Luminant

Dynegy Midwest Generation, LLC
1500 Eastport Plaza Drive
Collinsville, IL 62234

December 1, 2023

Illinois Environmental Protection Agency
DWPC – Permits MC#15
Attn: 35 I.A.C. § 845.650(e) Alternative Source Demonstration Submittal
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

Re: Vermilion Power Plant New East Ash Pond; IEPA ID # W1838000002-04

Dear Mr. LeCrone:

In accordance with Title 35 of the Illinois Administrative Code (35 I.A.C.) Section (§) 845.650(e), Dynegy Midwest Generation, LLC (DMG) is submitting this Alternative Source Demonstration (ASD) for exceedances observed from the Quarter 2 2023 sampling event at the Vermilion Power Plant New East Ash Pond, identified by Illinois Environmental Protection Agency (IEPA) ID No. W1838000002-04.

This ASD is being submitted within 60 days from the date of determination of an exceedance of a groundwater protection standard (GWPS) for constituents listed in 35 I.A.C. § 845.600. As required by 35 I.A.C. § 845.650 (e)(1), the ASD was placed on the facility's website within 24 hours of submittal to the agency.

One hard copy is provided with this submittal.

Sincerely,

Dianna Tickner

Dianna Tickner
Sr. Director – Decommission and Demolition

Enclosures
Alternate Source Demonstration, Quarter 2 2023, New East Ash Pond Vermilion Power Plant

Intended for
Dynegy Midwest Generation, LLC

Date
December 1, 2023

Project No.
1940103649-014

35 I.A.C. § 845.650(E): ALTERNATIVE SOURCE DEMONSTRATION

NEW EAST ASH POND
VERMILION POWER PLANT
OAKWOOD, ILLINOIS
IEPA ID: W1838000002-04

Bright ideas. Sustainable change.

CERTIFICATIONS

I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used other than for its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Eric J. Tlachac

Eric J. Tlachac
Qualified Professional Engineer
062-063091
Illinois
Ramboll Americas Engineering Solutions, Inc.
Date: December 1, 2023

ERIC J. TLACHAC
062-063091

I, Brian G. Hennings, a professional geologist in good standing in the State of Illinois, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used other than for its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Brian G. Hennings
Professional Geologist
196-001482
Illinois
Ramboll Americas Engineering Solutions, Inc.
Date: December 1, 2023

BRIAN G. HENNINGS
196.001482

CONTENTS

TABLES (IN TEXT)

FIGURES (IN TEXT)

FIGURES (ATTACHED)

APPENDICES

ACRONYMS AND ABBREVIATIONS

35 I.A.C.	Title 35 of the Illinois Administrative Code
ASD	Alternative Source Demonstration
BCU	Bedrock Confining Unit
CCR	coal combustion residuals
DMG	Dynegy Midwest Generation, LLC
E001	Event 1
EPRI	Electric Power Research Institute
GMP	Groundwater Monitoring Plan
GWPS	groundwater protection standard
HCR	Hydrogeologic Site Characterization Report
ISGS	Illinois State Geological Survey
IQR	interquartile range
LOE(s)	line(s) of evidence
mg/L	milligrams per liter
Middle Fork	Middle Fork of the Vermilion River
NAVD88	North American Vertical Datum of 1988
NEAP	New East Ash Pond
PCA	principal component analysis
Ramboll	Ramboll Americas Engineering Solutions, Inc.
SEP	sequential extraction procedure
SI	surface impoundment
SSL	statistically significant level
TDS	total dissolved solids
TU	tritium units
UCU	Upper Confining Unit
UU	Upper Unit
VPP	Vermilion Power Plant

1. INTRODUCTION

Under Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845.650(e), within 60 days from the date of determination of an exceedance of a groundwater protection standard (GWPS) for constituents listed in 35 I.A.C. § 845.600, an owner or operator of a coal combustion residuals (CCR) surface impoundment (SI) may complete a written demonstration that a source other than the CCR SI caused the contamination and the CCR SI did not contribute to the contamination, or that the exceedance of the GWPS resulted from error in sampling, analysis, statistical evaluation, natural variation in groundwater quality, or a change in the potentiometric surface and groundwater flow direction (Alternative Source Demonstration [ASD]).

This ASD has been prepared on behalf of Dynegy Midwest Generation, LLC (DMG) by Ramboll Americas Engineering Solutions, Inc (Ramboll), to provide pertinent information pursuant to 35 I.A.C. § 845.650(e) for the Vermilion Power Plant (VPP) New East Ash Pond (NEAP) (*i.e.,* Site) located near Oakwood, Illinois.

The most recent quarterly sampling event (Event 1 [E001]) was completed on June 29, 2023, and analytical data were received on August 3, 2023. In accordance with 35 I.A.C. § 845.610(b)(3)(C), comparison of statistically derived values with the GWPSs described in 35 I.A.C. § 845.600 to determine exceedances of the GWPS was completed by October 2, 2023, within 60 days of receipt of the analytical data (Ramboll, 2023). The statistical comparison identified the following GWPS exceedances at compliance groundwater monitoring wells:

- Chloride at wells 35D and 70D
- Lithium at wells 35D and 70D
- Sulfate at wells 35D and 70S
- Total dissolved solids (TDS) at wells 35D and 70S

Pursuant to 35 I.A.C. § 845.650(e), the lines of evidence (LOE) presented in **Section 3** demonstrate that sources other than the NEAP are the cause of the chloride, lithium, sulfate, and TDS GWPS exceedances at **wells 35D and 70D** listed above and the NEAP has not contributed to the exceedances.

This ASD was completed by December 1, 2023, within 60 days of determination of the exceedances (October 2, 2023), as required by 35 I.A.C. § 845.650(e). This ASD has been completed in conformance with guidance provided in the Electric Power Research Institute (EPRI) guidance for development of ASDs at CCR sites (EPRI, 2017), and the United States Environmental Protection Agency (USEPA)'s Solid Waste Disposal Facility Criteria: Technical Manual (USEPA, 1993).

Sulfate and TDS GWPS exceedances at **well 70S** will be addressed in accordance with 35 I.A.C. § 845.660.

2. BACKGROUND

2.1 Site Location and Description

The former VPP is located four miles northeast of the Village of Oakwood in Vermilion County. The NEAP lies in the bottomlands of the Middle Fork of the Vermilion River (Middle Fork) and is bordered to the west by bluffs, to the south by unimproved DMG land, and to the north and east by the Middle Fork. Several underground coal mines and one surface mine were historically operated both beneath the NEAP and in the vicinity of the VPP.

2.2 Description of New East Ash Pond CCR Unit

The NEAP is a 29-acre inactive, unlined CCR SI constructed overtop a thick shale formation using berms constructed with a low-permeability clay core and cutoff walls keyed into the underlying shale formation.

The original East Ash Pond (1989 pond footprint) was constructed in 1989 and expanded in 2002 to form the present-day NEAP. The 1989 pond footprint was built overtop a thick shale formation which is greater than 80 feet thick in the vicinity of the ash ponds. The earthen berms on the north, east, and south sides of the 1989 pond footprint were constructed with a low-permeability clay core and cutoff walls keyed into the underlying shale formation. The cutoff walls extended approximately 8 feet into the underlying shale. A natural earthen bluff composed of low-permeability native clays formed the west side of the 1989 pond footprint.

New berms were constructed to expand the capacity of the 1989 pond footprint in 2002, forming the footprint of the present-day NEAP. The new berms raised the height of the original berms and were constructed with clay liners keyed into the underlying clay core. A cutoff trench backfilled with low permeability fill was placed along the western side slope of the enlarged NEAP. The low-permeability materials surrounding the footprint of the present-day NEAP form the existing containment system. The secondary pond was not expanded or modified as part of the 2002 NEAP expansion. The VPP ceased operations in 2011 when the power plant was retired.

2.3 Geology and Hydrogeology

2.3.1 Site Hydrogeology

Significant site investigation has been completed at the VPP to fully characterize the geology, hydrogeology, and groundwater quality as provided in the October 2021 operating permit application (Geosyntec, 2021), the January 2022 construction permit application (Geosyntec, 2022), and the Hydrogeologic Site Characterization Report (HCR; Ramboll, 2021a). These materials are incorporated herein. A site conceptual model has been developed and is discussed below.

In addition to the CCRs present in the NEAP, there are three different types of unlithified material present above the bedrock, which were categorized into hydrostratigraphic units in this report as follows:

- **Upper Unit (UU):** includes mixed Quaternary alluvial deposits of the Cahokia Alluvium described as sand with occasional layers of silty clay. The alluvial sand is generally a fine to medium sand that contains silts, clays, and gravels in varying amounts. This unit is present outside of the NEAP and in the bottomlands of the Middle Fork.

- **Upper Confining Unit (UCU):** consists of predominantly low permeability silty and clayey diamictons (glacial till) of the Wedron Formation with intermittent sand layers and lenses. This unit is present outside of the NEAP and along the western bluff of the Middle Fork.
- **Bedrock Confining Unit (BCU):** lowermost unit identified at the site and underlies all unlithified deposits. This unit occurs within Pennsylvanian shale which is the uppermost lithified unit at the Site.

None of the hydrostratigraphic units described above have been identified as an aquifer. However, the Upper Unit and BCU have been identified as potential migration pathways (PMPs).

Groundwater flow direction and gradients toward the Middle Fork have not changed significantly since the hydrogeologic study of the NEAP was completed in 2003 (Ramboll, 2021a; Kelron, 2003), and recent data supports the existing conceptual site model. A bedrock potentiometric surface map for June 19, 2023, is presented in **Figure 1**.

2.3.2 Regional Bedrock Geology

Regional investigations of the Illinois Basin have identified bedrock (specifically brines within the bedrock formations) as a source of chloride in groundwater (Kelley et al, 2012; Panno et al, 2018). Studies by Cartwright (1970) and Siegel (1989) indicate that groundwater migrates toward the center of the Illinois Basin and discharges upward through overlying confining units. The "Saline groundwater and brines can be brought near or to the land surface by natural conditions, such as migrating up prominent fractures and/or faults in bedrock, or by anthropogenic activities, such as exploration for and exploitation of petroleum. The mixing of upward-migrating saline groundwater with fresh groundwater from shallow aquifers can make groundwater from private wells undrinkable and can present a very expensive problem for municipalities (Panno and Hackley, 2010). Illinois State Geological Survey reporting includes 31 chloride results from available water samples (including some samples from VPP) which range from 2.1 to 30,269 milligrams per liter (mg/L) with mean value of 1,689 mg/L and median of 13 mg/L (Illinois State Geological Survey [ISGS] 2002). The report also concludes that water from the wells completed in shale contained higher concentrations of aluminum, barium, bromide, boron, chloride, fluoride, iron, lithium, potassium, sodium, and strontium. Tritium and carbon-14 age dating has demonstrated that groundwater from the bedrock is significantly older than that from the shallow Quaternary deposits (Kelron, 2003; ISGS, 2002).

2.4 Groundwater and NEAP Monitoring

The monitoring system for the NEAP was established in the Groundwater Monitoring Plan (GMP; Ramboll, 2021b) and consists of monitoring wells installed in the UU, UCU, and BCU, including background monitoring wells 10 and 22, located west of the NEAP, and compliance monitoring wells 16A, 16B, 35S, 35D, 70S, 70D, 71S and 71D (**Figure 1**). NED1 (installed in CCR) is used to collect porewater samples and monitor water levels within the NEAP.

3. LINES OF EVIDENCE THAT POTENTIAL GROUNDWATER PROTECTION STANDARD EXCEEDANCES ARE NOT RELATED TO THE NEAP

As allowed by 35 I.A.C. § 845.650(e), this ASD demonstrates that sources other than the NEAP (the CCR unit) caused the exceedances at 35D (chloride, lithium, sulfate, and TDS) and 70D (chloride and lithium) and the NEAP did not contribute to the exceedances. Specifically, the following LOEs conclude that the chloride and lithium exceedances at 35D and 70D are due to groundwater interactions with the bedrock, and that the sulfate exceedance at 35D is due to influence from historic coal mining activities. LOEs supporting this ASD include the following:

1. The ionic composition of bedrock groundwater is different than the ionic composition of porewater and consistent with published observations for Pennsylvanian Bedrock.
2. Concentrations of chloride in the NEAP porewater are lower than those observed in the groundwater.
3. A bedrock solids and geochemical evaluation identified naturally occurring shales as the source of lithium and chloride exceedances at 35D and 70D.
4. A bedrock solids and geochemical evaluation identified naturally occurring coal seams as the source of the sulfate exceedance at 35D due to regional upward vertical hydraulic gradients in the shale bedrock.
5. Isotopic analysis of groundwater from the bedrock and overlying Quaternary deposits indicate that bedrock groundwater is between 13,000 and 35,000 years older than groundwater in the Quaternary deposits; and bedrock groundwater is isolated from the groundwater in the quaternary deposits.

These LOEs are described and supported in greater detail below.

Since the major contributors to TDS are chloride and sulfate at 70D and 35D (respectively), the LOEs that apply to chloride and sulfate also apply to TDS. **Figure A** (on the following page) shows boxplots summarizing the relative contribution of each major ion to TDS in groundwater from wells 35D and 70D since 2021. Box plots graphically represent the range of a given dataset using lines to construct a box where the lower line, midline, and upper line of the box represent the values of the first quartile, median, and third quartile values, respectively. The minimum and maximum values of the dataset (excluding outliers) are illustrated by whisker lines extending beyond the first and third quartiles of (*i.e.,* below and above) the box plot. The interquartile range (IQR) is the distance between the first and third quartiles. Outliers (values that are at least 1.5 times the IQR away from the edges of the box) are represented by single points plotted outside of the range of the whiskers. **Figure A** shows that chloride has the greatest contribution to TDS concentrations at 70D (median of 42 percent) and sulfate has the greatest contribution to TDS at 35D (median of 42 percent).

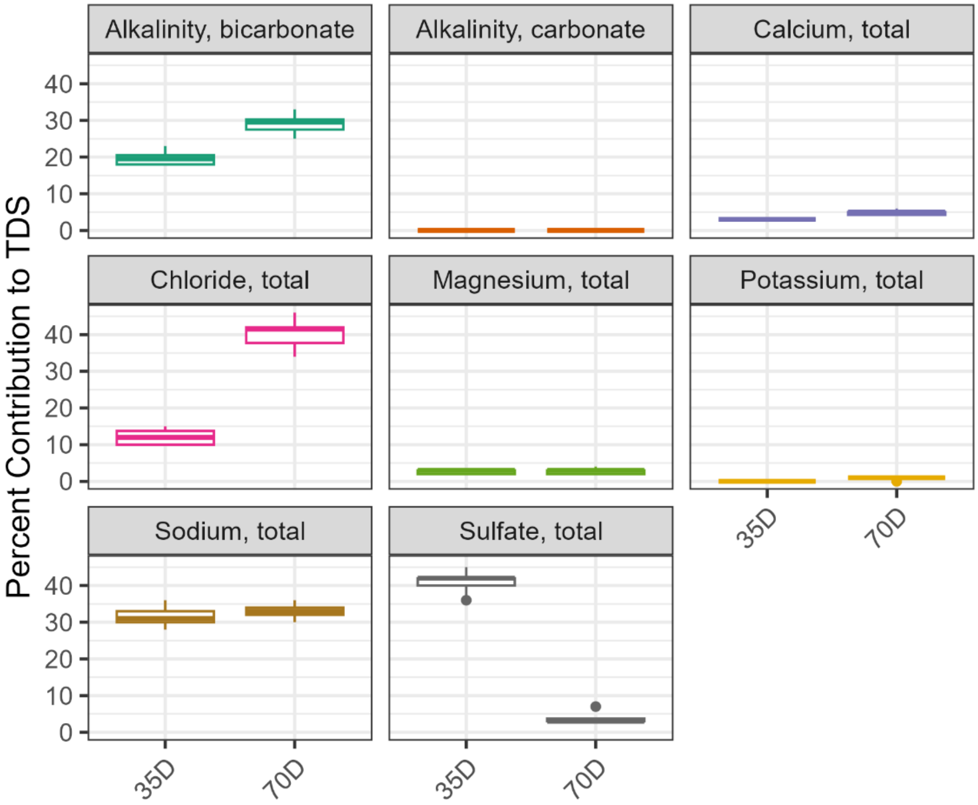

Figure A. Contribution of each major ion to TDS at wells 35D and 70D.

3.1 LOE #1: The Ionic Composition of Bedrock Groundwater is Different Than the Ionic Composition of Porewater and Consistent with Published Observations for Pennsylvanian Bedrock

Piper diagrams graphically represent ionic composition of aqueous solutions. A Piper diagram displays the position of water samples with respect to their major cation and anion content on the two lower triangular portions of the diagram, providing the information which, when combined on the central, diamond-shaped portion of the diagram, identify composition categories or groupings (hydrochemical facies). **Figure B** below is a Piper diagram that displays the ionic composition of samples collected from the bedrock background and bedrock compliance wells associated with the NEAP (sampled June 20 and 29, 2023), and porewater sampling location associated with the NEAP (sampled August 17, 2021).

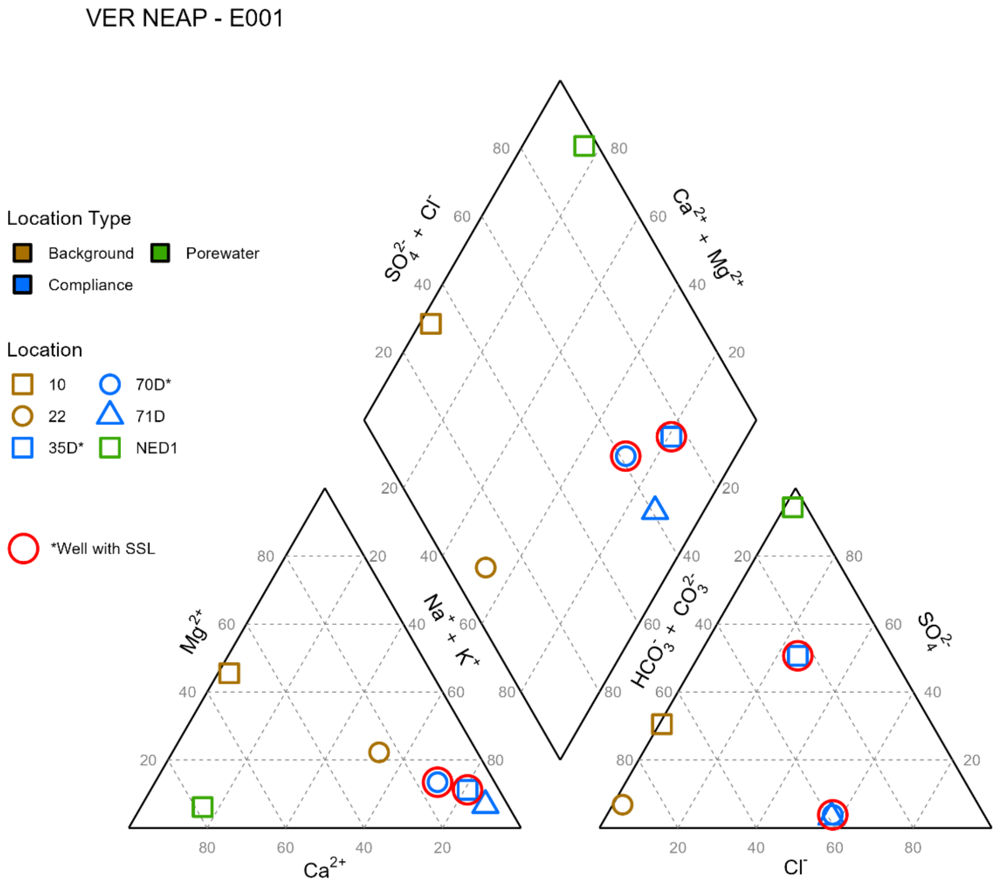

Figure B. Piper Diagram. Shows ionic composition of samples of bedrock groundwater (collected June 20 and 29, 2023) and porewater associated with the NEAP (collected on August 17, 2021).

It is evident from the piper diagram (**Figure B**) that porewater from the NEAP (green symbol) is primarily in the calcium-sulfate hydrochemical facies, while the bedrock groundwater samples (blue symbols) are in the sodium-chloride hydrochemical facies. The background BCU sample (brown symbol) is in the sodium-bicarbonate hydrochemical facies. The background BCU sample is collected from well 22, which is screened at from 556 to 576 feet North American Vertical Datum 1988 (NAVD88), and wells 35D and 70D are screened at lower elevations (536 to 546 feet NAVD88 and 541 to 551 feet NAVD88, respectively). Groundwater from deeper in Pennsylvanian aquifers tends to be more dominant in chloride, and groundwater may change from a sodium-bicarbonate to a sodium-chloride facies over small changes in depth (Lloyd and Lyke 1995). Therefore, compliance groundwater samples have a different ionic composition than porewater and a composition relative to background that is consistent with expected changes due to screen depth, indicating that NEAP porewater is not the source of CCR constituents detected in wells 35D or 70D.

3.2 LOE #2: Concentrations of Chloride in the NEAP Porewater are Lower than Those Observed in the Groundwater

A box plot of chloride concentrations in compliance monitoring wells 35D and 70D and porewater well NED1 is provided in **Figure C** on the following page. Chloride concentrations are lower in

NEAP porewater samples[1] collected during 2021 than in compliance groundwater samples collected from wells 35D and 70D from 2021 to 2023. The maximum concentration of chloride detected in NEAP porewater (44 mg/L) is lower than the minimum concentration of chloride in 35D (199 mg/L) or 70D (317 mg/L). In addition, median concentrations of chloride in wells 35D and 70D are 15 and 27 times greater, respectively, than the median chloride of 25 mg/L in NEAP porewater. Therefore, the NEAP cannot be the source of the elevated chloride concentrations observed in 35D and 70D.

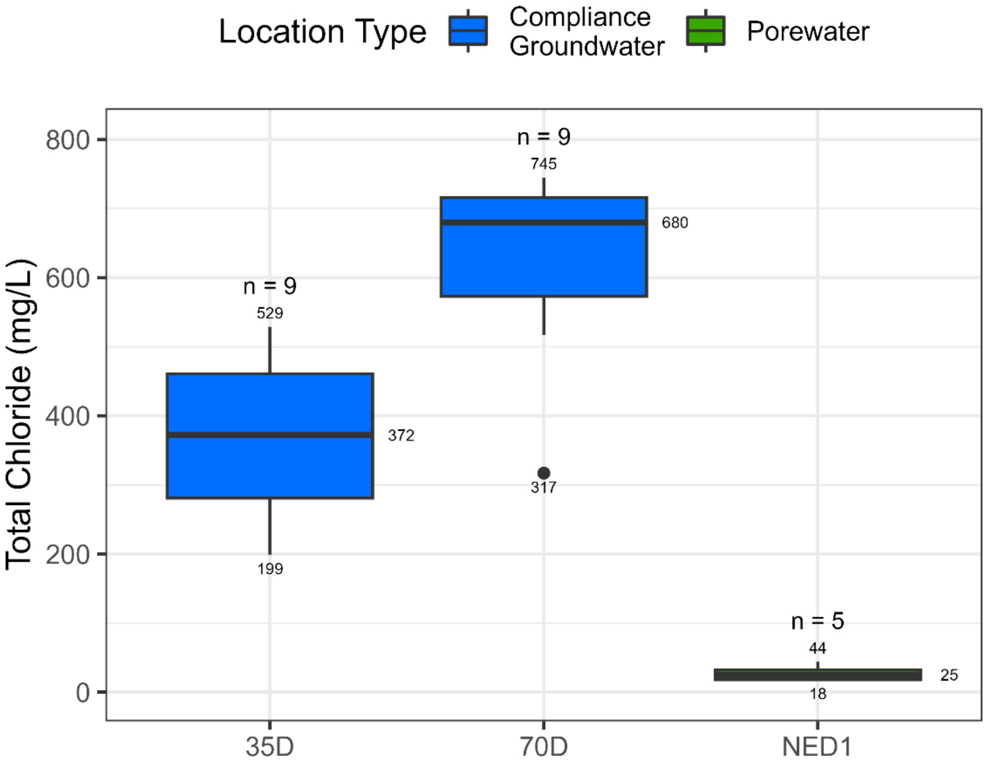

Figure C. Chloride Box Plot. The sample size (n), maximum, median, and minimum values are noted.

3.3 LOE #3: A Bedrock Solids and Geochemical Evaluation Identified Naturally Occurring Shales as the Source of Lithium and Chloride Exceedances at 35D and 70D

Appendix A presents the results of additional analysis performed in 2023 by Geosyntec. Their evaluation of site-specific solid phase compositions and geochemical conditions, multivariate statistical analyses, and literature review of Pennsylvanian-aged shale bedrock groundwaters identified naturally occurring lithium and chloride associated with shales as the alternative source of these constituents to the groundwater at 35D and 70D based on the following observations:

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[1] CCR porewater most accurately represents the mobile constituents associated with the waste management activity within the CCR SI (EPRI, 2017). The composition of CCR porewater accumulated at the base of the CCR unit, which is derived from, and represents contact with, CCR material above and around the well screen, is the truest representation of mobile constituents throughout the CCR SI.

- Sequential extraction procedure (SEP) analyses demonstrated that much of the lithium in the solid phase is associated with the fractions which correlate to primary minerals such as micas and clay minerals, as well as the fractions associated with sulfides and oxide minerals.
- Geochemical conditions in the groundwater support desorption or dissolution of the sulfide and iron oxide mineral phases that host lithium.
- X-ray diffraction confirmed the presence of abundant micas and clay minerals, which host native lithium, in the shale bedrock.
- Groundwater chloride concentrations observed in Pennsylvanian-age shale bedrock aquifers are comparable to or higher than those observed at wells 35D and 70D.
- Principal component analysis (PCA) shows that BCU well groundwater is distinct from CCR porewater.

3.4 LOE #4: A Bedrock Solids and Geochemical Evaluation Identified Naturally Occurring Coal Seams as the Source of the Sulfate Exceedance at 35D Due to Regional Upward Vertical Hydraulic Gradients in the Shale Bedrock

Appendix A presents an evaluation of the geochemistry at 35D in the context of previously reported site conditions. This data demonstrates that elevated sulfate concentrations at 35D are the result of influence from a major coal seam in the bedrock based on the following observations:

- The coal seam mined near the site has been previously characterized and contains both iron sulfide minerals and siderite (FeCO3), which is evidence of rapid oxidation of the iron sulfide minerals.
- The groundwater chemistry at 35D suggests that siderite and the iron oxide mineral ferrihydrite are in a state of dynamic equilibrium, consistent with weathering of pyrite to siderite to ferrihydrite.
- Oxidation of sulfide minerals releases sulfate to the groundwater.
- Strong upward groundwater hydraulic gradients are present within the bedrock that provide hydraulic connection between the coal seam the bedrock that well 35D is screened.

3.5 LOE #5: Isotopic Analysis of Groundwater from the Bedrock and Overlying Quaternary Deposits Indicate that Bedrock Groundwater is Between 13,000 and 35,000 years Older Than Groundwater in the Quaternary Deposits; and, Bedrock Groundwater is Isolated from the Groundwater in the Quaternary Deposits

In 2002 ISGS and Dynegy collected groundwater samples from 8 monitoring wells and tested the samples for carbon-14 and hydrogen-3 (tritium) (ISGS, 2002). Six of the monitoring wells (25, 26, 27, 28, 29, and 30) were located adjacent to the NEAP (**Figure 2**). Wells 26 and 28 had well screens that intersected Quaternary deposits of the UU and the remaining wells were screened in shallow shale bedrock. Results of the testing are presented in Table 11 of the ISGS report included below as **Table A** and on **Figure 2**.

Table A. Isotopic Data from ISGS Sampled Wells (Table 11 from ISGS, 2002)

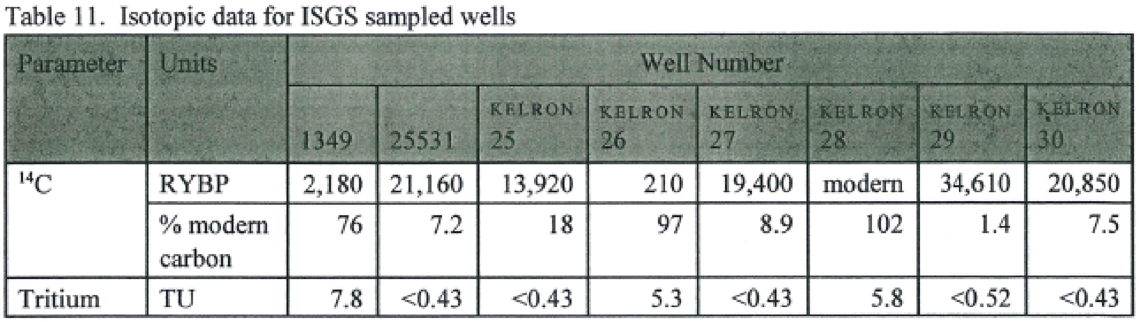

Table 11. Isotopic data for ISGS sampled wells

Parameter	Units	Well Number							
		1349	25531	KELRON 25	KELRON 26	KELRON 27	KELRON 28	KELRON 29	KELRON 30
^{14}C	RYBP	2,180	21,160	13,920	210	19,400	modern	34,610	20,850
	% modern carbon	76	7.2	18	97	8.9	102	1.4	7.5
Tritium	TU	7.8	<0.43	<0.43	5.3	<0.43	5.8	<0.52	<0.43

^{14}C = carbon-14

RYBP = Radiocarbon Years Before Present

TU = tritium units

Tritium is generated in the atmosphere and decays in the isolated subsurface. Water with tritium concentrations greater than 5 tritium units (TU) is considered to be recent, while water with nondetectable tritium concentrations is considered to be greater than 50 years old (ISGS, 2002). Groundwater collected from shallow Quaternary deposits is recent (TU>5), while groundwater from the shallow bedrock is older (no tritium detected). The tritium results are consistent with the carbon-14 results, which indicate that the shallow bedrock wells contain an inorganic carbon signature substantially older than that from wells screened in the Quaternary deposits. Groundwater collected from wells screened in shallow bedrock in the vicinity of the NEAP (wells 25, 27, 29, and 30) had estimated ages ranging from 13,920 to 34,610 years based on carbon-14 age dating. This is in contrast to groundwater collected from wells 26 and 28 (screened in the Quaternary deposits) which had estimated ages of less than 210 years. These results indicated to ISGS that the wells that "draw water from the bedrock are either only slightly connected to or completely isolated from the local groundwater flow system [overlying Quaternary deposits]".

In addition to the spatial location of the wells tested for carbon-14 and tritium relative to the NEAP, the elevations of the well screens and lithology of the age dated wells overlap with the well screen elevations and lithology of wells 35D and 70D which contain the GWPS exceedances (**Table B**) with the exception of MW30, which is screened at a lower elevation than all of the other wells.

Table B. Summary of Bedrock Well Screen Elevations and Lithology

Well ID	Screen Elevation (feet NAVD88)	Lithology
MW35D – exceedance well	546 to 536	shale bedrock
MW70D – exceedance well	550 to 540	shale bedrock
MW25	560 to 540	shale bedrock
MW27	557 to 537	shale bedrock
MW29	558 to 538	shale bedrock
MW30	519 to 499	shale bedrock

This data demonstrates that bedrock groundwater in the vicinity of the NEAP is isolated from the overlying Quaternary deposits and the NEAP is not the source of exceedances to the GWPS in bedrock compliance wells 35D and 70D.

4. CONCLUSIONS

Based on these five LOEs, it has been demonstrated that the NEAP is not the source of the chloride, lithium, sulfate, and TDS GWPS exceedances in wells 35D and 70D and has not contributed to exceedances identified during the first quarterly sampling event. The chloride and lithium exceedances are due to groundwater interactions with the bedrock, and the sulfate exceedance is due to influence from historic coal mining activities. Because the major contributors to TDS are chloride and sulfate, LOEs that apply to chloride and sulfate also apply to TDS.

1. The ionic composition of bedrock groundwater is different than the ionic composition of porewater and consistent with published observations for Pennsylvanian Bedrock.
2. Concentrations of chloride in the NEAP porewater are lower than those observed in the groundwater.
3. A bedrock solids and geochemical evaluation identified naturally occurring shales as the source of lithium and chloride exceedances at 35D and 70D.
4. A bedrock solids and geochemical evaluation identified naturally occurring coal seams as the source of the sulfate exceedance at 35D due to regional upward vertical hydraulic gradients in the shale bedrock.
5. Isotopic analysis of groundwater from the bedrock and overlying Quaternary deposits indicate that bedrock groundwater is between 13,000 and 35,000 years older than groundwater in the Quaternary deposits; and, bedrock groundwater is isolated from the groundwater in the quaternary deposits.

This information serves as the written ASD prepared in accordance with 35 I.A.C. § 845.650(e), demonstrating that the chloride, lithium, sulfate, and TDS exceedances observed at wells 35D and 70D during the first quarterly sampling event were not due to the NEAP and are attributable to natural groundwater interactions with bedrock and historic coal mining. Therefore, assessment of corrective measures is not required for these constituents at the NEAP.

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FIGURES

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Y:\Mapping\Projects\22\2285\MXD\Alt_Source_Dem\Vermilion\NEAP_912\E001\Figure 1. VER 912 NEAP Pot Surface 20230619.mxd

PROJECT: 169000XXXX | DATED: 11/28/2023 | DESIGNER: GALARNMC

⊞	COMPLIANCE MONITORING WELL
⊞	BACKGROUND MONITORING WELL
⊞	PORE WATER WELL
⊞	MONITORING WELL
—	GROUNDWATER ELEVATION CONTOUR (10-FT CONTOUR INTERVAL, NAVD88)
- -	INFERRED GROUNDWATER ELEVATION CONTOUR
→	GROUNDWATER FLOW DIRECTION
▭	REGULATED UNIT (SUBJECT UNIT)
▭	SITE FEATURE
⬚	PROPERTY BOUNDARY

NOTES:

1. ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.
2. ELEVATIONS IN BRACKETS WERE OBTAINED OUTSIDE OF THE 24 HOUR PERIOD FROM INITIATION OF DEPTH TO GROUNDWATER MEASUREMENTS BUT WITHIN THE SAME SAMPLING EVENT.
3. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988

0 150 300
Feet

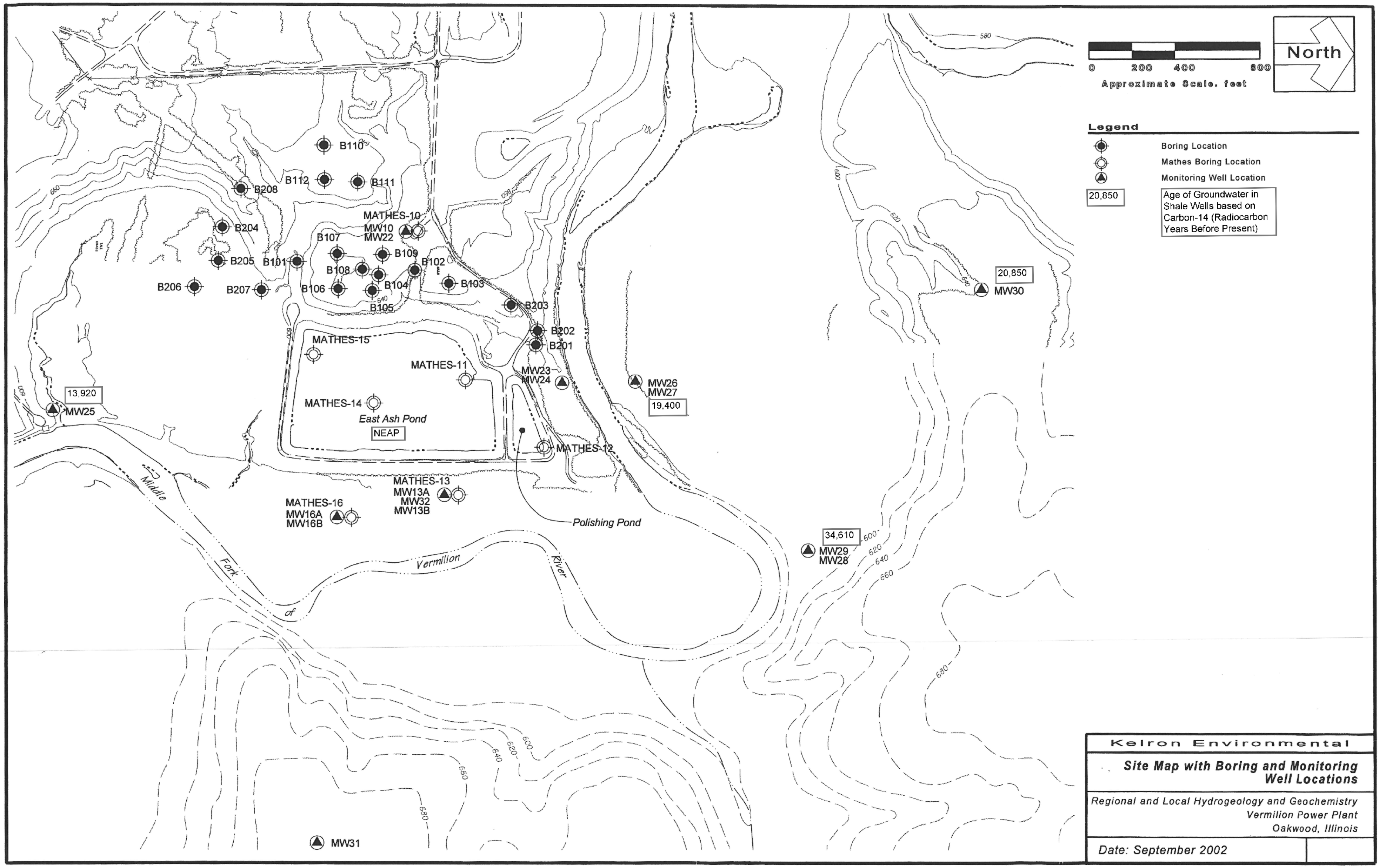
POTENTIOMETRIC SURFACE MAP
JUNE 19, 2023

ALTERNATIVE SOURCE DEMONSTRATION
NEW EAST ASH POND
VERMILION POWER PLANT
OAKWOOD, ILLINOIS

FIGURE 1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

Y:\Mapping\Projects\22\2285\MXD\Alt_Source_Dem\Vermilion\NEAP_912\E001\Figure 2. Monitoring Well Location Map Carbon14.mxd



Service Layer Credits:

PROJECT: 169000XXXX | DATED: 11/28/2023 | DESIGNER: GALARNMC

MONITORING WELL LOCATION MAP WITH RESULTS OF CARBON-14 AGE DATING

ALTERNATIVE SOURCE DEMONSTRATION
NEW EAST ASH POND
VERMILION POWER PLANT
OAKWOOD, ILLINOIS

FIGURE 2

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

APPENDICES

APPENDIX A
GEOSYNTEC CONSULTANTS, 2023. TECHNICAL MEMORANDUM: EVALUATION OF ALTERNATIVE SOURCES WITHIN AQUIFER SOLIDS, VERMILION POWER PLANT - NEW EAST ASH POND. OCTOBER 26, 2023.

Geosyntec consultants

500 W. Wilson Bridge Road, Suite 250
Worthington, Ohio 43085
PH 614.468.0421
FAX 614.468.0416
www.geosyntec.com

TECHNICAL MEMORANDUM

Date:	November 30, 2023
To:	Brian Voelker, Dynegy Midwest Generation, LLC
Copies to:	Stu Cravens and Phil Morris, Dynegy Midwest Generation, LLC Eric Tlachac and Brian Hennings, Ramboll
From:	Allison Kreinberg and Ryan Fimmen, PhD, Geosyntec Consultants
Subject:	Evaluation of Alternative Sources within Bedrock Solids Vermilion Power Plant – New East Ash Pond

This document serves as an Appendix to the December 1, 2023, Alternative Source Demonstration (ASD) for the Vermilion Power Plant New East Ash Pond (NEAP) (Site) for the Quarter 2 2023 sampling event completed to fulfill the requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845.650(e) (VER NEAP E001 ASD). A previous Evaluation of Potential Groundwater Protection Standard (GWPS) Exceedances prepared by Ramboll Americas Engineering Solutions, Inc. (Ramboll) in January 2022 concluded that the potential GWPS exceedances of chloride, lithium, and total dissolved solids (TDS) at downgradient monitoring wells 35D and 70D could be attributed to sources other than the NEAP (Ramboll 2022). Geosyntec Consultants, Inc. (Geosyntec) has completed a review of geochemical and site conditions at the Site to evaluate the influence of the solid-phase mineralogy and geochemistry of the bedrock confining unit potential migration pathway (“bedrock") on groundwater composition. Using additional evidence from laboratory analyses and statistical evaluations, this technical memorandum demonstrates that naturally occurring lithium and chloride associated with bedrock underlying the Site is a source of lithium, chloride, and total dissolved solids (TDS) to Site groundwater. Additionally, this memorandum provides evidence that sulfate concentrations at well 35D can be attributed to the weathering of sulfur-bearing minerals within the coal seams in the Site lithology.

SITE CONDITIONS

Site geology consists primarily of unlithified alluvial and glacial deposits overlying shale bedrock that contains a major coal seam mined in the region. The alluvial deposits consist of the Cahokia Alluvium composed primarily of sand with occasional layers of silty clay and the Upper Till Unit (Wedron Formation and Glasford Formation Till) consisting of clay and silty clay with occasional sand lenses. The Cahokia Alluvium comprises the Upper Unit (UU) at the NEAP and is generally 10 to 25 feet thick. Below this unit is the Upper Confining Unit (UCU) that is comprised of the lower permeability Wedron and Glasford Formations. The UCU is of variable thickness, ranging from up to 100 feet west of the NEAP and absent east of the NEAP (Ramboll 2021).

The Bedrock Confining Unit (BCU), typically greater than 80 feet thick, consists of the Pennsylvanian-age Shelburn Formation, which is primarily a low permeability shale with thin limestone, sandstone, and coal beds. The top of the shale unit in the vicinity of the NEAP is described as highly weathered and decomposed. This unit contains the Danville (No. 7) Coal, which was encountered near the NEAP at approximately 80 to 100 feet below ground surface (ft bgs). Wells 35D and 70D are both screened within the BCU.

Groundwater within the BCU exhibits an upward hydraulic gradient and high dissolved mineral content (Ramboll 2021). Previous isotopic analyses by Kelron Environmental (Kelron) suggest that groundwater in the BCU is significantly older than the recent groundwater in the overlying unlithified deposits by approximately 13,000 to 35,000 radiocarbon years before present (Kelron 2003). Additional information regarding Site hydrogeology and stratigraphy is provided in the ASD prepared by Ramboll.

BEDROCK SOLIDS EVALUATION

Geosyntec reviewed the results of analyses completed on solid phase samples collected from the Site to evaluate if lithium and chloride concentrations in groundwater at wells 35D and 70D in excess of the GWPS could be derived from the native weathered shale bedrock lithology.

Samples were collected from soil borings advanced in June 2023 near two locations: compliance well 35D and compliance well 70D (**Figure 1**). Due to access limitations and health and safety considerations at the Site, the boring locations were adjusted in the field and are approximately 200-250 feet offset from the original well locations. Differences in ground surface elevations and bedrock dip were considered during drilling and sample selection so that the sampled intervals correspond with the well screen interval. Boring locations and well screen intervals are shown in the cross sections provided in **Attachment 2**. The material sampled for geochemical characterization is consistent with the material present in the well screens (gray weathered shale).

The field boring log for these soil borings are provided as **Attachment 2**. Soil boring logs and well construction logs for 35D and 70D are also included in **Attachment 2**. Two samples were collected from the boring near well 35D (VER-35), and three samples were collected from the boring near well 70D (VER-70) at various depths.

All samples were submitted for analysis of mineralogy via X-ray diffraction (XRD), and two samples from VER-35 (55-60 ft bgs and 60-63 ft bgs) and one sample from well VER-70[1] (75-80 ft bgs) were submitted for analyses of total lithium and lithium distribution within the bedrock using sequential extraction procedure (SEP). SEP is an analytical technique that uses progressively stronger reagents to solubilize metals from specific phases within the solid matrix and is used to infer associations between constituents and different classes of solids (Tessier et al. 1979). These classes of solids are identified based on their solubility under different reagents; the reagents are provided in **Attachment 3**. Analysis of chloride by SEP was not performed due to the high solubility of the chloride ion in solution.

Results for total and SEP analyses of lithium in these samples are presented in **Table 1** and the analytical laboratory reports are provided as **Attachment 3**. As a first step to evaluate data quality in an SEP analysis, the sum of individual extraction steps from the SEP was compared to the total lithium concentration. The sum of the SEP procedure is not expected to be exactly equal to the total metals analysis but should generally be consistent with the total metals analysis. The total lithium concentrations ranged from 39 micrograms per gram of material (µg/g) to 42 µg/g in the shale samples. The summed concentrations of lithium from the SEP analyses ranged from 45.3 to 50.8 µg/g. The results were generally consistent between the total metals analyses and the summed SEP steps, indicating good metals recovery and data quality. These results are also consistent with previous samples collected at the Site (31.1-33.3 mg/kg, Ramboll 2021) and within the Danville coal (5.5-89 mg/kg, USGS 2002).

The results presented in **Table 1** demonstrate that lithium is associated with multiple solid phase components. The majority of the lithium was released via leaching steps associated with two reactive solid phase components: metal oxides (between 24 and 28%) and sulfides (between 28 and 31%). Lithium associated with oxides and sulfides may be mobilized via desorption or dissolution of these phases in the event of geochemical changes to the system due to the relative instability of oxide and sulfide minerals.

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[1] Two samples from the unlithified units from VER-70 (30-40 ft bgs) and (41-42 ft bgs) are excluded from subsequent results tables and discussion to emphasize findings associated with shale lithologies in support of an assessment of naturally occurring lithium in bedrock.

Eh-pH diagrams were generated using groundwater data for well 35D (**Figure 2**) and well 70D (**Figure 3**) to evaluate groundwater conditions at these wells relative to the thermodynamic stability of iron oxide and iron sulfide minerals. As indicated on **Figures 2** and **3**, groundwater chemistry at both monitoring wells generally favor thermodynamic stability of the iron oxide phase. However, multiple samples from well 35D plot within the three-phase stability boundary between amorphous iron oxide $Fe(OH)_3$(ppd), the iron carbonate mineral siderite, and aqueous Fe^{2+} (**Figure 2**), indicating that groundwater at this well is experiencing dynamic equilibrium conditions in which chemical reactions between these phases may occur. Groundwater from well 70D indicates a preference for iron oxide phases ($Fe(OH)_3$(ppd)), although groundwater chemistry at this well may be trending towards iron carbonate (siderite) stability (**Figure 3**). Iron sulfide minerals such as pyrite are not predicted to be in a stable phase at either well; therefore, any existing sulfidic minerals within the bedrock would be expected to undergo oxidative dissolution. Lithium associated with the sulfide solid phase component (**Table 1)** would then become mobilized due to dissolution/desorption processes and resulting in an increase in aqueous lithium in groundwater. Similarly, dissolution of iron oxides would occur under variable equilibrium conditions and result in an increase in aqueous lithium in groundwater.

Notable abundances (31 to 37%) of lithium were also found to be associated with the final extraction of the analysis, which is typically considered to be associated with residual metals which are immobile and not readily soluble. The abundance of lithium within this residual fraction indicates association with inseparable primary mineral phases such as clay minerals (Tessier et al., 1979). Clay minerals are known to be common sorbents for naturally occurring lithium (Starkey 1982). Lithium is known to leach from lithium-hosting igneous rocks and micas through weathering processes. Mineral weathering reactions occurring in micas may result in lithium-rich micas transforming directly to illitic clays, and then to mixed-layer and smectite clays. The lithium within these primary minerals either becomes incorporated directly into the crystal structures of the clay minerals or is transported in water and later concentrated in brines through evaporation (Ronov et al. 1970). Lithium-enriched brines constitute a common origin of lithium in clay minerals, as eroded fine-grained materials (i.e., detrital clays) deposited in these brines are capable of hosting lithium within vacant sites in the octahedral layers comprising part of their crystal structures (Schultz 1969). Field lithologic descriptions of the samples from VER-35 and VER-70 indicate that the samples collected from these two locations consist of weathered shale, which is comprised primarily of mica and clay minerals that are known to be hosts of natural lithium.

Mineralogical analyses were completed using XRD to evaluate whole rock mineralogy and determine the abundance of iron oxide minerals, iron sulfide minerals, clay minerals, and micas within the bedrock solids. Whole rock mineralogy results are provided in **Table 2**. Sample mineralogy consists predominantly of quartz, mica (muscovite), feldspars (albite and microcline), and clay minerals (illite, chlorite, and kaolinite) (**Table 2**). Of these minerals, muscovite and clays are known hosts of natural lithium within their crystal structures and comprise natural sources of lithium in the system (Zawidzki 1976; Starkey 1982). As indicated in **Table 2**, these minerals are present at large abundances in samples from well 35D and well 70D (between 43.0 to 47.4%), indicating that these lithium-host minerals occur in the BCU and constitute a natural source of aqueous lithium to groundwater.

While iron oxides were not identified via XRD, they are likely present in the system. Amorphous $Fe(OH)_3$(ppd), which is thermodynamically favored to form at the Eh and pH measured in groundwater (**Figures 2 and 3**), cannot be identified via XRD due to its lack of crystalline structure. However, the SEP results identified an abundance of iron in the leaching step associated with non-crystalline oxides (step 3; **Attachment 3**), and iron oxides are often present on clay surfaces due to the relationship between their surface charges (Ohtsubo 1989). As discussed above, the XRD analysis identified the presence of clay minerals within the shale (**Table 2**, **Attachment 4**). Thus, weathering reactions involving iron oxides likely constitute an additional natural source of aqueous lithium to groundwater.

As discussed above, the shale bedrock material consists predominantly of micas and clays which are known hosts of lithium within their crystal structures. The weathered nature of the shale bedrock material suggests that chemical weathering processes are likely occurring, the result of which supports the occurrence of weathering reactions involving metal oxide and sulfide minerals, as well as alteration reactions between mica and clay minerals and between different types of clay minerals. These reactions all represent processes by which lithium associated with the native geologic materials may become mobilized, contributing aqueous lithium to groundwater.

Similar to lithium, chloride occurs naturally within shale bedrock, which likely contributes to elevated chloride in groundwater. Because of the high solubility of chloride, it is not feasible to determine phase associations through SEP; however, studies within the region have found that groundwater chloride concentrations comparable to or higher than those observed at wells 35D and 70D are often found within the Pennsylvanian-aged shale bedrock. The mean chloride concentration in Pennsylvanian bedrock aquifers in the area reported by the Illinois State Geological Survey (ISGS) is 1,689 mg/L and a chloride maximum concentration of 30,269 mg/L was reported (ISGS 2002). Chloride concentrations observed in wells 35D and 70D are 251 mg/L and 492 mg/L, respectively. A USGS summary found that water within the upper parts of the Pennsylvanian-aged bedrock is generally similar throughout the Illinois and Indiana basins. This water is influenced by the interaction with the variable interbedded rock types present in the bedrock; it can vary from a sodium bicarbonate to a sodium chloride type within a few feet of change in depth (Lloyd and Lyke 1995).

Furthermore, seeps with high naturally occurring salinity (i.e., brines) are known to occur in southern Illinois. Samples of seeps and shallow wells affected by brine in Illinois had highly variable chloride concentrations ranging from ~100 mg/L up to more than 15,000 mg/L (Panno, et al. 2005). These results suggest that contact with Pennsylvanian-aged bedrock can result in natural variability in the reported chloride concentrations in groundwater at ranges consistent with those observed at the site.

STATISTICAL EVALUATION OF GROUNDWATER COMPOSITION

Advanced statistical analyses were employed to evaluate the similarity or dissimilarity among different groundwater samples or groups based on a broad suite of analytes. Dimensional reduction techniques, such as principal component analysis (PCA), are especially effective in identifying the analytes responsible for statistical differences between samples and revealing underlying patterns related to environmental factors, contamination sources, or other natural characteristics of the Site. Clustering methods were further utilized to group samples based on their combined chemical composition through maximizing intra-group similarity and minimizing inter-group similarity.

PCA is often used to simplify large datasets with multiple variables by creating new uncorrelated variables known as principal components (PCs). The PCs are linear combinations of the original variables; the first few PCs typically capture most of the variation within the dataset. Factor loadings are calculated based on the correlation between PCs and the original variables. As such, variables with notably higher positive or negative factor loadings are main drivers of similarity or dissimilarity and clustering of samples. Factor scores are calculated based on the correlation between the combined chemical composition of each sample and the PCs. Samples with similar chemical compositions show similar factor scores and tend to cluster together on a PCA plot.

In this study, the dataset used for PCA included 62 groundwater samples collected in 2021 and 2023 from upgradient wells (10 and 22), downgradient wells (70S, 71S, 70D, 71D, 16A, and 35D) and a porewater well (NED1).[2] PCA requires that input variables have similar scales of measurement and variances. As such, data were standardized by mean-centering and scaling to unit variance prior to performing PCA. Data were further square transformed to reduce the skewness of dataset. The fraction of total variation explained by each PC is shown in **Figure 4a**, with the first two PCs accounting for approximately 80 percent [%] of the total variation in the datasets. Additionally, the quality of representation of each variable is presented in **Figure 4b**. As

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[2] Analytes included in the PCA include alkalinity, boron, calcium, pH, barium, chloride, and fluoride. The complete dataset used for PCA analysis is provided with this submission as **Attachment 5**.

illustrated in the figure, the first dimension is dominated by alkalinity, boron, and calcium, while the second dimension is dominated by fluoride, chloride, and barium.

PCA results are often visualized using biplots where samples are projected on to the first two PCs (i.e., factor scores), and factor loadings are represented as vectors. The closer the data points are on the graph, the greater the similarity in their chemical composition. The result from this study is shown on **Figure 5**, where the samples acquired from BCU are orange, UCU and UU are shades of blue, and the porewater samples are gray. The biplot suggests that porewater samples cluster relatively separately from the BCU, UCU, and UU samples. Additionally, the chemical signatures of groundwater samples from the BCU are different than combined group of UCU and UU samples, whereas the composition of upgradient samples from the UCU are similar to those from downgradient UU locations. Upgradient well 22 clusters more closely with the shallower UCU and UU wells. The PCA results indicate that the composition of the BCU groundwater samples is statistically different than that from the porewater, suggesting that the porewater is not the source of elevated lithium, chloride, and TDS to Site groundwater.

Furthermore, the factor loadings, represented as vectors on the biplot, suggest that constituents such as boron and carbonate alkalinity are responsible for the chemical signature of the porewater cluster. In contrast, chloride is one of the drivers for the distinct chemical composition of the BCU cluster.

Clustering was further explored using Ward's hierarchical clustering method, a distance measure employed in agglomerative algorithms and commonly applied in hydrogeochemical studies. The analysis was performed on a scaled and centered dataset. The results from clustering (**Figure 6**), align with findings from the PCA (**Figure 5**) and supported the distinction between porewater samples from downgradient and upgradient groundwater samples from BCU, UCU and UU. Furthermore, the distinct clustering of the BCU samples relative to the clustering of the UCU/UU samples suggests that chemical composition of groundwater samples is primarily influenced by their lithography rather than their relative locations to the CCR unit (i.e., upgradient or downgradient). These results support the conclusion that downgradient locations with lithium and chloride exceedances are not affected by the CCR unit, and their geochemistry is instead influenced by the native lithology.

SULFATE EVALUATION

Elevated sulfate concentrations have been observed in well 35D that are inconsistent with other BCU wells at the Site, as indicated by exceedances of the GWPS for sulfate at well 35D and not at other BCU wells. The PCA results shown in **Figure 5** indicate that for parameters other than sulfate (which was not included in the parameters evaluated in the PCA), the groundwater chemistry from well 35D is similar to overall bedrock groundwater chemistry. As described above and in greater detail in the Site Hydrogeologic Characterization Report (Ramboll 2021), the BCU contains a major coal seam that has been mined in the vicinity of the NEAP. Samples of this coal were collected and analyzed by Kelron and the ISGS, and XRD results indicate that the coal contains up to 10% iron sulfide, primarily pyrite and marcasite (FeS_2) (Mehnert 2002). Pyrite and especially marcasite are unstable under oxidizing conditions and will readily undergo oxidative dissolution to form dissolved iron and sulfate. This mechanism of sulfate mobilization is further supported by the observation of the iron carbonate mineral siderite ($FeCO_3$), which was described as a "needle-like white precipitate above the coal in the core" which "is undoubtedly the result of this rapid oxidation" (Mehnert 2002). Siderite is also identified in the bedrock samples collected from borings VER-35 and VER-70 at concentrations ranging from 4.9 to 5.4 weight percent (**Table 2**).

Figure 2 shows the iron thermodynamic stability diagram for the well 35D groundwater. Groundwater pH and ORP data are plotted within the iron stability field, which illustrates that under these conditions, siderite and ferrihydrite are in a state of dynamic equilibrium. The weathering of pyrite to siderite to ferrihydrite would result in an increase in aqueous sulfate concentrations.

Furthermore, strong upward vertical hydraulic gradients are present within the BCU (Kelron 2003; Ramboll 2021). While it is estimated that the coal seam is deeper than the screened interval at well 35D, an upward vertical gradient would cause sulfate generated from sulfide oxidation in the coal to influence the groundwater composition at 35D. **Figure 7** shows the locations where coal and void space were observed during exploratory drilling for the historic coal mine (Kelron 2003). In boring locations B201 and B202, artesian conditions were observed, with water geysering more than 30 feet above ground surface at an estimated flow rate of greater than 100 gallons per minute when the fractured shale was penetrated as the borings were advanced (Kelron 2003). These field observations indicate that the high hydraulic head within the coal seam can influence overlying formations.

As noted above, isotopic analyses of tritium (^3H) and radiocarbon (^{14}C) suggest that the bedrock groundwater is significantly older than the shallower groundwater at the Site (Kelron 2003). Tritium concentrations in the groundwater from the overlying unlithified deposits are between 5.3 and 5.8 tritium units and can be classified as "recent water". Tritium concentrations in the bedrock were non-detect. The age of the bedrock groundwater ranges from approximately 13,000 to 35,000 years before present as determined by radiocarbon dating. The lack of influence from recent water within the bedrock groundwater system provides further evidence that it is isolated from the shallow groundwater and that the elevated sulfate observed in 35D is due to natural variations in sulfur-bearing minerals in the bedrock.

CONCLUSION

Naturally occurring lithium, chloride, and sulfate associated with minerals in the BCU and the coal seam in the vicinity of the NEAP at the Site were identified as alternative sources of these constituents to Site groundwater. Solid-phase samples collected near compliance wells 35D and 70D contained lithium, and SEP analyses demonstrated that much of the lithium in the solid phase is associated with the fractions which correlate to primary minerals such as micas and clay minerals, as well as the fractions associated with sulfides and oxide minerals. XRD identified abundant micas and clay minerals hosted in the shale bedrock that are the source of lithium in Site groundwater. Elevated chloride concentrations in groundwater are observed in the region that originate from Pennsylvanian-aged shale bedrock and brine migration over time. Elevated sulfate concentrations at 35D are associated with the oxidative dissolution of iron sulfide minerals present in coal seams within the bedrock and transported through upward hydraulic gradients within the BCU. Advanced statistical methods demonstrate that groundwater geochemical signatures from the BCU, the UCU, and the UU are distinctly different from that of the porewater based on a combination of parameters.

The alternative source of lithium and chloride observed in wells 35D and 70D is the shale bedrock. The alternative source of sulfate observed in well 35D is the coal seams within the BCU. These elevated chloride and sulfate concentrations are the dominant contributors of elevated TDS values at 70D and 35D, respectively (VER NEAP E001 ASD). This information serves as the written ASD demonstrating that the GWPS exceedances for lithium, chloride, and TDS at well 70D and for lithium, chloride, sulfate, and TDS at 35D were not due to the NEAP CCR unit.

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TABLES

Table 1 - Lithium SEP Results Summary
Vermilion Power Plant - New East Ash Pond

Soil Boring Location		**VER-35**		**VER-35**		**VER-70**	
Sample Depth (ft bgs)		**(55-60)**		**(60-63)**		**(75-80)**	
Location		**Downgradient**		**Downgradient**		**Downgradient**	
Field Boring Log Description		**Weathered Shale**		**Highly Weathered Shale**		**Highly Weathered Shale**	
Total Lithium		42		39		42	
SEP Results							
SEP Fraction	**SEP Reagent**	**Concentration**	**% of Total**	**Concentration**	**% of Total**	**Concentration**	**% of Total**
Exchangeable Metals Fraction	$MgSO_4$	<10	--	<10	--	<11	--
Metals Bound to Carbonates Fraction	Sodium acetate, acetic acid	0.56 J	1%	0.62 J	1%	<8.3	--
Non-crystalline Materials Fraction	Ammonium oxalate (pH 3)	0.52 J	1%	0.74 J	2%	0.41 J	1%
Metals Bound to Metal Hydroxide Fraction	Hydroxylamine HCl and acetic acid	13	28%	12	27%	12	24%
Bound to Organic Material Fraction	5% sodium hypochlorite (pH 9.5)	4.1 J	9%	3.9 J	9%	4.4 J	9%
Metals Bound to Acid/Sulfide Fraction	HNO_3, HCl, and H_2O	13	28%	14	31%	15	30%
Residual Metals Fraction	HF, HNO_3, HCL, and H_3BO_3	15	33%	14	31%	19	37%
SEP Total		46.2	100%	45.3	100%	50.8	100%

Notes:
SEP - sequential extraction procedure
ft bgs - feet below ground surface
All results shown in microgram of lithium per gram of soil (µg/g).
Total lithium was analyzed using aqua regia digest, ICP-MS
Non-detect values are shown as less than the reporting limit.
The lithium fraction associated with each SEP phase is shown.
% of total lithium is calculated from the sum of the SEP fractions.

Table 2 - Summary of X-Ray Diffraction Analysis
Vermillion Power Plant - New East Ash Pond

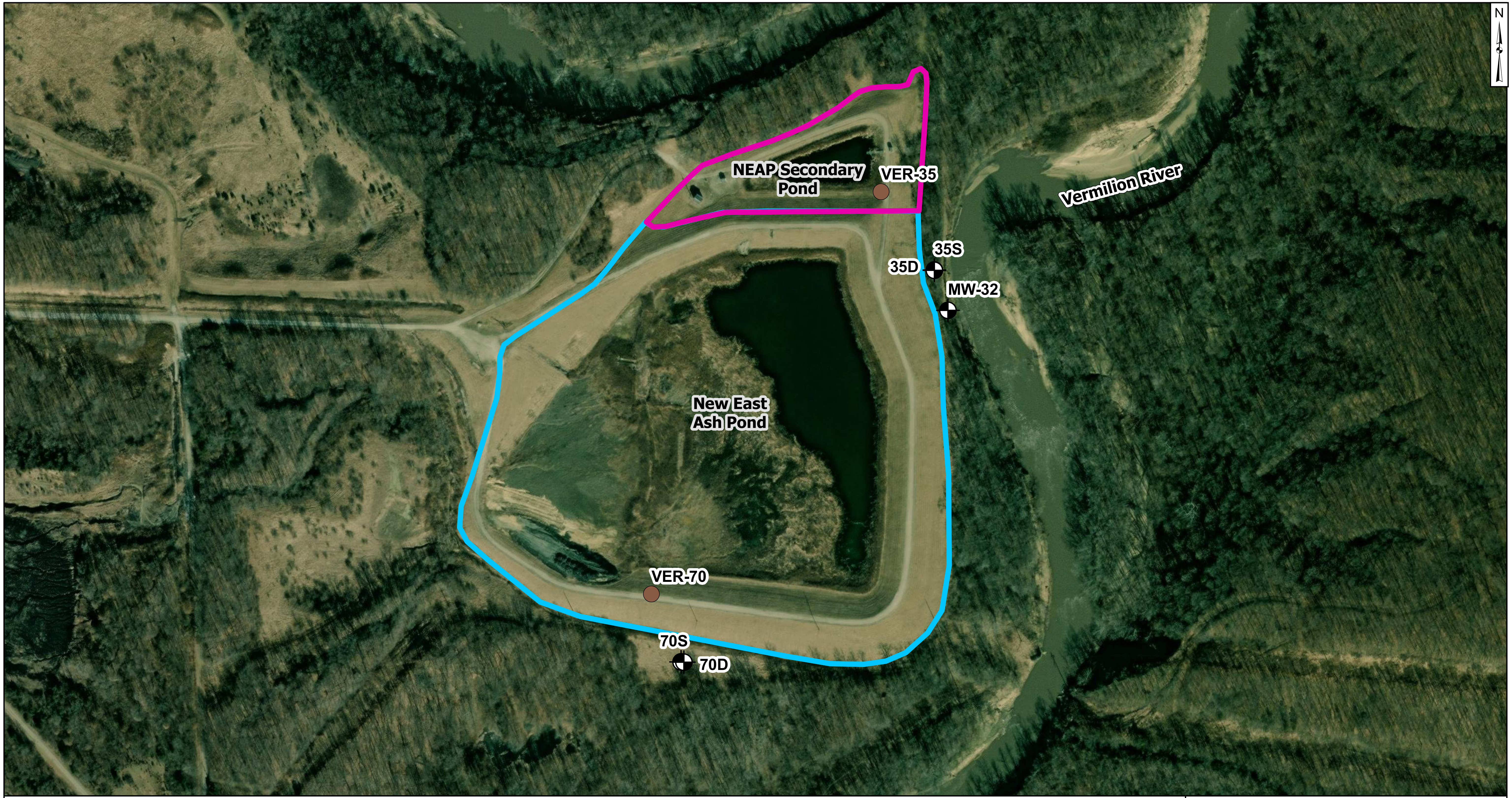
Field Boring Location			**VER-35**	**VER-35**	**VER-70**
Sample Depth (ft bgs)			**(55-60)**	**(60-63)**	**(75-80)**
Location			**Downgradient**	**Downgradient**	**Downgradient**
Field Boring Log Description			**Weathered Shale**	**Highly Weathered Shale**	**Highly Weathered Shale**
Mineral/Compound	**Formula**	**Mineral Type**	**(wt %)**	**(wt %)**	**(wt %)**
Quartz	SiO_2	Silicate	38.5	38.1	35.0
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	Mica	23.4	23.0	27.0
Albite	$NaAlSi_3O_8$	Feldspar	12.6	12.6	11.5
Illite	$K(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)_2$	Clay	7.1	8.0	5.2
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	Clay	6.9	6.8	7.7
Kaolinite	$Al_2Si_2O_5(OH)_4$	Clay	5.6	5.4	7.5
Siderite	$FeCO_3$	Carbonate	4.9	5.0	5.4
Microcline	$KAlSi_3O_8$	Feldspar	1.0	1.1	0.70
Clay Minerals Total			19.6	20.2	20.4
Clays + Muscovite Total			43.0	43.2	47.4

Notes

Sample depth is shown in feet below ground surface (ft bgs).

wt %: percentage by weight

FIGURES



Legend

⊕ Monitoring Well

● Boring Location

🟦 New East Ash Pond (NEAP)

🟪 NEAP Secondary Pond

Notes

- Soil boring locations are approximate.
- Only select monitoring well locations are shown.
- Ash pond boundaries are approximate.

250 125 0 250
Feet

Boring Locations

Dynegy Midwest Generation
Vermilion Site
Oakwood, Illinois

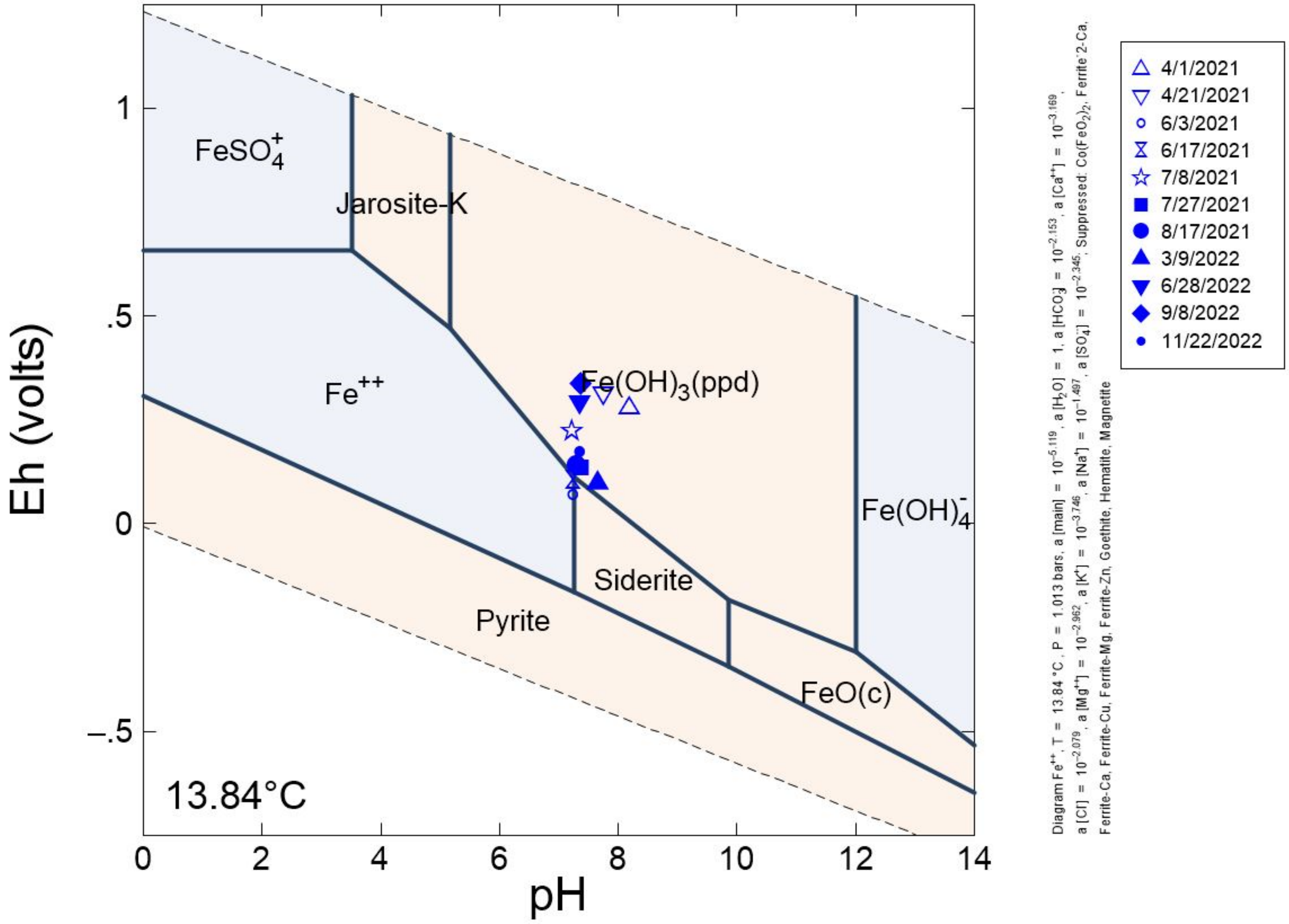
Geosyntec
consultants

Columbus, Ohio

October 2023

Figure
1

Y:\Company\Projects_post_2014\CHE8404_VPS_Closure_RIA_Sprt\500 - Technical\572 - MNA and GSI Evaluation\GIS\MXDs\20231020_Figure 1-Boring_Locations.mxd. ASoltero. 10/20/2023. Project/Phase/Task.



Notes:
1. Iron stability diagram with groundwater sampling results from well 35D.
2. Activities of constituents were calculated from average values for well 35D groundwater.
Fe – iron, pyrite – FeS_2, siderite – $FeCO_3$, $Fe(OH)_3$(ppd) – precipitated ferrihydrite, Eh – oxidation reduction potential (converted from field measurements using + 0.2 volts)

Well 35D Iron Stability Diagram

Vermilion Power Plant – New East Ash Pond

Geosyntec consultants

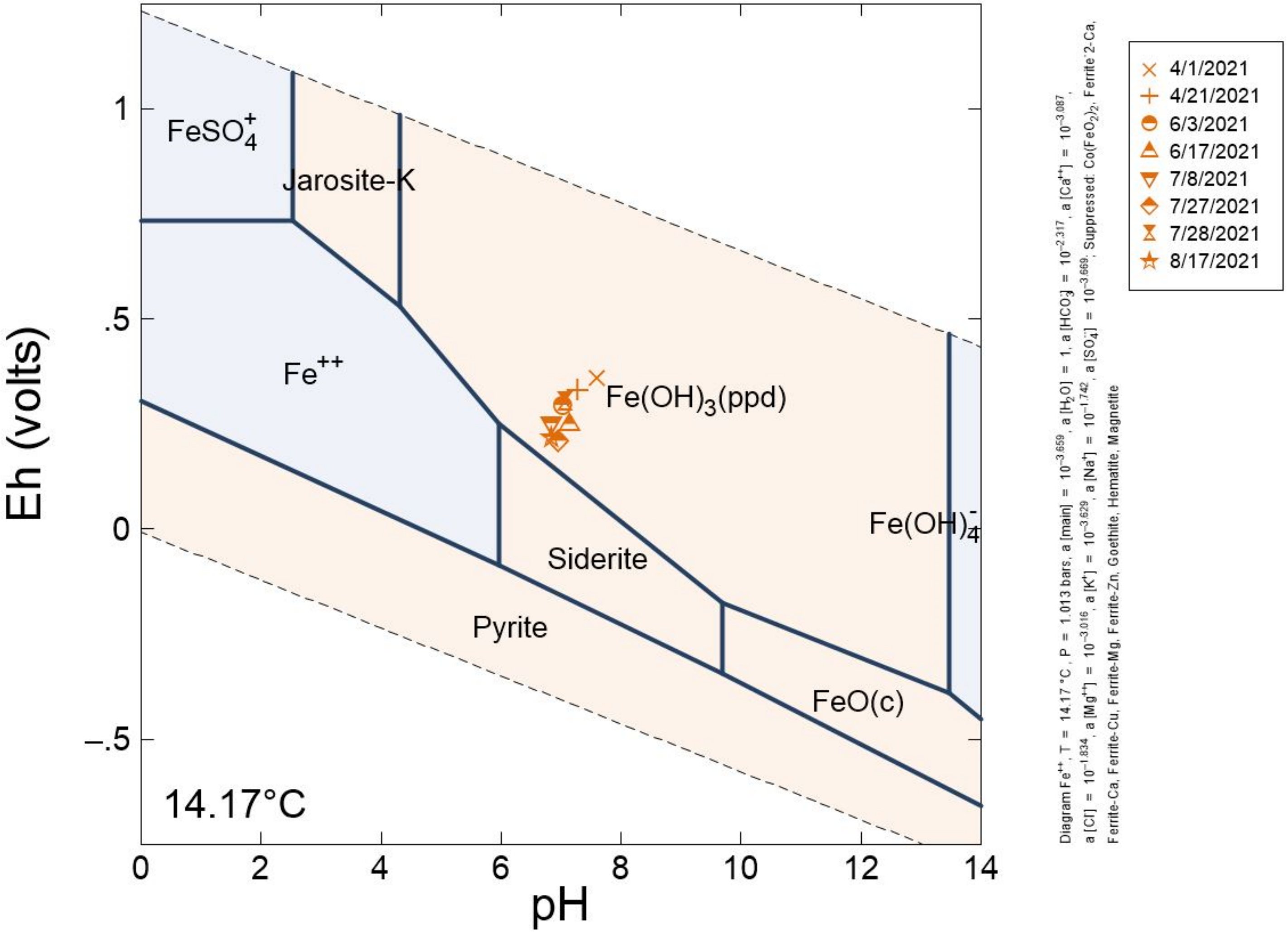
Figure

2

Columbus, Ohio

October 2023

Vistra - Groundwater Compliance - Documents\General\2023_Data_Gap_Assessment\Baldwin\2023-09 CI and F ASD Report



Notes:
1. Iron stability diagram with groundwater sampling results from well 70D.
2. Activities of constituents were calculated from average values for well 70D groundwater.
Fe – iron, pyrite – FeS_2, siderite – $FeCO_3$, $Fe(OH)_3$(ppd) – precipitated ferrihydrite, Eh – oxidation reduction potential (converted from field measurements using + 0.2 volts)

Well 70D Iron Stability Diagram

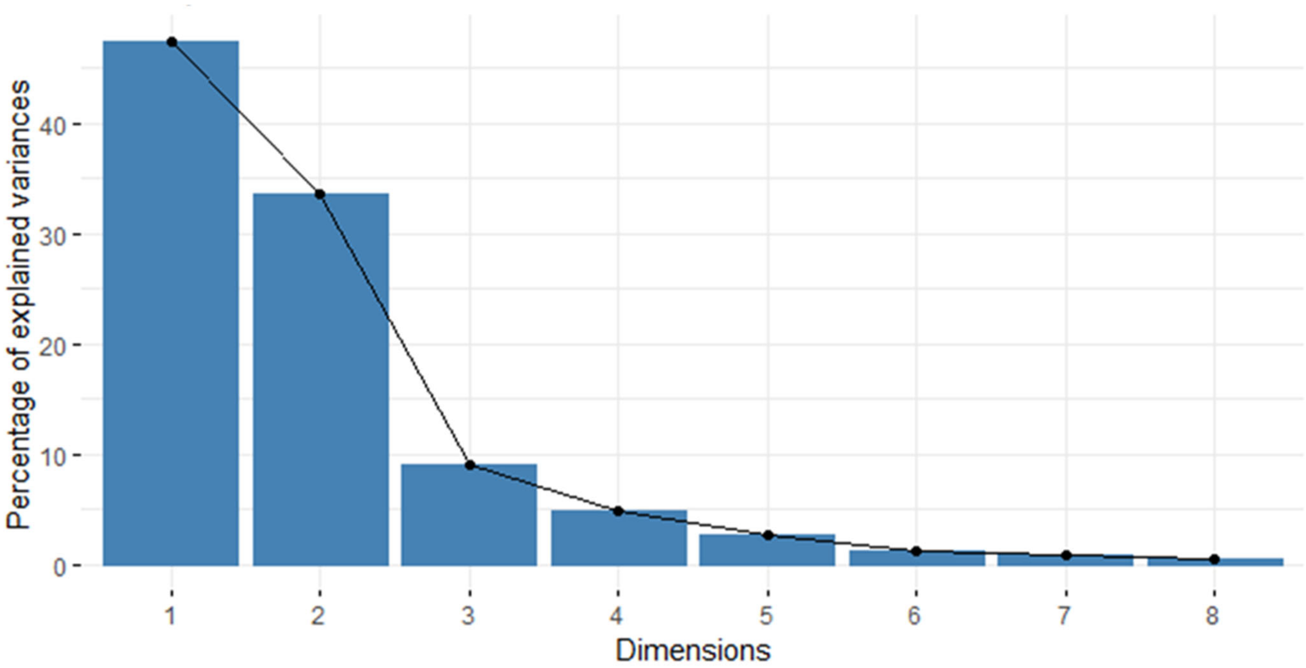
Vermilion Power Plant – New East Ash Pond

Geosyntec consultants

Columbus, Ohio

October 2023

Figure
3



Notes:
1. Samples collected from upgradient wells 10 and 22, downgradient wells 70S, 71S, 16, 35D, 70D, and 71D, and porewater well NED1 were included in the evaluation.

PCA Analysis - Quality of Representation of Principal Components

Vermilion Power Plant – New East Ash Pond

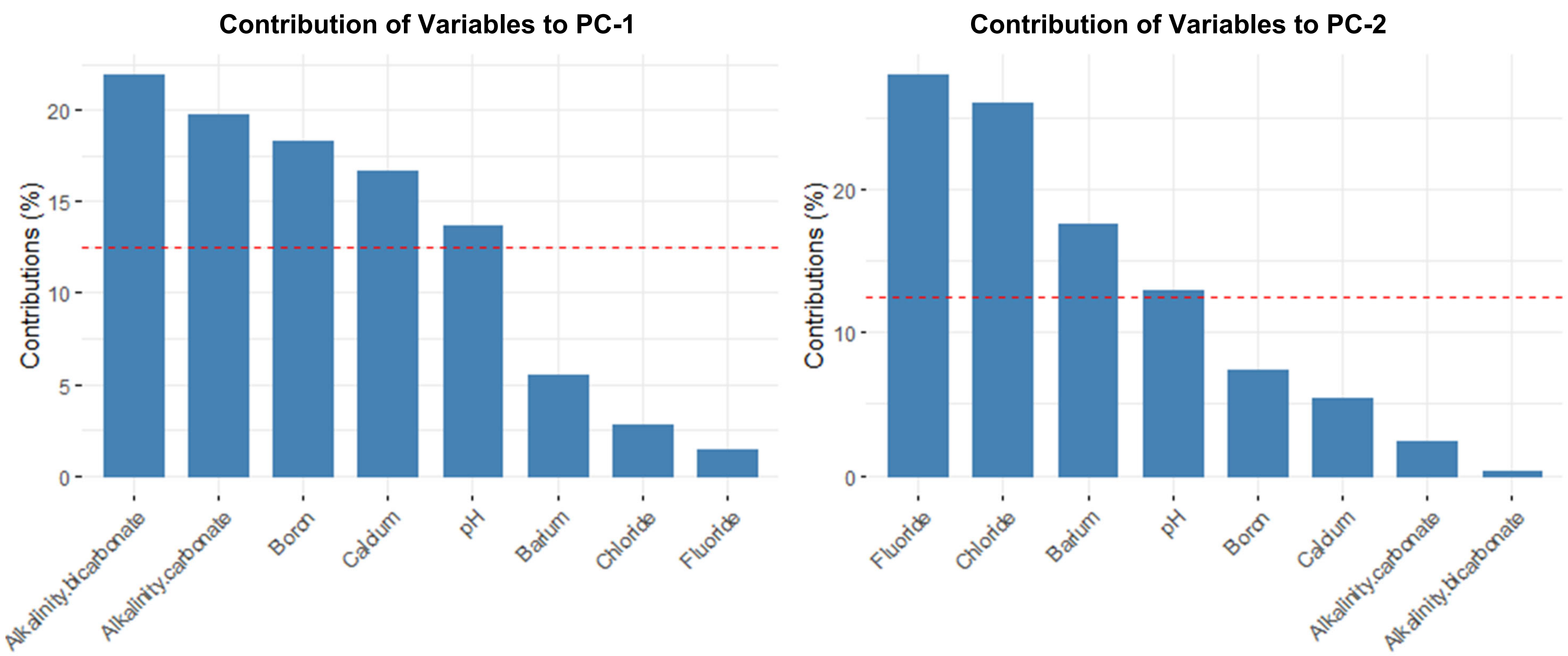
Geosyntec consultants

Figure

4a

Columbus, Ohio

October 2023



Notes:

1. The dashed red line represents the anticipated value for uniform contribution. The constituents with a contribution exceeding the reference line are considered significant in its contribution to each PC (principal component).

Contribution of Variables to First Two Principal Components

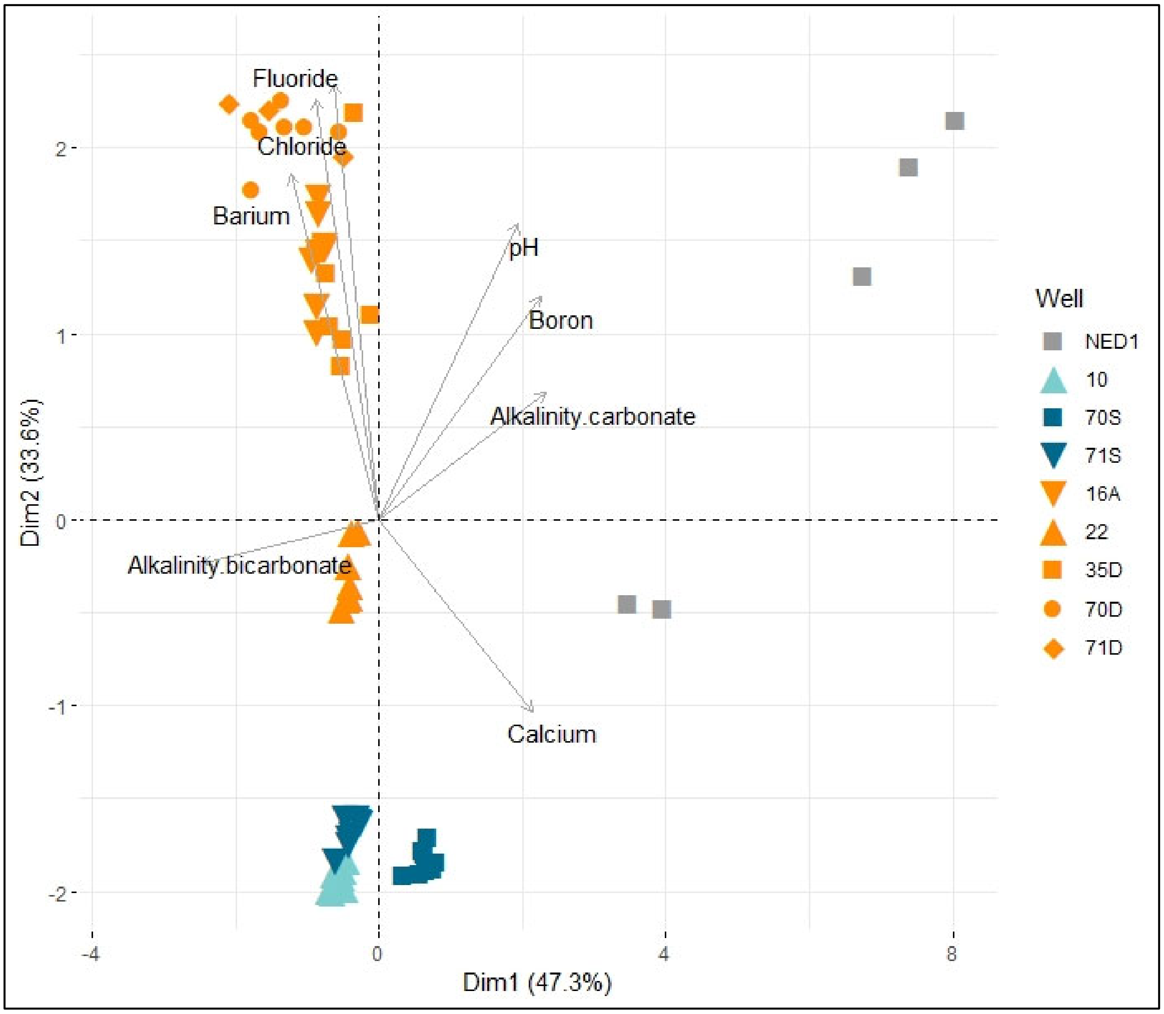
Vermilion Power Plant – New East Ash Pond

Columbus, Ohio

October 2023

Figure

4b



Notes:
1. The arrows signify the correlations between the constituents and the principal components.
2. Datapoints are colored based on hydrostratigraphic unit of sampling locations as follows:
   - -Bedrock Confining Unit (BCU) wells: 16A, 22, 35D, 70D, 71D,
   - -Upper Confining Unit (UCU) well: 10
   - -Upper Unit (UU) wells: 70S, 71S
   - -Coal Combustion Residual (CCR) well: NED

Principal Component Analysis Biplot

Vermilion Power Plant – New East Ash Pond

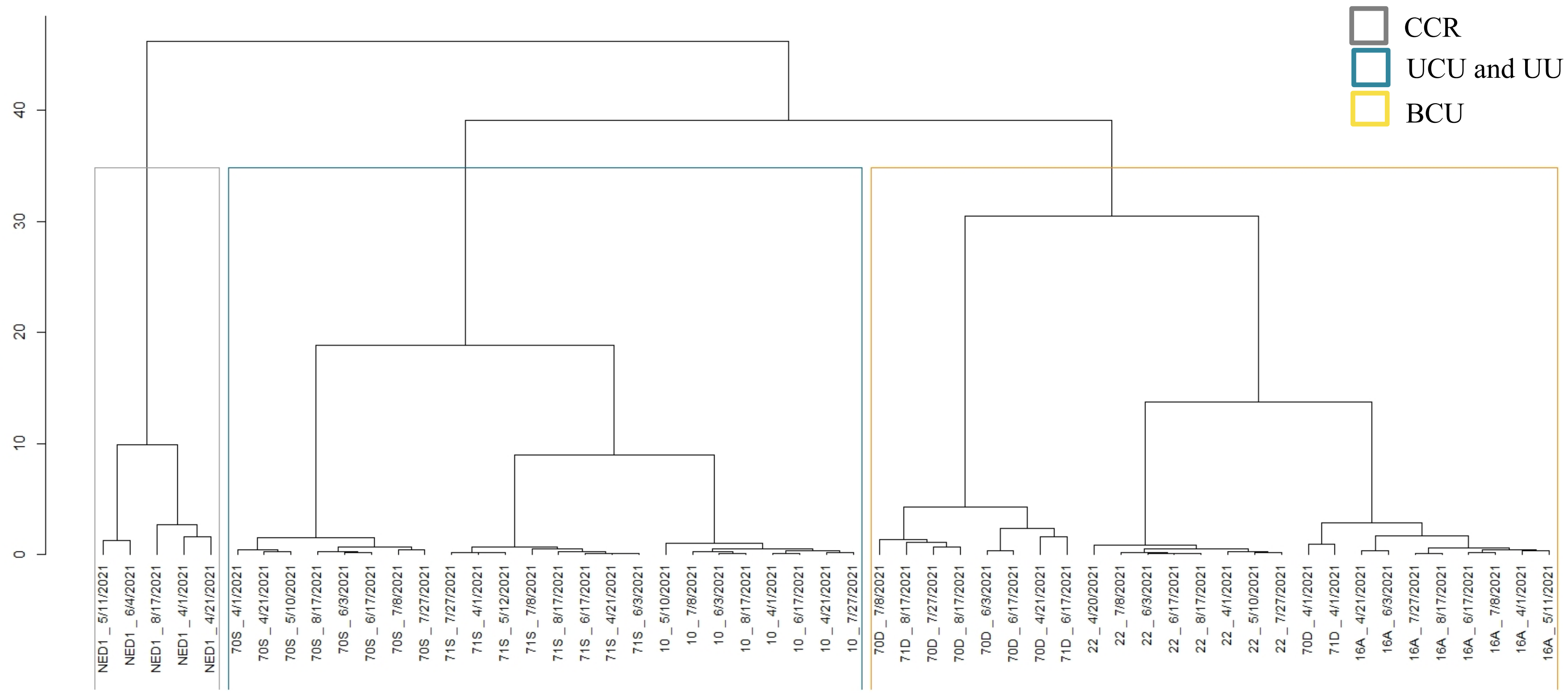
Geosyntec consultants

Figure

5

Columbus, Ohio

October 2023



Notes:

1. The cluster analysis used Euclidean distances as the similarity measure and Ward's method as the clustering algorithm.
2. BCU, CCR, UCU and UU refer to Bedrock Confining Unit, Coal Combustion Residual, Upper Confining Unit, and Upper Unit, respectively.

Dendrogram Graph from Cluster Analysis

Vermilion Power Plant – New East Ash Pond

Geosyntec consultants

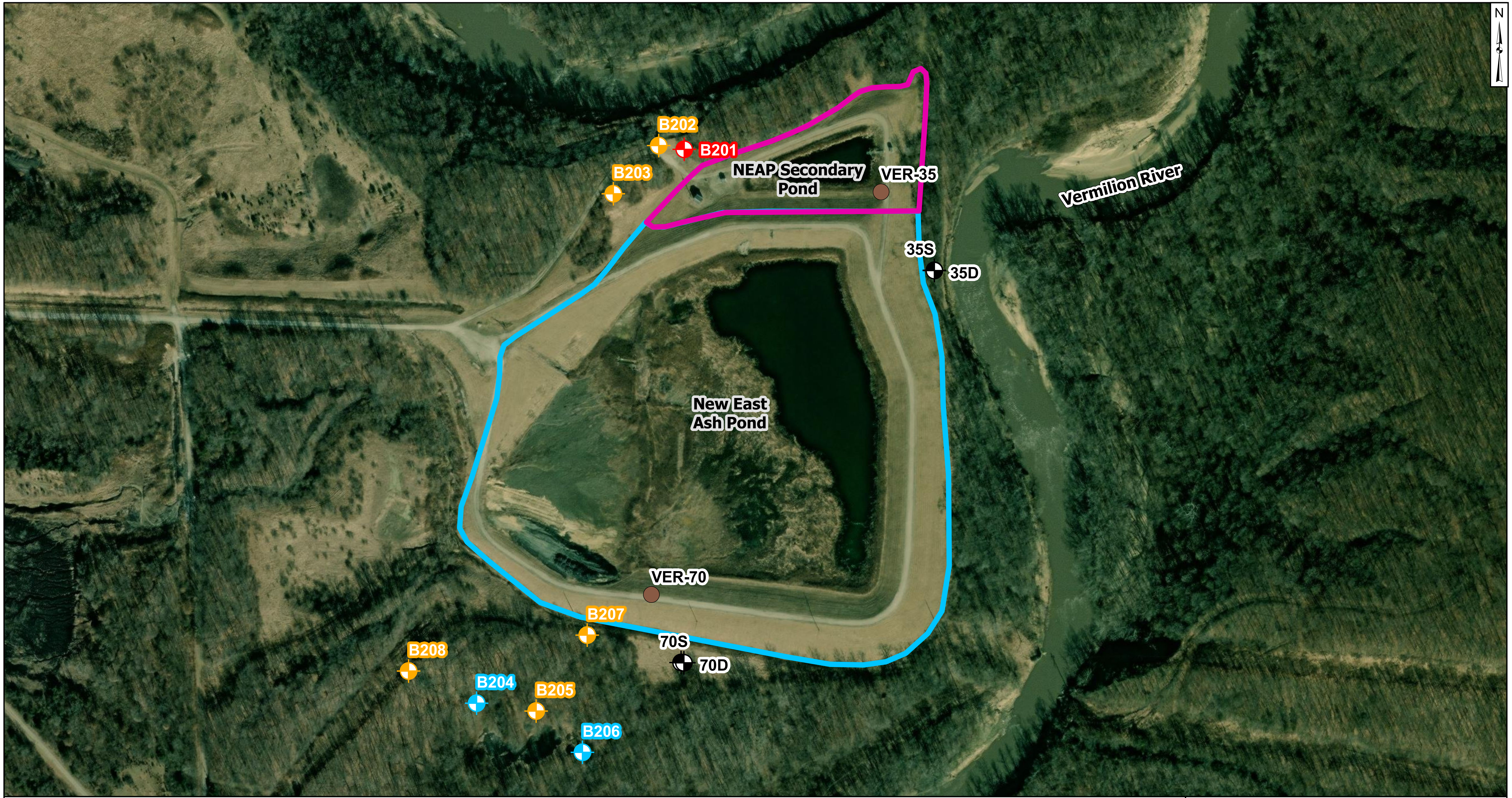
Figure

6

Columbus, Ohio

October 2023

Vistra - Groundwater Compliance - Documents\General\2023_Data_Gap_Assessment\Baldwin\2023-09 CI and F ASD Report



Legend

2001 borings which identified:

- Coal
- Void Space
- Coal & Void Space
- Monitoring Well
- ● Boring Location
- New East Ash Pond (NEAP)
- NEAP Secondary Pond

Notes

- Soil boring locations are approximate.
- Ash pond boundaries are approximate.

Coal and Void Locations

Dynegy Midwest Generation
Vermilion Site
Oakwood, Illinois

Geosyntec
consultants

Columbus, Ohio
October 2023

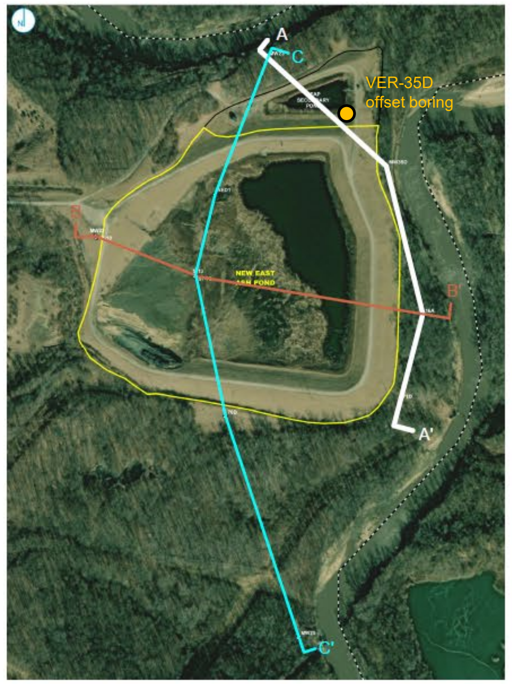
Figure
7

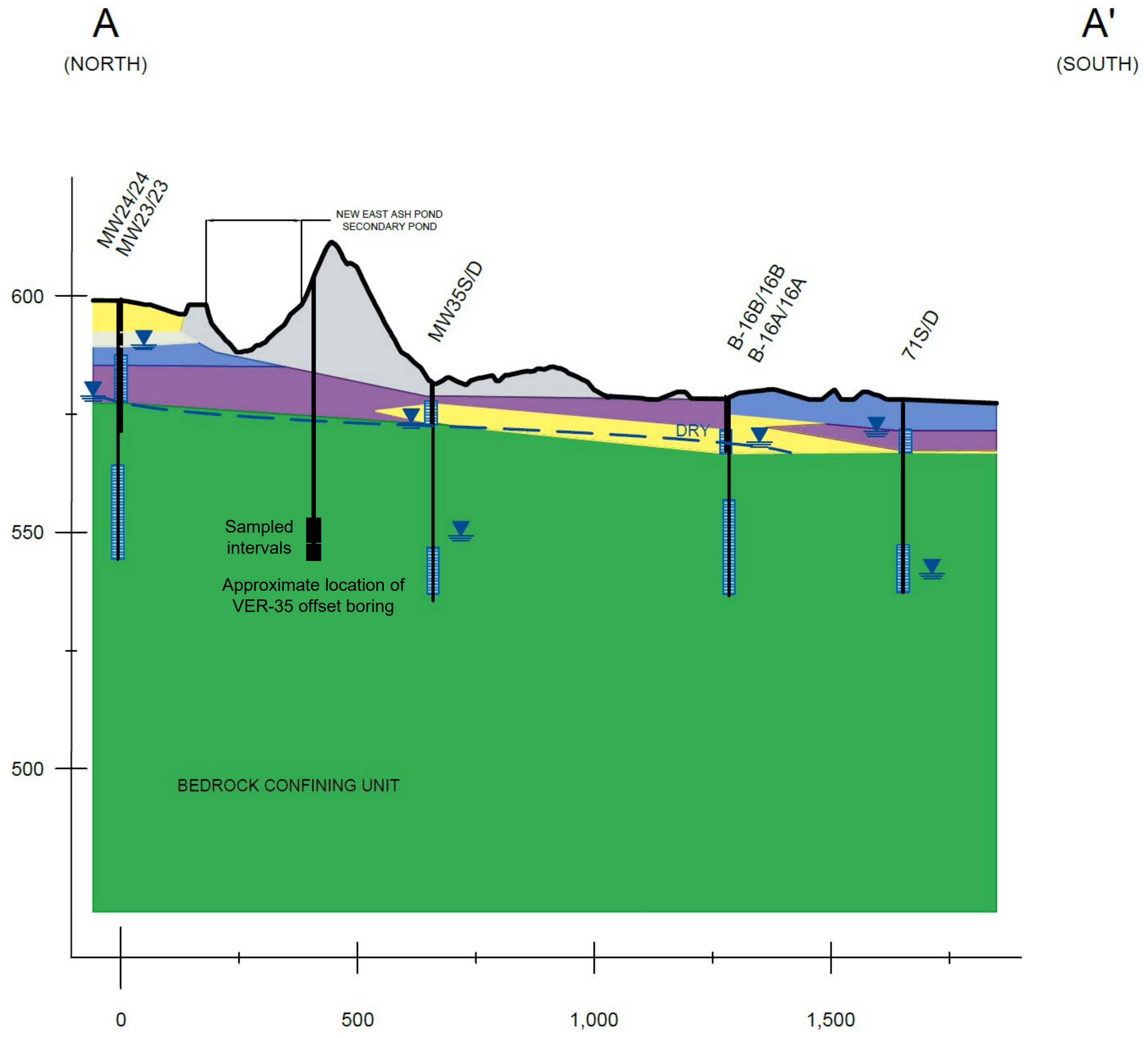
Y:\Company\Projects_post_2014\CHE8404_VPS_Closure_RIA_Sprt\500 - Technical\572 - MNA and GSI Evaluation\GIS\MXDs\20231020_Figure 1-Coal_Locations.mxd. ASoltero. 10/20/2023. Project/Phase/Task.

ATTACHMENT 1

Cross Sections

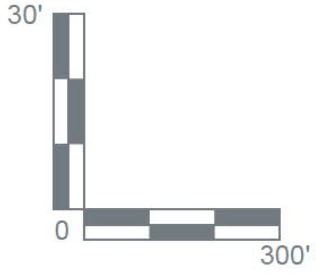
\\ramboll.sharepoint.com@SSL\DavWWWRoot\sites\vistra\Shared Documents\CCR GW Deliverables\Part 845 Operating Permits\Sites\Vermilion\Hydrogeo Report\NEAP HCR\Figures\working files\CAD\Cross Sections\Vermilion-NEAP-Cross Sections.dwg
PROJECT: 1940100806 | DATED: 10/12/2021 | DESIGNER: ENGELHSA





NOTES

1. This profile was developed by interpolation between widely spaced boreholes. Only at the borehole location should it be considered as an approximately accurate representation and then only to the degree implied by the notes on the borehole logs.
2. Scale is approximate.
3. Vertical scale is exaggerated 10X.
4. Groundwater elevations measured on March 29, 2021.
5. PMP = Potential Migration Pathway



LEGEND

⬜	FILL
🟪	CLAY (CL/CH)
⬜	TILL (CL/CH)
🟦	SILT (ML)
🟨	SAND (SP/SM/SW)
⬜	GRAVEL (GP/GW)
🟩	BEDROCK / WEATHERED BEDROCK (INTERBEDDED SHALE, LIMESTONE, SANDSTONE, V. LITTLE SS)
▤	WELL SCREEN INTERVAL
- - -	BEDROCK CONFINING UNT POTENTIOMETRIC SURFACE
▼	BEDROCK CONFINING UNIT / PMP GROUNDWATER / OTHER GROUNDWATER / SURFACE WATER ELEVATION(S)

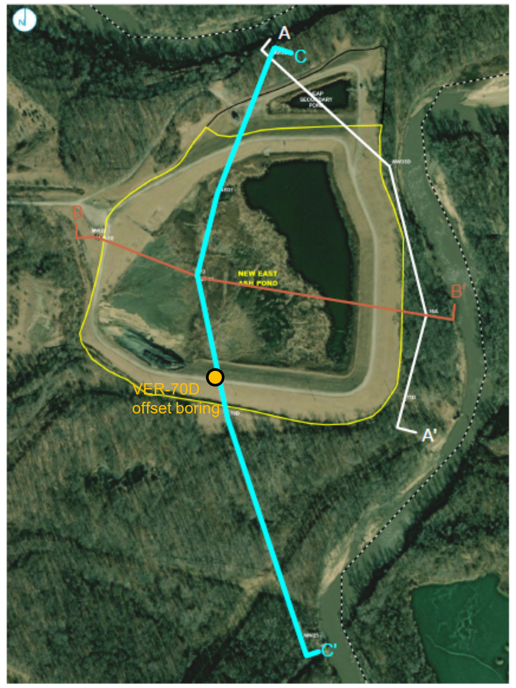
GEOLOGIC CROSS SECTION
A-A'

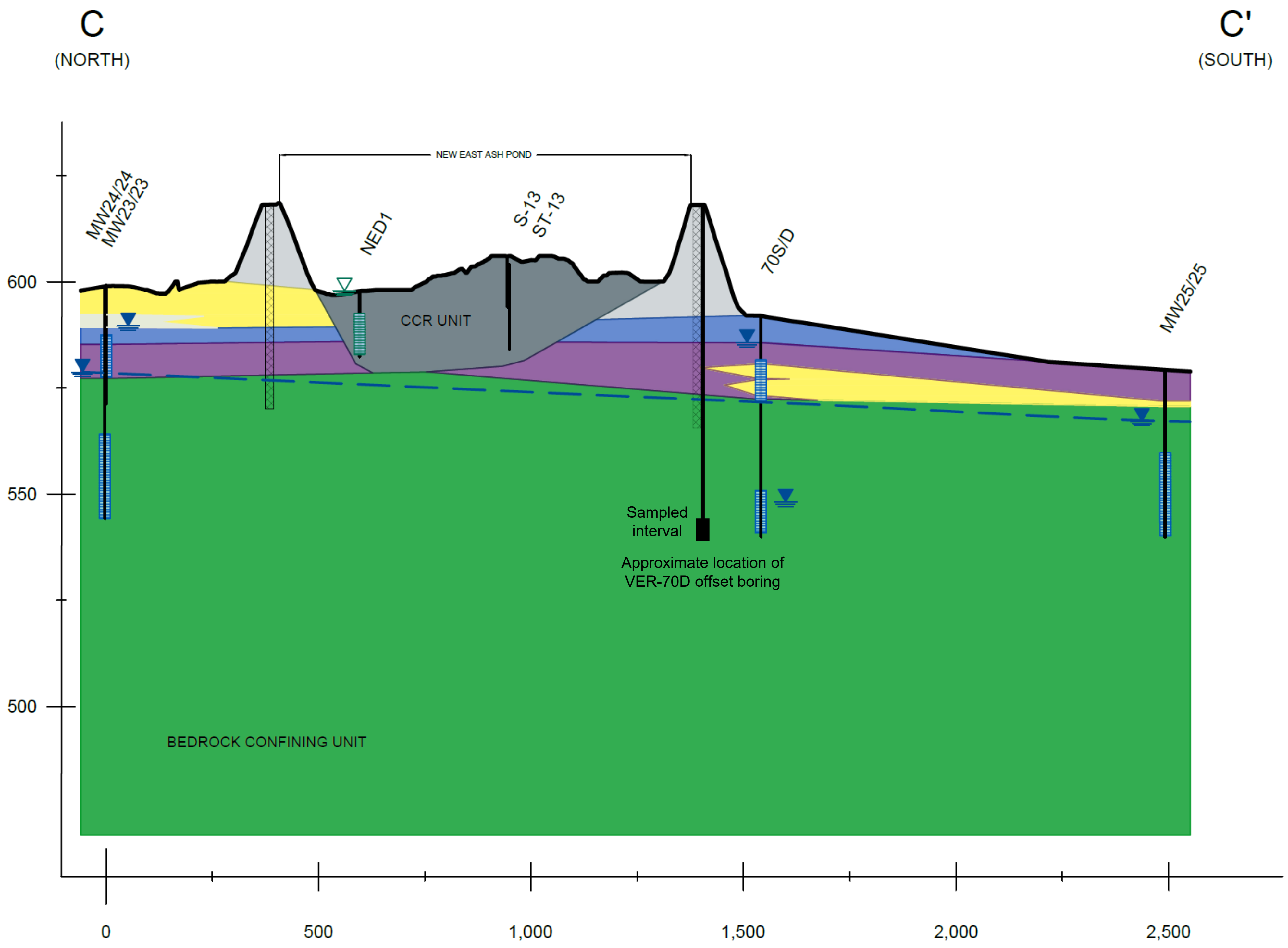
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
NEW EAST ASH POND
VERMILION POWER PLANT
OAKWOOD, ILLINOIS

FIGURE 2-9

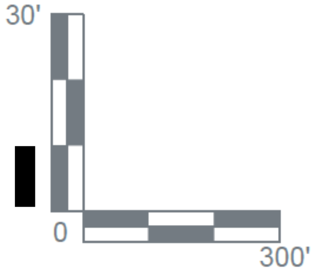
RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

\\ramboll.sharepoint.com@SSL\DavWWWRoot\sites\vista\Shared Documents\CCR GW\Deliverables\Part 845 Operating Permits\Sites\Vermilion\Hydrogeo Report\NEAP HCR\Figures\working files\CAD\Cross Sections\Vermilion-NEAP-Cross Sections.dwg
PROJECT: 1940100806 DATED: 10/12/2021 DESIGNER: ENGELHSA





NOTES
1. This profile was developed by interpolation between widely spaced boreholes. Only at the borehole location should it be considered as an approximately accurate representation and then only to the degree implied by the notes on the borehole logs.
2. Scale is approximate.
3. Vertical scale is exaggerated 10X.
4. Groundwater elevations measured on March 29, 2021.
5. PMP = Potential Migration Pathway



LEGEND

▇	COAL COMBUSTION RESIDUALS (CCR)
▇	FILL
▇	CLAY (CL/CH)
▇	TILL (CL/CH)
▇	SILT (ML)
▇	SAND (SP/SM/SW)
▇	GRAVEL (GP/GW)
🟩	BEDROCK / WEATHERED BEDROCK (INTERBEDDED SHALE, LIMESTONE, SANDSTONE, V. LITTLE SS)
▤	WELL SCREEN INTERVAL
– –	BEDROCK CONFINING UNT POTENTIOMETRIC SURFACE
▽	POREWATER ELEVATION
▼	BEDROCK CONFINING UNIT / PMP GROUNDWATER / OTHER GROUNDWATER / SURFACE WATER ELEVATION(S)
▨	CLAY CORE KEYED 8-FT INTO BEDROCK

GEOLOGIC CROSS SECTION
C-C'

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
NEW EAST ASH POND
VERMILION POWER PLANT
OAKWOOD, ILLINOIS

FIGURE 2-11

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

ATTACHMENT 2

Boring Logs - VER-35 and VER-70

Soil Boring and Well Construction Logs - 35D and 70D

Geosyntec consultants
engineers | scientists | innovators

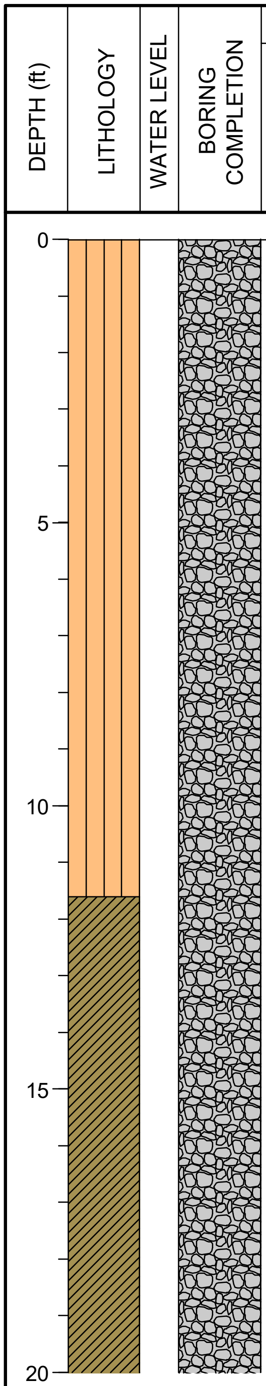
Client: Vistra
Project: Vermilion Power Plant New East Ash Pond
Address: 10188 East 2150 North Road, Oakwood, IL

BORING LOG

Boring No. VER-35
Page: 1 of 4

Drilling Start Date:	**06/24/2023**	Boring Depth (ft):	**63**
Drilling End Date:	**06/24/2023**	Boring Diameter (in):	**6**
Drilling Company:	**Cascade Drilling**	Ground Surface Elev. (ft):	**Not surveyed**
Drilling Method:	**Sonic**		
Drilling Equipment:	**Geoprobe**		
Driller:	**Jeff Jehn**		
Logged By:	**Andrew Kelley**		

Boring was advanced adjacent to well 35D.
Samples collected from 55-60 ft bgs and 60-63 ft bgs



COLLECT				
Sample Type	Date & Time	Blow Counts	Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION
	10:35	NA	5.1/ 10	(0') GRAVELLY SILT (ML); light gray to brown (darkens downward), dry, loose, little sand, minor concretions.
				(3') CLAYEY SILT (ML); dark reddish brown, moist, firm, some black organics staining, few gravel, minor iron oxide stains.
	10:45		2.5/ 10	(10') As above.
				(10.6') GRAVELLY SILT (ML); light gray to brown, moist, loose, fine to coarse gravel, little sand.
				(11.6') SILTY CLAY (CL); dark grayish brown, moist, stiff, medium plasticity.

NOTES:

Geosyntec consultants
engineers | scientists | innovators

Client: Vistra
Project: Vermilion Power Plant New East Ash Pond
Address: 10188 East 2150 North Road, Oakwood, IL

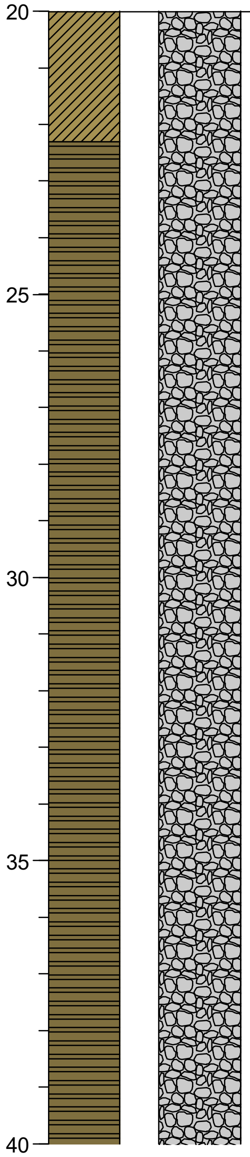
BORING LOG

Boring No. VER-35
Page: 2 of 4

Drilling Start Date: **06/24/2023**
Drilling End Date: **06/24/2023**
Drilling Company: **Cascade Drilling**
Drilling Method: **Sonic**
Drilling Equipment: **Geoprobe**
Driller: **Jeff Jehn**
Logged By: **Andrew Kelley**

Boring Depth (ft): **63**
Boring Diameter (in): **6**
Ground Surface Elev. (ft): **Not surveyed**

Boring was advanced adjacent to well 35D.
Samples collected from 55-60 ft bgs and 60-63 ft bgs



DEPTH (ft)	Sample Type	Date & Time	Blow Counts	Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION
20		10:55	NA	8/8	(20') CLAY (CL); gray to light brown, moist, very soft, trace coarse gravel, high plasticity.
22.3					(22.3') WEATHERED SHALE, gray, moist, highly decomposed, moderately disintegrated.
28				2/2	(28') As above.
30		11:55		8/10	(30') SHALE, gray, wet, highly decomposed, slightly disintegrated.
35.3					(35.3') WEATHERED SHALE, gray, moist, highly decomposed, highly disintegrated.

NOTES:

Geosyntec consultants engineers | scientists | innovators	**Client:** Vistra **Project:** Vermilion Power Plant New East Ash Pond **Address:** 10188 East 2150 North Road, Oakwood, IL	**BORING LOG** **Boring No.** **VER-35** **Page:** **3 of 4**

Drilling Start Date: **06/24/2023**
Drilling End Date: **06/24/2023**
Drilling Company: **Cascade Drilling**
Drilling Method: **Sonic**
Drilling Equipment: **Geoprobe**
Driller: **Jeff Jehn**
Logged By: **Andrew Kelley**

Boring Depth (ft): **63**
Boring Diameter (in): **6**
Ground Surface Elev. (ft): **Not surveyed**
Boring was advanced adjacent to well 35D.
Samples collected from 55-60 ft bgs and 60-63 ft bgs

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT				SOIL/ROCK VISUAL DESCRIPTION
				Sample Type	Date & Time	Blow Counts	Recovery (ft)	
40					12:10	NA	2/2	(40') As above.
					13:20		4/5	(42') WEATHERED SHALE, gray, moist, highly decomposed, highly disintegrated.
45								
					13:40		3.3/4	(47') As above.
50								
					14:05		3/4	(51') As above: slightly decomposed, competent at 1.5-1.6 ft.
55					14:20		4/5	(55') As above: slightly less weathered.
60								

NOTES:

Client: Vistra Project: Vermilion Power Plant New East Ash Pond Address: 10188 East 2150 North Road, Oakwood, IL		**BORING LOG** **Boring No. VER-35** **Page: 4 of 4**

Drilling Start Date:	**06/24/2023**	Boring Depth (ft):	**63**
Drilling End Date:	**06/24/2023**	Boring Diameter (in):	**6**
Drilling Company:	**Cascade Drilling**	Ground Surface Elev. (ft):	**Not surveyed**
Drilling Method:	**Sonic**	Boring was advanced adjacent to well 35D. Samples collected from 55-60 ft bgs and 60-63 ft bgs	
Drilling Equipment:	**Geoprobe**		
Driller:	**Jeff Jehn**		
Logged By:	**Andrew Kelley**		

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT				SOIL/ROCK VISUAL DESCRIPTION
				Sample Type	Date & Time	Blow Counts	Recovery (ft)	
60	▤		▨		14:50	NA	2/3	(60') As above: gray, moist, highly decomposed, highly disintegrated, few fragments are slightly more competent.
								(63') End of Boring.
65								

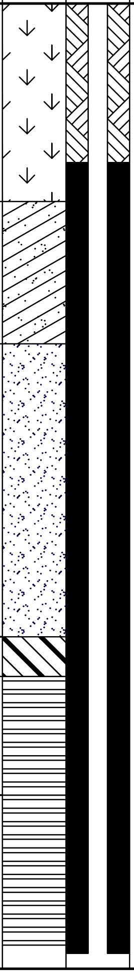
NOTES:

NATURAL RESOURCE TECHNOLOGY

SOIL BORING LOG INFORMATION

Page 1 of 3

Facility/Project Name: Vermilion Power Station
License/Permit/Monitoring Number:
Boring Number: MW35D
Boring Drilled By: Name of crew chief (first, last) and Firm: Bruno Williamson, Ramsey Geotechnical Engineering
Date Drilling Started: 3/1/2017
Date Drilling Completed: 3/3/2017
Drilling Method: rotary/auger
Common Well Name: MW35D
Final Static Water Level: Feet (NAVD88)
Surface Elevation: 581.25 Feet (NAVD88)
Borehole Diameter: 7.3 inches
Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 1,279,955.58 N, 1,151,276.17 E [✓ E]/W
1/4 of 1/4 of Section , T N, R
Lat 40° 10'47.14212"
Long 87° 44' 8.06652"
Local Grid Location: Feet ☐ N ☐ S Feet ☐ E ☐ W
Facility ID:
County: Vermilion
State: IL
Civil Town/City/ or Village: Danville



Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24 16.5	2 2 3 3		0 - 2.5' **FILL, SILT:** ML, very dark grayish brown (10YR 3/2), 15-30% silt, trace wood and roots, cohesive, low plasticity, moist.	(FILL) ML									
			1											
2 SS	24 19	1 3 3 3	2											
				2.5 - 4.3' **SANDY LEAN CLAY:** s(CL), weak red (2.5YR 4/2), 5-15% fine sand, sand content increasing with depth, low plasticity, moist.	s(CL)									
			3											
3 SS	24 21	2 3 4 3	4											
				4.3 - 8' **POORLY-GRADED SAND:** SP, yellowish brown (10YR 5/6), fine sand, 15-30% clay, moist. 5.1' trace clay.	SP									
			5											
4 SS	24 18	3 3 3 3	6											Auger bringing up cobbles on flights.
			7	7.5' trace gravel and cobbles.										
5 SS	24 10	3 4 4 22	8	8 - 8.5' **FAT CLAY:** CH, very dark grayish brown (10YR 3/2), trace silt, high plasticity, moist.	CH				0.5					
			9	8.5 - 10' **Weathered SHALE Bedrock** BDX (SH), very dark grayish brown (10YR 3/2) to very dark greenish gray (GLEY 1 3/10Y), highly weathered, red (7.5YR 4/6) discoloration, fissile, moist.	BDX (SH)									
6 SS	15 15	20 34 50 for 3"	10	10 - 15.6' **Weathered SHALE Bedrock** to **SHALE:** BDX (SH), gray (GLEY 1 6/N), weak, fissile, intensely fractured, red (7.5YR 4/6) discoloration, dry.	BDX (SH)									
			11											
			12											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm Natural Resource Technology
234 W. Florida St., Fifth Floor, Milwaukee, WI 53204
Tel: (414) 837-3607
Fax: (414) 837-3608

Template: ILLINOIS BORING LOG - Project: 2411 GINT 2017.GPJ

NATURAL RESOURCE TECHNOLOGY

SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number MW35D

Page 2 of 3

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
7 SS	8 9	45 50 for 2"	13	10 - 15.6' **Weathered SHALE Bedrock** to **SHALE:** BDX (SH), gray (GLEY 1 6/N), weak, fissile, intensely fractured, red (7.5YR 4/6) discoloration, dry. *(continued)*	BDX (SH)									
8 SS	9 7	31 50 for 3"	14 15											
9 CORE	120 120		16 17 18 19 20 21 22 23 24 25	15.6 - 45.8' **SHALE:** BDX (SH), dark reddish gray (10YR 4/1) to gray (2.5Y 5/1), microcrystalline, thinly bedded to laminated, weak, slightly decomposed (very dark gray (10YR 3/1) to black (10YR 2/1) discoloration in partly healed fractures), competent, dry to moist in fractures.	BDX (SH)									Core 9, RQD = 89%. Light brown gray return water. 4" diameter outer casing set from 0-16 ft bgs.
10 CORE	131.3 120		26 27 28 29 30 31 32	25.6' partly to totally healed fractures.										Core 10, RQD = 89%. Light gray return water.

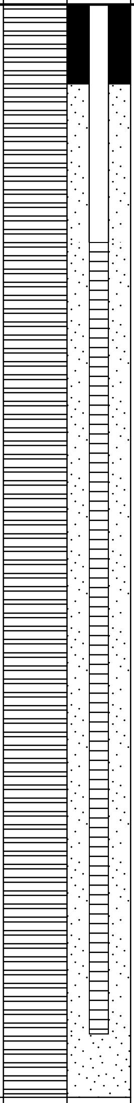
NATURAL RESOURCE TECHNOLOGY

SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number MW35D

Page 3 of 3

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties Compressive Strength (tsf)	Soil Properties Moisture Content	Soil Properties Liquid Limit	Soil Properties Plasticity Index	Soil Properties P 200	RQD/ Comments
			33	15.6 - 45.8' **SHALE:** BDX (SH), dark reddish gray (10YR 4/1) to gray (2.5Y 5/1), microcrystalline, thinly bedded to laminated, weak, slightly decomposed (very dark gray (10YR 3/1) to black (10YR 2/1) discoloration in partly healed fractures), competent, dry to moist in fractures. *(continued)*										
			34											
			35											
			36											
11 CORE	111.1 120		37											Core 11, RQD = 93%. Gray return water.
			38											
			39		BDX (SH)									
			40											
			41											
			42	41.9' - 43' crossbedding.										
			43											
			44											
			45											
				45.8' End of Boring.										



NATURAL RESOURCE TECHNOLOGY

MONITORING WELL CONSTRUCTION

Facility/Project Name: Vermilion Power Station

Local Grid Location of Well: ______ft. ☐ N. ☐ S. ______ft. ☐ E. ☐ W.

Well Name: MW35D

Facility License, Permit or Monitoring No.

Local Grid Origin ☐ (estimated: ☐) or Well Location ☒

Lat. 40° 10' 47.142" Long. 87° 44' 8.067" or

Facility ID

St. Plane 1,279,955.58 ft. N, 1,151,276.17 ft. E. [✓ E]/W

Date Well Installed: 03/03/2017

Section Location of Waste/Source

____1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E ☐ W

Type of Well: mw

Well Installed By: (Person's Name and Firm)

Bruno Williamson

Ramsey Geotechnical Engineering

Distance from Waste/ Source ____ ft.

State: IL

Location of Well Relative to Waste/Source

u ☐ Upgradient s ☐ Sidegradient

d ☐ Downgradient n ☐ Not Known

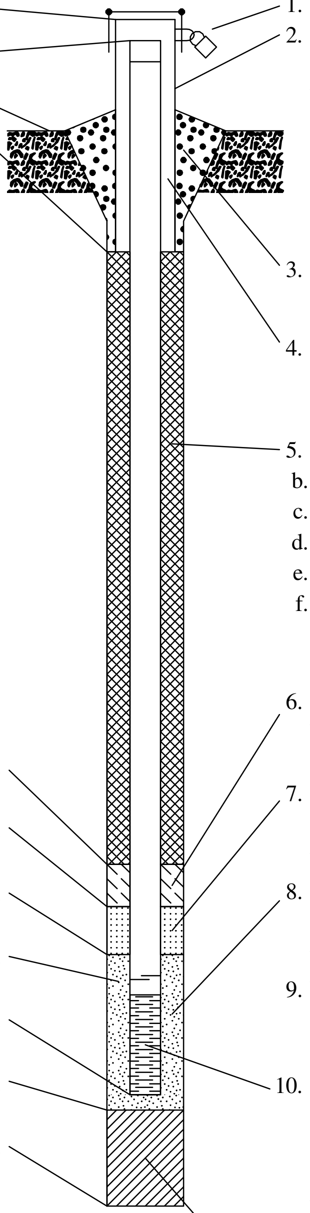
Gov. Lot Number ______

A. Protective pipe, top elevation ______ ft. MSL

B. Well casing, top elevation 584.15 ft. MSL

C. Land surface elevation 581.25 ft. MSL

D. Surface seal, bottom 579.3 ft. MSL or 2.0 ft.



12. USCS classification of soil near screen:

GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐

SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐

Bedrock ☒

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used:

Rotary ☐

Hollow Stem Auger ☐

HSA / Rotary Other ☒

15. Drilling fluid used: Water ☒ 0 2 Air ☐

Drilling Mud ☐ 0 3 None ☐

16. Drilling additives used? ☐ Yes ☒ No

Describe ______

17. Source of water (attach analysis, if required):

City of Champaign

E. Bentonite seal, top 551.3 ft. MSL or 30.0 ft.

F. Fine sand, top ______ ft. MSL or ______ ft.

G. Filter pack, top 548.3 ft. MSL or 33.0 ft.

H. Screen joint, top 546.3 ft. MSL or 35.0 ft.

I. Well bottom 536.3 ft. MSL or 45.0 ft.

J. Filter pack, bottom 535.5 ft. MSL or 45.8 ft.

K. Borehole, bottom 535.5 ft. MSL or 45.8 ft.

L. Borehole, diameter 7.3 in.

M. O.D. well casing 2.38 in.

N. I.D. well casing 1.99 in.

1. Cap and lock? ☒ Yes ☐ No

2. Protective cover pipe:
   - a. Inside diameter: 6.0 in.
   - b. Length: 6.0 ft.
   - c. Material: Steel ☒ ______ Other ☐
   - d. Additional protection? ☒ Yes ☐ No

     If yes, describe: 4" diameter protective PVC casing

3. Surface seal: Bentonite ☐ Concrete ☒ ______ Other ☐

4. Material between well casing and protective pipe: Bentonite ☒ Sand Other ☒

5. Annular space seal: a. Granular/Chipped Bentonite ☐
   - b. ____Lbs/gal mud weight . . . Bentonite-sand slurry ☐
   - c. ____Lbs/gal mud weight . . . Bentonite slurry ☐
   - d. 30 % Bentonite . . . Bentonite-cement grout ☒
   - e. ______ Ft^3 volume added for any of the above
   - f. How installed: Tremie ☒ Tremie pumped ☐ Gravity ☐

6. Bentonite seal: a. Bentonite granules ☐
   - b. ☐ 1/4 in. ☒ 3/8 in. ☐ 1/2 in. Bentonite chips ☒
   - c. ______ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
   - a. ______
   - b. Volume added ______ ft^3

8. Filter pack material: Manufacturer, product name & mesh size
   - a. NSF Quartz Sand #10-20
   - b. Volume added ______ ft^3

9. Well casing: Flush threaded PVC schedule 40 ☒ Flush threaded PVC schedule 80 ☐ ______ Other ☐

10. Screen material: Schedule 40 PVC
    - a. Screen Type: Factory cut ☒ Continuous slot ☐ ______ Other ☐
    - b. Manufacturer ______
    - c. Slot size: 0.100 in.
    - d. Slotted length: 10.0 ft.

11. Backfill material (below filter pack): None ☒ ______ Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Date Modified: 4/6/2017

Signature

Firm: Natural Resource Technology

234 W. Florida Street, Floor 5, Milwaukee, WI 53204

Tel: (414) 837-3607

Fax: (414) 837-3608

Client: Vistra
Project: Vermilion Power Plant New East Ash Pond
Address: 10188 East 2150 North Road, Oakwood, IL

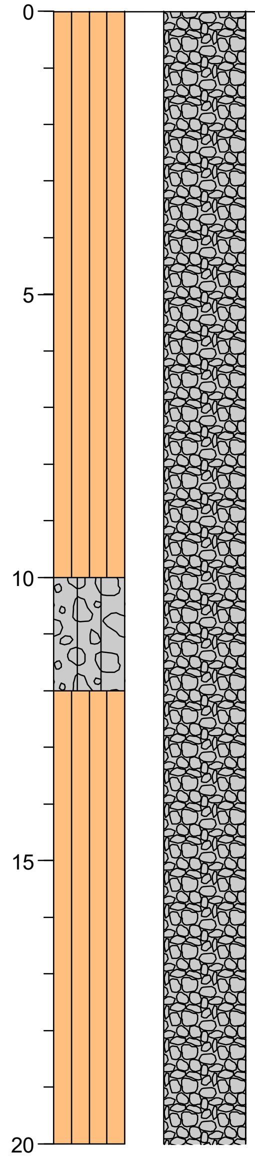
BORING LOG

Boring No. VER-70
Page: 1 of 4

Drilling Start Date: **06/23/2023**
Drilling End Date: **06/23/2023**
Drilling Company: **Cascade Drilling**
Drilling Method: **Sonic**
Drilling Equipment: **Geoprobe**
Driller: **Jeff Jehn**
Logged By: **Andrew Kelley**

Boring Depth (ft): **80**
Boring Diameter (in): **6**
Ground Surface Elev. (ft): **Not surveyed**

Boring was advanced adjacent to well 70D.
Samples collected from 30-40 ft bgs, 41-42 ft bgs and 75-80 ft bgs



Sample Type	Date & Time	Blow Counts	Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION
	10:40	NA	6/10	(0') SILT WITH GRAVEL (ML); light brown, dry, loose, fine to coarse gravel.
				(1') SILT (ML); brown to tan, dry, firm, moderate concretions, little gravel, few clay.
				(3.6') SILT (ML); gray to dark gray with little brown, dry, firm, few fine sand, few fine gravel, coarsens downwards, moderate concretions.
	10:55		4/10	(10') SILTY GRAVEL (GM); gray to dark gray, moist, loose, some fine to coarse sand.
				(10.5') SILTY GRAVEL (GM); light gray, moist, loose, fines downward.
				(12') SANDY SILT (ML); brown, moist, medium dense, firm, little clay, little fine gravel.

NOTES:

Geosyntec consultants
engineers | scientists | innovators

Client:	**Vistra**
Project:	**Vermilion Power Plant New East Ash Pond**
Address:	**10188 East 2150 North Road, Oakwood, IL**

BORING LOG

Boring No. **VER-70**
Page: **2 of 4**

Drilling Start Date:	**06/23/2023**
Drilling End Date:	**06/23/2023**
Drilling Company:	**Cascade Drilling**
Drilling Method:	**Sonic**
Drilling Equipment:	**Geoprobe**
Driller:	**Jeff Jehn**
Logged By:	**Andrew Kelley**

Boring Depth (ft):	**80**
Boring Diameter (in):	**6**
Ground Surface Elev. (ft):	**Not surveyed**

Boring was advanced adjacent to well 70D.
Samples collected from 30-40 ft bgs, 41-42 ft bgs and 75-80 ft bgs

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT				SOIL/ROCK VISUAL DESCRIPTION
				Sample Type	Date & Time	Blow Counts	Recovery (ft)	
20	▨		▩		13:00	NA	3/10	(20') CLAY WITH SILT (CL); grayish brown, wet, stiff, little sand, little fine to coarse gravel.
								(21') SILTY CLAY (CL); grayish brown, wet, soft, little fine gravel, few sand.
								(21.3') SANDY CLAY (CL); grayish brown, wet, very stiff, some gravel.
25								
30							3/10	(30') GRAVELLY CLAY WITH SAND (CL); grayish brown, wet, firm, sand coarsens downward.
								(31.8') CLAY (CL); dark gray to black, wet, firm, little gravel, few roots observed, dark organics.
35								
40								

NOTES:

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Client: Vistra
Project: Vermilion Power Plant New East Ash Pond
Address: 10188 East 2150 North Road, Oakwood, IL

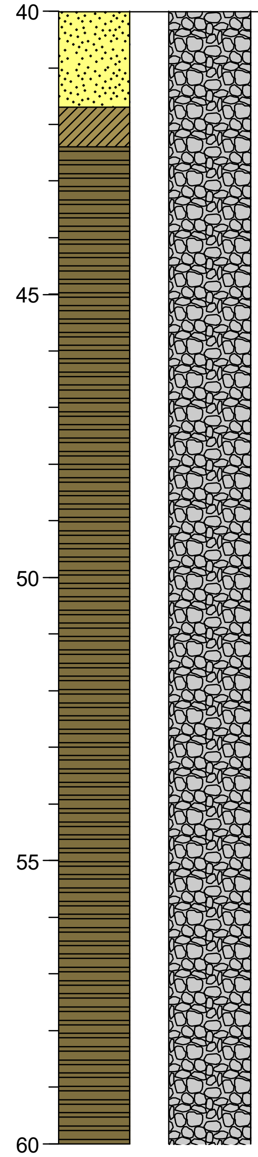
BORING LOG

Boring No. VER-70
Page: 3 of 4

Drilling Start Date: **06/23/2023**
Drilling End Date: **06/23/2023**
Drilling Company: **Cascade Drilling**
Drilling Method: **Sonic**
Drilling Equipment: **Geoprobe**
Driller: **Jeff Jehn**
Logged By: **Andrew Kelley**

Boring Depth (ft): **80**
Boring Diameter (in): **6**
Ground Surface Elev. (ft): **Not surveyed**

Boring was advanced adjacent to well 70D.
Samples collected from 30-40 ft bgs, 41-42 ft bgs and 75-80 ft bgs



DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT				SOIL/ROCK VISUAL DESCRIPTION
				Sample Type	Date & Time	Blow Counts	Recovery (ft)	
40					13:50	NA	8/10	(40') POORLY GRADED SAND (SP); brown with hint of gray, wet, medium dense, fine grained.
								(41.7') CLAY (CL); brownish gray, moist, very stiff, few coarse gravel, some sand.
								(42.4') SHALE, gray, moist, laminated, highly decomposed, moderately disintegrated.
50					14:30		5/10	(50') As above.

NOTES:

Geosyntec consultants
engineers | scientists | innovators

Client: Vistra
Project: Vermilion Power Plant New East Ash Pond
Address: 10188 East 2150 North Road, Oakwood, IL

BORING LOG

Boring No. VER-70
Page: 4 of 4

Drilling Start Date: **06/23/2023**
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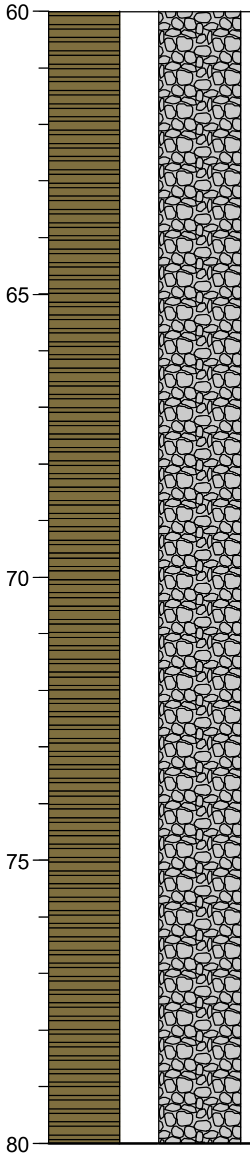
Drilling Company: **Cascade Drilling**
Drilling Method: **Sonic**
Drilling Equipment: **Geoprobe**
Driller: **Jeff Jehn**
Logged By: **Andrew Kelley**

Boring Depth (ft): **80**
Boring Diameter (in): **6**
Ground Surface Elev. (ft): **Not surveyed**

Boring was advanced adjacent to well 70D.
Samples collected from 30-40 ft bgs, 41-42 ft bgs and 75-80 ft bgs



DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT				SOIL/ROCK VISUAL DESCRIPTION
				Sample Type	Date & Time	Blow Counts	Recovery (ft)	
60					15:15	NA	1/10	(60') SHALE, gray to dark gray, wet (driller water), foliated, highly decomposed, slightly disintegrated, weaker and more highly disintegrated shale likely washed out by driller fluids.
70					17:00		10/10	(70') SHALE, gray to dark gray, wet, highly decomposed, moderately disintegrated, coated in wet clay (likely slough).
75								(75') SHALE, gray to dark gray, moist, highly decomposed, slightly disintegrated.
80								(80') End of Boring.

NOTES:

SOIL BORING LOG INFORMATION

Page 1 of 3

Facility/Project Name: Vermilion Power Station

License/Permit/Monitoring Number:

Boring Number: 70D

Boring Drilled By: Name of crew chief (first, last) and Firm: Jason Greer, Cascade Drilling

Date Drilling Started: 3/4/2021

Date Drilling Completed: 3/4/2021

Drilling Method: Mini Sonic

Common Well Name: 70D

Final Static Water Level: Feet (NAVD88)

Surface Elevation: 591.90 Feet (NAVD88)

Borehole Diameter: 6.0 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐

State Plane 1,278,929.46 N, 1,150,617.15 E [✓ E]/ W

1/4 of 1/4 of Section , T N, R

Lat ___ ° ___ ' ______ "

Long ___ ° ___ ' ______ "

Local Grid Location: Feet ☐ N ☐ S Feet ☐ E ☐ W

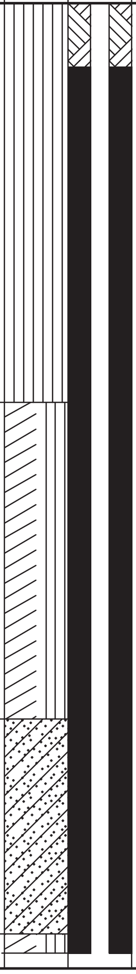
Facility ID:

County: Vermilion

State: Illinois

Civil Town/City/ or Village: Oakwood

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Soil Properties: Compressive Strength (tsf)	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
1 CS	60 47			0 - 6.3' **SILT:** ML, dark brown (10YR 3/3) to brown (10YR 4/3), clay (15-25%), sand, (0-5%), roots (0-5%), stiff, slow dilatancy, low toughness, low plasticity, moist.										CS= Core Sample
			1						1.5					
			2											
			3		ML				1.5					
			4											
2 CS	60 60		5						1.5					
			6											
				6.3 - 11.3' **SILTY CLAY:** CL/ML, brown (10YR 4/3), sand (0-10%), gravel (0-5%), firm, slow dilatancy, low toughness, medium plasticity, moist.										
			7						0.75					
			8											
			9		CL/ML				0.75					
				9.4' color change to yellowish brown (10YR 5/4).										
3 CS	120 120		10											
			11											
				11.3 - 14.7' **CLAYEY SAND:** SC, yellowish brown (10YR 5/6), rounded fine sand, silt (5-10%), gravel (0-5%), loose, wet.										
			12											
			13		SC									
			14											
			15											



I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm: Ramboll

234 W. Florida Street, Milwaukee, WI 53204

Tel: (414) 837-3607

Fax: (414) 837-3608

Template: RAMBOLL_IL_BORING LOG - Project: 845_VERMILION_2021 (2).GPJ

SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 70D

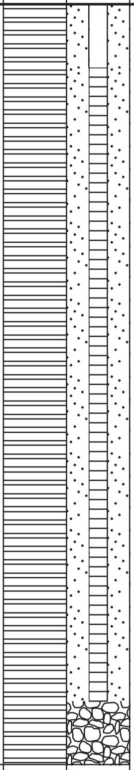
Page 2 of 3

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Soil Properties Compressive Strength (tsf)	Soil Properties Moisture Content	Soil Properties Liquid Limit	Soil Properties Plasticity Index	Soil Properties P 200	RQD/ Comments
			16	14.7 - 15' **SILTY CLAY:** CL/ML, yellowish brown (10YR 5/6), soft, slow dilatancy, low toughness, medium plasticity.	CL/ML									
			17	15 - 16.2' **CLAYEY SAND:** SC, yellowish brown (10YR 5/6), rounded fine sand, silt (5-10%), gravel (0-5%), loose, wet.	SC									
			18	16.2 - 18.8' **POORLY-GRADED SAND WITH CLAY:** SP-SC, ???, subrounded to rounded, fine to medium sand, loose, wet.	SP-SC									
			19	18.8 - 19.6' **LEAN CLAY:** CL, dark gray (10YR 4/1), gravel, (0-5%), sand (0-5%), stiff, no dilatancy, low toughness, medium plasticity, moist.	CL				2.5					
4 CS	120 97		20	19.6 - 20.3' **Weathered SHALE Bedrock** BDX (SH), gray (10YR 5/1), dry.	BDX (SH)									
			21	20.3 - 52' **SHALE:** BDX (SH), gray (10YR 5/1).										
			22											
			23											
			24											
			25											
			26											
			27											
			28											
			29											
5 CS	132 132		30		BDX (SH)									
			31											
			32											
			33											
			34											
			35											
			36											
			37											
			38											
			39											
			40											

SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 70D

Page 3 of 3

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	
6 CS	132 132		41 42 43 44 45 46 47 48 49 50 51 52	20.3 - 52' **SHALE:** BDX (SH), gray (10YR 5/1). *(continued)*	BDX (SH)									
				52' End of Boring.										

MONITORING WELL CONSTRUCTION

Facility/Project Name: Vermilion Power Station

Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.

Well Name: 70D

Facility License, Permit or Monitoring No.:

Local Grid Origin ☐ (estimated: ☐) or Well Location ☐

Lat. ____ ° ____ ' ____ " Long. ____ ° ____ ' ____ " or

St. Plane 1,278,929 ft. N, 1,150,617 ft. E. [✓ E]/W

Date Well Installed: 03/04/2021

Facility ID:

Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E ☐ W

Type of Well: Well Code 12/pz

Well Installed By: (Person's Name and Firm)
Jason Greer
Cascade Drilling

Distance from Waste/Source: ft.

State: Illinois

Location of Well Relative to Waste/Source:
u ☐ Upgradient s ☐ Sidegradient
d ☒ Downgradient n ☐ Not Known

Gov. Lot Number:

A. Protective pipe, top elevation 595.10 ft. MSL

B. Well casing, top elevation 594.52 ft. MSL

C. Land surface elevation 591.9 ft. MSL

D. Surface seal, bottom 590.9 ft. MSL or 1.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☒

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐
Hollow Stem Auger ☐
Sonic Other ☒

15. Drilling fluid used: Water ☒ 0 2 Air ☐
Drilling Mud ☐ 0 3 None ☐

16. Drilling additives used? ☐ Yes ☒ No

Describe ____

17. Source of water (attach analysis, if required):
Potable City Water

E. Bentonite seal, top 557.9 ft. MSL or 34.0 ft.

F. Fine sand, top ____ ft. MSL or ____ ft.

G. Filter pack, top 552.9 ft. MSL or 39.0 ft.

H. Screen joint, top 550.9 ft. MSL or 41.0 ft.

I. Well bottom 540.9 ft. MSL or 51.0 ft.

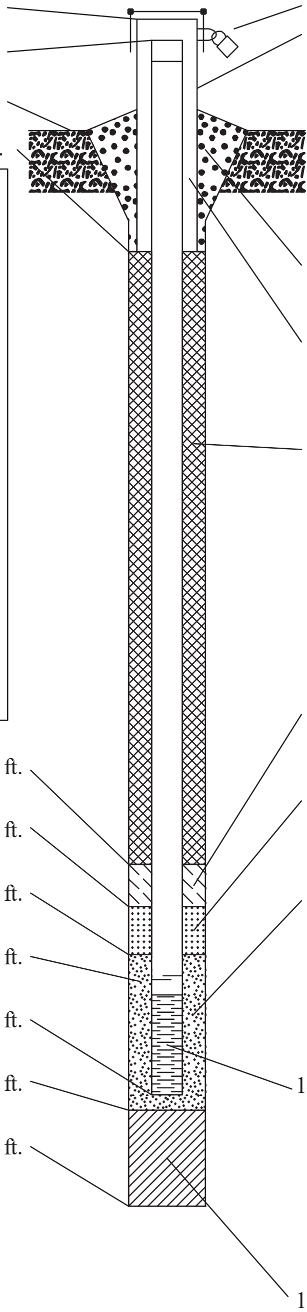
J. Filter pack, bottom 540.9 ft. MSL or 51.0 ft.

K. Borehole, bottom 539.9 ft. MSL or 52.0 ft.

L. Borehole, diameter 6.0 in.

M. O.D. well casing 2.38 in.

N. I.D. well casing 2.07 in.



1. Cap and lock? ☒ Yes ☐ No
2. Protective cover pipe:
   a. Inside diameter: 4.0 in.
   b. Length: 5.0 ft.
   c. Material: Steel ☒ Other ☐
   d. Additional protection? ☒ Yes ☐ No
   If yes, describe: 4 Steel Bollards
3. Surface seal: Bentonite ☐ Concrete ☒ Other ☐
4. Material between well casing and protective pipe: Bentonite ☐
   Sand Other ☒
5. Annular space seal: a. Granular/Chipped Bentonite ☐
   b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐
   c. 9.2 Lbs/gal mud weight . . . Bentonite slurry ☒
   d. ____ % Bentonite . . . Bentonite-cement grout ☐
   e. ____ Ft^3 volume added for any of the above
   f. How installed: Tremie ☐ Tremie pumped ☒ Gravity ☐
6. Bentonite seal: a. Bentonite granules ☐
   b. ☐ 1/4 in. ☒ 3/8 in. ☐ 1/2 in. Bentonite chips ☒
   c. ____ Other ☐
7. Fine sand material: Manufacturer, product name & mesh size
   a. NA
   b. Volume added 0 ft^3
8. Filter pack material: Manufacturer, product name & mesh size
   a. FILTERSIL 0.85
   b. Volume added ____ ft^3
9. Well casing: Flush threaded PVC schedule 40 ☒
   Flush threaded PVC schedule 80 ☐
   Other ☐
10. Screen material: Schedule 40 PVC
    a. Screen Type: Factory cut ☒ Continuous slot ☐ Other ☐
    b. Manufacturer Johnson Screens
    c. Slot size: 0.010 in.
    d. Slotted length: 10.0 ft.
11. Backfill material (below filter pack): None ☐
    Formation Materials Other ☒

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Date Modified: 3/31/2021

Signature:

Firm:
Ramboll
234 W. Florida Street, Milwaukee, WI 53204

Tel: (414) 837-3607
Fax: (414) 837-3608

ATTACHMENT 3

Sequential Extraction Procedure Laboratory Analytical Reports

ANALYTICAL REPORT

PREPARED FOR

Attn: Allison Kreinberg
Geosyntec Consultants Inc
941 Chatham Lane
Suite 103
Columbus, Ohio 43221

Generated 8/3/2023 11:56:48 AM

JOB DESCRIPTION

Vermilion SEP

JOB NUMBER

140-32513-1

Eurofins Knoxville
5815 Middlebrook Pike
Knoxville TN 37921

See page two for job notes and contact information.

Eurofins Knoxville

Job Notes

This report may not be reproduced except in full, and with written approval from the laboratory. The results relate only to the samples tested. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

The test results in this report relate only to the samples as received by the laboratory and will meet all requirements of the methodology, with any exceptions noted. This report shall not be reproduced except in full, without the express written approval of the laboratory. All questions should be directed to the Eurofins TestAmerica Project Manager.

Authorization

Ryan Henry

Authorized for release by
Ryan Henry, Project Manager I
WilliamR.Henry@et.eurofinsus.com
(865)291-3006

Generated
8/3/2023 11:56:48 AM

Table of Contents

Definitions/Glossary

Qualifiers

Metals

Qualifier	Qualifier Description
B	Compound was found in the blank and sample.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Case Narrative

1
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Job ID: 140-32513-1

Laboratory: Eurofins Knoxville

Narrative

Job Narrative
140-32513-1

Receipt
The samples were received on 7/3/2023 at 11:15am and arrived in good condition, and where required, properly preserved and on ice. The temperature of the cooler at receipt was 20.3º C.

Receipt Exceptions
The Field Sampler was not listed on the Chain of Custody.

Metals
7 Step Sequential Extraction Procedure

These soil samples were prepared and analyzed using Eurofins TestAmerica Knoxville standard operating procedure KNOX-MT-0008, “7 Step Sequential Extraction Procedure”. SW-846 Method 6010B as incorporated in Eurofins TestAmerica Knoxville standard operating procedure KNOX-MT-0007 was used to perform the final instrument analyses.

An aliquot of each sample was sequentially extracted using the steps listed below:

- Step 1 - Exchangeable Fraction: A 5 gram aliquot of sample was extracted with 25 mL of 1M magnesium sulfate (MgSO4), centrifuged and filtered. 5 mL of the resulting leachate was digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
- Step 2 - Carbonate Fraction: The sample residue from step 1 was extracted with 25 mL of 1M sodium acetate/acetic acid (NaOAc/HOAc) at pH 5, centrifuged and filtered. 5 mL of the resulting leachate was digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
- Step 3 - Non-crystalline Materials Fraction: The sample residue from step 2 was extracted with 25 mL of 0.2M ammonium oxalate (pH 3), centrifuged and filtered. 5 mL of the resulting leachate was digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
- Step 4 - Metal Hydroxide Fraction: The sample residue from step 3 was extracted with 25 mL of 1M hydroxylamine hydrochloride solution in 25% v/v acetic acid, centrifuged and filtered. 5 mL of the resulting leachate was digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
- Step 5 - Organic-bound Fraction: The sample residue from step 4 was extracted three times with 25 mL of 5% sodium hypochlorite (NaClO) at pH 9.5, centrifuged and filtered. The resulting leachates were combined and 5 mL were digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
- Step 6 - Acid/Sulfide Fraction: The sample residue from step 5 was extracted with 25 mL of a 3:1:2 v/v solution of HCl-HNO3-H2O, centrifuged and filtered. 5 mL of the resulting leachate was diluted to 50 mL with reagent water and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
- Step 7 - Residual Fraction: A 1.0 g aliquot of the sample residue from step 6 was digested using HF, HNO3, HCl and H3BO3. The digestate was analyzed by ICP using method 6010B. Results are reported in mg/kg on a dry weight basis.

In addition, a 1.0 g aliquot of the original sample was digested using HF, HNO3, HCl and H3BO3. The digestate was analyzed by ICP using method 6010B. Total metal results are reported in mg/kg on a dry weight basis.

Results were calculated using the following equation:

$$\text{Result, µg/g or mg/Kg, dry weight} = (C \times V \times V1 \times D) / (W \times S \times V2)$$

Where:
C = Concentration from instrument readout, µg/mL
V = Final volume of digestate, mL
D = Instrument dilution factor
V1 = Total volume of leachate, mL
V2 = Volume of leachate digested, mL
W = Wet weight of sample, g

Job ID: 140-32513-1 (Continued)

Laboratory: Eurofins Knoxville (Continued)

S = Percent solids/100

A method blank, laboratory control sample and laboratory control sample duplicate were prepared and analyzed with each SEP step in order to provide information about both the presence of elements of interest in the extraction solutions, and the recovery of elements of interest from the extraction solutions. Results outside of laboratory QC limits do not reflect out of control performance, but rather the effect of the extraction solution upon the analyte.

A laboratory sample duplicate was prepared and analyzed with each batch of samples in order to provide information regarding the reproducibility of the procedure.

SEP Report Notes:

The final report lists the results for each step, the result for the total digestion of the sample, and a sum of the results of steps 1 through 7 by element.

Magnesium was not reported for step 1 because the extraction solution for this step (magnesium sulfate) contains high levels of magnesium.

Sodium was not reported for steps 2 and 5 since the extraction solution for these steps contain high levels of sodium.

The sum of steps 1 through 7 is much higher than the total result for sodium and magnesium due to the magnesium and sodium introduced by the extraction solutions.

The digestates for steps 1, 2 and 5 were analyzed at a dilution due to instrument problems caused by the high solids content of the digestates. The reporting limits were adjusted accordingly.

The serial diilution is analyzed at an additional 5 fold dilution using the dilution factors applied to the duplicate and the associated original sample. Due to a limitation of the expanded deliverable forms, the dilutions of the duplicate and serial dilution in the expanded deliverable are not expressed on a per analyte basis.

Please refer to the summary section of the report for the duplicate information as it contains the dilution factors at which the sample was analyzed.

Method 6010B: The serial dilution performed for the following samples associated with batch 140-75976 were outside control limits: VER-35 55-60 20230624 (140-32513-1), (140-32513-A-1-C SD ^10) and (140-32513-A-1-C SD ^5)

Method 6010B: The following samples were diluted to bring the concentration of target analyte, Iron, within the calibration range: VER-35 55-60 20230624 (140-32513-1), VER-35 60-63 20230624 (140-32513-2) and VER-70 75-80 20230623 (140-32513-3). Elevated reporting limits (RLs) are provided.

Method 6010B SEP: The serial dilution performed for the following samples associated with batch 140-75894 was outside control limits: VER-35 55-60 20230624 (140-32513-1), (140-32513-A-1-S SD ^5) and (140-32513-A-1-W SD ^5)

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

General Chemistry
% Moisture: The samples were analyzed for percent moisture using SOP number KNOX-WC-0012 (based on Modified MCAWW 160.3 and SM2540B and on the percent moisture determinations described in methods 3540C and 3550B).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Sample Summary

Client: Geosyntec Consultants Inc
Project/Site: Vermilion SEP

Job ID: 140-32513-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
140-32513-1	VER-35 55-60 20230624	Solid	06/24/23 14:20	07/03/23 11:15
140-32513-2	VER-35 60-63 20230624	Solid	06/24/23 14:50	07/03/23 11:15
140-32513-3	VER-70 75-80 20230623	Solid	06/23/23 17:00	07/03/23 11:15

Client Sample Results

Client: Geosyntec Consultants Inc
Project/Site: Vermilion SEP

Job ID: 140-32513-1

Client Sample ID: VER-35 55-60 20230624

Date Collected: 06/24/23 14:20
Date Received: 07/03/23 11:15

Lab Sample ID: 140-32513-1

Matrix: Solid
Percent Solids: 95.4

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		21	12	mg/Kg	☼	07/11/23 08:00	07/27/23 13:01	4
Lithium	ND		10	0.63	mg/Kg	☼	07/11/23 08:00	07/27/23 13:01	4
Manganese	**7.6**		3.1	0.13	mg/Kg	☼	07/11/23 08:00	07/27/23 13:01	4

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**560**		16	9.1	mg/Kg	☼	07/12/23 08:00	07/27/23 13:51	3
Lithium	**0.56**	**J**	7.9	0.47	mg/Kg	☼	07/12/23 08:00	07/27/23 13:51	3
Manganese	**29**		2.4	0.88	mg/Kg	☼	07/12/23 08:00	07/27/23 13:51	3

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**4300**		5.2	3.0	mg/Kg	☼	07/13/23 08:00	07/27/23 14:40	1
Lithium	**0.52**	**J**	2.6	0.16	mg/Kg	☼	07/13/23 08:00	07/27/23 14:40	1
Manganese	**110**	**B**	0.79	0.028	mg/Kg	☼	07/13/23 08:00	07/27/23 14:40	1

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**20000**		5.2	3.0	mg/Kg	☼	07/17/23 08:00	07/28/23 12:49	1
Lithium	**13**		2.6	0.16	mg/Kg	☼	07/17/23 08:00	07/28/23 12:49	1
Manganese	**430**		0.79	0.14	mg/Kg	☼	07/17/23 08:00	07/28/23 12:49	1

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		79	46	mg/Kg	☼	07/19/23 08:00	07/28/23 13:39	5
Lithium	**4.1**	**J**	39	2.3	mg/Kg	☼	07/19/23 08:00	07/28/23 13:39	5
Manganese	**46**		12	1.9	mg/Kg	☼	07/19/23 08:00	07/28/23 13:39	5

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**11000**		5.2	3.0	mg/Kg	☼	07/19/23 08:00	07/28/23 14:29	1
Lithium	**13**		2.6	0.16	mg/Kg	☼	07/19/23 08:00	07/28/23 14:29	1
Manganese	**130**		0.79	0.26	mg/Kg	☼	07/19/23 08:00	07/28/23 14:29	1

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**4300**		5.2	4.3	mg/Kg	☼	07/20/23 08:00	07/31/23 12:46	1
Lithium	**15**		2.6	0.16	mg/Kg	☼	07/20/23 08:00	07/31/23 12:46	1
Manganese	**31**		0.79	0.32	mg/Kg	☼	07/20/23 08:00	07/31/23 12:46	1

Method: SW846 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**41000**		5.0	4.1	mg/Kg			08/02/23 14:24	1
Lithium	**46**		2.5	0.15	mg/Kg			08/02/23 14:24	1
Manganese	**780**		0.75	0.052	mg/Kg			08/02/23 14:24	1

Method: SW846 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**38000**		10	8.6	mg/Kg	☼	07/21/23 08:00	07/31/23 14:12	2
Lithium	**42**		2.6	0.16	mg/Kg	☼	07/21/23 08:00	07/31/23 13:22	1
Manganese	**610**		0.79	0.32	mg/Kg	☼	07/21/23 08:00	07/31/23 13:22	1

Client Sample Results

Client Sample ID: VER-35 60-63 20230624

Lab Sample ID: 140-32513-2

Date Collected: 06/24/23 14:50
Date Received: 07/03/23 11:15

Matrix: Solid
Percent Solids: 95.4

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		21	12	mg/Kg	☼	07/11/23 08:00	07/27/23 13:11	4
Lithium	ND		10	0.63	mg/Kg	☼	07/11/23 08:00	07/27/23 13:11	4
Manganese	**7.9**		3.1	0.13	mg/Kg	☼	07/11/23 08:00	07/27/23 13:11	4

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**570**		16	9.1	mg/Kg	☼	07/12/23 08:00	07/27/23 14:01	3
Lithium	**0.62**	**J**	7.9	0.47	mg/Kg	☼	07/12/23 08:00	07/27/23 14:01	3
Manganese	**29**		2.4	0.88	mg/Kg	☼	07/12/23 08:00	07/27/23 14:01	3

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**4200**		5.2	3.0	mg/Kg	☼	07/13/23 08:00	07/27/23 14:50	1
Lithium	**0.74**	**J**	2.6	0.16	mg/Kg	☼	07/13/23 08:00	07/27/23 14:50	1
Manganese	**110**	**B**	0.79	0.028	mg/Kg	☼	07/13/23 08:00	07/27/23 14:50	1

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**18000**		5.2	3.0	mg/Kg	☼	07/17/23 08:00	07/28/23 12:59	1
Lithium	**12**		2.6	0.16	mg/Kg	☼	07/17/23 08:00	07/28/23 12:59	1
Manganese	**380**		0.79	0.14	mg/Kg	☼	07/17/23 08:00	07/28/23 12:59	1

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		79	46	mg/Kg	☼	07/19/23 08:00	07/28/23 13:49	5
Lithium	**3.9**	**J**	39	2.3	mg/Kg	☼	07/19/23 08:00	07/28/23 13:49	5
Manganese	**35**		12	1.9	mg/Kg	☼	07/19/23 08:00	07/28/23 13:49	5

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**11000**		5.2	3.0	mg/Kg	☼	07/19/23 08:00	07/28/23 14:39	1
Lithium	**14**		2.6	0.16	mg/Kg	☼	07/19/23 08:00	07/28/23 14:39	1
Manganese	**140**		0.79	0.26	mg/Kg	☼	07/19/23 08:00	07/28/23 14:39	1

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**4200**		5.2	4.3	mg/Kg	☼	07/20/23 08:00	07/31/23 12:57	1
Lithium	**14**		2.6	0.16	mg/Kg	☼	07/20/23 08:00	07/31/23 12:57	1
Manganese	**30**		0.79	0.33	mg/Kg	☼	07/20/23 08:00	07/31/23 12:57	1

Method: SW846 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**38000**		5.0	4.1	mg/Kg			08/02/23 14:24	1
Lithium	**45**		2.5	0.15	mg/Kg			08/02/23 14:24	1
Manganese	**730**		0.75	0.052	mg/Kg			08/02/23 14:24	1

Method: SW846 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**37000**		10	8.6	mg/Kg	☼	07/21/23 08:00	07/31/23 14:22	2
Lithium	**39**		2.6	0.16	mg/Kg	☼	07/21/23 08:00	07/31/23 13:33	1
Manganese	**520**		0.79	0.33	mg/Kg	☼	07/21/23 08:00	07/31/23 13:33	1

1 2 3 4 5 6 7 8 9 10 11 12 13

Client Sample ID: VER-70 75-80 20230623

Date Collected: 06/23/23 17:00
Date Received: 07/03/23 11:15

Lab Sample ID: 140-32513-3
Matrix: Solid
Percent Solids: 90.0

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		22	13	mg/Kg	☼	07/11/23 08:00	07/27/23 13:16	4
Lithium	ND		11	0.67	mg/Kg	☼	07/11/23 08:00	07/27/23 13:16	4
Manganese	**7.6**		3.3	0.14	mg/Kg	☼	07/11/23 08:00	07/27/23 13:16	4

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**730**		17	9.7	mg/Kg	☼	07/12/23 08:00	07/27/23 14:06	3
Lithium	ND		8.3	0.50	mg/Kg	☼	07/12/23 08:00	07/27/23 14:06	3
Manganese	**36**		2.5	0.93	mg/Kg	☼	07/12/23 08:00	07/27/23 14:06	3

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**5500**		5.6	3.2	mg/Kg	☼	07/13/23 08:00	07/27/23 14:55	1
Lithium	**0.41**	**J**	2.8	0.17	mg/Kg	☼	07/13/23 08:00	07/27/23 14:55	1
Manganese	**130**	**B**	0.83	0.030	mg/Kg	☼	07/13/23 08:00	07/27/23 14:55	1

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**31000**		11	6.4	mg/Kg	☼	07/17/23 08:00	07/28/23 14:55	2
Lithium	**12**		2.8	0.17	mg/Kg	☼	07/17/23 08:00	07/28/23 13:04	1
Manganese	**510**		0.83	0.14	mg/Kg	☼	07/17/23 08:00	07/28/23 13:04	1

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**61**	**J**	83	49	mg/Kg	☼	07/19/23 08:00	07/28/23 13:54	5
Lithium	**4.4**	**J**	42	2.4	mg/Kg	☼	07/19/23 08:00	07/28/23 13:54	5
Manganese	**54**		12	2.1	mg/Kg	☼	07/19/23 08:00	07/28/23 13:54	5

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**14000**		5.6	3.2	mg/Kg	☼	07/19/23 08:00	07/28/23 14:44	1
Lithium	**15**		2.8	0.17	mg/Kg	☼	07/19/23 08:00	07/28/23 14:44	1
Manganese	**160**		0.83	0.28	mg/Kg	☼	07/19/23 08:00	07/28/23 14:44	1

Method: SW846 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**5500**		5.6	4.6	mg/Kg	☼	07/20/23 08:00	07/31/23 13:17	1
Lithium	**19**		2.8	0.17	mg/Kg	☼	07/20/23 08:00	07/31/23 13:17	1
Manganese	**39**		0.83	0.34	mg/Kg	☼	07/20/23 08:00	07/31/23 13:17	1

Method: SW846 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**57000**		5.0	4.1	mg/Kg			08/02/23 14:24	1
Lithium	**51**		2.5	0.15	mg/Kg			08/02/23 14:24	1
Manganese	**940**		0.75	0.052	mg/Kg			08/02/23 14:24	1

Method: SW846 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	**66000**		28	23	mg/Kg	☼	07/21/23 08:00	07/31/23 15:08	5
Lithium	**42**		2.8	0.17	mg/Kg	☼	07/21/23 08:00	07/31/23 13:39	1
Manganese	**720**		0.83	0.34	mg/Kg	☼	07/21/23 08:00	07/31/23 13:39	1

Default Detection Limits

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Prep: 3010A

SEP: Exchangeable

Analyte	RL	MDL	Units
Iron	5.0	2.9	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.031	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Prep: 3010A

SEP: Carbonate

Analyte	RL	MDL	Units
Iron	5.0	2.9	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.28	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Prep: 3010A

SEP: Non-Crystalline

Analyte	RL	MDL	Units
Iron	5.0	2.9	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.027	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Prep: 3010A

SEP: Metal Hydroxide

Analyte	RL	MDL	Units
Iron	5.0	2.9	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.13	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Prep: 3010A

SEP: Organic-Bound

Analyte	RL	MDL	Units
Iron	15	8.8	mg/Kg
Lithium	7.5	0.44	mg/Kg
Manganese	2.3	0.37	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 6

SEP: Acid/Sulfide

Analyte	RL	MDL	Units
Iron	5.0	2.9	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.25	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Prep: Residual

Analyte	RL	MDL	Units
Iron	5.0	4.1	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.31	mg/Kg

Default Detection Limits

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	RL	MDL	Units
Iron	5.0	4.1	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.052	mg/Kg

Method: 6010B - SEP Metals (ICP) - Total

Prep: Total

Analyte	RL	MDL	Units
Iron	5.0	4.1	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.31	mg/Kg

QC Sample Results

Client: Geosyntec Consultants Inc
Project/Site: Vermilion SEP

Job ID: 140-32513-1

Method: 6010B - SEP Metals (ICP) - Total

Lab Sample ID: MB 140-75187/5-A
Matrix: Solid
Analysis Batch: 75976

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 75187

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		5.0	4.1	mg/Kg		07/21/23 08:00	07/31/23 12:31	1
Lithium	ND		2.5	0.15	mg/Kg		07/21/23 08:00	07/31/23 12:31	1
Manganese	ND		0.75	0.31	mg/Kg		07/21/23 08:00	07/31/23 12:31	1

Lab Sample ID: LCS 140-75187/6-A
Matrix: Solid
Analysis Batch: 75976

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 75187

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Iron	50.0	53.2		mg/Kg		106	80 - 120
Lithium	5.00	5.23		mg/Kg		105	80 - 120
Manganese	5.00	5.21		mg/Kg		104	80 - 120

Lab Sample ID: LCSD 140-75187/7-A
Matrix: Solid
Analysis Batch: 75976

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 75187

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Iron	50.0	54.5		mg/Kg		109	80 - 120	2	30
Lithium	5.00	5.14		mg/Kg		103	80 - 120	2	30
Manganese	5.00	5.27		mg/Kg		105	80 - 120	1	30

Lab Sample ID: 140-32513-1 DU
Matrix: Solid
Analysis Batch: 75976

Client Sample ID: VER-35 55-60 20230624
Prep Type: Total/NA
Prep Batch: 75187

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Lithium	42		42.1		mg/Kg	☼	0	30
Manganese	610		613		mg/Kg	☼	0.8	30

Lab Sample ID: 140-32513-1 DU
Matrix: Solid
Analysis Batch: 75976

Client Sample ID: VER-35 55-60 20230624
Prep Type: Total/NA
Prep Batch: 75187

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Iron	38000		39200		mg/Kg	☼	2	30

Method: 6010B SEP - SEP Metals (ICP)

Lab Sample ID: MB 140-75184/5-B ^4
Matrix: Solid
Analysis Batch: 75871

Client Sample ID: Method Blank
Prep Type: Step 1
Prep Batch: 75207

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		20	12	mg/Kg		07/11/23 08:00	07/27/23 12:47	4
Lithium	ND		10	0.60	mg/Kg		07/11/23 08:00	07/27/23 12:47	4
Manganese	ND		3.0	0.12	mg/Kg		07/11/23 08:00	07/27/23 12:47	4

QC Sample Results

Client: Geosyntec Consultants Inc
Project/Site: Vermilion SEP

Job ID: 140-32513-1

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCS 140-75184/6-B ^5
Matrix: Solid
Analysis Batch: 75871

Client Sample ID: Lab Control Sample
Prep Type: Step 1
Prep Batch: 75207

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Iron	50.0	54.4		mg/Kg		109	80 - 120
Lithium	5.00	5.66	J	mg/Kg		113	80 - 120
Manganese	5.00	5.54		mg/Kg		111	80 - 120

Lab Sample ID: LCSD 140-75184/7-B ^5
Matrix: Solid
Analysis Batch: 75871

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 1
Prep Batch: 75207

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Iron	50.0	54.2		mg/Kg		108	80 - 120	0	30
Lithium	5.00	5.44	J	mg/Kg		109	80 - 120	4	30
Manganese	5.00	5.51		mg/Kg		110	80 - 120	1	30

Lab Sample ID: 140-32513-1 DU
Matrix: Solid
Analysis Batch: 75871

Client Sample ID: VER-35 55-60 20230624
Prep Type: Step 1
Prep Batch: 75207

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Iron	ND		ND		mg/Kg	☼	NC	30
Lithium	ND		ND		mg/Kg	☼	NC	30
Manganese	7.6		7.29		mg/Kg	☼	4	30

Lab Sample ID: MB 140-75227/5-B ^3
Matrix: Solid
Analysis Batch: 75871

Client Sample ID: Method Blank
Prep Type: Step 2
Prep Batch: 75260

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		15	8.7	mg/Kg		07/12/23 08:00	07/27/23 13:36	3
Lithium	ND		7.5	0.45	mg/Kg		07/12/23 08:00	07/27/23 13:36	3
Manganese	ND		2.3	0.84	mg/Kg		07/12/23 08:00	07/27/23 13:36	3

Lab Sample ID: LCS 140-75227/6-B ^5
Matrix: Solid
Analysis Batch: 75871

Client Sample ID: Lab Control Sample
Prep Type: Step 2
Prep Batch: 75260

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Iron	50.0	ND		mg/Kg		3	
Lithium	5.00	5.13	J	mg/Kg		103	80 - 120
Manganese	5.00	5.01		mg/Kg		100	80 - 120

Lab Sample ID: LCSD 140-75227/7-B ^5
Matrix: Solid
Analysis Batch: 75871

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 2
Prep Batch: 75260

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Iron	50.0	ND		mg/Kg		3		28	
Lithium	5.00	4.95	J	mg/Kg		99	80 - 120	4	30
Manganese	5.00	4.96		mg/Kg		99	80 - 120	1	30

QC Sample Results

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: 140-32513-1 DU
Matrix: Solid
Analysis Batch: 75871
Client Sample ID: VER-35 55-60 20230624
Prep Type: Step 2
Prep Batch: 75260

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Iron	560			531		mg/Kg	☼			5	
Lithium	0.56	J		ND		mg/Kg	☼			NC	30
Manganese	29			27.9		mg/Kg	☼			4	30

Lab Sample ID: MB 140-75274/5-B
Matrix: Solid
Analysis Batch: 75871
Client Sample ID: Method Blank
Prep Type: Step 3
Prep Batch: 75294

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		5.0	2.9	mg/Kg		07/13/23 08:00	07/27/23 14:26	1
Lithium	ND		2.5	0.15	mg/Kg		07/13/23 08:00	07/27/23 14:26	1
Manganese	0.0935	J	0.75	0.027	mg/Kg		07/13/23 08:00	07/27/23 14:26	1

Lab Sample ID: LCS 140-75274/6-B
Matrix: Solid
Analysis Batch: 75871
Client Sample ID: Lab Control Sample
Prep Type: Step 3
Prep Batch: 75294

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Iron			50.0	51.9		mg/Kg		104	80 - 120		
Lithium			5.00	4.98		mg/Kg		100	80 - 120		
Manganese			5.00	5.04		mg/Kg		101	80 - 120		

Lab Sample ID: LCSD 140-75274/7-B
Matrix: Solid
Analysis Batch: 75871
Client Sample ID: Lab Control Sample Dup
Prep Type: Step 3
Prep Batch: 75294

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Iron			50.0	49.5		mg/Kg		99	80 - 120	5	30
Lithium			5.00	4.82		mg/Kg		96	80 - 120	3	30
Manganese			5.00	4.89		mg/Kg		98	80 - 120	3	30

Lab Sample ID: 140-32513-1 DU
Matrix: Solid
Analysis Batch: 75871
Client Sample ID: VER-35 55-60 20230624
Prep Type: Step 3
Prep Batch: 75294

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Iron	4300			4280		mg/Kg	☼			1	30
Lithium	0.52	J		0.516	J	mg/Kg	☼			1	30
Manganese	110	B		114		mg/Kg	☼			2	30

Lab Sample ID: MB 140-75320/5-B
Matrix: Solid
Analysis Batch: 75894
Client Sample ID: Method Blank
Prep Type: Step 4
Prep Batch: 75407

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		5.0	2.9	mg/Kg		07/17/23 08:00	07/28/23 12:35	1
Lithium	ND		2.5	0.15	mg/Kg		07/17/23 08:00	07/28/23 12:35	1
Manganese	ND		0.75	0.13	mg/Kg		07/17/23 08:00	07/28/23 12:35	1

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCS 140-75320/6-B
Client Sample ID: Lab Control Sample
Matrix: Solid
Prep Type: Step 4
Analysis Batch: 75894
Prep Batch: 75407

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Iron	50.0	55.0		mg/Kg		110	80 - 120
Lithium	5.00	5.38		mg/Kg		108	80 - 120
Manganese	5.00	5.49		mg/Kg		110	80 - 120

Lab Sample ID: LCSD 140-75320/7-B
Client Sample ID: Lab Control Sample Dup
Matrix: Solid
Prep Type: Step 4
Analysis Batch: 75894
Prep Batch: 75407

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Iron	50.0	54.6		mg/Kg		109	80 - 120	1	30
Lithium	5.00	5.41		mg/Kg		108	80 - 120	0	30
Manganese	5.00	5.45		mg/Kg		109	80 - 120	1	30

Lab Sample ID: 140-32513-1 DU
Client Sample ID: VER-35 55-60 20230624
Matrix: Solid
Prep Type: Step 4
Analysis Batch: 75894
Prep Batch: 75407

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Iron	20000		19600		mg/Kg	☼	4	30
Lithium	13		12.6		mg/Kg	☼	3	30
Manganese	430		406		mg/Kg	☼	5	30

Lab Sample ID: MB 140-75406/5-B ^5
Client Sample ID: Method Blank
Matrix: Solid
Prep Type: Step 5
Analysis Batch: 75894
Prep Batch: 75487

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		75	44	mg/Kg		07/19/23 08:00	07/28/23 13:24	5
Lithium	ND		38	2.2	mg/Kg		07/19/23 08:00	07/28/23 13:24	5
Manganese	ND		11	1.9	mg/Kg		07/19/23 08:00	07/28/23 13:24	5

Lab Sample ID: LCS 140-75406/6-B ^5
Client Sample ID: Lab Control Sample
Matrix: Solid
Prep Type: Step 5
Analysis Batch: 75894
Prep Batch: 75487

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Iron	150	ND		mg/Kg		-0.07	
Lithium	15.0	16.9	J	mg/Kg		112	80 - 150
Manganese	15.0	3.96	J	mg/Kg		26	1 - 60

Lab Sample ID: LCSD 140-75406/7-B ^5
Client Sample ID: Lab Control Sample Dup
Matrix: Solid
Prep Type: Step 5
Analysis Batch: 75894
Prep Batch: 75487

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Iron	150	ND		mg/Kg		-0.5		156	
Lithium	15.0	16.7	J	mg/Kg		111	80 - 150	1	30
Manganese	15.0	4.01	J	mg/Kg		27	1 - 60	1	30

QC Sample Results

Client: Geosyntec Consultants Inc
Project/Site: Vermilion SEP

Job ID: 140-32513-1

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: 140-32513-1 DU
Matrix: Solid
Analysis Batch: 75894

Client Sample ID: VER-35 55-60 20230624
Prep Type: Step 5
Prep Batch: 75487

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Iron	ND			ND		mg/Kg	☼			NC	
Lithium	4.1	J		4.21	J	mg/Kg	☼			2	30
Manganese	46			40.0		mg/Kg	☼			14	30

Lab Sample ID: MB 140-75511/5-A
Matrix: Solid
Analysis Batch: 75894

Client Sample ID: Method Blank
Prep Type: Step 6
Prep Batch: 75511

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		5.0	2.9	mg/Kg		07/19/23 08:00	07/28/23 14:14	1
Lithium	ND		2.5	0.15	mg/Kg		07/19/23 08:00	07/28/23 14:14	1
Manganese	ND		0.75	0.25	mg/Kg		07/19/23 08:00	07/28/23 14:14	1

Lab Sample ID: LCS 140-75511/6-A
Matrix: Solid
Analysis Batch: 75894

Client Sample ID: Lab Control Sample
Prep Type: Step 6
Prep Batch: 75511

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Iron			50.0	54.8		mg/Kg		110	80 - 120		
Lithium			5.00	5.27		mg/Kg		105	80 - 120		
Manganese			5.00	5.47		mg/Kg		109	80 - 120		

Lab Sample ID: LCSD 140-75511/7-A
Matrix: Solid
Analysis Batch: 75894

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 6
Prep Batch: 75511

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Iron			50.0	50.7		mg/Kg		101	80 - 120	8	30
Lithium			5.00	4.89		mg/Kg		98	80 - 120	7	30
Manganese			5.00	5.06		mg/Kg		101	80 - 120	8	30

Lab Sample ID: 140-32513-1 DU
Matrix: Solid
Analysis Batch: 75894

Client Sample ID: VER-35 55-60 20230624
Prep Type: Step 6
Prep Batch: 75511

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Iron	11000			10600		mg/Kg	☼			4	30
Lithium	13			12.7		mg/Kg	☼			4	30
Manganese	130			127		mg/Kg	☼			2	30

Lab Sample ID: MB 140-75565/5-A
Matrix: Solid
Analysis Batch: 75976

Client Sample ID: Method Blank
Prep Type: Step 7
Prep Batch: 75565

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron	ND		5.0	4.1	mg/Kg		07/20/23 08:00	07/31/23 12:16	1
Lithium	ND		2.5	0.15	mg/Kg		07/20/23 08:00	07/31/23 12:16	1
Manganese	ND		0.75	0.31	mg/Kg		07/20/23 08:00	07/31/23 12:16	1

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCS 140-75565/6-A
Matrix: Solid
Analysis Batch: 75976

Client Sample ID: Lab Control Sample
Prep Type: Step 7
Prep Batch: 75565

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Iron			50.0	54.2		mg/Kg		108	80 - 120		
Lithium			5.00	5.37		mg/Kg		107	80 - 120		
Manganese			5.00	5.35		mg/Kg		107	80 - 120		

Lab Sample ID: LCSD 140-75565/7-A
Matrix: Solid
Analysis Batch: 75976

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 7
Prep Batch: 75565

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Iron			50.0	54.0		mg/Kg		108	80 - 120	0	30
Lithium			5.00	5.29		mg/Kg		106	80 - 120	2	30
Manganese			5.00	5.30		mg/Kg		106	80 - 120	1	30

Lab Sample ID: 140-32513-1 DU
Matrix: Solid
Analysis Batch: 75976

Client Sample ID: VER-35 55-60 20230624
Prep Type: Step 7
Prep Batch: 75565

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Iron	4300			4610		mg/Kg	☼			6	30
Lithium	15			16.0		mg/Kg	☼			9	30
Manganese	31			32.3		mg/Kg	☼			3	30

Metals

SEP Batch: 75184

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 1	Solid	Exchangeable	
140-32513-2	VER-35 60-63 20230624	Step 1	Solid	Exchangeable	
140-32513-3	VER-70 75-80 20230623	Step 1	Solid	Exchangeable	
MB 140-75184/5-B ^4	Method Blank	Step 1	Solid	Exchangeable	
LCS 140-75184/6-B ^5	Lab Control Sample	Step 1	Solid	Exchangeable	
LCSD 140-75184/7-B ^5	Lab Control Sample Dup	Step 1	Solid	Exchangeable	
140-32513-1 DU	VER-35 55-60 20230624	Step 1	Solid	Exchangeable	

Prep Batch: 75187

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Total/NA	Solid	Total	
140-32513-2	VER-35 60-63 20230624	Total/NA	Solid	Total	
140-32513-3	VER-70 75-80 20230623	Total/NA	Solid	Total	
MB 140-75187/5-A	Method Blank	Total/NA	Solid	Total	
LCS 140-75187/6-A	Lab Control Sample	Total/NA	Solid	Total	
LCSD 140-75187/7-A	Lab Control Sample Dup	Total/NA	Solid	Total	
140-32513-1 DU	VER-35 55-60 20230624	Total/NA	Solid	Total	

Prep Batch: 75207

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 1	Solid	3010A	75184
140-32513-2	VER-35 60-63 20230624	Step 1	Solid	3010A	75184
140-32513-3	VER-70 75-80 20230623	Step 1	Solid	3010A	75184
MB 140-75184/5-B ^4	Method Blank	Step 1	Solid	3010A	75184
LCS 140-75184/6-B ^5	Lab Control Sample	Step 1	Solid	3010A	75184
LCSD 140-75184/7-B ^5	Lab Control Sample Dup	Step 1	Solid	3010A	75184
140-32513-1 DU	VER-35 55-60 20230624	Step 1	Solid	3010A	75184

SEP Batch: 75227

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 2	Solid	Carbonate	
140-32513-2	VER-35 60-63 20230624	Step 2	Solid	Carbonate	
140-32513-3	VER-70 75-80 20230623	Step 2	Solid	Carbonate	
MB 140-75227/5-B ^3	Method Blank	Step 2	Solid	Carbonate	
LCS 140-75227/6-B ^5	Lab Control Sample	Step 2	Solid	Carbonate	
LCSD 140-75227/7-B ^5	Lab Control Sample Dup	Step 2	Solid	Carbonate	
140-32513-1 DU	VER-35 55-60 20230624	Step 2	Solid	Carbonate	

Prep Batch: 75260

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 2	Solid	3010A	75227
140-32513-2	VER-35 60-63 20230624	Step 2	Solid	3010A	75227
140-32513-3	VER-70 75-80 20230623	Step 2	Solid	3010A	75227
MB 140-75227/5-B ^3	Method Blank	Step 2	Solid	3010A	75227
LCS 140-75227/6-B ^5	Lab Control Sample	Step 2	Solid	3010A	75227
LCSD 140-75227/7-B ^5	Lab Control Sample Dup	Step 2	Solid	3010A	75227
140-32513-1 DU	VER-35 55-60 20230624	Step 2	Solid	3010A	75227

SEP Batch: 75274

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 3	Solid	Non-Crystalline	

Metals (Continued)

SEP Batch: 75274 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-2	VER-35 60-63 20230624	Step 3	Solid	Non-Crystalline	
140-32513-3	VER-70 75-80 20230623	Step 3	Solid	Non-Crystalline	
MB 140-75274/5-B	Method Blank	Step 3	Solid	Non-Crystalline	
LCS 140-75274/6-B	Lab Control Sample	Step 3	Solid	Non-Crystalline	
LCSD 140-75274/7-B	Lab Control Sample Dup	Step 3	Solid	Non-Crystalline	
140-32513-1 DU	VER-35 55-60 20230624	Step 3	Solid	Non-Crystalline	

Prep Batch: 75294

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 3	Solid	3010A	75274
140-32513-2	VER-35 60-63 20230624	Step 3	Solid	3010A	75274
140-32513-3	VER-70 75-80 20230623	Step 3	Solid	3010A	75274
MB 140-75274/5-B	Method Blank	Step 3	Solid	3010A	75274
LCS 140-75274/6-B	Lab Control Sample	Step 3	Solid	3010A	75274
LCSD 140-75274/7-B	Lab Control Sample Dup	Step 3	Solid	3010A	75274
140-32513-1 DU	VER-35 55-60 20230624	Step 3	Solid	3010A	75274

SEP Batch: 75320

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 4	Solid	Metal Hydroxide	
140-32513-2	VER-35 60-63 20230624	Step 4	Solid	Metal Hydroxide	
140-32513-3	VER-70 75-80 20230623	Step 4	Solid	Metal Hydroxide	
MB 140-75320/5-B	Method Blank	Step 4	Solid	Metal Hydroxide	
LCS 140-75320/6-B	Lab Control Sample	Step 4	Solid	Metal Hydroxide	
LCSD 140-75320/7-B	Lab Control Sample Dup	Step 4	Solid	Metal Hydroxide	
140-32513-1 DU	VER-35 55-60 20230624	Step 4	Solid	Metal Hydroxide	

SEP Batch: 75406

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 5	Solid	Organic-Bound	
140-32513-2	VER-35 60-63 20230624	Step 5	Solid	Organic-Bound	
140-32513-3	VER-70 75-80 20230623	Step 5	Solid	Organic-Bound	
MB 140-75406/5-B ^5	Method Blank	Step 5	Solid	Organic-Bound	
LCS 140-75406/6-B ^5	Lab Control Sample	Step 5	Solid	Organic-Bound	
LCSD 140-75406/7-B ^5	Lab Control Sample Dup	Step 5	Solid	Organic-Bound	
140-32513-1 DU	VER-35 55-60 20230624	Step 5	Solid	Organic-Bound	

Prep Batch: 75407

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 4	Solid	3010A	75320
140-32513-2	VER-35 60-63 20230624	Step 4	Solid	3010A	75320
140-32513-3	VER-70 75-80 20230623	Step 4	Solid	3010A	75320
MB 140-75320/5-B	Method Blank	Step 4	Solid	3010A	75320
LCS 140-75320/6-B	Lab Control Sample	Step 4	Solid	3010A	75320
LCSD 140-75320/7-B	Lab Control Sample Dup	Step 4	Solid	3010A	75320
140-32513-1 DU	VER-35 55-60 20230624	Step 4	Solid	3010A	75320

Prep Batch: 75487

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 5	Solid	3010A	75406
140-32513-2	VER-35 60-63 20230624	Step 5	Solid	3010A	75406

Metals (Continued)

Prep Batch: 75487 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-3	VER-70 75-80 20230623	Step 5	Solid	3010A	75406
MB 140-75406/5-B ^5	Method Blank	Step 5	Solid	3010A	75406
LCS 140-75406/6-B ^5	Lab Control Sample	Step 5	Solid	3010A	75406
LCSD 140-75406/7-B ^5	Lab Control Sample Dup	Step 5	Solid	3010A	75406
140-32513-1 DU	VER-35 55-60 20230624	Step 5	Solid	3010A	75406

SEP Batch: 75511

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 6	Solid	Acid/Sulfide	
140-32513-2	VER-35 60-63 20230624	Step 6	Solid	Acid/Sulfide	
140-32513-3	VER-70 75-80 20230623	Step 6	Solid	Acid/Sulfide	
MB 140-75511/5-A	Method Blank	Step 6	Solid	Acid/Sulfide	
LCS 140-75511/6-A	Lab Control Sample	Step 6	Solid	Acid/Sulfide	
LCSD 140-75511/7-A	Lab Control Sample Dup	Step 6	Solid	Acid/Sulfide	
140-32513-1 DU	VER-35 55-60 20230624	Step 6	Solid	Acid/Sulfide	

Prep Batch: 75565

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 7	Solid	Residual	
140-32513-2	VER-35 60-63 20230624	Step 7	Solid	Residual	
140-32513-3	VER-70 75-80 20230623	Step 7	Solid	Residual	
MB 140-75565/5-A	Method Blank	Step 7	Solid	Residual	
LCS 140-75565/6-A	Lab Control Sample	Step 7	Solid	Residual	
LCSD 140-75565/7-A	Lab Control Sample Dup	Step 7	Solid	Residual	
140-32513-1 DU	VER-35 55-60 20230624	Step 7	Solid	Residual	

Analysis Batch: 75871

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 1	Solid	6010B SEP	75207
140-32513-1	VER-35 55-60 20230624	Step 2	Solid	6010B SEP	75260
140-32513-1	VER-35 55-60 20230624	Step 3	Solid	6010B SEP	75294
140-32513-2	VER-35 60-63 20230624	Step 1	Solid	6010B SEP	75207
140-32513-2	VER-35 60-63 20230624	Step 2	Solid	6010B SEP	75260
140-32513-2	VER-35 60-63 20230624	Step 3	Solid	6010B SEP	75294
140-32513-3	VER-70 75-80 20230623	Step 1	Solid	6010B SEP	75207
140-32513-3	VER-70 75-80 20230623	Step 2	Solid	6010B SEP	75260
140-32513-3	VER-70 75-80 20230623	Step 3	Solid	6010B SEP	75294
MB 140-75184/5-B ^4	Method Blank	Step 1	Solid	6010B SEP	75207
MB 140-75227/5-B ^3	Method Blank	Step 2	Solid	6010B SEP	75260
MB 140-75274/5-B	Method Blank	Step 3	Solid	6010B SEP	75294
LCS 140-75184/6-B ^5	Lab Control Sample	Step 1	Solid	6010B SEP	75207
LCS 140-75227/6-B ^5	Lab Control Sample	Step 2	Solid	6010B SEP	75260
LCS 140-75274/6-B	Lab Control Sample	Step 3	Solid	6010B SEP	75294
LCSD 140-75184/7-B ^5	Lab Control Sample Dup	Step 1	Solid	6010B SEP	75207
LCSD 140-75227/7-B ^5	Lab Control Sample Dup	Step 2	Solid	6010B SEP	75260
LCSD 140-75274/7-B	Lab Control Sample Dup	Step 3	Solid	6010B SEP	75294
140-32513-1 DU	VER-35 55-60 20230624	Step 1	Solid	6010B SEP	75207
140-32513-1 DU	VER-35 55-60 20230624	Step 2	Solid	6010B SEP	75260
140-32513-1 DU	VER-35 55-60 20230624	Step 3	Solid	6010B SEP	75294

QC Association Summary

Client: Geosyntec Consultants Inc
Project/Site: Vermilion SEP

Job ID: 140-32513-1

Metals

Analysis Batch: 75894

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 4	Solid	6010B SEP	75407
140-32513-1	VER-35 55-60 20230624	Step 5	Solid	6010B SEP	75487
140-32513-1	VER-35 55-60 20230624	Step 6	Solid	6010B SEP	75511
140-32513-2	VER-35 60-63 20230624	Step 4	Solid	6010B SEP	75407
140-32513-2	VER-35 60-63 20230624	Step 5	Solid	6010B SEP	75487
140-32513-2	VER-35 60-63 20230624	Step 6	Solid	6010B SEP	75511
140-32513-3	VER-70 75-80 20230623	Step 4	Solid	6010B SEP	75407
140-32513-3	VER-70 75-80 20230623	Step 4	Solid	6010B SEP	75407
140-32513-3	VER-70 75-80 20230623	Step 5	Solid	6010B SEP	75487
140-32513-3	VER-70 75-80 20230623	Step 6	Solid	6010B SEP	75511
MB 140-75320/5-B	Method Blank	Step 4	Solid	6010B SEP	75407
MB 140-75406/5-B ^5	Method Blank	Step 5	Solid	6010B SEP	75487
MB 140-75511/5-A	Method Blank	Step 6	Solid	6010B SEP	75511
LCS 140-75320/6-B	Lab Control Sample	Step 4	Solid	6010B SEP	75407
LCS 140-75406/6-B ^5	Lab Control Sample	Step 5	Solid	6010B SEP	75487
LCS 140-75511/6-A	Lab Control Sample	Step 6	Solid	6010B SEP	75511
LCSD 140-75320/7-B	Lab Control Sample Dup	Step 4	Solid	6010B SEP	75407
LCSD 140-75406/7-B ^5	Lab Control Sample Dup	Step 5	Solid	6010B SEP	75487
LCSD 140-75511/7-A	Lab Control Sample Dup	Step 6	Solid	6010B SEP	75511
140-32513-1 DU	VER-35 55-60 20230624	Step 4	Solid	6010B SEP	75407
140-32513-1 DU	VER-35 55-60 20230624	Step 5	Solid	6010B SEP	75487
140-32513-1 DU	VER-35 55-60 20230624	Step 6	Solid	6010B SEP	75511

Analysis Batch: 75976

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Step 7	Solid	6010B SEP	75565
140-32513-1	VER-35 55-60 20230624	Total/NA	Solid	6010B	75187
140-32513-1	VER-35 55-60 20230624	Total/NA	Solid	6010B	75187
140-32513-2	VER-35 60-63 20230624	Step 7	Solid	6010B SEP	75565
140-32513-2	VER-35 60-63 20230624	Total/NA	Solid	6010B	75187
140-32513-2	VER-35 60-63 20230624	Total/NA	Solid	6010B	75187
140-32513-3	VER-70 75-80 20230623	Step 7	Solid	6010B SEP	75565
140-32513-3	VER-70 75-80 20230623	Total/NA	Solid	6010B	75187
140-32513-3	VER-70 75-80 20230623	Total/NA	Solid	6010B	75187
MB 140-75187/5-A	Method Blank	Total/NA	Solid	6010B	75187
MB 140-75565/5-A	Method Blank	Step 7	Solid	6010B SEP	75565
LCS 140-75187/6-A	Lab Control Sample	Total/NA	Solid	6010B	75187
LCS 140-75565/6-A	Lab Control Sample	Step 7	Solid	6010B SEP	75565
LCSD 140-75187/7-A	Lab Control Sample Dup	Total/NA	Solid	6010B	75187
LCSD 140-75565/7-A	Lab Control Sample Dup	Step 7	Solid	6010B SEP	75565
140-32513-1 DU	VER-35 55-60 20230624	Step 7	Solid	6010B SEP	75565
140-32513-1 DU	VER-35 55-60 20230624	Total/NA	Solid	6010B	75187
140-32513-1 DU	VER-35 55-60 20230624	Total/NA	Solid	6010B	75187

Analysis Batch: 76083

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Sum of Steps 1-7	Solid	6010B SEP	
140-32513-2	VER-35 60-63 20230624	Sum of Steps 1-7	Solid	6010B SEP	
140-32513-3	VER-70 75-80 20230623	Sum of Steps 1-7	Solid	6010B SEP	

QC Association Summary

Client: Geosyntec Consultants Inc
Project/Site: Vermilion SEP

Job ID: 140-32513-1

General Chemistry

Analysis Batch: 75814

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-32513-1	VER-35 55-60 20230624	Total/NA	Solid	Moisture	
140-32513-2	VER-35 60-63 20230624	Total/NA	Solid	Moisture	
140-32513-3	VER-70 75-80 20230623	Total/NA	Solid	Moisture	
140-32513-1 DU	VER-35 55-60 20230624	Total/NA	Solid	Moisture	

Client Sample ID: VER-35 55-60 20230624

Date Collected: 06/24/23 14:20
Date Received: 07/03/23 11:15

Lab Sample ID: 140-32513-1

Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			76083	08/02/23 14:24	KNC	EET KNX
	Instrument ID:	NOEQUIP								
Total/NA	Analysis	Moisture		1			75814	07/26/23 15:29	ACW	EET KNX
	Instrument ID:	NOEQUIP								

Client Sample ID: VER-35 55-60 20230624

Date Collected: 06/24/23 14:20
Date Received: 07/03/23 11:15

Lab Sample ID: 140-32513-1

Matrix: Solid
Percent Solids: 95.4

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.00 g	50 mL	75187	07/21/23 08:00	LAH	EET KNX
Total/NA	Analysis	6010B		1			75976	07/31/23 13:22	KNC	EET KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1.00 g	50 mL	75187	07/21/23 08:00	LAH	EET KNX
Total/NA	Analysis	6010B		2			75976	07/31/23 14:12	KNC	EET KNX
	Instrument ID:	DUO								
Step 1	SEP	Exchangeable			5.00 g	25 mL	75184	07/10/23 12:30	LAH	EET KNX
Step 1	Prep	3010A			5 mL	50 mL	75207	07/11/23 08:00	LAH	EET KNX
Step 1	Analysis	6010B SEP		4			75871	07/27/23 13:01	KNC	EET KNX
	Instrument ID:	DUO								
Step 2	SEP	Carbonate			5.00 g	25 mL	75227	07/11/23 08:00	LAH	EET KNX
Step 2	Prep	3010A			5 mL	50 mL	75260	07/12/23 08:00	LAH	EET KNX
Step 2	Analysis	6010B SEP		3			75871	07/27/23 13:51	KNC	EET KNX
	Instrument ID:	DUO								
Step 3	SEP	Non-Crystalline			5.00 g	25 mL	75274	07/12/23 08:00	LAH	EET KNX
Step 3	Prep	3010A			5 mL	50 mL	75294	07/13/23 08:00	LAH	EET KNX
Step 3	Analysis	6010B SEP		1			75871	07/27/23 14:40	KNC	EET KNX
	Instrument ID:	DUO								
Step 4	SEP	Metal Hydroxide			5.00 g	25 mL	75320	07/13/23 08:00	LAH	EET KNX
Step 4	Prep	3010A			5 mL	50 mL	75407	07/17/23 08:00	LAH	EET KNX
Step 4	Analysis	6010B SEP		1			75894	07/28/23 12:49	KNC	EET KNX
	Instrument ID:	DUO								
Step 5	SEP	Organic-Bound			5.00 g	75 mL	75406	07/17/23 08:00	LAH	EET KNX
Step 5	Prep	3010A			5 mL	50 mL	75487	07/19/23 08:00	LAH	EET KNX
Step 5	Analysis	6010B SEP		5			75894	07/28/23 13:39	KNC	EET KNX
	Instrument ID:	DUO								
Step 6	SEP	Acid/Sulfide			5.00 g	250 mL	75511	07/19/23 08:00	LAH	EET KNX
Step 6	Analysis	6010B SEP		1			75894	07/28/23 14:29	KNC	EET KNX
	Instrument ID:	DUO								
Step 7	Prep	Residual			1.00 g	50 mL	75565	07/20/23 08:00	LAH	EET KNX
Step 7	Analysis	6010B SEP		1			75976	07/31/23 12:46	KNC	EET KNX
	Instrument ID:	DUO								

Lab Chronicle

Client: Geosyntec Consultants Inc
Project/Site: Vermilion SEP

Job ID: 140-32513-1

Client Sample ID: VER-35 60-63 20230624
Date Collected: 06/24/23 14:50
Date Received: 07/03/23 11:15

Lab Sample ID: 140-32513-2
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			76083	08/02/23 14:24	KNC	EET KNX
	Instrument ID:	NOEQUIP								
Total/NA	Analysis	Moisture		1			75814	07/26/23 15:29	ACW	EET KNX
	Instrument ID:	NOEQUIP								

Client Sample ID: VER-35 60-63 20230624
Date Collected: 06/24/23 14:50
Date Received: 07/03/23 11:15

Lab Sample ID: 140-32513-2
Matrix: Solid
Percent Solids: 95.4

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.00 g	50 mL	75187	07/21/23 08:00	LAH	EET KNX
Total/NA	Analysis	6010B		1			75976	07/31/23 13:33	KNC	EET KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1.00 g	50 mL	75187	07/21/23 08:00	LAH	EET KNX
Total/NA	Analysis	6010B		2			75976	07/31/23 14:22	KNC	EET KNX
	Instrument ID:	DUO								
Step 1	SEP	Exchangeable			5.00 g	25 mL	75184	07/10/23 12:30	LAH	EET KNX
Step 1	Prep	3010A			5 mL	50 mL	75207	07/11/23 08:00	LAH	EET KNX
Step 1	Analysis	6010B SEP		4			75871	07/27/23 13:11	KNC	EET KNX
	Instrument ID:	DUO								
Step 2	SEP	Carbonate			5.00 g	25 mL	75227	07/11/23 08:00	LAH	EET KNX
Step 2	Prep	3010A			5 mL	50 mL	75260	07/12/23 08:00	LAH	EET KNX
Step 2	Analysis	6010B SEP		3			75871	07/27/23 14:01	KNC	EET KNX
	Instrument ID:	DUO								
Step 3	SEP	Non-Crystalline			5.00 g	25 mL	75274	07/12/23 08:00	LAH	EET KNX
Step 3	Prep	3010A			5 mL	50 mL	75294	07/13/23 08:00	LAH	EET KNX
Step 3	Analysis	6010B SEP		1			75871	07/27/23 14:50	KNC	EET KNX
	Instrument ID:	DUO								
Step 4	SEP	Metal Hydroxide			5.00 g	25 mL	75320	07/13/23 08:00	LAH	EET KNX
Step 4	Prep	3010A			5 mL	50 mL	75407	07/17/23 08:00	LAH	EET KNX
Step 4	Analysis	6010B SEP		1			75894	07/28/23 12:59	KNC	EET KNX
	Instrument ID:	DUO								
Step 5	SEP	Organic-Bound			5.00 g	75 mL	75406	07/17/23 08:00	LAH	EET KNX
Step 5	Prep	3010A			5 mL	50 mL	75487	07/19/23 08:00	LAH	EET KNX
Step 5	Analysis	6010B SEP		5			75894	07/28/23 13:49	KNC	EET KNX
	Instrument ID:	DUO								
Step 6	SEP	Acid/Sulfide			5.00 g	250 mL	75511	07/19/23 08:00	LAH	EET KNX
Step 6	Analysis	6010B SEP		1			75894	07/28/23 14:39	KNC	EET KNX
	Instrument ID:	DUO								
Step 7	Prep	Residual			1.00 g	50 mL	75565	07/20/23 08:00	LAH	EET KNX
Step 7	Analysis	6010B SEP		1			75976	07/31/23 12:57	KNC	EET KNX
	Instrument ID:	DUO								

Client Sample ID: VER-70 75-80 20230623

Lab Sample ID: 140-32513-3

Date Collected: 06/23/23 17:00
Matrix: Solid
Date Received: 07/03/23 11:15

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			76083	08/02/23 14:24	KNC	EET KNX
	Instrument ID:	NOEQUIP								
Total/NA	Analysis	Moisture		1			75814	07/26/23 15:29	ACW	EET KNX
	Instrument ID:	NOEQUIP								

Client Sample ID: VER-70 75-80 20230623

Lab Sample ID: 140-32513-3

Date Collected: 06/23/23 17:00
Matrix: Solid
Date Received: 07/03/23 11:15
Percent Solids: 90.0

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.00 g	50 mL	75187	07/21/23 08:00	LAH	EET KNX
Total/NA	Analysis	6010B		1			75976	07/31/23 13:39	KNC	EET KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1.00 g	50 mL	75187	07/21/23 08:00	LAH	EET KNX
Total/NA	Analysis	6010B		5			75976	07/31/23 15:08	KNC	EET KNX
	Instrument ID:	DUO								
Step 1	SEP	Exchangeable			5.00 g	25 mL	75184	07/10/23 12:30	LAH	EET KNX
Step 1	Prep	3010A			5 mL	50 mL	75207	07/11/23 08:00	LAH	EET KNX
Step 1	Analysis	6010B SEP		4			75871	07/27/23 13:16	KNC	EET KNX
	Instrument ID:	DUO								
Step 2	SEP	Carbonate			5.00 g	25 mL	75227	07/11/23 08:00	LAH	EET KNX
Step 2	Prep	3010A			5 mL	50 mL	75260	07/12/23 08:00	LAH	EET KNX
Step 2	Analysis	6010B SEP		3			75871	07/27/23 14:06	KNC	EET KNX
	Instrument ID:	DUO								
Step 3	SEP	Non-Crystalline			5.00 g	25 mL	75274	07/12/23 08:00	LAH	EET KNX
Step 3	Prep	3010A			5 mL	50 mL	75294	07/13/23 08:00	LAH	EET KNX
Step 3	Analysis	6010B SEP		1			75871	07/27/23 14:55	KNC	EET KNX
	Instrument ID:	DUO								
Step 4	SEP	Metal Hydroxide			5.00 g	25 mL	75320	07/13/23 08:00	LAH	EET KNX
Step 4	Prep	3010A			5 mL	50 mL	75407	07/17/23 08:00	LAH	EET KNX
Step 4	Analysis	6010B SEP		1			75894	07/28/23 13:04	KNC	EET KNX
	Instrument ID:	DUO								
Step 4	SEP	Metal Hydroxide			5.00 g	25 mL	75320	07/13/23 08:00	LAH	EET KNX
Step 4	Prep	3010A			5 mL	50 mL	75407	07/17/23 08:00	LAH	EET KNX
Step 4	Analysis	6010B SEP		2			75894	07/28/23 14:55	KNC	EET KNX
	Instrument ID:	DUO								
Step 5	SEP	Organic-Bound			5.00 g	75 mL	75406	07/17/23 08:00	LAH	EET KNX
Step 5	Prep	3010A			5 mL	50 mL	75487	07/19/23 08:00	LAH	EET KNX
Step 5	Analysis	6010B SEP		5			75894	07/28/23 13:54	KNC	EET KNX
	Instrument ID:	DUO								
Step 6	SEP	Acid/Sulfide			5.00 g	250 mL	75511	07/19/23 08:00	LAH	EET KNX
Step 6	Analysis	6010B SEP		1			75894	07/28/23 14:44	KNC	EET KNX
	Instrument ID:	DUO								
Step 7	Prep	Residual			1.00 g	50 mL	75565	07/20/23 08:00	LAH	EET KNX
Step 7	Analysis	6010B SEP		1			75976	07/31/23 13:17	KNC	EET KNX
	Instrument ID:	DUO								

Client Sample ID: Method Blank
Lab Sample ID: MB 140-75184/5-B ^4

Date Collected: N/A
Date Received: N/A
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 1	SEP	Exchangeable			5.00 g	25 mL	75184	07/10/23 12:30	LAH	EET KNX
Step 1	Prep	3010A			5 mL	50 mL	75207	07/11/23 08:00	LAH	EET KNX
Step 1	Analysis	6010B SEP		4			75871	07/27/23 12:47	KNC	EET KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank
Lab Sample ID: MB 140-75187/5-A

Date Collected: N/A
Date Received: N/A
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.00 g	50 mL	75187	07/21/23 08:00	LAH	EET KNX
Total/NA	Analysis	6010B		1			75976	07/31/23 12:31	KNC	EET KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank
Lab Sample ID: MB 140-75227/5-B ^3

Date Collected: N/A
Date Received: N/A
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 2	SEP	Carbonate			5.00 g	25 mL	75227	07/11/23 08:00	LAH	EET KNX
Step 2	Prep	3010A			5 mL	50 mL	75260	07/12/23 08:00	LAH	EET KNX
Step 2	Analysis	6010B SEP		3			75871	07/27/23 13:36	KNC	EET KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank
Lab Sample ID: MB 140-75274/5-B

Date Collected: N/A
Date Received: N/A
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 3	SEP	Non-Crystalline			5.00 g	25 mL	75274	07/12/23 08:00	LAH	EET KNX
Step 3	Prep	3010A			5 mL	50 mL	75294	07/13/23 08:00	LAH	EET KNX
Step 3	Analysis	6010B SEP		1			75871	07/27/23 14:26	KNC	EET KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank
Lab Sample ID: MB 140-75320/5-B

Date Collected: N/A
Date Received: N/A
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 4	SEP	Metal Hydroxide			5.00 g	25 mL	75320	07/13/23 08:00	LAH	EET KNX
Step 4	Prep	3010A			5 mL	50 mL	75407	07/17/23 08:00	LAH	EET KNX
Step 4	Analysis	6010B SEP		1			75894	07/28/23 12:35	KNC	EET KNX
	Instrument ID: DUO									

Lab Chronicle

Client Sample ID: Method Blank

Lab Sample ID: MB 140-75406/5-B ^5

Date Collected: N/A
Date Received: N/A

Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 5	SEP	Organic-Bound			5.00 g	75 mL	75406	07/17/23 08:00	LAH	EET KNX
Step 5	Prep	3010A			5 mL	50 mL	75487	07/19/23 08:00	LAH	EET KNX
Step 5	Analysis	6010B SEP		5			75894	07/28/23 13:24	KNC	EET KNX
	Instrument ID:	DUO								

Client Sample ID: Method Blank

Lab Sample ID: MB 140-75511/5-A

Date Collected: N/A
Date Received: N/A

Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 6	SEP	Acid/Sulfide			5.00 g	250 mL	75511	07/19/23 08:00	LAH	EET KNX
Step 6	Analysis	6010B SEP		1			75894	07/28/23 14:14	KNC	EET KNX
	Instrument ID:	DUO								

Client Sample ID: Method Blank

Lab Sample ID: MB 140-75565/5-A

Date Collected: N/A
Date Received: N/A

Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 7	Prep	Residual			1.00 g	50 mL	75565	07/20/23 08:00	LAH	EET KNX
Step 7	Analysis	6010B SEP		1			75976	07/31/23 12:16	KNC	EET KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-75184/6-B ^5

Date Collected: N/A
Date Received: N/A

Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 1	SEP	Exchangeable			5.00 g	25 mL	75184	07/10/23 12:30	LAH	EET KNX
Step 1	Prep	3010A			5 mL	50 mL	75207	07/11/23 08:00	LAH	EET KNX
Step 1	Analysis	6010B SEP		5			75871	07/27/23 12:52	KNC	EET KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-75187/6-A

Date Collected: N/A
Date Received: N/A

Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.00 g	50 mL	75187	07/21/23 08:00	LAH	EET KNX
Total/NA	Analysis	6010B		1			75976	07/31/23 12:36	KNC	EET KNX
	Instrument ID:	DUO								

Lab Chronicle

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-75227/6-B ^5

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 2	SEP	Carbonate			5.00 g	25 mL	75227	07/11/23 08:00	LAH	EET KNX
Step 2	Prep	3010A			5 mL	50 mL	75260	07/12/23 08:00	LAH	EET KNX
Step 2	Analysis	6010B SEP		5			75871	07/27/23 13:41	KNC	EET KNX

Instrument ID: DUO

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-75274/6-B

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 3	SEP	Non-Crystalline			5.00 g	25 mL	75274	07/12/23 08:00	LAH	EET KNX
Step 3	Prep	3010A			5 mL	50 mL	75294	07/13/23 08:00	LAH	EET KNX
Step 3	Analysis	6010B SEP		1			75871	07/27/23 14:31	KNC	EET KNX

Instrument ID: DUO

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-75320/6-B

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 4	SEP	Metal Hydroxide			5.00 g	25 mL	75320	07/13/23 08:00	LAH	EET KNX
Step 4	Prep	3010A			5 mL	50 mL	75407	07/17/23 08:00	LAH	EET KNX
Step 4	Analysis	6010B SEP		1			75894	07/28/23 12:40	KNC	EET KNX

Instrument ID: DUO

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-75406/6-B ^5

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 5	SEP	Organic-Bound			5.00 g	75 mL	75406	07/17/23 08:00	LAH	EET KNX
Step 5	Prep	3010A			5 mL	50 mL	75487	07/19/23 08:00	LAH	EET KNX
Step 5	Analysis	6010B SEP		5			75894	07/28/23 13:29	KNC	EET KNX

Instrument ID: DUO

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-75511/6-A

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 6	SEP	Acid/Sulfide			5.00 g	250 mL	75511	07/19/23 08:00	LAH	EET KNX
Step 6	Analysis	6010B SEP		1			75894	07/28/23 14:19	KNC	EET KNX

Instrument ID: DUO

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-75565/6-A

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 7	Prep	Residual			1.00 g	50 mL	75565	07/20/23 08:00	LAH	EET KNX
Step 7	Analysis	6010B SEP		1			75976	07/31/23 12:21	KNC	EET KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample Dup

Lab Sample ID: LCSD 140-75184/7-B ^5

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 1	SEP	Exchangeable			5.00 g	25 mL	75184	07/10/23 12:30	LAH	EET KNX
Step 1	Prep	3010A			5 mL	50 mL	75207	07/11/23 08:00	LAH	EET KNX
Step 1	Analysis	6010B SEP		5			75871	07/27/23 12:57	KNC	EET KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample Dup

Lab Sample ID: LCSD 140-75187/7-A

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.00 g	50 mL	75187	07/21/23 08:00	LAH	EET KNX
Total/NA	Analysis	6010B		1			75976	07/31/23 12:41	KNC	EET KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample Dup

Lab Sample ID: LCSD 140-75227/7-B ^5

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 2	SEP	Carbonate			5.00 g	25 mL	75227	07/11/23 08:00	LAH	EET KNX
Step 2	Prep	3010A			5 mL	50 mL	75260	07/12/23 08:00	LAH	EET KNX
Step 2	Analysis	6010B SEP		5			75871	07/27/23 13:46	KNC	EET KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample Dup

Lab Sample ID: LCSD 140-75274/7-B

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 3	SEP	Non-Crystalline			5.00 g	25 mL	75274	07/12/23 08:00	LAH	EET KNX
Step 3	Prep	3010A			5 mL	50 mL	75294	07/13/23 08:00	LAH	EET KNX
Step 3	Analysis	6010B SEP		1			75871	07/27/23 14:36	KNC	EET KNX
	Instrument ID:	DUO								

Lab Chronicle

Client Sample ID: Lab Control Sample Dup

Lab Sample ID: LCSD 140-75320/7-B

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 4	SEP	Metal Hydroxide			5.00 g	25 mL	75320	07/13/23 08:00	LAH	EET KNX
Step 4	Prep	3010A			5 mL	50 mL	75407	07/17/23 08:00	LAH	EET KNX
Step 4	Analysis	6010B SEP		1			75894	07/28/23 12:44	KNC	EET KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample Dup

Lab Sample ID: LCSD 140-75406/7-B ^5

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 5	SEP	Organic-Bound			5.00 g	75 mL	75406	07/17/23 08:00	LAH	EET KNX
Step 5	Prep	3010A			5 mL	50 mL	75487	07/19/23 08:00	LAH	EET KNX
Step 5	Analysis	6010B SEP		5			75894	07/28/23 13:34	KNC	EET KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample Dup

Lab Sample ID: LCSD 140-75511/7-A

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 6	SEP	Acid/Sulfide			5.00 g	250 mL	75511	07/19/23 08:00	LAH	EET KNX
Step 6	Analysis	6010B SEP		1			75894	07/28/23 14:24	KNC	EET KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample Dup

Lab Sample ID: LCSD 140-75565/7-A

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 7	Prep	Residual			1.00 g	50 mL	75565	07/20/23 08:00	LAH	EET KNX
Step 7	Analysis	6010B SEP		1			75976	07/31/23 12:26	KNC	EET KNX
	Instrument ID: DUO									

Client Sample ID: VER-35 55-60 20230624

Lab Sample ID: 140-32513-1 DU

Date Collected: 06/24/23 14:20
Matrix: Solid
Date Received: 07/03/23 11:15

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			75814	07/26/23 15:29	ACW	EET KNX
	Instrument ID: NOEQUIP									

Lab Chronicle

Client: Geosyntec Consultants Inc
Project/Site: Vermilion SEP

Job ID: 140-32513-1

Client Sample ID: VER-35 55-60 20230624
Date Collected: 06/24/23 14:20
Date Received: 07/03/23 11:15

Lab Sample ID: 140-32513-1 DU
Matrix: Solid
Percent Solids: 95.4

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.00 g	50 mL	75187	07/21/23 08:00	LAH	EET KNX
Total/NA	Analysis	6010B		1			75976	07/31/23 13:28	KNC	EET KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1.00 g	50 mL	75187	07/21/23 08:00	LAH	EET KNX
Total/NA	Analysis	6010B		2			75976	07/31/23 14:17	KNC	EET KNX
	Instrument ID:	DUO								
Step 1	SEP	Exchangeable			5.00 g	25 mL	75184	07/10/23 12:30	LAH	EET KNX
Step 1	Prep	3010A			5 mL	50 mL	75207	07/11/23 08:00	LAH	EET KNX
Step 1	Analysis	6010B SEP		4			75871	07/27/23 13:06	KNC	EET KNX
	Instrument ID:	DUO								
Step 2	SEP	Carbonate			5.00 g	25 mL	75227	07/11/23 08:00	LAH	EET KNX
Step 2	Prep	3010A			5 mL	50 mL	75260	07/12/23 08:00	LAH	EET KNX
Step 2	Analysis	6010B SEP		3			75871	07/27/23 13:56	KNC	EET KNX
	Instrument ID:	DUO								
Step 3	SEP	Non-Crystalline			5.00 g	25 mL	75274	07/12/23 08:00	LAH	EET KNX
Step 3	Prep	3010A			5 mL	50 mL	75294	07/13/23 08:00	LAH	EET KNX
Step 3	Analysis	6010B SEP		1			75871	07/27/23 14:45	KNC	EET KNX
	Instrument ID:	DUO								
Step 4	SEP	Metal Hydroxide			5.00 g	25 mL	75320	07/13/23 08:00	LAH	EET KNX
Step 4	Prep	3010A			5 mL	50 mL	75407	07/17/23 08:00	LAH	EET KNX
Step 4	Analysis	6010B SEP		1			75894	07/28/23 12:54	KNC	EET KNX
	Instrument ID:	DUO								
Step 5	SEP	Organic-Bound			5.00 g	75 mL	75406	07/17/23 08:00	LAH	EET KNX
Step 5	Prep	3010A			5 mL	50 mL	75487	07/19/23 08:00	LAH	EET KNX
Step 5	Analysis	6010B SEP		5			75894	07/28/23 13:44	KNC	EET KNX
	Instrument ID:	DUO								
Step 6	SEP	Acid/Sulfide			5.00 g	250 mL	75511	07/19/23 08:00	LAH	EET KNX
Step 6	Analysis	6010B SEP		1			75894	07/28/23 14:34	KNC	EET KNX
	Instrument ID:	DUO								
Step 7	Prep	Residual			1.00 g	50 mL	75565	07/20/23 08:00	LAH	EET KNX
Step 7	Analysis	6010B SEP		1			75976	07/31/23 12:51	KNC	EET KNX
	Instrument ID:	DUO								

Laboratory References:

EET KNX = Eurofins Knoxville, 5815 Middlebrook Pike, Knoxville, TN 37921, TEL (865)291-3000

Accreditation/Certification Summary

Client: Geosyntec Consultants Inc
Project/Site: Vermilion SEP

Job ID: 140-32513-1

Laboratory: Eurofins Knoxville

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	Identification Number	Expiration Date
	AFCEE	N/A	
ANAB	Dept. of Defense ELAP	L2311	02-13-25
ANAB	Dept. of Energy	L2311.01	02-13-25
ANAB	ISO/IEC 17025	L2311	02-13-25
Arkansas DEQ	State	88-0688	06-16-24
Colorado	State	TN00009	02-29-24
Connecticut	State	PH-0223	09-30-23
Florida	NELAP	E87177	06-30-24
Georgia (DW)	State	906	07-27-25
Hawaii	State	NA	07-27-23 *
Kansas	NELAP	E-10349	10-31-23
Kentucky (DW)	State	90101	12-31-23
Louisiana (All)	NELAP	83979	06-30-24
Louisiana (DW)	State	LA019	12-31-23
Maryland	State	277	03-31-24
Michigan	State	9933	07-27-25
Nevada	State	TN00009	07-31-23 *
New Hampshire	NELAP	2999	01-17-24
New Jersey	NELAP	TN001	07-01-24
New York	NELAP	10781	03-31-24
North Carolina (DW)	State	21705	07-31-24
North Carolina (WW/SW)	State	64	12-31-23
Oklahoma	State	9415	08-31-23
Oregon	NELAP	TNI0189	01-01-24
Pennsylvania	NELAP	68-00576	12-01-23
Tennessee	State	02014	07-27-25
Texas	NELAP	T104704380-22-17	08-31-23
US Fish & Wildlife	US Federal Programs	058448	07-31-24
USDA	US Federal Programs	525-22-279-18762	10-06-25
Utah	NELAP	TN00009	07-31-24
Virginia	NELAP	460176	09-14-23
Washington	State	C593	01-19-24
West Virginia (DW)	State	9955C	12-31-23
West Virginia DEP	State	345	04-30-24
Wisconsin	State	998044300	08-31-23

* Accreditation/Certification renewal pending - accreditation/certification considered valid.

Method Summary

Method	Method Description	Protocol	Laboratory
6010B	SEP Metals (ICP) - Total	SW846	EET KNX
6010B SEP	SEP Metals (ICP)	SW846	EET KNX
Moisture	Percent Moisture	EPA	EET KNX
3010A	Preparation, Total Metals	SW846	EET KNX
Acid/Sulfide	Sequential Extraction Procedure, Acid/Sulfide Fraction	TAL-KNOX	EET KNX
Carbonate	Sequential Extraction Procedure, Carbonate Fraction	TAL-KNOX	EET KNX
Exchangeable	Sequential Extraction Procedure, Exchangeable Fraction	TAL-KNOX	EET KNX
Metal Hydroxide	Sequential Extraction Procedure, Metal Hydroxide Fraction	TAL-KNOX	EET KNX
Non-Crystalline	Sequential Extraction Procedure, Non-crystalline Materials	TAL-KNOX	EET KNX
Organic-Bound	Sequential Extraction Procedure, Organic Bound Fraction	TAL-KNOX	EET KNX
Residual	Sequential Extraction Procedure, Residual Fraction	TAL-KNOX	EET KNX
Total	Preparation, Total Material	TAL-KNOX	EET KNX

Protocol References:

EPA = US Environmental Protection Agency
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.
TAL-KNOX = TestAmerica Laboratories, Knoxville, Facility Standard Operating Procedure.

Laboratory References:

EET KNX = Eurofins Knoxville, 5815 Middlebrook Pike, Knoxville, TN 37921, TEL (865)291-3000

Eurofins TestAmerica, Knoxville
5815 Middlebrook Pike

Knoxville, TN 37921-5947
phone 865.291.3000 fax 865.584.4315

Chain of Custody Record

eurofins Environment Testing TestAmerica

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☑ Other:

TestAmerica Laboratories, Inc. d/b/a Eurofins TestAmerica

Client Contact
Geosyntec Consultants, Inc.
941 Chatham Lane, Suite 103
Columbus, OH 43221
(614) 468-0421 Phone

Project Name: Vistra
Site: Vermilion
P O #

Project Manager: Allison Kreinberg
Tel/Fax:

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ______
☒ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Site Contact: NA
Lab Contact: Ryan Henry
Date:
Carrier:

COC No:
__1__ of __1__ COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	6010B SEP (Li, Fe, Mn)	Sample Specific Notes:
VER-35 55-60 20230624	6/24/2023	1420	G	Solid	1	N	N	X	
VER-35 60-63 20230624	6/24/2023	1450	G	Solid	1	N	N	X	
VER-70 75-80 20230623	6/23/2023	1700	G	Solid	1	N	N	X	

No Custody Seal
Received Ambient RT: 20.0/CT: 20.3°C
DH 7/13/23
1 Box FedEx 7804 7929 1869 G

140-32513 Chain of Custody

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☑ Archive for______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd:________ Corr'd:________ Therm ID No.:________

Relinquished by: Jordan Kelley
Company: GEOSYNTEC
Date/Time: 6/28/23 1600
Received by: Dean Hick
Company: ETA KNX
Date/Time: 7/13/23 ~~9:00~~ 11:15 DH 7/13/23

Relinquished by:
Company:
Date/Time:
Received by:
Company:
Date/Time:

Relinquished by:
Company:
Date/Time:
Received in Laboratory by:
Company:
Date/Time:

Form No. CA-C-WI-002, Rev. 4.21, dated 4/4/2019

Loc: 140
32513

EUROFINS/TESTAMERICA KNOXVILLE SAMPLE RECEIPT/CONDITION UPON RECEIPT ANOMALY CHECKLIST

Log In Number:

Review Items	Yes	No	NA	If No, what was the problem?
1. Are the shipping containers intact?	✓			☐ **Containers, Broken**
2. Were ambient air containers received intact?			✓	☐ Checked in lab
3. The coolers/containers custody seal if present, is it intact?			✓	☐ Yes ☐ NA
4. Is the cooler temperature within limits? (> freezing temp. of water to 6 °C, VOST: 10°C) Thermometer ID : SC73 Correction factor: +0.3°C			✓	☐ **Cooler Out of Temp, Client Contacted, Proceed/Cancel** ☐ **Cooler Out of Temp, Same Day Receipt**
5. Were all of the sample containers received intact?	✓			☐ **Containers, Broken**
6. Were samples received in appropriate containers?			✓	☐ **Containers, Improper; Client Contacted; Proceed/Cancel**
7. Do sample container labels match COC? (IDs, Dates, Times)	✓			☐ **COC & Samples Do Not Match** ☐ **COC Incorrect/Incomplete** ☐ **COC Not Received**
8. Were all of the samples listed on the COC received?	✓			☐ **Sample Received, Not on COC** ☐ **Sample on COC, Not Received**
9. Is the date/time of sample collection noted?	✓			☐ **COC; No Date/Time; Client Contacted**
10. Was the sampler identified on the COC?		✓		☐ **Sampler Not Listed on COC**
11. Is the client and project name/# identified?	✓			☐ **COC Incorrect/Incomplete**
12. Are tests/parameters listed for each sample?	✓			☐ **COC No tests on COC**
13. Is the matrix of the samples noted?	✓			☐ **COC Incorrect/Incomplete**
14. Was COC relinquished? (Signed/Dated/Timed)	✓			☐ **COC Incorrect/Incomplete**
15. Were samples received within holding time?	✓			☐ **Holding Time - Receipt**
16. Were samples received with correct chemical preservative (excluding Encore)?			✓	☐ **pH Adjusted, pH Included (See box 16A)** ☐ **Incorrect Preservative**
17. Were VOA samples received without headspace?			✓	☐ **Headspace (VOA only)**
18. Did you check for residual chlorine, if necessary? (e.g. 1613B, 1668) Chlorine test strip lot number:			✓	☐ **Residual Chlorine**
19. For 1613B water samples is pH<9?			✓	☐ If no, notify lab to adjust
20. For rad samples was sample activity info. Provided?			✓	☐ Project missing info

Comments/Actions Taken

10,

Labeling Verified by: **Date:**

pH test strip lot number:

	Box 16A: pH Preservation	Box 18A: Residual Chlorine
Preservative:		
Lot Number:		
Exp Date:		
Analyst:		
Date:		
Time:		

Project #: 14006199 PM Instructions:

Sample Receiving Associate: Dean Hick Date: 7/3/23

QA026R32.doc, 062719

ATTACHMENT 4

X-Ray Diffraction
Laboratory Analytical Report

SGS

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*Environmental Services*
Project Number/ LIMS No.	*Custom XRD/MI4526-AUG23*
Sample Receipt:	*August 10, 2023*
Sample Analysis:	*August 31, 2023*
Reporting Date:	*September 13, 2023*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 35 kV, 40 mA; Detector: LYNXEYE Regular Scanning: Step: 0.02°, Step time: 0.75s, 2θ range: 6-80° Clay Section Scanning: Step: 0.01°, Step time:0.2s, 2θ range: 3-40°
Interpretations :	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

Kim Gibbs

Zhihai (Adrian) Zhang, Ph.D
Mineralogist

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

ACCREDITATION: SGS Natural Resources Lakefield is accredited to the requirements of ISO/IEC 17025 for specific tests as listed on our scope of accreditation, including geochemical, mineralogical and trade mineral tests. To view a list of the accredited methods, please visit the following website and search SGS Canada Inc. - Minerals: https://www.scc.ca/en/search/palcan.

Method Summary

The Rietveld Method of Mineral Identification by XRD (ME-LR-MIN-MET-MN-D05) method used by SGS Natural Resources is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Clay Mineral Separation and Identification:

Clay minerals are typically fine-grained (<2 µm) phyllosilicates in sedimentary rock. Due to the poor crystallinity and fine size of clay minerals, separation of the clay fraction from bulk samples by centrifuge is required. A slide of the oriented clay fraction is prepared and scanned followed by a series of procedures (the addition of ethylene glycol and high temperature heating). Clay minerals are identified by their individual diffraction patterns and changes in their diffraction pattern after different treatments. Clay speciation and mineral identification of the bulk sample are performed using DIFFRACplus EVA (Bruker AXS).

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

Summary of Rietveld Quantitative Analysis X-Ray Diffraction Results

Mineral/Compound	**VER-35 55-60 20230624 AUG4526-01** (wt %)	**VER-35 60-63 20230624 AUG4526-02** (wt %)	**VER-70 30-40 20230623 AUG4526-03** (wt %)	**VER-70 41-42 20230623 AUG4526-04** (wt %)	**VER-70 75-80 20230623 AUG4526-05** (wt %)
Quartz	38.5	38.1	48.6	48.2	35.0
Chlorite	6.9	6.8	1.2	3.6	7.7
Muscovite	23.4	23.0	13.5	15.2	27.0
Albite	12.6	12.6	10.6	10.8	11.5
Microcline	1.0	1.1	1.3	1.1	0.7
Siderite	4.9	5.0	0.9	0.1	5.4
Actinolite	-	-	0.8	-	-
Dolomite	-	-	11.7	11.7	-
Clays					
Illite	7.1	8.0	7.4	5.6	5.2
Kaolinite	5.6	5.4	3.2	3.7	7.5
Montmorillonite	-	-	0.8	-	-
TOTAL	100	100	100	100	100

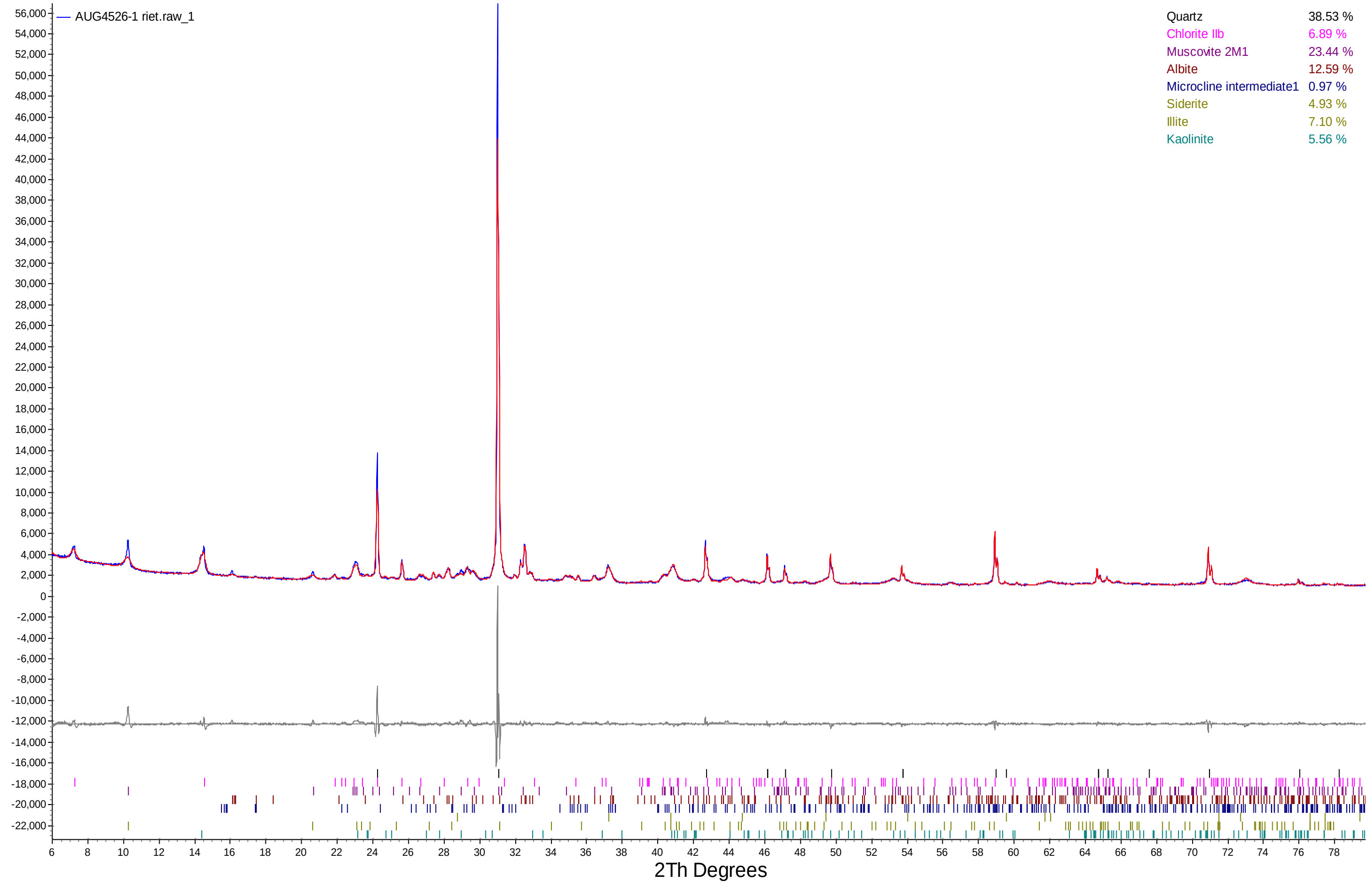
Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identified by the analyst and not included in the refinement calculation for the sample.

The weight percent quantities indicated have been normalized to a sum of 100%. The quantity of amorphous material has not been determined.

Mineral/Compound	**Formula**
Quartz	SiO_2
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Albite	$NaAlSi_3O_8$
Microcline	$KAlSi_3O_8$
Siderite	$FeCO_3$
Illite	$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$
Dolomite	$CaMg(CO_3)_2$
Montmorillonite	$(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2\cdot 10H_2O$

VER-35 55-60 20230624



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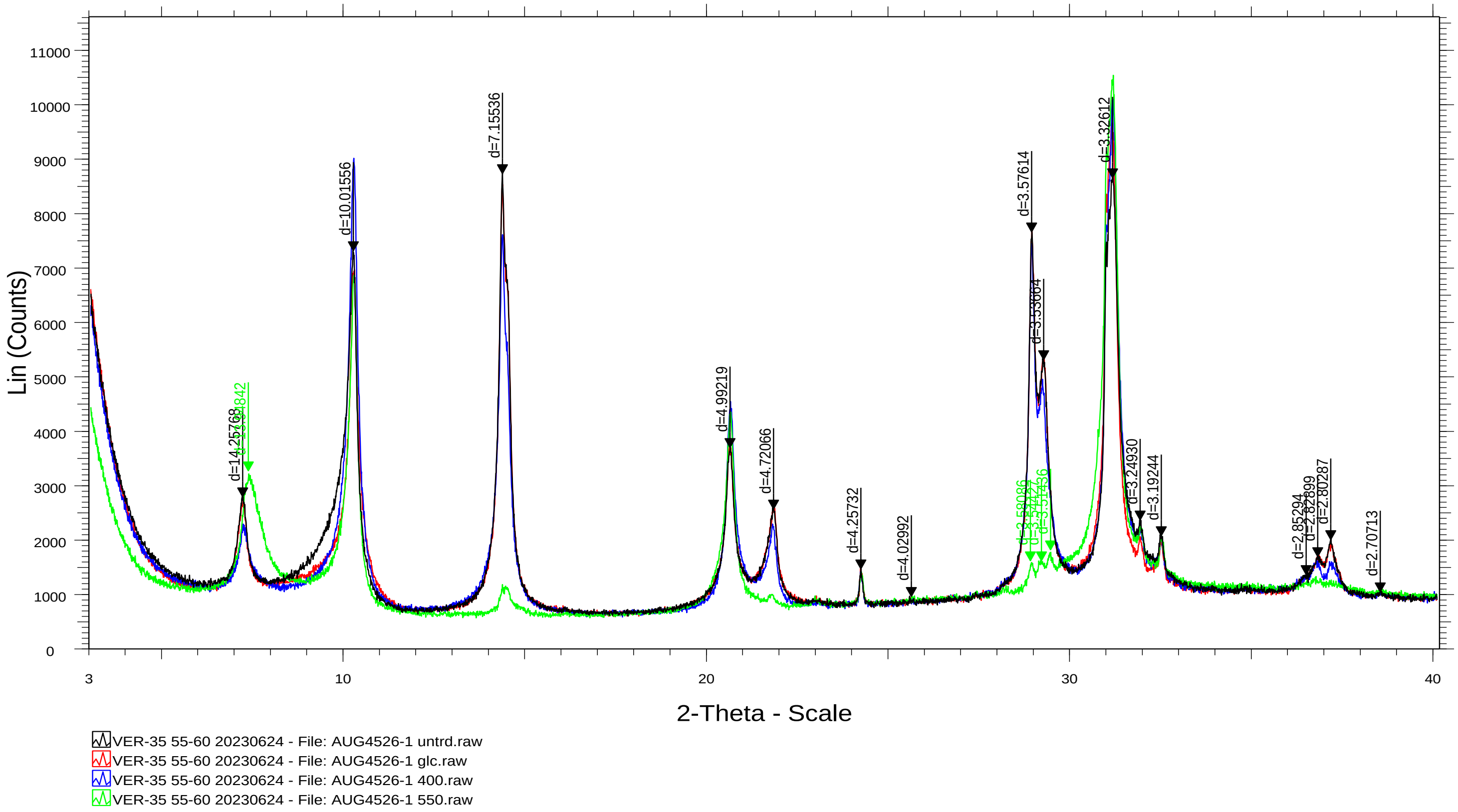

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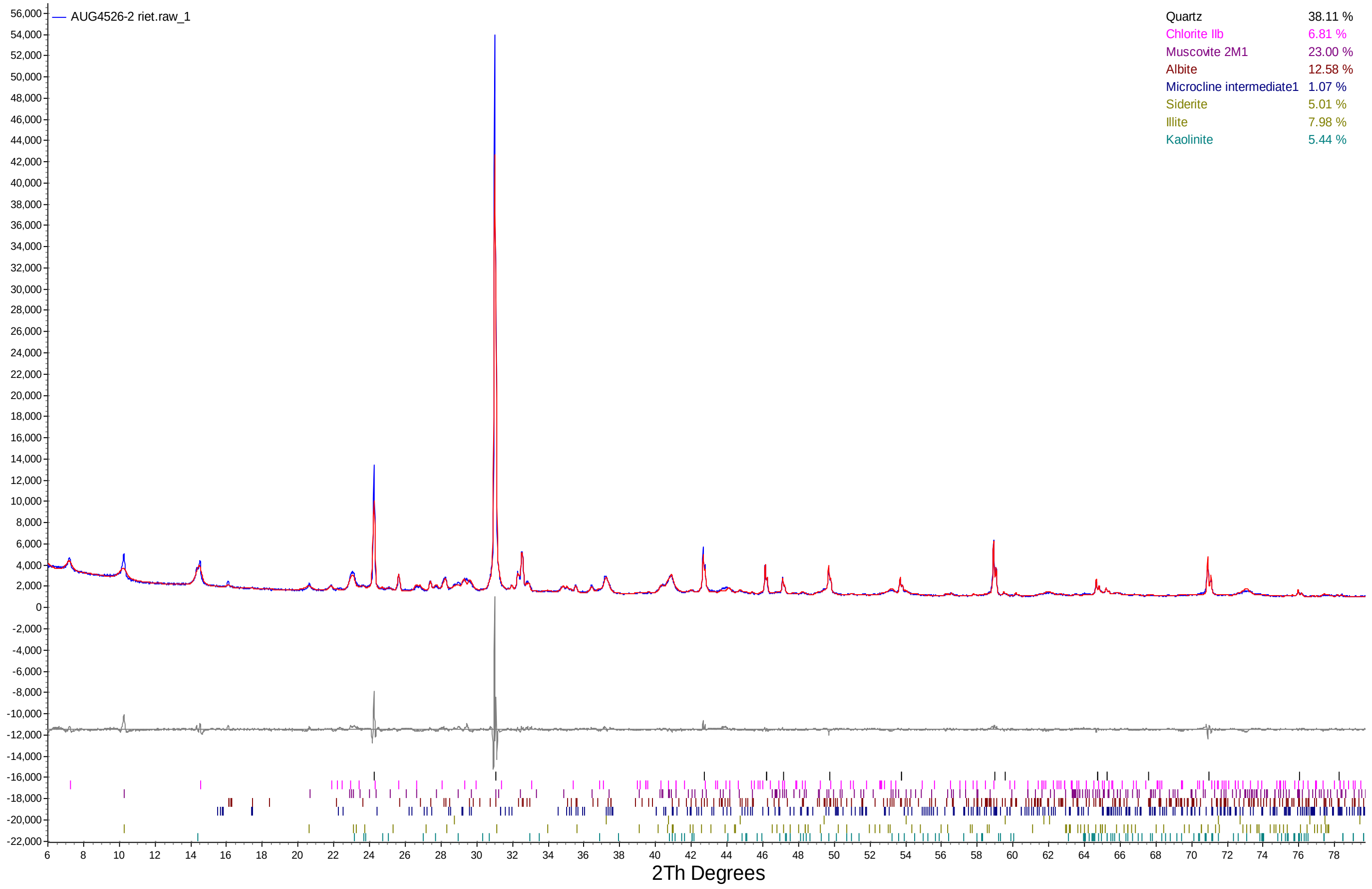

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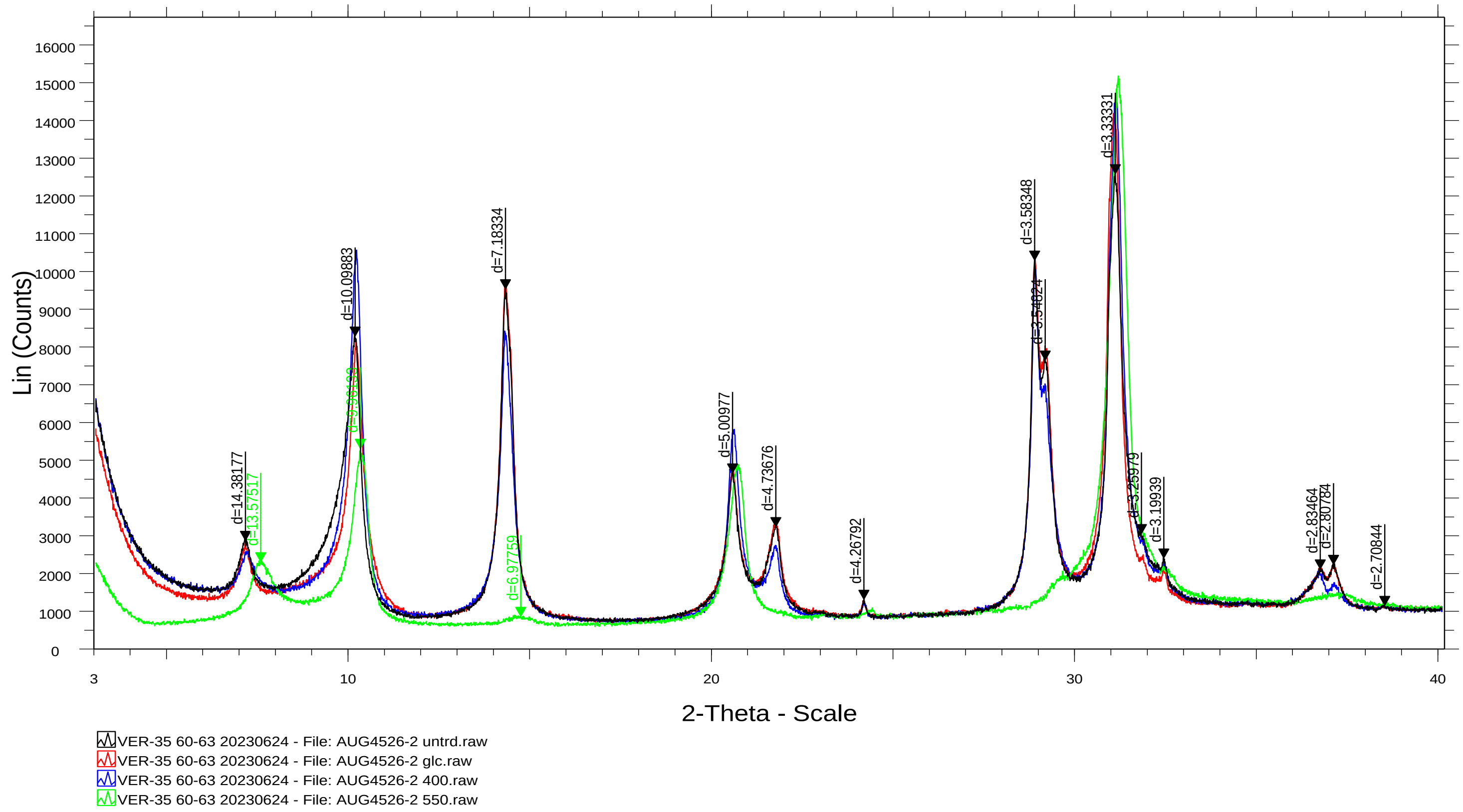

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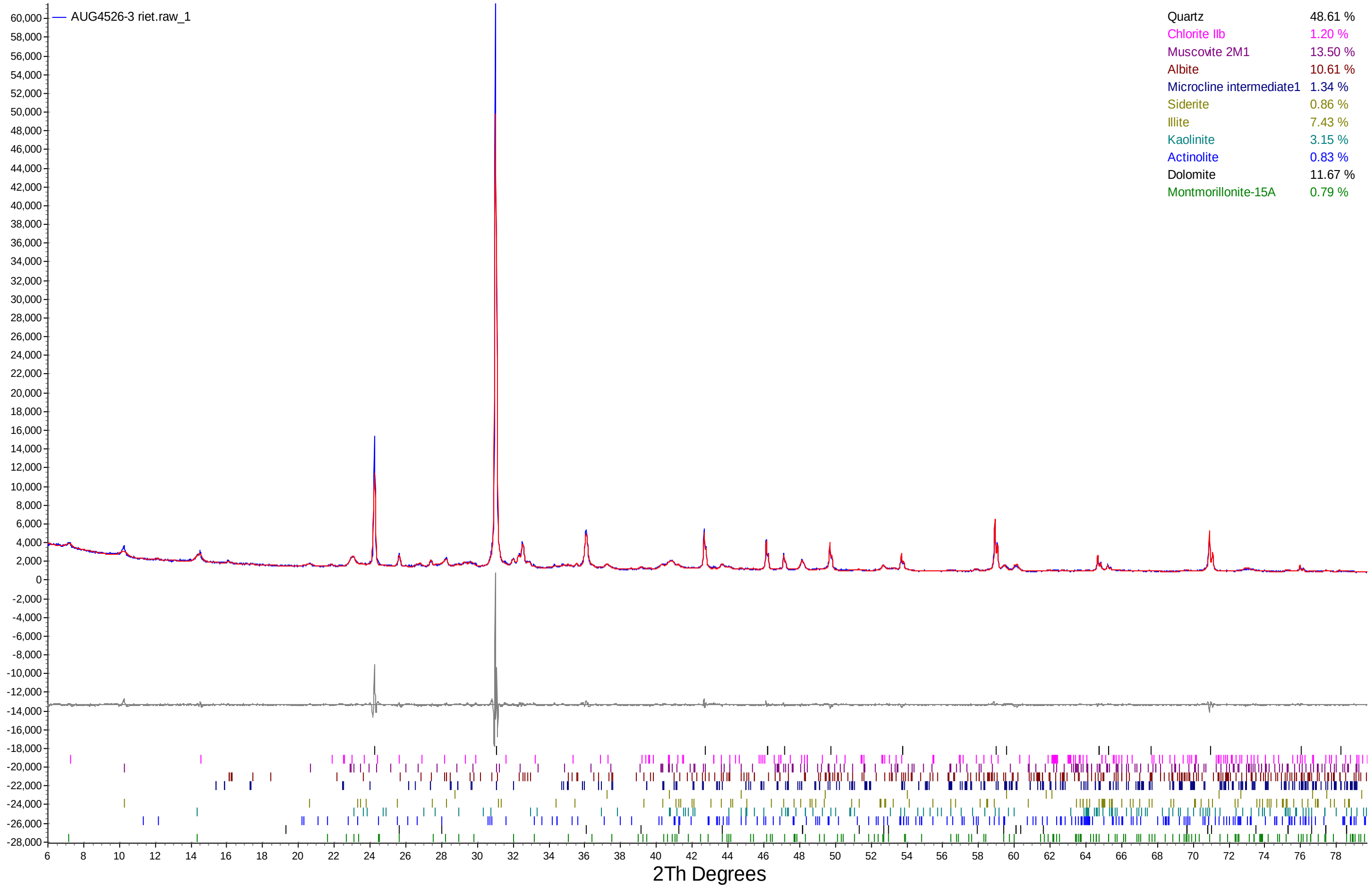

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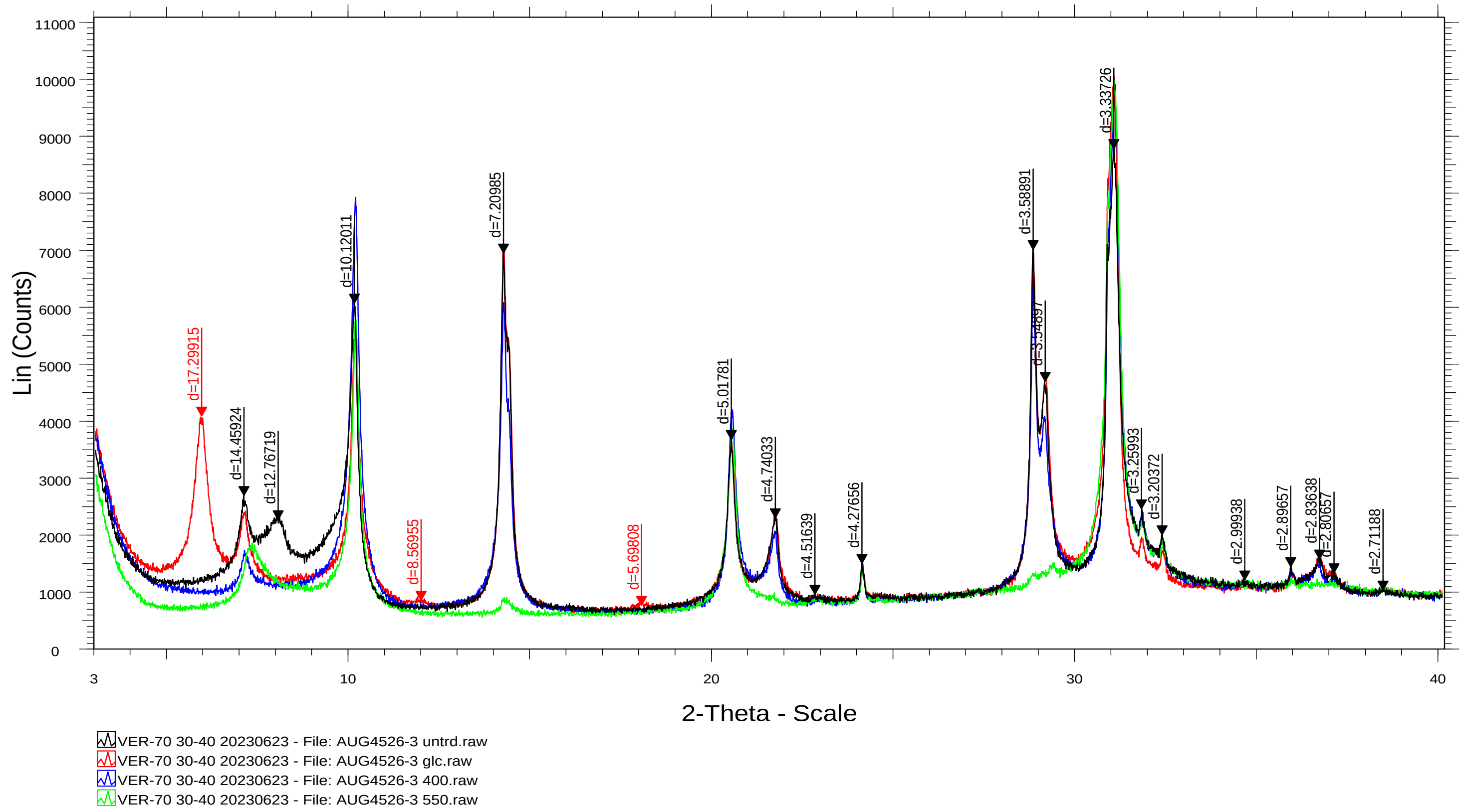
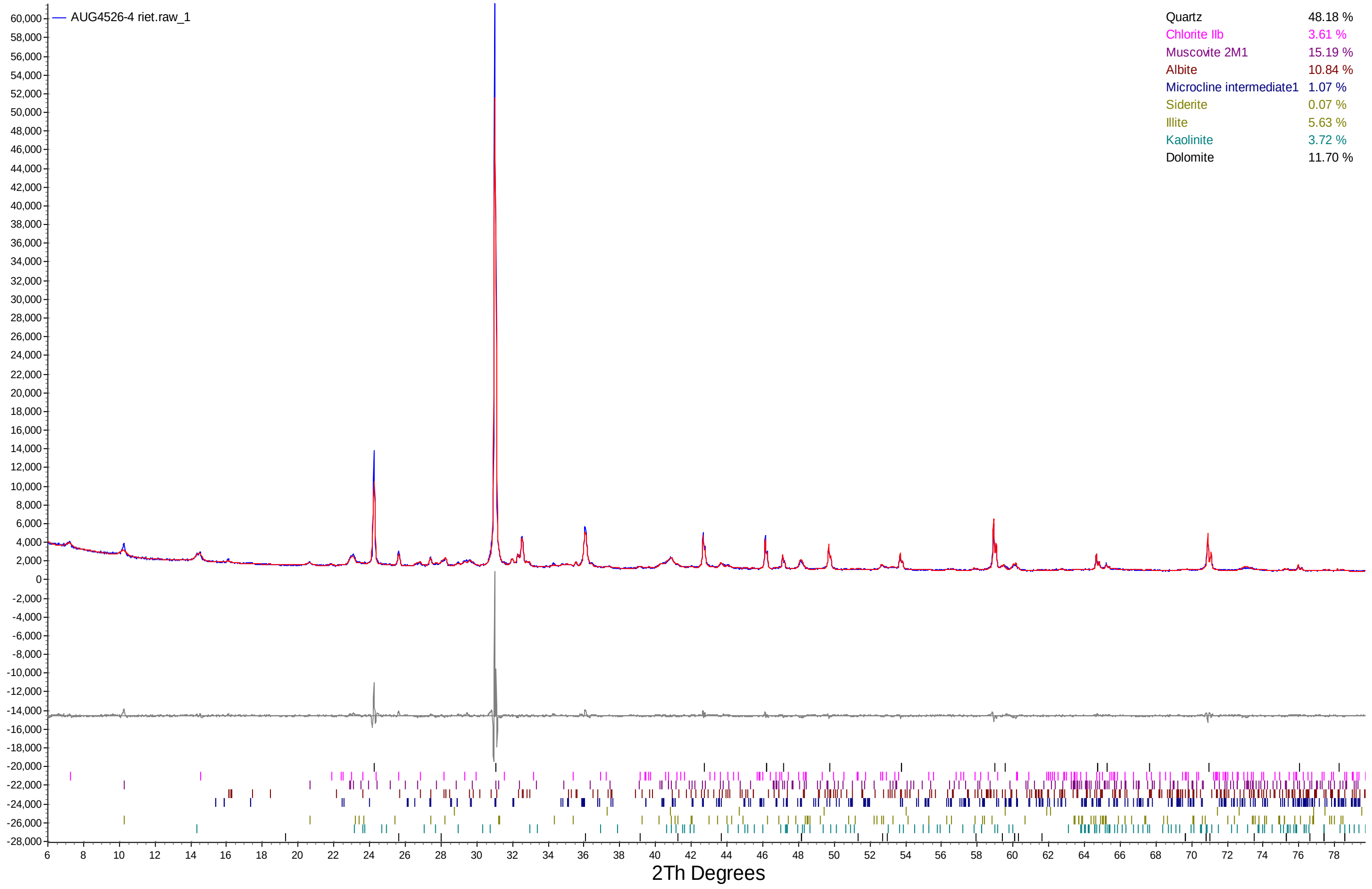
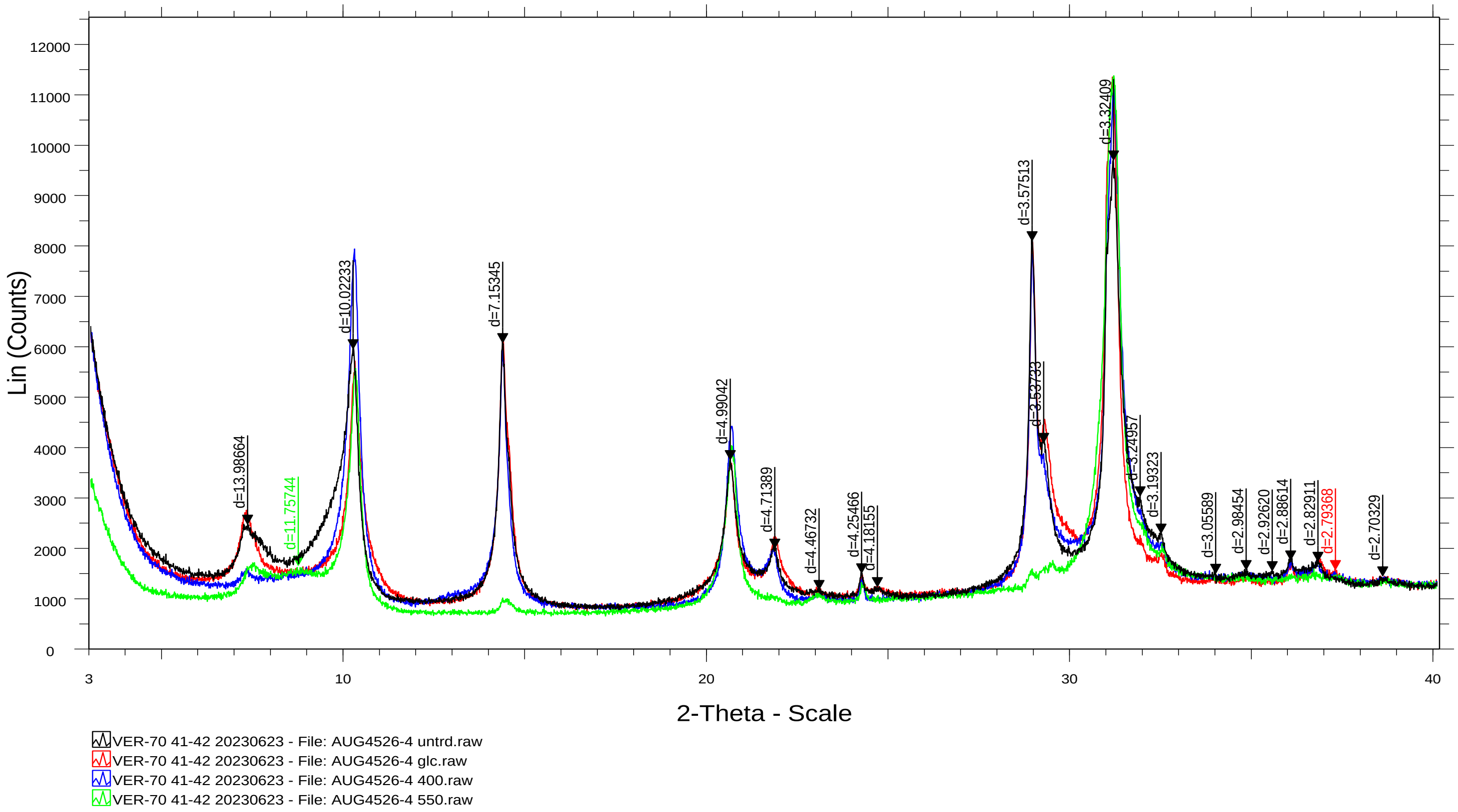


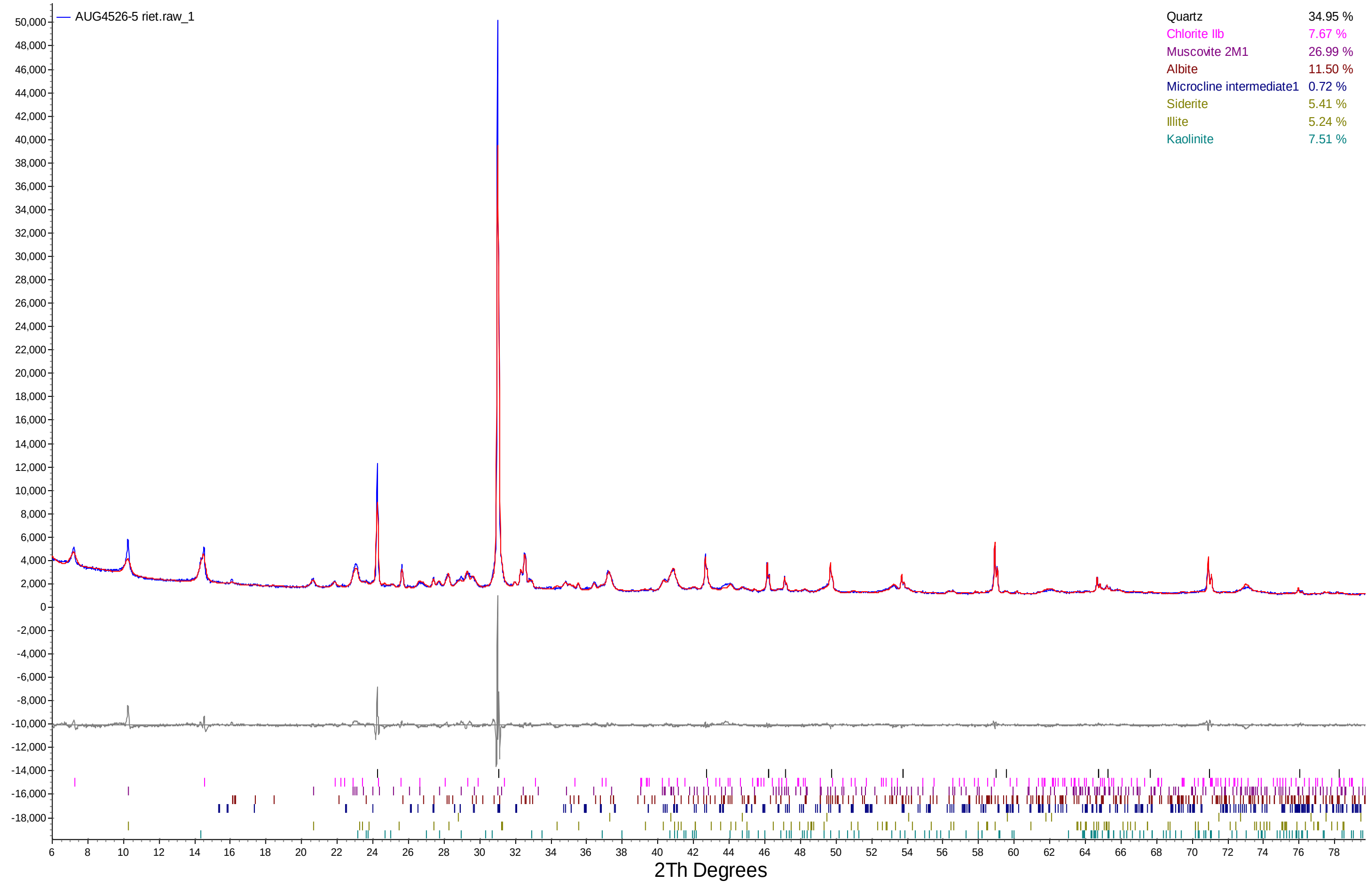


VER-70 41-42 20230623

VER-70 41-42 20230623



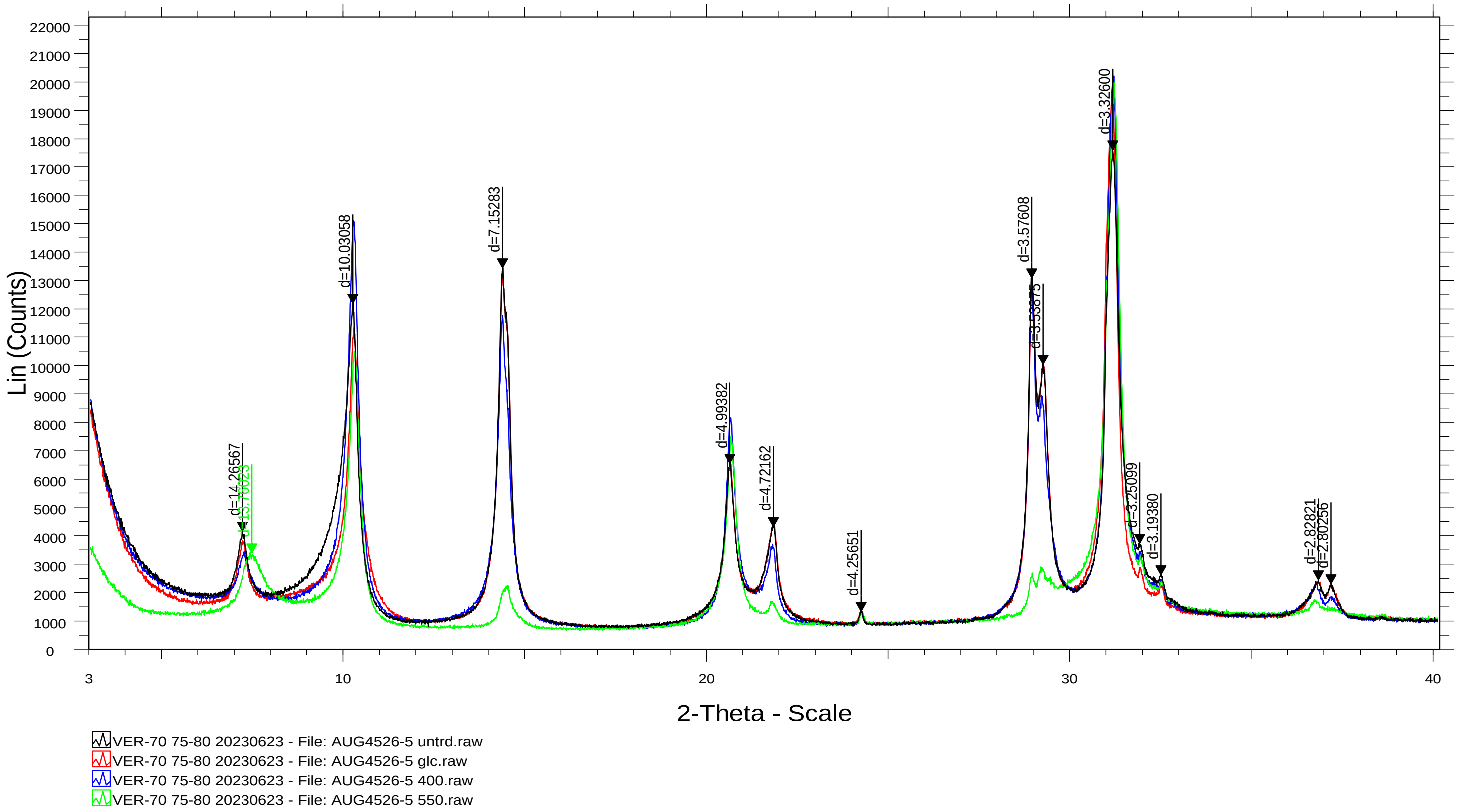
VER-70 75-80 20230623



Quartz	34.95 %
Chlorite IIb	7.67 %
Muscovite 2M1	26.99 %
Albite	11.50 %
Microcline intermediate1	0.72 %
Siderite	5.41 %
Illite	5.24 %
Kaolinite	7.51 %

Environmental Services
Custom XRD/MI4526-AUG23
13-Sep-23

VER-70 75-80 20230623



ATTACHMENT 5

Principal Component Analysis Input Data

ELECTRONIC PCA DATA FOR ATTACHMENT 5

35 I.A.C. § 845: ALTERNATIVE SOURCE DEMONSTRATION
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Well	HSU	Date	Well Type	pH (SU)	Alkalinity, bicarbonate (mg/L)	Alkalinity, carbonate (mg/L)	Barium (mg/L)	Boron (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Fluoride (mg/L)
16A	BCU	4/1/2021	Downgradient	7.50	390	1.5	0.261	0.675	40.8	131	0.77
16A	BCU	4/21/2021	Downgradient	7.20	407	1.5	0.335	0.613	71.10	106	0.64
16A	BCU	5/11/2021	Downgradient	7.40	361	1.5	0.245	0.807	36.6	139	0.78
16A	BCU	6/3/2021	Downgradient	7.26	405	1.5	0.272	0.716	51.60	128	0.68
16A	BCU	6/17/2021	Downgradient	7.40	406	1.5	0.251	0.746	42.20	144	0.78
16A	BCU	7/8/2021	Downgradient	7.31	404	1.5	0.249	0.768	38.00	151	0.77
16A	BCU	7/27/2021	Downgradient	7.45	390	1.5	0.248	0.794	35.30	163	0.84
16A	BCU	8/17/2021	Downgradient	7.50	393	1.5	0.261	0.755	33.30	176	0.84
35D	BCU	4/1/2021	Downgradient	8.20	707	1.5	0.111	2.01	112.0	529	0.76
35D	BCU	4/21/2021	Downgradient	7.76	533	1.5	0.0294	1.8	93.60	281	0.65
35D	BCU	6/3/2021	Downgradient	7.25	637	1.5	0.0546	2.5	98.10	461	0.75
35D	BCU	6/17/2021	Downgradient	7.25	603	1.5	0.14	1.8	99.40	393	0.75
35D	BCU	7/8/2021	Downgradient	7.22	582	1.5	0.0297	1.9	86.00	372	0.74
35D	BCU	7/27/2021	Downgradient	7.37	507	1.5	0.0263	1.5	70.40	234	0.79
35D	BCU	8/17/2021	Downgradient	7.30	491	1.5	0.0269	1.4	65.7	199	0.76
70D	BCU	4/1/2021	Downgradient	7.60	262	1.5	0.3360	0.712	39.6	317	0.76
70D	BCU	4/21/2021	Downgradient	7.28	334	1.5	0.521	1.01	48.1	517	0.57
70D	BCU	6/3/2021	Downgradient	7.03	416	1.5	0.687	1.56	68.6	665	0.47
70D	BCU	6/17/2021	Downgradient	7.14	443	1.5	0.7260	1.33	73.1	680	0.5
70D	BCU	7/8/2021	Downgradient	6.85	527	1.5	0.954	1.58	82.5	735	0.41
70D	BCU	7/27/2021	Downgradient	6.96	540	1.5	0.734	1.54	78.1	745	0.44
70D	BCU	8/17/2021	Downgradient	6.84	610	1.5	0.761	1.54	91.5	716	0.36
71D	BCU	4/1/2021	Downgradient	7.60	258	1.5	0.299	0.58	37.7	172	0.92
71D	BCU	6/17/2021	Downgradient	7.15	475	1.5	0.4	1.1	28.7	563	0.73
71D	BCU	8/17/2021	Downgradient	6.95	628	1.5	0.677	1.3	34.9	674	0.56
22	BCU	4/1/2021	Upgradient	7.40	390	1.5	0.0723	0.41	41.5	23	0.43
22	BCU	4/20/2021	Upgradient	7.58	407	1.5	0.0798	0.4	37.5	11	0.4000
22	BCU	5/10/2021	Upgradient	7.29	395	1.5	0.0795	0.433	45.7	11	0.4200
22	BCU	6/3/2021	Upgradient	7.26	390	1.5	0.0787	0.361	48.3	7	0.3800
22	BCU	6/17/2021	Upgradient	7.23	406	1.5	0.0791	0.377	50.3	7	0.3900
22	BCU	7/8/2021	Upgradient	7.20	412	1.5	0.082	0.348	47.7	7	0.37
22	BCU	7/27/2021	Upgradient	7.34	401	1.5	0.0795	0.311	48.2	7	0.39
22	BCU	8/17/2021	Upgradient	7.26	402	1.5	0.0785	0.34	47.1	7	0.38
NED1	CCR	4/1/2021	CCR	9.20	1.5	81	0.032	18.6	497.0	44	0.3200
NED1	CCR	4/21/2021	CCR	8.86	4	62	0.029	19.3	472.0	32	0.3800
NED1	CCR	5/11/2021	CCR	7.88	132	1.5	0.0289	14	674.0	18	0.2
NED1	CCR	6/4/2021	CCR	7.55	117	1.5	0.0319	13.5	532.0	18	0.24
NED1	CCR	8/17/2021	CCR	8.73	18	41	0.0314	18.3	531.0	25	0.29
10	UCU	4/1/2021	Upgradient	6.80	550	1.5	0.079	0.0587	182.0	6	0.13
10	UCU	4/21/2021	Upgradient	6.80	546	1.5	0.047	0.0587	193.0	6	0.14
10	UCU	5/10/2021	Upgradient	6.76	476	1.5	0.068	0.053	160.0	4	0.14
10	UCU	6/3/2021	Upgradient	6.74	579	1.5	0.0795	0.0835	186.0	5	0.14
10	UCU	6/17/2021	Upgradient	6.76	550	1.5	0.0625	0.111	186.0	6	0.14
10	UCU	7/8/2021	Upgradient	6.69	561	1.5	0.068	0.0499	166.0	5	0.13
10	UCU	7/27/2021	Upgradient	6.80	550	1.5	0.0712	0.237	182.0	4	0.14
10	UCU	8/17/2021	Upgradient	6.69	582	1.5	0.0772	0.0695	192.0	5	0.13
70S	UU	4/1/2021	Downgradient	7.00	310	1.5	0.018	0.457	253.0	19	0.14
70S	UU	4/21/2021	Downgradient	6.94	270	1.5	0.0205	0.403	281.0	17	0.14
70S	UU	5/10/2021	Downgradient	6.99	262	1.5	0.0185	0.382	270.0	16	0.14
70S	UU	6/3/2021	Downgradient	6.91	272	1.5	0.0165	0.424	245.0	15	0.14
70S	UU	6/17/2021	Downgradient	6.85	278	1.5	0.0187	0.363	250.0	15	0.15
70S	UU	7/8/2021	Downgradient	6.80	305	1.5	0.0172	0.253	220.0	14	0.16
70S	UU	7/27/2021	Downgradient	7.01	287	1.5	0.01	0.556	229.0	11	0.17
70S	UU	8/17/2021	Downgradient	6.87	272	1.5	0.02	0.538	232.0	15	0.16
71S	UU	4/1/2021	Downgradient	6.90	422	1.5	0.0476	0.179	115.0	2	0.18
71S	UU	4/21/2021	Downgradient	6.73	419	1.5	0.0534	0.215	116.0	3	0.17
71S	UU	5/12/2021	Downgradient	6.84	403	1.5	0.0487	0.227	124.0	3	0.18
71S	UU	6/3/2021	Downgradient	6.71	419	1.5	0.0446	0.229	116.0	2	0.18
71S	UU	6/17/2021	Downgradient	6.76	422	1.5	0.0421	0.219	117.0	2	0.19
71S	UU	7/8/2021	Downgradient	6.60	462	1.5	0.0493	0.173	128.0	2	0.19
71S	UU	7/27/2021	Downgradient	6.83	421	1.5	0.0462	0.251	132.0	2	0.2
71S	UU	8/17/2021	Downgradient	6.73	442	1.5	0.0672	0.272	122.0	3	0.19

Notes:
mg/L = milligrams per liter
SU= standard units
HSU = hydrostratigraphic unit
CCR = coal combustion residual
BCU = Bedrock Confining Unit
UCU = Upper Confining Unit
UU = Upper Unit
Non-detect values were replaced with half of detection limit.