vehicle for lithium transport. It appears that these particles remain in suspension during low-flow groundwater sampling even after very long purge times, as evidenced by the historical high turbidities measured in Site groundwater. During groundwater sampling, an abundance of suspended matter is mobilized with the sample which, after nitric-acid preservation, releases the lithium into solution where it often results in elevated concentrations.

A simple model to illustrate the effect of suspended solids on total (unfiltered) lithium is shown in **Figure 6**. This model used the partition coefficients described in Section 2.1.1 to calculate the dissolved phase concentrations of lithium plus the contribution of lithium to groundwater by the particulate (see **Table 7**). Although results for the two sources are not identical, the figure shows that when the abundance of suspended matter reaches a certain level (approximately 10 g/L or higher) the total lithium (dissolved plus suspended) can greatly exceed that of the dissolved phase alone. According to the model, lithium concentrations are less variable when lower concentrations of suspended solids are present in groundwater. This provides an explanation for why observed lithium concentrations at the Site are not clearly correlated with turbidity. The analytical data, geologic information, and sorption model presented above provide a mechanism for the distribution and transport of naturally occurring lithium in Site groundwater.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.95(g)(3)(ii) and supports the position that the SSLs for lithium at wells AD-31 and AD-32 identified during assessment monitoring in 2018 were not due to a release from the EBAP. The identified SSLs were, instead, attributed to natural variation in the underlying geology. Therefore, no further action for lithium is warranted, and the EBAP will remain in the assessment monitoring program. Certification of this ASD by a qualified professional engineer is provided in **Attachment F**.

SECTION 4

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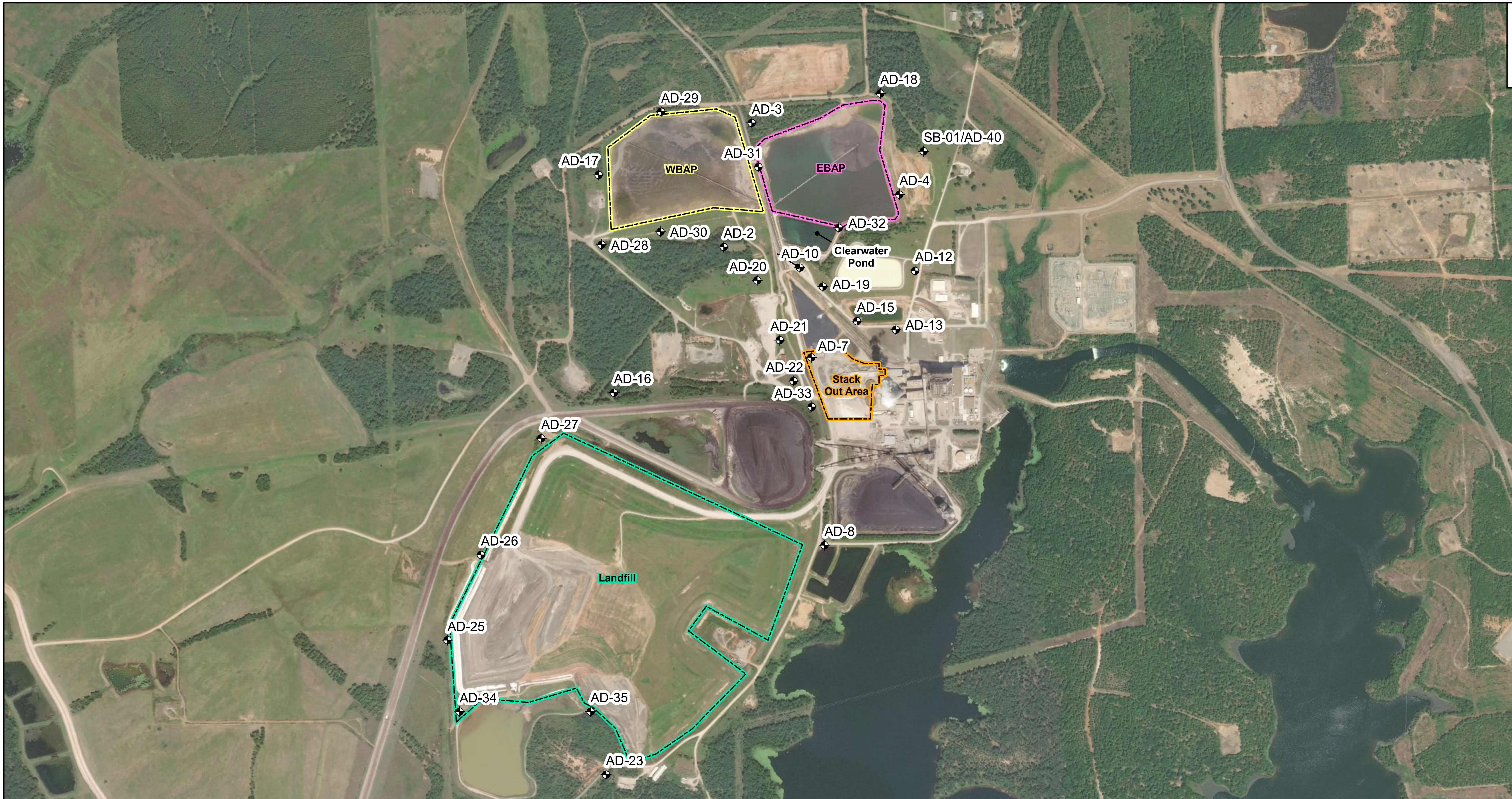
Figures



Legend

- Monitoring Well
- EBAP
- Landfill
- Stack Out Area
- WBAP

Notes

- Monitoring well coordinates provided by AEP.
-AD-15 location is approximated

800 400 0 800 Feet

Site Layout

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2019/07/10

Figure 1

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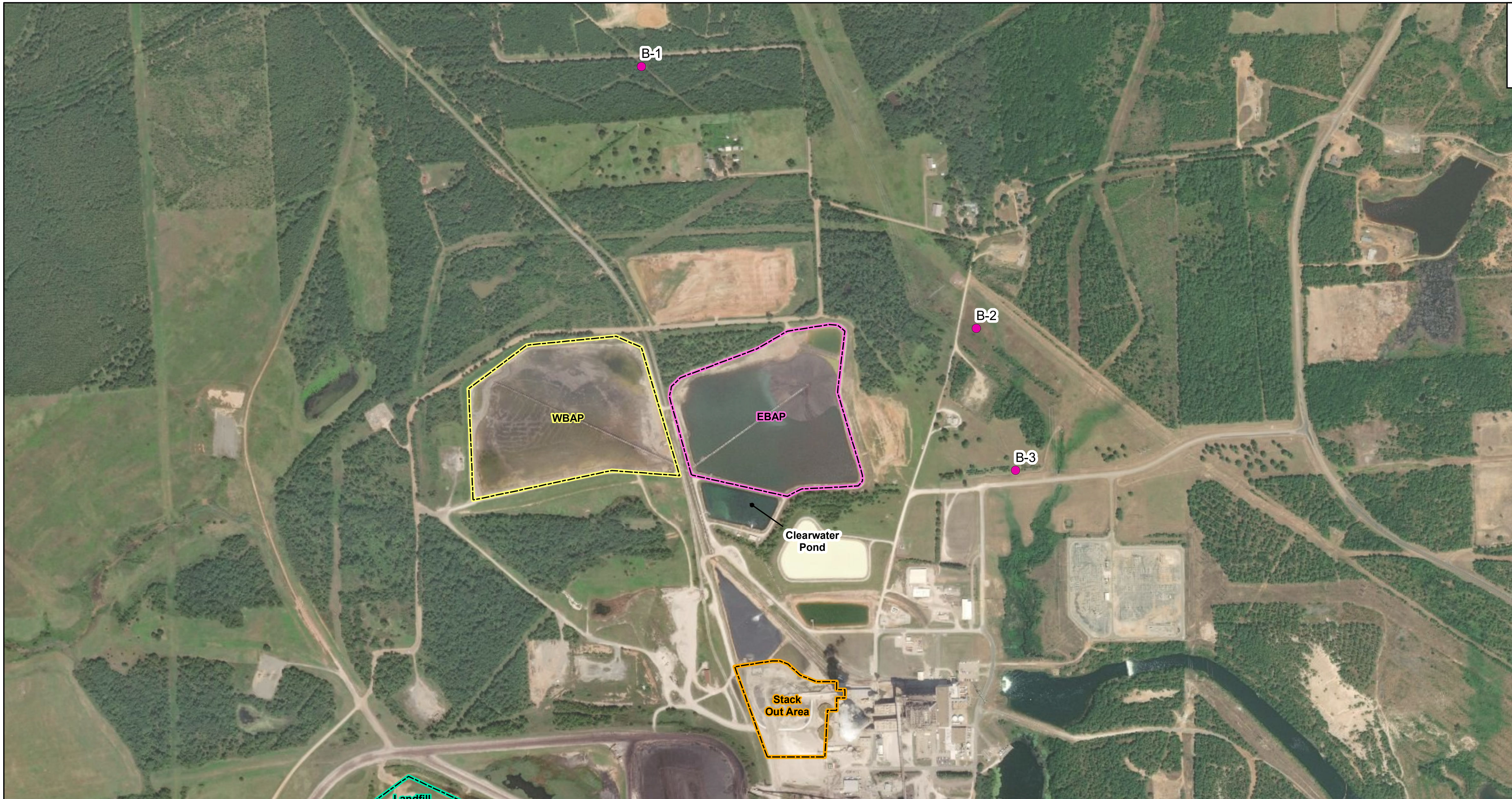

Legend

- Soil Boring Location
- EBAP
- Landfill
- Stack Out Area
- WBAP

Notes
-Data provided by AEP, 2019.
-Soil Boring locations are approximate.

0 350 700 1,400 2,100 Feet

Soil Boring Locations

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2019/07/10

Figure **2**

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Legend

- Borehole
- Monitoring Well

Location Boundaries

- EBAP
- Landfill
- Stack Out Area
- WBAP

Notes

- Lithium concentrations in mg/l
- Monitoring well coordinates and water level data (collected on August 20-21, 2018) provided by AEP.
- Data provided by AEP 2019
- AD-15 location is approximated

Lithium Values May 2019

AEP Pirkey Power Plant
Hallsville, Texas

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Figure **3**

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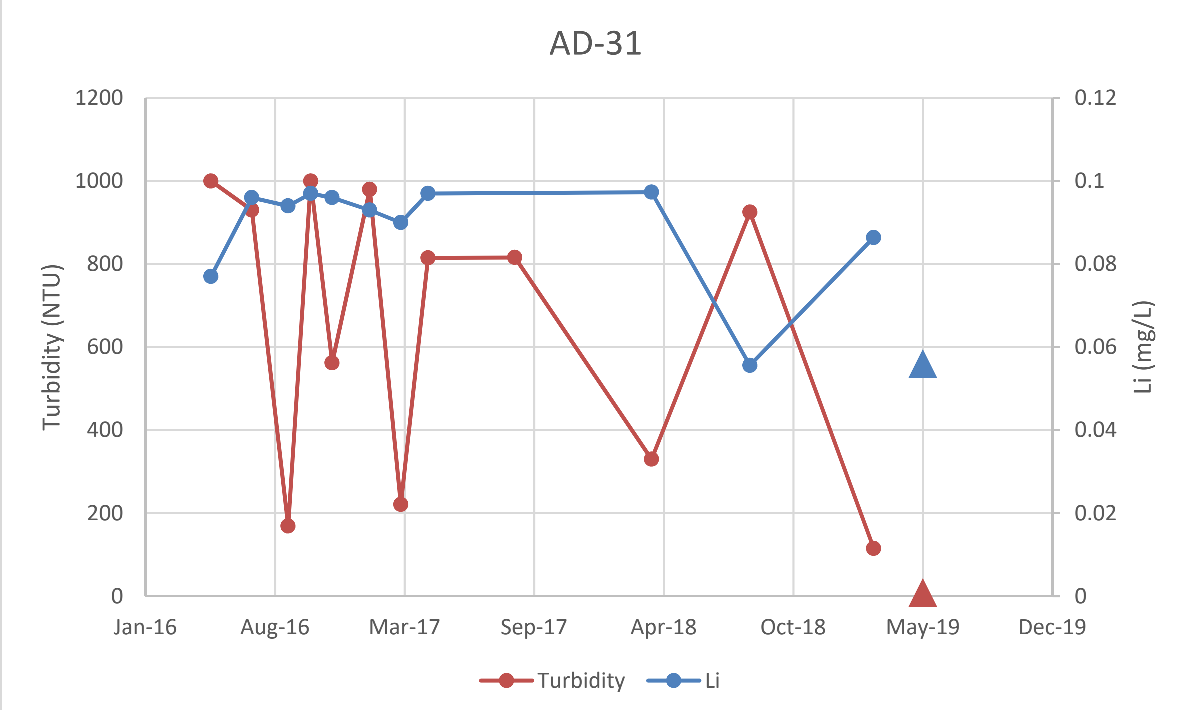

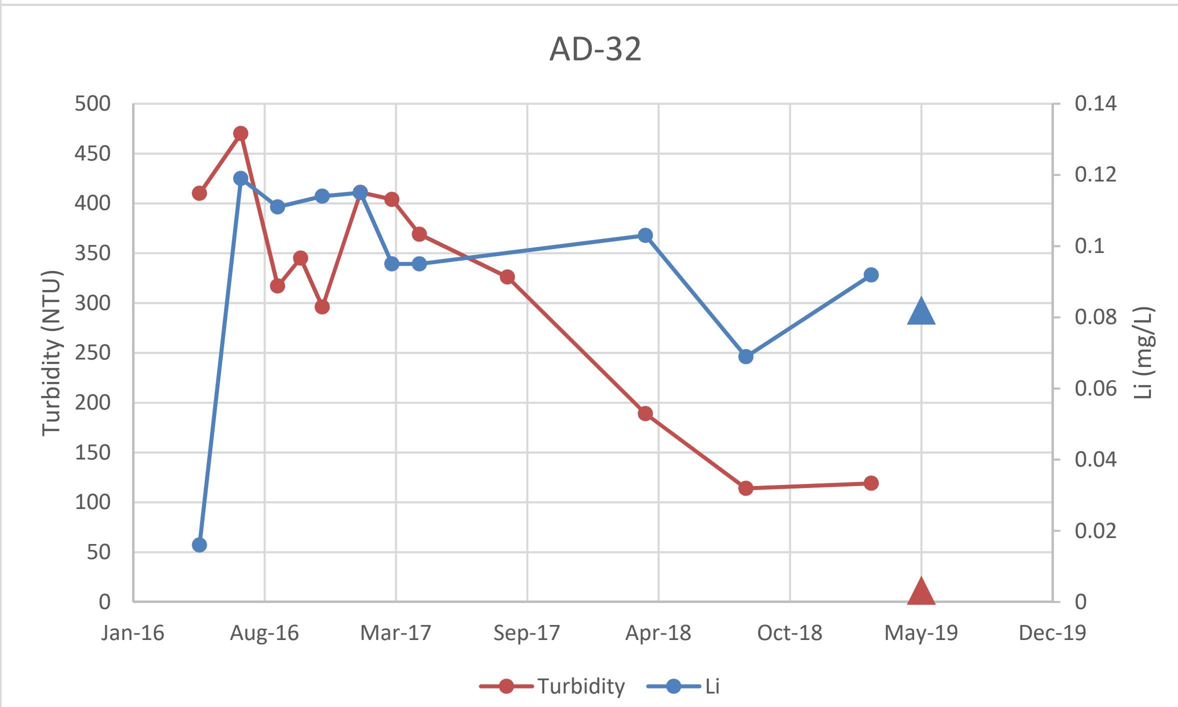

Notes:
NTU: nephelometric turbidity units
mg/L: milligrams per liter

Lithium and Turbidity Time Series Graphs
Pirkey East Bottom Ash Pond

Geosyntec consultants

AMERICAN ELECTRIC POWER

Columbus, Ohio | 7-Jul-2019

Figure
4

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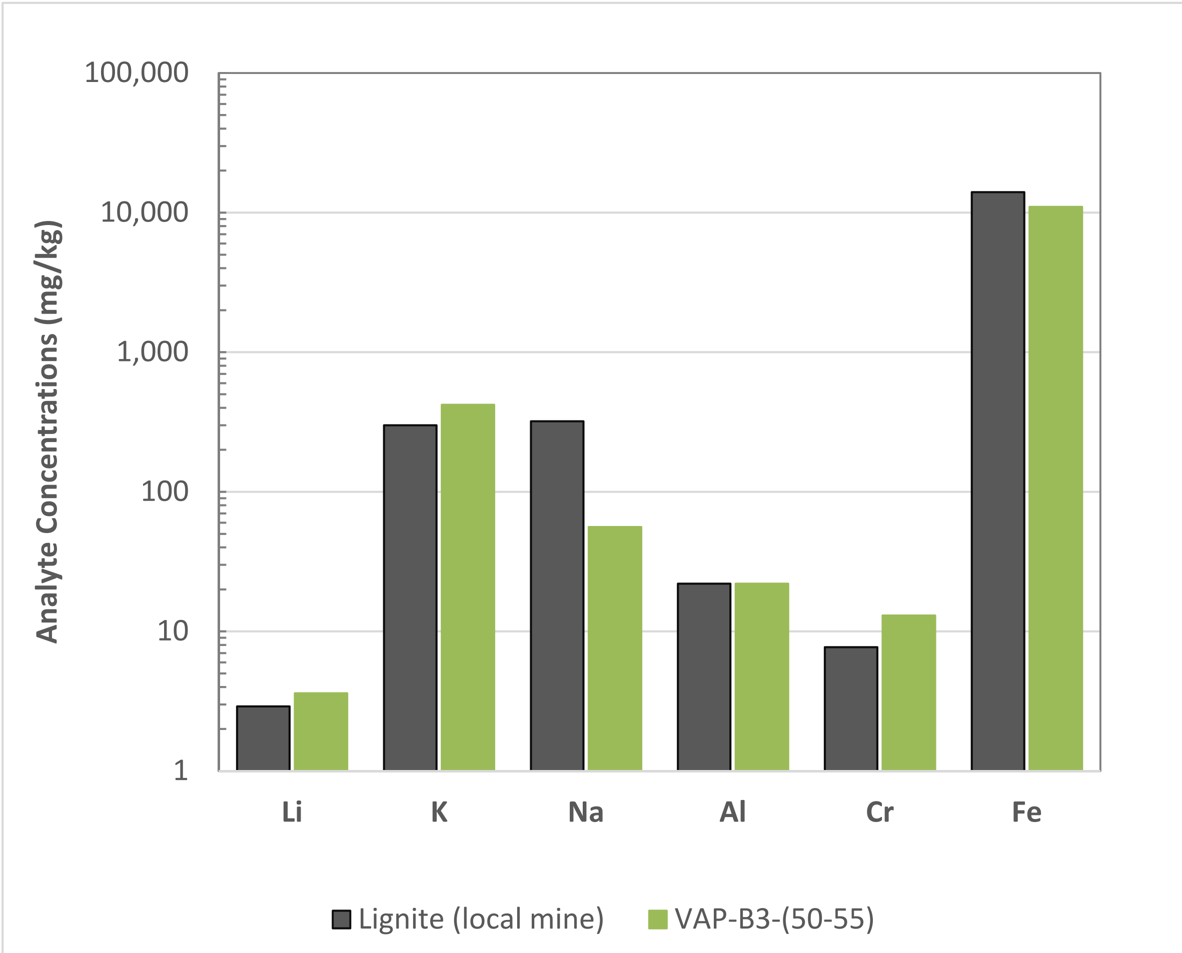

Notes: VAP-B3-(50-55) sample was obtained by centrifuging suspended solids in groundwater at the 50-55 ft interval. Locally mined lignite was collected from the coal pile at the Site.

Total Metals Concentrations

Pirkey East Bottom Ash Pond

Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure **5**

Columbus, Ohio

7-Jul-2019

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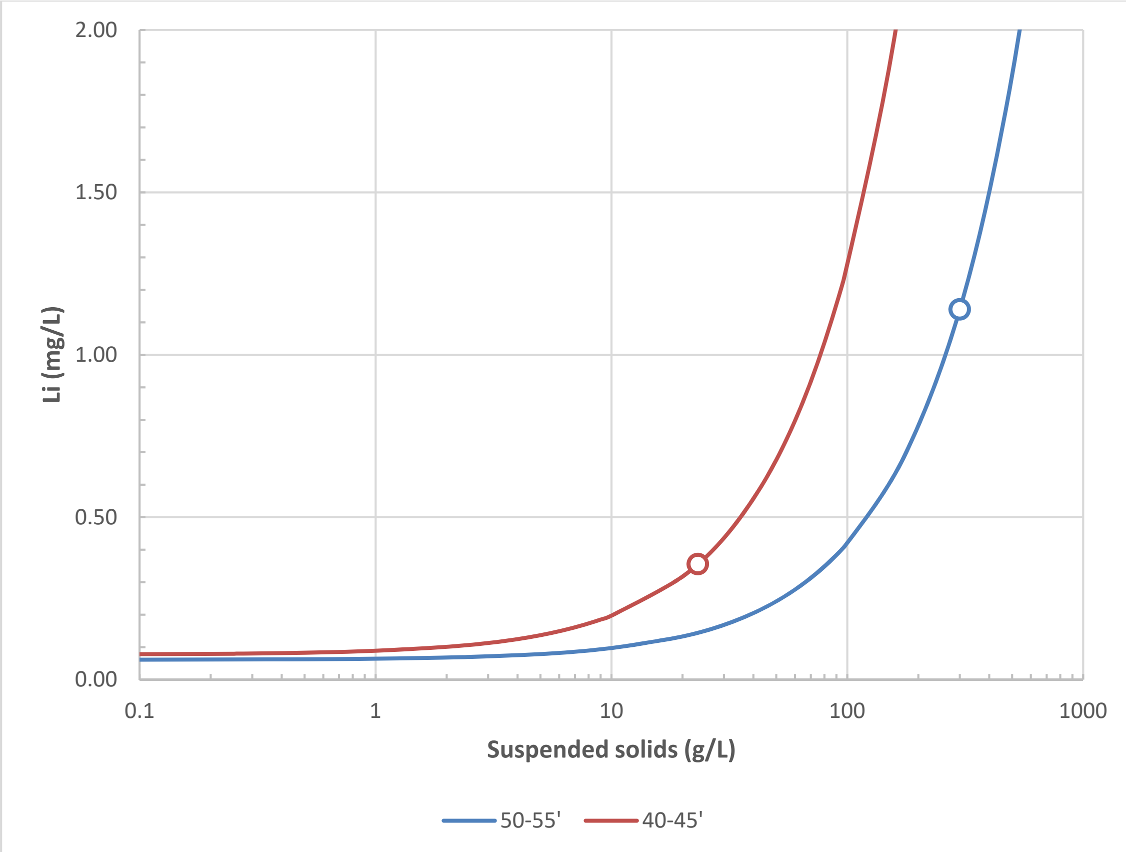


Notes: Model for lithium concentrations based on sorption on suspended solids. The model was generated using the results from VAP-B3-(50-55) and –(45-55). Symbols represent results of unfiltered samples.

Calculated Lithium Sorption Model

Pirkey East Bottom Ash Pond

Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure 6

Columbus, Ohio

7-Jul-2019

internal info: path, date revised, author

Tables

Table 1: August 2018 Groundwater Lithium and Turbidity Results
Pirkey Plant - East Bottom Ash Pond

Well	Lithium (mg/L)	Turbidity (NTU)	CCR Unit Network
AD-2	0.0479	155	EBAP
AD-3	0.0876	190	WBAP
AD-4	0.0294	201	EBAP
AD-7	0.0877	103	Stackout
AD-8	0.0221	103	Landfill
AD-12	0.0143	177	EBAP/WBAP/Landfill/Stackout
AD-13	0.146	181	Stackout
AD-16	0.0347	100	Landfill
AD-17	0.0234	124	WBAP
AD-18	0.0175	278	EBAP/WBAP
AD-22	0.132	235	Stackout
AD-23	0.00634	995	Landfill
AD-27	0.0921	279	Landfill
AD-28	0.0307	216	WBAP
AD-30	0.0118	142	WBAP
AD-31	0.0556	925	EBAP
AD-32	0.0689	114	EBAP
AD-33	0.0178	102	Stackout
AD-34	0.114	131	Landfill
AD-35	0.00876	258	Landfill

Notes:
mg/L: milligrams per liter
NTU: nephelometric turbidity units
EBAP: East Bottom Ash Pond
WBAP: West Bottom Ash Pond
Stackout: Stackout Pad

Table 2: Soil Sampling Results
Pirkey Plant - East Bottom Ash Pond

	Boring	B-1	B-2					B-3		
	Depth (ft bgs)	16-21	9.5-10.5	19-20	71-72	81.5	87-88	9.5-10.5	19.5-20.5	96.5-97
	Sampling Rationale	Soil above groundwater table	Soil 10 ft bgs	Soil above groundwater table	Soil with abundant coal material	Coal Fragments	Soil at auger refusal depth (93 ft bgs)	Soil 10 ft bgs	Soil above groundwater table	Soil at auger refusal depth (97 ft bgs)
	Soil Type	Sandy clay/clay/ clayey sand	Fat clay	Clay, medium plasticity	Coal/sand interbeds with clay	--	Silty clay, low plasticity	Silty clay	Fat clay	Silty clay, low plasticity
Metals Concentrations (mg/kg)	Aluminum	NM	NM	NM	NM	NM	NM	15600	8170	NM
	Antimony	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
	Arsenic	14.3	17.9	12.3	7.94	5.01	1.88	17.4	9.96	0.89
	Barium	51.7	53.8	39.5	39.4	53.7	27.5	47.2	206	35.5
	Beryllium	0.376	0.477	0.385	0.217	1.99	0.233	0.419	0.301	0.273
	Boron	11.9	11	13.1	13.6	48.3	12.1	11.2	5.44	7.8
	Cadmium	0.185	0.116	0.234	0.208	<0.05	<0.05	<0.05	<0.05	0.05
	Calcium	183	117	195	245	1820	479	36	45.4	226
	Chromium	37.6	33.3	26.2	6.93	42.5	16.1	31.2	19.6	13.2
	Cobalt	2.95	2.36	3.62	10.3	7.21	3.11	1.3	0.593	1.11
	Iron	41000	36900	42800	38100	22600	17300	25300	13800	2880
	Lead	12.1	9.31	8.29	6.87	9.5	10.5	8.8	5.21	9.1
	Lithium	5	5.3	3.97	7.42	4.32	13.1	3.64	2.59	11.1
	Magnesium	968	2840	1720	362	716	845	1400	528	365
	Manganese	15.6	10.4	12.7	38.8	48.8	32.1	10.5	6.9	16.1
	Molybdenum	0.828	0.608	0.479	3.38	1.63	0.8	0.692	0.654	0.334
	Nickel	NM	NM	NM	NM	NM	NM	3.05	4.26	NM
	Potassium	1370	2360	1860	456	276	663	2230	1120	437
	Selenium	1.57	1.02	1.13	2.04	2.52	1.84	0.666	0.448	1.39
	Sodium	53.1	139	51.7	57.6	86.3	53.7	47.3	56.3	39.9
	Strontium	62.5	47.9	13.4	6.52	15.5	10.5	12.8	6.51	8.24
	Thallium	<0.25	<0.25	<0.25	0.306	0.799	<0.25	<0.25	<0.25	<0.25
Dry Weight (%)		74.3	78.5	78.9	84.7	75.3	87.3	80.3	78.5	86.8

Notes:
ft bgs - feet below ground surface
< - Analyte not detected above analytical detection limit
NM - Not measured

Table 3: Groundwater Lithium Sampling Results
Pirkey Plant - East Bottom Ash Pond

Boring	Depth Interval (ft bgs)	Drilling Method	Lithium Concentration (mg/L)	
			Total	Lab Filtered
B-1	16-21	DPT	0.202	0.022
B-2	10-14	DPT	0.045	0.006
	38-43	HSA	0.140 (0.142)	0.056 (<0.05)
	48-53	HSA	0.112	<0.05
	58-63	HSA	0.143	<0.05
	78-83	HSA	0.201	0.097
B-3	20-24	DPT	0.053	0.013
	33-37	HSA	0.152	0.105
	40-45	HSA	0.356	0.077
	50-55	HSA	1.140	0.061
	60-65	HSA	0.098	0.052
	72.5-77.5	HSA	0.812	0.009
	82.5-87.5	HSA	0.102	0.023

Notes:
< - Analyte not detected above analytical detection limit
DPT: Direct push technology
HSA: Hollow stem auger
Results for other groundwater parameters available for B-1 and B-3 in Attachment B.
Total lithium results from unfiltered sample volume collected in HNO_3 preserved bottle.
Lab filtered results from laboratory vacuum-filtered sample volume collected in unpreserved bottle.
Duplicate results in parentheses.

Table 4: X-Ray Diffraction Results
Pirkey Plant - East Bottom Ash Pond

	B-2(19-20)	VAP-B3-(40-45)
Quartz	67	15
Plagioclase Feldspar	ND	0.5
Orthoclase	<0.5	ND
Calcite	<0.5	ND
Dolomite	1	ND
Siderite	ND	0.5
Goethite	2	ND
Hematite	ND	2
Pyrite	ND	3
Kaolinte	4	42
Chlorite	1	4
Illite/Mica	2	6
Smectite	16	12
Amorphous	7	15

Notes:
ND: Not detected
<0.5 indicates mineral phase is present but below quantification limits.
B-2(19-20) sample represents bulk soil.
VAP-B3-(40-45) is the centrifuged solid material from the groundwater sample collected at that interval.

Table 5: SEM/EDS Microscopy Results
Pirkey Plant - East Bottom Ash Pond

	Centrifuged Material (Weight Percent)
Al_2O_3	31.1%
SiO_2	60.9%
FeS_2	3.4%
K_2O	1.7%
TiO_2	ND
Fe_2O_3	2.8%

Notes:
ND: component not detected
concentration below the analytical detection limit
Centrifuged material was the solid material which separate from the groundwater sample at VAP interval B3-(50-55) after centrifugation.
Oxide calculations are expressed on a dry basis and do not include molecular structural water.

Table 6: Centrifuged Solids Total Metals Results
Pirkey Plant - East Bottom Ash Pond

Depth (ft bgs)		B3-(40-45)	B3-(50-55)	Lignite
Analyte Concentrations (mg/kg)	Aluminum	68 J	22 J	22 J
	Boron	6.4 J	2.3 J	77
	Calcium	1,200	160 J	7,700
	Chromium	37	13	7.7
	Iron	26,000	11,000	14,000
	Lithium	12	3.6 J	2.9 J
	Magnesium	880	260	1,900
	Potassium	960	420 J	300 J
	Sodium	270 J	56 J	320 J
	Mercury	1.1	0.026 J	0.13 J

Notes:
ft bgs - feet below ground surface
< - Analyte not detected above analytical detection limit
mg/kg: milligrams per kilogram
J - Estimated analyte concentration below the reporting limit and above the method detection limit
B-3 samples are centrifuged solid material separated from groundwater samples collected at the designated interval.
Lignite was collected from a local mine.

Table 7: Calculated Site-Specific Partition Coefficients
Pirkey Plant - East Bottom Ash Pond

Source	B-3 40-45 ft bgs						Literature Value
Unit	mg/L	mg/L	mg/L	mg/kg	g/L	L/kg	L/kg
Element	**Aqueous Phase**	**Aqueous + Suspended**	**Suspended**	**Adsorbed**	**Calculated Suspended Solids**	**Kd**	**Kd**
Li	0.0770	0.356	0.279	12	23	156	43-370
K	2.46	19.1	16.6	960	17	390	42-1200
Na	12.6	18.1	5.50	270	20	21	5.2-82
Mg	1.92	12.6	10.7	880	12	458	46-1400
Ca	1.84	7.00	5.16	1200	4	652	24-460
Cr	0.0442	0.253	0.209	37	6	838	140-5,500
B	0.02	0.03	0.01	6.4	2	320	63-170
Fe	2.03	361	359	26000	14	12808	4900-160000
Measured Total Suspended Solids					10		

Source	B-3 50-55 ft bgs						Literature Value
Unit	mg/L	mg/L	mg/L	mg/kg	g/L	L/kg	L/kg
Element	**Aqueous Phase**	**Aqueous + Suspended**	**Suspended**	**Adsorbed**	**Calculated Suspended Solids**	**Kd**	**Kd**
Li	0.061	1.14	1.079	3.6	300	59	43-370
K	2.86	53.3	50.44	420	120	147	42-1200
Na	12.8	17.9	5.1	56	91	4	5.2-82
Mg	0.925	41	40.075	260	154	281	46-1400
Ca	0.749	16.4	15.651	160	98	214	24-460
Cr	0.0213	1.9	1.879	13	145	611	140-5,500
B	0.203	0.675	0.472	2.3	205	11	63-170
Fe	3.88	1440	1436	11000	131	2835	4900-160000
Measured Total Suspended Solids					51		

Notes:
mg/L: milligrams per liter
mg/kg: milligrams per kilogram
g/L: grams per liter
L/kg: liters per kilogram
Kd: partition coefficient
Adsorbed values are total metals concentrations reported by USEPA Method 6010B.
Literature values represent maximum and minimum values for the parameter as reported in Sheppard et al, 2009 (Table 4-1, all sites) and Sheppard et al, 2011 (Table 3-3 cultivated peat and wetland peat only).

Attachment A

Boring Logs

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name: B-1

Project Location: Hallsville, TX

Boring Date: 5/14/2019

Soil Profile

Depth Scale Feet	Water Table	Description		PID
		0.0' - 5.0' were hand augered on a previous date.		
0		0.0'-1.0':	No Recovery	
		1.0'-4.0':	Light gray and dark red clay, medium plasticity, low stiffness; trace silt	
		4.0'-5.1':	No Recovery	
5		5.1'-5.5':	Light gray and dark red clay, high plasticity, low stiffness	
		5.5'-8.0':	Light gray and orange clay, high plasticity, low stiffnedd; trace silt	
		8.0'-8.9':	Light gray and dark red clay, high plasticity, low stiffness	
		8.9'-9.6':	Light purple and gray clay, high plasticity, low stiffness; trace silt	
		9.6'-10.5':	Light gray sandy clay, very fine grained; sand grains are orange	
10		10.5'-10.7':	Light gray fine grained sand, very well sorted	
		10.7'-10.9':	Moist, Tan and orange fine grained sand, very well sorted	
		10.9'-12.0':	Light purple and gray sandy clay	
		12.0'-12.5':	No Recovery	
		12.5'-13.0':	Moist, Light brown silty clay	
15		13.0'-14.1':	Moist, light brown silty sand, fine grained, moderate sorting	
		14.1'-16.0':	Light purple and gray clay, medium stiffness, medium plasticity	
		16.0'-17.3':	Wet, light brown sandy clay	
		17.3'-20.0':	Maroon/Purple clay, high stiffness, medium plasticity	
20		20.0'-20.9':	Wet, Light brown clayey sand	
		20.9'-24.0':	Maroon/Purple clay, high stiffness, low plasticity; trace brown silt	
		24.0'-24.3':	Maroon/Purple clay, high stiffness, low plasticity; trace brown silt	
		24.3'-26.5':	Dark purple/black clay, high stiffness, no plasticity	
25		26.5'-28.0':	Moist, Dark gray clayey sand, fine grained	
		28.0'-28.7':	Wet, Brown and dark gray clayey sand	
		28.7'-29.7':	Dark gray fine grained sand, well sorted; trace sand	
		29.7'-30.3':	Dark gray clay, medium stiffness, Medium plasticity	
30		30.3'-30.6':	Tan silt with gravel	
		30.6'-32.0':	Dark gray/black and purple clay, very high stiffness, no plasticity	
		32.0'-33.8':	Wet, Brown and dark green silty clay, low plasticity	
		33.8'-35.1':	Moist, Dark green fine grained sand, well sorted	
35		35.1'-36.0':	Moist, Dark gray fine grained sand, well sorted; trace clay	
			EOB @ 36' BGS	
			Boring backfilled with bentonite	
40				

Drill Rig: Geoprobe 7822 DT

Drilling Contractor: Best Drilling

Driller: Ramon Gutierrez

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey | Boring/Well Name: B-2
Project Location: Hallsville, TX | Boring Date: 5/13/2019 to 5/17/2019

Soil Profile

Depth Scale Feet	Water Table	Description		PID
		0.0' - 5.0' were hand augered on a previous date.		
0		0.0'-0.5':	Black, soft fine grained silty sand, vegetation	
		0.5-2.0':	Red/brown fine grained sand, moderate sorting	
		2.5-5.0':	Alternating layers red+brown sandy clay, low plasticity	
5		5.0-5.5':	No Recovery	
		5.5-6.7':	Gray + brown/red sandy clay, medium plasticity, low stiffness	
		6.7'-8.0':	Gray clay, medium plasticity, medium hardness with brown/red sand lenses throughout	
		8.0-11.0':	Gray clay with brown striations, high stiffness, high plasticity, tree roots present @ 8.3' bgs	
10		11.0-11.5':	Gray clay, medium stiffness, high plasticity, trace gravel @ 11.25'	
		11.5-12.0':	(Gray) clayey (red-brown) sand, poorly sorted, soft	
		12.0-14.0':	No Recovery	
		14.0-14.75':	Reddish brown + gray sandy clay, trace gravel @ 14.5', medium stiffness, medium plasticity	
		14.75-16.0':	Gray + red clay, medium hardness, high plasticity, trace brown fine grained sand	
15		16.0-18.5':	No Recovery	
		18.5-18.75':	Soft, red + gray clay, high plasticity, trace silt	
		18.75-18.95':	Tan, sand fine-coarse grained, poorly sorted, small coal fragment	
		18.95-20.0':	Red/dark gray clay, high stiffness, medium plasticity	
20		20.0-21.1':	No recovery	
		21.1'-21.8':	Wet, sandy clay, light brown + red	
		21.8-24.0':	Red + dark gray clay, hard stiffness, medium plasticity; 1" gravel lens present @ 22.5'	
		24.0-24.5':	Light brown sandy clay, wet, very soft, no plasticity	
		24.5-24.8':	Red-brown sandy clay, wet, medium plasticity	
25		24.8-28.0':	Purple + gray clay, high stiffness, no plasticity, trace fine grained sand @ 25.0' & 26.7'	
		28.0-29.9':	Dark purple clay, high stiffness, no plasticity	
30		29.9-30.7':	Black/dark gray clay, high stiffness, no plasticity	
		30.7-32.0':	Balck/dark gray silty clay, medium stiffness, medium plasticity	
		32.0-33.5':	Dark gray silty clay, soft, high plasticity	
		33.5-36':	Black silty clay, high stiffness, no plasticity	
35		36-36.5':	No recovery	
		36.5-40':	Dark green fine grained sand, well sorted	
40				

Geoprobe refusal @ 40' bgs. HSA continued drilling, log continued on next page.

Drill Rig Geoprobe 7822 DT & HSA Rig
Drilling Contractor: Best Drilling & AEP Drillers
Driller: Ramon Gutierrez & Zack Racer

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey | Boring/Well Name: B-2

Project Location: Hallsville, TX | Boring Date: 5/13/2019 to 5/17/2019

Soil Profile

0.0' - 40.0' were drilled with DPT, logged on previous page. HSA boring log follows.

Depth	Description
38.1-38.3':	Dark brown silty sand, fine grained, trace clay, loose, wet, well graded
38.3-38.4':	Very dark brown clayey sand; thin seam of red-brown lean clay @ 38.4', med soft
38.4-38.5':	Dark green silty sand, fine grained, wet
38.5-39.0':	Dark brown silty sand, fine grained, trace clay, loose, wet, well graded
39.0-39.2':	Laminated sandy clay/clayey sands, gray to dark gray, loose/soft, wet
39.2-43.1':	No Recovery
43.1-44.5':	Greenish gray w. graded fine sand w/ trace silt, loose, wet; thin layer of light gray silty sand @ 44.5'
44.5-47.0':	Dark brown clayey sand/sandy clay, fine sand, w. graded, low plastiicty, dense/stiff, moist
47.0-48.1':	No Recovery
48.1-54.2':	Same clayey sand/sandy clay as above; thin bed of gray fine grained sand, trace clay @ 51.6'
54.2-55.0':	Dark brown hard, sandy clay, low plas
55.0-57.1':	Dark brown clayey sand/sandy clay, fine sand, w. graded, low plastiicty, dense/stiff, moist
57.1-58.1':	Dark brown clayey sand w/ thin intermittent balck hard material layers, possible coal/plant debris
58.1-61.9':	Dark grayish brown clayey sand, fine grained, w. graded, moise, med-dense to loose
61.9-63.1':	Same clayey sand as above with thin bands of mottled dark brown silty clay with gray silty sand
63.1-64.6':	Gray silty sands mottled 50/50 w/ dark brown sandy clays, trace coal fragments, stiff/dense
64.6-68.1	Grades from above to thinly laminated interbeds of silty/clayey sands and sandy clay. Clays are dark brown, sand is gray. Low plasticity, moist, dense/stiff
68.1-70.7':	Dark brown sandy clay w/ 1% mottles of gray silty sand, low plasticity, trace moist, silty, stiff
70.7-71.3':	Dark brown clayey sand, fine grained, trace coal fragments, moist, dense/med dense
71.3-71.5':	Interval of coal/sand interbeds w/ clay, friable
71.5-73.5':	Dark brown sandy clay, low plas, trace moist, stiff to hard
73.5-74.5':	Sandy clay grading to clayey sand (fine grained, w. graded moist)
74.5-75.1':	Gray silty sand, fine grained, moist, w. graded, med. Dense

Depth Scale Feet: 35, 40, 45, 50, 55, 60, 65, 70, 75 | Water Table | PID

Drill Rig: Geoprobe 7822 DT & HSA Rig

Drilling Contractor: Best Drilling & AEP Drillers

Driller: Ramon Gutierrez & Zack Racer

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey | Boring/Well Name: B-2
Project Location: Hallsville, TX | Boring Date: 5/13/2019 to 5/17/2019

Soil Profile

Depth Scale Feet	Water Table	Description		PID
75		75.1-75.3':	SAA except trace clay	
		75.3-75.6':	Interval of gray sand interbedded w/ dark brown silty/sandy clay	
		75.6-79.2':	Dark brown clayey sand w/ some 1-2 mm lenses of gray sand mottled throughout, moist, fine grained, dense. Dark brown interbeds of silty clay @ 78.1-79.2'	
		79.2-80.4':	Dark brown sandy clay mottled w/ gray sand, stiff, low plasticity, trace moist, trace coal fragments	
80		80.4-82.1':	Dark grayish brown silty sand w/ trace clay, loose; coal fragment @ 81.6'	
		82.1-83.6':	Dark brown silty clay w/ some sand, low plasticity, hard, trace moist; thin lighter color laminations @ 83.1'	
		83.6-85.5':	Dark grayish brown sandy clay, fine sand, low plasticity, very stiff, trace mottles of sandier material, trace moist	
85		85.5-93.1':	Dark reddish brown silty clay w/ trace fine sand, trace moist, hard, low plasticity, trace mottles of light gray sand, some black mottling. Color fades to dark brown when exposed to air.	
90		90.1'	Thin gray sand seam	
		92.3'	Thin gray sand seam	
			HSA refusal, EOB @ 93.1' bgs	
			Boring grouted to surface, permanent well installed in offset w/ screen @ 38-48' bgs.	
95				
100				
105				
110				
115				

Drill Rig: Geoprobe 7822 DT & HSA Rig
Drilling Contractor: Best Drilling & AEP Drillers
Driller: Ramon Gutierrez & Zack Racer

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name: B-3

Project Location: Hallsville, TX

Boring Date: 5/7/19, 5/13/19

Soil Profile

Depth Scale Feet	Water Table	Description		PID
		0.0' - 5.0' were hand augered		
0		0.0-2.0':	Clay, medium-red brown, some fine to medium grain material, poorly graded, silty clays, medium plasticity, medium dense, dry, mottled	
		2.0-3.0':	Clay, light brown, some fine to medium grain material, poorly graded, silty clays, medium plasticity, medium dense, dry, mottled	
		3.0-4.0':	Organic clay, Grey to light brown, soft, medium density, some medium grain sand, moist	
		4.0-4.5':	Organic clay, light brown, soft, medium density, moist	
		4.5-5.0':	Organic clay, light brown to reddish brown, soft, medium density, moist	
5		5.0-9.5':	Organic clay, light brown to reddish brown, soft, medium density, moist	
		9.5-10.5':	Silty clay, reddish-orange, poorly graded, medium to low plasticity, wet (perched zone)	
10		10.5-11.0':	Poorly-graded gravel, lense of cobbly material, moist	
		11.0-13.0':	Clayey sand, mottled clay and sand	
		13.0-13.9':	Sandy clay, brown to orange, low plasticity, some cobbles, loose, wet, nonplastic	
		13.9-15.0':	Sand, orange, loose, nonplastic, very fine grained, moist	
15		15.0-16.0':	Sandy clay, medium plasticity, cohesive, medium stiff, moist	
		16.0-18.0':	Sand, orange, gray organic staining, moist	
		18.0-18.5':	A lense of fat clay, grayish purple, medium to high plasticity, moist	
		18.5-19.5':	Sand, orange to grayish orange, moist	
		19.5-20.0':	Fat clay, greyish purple, dense, medium stiff to stiff, medium to high plasticity, moist.	
20		20.0-22.1':	Sand, light brown to orange, fine to medium grained, wet	
		22.1-22.3':	Lense of fat clay, dark grey to purple, stiff, high plasticity, wet	
		22.3-22.6':	Sand, light brown to orange, fine grained, moist	
		22.6-23.0':	Gravelly sand, orange to gray mottles, loose, well graded	
		23.0-24.0':	Sandy clay, grayish purple and brown mottles, moist	
25		24.0-25.6':	Sand, tan to light brown, fine to medium grained, well sorted, moist	
		25.6-26.4':	Clay, purple and gray, medium plasticity, trace fine grained sand	
		26.4-26.8':	Clayey sand, tan to light brown, fine grained, medium sorted	
		26.8-27.3':	Clay, purple, medium stiffness, medium plasticity	
		27.3-28.0':	Clay, dark gray, hard, trace silt, high plasticity	
30		28.0-28.6':	no recovery	
		28.6-29.2':	Sand, light brown, fine grained, moderate sorting, wet, from casing trip	
		29.2-29.5':	Silty clay, dark gray, fine grained, low plasticity	
		29.5-32.0':	Clay, dark gray to black, hard, low plasticity, trace silt	
		32.0-32.7':	Clay, dark gray, medium stiff, medium plasticity, trace silt	
35		32.7-33.1':	Clayey silt, dark gray, medium plasticity	
		33.1-36.0':	Sand, dark gray, fine grained, well sorted, moist	
		36.0-36.3':	no recovery	
		36.3-36.9':	Silty sand, dark gray to black, very fine grained, well sorted, moist	
		36.9-37.3':	Sand, gray, fine grained, well sorted, moist	
40		37.3-38.4':	Silty clay, dark gray, soft, low plasticity, 1" coal seam at 37.8 ft bgs	

Drill Rig: Geoprobe 7822 DT & HSA Rig

Drilling Contractor: Best Drilling & AEP Drillers

Driller: Ramon Gutierrez & Zack Racer

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey | Boring/Well Name: B-3

Project Location: Hallsville, TX | Boring Date: 5/7/19, 5/13/19

Soil Profile

Depth Scale Feet	Water Table	Description	PID
		38.4-40.0': Clay, dark gray to black, very stiff, low plasticity (DPT refusal @ 40' bgs, HSA drilling continued below)	
40		40.0-42.5': Silty clay with trace sand, dark gray, very stiff to hard, mottled	
		42.5-46.4': Interbedded sandy clays and clayey sands, dark gray to black, moist, very dense, stiff, low plasticity, low cohesivity, coal and plant fragments at 45.1 to 45.25 feet bgs	
45		46.4-47.5': Sandy clay with silt, dark gray to black, hard, low plasticity, moist, fine grained sand	
		47.5-48.7': Sand with trace silt, brown, poorly graded, some brown clay laminations, coal seam from 48.4 to 48.7 feet bgs,	
		48.7-49.6': Sand, gray to brown, well graded, with dark clayey interbeds/laminations, trace silt, loose to medium dense, moist	
		49.6-52.8': Sand, brown to grayish brown, well graded, trace silt, loose to medium dense, moist to wet	
50		52.8-53.6': Interbedded sandy clays and clayey sands, gray to dark gray, moist, dense to very dense	
		53.6-53.7': Silty clay, dark brown, very stiff	
		53.7-55.0': Interbedded sandy clays and clayey sands, gray to dark gray, moist, dense to very dense	
55		55.0-58.8': Interbedded sandy clays and clayey sands, gray to dark gray, moist, dense to very dense	
		58.8-59.0': Sand with some clay and silt, very dark gray, fine grained, massive bedding, moist	
		59.0-60.0': no recovery	
60		60.0-60.7': Sand with some silt and trace clay, very dark gray, fine grained, massive bedding, moist	
		60.7-61.6': Sand with some silt and trace clay, gray, fine grained, massive bedding, moist, laminations of dark gray clayey sand	
		61.6-61.8': Silty clay, dark gray, hard, no plasticity	
		61.8-63.0': Silty clay, dark gray, fine grained, well graded, at 62.8 feet bgs a layer of dark gray silty clay	
		63.0-65.0': no recovery	
65		65.0-67.5': Silty sand, grayish brown, fine grained, well graded, wet, loose	
		67.5-72.5': No recovery, heavy sands. Water introduced to retrieve samples. During flushing, some grayish brown silty sand observed	
70		72.5-73.1': Silty sand, grayish brown, fine grained, well graded, wet, loose	
		73.1-73.6': Sand with trace silt, gray, fine grained, well graded, wet, loose	
		73.6-74.7': Thin layer of dark brown friable material, possibly plant material	
		74.7-74.8': Thin layer of stiff sand and silt, dark brown	
		74.8-76.0': Silty sand, grayish brown, fine grained, well graded, wet, loose	
75		76.0-76.1': Thin layer of clay, dark brown, stiff, trace coal fragments	
		76.1-76.4': Silty sand, grayish brown, fine grained, well graded, wet, loose	
		76.4-76.5': Silty clay, dark brown, stiff	
		76.5-77.5': Silty sand, grayish brown, fine grained, well graded, wet, loose	
		77.5-82.9': Silty sand, dark gray to brown, fine grained, well graded, medium dense to dense, moist to wet, trace clay	
80			

Drill Rig: Geoprobe 7822 DT & HSA Rig

Drilling Contractor: Best Drilling & AEP Drillers

Driller: Ramon Gutierrez & Zack Racer

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey | Boring/Well Name: B-3
Project Location: Hallsville, TX | Boring Date: 5/7/19, 5/13/19

Soil Profile

Depth Scale Feet	Water Table	Description		PID
80		82.9-84.3':	Silty sand, gray to dark gray, fine grained, well graded, medium dense to dense, moist to wet, trace clay	
		84.3-85.2':	Clayey sand, dark grayish brown, fine grained, well graded, moist	
		85.2-85.3':	Silty sand, gray	
85		85.3-85.5':	Silty sand, gray to dark gray, fine grained, well graded, medium dense to dense, moist to wet, trace clay	
		85.5-86.3':	Silty clay with sand, dark brown, low plasticity, hard, moist, laminated with gray sand layers ~1-2mm thick	
		86.3-87.5':	Clayey sand, dark grayish brown, fine grained, well graded, moist	
		87.5-88.2':	Clayey sand, dark grayish brown, fine grained, well graded, moist	
		88.2-89.1':	Clayey sand, dark grayish brown, fine grained, well graded, moist. Clay laminations darker than surrounding sand	
90		89.1-89.4':	Interval of interbedded sandy clays and clayey sands, breaks apart along bedding planes, medium dense, medium stiff	
		89.4-92.5':	Silty clay, dark brown to black, hard, trace moisture, low plasticity	
		92.5-97.5':	Silty clay, dark brown to black, hard, trace moisture, low plasticity. Thin gray sand layer at 94.7 feet bgs	
95				
			HSA refusal, EOB @ 97.1' bgs	
			Boring grouted to surface.	
			Permanent well installed in offset boring, screen set @ 29-34' bgs.	
100				
105				
110				
115				
120				

Drill Rig: Geoprobe 7822 DT & HSA Rig
Drilling Contractor: Best Drilling & AEP Drillers
Driller: Ramon Gutierrez & Zack Racer

Geosyntec Consultants

Attachment B
Groundwater Analytical Results

Boring	Depth (ft bgs)	Metals (mg/l)															
		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Calcium		Chromium	
		Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered
B-1	16-21	<0.00093	<0.0035805	0.214	0.0041586	3.28	0.0267562	0.01693	<0.000077	0.293	0.038043	0.03747	<0.0002695	41.8	1.34	1.08	<0.0008855
B-3	20-24	<0.00093	<0.0465	0.141	0.0472	0.779	0.132	0.00571	<0.001	0.105	0.308	0.00032	<0.0035	4.19	1.42	0.46	<0.0115
	33-37	0.00113	0.005776	0.02767	<0.113925	0.299	0.114	0.00427	<0.00217	0.104	0.443	<0.00007	<0.007595	15.6	5.95	0.208	<0.024955
	40-45	<0.00093	<0.17856	0.141	0.0851	1.64	0.0314	0.04958	<0.00384	0.292	0.453	0.00266	<0.01344	7	<1.8432	0.253	<0.04416
	50-55	<0.0465	<0.086025	0.662	<0.097125	4.76	0.09501	0.098	<0.00185	0.675	0.203	<0.0035	<0.006475	16.4	0.749	1.9	<0.021275
	60-65	<0.00093	<0.0465	0.05695	0.0472	0.412	0.0849	0.00559	<0.001	0.06661	0.071	0.00265	<0.0035	1.37	<0.48	0.307	<0.0115
	72.5-77.5	<0.00093	0.0022	0.932	0.0116	7.97	0.0123	0.132	<0.0002	1.52	0.375	0.277	<0.0007	36.9	0.209	3.25	0.0005
	82.5-87.5	<0.00093	0.0014372	0.04923	0.0058415	0.583	0.0083163	0.00297	<0.000111	0.214	0.311	0.00368	<0.0003885	1.44	0.21	0.152	<0.0012765

Boring	Depth (ft bgs)	Metals (mg/l)															
		Cobalt		Iron		Lead		Lithium		Magnesium		Manganese		Molybdenum		Potassium	
		Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered
B-1	16-21	0.192	0.001279	988	0.669	0.392	<0.002618	0.202	0.0217358	40	0.59	1.14	0.0206	0.02491	<0.0011165	37.1	1.07
B-3	20-24	0.02653	0.01	430	3.91	0.07225	<0.034	0.05327	0.0127	8	1.15	0.189	<0.05	0.00807	0.0022	15.2	1.26
	33-37	0.02721	0.00368	95.2	<1.085	0.0148	<0.07378	0.152	0.105	5.19	3.12	1.02	0.599	0.07587	0.012642	9.29	5.39
	40-45	0.23	0.00467	361	2.03	0.149	<0.13056	0.356	0.07701	12.6	<1.92	0.819	<0.192	0.01355	<0.05568	19.1	2.46
	50-55	0.786	0.01441	1440	3.88	0.703	<0.0629	1.14	0.060508	41	<0.925	3.46	0.0968	0.106	<0.026825	53.3	2.86
	60-65	0.07494	0.004	122	2.07	0.04529	<0.034	0.09786	0.0518	2.75	0.6	0.29	0.07	0.01507	0.0019	7.59	2.76
	72.5-77.5	1.37	0.0015	3250	0.587	0.636	<0.0068	0.812	0.0089	67.3	0.139	7.78	0.01	0.057	0.0013	57.9	1.26
	82.5-87.5	0.05576	0.000855	281	0.0745	0.05542	<0.003774	0.102	0.0228905	2.75	0.124	0.282	0.00751	0.01954	0.0172347	11.1	1.59

Boring	Depth (ft bgs)	Metals (mg/L)								General Chemistry (mg/L)		Anions (mg/L)			
		Selenium		Sodium		Strontium		Thallium		Total Alkalinity	Total Dissolved Solids	Chloride	Fluoride	Sulfate	Bromide
		Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Total	Total	Total	Total	Total
B-1	16-21	0.0124	<0.0038115	10.7	8.31	2.3	0.00834	0.00339	0.002654	5.72	220	4.31	<0.04	13.8	<0.1
B-3	20-24	0.00647	<0.0495	25.6	22.6	0.078	<0.05	0.00309	0.026	0.76	156	33.7	0.04	14.6	0.2
	33-37	0.00142	<0.107415	22	17.1	0.079	<0.1085	0.00151	0.00642	49.54	132	10.9	0.1	19.4	<0.1
	40-45	0.01837	<0.19008	18.1	12.6	0.229	<0.192	0.00229	<0.16512	1.54	1394	8.91	<0.04	21.1	<0.1
	50-55	0.0269	<0.091575	17.9	12.8	0.686	<0.0925	0.067	<0.07955	12.68	734	13.4	<0.04	17.3	<0.1
	60-65	0.00539	<0.0495	8.13	7.64	0.053	<0.05	<0.00086	<0.043	3.14	148	12	<0.04	7.9	<0.1
	72.5-77.5	0.04618	<0.0099	156	65.5	0.575	0	0.00092	<0.0086	140.74	632	44.5	0.04	24.5	<0.1
	82.5-87.5	0.00987	<0.0054945	148	103	0.101	0.00278	0.00224	<0.004773	210.08	1026	35.8	0.35	13	<0.1

Notes:

< - Analyte not detected above analytical detection limit

NM - Not measured

Total lithium results from unfiltered sample volume collected in HNO3 preserved bottle.

Lab filtered results from laboratory vaccum-filtered sample volume collected in unpreserved bottle.

Total metals data are not available for B-2 sample intervals due to incorrect analytical techniques.

Attachment C

Well Construction Diagrams

Geosyntec consultants

Well Construction Log

Site: AEP Pirkey Power Plant

Well ID: B-2

Drilling Company: AEP Service

Drillers: Zach Racer

Geologist: Nathan Quick

Date: 5/20/19

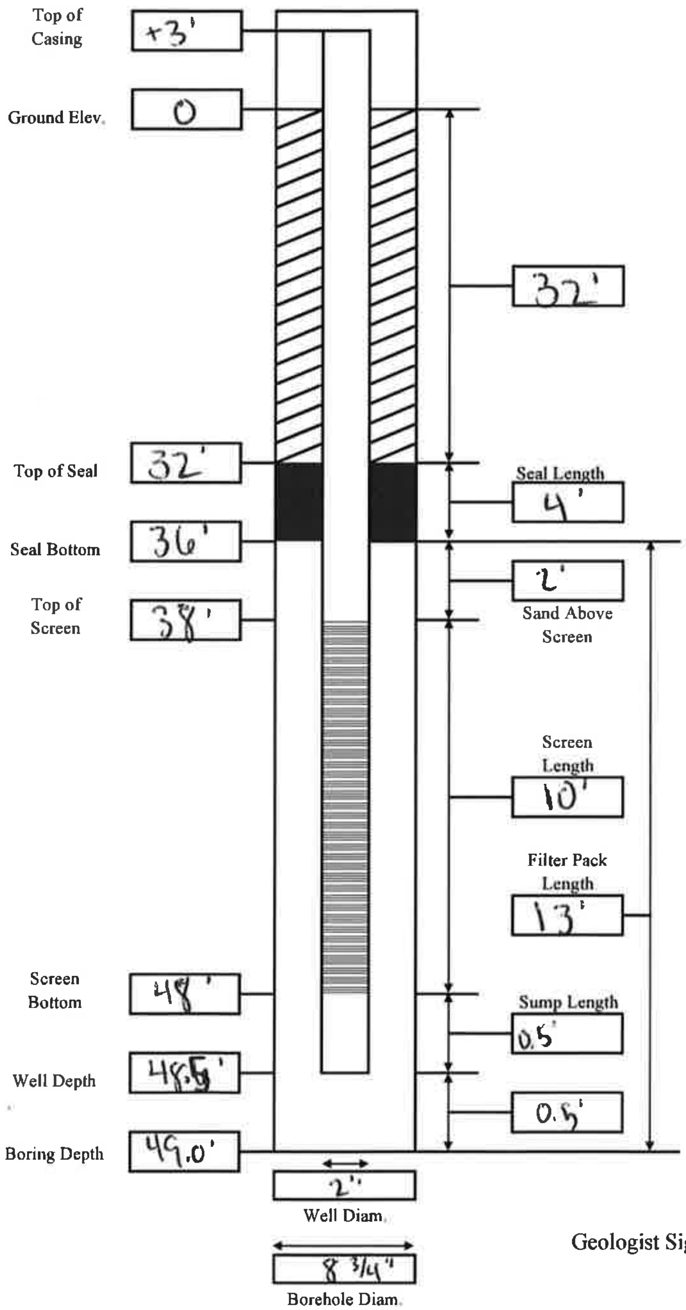
Drilling Method: Hollow Stem Auger

Boring Depth: 49'

Boring Diameter: 8 3/4"

Well Depth: 48.5'

Well Diameter: 2"



Well Construction:

Material: Sch. 40 PVC

Inside Diamter: 2"

Screen Slot Size: 0.01'

Screen Beg.: 38 End: 48

Sump (Y) / N

Type/Lenth: Sch. 40 PVC, 10"

Filter Pack:

Type/Brand: Pioneer Sands 20/40

Amount Used: 8.5 bags (50 lbs per bag)

Placement Method: Surface

Seal:

Type/Brand: Plug Pel coated bentonite chips

Amount Used: 100 lbs

Vol. Fluid Added:

Set-up Time: 1.5 hours

Placement Method: Surface

Grout:

Type/Brand:

Amount Used:

Vol. Fluid Added:

Placement Method: tremie

Well Completion:

(Above Grade) / Below Grade

Guard Posts? (Y) / N

Pad Size: 2x2

Cover Type/Size: Stainless steel

Comments:

Geologist Signature: Nat Q

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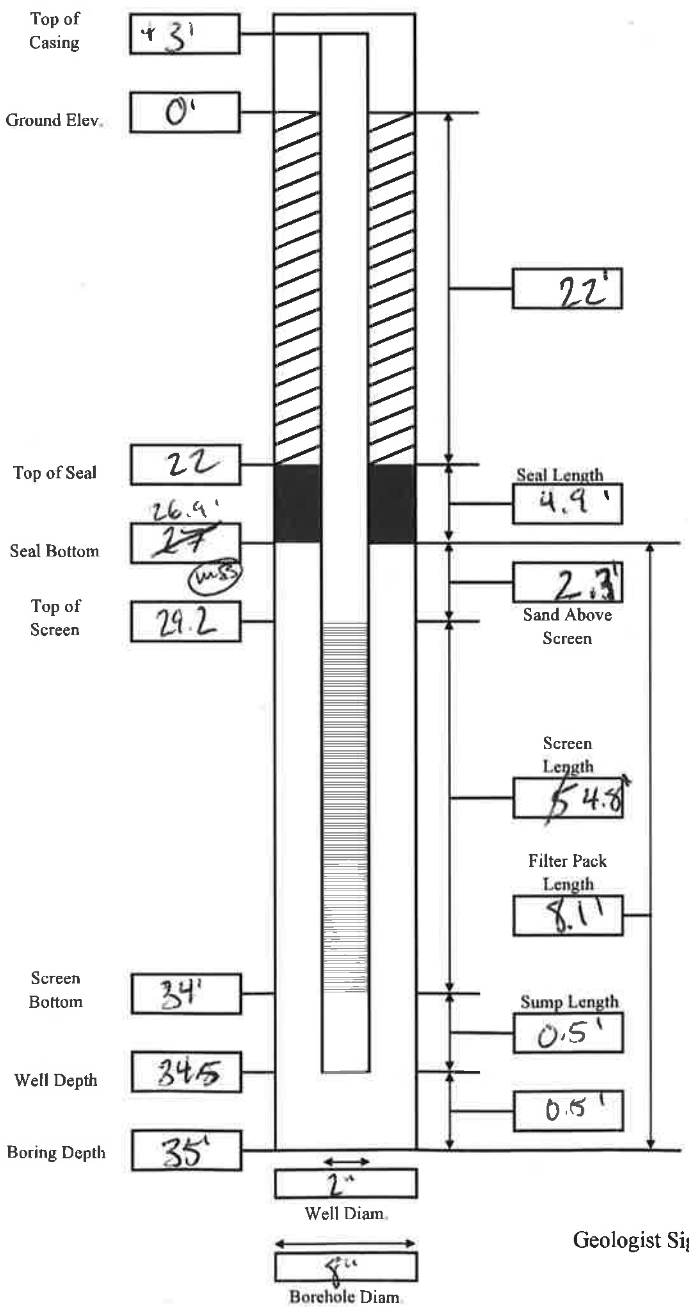
Geosyntec consultants
Well Construction Log

Site:	AEP Pirkey Power Plant	Date:	5/15/19
Well ID:	B-3	Drilling Method:	HSA
Drilling Company:	AEP / Best Drilling	Boring Depth:	35'
Drillers:	Z. Rover	Boring Diameter:	8"
Geologist:	M. Bizjack	Well Depth:	35'
		Well Diameter:	2"



Well Construction:

- Material: Sched 40 PVC
- Inside Diamter: Sched 40
- Screen Slot Size: 10 mm
- Screen Beg.: ~~34~~ 29' End: 34'
- Sump (Y) N
- Type/Lenth: End cap, 0.5'

Filter Pack:

- Type/Brand: Pioneer 20/40 0.45-0.48
- Amount Used: ~~½~~ 5.5 bags (275 lbs)
- Placement Method: Manual

Seal:

- Type/Brand: 3/8" Pel-plug coated Bentonite Pellets
- Amount Used: 2 buckets (100 lbs)
- Vol. Fluid Added:
- Set-up Time: >8hr
- Placement Method: Manual

Grout:

- Type/Brand: Halliburton Quik Grout
- Amount Used:
- Vol. Fluid Added:
- Placement Method: Pump

Well Completion:

- (Above Grade) / Below Grade
- Guard Posts? Y / N
- Pad Size: 2x2
- Cover Type/Size:

Comments:

Geologist Signature: Matt Biz

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Attachment D

Well Development Logs

well development

~~LOW FLOW~~ GROUNDWATER SAMPLING LOG

Geosyntec consultants

MONITORING WELL ID: B-2

PROJECT: AEP Pirkey

PROJECT NO: CHA8462.12

SITE LOCATION: Hallsville, TX

DATE MONITORED: 5/22/19 **WATER QUALITY METER MAKE/MODEL:** Horiba

DATE PURGED: 5/22/19 **LATEST CALIBRATION DATE/TIME:** 5/22/19

SAMPLING PERSONNEL: N. Quirk **DUP OR MS/MSD:**

MONITORING WELL INFORMATION

Well Diameter: 2 IN.

Static Depth to Groundwater (DTW): 12.31 FT.

Total Depth of Monitoring Well (TD): 51.50 FT. btoc

Screen Length (SL) from Boring Logs: 10 FT.

Depth to Top of Well Screen (TD-SL): NR FT.

Height of Water Column in Monitoring Well (H=TD-DTW): FT.

Pump Depth FT.

Coversion Factors:
Well Volume (2-in): Hx0.17 gal/ft
1 L = 0.264 gal

Purge Method: Tornado pump

LOW FLOW MONITORING PARAMETERS

Time	Volume Purged	pH	Specific Conductivity	Dissolved Oxygen	Temp.	ORP	Depth to Water	Flow Rate	Turbidity, Odor, Color
Hr : Min	mL	-	mS/cm	mg/L	C	mV	Feet	L/min	--
Targets	--	+/- 0.1	+/- 3%	+/- 10%	+/- 1 C	+/- 10 mV	<0.3 ft. drawdown	<0.5 L/min	nTU --
1157		5.89	0.219	9.87	24.01	42	21.31	.5	1000+ light brown, silty
1202		5.93	0.241	9.47	22.11	25	22.21	.5	950 light brown
1207		5.94	0.217	9.36	22.09	23	22.31	.5	890 "
1212		5.87	0.214	9.64	21.89	30	22.83	.5	669 "
1217		5.82	0.201	9.50	22.18	42	22.31	.5	390 "
1222		5.82	0.201	9.50	22.25	38	20.58	.5	260 cloudy
1227		5.82	0.198	9.62	22.12	41	19.41	.5	152 cloudy
1232		5.76	0.194	9.44	22.11	40	18.83	.5	84.9
1237		5.76	0.194	8.92	22.08	46	18.15	.5	75.2
1242		5.72	0.194	9.54	22.15	45	17.97	.5	72.4
1247		5.73	0.194	9.34	22.21	42	17.45	.5	66.9
1 1252		5.75	0.195	9.50	22.34	44	22.15	.5	146 light brown
1302		5.79	0.200	9.76	22.31	49	22.41	.5	352 "
1312		5.75	0.194	9.41	22.30	51	22.71	.5	105 cloudy
1322		5.75	0.189	9.43	22.41	53	23.00	.5	57.4 clear
1332		5.75	0.189	9.53	22.48	56	23.15	.5	50.7 "

Notes: 1) well was surged using pump to make sure all fines were removed — end of development

1. Water quality parameter measurements obtained every 3 to 5 minutes.
2. Well is **STABLE** once 3 consecutive measurements have been obtained for as many as 3 water quality parameters
3. Low flow rate target is 0.1 to 0.5 liters/min (0.026 to 0.132 Gallons per Minute).

Purge Flow Rate (pump purge only) ______ gal per min ______ liter per min (3.8 x gpm)
TOTAL Volume Purged ______ gallons ______ liters

Date & Time of Sample Collection - DATE - TIME NQ INITIALS *revised: Feb. 2007*

[signature]

Well Development ~~LOW FLOW~~ GROUNDWATER SAMPLING LOG

Geosyntec consultants

MONITORING WELL ID: B-3

PROJECT: AEP Pirkey

PROJECT NO: CHA8462.12

SITE LOCATION: Hallsville, TX

DATE MONITORED: 5/17/19 **WATER QUALITY METER MAKE/MODEL:** Horiba

DATE PURGED: 5/17/19 **LATEST CALIBRATION DATE/TIME:** 5/17/19

SAMPLING PERSONNEL: N. Quick **DUP OR MS/MSD:** –

MONITORING WELL INFORMATION

Well Diameter:	2	IN.	
Static Depth to Groundwater (DTW):	9.02'	FT.	**Coversion Factors:**
Total Depth of Monitoring Well (TD):	36.95	FT.	Well Volume (2-in): Hx0.17 gal/ft
Screen Length (SL) from Boring Logs:		FT.	1 L = 0.264 gal
Depth to Top of Well Screen (TD-SL):		FT.	
Height of Water Column in Monitoring Well (H=TD-DTW):		FT.	**Purge Method:**
Pump Depth		FT.	tornado pump

LOW FLOW MONITORING PARAMETERS

Time	Volume Purged	pH	Specific Conductivity	Dissolved Oxygen	Temp.	ORP	Depth to Water	Flow Rate	Turbidity, Odor, Color
Hr : Min	mL	-	mS/cm	mg/L	C	mV	Feet	L/min	--
Targets	--	+/- 0.1	+/- 3%	+/- 10%	+/- 1 C	+/- 10 mV	<0.3 ft. drawdown	~~<0.5 L/min~~ NTU	--
0944		6.07	.605	3.30	20.39	89			brown, silty
0947		6.14	0.516	0.51	20.72	28			brown
0951		5.84	.438	3.42	21.37	69			brown
		well is purging dry, pump is kicking off + on due to low water level;							
		to let well recharge + continue to develop							
1034		6.18	.450	4.01	22.09	88	19.34		
		pump removed to check connections;							
1100		6.17	0.263	3.78	22.15	78	15.29		
					went dry				
1216		5.81	0.282	2.04	22.74	85	15.32		light brown
1220		5.64	0.195	2.07	22.04	102			cloudy
1225		5.65	0.194	1.87	22.24	98	23.05	888	cloudy
1235		5.71	0.191	1.59	22.98	85		683	cloudy
1240		5.71	0.190	1.48	23.05	87	25.75	605	cloudy
1250		5.69	0.188	1.43	23.36	83		462	
1257		5.69	0.184	1.19	23.14	81	28.14	370	

Notes:

1. Water quality parameter measurements obtained every 3 to 5 minutes.
2. Well is **STABLE** once 3 consecutive measurements have been obtained for as many as 3 water quality parameters
3. Low flow rate target is 0.1 to 0.5 liters/min (0.026 to 0.132 Gallons per Minute).

Purge Flow Rate (pump purge only) ______ gal per min ______ liter per min (3.8 x gpm)

TOTAL Volume Purged ______ gallons ______ liters

Date & Time of Sample Collection – **DATE** – **TIME** NQ **INITIALS** *revised: Feb. 2007*

Nate [signature]

Development

~~LOW FLOW~~ GROUNDWATER SAMPLING LOG

2 of 2

Geosyntec consultants

MONITORING WELL ID: B-3

PROJECT: AEP Pirkey

PROJECT NO: CHA8462.12

SITE LOCATION: Hallsville, TX

DATE MONITORED: 5/17/19 **WATER QUALITY METER MAKE/MODEL:** Horiba

DATE PURGED: 5/17/19 **LATEST CALIBRATION DATE/TIME:** 5/17/19

SAMPLING PERSONNEL: N. Quick **DUP OR MS/MSD:** –

MONITORING WELL INFORMATION

Well Diameter: 2 IN.

Static Depth to Groundwater (DTW): 9.02 FT.

Total Depth of Monitoring Well (TD): 36.65 FT.

Screen Length (SL) from Boring Logs: FT.

Depth to Top of Well Screen (TD-SL): FT.

Height of Water Column in Monitoring Well (H=TD-DTW): FT.

Pump Depth FT.

Coversion Factors:

Well Volume (2-in): Hx0.17 gal/ft

1 L = 0.264 gal

Purge Method: tornado pump

LOW FLOW MONITORING PARAMETERS

Time	Volume Purged	pH	Specific Conductivity	Dissolved Oxygen	Temp.	ORP	Depth to Water	Flow Rate	Turbidity, Odor, Color
Hr : Min	mL	-	mS/cm	mg/L	C	mV	Feet	L/min	--
Targets	--	+/- 0.1	+/- 3%	+/- 10%	+/- 1 C	+/- 10 mV	<0.3 ft. drawdown	<0.5 L/min	NTU --
1305		5.68	0.182	1.08	23.31	87	28.09		312
1310		5.67	0.181	1.03	23.25	83			275
1315		5.67	0.179	1.01	23.70	81	25.81		238
1325		5.66	0.178	1.00	23.62	82			192
1330		5.65	0.176	0.89	23.80	81	25.34		165 clear/slightly cloudy
			end of	development					

Notes:

1. Water quality parameter measurements obtained every 3 to 5 minutes.
2. Well is **STABLE** once 3 consecutive measurements have been obtained for as many as 3 water quality parameters
3. Low flow rate target is 0.1 to 0.5 liters/min (0.026 to 0.132 Gallons per Minute).

Purge Flow Rate (pump purge only) ______ gal per min ______ liter per min (3.8 x gpm)

TOTAL Volume Purged ______ gallons ______ liters

Date & Time of Sample Collection – **DATE** – **TIME** NQ **INITIALS** *revised: Feb. 2007*

[signature]

Attachment E
Low-Flow Groundwater Sampling Logs

Geosyntec consultants

GROUNDWATER SAMPLING LOG

SITE NAME:	**AEP Pirkey Power Plant**	SITE LOCATION:	**Hallsville, TX**

WELL NO: B-2 | SAMPLE ID: B-2-well-20190522-1 + -2 | DATE: 5/22/19

WELL DIAMETER (inches): 2 | TUBING DIAMETER (inches): 3/8 | WELL SCREEN INTERVAL: 38 feet to 48 feet bgl | STATIC DEPTH TO WATER (feet): 12.61 | PURGE PUMP TYPE OR BAILER: hurricane

WELL VOLUME PURGE: (TOTAL WELL DEPTH − STATIC DEPTH TO WATER) X WELL CAPACITY = WELL VOLUME

(51.50 ft − 12.61 ft) X 0.16 gal/ft = 6.22 gallons

EQUIPMENT VOLUME PURGE: PUMP VOL. + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOL = EQUIPMENT VOLUME

Gal + (0.006 gal/ft X ft) + gal = gal

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 45 | FINAL PUMP OR TUBING DEPTH IN WELL (feet): 45 | PURGING INITIATED AT: 1630 | PURGING ENDED AT: 1825 | TOTAL VOLUME PURGED (gallons):

TIME	CUMUL.VOL. PURGED (gallons)	PURGE RATE (gpm or mL/min)	DEPTH TO WATER (feet)	pH (S.U.)	TEMP. (°C)	COND. (mS/cm)	DO (mg/L)	TURBIDITY (NTUs)	ORP (mV)
1637		250	14.24	5.74	22.99	0.195	2.50	1000+	79
1642		250	15.68	5.72	21.89	0.184	3.95	1000+	54
1647		250	16.62	5.71	21.52	0.196	5.47	705	53
1652		250	17.38	5.72	21.29	0.201	9.21	454	56
1657		250	18.24	5.70	21.23	0.197	8.33	271	61
1702		250	18.51	5.68	21.22	0.197	2.25	178	52
1707		250	18.99	5.65	21.12	0.196	2.42	136	68
1712		250	19.21	5.64	20.83	0.195	1.89	92.2	65
1717		250	19.29	5.61	21.16	0.192	1.95	89.2	69
1722		250	19.40	5.60	20.91	0.195	2.42	90.6	65
1727		250	19.55	5.59	20.94	0.193	2.97	102	71
1732		250	19.61	5.58	20.89	0.195	3.09	62.5	74

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88

TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

SAMPLED BY (PRINT) / AFFILIATION: Nathan Quick / Geosyntec | SAMPLER(S) SIGNATURES: Nat Qr | SAMPLING INITIATED AT: 1825 | SAMPLING ENDED AT:

PUMP OR TUBING DEPTH IN WELL (feet): 45 | SAMPLE PUMP FLOW RATE (mL per minute): 250 | TUBING MATERIAL CODE:

FIELD DECON: Y N | FLD-FILTERED: (Y) N FILTER SIZE: 45 µm Filtration Equipment: | EQUIPMENT. BLANK: Y (N) Sample ID: | DUPLICATE: Y (N)

SAMPLE ID CODE	# Bottles	MATERIAL CODE	VOLUME	PRESERV. USED	ANALYSIS/ METHOD	SAMPLING EQUIPMENT CODE

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING/PURGING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **VT** = Vacuum Trap; **O** = Other (Specify)

STABILIZATION CRITERIA	pH = ± 0.2	ORP = ± 20 mV	Specific Conductance = 3 **readings within** ± 3%
Dissolved Oxygen =	A) **≤ 10% saturation** (≤ 1.82 mg/l @ 20 °C, ≤ 1.65 mg/l @ 25 °C, ≤ 1.51 mg/l @ 30 °C)		
	B) **readings within ± 0.2 mg/L (for readings ≤ 2 mg/L), whichever greater**		
Turbidity =	**A)** ≤ 10 NTUs; OR		
	B) 3 readings within ± 10%		

Nat Qr

Geosyntec consultants

GROUNDWATER SAMPLING LOG

Page 2 of 2

SITE NAME: AEP Pirkey Power Plant	SITE LOCATION: Hallsville, TX

WELL NO: B-2	SAMPLE ID: B-2-well-20190522-1/2	DATE: 5/22/19

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 3/8	WELL SCREEN INTERVAL: 38 feet to 48 feet bgs	STATIC DEPTH TO WATER (feet): 12.61	PURGE PUMP TYPE OR BAILER: hurricane

WELL VOLUME PURGE: (TOTAL WELL DEPTH − STATIC DEPTH TO WATER) X WELL CAPACITY = WELL VOLUME

(51.50 ft − 12.61 ft) X 0.16 gal/ft = 6.22 gallons

EQUIPMENT VOLUME PURGE: PUMP VOL. + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOL = EQUIPMENT VOLUME

Gal + (gal/ft X ft) + gal = gal

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 45	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 45	PURGING INITIATED AT: 1630	PURGING ENDED AT: 1825	TOTAL VOLUME PURGED (gallons):

TIME	CUMUL.VOL. PURGED (gallons)	PURGE RATE (gpm or mL/min)	DEPTH TO WATER (feet)	pH (S.U.)	TEMP. (°C)	COND. (mS/cm)	DO (mg/L)	TURBIDITY (NTUs)	ORP (mV)
1737		250	19.64	5.56	20.80	0.197	3.42	61.2	75
1742		250	19.67	5.55	20.85	0.199	1.71	52.9	74
1747		250	19.70	5.53	20.86	0.200	1.82	44.3	72
1752		250	19.68	5.53	20.81	0.200	1.93	42.4	76
1757		250	19.64	5.52	20.75	0.202	2.01	30.7	70
1802		250	19.62	5.50	20.82	0.200	1.97	25.7	73
1807		250	19.62	5.49	20.73	0.198	1.93	25.0	75
1812		250	19.63	5.49	20.75	0.199	1.95	40.2	74
1817		250	19.60	5.48	20.82	0.193	1.67	27.7	80
1822		250	19.61	5.48	20.77	0.192	1.65	19.5	79
		sampled via dedicated tubing; 2 hour max met							

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

SAMPLED BY (PRINT) / AFFILIATION: Nathan Quirk / Geosyntec	SAMPLER(S) SIGNATURES: Nat Quirk	SAMPLING INITIATED AT: 1825	SAMPLING ENDED AT:
PUMP OR TUBING DEPTH IN WELL (feet):	SAMPLE PUMP FLOW RATE (mL per minute): 250	TUBING MATERIAL CODE:	

FIELD DECON: Y N	FLD-FILTERED: (Y) N FILTER SIZE: 0.45 µm Filtration Equipment:	EQUIPMENT. BLANK: Y (N) Sample ID:	DUPLICATE: Y (N)

SAMPLE ID CODE	# Bottles	MATERIAL CODE	VOLUME	PRESERV. USED	ANALYSIS/ METHOD	SAMPLING EQUIPMENT CODE

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING/PURGING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **VT** = Vacuum Trap; **O** = Other (Specify)

STABILIZATION CRITERIA	pH = ± 0.2	ORP = ± 20 mV	Specific Conductance = 3 **readings within** ± 3%
Dissolved Oxygen =	A) **≤ 10% saturation** (≤ 1.82 mg/l @ 20 °C, ≤ 1.65 mg/l @ 25 °C, ≤ 1.51 mg/l @ 30 °C)		
	B) **readings within ± 0.2 mg/L (for readings ≤ 2 mg/L), whichever greater**		
Turbidity =	**A)** ≤ 10 NTUs; OR		
	B) 3 readings within ± 10%		

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GROUNDWATER SAMPLING LOG

SITE NAME: **AEP Pirkey Power Plant**		SITE LOCATION: **Hallsville, TX**	
WELL NO: B-3	SAMPLE ID: B-3-well-20190521		DATE: 5/21/19
WELL DIAMETER (inches): 2"	TUBING DIAMETER (inches): 3/8	WELL SCREEN INTERVAL: feet to feet	STATIC DEPTH TO WATER (feet): 10.15
PURGE PUMP TYPE OR BAILER: hurricane			

WELL VOLUME PURGE: (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY = WELL VOLUME

(ft – 10.15 ft) X 0.16 gal/ft = gallons

EQUIPMENT VOLUME PURGE: PUMP VOL. + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOL = EQUIPMENT VOLUME

Gal + NA ~~0.0006~~ gal/ft X ft) + gal = gal

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 38.5	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 38.5	PURGING INITIATED AT: 1106	PURGING ENDED AT: 1245	TOTAL VOLUME PURGED (gallons):

TIME	CUMUL.VOL. PURGED (gallons)	PURGE RATE (gpm or mL/min)	DEPTH TO WATER (feet)	pH (S.U.)	TEMP. (°C)	COND. (mS/cm)	DO (mg/L)	TURBIDITY (NTUs)	ORP (mV)
1110		200	10.87	6.57	26.79	0.241	9.14	47.7	125
1115		200	11.91	6.16	24.77	0.257	9.78	525	98
1120		200	14.72	6.01	23.45	0.219	3.01	504	105
1125		200	18.01	5.98	22.95	0.207	5.89	550	87
1130		200	22.18	5.82	23.18	0.250	8.87	602	85
1135		200	24.91	5.81	23.29	0.225	8.82	625	88
1145		200	25.52	5.76	23.56	0.217	8.79	572	89
1155		200	26.12	5.78	23.51	0.189	8.90	501	89
1205		200	26.23	5.68	23.39	0.180	4.71	128	88
1210		200	26.31	5.66	23.28	0.181	5.02	58	88
1215		200	26.51	5.65	23.40	0.174	4.64	64	90
1225		200	26.63	5.65	23.53	0.166	4.52	66.2	81

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88

TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

SAMPLED BY (PRINT) / AFFILIATION: Nathan Quick / Geosyntec	SAMPLER(S) SIGNATURES: Nat Qk	SAMPLING INITIATED AT: 1245	SAMPLING ENDED AT: 1305
PUMP OR TUBING DEPTH IN WELL (feet):	SAMPLE PUMP FLOW RATE (mL per minute): 200	TUBING MATERIAL CODE:	
FIELD DECON: Y N	FLD-FILTERED: (Y) N FILTER SIZE: 45 µm Filtration Equipment:	EQUIPMENT. BLANK: Y (N) Sample ID:	DUPLICATE: Y (N)

SAMPLE ID CODE	# Bottles	MATERIAL CODE	VOLUME	PRESERV. USED	ANALYSIS/ METHOD	SAMPLING EQUIPMENT CODE

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING/PURGING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **VT** = Vacuum Trap; **O** = Other (Specify)

STABILIZATION CRITERIA	pH = ± 0.2	ORP = ± 20 mV	Specific Conductance = 3 **readings within ± 3%**
Dissolved Oxygen =	A) **≤ 10% saturation** (≤ 1.82 mg/l @ 20 °C, ≤ 1.65 mg/l @ 25 °C, ≤ 1.51 mg/l @ 30 °C)		
	B) **readings within ± 0.2 mg/L (for readings ≤ 2 mg/L), whichever greater**		
Turbidity =	**A)** ≤ 10 NTUs; OR		
	B) 3 readings within ± 10%		

Nat Qk

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LOW FLOW GROUNDWATER SAMPLING LOG

MONITORING WELL ID: B-3

PROJECT: AEP Pirkey

PROJECT NO: CHA8462.12

SITE LOCATION: Hallsville, TX

DATE MONITORED: 5/21/19 **WATER QUALITY METER MAKE/MODEL:** Horiba

DATE PURGED: 5/21/19 **LATEST CALIBRATION DATE/TIME:** 5/21/19

SAMPLING PERSONNEL: N. Quick **DUP OR MS/MSD:** -

MONITORING WELL INFORMATION

Well Diameter:	2	IN.
Static Depth to Groundwater (DTW):	10.15	FT.
Total Depth of Monitoring Well (TD):	39.	FT.
Screen Length (SL) from Boring Logs:	10	FT.
Depth to Top of Well Screen (TD-SL):		FT.
Height of Water Column in Monitoring Well (H=TD-DTW):		FT.
Pump Depth		FT.

Coversion Factors:
Well Volume (2-in): Hx0.17 gal/ft
1 L = 0.264 gal

Purge Method: ~~low~~ No low flow

LOW FLOW MONITORING PARAMETERS

Time	Volume Purged	pH	Specific Conductivity	Dissolved Oxygen	Temp.	ORP	Depth to Water	Flow Rate	Turbidity, Odor, Color
Hr : Min	mL	-	mS/cm	mg/L	C	mV	Feet	L/min	--
Targets	--	+/- 0.1	+/- 3%	+/- 10%	+/- 1 C	+/- 10 mV	<0.3 ft. drawdown	<0.5 L/min	nTU --
1230		5.63	0.169	4.01	23.88	103		.20	74.2
	sampled via dedicated tubing								

Notes:
1. Water quality parameter measurements obtained every 3 to 5 minutes.
2. Well is **STABLE** once 3 consecutive measurements have been obtained for as many as 3 water quality parameters
3. Low flow rate target is 0.1 to 0.5 liters/min (0.026 to 0.132 Gallons per Minute).

Purge Flow Rate (pump purge only) ______ gal per min ______ liter per min (3.8 x gpm)
TOTAL Volume Purged ______ gallons ______ liters

Date & Time of Sample Collection 5/21/19 **DATE** 1245 **TIME** NQ **INITIALS** *revised: Feb. 2007*

Nat Q

Geosyntec consultants

GROUNDWATER SAMPLING LOG

SITE NAME: **AEP Pirkey Power Plant**	SITE LOCATION: **Hallsville, TX**

WELL NO: AD-31	SAMPLE ID: AD-31-20190515	DATE: 5/15/19

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 3/8	WELL SCREEN INTERVAL: 30.5 feet to 40.5 feet	STATIC DEPTH TO WATER (feet): 10.90	PURGE PUMP TYPE OR BAILER: Hurricane SS

WELL VOLUME PURGE: (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY = WELL VOLUME

(40.5 ft – 10.92 ft) X 0.16 gal/ft = 4.73 gallons

EQUIPMENT VOLUME PURGE: PUMP VOL. + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOL = EQUIPMENT VOLUME

Gal + (gal/ft X ft) + gal = gal

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 35.0	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 35.0	PURGING INITIATED AT: 1220	PURGING ENDED AT: 1250	TOTAL VOLUME PURGED (gallons):

TIME	CUMUL.VOL. PURGED (gallons)	PURGE RATE (gpm or mL/min)	DEPTH TO WATER (feet)	pH (S.U.)	TEMP. (°C)	COND. (mS/cm)	DO (mg/L)	TURBIDITY (NTUs)	ORP (mV)
1223	NM	400	11.32	3.19	26.94	0.302	3.81	736	435
1229	NM	400	11.43	3.18	25.04	0.311	0.48	610	439
1236	NM	400	12.54	3.11	24.13	0.319	0.38	37.9	450
~~1244~~ 1243	NM	400	11.49	3.03	23.83	0.317	0.33	13.1	452
1248	NM	350	11.39	3.06	24.34	0.319	0.32	8.38	449

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

SAMPLED BY (PRINT) / AFFILIATION: Olivia Bramlet / Geosyntec	SAMPLER(S) SIGNATURES: [signature]	SAMPLING INITIATED AT: 1259	SAMPLING ENDED AT: 1337
PUMP OR TUBING DEPTH IN WELL (feet): 35.0	SAMPLE PUMP FLOW RATE (mL per minute):	TUBING MATERIAL CODE:	

FIELD DECON: Y N	FLD-FILTERED: Y N FILTER SIZE: ____ µm Filtration Equipment: ____	EQUIPMENT. BLANK: Y (N) Sample ID:	DUPLICATE: Y (N)

SAMPLE ID CODE	# Bottles	MATERIAL CODE	VOLUME	PRESERV. USED	ANALYSIS/ METHOD	SAMPLING EQUIPMENT CODE

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING/PURGING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **VT** = Vacuum Trap; **O** = Other (Specify)

STABILIZATION CRITERIA	pH = **± 0.2**	ORP = **± 20 mV**	Specific Conductance = 3 **readings within ± 3%**
Dissolved Oxygen =	A) **≤ 10% saturation** (≤ 1.82 mg/l @ 20 °C, ≤ 1.65 mg/l @ 25 °C, ≤ 1.51 mg/l @ 30 °C)		
	B) **readings within ± 0.2 mg/L (for readings ≤ 2 mg/L), whichever greater**		
Turbidity =	**A)** ≤ 10 NTUs; OR		
	B) 3 readings within ± 10%		

Geosyntec consultants

GROUNDWATER SAMPLING LOG

SITE NAME: AEP Pirkey Power Plant	SITE LOCATION: Hallsville, TX

WELL NO: AD32	SAMPLE ID: AD-32-20190515	DATE: 5/15/2019

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 3/8	WELL SCREEN INTERVAL: 13.0 feet to 33.0 feet	STATIC DEPTH TO WATER (feet): 4.61	PURGE PUMP TYPE OR BAILER: Hurricane SS

WELL VOLUME PURGE: (TOTAL WELL DEPTH − STATIC DEPTH TO WATER) X WELL CAPACITY = WELL VOLUME
(33.0 ft − 4.61 ft) X 0.16 gal/ft = 4.54 gallons

EQUIPMENT VOLUME PURGE: PUMP VOL. + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOL = EQUIPMENT VOLUME
Gal + (gal/ft X ft) + gal = gal

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 23.0	FINAL PUMP OR TUBING DEPTH IN WELL (feet):	PURGING INITIATED AT: ~~1010~~ 1015	PURGING ENDED AT: 1113	TOTAL VOLUME PURGED (gallons):

TIME	CUMUL.VOL. PURGED (gallons)	PURGE RATE (gpm or mL/min)	DEPTH TO WATER (feet)	pH (S.U.)	TEMP. (°C)	COND. (mS/cm)	DO (mg/L)	TURBIDITY (NTUs)	ORP (mV)
1021	NM	280	4.89	2.35	24.22	0.339	0.68	827	389
1030	NM	300	4.99	2.23	23.04	0.226	0.37	92.3	402
1040	NM	400	5.06	2.05	22.85	0.348	0.30	39.7	418
1046	NM	400	5.06	2.00	22.95	0.351	0.28	26.8	~~433~~ 422
1054	NM	480	5.24	1.96	22.76	0.354	0.37	20.1	427
1102	NM	400	5.08	1.89	23.72	0.354	0.29	18.2	428
1110	NM	350	5.05	1.85	23.81	0.354	0.26	11.8	431

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

SAMPLED BY (PRINT) / AFFILIATION: Olivia Bramlet / Geosyntec	SAMPLER(S) SIGNATURES: [signature]	SAMPLING INITIATED AT: 1115	SAMPLING ENDED AT: 1128
PUMP OR TUBING DEPTH IN WELL (feet): 23.0	SAMPLE PUMP FLOW RATE (mL per minute): 350	TUBING MATERIAL CODE:	
FIELD DECON: Y N	FLD-FILTERED: Y N FILTER SIZE: ____ µm Filtration Equipment: ____	EQUIPMENT. BLANK: Y (N) Sample ID:	DUPLICATE: (Y) N

SAMPLE ID CODE	# Bottles	MATERIAL CODE	VOLUME	PRESERV. USED	ANALYSIS/ METHOD	SAMPLING EQUIPMENT CODE
AD-32-20190515	4					
AD-32-20190515 DUP	4					

REMARKS: After sampling the Horiba unit, checked w/ cal solution & reading low @ 2.96 pH - pH on form likely low. All WL measurements from top of casing.

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING/PURGING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)

STABILIZATION CRITERIA	pH = ± 0.2	ORP = ± 20 mV	Specific Conductance = 3 **readings within ± 3%**
Dissolved Oxygen =	A) **≤ 10% saturation** (≤ 1.82 mg/l @ 20 °C, ≤ 1.65 mg/l @ 25 °C, ≤ 1.51 mg/l @ 30 °C)		
	B) **readings within ± 0.2 mg/L (for readings ≤ 2 mg/L), whichever greater**		
Turbidity =	**A)** ≤ 10 NTUs; OR		
	B) 3 readings within ± 10%		

Attachment F

Certification by a Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Pirkey East Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.95(g)(3)(ii) have been met.

Beth Ann Gross
Printed Name of Licensed Professional Engineer

Beth Ann Gross
Signature

Geosyntec Consultants
8217 Shoal Creek Blvd., Suite 200
Austin, TX 78757

Texas Registered Engineering Firm
No. F-1182

79864	Texas	July 22, 2019
License Number	Licensing State	Date