ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

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

Submitted to

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LIST OF ACRONYMS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
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
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 detection monitoring event of 2020. The FGD Stackout Pad is registered as a waste pile under Texas Commission on Environmental Quality (TCEQ) Industrial and Hazardous Waste Solid Waste Registration No. 33240.

The H.W. Pirkey Plant has four regulated coal combustion residuals (CCR) storage units, including the FGD Stackout Pad Area (**Figure 1**). In June 2020, a semi-annual assessment monitoring event was conducted at the FGD Stackout Area in accordance with 40 CFR 257.95(d)(1). 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 (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, for constituents without an MCL, the risk-based level specified 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 re-calculated for Appendix IV parameters at the compliance wells to assess whether these parameters were present at a statistically significant level (SSL) above the GWPSs. Seasonal patterns were observed for beryllium, cobalt, and combined radium at AD-7 and for beryllium, cadmium, cobalt, combined radium, and lithium at AD-22 (Geosyntec, 2020a). 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 Pad:

- The deseasonalized LCL for beryllium exceeded the GWPS of 0.00400 mg/L at AD-7 (0.00439 mg/L) and AD-22 (0.00635 mg/L); and

- The deseasonalized LCL for cobalt exceeded the GWPS of 0.0560 mg/L at AD-22 (0.0727 mg/L).

No other SSLs were identified (Geosyntec, 2020a).

1.1 CCR Rule Requirements

USEPA regulations regarding assessment monitoring programs for 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 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 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 beryllium and cobalt and the proposed alternative source are described below.

2.1 Proposed Alternative Source

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

2.1.1 Beryllium

SSLs were identified for beryllium at AD-7 and AD-22 using deseasonalized statistics (Geosyntec, 2020a). 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).

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, beryllium concentrations in 2020 at AD-22 were 0.0101 milligrams per liter (mg/L) in March 2020, in contrast to 0.0080 mg/L in June 2020. Previous ASDs for the Stackout Pad showed that beryllium concentrations at AD-22 and AD-7 appear to correlate with groundwater elevations at the wells (Geosyntec, 2019; Geosyntec, 2020b). This relationship still holds true at both AD-22 and AD-7 (**Figure 2**). Beryllium concentrations at AD-7 and AD-22 are both correlated with seasonal changes in other 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 are related to cation exchange behavior with clay minerals present in the native soil.

Soil borings which were advanced in March 2020 found that clay materials were identified in the seasonally saturated zones above the permanent water table (Geosyntec, 2020b). At AD-7, which was relogged by SP-B2, the depth to water fluctuated between approximately 9 and 15 feet below ground surface (ft bgs). Silty clay was identified from approximately 2.5-6.9 ft bgs before transitioning to clay until 18.8 ft bgs (**Figure 5**). At AD-22, which was relogged by SP-B4, 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 6**). Analysis by X-ray diffraction (XRD) confirmed the presence of clays within the seasonal water table and sand within the screened interval, as summarized in **Table 1**. The clay fraction of the uppermost samples collected from within the seasonal water table were further analyzed to identify the type of clays present. Smectite-type clays, which are 2:1-layer clays with characteristic cation exchange capacity, make up the majority of the clay minerals present at those intervals.

Sorption and desorption of beryllium from smectite-type clays is well documented (Boschi and Willenbring, 2016a; You, et al., 1989). Desorption was found to be affected by pH, with 75% of beryllium desorbed 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 Federal 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-22 and AD-7 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.

2.1.2 Cobalt

An SSL was identified for cobalt at AD-22 using deseasonalized statistics (Geosyntec, 2020a). As shown in a previous ASD (Geosyntec, 2020b), the cobalt concentrations at AD-22 also appear to correlate with seasonal changes in groundwater elevation (**Figure 7**). The cobalt concentrations are also well correlated with changes in other cations, including calcium and lithium (**Figure 8**), suggesting natural variability associated with interactions with the aquifer solids.

The concentration ratio between calcium and cobalt is consistently on the order of 1000:1 at both upgradient and downgradient locations (**Figure 9**). A sample was collected of the solid FGD sludge material which is accumulated on the Stackout Pad. The solid phase sample was leached using both USEPA's Synthetic Precipitation Leaching Profile (SPLP) testing procedure (SW-846 Test Method 1312) and TCEQ's 7-Day Distilled Water Leachate Test Procedure (30 TAC 335.521 Appendix 4). While cobalt concentrations in both of the leached samples are consistent with those observed in the groundwater samples, the leached calcium concentrations are approximately two to three orders of magnitude higher. However, calcium concentrations in groundwater are generally consistent between AD-22 and upgradient well AD-13 (**Figure 10**). The different ratio between calcium and cobalt in the leached FGD sludge material (about 45,000:1) as compared to the ratio for groundwater indicate that dissolved calcium concentrations at AD-22 would be significantly higher if the groundwater at this location were affected by leachate. The similarity between upgradient and downgradient calcium concentrations, provides an additional line of evidence that the exceedances observed at the FGD Stackout Pad are not due to a release from the unit.

Siderite and pyrite, both reduced iron-bearing minerals, were identified below the seasonal water table (within the saturated zone) at AD-22. 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, 2020c) and West Bottom Ash Pond (WBAP; Geosyntec, 2020d).

Goethite (an iron oxide) 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 11**). During weathering from reduced to oxidized iron minerals, cobalt would be released from the mineral structure. 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.

2.1.3 Conceptual Site Model

The seasonal fluctuations in beryllium concentrations at AD-7 and AD-22 and cobalt 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 desorption of beryllium and cobalt as the amount of aquifer solids that are saturated increases.

2.2 Sampling Requirements

As the ASD described 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 semi-annual basis.

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 SSL of beryllium at AD-7 and cobalt at AD-22 identified during assessment monitoring in June 2020 were not due to a release from the FGD Stackout Area. The identified SSLs were, instead, attributed to natural variation related to seasonal desorption or dissolution of beryllium and cobalt from 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 C.**

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

- Downgradient Monitoring Well
- Upgradient Monitoring Well
- 2020 Soil Borings
- Stackout Pad

Notes

- Soil boring locations are approximate.
- Monitoring well locations are provided by AEP.

500 250 0 500 Feet

Site Layout

AEP Pirkey Power Plant
Hallsville, Texas

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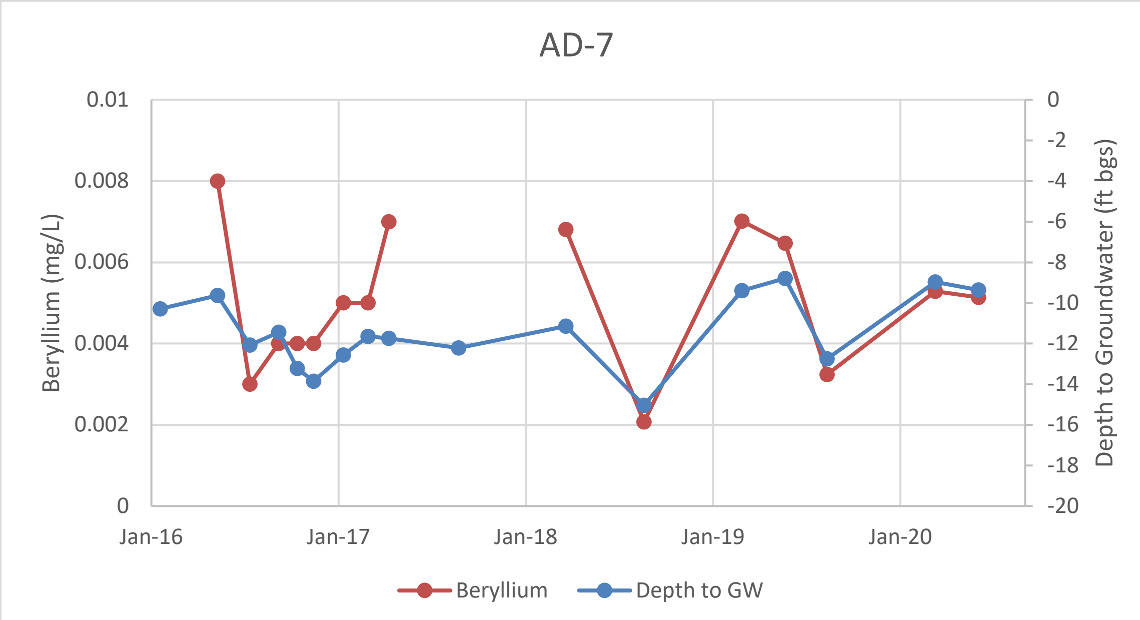
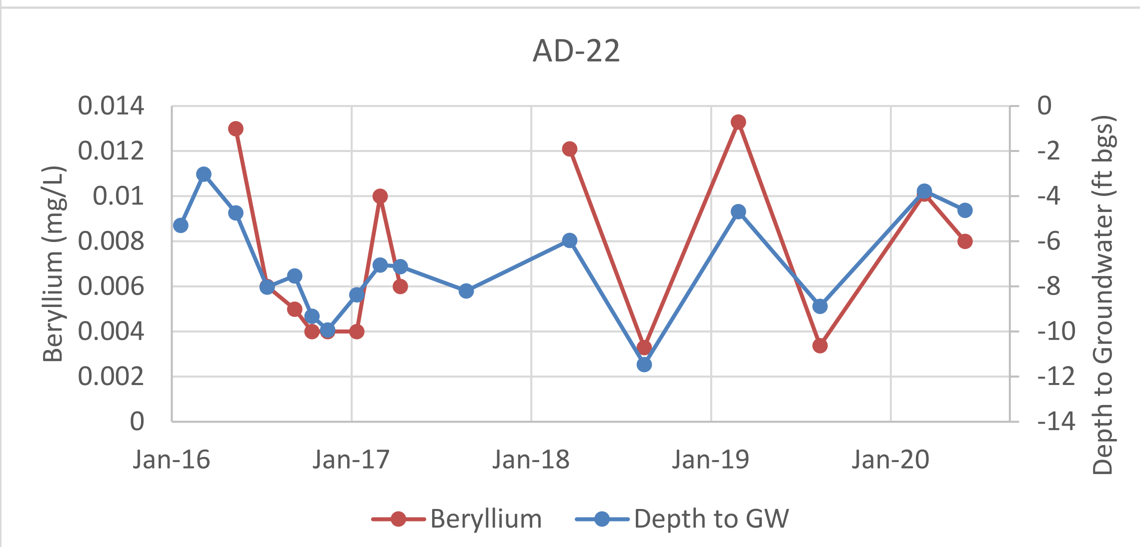
Columbus, Ohio | 2020/03/27

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\Mike's GIS Files\Pirkey\MXDs\AEP-Pirkey_Stacker_Site_Layout.mxd. BAres. 3/27/2020. Project/Phase/Task.





Notes: Beryllium concentrations are shown in milligrams per liter (mg/L). Depth to water is shown as feet below ground surface (ft bgs). The gap in beryllium data represents the time period in which detection monitoring took place and samples were not analyzed for beryllium.

Beryllium v. Depth to Groundwater

Pirkey FGD Stackout Pad

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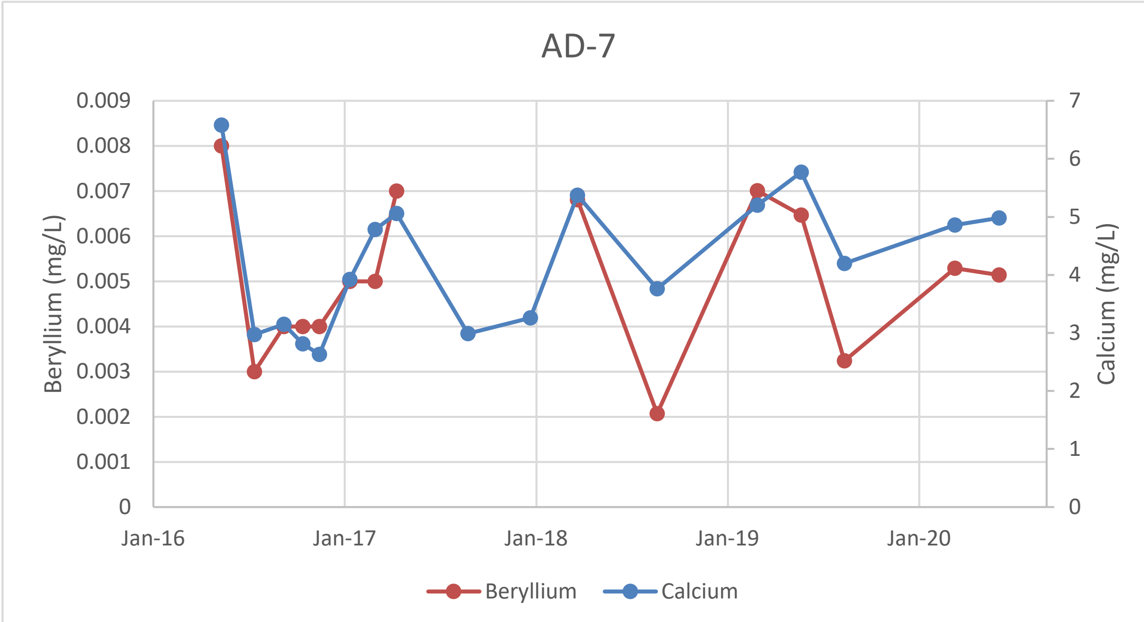
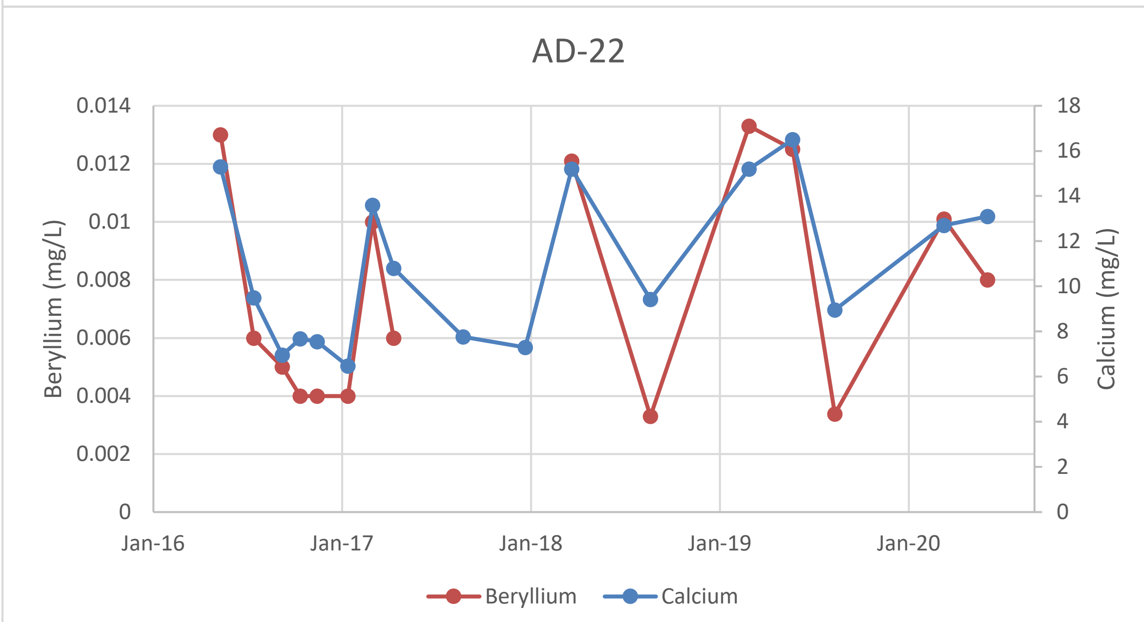
Figure

2

Columbus, Ohio

2-Nov-2020



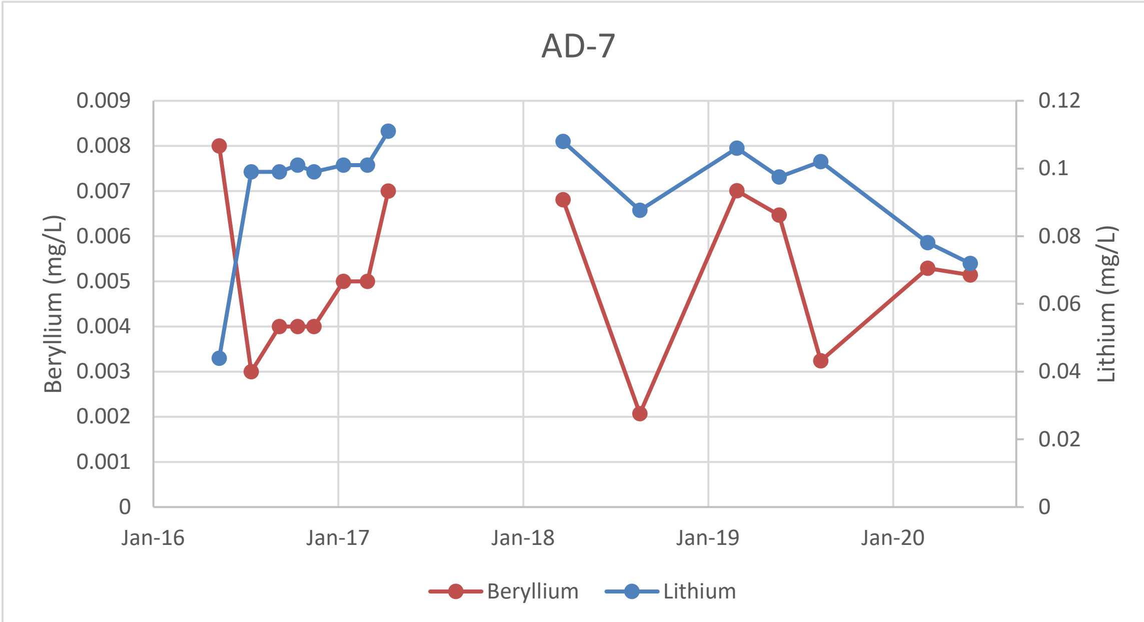


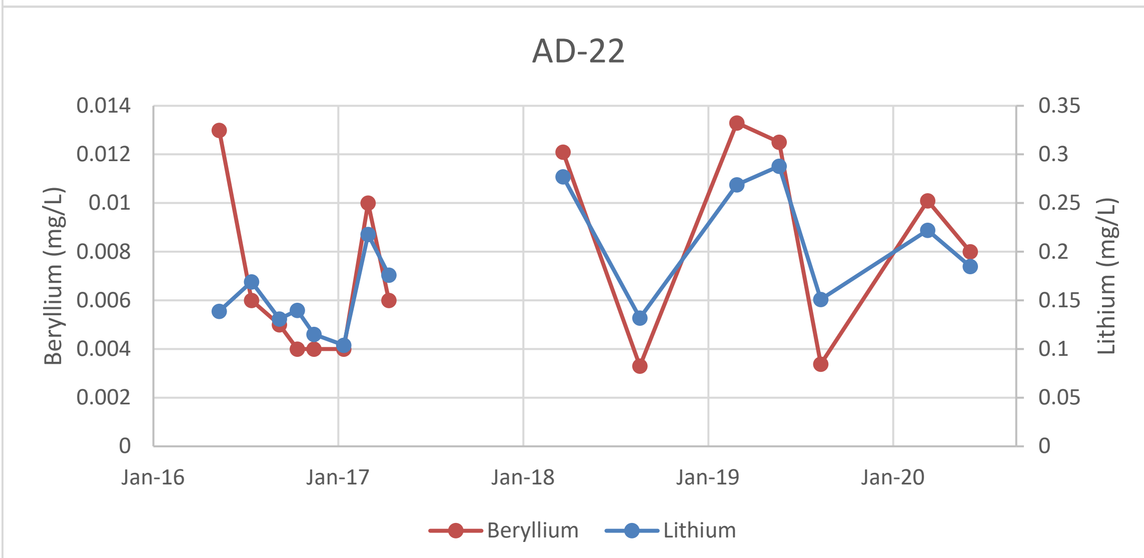
Notes: Beryllium and calcium concentrations are shown in milligrams per liter (mg/L). The gaps in beryllium data represent the time period in which detection monitoring took place and samples were not analyzed for beryllium.

Beryllium v. Calcium Concentrations

Pirkey FGD Stackout Pad

Geosyntec consultants	AMERICAN ELECTRIC POWER	Figure 3
Columbus, Ohio	02-Nov-2020	





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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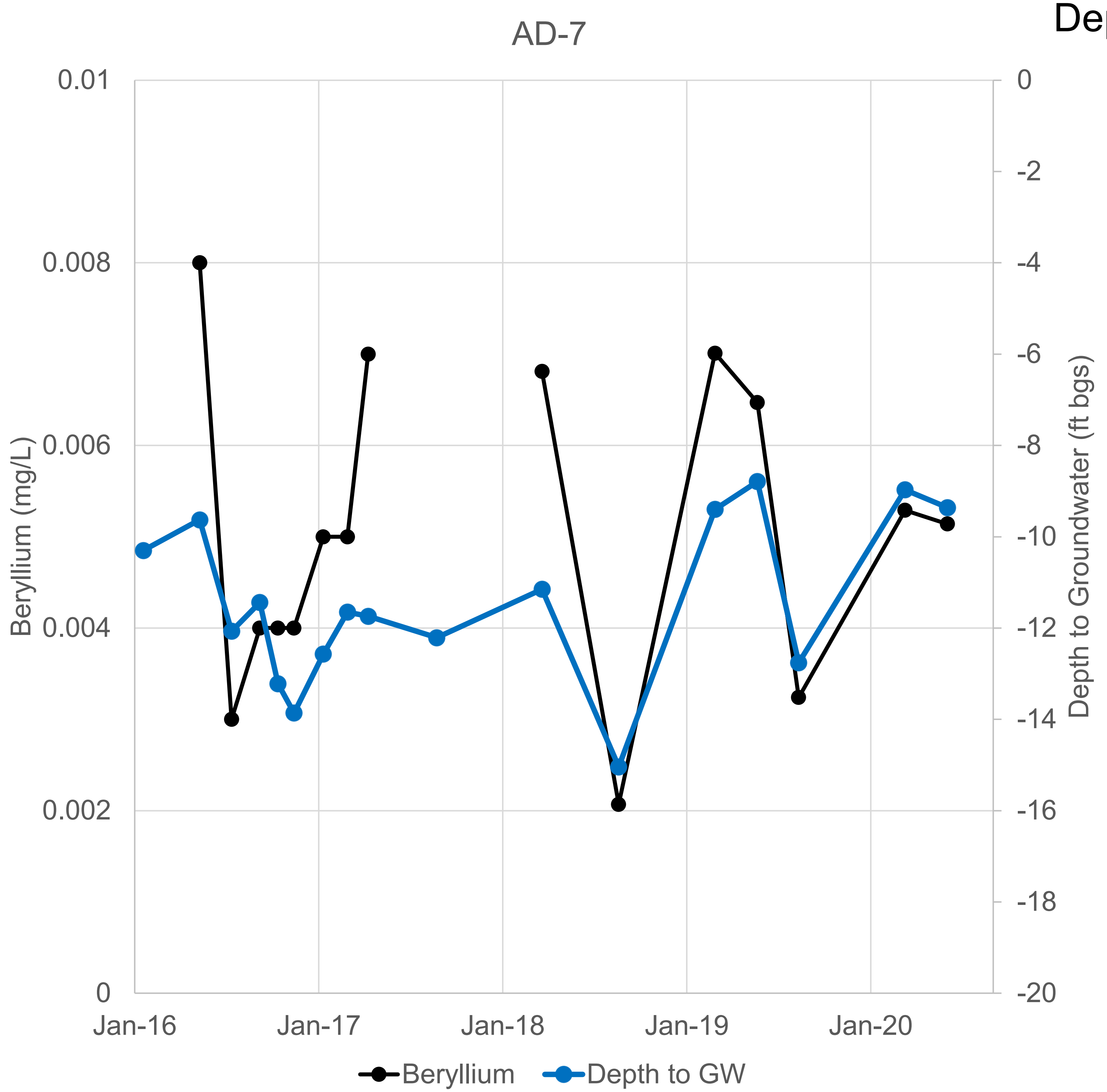
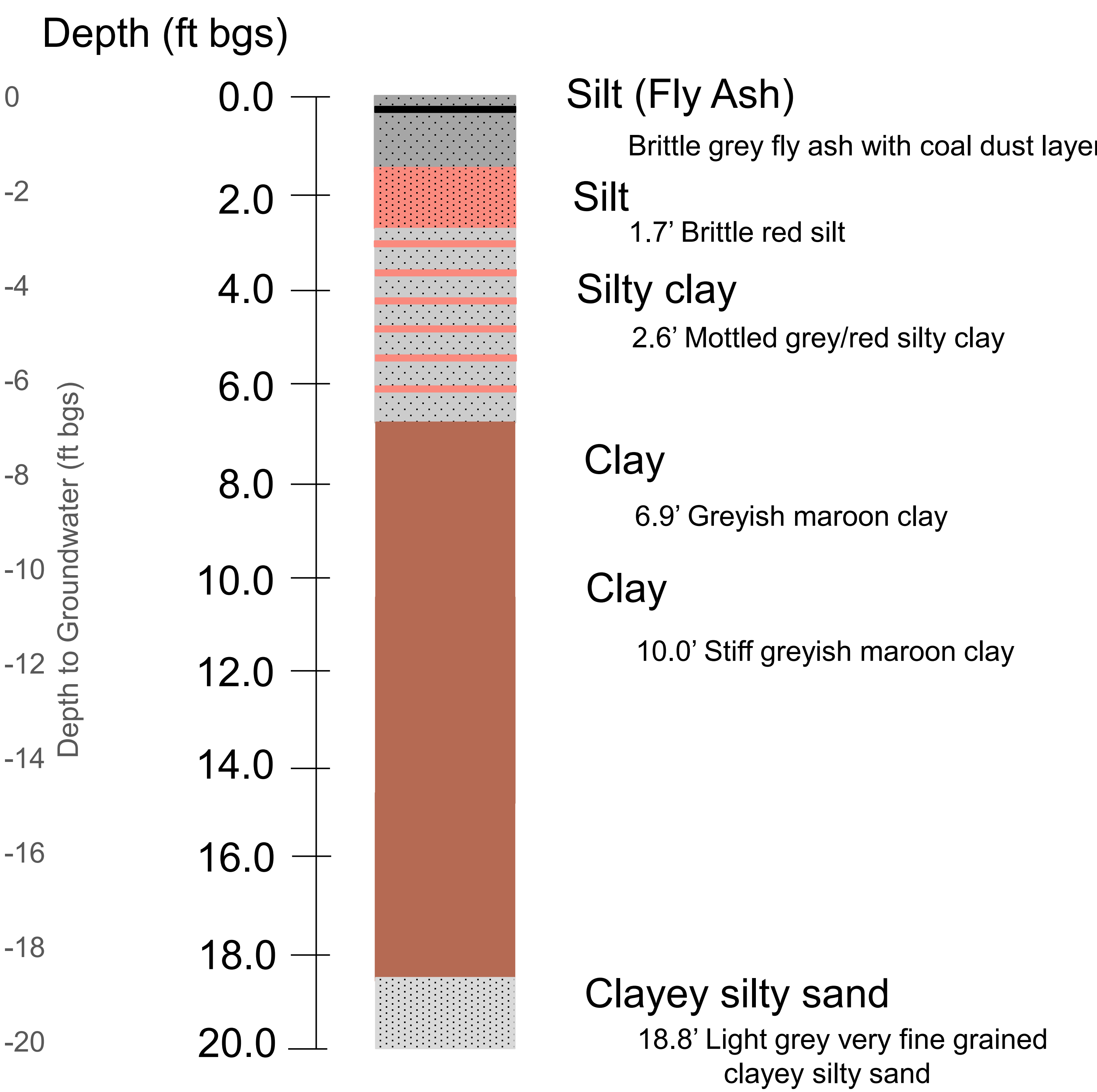
Columbus, Ohio

02-Nov-2020

Figure 4





Notes:
-A sample was collected for analysis of mineralogy from 10-12 ft bgs.
-The full boring log is available in Attachment A.

AD-7 Seasonal Water Table Geology
H.W. Pirkey Plant – FGD Stackout Pad

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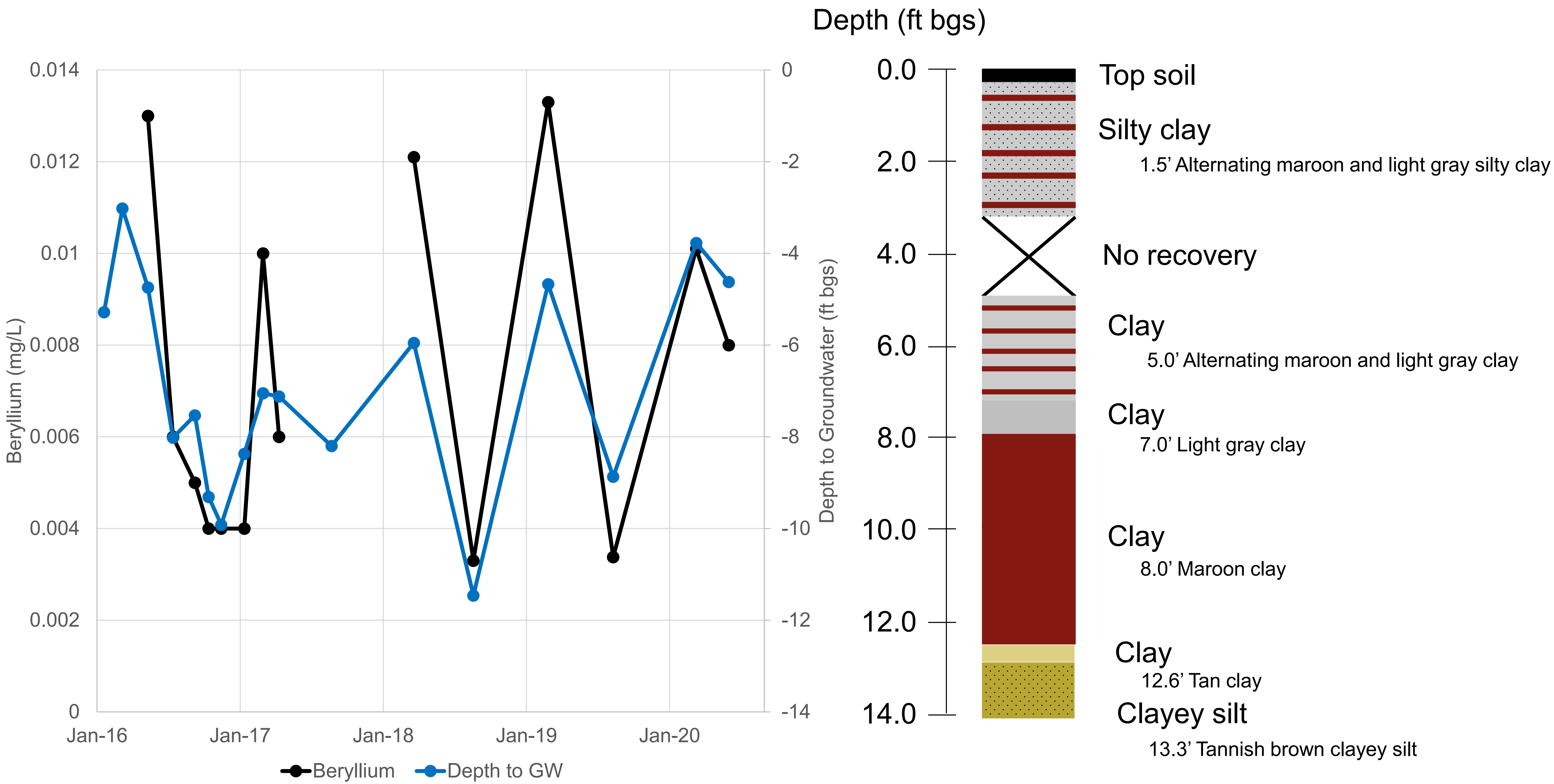
Figure 5

Columbus, OH | 02-Nov-2020

Internal info: Path, date revised, author



Notes:
-A sample was collected for analysis of mineralogy from 6-8 ft bgs.
-The full boring log is available in Attachment A.

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

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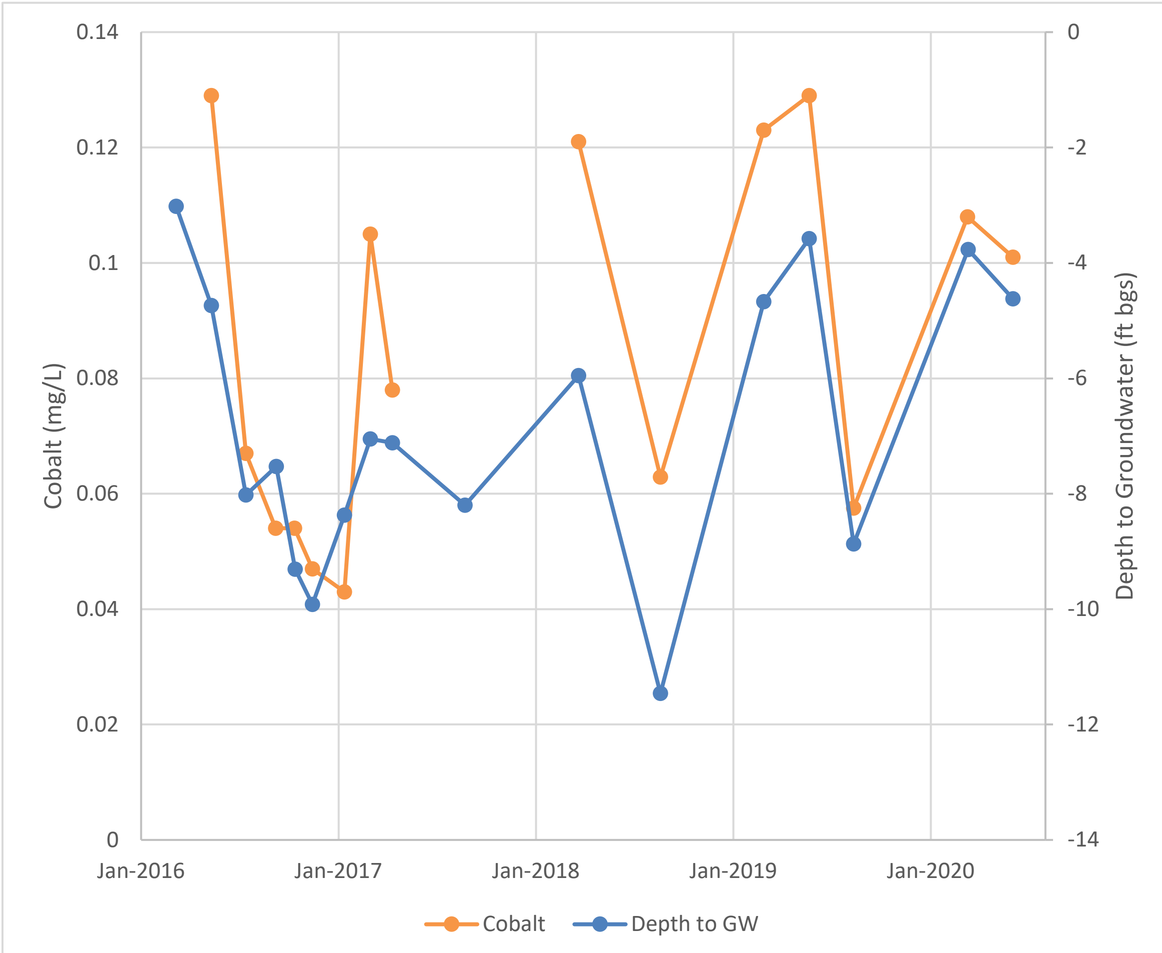
Figure **6**

Columbus, OH | 02-Nov-2020

Internal info: Path, date revised, author



Notes: Cobalt concentrations are shown in milligrams per liter (mg/L). Depth to water is shown as feet below ground surface (ft bgs). 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 v. Depth to Groundwater

Pirkey FGD Stackout Pad

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Figure

7

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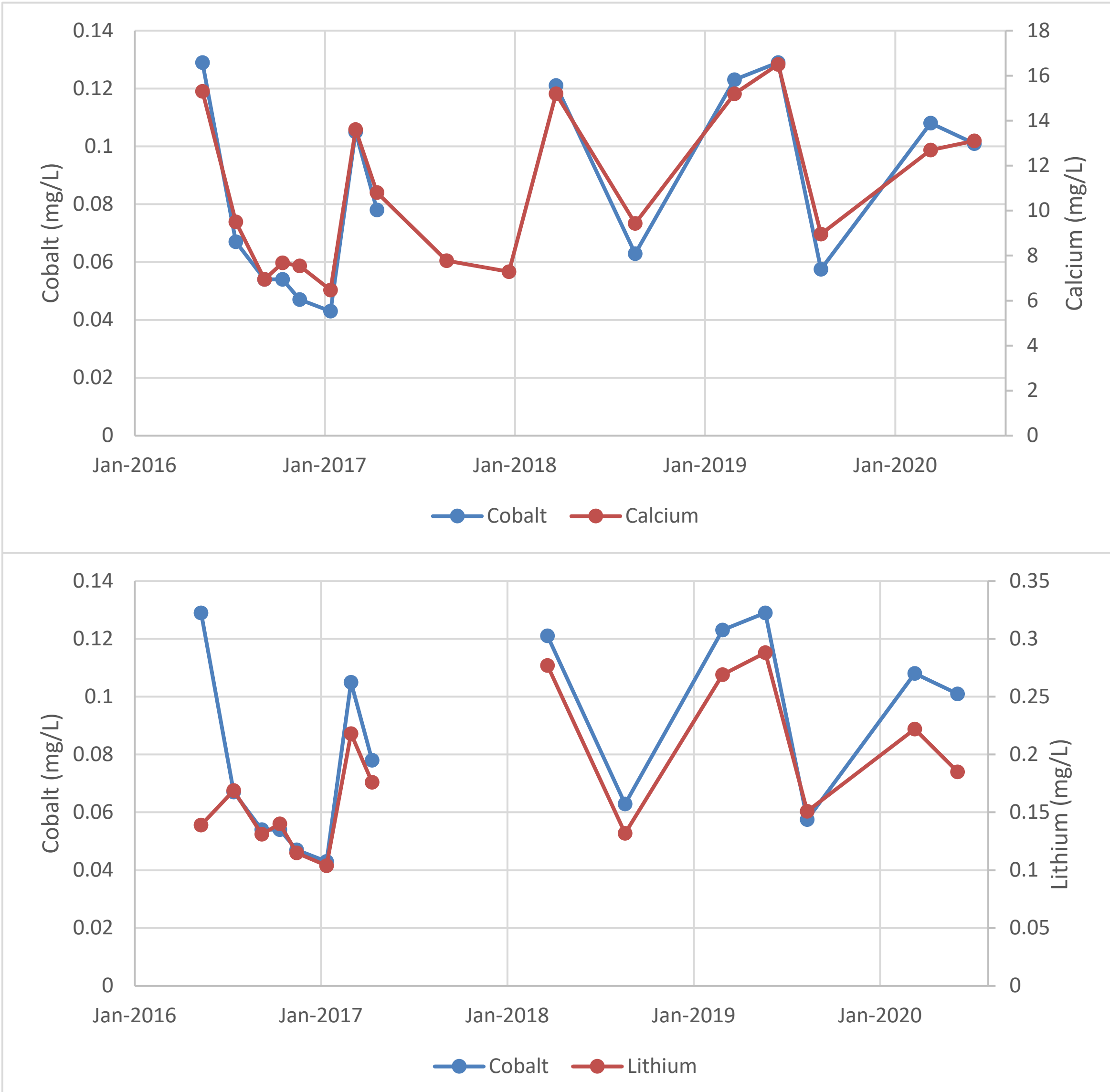
16-Nov-2020

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

Pirkey FGD Stackout Pad

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Figure

8

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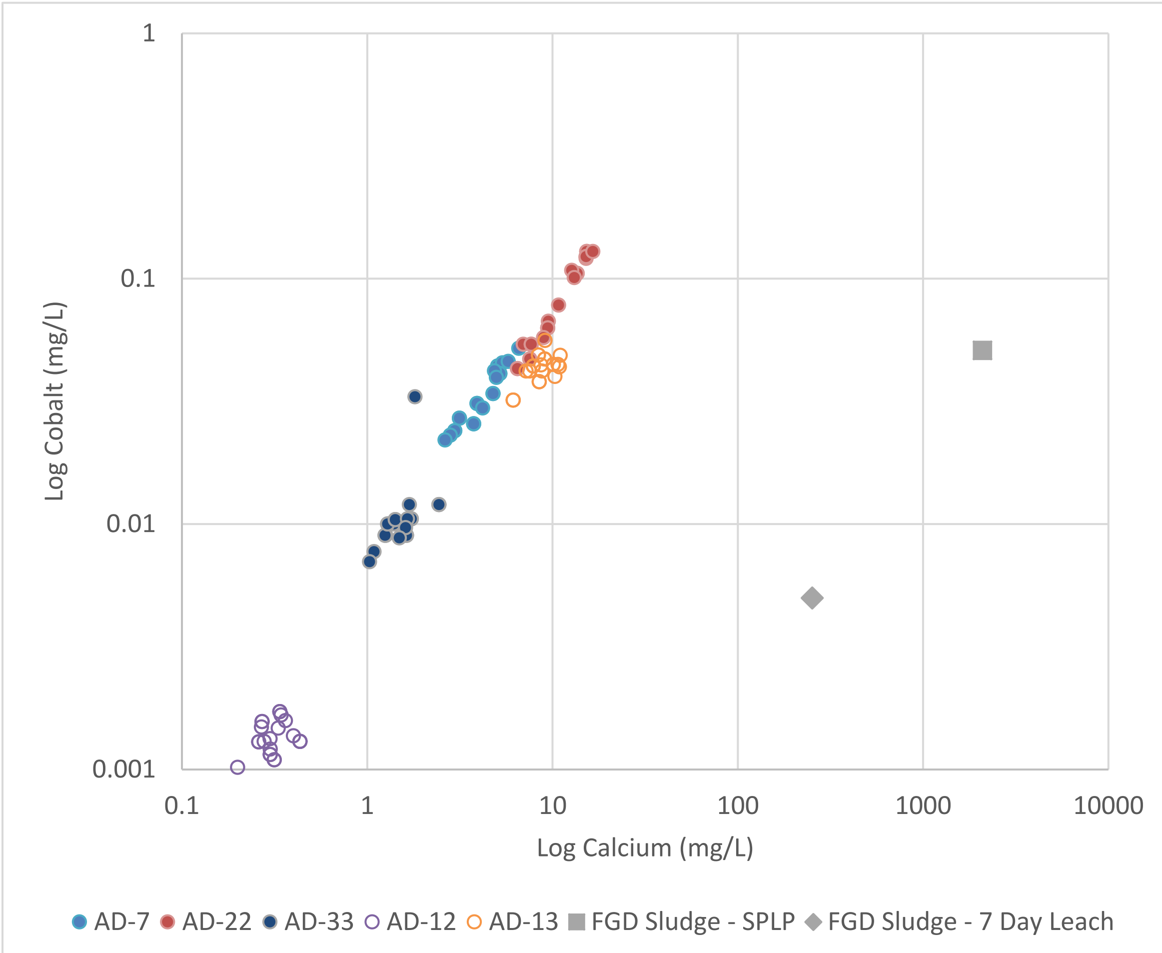
16-Nov-2020



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

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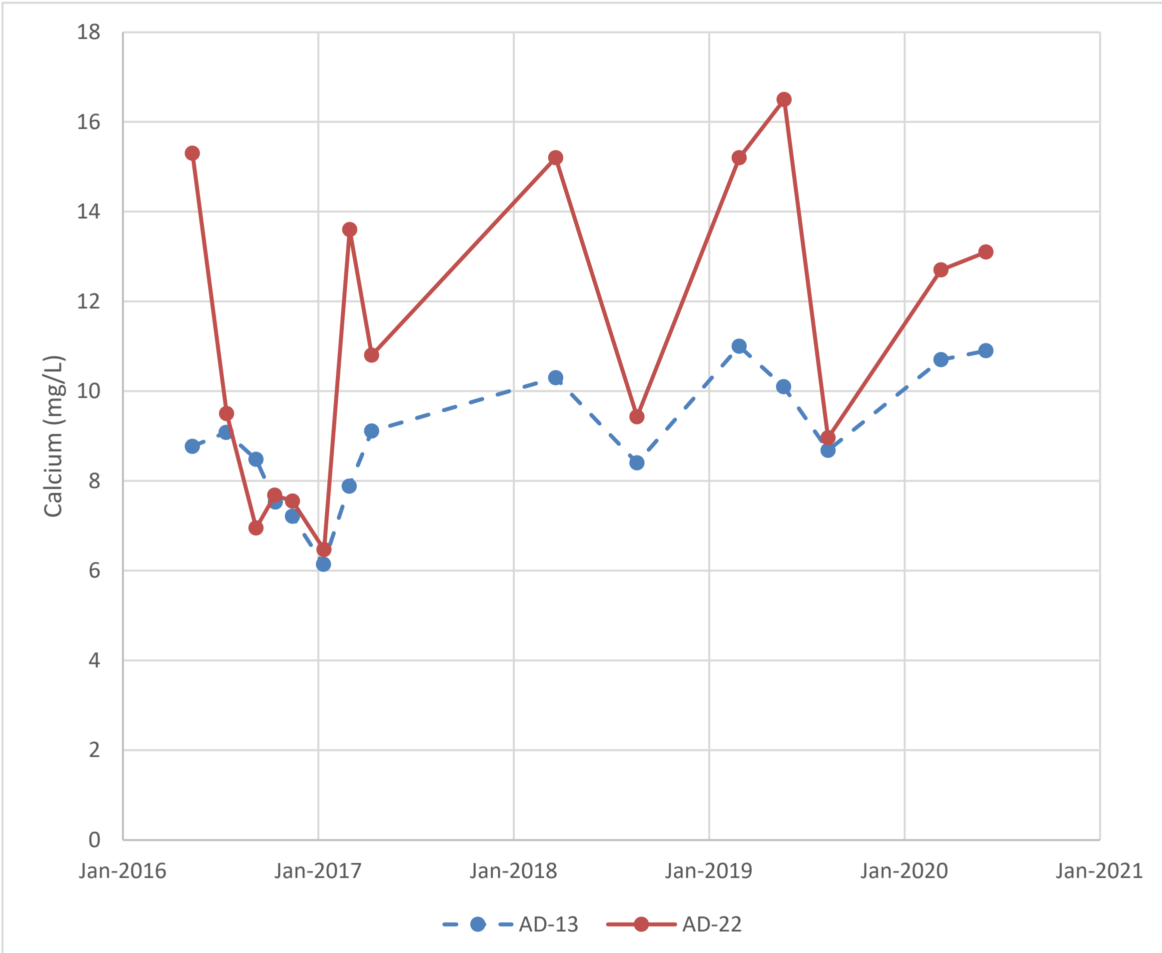
Columbus, Ohio | 18-Dec-2020



Notes: Calcium concentrations are shown in milligrams per liter (mg/L). AD-13 is shown with a dashed line because it is an upgradient location.

Calcium Time Series Graph

Pirkey FGD Stackout Pad

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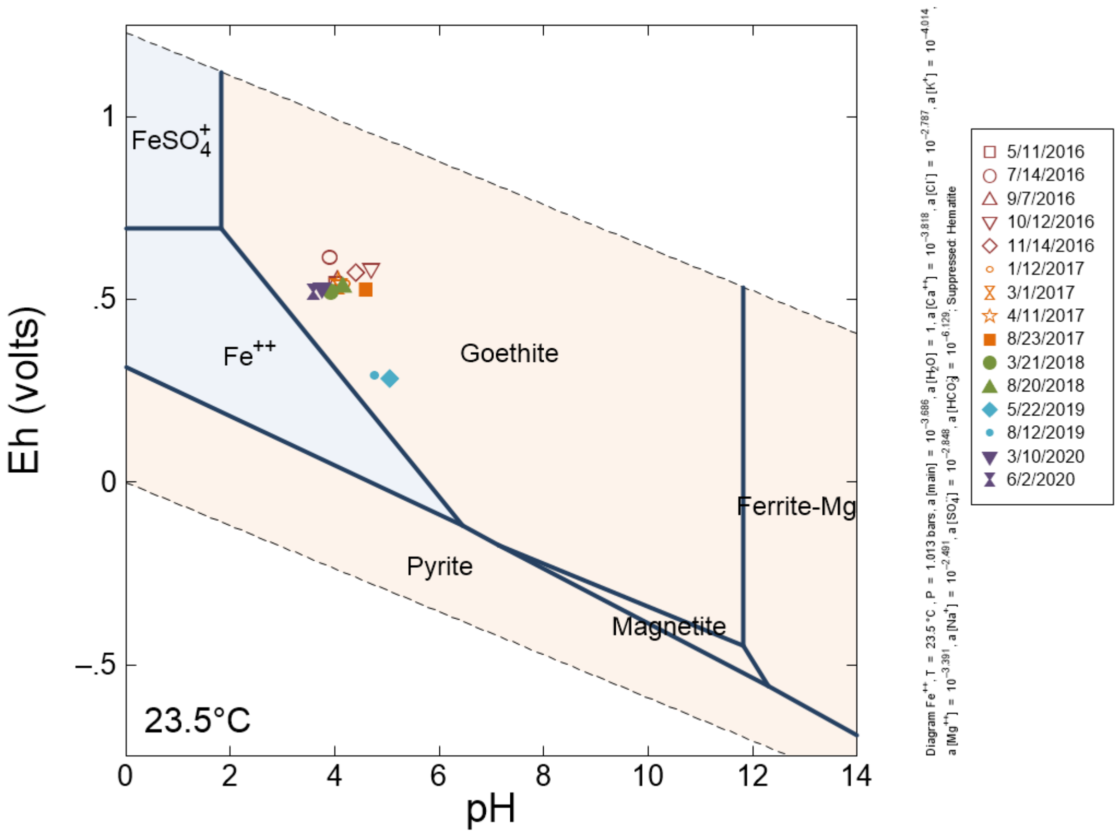
Columbus, Ohio

15-Dec-2020

Figure

10



Notes: Average groundwater concentrations of major cations and anions at AD-22 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

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Columbus, Ohio

15-Dec2020

Figure

11

internal info; path, date revised, author

ATTACHMENT A

March 2020 Boring Logs

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name:______ SP-B1

Project Location:____ Hallsville, TX

Boring Date:__ 3/2/2020

Depth Scale Feet	Water Table	Soil Profile: Description		PID*
		pp= pocket penetrometer		
0		0.0'-0.4':	Top soil with vegetation, black silt	
		0.4'-2.1':	Brown silt, fine grained, little cohesion, dry	
		2.1'-4.3':	Light maroon and gray clay, low plasticity, moderate stiffness (pp. 3.5); light brown silt/iron ore	
		4.3'-10.0':	Maroon clay, low plasticity, high stiffness (pp. 4.0-5.0), iron ore (brown/red silt pockets throughout), moist at 8.5'	
5				
10	▼	10.0'-15.0':	Dark maroon clay, wet, moderate plasticity, moderate stiffness (pp. 2.5-3.0), red/brown silt pockets (iron ore)	
15		15.0'-15.5':	Dark maroon and red/brown clayey silt; low cohesion; wet	
		15.5'-20.0':	Light gray and red/brown clayey silt, wet, low cohesion, iron ore present	
20		20.0'-21.8':	Dark maroon and red/brown clayey silt; good cohesion; wet	
		21.8'-24.0':	Black silty clay, high stiffness (pp. >5.0), low plasticity	
		24.0'-24.5':	Black silty clay, low stiffness (pp. 2.0), moderate plasticity	
25		24.5'-30.0':	Dark gray/dark green fine grained sand, well sorted, trace silt; wet	
30			Samples collected at 10-12'; 16-18'; 27-29'	
			TD at 30' bgs	
			*PID readings not collected	
35				

Drill Rig Geoprobe 7822 DT

Drilling Contractor:___ Best Drilling

Driller:_ Ramon Gutierrez

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name:______ SP-B2

Project Location:____ Hallsville, TX

Boring Date:__ 3/2/2020

Depth Scale Feet	Water Table	Soil Profile 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

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name:______ SP-B3

Project Location:____ Hallsville, TX

Boring Date:__ 3/2/2020

Depth Scale Feet	Water Table	Soil Profile — Description		PID*
		pp= pocket penetrometer		
0		0.0'-0.4':	Top soil, Black silt with vegetation	
		0.4'-0.7':	Brown silt, moist, low cohesion	
		0.7'-2.0':	Maroon and light gray silty clay, moderate stiffness (pp.2.5), moderate plasticity, iron ore/mottling present	
		2.0'-2.2':	Brown silt, dry, brittle	
		2.2'-5.6':	Maroon and ligh gray clay, high stiffness (pp. 4.0), low plasticity	
5		5.6'-6.0':	Orange silt, no cohesion, dry	
		6.0'-13.5':	Maroon clay, high stiffness (pp >4.5), low plasticity; moist at 9'; wet at 12'	
10	▼			
		13.5'-13.6':	Brown/orange silt (iron ore), no cohesion	
		13.6'-17.5':	Gray and orange clayey silt, good cohesion; iron ore present; wet	
15				
		17.5'-20.2':	Maroon and orange silty clay, low stiffness(pp. 0.5), moderate plasticity; iron ore present; wet	
20		20.2'-21.1':	Brown silt, no cohesion; wet	
		21.1'-22.7':	Brown fine grained sand, well sorted; wet	
		22.7'-25.0':	Maroon and orange silty clay, low stiffness (pp. 0.5), low plasticity; iron ore present; wet	
25				
30			Samples collected at 10-12'; 15-17'; 22-24'	
			TD at 25' bgs; refusal	
			*PID readings not collected	
35				

Drill Rig Geoprobe 3230 DT

Drilling Contractor:___ C&S

Driller:_ DJ Diduch

Geosyntec Consultants

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	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

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name:______ SP-B5

Project Location:____ Hallsville, TX

Boring Date:__ 3/5/2020

Soil Profile

Depth Scale Feet	Water Table	Description		PID*
		pp= pocket penetrometer		
0		0.0'-0.6':	Top soil, black silt, vegetation	
		0.6'-0.9':	Brown clayey silt, good cohesion	
		0.9'-2.4':	Red and gray silty clay, moderate/high stiffness (pp. 3.5), high plasticity; iron ore present	
		2.4'-5.0':	NO RECOVERY	
5		5.0'-8.6':	Maroon and gray clay, moderate/high stiffness (pp. 3.5), low plasticity; iron ore present; moist	
	▽	8.6'-10.0':	Light gray and maroon clay, moderate/low stiffness (pp.2.0), high plasticity; iron ore present; wet	
10		10.0'-12.0':	Maroon and gray clay, high stiffness (pp. 4.0), moderate plasticity, iron ore present; wet	
		12.0'-12.9':	Iron ore with maroon clay, high stiffness (pp.4.0), moderate plasticity; wet	
		12.9'-15.0':	Maroon clay, high stiffness (pp.4.0), high plasticity; iron ore present; wet	
15		15.0'-18.4':	Light gray and orange clayey silt, good cohesion; iron ore present; wet	
		18.4'-18.6':	Dark maroon iron ore; wet	
		18.6'-20.0':	Orange and gray clayey silt, good cohesion; iron ore present; wet	
		20.0'-21.2':	Maroon and orange clayey silt, good cohesion; iron ore present; wet	
20		21.2'-22.3':	Black clay, trace silt, low stiffness (pp.1.0), high plasticity; wet	
		22.3'-22.6':	Black clay, high stiffness (pp.4.5), moderate plasticity	
		22.6'-22.9':	Black silt, no cohesion; wet	
		22.9'-23.4':	Black clay, trace silt, moderate stiffness (pp.2.5), high plasticity; wet	
		23.4'-25.0':	Dark gray and green fine grained sand; well sorted; wet; glauconite present	
25			Samples collected at 6-8'; 16-18'; 23-25'	
			TD at 25' bgs; refusal	
			*PID readings not collected	
30				
35				

Drill Rig Geoprobe 3230 DT

Drilling Contractor:___ C&S

Driller:_ DJ Diduch

Geosyntec Consultants

ATTACHMENT B

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

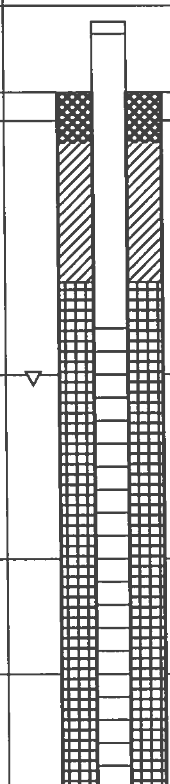
FACILITY ADDRESS: Hallsville, Texas

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	Riser Interval:	+3 (ags)-10'
Filter Sand (Size/Interval):	8-30'	Screen Interval:	10-30'
Grout (Type/Interval):	Grout from 0-2'; Bentonite from 2-8'	Water level:	12.5'
Surface Completion	☐ Flush ■	Above Ground	3'

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

ATTACHMENT C

Certification by 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 FGD Stackout Area 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

Signature

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

Texas Registered Engineering Firm
No. F-1182

79864	Texas	12/31/2020
License Number	Licensing State	Date