Annual Groundwater Monitoring Report

Public Service Company of Oklahoma

Northeastern Power Station

Bottom Ash Pond CCR Management Unit

Permit No. Pending

7300 E HWY 88

Oologah, Oklahoma

January 31, 2024

Prepared by:
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PUBLIC SERVICE COMPANY OF OKLAHOMA℠

An AEP Company

BOUNDLESS ENERGY℠

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Abbreviations:
ASD - Alternate Source Demonstration
BAP – Bottom Ash Pond
CCR – Coal Combustion Residual
GWPS - Groundwater protection standards
NPS – Northeastern Power Station
SSI - Statistically Significant Increase
SSL - Statistically Significant Level

I. Overview

This *Annual Groundwater Monitoring Report* (Report) has been prepared to report the status of activities for the preceding year for an existing Coal Combustion Residual (CCR) unit at Public Service Company of Oklahoma's (PSO's), a wholly owned subsidiary of American Electric Power Company (AEP), Northeastern Power Station (NPS). The Oklahoma Department of Environmental Quality (ODEQ) CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31, 2024.
In general, the following activities were completed:

- At the start of the current annual reporting period, the BAP was operating under the Assessment monitoring program.
- At the end of the current annual reporting period, the BAP was operating under the Assessment monitoring program.
- The BAP initiated an assessment monitoring program on April 13, 2018.
- A statistical process in accordance with OAC 252:517 to evaluate groundwater data was updated, certified, and posted to AEP's CCR website in 2022 titled: *Statistical Analysis Plan (*Geosyntec Nov 2021). The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance," USEPA, 2009). This report was approved by ODEQ January 20, 2022.
- Semi-Annual groundwater samples were collected from SP-1, SP-2, SP-4, SP-5R, SP-10 and SP-11 and analyzed for Appendix A and Appendix B constituents, as specified in OAC 255:517-9-6 Assessment Monitoring program and AEP's *Groundwater Sampling and Analysis Plan* (2021).
- Data and statistical analysis not available for the previous reporting period indicated that during the 2nd semi-annual 2022 sampling event (November 2022):
    - Potential SSIs were identified for:
        - Boron at SP-10
        - Chloride at SP-10
        - Fluoride at SP-10
        - Sulfate SP-11
        - TDS at SP-10
    - Potential SSLs were identified for:
        - Lithium, Barium, and Fluoride in SP-10

- During the 1st semi-annual 2023 sampling event (June 2023):
    - Potential SSIs were identified for:
        - Boron at SP-10 and SP-11
        - Chloride at SP-10
        - Fluoride at SP-10
        - Sulfate at SP-11
        - TDS at SP-2 and SP-10
    - Potential SSLs were identified for:
        - Lithium, Barium, and Fluoride in SP-10
- Statistical evaluation of the 2nd semi-annual 2023 groundwater sampling event in October 2023 is underway.
- ASDs for the 1st semi-annual 2022 potential Lithium, Barium, and Fluoride SSLs were certified January 5, 2023, and approved by ODEQ March 9, 2023.
- ASDs for the 2nd semi-annual 2022 potential Lithium, Barium, and Fluoride SSLs were certified May 5, 2023, and approved by ODEQ July 12, 2023.
- ASDs for the 1st semi-annual 2023 potential Lithium, Barium, and Fluoride SSLs have been submitted to ODEQ for review on January 2, 2024.

The major components of this annual report, to the extent applicable at this time, are presented in sections that follow:

- A map, aerial photograph or a drawing showing the BAP CCR management unit, all groundwater monitoring wells and monitoring well identification numbers;
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs is included in Appendix 1;
- Statistical comparison of monitoring data to determine if there have been SSI(s) or SSL(s) (Attached as Appendix 2, where applicable);
- A discussion of whether any alternate source demonstrations (ASDs) were performed, and the conclusions (Attached as Appendix 3, where applicable);
- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection

monitoring to assessment monitoring, in addition to identifying the constituents detected at a statistically significant increase over background concentrations (Appendix 4).

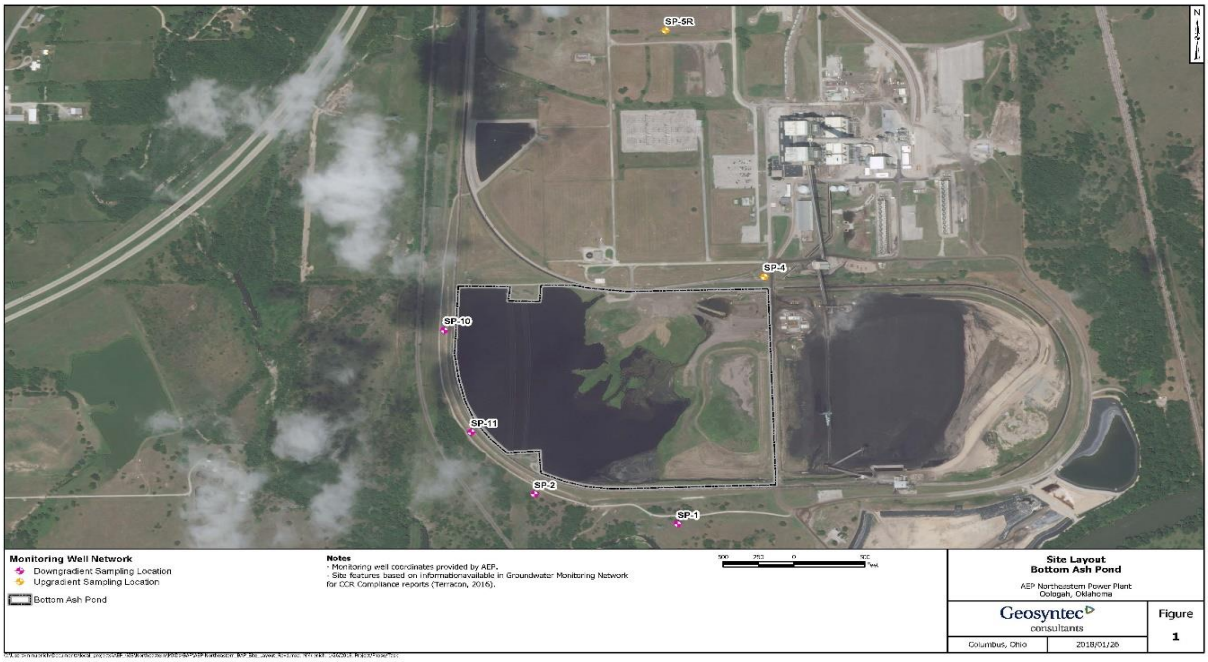
- Identification of any monitoring wells that were installed, or decommissioned during the preceding year, along with a statement as to why that happened (Attached as Appendix 5, where applicable); and
- Other information required to be included in the annual report such as field sheets and analytical reports, if applicable.

In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.

II. Groundwater Monitoring Well Locations and Identification Numbers

The figure that follows depicts the PE-certified groundwater monitoring network, the monitoring well locations and their corresponding identification numbers.

Bottom Ash Pond Monitoring Wells	
Background	Down Gradient
SP-4	SP-1
SP-5R	SP-2
	SP-10
	SP-11



III. Monitoring Wells Installed or Decommissioned

There were no groundwater monitoring wells installed or decommissioned during this reporting period. The network design, as summarized in the *Groundwater Monitoring Network Design Report* (September 2017) and as posted at the CCR website for NPS's Bottom Ash Pond (BAP), did not change. That network design report, viewable on the AEP CCR web site, discusses the facility location, the hydrogeological setting, the hydrostratigraphic units, the uppermost aquifer, downgradient monitoring well locations and the upgradient monitoring well locations.

IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction and Discussion

Appendix 1 contains tables showing the applicable groundwater quality data obtained under OAC 252:517-9-4 through 252:517-9-6 relevant to this reporting period. Static water elevation data from each monitoring event also are shown in Appendix 1, along with the groundwater velocity calculations groundwater flow directions and potentiometric maps developed after each sampling event.

The site-wide groundwater flow velocity varies from the velocity computed in residence time calculations because assumptions used in these calculations vary based on the scale of the application of groundwater flow. The site-wide groundwater flow velocity is determined as a representative average over the entire CCR unit, which is a large area (multiple acres) consisting of different rock formations. The residence time calculation is a localized estimate use to establish the residence time of groundwater within a single well (<100 sq ft). The site-wide groundwater flow velocity utilizes the maximum and minimum hydraulic gradient based on groundwater elevation differences between two widely spaced site monitoring wells. For a localized hydraulic gradient, the residence time calculations use the elevation difference between the target monitoring well and the nearest groundwater elevation contour line. Additionally, the hydraulic conductivity and effective porosity used in the site-wide groundwater flow velocity are represented by average parameters based on field tests conducted at the Unit. The residence time calculation uses an estimated hydraulic conductivity and effective porosity from a reference work representative of the formation in contact with the well.

A summary of the varying methods is shown below

	Site-Wide Flow Calculation	Residence Time Calculation
Purpose	Determine representative average groundwater flow velocity across the entire Unit (multiple acres)	Determine residence time of groundwater within a 2-inch diameter groundwater monitoring well (<100 square feet)
Hydraulic Gradient	Greatest groundwater elevation difference between two wells monitoring the Unit, and smallest groundwater elevation difference between two wells monitoring the Unit	Elevation difference between target groundwater monitoring well, and nearest groundwater elevation contour line
Hydraulic Conductivity	Average hydraulic conductivity determined from slug tests conducted at the Unit	Estimated hydraulic conductivity from referenced work representative of the formation in contact with the individual well
Effective Porosity	Average effective porosity determined from field tests	Estimated effective porosity from referenced work representative of the formation in contact with the well

ODEQ agreed via email dated August 22, 2022, that the 252:517-9-6(b) sampling event is not needed if all Appendix A and B parameters are collected during each semi-annual sampling event (email attached in Appendix 6). Therefore, PSO will no longer conduct the 252:517-9-6(b) sampling event and will collect all Appendix A and B parameters at each monitoring well for this CCR Unit during each semi-annual sampling event.

The semi-annual groundwater sampling events for Appendix A and Appendix B constituents were conducted June 20, 2023, and October 10, 2023. When the data becomes available, it is placed into NPS's Operating Record, satisfying the requirement of 252:517-9-6(d).

Appendix 6 contains the available Field sheets and laboratory reports for this reporting period.

V. Groundwater Quality Data Statistical Analysis

Semi-Annual groundwater samples were collected SP-1, SP-2, SP-4, SP-5R, SP-10 and SP-11 and analyzed for Appendix A and Appendix B constituents, as specified in OAC 255:517-9-6 Assessment Monitoring program and AEP's *Groundwater Sampling and Analysis Plan* (2021) and approved by ODEQ January 20, 2022.

Appendix 2 contains the available statistical analysis reports for this reporting period.

Data and statistical analysis not available for the previous reporting period was certified February 23, 2023 and indicated that during the 2nd semi-annual 2022 sampling event (November 8, 2022):

- Potential SSIs were identified for:
    - Boron at SP-10
    - Chloride at SP-10
    - Fluoride at SP-10
    - Sulfate SP-11
    - TDS at SP-10
- Potential SSLs were identified for:
    - Lithium, Barium, and Fluoride in SP-10

During the 1st semi-annual 2023 sampling event (June 20, 2023) and certified October 3, 2023 indicated:

- Potential SSIs were identified for:
    - Boron at SP-10 and SP-11
    - Chloride at SP-10
    - Fluoride at SP-10
    - Sulfate at SP-11
    - TDS at SP-2 and SP-10
- Potential SSLs were identified for:
    - Lithium, Barium, and Fluoride in SP-10

Statistical evaluation of the 2nd semi-annual 2023 groundwater sampling event in October 2023 is underway.

VI. Alternate Source Demonstrations Completed

An alternate source demonstration (ASD) investigation relative to past SSIs was completed in April 2018. That demonstration concluded that alternate sources could not be identified. Additionally, an ASD investigation was not undertaken for the current SSI(s).

ASDs for the 1st semi-annual 2022 potential Lithium, Barium, and Fluoride SSLs were certified January 5, 2023, and approved by ODEQ March 9, 2023.

ASDs for the 2nd semi-annual 2022 potential Lithium, Barium, and Fluoride SSLs were certified May 5, 2023, and approved by ODEQ July 12, 2023.

ASDs for the 1st semi-annual 2023 potential Lithium, Barium, and Fluoride SSLs have been submitted to ODEQ for review on January 2, 2024.

Because successful ASDs for the potential SSL(s) were identified, but no alternate sources for the SSI(s) were identified, the BAP remained in Assessment Monitoring.

VII. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency

Because an ASD for the SSIs could not be identified, an assessment monitoring program was established at NE's BAP in April 2018. Assessment monitoring continued throughout the 2023 calendar year.

VIII. Other Information Required

A statistical process in accordance with OAC 252:517 to evaluate groundwater data was updated, certified, and posted to AEP's CCR website in 2022 titled: *Statistical Analysis Plan (*Geosyntec Nov 2021). The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance," USEPA, 2009). This report was approved by ODEQ January 20, 2022.

NPS continues to work with ODEQ towards completing the permit for this CCR Unit.
Appendix 2 contains a memorandum that explains the reissuance of select analytical laboratory reports to correct laboratory equipment data quality assurance/quality control issues.

IX. Description of Any Problems Encountered and Actions Taken

No significant problems were encountered. The low flow sampling effort continued, and the schedule was met to support the annual groundwater report preparation covering this reporting period's groundwater monitoring activities.

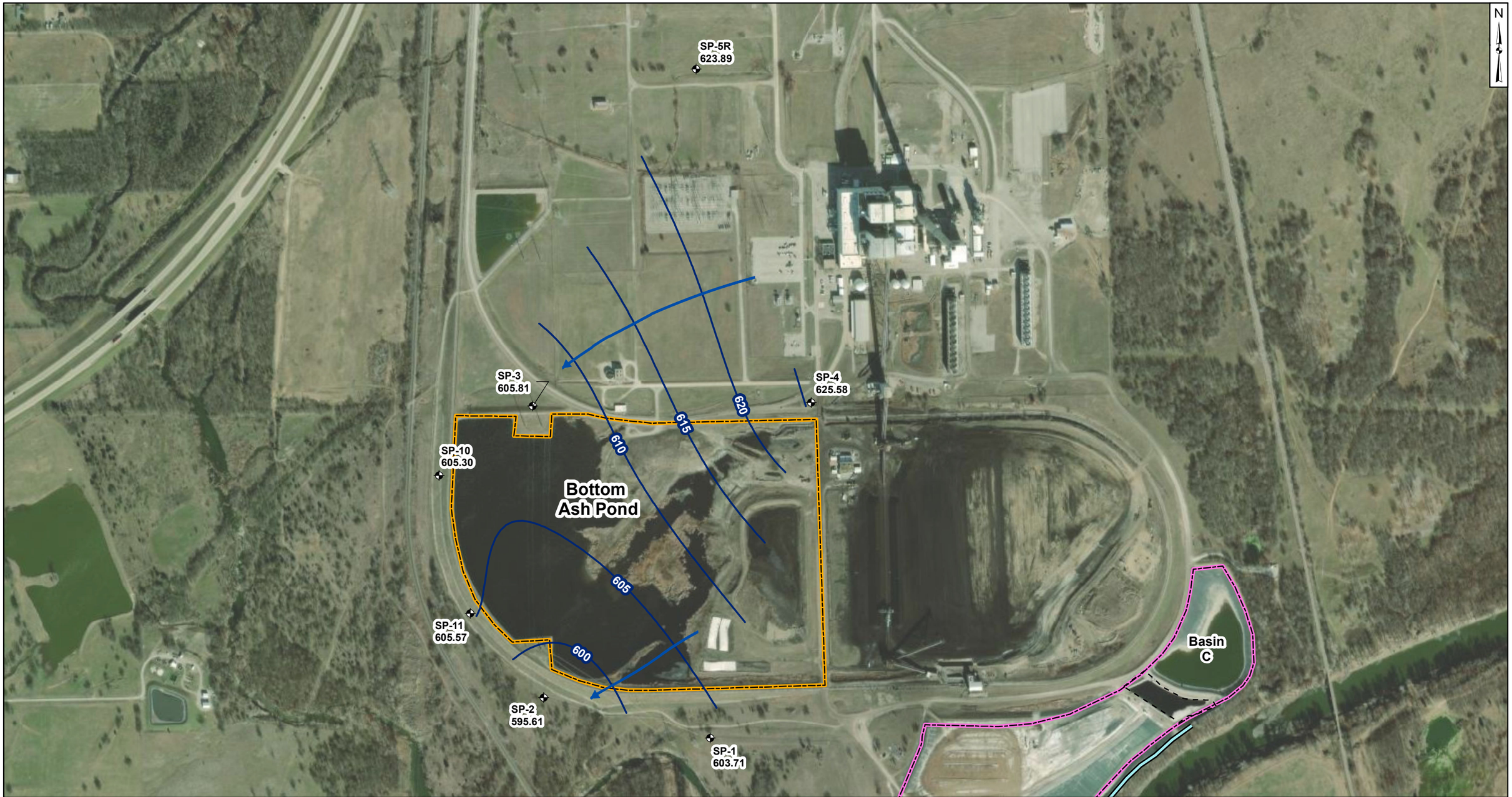
X. A Projection of Key Activities for the Upcoming Year

Key activities for the next reporting period include:

- As required by OAC 252:517-9-6, conduct assessment monitoring of the groundwater for the BAP CCR unit on a semi-annual basis;
- Evaluation of the assessment monitoring results from a statistical analysis viewpoint, looking for SSLs above GWPS;
- Complete ASDs for potential SSLs and submit to ODEQ for approval;
- Continue to work towards obtaining a permit;
- Preparation of the next annual groundwater report.

APPENDIX 1

Potentiometric Maps and Tables follow, showing the groundwater monitoring data collected, the rate and direction of groundwater flow, and a summary showing the number of samples collected per monitoring well. The dates that the samples were collected also is shown.



Legend

- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Approximate Groundwater Flow Direction
- Bottom Ash Pond
- Impoundment
- Landfill
- Slurry Wall

Notes

1. Monitoring well coordinates and water level data (collected on June 20, 2023) provided by AEP.
2. Groundwater elevation units are feet above mean sea level (ft. msl).
3. Only wells screened in the upper portion of the Oolagah Limestone were used for contouring.
4. Satellite imagery provided by ESRI.

500 250 0 500
Feet

Potentiometric Contours - Uppermost Aquifer
June 2023

AEP Northeastern Power Plant - Bottom Ash Pond
Oologah, Oklahoma

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Figure 1

A:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Northeastern\2023\AEP-Northeastern_BAP_2023-06_June.mxd. Okiemute.Commander. 10/13/2023. Project/Phase/Task.

SP-5R
623.27

SP-3
605

SP-4
624.67

SP-10
617.52

Bottom
Ash Pond

SP-11
604.49

SP-2
589.15

SP-1
603.41

Basin
C

620
615
610
605
600
595
615

N

Legend

- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Approximate Groundwater Flow Direction
- Bottom Ash Pond
- Impoundment
- Landfill
- Slurry Wall

Notes

1. Monitoring well coordinates and water level data (collected on October 10, 2023) provided by AEP.
2. Groundwater elevation units are feet above mean sea level (ft. msl).
3. Only wells screened in the upper portion of the Oolagah Limestone were used for contouring.
4. Satellite imagery provided by ESRI.

500 250 0 500
Feet

Potentiometric Contours - Uppermost Aquifer
October 2023

AEP Northeastern Power Plant - Bottom Ash Pond
Oologah, Oklahoma

Geosyntec consultants

Columbus, Ohio | 2023/11/07

Figure
2

A:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Northeastern\2023\AEP-Northeastern_BAP_2023-10_Oct.mxd. Okiemute.Commander. 11/7/2023. Project/Phase/Task.

Table 1: Residence Time Calculation Summary
Northeastern Bottom Ash Pond

Geosyntec Consultants, Inc.

			2023-06		2023-10	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Bottom Ash Pond	SP-1 [2]	2.0	3.3	18.7	3.5	17.3
	SP-2 [2]	2.0	5.1	11.9	8.0	7.6
	SP-4 [2]	2.0	5.0	12.1	5.3	11.5
	SP-5R [1]	2.0	2.5	24.4	2.0	30.5
	SP-10 [1]	2.0	1.5	39.6	8.6	7.1
	SP-11 [1]	2.0	5.1	12.0	7.9	7.7

Notes:
[1] - Background Well
[2] - Downgradient Well

Table 1. Groundwater Data Summary: SP-1
Northeastern - BAP
Appendix A Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
1/25/2017	Background	0.298	111	60	< 1 U1	7.5	66	514
3/13/2017	Background	0.186	117	548	4	--	30	480
4/24/2017	Background	0.202	108	83	1.02	7.6	60	496
5/18/2017	Background	0.284	131	104	1.3	--	60	574
6/15/2017	Background	0.242	115	50	0.6437 J1	9.3	48	478
6/27/2017	Background	0.232	113	19	0.582 J1	11.1	48	424
7/12/2017	Background	0.287	122	70	0.6283 J1	9.8	56	504
8/4/2017	Background	0.299	125	20	0.542 J1	8.7	52	394
8/17/2017	Background	--	--	--	--	7.9	--	--
8/30/2017	Background	0.25	120	34	0.581 J1	7.7	59	456
9/13/2017	Background	0.369	119	62	0.4042 J1	8.2	54	536
9/20/2017	Background	0.331	129	22	< 0.083 U1	7.3	62	440
10/11/2017	Detection	0.35	152	136	1.4051	7.4	58	676
1/22/2018	Detection	--	119	--	--	6.9	--	--
5/30/2018	Assessment	--	--	--	1.2525	7.3	--	--
7/30/2018	Assessment	0.397	130	46	0.9863 J1	7.0	63	1,060
2/4/2019	Assessment	0.354	150	--	--	--	--	--
2/27/2019	Assessment	0.200	122	42.7	0.80	7.3	87.1	532
6/20/2019	Assessment	0.198	126	25.2	0.77	7.1	61.4	452
8/26/2019	Assessment	0.124	120	9	0.525 J1	9.0	48	438
3/25/2020	Assessment	0.184	96.7	40.8	0.96	8.5	62.9	500
6/30/2020	Assessment	0.180	99.4	29.6	0.81	9.0	49.3	435
7/28/2020	Assessment	--	--	--	--	8.4	--	--
10/20/2020	Assessment	0.146	103	12.9	0.81	8.5	51.1	427
3/3/2021	Assessment	0.169	105	--	0.85	7.4	--	--
4/12/2021	Assessment	0.186	104	37.2	0.88	7.6	50.0	438
12/28/2021	Assessment	0.127	91.2	34.2	0.93	7.1	40.0	410
6/14/2022	Assessment	0.176	102	21.2	0.78	7.3	65.2	430 L1
11/8/2022	Assessment	0.147	102 M1	16.3	0.85	7.3	54.1	400
6/20/2023	Assessment	0.158	100	84.3	0.82	7.2	65.0	460
10/10/2023	Assessment	0.159	102	45.1	0.96	7.4	84.8	470

Table 1. Groundwater Data Summary: SP-1
Northeastern - BAP
Appendix B Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
1/25/2017	Background	< 5 U1	< 5 U1	211	< 1 U1	< 1 U1	< 1 U1	< 5 U1	3.48	< 1 U1	< 5 U1	0.006	< 0.025 U1	11	< 5 U1	< 2 U1
3/13/2017	Background	< 5 U1	< 5 U1	146	< 1 U1	< 1 U1	< 1 U1	< 5 U1	3.014	4	< 5 U1	0.007	< 0.025 U1	16	< 5 U1	< 2 U1
4/24/2017	Background	2.75 J1	1.91 J1	195	0.1 J1	< 0.07 U1	0.84 J1	2.42 J1	4.71	1.02	0.94 J1	0.00789	< 0.005 U1	19.92	4.85 J1	< 0.86 U1
5/18/2017	Background	6.85	5.48	243	0.26 J1	0.22 J1	2.55	2.55 J1	4.12	1.3	1.63 J1	0.00853	0.023 J1	16.77	6.51	< 0.86 U1
6/15/2017	Background	1.14 J1	< 1.05 U1	183	0.04 J1	< 0.07 U1	< 0.23 U1	0.77 J1	2.096	0.6437 J1	< 0.68 U1	0.00407	0.009 J1	7.02	2.54 J1	< 0.86 U1
6/27/2017	Background	< 0.93 U1	< 1.05 U1	187	< 0.02 U1	< 0.07 U1	< 0.23 U1	0.77 J1	14.29	0.582 J1	< 0.68 U1	0.00334	< 0.005 U1	6.42	2.77 J1	< 0.86 U1
7/12/2017	Background	1.25 J1	< 1.05 U1	217	0.09 J1	< 0.07 U1	0.62 J1	1.34 J1	4.01	0.6283 J1	1.24 J1	0.00395	< 0.005 U1	8.14	5.21	0.89 J1
8/4/2017	Background	< 0.93 U1	2.11 J1	298	0.1 J1	< 0.07 U1	0.78 J1	1.33 J1	3.41	0.542 J1	0.94 J1	0.00577	0.009 J1	19.96	11.96	< 0.86 U1
8/30/2017	Background	2.09 J1	1.34 J1	218	0.14 J1	< 0.07 U1	0.55 J1	1.75 J1	4.15	0.581 J1	< 0.68 U1	0.00468	< 0.005 U1	12.08	3.51 J1	< 0.86 U1
9/13/2017	Background	< 0.93 U1	< 1.05 U1	210	0.09 J1	0.08 J1	0.31 J1	1.07 J1	2.584	0.4042 J1	< 0.68 U1	0.00548	< 0.005 U1	14.65	4.13 J1	< 0.86 U1
9/20/2017	Background	< 0.93 U1	< 1.05 U1	168	0.05 J1	0.11 J1	< 0.23 U1	1.15 J1	4.53	< 0.083 U1	< 0.68 U1	0.00318	< 0.005 U1	5.32	< 0.99 U1	< 0.86 U1
5/30/2018	Assessment	< 0.93 U1	< 1.05 U1	190	< 0.02 U1	< 0.07 U1	< 0.23 U1	0.53 J1	3.64	1.2525	< 0.68 U1	0.00785	< 0.005 U1	16.39	4.23 J1	2
7/30/2018	Assessment	0.69	0.93	174	0.06 J1	0.08 J1	1.83	0.676	3.056	0.9863 J1	0.354	0.00615	< 0.005 U1	17.1	5.8	0.09 J1
2/27/2019	Assessment	0.6 J1	0.7 J1	168	< 0.2 U1	< 0.1 U1	2.72	< 0.2 U1	3.056	0.80	0.2 J1	0.00641	< 0.005 U1	10 J1	2.8	< 1 U1
6/20/2019	Assessment	0.93	1.44	242	0.2 J1	0.1 J1	0.7 J1	5.54	2.745	0.77	0.650	0.03 J1	0.01 J1	12.1	9.9	< 0.5 U1
8/26/2019	Assessment	0.43	0.73	160	0.08 J1	0.09	1.49	0.481	2.75	0.525 J1	0.835	0.00285	< 0.005 U1	5.86	3.4	0.1 J1
3/25/2020	Assessment	0.62	0.72	158	0.07 J1	0.08	0.499	0.362	6.67	0.96	0.351	0.00600	< 0.002 U1	15.8	6.6	< 0.1 U1
6/30/2020	Assessment	0.58	0.69	159	0.07 J1	0.07	0.969	0.431	2.531	0.81	0.886	0.00534	< 0.002 U1	13.6	8.3	< 0.1 U1
10/20/2020	Assessment	0.46	0.57	143	0.05 J1	0.08	0.215	0.727	2.82	0.81	0.254	0.00336	< 0.002 U1	11.5	3.8	< 0.1 U1
3/3/2021	Assessment	0.51	0.53	144	0.05 J1	0.08	0.426	0.307	4.27	0.85	0.259	0.00443	< 0.002 U1	14.3	4.5	< 0.1 U1
4/12/2021	Assessment	0.46	0.54	158	0.04 J1	0.05	0.359	0.202	3.47	0.88	0.2 J1	0.00549	< 0.002 U1	13.7	3.9	0.05 J1
12/28/2021	Assessment	0.51	0.51	155	0.040 J1	0.051	0.70	0.246	4.12	0.93	0.24	0.00474	< 0.002 U1	15.2	6.45	0.05 J1
6/14/2022	Assessment	0.72	0.84	161	0.061	0.066	0.60	1.14	3.98	0.78	0.22	0.00473	< 0.002 U1	21.2	9.63	0.07 J1
11/8/2022	Assessment	0.80	0.69	157	0.054	0.055	1.30	0.684	5.68	0.85	0.15 J1	0.00558	< 0.002 U1	28.8	15.4	0.07 J1
6/20/2023	Assessment	0.491	0.45	145	0.091	0.047	0.41	0.174	6.92	0.82	0.24	0.00726	< 0.002 U1	17.2	7.58	0.07 J1
10/10/2023	Assessment	0.745	0.65	138	0.053	0.041	0.47	0.717	3.06	0.96	0.17 J1	0.00819	< 0.002 U1	26.0	11.8	0.11 J1

Table 1. Groundwater Data Summary: SP-2
Northeastern - BAP
Appendix A Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
1/25/2017	Background	0.274	108	607	3	6.4	21	1,786
3/13/2017	Background	0.251	82.6	37	1	--	70	1,340
4/24/2017	Background	0.152	62	527	2.82	6.5	27	1,242
5/18/2017	Background	0.336	117	1,240	3	--	15	2,214
6/15/2017	Background	0.303	108	888	2.96	8.3	61	1,912
6/27/2017	Background	0.292	98.5	883	2.8408	7.4	58	1,872
7/12/2017	Background	0.339	111	863	3.581	7.9	58	1,846
8/4/2017	Background	0.28	147	1,064	2.788	7.2	57	2,132
8/17/2017	Background	--	--	--	--	7.6	--	--
8/30/2017	Background	0.275	86.8	1,001	4.0998	7.5	47	2,192
9/13/2017	Background	0.311	91.8	930	3.196	7.0	43	1,956
9/20/2017	Background	0.3	129	856	1.726	6.9	37	1,778
10/11/2017	Detection	0.307	91.9	970	3.5881	7.3	41	2,076
1/22/2018	Detection	--	--	975	--	7.0	--	1,910
5/30/2018	Assessment	--	--	--	3.4972	7.5	--	--
7/30/2018	Assessment	0.276	117	268	2.6556	7.5	30	1,006
2/27/2019	Assessment	0.116	94.0	351	2.68	7.6	26.1	932
6/20/2019	Assessment	0.109	58.2	357	2.69	6.8	28.5	1,044
8/26/2019	Assessment	0.173	211	1,072	2.685	8.5	14	2,246
3/25/2020	Assessment	0.114	60.4	418	2.73	8.8	22.0	1,120
6/30/2020	Assessment	0.163	83.9	420	2.64	8.8	26.3	977
7/28/2020	Assessment	--	--	--	--	8.4	--	--
10/20/2020	Assessment	0.151	75.3	850	2.98	8.7	19.1	1,790
3/3/2021	Assessment	0.140	72.0	--	3.00	7.5	--	--
4/12/2021	Assessment	0.255	91.5	1,130	3.19	7.6	12.4	2,000
12/28/2021	Assessment	0.111	104	341	2.73	7.3	20.8	920
6/14/2022	Assessment	0.228	115	844	3.08	7.4	22.3	1,720 L1
11/8/2022	Assessment	0.108	103	695	2.7	7.3	18.1	1,480
6/20/2023	Assessment	0.105	87.2	--	--	7.3	--	--
6/29/2023	Assessment	--	--	604	3.02	--	18.1	1,780
10/10/2023	Assessment	0.210	151	699	2.79	7.6	20.2	1,470

Table 1. Groundwater Data Summary: SP-2
Northeastern - BAP
Appendix B Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
1/25/2017	Background	< 5 U1	11	1,460	< 1 U1	< 1 U1	3	< 5 U1	6.89	3	< 5 U1	0.098	< 0.025 U1	19	< 5 U1	< 2 U1
3/13/2017	Background	< 5 U1	5	1,130	< 1 U1	< 1 U1	1	< 5 U1	9.96	1	< 5 U1	0.073	< 0.025 U1	23	< 5 U1	< 2 U1
4/24/2017	Background	2.09 J1	2.08 J1	760	0.04 J1	< 0.07 U1	0.24 J1	0.87 J1	8.98	2.82	< 0.68 U1	0.05305	< 0.005 U1	24.67	2.04 J1	< 0.86 U1
5/18/2017	Background	8.71	9.02	3,130	0.26 J1	0.18 J1	2.87	2.77 J1	26.48	3	2.02 J1	0.111	0.006 J1	11.63	6.16	< 0.86 U1
6/15/2017	Background	11.34	5.5	1,710	0.18 J1	< 0.07 U1	2.04	2.51 J1	22.16	2.96	< 0.68 U1	0.103	0.005 J1	29.57	37.83	< 0.86 U1
6/27/2017	Background	5.15	1.4 J1	1,560	0.06 J1	< 0.07 U1	1.29	1.82 J1	--	2.8408	< 0.68 U1	0.09272	< 0.005 U1	29.62	22.41	< 0.86 U1
7/12/2017	Background	4.74 J1	2.51 J1	1,540	0.07 J1	< 0.07 U1	0.59 J1	1.23 J1	--	3.581	1.41 J1	0.0961	< 0.005 U1	33.32	23.23	< 0.86 U1
8/4/2017	Background	3.51 J1	2.54 J1	1,010	0.09 J1	0.07 J1	1.07	1.08 J1	16.34	2.788	< 0.68 U1	0.09164	0.014 J1	39.4	23.36	< 0.86 U1
8/30/2017	Background	2.95 J1	1.25 J1	1,120	0.12 J1	< 0.07 U1	< 0.23 U1	0.8 J1	14.48	4.0998	< 0.68 U1	0.0931	< 0.005 U1	33.86	11.86	< 0.86 U1
9/13/2017	Background	2.67 J1	1.83 J1	992	0.11 J1	< 0.07 U1	< 0.23 U1	0.87 J1	14.89	3.196	< 0.68 U1	0.09207	0.006 J1	37.61	9.87	< 0.86 U1
9/20/2017	Background	2.64 J1	3.05 J1	1,150	0.2 J1	0.09 J1	3.46	2.55 J1	--	1.726	0.91 J1	0.09111	< 0.005 U1	39.39	9.87	< 0.86 U1
5/30/2018	Assessment	1.3 J1	< 1.05 U1	869	< 0.02 U1	< 0.07 U1	< 0.23 U1	0.55 J1	7.85	3.4972	< 0.68 U1	0.04039	< 0.005 U1	26.46	2.16 J1	< 0.86 U1
7/30/2018	Assessment	1.21	1.42	656	0.05 J1	0.08 J1	< 40 U1	0.400	9.61	2.6556	0.245	0.0346	< 0.005 U1	26.1	2.9	0.06 J1
2/27/2019	Assessment	1.39	1.29	841	< 0.2 U1	< 0.1 U1	4.30	< 0.2 U1	5.76	2.68	0.3 J1	0.0329	< 0.005 U1	25.8	3.7	< 1 U1
6/20/2019	Assessment	1.34	1.43	868	0.1 J1	0.09 J1	0.9 J1	0.434	7.94	2.69	0.4 J1	0.062	< 0.005 U1	25.0	2.9	< 0.5 U1
8/26/2019	Assessment	1.22	1.53	1,220	0.07 J1	0.05	0.701	0.568	8.72	2.685	0.334	0.0582	< 0.005 U1	22.3	3.7	0.1 J1
3/25/2020	Assessment	1.14	1.68	1,060	0.07 J1	0.13	0.806	0.361	9.73	2.73	0.694	0.0352	< 0.002 U1	20.3	2.4	< 0.1 U1
6/30/2020	Assessment	1.26	1.28	1,140	0.109	0.05	0.573	0.733	7.84	2.64	0.263	0.0585	< 0.002 U1	19.7	6.2	< 0.1 U1
10/20/2020	Assessment	1.22	1.08	1,110	0.07 J1	0.04 J1	0.398	0.433	12.96	2.98	0.1 J1	0.0517	< 0.002 U1	20.1	4.4	< 0.1 U1
3/3/2021	Assessment	1.09	1.07	1,050	0.09 J1	0.06	0.700	0.323	11.81	3.00	0.253	0.0523	< 0.002 U1	17.1	3.5	< 0.1 U1
4/12/2021	Assessment	0.84	1.53	1,790	0.112	0.04 J1	0.559	1.10	7.87	3.19	0.211	0.0862	< 0.002 U1	14.6	1.1	0.05 J1
12/28/2021	Assessment	0.97	1.08	1,210	0.055	0.044	0.52	0.312	12.05	2.73	0.16 J1	0.0327	< 0.002 U1	13.8	2.08	< 0.04 U1
6/14/2022	Assessment	1.51	1.11	1,070	0.1 J1	0.063	1.05	0.791	10.83	3.08	0.17 J1	0.084	< 0.002 U1	26.5	9.56	0.07 J1
11/8/2022	Assessment	1.17	1.21	872	0.048 J1	0.328	2.12	0.186	6.75	2.7	0.33	0.0308	< 0.002 U1	22.1	2.36	< 0.04 U1
6/20/2023	Assessment	0.957	1.11	989	0.077	0.076	0.51	0.326	12.46	--	0.17 J1	0.0326	< 0.002 U1	14.8	2.28	0.03 J1
6/29/2023	Assessment	--	--	--	--	--	--	--	--	3.02	--	--	--	--	--	--
10/10/2023	Assessment	1.06	0.82	1,270	0.086	0.047	0.62	0.322	8.06	2.79	0.15 J1	0.0809	< 0.002 U1	15.9	3.63	0.05 J1

Table 1. Groundwater Data Summary: SP-4
Northeastern - BAP
Appendix A Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
1/25/2017	Background	0.406	57.7	401	3	7.7	37	1,122
3/15/2017	Background	0.399	67	52	4	--	38	1,128
4/24/2017	Background	0.442	58.8	459	3.2	7.0	41	1,128
5/18/2017	Background	0.411	296	232	2.1	--	50	846
6/15/2017	Background	0.395	118	475	3.34	8.3	36	1,164
6/27/2017	Background	0.388	110	471	3.2489	8.1	37	1,388
7/12/2017	Background	0.42	648	489	3.863	8.1	36	1,128
8/4/2017	Background	0.412	1,920	469	3.078	7.7	50	1,150
8/17/2017	Background	0.493	793	460	3.049	7.8	75	1,132
8/30/2017	Background	0.392	612	576	4.086	7.6	74	1,400
9/13/2017	Background	0.387	810	450	3.199	7.7	88	1,236
9/20/2017	Background	0.477	630	440	1.747	7.2	90	1,208
10/11/2017	Detection	0.425	206	431	3.7702	7.4	78	1,200
5/30/2018	Assessment	--	--	--	4.169	7.4	--	--
7/30/2018	Assessment	0.399	164	521	< 0.083 U1	7.6	70	1,180
2/27/2019	Assessment	0.370	85.6	470	3.26	7.4	61.5	1,122
6/20/2019	Assessment	0.325	56.4	450	3.24	7.1	58.0	1,128
8/26/2019	Assessment	0.365	182	458	2.99	8.8	61	1,170
3/25/2020	Assessment	0.340	59.6	476	3.29	9.1	68.6	1,130
6/30/2020	Assessment	0.338	80.5	531	3.16	9.0	70.2	1,160
10/21/2020	Assessment	0.333	63.9	441	3.24	8.9	70.4	1,150
3/3/2021	Assessment	0.347	58.7	--	3.50	7.8	--	--
4/12/2021	Assessment	0.393	70.8	495	3.49	7.7	68.1	1,160
12/28/2021	Assessment	0.342	88.7	458	3.24	7.4	79.6	1,100
6/14/2022	Assessment	0.367	70.2	452	3.25	7.8	80.4	1,160 L1
11/8/2022	Assessment	0.354	97.6	447	3.23	7.4	81.9	1,150
6/20/2023	Assessment	0.323	82.1	468	3.29	7.5	83.0	1,170
10/10/2023	Assessment	0.339	90.9	450	3.19	7.6	81.4	1,160

Table 1. Groundwater Data Summary: SP-4
Northeastern - BAP
Appendix B Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
1/25/2017	Background	< 5 U1	< 5 U1	398	< 1 U1	< 1 U1	< 1 U1	< 5 U1	4.00	3	< 5 U1	0.072	< 0.025 U1	< 5 U1	< 5 U1	< 2 U1
3/15/2017	Background	< 5 U1	< 5 U1	477	< 1 U1	< 1 U1	< 1 U1	< 5 U1	3.57	4	< 5 U1	0.073	< 0.025 U1	< 5 U1	< 5 U1	< 2 U1
4/24/2017	Background	1.36 J1	1.72 J1	578	0.03 J1	0.1 J1	0.64 J1	1.01 J1	2.566	3.2	< 0.68 U1	0.06973	< 0.005 U1	1.5 J1	< 0.99 U1	1.21 J1
5/18/2017	Background	2.04 J1	5.5	762	0.56 J1	0.57 J1	10.73	5.49	6.37	2.1	3.65 J1	0.07998	0.015 J1	1.02 J1	< 0.99 U1	< 0.86 U1
6/15/2017	Background	1.74 J1	4.59 J1	633	0.34 J1	< 0.07 U1	4.04	4.63 J1	4.18	3.34	1.39 J1	0.07422	< 0.005 U1	0.65 J1	1.67 J1	< 0.86 U1
6/27/2017	Background	< 0.93 U1	2.01 J1	576	0.24 J1	< 0.07 U1	2.98	5.29	9.64	3.2489	0.96 J1	0.07041	< 0.005 U1	0.46 J1	< 0.99 U1	< 0.86 U1
7/12/2017	Background	2.66 J1	10.65	1,340	1.28	1.37	22.48	10.64	5.79	3.863	8.47	0.09243	0.01 J1	< 0.29 U1	< 0.99 U1	< 0.86 U1
8/4/2017	Background	3.87 J1	44.98	4,590	4.97	6.55	84.15	40.69	4.04	3.078	36.63	0.136	0.058	5.03	4.99 J1	< 0.86 U1
8/17/2017	Background	< 0.93 U1	19.31	2,310	2.12	2.05	41.82	17.86	6.71	3.049	10.7	0.111	0.03	4.23 J1	1.04 J1	< 0.86 U1
8/30/2017	Background	2.45 J1	9.13	1,490	1.26	1.66	25.81	12.06	8.09	4.086	7.11	0.0962	0.021 J1	4.61 J1	1.86 J1	< 0.86 U1
9/13/2017	Background	< 0.93 U1	16.34	1,910	1.71	2.47	30.83	17.71	5.92	3.199	8.92	0.104	0.029	6.21	1.65 J1	< 0.86 U1
9/20/2017	Background	2.3 J1	13.95	1,930	1.77	1.9	34.55	16.32	--	1.747	9.6	0.101	0.014 J1	7.02	< 0.99 U1	< 0.86 U1
5/30/2018	Assessment	5.14	< 1.05 U1	268	< 0.02 U1	< 0.07 U1	< 0.23 U1	0.49 J1	3.186	4.169	< 0.68 U1	0.06851	< 0.005 U1	3.7 J1	< 0.99 U1	1.62 J1
7/30/2018	Assessment	0.37	1.14	303	0.078	0.07	0.562	0.497	4.85	< 0.083 U1	0.356	0.0627	0.006 J1	3.63	0.7	0.05 J1
2/27/2019	Assessment	0.3 J1	1 J1	276	< 0.2 U1	< 0.1 U1	5.71	< 0.2 U1	3.144	3.26	< 0.2 U1	0.0602	< 0.005 U1	< 4 U1	0.6 J1	< 1 U1
6/20/2019	Assessment	0.3 J1	0.83	337	< 0.1 U1	0.07 J1	1.06	0.388	3.751	3.24	1.07	0.068	0.007 J1	2 J1	0.4 J1	< 0.5 U1
8/26/2019	Assessment	0.25	1.64	359	0.101	0.05	1.01	1.07	3.24	2.99	0.596	0.0554	< 0.005 U1	2 J1	0.6	< 0.1 U1
3/25/2020	Assessment	0.28	0.83	327	0.04 J1	0.04 J1	0.332	0.166	4.28	3.29	0.2 J1	0.0535	< 0.002 U1	4.07	0.7	< 0.1 U1
6/30/2020	Assessment	0.32	1.52	334	0.118	0.04 J1	1.09	1.28	4.16	3.16	0.527	0.0564	< 0.002 U1	3.57	0.7	< 0.1 U1
10/21/2020	Assessment	0.29	1.03	322	0.06 J1	0.07	0.523	0.508	3.42	3.24	0.359	0.0559	< 0.002 U1	3.24	0.7	< 0.1 U1
3/3/2021	Assessment	0.27	0.99	367	0.04 J1	0.06	0.449	0.207	5.49	3.50	1.17	0.0594	< 0.002 U1	3.60	0.6	< 0.1 U1
4/12/2021	Assessment	0.22	1.41	435	0.09 J1	0.04 J1	1.03	0.921	4.09	3.49	0.392	0.0613	< 0.002 U1	2.94	0.4 J1	< 0.04 U1
12/28/2021	Assessment	0.26	0.76	304	0.033 J1	0.035	0.47	0.240	4.48	3.24	0.14 J1	0.0529	< 0.002 U1	3.0	0.48 J1	< 0.04 U1
6/14/2022	Assessment	0.21	0.80	246	0.04 J1	0.024	0.56	0.159	3.56	3.25	0.10 J1	0.0571	< 0.002 U1	3.7	0.38 J1	< 0.04 U1
11/8/2022	Assessment	0.23	0.92	214	0.053	0.059	1.19	0.345	6.29	3.23	0.38	0.0579	< 0.002 U1	3.5	0.39 J1	< 0.04 U1
6/20/2023	Assessment	0.192	1.26	204	0.074	0.044	0.61	0.470	7.96	3.29	0.21	0.0507	< 0.002 U1	2.8	0.41 J1	0.02 J1
10/10/2023	Assessment	0.249	0.84	232	0.036 J1	0.057	0.59	0.218	3.23	3.19	0.38	0.0554	< 0.002 U1	3.3	0.30 J1	0.02 J1

Table 1. Groundwater Data Summary: SP-5R
Northeastern - BAP
Appendix A Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
1/25/2017	Background	0.233	52.4	500	3	8.0	10	1,354
3/15/2017	Background	0.236	61.7	62	4	--	10	1,420
4/24/2017	Background	0.245	53.8	674	3.06	7.5	9	1,436
5/18/2017	Background	0.319	79.1	1,834	4	--	8	3,008
6/15/2017	Background	0.231	57.1	607	3	8.3	7	1,368
6/27/2017	Background	0.224	53	636	2.835	8.2	8	1,156
7/12/2017	Background	0.261	53.8	640	3.156	8.2	7	1,388
8/4/2017	Background	0.256	61.3	638	2.889	7.9	8	1,372
8/17/2017	Background	0.293	52	661	3.258	8.2	6	1,378
8/30/2017	Background	0.252	57.3	652	3.5698	7.7	7	1,424
9/13/2017	Background	0.232	55.6	644	2.797	8.4	6	1,452
9/20/2017	Background	0.257	53.7	729	1.535	7.4	6	1,312
10/11/2017	Detection	0.61	71	630	3.7844	7.5	5	1,368
5/30/2018	Assessment	--	--	--	4.1115	7.6	--	--
7/30/2018	Assessment	0.246	131	793	4.3905	8.0	4	1,480
2/27/2019	Assessment	0.233	72.8	739	3.08	7.7	1.6	1,530
6/20/2019	Assessment	0.202	48.5	675	3.06	7.3	0.9 J1	1,428
8/26/2019	Assessment	0.220	128	697	2.789	8.8	3	1,450
3/25/2020	Assessment	0.214	49.2	790	3.13	8.8	0.8 J1	1,580
6/30/2020	Assessment	0.211	64.9	840	2.99	9.0	5.1	1,560
10/21/2020	Assessment	0.188	50.4	584	3.03	8.8	5.0	1,320
3/3/2021	Assessment	0.188	52.4	--	3.18	7.6	--	--
4/12/2021	Assessment	0.215	54.6	725	3.20	7.9	7.0	1,420
12/27/2021	Assessment	0.190	71.7	660	3.09	7.4	6.1	1,370
6/14/2022	Assessment	0.209	52.5	675	3.09	7.7	4.7	1,410 L1
11/8/2022	Assessment	0.256	90.2	1,010	3.28	7.4	2.8	1,940
6/20/2023	Assessment	0.191	94.5	782	3.09	7.5	3.8	1,580
10/10/2023	Assessment	0.228	107	964	3.21	7.3	2.6	1,830

Table 1. Groundwater Data Summary: SP-5R
Northeastern - BAP
Appendix B Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
1/25/2017	Background	< 5 U1	12	1,650	< 1 U1	< 1 U1	< 1 U1	< 5 U1	10.09	3	< 5 U1	0.114	< 0.025 U1	< 5 U1	< 5 U1	< 2 U1
3/15/2017	Background	< 5 U1	13	1,590	< 1 U1	< 1 U1	1	< 5 U1	9.65	4	< 5 U1	0.112	< 0.025 U1	< 5 U1	< 5 U1	< 2 U1
4/24/2017	Background	< 0.93 U1	17.03	1,610	0.03 J1	< 0.07 U1	0.33 J1	0.88 J1	10.27	3.06	< 0.68 U1	0.112	0.016 J1	1.16 J1	< 0.99 U1	< 0.86 U1
5/18/2017	Background	< 0.93 U1	29.42	2,270	0.23 J1	< 0.07 U1	3.41	2.32 J1	15.3	4	2.36 J1	0.163	< 0.005 U1	< 0.29 U1	< 0.99 U1	< 0.86 U1
6/15/2017	Background	2.02 J1	13.7	2,050	0.11 J1	< 0.07 U1	1.42	1.44 J1	10.27	3	< 0.68 U1	0.109	0.016 J1	< 0.29 U1	< 0.99 U1	< 0.86 U1
6/27/2017	Background	< 0.93 U1	12.65	1,790	0.02 J1	< 0.07 U1	0.3 J1	1.01 J1	15.84	2.835	0.76 J1	0.1	< 0.005 U1	< 0.29 U1	< 0.99 U1	< 0.86 U1
7/12/2017	Background	< 0.93 U1	17.24	1,880	0.06 J1	< 0.07 U1	0.5 J1	1.1 J1	12.21	3.156	0.9 J1	0.111	< 0.005 U1	< 0.29 U1	1.14 J1	< 0.86 U1
8/4/2017	Background	< 0.93 U1	21.6	1,800	0.09 J1	< 0.07 U1	1.69	1.32 J1	11.6	2.889	1.44 J1	0.119	0.015 J1	1.27 J1	< 0.99 U1	< 0.86 U1
8/17/2017	Background	1.63 J1	19.11	1,890	0.04 J1	< 0.07 U1	< 0.23 U1	1 J1	10.95	3.258	< 0.68 U1	0.106	< 0.005 U1	< 0.29 U1	< 0.99 U1	< 0.86 U1
8/30/2017	Background	< 0.93 U1	19.47	1,930	0.11 J1	< 0.07 U1	1.16	1.2 J1	12.47	3.5698	< 0.68 U1	0.112	0.009 J1	< 0.29 U1	< 0.99 U1	< 0.86 U1
9/13/2017	Background	< 0.93 U1	20.36	1,930	0.1 J1	0.16 J1	0.62 J1	1 J1	10.62	2.797	< 0.68 U1	0.11	< 0.005 U1	< 0.29 U1	< 0.99 U1	< 0.86 U1
9/20/2017	Background	< 0.93 U1	20.77	1,880	0.05 J1	< 0.07 U1	< 0.23 U1	0.97 J1	10.5	1.535	1.06 J1	0.111	< 0.005 U1	< 0.29 U1	< 0.99 U1	< 0.86 U1
5/30/2018	Assessment	1.21 J1	28.86	1,760	< 0.02 U1	< 0.07 U1	< 0.23 U1	0.88 J1	9.15	4.1115	< 0.68 U1	0.102	< 0.005 U1	< 0.29 U1	< 0.99 U1	< 0.86 U1
7/30/2018	Assessment	0.05 J1	47.3	2,140	0.052	0.02 J1	0.082	0.482	11.28	4.3905	0.415	0.0946	< 0.005 U1	1.17	0.1	0.02 J1
2/27/2019	Assessment	< 0.2 U1	25.7	2,130	< 0.2 U1	< 0.1 U1	2 J1	0.3 J1	6.702	3.08	0.7 J1	0.102	< 0.005 U1	< 4 U1	< 0.3 U1	< 1 U1
6/20/2019	Assessment	< 0.1 U1	59.9	2,410	< 0.1 U1	< 0.05 U1	0.8 J1	0.598	12.977	3.06	0.701	0.111	0.008 J1	< 2 U1	< 0.2 U1	< 0.5 U1
8/26/2019	Assessment	0.06 J1	49.3	2,340	0.06 J1	0.02 J1	0.335	0.485	11.56	2.789	0.545	0.0928	< 0.005 U1	1 J1	0.1 J1	< 0.1 U1
3/25/2020	Assessment	0.05 J1	26.2	2,600	0.04 J1	0.02 J1	0.346	0.296	12.09	3.13	0.371	0.0911	< 0.002 U1	1 J1	0.1 J1	< 0.1 U1
6/30/2020	Assessment	0.13	27.0	2,520	0.151	0.04 J1	1.51	0.774	14.34	2.99	1.65	0.0913	< 0.002 U1	1 J1	0.5	< 0.1 U1
10/21/2020	Assessment	0.10	10.9	2,070	0.05 J1	< 0.01 U1	0.320	0.378	6.502	3.03	0.373	0.0792	< 0.002 U1	0.8 J1	0.2 J1	< 0.1 U1
3/3/2021	Assessment	0.16	6.56	1,840	0.05 J1	0.27	0.496	0.391	13.31	3.18	0.793	0.0856	< 0.002 U1	0.7 J1	0.1 J1	< 0.1 U1
4/12/2021	Assessment	0.09 J1	7.12	2,180	0.05 J1	0.01 J1	0.415	0.378	14.10	3.20	0.325	0.0894	< 0.002 U1	1 J1	0.1 J1	< 0.04 U1
12/27/2021	Assessment	0.09 J1	10.0	1,840	0.031 J1	0.029	0.26	0.257	13.16	3.09	0.18 J1	0.0766	< 0.002 U1	0.9	< 0.09 U1	< 0.04 U1
6/14/2022	Assessment	0.19	20.3	2,010	0.07 J1	0.200	0.47	0.699	11.26	3.09	0.66	0.0896	< 0.002 U1	0.9	0.1 J1	< 0.04 U1
11/8/2022	Assessment	0.16	14.2	2,070	0.066	0.108	0.75	0.511	9.37	3.28	4.34	0.120	< 0.002 U1	0.8	0.11 J1	< 0.04 U1
6/20/2023	Assessment	0.230	9.09	2,120	0.276	0.074	2.73	1.18	16.19	3.09	2.11	0.0822	< 0.002 U1	0.8	0.91	0.05 J1
10/10/2023	Assessment	0.195	15.8	2,770	0.201	0.076	2.64	1.03	24.78	3.21	2.52	0.123	< 0.002 U1	0.7	0.94	0.04 J1

Table 1. Groundwater Data Summary: SP-10
Northeastern - BAP
Appendix A Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/12/2017	Background	0.965	53	1,844	6.502	6.7	294	3,416
8/4/2017	Background	1.08	83.1	1,616	< 0.083 U1	7.6	761	5,142
8/17/2017	Background	1.09	91.4	1,700	< 0.083 U1	7.8	915	5,678
8/30/2017	Background	1.09	81.8	1,932	10.2663	7.6	834	5,264
9/13/2017	Background	1.1	76.9	1,592	7.028	8.3	738	5,168
9/20/2017	Background	1.08	64.6	1,946	< 0.083 U1	7.1	544	4,424
9/27/2017	Background	1.07	65.7	1,784	5	7.8	419	4,516
10/4/2017	Background	1.1	52.3	1,553	5.11	7.4	286	3,660
10/11/2017	Detection	1.03	58.4	1,934	7.3938	7.0	188	4,060
1/22/2018	Detection	1.08	--	1,630	5.71	7.0	63.1	3,236
5/30/2018	Assessment	--	--	--	7.333	7.8	--	--
7/30/2018	Assessment	1.17	227	2,283	8.9991	7.6	75	3,632
2/4/2019	Assessment	1.17	144	--	--	--	--	--
2/27/2019	Assessment	1.16	92.6	1,740	5.59	7.8	6.9	3,504
6/20/2019	Assessment	0.916	50.3	1,780	6.40	7.8	30.3	3,512
8/26/2019	Assessment	1.03	216	1,939	4.874	8.9	29	3,446
3/25/2020	Assessment	1.04	44.2	2,000	6.45	8.2	12.6	3,560
6/30/2020	Assessment	0.944	52.1	2,010	6.29	8.9	25.5	3,550
7/28/2020	Assessment	0.914	--	1,960	6.63	8.3	--	3,440
10/20/2020	Assessment	0.955	39.9	1,830	6.55	9.1	9.6	3,540
3/3/2021	Assessment	0.853	40.4	--	7.12	7.7	--	--
4/12/2021	Assessment	1.03	43.8	2,000	6.84	8.1	15.4	3,540
12/27/2021	Assessment	0.868	76.6	1,890	6.7	7.6	10.4	3,440
6/14/2022	Assessment	1.04	56.1	1,810	6.3	7.7	16.3	3,600 L1
11/8/2022	Assessment	0.967	109	1,820	6.8	7.4	16.7	3,330
6/20/2023	Assessment	0.916	83.0	1,960	6.3	7.5	19.7	3,500
10/10/2023	Assessment	0.879	93.0	1,820	6.3	7.7	19.2	3,460

Table 1. Groundwater Data Summary: SP-10
Northeastern - BAP
Appendix B Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/12/2017	Background	4.62 J1	< 1.05 U1	1,900	< 0.02 U1	< 0.07 U1	110	5.96	17.23	6.502	< 0.68 U1	0.278	0.006 J1	934	5.67	< 0.86 U1
8/4/2017	Background	2.51 J1	2.43 J1	330	0.03 J1	< 0.07 U1	2.44	4.74 J1	1.153	< 0.083 U1	< 0.68 U1	0.284	0.029	129	8.82	< 0.86 U1
8/17/2017	Background	< 0.93 U1	< 1.05 U1	282	< 0.02 U1	< 0.07 U1	< 0.23 U1	< 0.14 U1	0.995	< 0.083 U1	< 0.68 U1	0.317	0.027	45.43	< 0.99 U1	< 0.86 U1
8/30/2017	Background	< 0.93 U1	5.66	279	0.06 J1	< 0.07 U1	1.09	4.27 J1	0.763	10.2663	< 0.68 U1	0.306	0.019 J1	30.35	2.56 J1	< 0.86 U1
9/13/2017	Background	< 0.93 U1	9.42	266	0.07 J1	< 0.07 U1	0.46 J1	2.41 J1	0.774	7.028	< 0.68 U1	0.315	0.013 J1	16.28	3.11 J1	< 0.86 U1
9/20/2017	Background	1.16 J1	13.92	399	0.03 J1	< 0.07 U1	0.72 J1	2.19 J1	1.062	< 0.083 U1	< 0.68 U1	0.292	0.016 J1	13.58	2.38 J1	< 0.86 U1
9/27/2017	Background	1.57 J1	15.31	928	0.04 J1	< 0.07 U1	2.07	3.71 J1	1.723	5	< 0.68 U1	0.329	0.013 J1	35.93	3.84 J1	< 0.86 U1
10/4/2017	Background	1.27 J1	4.3 J1	664	0.03 J1	< 0.07 U1	0.36 J1	4.02 J1	3.226	5.11	0.87 J1	0.279	0.015 J1	29.19	< 0.99 U1	< 0.86 U1
5/30/2018	Assessment	< 0.93 U1	8.9	2,550	< 0.02 U1	< 0.07 U1	< 0.23 U1	0.83 J1	6.06	7.333	< 0.68 U1	0.245	< 0.005 U1	2.94 J1	2.26 J1	< 0.86 U1
7/30/2018	Assessment	0.34	7.61	2,330	0.043	0.02 J1	0.06 J1	2.16	7.89	8.9991	0.102	0.242	0.006 J1	18.5	0.09 J1	0.04 J1
2/27/2019	Assessment	2 J1	3.48	5,810	< 0.4 U1	< 0.2 U1	1 J1	< 0.4 U1	15.35	5.59	< 0.4 U1	0.275	< 0.005 U1	< 8 U1	< 0.6 U1	< 2 U1
6/20/2019	Assessment	0.65	3.66	3,880	< 0.1 U1	< 0.05 U1	8.76	0.743	26.4	6.40	0.3 J1	0.290	0.01 J1	9 J1	< 0.2 U1	< 0.5 U1
8/26/2019	Assessment	0.61	3.00	3,060	0.08 J1	0.03 J1	1.61	1.06	8.11	4.874	0.449	0.241	< 0.005 U1	8.22	0.4	< 0.1 U1
3/25/2020	Assessment	0.17	0.61	6,670	< 0.02 U1	0.03 J1	0.383	0.522	26.79	6.45	0.08 J1	0.214	< 0.002 U1	7.39	0.1 J1	< 0.1 U1
6/30/2020	Assessment	0.21	1.40	3,960	0.03 J1	0.01 J1	0.204	0.724	8.33	6.29	0.07 J1	0.226	< 0.002 U1	4.81	0.08 J1	< 0.1 U1
10/20/2020	Assessment	0.08 J1	0.42	6,800	0.03 J1	0.01 J1	0.2 J1	0.103	13.9507	6.55	0.1 J1	0.209	< 0.002 U1	0.6 J1	0.09 J1	< 0.1 U1
3/3/2021	Assessment	0.08 J1	0.36	5,530	0.02 J1	0.03 J1	0.409	0.199	18.84	7.12	0.230	0.218	< 0.002 U1	1 J1	0.08 J1	< 0.1 U1
4/12/2021	Assessment	0.12	1.14	6,360	0.03 J1	0.01 J1	0.277	0.218	20.36	6.84	0.1 J1	0.221	< 0.002 U1	5.01	< 0.09 U1	< 0.04 U1
12/27/2021	Assessment	0.08 J1	0.34	6,980	0.019 J1	0.021	0.19 J1	0.044	17.31	6.7	0.05 J1	0.198	< 0.002 U1	0.4 J1	< 0.09 U1	< 0.04 U1
6/14/2022	Assessment	0.03 J1	0.19	7,590	< 0.4 U1	0.033	0.57	0.216	20.11 R2	6.3	0.19 J1	0.289	< 0.002 U1	0.5	< 0.09 U1	< 0.04 U1
11/8/2022	Assessment	0.05 J1	0.61	5,050	0.036 J1	0.017 J1	0.47	0.061	19.09	6.8	0.06 J1	0.242	< 0.002 U1	0.3 J1	< 0.09 U1	< 0.04 U1
6/20/2023	Assessment	0.083 J1	0.29	5,180	0.027 J1	0.009 J1	0.45	0.146	18.07	6.3	0.09 J1	0.206	< 0.002 U1	0.7	< 0.04 U1	< 0.02 U1
10/10/2023	Assessment	0.062 J1	0.65	6,010	0.035 J1	0.007 J1	0.36	0.039	21.79	6.3	0.08 J1	0.235	< 0.002 U1	0.2 J1	0.06 J1	< 0.02 U1

Table 1. Groundwater Data Summary: SP-11
Northeastern - BAP
Appendix A Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/12/2017	Background	0.839	742	568	2.386	7.4	798	2,880
8/4/2017	Background	0.543	272	567	3.355	7.9	870	3,076
8/17/2017	Background	0.453	171	789	4.52	6.9	741	3,308
8/30/2017	Background	0.428	161	683	4.1325	7.6	541	2,732
9/13/2017	Background	0.447	190	628	3.359	7.2	515	2,420
9/20/2017	Background	0.469	1,220	690	2.016	7.2	329	2,336
9/27/2017	Background	0.447	1,170	759	3	7.2	332	2,428
10/4/2017	Background	0.531	1,110	744	2.9	7.5	305	2,288
10/11/2017	Detection	0.446	479	824	4.4661	7.0	223	2,322
1/22/2018	Detection	--	--	470	2.96	6.9	222	1,544
5/30/2018	Assessment	--	--	--	3.574	7.5	--	--
7/30/2018	Assessment	0.280	124	234	3.7832	7.7	79	996
2/27/2019	Assessment	0.375	49.6	241	3.44	7.7	95.1	1,168
6/20/2019	Assessment	0.550	65.6	137	1.67	6.8	203	1,000
8/26/2019	Assessment	0.304	139	129	2.225	8.9	122	970
3/25/2020	Assessment	0.428	40.5	187	2.66	9.0	108	1,060
6/30/2020	Assessment	0.545	57.3	140	1.77	8.9	188	927
7/28/2020	Assessment	0.301	--	--	--	8.6	158	--
10/20/2020	Assessment	0.220	43.8	98.1	3.05	9.2	35.6	764
3/3/2021	Assessment	0.371	39.0	--	2.88	7.7	--	--
4/12/2021	Assessment	0.562	79.6	130	1.66	7.8	232	918
12/27/2021	Assessment	0.459	77.6	78.9	1.76	7.5	193	840
6/14/2022	Assessment	0.627	113	60.0	1.10	7.3	402	1,020 L1
11/8/2022	Assessment	0.510	113	97.3	1.3	7.2	356	1,060
6/20/2023	Assessment	0.543	86.7	99.3	1.43	7.2	358	1,070
10/10/2023	Assessment	0.354	79.1	79.4	2.28	7.2	184	880

Table 1. Groundwater Data Summary: SP-11
Northeastern - BAP
Appendix B Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/12/2017	Background	9.43	3.99 J1	194	0.22 J1	1.4	18.52	9.76	--	2.386	5.16	0.04698	0.009 J1	61.27	5.95	< 0.86 U1
8/4/2017	Background	4.7 J1	1.82 J1	98.74	0.07 J1	0.44 J1	5.25	6.52	25.367	3.355	2.01 J1	0.0877	0.023 J1	66.41	6.26	< 0.86 U1
8/17/2017	Background	< 0.93 U1	< 1.05 U1	83.42	< 0.02 U1	< 0.07 U1	< 0.23 U1	< 0.14 U1	0.947	4.52	< 0.68 U1	0.08931	0.007 J1	51.5	< 0.99 U1	< 0.86 U1
8/30/2017	Background	4.29 J1	1.2 J1	93.07	0.07 J1	0.34 J1	2.76	3.85 J1	0.438	4.1325	1.23 J1	0.08933	0.008 J1	44.33	2.49 J1	< 0.86 U1
9/13/2017	Background	2.4 J1	3.66 J1	108	0.08 J1	0.09 J1	2.57	3.21 J1	2.685	3.359	< 0.68 U1	0.105	0.009 J1	36.16	1.55 J1	< 0.86 U1
9/20/2017	Background	7.73	12.14	240	0.39 J1	2.7	31.3	14.62	4.2	2.016	8.16	0.13	0.027	46.9	5.46	< 0.86 U1
9/27/2017	Background	6.89	7.5	269	0.39 J1	3.01	32.71	14.37	--	3	8.58	0.129	0.048	48.61	7.47	< 0.86 U1
10/4/2017	Background	4.44 J1	8.47	347	0.35 J1	2.49	29.49	11.99	2.817	2.9	7.05	0.146	0.047	42.14	3.27 J1	< 0.86 U1
5/30/2018	Assessment	< 0.93 U1	5.3	160	< 0.02 U1	< 0.07 U1	0.34 J1	1.61 J1	1.334	3.574	< 0.68 U1	0.04956	< 0.005 U1	3.27 J1	1.43 J1	< 0.86 U1
7/30/2018	Assessment	0.35	4.22	539	0.029	0.04	0.379	5.12	0.95	3.7832	0.404	0.0370	0.005 J1	8.85	0.7	0.03 J1
2/27/2019	Assessment	< 0.2 U1	8.83	529	< 0.2 U1	< 0.1 U1	0.7 J1	0.720	1.81	3.44	0.2 J1	0.0580	< 0.005 U1	6 J1	< 0.3 U1	< 1 U1
6/20/2019	Assessment	0.3 J1	4.18	169	< 0.1 U1	0.06 J1	6.71	0.948	0.81	1.67	0.719	0.047	0.01 J1	< 2 U1	0.3 J1	< 0.5 U1
8/26/2019	Assessment	0.37	6.30	492	0.04 J1	0.13	1.47	2.73	1.623	2.225	0.764	0.0337	< 0.005 U1	5.70	0.8	< 0.1 U1
3/25/2020	Assessment	0.15	2.88	415	0.02 J1	0.05 J1	0.705	0.702	1.73	2.66	0.409	0.0402	0.003 J1	3.01	0.3	< 0.1 U1
6/30/2020	Assessment	0.14	2.79	187	< 0.02 U1	0.01 J1	0.201	0.620	3.845	1.77	0.1 J1	0.0278	0.008	2.15	0.2 J1	< 0.1 U1
10/20/2020	Assessment	0.48	1.49	630	0.03 J1	0.15	2.20	1.16	0.661	3.05	0.719	0.0298	0.004 J1	2 J1	0.5	< 0.1 U1
3/3/2021	Assessment	0.06 J1	1.33	330	< 0.02 U1	0.01 J1	0.243	0.939	0.901	2.88	0.1 J1	0.0396	< 0.002 U1	2 J1	0.2 J1	< 0.1 U1
4/12/2021	Assessment	0.19	2.14	212	0.02 J1	0.02 J1	0.944	1.52	1.354	1.66	0.224	0.0248	< 0.002 U1	2 J1	0.2 J1	< 0.04 U1
12/27/2021	Assessment	0.28	1.11	270	0.013 J1	0.021	0.28	0.259	2.06	1.76	0.14 J1	0.0187	< 0.002 U1	1.8	0.20 J1	< 0.04 U1
6/14/2022	Assessment	0.43	2.73	139	< 0.04 U1	0.027	0.59	2.36	1.17	1.10	0.23	0.0140	< 0.002 U1	2.9	0.19 J1	< 0.04 U1
11/8/2022	Assessment	0.12	2.29	146	0.027 J1	0.009 J1	0.46	1.76	3.32	1.3	0.11 J1	0.0157	< 0.002 U1	1.7	0.15 J1	< 0.04 U1
6/20/2023	Assessment	0.038 J1	1.51	102	0.025 J1	< 0.004 U1	0.34	0.717	1.21	1.43	0.08 J1	0.0179	< 0.002 U1	0.8	0.10 J1	< 0.02 U1
10/10/2023	Assessment	0.075 J1	3.61	455	0.027 J1	0.031	0.90	0.635	2.91	2.28	0.45	0.0222	< 0.002 U1	0.9	0.23 J1	< 0.02 U1

Notes:
- -: Not analyzed
<: Non-detect value. Analytes which were not detected are shown as less than the method detection limit (MDL) followed by a 'U1' flag.
In analytical data prior to 5/18/2021, U1 flags were reported as U in the analytical report.
J1: Concentration estimated. Analyte was detected between the method detection limit and the reporting limit.
In analytical data prior to 5/18/2021, J1 flags were reported as J in the analytical report.
L1: The associated laboratory control sample (LCS) or laboratory control sample duplicate (LCSD) recovery was outside acceptance limits.
M1: The associated matrix spike (MS) or matrix spike duplicate (MSD) recovery was outside acceptance limits.
mg/L: milligrams per liter
pCi/L: picocuries per liter
R2: Radium-226 carrier recovery outside of acceptance limits.
SU: standard unit
µg/L: micrograms per liter

APPENDIX 2

Where applicable, shown in this appendix are the results from statistical analyses, and a description of the statistical analysis method chosen.

Geosyntec consultants

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Memorandum

Date:	January 16, 2024
To:	Rebecca Jones (AEP)
Copies to:	Brian Newton (AEP)
From:	Allison Kreinberg (Geosyntec)
Subject:	Evaluation of 2023 Reissued Analytical Laboratory Data for Northeastern Power Station's Bottom Ash Pond (BAP)

In accordance with Oklahoma Department of Environmental Quality (ODEQ) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (Oklahoma Administrative Code [OAC] 252:517) groundwater sampling was completed in 2023 to support assessment monitoring at the Bottom Ash Pond (BAP), an existing CCR unit at the Northeastern Power Station in Oologah, Oklahoma. After the statistical evaluation was completed using data from the first semiannual assessment monitoring event,[1] select analytical laboratory reports were reissued to correct an inconsistent number of significant figures in electronic data deliverables and the published laboratory reports.

A review of the reissued analytical laboratory reports found that the lithium result of 0.0073 milligrams per liter (mg/L) reported for the June 26, 2023 sample at downgradient location SP-1 had the number of significant figures changed, resulting in a revised value of 0.00726 mg/L. Both the initial reported lithium value and the revised lithium value at downgradient location SP-1 were below the site-specific groundwater protection standard of 0.163 milligrams per liter, and a statistically significant level of lithium was not identified at SP-1 during the first semiannual assessment monitoring event.[1] Therefore, no changes to the statistical outcome of the first semiannual assessment monitoring event would occur.

The revised lithium value in the reissued laboratory analytical report will be used in future reporting and statistical evaluations.

[1] Geosyntec. 2023. *Statistical Analysis Summary – Bottom Ash Pond. Northeastern Power Station, Oologah, Oklahoma*. Geosyntec Consultants, Inc. October.

Geosyntec consultants

engineers | scientists | innovators

STATISTICAL ANALYSIS SUMMARY

BOTTOM ASH POND

Northeastern Power Station

Oologah, Oklahoma

Prepared for

American Electric Power
1 Riverside Plaza
Columbus, Ohio 43215-2372

Prepared by

Geosyntec Consultants, Inc.
500 West Wilson Bridge Road, Suite 250
Worthington, Ohio 432085

Project Number: CHA8500B

February 23, 2023

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ACRONYMS AND ABBREVIATIONS

ASD	Alternative Source Demonstration
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NELAP	National Environmental Laboratory Accreditation Program
NPS	Northeastern Power Station
ODEQ	Oklahoma Department of Environmental Quality
OAC	Oklahoma Administrative Code
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
SU	Standard Units
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1 EXECUTIVE SUMMARY

In accordance with the Oklahoma Department of Environmental Quality (ODEQ) and Oklahoma administrative code (OAC) regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (OAC 252:517), groundwater monitoring has been conducted at the Bottom Ash Pond (BAP), an existing CCR unit at the Northeastern Power Station (NPS) located in Oologah, Oklahoma. Recent groundwater monitoring results were compared to site-specific groundwater protection standards (GWPSs) to identify potential exceedances.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron, chloride, fluoride, total dissolved solids (TDS), and sulfate at the BAP. Also, pH values below the lower prediction limit (LPL) resulted in SSIs below background as well. GWPSs were set in accordance with OAC 252:517-9-6(h) and assessment monitoring was initiated. An assessment monitoring event was conducted at the BAP in June 2022, in accordance with OAC 252:517-9-6(d). During the June 2022 assessment monitoring event, statistically significant levels (SSLs) were observed for barium, fluoride, and lithium (Geosyntec, 2022a). An alternative source demonstration (ASD) was successfully completed (Geosyntec, 2023); thus the unit remained in assessment monitoring. One assessment monitoring event was conducted at the BAP in November 2022, in accordance with OAC 252:517-9-6(d). The results of the November 2022 event are documented in this report.

Prior to conducting the statistical analyses, the groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. GWPSs were re-established for the Appendix B parameters. Confidence intervals were calculated for Appendix B parameters at the compliance wells to assess whether SSLs of Appendix B parameters were present above the GWPS. SSLs were identified for barium, fluoride, and lithium. Thus, either the unit will move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A. The statistical analysis and certification of the selected methods were completed within 90 days of obtaining the data.

SECTION 2 BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, one set of samples was collected in November 2022 for analysis from each upgradient and downgradient well to meet the requirements of OAC 252:517-9-6(d)(1). Samples from this sampling event were analyzed for both the Appendix A and Appendix B parameters. A summary of data collected during this assessment monitoring event may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.36 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the BAP were conducted in accordance with the November 2021 *Statistical Analysis Plan* (Geosyntec, 2021) for the samples collected in November 2022. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained in November 2022 were screened for potential outliers. No outliers were identified for this event.

2.2.1 Background Date Range Evaluation

All wells were sampled on an approximately monthly basis in 2017 in order to establish the initial background limits. Since 2017, samples have been collected on a roughly semiannual basis; see time series graphs provided in Attachment B.

A lack of temporal independence can result in background limits which do not fully represent natural variation in groundwater quality. Given the close temporal proximity of the initial background samples, rank von Neumann serial correlation tests were completed to evaluate whether the samples collected in 2017 were statistically independent or whether temporal correlation was present amongst the measurements. The rank von Neumann test is recommended in the Unified Guidance to evaluate temporal autocorrelation due to its ease of use and strength for both normal or non-normal distributions (United States Environmental Protection Agency [USEPA], 2007). Where significant temporal correlation was identified, the datasets were truncated to remove earlier measurements and statistical limits were constructed using only more recent data that better represent independent samples. The results of the rank von Neumann tests and a list of well-parameter pairs where the dataset was truncated is provided in Attachment B.

2.2.2 Establishment of GWPSs

A GWPS was established for each Appendix B parameter in accordance with OAC 252:517-9-6(h) and the *Statistical Analysis Plan* (Geosyntec, 2021). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in OAC 252:517-9-6(h) for each Appendix B 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. Tolerance limits were calculated parametrically with 95% coverage and 95% confidence for antimony, cadmium, and chromium. Non-parametric tolerance limits were calculated for arsenic, barium, beryllium, cobalt, combined radium, fluoride, lead, lithium, molybdenum and selenium due to apparent non-normal distributions and for mercury and thallium due to a high non-detect frequency. Upper tolerance limits and the final GWPSs are summarized in Table 2.

2.2.3 Evaluation of Potential Appendix B SSLs

A confidence interval was constructed for each Appendix B parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

The following SSLs were identified at the Northeastern BAP:

- The LCL for barium exceeded the GWPS of 2.60 mg/L at SP-10 (3.98 mg/L).
- The LCL for fluoride exceeded the GWPS of 4.39 mg/L at SP-10 (5.31 mg/L).
- The LCL for lithium exceeded the GWPS of 0.163 mg/L at SP-10 (0.240 mg/L).

ODEQ previously noted in a letter provided to the NPS that "If lithium and fluoride continue to exceed their relative GWPS in the future and conditions have not changed, NPS may refer to the October 29, 2019 ASD approval for lithium and June 4, 2021 approval for fluoride and continue assessment monitoring for the BAP in accordance with OAC 252:517-6(g)(3)(B)" (ODEQ, 2021). ODEQ provided a similar letter dated September 20, 2022 documenting ASD approval for a barium SSL at SP-10 which is applicable in the future if conditions do not change (ODEQ, 2022). Thus, an ASD will be submitted to ODEQ demonstrating that conditions at the BAP remain unchanged so that the unit will continue assessment monitoring.

2.2.4 Establishment of Appendix A Prediction Limits

Upper prediction limits (UPL) were previously established for all Appendix A parameters following the background monitoring period (Geosyntec, 2018). Intrawell tests were used to evaluate potential SSIs for calcium, whereas interwell tests were used to evaluate potential SSIs for boron, chloride, fluoride, pH, sulfate, and TDS. Interwell and intrawell prediction limits are updated periodically during the assessment monitoring period as sufficient data became available.

Mann-Whitney (Wilcoxon rank-sum) tests were performed to determine whether the newer data reflect a release from the BAP. Because the interwell Appendix A limits and the Appendix B GWPSs are based on data from upgradient wells which we would not expect to have been impacted by a release, these tests were used for intrawell Appendix A tests only. Mann-Whitney tests were used to compare the medians of historical data (January 2017 – June 2020) to the new compliance samples (October 2020 – June 2022) for calcium. Results were evaluated to determine if the medians of the two groups were similar at the 99% confidence level. Where no significant difference was found, the new compliance data were added to the background dataset. Where a statistically significant difference was found between the medians of the two groups, the data were reviewed to evaluate the cause of the difference and to determine if adding newer data to the background dataset, replacing the background dataset with the newer data, or continuing to use the existing background dataset was most appropriate. If the differences appeared to have been caused by a release, then the previous background dataset would have continued to be used.

The complete Mann-Whitney test results and a summary of the significant findings can be found in Attachment B. While a statistically significant difference was observed for calcium at compliance well SP-1, the entire dataset was used because the results were within the range of historic concentrations and inclusion of all observations resulted in a prediction limit that was more conservative (i.e., lower). Thus, the background datasets for calcium were updated to include all available data through June 2022.

Prediction limits for the interwell tests were calculated using data collected during the 2022 assessment monitoring events. New upgradient well data were tested for outliers prior to being added to the background dataset. Upgradient well data were also evaluated for statistically significant trends using the Sen's Slope/Mann-Kendall trend test, and the results are included in Attachment B.

After the revised background set was established, a parametric or non-parametric analysis was selected based on the distribution of the data and the frequency of non-detect data. Estimated results less than the reporting limit (practical quantitation limit [PQL]) but above the method detection limit (MDL) – i.e., "J-flagged" data – were considered detections and the estimated results were used in the statistical analyses. Non-parametric analyses were selected for datasets with at least 50% non-detect data or datasets that could not be normalized. Parametric analyses were selected for datasets (either transformed or untransformed) that passed the Shapiro-Wilk / Shapiro-Francía test for normality. The Kaplan-Meier non-detect adjustment was applied to datasets with between 15% and 50% non-detect data. For datasets with fewer than 15% non-detect data, non-detect data were replaced with one half of the PQL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment B.

Interwell UPLs were updated for boron, chloride, fluoride, pH, sulfate, and TDS and interwell LPLs were updated for pH using all historical data through November 2022 (except as noted in Attachment B) to represent background values. The intrawell UPLs for calcium were updated using all historical data through June 2022 (except as noted in Attachment B) to represent background values. The updated prediction limits are summarized in Table 3. The prediction limits were calculated for a one-of-two retesting procedure; i.e., if at least one sample in a series of two does not exceed the UPL, or in the case of pH, is neither less than the LPL nor greater than the

UPL, then it can be concluded that an SSI has not occurred. In practice, where the initial result does not exceed the UPL, or in the case of pH, is neither less than the LPL nor greater than the UPL, a second sample will not be collected. The retesting procedures allowed achieving an acceptably high statistical power to detect changes at downgradient wells for constituents evaluated using intrawell prediction limits.

2.2.5 Evaluation of Potential Appendix A SSIs

While SSLs were identified, a review of the Appendix A results was also completed to assess whether concentrations of Appendix A parameters at the compliance wells exceeded background concentrations.

Data collected during the November 2022 assessment monitoring event from each compliance well were compared to the calculated prediction limits to evaluate results above background values. The results from this event and the prediction limits are summarized in Table 3. The following exceedances of the UPLs were noted:

- Boron concentrations exceeded the interwell UPL of 0.503 mg/L at SP-10 (0.967 mg/L) and SP-11 (0.510 mg/L).
- Chloride concentrations exceeded the interwell UPL of 834 mg/L at SP-10 (1,820 mg/L).
- Fluoride concentrations exceeded the interwell UPL of 4.39 mg/L at SP-10 (6.8 mg/L).
- Sulfate concentrations exceeded the interwell UPL of 81.9 mg/L at SP-11 (356 mg/L).
- TDS concentrations exceeded the interwell UPL of 1,640 mg/L at SP-10 (3,330 mg/L).

While the prediction limits were calculated for a one-of-two retesting procedure, SSIs were conservatively assumed if the November 2022 sample was above the UPL or below the LPL. Based on these results, boron, chloride, fluoride, sulfate, and TDS concentrations exceeded background levels at compliance wells at the Northeastern BAP during assessment monitoring.

2.3 Conclusions

A semiannual assessment monitoring event was conducted in November 2022 in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the November 2022 data. GWPSs were re-established for the Appendix B parameters. A confidence interval was constructed at each compliance well for each Appendix B parameter; SSLs were concluded if the entire confidence interval exceeded the GWPSs. SSLs were identified for barium, fluoride, and lithium. Appendix A parameters were compared to prediction limits, with exceedances identified for boron, chloride, fluoride, sulfate, and TDS.

Based on this evaluation, the Northeastern BAP CCR unit will either move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring.

SECTION 3 REFERENCES

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – Bottom Ash Pond, Northeastern Plant, Oologah, Oklahoma. January.

Geosyntec. 2021. Statistical Analysis Plan – Northeastern Power Station. Oologah, Oklahoma. November.

Geosyntec. 2022a. Statistical Analysis Summary – Bottom Ash Pond. Northeastern Power Station. Oologah, Oklahoma. October.

Geosyntec. 2023. Alternative Source Demonstration Update – Northeastern Power Station Bottom Ash Pond. Oologah, Rogers County, Oklahoma. January.

Oklahoma Department of Environmental Quality (ODEQ). 2021. Letter Transmittal – Alternate Source Demonstration for Fluoride and Lithium Exceedance – Bottom Ash Pond. Public Service Company of Oklahoma – Northeastern Power Station. June.

ODEQ. 2022. Letter Transmittal – Alternate Source Demonstration for Barium, Fluoride, and Lithium Exceedance – Bottom Ash Pond. Public Service Company of Oklahoma – Northeastern Power Station. September.

United States Environmental Protection Agency (USEPA), 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March 2009.

TABLES

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

Geosyntec Consultants, Inc.

Well ID		SP-1	SP-2	SP-4	SP-5R	SP-10	SP-11
Well Classification		Compliance	Compliance	Background	Background	Compliance	Compliance
Parameter	Unit	11/8/2022	11/8/2022	11/8/2022	11/8/2022	11/8/2022	11/8/2022
Antimony	µg/L	0.80	1.17	0.23	0.16	0.05 J1	0.12
Arsenic	µg/L	0.69	1.21	0.92	14.2	0.61	2.29
Barium	µg/L	157	872	214	2,070	5,050	146
Beryllium	µg/L	0.054	0.048 J1	0.053	0.066	0.036 J1	0.027 J1
Boron	mg/L	0.147	0.108	0.354	0.256	0.967	0.510
Cadmium	µg/L	0.055	0.328	0.059	0.108	0.017 J1	0.009 J1
Calcium	mg/L	102 M1	103	97.6	90.2	109	113
Chloride	mg/L	16.3	695	447	1,010	1,820	97.3
Chromium	µg/L	1.30	2.12	1.19	0.75	0.47	0.46
Cobalt	µg/L	0.684	0.186	0.345	0.511	0.061	1.76
Combined Radium	pCi/L	5.68	6.75	6.29	9.37	19.09	3.32
Fluoride	mg/L	0.85	2.7	3.23	3.28	6.8	1.3
Lead	µg/L	0.15 J1	0.33	0.38	4.34	0.06 J1	0.11 J1
Lithium	mg/L	0.00558	0.0308	0.0579	0.120	0.242	0.0157
Mercury	µg/L	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1
Molybdenum	µg/L	28.8	22.1	3.5	0.8	0.3 J1	1.7
Selenium	µg/L	15.4	2.36	0.39 J1	0.11 J1	0.5 U1	0.15 J1
Sulfate	mg/L	54.1	18.1	81.9	2.8	16.7	356
Thallium	µg/L	0.07 J1	0.2 U1	0.2 U1	0.2 U1	0.2 U1	0.2 U1
Total Dissolved Solids	mg/L	400	1,480	1,150	1,940	3,330	1,060
pH	SU	7.33	7.31	7.41	7.36	7.42	7.22

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U1: Non-detected at or above the method detection limit (MDL). For statistical analysis, parameters which were not detected were replaced with the reporting limit.
J1: Concentration estimated. Analyte was detected between the method detection limit and the reporting limit.
M1: The associated matrix spike (MS) or matrix spike duplicate (MSD) recovery was outside acceptance limits.

Table 2 - Appendix B Groundwater Protection Standards
Northeastern Plant - Bottom Ash Pond

Geosyntec Consultants, Inc.

Constituent Name	MCL	CCR Rule-Specified	Calculated UTL	GWPS
Antimony, Total (mg/L)	0.00600		0.00570	0.00600
Arsenic, Total (mg/L)	0.0100		0.0599	0.0599
Barium, Total (mg/L)	2.00		2.60	2.60
Beryllium, Total (mg/L)	0.00400		0.00212	0.00400
Cadmium, Total (mg/L)	0.00500		0.00207	0.00500
Chromium, Total (mg/L)	0.100		0.00342	0.100
Cobalt, Total (mg/L)	n/a	0.00600	0.0179	0.0179
Combined Radium, Total (pCi/L)	5.00		15.8	15.8
Fluoride, Total (mg/L)	4.00		4.39	4.39
Lead, Total (mg/L)	n/a	0.0150	0.0107	0.0150
Lithium, Total (mg/L)	n/a	0.0400	0.163	0.163
Mercury, Total (mg/L)	0.00200		0.0000300	0.00200
Molybdenum, Total (mg/L)	n/a	0.100	0.0100	0.100
Selenium, Total (mg/L)	0.0500		0.00499	0.0500
Thallium, Total (mg/L)	0.00200		0.00162	0.00200

Notes:
MCL = Maximum Contaminant Level
CCR = Coal Combustion Residual
GWPS = Groundwater Protection Standard
Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
Grey cells indicate the GWPS is based on the calculated UTL, which is higher than the MCL or CCR Rule-specified value.

Table 3 - Appendix A Data Summary
Northeastern Plant - Bottom Ash Pond

Geosyntec Consultants, Inc.

Analyte	Unit	Description	SP-1	SP-2	SP-10	SP-11
			11/8/2022	11/8/2022	11/8/2022	11/8/2022
Boron	mg/L	Interwell Background Value (UPL)	0.503			
		Analytical Result	0.147	0.108	**0.967**	**0.510**
Calcium	mg/L	Intrawell Background Value (UPL)	141	167	227	156
		Analytical Result	102	103	109	113
Chloride	mg/L	Interwell Background Value (UPL)	834			
		Analytical Result	16.3	695	**1,820**	97.3
Fluoride	mg/L	Interwell Background Value (UPL)	4.39			
		Analytical Result	0.85	2.7	**6.8**	1.3
pH	SU	Interwell Background Value (UPL)	9.1			
		Interwell Background Value (LPL)	7.0			
		Analytical Result	7.3	7.3	7.4	7.2
Sulfate	mg/L	Interwell Background Value (UPL)	81.9			
		Analytical Result	54.1	18.1	16.7	**356**
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	1,640			
		Analytical Result	400	1,480	**3,330**	1,060

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Northeastern Bottom Ash Pond CCR management area and that the requirements of OAC 252:517-9-4(g) have been met.

David Anthony Miller

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

26057	Oklahoma	02.24.2023
License Number	Licensing State	Date

ATTACHMENT B
Statistical Analysis Output

FIGURE A
Time Series

GROUNDWATER STATS CONSULTING

February 15, 2023

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Northeastern BAP (Bottom Ash Pond)
Background Update & Assessment Monitoring Statistics – November 2022

Dear Ms. Kreinberg,

Groundwater Stats Consulting (GSC), formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the statistical analysis and background update of 2022 groundwater data for American Electric Power Inc.'s Northeastern BAP. The analysis complies with the Oklahoma Administrative Code (OAC) as well as with the United States Environmental Protection Agency (USEPA) Unified Guidance (2009).

Sampling began at the site for the OAC program in 2017. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** SP-4 and SP-5R
- **Downgradient wells:** SP-1, SP2, SP-10, and SP-11

Data were sent electronically, and the statistical analysis was conducted according to the Statistical Analysis Plan and screening evaluation prepared by GSC and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC. The analysis was reviewed by Kristina Rayner, Senior Statistician and Founder of Groundwater Stats Consulting.

The OAC program consists of the following constituents listed below. The terms "constituent" and "parameter" are interchangeable.

- **Appendix A** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS
- **Appendix B** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium

For all constituents, a substitution of the most recent reporting limit is used for non-detect data. For calculating intrawell prediction limits, the substitution is performed for individual wells and may differ across wells. This generally gives the most conservative limit in each case.

Time series plots for Appendix A and B parameters are provided for all wells and are used to evaluate concentrations over time as well as for the purpose of updating statistical limits (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). Values in background which have been flagged as outliers may be seen in a lighter font and as a disconnected symbol on the graph. A summary of these values follows this letter (Figure C). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells.

For regulatory comparison of current observations against statistical limits for Appendix A constituents, the annual site-wide false positive rate is based on the USEPA Unified Guidance (2009) recommendation of 10% (5% for each semi-annual sample event). Power curves were provided with the previous screening and demonstrated that the selected statistical method provides sufficient power to detect a change at any of the downgradient wells which complies with the USEPA Unified Guidance recommendation. The EPA suggests the selected statistical method should provide at least 55% power at 3 standard deviations or at least 80% power at 4 standard deviations. Power curves were based on the following:

Semi-Annual Sampling
1-of-2 resample plan
Constituents, c=7
Downgradient wells, w=4

Summary of Statistical Method – Appendix A Parameters

Based on the original background screening described in the 2017 screening report, the following statistical methods were selected for Appendix A parameters:

1) Intrawell prediction limits, combined with a 1-of-2 resample plan for calcium
2) Interwell prediction limits, combined with a 1-of-2 resample plan for boron, chloride, fluoride, pH, sulfate, and TDS

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are non-detects, a nonparametric test is utilized. While the annual false positive rate associated with parametric limits is fixed at 10% as recommended by the EPA Unified Guidance (2009), the false positive rate associated with nonparametric limits is not fixed and depends upon the available background sample size, number of future comparisons, and verification resample plan. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits as appropriate. Non-detects are handled as follows:

- No statistical analyses are required on wells and analytes containing 100% non-detects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% non-detects, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for non-detects is the most recent practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% non-detects, the Kaplan-Meier non-detect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% non-detects.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits is necessary to accommodate these types of changes. In the intrawell case, data for all wells and constituents may be re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater

quality. In the interwell case, prediction limits may be updated with upgradient well data following each sampling event after careful screening for any new outliers. In some cases, deselecting the earlier portion of data may be necessary prior to construction of limits so that resulting statistical limits are conservative (lower) from a regulatory perspective and capable of rapidly detecting changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

Summary of Appendix A Background Screening and Updates

December 2017 – Initial Background Screening

Interwell prediction limits combined with a 1-of-2 verification strategy were recommended for boron, chloride, fluoride, pH, sulfate and TDS; and intrawell prediction limits combined with a 1-of-2 verification strategy were recommended for calcium. All proposed background data were screened for outliers and trends during the background screening. The findings of those reports were submitted with that analysis. Interwell prediction limits utilize all upgradient well data for construction of statistical limits. During each sample event, upgradient well data may be screened for any newly suspected outliers or obvious trending patterns using time series plots. Intrawell prediction limits utilized the background data set that was originally screened in 2017. As recommended in the EPA Unified Guidance (2009), the background data sets are evaluated for the purpose of updating statistical limits, as described below, using the Mann-Whitney test when at least four additional measurements are available.

Background Update Summaries

December 2020

<u>Outlier Analysis</u>

Prior to updating background data sets for the Fall 2020 analysis, Tukey's outlier test and visual screening were used to re-evaluate data for outliers at all wells for calcium and at all upgradient wells for boron, chloride, fluoride, pH, sulfate, and TDS. No outliers were noted by Tukey's test at any of the wells for calcium. Values were flagged as outliers as a result of not accurately representing the populations for the following constituents in downgradient well SP-1: chloride, fluoride, and TDS. These constituents are evaluated using interwell methods; therefore, the values have no effect on the calculation of the prediction limits. Tukey's outlier test on pooled upgradient well data identified a few

outliers for Appendix A parameters, which included chloride and TDS. These values were flagged accordingly in the database.

Mann-Whitney Test

For calcium, which requires intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through October 2017 to the new compliance samples at each well through June 2020. A statistically significant difference was found between the two groups for calcium in well SP-11. The background for calcium in well SP-11 was truncated to consist of the 8 most recent samples at that time, which represented more recent current groundwater quality while providing statistical limits that are conservative from a regulatory perspective. Intrawell prediction limits, combined with a 1-of-2 resample plan, were constructed using all historical data through June 2020 for the remaining well/constituent pairs for calcium.

Trend Test

For parameters tested using interwell analyses (boron, chloride, fluoride, pH, sulfate, and TDS), the Sen's Slope/Mann-Kendall trend test was used on upgradient wells to determine whether concentrations are statistically increasing, decreasing or stable. Although statistically significant trends were identified, the magnitudes of the trends were either fairly small relative to average concentrations within each well or would not greatly affect the interwell prediction limits. Therefore, all well/constituent pairs using interwell prediction limits were updated using data through October 2020.

March 2022

Upgradient well data through December 2021 were screened for the purpose of updating the interwell prediction limits for boron, chloride, fluoride, pH, sulfate, and TDS. Intrawell prediction limits for calcium were updated after the Fall 2022 sample event when sufficient compliance samples were available.

Outlier Analysis

Prior to updating interwell prediction limits, Tukey's outlier test and visual screening were used to re-evaluate data through December 2021 at all upgradient wells for boron, chloride, fluoride, pH, sulfate, and TDS. Tukey's outlier test on pooled upgradient well data confirmed previously identified values for chloride and TDS, and no new values were flagged. No changes to values flagged in previous background updates occurred. As mentioned above, any flagged data are displayed in a lighter font and as a disconnected

symbol on the time series reports, as well as in a lighter font on the accompanying data pages.

Intrawell - Prediction Limits

Intrawell prediction limits, combined with a 1-of-2 resample plan, are constructed using historical data through June 2020 for calcium at all wells. As discussed earlier, background data sets for calcium are updated when a minimum of 4 new compliance samples are available. A list of well/constituent pairs using a truncated portion of their records follows this report (Date Ranges Table).

Interwell – Trend Test Evaluation

For parameters tested using interwell analyses (boron, chloride, fluoride, pH, sulfate, and TDS) the Sen's Slope/Mann-Kendall trend test was used on upgradient wells to determine whether concentrations are statistically increasing, decreasing or stable. Statistically significant trends were identified for the following upgradient well/constituent pairs:

Increasing:

- Sulfate: SP-4

Decreasing:

- Boron: SP-4 and SP-5R
- Sulfate: SP-5R

The magnitudes of the trends above were either fairly small relative to average concentrations within each well or would not greatly affect the interwell prediction limits. With limited background samples collected to date, all data from upgradient wells were used to construct interwell prediction limits for all Appendix A parameters except calcium, which is tested using intrawell prediction limits. As more data are collected, all upgradient well data will be re-evaluated for possible deselection of earlier measurements if they no longer represent present-day groundwater quality conditions.

Interwell – Prediction Limits

Interwell prediction limits, combined with a 1-of-2 resample plan, were updated using all available data from upgradient wells through October 2021 for boron, chloride, fluoride, pH, sulfate, and TDS. Interwell prediction limits pool upgradient well data to establish a background limit for an individual constituent.

February 2023

During this analysis, Tukey's outlier test and visual screening were used to evaluate data through June 2022 at all wells for calcium, which is tested using intrawell prediction limits, and through November 2022 at upgradient wells for boron, chloride, fluoride, pH, sulfate, and TDS, which are tested using interwell prediction limits (Figure C).

Additionally, prior to updating statistical limits, the Rank Von Neumann serial correlation test was used to evaluate earlier calcium data at all wells and boron, chloride, fluoride, pH, sulfate, and TDS data at upgradient wells as described below.

Outlier Analysis

Tukey's outlier test did not identify any outliers for calcium; therefore, no values were flagged. Tukey's outlier test on pooled upgradient well data confirmed previously identified values for chloride and TDS, but no new values were flagged. No changes to values flagged in previous background updates occurred. As mentioned above, any flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. A summary table of all flagged outliers follows this report (Figure C).

Rank Von Neumann

All wells were sampled approximately on a monthly basis in 2017 in order to establish initial baseline limits. After that time, sampling was performed on a semi-annual basis to ensure collection of independent groundwater samples as recommended in the EPA Unified Guidance (2009). During this analysis, the Rank Von Neumann serial correlation test was used to evaluate whether the measurements collected during 2017 represented independent samples, or whether serial correlation was present among the measurements which can result in limits which do not fully represent natural variation in groundwater quality (Figure D). The test was used to evaluate calcium at all wells and the remaining Appendix A constituents at upgradient wells. Significant serial correlation was identified for the following Appendix A well/constituent pairs:

- Calcium: SP-4 (upgradient)
- Sulfate: SP-4 and SP-5R (both upgradient)

As a result, the records for these well/constituent pairs were truncated to remove earlier measurements for construction of statistical limits using only more recent data that represent independent samples. Results of the Rank Von Neumann test follow this report.

Intrawell – Mann-Whitney Test

For calcium which is tested using intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through August 2020 to the new compliance samples at each well through June 2022 to evaluate whether the groups are statistically similar at the 99% confidence level, in which case background data may be updated with compliance data (Figure E). A statistically significant difference was identified for the following well/constituent pair:

- Calcium: SP-1

Although a statistically significant difference was identified, most compliance data were within the range of historic concentrations and including these observations resulted in a statistical limit that is more conservative (i.e., lower) form a regulatory perspective. Additionally, while a significant result was not identified by the Mann-Whitney test, the record for calcium at well SP-11 was slightly truncated to exclude elevated historical concentrations and use stable concentrations representative of present-day groundwater quality conditions for constructing statistical limits. Therefore, all data sets for calcium were updated with compliance samples through June 2022.

Intrawell - Prediction Limits

Intrawell prediction limits, combined with a 1-of-2 resample plan, are constructed using historical data through June 2022 for calcium at all wells. A summary table of the limits follows this report (Figure F). A list of well/constituent pairs using a truncated portion of their records follows this report (Date Ranges Table). No comparison of the November 2022 observation was performed in this analysis.

Interwell – Trend Test Evaluation

For parameters tested using interwell analyses (boron, chloride, fluoride, pH, sulfate, and TDS) the Sen's Slope/Mann-Kendall trend test was used on upgradient wells to determine whether concentrations are statistically increasing, decreasing or stable at the 99% confidence level (Figure G). Statistically significant trends were identified for the following upgradient well/constituent pairs:

Increasing:

- Sulfate: SP-4
- Chloride: SP-5R

Decreasing:

- Boron: SP-4 and SP-5R

The magnitudes of the trends above are either fairly small relative to average concentrations within each well or would not greatly affect the interwell prediction limits. With limited background samples collected to date, all data from upgradient wells were used to construct interwell prediction limits for all Appendix A parameters except calcium, which is tested using intrawell prediction limits. As more data are collected, all upgradient well data will be re-evaluated for possible deselection of earlier measurements if concentrations no longer represent present-day groundwater quality conditions.

Interwell – Prediction Limits

Interwell prediction limits, combined with a 1-of-2 resample plan, were updated using all available data from upgradient wells through November 2022 for boron, chloride, fluoride, pH, sulfate, and TDS (Figure H). Interwell prediction limits pool upgradient well data to establish a background limit for an individual constituent. A summary table of the updated limits may be found following this letter in the Prediction Limit Summary Tables. No comparison of the November 2022 observation was performed in this analysis.

Evaluation of Appendix B Parameters – November 2022

Prior to evaluating Appendix B parameters, background data are screened through visual screening and Tukey's outlier test for potential outliers and extreme trending patterns that would lead to artificially elevated statistical limits.

Outlier Analysis

For the current analysis, Tukey's outlier test on pooled upgradient well data identified outliers for fluoride, lead, mercury, and selenium and confirmed previously flagged values. Several of the values identified by Tukey's test were either similar to concentrations upgradient of the facility or were lower than the respective Maximum Contaminant Level (MCL); therefore, the values were not flagged as outliers. A summary of previously flagged outliers follows this report (Figure C).

During previous screenings, due to no variation in the data, Tukey's outlier test was not performed for cadmium in well SP-5R, mercury in all wells, selenium in well SP-5R, and thallium in all wells. Among upgradient wells, high values for cadmium, lead, and selenium were identified by Tukey's outlier test. Only the highest values for cadmium and lead were flagged as outliers to maintain statistical limits that are conservative from a regulatory

perspective. Substantially high values were identified for upgradient well SP-4 on 8/4/17 through visual screening and the highest values for arsenic, beryllium, cobalt, and mercury were flagged. This step will result in upper tolerance limits that are conservative (lower) from a regulatory perspective. More recent concentrations for barium in downgradient well SP-10 were noted to be significantly higher than historical concentrations. Therefore, earlier concentrations were previously deselected prior to constructing confidence intervals in order to evaluate present-day groundwater concentrations of barium at this well. As mentioned above, list of well/constituent pairs using a truncated portion of their records follows this report (Date Ranges Table).

Additionally, downgradient well data through November 2022 were screened through visual screening using time series graphs. Since the downgradient well data are used to construct confidence intervals, a regulatory conservative approach is taken in that values that are marginally high relative to the rest of the data are retained unless there is particular justification for excluding them. No additional outliers among downgradient wells were flagged during this analysis. Previously a high value for combined radium 226 + 228 in well SP-1 was flagged as an outlier. The following additional values were flagged as outliers as they did not adequately represent the populations at their respective wells: chromium in well SP-10; combined radium 226 + 228 in well SP-11; lithium in well SP-1; and molybdenum in well SP-10.

Rank Von Neumann

As mentioned above, background samples were collected approximately on a monthly basis during 2017 at all wells for Appendix B constituents. Since the EPA Unified Guidance recommends collection of independent groundwater samples, the Rank Von Neumann test for serial correlation was used to determine whether serial correlation was present among these earlier samples (Figure D). Significant serial correlation was identified for the following Appendix B well/constituent pairs:

- Barium: SP-4 (upgradient) and SP-11
- Cadmium: SP-4 and SP-5R (both upgradient), SP-1, and SP-10
- Chromium: SP-4 (upgradient)
- Lead: SP-10
- Lithium: SP-4 (upgradient) and SP-11
- Molybdenum: SP-2
- Selenium: SP-5R (upgradient) and SP-2
- Thallium: SP-4 and SP-5R (both upgradient), SP-1, SP-2, SP-10, and SP-11

As a result, the records for these well/constituent pairs were truncated to remove earlier measurements for construction of statistical limits using only more recent data that represent independent samples. Results of the Rank Von Neumann test follow this report.

Tolerance Limits

Parametric tolerance limits were used to calculate background limits from pooled upgradient well data through November 2022 for Appendix B parameters with a target of 95% confidence and 95% coverage to determine background limits. These limits will be updated on an annual basis at the end of each year. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the MCLs and background limits in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure I).

Groundwater Protection Standards

These background limits were compared to the Maximum Contaminant Levels (MCLs) and CCR Rule-Specified levels as shown in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure J).

Confidence Intervals

Confidence intervals were constructed on downgradient wells with data through November 2022 for each of the Appendix B parameters and then compared to the GWPS, i.e., the highest limit of the MCL, CCR Rule-Specified level, or background limit as discussed above (Figure K). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. Complete graphical results of the confidence intervals follow this letter. Exceedances were identified for the following well/constituent pairs:

- Barium: SP-10
- Fluoride: SP-10
- Lithium: SP-10

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Northeastern BAP. If you have any questions or comments, please feel free to contact us.

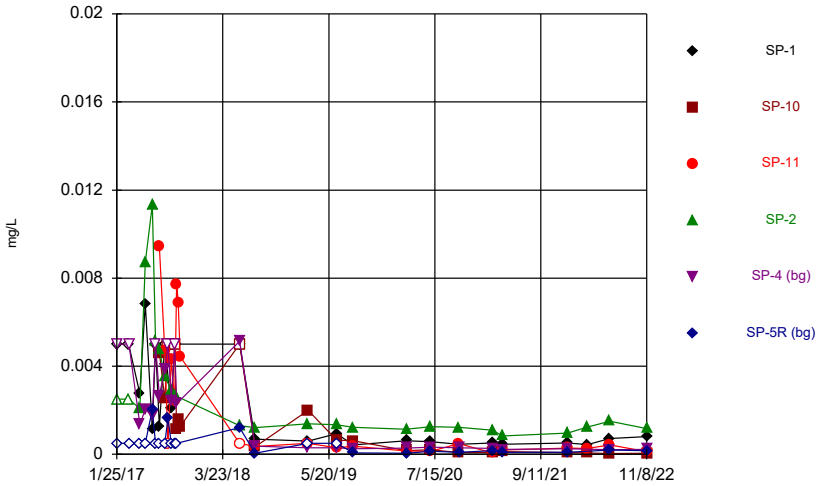
For Groundwater Stats Consulting,

Andrew T. Collins
Project Manager

Kristina L. Rayner
Senior Statistician

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



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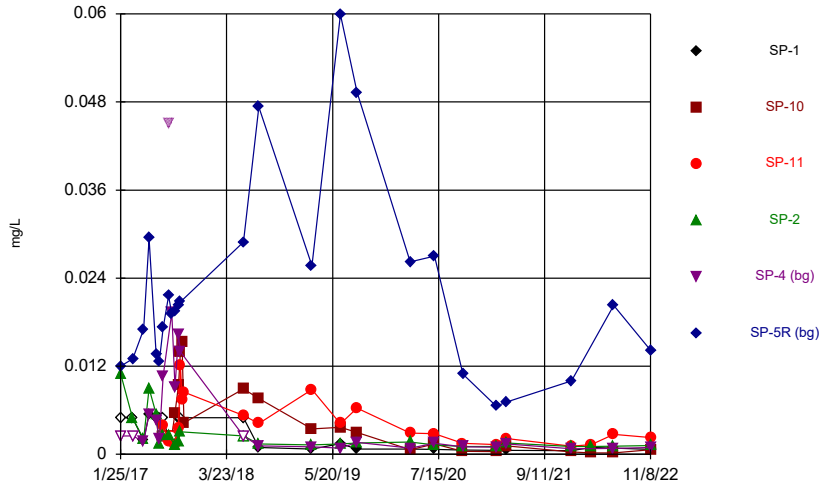

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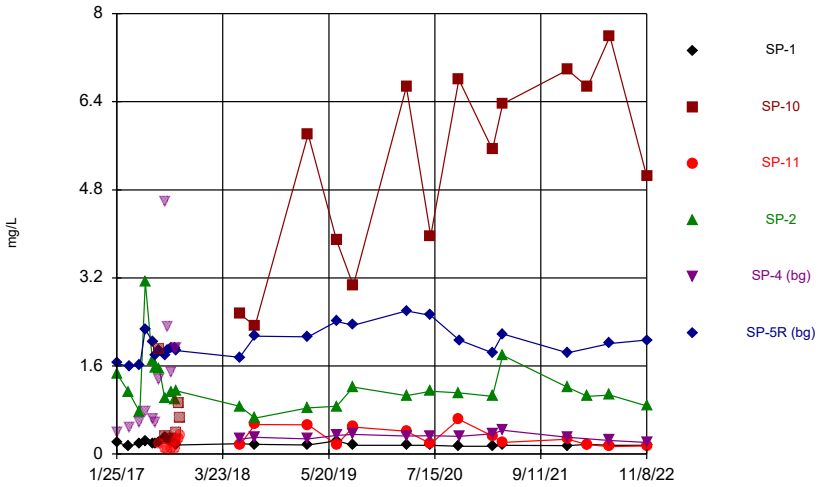
Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series



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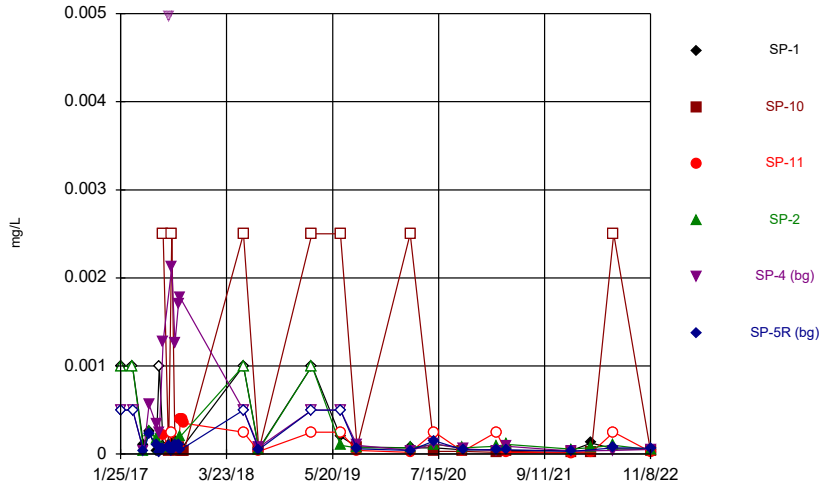

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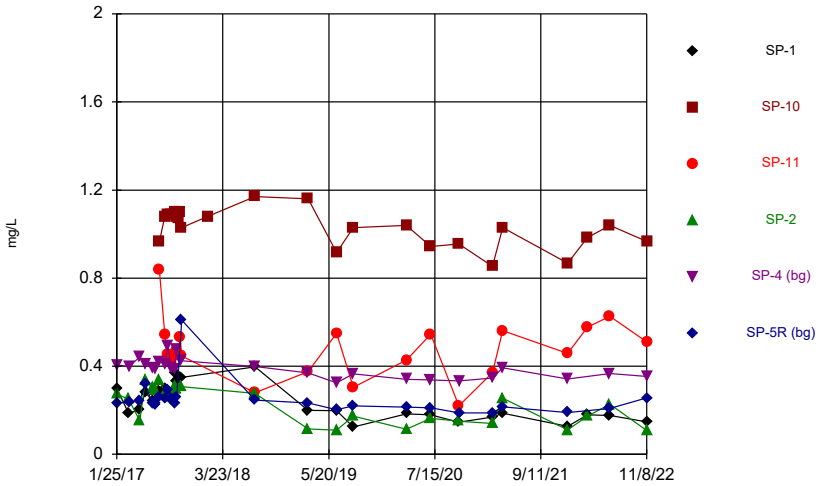
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series



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Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

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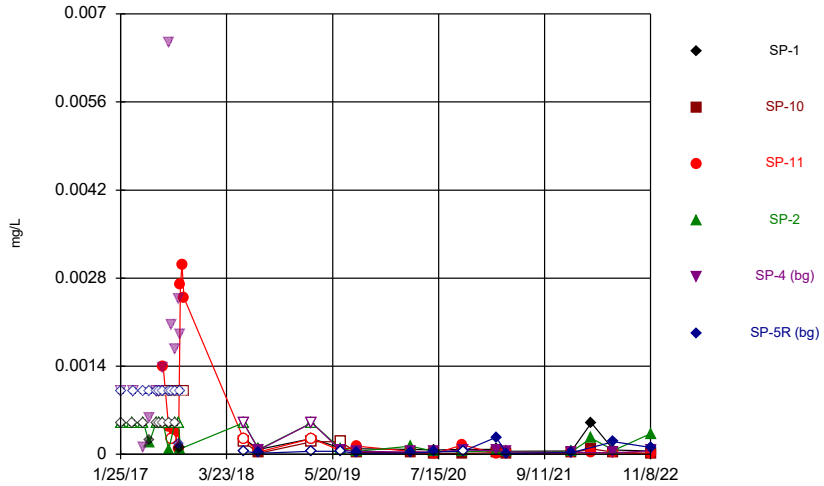

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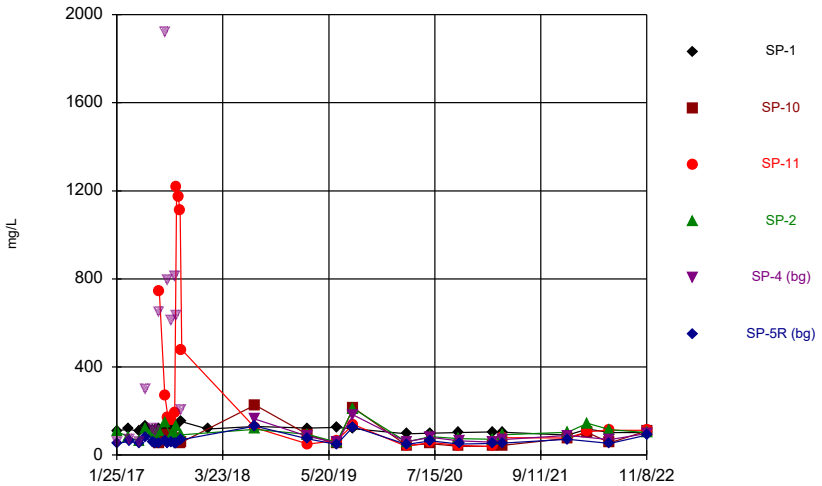
Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series



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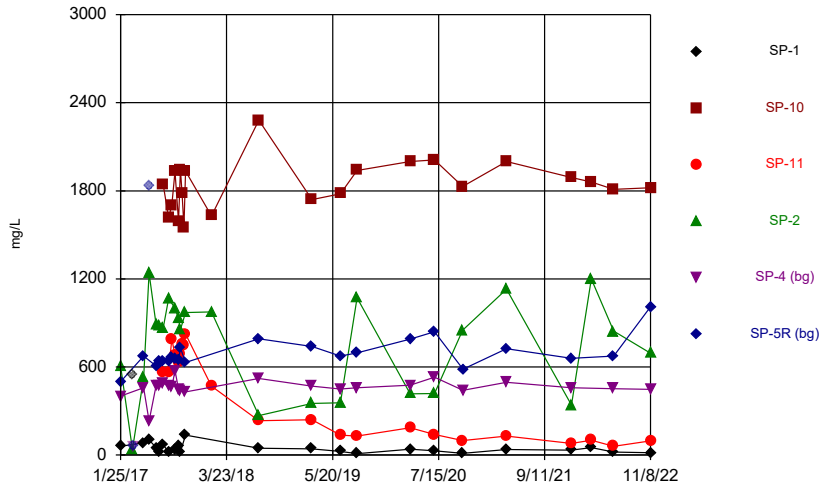
Time Series



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Hollow symbols indicate censored values.

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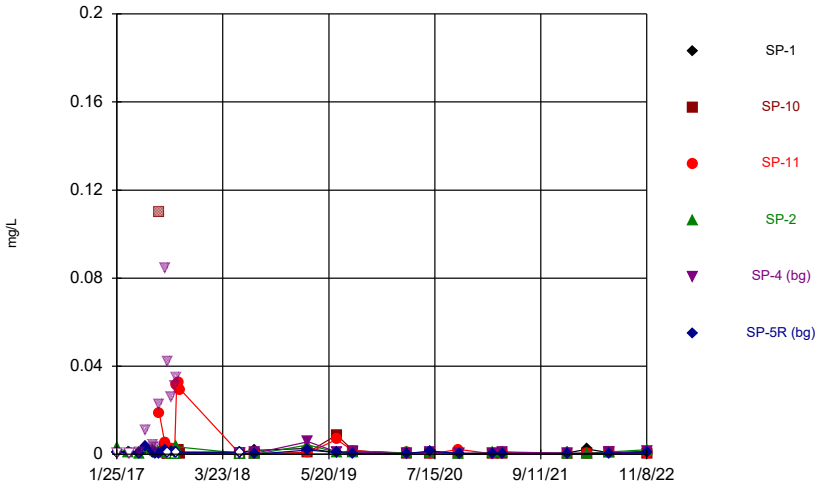

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Hollow symbols indicate censored values.

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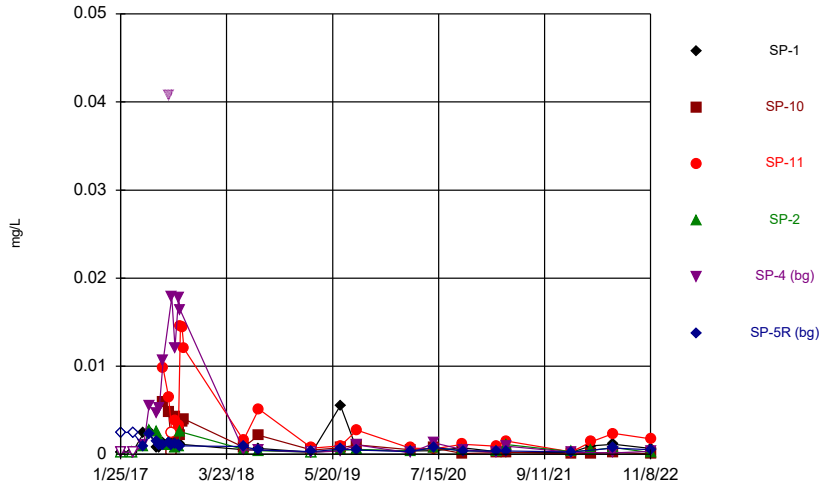

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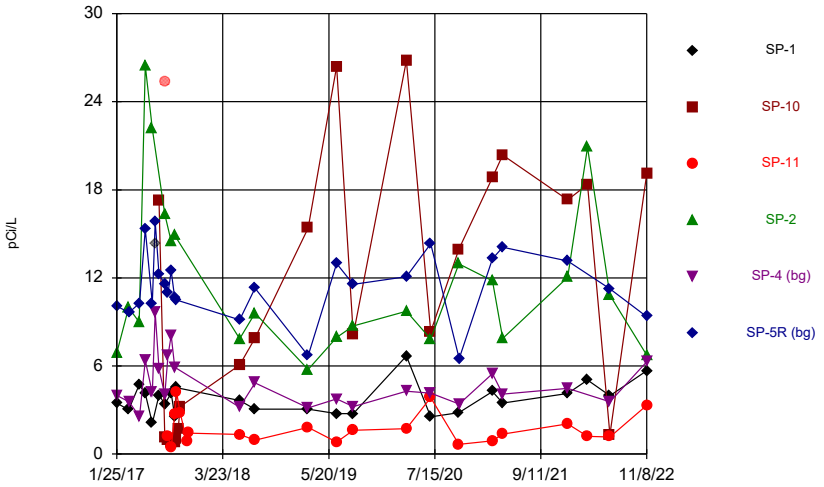
Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series



Constituent: Combined Radium 226 + 228 Analysis Run 2/10/2023 11:53 AM
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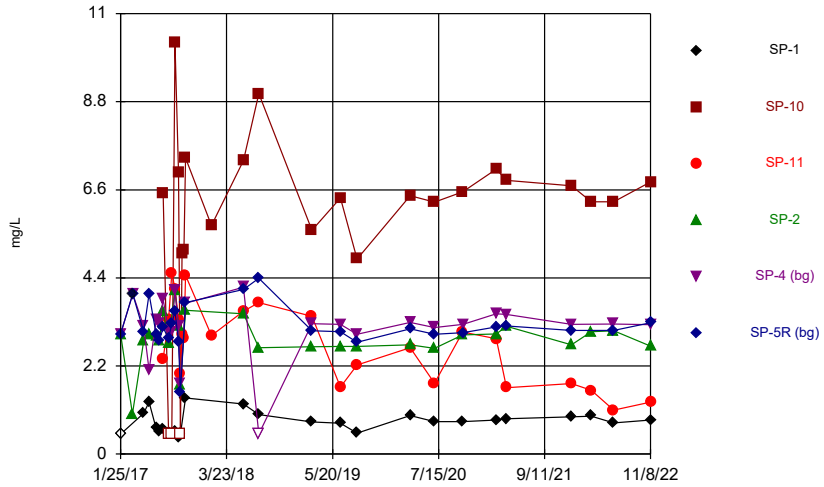
Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Fluoride Analysis Run 2/10/2023 11:53 AM
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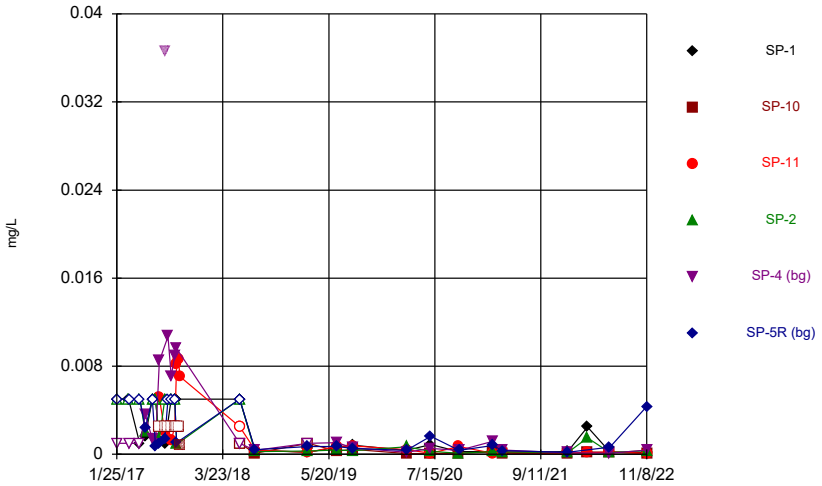
Hollow symbols indicate censored values.

Time Series



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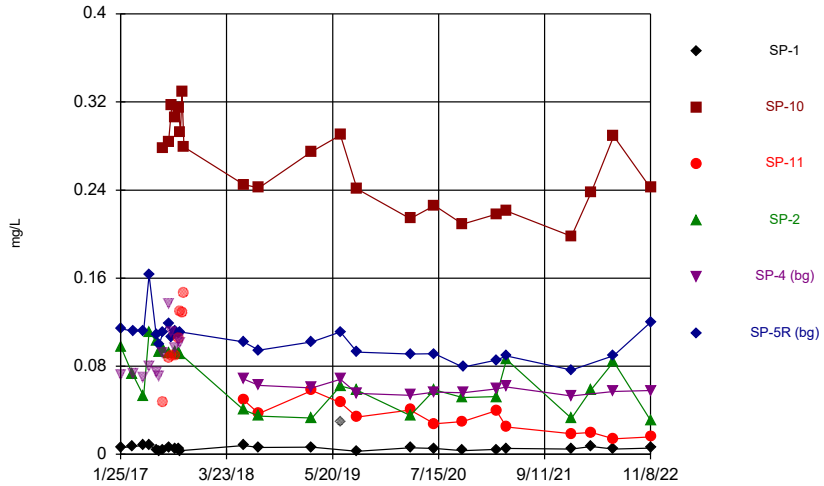
Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series



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Hollow symbols indicate censored values.

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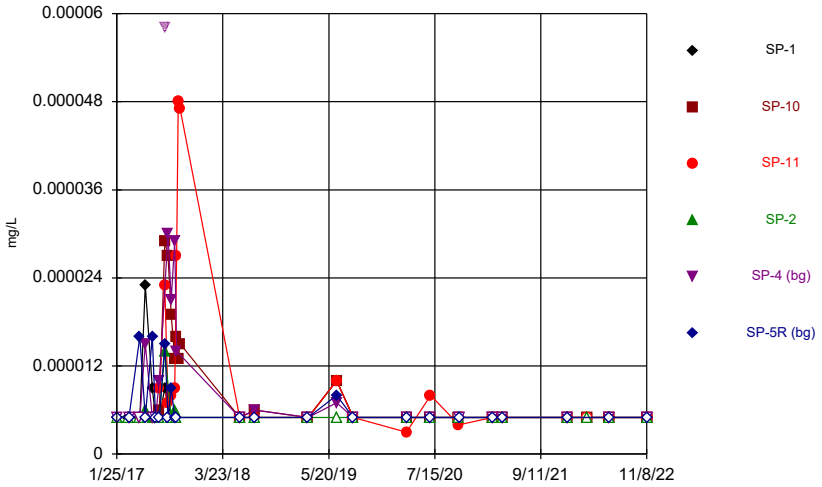

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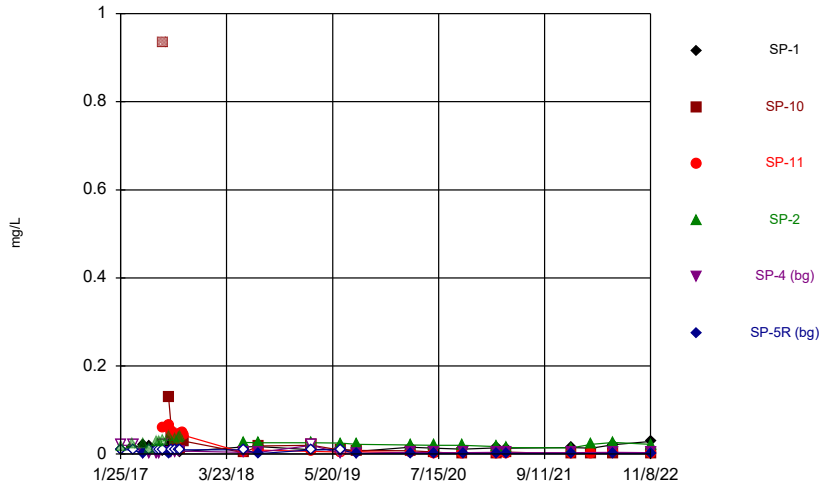
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

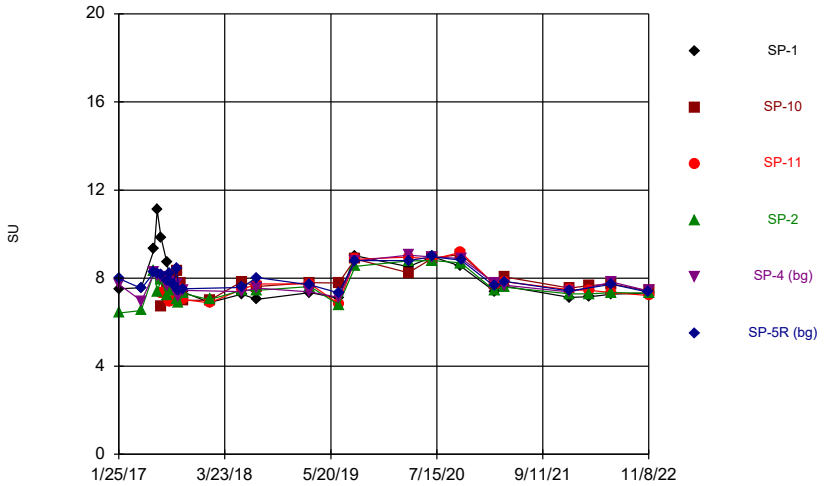
Time Series



Constituent: Molybdenum Analysis Run 2/10/2023 11:53 AM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series

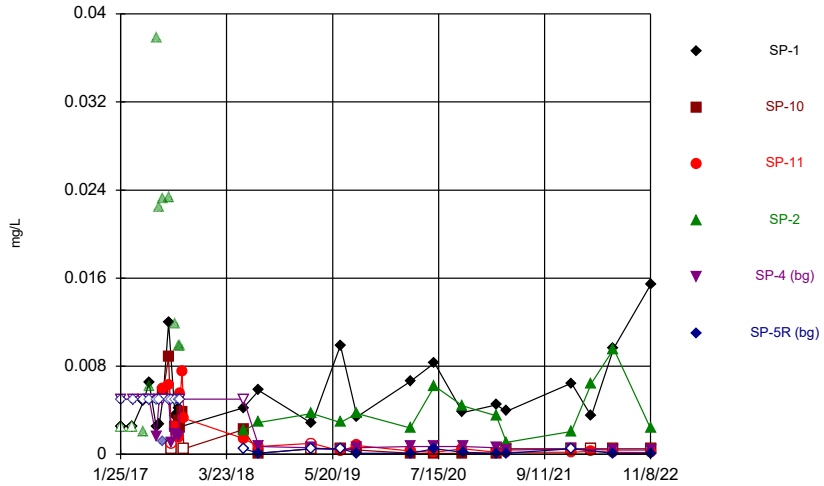


Constituent: pH, field Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series

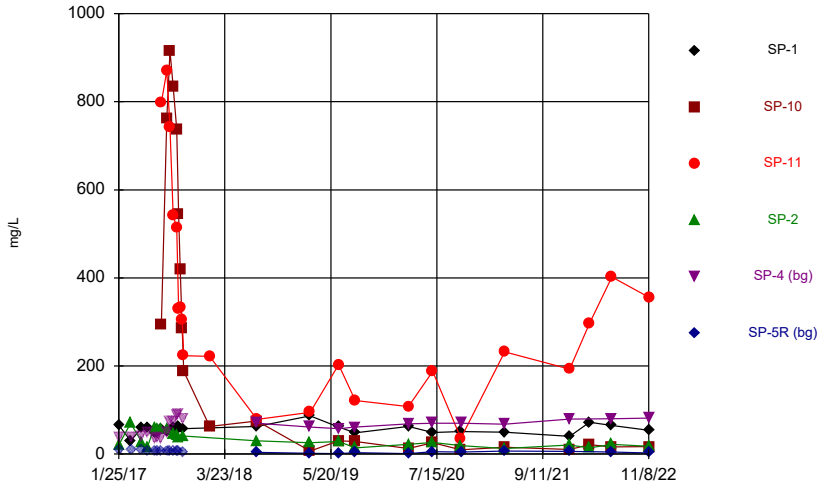


Constituent: Selenium Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series

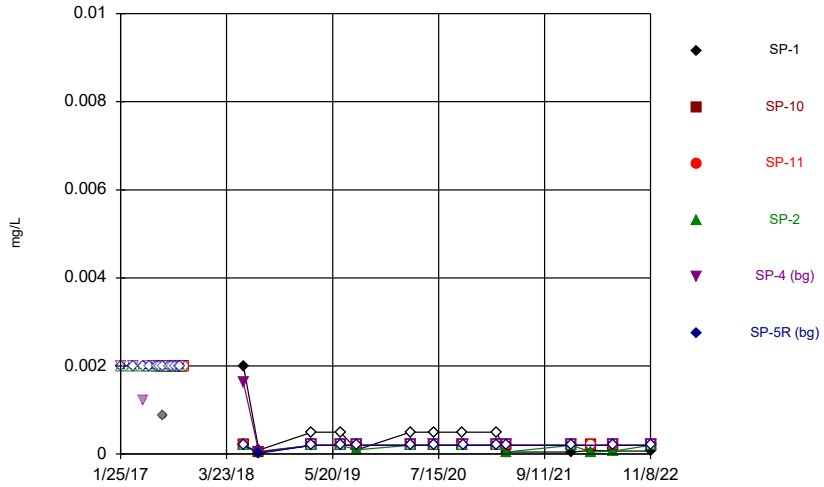


Constituent: Sulfate Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

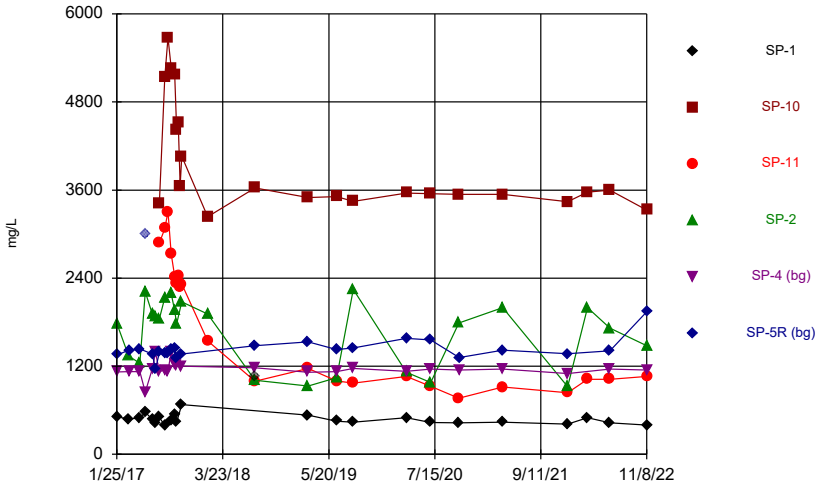
Time Series



Constituent: Thallium Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Time Series



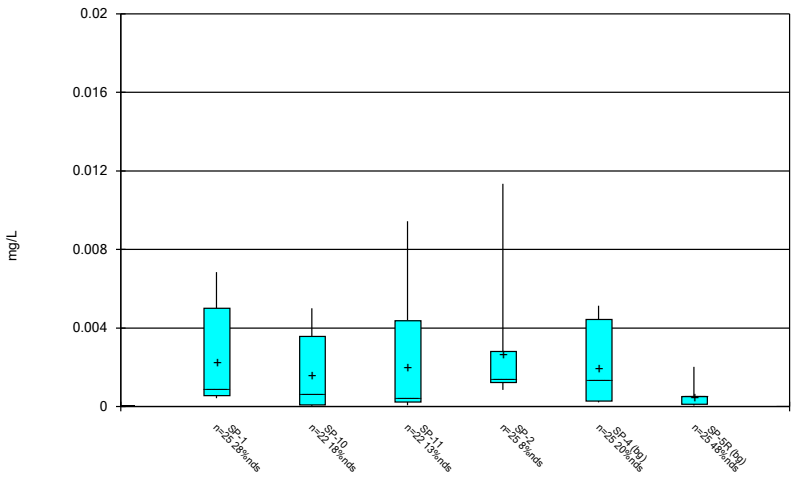
Constituent: Total Dissolved Solids [TDS] Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE B
Box Plots

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Box & Whiskers Plot

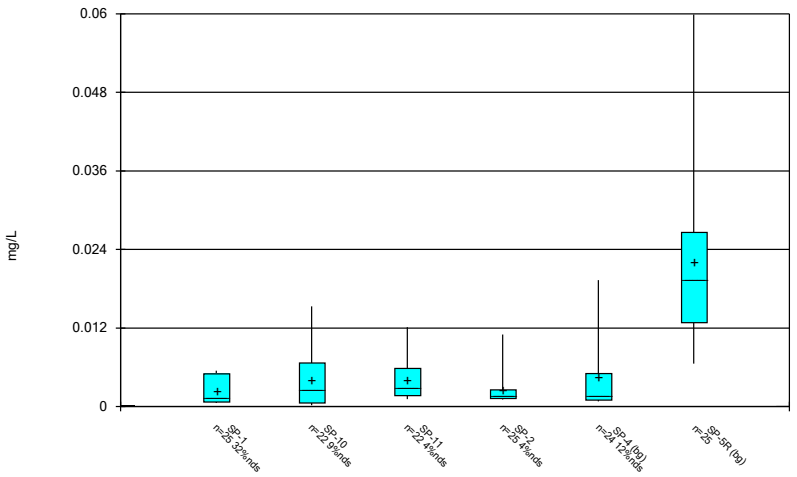


Constituent: Antimony Analysis Run 2/10/2023 1:10 PM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Box & Whiskers Plot

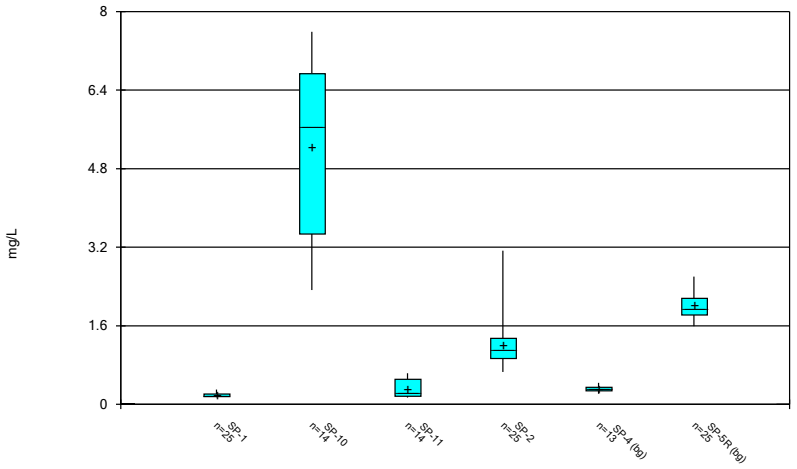


Constituent: Arsenic Analysis Run 2/10/2023 1:10 PM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Box & Whiskers Plot

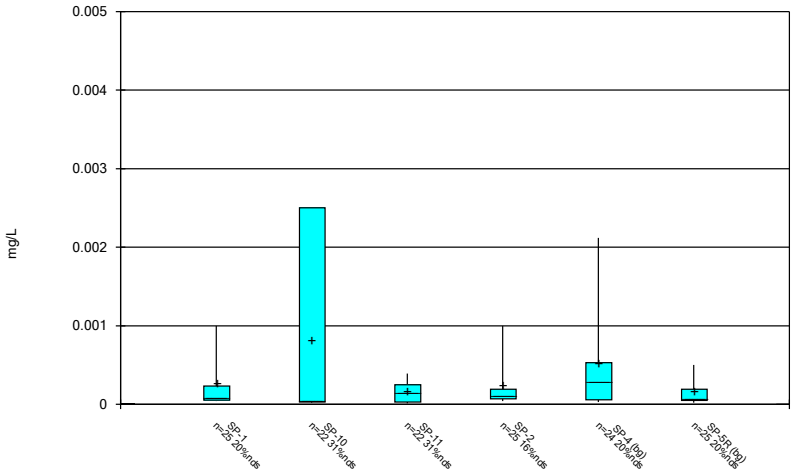


Constituent: Barium Analysis Run 2/10/2023 1:10 PM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

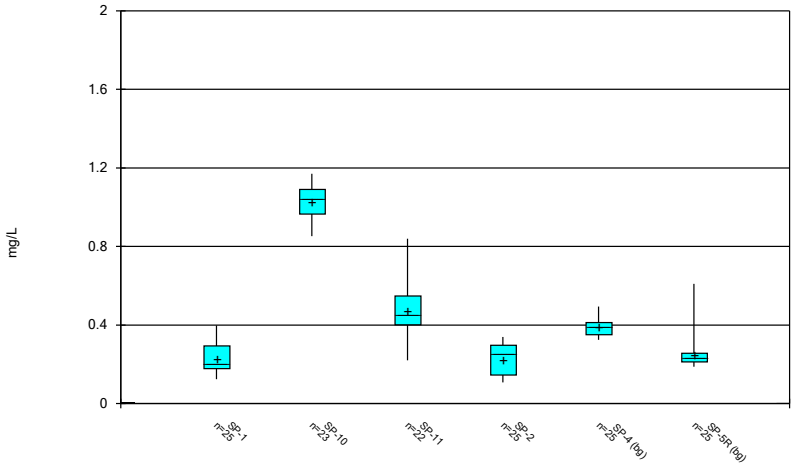
Box & Whiskers Plot



Constituent: Beryllium Analysis Run 2/10/2023 1:10 PM

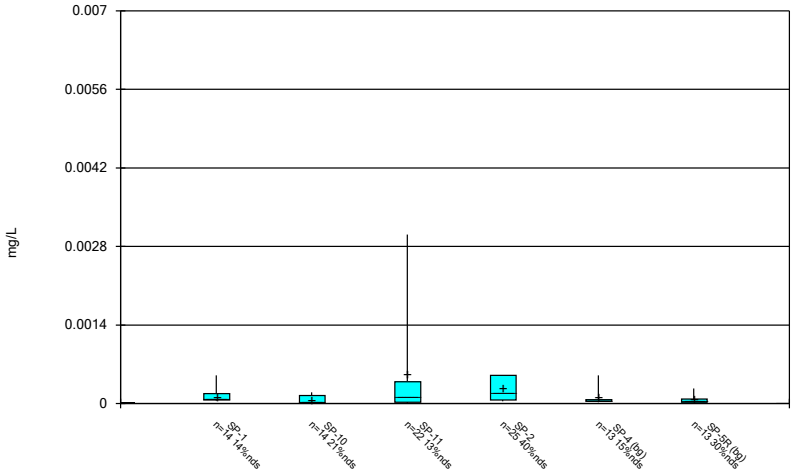
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



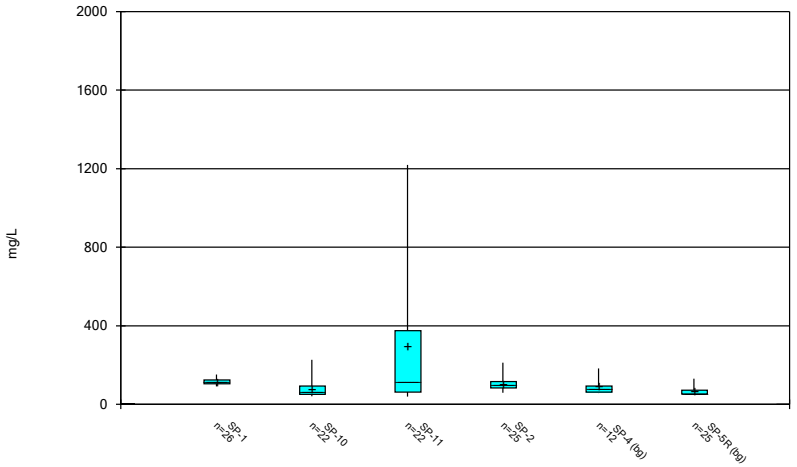
Constituent: Boron Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



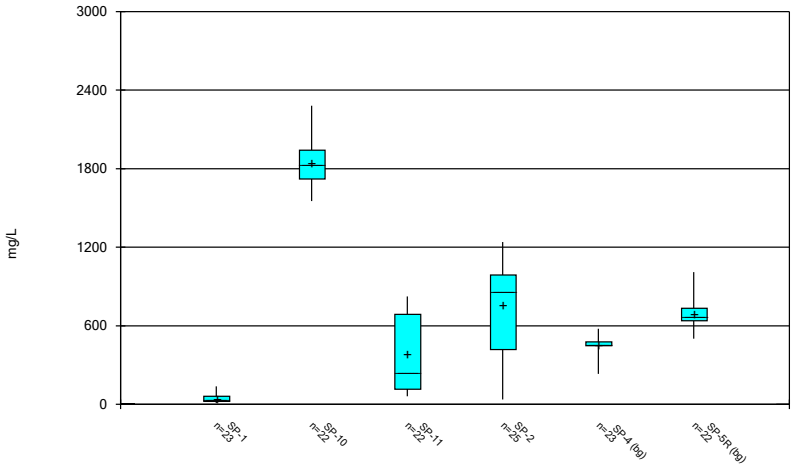
Constituent: Cadmium Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



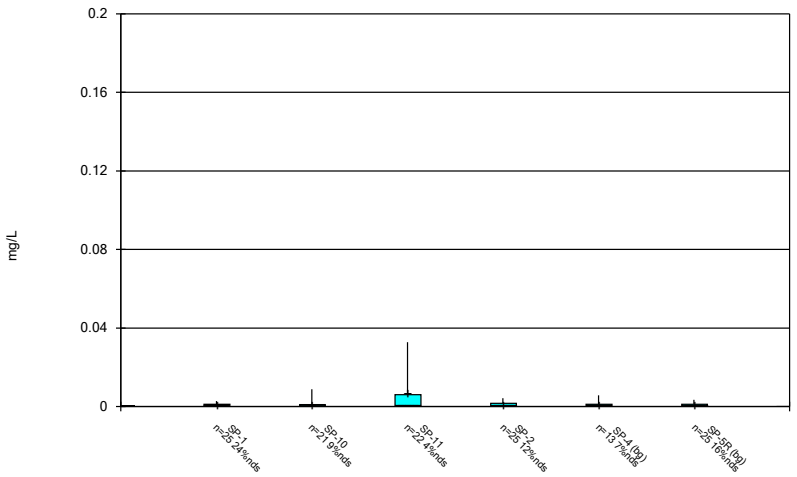
Constituent: Calcium Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



Constituent: Chloride Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

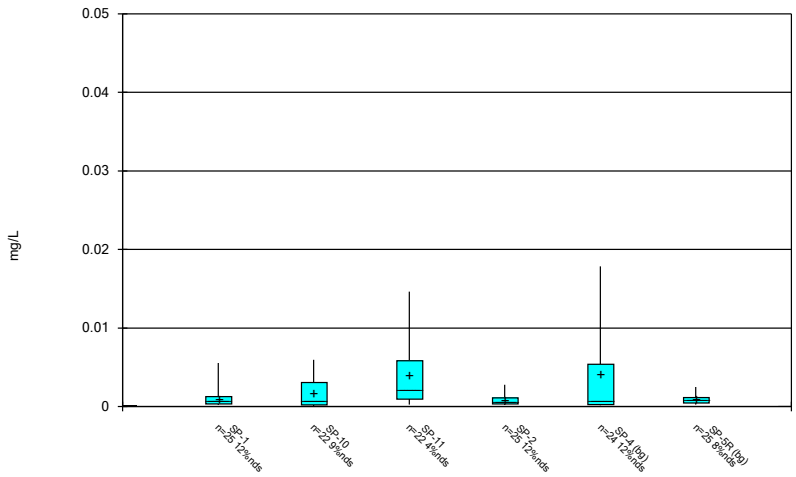
Box & Whiskers Plot



Constituent: Chromium Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

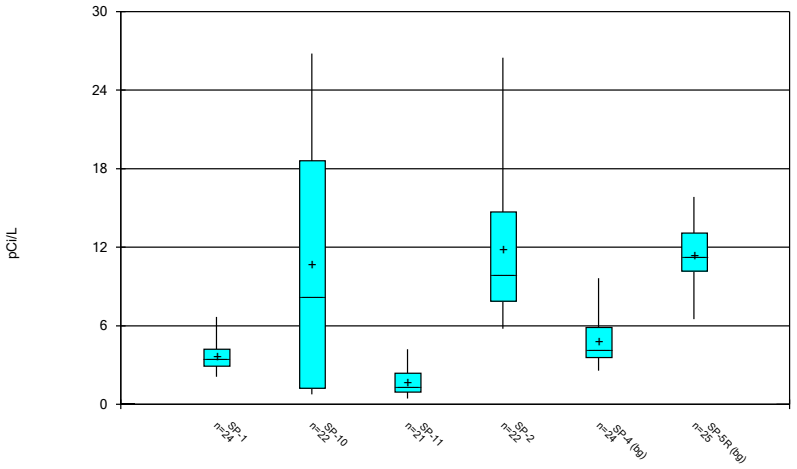
Box & Whiskers Plot



Constituent: Cobalt Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

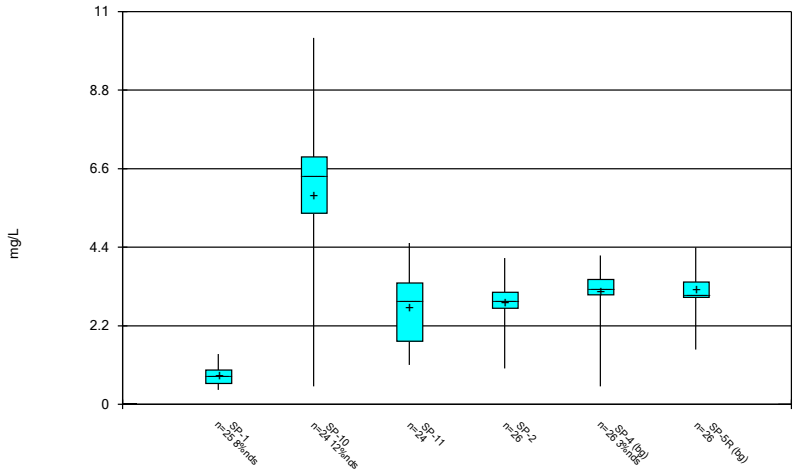
Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

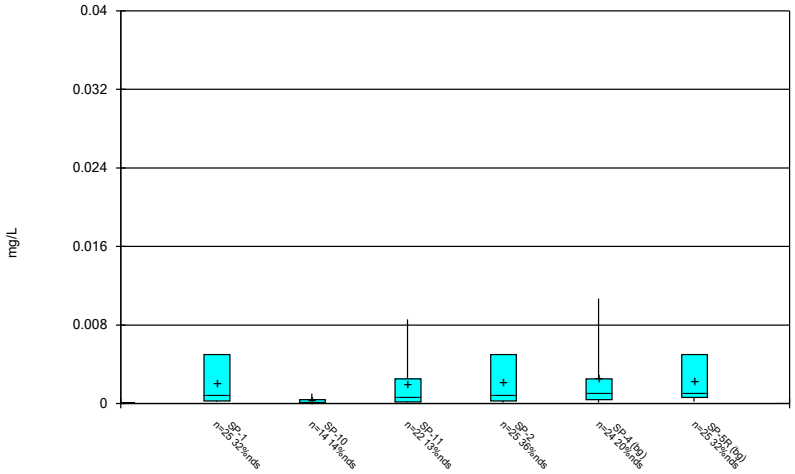
Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Box & Whiskers Plot



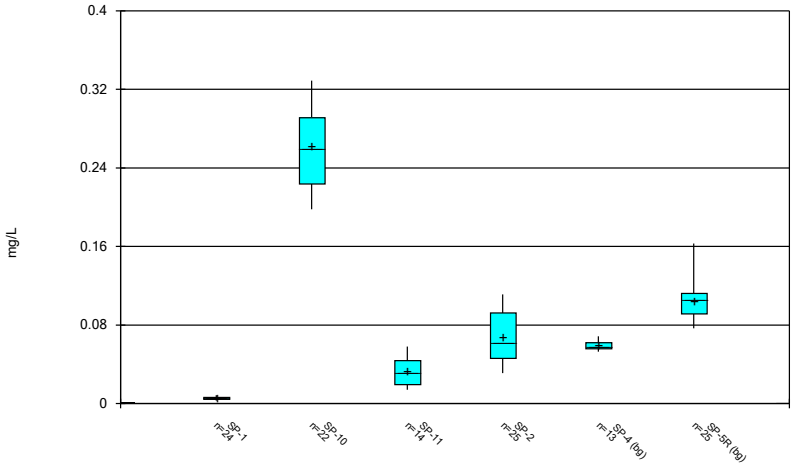
Constituent: Fluoride Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



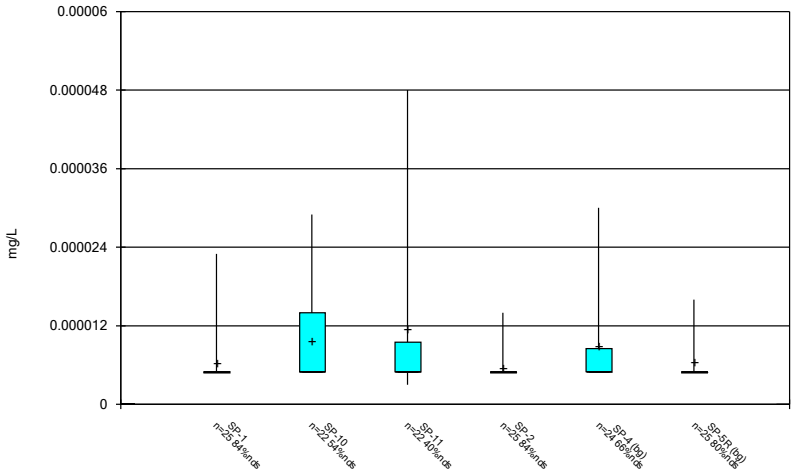
Constituent: Lead Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



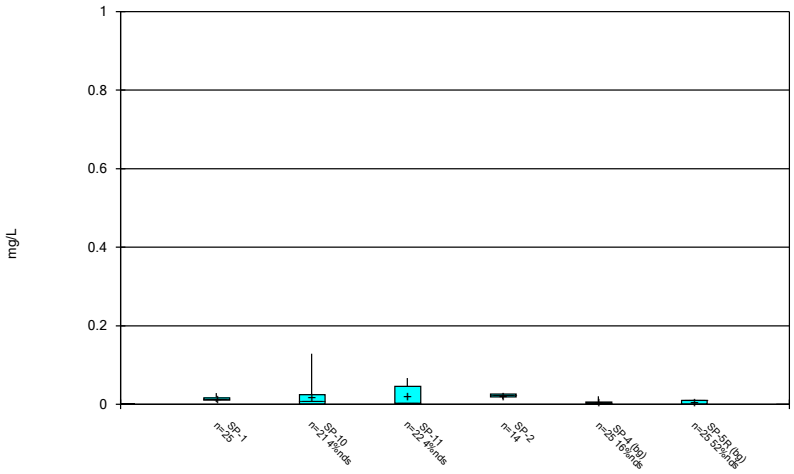
Constituent: Lithium Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



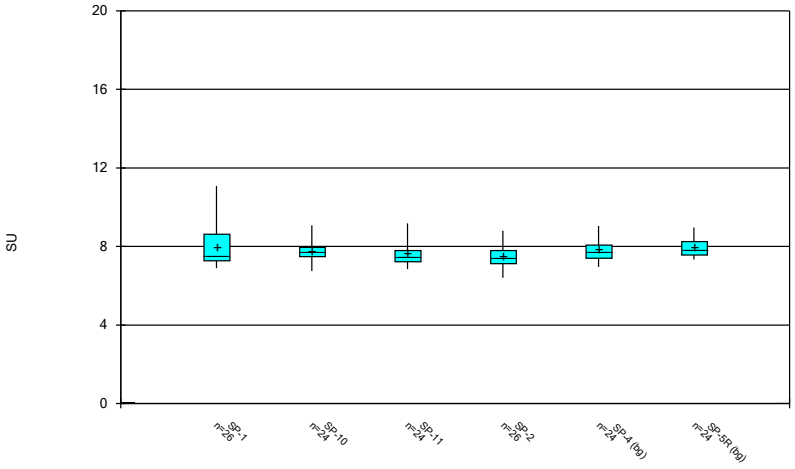
Constituent: Mercury Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



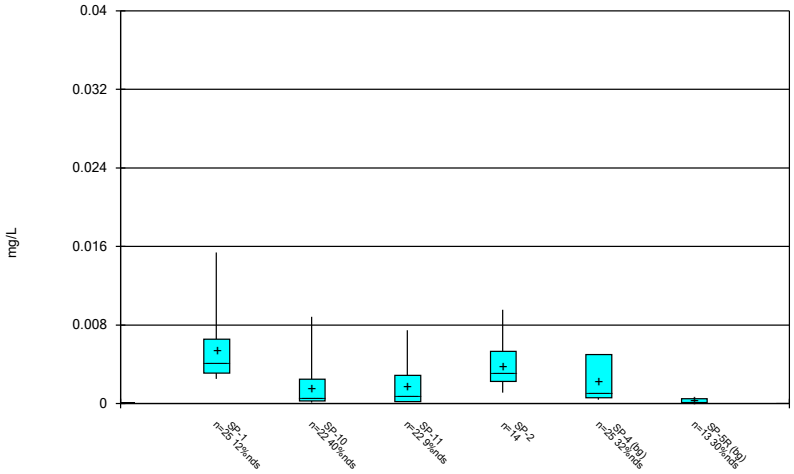
Constituent: Molybdenum Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



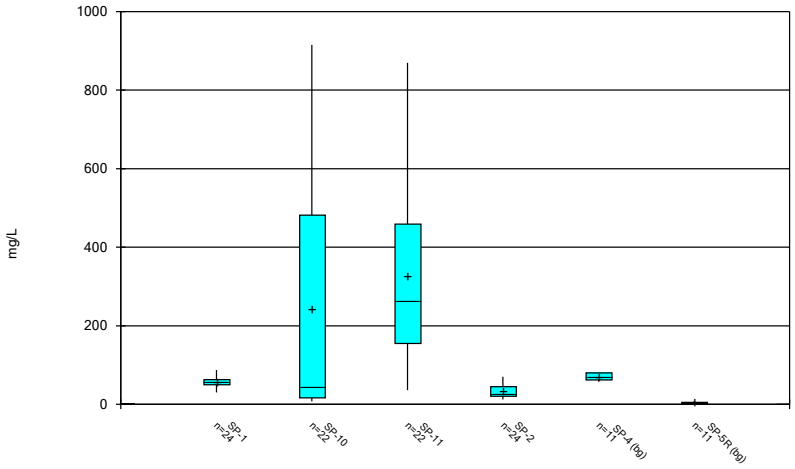
Constituent: pH, field Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



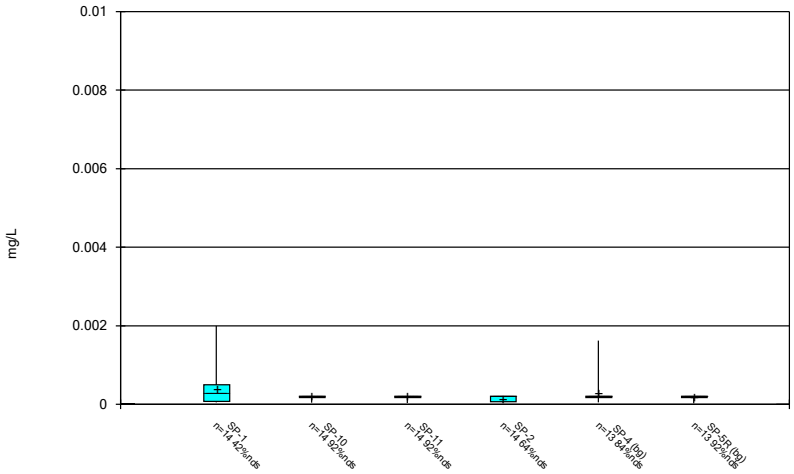
Constituent: Selenium Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



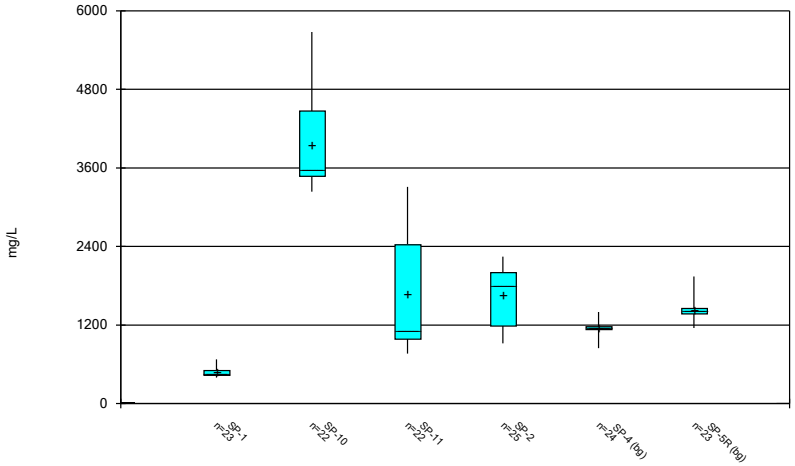
Constituent: Sulfate Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



Constituent: Thallium Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



Constituent: Total Dissolved Solids [TDS] Analysis Run 2/10/2023 1:10 PM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE C

Outlier Summary and Tukey's Outlier Test

Outlier Summary

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:15 PM

	SP-4 Arsenic (mg/L)	SP-4 Beryllium (mg/L)	SP-1 Chloride (mg/L)	SP-4 Chloride (mg/L)	SP-5R Chloride (mg/L)	SP-10 Chromium (mg/L)	SP-4 Cobalt (mg/L)	SP-1 Combined Radium 226 + 228 (pCi/L)	SP-11 Combined Radium 226 + 228 (pCi/L)	SP-1 Fluoride (mg/L)
3/13/2017			548 (o)							4 (o)
3/15/2017				52 (o)	62 (o)					
5/18/2017					1834 (o)					
6/27/2017								14.29 (o)		
7/13/2017						0.11 (o)				
8/4/2017	0.04498 (o)	0.00497 (o)					0.04069 (o)		25.367 (o)	
7/30/2018										
6/20/2019										

	SP-4 Lead (mg/L)	SP-1 Lithium (mg/L)	SP-4 Mercury (mg/L)	SP-10 Molybdenum (mg/L)	SP-1 Total Dissolved Solids [TDS] (mg/L)	SP-5R Total Dissolved Solids [TDS] (mg/L)
3/13/2017						
3/15/2017						
5/18/2017					3008 (o)	
6/27/2017						
7/13/2017				0.934 (o)		
8/4/2017	0.03663 (o)		5.8E-05 (o)			
7/30/2018					1060 (o)	
6/20/2019		0.03 (J,o)				

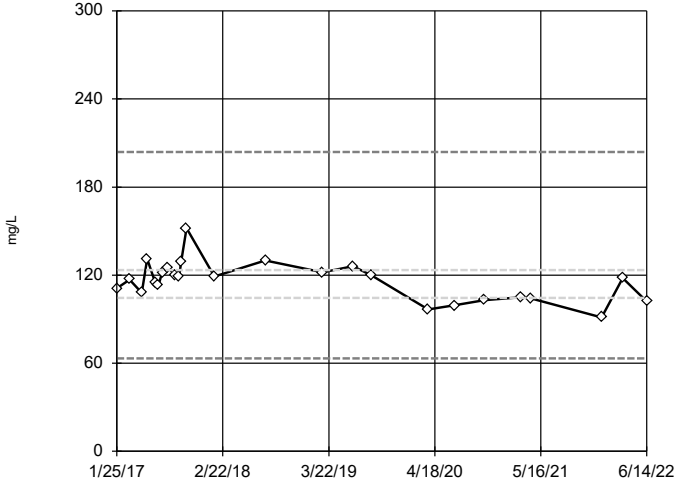
Tukey's Outlier Test - All Results (No Significant)

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:14 PM

Constituent	Well	Outlier	Value(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Calcium (mg/L)	SP-1	No	n/a	NP	NaN	25	115.9	13.21	ln(x)	ShapiroWilk
Calcium (mg/L)	SP-10	No	n/a	NP	NaN	21	79.44	50.65	ln(x)	ShapiroWilk
Calcium (mg/L)	SP-11	No	n/a	NP	NaN	21	307.2	396.2	ln(x)	ShapiroWilk
Calcium (mg/L)	SP-2	No	n/a	NP	NaN	24	102.5	33.2	ln(x)	ShapiroWilk
Calcium (mg/L)	SP-4 (bg)	No	n/a	NP	NaN	11	89.13	43.03	ln(x)	ShapiroWilk
Calcium (mg/L)	SP-5R (bg)	No	n/a	NP	NaN	24	64.08	21.76	ln(x)	ShapiroWilk

Tukey's Outlier Screening

SP-1



n = 25

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

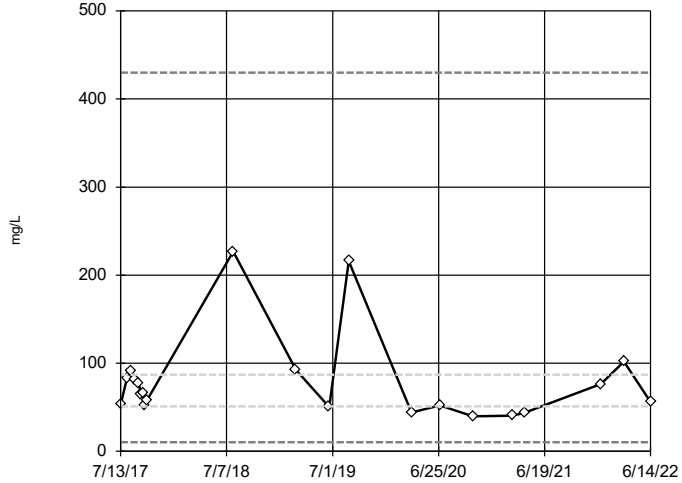
High cutoff = 203.8, low cutoff = 63.32, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 2/10/2023 1:14 PM View: Outlier Test
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

SP-10



n = 21

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

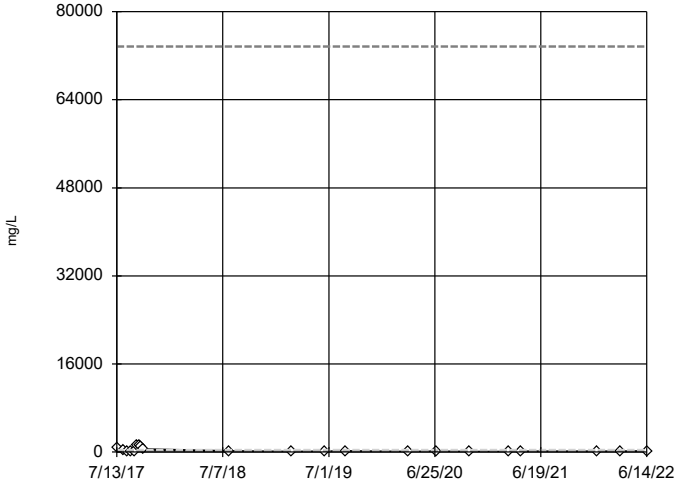
High cutoff = 430, low cutoff = 10.38, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 2/10/2023 1:14 PM View: Outlier Test
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

SP-11



n = 21

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

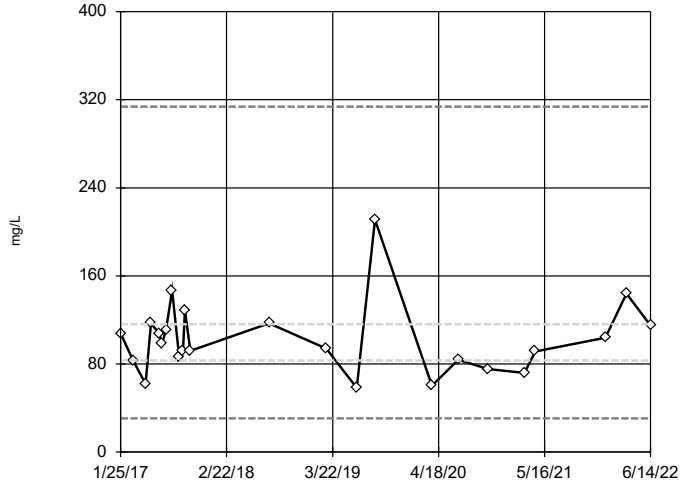
High cutoff = 73658, low cutoff = 0.3004, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 2/10/2023 1:14 PM View: Outlier Test
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

SP-2



n = 24

No outliers found. Tukey's method selected by user.

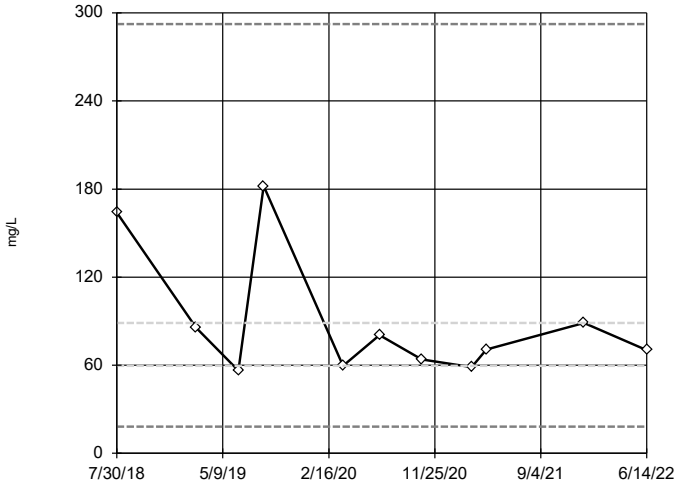
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 313.8, low cutoff = 30.77, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 2/10/2023 1:14 PM View: Outlier Test
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tukey's Outlier Screening

SP-4 (bg)



n = 11

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 292.4, low cutoff = 18.08, based on IQR multiplier of 3.

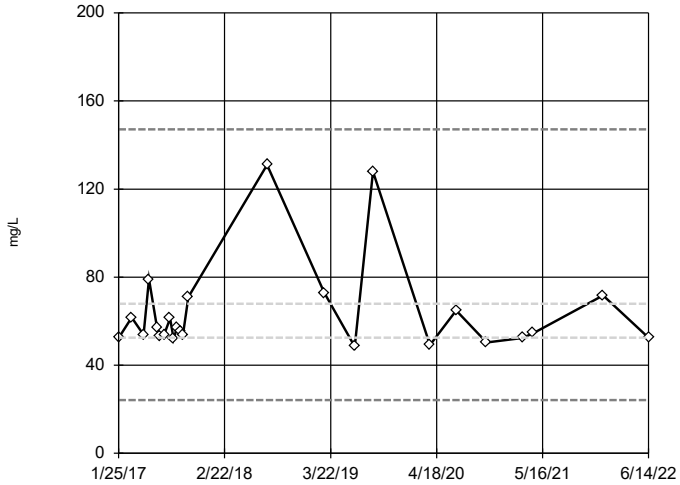
Constituent: Calcium Analysis Run 2/10/2023 1:14 PM View: Outlier Test

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

SP-5R (bg)



n = 24

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 147.2, low cutoff = 24.2, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 2/10/2023 1:14 PM View: Outlier Test

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tukey's Outlier Test - Upgradient Wells - Significant Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:13 PM

Constituent	Well	Outlier	Value(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Chloride (mg/L)	**SP-4,SP-5R**	**Yes**	**52,62,1834**	**NP**	**NaN**	**48**	**577.1**	**254**	**sqrt(x)**	**ShapiroWilk**
Fluoride (mg/L)	**SP-4,SP-5R**	**Yes**	**0.5**	**NP**	**NaN**	**52**	**3.184**	**0.6516**	**x^2**	**ShapiroFrancia**
Lead (mg/L)	**SP-4,SP-5R**	**Yes**	**0.03663**	**NP**	**NaN**	**50**	**0.002466**	**0.005558**	**ln(x)**	**ShapiroFrancia**
Mercury (mg/L)	**SP-4,SP-5R**	**Yes**	**0.000058,0.00003,0.000029**	**NP**	**NaN**	**50**	**0.00000868**	**0.000009222**	**ln(x)**	**ShapiroFrancia**
Selenium (mg/L)	**SP-4,SP-5R**	**Yes**	**0.00499**	**NP**	**NaN**	**38**	**0.000665**	**0.0008285**	**ln(x)**	**ShapiroWilk**
Total Dissolved Solids [TDS] (mg/L)	**SP-4,SP-5R**	**Yes**	**3008**	**NP**	**NaN**	**48**	**1328**	**306.5**	**ln(x)**	**ShapiroWilk**

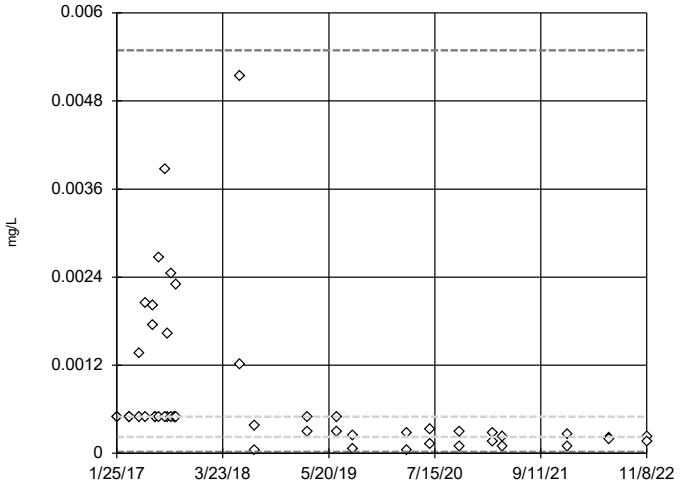
Tukey's Outlier Test - Upgradient Wells - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:13 PM

Constituent	Well	Outlier	Value(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	50	0.000786	0.001025	ln(x)	ShapiroFrancia
Arsenic (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	50	0.01397	0.01404	x^(1/3)	ShapiroFrancia
Barium (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	38	1.428	0.8429	x^3	ShapiroWilk
Beryllium (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	50	0.0004279	0.0008146	ln(x)	ShapiroFrancia
Boron (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	50	0.3188	0.09559	ln(x)	ShapiroFrancia
Cadmium (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	26	0.00006058	0.00005613	ln(x)	ShapiroWilk
Chloride (mg/L)	**SP-4,SP-5R**	**Yes**	**52,62,1834**	**NP**	**NaN**	**48**	**577.1**	**254**	**sqrt(x)**	**ShapiroWilk**
Chromium (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	38	0.0009132	0.001008	ln(x)	ShapiroWilk
Cobalt (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	50	0.003158	0.007029	ln(x)	ShapiroFrancia
Combined Radium 226 + 228 (pCi/L)	SP-4,SP-5R	No	n/a	NP	NaN	49	8.172	3.909	sqrt(x)	ShapiroWilk
Fluoride (mg/L)	**SP-4,SP-5R**	**Yes**	**0.5**	**NP**	**NaN**	**52**	**3.184**	**0.6516**	**x^2**	**ShapiroFrancia**
Lead (mg/L)	**SP-4,SP-5R**	**Yes**	**0.03663**	**NP**	**NaN**	**50**	**0.002466**	**0.005558**	**ln(x)**	**ShapiroFrancia**
Lithium (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	38	0.08877	0.02587	sqrt(x)	ShapiroWilk
Mercury (mg/L)	**SP-4,SP-5R**	**Yes**	**0.000058,0.00003,0.000029**	**NP**	**NaN**	**50**	**0.00000868**	**0.000009222**	**ln(x)**	**ShapiroFrancia**
Molybdenum (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	50	0.005028	0.003874	ln(x)	ShapiroFrancia
pH, field (SU)	SP-4,SP-5R	No	n/a	NP	NaN	48	7.896	0.5467	ln(x)	ShapiroWilk
Selenium (mg/L)	**SP-4,SP-5R**	**Yes**	**0.00499**	**NP**	**NaN**	**38**	**0.000665**	**0.0008285**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	22	36.85	34.38	ln(x)	ShapiroWilk
Thallium (mg/L)	SP-4,SP-5R	n/a	n/a	NP	NaN	26	0.0002419	0.0002846	unknown	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	**SP-4,SP-5R**	**Yes**	**3008**	**NP**	**NaN**	**48**	**1328**	**306.5**	**ln(x)**	**ShapiroWilk**

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

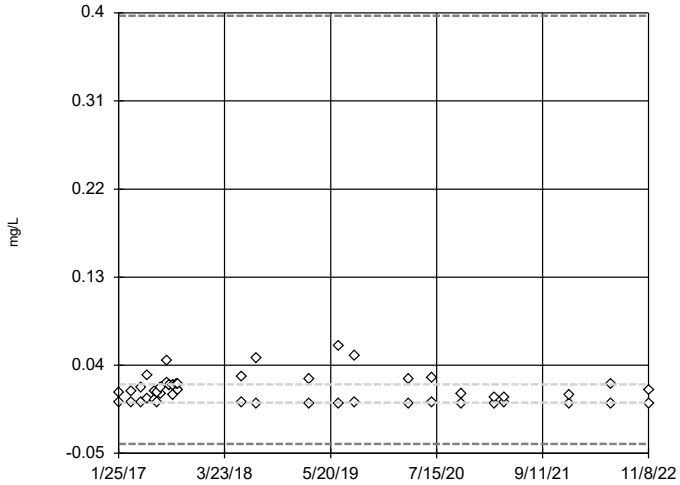
High cutoff = 0.005491, low cutoff = 0.00002048, based on IQR multiplier of 3.

Constituent: Antimony Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

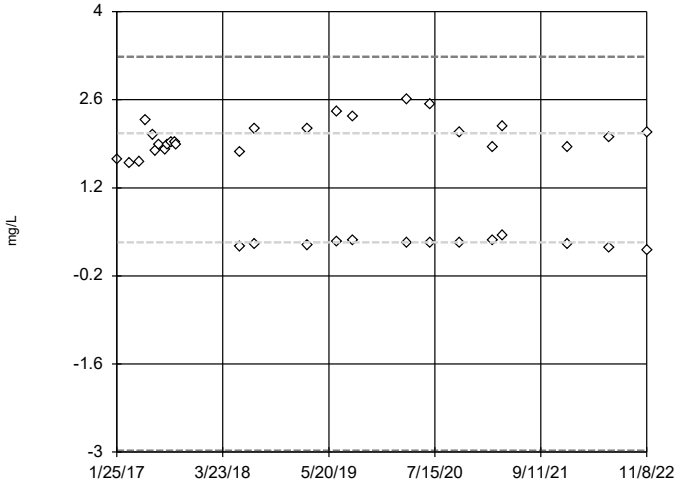
High cutoff = 0.3972, low cutoff = -0.04046, based on IQR multiplier of 3.

Constituent: Arsenic Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 38

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

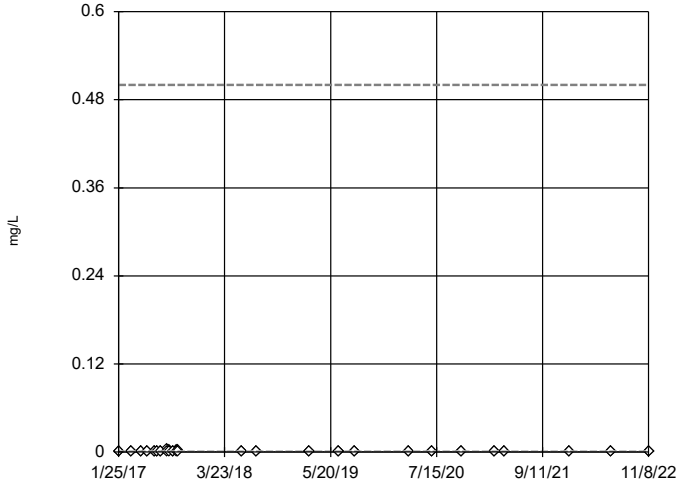
High cutoff = 3.282, low cutoff = -2.98, based on IQR multiplier of 3.

Constituent: Barium Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

No outliers found. Tukey's method selected by user.

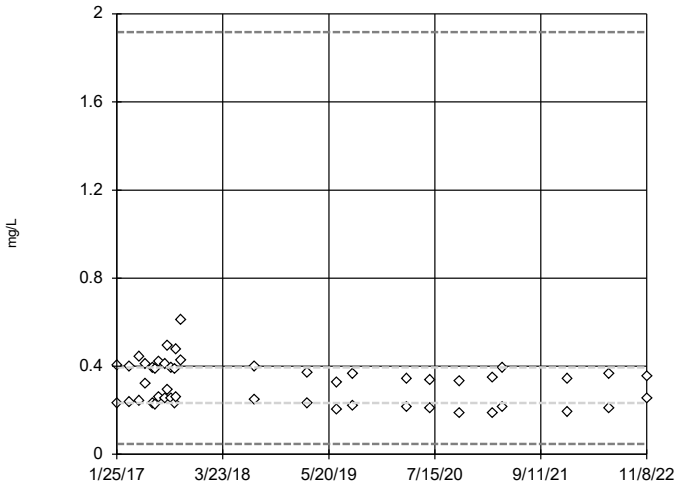
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.5, low cutoff = 5.0e-8, based on IQR multiplier of 3.

Constituent: Beryllium Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

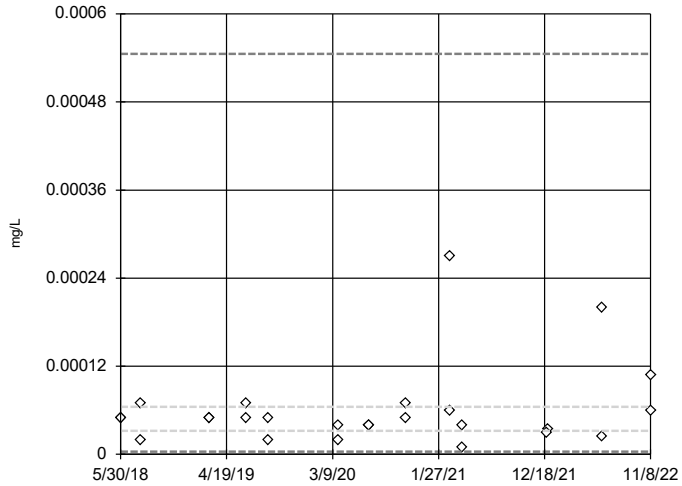
High cutoff = 1.917, low cutoff = 0.04778, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 26

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

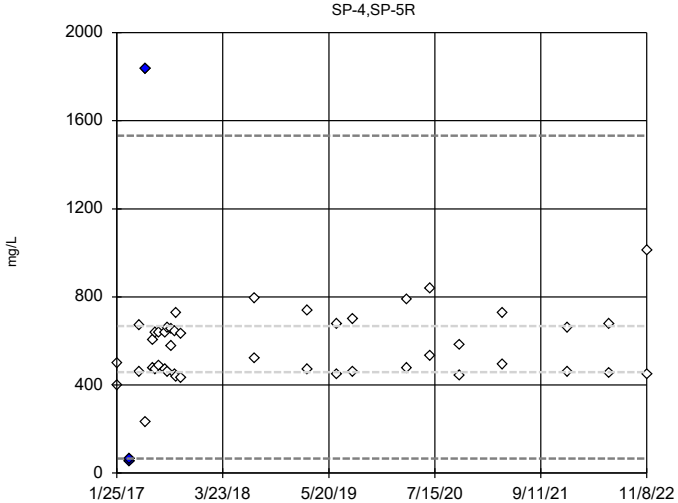
High cutoff = 0.0005455, low cutoff = 0.000003785, based on IQR multiplier of 3.

Constituent: Cadmium Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 48

Outliers are drawn as solid.
Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

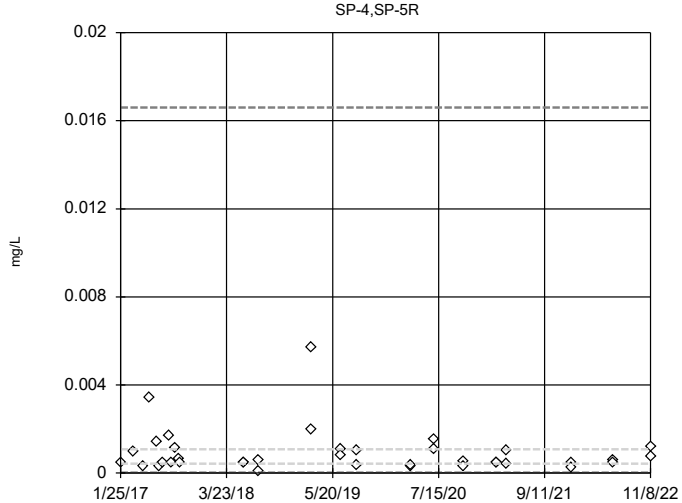
High cutoff = 1532, low cutoff = 65.55, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 38

No outliers found.
Tukey's method selected by user.

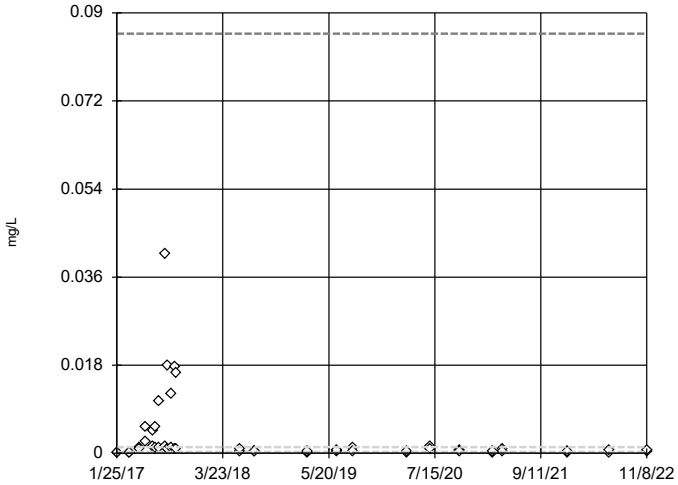
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.0166, low cutoff = 0.00002796, based on IQR multiplier of 3.

Constituent: Chromium Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

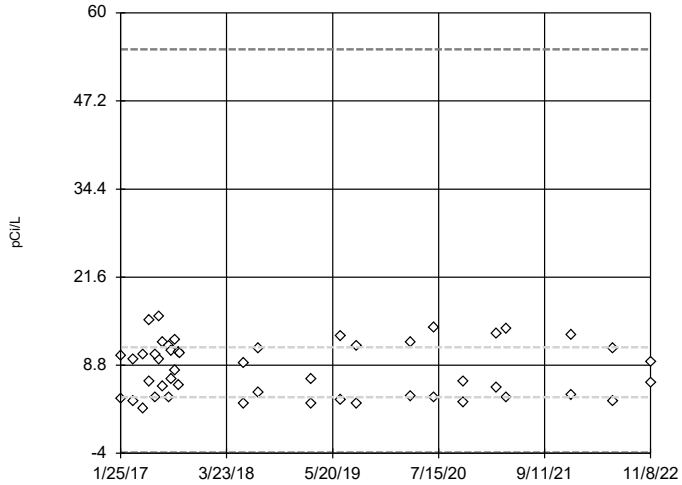
High cutoff = 0.08573, low cutoff = 0.000004878, based on IQR multiplier of 3.

Constituent: Cobalt Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 49

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

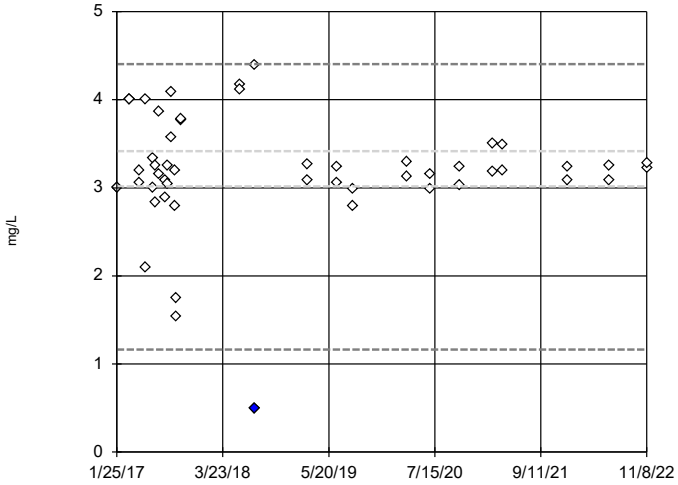
High cutoff = 54.71, low cutoff = -3.897, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 52

Outlier is drawn as solid. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

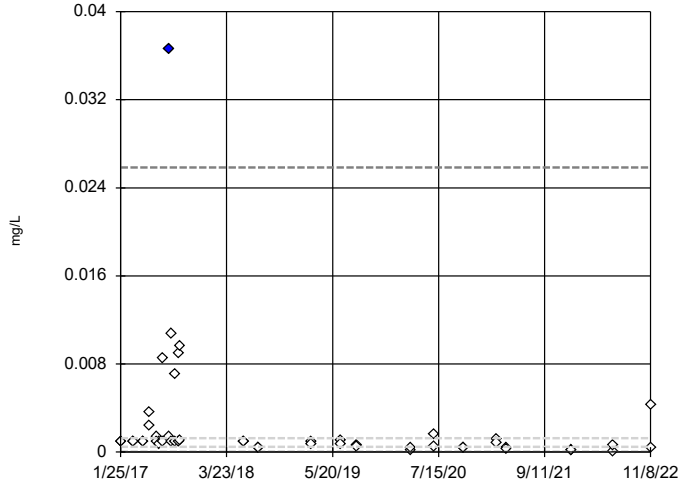
High cutoff = 4.405, low cutoff = 1.165, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

Outlier is drawn as solid. Tukey's method selected by user.

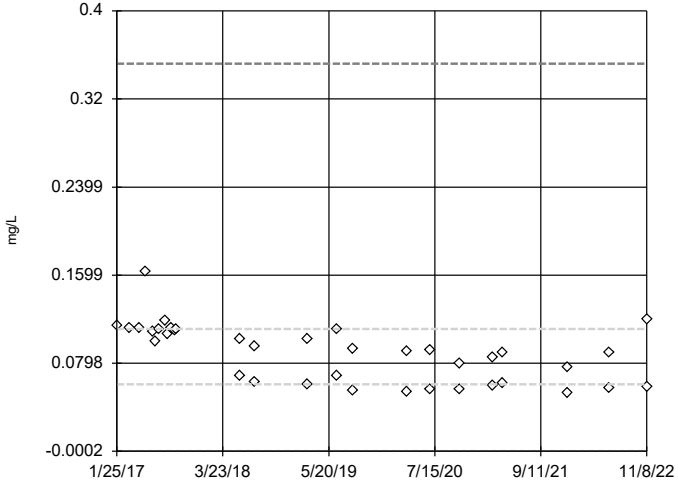
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.02586, low cutoff = 0.00002306, based on IQR multiplier of 3.

Constituent: Lead Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 38

No outliers found.
Tukey's method select-ed by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

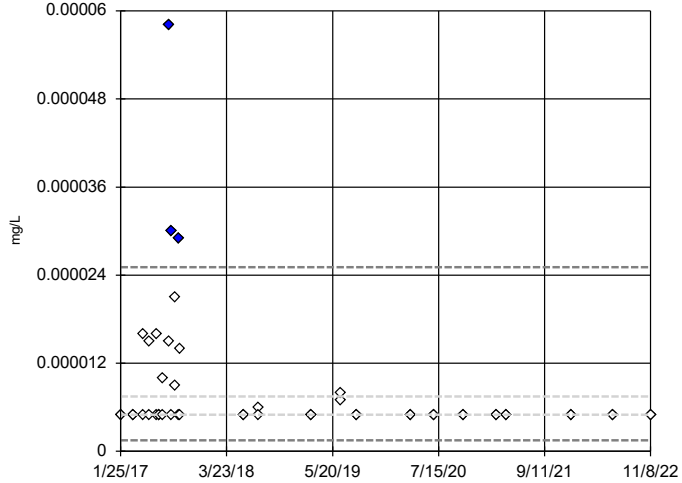
High cutoff = 0.3519, low cutoff = -0.0001852, based on IQR multiplier of 3.

Constituent: Lithium Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

Outliers are drawn as solid.
Tukey's method select-ed by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

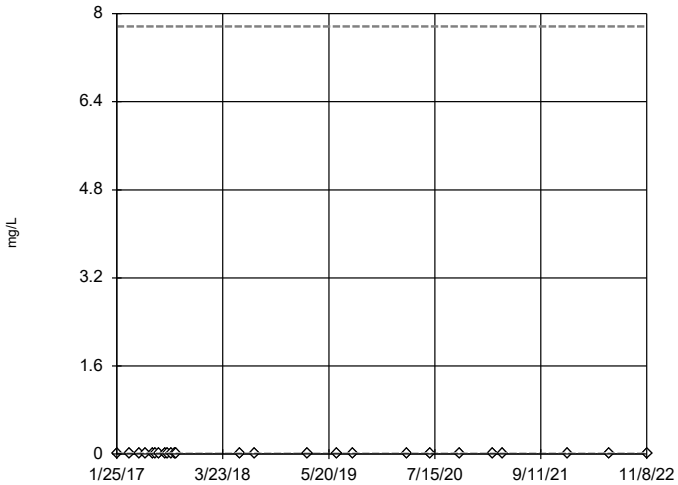
High cutoff = 0.00002509, low cutoff = 0.000001491, based on IQR multiplier of 3.

Constituent: Mercury Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

No outliers found.
Tukey's method select-ed by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

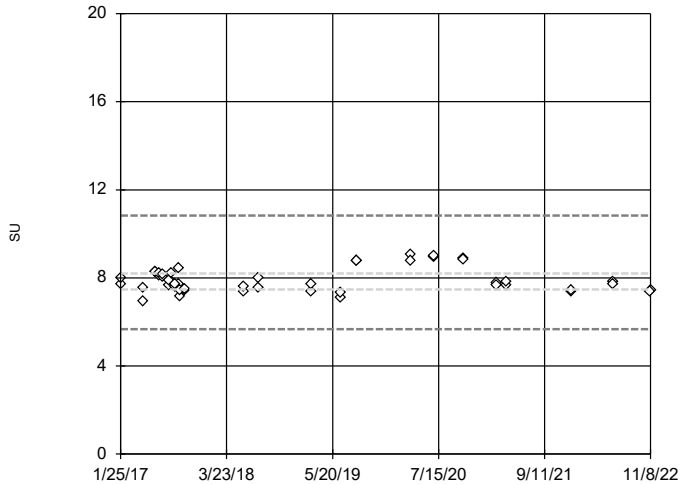
High cutoff = 7.77, low cutoff = 0.0000014, based on IQR multiplier of 3.

Constituent: Molybdenum Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 48

No outliers found.
Tukey's method select-ed by user.

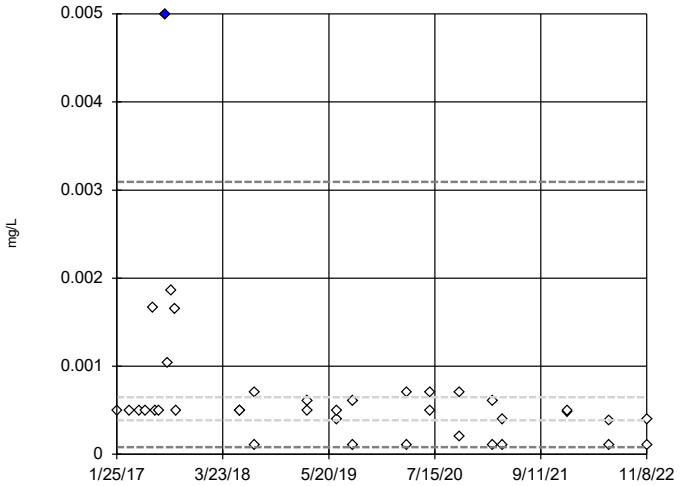
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 10.83, low cutoff = 5.667, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 38

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

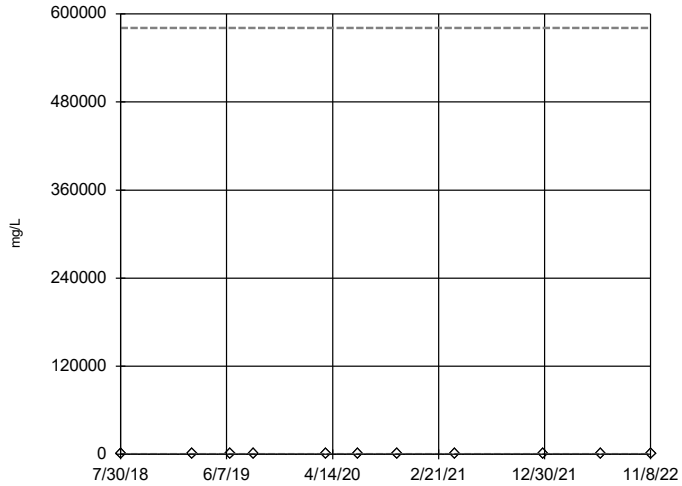
High cutoff = 0.003092, low cutoff = 0.00008069, based on IQR multiplier of 3.

Constituent: Selenium Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 22

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

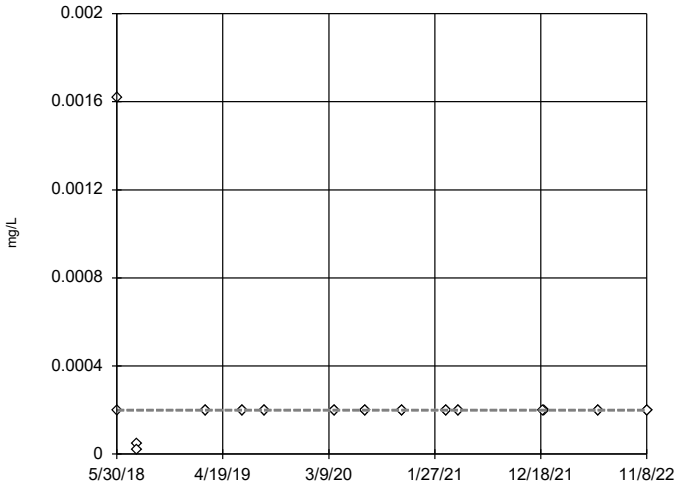
High cutoff = 580896, low cutoff = 0.000418, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 26

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

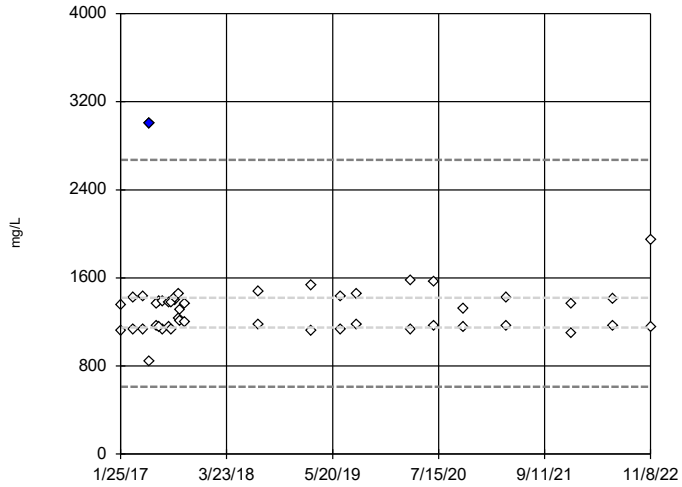
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 48

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2673, low cutoff = 610.8, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE D

Rank Von Neumann

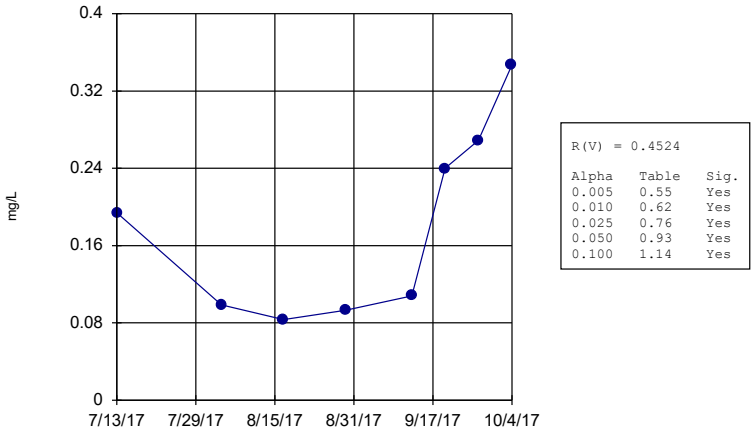
Rank Von Neumann - Significant Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/8/2023, 9:47 AM

Constituent	Well	N	R(V)	Alpha	Table	Sig.
Barium (mg/L)	**SP-11**	**8**	**0.4524**	**0.010**	**0.62**	**Yes**
Barium (mg/L)	**SP-4 (bg)**	**11**	**0.5182**	**0.010**	**0.77**	**Yes**
Cadmium (mg/L)	**SP-1**	**11**	**0.7614**	**0.010**	**0.77**	**Yes**
Cadmium (mg/L)	**SP-10**	**8**	**0**	**0.010**	**0.62**	**Yes**
Cadmium (mg/L)	**SP-4 (bg)**	**11**	**0.4705**	**0.010**	**0.77**	**Yes**
Cadmium (mg/L)	**SP-5R (bg)**	**12**	**0.5035**	**0.010**	**0.81**	**Yes**
Calcium (mg/L)	**SP-4 (bg)**	**12**	**0.8042**	**0.010**	**0.81**	**Yes**
Chromium (mg/L)	**SP-4 (bg)**	**11**	**0.5932**	**0.010**	**0.77**	**Yes**
Lead (mg/L)	**SP-10**	**8**	**0.381**	**0.010**	**0.62**	**Yes**
Lithium (mg/L)	**SP-11**	**8**	**0.3095**	**0.010**	**0.62**	**Yes**
Lithium (mg/L)	**SP-4 (bg)**	**12**	**0.7692**	**0.010**	**0.81**	**Yes**
Molybdenum (mg/L)	**SP-2**	**11**	**0.5091**	**0.010**	**0.77**	**Yes**
Selenium (mg/L)	**SP-2**	**11**	**0.75**	**0.010**	**0.77**	**Yes**
Selenium (mg/L)	**SP-5R (bg)**	**12**	**0.5035**	**0.010**	**0.81**	**Yes**
Sulfate (mg/L)	**SP-4 (bg)**	**13**	**0.5865**	**0.010**	**0.84**	**Yes**
Sulfate (mg/L)	**SP-5R (bg)**	**13**	**0.5508**	**0.010**	**0.84**	**Yes**
Thallium (mg/L)	**SP-1**	**11**	**0.55**	**0.010**	**0.77**	**Yes**
Thallium (mg/L)	**SP-10**	**8**	**0**	**0.010**	**0.62**	**Yes**
Thallium (mg/L)	**SP-11**	**8**	**0**	**0.010**	**0.62**	**Yes**
Thallium (mg/L)	**SP-2**	**11**	**0**	**0.010**	**0.77**	**Yes**
Thallium (mg/L)	**SP-4 (bg)**	**11**	**0.55**	**0.010**	**0.77**	**Yes**
Thallium (mg/L)	**SP-5R (bg)**	**12**	**0**	**0.010**	**0.81**	**Yes**

Rank Von Neumann

SP-11



R(V) = 0.4524

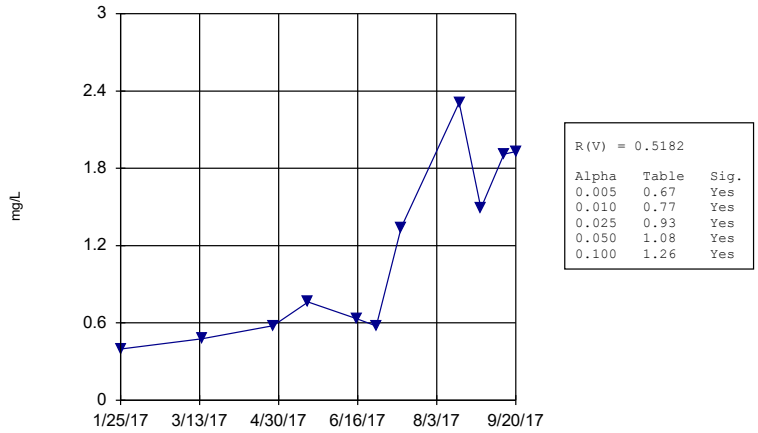
Alpha	Table	Sig.
0.005	0.55	Yes
0.010	0.62	Yes
0.025	0.76	Yes
0.050	0.93	Yes
0.100	1.14	Yes

Constituent: Barium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-4 (bg)



R(V) = 0.5182

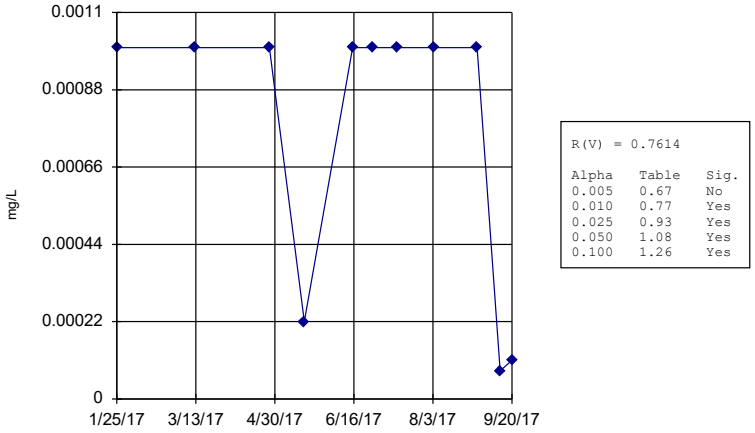
Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Barium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-1



R(V) = 0.7614

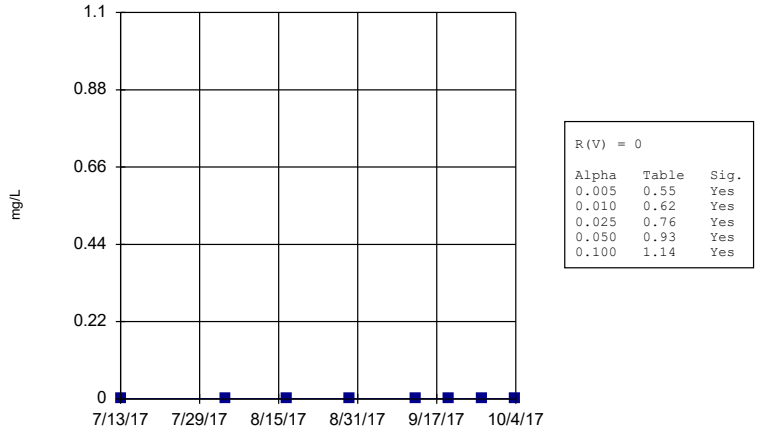
Alpha	Table	Sig.
0.005	0.67	No
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Cadmium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-10



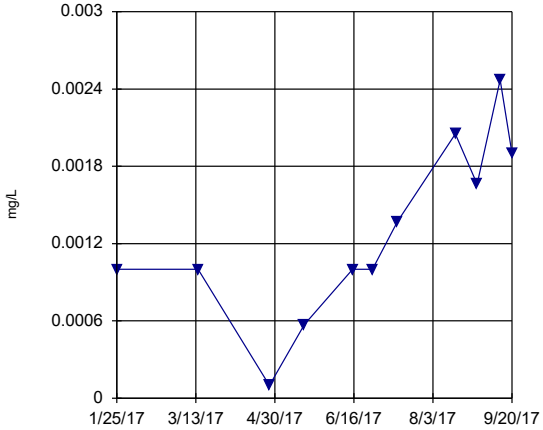
R(V) = 0

Alpha	Table	Sig.
0.005	0.55	Yes
0.010	0.62	Yes
0.025	0.76	Yes
0.050	0.93	Yes
0.100	1.14	Yes

Constituent: Cadmium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Rank Von Neumann

SP-4 (bg)



R(V) = 0.4705

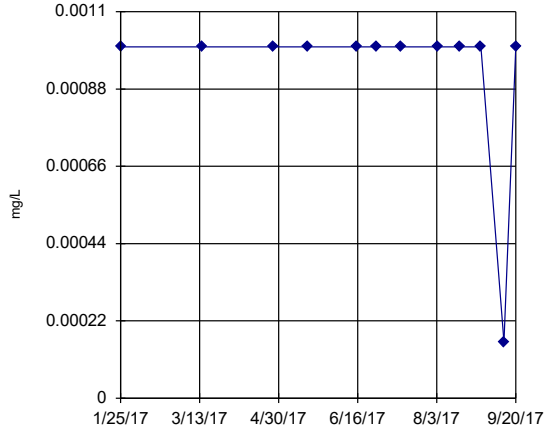
Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Cadmium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-5R (bg)



R(V) = 0.5035

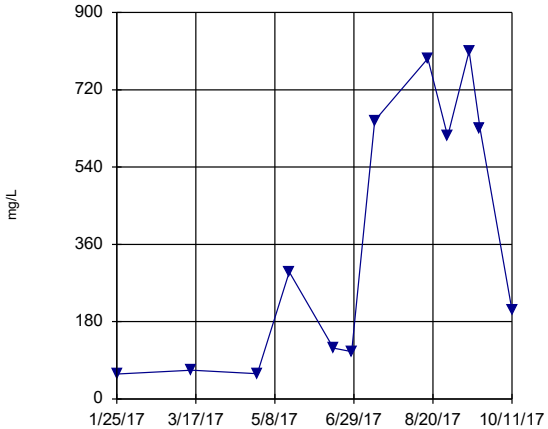
Alpha	Table	Sig.
0.005	0.71	Yes
0.010	0.81	Yes
0.025	0.96	Yes
0.050	1.11	Yes
0.100	1.29	Yes

Constituent: Cadmium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-4 (bg)



R(V) = 0.8042

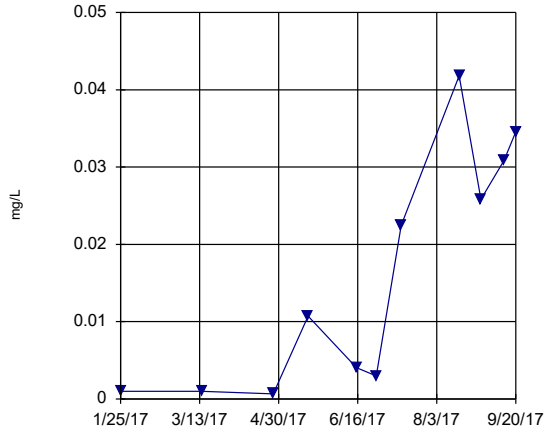
Alpha	Table	Sig.
0.005	0.71	No
0.010	0.81	Yes
0.025	0.96	Yes
0.050	1.11	Yes
0.100	1.29	Yes

Constituent: Calcium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-4 (bg)



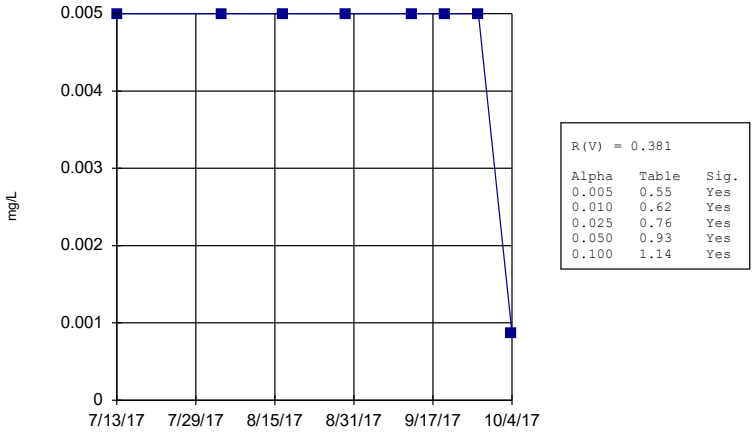
R(V) = 0.5932

Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Chromium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Rank Von Neumann

SP-10



R(V) = 0.381

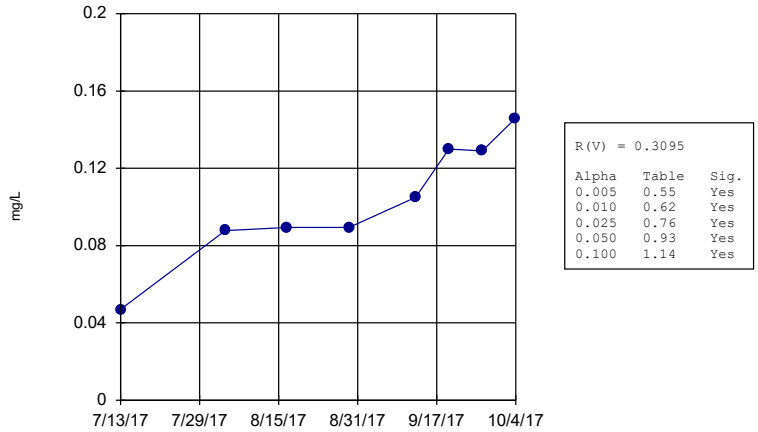
Alpha	Table	Sig.
0.005	0.55	Yes
0.010	0.62	Yes
0.025	0.76	Yes
0.050	0.93	Yes
0.100	1.14	Yes

Constituent: Lead Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-11



R(V) = 0.3095

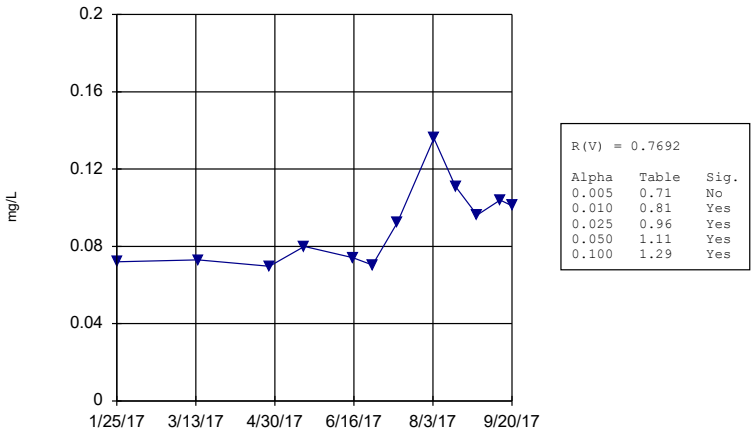
Alpha	Table	Sig.
0.005	0.55	Yes
0.010	0.62	Yes
0.025	0.76	Yes
0.050	0.93	Yes
0.100	1.14	Yes

Constituent: Lithium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-4 (bg)



R(V) = 0.7692

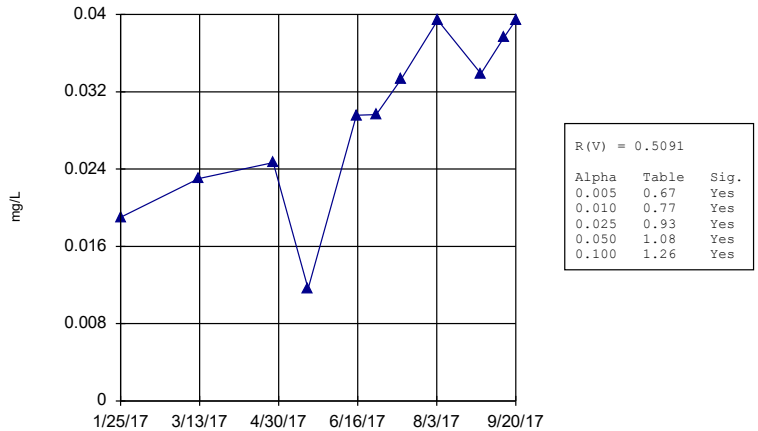
Alpha	Table	Sig.
0.005	0.71	No
0.010	0.81	Yes
0.025	0.96	Yes
0.050	1.11	Yes
0.100	1.29	Yes

Constituent: Lithium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-2



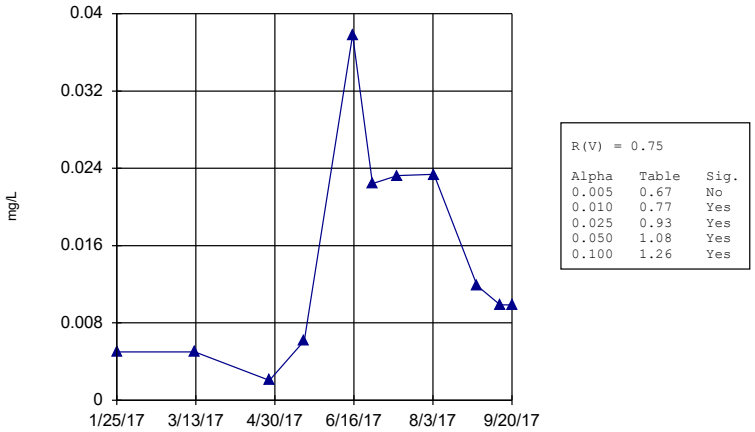
R(V) = 0.5091

Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Molybdenum Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Rank Von Neumann

SP-2



R(V) = 0.75

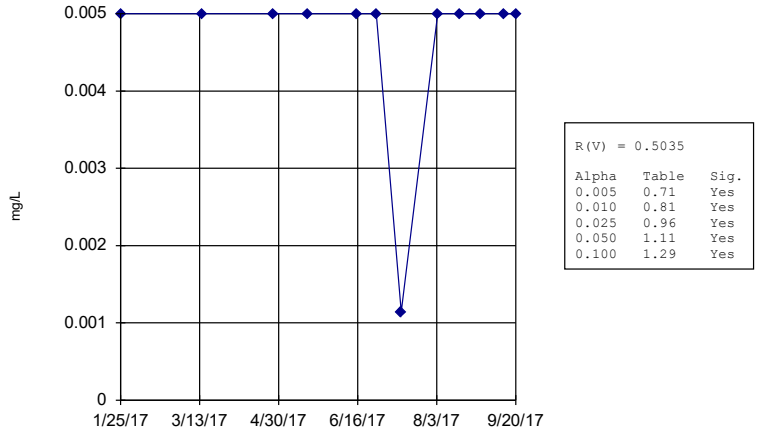
Alpha	Table	Sig.
0.005	0.67	No
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Selenium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-5R (bg)



R(V) = 0.5035

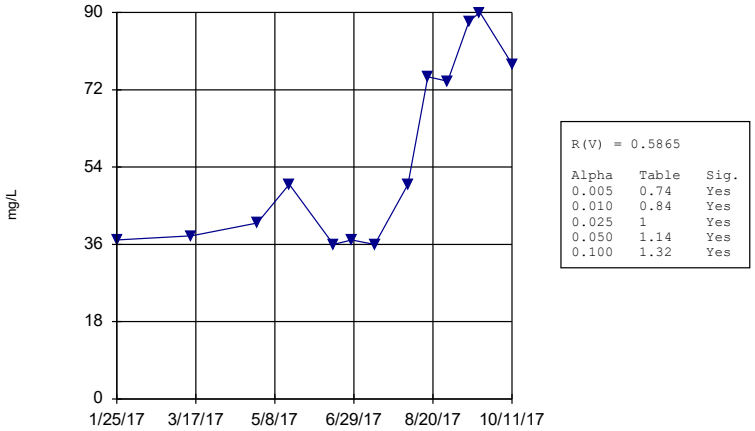
Alpha	Table	Sig.
0.005	0.71	Yes
0.010	0.81	Yes
0.025	0.96	Yes
0.050	1.11	Yes
0.100	1.29	Yes

Constituent: Selenium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-4 (bg)



R(V) = 0.5865

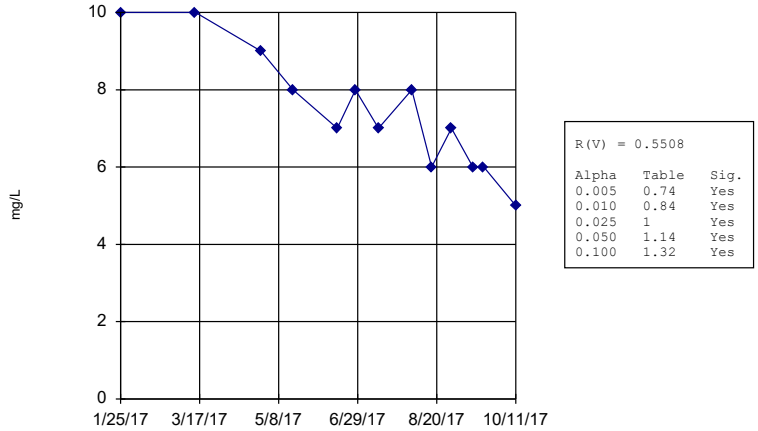
Alpha	Table	Sig.
0.005	0.74	Yes
0.010	0.84	Yes
0.025	1	Yes
0.050	1.14	Yes
0.100	1.32	Yes

Constituent: Sulfate Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-5R (bg)



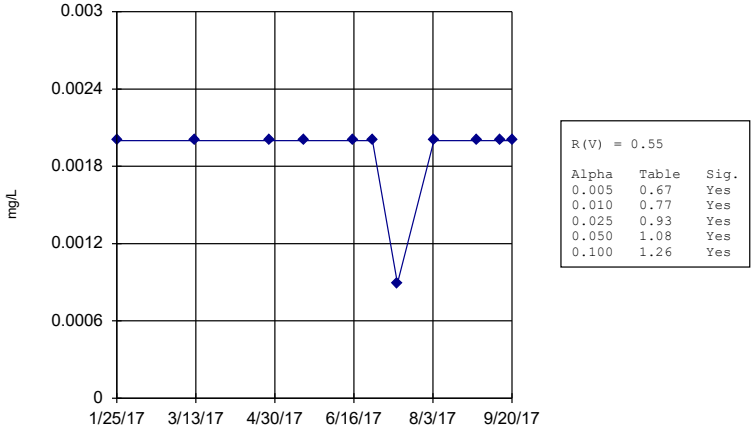
R(V) = 0.5508

Alpha	Table	Sig.
0.005	0.74	Yes
0.010	0.84	Yes
0.025	1	Yes
0.050	1.14	Yes
0.100	1.32	Yes

Constituent: Sulfate Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Rank Von Neumann

SP-1



R(V) = 0.55

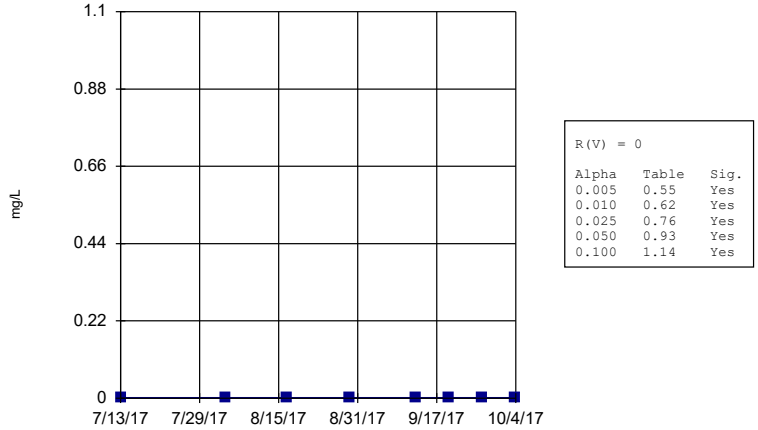
Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Thallium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-10



R(V) = 0

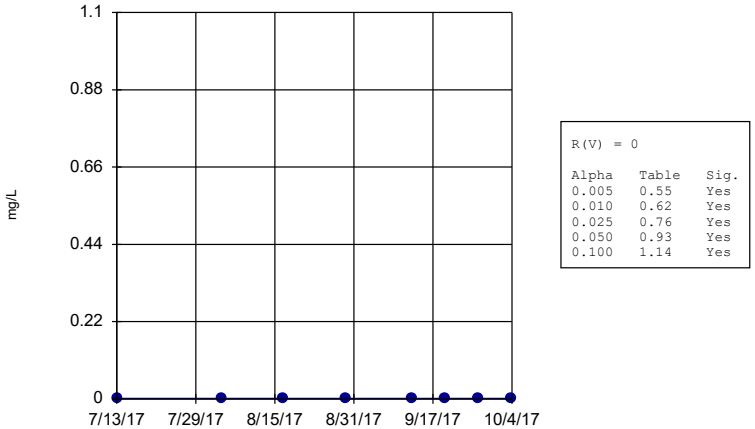
Alpha	Table	Sig.
0.005	0.55	Yes
0.010	0.62	Yes
0.025	0.76	Yes
0.050	0.93	Yes
0.100	1.14	Yes

Constituent: Thallium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-11



R(V) = 0

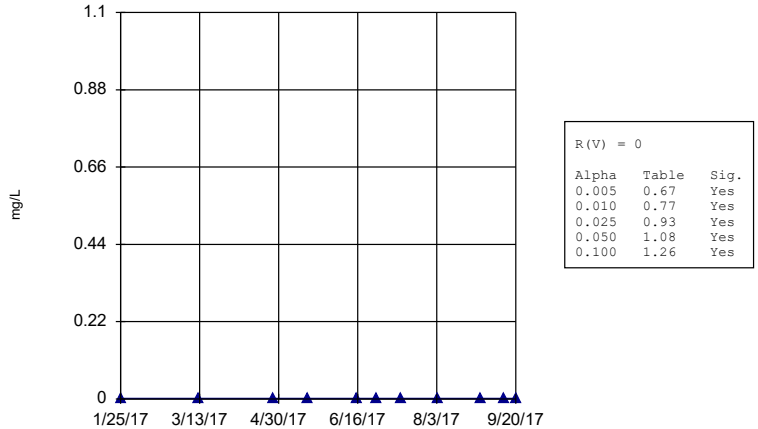
Alpha	Table	Sig.
0.005	0.55	Yes
0.010	0.62	Yes
0.025	0.76	Yes
0.050	0.93	Yes
0.100	1.14	Yes

Constituent: Thallium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-2



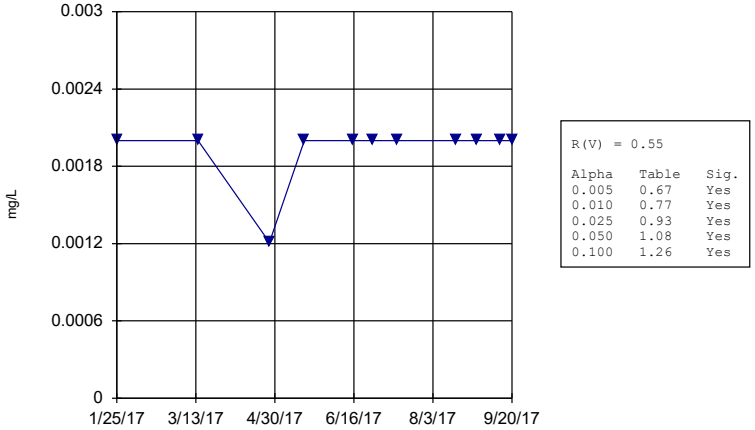
R(V) = 0

Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Thallium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Rank Von Neumann

SP-4 (bg)



R(V) = 0.55

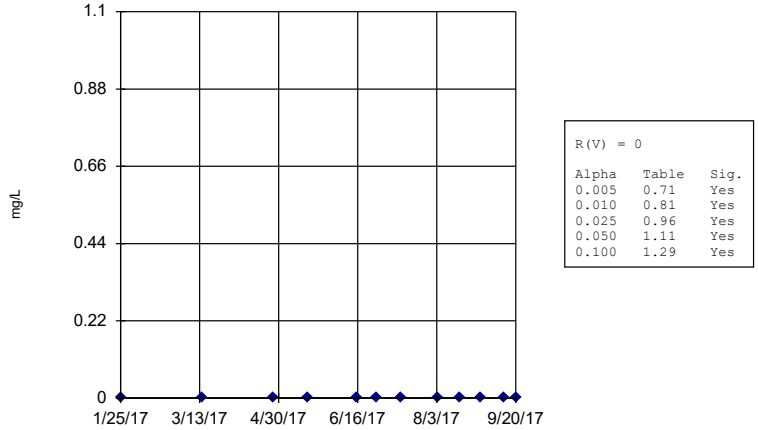
Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Thallium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-5R (bg)



R(V) = 0

Alpha	Table	Sig.
0.005	0.71	Yes
0.010	0.81	Yes
0.025	0.96	Yes
0.050	1.11	Yes
0.100	1.29	Yes

Constituent: Thallium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE E

Mann-Whitney

Welch's t-test/Mann-Whitney - Significant Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:24 PM

Constituent	Well	Calc.	0.01	Method
Calcium (mg/L)	**SP-1**	**-2.706**	**Yes**	**Mann-W**

Welch's t-test/Mann-Whitney - All Results

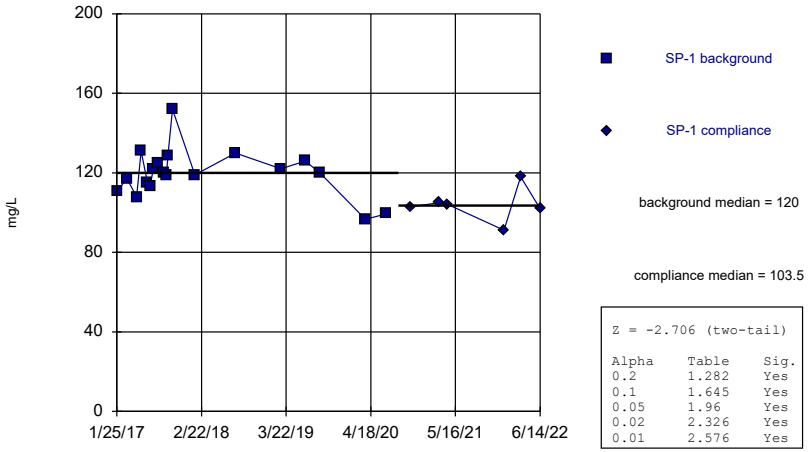
Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:24 PM

Constituent	Well	Calc.	0.01	Method
Calcium (mg/L)	**SP-1**	**-2.706**	**Yes**	**Mann-W**
Calcium (mg/L)	SP-10	-1.518	No	Mann-W
Calcium (mg/L)	SP-11	-0.9682	No	Mann-W
Calcium (mg/L)	SP-2	-0.2334	No	Mann-W
Calcium (mg/L)	SP-4 (bg)	-0.8216	No	Mann-W
Calcium (mg/L)	SP-5R (bg)	-1.102	No	Mann-W

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

SP-1



Z = -2.706 (two-tail)

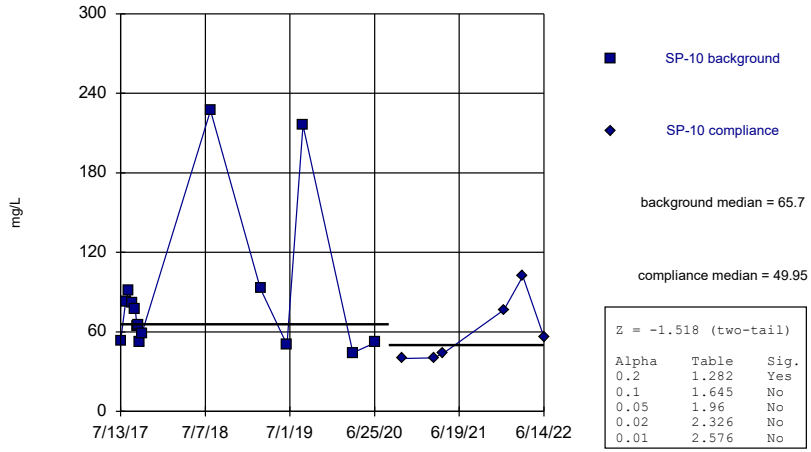
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: Calcium Analysis Run 2/10/2023 1:23 PM View: Mann-Whitney
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

SP-10



Z = -1.518 (two-tail)

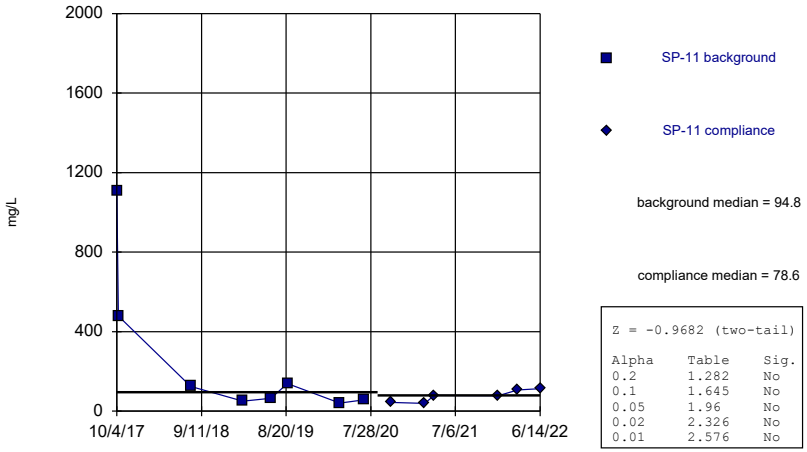
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 2/10/2023 1:23 PM View: Mann-Whitney
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

SP-11



Z = -0.9682 (two-tail)

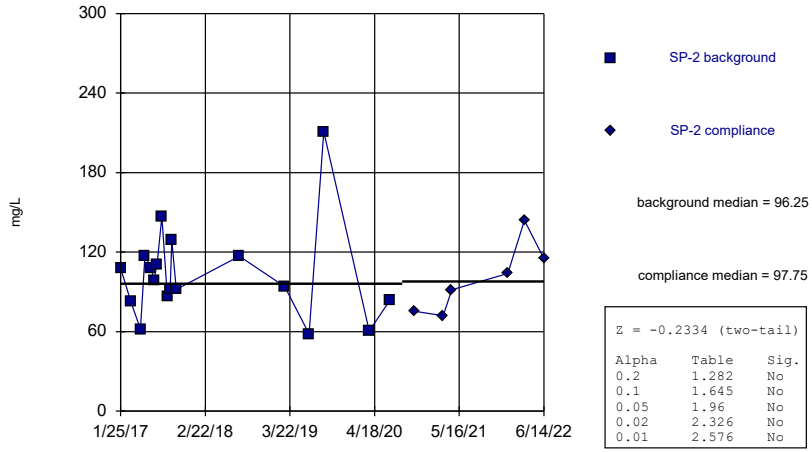
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 2/10/2023 1:23 PM View: Mann-Whitney
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

SP-2



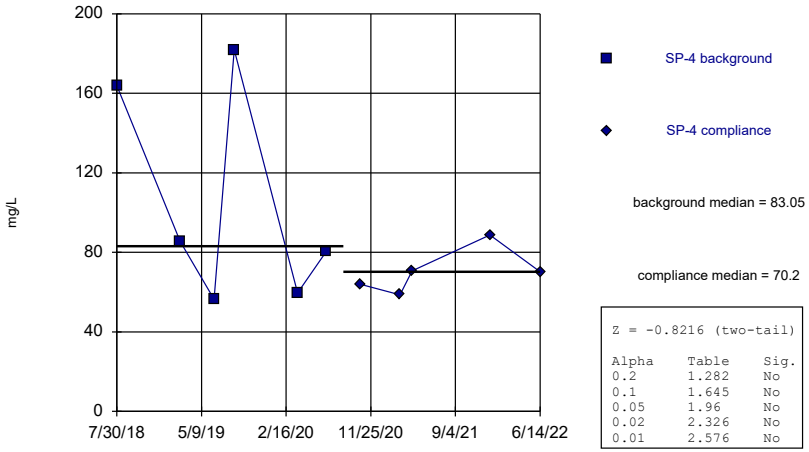
Z = -0.2334 (two-tail)

Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 2/10/2023 1:23 PM View: Mann-Whitney
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Mann-Whitney (Wilcoxon Rank Sum)

SP-4 (bg)



Z = -0.8216 (two-tail)

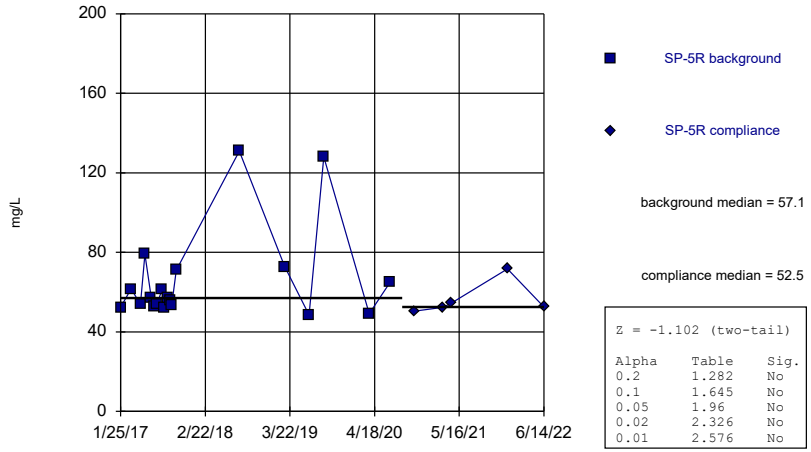
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 2/10/2023 1:23 PM View: Mann-Whitney
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

SP-5R (bg)



Z = -1.102 (two-tail)

Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 2/10/2023 1:23 PM View: Mann-Whitney
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE F

Intrawell PLs

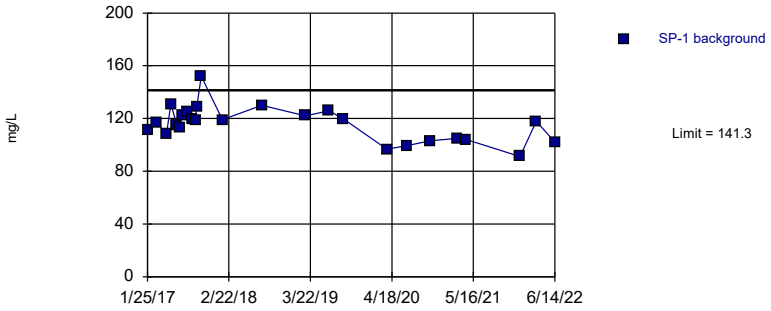
Intrawell Prediction Limits - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:33 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Calcium (mg/L)	SP-1	141.3	n/a	n/a	1 future	n/a	25	115.9	13.21	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	SP-10	227	n/a	n/a	1 future	n/a	21	n/a	n/a	0	n/a	n/a	0.003999	NP Intra (normality) 1 of 2
Calcium (mg/L)	SP-11	155.9	n/a	n/a	1 future	n/a	12	78	34.89	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	SP-2	166.8	n/a	n/a	1 future	n/a	24	102.5	33.2	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	SP-4	182	n/a	n/a	1 future	n/a	11	n/a	n/a	0	n/a	n/a	0.01276	NP Intra (normality) 1 of 2
Calcium (mg/L)	SP-5R	131	n/a	n/a	1 future	n/a	24	n/a	n/a	0	n/a	n/a	0.003124	NP Intra (normality) 1 of 2

Prediction Limit

Intrawell Parametric, SP-1

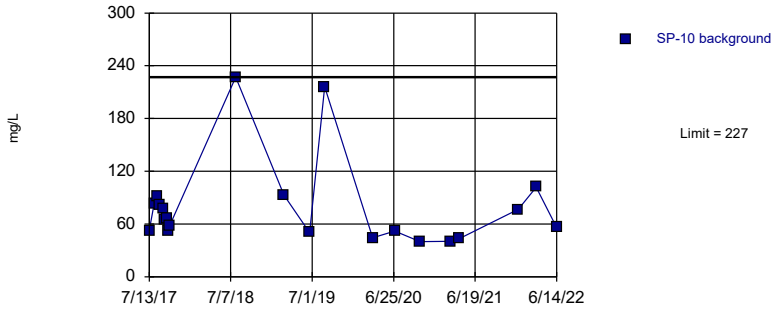


Background Data Summary: Mean=115.9, Std. Dev.=13.21, n=25. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9663, critical = 0.888. Kappa = 1.924 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 2/10/2023 1:30 PM View: Intrawell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Prediction Limit

Intrawell Non-parametric, SP-10

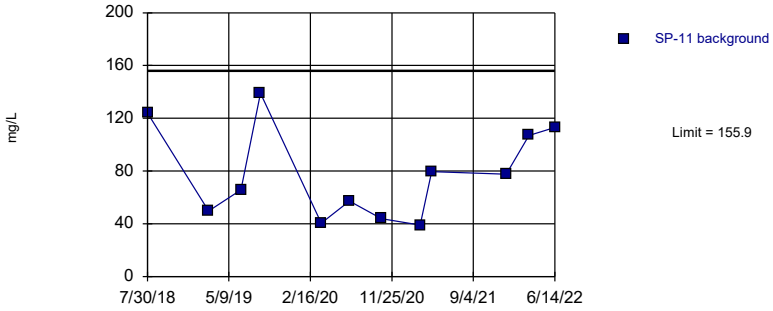


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 21 background values. Well-constituent pair annual alpha = 0.007982. Individual comparison alpha = 0.003999 (1 of 2). Assumes 1 future value.

Constituent: Calcium Analysis Run 2/10/2023 1:30 PM View: Intrawell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Prediction Limit

Intrawell Parametric, SP-11

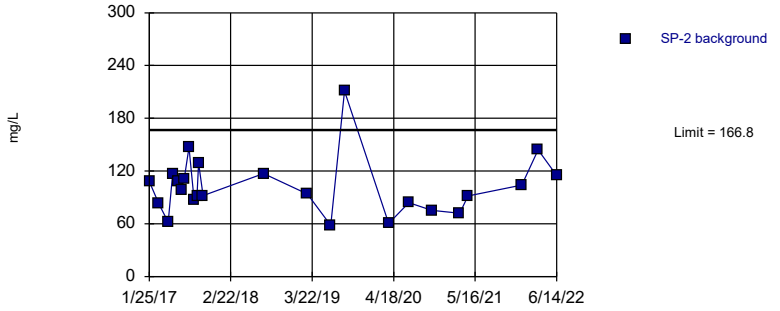


Background Data Summary: Mean=78, Std. Dev.=34.89, n=12. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9081, critical = 0.859. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 2/10/2023 1:30 PM View: Intrawell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Prediction Limit

Intrawell Parametric, SP-2

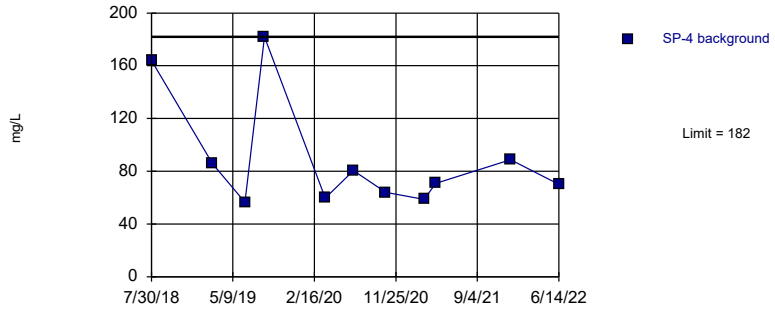


Background Data Summary: Mean=102.5, Std. Dev.=33.2, n=24. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8901, critical = 0.884. Kappa = 1.937 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 2/10/2023 1:30 PM View: Intrawell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Prediction Limit

Intrawell Non-parametric, SP-4 (bg)



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.05 alpha level. Limit is highest of 11 background values. Well-constituent pair annual alpha = 0.02537. Individual comparison alpha = 0.01276 (1 of 2). Assumes 1 future value.

Constituent: Calcium Analysis Run 2/10/2023 1:30 PM View: Intrawell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

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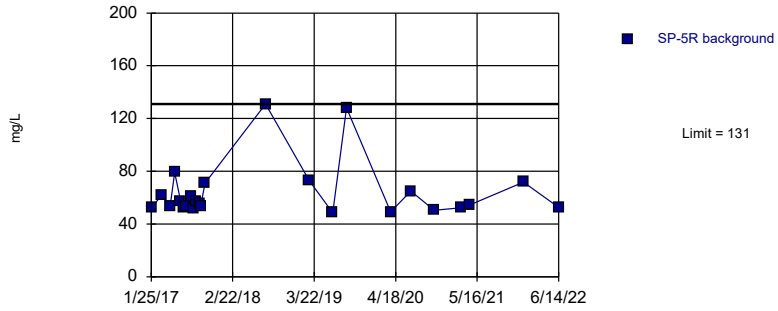
Prediction Limit

Intrawell Non-parametric, SP-5R (bg)



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 24 background values. Well-constituent pair annual alpha = 0.006238. Individual comparison alpha = 0.003124 (1 of 2). Assumes 1 future value.

Constituent: Calcium Analysis Run 2/10/2023 1:30 PM View: Intrawell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE G
Upgradient Well Trend Tests

Trend Tests - Upgradient Wells - Significant Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:42 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron (mg/L)	**SP-4 (bg)**	**-0.0147**	**-137**	**-111**	**Yes**	**25**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Boron (mg/L)	**SP-5R (bg)**	**-0.01018**	**-115**	**-111**	**Yes**	**25**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride (mg/L)	**SP-5R (bg)**	**32.49**	**100**	**92**	**Yes**	**22**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate (mg/L)	**SP-4 (bg)**	**5.516**	**35**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**

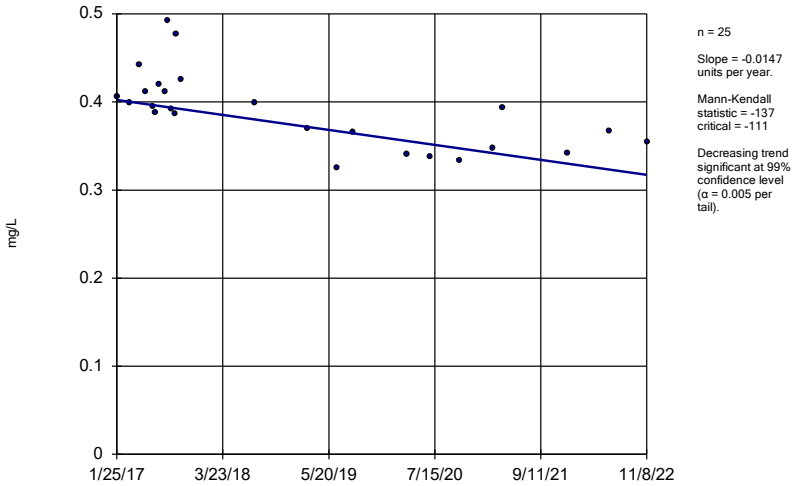
Trend Tests - Upgradient Wells - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:42 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron (mg/L)	**SP-4 (bg)**	**-0.0147**	**-137**	**-111**	**Yes**	**25**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Boron (mg/L)	**SP-5R (bg)**	**-0.01018**	**-115**	**-111**	**Yes**	**25**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride (mg/L)	SP-4 (bg)	0.4207	7	98	No	23	0	n/a	n/a	0.01	NP
Chloride (mg/L)	**SP-5R (bg)**	**32.49**	**100**	**92**	**Yes**	**22**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Fluoride (mg/L)	SP-4 (bg)	0.006073	12	118	No	26	3.846	n/a	n/a	0.01	NP
Fluoride (mg/L)	SP-5R (bg)	0.006591	15	118	No	26	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	**SP-4 (bg)**	**5.516**	**35**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate (mg/L)	SP-5R (bg)	0.6152	13	34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	SP-4 (bg)	0.33	12	105	No	24	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	SP-5R (bg)	34.4	73	98	No	23	0	n/a	n/a	0.01	NP

Sen's Slope Estimator

SP-4 (bg)



n = 25

Slope = -0.0147 units per year.

Mann-Kendall statistic = -137 critical = -111

Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 2/10/2023 1:41 PM View: Trend Tests

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

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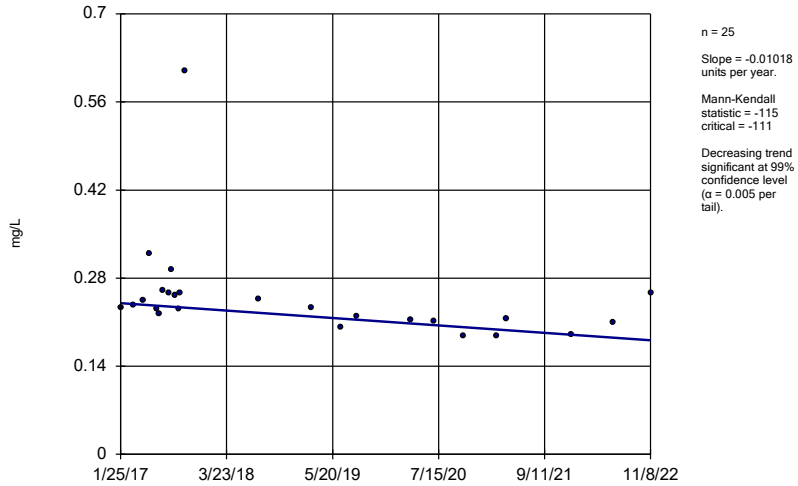
Sen's Slope Estimator

SP-5R (bg)



n = 25

Slope = -0.01018 units per year.

Mann-Kendall statistic = -115 critical = -111

Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

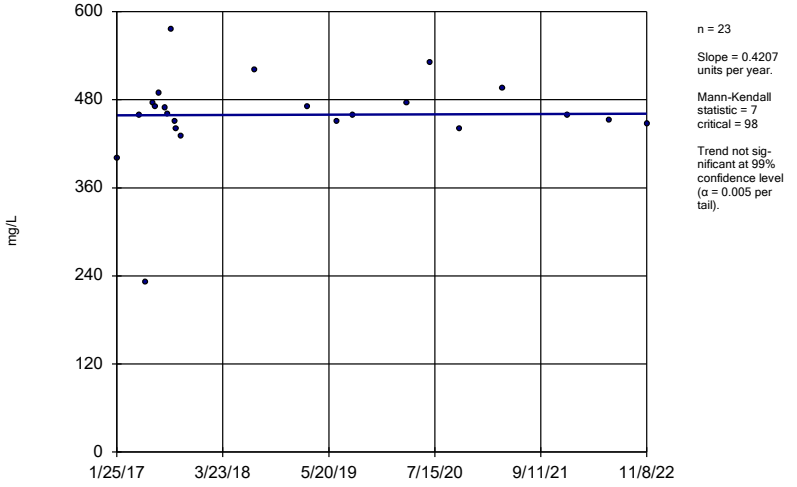
Constituent: Boron Analysis Run 2/10/2023 1:41 PM View: Trend Tests

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Sen's Slope Estimator

SP-4 (bg)



n = 23

Slope = 0.4207 units per year.

Mann-Kendall statistic = 7 critical = 98

Trend not significant at 99% confidence level (α = 0.005 per tail).

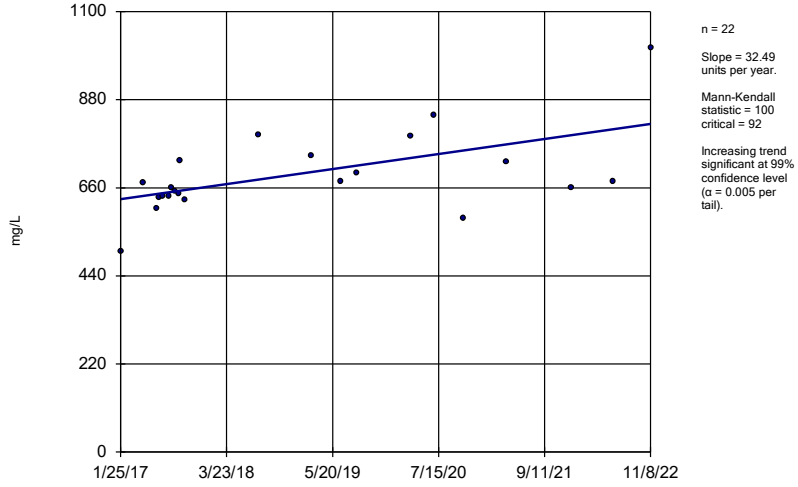
Constituent: Chloride Analysis Run 2/10/2023 1:41 PM View: Trend Tests

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Sen's Slope Estimator

SP-5R (bg)



n = 22

Slope = 32.49 units per year.

Mann-Kendall statistic = 100 critical = 92

Increasing trend significant at 99% confidence level (α = 0.005 per tail).

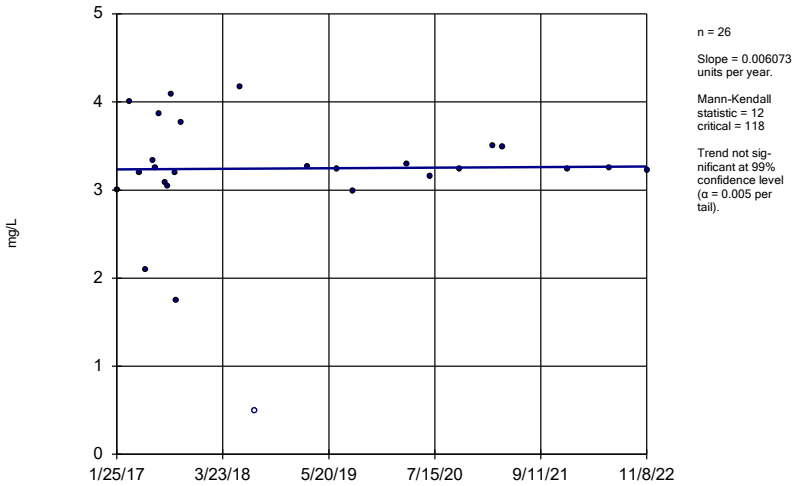
Constituent: Chloride Analysis Run 2/10/2023 1:41 PM View: Trend Tests

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Hollow symbols indicate censored values.

Sen's Slope Estimator

SP-4 (bg)



n = 26

Slope = 0.006073 units per year.

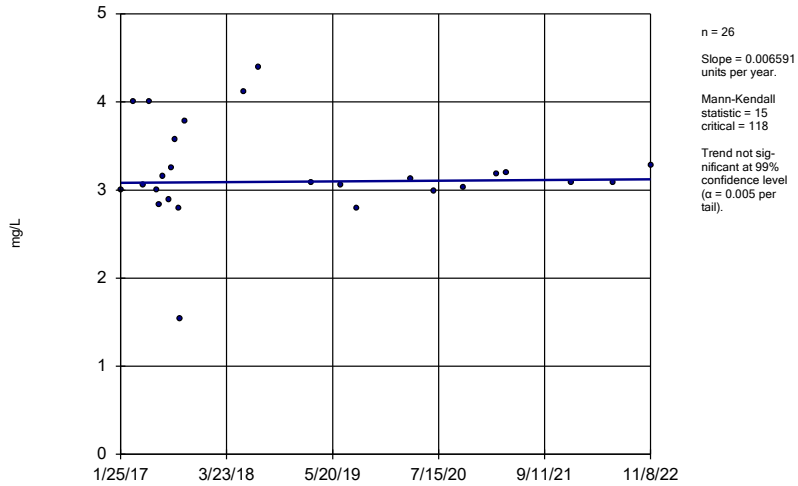
Mann-Kendall statistic = 12
critical = 118

Trend not sig-nificant at 99% confidence level (α = 0.005 per tail).

Constituent: Fluoride Analysis Run 2/10/2023 1:41 PM View: Trend Tests
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sen's Slope Estimator

SP-5R (bg)



n = 26

Slope = 0.006591 units per year.

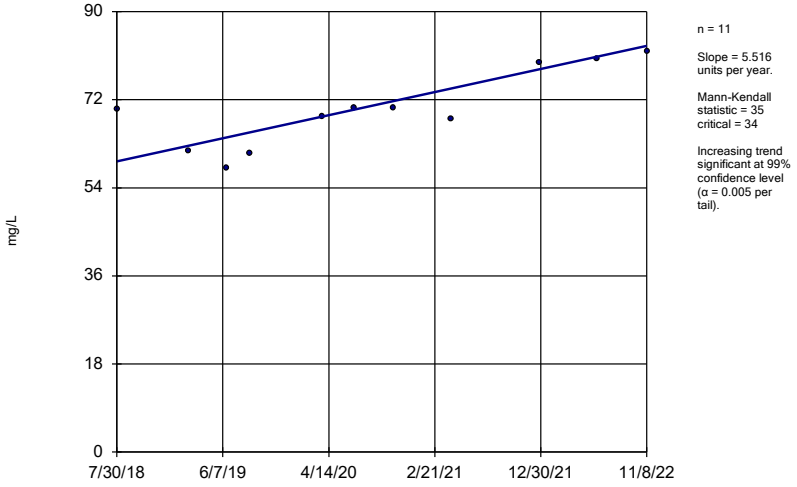
Mann-Kendall statistic = 15
critical = 118

Trend not sig-nificant at 99% confidence level (α = 0.005 per tail).

Constituent: Fluoride Analysis Run 2/10/2023 1:41 PM View: Trend Tests
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sen's Slope Estimator

SP-4 (bg)



n = 11

Slope = 5.516 units per year.

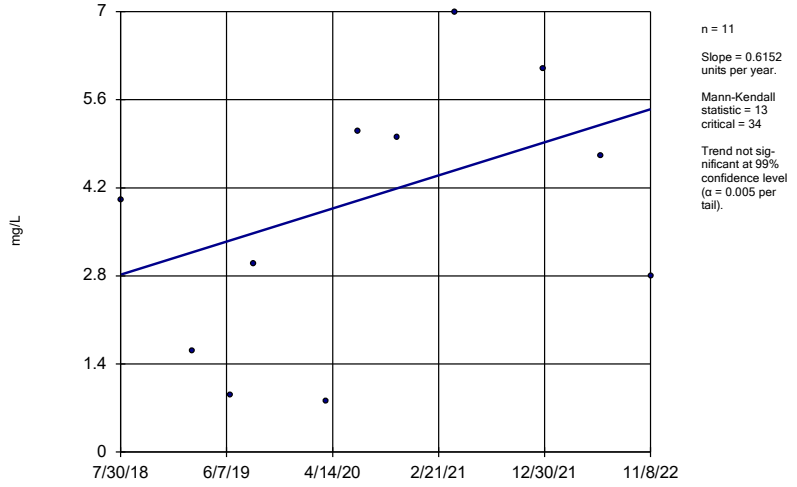
Mann-Kendall statistic = 35
critical = 34

Increasing trend significant at 99% confidence level (α = 0.005 per tail).

Constituent: Sulfate Analysis Run 2/10/2023 1:41 PM View: Trend Tests
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sen's Slope Estimator

SP-5R (bg)



n = 11

Slope = 0.6152 units per year.

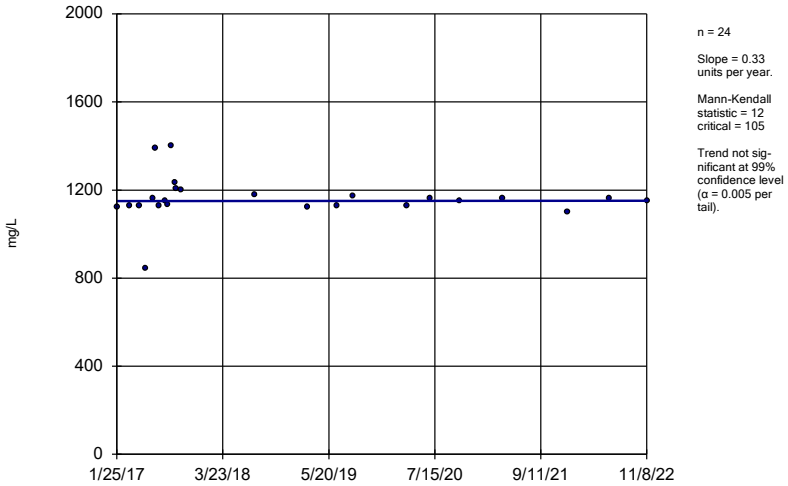
Mann-Kendall statistic = 13
critical = 34

Trend not sig-nificant at 99% confidence level (α = 0.005 per tail).

Constituent: Sulfate Analysis Run 2/10/2023 1:41 PM View: Trend Tests
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sen's Slope Estimator

SP-4 (bg)



n = 24

Slope = 0.33 units per year.

Mann-Kendall statistic = 12 critical = 105

Trend not sig-nificant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids [TDS] Analysis Run 2/10/2023 1:41 PM View: Trend Tests

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

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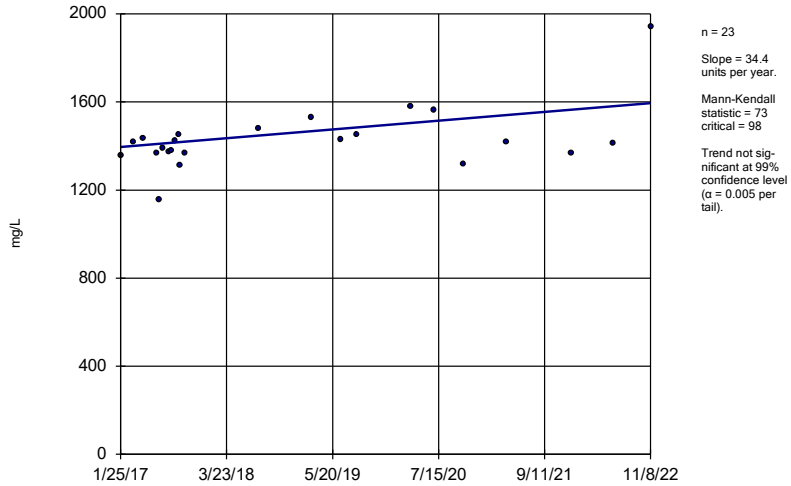
Sen's Slope Estimator

SP-5R (bg)



n = 23

Slope = 34.4 units per year.

Mann-Kendall statistic = 73 critical = 98

Trend not sig-nificant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids [TDS] Analysis Run 2/10/2023 1:41 PM View: Trend Tests

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE H
Interwell PLs

Interwell Prediction Limits - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:44 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron (mg/L)	n/a	0.5029	n/a	n/a	4 future	n/a	50	0.5585	0.08359	0	None	sqrt(x)	0.00188	Param Inter 1 of 2
Chloride (mg/L)	n/a	833.5	n/a	n/a	4 future	n/a	45	572.2	143.9	0	None	No	0.00188	Param Inter 1 of 2
Fluoride (mg/L)	n/a	4.39	n/a	n/a	4 future	n/a	52	n/a	n/a	1.923	n/a	n/a	0.000701	NP Inter (normality) 1 of 2
pH, field (SU)	n/a	9.05	6.96	n/a	4 future	n/a	48	n/a	n/a	0	n/a	n/a	0.001648	NP Inter (normality) 1 of 2
Sulfate (mg/L)	n/a	81.9	n/a	n/a	4 future	n/a	22	n/a	n/a	0	n/a	n/a	0.003544	NP Inter (normality) 1 of 2
Total Dissolved Solids [TDS] (mg/L)	n/a	1637	n/a	n/a	4 future	n/a	47	10.87	0.5051	0	None	x^(1/3)	0.00188	Param Inter 1 of 2

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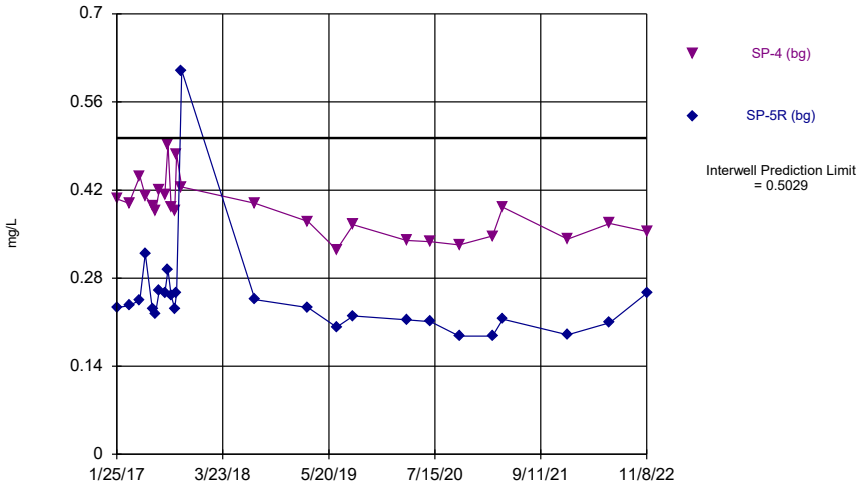
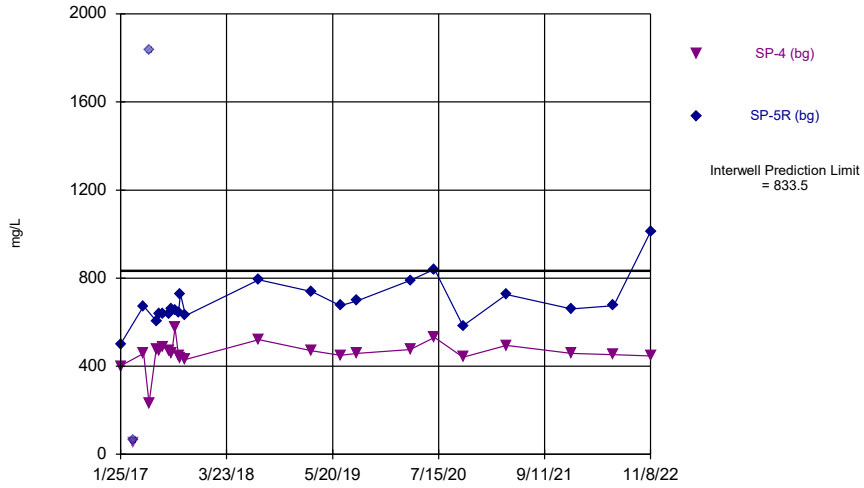
Time Series



Constituent: Boron Analysis Run 2/13/2023 1:21 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

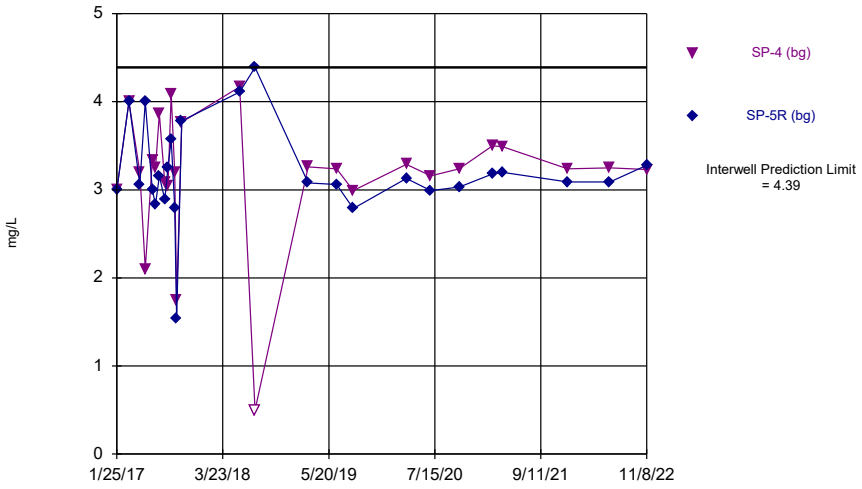
Time Series



Constituent: Chloride Analysis Run 2/13/2023 1:21 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

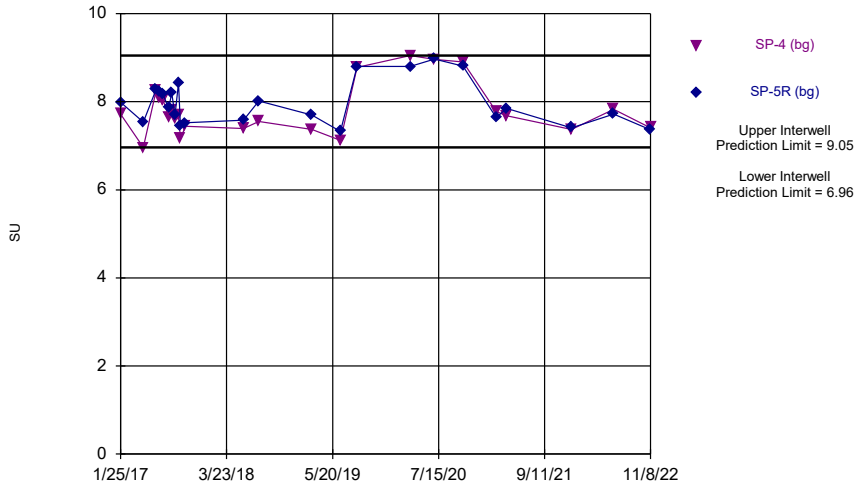
Time Series



Constituent: Fluoride Analysis Run 2/13/2023 1:21 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

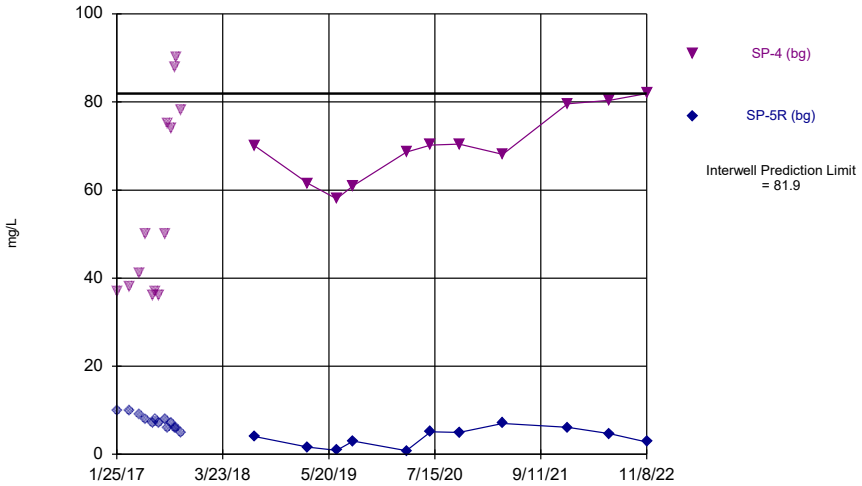
Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series



Constituent: pH, field Analysis Run 2/13/2023 1:22 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

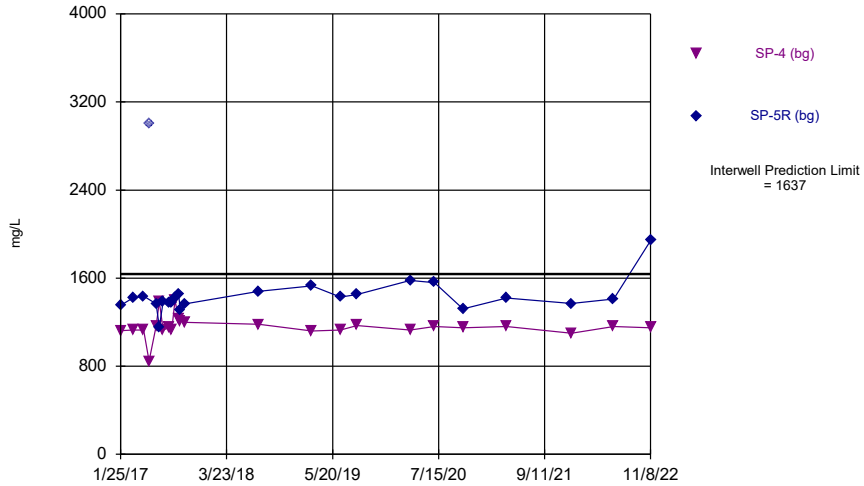
Time Series



Constituent: Sulfate Analysis Run 2/13/2023 1:23 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

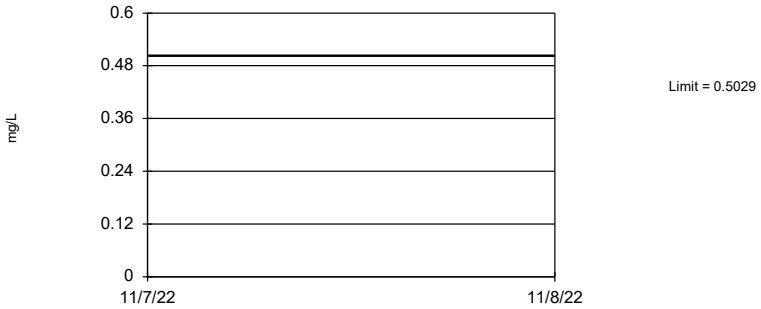
Time Series



Constituent: Total Dissolved Solids [TDS] Analysis Run 2/13/2023 1:23 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Prediction Limit

Interwell Parametric



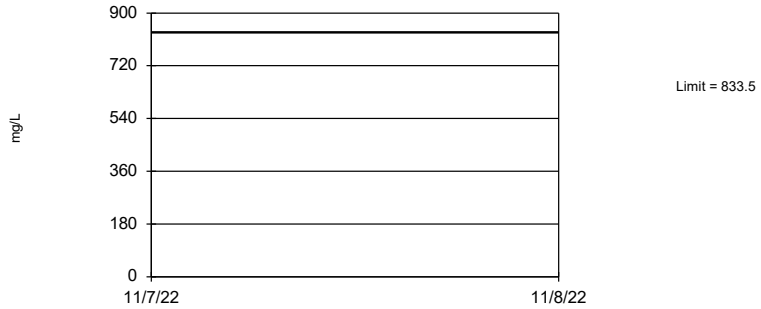
Background Data Summary (based on square root transformation): Mean=0.5585, Std. Dev.=0.08359, n=50. Normality test: Shapiro Francia @alpha = 0.01, calculated = 0.9478, critical = 0.935. Kappa = 1.802 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.00188. Assumes 4 future values.

Constituent: Boron Analysis Run 2/10/2023 1:42 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Prediction Limit

Interwell Parametric



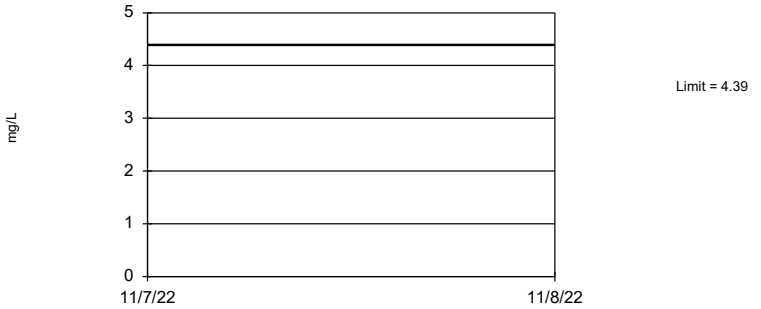
Background Data Summary: Mean=572.2, Std. Dev.=143.9, n=45. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9407, critical = 0.926. Kappa = 1.816 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.00188. Assumes 4 future values.

Constituent: Chloride Analysis Run 2/10/2023 1:42 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Prediction Limit

Interwell Non-parametric



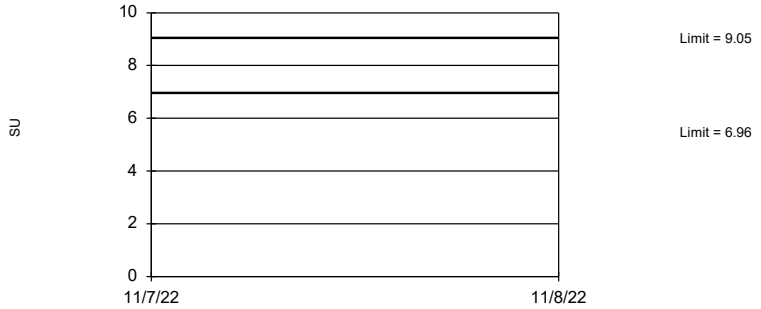
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Francia normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 52 background values. 1.923% NDs. Annual per-constituent alpha = 0.005594. Individual comparison alpha = 0.000701 (1 of 2). Assumes 4 future values.

Constituent: Fluoride Analysis Run 2/10/2023 1:42 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Prediction Limit

Interwell Non-parametric

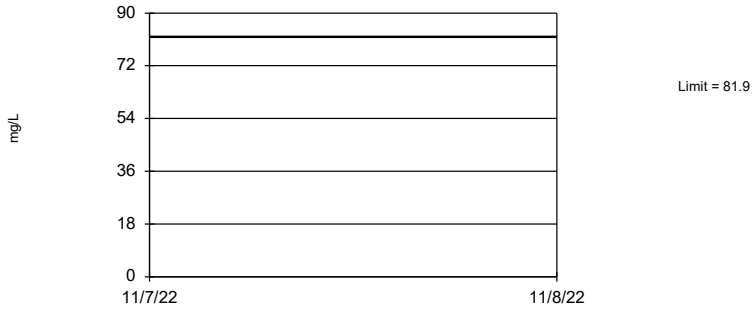


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 48 background values. Annual per-constituent alpha = 0.01315. Individual comparison alpha = 0.001648 (1 of 2). Assumes 4 future values.

Constituent: pH, field Analysis Run 2/10/2023 1:42 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Prediction Limit

Interwell Non-parametric



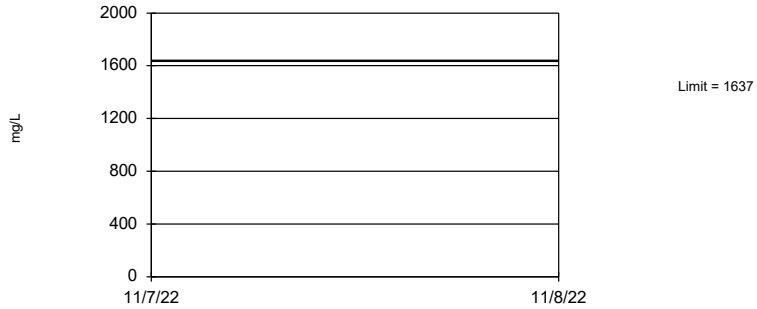
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 22 background values. Annual per-constituent alpha = 0.028. Individual comparison alpha = 0.003544 (1 of 2). Assumes 4 future values.

Constituent: Sulfate Analysis Run 2/10/2023 1:42 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Prediction Limit

Interwell Parametric



Background Data Summary (based on cube root transformation): Mean=10.87, Std. Dev.=0.5051, n=47. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9284, critical = 0.928. Kappa = 1.81 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.00188. Assumes 4 future values.

Constituent: Total Dissolved Solids [TDS] Analysis Run 2/10/2023 1:42 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE

UTLs

Upper Tolerance Limits Summary Table

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/13/2023, 11:12 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony (mg/L)	n/a	0.005698	n/a	n/a	n/a	n/a 50	-7.963	1.354	34	Kaplan-Meier	ln(x)	0.05	Inter
Arsenic (mg/L)	n/a	0.0599	n/a	n/a	n/a	n/a 49	n/a	n/a	6.122	n/a	n/a	0.08099	NP Inter(normality)
Barium (mg/L)	n/a	2.6	n/a	n/a	n/a	n/a 38	n/a	n/a	0	n/a	n/a	0.1424	NP Inter(normality)
Beryllium (mg/L)	n/a	0.00212	n/a	n/a	n/a	n/a 49	n/a	n/a	20.41	n/a	n/a	0.08099	NP Inter(normality)
Cadmium (mg/L)	n/a	0.0002066	n/a	n/a	n/a	n/a 26	-10.48	0.8742	23.08	Kaplan-Meier	ln(x)	0.05	Inter
Chromium (mg/L)	n/a	0.003419	n/a	n/a	n/a	n/a 38	-7.327	0.7698	13.16	None	ln(x)	0.05	Inter
Cobalt (mg/L)	n/a	0.01786	n/a	n/a	n/a	n/a 49	n/a	n/a	10.2	n/a	n/a	0.08099	NP Inter(normality)
Combined Radium 226 + 228 (pCi/L)	n/a	15.84	n/a	n/a	n/a	n/a 49	n/a	n/a	0	n/a	n/a	0.08099	NP Inter(normality)
Fluoride (mg/L)	n/a	4.39	n/a	n/a	n/a	n/a 52	n/a	n/a	1.923	n/a	n/a	0.06944	NP Inter(normality)
Lead (mg/L)	n/a	0.0107	n/a	n/a	n/a	n/a 49	n/a	n/a	26.53	n/a	n/a	0.08099	NP Inter(normality)
Lithium (mg/L)	n/a	0.163	n/a	n/a	n/a	n/a 38	n/a	n/a	0	n/a	n/a	0.1424	NP Inter(normality)
Mercury (mg/L)	n/a	0.00003	n/a	n/a	n/a	n/a 49	n/a	n/a	73.47	n/a	n/a	0.08099	NP Inter(NDs)
Molybdenum (mg/L)	n/a	0.01	n/a	n/a	n/a	n/a 50	n/a	n/a	34	n/a	n/a	0.07694	NP Inter(normality)
Selenium (mg/L)	n/a	0.00499	n/a	n/a	n/a	n/a 38	n/a	n/a	31.58	n/a	n/a	0.1424	NP Inter(normality)
Thallium (mg/L)	n/a	0.00162	n/a	n/a	n/a	n/a 26	n/a	n/a	88.46	n/a	n/a	0.2635	NP Inter(NDs)

Tolerance Limit

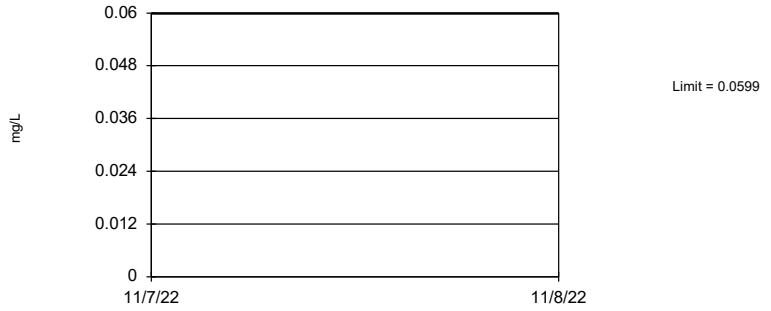
Interwell Parametric

95% coverage. Background Data Summary (based on natural log transformation) (after Kaplan-Meier Adjustment): Mean=-7.963, Std. Dev.=1.354, n=50, 34% NDs. Normality test: Shapiro Francia @alpha = 0.01, calculated = 0.9543, critical = 0.935. Report alpha = 0.05.

Constituent: Antimony Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric

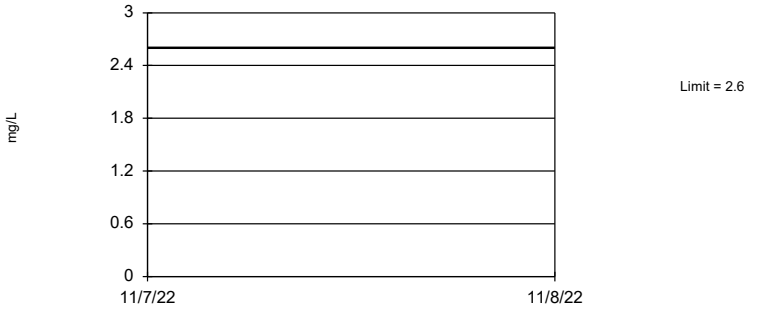


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 6.122% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Arsenic Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric

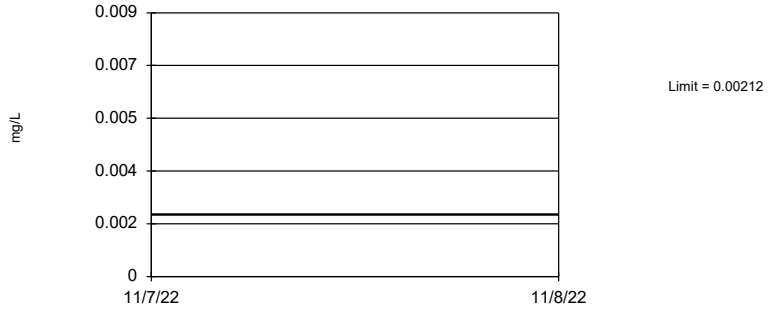


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 38 background values. 88.48% coverage at alpha=0.01; 92.38% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1424.

Constituent: Barium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric

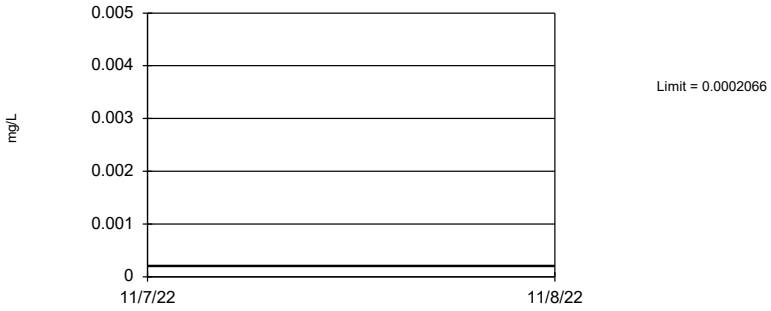


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 20.41% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Beryllium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Parametric



95% coverage. Background Data Summary (based on natural log transformation) (after Kaplan-Meier Adjustment): Mean=-10.48, Std. Dev.=0.8742, n=26, 23.08% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9372, critical = 0.891. Report alpha = 0.05.

Constituent: Cadmium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

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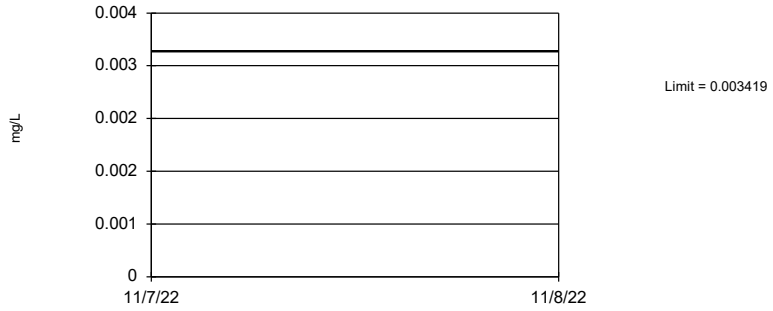
Tolerance Limit

Interwell Parametric



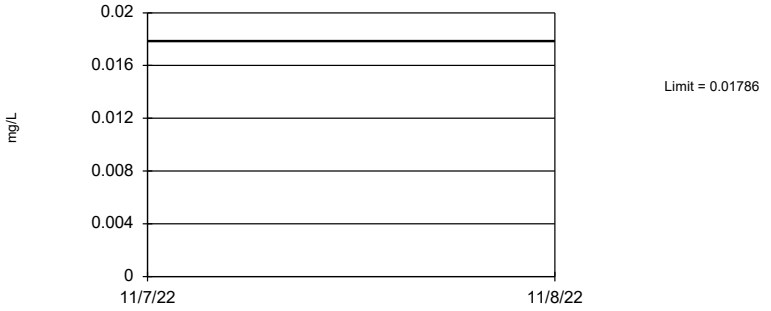
95% coverage. Background Data Summary (based on natural log transformation): Mean=-7.327, Std. Dev.=0.7698, n=38, 13.16% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9508, critical = 0.916. Report alpha = 0.05.

Constituent: Chromium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



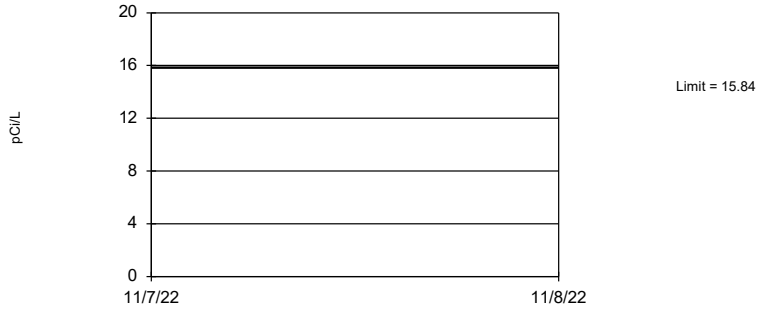
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 10.2% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Cobalt Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric

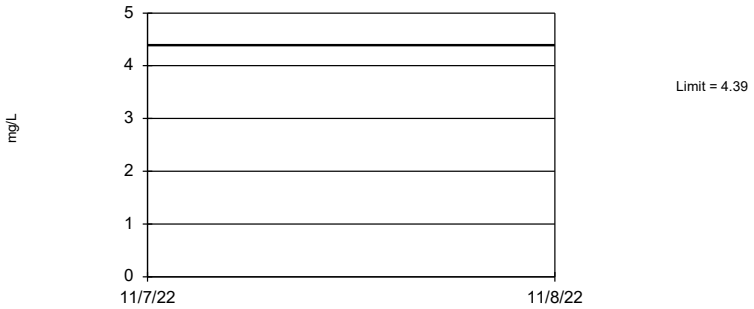


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Combined Radium 226 + 228 Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limit
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric



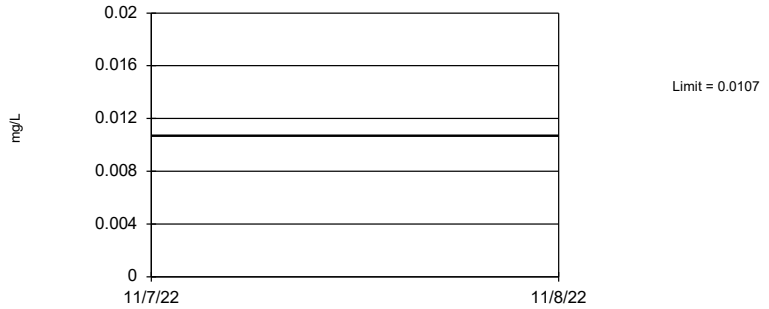
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Francia normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 52 background values. 1.923% NDs. 91.6% coverage at alpha=0.01; 94.34% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.06944.

Constituent: Fluoride Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



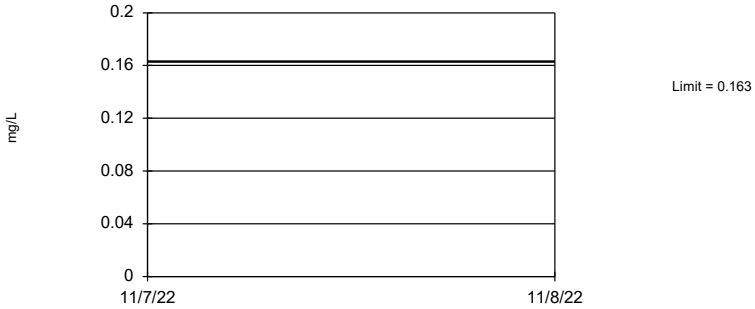
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 26.53% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Lead Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



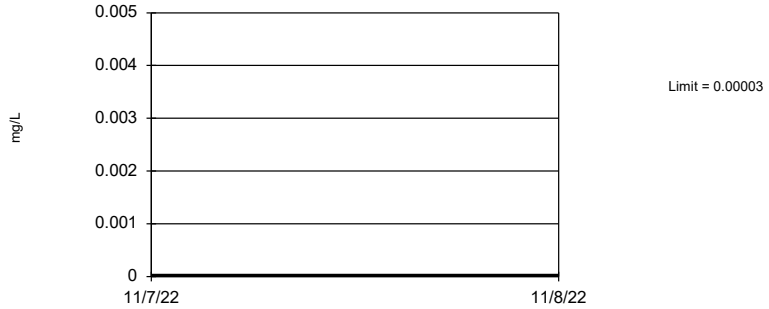
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 38 background values. 88.48% coverage at alpha=0.01; 92.38% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1424.

Constituent: Lithium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric

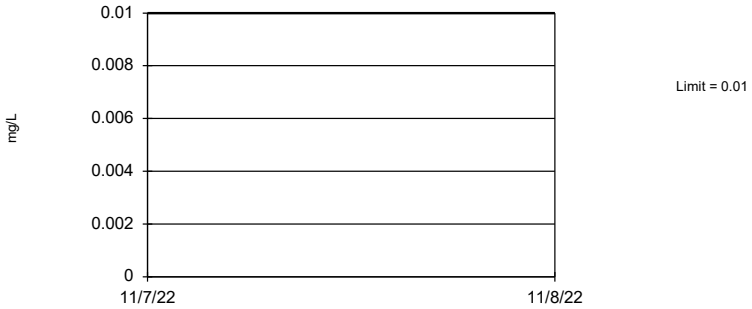


Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Limit is highest of 49 background values. 73.47% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Mercury Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Francia normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 50 background values. 34% NDs. 91.21% coverage at alpha=0.01; 94.34% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.07694.

Constituent: Molybdenum Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

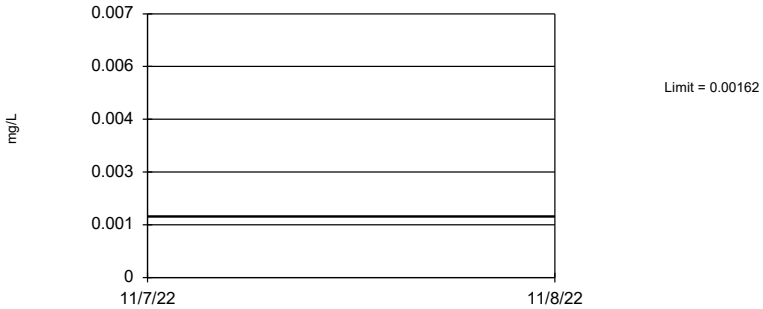
Interwell Non-parametric

Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 38 background values. 31.58% NDs. 88.48% coverage at alpha=0.01; 92.38% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1424.

Constituent: Selenium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Limit is highest of 26 background values. 88.46% NDs. 83.79% coverage at alpha=0.01; 89.26% coverage at alpha=0.05; 97.46% coverage at alpha=0.5. Report alpha = 0.2635.

Constituent: Thallium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE J

GWPS

NORTHEASTERN BAP GWPS				
Constituent Name	**MCL**	**CCR- Rule Specified Level**	**Background Limit**	**GWPS**
Antimony, Total (mg/L)	0.006		0.0057	0.006
Arsenic, Total (mg/L)	0.01		0.06	0.06
Barium, Total (mg/L)	2		2.6	2.6
Beryllium, Total (mg/L)	0.004		0.0021	0.004
Cadmium, Total (mg/L)	0.005		0.00021	0.005
Chromium, Total (mg/L)	0.1		0.034	0.1
Cobalt, Total (mg/L)	n/a	0.006	0.018	0.018
Combined Radium, Total (pCi/L)	5		15.84	15.84
Fluoride, Total (mg/L)	4		4.39	4.39
Lead, Total (mg/L)	n/a	0.015	0.011	0.015
Lithium, Total (mg/L)	n/a	0.04	0.16	0.16
Mercury, Total (mg/L)	0.002		0.00003	0.002
Molybdenum, Total (mg/L)	n/a	0.1	0.01	0.1
Selenium, Total (mg/L)	0.05		0.005	0.05
Thallium, Total (mg/L)	0.002		0.0016	0.002

**Grey cell indicates Background Limit is higher than MCL*

**GWPS = Groundwater Protection Standard*

**MCL = Maximum Contaminant Level*

**CCR = Coal Combustion Residuals*

FIGURE K
Confidence Intervals

Confidence Intervals - Significant Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/13/2023, 11:23 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Barium (mg/L)	**SP-10**	**6.485**	**3.978**	**2.6**	**Yes**	**14**	**5.231**	**1.77**	**0**	**None**	**No**	**0.01**	**Param.**
Fluoride (mg/L)	**SP-10**	**7.192**	**5.309**	**4.39**	**Yes**	**24**	**5.877**	**2.377**	**12.5**	**None**	**x^2**	**0.01**	**Param.**
Lithium (mg/L)	**SP-10**	**0.2823**	**0.2403**	**0.16**	**Yes**	**22**	**0.2613**	**0.03909**	**0**	**None**	**No**	**0.01**	**Param.**

Confidence Intervals - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/13/2023, 11:23 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony (mg/L)	SP-1	0.005	0.00058	0.006	No	25	0.002273	0.002164	28	None	No	0.01	NP (normality)
Antimony (mg/L)	SP-10	0.0007107	0.0001324	0.006	No	22	0.001619	0.001957	18.18	Kaplan-Meier	ln(x)	0.01	Param.
Antimony (mg/L)	SP-11	0.001559	0.0003001	0.006	No	22	0.002024	0.002877	13.64	None	ln(x)	0.01	Param.
Antimony (mg/L)	SP-2	0.00267	0.00121	0.006	No	25	0.002628	0.002529	8	None	No	0.01	NP (normality)
Arsenic (mg/L)	SP-1	0.005	0.0007	0.06	No	25	0.002426	0.00205	32	None	No	0.01	NP (normality)
Arsenic (mg/L)	SP-10	0.005196	0.00131	0.06	No	22	0.003998	0.00442	9.091	None	sqrt(x)	0.01	Param.
Arsenic (mg/L)	SP-11	0.005082	0.002312	0.06	No	22	0.004009	0.002956	4.545	None	sqrt(x)	0.01	Param.
Arsenic (mg/L)	SP-2	0.00251	0.00125	0.06	No	25	0.002578	0.002526	4	None	No	0.01	NP (normality)
Barium (mg/L)	SP-1	0.2014	0.1659	2.6	No	25	0.1848	0.03747	0	None	sqrt(x)	0.01	Param.
Barium (mg/L)	**SP-10**	**6.485**	**3.978**	**2.6**	**Yes**	**14**	**5.231**	**1.77**	**0**	**None**	**No**	**0.01**	**Param.**
Barium (mg/L)	SP-11	0.4198	0.1877	2.6	No	14	0.3136	0.1734	0	None	sqrt(x)	0.01	Param.
Barium (mg/L)	SP-2	1.348	0.9779	2.6	No	25	1.215	0.4905	0	None	ln(x)	0.01	Param.
Beryllium (mg/L)	SP-1	0.0002	0.000054	0.004	No	25	0.0002708	0.0003755	20	None	No	0.01	NP (normality)
Beryllium (mg/L)	SP-10	0.0025	0.00003	0.004	No	22	0.0008215	0.001174	31.82	None	No	0.01	NP (normality)
Beryllium (mg/L)	SP-11	0.00025	0.000029	0.004	No	22	0.0001598	0.0001332	31.82	None	No	0.01	NP (normality)
Beryllium (mg/L)	SP-2	0.00018	0.00007	0.004	No	25	0.0002432	0.0003408	16	None	No	0.01	NP (normality)
Cadmium (mg/L)	SP-1	0.00025	0.000055	0.005	No	14	0.0001289	0.0001258	14.29	None	No	0.01	NP (normality)
Cadmium (mg/L)	SP-10	0.0002	0.00001	0.005	No	14	0.00006429	0.0000761	21.43	None	No	0.01	NP (normality)
Cadmium (mg/L)	SP-11	0.0003193	0.00004378	0.005	No	22	0.0005352	0.0009452	13.64	None	ln(x)	0.01	Param.
Cadmium (mg/L)	SP-2	0.0005	0.000063	0.005	No	25	0.0002629	0.0002082	40	None	No	0.01	NP (normality)
Chromium (mg/L)	SP-1	0.001131	0.0005386	0.1	No	25	0.001032	0.0006777	24	Kaplan-Meier	sqrt(x)	0.01	Param.
Chromium (mg/L)	SP-10	0.001021	0.0003153	0.1	No	21	0.001086	0.001867	9.524	None	ln(x)	0.01	Param.
Chromium (mg/L)	SP-11	0.003875	0.0006394	0.1	No	22	0.006307	0.01088	4.545	None	ln(x)	0.01	Param.
Chromium (mg/L)	SP-2	0.00152	0.0006052	0.1	No	25	0.001211	0.00111	12	None	sqrt(x)	0.01	Param.
Cobalt (mg/L)	SP-1	0.001235	0.000497	0.018	No	25	0.001047	0.001133	12	None	x^(1/3)	0.01	Param.
Cobalt (mg/L)	SP-10	0.002076	0.0004679	0.018	No	22	0.001604	0.001808	9.091	None	sqrt(x)	0.01	Param.
Cobalt (mg/L)	SP-11	0.004854	0.001412	0.018	No	22	0.004032	0.004522	4.545	None	x^(1/3)	0.01	Param.
Cobalt (mg/L)	SP-2	0.001045	0.0004629	0.018	No	25	0.0008764	0.0007563	12	None	x^(1/3)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-1	4.296	3.2	15.84	No	24	3.748	1.074	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-10	15.45	5.923	15.84	No	22	10.69	8.877	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-11	2.316	1.151	15.84	No	21	1.733	1.056	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-2	14.14	8.859	15.84	No	22	11.85	5.446	0	None	sqrt(x)	0.01	Param.
Fluoride (mg/L)	SP-1	0.9392	0.6814	4.39	No	25	0.8103	0.2586	8	None	No	0.01	Param.
Fluoride (mg/L)	**SP-10**	**7.192**	**5.309**	**4.39**	**Yes**	**24**	**5.877**	**2.377**	**12.5**	**None**	**x^2**	**0.01**	**Param.**
Fluoride (mg/L)	SP-11	3.237	2.226	4.39	No	24	2.731	0.9909	0	None	No	0.01	Param.
Fluoride (mg/L)	SP-2	3.179	2.674	4.39	No	26	2.882	0.5786	0	None	x^2	0.01	Param.
Lead (mg/L)	SP-1	0.005	0.000259	0.015	No	25	0.002073	0.002113	32	None	No	0.01	NP (normality)
Lead (mg/L)	SP-10	0.0003457	0.0000864	0.015	No	14	0.0002815	0.0003238	14.29	None	ln(x)	0.01	Param.
Lead (mg/L)	SP-11	0.001678	0.000324	0.015	No	22	0.001997	0.002719	13.64	None	ln(x)	0.01	Param.
Lead (mg/L)	SP-2	0.005	0.000263	0.015	No	25	0.002172	0.002212	36	None	No	0.01	NP (normality)
Lithium (mg/L)	SP-1	0.006209	0.004617	0.16	No	24	0.005413	0.00156	0	None	No	0.01	Param.
Lithium (mg/L)	**SP-10**	**0.2823**	**0.2403**	**0.16**	**Yes**	**22**	**0.2613**	**0.03909**	**0**	**None**	**No**	**0.01**	**Param.**
Lithium (mg/L)	SP-11	0.04207	0.02304	0.16	No	14	0.03256	0.01344	0	None	No	0.01	Param.
Lithium (mg/L)	SP-2	0.08145	0.0556	0.16	No	25	0.06852	0.02593	0	None	No	0.01	Param.
Mercury (mg/L)	SP-1	0.000009	0.000005	0.002	No	25	0.00000624	0.000003778	84	None	No	0.01	NP (NDs)
Mercury (mg/L)	SP-10	0.000015	0.000005	0.002	No	22	0.000009727	0.000007369	54.55	None	No	0.01	NP (NDs)
Mercury (mg/L)	SP-11	0.00001	0.000005	0.002	No	22	0.0000115	0.00001305	40.91	None	No	0.01	NP (normality)
Mercury (mg/L)	SP-2	0.000005	0.000005	0.002	No	25	0.00000544	0.000001805	84	None	No	0.01	NP (NDs)
Molybdenum (mg/L)	SP-1	0.01653	0.01116	0.1	No	25	0.01385	0.005379	0	None	No	0.01	Param.
Molybdenum (mg/L)	SP-10	0.02335	0.003624	0.1	No	21	0.01805	0.02862	4.762	None	sqrt(x)	0.01	Param.
Molybdenum (mg/L)	SP-11	0.04433	0.002	0.1	No	22	0.02026	0.02353	4.545	None	No	0.01	NP (normality)
Molybdenum (mg/L)	SP-2	0.02461	0.01857	0.1	No	14	0.02159	0.004265	0	None	No	0.01	Param.
Selenium (mg/L)	SP-1	0.006629	0.003771	0.05	No	25	0.005487	0.003295	12	None	sqrt(x)	0.01	Param.
Selenium (mg/L)	SP-10	0.0009747	0.00015	0.05	No	22	0.001545	0.0022	40.91	Kaplan-Meier	ln(x)	0.01	Param.
Selenium (mg/L)	SP-11	0.00164	0.000394	0.05	No	22	0.001813	0.002321	9.091	None	ln(x)	0.01	Param.

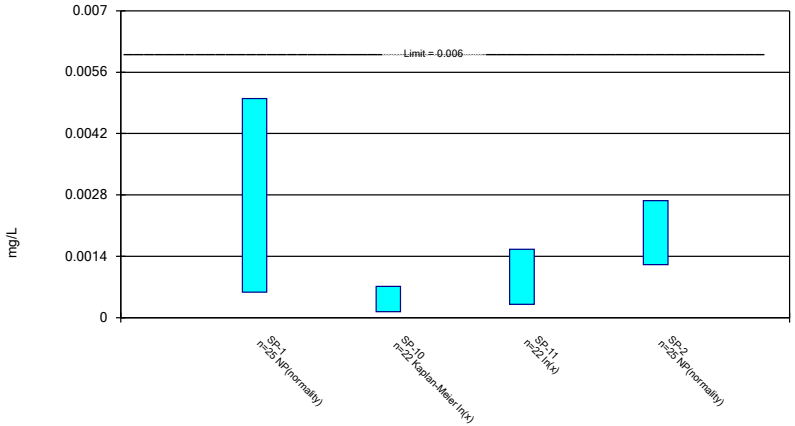
Confidence Intervals - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/13/2023, 11:23 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Selenium (mg/L)	SP-2	0.005112	0.002276	0.05	No	14	0.003814	0.002235	0	None	sqrt(x)	0.01	Param.
Thallium (mg/L)	SP-1	0.002	0.00007	0.002	No	14	0.0003936	0.0005092	42.86	None	No	0.01	NP (normality)
Thallium (mg/L)	SP-10	0.0002	0.00004	0.002	No	14	0.0001886	0.00004276	92.86	None	No	0.01	NP (NDs)
Thallium (mg/L)	SP-11	0.0002	0.00003	0.002	No	14	0.0001879	0.00004543	92.86	None	No	0.01	NP (NDs)
Thallium (mg/L)	SP-2	0.0002	0.00006	0.002	No	14	0.0001521	0.00006762	64.29	None	No	0.01	NP (NDs)

Parametric and Non-Parametric (NP) Confidence Interval

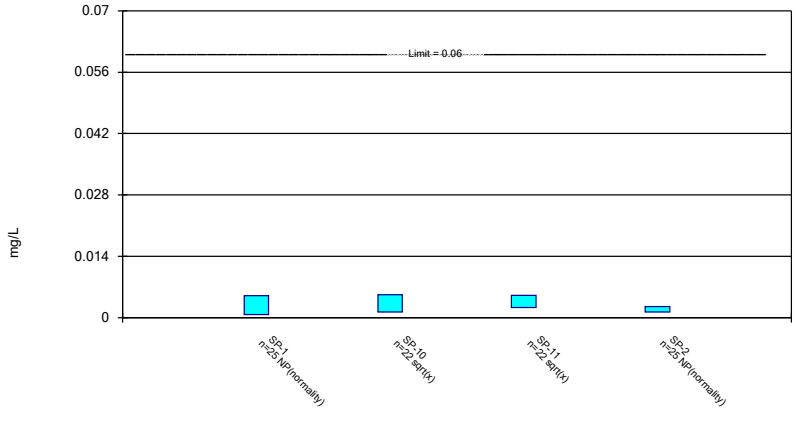
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Antimony Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric and Non-Parametric (NP) Confidence Interval

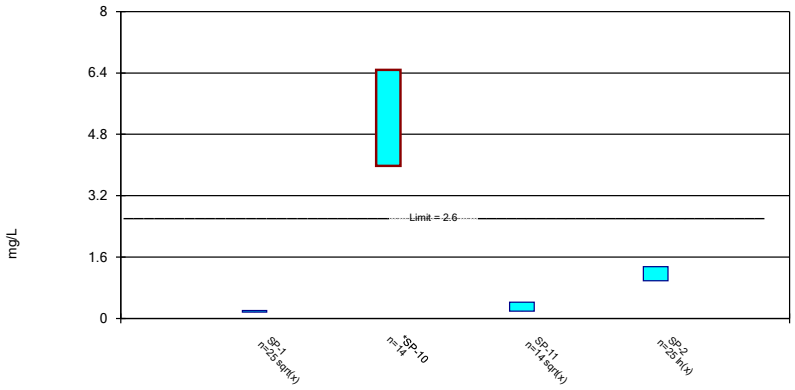
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Arsenic Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

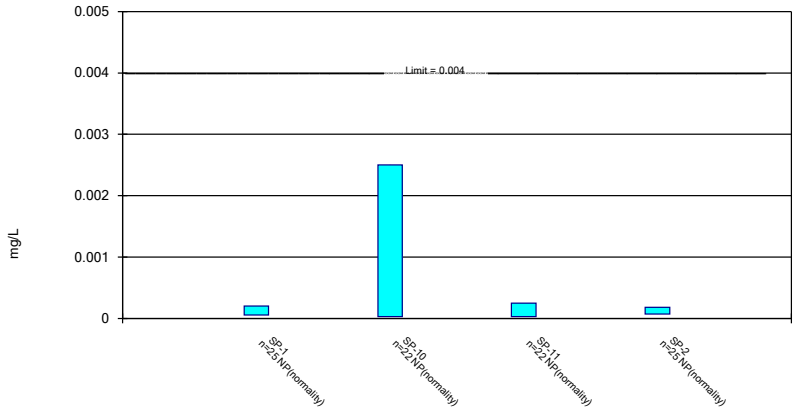
Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Barium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Non-Parametric Confidence Interval

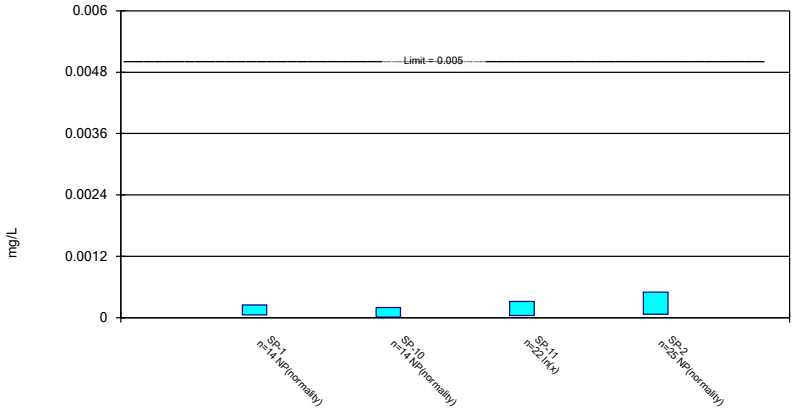
Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Beryllium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric and Non-Parametric (NP) Confidence Interval

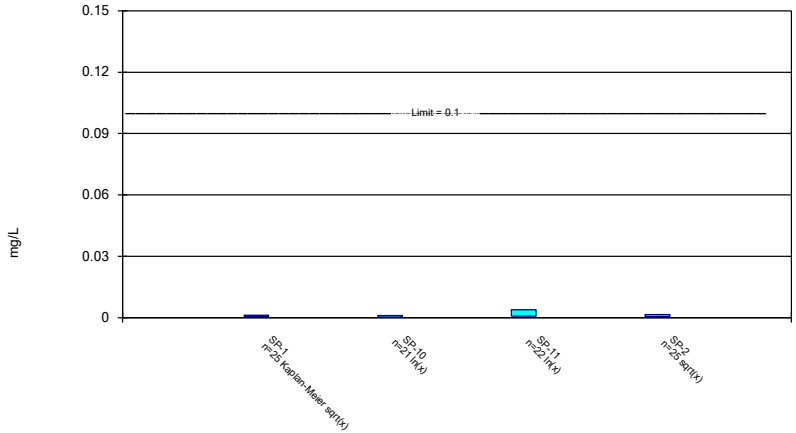
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Cadmium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

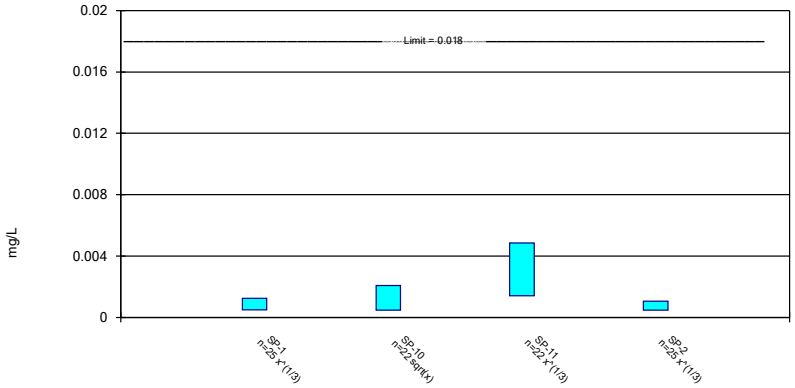
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Chromium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

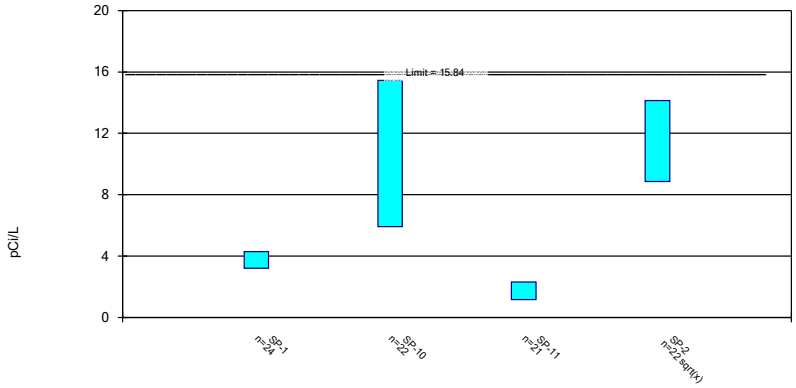
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Cobalt Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

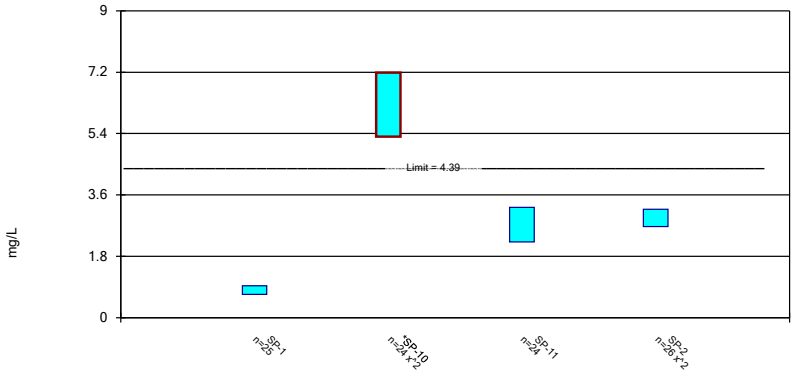


Constituent: Combined Radium 226 + 228 Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

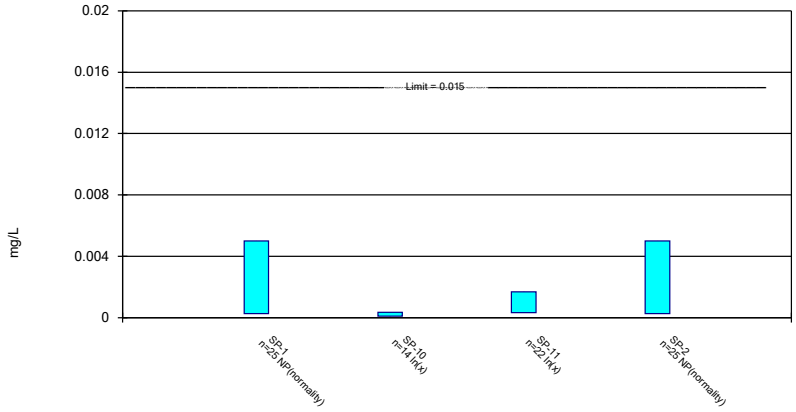


Constituent: Fluoride Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

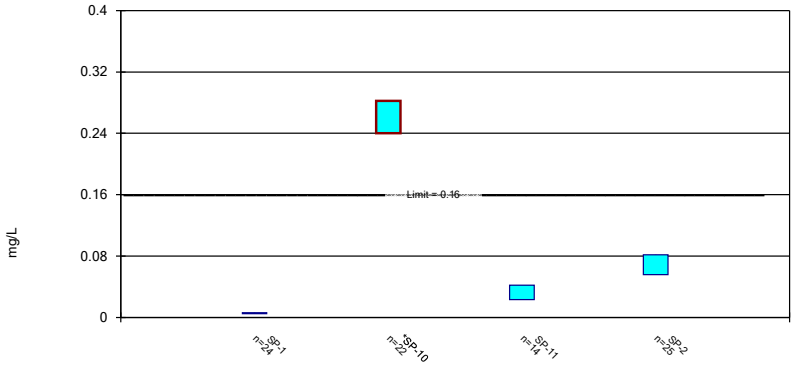


Constituent: Lead Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

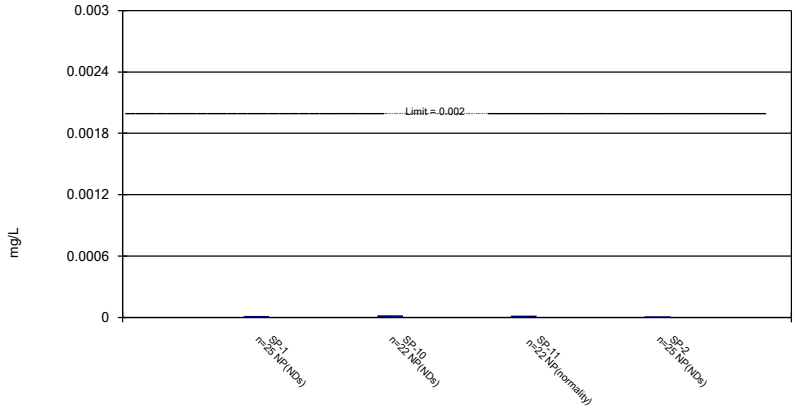


Constituent: Lithium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

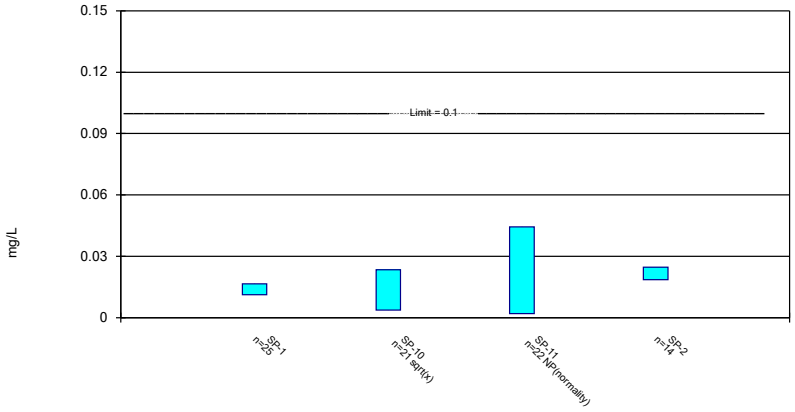
Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Mercury Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric and Non-Parametric (NP) Confidence Interval

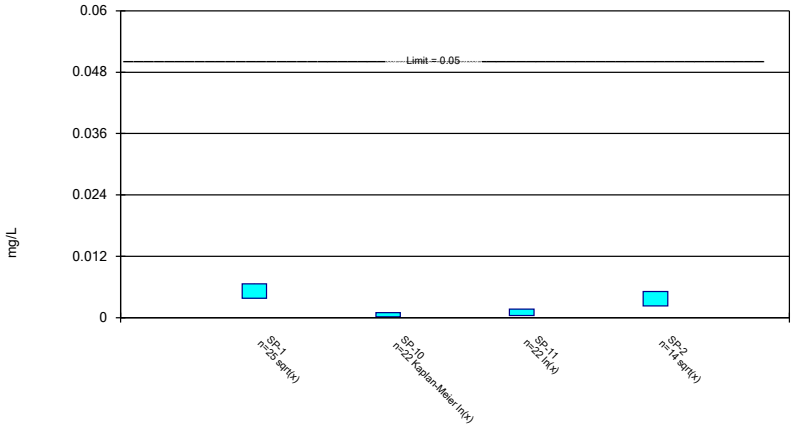
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Molybdenum Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

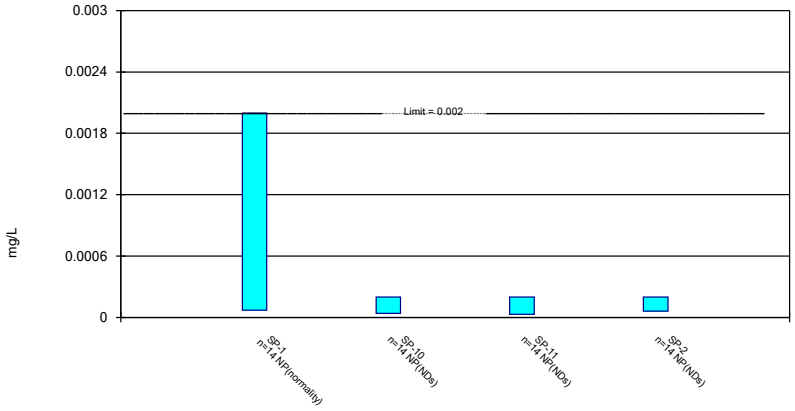
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Selenium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Thallium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Geosyntec consultants

engineers | scientists | innovators

STATISTICAL ANALYSIS SUMMARY, BOTTOM ASH POND

Northeastern Power Station

Oologah, Oklahoma

Prepared for

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October 3, 2023

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Attachment B: Statistical Analysis Output

ACRONYMS AND ABBREVIATIONS

ASD	alternative source demonstration
BAP	Bottom Ash Pond
CCR	coal combustion residuals
GWPS	groundwater protection standard
LCL	lower confidence limit
LPL	lower prediction limit
mg/L	milligrams per liter
NPS	Northeastern Power Station
OAC	Oklahoma Administrative Code
ODEQ	Oklahoma Department of Environmental Quality
QA/QC	quality assurance and quality control
SSI	statistically significant increase
SSL	statistically significant level
TDS	total dissolved solids
UPL	upper prediction limit

1. INTRODUCTION

In accordance with Oklahoma Department of Environmental Quality (ODEQ) requirements regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (Oklahoma Administrative Code [OAC] 252:517), groundwater monitoring has been conducted at the Bottom Ash Pond (BAP), an existing CCR unit at the Northeastern Power Station (NPS) in Oologah, Oklahoma. Recent groundwater monitoring results were used to identify concentrations of Appendix B constituents that are above the groundwater protection standards (GWPSs).

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron, chloride, fluoride, total dissolved solids (TDS), and sulfate at the BAP. In addition, pH values below the lower prediction limit (LPL) resulted in SSIs below background as well. GWPSs were set in accordance with OAC 252:517-9-6(h) and a statistical evaluation of the assessment monitoring data was conducted.

An assessment monitoring event was conducted at the BAP in November 2022 in accordance with OAC 252:517-9-6(d). During the November 2022 assessment monitoring event, statistically significant levels (SSLs) were observed for barium, fluoride, and lithium (Geosyntec 2023a). An alternative source demonstration (ASD) was successfully completed (Geosyntec 2023b), and the unit therefore remained in assessment monitoring. One assessment monitoring event was conducted at the BAP in June 2023, in accordance with OAC 252:517-9-6(d). Results of this event are documented in this report.

Before the statistical analyses were conducted, the groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues that would impact the usability of the data were identified.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Confidence intervals were calculated for Appendix B parameters at the compliance wells to assess whether SSLs were present above previously established GWPSs. SSLs were identified for barium, fluoride, and lithium. Therefore, either the unit will move to an assessment of corrective measures or an ASD will be conducted to evaluate whether the unit can remain in assessment monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A. The statistical analysis and certification of the selected methods were completed within 90 days of obtaining the data.

2. BOTTOM ASH POND EVALUATION

2.1 Data Validation and QA/QC

During the assessment monitoring program, one set of samples was collected in June 2023 for analysis from each upgradient and downgradient well to meet the requirements of OAC 252:517-9-6(d)(1). Samples from this sampling event were analyzed for both the Appendix A and Appendix B parameters. A summary of data collected during this assessment monitoring event may be found in Table 1. An additional sample was collected from SP-10 for dissolved Appendix B parameters based on a request from ODEQ (2023). The results for both the total and dissolved samples collected from SP-10 on June 20, 2023 are provided in Table 2.

Chemical analysis was completed by a National Environmental Laboratory Accreditation Program certified analytical laboratory. The laboratory completed analysis of quality assurance and quality control (QA/QC) samples such as laboratory reagent blanks, continuing calibration verification samples, and laboratory fortified blanks.

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.33 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues that would impact data usability were noted.

2.2 Statistical Analysis

Statistical analyses for the BAP were conducted in accordance with the November 2021 *Statistical Analysis Plan* (Geosyntec 2021) for the samples collected in June 2023. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained in June 2023 were screened for potential outliers. No outliers were identified for this event.

2.2.1 Evaluation of Potential Appendix B SSLs

A confidence interval was constructed for each Appendix B parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, nonparametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the nondetect frequency was too high). Select datasets were truncated if significant serial correlation was observed among the background samples that were collected on an approximately monthly basis in 2017. Additionally, the dataset for barium at SP-10 was truncated because earlier values were noted to be significantly lower than more recent results. A list of the truncated well/constituent pairs used for calculation of the confidence limits is provided in Attachment B.

An SSL was concluded if the lower confidence limit (LCL) was above the GWPS (i.e., if the entire confidence interval was above the GWPS). The calculated confidence limits (Attachment B) were compared to the GWPSs provided in Table 3. The GWPSs were established during a previous statistical analysis as either (a) the background concentration or (b) the maximum contaminant

level and risk-based levels specified in OAC 252:517-9-6(h), whichever was greater (Geosyntec 2023a).

The following SSLs were identified at the Northeastern BAP:

- The LCL for barium was above the GWPS of 2.60 milligrams per liter (mg/L) at SP-10 (4.07 mg/L).
- The LCL for fluoride was above the GWPS of 4.39 mg/L at SP-10 (5.36 mg/L).
- The LCL for lithium was above the GWPS of 0.163 mg/L at SP-10 (0.240 mg/L).

ODEQ previously noted in a letter provided to the NPS that "[i]f lithium and fluoride continue to exceed their relative GWPS in the future and conditions have not changed, NPS may refer to the October 29, 2019 ASD approval for lithium and June 4, 2021 approval for fluoride and continue assessment monitoring for the BAP in accordance with OAC 252:517-6(g)(3)(B)" (ODEQ 2021). ODEQ provided a similar letter dated September 20, 2022 documenting ASD approval for a barium SSL at SP-10 which is applicable in the future if conditions do not change (ODEQ 2022). Therefore, an ASD will be submitted to ODEQ demonstrating that conditions at the BAP remain unchanged so that the unit will continue assessment monitoring.

2.2.2 Evaluation of Potential Appendix A SSIs

While SSLs were identified, a review of the Appendix A results was also completed to assess whether concentrations of Appendix A parameters at the compliance wells were above background concentrations.

Data collected during the June 2023 assessment monitoring event from each compliance well were compared to previously calculated prediction limits to evaluate results above background values (Table 4). The following SSIs above the upper prediction limits (UPLs) were noted:

- Boron concentrations were above the interwell UPL of 0.503 mg/L at SP-10 (0.916 mg/L) and SP-11 (0.543 mg/L).
- Chloride concentrations were above the interwell UPL of 834 mg/L at SP-10 (1,960 mg/L).
- Fluoride concentrations were above the interwell UPL of 4.39 mg/L at SP-10 (6.3 mg/L).
- Sulfate concentrations were above the interwell UPL of 81.9 mg/L at SP-11 (358 mg/L).
- TDS concentrations were above the interwell UPL of 1,640 mg/L at SP-2 (1,780 mg/L) and SP-10 (3,500 mg/L).

While the prediction limits were calculated for a one-of-two retesting procedure, SSIs were conservatively assumed if the June 2023 sample was above the UPL or below the lower prediction limit. Based on these results, boron, chloride, fluoride, sulfate, and TDS concentrations were above background levels at compliance wells at the Northeastern BAP during assessment monitoring.

2.3 Conclusions

A semiannual assessment monitoring event was conducted in June 2023 in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, and no QA/QC issues that impacted data usability were identified. A review of outliers identified no potential outliers in the June 2023 data. A confidence interval was constructed at each compliance well for each Appendix B parameter; SSLs were concluded if the entire confidence interval was above the GWPSs. SSLs were identified for barium, fluoride, and lithium. Appendix A parameters were compared to prediction limits, with concentrations of boron, chloride, fluoride, sulfate, and TDS above background levels.

Based on this evaluation, either the Northeastern BAP CCR unit will move to an assessment of corrective measures or an ASD will be conducted to evaluate whether the unit can remain in assessment monitoring.

3. REFERENCES

Geosyntec. 2021. *Statistical Analysis Plan – Northeastern Power Station*, *Oologah, Oklahoma*. Geosyntec Consultants, Inc. November.

Geosyntec. 2023a. *Statistical Analysis Summary – Bottom Ash Pond*, *Northeastern Power Station, Oologah, Oklahoma*. Geosyntec Consultants, Inc. February.

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ODEQ. 2022. Letter Transmittal – Alternate Source Demonstration for Barium, Fluoride, and Lithium Exceedance – Bottom Ash Pond. Public Service Company of Oklahoma – Northeastern Power Station. Oklahoma Department of Environmental Quality. September.

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TABLES

Table 1. Groundwater Data Summary
Statistical Analysis Summary
Northeastern Plant - Bottom Ash Pond

Parameter	Unit	SP-1	SP-2	SP-4	SP-5R	SP-10	SP-11
		6/20/2023	6/20/2023	6/20/2023	6/20/2023	6/20/2023	6/20/2023
Antimony	µg/L	0.491	0.957	0.192	0.230	0.083 J1	0.038 J1
Arsenic	µg/L	0.45	1.11	1.26	9.09	0.29	1.51
Barium	µg/L	145	989	204	2,120	5,180	102
Beryllium	µg/L	0.091	0.077	0.074	0.276	0.027 J1	0.025 J1
Boron	mg/L	0.158	0.105	0.323	0.191	0.916	0.543
Cadmium	µg/L	0.047	0.076	0.044	0.074	0.009 J1	0.020 U1
Calcium	mg/L	100	87.2	82.1	94.5	83.0	86.7
Chloride	mg/L	84.3	604	468	782	1,960	99.3
Chromium	µg/L	0.41	0.51	0.61	2.73	0.45	0.34
Cobalt	µg/L	0.174	0.326	0.470	1.18	0.146	0.717
Combined Radium	pCi/L	6.92	12.46	7.96	16.19	18.07	1.21
Fluoride	mg/L	0.82	3.02	3.29	3.09	6.3	1.43
Lead	µg/L	0.24	0.17 J1	0.21	2.11	0.09 J1	0.08 J1
Lithium	mg/L	0.0073	0.0326	0.0507	0.0822	0.206	0.0179
Mercury	µg/L	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1
Molybdenum	µg/L	17.2	14.8	2.8	0.8	0.7	0.8
Selenium	µg/L	7.58	2.28	0.41 J1	0.91	0.5 U1	0.10 J1
Sulfate	mg/L	65.0	18.1	83.0	3.8	19.7	358
Thallium	µg/L	0.07 J1	0.03 J1	0.02 J1	0.05 J1	0.20 U1	0.20 U1
Total Dissolved Solids	mg/L	460	1,780	1,170	1,580	3,500	1,070
pH	SU	7.24	7.3	7.53	7.52	7.46	7.2

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Nondetect value. For statistical analysis, parameters that were not detected were replaced with the reporting limit.
J: Estimated value. Parameter was detected in concentrations below the reporting limit.

Table 2. SP-10 Total v. Dissolved Data
Statistical Analysis Summary
Northeastern Plant - Bottom Ash Pond

Parameter	Unit	SP-10	
		Total	Dissolved
Antimony	µg/L	0.083 J1	0.089 J1
Arsenic	µg/L	0.29	0.40
Barium	µg/L	5,180	5,280
Beryllium	µg/L	0.027 J1	0.022 J1
Boron	mg/L	0.916	0.916
Cadmium	µg/L	0.009 J1	0.02 U1
Calcium	mg/L	83.0	128
Chromium	µg/L	0.45	0.18 J1
Cobalt	µg/L	0.146	0.065
Combined Radium	pCi/L	18.07	20.00
Fluoride	mg/L	6.3	6.3
Lead	µg/L	0.09 J1	0.20 U1
Lithium	mg/L	0.206	0.214
Mercury	µg/L	0.005 U1	0.005 U1
Molybdenum	µg/L	0.7	0.9
Selenium	µg/L	0.5 U1	0.05 J1
Thallium	µg/L	0.20 U1	0.20 U1

Notes:
1. Both samples were collected on 6/20/2023.
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Nondetect value. For statistical analysis, parameters that were not detected were replaced with the reporting limit.
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not analyzed

Table 3. Appendix B Groundwater Protection Standards
Statistical Analysis Summary
Northeastern Plant - Bottom Ash Pond

Geosyntec Consultants, Inc.

Constituent Name	MCL	CCR Rule-Specified	Calculated UTL	GWPS
Antimony, Total (mg/L)	0.00600		0.00570	0.00600
Arsenic, Total (mg/L)	0.0100		0.0599	0.0599
Barium, Total (mg/L)	2.00		2.60	2.60
Beryllium, Total (mg/L)	0.00400		0.00212	0.00400
Cadmium, Total (mg/L)	0.00500		0.00207	0.00500
Chromium, Total (mg/L)	0.100		0.00342	0.100
Cobalt, Total (mg/L)	n/a	0.00600	0.0179	0.0179
Combined Radium, Total (pCi/L)	5.00		15.8	15.8
Fluoride, Total (mg/L)	4.00		4.39	4.39
Lead, Total (mg/L)	n/a	0.0150	0.0107	0.0150
Lithium, Total (mg/L)	n/a	0.0400	0.163	0.163
Mercury, Total (mg/L)	0.00200		0.0000300	0.00200
Molybdenum, Total (mg/L)	n/a	0.100	0.0100	0.100
Selenium, Total (mg/L)	0.0500		0.00499	0.0500
Thallium, Total (mg/L)	0.00200		0.00162	0.00200

Notes:
1. Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
2. Grey cells indicate the GWPS is based on the calculated UTL, which is higher than the MCL or CCR Rule-specified value.
CCR: Coal Combustion Residuals
GWPS: Groundwater Protection Standard
MCL: Maximum Contaminant Level
mg/L: milligrams per liter
pCi/L: picocuries per liter

Table 4. Appendix A Data Summary
Statistical Analysis Summary
Northeastern Plant - Bottom Ash Pond

Geosyntec Consultants, Inc.

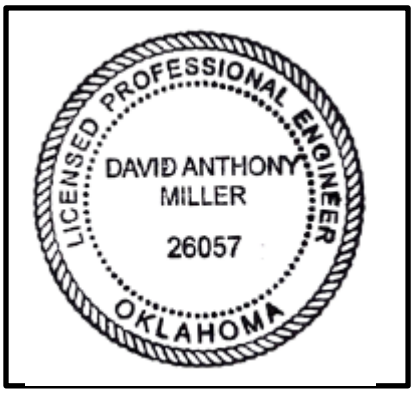
Analyte	Unit	Description	SP-1	SP-2	SP-10	SP-11
			6/20/2023	6/20/2023	6/20/2023	6/20/2023
Boron	mg/L	Interwell Background Value (UPL)	0.503			
		Analytical Result	0.158	0.105	**0.916**	**0.543**
Calcium	mg/L	Intrawell Background Value (UPL)	141	167		156
		Analytical Result	100	87.2	83.0	86.7
Chloride	mg/L	Interwell Background Value (UPL)	834			
		Analytical Result	84.3	604	**1,960**	99.3
Fluoride	mg/L	Interwell Background Value (UPL)	4.39			
		Analytical Result	0.82	3.02	**6.3**	1.43
pH	SU	Interwell Background Value (UPL)	9.1			
		Interwell Background Value (LPL)	7.0			
		Analytical Result	7.2	7.3	7.5	7.2
Sulfate	mg/L	Interwell Background Value (UPL)	81.9			
		Analytical Result	65.0	18.1	19.7	**358**
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	1,640			
		Analytical Result	460	**1,780**	**3,500**	1,070

Notes:
1. Bold values exceed the background value.
2. Background values are shaded gray.
LPL: lower prediction limit
mg/L: milligrams per liter
SU: standard units
UPL: upper prediction limit

ATTACHMENT A
Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Northeastern Bottom Ash Pond CCR management area and that the requirements of OAC 252:517-9-4(g) have been met.



David Anthony Miller

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

26057	Oklahoma	10.04.2023
License Number	Licensing State	Date

ATTACHMENT B
Statistical Analysis Output

GROUNDWATER STATS CONSULTING

August 7, 2023

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
500 W. Wilson Bridge Road, Suite 250
Worthington, OH 43085

Re: Northeastern BAP (Bottom Ash Pond)
Assessment Monitoring Statistics – June 2023

Dear Ms. Kreinberg,

Groundwater Stats Consulting (GSC), formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the June 2023 assessment monitoring analysis of groundwater data for American Electric Power Inc.'s Northeastern BAP. The analysis complies with the Oklahoma Administrative Code (OAC) as well as with the United States Environmental Protection Agency (USEPA) Unified Guidance (2009).

Sampling began at the site for the OAC program in 2017. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** SP-4 and SP-5R
- **Downgradient wells:** SP-1, SP2, SP-10, and SP-11

Data were sent electronically, and the statistical analysis was conducted according to the Statistical Analysis Plan and screening evaluation prepared by GSC and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC. The analysis was reviewed by Andrew Collins, Project Manager of GSC.

The OAC program consists of the following constituents listed below. The terms "constituent" and "parameter" are interchangeable.

- **Appendix B** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium

For all constituents, a substitution of the most recent reporting limit is used for non-detect data. For several constituents, varying detection limits were present. Time series and box plots are provided for all wells for the parameters listed above (Figures A & B). The time series plots display concentrations over time for each well while the box plots provide visual representation of variation within a given well and across all wells.

Summary of Background Screening

Evaluation of Appendix B Parameters – November 2022

Prior to evaluating Appendix B parameters, background data are screened through visual screening and Tukey's outlier test for potential outliers and extreme trending patterns that would lead to artificially elevated statistical limits.

Outlier Analysis

For the current analysis, Tukey's outlier test on pooled upgradient well data identified outliers for fluoride, lead, mercury, and selenium and confirmed previously flagged values. Several of the values identified by Tukey's test were either similar to concentrations upgradient of the facility or were lower than the respective Maximum Contaminant Level (MCL); therefore, the values were not flagged as outliers. A summary of previously flagged outliers follows this report (Figure C).

During previous screenings, due to no variation in the data, Tukey's outlier test was not performed for cadmium in well SP-5R, mercury in all wells, selenium in well SP-5R, and thallium in all wells. Among upgradient wells, high values for cadmium, lead, and selenium were identified by Tukey's outlier test. Only the highest values for cadmium and lead were flagged as outliers to maintain statistical limits that are conservative from a regulatory perspective. Substantially high values were identified for upgradient well SP-4 on 8/4/17 through visual screening and the highest values for arsenic, beryllium, cobalt, and mercury were flagged. This step will result in upper tolerance limits that are conservative (lower) from a regulatory perspective. More recent concentrations for barium in downgradient well SP-10 were noted to be significantly higher than historical concentrations. Therefore,

earlier concentrations were previously deselected prior to constructing confidence intervals in order to evaluate present-day groundwater concentrations of barium at this well. As mentioned above, list of well/constituent pairs using a truncated portion of their records follows this report (Date Ranges Table).

Additionally, downgradient well data through November 2022 were screened through visual screening using time series graphs. Since the downgradient well data are used to construct confidence intervals, a regulatory conservative approach is taken in that values that are marginally high relative to the rest of the data are retained unless there is particular justification for excluding them. No additional outliers among downgradient wells were flagged during this analysis. Previously a high value for combined radium 226 + 228 in well SP-1 was flagged as an outlier. The following additional values were flagged as outliers as they did not adequately represent the populations at their respective wells: chromium in well SP-10; combined radium 226 + 228 in well SP-11; lithium in well SP-1; and molybdenum in well SP-10.

Rank Von Neumann

As mentioned above, background samples were collected approximately on a monthly basis during 2017 at all wells for Appendix B constituents. Since the EPA Unified Guidance recommends collection of independent groundwater samples, the Rank Von Neumann test for serial correlation was used to determine whether serial correlation was present among these earlier samples. Significant serial correlation was identified for the following Appendix B well/constituent pairs:

- Barium: SP-4 (upgradient) and SP-11
- Cadmium: SP-4 and SP-5R (both upgradient), SP-1, and SP-10
- Chromium: SP-4 (upgradient)
- Lead: SP-10
- Lithium: SP-4 (upgradient) and SP-11
- Molybdenum: SP-2
- Selenium: SP-5R (upgradient) and SP-2
- Thallium: SP-4 and SP-5R (both upgradient), SP-1, SP-2, SP-10, and SP-11

As a result, the records for these well/constituent pairs were truncated to remove earlier measurements for construction of statistical limits using only more recent data that represent independent samples. Results of the Rank Von Neumann test were included with the previous update.

Tolerance Limits

Parametric tolerance limits were used to calculate background limits from pooled upgradient well data through November 2022 for Appendix B parameters with a target of 95% confidence and 95% coverage to determine background limits. These limits will be updated on an annual basis at the end of each year and will be updated again at the end of 2023. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the MCLs and background limits in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure D).

Groundwater Protection Standards

The upper tolerance limits were compared to the Maximum Contaminant Levels (MCLs) and background limits in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure E).

Evaluation of Appendix B Parameters – June 2023

For Appendix B parameters, confidence intervals for each downgradient well/constituent were compared against corresponding Groundwater Protection Standards (GWPS). GWPS were developed as described below. Downgradient well/constituent pairs that have 100% non-detects do not require analysis; however, no downgradient wells had 100% non-detects, and all well/constituent pairs were eligible for confidence intervals.

Confidence Intervals

Confidence intervals were then constructed on downgradient wells with data through June 2023 for each of the Appendix B parameters using the highest limit of the MCL or background limit as discussed above for the GWPS (Figure F). As mentioned above, the most recent reporting limit is substituted for historical non-detects within a given well, and the reporting limits vary among individual wells. These intervals were constructed as either parametric or nonparametric confidence intervals depending on the data distribution and percentage of non-detects.

When data followed a normal or transformed-normal distribution, parametric confidence intervals were used for Appendix B parameters. Nonparametric confidence intervals, which use the largest and smallest order statistics depending on the sample size as

interval limits, were constructed when data did not follow a normal or transformed-normal distribution or when there were greater than 50% non-detects. The lower confidence limit, which is constructed with 99% confidence for parametric confidence intervals, is compared to the GWPS prepared as described above. The confidence level associated with nonparametric confidence intervals is dependent upon the number samples available.

Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. A summary of the confidence interval results follows this letter. Exceedances were found for the following well/constituent pairs:

- Barium: SP-10
- Fluoride: SP-10
- Lithium: SP-10

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Northeastern BAP. If you have any questions or comments, please feel free to contact us.

For Groundwater Stats Consulting,

Tristan Clark
Groundwater Analyst

Andrew Collins
Project Manager

Date Ranges

Date: 8/5/2023 4:44 PM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Barium (mg/L)
- SP-10 overall:5/30/2018-6/20/2023
- SP-11 overall:5/30/2018-6/20/2023
- SP-4 overall:5/30/2018-6/20/2023

Cadmium (mg/L)
- SP-1 overall:5/30/2018-6/20/2023
- SP-10 overall:5/30/2018-6/20/2023
- SP-4 overall:5/30/2018-6/20/2023
- SP-5R overall:5/30/2018-6/20/2023

Calcium (mg/L)
- SP-11 background:7/30/2018-6/20/2023
- SP-4 overall:1/22/2018-6/20/2023

Chromium (mg/L)
- SP-4 overall:5/30/2018-6/20/2023

Lead (mg/L)
- SP-10 overall:5/30/2018-6/20/2023

Lithium (mg/L)
- SP-11 overall:5/30/2018-6/20/2023
- SP-4 overall:5/30/2018-6/20/2023

Molybdenum (mg/L)
- SP-2 overall:5/30/2018-6/20/2023

Selenium (mg/L)
- SP-2 overall:5/30/2018-6/20/2023
- SP-5R overall:5/30/2018-6/20/2023

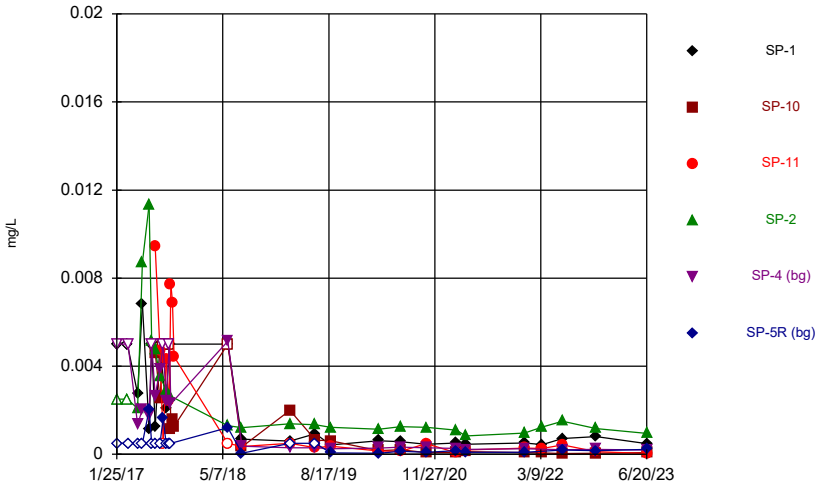
Sulfate (mg/L)
- SP-4 overall:5/30/2018-6/20/2023
- SP-5R overall:5/30/2018-6/20/2023

Thallium (mg/L)
- overall:5/30/2018-6/20/2023

FIGURE A
Time Series

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Antimony Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

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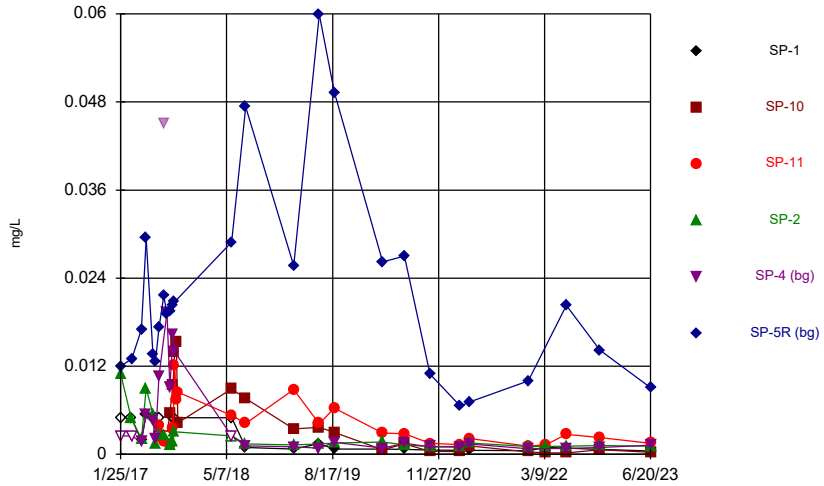

Constituent: Arsenic Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

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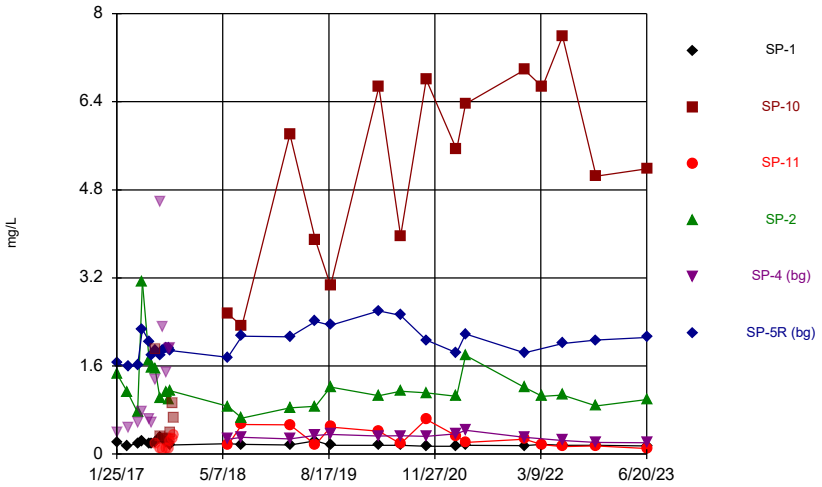

Constituent: Barium Analysis Run 8/3/2023 4:42 PM View: Appendix B
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Hollow symbols indicate censored values.

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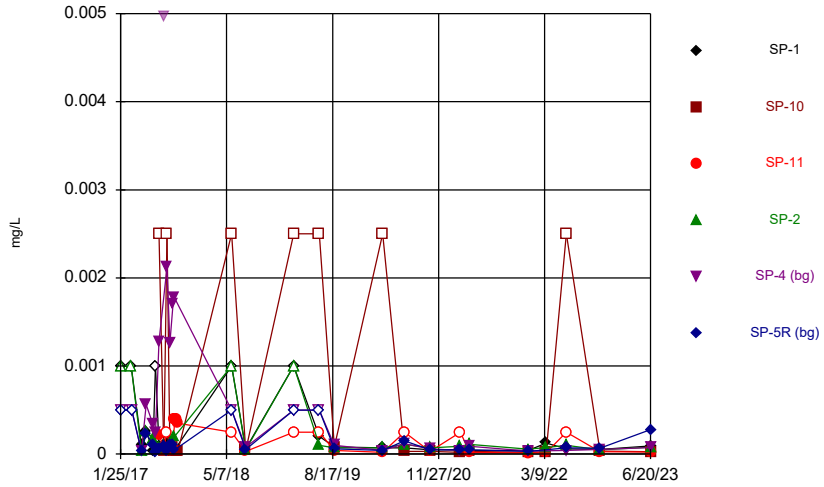
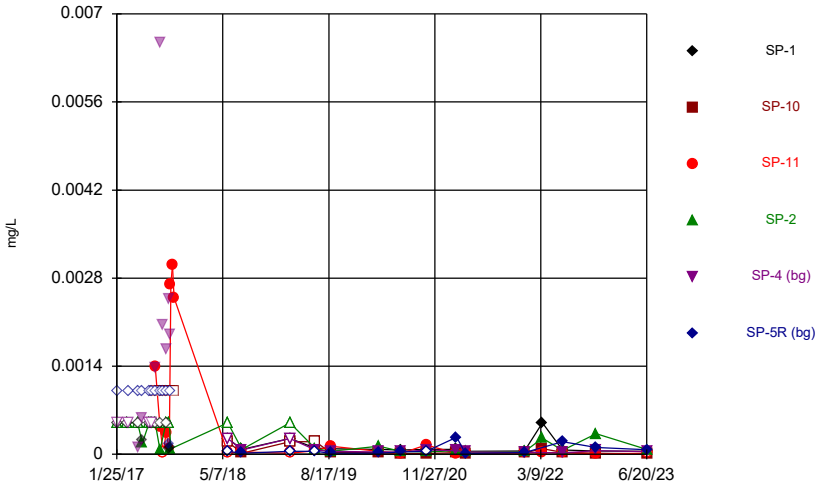


Constituent: Beryllium Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

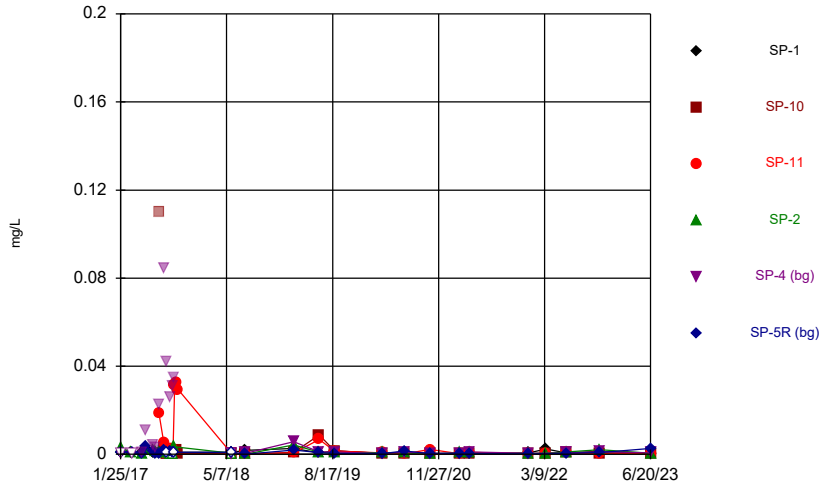
Time Series



Constituent: Cadmium Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

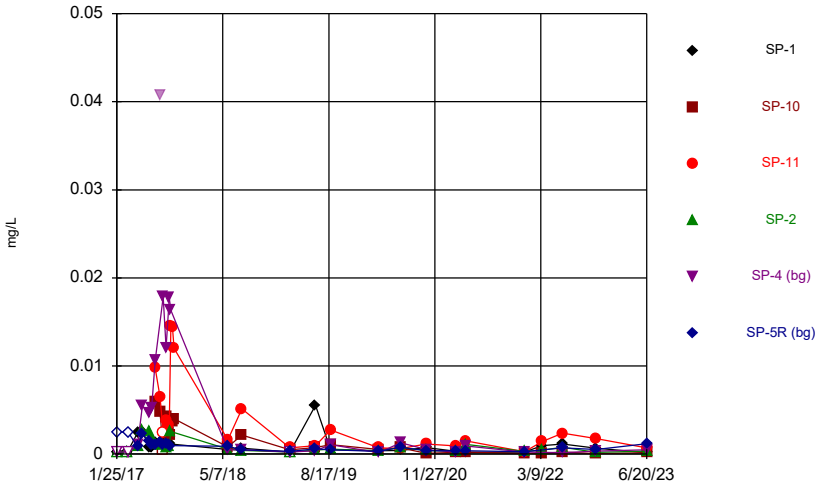
Time Series



Constituent: Chromium Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

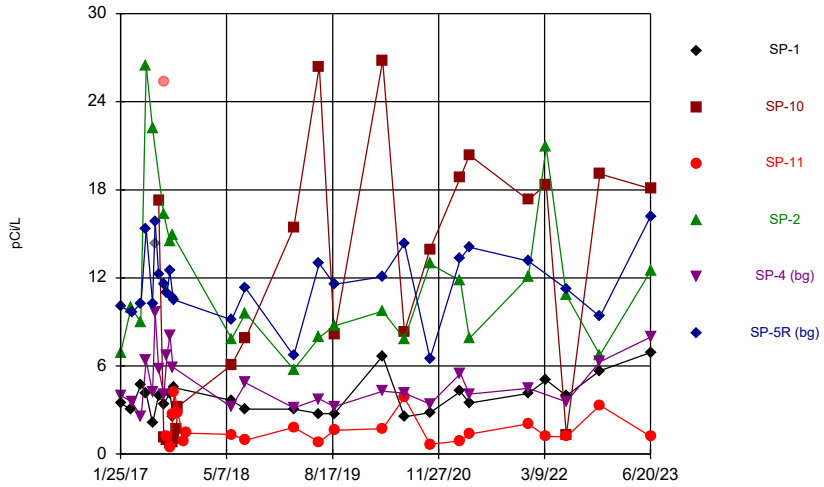
Time Series



Constituent: Cobalt Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

Time Series



Constituent: Combined Radium 226 + 228 Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

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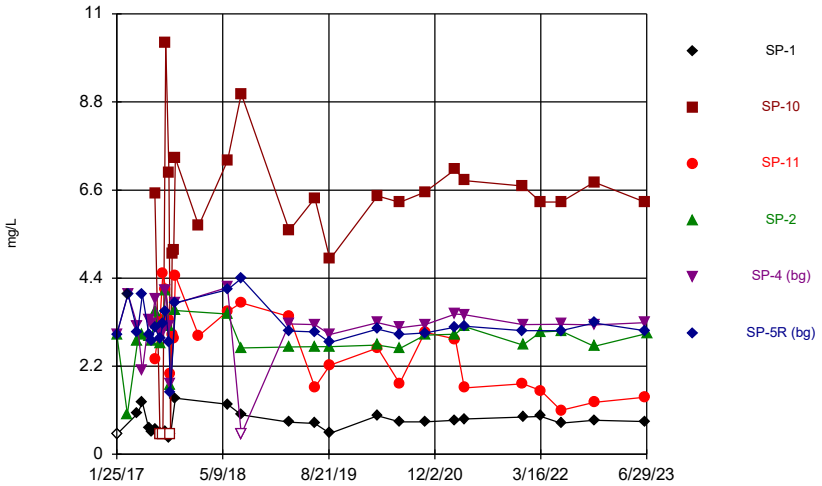
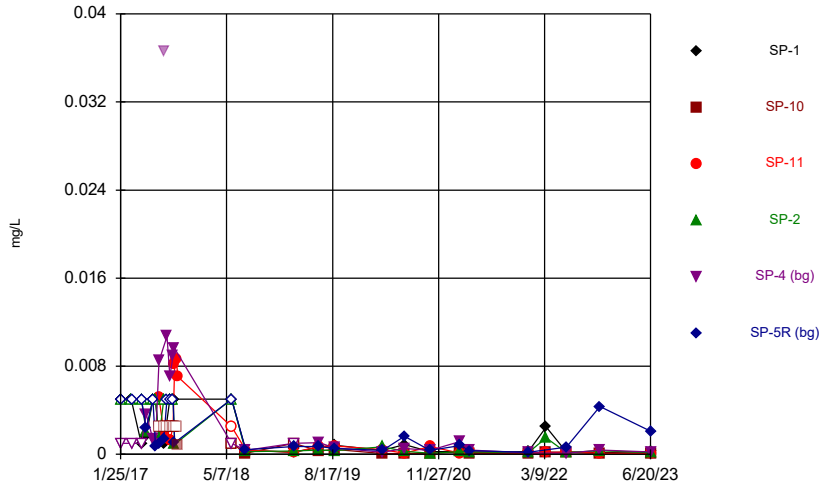


Constituent: Fluoride Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

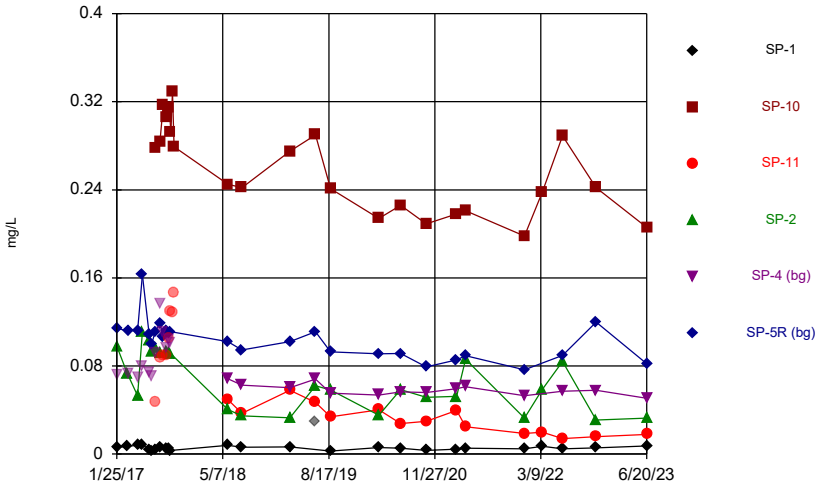
Time Series



Constituent: Lead Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

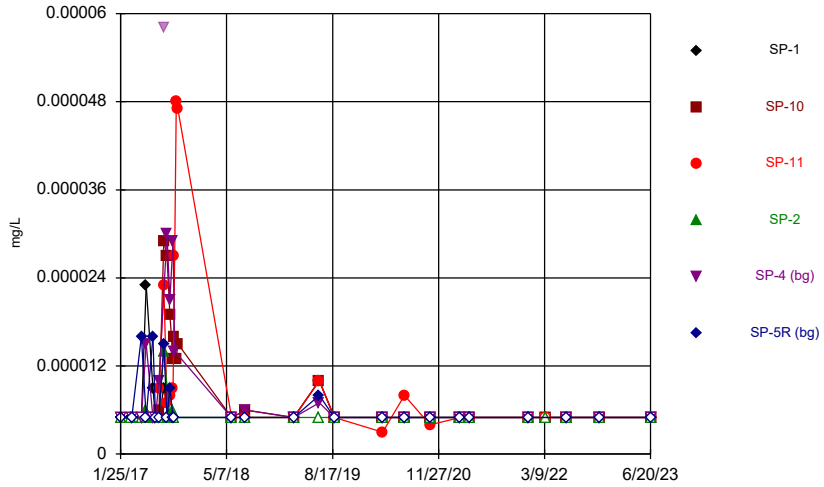
Time Series



Constituent: Lithium Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

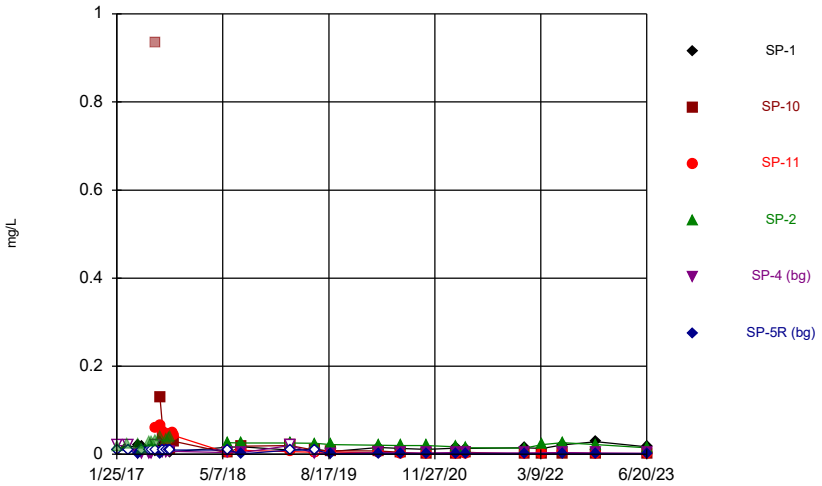
Time Series



Constituent: Mercury Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

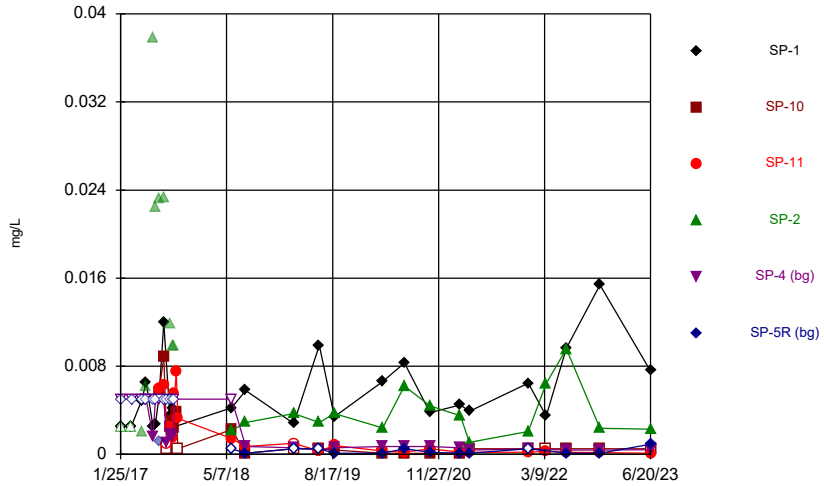
Time Series



Constituent: Molybdenum Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

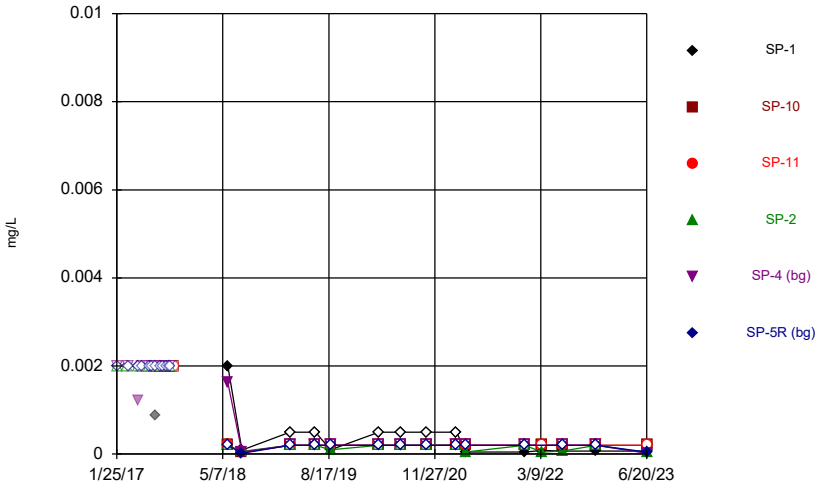
Time Series



Constituent: Selenium Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

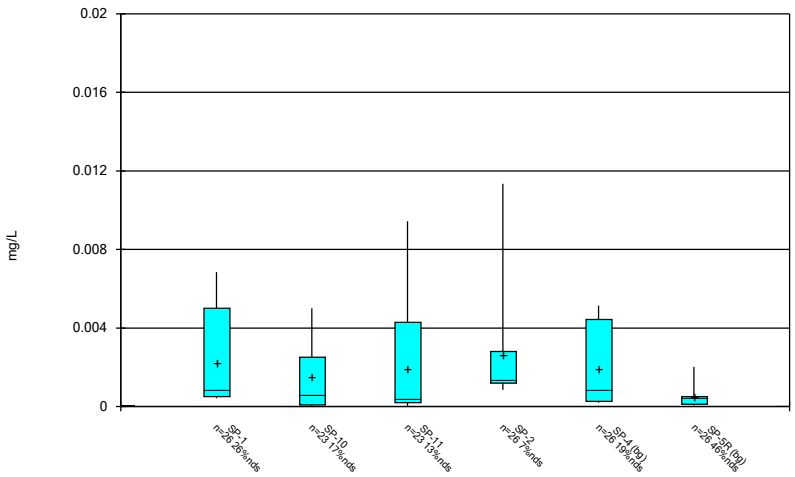
Time Series



Constituent: Thallium Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE B
Box Plots

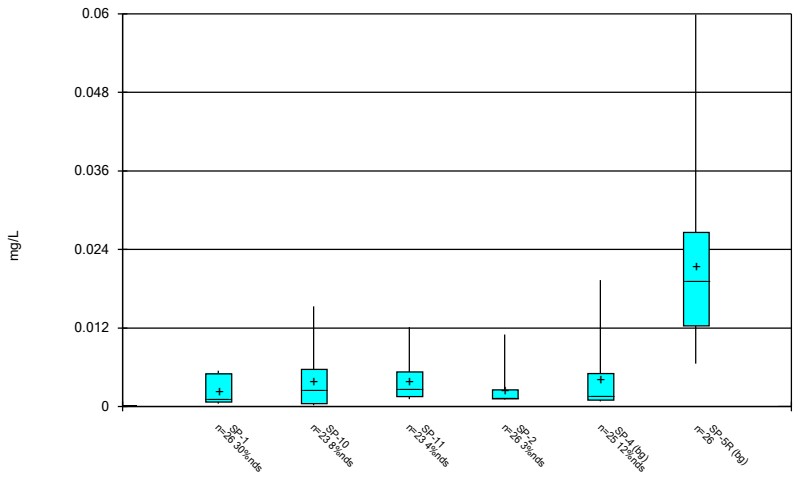
Box & Whiskers Plot



Constituent: Antimony Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

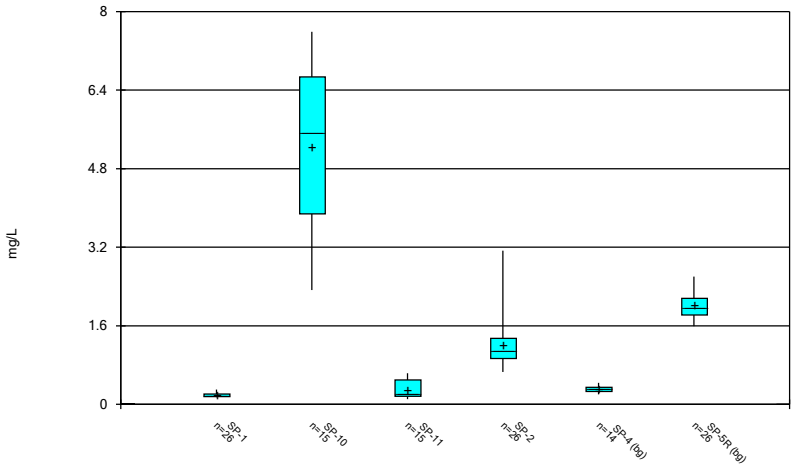
Box & Whiskers Plot



Constituent: Arsenic Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

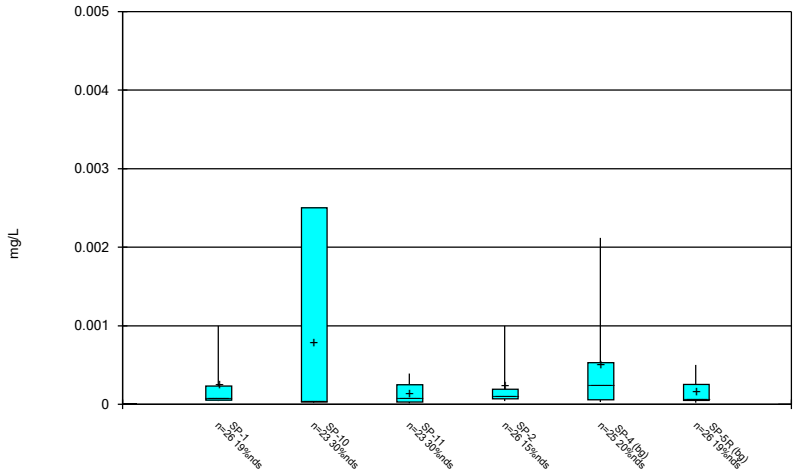
Box & Whiskers Plot



Constituent: Barium Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

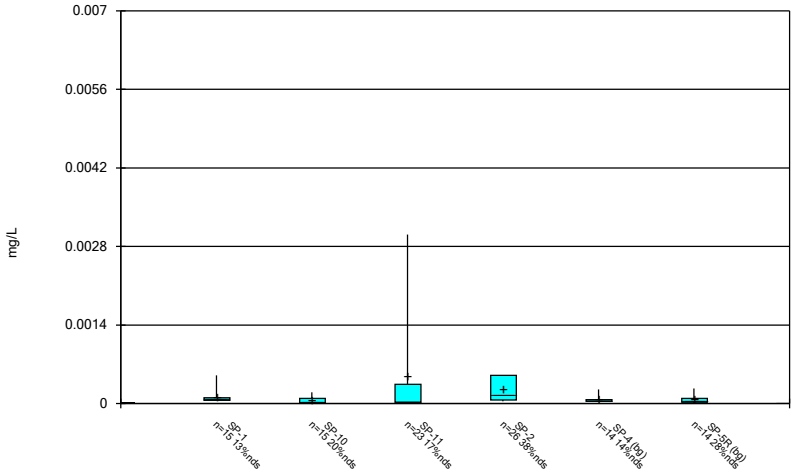
Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Beryllium Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

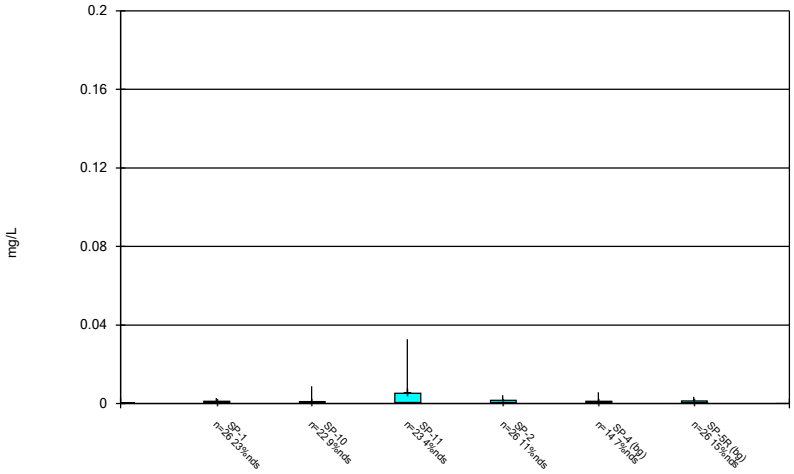
Box & Whiskers Plot



Constituent: Cadmium Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

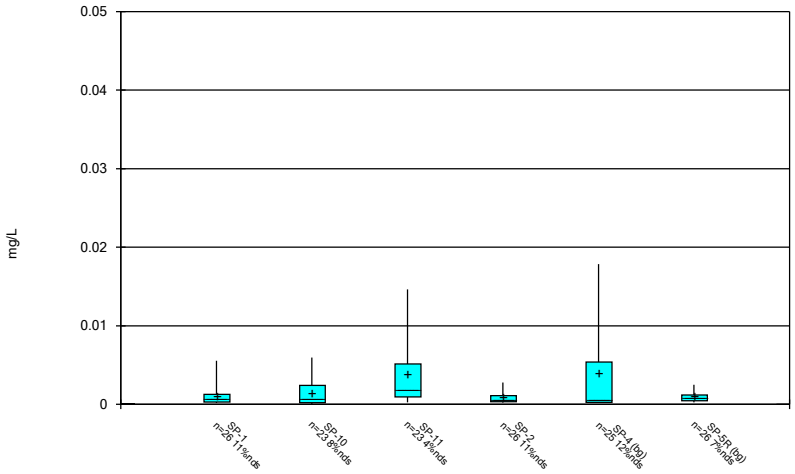
Box & Whiskers Plot



Constituent: Chromium Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

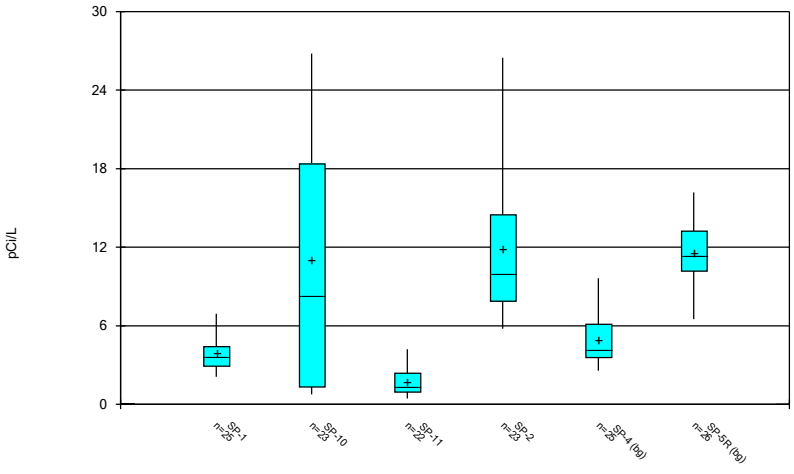
Box & Whiskers Plot



Constituent: Cobalt Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

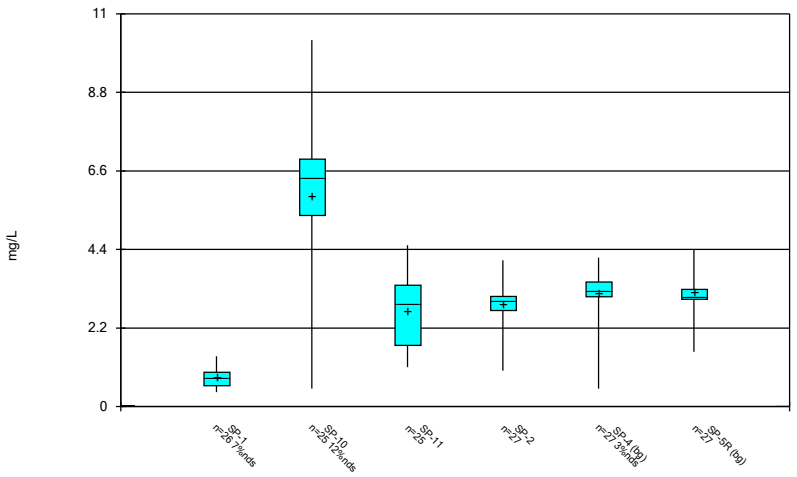
Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 8/3/2023 4:42 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

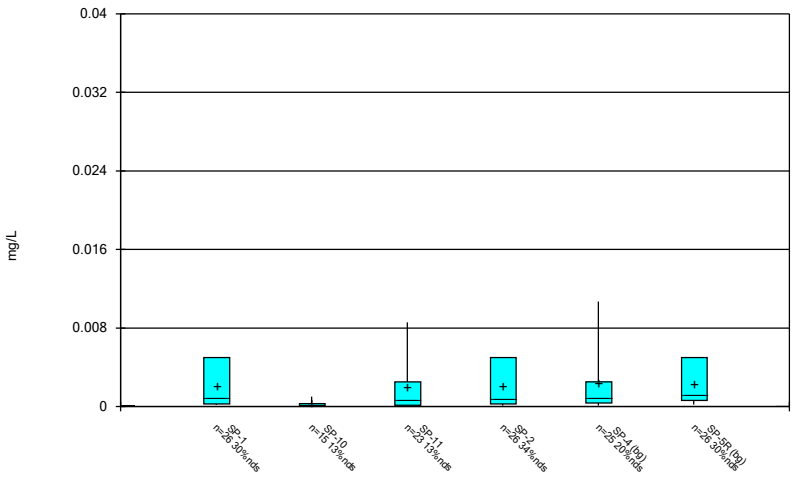
Box & Whiskers Plot



Constituent: Fluoride Analysis Run 8/3/2023 4:43 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

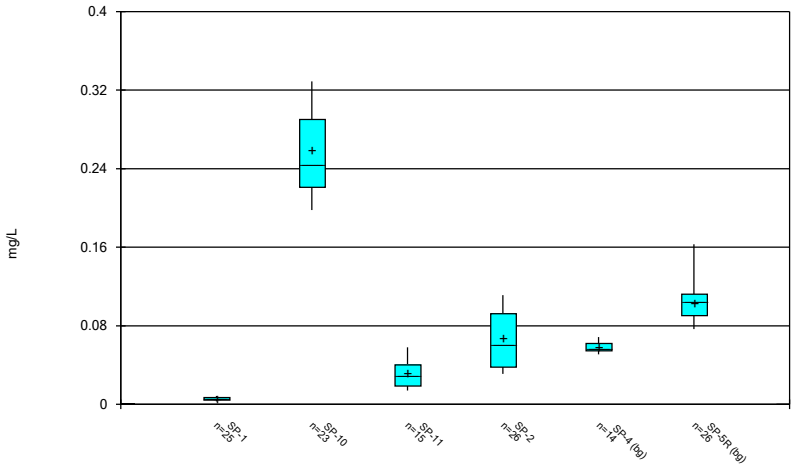
Box & Whiskers Plot



Constituent: Lead Analysis Run 8/3/2023 4:43 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

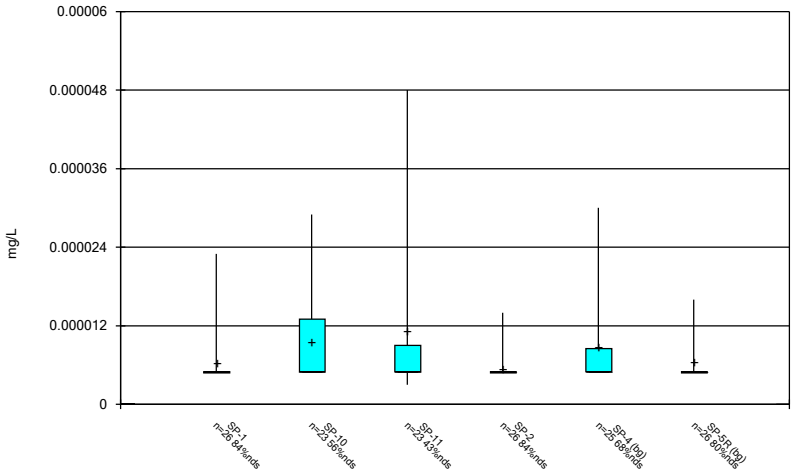
Box & Whiskers Plot



Constituent: Lithium Analysis Run 8/3/2023 4:43 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

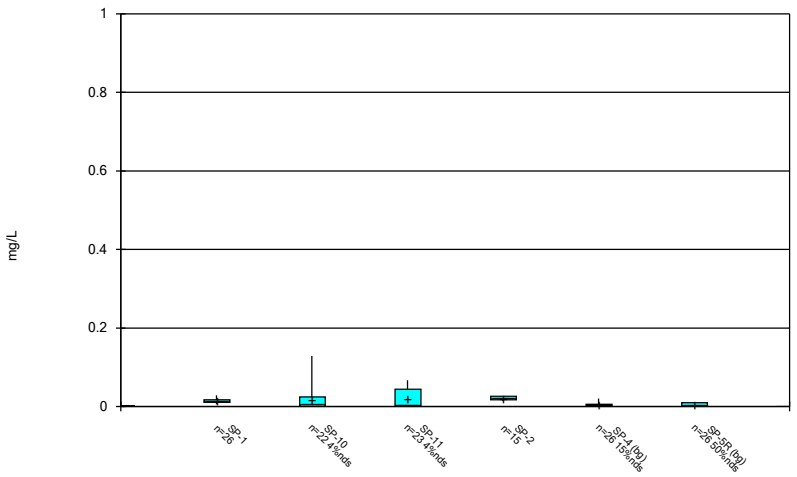
Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Mercury Analysis Run 8/3/2023 4:43 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

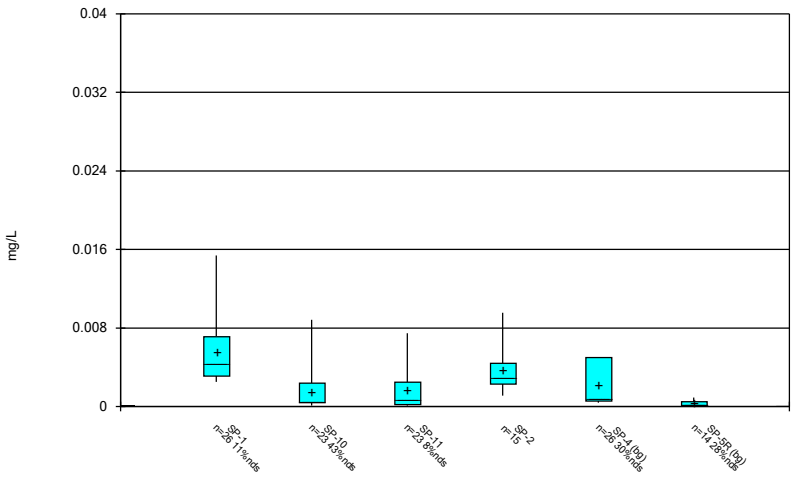
Box & Whiskers Plot



Constituent: Molybdenum Analysis Run 8/3/2023 4:43 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

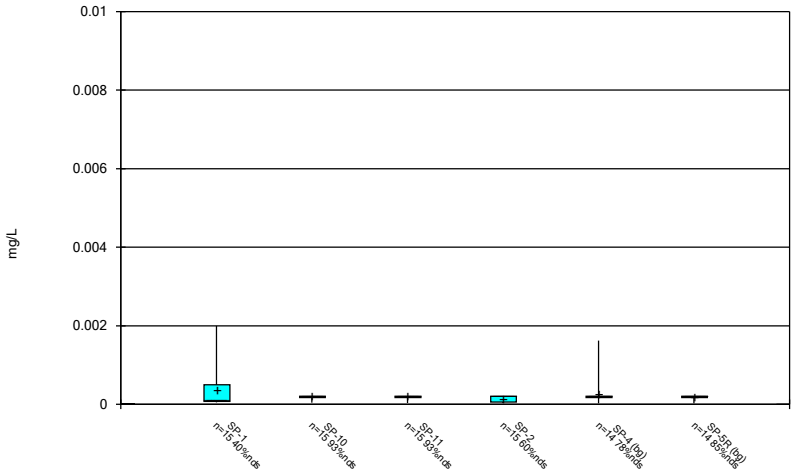
Box & Whiskers Plot



Constituent: Selenium Analysis Run 8/3/2023 4:43 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37a Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Thallium Analysis Run 8/3/2023 4:43 PM View: Appendix B
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE C
Outlier Summary

Outlier Summary

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 8/3/2023, 3:18 PM

	SP-4 Arsenic (mg/L)	SP-4 Beryllium (mg/L)	SP-10 Chromium (mg/L)	SP-4 Cobalt (mg/L)	SP-1 Combined Radium 226 + 228 (pCi/L)	SP-11 Combined Radium 226 + 228 (pCi/L)	SP-1 Fluoride (mg/L)	SP-4 Lead (mg/L)	SP-1 Lithium (mg/L)	SP-4 Mercury (mg/L)
3/13/2017							4 (o)			
6/27/2017					14.29 (o)					
7/13/2017			0.11 (o)							
8/4/2017	0.04498 (o)	0.00497 (o)		0.04069 (o)		25.367 (o)		0.03663 (o)		5.8E-05 (o)
6/20/2019									0.03 (Jo)	

	SP-10 Molybdenum (mg/L)
3/13/2017	
6/27/2017	
7/13/2017	0.934 (o)
8/4/2017	
6/20/2019	

FIGURE D

UTLs

Upper Tolerance Limits Summary Table

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/13/2023, 11:12 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony (mg/L)	n/a	0.005698	n/a	n/a	n/a	n/a 50	-7.963	1.354	34	Kaplan-Meier	ln(x)	0.05	Inter
Arsenic (mg/L)	n/a	0.0599	n/a	n/a	n/a	n/a 49	n/a	n/a	6.122	n/a	n/a	0.08099	NP Inter(normality)
Barium (mg/L)	n/a	2.6	n/a	n/a	n/a	n/a 38	n/a	n/a	0	n/a	n/a	0.1424	NP Inter(normality)
Beryllium (mg/L)	n/a	0.00212	n/a	n/a	n/a	n/a 49	n/a	n/a	20.41	n/a	n/a	0.08099	NP Inter(normality)
Cadmium (mg/L)	n/a	0.0002066	n/a	n/a	n/a	n/a 26	-10.48	0.8742	23.08	Kaplan-Meier	ln(x)	0.05	Inter
Chromium (mg/L)	n/a	0.003419	n/a	n/a	n/a	n/a 38	-7.327	0.7698	13.16	None	ln(x)	0.05	Inter
Cobalt (mg/L)	n/a	0.01786	n/a	n/a	n/a	n/a 49	n/a	n/a	10.2	n/a	n/a	0.08099	NP Inter(normality)
Combined Radium 226 + 228 (pCi/L)	n/a	15.84	n/a	n/a	n/a	n/a 49	n/a	n/a	0	n/a	n/a	0.08099	NP Inter(normality)
Fluoride (mg/L)	n/a	4.39	n/a	n/a	n/a	n/a 52	n/a	n/a	1.923	n/a	n/a	0.06944	NP Inter(normality)
Lead (mg/L)	n/a	0.0107	n/a	n/a	n/a	n/a 49	n/a	n/a	26.53	n/a	n/a	0.08099	NP Inter(normality)
Lithium (mg/L)	n/a	0.163	n/a	n/a	n/a	n/a 38	n/a	n/a	0	n/a	n/a	0.1424	NP Inter(normality)
Mercury (mg/L)	n/a	0.00003	n/a	n/a	n/a	n/a 49	n/a	n/a	73.47	n/a	n/a	0.08099	NP Inter(NDs)
Molybdenum (mg/L)	n/a	0.01	n/a	n/a	n/a	n/a 50	n/a	n/a	34	n/a	n/a	0.07694	NP Inter(normality)
Selenium (mg/L)	n/a	0.00499	n/a	n/a	n/a	n/a 38	n/a	n/a	31.58	n/a	n/a	0.1424	NP Inter(normality)
Thallium (mg/L)	n/a	0.00162	n/a	n/a	n/a	n/a 26	n/a	n/a	88.46	n/a	n/a	0.2635	NP Inter(NDs)

Tolerance Limit

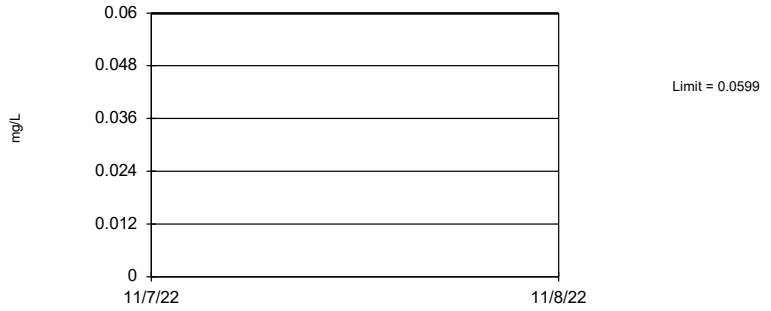
Interwell Parametric

95% coverage. Background Data Summary (based on natural log transformation) (after Kaplan-Meier Adjustment): Mean=-7.963, Std. Dev.=1.354, n=50, 34% NDs. Normality test: Shapiro Francia @alpha = 0.01, calculated = 0.9543, critical = 0.935. Report alpha = 0.05.

Constituent: Antimony Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric

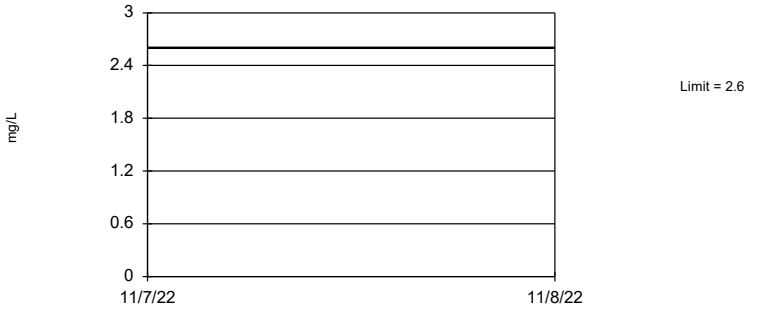


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 6.122% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Arsenic Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric

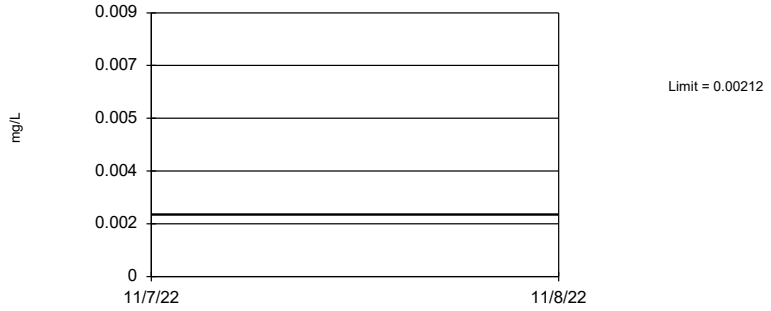


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 38 background values. 88.48% coverage at alpha=0.01; 92.38% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1424.

Constituent: Barium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric

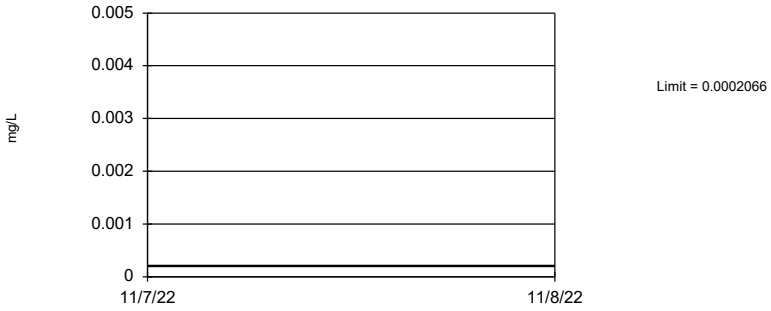


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 20.41% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Beryllium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Parametric



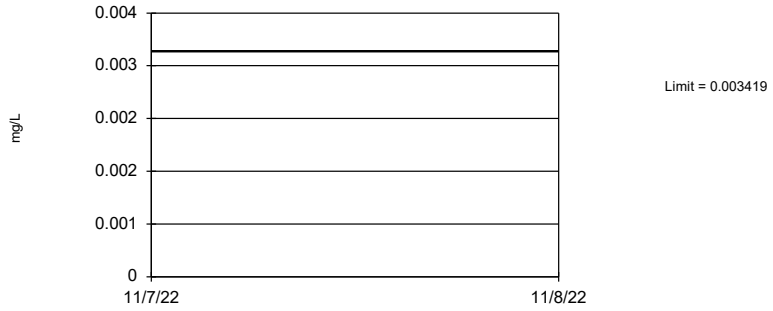
95% coverage. Background Data Summary (based on natural log transformation) (after Kaplan-Meier Adjustment): Mean=-10.48, Std. Dev.=0.8742, n=26, 23.08% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9372, critical = 0.891. Report alpha = 0.05.

Constituent: Cadmium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Parametric



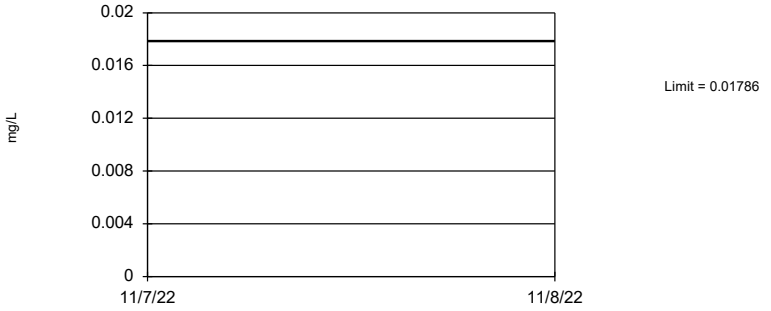
95% coverage. Background Data Summary (based on natural log transformation): Mean=-7.327, Std. Dev.=0.7698, n=38, 13.16% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9508, critical = 0.916. Report alpha = 0.05.

Constituent: Chromium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



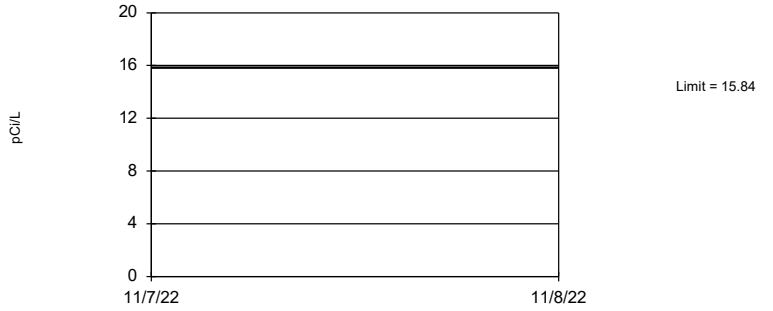
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 10.2% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Cobalt Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric

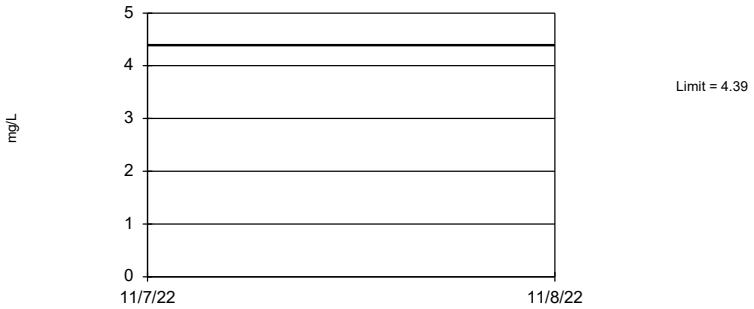


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Combined Radium 226 + 228 Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limit
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric



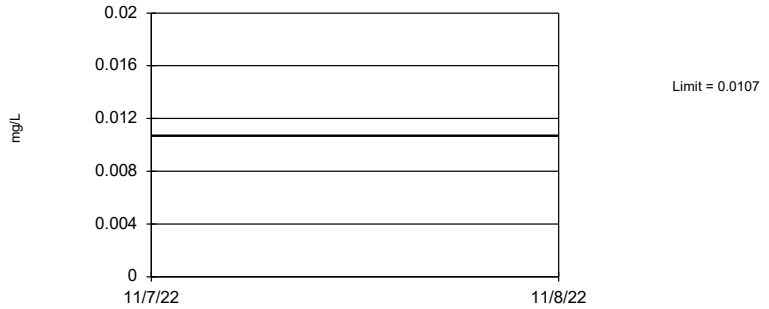
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Francia normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 52 background values. 1.923% NDs. 91.6% coverage at alpha=0.01; 94.34% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.06944.

Constituent: Fluoride Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



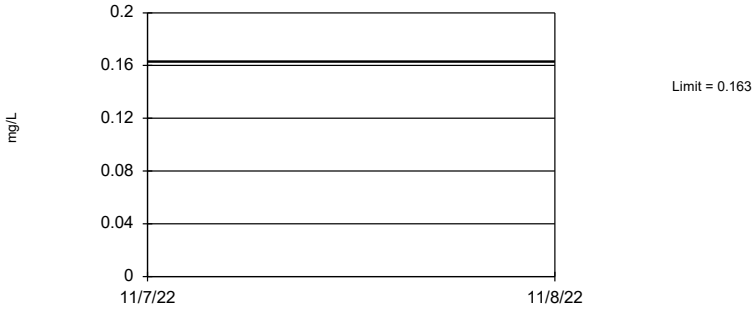
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 26.53% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Lead Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 38 background values. 88.48% coverage at alpha=0.01; 92.38% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1424.

Constituent: Lithium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

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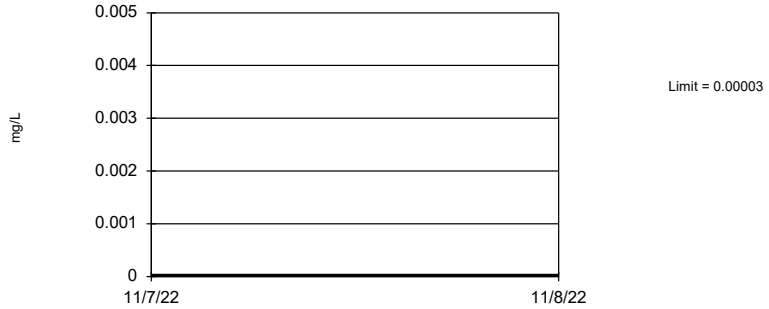
Tolerance Limit

Interwell Non-parametric

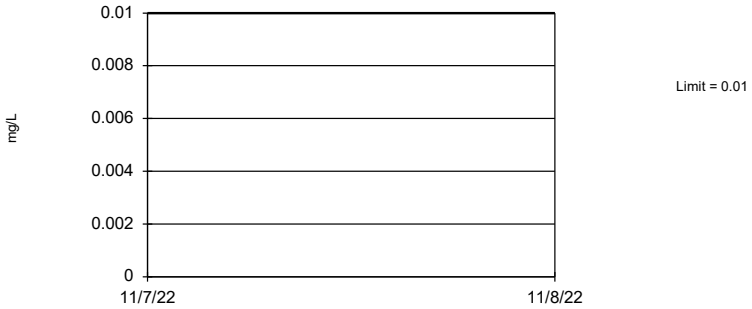


Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Limit is highest of 49 background values. 73.47% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Mercury Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Francia normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 50 background values. 34% NDs. 91.21% coverage at alpha=0.01; 94.34% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.07694.

Constituent: Molybdenum Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

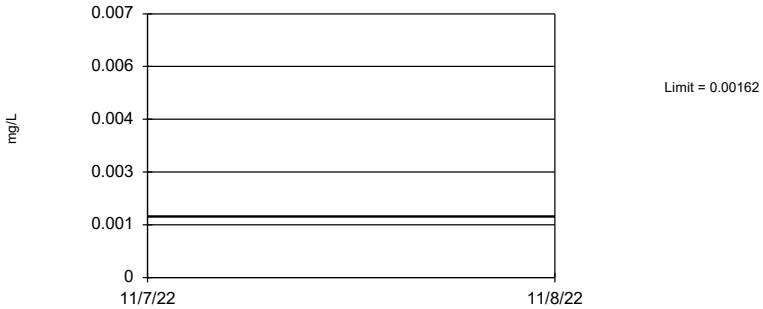
Interwell Non-parametric

Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 38 background values. 31.58% NDs. 88.48% coverage at alpha=0.01; 92.38% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1424.

Constituent: Selenium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Limit is highest of 26 background values. 88.46% NDs. 83.79% coverage at alpha=0.01; 89.26% coverage at alpha=0.05; 97.46% coverage at alpha=0.5. Report alpha = 0.2635.

Constituent: Thallium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE E

GWPS

NORTHEASTERN BAP GWPS				
Constituent Name	**MCL**	**CCR- Rule Specified Level**	**Background Limit**	**GWPS**
Antimony, Total (mg/L)	0.006		0.0057	0.006
Arsenic, Total (mg/L)	0.01		0.06	0.06
Barium, Total (mg/L)	2		2.6	2.6
Beryllium, Total (mg/L)	0.004		0.0021	0.004
Cadmium, Total (mg/L)	0.005		0.00021	0.005
Chromium, Total (mg/L)	0.1		0.034	0.1
Cobalt, Total (mg/L)	n/a	0.006	0.018	0.018
Combined Radium, Total (pCi/L)	5		15.84	15.84
Fluoride, Total (mg/L)	4		4.39	4.39
Lead, Total (mg/L)	n/a	0.015	0.011	0.015
Lithium, Total (mg/L)	n/a	0.04	0.16	0.16
Mercury, Total (mg/L)	0.002		0.00003	0.002
Molybdenum, Total (mg/L)	n/a	0.1	0.01	0.1
Selenium, Total (mg/L)	0.05		0.005	0.05
Thallium, Total (mg/L)	0.002		0.0016	0.002

**Grey cell indicates Background Limit is higher than MCL*

**GWPS = Groundwater Protection Standard*

**MCL = Maximum Contaminant Level*

**CCR = Coal Combustion Residuals*

FIGURE F

Confidence Interval

Confidence Intervals - Significant Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 8/8/2023, 2:19 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Lower Compl.	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Barium (mg/L)	**SP-10**	**6.384**	**4.072**	**2.6**	**n/a**	**Yes**	**15**	**5.228**	**1.705**	**0**	**None**	**No**	**0.01**	**Param.**
Fluoride (mg/L)	**SP-10**	**7.156**	**5.356**	**4.39**	**n/a**	**Yes**	**25**	**5.894**	**2.328**	**12**	**None**	**x^2**	**0.01**	**Param.**
Lithium (mg/L)	**SP-10**	**0.2797**	**0.238**	**0.16**	**n/a**	**Yes**	**23**	**0.2589**	**0.03989**	**0**	**None**	**No**	**0.01**	**Param.**

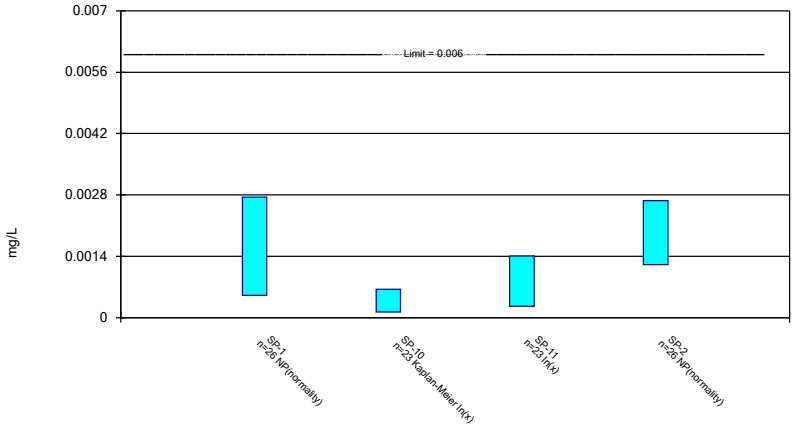
Confidence Intervals - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 8/8/2023, 2:19 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Lower Compl.	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony (mg/L)	SP-1	0.00275	0.00051	0.006	n/a	No	26	0.002205	0.002149	26.92	None	No	0.01	NP (normality)
Antimony (mg/L)	SP-10	0.0006446	0.0001272	0.006	n/a	No	23	0.001552	0.001939	17.39	Kaplan-Meier	ln(x)	0.01	Param.
Antimony (mg/L)	SP-11	0.001405	0.000259	0.006	n/a	No	23	0.001937	0.002841	13.04	None	ln(x)	0.01	Param.
Antimony (mg/L)	SP-2	0.00267	0.00121	0.006	n/a	No	26	0.002564	0.0025	7.692	None	No	0.01	NP (normality)
Arsenic (mg/L)	SP-1	0.005	0.00069	0.06	n/a	No	26	0.00235	0.002046	30.77	None	No	0.01	NP (normality)
Arsenic (mg/L)	SP-10	0.004912	0.001223	0.06	n/a	No	23	0.003837	0.004387	8.696	None	sqrt(x)	0.01	Param.
Arsenic (mg/L)	SP-11	0.004908	0.002257	0.06	n/a	No	23	0.0039	0.002935	4.348	None	sqrt(x)	0.01	Param.
Arsenic (mg/L)	SP-2	0.00251	0.00121	0.06	n/a	No	26	0.002521	0.002492	3.846	None	No	0.01	NP (normality)
Barium (mg/L)	SP-1	0.1994	0.1647	2.6	n/a	No	26	0.1833	0.03753	0	None	sqrt(x)	0.01	Param.
Barium (mg/L)	**SP-10**	**6.384**	**4.072**	**2.6**	**n/a**	**Yes**	**15**	**5.228**	**1.705**	**0**	**None**	**No**	**0.01**	**Param.**
Barium (mg/L)	SP-11	0.3995	0.1761	2.6	n/a	No	15	0.2995	0.1758	0	None	sqrt(x)	0.01	Param.
Barium (mg/L)	SP-2	1.332	0.9783	2.6	n/a	No	26	1.206	0.4826	0	None	ln(x)	0.01	Param.
Beryllium (mg/L)	SP-1	0.0002	0.000054	0.004	n/a	No	26	0.0002639	0.0003696	19.23	None	No	0.01	NP (normality)
Beryllium (mg/L)	SP-10	0.0025	0.00003	0.004	n/a	No	23	0.000787	0.001159	30.43	None	No	0.01	NP (normality)
Beryllium (mg/L)	SP-11	0.00025	0.000027	0.004	n/a	No	23	0.0001539	0.0001331	30.43	None	No	0.01	NP (normality)
Beryllium (mg/L)	SP-2	0.00018	0.00007	0.004	n/a	No	26	0.0002368	0.0003355	15.38	None	No	0.01	NP (normality)
Cadmium (mg/L)	SP-1	0.00025	0.000051	0.005	n/a	No	15	0.0001234	0.000123	13.33	None	No	0.01	NP (normality)
Cadmium (mg/L)	SP-10	0.0002	0.00001	0.005	n/a	No	15	0.0000606	0.00007471	20	None	No	0.01	NP (normality)
Cadmium (mg/L)	SP-11	0.00034	0.00002	0.005	n/a	No	23	0.0004828	0.0009419	17.39	None	No	0.01	NP (normality)
Cadmium (mg/L)	SP-2	0.0005	0.000063	0.005	n/a	No	26	0.0002557	0.0002073	38.46	None	No	0.01	NP (normality)
Chromium (mg/L)	SP-1	0.001097	0.0005286	0.1	n/a	No	26	0.001008	0.0006751	23.08	Kaplan-Meier	sqrt(x)	0.01	Param.
Chromium (mg/L)	SP-10	0.000981	0.0003212	0.1	n/a	No	22	0.001057	0.001827	9.091	None	ln(x)	0.01	Param.
Chromium (mg/L)	SP-11	0.00525	0.000379	0.1	n/a	No	23	0.006047	0.0107	4.348	None	No	0.01	NP (normality)
Chromium (mg/L)	SP-2	0.001474	0.0005998	0.1	n/a	No	26	0.001184	0.001096	11.54	None	sqrt(x)	0.01	Param.
Cobalt (mg/L)	SP-1	0.001182	0.0004726	0.018	n/a	No	26	0.001013	0.001123	11.54	None	x^(1/3)	0.01	Param.
Cobalt (mg/L)	SP-10	0.001962	0.0004423	0.018	n/a	No	23	0.00154	0.001793	8.696	None	sqrt(x)	0.01	Param.
Cobalt (mg/L)	SP-11	0.004598	0.001359	0.018	n/a	No	23	0.003888	0.004472	4.348	None	x^(1/3)	0.01	Param.
Cobalt (mg/L)	SP-2	0.001011	0.0004548	0.018	n/a	No	26	0.0008552	0.0007488	11.54	None	x^(1/3)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-1	4.487	3.263	15.84	n/a	No	25	3.875	1.228	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-10	15.62	6.401	15.84	n/a	No	23	11.01	8.809	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-11	2.118	1.116	15.84	n/a	No	22	1.709	1.036	0	None	sqrt(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-2	14.05	9.011	15.84	n/a	No	23	11.88	5.323	0	None	sqrt(x)	0.01	Param.
Fluoride (mg/L)	SP-1	0.9342	0.6872	4.39	n/a	No	26	0.8107	0.2534	7.692	None	No	0.01	Param.
Fluoride (mg/L)	**SP-10**	**7.156**	**5.356**	**4.39**	**n/a**	**Yes**	**25**	**5.894**	**2.328**	**12**	**None**	**x^2**	**0.01**	**Param.**
Fluoride (mg/L)	SP-11	3.18	2.179	4.39	n/a	No	25	2.679	1.004	0	None	No	0.01	Param.
Fluoride (mg/L)	SP-2	3.172	2.688	4.39	n/a	No	27	2.887	0.568	0	None	x^2	0.01	Param.
Lead (mg/L)	SP-1	0.00247	0.000254	0.015	n/a	No	26	0.002002	0.002101	30.77	None	No	0.01	NP (normality)
Lead (mg/L)	SP-10	0.0003167	0.00008644	0.015	n/a	No	15	0.0002687	0.0003159	13.33	None	ln(x)	0.01	Param.
Lead (mg/L)	SP-11	0.001519	0.000295	0.015	n/a	No	23	0.001913	0.002687	13.04	None	ln(x)	0.01	Param.
Lead (mg/L)	SP-2	0.005	0.000253	0.015	n/a	No	26	0.002095	0.002203	34.62	None	No	0.01	NP (normality)
Lithium (mg/L)	SP-1	0.006273	0.004705	0.16	n/a	No	25	0.005489	0.001573	0	None	No	0.01	Param.
Lithium (mg/L)	**SP-10**	**0.2797**	**0.238**	**0.16**	**n/a**	**Yes**	**23**	**0.2589**	**0.03989**	**0**	**None**	**No**	**0.01**	**Param.**
Lithium (mg/L)	SP-11	0.04072	0.02244	0.16	n/a	No	15	0.03158	0.01349	0	None	No	0.01	Param.
Lithium (mg/L)	SP-2	0.07999	0.05429	0.16	n/a	No	26	0.06714	0.02637	0	None	No	0.01	Param.
Mercury (mg/L)	SP-1	0.000009	0.000005	0.002	n/a	No	26	0.000006192	0.00000371	84.62	None	No	0.01	NP (NDs)
Mercury (mg/L)	SP-10	0.000013	0.000005	0.002	n/a	No	23	0.000009522	0.000007267	56.52	None	No	0.01	NP (NDs)
Mercury (mg/L)	SP-11	0.000009	0.000005	0.002	n/a	No	23	0.00001122	0.00001282	43.48	None	No	0.01	NP (normality)
Mercury (mg/L)	SP-2	0.000005	0.000005	0.002	n/a	No	26	0.000005423	0.00000177	84.62	None	No	0.01	NP (NDs)
Molybdenum (mg/L)	SP-1	0.01656	0.01139	0.1	n/a	No	26	0.01397	0.005312	0	None	No	0.01	Param.
Molybdenum (mg/L)	SP-10	0.01887	0.00297	0.1	n/a	No	22	0.01726	0.02817	4.545	None	x^(1/3)	0.01	Param.
Molybdenum (mg/L)	SP-11	0.04433	0.002	0.1	n/a	No	23	0.01941	0.02334	4.348	None	No	0.01	NP (normality)
Molybdenum (mg/L)	SP-2	0.02417	0.01811	0.1	n/a	No	15	0.02114	0.004469	0	None	No	0.01	Param.
Selenium (mg/L)	SP-1	0.006678	0.003883	0.05	n/a	No	26	0.005567	0.003255	11.54	None	sqrt(x)	0.01	Param.
Selenium (mg/L)	SP-10	0.0008877	0.0001458	0.05	n/a	No	23	0.001499	0.002161	43.48	Kaplan-Meier	ln(x)	0.01	Param.
Selenium (mg/L)	SP-11	0.001502	0.0003588	0.05	n/a	No	23	0.001738	0.002295	8.696	None	ln(x)	0.01	Param.
Selenium (mg/L)	SP-2	0.004896	0.002271	0.05	n/a	No	15	0.003712	0.00219	0	None	sqrt(x)	0.01	Param.
Thallium (mg/L)	SP-1	0.0005	0.00007	0.002	n/a	No	15	0.000372	0.0004977	40	None	No	0.01	NP (normality)
Thallium (mg/L)	SP-10	0.0002	0.00004	0.002	n/a	No	15	0.0001893	0.00004131	93.33	None	No	0.01	NP (NDs)
Thallium (mg/L)	SP-11	0.0002	0.00003	0.002	n/a	No	15	0.0001887	0.00004389	93.33	None	No	0.01	NP (NDs)
Thallium (mg/L)	SP-2	0.0002	0.00005	0.002	n/a	No	15	0.000144	0.00007239	60	None	No	0.01	NP (NDs)

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Antimony Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

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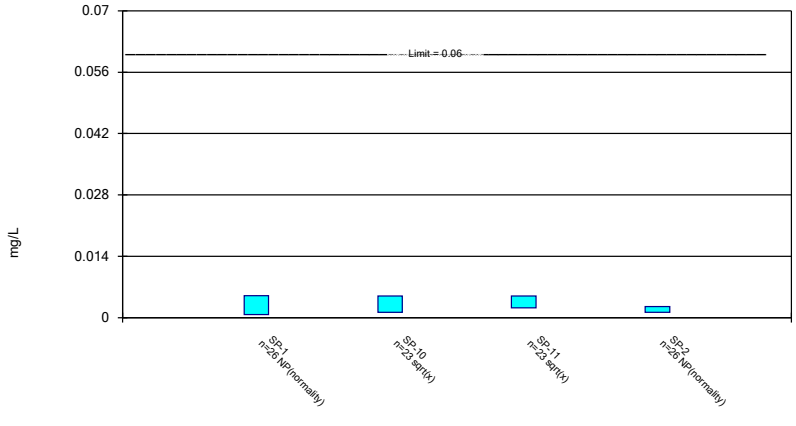
Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

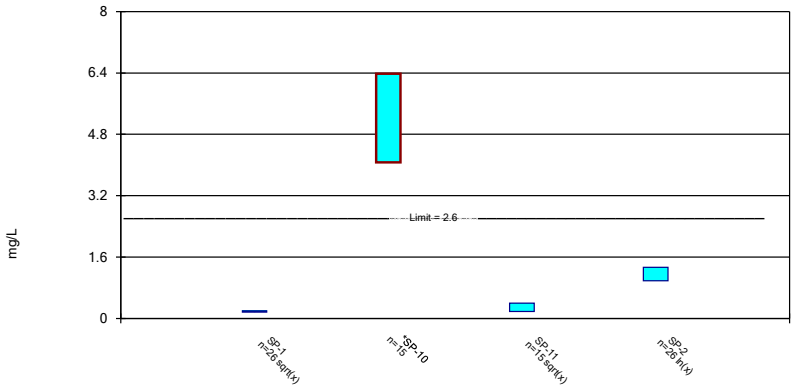


Constituent: Arsenic Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

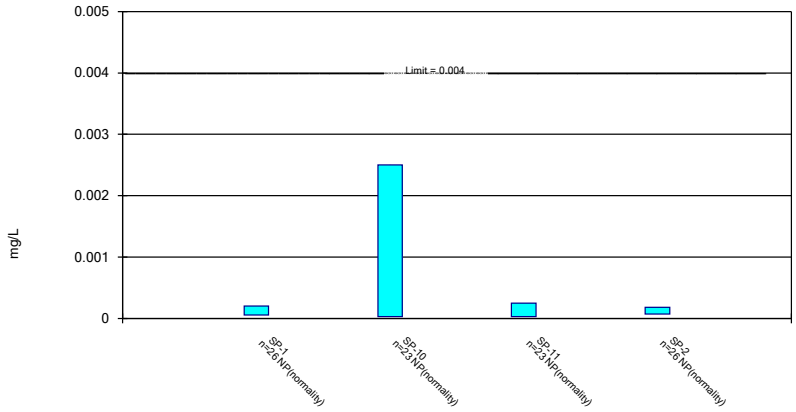


Constituent: Barium Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37 Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

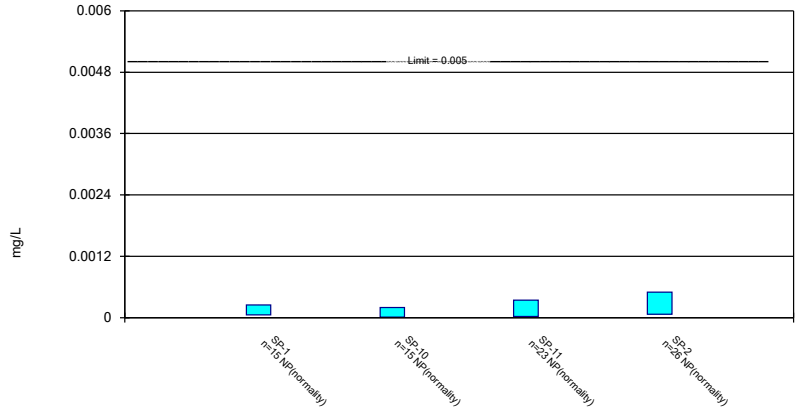
Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Beryllium Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Non-Parametric Confidence Interval

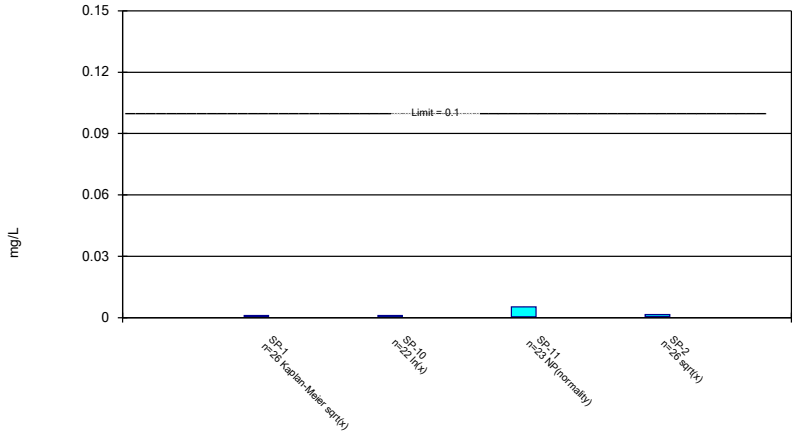
Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Cadmium Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric and Non-Parametric (NP) Confidence Interval

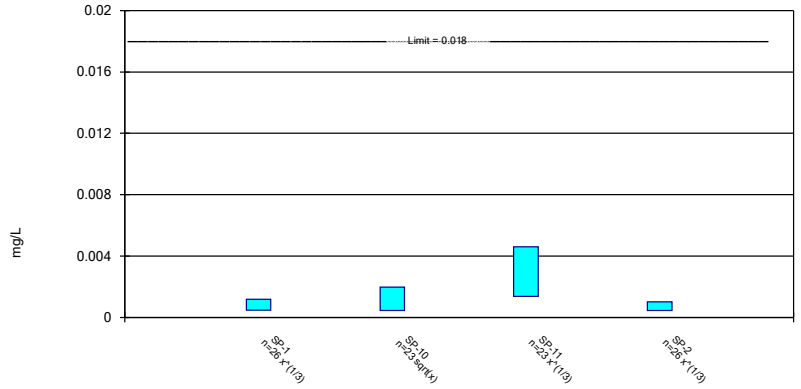
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Chromium Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

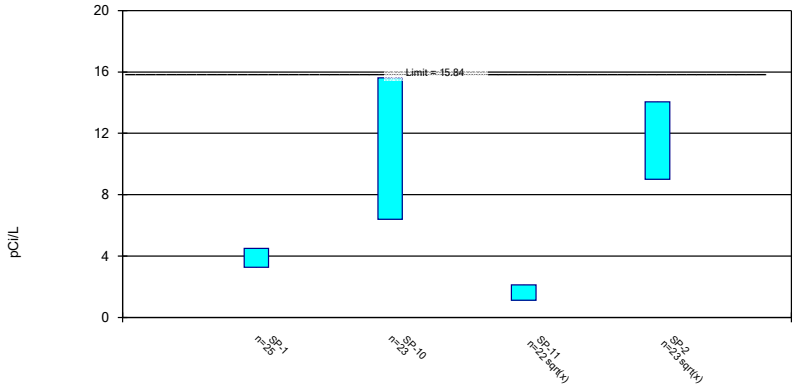
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Cobalt Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

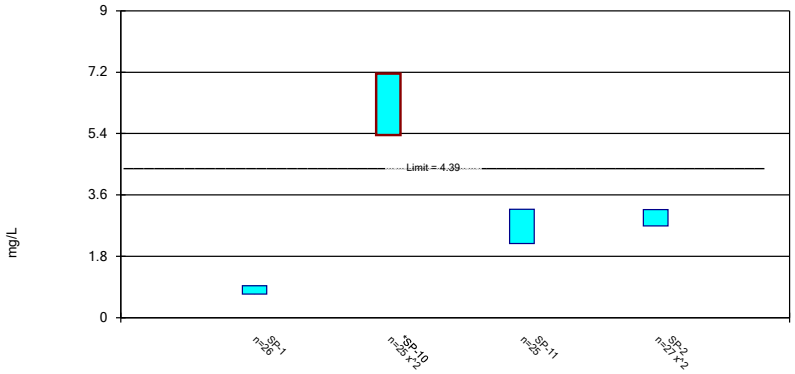
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Combined Radium 226 + 228 Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

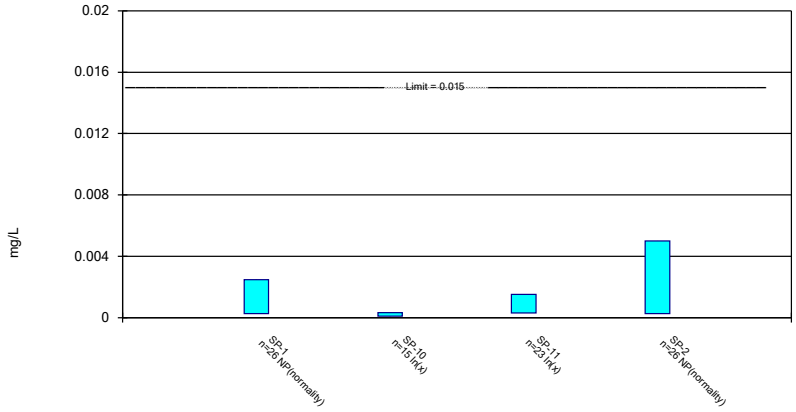
Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Fluoride Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric and Non-Parametric (NP) Confidence Interval

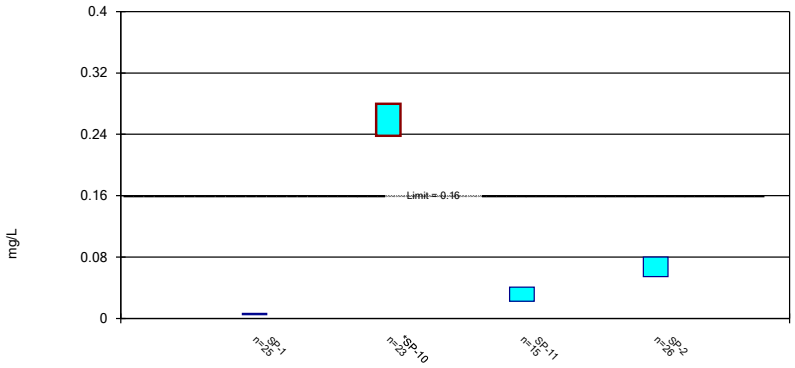
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Lead Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

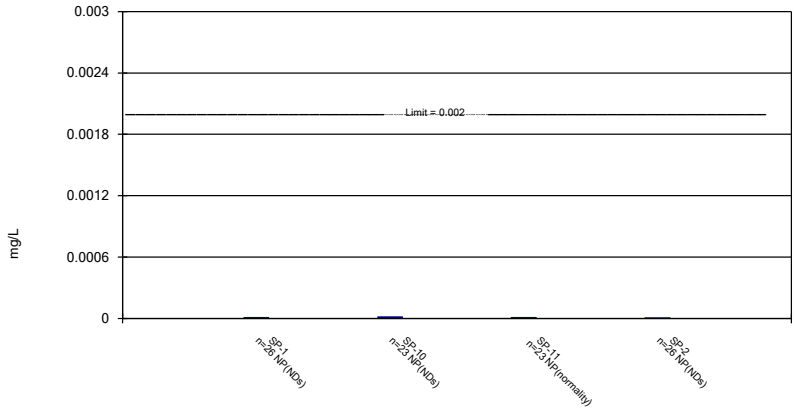
Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Lithium Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Non-Parametric Confidence Interval

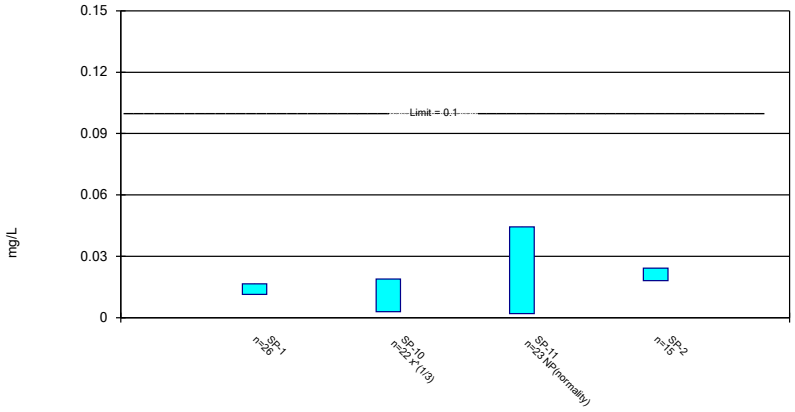
Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Mercury Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

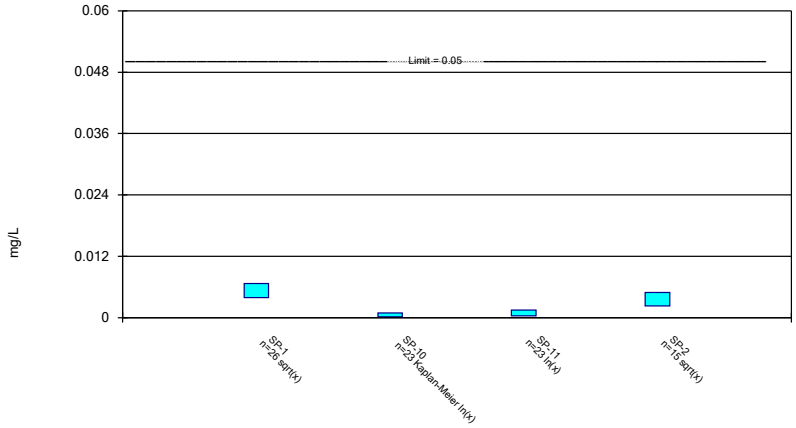


Constituent: Molybdenum Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

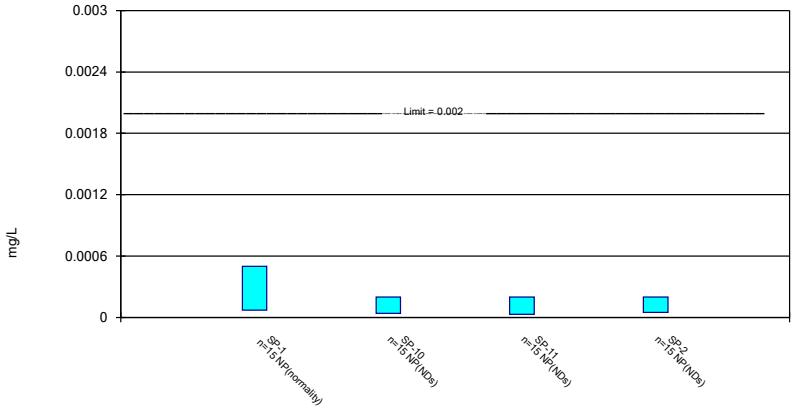


Constituent: Selenium Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.37 Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Thallium Analysis Run 8/8/2023 2:18 PM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

APPENDIX 3

Alternative Source Demonstrations

Scott A. Thompson
Executive Director

OKLAHOMA Environmental Quality

Kevin Stitt
Governor

March 9, 2023

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

Re: Alternate Source Demonstration for Fluoride and Lithium Exceedance –Bottom Ash Pond
Public Service Company of Oklahoma (PSO) – Northeastern Power Station (NPS)
Bottom Ash Pond (BAP), Rogers County
Solid Waste Permit No. None

Dear Ms. Parker-Witt:

On July 15, 2021, the Oklahoma Department of Environmental Quality (DEQ) approved the revised alternate source demonstration (ASD) for lithium and fluoride detected in monitoring well SP-10 for the Bottom Ash Pond (BAP). On January 10, 2023, DEQ received from NPS an Alternate Source Demonstration (ASD) for barium at SP-10.

During the first semi-annual 2022 assessment monitoring event for the BAP, potential statistically significant levels (SSLs) were identified for lithium, fluoride, and barium at SP-10. Barium (7.59 mg/L) in SP-10 had a statistical exceedance of the groundwater protection standard (GWPS) of 2.60 mg/L.

A Mann-Kendall statistical analysis of the time series plot determined that concentrations at SP-10 display a statistically significant increasing trend. However, a Schoeller diagram showing select events where major cations and anions were sampled, the holistic geochemistry at SP-10 does not change over time as would be expected if a release occurred from the BAP. Moving forward, samples from SP-10 will be collected and analyzed for the full suite of major ion chemistry. Concentrations of barium in sediment and porewater collected from the BAP were roughly an order of magnitude lower than barium concentrations collected from monitoring well SP-10.

The release of lithium is attributed to the clay minerals in the shale lens locate at 46 ft below ground surface in the screened interval of SP-10. Analytical results suggest that naturally occurring barium and fluoride are also associated with the shale lenses and are contributing to barium and fluoride concentrations at SP-10. DEQ suggests that a split sample of water from SP-10 be filtered prior to acidification and analysis to obtain the dissolved concentrations of Appendix B parameters for comparison to the total concentrations. If the dissolved (filtered) concentrations are much less than the totals, then it would provide additional supporting evidence that the high lithium, barium and fluoride concentrations are from entrained solids in the water sample sourced by the shale lens and not from a BAP release.

If lithium, fluoride, and barium continue to exceed their relative GWPS at SP-10 in the future and conditions have not changed, NPS may refer to the October 29, 2019 ASD approval for lithium, the June 4, 2021 ASD approval for fluoride, and this ASD approval for barium and continue assessment monitoring for the BAP in accordance with Oklahoma Administrative Code 252:517-9-6(g)(3)(B).

The ASD for barium is approved. If you have any questions, please contact Kaylee Daneshmand at (405) 702-5196 or Kaylee.daneshmand@deq.ok.gov.

Sincerely,

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

HY/kd

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

January 5, 2023

Via 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)
Bottom Ash Pond (BAP)
Public Service Company of Oklahoma (PSO) - Northeastern Power Station (NPS)
Roger County
Solid Waste Permit No. Pending

Dear Ms. Young,

AEP/PSO received ODEQ's correspondence dated June 4, 2021, in which ODEQ accepted the ASD for the lithium and fluoride detected in SP-10 during the October 28, 2020, sampling event. ODEQ indicated that if lithium and fluoride continue to exceed the groundwater protection standards (GWPS) in the future and conditions have not changed, NPS may refer to the October 24, 2019, ASD approval for lithium and June 4, 2021, ASD approval for fluoride and continue assessment monitoring for the BAP in accordance with OAC 252:517-9-6(g)(3)(B).

On October 7, 2022, the statistical evaluation of the first semi-annual 2022 assessment monitoring event (June 14, 2022) for the BAP was certified and in that statistical evaluation report, potential SSLs were identified for lithium, fluoride, and barium at SP-10.

The statistical findings are summarized as follows:

The Lower Confidence Level (LCL) for lithium (0.24 mg/L) exceeded the GWPS (a calculated Upper Tolerance Limit (UTL)) of 0.14 mg/L at SP-10. The actual detected lithium concentration in SP-10 was 0.289 mg/l.

The LCL for fluoride (5.17 mg/L) exceeded the GWPS (UTL of 4.39 mg/L) was exceeded as at SP-10. The actual detected fluoride concentration in SP-10 was 6.3 mg/L.

The LCL for barium (3.46 mg/L) exceeded the GWPS (UTL of 2.60 mg/L) was exceeded as at SP-10. The actual detected barium concentration in SP-10 was 7.59 mg/L.

Attached are the alternative source demonstrations for your review outlining the lines of evidence that these exceedances are the result of natural variations occurring in the groundwater at SP-10 and that the conditions at the BAP have not changed.

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 Principal

Attachments

Geosyntec consultants

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

Memorandum

Date:	January 4, 2023
To:	Jill Parker-Witt, American Electric Power (AEP)
From:	Beth Gross, Ph.D., P.E. (OK) and Allison Kreinberg, Geosyntec
Subject:	Alternative Source Demonstration Update Northeastern Power Station Bottom Ash Pond Oologah, Rogers County, Oklahoma

---

The Bottom Ash Pond (BAP) is a regulated coal combustion residual (CCR) management unit at the Northeastern Power Station (NPS) in Oologah, Oklahoma. A semiannual assessment monitoring event was completed at the BAP on June 14, 2022 in accordance with the assessment monitoring requirements of Oklahoma Administrative Code OAC 252:517-9-6. Analysis of the June 2022 data identified statistically significant levels (SSLs) above the groundwater protection standards (GWPSs) for lithium, fluoride, and barium at SP-10 (Attachment B). The following SSLs were identified at the Northeastern BAP:

- The lower confidence limit (LCL) for lithium exceeded the GWPS of 0.140 milligrams per liter (mg/L) at SP-10 (0.240 mg/L).
- The LCL for fluoride exceeded the GWPS of 4.39 mg/L at SP-10 (5.17 mg/L).
- The LCL for barium exceeded the GWPS of 2.60 (mg/L) at SP-10 (3.66 mg/L).

As described in previous ASDs (Geosyntec, 2019; Geosyntec, 2021a,b,c; Geosyntec, 2022), lower concentrations of lithium, fluoride, and barium in the BAP water (including pore water) and BAP sediments than those observed at SP-10 suggest that the BAP is not the source of these exceedances. Key analytical results for samples collected from the BAP and from SP-10 are provided in **Table 1**. Instead, the release of lithium from the clay minerals in the shale lens located at 46 ft below ground surface in the screened interval of SP-10 is the likely source of lithium in groundwater at that location. Analytical results suggest that naturally occurring barium and fluoride are also associated with the shale lenses and are contributing to aqueous barium and fluoride concentrations at SP-10.

Oklahoma Department Environmental Quality (DEQ) previously noted in a letter to the NPS dated June 4, 2021 that "If lithium and fluoride continue to exceed their relative GWPS in the future and conditions have not changed, NPS may refer to the October 29, 2019 ASD approval for lithium and this *(June 4, 2021)* approval for fluoride and continue assessment monitoring for the BAP in accordance with OAC 252:517-6(g)(3)(B)" (DEQ, 2021). DEQ provided a similar letter to the NPS dated September 20, 2022 that indicated that "The *(July 14, 2022)* ASD is applicable for Ba exceedance in SP-10 of the GWPS if conditions do not change. AEP may refer to the ASD approval for Ba and continue assessment monitoring for the BAP in accordance with OAC 252:517-9-6(g)(3)(B)" (DEQ, 2022). This ASD update presents an evaluation of the BAP for changing conditions that may affect previously approved ASDs for lithium, fluoride, and barium exceedances at SP-10.

The sample collected from the June 2022 monitoring event at SP-10 contained a lithium concentration of 0.289 mg/L, fluoride concentration of 6.30 mg/L, and barium concentration of 7.59 mg/L. The lithium and fluoride concentrations are consistent with previous results collected during the assessment monitoring period and continue to show no statistically significant positive trends (**Figure 1** and **Figure 2**, respectively). This is an indication that conditions have not changed substantially since the preceding ASD was submitted (Geosyntec, 2022) and the arguments presented in the previous ASDs are still valid. Thus, the lithium and fluoride concentrations at SP-10 during the June 2022 assessment monitoring event are not attributed to a release from the BAP.

A time series plot of the barium concentrations at SP-10 and a Mann-Kendall statistical analysis of the reported barium results over time is shown in **Figure 3**. The analysis determined that barium concentrations at SP-10 display a statistically significant increasing trend. However, based on a Schoeller diagram showing select events where major cations and anions were sampled (**Figure 4**)[1], the holistic geochemistry at monitoring well SP-10 does not change over time in a manner indicative of a release from the BAP. The June 2022 sample is displayed on the plot as the bold black line. **Figure 4** demonstrates that the geochemistry of SP-10 has remained consistent over the past several years, indicating conditions at SP-10 have not changed. Moving forward, samples from SP-10 will be collected and analyzed for the full suite of major ion chemistry. This will facilitate the preparation of more robust data visuals such as Piper plots and Stiff diagrams to better support the finding that groundwater at SP-10 is geochemically stable in future ASD memoranda.

[1] Piper diagrams were previously used to visualize the geochemical composition of SP-10 over time (Geosyntec, 2019; Geosyntec, 2021a; Geosyntec, 2022). Alkalinity data was unavailable for the June 2022 sampling event, precluding the use of a Piper diagram to show the results of the most recent sampling event.

As mentioned in the previous ASD completed for barium at SP-10 (Geosyntec, 2022), concentrations of barium in sediment and porewater collected from the BAP were roughly an order of magnitude lower than barium concentrations collected from monitoring well SP-10 (**Table 1**). An additional porewater sample was collected from the BAP on August 25, 2022. This porewater sample contained a large component of solids and was unable to be analyzed as an aqueous sample, although the solid component of this sample was separated and submitted for synthetic precipitation leaching procedure (SPLP) to evaluate the leachable component of barium in the solid phase. Leachable barium was reported as 0.22 mg/L from this sample (Attachment C), which is more than an order of magnitude less than the most recent concentration detected in SP-10 groundwater (7.59 mg/L) or the GWPS (2.60 mg/L). This result is consistent with the previously reported concentration of leachable barium in the BAP solids of 0.352 mg/L. Based on this result and previous samples collected from the BAP, the BAP does not appear to be the source for elevated barium concentrations in SP-10 groundwater.

The information above, as well as the information presented in previous ASDs (Geosyntec, 2019; Geosyntec, 2021a,b,c; Geosyntec, 2022), continue to support the position that barium, fluoride, and lithium concentrations are a result of natural variation in the underlying lithology, including the presence of shale lenses containing barium, fluoride, and 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 memorandum by a qualified professional engineer is in Attachment A.

******

Geosyntec Consultants, 2019. Alternative Source Demonstration. Bottom Ash Pond – Northeastern Power Station, Oologah, Oklahoma. April.

Geosyntec Consultants, 2021a. Alternative Source Demonstration. Bottom Ash Pond – Northeastern Power Station, Oologah, Oklahoma. January.

Geosyntec Consultants, 2021b. Alternative Source Demonstration. Bottom Ash Pond – Northeastern Power Station, Oologah, Oklahoma. May.

Geosyntec Consultants, 2021c. Alternative Source Demonstration. Bottom Ash Pond – Northeastern Power Station, Oologah, Oklahoma. October.

Geosyntec Consultants, 2022. Alternative Source Demonstration. Bottom Ash Pond – Northeastern Power Station, Oologah, Oklahoma. July.

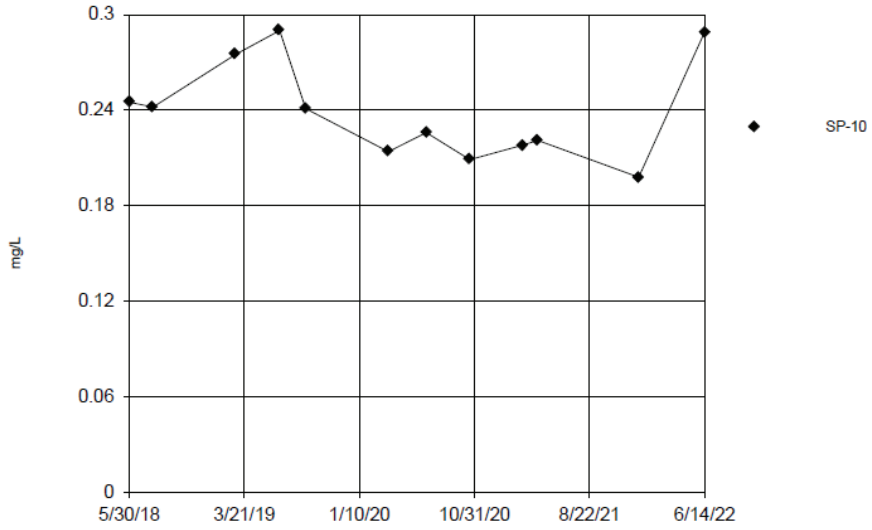
Oklahoma Department of Environmental Quality. 2021. Alternate Source Demonstration for Fluoride and Lithium Exceedance – Bottom Ash Pond, Public Service Company of Oklahoma Northeastern Power Station, Rogers County. June 4.

Oklahoma Department of Environmental Quality, 2022. Alternative Source Demonstration for Barium, Fluoride, and Lithium Exceedances – Bottom Ash Pond, Public Service Company of Oklahoma - Northeastern Power Station, Rogers County. September 20.

FIGURES

Sanitas™ v.9.6.32 Sanitas software licensed to Geosyntec Consultants. UG

Time Series



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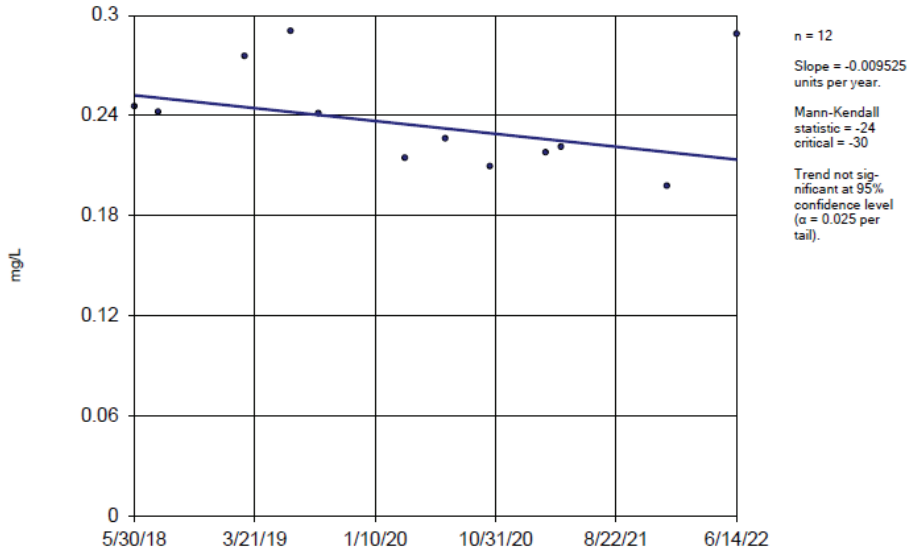
Oologah Client: AEP Data: AEP Concentration Sanitas Format 2018 on

Sanitas™ v.9.6.32 Sanitas software licensed to Geosyntec Consultants. UG

Sen's Slope Estimator

SP-10



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Oologah Client: AEP Data: AEP Concentration Sanitas Format 2018 on

internal info: path, date revised, author

Lithium Time Series and Trend Test – SP-10

Northeastern Bottom Ash Pond

Geosyntec consultants

AMERICAN ELECTRIC POWER

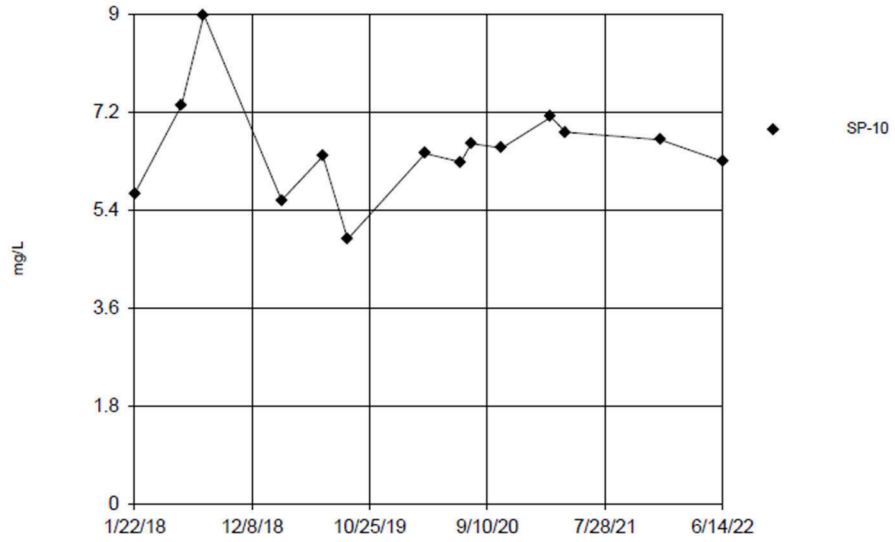
Figure 1

Columbus, Ohio

December 29, 2022

Sanitas™ v.9.6.32 Sanitas software licensed to Geosyntec Consultants. UG

Time Series



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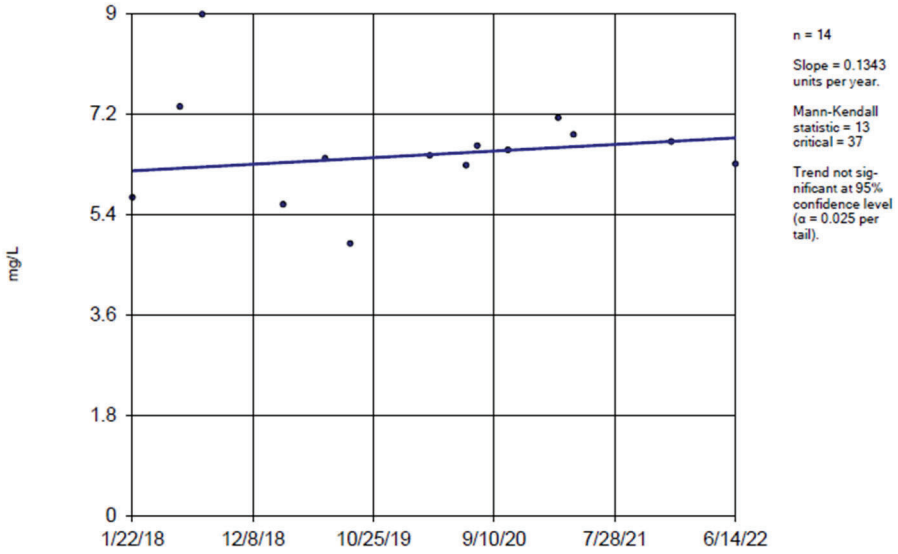
Oologah Client: AEP Data: AEP Concentration Sanitas Format 2018 on

Sanitas™ v.9.6.32 Sanitas software licensed to Geosyntec Consultants. UG

Sen's Slope Estimator

SP-10



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Oologah Client: AEP Data: AEP Concentration Sanitas Format 2018 on

internal info: path, date revised, author

Fluoride Time Series and Trend Test – SP-10

Northeastern Bottom Ash Pond

Geosyntec consultants

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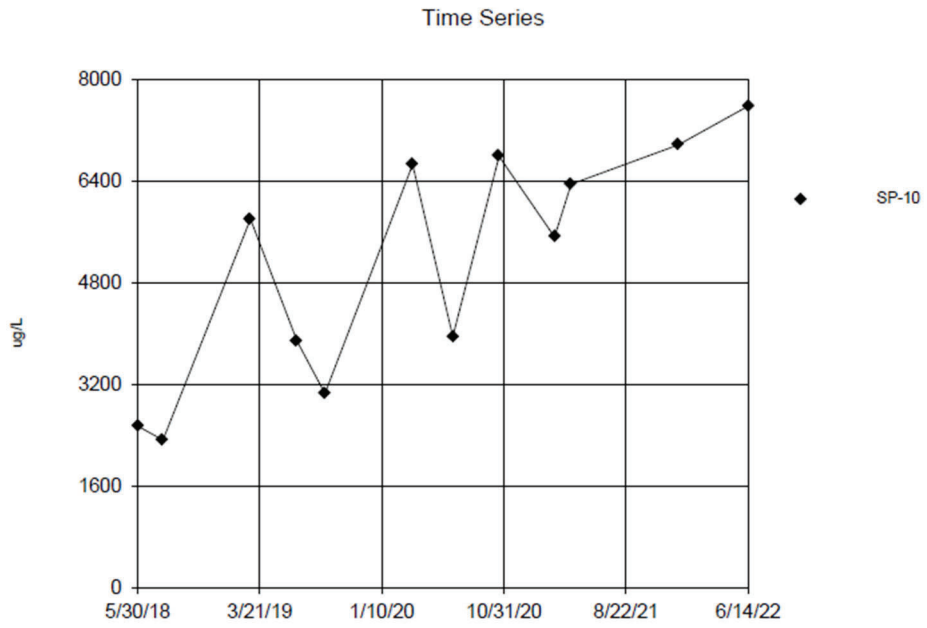
Figure **2**

Columbus, Ohio

December 29, 2022

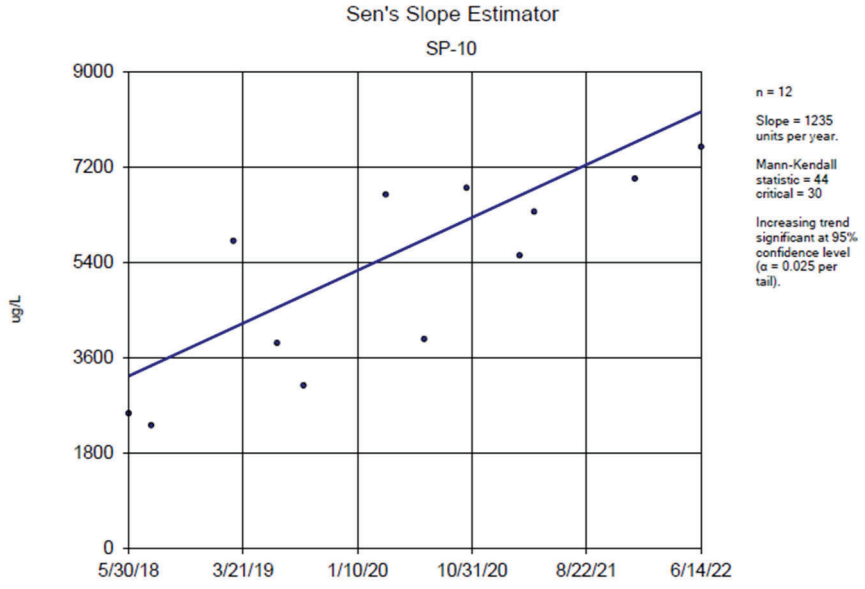
Sanitas™ v.9.6.32 Sanitas software licensed to Geosyntec Consultants. UG



Constituent: Barium Analysis Run 12/29/2022 9:00 AM

Oologah Client: AEP Data: AEP Concentration Sanitas Format 2018 on

Sanitas™ v.9.6.32 Sanitas software licensed to Geosyntec Consultants. UG



Constituent: Barium Analysis Run 12/29/2022 9:28 AM

Oologah Client: AEP Data: AEP Concentration Sanitas Format 2018 on

internal info: path, date revised, author

Barium Time Series and Trend Test – SP-10

Northeastern Bottom Ash Pond

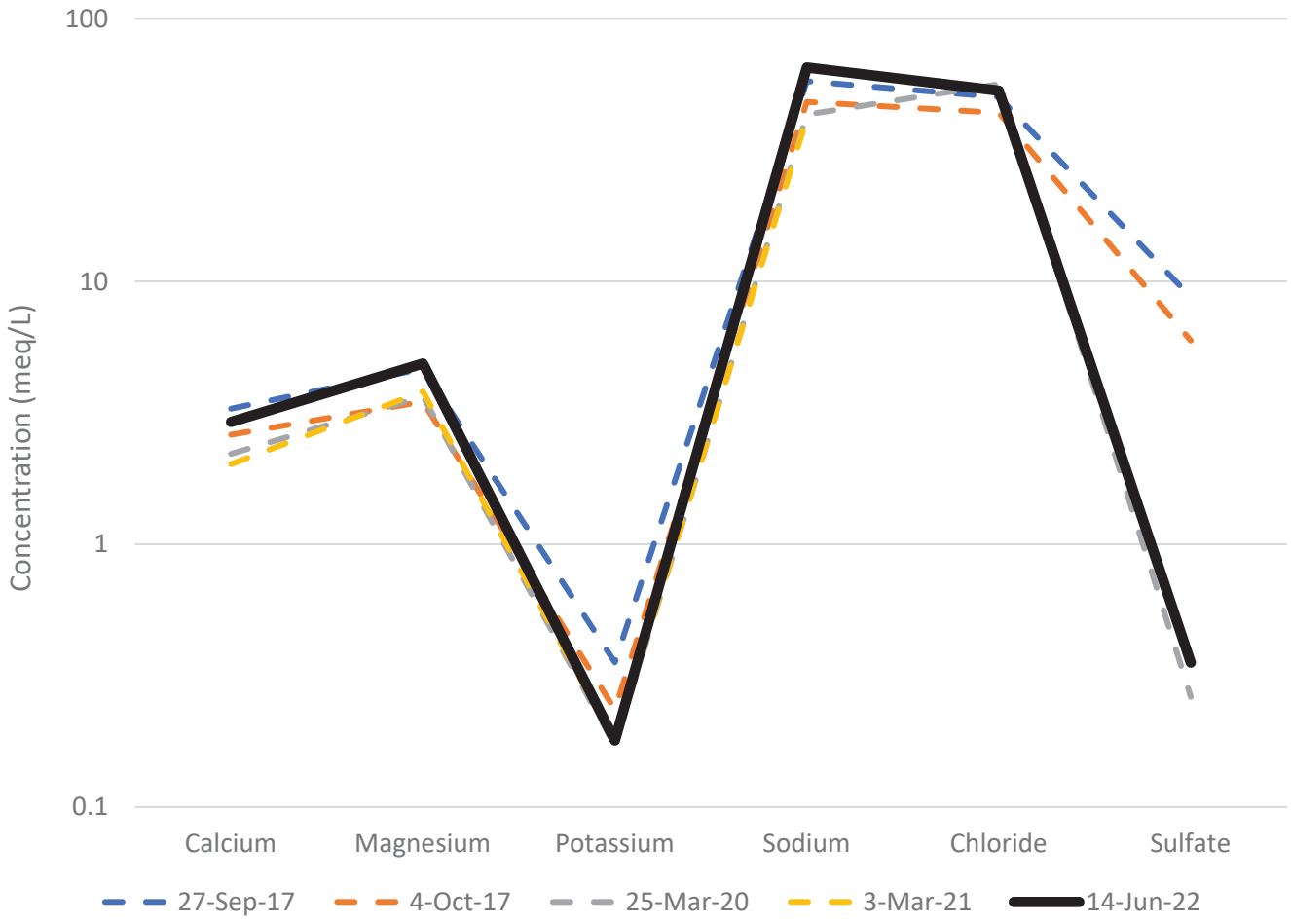
Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure 3

Columbus, Ohio

December 29, 2022



Notes: Groundwater results from monitoring well SP-10 are displayed on the plot. Concentrations of all parameters are displayed in units of milliequivalents per liter (meq/L). The most recent sample, collected in June 2022, is displayed as the bold black line.

SP-10 Schoeller Diagram
Northeastern Bottom Ash Pond

Geosyntec consultants | AMERICAN ELECTRIC POWER | Figure 4

Columbus, Ohio | January 2023

internal info: path, date revised, author

TABLES

Table 1: Summary of Key Analytical Data
Bottom Ash Pond - Northeastern Power Station

Sample	Sample Date	Lithium Concentration (mg/L)	Fluoride Concentration (mg/L)	Barium Concentration (mg/L)
SPLP Leachate of Bottom Ash	7/10/2019	0.001	0.458	0.352
	8/25/2022	< 0.5	NA	0.22
BAP Surface Water	2/5/2019	0.00874	0.37	0.315
BAP Pore Water	7/10/2019	0.003	< 0.83	0.083
SP-10 June 2022 Result	6/14/2022	0.289	6.3	7.59

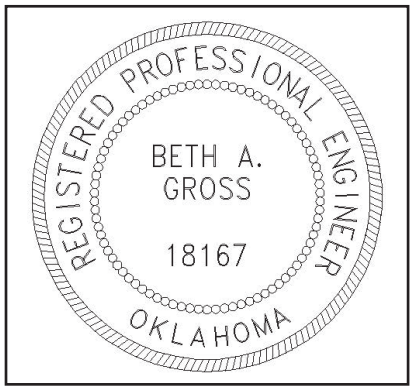
Notes:
NA - not analyzed
mg/L - milligram per liter
BAP - Bottom Ash Pond
SPLP - Synthetic precipitation leaching procedure
Non-detect results are shown as less than the reporting limit.

ATTACHMENT A

Certification by Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the 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
2039 Centre Pointe Boulevard, Suite 103
Tallahassee, Florida 32308

Oklahoma Firm Certificate of
Authorization No. 1996
Exp. 6/30/2024

18167	Oklahoma	January 5, 2023
License Number	Licensing State	Date

* * * * *

ATTACHMENT B

Assessment Statistics Report

2022 First Semiannual Event

STATISTICAL ANALYSIS SUMMARY
BOTTOM ASH POND
Northeastern Power Station
Oologah, Oklahoma

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

500 West Wilson Bridge Road
Suite 250
Worthington, Ohio 43085

October 7, 2022

CHA8500B

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2.2.1 Evaluation of Potential Appendix B SSLs 2-1
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Table 2 Appendix B Groundwater Protection Standards
Table 3 Appendix A Data Summary

LIST OF ATTACHMENTS

Attachment A Certification by Qualified Professional Engineer
Attachment B Statistical Analysis Output

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
NPS	Northeastern Power Station
ODEQ	Oklahoma Department of Environmental Quality
OAC	Oklahoma Administrative Code
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
SU	Standard Units
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the Oklahoma Department of Environmental Quality (ODEQ) and Oklahoma administrative code (OAC) regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (OAC 252:517), groundwater monitoring has been conducted at the Bottom Ash Pond (BAP), an existing CCR unit at the Northeastern Power Station (NPS) located in Oologah, Oklahoma. Recent groundwater monitoring results were compared to site-specific groundwater protection standards (GWPSs) to identify potential exceedances.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron, chloride, fluoride, total dissolved solids (TDS), and sulfate at the BAP. Also, pH values below the lower prediction limit (LPL) resulted in SSIs below background as well. GWPSs were set in accordance with OAC 252:517-9-6(h) and a statistical evaluation of the assessment monitoring data was conducted. An assessment monitoring event was conducted at the BAP in December 2021, in accordance with OAC 252:517-9-6(d). During the December 2021 assessment monitoring event, statistically significant levels (SSLs) were observed for barium, fluoride, and lithium (Geosyntec, 2022a). An alternative source demonstration (ASD) was successfully completed (Geosyntec, 2022b); thus the unit remained in assessment monitoring. One assessment monitoring event was conducted at the BAP in June 2022, in accordance with OAC 252:517-9-6(d). Results of this event are documented in this report.

Prior to conducting the statistical analyses, the groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Confidence intervals were calculated for Appendix B parameters at the compliance wells to assess whether SSLs for Appendix B parameters were present above previously calculated GWPSs. SSLs were identified for barium, fluoride, and lithium. Thus, either the unit will move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A. The statistical analysis and certification of the selected methods were completed within 90 days of obtaining the data.

SECTION 2

BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, one set of samples was collected in June 2022 for analysis from each upgradient and downgradient well to meet the requirements of OAC 252:517-9-6(d)(1). Samples from this sampling event were analyzed for both the Appendix A and Appendix B parameters. A summary of data collected during this assessment monitoring event may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.33 statistics software. The export file was checked against the analytical data for transcription errors and completeness. While the TDS results were flagged for laboratory control sample results outside of the acceptance limits (Table 1), the results were similar to previous results and were retained in the dataset for statistical evaluation. Thus, no QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the BAP were conducted in accordance with the November 2021 *Statistical Analysis Plan* (Geosyntec, 2021) for the samples collected in June 2022. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained in June 2022 were screened for potential outliers. No outliers were identified for this event.

2.2.1 Evaluation of Potential Appendix B SSLs

A confidence interval was constructed for each Appendix B parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B. The calculated confidence

limits were compared to the GWPSs provided in Table 2. The GWPSs were established during a previous statistical analysis as either the greater value of the background concentration or the maximum contaminant level (MCL) and risk-based level specified in OAC 252:517-9-6(h) (Geosyntec, 2022).

The following SSLs were identified at the Northeastern BAP:

- The LCL for barium exceeded the GWPS of 2.60 mg/L at SP-10 (3.66 mg/L).
- The LCL for fluoride exceeded the GWPS of 4.39 mg/L at SP-10 (5.17 mg/L).
- The LCL for lithium exceeded the GWPS of 0.140 mg/L at SP-10 (0.240 mg/L).

ODEQ previously noted in a letter provided to the NPS that "If lithium and fluoride continue to exceed their relative GWPS in the future and conditions have not changed, NPS may refer to the October 29, 2019 ASD approval for lithium and June 4, 2021 approval for fluoride and continue assessment monitoring for the BAP in accordance with OAC 252:517-6(g)(3)(B)" (ODEQ, 2021). ODEQ provided a similar letter dated September 20, 2022 documenting ASD approval for a barium SSL at SP-10 which is applicable in the future if conditions do not change (ODEQ, 2022). Thus, an ASD will be submitted to ODEQ demonstrating that conditions at the BAP remain unchanged so that the unit will continue assessment monitoring.

2.2.2 Evaluation of Potential Appendix A SSIs

While SSLs were identified, a review of the Appendix A results was also completed to assess whether concentrations of Appendix A parameters at the compliance wells exceeded background concentrations.

Data collected during the June 2022 assessment monitoring event from each compliance well were compared to previously calculated prediction limits to evaluate results above background values. The results from this event and the prediction limits are summarized in Table 3. The following exceedances of the UPLs were noted:

- Boron concentrations exceeded the interwell UPL of 0.510 mg/L at SP-10 (1.04 mg/L) and SP-11 (0.627 mg/L).
- Chloride concentrations exceeded the interwell UPL of 802 mg/L at SP-2 (844 mg/L) and SP-10 (1,810 mg/L).
- Fluoride concentrations exceeded the interwell UPL of 4.39 mg/L at SP-10 (6.3 mg/L).
- Sulfate concentrations exceeded the interwell UPL of 90.0 mg/L at SP-11 (402 mg/L).
- TDS concentrations exceeded the interwell UPL of 1,570 mg/L at SP-2 (1,720 mg/L) and SP-10 (3,600 mg/L).

While the prediction limits were calculated for a one-of-two retesting procedure, SSIs were conservatively assumed if the June 2022 sample was above the UPL or below the LPL. Based on these results, boron, chloride, fluoride, sulfate, and TDS concentrations exceeded background levels at compliance wells at the Northeastern BAP during assessment monitoring.

2.3 Conclusions

A semi-annual assessment monitoring event was conducted in June 2022 in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the June 2022 data. A confidence interval was constructed at each compliance well for each Appendix B parameter; SSLs were concluded if the entire confidence interval exceeded the GWPSs. SSLs were identified for barium, fluoride, and lithium. Appendix A parameters were compared to prediction limits, with exceedances identified for boron, chloride, fluoride, sulfate, and TDS.

Based on this evaluation, the Northeastern BAP CCR unit will either move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring.

SECTION 3

REFERENCES

Geosyntec. 2021. Statistical Analysis Plan – Northeastern Power Station. Oologah, Oklahoma. November.

Geosyntec. 2022a. Statistical Analysis Summary – Bottom Ash Pond. Northeastern Power Station. Oologah, Oklahoma. April.

Geosyntec. 2022b. Alternative Source Demonstration Report – State CCR Rule. Northeastern Power Station – Bottom Ash Pond. Oologah, Oklahoma. July.

Oklahoma Department of Environmental Quality (ODEQ). 2021. Letter Transmittal – Alternate Source Demonstration for Fluoride and Lithium Exceedance – Bottom Ash Pond. Public Service Company of Oklahoma – Northeastern Power Station. June.

ODEQ. 2022. Letter Transmittal – Alternate Source Demonstration for Barium, Fluoride, and Lithium Exceedance – Bottom Ash Pond. Public Service Company of Oklahoma – Northeastern Power Station. September.

TABLES

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

Geosyntec Consultants, Inc.

Well ID		SP-1	SP-2	SP-4	SP-5R	SP-10	SP-11
Well Classification		Compliance	Compliance	Background	Background	Compliance	Compliance
Parameter	Unit	6/14/2022	6/14/2022	6/14/2022	6/14/2022	6/14/2022	6/14/2022
Antimony	µg/L	0.72	1.51	0.21	0.19	0.03 J1	0.43
Arsenic	µg/L	0.84	1.11	0.80	20.3	0.19	2.73
Barium	µg/L	161	1,070	246	2,010	7,590	139
Beryllium	µg/L	0.061	0.1 J1	0.04 J1	0.07 J1	2.5 U1	0.25 U1
Boron	mg/L	0.176	0.228	0.367	0.209	1.04	0.627
Cadmium	µg/L	0.066	0.063	0.024	0.200	0.033	0.027
Calcium	mg/L	102	115	70.2	52.5	56.1	113
Chloride	mg/L	21.2	844	452	675	1,810	60.0
Chromium	µg/L	0.60	1.05	0.56	0.47	0.57	0.59
Cobalt	µg/L	1.14	0.791	0.159	0.699	0.216	2.36
Combined Radium	pCi/L	3.98	10.83	3.56	11.26	1.31	1.17
Fluoride	mg/L	0.78	3.08	3.25	3.09	6.3	1.10
Lead	µg/L	0.22	0.17 J1	0.10 J1	0.66	0.19 J1	0.23
Lithium	mg/L	0.00473	0.084	0.0571	0.0896	0.289	0.0140
Mercury	µg/L	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1
Molybdenum	µg/L	21.2	26.5	3.7	0.9	0.5	2.9
Selenium	µg/L	9.63	9.56	0.38 J1	0.1 J1	0.5 U1	0.19 J1
Sulfate	mg/L	65.2	22.3	80.4	4.7	16.3	402
Thallium	µg/L	0.07 J1	0.07 J1	0.2 U1	0.2 U1	0.2 U1	0.2 U1
Total Dissolved Solids	mg/L	430 L1	1,720 L1	1,160 L1	1,410 L1	3,600 L1	1,020 L1
pH	SU	7.27	7.35	7.83	7.72	7.74	7.34

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U1: Non-detect value. For statistical analysis, parameters which were not detected were replaced with the reporting limit.
J1: Estimated value. Parameter was detected in concentrations below the reporting limit.
L1: The associated laboratory control sample (LCS) or laboratory control sample duplicate (LCSD) recovery was outside acceptance limits.
-: Not analyzed

Table 2 - Appendix B Groundwater Protection Standards
Northeastern Plant - Bottom Ash Pond

Geosyntec Consultants, Inc.

Constituent Name	MCL	CCR Rule-Specified	Calculated UTL	GWPS
Antimony, Total (mg/L)	0.00600		0.00708	0.00708
Arsenic, Total (mg/L)	0.0100		0.0572	0.0572
Barium, Total (mg/L)	2.00		2.60	2.60
Beryllium, Total (mg/L)	0.00400		0.00212	0.00400
Cadmium, Total (mg/L)	0.00500		0.00247	0.00500
Chromium, Total (mg/L)	0.100		0.0418	0.100
Cobalt, Total (mg/L)	n/a	0.00600	0.0179	0.0179
Combined Radium, Total (pCi/L)	5.00		15.8	15.8
Fluoride, Total (mg/L)	4.00		4.39	4.39
Lead, Total (mg/L)	n/a	0.0150	0.0107	0.0150
Lithium, Total (mg/L)	n/a	0.0400	0.140	0.140
Mercury, Total (mg/L)	0.00200		0.0000300	0.00200
Molybdenum, Total (mg/L)	n/a	0.100	0.0100	0.100
Selenium, Total (mg/L)	0.0500		0.00499	0.0500
Thallium, Total (mg/L)	0.00200		0.00162	0.00200

Notes:
MCL = Maximum Contaminant Level
CCR = Coal Combustion Residual
GWPS = Groundwater Protection Standard
Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
Grey cells indicate the GWPS is based on the calculated UTL, which is higher than the MCL or CCR Rule-specified value.

Table 3 - Appendix A Data Summary
Northeastern Plant - Bottom Ash Pond

Geosyntec Consultants, Inc.

Analyte	Unit	Description	SP-1	SP-2	SP-10	SP-11
			6/14/2022	6/14/2022	6/14/2022	6/14/2022
Boron	mg/L	Interwell Background Value (UPL)	0.510			
		Analytical Result	0.176	0.228	**1.04**	**0.627**
Calcium	mg/L	Intrawell Background Value (UPL)	144	176	227	1,460
		Analytical Result	102	115	56.1	113
Chloride	mg/L	Interwell Background Value (UPL)	802			
		Analytical Result	21.2	**844**	**1,810**	60.0
Fluoride	mg/L	Interwell Background Value (UPL)	4.39			
		Analytical Result	0.78	3.08	**6.3**	1.10
pH	SU	Interwell Background Value (UPL)	9.0			
		Interwell Background Value (LPL)	6.9			
		Analytical Result	7.3	7.4	7.7	7.3
Sulfate	mg/L	Interwell Background Value (UPL)	90.0			
		Analytical Result	65.2	22.3	16.3	**402**
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	1,570			
		Analytical Result	430	**1,720**	**3,600**	1,020

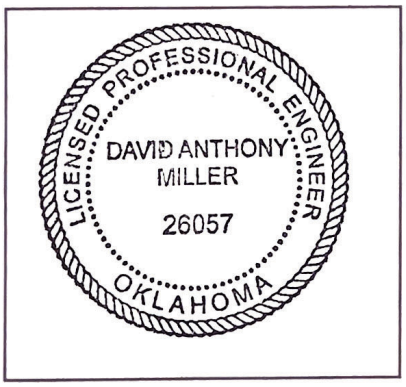
Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Northeastern Bottom Ash Pond CCR management area and that the requirements of OAC 252:517-9-4(g) have been met.



DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

26057	OKLAHOMA	10.07.22
License Number	Licensing State	Date

ATTACHMENT B
Statistical Analysis Output

GROUNDWATER STATS CONSULTING

August 31, 2022

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Northeastern BAP (Bottom Ash Pond)
Assessment Monitoring Statistics –June 2022

Dear Ms. Kreinberg,

Groundwater Stats Consulting (GSC), formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the June 2022 assessment monitoring analysis of groundwater data for American Electric Power Inc.'s Northeastern BAP. The analysis complies with the Oklahoma Administrative Code (OAC) as well as with the United States Environmental Protection Agency (USEPA) Unified Guidance (2009).

Sampling began at the site for the OAC program in 2017. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** SP-4 and SP-5R
- **Downgradient wells:** SP-1, SP2, SP-10, and SP-11

Data were sent electronically, and the statistical analysis was conducted according to the Statistical Analysis Plan and screening evaluation prepared by GSC and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC. The analysis was reviewed by Andrew Collins, Project Manager of GSC.

The OAC program consists of the following constituents listed below. The terms "constituent" and "parameter" are interchangeable.

- **Appendix B** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium

For all constituents, a substitution of the most recent reporting limit is used for non-detect data. Time series and box plots are provided for all wells for the parameters listed above (Figures A & B). The time series plots display concentrations over time for each well while the box plots provide visual representation of variation within a given well and across all wells.

Summary of Background Screening

Outlier Screening

Data were re-evaluated for outliers using Tukey's outlier test during the background update performed in April 2022, and a summary of those findings was submitted with that report. No additional values were flagged during that screening; however, elevated concentrations earlier in the record for barium at well SP-10 were deselected to construct confidence intervals that are representative of present-day groundwater quality conditions for barium at this well. Values identified as outliers are flagged in the database with "o" and are deselected prior to construction of statistical limits. A list of all previously flagged outliers follows this letter (Figure C). Additionally, flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. A list of well/constituent pairs using a truncated portion of their records follows this report (Date Ranges Table)

Evaluation of Appendix B Parameters – June 2022

For Appendix B parameters, confidence intervals for each downgradient well/constituent were compared against corresponding Groundwater Protection Standards (GWPS). GWPS were developed as described below. Downgradient well/constituent pairs that have 100% non-detects do not require analysis; however, no downgradient wells had 100% non-detects, and all well/constituent pairs were eligible for confidence intervals.

Interwell Upper Tolerance Limits

Interwell upper tolerance limits were used to calculate the site-specific background limits from pooled upgradient well data during the Fall 2021 analysis using data through December 2021 for Appendix B parameters (Figure D). These limits are updated on an annual basis and will be updated again during the Fall 2022 sample event. Parametric tolerance limits are calculated, with a target of 95% confidence and 95% coverage, when data follow a normal or transformed-normal distribution. When data contained greater than 50% non-detects or did not follow a normal or transformed-normal distribution, non-parametric tolerance limits were constructed using the highest background measurement. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples.

Groundwater Protection Standards

The upper tolerance limits were compared to the Maximum Contaminant Levels (MCLs) and background limits in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure E).

Confidence Intervals

Confidence intervals were then constructed on downgradient wells with data through June 2022 for each of the Appendix B parameters using the highest limit of the MCL or background limit as discussed above for the GWPS (Figure F). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. A summary of the confidence interval results follows this letter. Exceedances were found for the following well/constituent pairs:

- Barium: SP-10
- Fluoride: SP-10
- Lithium: SP-10

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Northeastern BAP. If you have any questions or comments, please feel free to contact us.

For Groundwater Stats Consulting,

Tristan Clark
Groundwater Analyst

Andrew Collins
Project Manager

Date Ranges

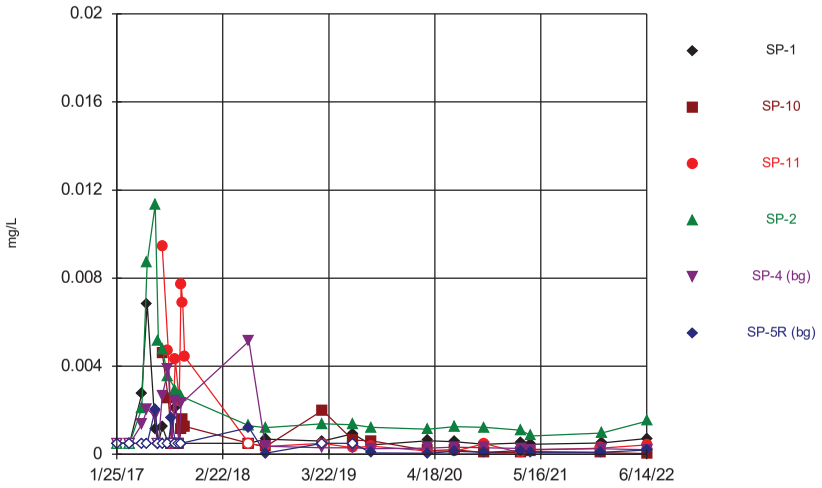
Date: 8/8/2022 3:09 PM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Barium (mg/L)
SP-10 overall:5/30/2018-6/14/2022
Calcium (mg/L)
SP-11 background:10/4/2017-6/30/2020

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

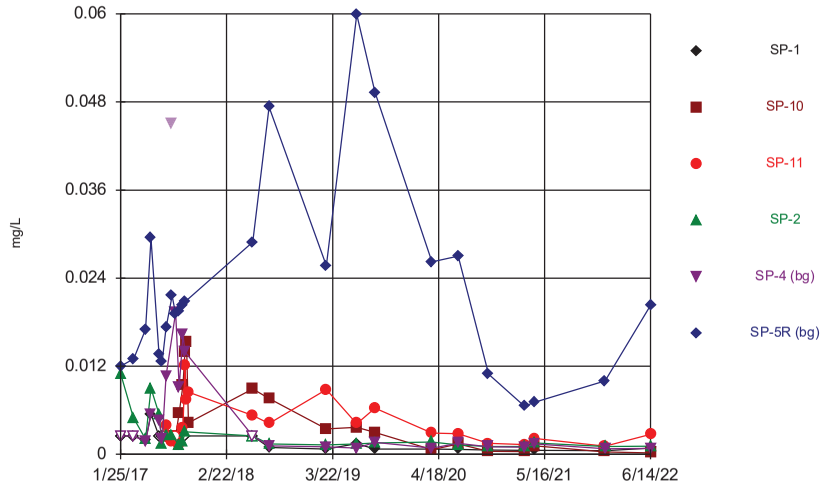
Time Series



Constituent: Antimony Analysis Run 8/30/2022 2:18 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Arsenic Analysis Run 8/30/2022 2:18 PM View: Appendix IV
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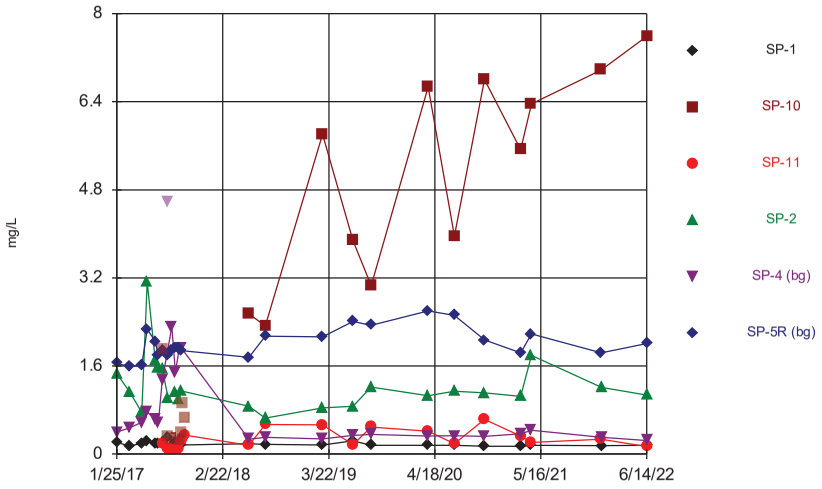
Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

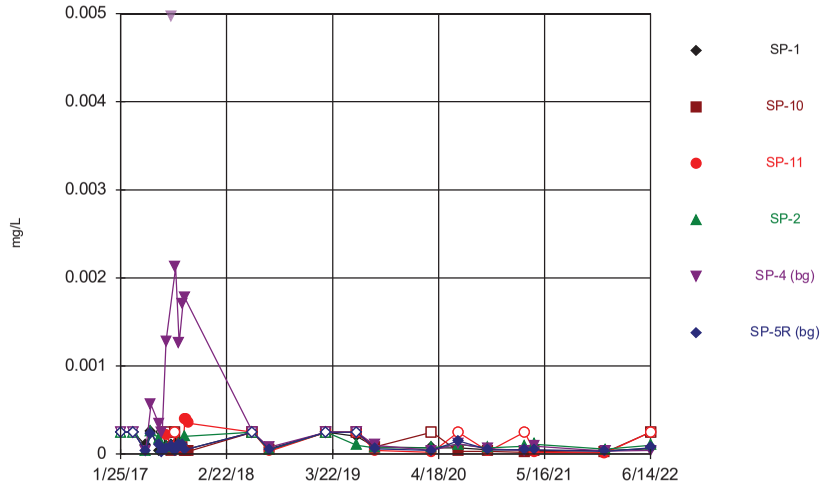
Time Series



Constituent: Barium Analysis Run 8/30/2022 2:18 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

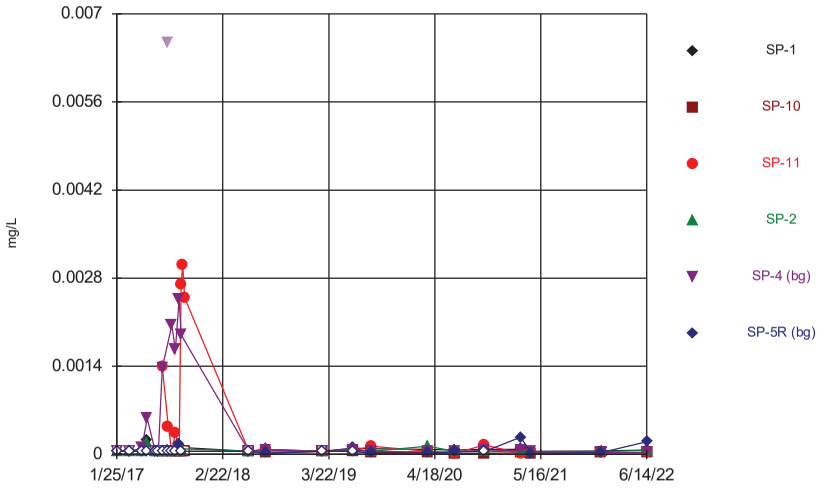
Time Series



Constituent: Beryllium Analysis Run 8/30/2022 2:18 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

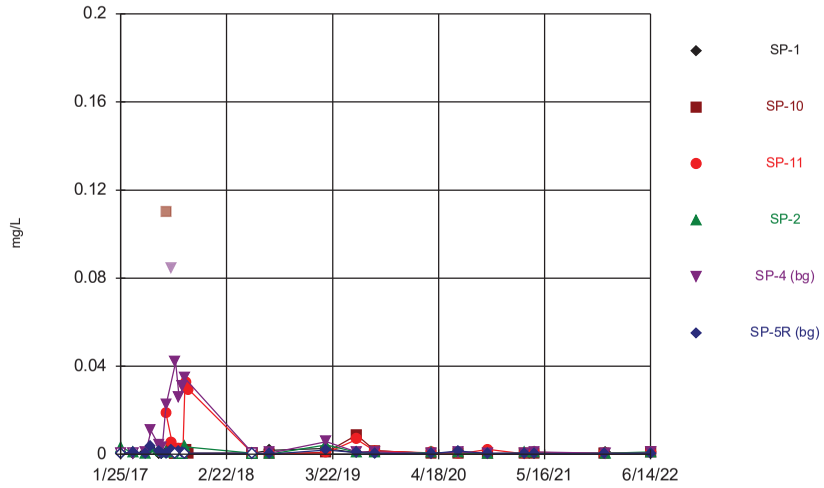
Time Series



Constituent: Cadmium Analysis Run 8/30/2022 2:18 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

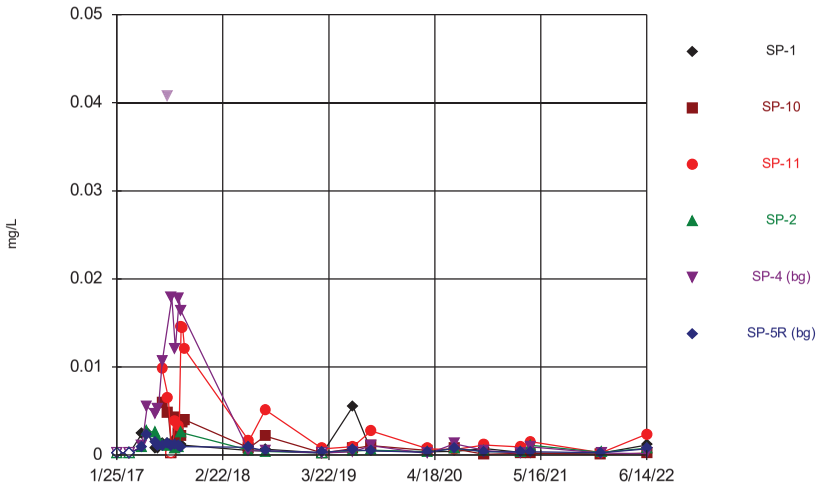
Time Series



Constituent: Chromium Analysis Run 8/30/2022 2:18 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

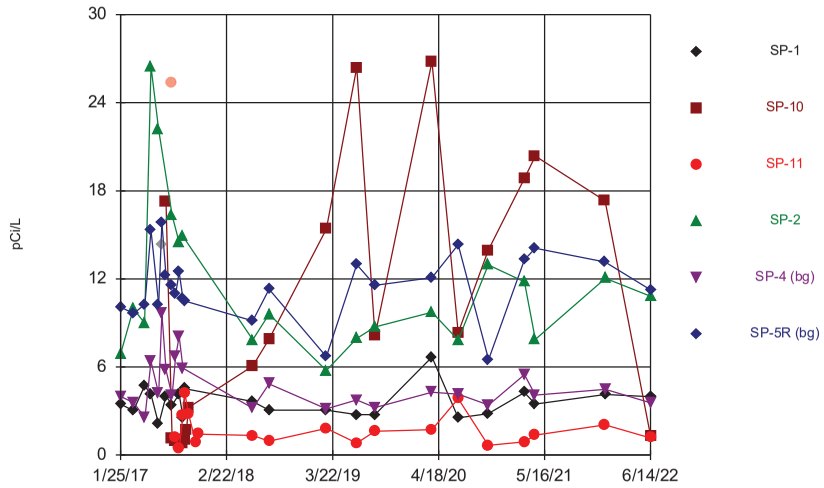
Time Series



Constituent: Cobalt Analysis Run 8/30/2022 2:18 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

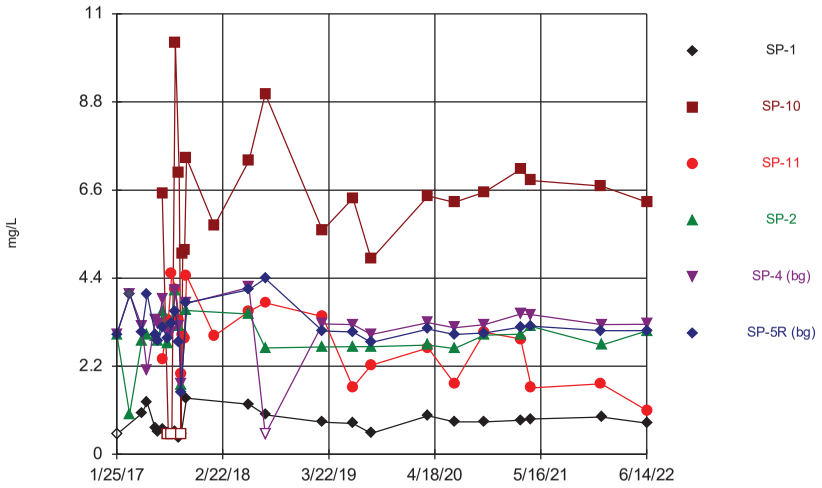
Time Series



Constituent: Combined Radium 226 + 228 Analysis Run 8/30/2022 2:18 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Fluoride Analysis Run 8/30/2022 2:18 PM View: Appendix IV
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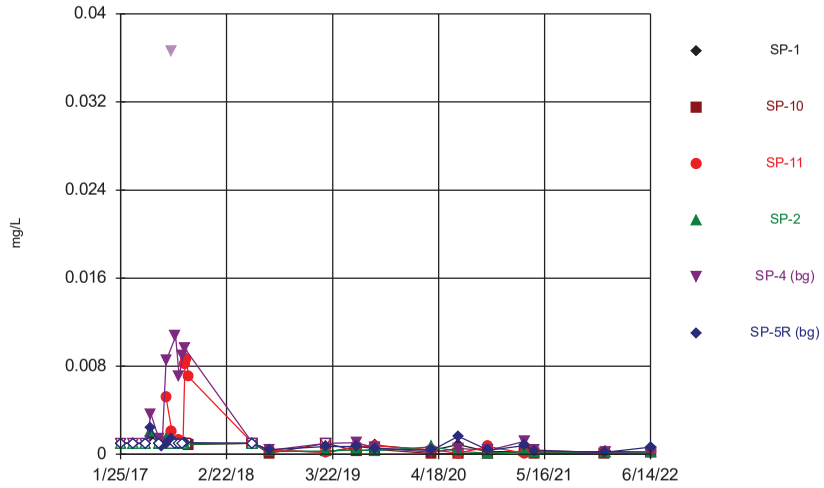
Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

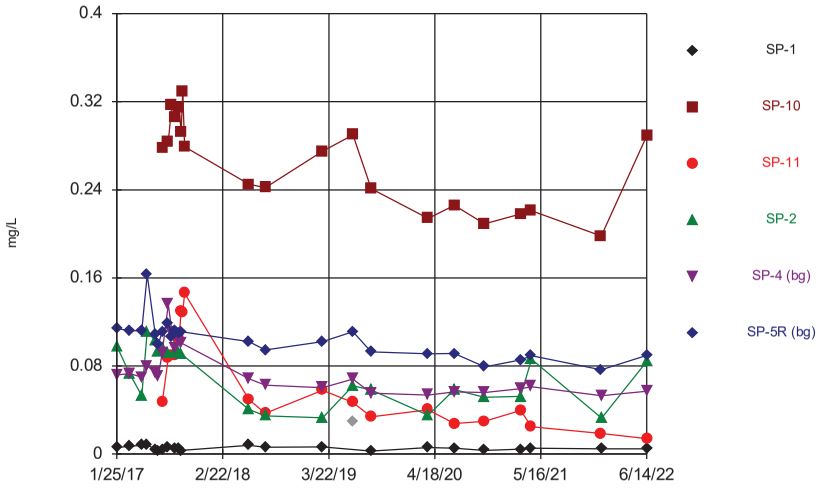
Time Series



Constituent: Lead Analysis Run 8/30/2022 2:18 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

Time Series



Constituent: Lithium Analysis Run 8/30/2022 2:18 PM View: Appendix IV
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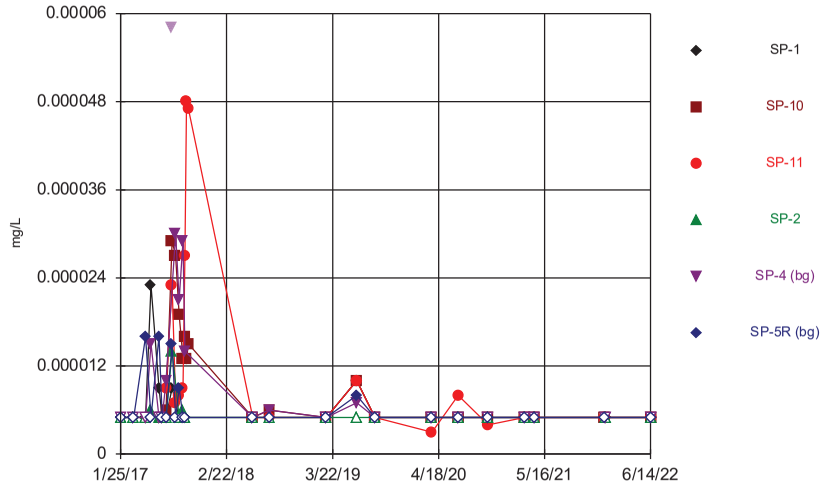
Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

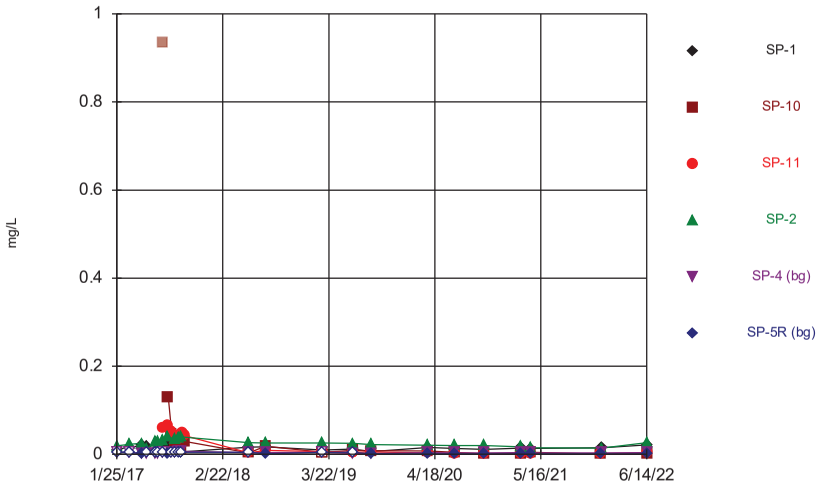
Time Series



Constituent: Mercury Analysis Run 8/30/2022 2:18 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

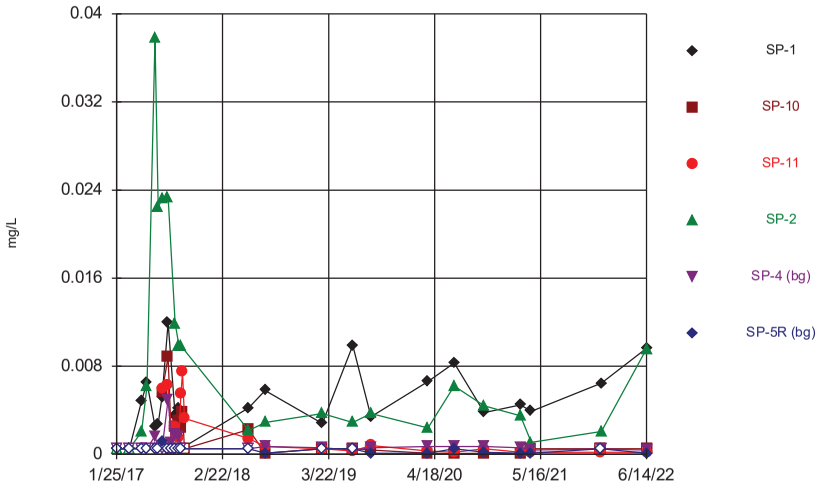
Time Series



Constituent: Molybdenum Analysis Run 8/30/2022 2:18 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

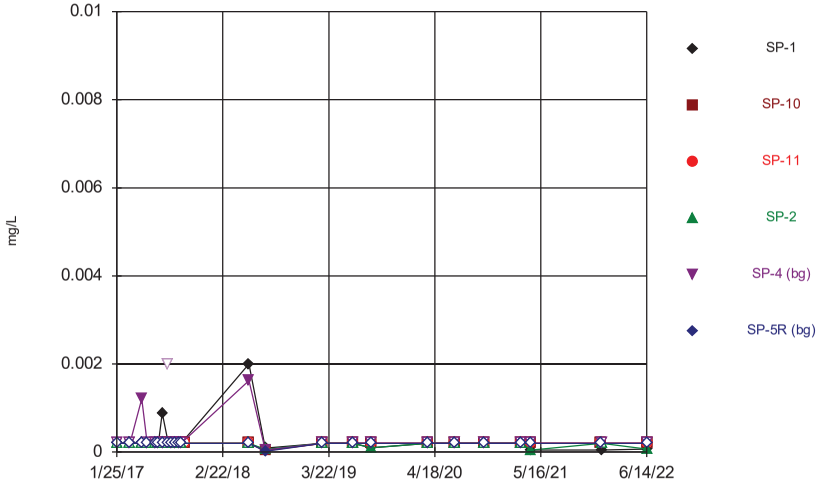
Time Series



Constituent: Selenium Analysis Run 8/30/2022 2:18 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

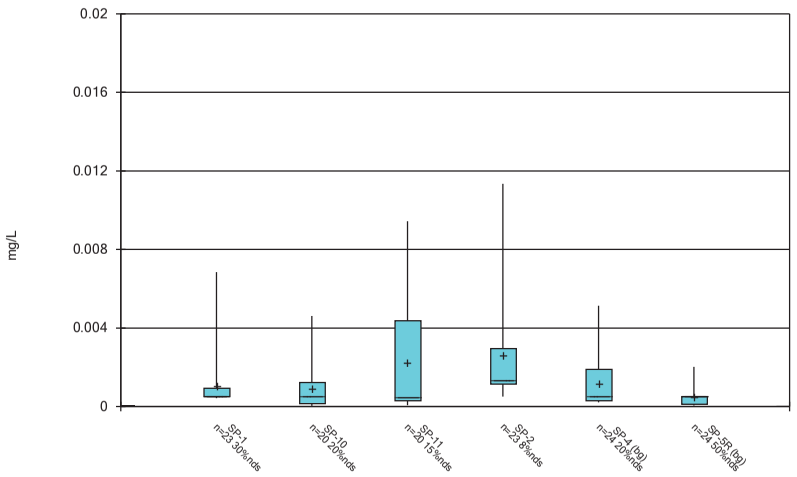
Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Thallium Analysis Run 8/30/2022 2:18 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

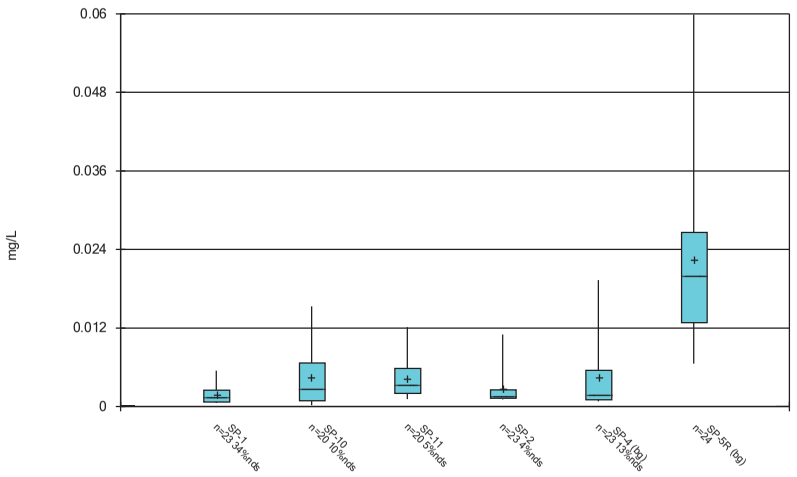
Box & Whiskers Plot



Constituent: Antimony Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

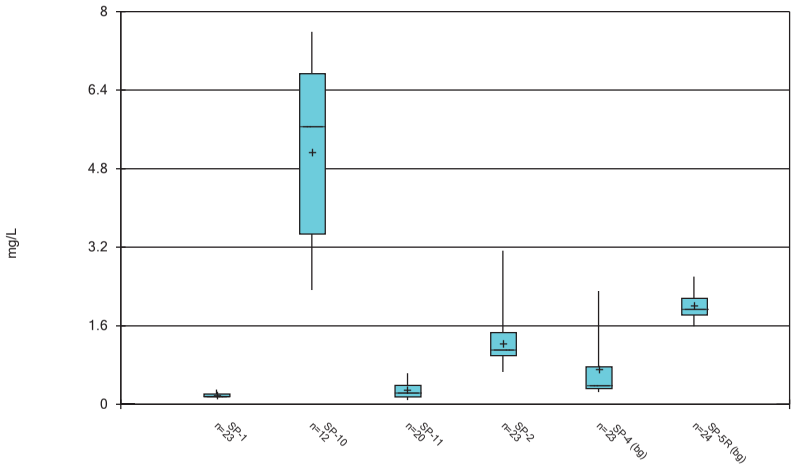
Box & Whiskers Plot



Constituent: Arsenic Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

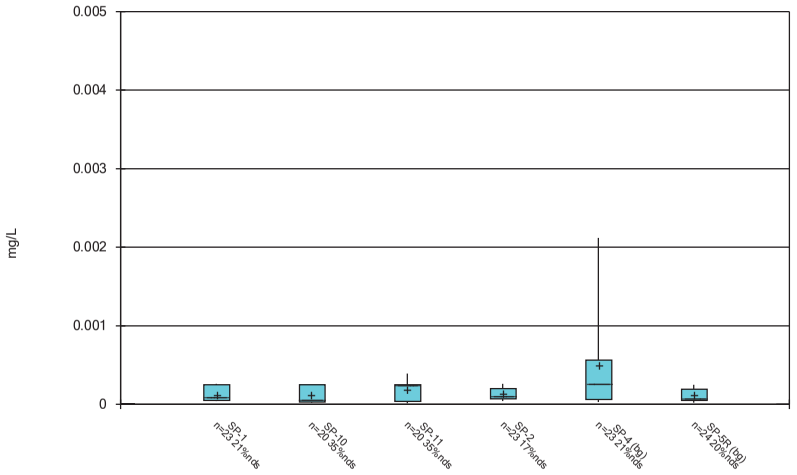
Box & Whiskers Plot



Constituent: Barium Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

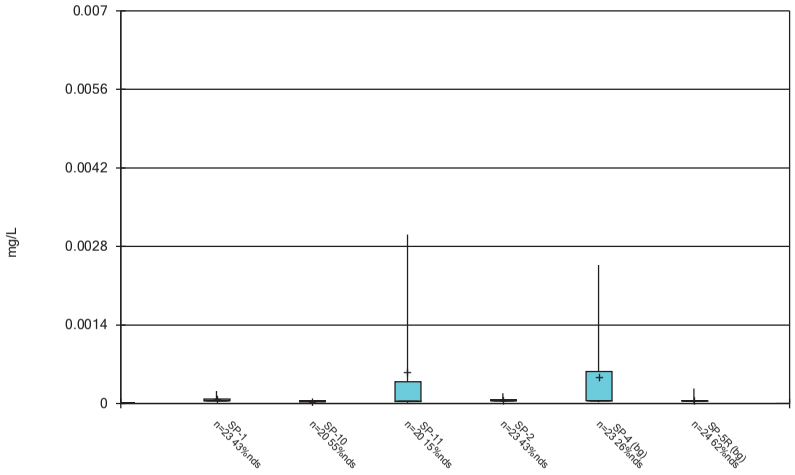
Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Beryllium Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

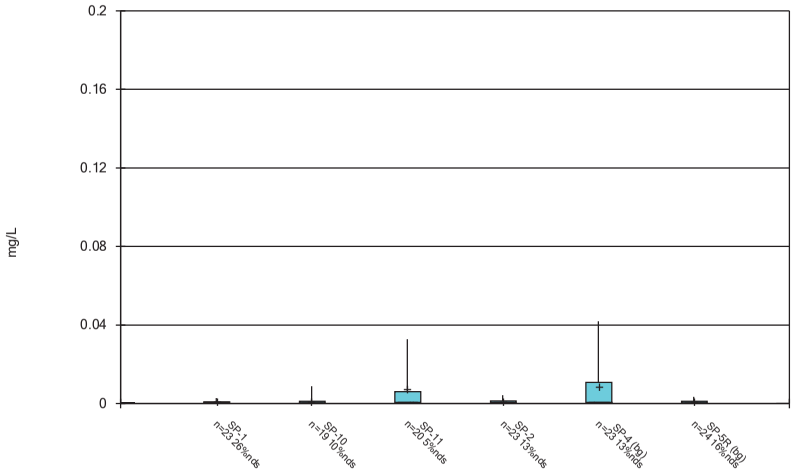
Box & Whiskers Plot



Constituent: Cadmium Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

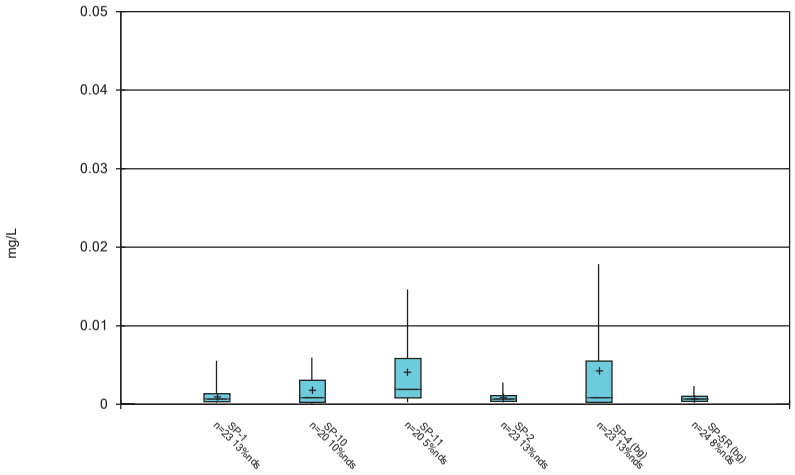
Box & Whiskers Plot



Constituent: Chromium Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

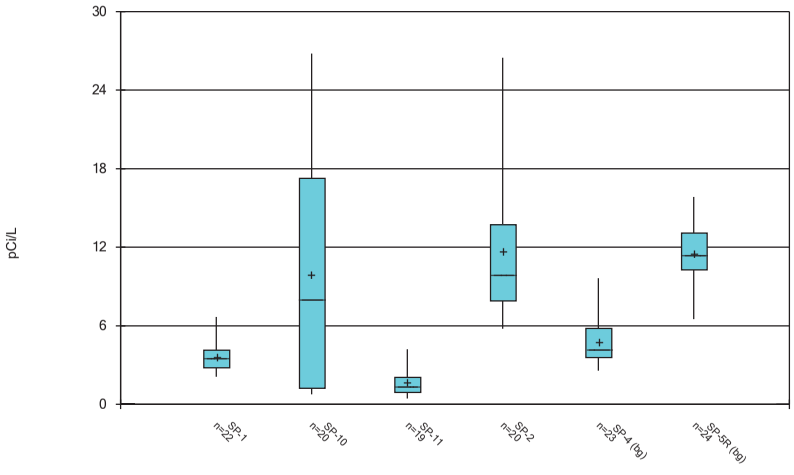
Box & Whiskers Plot



Constituent: Cobalt Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

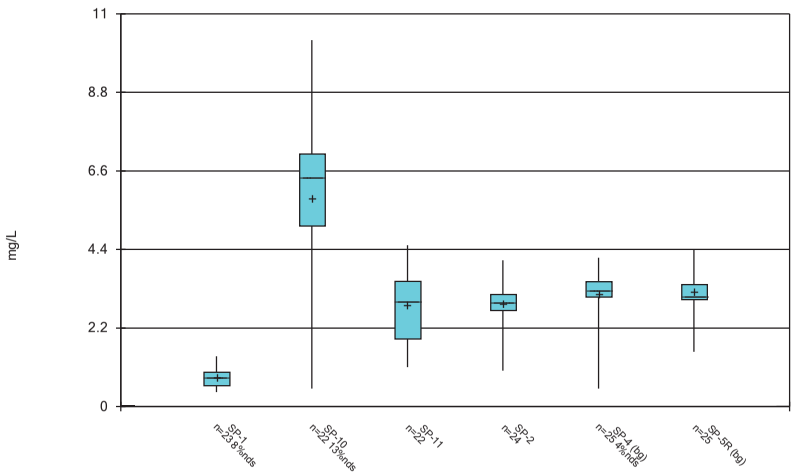
Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

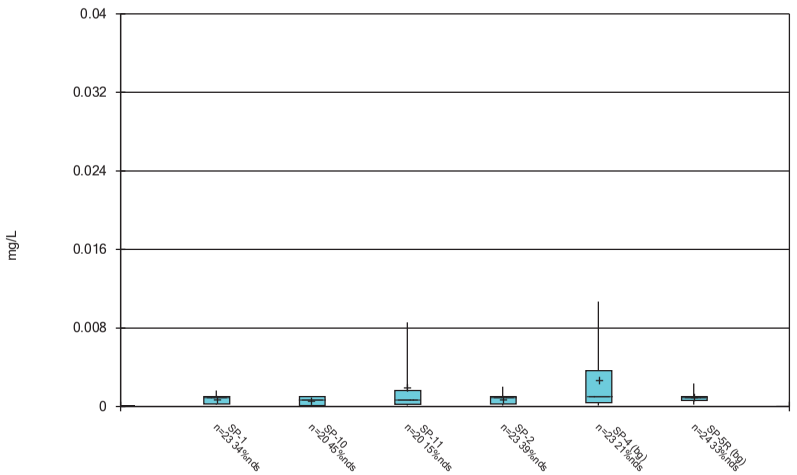
Box & Whiskers Plot



Constituent: Fluoride Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

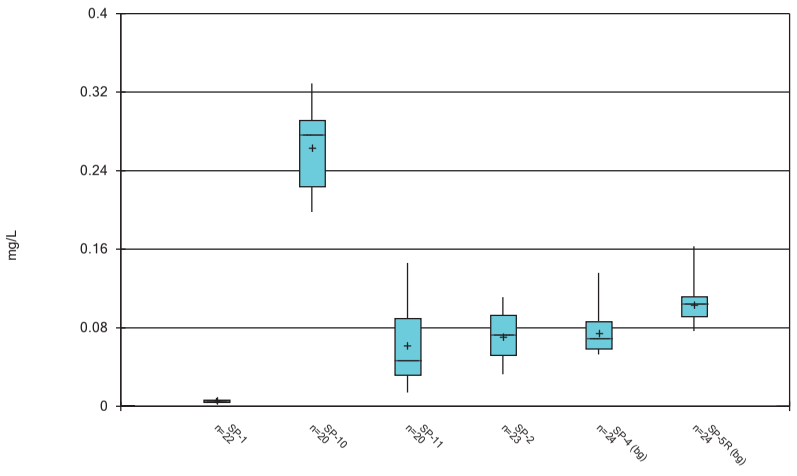
Box & Whiskers Plot



Constituent: Lead Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

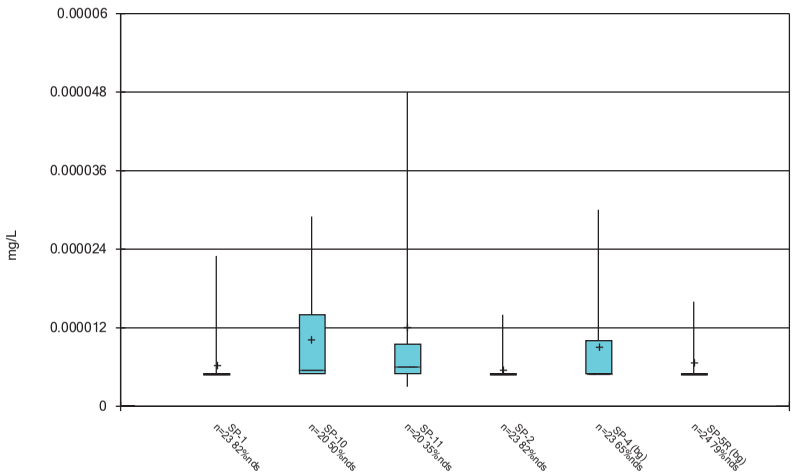
Box & Whiskers Plot



Constituent: Lithium Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

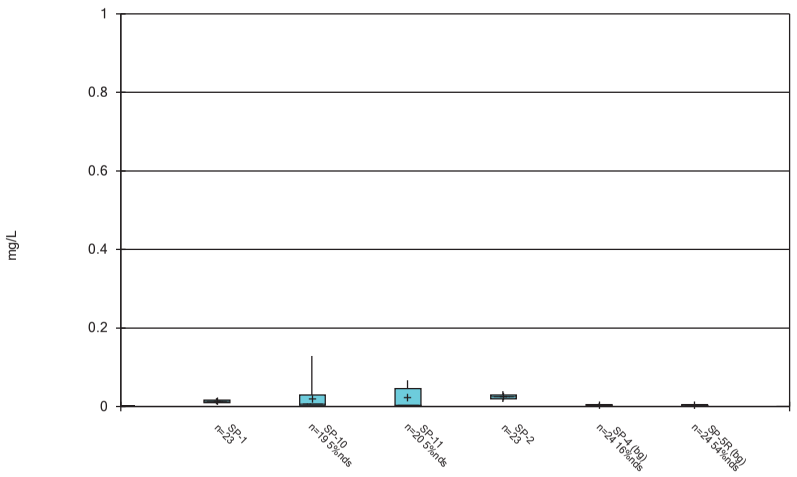
Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Mercury Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

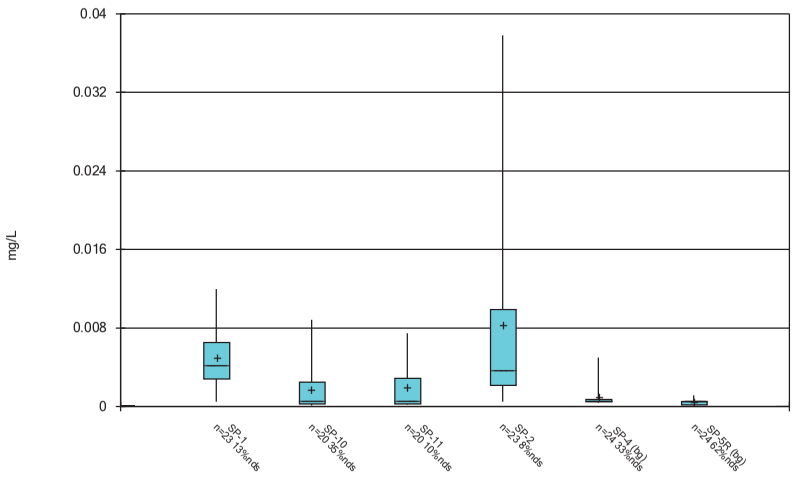
Box & Whiskers Plot



Constituent: Molybdenum Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

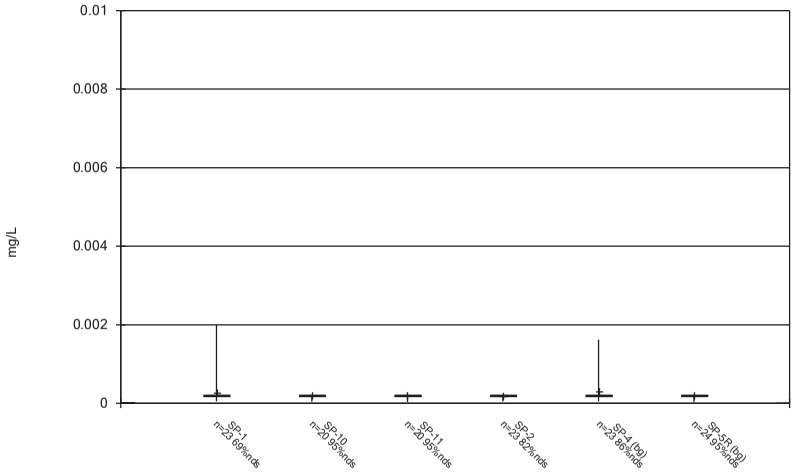
Box & Whiskers Plot



Constituent: Selenium Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Thallium Analysis Run 8/30/2022 2:20 PM View: Appendix IV
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Outlier Summary

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 8/8/2022, 3:12 PM

	SP-4 Arsenic (mg/L)	SP-4 Barium (mg/L)	SP-4 Beryllium (mg/L)	SP-4 Cadmium (mg/L)	SP-10 Chromium (mg/L)	SP-4 Chromium (mg/L)	SP-4 Cobalt (mg/L)	SP-1 Combined Radium 226 + 228 (pCi/L)	SP-11 Combined Radium 226 + 228 (pCi/L)	SP-1 Fluoride (mg/L)
3/13/2017										4 (o)
6/27/2017								14.29 (o)		
7/13/2017					0.11 (o)					
8/4/2017	0.04498 (o)	4.59 (o)	0.00497 (o)	0.00655 (o)		0.08415 (o)	0.04069 (o)		25.367 (o)	
6/20/2019										

	SP-4 Lead (mg/L)	SP-1 Lithium (mg/L)	SP-4 Mercury (mg/L)	SP-10 Molybdenum (mg/L)	SP-4 Thallium (mg/L)
3/13/2017					
6/27/2017					
7/13/2017				0.934 (o)	
8/4/2017	0.03663 (o)		5.8E-05 (o)		<0.0002 (o)
6/20/2019		0.03 (Jo)			

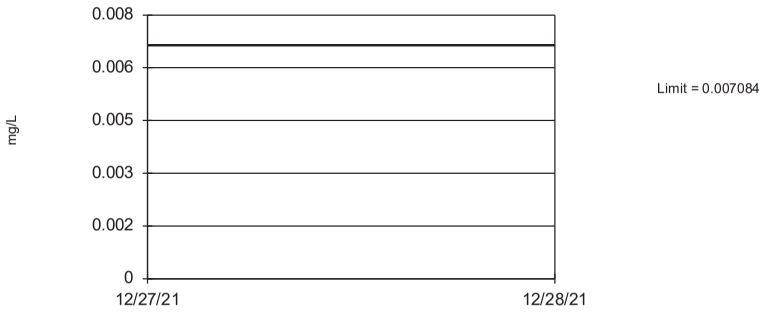
Upper Tolerance Limits Summary Table

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 3/22/2022, 10:42 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony (mg/L)	n/a	0.007084	n/a	n/a	n/a	n/a	46	-7.866	1.398	36.96	Kaplan-Meier	ln(x)	0.05	Inter
Arsenic (mg/L)	n/a	0.05715	n/a	n/a	n/a	n/a	45	0.2106	0.08347	6.667	None	x^(1/3)	0.05	Inter
Barium (mg/L)	n/a	2.6	n/a	n/a	n/a	n/a	45	n/a	n/a	0	n/a	n/a	0.09944	NP Inter(normality)
Beryllium (mg/L)	n/a	0.00212	n/a	n/a	n/a	n/a	45	n/a	n/a	22.22	n/a	n/a	0.09944	NP Inter(normality)
Cadmium (mg/L)	n/a	0.00247	n/a	n/a	n/a	n/a	45	n/a	n/a	46.67	n/a	n/a	0.09944	NP Inter(normality)
Chromium (mg/L)	n/a	0.04182	n/a	n/a	n/a	n/a	45	n/a	n/a	15.56	n/a	n/a	0.09944	NP Inter(normality)
Cobalt (mg/L)	n/a	0.01786	n/a	n/a	n/a	n/a	45	n/a	n/a	11.11	n/a	n/a	0.09944	NP Inter(normality)
Combined Radium 226 + 228 (pCi/L)	n/a	15.84	n/a	n/a	n/a	n/a	45	n/a	n/a	0	n/a	n/a	0.09944	NP Inter(normality)
Fluoride (mg/L)	n/a	4.39	n/a	n/a	n/a	n/a	48	n/a	n/a	2.083	n/a	n/a	0.08526	NP Inter(normality)
Lead (mg/L)	n/a	0.0107	n/a	n/a	n/a	n/a	45	n/a	n/a	28.89	n/a	n/a	0.09944	NP Inter(normality)
Lithium (mg/L)	n/a	0.1404	n/a	n/a	n/a	n/a	46	0.08976	0.02426	0	None	No	0.05	Inter
Mercury (mg/L)	n/a	0.00003	n/a	n/a	n/a	n/a	45	n/a	n/a	71.11	n/a	n/a	0.09944	NP Inter(NDs)
Molybdenum (mg/L)	n/a	0.01	n/a	n/a	n/a	n/a	46	n/a	n/a	36.96	n/a	n/a	0.09447	NP Inter(normality)
Selenium (mg/L)	n/a	0.00499	n/a	n/a	n/a	n/a	46	n/a	n/a	50	n/a	n/a	0.09447	NP Inter(normality)
Thallium (mg/L)	n/a	0.00162	n/a	n/a	n/a	n/a	45	n/a	n/a	91.11	n/a	n/a	0.09944	NP Inter(NDs)

Tolerance Limit

Interwell Parametric



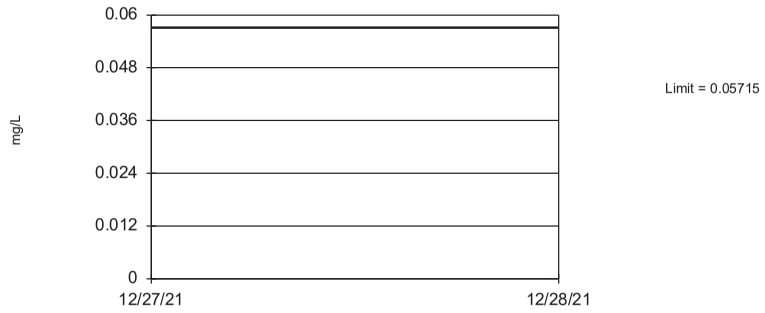
95% coverage. Background Data Summary (based on natural log transformation) (after Kaplan-Meier Adjustment): Mean=-7.866, Std. Dev.=1.398, n=46, 36.96% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9381, critical = 0.927. Report alpha = 0.05.

Constituent: Antimony Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.32 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Parametric



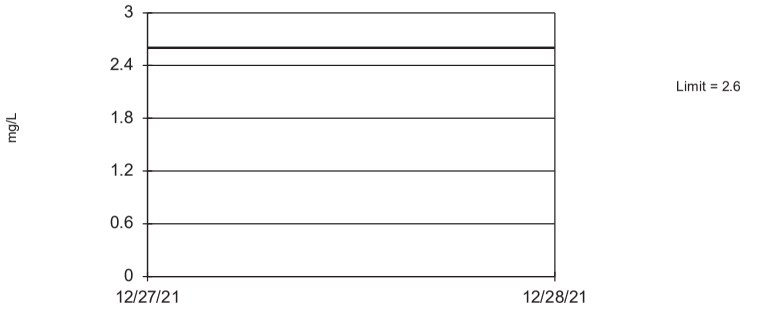
95% coverage. Background Data Summary (based on cube root transformation): Mean=0.2106, Std. Dev.=0.08347, n=45, 6.667% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9293, critical = 0.926. Report alpha = 0.05.

Constituent: Arsenic Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.32 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



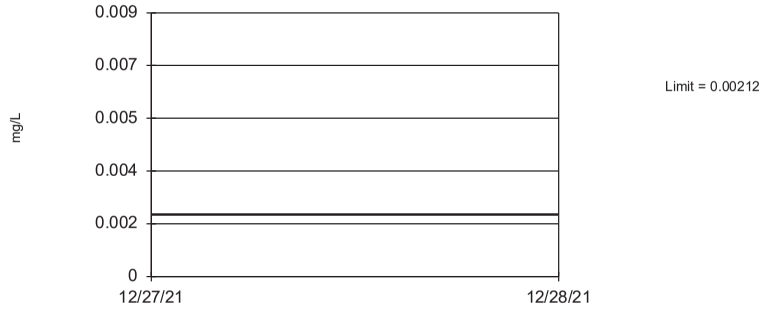
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 45 background values. 90.43% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.09944.

Constituent: Barium Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.32 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric

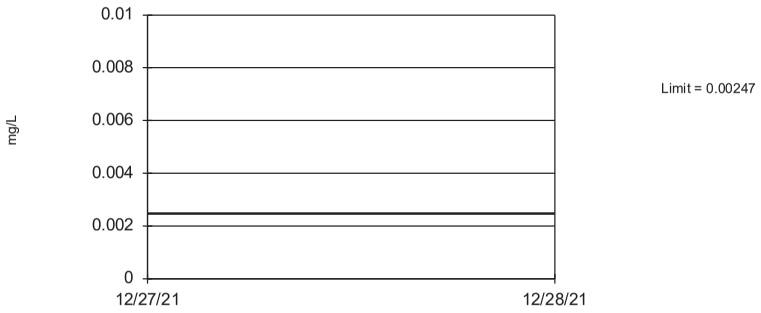


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 45 background values. 22.22% NDs. 90.43% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.09944.

Constituent: Beryllium Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric



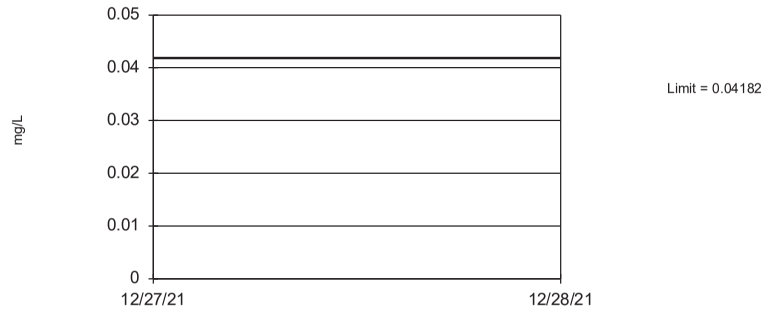
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 45 background values. 46.67% NDs. 90.43% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.09944.

Constituent: Cadmium Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.32 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



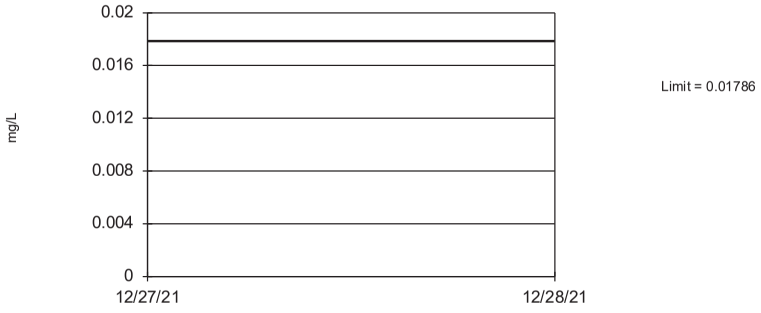
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 45 background values. 15.56% NDs. 90.43% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.09944.

Constituent: Chromium Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.32 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



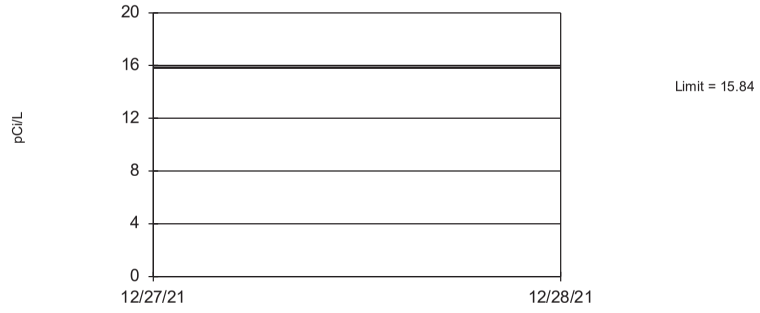
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 45 background values. 11.11% NDs. 90.43% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.09944.

Constituent: Cobalt Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.32 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric

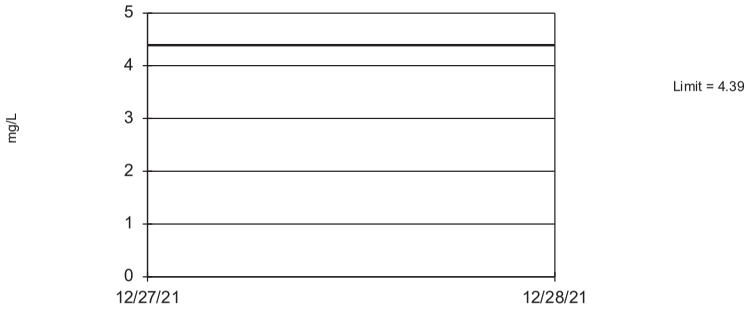


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 45 background values. 90.43% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.09944.

Constituent: Combined Radium 226 + 228 Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric



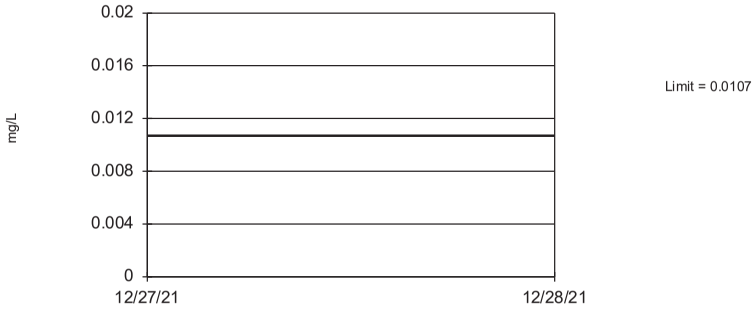
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 48 background values. 2.083% NDs. 90.82% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08526.

Constituent: Fluoride Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.32 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



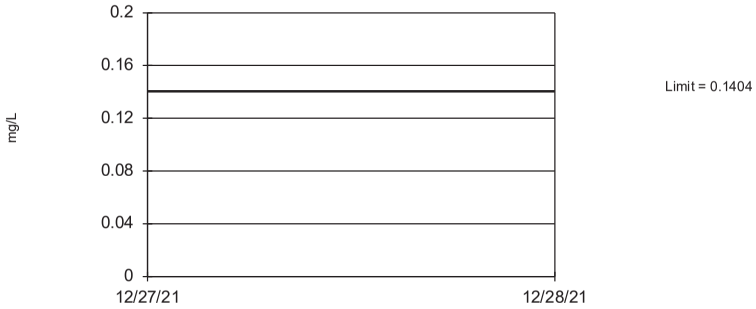
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 45 background values. 28.89% NDs. 90.43% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.09944.

Constituent: Lead Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.32 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Parametric



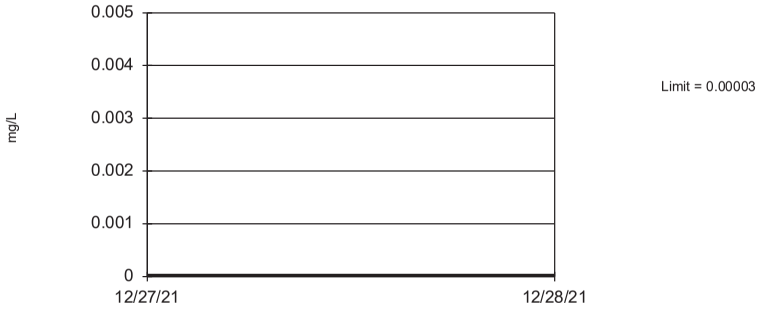
95% coverage. Background Data Summary: Mean=0.08976, Std. Dev.=0.02426, n=46. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9416, critical = 0.927. Report alpha = 0.05.

Constituent: Lithium Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.32 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric

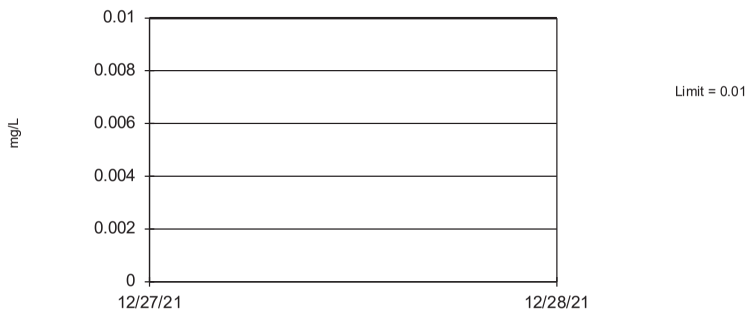


Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Limit is highest of 45 background values. 71.11% NDs. 90.43% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.09944.

Constituent: Mercury Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric

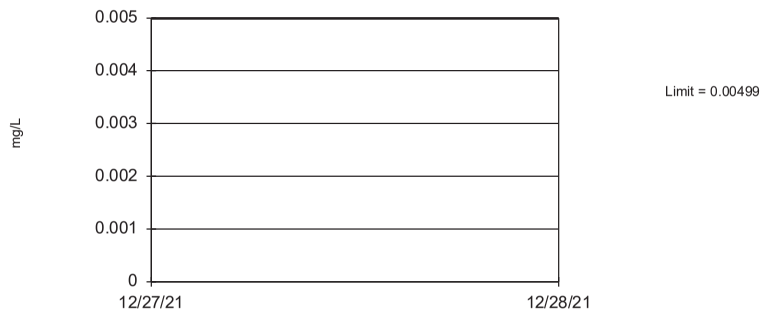


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 46 background values. 36.96% NDs. 90.43% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.09447.

Constituent: Molybdenum Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric

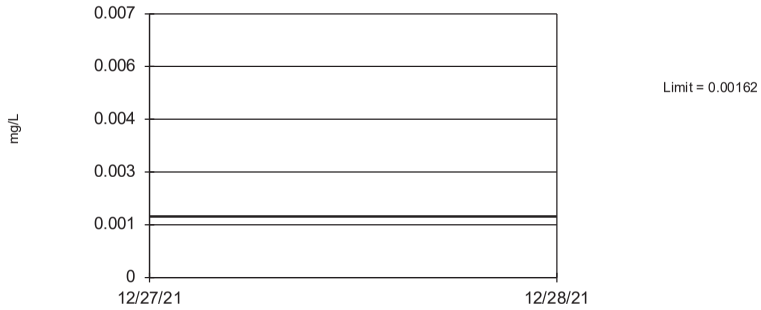


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 46 background values. 50% NDs. 90.43% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.09447.

Constituent: Selenium Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Limit is highest of 45 background values. 91.11% NDs. 90.43% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.09944.

Constituent: Thallium Analysis Run 3/22/2022 10:40 AM View: Appendix IV - UTLs
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

NORTHEASTERN BAP GWPS				
Constituent Name	**MCL**	**CCR-Rule Specified Level**	**Background Limit**	**GWPS**
Antimony, Total (mg/L)	0.006		0.0071	0.0071
Arsenic, Total (mg/L)	0.01		0.057	0.057
Barium, Total (mg/L)	2		2.6	2.6
Beryllium, Total (mg/L)	0.004		0.0021	0.004
Cadmium, Total (mg/L)	0.005		0.0025	0.005
Chromium, Total (mg/L)	0.1		0.042	0.1
Cobalt, Total (mg/L)	n/a	0.006	0.018	0.018
Combined Radium, Total (pCi/L)	5		15.84	15.84
Fluoride, Total (mg/L)	4		4.39	4.39
Lead, Total (mg/L)	n/a	0.015	0.011	0.015
Lithium, Total (mg/L)	n/a	0.04	0.14	0.14
Mercury, Total (mg/L)	0.002		0.00003	0.002
Molybdenum, Total (mg/L)	n/a	0.1	0.01	0.1
Selenium, Total (mg/L)	0.05		0.005	0.05
Thallium, Total (mg/L)	0.002		0.0016	0.002

**Grey cell indicates Background Limit is higher than MCL*

**GWPS = Groundwater Protection Standard*

**MCL = Maximum Contaminant Level*

**CCR = Coal Combustion Residuals*

Confidence Interval - Significant Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 8/30/2022, 2:23 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Barium (mg/L)	**SP-10**	**6.594**	**3.659**	**2.6**	**Yes**	**12**	**0**	**No**	**0.01**	**Param.**
Fluoride (mg/L)	**SP-10**	**7.254**	**5.171**	**4.39**	**Yes**	**22**	**13.64**	**x^2**	**0.01**	**Param.**
Lithium (mg/L)	**SP-10**	**0.2864**	**0.2404**	**0.14**	**Yes**	**20**	**0**	**No**	**0.01**	**Param.**

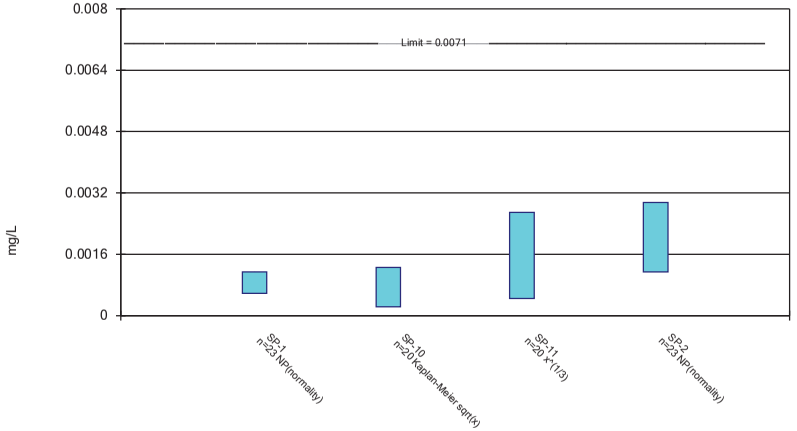
Confidence Interval - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 8/30/2022, 2:23 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Antimony (mg/L)	SP-1	0.00114	0.00058	0.0071	No	23	30.43	No	0.01	NP (normality)
Antimony (mg/L)	SP-10	0.00126	0.0002275	0.0071	No	20	20	sqrt(x)	0.01	Param.
Antimony (mg/L)	SP-11	0.002695	0.0004495	0.0071	No	20	15	x^(1/3)	0.01	Param.
Antimony (mg/L)	SP-2	0.00295	0.00114	0.0071	No	23	8.696	No	0.01	NP (normality)
Arsenic (mg/L)	SP-1	0.001272	0.0006887	0.057	No	23	34.78	ln(x)	0.01	Param.
Arsenic (mg/L)	SP-10	0.005835	0.001509	0.057	No	20	10	sqrt(x)	0.01	Param.
Arsenic (mg/L)	SP-11	0.005939	0.002519	0.057	No	20	5	No	0.01	Param.
Arsenic (mg/L)	SP-2	0.00254	0.00128	0.057	No	23	4.348	No	0.01	NP (normality)
Barium (mg/L)	SP-1	0.2066	0.1662	2.6	No	23	0	No	0.01	Param.
Barium (mg/L)	**SP-10**	**6.594**	**3.659**	**2.6**	**Yes**	**12**	**0**	**No**	**0.01**	**Param.**
Barium (mg/L)	SP-11	0.3698	0.1807	2.6	No	20	0	No	0.01	Param.
Barium (mg/L)	SP-2	1.386	0.9815	2.6	No	23	0	ln(x)	0.01	Param.
Beryllium (mg/L)	SP-1	0.00026	0.00005	0.004	No	23	21.74	No	0.01	NP (normality)
Beryllium (mg/L)	SP-10	0.0025	0.00003	0.004	No	20	35	No	0.01	NP (normality)
Beryllium (mg/L)	SP-11	0.0025	0.00003	0.004	No	20	35	No	0.01	NP (normality)
Beryllium (mg/L)	SP-2	0.0002	0.00007	0.004	No	23	17.39	No	0.01	NP (normality)
Cadmium (mg/L)	SP-1	0.0002	0.00008	0.005	No	23	43.48	No	0.01	NP (normality)
Cadmium (mg/L)	SP-10	0.0002	0.000021	0.005	No	20	55	No	0.01	NP (NDs)
Cadmium (mg/L)	SP-11	0.0003893	0.00005019	0.005	No	20	15	ln(x)	0.01	Param.
Cadmium (mg/L)	SP-2	0.0002	0.00006	0.005	No	23	43.48	No	0.01	NP (normality)
Chromium (mg/L)	SP-1	0.0009329	0.0004677	0.1	No	23	26.09	ln(x)	0.01	Param.
Chromium (mg/L)	SP-10	0.001107	0.000298	0.1	No	19	10.53	ln(x)	0.01	Param.
Chromium (mg/L)	SP-11	0.00472	0.000676	0.1	No	20	5	ln(x)	0.01	Param.
Chromium (mg/L)	SP-2	0.001537	0.0005699	0.1	No	23	13.04	sqrt(x)	0.01	Param.
Cobalt (mg/L)	SP-1	0.001281	0.0004727	0.018	No	23	13.04	x^(1/3)	0.01	Param.
Cobalt (mg/L)	SP-10	0.002317	0.0005156	0.018	No	20	10	sqrt(x)	0.01	Param.
Cobalt (mg/L)	SP-11	0.005575	0.001289	0.018	No	20	5	sqrt(x)	0.01	Param.
Cobalt (mg/L)	SP-2	0.001123	0.0004879	0.018	No	23	13.04	x^(1/3)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-1	4.133	3.069	15.84	No	22	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-10	14.95	4.817	15.84	No	20	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-11	2.138	1.047	15.84	No	19	0	sqrt(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-2	13.99	8.718	15.84	No	20	0	sqrt(x)	0.01	Param.
Fluoride (mg/L)	SP-1	0.9428	0.6622	4.39	No	23	8.696	No	0.01	Param.
Fluoride (mg/L)	**SP-10**	**7.254**	**5.171**	**4.39**	**Yes**	**22**	**13.64**	**x^2**	**0.01**	**Param.**
Fluoride (mg/L)	SP-11	3.358	2.339	4.39	No	22	0	No	0.01	Param.
Fluoride (mg/L)	SP-2	3.202	2.655	4.39	No	24	0	x^2	0.01	Param.
Lead (mg/L)	SP-1	0.002	0.000259	0.015	No	23	34.78	No	0.01	NP (normality)
Lead (mg/L)	SP-10	0.002	0.0001	0.015	No	20	45	No	0.01	NP (normality)
Lead (mg/L)	SP-11	0.002506	0.0004524	0.015	No	20	15	x^(1/3)	0.01	Param.
Lead (mg/L)	SP-2	0.002	0.000253	0.015	No	23	39.13	No	0.01	NP (normality)
Lithium (mg/L)	SP-1	0.006181	0.004477	0.14	No	22	0	No	0.01	Param.
Lithium (mg/L)	**SP-10**	**0.2864**	**0.2404**	**0.14**	**Yes**	**20**	**0**	**No**	**0.01**	**Param.**
Lithium (mg/L)	SP-11	0.0851	0.03925	0.14	No	20	0	No	0.01	Param.
Lithium (mg/L)	SP-2	0.08403	0.05715	0.14	No	23	0	No	0.01	Param.
Mercury (mg/L)	SP-1	0.000009	0.000005	0.002	No	23	82.61	No	0.01	NP (NDs)
Mercury (mg/L)	SP-10	0.000015	0.000005	0.002	No	20	50	No	0.01	NP (normality)
Mercury (mg/L)	SP-11	0.00001	0.000005	0.002	No	20	35	No	0.01	NP (normality)
Mercury (mg/L)	SP-2	0.000005	0.000005	0.002	No	23	82.61	No	0.01	NP (NDs)
Molybdenum (mg/L)	SP-1	0.01561	0.01082	0.1	No	23	0	No	0.01	Param.
Molybdenum (mg/L)	SP-10	0.0229	0.003682	0.1	No	19	5.263	x^(1/3)	0.01	Param.
Molybdenum (mg/L)	SP-11	0.0469	0.00215	0.1	No	20	5	No	0.01	NP (normality)
Molybdenum (mg/L)	SP-2	0.02929	0.02105	0.1	No	23	0	No	0.01	Param.
Selenium (mg/L)	SP-1	0.00645	0.003314	0.05	No	23	13.04	No	0.01	Param.
Selenium (mg/L)	SP-10	0.001805	0.0002167	0.05	No	20	35	x^(1/3)	0.01	Param.
Selenium (mg/L)	SP-11	0.001829	0.0004073	0.05	No	20	10	ln(x)	0.01	Param.
Selenium (mg/L)	SP-2	0.01074	0.003089	0.05	No	23	8.696	sqrt(x)	0.01	Param.
Thallium (mg/L)	SP-1	0.00089	0.0001	0.002	No	23	69.57	No	0.01	NP (NDs)
Thallium (mg/L)	SP-10	0.0002	0.00004	0.002	No	20	95	No	0.01	NP (NDs)
Thallium (mg/L)	SP-11	0.0002	0.00003	0.002	No	20	95	No	0.01	NP (NDs)
Thallium (mg/L)	SP-2	0.0002	0.0001	0.002	No	23	82.61	No	0.01	NP (NDs)

Parametric and Non-Parametric (NP) Confidence Interval

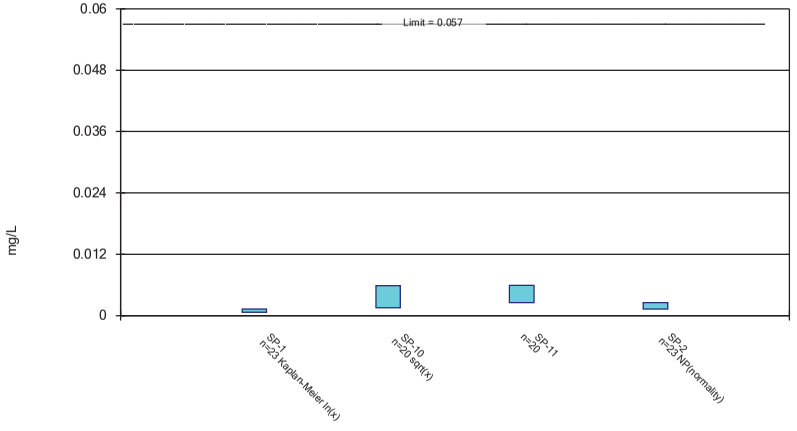
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Antimony Analysis Run 8/30/2022 2:21 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric and Non-Parametric (NP) Confidence Interval

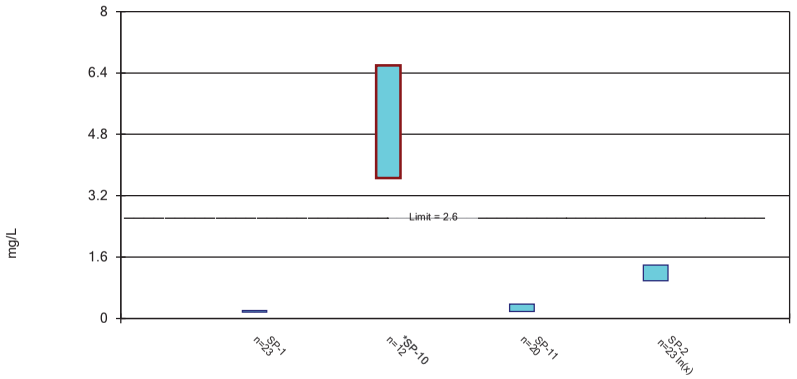
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Arsenic Analysis Run 8/30/2022 2:21 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

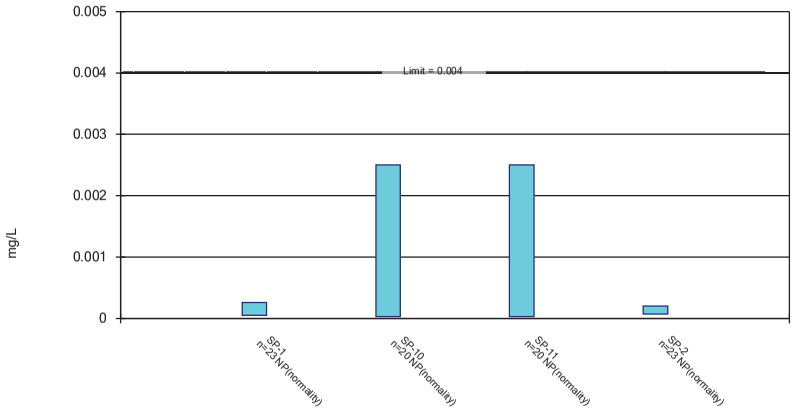
Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Barium Analysis Run 8/30/2022 2:21 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Non-Parametric Confidence Interval

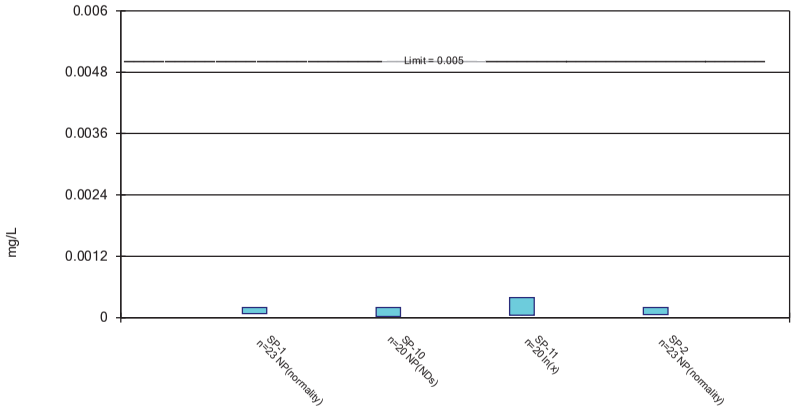
Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Beryllium Analysis Run 8/30/2022 2:21 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric and Non-Parametric (NP) Confidence Interval

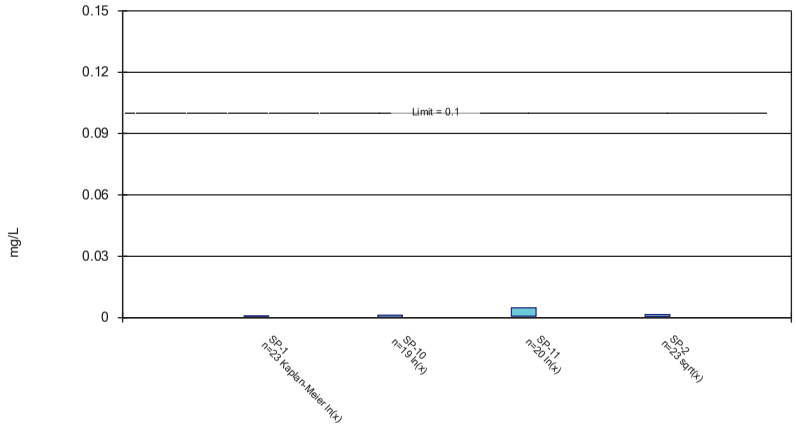
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Cadmium Analysis Run 8/30/2022 2:21 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

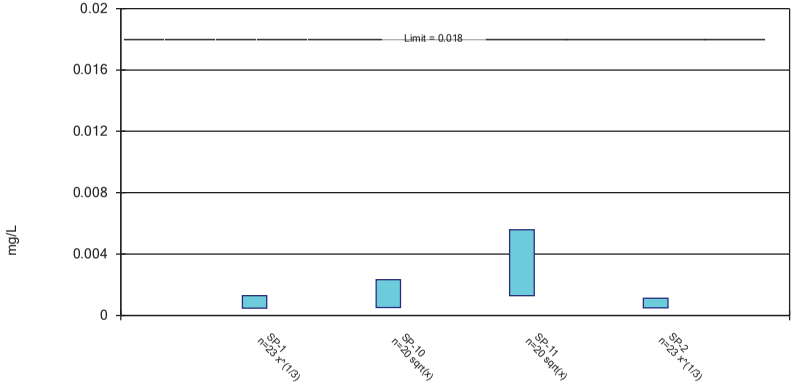
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Chromium Analysis Run 8/30/2022 2:21 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

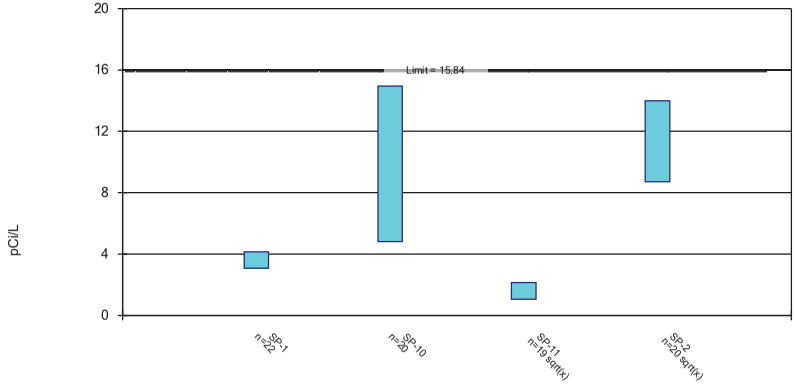
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Cobalt Analysis Run 8/30/2022 2:21 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

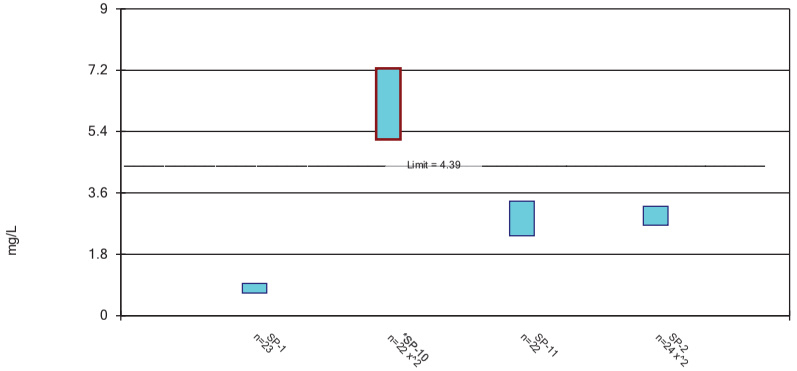
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Combined Radium 226 + 228 Analysis Run 8/30/2022 2:21 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

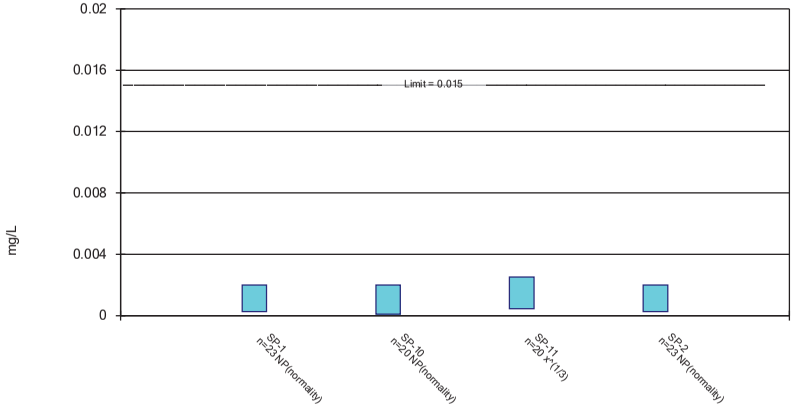
Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Fluoride Analysis Run 8/30/2022 2:21 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric and Non-Parametric (NP) Confidence Interval

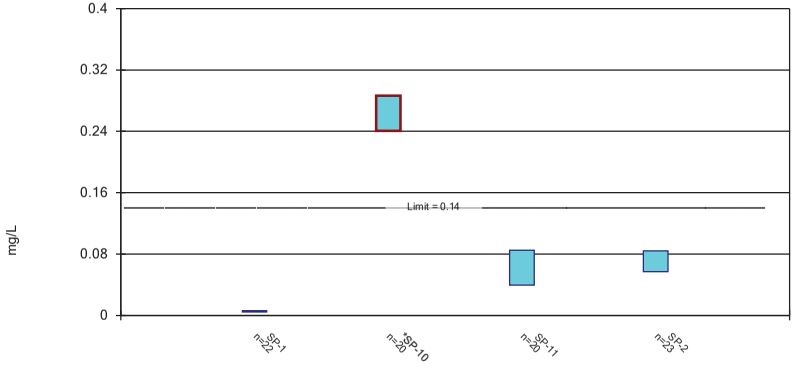
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Lead Analysis Run 8/30/2022 2:21 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

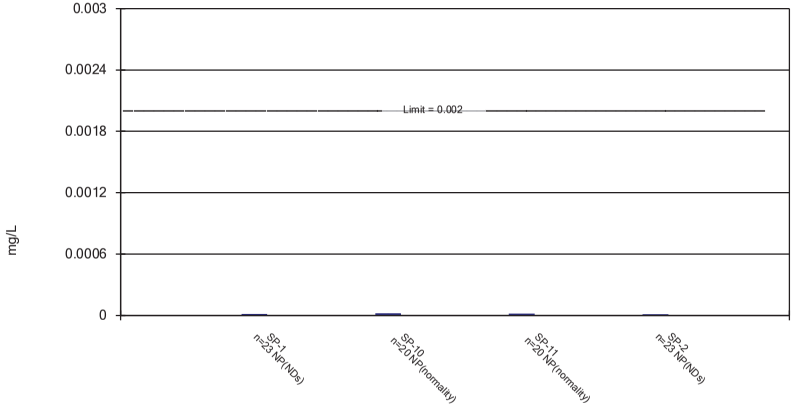
Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Lithium Analysis Run 8/30/2022 2:21 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Non-Parametric Confidence Interval

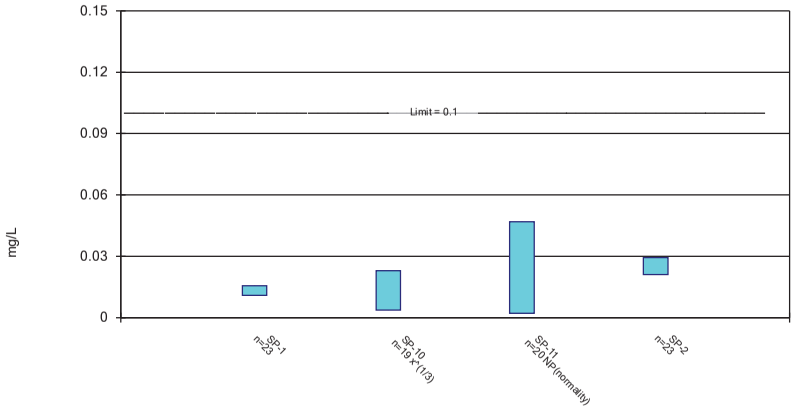
Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Mercury Analysis Run 8/30/2022 2:22 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

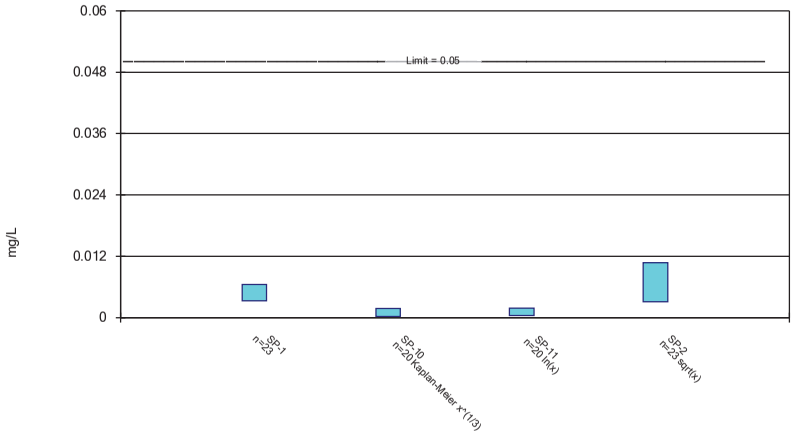


Constituent: Molybdenum Analysis Run 8/30/2022 2:22 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

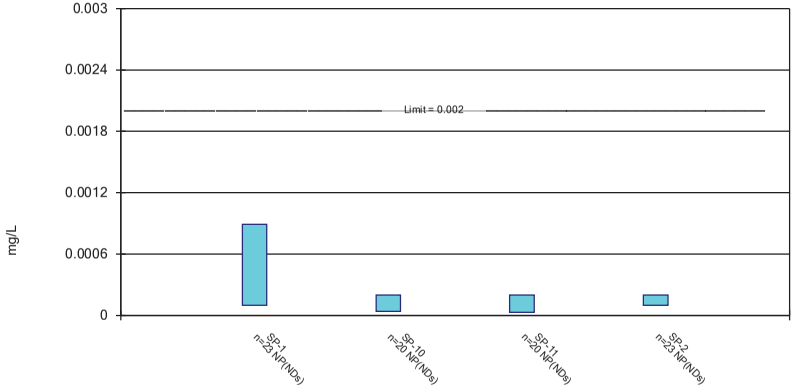


Constituent: Selenium Analysis Run 8/30/2022 2:22 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.33 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Thallium Analysis Run 8/30/2022 2:22 PM View: Confidence Interval
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

ATTACHMENT C

August 2022 BAP Sediment SPLP Analysis

Waste Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 222808 **Customer: Northeastern 3&4 Power Stati** **Date Reported: 09/26/2022**

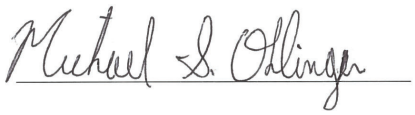
Lab Number: 222808-001
Customer Sample ID: BAP Pore Water
Customer Description:

Preparation: SPLP per SW-846 1312-1994, Rev. 0
Date Collected: 08/25/2022
Date Received: 08/31/2022

Parameter	USEPA Limit	Dilution	Result	Units	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Lithium		5	<0.5	mg/L	0.5	0.1		SDW	09/22/2022	SW-846 6010D-2018, Rev. 5.0
Antimony		5	<0.25	mg/L	0.25	0.08		SDW	09/22/2022	SW-846 6010D-2018, Rev. 5.0
Arsenic	5	5	<0.25	mg/L	0.25	0.03		SDW	09/22/2022	SW-846 6010D-2018, Rev. 5.0
Barium	100	5	0.22	mg/L	0.10	0.01		SDW	09/22/2022	SW-846 6010D-2018, Rev. 5.0
Beryllium	100	5	<0.010	mg/L	0.010	0.001		SDW	09/22/2022	SW-846 6010D-2018, Rev. 5.0
Cadmium	1	5	<0.010	mg/L	0.010	0.003		SDW	09/22/2022	SW-846 6010D-2018, Rev. 5.0
Chromium	5	5	<0.025	mg/L	0.025	0.005		SDW	09/22/2022	SW-846 6010D-2018, Rev. 5.0
Cobalt	5	5	<0.025	mg/L	0.025	0.005		SDW	09/22/2022	SW-846 6010D-2018, Rev. 5.0
Lead	5	5	<0.10	mg/L	0.10	0.03		SDW	09/22/2022	SW-846 6010D-2018, Rev. 5.0
Molybdenum	5	5	<0.05	mg/L	0.05	0.01		SDW	09/22/2022	SW-846 6010D-2018, Rev. 5.0
Selenium	1	5	<0.25	mg/L	0.25	0.04		SDW	09/22/2022	SW-846 6010D-2018, Rev. 5.0
Thallium	1	5	<0.25	mg/L	0.25	0.05		SDW	09/22/2022	SW-846 6010D-2018, Rev. 5.0

Report Verification

This report and the above data have been confirmed by the following analyst.



Michael Ohlinger, Chemist
Email: msohlinger@aep.com
Phone: 614-836-4184
Audinet: 8-210-4184

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 222808 **Customer: Northeastern 3&4 Power Stati** **Date Reported: 09/26/2022**

Data Qualifer Legend

B1	Analyte detected in method blank (MB) at or above the method criteria.
B2	Analyte detected in initial calibration blank (ICB) at or above the method criteria.
B3	Analyte detected in continuing calibration blank (CCB) at or above the method criteria.
H1	Sample was received past holding time.
H2	Sample analysis performed past holding time.
J1	Concentration estimated. Analyte was detected between the method detection limit and the reporting limit.
J2	Concentration estimated. Analyte exceeded calibration range.
L1	The associated laboratory control sample (LCS) or labatory control sample duplicate (LCSD) recovery was outside acceptance limits.
M1	The associated matrix spike (MS) or matrix spike duplicate (MSD) recovery was outside acceptance limits.
M2	Analyzed by method of standard additions (MSA).
P1	The precision between duplicate results was above acceptance limits.
P2	The precision on the laboratory control sample duplicate (LCSD) was above acceptance limits.
P3	The precision on the matrix spike duplicate (MSD) was above acceptance limits.
Q1	Sample received in inappropriate sample container.
Q2	Sample was received damaged. The sample was recoverable.
Q3	Sample container was received damaged. Unable to recover the sample.
Q4	Sample was received outside of thermal preservation range.
Q5	Sample was received with improper chemical preservation.
Q6	Insufficient sample was received by the laboratory to perform the requested analysis.
Q7	Insufficient sample was received to meet method QC requirements.
Q8	Sample was received with head space.
Q9	Due to instrument malfunction, sample was invalidated.
Q10	Analysis was performed by a contracted laboratory. See attached report.
Q11	Sample contains free liquid.
Q12	Sample does not contain free liquid.
Q13	Sample did not ignite.
Q14	This analyte and method are not included on the primary Laboratory Scope of TNI Accreditation.
Q15	The reporting limit for oil and grease is directly affected by the collected sample volume.
Q16	Analysis performed by a contract laboratory. See attached report.
R1	Surrogate recovery was outside acceptance limits.
R2	Carrier recovery was outside acceptance limits.
R3	Internal standard recovery was outside acceptance limits.
U1	Not detected at or above method detection limit (MDL).
V1	The associated initial calibration verification (ICV) recovery was outside acceptance limits.
V2	The associated continuing calibration verification (CCV) recovery was outside acceptance limits.

Scott A. Thompson
Executive Director

OKLAHOMA Environmental Quality

Kevin Stitt
Governor

July 12, 2023

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

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

Dear Ms. Parker-Witt:

The Oklahoma Department of Environmental Quality received the Alternate Source Demonstration (ASD) dated May 24, 2023 for lithium, barium, and fluoride detected in SP-10 during the June 14, 2022 sampling event at the bottom ash pond (BAP). The Lower Confidence Levels (LCL) for lithium, barium, and fluoride exceeded the Groundwater Protection Standards (GWPS). The detected concentrations for each constituent also exceeded their respective LCL.

On October 29, 2019, DEQ approved the revised ASD for lithium detected in monitoring well SP-10 for the BAP. The ASD proposed that naturally occurring lithium was the source of the statistically significant level (SSL) above the GWPS in SP-10 during the 2018 sampling events. On June 3, 2021, DEQ approved an ASD for fluoride exceedances detected in SP-10 for the BAP.

In a July 15, 2022 email, American Electric Power Public Service Company of Oklahoma – Northeastern Power Station (AEP) submitted a notification of barium, lithium and fluoride exceedances in SP-10 during the second 2021 semi-annual sampling event conducted on December 27, 2021.

The ASD for barium in SP-10 was approved in a letter dated September 20, 2022. The ASD attributes barium concentrations to the clay minerals in the shale lenses observed within the screened interval of SP-10. The barium concentrations observed in the BAP pore water are nearly an order of magnitude lower than the barium observed in SP-10. A comparison of the BAP pore water and extractable barium samples with SP-10 groundwater samples using Piper diagrams also showed dissimilar fingerprinting signatures.

The ASD is applicable for lithium, fluoride, and barium exceedances of the GWPS in SP-10 if conditions do not change. AEP may refer to the ASD approval and continue assessment monitoring for the BAP in accordance with OAC 252:517-9-6(g)(3)(B). If exceedances of GWPSs are determined in other monitoring wells, AEP is required to submit a separate ASD for constituents in those monitoring wells if applicable.

The ASD for barium, fluoride, and lithium exceedances in SP-10 is accepted as submitted. If you have any questions, please contact Kaylee Daneshmand at (405) 702-5196 or at Kaylee.daneshmand@deq.ok.gov.

Sincerely,

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

HY/kd

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

May 24, 2023

Via 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)
Bottom Ash Pond (BAP)
Public Service Company of Oklahoma (PSO) - Northeastern Power Station (NPS)
Roger County
Solid Waste Permit No. Pending

Dear Ms. Young,

AEP/PSO received ODEQ's correspondence dated March 9, 2023, in which ODEQ accepted the ASD for the lithium, fluoride, and barium detected in SP-10 during the June 14, 2022, sampling event. ODEQ indicated that if lithium, fluoride, and barium continue to exceed the groundwater protection standards (GWPS) in the future and conditions have not changed, NPS may refer to the October 24, 2019, ASD approval for lithium; June 4, 2021, ASD approval for fluoride; and to the March 9, 2023, ASD approval for barium and continue assessment monitoring for the BAP in accordance with OAC 252:517-9-6(g)(3)(B).

On February 23, 2023, the statistical evaluation of the second semi-annual 2022 assessment monitoring event (November 8, 2022) for the BAP was certified and in that statistical evaluation report, potential SSLs were identified for lithium, fluoride, and barium at SP-10.

The statistical findings are summarized as follows:

The Lower Confidence Level (LCL) for lithium (0.240 mg/L) exceeded the GWPS (a calculated Upper Tolerance Limit (UTL)) of 0.163 mg/L at SP-10. The actual detected lithium concentration in SP-10 was 0.242 mg/l.

The LCL for fluoride (5.31 mg/L) exceeded the GWPS (UTL of 4.39 mg/L) was exceeded as at SP-10. The actual detected fluoride concentration in SP-10 was 6.8 mg/L.

The LCL for barium (3.98 mg/L) exceeded the GWPS (UTL of 2.60 mg/L) was exceeded as at SP-10. The actual detected barium concentration in SP-10 was 5.05 mg/L.

Attached are the alternative source demonstrations for your review outlining the lines of evidence that these exceedances are the result of natural variations occurring in the groundwater at SP-10 and that the conditions at the BAP have not changed.

Please do not hesitate to contact me if you have any questions or would like to discuss. I can be reached by email at: rdjones2@aep.com or by phone at: (737) 330-3725.

Sincerely,

Rebecca D Jones

Rebecca D. Jones, P.G.

AEP, Environmental Specialist

Attachments

Geosyntec consultants

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

Memorandum

Date:	May 22, 2023
To:	Rebecca Jones, American Electric Power (AEP)
From:	Beth Gross, PhD, PE (OK) and Allison Kreinberg, Geosyntec
Subject:	Alternative Source Demonstration Update Northeastern Power Station Bottom Ash Pond Oologah, Rogers County, Oklahoma

The Bottom Ash Pond (BAP) is a regulated coal combustion residual (CCR) management unit at the Northeastern Power Station (NPS) in Oologah, Oklahoma. A semiannual assessment monitoring event was completed at the BAP on November 8, 2022, in accordance with the assessment monitoring requirements of Oklahoma Administrative Code (OAC) 252:517-9-6. Analysis of the November 2022 data identified statistically significant levels (SSLs) above the groundwater protection standards (GWPSs) for lithium, fluoride, and barium at SP-10 (Attachment B). The following SSLs were identified at the Northeastern BAP:

- The lower confidence limit (LCL) for lithium exceeded the GWPS of 0.163 milligrams per liter (mg/L) at SP-10 (0.240 mg/L).
- The LCL for fluoride exceeded the GWPS of 4.39 mg/L at SP-10 (5.31 mg/L).
- The LCL for barium exceeded the GWPS of 2.60 mg/L at SP-10 (3.98 mg/L).

As described in previous alternative source demonstrations (ASDs) (Geosyntec 2019, Geosyntec 2021a, Geosyntec 2021b, Geosyntec 2021c, Geosyntec 2022, Geosyntec 2023), concentrations of lithium, fluoride, and barium in the BAP water (including pore water) and BAP sediments lower than concentrations observed at SP-10 suggest that the BAP is not the source of these exceedances. Key analytical results for samples collected from the BAP and from SP-10 are provided in **Table 1**. Instead, the release of lithium from the clay minerals in the shale lens located at 46 feet below ground surface in the screened interval of SP-10 is the likely source of lithium in groundwater at that location. Analytical results suggest that naturally occurring barium and fluoride are also associated with the shale lenses and are contributing to aqueous barium and fluoride concentrations at SP-10.

The Oklahoma Department of Environmental Quality (DEQ) previously noted in a letter to the NPS dated June 4, 2021, that "[i]f lithium and fluoride continue to exceed their relative GWPS in the future and conditions have not changed, NPS may refer to the October 29, 2019 ASD approval

for lithium and this [June 4, 2021] approval for fluoride and continue assessment monitoring for the BAP in accordance with OAC 252:517-6(g)(3)(B)" (DEQ 2021). DEQ provided a similar letter to the NPS dated September 20, 2022, that indicated that the July 14, 2022 ASD "is applicable for the barium exceedance in SP-10 of the GWPS if conditions do not change. AEP may refer to the ASD approval for barium and continue assessment monitoring for the BAP in accordance with OAC 252:517-9-6(g)(3)(B)" (DEQ 2022). This ASD update presents an evaluation of the BAP for changing conditions that may affect previously approved ASDs for lithium, fluoride, and barium exceedances at SP-10.

The sample collected from the November 2022 monitoring event at SP-10 contained a lithium concentration of 0.242 mg/L, fluoride concentration of 6.8 mg/L, and barium concentration of 5.05 mg/L. The lithium concentration (**Figure 1**) and fluoride concentration (**Figure 2**) are consistent with previous results collected during the assessment monitoring period and continue to show no statistically significant positive trends. This is an indication that conditions have not changed substantially since the preceding ASD was submitted (Geosyntec 2023), and the arguments presented in the previous ASDs are still valid. Thus, the lithium and fluoride concentrations at SP-10 during the November 2022 assessment monitoring event are not attributed to a release from the BAP.

A time series plot of the barium concentrations at SP-10 and a Mann-Kendall statistical analysis of the reported barium results over time is shown in **Figure 3**. The analysis determined that barium concentrations at SP-10 display a statistically significant increasing trend. However, based on a Schoeller diagram showing select events where major cations and anions were sampled (**Figure 4**), the holistic geochemistry at monitoring well SP-10 does not change over time in a manner indicative of a release from the BAP.[1] The November 2022 sample is displayed on the plot as the bold black line. **Figure 4** demonstrates that the geochemistry of SP-10 has remained consistent over the past several years, indicating that conditions at SP-10 have not changed. Moving forward, samples from SP-10 will be collected and analyzed for the full suite of major ion chemistry. This will facilitate the preparation of more robust data visuals, such as Piper plots and Stiff diagrams, to better support the finding that groundwater at SP-10 is geochemically stable in future ASD memoranda.

The information above, as well as the information presented in previous ASDs (Geosyntec 2019, Geosyntec 2021a, Geosyntec 2021b, Geosyntec 2021c, Geosyntec 2022, Geosyntec 2023), continues to support the position that barium, fluoride, and lithium concentrations are a result of natural variation in the underlying lithology, including the presence of shale lenses containing barium, fluoride, and lithium within the screened interval at SP-10. Therefore, no further action is

[1] Piper diagrams were previously used to visualize the geochemical composition of SP-10 over time (Geosyntec 2019, Geosyntec 2021a, Geosyntec 2022). Alkalinity data was unavailable for the November 2022 sampling event, precluding the use of a Piper diagram to show the results of the most recent sampling event.

warranted, and the BAP will remain in the assessment monitoring program. Certification of this ASD memorandum by a qualified professional engineer is in Attachment A.

******

REFERENCES

DEQ. 2021. Alternate Source Demonstration for Fluoride and Lithium Exceedance – Bottom Ash Pond, Public Service Company of Oklahoma Northeastern Power Station, Rogers County. Oklahoma Department of Environmental Quality. June 4.

DEQ. 2022. Alternative Source Demonstration for Barium, Fluoride, and Lithium Exceedances – Bottom Ash Pond, Public Service Company of Oklahoma - Northeastern Power Station, Rogers County. Oklahoma Department of Environmental Quality. September 20.

Geosyntec. 2019. Alternative Source Demonstration. Bottom Ash Pond – Northeastern Power Station, Oologah, Oklahoma. Geosyntec Consultants. April.

Geosyntec. 2021a. Alternative Source Demonstration. Bottom Ash Pond – Northeastern Power Station, Oologah, Oklahoma. Geosyntec Consultants. January.

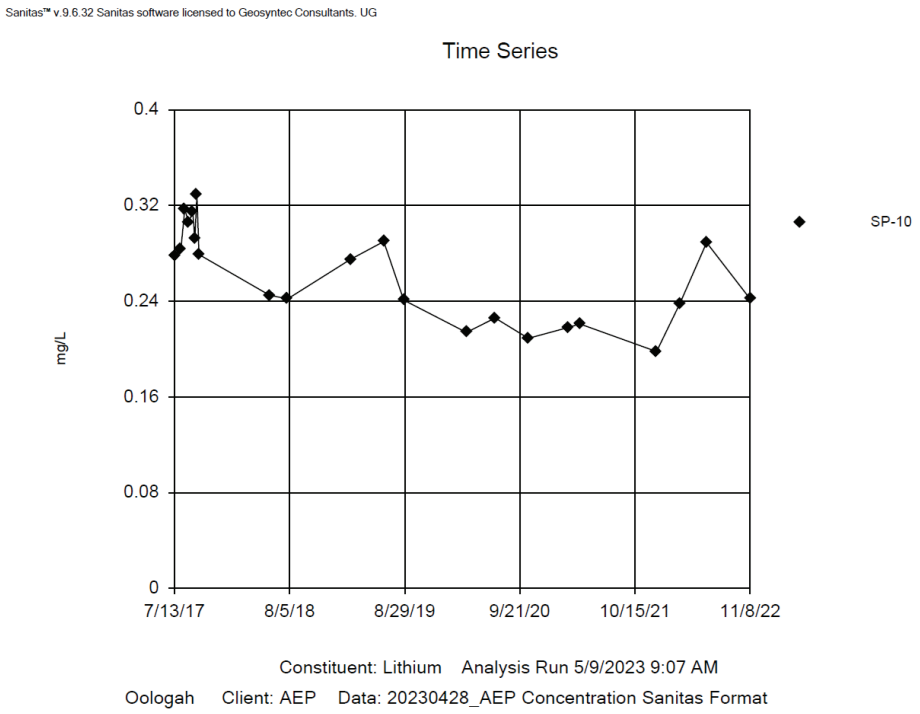
Geosyntec. 2021b. Alternative Source Demonstration. Bottom Ash Pond – Northeastern Power Station, Oologah, Oklahoma. Geosyntec Consultants. May.

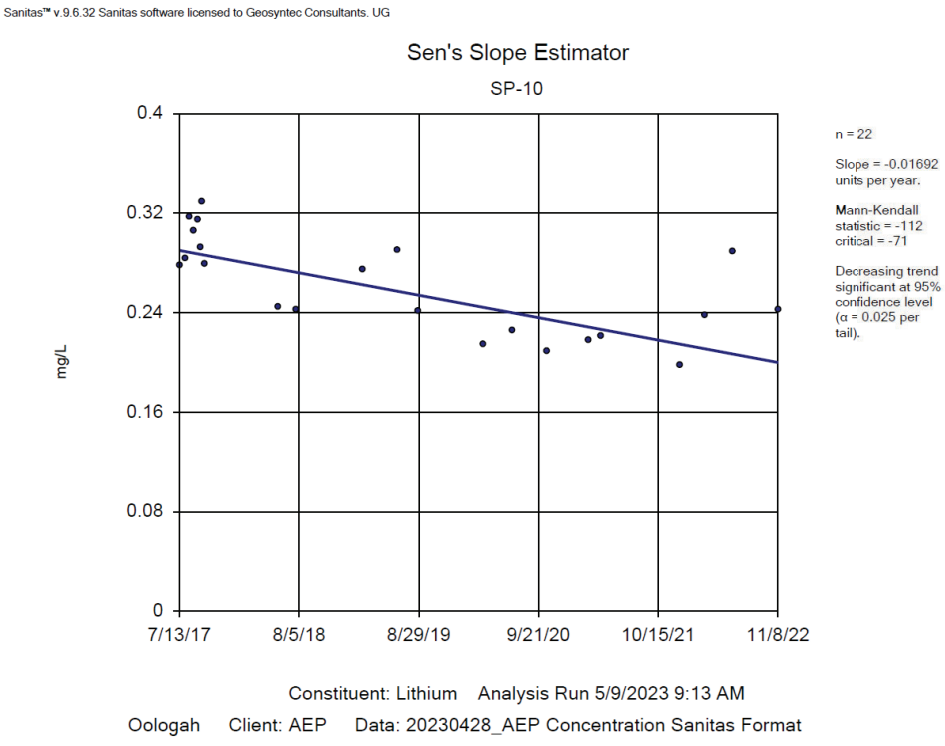
Geosyntec. 2021c. Alternative Source Demonstration. Bottom Ash Pond – Northeastern Power Station, Oologah, Oklahoma. Geosyntec Consultants. October.

Geosyntec. 2022. Alternative Source Demonstration. Bottom Ash Pond – Northeastern Power Station, Oologah, Oklahoma. Geosyntec Consultants. July.

Geosyntec. 2023. Alternative Source Demonstration. Bottom Ash Pond – Northeastern Power Station, Oologah, Oklahoma. Geosyntec Consultants. January.

FIGURES





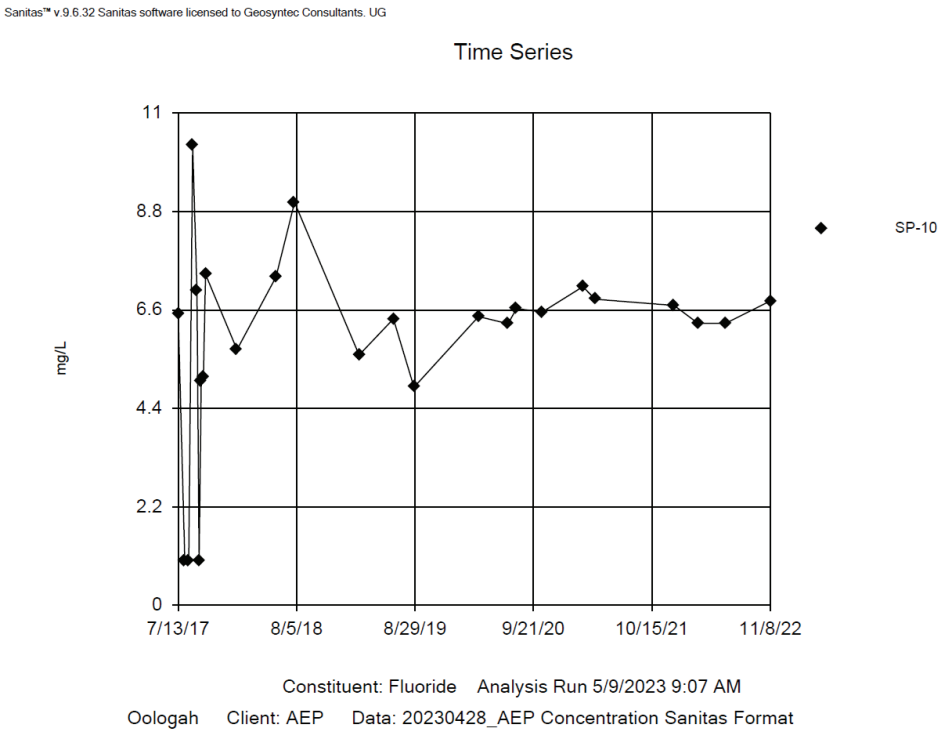
Notes: Lithium results from monitoring well SP-10 are displayed on the plots.

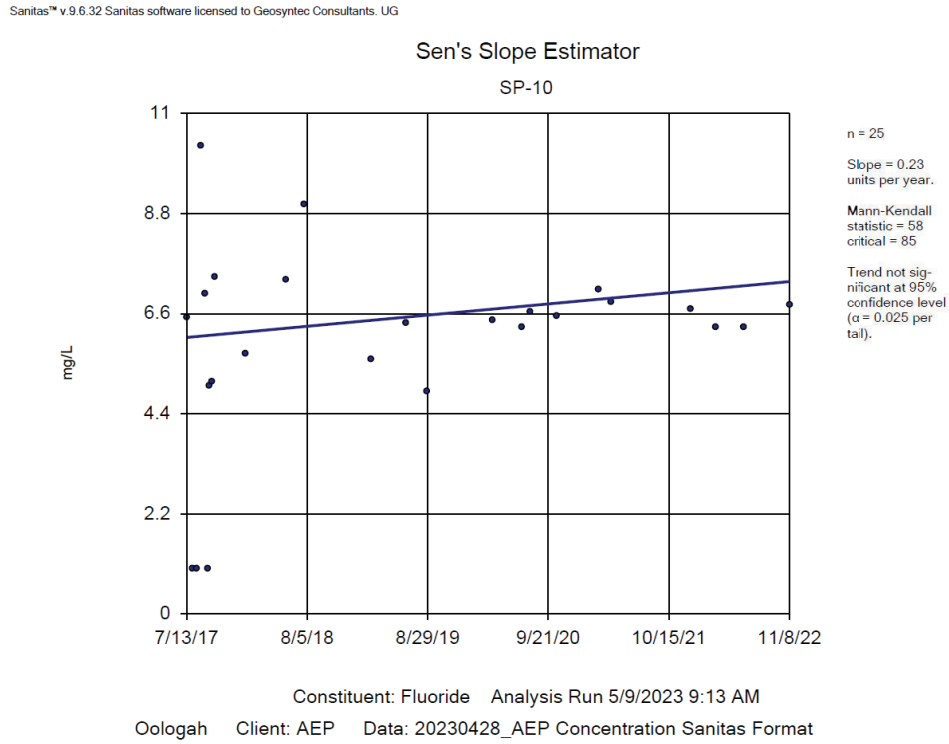
AEP: American Electric Power
mg/L: milligrams per liter

Lithium Time Series and Trend Test: SP-10
Northeastern Bottom Ash Pond

Geosyntec consultants | AMERICAN ELECTRIC POWER | Figure 1

Columbus, Ohio | May 11, 2023





Notes: Fluoride results from monitoring well SP-10 are displayed on the plots.

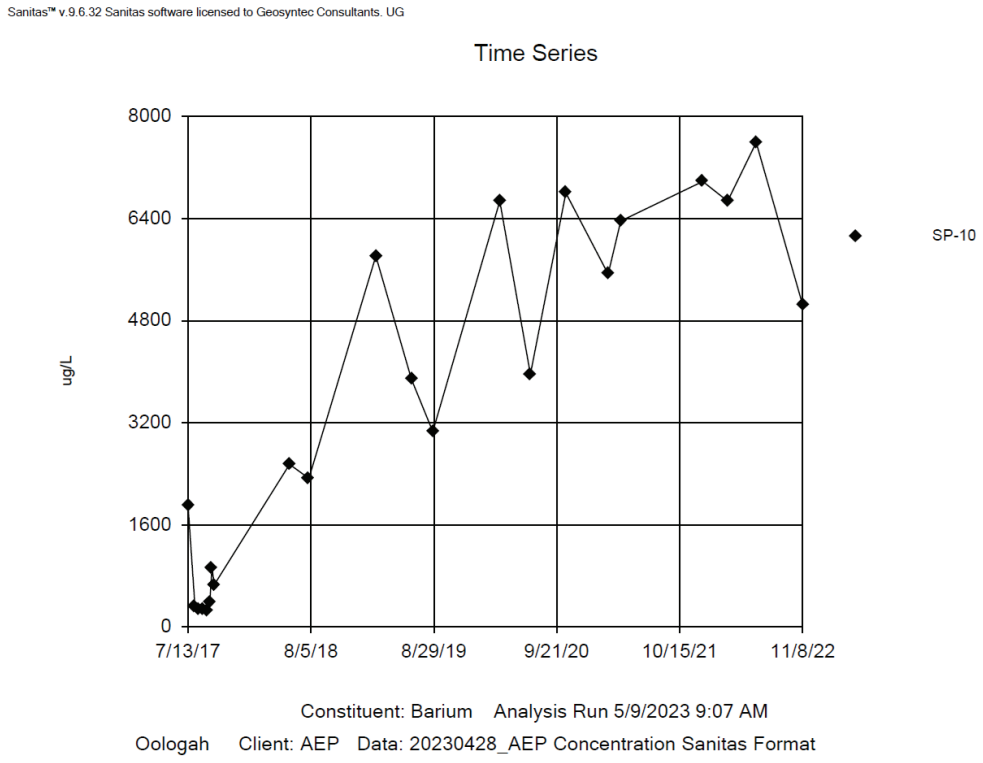
AEP: American Electric Power
mg/L: milligrams per liter

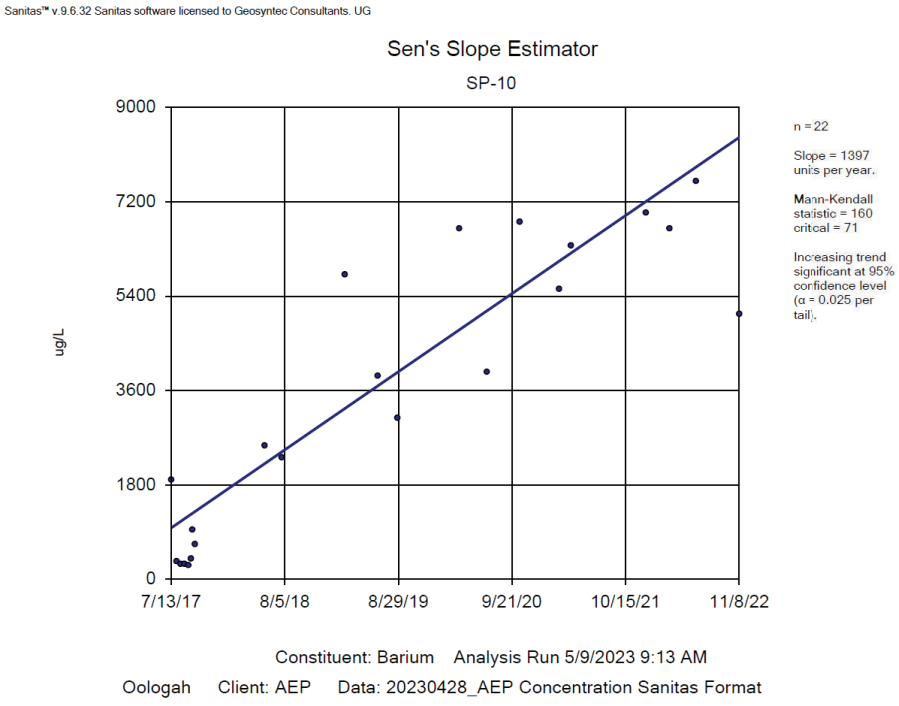
Fluoride Time Series and Trend Test: SP-10
Northeastern Bottom Ash Pond

Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | May 11, 2023

Figure **2**





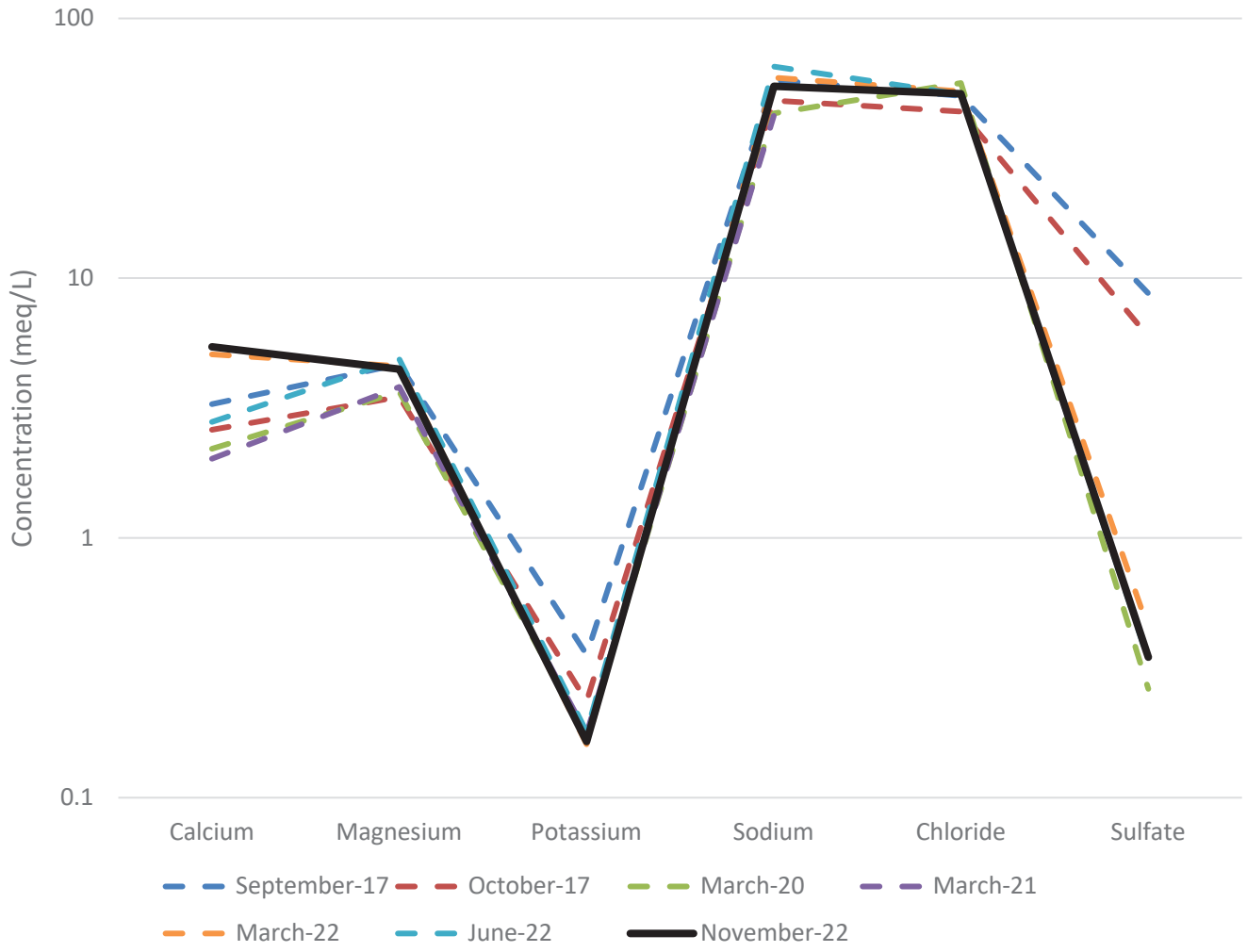
Notes: Barium results from monitoring well SP-10 are displayed on the plots.

AEP: American Electric Power
ug/L: micrograms per liter

Barium Time Series and Trend Test: SP-10
Northeastern Bottom Ash Pond

Geosyntec consultants | AMERICAN ELECTRIC POWER | Figure 3

Columbus, Ohio | May 11, 2023



Notes: Groundwater results from monitoring well SP-10 are displayed on the plot. Concentrations of all parameters are displayed in units of milliequivalents per liter (meq/L). The most recent sample, collected in November 2022, is displayed as the bold black line.

SP-10 Schoeller Diagram
Northeastern Bottom Ash Pond

Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | May 11, 2023

Figure **4**

TABLES

Table 1. Summary of Key Analytical Data
Alternative Source Demonstration Update Memorandum
Northeastern Power Station Bottom Ash Pond, Oologah, Oklahoma

Sample	Sample Date	Lithium Concentration (mg/L)	Fluoride Concentration (mg/L)	Barium Concentration (mg/L)
SPLP Leachate of Bottom Ash	7/10/2019	0.001	0.458	0.352
	8/25/2022	< 0.5	NA	0.22
BAP Surface Water	2/5/2019	0.00874	0.37	0.315
BAP Pore Water	7/10/2019	0.003	< 0.83	0.083
SP-10 November 2022 Result	11/8/2022	0.242	6.8	5.05

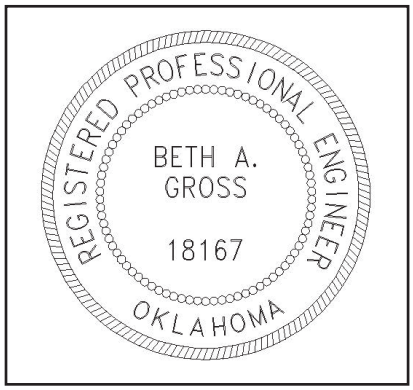
Notes:
1. Nondetect results are shown as less than the reporting limit.
BAP: Bottom Ash Pond
mg/L: milligram per liter
NA: not analyzed
SPLP: synthetic precipitation leaching procedure

ATTACHMENT A

Certification by Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the 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
2039 Centre Pointe Boulevard, Suite 103
Tallahassee, Florida 32308

Oklahoma Firm Certificate of
Authorization No. 1996
Exp. 6/30/2024

18167	Oklahoma	May 22, 2023
License Number	Licensing State	Date

* * * * *

ATTACHMENT B

Assessment Statistics Report

2022 Second Semiannual Event

Geosyntec consultants

engineers | scientists | innovators

STATISTICAL ANALYSIS SUMMARY

BOTTOM ASH POND

Northeastern Power Station

Oologah, Oklahoma

Prepared for

American Electric Power
1 Riverside Plaza
Columbus, Ohio 43215-2372

Prepared by

Geosyntec Consultants, Inc.
500 West Wilson Bridge Road, Suite 250
Worthington, Ohio 432085

Project Number: CHA8500B

February 23, 2023

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Table 1: Groundwater Data Summary
Table 2: Appendix B Groundwater Protection Standards
Table 3: Appendix A Data Summary

LIST OF ATTACHMENTS

Attachment A: Certification by Qualified Professional Engineer
Attachment B: Statistical Analysis Output

ACRONYMS AND ABBREVIATIONS

ASD	Alternative Source Demonstration
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NELAP	National Environmental Laboratory Accreditation Program
NPS	Northeastern Power Station
ODEQ	Oklahoma Department of Environmental Quality
OAC	Oklahoma Administrative Code
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
SU	Standard Units
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1 EXECUTIVE SUMMARY

In accordance with the Oklahoma Department of Environmental Quality (ODEQ) and Oklahoma administrative code (OAC) regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (OAC 252:517), groundwater monitoring has been conducted at the Bottom Ash Pond (BAP), an existing CCR unit at the Northeastern Power Station (NPS) located in Oologah, Oklahoma. Recent groundwater monitoring results were compared to site-specific groundwater protection standards (GWPSs) to identify potential exceedances.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron, chloride, fluoride, total dissolved solids (TDS), and sulfate at the BAP. Also, pH values below the lower prediction limit (LPL) resulted in SSIs below background as well. GWPSs were set in accordance with OAC 252:517-9-6(h) and assessment monitoring was initiated. An assessment monitoring event was conducted at the BAP in June 2022, in accordance with OAC 252:517-9-6(d). During the June 2022 assessment monitoring event, statistically significant levels (SSLs) were observed for barium, fluoride, and lithium (Geosyntec, 2022a). An alternative source demonstration (ASD) was successfully completed (Geosyntec, 2023); thus the unit remained in assessment monitoring. One assessment monitoring event was conducted at the BAP in November 2022, in accordance with OAC 252:517-9-6(d). The results of the November 2022 event are documented in this report.

Prior to conducting the statistical analyses, the groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. GWPSs were re-established for the Appendix B parameters. Confidence intervals were calculated for Appendix B parameters at the compliance wells to assess whether SSLs of Appendix B parameters were present above the GWPS. SSLs were identified for barium, fluoride, and lithium. Thus, either the unit will move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A. The statistical analysis and certification of the selected methods were completed within 90 days of obtaining the data.

SECTION 2 BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, one set of samples was collected in November 2022 for analysis from each upgradient and downgradient well to meet the requirements of OAC 252:517-9-6(d)(1). Samples from this sampling event were analyzed for both the Appendix A and Appendix B parameters. A summary of data collected during this assessment monitoring event may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.36 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the BAP were conducted in accordance with the November 2021 *Statistical Analysis Plan* (Geosyntec, 2021) for the samples collected in November 2022. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained in November 2022 were screened for potential outliers. No outliers were identified for this event.

2.2.1 Background Date Range Evaluation

All wells were sampled on an approximately monthly basis in 2017 in order to establish the initial background limits. Since 2017, samples have been collected on a roughly semiannual basis; see time series graphs provided in Attachment B.

A lack of temporal independence can result in background limits which do not fully represent natural variation in groundwater quality. Given the close temporal proximity of the initial background samples, rank von Neumann serial correlation tests were completed to evaluate whether the samples collected in 2017 were statistically independent or whether temporal correlation was present amongst the measurements. The rank von Neumann test is recommended in the Unified Guidance to evaluate temporal autocorrelation due to its ease of use and strength for both normal or non-normal distributions (United States Environmental Protection Agency [USEPA], 2007). Where significant temporal correlation was identified, the datasets were truncated to remove earlier measurements and statistical limits were constructed using only more recent data that better represent independent samples. The results of the rank von Neumann tests and a list of well-parameter pairs where the dataset was truncated is provided in Attachment B.

2.2.2 Establishment of GWPSs

A GWPS was established for each Appendix B parameter in accordance with OAC 252:517-9-6(h) and the *Statistical Analysis Plan* (Geosyntec, 2021). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in OAC 252:517-9-6(h) for each Appendix B 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. Tolerance limits were calculated parametrically with 95% coverage and 95% confidence for antimony, cadmium, and chromium. Non-parametric tolerance limits were calculated for arsenic, barium, beryllium, cobalt, combined radium, fluoride, lead, lithium, molybdenum and selenium due to apparent non-normal distributions and for mercury and thallium due to a high non-detect frequency. Upper tolerance limits and the final GWPSs are summarized in Table 2.

2.2.3 Evaluation of Potential Appendix B SSLs

A confidence interval was constructed for each Appendix B parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

The following SSLs were identified at the Northeastern BAP:

- The LCL for barium exceeded the GWPS of 2.60 mg/L at SP-10 (3.98 mg/L).
- The LCL for fluoride exceeded the GWPS of 4.39 mg/L at SP-10 (5.31 mg/L).
- The LCL for lithium exceeded the GWPS of 0.163 mg/L at SP-10 (0.240 mg/L).

ODEQ previously noted in a letter provided to the NPS that "If lithium and fluoride continue to exceed their relative GWPS in the future and conditions have not changed, NPS may refer to the October 29, 2019 ASD approval for lithium and June 4, 2021 approval for fluoride and continue assessment monitoring for the BAP in accordance with OAC 252:517-6(g)(3)(B)" (ODEQ, 2021). ODEQ provided a similar letter dated September 20, 2022 documenting ASD approval for a barium SSL at SP-10 which is applicable in the future if conditions do not change (ODEQ, 2022). Thus, an ASD will be submitted to ODEQ demonstrating that conditions at the BAP remain unchanged so that the unit will continue assessment monitoring.

2.2.4 Establishment of Appendix A Prediction Limits

Upper prediction limits (UPL) were previously established for all Appendix A parameters following the background monitoring period (Geosyntec, 2018). Intrawell tests were used to evaluate potential SSIs for calcium, whereas interwell tests were used to evaluate potential SSIs for boron, chloride, fluoride, pH, sulfate, and TDS. Interwell and intrawell prediction limits are updated periodically during the assessment monitoring period as sufficient data became available.

Mann-Whitney (Wilcoxon rank-sum) tests were performed to determine whether the newer data reflect a release from the BAP. Because the interwell Appendix A limits and the Appendix B GWPSs are based on data from upgradient wells which we would not expect to have been impacted by a release, these tests were used for intrawell Appendix A tests only. Mann-Whitney tests were used to compare the medians of historical data (January 2017 – June 2020) to the new compliance samples (October 2020 – June 2022) for calcium. Results were evaluated to determine if the medians of the two groups were similar at the 99% confidence level. Where no significant difference was found, the new compliance data were added to the background dataset. Where a statistically significant difference was found between the medians of the two groups, the data were reviewed to evaluate the cause of the difference and to determine if adding newer data to the background dataset, replacing the background dataset with the newer data, or continuing to use the existing background dataset was most appropriate. If the differences appeared to have been caused by a release, then the previous background dataset would have continued to be used.

The complete Mann-Whitney test results and a summary of the significant findings can be found in Attachment B. While a statistically significant difference was observed for calcium at compliance well SP-1, the entire dataset was used because the results were within the range of historic concentrations and inclusion of all observations resulted in a prediction limit that was more conservative (i.e., lower). Thus, the background datasets for calcium were updated to include all available data through June 2022.

Prediction limits for the interwell tests were calculated using data collected during the 2022 assessment monitoring events. New upgradient well data were tested for outliers prior to being added to the background dataset. Upgradient well data were also evaluated for statistically significant trends using the Sen's Slope/Mann-Kendall trend test, and the results are included in Attachment B.

After the revised background set was established, a parametric or non-parametric analysis was selected based on the distribution of the data and the frequency of non-detect data. Estimated results less than the reporting limit (practical quantitation limit [PQL]) but above the method detection limit (MDL) – i.e., "J-flagged" data – were considered detections and the estimated results were used in the statistical analyses. Non-parametric analyses were selected for datasets with at least 50% non-detect data or datasets that could not be normalized. Parametric analyses were selected for datasets (either transformed or untransformed) that passed the Shapiro-Wilk / Shapiro-Francía test for normality. The Kaplan-Meier non-detect adjustment was applied to datasets with between 15% and 50% non-detect data. For datasets with fewer than 15% non-detect data, non-detect data were replaced with one half of the PQL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment B.

Interwell UPLs were updated for boron, chloride, fluoride, pH, sulfate, and TDS and interwell LPLs were updated for pH using all historical data through November 2022 (except as noted in Attachment B) to represent background values. The intrawell UPLs for calcium were updated using all historical data through June 2022 (except as noted in Attachment B) to represent background values. The updated prediction limits are summarized in Table 3. The prediction limits were calculated for a one-of-two retesting procedure; i.e., if at least one sample in a series of two does not exceed the UPL, or in the case of pH, is neither less than the LPL nor greater than the

UPL, then it can be concluded that an SSI has not occurred. In practice, where the initial result does not exceed the UPL, or in the case of pH, is neither less than the LPL nor greater than the UPL, a second sample will not be collected. The retesting procedures allowed achieving an acceptably high statistical power to detect changes at downgradient wells for constituents evaluated using intrawell prediction limits.

2.2.5 Evaluation of Potential Appendix A SSIs

While SSLs were identified, a review of the Appendix A results was also completed to assess whether concentrations of Appendix A parameters at the compliance wells exceeded background concentrations.

Data collected during the November 2022 assessment monitoring event from each compliance well were compared to the calculated prediction limits to evaluate results above background values. The results from this event and the prediction limits are summarized in Table 3. The following exceedances of the UPLs were noted:

- Boron concentrations exceeded the interwell UPL of 0.503 mg/L at SP-10 (0.967 mg/L) and SP-11 (0.510 mg/L).
- Chloride concentrations exceeded the interwell UPL of 834 mg/L at SP-10 (1,820 mg/L).
- Fluoride concentrations exceeded the interwell UPL of 4.39 mg/L at SP-10 (6.8 mg/L).
- Sulfate concentrations exceeded the interwell UPL of 81.9 mg/L at SP-11 (356 mg/L).
- TDS concentrations exceeded the interwell UPL of 1,640 mg/L at SP-10 (3,330 mg/L).

While the prediction limits were calculated for a one-of-two retesting procedure, SSIs were conservatively assumed if the November 2022 sample was above the UPL or below the LPL. Based on these results, boron, chloride, fluoride, sulfate, and TDS concentrations exceeded background levels at compliance wells at the Northeastern BAP during assessment monitoring.

2.3 Conclusions

A semiannual assessment monitoring event was conducted in November 2022 in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the November 2022 data. GWPSs were re-established for the Appendix B parameters. A confidence interval was constructed at each compliance well for each Appendix B parameter; SSLs were concluded if the entire confidence interval exceeded the GWPSs. SSLs were identified for barium, fluoride, and lithium. Appendix A parameters were compared to prediction limits, with exceedances identified for boron, chloride, fluoride, sulfate, and TDS.

Based on this evaluation, the Northeastern BAP CCR unit will either move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring.

SECTION 3 REFERENCES

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – Bottom Ash Pond, Northeastern Plant, Oologah, Oklahoma. January.

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Oklahoma Department of Environmental Quality (ODEQ). 2021. Letter Transmittal – Alternate Source Demonstration for Fluoride and Lithium Exceedance – Bottom Ash Pond. Public Service Company of Oklahoma – Northeastern Power Station. June.

ODEQ. 2022. Letter Transmittal – Alternate Source Demonstration for Barium, Fluoride, and Lithium Exceedance – Bottom Ash Pond. Public Service Company of Oklahoma – Northeastern Power Station. September.

United States Environmental Protection Agency (USEPA), 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March 2009.

TABLES

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

Geosyntec Consultants, Inc.

Well ID		SP-1	SP-2	SP-4	SP-5R	SP-10	SP-11
Well Classification		Compliance	Compliance	Background	Background	Compliance	Compliance
Parameter	Unit	11/8/2022	11/8/2022	11/8/2022	11/8/2022	11/8/2022	11/8/2022
Antimony	µg/L	0.80	1.17	0.23	0.16	0.05 J1	0.12
Arsenic	µg/L	0.69	1.21	0.92	14.2	0.61	2.29
Barium	µg/L	157	872	214	2,070	5,050	146
Beryllium	µg/L	0.054	0.048 J1	0.053	0.066	0.036 J1	0.027 J1
Boron	mg/L	0.147	0.108	0.354	0.256	0.967	0.510
Cadmium	µg/L	0.055	0.328	0.059	0.108	0.017 J1	0.009 J1
Calcium	mg/L	102 M1	103	97.6	90.2	109	113
Chloride	mg/L	16.3	695	447	1,010	1,820	97.3
Chromium	µg/L	1.30	2.12	1.19	0.75	0.47	0.46
Cobalt	µg/L	0.684	0.186	0.345	0.511	0.061	1.76
Combined Radium	pCi/L	5.68	6.75	6.29	9.37	19.09	3.32
Fluoride	mg/L	0.85	2.7	3.23	3.28	6.8	1.3
Lead	µg/L	0.15 J1	0.33	0.38	4.34	0.06 J1	0.11 J1
Lithium	mg/L	0.00558	0.0308	0.0579	0.120	0.242	0.0157
Mercury	µg/L	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1
Molybdenum	µg/L	28.8	22.1	3.5	0.8	0.3 J1	1.7
Selenium	µg/L	15.4	2.36	0.39 J1	0.11 J1	0.5 U1	0.15 J1
Sulfate	mg/L	54.1	18.1	81.9	2.8	16.7	356
Thallium	µg/L	0.07 J1	0.2 U1	0.2 U1	0.2 U1	0.2 U1	0.2 U1
Total Dissolved Solids	mg/L	400	1,480	1,150	1,940	3,330	1,060
pH	SU	7.33	7.31	7.41	7.36	7.42	7.22

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U1: Non-detected at or above the method detection limit (MDL). For statistical analysis, parameters which were not detected were replaced with the reporting limit.
J1: Concentration estimated. Analyte was detected between the method detection limit and the reporting limit.
M1: The associated matrix spike (MS) or matrix spike duplicate (MSD) recovery was outside acceptance limits.

Table 2 - Appendix B Groundwater Protection Standards
Northeastern Plant - Bottom Ash Pond

Geosyntec Consultants, Inc.

Constituent Name	MCL	CCR Rule-Specified	Calculated UTL	GWPS
Antimony, Total (mg/L)	0.00600		0.00570	0.00600
Arsenic, Total (mg/L)	0.0100		0.0599	0.0599
Barium, Total (mg/L)	2.00		2.60	2.60
Beryllium, Total (mg/L)	0.00400		0.00212	0.00400
Cadmium, Total (mg/L)	0.00500		0.00207	0.00500
Chromium, Total (mg/L)	0.100		0.00342	0.100
Cobalt, Total (mg/L)	n/a	0.00600	0.0179	0.0179
Combined Radium, Total (pCi/L)	5.00		15.8	15.8
Fluoride, Total (mg/L)	4.00		4.39	4.39
Lead, Total (mg/L)	n/a	0.0150	0.0107	0.0150
Lithium, Total (mg/L)	n/a	0.0400	0.163	0.163
Mercury, Total (mg/L)	0.00200		0.0000300	0.00200
Molybdenum, Total (mg/L)	n/a	0.100	0.0100	0.100
Selenium, Total (mg/L)	0.0500		0.00499	0.0500
Thallium, Total (mg/L)	0.00200		0.00162	0.00200

Notes:
MCL = Maximum Contaminant Level
CCR = Coal Combustion Residual
GWPS = Groundwater Protection Standard
Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
Grey cells indicate the GWPS is based on the calculated UTL, which is higher than the MCL or CCR Rule-specified value.

Table 3 - Appendix A Data Summary
Northeastern Plant - Bottom Ash Pond

Geosyntec Consultants, Inc.

Analyte	Unit	Description	SP-1	SP-2	SP-10	SP-11
			11/8/2022	11/8/2022	11/8/2022	11/8/2022
Boron	mg/L	Interwell Background Value (UPL)	0.503			
		Analytical Result	0.147	0.108	**0.967**	**0.510**
Calcium	mg/L	Intrawell Background Value (UPL)	141	167	227	156
		Analytical Result	102	103	109	113
Chloride	mg/L	Interwell Background Value (UPL)	834			
		Analytical Result	16.3	695	**1,820**	97.3
Fluoride	mg/L	Interwell Background Value (UPL)	4.39			
		Analytical Result	0.85	2.7	**6.8**	1.3
pH	SU	Interwell Background Value (UPL)	9.1			
		Interwell Background Value (LPL)	7.0			
		Analytical Result	7.3	7.3	7.4	7.2
Sulfate	mg/L	Interwell Background Value (UPL)	81.9			
		Analytical Result	54.1	18.1	16.7	**356**
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	1,640			
		Analytical Result	400	1,480	**3,330**	1,060

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Northeastern Bottom Ash Pond CCR management area and that the requirements of OAC 252:517-9-4(g) have been met.

David Anthony Miller

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

26057	Oklahoma	02.24.2023
License Number	Licensing State	Date

ATTACHMENT B
Statistical Analysis Output

GROUNDWATER STATS CONSULTING

February 15, 2023

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Northeastern BAP (Bottom Ash Pond)
Background Update & Assessment Monitoring Statistics – November 2022

Dear Ms. Kreinberg,

Groundwater Stats Consulting (GSC), formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the statistical analysis and background update of 2022 groundwater data for American Electric Power Inc.'s Northeastern BAP. The analysis complies with the Oklahoma Administrative Code (OAC) as well as with the United States Environmental Protection Agency (USEPA) Unified Guidance (2009).

Sampling began at the site for the OAC program in 2017. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** SP-4 and SP-5R
- **Downgradient wells:** SP-1, SP2, SP-10, and SP-11

Data were sent electronically, and the statistical analysis was conducted according to the Statistical Analysis Plan and screening evaluation prepared by GSC and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC. The analysis was reviewed by Kristina Rayner, Senior Statistician and Founder of Groundwater Stats Consulting.

The OAC program consists of the following constituents listed below. The terms "constituent" and "parameter" are interchangeable.

- **Appendix A** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS
- **Appendix B** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium

For all constituents, a substitution of the most recent reporting limit is used for non-detect data. For calculating intrawell prediction limits, the substitution is performed for individual wells and may differ across wells. This generally gives the most conservative limit in each case.

Time series plots for Appendix A and B parameters are provided for all wells and are used to evaluate concentrations over time as well as for the purpose of updating statistical limits (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). Values in background which have been flagged as outliers may be seen in a lighter font and as a disconnected symbol on the graph. A summary of these values follows this letter (Figure C). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells.

For regulatory comparison of current observations against statistical limits for Appendix A constituents, the annual site-wide false positive rate is based on the USEPA Unified Guidance (2009) recommendation of 10% (5% for each semi-annual sample event). Power curves were provided with the previous screening and demonstrated that the selected statistical method provides sufficient power to detect a change at any of the downgradient wells which complies with the USEPA Unified Guidance recommendation. The EPA suggests the selected statistical method should provide at least 55% power at 3 standard deviations or at least 80% power at 4 standard deviations. Power curves were based on the following:

Semi-Annual Sampling
1-of-2 resample plan
Constituents, c=7
Downgradient wells, w=4

Summary of Statistical Method – Appendix A Parameters

Based on the original background screening described in the 2017 screening report, the following statistical methods were selected for Appendix A parameters:

1) Intrawell prediction limits, combined with a 1-of-2 resample plan for calcium
2) Interwell prediction limits, combined with a 1-of-2 resample plan for boron, chloride, fluoride, pH, sulfate, and TDS

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are non-detects, a nonparametric test is utilized. While the annual false positive rate associated with parametric limits is fixed at 10% as recommended by the EPA Unified Guidance (2009), the false positive rate associated with nonparametric limits is not fixed and depends upon the available background sample size, number of future comparisons, and verification resample plan. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits as appropriate. Non-detects are handled as follows:

- No statistical analyses are required on wells and analytes containing 100% non-detects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% non-detects, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for non-detects is the most recent practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% non-detects, the Kaplan-Meier non-detect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% non-detects.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits is necessary to accommodate these types of changes. In the intrawell case, data for all wells and constituents may be re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater

quality. In the interwell case, prediction limits may be updated with upgradient well data following each sampling event after careful screening for any new outliers. In some cases, deselecting the earlier portion of data may be necessary prior to construction of limits so that resulting statistical limits are conservative (lower) from a regulatory perspective and capable of rapidly detecting changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

Summary of Appendix A Background Screening and Updates

December 2017 – Initial Background Screening

Interwell prediction limits combined with a 1-of-2 verification strategy were recommended for boron, chloride, fluoride, pH, sulfate and TDS; and intrawell prediction limits combined with a 1-of-2 verification strategy were recommended for calcium. All proposed background data were screened for outliers and trends during the background screening. The findings of those reports were submitted with that analysis. Interwell prediction limits utilize all upgradient well data for construction of statistical limits. During each sample event, upgradient well data may be screened for any newly suspected outliers or obvious trending patterns using time series plots. Intrawell prediction limits utilized the background data set that was originally screened in 2017. As recommended in the EPA Unified Guidance (2009), the background data sets are evaluated for the purpose of updating statistical limits, as described below, using the Mann-Whitney test when at least four additional measurements are available.

Background Update Summaries

December 2020

<u>Outlier Analysis</u>

Prior to updating background data sets for the Fall 2020 analysis, Tukey's outlier test and visual screening were used to re-evaluate data for outliers at all wells for calcium and at all upgradient wells for boron, chloride, fluoride, pH, sulfate, and TDS. No outliers were noted by Tukey's test at any of the wells for calcium. Values were flagged as outliers as a result of not accurately representing the populations for the following constituents in downgradient well SP-1: chloride, fluoride, and TDS. These constituents are evaluated using interwell methods; therefore, the values have no effect on the calculation of the prediction limits. Tukey's outlier test on pooled upgradient well data identified a few

outliers for Appendix A parameters, which included chloride and TDS. These values were flagged accordingly in the database.

Mann-Whitney Test

For calcium, which requires intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through October 2017 to the new compliance samples at each well through June 2020. A statistically significant difference was found between the two groups for calcium in well SP-11. The background for calcium in well SP-11 was truncated to consist of the 8 most recent samples at that time, which represented more recent current groundwater quality while providing statistical limits that are conservative from a regulatory perspective. Intrawell prediction limits, combined with a 1-of-2 resample plan, were constructed using all historical data through June 2020 for the remaining well/constituent pairs for calcium.

Trend Test

For parameters tested using interwell analyses (boron, chloride, fluoride, pH, sulfate, and TDS), the Sen's Slope/Mann-Kendall trend test was used on upgradient wells to determine whether concentrations are statistically increasing, decreasing or stable. Although statistically significant trends were identified, the magnitudes of the trends were either fairly small relative to average concentrations within each well or would not greatly affect the interwell prediction limits. Therefore, all well/constituent pairs using interwell prediction limits were updated using data through October 2020.

March 2022

Upgradient well data through December 2021 were screened for the purpose of updating the interwell prediction limits for boron, chloride, fluoride, pH, sulfate, and TDS. Intrawell prediction limits for calcium were updated after the Fall 2022 sample event when sufficient compliance samples were available.

Outlier Analysis

Prior to updating interwell prediction limits, Tukey's outlier test and visual screening were used to re-evaluate data through December 2021 at all upgradient wells for boron, chloride, fluoride, pH, sulfate, and TDS. Tukey's outlier test on pooled upgradient well data confirmed previously identified values for chloride and TDS, and no new values were flagged. No changes to values flagged in previous background updates occurred. As mentioned above, any flagged data are displayed in a lighter font and as a disconnected

symbol on the time series reports, as well as in a lighter font on the accompanying data pages.

Intrawell - Prediction Limits

Intrawell prediction limits, combined with a 1-of-2 resample plan, are constructed using historical data through June 2020 for calcium at all wells. As discussed earlier, background data sets for calcium are updated when a minimum of 4 new compliance samples are available. A list of well/constituent pairs using a truncated portion of their records follows this report (Date Ranges Table).

Interwell – Trend Test Evaluation

For parameters tested using interwell analyses (boron, chloride, fluoride, pH, sulfate, and TDS) the Sen's Slope/Mann-Kendall trend test was used on upgradient wells to determine whether concentrations are statistically increasing, decreasing or stable. Statistically significant trends were identified for the following upgradient well/constituent pairs:

Increasing:

- Sulfate: SP-4

Decreasing:

- Boron: SP-4 and SP-5R
- Sulfate: SP-5R

The magnitudes of the trends above were either fairly small relative to average concentrations within each well or would not greatly affect the interwell prediction limits. With limited background samples collected to date, all data from upgradient wells were used to construct interwell prediction limits for all Appendix A parameters except calcium, which is tested using intrawell prediction limits. As more data are collected, all upgradient well data will be re-evaluated for possible deselection of earlier measurements if they no longer represent present-day groundwater quality conditions.

Interwell – Prediction Limits

Interwell prediction limits, combined with a 1-of-2 resample plan, were updated using all available data from upgradient wells through October 2021 for boron, chloride, fluoride, pH, sulfate, and TDS. Interwell prediction limits pool upgradient well data to establish a background limit for an individual constituent.

February 2023

During this analysis, Tukey's outlier test and visual screening were used to evaluate data through June 2022 at all wells for calcium, which is tested using intrawell prediction limits, and through November 2022 at upgradient wells for boron, chloride, fluoride, pH, sulfate, and TDS, which are tested using interwell prediction limits (Figure C).

Additionally, prior to updating statistical limits, the Rank Von Neumann serial correlation test was used to evaluate earlier calcium data at all wells and boron, chloride, fluoride, pH, sulfate, and TDS data at upgradient wells as described below.

Outlier Analysis

Tukey's outlier test did not identify any outliers for calcium; therefore, no values were flagged. Tukey's outlier test on pooled upgradient well data confirmed previously identified values for chloride and TDS, but no new values were flagged. No changes to values flagged in previous background updates occurred. As mentioned above, any flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. A summary table of all flagged outliers follows this report (Figure C).

Rank Von Neumann

All wells were sampled approximately on a monthly basis in 2017 in order to establish initial baseline limits. After that time, sampling was performed on a semi-annual basis to ensure collection of independent groundwater samples as recommended in the EPA Unified Guidance (2009). During this analysis, the Rank Von Neumann serial correlation test was used to evaluate whether the measurements collected during 2017 represented independent samples, or whether serial correlation was present among the measurements which can result in limits which do not fully represent natural variation in groundwater quality (Figure D). The test was used to evaluate calcium at all wells and the remaining Appendix A constituents at upgradient wells. Significant serial correlation was identified for the following Appendix A well/constituent pairs:

- Calcium: SP-4 (upgradient)
- Sulfate: SP-4 and SP-5R (both upgradient)

As a result, the records for these well/constituent pairs were truncated to remove earlier measurements for construction of statistical limits using only more recent data that represent independent samples. Results of the Rank Von Neumann test follow this report.

Intrawell – Mann-Whitney Test

For calcium which is tested using intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through August 2020 to the new compliance samples at each well through June 2022 to evaluate whether the groups are statistically similar at the 99% confidence level, in which case background data may be updated with compliance data (Figure E). A statistically significant difference was identified for the following well/constituent pair:

- Calcium: SP-1

Although a statistically significant difference was identified, most compliance data were within the range of historic concentrations and including these observations resulted in a statistical limit that is more conservative (i.e., lower) form a regulatory perspective. Additionally, while a significant result was not identified by the Mann-Whitney test, the record for calcium at well SP-11 was slightly truncated to exclude elevated historical concentrations and use stable concentrations representative of present-day groundwater quality conditions for constructing statistical limits. Therefore, all data sets for calcium were updated with compliance samples through June 2022.

Intrawell - Prediction Limits

Intrawell prediction limits, combined with a 1-of-2 resample plan, are constructed using historical data through June 2022 for calcium at all wells. A summary table of the limits follows this report (Figure F). A list of well/constituent pairs using a truncated portion of their records follows this report (Date Ranges Table). No comparison of the November 2022 observation was performed in this analysis.

Interwell – Trend Test Evaluation

For parameters tested using interwell analyses (boron, chloride, fluoride, pH, sulfate, and TDS) the Sen's Slope/Mann-Kendall trend test was used on upgradient wells to determine whether concentrations are statistically increasing, decreasing or stable at the 99% confidence level (Figure G). Statistically significant trends were identified for the following upgradient well/constituent pairs:

Increasing:

- Sulfate: SP-4
- Chloride: SP-5R

Decreasing:

- Boron: SP-4 and SP-5R

The magnitudes of the trends above are either fairly small relative to average concentrations within each well or would not greatly affect the interwell prediction limits. With limited background samples collected to date, all data from upgradient wells were used to construct interwell prediction limits for all Appendix A parameters except calcium, which is tested using intrawell prediction limits. As more data are collected, all upgradient well data will be re-evaluated for possible deselection of earlier measurements if concentrations no longer represent present-day groundwater quality conditions.

Interwell – Prediction Limits

Interwell prediction limits, combined with a 1-of-2 resample plan, were updated using all available data from upgradient wells through November 2022 for boron, chloride, fluoride, pH, sulfate, and TDS (Figure H). Interwell prediction limits pool upgradient well data to establish a background limit for an individual constituent. A summary table of the updated limits may be found following this letter in the Prediction Limit Summary Tables. No comparison of the November 2022 observation was performed in this analysis.

Evaluation of Appendix B Parameters – November 2022

Prior to evaluating Appendix B parameters, background data are screened through visual screening and Tukey's outlier test for potential outliers and extreme trending patterns that would lead to artificially elevated statistical limits.

Outlier Analysis

For the current analysis, Tukey's outlier test on pooled upgradient well data identified outliers for fluoride, lead, mercury, and selenium and confirmed previously flagged values. Several of the values identified by Tukey's test were either similar to concentrations upgradient of the facility or were lower than the respective Maximum Contaminant Level (MCL); therefore, the values were not flagged as outliers. A summary of previously flagged outliers follows this report (Figure C).

During previous screenings, due to no variation in the data, Tukey's outlier test was not performed for cadmium in well SP-5R, mercury in all wells, selenium in well SP-5R, and thallium in all wells. Among upgradient wells, high values for cadmium, lead, and selenium were identified by Tukey's outlier test. Only the highest values for cadmium and lead were flagged as outliers to maintain statistical limits that are conservative from a regulatory

perspective. Substantially high values were identified for upgradient well SP-4 on 8/4/17 through visual screening and the highest values for arsenic, beryllium, cobalt, and mercury were flagged. This step will result in upper tolerance limits that are conservative (lower) from a regulatory perspective. More recent concentrations for barium in downgradient well SP-10 were noted to be significantly higher than historical concentrations. Therefore, earlier concentrations were previously deselected prior to constructing confidence intervals in order to evaluate present-day groundwater concentrations of barium at this well. As mentioned above, list of well/constituent pairs using a truncated portion of their records follows this report (Date Ranges Table).

Additionally, downgradient well data through November 2022 were screened through visual screening using time series graphs. Since the downgradient well data are used to construct confidence intervals, a regulatory conservative approach is taken in that values that are marginally high relative to the rest of the data are retained unless there is particular justification for excluding them. No additional outliers among downgradient wells were flagged during this analysis. Previously a high value for combined radium 226 + 228 in well SP-1 was flagged as an outlier. The following additional values were flagged as outliers as they did not adequately represent the populations at their respective wells: chromium in well SP-10; combined radium 226 + 228 in well SP-11; lithium in well SP-1; and molybdenum in well SP-10.

Rank Von Neumann

As mentioned above, background samples were collected approximately on a monthly basis during 2017 at all wells for Appendix B constituents. Since the EPA Unified Guidance recommends collection of independent groundwater samples, the Rank Von Neumann test for serial correlation was used to determine whether serial correlation was present among these earlier samples (Figure D). Significant serial correlation was identified for the following Appendix B well/constituent pairs:

- Barium: SP-4 (upgradient) and SP-11
- Cadmium: SP-4 and SP-5R (both upgradient), SP-1, and SP-10
- Chromium: SP-4 (upgradient)
- Lead: SP-10
- Lithium: SP-4 (upgradient) and SP-11
- Molybdenum: SP-2
- Selenium: SP-5R (upgradient) and SP-2
- Thallium: SP-4 and SP-5R (both upgradient), SP-1, SP-2, SP-10, and SP-11

As a result, the records for these well/constituent pairs were truncated to remove earlier measurements for construction of statistical limits using only more recent data that represent independent samples. Results of the Rank Von Neumann test follow this report.

Tolerance Limits

Parametric tolerance limits were used to calculate background limits from pooled upgradient well data through November 2022 for Appendix B parameters with a target of 95% confidence and 95% coverage to determine background limits. These limits will be updated on an annual basis at the end of each year. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the MCLs and background limits in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure I).

Groundwater Protection Standards

These background limits were compared to the Maximum Contaminant Levels (MCLs) and CCR Rule-Specified levels as shown in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure J).

Confidence Intervals

Confidence intervals were constructed on downgradient wells with data through November 2022 for each of the Appendix B parameters and then compared to the GWPS, i.e., the highest limit of the MCL, CCR Rule-Specified level, or background limit as discussed above (Figure K). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. Complete graphical results of the confidence intervals follow this letter. Exceedances were identified for the following well/constituent pairs:

- Barium: SP-10
- Fluoride: SP-10
- Lithium: SP-10

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Northeastern BAP. If you have any questions or comments, please feel free to contact us.

For Groundwater Stats Consulting,

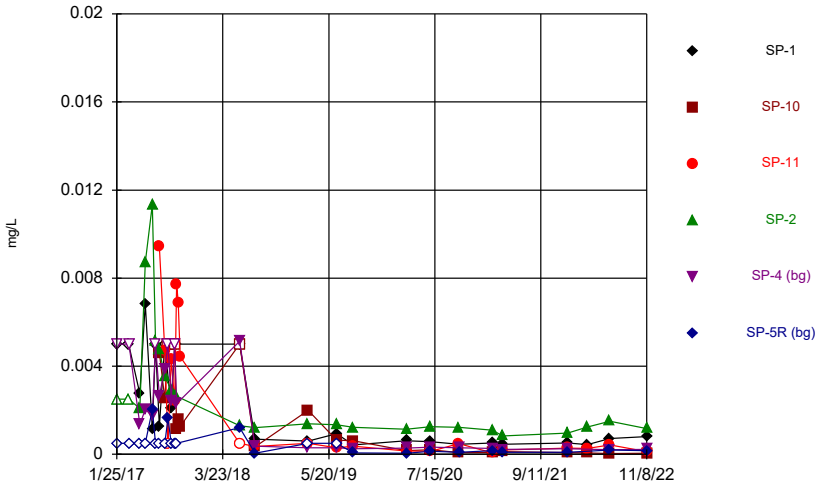
Andrew T. Collins
Project Manager

Kristina L. Rayner
Senior Statistician

FIGURE A
Time Series

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

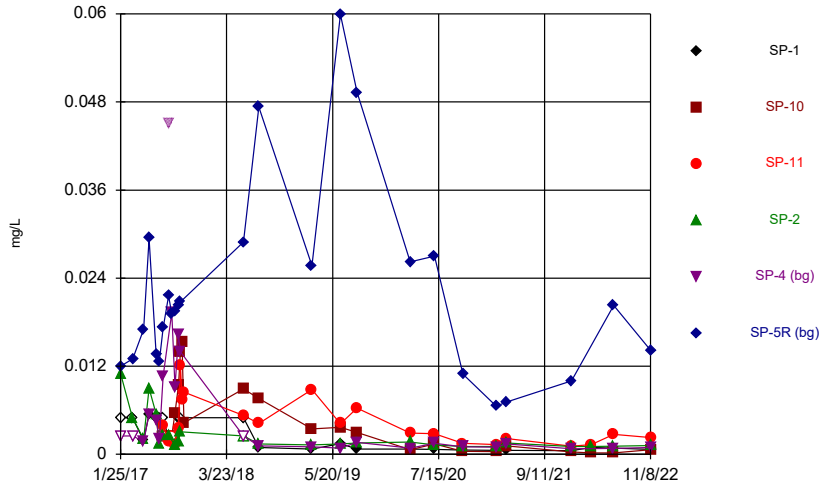
Time Series



Constituent: Antimony Analysis Run 2/10/2023 11:53 AM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

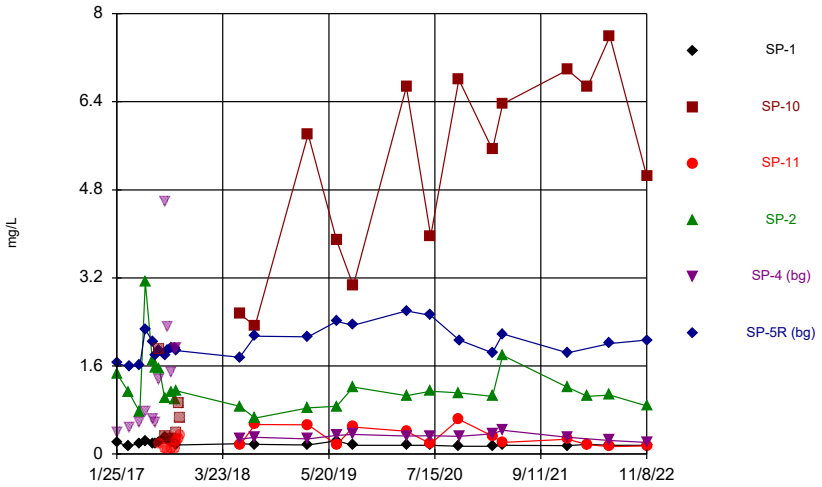
Time Series



Constituent: Arsenic Analysis Run 2/10/2023 11:53 AM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

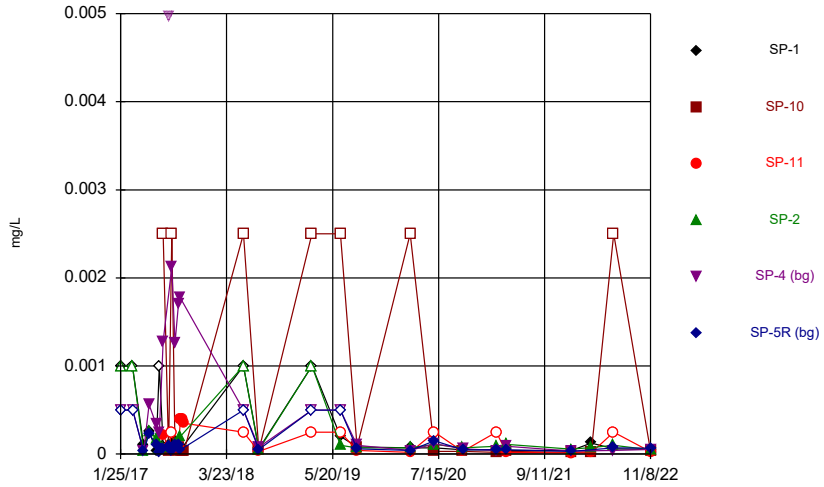
Time Series



Constituent: Barium Analysis Run 2/10/2023 11:53 AM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

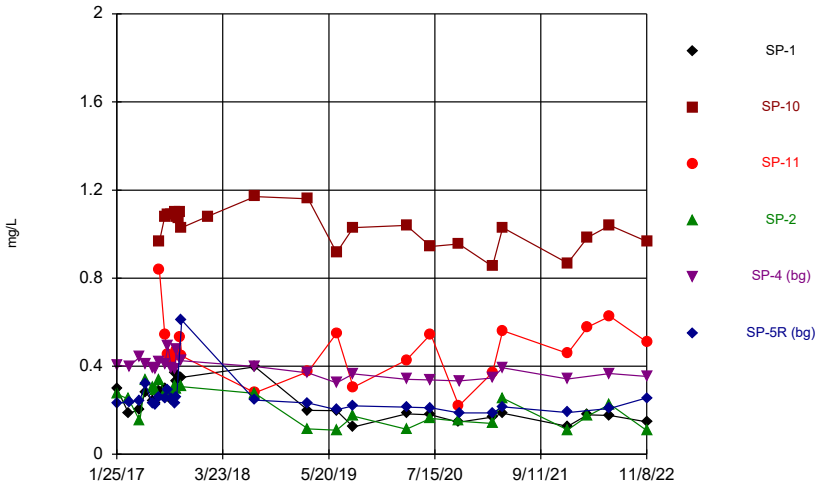
Time Series



Constituent: Beryllium Analysis Run 2/10/2023 11:53 AM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series



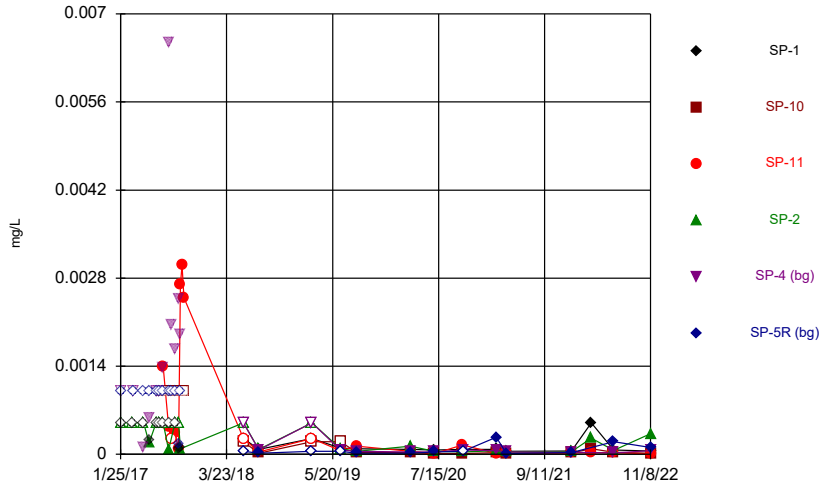
Constituent: Boron Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

Time Series

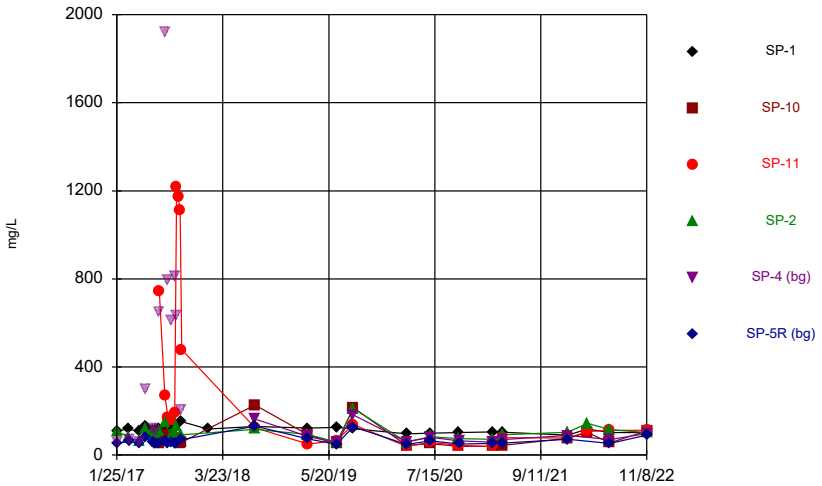


Constituent: Cadmium Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series

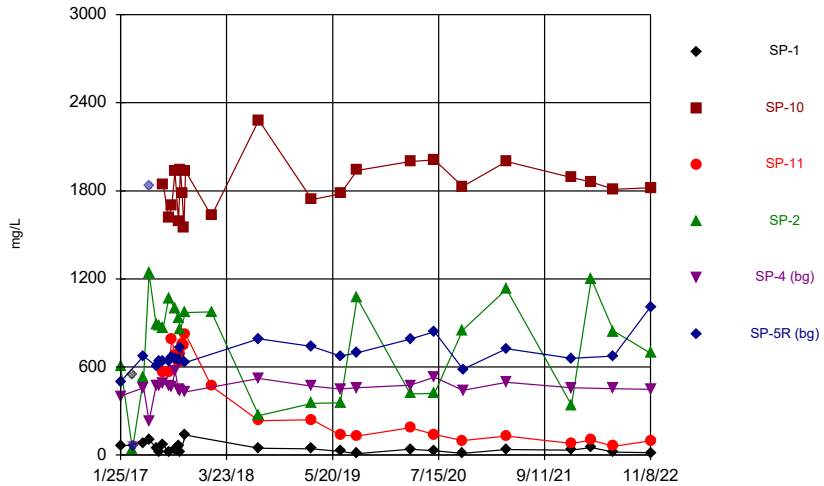


Constituent: Calcium Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series

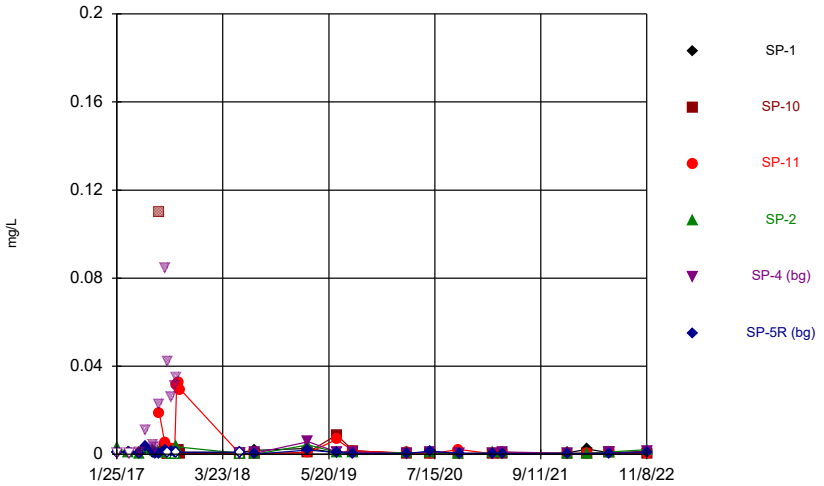


Constituent: Chloride Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

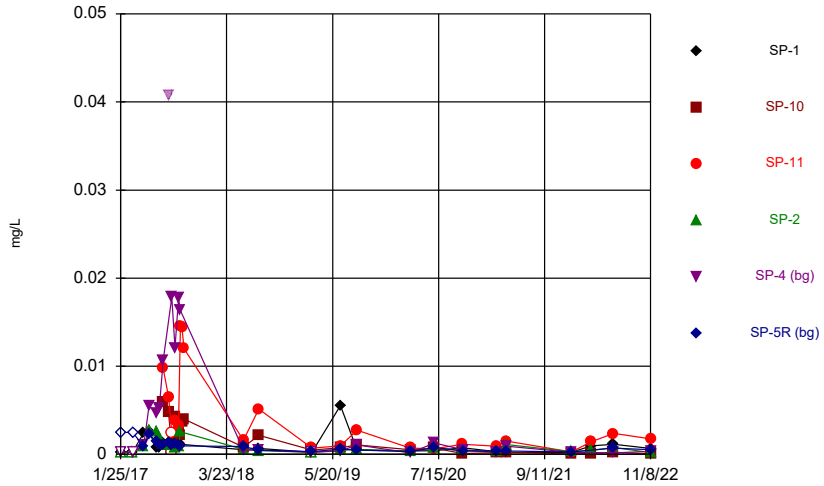
Time Series



Constituent: Chromium Analysis Run 2/10/2023 11:53 AM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

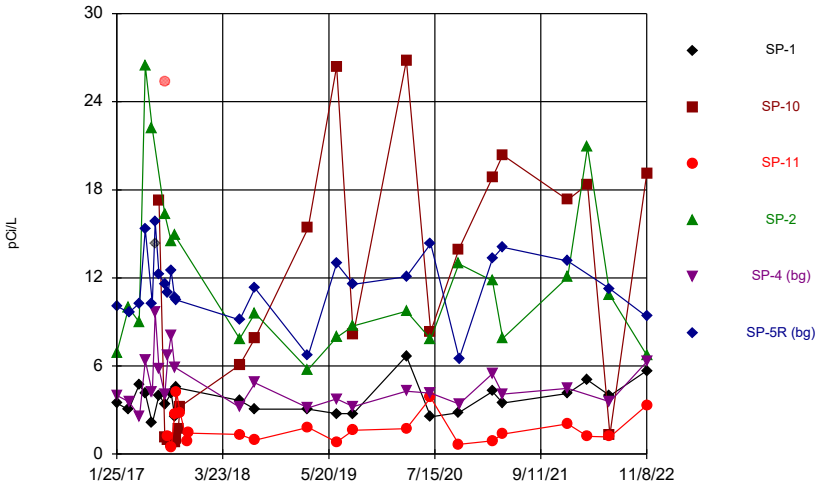
Time Series



Constituent: Cobalt Analysis Run 2/10/2023 11:53 AM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

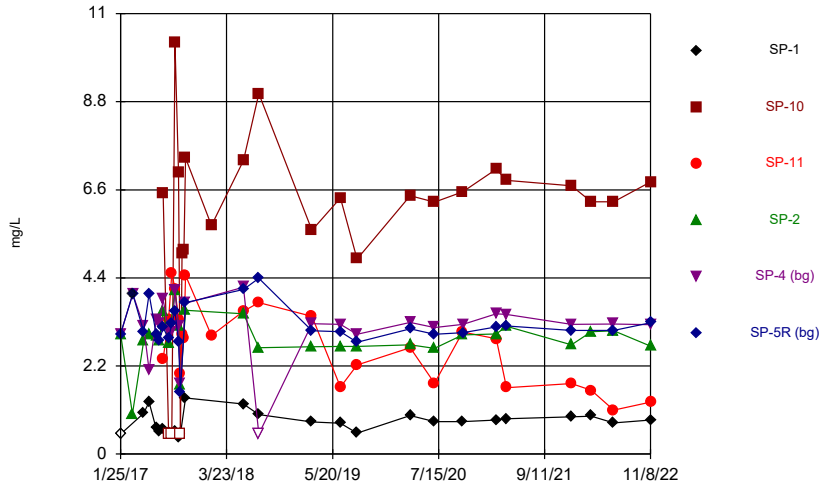
Time Series



Constituent: Combined Radium 226 + 228 Analysis Run 2/10/2023 11:53 AM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

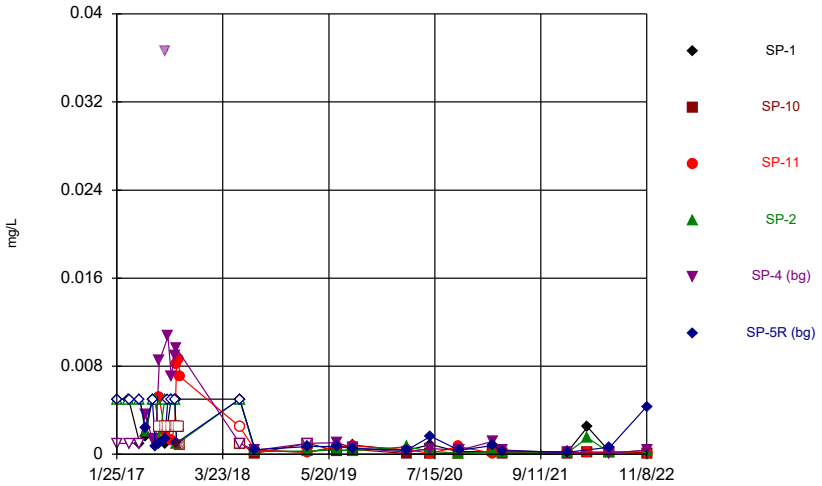
Time Series



Constituent: Fluoride Analysis Run 2/10/2023 11:53 AM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

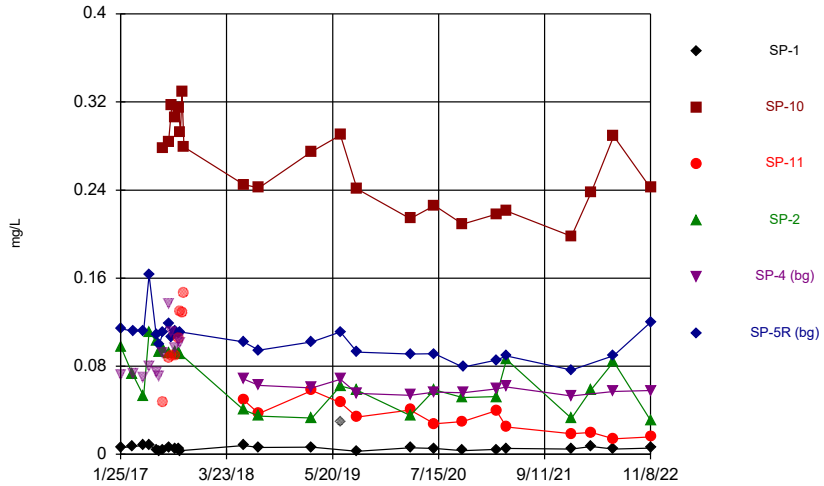
Time Series



Constituent: Lead Analysis Run 2/10/2023 11:53 AM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

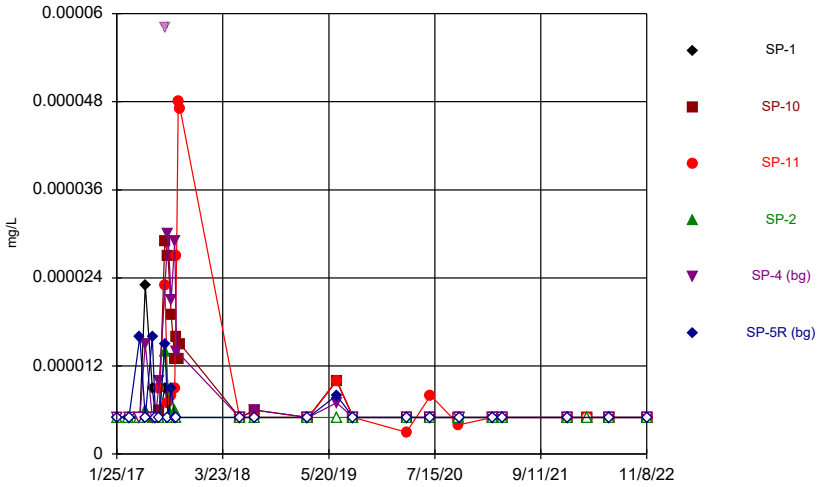
Time Series



Constituent: Lithium Analysis Run 2/10/2023 11:53 AM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

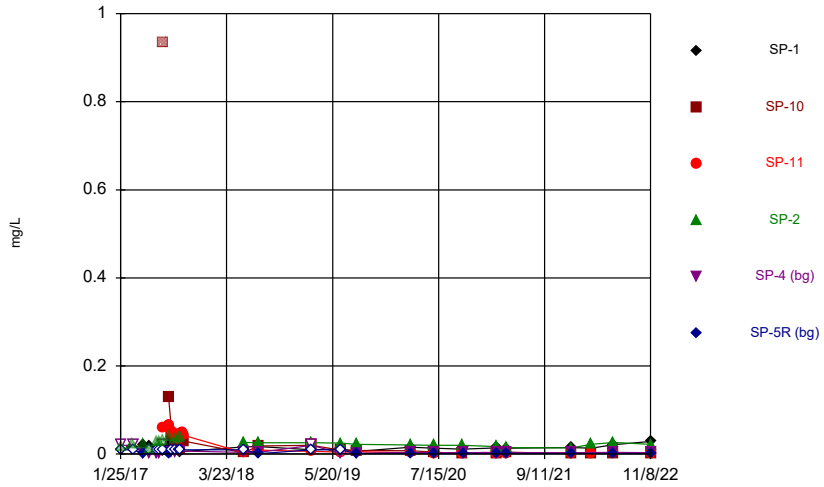
Time Series



Constituent: Mercury Analysis Run 2/10/2023 11:53 AM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

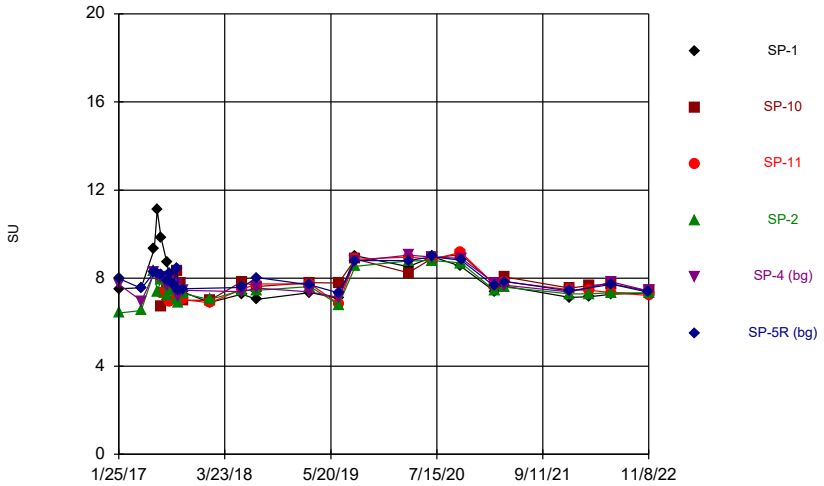
Time Series



Constituent: Molybdenum Analysis Run 2/10/2023 11:53 AM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series

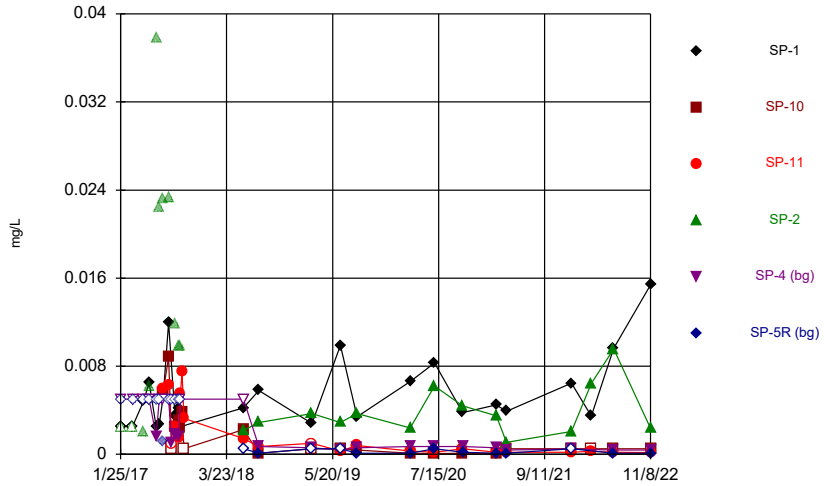


Constituent: pH, field Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series

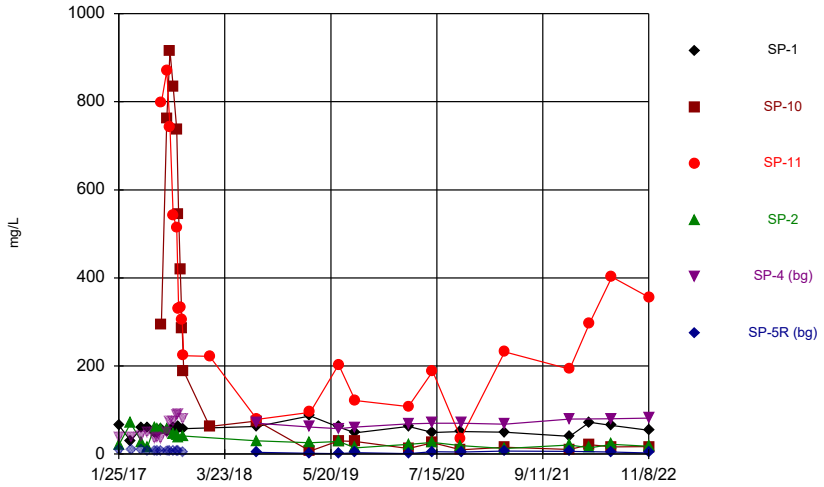


Constituent: Selenium Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series

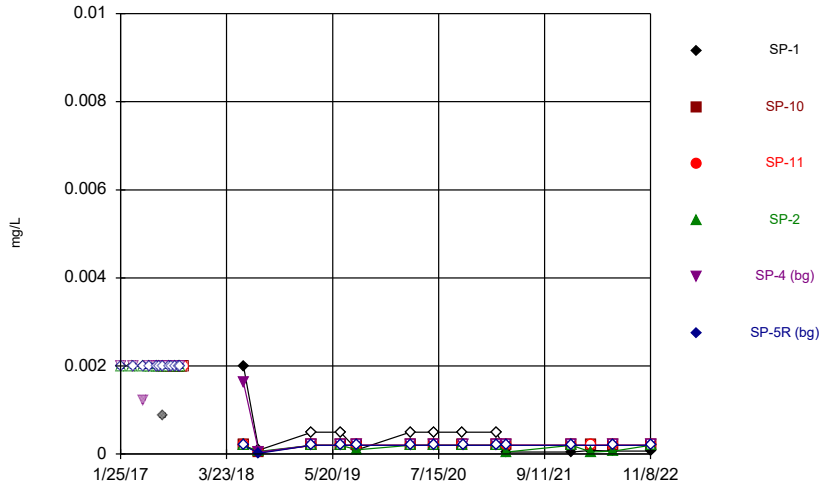


Constituent: Sulfate Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

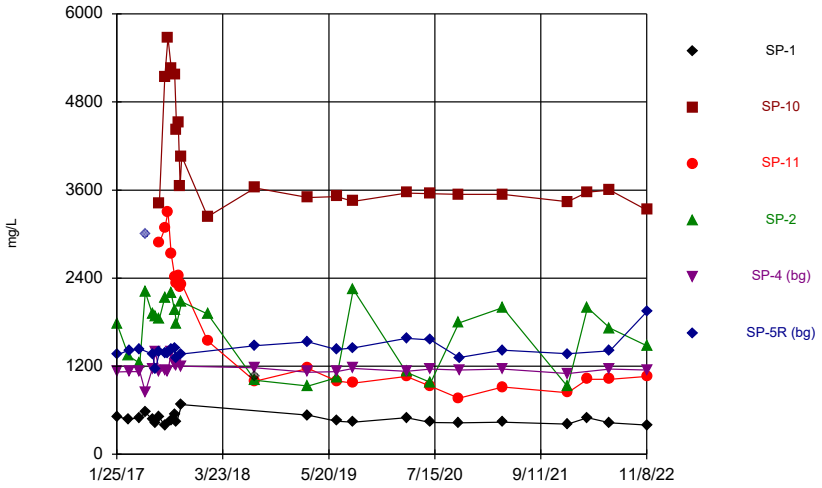
Time Series



Constituent: Thallium Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Time Series



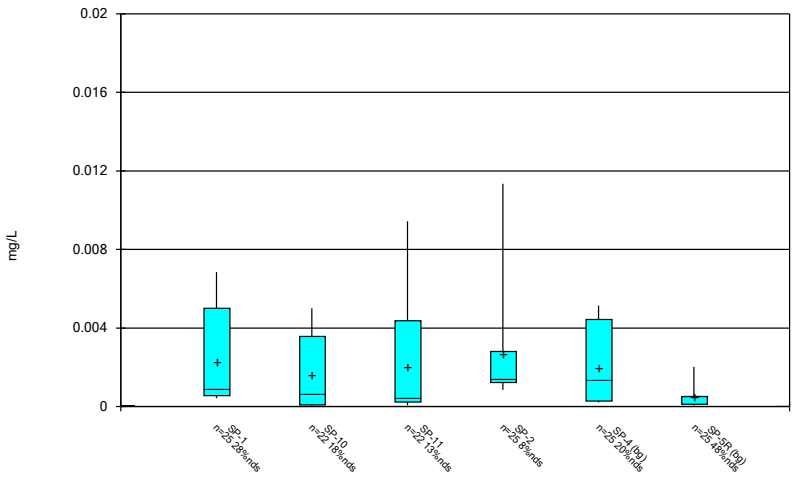
Constituent: Total Dissolved Solids [TDS] Analysis Run 2/10/2023 11:53 AM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE B
Box Plots

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Box & Whiskers Plot

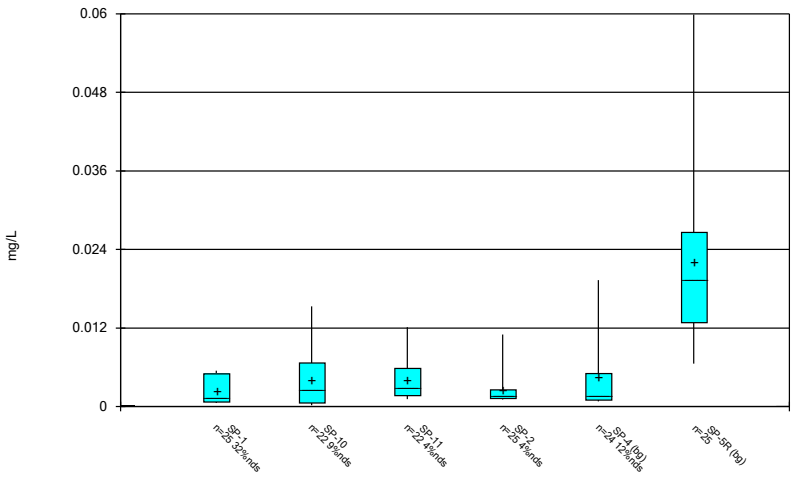


Constituent: Antimony Analysis Run 2/10/2023 1:10 PM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Box & Whiskers Plot

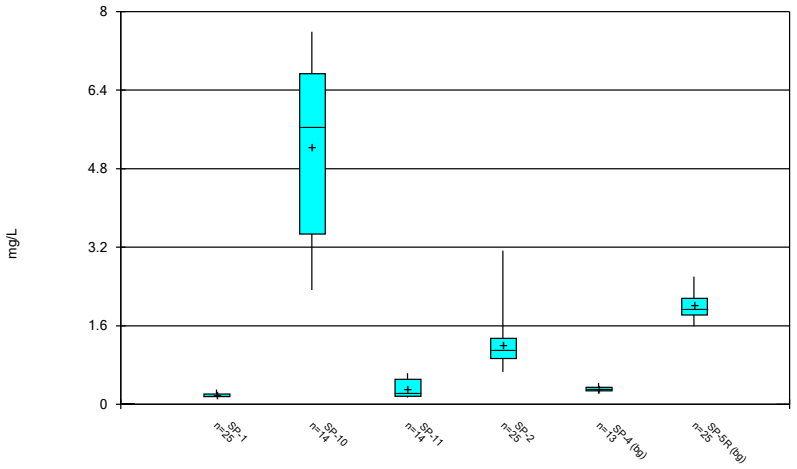


Constituent: Arsenic Analysis Run 2/10/2023 1:10 PM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Box & Whiskers Plot

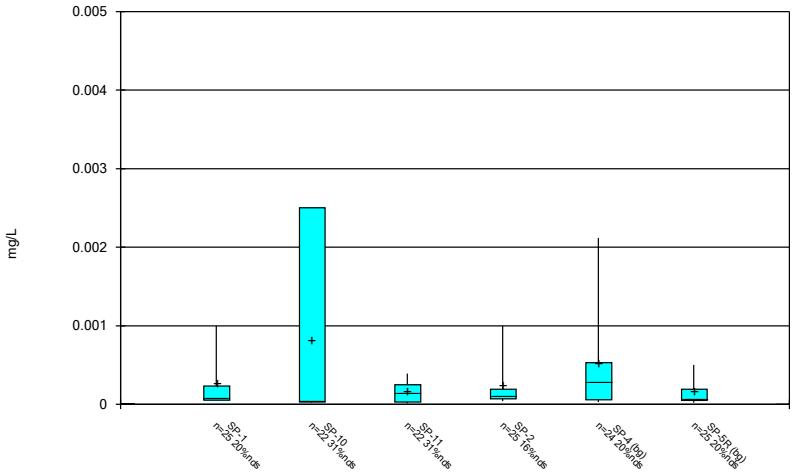


Constituent: Barium Analysis Run 2/10/2023 1:10 PM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

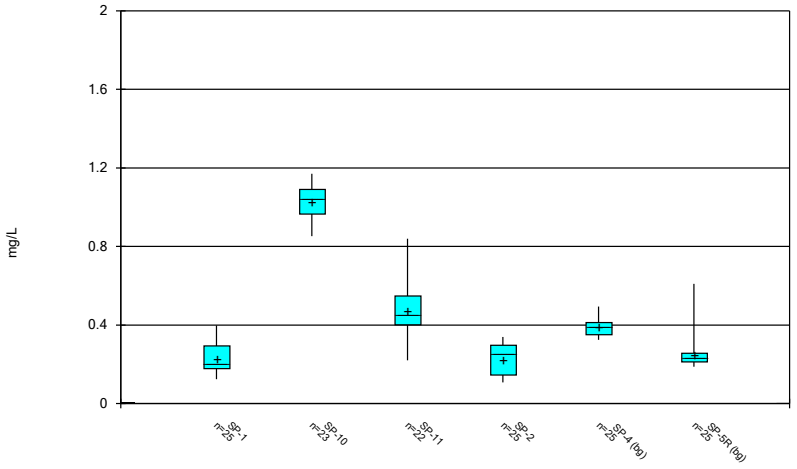
Box & Whiskers Plot



Constituent: Beryllium Analysis Run 2/10/2023 1:10 PM

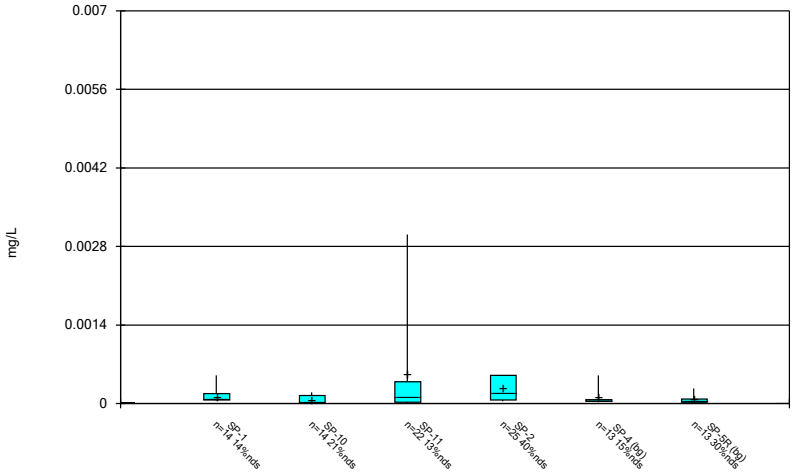
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



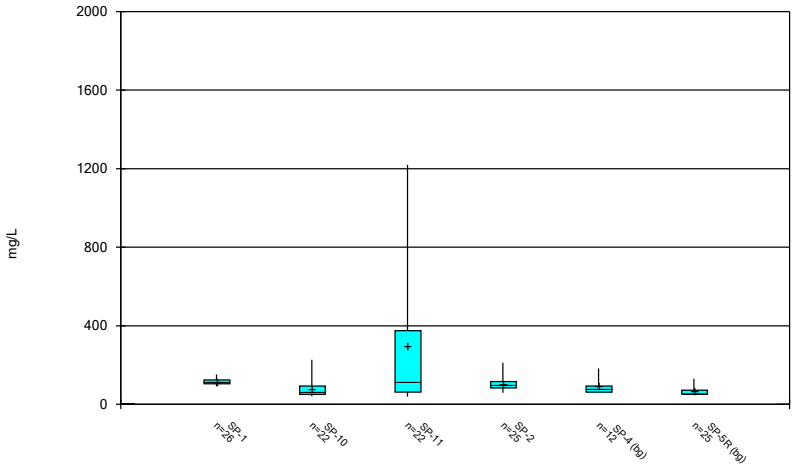
Constituent: Boron Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



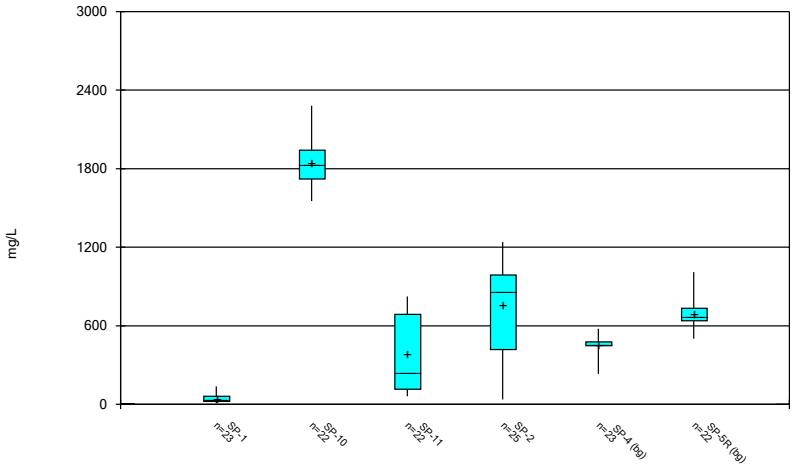
Constituent: Cadmium Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



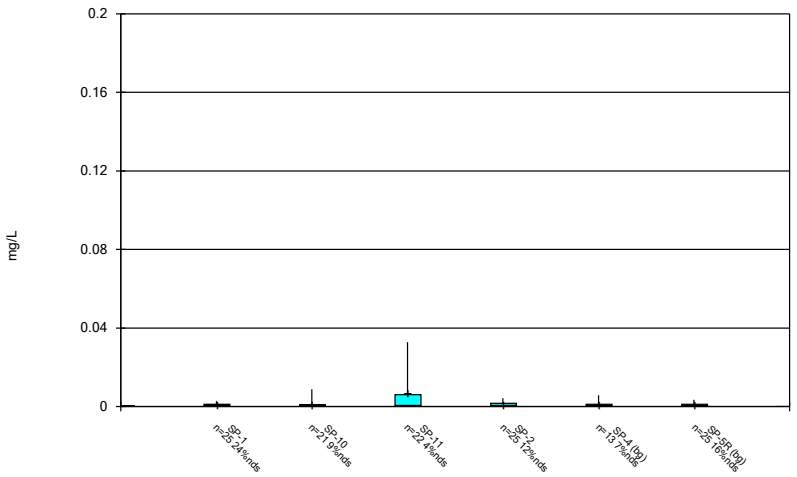
Constituent: Calcium Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



Constituent: Chloride Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

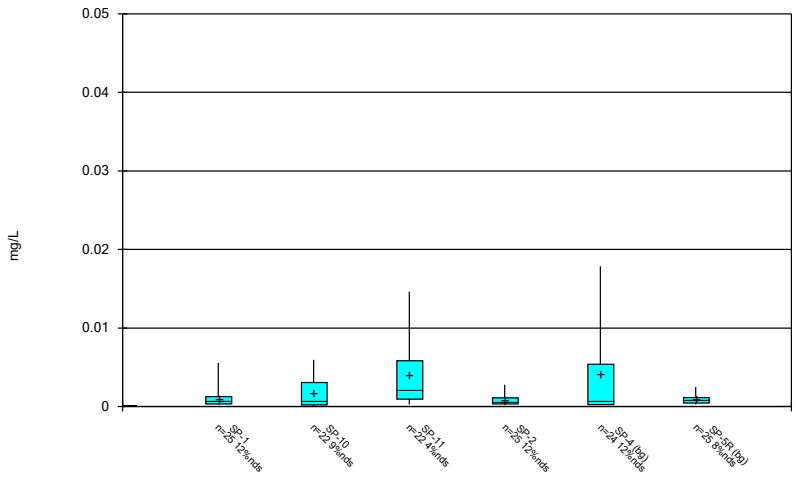
Box & Whiskers Plot



Constituent: Chromium Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

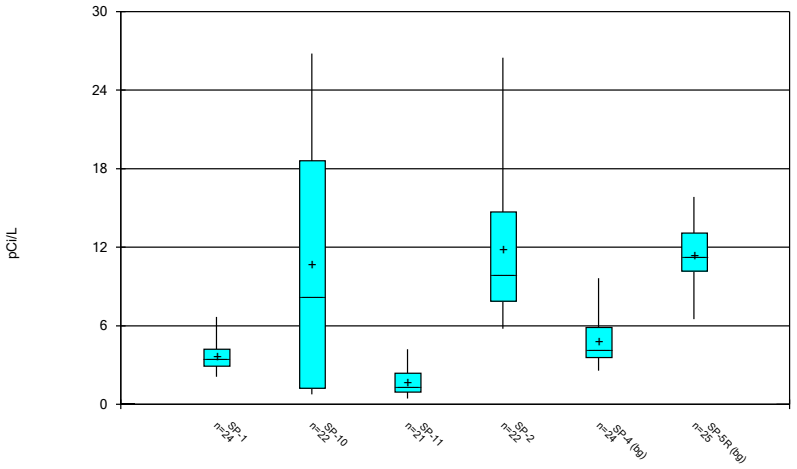
Box & Whiskers Plot



Constituent: Cobalt Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

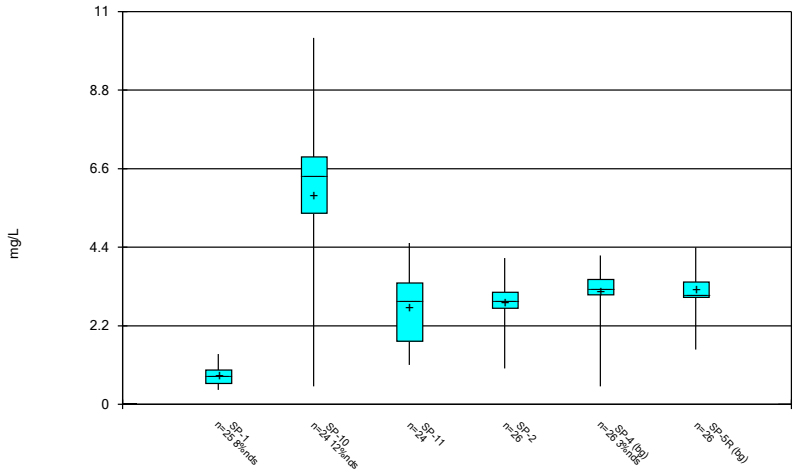
Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

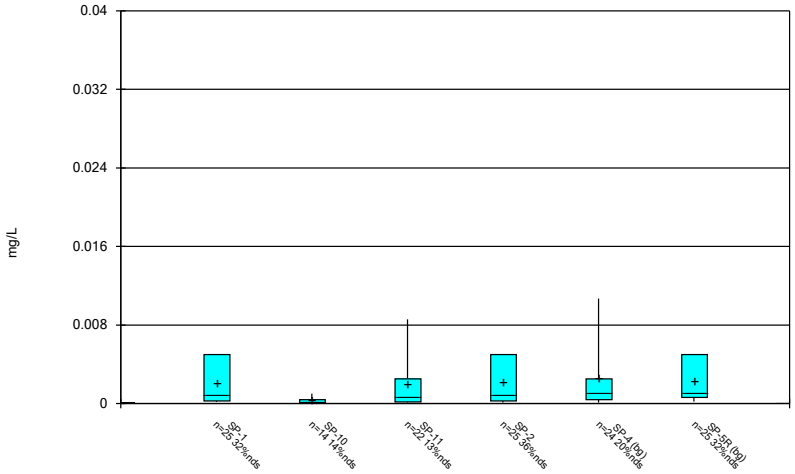
Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Box & Whiskers Plot



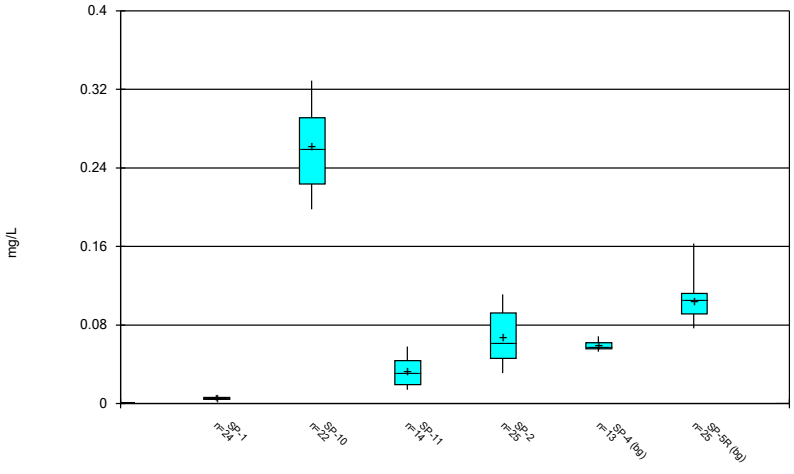
Constituent: Fluoride Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



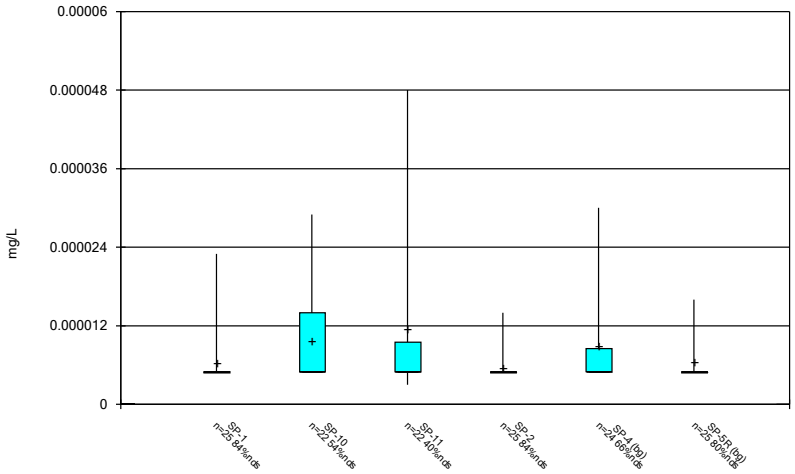
Constituent: Lead Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



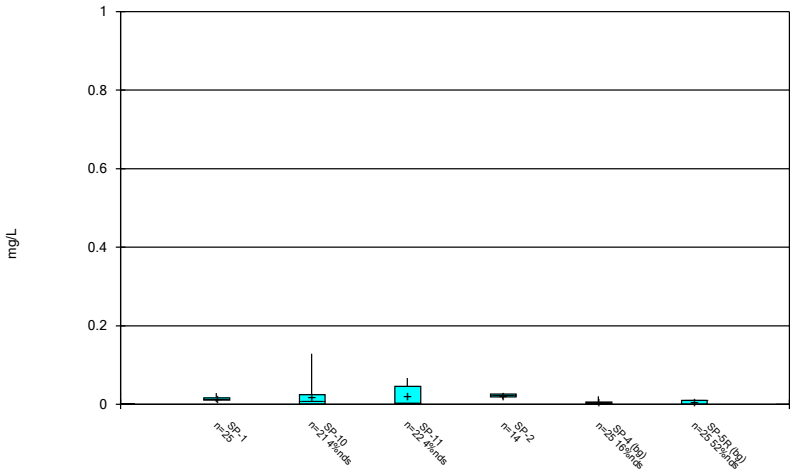
Constituent: Lithium Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



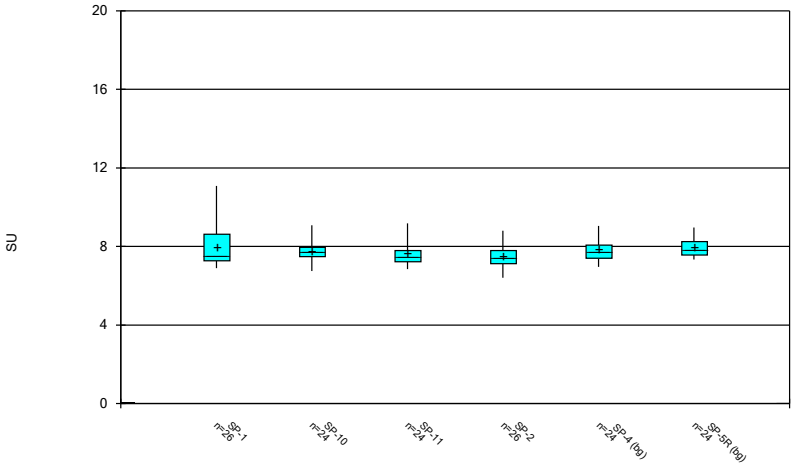
Constituent: Mercury Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



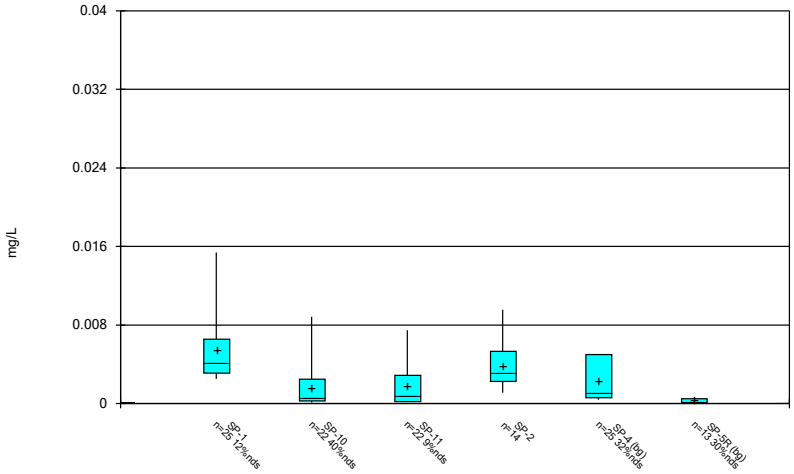
Constituent: Molybdenum Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



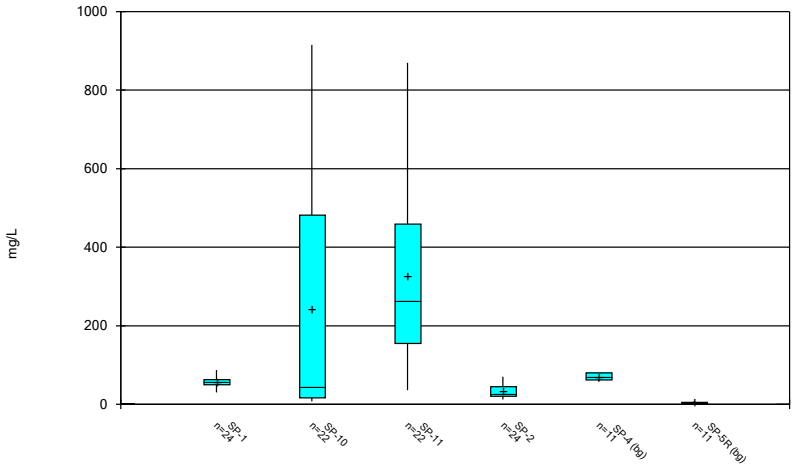
Constituent: pH, field Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



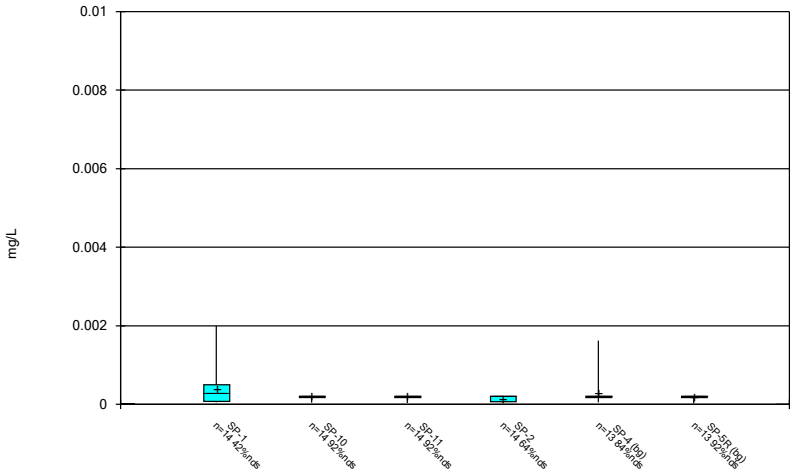
Constituent: Selenium Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



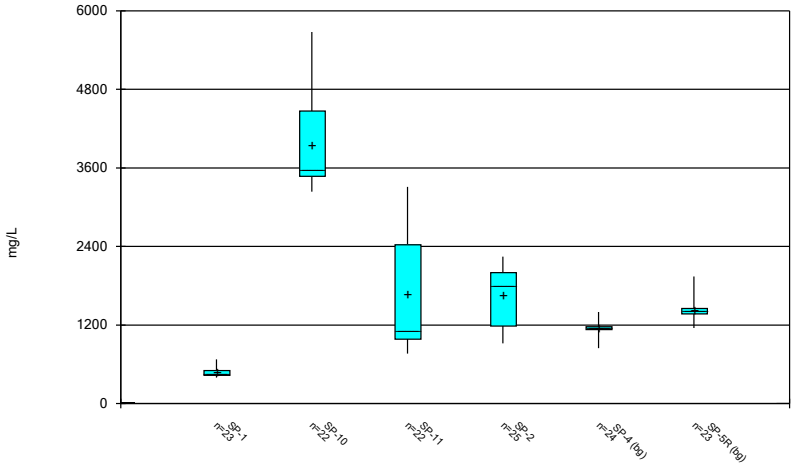
Constituent: Sulfate Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



Constituent: Thallium Analysis Run 2/10/2023 1:10 PM
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Box & Whiskers Plot



Constituent: Total Dissolved Solids [TDS] Analysis Run 2/10/2023 1:10 PM

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE C

Outlier Summary and Tukey's Outlier Test

Outlier Summary

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:15 PM

	SP-4 Arsenic (mg/L)	SP-4 Beryllium (mg/L)	SP-1 Chloride (mg/L)	SP-4 Chloride (mg/L)	SP-5R Chloride (mg/L)	SP-10 Chromium (mg/L)	SP-4 Cobalt (mg/L)	SP-1 Combined Radium 226 + 228 (pCi/L)	SP-11 Combined Radium 226 + 228 (pCi/L)	SP-1 Fluoride (mg/L)
3/13/2017			548 (o)							4 (o)
3/15/2017				52 (o)	62 (o)					
5/18/2017					1834 (o)					
6/27/2017								14.29 (o)		
7/13/2017						0.11 (o)				
8/4/2017	0.04498 (o)	0.00497 (o)					0.04069 (o)		25.367 (o)	
7/30/2018										
6/20/2019										

	SP-4 Lead (mg/L)	SP-1 Lithium (mg/L)	SP-4 Mercury (mg/L)	SP-10 Molybdenum (mg/L)	SP-1 Total Dissolved Solids [TDS] (mg/L)	SP-5R Total Dissolved Solids [TDS] (mg/L)
3/13/2017						
3/15/2017						
5/18/2017					3008 (o)	
6/27/2017						
7/13/2017				0.934 (o)		
8/4/2017	0.03663 (o)		5.8E-05 (o)			
7/30/2018					1060 (o)	
6/20/2019		0.03 (J,o)				

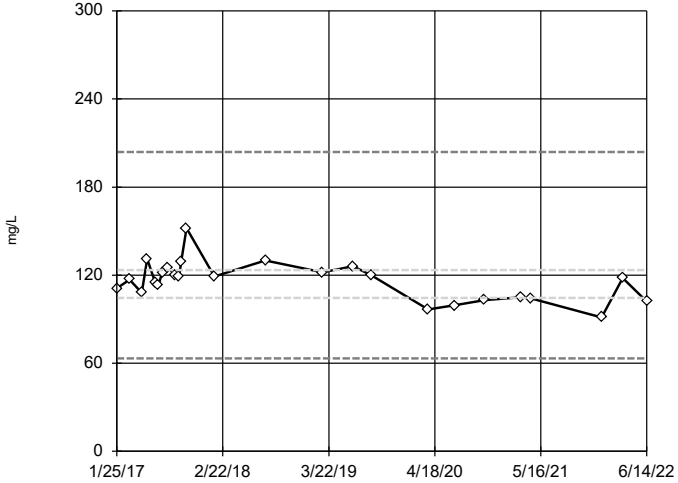
Tukey's Outlier Test - All Results (No Significant)

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:14 PM

Constituent	Well	Outlier	Value(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Calcium (mg/L)	SP-1	No	n/a	NP	NaN	25	115.9	13.21	ln(x)	ShapiroWilk
Calcium (mg/L)	SP-10	No	n/a	NP	NaN	21	79.44	50.65	ln(x)	ShapiroWilk
Calcium (mg/L)	SP-11	No	n/a	NP	NaN	21	307.2	396.2	ln(x)	ShapiroWilk
Calcium (mg/L)	SP-2	No	n/a	NP	NaN	24	102.5	33.2	ln(x)	ShapiroWilk
Calcium (mg/L)	SP-4 (bg)	No	n/a	NP	NaN	11	89.13	43.03	ln(x)	ShapiroWilk
Calcium (mg/L)	SP-5R (bg)	No	n/a	NP	NaN	24	64.08	21.76	ln(x)	ShapiroWilk

Tukey's Outlier Screening

SP-1



n = 25

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 203.8, low cutoff = 63.32, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 2/10/2023 1:14 PM View: Outlier Test
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

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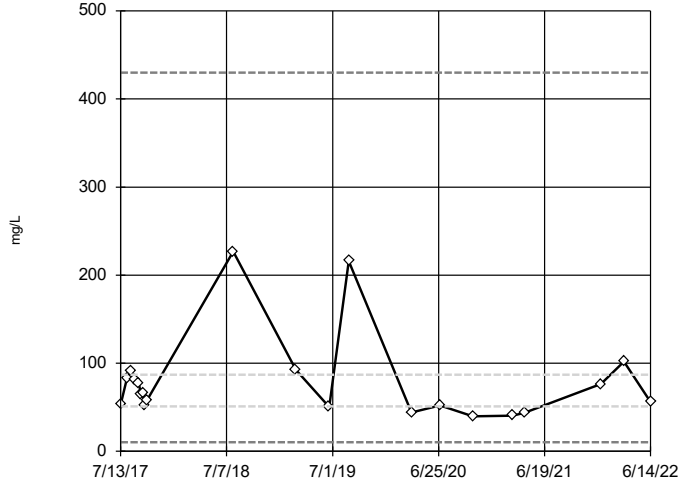
Tukey's Outlier Screening

SP-10



n = 21

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

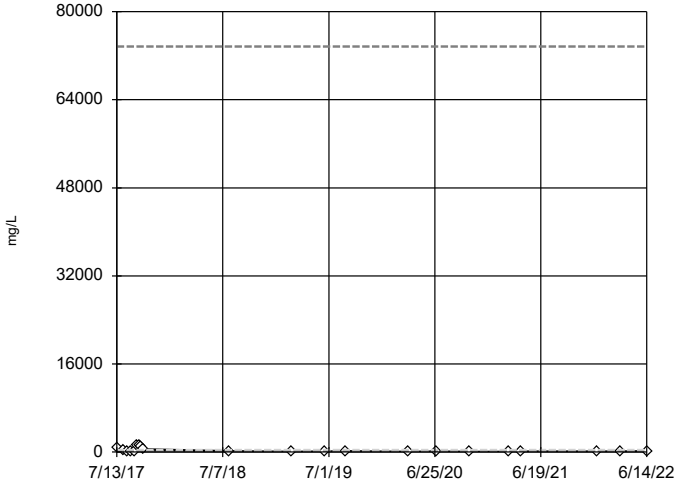
High cutoff = 430, low cutoff = 10.38, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 2/10/2023 1:14 PM View: Outlier Test
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

SP-11



n = 21

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

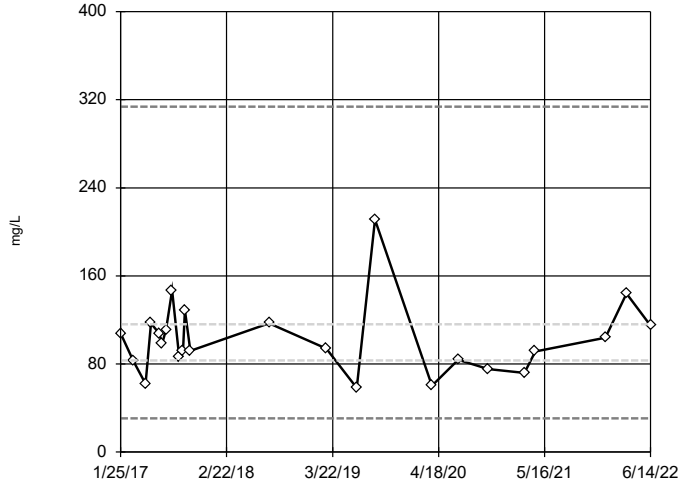
High cutoff = 73658, low cutoff = 0.3004, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 2/10/2023 1:14 PM View: Outlier Test
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

SP-2



n = 24

No outliers found. Tukey's method selected by user.

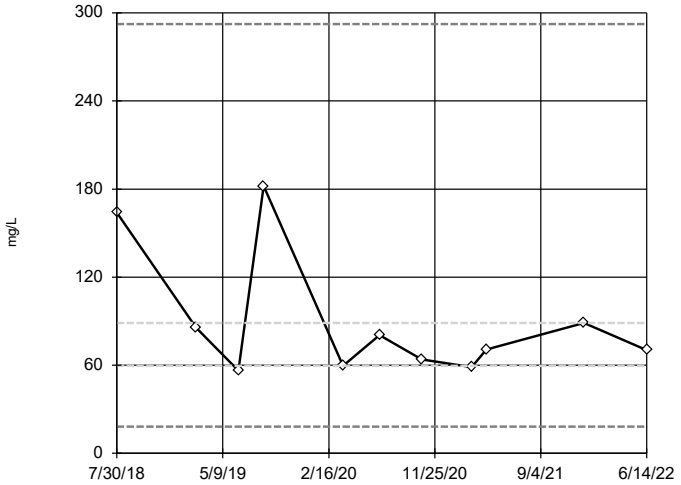
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 313.8, low cutoff = 30.77, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 2/10/2023 1:14 PM View: Outlier Test
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tukey's Outlier Screening

SP-4 (bg)



n = 11

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 292.4, low cutoff = 18.08, based on IQR multiplier of 3.

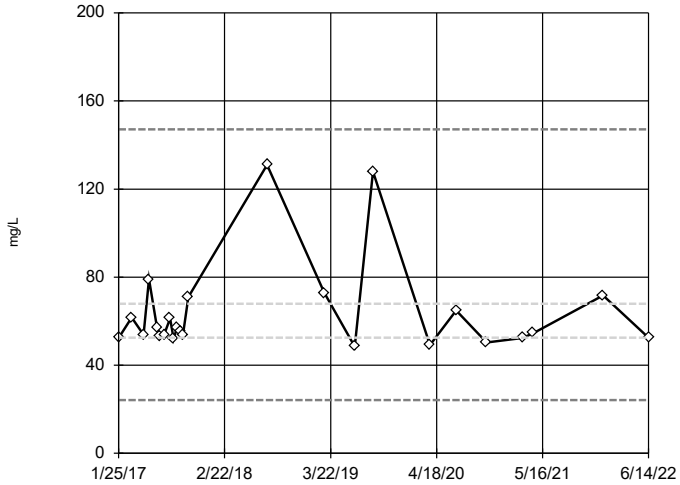
Constituent: Calcium Analysis Run 2/10/2023 1:14 PM View: Outlier Test

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

SP-5R (bg)



n = 24

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 147.2, low cutoff = 24.2, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 2/10/2023 1:14 PM View: Outlier Test

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tukey's Outlier Test - Upgradient Wells - Significant Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:13 PM

Constituent	Well	Outlier	Value(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Chloride (mg/L)	**SP-4,SP-5R**	**Yes**	**52,62,1834**	**NP**	**NaN**	**48**	**577.1**	**254**	**sqrt(x)**	**ShapiroWilk**
Fluoride (mg/L)	**SP-4,SP-5R**	**Yes**	**0.5**	**NP**	**NaN**	**52**	**3.184**	**0.6516**	**x^2**	**ShapiroFrancia**
Lead (mg/L)	**SP-4,SP-5R**	**Yes**	**0.03663**	**NP**	**NaN**	**50**	**0.002466**	**0.005558**	**ln(x)**	**ShapiroFrancia**
Mercury (mg/L)	**SP-4,SP-5R**	**Yes**	**0.000058,0.00003,0.000029**	**NP**	**NaN**	**50**	**0.00000868**	**0.000009222**	**ln(x)**	**ShapiroFrancia**
Selenium (mg/L)	**SP-4,SP-5R**	**Yes**	**0.00499**	**NP**	**NaN**	**38**	**0.000665**	**0.0008285**	**ln(x)**	**ShapiroWilk**
Total Dissolved Solids [TDS] (mg/L)	**SP-4,SP-5R**	**Yes**	**3008**	**NP**	**NaN**	**48**	**1328**	**306.5**	**ln(x)**	**ShapiroWilk**

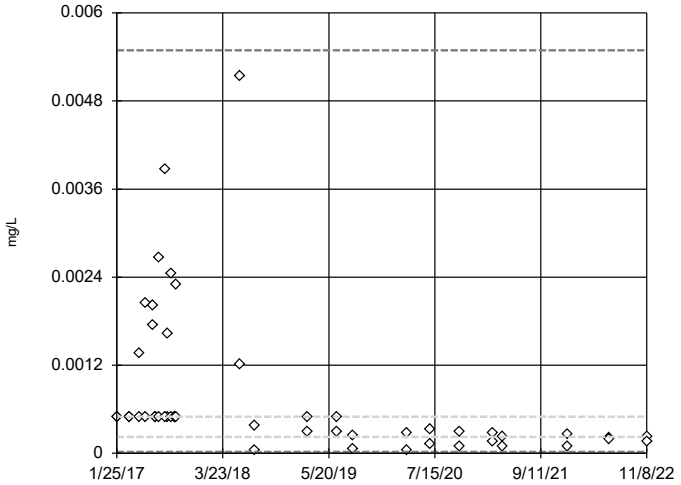
Tukey's Outlier Test - Upgradient Wells - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:13 PM

Constituent	Well	Outlier	Value(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	50	0.000786	0.001025	ln(x)	ShapiroFrancia
Arsenic (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	50	0.01397	0.01404	x^(1/3)	ShapiroFrancia
Barium (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	38	1.428	0.8429	x^3	ShapiroWilk
Beryllium (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	50	0.0004279	0.0008146	ln(x)	ShapiroFrancia
Boron (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	50	0.3188	0.09559	ln(x)	ShapiroFrancia
Cadmium (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	26	0.00006058	0.00005613	ln(x)	ShapiroWilk
Chloride (mg/L)	**SP-4,SP-5R**	**Yes**	**52,62,1834**	**NP**	**NaN**	**48**	**577.1**	**254**	**sqrt(x)**	**ShapiroWilk**
Chromium (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	38	0.0009132	0.001008	ln(x)	ShapiroWilk
Cobalt (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	50	0.003158	0.007029	ln(x)	ShapiroFrancia
Combined Radium 226 + 228 (pCi/L)	SP-4,SP-5R	No	n/a	NP	NaN	49	8.172	3.909	sqrt(x)	ShapiroWilk
Fluoride (mg/L)	**SP-4,SP-5R**	**Yes**	**0.5**	**NP**	**NaN**	**52**	**3.184**	**0.6516**	**x^2**	**ShapiroFrancia**
Lead (mg/L)	**SP-4,SP-5R**	**Yes**	**0.03663**	**NP**	**NaN**	**50**	**0.002466**	**0.005558**	**ln(x)**	**ShapiroFrancia**
Lithium (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	38	0.08877	0.02587	sqrt(x)	ShapiroWilk
Mercury (mg/L)	**SP-4,SP-5R**	**Yes**	**0.000058,0.00003,0.000029**	**NP**	**NaN**	**50**	**0.00000868**	**0.000009222**	**ln(x)**	**ShapiroFrancia**
Molybdenum (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	50	0.005028	0.003874	ln(x)	ShapiroFrancia
pH, field (SU)	SP-4,SP-5R	No	n/a	NP	NaN	48	7.896	0.5467	ln(x)	ShapiroWilk
Selenium (mg/L)	**SP-4,SP-5R**	**Yes**	**0.00499**	**NP**	**NaN**	**38**	**0.000665**	**0.0008285**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	SP-4,SP-5R	No	n/a	NP	NaN	22	36.85	34.38	ln(x)	ShapiroWilk
Thallium (mg/L)	SP-4,SP-5R	n/a	n/a	NP	NaN	26	0.0002419	0.0002846	unknown	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	**SP-4,SP-5R**	**Yes**	**3008**	**NP**	**NaN**	**48**	**1328**	**306.5**	**ln(x)**	**ShapiroWilk**

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.005491, low cutoff = 0.00002048, based on IQR multiplier of 3.

Constituent: Antimony Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

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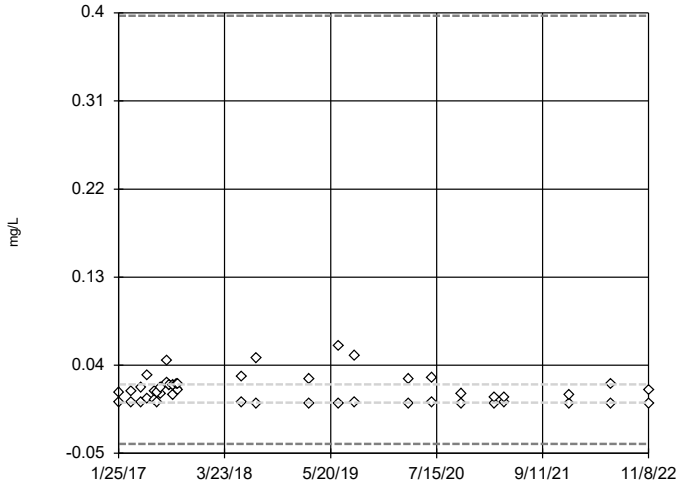
Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

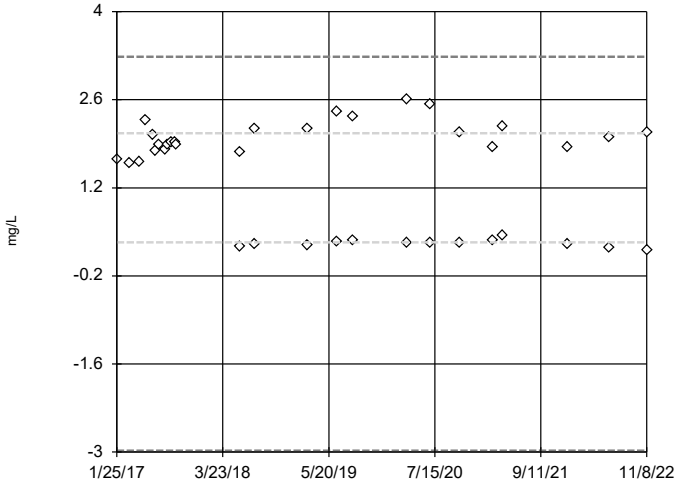
High cutoff = 0.3972, low cutoff = -0.04046, based on IQR multiplier of 3.

Constituent: Arsenic Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 38

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

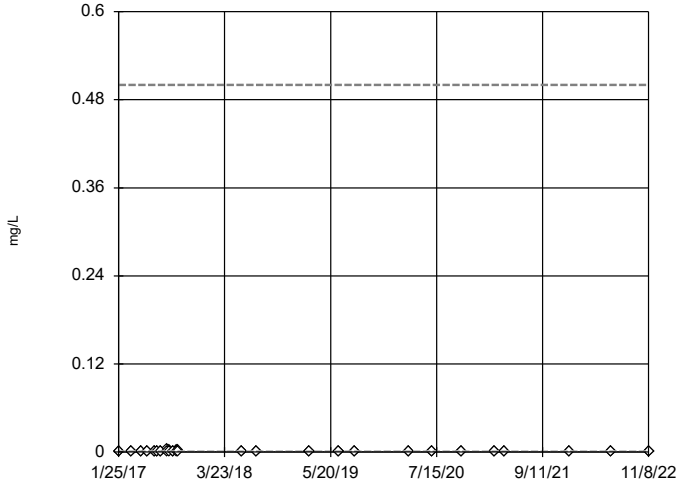
High cutoff = 3.282, low cutoff = -2.98, based on IQR multiplier of 3.

Constituent: Barium Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

No outliers found. Tukey's method selected by user.

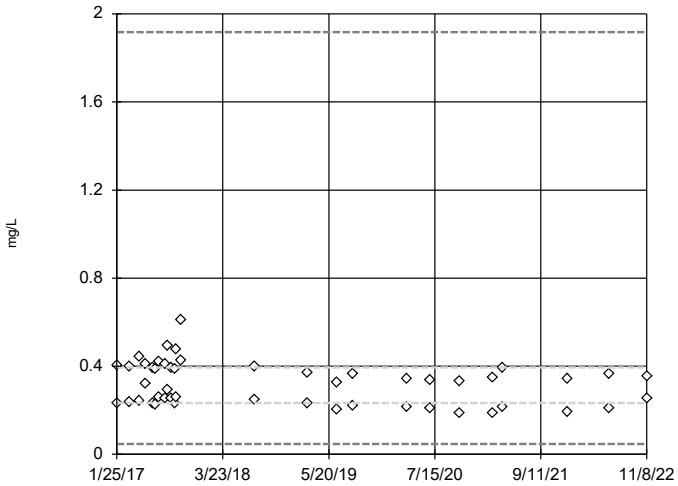
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.5, low cutoff = 5.0e-8, based on IQR multiplier of 3.

Constituent: Beryllium Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

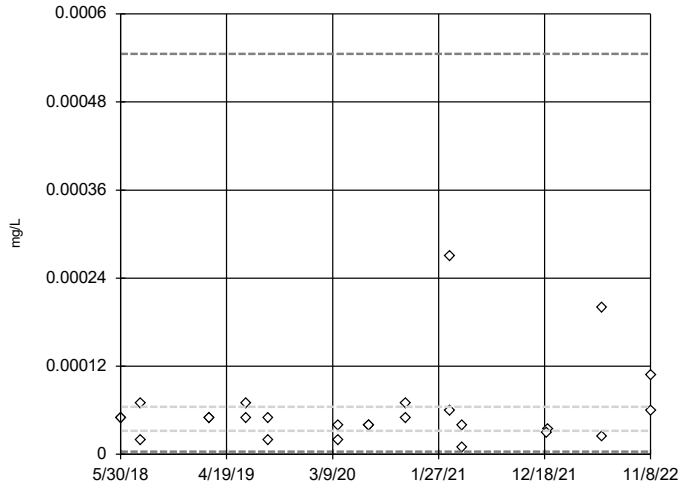
High cutoff = 1.917, low cutoff = 0.04778, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 26

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

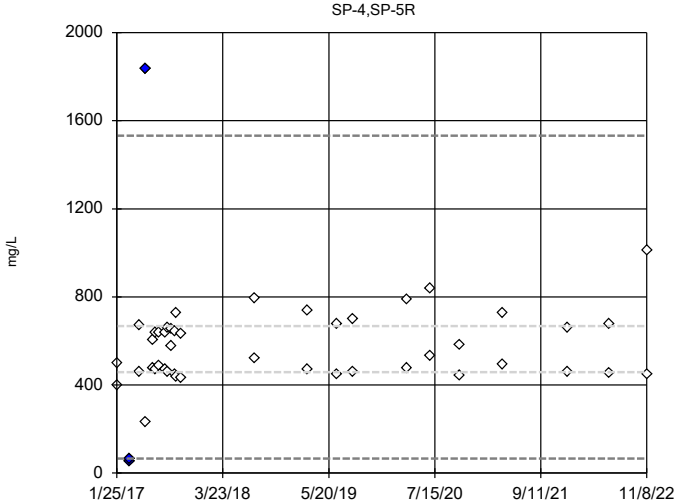
High cutoff = 0.0005455, low cutoff = 0.000003785, based on IQR multiplier of 3.

Constituent: Cadmium Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 48

Outliers are drawn as solid.
Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

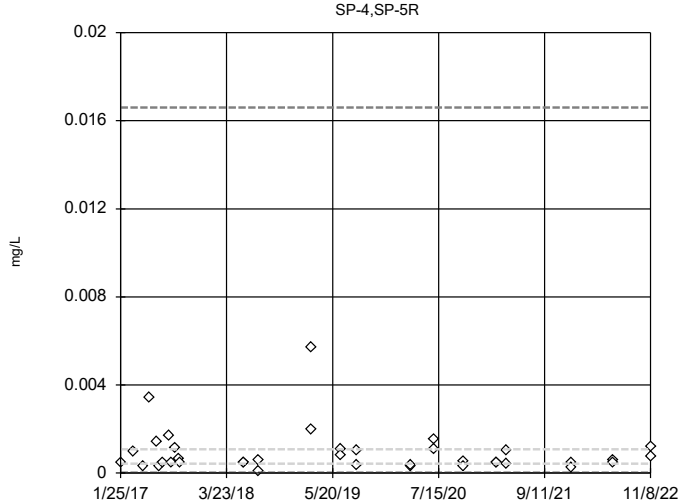
High cutoff = 1532, low cutoff = 65.55, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 38

No outliers found.
Tukey's method selected by user.

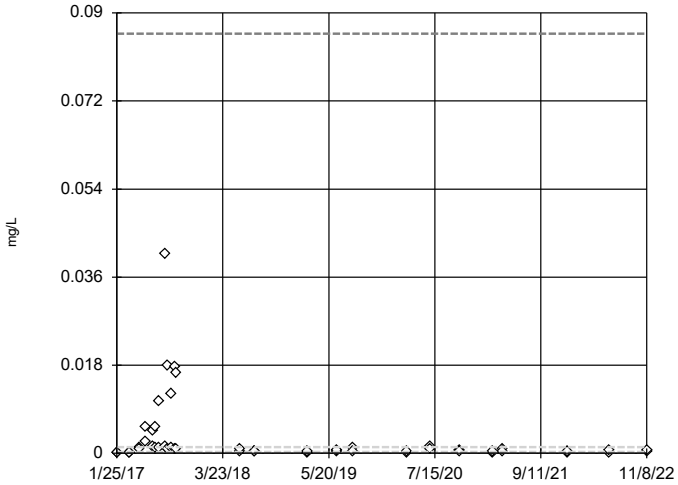
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.0166, low cutoff = 0.00002796, based on IQR multiplier of 3.

Constituent: Chromium Analysis Run 2/10/2023 1:11 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

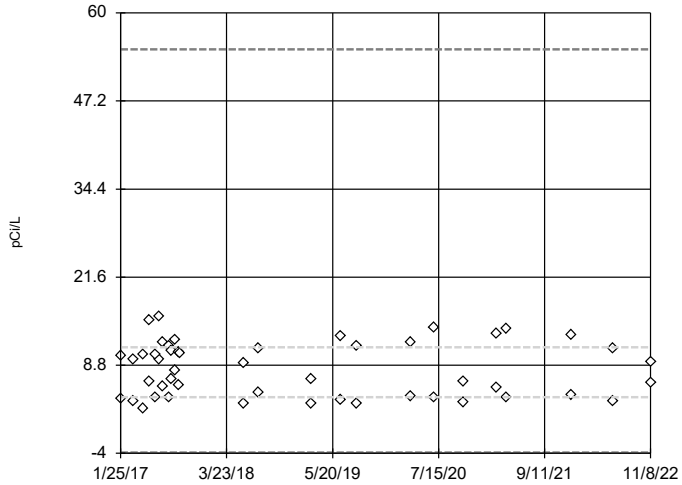
High cutoff = 0.08573, low cutoff = 0.000004878, based on IQR multiplier of 3.

Constituent: Cobalt Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 49

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

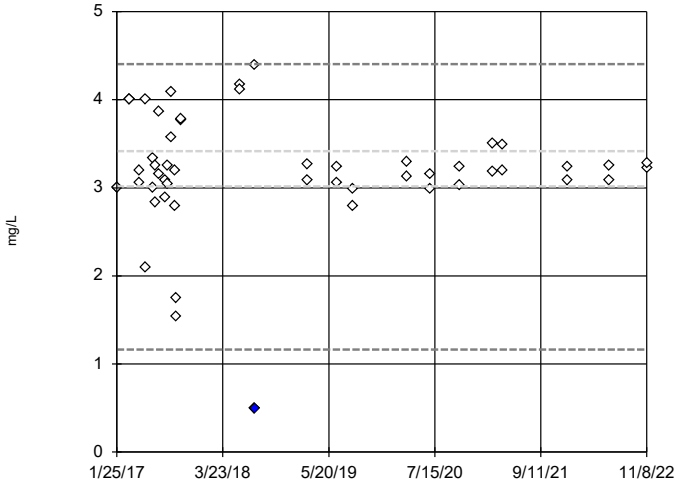
High cutoff = 54.71, low cutoff = -3.897, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 52

Outlier is drawn as solid. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

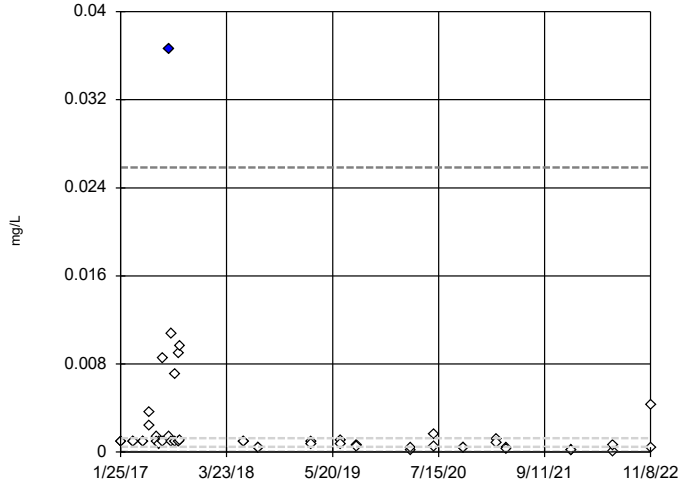
High cutoff = 4.405, low cutoff = 1.165, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

Outlier is drawn as solid. Tukey's method selected by user.

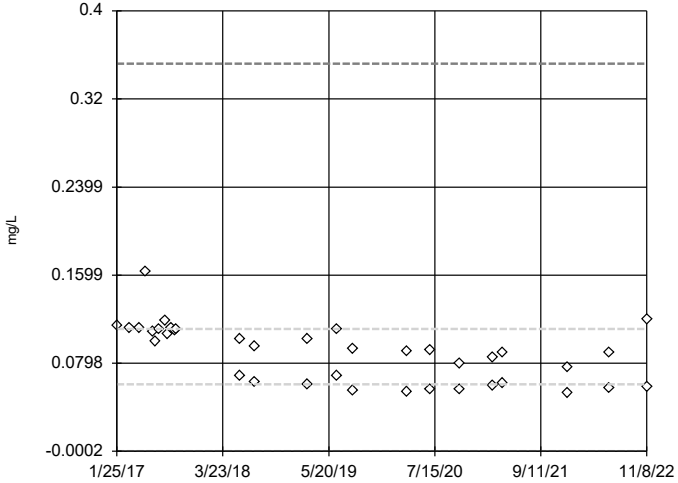
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.02586, low cutoff = 0.00002306, based on IQR multiplier of 3.

Constituent: Lead Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 38

No outliers found.
Tukey's method select-ed by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

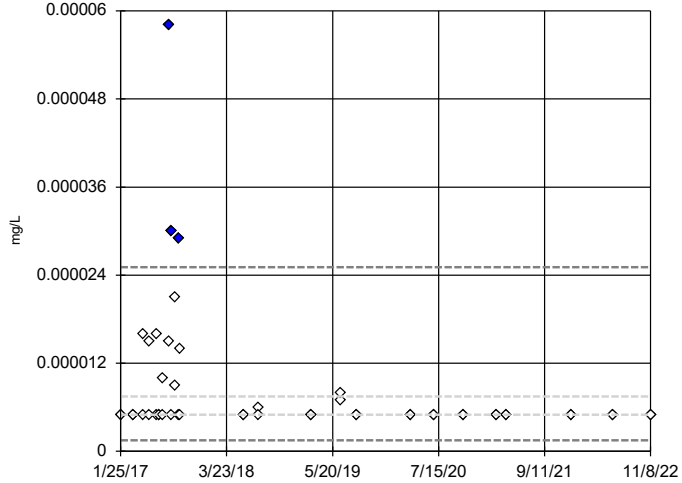
High cutoff = 0.3519, low cutoff = -0.0001852, based on IQR multiplier of 3.

Constituent: Lithium Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

Outliers are drawn as solid.
Tukey's method select-ed by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

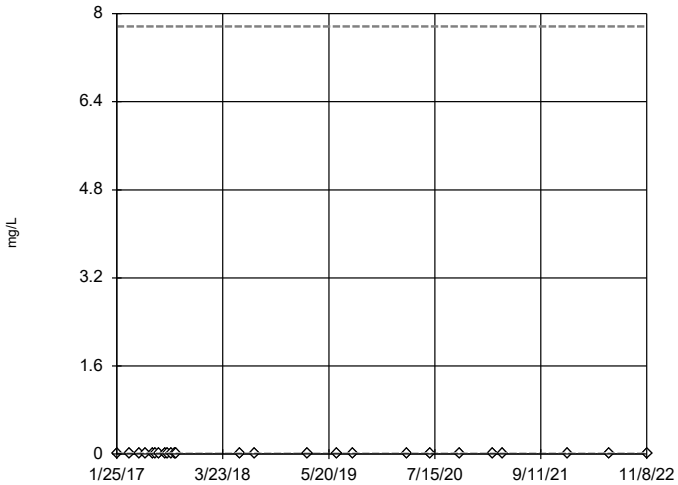
High cutoff = 0.00002509, low cutoff = 0.000001491, based on IQR multiplier of 3.

Constituent: Mercury Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 50

No outliers found.
Tukey's method select-ed by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

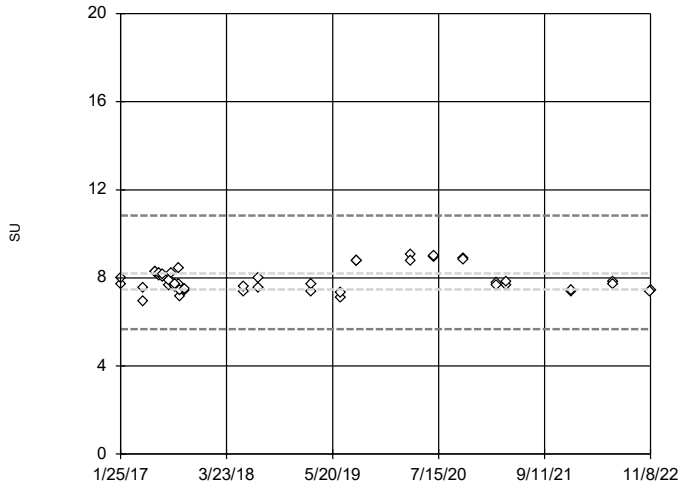
High cutoff = 7.77, low cutoff = 0.0000014, based on IQR multiplier of 3.

Constituent: Molybdenum Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 48

No outliers found.
Tukey's method select-ed by user.

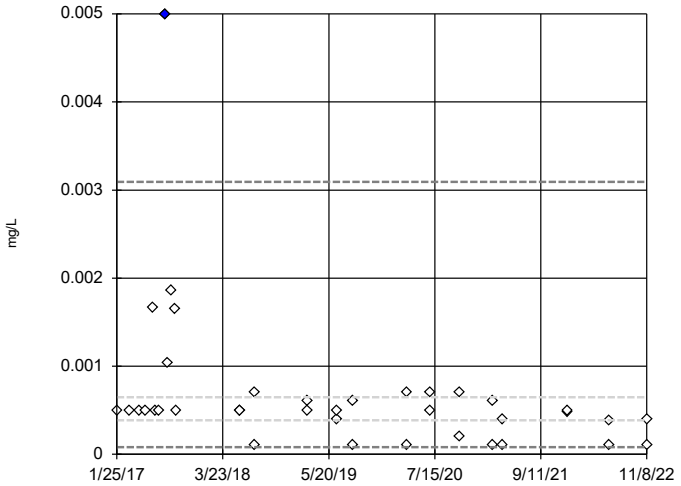
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 10.83, low cutoff = 5.667, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 38

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

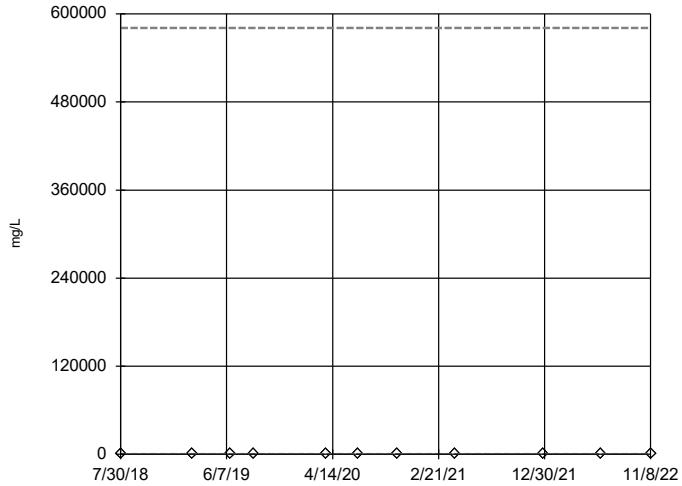
High cutoff = 0.003092, low cutoff = 0.00008069, based on IQR multiplier of 3.

Constituent: Selenium Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 22

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

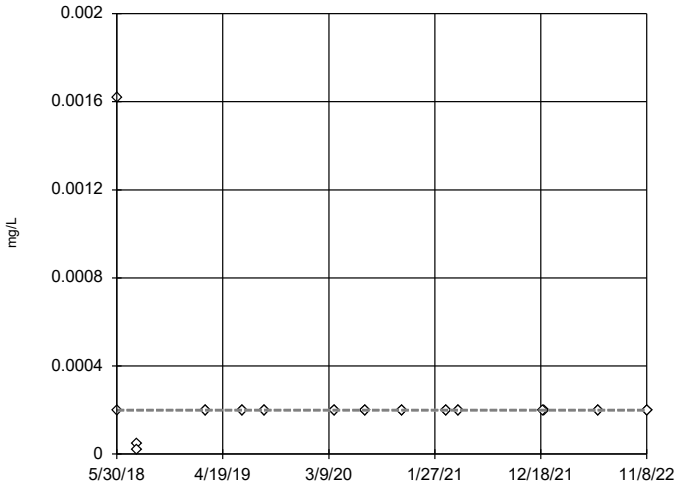
High cutoff = 580896, low cutoff = 0.000418, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 26

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

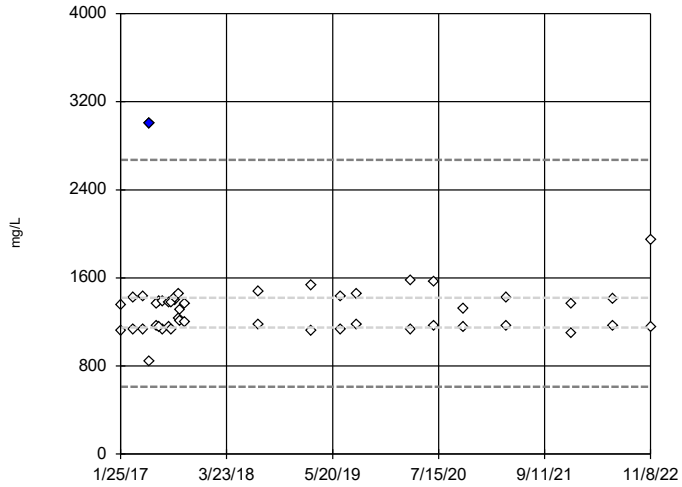
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

SP-4,SP-5R



n = 48

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2673, low cutoff = 610.8, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 2/10/2023 1:12 PM View: Outlier
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE D

Rank Von Neumann

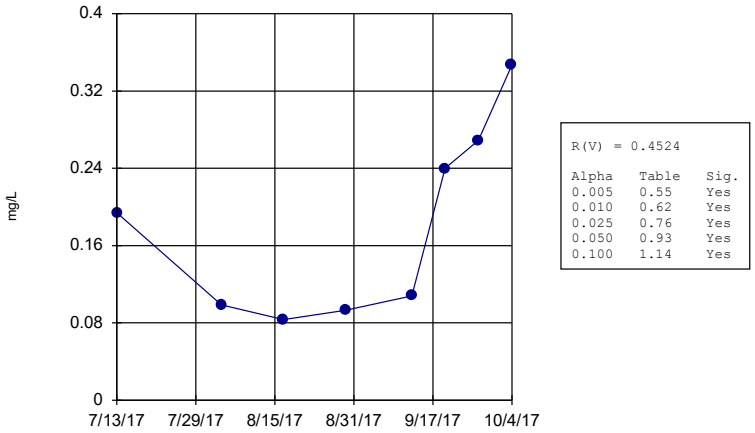
Rank Von Neumann - Significant Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/8/2023, 9:47 AM

Constituent	Well	N	R(V)	Alpha	Table	Sig.
Barium (mg/L)	**SP-11**	**8**	**0.4524**	**0.010**	**0.62**	**Yes**
Barium (mg/L)	**SP-4 (bg)**	**11**	**0.5182**	**0.010**	**0.77**	**Yes**
Cadmium (mg/L)	**SP-1**	**11**	**0.7614**	**0.010**	**0.77**	**Yes**
Cadmium (mg/L)	**SP-10**	**8**	**0**	**0.010**	**0.62**	**Yes**
Cadmium (mg/L)	**SP-4 (bg)**	**11**	**0.4705**	**0.010**	**0.77**	**Yes**
Cadmium (mg/L)	**SP-5R (bg)**	**12**	**0.5035**	**0.010**	**0.81**	**Yes**
Calcium (mg/L)	**SP-4 (bg)**	**12**	**0.8042**	**0.010**	**0.81**	**Yes**
Chromium (mg/L)	**SP-4 (bg)**	**11**	**0.5932**	**0.010**	**0.77**	**Yes**
Lead (mg/L)	**SP-10**	**8**	**0.381**	**0.010**	**0.62**	**Yes**
Lithium (mg/L)	**SP-11**	**8**	**0.3095**	**0.010**	**0.62**	**Yes**
Lithium (mg/L)	**SP-4 (bg)**	**12**	**0.7692**	**0.010**	**0.81**	**Yes**
Molybdenum (mg/L)	**SP-2**	**11**	**0.5091**	**0.010**	**0.77**	**Yes**
Selenium (mg/L)	**SP-2**	**11**	**0.75**	**0.010**	**0.77**	**Yes**
Selenium (mg/L)	**SP-5R (bg)**	**12**	**0.5035**	**0.010**	**0.81**	**Yes**
Sulfate (mg/L)	**SP-4 (bg)**	**13**	**0.5865**	**0.010**	**0.84**	**Yes**
Sulfate (mg/L)	**SP-5R (bg)**	**13**	**0.5508**	**0.010**	**0.84**	**Yes**
Thallium (mg/L)	**SP-1**	**11**	**0.55**	**0.010**	**0.77**	**Yes**
Thallium (mg/L)	**SP-10**	**8**	**0**	**0.010**	**0.62**	**Yes**
Thallium (mg/L)	**SP-11**	**8**	**0**	**0.010**	**0.62**	**Yes**
Thallium (mg/L)	**SP-2**	**11**	**0**	**0.010**	**0.77**	**Yes**
Thallium (mg/L)	**SP-4 (bg)**	**11**	**0.55**	**0.010**	**0.77**	**Yes**
Thallium (mg/L)	**SP-5R (bg)**	**12**	**0**	**0.010**	**0.81**	**Yes**

Rank Von Neumann

SP-11



R(V) = 0.4524

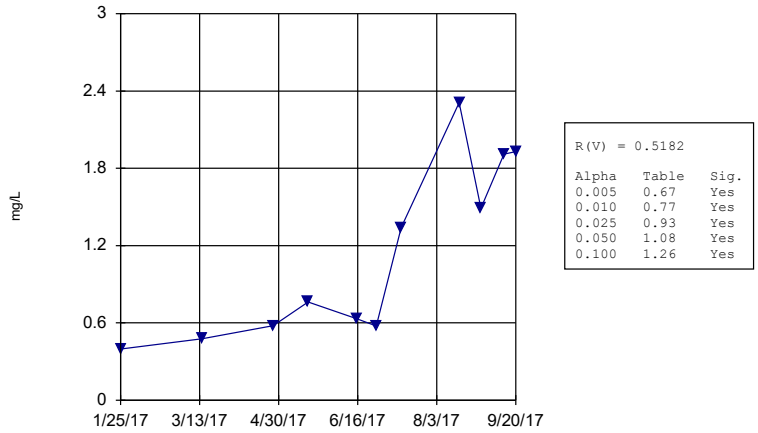
Alpha	Table	Sig.
0.005	0.55	Yes
0.010	0.62	Yes
0.025	0.76	Yes
0.050	0.93	Yes
0.100	1.14	Yes

Constituent: Barium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-4 (bg)



R(V) = 0.5182

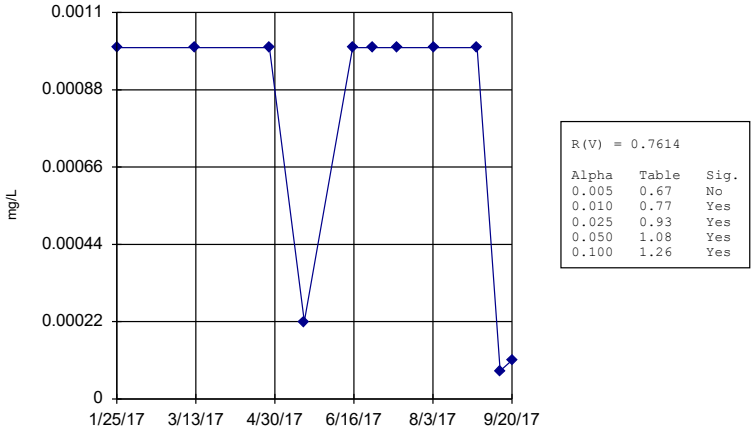
Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Barium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-1



R(V) = 0.7614

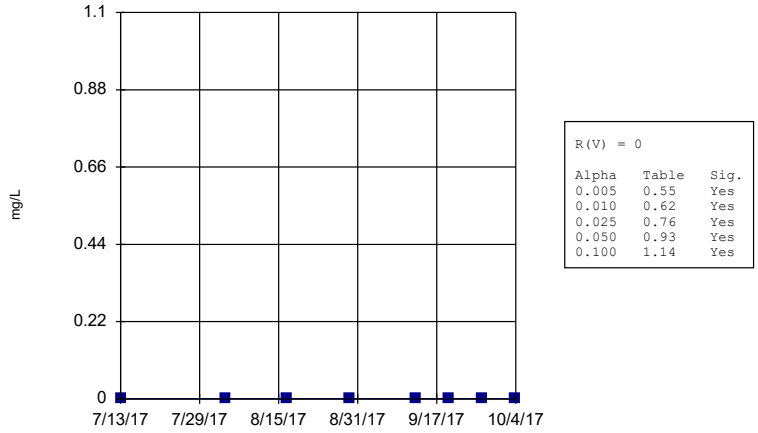
Alpha	Table	Sig.
0.005	0.67	No
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Cadmium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-10



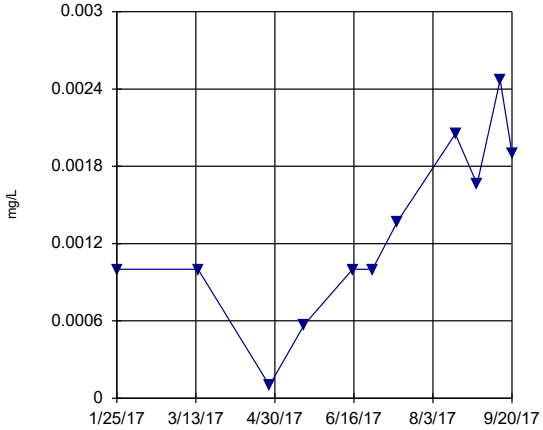
R(V) = 0

Alpha	Table	Sig.
0.005	0.55	Yes
0.010	0.62	Yes
0.025	0.76	Yes
0.050	0.93	Yes
0.100	1.14	Yes

Constituent: Cadmium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Rank Von Neumann

SP-4 (bg)



R(V) = 0.4705

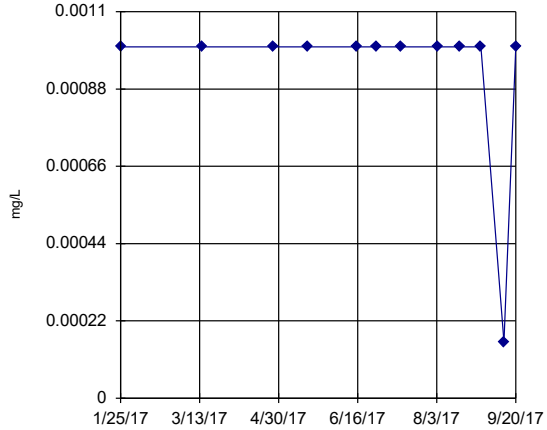
Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Cadmium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-5R (bg)



R(V) = 0.5035

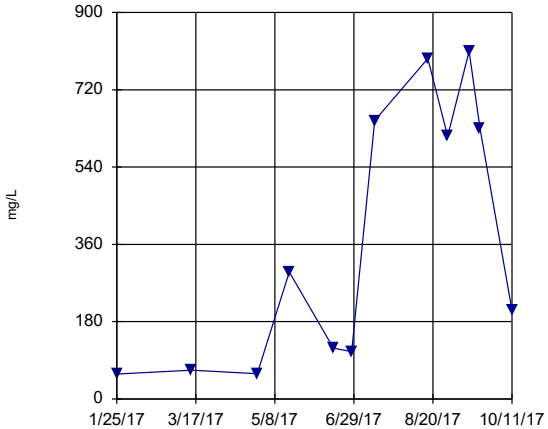
Alpha	Table	Sig.
0.005	0.71	Yes
0.010	0.81	Yes
0.025	0.96	Yes
0.050	1.11	Yes
0.100	1.29	Yes

Constituent: Cadmium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-4 (bg)



R(V) = 0.8042

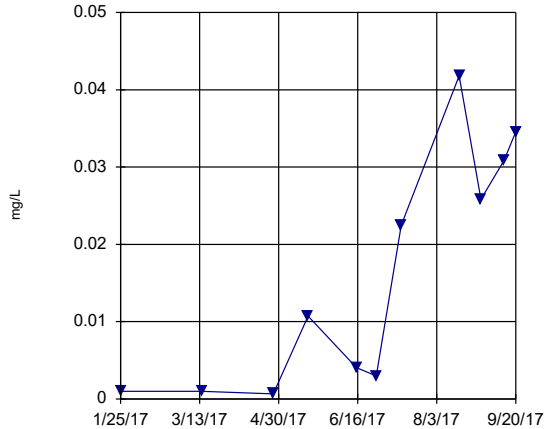
Alpha	Table	Sig.
0.005	0.71	No
0.010	0.81	Yes
0.025	0.96	Yes
0.050	1.11	Yes
0.100	1.29	Yes

Constituent: Calcium Analysis Run 2/8/2023 9:43 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-4 (bg)



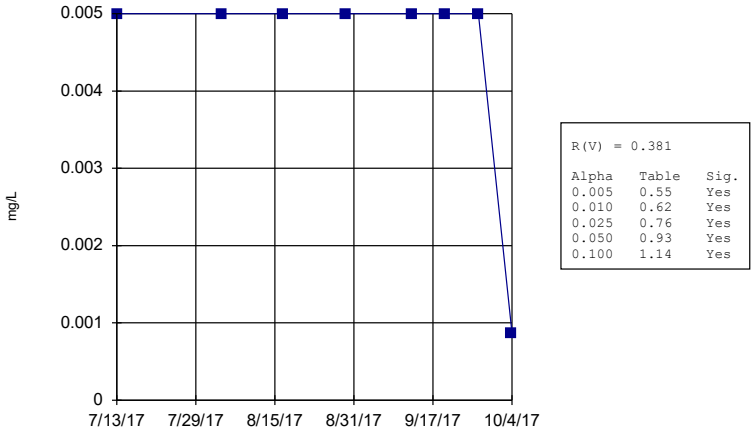
R(V) = 0.5932

Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Chromium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Rank Von Neumann

SP-10



R(V) = 0.381

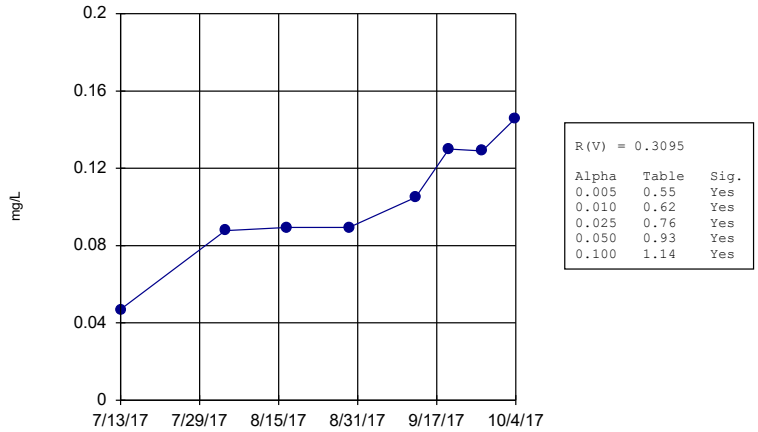
Alpha	Table	Sig.
0.005	0.55	Yes
0.010	0.62	Yes
0.025	0.76	Yes
0.050	0.93	Yes
0.100	1.14	Yes

Constituent: Lead Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-11



R(V) = 0.3095

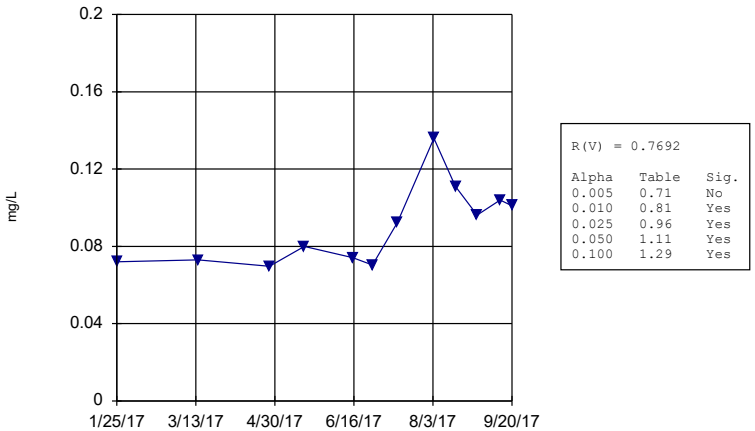
Alpha	Table	Sig.
0.005	0.55	Yes
0.010	0.62	Yes
0.025	0.76	Yes
0.050	0.93	Yes
0.100	1.14	Yes

Constituent: Lithium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-4 (bg)



R(V) = 0.7692

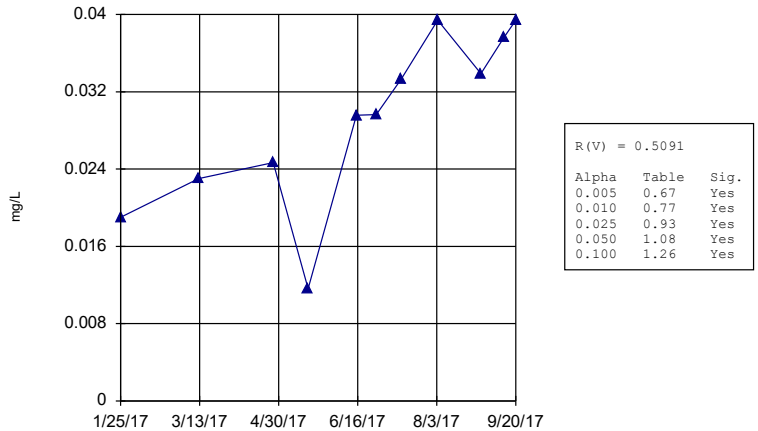
Alpha	Table	Sig.
0.005	0.71	No
0.010	0.81	Yes
0.025	0.96	Yes
0.050	1.11	Yes
0.100	1.29	Yes

Constituent: Lithium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-2



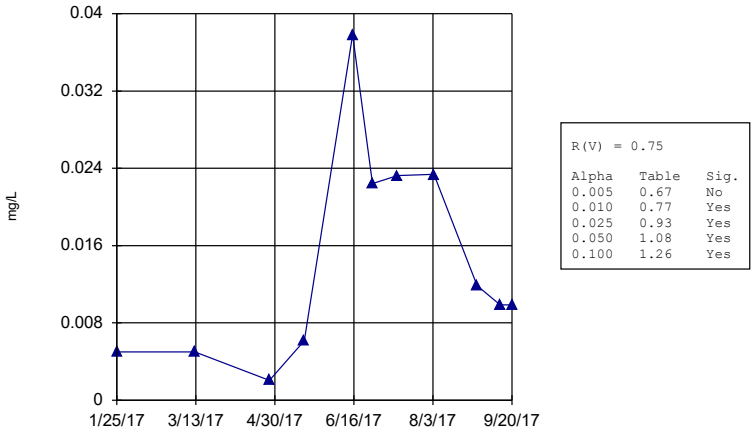
R(V) = 0.5091

Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Molybdenum Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Rank Von Neumann

SP-2



R(V) = 0.75

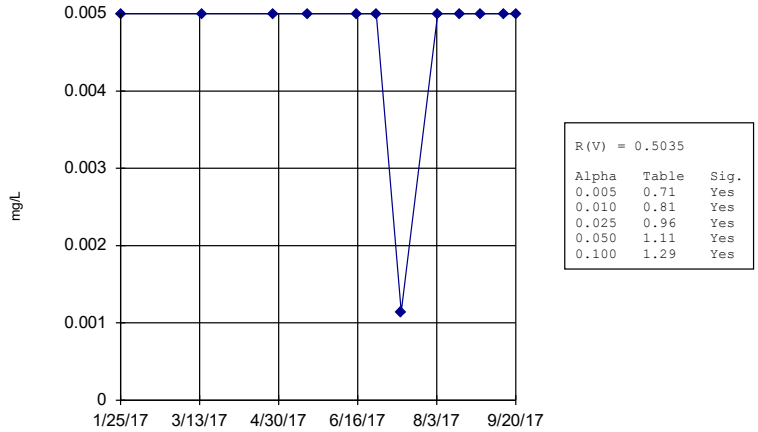
Alpha	Table	Sig.
0.005	0.67	No
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Selenium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-5R (bg)



R(V) = 0.5035

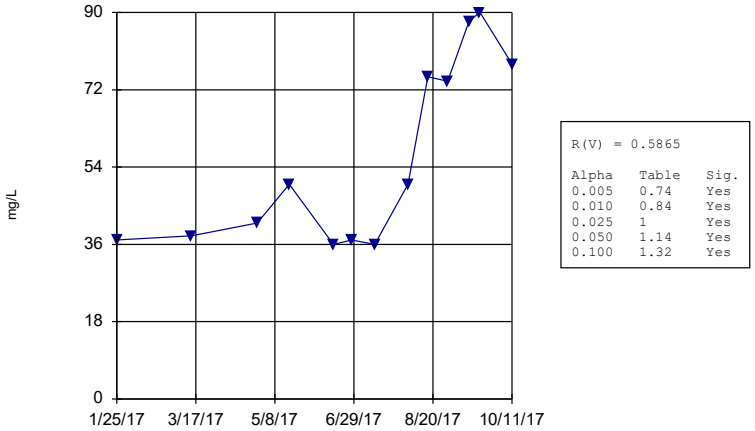
Alpha	Table	Sig.
0.005	0.71	Yes
0.010	0.81	Yes
0.025	0.96	Yes
0.050	1.11	Yes
0.100	1.29	Yes

Constituent: Selenium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-4 (bg)



R(V) = 0.5865

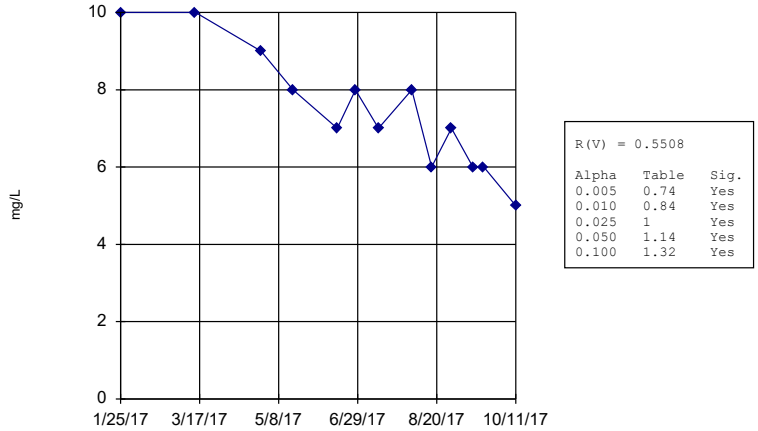
Alpha	Table	Sig.
0.005	0.74	Yes
0.010	0.84	Yes
0.025	1	Yes
0.050	1.14	Yes
0.100	1.32	Yes

Constituent: Sulfate Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-5R (bg)



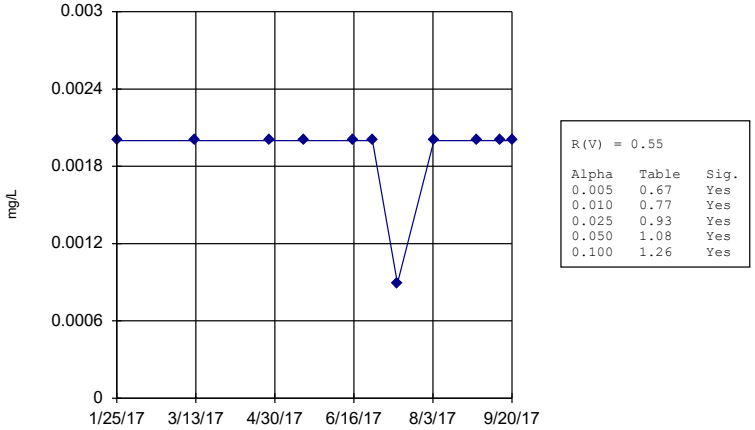
R(V) = 0.5508

Alpha	Table	Sig.
0.005	0.74	Yes
0.010	0.84	Yes
0.025	1	Yes
0.050	1.14	Yes
0.100	1.32	Yes

Constituent: Sulfate Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Rank Von Neumann

SP-1



R(V) = 0.55

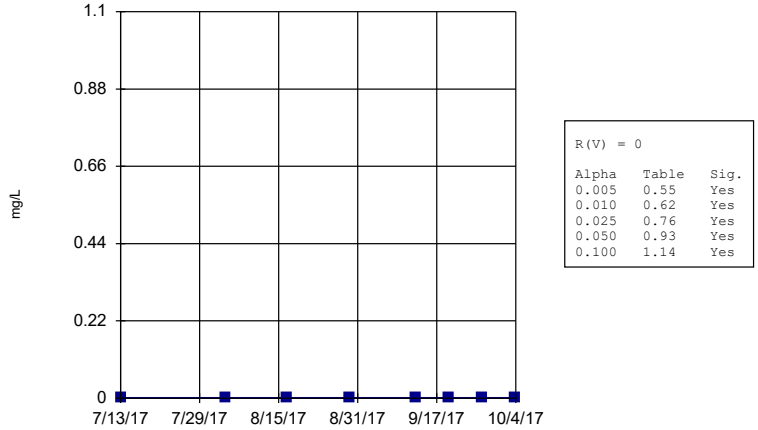
Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Thallium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-10



R(V) = 0

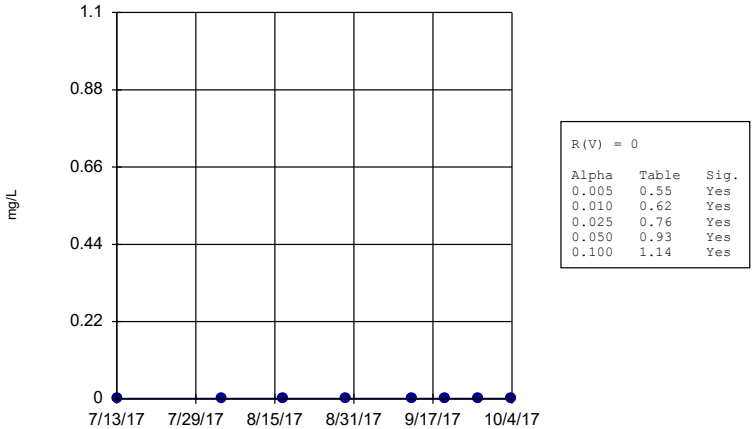
Alpha	Table	Sig.
0.005	0.55	Yes
0.010	0.62	Yes
0.025	0.76	Yes
0.050	0.93	Yes
0.100	1.14	Yes

Constituent: Thallium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-11



R(V) = 0

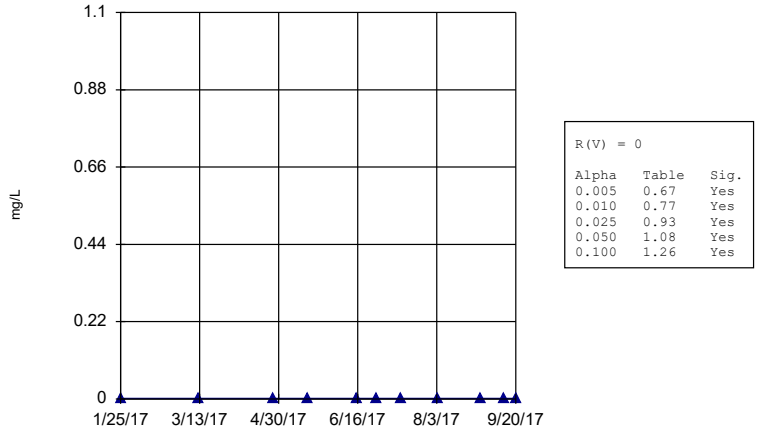
Alpha	Table	Sig.
0.005	0.55	Yes
0.010	0.62	Yes
0.025	0.76	Yes
0.050	0.93	Yes
0.100	1.14	Yes

Constituent: Thallium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-2



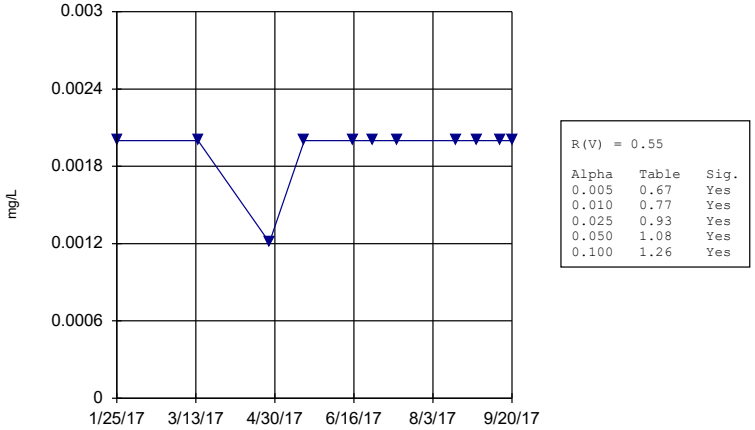
R(V) = 0

Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Thallium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Rank Von Neumann

SP-4 (bg)



R(V) = 0.55

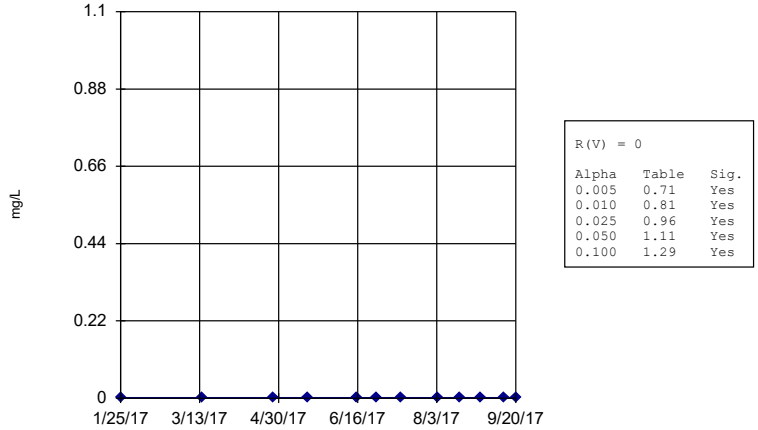
Alpha	Table	Sig.
0.005	0.67	Yes
0.010	0.77	Yes
0.025	0.93	Yes
0.050	1.08	Yes
0.100	1.26	Yes

Constituent: Thallium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Rank Von Neumann

SP-5R (bg)



R(V) = 0

Alpha	Table	Sig.
0.005	0.71	Yes
0.010	0.81	Yes
0.025	0.96	Yes
0.050	1.11	Yes
0.100	1.29	Yes

Constituent: Thallium Analysis Run 2/8/2023 9:44 AM View: Rank Von Neumann
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE E

Mann-Whitney

Welch's t-test/Mann-Whitney - Significant Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:24 PM

Constituent	Well	Calc.	0.01	Method
Calcium (mg/L)	**SP-1**	**-2.706**	**Yes**	**Mann-W**

Welch's t-test/Mann-Whitney - All Results

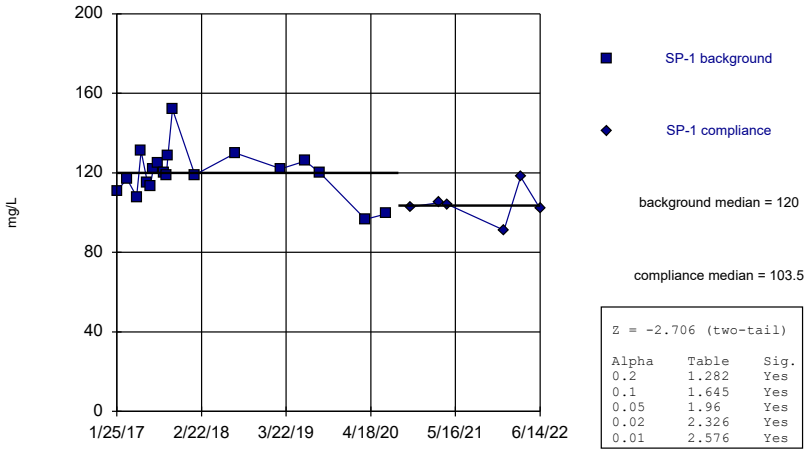
Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:24 PM

Constituent	Well	Calc.	0.01	Method
Calcium (mg/L)	**SP-1**	**-2.706**	**Yes**	**Mann-W**
Calcium (mg/L)	SP-10	-1.518	No	Mann-W
Calcium (mg/L)	SP-11	-0.9682	No	Mann-W
Calcium (mg/L)	SP-2	-0.2334	No	Mann-W
Calcium (mg/L)	SP-4 (bg)	-0.8216	No	Mann-W
Calcium (mg/L)	SP-5R (bg)	-1.102	No	Mann-W

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

SP-1



Z = -2.706 (two-tail)

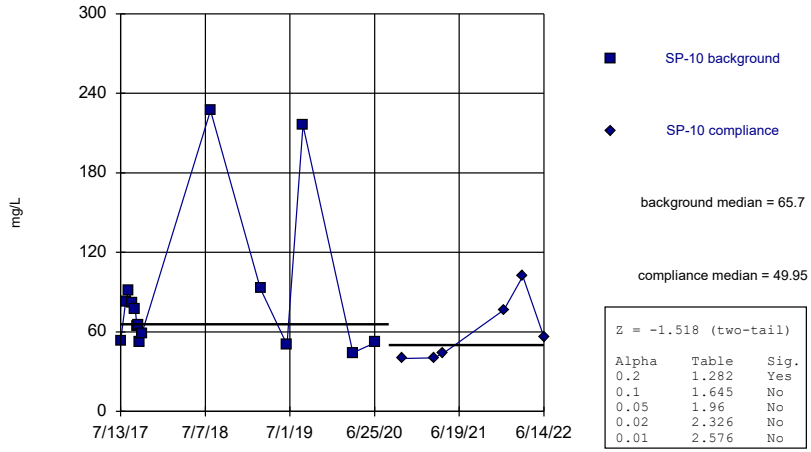
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: Calcium Analysis Run 2/10/2023 1:23 PM View: Mann-Whitney
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

SP-10



Z = -1.518 (two-tail)

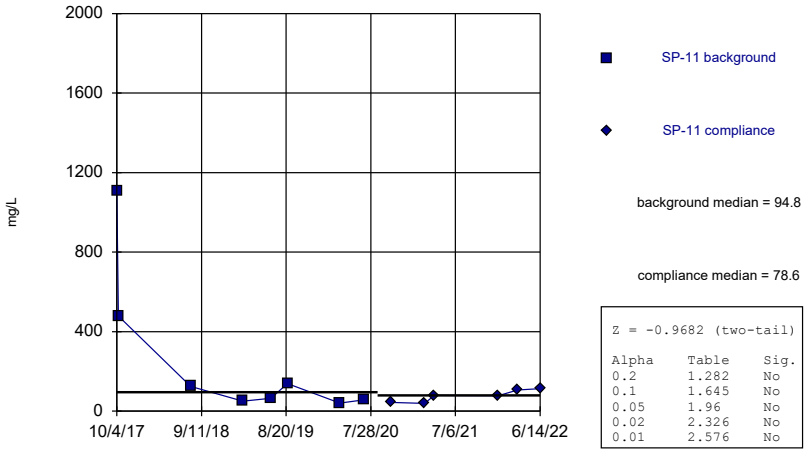
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 2/10/2023 1:23 PM View: Mann-Whitney
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

SP-11



Z = -0.9682 (two-tail)

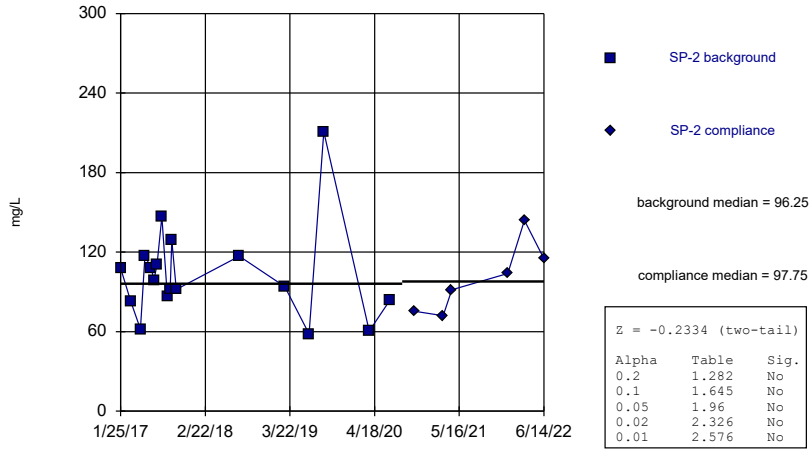
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 2/10/2023 1:23 PM View: Mann-Whitney
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

SP-2



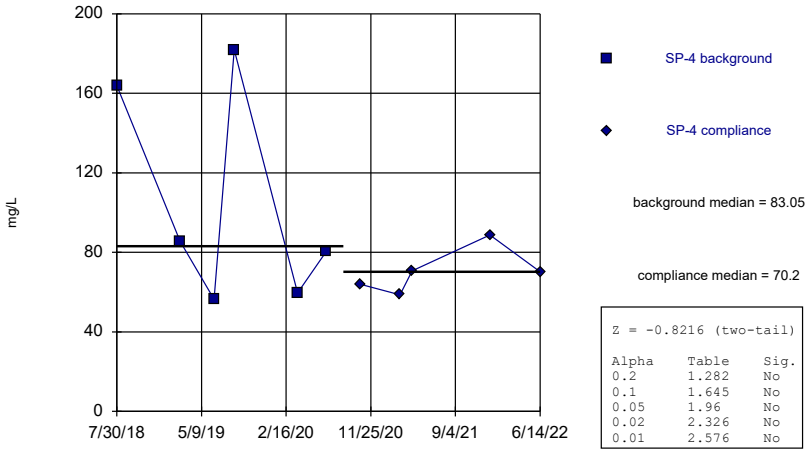
Z = -0.2334 (two-tail)

Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 2/10/2023 1:23 PM View: Mann-Whitney
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Mann-Whitney (Wilcoxon Rank Sum)

SP-4 (bg)



Z = -0.8216 (two-tail)

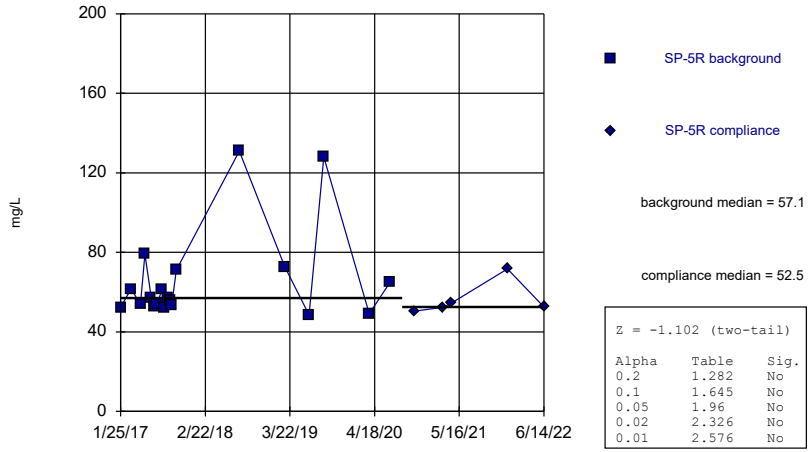
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 2/10/2023 1:23 PM View: Mann-Whitney
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

SP-5R (bg)



Z = -1.102 (two-tail)

Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 2/10/2023 1:23 PM View: Mann-Whitney
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE F

Intrawell PLs

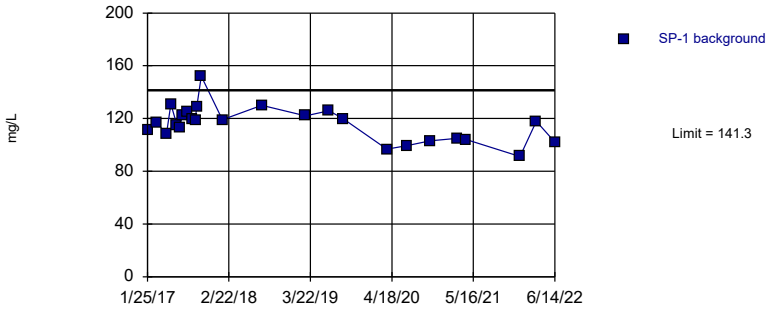
Intrawell Prediction Limits - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:33 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Calcium (mg/L)	SP-1	141.3	n/a	n/a	1 future	n/a	25	115.9	13.21	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	SP-10	227	n/a	n/a	1 future	n/a	21	n/a	n/a	0	n/a	n/a	0.003999	NP Intra (normality) 1 of 2
Calcium (mg/L)	SP-11	155.9	n/a	n/a	1 future	n/a	12	78	34.89	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	SP-2	166.8	n/a	n/a	1 future	n/a	24	102.5	33.2	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	SP-4	182	n/a	n/a	1 future	n/a	11	n/a	n/a	0	n/a	n/a	0.01276	NP Intra (normality) 1 of 2
Calcium (mg/L)	SP-5R	131	n/a	n/a	1 future	n/a	24	n/a	n/a	0	n/a	n/a	0.003124	NP Intra (normality) 1 of 2

Prediction Limit

Intrawell Parametric, SP-1

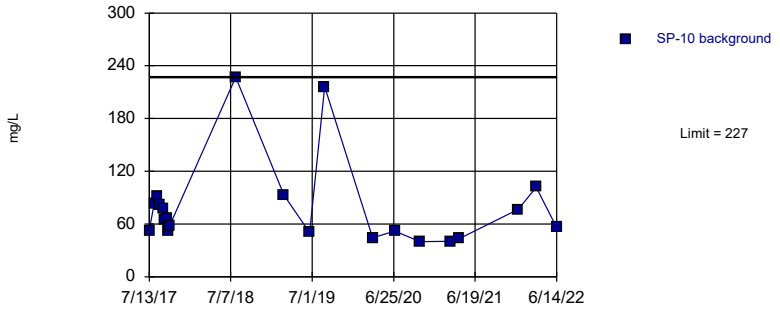


Background Data Summary: Mean=115.9, Std. Dev.=13.21, n=25. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9663, critical = 0.888. Kappa = 1.924 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 2/10/2023 1:30 PM View: Intrawell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Prediction Limit

Intrawell Non-parametric, SP-10

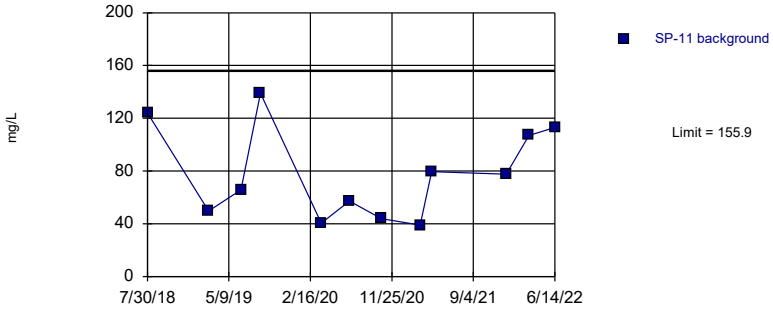


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 21 background values. Well-constituent pair annual alpha = 0.007982. Individual comparison alpha = 0.003999 (1 of 2). Assumes 1 future value.

Constituent: Calcium Analysis Run 2/10/2023 1:30 PM View: Intrawell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Prediction Limit

Intrawell Parametric, SP-11

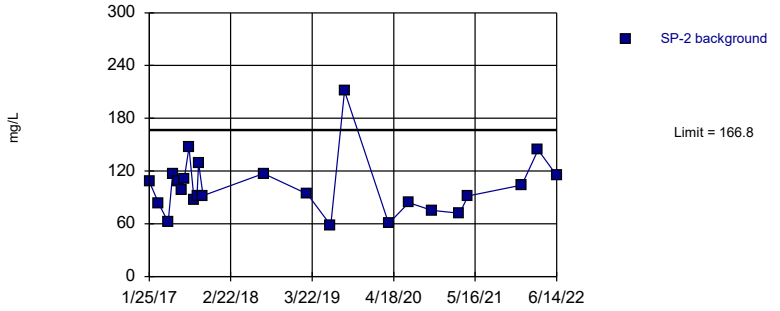


Background Data Summary: Mean=78, Std. Dev.=34.89, n=12. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9081, critical = 0.859. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 2/10/2023 1:30 PM View: Intrawell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Prediction Limit

Intrawell Parametric, SP-2

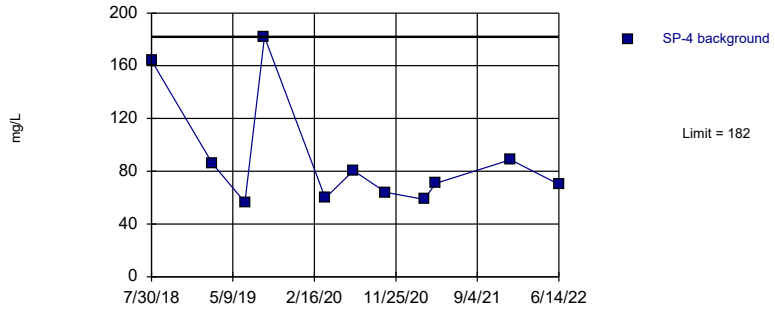


Background Data Summary: Mean=102.5, Std. Dev.=33.2, n=24. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8901, critical = 0.884. Kappa = 1.937 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 2/10/2023 1:30 PM View: Intrawell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Prediction Limit

Intrawell Non-parametric, SP-4 (bg)



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.05 alpha level. Limit is highest of 11 background values. Well-constituent pair annual alpha = 0.02537. Individual comparison alpha = 0.01276 (1 of 2). Assumes 1 future value.

Constituent: Calcium Analysis Run 2/10/2023 1:30 PM View: Intrawell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

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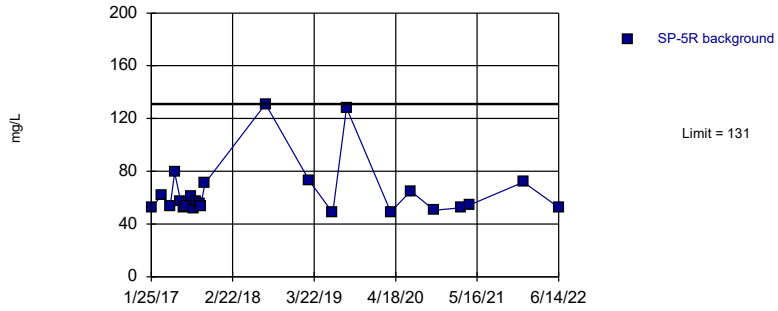
Prediction Limit

Intrawell Non-parametric, SP-5R (bg)



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 24 background values. Well-constituent pair annual alpha = 0.006238. Individual comparison alpha = 0.003124 (1 of 2). Assumes 1 future value.

Constituent: Calcium Analysis Run 2/10/2023 1:30 PM View: Intrawell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE G
Upgradient Well Trend Tests

Trend Tests - Upgradient Wells - Significant Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:42 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron (mg/L)	**SP-4 (bg)**	**-0.0147**	**-137**	**-111**	**Yes**	**25**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Boron (mg/L)	**SP-5R (bg)**	**-0.01018**	**-115**	**-111**	**Yes**	**25**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride (mg/L)	**SP-5R (bg)**	**32.49**	**100**	**92**	**Yes**	**22**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate (mg/L)	**SP-4 (bg)**	**5.516**	**35**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**

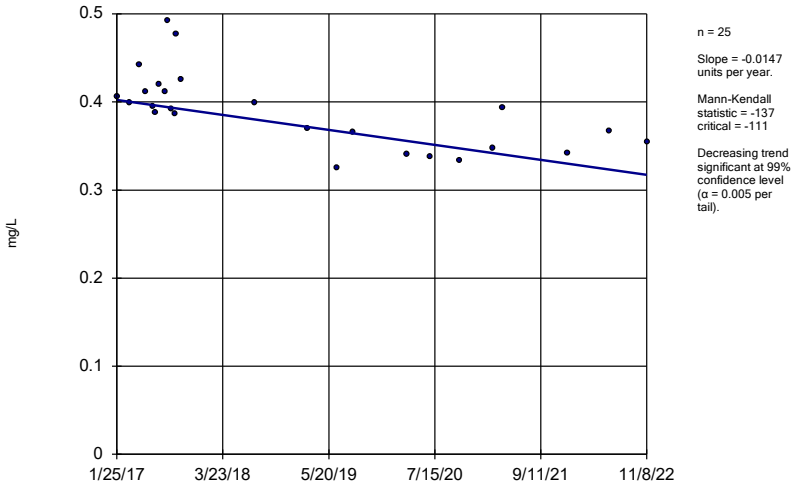
Trend Tests - Upgradient Wells - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:42 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron (mg/L)	**SP-4 (bg)**	**-0.0147**	**-137**	**-111**	**Yes**	**25**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Boron (mg/L)	**SP-5R (bg)**	**-0.01018**	**-115**	**-111**	**Yes**	**25**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride (mg/L)	SP-4 (bg)	0.4207	7	98	No	23	0	n/a	n/a	0.01	NP
Chloride (mg/L)	**SP-5R (bg)**	**32.49**	**100**	**92**	**Yes**	**22**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Fluoride (mg/L)	SP-4 (bg)	0.006073	12	118	No	26	3.846	n/a	n/a	0.01	NP
Fluoride (mg/L)	SP-5R (bg)	0.006591	15	118	No	26	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	**SP-4 (bg)**	**5.516**	**35**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate (mg/L)	SP-5R (bg)	0.6152	13	34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	SP-4 (bg)	0.33	12	105	No	24	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	SP-5R (bg)	34.4	73	98	No	23	0	n/a	n/a	0.01	NP

Sen's Slope Estimator

SP-4 (bg)



n = 25

Slope = -0.0147 units per year.

Mann-Kendall statistic = -137 critical = -111

Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 2/10/2023 1:41 PM View: Trend Tests

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

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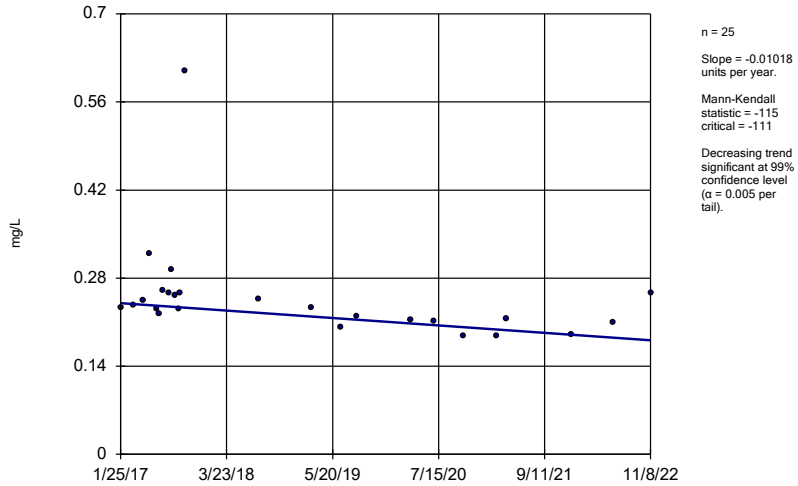
Sen's Slope Estimator

SP-5R (bg)



n = 25

Slope = -0.01018 units per year.

Mann-Kendall statistic = -115 critical = -111

Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

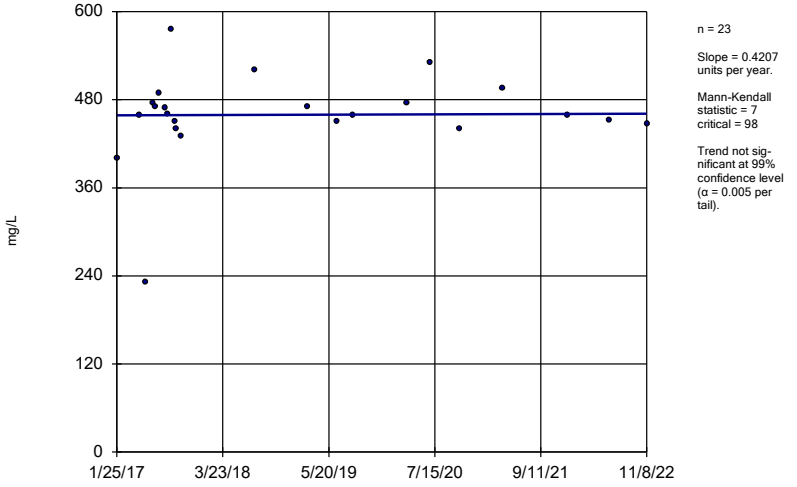
Constituent: Boron Analysis Run 2/10/2023 1:41 PM View: Trend Tests

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Sen's Slope Estimator

SP-4 (bg)



n = 23

Slope = 0.4207 units per year.

Mann-Kendall statistic = 7 critical = 98

Trend not significant at 99% confidence level (α = 0.005 per tail).

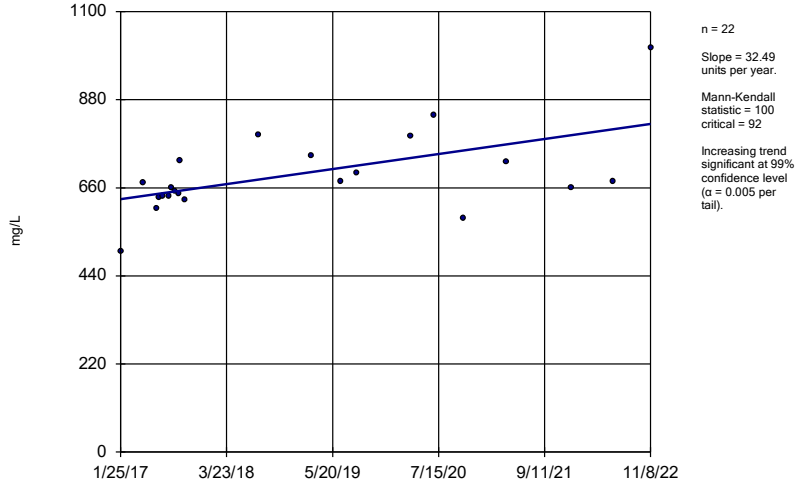
Constituent: Chloride Analysis Run 2/10/2023 1:41 PM View: Trend Tests

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Sen's Slope Estimator

SP-5R (bg)



n = 22

Slope = 32.49 units per year.

Mann-Kendall statistic = 100 critical = 92

Increasing trend significant at 99% confidence level (α = 0.005 per tail).

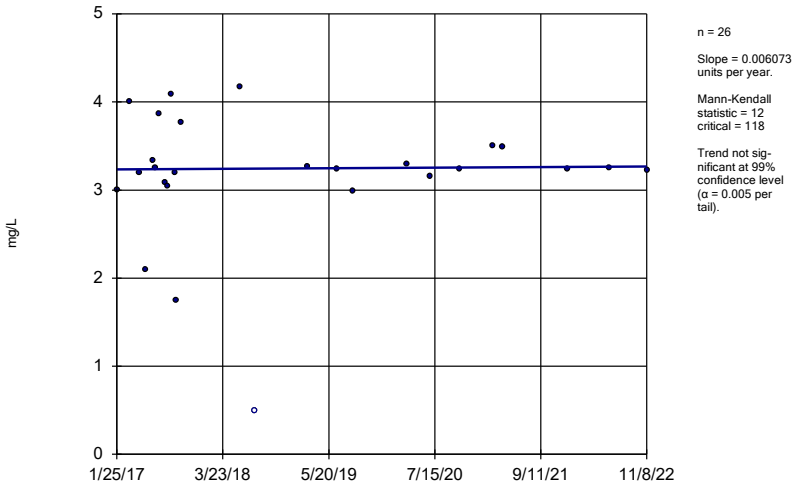
Constituent: Chloride Analysis Run 2/10/2023 1:41 PM View: Trend Tests

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Hollow symbols indicate censored values.

Sen's Slope Estimator

SP-4 (bg)



n = 26

Slope = 0.006073 units per year.

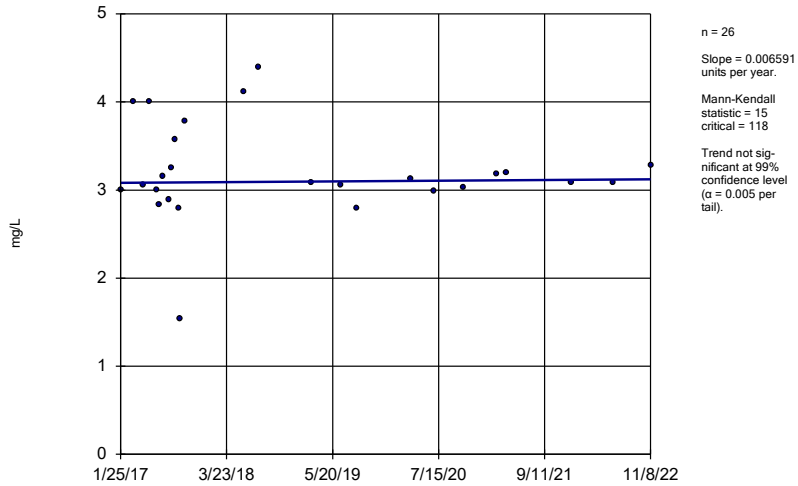
Mann-Kendall statistic = 12
critical = 118

Trend not sig-nificant at 99% confidence level (α = 0.005 per tail).

Constituent: Fluoride Analysis Run 2/10/2023 1:41 PM View: Trend Tests
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sen's Slope Estimator

SP-5R (bg)



n = 26

Slope = 0.006591 units per year.

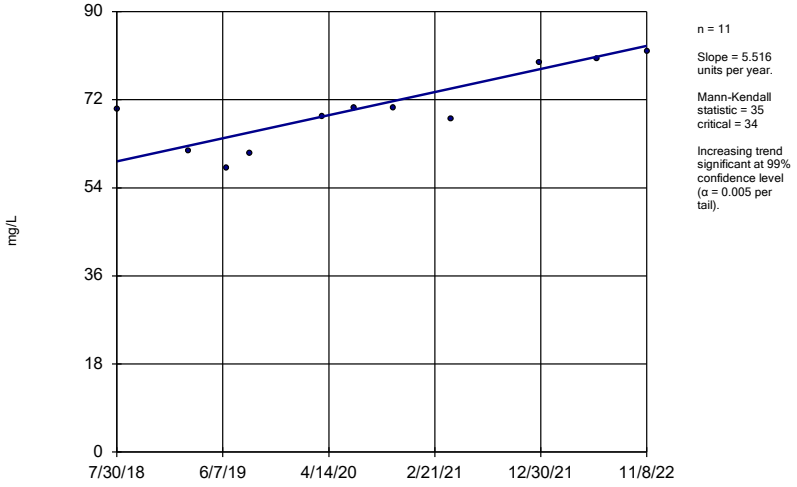
Mann-Kendall statistic = 15
critical = 118

Trend not sig-nificant at 99% confidence level (α = 0.005 per tail).

Constituent: Fluoride Analysis Run 2/10/2023 1:41 PM View: Trend Tests
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sen's Slope Estimator

SP-4 (bg)



n = 11

Slope = 5.516 units per year.

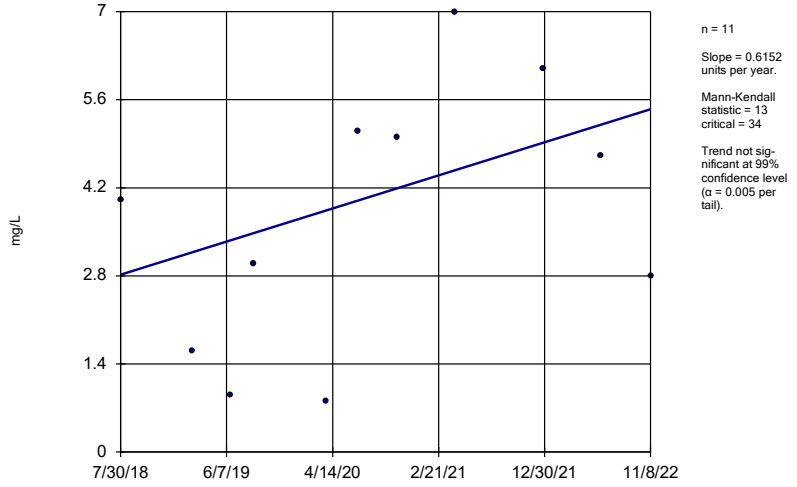
Mann-Kendall statistic = 35
critical = 34

Increasing trend significant at 99% confidence level (α = 0.005 per tail).

Constituent: Sulfate Analysis Run 2/10/2023 1:41 PM View: Trend Tests
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sen's Slope Estimator

SP-5R (bg)



n = 11

Slope = 0.6152 units per year.

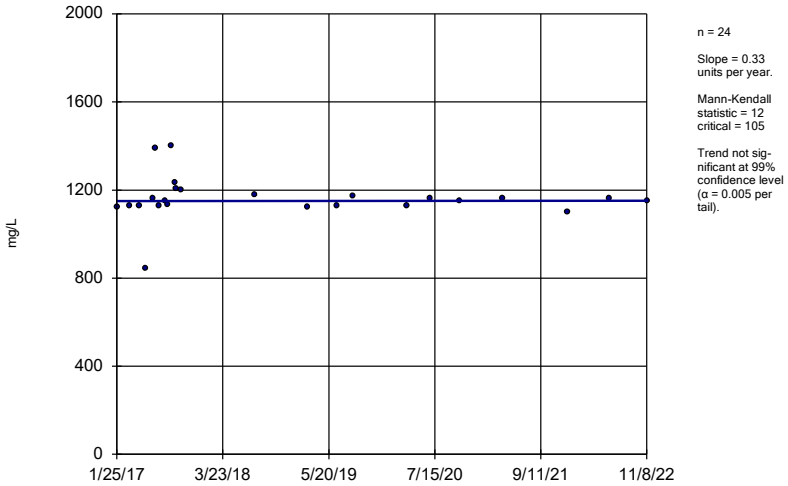
Mann-Kendall statistic = 13
critical = 34

Trend not sig-nificant at 99% confidence level (α = 0.005 per tail).

Constituent: Sulfate Analysis Run 2/10/2023 1:41 PM View: Trend Tests
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sen's Slope Estimator

SP-4 (bg)



n = 24

Slope = 0.33 units per year.

Mann-Kendall statistic = 12 critical = 105

Trend not sig-nificant at 99% confidence level (α = 0.005 per tail).

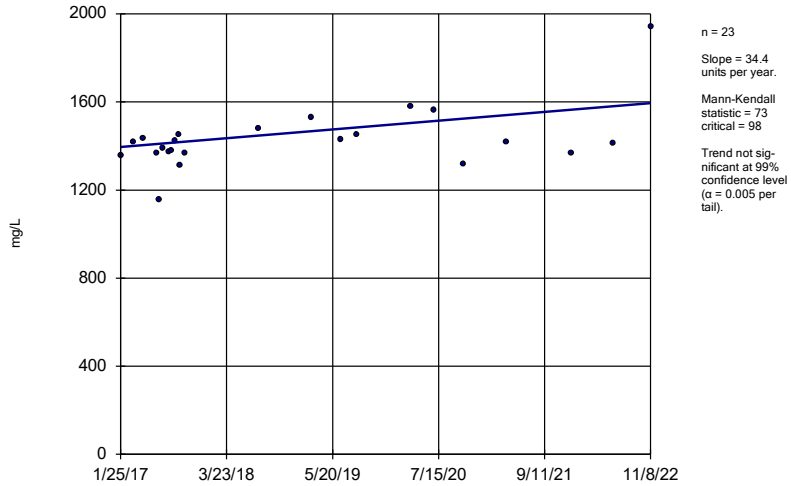
Constituent: Total Dissolved Solids [TDS] Analysis Run 2/10/2023 1:41 PM View: Trend Tests

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Sen's Slope Estimator

SP-5R (bg)



n = 23

Slope = 34.4 units per year.

Mann-Kendall statistic = 73 critical = 98

Trend not sig-nificant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids [TDS] Analysis Run 2/10/2023 1:41 PM View: Trend Tests

Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE H
Interwell PLs

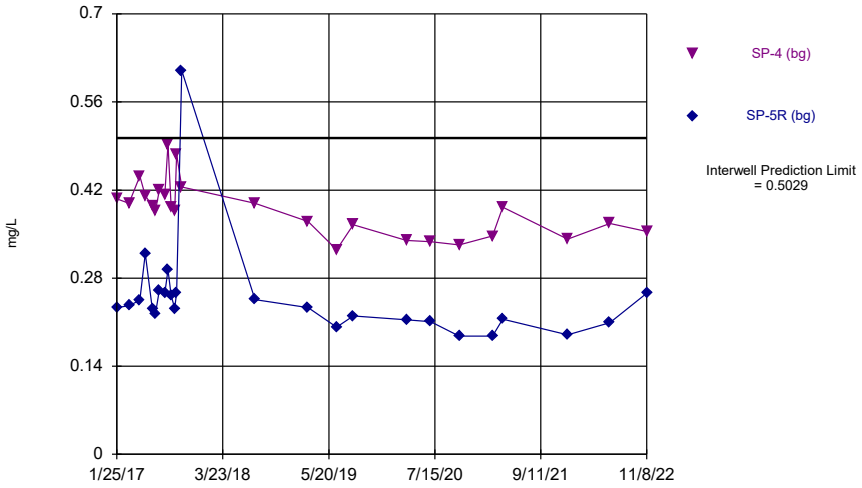
Interwell Prediction Limits - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/10/2023, 1:44 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron (mg/L)	n/a	0.5029	n/a	n/a	4 future	n/a	50	0.5585	0.08359	0	None	sqrt(x)	0.00188	Param Inter 1 of 2
Chloride (mg/L)	n/a	833.5	n/a	n/a	4 future	n/a	45	572.2	143.9	0	None	No	0.00188	Param Inter 1 of 2
Fluoride (mg/L)	n/a	4.39	n/a	n/a	4 future	n/a	52	n/a	n/a	1.923	n/a	n/a	0.000701	NP Inter (normality) 1 of 2
pH, field (SU)	n/a	9.05	6.96	n/a	4 future	n/a	48	n/a	n/a	0	n/a	n/a	0.001648	NP Inter (normality) 1 of 2
Sulfate (mg/L)	n/a	81.9	n/a	n/a	4 future	n/a	22	n/a	n/a	0	n/a	n/a	0.003544	NP Inter (normality) 1 of 2
Total Dissolved Solids [TDS] (mg/L)	n/a	1637	n/a	n/a	4 future	n/a	47	10.87	0.5051	0	None	x^(1/3)	0.00188	Param Inter 1 of 2

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

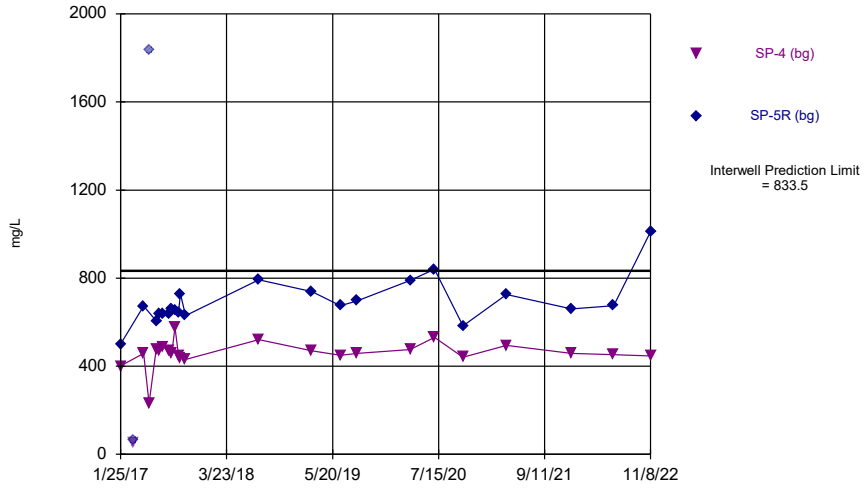
Time Series



Constituent: Boron Analysis Run 2/13/2023 1:21 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

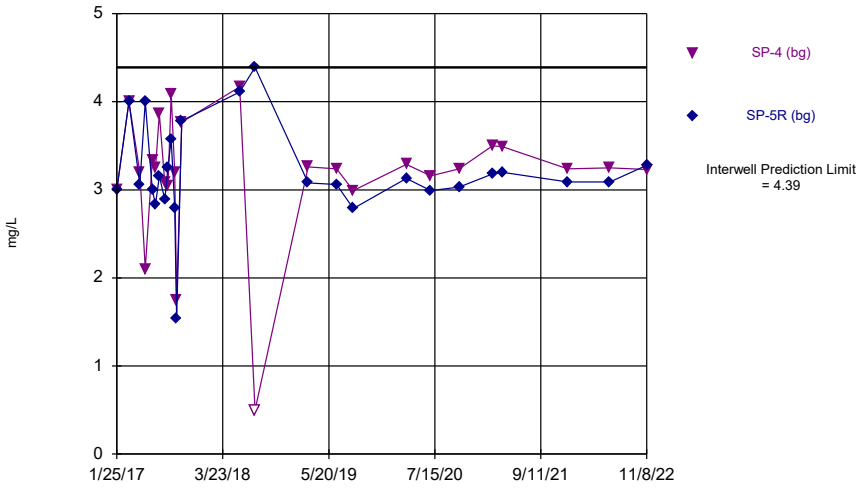
Time Series



Constituent: Chloride Analysis Run 2/13/2023 1:21 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

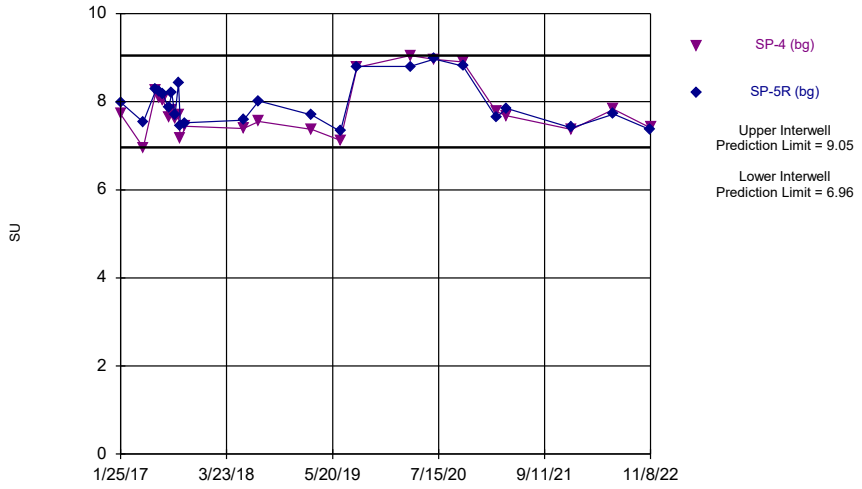
Time Series



Constituent: Fluoride Analysis Run 2/13/2023 1:21 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

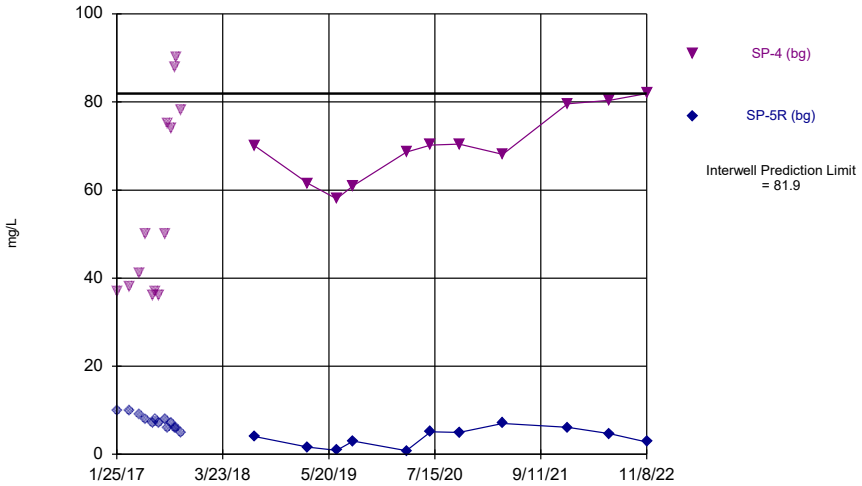
Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Time Series



Constituent: pH, field Analysis Run 2/13/2023 1:22 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

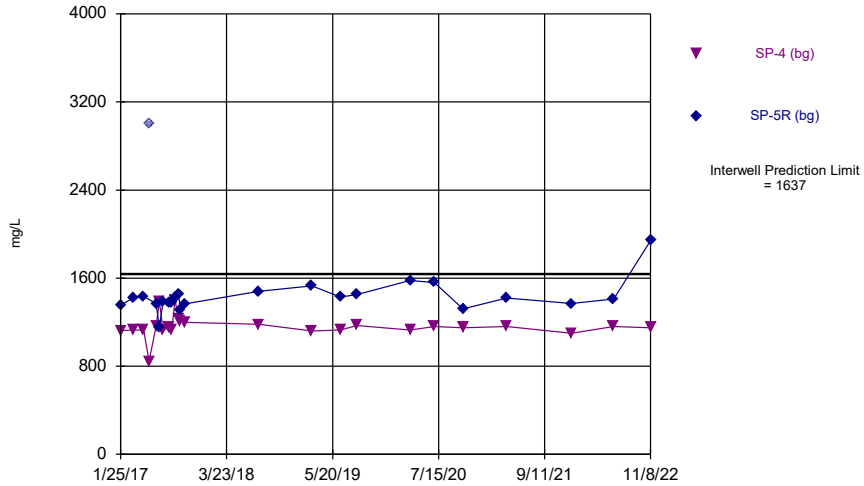
Time Series



Constituent: Sulfate Analysis Run 2/13/2023 1:23 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

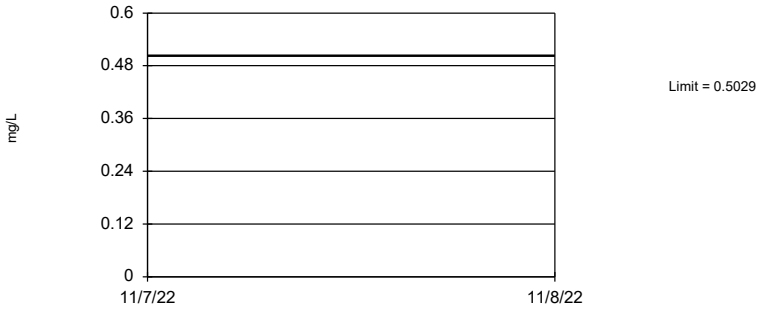
Time Series



Constituent: Total Dissolved Solids [TDS] Analysis Run 2/13/2023 1:23 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Prediction Limit

Interwell Parametric



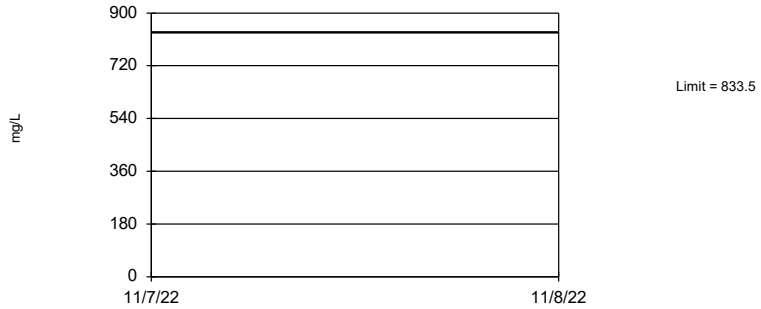
Background Data Summary (based on square root transformation): Mean=0.5585, Std. Dev.=0.08359, n=50. Normality test: Shapiro Francia @alpha = 0.01, calculated = 0.9478, critical = 0.935. Kappa = 1.802 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.00188. Assumes 4 future values.

Constituent: Boron Analysis Run 2/10/2023 1:42 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Prediction Limit

Interwell Parametric



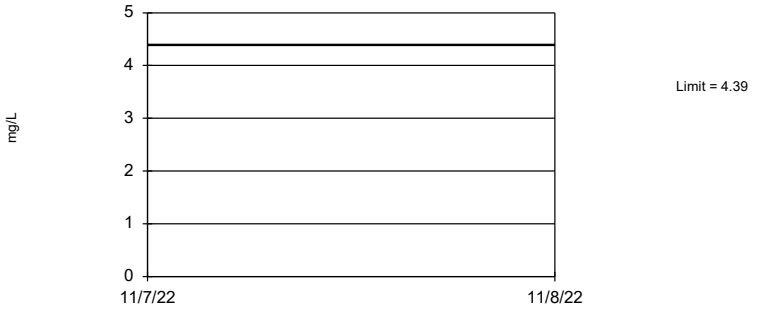
Background Data Summary: Mean=572.2, Std. Dev.=143.9, n=45. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9407, critical = 0.926. Kappa = 1.816 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.00188. Assumes 4 future values.

Constituent: Chloride Analysis Run 2/10/2023 1:42 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Prediction Limit

Interwell Non-parametric



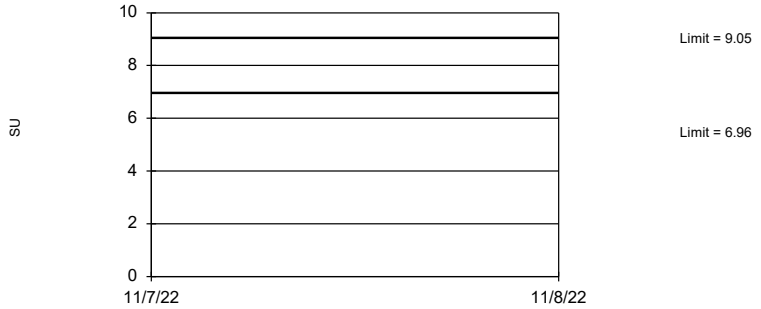
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Francia normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 52 background values. 1.923% NDs. Annual per-constituent alpha = 0.005594. Individual comparison alpha = 0.000701 (1 of 2). Assumes 4 future values.

Constituent: Fluoride Analysis Run 2/10/2023 1:42 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Prediction Limit

Interwell Non-parametric

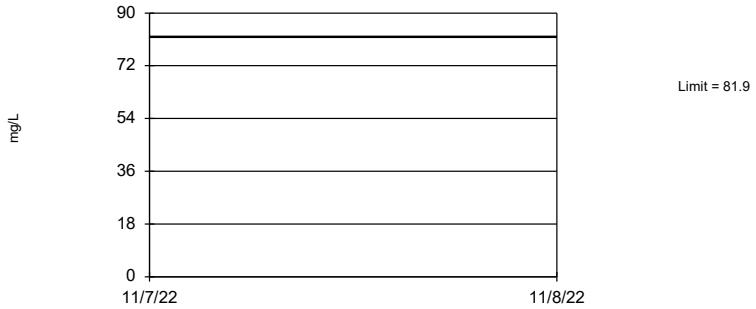


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 48 background values. Annual per-constituent alpha = 0.01315. Individual comparison alpha = 0.001648 (1 of 2). Assumes 4 future values.

Constituent: pH, field Analysis Run 2/10/2023 1:42 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Prediction Limit

Interwell Non-parametric



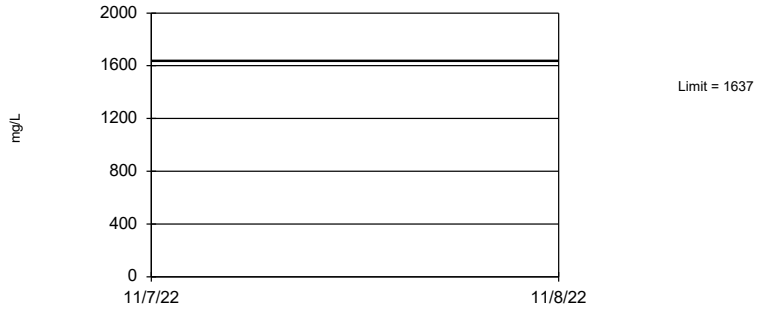
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 22 background values. Annual per-constituent alpha = 0.028. Individual comparison alpha = 0.003544 (1 of 2). Assumes 4 future values.

Constituent: Sulfate Analysis Run 2/10/2023 1:42 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Prediction Limit

Interwell Parametric



Background Data Summary (based on cube root transformation): Mean=10.87, Std. Dev.=0.5051, n=47. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9284, critical = 0.928. Kappa = 1.81 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.00188. Assumes 4 future values.

Constituent: Total Dissolved Solids [TDS] Analysis Run 2/10/2023 1:42 PM View: Interwell
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE

UTLs

Upper Tolerance Limits Summary Table

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/13/2023, 11:12 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony (mg/L)	n/a	0.005698	n/a	n/a	n/a	n/a 50	-7.963	1.354	34	Kaplan-Meier	ln(x)	0.05	Inter
Arsenic (mg/L)	n/a	0.0599	n/a	n/a	n/a	n/a 49	n/a	n/a	6.122	n/a	n/a	0.08099	NP Inter(normality)
Barium (mg/L)	n/a	2.6	n/a	n/a	n/a	n/a 38	n/a	n/a	0	n/a	n/a	0.1424	NP Inter(normality)
Beryllium (mg/L)	n/a	0.00212	n/a	n/a	n/a	n/a 49	n/a	n/a	20.41	n/a	n/a	0.08099	NP Inter(normality)
Cadmium (mg/L)	n/a	0.0002066	n/a	n/a	n/a	n/a 26	-10.48	0.8742	23.08	Kaplan-Meier	ln(x)	0.05	Inter
Chromium (mg/L)	n/a	0.003419	n/a	n/a	n/a	n/a 38	-7.327	0.7698	13.16	None	ln(x)	0.05	Inter
Cobalt (mg/L)	n/a	0.01786	n/a	n/a	n/a	n/a 49	n/a	n/a	10.2	n/a	n/a	0.08099	NP Inter(normality)
Combined Radium 226 + 228 (pCi/L)	n/a	15.84	n/a	n/a	n/a	n/a 49	n/a	n/a	0	n/a	n/a	0.08099	NP Inter(normality)
Fluoride (mg/L)	n/a	4.39	n/a	n/a	n/a	n/a 52	n/a	n/a	1.923	n/a	n/a	0.06944	NP Inter(normality)
Lead (mg/L)	n/a	0.0107	n/a	n/a	n/a	n/a 49	n/a	n/a	26.53	n/a	n/a	0.08099	NP Inter(normality)
Lithium (mg/L)	n/a	0.163	n/a	n/a	n/a	n/a 38	n/a	n/a	0	n/a	n/a	0.1424	NP Inter(normality)
Mercury (mg/L)	n/a	0.00003	n/a	n/a	n/a	n/a 49	n/a	n/a	73.47	n/a	n/a	0.08099	NP Inter(NDs)
Molybdenum (mg/L)	n/a	0.01	n/a	n/a	n/a	n/a 50	n/a	n/a	34	n/a	n/a	0.07694	NP Inter(normality)
Selenium (mg/L)	n/a	0.00499	n/a	n/a	n/a	n/a 38	n/a	n/a	31.58	n/a	n/a	0.1424	NP Inter(normality)
Thallium (mg/L)	n/a	0.00162	n/a	n/a	n/a	n/a 26	n/a	n/a	88.46	n/a	n/a	0.2635	NP Inter(NDs)

Tolerance Limit

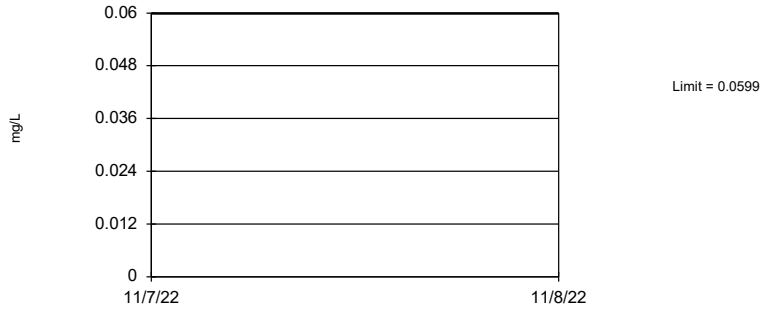
Interwell Parametric

95% coverage. Background Data Summary (based on natural log transformation) (after Kaplan-Meier Adjustment): Mean=-7.963, Std. Dev.=1.354, n=50, 34% NDs. Normality test: Shapiro Francia @alpha = 0.01, calculated = 0.9543, critical = 0.935. Report alpha = 0.05.

Constituent: Antimony Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric

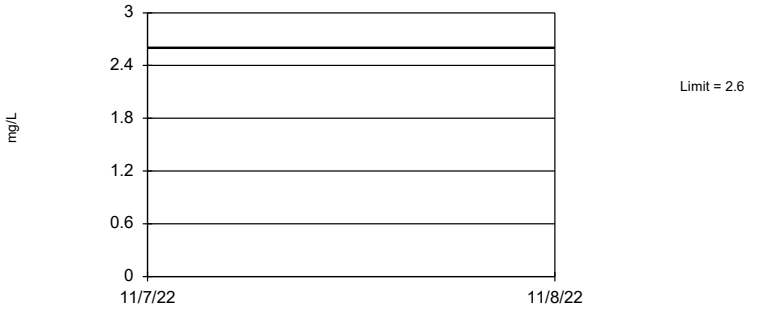


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 6.122% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Arsenic Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric

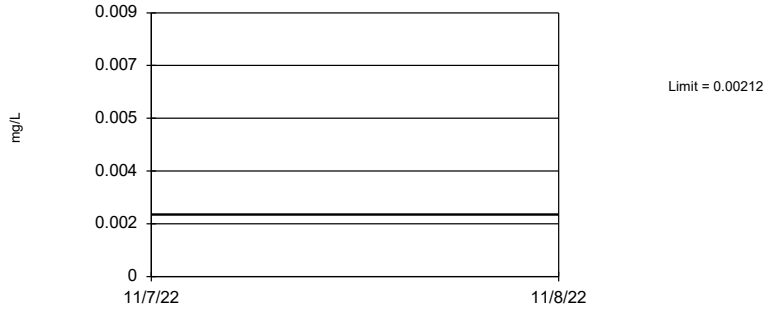


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 38 background values. 88.48% coverage at alpha=0.01; 92.38% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1424.

Constituent: Barium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric

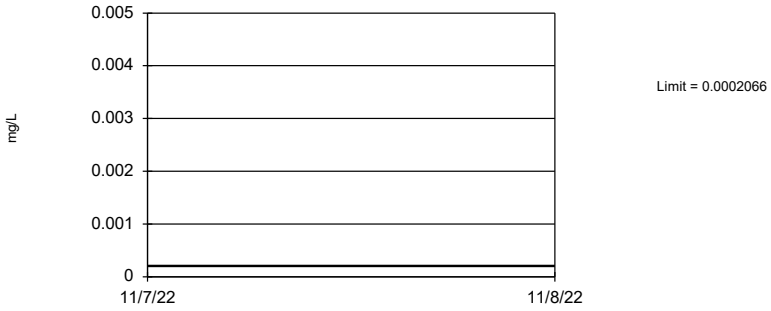


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 20.41% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Beryllium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Parametric



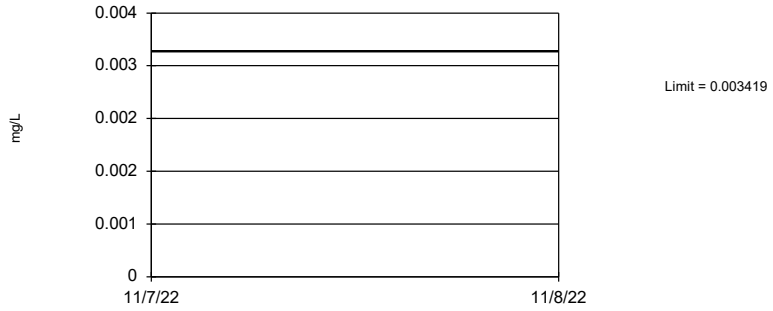
95% coverage. Background Data Summary (based on natural log transformation) (after Kaplan-Meier Adjustment): Mean=-10.48, Std. Dev.=0.8742, n=26, 23.08% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9372, critical = 0.891. Report alpha = 0.05.

Constituent: Cadmium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Parametric



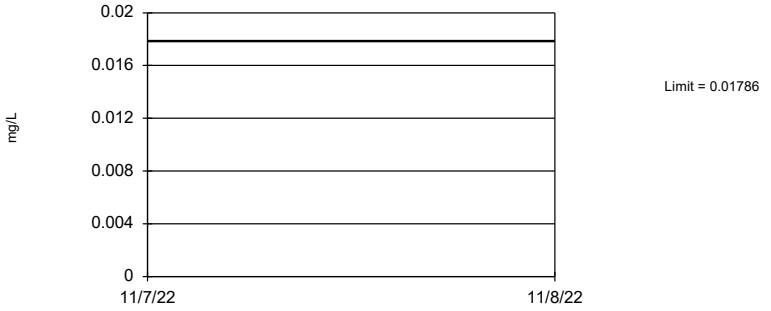
95% coverage. Background Data Summary (based on natural log transformation): Mean=-7.327, Std. Dev.=0.7698, n=38, 13.16% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9508, critical = 0.916. Report alpha = 0.05.

Constituent: Chromium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



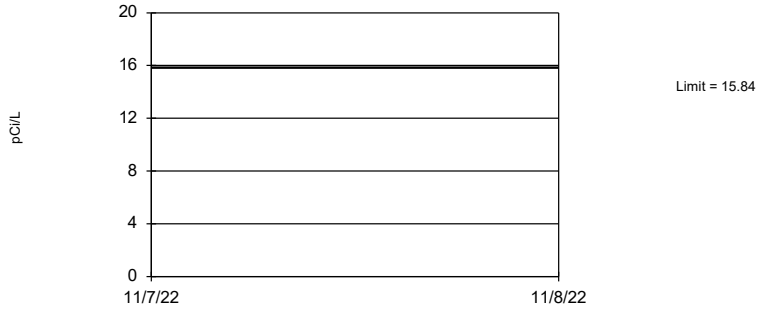
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 10.2% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Cobalt Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric

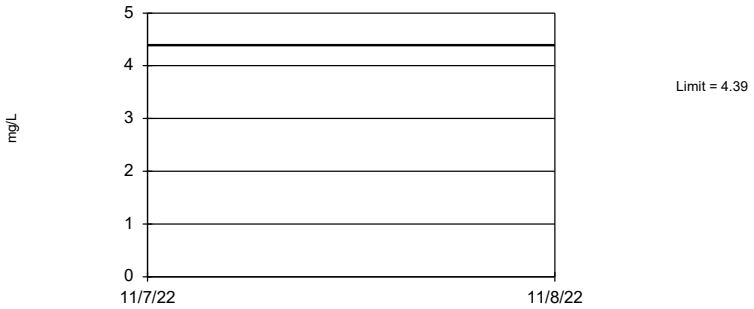


Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Combined Radium 226 + 228 Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limit
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric



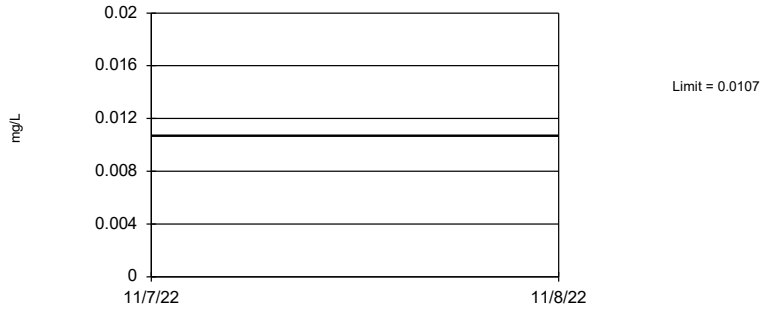
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Francia normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 52 background values. 1.923% NDs. 91.6% coverage at alpha=0.01; 94.34% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.06944.

Constituent: Fluoride Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



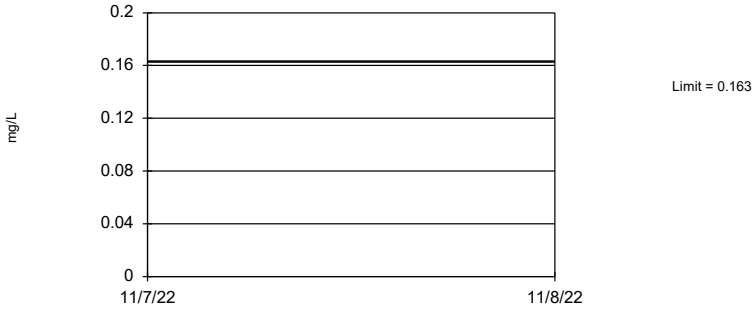
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 49 background values. 26.53% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Lead Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



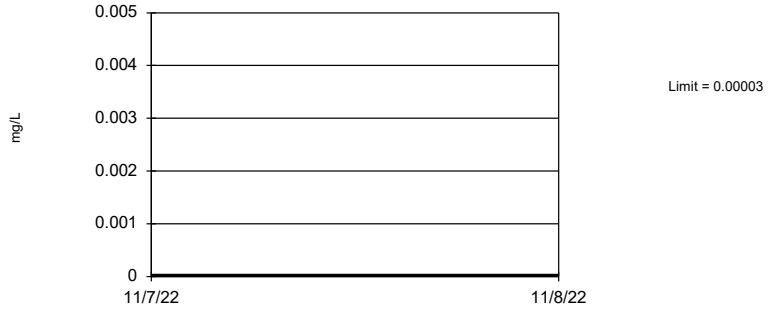
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 38 background values. 88.48% coverage at alpha=0.01; 92.38% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1424.

Constituent: Lithium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric

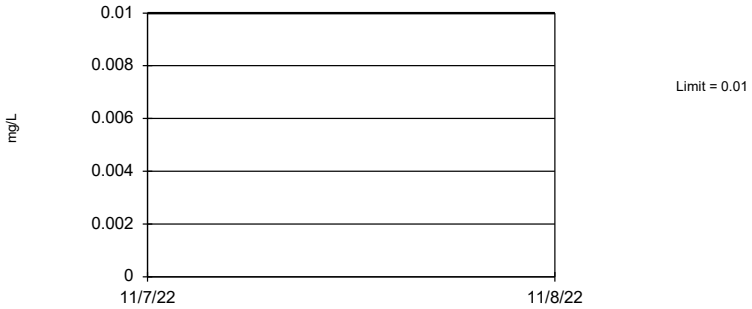


Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Limit is highest of 49 background values. 73.47% NDs. 91.21% coverage at alpha=0.01; 93.95% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.08099.

Constituent: Mercury Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Francia normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 50 background values. 34% NDs. 91.21% coverage at alpha=0.01; 94.34% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.07694.

Constituent: Molybdenum Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

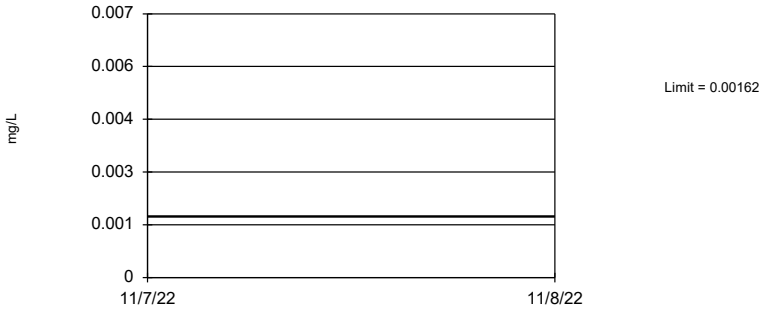
Interwell Non-parametric

Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 38 background values. 31.58% NDs. 88.48% coverage at alpha=0.01; 92.38% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1424.

Constituent: Selenium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Limit is highest of 26 background values. 88.46% NDs. 83.79% coverage at alpha=0.01; 89.26% coverage at alpha=0.05; 97.46% coverage at alpha=0.5. Report alpha = 0.2635.

Constituent: Thallium Analysis Run 2/13/2023 11:11 AM View: Upper Tolerance Limits
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

FIGURE J

GWPS

NORTHEASTERN BAP GWPS				
Constituent Name	**MCL**	**CCR- Rule Specified Level**	**Background Limit**	**GWPS**
Antimony, Total (mg/L)	0.006		0.0057	0.006
Arsenic, Total (mg/L)	0.01		0.06	0.06
Barium, Total (mg/L)	2		2.6	2.6
Beryllium, Total (mg/L)	0.004		0.0021	0.004
Cadmium, Total (mg/L)	0.005		0.00021	0.005
Chromium, Total (mg/L)	0.1		0.034	0.1
Cobalt, Total (mg/L)	n/a	0.006	0.018	0.018
Combined Radium, Total (pCi/L)	5		15.84	15.84
Fluoride, Total (mg/L)	4		4.39	4.39
Lead, Total (mg/L)	n/a	0.015	0.011	0.015
Lithium, Total (mg/L)	n/a	0.04	0.16	0.16
Mercury, Total (mg/L)	0.002		0.00003	0.002
Molybdenum, Total (mg/L)	n/a	0.1	0.01	0.1
Selenium, Total (mg/L)	0.05		0.005	0.05
Thallium, Total (mg/L)	0.002		0.0016	0.002

**Grey cell indicates Background Limit is higher than MCL*

**GWPS = Groundwater Protection Standard*

**MCL = Maximum Contaminant Level*

**CCR = Coal Combustion Residuals*

FIGURE K
Confidence Intervals

Confidence Intervals - Significant Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/13/2023, 11:23 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Barium (mg/L)	**SP-10**	**6.485**	**3.978**	**2.6**	**Yes**	**14**	**5.231**	**1.77**	**0**	**None**	**No**	**0.01**	**Param.**
Fluoride (mg/L)	**SP-10**	**7.192**	**5.309**	**4.39**	**Yes**	**24**	**5.877**	**2.377**	**12.5**	**None**	**x^2**	**0.01**	**Param.**
Lithium (mg/L)	**SP-10**	**0.2823**	**0.2403**	**0.16**	**Yes**	**22**	**0.2613**	**0.03909**	**0**	**None**	**No**	**0.01**	**Param.**

Confidence Intervals - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/13/2023, 11:23 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony (mg/L)	SP-1	0.005	0.00058	0.006	No	25	0.002273	0.002164	28	None	No	0.01	NP (normality)
Antimony (mg/L)	SP-10	0.0007107	0.0001324	0.006	No	22	0.001619	0.001957	18.18	Kaplan-Meier	ln(x)	0.01	Param.
Antimony (mg/L)	SP-11	0.001559	0.0003001	0.006	No	22	0.002024	0.002877	13.64	None	ln(x)	0.01	Param.
Antimony (mg/L)	SP-2	0.00267	0.00121	0.006	No	25	0.002628	0.002529	8	None	No	0.01	NP (normality)
Arsenic (mg/L)	SP-1	0.005	0.0007	0.06	No	25	0.002426	0.00205	32	None	No	0.01	NP (normality)
Arsenic (mg/L)	SP-10	0.005196	0.00131	0.06	No	22	0.003998	0.00442	9.091	None	sqrt(x)	0.01	Param.
Arsenic (mg/L)	SP-11	0.005082	0.002312	0.06	No	22	0.004009	0.002956	4.545	None	sqrt(x)	0.01	Param.
Arsenic (mg/L)	SP-2	0.00251	0.00125	0.06	No	25	0.002578	0.002526	4	None	No	0.01	NP (normality)
Barium (mg/L)	SP-1	0.2014	0.1659	2.6	No	25	0.1848	0.03747	0	None	sqrt(x)	0.01	Param.
Barium (mg/L)	**SP-10**	**6.485**	**3.978**	**2.6**	**Yes**	**14**	**5.231**	**1.77**	**0**	**None**	**No**	**0.01**	**Param.**
Barium (mg/L)	SP-11	0.4198	0.1877	2.6	No	14	0.3136	0.1734	0	None	sqrt(x)	0.01	Param.
Barium (mg/L)	SP-2	1.348	0.9779	2.6	No	25	1.215	0.4905	0	None	ln(x)	0.01	Param.
Beryllium (mg/L)	SP-1	0.0002	0.000054	0.004	No	25	0.0002708	0.0003755	20	None	No	0.01	NP (normality)
Beryllium (mg/L)	SP-10	0.0025	0.00003	0.004	No	22	0.0008215	0.001174	31.82	None	No	0.01	NP (normality)
Beryllium (mg/L)	SP-11	0.00025	0.000029	0.004	No	22	0.0001598	0.0001332	31.82	None	No	0.01	NP (normality)
Beryllium (mg/L)	SP-2	0.00018	0.00007	0.004	No	25	0.0002432	0.0003408	16	None	No	0.01	NP (normality)
Cadmium (mg/L)	SP-1	0.00025	0.000055	0.005	No	14	0.0001289	0.0001258	14.29	None	No	0.01	NP (normality)
Cadmium (mg/L)	SP-10	0.0002	0.00001	0.005	No	14	0.00006429	0.0000761	21.43	None	No	0.01	NP (normality)
Cadmium (mg/L)	SP-11	0.0003193	0.00004378	0.005	No	22	0.0005352	0.0009452	13.64	None	ln(x)	0.01	Param.
Cadmium (mg/L)	SP-2	0.0005	0.000063	0.005	No	25	0.0002629	0.0002082	40	None	No	0.01	NP (normality)
Chromium (mg/L)	SP-1	0.001131	0.0005386	0.1	No	25	0.001032	0.0006777	24	Kaplan-Meier	sqrt(x)	0.01	Param.
Chromium (mg/L)	SP-10	0.001021	0.0003153	0.1	No	21	0.001086	0.001867	9.524	None	ln(x)	0.01	Param.
Chromium (mg/L)	SP-11	0.003875	0.0006394	0.1	No	22	0.006307	0.01088	4.545	None	ln(x)	0.01	Param.
Chromium (mg/L)	SP-2	0.00152	0.0006052	0.1	No	25	0.001211	0.00111	12	None	sqrt(x)	0.01	Param.
Cobalt (mg/L)	SP-1	0.001235	0.000497	0.018	No	25	0.001047	0.001133	12	None	x^(1/3)	0.01	Param.
Cobalt (mg/L)	SP-10	0.002076	0.0004679	0.018	No	22	0.001604	0.001808	9.091	None	sqrt(x)	0.01	Param.
Cobalt (mg/L)	SP-11	0.004854	0.001412	0.018	No	22	0.004032	0.004522	4.545	None	x^(1/3)	0.01	Param.
Cobalt (mg/L)	SP-2	0.001045	0.0004629	0.018	No	25	0.0008764	0.0007563	12	None	x^(1/3)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-1	4.296	3.2	15.84	No	24	3.748	1.074	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-10	15.45	5.923	15.84	No	22	10.69	8.877	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-11	2.316	1.151	15.84	No	21	1.733	1.056	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	SP-2	14.14	8.859	15.84	No	22	11.85	5.446	0	None	sqrt(x)	0.01	Param.
Fluoride (mg/L)	SP-1	0.9392	0.6814	4.39	No	25	0.8103	0.2586	8	None	No	0.01	Param.
Fluoride (mg/L)	**SP-10**	**7.192**	**5.309**	**4.39**	**Yes**	**24**	**5.877**	**2.377**	**12.5**	**None**	**x^2**	**0.01**	**Param.**
Fluoride (mg/L)	SP-11	3.237	2.226	4.39	No	24	2.731	0.9909	0	None	No	0.01	Param.
Fluoride (mg/L)	SP-2	3.179	2.674	4.39	No	26	2.882	0.5786	0	None	x^2	0.01	Param.
Lead (mg/L)	SP-1	0.005	0.000259	0.015	No	25	0.002073	0.002113	32	None	No	0.01	NP (normality)
Lead (mg/L)	SP-10	0.0003457	0.0000864	0.015	No	14	0.0002815	0.0003238	14.29	None	ln(x)	0.01	Param.
Lead (mg/L)	SP-11	0.001678	0.000324	0.015	No	22	0.001997	0.002719	13.64	None	ln(x)	0.01	Param.
Lead (mg/L)	SP-2	0.005	0.000263	0.015	No	25	0.002172	0.002212	36	None	No	0.01	NP (normality)
Lithium (mg/L)	SP-1	0.006209	0.004617	0.16	No	24	0.005413	0.00156	0	None	No	0.01	Param.
Lithium (mg/L)	**SP-10**	**0.2823**	**0.2403**	**0.16**	**Yes**	**22**	**0.2613**	**0.03909**	**0**	**None**	**No**	**0.01**	**Param.**
Lithium (mg/L)	SP-11	0.04207	0.02304	0.16	No	14	0.03256	0.01344	0	None	No	0.01	Param.
Lithium (mg/L)	SP-2	0.08145	0.0556	0.16	No	25	0.06852	0.02593	0	None	No	0.01	Param.
Mercury (mg/L)	SP-1	0.000009	0.000005	0.002	No	25	0.00000624	0.000003778	84	None	No	0.01	NP (NDs)
Mercury (mg/L)	SP-10	0.000015	0.000005	0.002	No	22	0.000009727	0.000007369	54.55	None	No	0.01	NP (NDs)
Mercury (mg/L)	SP-11	0.00001	0.000005	0.002	No	22	0.0000115	0.00001305	40.91	None	No	0.01	NP (normality)
Mercury (mg/L)	SP-2	0.000005	0.000005	0.002	No	25	0.00000544	0.000001805	84	None	No	0.01	NP (NDs)
Molybdenum (mg/L)	SP-1	0.01653	0.01116	0.1	No	25	0.01385	0.005379	0	None	No	0.01	Param.
Molybdenum (mg/L)	SP-10	0.02335	0.003624	0.1	No	21	0.01805	0.02862	4.762	None	sqrt(x)	0.01	Param.
Molybdenum (mg/L)	SP-11	0.04433	0.002	0.1	No	22	0.02026	0.02353	4.545	None	No	0.01	NP (normality)
Molybdenum (mg/L)	SP-2	0.02461	0.01857	0.1	No	14	0.02159	0.004265	0	None	No	0.01	Param.
Selenium (mg/L)	SP-1	0.006629	0.003771	0.05	No	25	0.005487	0.003295	12	None	sqrt(x)	0.01	Param.
Selenium (mg/L)	SP-10	0.0009747	0.00015	0.05	No	22	0.001545	0.0022	40.91	Kaplan-Meier	ln(x)	0.01	Param.
Selenium (mg/L)	SP-11	0.00164	0.000394	0.05	No	22	0.001813	0.002321	9.091	None	ln(x)	0.01	Param.

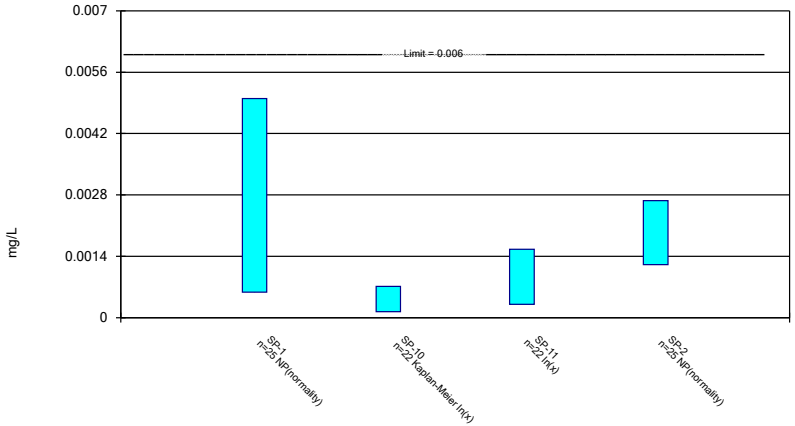
Confidence Intervals - All Results

Northeastern BAP Client: Geosyntec Data: Northeastern BAP Printed 2/13/2023, 11:23 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Selenium (mg/L)	SP-2	0.005112	0.002276	0.05	No	14	0.003814	0.002235	0	None	sqrt(x)	0.01	Param.
Thallium (mg/L)	SP-1	0.002	0.00007	0.002	No	14	0.0003936	0.0005092	42.86	None	No	0.01	NP (normality)
Thallium (mg/L)	SP-10	0.0002	0.00004	0.002	No	14	0.0001886	0.00004276	92.86	None	No	0.01	NP (NDs)
Thallium (mg/L)	SP-11	0.0002	0.00003	0.002	No	14	0.0001879	0.00004543	92.86	None	No	0.01	NP (NDs)
Thallium (mg/L)	SP-2	0.0002	0.00006	0.002	No	14	0.0001521	0.00006762	64.29	None	No	0.01	NP (NDs)

Parametric and Non-Parametric (NP) Confidence Interval

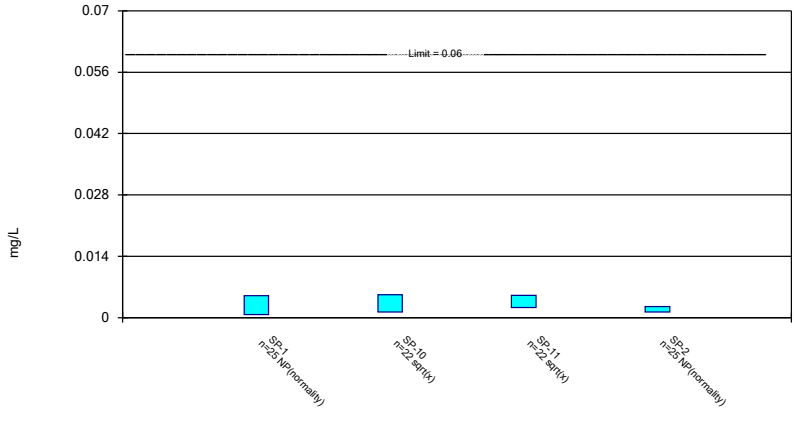
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Antimony Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric and Non-Parametric (NP) Confidence Interval

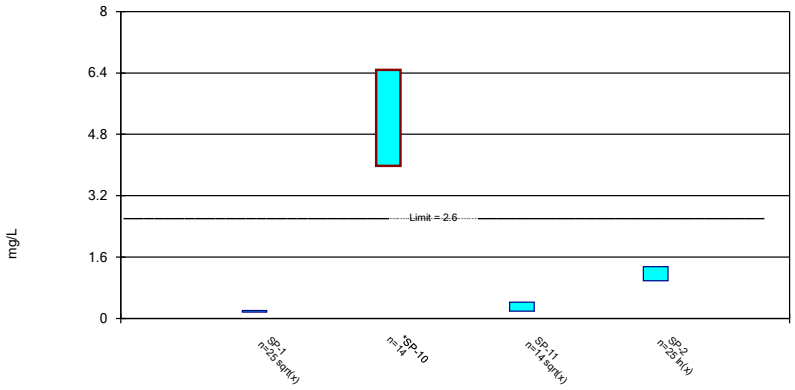
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Arsenic Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

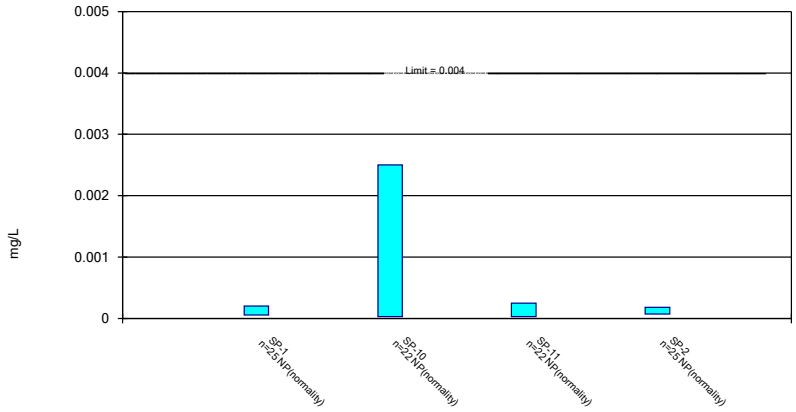
Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Barium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Non-Parametric Confidence Interval

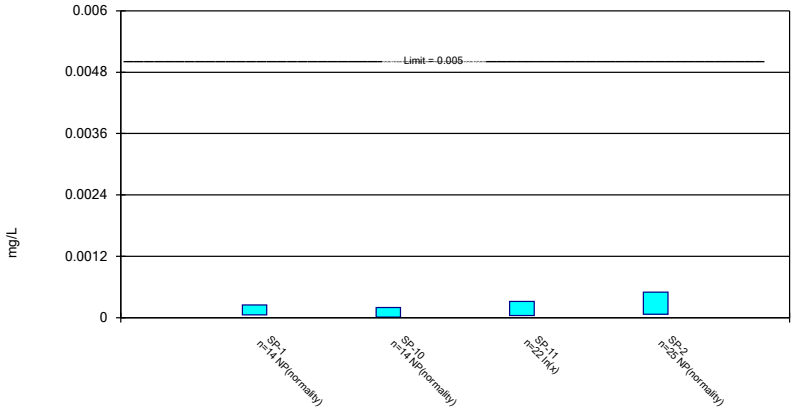
Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Beryllium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric and Non-Parametric (NP) Confidence Interval

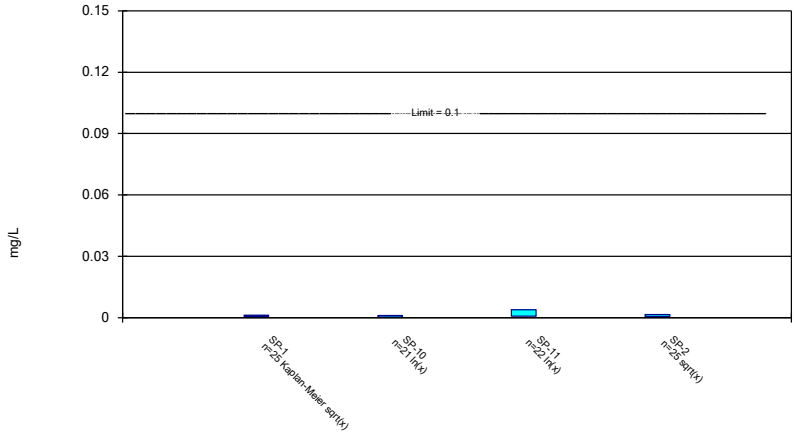
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Cadmium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

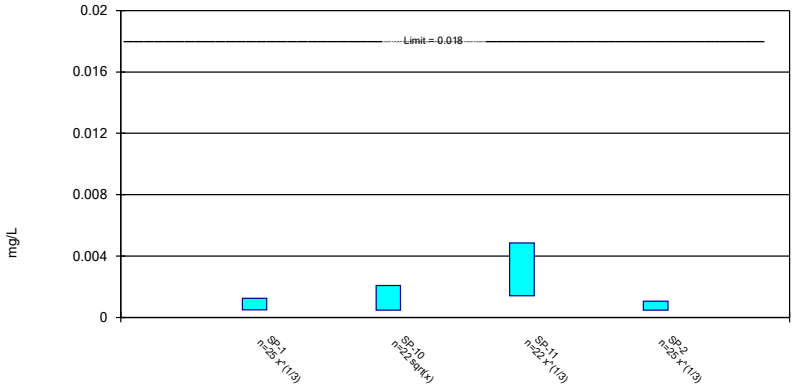
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Chromium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

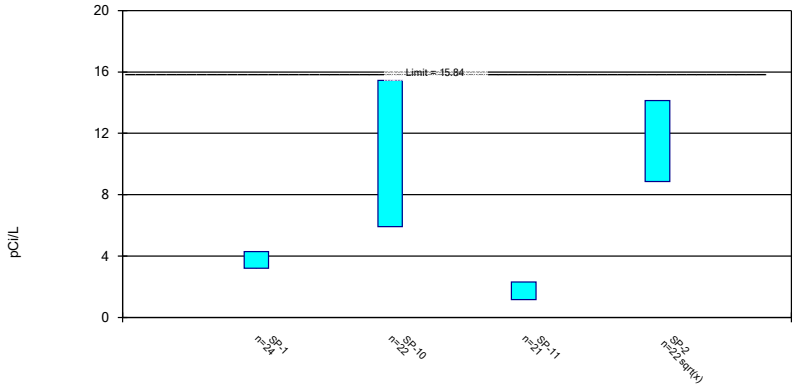
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Cobalt Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

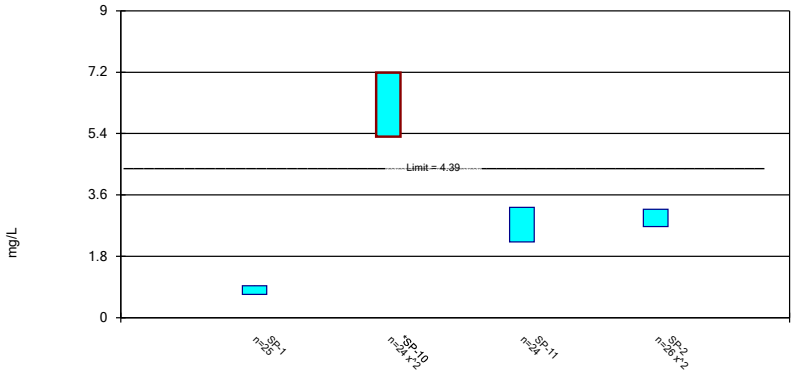


Constituent: Combined Radium 226 + 228 Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

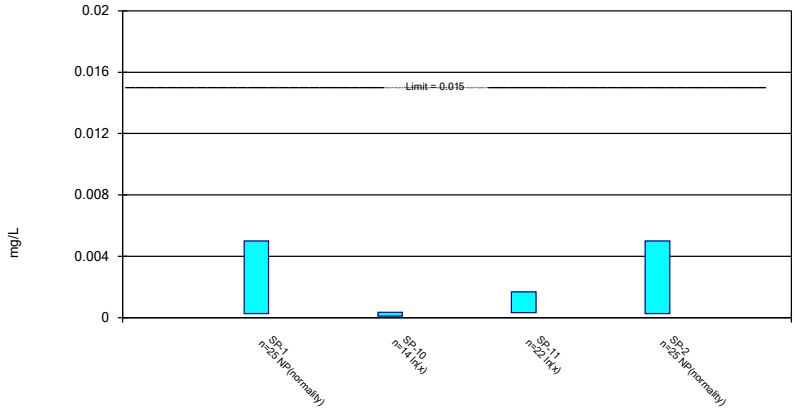


Constituent: Fluoride Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

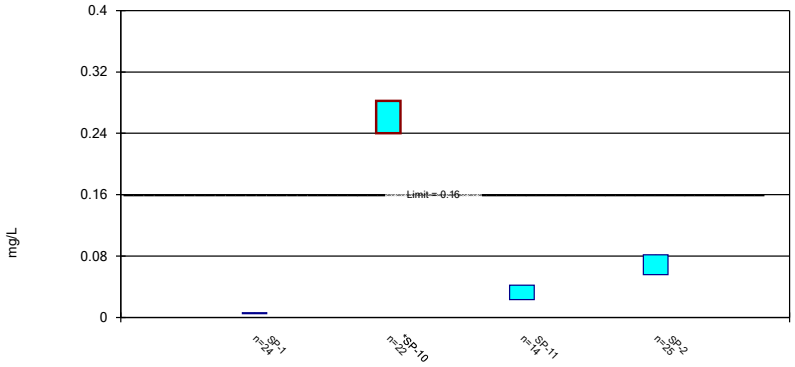


Constituent: Lead Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

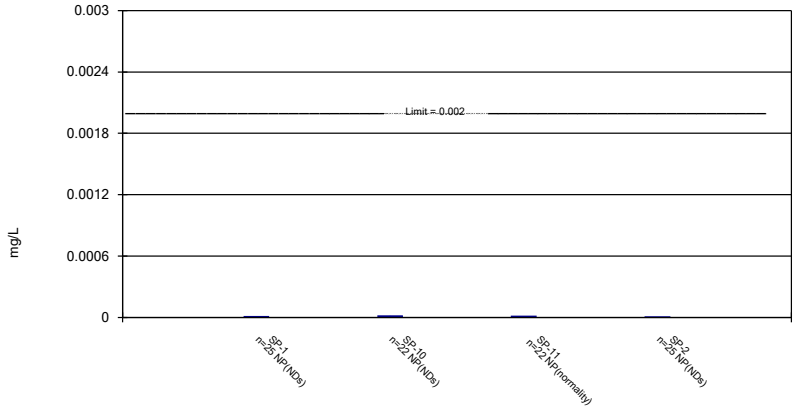


Constituent: Lithium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Sanitas™ v.9.6.36 Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

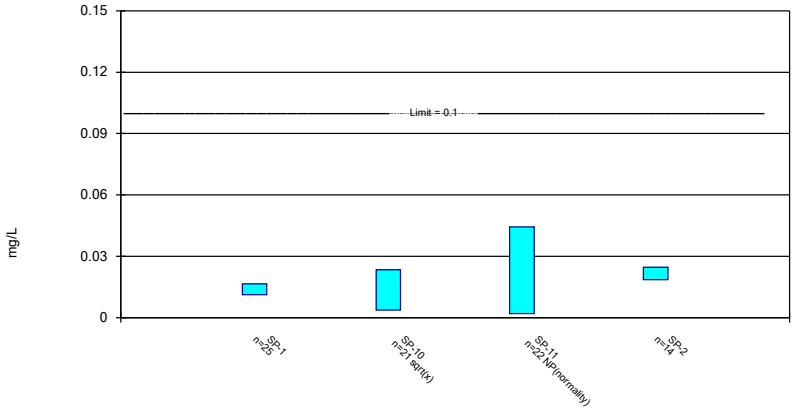
Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Mercury Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric and Non-Parametric (NP) Confidence Interval

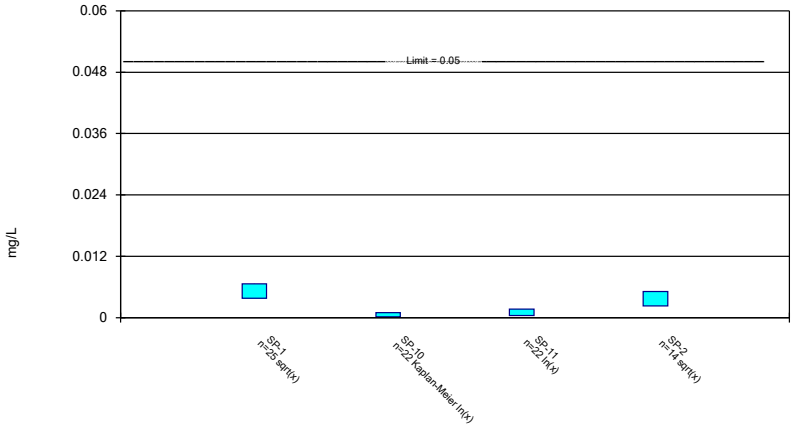
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Molybdenum Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Parametric Confidence Interval

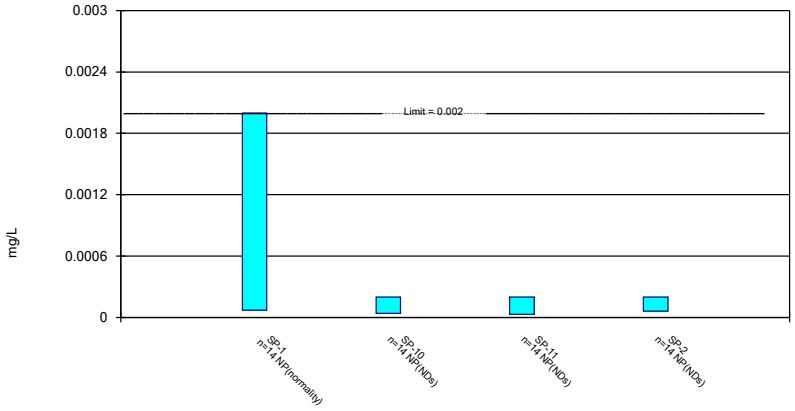
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Selenium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Thallium Analysis Run 2/13/2023 11:21 AM View: Confidence Intervals
Northeastern BAP Client: Geosyntec Data: Northeastern BAP

APPENDIX 6

Groundwater monitoring Field and Laboratory Reports

NORTHEASTERN POWER PLANT
GROUNDWATER SAMPLING DATA FORM

SAMPLED BY: Kenny McDonald/Matt Hamilton . **DATE:** 06/20/23 .

Well Identification Number	SP-1	SP-2	SP-4	SP-5R	SP-10	SP-11
Activities	Gauge	Gauge	Gauge	Gauge	Gauge	Gauge
Samples	Appendix III & IV	Appendix III & IV	Appendix III & IV	Appendix III & IV	Appendix III & IV	Appendix III & IV
Depth to Water (ft)	17.55	21.88	13.58	7.28	12.22	9.60
Measured Depth Total Depth of Well (ft.)	37.99	38.19	38.30	78.00	54.10	34.51
Height of Water Column (ft.)	20.44	16.31	24.72	70.72	41.88	24.91
Well Size (I.D.) (inches)	2	2	2	2	2	2
Volume of Water in Well (gallons)	3.33	2.66	4.03	11.53	6.83	4.06
Water Removed From Well (gallons)	12.50	9.25	9.75	29.00	17.50	7.75
Method of Removal	Pump	Pump	Pump	Pump	Pump	Pump
Was Well Purged Dry?	No	No	Yes	Yes	Yes	Yes
pH (standard units)	7.24	7.30	7.53	7.52	7.46	7.2
Temperature (°C)	20.41	21.73	20.71	22.31	19.83	22.31
Conductivity (µmhos/cc)	742	2,540	2,010	2,960	6,660	1,560
Turbidity (NTU)	8.6	22.1	14.1	20.3	9.3	11.6
Appearance	Clear	Clear	Clear	Clear	Clear	Clear
Odor	None	None	None	None	Sulphur	None
Containers	250 mL HNO3 125 mL HCL 3 x 1L HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 3 x 1L HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 3 x 1L HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 3 x 1L HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 3 x 1L HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 3 x 1L HNO3 1 L Cool 0-6C
Sample Time	1604	1546	1613	1141	1513	1536
Sample Date	6/20/2023	6/20/2023	6/20/2023	6/20/2023	6/20/2023	6/20/2023

BAP Dup 1200

For 2" well multiply by	0.163
For 4" well multiply by	0.653

NORTHEASTERN POWER PLANT
GROUNDWATER SAMPLING DATA FORM

SAMPLED BY: Kenny McDonald/Matt Hamilton . **DATE:** 06/20/23 .

Well Identification Number	SP-3	SP-6	SP-7	SP-8	SP-9	
Activities	Gauge	Gauge	Gauge	Gauge	Gauge	
Samples	NA	NA	NA	NA	NA	
Depth to Water (ft)	15.21	20.88	24.84	6.18	48.17	
Measured Depth Total Depth of Well (ft.)	37.90	73.93	84.02	74.06	78.82	
Height of Water Column (ft.)	22.69	53.05	59.18	67.88	30.65	
Well Size (I.D.) (inches)	2	2	2	2	2	
Volume of Water in Well (gallons)	3.70	8.65	9.65	11.06	5.00	
Water Removed From Well (gallons)	----	----	----	----	----	
Method of Removal	----	----	----	----	----	
Was Well Purged Dry?	----	----	----	----	----	
pH (standard units)	----	----	----	----	----	
Temperature (°C)	----	----	----	----	----	
Conductivity (µmhos/cc)	----	----	----	----	----	
Turbidity (NTU)	----	----	----	----	----	
Appearance	----	----	----	----	----	
Odor	----	----	----	----	----	
Containers	----	----	------	----	----	
Sample Time	----	----	----	----	----	
Sample Date	----	----	----	----	----	

For 2" well multiply by	0.163
For 4" well multiply by	0.653

NORTHEASTERN POWER PLANT
GROUNDWATER SAMPLING DATA FORM

SAMPLED BY: Kenny McDonald/Matt Hamilton . **DATE:** 10/10/23 .

Well Identification Number	SP-1	SP-2	SP-4	SP-5R	SP-10	SP-11
Activities	Gauge	Gauge	Gauge	Gauge	Gauge	Gauge
Samples	Appendix III & IV	Appendix III & IV	Appendix III & IV	Appendix III & IV	Appendix III & IV ++	Appendix III & IV
Depth to Water (ft)	17.85	28.34	14.49	7.90	Top of Casing	10.68
Measured Depth Total Depth of Well (ft.)	37.99	38.19	38.30	78.00	54.10	34.51
Height of Water Column (ft.)	20.14	9.85	23.81	70.10	54.10	23.83
Well Size (I.D.) (inches)	2	2	2	2	2	2
Volume of Water in Well (gallons)	3.28	1.61	3.88	11.43	8.82	3.88
Water Removed From Well (gallons)	11.25	7.00	9.25	27.5	22.50	6.75
Method of Removal	Pump	Pump	Pump	Pump	Pump	Pump
Was Well Purged Dry?	No	No	Yes	Yes	Yes	Yes
pH (standard units)	7.42	7.6	7.62	7.32	7.73	7.24
Temperature (°C)	18.72	19.44	18.67	17.46	21.23	18.14
Conductivity (µmhos/cc)	1,350	2,180	2,240	5,070	6,330	1,520
Turbidity (NTU)	10.8	21.3	26.4	118	14.3	8.7
Appearance	Clear	Clear	Clear	Slightly Turbid	Clear	Clear
Odor	None	None	None	Sulphur	Sulphur	None
Containers	250 mL HNO3 125 mL HCL 3 x 1L HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 3 x 1L HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 3 x 1L HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 3 x 1L HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 3 x 1L HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 3 x 1L HNO3 1 L Cool 0-6C
Sample Time	926	1039	854	835	1054	1111
Sample Date	10/10/2023	10/10/2023	10/10/2023	10/10/2023	10/10/2023	10/10/2023

BAP Dup 1400

For 2" well multiply by	0.163
For 4" well multiply by	0.653

NORTHEASTERN POWER PLANT
GROUNDWATER SAMPLING DATA FORM

SAMPLED BY: Kenny McDonald/Matt Hamilton . **DATE:** 10/10/23 .

Well Identification Number	SP-3	SP-6	SP-7	SP-8	SP-9	
Activities	Gauge	Gauge	Gauge	Gauge	Gauge	
Samples	NA	NA	NA	NA	NA	
Depth to Water (ft)	16.02	21.24	24.65	7.13	46.27	
Measured Depth Total Depth of Well (ft.)	37.90	73.93	84.02	74.06	78.82	
Height of Water Column (ft.)	37.90	52.69	59.37	66.93	32.55	
Well Size (I.D.) (inches)	2	2	2	2	2	
Volume of Water in Well (gallons)	6.18	8.59	9.68	10.91	5.31	
Water Removed From Well (gallons)	----	----	----	----	----	
Method of Removal	----	----	----	----	----	
Was Well Purged Dry?	----	----	----	----	----	
pH (standard units)	----	----	----	----	----	
Temperature (°C)	----	----	----	----	----	
Conductivity (µmhos/cc)	----	----	----	----	----	
Turbidity (NTU)	----	----	----	----	----	
Appearance	----	----	----	----	----	
Odor	----	----	----	----	----	
Containers	----	----	------	----	----	
Sample Time	----	----	----	----	----	
Sample Date	----	----	----	----	----	

For 2" well multiply by	0.163
For 4" well multiply by	0.653

Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 231873 **Customer: Northeastern 3&4 Power Station** **Date Reported: 07/12/2023**

Customer Sample ID: SP-1
Lab Number: 231873-001
Date Collected: 06/20/2023 17:04 EDT
Customer Description:
Preparation:
Date Received: 06/22/2023 10:45 EDT

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	84.3	mg/L	5	0.10	0.03		CRJ	07/07/2023 22:37	EPA 300.1 -1997, Rev. 1.0
Fluoride	0.82	mg/L	5	0.15	0.05		CRJ	07/07/2023 22:37	EPA 300.1 -1997, Rev. 1.0
Sulfate	65.0	mg/L	5	1.5	0.3		CRJ	07/07/2023 22:37	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
TDS, Filterable Residue	460	mg/L	1	50	20		ELT	06/23/2023 09:21	SM 2540C-2015

Customer Sample ID: SP-4
Lab Number: 231873-003
Date Collected: 06/20/2023 17:13 EDT
Customer Description:
Preparation:
Date Received: 06/22/2023 10:45 EDT

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	468	mg/L	50	1.0	0.3		CRJ	07/07/2023 16:35	EPA 300.1 -1997, Rev. 1.0
Fluoride	3.29	mg/L	5	0.15	0.05		CRJ	07/07/2023 21:31	EPA 300.1 -1997, Rev. 1.0
Sulfate	83.0	mg/L	5	1.5	0.3		CRJ	07/07/2023 21:31	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
TDS, Filterable Residue	1170	mg/L	1	50	20		ELT	06/23/2023 09:28	SM 2540C-2015

Customer Sample ID: SP-5R
Lab Number: 231873-004
Date Collected: 06/20/2023 12:41 EDT
Customer Description:
Preparation:
Date Received: 06/22/2023 10:45 EDT

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	782	mg/L	50	1.0	0.3		CRJ	07/07/2023 16:02	EPA 300.1 -1997, Rev. 1.0
Fluoride	3.09	mg/L	5	0.15	0.05		CRJ	07/07/2023 20:58	EPA 300.1 -1997, Rev. 1.0
Sulfate	3.8	mg/L	5	1.5	0.3		CRJ	07/07/2023 20:58	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
TDS, Filterable Residue	1580	mg/L	2	100	40		ELT	06/23/2023 09:28	SM 2540C-2015

Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 231873 **Customer: Northeastern 3&4 Power Station** **Date Reported: 07/12/2023**

Customer Sample ID: SP-10 Customer Description:
Lab Number: 231873-005 Preparation:
Date Collected: 06/20/2023 16:13 EDT Date Received: 06/22/2023 10:45 EDT

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	1960	mg/L	250	5	1		CRJ	07/07/2023 17:41	EPA 300.1 -1997, Rev. 1.0
Fluoride	6.3	mg/L	10	0.3	0.1		CRJ	07/07/2023 18:13	EPA 300.1 -1997, Rev. 1.0
Sulfate	19.7	mg/L	10	3.0	0.6		CRJ	07/07/2023 18:13	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Alkalinity, as CaCO3	448	mg/L	1	20	5		MGK	06/26/2023 15:10	SM 2320B-2011
Bicarbonate Alkalinity	446	mg/L	1	20	5		MGK	06/26/2023 15:10	SM 4500 CO2D-2011
TDS, Filterable Residue	3500	mg/L	20	1000	400		ELT	06/23/2023 09:40	SM 2540C-2015

Customer Sample ID: SP-11 Customer Description:
Lab Number: 231873-006 Preparation:
Date Collected: 06/20/2023 16:36 EDT Date Received: 06/22/2023 10:45 EDT

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	99.3	mg/L	50	1.0	0.3		CRJ	07/07/2023 15:29	EPA 300.1 -1997, Rev. 1.0
Fluoride	1.43	mg/L	5	0.15	0.05		CRJ	07/07/2023 19:52	EPA 300.1 -1997, Rev. 1.0
Sulfate	358	mg/L	50	15	3		CRJ	07/07/2023 15:29	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
TDS, Filterable Residue	1070	mg/L	2	100	40		ELT	06/23/2023 10:16	SM 2540C-2015

Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 231873 **Customer: Northeastern 3&4 Power Station** **Date Reported: 07/12/2023**

Customer Sample ID: BAP DUPLICATE
Customer Description:
Lab Number: 231873-007
Preparation:
Date Collected: 06/20/2023 13:00 EDT
Date Received: 06/22/2023 10:45 EDT

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	783	mg/L	50	1.0	0.3		CRJ	07/07/2023 14:56	EPA 300.1 -1997, Rev. 1.0
Fluoride	3.09	mg/L	5	0.15	0.05		CRJ	07/07/2023 19:19	EPA 300.1 -1997, Rev. 1.0
Sulfate	3.6	mg/L	5	1.5	0.3		CRJ	07/07/2023 19:19	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
TDS, Filterable Residue	1530	mg/L	2	100	40		ELT	06/23/2023 10:23	SM 2540C-2015

231873
Job Comments:

SP-2 Lid was off inside cooler sample was ruined

Report Verification

This report and the above data have been confirmed by the following analyst.

Jonathan Barnhill, Dolan Chemical Lab Supervisor
Email: jdbarnhill@aep.com
Phone: 614-836-4256
Audinet: 8-210-4256

Chain of Custody Record

Program: Coal Combustion Residuals (CCR)

Dolan Chemical Laboratory (DCL)
4001 Bixby Road
Groveport, Ohio 43125
Contacts: Jonathan Barnhill (318-673-3803)
Michael Ohlinger (614-836-4184)

Project Name: NE PS BAP Semi-Annual CCR sampling
Contact Name: Rebecca Jones
Contact Phone: 737-330-3725
Sampler(s): Kenny McDonald

Analysis Turnaround Time (in Calendar Days)
Routine (28 days for Monitoring Wells)

Site Contact:

Date:

For Lab Use Only:
COC/Order #: 231873

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Sampler(s) Initials	250 mL bottle, pH<2, HNO_3 As, B, Ba, Be, Ca,Cd, Cr, Co, K, Li, Na, Pb, Mg, Mo, Sb, Se, Tl	1 L bottle, Cool, 0-6°C TDS, F, Cl, SO_4	Three (six every 10th*) 1 L bottles, pH<2, HNO_3 Ra-226, Ra-228	250 mL Glass bottle, HCl**, pH<2 Hg	Field-filter 250 mL bottle, pH<2, HNO_3 dissolved Fe and Mn	1 L bottle Cool, 0-6°C TDS, F, Cl, SO4, TOTAL ALKALINITY, BICARBONATE ALKALINITY	Sample Specific Notes:
SP-1	6/20/2023	1604	G	GW	1			X					
SP-2	6/20/2023	1546	G	GW	1			X					Lid open on arrival - TB
SP-4	6/20/2023	1613	G	GW	1			X					
SP-5R	6/20/2023	1141	G	GW	1			X					
SP-10	6/20/2023	1513	G	GW	1							X	
SP-11	6/20/2023	1536	G	GW	1			X					
BAP DUPLICATE	6/20/2023	1200	G	GW	1			X					
Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____; F= filter in field							4	1	4				

* *Six 1L Bottles must be collected for Radium for every 10th sample.*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
KAN	EAGLE	06/21/23 1400		
Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Date/Time:
			Tami Palmer	06/22/23 1045

AEP WATER & WASTE SAMPLE RECEIPT FORM

Package Type	Delivery Type
(Cooler) Box Bag Envelope	PONY (UPS) FedEX USPS
	Other _____

Plant/Customer Northeastern **Number of Plastic Containers:** 7

Opened By T. Palmer **Number of Glass Containers:** Ø

Date/Time 06/22/23 1045 **Number of Mercury Containers:** Ø

Were all temperatures within 0-6°C? (Y) N or N/A **Initial:** JAB (on ice) no ice

(IR Gun Ser# 2213689000, *Expir.* 03/24/2024) - If No, specify each deviation: _____

Was container in good condition? (Y) N Comments _____

Was Chain of Custody received? (Y) N Comments _____

Requested turnaround: Routine If **RUSH**, who was notified? _____

pH (15 min)	Cr^{+6} (pres) (24 hr)	NO_2 or NO_3 (48 hr)	*ortho*-PO_4 (48 hr)	Hg-diss (pres) (48 hr)

Was COC filled out properly? (Y) / N Comments _____

Were samples labeled properly? (Y) N Comments _____

Were correct containers used? (Y) N Comments _____

Was pH checked & Color Coding done? (Y) N or N/A **Initial & Date:** JB 06/22/23

pH paper (circle one): MQuant,PN1.09535.0001,LOT#_____ {OR} ~~Lab Rat,PN4801,LOT#~~ X000RWDG21 Exp 11/15/2024

- Was Add'l Preservative needed? Y (N) If Yes: By whom & when: _____ (See Prep Book)

Is sample filtration requested? Y / (N) Comments _____ (See Prep Book)

Was the customer contacted? If Yes: Person Contacted: _____

Initial & Date & Time : _____

Lab ID# Ø31873

Comments: Lid off on SP-2 sample spilled in cooler

Logged by JB

Reviewed by JAB

REMINDER: Document the pertinent sample integrity information and deviations in sample receipt (as noted above) in the "Notes" field in the LIMS to be included on the report to the customer.

Water Analysis Report

Reissued

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 231874 **Customer: Northeastern 3&4 Power Station** **Date Reported: 10/29/2023**

Customer Sample ID: Customer Description:
Lab Number: 231874-001 Preparation: Dissolved
Date Collected: 06/20/2023 16:13 EDT Date Received: 06/22/2023 10:45 EDT

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Fluoride	6.3	mg/L	10	0.3	0.1		CRJ	07/10/2023 21:52	EPA 300.1 -1997, Rev. 1.0

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.089	µg/L	1	0.100	0.008	J1	GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Arsenic	0.40	µg/L	1	0.10	0.03		GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Barium	5280	µg/L	10	2.0	0.5		GES	06/27/2023 06:28	EPA 200.8-1994, Rev. 5.4
Beryllium	0.022	µg/L	1	0.050	0.007	J1	GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Boron	0.916	mg/L	1	0.050	0.007		GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Cadmium	<0.004	µg/L	1	0.020	0.004	U1	GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Calcium	128	mg/L	1	0.05	0.01		GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Chromium	0.18	µg/L	1	0.30	0.07	J1	GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Cobalt	0.065	µg/L	1	0.020	0.005		GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Lead	<0.05	µg/L	1	0.20	0.05	U1	GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Lithium	0.214	mg/L	1	0.00030	0.00007		GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Magnesium	51.0	mg/L	1	0.100	0.006		GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	06/28/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	0.9	µg/L	1	0.5	0.1		GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Potassium	6.58	mg/L	1	0.100	0.008		GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Selenium	0.05	µg/L	1	0.50	0.04	J1	GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4
Sodium	1210	mg/L	10	2.0	0.1		GES	06/27/2023 06:28	EPA 200.8-1994, Rev. 5.4
Thallium	<0.02	µg/L	1	0.20	0.02	U1	GES	06/27/2023 06:23	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	18.30	pCi/L	0.71	0.15	R2	TTP	06/30/2023 11:03	SW-846 9315-1986, Rev. 0
Carrier Recovery	137	%						
Radium-228	1.70	pCi/L	0.14	0.39		ST	07/03/2023 15:12	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	103	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

231874
Job Comments:

Report originally issued 7/12/23. Report reissued 10/29/23 to correct rounding errors on report and EDD.

Water Analysis Report

Reissued

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 231874 **Customer: Northeastern 3&4 Power Station** **Date Reported: 10/29/2023**

Report Verification

This report and the above data have been confirmed by the following analyst.

Michael Ohlinger, Chemist
Email: msohlinger@aep.com
Phone: 614-836-4184
Audinet: 8-210-4184

Data Qualifer Legend

J1 - Concentration estimated. Analyte was detected between the method detection limit and the reporting limit.
U1 - Not detected at or above method detection limit (MDL).
R2 - Carrier recovery was outside acceptance limits.

Chain of Custody Record

Program: Coal Combustion Residuals (CCR)

Dolan Chemical Laboratory (DCL)
4001 Bixby Road
Groveport, Ohio 43125
Contacts: Jonathan Barnhill (318-673-3803)
Michael Ohlinger (614-836-4184)

Project Name: NE Dis BAP wells

Contact Name: Rebecca Jones

Contact Phone: 737-330-3725

Sampler(s): Kenny McDonald

Analysis Turnaround Time (in Calendar Days)
Routine (28 days for Monitoring Wells)

Site Contact:

Date:

For Lab Use Only:
COC/Order #: 231874

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Sampler(s) Initials	250 mL bottle, pH<2, HNO_3 TOTAL - B, Ca, Li, Sb, As, Ba, Be, Cd, Cr, Co, Pb, Mo, Se, TL	Field-filter 250 mL bottle, then pH<2, HNO_3 DISSOLVED - As, B, Ba, Be, Ca,Cd, Cr, Co,K, Li, Na, Pb, Mg, Mo, Sb, Se, TL	Field-Filter 1000 mL bottle, Cool, 0-6°C DISSOLVED F	Field-filter Three (six every 10th*) 1 L bottles, pH<2, HNO_3 DISSOLVED Ra-226, Ra-228	250 mL Glass or 125/250 mL PTFE lined bottle, HCL**, pH<2 TOTAL HG	Field Filter 250 mL Glass or 125/250 mL PTFE lined bottle, HCL**, pH<2 DISSOLVED Hg	Sample Specific Notes:
SP-10	6/20/2023	1513	G	GW	6			X	X	X		X	
Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____; F= filter in field							4	F4	1	4			

* Six 1L Bottles must be collected for Radium for every 10th sample.

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
[signature]	FAGLE	06/21/23 1400		
Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Date/Time:
			Tami Palmer	06/22/23 1045

Form COC-04, AEP Chain of Custody (COC) Record for Coal Combustion Residual (CCR) Sampling - Shreveport, Rev. 1, 1/10/17

AEP WATER & WASTE SAMPLE RECEIPT FORM

Package Type	Delivery Type
(Cooler) Box Bag Envelope	PONY (UPS) FedEX USPS
	Other _____

Plant/Customer Northeastern **Number of Plastic Containers:** 4

Opened By T. Palmer **Number of Glass Containers:** Ø

Date/Time 06/22/23 1045 **Number of Mercury Containers:** 1

Were all temperatures within 0-6°C? (Y) N or N/A **Initial:** JAB (on ice) / no ice

(IR Gun Ser# 2213689000, *Expir.* 03/24/2024) - If No, specify each deviation: _____

Was container in good condition? (Y) / N Comments _____

Was Chain of Custody received? (Y) / N Comments _____

Requested turnaround: _____ If **RUSH**, who was notified? _____

pH (15 min)	Cr^{+6} (pres) (24 hr)	NO_2 or NO_3 (48 hr)	*ortho*-PO_4 (48 hr)	Hg-diss (pres) (48 hr)

Was COC filled out properly? (Y) N Comments _____

Were samples labeled properly? (Y) / N Comments _____

Were correct containers used? (Y) N Comments _____

Was pH checked & Color Coding done? (Y) N or N/A **Initial & Date:** JAB 6/22/23

pH paper (circle one): MQuant,PN1.09535.0001,LOT#_____ [OR] Lab Rat,PN4801,LOT# X000RWDG21 Exp 11/15/2024

- Was Add'l Preservative needed? Y (N) If Yes: By whom & when: _____ (See Prep Book)

Is sample filtration requested? Y / (N) Comments _____ (See Prep Book)

Was the customer contacted? If Yes: Person Contacted: _____

Initial & Date & Time : _____

Lab ID# 231874

Comments: _____

Logged by _____

Reviewed by JAB

REMINDER: Document the pertinent sample integrity information and deviations in sample receipt (as noted above) in the "Notes" field in the LIMS to be included on the report to the customer.

Water Analysis Report

Reissued

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 231920 **Customer: Northeastern 3&4 Power Station** **Date Reported: 10/29/2023**

Customer Sample ID: SP-1
Lab Number: 231920-001
Date Collected: 06/20/2023 17:04 EDT

Customer Description:
Preparation:
Date Received: 06/26/2023 14:00 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.491	µg/L	1	0.100	0.008		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Arsenic	0.45	µg/L	1	0.10	0.03		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Barium	145	µg/L	1	0.20	0.05		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Beryllium	0.091	µg/L	1	0.050	0.007		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Boron	0.158	mg/L	1	0.050	0.007		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Cadmium	0.047	µg/L	1	0.020	0.004		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Calcium	100	mg/L	1	0.05	0.01		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Chromium	0.41	µg/L	1	0.30	0.07		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Cobalt	0.174	µg/L	1	0.020	0.005		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Lead	0.24	µg/L	1	0.20	0.05		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Lithium	0.00726	mg/L	1	0.00030	0.00007		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Magnesium	28.0	mg/L	1	0.100	0.006		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	06/28/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	17.2	µg/L	1	0.5	0.1		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Potassium	0.907	mg/L	1	0.100	0.008		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Selenium	7.58	µg/L	1	0.50	0.04		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Sodium	48.4	mg/L	1	0.20	0.01		GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4
Thallium	0.07	µg/L	1	0.20	0.02	J1	GES	07/06/2023 18:54	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	4.26	pCi/L	0.49	0.33		TTP	06/30/2023 11:51	SW-846 9315-1986, Rev. 0
Carrier Recovery	87.2	%						
Radium-228	2.66	pCi/L	0.19	0.52		ST	07/03/2023 15:12	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	76.4	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

AMERICAN ELECTRIC POWER

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Water Analysis Report

Reissued

Job ID: 231920 **Customer: Northeastern 3&4 Power Station** **Date Reported: 10/29/2023**

Customer Sample ID: SP-2
Lab Number: 231920-002
Date Collected: 06/20/2023 16:46 EDT

Customer Description:
Preparation:
Date Received: 06/26/2023 14:00 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.957	µg/L	1	0.100	0.008		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Arsenic	1.11	µg/L	1	0.10	0.03		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Barium	989	µg/L	1	0.20	0.05		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Beryllium	0.077	µg/L	1	0.050	0.007		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Boron	0.105	mg/L	1	0.050	0.007		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Cadmium	0.076	µg/L	1	0.020	0.004		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Calcium	87.2	mg/L	1	0.05	0.01		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Chromium	0.51	µg/L	1	0.30	0.07		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Cobalt	0.326	µg/L	1	0.020	0.005		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Lead	0.17	µg/L	1	0.20	0.05	J1	GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Lithium	0.0326	mg/L	1	0.00030	0.00007		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Magnesium	54.6	mg/L	1	0.100	0.006		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	06/28/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	14.8	µg/L	1	0.5	0.1		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Potassium	1.89	mg/L	1	0.100	0.008		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Selenium	2.28	µg/L	1	0.50	0.04		GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4
Sodium	226	mg/L	5	1.00	0.05		GES	07/06/2023 19:04	EPA 200.8-1994, Rev. 5.4
Thallium	0.03	µg/L	1	0.20	0.02	J1	GES	07/06/2023 18:59	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	7.20	pCi/L	0.54	0.23		TTP	06/30/2023 11:51	SW-846 9315-1986, Rev. 0
Carrier Recovery	121	%						
Radium-228	5.26	pCi/L	0.23	0.56		ST	07/03/2023 15:12	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	76.4	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

AMERICAN ELECTRIC POWER

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Water Analysis Report

Reissued

Job ID: 231920 **Customer: Northeastern 3&4 Power Station** **Date Reported: 10/29/2023**

Customer Sample ID: SP-4
Lab Number: 231920-003
Date Collected: 06/20/2023 17:13 EDT

Customer Description:
Preparation:
Date Received: 06/26/2023 14:00 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.192	µg/L	1	0.100	0.008		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Arsenic	1.26	µg/L	1	0.10	0.03		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Barium	204	µg/L	1	0.20	0.05		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Beryllium	0.074	µg/L	1	0.050	0.007		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Boron	0.323	mg/L	1	0.050	0.007		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Cadmium	0.044	µg/L	1	0.020	0.004		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Calcium	82.1	mg/L	1	0.05	0.01		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Chromium	0.61	µg/L	1	0.30	0.07		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Cobalt	0.470	µg/L	1	0.020	0.005		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Lead	0.21	µg/L	1	0.20	0.05		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Lithium	0.0507	mg/L	1	0.00030	0.00007		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Magnesium	37.8	mg/L	1	0.100	0.006		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	06/28/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	2.8	µg/L	1	0.5	0.1		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Potassium	2.26	mg/L	1	0.100	0.008		GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Selenium	0.41	µg/L	1	0.50	0.04	J1	GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4
Sodium	283	mg/L	5	1.00	0.05		GES	07/06/2023 19:15	EPA 200.8-1994, Rev. 5.4
Thallium	0.02	µg/L	1	0.20	0.02	J1	GES	07/06/2023 19:09	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	2.40	pCi/L	0.33	0.32		TTP	06/30/2023 11:51	SW-846 9315-1986, Rev. 0
Carrier Recovery	102	%						
Radium-228	5.56	pCi/L	0.35	0.92		ST	07/03/2023 15:12	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	43.7	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

Water Analysis Report

Reissued

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 231920 **Customer: Northeastern 3&4 Power Station** **Date Reported: 10/29/2023**

Customer Sample ID: SP-5R
Lab Number: 231920-004
Date Collected: 06/20/2023 12:41 EDT

Customer Description:
Preparation:
Date Received: 06/26/2023 14:00 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.230	µg/L	1	0.100	0.008		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Arsenic	9.09	µg/L	1	0.10	0.03		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Barium	2120	µg/L	5	1.0	0.3		GES	07/06/2023 19:25	EPA 200.8-1994, Rev. 5.4
Beryllium	0.276	µg/L	1	0.050	0.007		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Boron	0.191	mg/L	1	0.050	0.007		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Cadmium	0.074	µg/L	1	0.020	0.004		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Calcium	94.5	mg/L	1	0.05	0.01		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Chromium	2.73	µg/L	1	0.30	0.07		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Cobalt	1.18	µg/L	1	0.020	0.005		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Lead	2.11	µg/L	1	0.20	0.05		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Lithium	0.0822	mg/L	1	0.00030	0.00007		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Magnesium	31.2	mg/L	1	0.100	0.006		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	06/28/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	0.8	µg/L	1	0.5	0.1		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Potassium	3.14	mg/L	1	0.100	0.008		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Selenium	0.91	µg/L	1	0.50	0.04		GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4
Sodium	449	mg/L	5	1.00	0.05		GES	07/06/2023 19:25	EPA 200.8-1994, Rev. 5.4
Thallium	0.05	µg/L	1	0.20	0.02	J1	GES	07/06/2023 19:20	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	11.10	pCi/L	0.67	0.21		TTP	06/30/2023 11:51	SW-846 9315-1986, Rev. 0
Carrier Recovery	123	%						
Radium-228	5.09	pCi/L	0.18	0.38		ST	07/03/2023 15:12	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	92.0	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

AMERICAN ELECTRIC POWER

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Water Analysis Report

Reissued

Job ID: 231920 **Customer: Northeastern 3&4 Power Station** **Date Reported: 10/29/2023**

Customer Sample ID: SP-10	Customer Description:
Lab Number: 231920-005	Preparation:
Date Collected: 06/20/2023 16:13 EDT	Date Received: 06/26/2023 14:00 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.083	µg/L	1	0.100	0.008	J1	GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Arsenic	0.29	µg/L	1	0.10	0.03		GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Barium	5180	µg/L	10	2.0	0.5		GES	07/06/2023 19:35	EPA 200.8-1994, Rev. 5.4
Beryllium	0.027	µg/L	1	0.050	0.007	J1	GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Boron	0.916	mg/L	1	0.050	0.007		GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Cadmium	0.009	µg/L	1	0.020	0.004	J1	GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Calcium	83.0	mg/L	1	0.05	0.01		GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Chromium	0.45	µg/L	1	0.30	0.07		GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Cobalt	0.146	µg/L	1	0.020	0.005		GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Lead	0.09	µg/L	1	0.20	0.05	J1	GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Lithium	0.206	mg/L	1	0.00030	0.00007		GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Magnesium	49.0	mg/L	1	0.100	0.006		GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	06/28/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	0.7	µg/L	1	0.5	0.1		GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Potassium	6.17	mg/L	1	0.100	0.008		GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Selenium	<0.04	µg/L	1	0.50	0.04	U1	GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4
Sodium	1150	mg/L	10	2.0	0.1		GES	07/06/2023 19:35	EPA 200.8-1994, Rev. 5.4
Thallium	<0.02	µg/L	1	0.20	0.02	U1	GES	07/06/2023 19:30	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	16.90	pCi/L	0.78	0.18		TTP	06/30/2023 11:51	SW-846 9315-1986, Rev. 0
Carrier Recovery	143	%						
Radium-228	1.17	pCi/L	0.11	0.33		ST	07/03/2023 15:12	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	113	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

Water Analysis Report

Reissued

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 231920 **Customer: Northeastern 3&4 Power Station** **Date Reported: 10/29/2023**

Customer Sample ID: SP-11
Lab Number: 231920-006
Date Collected: 06/20/2023 16:36 EDT

Customer Description:
Preparation:
Date Received: 06/26/2023 14:00 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.038	µg/L	1	0.100	0.008	J1	GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Arsenic	1.51	µg/L	1	0.10	0.03		GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Barium	102	µg/L	1	0.20	0.05		GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Beryllium	0.025	µg/L	1	0.050	0.007	J1	GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Boron	0.543	mg/L	1	0.050	0.007		GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Cadmium	<0.004	µg/L	1	0.020	0.004	U1	GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Calcium	86.7	mg/L	1	0.05	0.01		GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Chromium	0.34	µg/L	1	0.30	0.07		GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Cobalt	0.717	µg/L	1	0.020	0.005		GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Lead	0.08	µg/L	1	0.20	0.05	J1	GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Lithium	0.0179	mg/L	1	0.00030	0.00007		GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Magnesium	15.2	mg/L	1	0.100	0.006		GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	06/28/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	0.8	µg/L	1	0.5	0.1		GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Potassium	3.50	mg/L	1	0.100	0.008		GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Selenium	0.10	µg/L	1	0.50	0.04	J1	GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4
Sodium	262	mg/L	5	1.00	0.05		GES	07/06/2023 19:45	EPA 200.8-1994, Rev. 5.4
Thallium	<0.02	µg/L	1	0.20	0.02	U1	GES	07/06/2023 19:40	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	0.74	pCi/L	0.19	0.24		TTP	06/30/2023 11:51	SW-846 9315-1986, Rev. 0
Carrier Recovery	95.9	%						
Radium-228	0.47	pCi/L	0.17	0.55		ST	07/03/2023 15:12	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	68.9	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

AMERICAN ELECTRIC POWER

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Water Analysis Report

Reissued

Job ID: 231920 **Customer: Northeastern 3&4 Power Station** **Date Reported: 10/29/2023**

Customer Sample ID: BAP DUPLICATE
Customer Description:
Lab Number: 231920-007
Preparation:
Date Collected: 06/20/2023 13:00 EDT
Date Received: 06/26/2023 14:00 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.213	µg/L	1	0.100	0.008		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Arsenic	8.30	µg/L	1	0.10	0.03		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Barium	2070	µg/L	5	1.0	0.3		GES	07/06/2023 19:56	EPA 200.8-1994, Rev. 5.4
Beryllium	0.228	µg/L	1	0.050	0.007		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Boron	0.201	mg/L	1	0.050	0.007		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Cadmium	0.063	µg/L	1	0.020	0.004		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Calcium	95.5	mg/L	1	0.05	0.01		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Chromium	2.59	µg/L	1	0.30	0.07		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Cobalt	1.18	µg/L	1	0.020	0.005		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Lead	2.08	µg/L	1	0.20	0.05		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Lithium	0.0831	mg/L	1	0.00030	0.00007		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Magnesium	33.2	mg/L	1	0.100	0.006		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	06/28/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	0.7	µg/L	1	0.5	0.1		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Potassium	3.17	mg/L	1	0.100	0.008		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Selenium	0.78	µg/L	1	0.50	0.04		GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4
Sodium	458	mg/L	5	1.00	0.05		GES	07/06/2023 19:56	EPA 200.8-1994, Rev. 5.4
Thallium	0.04	µg/L	1	0.20	0.02	J1	GES	07/06/2023 19:50	EPA 200.8-1994, Rev. 5.4

AMERICAN ELECTRIC POWER

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Water Analysis Report

Reissued

Job ID: 231920 **Customer: Northeastern 3&4 Power Station** **Date Reported: 10/29/2023**

Customer Sample ID: BAP EQUIPMENT BLANK
Customer Description:
Lab Number: 231920-008
Preparation:
Date Collected: 06/20/2023 12:57 EDT
Date Received: 06/26/2023 14:00 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	<0.008	µg/L	1	0.100	0.008	U1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Arsenic	<0.03	µg/L	1	0.10	0.03	U1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Barium	0.08	µg/L	1	0.20	0.05	J1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Beryllium	0.031	µg/L	1	0.050	0.007	J1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Boron	<0.007	mg/L	1	0.050	0.007	U1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Cadmium	<0.004	µg/L	1	0.020	0.004	U1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Calcium	<0.01	mg/L	1	0.05	0.01	U1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Chromium	0.29	µg/L	1	0.30	0.07	J1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Cobalt	0.013	µg/L	1	0.020	0.005	J1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Lead	<0.05	µg/L	1	0.20	0.05	U1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Lithium	<0.00007	mg/L	1	0.00030	0.00007	U1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Magnesium	<0.006	mg/L	1	0.100	0.006	U1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	06/28/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	<0.1	µg/L	1	0.5	0.1	U1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Potassium	<0.008	mg/L	1	0.100	0.008	U1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Selenium	<0.04	µg/L	1	0.50	0.04	U1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Sodium	0.03	mg/L	1	0.20	0.01	J1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4
Thallium	<0.02	µg/L	1	0.20	0.02	U1	GES	07/06/2023 20:01	EPA 200.8-1994, Rev. 5.4

231920
Job Comments:

Report originally issued 7/12/23. Report reissued 10/29/23 to correct rounding errors on report and EDD.

Water Analysis Report

Reissued

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 231920 **Customer: Northeastern 3&4 Power Station** **Date Reported: 10/29/2023**

Report Verification

This report and the above data have been confirmed by the following analyst.

Michael Ohlinger, Chemist
Email: msohlinger@aep.com
Phone: 614-836-4184
Audinet: 8-210-4184

Data Qualifer Legend

U1 - Not detected at or above method detection limit (MDL).

J1 - Concentration estimated. Analyte was detected between the method detection limit and the reporting limit.

Chain of Custody Record

Program: Coal Combustion Residuals (CCR)

Dolan Chemical Laboratory (DCL)
4001 Bixby Road
Groveport, Ohio 43125
Contacts: Jonathan Barnhill (318-673-3803)
Michael Ohlinger (614-836-4184)

Project Name: NE PS BAP Semi-Annual CCR sampling
Contact Name: Rebecca Jones
Contact Phone: 737-330-3725
Sampler(s): Kenny McDonald

Analysis Turnaround Time (in Calendar Days)
Routine (28 days for Monitoring Wells)

Site Contact:

Date:

For Lab Use Only:
COC/Order #: 231920

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Sampler(s) Initials	250 mL bottle, pH<2, HNO_3 As, B, Ba, Be, Ca,Cd, Cr, Co,K, Li, Na, Pb, Mg, Mo, Sb, Se, Tl	1 L bottle, Cool, 0-6°C TDS, F, Cl, SO_4	Three (six every 10th*) 1 L bottles, pH<2, HNO_3 Ra-226, Ra-228	250 mL Glass or 125/250 mL PTFE lined bottle, HCL**, pH<2 Hg	Field-filter 500 mL bottle, then pH<2, HNO_3 dissolved Fe and Mn		Sample Specific Notes:
SP-1	6/20/2023	1604	G	GW	5		X		X	X			
SP-2	6/20/2023	1546	G	GW	5		X		X	X			
SP-4	6/20/2023	1613	G	GW	5		X		X	X			
SP-5R	6/20/2023	1141	G	GW	8		X		X	X			
SP-10	6/20/2023	1513	G	GW	5		X		X	X			
SP-11	6/20/2023	1536	G	GW	5		X		X	X			
BAP DUPLICATE	6/20/2023	1200	G	GW	2		X			X			
BAP EQUIPMENT BLANK	6/20/2023	1157	G	W	2		X			X			
Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____; F= filter in field							4	1	4				

* *Six 1L Bottles must be collected for Radium for every 10th sample.*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
[signature]	TAGLI	06/22/23 14:00		
Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by: [signature]	Date/Time: 6/24/23 2:00 PM

AEP WATER & WASTE SAMPLE RECEIPT FORM

Package Type	Delivery Type
(Cooler) Box Bag Envelope	PONY UPS (FedEX) USPS
	Other _____

Plant/Customer Northeastern **Number of Plastic Containers:** 29

Opened By MSO/MGK **Number of Glass Containers:** _____

Date/Time 6/26/23 2:00PM **Number of Mercury Containers:** 8

Were all temperatures within 0-6°C? Y / N or (N/A) **Initial:** _____ on ice / (no ice)

(IR Gun Ser# 2213689000, *Expir.* 03/24/2024) - If No, specify each deviation: _____

Was container in good condition? (Y) / N Comments _____

Was Chain of Custody received? (Y) / N Comments _____

Requested turnaround: Routine If **RUSH**, who was notified? _____

pH (15 min)	Cr^{+6} (pres) (24 hr)	NO_2 or NO_3 (48 hr)	*ortho*-PO_4 (48 hr)	Hg-diss (pres) (48 hr)

Was COC filled out properly? (Y) / N Comments _____

Were samples labeled properly? (Y) / N Comments _____

Were correct containers used? (Y) / N Comments _____

Was pH checked & Color Coding done? (Y) N or N/A **Initial & Date:** MGK 6/26/23

pH paper (circle one): MQuant,PN1.09535.0001,LOT#_____ [OR] (Lab Rat,PN4801,LOT# X000RWDG21 Exp 11/15/2024)

- Was Add'l Preservative needed? Y / (N) If Yes: By whom & when: _____ (See Prep Book)

Is sample filtration requested? Y / (N) Comments _____ (See Prep Book)

Was the customer contacted? If Yes: Person Contacted: _____

Lab ID# 231920 Initial & Date & Time : _____

Comments: _____

Logged by MSO _____

Reviewed by WCG _____

_____

REMINDER: Document the pertinent sample integrity information and deviations in sample receipt (as noted above) in the "Notes" field in the LIMS to be included on the report to the customer.

Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 231983 **Customer: Northeastern 3&4 Power Station** **Date Reported: 07/12/2023**

Customer Sample ID: SP-2
Lab Number: 231983-001
Date Collected: 06/29/2023 15:23 EDT

Customer Description:
Preparation:
Date Received: 06/30/2023 10:00 EDT

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	604	mg/L	50	1.0	0.3		CRJ	07/11/2023 02:49	EPA 300.1 -1997, Rev. 1.0
Fluoride	3.02	mg/L	5	0.15	0.05		CRJ	07/11/2023 06:39	EPA 300.1 -1997, Rev. 1.0
Sulfate	18.1	mg/L	5	1.5	0.3		CRJ	07/11/2023 06:39	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
TDS, Filterable Residue	1780	mg/L	1	50	20		JAB	07/03/2023 14:02	SM 2540C-2015

Report Verification

This report and the above data have been confirmed by the following analyst.

Jonathan Barnhill, Dolan Chemical Lab Supervisor
Email: jdbarnhill@aep.com
Phone: 614-836-4256
Audinet: 8-210-4256

Chain of Custody Record

Program: Coal Combustion Residuals (CCR)

Dolan Chemical Laboratory (DCL)
4001 Bixby Road
Groveport, Ohio 43125
Contacts: Jonathan Barnhill (318-673-3803)
Michael Ohlinger (614-836-4184)

Project Name: NE PS BAP Semi-Annual CCR sampling
Contact Name: Rebecca Jones
Contact Phone: 737-330-3725
Sampler(s): Kenny McDonald

Analysis Turnaround Time (in Calendar Days)
Routine (28 days for Monitoring Wells)

Site Contact:

Date:

For Lab Use Only:
COC/Order #: 231983

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Sampler(s) Initials	250 mL bottle, pH<2, HNO_3 As, B, Ba, Be, Ca, Cd, Cr, Co, K, Li, Na, Pb, Mg, Mo, Sb, Se, TL	500 mL bottle, Cool, 0-6°C TDS, F, Cl, SO_4	Three (six every 10th*) 1 L bottles, pH<2, HNO_3 Ra-226, Ra-228	250 mL Glass bottle, HCL**, pH<2 Hg	Field-filter 250 mL bottle, pH<2, HNO_3 dissolved Fe and Mn	1 L bottle Cool, 0-6°C TDS, F, CL, SO4, TOTAL ALKALINITY, BICARBONATE ALKALINITY	Sample Specific Notes:
SP-2	06/29/23	1423	G	GW	3			X					
Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____; F= filter in field							4	1	4				

* *Six 1L Bottles must be collected for Radium for every 10th sample.*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company: EAGLE	Date/Time: 06/29/23 1532	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by: Michael Ohlinger	Date/Time: 6/30/23 10:00 AM

AEP WATER & WASTE SAMPLE RECEIPT FORM

Package Type	Delivery Type
(Cooler) Box Bag Envelope	PONY UPS (FedEX) USPS
	Other _____

Plant/Customer Northeastern **Number of Plastic Containers:** ~~3~~ MSD 6/30/23 3

Opened By MSD/ ~~WCG~~ **Number of Glass Containers:** —

Date/Time 6/30/23 10:00AM **Number of Mercury Containers:** —

Were all temperatures within 0-6°C? (Y) / N or N/A **Initial:** WCG (on ice) / no ice

(IR Gun Ser# 2213689000, *Expir.* 03/24/2024) - If No, specify each deviation: _____

Was container in good condition? (Y) / N Comments _____

Was Chain of Custody received? (Y) / N Comments _____

Requested turnaround: Routine If **RUSH**, who was notified? _____

pH (15 min)	Cr^{+6} (pres) (24 hr)	NO_2 or NO_3 (48 hr)	*ortho*-PO_4 (48 hr)	Hg-diss (pres) (48 hr)

Was COC filled out properly? (Y) / N Comments _____

Were samples labeled properly? (Y) / N Comments _____

Were correct containers used? (Y) / N Comments _____

Was pH checked & Color Coding done? (Y) / N or N/A **Initial & Date:** ~~WCG~~ WCG 6/30/23

pH paper (circle one): MQuant,PN1.09535.0001,LOT#_____ [QR] Lab Rat,PN4801,LOT# X000RWDG21 Exp 11/15/2024

- Was Add'l Preservative needed? Y (N) If Yes: By whom & when: _____ (See Prep Book)

Is sample filtration requested? Y (N) Comments _____ (See Prep Book)

Was the customer contacted? If Yes: Person Contacted: _____

Initial & Date & Time : _____

Lab ID# 231983

Comments: _____

Logged by MSD _____

Reviewed by WCG _____

REMINDER: Document the pertinent sample integrity information and deviations in sample receipt (as noted above) in the "Notes" field in the LIMS to be included on the report to the customer.

Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 233154 **Customer: Northeastern 3&4 Power Station** **Date Reported: 10/31/2023**

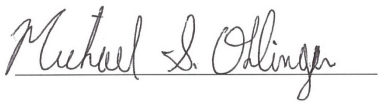
Customer Sample ID: SP-10
Customer Description:
Lab Number: 233154-001
Preparation: Dissolved
Date Collected: 10/10/2023 11:54 EDT
Date Received: 10/12/2023 10:00 EDT

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Fluoride	6.5	mg/L	10	0.3	0.1		CRJ	10/31/2023 01:44	EPA 300.1 -1997, Rev. 1.0

Report Verification

This report and the above data have been confirmed by the following analyst.



Michael Ohlinger, Chemist
Email: msohlinger@aep.com
Phone: 614-836-4184
Audinet: 8-210-4184

Chain of Custody Record

Program: Coal Combustion Residuals (CCR)

Dolan Chemical Laboratory (DCL)
4001 Bixby Road
Groveport, Ohio 43125
Contacts: Jonathan Barnhill (318-673-3803)
Michael Ohlinger (614-836-4184)

Project Name: NE Dis BAP wells

Contact Name: Rebecca Jones

Contact Phone: 737-330-3725

Sampler(s): Kenny McDonald/Matt Hamilton

Site Contact:

Date:

For Lab Use Only:
COC/Order #: 233154

Analysis Turnaround Time (in Calendar Days)
Routine (28 days for Monitoring Wells)

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Sampler(s) Initials	250 mL bottle, pH<2, HNO_3 TOTAL - B, Ca, Li, Sb, As, Ba, Be, Cd, Cr, Co, Pb, Mo, Se, TL	Field-filter 250 mL bottle, then pH<2, HNO_3 DISSOLVED - As, B, Ba, Be, Ca,Cd, Cr, Co,K, Li, Na, Pb, Mg, Mo, Sb, Se, TL	Field-Filter 250 mL bottle, Cool, 0-6°C DISSOLVED F	Field-filter Three (six every 10th*) 1 L bottles, pH<2, HNO_3 DISSOLVED Ra-226, Ra-228	250 mL Glass or 125/250 mL PTFE lined bottle, HCL**, pH<2 TOTAL HG	Field Filter 250 mL Glass or 125/250 mL PTFE lined bottle, HCL**, pH<2 DISSOLVED Hg	Sample Specific Notes:
SP-10	10/10/2023	1054	G	GW	1				X				
Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____; F= filter in field							4	F4	1	4			

** Six 1L Bottles must be collected for Radium for every 10th sample.*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
[signature]	EAGLE	10/11/23 1300		
Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Date/Time:
			[signature]	10/12/23 1000

AEP WATER & WASTE SAMPLE RECEIPT FORM

Package Type	Delivery Type
(Cooler) Box Bag Envelope	PONY UPS (FedEX) USPS
	Other _____

Plant/Customer NE DisBAP Wells **Number of Plastic Containers:** 1

Opened By Misgina/Williams **Number of Glass Containers:** _____

Date/Time 10/12/23 10:00Am **Number of Mercury Containers:** _____

Were all temperatures within 0-6°C? (Y) / N or N/A **Initial:** MGK (on ice) / no ice

(IR Gun Ser# 2213689000, *Expir.* 03/24/2024) - If No, specify each deviation: _____

Was container in good condition? (Y) / N Comments _____

Was Chain of Custody received? (Y) / N Comments _____

Requested turnaround: 28 days If **RUSH**, who was notified? _____

pH (15 min)	Cr^{+6} (pres) (24 hr)	NO_2 or NO_3 (48 hr)	*ortho*-PO_4 (48 hr)	Hg-diss (pres) (48 hr)

Was COC filled out properly? (Y) / N Comments _____

Were samples labeled properly? (Y) / N Comments _____

Were correct containers used? (Y) / N Comments _____

Was pH checked & Color Coding done? (Y) / N or N/A **Initial & Date:** MGK 10/12/23

pH paper (circle one): MQuant,PN1.09535.0001,LOT#_____ {OR} Lab Rat,PN4801,LOT# X000RWDG21 Exp 11/15/2024

- Was Add'l Preservative needed? Y / (N) If Yes: By whom & when: _____ (See Prep Book)

Is sample filtration requested? Y / (N) Comments _____ (See Prep Book)

Was the customer contacted? If Yes: Person Contacted: _____

Lab ID# 233194 Initial & Date & Time : _____

Comments: _____

Logged by WCG _____

Reviewed by MGK _____

REMINDER: Document the pertinent sample integrity information and deviations in sample receipt (as noted above) in the "Notes" field in the LIMS to be included on the report to the customer.

Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 233156 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/07/2023**

Customer Sample ID: SP-1 **Customer Description:**
Lab Number: 233156-001 **Preparation:**
Date Collected: 10/10/2023 10:26 EDT **Date Received: 10/12/2023 10:00 EDT**

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	45.1	mg/L	5	0.10	0.03		CRJ	11/02/2023 15:24	EPA 300.1 -1997, Rev. 1.0
Fluoride	0.96	mg/L	5	0.15	0.05		CRJ	11/02/2023 15:24	EPA 300.1 -1997, Rev. 1.0
Sulfate	84.8	mg/L	5	1.5	0.3		CRJ	11/02/2023 15:24	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
TDS, Filterable Residue	470	mg/L	2	100	40		ELT	10/13/2023 12:53	SM 2540C-2015

Customer Sample ID: SP-2 **Customer Description:**
Lab Number: 233156-002 **Preparation:**
Date Collected: 10/10/2023 11:39 EDT **Date Received: 10/12/2023 10:00 EDT**

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	699	mg/L	50	1.0	0.3		CRJ	11/02/2023 03:42	EPA 300.1 -1997, Rev. 1.0
Fluoride	2.79	mg/L	5	0.15	0.05		CRJ	11/02/2023 08:05	EPA 300.1 -1997, Rev. 1.0
Sulfate	20.2	mg/L	5	1.5	0.3		CRJ	11/02/2023 08:05	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
TDS, Filterable Residue	1470	mg/L	2	100	40		ELT	10/13/2023 12:59	SM 2540C-2015

Customer Sample ID: SP-4 **Customer Description:**
Lab Number: 233156-003 **Preparation:**
Date Collected: 10/10/2023 09:54 EDT **Date Received: 10/12/2023 10:00 EDT**

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	450	mg/L	50	1.0	0.3		CRJ	11/02/2023 04:15	EPA 300.1 -1997, Rev. 1.0
Fluoride	3.19	mg/L	5	0.15	0.05		CRJ	11/02/2023 09:11	EPA 300.1 -1997, Rev. 1.0
Sulfate	81.4	mg/L	5	1.5	0.3		CRJ	11/02/2023 09:11	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
TDS, Filterable Residue	1160	mg/L	2	100	40		ELT	10/13/2023 12:59	SM 2540C-2015

AMERICAN ELECTRIC POWER

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Water Analysis Report

Job ID: 233156 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/07/2023**

Customer Sample ID: SP-5R
Lab Number: 233156-004
Date Collected: 10/10/2023 09:35 EDT
Customer Description:
Preparation:
Date Received: 10/12/2023 10:00 EDT

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	964	mg/L	50	1.0	0.3		CRJ	11/02/2023 04:48	EPA 300.1 -1997, Rev. 1.0
Fluoride	3.21	mg/L	5	0.15	0.05		CRJ	11/02/2023 09:44	EPA 300.1 -1997, Rev. 1.0
Sulfate	2.6	mg/L	5	1.5	0.3		CRJ	11/02/2023 09:44	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
TDS, Filterable Residue	1830	mg/L	2	100	40		ELT	10/13/2023 13:06	SM 2540C-2015

Customer Sample ID: SP-10
Lab Number: 233156-005
Date Collected: 10/10/2023 11:54 EDT
Customer Description:
Preparation:
Date Received: 10/12/2023 10:00 EDT

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	1820	mg/L	250	5	1		CRJ	11/02/2023 05:20	EPA 300.1 -1997, Rev. 1.0
Fluoride	6.3	mg/L	10	0.3	0.1		CRJ	11/02/2023 11:23	EPA 300.1 -1997, Rev. 1.0
Sulfate	19.2	mg/L	10	3.0	0.6		CRJ	11/02/2023 11:23	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Alkalinity, as CaCO3	467	mg/L	1	20	5		MGK	10/13/2023 15:51	SM 2320B-2011
Bicarbonate Alkalinity	465	mg/L	1	20	5		MGK	10/13/2023 15:51	SM 4500 CO2D-2011
TDS, Filterable Residue	3460	mg/L	2	100	40		ELT	10/13/2023 13:06	SM 2540C-2015

Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 233156 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/07/2023**

Customer Sample ID: SP-11
Customer Description:
Lab Number: 233156-006
Preparation:
Date Collected: 10/10/2023 12:11 EDT
Date Received: 10/12/2023 10:00 EDT

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	79.4	mg/L	5	0.10	0.03		CRJ	11/02/2023 10:50	EPA 300.1 -1997, Rev. 1.0
Fluoride	2.28	mg/L	5	0.15	0.05		CRJ	11/02/2023 10:50	EPA 300.1 -1997, Rev. 1.0
Sulfate	184	mg/L	5	1.5	0.3		CRJ	11/02/2023 10:50	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
TDS, Filterable Residue	880	mg/L	2	100	40		ELT	10/13/2023 13:25	SM 2540C-2015

Customer Sample ID: BAP DUPLICATE
Customer Description:
Lab Number: 233156-007
Preparation:
Date Collected: 10/10/2023 15:00 EDT
Date Received: 10/12/2023 10:00 EDT

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Chloride	56.6	mg/L	5	0.10	0.03		CRJ	11/02/2023 16:30	EPA 300.1 -1997, Rev. 1.0
Fluoride	0.98	mg/L	5	0.15	0.05		CRJ	11/02/2023 16:30	EPA 300.1 -1997, Rev. 1.0
Sulfate	85.7	mg/L	5	1.5	0.3		CRJ	11/02/2023 16:30	EPA 300.1 -1997, Rev. 1.0

Wet Chemistry

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
TDS, Filterable Residue	540	mg/L	2	100	40		ELT	10/13/2023 13:25	SM 2540C-2015

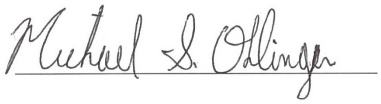
Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 233156 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/07/2023**

Report Verification

This report and the above data have been confirmed by the following analyst.



Michael Ohlinger, Chemist
Email: msohlinger@aep.com
Phone: 614-836-4184
Audinet: 8-210-4184

Chain of Custody Record

Program: Coal Combustion Residuals (CCR)

Dolan Chemical Laboratory (DCL)
4001 Bixby Road
Groveport, Ohio 43125
Contacts: Jonathan Barnhill (318-673-3803)
Michael Ohlinger (614-836-4184)

Project Name: NE PS BAP Semi-Annual CCR sampling

Contact Name: Rebecca Jones

Contact Phone: 737-330-3725

Sampler(s): Kenny McDonald/Matt Hamilton

Analysis Turnaround Time (in Calendar Days)
Routine (28 days for Monitoring Wells)

Site Contact:

Date:

For Lab Use Only:
COC/Order #: 233196

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Sampler(s) Initials	250 mL bottle, pH<2, HNO_3 — As, B, Ba, Be, Ca, Cd, Cr, Co, K, Li, Na, Pb, Mg, Mo, Sb, Se, Tl	1 L bottle, Cool, 0-6°C — TDS, F, Cl, SO_4	Three (six every 10th*) 1 L bottles, pH<2, HNO_3 — Ra-226, Ra-228	250 mL Glass bottle, HCL**, pH<2 — Hg	Field-filter 250 mL bottle, pH<2, HNO_3 — dissolved Fe and Mn	1 L bottle Cool, 0-6°C — TDS, F, CL, SO4, TOTAL ALKALINITY, BICARBONATE ALKALINITY	Sample Specific Notes:
SP-1	10/10/2023	926	G	GW	1			X					
SP-2	10/10/2023	1039	G	GW	1			X					
SP-4	10/10/2023	854	G	GW	1			X					
SP-5R	10/10/2023	835	G	GW	1			X					
SP-10	10/10/2023	1054	G	GW	1							X	
SP-11	10/10/2023	1111	G	GW	1			X					
BAP DUPLICATE	10/10/2023	1400	G	GW	1			X					
Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____; F= filter in field							4	1	4				

* Six 1L Bottles must be collected for Radium for every 10th sample.

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
[signature]	EAGLE	10/11/23 1300		
Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by: [signature]	Date/Time: 10/12/23 1000

AEP WATER & WASTE SAMPLE RECEIPT FORM

Package Type

Cooler (circled) Box Bag Envelope

Delivery Type

PONY UPS FedEX (circled) USPS

Other ____

Plant/Customer NE

Number of Plastic Containers: ~~6~~ 7 (correction initialed OWC 10/12/23)

Opened By Misgina Williams

Number of Glass Containers: ____

Date/Time 10/12/23 10:00 Am

Number of Mercury Containers: ____

Were all temperatures within 0-6°C? (Y) / N or N/A **Initial:** MGK (on ice) / no ice

(IR Gun Ser# 2213689000, *Expir.* 03/24/2024) - If No, specify each deviation: ____

Was container in good condition? (Y) / N Comments ____

Was Chain of Custody received? (Y) / N Comments ____

Requested turnaround: 28 days If **RUSH**, who was notified? ____

pH (15 min) Cr^{+6} (pres) (24 hr) NO_2 or NO_3 (48 hr) *ortho*-PO_4 (48 hr) Hg-diss (pres) (48 hr)

Was COC filled out properly? (Y) N Comments ____

Were samples labeled properly? (Y) / N Comments ____

Were correct containers used? (Y) / N Comments ____

Was pH checked & Color Coding done? (Y) / N or N/A **Initial & Date:** MGK 10/12/23

pH paper (circle one): MQuant,PN1.09535.0001,LOT# ____ (OR) Lab Rat,PN4801,LOT# (X000RWDG21 Exp 11/15/2024)

- Was Add'l Preservative needed? Y / (N) If Yes: By whom & when: ____ (See Prep Book)

Is sample filtration requested? Y / (N) Comments ____ (See Prep Book)

Was the customer contacted? If Yes: Person Contacted: ____

Lab ID# 233156

Initial & Date & Time: ____

Comments: ____

Logged by WCG

Reviewed by MGK

REMINDER: Document the pertinent sample integrity information and deviations in sample receipt (as noted above) in the "Notes" field in the LIMS to be included on the report to the customer.

Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 233181 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/28/2023**

Customer Sample ID: SP-1
Customer Description:
Lab Number: 233181-001
Preparation:
Date Collected: 10/10/2023 10:26 EDT
Date Received: 10/13/2023 10:45 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.745	µg/L	1	0.100	0.008		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Arsenic	0.65	µg/L	1	0.10	0.03		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Barium	138	µg/L	1	0.20	0.05		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Beryllium	0.053	µg/L	1	0.050	0.007		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Boron	0.159	mg/L	1	0.050	0.007		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Cadmium	0.041	µg/L	1	0.020	0.004		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Calcium	102	mg/L	1	0.05	0.01		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Chromium	0.47	µg/L	1	0.30	0.07		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Cobalt	0.717	µg/L	1	0.020	0.005		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Lead	0.17	µg/L	1	0.20	0.05	J1	GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Lithium	0.00819	mg/L	1	0.00030	0.00007		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Magnesium	28.0	mg/L	1	0.100	0.006		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	10/17/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	26.0	µg/L	1	0.5	0.1		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Potassium	1.01	mg/L	1	0.100	0.008		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Selenium	11.8	µg/L	1	0.50	0.04		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Sodium	51.2	mg/L	1	0.20	0.01		GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4
Thallium	0.11	µg/L	1	0.20	0.02	J1	GES	10/30/2023 18:57	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	0.96	pCi/L	0.15	0.13	P1	TTP	11/04/2023 17:41	SW-846 9315-1986, Rev. 0
Carrier Recovery	99.8	%						
Radium-228	2.10	pCi/L	0.22	0.66	M1	ST	11/11/2023 16:41	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	67.8	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 233181 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/28/2023**

Customer Sample ID: SP-2 Customer Description:
Lab Number: 233181-002 Preparation:
Date Collected: 10/10/2023 11:39 EDT Date Received: 10/13/2023 10:45 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	1.06	µg/L	1	0.100	0.008		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Arsenic	0.82	µg/L	1	0.10	0.03		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Barium	1270	µg/L	1	0.20	0.05		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Beryllium	0.086	µg/L	1	0.050	0.007		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Boron	0.210	mg/L	1	0.050	0.007		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Cadmium	0.047	µg/L	1	0.020	0.004		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Calcium	151	mg/L	1	0.05	0.01		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Chromium	0.62	µg/L	1	0.30	0.07		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Cobalt	0.322	µg/L	1	0.020	0.005		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Lead	0.15	µg/L	1	0.20	0.05	J1	GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Lithium	0.0809	mg/L	1	0.00030	0.00007		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Magnesium	65.8	mg/L	1	0.100	0.006		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	10/17/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	15.9	µg/L	1	0.5	0.1		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Potassium	3.41	mg/L	1	0.100	0.008		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Selenium	3.63	µg/L	1	0.50	0.04		GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4
Sodium	522	mg/L	5	1.00	0.05		GES	10/30/2023 19:07	EPA 200.8-1994, Rev. 5.4
Thallium	0.05	µg/L	1	0.20	0.02	J1	GES	10/30/2023 19:02	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	3.07	pCi/L	0.26	0.11		TTP	11/04/2023 17:41	SW-846 9315-1986, Rev. 0
Carrier Recovery	115	%						
Radium-228	4.99	pCi/L	0.24	0.61		ST	11/11/2023 16:41	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	69.2	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

AMERICAN ELECTRIC POWER

Dolan Chemical Laboratory
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Water Analysis Report

Job ID: 233181 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/28/2023**

Customer Sample ID: SP-4
Lab Number: 233181-003
Date Collected: 10/10/2023 09:54 EDT

Customer Description:
Preparation:
Date Received: 10/13/2023 10:45 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.249	µg/L	1	0.100	0.008		GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Arsenic	0.84	µg/L	1	0.10	0.03		GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Barium	232	µg/L	1	0.20	0.05		GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Beryllium	0.036	µg/L	1	0.050	0.007	J1	GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Boron	0.339	mg/L	1	0.050	0.007		GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Cadmium	0.057	µg/L	1	0.020	0.004		GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Calcium	90.9	mg/L	1	0.05	0.01		GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Chromium	0.59	µg/L	1	0.30	0.07		GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Cobalt	0.218	µg/L	1	0.020	0.005		GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Lead	0.38	µg/L	1	0.20	0.05		GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Lithium	0.0554	mg/L	1	0.00030	0.00007		GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Magnesium	39.5	mg/L	1	0.100	0.006		GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	10/17/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	3.3	µg/L	1	0.5	0.1		GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Potassium	2.49	mg/L	1	0.100	0.008		GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Selenium	0.30	µg/L	1	0.50	0.04	J1	GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4
Sodium	324	mg/L	5	1.00	0.05		GES	10/30/2023 19:17	EPA 200.8-1994, Rev. 5.4
Thallium	0.02	µg/L	1	0.20	0.02	J1	GES	10/30/2023 19:12	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	0.93	pCi/L	0.17	0.18		TTP	11/04/2023 17:41	SW-846 9315-1986, Rev. 0
Carrier Recovery	77.5	%						
Radium-228	2.30	pCi/L	0.20	0.58		ST	11/11/2023 16:41	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	76.2	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

AMERICAN ELECTRIC POWER

Dolan Chemical Laboratory
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Water Analysis Report

Job ID: 233181 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/28/2023**

Customer Sample ID: SP-5R
Customer Description:
Lab Number: 233181-004
Preparation:
Date Collected: 10/10/2023 09:35 EDT
Date Received: 10/13/2023 10:45 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.195	µg/L	1	0.100	0.008		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Arsenic	15.8	µg/L	1	0.10	0.03		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Barium	2770	µg/L	5	1.0	0.3		GES	10/30/2023 19:27	EPA 200.8-1994, Rev. 5.4
Beryllium	0.201	µg/L	1	0.050	0.007		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Boron	0.228	mg/L	1	0.050	0.007		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Cadmium	0.076	µg/L	1	0.020	0.004		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Calcium	107	mg/L	1	0.05	0.01		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Chromium	2.64	µg/L	1	0.30	0.07		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Cobalt	1.03	µg/L	1	0.020	0.005		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Lead	2.52	µg/L	1	0.20	0.05		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Lithium	0.123	mg/L	1	0.00030	0.00007		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Magnesium	35.3	mg/L	1	0.100	0.006		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	10/17/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	0.7	µg/L	1	0.5	0.1		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Potassium	3.70	mg/L	1	0.100	0.008		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Selenium	0.94	µg/L	1	0.50	0.04		GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4
Sodium	648	mg/L	5	1.00	0.05		GES	10/30/2023 19:27	EPA 200.8-1994, Rev. 5.4
Thallium	0.04	µg/L	1	0.20	0.02	J1	GES	10/30/2023 19:22	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	18.30	pCi/L	0.65	0.08	R2	TTP	11/04/2023 18:22	SW-846 9315-1986, Rev. 0
Carrier Recovery	139	%						
Radium-228	6.48	pCi/L	0.25	0.64		ST	11/11/2023 16:41	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	81.4	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

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Water Analysis Report

Job ID: 233181 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/28/2023**

Customer Sample ID: SP-10
Lab Number: 233181-005
Date Collected: 10/10/2023 11:54 EDT

Customer Description:
Preparation:
Date Received: 10/13/2023 10:45 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.062	µg/L	1	0.100	0.008	J1	GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Arsenic	0.65	µg/L	1	0.10	0.03		GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Barium	6010	µg/L	10	2.0	0.5		GES	10/30/2023 19:38	EPA 200.8-1994, Rev. 5.4
Beryllium	0.035	µg/L	1	0.050	0.007	J1	GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Boron	0.879	mg/L	1	0.050	0.007		GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Cadmium	0.007	µg/L	1	0.020	0.004	J1	GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Calcium	93.0	mg/L	1	0.05	0.01		GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Chromium	0.36	µg/L	1	0.30	0.07		GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Cobalt	0.039	µg/L	1	0.020	0.005		GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Lead	0.08	µg/L	1	0.20	0.05	J1	GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Lithium	0.235	mg/L	1	0.00030	0.00007		GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Magnesium	46.2	mg/L	1	0.100	0.006		GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	10/17/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	0.2	µg/L	1	0.5	0.1	J1	GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Potassium	6.20	mg/L	1	0.100	0.008		GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Selenium	0.06	µg/L	1	0.50	0.04	J1	GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4
Sodium	1210	mg/L	10	2.0	0.1		GES	10/30/2023 19:38	EPA 200.8-1994, Rev. 5.4
Thallium	<0.02	µg/L	1	0.20	0.02	U1	GES	10/30/2023 19:33	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	20.40	pCi/L	0.70	0.10	R2	TTP	11/04/2023 18:22	SW-846 9315-1986, Rev. 0
Carrier Recovery	136	%						
Radium-228	1.39	pCi/L	0.13	0.37		ST	11/11/2023 16:41	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	101	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

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Water Analysis Report

Job ID: 233181 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/28/2023**

Customer Sample ID: SP-11
Lab Number: 233181-006
Date Collected: 10/10/2023 12:11 EDT

Customer Description:
Preparation:
Date Received: 10/13/2023 10:45 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.075	µg/L	1	0.100	0.008	J1	GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Arsenic	3.61	µg/L	1	0.10	0.03		GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Barium	455	µg/L	1	0.20	0.05		GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Beryllium	0.027	µg/L	1	0.050	0.007	J1	GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Boron	0.354	mg/L	1	0.050	0.007		GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Cadmium	0.031	µg/L	1	0.020	0.004		GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Calcium	79.1	mg/L	1	0.05	0.01		GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Chromium	0.90	µg/L	1	0.30	0.07		GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Cobalt	0.635	µg/L	1	0.020	0.005		GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Lead	0.45	µg/L	1	0.20	0.05		GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Lithium	0.0222	mg/L	1	0.00030	0.00007		GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Magnesium	13.0	mg/L	1	0.100	0.006		GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	10/17/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	0.9	µg/L	1	0.5	0.1		GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Potassium	2.62	mg/L	1	0.100	0.008		GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Selenium	0.23	µg/L	1	0.50	0.04	J1	GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4
Sodium	252	mg/L	5	1.00	0.05		GES	10/30/2023 19:48	EPA 200.8-1994, Rev. 5.4
Thallium	<0.02	µg/L	1	0.20	0.02	U1	GES	10/30/2023 19:43	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	2.91	pCi/L	0.20	0.07	R2	TTP	11/04/2023 18:22	SW-846 9315-1986, Rev. 0
Carrier Recovery	171	%						
Radium-228	-0.08	pCi/L	0.15	0.54		ST	11/11/2023 16:41	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	69.0	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
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Job ID: 233181 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/28/2023**

Customer Sample ID: BAP DUPLICATE
Customer Description:
Lab Number: 233181-007
Preparation:
Date Collected: 10/10/2023 15:00 EDT
Date Received: 10/13/2023 10:45 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.775	µg/L	1	0.100	0.008		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Arsenic	0.76	µg/L	1	0.10	0.03		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Barium	151	µg/L	1	0.20	0.05		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Beryllium	0.054	µg/L	1	0.050	0.007		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Boron	0.168	mg/L	1	0.050	0.007		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Cadmium	0.061	µg/L	1	0.020	0.004		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Calcium	113	mg/L	1	0.05	0.01		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Chromium	0.59	µg/L	1	0.30	0.07		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Cobalt	0.767	µg/L	1	0.020	0.005		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Lead	0.20	µg/L	1	0.20	0.05		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Lithium	0.00764	mg/L	1	0.00030	0.00007		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Magnesium	29.7	mg/L	1	0.100	0.006		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	10/17/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	24.9	µg/L	1	0.5	0.1		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Potassium	1.07	mg/L	1	0.100	0.008		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Selenium	11.7	µg/L	1	0.50	0.04		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Sodium	54.0	mg/L	1	0.20	0.01		GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4
Thallium	0.09	µg/L	1	0.20	0.02	J1	GES	10/30/2023 19:53	EPA 200.8-1994, Rev. 5.4

AMERICAN ELECTRIC POWER

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Water Analysis Report

Job ID: 233181 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/28/2023**

Customer Sample ID: BAP EQUIPMENT BLANK
Customer Description:
Lab Number: 233181-008
Preparation:
Date Collected: 10/10/2023 11:50 EDT
Date Received: 10/13/2023 10:45 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	<0.008	µg/L	1	0.100	0.008	U1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Arsenic	<0.03	µg/L	1	0.10	0.03	U1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Barium	0.06	µg/L	1	0.20	0.05	J1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Beryllium	<0.007	µg/L	1	0.050	0.007	U1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Boron	<0.007	mg/L	1	0.050	0.007	U1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Cadmium	<0.004	µg/L	1	0.020	0.004	U1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Calcium	0.02	mg/L	1	0.05	0.01	J1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Chromium	0.33	µg/L	1	0.30	0.07		GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Cobalt	0.086	µg/L	1	0.020	0.005		GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Lead	<0.05	µg/L	1	0.20	0.05	U1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Lithium	<0.00007	mg/L	1	0.00030	0.00007	U1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Magnesium	<0.006	mg/L	1	0.100	0.006	U1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	10/17/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	<0.1	µg/L	1	0.5	0.1	U1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Potassium	<0.008	mg/L	1	0.100	0.008	U1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Selenium	<0.04	µg/L	1	0.50	0.04	U1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Sodium	0.54	mg/L	1	0.20	0.01		GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4
Thallium	<0.02	µg/L	1	0.20	0.02	U1	GES	10/30/2023 20:03	EPA 200.8-1994, Rev. 5.4

Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 233181 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/28/2023**

Customer Sample ID: BAP FIELD BLANK
Lab Number: 233181-009
Date Collected: 10/10/2023 12:03 EDT

Customer Description:
Preparation:
Date Received: 10/13/2023 10:45 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	<0.008	µg/L	1	0.100	0.008	U1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Arsenic	<0.03	µg/L	1	0.10	0.03	U1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Barium	0.09	µg/L	1	0.20	0.05	J1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Beryllium	<0.007	µg/L	1	0.050	0.007	U1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Boron	<0.007	mg/L	1	0.050	0.007	U1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Cadmium	<0.004	µg/L	1	0.020	0.004	U1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Calcium	0.01	mg/L	1	0.05	0.01	J1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Chromium	0.36	µg/L	1	0.30	0.07		GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Cobalt	0.033	µg/L	1	0.020	0.005		GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Lead	<0.05	µg/L	1	0.20	0.05	U1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Lithium	<0.00007	mg/L	1	0.00030	0.00007	U1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Magnesium	<0.006	mg/L	1	0.100	0.006	U1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Molybdenum	<0.1	µg/L	1	0.5	0.1	U1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Potassium	<0.008	mg/L	1	0.100	0.008	U1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Selenium	<0.04	µg/L	1	0.50	0.04	U1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Sodium	<0.01	mg/L	1	0.20	0.01	U1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4
Thallium	<0.02	µg/L	1	0.20	0.02	U1	GES	10/30/2023 20:08	EPA 200.8-1994, Rev. 5.4

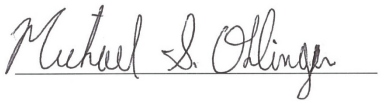
Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 233181 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/28/2023**

Report Verification

This report and the above data have been confirmed by the following analyst.



Michael Ohlinger, Chemist
Email: msohlinger@aep.com
Phone: 614-836-4184
Audinet: 8-210-4184

Data Qualifer Legend

J1 - Concentration estimated. Analyte was detected between the method detection limit and the reporting limit.
U1 - Not detected at or above method detection limit (MDL).
P1 - The precision between duplicate results was above acceptance limits.
M1 - The associated matrix spike (MS) or matrix spike duplicate (MSD) recovery was outside acceptance limits.
R2 - Carrier recovery was outside acceptance limits.

Chain of Custody Record

Program: Coal Combustion Residuals (CCR)

Dolan Chemical Laboratory (DCL)
4001 Bixby Road
Groveport, Ohio 43125
Contacts: Jonathan Barnhill (318-673-3803)
Michael Ohlinger (614-836-4184)

Project Name: NE PS BAP Semi-Annual CCR sampling

Contact Name: Rebecca Jones

Contact Phone: 737-330-3725

Sampler(s): Kenny McDonald/Matt Hamilton

Analysis Turnaround Time (in Calendar Days)
Routine (28 days for Monitoring Wells)

Site Contact:

Date:

For Lab Use Only:
COC/Order #: 233181

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Sampler(s) Initials	250 mL bottle, pH<2, HNO_3 As, B, Ba, Be, Ca, Cd, Cr, Co, K, Li, Na, Pb, Mg, Mo, Sb, Se, Tl	1 L bottle, Cool, 0-6°C TDS, F, Cl, SO_4	Three (six every 10th*) 1 L bottles, pH<2, HNO_3 Ra-226, Ra-228	250 mL Glass or 125/250 mL PTFE lined bottle, HCL** pH<2 Hg	Field-filter 500 mL bottle, then pH<2, HNO_3 dissolved Fe and Mn		Sample Specific Notes:
SP-1	10/10/2023	926	G	GW	5		X		X	X			
SP-2	10/10/2023	1039	G	GW	5		X		X	X			
SP-4	10/10/2023	854	G	GW	5		X		X	X			
SP-5R	10/10/2023	835	G	GW	5		X		X	X			
SP-10	10/10/2023	1054	G	GW	5		X		X	X			
SP-11	10/10/2023	1111	G	GW	5		X		X	X			
BAP DUPLICATE	10/10/2023	1400	G	GW	2		X			X			
BAP EQUIPMENT BLANK	10/10/2023	1050	G	W	2		X			X			
BAP FIELD BLANK	10/10/2023	1103	G	W	1		X						
Preservation Used: 1= Ice, 2= HCl; 3= H_2SO_4; 4=HNO_3; 5=NaOH; 6= Other _____; F= filter in field							**4**	**1**	**4**				

** Six 1L Bottles must be collected for Radium for every 10th sample.*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company: EAGLE	Date/Time: 10/11/23 1300	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by: Michael Ohlinger	Date/Time: 10/13/23 10:45AM

AEP WATER & WASTE SAMPLE RECEIPT FORM

Package Type	Delivery Type
(Cooler) Box Bag Envelope	PONY UPS (FedEX) USPS
	Other _____

Plant/Customer Northeastern **Number of Plastic Containers:** 27

Opened By MSO **Number of Glass Containers:** _____

Date/Time 10/13/23 1045 **Number of Mercury Containers:** 8

Were all temperatures within 0-6°C? Y / N or (N/A) **Initial**: _____ on ice / no ice

(IR Gun Ser# 2213689000, *Expir.* 03/24/2024) - If No, specify each deviation: _____

Was container in good condition? (Y) / N Comments _____

Was Chain of Custody received? (Y) / N Comments _____

Requested turnaround: Routine If **RUSH**, who was notified? _____

pH (15 min) Cr^{+6} (pres) (24 hr) NO_2 or NO_3 (48 hr) *ortho*-PO_4 (48 hr) Hg-diss (pres) (48 hr)

Was COC filled out properly? (Y) / N Comments _____

Were samples labeled properly? (Y) / N Comments _____

Were correct containers used? (Y) / N Comments _____

Was pH checked & Color Coding done? (Y) / N or N/A **Initial & Date**: WCG MGK 10/13/23

pH paper (circle one): MQuant,PN1.09535.0001,LOT#_____ [OR] (Lab Rat,PN4801,LOT# X000RWDG21 Exp 11/15/2024)

- Was Add'l Preservative needed? Y / (N) If Yes: By whom & when: _____ (See Prep Book)

Is sample filtration requested? Y / (N) Comments _____ (See Prep Book)

Was the customer contacted? If Yes: Person Contacted: _____

Lab ID# 233181 Initial & Date & Time : _____

Comments: _____

Logged by MSO _____

Reviewed by WCG _____

REMINDER: Document the pertinent sample integrity information and deviations in sample receipt (as noted above) in the "Notes" field in the LIMS to be included on the report to the customer.

Water Analysis Report

Reissued

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 233182 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/28/2023**

Customer Sample ID: SP-10
Lab Number: 233182-001
Date Collected: 10/10/2023 11:54 EDT

Customer Description:
Preparation: Dissolved
Date Received: 10/13/2023 10:45 EDT

Metals

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Antimony	0.075	µg/L	1	0.100	0.008	J1	GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Arsenic	0.87	µg/L	1	0.10	0.03		GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Barium	5510	µg/L	10	2.0	0.5		GES	10/24/2023 14:35	EPA 200.8-1994, Rev. 5.4
Beryllium	0.031	µg/L	1	0.050	0.007	J1	GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Boron	0.889	mg/L	1	0.050	0.007		GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Cadmium	<0.004	µg/L	1	0.020	0.004	U1	GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Calcium	111	mg/L	1	0.05	0.01		GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Chromium	0.24	µg/L	1	0.30	0.07	J1	GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Cobalt	0.023	µg/L	1	0.020	0.005		GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Lead	<0.05	µg/L	1	0.20	0.05	U1	GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Lithium	0.233	mg/L	1	0.00030	0.00007		GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Magnesium	43.9	mg/L	1	0.100	0.006		GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Mercury	<2	ng/L	1	5	2	U1	RLP	10/17/2023 00:00	EPA 245.7-2005, Rev. 2.0
Molybdenum	0.3	µg/L	1	0.5	0.1	J1	GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Potassium	5.65	mg/L	1	0.100	0.008		GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Selenium	<0.04	µg/L	1	0.50	0.04	U1	GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4
Sodium	1180	mg/L	10	2.0	0.1		GES	10/24/2023 14:35	EPA 200.8-1994, Rev. 5.4
Thallium	<0.02	µg/L	1	0.20	0.02	U1	GES	10/24/2023 14:30	EPA 200.8-1994, Rev. 5.4

Radiochemistry

Parameter	Result	Units	UNC*(+/-)	MDA*	Data Qualifiers	Analyst	Analysis Date	Method
Radium-226	23.20	pCi/L	0.82	0.11		TTP	11/04/2023 18:22	SW-846 9315-1986, Rev. 0
Carrier Recovery	125	%						
Radium-228	1.79	pCi/L	0.15	0.42		ST	11/08/2023 15:32	SW-846 9320-2014, Rev. 1.0
Carrier Recovery	108	%						

* The Required Detection Limit (RDL) is equivalent to the RL and for Radium-226 and Radium-228, the RDL is calculated to be 1.0 pCi/L. The Minimal Detectable Activity (MDA) listed with these results is sample specific and empirical. The combined standard uncertainty (UNC) is a counting uncertainty representing "one-sigma" which has the same units of measurement as the result.

233182
Job Comments:

Original report issued 11/14/23. Report reissued 11/28/23 due to an update in the correction factor for Radium 226.

Water Analysis Report

Reissued

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 233182 **Customer: Northeastern 3&4 Power Station** **Date Reported: 11/28/2023**

Report Verification

This report and the above data have been confirmed by the following analyst.

Michael Ohlinger, Chemist
Email: msohlinger@aep.com
Phone: 614-836-4184
Audinet: 8-210-4184

Data Qualifer Legend

J1 - Concentration estimated. Analyte was detected between the method detection limit and the reporting limit.
U1 - Not detected at or above method detection limit (MDL).

Chain of Custody Record

Program: Coal Combustion Residuals (CCR)

Dolan Chemical Laboratory (DCL)
4001 Bixby Road
Groveport, Ohio 43125
Contacts: Jonathan Barnhill (318-673-3803)
Michael Ohlinger (614-836-4184)

Project Name: NE Dis BAP wells
Contact Name: Rebecca Jones
Contact Phone: 737-330-3725
Sampler(s): Kenny McDonald/Matt Hamilton

Analysis Turnaround Time (in Calendar Days)
Routine (28 days for Monitoring Wells)

Site Contact:

Date:

For Lab Use Only:
COC/Order #: 233182

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Sampler(s) Initials	250 mL bottle, pH<2, HNO_3 — TOTAL - B, Ca, Li, Sb, As, Ba, Be, Cd, Cr, Co, Pb, Mo, Se, TL	Field-filter 250 mL bottle, then pH<2, HNO_3 — DISSOLVED - As, B, Ba, Be, Ca,Cd, Cr, Co,K, Li, Na, Pb, Mg, Mo, Sb, Se, TL	Field-Filter 250 mL bottle, Cool, 0-6°C — DISSOLVED F	Field-filter Three (six every 10th*) 1 L bottles, pH<2, HNO_3 — DISSOLVED Ra-226, Ra-228	250 mL Glass or 125/250 mL PTFE lined bottle, HCL**, pH<2 — TOTAL HG	Field Filter 250 mL Glass or 125/250 mL PTFE lined bottle, HCL**, pH<2 — DISSOLVED Hg	Sample Specific Notes:
SP-10	10/10/2023	1054	G	GW	5			X		X		X	
Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____; F= filter in field							4	F4	1	4			

* *Six 1L Bottles must be collected for Radium for every 10th sample.*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
[signature]	EAGLE	10/11/23 1700		
Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Date/Time:
			[signature]	10/13/23 10:45AM

AEP WATER & WASTE SAMPLE RECEIPT FORM

Package Type	Delivery Type
(Cooler) Box Bag Envelope	PONY UPS (FedEX) USPS
	Other ______

Plant/Customer Northeastern — Number of Plastic Containers: 4

Opened By MSO — Number of Glass Containers: ______

Date/Time 10/13/23 1045 — Number of Mercury Containers: 1

Were all temperatures within 0-6°C? Y / N or (N/A) Initial: ______ on ice / no ice

(IR Gun Ser# 2213689000, *Expir.* 03/24/2024) - If No, specify each deviation: ______

Was container in good condition? (Y) / N Comments ______

Was Chain of Custody received? (Y) / N Comments ______

Requested turnaround: Routine If **RUSH**, who was notified? ______

pH (15 min) Cr^{+6} (pres) (24 hr) NO_2 or NO_3 (48 hr) *ortho*-PO_4 (48 hr) Hg-diss (pres) (48 hr)

Was COC filled out properly? (Y) / N Comments ______

Were samples labeled properly? (Y) / N Comments ______

Were correct containers used? (Y) / N Comments ______

Was pH checked & Color Coding done? (Y) / N or N/A **Initial & Date:** WCG MGK 10/13/23

pH paper (circle one): MQuant.PN1.09535.0001.LOT# ______ (OR) (Lab Rat.PN4801.LOT# X000RWDG21 Exp 11/15/2024)

- Was Add'l Preservative needed? Y / (N) If Yes: By whom & when: ______ (See Prep Book)

Is sample filtration requested? Y / (N) Comments ______ (See Prep Book)

Was the customer contacted? If Yes: Person Contacted ______

Initial & Date & Time : ______

Lab ID# 233182

Comments ______

Logged by MSO

Reviewed by WCG

REMINDER: Document the pertinent sample integrity information and deviations in sample receipt (as noted above) in the "Notes" field in the LIMS to be included on the report to the customer.