SCOTT A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

KEVIN STITT
Governor

October 29, 2019

Ms. Jill Parker-Witt, P.E.
American Electric Power
502 North Allen Avenue
Shreveport, LA 71101

Re: Alternate Source Demonstration for Lithium –Bottom Ash Pond
Public Service Company of Oklahoma
Northeastern Power Station
Rogers County
Solid Waste Permit No. none

Dear Ms. Parker-Witt:

On July 8, 2019, DEQ denied the alternate source demonstration (ASD) for lithium in the Bottom Ash Pond (BAP) that was submitted by AEP/Public Service Company of Oklahoma Northeastern Power Station (NPS) to demonstrate that a source other than the coal combustion residuals (CCR) unit caused the lithium statistically significant level (SSL) detected in monitoring well SP-10. DEQ stated in the letter that if additional information was attained to support a revised ASD, DEQ would re-evaluate the revised ASD.

On September 13, 2019, NPS submitted a revised ASD that addressed concerns DEQ had with the ASD which proposed naturally occurring concentrations of lithium in groundwater are the source of the SSL in SP-10.

In the revised ASD, NPS questioned DEQ's statement in the July 8, 2019 letter that the lithium concentration in monitoring well SP-5R was "not elevated". To clarify, DEQ's meaning of elevated level in the July 8, 2019 letter meant the concentration of lithium detected in SP-5R was not elevated when compared to lithium levels in the lower zone as measured in SP-6, SP-7 and SP-10. Similarly lithium in SP-8, which is screened in the lower zone, was not elevated leading DEQ to question the conceptual model which proposes the clay mineral in lower zone shales is the source of elevated lithium.

NPS sampled and analyzed the sediment, leachate and pore water in the BAP to compare to the data collected from SP-10. The results showed lithium in the sediment leachate and pore water measured 1 µg/L and 3 µg/L, respectively, compared to 286 µg/L measured in SP-10 on March 14, 2019. The lithium concentration of the sluice water (5.87 µg/L) entering the BAP was also much lower than that in SP-10. DEQ agrees that the low concentration of lithium in the BAP as well as the different water chemistry as depicted in the Piper diagram furthers the proposal that the BAP is not a direct source of the lithium SSL in SP-10.

DEQ reviewed the additional information concerning SP-5R and SP-8 provided in the revised ASD. DEQ accepts that the elevated lithium concentration detected in SP-10 may be produced from the shale lenses within the screened interval of SP-10.

The new data presented in both ASDs depicts a new conceptual model that still does not completely fit with all of the groundwater sampling data. Please contact DEQ to arrange a time to discuss modifying the groundwater monitoring network.

DEQ accepts the revised ASD as submitted. The BAP may return to assessment monitoring in accordance with OAC 252:517-9-6(g)(3)(B). NPS must include the revised ASD in the annual groundwater monitoring and corrective action report required by OAC 252:517-9-1(e).

If you have any questions, please contact Ms. Cindy Hailes at (405) 702-5114.

Sincerely,

Hillary Young, P.E.
Chief Engineer
Land Protection Division

HY/ckh

American Electric Power
502 North Allen Avenue
Shreveport, LA 71101
AEP.com

September 11, 2019

Via U.S. and electronic mail

Ms. Hillary Young
Oklahoma Department of Environmental Quality ("ODEQ")
707 North Robinson, P.O. Box 1677
Oklahoma City, OK 73101-1677

Re: Alternate Source Demonstration ("ASD") for lithium- Bottom Ash Pond
Public Service Company of Oklahoma
Northeastern Power Station (NPS)

Dear Ms. Young,

PSO received ODEQ's correspondence dated July 8, 2019 communicating that ODEQ could not conclude that NPS's bottom ash pond ("BAP") was not the source of lithium detected in the groundwater above the Groundwater Protective Standard (GWPS) based on the data presented. We appreciate ODEQ's consideration of PSO's ASD and understand that at this time, ODEQ has not approved the ASD. ODEQ's correspondence identified possible deficiencies in the ASD that could be developed further and ODEQ inferred that it would reconsider the ASD in light of additional information. PSO would like to provide clarification as well as additional data and information for ODEQ's reconsideration that an alternate source exists for lithium other than the BAP.

This letter will present the following lines of evidence in support of the existence of naturally occurring concentrations of groundwater lithium at the Site:

- Upgradient wells contain higher lithium concentrations than EPA's Regional Screening Levels (0.04 mg/L)
- Upgradient well SP-5R contains higher concentrations of lithium than upgradient well SP-4, even though SP-5R is farther from the BAP than SP-4
- Detection of a higher lithium concentration in the mineral formation (76 mg/kg) than in the BAP solids (15 mg/kg)
- Detection of a lower lithium concentration in the BAP sluiced water and BAP pore water than in the groundwater
- Leachability of the BAP sediments produced a lithium concentration equal to the method detection level (0.001 mg/L)
- The water chemistries of the BAP sediment, pore water, and pond water are similar but they are very different from SP-10's water chemistry , indicating the waters are not from the same source
- The spatial distribution of lithium in the groundwater indicates there is an increasing lithium concentration with depth and distance from the BAP, which does not conform to the principles of contaminate transport

A. <u>Clarification of ASD submittal</u>

After reviewing ODEQ's letter, PSO realized certain information in the ASD may not have been as evident and would benefit from further clarification. Specifically, PSO would like to provide additional clarification and information to address certain statements made by ODEQ in their letter.

The paragraph and statements for which PSO will provide further clarification are on page 2 of ODEQ's July 8, 2019 letter:

> Elevated lithium concentrations were detected in down gradient monitoring well SP-10; however, *lithium was not detected in elevated levels in upgradient, monitoring well SP - 5R* even though *boring logs from SP-5R show the monitoring well contains interbeds of dark limey shale within the screened interval.* Also *SP-8, located near SP-10, and*

> *screened across a lower zone shale exhibits low concentrations of lithium*. If the lithium at SP-10 was due to the presence of shale lenses within the screened interval of SP-10, then both SP-5R and SP-8 should exhibit elevated levels of lithium. The conceptual model that NPS proposed does not fit the actual ground water sampling data. [emphasis added]

First, PSO would like to provide context to the statement: "…lithium was not detected in elevated levels in upgradient monitoring well SP-5R…" PSO is not certain what lithium concentration ODEQ is using but in the ASD PSO relies on EPA's Regional Screening level (RSL, 4-2019) for lithium which is 0.04 mg/L that supersedes the former EPA Region 3 (RBC Table), Region 6 (HHMSSL Table), and 9 (PRG Table) (see attached table). SP-5R is located approximately 2,000 feet upgradient (77 yrs travel time, given the estimated groundwater velocity of 0.071 ft/day or 26 ft/yr) from the BAP. During the collection of groundwater background data, SP-5R had lithium concentrations that ranged from 0.100 mg/L to 0.163 mg/L. Additionally during the collection of background data, SP-4 (located 100 feet upgradient of the BAP) had lithium concentrations that ranged from 0.0697 mg/l to 0.136 mg/L, less than that found in SP-5R. The lithium concentrations in these wells are 1.75 to 4 times greater than EPA's RSL. Therefore, PSO interprets the naturally occurring lithium concentrations in these upgradient, background wells to be "elevated" as compared to the EPA's RSL. The presence of "elevated" lithium in the upgradient wells, which has produced a GWPS of 0.15 mg/L (3.75 times the EPA's RLS), particularly with greater concentrations of lithium detected farther from the BAP, supports the conclusion that lithium is naturally occurring within the groundwater at the site.

ODEQ continues with the phrase: "…even though boring logs from SP-5R show that the monitoring well contains interbeds of dark limey shale within the screened interval." SP-5R was drilled initially to a depth of 35 ft but did not produce water therefore the well was re-drilled to a total depth of 75 feet with a screen interval of 34-75 ft bgs. [Top of sand pack at 31 ft bgs]. Moisture was encountered around 61 feet. The boring logs for SP-5R show the limey shale present at 4ft -12 ft bgs and then again from 30-35 ft bgs. The re-drilled log also indicates that SP-5R's screen interval contains very little limey shale and there is no mention in the re-drilled

log that the frequency of limey shale layers increasing with depth. The SP-5R boring log differs to the boring log for SP-10 that states that the frequency of shale layers does appear to increase with depth. Laboratory analysis of the limey shale material shows that it contains 76 mg/kg lithium (solids expressed in mg/kg; groundwater expressed as mg/L).

Therefore, lower groundwater lithium concentrations in SP-5R (ranging from 0.100 mg/L to 0.163 mg/L) can be expected with the presence of less lithium containing material within the screened interval of SP-5R than those concentrations detected in SP-10 (ranging from 0.278 mg/L to 0.329 mg/L) which was observed to have more lithium containing material. Even though it is not possible to identify the actual location where groundwater encounters the limey shale, this evidence further verifies that lithium resides in the geological formation and the lithium concentrations in groundwater vary based on the amount of mineral content of the formation within the screened intervals of the wells.

Finally, ODEQ states, "SP-8, located near SP-10, and screened across a lower zone shale exhibits low concentrations of lithium." SP-8 is located approximately 750 feet from SP-10 and is "nested" with SP-11. SP-10 is "nested" with SP-9. See figure below.

Since SP-8 is not within the CCR groundwater well network, SP-8 is not sampled on a regular basis. The available concentrations of lithium detected in SP-8 are listed below.

	Sample Date	Li (mg/l)
SP-8	11/03/16	0.337
SP-8	5/18/2017	0.128
SP-8	6/15/2017	0.0295*
SP-8	6/27/2017	0.0179*
SP-8	7/12/2017	0.0359*
SP-8	3/14/2019	0.780

The “lower concentrations” of lithium (denoted in the table by an asterisk) occurred during a time period when samples were collected temporally close together (12-28 days) only allowing enough time for groundwater to travel less than 2 feet through the lithology (given a groundwater velocity of 0.071 ft/day). The variation of groundwater lithium concentrations in SP-8 is attributed to the time allotted for the dissolution of lithium from the solid formation material into the groundwater. The longer the period between sampling events results in detecting higher lithium concentrations in SP-8 than those detected in SP-10, which is part of the CCR monitoring well network and is sampled more regularly.

As mentioned above, SP-8 (screen interval 59-71 ft bgs) is nested with SP-11(screen interval is 16-19 ft bgs) and these wells can be used to compare the lithium concentrations in the upper and lower groundwater bearing zones. Samples collected from these nested wells on 3/14/19 show the lithium concentrations in SP-11 (the shallower well) as 0.094 mg/L and in SP-8 (the deeper well) as 0.780 mg/L.

As noted above, SP-10 (screen interval of 40-50 ft bgs) is nested with SP-9 (screen interval of 65-75 ft. bgs). SP-9 is also not within the groundwater monitoring well network so it is not sampled on a regular basis. However, samples collected from SPs 9 and 10 on 3/14-15/19 show

that the shallower well SP-10 contained 0.286 mg/L lithium and the deeper well SP-9 contained 2.75 mg/L in the groundwater.

Because wells SPs 6 thru 9 were logged by reviewing the cuttings, the ability to accurately identify the lithology is limited. Therefore, borings BAP-B1 (total depth of 186 ft bgs) and BAP-B2 (total depth of 90 ft bgs) were advanced to clearly identify the vertical lithologies, which were presented in the ASD. BAP-B2 was located within 150 feet from SP-8 and screened between 59-71 ft bgs (which is the same screen interval of SP-8). Unfractured limestone was observed with alternating limestone and shale, not a uniform shale unit as described from SP-8's cuttings. The BAP-B1 boring demonstrates that limestone with interbedded clay material extends to 100 ft bgs at which point a shale unit was encountered.

Based on the principles of contaminate hydrogeology, the predominate transport mechanism is advection, where solutes are transported along with groundwater in the direction of decreasing hydraulic gradient. Additionally, solutes are transported through diffusion, where a solute in water moves from an area of greater concentration towards an area of less concentration, as long as a concentration gradient exists, even if the groundwater is not moving. Therefore, a release from a unit would produce a more concentrated zone of lithium closer to the source, and the concentration would decreased with distance. The extremely low groundwater flow velocity and low effective porosity at the Site would produce this type of contaminate distribution with higher concentrations of lithium in wells that have their screen interval set at the elevation closer to that of the BAP's bottom, if a release of lithium had occurred. However, the lithium concentration detected in the shallower zone (in wells SP 10 and 11) is less than that found in the deeper zone, (SPs 8 and 9).

Even though the deeper screened wells SP-6 (60-70 ft bgs) and SP-7 (70-80 ft bgs) are not nested with shallower screened wells SPs 1 and 2 (both at 24-35 ft bgs), they also provide evidence that the spatial distribution of groundwater lithium concentrations do not reflect the principles of contaminate transport. During the collection of the background data, the lithium concentration in shallow well SP-1 ranged from 0.003 mg/L to 0.009 mg/L and in SP-2 ranged from 0.05 mg/L to 0.11 mg/L. These concentrations are three (3) orders of magnitude lower than the lithium

concentrations detected in the deeper wells SP-6 (1.55 mg/L and 1.89 mg/L) and SP-7 (2.02 mg/L and 3.83 mg/L).

Additionally well MW-8D, which is located approximately 300 feet south and side gradient to groundwater flow from the BAP and 900 feet upgradient from the fly ash landfill, has a screen interval (50-60 ft bgs) which is approximately the same elevation as SP-10 screen interval. The soil boring for MW- 8D indicates that the shale beds become thicker after 29 ft bgs. Since MW-8D is located much farther from the BAP than SP-10, PSO expected that MW-8D's lithium concentration would be less than SP-10 even if a release from the BAP had occurred. However, the lithium concentrations detected in MW-8D during the collection of background data, ranged from 1.07-1.44 mg/L, which is an order of magnitude greater than what has been detected in SP-10.

All this spatially distributed data demonstrates that the shallow groundwater zones contain less lithium than the deeper zones and provides further support that the BAP is not the source of lithium detected in the groundwater monitoring well network.

B. New Information

ODEQ also stated that "NPS did not sample and analyze the sediment in the BAP for lithium or other constituents to compare that data to the data collected in SP-10." Therefore, PSO recently collected a sediment sample from the bottom of the BAP near SP-10. The sediment was evaluated using EPA test method 1312/6010B for the leachability of the sediment and EPA test method 6010B for the contents of the pore water. The results indicated that the sediment leached 0.001 mg/L lithium and the pore water contained 0.003 mg/L lithium. These concentrations are two (2) orders of magnitude below the concentrations of lithium detected in SP-10. See attached laboratory report. Additionally, the total lithium detected in the bottom ash solids was 15 mg/kg, which is much less than the lithium detected in the lithological minerals (78 mg/kg). The differences in these concentration also supports that the BAP is not the source of lithium detected within the groundwater monitoring well network. This new information was added to the piper diagrams presented in the ASD and demonstrates that the water chemistries of the BAP

sediment, pore water, and pond water are similar but they are very different from SP-10 water chemistry, indicating the waters are not from the same source.

These lines of evidence support the conclusion that the groundwater lithium concentrations are not due to a release from the BAP. The spatially distributed lithium concentrations detected within the groundwater monitoring well network demonstrate a natural variation in the groundwater more associated with a release of lithium from the minerals within the lithological shale lenses that are present within the screened intervals of the monitoring wells.

Based on these additional clarifications and the new information provided in this letter, PSO requests that ODEQ reconsider the agencies' conclusion that "the conceptual model that NPS proposed does not fit the actual groundwater sampling data."

Please do not hesitate to contact me if you have any questions or would like to discuss. I can be reached by email at: jcparker-witt@aep.com or by phone at: (318) 673-3816.

Sincerely,

Jill Parker-Witt

Jill Parker-Witt, P.E.
AEP, Engineer Principle

Attachments

SCOTT A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

KEVIN STITT
Governor

July 8, 2019

Ms. Jill Parker-Witt, P.E.
American Electric Power
502 North Allen Avenue
Shreveport, LA 71101

Re: Alternate Source Demonstration for Lithium –Bottom Ash Pond
Public Service Company of Oklahoma
Northeastern Power Station
Rogers County
Solid Waste Permit No. none

Dear Ms. Parker-Witt:

Monitoring Well SP-10 is currently in the assessment monitoring program. Lithium was detected in SP-10 at concentrations of 0.245 mg/L on May 30, 2018 and 0.242 mg/L on July 30, 2018. A statistically significant level (SSL) was determined, on January 8, 2019, when the lower confidence limit (LCL) for lithium (0.263 mg/L) exceeded the groundwater protection standard (0.15 mg/L). Oklahoma Administrative Code (OAC) 252:517-9-6(g)(3)(B) allows AEP/Public Service Company of Oklahoma Northeastern Power Station (NPS) to demonstrate that a source other than the coal combustion residuals (CCR) unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

On March 12, 2019, by email, DEQ approved a 30-day extension for submittal of the alternate source demonstration (ASD) so that NPS could receive sample analyses from the lab and to gather additional information on the Bandera shale formation from analyses of cores from two (2) new boreholes drilled at the site. On May 1, 2019, the Department of Environmental Quality (DEQ) received, by email, an ASD for lithium in monitoring well SP-10 from NPS. The ASD was presented to DEQ by NPS in a meeting on May 29, 2019. DEQ requested revised figures and cross-sections that were presented during the meeting. A revised Figure 4 and Figure 12 were received by email on June 4, 2019. The cross-sections were received by email on June 5, 2019.

The ASD asserts that the statistically significant level (SSL) exceeding the groundwater protection standards is a natural variation in groundwater quality due to the release of lithium from the clay minerals within the shale lens underlying the Bottom Ash Pond (BAP) and is not due to a release from the BAP itself. Additionally, NPS contends that the low concentration of lithium in the surface water in the BAP and limited transport from the BAP to the screened interval in SP-10 do not support a release.

DEQ reviewed the ASD and made the following determination:

Elevated lithium concentrations were detected in downgradient monitoring well SP-10; however, lithium was not detected in elevated levels in upgradient monitoring well SP-5R even though boring logs from SP-5R show the monitoring well contains interbeds of dark limey shale within the screened interval. Also, SP-8, located near SP-10, and screened across a lower zone shale exhibits low concentrations of lithium. If the lithium at SP-10 was due to the presence of shale lenses within the screened interval of SP-10, then both SP-5R and SP-8 should exhibit elevated levels of lithium. The conceptual model that NPS proposed does not fit the actual groundwater sampling data.

NPS collected and analyzed a surface water sample from the BAP for comparison to data collected from SP-10 to support the claim that unless the BAP is directly connected to SP-10 through a fracture in the limestone, it is unlikely to affect the lithium concentration detected in SP-10. NPS did not sample and analyze the sediment in the BAP for lithium or other constituents to compare that data to the data collected from SP-10. The surface water sample may have a lower concentration of lithium than water that percolates through the sediment in the BAP and potentially reaches SP-10. DEQ does not believe enough data was presented to accept NPS's conclusion that the lithium at SP-10 was not due to a release from the BAP.

Should additional information be attained to support a revised ASD, DEQ will re-evaluate such a submittal. NPS is now required by OAC 252:517-9-6(g)(4) to initiate the assessment of corrective measures (ACM) as required by OAC 252:517-9-7. Please submit the proposed ACM plan and schedule for analyzing the lithium release and developing corrective action to address the release within ninety (90) days of receipt of this letter. Assessment monitoring for the BAP will continue.

If you have any questions, please contact Ms. Cindy Hailes at (405) 702-5114.

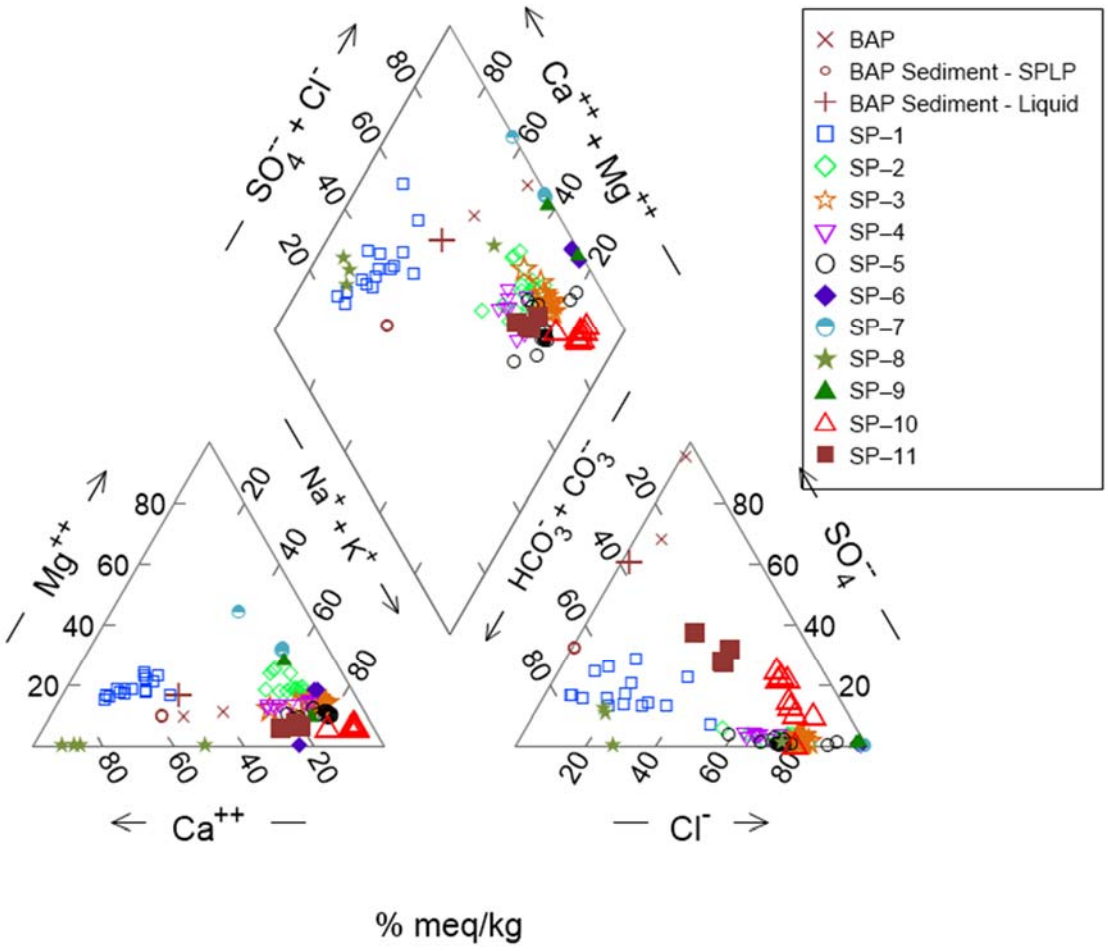
Sincerely,

Hillary Young, P.E.
Chief Engineer
Land Protection Division

HY/ckh

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; W = TEF applied; E = RPF applied; G = user's guide Section 5; M = mutagen; V = volatile; R = RBA applied;
c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = ceiling limit exceeded; s = Csat exceeded.

Toxicity and Chemical-specific Information												Contaminant		Screening Levels												Protection of Ground Water SSLs		
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	vol	mutagen	GIABS	ABS_d	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	key	MCL-based SSL (mg/kg)
				4.0E-04	P					1	0.1		Hexamethylphosphoramide	680-31-9	2.5E+01	n	3.3E+02	n					8.0E+00	n		1.8E-03	n	
						7.0E-01	I	V		1		1.4E+02	Hexane, N-	110-54-3	6.1E+02	ns	2.5E+03	ns	7.3E+02	n	3.1E+03	n	1.5E+03	n		1.0E+01	n	
				2.0E+00	P					1	0.1		Hexanedioic Acid	124-04-9	1.3E+05	nm	1.6E+06	nm					4.0E+04	n		9.9E+00	n	
9.5E-03	P			7.0E-02	P	4.0E-04	P	V		1			Hexanol, 1-,2-ethyl- (2-Ethyl-1-hexanol)	104-76-7	7.3E+01	c*	3.4E+02	c	4.2E-01	n	1.8E+00	n	8.3E-01	n				
				5.0E-03	I	3.0E-02	I	V		1		3.3E+03	Hexanone, 2-	591-78-6	2.0E+02	n	1.3E+03	n	3.1E+01	n	1.3E+02	n	3.8E+01	n		8.8E-03	n	
				3.3E-02	I					1	0.1		Hexazinone	51235-04-2	2.1E+03	n	2.7E+04	n					6.4E+02	n		3.0E-01	n	
				2.5E-02	I					1	0.1		Hexythiazox	78587-05-0	1.6E+03	n	2.1E+04	n					1.1E+02	n		5.0E-01	n	
				1.7E-02	O					1	0.1		Hydramethylnon	67485-29-4	1.1E+03	n	1.4E+04	n					3.4E+02	n		1.2E+05	n	
3.0E+00	I	4.9E-03	I			3.0E-05	P	V		1		1.1E+05	Hydrazine	302-01-2	3.2E-02	c*	1.4E-01	c*	5.7E-04	c*	2.5E-03	c*	1.1E-03	c*		2.2E-07	c*	
3.0E+00	I	4.9E-03	I							1			Hydrazine Sulfate	10034-93-2	2.3E-01	c	1.1E+00	c	5.7E-04	c	2.5E-03	c	2.6E-02	c				
						2.0E-02	I	V		1			Hydrogen Chloride	7647-01-0	2.8E+07	nm	1.2E+08	nm	2.1E+01	n	8.8E+01	n	4.2E+01	n				
				4.0E-02	C	1.4E-02	C	V		1			Hydrogen Fluoride	7664-39-3	3.1E+03	n	4.7E+04	n	1.5E+01	n	6.1E+01	n	2.8E+01	n				
						2.0E-03	I	V		1			Hydrogen Sulfide	7783-06-4	2.8E+06	nm	1.2E+07	nm	2.1E+00	n	8.8E+00	n	4.2E+00	n				
6.0E-02	P			4.0E-02	P					1	0.1		Hydroquinone	123-31-9	9.0E+00	c	3.8E+01	c					1.3E+00	c		8.7E-04	c	
6.1E-02	O			2.5E-03	O					1	0.1		Imazalil	35554-44-0	8.9E+00	c*	3.8E+01	c*					9.0E-01	c*		1.5E-02	c*	
				2.5E-01	I					1	0.1		Imazaquin	81335-37-7	1.6E+04	n	2.1E+05	nm					4.9E+03	n		2.4E+01	n	
				2.5E+00	O					1	0.1		Imazethapyr	81335-77-5	1.6E+05	nm	2.1E+06	nm					4.7E+04	n		4.1E+01	n	
				1.0E-02	A					1			Iodine	7553-56-2	7.8E+02	n	1.2E+04	n					2.0E+02	n		1.2E+01	n	
				4.0E-02	I					1	0.1		Iprodione	36734-19-7	2.5E+03	n	3.3E+04	n					7.4E+02	n		2.2E-01	n	
				7.0E-01	P					1			Iron	7439-89-6	5.5E+04	n	8.2E+05	nm					1.4E+04	n		3.5E+02	n	
				3.0E-01	I			V		1		1.0E+04	Isobutyl Alcohol	78-83-1	2.3E+04	ns	3.5E+05	s					5.9E+03	n		1.2E+00	n	
9.5E-04	I			2.0E-01	I	2.0E+00	C			1	0.1		Isophorone	78-59-1	5.7E+02	c*	2.4E+03	c*	2.1E+03	n	8.8E+03	n	7.8E+01	c*		2.6E-02	c*	
				1.5E-02	I			V		1			Isopropalin	33820-53-0	1.2E+03	n	1.8E+04	n					4.0E+01	n		9.2E-01	n	
				2.0E+00	P	2.0E-01	P	V		1		1.1E+05	Isopropanol	67-63-0	5.6E+03	n	2.4E+04	n	2.1E+02	n	8.8E+02	n	4.1E+02	n		8.4E-02	n	
				1.0E-01	I					1	0.1		Isopropyl Methyl Phosphonic Acid	1832-54-8	6.3E+03	n	8.2E+04	n					2.0E+03	n		4.3E-01	n	
				5.0E-02	I					1	0.1		Isoxaben	82558-50-7	3.2E+03	n	4.1E+04	n					7.3E+02	n		2.0E+00	n	
						3.0E-01	A	V		1			JP-7	E1737665	4.3E+08	nm	1.8E+09	nm	3.1E+02	n	1.3E+03	n	6.3E+02	n				
				8.0E-03	O					1	0.1		Lactofen	77501-63-4	5.1E+02	n	6.6E+03	n					1.0E+02	n		4.6E+00	n	
				2.0E-04	X					1	0.1		Lactonitrile	78-97-7	1.3E+01	n	1.6E+02	n					4.0E+00	n		8.1E-04	n	
				5.0E-05	P					1			Lanthanum	7439-91-0	3.9E+00	n	5.8E+01	n					1.0E+00	n				
				2.1E-05	P					1	0.1		Lanthanum Acetate Hydrate	100587-90-4	1.3E+00	n	1.7E+01	n					4.2E-01	n				
				1.9E-05	P					1			Lanthanum Chloride Heptahydrate	10025-84-0	1.5E+00	n	2.2E+01	n					3.7E-01	n				
				2.8E-05	P					1			Lanthanum Chloride, Anhydrous	10099-58-8	2.2E+00	n	3.3E+01	n					5.7E-01	n				
				1.6E-05	P					1			Lanthanum Nitrate Hexahydrate	10277-43-7	1.3E+00	n	1.9E+01	n					3.2E-01	n				
													Lead Compounds																
8.5E-03	C	1.2E-05	C							1			~Lead Phosphate	7446-27-7	8.2E+01	c	3.8E+02	c	2.3E-01	c	1.0E+00	c	9.1E+00	c				
8.5E-03	C	1.2E-05	C							1	0.1		~Lead acetate	301-04-2	6.4E+01	c	2.7E+02	c	2.3E-01	c	1.0E+00	c	9.2E+00	c		1.8E-03	c	
										1			~Lead and Compounds	7439-92-1	4.0E+02	G	8.0E+02	G	1.5E-01	G			1.5E+01	G	15			1.4E+01
8.5E-03	C	1.2E-05	C							1	0.1		~Lead subacetate	1335-32-6	6.4E+01	c	2.7E+02	c	2.3E-01	c	1.0E+00	c	9.2E+00	c		2.0E-03	c	
				1.0E-07	I			V		1		2.4E+00	~Tetraethyl Lead	78-00-2	7.8E-03	n	1.2E-01	n					1.3E-03	n		4.7E-06	n	
				5.0E-06	P			V		1		3.8E+02	Lewisite	541-25-3	3.9E-01	n	5.8E+00	n					9.0E-02	n		3.8E-05	n	
				7.7E-03	O					1	0.1		Linuron	330-55-2	4.9E+02	n	6.3E+03	n					1.3E+02	n		1.1E-01	n	
				2.0E-03	P					1			Lithium	7439-93-2	1.6E+02	n	2.3E+03	n					4.0E+01	n		1.2E+01	n	
				5.0E-04	I					1	0.1		MCPA	94-74-6	3.2E+01	n	4.1E+02	n					7.5E+00	n		2.0E-03	n	
				4.4E-03	O					1	0.1		MCPB	94-81-5	2.8E+02	n	3.6E+03	n					6.5E+01	n		2.6E-02	n	
				1.0E-03	I					1	0.1		MCPP	93-65-2	6.3E+01	n	8.2E+02	n					1.6E+01	n		4.7E-03	n	
				2.0E-02	I					1	0.1		Malathion	121-75-5	1.3E+03	n	1.6E+04	n					3.9E+02	n		1.0E-01	n	
				1.0E-01	I	7.0E-04	C			1	0.1		Maleic Anhydride	108-31-6	6.3E+03	n	8.0E+04	n	7.3E-01	n	3.1E+00	n	1.9E+03	n		3.8E-01	n	
				5.0E-01	I					1	0.1		Maleic Hydrazide	123-33-1	3.2E+04	n	4.1E+05	nm					1.0E+04	n		2.1E+00	n	
				1.0E-04	P					1	0.1		Malononitrile	109-77-3	6.3E+00	n	8.2E+01	n					2.0E+00	n		4.1E-04	n	
				3.0E-02	H					1	0.1		Mancozeb	8018-01-7	1.9E+03	n	2.5E+04	n					5.4E+02	n		7.6E-01	n	
				5.0E-03	I					1	0.1		Maneb	12427-38-2	3.2E+02	n	4.1E+03	n					9.8E+01	n		1.4E-01	n	
				1.4E-01	I	5.0E-05	I			1			Manganese (Diet)	7439-96-5														
				2.4E-02	G	5.0E-05	I			0.04			Manganese (Non-diet)	7439-96-5	1.8E+03	n	2.6E+04	n	5.2E-02	n	2.2E-01	n	4.3E+02	n		2.8E+01	n	
				9.0E-05	H					1	0.1		Mephosfolan	950-10-7	5.7E+00	n	7.4E+01	n					1.8E+00	n		2.6E-03	n	
				3.0E-02	I					1	0.1		Mepiquat Chloride	24307-26-4	1.9E+03	n	2.5E+04	n					6.0E+02	n		2.0E-01	n	
1.1E-02	P			4.0E-03	P					1	0.1		Mercaptobenzothiazole, 2-	149-30-4	4.9E+01	c**	2.1E+02	c*					6.3E+00	c*		1.8E-02	c*	
													Mercury Compounds																
				3.0E-04	I	3.0E-04	G			0.07			~Mercuric Chloride (and other Mercury salts)	7487-94-7	2.3E+01	n	3.5E+02	n	3.1E-01	n	1.3E+00	n	5.7E+00	n	2			
						3.0E-04	I	V		1		3.1E+00	~Mercury (elemental)	7439-97-6	1.1E+01	ns	4.6E+01	ns	3.1E-01	n	1.3E+00	n	6.3E-01	n	2	3.3E-02	n	1.0E-01
				1.0E-04	I					1			~Methyl Mercury	22967-92-6	7.8E+00	n	1.2E+02	n					2.0E+00	n		1.4E+01	n	
				8.0E-05	I					1	0.1		~Phenylmercuric Acetate	62-38-4	5.1E+00	n	6.6E+01	n					1.6E+00	n		5.0E-04	n	
				3.0E-05	I			V		1			Merphos	150-50-5	2.3E+00	n	3.5E+01	n					6.0E-01	n		5.9E-02	n	
				1.0E-04	O					1	0.1		Merphos Oxide	78-48-8	6.3E+00	n	8.2E+01	n					2.8E-01	n		1.4E-03	n	
				6.0E-02	I					1	0.1		Metalaxyl	57837-19-1	3.8E+03	n	4.9E+04	n					1.2E+03	n		3.3E-01	n	
				1.0E-04	I	3.0E-02	P	V		1		4.6E+03	Methacrylonitrile	126-98-7	7.5E+00	n	1.0E+02	n	3.1E+01	n	1.3E+02	n	1.9E+00	n		4.3E-04	n	
				5.0E-05	I					1	0.1		Methamidophos	10265-92-6	3.2E+00	n	4.1E+01	n					1.0E+00	n		2.1E-04	n	
				2.0E+00	I	2.0E+01	I	V		1		1.1E+05	Methanol	67-56-1	1.2E+05	s	1.2E+06	s	2.1E+04	n	8.8E+04	n	2.0E+04	n		4.1E+00	n	
				1.5E-03	O					1	0.1		Methidathion	950-37-8	9.5E+01	n	1.2E+03	n					2.9E+01	n		7.1E-03	n	
				2.5E-02	I					1	0.1		Methomyl	16752-77-5	1.6E+03	n	2.1E+04	n					5.0E+02	n		1.1E-01	n	
4.9E-02	C	1.4E-05	C							1	0.1		Methoxy-5-nitroaniline, 2-	99-59-2	1.1E+01	c	4.7E+01	c	2.0E-01	c	8.8E-01	c	1.5E+00	c		5.3E-04	c	
				5.0E-03	I					1	0.1		Methoxychlor	72-43-5	3.2E+02	n	4.1E+03	n					3.7E+01	n	40	2.0E+00	n	2.2E+00
				8.0E-03	P	1.0E-03	P	V		1		1.2E+05	Methoxyethanol Acetate, 2-	110-49-6	1.1E+02	n	5.1E+02	n	1.0E+00	n	4.4E+00	n	2.1E+00	n		4.2E-04	n	
				5.0E-03	P	2.0E-02	I	V		1		1.1E+05	Methoxyethanol, 2-	109-86-4	3.3E+02	n	3.5E+03	n	2.1E+01	n	8.8E+01	n	2.9E+01	n		5.9E-03	n	
				1.0E+00	X			V		1		2.9E+04	Methyl Acetate	79-20-9	7.8E+04	ns	1.2E+06	s					2.0E+04	n		4.1E+00	n	



Notes: Multiple events for each well are graphed where data are available.

Piper Plot – SPLP Results
Northeastern Bottom Ash Pond

Geosyntec consultants

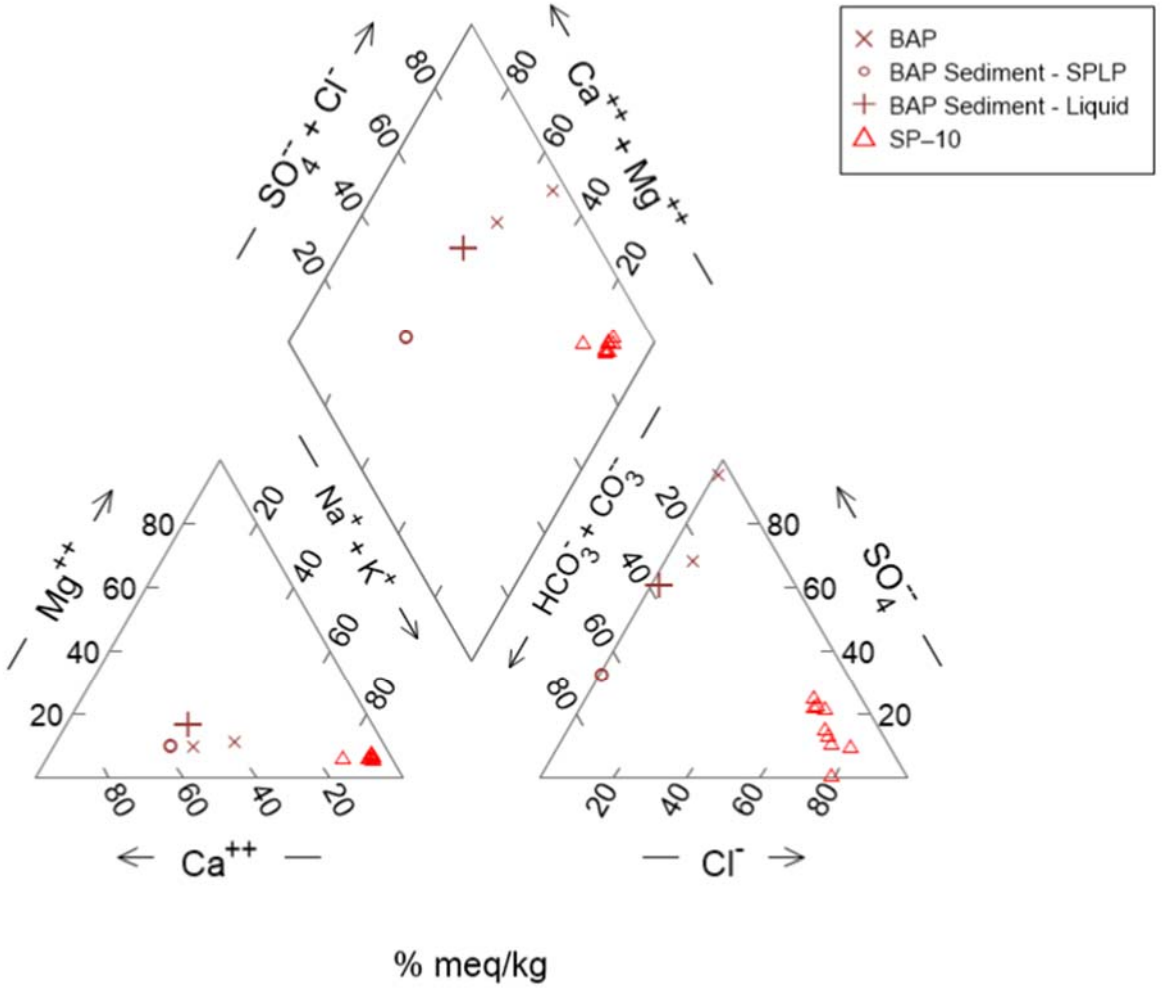
AMERICAN ELECTRIC POWER

Columbus, Ohio

09-Aug-2019

Figure **1a**

internal info: path, date revised, author



Notes: Multiple events for the BAP and SP-10 are included.

Piper Plot – SP-10
Northeastern Bottom Ash Pond

Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | 09-Aug-2019

Figure **1b**

internal info: path, date revised, author

502 North Allen Ave.
Shreveport, LA 71101
Phone: (318) 673-3802
Fax: (318) 673-3960

AEP ANALYTICAL CHEMISTRY SERVICES
Analysis Report

Report ID : 40115
Date Received: 07/12/2019

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
Phone: (318) 673-3816

Address: 502 N. Allen Avenue
Shreveport, LA 71101
Fax: (318) 673-3960

AEP Sample ID : 226939
Cust Sample ID: Sediment
Sample Desc.: BAP Sediment SPLP

Collected Date: 07/10/2019
Location: NE BAP Sediment Sample

By: BW
Matrix: Liquid

SPLP (226939)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Aluminum	0.777	mg/L	0.005	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Antimony	< 0.005	mg/L	0.005	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Arsenic	< 0.005	mg/L	0.005	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Barium	0.352	mg/L	0.001	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Beryllium	< 0.001	mg/L	0.001	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Boron	0.389	mg/L	0.01	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Cadmium	< 0.001	mg/L	0.001	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Calcium	24.3	mg/L	0.01	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Chromium	< 0.001	mg/L	0.001	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Cobalt	< 0.005	mg/L	0.005	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Copper	0.004	mg/L	0.001	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Iron	0.1	mg/L	0.01	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Lead	< 0.005	mg/L	0.005	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Lithium	0.001	mg/L	0.001	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Magnesium	2.44	mg/L	0.01	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Manganese	0.01	mg/L	0.001	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Molybdenum	< 0.005	mg/L	0.005	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Nickel	< 0.025	mg/L	0.025	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Potassium	0.703	mg/L	0.01	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Selenium	< 0.005	mg/L	0.005	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Silver	< 0.001	mg/L	0.001	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Sodium	14.9	mg/L	0.01	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Strontium	0.327	mg/L	0.001	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Thallium	< 0.005	mg/L	0.005	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Tin	0.011	mg/L	0.005	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Titanium	0.012	mg/L	0.005	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB

502 North Allen Ave.
Shreveport, LA 71101
Phone: (318) 673-3802
Fax: (318) 673-3960

AEP ANALYTICAL CHEMISTRY SERVICES
Analysis Report

Report ID : 40115
Date Received: 07/12/2019

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
Phone: (318) 673-3816

Address: 502 N. Allen Avenue
Shreveport, LA 71101
Fax: (318) 673-3960

Vanadium	0.023	mg/L	0.001	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB
Zinc	0.067	mg/L	0.005	1	EPA 1312/6010B 1996	07/25/2019 21:45		JDB

Water (226939)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Alkalinity, Bicarbonate	101.24	mg/L	5	1	SM 2320 B-2011	08/06/2019 15:30	H1	JTD
Alkalinity, Carbonate	< 5	mg/L	5	1	SM 2320 B-2011	08/06/2019 15:30	H1	JTD
Alkalinity, Total	101.24	mg/L	5	1	SM 2320 B-2011	08/06/2019 15:30	H1	JTD
Chloride	0.839	mg/L	0.219	1	EPA 300.0	08/04/2019 5:20		GB
Fluoride	0.458	mg/L	0.083	1	EPA 300.0	08/04/2019 5:20		GB
Sulfate	38	mg/L	0.140	1	EPA 300.0	08/04/2019 5:20		GB

502 North Allen Ave.
Shreveport, LA 71101
Phone: (318) 673-3802
Fax: (318) 673-3960

AEP ANALYTICAL CHEMISTRY SERVICES
Analysis Report

Report ID : 40115
Date Received: 07/12/2019

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
Phone: (318) 673-3816

Address: 502 N. Allen Avenue
Shreveport, LA 71101
Fax: (318) 673-3960

AEP Sample ID : 226940
Cust Sample ID: Liquid portion
Sample Desc.: BAP Sediment

Collected Date: 07/10/2019
Location: NE BAP Sediment Sample

By: BW
Matrix: Liquid

Metals (226940)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Aluminum	0.076	mg/L	0.005	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Antimony	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Arsenic	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Barium	0.083	mg/L	0.001	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Beryllium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Boron	0.754	mg/L	0.01	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Cadmium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Calcium	85.7	mg/L	0.01	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Chromium	< 0.001	mg/L	0.001	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Cobalt	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Copper	0.004	mg/L	0.001	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Iron	< 0.01	mg/L	0.01	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Lead	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Lithium	0.003	mg/L	0.001	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Magnesium	17.4	mg/L	0.01	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Manganese	0.032	mg/L	0.001	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Molybdenum	0.027	mg/L	0.005	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Nickel	< 0.025	mg/L	0.025	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Potassium	6.94	mg/L	0.01	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Selenium	0.005	mg/L	0.005	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Silver	< 0.001	mg/L	0.001	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Sodium	99.9	mg/L	0.01	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Strontium	1.22	mg/L	0.001	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Thallium	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Tin	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Titanium	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/25/2019 21:37		JDB

502 North Allen Ave.
Shreveport, LA 71101
Phone: (318) 673-3802
Fax: (318) 673-3960

AEP ANALYTICAL CHEMISTRY SERVICES
Analysis Report

Report ID : 40115
Date Received: 07/12/2019

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
Phone: (318) 673-3816

Address: 502 N. Allen Avenue
Shreveport, LA 71101
Fax: (318) 673-3960

Vanadium	0.006	mg/L	0.001	1	EPA 6010B 1996	07/25/2019 21:37		JDB
Zinc	< 0.005	mg/L	0.005	1	EPA 6010B 1996	07/25/2019 21:37		JDB

Water (226940)

Parameter	Value	Unit	Det. Limit	Dil./Conc.	Method	Analysis Date/Time	Codes	Tech
Alkalinity, Bicarbonate	399.2	mg/L	5	1	SM 2320 B-2011	08/06/2019 15:30	H1	JTD
Alkalinity, Carbonate	< 5	mg/L	5	1	SM 2320 B-2011	08/06/2019 15:30	H1	JTD
Alkalinity, Total	399.2	mg/L	5	1	SM 2320 B-2011	08/06/2019 15:30	H1	JTD
Chloride	14	mg/L	0.219	1	EPA 300.0	08/04/2019 5:58		GB
Fluoride	< 0.083	mg/L	0.083	1	EPA 300.0	08/04/2019 5:58		GB
Sulfate	514	mg/L	0.140	1:10	EPA 300.0	08/04/2019 6:16		GB

502 North Allen Ave.
Shreveport, LA 71101
Phone: (318) 673-3802
Fax: (318) 673-3960

AEP ANALYTICAL CHEMISTRY SERVICES
Analysis Report

Report ID : 40115
Date Received: 07/12/2019

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
Phone: (318) 673-3816

Address: 502 N. Allen Avenue
Shreveport, LA 71101
Fax: (318) 673-3960

Quality Control Data

* Quality control units are the same as reported analytical results

Date	Parameter	Sample ID	Blank Value *	Standard			Spike			Surrogate % Recovery	Duplicate % Difference	Tech
				Value *	Recovery*	%	Value *	Recovery*	%			
8/6/2019	Alkalinity, Total			50	50.84	101.7						JTD
8/6/2019	Alkalinity, Total	227498	<5	50	52.62	105.2	50	47.14	94.3		2.5	JTD
7/25/2019	Aluminum	227041.1	<0.005	2	2.0229733	101.1	2	2.2242	111.2		0.0	JDB
7/25/2019	Aluminum	226939.1	<0.005	2	2.0229733	101.1	2	2.071639	103.6		0.4	JDB
7/25/2019	Antimony	227041.1	<0.005	0.8	0.8092462	101.2	0.8	0.7671843	95.9		0.5	JDB
7/25/2019	Antimony	226939.1	<0.005	0.8	0.8092462	101.2	0.8	0.8159776	102.0		0.2	JDB
7/25/2019	Arsenic	227041.1	<0.005	0.8	0.8086795	101.1	0.8	0.7758421	97.0		0.0	JDB
7/25/2019	Arsenic	226939.1	<0.005	0.8	0.8086795	101.1	0.8	0.8086275	101.1		0.1	JDB
7/25/2019	Barium	226939.1	<0.001	0.2	0.2080557	104.0	0.2	0.209543	104.8		0.1	JDB
7/25/2019	Barium	227041.1	<0.05	0.2	0.2080557	104.0	0.2	0.1829767	91.5		0.4	JDB
7/25/2019	Beryllium	226939.1	<0.001	0.2	0.2122779	106.1	0.2	0.2142832	107.1		0.3	JDB
7/25/2019	Beryllium	227041.1	<0.001	0.2	0.2122779	106.1	0.2	0.1992329	99.6		0.4	JDB
7/25/2019	Boron	226939.1	<0.01	0.3	0.2995651	99.9	0.3	0.2984183	99.5		0.7	JDB
7/25/2019	Boron	227041.1	<0.5	0.3	0.2995651	99.9	0.3	0.2855333	95.2		0.5	JDB
7/25/2019	Cadmium	227041.1	<0.001	0.2	0.2069934	103.5	0.2	0.1836838	91.8		0.6	JDB
7/25/2019	Cadmium	226939.1	<0.001	0.2	0.2069934	103.5	0.2	0.2061243	103.1		0.5	JDB
7/25/2019	Calcium	226939.1	<0.01	1	1.0087505	100.9	1	1.0243667	102.4		0.9	JDB
7/25/2019	Chromium	226939.1	<0.001	0.4	0.4116387	102.9	0.4	0.4125529	103.1		0.4	JDB
7/25/2019	Chromium	227041.1	<0.001	0.4	0.4116387	102.9	0.4	0.3867339	96.7		0.3	JDB
7/25/2019	Cobalt	226939.1	<0.005	0.2	0.2043482	102.2	0.2	0.2054714	102.7		0.4	JDB
7/25/2019	Cobalt	227041.1	<0.005	0.2	0.2043482	102.2	0.2	0.1839347	92.0		0.4	JDB
7/25/2019	Copper	227041.1	<0.001	0.3	0.3066399	102.2	0.3	0.2963301	98.8		0.1	JDB
7/25/2019	Copper	226939.1	<0.001	0.3	0.3066399	102.2	0.3	0.3109092	103.6		0.1	JDB
7/25/2019	Iron	227041.1	<0.5	3	3.1158893	103.9	150	159.28837	106.2		0.8	JDB
7/25/2019	Iron	226939.1	<0.01	3	3.1158893	103.9	3	3.1231158	104.1		1.0	JDB
7/25/2019	Lead	226939.1	<0.005	1	1.0430644	104.3	1	1.0416574	104.2		0.4	JDB
7/25/2019	Lead	227041.1	<0.005	1	1.0430644	104.3	1	0.9320653	93.2		0.6	JDB
7/25/2019	Lithium	227041.1	<0.001	0.2	0.2119096	106.0	0.2	0.2353987	117.7		0.1	JDB
7/25/2019	Lithium	226939.1	<0.001	0.2	0.2119096	106.0	0.2	0.2163799	108.2		0.4	JDB
7/25/2019	Magnesium	226939.1	<0.01	2	2.0868175	104.3	2	2.0877567	104.4		0.2	JDB
7/25/2019	Magnesium	227041.1	<0.5	2	2.0868175	104.3	2	1.9791333	99.0		0.6	JDB
7/25/2019	Manganese	227041.1	<0.001	0.2	0.2072869	103.6	0.2	0.16684	83.4		0.7	JDB

AEP ANALYTICAL CHEMISTRY SERVICES
502 North Allen Ave.
Shreveport, LA 71101
Phone: (318) 673-3802
Fax: (318) 673-3960

Analysis Report

Report ID : 40115
Date Received: 07/12/2019

Company: SEP - Environmental (JP-W)
Contact: Jill Parker-Witt
Phone: (318) 673-3816

Address: 502 N. Allen Avenue
Shreveport, LA 71101
Fax: (318) 673-3960

7/25/2019	Manganese	226939.1	<0.001	0.2	0.2072869	103.6	0.2	0.2077536	103.9		0.2	JDB
7/25/2019	Molybdenum	226939.1	<0.005	0.2	0.2067657	103.4	0.2	0.2076129	103.8		0.4	JDB
7/25/2019	Molybdenum	227041.1	<0.005	0.2	0.2067657	103.4	0.2	0.197727	98.9		0.5	JDB
7/25/2019	Nickel	227041.1	<0.025	0.5	0.5192594	103.9	0.5	0.46183	92.4		0.6	JDB
7/25/2019	Nickel	226939.1	<0.025	0.5	0.5192594	103.9	0.5	0.5209379	104.2		0.6	JDB
7/25/2019	Potassium	226939.1	<0.01	10	9.3692109	93.7	10	9.4631223	94.6		0.2	JDB
7/25/2019	Potassium	227041.1	<0.01	10	9.3692109	93.7	10	11.11754	111.2		0.3	JDB
7/25/2019	Selenium	227041.1	<0.005	2	1.9998495	100.0	2	1.991203	99.6		0.7	JDB
7/25/2019	Selenium	226939.1	<0.005	2	1.9998495	100.0	2	1.9816300	99.1		0.8	JDB
7/25/2019	Silver	227041.1	<0.001	0.075	0.0712930	95.1	0.075	0.0708639	94.5		0.2	JDB
7/25/2019	Silver	226939.1	<0.001	0.075	0.0712930	95.1	0.075	0.0714285	95.2		0.1	JDB
7/25/2019	Sodium	226939.1	<0.01	3	3.1384831	104.6	3	2.4693667	82.3		0.1	JDB
7/25/2019	Sodium	227041.1	<0.5	3	3.1384831	104.6	3	2.3746333	79.2		0.0	JDB
7/25/2019	Strontium	226939.1	<0.001	0.2	0.2059899	103.0	0.2	0.2081687	104.1		0.4	JDB
7/25/2019	Thallium	226939.1	<0.005	0.4	0.4152040	103.8	0.4	0.4171124	104.3		0.0	JDB
7/25/2019	Thallium	227041.1	<0.005	0.4	0.4152040	103.8	0.4	0.3682771	92.1		1.2	JDB
7/25/2019	Tin	226939.1	<0.005	0.7	0.6995446	99.9	0.7	0.6930628	99.0		0.2	JDB
7/25/2019	Tin	227041.1	<0.005	0.7	0.6995446	99.9	0.7	0.644164	92.0		0.2	JDB
7/25/2019	Titanium	227041.1	<0.005	0.2	0.2109341	105.5	0.2	0.2098874	104.9		0.2	JDB
7/25/2019	Titanium	226939.1	<0.005	0.2	0.2109341	105.5	0.2	0.2124567	106.2		0.1	JDB
7/25/2019	Vanadium	226939.1	<0.001	0.3	0.3076519	102.6	0.3	0.3104754	103.5		0.4	JDB
7/25/2019	Vanadium	227041.1	<0.001	0.3	0.3076519	102.6	0.3	0.2997157	99.9		0.6	JDB
7/25/2019	Zinc	226939.1	<0.005	0.2	0.2091679	104.6	0.2	0.2081374	104.1		0.3	JDB
7/25/2019	Zinc	227041.1	<0.005	0.2	0.2091679	104.6	0.2	0.1851907	92.6		0.1	JDB

On 7/30/2019, Jill asked for us to add Chloride, Fluoride, and Sulfate.

Code	***Code Description***
H1	Sample analysis performed past holding time

Jonathan Barnhill
Quality Assurance Officer

08-Aug-19
Report Date

JOB 7-15-19

Chain of Custody Record

Program: Coal Combustion Residuals (CCR)

Shreveport Chemical Laboratory (SCL)
502 N. Allen Ave.
Shreveport , LA 71101
Contacts: Jonathan Barnhill (318-673-3803)

Project Name: NE BAP Sediment sample
Contact Name: Bryan White
Contact Phone: 8-719-0873
Sampler(s): BRYAN WHITE

Analysis Turnaround Time (in Calendar Days) - **RUSH**

Site Contact:

Date:

For Lab Use Only:
COC/Order #: 4/0115

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Sampler(s) Initials	Li							Sample Specific Notes:
BAP Sediment	7-10-19	1600	grab	solid/water	1L		X							SPLP on the sediment particles, also run Li analysis of pore water
	JOB 7-15-19													

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____; F= filter in field

Special Instructions/QC Requirements & Comments: **Submit results to Jill Parker-Witt**

Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
William Matthew Stephens	AEP-PSO	7/11/19 10:05		
Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Date/Time:
				7/12/19 14:34

SHREVEPORT CHEMICAL LABORATORY

502 N. Allen Ave.
Shreveport, LA 71101
Phone 318-673-3802
FAX 318-673-3960

PROJECT R

Container Type					Delivery Type				
Ice Chest	Bag	Action Pak	PCB Mailer	Bottle	UPS	FEDEX	US Mail	Walk in	Shuttle
(Other) Box					Other				
					Tracking #				

Client: Bryan White
Received By: JTD
Received Date: 7/12/19
Open Date:

Sample Matrix: DGA | PCB Oil | Water | Oil | Soil
Solid | (Liquid) | Other

Container Temp Read: 28 (Thermometer Serial #F04103)
Correction Factor: +1.2
Corrected Temp: 29.2

Project I.D.

Were samples received on ice? YES NO

Did container arrive in good condition? (YES) NO

Was sample documentation received? (YES) NO

Was documentation filled out properly? (YES) JTD 7/12/19 NO Date and time for collection not filled

Were samples labeled properly? (YES) NO

Were correct containers used? (YES) NO

Were the pH's of samples appropriately checked? YES (NO) N/A

Total number of sample containers: 1

Was any corrective action taken? NO

Person Contacted: Jill Parker W.T.F
Date & Time: 7-12-19 1520

Comments: Informed Jill that No Date and time was entered for collection she said she would contact the sampler and get that information. JDB 7-12-19

Form REP-703
Rev. 1, 11/2013

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
T: 614-836-4221, Audinet 210-4221
F: 614-836-4168, Audinet 210-4168
http://aepenv/labs

Water Analysis

Location: Northeastern Station ***Report Date: 2/25/2019***

BA Sluice Water A

Sample Number: 190503-001 **Date Collected: 02/11/2019 13:10** **Date Received: 2/13/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Antimony, Sb	0.60	ug/L		0.5	0.1	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Arsenic, As	3.96	ug/L		0.5	0.2	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Barium, Ba	583	ug/L		0.5	0.1	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Beryllium, Be	0.2	ug/L	J	0.5	0.1	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Cadmium, Cd	0.08	ug/L	J	0.2	0.05	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Chromium, Cr	6.87	ug/L		1	0.2	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Cobalt, Co	1.41	ug/L		0.2	0.1	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Lead, Pb	1.46	ug/L		0.5	0.1	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Molybdenum, Mo	20.7	ug/L		10	2	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Selenium, Se	4.8	ug/L		1	0.2	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Thallium, Tl	< 0.5	ug/L	U	2	0.5	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Boron, B	0.778	mg/L		0.02	0.005	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	98.4	mg/L		0.1	0.02	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Iron, Fe	2.14	mg/L		0.05	0.01	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Lithium, Li	0.00587	mg/L		0.001	0.00005	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Magnesium, Mg	16.3	mg/L		0.05	0.01	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Sodium, Na	106	mg/L		0.2	0.05	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Manganese, Mn	15.5	ug/L		0.5	0.1	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Potassium, K	5.90	mg/L		0.2	0.05	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4
Strontium, Sr	1.24	mg/L		0.001	0.0002	GES	02/19/2019 14:42	EPA 200.8-1994, Rev. 5.4

BA Sluice Water B

Sample Number: 190503-002 **Date Collected: 02/11/2019 13:10** **Date Received: 2/13/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	156	mg/L		10	3	GES	02/15/2019 13:38	SM 2320B-2011
Bromide, Br	0.3	mg/L	J	0.5	0.1	CRJ	02/20/2019 22:21	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	27.2	mg/L		0.1	0.03	CRJ	02/20/2019 22:21	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.42	mg/L		0.2	0.04	CRJ	02/20/2019 22:21	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	726	mg/L		40	10	KAL	02/18/2019	SM 2540C-2011
Sulfate, SO4	351	mg/L		10	2	CRJ	02/20/2019 21:12	EPA 300.1-1997, Rev. 1.0

SP-10 -20190314

Sample Number: 190984-004 **Date Collected:** 03/14/2019 15:45 **Date Received:** 3/19/2019

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Antimony, Sb	5.10	ug/L		4	0.8	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Arsenic, As	4.45	ug/L		4	1	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Barium, Ba	6780	ug/L		4	0.8	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Beryllium, Be	< 0.8	ug/L	U	4	0.8	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Cadmium, Cd	< 0.4	ug/L	U	2	0.4	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Chromium, Cr	2300	ug/L		8	2	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Cobalt, Co	25.8	ug/L		2	0.8	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Lead, Pb	54.5	ug/L		4	0.8	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Molybdenum, Mo	95.3	ug/L		80	20	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Selenium, Se	< 1	ug/L	U	8	1	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Thallium, Tl	< 4	ug/L	U	20	4	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Boron, B	1.14	mg/L		0.2	0.04	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	127	mg/L		0.8	0.1	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Lithium, Li	0.286	mg/L		0.008	0.0004	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Magnesium, Mg	51.5	mg/L		0.4	0.08	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Sodium, Na	1320	mg/L		2	0.4	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Potassium, K	14.0	mg/L		2	0.4	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Strontium, Sr	17.8	mg/L		0.008	0.001	CTK	04/05/2019 20:32	EPA 200.8-1994, Rev. 5.4
Alkalinity, as CaCO3	520	mg/L		10	3	GES	03/21/2019 10:40	SM 2320B-2011
Bromide, Br	8.37	mg/L		1	0.2	CRJ	04/04/2019 17:49	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	1970	mg/L		2	0.6	CRJ	04/04/2019 17:24	EPA 300.1-1997, Rev. 1.0
Fluoride, F	6.90	mg/L		0.3	0.07	CRJ	04/04/2019 17:49	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	4230	mg/L		80	20	KAL	03/20/2019	SM 2540C-2011
Sulfate, SO4	16.3	mg/L		2	0.3	CRJ	04/04/2019 17:49	EPA 300.1-1997, Rev. 1.0

SP-10 Dissolved -20190314

HNO3 was added to the dissolved metals sample upon arrival.

Sample Number: 190984-004A **Date Collected:** 03/14/2019 15:45 **Date Received:** 3/19/2019

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Iron, Fe	0.08	mg/L	J	0.4	0.08	CTK	04/05/2019 20:37	EPA 200.8-1994, Rev. 5.4
Manganese, Mn	33.6	ug/L		4	0.8	CTK	04/05/2019 20:37	EPA 200.8-1994, Rev. 5.4

HNO3 was added to the dissolved metals sample upon arrival.

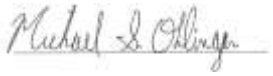
SP-9 -20190315 **Acid was added tot the metals sample upon arrival.**

Sample Number: 190984-013 **Date Collected: 03/15/2019 10:20** **Date Received: 3/19/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Antimony, Sb	2.25	ug/L		2	0.4	CTK	04/05/2019 17:02	EPA 200.8-1994, Rev. 5.4
Arsenic, As	9.33	ug/L		2	0.6	CTK	04/05/2019 17:02	EPA 200.8-1994, Rev. 5.4
Barium, Ba	686	ug/L		2	0.4	CTK	04/05/2019 17:02	EPA 200.8-1994, Rev. 5.4
Beryllium, Be	< 2	ug/L	U	10	2	CTK	04/08/2019 16:27	EPA 200.8-1994, Rev. 5.4
Cadmium, Cd	5.12	ug/L		1	0.2	CTK	04/05/2019 17:02	EPA 200.8-1994, Rev. 5.4
Chromium, Cr	22.9	ug/L		4	0.8	CTK	04/05/2019 17:02	EPA 200.8-1994, Rev. 5.4
Cobalt, Co	16.4	ug/L		1	0.4	CTK	04/05/2019 17:02	EPA 200.8-1994, Rev. 5.4
Lead, Pb	22.8	ug/L		10	2	CTK	04/08/2019 16:27	EPA 200.8-1994, Rev. 5.4
Molybdenum, Mo	< 8	ug/L	U	40	8	CTK	04/05/2019 17:02	EPA 200.8-1994, Rev. 5.4
Selenium, Se	10.7	ug/L		4	0.6	CTK	04/05/2019 17:02	EPA 200.8-1994, Rev. 5.4
Thallium, Tl	< 10	ug/L	U	50	10	CTK	04/08/2019 16:27	EPA 200.8-1994, Rev. 5.4
Boron, B	1.76	mg/L		0.1	0.02	CTK	04/05/2019 17:02	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	2980	mg/L		0.4	0.06	CTK	04/05/2019 17:02	EPA 200.8-1994, Rev. 5.4
Lithium, Li	2.75	mg/L		0.02	0.001	CTK	04/08/2019 16:27	EPA 200.8-1994, Rev. 5.4
Magnesium, Mg	1280	mg/L		0.2	0.04	CTK	04/05/2019 17:02	EPA 200.8-1994, Rev. 5.4
Sodium, Na	17400	mg/L		1	0.2	CTK	04/05/2019 17:02	EPA 200.8-1994, Rev. 5.4
Potassium, K	53.7	mg/L		1	0.2	CTK	04/05/2019 17:02	EPA 200.8-1994, Rev. 5.4
Strontium, Sr	264	mg/L		0.08	0.01	CTK	04/08/2019 16:17	EPA 200.8-1994, Rev. 5.4
Alkalinity, as CaCO3	918	mg/L		10	3	GES	03/21/2019 10:40	SM 2320B-2011
Bromide, Br	110	mg/L		5	1	CRJ	04/05/2019 02:31	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	27200	mg/L		50	20	CRJ	04/05/2019 00:01	EPA 300.1-1997, Rev. 1.0
Fluoride, F	1.88	mg/L		2	0.4	CRJ	04/05/2019 02:31	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	44400	mg/L		400	100	KAL	03/20/2019	SM 2540C-2011
Sample was analyzed with 5mL (20x dilution) but the residue weight still exceeds 0.2000g. Sample will not be re-analyzed. Sdw032519								
Sulfate, SO4	613	mg/L		10	2	CRJ	04/05/2019 02:31	EPA 300.1-1997, Rev. 1.0

Acid was added tot the metals sample upon arrival.

U: Analyte was analyzed and not detected at or above adjusted Method Detection Limit
J: Analyte was positively identified, though the quantitation was below Reporting Limit.



Michael Ohlinger, Chemist

Email msohlinger@aep.com Tel.

Fax 614-836-4168 Audinet 8-210-

Form REP-703
Rev. 1, 11/2013

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
T: 614-836-4221, Audinet 210-4221
F: 614-836-4168, Audinet 210-4168
http://aepenv/labs

Water Analysis

Location: Northeastern Station ***Report Date: 6/14/2019***

SP-6

Sample Number: 191628-001 **Date Collected: 05/07/2019 14:10** **Date Received: 5/10/2019**

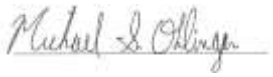
Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Antimony, Sb	12.2	ug/L		2	0.4	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4
Arsenic, As	2.06	ug/L		2	0.6	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4
Barium, Ba	38100	ug/L		2	0.4	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4
Beryllium, Be	< 0.4	ug/L	U	2	0.4	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4
Cadmium, Cd	0.4	ug/L	J	1	0.2	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4
Chromium, Cr	4	ug/L	J	4	0.8	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4
Cobalt, Co	8.86	ug/L		1	0.4	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4
Lead, Pb	1	ug/L	J	2	0.4	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4
Molybdenum, Mo	75.8	ug/L		40	8	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4
Selenium, Se	1	ug/L	J	4	0.6	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4
Thallium, Tl	< 2	ug/L	U	10	2	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4
Boron, B	1.59	mg/L		0.1	0.02	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	1240	mg/L		0.4	0.06	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4
Lithium, Li	1.55	mg/L		0.004	0.0002	GES	06/04/2019 15:36	EPA 200.8-1994, Rev. 5.4

SP-7

Sample Number: 191628-002 **Date Collected: 05/07/2019 13:40** **Date Received: 5/10/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Antimony, Sb	1.25	ug/L		0.5	0.1	GES	06/04/2019 15:41	EPA 200.8-1994, Rev. 5.4
Arsenic, As	3.30	ug/L		0.5	0.2	GES	06/04/2019 15:41	EPA 200.8-1994, Rev. 5.4
Barium, Ba	244000	ug/L		0.5	0.1	GES	06/04/2019 15:41	EPA 200.8-1994, Rev. 5.4
Beryllium, Be	< 0.1	ug/L	U	0.5	0.1	GES	06/04/2019 15:41	EPA 200.8-1994, Rev. 5.4
Cadmium, Cd	< 0.05	ug/L	U	0.2	0.05	GES	06/04/2019 15:41	EPA 200.8-1994, Rev. 5.4
Chromium, Cr	0.6	ug/L	J	1	0.2	GES	06/04/2019 15:41	EPA 200.8-1994, Rev. 5.4
Cobalt, Co	1.95	ug/L		0.2	0.1	GES	06/04/2019 15:41	EPA 200.8-1994, Rev. 5.4
Lead, Pb	1	ug/L	J	4	0.8	GES	06/10/2019 15:41	EPA 200.8-1994, Rev. 5.4
Molybdenum, Mo	17.0	ug/L		10	2	GES	06/04/2019 15:41	EPA 200.8-1994, Rev. 5.4
Selenium, Se	< 0.2	ug/L	U	1	0.2	GES	06/04/2019 15:41	EPA 200.8-1994, Rev. 5.4
Thallium, Tl	< 4	ug/L	U	20	4	GES	06/10/2019 15:41	EPA 200.8-1994, Rev. 5.4
Boron, B	1.33	mg/L		0.02	0.005	GES	06/04/2019 15:41	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	2470	mg/L		0.1	0.02	GES	06/04/2019 15:41	EPA 200.8-1994, Rev. 5.4
Lithium, Li	2.02	mg/L		0.001	0.00005	GES	06/04/2019 15:41	EPA 200.8-1994, Rev. 5.4
Chloride, Cl	30900	mg/L		50	20	CRJ	05/22/2019 15:34	EPA 300.1-1997, Rev. 1.0
Fluoride, F	1	mg/L	J	2	0.4	CRJ	05/21/2019 17:49	EPA 300.1-1997, Rev. 1.0
Sulfate, SO4	3	mg/L	J	10	2	CRJ	05/21/2019 17:49	EPA 300.1-1997, Rev. 1.0

U: Analyte was analyzed and not detected at or above adjusted Method Detection Limit
J: Analyte was positively identified, though the quantitation was below Reporting Limit.



Michael Ohlinger, Chemist

Email msohlinger@aep.com *Tel.*

Fax 614-836-4168 *Audinet 8-210-*

Form REP-703
Rev. 1, 11/2013

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
T: 614-836-4221, Audinet 210-4221
F: 614-836-4168, Audinet 210-4168
http://aepenv/labs

Water Analysis

Location: Northeastern Station ***Report Date: 7/17/2019***

SP-6

Sample Number: 192191-001 **Date Collected: 06/21/2019 14:30** **Date Received: 6/25/2019**

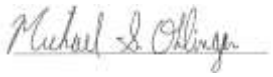
Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Antimony, Sb	1	ug/L	J	2	0.4	GES	07/15/2019 15:07	EPA 200.8-1994, Rev. 5.4
Arsenic, As	3.88	ug/L		2	0.6	GES	07/15/2019 15:07	EPA 200.8-1994, Rev. 5.4
Barium, Ba	29600	ug/L		2	0.4	GES	07/15/2019 15:07	EPA 200.8-1994, Rev. 5.4
Beryllium, Be	< 0.4	ug/L	U	2	0.4	GES	07/15/2019 15:07	EPA 200.8-1994, Rev. 5.4
Cadmium, Cd	0.4	ug/L	J	1	0.2	GES	07/15/2019 15:07	EPA 200.8-1994, Rev. 5.4
Chromium, Cr	< 0.8	ug/L	U	4	0.8	GES	07/15/2019 15:07	EPA 200.8-1994, Rev. 5.4
Cobalt, Co	4.88	ug/L		1	0.4	GES	07/15/2019 15:07	EPA 200.8-1994, Rev. 5.4
Lead, Pb	0.8	ug/L	J	2	0.4	GES	07/15/2019 15:07	EPA 200.8-1994, Rev. 5.4
Molybdenum, Mo	9	ug/L	J	40	8	GES	07/15/2019 15:07	EPA 200.8-1994, Rev. 5.4
Selenium, Se	1	ug/L	J	4	0.6	GES	07/15/2019 15:07	EPA 200.8-1994, Rev. 5.4
Thallium, Tl	< 2	ug/L	U	10	2	GES	07/15/2019 15:07	EPA 200.8-1994, Rev. 5.4
Boron, B	1.15	mg/L		0.1	0.02	DAM	07/15/2019 14:07	EPA 200.7-1994, Rev. 4.4
Calcium, Ca	351	mg/L		0.3	0.04	DAM	07/15/2019 14:07	EPA 200.7-1994, Rev. 4.4
Lithium, Li	1.89	mg/L		0.03	0.009	DAM	07/15/2019 14:07	EPA 200.7-1994, Rev. 4.4

SP-7

Sample Number: 192191-002 **Date Collected: 06/21/2019 14:50** **Date Received: 6/25/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Antimony, Sb	0.8	ug/L	J	2	0.4	GES	07/15/2019 15:12	EPA 200.8-1994, Rev. 5.4
Arsenic, As	9.77	ug/L		2	0.6	GES	07/15/2019 15:12	EPA 200.8-1994, Rev. 5.4
Barium, Ba	292000	ug/L		2	0.4	GES	07/15/2019 15:12	EPA 200.8-1994, Rev. 5.4
Beryllium, Be	< 0.4	ug/L	U	2	0.4	GES	07/15/2019 15:12	EPA 200.8-1994, Rev. 5.4
Cadmium, Cd	< 0.2	ug/L	U	1	0.2	GES	07/15/2019 15:12	EPA 200.8-1994, Rev. 5.4
Chromium, Cr	1	ug/L	J	4	0.8	GES	07/15/2019 15:12	EPA 200.8-1994, Rev. 5.4
Cobalt, Co	2.85	ug/L		1	0.4	GES	07/15/2019 15:12	EPA 200.8-1994, Rev. 5.4
Lead, Pb	< 0.4	ug/L	U	2	0.4	GES	07/15/2019 15:12	EPA 200.8-1994, Rev. 5.4
Molybdenum, Mo	< 8	ug/L	U	40	8	GES	07/15/2019 15:12	EPA 200.8-1994, Rev. 5.4
Selenium, Se	< 0.6	ug/L	U	4	0.6	GES	07/15/2019 15:12	EPA 200.8-1994, Rev. 5.4
Thallium, Tl	< 2	ug/L	U	10	2	GES	07/15/2019 15:12	EPA 200.8-1994, Rev. 5.4
Boron, B	1.25	mg/L		0.1	0.02	DAM	07/15/2019 14:11	EPA 200.7-1994, Rev. 4.4
Calcium, Ca	716	mg/L		0.3	0.04	DAM	07/15/2019 14:11	EPA 200.7-1994, Rev. 4.4
Lithium, Li	3.83	mg/L		0.03	0.009	DAM	07/15/2019 14:11	EPA 200.7-1994, Rev. 4.4
Chloride, Cl	30200	mg/L		50	20	CRJ	06/26/2019 17:51	EPA 300.1-1997, Rev. 1.0
Fluoride, F	1.72	mg/L		2	0.4	CRJ	06/26/2019 18:14	EPA 300.1-1997, Rev. 1.0
Sulfate, SO4	< 2	mg/L	U	10	2	CRJ	06/26/2019 18:14	EPA 300.1-1997, Rev. 1.0

U: Analyte was analyzed and not detected at or above adjusted Method Detection Limit
J: Analyte was positively identified, though the quantitation was below Reporting Limit.



Michael Ohlinger, Chemist

Email msohlinger@aep.com *Tel.*

Fax 614-836-4168 *Audinet 8-210-*

Microbac

Laboratory Report Number: L19012057

Dave Conover
DOLAN LABORATORY
4001 Bixby Road
Groveport, OH 43125

Please find enclosed the analytical results for the samples you submitted to Microbac Laboratories. Review and compilation of your report was completed by Microbac's Ohio Valley Division (OVD). If you have any questions, comments, or require further assistance regarding this report, please contact your service representative listed below.

Laboratory Contact:
Stephanie Mossburg – Team Chemist/Data Specialist
(740) 373-4071
Stephanie.Mossburg@microbac.com

I certify that all test results meet all of the requirements of the accrediting authority listed below. All results for soil samples are reported on a 'dry-weight' basis unless specified otherwise. Analytical results for water and wastes are reported on a 'as received' basis unless specified otherwise. A statement of uncertainty for each analysis is available upon request. This laboratory report shall not be reproduced, except in full, without the written approval of Microbac Laboratories. The reported results are related only to the samples analyzed as received.

This report was certified on February 07 2019

Leslie Bucina – Laboratory Manager

State of Origin: OH
Accrediting Authority: N/A ID:OH00218
QAPP: Microbac OVD

Record of Sample Receipt and Inspection

Comments/Discrepancies

This is the record of the shipment conditions and the inspection records for the samples received and reported as a sample delivery group (SDG). All of the samples were inspected and observed to conform to our receipt policies, except as noted below.

There were no discrepancies.

Discrepancy	Resolution

Coolers

Cooler #	Temperature Gun	Temperature	COC #	Airbill #	Temp Required?
00115915	I	0.0		1Z5235750354470648	X

Inspection Checklist

#	Question	Result
1	Were shipping coolers sealed?	Yes
2	Were custody seals intact?	NA
3	Were cooler temperatures in range of 0-6?	Yes
4	Was ice present?	Yes
5	Were COC's received/information complete/signed and dated?	Yes
6	Were sample containers intact and match COC?	Yes
7	Were sample labels intact and match COC?	Yes
8	Were the correct containers and volumes received?	Yes
9	Were samples received within EPA hold times?	Yes
10	Were correct preservatives used? (water only)	NA
11	Were pH ranges acceptable? (voa's excluded)	NA
12	Were VOA samples free of headspace (less than 6mm)?	NA

Microbac

Lab Report #: L19012057
Lab Project #: 2490.001
Project Name: DOLAN LABS
Lab Contact: Stephanie Mossburg

Samples Received

Client ID	Laboratory ID	Date Collected	Date Received
190312-001	L19012057-01	01/28/2019 10:20	01/31/2019 10:58

Microbac Laboratories ● Ohio Valley Division
158 Starlite Drive, Marietta, OH 45750 ● T: (740)373-4071 F: (740)373-4835
www.microbac.com

Microbac

Lab Report #: L19012057
Lab Project #: 2490.001
Project Name: DOLAN LABS
Lab Contact: Stephanie Mossburg

Certificate of Analysis

Sample #:	L19012057-01	**PrePrep Method:**	N/A	**Instrument:**	ICP-THERMO1
Client ID:	190312-001	**Prep Method:**	3051A	**Prep Date:**	02/04/2019 07:21
Matrix:	Solidwaste	**Analytical Method:**	6010B	**Cal Date:**	02/05/2019 13:13
Workgroup #:	WG694836	**Analyst:**	PDM	**Run Date:**	02/05/2019 17:20
Collect Date:	01/28/2019 10:20	**Dilution:**	1	**File ID:**	T1.020519.172058
Sample Tag:	01	**Units:**	mg/kg		

Analyte	CAS #	Result	Qual	RL	MDL
Lithium, Total	7439-93-2	15.0		4.95	2.47

Microbac Laboratories Inc.

METHOD BLANK SUMMARY

Login Number:	L19012057	**Work Group:**	WG694836
Blank File ID:	T1.020519.163605	**Blank Sample ID:**	WG694609-03
Prep Date:	02/04/19 07:21	**Instrument ID:**	ICP-THERMO1
Analyzed Date:	02/05/19 16:36	**Method:**	6010B
Analyst:	PDM		

This Method Blank Applies To The Following Samples:

Client ID	Lab Sample ID	Lab File ID	Time Analyzed	TAG
LCS	WG694609-04	T1.020519.163905	02/05/19 16:39	01
190312-001	L19012057-01	T1.020519.172058	02/05/19 17:20	01

Report Name: BLANK_SUMMARY
PDF File ID: 6292203
Report generated 02/06/2019 14:00

Microbac Laboratories Inc.

METHOD BLANK REPORT

Login Number: L19012057 Prep Date: 02/04/19 07:21 Sample ID: WG694609-03
Instrument ID: ICP-THERMO1 Run Date: 02/05/19 16:36 Prep Method: 3051A
File ID: T1.020519.163605 Analyst: PDM Method: 6010B
Workgroup (AAB#): WG694836 Matrix: Soil Units: mg/kg
Contract #: Cal ID: ICP-TH-05-FEB-19

Analytes	MDL	RL	Concentration	Dilution	Qualifier
Lithium, Total	2.50	5.00	2.50	1	U

MDL Method Detection Limit
RL Reporting/Practical Quantitation Limit
ND Analyte Not detected at or above reporting limit
* |Analyte concentration| > RL

Report Name:BLANK
PDF ID: 6292204
06-FEB-2019 14:00

Microbac Laboratories Inc.
LABORATORY CONTROL SAMPLE (LCS)

Login Number: L19012057 **Run Date:** 02/05/2019 **Sample ID:** WG694609-04
Instrument ID: ICP-THERMO1 **Run Time:** 16:39 **Prep Method:** 3051A
File ID: T1.020519.163905 **Analyst:** PDM **Method:** 6010B
Workgroup (AAB#): WG694836 **Matrix:** Soil **Units:** mg/kg
QC Key: STD **Lot#:** STD91905 **Cal ID:** ICP-TH-05-FEB-19

Analytes	Expected	Found	% Rec	LCS Limits	Q
Lithium, Total	25.0	26.4	106	80 - 120	

LCS - Modified 03/06/2008
PDF File ID: 6292205
Report generated: 02/06/2019 14:00

Microbac Laboratories Inc.

MATRIX SPIKE AND MATRIX SPIKE DUP (MS/MSD)

Loginnum:L19012057 Cal ID:ICP-THERMO1- Worknum:WG694836

Instrument ID:ICP-THERMO1 Contract #: Method:6010B

Parent ID:WG694609-01 File ID:T1.020519.164201 Dil:1 Matrix:SOLID

Sample ID:WG694609-05 MS File ID:T1.020519.165441 Dil:1 Units:mg/kg

Sample ID:WG694609-06 MSD File ID:T1.020519.165803 Dil:1

Analyte	Parent	MS Spiked	MS Found	MS %Rec	MSD Spiked	MSD Found	MSD %Rec	%RPD	%Rec Limits	RPD Limit	Q
Lithium	9.64	19.0	26.1	86.3	18.2	28.8	105	10.2	80 - 120	20	

* FAILS %REC LIMIT

FAILS RPD LIMIT

NOTE: This is an internal quality control sample.

WG_MS_MSD_DRYWT - Modified 05/26/2011

PDF File ID: 6292206

Report generated 02/06/2019 14:00

Microbac Laboratories Inc.
Ohio Valley Division Analyst List
February 7, 2019

001 - BIO-CHEM TESTING WVDEP 220	002 - REIC Consultants, Inc. WVDEP 060
003 - Sturm Environmental	004 - MICROBAC PITTSBURGH
005 - ES LABORATORIES	006 - ALCOSAN LABORATORIES
007 - ALS LABORATORIES	008 - BENCHMARK LABORATORIES
010 - MICROBAC CHICAGOLAND	AC - AMBER R. CARMICHAEL
ACG - ALEX C. GEDON	ADC - ANTHONY D. CANTER
ADG - APRIL D. GREENE	ADW - ALICIA D. WALKER
ALS - ADRIANE L. STEED	APH - ANDREW P. HOUT
AT - Asa R. Timmons	ATK - ALEX T. KLINTWORTH
AWE - ANDREW W. ESSIG	AZH - AFTER HOURS
BLG - BRENDA L. GREENWALT	BRG - BRENDA R. GREGORY
CAS - Craig A. Smith	CEB - CHAD E. BARNES
CLC - CHRYS L. CRAWFORD	COR - Corporate IT
CPD - CHAD P. DAVIS	CSH - CHRIS S. HILL
DIH - DEANNA I. HESSON	DLB - DAVID L. BUMGARNER
DLP - DOROTHY L. PAYNE	DSM - DAVID S. MOSSOR
ECL - ERIC C. LAWSON	EEA - EMILY E. ALLEN
EGS - EMILY G. SHILLING	EPT - ETHAN P. TIDD
ERP - ERIN R. PORTER	JAO - Jeff A. Ogle
JDH - JUSTIN D. HESSON	JDS - JARED D. SMITH
JDW - JAMES D. WRIGHT	JKP - JACQUELINE K. PARSONS
JLR - JIMMY L. RUSH	JRH - Justin R. Hill
JST - JOSHUA S. TAYLOR	JTP - JOSHUA T. PEMBERTON
JWR - JOHN W. RICHARDS	JYH - JI Y. HU
KAK - KATHY A. KIRBY	KEB - KATIE E. BARNES
KEH - Katelyn E. Hoover	KFR - KARISSA F. REYNOLDS
KHR - KIM H. RHODES	KKB - KERRI K. BUCK
KMC - KAYLA M. CHEVALIER	KMG - KALEN M. GANDOR
KRA - KATHY R. ALBERTSON	KRP - KATHY R. PARSONS
KWD - Kurtis W. Decker	LLS - LARRY L. STEPHENS
LSB - LESLIE S. BUCINA	LSJ - LAURA S. JONES
MAP - MARLA A. PORTER	MES - MARY E. SCHILLING
MMB - MAREN M. BEERY	MRT - MICHELLE R. TAYLOR
PDM - PIERCE D. MORRIS	PIT - MICROBAC WARRENDALE
RLB - BOB BUCHANAN	RNM - Rene N. Miller
RNP - RICK N. PETTY	SAV - SARAH A. VANDENBERG
SCB - SARAH C. BOGOLIN	SLM - STEPHANIE L. MOSSBURG
TB - TODD BOYLE	TMM - TAMMY M. MORRIS
VC - VICKI COLLIER	WTD - WADE T. DELONG
XXX - UNAVAILABLE OR SUBCONTRACT	ZTB - ZACH T. BARNES

Microbac Laboratories Inc.
List of Valid Qualifiers
February 07, 2019

Qualkey: STD_ND=U

Qualifier	Description
*	Surrogate or spike compound out of range
+	Correlation coefficient for the MSA is less than 0.995
<	Result is less than the associated numerical value.
>	Result is greater than the associated numerical value.
A	See the report narrative
B	Analyte present in method blank
B1	Target analyte detected in method blank at or above the method reporting limit
B3	Target analyte detected in calibration blank at or above the method reporting limit
B4	The BOD unseeded dilution water blank exceeded 0.2 mg/L
C	Confirmed by GC/MS
CG	Confluent growth
CT1	The cooler temperature at receipt exceeded regulatory guidance.
DL	Surrogate or spike compound was diluted out
E	Estimated concentration due to sample matrix interference
EDL	Elevated sample reporting limits, presence of non-target analytes
EMPC	Estimated Maximum Possible Concentration
F, S	Estimated result below quantitation limit; method of standard additions(MSA)
FL	Free Liquid
FP1	Did not ignite.
H1	Sample analysis performed past holding time.
I	Semiquantitative result (out of instrument calibration range)
J	The analyte was positively identified, but the quantitation was below the RL
J,B	Analyte detected in both the method blank and sample above the MDL.
J,CT1	Estimated. The cooler temperature at receipt exceeded the regulatory guidance.
J,H1	The analyte was positively identified, but the quantitation was below the RL. Sample analysis performed past holding time
J,P	Estimate; columns don't agree to within 40%
J,S	Estimated concentration; analyzed by method of standard addition (MSA)
L	Sample reporting limits elevated due to matrix interference
L1	The associated blank spike (LCS) recovery was above the laboratory acceptance limits.
L2	The associated blank spike (LCS) recovery was below the laboratory acceptance limits.
M	Matrix effect; the concentration is an estimate due to matrix effect.
N	Tentatively identified compound(TIC)
NA	Not applicable
ND, S	Not detected; analyzed by method of standard addition (MSA)
ND,L	Not detected; sample reporting limit (RL) elevated due to interference
NF	Not found by library search
NFL	No free liquid
NI	Non-ignitable
NR	Analyte is not required to be analyzed
NS	Not spiked
P	Concentrations >40% difference between the two GC columns
Q	One or more quality control criteria failed. See narrative.
QNS	Quantity of sample not sufficient to perform analysis
RA	Reanalysis confirms reported results
RE	Reanalysis confirms sample matrix interference
S	Analyzed by method of standard addition (MSA)
SMI	Sample matrix interference on surrogate
SP	Reported results are for spike compounds only
TIC	Library Search Compound
TNTC	Too numerous to count
U	Not detected at or above adjusted sample detection limit
U,CT1	Not detected. The cooler temperature at receipt exceeded regulatory guidance.
U,H1	Not detected; sample analysis performed past holding time.
UJ	Undetected; the MDL and RL are estimated due to quality control discrepancies.
W	Post-digestion spike for furnace AA out of control limits
X	Exceeds regulatory limit
X, S	Exceeds regulatory limit; method of standard additions (MSA)
Y	This analyte is not on the laboratory's current scope of accreditation.
Z	Cannot be resolved from isomer - see below

Chain of Custody Record

Microbac Laboratories, Inc.
158 Starlite Dr, Marrietta, OH 45750
Phone: 740-373-4071
Fax: 740-373-4835

Contact Name:	Michael Ohlinger AEP Dolan Lab	Contact Phone #:	(614) 836-4184
Address:	4001 Bixby Rd. Groveport, OH 43125	Billing Contact #:	(614) 836-4221
Additional Requirements:			

Microbac Information:
Customer #:
Additional Labor:

Turn Around: Routine	Project ID:	Sampler: Jason Blanton

Sample ID	Sample Description	Collected Date/Time	Analysis Requested	Grab/ Comp.	No. of Cont.	Matrix & Preservative
190312-001	Northeastern Bottom Ash	1/28/2019 10:20 AM	Lithium	Grab	1	Solids/Soil Cold

Relinquished By: Michael Ohly Date/Time: 1/30/19 12:05 pm

Received By: Date/Time:

Microbac OVD
Received: 01/31/2019 10:58
By: BRENDA GREGORY
221000132389

Time:

Time:

MICROBAC®

Cooler ID 2389

COOLER TEMP >6° C LOG

SAMPLE ID	Bottle 1 °C	Bottle 2 °C	Bottle 3 °C	Bottle 4 °C	Bottle 5 °C	Bottle 6 °C

BG 1/31/19

pH Lot # N/A

pH Exceptions

SAMPLE ID	Bottle 1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6

BG 1/31/19

PRESERVATIVE EXCEPTIONS

NONE

AS NOTED

BG 1/31/19

Document Control # 1957
Last 10-07-2016

Issued to: Document Master File

Table 1: Groundwater Data Summary
Northeastern Plant - Landfill

Parameter	Unit	MW-8D											
		1/25/2017	3/15/2017	4/24-4/27/2017	5/18/2017	6/15-6/16/2017	6/27-6/28/2017	7/12-7/13/2017	8/4/2017	8/17/2017	8/30/2017	9/13/2017	10/11/2017
		Background											Detection
Antimony	mg/L	<0.00093 U	0.00500	0.00256 J	0.00713	0.0203	0.00467 J	0.00328 J	0.00232 J	0.00794	0.00508	0.00378 J	-
Arsenic	mg/L	0.00700	<0.00105 U	0.00448 J	0.0103	0.0134	0.00178 J	0.00270 J	0.00430 J	0.00580	0.00952	0.00704	-
Barium	mg/L	1.17	1.66	2.32	7.14	7.37	5.29	3.72	1.90	2.38	3.86	4.51	-
Beryllium	mg/L	<0.00002 U	<0.00002 U	0.000120 J	0.000460 J	0.000740 J	0.0000800 J	0.000130 J	0.000170 J	0.000220 J	0.000750 J	0.000450 J	-
Boron	mg/L	1.31	1.29	1.28	1.27	1.34	1.29	1.36	1.35	1.35	1.36	1.36	1.32
Cadmium	mg/L	0.00100	0.00200	0.000930 J	0.00507	0.00826	0.00254	0.00141	0.000970 J	0.00139	0.00275	0.00182	-
Calcium	mg/L	446	417	376	529	861	416	381	416	450	586	479	445
Chloride	mg/L	12000	13200	11200	14600	10200	11200	11800	11800	11300	12300	12300	11600
Chromium	mg/L	0.00400	0.00100	<0.00023 U	0.00894	0.0154	0.000590 J	<0.00023 U	0.00102	0.00175	0.0143	0.00662	-
Cobalt	mg/L	<0.00014 U	<0.00014 U	0.00145 J	0.00592	0.0108	0.00385 J	0.00235 J	0.00265 J	0.00273 J	0.00653	0.00430 J	-
Combined Radium	pCi/L	7.48	4.66	5.29	5.58	5.37	-	-	9.67	6.39	5.98	-	-
Fluoride	mg/L	<0.083 U	<0.083 U	0.240 J	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U
Lead	mg/L	<0.00068 U	<0.00068 U	0.000900 J	0.00659	0.00560	0.00231 J	0.00214 J	0.00282 J	0.00217 J	0.00511	0.00289 J	-
Lithium	mg/L	1.44	1.10	1.07	1.30	1.22	1.14	1.19	1.08	1.12	1.19	1.23	-
Mercury	mg/L	<0.000005 U	<0.000005 U	0.0000100 J	0.0000220 J	0.0000250	0.0000120 J	0.0000150 J	0.0000120 J	<0.000005 U	0.0000290	0.0000300	-
Molybdenum	mg/L	<0.005 U	<0.005 U	0.000910 J	0.00243 J	0.00281 J	0.00120 J	0.00168 J	0.00190 J	0.00191 J	0.00340 J	0.00453 J	-
Selenium	mg/L	0.00600	<0.00099 U	0.00391 J	0.00370 J	0.00371 J	0.00134 J	0.00578	0.00603	0.00605	0.00474 J	0.00466 J	-
Total Dissolved Solids	mg/L	20800	19000	20800	22300	20100	21000	21100	22200	22400	23000	23000	21900
Sulfate	mg/L	144	72.0	58.0	112	122	116	128	113	103	112	126	300
Thallium	mg/L	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	-
pH	SU	7.10	-	7.34	-	7.21	7.04	7.15	6.98	6.94	6.99	6.89	6.90

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1: Groundwater Data Summary
Northeastern Plant - Bottom Ash Pond

Parameter	Unit	SP-1												
		1/25/2017	3/13/2017	4/24-4/27/2017	5/18/2017	6/15-6/16/2017	6/27-6/28/2017	7/12-7/13/2017	8/4/2017	8/17/2017	8/30/2017	9/13/2017	9/20/2017	10/11/2017
		Background												Detection
Antimony	mg/L	0.005U*	0.005U*	0.00275J	0.00685	0.00114J	0.005U	0.00125J	0.005U	-	0.00209J	0.005U	0.005U	-
Arsenic	mg/L	0.005U*	0.005U*	0.00191J	0.00548	0.005U	0.005U	0.005U	0.00211J	-	0.00134J	0.005U	0.005U	-
Barium	mg/L	0.211	0.146	0.195	0.243	0.183	0.187	0.217	0.298	-	0.218	0.21	0.168	-
Beryllium	mg/L	0.001U*	0.001U*	0.0001J	0.00026J	0.00004J	0.001U	0.00009J	0.0001J	-	0.00014J	0.00009J	0.00005J	-
Boron	mg/L	0.298	0.186	0.202	0.284	0.242	0.232	0.287	0.299	-	0.25	0.369	0.331	0.35
Cadmium	mg/L	0.001U*	0.001U*	0.001U	0.00022J	0.001U	0.001U	0.001U	0.001U	-	0.001U	0.00008J	0.00011J	-
Calcium	mg/L	111	117	108	131	115	113	122	125	-	120	119	129	152
Chloride	mg/L	60	548	83	104	50	19	70	20	-	34	62	22	136
Chromium	mg/L	0.001U*	0.001U*	0.00084J	0.00255	0.001U	0.001U	0.00062J	0.00078J	-	0.00055J	0.00031J	0.001U	-
Cobalt	mg/L	0.005U*	0.005U*	0.00242J	0.00255J	0.00077J	0.00077J	0.00134J	0.00133J	-	0.00175J	0.00107J	0.00115J	-
Combined Radium	pCi/L	3.48	3.014	4.71	4.12	2.096	14.29	4.01	3.41	-	4.15	2.584	4.53	-
Fluoride	mg/L	1U*	4	1.02	1.3	0.6437J	0.582J	0.6283J	0.542J	-	0.581J	0.4042J	1U	1.4051
Lead	mg/L	0.005U*	0.005U*	0.00094J	0.00163J	0.005U	0.005U	0.00124J	0.00094J	-	0.005U	0.005U	0.005U	-
Lithium	mg/L	0.006	0.007	0.00789	0.00853	0.00407	0.00334	0.00395	0.00577	-	0.00468	0.00548	0.00318	-
Mercury	mg/L	0.000025U*	0.000025U*	0.000025U	0.000023J	0.000009J	0.000025U	0.000025U	0.000009J	-	0.000025U	0.000025U	0.000025U	-
Molybdenum	mg/L	0.011	0.016	0.01992	0.01677	0.00702	0.00642	0.00814	0.01996	-	0.01208	0.01465	0.00532	-
Selenium	mg/L	0.005U*	0.005U*	0.00485J	0.00651	0.00254J	0.00277J	0.00521	0.01196	-	0.00351J	0.00413J	0.005U	-
Total Dissolved Solids	mg/L	514	480	496	574	478	424	504	394	-	456	536	440	676
Sulfate	mg/L	66	30	60	60	48	48	56	52	-	59	54	62	58
Thallium	mg/L	0.002U*	0.002U*	0.002U	0.002U	0.002U	0.002U	0.00089J	0.002U	-	0.002U	0.002U	0.002U	-
pH	SU	7.52	-	7.56	-	9.34	11.09	9.84	8.72	7.94	7.73	8.19	7.33	7.36

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Parameter was not present in concentrations above method detection limit and is reported as the reporting limit
*: Parameter was not present in concentrations above method detection limit and is reported as the method detection limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1: Groundwater Data Summary
Northeastern Plant - Bottom Ash Pond

Parameter	Unit	SP-2												
		1/25/2017	3/13/2017	4/24-4/27/2017	5/18/2017	6/15-6/16/2017	6/27-6/28/2017	6/12-7/13/2017	8/4/2017	8/17/2017	8/30/2017	9/13/2017	9/20/2017	10/11/2017
		Background												Detection
Antimony	mg/L	0.005U*	0.005U*	0.00209J	0.00871	0.01134	0.00515	0.00474J	0.00351J	-	0.00295J	0.00267J	0.00264J	-
Arsenic	mg/L	0.011	0.005	0.00208J	0.00902	0.0055	0.0014J	0.00251J	0.00254J	-	0.00125J	0.00183J	0.00305J	-
Barium	mg/L	1.46	1.13	0.76	3.13	1.71	1.56	1.54	1.01	-	1.12	0.992	1.15	-
Beryllium	mg/L	0.001U*	0.001U*	0.00004J	0.00026J	0.00018J	0.00006J	0.00007J	0.00009J	-	0.00012J	0.00011J	0.0002J	-
Boron	mg/L	0.274	0.251	0.152	0.336	0.303	0.292	0.339	0.28	-	0.275	0.311	0.3	0.307
Cadmium	mg/L	0.001U*	0.001U*	0.001U	0.00018J	0.001U	0.001U	0.001U	0.00007J	-	0.001U	0.001U	0.00009J	-
Calcium	mg/L	108	82.6	62	117	108	98.5	111	147	-	86.8	91.8	129	91.9
Chloride	mg/L	607	37	527	1240	888	883	863	1064	-	1001	930	856	970
Chromium	mg/L	0.003	0.001	0.00024J	0.00287	0.00204	0.00129	0.00059J	0.00107	-	0.001U	0.001U	0.00346	-
Cobalt	mg/L	0.005U*	0.005U*	0.00087J	0.00277J	0.00251J	0.00182J	0.00123J	0.00108J	-	0.0008J	0.00087J	0.00255J	-
Combined Radium	pCi/L	6.89	9.96	8.98	26.48	22.16	-	-	16.34	-	14.48	14.89	-	-
Fluoride	mg/L	3	1	2.82	3	2.96	2.8408	3.581	2.788	-	4.0998	3.196	1.726	3.5881
Lead	mg/L	0.005U*	0.005U*	0.005U	0.00202J	0.005U	0.005U	0.00141J	0.005U	-	0.005U	0.005U	0.00091J	-
Lithium	mg/L	0.098	0.073	0.05305	0.111	0.103	0.09272	0.0961	0.09164	-	0.0931	0.09207	0.09111	-
Mercury	mg/L	0.000025U*	0.000025U*	0.000025U	0.000006J	0.000005J	0.000025U	0.000025U	0.000014J	-	0.000025U	0.000006J	0.000025U	-
Molybdenum	mg/L	0.019	0.023	0.02467	0.01163	0.02957	0.02962	0.03332	0.0394	-	0.03386	0.03761	0.03939	-
Selenium	mg/L	0.005U*	0.005U*	0.00204J	0.00616	0.03783	0.02241	0.02323	0.02336	-	0.01186	0.00987	0.00987	-
Total Dissolved Solids	mg/L	1786	1340	1242	2214	1912	1872	1846	2132	-	2192	1956	1778	2076
Sulfate	mg/L	21	70	27	15	61	58	58	57	-	47	43	37	41
Thallium	mg/L	0.002U*	0.002U*	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	-	0.002U	0.002U	0.002U	-
pH	SU	6.41	-	6.53	-	8.31	7.38	7.94	7.21	7.64	7.46	7.04	6.86	7.3

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Parameter was not present in concentrations above method detection limit and is reported as the reporting limit
*: Parameter was not present in concentrations above method detection limit and is reported as the method detection limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1: Groundwater Data Summary
Northeastern Plant - Bottom Ash Pond

Parameter	Unit	SP-4												
		1/25/2017	3/15/2017	4/25-4/27/2017	5/18/2017	6/15-6/16/2017	6/27-6/28/2017	7/12-7/13/2017	8/4/2017	8/17/2017	8/30-8/31/2017	9/13/2017	9/20/2017	10/11/2017
		Background												Detection
Antimony	mg/L	0.005U*	0.005U*	0.00136J	0.00204J	0.00174J	0.005U	0.00266J	0.00387J	0.005U	0.00245J	0.005U	0.0023J	-
Arsenic	mg/L	0.005U*	0.005U*	0.00172J	0.0055	0.00459J	0.00201J	0.01065	0.04498	0.01931	0.00913	0.01634	0.01395	-
Barium	mg/L	0.398	0.477	0.578	0.762	0.633	0.576	1.34	4.59	2.31	1.49	1.91	1.93	-
Beryllium	mg/L	0.001U*	0.001U*	0.00003J	0.00056J	0.00034J	0.00024J	0.00128	0.00497	0.00212	0.00126	0.00171	0.00177	-
Boron	mg/L	0.406	0.399	0.442	0.411	0.395	0.388	0.42	0.412	0.493	0.392	0.387	0.477	0.425
Cadmium	mg/L	0.001U*	0.001U*	0.0001J	0.00057J	0.001U	0.001U	0.00137	0.00655	0.00205	0.00166	0.00247	0.0019	-
Calcium	mg/L	57.7	67	58.8	296	118	110	648	1920	793	612	810	630	206
Chloride	mg/L	401	52	459	232	475	471	489	469	460	576	450	440	431
Chromium	mg/L	0.001U*	0.001U*	0.00064J	0.01073	0.00404	0.00298	0.02248	0.08415	0.04182	0.02581	0.03083	0.03455	-
Cobalt	mg/L	0.005U*	0.005U*	0.00101J	0.00549	0.00463J	0.00529	0.01064	0.04069	0.01786	0.01206	0.01771	0.01632	-
Combined Radium	pCi/L	4	3.57	2.566	6.37	4.18	9.64	5.79	4.04	6.71	8.09	5.92	-	-
Fluoride	mg/L	3	4	3.2	2.1	3.34	3.2489	3.863	3.078	3.049	4.086	3.199	1.747	3.7702
Lead	mg/L	0.005U*	0.005U*	0.005U	0.00365J	0.00139J	0.00096J	0.00847	0.03663	0.0107	0.00711	0.00892	0.0096	-
Lithium	mg/L	0.072	0.073	0.06973	0.07998	0.07422	0.07041	0.09243	0.136	0.111	0.0962	0.104	0.101	-
Mercury	mg/L	0.000025U*	0.000025U*	0.000025U	0.000015J	0.000025U	0.000025U	0.00001J	0.000058	0.00003	0.000021J	0.000029	0.000014J	-
Molybdenum	mg/L	0.005U*	0.005U*	0.0015J	0.00102J	0.00065J	0.00046J	0.005U	0.00503	0.00423J	0.00461J	0.00621	0.00702	-
Selenium	mg/L	0.005U*	0.005U*	0.005U	0.005U	0.00167J	0.005U	0.005U	0.00499J	0.00104J	0.00186J	0.00165J	0.005U	-
Total Dissolved Solids	mg/L	1122	1128	1128	846	1164	1388	1128	1150	1132	1400	1236	1208	1200
Sulfate	mg/L	37	38	41	50	36	37	36	50	75	74	88	90	78
Thallium	mg/L	0.002U*	0.002U*	0.00121J	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	-
pH	SU	7.72	-	6.96	-	8.25	8.1	8.05	7.66	7.82	7.61	7.71	7.17	7.44

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Parameter was not present in concentrations above method detection limit and is reported as the reporting limit
*: Parameter was not present in concentrations above method detection limit and is reported as the method detection limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1: Groundwater Data Summary
Northeastern Plant - Bottom Ash Pond

Parameter	Unit	SP-5												
		1/25/2017	3/15/2017	4/25-4/27/2017	5/18/2017	6/15-6/16/2017	6/27-6/28/2017	/12-7/13/201	8/4/2017	8/17/2017	8/30/2017	9/13/2017	9/20/2017	10/11/2017
		Background												Detection
Antimony	mg/L	0.005U*	0.005U*	0.005U	0.005U	0.00202J	0.005U	0.005U	0.005U	0.00163J	0.005U	0.005U	0.005U	-
Arsenic	mg/L	0.012	0.013	0.01703	0.02942	0.0137	0.01265	0.01724	0.0216	0.01911	0.01947	0.02036	0.02077	-
Barium	mg/L	1.65	1.59	1.61	2.27	2.05	1.79	1.88	1.8	1.89	1.93	1.93	1.88	-
Beryllium	mg/L	0.001U*	0.001U*	0.00003J	0.00023J	0.00011J	0.00002J	0.00006J	0.00009J	0.00004J	0.00011J	0.0001J	0.00005J	-
Boron	mg/L	0.233	0.236	0.245	0.319	0.231	0.224	0.261	0.256	0.293	0.252	0.232	0.257	0.61
Cadmium	mg/L	0.001U*	0.001U*	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.00016J	0.001U	-
Calcium	mg/L	52.4	61.7	53.8	79.1	57.1	53	53.8	61.3	52	57.3	55.6	53.7	71
Chloride	mg/L	500	62	674	1834	607	636	640	638	661	652	644	729	630
Chromium	mg/L	0.001U*	0.001	0.00033J	0.00341	0.00142	0.0003J	0.0005J	0.00169	0.001U	0.00116	0.00062J	0.001U	-
Cobalt	mg/L	0.005U*	0.005U*	0.00088J	0.00232J	0.00144J	0.00101J	0.0011J	0.00132J	0.001J	0.0012J	0.001J	0.00097J	-
Combined Radium	pCi/L	10.09	9.65	10.27	15.3	10.27	15.84	12.21	11.6	10.95	12.47	10.62	10.5	-
Fluoride	mg/L	3	4	3.06	4	3	2.835	3.156	2.889	3.258	3.5698	2.797	1.535	3.7844
Lead	mg/L	0.005U*	0.005U*	0.005U	0.00236J	0.005U	0.00076J	0.0009J	0.00144J	0.005U	0.005U	0.005U	0.00106J	-
Lithium	mg/L	0.114	0.112	0.112	0.163	0.109	0.1	0.111	0.119	0.106	0.112	0.11	0.111	-
Mercury	mg/L	0.000025U*	0.000025U*	0.000016J	0.000025U	0.000016J	0.000025U	0.000025U	0.000015J	0.000025U	0.000009J	0.000025U	0.000025U	-
Molybdenum	mg/L	0.005U*	0.005U*	0.00116J	0.005U	0.005U	0.005U	0.005U	0.00127J	0.005U	0.005U	0.005U	0.005U	-
Selenium	mg/L	0.005U*	0.005U*	0.005U	0.005U	0.005U	0.005U	0.00114J	0.005U	0.005U	0.005U	0.005U	0.005U	-
Total Dissolved Solids	mg/L	1354	1420	1436	3008	1368	1156	1388	1372	1378	1424	1452	1312	1368
Sulfate	mg/L	10	10	9	8	7	8	7	8	6	7	6	6	5
Thallium	mg/L	0.002U*	0.002U*	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	-
pH	SU	7.99	-	7.54	-	8.28	8.22	8.18	7.86	8.19	7.69	8.43	7.44	7.52

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Parameter was not present in concentrations above method detection limit and is reported as the reporting limit
*: Parameter was not present in concentrations above method detection limit and is reported as the method detection limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1: Groundwater Data Summary
Northeastern Plant - Bottom Ash Pond

Parameter	Unit	SP-10									SP-11										
		7/12-7/13/2017	8/4/2017	8/17/2017	8/30/2017	9/13/2017	9/20/2017	9/27/2017	10/4/2017	10/11/2017	7/12-7/13/2017	8/4/2017	8/17/2017	8/30/2017	9/13/2017	9/20/2017	9/27/2017	10/4/2017	10/11/2017	10/31/2017	11/8/2017
		Background								Detection	Background								Detection		
Antimony	mg/L	0.00462J	0.00251J	0.005U	0.005U	0.005U	0.00116J	0.00157J	0.00127J	-	0.00943	0.0047J	0.005U	0.00429J	0.0024J	0.00773	0.00689	0.00444J	-	-	-
Arsenic	mg/L	0.005U	0.00243J	0.005U	0.00566	0.00942	0.01392	0.01531	0.0043J	-	0.00399J	0.00182J	0.005U	0.0012J	0.00366J	0.01214	0.0075	0.00847	-	-	-
Barium	mg/L	1.9	0.33	0.282	0.279	0.266	0.399	0.928	0.664	-	0.194	0.09874	0.08342	0.09307	0.108	0.24	0.269	0.347	-	-	-
Beryllium	mg/L	0.001U	0.00003J	0.001U	0.00006J	0.00007J	0.00003J	0.00004J	0.00003J	-	0.00022J	0.00007J	0.001U	0.00007J	0.00008J	0.00039J	0.00039J	0.00035J	-	-	-
Boron	mg/L	0.965	1.08	1.09	1.09	1.1	1.08	1.07	1.1	1.03	0.839	0.543	0.453	0.428	0.447	0.469	0.447	0.531	0.446	-	-
Cadmium	mg/L	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	-	0.0014	0.00044J	0.001U	0.00034J	0.00009J	0.0027	0.00301	0.00249	-	-	-
Calcium	mg/L	53	83.1	91.4	81.8	76.9	64.6	65.7	52.3	58.4	742	272	171	161	190	1220	1170	1110	479	-	-
Chloride	mg/L	1844	1616	1700	1932	1592	1946	1784	1553	1934	568	567	789	683	628	690	759	744	824	-	-
Chromium	mg/L	0.11	0.00244	0.001U	0.00109	0.00046J	0.00072J	0.00207	0.00036J	-	0.01852	0.00525	0.001U	0.00276	0.00257	0.0313	0.03271	0.02949	-	-	-
Cobalt	mg/L	0.00596	0.00474J	0.005U	0.00427J	0.00241J	0.00219J	0.00371J	0.00402J	-	0.00976	0.00652	0.005U	0.00385J	0.00321J	0.01462	0.01437	0.01199	-	-	-
Combined Radium	pCi/L	17.23	1.153	0.995	0.763	0.774	1.062	1.723	3.226	-	-	25.367	0.947	0.438	2.685	4.2	-	2.817	-	0.857	1.423
Fluoride	mg/L	6.502	1U	1U	10.2663	7.028	1U	5	5.11	7.3938	2.386	3.355	4.52	4.1325	3.359	2.016	3	2.9	4.4661	-	-
Lead	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.00087J	-	0.00516	0.00201J	0.005U	0.00123J	0.005U	0.00816	0.00858	0.00705	-	-	-
Lithium	mg/L	0.278	0.284	0.317	0.306	0.315	0.292	0.329	0.279	-	0.04698	0.0877	0.08931	0.08933	0.105	0.13	0.129	0.146	-	-	-
Mercury	mg/L	0.000006J	0.000029	0.000027	0.000019J	0.000013J	0.000016J	0.000013J	0.000015J	-	0.000009J	0.000023J	0.000007J	0.000008J	0.000009J	0.000027	0.000048	0.000047	-	-	-
Molybdenum	mg/L	0.934	0.129	0.04543	0.03035	0.01628	0.01358	0.03593	0.02919	-	0.06127	0.06641	0.0515	0.04433	0.03616	0.0469	0.04861	0.04214	-	-	-
Selenium	mg/L	0.00567	0.00882	0.005U	0.00256J	0.00311J	0.00238J	0.00384J	0.005U	-	0.00595	0.00626	0.005U	0.00249J	0.00155J	0.00546	0.00747	0.00327J	-	-	-
Total Dissolved Solids	mg/L	3416	5142	5678	5264	5168	4424	4516	3660	4060	2880	3076	3308	2732	2420	2336	2428	2288	2322	-	-
Sulfate	mg/L	294	761	915	834	738	544	419	286	188	798	870	741	541	515	329	332	305	223	-	-
Thallium	mg/L	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	-	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	-	-	-
pH	SU	6.74	7.6	7.82	7.58	8.34	7.07	7.77	7.37	6.99	7.35	7.89	6.94	7.61	7.21	7.24	7.18	7.52	7.03	-	-

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Parameter was not present in concentrations above method detection limit and is reported as the reporting limit
*: Parameter was not present in concentrations above method detection limit and is reported as the method detection limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

TABLE 2

NORTHEASTERN STATION 3 & 4

NON-HAZARDOUS INDUSTRIAL WASTE (NHIW) LANDFILL

MONITORING WELL/PIEZOMETER CONSTRUCTION DETAILS

Well Number	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole Depth ft.bls	Date Installed	Screen Material	Well Diameter inches	Top of Screen Depth ft. bls	Top of Screen Elevation ft. msl	Bottom of Screen Depth ft. bls	Bottom of Screen Elevation ft. msl
MW-3D	36° 25' 00.14299"	95° 41' 44.01366"	627.66	630.65	60	2/21/2008	PVC	2	49.7	580.95	60	567.66
MW-6D	36° 24' 54.41869"	95° 41' 51.01306"	633.72	636.66	55	10/23/2008	PVC	2	44.92	591.74	55.22	578.50
MW-7D	36° 25' 06.30327"	95° 41' 47.03123"	623.74	626.46	55	10/22/2008	PVC	2	45.25	581.21	55.55	568.19
MW-8D	36° 25' 04.35228"	95° 42' 10.11303"	626.04	629.32	60	10/21/2008	PVC	2	49.95	579.37	60.25	565.79
MW-9D	36° 24' 50.88110"	95° 41' 54.22530"	633.90	637.04	60	4/6/2010	PVC	2	49.7	587.34	60	573.90
MW-15	36° 24' 48.0816"	95° 41' 56.4658"	634.34	637.71	71	2/23/2016	PVC	2	61.05	576.66	71.45	562.89

TABLE 2

NORTHEASTERN STATION 3 & 4

BOTTOM ASH POND

MONITORING WELL/PIEZOMETER CONSTRUCTION DETAILS

Well Number	Latitude	Longitude	Ground Surface Elevation	Top of Casing Elevation	Borehole Depth ft.bls	Date Installed	Screen Material	Well Diameter inches	Top of Screen Depth ft. bls	Top of Screen Elevation ft. msl	Bottom of Screen Depth ft. bls	Bottom of Screen Elevation ft. msl
SP-1	36° 25' 03.77705"	95° 42' 14.44814"	618.26	621.26	35	4/5/2011	PVC	2	24.7	596.56	35	583.26
SP-2	36° 25' 06.44515"	95° 42' 26.73557"	614.49	617.49	35	4/5/2011	PVC	2	24.9	592.59	35.2	579.29
SP-3	36° 25' 23.91757"	95° 42' 27.02763"	618.02	621.02	35	4/5/2011	PVC	2	24.6	596.42	34.9	583.12
SP-4	36° 25' 23.73526"	95° 42' 06.38375"	636.16	639.16	35	4/6/2011	PVC	2	25	614.16	35.3	600.86
SP-5	36° 25' 43.92075"	95° 42' 14.32901"	628.17	631.17	35	4/6/2011	PVC	2	24.9	606.27	35.2	592.97
SP-5R*	36° 25' 43.92075"	95° 42' 14.32901"	628.17	631.17	75	4/11/2012	PVC	2	34.7	596.47	75	553.17
SP-6	36° 25' 08.5783"	95° 42' 05.0916"	638.08	641.35	71	3/3/2016	PVC	2	60.41	580.94	70.81	567.27
SP-7	36° 25' 05.8073"	95° 42' 17.9217"	613.39	616.84	81	3/7/2016	PVC	2	70.35	546.49	80.75	532.64
SP-8	36° 25' 11.8762"	95° 42' 32.2316"	611.51	614.89	71	3/8/2016	PVC	2	60.45	554.44	70.85	540.66
SP-9	36° 25' 19.3270"	95° 42' 34.0978"	614.00	617.24	75	3/10/2016	PVC	2	65.22	552.02	75.62	538.38

* SP-5R replaced SP-5

AMERICAN ELECTRIC POWER

American Electric Power
502 North Allen Avenue
Shreveport, LA 71101
AEP.com

May 1, 2019

Hillary Young, P.E.
Oklahoma Department of Environmental Quality
707 N Robinson
Oklahoma City, OK 73102

Subject: Northeastern Power Station
252:517 - Coal Combustion Residual
Alternate Source Demonstration – Bottom Ash Pond

Dear Ms. Young:

In accordance with 252:517-9-6-(g)(3)(B) American Electric Power is submitting a report documenting the demonstration of an alternate source for the statistically significant level of lithium detected at the facility referenced above for your approval. This report has been certified by a qualitied professional engineer. This report is being submitted with in the required time frame which includes the 30 day extension granted by ODEQ in correspondence dated march 19, 2019.

Based on the alternate source demonstration the Bottom Ash Pond will continue to operate under the assessment monitoring program. This alternate source demonstration will be included in the annual 2019 groundwater monitoring and corrective action report in accordance with OAC 252:517-9-1(e).

If you have any questions regarding these submittals, you can contact me at 318-673-3816, or by email at jcparker-witt@aep.com.

Sincerely,

Jill Parker-Witt
AEP Environmental Services

ALTERNATIVE SOURCE DEMONSTRATION REPORT STATE CCR RULE

Northeastern Power Station
Bottom Ash Pond
Oologah, Oklahoma

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, OH 43221

April 24, 2019

CHA8462

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
ASL	Alternate Screening Level
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CEC	Cation Exchange Capacity
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
GSC	Groundwater Stats Consulting, LLC
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
MCL	Maximum Contaminant Level
OAC	Oklahoma Administrative Code
ODEQ	Oklahoma Department of Environmental Quality
OGS	Oklahoma Geological Survey
QA	Quality Assurance
QC	Quality Control
SSL	Statistically Significant Level
UTL	Upper Tolerance Limit
USEPA	United States Environmental Protection Agency
XRD	X-Ray Diffraction
XRF	X-Ray Fluorescence

SECTION 1

INTRODUCTION AND SUMMARY

The Northeastern Power Station has two regulated coal combustion residuals (CCR) management units, including the Bottom Ash Pond (BAP). In 2018, two assessment monitoring events were conducted at the BAP in accordance with OAC 252:517-9-6. The monitoring data were submitted to Groundwater Stats Consulting, LLC (GSC) for statistical analysis. Groundwater protection standards (GWPSs) were established for each Appendix IV parameter in accordance with United States Environmental Protection Agency's (USEPA) *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (Unified Guidance; USEPA, 2009). The established GWPSs were determined as the greater of the background concentration and the maximum contaminant level (MCL) or alternate screen level (ASL) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events.

Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at a statistically significant level (SSL) above the GWPS. An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). An SSL was identified for lithium at SP-10 at the BAP (Geosyntec, 2019). The LCL for lithium at SP-10 of 0.263 milligram/liter (mg/L) exceeded the GWPS of 0.15 mg/L.

1.1 CCR Rule Requirements

Oklahoma Department of Environmental Quality (ODEQ) regulations regarding assessment monitoring of CCR landfills and surface impoundments provide owners and operators with the option to make an alternative source demonstration when an SSL is identified (OAC 252:517-9-6(g)(3)(B)). An owner or operator may:

> *Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a qualified professional engineer and submitted to DEQ for approval. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this Section…*

Pursuant to OAC 252:517-9-6(g)(3)(B), Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report to document that the SSL identified for lithium should not be attributed to the BAP.

1.2 Demonstration of Alternative Sources

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

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

A demonstration was conducted to show that the SSL identified for lithium was based on a Type IV cause at SP-10 and not by a release from the BAP.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

In accordance with OAC 252:517-9-6(g)(3)(B), the owner or operator of a CCR unit has 90 days from the determination of an SSL to demonstrate that a source other than the CCR unit caused the SSL. On March 19, 2019 ODEQ granted a 30-day extension for completion of this demonstration. Initial review of site groundwater geochemistry, historical data, and laboratory QA/QC did not identify alternative sources due to Type I (sampling), Type II (laboratory), or Type III (statistical evaluation) issues. As described below, the SSL has been attributed to natural variation in the underlying geology and geochemistry, which are Type IV issues.

2.1 Regional Geology

The generalized stratigraphic column of the regional geology in the Site vicinity is summarized below:

Series	Group	Formation
Desmoinesian	Marmaton	Oolagah
		Labette
		Fort Scott Limestone
	Cherokee	Senora
		Boggy
		Savanna

The Site is underlain by the Oologah Formation. The Oologah Formation is characterized as a dark gray argillaceous limestone with a small amount of fissile shale (Oakes et al., 1952). The limestone is typically dense to moderately crystalline, unjointed, and thinly to massively bedded. The Oologah Formation is approximately 80 to 100 feet thick and is subdivided into three members, the Altamont Limestone, the Bandera Shale, and the Pawnee Limestone (in descending order) as described below:

- *Altamont Limestone*. Grayish orange pink (5YR7/2) to medium gray (N5) limestone, mudstone, wackestones and locally packstones. The texture varies from thin and somewhat wavy to medium planar and is influenced by the presence of fossil algal material. The bedding of the upper portion of the member is typically thinner than the lower portion (Oklahoma Geological Survey [OGS], 2005). The thickness of the Altamont Limestone typically ranges from approximately 65 to 100 feet.
- *Bandera Shale*. Medium dark gray to dark gray, well-laminated to fissile shale. The member is approximately 2-feet thick about 13 miles south of the Site (OGS, 2005 and Woodruff, 1928).
- *Pawnee Limestone*. Medium gray, slightly wavy, thin to medium bedded limestone. The bedding is typically 2 to 4-inches thick but can reach 12 inches in thickness. The Pawnee

Limestone contains abundant fossil debris and varies in thickness from approximately 19 to 22 feet (OGS, 2005).

The Oologah Formation is underlain by the Labette Formation, a grayish-brown to dark gray, laminated clayshale. The clayshale contains some zones of weakly calcareous shale, and multiple horizons of sandy shale to sandstone. The thickness of the Labette Formation typically ranges from approximately 120 to 180 feet. A zone of alternating shale and sandstone (Peru Sandstone) or shale and limestone (Sageeyah Limestone) may be present near the top of the Labette Formation. This member (if present) does not typically contain fossils and varies in thickness up to 20 feet south of the Site (OGS, 2005).

The Labette Formation is underlain by the Fort Scott Formation which consists of three members, in descending order: the Higginsville Limestone; the Little Osage Shale; and the Blackjack Creek Limestone. The Fort Scott Formation limestone consists primarily of a light gray, thin to medium, wavy-bedded fossiliferous wackestone and mudstone (OGS, 2004).

2.2 Site Geology

According to the groundwater monitoring network report for the BAP (Terracon, 2017), the Site is underlain by a limestone unit from ground surface to approximately 30 to 50 feet below ground surface (ft bgs), with a shale unit underlying the limestone. The wells within the CCR compliance network (SP-1, SP-2, SP-4, SP-5R, SP-10, and SP-11) were selected to monitor the upper limestone unit, which was determined to contain the shallow aquifer at the site. Wells set at deeper intervals (SP-3, SP-6, SP-7, SP-8, SP-9) were not selected for inclusion in the CCR compliance monitoring well network, as they were believed to be screened within the lower shale unit.

A subsequent review of the boring logs for co-located wells SP-9 (shale) and SP-10 (limestone) indicates a discrepancy regarding the upper elevation of the limestone-shale interface. The SP-9 boring log identified shale with interbedded limestone beginning at approximately 40 ft bgs, whereas the SP-10 boring log identified limestone to approximately 51.5 ft bgs, with increasing frequency of interbedded shale at greater depths. The two borings were logged using cuttings, which can obscure lithologic changes. To clarify the site geology, Geosyntec advanced two additional borings at the Site in early 2019 (Figure 1). Boring BAP-B1 was advanced to a depth of 186 ft bgs.

The following is a general summary of the geologic units encountered at BAP-B1:

Geologic Unit	Depth (ft bgs)	Elevation (ft amsl)[1]
Unconsolidated Soil	0 to 3	625.8 to 622.8
Limestone (Oologah Formation)	3 to 100	622.8 to 525.8
Shale (Labette Formation)	100 to 181	525.8 to 444.8
Limestone (Fort Scott Formation)	181 to 186	444.8 to 439.8

Note: 1. ft amsl = feet above mean sea level

The boring log for BAP-B1 is provided in Attachment A and a photolog documenting the observed lithology is provided in Attachment B. Based on this and logs for other borings near the BAP, it appears that all wells near the BAP are set within the upper limestone unit. This limestone unit appears representative of the Oologah Formation and may be inclusive of the Altamont limestone member (upper portion of the Oologah Formation) and the Pawnee member (lower portion of the Oologah Formation). At several boring locations, thin horizons of shale were identified from elevations of approximately 25 to 75 ft bgs.

Boring BAP-B2 was advanced in the vicinity of SP-10 to relog that location and provide clarity regarding the geology of the well at the screened interval. The boring log for BAP-B2 is provided in Attachment A. A thin shale horizon was observed at 46 ft bgs, which is within the screened interval of SP-10.

Samples were collected from four intervals at boring BAP-B2 for laboratory analysis, as summarized below:

Sample Depth (ft bgs)	Sample ID	Description
32.0-32.4	SP-10-LOG-1	Upper limestone
46.0-47.0	SP-10-LOG-2	Shale lens within the screened interval of SP-10
46.0-47.0	SP-10-LOG-3	Limestone within screened interval of SP-10
72.0-72.4	SP-10-LOG-4	Limestone within the screened interval of SP-9

The samples were submitted to Mineralogy, Inc. (Tulsa, Oklahoma) for mineralogical analysis, including bulk analysis by X-ray diffraction (XRD), X-ray fluorescence (XRF), cation exchange capacity (CEC), and thin section petrography. A portion of each sample was submitted to Accurate Environmental Laboratories (Tulsa, Oklahoma) for acid digestion and analysis of total lithium by USEPA Method 6020A.

The XRD analysis confirmed that limestone is present at depths to at least 72 ft bgs, which is deeper than expected based on the previous monitoring well network report and boring logs. The analyses also confirmed the horizon observed at 46 ft bgs is a shale parting, with clay minerals including illite and smectite (Table 1). The mineralogy report is provided as Attachment C.

2.3 Site Hydrogeology

A review of groundwater conditions across the Site suggests that groundwater is not significantly present or laterally contiguous within the shallow limestone unit. Many of the wells in the vicinity of the BAP, including wells SP-2, SP-4, and SP-11 within the monitoring well network, typically have insufficient water for sampling (less than 0.5 feet of water in the well). Static water level measurements have shown significant variability between wells during each measurement event (typically on the order of approximately 30 feet), significant variation at individual wells over time, and inconsistent trend variation between wells over time. A time series graph illustrating groundwater elevation data over time shows chaotic fluctuations both within and between wells (Figure 2).

The petrographic analysis identified minimal porosity in the limestone fraction (Attachment C). Optical analysis of the sample collected at 32 ft bgs noted that porosity accounted for approximately 0.5-1.0% of the bulk volume of the sample. The deeper limestone samples collected at 46 ft bgs and 72 ft bgs were both described as non-porous. It was noted that the shale sample collected at 46 ft bgs had minor to trace amounts of micro-crack porosity. Thus, the geology at the site is generally non-porous, and indicates that there is little groundwater within the limestone.

These results suggest groundwater in the shallow limestone unit likely resides in discrete non-connected and poorly defined features (i.e., joints, fractures, cavities, or bedding planes).

2.4 Site Geochemistry

A review of groundwater geochemistry at the Site generally supports the conceptual site model that groundwater in the shallow limestone unit resides in discrete, non-connected, and poorly defined features. Groundwater chemistry indicates different water types are present at the Site, as illustrated by the observed variability in both Schoeller and Piper diagrams (Figures 3 and 4, respectively). The Schoeller diagram illustrates data from one representative sampling event at each well, whereas the Piper plot depicts all available data over several sampling events. These different water types include calcium-carbonate, sodium-chloride, and sodium-chloride-sulfate groundwaters, as described below.

Groundwater in contact with limestone typically reaches equilibrium with carbonates such as calcite ($CaCO_3$) or dolomite [$CaMg(CO_3)_2$] due to relatively fast reaction kinetics. Equilibrium with carbonate minerals controls the concentration of calcium, alkalinity, and pH in the groundwater. This equilibrium results in a calcium-carbonate type groundwater signature, which is high in both calcium and carbonate. While all of the wells at the Site are believed to be screened in the upper limestone unit as described in Section 2.2, only SP-1 and SP-8 groundwater appears to represent calcium-carbonate type water (Figure 5). For instance, the presence of relatively high

magnesium at SP-1 suggests that dolomitic limestone is in close proximity to the well screen, whereas the low concentration of magnesium at SP-8 suggests the limestone is predominantly calcite near that well screen. There appears to be no hydraulic connection between these two wells, and no indications of mixing, which would be represented by similar magnesium concentrations at each well.

While carbonate is present in all the wells near the BAP, several of the wells appear to be dominated by a sodium-chloride type of water (SP-2, SP-3, SP-4, SP-5). Wells SP-6, SP-7, and SP-9 also are sodium-chloride type water; however, the concentration of total dissolved solids (TDS) concentrations are over an order of magnitude higher than SP2, SP-3, SP-4 and SP-5. The increase in TDS is the result of higher concentrations of sodium and chloride (Figure 3). These elevated sodium and chloride concentrations may indicate the presence of mineral salts in some parts of the aquifer. SP-10 and SP-11 are also sodium-chloride type waters, although they contain bicarbonate and sulfate anions as well (Figure 5).

This variability in groundwater chemistry suggests that the groundwater in the wells across the Site are not connected by a common aquifer. The different water types seem to be distributed randomly throughout the BAP unit, instead of being grouped according to physical location (Figure 6). On a constituent basis, sodium appears to correlate with the depth of the well screen interval, with higher concentrations detected at lower elevations (Figure 7). This suggests that the groundwater at locations with deeper screened intervals (i.e., SP-7, SP-9) may be influenced by the interbedded shale partings within the limestone, which generally become more prevalent at depth. The shale partings are a potential source of sodium, as shale contains clay fractions which can release sodium and other cations by ion exchange.

Mineralogical analysis of a sample from a shale lens at BAP-B2 (46 ft bgs) indicates that clay minerals such as illite and smectite comprised more than half of the sample material (Table 1). Smectite has a very high CEC, which includes a significant number of labile cations that populate its interlayer region. Additionally, this shale fraction has detectable levels of exchangeable cations (potassium and sodium), at higher concentrations than the limestone samples, suggesting that it is a source of cations to the groundwater (Table 2).

Some deeper wells (i.e., SP-8, SP-10) do not have high chloride concentrations as would be predicted based on the depth of their screened interval and the relationship noted above. This could be due to a lower prevalence of shale lenses within the screened interval at these locations compared to wells with higher chloride concentrations. The multiple types of groundwater and their limited relationship to spatial location or depth suggests that groundwater composition is highly variable at the site. This variability provides evidence that groundwater geochemistry at each well is influenced by localized geology (i.e., carbonate type, presence or absence of shale lenses) and indicates a lack of groundwater communication or mixing between wells.

2.4.1 Lithium Distribution at the Site

Lithium concentrations at the Site are also variable. While SP-10 has the highest lithium concentrations of the wells included in the monitoring network, other wells located near the BAP have significantly higher lithium concentrations (Figure 8). SP-9, which is co-located with SP-10 but screened approximately 20 feet deeper, has lithium concentrations which are approximately an order of magnitude higher. If lithium in groundwater was due to a release from the pond, we would expect to see higher concentrations at the shallower intervals closer to the source. Additionally, SP-6, which is east of the Pond also has concentrations that are much higher than those observed at SP-10.

Lithium at the Site appears to be correlated with the concentrations of major cations and anions, including sodium (Figure 9) and chloride (Figure 10). If lithium were elevated at a well due to a unique source (such as a release from the BAP), the ratio of lithium to other constituents would likely change due to differential mixing. However, the approximately linear relationship between lithium and other alkali metals, especially sodium and potassium, suggests that the lithium is a minor constituent of the saline source which is consistent across the Site.

As discussed in Section 2.4, the concentration of sodium is generally correlated with screen depth. A similar relationship is observed for lithium (Figure 11), with the same hypothesis that this increase in lithium with depth is due to the increasing frequency of shale lenses. Figure 12 compares the distribution of the exchangeable species in sample SP-10-LOG-2 with the concentration of the same group of cations in groundwater at SP-10. Based on their respective concentrations, calcium is preferentially taken up by exchange sites on clay minerals. This is apparent in the figure showing calcium occupying half the number of exchanges sites (upper graph), while dissolved calcium represents a relatively smaller fraction of the groundwater (lower graph). The clay's preference for calcium can be quantified using the values in Table 2. The ratio of exchangeable sodium to exchangeable calcium is 0.55/1, whereas the ratio of dissolved sodium to dissolved calcium in groundwater is 13/1, indicating a much higher proportion (factor of 24) of exchangeable calcium in the interlayer spaces than in the groundwater. The greater affinity for calcium in the interlayer region is mainly due to its divalent positive charge, whereas sodium and other alkali metals have a single positive charge.

Note that exchangeable cations were quantified for sodium, potassium, calcium and magnesium, whereas exchangeable lithium was too low to be detected by the standard laboratory method. Based on the slope of the relationship between lithium and sodium, the ratio of dissolved sodium to dissolved lithium is about 1400/1 (Figure 9). Using this ratio, exchangeable lithium is not likely to be present above the detection limit based on the concentration of exchangeable sodium observed (Table 2). While the laboratory results do not provide sufficient evidence for the release of lithium from the clay shale layers due to the relationship between the expected aqueous lithium concentration and the detection limit, total lithium was identified at a concentration of 76 mg/kg dry weight in the sample collected from the shale fraction at BAP-B2 (intended to serve as re-logging for SP-10) and analyzed following total digestion.

The process by which groundwater reaches equilibrium with the host rock can be described in the following conceptual model. Recharge surface water coming into contact with limestone becomes enriched in calcium as the water equilibrates with calcite. The magnesium concentration will also increase during this process if dolomite is present. As limestone minerals equilibrate with the groundwater solution, dissolved calcium then interacts with clay minerals in the shale zones which results in calcium displacing sodium (or other alkali metals such as lithium and potassium) on exchange sites. The presence of lithium within the shale fraction at BAP-B2 provides evidence that this process is occurring within SP-10 groundwater.

2.5 Pond Chemistry

The BAP has much lower concentrations of lithium than those observed at SP-10, with one sample reporting an estimated lithium concentration of 0.00874 mg/L (Attachment D), which is approximately 20 times less than the GWPS for lithium of 0.15 mg/L. Additionally, a review of the chemistry of the BAP as compared to SP-10 groundwater chemistry illustrates that they have very different chemical compositions (Figure 13). This supports the hydrogeologic conceptual model presented in Section 2.3, which suggests that unless the Pond is directly connected to SP-10 through a fracture in the limestone, it is unlikely to affect groundwater chemistry at the well.

2.6 Proposed Alternative Source

The presence of naturally occurring lithium in shale lenses in the monitored zone, limited possibility of transport from the BAP to the screened interval at SP-10, and the low concentration of lithium in the pond suggest the BAP is not the source of lithium at SP-10. A review of the hydrogeology of the Site provides evidence that groundwater in the shallow limestone unit likely resides in discrete non-connected features such as joints or fractures instead of as a discrete aquifer. Thus, the groundwater composition at each well is likely controlled by its immediate geology. As discussed above, lithium appears to be naturally occurring at the Site and correlated with the shale lenses that are present with increasing frequency with depth. The release of lithium from the clay minerals within the shale lens located at 46 ft bgs within the screened interval of SP-10 is the likely source of lithium in groundwater at that location.

2.7 Sampling Requirements

As the ASD described above supports the position that the identified SSL is not due to a release from the BAP, the unit will remain in the assessment monitoring program. Groundwater at the unit will continue to be sampled for Appendix IV parameters on a semi-annual basis.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with OAC 252:517-9-6(g)(3)(B) and supports the position that the SSL of lithium at SP-10 identified during assessment monitoring in 2018 was not due to a release from the BAP. The identified SSL was, instead, attributed to natural variation in the underlying lithology including the presence of shale lenses containing lithium within the screened interval at SP-10. Therefore, no further action is warranted, and the BAP will remain in the assessment monitoring program. Certification of this ASD by a qualified professional engineer is provided in Attachment E.

SECTION 4

REFERENCES

AEP, 2017. Statistical Analysis Plan – Northeastern Power Station, Oologah, Oklahoma. January.

EPRI, 2017. Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites. 3002010920. October.

Geosyntec Consultants, 2019. Statistical Analysis Summary Bottom Ash Pond – Northeastern Power Station, Oologah, Oklahoma. Oologah, Oklahoma. January.

Oakes, M.C., Dille, G.S., and Warren, J.H.,1952. Geology and Mineral Resources of Tulsa County, Oklahoma. *Okla. Geol. Survey. Bull.* 69.

Oklahoma Geological Survey, 2004. *Geologic Map of the Sageeyah 7.5' Quadrangle*, *Rodgers County, Oklahoma*.

Oklahoma Geologic Survey, 2005. *Geologic Map of the Collinsville 7.5' Quadrangle, Rogers and Tulsa Counties, Oklahoma*.

Terracon, 2017. Report 1 – Groundwater Monitoring Network for CCR Compliance. Public Service Company of Oklahoma Northeastern Station 3&4 Bottom Ash Pond. September.

USEPA, 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09/007. March.

Woodruff, E.G. and Cooper, C.L. 1928. Oil and Gas in Oklahoma,Geology of Rogers County, *Okla. Geol. Survey Bull.* 40.

FIGURES

Legend

- Monitoring Well Location
- 2019 Boring Location
- Bottom Ash Pond

Notes

- Aerial imagery obtained from ESRI

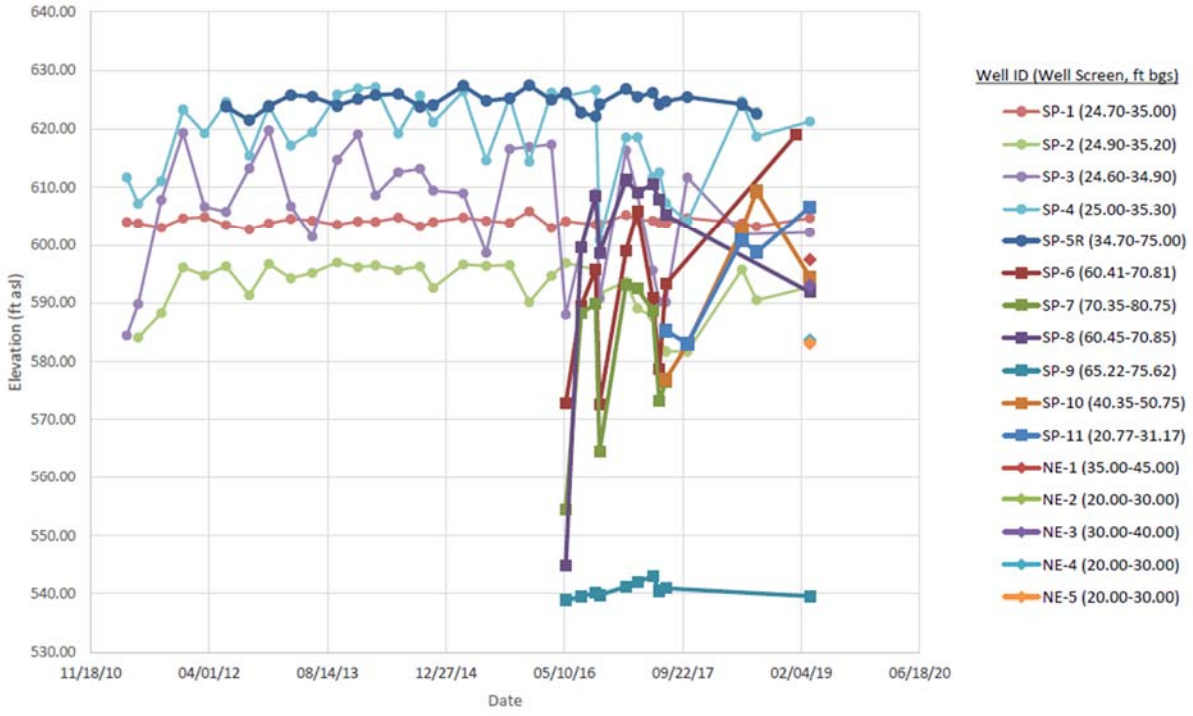
1,000 500 0 1,000 Feet

Soil Boring and Monitoring Well Location Map
Northeastern Bottom Ash Pond

Geosyntec consultants

Columbus, Ohio | 2019/04/17

Figure 1



Notes:
ft asl: feet above mean sea level
ft bgs: feet below ground surface

Water Level Time Series Graph
Northeastern Bottom Ash Pond

Geosyntec consultants

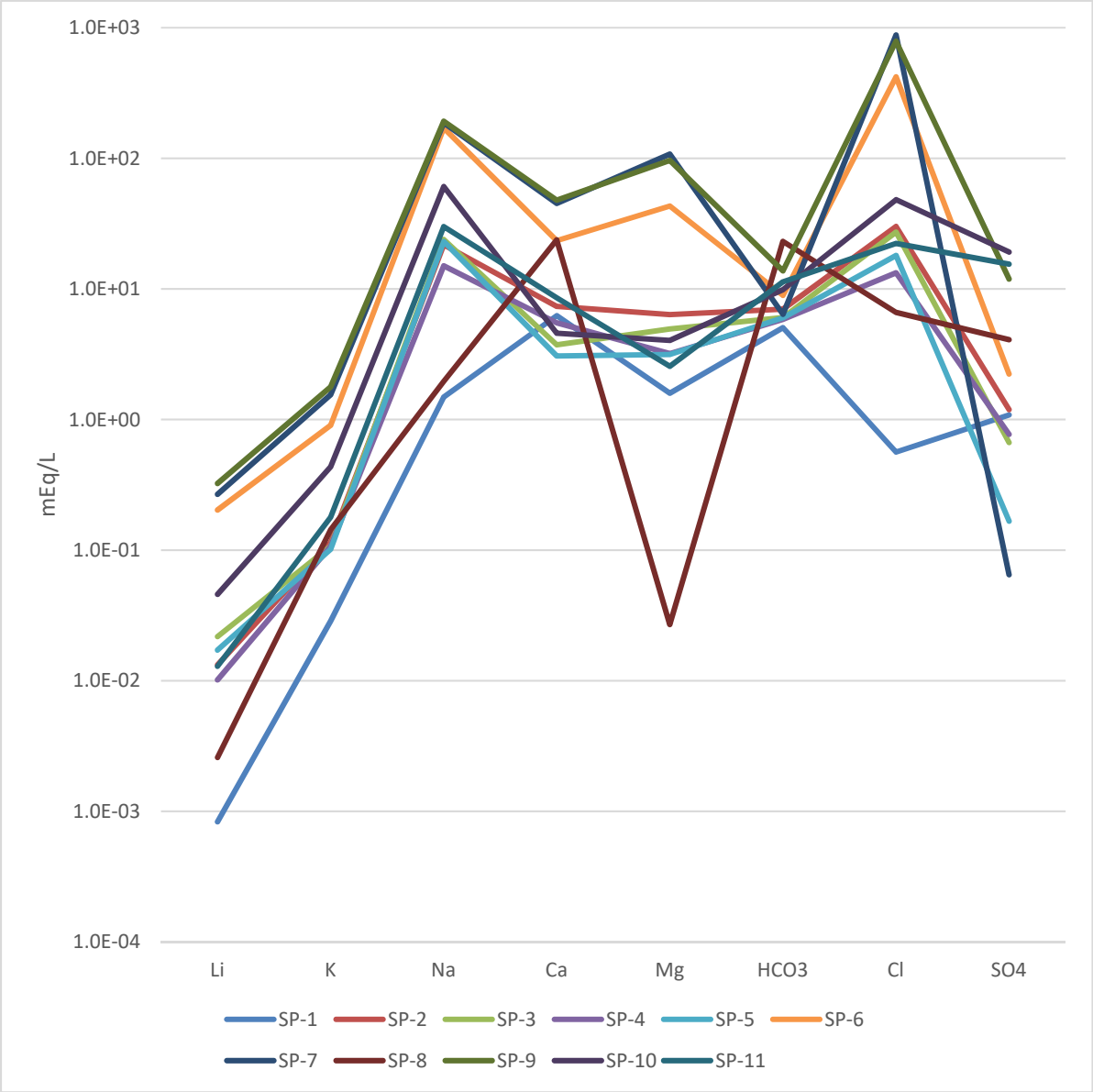
AMERICAN ELECTRIC POWER

Figure **2**

Columbus, Ohio

16-Apr-2019

internal info: path, date revised, author



Notes: One representative sample for each well was graphed. Data for all wells were selected for sampling events between July and September 2017.

Schoeller Diagram
Northeastern Bottom Ash Pond

Geosyntec consultants

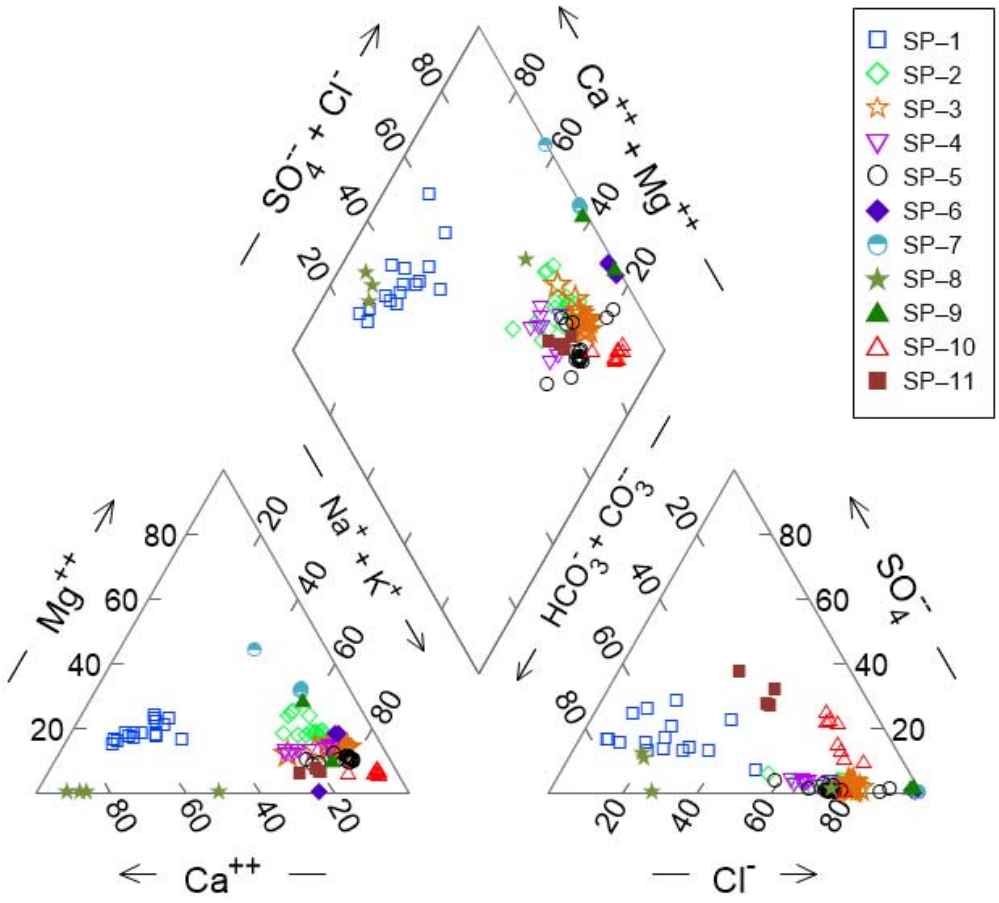
AMERICAN ELECTRIC POWER

Figure **3**

Columbus, Ohio

02-Apr-2019

internal info: path, date revised, author



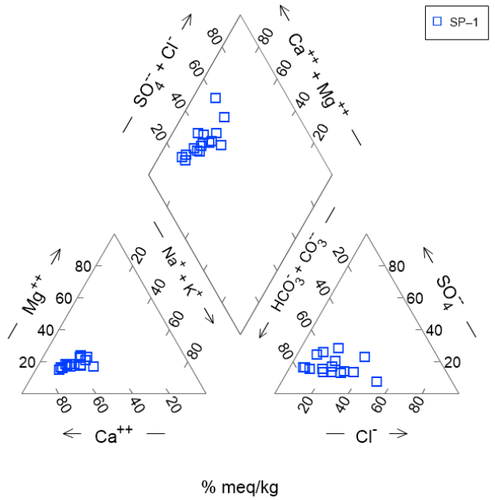
Notes: Multiple events for each well are graphed where data were available.

Piper Plot
Northeastern Bottom Ash Pond

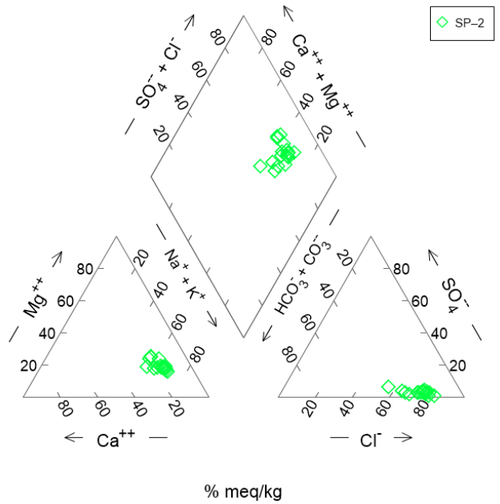
Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | 02-Apr-2019

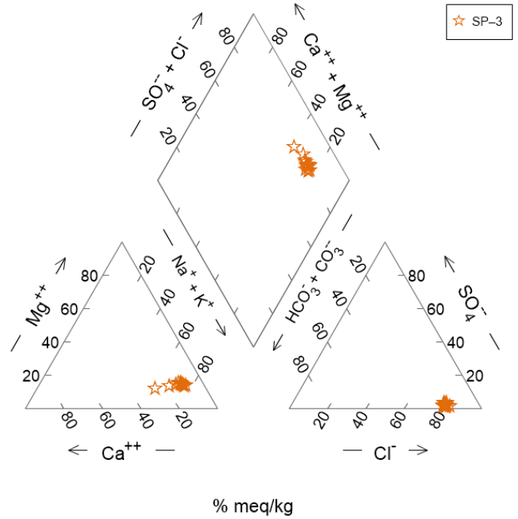
Figure **4**



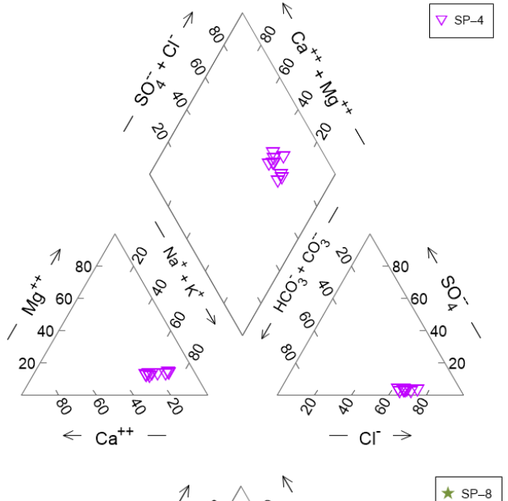
% meq/kg

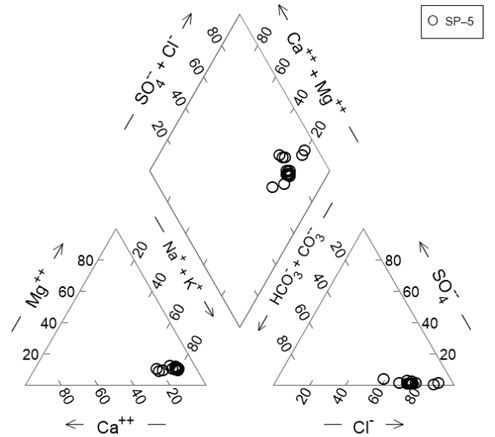


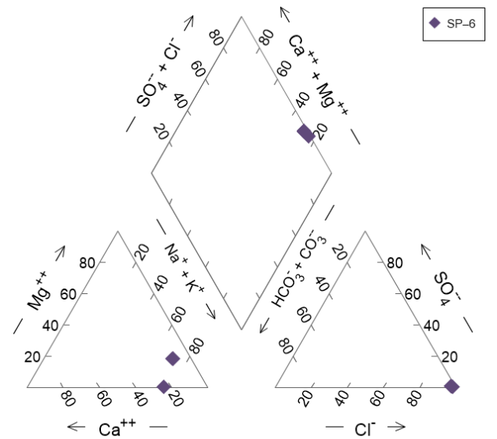
% meq/kg

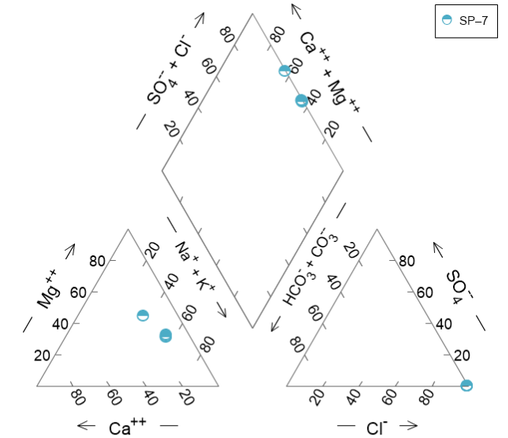


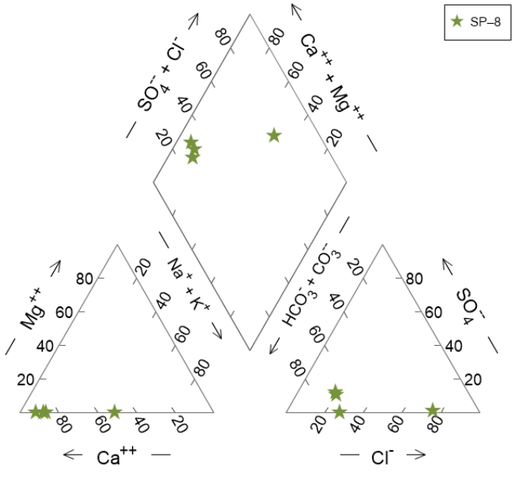
% meq/kg



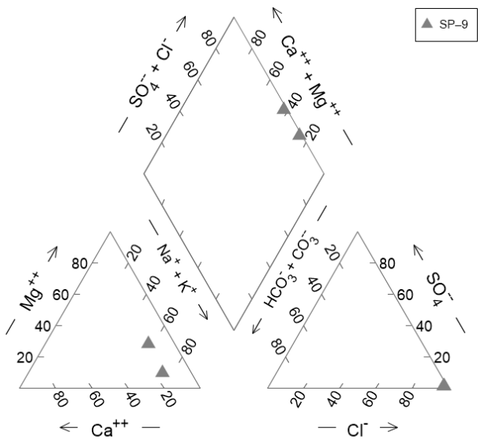




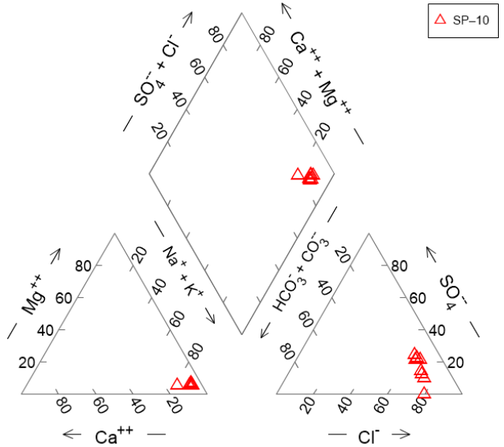




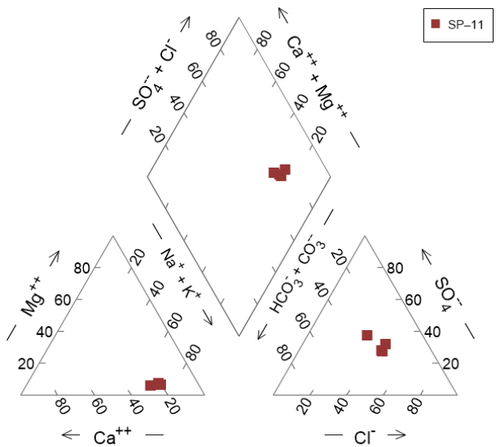
% meq/kg



% meq/kg



% meq/kg



% meq/kg

Piper Diagrams - Individual Wells
Northeastern Bottom Ash Pond

Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure **5**

Columbus, OH

16-Apr-2019

internal:\do; Path, date revised, author

Legend

- Na-Cl
- Na-Cl-SO4
- Na-Cl Brine
- Limestone
- Bottom Ash Pond
- Landfill
- Impoundment
- Slurry Wall

Notes

- Monitoring well coordinates provided by AEP.
- Site features based on information available in Groundwater Monitoring Network for CCR Compliance reports (Terracon, 2016).
- Na: Sodium
- Cl: Chloride
- SO4: Sulfate

600 300 0 600
Feet

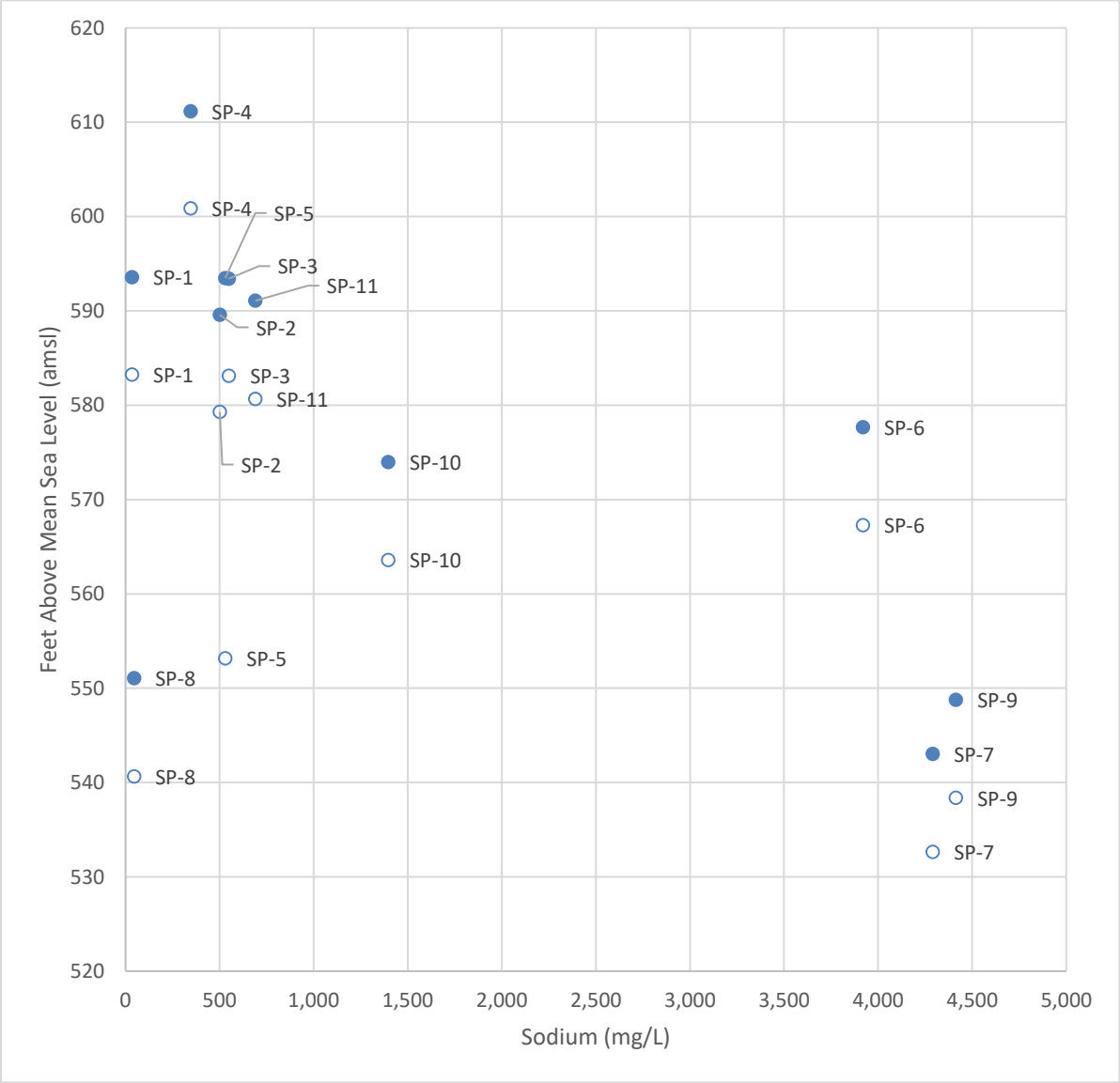
Spatial Distribution of Groundwater Types
Northeastern Bottom Ash Pond

Geosyntec consultants

Columbus, Ohio | 2019/04/04

Figure **6**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Northeastern\2018\AEP-Northeastern_Brine2019.mxd. ARevezzo. 4/4/2019.



Notes:
Filled circles represent the elevation of the top of the well screen for the identified well. Hollow circles represent the bottom of the well screen for the identified well.

Sodium v. Well Screen Interval
Northeastern Bottom Ash Pond

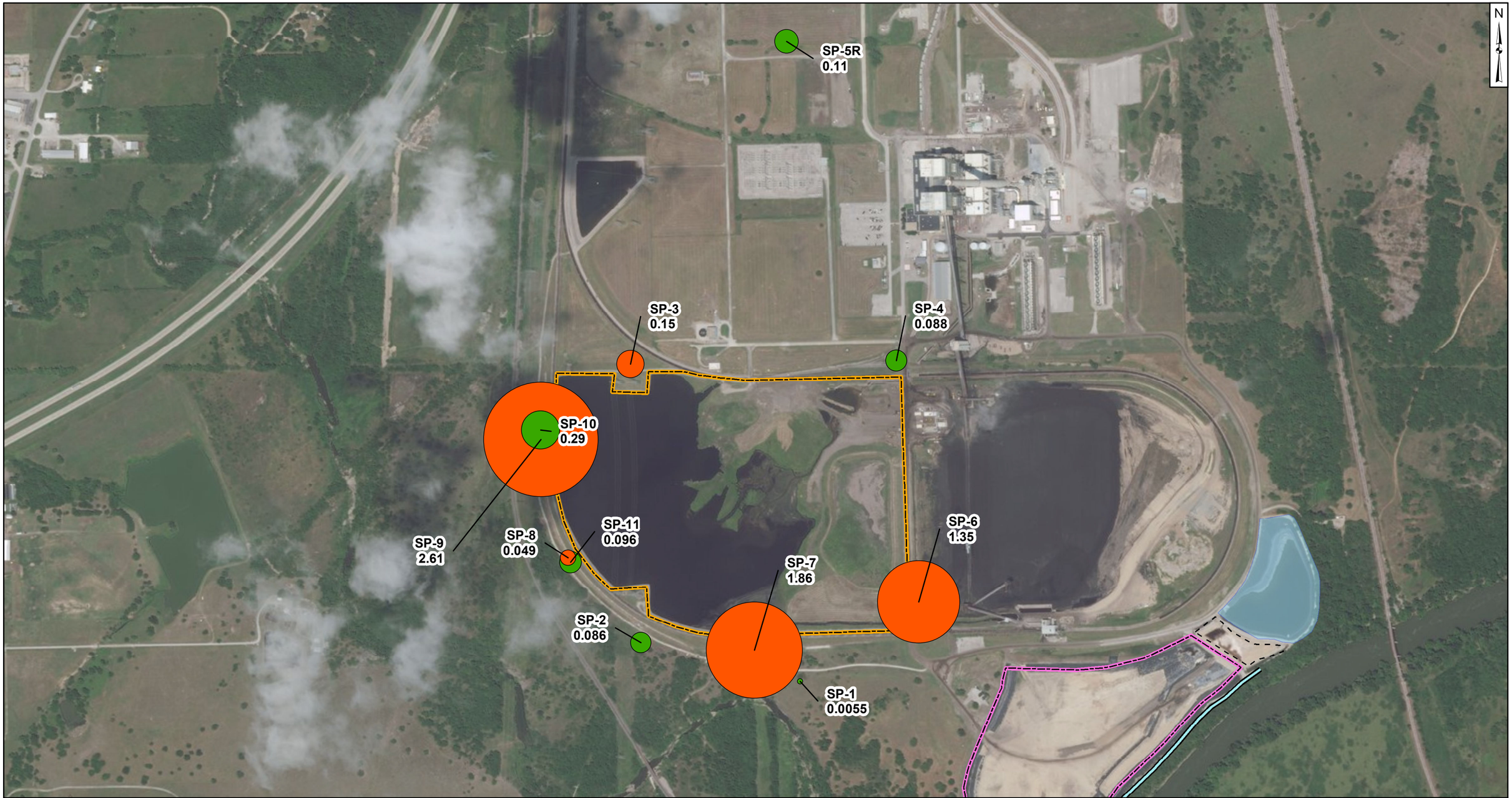
Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure **7**

Columbus, Ohio

16-Apr-2019



Legend

- Bottom Ash Pond
- Landfill
- Impoundment
- Slurry Wall

Notes

- Monitoring well coordinates provided by AEP.
- Site features based on information available in Groundwater Monitoring Network for CCR Compliance reports (Terracon, 2016).
- Lithium concentrations shown are an average of available data.
- Lithium concentrations shown in milligrams per liter (mg/L).
- In-Network monitoring wells are indicated with green symbology. Out-of-Network monitoring wells are shown with orange symbology.

600 300 0 600
Feet

Spatial Distribution of Lithium

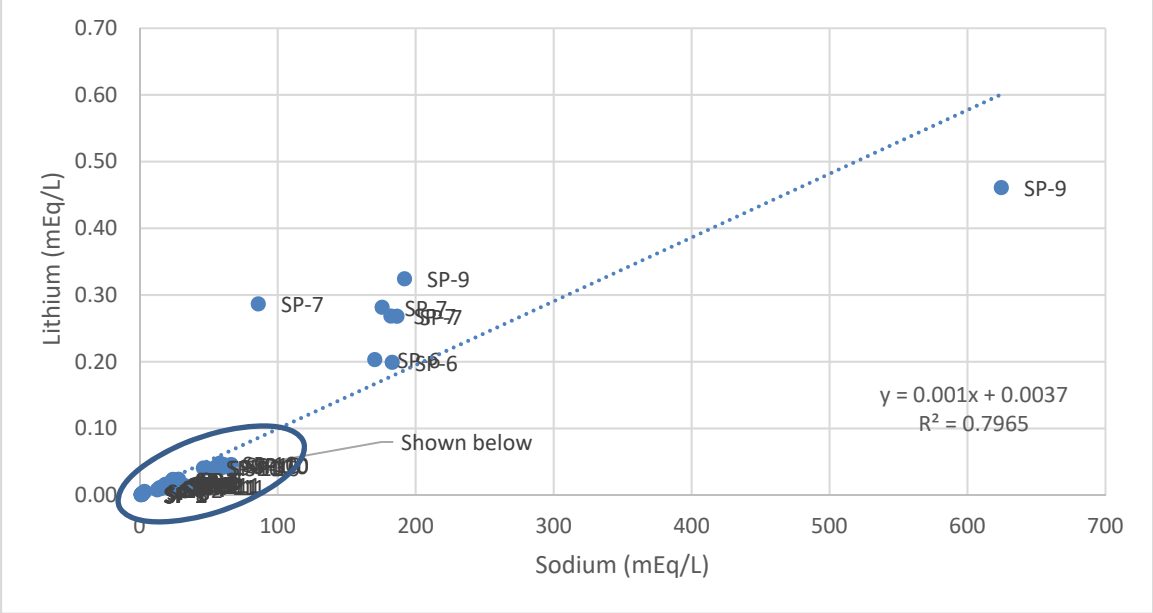
AEP Northeastern Power Plant - Bottom Ash Pond
Oologah, Oklahoma

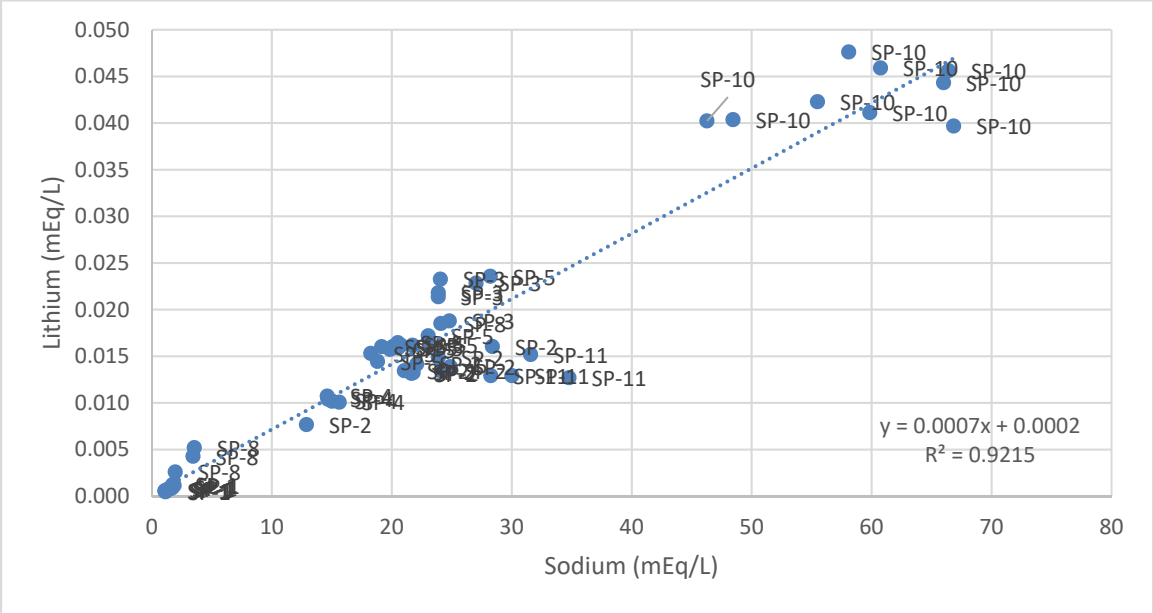
Geosyntec consultants

Columbus, Ohio | 2019/04/16

Figure **8**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Northeastern\2018\AEP-Northeastern_Lithium2019.mxd. ARevezzo. 4/16/2019.





Notes:
All results are shown in milliequivalents per liter (mEq/L). The top graph shows all data, whereas the bottom graph excludes wells SP-6, SP-7, and SP-9, which have significantly higher concentrations of both lithium and sodium.

Sodium v. Lithium Concentrations
Northeastern Bottom Ash Pond

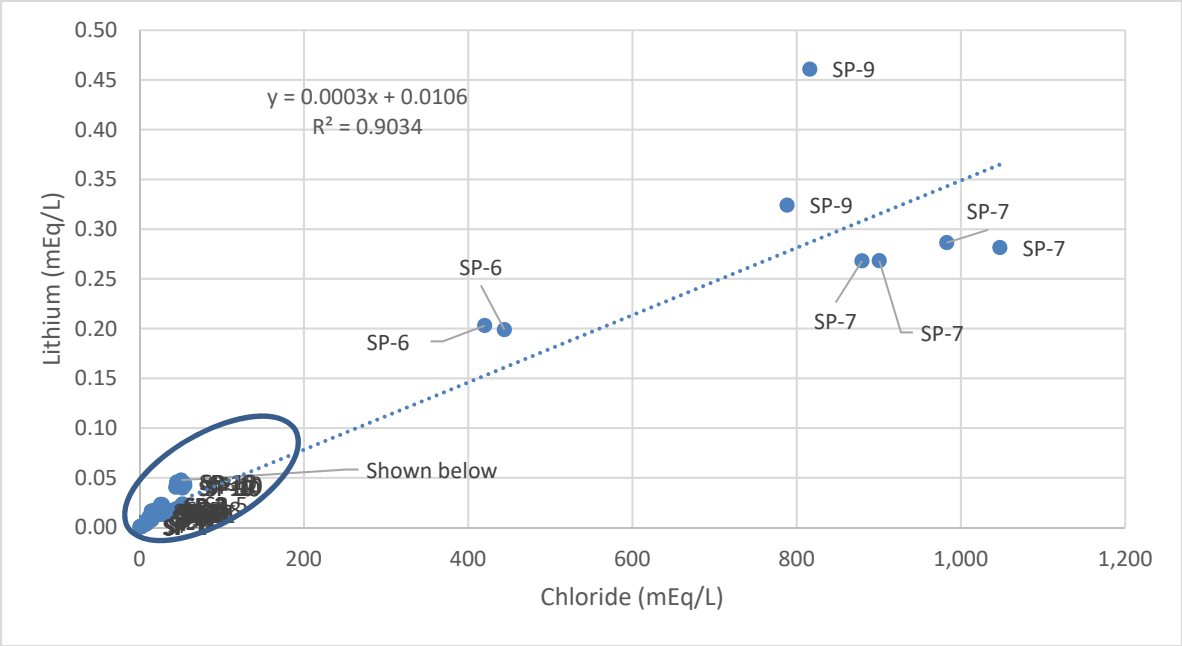
Geosyntec consultants

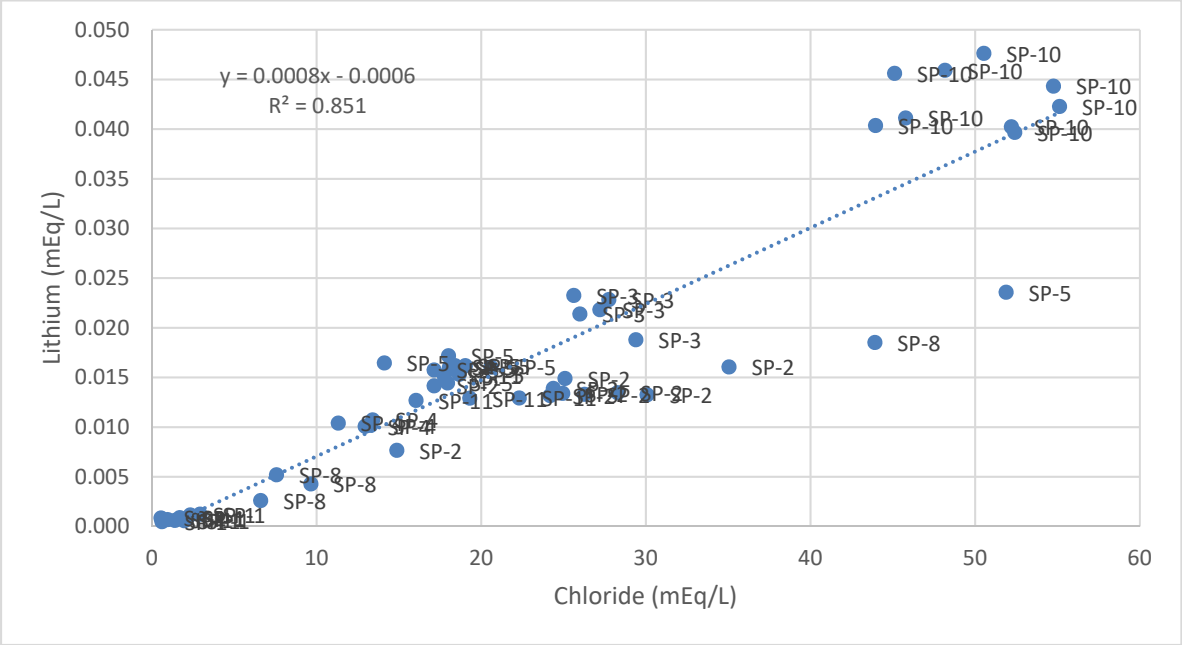
AMERICAN ELECTRIC POWER

Figure 9

Columbus, Ohio

16-Apr-2019





Notes:
All results are shown in milliequivalents per liter (mEq/L). The top graph shows all data, whereas the bottom graph excludes wells SP-6, SP-7, and SP-9, which have significantly higher concentrations of both lithium and chloride.

Chloride v. Lithium Concentrations
Northeastern Bottom Ash Pond

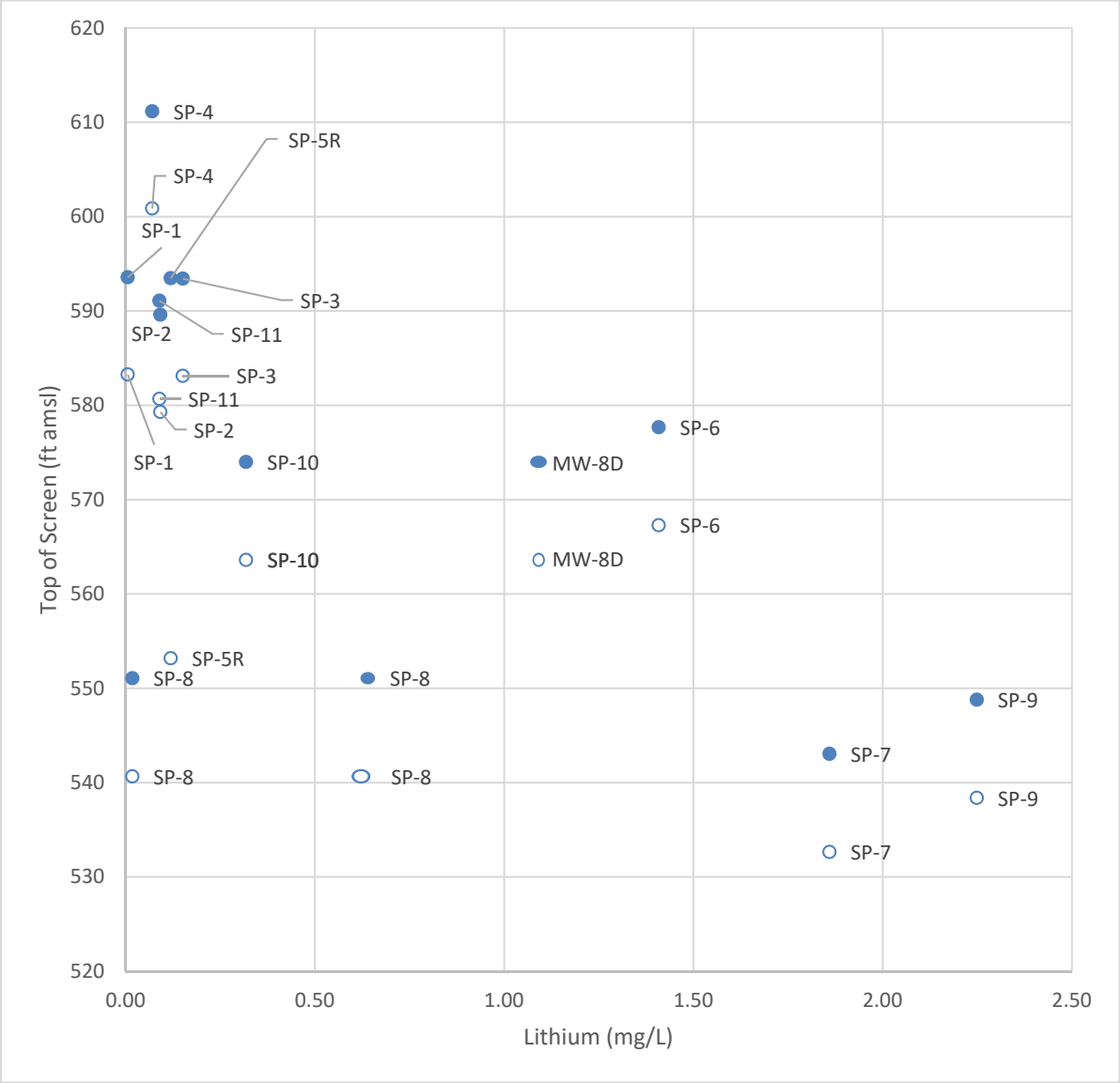
Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure **10**

Columbus, Ohio

16-Apr-2019



Notes:
Filled circles represent the elevation of the top of the well screen for the identified well. Hollow circles represent the bottom of the well screen for the identified well.

Lithium v. Well Screen Interval
Northeastern Bottom Ash Pond

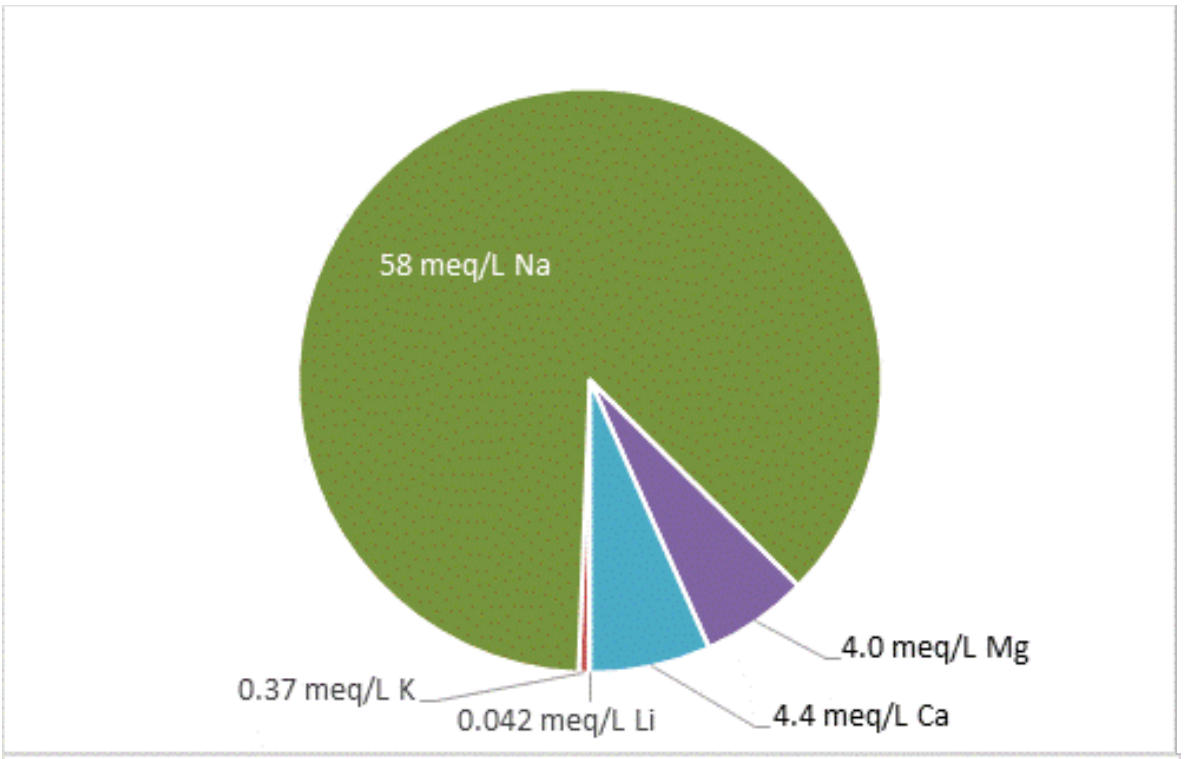
Geosyntec consultants

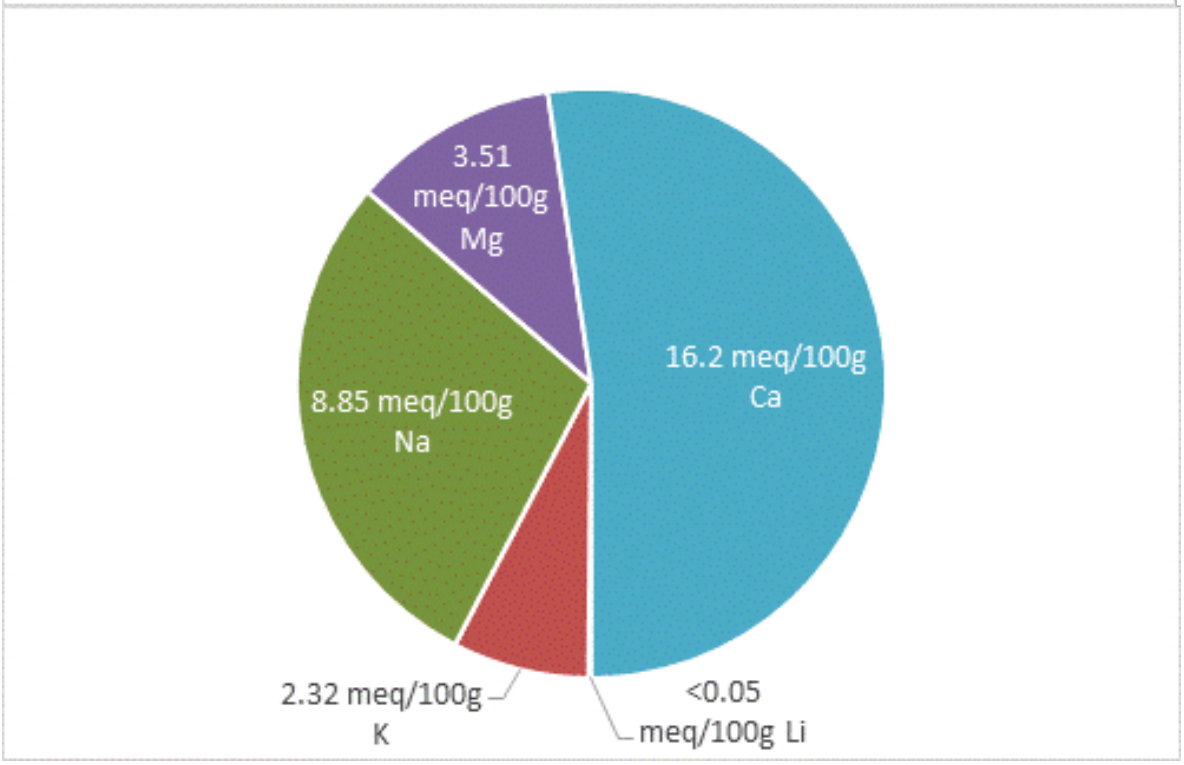
AMERICAN ELECTRIC POWER

Figure **11**

Columbus, Ohio

16-Apr-2019



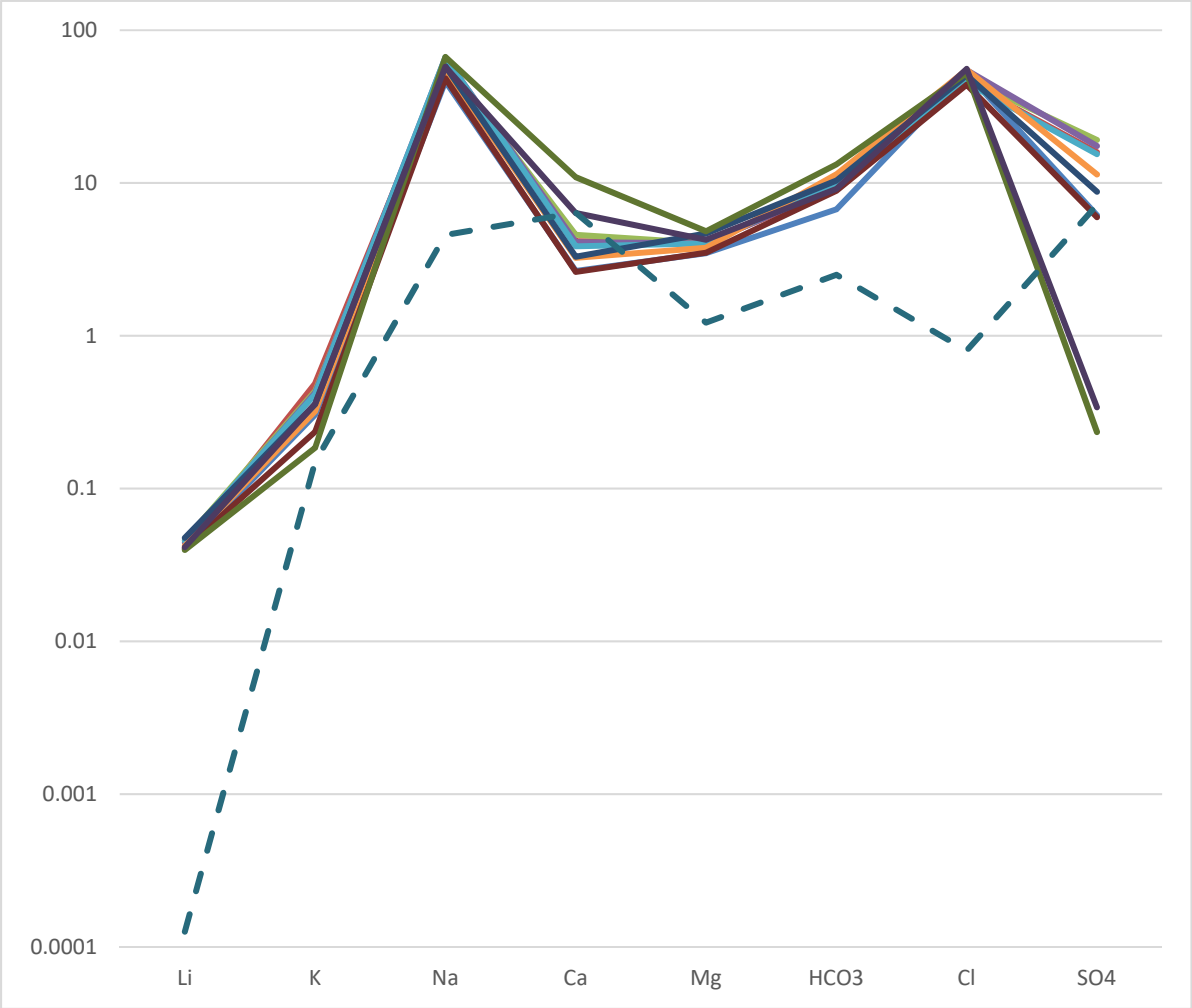


Notes: The top graph shows the concentration of exchangeable cations in the shale sample (SP-LOG-10-2) in meq/100g, while the bottom graph shows concentrations of these cations in time-averaged SP-10 groundwater (in meq/L).

Cation Distribution
Northeastern Bottom Ash Pond

Geosyntec consultants | AMERICAN ELECTRIC POWER | Figure **12**

Columbus, Ohio | 16-Apr-2019



Notes: The dashed line represents a surface water sample collected from the bottom ash pond on February 5, 2019. All other lines represent individual sampling events at SP-10 between 2017 and 2019.

Bottom Ash Pond Schoeller Diagram
Northeastern Bottom Ash Pond

Geosyntec consultants | AMERICAN ELECTRIC POWER | Figure **13**

Columbus, Ohio | 16-Apr-2019

internal info: path, date revised, author

TABLES

Table 1: X-Ray Diffraction Laboratory Analysis Results
Northeastern Plant Bottom Ash Pond

Geosyntec Consultants

Sample ID	SP-10-LOG 1	SP-10-LOG 2	SP-10-LOG 4	SP-10-LOG 4
Depth (ft bgs)	32-32.4	46.0-47.0	46.0-47.0	72-72.4
Description	Upper Limestone	Shale within screened interval of SP-10	Limestone within screened interval of SP-10	Limestone within screened interval of SP-9
Quartz	1	20	3	6
Albite	ND	4	ND	ND
Microcline	ND	1	ND	ND
Calcite	95	2	93	91
Ferroan Dolomite	4	ND	ND	2
Siderite	ND	1	ND	ND
Pyrite	ND	5	1	ND
Kaolinite	ND	2	1	<0.5
Chlorite	ND	3	<0.5	ND
Illite/Mica	ND	38	1	1
Mixed-Layered Illite/Smectite	ND	24	1	<0.5
% Illite Layers in ML I/S	*N/A*	*75*	*75*	*BDL*

Notes:
Results are shown as percentage of the bulk material.
ND: not detected
N/A: not applicable
BDL: below detection limit

Table 2: Cation Exchange Capacity and Total Lithium Analytical
Northeastern Plant Bottom Ash Pond

Geosyntec Consultants

Sample ID	Sample Depth	Description	Total Lithium (mg/kg dry wt)	Exchangeable Lithium (mEq/100g)	Exchangeable Calcium (mEq/100g)	Exchangeable Magnesium (mEq/100g)	Exchangeable Potassium (mEq/100g)	Exchangeable Sodium (mEq/100g)
SP-10-LOG-1	32.0-32.4'	Upper limestone	<10.0	<0.05	20	0.567	<0.10	0.226
SP-10-LOG-2	46.0-47.0'	Shale lens within screened interval of SP-10	76	<0.05	16.2	3.51	2.32	8.85
SP-20-LOG-3	46.0-47.0'	Limestone within screened interval of SP-10	<10.0	<0.05	21.6	0.642	0.250	0.896
SP-10-LOG-4	72.0-72.4'	Limestone within screened interval of SP-9	<10.0	<0.05	21.1	1.16	0.313	0.822

Notes:
mg/kg dry weight: milligram of lithium per kilogram dry weight of material
mEq/100g: milliequivalent per 100 gram of material

ATTACHMENT A

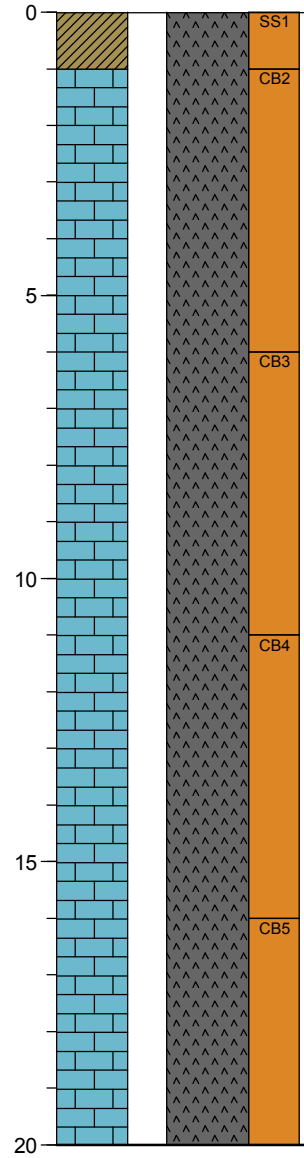
Boring Logs

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B1
Page: 1 of 10

Drilling Start Date:	3/11/2019	Boring Depth (ft):	186
Drilling End Date:	3/14/2019	Boring Diameter (in):	7"/3"
Drilling Company:	Geotechnology	Sampling Method(s):	SS/NQ2
Drilling Method:	HSA/Air Rotary	DTW During Drilling (ft):	
Drilling Equipment:	HSA/Air Rotary	DTW After Drilling (ft):	
Driller:	C. Steiner	Ground Surface Elev. (ft):	625.8
Logged By:	M. Bizjack	Location (X,Y):	2644286.365, 524133.353



DEPTH (ft)	Sample Type	Recovery (ft)	N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS
0	SS1	1.0		(0') LEAN CLAY (CL), brown, low plasticity to non-plastic, some organics (roots), medium, moist.	
	CB2	3.0	21%	(1') LIMESTONE, strong, medium gray (N5), crystalline to fine-grained calcite fossil infill, bedding not apparent to thick, slightly decomposed at fractures, intensely fractured (fractures-joints at 1.6 and 2.3 ft, sub horizontal to 50°, tight to wide, surface oxidation and soil filled, rough, wet), fossiliferous.	Auger refusal. Boring offset 3 ft due to auger deflection. NQ2 core started at 1 ft bgs. Driller reported water loss and void encountered during run.
				(1.8') Roots.	
5				(3') Wavy crinoid debris layer at fractured interval 0.2 ft thick.	
	CB3	5.0	100%	(6') Moderately fractured and thickly bedded with approximately 0.3-ft thick intervals of darker wavy bedding with crinoid debris abundant, isolated chert interval with chaotic bedding (at 9.5, 10.3, and 11 ft), isolated other fossil debris. Wavy beds occur at 0.5 to 1 ft intervals, fractures less weathered, very little soil infill.	
10	CB4	5.0	100%	(11') Changes to slightly fractured, darker wavy beds (N3), crinoid fossils less abundant.	
15				(14.5-16') Tight, healed vertical fracture. Interval of trace pits and small vugs with mineral fill.	
	CB5	5.0	96%	(16') Changes to thinner dark wavy beds (less than 0.1 ft). Lighter colored intervals (N5) characterized by chaotic fossil debris texture. Non-solid recovery from 16-16.25 ft due to core barrel slipping.	
20					

NOTES: Boring backfilled to surface with Portland cement.

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B1
Page: 2 of 10

Drilling Start Date:	3/11/2019	Boring Depth (ft):	186
Drilling End Date:	3/14/2019	Boring Diameter (in):	7"/3"
Drilling Company:	Geotechnology	Sampling Method(s):	SS/NQ2
Drilling Method:	HSA/Air Rotary	DTW During Drilling (ft):	
Drilling Equipment:	HSA/Air Rotary	DTW After Drilling (ft):	
Driller:	C. Steiner	Ground Surface Elev. (ft):	625.8
Logged By:	M. Bizjack	Location (X,Y):	2644286.365, 524133.353

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS	DEPTH (ft)
20				CB6			5.0	100%	Isolated chaotic cherty intervals (at 21.7, 22.5, 23.3, 24.1, and 24.6 ft), pits and vugs continue.		20
									(22.8' and 25') Approximately 30° inclined fractures associated with dark bedding planes.		
25				CB7			5.0	100%			25
									(26.6-26.7') Chaotic cherty layer above wavy dark bedding.		
									(27.5') Chaotic cherty layer interbedded with dark wavy bedding, tight 30° fracture.		
									(27.7-31.8') Color changes to medium-dark gray (N4-N3) and very dark gray, interbedded, algal/crinoid fossils abundant, wavy bedding, thinly bedded.		
30				CB8			3.75	75%			30
									(31.8') Distinctive cherty, wavy, crinoid debris layer with associated dark wavy bedding from 31.8-31.9 ft, moderately fractured.		
									(31.9-32.8') Significant vertical fracture with little to no healing/weathering.		
									(32.8-33.4') Color changes to N3 below a thin dark wavy bed, significant vertical fractures.		
35				CB9			5.0	100%	(32.9') Notable fossil demineralized vug.		35
									(34.2') Color changes to N5-N4 below wavy dark bed.		
									(36.7 and 37.7') Darker wavy beds.		
									(38.7') Grades to N3-N4 limestone at 39.2 ft.		
									(39.2') Interval of thinly bedded limestone (N3)		
40											40

NOTES: Boring backfilled to surface with Portland cement.

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B1
Page: 3 of 10

Drilling Start Date:	3/11/2019	Boring Depth (ft):	186
Drilling End Date:	3/14/2019	Boring Diameter (in):	7"/3"
Drilling Company:	Geotechnology	Sampling Method(s):	SS/NQ2
Drilling Method:	HSA/Air Rotary	DTW During Drilling (ft):	
Drilling Equipment:	HSA/Air Rotary	DTW After Drilling (ft):	
Driller:	C. Steiner	Ground Surface Elev. (ft):	625.8
Logged By:	M. Bizjack	Location (X,Y):	2644286.365, 524133.353

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS	DEPTH (ft)
40									and shaly limestone (N2) from 39.2-41 ft. Fossil debris noted at 39.5 ft.		40
				CB10			4.9	91%	(41') Interval of fine-grained wackestone with fossil debris.		
									(42.3') 0.1-ft thick interval of fine sandstone with crinoid debris above a thin shaly/wavy bed.		
									(42.4') Grades from fine to crystalline limestone (N5-N4).		
45									(42.9') Color changes to medium dark gray to dark gray (N4-N3).		45
				CB11			5.0	100%	(43.8-45.15') Significant fracture, vertical, mostly healed with calcite, tight.		
									(44.2-44.75') Interval of thinly bedded shale/limestone.	Core broken in one place, likely mechanical.	
									(46') Interbedded argillaceous limestone and calcareous shale, limestone is (N4-N3) and shale (N2) occur at 0.5 to 1 ft intervals, fossils trace to not present, core preferentially breaks at shale beds, shale is strong and not friable.		
50				CB12			5.0	100%			50
55				CB13			5.0	100%	(55.2-56') Shale is interbedded with fine sandstone and wavy bedded.		55
									(56-56.5') Some mottled interbeds of shale and fine sandstone. Sand in thin lenses, interbedded.		
									(56.5-60.2') Same argillaceous limestone as above (N3). Strong shale layer at 58.4-58.6 ft (N2), trace small crinoid fossils throughout.		
									(58.1') Re-mineralized approximately vertical crack, possible fossil infill.		
60											60

NOTES: Boring backfilled to surface with Portland cement.

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B1
Page: 4 of 10

Drilling Start Date:	3/11/2019	Boring Depth (ft):	186
Drilling End Date:	3/14/2019	Boring Diameter (in):	7"/3"
Drilling Company:	Geotechnology	Sampling Method(s):	SS/NQ2
Drilling Method:	HSA/Air Rotary	DTW During Drilling (ft):	
Drilling Equipment:	HSA/Air Rotary	DTW After Drilling (ft):	
Driller:	C. Steiner	Ground Surface Elev. (ft):	625.8
Logged By:	M. Bizjack	Location (X,Y):	2644286.365, 524133.353

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS	DEPTH (ft)
60									(60.2') Interval of sand/shale lens interbedding.		60
				CB14			5.0	100%	(61-77.4') Interbedded argillaceous limestone (N3) and calcareous shale (N2), shale layers 0.2 to 0.4 ft thick, trace crinoid debris.	Core broken in one place, likely mechanical.	
									(62.4-62.6') Re-mineralized vertical fracture.		
									(63.1-63.2') Re-mineralized vug/fracture.		
65				CB15			5.0	100%			65
70				CB16			5.0	100%			70
75				CB17			5.0	100%	(77.4-77.6') Sandy limestone shell debris layer.		75
									(77.6-82.2') Limestone, strong, medium gray (N5), some fine sand, fossils absent.		
80											80

NOTES: Boring backfilled to surface with Portland cement.

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B1
Page: 5 of 10

Drilling Start Date:	**3/11/2019**	Boring Depth (ft):	**186**
Drilling End Date:	**3/14/2019**	Boring Diameter (in):	**7"/3"**
Drilling Company:	**Geotechnology**	Sampling Method(s):	**SS/NQ2**
Drilling Method:	**HSA/Air Rotary**	DTW During Drilling (ft):	
Drilling Equipment:	**HSA/Air Rotary**	DTW After Drilling (ft):	
Driller:	**C. Steiner**	Ground Surface Elev. (ft):	**625.8**
Logged By:	**M. Bizjack**	Location (X,Y):	**2644286.365, 524133.353**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS	DEPTH (ft)
80				CB18			5.0	100%	(82.2-82.5') Interval of fine sandstone, medium gray to medium dark gray, thinly bedded, bedding lenticular. (82.5-95.1') Sandy limestone with some shaly beds, color generally uniform (N4-N3). (83.9') Notable ammonite fossil (approximately 1 cm), fossils largely absent otherwise.		80
85				CB19			5.0	100%			85
90				CB20			5.0	100%			90
95				CB21			5.0	100%	(95.1') Grades into fine-grained limestone, matrix color same as above (N4-N3), abundant whole fossils and debris (crinoid and brachiopod), wackestone/packstone texture. (95.9') Grades into shale (calcareous) matrix within argillaceous limestone beds, fossils still abundant and calcareous, bedding not apparent (massive). (98.2-98.4') Interbedded fossiliferous argillaceous limestone interval within massive shale.		95
100											100

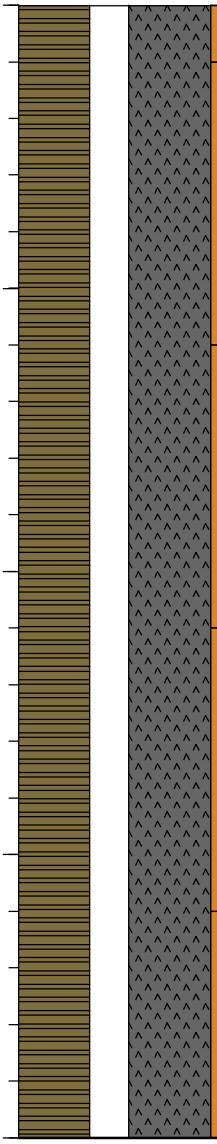
NOTES: Boring backfilled to surface with Portland cement.

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B1
Page: 6 of 10

Drilling Start Date:	3/11/2019	Boring Depth (ft):	186
Drilling End Date:	3/14/2019	Boring Diameter (in):	7"/3"
Drilling Company:	Geotechnology	Sampling Method(s):	SS/NQ2
Drilling Method:	HSA/Air Rotary	DTW During Drilling (ft):	
Drilling Equipment:	HSA/Air Rotary	DTW After Drilling (ft):	
Driller:	C. Steiner	Ground Surface Elev. (ft):	625.8
Logged By:	M. Bizjack	Location (X,Y):	2644286.365, 524133.353



DEPTH (ft)	Sample Type	Date & Time	Blow Counts	Recovery (ft)	N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS
100						(98.4-98.6') Interval of N5 limestone/carbonate mudstone.	
	CB22			5.0	94%	(99.6-99.7') Wackestone limestone, abundant fossils, distinct contact with below interval.	
						(99.7') SHALE, moderate strength, grayish black (N2), massive, no decomposition, no disintegration, unfractured except for bedding plane mechanical breaks, pyritic with trace small crinoids.	
105						(101') With trace brachiopod fossils observed, some grayish brown lenses, shale has waxy/greasy/soapy texture.	
	CB23			5.0	98%	(106') Sandy sediment present, friable when broken.	
110	CB24			4.7	88%	(111') Pyrite largely absent.	
115						(114.9 and 115.4') Small intervals of fat clay, possible artifact from drilling.	
	CB25			5.0	91%	(114.95 and 115.15') Notable round/tube fossils, possible bryozoan sediment and mineral filled (quartz).	
						(116') Lacks fossils.	
120						(118.8 and 118.9') Medium brown fine sandstone with thinly bedded shale.	

NOTES: Boring backfilled to surface with Portland cement.

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B1
Page: 7 of 10

Drilling Start Date:	3/11/2019	Boring Depth (ft):	186
Drilling End Date:	3/14/2019	Boring Diameter (in):	7"/3"
Drilling Company:	Geotechnology	Sampling Method(s):	SS/NQ2
Drilling Method:	HSA/Air Rotary	DTW During Drilling (ft):	
Drilling Equipment:	HSA/Air Rotary	DTW After Drilling (ft):	
Driller:	C. Steiner	Ground Surface Elev. (ft):	625.8
Logged By:	M. Bizjack	Location (X,Y):	2644286.365, 524133.353

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS	DEPTH (ft)
120									(119.1-119.2') Sandstone horizon.		120
				CB26			5.0	100%		End of 3/12/2019	
									(122.1-122.2') Fine brown sandstone horizon.		
									(123.2') Color varies between grayish black/black/brownish-black, thinly bedded, planar.		
125											125
				CB27			5.0	100%			
130									(129.75-129.8') Thinly bedded shaly fine sand horizon, brown/grayish brown.		130
				CB28			5.0	100%			
									(133.45-133.6') Horizon of fine sandstone (grayish brown).		
135									(134.6-134.7') Horizon of fine sandstone.		135
				CB29			5.0	93%	(136') Thinly bedded shale.		
									(137.65-137.75') Fine sandstone.		
									(137.75') Bedding becomes less obvious (homogenous color, black to grayish black).		
140									(139.4-139.5') Fine sandstone.		140

NOTES: Boring backfilled to surface with Portland cement.

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B1
Page: 8 of 10

Drilling Start Date:	3/11/2019	Boring Depth (ft):	186
Drilling End Date:	3/14/2019	Boring Diameter (in):	7"/3"
Drilling Company:	Geotechnology	Sampling Method(s):	SS/NQ2
Drilling Method:	HSA/Air Rotary	DTW During Drilling (ft):	
Drilling Equipment:	HSA/Air Rotary	DTW After Drilling (ft):	
Driller:	C. Steiner	Ground Surface Elev. (ft):	625.8
Logged By:	M. Bizjack	Location (X,Y):	2644286.365, 524133.353

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS	DEPTH (ft)
140				CB30			5.0	100%	(141.35') Sandstone with pyrite nodule.		140
145				CB31			5.0	77%			145
150				CB32			5.0	81%	(149.75') Fractures with friable shale, peels easily into small pieces, disintegrated, decomposed. (150.15-150.5') Intensely fractured shale. (150.25') Thin bed of re-mineralized calcite possible healed fracture or bedding plane. (151-156') Horizons of cross-bedded shaly sandstone occur at 0.5 to 1 ft intervals.		150
155				CB33			5.0	74%	(156') Same shale as above, moderately fractured (mechanical breaks accentuated by drilling process), some fossils. (156.55-156.6') Thin laminated shaly sandstone. (158.6-158.7') Thinly laminated shaly sandstone lens, pyritic.		155
160											160

NOTES: Boring backfilled to surface with Portland cement.

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B1
Page: 9 of 10

Drilling Start Date:	3/11/2019	Boring Depth (ft):	186
Drilling End Date:	3/14/2019	Boring Diameter (in):	7"/3"
Drilling Company:	Geotechnology	Sampling Method(s):	SS/NQ2
Drilling Method:	HSA/Air Rotary	DTW During Drilling (ft):	
Drilling Equipment:	HSA/Air Rotary	DTW After Drilling (ft):	
Driller:	C. Steiner	Ground Surface Elev. (ft):	625.8
Logged By:	M. Bizjack	Location (X,Y):	2644286.365, 524133.353

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS	DEPTH (ft)
160				CB34			5.0	96%	(161') Sandier horizons have brownish hue, occur at 1-2 ft intervals and are less than 0.1 ft thick. (161.7') Laminated shaly sandstone. (162.95-163.05') Layer of laminated shaly sandstone.		160
165				CB35			5.0	100%	(164.35-164.45') Thinly cross bedded shaly sandstone overlying shale bed with flame structures and a mollusk fossil. (165.5') 0.1-ft thick lens of laminated shaly sandstone. (166') Same shale as above, laminated shaly sandstone intervals.		165
170				CB36			5.0	99%	(171') SHALE, moderate strength (breaks by hand along bedding planes), grayish black to brownish-black, crystalline, massively bedded visually and thinly bedded structurally, fresh, competent, unfractured except mechanical breaks, trace crinoid/mollusk debris throughout. (171.4-171.5') Fossiliferous sandy lens. (172.2-172.8') Fossiliferous sandy shale interval, fossils (crinoid, mollusk debris).		170
175				CB37			4.9	89%		End of 3/13/2019	175
180									(178.9') 0.5-inch pyritic nodule. (179.3') 0.5-inch pyritic nodule.		180

NOTES: Boring backfilled to surface with Portland cement.

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B1
Page: 10 of 10

Drilling Start Date:	**3/11/2019**	Boring Depth (ft):	**186**
Drilling End Date:	**3/14/2019**	Boring Diameter (in):	**7"/3"**
Drilling Company:	**Geotechnology**	Sampling Method(s):	**SS/NQ2**
Drilling Method:	**HSA/Air Rotary**	DTW During Drilling (ft):	
Drilling Equipment:	**HSA/Air Rotary**	DTW After Drilling (ft):	
Driller:	**C. Steiner**	Ground Surface Elev. (ft):	**625.8**
Logged By:	**M. Bizjack**	Location (X,Y):	**2644286.365, 524133.353**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS	DEPTH (ft)
180				CB38			5.0	100%	(180.1') Shaly SANDSTONE, fossiliferous, fine-grained, some limestone and shale thin interbeds/lenses, wavy/chaotic texture, pyritic, moderately fractured (mechanical).		180
									(181') LIMESTONE, strong, brownish gray at top grading through medium gray to light gray at base, microcrystalline, bedding chaotic to wavy and medium bedded, no decomposition, no disintegration, unfractured to slightly fractured at wavy bedding planes (mechanical joints), fossiliferous (crinoid, brachiopod, algae), wavy bedding is more argillaceous than matrix.		
185											185
									(186') Boring terminated.		
190											190

NOTES: Boring backfilled to surface with Portland cement.

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B2
Page: 1 of 5

Drilling Start Date:	**2/18/2019**	Boring Depth (ft):	**90**
Drilling End Date:	**2/19/2019**	Boring Diameter (in):	**7"/3"**
Drilling Company:	**Geotechnology**	Sampling Method(s):	**SS/NQ2**
Drilling Method:	**HSA/Air Rotary**	DTW During Drilling (ft):	
Drilling Equipment:	**HSA/Air Rotary**	DTW After Drilling (ft):	
Driller:	**C. Steiner**	Ground Surface Elev. (ft):	**612.1**
Logged By:	**M. Bizjack**	Location (X,Y):	**2642411.069, 525028.743**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	Date & Time	Blow Counts	Recovery (ft)	N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS	DEPTH (ft)
0				SS1			1.5		(0') LEAN CLAY (CL), dark brown, low plasticity to non-plastic, trace red iron stained specks, stiff, moist, organics at surface (grass/roots).		0
				SS2			0.9		(2') Trace limestone gravel in shoe.		
				SS3			0.2		(3') Very little recovery, augered through weathered limestone bedrock.	SS refusal	
				CB4			1.0	0%	(4') LIMESTONE, very strong, medium gray (N5), crystalline, thickly bedded with wavy bedding, slightly decomposed at fractures, competent, intensely to moderately fractured, fractures are narrow to very narrow, joints and mechanical breaks, not healed, rough, surface oxidation reacts vigorously with HCl.	Begin coring with NQ2 (3 inch)	
5				CB5			4.8	59%	(5.3') Soil filled fracture (joint, 0.05 foot).		5
10				CB6			5.0	92%	(10') Changes to slightly fractured along bedding planes, mechanical fractures or joints, changes to medium bedded at the top of run, abundant crinoid pieces near dark wavy beds and scattered throughout, pieces of brachiopods throughout.		10
15				CB7			5.0	92%	(15') Very few fractures, all tight, slight weathering at fractures.		15
20											20

NOTES:

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B2
Page: 2 of 5

Drilling Start Date:	**2/18/2019**	Boring Depth (ft):	**90**
Drilling End Date:	**2/19/2019**	Boring Diameter (in):	**7"/3"**
Drilling Company:	**Geotechnology**	Sampling Method(s):	**SS/NQ2**
Drilling Method:	**HSA/Air Rotary**	DTW During Drilling (ft):	
Drilling Equipment:	**HSA/Air Rotary**	DTW After Drilling (ft):	
Driller:	**C. Steiner**	Ground Surface Elev. (ft):	**612.1**
Logged By:	**M. Bizjack**	Location (X,Y):	**2642411.069, 525028.743**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS	DEPTH (ft)
20				CB8			5.0	96%			20
25				CB9			5.0	100%	(25.6') Begin trace pits and vugs with partial mineral fill, vugs not cemented.		25
30				CB10			5.0	100%	(28') Prominent darker bedding, wavy, every 1-1.5 feet, 1-2 inch thick section of thin wavy bedding. (30.5') Healed fracture (possible pyrite and quartz fill).		30
35				CB11			5.0	100%	(33.4') Changes to gray (N3/N2) intervals of thin wavy bedded, darker bedding at 33.4, 34, 34.6 feet, intervals are thicker (approximately 2-4 inch). (33.8') Color changes to medium dark gray (N4). (35') Changes to thinly bedded. (37.5') Thicker section of darker (N4) limestone, fossil still present, whole shell and debris.		35
40											40

NOTES:

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B2
Page: 3 of 5

Drilling Start Date:	**2/18/2019**	Boring Depth (ft):	**90**
Drilling End Date:	**2/19/2019**	Boring Diameter (in):	**7"/3"**
Drilling Company:	**Geotechnology**	Sampling Method(s):	**SS/NQ2**
Drilling Method:	**HSA/Air Rotary**	DTW During Drilling (ft):	
Drilling Equipment:	**HSA/Air Rotary**	DTW After Drilling (ft):	
Driller:	**C. Steiner**	Ground Surface Elev. (ft):	**612.1**
Logged By:	**M. Bizjack**	Location (X,Y):	**2642411.069, 525028.743**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS	DEPTH (ft)
40				CB12			5.0	98%	(41') Possible natural fracture aggravated by drilling break along darker wavy bedding plane, 30-40° from horizontal, slight weathering.		40
45				CB13			5.0	83%	(45') Texture change with obvious grains, more mottled in color (N5), abundant fossil (whole and debris), intensely fractured (horizontal, joints). (45.8') 1 inch shale, grayish black, friable, thinly bedded, weak, followed by approximately 2 inches of mottled limestone, underlain by approximately 2 inch section of same shale. (46.2') Grades back into more uniform alternating darker/lighter (N3/N4) wavy beds, moderately fractured, abundant fossil debris, strong, breaks along darker bedding, still react strongly with HCl.	Driller noted hydrocarbon odor in drilling water	45
50				CB14			5.0	85%	(47.5') Possible concretion or fossil infill (light gray). (50') Darker limestone present with alternating lighter gray sediments with chaotic texture, whole fossils and debris, intensely fractured from 50-51 feet. Grayish black (N2) shaly limestone, joints and bedding planes. (51') Changes to medium dark gray (N4) and dark gray (N3) limestone.		50
55				CB15			5.0	96	(55') Crinoid/brachiopod debris present.		55
60											60

NOTES:

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B2
Page: 4 of 5

Drilling Start Date:	**2/18/2019**	Boring Depth (ft):	**90**
Drilling End Date:	**2/19/2019**	Boring Diameter (in):	**7"/3"**
Drilling Company:	**Geotechnology**	Sampling Method(s):	**SS/NQ2**
Drilling Method:	**HSA/Air Rotary**	DTW During Drilling (ft):	
Drilling Equipment:	**HSA/Air Rotary**	DTW After Drilling (ft):	
Driller:	**C. Steiner**	Ground Surface Elev. (ft):	**612.1**
Logged By:	**M. Bizjack**	Location (X,Y):	**2642411.069, 525028.743**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS	DEPTH (ft)
60				CB16			5.0	100%	(60') Unfractured.		60
65				CB17			5.0	100%	(65') Alternating limestone and shale. Notable brachiopod fossil.		65
									(67.8') Healed fracture infilled with quartz possibly pyrite (3mm aperture) and shaly matrix.		
70				CB18			5.0	100%			70
									(72') Alternating limestone and shale, isolated fossils (crinoid debris), limestone beds lighter and have wavy bedding in places, HCl reacts strongly with lighter beds and picks out thin beds on darker rock.		
75				CB19			5.0	100%	(75') Same interbedded shale and argillaceous limestone, limestones are medium-very dark gray, calcareous shales are grayish-black, scattered fossils (crinoid debris).	Core broken in one place	75
80											80

NOTES:

Geosyntec consultants
engineers | scientists | innovators

Client: American Electric Power / Northeastern Plant
Project: CHW8290
Address: Oologah, OK

BORING LOG
Boring No. BAP-B2
Page: 5 of 5

Drilling Start Date:	**2/18/2019**	Boring Depth (ft):	**90**
Drilling End Date:	**2/19/2019**	Boring Diameter (in):	**7"/3"**
Drilling Company:	**Geotechnology**	Sampling Method(s):	**SS/NQ2**
Drilling Method:	**HSA/Air Rotary**	DTW During Drilling (ft):	
Drilling Equipment:	**HSA/Air Rotary**	DTW After Drilling (ft):	
Driller:	**C. Steiner**	Ground Surface Elev. (ft):	**612.1**
Logged By:	**M. Bizjack**	Location (X,Y):	**2642411.069, 525028.743**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	COLLECT: N Value RQD (%)	SOIL/ROCK VISUAL DESCRIPTION	REMARKS	DEPTH (ft)
80				CB20			5.0	100%	(80') Same interbedded shaly limestone/calcareous shale, light or dark gray limestones generally chaotically bedded, 0.5-1 foot in size, shaly intervals are generally thinner or massive beds and 0.5-1 foot in size, isolated rare fossil debris.		80
85				CB21			4.4	95%	(85') Same alternating shale/limestone, dark thinly bedded shaly lime/limey shale intervals alternating with chaotic paler (dark gray) limestones with chaotic bedding and often fossils.	Core broken in one place	85
									(88.4') Notable ammonite in fossil debris bed.		
90									(90') Boring terminated.		90
95											95

NOTES:

ATTACHMENT B
BAP-B1 Photolog

Geosyntec Consultants
Photographic Record

Client: AEP	Project Number: CHW8193
Site Name: Northeastern Plant	Site Location: Oologah, OK

Photograph 1 Date: 3/12/2019 Direction: BAP-B1 Comments: 1-12.5 feet (ft) below ground surface (bgs)	
Photograph 2 Date: 3/12/2019 Direction: BAP-B1 Comments: 12.5-21.9 ft bgs	

Geosyntec Consultants
Photographic Record

Client: AEP	Project Number: CHW8193
Site Name: Northeastern Plant	Site Location: Oologah, OK

Photograph 3 Date: 3/12/2019 Direction: BAP-B1 Comments: 21-26 ft bgs	
Photograph 4 Date: 3/12/2019 Direction: BAP-B1 Comments: 26-31 ft bgs	

Geosyntec Consultants
Photographic Record

Client: AEP	Project Number: CHW8193
Site Name: Northeastern Plant	Site Location: Oologah, OK

Photograph 5 Date: 3/14/2019 Direction: BAP-B1 Comments: 31.4-41 ft bgs	
Photograph 6 Date: 3/14/2019 Direction: BAP-B1 Comments: 41-50.75 ft bgs	

Geosyntec Consultants
Photographic Record

Client: AEP	Project Number: CHW8193
Site Name: Northeastern Plant	Site Location: Oologah, OK

Photograph 7 Date: 3/14/2019 Direction: BAP-B1 Comments: 50.75-60.55 ft bgs	
Photograph 8 Date: 3/12/2019 Direction: BAP-B1 Comments: 61-66 ft bgs	

Geosyntec Consultants
Photographic Record

Client: AEP	Project Number: CHW8193
Site Name: Northeastern Plant	Site Location: Oologah, OK

Photograph 9 Date: 3/12/2019 Direction: BAP-B1 Comments: 66-71 ft bgs	
Photograph 10 Date: 3/12/2019 Direction: BAP-B1 Comments: 71-76 ft bgs	

Geosyntec Consultants
Photographic Record

Client: AEP	Project Number: CHW8193
Site Name: Northeastern Plant	Site Location: Oologah, OK

Photograph 11 Date: 3/12/2019 Direction: BAP-B1 Comments: 76-81 ft bgs	

Photograph 12 Date: 3/12/2019 Direction: BAP-B1 Comments: 81-86 ft bgs	

Geosyntec Consultants
Photographic Record

Client: AEP	Project Number: CHW8193
Site Name: Northeastern Plant	Site Location: Oologah, OK

Photograph 13 Date: 3/12/2019 Direction: BAP-B1 Comments: 86-91 ft bgs	
Photograph 14 Date: 3/12/2019 Direction: BAP-B1 Comments: 91-96ft bgs	

Geosyntec Consultants
Photographic Record

Client: AEP	Project Number: CHW8193
Site Name: Northeastern Plant	Site Location: Oologah, OK

Photograph 15 Date: 3/12/2019 Direction: BAP-B1 Comments: 96-101 ft bgs	
Photograph 16 Date: 3/12/2019 Direction: BAP-B1 Comments: 101-106 ft bgs	

Geosyntec Consultants
Photographic Record

Client: AEP	Project Number: CHW8193
Site Name: Northeastern Plant	Site Location: Oologah, OK

Photograph 17 Date: 3/12/2019 Direction: BAP-B1 Comments: 106-111 ft bgs	
Photograph 18 Date: 3/13/2019 Direction: BAP-B1 Comments: 108.8-118.5 ft bgs	

Geosyntec Consultants
Photographic Record

Client: AEP	Project Number: CHW8193
Site Name: Northeastern Plant	Site Location: Oologah, OK

Photograph 19 Date: 3/13/2019 Direction: BAP-B1 Comments: 118.5-128.2 ft bgs	
Photograph 20 Date: 3/13/2019 Direction: BAP-B1 Comments: 128.2-138 ft bgs	

Geosyntec Consultants
Photographic Record

Client: AEP	Project Number: CHW8193
Site Name: Northeastern Plant	Site Location: Oologah, OK

Photograph 21 Date: 3/13/2019 Direction: BAP-B1 Comments: 138-148 ft bgs	
Photograph 22 Date: 3/13/2019 Direction: BAP-B1 Comments: 148-158 ft bgs	

Geosyntec Consultants
Photographic Record

Client: AEP	Project Number: CHW8193
Site Name: Northeastern Plant	Site Location: Oologah, OK

Photograph 23 Date: 3/13/2019 Direction: BAP-B1 Comments: 158-167.7 ft bgs	
Photograph 24 Date: 3/13/2019 Direction: BAP-B1 Comments: 167.7-176 ft bgs	

Geosyntec Consultants
Photographic Record

Client: AEP	Project Number: CHW8193
Site Name: Northeastern Plant	Site Location: Oologah, OK

Photograph 25

Date: 3/13/2019

Direction: BAP-B1

Comments:
177-186 ft bgs

ATTACHMENT C

Mineralogical Analysis Laboratory Report

MINERALOGY INC
WHERE SCIENCE GETS DOWN TO EARTH

CHA8462/10/01

Requested by:
Alison Kreinberg
Geosyntec Consultants

Mineralogy, Inc. Number 19051

Date:
March 21, 2019

Submitted by:

Timothy B. Murphy

Mineralogy, Inc.
3321 East 27th Street
Tulsa, Oklahoma 74114
USA
+1 (918) 744.8284

www.mineralogy-inc.com

Table of Contents

Sample ID		Petrographic Data	Thin Section Images
SP-10-LOG 1 (32-32.4')	19051-01	•	•
SP-10-LOG 2 (46')	19051-02	•	•
SP-10-LOG 3 (46')	19051-03	•	•
SP-10-LOG 4 (72-72.4')	19051-04	•	•

Table of Contents

CONDITIONS AND QUALIFICATIONS

Mineralogy, Inc. will endeavor to provide accurate and reliable laboratory measurements of the samples provided by the client. The results of any x-ray diffraction, petrographic or core analysis test are necessarily influenced by the condition and selection of the samples to be analyzed. It should be recognized that geological samples are commonly heterogeneous and lack uniform properties. Mineralogical, geochemical and/or petrographic data obtained for a specific sample provides compositional data pertinent to that specific sampling location. Such "site-specific data" may fail to provide adequate characterization of the range of compositional variability possible within a given project area, thus the "projection" of these laboratory findings and values to adjoining, "untested" areas of the formation or project area is inherently risky, and exceeds the scope of the laboratory work request. Hence, Mineralogy, Inc. shall not assume any liability risk or responsibility for any loss or potential failure associated with the application of "site or sample-specific laboratory data" to "untested" areas of the formation or project area. Unless otherwise directed, the samples selected for analysis will be chosen to reflect a visually representative portion of the bulk sample submitted for analysis. Where provided, the interpretation of x-ray diffraction, petrographic or core analysis results constitutes the best geological judgment of Mineralogy, Inc., and is subject to the sampling limitations described above, and the detection limits inherent to semi-quantitative and/or qualitative mineralogical and microscopic analysis. Mineralogy, Inc. assumes no responsibility nor offers any guarantee of the productivity, suitability or performance of any oil or gas well, hydrocarbon recovery process, dimension stone, and/or ore material based upon the data or conclusions presented in this report.

Table of Contents

Introduction

Four selected core intervals have been submitted for a combination of mineralogical, chemical, and petrographic analysis. The results of the x-ray diffraction mineralogical analysis are summarized in Table I. X-ray fluorescence chemical analysis data for these samples are presented in Table II. Results of the cation exchange capacity analysis (CEC) are summarized in Table III. The CEC results provide exchange capacities for a series of selected cation species, including: lithium, calcium, potassium, magnesium and sodium ions. The results of the thin section petrographic analysis are summarized in the individual thin section descriptions presented following Table III. The descriptive summaries include thin section photomicrographs that offer representative images of the micro-fabric for these core samples.

Sample ID	Mineralogy, Inc. No.	Analysis Requested
SP-10-LOG 1 (32-32.4')	19051-01	XRD / XRF / CEC / TSP
SP-10-LOG 2 (46')	19051-02	XRD / XRF / CEC / TSP
SP-10-LOG 3 (46')	19051-03	XRD / XRF / CEC / TSP
SP-10-LOG 4 (72-72.4')	19051-04	XRD / XRF / CEC / TSP

XRD = X-ray Diffraction | XRF = X-ray Fluorescence | CEC = Cation Exchange Capacity | TSP = Thin Section Petrography

Table of Contents

X-ray Diffraction

Client:	Geosyntec Consultants	MI#:	19051
Project:	CHA8462/10/01	Date:	03/21/19
Location:	N/A	Method:	X-ray Diffraction

Sample ID	SP-10-LOG 1	SP-10-LOG 2	SP-10-LOG 4	SP-10-LOG 4
Depth (ft)	32-32.4	46	46	72-72.4
MI#	19051-01	19051-02	19051-03	19051-04
Mineral Constituent	**Relative Abundance (%)**			
Quartz	1	20	3	6
Albite	ND	4	ND	ND
Microcline	ND	1	ND	ND
Calcite	95	2	93	91
Ferroan Dolomite	4	ND	ND	2
Siderite	ND	1	ND	ND
Pyrite	ND	5	1	ND
Kaolinite	ND	2	1	<0.5
Chlorite	ND	3	<0.5	ND
Illite/Mica	ND	38	1	1
Mixed-Layered Illite/Smectite	ND	24	1	<0.5
Total	**100**	**100**	**100**	**100**
% Illite Layers in ML I/S		*75%*	*75%*	*BDL*

**ND = Not Detected*
BDL = Below Detection Limit

Table of Contents

X-ray Fluorescence

Client:	Geosyntec Consultants	MI#:	19051
Project:	CHA8462/10/01	Date:	03/21/19
Location:	N/A	Method:	X-ray Fluorescence

Sample ID	SP-10-LOG 1	SP-10-LOG 2	SP-10-LOG 4	SP-10-LOG 4
Depth (ft)	32-32.4	46	46	72-72.4
MI#	19051-01	19051-02	19051-03	19051-04
Compound	**Results (mass %)**			
Na2O	ND	0.1895	0.115	0.1679
MgO	0.8658	0.8691	0.6868	1.2152
Al2O3	0.229	2.623	2.8345	1.8392
SiO2	1.8268	9.8542	11.7333	15.4175
P2O5	0.1167	0.2455	0.1844	0.1426
S	0.0281	0.5322	0.3903	0.1484
Cl	0.0366	0.0313	0.0366	0.0309
K2O	0.0729	0.5631	0.36	0.4304
CaO	95.2326	80.3021	79.7826	78.3752
TiO2	ND	0.1647	0.0679	0.1096
MnO	0.0797	0.1224	0.1512	0.1627
Fe2O3	0.7094	2.596	1.912	1.2662
Sr	0.5788	0.8884	0.922	0.3485
Y	ND	ND	0.0116	ND
BaO	0.0758	0.0597	0.056	0.0598

**ND = Not Detected*

Table of Contents

Cation Exchange Capacity

Client:	Geosyntec Consultants	MI#:	19051
Project:	CHA8462/10/01	Date:	03/21/19
Location:	N/A	Method:	C.E.C.

	Lithium		Calcium		Magnesium		Potassium		Sodium	
	Results	PQL**	Results	PQL**	Results	PQL**	Results	PQL**	Results	PQL**
Sample ID	(meg/100g)		(meg/100g)		(meg/100g)		(meg/100g)		(meg/100g)	
SP-10-LOG 1 32 - 32.4'	BPQL	0.05	20.0	0.100	0.567	0.100	BPQL	0.100	0.226	0.100
SP-10-LOG 2 46'	BPQL	0.05	16.2	0.100	3.51	0.100	2.32	0.100	8.85	0.100
SP-10-LOG 3 46'	BPQL	0.05	21.6	0.100	0.642	0.100	0.250	0.100	0.896	0.100
SP-10-LOG 4 72 - 72.4'	BPQL	0.05	21.1	0.100	1.16	0.100	0.313	0.100	0.822	0.100

Method Reference: 40 CFR 136, 261, Method for Chemical Analysis of Water and Waste EPA-600/4-79-020 March 1983

CEC Method Reference: Method of Soil Analysis, Chemical and Microbiological Properties, 2nd Ed.; American Society of Agronomy, Inc.

Soil Science Society of America, Inc. page 160.

**CEC analysis provided by Accurate Laboratories & Training Center; Stillwater, OK*

***PQL= Practical Quantitation Limit | BPQL = Below Practical Quantitation Limit*

Table of Contents

SP-10-LOG 1 (32-32.4'); MI#19051-01 Petrographic Data

This core interval is comprised of non-porous, partially recrystallized, slightly dolomitic, mollusk lime wackstone. Some characteristics of the limestone framework and micro-fabric are noted as follows:

- The limestone is extensively crystalized and exhibits a grain assemblage that includes recrystallized mollusk shells and gastropod fragments, undifferentiated skeletal debris (recrystallized skeletal grains partially to completely replaced with calcite spar and/or dolomite cement), foram tests, and ostracod fragments.
- The sedimentary fabric is burrow mottled and exhibits localized evidence of geopetal sheltering adjoining selected shell fragments. The sheltered portions of the limestone fabric exhibit contrasts in the matrix packing density & the distribution of some secondary cements within this interval.
- The groundmass of this sample is dominated by microcrystalline calcite. Portions of the matrix have been locally replaced with very finely crystalline calcite spar +/- dolomite cement owing to aggrading neomorphism.
- Traces of microcrystalline chert cement are locally present as a late stage secondary cement occupying patches of sheltered inter-crystalline porosity that adjoin the mollusk shell fragments. The chert cement is visually estimated to account for <1% of the mineral volume in this interval.
- Porosity accounts for ~0.5-1.0% of the bulk volume. Void types include scattered secondary dissolution voids (associated with the dolomite-replaced mollusk shell fragments), and traces of inter-crystalline microporosity.

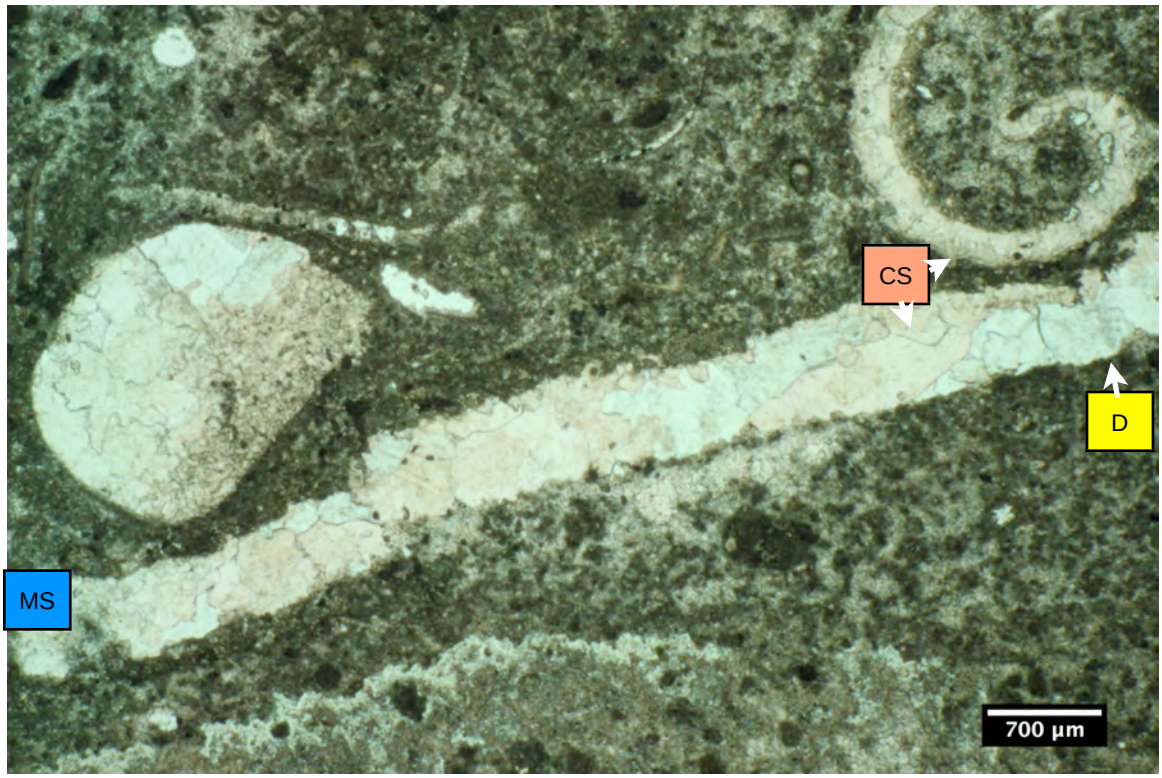
Mineralogical Data

Mineral Constituents	Concentration (%)
Quartz	1
Calcite	95
Ferroan Dolomite	4

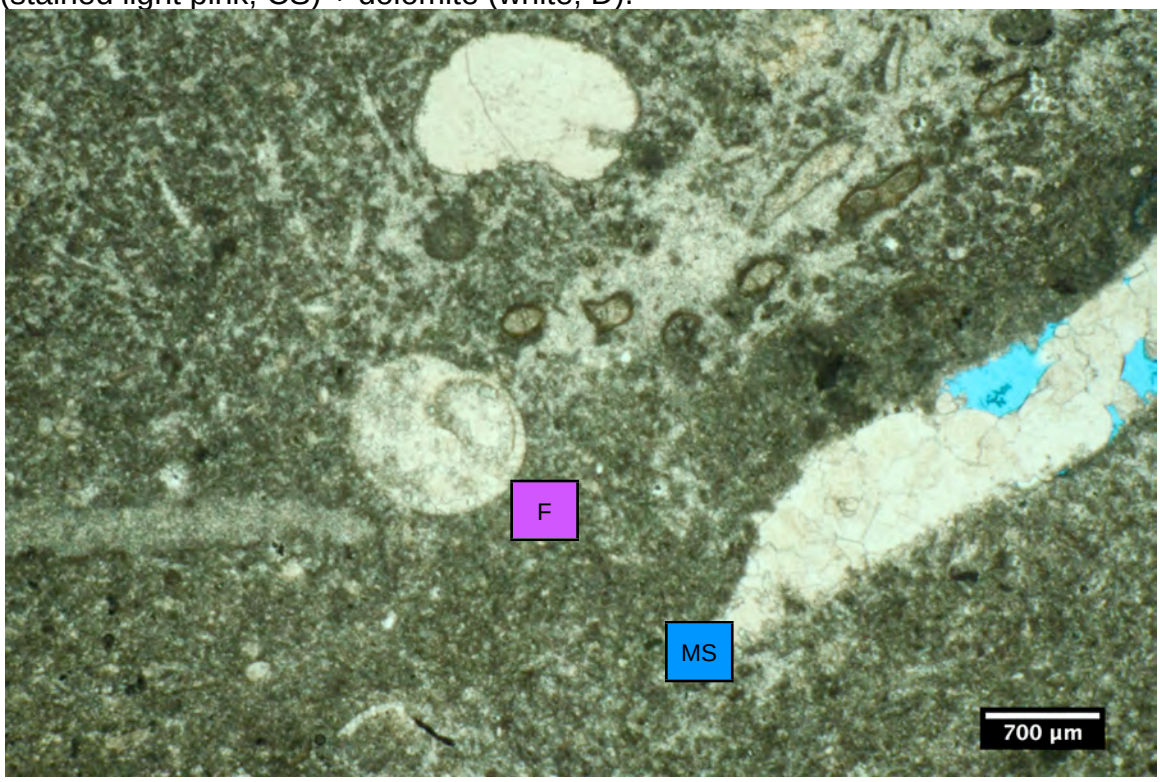
Photo Tags

Calcite spar cement	CS
Dolomite	D
Mollusk shell fragments	MS
Foram test	F

Table of Contents



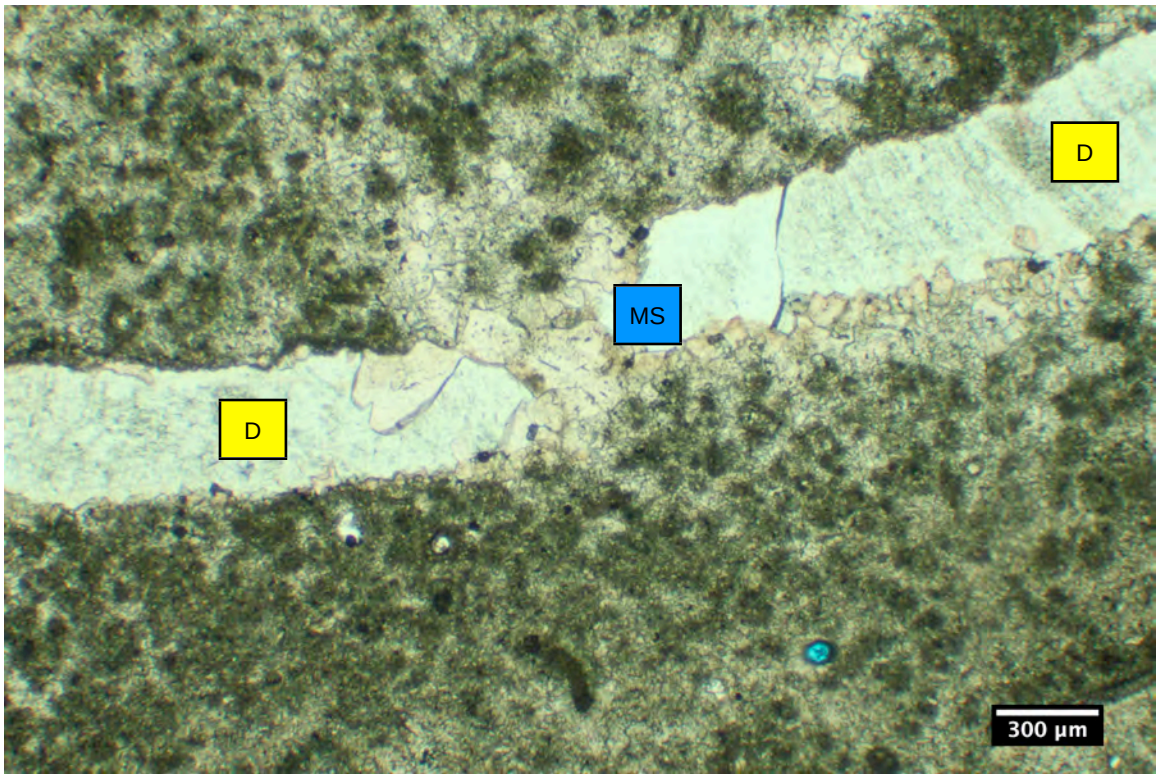
1A. Mollusk shell fragments (MS) recrystallized and replaced with calcite spar (stained light pink; CS) + dolomite (white; D).



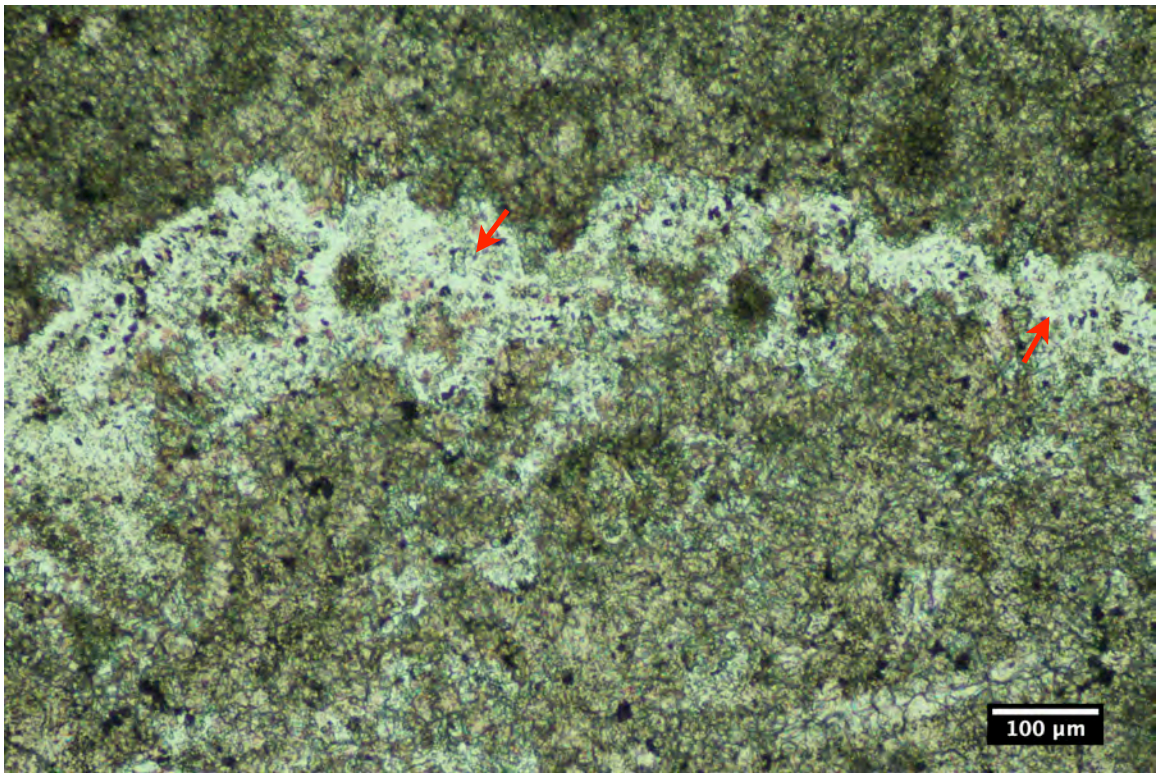
1B. Secondary intraparticle dissolution macroporosity (blue) associated with a leached mollusk shell fragment (MS). Recrystallized foram (?) test (F).

Table of Contents

SP-10-LOG 1 (32-32.4'); MI#19051-01



1C. Dolomite replacement (D) within a re-crystallized mollusk shell fragment (MS).



1D. Chert cement (red arrows) replacing portions of the lime mud groundmass within this limestone sample.

Table of Contents

SP-10-LOG 2 (46'); MI#19051-02 Petrographic Data

This core sample is characterized as a parallel-bedded, organic matter-rich, calcareous and fossiliferous, silty shale. The fabric and mineralogy of this core interval is noted as follows:

- The silty shale groundmass is densely packed & exhibits parallel-bedded lamina of organic matter-rich detrital clay interbedded with limestone skeletal fragments and lens-shaped concentrations of quartz-rich silt. The clay matrix fraction accounts for ~ 67% of the mineral volume & includes illite/mica, mixed-layered illite/smectite, kaolinite and chlorite.
- The silty shale is interbedded with clay matrix-rich skeletal lime wackstone. The interbedded limestone materials are burrow mottled, fossiliferous, and incorporate common lenses of organic-rich clay. The matrix materials locally drape the carbonate grains and fill intercrystalline voids of the limestone. Skeletal allochems include very poorly preserved mollusk shell fragments, calcareous algae plates, and foram tests. Most of the carbonate grains have been completely recrystallized and replaced with calcite spar cement.
- Burial compaction and deformation of the interbedded matrix materials has contributed to the development of pressure solution artifacts including low amplitude stylolites.
- Minor to trace amounts of micro-crack porosity are present within the organic-rich silty-shale materials. The fracture voids are parallel to bedding and likely represent artifacts related to fabric relaxation.

Mineralogical Data

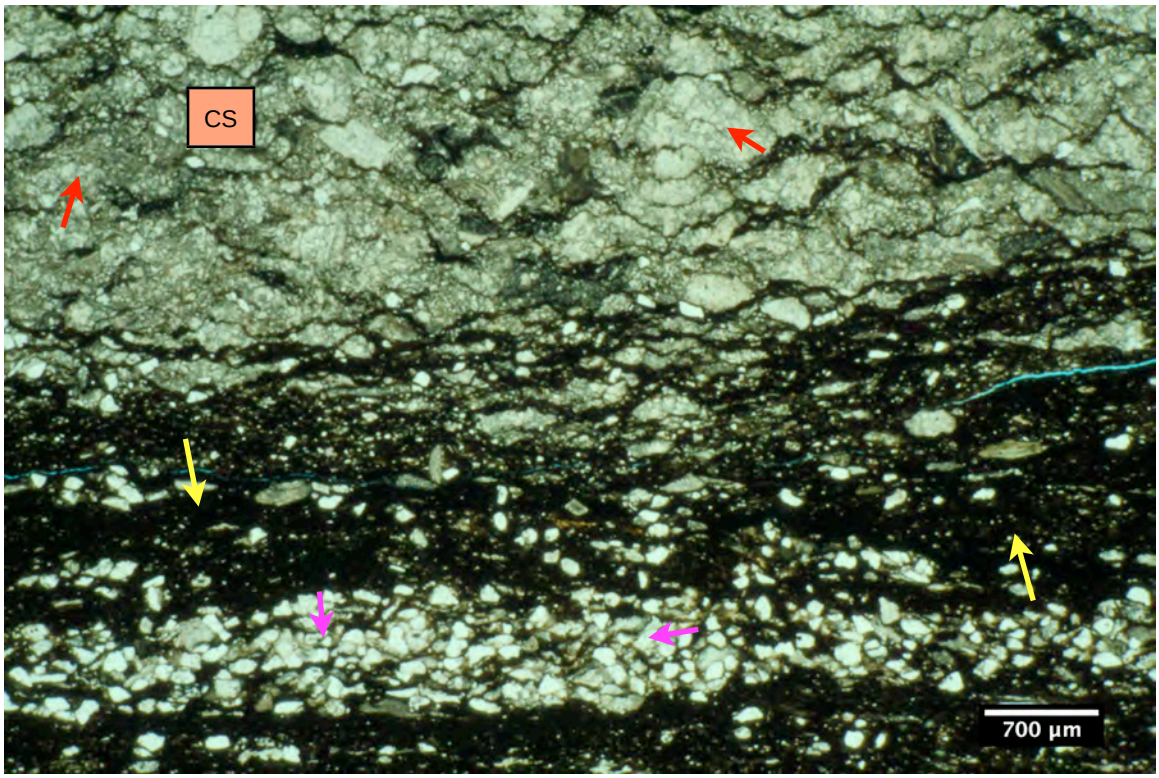
Mineral Constituents	Concentration (%)
Quartz	20
Albite	4
Microcline	1
Calcite	2
Siderite	1
Pyrite	5
Kaolinite	2
Chlorite	3
Illite/Mica	38
Mixed-Layered Illite/Smectite	24

Photo Tags

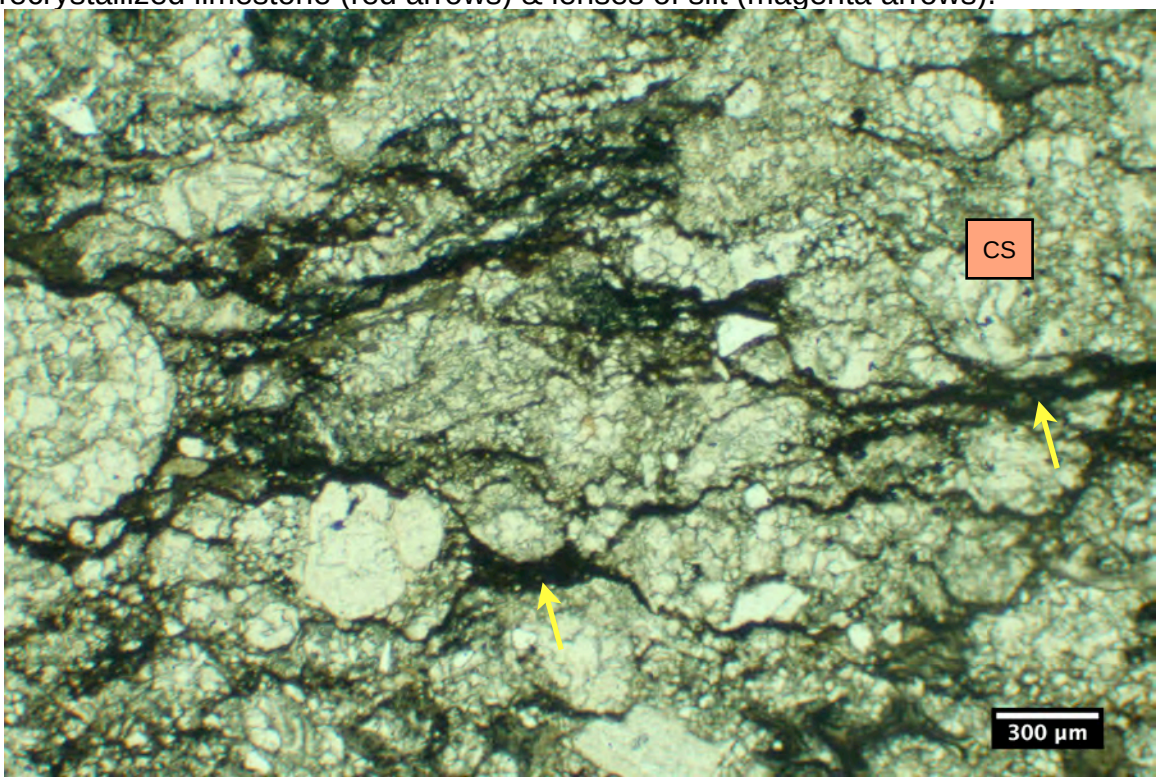
Calcite spar cement	CS
Dolomite	D
Mollusk shell fragments	MS
Foram test	F

Table of Contents

SP-10-LOG 2 (46'); MI#19051-02

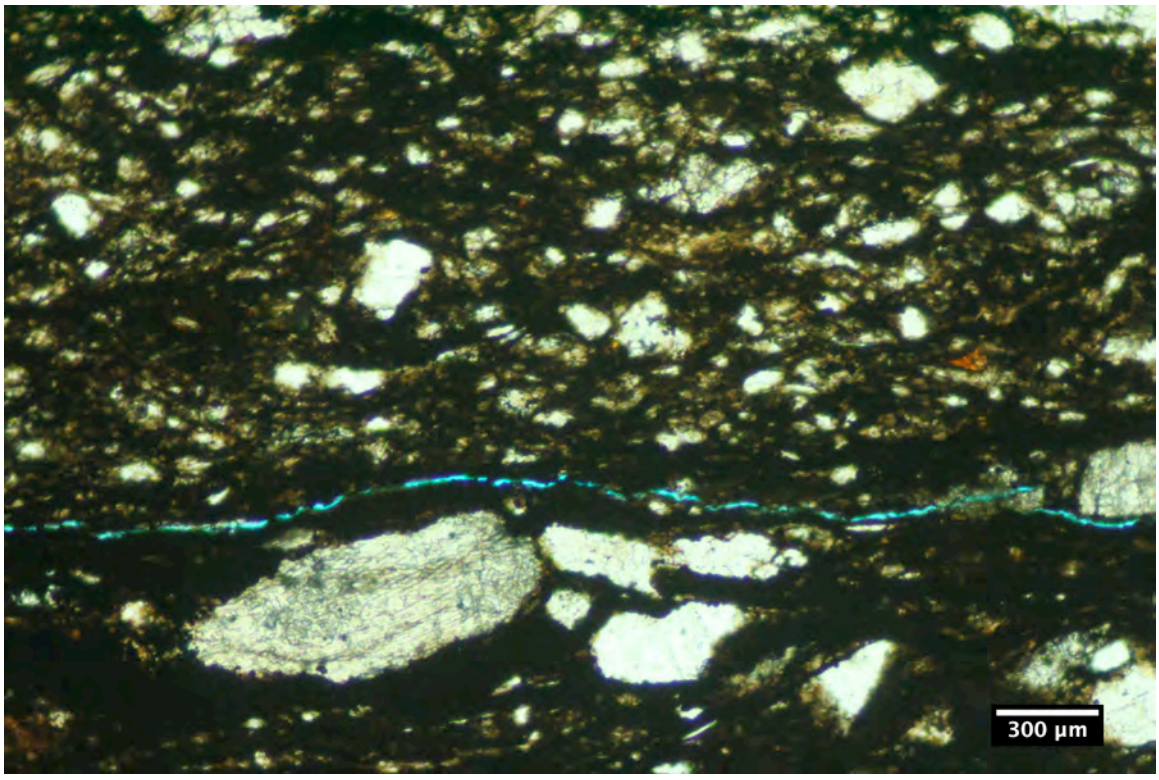


2A. The silty shale (yellow arrows) is organic matter-rich & contains interbeds of recrystallized limestone (red arrows) & lenses of silt (magenta arrows).

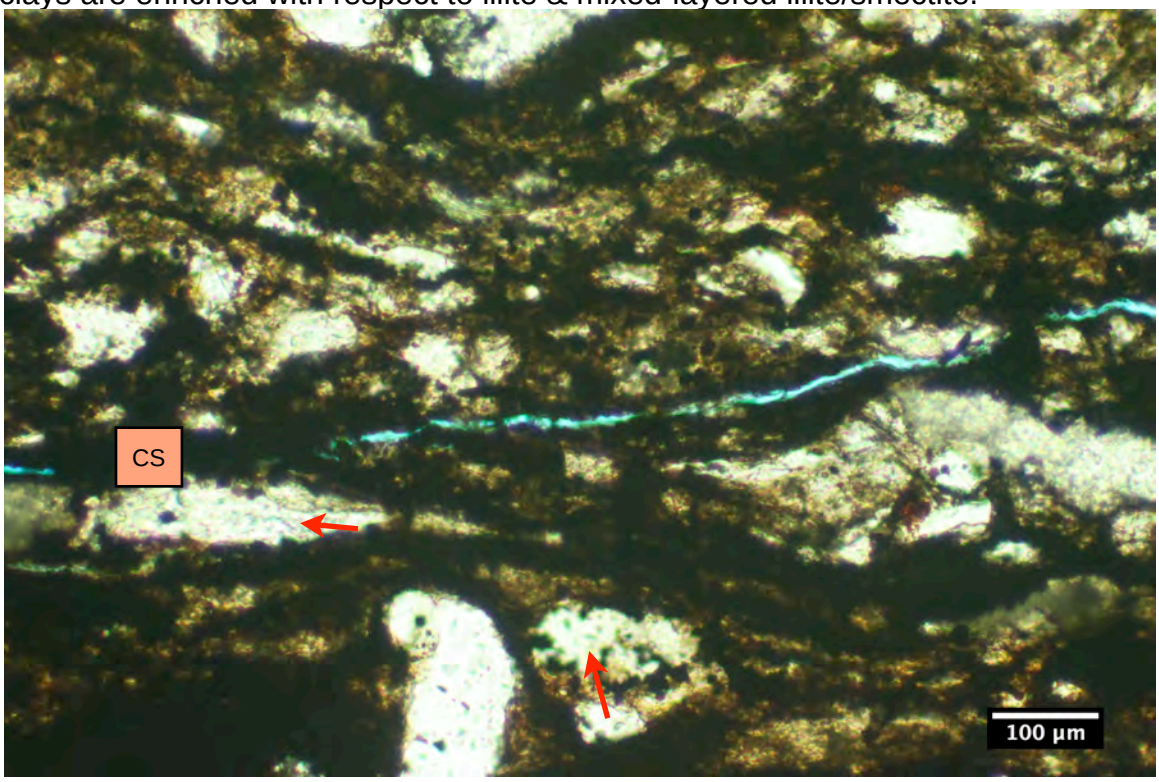


2B. The limestone interbed is flaser-bedded & exhibits lenses of black-colored, organic-rich matrix (yellow arrows) draping the calcite crystals (CS).

Table of Contents



2C. Micro-crack (blue) attributed to fabric relaxation of the compressed shale. The clays are enriched with respect to illite & mixed-layered illite/smectite.



2D. Nearly all of the available intergranular space is choked with organic-rich detrital clay of carbonate cement (red arrows).

Table of Contents

SP-10-LOG 3 (46'); MI#19051-03 Petrographic Data

This core sample is characterized as an organic matter and clay matrix-rich skeletal lime packstone. The limestone is non-porous and exhibits wavy or flaser bedding, with detrital clay matrix locally concentrated in the 'troughs' of the fabric. Clay lenses and lamina are locally deformed along low amplitude pressure solution seams.

- The limestone mineralogy is dominated by calcite (~93%), together with modest amounts of quartz (3%), pyrite (1%), and clay matrix minerals (~3%). The clay mineral suite for this sample includes a mix of illite/mica, mix-layered illite/smectite, kaolinite, and traces of chlorite.
- Skeletal allochems include: undifferentiated and locally recrystallized skeletal grains, mollusk shell fragments, foram tests, intraclasts (lime wackstone and lime mudstone), bryozoan fronds, gastropod fragments, and traces of quartz-rich silt and sand.
- Pyrite cement occurs as a common replacement for organic matter.

Mineralogical Data

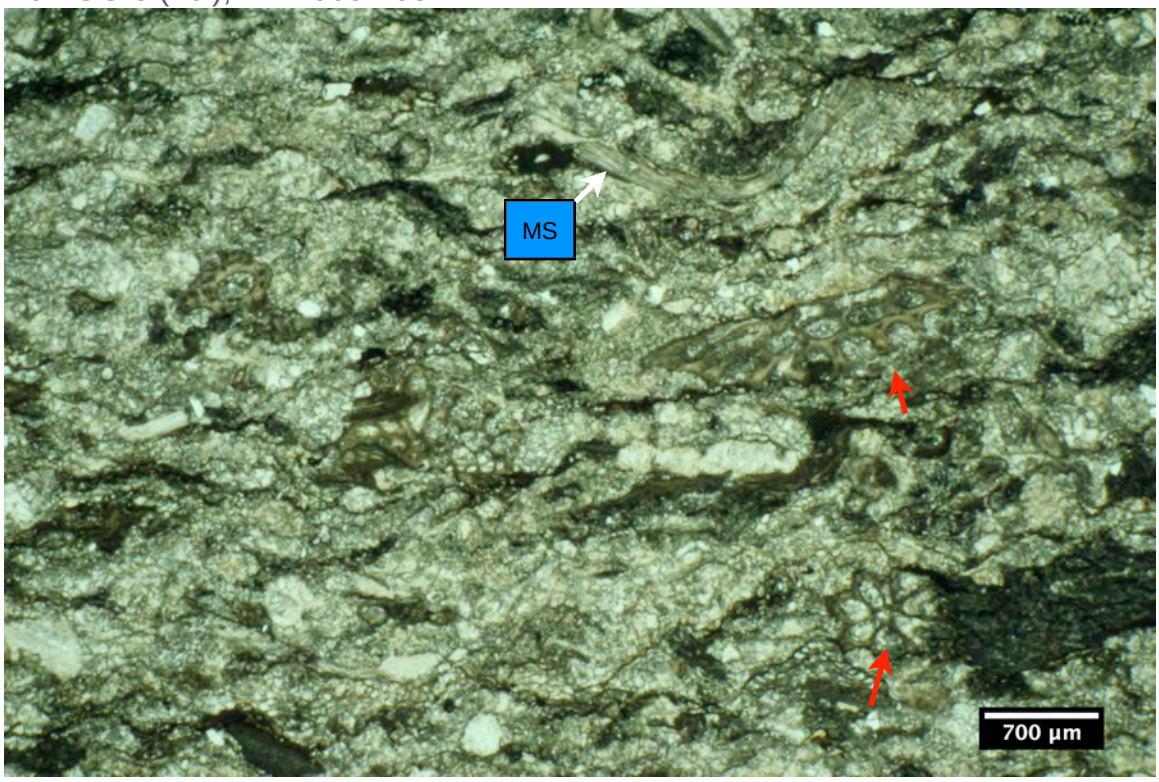
Mineral Constituents	Concentration (%)
Quartz	3
Calcite	93
Pyrite	1
Kaolinite	1
Chlorite	<0.5
Illite/Mica	1
Mixed-Layered Illite/Smectite	1

Photo Tags

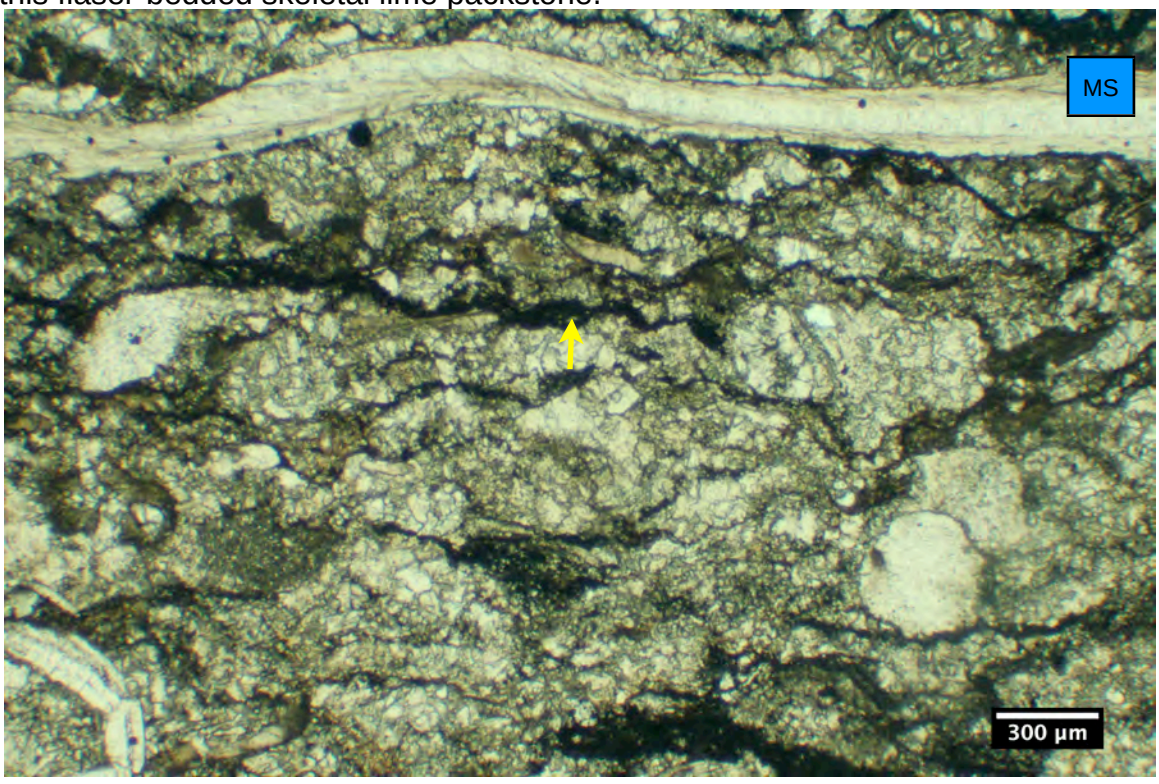
Calcite spar cement	CS
Dolomite	D
Mollusk shell fragments	MS
Foram test	F

Table of Contents

SP-10-LOG 3 (46'); MI#19051-03



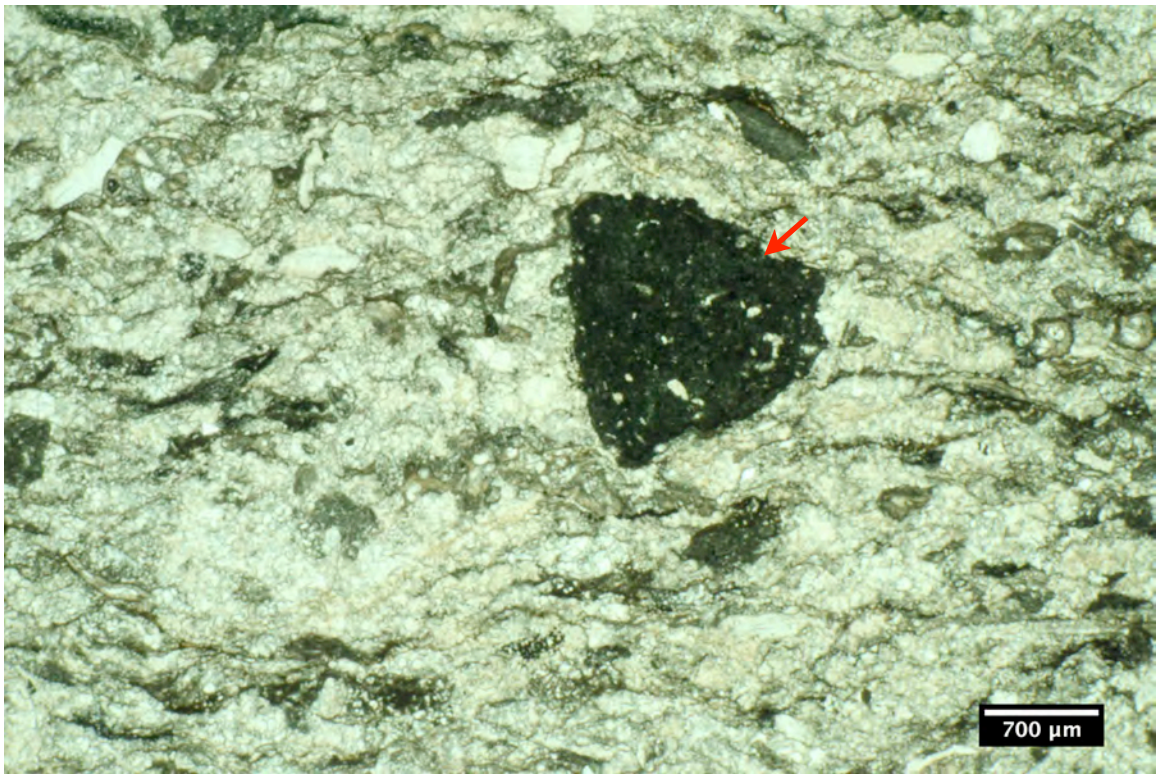
3A. Bryozoan fronds (red arrows) + poorly preserved mollusk shell fragments (MS) in this flaser-bedded skeletal lime packstone.



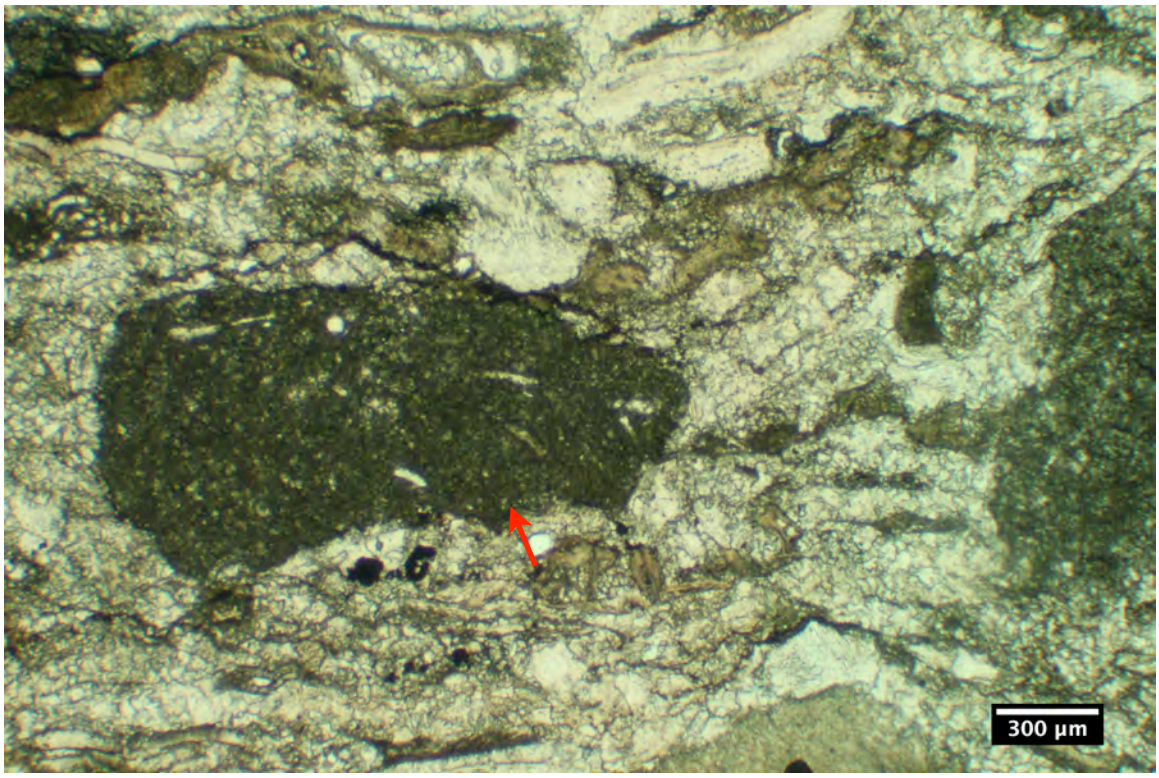
3B. Mollusk shell fragment (MS) + undifferentiated & skeletal fragments. Note the mechanically deformed & compacted matrix lenses (yellow arrow).

Table of Contents

SP-10-LOG 3 (46'); MI#19051-03



3C. Intraclast of lime wackestone (red arrow). The limestone fabric is non-porous.



3D. Intraclast (red arrow) within this extensively recrystallized skeletal lime packstone.

Table of Contents

SP-10-LOG 4 (72-72.4'); MI#19051-04 Petrographic Data

This core interval is comprised of densely-crystallized, burrow mottled, skeletal lime packstone/wackstone. The mineralogy and fabric properties for this sample are noted as follows:

- The sample fabric is parallel-bedded and burrow mottled. The skeletal grain assemblage is comprised of very poorly preserved and locally re-crystallized sponge spicules, calcareous algae plates, pelloids, and undifferentiated skeletal fragments.
- The limestone is locally interbedded with parallel bedded lamina of organic matter-rich silty-shale.
- The mineralogy of the limestone is dominated by calcite (91%), coupled with significant amounts of quartz-rich silt and sand (~6%), ferroan dolomite (~2%), and clay matrix minerals (~1%). The XRD analysis of the clay matrix fraction indicates a mineralogy dominated by illite/mica coupled with minor to accessory amounts of mixed-layered illite/smectite and kaolinite.
- The limestone fabric is described as non-porous and extensively recrystallized. Very finely crystalline calcite spar and patches of dolomite cement are common replacements for skeletal grains present in this sample.

Mineralogical Data

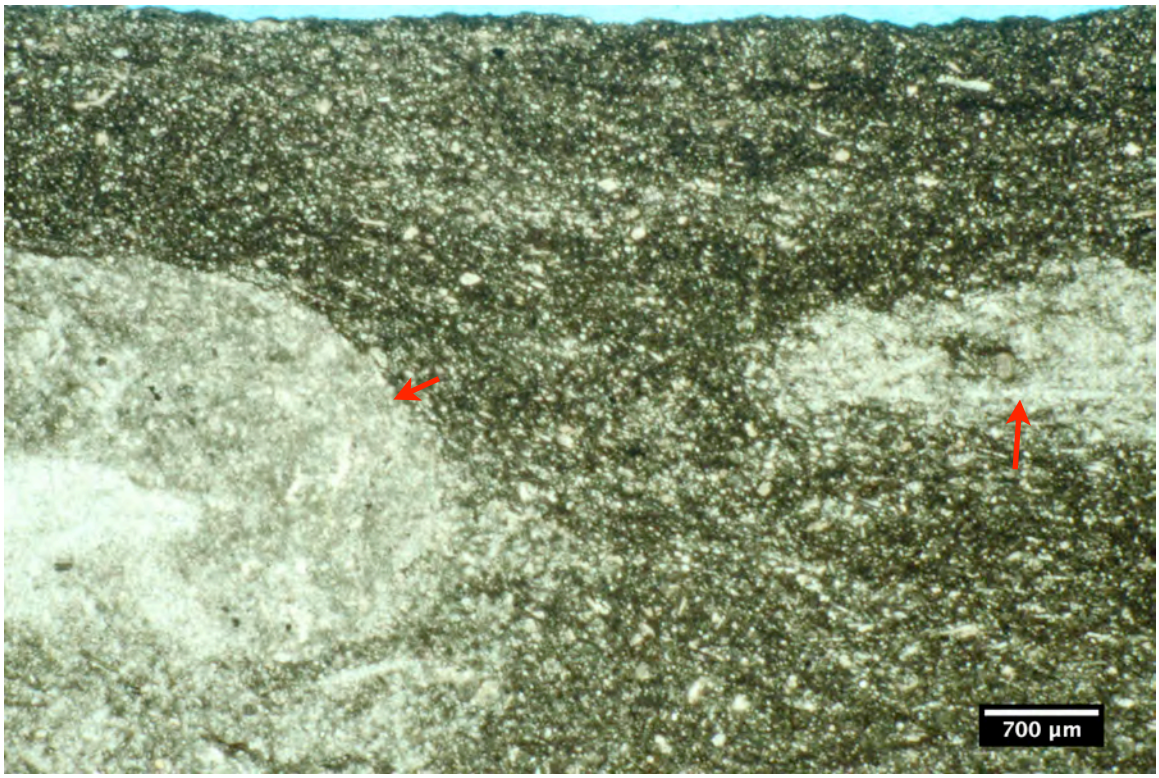
Mineral Constituents	Concentration (%)
Quartz	6
Calcite	91
Ferroan Dolomite	2
Kaolinite	<0.5
Illite/Mica	1
Mixed-Layered Illite/Smectite	<0.5

Photo Tags

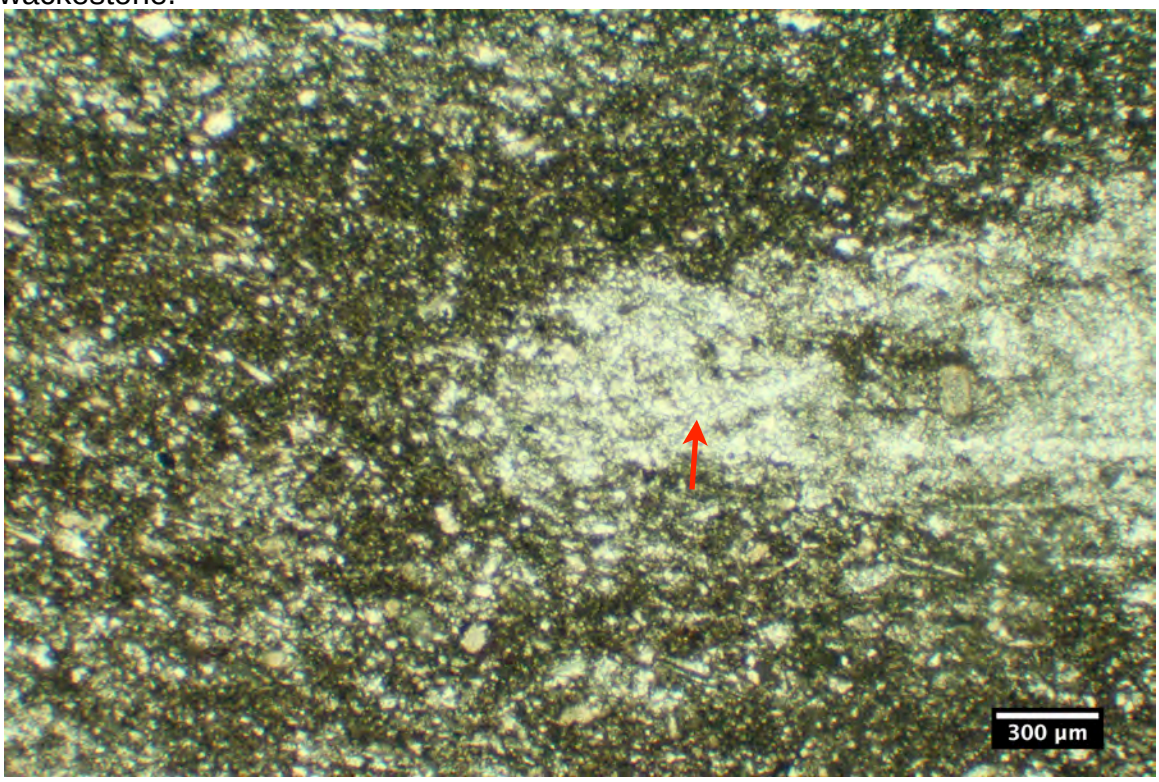
Calcite spar cement	CS
Dolomite	D
Mollusk shell fragments	MS
Foram test	F

Table of Contents

SP-10-LOG 4 (72-72.4'); MI#19051-04

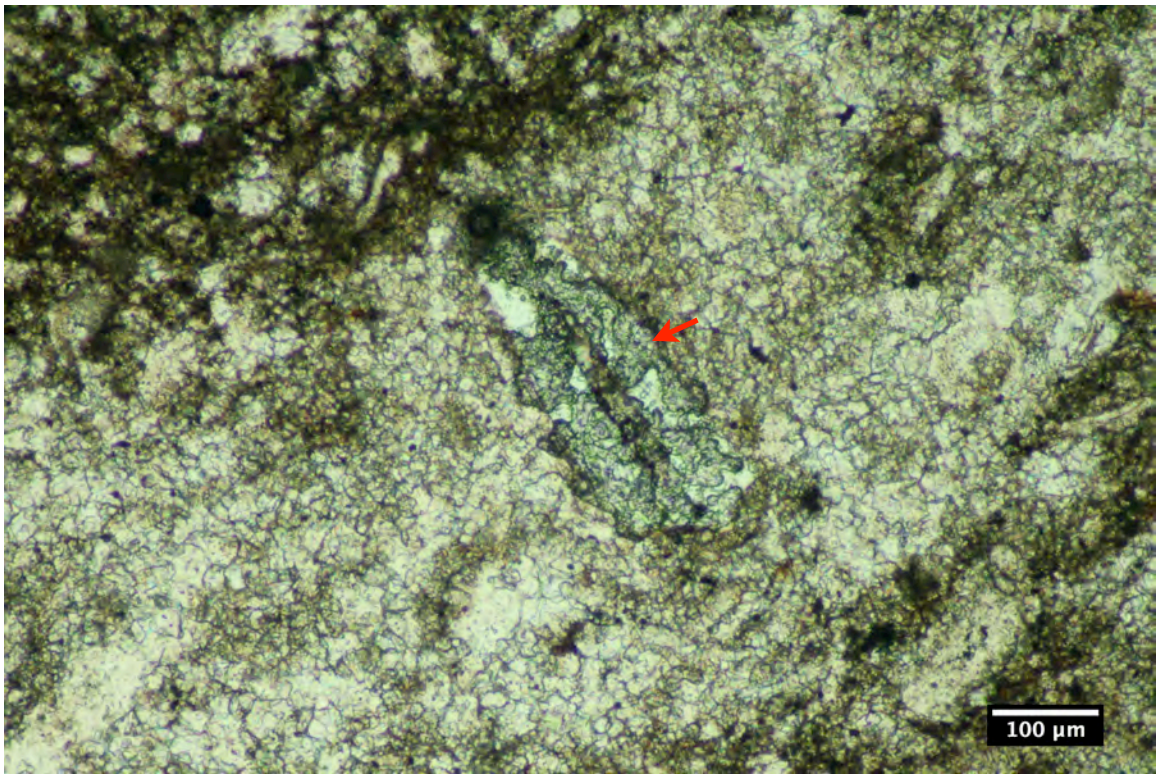


4A. Burrow molds (red arrows) within this sponge spicule-rich lime packstone/ wackestone.

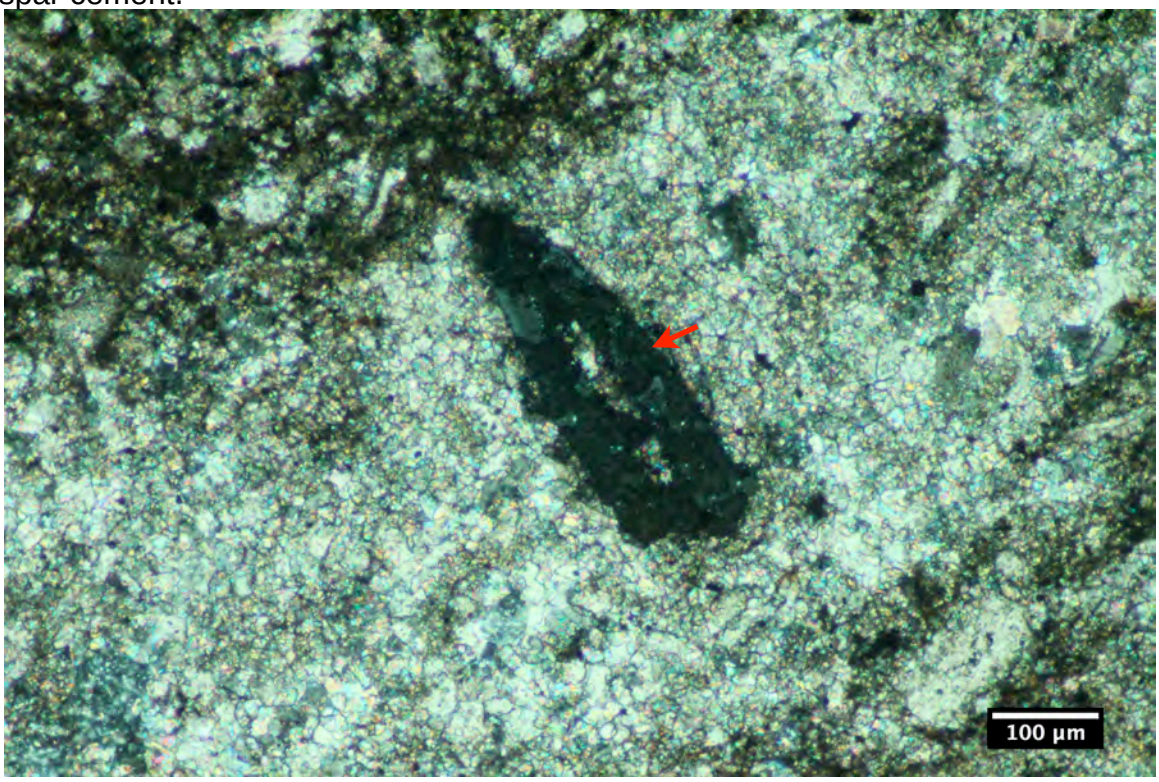


4B. The groundmass of this sample is enriched with respect to lime mud & contains recrystallized skeletal fragments that include sponge fragments, calcareous algae, pelloids, and undifferentiated skeletal fragments.

Table of Contents



4C. A phosphatic bone fragment (red arrows) surrounded by recrystallized calcite spar cement.



4D. As in Figure 4C, with cross polarized light.

Table of Contents

March 08, 2019

Client: Mineralogy Inc.

3321 East 27th Street

Tulsa, OK 74114

Requested By: Kristopher Murphy

National Environmental Laboratory Accreditation Program
Kansas CERT # E-10219

Sample Project Name:	19051
Date Samples Received:	February 25, 2019 Time: 9:15 sample temp upon arrival at lab = 19°C
Matrix:	Solid
Lab Log Numbers:	**BB25007-01 BB25007-02 BB25007-03 BB25007-04**
Work Order:	BB25007
Report #	BB25007-0308191045
EPA Lab ID#'s:	**Stillwater OK00092 Tulsa OK00983 OKC OK00129 ICR OK 001**
Oklahoma Certification:	Stillwater WasteWater, DEQ 8316/ Drinking Water, DEQ D9602 Tulsa WasteWater, DEQ 9905 / Drinking Water, DEQ D9901 Oklahoma City WasteWater DEQ 7202 / Drinking Water, DEQ D9937
Kansas Certification:	Stillwater NELAP CERT # E-10219 Oklahoma City NELAP CERT # E-10414
New Hampshire Cert.:	Oklahoma City Drinking Water NH ELAP Lab ID # 2072
Texas Certification:	Stillwater Drinking Water NELAP CERT # T105704533-14-1
Method Reference:	40 CFR 136, 141, and 261 Methods for Chemical Analysis of Water and Wastes EPA-600/4-79-020, March 1983. Test Methods for Evaluating Solid Wastes, SW-846, Final Update III. Standard Methods 1998 (20th Edition), Standard Methods 2005 (21st Edition) and Standard Methods 2011 (22nd Edition) for the Examination of Water and Wastewater.
Analysis Reference:	If qualifiers present in "Prep Info" or "Analysis Info", then analysis performed as follows: @= Tulsa Lab and * = OKC Lab. If no qualifiers present, then analysis performed at Stillwater Lab.

Accurate Environmental Laboratories certify that the test results performed at the Stillwater lab meet all requirements of NELAP. Any exceptions to this can be found in the report footer or Quality Control Section of the report.

This report is to only be replicated in its entirety.

Accurate Environmental sampling protocol was followed for any sampling performed by Accurate Field Services.

Sample: ***19051-01*** **Location Code:** **PWSID#:**

Collection Type: Grab Sample Time: 2/25/19 0:00 **Lab Log#** BB25007-01

Method/Parameter	Test	Result	Notes	PQL#	Prep Info	Analysis Info
Lithium (Li) EPA 6020A	Lithium	BPQL mg/kg dry		10.0	03/04/19 10:15 LF	03/06/19 11:26 LF
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Calcium	20.0 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:17 RW
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Magnesium	0.567 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:17 RW
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Potassium	BPQL meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:17 RW
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Sodium	0.226 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:17 RW

Sample: ***19051-02*** **Location Code:** **PWSID#:**

Collection Type: Grab Sample Time: 2/25/19 0:00 **Lab Log#** BB25007-02

Method/Parameter	Test	Result	Notes	PQL#	Prep Info	Analysis Info
Lithium (Li) EPA 6020A	Lithium	76.0 mg/kg dry		10.0	03/04/19 10:15 LF	03/06/19 11:30 LF
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Calcium	16.2 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:21 RW
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Magnesium	3.51 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:21 RW
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Potassium	2.32 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:21 RW
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Sodium	8.85 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:21 RW

Sample: ***19051-03*** **Location Code:** **PWSID#:**

Collection Type: Grab Sample Time: 2/25/19 0:00 **Lab Log#** BB25007-03

Method/Parameter	Test	Result	Notes	PQL#	Prep Info	Analysis Info
Lithium (Li) EPA 6020A	Lithium	BPQL mg/kg dry		10.0	03/04/19 10:15 LF	03/06/19 11:35 LF
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Calcium	21.6 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:24 RW
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Magnesium	0.642 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:24 RW
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Potassium	0.250 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:24 RW
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Sodium	0.896 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:24 RW

Sample: ***19051-04*** **Location Code:** **PWSID#:**

Collection Type: Grab Sample Time: 2/25/19 0:00 **Lab Log#** BB25007-04

Method/Parameter	Test	Result	Notes	PQL#	Prep Info	Analysis Info
Lithium (Li) EPA 6020A	Lithium	BPQL mg/kg dry		10.0	03/04/19 10:15 LF	03/06/19 11:39 LF
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Calcium	21.1 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:28 RW
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Magnesium	1.16 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:28 RW

Sample: **Location Code:** **PWSID#:**

Collection Type: Grab Sample Time: 2/25/19 0:00 **Lab Log#** BB25007-04

Method/Parameter	Test	Result	Notes	PQL#	Prep Info	Analysis Info
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Potassium	0.313 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:28 RW
Exchangeable Cations EPA 9081 (No Cert. Avail.)	Sodium	0.822 meq/100g		0.100	02/28/19 09:30 LF	03/01/19 13:28 RW

Notes and Definitions

MCL Analyte concentration may exceed Maximum Contaminant Limit (MCL) for EPA Primary or Secondary Drinking Water Regulations.

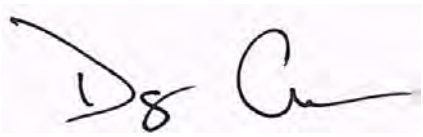
Analyte concentration may exceed regulatory limit.

PQL Practical Quantitation Limit - the method reporting limit (MRL) adjusted for any dilutions or other changes made to the sample to deal with interferences/matrix effects

BPQL Below Practical Quantitation Limit (if applicable).

The "Prep Date" of the QC analysis coincides with the characters of the appropriate QC Lab ID. (Example: 19 A 02 15 - BLK = 2019, Jan 2, Batch #15 - Blank)

Lab Manager



Quality Control Data

Blank Data

QC Lab #	Test Group	Test	Result	PQL	Flags
19C0429-BLK1	Lithium (Li) EPA 6020A	Lithium	BPQL mg/kg dry	10.0	

Duplicate Sample Data

QC Lab #	Test Group	Test Name	Source	Dup Result	Samp Result	% RPD	RPD Limit	Flags
19B2864-DUP1	Exchangeable Cations EPA 9081 (No Cert. Avail.)	Calcium	BB25007-04	21.7	21.1	3	20	
19B2864-DUP1	Exchangeable Cations EPA 9081 (No Cert. Avail.)	Magnesium	BB25007-04	1.19	1.16	3	20	
19B2864-DUP1	Exchangeable Cations EPA 9081 (No Cert. Avail.)	Potassium	BB25007-04	0.318	0.313	2	20	
19B2864-DUP1	Exchangeable Cations EPA 9081 (No Cert. Avail.)	Sodium	BB25007-04	0.896	0.822	9	20	

Laboratory Control Sample Data

Lab QC#	Test Group	Test Name	LCS Result	Spike Level	Units	% Rec.	Control Limits	Flags
19C0429-BS1	Lithium (Li) EPA 6020A	Lithium	491	495.0	mg/kg dry	99	85 - 115	

Matrix Spike Data

QC Lab #	Test Group	Test Name	Source Sample	Sample Result	Units	Spike Result	Spike Level	% Rec.	Acceptance Limits	Flags
19C0429-MS1	Lithium (Li) EPA 6020A	Lithium	BB25007-04	5.29	mg/kg dry	484	478.7	100	85 - 115	

Matrix Spike Duplicate Data

QC Lab #	Test Group	Test Name	Sample Result	Spike Result	Spike Level	Units	% Rec.	Rec. Limits	% RPD	RPD Limit	Flags
19C0429-MSD1	Lithium (Li) EPA 6020A	Lithium	5.29	482	490.2	ng/kg dry	97	85-115	0.5	20	

MINERALOGY- INC

MI NUMBER

BB25007

19051

DATE: Feb 25, 2019

P.O.#

PROJECT: 19051

DATE REQUESTED: Standard

BILL TO:

Mineralogy, Inc.
3321 E 27th ST
Tulsa, OK 74114
mickala@mineralogy-inc.com
kris@mineralogy-inc.com

PROJECT INFORMATION:

19051

M.I.#	SAMPLE ID	LOCATION	TYPE	ANALYSIS
01	19051-01			CEC
02	19051-02			CEC
03	19051-03			CEC
04	19051-04			CEC

No Sample date / time provided to Mineralogy.

19.5°C

SPECIAL INSTRUCTIONS / COMMENTS

RELINQUISHED BY Austin Shearmire — **DATE/TIME** 2/25/19 0915

RECEIVED BY — **DATE/TIME** 2/25/19 0915

MINERALOGY-INC

02/25/19

Accurate Labs
505 S. Lowry St.
Stillwater, OK 74074
Attn: Dr. Ali Fazel

Re: C.E.C. analysis (MI#19051-01 - 19051-04)

Dr. Fazel:

Please provide C.E.C. + leachate analysis for the included samples. The standard protocol you've used for our samples in the past would be great (i.e., calcium, sodium, potassium, magnesium). Results can be sent to kris@mineralogy-inc.com. If you have any questions, please feel free to call or write. Thanks as always for the continued service.

Best regards,

Kristopher Murphy
Mineralogy, Inc.

ATTACHMENT D

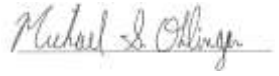
Bottom Ash Pond Water Laboratory Analytical Data

BAP Surface Water

Sample Number: 190407-003 **Date Collected:** 02/05/2019 12:30 **Date Received:** 2/6/2019

Parameter	Result Units	RL	MDL	Analysis By	Analysis Date/Time	Method
Antimony, Sb	0.57 ug/L	0.10	0.020	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Arsenic, As	5.18 ug/L	0.10	0.030	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Barium, Ba	315 ug/L	0.10	0.020	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Beryllium, Be	0.245 ug/L	0.10	0.020	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Cadmium, Cd	0.19 ug/L	0.050	0.010	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Chromium, Cr	647 ug/L	0.20	0.040	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Cobalt, Co	9.04 ug/L	0.050	0.020	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Lead, Pb	3.33 ug/L	0.10	0.020	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Molybdenum, Mo	26.7 ug/L	2.0	0.40	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Selenium, Se	4.5 ug/L	0.20	0.030	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Thallium, Tl	< 0.500 ug/L	0.50	0.10	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Boron, B	0.617 mg/L	0.0050	0.0009	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	128 mg/L	0.020	0.0030	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Iron, Fe	5.77 mg/L	0.010	0.0020	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Lithium, Li	0.00874 mg/L	0.0002	0.00001	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Magnesium, Mg	14.8 mg/L	0.010	0.0020	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Sodium, Na	105 mg/L	0.050	0.010	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Manganese, Mn	292 ug/L	0.10	0.020	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Potassium, K	5.85 mg/L	0.050	0.010	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Strontium, Sr	1.25 mg/L	0.0002	0.00003	GES	02/06/2019 13:59	EPA 200.8-1994, Rev. 5.4
Alkalinity, as CaCO3	127 mg/L	10	3.0	GES	02/06/2019 16:44	SM 2320B-2011
Bromide, Br	< 0.500 mg/L	0.50	0.10	CRJ	02/06/2019 17:11	EPA 300.1-1997, Rev. 1.0
Surrogate is recovering above acceptance limits due to Chlorate being in the as-rec'd sample.						
Chloride, Cl	28.3 mg/L	0.10	0.030	CRJ	02/06/2019 17:11	EPA 300.1-1997, Rev. 1.0
Surrogate is recovering above acceptance limits due to Chlorate being in the as-rec'd sample.						
Fluoride, F	0.37 mg/L	0.15	0.035	CRJ	02/06/2019 17:11	EPA 300.1-1997, Rev. 1.0
Surrogate is recovering above acceptance limits due to Chlorate being in the as-rec'd sample.						
Residue, Filterable, TDS	694 mg/L	40	10	KAL	02/07/2019	SM 2540C-2011
Due to the reduced time allowed for analysis per the plant's request, the samples were dried at 180*C. KAL020719						
Sulfate, SO4	345 mg/L	10	1.5	CRJ	02/06/2019 14:22	EPA 300.1-1997, Rev. 1.0

Report was reissued on 2/12/19 due to a reanalysis that occurred on alkalinity.



Michael Ohlinger, Chemist

Email msohlinger@aep.com Tel.

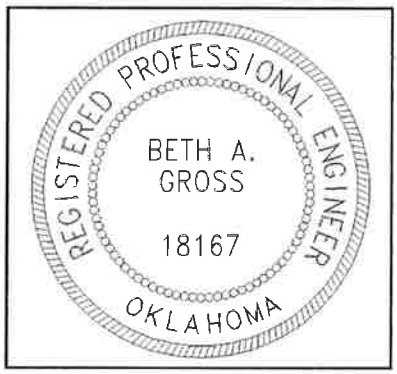
Fax 614-836-4168 Audinet 8-210-

ATTACHMENT E

Certification by Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Bottom Ash Pond CCR management area at the Northeastern Power Station and that the requirements of OAC 252:517-9-6(g)(3)(B) have been met.



Beth Ann Gross
Printed Name of Licensed Professional Engineer

Beth Ann Gross
Signature

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

Oklahoma Firm Certificate of
Authorization No. 1996
Exp. 6/30/2020

18167	Oklahoma	4/24/2019
License Number	Licensing State	Date