ALTERNATIVE SOURCE DEMONSTRATION REPORT TEXAS STATE CCR RULE

H.W. Pirkey Power Plant Flue Gas Desulfurization (FGD) Stackout Area Hallsville, Texas

Submitted to

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ATTACHMENTS

LIST OF ACRONYMS

ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
EBAP	East Bottom Ash Pond
EPRI	Electric Power Research Institute
FGD	Flue Gas Desulfurization
GSC	Groundwater Stats Consulting, LLC
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
MCL	Maximum Contaminant Level
QA	Quality Assurance
QC	Quality Control
SPLP	Synthetic Precipitation Leaching Profile
SSL	Statistically Significant Level
SU	Standard Unit
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
UTL	Upper Tolerance Limit
USEPA	United States Environmental Protection Agency
WBAP	West Bottom Ash Pond
XRD	X-Ray Diffraction

SECTION 1

INTRODUCTION AND SUMMARY

This Alternative Source Demonstration (ASD) report has been prepared to address statistically significant levels (SSLs) for beryllium and cobalt in the groundwater monitoring network at the H.W. Pirkey Plant Flue Gas Desulfurization (FGD) Stackout Area, located in Hallsville, Texas, following the first semiannual assessment monitoring event of 2022. The H.W. Pirkey Plant has four coal combustion residuals (CCR) storage units regulated by the Texas Commission on Environmental Quality (TCEQ) under Registration No. CCR104, including the FGD Stackout Area (**Figure 1**).

In June 2022, a semiannual assessment monitoring event was conducted at the FGD Stackout Area in accordance with 30 TAC §352.951(a). 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 unit (Geosyntec, 2020a) 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 either the background concentration or, for constituents with a maximum contaminant level (MCL), the MCL. 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 re-calculated for Appendix IV parameters at the compliance wells to assess whether these parameters were present at SSLs above the GWPSs. Seasonal patterns were observed for beryllium, cadmium, cobalt, combined radium, fluoride, and lithium at AD-22 (Geosyntec, 2022a). To correctly account for seasonality, confidence intervals for these wells and constituents were constructed using deseasonalized values. 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 FGD Stackout Area (Geosyntec, 2022a):

- The LCL for beryllium exceeded the GWPS of 0.00400 milligrams per liter (mg/L) at AD-7 (0.00406 mg/L). The deseasonalized LCL for beryllium exceeded the GWPS of 0.00400 at AD-22 (0.00557 mg/L).

- The deseasonalized LCL for cobalt exceeded the GWPS of 0.0560 mg/L at AD-22 (0.0742 mg/L).

No other SSLs were identified.

1.1 CCR Rule Requirements

TCEQ regulations regarding assessment monitoring programs for CCR landfills and surface impoundments (TCEQ, 2020a) provide owners and operators with the option to make an ASD when an SSL is identified (30 TAC §352.951(e)):

> *… In making a demonstration under this subsection, the owner or operator must, within 90 days of detecting a statistically significant level above the groundwater protection standard of any constituent listed in Appendix IV adopted by reference in §352.1431 of this title, submit a report prepared and certified in accordance with §352.4 of this title (relating to Engineering and Geoscientific Information) to the executive director, and any local pollution agency with jurisdiction that has requested to be notified, demonstrating that a source other than a CCR unit caused the exceedance or that the exceedance resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.*

Pursuant to 30 TAC §352.951(e), Geosyntec Consultants, Inc. (Geosyntec) has prepared this ASD report to document that the SSLs identified for beryllium at AD-7 and AD-22 and cobalt at AD-22 are from a source other than the FGD Stackout Area.

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 beryllium and cobalt were based on a Type IV cause and not by a release from the Pirkey FGD Stackout Area.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The TCEQ CCR rules 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. Descriptions of the Stackout Area design and construction, regional geology and site hydrogeology, methodology used to evaluate the SSLs, and proposed alternative source are described below.

2.1 FGD Stackout Area Design and Construction

The Pirkey FGD Stackout Area is an approximately 7-acre storage area located due west of the Pirkey Plant (**Figure 1**). It was designed for temporary stockpiling of stabilized FGD material placed on the native clay soil in the in the unit until it can be hauled to the on-site landfill for disposal (Arcadis, 2016). The ground surface elevation in the Stackout Area ranges from approximately 360 to 365 feet above mean sea level. Based on lithological borings advanced in the vicinity, the Stackout Pad is underlain by approximately 20 feet of clay (Arcadis, 2016).

The maximum height of the stockpiles in the Stackout Area is approximately 41 feet above ground surface. Containment of contact water from the stockpiles is provided by a stone berm with a geomembrane cover constructed around the Stackout Area perimeter. Also, stockpiles are located no closer than approximately 50 feet from the Stackout Area perimeter (Arcadis, 2016).

2.2 Regional Geology/Site Hydrogeology

The Stackout Area is positioned on an outcrop of the Eocene-age Recklaw Formation, which consists predominantly of clay and fine-grained sand (Arcadis, 2016). The Recklaw Formation is underlain by the Carrizo Sand, which crops out in the topographically lower southern portion of the plant. The Carrizo Sand consists of fine to medium grained sand interbedded with silt and clay.

The Stackout Area monitoring well network monitors groundwater within the uppermost aquifer, which was defined by Arcadis (2016) as very fine to fine grained clayey and silty sand located about 10 to 20 feet below the Stackout Area with an average thickness of approximately 20 feet. Geologic cross-sections B-B' and E-E' from Arcadis (2016) show the subsurface structure of the uppermost aquifer (indicated on the figures as clayey silty sand, brown to gray in color) underlying the Stackout Area. These figures as well as a cross-section location map are provided in **Attachment A**. The geologic cross-sections demonstrate lateral continuity of the uppermost aquifer at and around the Stackout Area.

Groundwater flow direction at and near the Stackout Area is west-northwesterly (**Figure 1**). Groundwater flow velocities in the uppermost aquifer in the vicinity of the Stackout Area have been reported as approximately 5 to 35 feet/year. The Stackout Area monitoring well network consists of upgradient monitoring wells AD-12 and AD-13, and downgradient compliance wells AD-7, AD-22, and AD-33, all of which are screened within the uppermost aquifer.

2.3 Proposed Alternative Source

An initial review of site geochemistry, site historical data, and laboratory quality assurance/quality control (QA/QC) data did not identify alternative sources for beryllium and cobalt due to Type I (sampling), Type II (laboratory), Type III (statistical evaluation), or Type V (anthropogenic) issues. Groundwater sampling, laboratory analysis, and statistical evaluations were generally completed in accordance with 30 TAC §352.931 and the draft TCEQ guidance for groundwater monitoring (TCEQ, 2020b). As described below, the SSLs have been attributed to natural variation associated with seasonal effects, which is a Type IV (natural variation) issue.

2.3.1 Beryllium

An SSL was identified for beryllium at AD-22 using deseasonalized statistics (Geosyntec, 2022a). According to the Unified Guidance, "seasonal correction should be done both to minimize the chance of mistaking a seasonal effect for evidence of contaminated groundwater, and also to build more powerful background to compliance point tests. Problems can arise, for instance, from measurement variations associated with changing recharge rates during different seasons" (USEPA, 2009). An SSL was also identified for beryllium at AD-7, although deseasonalized statistics were not used.

The seasonal effects observed in the statistical analysis occur in roughly annual cycles, with somewhat higher beryllium concentrations occurring in early spring and lower concentrations in early fall. For example, the beryllium concentration at AD-22 was 0.00878 milligrams per liter (mg/L) in March 2022, in contrast to 0.0025 mg/L in November 2021. Previous ASDs for the FGD Stackout Area showed that beryllium concentrations at AD-7 and AD-22 appear to correlate with groundwater elevations (Geosyntec, 2019; Geosyntec, 2020b; Geosyntec, 2020c; Geosyntec, 2021a; Geosyntec, 2021d; Geosyntec, 2022b). This relationship generally still holds true (**Figure 2**). Beryllium concentrations at AD-7 and AD-22 are generally correlated with seasonal changes in other relatively mobile cationic constituents, including calcium (**Figure 3**) and lithium (**Figure 4**). The correlation between beryllium and both monovalent (lithium) and divalent (calcium) cations suggests that the variability in observed beryllium concentrations is related to cation exchange behavior with clay minerals present in the native soil.

In March of 2020, the geology near AD-7 was relogged at soil boring SP-B2. Silty clay was identified from approximately 2.5-6.9 feet below ground surface (bgs) before transitioning to clay until 18.8 ft bgs (**Figure 5a**). It was also noted that the depth to water fluctuated between approximately 9 and 15 ft bgs. The boring log for SP-B2 is provided in **Attachment B**, and the original boring log and well construction diagram is provided in **Attachment C**. Soil boring SP-B4, which was advanced in March 2020 to re-log AD-22, found that clay materials were present in the seasonally saturated zones above the permanent water table (**Figure 5b**). The boring log for SP-B4 is provided in **Attachment D,** and the original boring log and well construction diagram is provided in **Attachment E**. At AD-22, the depth to water fluctuated between approximately 3 and 12 ft bgs. Clay was identified from approximately 1.5 ft bgs to 13.3 ft bgs, where it transitioned to a clayey silt (**Figure 5b**). Analysis by X-ray diffraction (XRD) confirmed the presence of clay minerals within the seasonal water table and sand within the screened intervals for both AD-7 and AD-22, as summarized in **Table 1**. The clay fraction of the uppermost samples collected from within the seasonal water table was further analyzed to identify the type of clays present. Smectite-type clays, which are 2:1-layer high-activity clays with characteristically high cation exchange capacity (compared to low-activity 1:1 clay minerals), make up the majority of the clay minerals present at those intervals.

Sorption and desorption of beryllium from smectite-type clays is well documented (You, et al., 1989; Boschi and Willenbring, 2016a). Desorption was found to be affected by pH, with 75% of beryllium desorbing from a smectite-type clay as pH decreased from 6.0 standard units (SU) to 3.0 SU (Boschi and Willenbring, 2016b). The pH values recorded at AD-7 and AD-22 for samples collected under the Texas CCR Rule ranged from 2.9 to 4.1 SU and 3.9 to 5.1 SU, respectively, suggesting that conditions are favorable for beryllium desorption from smectite-type clays. The presence of these exchangeable clays provides further evidence that the exceedances of beryllium at AD-7 and AD-22 can be attributed to the effects of seasonal groundwater elevation changes, and the resulting cation exchange between groundwater and the exchangeable clay within the seasonal water table, on groundwater quality.

2.3.2 Cobalt

An SSL was identified for cobalt at AD-22 using deseasonalized statistics (Geosyntec, 2022a). As shown in previous ASDs (Geosyntec, 2020b; Geosyntec, 2020c; Geosyntec, 2021a; Geosyntec, 2021d; Geosyntec, 2022b), the cobalt groundwater concentrations at AD-22 also appear to correlate with seasonal changes in groundwater elevation (**Figure 6**). In addition, the cobalt concentrations are well correlated with changes in other cations, including calcium and lithium (**Figure 7**), suggesting natural variability associated with groundwater-mineral interactions within the seasonally saturated zone is governing dissolved cobalt concentrations.

A sample of the solid FGD sludge material accumulated on the FGD Stackout Area was collected in July 2019 and submitted for laboratory analyses. The solid phase sample was leached using both USEPA's Synthetic Precipitation Leaching Profile (SPLP) testing procedure (SW-846 Test Method 1312 [USEPA, 1994]) and TCEQ's 7-Day Distilled Water Leachate Test Procedure (30 TAC 335.521 Appendix 4) to evaluate the material as a potential source of cobalt. No changes to material handling or plant operations have occurred which would alter the anticipated chemical composition since this sample was initially collected. Calcium-cobalt ratios for the leached sludge material and site groundwater are displayed on **Figure 8**. The concentration ratio between calcium and cobalt is consistently on the order of 100:1 at both upgradient and downgradient locations (**Figure 8**). Calcium concentrations in groundwater are generally consistent between AD-22 and upgradient well AD-13 (**Figure 9**); however, leached calcium concentrations from the FGD sludge material are approximately two to three orders of magnitude greater than site groundwater. The difference between the ratio of calcium to cobalt in the leached FGD sludge material (about 45,000:1) compared to the ratio for groundwater suggests that dissolved calcium concentrations at AD-22 would be significantly higher if the groundwater at this location were affected by leachate.

Siderite and pyrite, both reduced iron-bearing minerals, were identified below the seasonal water table (within the saturated zone) at AD-22 (**Table 1**). Cobalt is known to undergo isomorphic substitution for iron in both siderite and pyrite (Gross, 1965; Hitzman, et al., 2017; Krupka and Serne, 2002). This is due to the similarity of their ionic radii (approximately 1.56 angstrom (Å) for iron vs. 1.52 Å for cobalt [Clementi and Raimondi, 1963). The proposed substitution of cobalt for iron in the crystal lattice of pyrite has been documented in other ASDs prepared for the Pirkey Plant's East Bottom Ash Pond (EBAP; Geosyntec, 2022b) and West Bottom Ash Pond (WBAP; Geosyntec, 2022c).

Goethite (an iron hydroxide) was identified within the seasonally saturated zone and the screened interval at AD-22 (**Table 1**). The weathering of siderite and pyrite to goethite under oxidizing conditions is a well-understood phenomenon, including in formations in east Texas (Senkayi, et al., 1986; Dixon, et al., 1982) and may have occurred within the seasonally saturated zone. A review of geochemical conditions at AD-22 shows that the conditions observed at AD-22 are favorable for goethite formation (**Figure 10**). During weathering from reduced (pyrite and siderite) to oxidized (goethite) iron minerals, isomorphically substituted cobalt may be released from the mineral structure into groundwater. The contribution of cobalt to groundwater via dissolution of siderite or pyrite within the saturated aquifer is not likely to change seasonally. However, the mobilization of cobalt which was released during weathering of siderite or pyrite to goethite in the seasonally saturated zone may explain the variability in aqueous cobalt concentrations and their correlation with the groundwater elevation.

2.3.3 Conceptual Site Model

The seasonal fluctuations in beryllium at AD-7 and AD-22 and cobalt concentrations at AD-22 can be attributed to variations in the amount of the aquifer solids that are in contact with groundwater as the water table elevation changes. When the water table is higher, more clay material is in contact with groundwater, allowing greater desorption of cations (including beryllium) from the cation exchange sites on the clay. In the case of cobalt, more iron oxides are in contact with groundwater as the water table rises, allowing for the release of cobalt from mineral phases where it has isomorphically substituted for iron. Thus, the observed SSLs were attributed to natural variation associated with seasonal fluctuation of beryllium and cobalt as the amount of aquifer solids that are saturated increases.

2.4 <u>Sampling Requirements</u>

As the ASD presented above supports the position that the identified SSLs are not due to a release from the Pirkey FGD Stackout Area, the unit will remain in the assessment monitoring program. Groundwater at the unit will continue to be sampled for Appendix IV parameters on a semiannual basis.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 30 TAC §352.951(e) and supports the position that the SSLs of beryllium at AD-7 and AD-22 as well as cobalt at AD-22 identified during the first semiannual assessment monitoring event of 2022 were not due to a release from the FGD Stackout Area. The identified SSLs were, instead, attributed to natural variation related to seasonal desorption of beryllium and dissolution of cobalt-bearing minerals comprising the aquifer solids. Therefore, no further action is warranted, and the Pirkey FGD Stackout Area 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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TABLES

Table 1: X-Ray Diffraction Results
FGD Stackout Pad - H. W. Pirkey Plant

Boring Location	**SP-B2**			**SP-B4**		
Associated Well	**AD-7**			**AD-22**		
Depth (ft bgs)	**10-12**	**16-18**	**27-29**	**6-8**	**18-20**	**28-30**
Sample Location	**Within Seasonal Water Table**	**Below Seasonal Water Table**	**Within Screened Interval**	**Within Seasonal Water Table**	**Below Seasonal Water Table**	**Within Screened Interval**
Quartz	39	37	79	28	47.5	95
Plagioclase Feldspar	-	1	-	<0.5	<0.5	1
K-Feldspar	<0.5	1	-	1	0.5	-
Goethite	1	2	0.5	1	-	2
Hematite	-	-	0.5	-	-	-
Chlorite	-	-	-	1	-	-
Siderite		-			10	-
Pyrite	-	-	-	-	2	-
Clays	*	59	20	*	40	2
Kaolinite	9			13		
Illite/Mica	1			2		
Smectite	50			43		
Mixed-Layered Illite/Smectite	-			11		

Notes:
-: not detected
Mineral constituents are reported in percentage.
Values shown as less than indicate the mineral constituent is present but below the quantification limit.
*The clay fraction at SP-B2-10-12 and SP-B4-6-8 were further analyzed to characterize the types of clays present, as listed below.

FIGURES

Legend

Groundwater Monitoring Wells

- Out of Network
- EBAP
- WBAP
- Landfill
- Stackout Area
- EBAP and WBAP
- All CCR Unit Networks
- Piezometer
- Groundwater Elevation Contour
- Groundwater Elevation Contours (Inferred)
- Approximate Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on June 20-22, 2022) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluation Update (Arcadis, 2022) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- AD-10, AD-19, AD-20, AD-21, AD-24, AD-29, AD-35, and W-3 were not gauged during the June 2022 event.
- AD-35 was abandoned on November 13, 2018.

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Beth Ann Gross

12/29/2022

Geosyntec Consultants, Inc.
Texas Firm
Registration No. 1182

Potentiometric Contours - Uppermost Aquifer June 2022

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Figure 1

Columbus, Ohio | 2022/12/21

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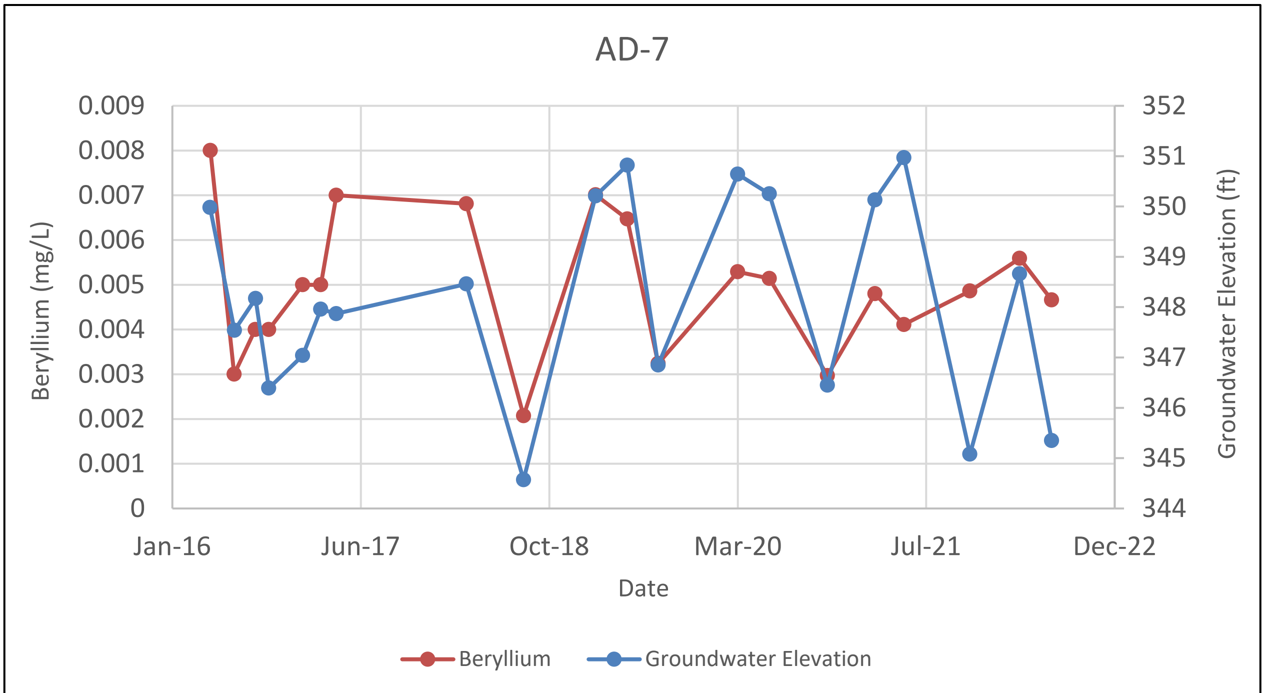

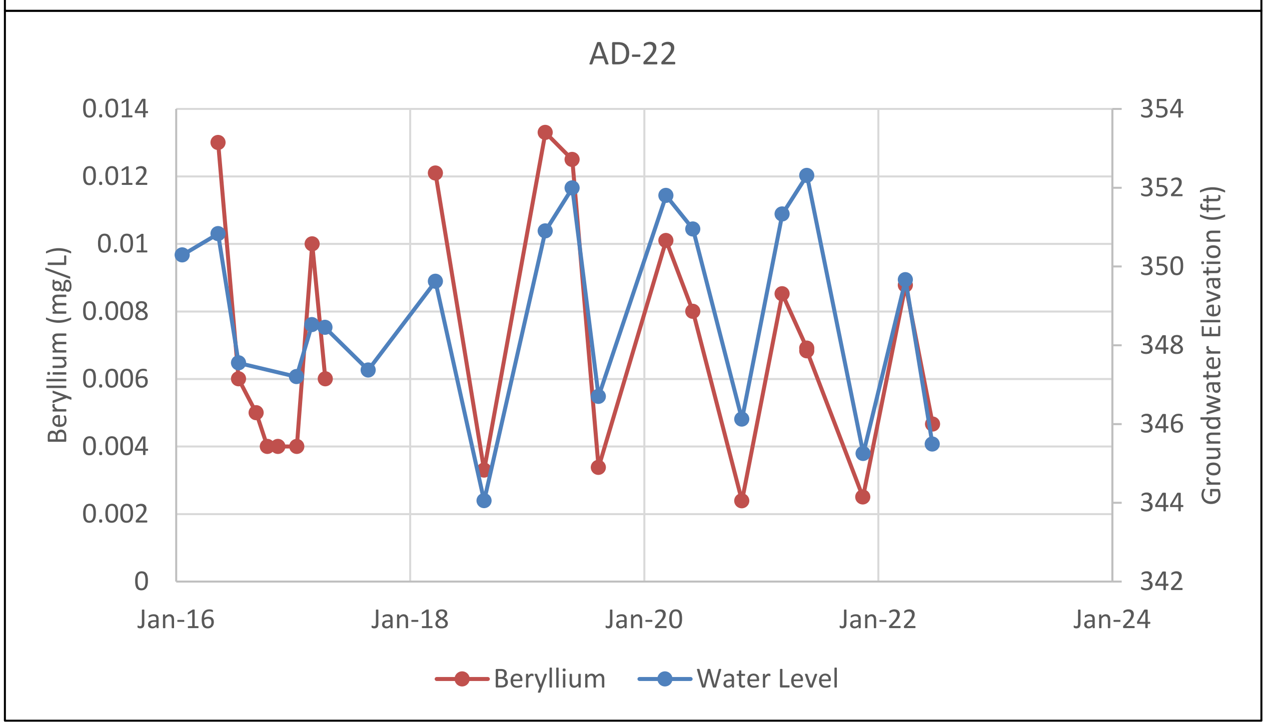

Notes: Beryllium concentrations are shown in milligrams per liter (mg/L). Water level is shown as groundwater elevation (ft). The gap in beryllium data represents the time period in which detection monitoring took place and samples were not analyzed for beryllium.

Beryllium Concentration v. Groundwater Elevation

Pirkey FGD Stackout Pad

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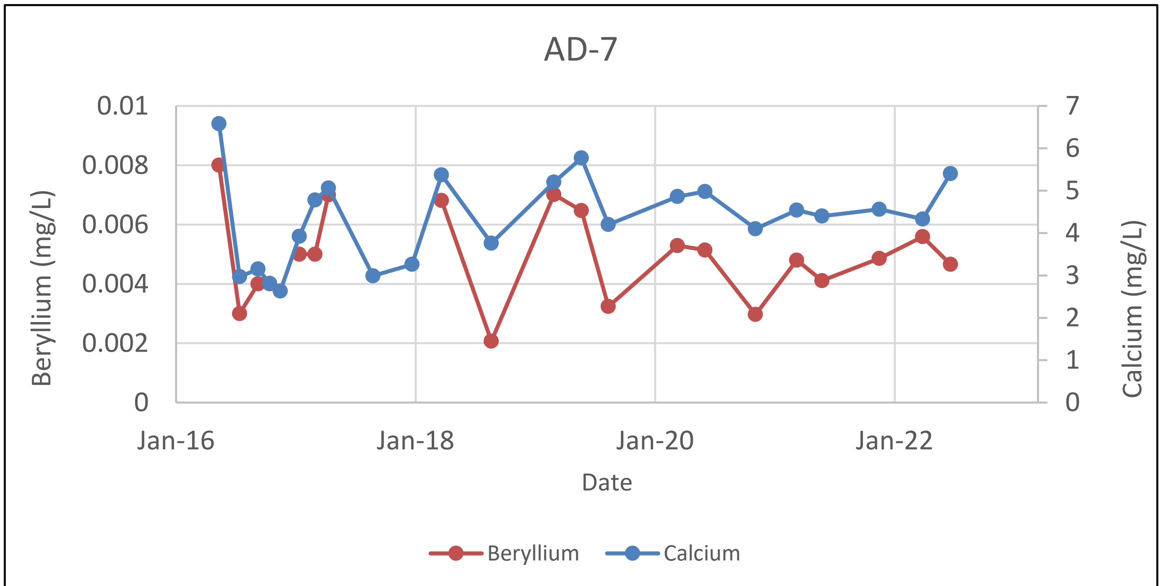
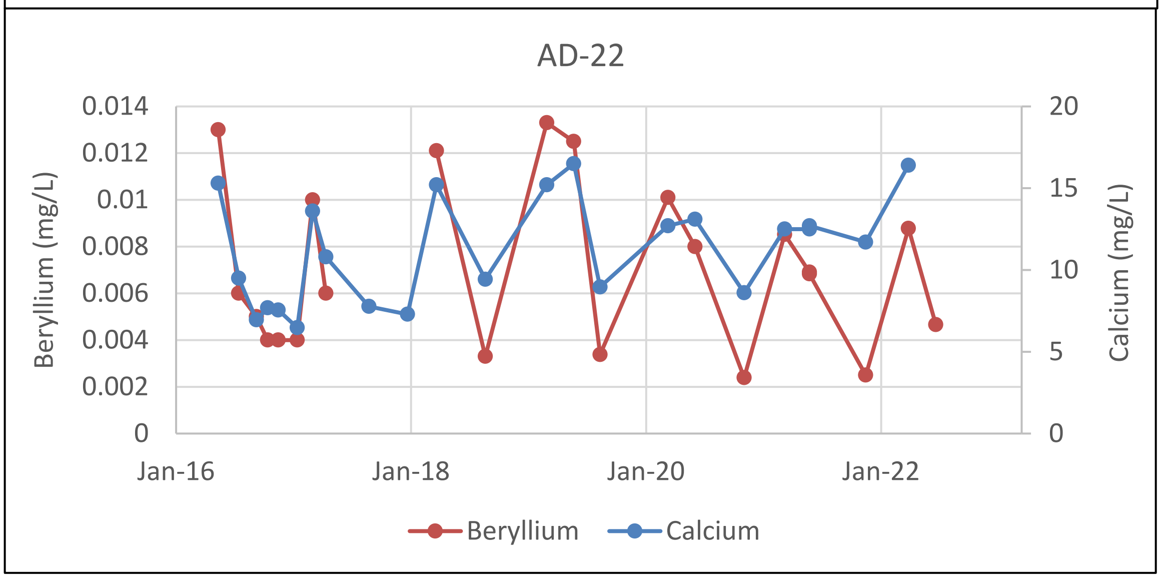
Figure

2

Columbus, Ohio

December-2022





Notes: Beryllium and calcium concentrations are shown in milligrams per liter (mg/L). The gaps in beryllium data represent the time period in which detection monitoring took place and samples were not analyzed for beryllium.

Beryllium v. Calcium Concentrations

Pirkey FGD Stackout Pad

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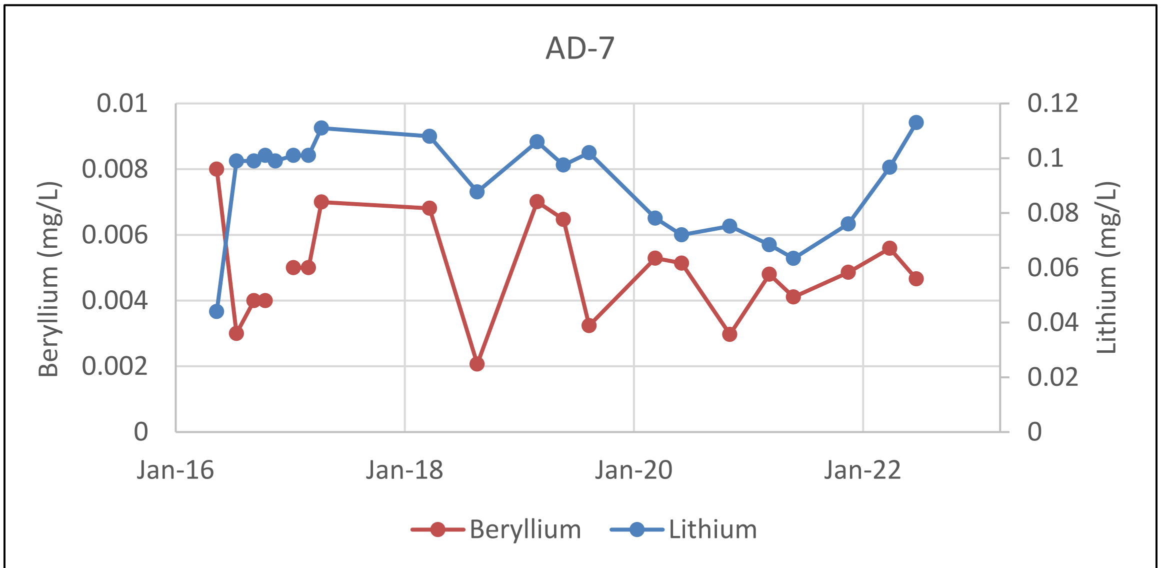
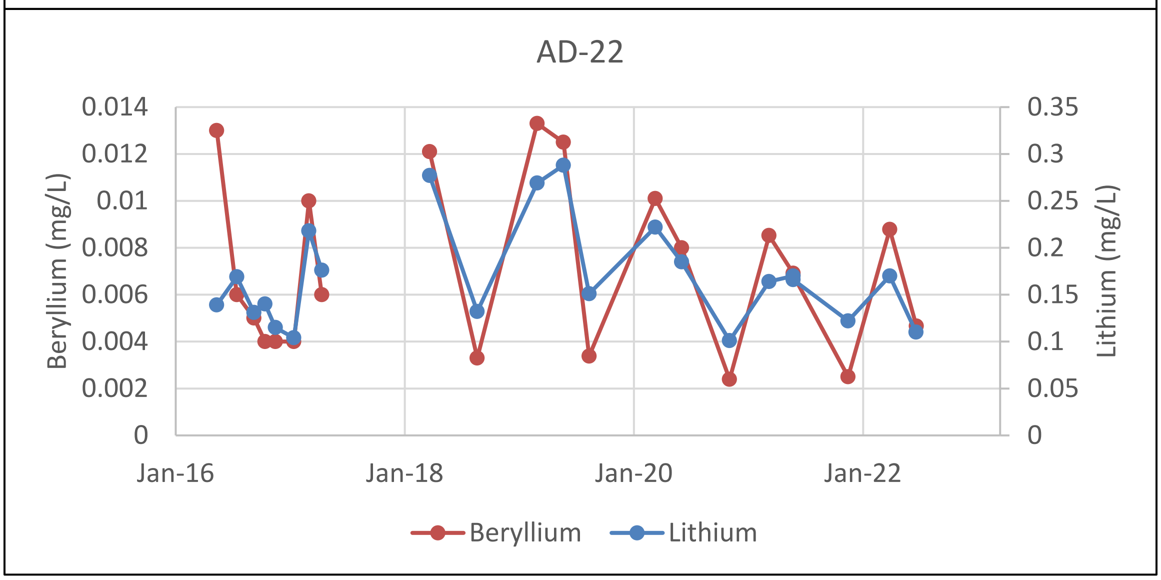
Columbus, Ohio

December-2022

Figure

3





Notes: Beryllium and lithium concentrations are shown in milligrams per liter (mg/L). The gaps in data represents the time period in which detection monitoring took place and samples were not analyzed for beryllium or lithium.

Beryllium v. Lithium Concentrations

Pirkey FGD Stackout Pad

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Figure

4

Columbus, Ohio

December-2022

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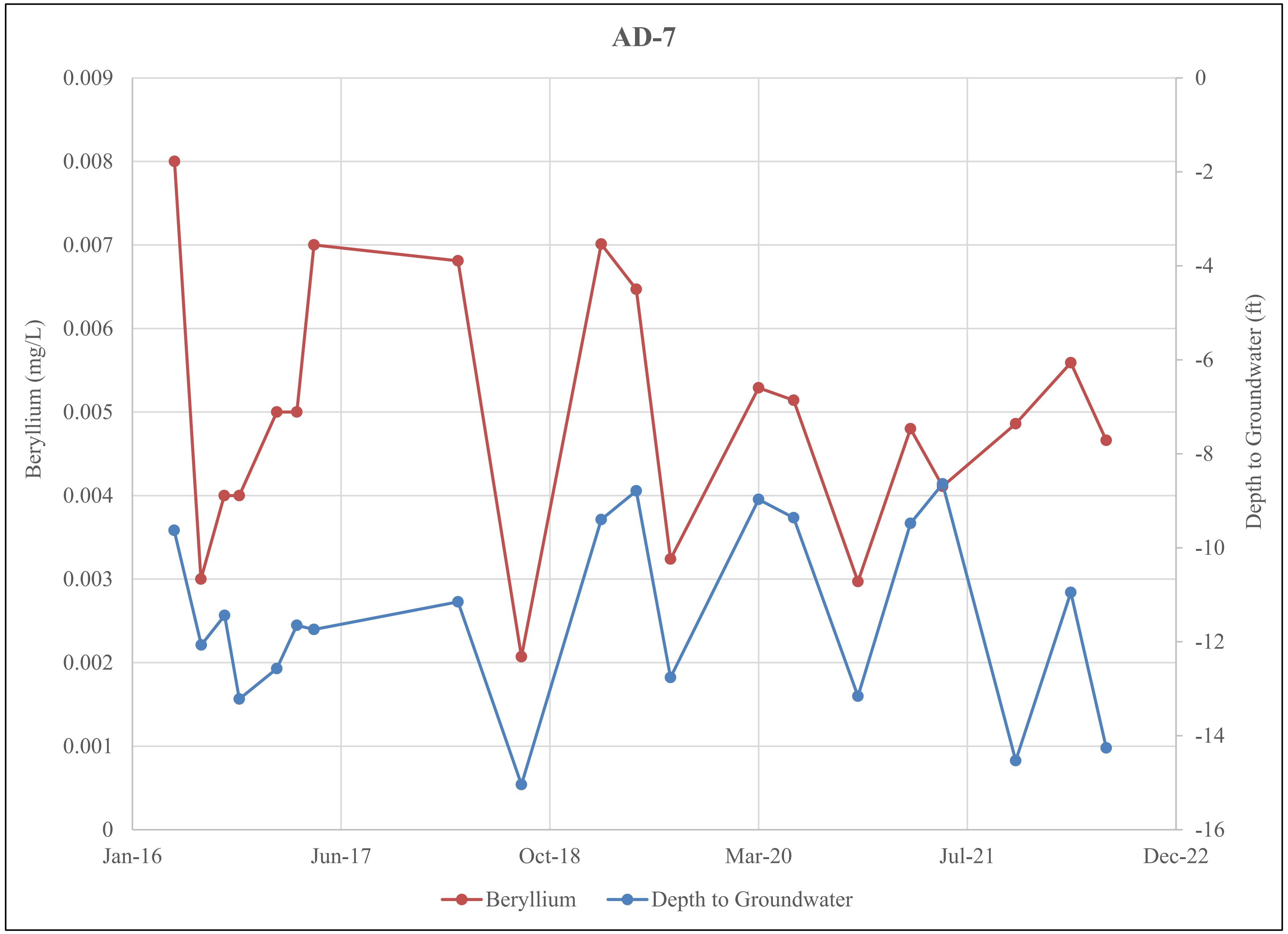
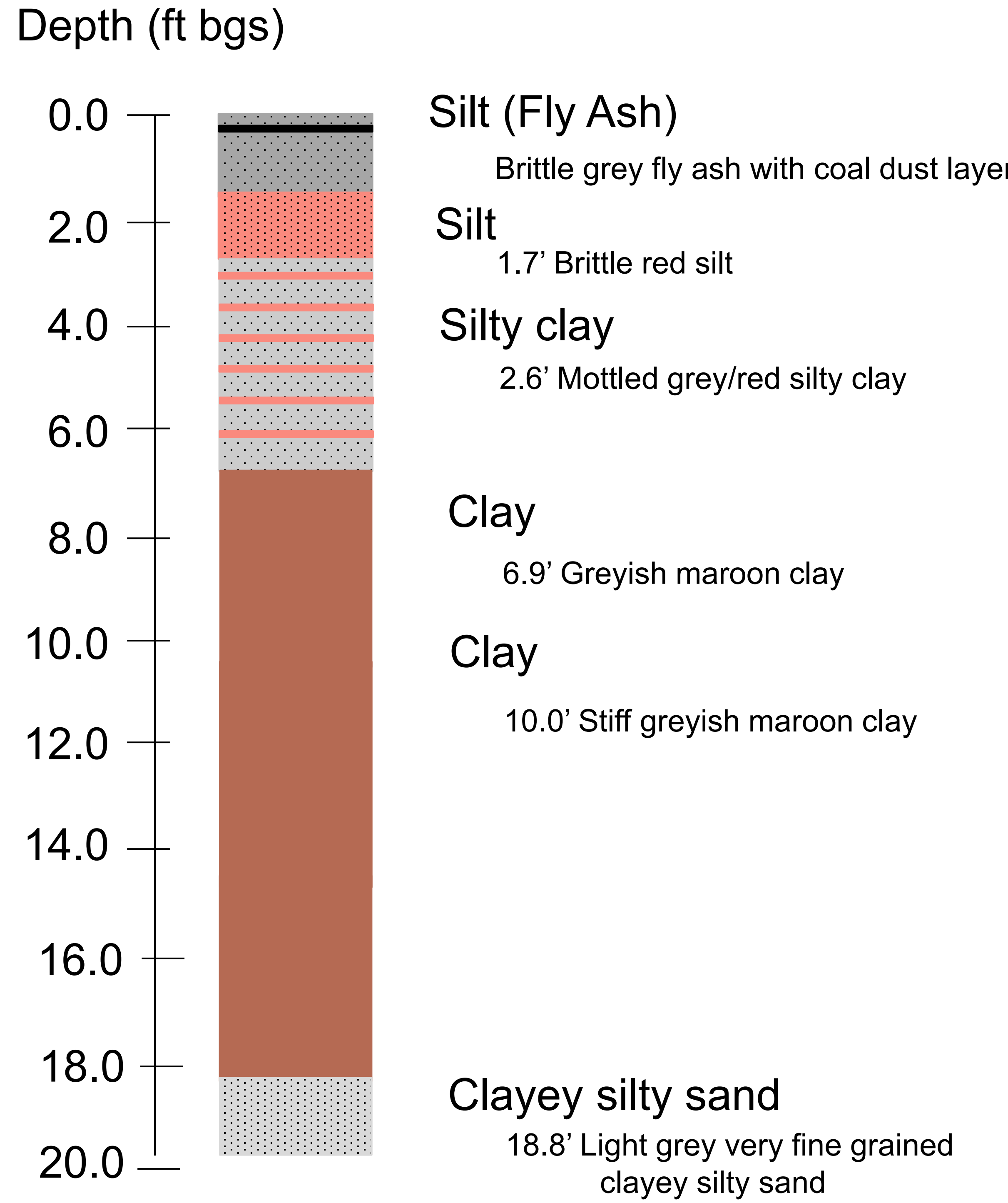
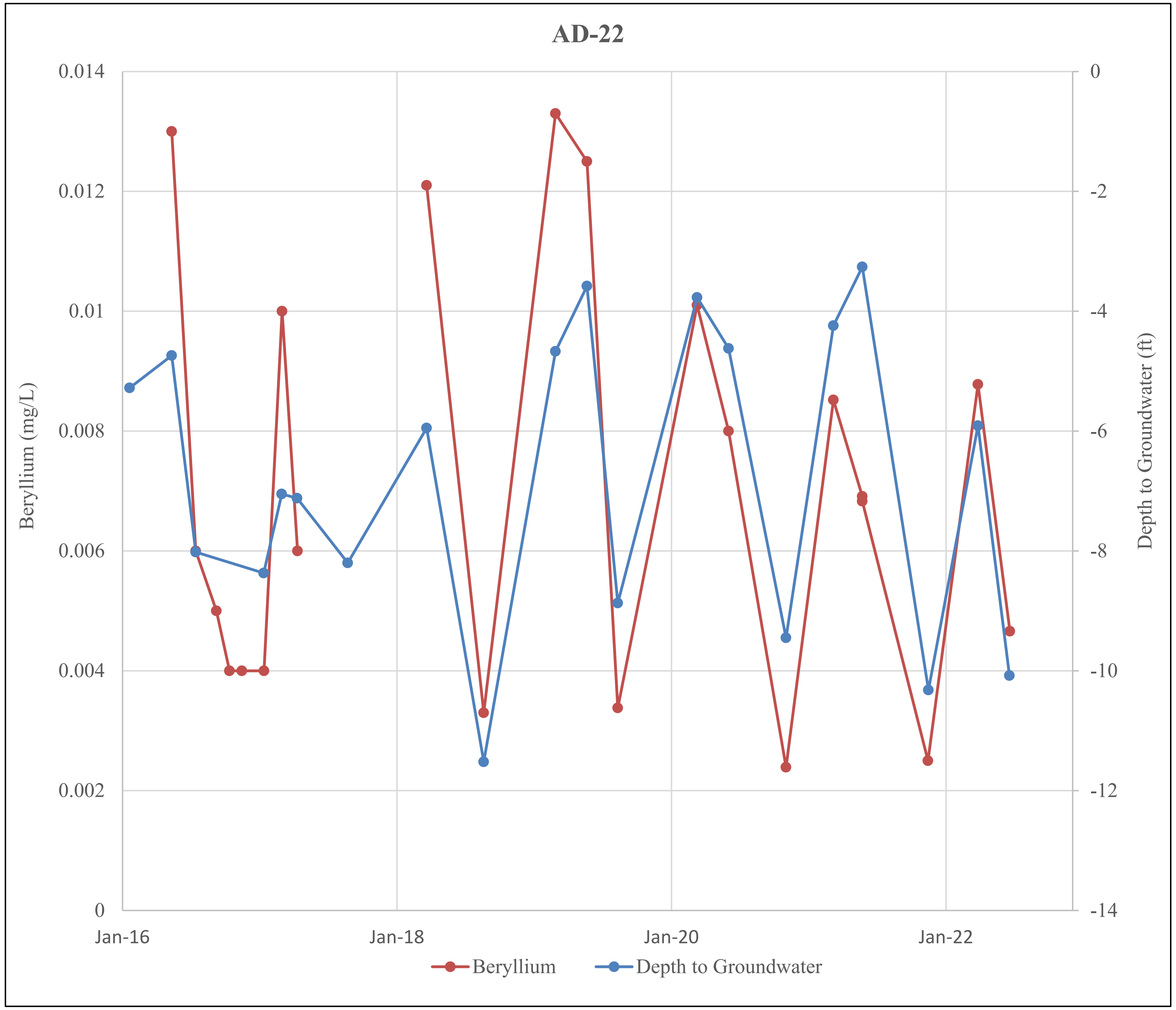
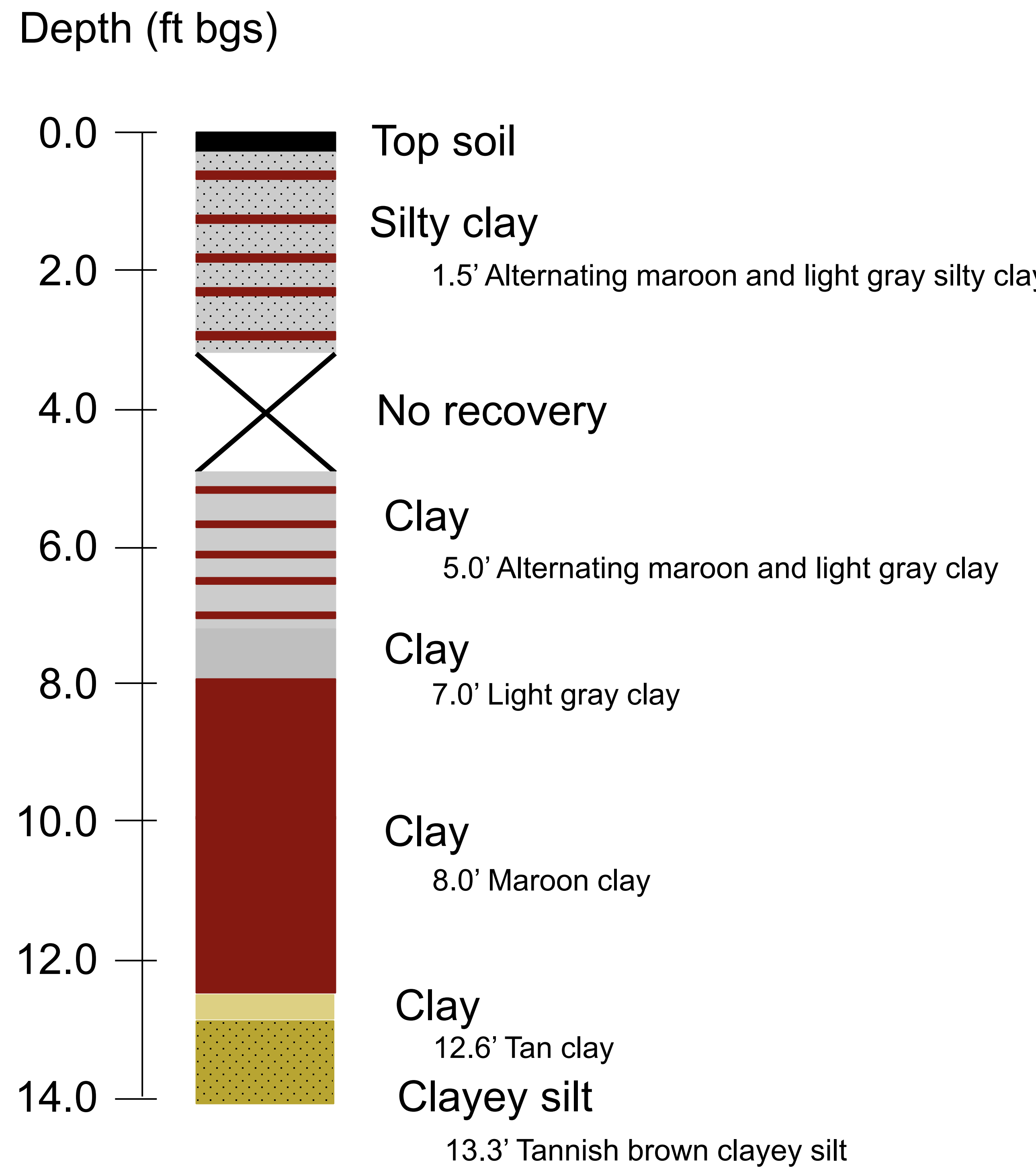




Notes:
-A sample was collected for analysis of mineralogy from 10-12 ft bgs.
-This illustration represents the log for boring SP-B2. The full boring log is available in Attachment B.
-AD-7 is screened at the interval of 19-39 ft bgs.

AD-7 Seasonal Water Table Geology H.W. Pirkey Plant – FGD Stackout Pad	
Geosyntec consultants	Figure **5a**
Columbus, OH — January - 2023	



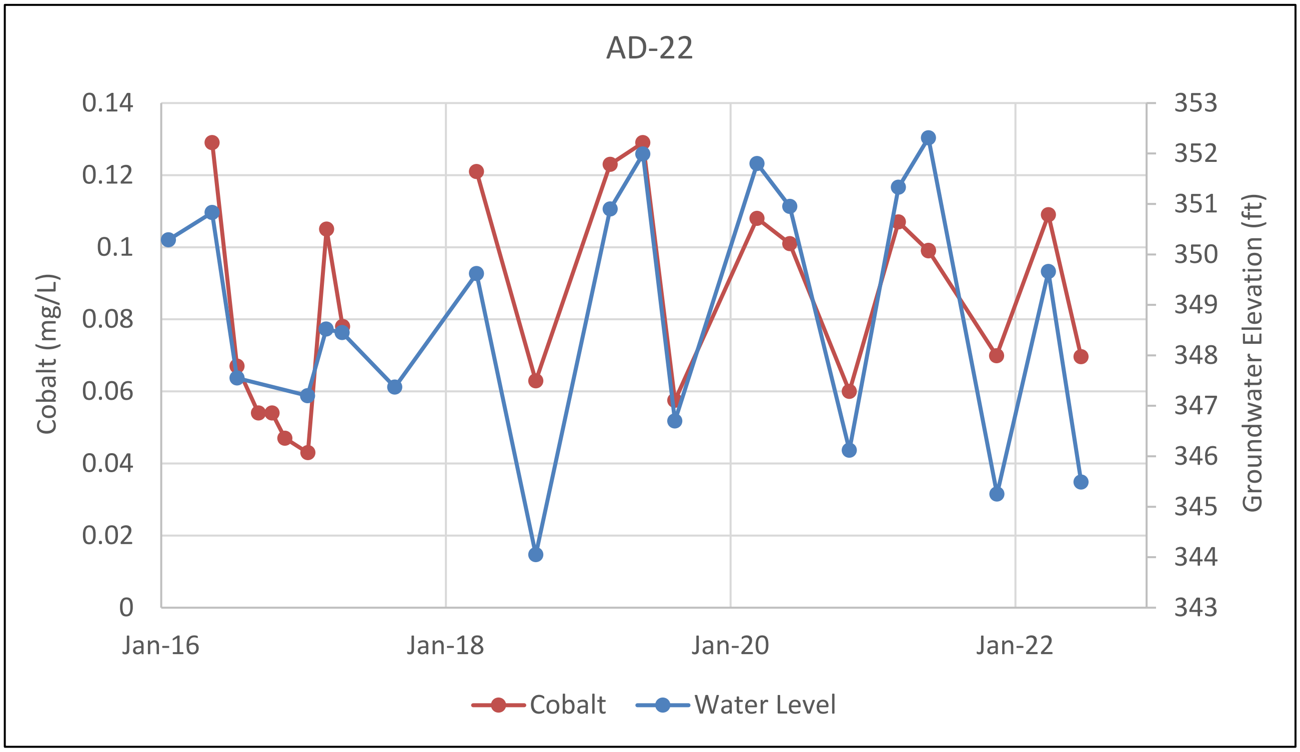


Notes:
-A sample was collected for analysis of mineralogy from 6-8 ft bgs.
-This illustration represents the log for boring SP-B4. The full boring log is available in Attachment D.
-AD-22 is screened at the interval of 10-30 ft bgs.

AD-22 Seasonal Water Table Geology
H. W. Pirkey Plant – FGD Stackout Pad

Geosyntec consultants

Columbus, OH	January - 2023	Figure 5b



Notes: Cobalt concentrations are shown in milligrams per liter (mg/L). Water level is shown as groundwater elevation (ft). The gap in cobalt data represents the time period in which detection monitoring took place and samples were not analyzed for cobalt.

AD-22 Cobalt Concentration v. Groundwater Elevation

Pirkey FGD Stackout Pad

Geosyntec consultants

AMERICAN ELECTRIC POWER

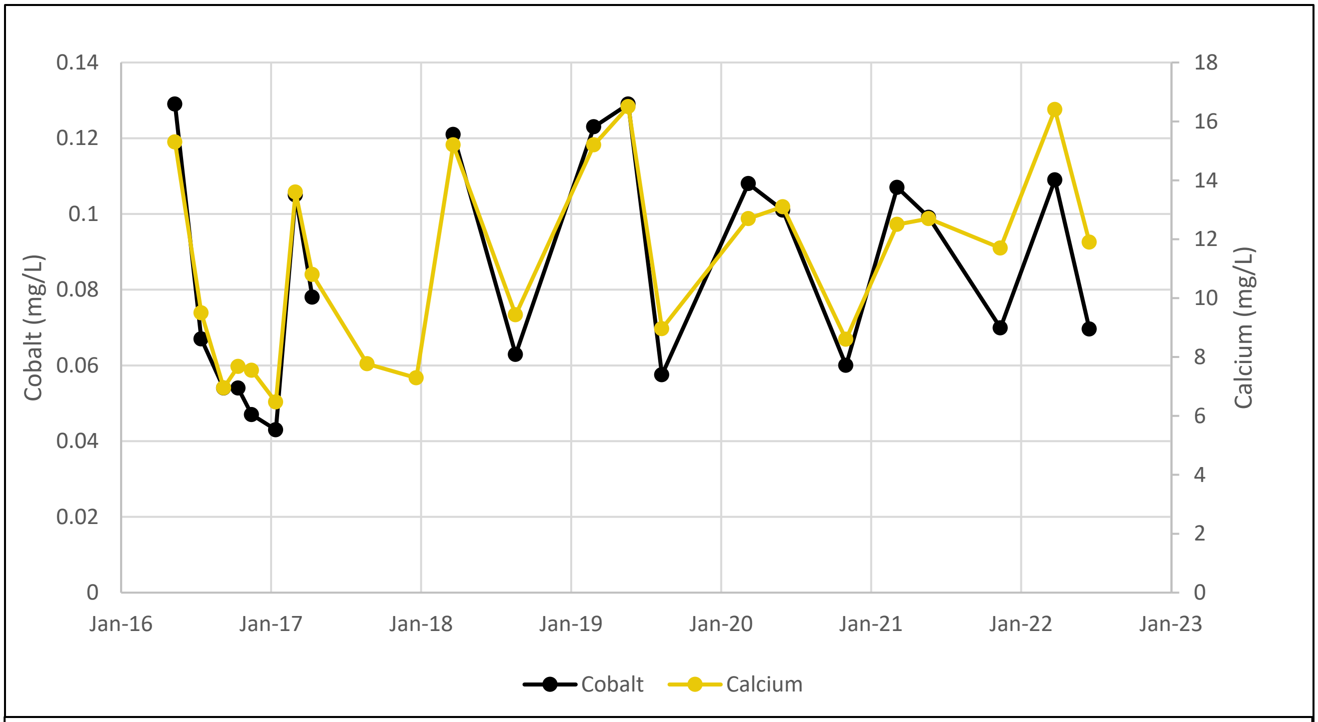
Figure

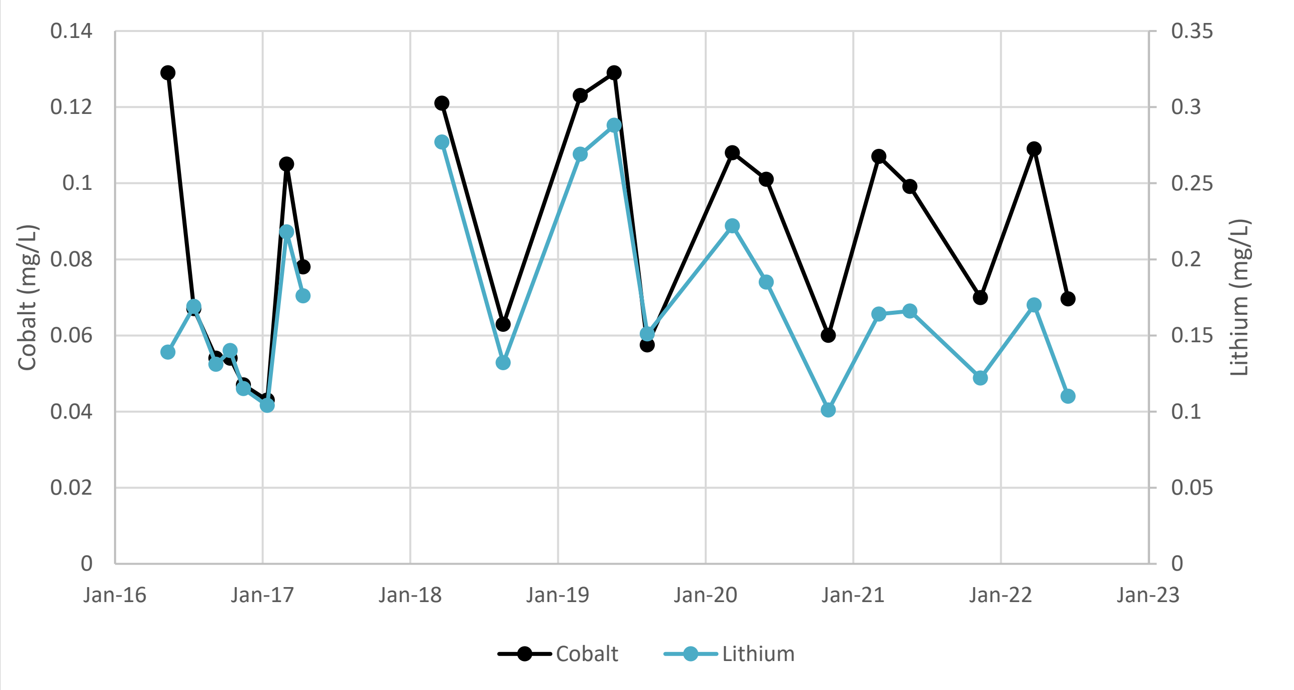
6

Columbus, Ohio

December-2022

internal info: path, date revised, author





Notes: Cobalt, calcium, and lithium concentrations are shown in milligrams per liter (mg/L). The gaps in cobalt and lithium data represent the time period during which detection monitoring took place and samples were not analyzed for cobalt and lithium.

AD-22 Cobalt v. Calcium and Lithium Concentrations

Pirkey FGD Stackout Pad

Geosyntec consultants

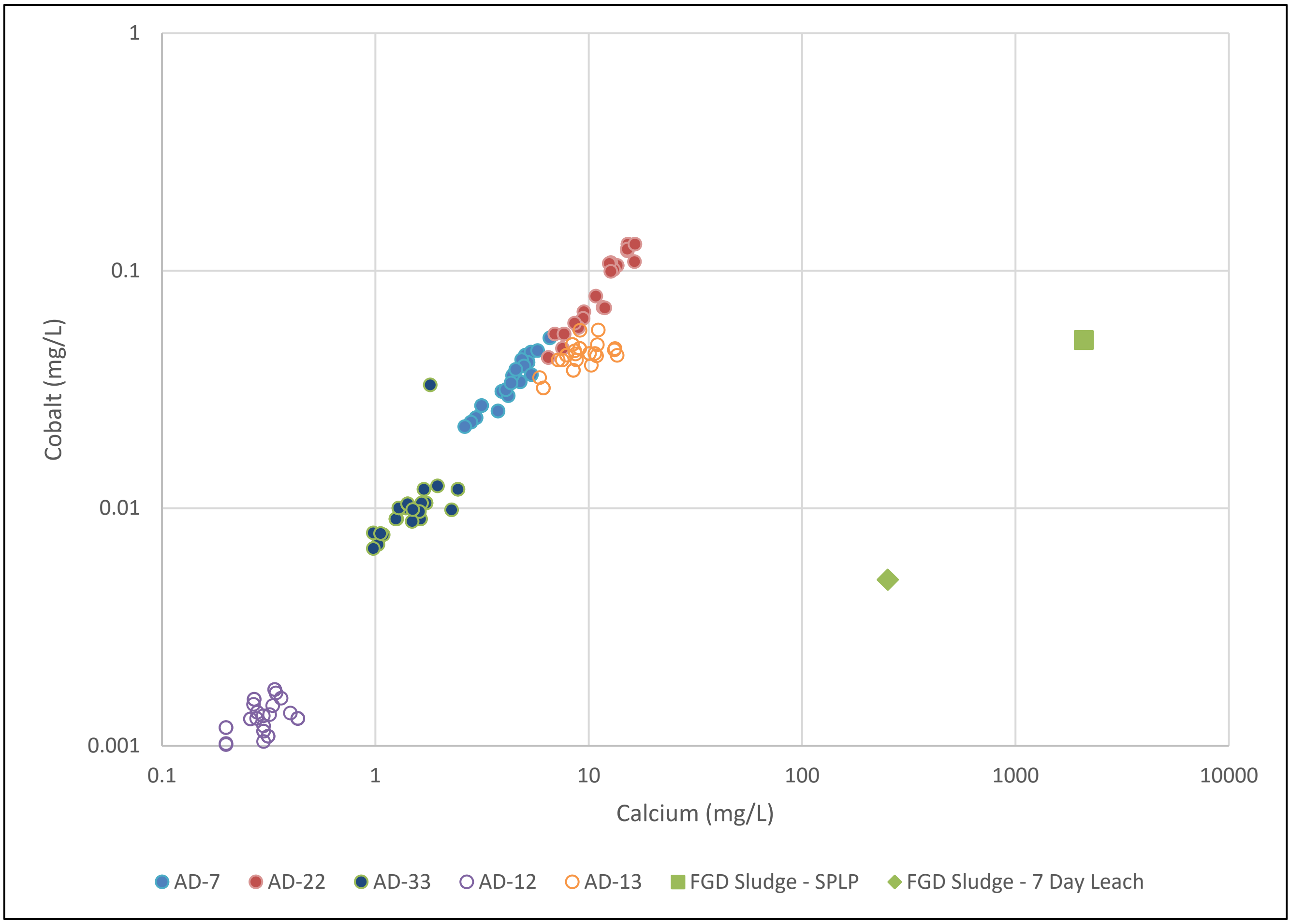
AMERICAN ELECTRIC POWER

Figure

7

Columbus, Ohio

December-2022



Notes: Cobalt and calcium concentrations are shown in milligrams per liter (mg/L). Upgradient wells are shown with hollow circles. 'FGD Sludge-SPLP' and 'FGD Sludge 7 Day Leach' present the leached concentrations of cobalt and calcium using the Synthetic Precipitation Leaching Procedure (SW-846 Test Method 1312) and the 7-Day Distilled Water Leachate Test Procedure (30 TAC 335.521 Appendix 4), respectively.

Cobalt and Calcium Concentration Distribution

Pirkey FGD Stackout Pad

Geosyntec consultants

AMERICAN ELECTRIC POWER

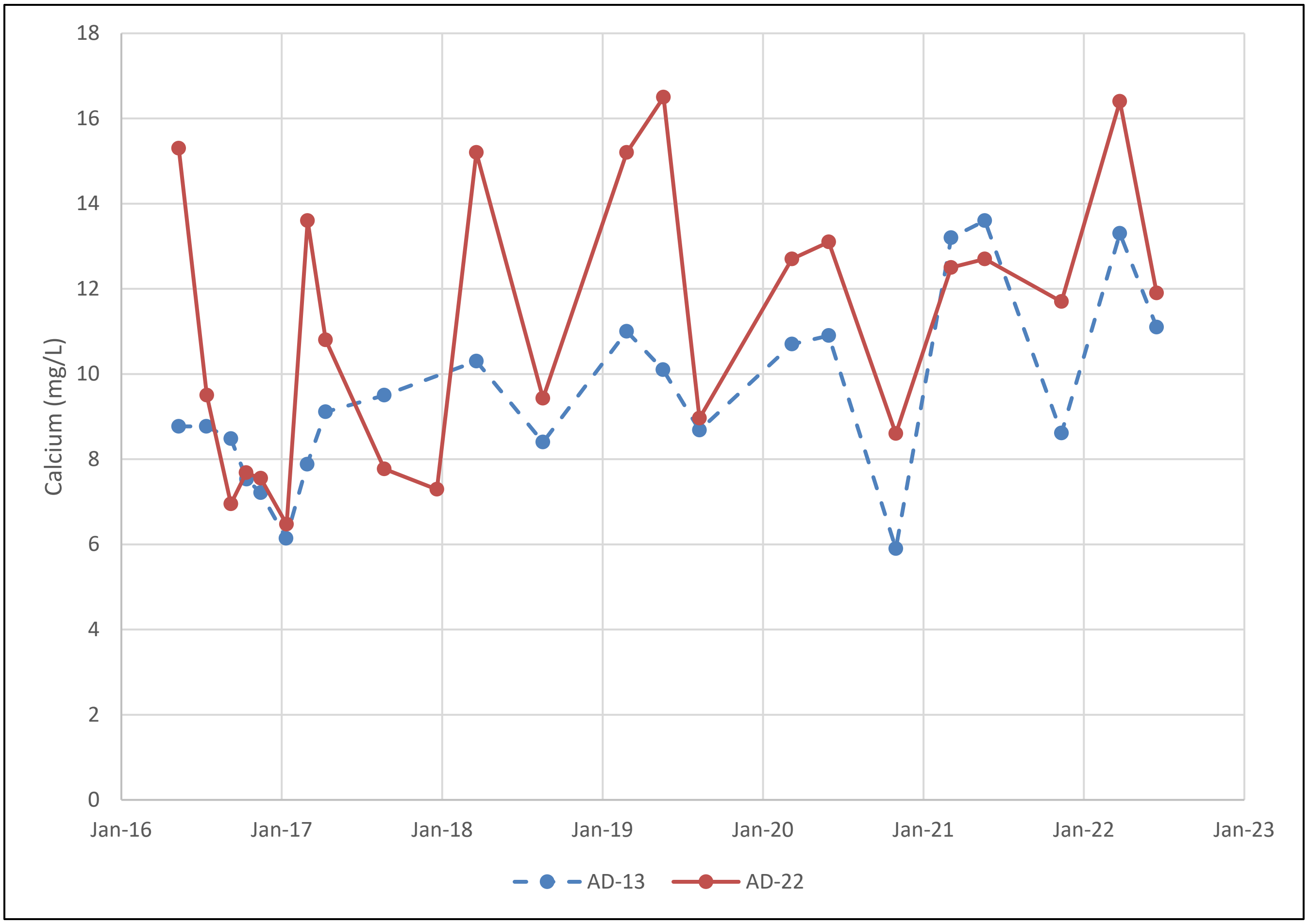
Figure

8

Columbus, Ohio

December-2022

internal info: path, date revised, author



Notes: Calcium concentrations are shown in milligrams per liter (mg/L). Upgradient monitoring well AD-13 is shown with a dashed line.

Calcium Time Series Graph

Pirkey FGD Stackout Pad

Geosyntec consultants

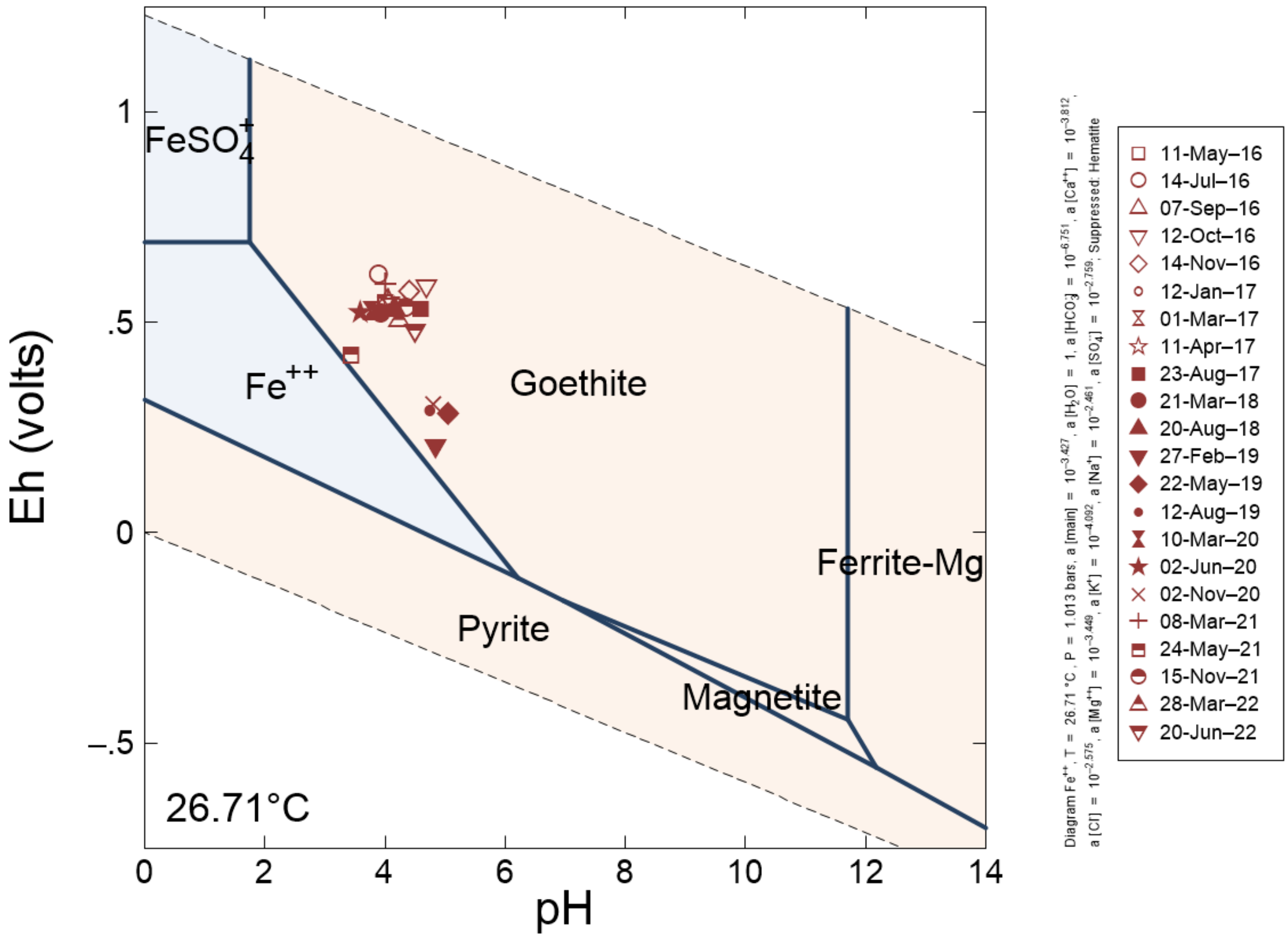
AMERICAN ELECTRIC POWER

Figure

9

Columbus, Ohio

December-2022



Notes: Groundwater concentrations of major cations and anions at AD-22 from the March 2022 sampling event were used to establish baseline conditions for the diagram. Eh and pH values for sampling dates at AD-22 are shown on the diagram.

AD-22 Eh-pH Diagram

Pirkey FGD Stackout Pad

Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure

10

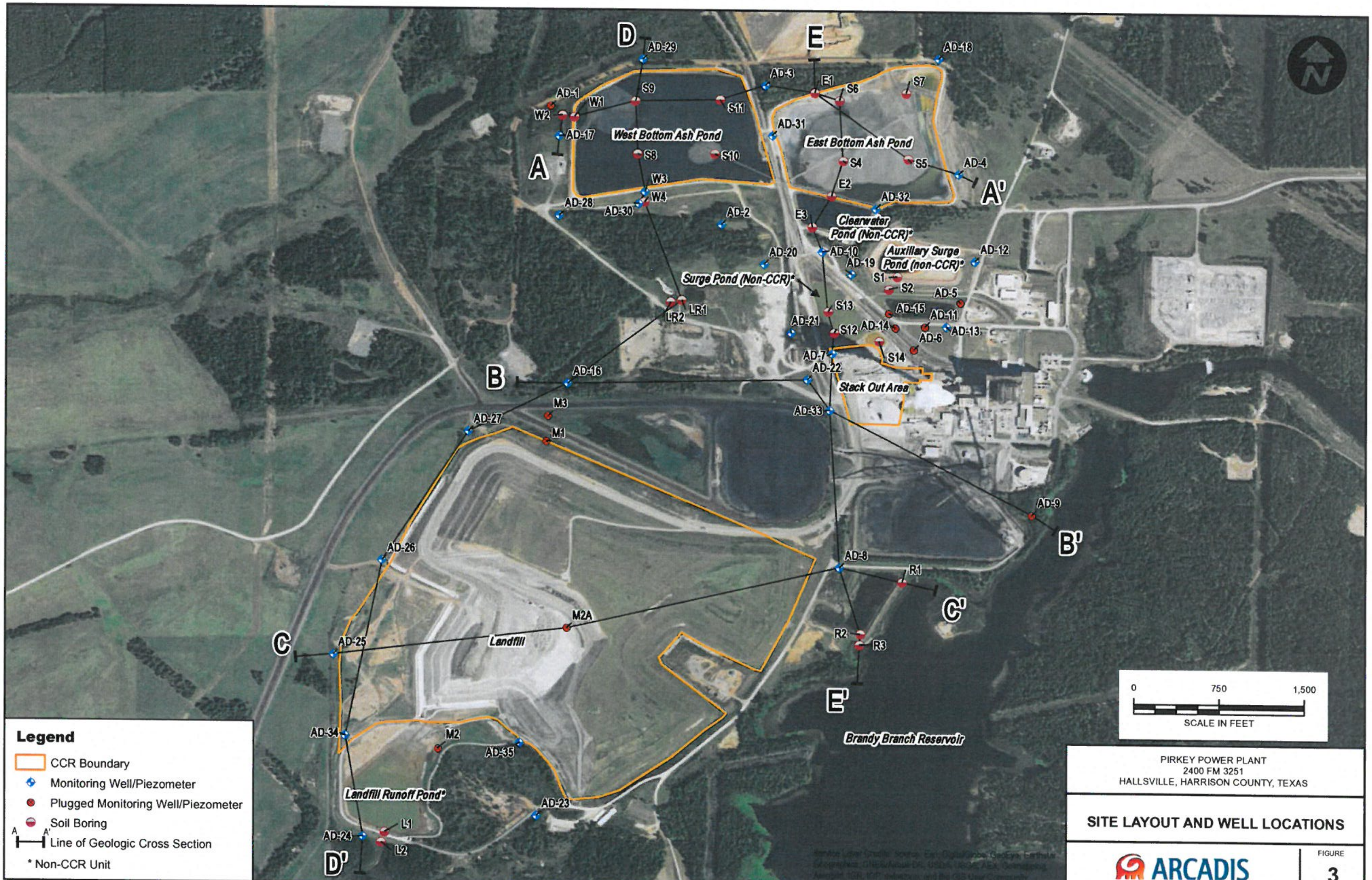
Columbus, Ohio

December-2022

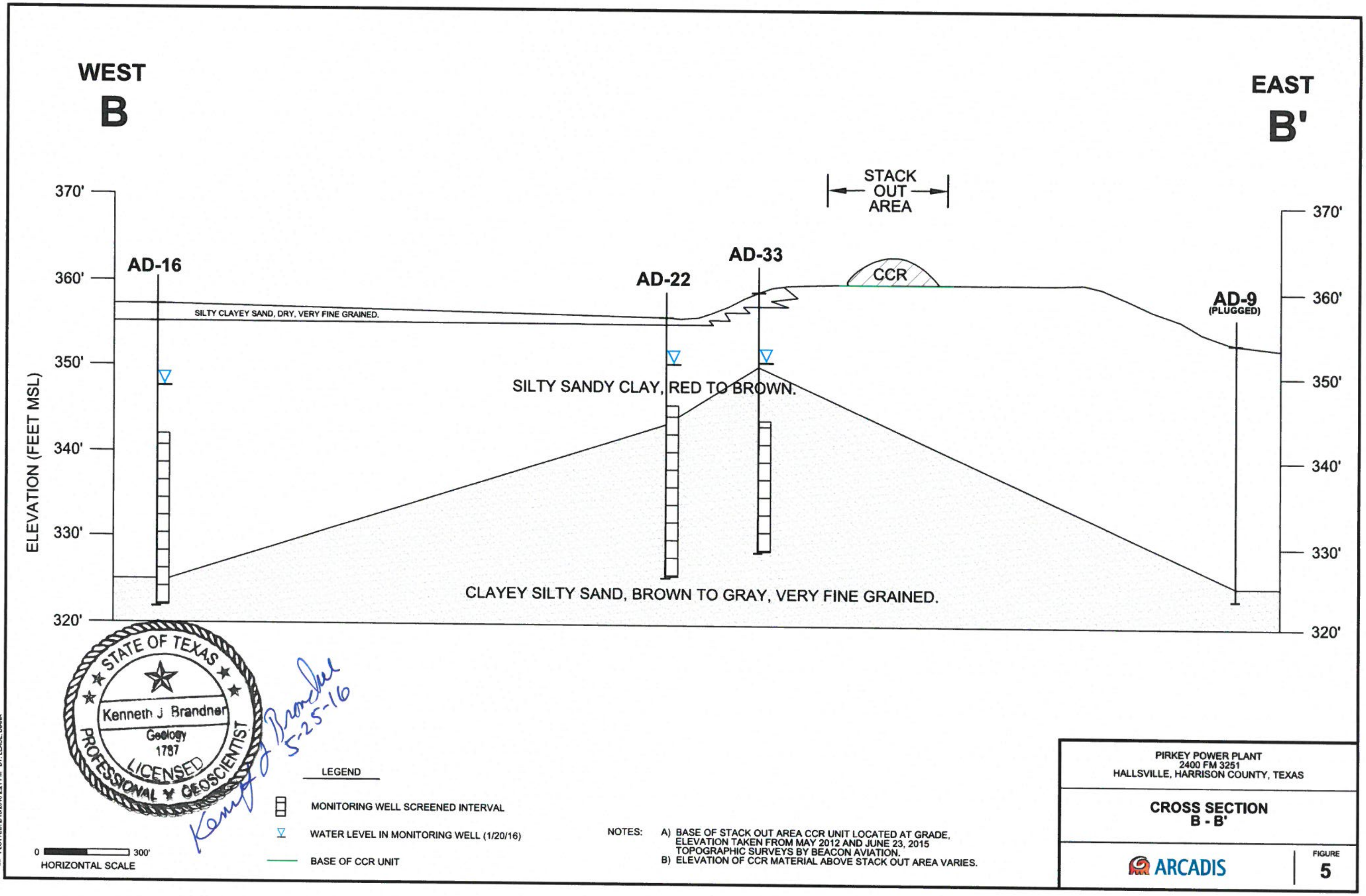
internal info: path, date revised, author

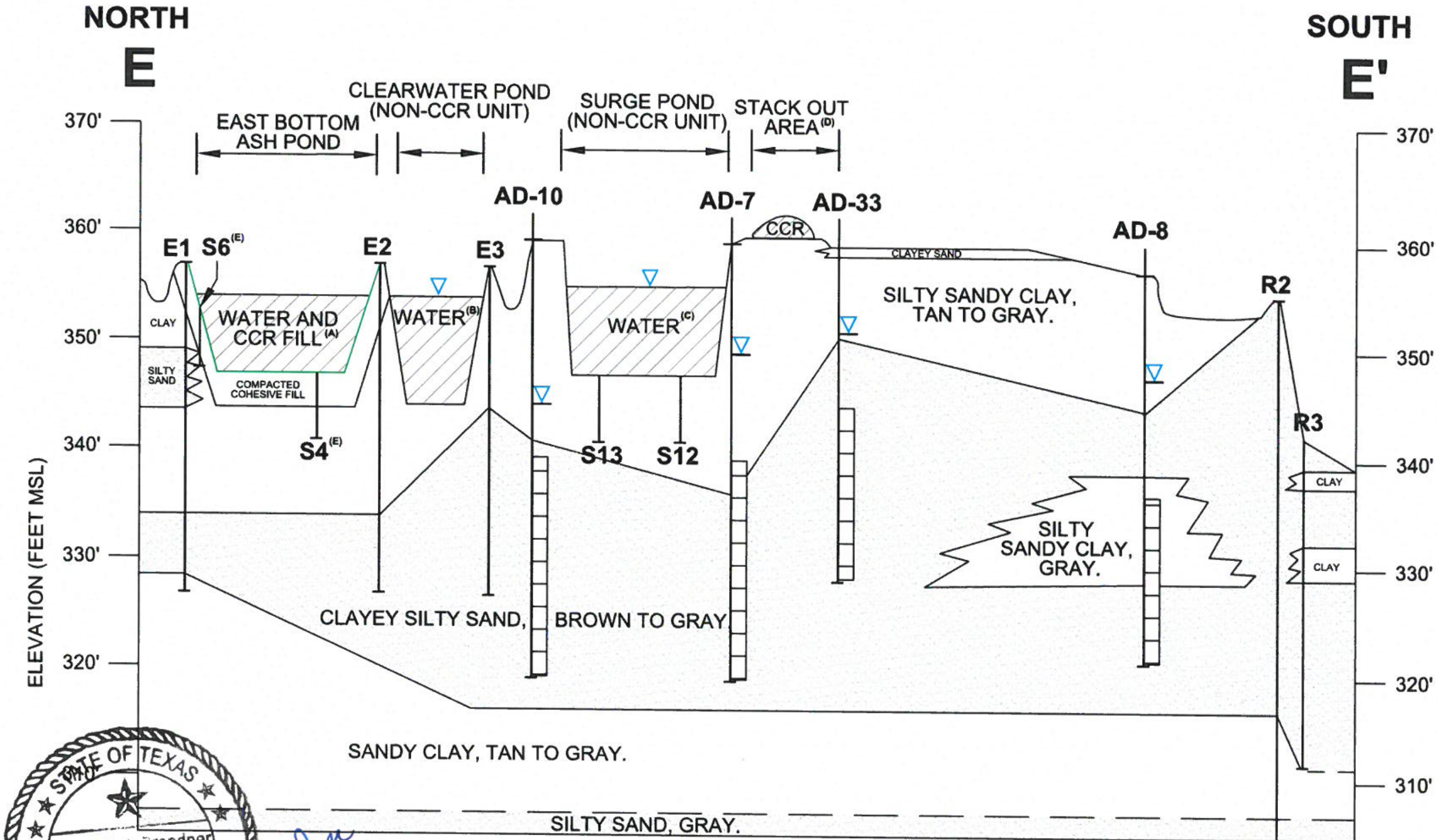
ATTACHMENT A

Geologic Cross Sections



Document Path: Z:\GISPROJECTS_ENV\AEP\Pirkey Plant\MXD\Figure 3 - Site Layout and Well Locations.mxd


WEST
B
EAST
B'
370'
360'
350'
340'
330'
320'
ELEVATION (FEET MSL)
STACK OUT AREA
CCR
AD-16
AD-22
AD-33
AD-9
(PLUGGED)
SILTY CLAYEY SAND, DRY, VERY FINE GRAINED.
SILTY SANDY CLAY, RED TO BROWN.
CLAYEY SILTY SAND, BROWN TO GRAY, VERY FINE GRAINED.
STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST
Kenneth J Brandner
5-25-16
LEGEND
MONITORING WELL SCREENED INTERVAL
WATER LEVEL IN MONITORING WELL (1/20/16)
BASE OF CCR UNIT
0
300'
HORIZONTAL SCALE
NOTES:
A) BASE OF STACK OUT AREA CCR UNIT LOCATED AT GRADE, ELEVATION TAKEN FROM MAY 2012 AND JUNE 23, 2015 TOPOGRAPHIC SURVEYS BY BEACON AVIATION.
B) ELEVATION OF CCR MATERIAL ABOVE STACK OUT AREA VARIES.
PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS
CROSS SECTION
B - B'
ARCADIS
FIGURE
5



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

Kenneth J. Brandner
5-25-16

0 500'
HORIZONTAL SCALE

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'

ARCADIS

FIGURE
8

ATTACHMENT B

SP-B2 Boring Log

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name:______ SP-B2

Project Location:____ Hallsville, TX

Boring Date:__ 3/2/2020

Soil Profile

Depth Scale Feet	Water Table	Depth	Description	PID*
			pp= pocket penetrometer	
0		0.0'-0.2':	Gray silt, dry, brittle (fly ash)	
		0.2'-0.4':	Black, coal dust, strong odor	
		0.4'-1.7':	Gray silt, dry, brittle (fly ash)	
		1.7'-2.6':	red silt, brittle, dry	
		2.6'-6.5':	Gray and red silty clay, high stiffness (pp. 4.0-5.0), low plasticity, iron ore/mottling present	
5				
		6.5'-6.9':	Light gray, red and tan clay, low stiffness (pp. 1.5), moderate plasticity	
		6.9'-10.0':	Light gray and maroon clay, moderate stiffness (pp. 3.5), low plasticity, iron ore/mottling present; moist near 9'	
10	▼	10.0'-15.0':	Light gray and maroon clay, moderate/high stiffness (pp. 3.5-4.5), low plasticity, iron ore/mottling present; wet	
15		15.0'-18.5':	Maroon and light gray clay, moderate/high stiffness (pp. 3.0-4.0), low plasticity; wet	
		18.5'-18.8':	Red/brown silt, trace clay, good cohesion	
		18.8'-20.5':	Light gray clayey silty sand, very fine grained, moderate sorting, mottling present; wet	
20		20.5'-23.4':	Light gray and orange clayey silty sand, very fine grained; mottling present, moderate sorting; wet	
		23.4'-25.0':	Maroon and orange silty clay, low stiffness (pp. 0.5), high plasticity; wet	
25		25.0'-29.0':	Same as above; interchanging between silty clay and clayey silt throughout interval, iron ore/mottling present throughout	
		29.0'-29.5':	Black clay, moderate stiffness (pp.3.0), low plasticity	
		29.5'-30.0':	Gray fine grained sand, well sorted; wet	
30			Samples collected at 10-12'; 16-18'; 27-29'	
			TD at 30' bgs	
			*PID readings not collected	
35				

Drill Rig Geoprobe 3230 DT

Drilling Contractor:___ C&S

Driller:_ DJ Diduch

Geosyntec Consultants

ATTACHMENT C

AD-7 Boring Log

832964

LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: MW-7
LOCATION: Hallsville

Date: 10-3-83 Type: Auger Ground Elevation:

Legend: Sample X Penetration ▼ Water

Depth, Feet	Description of Stratum
5	Stiff red, tan and grey sandy silty clay w/iron ore
10	Stiff tan and grey clay w/iron ore
15	Stiff tan and grey silty sandy clay lenses w/iron ore
20	Stiff tan and grey very sandy silty clay
25	Firm tan and grey clayey silty sand
30	Very dense grey silty sand 23-27=12" 50 B/F
35	Very dense grey clayey silty sand 17-35=12" 50 B/F
40	Very dense grey clayey silty sand 25-25=10½" 50 B/10½"
	Bottom of boring at 40 feet.
45	
50	

ATTACHMENT D

SP-B4 Boring Log

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name:______ SP-B4

Project Location:____ Hallsville, TX

Boring Date:__ 3/3/2020

Soil Profile

Depth Scale Feet	Water Table	Depth	Description	PID*
		pp= pocket penetrometer		
0		0.0'-0.4':	Top soil, black silt, vegetation	
		0.4'-0.7':	Brown clayey silt, good cohesion	
		0.7'-1.5':	Red and light gray silty clay, moderate stiffness (pp. 2.5), high plasticity	
		1.5'-3.7':	Maroon and light gray clay, high stiffness (pp. 4.5-5.0), low plasticity; iron ore present 3.1'-3.7'	
		3.7'-5.0':	NO RECOVERY	
5		5.0'-7.0':	Maroon and light gray clay, high stiffness (pp. 4.5-5.0), low plasticity; iron ore present throughout	
		7.0'-8.0':	Light gray clay with iron ore, moderate stiffness (pp.2.5-3.0), moderate plasticity	
		8.0'-10.0':	Maroon clay, moderate stiffness (pp. 3.5), moderate plasticity; iron ore present; moist at 9'	
10		10.0'-12.6':	Maroon clay, moderate stiffness (pp. 3.5), moderate plasticity; iron ore present; wet at 12'	
	▽			
		12.6'-13.3':	Tan clay, low stiffness (pp.1.5), high plasticity; wet	
		13.3'-18.5':	Tan and brown clayey silt, moderate cohesion; iron ore present; wet	
15				
		18.5'-20.3':	Maroon silty clay, low stiffness (pp. 1.0), moderate plasticity; iron ore; wet	
20		20.3'-21.1':	Dark gray/black clay, trace silt, low stiffness (pp. 1.5), high plasticity; wet	
		21.1'-21.3':	Dark gray silt, good cohesion; wet	
		21.3'-21.9':	Dark gray silty clay, low stiffness (pp. 1.5), high plasticity; wet	
		21.9'-22.3':	Dark gray silt, moderate cohesion; wet	
		22.3'-22.7':	light brown silt; low cohesion; wet	
		22.7'-24.4':	Dark gray and dark green silty clay, moderate/high stiffness (pp.3.5), moderate plasticity; wet, glauconite present	
		24.4'-27.8':	Dark green/gray fine grained sand, well sorted; wet; glauconite present	
25		27.8'-30.0':	Red and orange fine grained sand, well sorted, with iron ore; wet	
30				
			Samples collected at 6-8'; 18-20'; 28-30'	
			TD at 30' bgs; refusal	
			*PID readings not collected	
35				

Drill Rig Geoprobe 3230 DT

Drilling Contractor:___ C&S

Driller:_ DJ Diduch

Geosyntec Consultants

ATTACHMENT E

AD-22 Boring Log and Well Installation Diagram

☐ BORING ■ MONITOR WELL

APEX PROJECT NO.: 110-089 **BORING NUMBER:** ______ **MONITOR WELL NUMBER:** AD-22

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

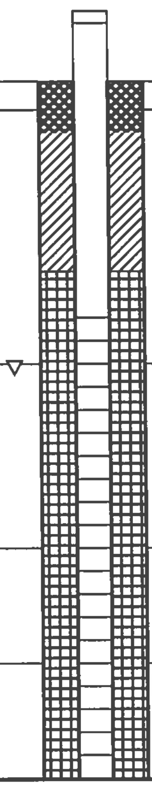
FACILITY ADDRESS: Hallsville, Texas

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

DRILLER: Ed Wilson, Apex Geoscience Inc. **COMPLETION DATE:** 12/16/2010

PREPARED BY: David Bedford **LOGGED BY:** David Bedford

LATTITUDE: N 32°27'03.3" Datum: WGS-84 **WELL LOCATION:** Triangle- South side Quansit Hut
LONGITUDE: W94°29'41.3"



DEPTH (FEET)	PID (PPM)	SAMPLE INTERVAL	WELL LOG AND COMPLETION DETAILS	USCS CODE	SOIL DESCRIPTION AND COMMENTS	Odor	Moisture
1			0-0.5	SC	Clayey sand, light brown, very fine grained	None	Moist
2-12			0.5-12	CL	Lean clay, light brown mottled with light gray Few iron ore (small) pebbles in clayey sandy streaks	None	Slightly Moist
13-20			12-20	SC	Clayey sand, grayish brown with orangish brown streaks, very fine grained Slightly wet @ 12.5' from seepage Large amount of iron ore 15-17' Very firm 18-18.5'	None	Slightly Wet
21-25			20-25	SC	(Dense crystalline rock 21-21.1'), light brown clayey sand, greenish black, mica, black clay streaks, very fine grained, wet @ 20'	None	Wet
26-30			25-30	SM	Sand, greenish brown (1') grading to orangish brown, silty, very fine grained	None	Wet
31-40					Boring Terminated at 30'		

Cement Bentonite Filter Sand ▽ Water Level

Apex geoscience inc.

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

Riser Interval: +3 (ags)-10'
Screen Interval: 10-30'
Water level: 12.5'
Above Ground 3'

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

ATTACHMENT F

Certification by a Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Pirkey FGD Stackout Area CCR management area and that the requirements of 30 TAC §352.951(e) have been met.

Beth Ann Gross
Printed Name of Licensed Professional Engineer

Beth Ann Gross
Digitally signed by Beth Gross,
Date: 2023.01.25 16:49:31 -05'00'

Signature

Geosyntec Consultants
2039 Centre Pointe Blvd, Suite 103
Tallahassee, Florida 32308

Texas Registered Engineering Firm
No. F-1182

79864	Texas	January 25, 2023
License Number	Licensing State	Date