Annual Groundwater Monitoring Report

Public Service Company of Oklahoma

Northeastern 3&4 Power Station

Landfill CCR Management Unit

Permit Number: FA3566010

7300 E HWY 88

Oologah, Oklahoma

January 2022

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

PUBLIC SERVICE COMPANY OF OKLAHOMA℠

An AEP Company

BOUNDLESS ENERGY℠

Table of Contents

Abbreviations:
ASD - Alternate Source Demonstration
CCR – Coal Combustion Residual
GWPS - Groundwater protection standards
LF – Landfill
NPS – Northeastern Power Station
SSI - Statistically Significant Increase

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 3&4 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, 2022.
In general, the following activities were completed:

- At the start of the current annual reporting period, the LF was operating under the Detection monitoring program.
- At the end of the current annual reporting period, the LF was operating under the Detection monitoring program.
- Groundwater samples were collected and analyzed for Appendix A constituents, as specified in OAC 255:517-9-5 Detection Monitoring program and AEP's *Groundwater Sampling and Analysis Plan* (2018).
- Data and statistical analysis not available for the previous reporting period indicated that during the 2nd semi-annual 2020 sampling event (October, 2020):
    - No SSIs were detected.
- During the 1st semi-annual 2021 sampling event (April, 2021):
    - A potential SSI was identified for:
        - Sulfate at MW-15
- Statistical evaluation of the 2nd semi-annual 2021 groundwater sampling event in December 2021 is underway.
- An ASD for the pH (MW-9D) and Sulfate (MW-5D and MW-15) potential SSIs identified during the 1st semi-annual 2020 groundwater monitoring was certified February 26, 2021 and approved by ODEQ on June 22, 2021.
- An ASD for the Sulfate (MW-15) potential SSIs identified during the 1st semi-annual 2021 groundwater monitoring was certified October 18, 2021 and approved by ODEQ on November 23, 2021.
- NPS continues to evaluate the site for appropriate upgradient/background well placement.

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

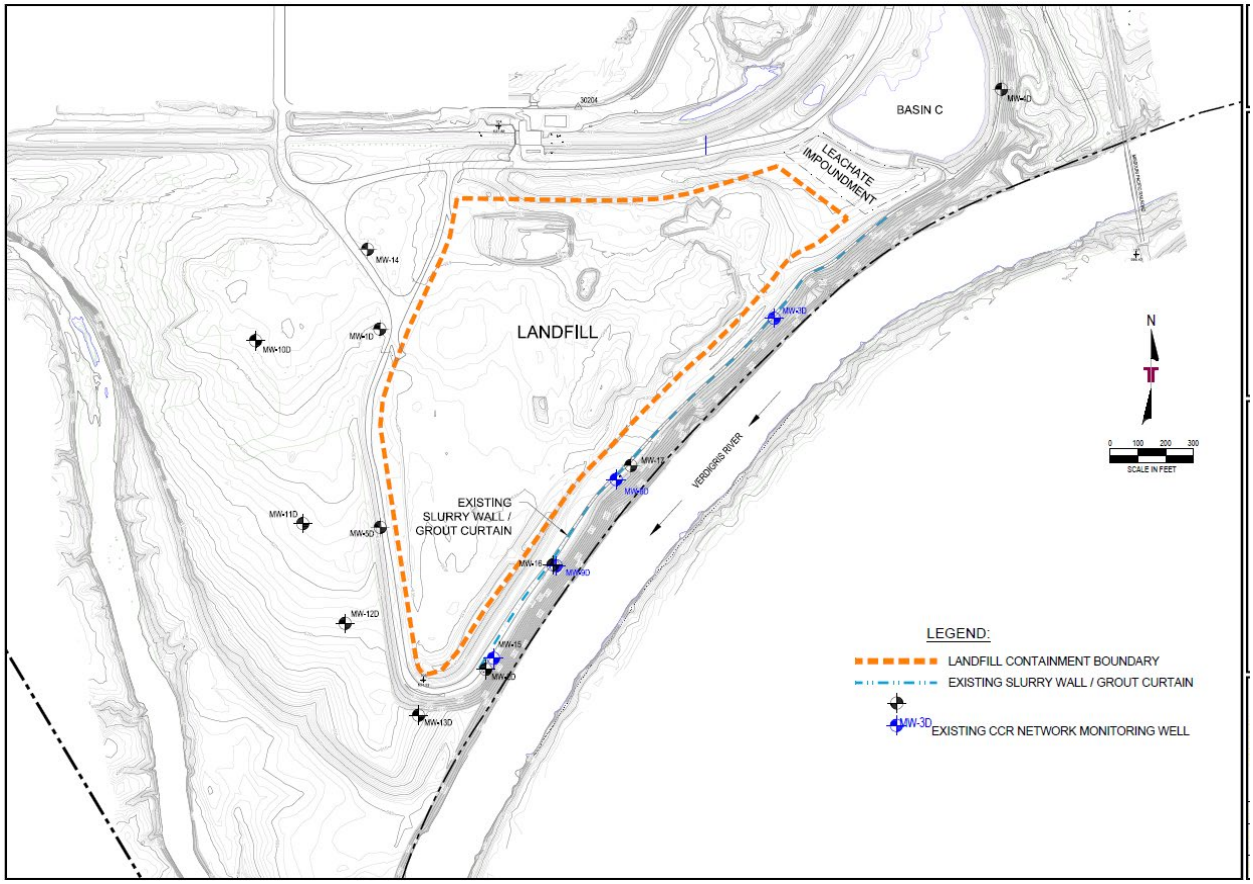
- A map, aerial photograph or a drawing showing the LF CCR management unit, all groundwater monitoring wells and monitoring well identification numbers;
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened;
- 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 programs is included in Appendix 1;
- Statistical comparison of monitoring data to determine if there have been SSI(s) (Attached as Appendix 2, where applicable);
- A discussion of whether any alternate source demonstrations were performed, and the conclusions (Attached as Appendix 3, where applicable);
- A summary of any transition between monitoring programs or an alternate monitoring frequency (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 field sheets, 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.

Landfill Monitoring Wells	
Up Gradient	**Down Gradient**
Pending	MW-1D through MW-6D,
	MW-9D through MW-13D
	MW-14 through MW-17



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 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 252:517-9-5 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.

Groundwater samples were collected and analyzed for Appendix A constituents, as specified in OAC 255:517-9-5 Detection Monitoring program and AEP's Groundwater Sampling and Analysis Plan (2018), which was approved by ODEQ September 2018.

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

Appendix 6 contains the field sheets and laboratory analytical reports that are available for this reporting period.

V. Groundwater Quality Data Statistical Analysis

ODEQ issued a Notice Of Deficiency (NOD) January 30, 2020 for the boron ASD submitted October 2018, which presented revised statistical results through intra-well analysis. ODEQ agreed that a statistical error had occurred related to inappropriate background wells MWs 7D and 8D and background concentrations could not be established; therefore prior to instituting an assessment monitoring program, a background well or wells representative of the aquifer must be established. Until the background concentrations can be established, statistical analysis will be completed through intra-well comparison.

- Data and statistical analysis not available for the previous reporting period indicated that during the 2nd semi-annual 2020 event groundwater sampling event conducted October 20-21, 2020, with 2 of 2 confirmatory sampling conducted December 16, 2020:
    - No potential SSIs were identified

- During the 1st semi-annual 2021 sampling event conducted April 13, 2021 with 2 of 2 confirmatory sampling conducted June 22, 2021:
    - A potential SSI was identified for:
        - Sulfate at MW-15
- The 2nd semi-annual 2021 statistical evaluation for the groundwater samples collected in December 2021 is underway.

- Background Calculations were updated to include the more recent semi-annual and verification groundwater analytical results.

- The statistical reports available for this reporting period are found in Appendix 2.

VI. Alternate Source Demonstrations completed

Alternate source demonstrations (ASD) for the pH (MW-9D) and Sulfate (MW-5D and MW-15) potential SSIs identified during the 1st semi-annual 2020 groundwater monitoring was certified February 26, 2021 and approved by ODEQ on June 22, 2021.

An ASD for the Sulfate (MW-15) potential SSI identified during the 1st semi-annual 2021 groundwater monitoring was certified October 18, 2021 and approved by ODEQ on November 23, 2021.

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

This CCR Unit remained in detection monitoring throughout 2021.

The semi-annually sampling frequency will be maintained for the current monitoring program.

VIII. Other Information Required

NPS continues to work towards completing the field work for identifying background/upgradient groundwater monitoring wells for this CCR Unit.

IX. Description of Any Problems Encountered and Actions Taken

As required by OAC 252:517-9-1(b)(1)(c), a minimum of eight independent samples are to be collected from each downgradient well within the monitoring well network. NPS continues to

attempt to collect background data from wells 1D, 2D, 10D, 11D, 13D, 14, 16, and 17, which often lack sufficient water volume for sample collection after allowing for 24 hours of recharge.

Of these wells:

During the 1st semi-annual sampling event, groundwater samples were successfully collected from wells 2D and 13D.

During the 2nd semi-annual sampling event, groundwater samples were successfully collected from MWs 13D and 14, data to be included in next year's annual report.

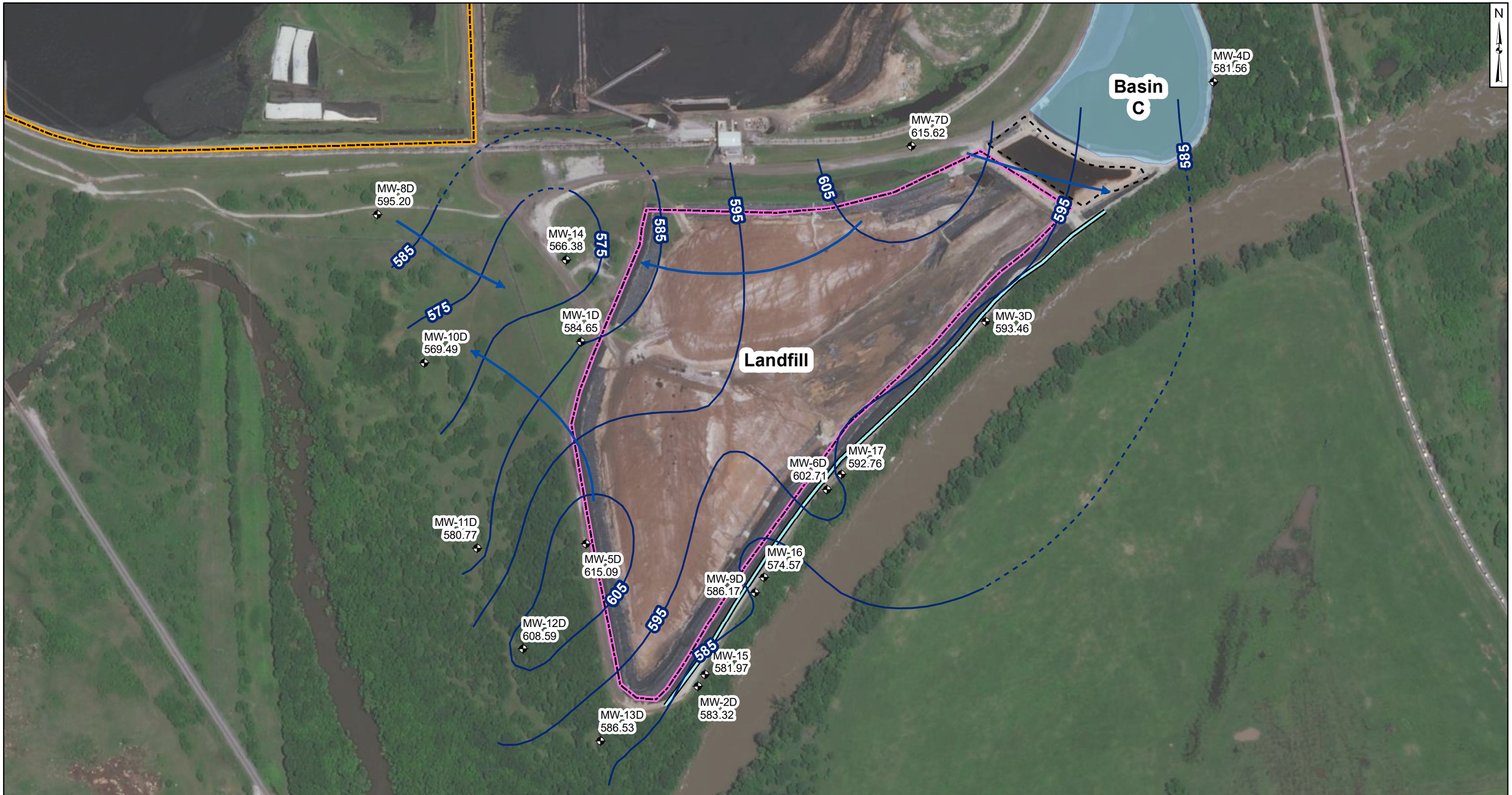
X. A Projection of Key Activities for the Upcoming Year

Key activities for the upcoming year include:

- As required by OAC 252:517-9-5, conduct detection monitoring of the groundwater for the LF CCR unit;
- Evaluation of the detection monitoring results from a statistical analysis viewpoint, looking for SSIs above background;
- Complete ASDs for potential SSIs, as needed, and submit to ODEQ for approval;
- Carry out field work approved in the landfill drilling plan;
- 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
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Bottom Ash Pond Impoundment
- Landfill
- Slurry Wall

Notes

- Monitoring well coordinates and water level data (collected April 13, 2021) provided by AEP.
- Groundwater elevation units are feet above mean sea level (ft. msl).
- River water elevation was 532.64 ft. msl on April 13, 2021 (USGS 07178452)
- Only wells screened in the Labette Shale were used for contouring.

Potentiometric Contours - Uppermost Aquifer
April 2021

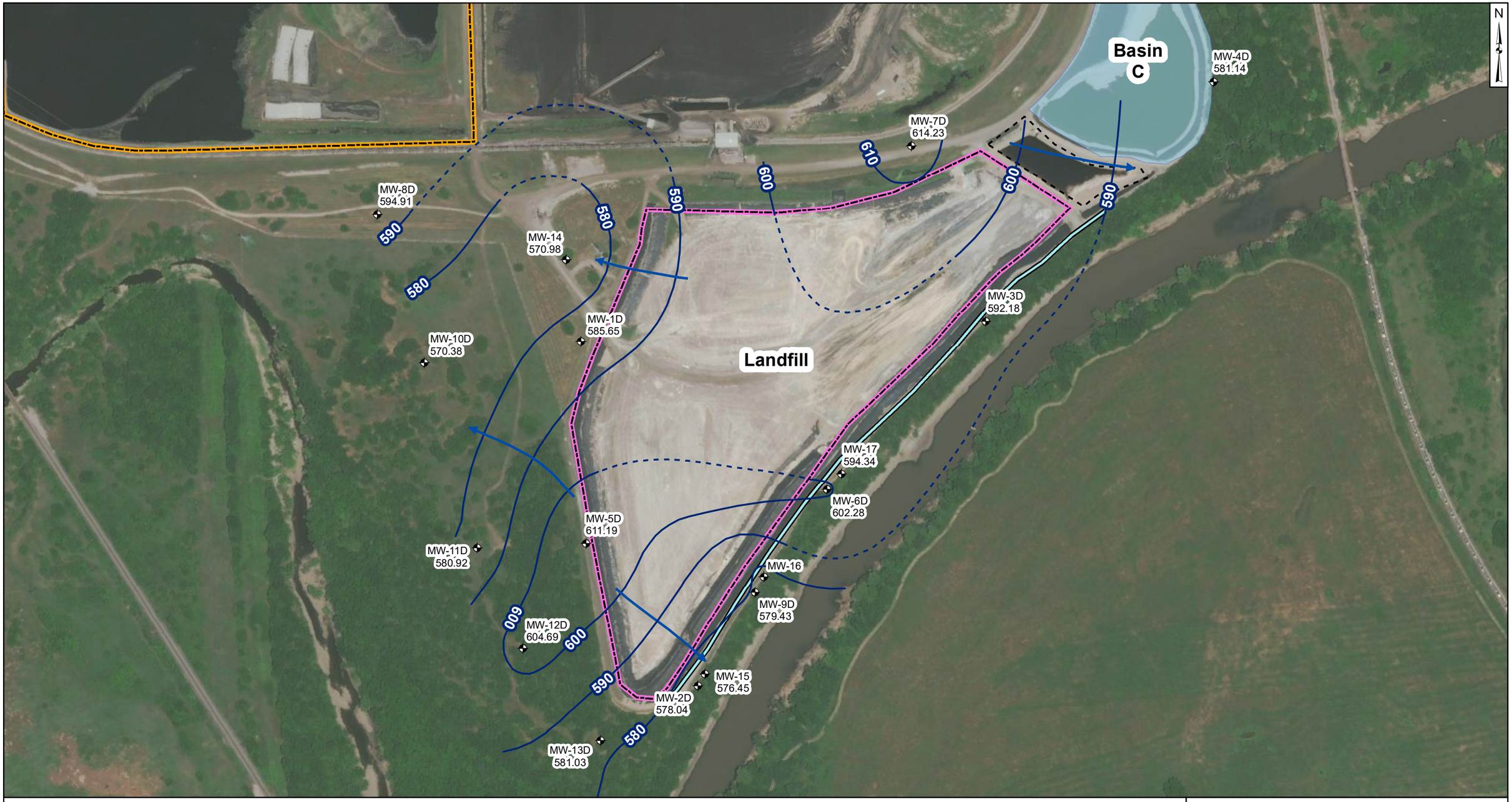
AEP Northeastern Power Plant - Landfill
Oologah, Oklahoma

Geosyntec consultants

Columbus, Ohio | 2021/08/30

Figure **1**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Northeastern\2021\AEP-Northeastern_LF_2021-04April.mxd. ARevezzo. 8/30/2021. Project/Phase/Task.



Legend

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

Notes

- Monitoring well coordinates and water level data (collected December 27, 2021) provided by AEP.
- MW-16 was dry during the December 2021 event.
- Groundwater elevation units are feet above mean sea level (ft. msl).
- River water elevation was 532.70 ft. msl on December 27, 2021 (USGS 07178452)
- Only wells screened in the Labette Shale were used for contouring.

400 200 0 400 Feet

Potentiometric Contours - Uppermost Aquifer December 2021

AEP Northeastern Power Plant - Landfill
Oologah, Oklahoma

Geosyntec consultants

Columbus, Ohio | 2022/01/20

Figure **2**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Northeastern\2021\AEP-Northeastern_LF_2021-12Dec.mxd. ASoltero. 1/20/2022. Project/Phase/Task.

site-wide groundwater flow velocity

NE CCR Units

Landfill Distance between wells.

	MW1D	MW2D	MW3D	MW4D	MW5D	MW6D	MW7D	MW8D	MW9D	MW10D	MW11D	MW12D	MW13D	MW14	MW15	MW-16	MW-17
MW1D	-	1310.9	1432.3	2423.7	692.7	1022.1	1379.1	837.6	1071.3	425.4	759.9	1071.5	1400.8	393.3	1262.4	1063.5	1081.8
MW2D		-	1634.9	2820.3	640.46	853.7	2044.8	2024.5	470.4	1458.2	854.0	532.9	284.9	1651.2	96.8	538.6	931.7
MW3D			-	1185.0	1596.7	783.1	642.6	2178.2	1166.8	1869.4	1843.4	1907.6	1932.2	1360.9	1548.4	1095.7	702.8
MW4D				-	2749.0	1975.0	1059.3	2997.7	2365.6	2367.5	2969.9	3084.3	3110.0	2198.6	2735.2	2297.8	1875.8
MW5D					-	887.4	1814.0	1365.3	654.3	795.2	292.2	385.4	701.4	1086.4	658.8	699.6	981.5
MW6D						-	1214.7	1864.0	391.2	1405.8	1155.3	1134.2	1151.9	1181.5	773.9	131.6	11.7
MW7D							-	1942.1	1607.6	1758.5	2006.3	2168.0	2306.8	1139.0	1969.5	1525.8	1167.2
MW8D								-	1885.8	563.4	1244.4	1633.3	2036.8	828.7	2015.9	1902.5	1916.8
MW9D									-	1363.6	895.9	809.8	738.2	1345.5	385.8	78.5	486.6
MW10D										-	702.5	1081.7	1465.2	671.1	1442.0	1371.0	1461.4
MW11D											-	395.4	801.6	1145.4	851.1	969.7	1237.4
MW12D												-	418.7	1473.7	583.2	884.4	1229.6
MW13D													-	1774.2	389.2	837.6	1234.9
MW14														-	1604.9	1309.3	1221.9
MW15															-	470.7	856.8
MW-16																-	396.9
MW-17																	-

NE Landfill

Hydraulic gradient. Use row **72** 12/27/2021

	MW1D	MW2D	MW3D	MW4D	MW5D	MW6D	MW7D	MW8D	MW9D	MW10D	MW11D	MW12D	MW13D	MW14	MW15	MW-16	MW-17	
MW1D	-	0.00580504	0.004559	0.001861	0.036872	0.01626979	0.0207243	0.0110558	0.005806	0.0358956	0.0062247	0.0177696	0.0032982	0.0373026	0.007288	0.02571649	0.008032834	max
MW2D		-	0.008649	0.001099	0.05176	0.02839372	0.0176988	0.0083331	0.0029551	0.0052529	0.0033722	0.0500094	0.0104964	0.0042757		0.0366533	0.017494338	min
MW3D			-	0.009316	0.011906	0.01289828	0.0343148	0.0012533	0.0109276	0.0116612	0.0061082	0.0065579	0.0057708	0.0155776	0.010159	0.03092003	0.003073639	
MW4D				-	0.010931	0.01070407	0.0312382	0.0045936	0.0007229	0.0045449	7.408E-05	0.0076355	3.537E-05	0.0046211	0.001715	0.00994016	0.007037185	
MW5D					-	0.01004045	0.0016759	0.0119239	0.0485412	0.051323	0.1036041	0.0168638	0.0429991	0.0370135	0.052736	0.0756025	0.017166901	
MW6D						-	0.0098381	0.003954	0.0584055	0.0226924	0.0184882	0.0021248	0.018448	0.0264929	0.033376			
MW7D							-	0.009948	0.0216466	0.0249357	0.0166029	0.0044003	0.0143922	0.0379732	0.019182	0.03665594	0.017040635	
MW8D								-	0.0082088	0.0435361	0.0112425	0.0059881	0.0068147	0.0288762	0.009157	0.019243	0.000297371	
MW9D									-	0.006637	0.0016631	0.0311933	0.0021675	0.0062803	0.007724		0.030641184	
MW10D										-	0.0150029	0.0317189	0.0072686	0.000894	0.004209	0.00881141	0.016395686	
MW11D											-	0.0601103	0.0001372	0.0086782	0.005252	0.02332656	0.010845321	
MW12D												-	0.0565109	0.0228752	0.048421	0.05245601	0.008417714	
MW13D													-	0.0056645	0.011768	0.02713771	0.010778375	
MW14														-	0.003408	0.00968471	0.01911808	
MW15															-	0.0385637	0.0208810	
MW-16																-	0.0907969	
MW-17																		

effective porosity(n) = 0.045 0.05
Hydraulic conductivity of aquifer (k) = 2 2.5
Max gradient (dh/dl)

max	**0.104**	**12/27/2021**
min	0.000035	12/27/2021

$$v = k\,\frac{(dh\,/\,dl)}{n}$$

Welsh landfill MW monitoring wells

	MW1D	MW2D	MW3D	MW4D	MW5D	MW6D	MW7D	MW8D	MW9D	MW10D	MW11D	MW12D	MW13D	MW14	MW15	MW-16	MW-17
TD(ft bgs)	55.00	33.50	63.04	50.00	55.00	58.22	58.65	63.54	63.09	68.00	48.00	42.00	48.00	42.00	45.00	78.96	74.21
TOC, ft	638.07	638.19	630.65	625.00	636.84	636.66	626.46	629.32	637.04	639.32	628.27	623.67	619.06	640.89	637.71	637.26	636.52

Groundwater elevations, sea level

	MW1D	MW2D	MW3D	MW4D	MW5D	MW6D	MW7D	MW8D	MW9D	MW10D	MW11D	MW12D	MW13D	MW14	MW15	MW-16	MW-17	**Max**	**Min**
TOC, ft	638.07	638.19	630.65	625.00	636.84	636.66	626.46	629.32	637.04	639.32	628.27	623.67	619.06	640.89	637.71	637.26	636.52		
tos, ft	594.07	589.49	580.95	585.30	592.12	591.74	581.21	579.37	587.34	581.62	590.57	591.97	584.36	575.39	576.66	586.46	591.02		

Date

Date	MW1D	MW2D	MW3D	MW4D	MW5D	MW6D	MW7D	MW8D	MW9D	MW10D	MW11D	MW12D	MW13D	MW14	MW15	MW-16	MW-17			**(dh/dl) gradient**	max	Min	
03/16/16	NG	NG	38.08	NG	NG	34.91	13.58	32.39	55.41	NG	NG	NG	NG	75.78	54.94	60.29	57.63				**v(ft/yr)**		
05/16/16	NG	NG	37.04	NG	NG	33.64	29.65	42.78	55.69	NG	NG	NG	NG	76.16	55.99	60.18	54.88			0.051	**2.83**		
07/20/16	NG	NG	NG	NG	NG	NG	NG	45.93	NG	NG	NG	NG	NG	75.02	60.38	60.41	52.50			0.055	**3.06**		
09/19/16	NG	NG	37.70	NG	NG	33.75	22.87	52.27	56.02	NG	NG	NG	NG	74.03	61.14	61.11	49.56			0.020	**1.11**		
10/06/16	NG	NG	37.65	NG	NG	NG	NG	58.6		NG	NG	NG	NG	dry	61.28	dry	dry			0.056	**3.11**		
01/25/17	NG	NG	37.13	NG	NG	NG	NG	54.25		NG	NG	NG	NG	74.14	54.15	61.73	51.11			0.010	**0.56**		
03/14/17	NG	NG	37.15	NG	NG	34.80	21.81	46.88	57.59	NG	NG	NG	NG	37.29	64.32	62.24	49.92			0.019	**1.06**		
05/17/17	NG	NG	37.22	NG	NG	34.26	7.63	54.12	56.35	NG	NG	NG	NG	72.09	45.41	58.44	54.37			0.057	**3.17**		
06/15/17	NG	NG	37.26	NG	NG	33.22	9.15	59.79	56.29	NG	NG	NG	NG	76.13	55.76	60.25	55.94			0.055	**3.06**		
06/27/17	NG	NG	37.31	NG	NG	33.29	27.50	61.46	60.35	NG	NG	NG	NG	77.92	58.64	62.67	55.61			0.058	**3.22**		
07/12/17	NG	NG	38.02	NG	NG	34.06	43.72	60.87	60.36	NG	NG	NG	NG	77.63	59.81	61.61	57.03			0.068	**3.78**		
10/11/17	55.24	57.89	37.42	43.26	27.37	33.58	57.38	61.51	61.89	69.04	47.86	18.56	41.32	75.94	59.45	61.62	56.42			0.066	**3.67**		
05/01/18	54.04	55.13	37.07	43.15	22.20	33.95	13.93	22.36	57.03	68.32	47.68	15.62	34.78	72.21	55.85	61.29	52.11			0.099	**5.50**	0.007167	
05/29/18	53.76	58.41	31.77	43.54	29.73	33.66	13.12	21.71	56.66	68.15	47.57	18.75	40.69	71.65	60.04	61.18	51.54			0.117	**5.00**	0.000222	
10/15/18	54.45	60.59		43.49	32.01					69.11	48.31	19.97	45.62	75.58	61.94	61.11	56.02			0.090	**5.00**	0.012533	
10/22/18			37.09	43.41	41.92	34.34	13.08	32.72	56.6			19.85			60.80									
1/15/2019	54.06	49.60	36.69	42.90	25.38	34.05	13.66	31.73	56.52	68.77	48.26	13.14	45.41	75.30	50.42	60.02	54.38			0.090	**5.00**		
2/27/2019	53.80	56.68	36.98	43.23	24.81	34.12	12.38	26.23	55.76	68.64	48.26	16.95	42.84	74.45	58.24	62.66	53.65			0.108	**6.00**	0.001167	2 of 2
8/26/2019	52.71	57.91	37.34	43.73	24.20	32.83	11.45	23.13	53.55	67.96	48.11	18.66	37.42	68.82	59.72	62.60	50.89			0.110	**6.11**	0.005111	1H 2019
6/29/2020	51.28	57.64	37.23	43.81	22.44	32.74	10.24	25.14	47.34	66.89	47.73	18.11	37.15	66.40	59.56	62.68	46.56			0.111	**6.17**	0.003889	2H 2019
10/20/2020	50.96	60.17	37.63	43.87	29.65	33.81	12.45	31.25	55.82	66.51	47.63	19.29	42.51	68.60	61.39	62.15	45.41			0.117	**6.44**	0.000667	1H 2020
12/16/2020			36.90			33.36			55.46						61.44					0.090	**5.00**	0.00004	2 of 2 2H 2020
4/12/2021	53.42	54.87	37.19	43.44	21.75	33.95	10.84	34.12	50.87	69.83	47.5	15.08	32.53	74.51	55.74	62.69	43.76			0.117	**6.50**	0.00015	1H 2021
6/22/2021				43.62	23.25				55.91				34.53		58.06					0.090	**5.00**	0.00004	2 of 2 2H 2021
12/27/2021	52.42	60.15	38.47	43.86	25.65	34.38	12.23	34.41	57.61	68.94	47.35	18.98	38.03	69.91	61.26	78.96	42.18			0.104	**5.78**	0.000035	2H 2021

	MW1D	MW2D	MW3D	MW4D	MW5D	MW6D	MW7D	MW8D	MW9D	MW10D	MW11D	MW12D	MW13D	MW14	MW15	MW-16	MW-17
09/8/2020			37.16		29.81	33.51			55.43						60.55		
10/20/2020	50.96	60.17	37.63	43.87	29.65	33.81	12.45	31.25	55.82	66.51	47.63	19.29	42.51	68.60	61.39	62.15	45.41
12/16/2020			36.90			33.36			55.46						61.44		
4/12/2021	53.42	54.87	37.19	43.44	21.75	33.95	10.84	34.12	50.87	69.83	47.5	15.08	32.53	74.51	55.74	62.69	43.76
6/22/2021				43.62	23.25				55.91				34.53		58.06		
12/27/2021	52.42	60.15	38.47	43.86	25.65	34.38	12.23	34.41	57.61	68.94	47.35	18.98	38.03	69.91	61.26	78.96	42.18

	MW1D	MW2D	MW3D	MW4D	MW5D	MW6D	MW7D	MW8D	MW9D	MW10D	MW11D	MW12D	MW13D	MW14	MW15	MW-16	MW-17
09/08/20			593.49		607.03	603.15			581.61						577.16		
10/20/20	587.11	578.02	593.02	581.13	607.19	602.85	614.01	598.07	581.22	572.81	580.64	604.38	576.55	572.29	576.32	575.11	591.11
12/16/20			593.75			603.30			581.58						576.27		
04/12/21	584.65	583.32	593.46	581.56	615.09	602.71	615.62	595.20	586.17	569.49	580.77	608.59	586.53	566.38	581.97	574.57	592.76
06/22/21			630.65			636.66			581.13						579.65		
12/27/21	585.65	578.04	592.18	581.14	611.19	602.28	614.23	594.91	579.43	570.38	580.92	604.69	581.03	570.98	576.45	558.30	594.34

09/8/2020																	
10/20/2020	614.01	572.29	0.090	**5.00**	0.000667	2H 2020											
12/16/2020	603.30	576.27	0.090	**5.00**	0.00004	2 of 2 2H 2020											
4/12/2021	615.62	566.38	0.117	**6.50**	0.00015	1H 2021											
6/22/2021	636.66	579.65				2 of 2 2H 2021											
12/27/2021	614.23	558.30	0.104	**5.78**	0.000035	2H 2021											

average LGWV 4.20 ft/yr

Residence Time Calculation Summary
Northeastern Landfill

Geosyntec Consultants, Inc.

			2021-04		2021-06[3]		2021-12	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	MW-3D [2]	2.0	0.7	83	NC	NC	0.8	73
	MW-4D [2]	2.0	1.8	34	0.7	83	0.7	84
	MW-5D [2]	2.0	1.4	43	1.3	46	1.5	41
	MW-6D [2]	2.0	1.9	31	NC	NC	2.8	21
	MW-7D [1]	2.0	1.0	59	NC	NC	1.1	55
	MW-8D [1]	2.0	1.6	39	NC	NC	1.7	37
	MW-9D [2]	2.0	1.5	40	1.3	46	1.3	48
	MW-12D [2]	2.0	2.1	29	NC	NC	1.8	33
	MW-15 [2]	2.0	1.3	47	1.6	37	1.3	47

Notes:
[1] - Observation Well
[2] - Downgradient Well
[3] - Only select wells were gauged as part of two-of-two verification sampling
NC - Not Calculated

Table 1 - Groundwater Data Summary: MW-1D
Northeastern - LF
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
5/30/2018	Background	1.2	135	--	--	7.38	--	--

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-1D
Northeastern - LF
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
5/30/2018	Background	4.57 J1	< 1.05 U1	18.1	< 0.02 U1	< 0.07 U1	< 0.23 U1	0.36 J1	--	--	< 0.68 U1	0.05481	< 0.005 U1	10.73	3.11 J1	43

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-2D
Northeastern - LF
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
5/2/2018	Background	10.5	7.52	14	2.028	10.6	628	1,206
5/30/2018	Background	10.1	19.2	--	--	10.4	--	--
2/27/2019	Background	9.67	9.26	16.4	1.56	11.0	612	1,218
8/26/2019	Background	10.7	14.3	12	1.661	12.8	591	1,236
6/29/2020	Background	11.3	11.9	11.5	1.91	13.7	732	1,310
4/13/2021	Background	10.6	12.5	12.1	1.81	11.0	654	1,250

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-2D
Northeastern - LF
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
5/2/2018	Background	2.12 J1	37.15	9.62	< 0.02 U1	0.3 J1	< 0.23 U1	0.36 J1	1.259	2.028	< 0.68 U1	0.0006 J1	0.046	588	82.77	1.1 J1
5/30/2018	Background	1.95 J1	34.61	29.17	< 0.02 U1	0.44 J1	1.4	0.3 J1	--	--	1.28 J1	0.00125	0.04	552	72.31	2
2/27/2019	Background	--	--	--	--	--	--	--	--	1.56	--	--	0.028	--	--	--
8/26/2019	Background	--	--	--	--	--	--	--	--	1.661	--	--	--	--	--	--
6/29/2020	Background	--	--	--	--	--	--	--	--	1.91	--	--	--	--	--	--
4/13/2021	Background	--	--	--	--	--	--	--	--	1.81	--	--	--	--	--	--

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-3D
Northeastern - LF
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	0.919	111	16	< 1 U1	7.5	174	658
3/14/2017	Background	0.913	120	14	1	--	175	648
4/25/2017	Background	0.972	110	14	0.77 J1	7.9	181	662
5/18/2017	Background	0.789	163	12	< 0.083 U1	--	192	598
6/15/2017	Background	0.873	137	12	0.8472 J1	7.3	225	742
6/27/2017	Background	0.84	194	13	0.7591 J1	7.3	232	766
7/12/2017	Background	0.864	129	13	< 0.083 U1	6.9	210	728
8/4/2017	Background	0.856	135	12	0.7381 J1	6.7	227	710
8/17/2017	Background	0.841	138	23	< 0.083 U1	6.8	213	728
8/30/2017	Background	0.84	136	12	0.7144 J1	6.9	216	696
9/13/2017	Background	0.877	152	11	< 0.083 U1	6.8	212	848
9/20/2017	Background	0.853	139	11	< 0.083 U1	6.9	214	724
10/11/2017	Detection	0.878	134	13	< 0.083 U1	6.9	218	722
5/2/2018	Detection	1.08	127	13	0.757 J1	7.3	196	736
5/30/2018	Detection	0.952	129	13	0.896 J1	7.5	214	724
10/22/2018	Detection	1.02	142	14.89	1.09	7.2	210.57	702
11/28/2018	Detection	0.964	--	--	0.648 J1	8.0	--	--
2/27/2019	Detection	0.973	127	13.2	0.71	7.8	223	700
5/7/2019	Detection	1.56	--	--	--	--	--	--
8/26/2019	Detection	0.979	130	12	0.608 J1	8.5	181	686
12/3/2019	Detection	--	--	--	--	7.4	--	--
6/30/2020	Detection	0.941	116	13.7	0.77	8.6	206	680
7/28/2020	Detection	--	--	--	--	8.3	--	--
10/21/2020	Detection	0.833	120	12.6	0.77	8.7	189	667
12/16/2020	Detection	--	--	--	--	6.9	--	--
4/13/2021	Detection	0.924	114	12.6	0.84	7.4	184	633

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-3D
Northeastern - LF
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	111	< 1 U1	< 1 U1	2	< 5 U1	2.153	< 1 U1	< 5 U1	0.017	< 0.025 U1	< 5 U1	< 5 U1	< 2 U1
3/14/2017	Background	< 5 U1	< 5 U1	100	< 1 U1	< 1 U1	< 1 U1	< 5 U1	1.456	1	< 5 U1	0.016	< 0.025 U1	< 5 U1	< 5 U1	< 2 U1
4/25/2017	Background	< 0.93 U1	3.3 J1	89.64	< 0.02 U1	0.26 J1	0.35 J1	1.3 J1	0.419	0.77 J1	< 0.68 U1	0.01508	< 0.005 U1	1.97 J1	< 0.99 U1	< 0.86 U1
5/18/2017	Background	< 0.93 U1	10.64	1,040	0.92 J1	0.61 J1	18.06	5.32	2.443	< 0.083 U1	3.24 J1	0.01943	0.01 J1	4.15 J1	< 0.99 U1	< 0.86 U1
6/15/2017	Background	1.44 J1	1.48 J1	150	0.08 J1	0.22 J1	1.23	1.09 J1	1.706	0.8472 J1	0.83 J1	0.01451	< 0.005 U1	3.04 J1	< 0.99 U1	< 0.86 U1
6/27/2017	Background	< 0.93 U1	< 1.05 U1	97.64	0.09 J1	0.45 J1	4.8	2.69 J1	2.431	0.7591 J1	2.99 J1	0.01836	0.007 J1	79.28	< 0.99 U1	< 0.86 U1
7/12/2017	Background	< 0.93 U1	< 1.05 U1	118	0.05 J1	0.08 J1	0.41 J1	0.82 J1	14.283	< 0.083 U1	< 0.68 U1	0.01435	< 0.005 U1	3.22 J1	< 0.99 U1	< 0.86 U1
8/4/2017	Background	< 0.93 U1	< 1.05 U1	124	0.07 J1	0.21 J1	0.82 J1	0.84 J1	2.242	0.7381 J1	0.8 J1	0.01344	0.013 J1	3.08 J1	< 0.99 U1	< 0.86 U1
8/17/2017	Background	< 0.93 U1	< 1.05 U1	274	0.17 J1	0.24 J1	3.11	1.83 J1	2.328	< 0.083 U1	< 0.68 U1	0.01495	< 0.005 U1	2.91 J1	1 J1	< 0.86 U1
8/30/2017	Background	< 0.93 U1	2.6 J1	244	0.16 J1	0.33 J1	2.36	1.54 J1	2.215	0.7144 J1	< 0.68 U1	0.01465	< 0.005 U1	2.68 J1	< 0.99 U1	< 0.86 U1
9/13/2017	Background	< 0.93 U1	4.52 J1	430	0.35 J1	0.49 J1	6.32	2.97 J1	1.566	< 0.083 U1	1.55 J1	0.01639	< 0.005 U1	2.74 J1	< 0.99 U1	1.02 J1
9/20/2017	Background	1.63 J1	1.14 J1	267	0.17 J1	0.21 J1	2.74	1.41 J1	2.162	< 0.083 U1	< 0.68 U1	0.01508	< 0.005 U1	3.33 J1	< 0.99 U1	< 0.86 U1

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-4D
Northeastern - LF
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
3/15/2017	Background	--	209	25	< 1 U1	--	237	848
5/2/2018	Background	1.21	192	22	< 0.083 U1	7.1	328	984
5/30/2018	Background	1.27	164	20	0.4188 J1	7.0	279	910
6/27/2018	Background	1.16	177	20	< 0.083 U1	7.9	258	882
7/31/2018	Background	1.04	196	31	< 0.083 U1	7.8	294	856
8/30/2018	Background	1.26	183	--	--	8.1	--	886
9/19/2018	Background	1.13	174	31	< 0.083 U1	7.8	260	884
10/15/2018	Background	0.656	195	37.9	< 0.083 U1	7.6	289.3	846
10/22/2018	Background	--	--	39.8	< 0.083 U1	7.9	306	--
11/28/2018	Background	1.24	193	27	0.3357 J1	7.9	295	972
1/15/2019	Detection	1.16	183	24.6	0.37 J1	7.5	417.6	--
2/27/2019	Detection	1.42	187	31.2	0.30	7.7	463	696
5/7/2019	Detection	--	--	--	--	--	419	--
8/26/2019	Detection	0.987	184	23	0.171 J1	8.1	274	830
6/30/2020	Detection	0.988	176	22.2	0.27	8.4	336	867
10/21/2020	Detection	0.761	163	24.3	0.27	8.4	272	813
4/12/2021	Detection	1.20	195	23.0	0.33	7.3	429	979
6/22/2021	Detection	--	--	--	--	7.1	398	--

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-4D
Northeastern - LF
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
3/15/2017	Background	< 5 U1	5	225	< 1 U1	< 1 U1	4	< 5 U1	--	< 1 U1	< 5 U1	--	< 0.025 U1	--	< 5 U1	< 2 U1
5/2/2018	Background	4.05 J1	2.3 J1	171	< 0.02 U1	0.14 J1	1.37	2.36 J1	1.625	< 0.083 U1	1.47 J1	0.00533	< 0.005 U1	6.74	< 0.99 U1	1.19 J1
5/30/2018	Background	< 0.93 U1	< 1.05 U1	173	< 0.02 U1	< 0.07 U1	< 0.23 U1	1.28 J1	1.991	0.4188 J1	< 0.68 U1	0.0033	< 0.005 U1	4.91 J1	< 0.99 U1	2.94
6/27/2018	Background	< 0.93 U1	< 1.05 U1	167	< 0.02 U1	< 0.07 U1	1.93	1.82 J1	1.244	< 0.083 U1	< 0.68 U1	0.00491	< 0.005 U1	4.64 J1	< 0.99 U1	2.94
7/31/2018	Background	0.05	1.25	173	0.01 J1	0.04	< 7 U1	0.521	1.506	< 0.083 U1	0.130	0.00315	< 0.005 U1	4.59	0.2	0.02 J1
8/30/2018	Background	0.1	1.6	163	0.049	0.11	0.551	0.807	0.912	--	0.804	0.00296	0.007 J1	4.48	0.3	0.02 J1
9/19/2018	Background	0.04 J1	1.20	177	0.02 J1	0.03 J1	0.273	0.551	3.91	< 0.083 U1	0.595	0.00289	< 0.005 U1	3.71	0.2	< 0.1 U1
10/15/2018	Background	0.15	2.28	166	0.06 J1	0.16	0.872	0.873	3.056	< 0.083 U1	1.41	0.00336	< 0.005 U1	4.58	0.3	< 0.1 U1
10/22/2018	Background	--	--	--	--	--	--	--	--	< 0.083 U1	--	--	--	--	--	--
11/28/2018	Background	< 0.1 U1	1.31	171	< 0.1 U1	0.06 J1	0.3 J1	0.677	1.629	0.3357 J1	0.3 J1	0.00378	< 0.005 U1	8 J1	0.2 J1	< 0.5 U1

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-5D
Northeastern - LF
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
3/14/2017	Background	--	127	--	--	--	--	--
5/2/2018	Background	0.476	132	25	0.703 J1	7.3	126	636
5/30/2018	Background	0.468	136	24	0.711 J1	7.2	113	628
6/27/2018	Background	0.478	134	26	0.7487 J1	8.2	122	658
7/31/2018	Background	0.491	142	30	0.8769 J1	8.3	662	628
8/30/2018	Background	0.52	158	--	--	8.1	--	648
9/19/2018	Background	0.444	156	30	0.7519 J1	7.7	134	662
10/15/2018	Background	0.439	141	30.2	0.845 J1	7.8	138.7	636
10/22/2018	Background	--	--	30.3	0.806 J1	8.0	138	--
11/28/2018	Background	0.612	143	24	0.371 J1	8.1	143	614
1/15/2019	Detection	0.540	157	24	0.316 J1	7.8	127.6	--
2/27/2019	Detection	0.531	130	26.7	0.50	8.5	153	616
5/7/2019	Detection	--	--	--	--	--	158	--
8/26/2019	Detection	0.568	146	24	0.412 J1	9.8	134	670
12/3/2019	Detection	--	--	--	--	7.2	--	--
6/29/2020	Detection	0.508	124	26.7	0.57	8.7	165	641
7/28/2020	Detection	--	--	--	--	8.3	--	--
10/21/2020	Detection	0.469	122	26.3	0.54	8.8	158	655
4/13/2021	Detection	0.539	131	27.3	0.59	7.6	160	632

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-5D
Northeastern - LF
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
3/14/2017	Background	< 5 U1	< 5 U1	99	< 1 U1	< 1 U1	< 1 U1	< 5 U1	--	--	< 5 U1	--	< 0.025 U1	--	< 5 U1	< 2 U1
5/2/2018	Background	2.91 J1	1.24 J1	127	< 0.02 U1	0.36 J1	0.59 J1	1.14 J1	2.449	0.703 J1	1.01 J1	0.01243	< 0.005 U1	1.33 J1	1.35 J1	1.25 J1
5/30/2018	Background	< 0.93 U1	< 1.05 U1	139	< 0.02 U1	< 0.07 U1	1.53	1.31 J1	3.06	0.711 J1	1.09 J1	0.01199	< 0.005 U1	< 0.29 U1	< 0.99 U1	< 0.86 U1
6/27/2018	Background	2.5 J1	< 1.05 U1	126	< 0.02 U1	< 0.07 U1	0.8 J1	0.63 J1	2.512	0.7487 J1	< 0.68 U1	0.01208	< 0.005 U1	0.96 J1	< 0.99 U1	2
7/31/2018	Background	0.16	1.27	143	0.103	0.21	0.355	0.482	2.876	0.8769 J1	1.43	0.011	< 0.005 U1	1.21	0.4	0.02 J1
8/30/2018	Background	0.1	0.98	111	0.076	0.1	0.518	0.3	2.906	--	0.706	0.0112	0.006 J1	1.24	0.3	0.04 J1
9/19/2018	Background	0.13	1.18	118	0.08 J1	0.09	0.745	0.336	5.163	0.7519 J1	0.720	0.0107	< 0.005 U1	2 J1	0.4	< 0.1 U1
10/15/2018	Background	0.07 J1	0.99	103	0.07 J1	0.08	0.423	0.289	5.319	0.845 J1	0.379	0.00977	< 0.005 U1	1 J1	0.3	< 0.1 U1
10/22/2018	Background	--	--	--	--	--	--	--	--	0.806 J1	--	--	--	--	--	--
11/28/2018	Background	< 0.1 U1	1.15	113	< 0.1 U1	0.06 J1	0.5 J1	0.324	2.393	0.371 J1	0.4 J1	0.0121	< 0.005 U1	0.2 J1	0.3 J1	< 0.5 U1

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-6D
Northeastern - LF
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
6/15/2017	Background	3.51	201	28	0.8054 J1	7.5	508	1,054
6/27/2017	Background	0.877	133	29	0.7596 J1	7.9	524	1,024
7/12/2017	Background	3.49	218	30	< 0.083 U1	7.3	504	1,044
8/4/2017	Background	3.64	222	31	0.7656 J1	6.4	532	1,022
8/17/2017	Background	3.55	211	30	0.729 J1	6.9	509	1,016
8/30/2017	Background	3.41	210	30	0.7158 J1	7.2	522	986
9/13/2017	Background	2.96	237	32	0.5406 J1	7.1	521	1,140
9/20/2017	Background	3.81	196	32	< 0.083 U1	7.1	505	1,008
10/11/2017	Detection	3.74	165	29	0.9597 J1	6.9	545	1,032
1/22/2018	Detection	4.24	--	--	0.76 J1	6.9	494	--
5/2/2018	Detection	3.52	173	31	0.806 J1	7.3	406	1,062
5/30/2018	Detection	3.35	269	32	0.9218 J1	7.4	401	1,090
10/22/2018	Detection	4.34	237	31.68	1.28	7.3	471.81	1,152
11/28/2018	Detection	--	--	--	0.844 J1	7.7	--	--
2/27/2019	Detection	3.63	360	26.9	0.89	7.6	496	1,144
5/7/2019	Detection	--	185	--	--	--	--	1,038
8/26/2019	Detection	2.88	181	13	0.634 J1	8.6	401	1,044
12/3/2019	Detection	--	--	--	--	7.5	--	--
6/30/2020	Detection	3.07	180	24.9	0.76	8.8	533	1,080
7/28/2020	Detection	--	--	--	--	8.4	--	--
10/21/2020	Detection	3.00	170	29.9	0.75	8.7	426	1,060
12/16/2020	Detection	--	--	--	--	7.1	--	--
4/13/2021	Detection	3.35	170	28.4	0.93	8.1	478	1,090

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-6D
Northeastern - LF
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
6/15/2017	Background	< 0.93 U1	1.99 J1	113	0.18 J1	0.8 J1	5.99	3.73 J1	1.822	0.8054 J1	3.48 J1	0.02203	0.012 J1	85.01	< 0.99 U1	< 0.86 U1
6/27/2017	Background	1.28 J1	< 1.05 U1	170	0.06 J1	0.37 J1	0.86 J1	1.09 J1	1.917	0.7596 J1	0.76 J1	0.01356	< 0.005 U1	2.79 J1	< 0.99 U1	< 0.86 U1
7/12/2017	Background	< 0.93 U1	< 1.05 U1	107	0.22 J1	0.56 J1	6.82	3.82 J1	1.784	< 0.083 U1	5	0.02244	0.007 J1	61.81	< 0.99 U1	< 0.86 U1
8/4/2017	Background	< 0.93 U1	< 1.05 U1	128	0.22 J1	0.93 J1	6.62	3.39 J1	1.115	0.7656 J1	4.96 J1	0.01921	0.016 J1	82.11	< 0.99 U1	< 0.86 U1
8/17/2017	Background	1.26 J1	1.18 J1	99.54	0.19 J1	0.44 J1	6.77	3.07 J1	1.155	0.729 J1	3.25 J1	0.01925	0.011 J1	81.32	< 0.99 U1	< 0.86 U1
8/30/2017	Background	< 0.93 U1	2.06 J1	103	0.22 J1	0.36 J1	6.68	3.03 J1	1.057	0.7158 J1	2.5 J1	0.01829	< 0.005 U1	85.75	< 0.99 U1	< 0.86 U1
9/13/2017	Background	< 0.93 U1	1.19 J1	109	0.31 J1	0.49 J1	8.15	3.71 J1	1.377	0.5406 J1	3.28 J1	0.02105	< 0.005 U1	58	< 0.99 U1	< 0.86 U1
9/20/2017	Background	1.18 J1	1.93 J1	75.04	0.14 J1	0.22 J1	3.86	2.27 J1	1.43	< 0.083 U1	2.33 J1	0.01701	< 0.005 U1	81	< 0.99 U1	< 0.86 U1

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-9D
Northeastern - LF
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
6/15/2017	Background	7.09	229	100	0.9857 J1	7.1	781	1,458
6/27/2017	Background	7.01	191	232	0.8986 J1	7.7	876	1,114
7/12/2017	Background	7.63	244	98	2.191	7.4	1,048	2,146
8/4/2017	Background	7.59	337	60	0.6947 J1	7.0	1,217	2,256
8/17/2017	Background	7.46	328	216	0.681 J1	7.1	1,193	2,486
8/30/2017	Background	6.93	354	64	< 0.083 U1	7.3	1,192	2,392
9/13/2017	Background	6.78	366	293	0.37 J1	7.2	1,244	2,826
10/4/2017	Background	6.68	304	180	< 0.083 U1	7.3	1,079	2,296
10/11/2017	Detection	7.07	288	314	1.5191	7.1	1,075	2,188
1/22/2018	Detection	7.43	--	--	--	7.1	--	--
10/22/2018	Detection	7.19	199	106	0.6 J1	7.1	519.42	1,258
2/27/2019	Detection	6.49	155	28.9	0.89	7.6	555	1,174
8/26/2019	Detection	6.95	136	24	0.758 J1	8.8	526	1,084
12/3/2019	Detection	--	--	--	--	7.6	--	--
6/30/2020	Detection	6.51	128	26.2	0.95	10.9	602	1,070
7/28/2020	Detection	--	--	--	--	8.7	--	--
10/21/2020	Detection	6.12	129	25.3	0.97	8.9	547	1,160
12/16/2020	Detection	--	--	--	--	7.5	--	--
4/13/2021	Detection	6.70	158	26.1	0.99	8.2	594	1,180
6/22/2021	Detection	--	--	--	--	7.6	--	--

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-9D
Northeastern - LF
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
6/15/2017	Background	< 0.93 U1	< 1.05 U1	188	0.32 J1	0.81 J1	12.34	6.18	0.931	0.9857 J1	7.02	0.02386	0.009 J1	173	5	< 0.86 U1
6/27/2017	Background	< 0.93 U1	< 1.05 U1	58.15	< 0.02 U1	0.26 J1	0.89 J1	7.14	--	0.8986 J1	1.24 J1	0.01647	< 0.005 U1	166	< 0.99 U1	< 0.86 U1
7/12/2017	Background	< 0.93 U1	< 1.05 U1	69.89	0.05 J1	< 0.07 U1	4.09	5.69	--	2.191	2.36 J1	0.02221	< 0.005 U1	151	1.32 J1	< 0.86 U1
8/4/2017	Background	< 0.93 U1	< 1.05 U1	132	0.17 J1	0.54 J1	7.15	7.34	--	0.6947 J1	4.26 J1	0.02155	0.017 J1	117	3.57 J1	< 0.86 U1
8/17/2017	Background	< 0.93 U1	< 1.05 U1	196	0.22 J1	0.25 J1	9.52	8.17	--	0.681 J1	5.33	0.02401	0.011 J1	98.19	3.53 J1	< 0.86 U1
8/30/2017	Background	< 0.93 U1	< 1.05 U1	323	0.37 J1	0.91 J1	20.06	15.08	--	< 0.083 U1	9.27	0.02964	0.016 J1	93.84	2.94 J1	< 0.86 U1
9/13/2017	Background	< 0.93 U1	< 1.05 U1	399	0.4 J1	0.68 J1	13.34	12.88	--	0.37 J1	8.28	0.03257	0.016 J1	78.39	2.8 J1	< 0.86 U1
10/4/2017	Background	< 0.93 U1	< 1.05 U1	410	0.43 J1	2.4	14.79	8.38	--	< 0.083 U1	9.69	0.03222	0.015 J1	73.77	3.83 J1	< 0.86 U1

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-10D
Northeastern - LF
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
5/30/2018	Background	1.15	54.9	--	--	7.46	--	--
6/27/2018	Background	1.16	52.5	--	--	--	--	--

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-10D
Northeastern - LF
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
5/30/2018	Background	2.47 J1	< 1.05 U1	102	< 0.02 U1	< 0.07 U1	< 0.23 U1	0.61 J1	--	--	< 0.68 U1	0.451	< 0.005 U1	19.72	7.02	< 0.86 U1
6/27/2018	Background	1.74 J1	1.59 J1	131	< 0.02 U1	< 0.07 U1	< 0.23 U1	1.01 J1	--	--	< 0.68 U1	0.461	< 0.005 U1	16.2	5.03	< 0.86 U1

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-11D
Northeastern - LF
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
5/30/2018	Background	0.641	114	--	--	7.34	--	--

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-11D
Northeastern - LF
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
5/30/2018	Background	< 0.93 U1	1.77 J1	55.76	< 0.02 U1	< 0.07 U1	2.1	0.43 J1	--	--	< 0.68 U1	0.03979	< 0.005 U1	12.14	< 0.99 U1	1.8 J1

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-12D
Northeastern - LF
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
3/15/2017	Background	--	76.9	16	2	--	613	1,142
5/2/2018	Background	8.63	184	17	2.199	7.4	541	1,044
5/30/2018	Background	8.35	89.9	91	2.379	7.7	542	1,088
6/27/2018	Background	8.45	74.9	17	1.988	8.2	586	1,070
7/31/2018	Background	8.72	108	22	2.6173	8.7	662	1,034
8/30/2018	Background	9.71	141	--	--	9.2	--	1,050
9/19/2018	Background	9.02	110	21	2.8416	8.1	582	1,052
10/15/2018	Background	8.68	70.0	21	2.99	9.4	561.2	1,060
10/22/2018	Background	--	--	19.44	2.8	9.0	504.3	--
11/28/2018	Background	9.69	103	16	2.2238	8.9	570	1,068
1/15/2019	Detection	9.08	68.0	14.6	2.028	8.1	437.4	--
2/27/2019	Detection	8.88	64.7	16.8	2.11	8.5	564	1,014
8/26/2019	Detection	8.90	96.3	14	1.6	8.7	540	1,018
6/29/2020	Detection	8.04	82.2	15.0	1.92	8.8	602	945
10/20/2020	Detection	7.19	118	16.1	2.06	9.1	585	1,060
4/13/2021	Detection	7.96	79.0	16.1	2.00	8.4	590	1,030

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-12D
Northeastern - LF
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
3/15/2017	Background	< 5 U1	< 5 U1	31	< 1 U1	< 1 U1	< 1 U1	< 5 U1	--	2	< 5 U1	--	< 0.025 U1	--	< 5 U1	< 2 U1
5/2/2018	Background	< 0.93 U1	1.56 J1	121	0.13 J1	0.8 J1	7.95	3.52 J1	1.625	2.199	7.03	0.00841	0.013 J1	693	4.5 J1	< 0.86 U1
5/30/2018	Background	< 0.93 U1	1.24 J1	77.75	< 0.02 U1	0.25 J1	2.74	1.49 J1	1.213	2.379	3.04 J1	0.00608	< 0.005 U1	667	3.88 J1	2.2
6/27/2018	Background	< 0.93 U1	< 1.05 U1	36.18	< 0.02 U1	< 0.07 U1	< 0.23 U1	0.39 J1	1.331	1.988	< 0.68 U1	0.00541	< 0.005 U1	666	1.55 J1	1.99 J1
7/31/2018	Background	0.11	3.00	42.0	0.053	0.07	0.414	0.674	0.721	2.6173	2.32	0.006	< 0.005 U1	818	1.7	0.106
8/30/2018	Background	0.2	3.39	65.8	0.097	0.31	1.82	2.17	3.137	--	5.43	0.00396	< 0.005 U1	872	3.1	0.241
9/19/2018	Background	0.36	4.67	82.6	0.1 J1	0.33	2.03	1.57	4.417	2.8416	5.18	0.00410	0.012 J1	828	2.9	0.2 J1
10/15/2018	Background	0.43	6.46	50.2	0.06 J1	0.20	1.60	1.31	3.541	2.99	3.51	0.00308	0.007 J1	774	4.6	0.3 J1
10/22/2018	Background	--	--	--	--	--	--	--	--	2.8	--	--	--	--	--	--
11/28/2018	Background	0.3 J1	3.99	71.7	0.1 J1	0.33	1.70	0.989	1.486	2.2238	4.12	0.00483	0.007 J1	744	1.9	< 0.5 U1

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-13D
Northeastern - LF
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
3/15/2017	Background	--	203	7	< 1 U1	7.5	402	1,116
5/2/2018	Background	1.08	172	5	< 0.083 U1	7.1	354	1,064
5/30/2018	Background	0.864	171	6	0.4361 J1	6.9	343	1,068
6/27/2018	Background	1.35	212	--	--	7.3	--	--
6/29/2020	Background	0.954	188	4.68	0.32	8.3	476	1,100
4/13/2021	Background	1.39	192	5.83	0.46	7.7	519	1,170

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-13D
Northeastern - LF
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
3/15/2017	Background	< 5 U1	< 5 U1	64	< 1 U1	< 1 U1	2	< 5 U1	--	< 1 U1	< 5 U1	--	< 0.025 U1	--	< 5 U1	< 2 U1
5/2/2018	Background	< 0.93 U1	< 1.05 U1	48.84	< 0.02 U1	0.13 J1	0.8 J1	1.61 J1	3.214	< 0.083 U1	< 0.68 U1	0.02997	< 0.005 U1	12.38	11.93	< 0.86 U1
5/30/2018	Background	< 0.93 U1	< 1.05 U1	76.07	0.03 J1	< 0.07 U1	1.48	4.37 J1	4.03	0.4361 J1	< 0.68 U1	0.03287	< 0.005 U1	13.07	11.96	< 0.86 U1
6/27/2018	Background	< 0.93 U1	1.13 J1	119	0.12 J1	< 0.07 U1	3.74	4.96 J1	--	--	1.84 J1	0.02781	< 0.005 U1	24.56	10.11	< 0.86 U1
6/29/2020	Background	--	--	--	--	--	--	--	--	0.32	--	--	--	--	--	--
4/13/2021	Background	--	--	--	--	--	--	--	--	0.46	--	--	--	--	--	--

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-14
Northeastern - LF
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
5/30/2018	Background	1.47	77.1	--	--	6.7	--	--
6/27/2018	Background	1.56	71	--	--	--	--	--
7/31/2018	Background	1.50	68.0	--	--	7.4	--	--
8/30/2018	Background	2.09	181	--	--	7.8	--	--
8/26/2019	Background	1.69	110	3,117	3.066	8.6	357	6,198
6/30/2020	Background	1.36	60.8	2,980	3.97	8.5	189	5,370
10/21/2020	Background	1.39	64.3	2,830	4.22	8.6	226	11,900

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-14
Northeastern - LF
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
5/30/2018	Background	0.93 J1	1.15 J1	157	< 0.02 U1	< 0.07 U1	< 0.23 U1	3.29 J1	--	--	< 0.68 U1	0.361	0.009 J1	20.67	5.51	< 0.86 U1
6/27/2018	Background	< 0.93 U1	< 1.05 U1	161	< 0.02 U1	< 0.07 U1	< 0.23 U1	3.14 J1	--	--	< 0.68 U1	0.378	0.006 J1	20.16	4.35 J1	42
7/31/2018	Background	1.35	0.58	172	0.029	0.18	< 7 U1	2.63	--	--	0.037	0.362	0.008 J1	27.8	3.5	0.05 J1
8/30/2018	Background	1.61	0.57	153	0.034	0.21	0.286	1.71	--	--	1.06	0.38	< 0.005 U1	31.7	2.2	0.03 J1
8/26/2019	Background	--	--	--	--	--	--	--	--	3.066	--	--	--	--	--	--
6/30/2020	Background	--	--	--	--	--	--	--	--	3.97	--	--	--	--	--	--
10/21/2020	Background	--	--	--	--	--	--	--	--	4.22	--	--	--	--	--	--

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-15
Northeastern - LF
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	9.45	87	19	2	8.0	530	1,112
3/13/2017	Background	8.23	104	28	2	--	551	1,110
4/25/2017	Background	9.44	73.1	78	1.83	7.6	558	1,128
5/18/2017	Background	10.2	52.2	111	2	--	596	1,092
6/15/2017	Background	9.74	126	24	1.96	7.9	559	1,060
6/27/2017	Background	9.75	79.2	22	1.8739	8.5	616	1,072
7/12/2017	Background	9.87	110	19	1.894	8.2	632	1,076
8/4/2017	Background	9.66	86.3	19	1.759	7.6	612	1,032
8/17/2017	Background	9.53	93.1	18	1.691	7.8	572	1,110
8/30/2017	Background	9.59	64.9	17	2.0289	6.7	590	1,038
9/13/2017	Background	9.13	68	17	1.671	8.6	584	1,080
9/20/2017	Background	9.65	67.6	15	0.642 J1	7.5	543	1,036
10/11/2017	Detection	9.62	80.1	46	1.9468	7.6	593	1,124
1/22/2018	Detection	9.16	--	--	--	7.2	--	--
5/30/2018	Detection	8.76	105	33	2.331	7.7	549	1,128
10/15/2018	Detection	--	--	--	2.27	--	--	--
10/22/2018	Detection	8.90	250	46.81	2.17	7.8	549.46	1,082
11/28/2018	Detection	--	119	--	--	8.3	--	--
2/27/2019	Detection	8.34	96.9	24.3	1.45	8.6	574	1,046
8/26/2019	Detection	8.28	119	20	1.252	10.5	587	1,072
12/3/2019	Detection	--	--	--	--	7.7	--	--
6/30/2020	Detection	8.00	105	17.9	1.55	9.3	706	1,100
7/28/2020	Detection	--	--	--	--	9.0	--	--
10/21/2020	Detection	7.79	117	15.7	1.53	11.0	631	1,140
12/16/2020	Detection	--	--	--	--	7.8	--	--
4/13/2021	Detection	8.40	93.5	15.5	1.71	8.8	659	1,100
6/22/2021	Detection	--	--	--	--	7.8	662	--

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-15
Northeastern - LF
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	107	< 1 U1	< 1 U1	3	< 5 U1	0.505	2	< 5 U1	0.012	< 0.025 U1	643	< 5 U1	< 2 U1
3/13/2017	Background	< 5 U1	< 5 U1	100	< 1 U1	< 1 U1	3	< 5 U1	1.241	2	< 5 U1	0.01	< 0.025 U1	550	< 5 U1	< 2 U1
4/25/2017	Background	1.31 J1	2.85 J1	55.73	< 0.02 U1	< 0.07 U1	0.23 J1	0.64 J1	0.203	1.83	< 0.68 U1	0.00786	< 0.005 U1	614	1.83 J1	1.05 J1
5/18/2017	Background	1.38 J1	13.61	52.06	< 0.02 U1	0.26 J1	0.96 J1	0.62 J1	1.097	2	1.7 J1	0.00834	0.022 J1	605	22.28	< 0.86 U1
6/15/2017	Background	< 0.93 U1	7.56	212	0.25 J1	0.64 J1	8.57	3.96 J1	1.215	1.96	5.25	0.01148	0.02 J1	662	12.46	< 0.86 U1
6/27/2017	Background	< 0.93 U1	4.4 J1	98.67	0.02 J1	< 0.07 U1	1.79	1.29 J1	1.652	1.8739	2.42 J1	0.00722	0.022 J1	644	5.76	< 0.86 U1
7/12/2017	Background	1.63 J1	3.77 J1	150	0.12 J1	0.09 J1	4.03	2.64 J1	0.287	1.894	2.87 J1	0.0091	0.009 J1	668	9	< 0.86 U1
8/4/2017	Background	1.56 J1	3.73 J1	94.19	0.08 J1	0.09 J1	1.51	1.4 J1	0.914	1.759	1.36 J1	0.00752	0.021 J1	647	6	< 0.86 U1
8/17/2017	Background	0.99 J1	4.44 J1	133	0.09 J1	< 0.07 U1	3.3	1.69 J1	0.649	1.691	1.44 J1	0.00823	0.015 J1	642	5.95	< 0.86 U1
8/30/2017	Background	< 0.93 U1	6.32	64.87	0.04 J1	< 0.07 U1	0.86 J1	0.78 J1	0.393	2.0289	< 0.68 U1	0.00629	0.01 J1	656	9.24	< 0.86 U1
9/13/2017	Background	< 0.93 U1	4.18 J1	54.34	0.03 J1	< 0.07 U1	< 0.23 U1	0.66 J1	1.07	1.671	< 0.68 U1	0.00635	0.008 J1	638	1.45 J1	< 0.86 U1
9/20/2017	Background	< 0.93 U1	3.87 J1	49.23	< 0.02 U1	< 0.07 U1	0.23 J1	0.77 J1	0.887	0.642 J1	< 0.68 U1	0.00621	< 0.005 U1	652	3.77 J1	< 0.86 U1

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-16
Northeastern - LF
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
5/18/2017	Background	4.77	338	62	< 0.083 U1	--	499	1,314
6/15/2017	Background	4.1	154	56	0.879 J1	8.5	467	1,328
8/17/2017	Background	6.48	201	36	0.84 J1	7.2	745	1,856

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-16
Northeastern - LF
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
5/18/2017	Background	< 0.93 U1	6.8	494	1.01	2.94	36.5	15.32	0.969	< 0.083 U1	16.64	0.05597	0.032	198	10.98	< 0.86 U1
6/15/2017	Background	< 0.93 U1	< 1.05 U1	83.73	0.07 J1	< 0.07 U1	2.51	2.43 J1	1.258	0.879 J1	1.44 J1	0.02944	0.007 J1	212	3.86 J1	< 0.86 U1
8/17/2017	Background	< 0.93 U1	< 1.05 U1	139	0.16 J1	0.41 J1	7.64	5.26	0.653	0.84 J1	3.4 J1	0.04163	0.012 J1	204	14.41	< 0.86 U1

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-17
Northeastern - LF
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	--	--	--	--	7.8	--	--
6/27/2017	Background	1.13	894	38	0.9268 J1	7.5	820	1,592
8/17/2017	Background	1.2	789	28	0.699 J1	7.4	1,078	2,046
5/30/2018	Background	0.702	191	--	--	8.0	--	--
6/27/2018	Background	0.715	205	--	--	--	--	--
7/31/2018	Background	0.843	234	--	--	8.6	--	--
9/19/2018	Background	0.767	330	--	--	7.9	--	--

Notes:
mg/L: milligrams per liter
SU: standard unit
<: 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.
- -: Not analyzed
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.

Table 1 - Groundwater Data Summary: MW-17
Northeastern - LF
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
6/27/2017	Background	< 0.93 U1	20.5	975	2.77	6.77	74.59	47.64	--	0.9268 J1	76.11	0.06776	0.144	30.24	19.31	< 0.86 U1
8/17/2017	Background	< 0.93 U1	18.23	763	2.66	3.88	91.46	47.25	--	0.699 J1	56.22	0.07669	0.097	29.04	17.5	< 0.86 U1
5/30/2018	Background	1.61 J1	< 1.05 U1	40.12	< 0.02 U1	< 0.07 U1	< 0.23 U1	0.31 J1	--	--	< 0.68 U1	0.01139	< 0.005 U1	8.38	26.7	< 0.86 U1
6/27/2018	Background	2.57 J1	< 1.05 U1	41.52	< 0.02 U1	< 0.07 U1	< 0.23 U1	0.75 J1	--	--	< 0.68 U1	0.01282	< 0.005 U1	7.94	12.46	1.63 J1
7/31/2018	Background	0.28	0.28	39.5	0.005 J1	0.10	< 0.007 U1	1.84	--	--	0.056	0.017	< 0.005 U1	8.66	5.4	0.057
9/19/2018	Background	0.20	0.27	36.7	< 0.02 U1	0.07	< 0.04 U1	2.98	--	--	0.06 J1	0.0121	< 0.005 U1	9.62	4.4	< 0.1 U1

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
<: 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.
- -: Not analyzed
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.

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

941 Chatham Lane, Suite 103
Columbus, Ohio 43212
PH 614.468.0415
FAX 614.468.0416
www.geosyntec.com

Memorandum

Date:	March 1, 2021
To:	David Miller (AEP)
Copies to:	Jill Parker-Witt (AEP)
From:	Allison Kreinberg (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Northeastern Plant's Landfill (LF)

In accordance with Oklahoma Department of Environmental Quality rules regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (OAC 252.517) detection monitoring events were completed on October 21, 2020 and December 16, 2020 at the Landfill (LF), an existing CCR unit at the Northeastern Power Plant located in Oologah, Oklahoma.

Background values for the LF were previously calculated for wells MW-3D, MW-6D, MW-9D, MW-12D, and MW-15 in January 2018. After a minimum of four detection monitoring events, the results of those events were compared to the existing background dataset, and the background dataset was updated as appropriate. Revised upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these revised background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 8, 2019. After a revision to the well network, background values for MW-4D, and MW-5D, and MW-12D were calculated in July 2019.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are compared in Table 1. No SSIs were observed at the Northeastern LF CCR unit, and as a result the Northeastern LF will remain in detection monitoring.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with OAC 252:517-9-4(h)(6). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Summary
Northeastern Plant - Landfill

Geosyntec Consultants

Analyte	Unit	Description	MW-3D		MW-4D	MW-5D	MW-6D		MW-9D		MW-12D	MW-15	
			10/21/2020	12/16/2020	10/21/2020	10/21/2020	10/21/2020	12/16/2020	10/21/2020	12/16/2020	10/21/2020	10/21/2020	12/16/2020
Boron	mg/L	Intrawell Background Value (UPL)	1.07		1.52	0.647	4.73		8.00		10.3	10.6	
		Analytical Result	0.833	--	0.761	0.469	3.00	--	6.12	--	7.19	7.79	--
Calcium	mg/L	Intrawell Background Value (UPL)	181		221	172	342		456		198	196	
		Analytical Result	120	--	163	122	170	--	129	--	118	117	--
Chloride	mg/L	Intrawell Background Value (UPL)	16.0		46.2	35.3	34.1		403		25.6	104	
		Analytical Result	12.6	--	24.3	26.3	29.9	--	25.3	--	16.1	15.7	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1.09		1.00	1.24	1.24		2.18		3.40	2.49	
		Analytical Result	0.77	--	0.27	0.54	0.75	--	0.97	--	2.06	1.53	--
pH	SU	Intrawell Background Value (UPL)	8.2		8.6	8.8	8.1		7.7		10.2	9.0	
		Intrawell Background Value (UPL)	6.3		6.7	6.9	6.3		6.8		6.7	6.7	
		Analytical Result	**8.7**	6.9	8.4	8.8	**8.7**	7.1	**8.9**	7.5	9.1	**11.5**	7.8
Sulfate	mg/L	Intrawell Background Value (UPL)	248		428	160	585		1,640		720	642	
		Analytical Result	189	--	272	158	426	--	547	--	585	631	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	832		1,040	686	1,180		3,480		1,160	1,160	
		Analytical Result	667	--	813	655	1,060	--	1,160	--	1,060	1,140	--

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

ATTACHMENT A

Certification by a Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

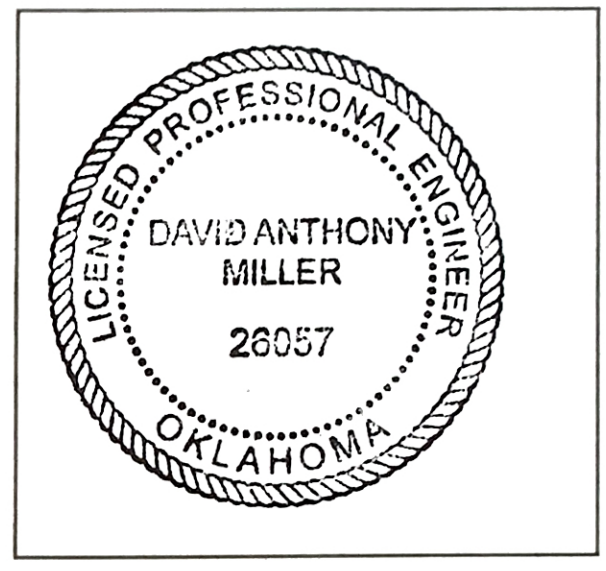
I certify that the selected statistical method, described above and in the January 8, 2020 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Northeastern LF CCR management area and that the requirements of OAC 252:517-9-4(g) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature



26057	OKLAHOMA	03.01.21
License Number	Licensing State	Date

Geosyntec consultants

941 Chatham Lane, Suite 103
Columbus, Ohio 43212
PH 614.468.0415
FAX 614.468.0416
www.geosyntec.com

Memorandum

Date:	July 21, 2021
To:	David Miller (AEP)
Copies to:	Jill Parker-Witt (AEP)
From:	Allison Kreinberg (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Northeastern Plant's Landfill (LF)

In accordance with Oklahoma Department of Environmental Quality rules regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (OAC 252.517), the first semi-annual detection monitoring event of 2021 at the Landfill (LF), an existing CCR unit at the Northeastern Power Plant located in Oologah, Oklahoma, was completed on April 13, 2021. Based on the results, verification sampling was completed on June 22, 2021.

Background values for the LF were previously calculated for wells MW-3D, MW-6D, MW-9D, MW-12D, and MW-15 in January 2018. After a minimum of four detection monitoring events, the results of those events were compared to the existing background dataset, and the background dataset was updated as appropriate. Revised upper prediction limits (UPLs) were calculated for each Appendix A parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these revised background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 8, 2020. After a revision to the well network, background values for MW-4D, and MW-5D, and MW-12D were calculated in July 2019.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are compared in Table 1 and noted exceedances are described in the list below.

- Sulfate concentrations exceeded the intrawell UPL of 642 mg/L in both the initial (659 mg/L) and second (662 mg/L) samples collected at MW-15. Therefore, an SSI over background is concluded for sulfate at MW-15.

In response to the exceedances noted above, the Northeastern LF CCR unit will either transition to assessment monitoring or an alternative source demonstration (ASD) for sulfate will be conducted in accordance with OAC 252:517-9-5(e)(2). If the ASD is successful, the Northeastern LF will remain in detection monitoring.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with OAC 252:517-9-4(h)(6). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Summary
Northeastern Plant - Landfill

Analyte	Unit	Description	MW-3D	MW-4D		MW-5D	MW-6D	MW-9D		MW-12D	MW-15	
			4/13/2021	4/13/2021	6/22/2021	4/13/2021	4/13/2021	4/13/2021	6/22/2021	4/13/2021	4/13/2021	6/22/2021
Boron	mg/L	Intrawell Background Value (UPL)	1.07	1.52		0.647	4.73	8.00		10.3	10.6	
		Analytical Result	0.924	1.20	--	0.539	3.35	6.70	--	7.96	8.40	--
Calcium	mg/L	Intrawell Background Value (UPL)	181	221		172	342	456		198	196	
		Analytical Result	114	195	--	131	170	158	--	79.0	93.5	--
Chloride	mg/L	Intrawell Background Value (UPL)	16.0	46.2		35.3	34.1	403		25.6	104	
		Analytical Result	12.6	23.0	--	27.3	28.4	26.1	--	16.1	15.5	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1.09	1.00		1.24	1.24	2.18		3.40	2.49	
		Analytical Result	0.84	0.33	--	0.59	0.93	0.99	--	2.00	1.71	--
pH	SU	Intrawell Background Value (UPL)	8.2	8.6		8.8	8.1	7.7		10.2	9.0	
		Intrawell Background Value (LPL)	6.3	6.7		6.9	6.3	6.8		6.7	6.7	
		Analytical Result	7.4	7.3	7.1	7.6	8.1	**8.2**	7.6	8.4	8.8	7.8
Sulfate	mg/L	Intrawell Background Value (UPL)	248	428		160	585	1,640		720	642	
		Analytical Result	184	**429**	398	160	478	594	--	590	**659**	**662**
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	832	1,040		686	1,180	3,480		1,160	1,160	
		Analytical Result	633	979	--	632	1,090	1,180	--	1,030	1,100	--

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
--: Not Analyzed

ATTACHMENT A

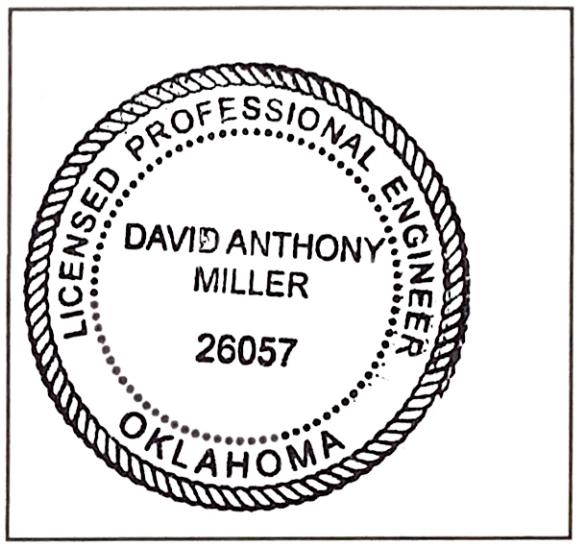
Certification by a Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 8, 2020 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Northeastern LF 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	07.22.21
License Number	Licensing State	Date

STATISTICAL ANALYSIS SUMMARY- Background Update Calculations Stations 3 and 4 Landfill – Northeastern Power Station Oologah, Oklahoma

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

December 28, 2021
CHA8500

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Value
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LF	Landfill
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
NELAP	National Environmental Laboratory Accreditation Program
ODEQ	Oklahoma Department of Environmental Quality
QA	Quality Assurance
QC	Quality Control
RL	Reporting Limit
SSI	Statistically Significant Increase
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the Oklahoma Department of Environmental Quality (ODEQ) and Oklahoma administrative code (OAC) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (OAC 252.517, "CCR rule"), groundwater monitoring has been conducted at the Stations 3 and 4 Landfill (LF), an existing CCR unit at the Northeastern Power Station located in Oologah, Oklahoma. Recent groundwater monitoring results were incorporated into the LF background dataset as appropriate and the site-specific background values were re-established for use in future detection monitoring events.

A minimum of eight monitoring events were completed prior to October 2017 to establish background concentrations for Appendix A and Appendix B parameters under the CCR rule. Following submittal of an alternate source demonstration (ASD) in April 2018 (Geosyntec, 2018a), ODEQ required intrawell statistics to be used until an appropriate background location can be identified and for additional wells to be added to the downgradient monitoring network. Prediction limits for Appendix A parameters were previously updated in January 2020 using data until May 2019 (Geosyntec, 2020). Since the last background update, four semiannual detection monitoring events were conducted between August 2019 and June 2021 for wells in the network.

Data from these four events, including both initial and verification results, were evaluated for inclusion in the background dataset. 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 detection monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. The compliance data were reviewed for outliers, which were removed (when appropriate) prior to updating upper prediction limits (UPLs) for each Appendix A parameter to represent background values. Oversight on the use of statistical calculations was provided by Dr. Jim Loftis of Groundwater Stats Consulting. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

LANDFILL EVALUATION

2.1 Previous Background Calculations

A minimum of eight monitoring events were completed prior to October 2017 to establish background concentrations for Appendix A and Appendix B parameters under the CCR rule for the initial monitoring well network. These wells are referred to as 'Original Well Network' in Table 1, which summarizes the background data ranges for each well. The data were reviewed for outliers and trends prior to calculating upper prediction limits (UPLs) for each Appendix A parameter. Lower prediction limits (LPLs) were also established for pH. Interwell tests were selected for boron and pH, whereas intrawell tests were selected for calcium, chloride, fluoride, sulfate, and total dissolved solids (TDS). The statistical analyses to establish background levels were previously documented in the January 2018 *Statistical Analysis Summary* report (Geosyntec, 2018b). Following submittal of an alternate source demonstration (ASD) in April 2018 (Geosyntec, 2018a), ODEQ noted that upgradient wells MW-7D and MW-8D are inappropriate for interwell statistics (ODEQ, 2019). Thus, these wells were removed from the network and intrawell statistics will be used until an appropriate background location can be identified.

At the request of ODEQ, the Landfill's groundwater monitoring network was expanded in July 2019 to include additional deep wells surrounding the unit. The current monitoring well network includes MW-1D through MW-6D, MW-9D through MW-13D, and MW-14 through MW-17 (Geosyntec, 2019). Once sufficient data were available at wells MW-4D, MW-5D, and MW-12D, the background values were calculated at those locations using data until January 2019. These wells are referred to as 'Revised Network' wells in Table 1. Intrawell tests were selected for all parameters. The other new wells in the network (MW-1D, MW-2D, MW-10D, MW-11D, MW-13D, MW-14, MW-16, and MW-17) were historically dry or did not have a minimum of eight samples to establish background limits. The statistical analyses to establish background levels were previously documented in the July 2019 *Statistical Analysis Summary* report (Geosyntec, 2019).

As recommended in the United States Environmental Protection Agency (USEPA) *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (Unified Guidance), background values should be updated every four to eight measurements (USEPA, 2009). Prediction limits for Appendix A parameters were previously updated in January 2020 for MW-3D, MW-6D, MW-9D, and MW-15 using data until May 2019 (Geosyntec, 2019). Intrawell tests using a one-of-two retesting procedure were selected and updated for all Appendix A parameters. These prediction limits were used for detection monitoring events completed between August 2019 and June 2021. The prediction limits for MW-4D, MW-5D, and MW-12D were not updated at that time since four independent events had not been completed since background was established. The date ranges for establishing and updating background for the different groups of wells within the groundwater monitoring network are shown in Table 1.

2.2 Data Validation & QA/QC

Four semiannual detection monitoring events, which were completed between August 2019 and June 2021, have been conducted at the original network wells since the previous background update (which used data through May 2019). Five semiannual detection monitoring events, which were completed between February 2019 and June 2021, have been conducted at the revised network wells since background was established (Table 1). If the initial results for each detection monitoring event identified possible exceedances, verification sampling was completed on an individual well/parameter basis. Thus, a minimum of four samples have been collected from each compliance well in which a sample could routinely be collected since the previous background calculation. A summary of data collected during these detection monitoring events may be found in Table 2. The other new wells in the network were historically dry or did not have the minimum of eight samples needed to establish background.

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.9.6.31 statistics software. The export was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.3 Statistical Analysis

The detection monitoring data used to conduct the statistical analyses described below are summarized in Table 2. Statistical analyses for the Landfill were conducted in accordance with the 2021 *Statistical Analysis Plan* (Geosyntec, 2021a), except where noted below:

- Several high values for calcium, chloride, sulfate, and TDS at MW-9D from June 2017 to October 2017 were flagged as outliers to truncate the background dataset to include only the lower, more recent concentrations and older data that are similar in magnitude to construct limits that are more conservative from a regulatory perspective while maintaining the minimum of eight data points required to establish background. This is further discussed in Section 2.3.2

The complete statistical analysis results are included in Attachment B.

Time series plots of Appendix A parameters are included in Attachment B and were used to evaluate concentrations over time and to provide an initial screening of suspected outliers and

trends. Box plots were also compiled to provide visual representation of variations between wells and within individual wells (Attachment B).

2.3.1 Outlier Evaluation

Potential outliers were evaluated using Tukey's outlier test; i.e., data points were considered potential outliers if they met one of the following criteria:

$$x_i < \tilde{x}_{0.25} - 3 \times IQR \quad (1)$$

or

$$x_i > \tilde{x}_{0.75} + 3 \times IQR \quad (2)$$

where:

$x_i =$ individual data point
$\tilde{x}_{0.25} =$ first quartile
$\tilde{x}_{0.75} =$ third quartile
$IQR =$ the interquartile range $= \tilde{x}_{0.75} - \tilde{x}_{0.25}$

Data that were evaluated as potential outliers are summarized in Attachment B. Next, the data were reviewed to identify possible sources of errors or discrepancies, including data recording errors, unusual sampling conditions, laboratory quality, or inconsistent sample turbidity.

No changes were made to previously flagged outliers (discussed in previous reports), and five additional values were flagged during this background update. Tukey's test identified the pH value of 10.87 on June 30, 2020 at MW-9D as an outlier. In addition, four other values that were not identified by Tukey's test to be outliers were also flagged to construct limits that are conservative from a regulatory perspective. These include:

- The pH values of 10.51 on August 26, 2019 and 11.45 on October 21, 2020 at MW-15; and,

- The calcium values of 250 mg/L on October 22, 2018 at MW-15 and 360 mg/L on February 27, 2019 at MW-6D.

In addition, several values for calcium, chloride, sulfate, and TDS at MW-9D from June 2017 to October 2017 were flagged as outliers to truncate the background dataset to include only the more recent concentrations and older data that are similar in magnitude in order to construct limits that are more conservative from a regulatory perspective while maintaining the minimum of eight data points required to establish background, as discussed in Section 2.3.2.

2.3.2 Establishment of Updated Background Dataset

Intrawell tests compare compliance data from a single well to background data within the same well and are most appropriate when 1) upgradient wells exhibit spatial variation; 2) when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; or 3) when downgradient water quality is not impacted compared to upgradient water quality for the same parameter. Periodic updating of background statistical limits is necessary as natural systems continuously change due to physical changes to the environment. For intrawell analyses, data for all wells and constituents are re-evaluated when a minimum of four new data points are available. These four (or more) new data points are used to determine if earlier concentrations are representative of present-day groundwater quality.

Mann-Whitney (Wilcoxon rank-sum) tests were used to compare the medians of historical data to the new compliance samples. The date ranges for these two groups are provided in Table 1 for both the original well network and revised network wells. 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. Significant differences were found between the two groups for the following downgradient well/parameter pairs:

- A decrease was found for boron at MW-15;
- A decrease was found for calcium at MW-9D;
- A decrease was found for chloride at MW-9D;
- A decrease was found for fluoride at MW-4D;
- Increases were found for pH at MW-6D and MW-9D; and
- Increases were found for sulfate at MW-15 and MW-5D.

For the significant decreases found for boron at MW-15 and fluoride at MW-4D, the background dataset was updated since the updated prediction limits will either remain near or decrease compared to the previous limits.

For calcium and chloride at MW-9D, the newer concentrations were much lower than the older concentrations; however, there were not enough new data points with lower concentrations to meet the minimum of eight data points recommended for constructing prediction limits. Thus, several results from the older dataset that have similar concentrations as the new data were included in the updated background dataset, while those with high concentrations in older dataset were excluded by flagging them as outliers. This approach allows the updated background dataset to have a minimum of eight data points and calculate limits that are conservative from a regulatory perspective. A similar pattern was observed for sulfate and TDS at MW-9D; although the Mann-Whitney test did not find significant differences in the medians between the older and newer groups of data, the dataset was also truncated using a similar approach.

For the significant increases found for pH at MW-6D and MW-9D, the background dataset was not updated with the newer data to construct limits that are more constructive from a regulatory perspective. A similar increase was observed for pH at MW-3D, and while the Mann-Whitney test did not find a significant difference between the medians of the older and newer data, the background dataset was also not updated for pH at MW-3D.

For the significant increases found for sulfate at MW-5D and MW-15, the records were updated because an ASD conducted in 2021 attributed the increase in sulfate concentrations to natural variability and laboratory method uncertainty (Geosyntec, 2021a).

2.3.3 Updated Prediction Limits

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 (RL) – 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 RL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment B.

Except as noted in Section 2.3.2, intrawell UPLs were updated using all the historical data through July 2021 to represent background values. Intrawell LPLs were also generated for pH. The updated prediction limits are summarized in Table 3.

The intrawell UPLs and LPLs 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 and the pH result is greater than or equal to the LPL, then it can be concluded that an SSI has not occurred. In practice, where the initial result does not exceed the UPL and the pH result is greater than or equal to the LPL, a second sample will not be collected. The retesting procedures allow achieving an acceptably high

statistical power to detect changes at downgradient wells for constituents evaluated using intrawell prediction limits.

2.4 Conclusions

For monitoring wells where at least four detection monitoring events were completed in accordance with the ODEQ's CCR Rule since the previous background update, the background datasets were statistically reassessed for potential inclusion of the new values. The laboratory and field data from these events were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. Mann-Whitney tests were completed to evaluate whether data from the detection monitoring events could be added to the existing background dataset. Where appropriate, the background datasets were updated, and UPLs and LPLs were recalculated. Intrawell tests using a one-of-two retesting procedure were selected and updated for all Appendix A parameters.

SECTION 3

REFERENCES

Geosyntec Consultants, 2018a. Alternative Source Demonstration Report – State and Federal CCR Rule. Northeastern Power Station Landfill. April.

Geosyntec Consultants, 2018b. Statistical Analysis Summary. Station 3 and 4 Landfill – Northeastern Power Station. January.

Geosyntec Consultants, 2019. Statistical Analysis Summary. Station 3 and 4 Landfill – Northeastern Power Station. July.

Geosyntec Consultants, 2021a. Alternative Source Demonstration Report – State and Federal CCR Rule. Northeastern Power Station Landfill. February.

Geosyntec Consultants. 2021b. Statistical Analysis Plan – Northeastern Power Station. November.

Oklahoma Department of Environmental Quality (ODEQ). 2019. Response to Notice of Deficiency – Alternate Source Demonstration (ASD) – Coal Combustion Residuals (CCR) Landfill. Letter to Ms. Jill Parker-Witt. January 30.

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

TABLES

Table 1: Background Date Ranges
Northeastern Plant - Landfill

Geosyntec Consultants, Inc.

Well Group	Well IDs	Date Range		
		Background	1st Update	2nd Update
Original Well Network	MW-3D, MW-6D, MW-9D, and MW-15	January 2017 - October 2017	October 2017- May 2019	August 2019 - July 2021
Updated Network	MW-4D, MW-5D, and MW-12D	May 2018 - January 2019	February 2019 - July 2021	N/A
Other Wells in the Network (Usually Dry)	MW-1D, MW-2D, MW-10D, MW-11D, MW-13D, MW-14, MW-16, and MW-17	N/A	N/A	N/A

Notes:
N/A - not applicable
Other wells - insufficient data to complete the necessary statistical tests

Table 2: Groundwater Data Summary
Northeastern Plant - Landfill

Geosyntec Consultants, Inc.

Parameter	Unit	MW-3D							MW-4D						
		8/26/2019	12/3/2019	6/30/2020	7/28/2020	10/21/2020	12/16/2020	4/13/2021	2/27/2019	5/7/2019	8/26/2019	6/30/2020	10/21/2020	4/13/2021	6/22/2021
		2019-D2	2019-D2-R1	2020-D1	2020-D1-R1	2020-D2	2020-D2-R1	2021-D1	2019-D1	2019-D1-R1	2019-D2	2020-D1	2020-D2	2021-D1	2021-D1-R1
Boron	mg/L	0.979	-	0.941	-	0.833	-	0.924	1.42	-	0.987	0.988	0.761	1.20	-
Calcium	mg/L	130	-	116	-	120	-	114	187	-	184	176	163	195	-
Chloride	mg/L	12	-	13.7	-	12.6	-	12.6	31.2	-	23	22.2	24.3	23.0	-
Fluoride	mg/L	0.608 J	-	0.77	-	0.77	-	0.84	0.30	-	0.171 J	0.27	0.27	0.33	-
Sulfate	mg/L	181	-	206	-	189	-	184	463	419	274	336	272	429	398
Total Dissolved Solids	mg/L	686	-	680	-	667	-	633	696	-	830	867	813	979	-
pH	SU	8.5	7.4	8.6	8.3	8.7	6.9	7.4	7.7	-	8.1	8.4	8.4	7.3	7.1

Parameter	Unit	MW-5D								MW-6D						
		2/27/2019	5/7/2019	8/26/2019	12/3/2019	6/29/2020	7/28/2020	10/21/2020	4/13/2021	8/26/2019	12/3/2019	6/30/2020	7/28/2020	10/21/2020	12/16/2020	4/13/2021
		2019-D1	2019-D1-R1	2019-D2	2019-D2-R1	2020-D1	2020-D1-R1	2020-D2	2021-D1	2019-D2	2019-D2-R1	2020-D1	2020-D1-R1	2020-D2	2020-D2-R1	2021-D1
Boron	mg/L	0.531	-	0.568	-	0.508	-	0.469	0.539	2.88	-	3.07	-	3.00	-	3.35
Calcium	mg/L	130	-	146	-	124	-	122	131	181	-	180	-	170	-	170
Chloride	mg/L	26.7	-	24	-	26.7	-	26.3	27.3	13	-	24.9	-	29.9	-	28.4
Fluoride	mg/L	0.50	-	0.412 J	-	0.57	-	0.54	0.59	0.634 J	-	0.76	-	0.75	-	0.93
Sulfate	mg/L	153	158	134	-	165	-	158	160	401	-	533	-	426	-	478
Total Dissolved Solids	mg/L	616	-	670	-	641	-	655	632	1,044	-	1,080	-	1,060	-	1,090
pH	SU	8.5	-	9.8	7.2	8.7	8.3	8.8	7.6	8.6	7.5	8.8	8.4	8.7	7.1	8.1

Parameter	Unit	MW-9D								MW-12D				
		8/26/2019	12/3/2019	6/30/2020	7/28/2020	10/21/2020	12/16/2020	4/13/2021	6/22/2021	2/27/2019	8/26/2019	6/29/2020	10/20/2020	4/13/2021
		2019-D2	2019-D2-R1	2020-D1	2020-D1-R1	2020-D2	2020-D2-R1	2021-D1	2021-D1-R1	2019-D1	2019-D2	2020-D1	2020-D2	2021-D1
Boron	mg/L	6.95	-	6.51	-	6.12	-	6.70	-	8.88	8.90	8.04	7.19	7.96
Calcium	mg/L	136	-	128	-	129	-	158	-	64.7	96.3	82.2	118	79.0
Chloride	mg/L	24	-	26.2	-	25.3	-	26.1	-	16.8	14	15.0	16.1	16.1
Fluoride	mg/L	0.758 J	-	0.95	-	0.97	-	0.99	-	2.11	1.6	1.92	2.06	2.00
Sulfate	mg/L	526	-	602	-	547	-	594	-	564	540	602	585	590
Total Dissolved Solids	mg/L	1,084	-	1,070	-	1,160	-	1,180	-	1,014	1,018	945	1,060	1,030
pH	SU	8.8	7.6	10.9	8.7	8.9	7.5	8.2	7.6	8.5	8.7	8.8	9.1	8.4

Parameter	Unit	MW-15							
		8/26/2019	12/3/2019	6/30/2020	7/28/2020	10/21/2020	12/16/2020	4/13/2021	6/22/2021
		2019-D2	2019-D2-R1	2020-D1	2020-D1-R1	2020-D2	2020-D2-R1	2021-D1	2021-D1-R1
Boron	mg/L	8.28	-	8.00	-	7.79	-	8.40	-
Calcium	mg/L	119	-	105	-	117	-	93.5	-
Chloride	mg/L	20	-	17.9	-	15.7	-	15.5	-
Fluoride	mg/L	1.252	-	1.55	-	1.53	-	1.71	-
Sulfate	mg/L	587	-	706	-	631	-	659	662
Total Dissolved Solids	mg/L	1,072	-	1,100	-	1,140	-	1,100	-
pH	SU	10.5	7.7	9.3	9.0	11.5	7.8	8.8	7.8

Notes:
mg/L: milligrams per liter
SU: standard unit
U: Parameter was not present in concentrations above the method detection limit and is reported as the reporting limit
J: Estimated value. Parameter was detected in concentrations below the reporting limit
--: Not Measured
D1: First semi-annual detection monitoring event of the year
D2: Second semi-annual detection monitoring event of the year
R1: First verification event associated with detection monitoring round
In-network downgradient wells MW-1D, MW-2D, MW-10D, MW-11D, MW-13D, MW-14, MW-16, and MW-17 were historically dry or not have enough data points to establish background concentrations; thus, the results were not included in this table.

Table 3: Background Level Summary
Northeastern Plant - Landfill

Geosyntec Consultants, Inc.

Analyte	Unit	Description	MW-3D	MW-4D	MW-5D	MW-6D	MW-9D	MW-12D	MW-15
Boron	mg/L	Intrawell Background Value (UPL)	1.06	1.59	0.621	4.52	7.94	10.2	10.6
Calcium	mg/L	Intrawell Background Value (UPL)	175	214	166	272	295	172	137
Chloride	mg/L	Intrawell Background Value (UPL)	15.5	41.0	32.6	34.1	147	23.3	111
Fluoride	mg/L	Intrawell Background Value (UPL)	1.02	0.500	1.05	1.18	2.03	3.16	2.59
pH	SU	Intrawell Background Value (UPL)	8.2	8.7	9.5	8.1	7.7	9.8	9.3
		Intrawell Background Value (LPL)	6.3	6.7	6.6	6.3	6.8	7.2	6.7
Sulfate	mg/L	Intrawell Background Value (UPL)	243	485	178	581	1,010	683	690
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	815	1,050	682	1,170	1,550	1,150	1,160

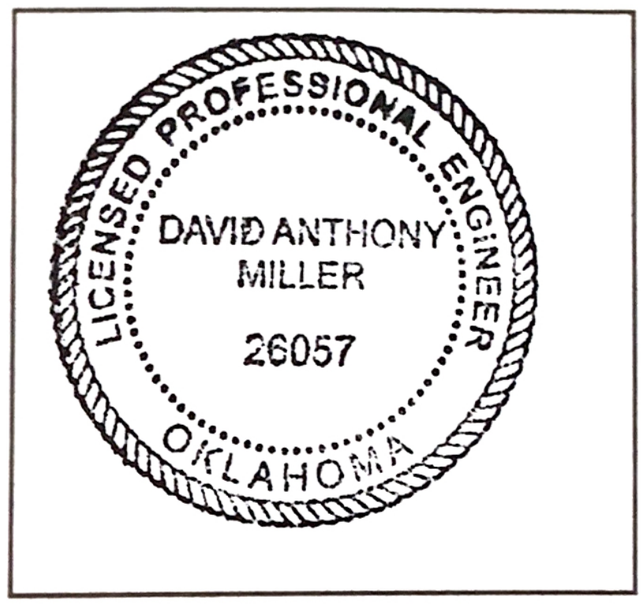
Notes
UPL: Upper prediction limit
LPL: Lower prediction limit

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 Landfill 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	12.28.21
License Number	Licensing State	Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS CONSULTING

November 19, 2021

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

Re: Northeastern Landfill - Background Update - 2021

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the background update of statistical limits with groundwater data through 2021 at American Electric Power's Northeastern Landfill. The analysis complies with the Oklahoma Administrative Code (OAC 252:517), the federal rule for the Disposal of Coal Combustion Residuals (CCR) from Electric Utilities (CCR Rule, 2015), as well as with the United States Environmental Protection Agency (USEPA) Unified Guidance (2009).

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

- **Downgradient wells**: MW-1D, MW-2D, MW-3D, MW-4D, MW-5D, MW-6D, MW-9D, MW-10, MW-11D, MW-12D, MW-13D, MW-14, MW-15, MW-16, and MW-17

Due to high salinity, upgradient wells have not yet been approved for this facility. Downgradient wells MW-2D and MW-14 were first sampled in 2019 and downgradient well MW-13D was first sampled in in 2020; therefore, the minimum 8 samples required for construction of intrawell prediction limits are not yet available. Additionally, well MW-14 was dry during the April 2021 sample event. While data from these wells are plotted on the time series and box plots, no formal statistics were required at this time. Newer wells MW-1D, MW-10D, MW-11D, MW-16, and MW-17 have historically been dry

during some of the sample events and do not have a minimum of 8 samples. Therefore, these wells are not included in this report.

The original background screening was conducted in October 2018 on all wells in the monitoring well network at that time. A summary of those findings is discussed below.

Data were sent electronically to Groundwater Stats Consulting, and the 2018 statistical analysis was reviewed by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting and primary author of the USEPA Unified Guidance. The background update performed during this analysis was reviewed by Dr. Jim Loftis, Civil & Environmental Engineering professor emeritus at Colorado State University and Senior Advisor to Groundwater Stats Consulting.

The following constituents were evaluated:

- **Appendix A** – boron, calcium, chloride, fluoride, pH, sulfate, and TDS

Time series plots for Appendix A parameters at all wells are provided for the purpose of screening data at these wells (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). 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. A substitution of the most recent reporting limit was applied when varying detection limits existed in data.

Data at all wells were evaluated during the initial screening for the following: 1) outliers; 2) trends; 3) most appropriate statistical method for Appendix A parameters based on site characteristics of groundwater data upgradient of the facility; and 4) eligibility of downgradient wells when intrawell statistical methods are recommended. Power curves were provided at that time and demonstrated that the selected statistical methods for Appendix A parameters comply with the USEPA Unified Guidance recommendations as discussed below.

Summary of Statistical Method

- Intrawell prediction limits, combined with a 1-of-2 resample plan for boron, calcium, 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. The distribution of data is tested

using the Shapiro-Wilk/Shapiro-Francia test for normality. While the false positive rate associated with the parametric limits is based on an annual 10% as recommended by the EPA Unified Guidance (2009), the false positive rate associated with the nonparametric limits is dependent upon the available background sample size, number of future comparisons, and verification resample plan. 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. 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 in background, 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 will be necessary to accommodate these types of changes. In the intrawell case, data for all wells and constituents may 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 some cases, the earlier portion of data are deselected prior to construction of limits to provide sensitive limits that will rapidly detect 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.

Historical Summary – October 2018 Background Screening

The initial background screening was performed in 2018 and is summarized below. Note that since the 2018 screening, upgradient wells have been removed from the well network.

Outlier Analysis

Time series plots were used to identify suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective, in proposed background data. Suspected outliers at all wells for Appendix A parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits. A discussion of flagged outliers was included with the screening report.

Seasonality

No seasonal patterns were observed on the time series plots for any of the detected data; therefore, no deseasonalizing adjustments were made to the data. When seasonal patterns are observed, data may be deseasonalized so that the resulting limits will correctly account for the seasonality as a predictable pattern rather than random variation or a release.

Trend Test Evaluation

While trends may be visually apparent, a quantification of each trend and its statistical significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends. In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed several statistically significant increasing trends, primarily in background wells, and a few statistically significant decreasing trends. The results of the trend tests were included in the Trend Test Summary table in the 2018 screening. No adjustments were made to the datasets at that time since the period of record was short. Trends noted in background wells are generally an indication that concentrations are changing due to natural variation.

Appendix A – Determination of Spatial Variation

The Analysis of Variance (ANOVA) was used to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying the most appropriate statistical approach. Interwell tests, which compare downgradient well data to statistical limits constructed from pooled upgradient well data, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation and when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective. In the 2018 screening, it was noted that for each constituent evaluated, the highest concentrations were reported in the upgradient wells.

The ANOVA identified variation for the majority of Appendix A parameters. Additionally, previous correspondence between Oklahoma Department of Environmental Quality and AEP demonstrated that due to natural variation in groundwater as well as changes in direction of groundwater flow, the background wells are not representative of upgradient groundwater quality in which case interwell statistical limits not recommended. Therefore, all Appendix A parameters are evaluated using intrawell methods. A summary of the ANOVA test results was submitted with that report.

Background Update Summary – December 2019

Intrawell prediction limits were last updated in December 2019 using historical data through February 2019. Data were screened for outliers and no new values were identified. All previously identified outliers remained flagged and a summary of those values was provided with the analysis.

The Mann-Whitney test described below was used to compare the medians of historical data to compliance data through February 2019 for all well/constituent pairs. Because wells MW-4D, MW-5D, and MW-12 were in their respective background sampling periods, the minimum 4 compliance samples required for the Mann-Whitney test were not available. Therefore, these wells used all available data through January 2019 for all constituent except TDS which included data through November 2018 to establish prediction limits. The Mann-Whitney test identified a statistically significant difference for boron at well MW-3D; however, this record was updated due to the majority of compliance measurements being similar to those reported historically. All other well/constituent pairs were updated with compliance samples. A full discussion and all reports were included with the previous update.

Background Update Summary – October 2021

Historical data through June 2021 were evaluated during this analysis as described below for the purpose of updating intrawell prediction limits that are representative of present-day groundwater conditions.

Outlier Analysis

All well/constituent pairs were evaluated for outliers using Tukey's outlier test and visual screening for all samples through June 2021 (Figure C). In some cases, wells had samples reported only through April 2021.

No changes were made to previously flagged outliers identified during the earlier 2018 screening. Additional values, however, were flagged in the more recent data. Tukey's outlier test identified high values for boron in well MW-3D, chloride in wells MW-3D and MW-12D, pH in well MW-9D, and sulfate in well MW-5D. These values were flagged as outliers in order to reduce variation and construct statistical limits that are conservative (i.e. lower) from a regulatory perspective. While Tukey's test did not identify potential outliers for calcium in wells MW-6D and MW-15 and pH in well MW-15, these high values were flagged for similar reasons. As discussed 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. An updated summary of Tukey's test results and flagged outliers follows this letter (Figure C).

Mann-Whitney Evaluation

For constituents requiring intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data -- through February 2019 for older wells and through January 2019 (November 2018 for TDS) for newer wells--to the new compliance samples through June 2021 at each well to evaluate whether the groups are statistically different at the 99% confidence level. When no statistically significant difference is found, background data may be updated with compliance data (Figure D). Statistically significant differences (either an increase or decrease in median concentrations) were found between the two groups for the following well/constituent pairs:

Increase

- pH: MW-6D and MW-9D
- Sulfate: MW-5D and MW-15

Decrease

- Boron: MW-15
- Calcium: MW-9D
- Chloride: MW-9D
- Fluoride: MW-4D

Typically, when the test concludes that the medians of the two groups are statistically significantly different, particularly in the downgradient wells, the background data are not updated to include the newer data, unless it can be reasonably justified that the change in concentrations reflects a naturally occurring shift unrelated to practices at the site. In studies such as the current one, in which at least one of the segments being compared is of short duration, the comparison is complicated by the fact that normal short-term variation may be mistaken for long-term change in medians.

Boron at well MW-15, calcium and chloride at well MW-9D, and fluoride at well MW-4D were determined by the Mann-Whitney test to have statistically significant lower medians in more recent measurements compared to their respective medians of historical data. Since the updated limits will either remain near or will decrease compared to the previous limits, these records were updated with the newer compliance data. For calcium, chloride, sulfate, and TDS) at well MW-9D, higher concentrations in background were deselected with an "o" flag after updating in order to construct statistical limits that are more conservative (i.e., lower) and more representative of present-day groundwater quality. If future observations continue at the current levels for boron at well MW-15 and fluoride at well MW-4D, the historically higher reported concentrations and non-detect data will be deselected to obtain more currently representative and conservative limits.

Although, sulfate at wells MW-5D and MW-15 had statistically significant increases in median concentrations when the newer measurements were compared to the historical records, these records were updated at this time due to more recent measurements of being reportedly attributed to natural variability and laboratory method uncertainty.

For pH in wells MW-6D and MW-9D, the Mann-Whitney test identified statistically significant increases between the median of more recent samples and the median of historical data. The background data sets, therefore, were not updated at this time due to the magnitude of difference in median concentrations as well as the variation in more recent concentrations, which would result in increased statistical limits that would not be conservative from a regulatory perspective. Additionally, while not identified by the Mann-Whitney test as significant at an alpha level of 0.01, the difference between the historical and compliance medians for pH at well MW-3D was significant at the alpha level of 0.02 and demonstrated similar patterns to those at wells MW-6D and MW-9D.

Therefore, the background data set for pH at this well was also not updated at this time. These well/constituent pairs will continue to use background data through February 2019, unless it is determined through further research that the change in concentrations is due to natural variation.

A list of well/constituent pairs with truncated records follows this letter in the Date Range Table. Table entries with "overall" date ranges indicate that background data sets will continue to use data through February 2019. All other records were updated with compliance data through June 2021.

Intrawell Prediction Limits

Intrawell prediction limits were constructed with a 1-of-2 resample plan using reported data through June 2021 except for the cases mentioned earlier. A summary of the updated limits follows this letter (Figure E). Future compliance observations at each well will be compared to these background limits after each subsequent semi-annual sampling event. All records will be re-evaluated for updating prediction limits when a minimum of 4 compliance samples are available.

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

For Groundwater Stats Consulting,

Andrew Collins
Project Manager

Kristina L. Rayner
Groundwater Statistician

Date Ranges

Date: 10/28/2021 11:03 AM

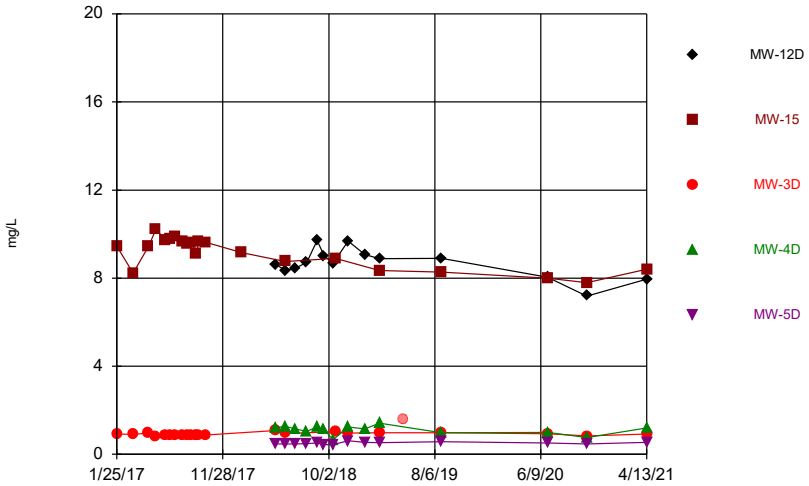
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

pH, field (SU)

MW-3D	background:1/25/2017-2/27/2019,	overall:1/25/2017-2/27/2019
MW-6D	background:6/15/2017-2/27/2019,	overall:6/15/2017-2/27/2019
MW-9D	background:6/15/2017-2/27/2019,	overall:6/15/2017-2/27/2019

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Time Series

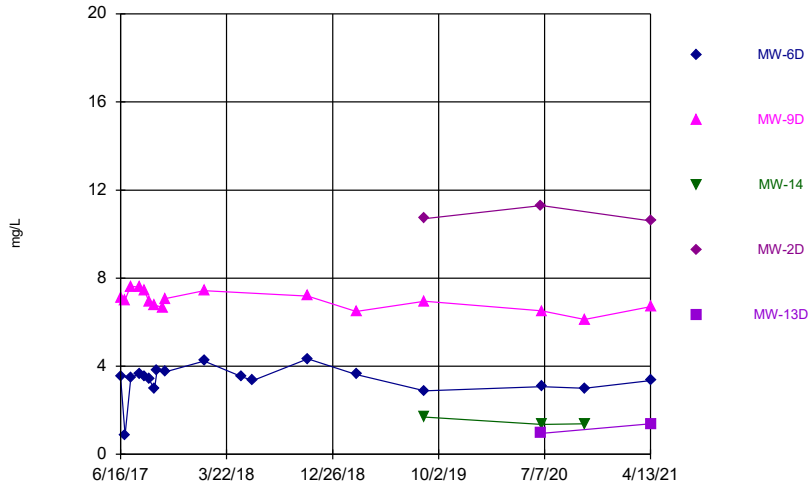


Constituent: Boron Analysis Run 10/29/2021 3:11 PM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Time Series

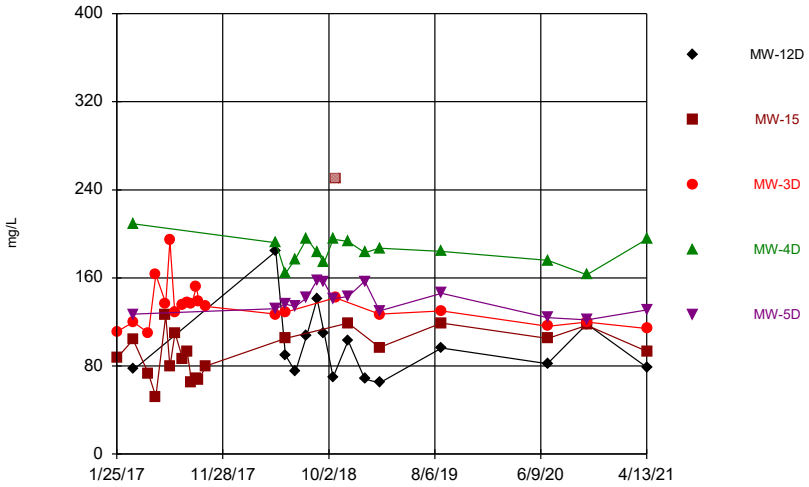


Constituent: Boron Analysis Run 10/29/2021 3:11 PM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Time Series

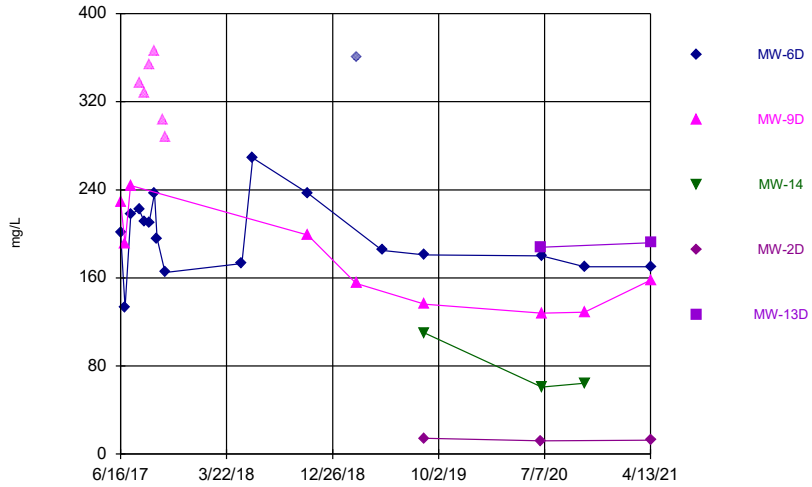


Constituent: Calcium Analysis Run 10/29/2021 3:11 PM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Time Series

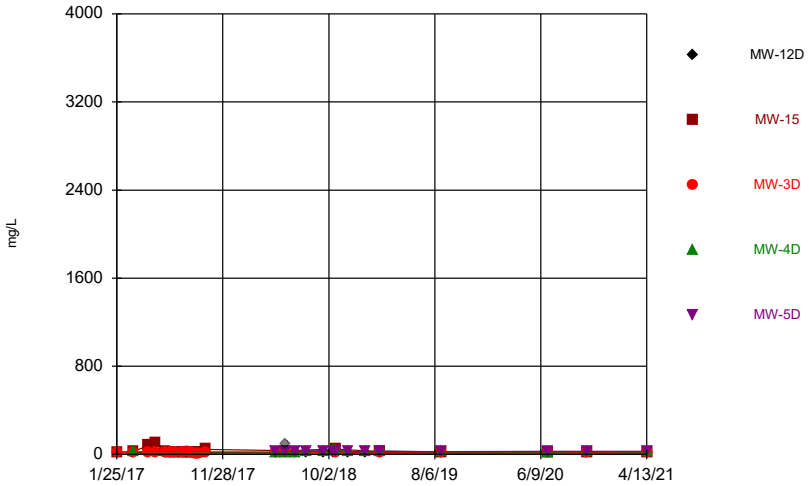


Constituent: Calcium Analysis Run 10/29/2021 3:11 PM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Time Series

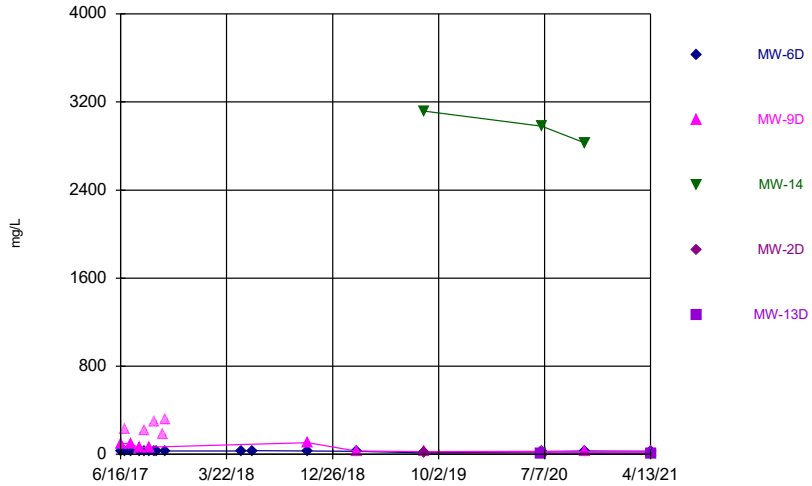


Constituent: Chloride Analysis Run 10/29/2021 3:11 PM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Time Series



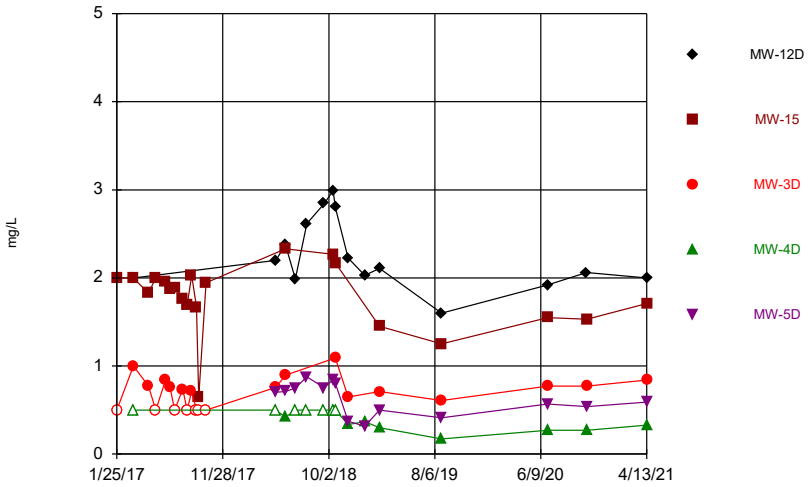
Constituent: Chloride Analysis Run 10/29/2021 3:11 PM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

Time Series



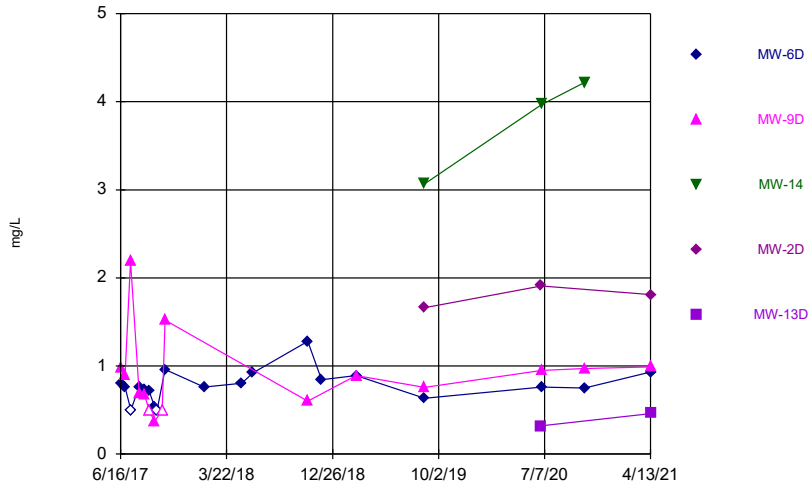
Constituent: Fluoride Analysis Run 10/29/2021 3:11 PM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

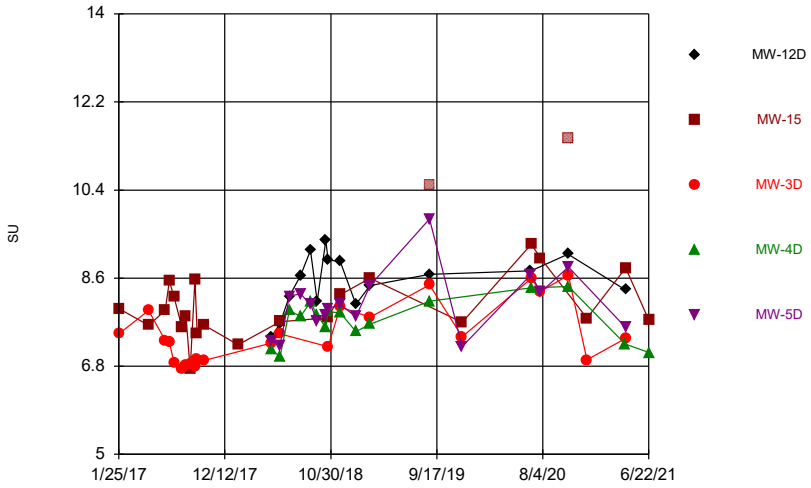
Time Series



Constituent: Fluoride Analysis Run 10/29/2021 3:11 PM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

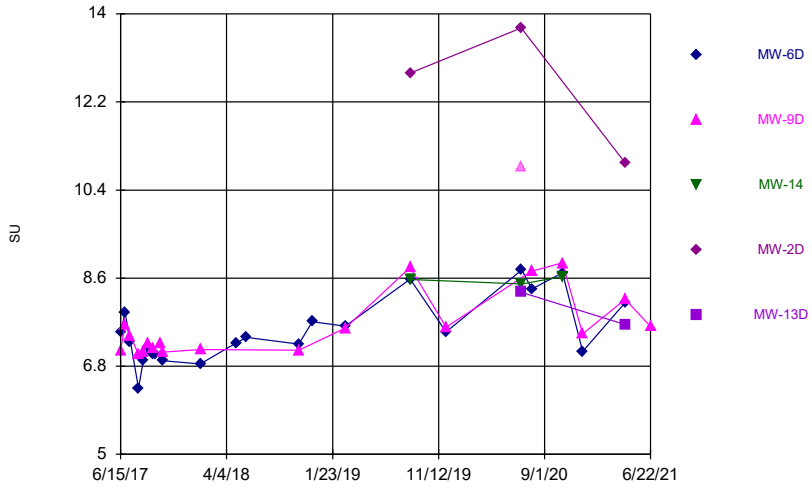
Time Series



Constituent: pH, field Analysis Run 10/29/2021 3:11 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

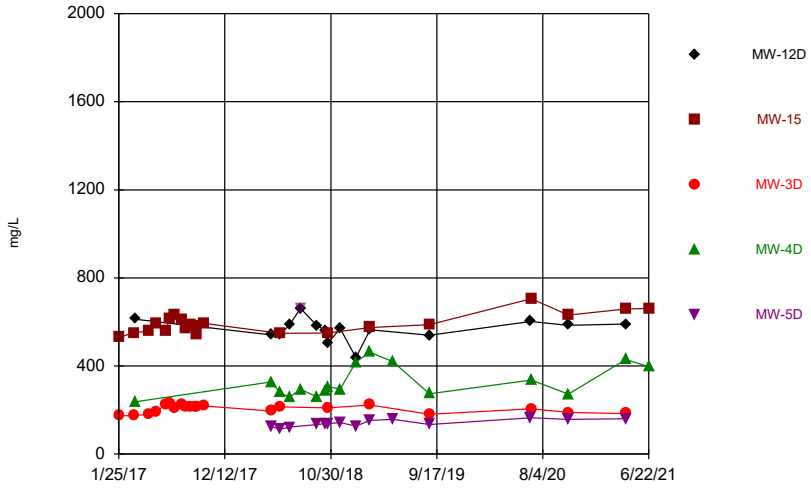
Time Series



Constituent: pH, field Analysis Run 10/29/2021 3:11 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

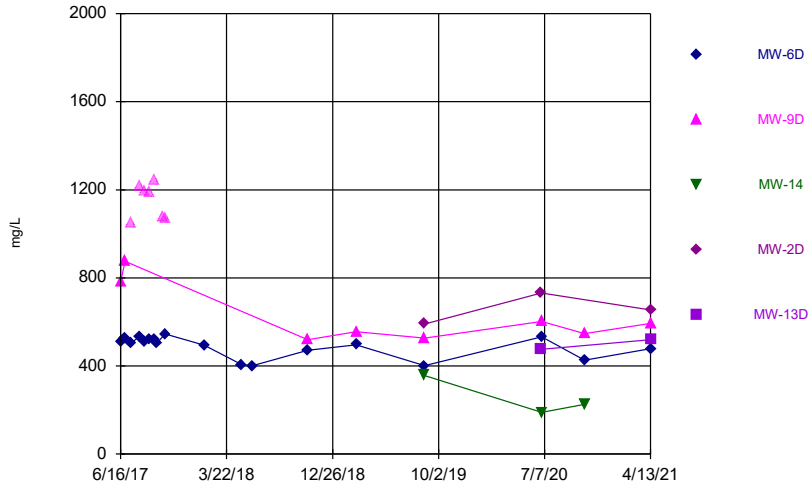
Time Series



Constituent: Sulfate Analysis Run 10/29/2021 3:11 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

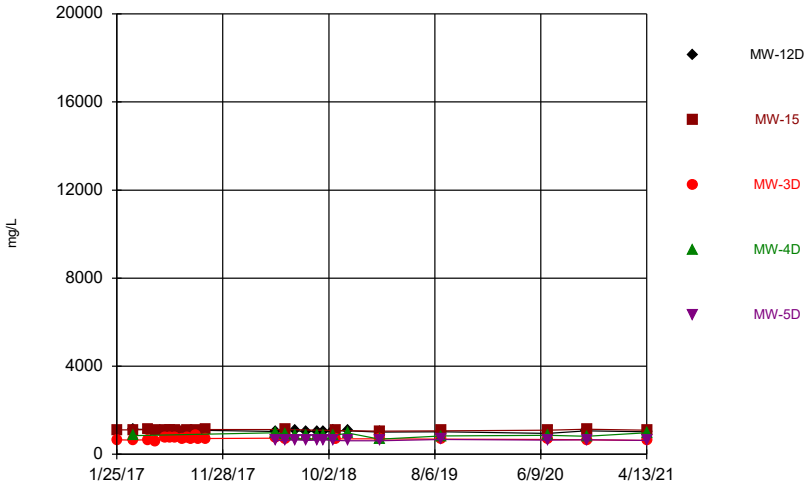
Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Time Series



Constituent: Sulfate Analysis Run 10/29/2021 3:11 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Time Series

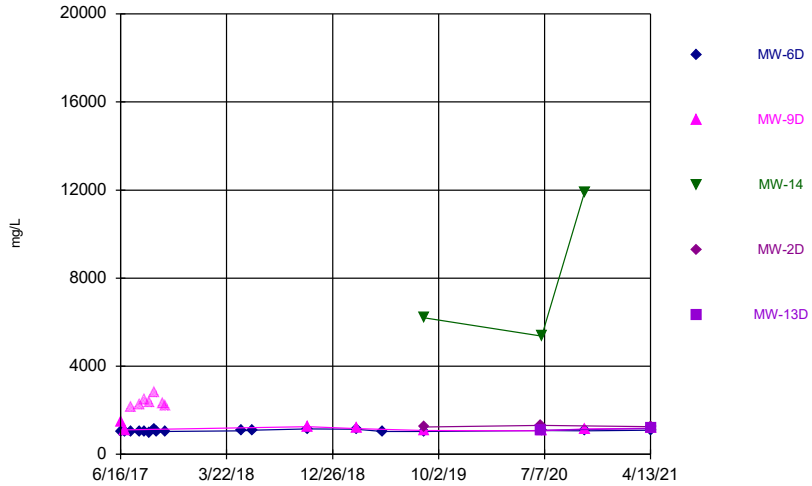


Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2021 3:11 PM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

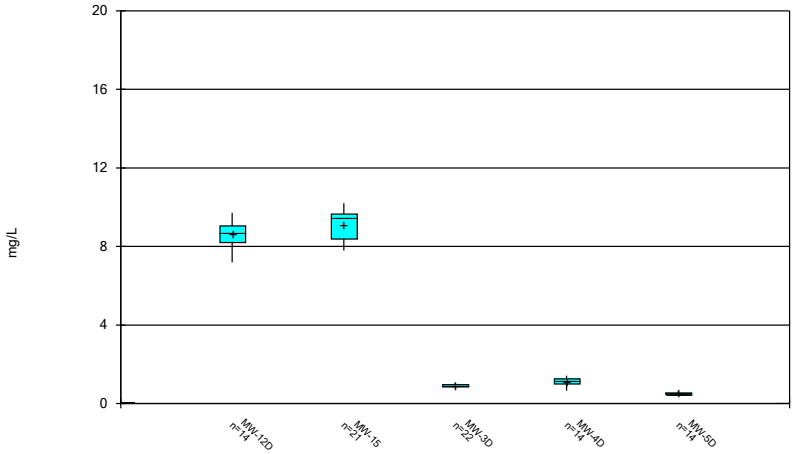
Time Series



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2021 3:11 PM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

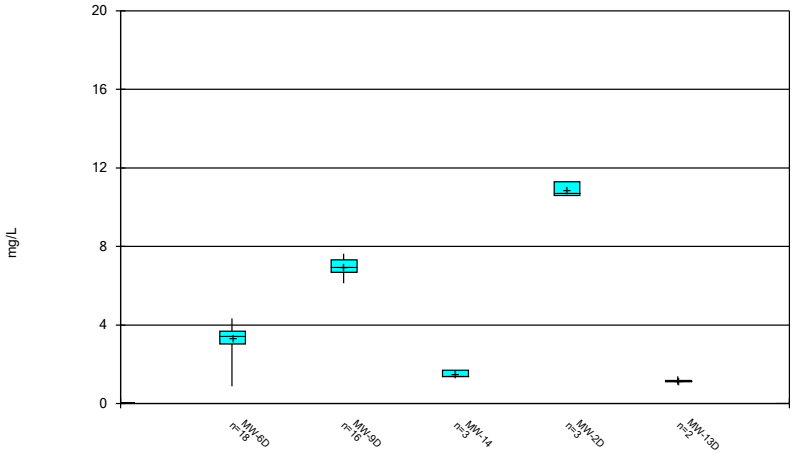
Box & Whiskers Plot



Constituent: Boron Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

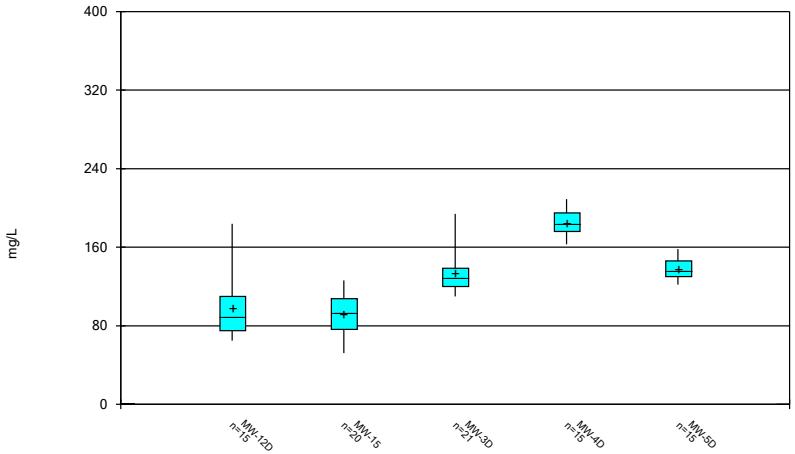
Box & Whiskers Plot



Constituent: Boron Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

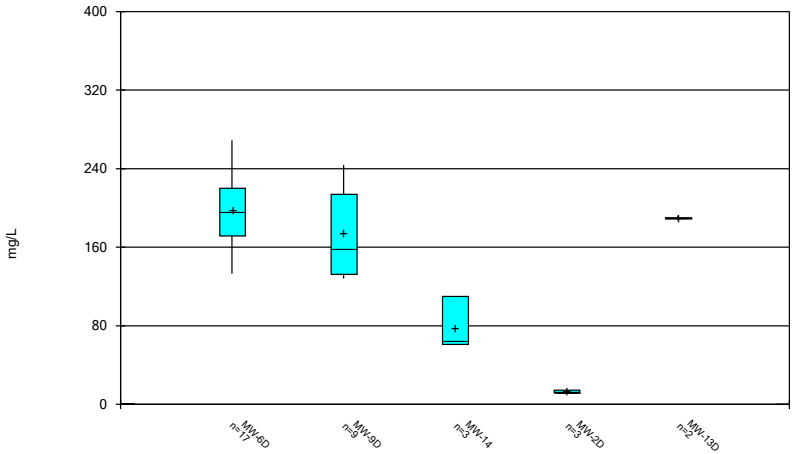
Box & Whiskers Plot



Constituent: Calcium Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

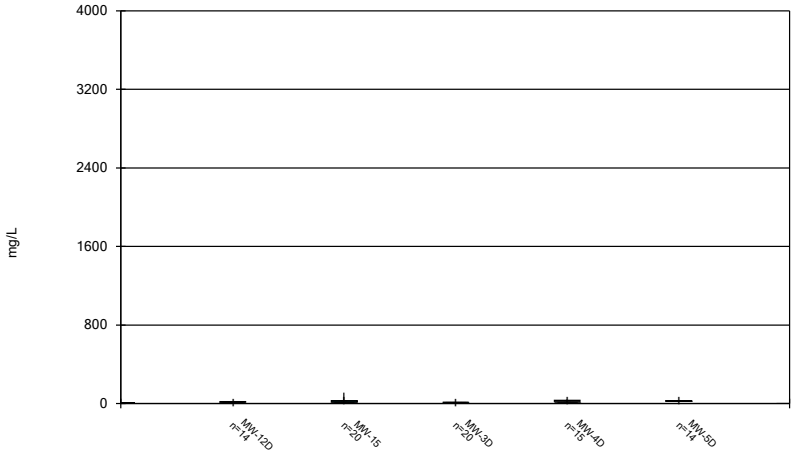
Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Calcium Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

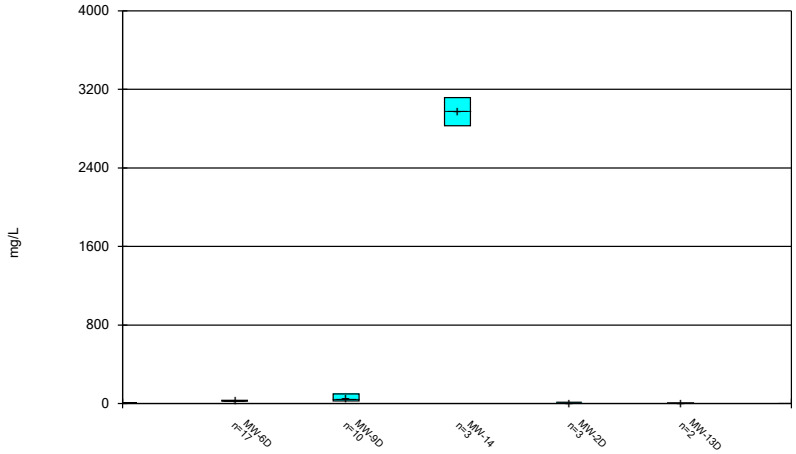
Box & Whiskers Plot



Constituent: Chloride Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

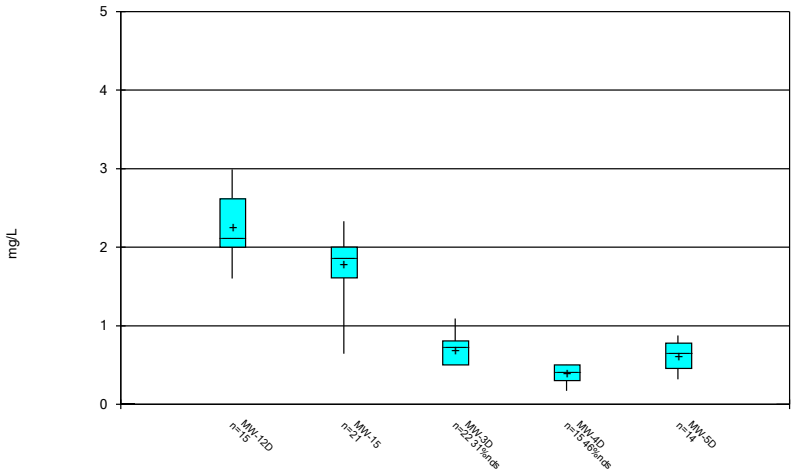
Box & Whiskers Plot



Constituent: Chloride Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

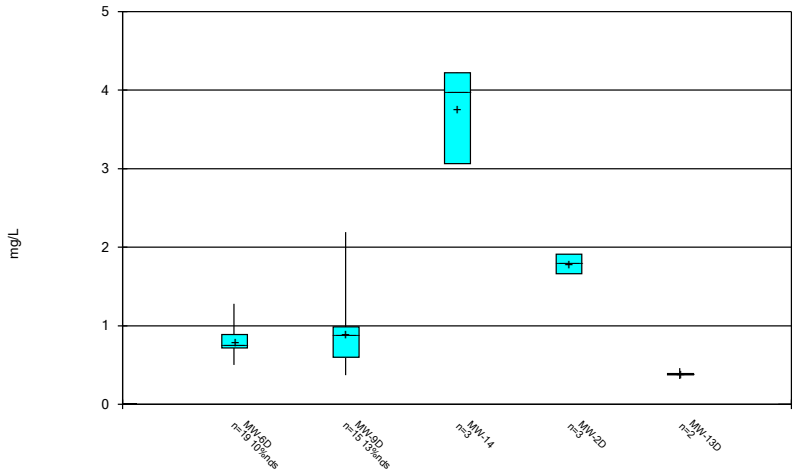
Box & Whiskers Plot



Constituent: Fluoride Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

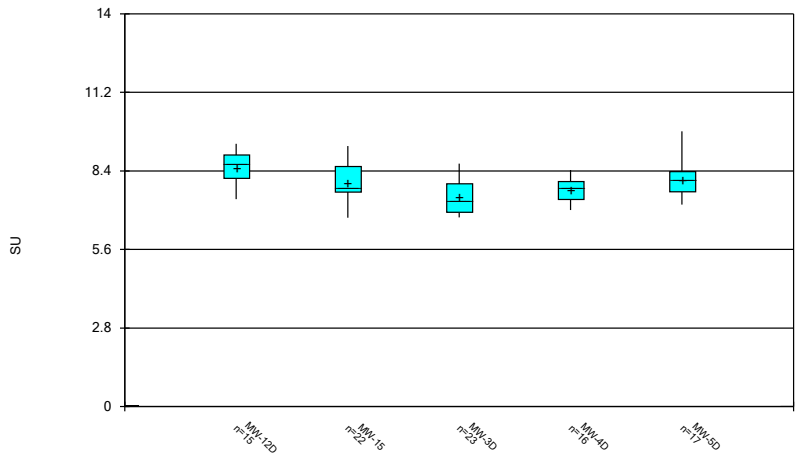
Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Fluoride Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

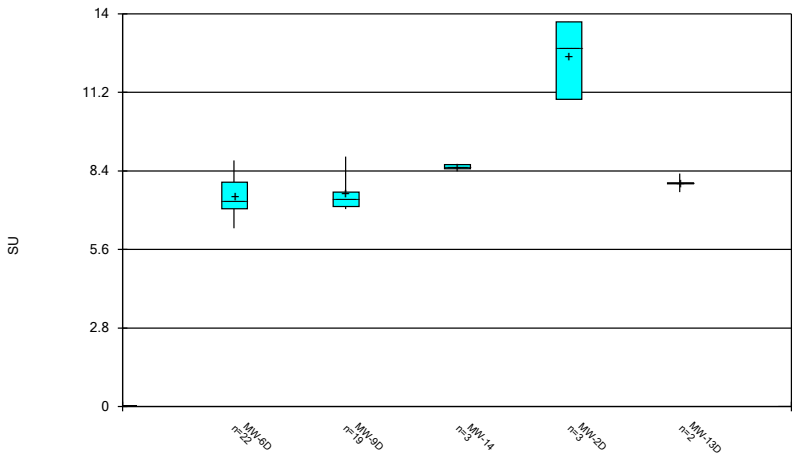
Box & Whiskers Plot



Constituent: pH, field Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

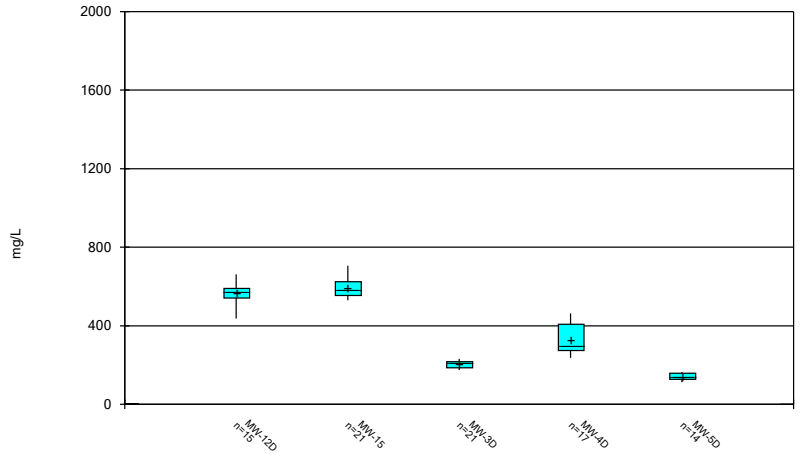
Box & Whiskers Plot



Constituent: pH, field Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

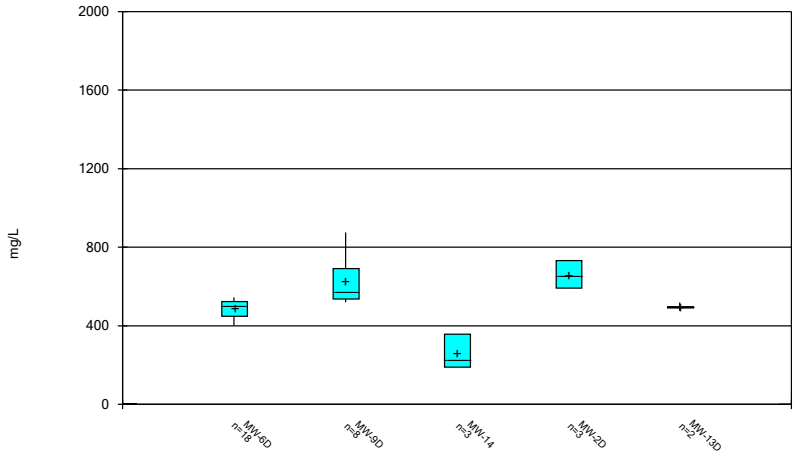
Box & Whiskers Plot



Constituent: Sulfate Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

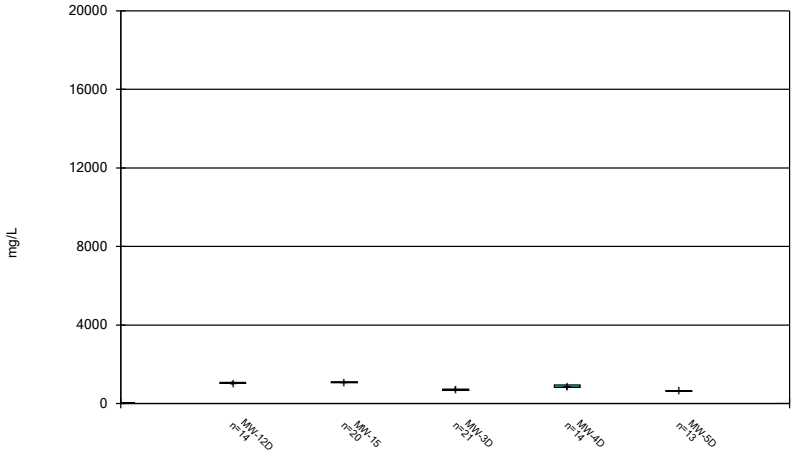
Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Sulfate Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

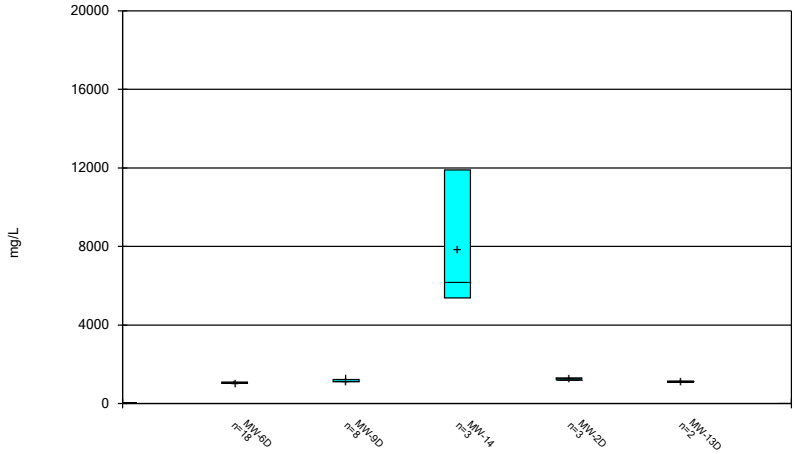
Box & Whiskers Plot



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2021 3:14 PM
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Outlier Summary

Northeastern Landfill Client: Geosyntec Data: Northeastern LF Printed 10/29/2021, 3:13 PM

	MW-3D Boron (mg/L)	MW-15 Calcium (mg/L)	MW-6D Calcium (mg/L)	MW-9D Calcium (mg/L)	MW-12D Chloride (mg/L)	MW-3D Chloride (mg/L)	MW-9D Chloride (mg/L)	MW-15 pH, field (SU)	MW-9D pH, field (SU)	MW-5D Sulfate (mg/L)	MW-9D Sulfate (mg/L)	MW-9D Total Dissolved Solids [TDS] (mg/L)
6/28/2017							232 (o)					
7/12/2017											1048 (o)	2146 (o)
8/4/2017				337 (o)							1217 (o)	2256 (o)
8/17/2017				328 (o)		23 (o)	216 (o)				1193 (o)	2486 (o)
8/30/2017				354 (o)							1192 (o)	2392 (o)
9/13/2017				366 (o)			293 (o)				1244 (o)	2826 (o)
10/4/2017				304 (o)			180 (o)				1079 (o)	2296 (o)
10/11/2017				288 (o)			314 (o)				1075 (o)	2188 (o)
5/30/2018					91 (o)							
7/31/2018									662 (o)			
10/22/2018		250 (o)										
2/27/2019			360 (o)									
5/7/2019	1.56 (o)											
8/26/2019								10.51 (o)				
6/30/2020									10.87 (o)			
10/21/2020								11.45 (o)				

Tukey's Outlier Test - Significant Results

Northeastern Landfill Client: Geosyntec Data: Northeastern LF Printed 10/6/2021, 9:38 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron (mg/L)	**MW-3D**	**Yes**	**1.56**	**5/7/2019**	**NP**	**NaN**	**23**	**0.9366**	**0.1527**	**ln(x)**	**ShapiroWilk**
Chloride (mg/L)	**MW-12D**	**Yes**	**91**	**5/30/2018**	**NP**	**NaN**	**15**	**22.2**	**19.19**	**ln(x)**	**ShapiroWilk**
Chloride (mg/L)	**MW-3D**	**Yes**	**23**	**8/17/2017**	**NP**	**NaN**	**21**	**13.38**	**2.504**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**MW-9D**	**Yes**	**10.87**	**6/30/2020**	**NP**	**NaN**	**20**	**7.759**	**0.9445**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	**MW-5D**	**Yes**	**662**	**7/31/2018**	**NP**	**NaN**	**15**	**175.5**	**135.5**	**ln(x)**	**ShapiroWilk**

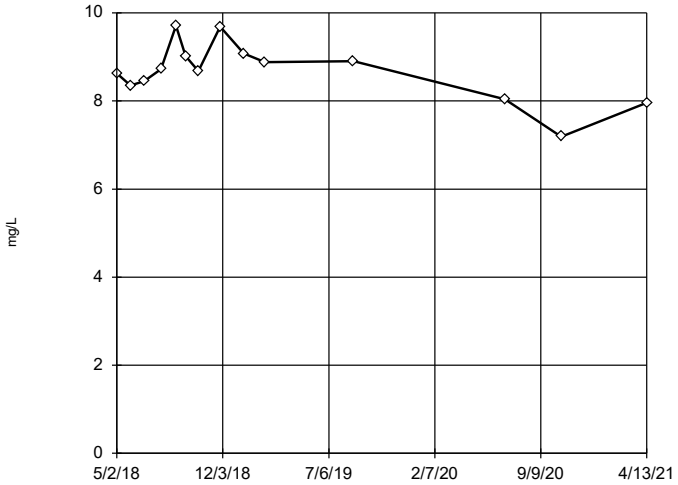
Tukey's Outlier Test - All Results

Northeastern Landfill Client: Geosyntec Data: Northeastern LF Printed 10/6/2021, 9:38 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron (mg/L)	MW-12D	No	n/a	n/a	NP	NaN	14	8.664	0.6654	x^2	ShapiroWilk
Boron (mg/L)	MW-15	No	n/a	n/a	NP	NaN	21	9.119	0.6986	x^6	ShapiroWilk
Boron (mg/L)	**MW-3D**	**Yes**	**1.56**	**5/7/2019**	**NP**	**NaN**	**23**	**0.9366**	**0.1527**	**ln(x)**	**ShapiroWilk**
Boron (mg/L)	MW-4D	No	n/a	n/a	NP	NaN	14	1.106	0.2052	x^3	ShapiroWilk
Boron (mg/L)	MW-5D	No	n/a	n/a	NP	NaN	14	0.5059	0.04899	ln(x)	ShapiroWilk
Boron (mg/L)	MW-6D	No	n/a	n/a	NP	NaN	18	3.354	0.7319	x^3	ShapiroWilk
Boron (mg/L)	MW-9D	No	n/a	n/a	NP	NaN	16	6.977	0.4247	x^2	ShapiroWilk
Calcium (mg/L)	MW-12D	No	n/a	n/a	NP	NaN	15	97.73	32.03	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-15	No	n/a	n/a	NP	NaN	21	99.85	39.97	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-3D	No	n/a	n/a	NP	NaN	21	133.5	19.06	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-4D	No	n/a	n/a	NP	NaN	15	184.7	12.57	x^2	ShapiroWilk
Calcium (mg/L)	MW-5D	No	n/a	n/a	NP	NaN	15	138.6	11.76	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-6D	No	n/a	n/a	NP	NaN	18	206.6	50.06	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-9D	No	n/a	n/a	NP	NaN	15	236.4	87.05	sqrt(x)	ShapiroWilk
Chloride (mg/L)	**MW-12D**	**Yes**	**91**	**5/30/2018**	**NP**	**NaN**	**15**	**22.2**	**19.19**	**ln(x)**	**ShapiroWilk**
Chloride (mg/L)	MW-15	No	n/a	n/a	NP	NaN	20	30.31	24.36	ln(x)	ShapiroWilk
Chloride (mg/L)	**MW-3D**	**Yes**	**23**	**8/17/2017**	**NP**	**NaN**	**21**	**13.38**	**2.504**	**ln(x)**	**ShapiroWilk**
Chloride (mg/L)	MW-4D	No	n/a	n/a	NP	NaN	15	26.8	6.134	ln(x)	ShapiroWilk
Chloride (mg/L)	MW-5D	No	n/a	n/a	NP	NaN	14	26.75	2.481	ln(x)	ShapiroWilk
Chloride (mg/L)	MW-6D	No	n/a	n/a	NP	NaN	17	28.75	4.497	x^6	ShapiroWilk
Chloride (mg/L)	MW-9D	No	n/a	n/a	NP	NaN	15	119.6	101.7	x^(1/3)	ShapiroWilk
Fluoride (mg/L)	MW-12D	No	n/a	n/a	NP	NaN	15	2.25	0.3951	ln(x)	ShapiroWilk
Fluoride (mg/L)	MW-15	No	n/a	n/a	NP	NaN	21	1.789	0.3748	x^3	ShapiroWilk
Fluoride (mg/L)	MW-3D	No	n/a	n/a	NP	NaN	22	0.7008	0.174	normal	ShapiroWilk
Fluoride (mg/L)	MW-4D	No	n/a	n/a	NP	NaN	15	0.3977	0.1123	normal	ShapiroWilk
Fluoride (mg/L)	MW-5D	No	n/a	n/a	NP	NaN	14	0.6244	0.1802	x^2	ShapiroWilk
Fluoride (mg/L)	MW-6D	No	n/a	n/a	NP	NaN	19	0.7817	0.1806	x^(1/3)	ShapiroWilk
Fluoride (mg/L)	MW-9D	No	n/a	n/a	NP	NaN	15	0.8999	0.4531	ln(x)	ShapiroWilk
pH, field (SU)	MW-12D	No	n/a	n/a	NP	NaN	15	8.528	0.5609	x^5	ShapiroWilk
pH, field (SU)	MW-15	No	n/a	n/a	NP	NaN	24	8.253	1.029	ln(x)	ShapiroWilk
pH, field (SU)	MW-3D	No	n/a	n/a	NP	NaN	23	7.453	0.6123	ln(x)	ShapiroWilk
pH, field (SU)	MW-4D	No	n/a	n/a	NP	NaN	16	7.731	0.4451	x^3	ShapiroWilk
pH, field (SU)	MW-5D	No	n/a	n/a	NP	NaN	17	8.082	0.6491	ln(x)	ShapiroWilk
pH, field (SU)	MW-6D	No	n/a	n/a	NP	NaN	22	7.517	0.6492	ln(x)	ShapiroWilk
pH, field (SU)	**MW-9D**	**Yes**	**10.87**	**6/30/2020**	**NP**	**NaN**	**20**	**7.759**	**0.9445**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	MW-12D	No	n/a	n/a	NP	NaN	15	565.3	51.11	x^3	ShapiroWilk
Sulfate (mg/L)	MW-15	No	n/a	n/a	NP	NaN	21	593	45.35	ln(x)	ShapiroWilk
Sulfate (mg/L)	MW-3D	No	n/a	n/a	NP	NaN	21	204.4	18.04	x^5	ShapiroWilk
Sulfate (mg/L)	MW-4D	No	n/a	n/a	NP	NaN	17	326.8	70.78	ln(x)	ShapiroWilk
Sulfate (mg/L)	**MW-5D**	**Yes**	**662**	**7/31/2018**	**NP**	**NaN**	**15**	**175.5**	**135.5**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	MW-6D	No	n/a	n/a	NP	NaN	18	487.6	47.47	x^6	ShapiroWilk
Sulfate (mg/L)	MW-9D	No	n/a	n/a	NP	NaN	15	869.9	291.1	x^2	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-12D	No	n/a	n/a	NP	NaN	14	1048	43.37	x^3	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-15	No	n/a	n/a	NP	NaN	20	1087	32.98	x^6	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-3D	No	n/a	n/a	NP	NaN	21	702.8	52.43	ln(x)	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-4D	No	n/a	n/a	NP	NaN	14	875.2	75.19	x^3	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-5D	No	n/a	n/a	NP	NaN	13	640.3	17.4	ln(x)	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-6D	No	n/a	n/a	NP	NaN	18	1060	47.77	ln(x)	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-9D	No	n/a	n/a	NP	NaN	15	1739	635.6	x^2	ShapiroWilk

Tukey's Outlier Screening

MW-12D



n = 14

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

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

High cutoff = 11.23, low cutoff = 4.798, based on IQR multiplier of 3.

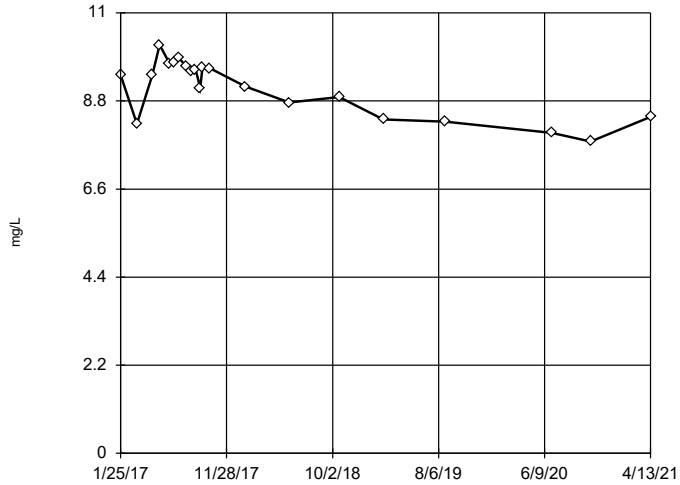
Constituent: Boron Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-15



n = 21

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

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 11.41, low cutoff = -10.09, based on IQR multiplier of 3.

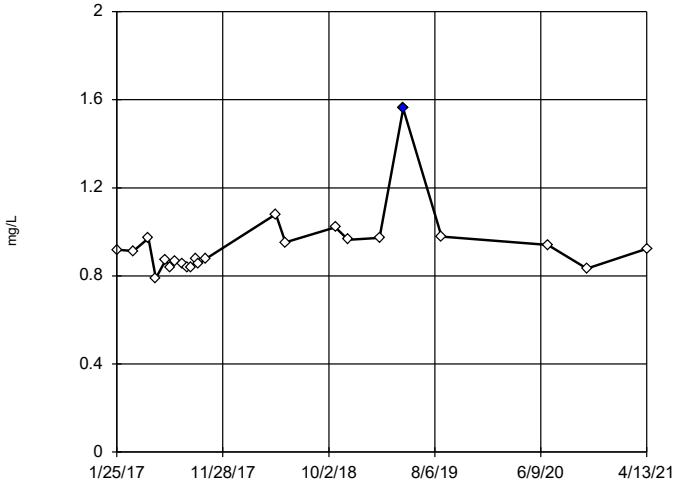
Constituent: Boron Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-3D



n = 23

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 = 1.438, low cutoff = 0.5765, based on IQR multiplier of 3.

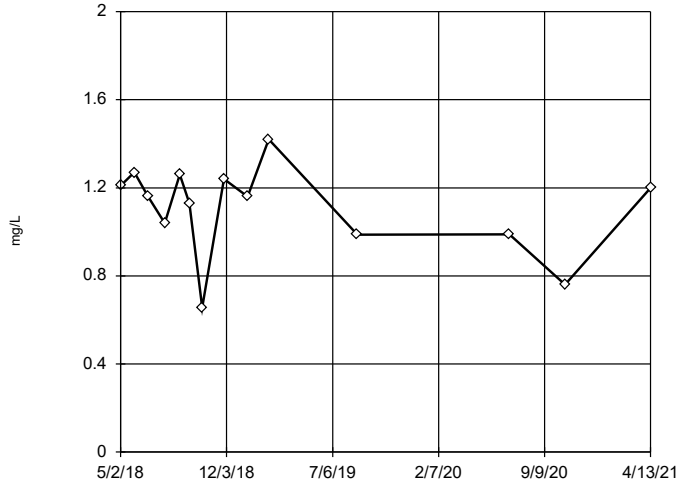
Constituent: Boron Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-4D



n = 14

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

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

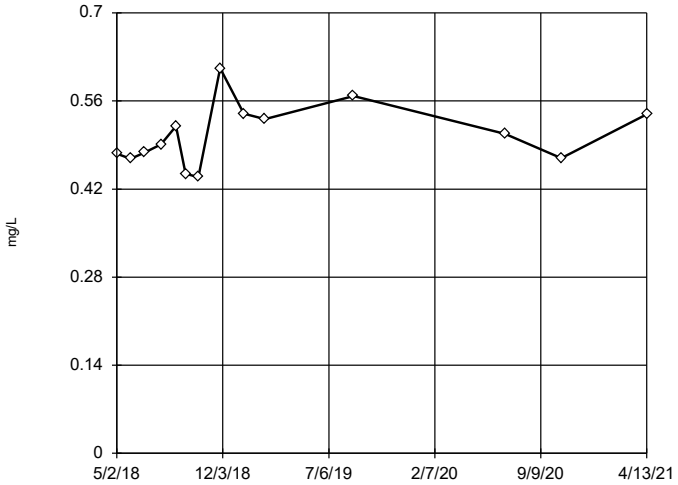
High cutoff = 1.701, low cutoff = -1.262, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-5D



n = 14

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 = 0.8238, low cutoff = 0.3068, based on IQR multiplier of 3.

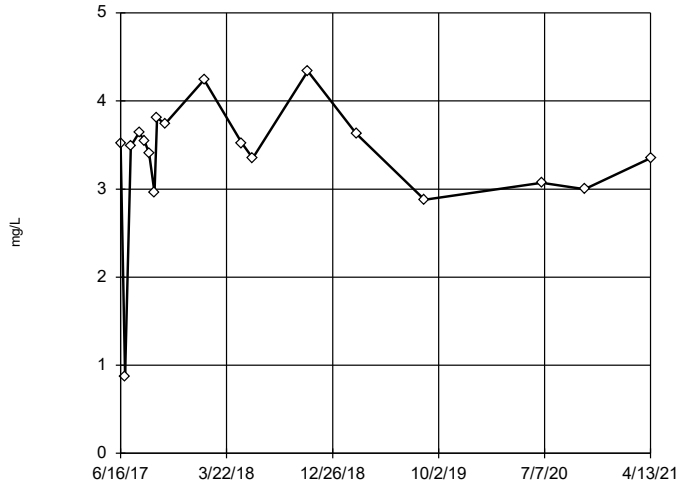
Constituent: Boron Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-6D



n = 18

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 = 4.894, low cutoff = -3.39, based on IQR multiplier of 3.

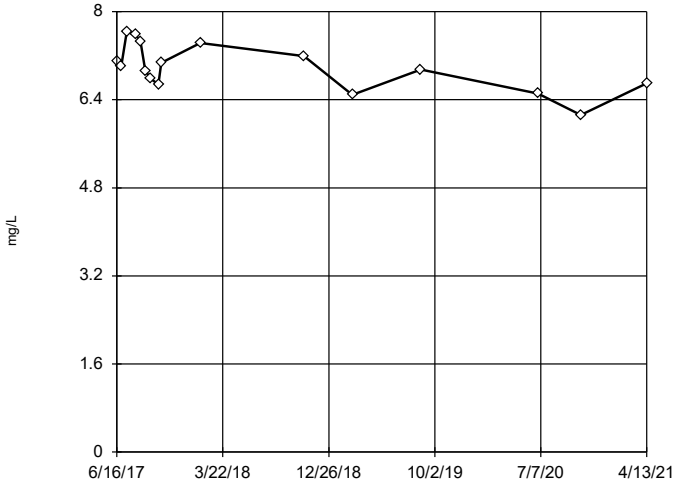
Constituent: Boron Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-9D



n = 16

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

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

High cutoff = 8.918, low cutoff = 4.321, based on IQR multiplier of 3.

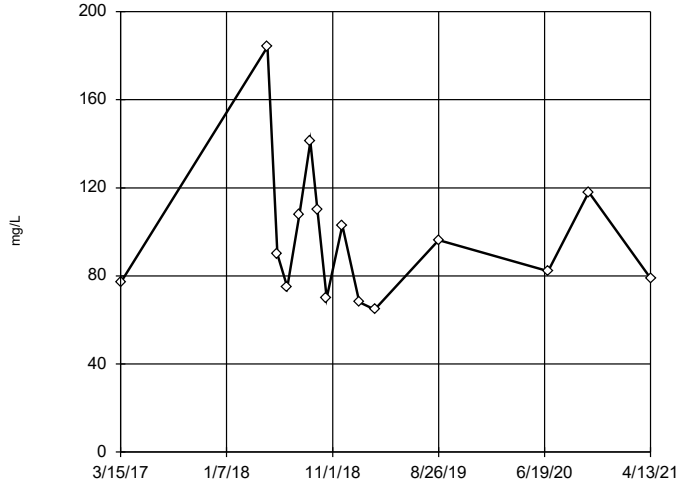
Constituent: Boron Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-12D



n = 15

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

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

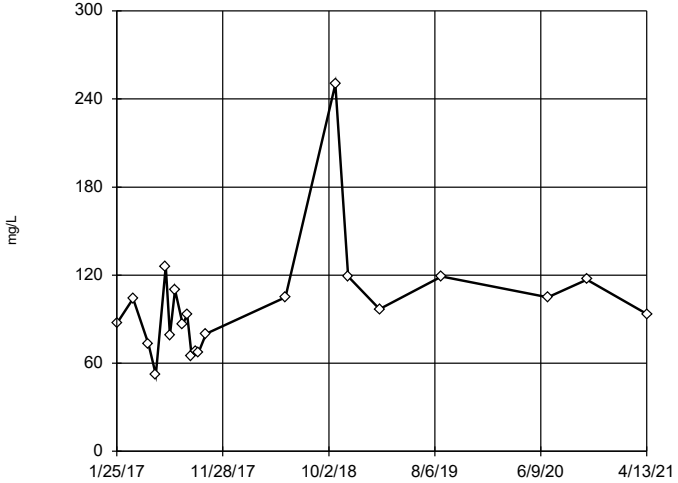
High cutoff = 348.4, low cutoff = 23.65, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-15



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 = 376, low cutoff = 22.96, based on IQR multiplier of 3.

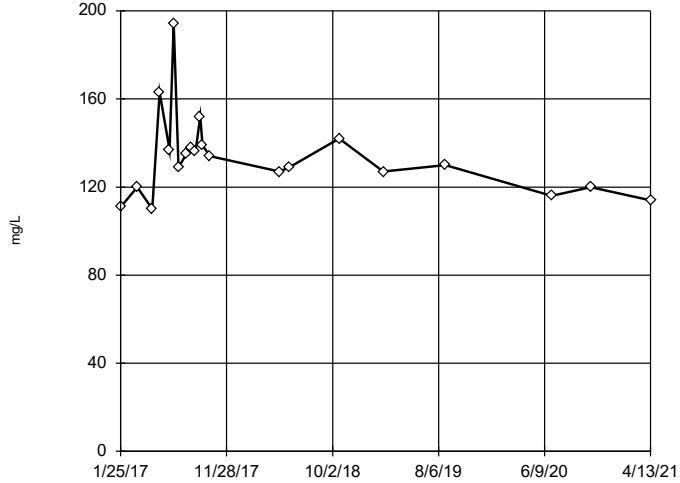
Constituent: Calcium Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-3D



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 = 212.9, low cutoff = 78.05, based on IQR multiplier of 3.

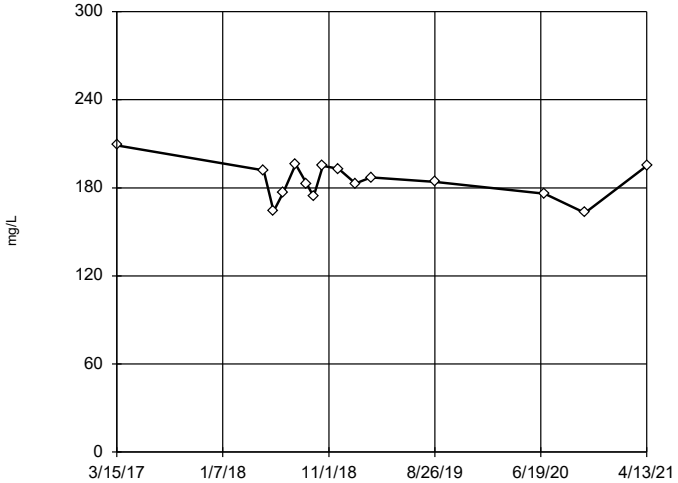
Constituent: Calcium Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-4D



n = 15

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

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

High cutoff = 243.3, low cutoff = 99.14, based on IQR multiplier of 3.

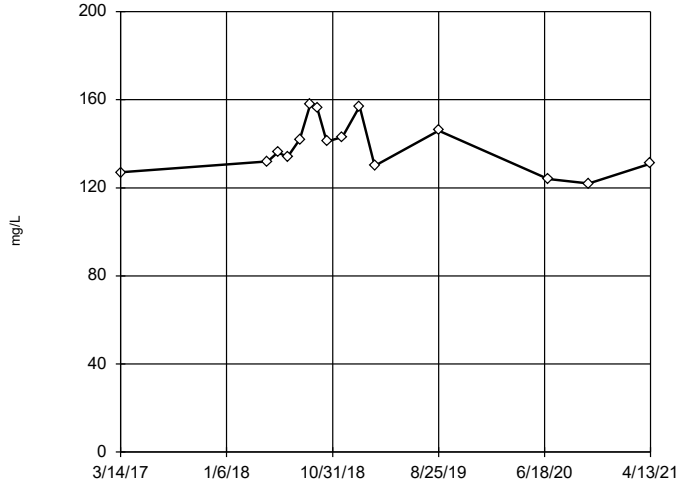
Constituent: Calcium Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-5D



n = 15

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

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

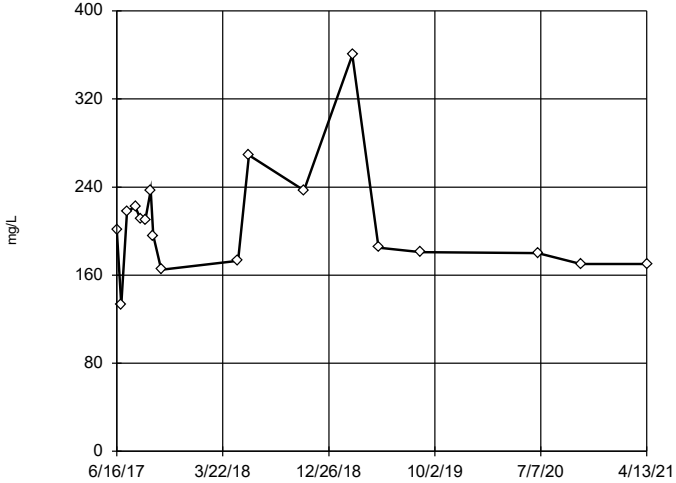
High cutoff = 206.8, low cutoff = 91.77, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-6D



n = 18

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 = 548.9, low cutoff = 71.67, based on IQR multiplier of 3.

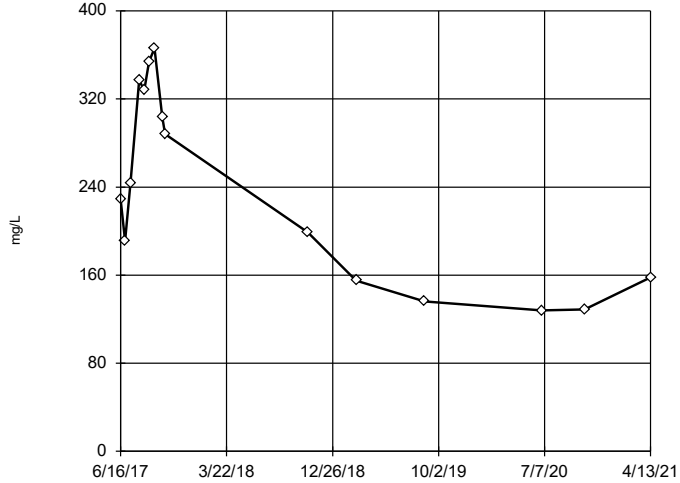
Constituent: Calcium Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-9D



n = 15

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 = 1232, low cutoff = -20.55, based on IQR multiplier of 3.

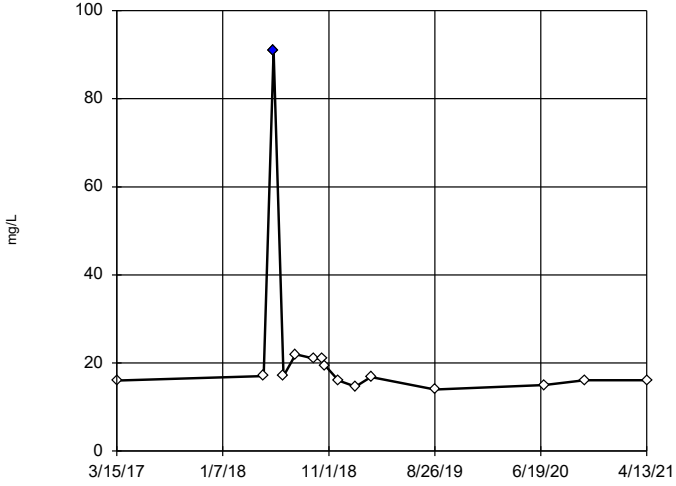
Constituent: Calcium Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-12D



n = 15

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 = 47.48, low cutoff = 7.077, based on IQR multiplier of 3.

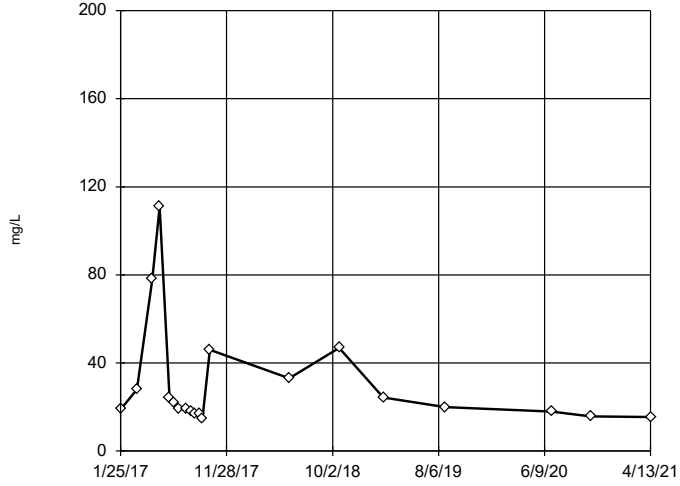
Constituent: Chloride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-15



n = 20

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

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

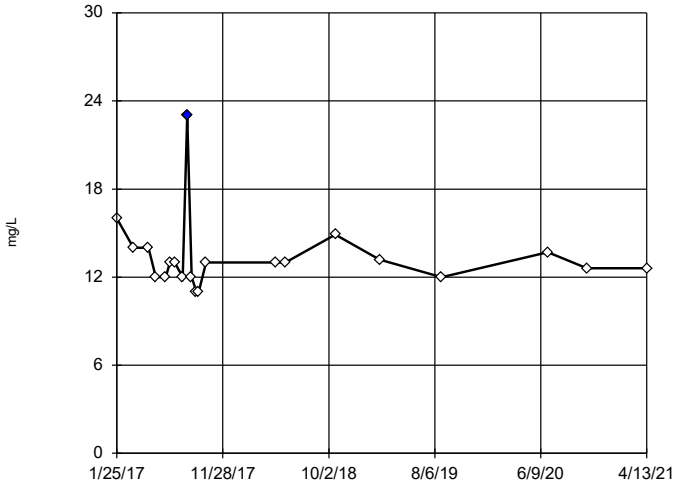
High cutoff = 160.8, low cutoff = 3.297, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-3D



n = 21

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 = 21.29, low cutoff = 7.806, based on IQR multiplier of 3.

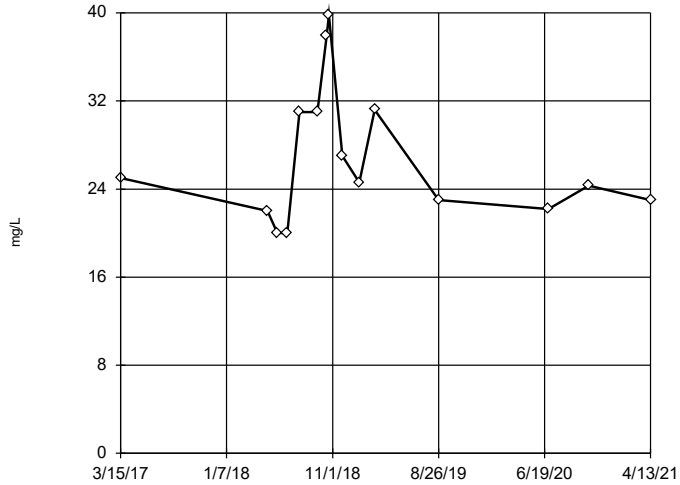
Constituent: Chloride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-4D



n = 15

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 = 84.41, low cutoff = 8.153, based on IQR multiplier of 3.

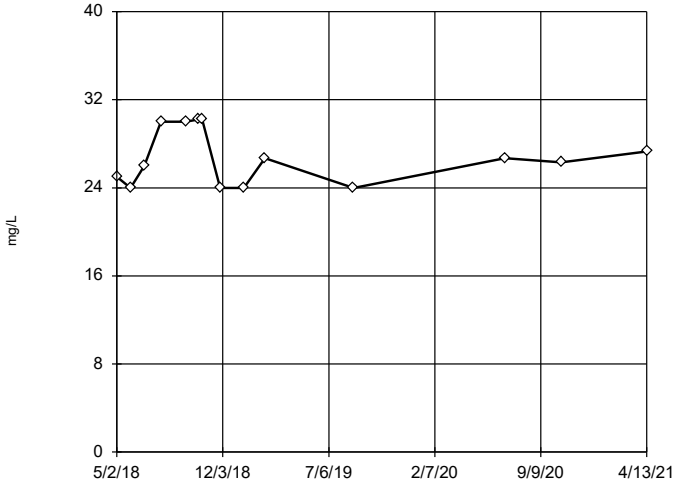
Constituent: Chloride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-5D



n = 14

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 = 58.59, low cutoff = 12.29, based on IQR multiplier of 3.

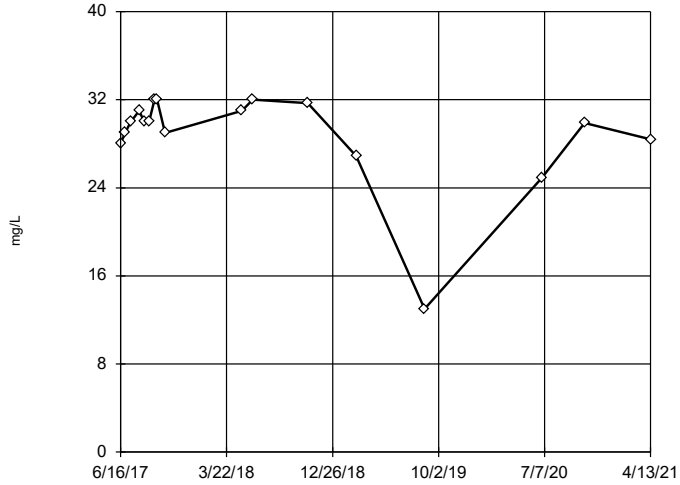
Constituent: Chloride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-6D



n = 17

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

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

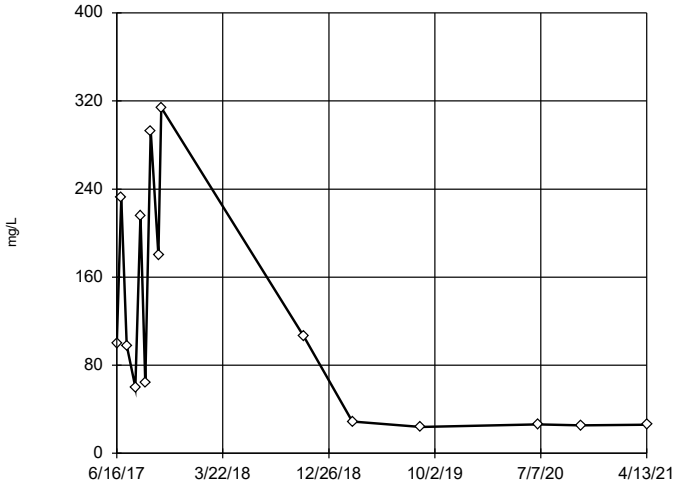
High cutoff = 36.3, low cutoff = -30.68, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-9D



n = 15

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

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

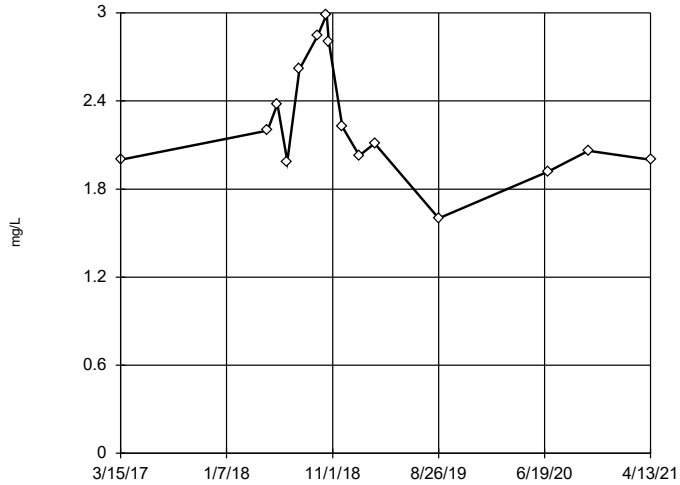
High cutoff = 3436, low cutoff = -229.2, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-12D



n = 15

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

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

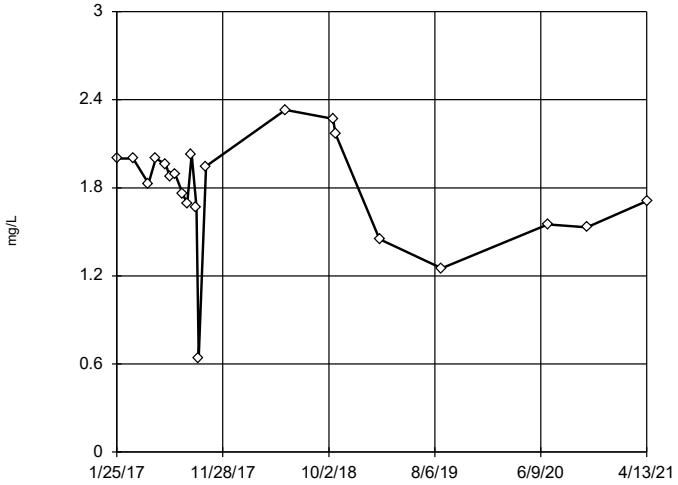
High cutoff = 5.866, low cutoff = 0.8924, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-15



n = 21

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

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

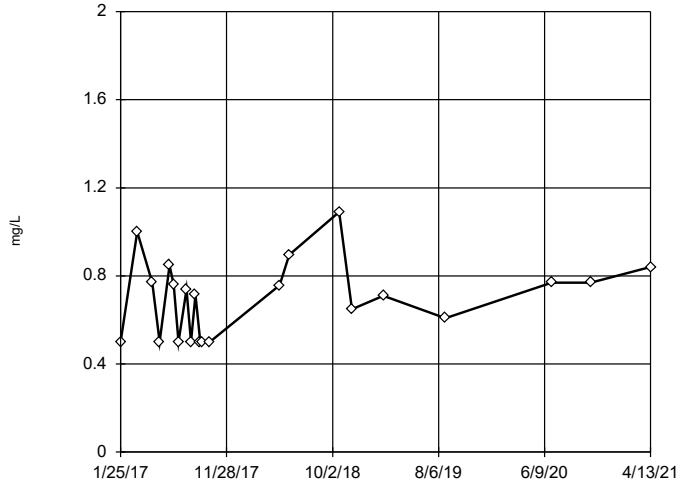
High cutoff = 2.688, low cutoff = -1.933, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-3D



n = 22

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

Ladder of Powers transformations did not improve normality; analysis run on raw data.

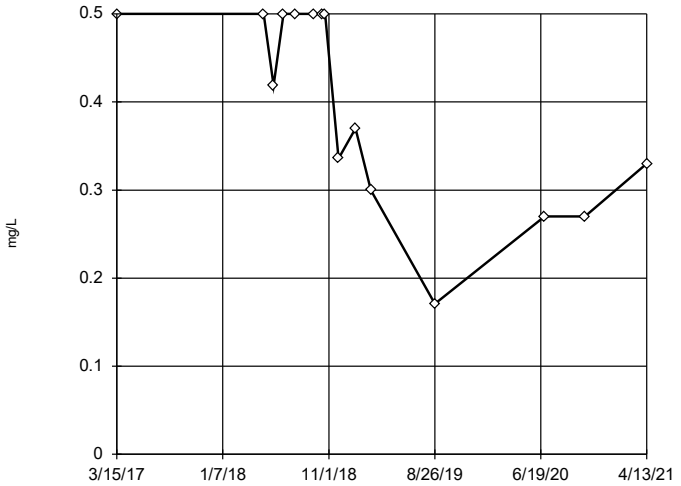
High cutoff = 1.72, low cutoff = -0.415, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-4D



n = 15

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

Ladder of Powers transformations did not improve normality; analysis run on raw data.

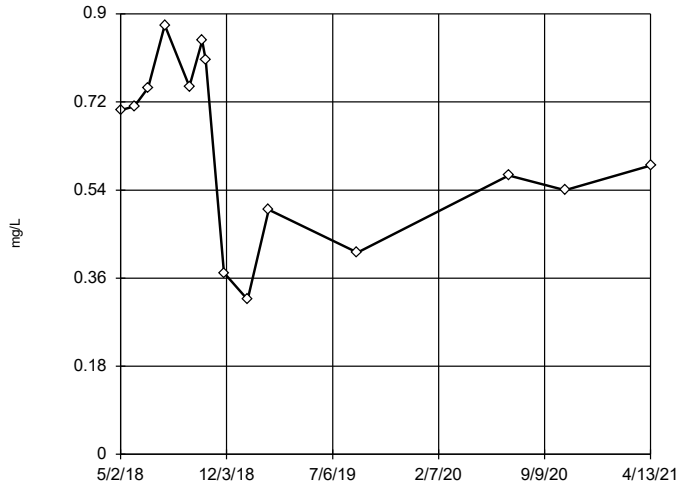
High cutoff = 1.1, low cutoff = -0.3, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-5D



n = 14

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

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

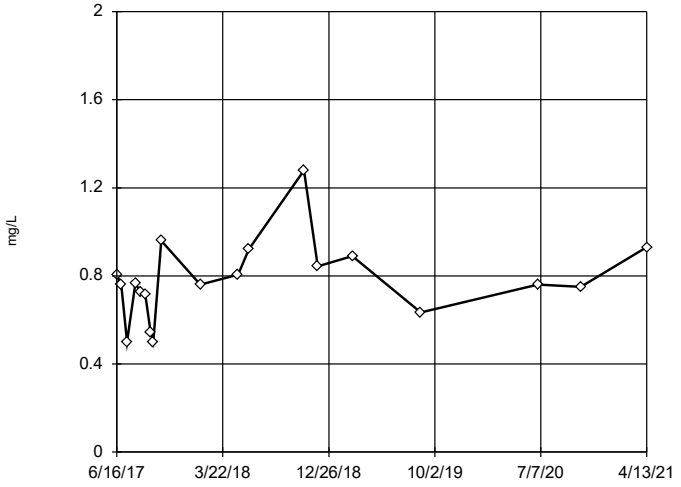
High cutoff = 1.342, low cutoff = -0.9915, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-6D



n = 19

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

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

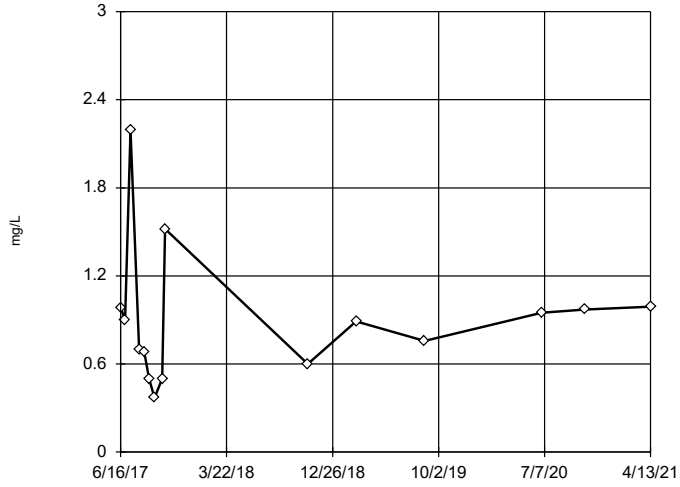
High cutoff = 1.577, low cutoff = 0.332, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-9D



n = 15

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

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

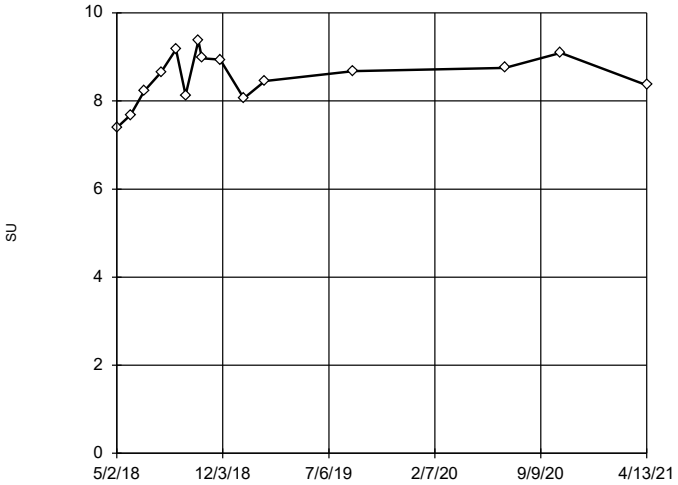
High cutoff = 4.37, low cutoff = 0.1353, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 10/6/2021 9:36 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-12D



n = 15

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

Data were x^5 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 10.47, low cutoff = -7.969, based on IQR multiplier of 3.

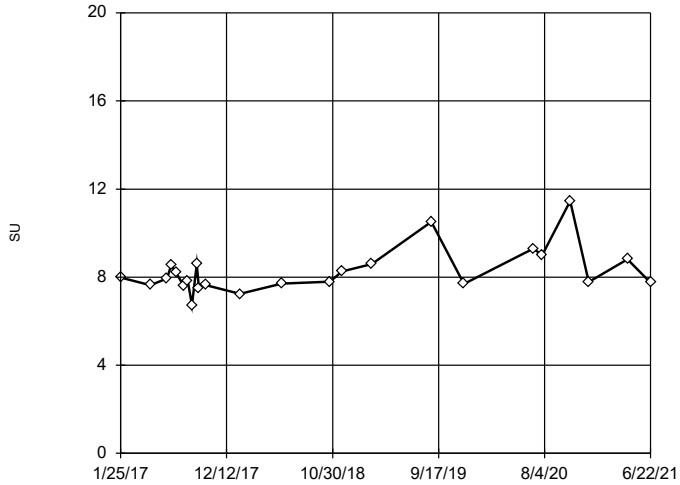
Constituent: pH, field Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-15



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 = 12.07, low cutoff = 5.46, based on IQR multiplier of 3.

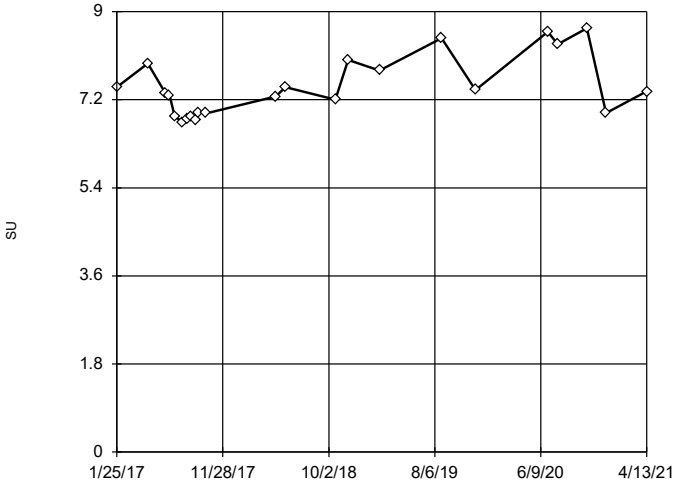
Constituent: pH, field Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-3D



n = 23

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 = 11.99, low cutoff = 4.581, based on IQR multiplier of 3.

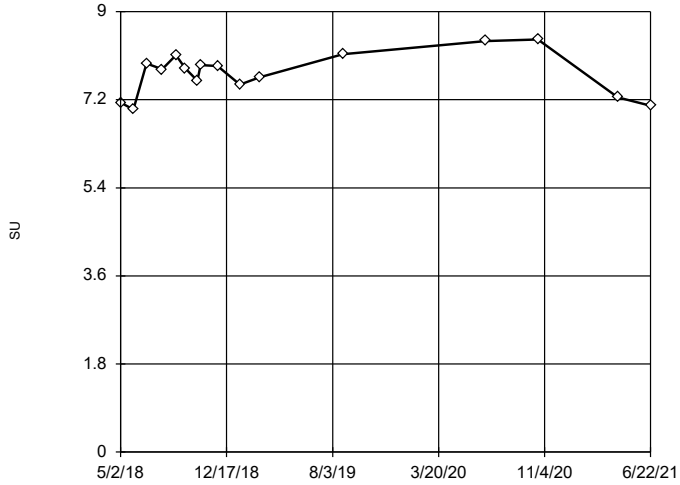
Constituent: pH, field Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-4D



n = 16

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

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

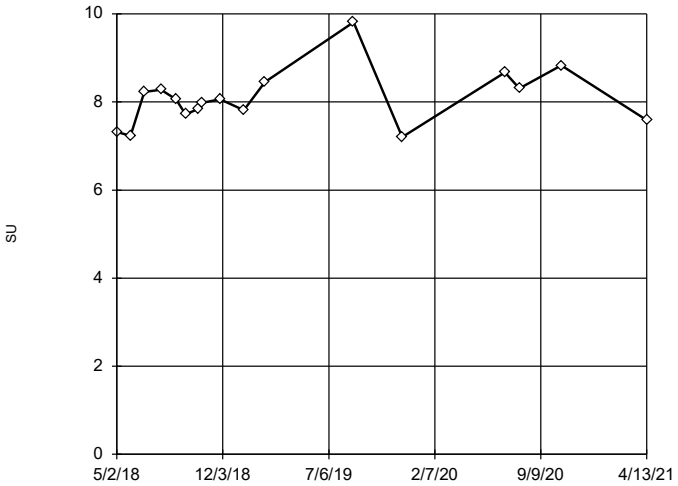
High cutoff = 9.513, low cutoff = 3.878, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-5D



n = 17

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 = 10.99, low cutoff = 5.835, based on IQR multiplier of 3.

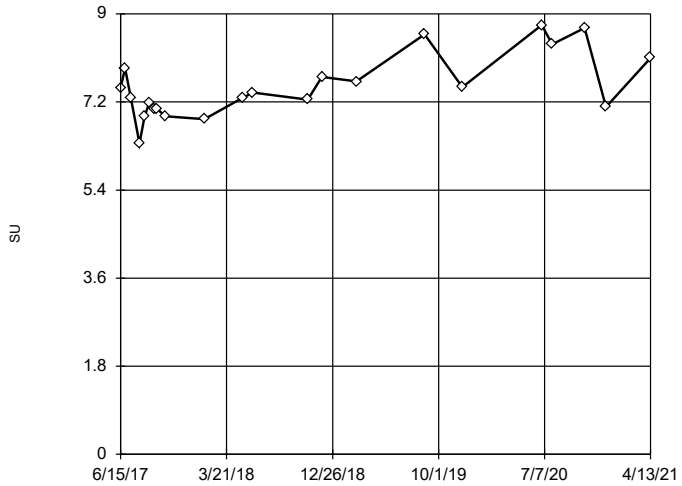
Constituent: pH, field Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-6D



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 = 11.66, low cutoff = 4.835, based on IQR multiplier of 3.

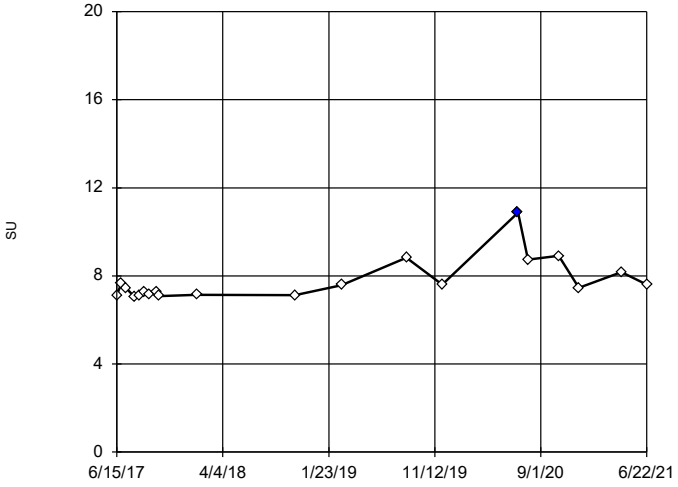
Constituent: pH, field Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-9D



n = 20

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 = 10.75, low cutoff = 5.245, based on IQR multiplier of 3.

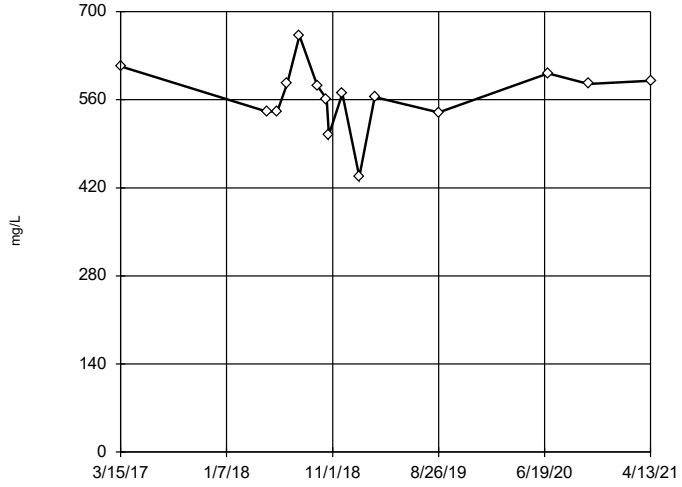
Constituent: pH, field Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-12D



n = 15

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

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

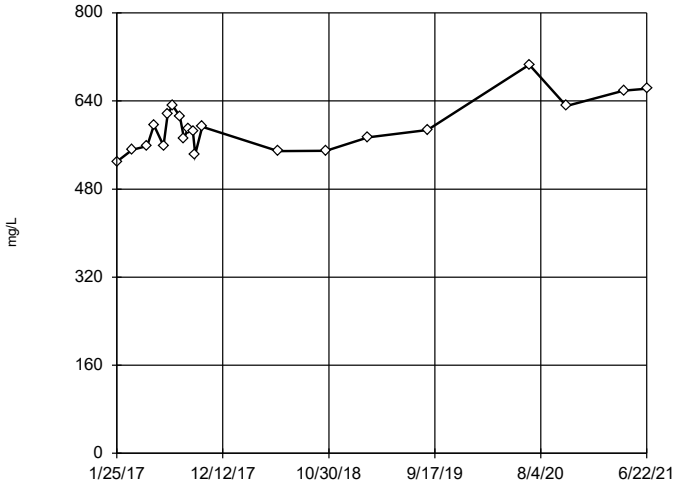
High cutoff = 702.4, low cutoff = 258.3, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-15



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).

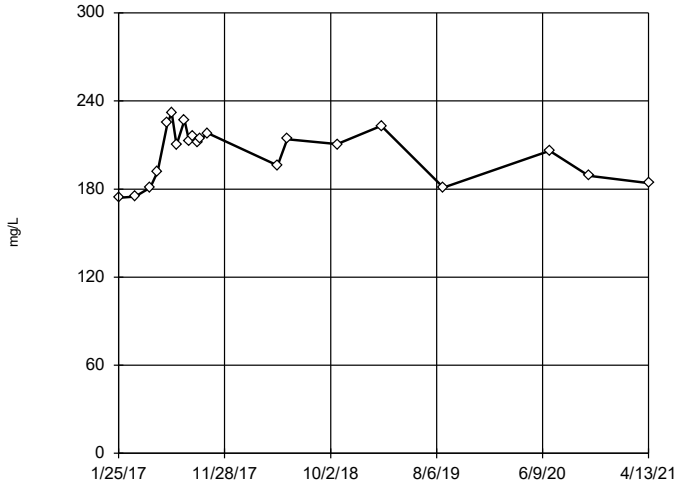
High cutoff = 886.2, low cutoff = 390.1, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-3D



n = 21

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

Data were x^5 transformed to achieve best W statistic (graph shown in original units).

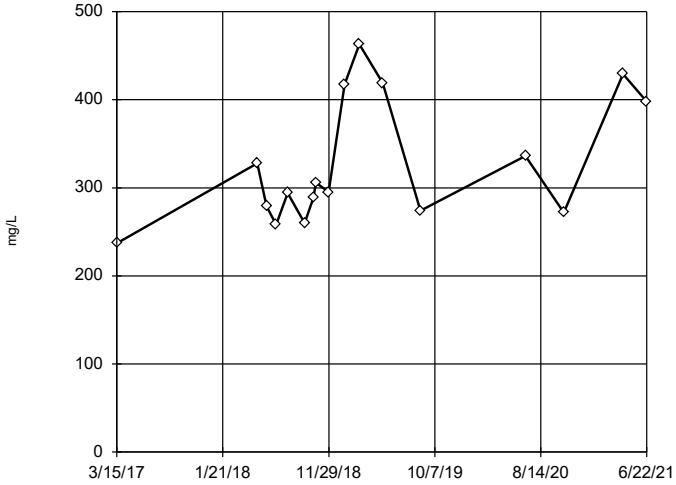
High cutoff = 262.5, low cutoff = -222, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-4D



n = 17

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

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

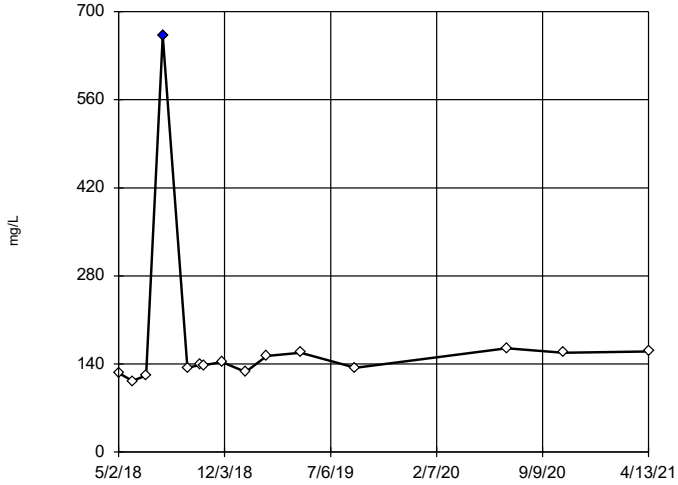
High cutoff = 1358, low cutoff = 81.97, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-5D



n = 15

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).

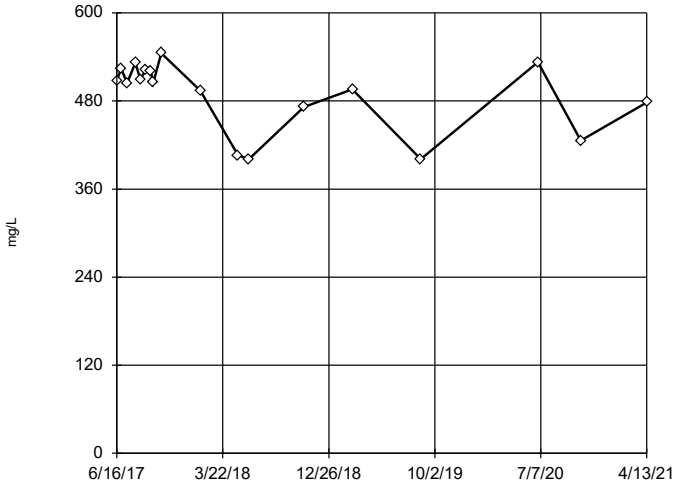
High cutoff = 300, low cutoff = 67.21, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-6D



n = 18

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

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 619.2, low cutoff = -549, based on IQR multiplier of 3.

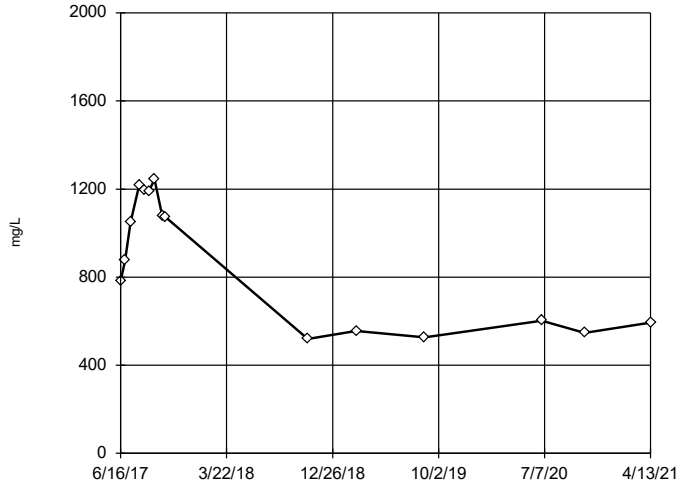
Constituent: Sulfate Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-9D



n = 15

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

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

High cutoff = 2182, low cutoff = -1741, based on IQR multiplier of 3.

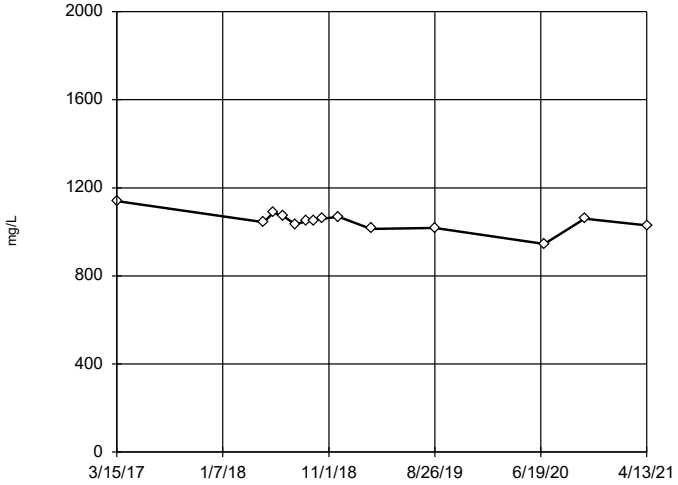
Constituent: Sulfate Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-12D



n = 14

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 = 1185, low cutoff = 857.5, based on IQR multiplier of 3.

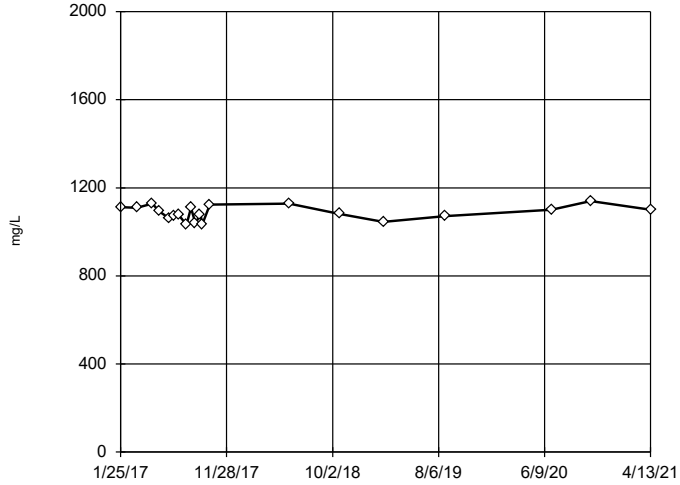
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-15



n = 20

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

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

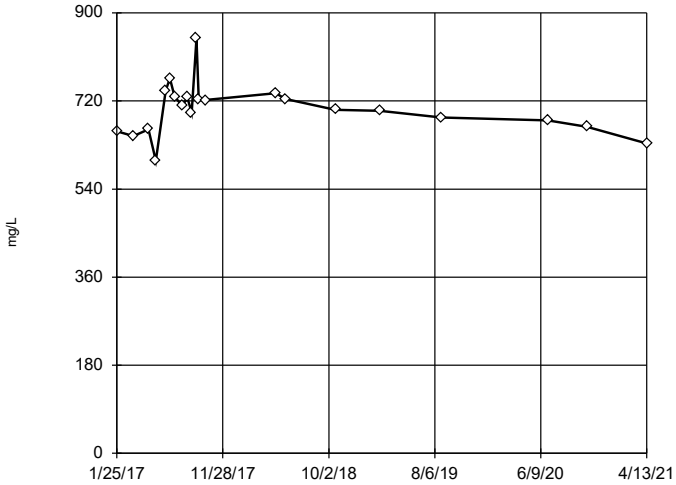
High cutoff = 1209, low cutoff = 783.1, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-3D



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 = 957.3, low cutoff = 505.3, based on IQR multiplier of 3.

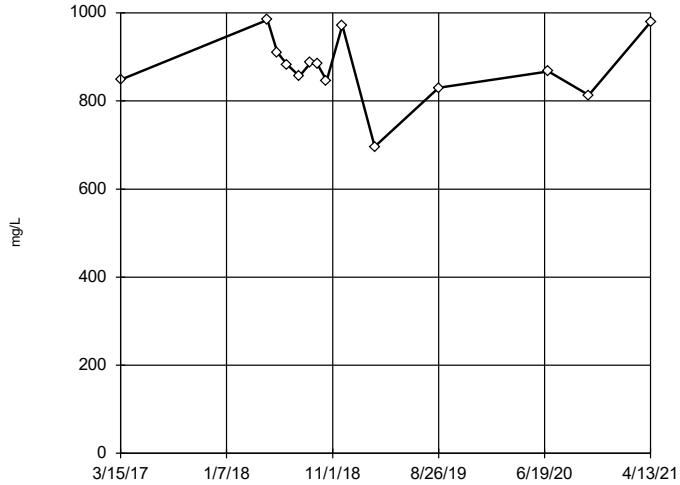
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-4D



n = 14

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 = 1164, low cutoff = -535.2, based on IQR multiplier of 3.

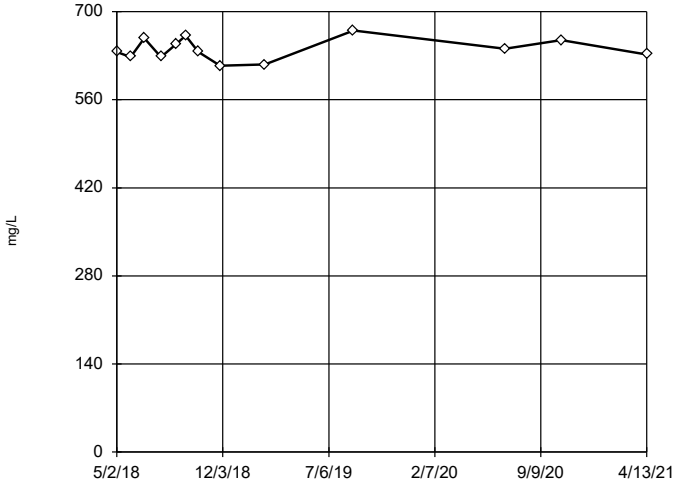
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-5D



n = 13

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 = 750, low cutoff = 549.7, based on IQR multiplier of 3.

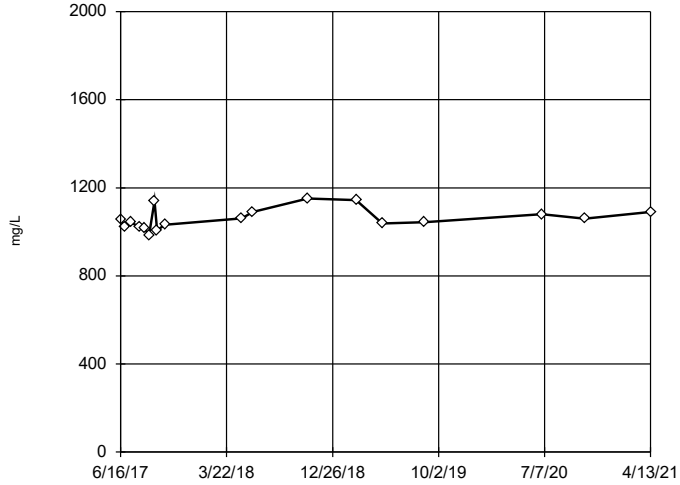
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-6D



n = 18

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

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

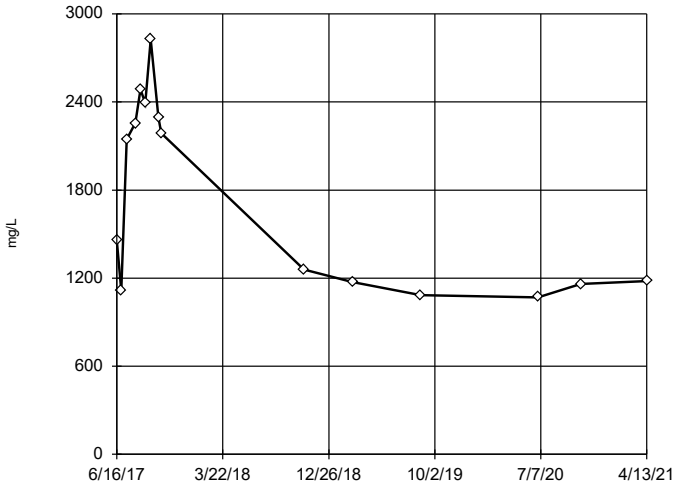
High cutoff = 1318, low cutoff = 845.7, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Tukey's Outlier Screening

MW-9D



n = 15

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

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

High cutoff = 4129, low cutoff = -3230, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/6/2021 9:37 AM

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

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

Northeastern Landfill Client: Geosyntec Data: Northeastern LF Printed 10/28/2021, 2:55 PM

Constituent	Well	Calc.	0.01	Method
Boron (mg/L)	**MW-15**	**-2.821**	**Yes**	**Mann-W**
Calcium (mg/L)	**MW-9D**	**-2.807**	**Yes**	**Mann-W**
Chloride (mg/L)	**MW-9D**	**-2.938**	**Yes**	**Mann-W**
Fluoride (mg/L)	**MW-4D**	**-3.295**	**Yes**	**Mann-W**
pH, field (SU)	**MW-6D**	**2.821**	**Yes**	**Mann-W**
pH, field (SU)	**MW-9D**	**3.171**	**Yes**	**Mann-W**
Sulfate (mg/L)	**MW-15**	**2.684**	**Yes**	**Mann-W**
Sulfate (mg/L)	**MW-5D**	**2.588**	**Yes**	**Mann-W**

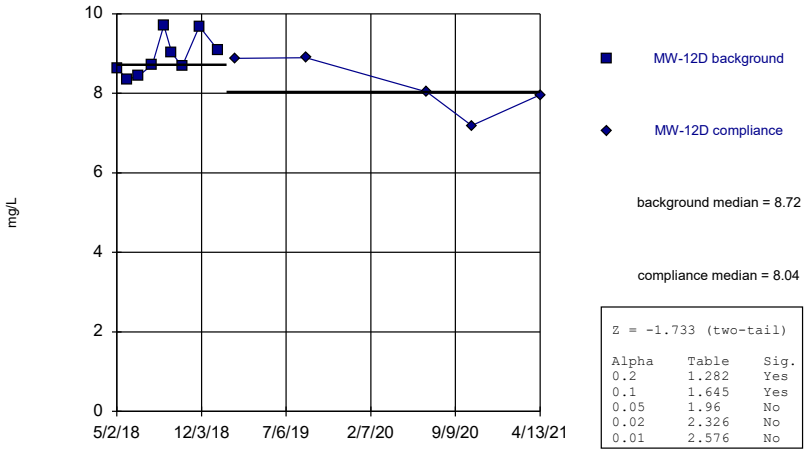
Welch's t-test/Mann-Whitney - All Results

Northeastern Landfill Client: Geosyntec Data: Northeastern LF Printed 10/28/2021, 2:55 PM

Constituent	Well	Calc.	0.01	Method
Boron (mg/L)	MW-12D	-1.733	No	Mann-W
Boron (mg/L)	**MW-15**	**-2.821**	**Yes**	**Mann-W**
Boron (mg/L)	MW-3D	0.3832	No	Mann-W
Boron (mg/L)	MW-4D	-0.8009	No	Mann-W
Boron (mg/L)	MW-5D	1.067	No	Mann-W
Boron (mg/L)	MW-6D	-2.231	No	Mann-W
Boron (mg/L)	MW-9D	-2.122	No	Mann-W
Calcium (mg/L)	MW-12D	-0.5511	No	Mann-W
Calcium (mg/L)	MW-15	1.749	No	Mann-W
Calcium (mg/L)	MW-3D	-1.883	No	Mann-W
Calcium (mg/L)	MW-4D	-0.7362	No	Mann-W
Calcium (mg/L)	MW-5D	-2.021	No	Mann-W
Calcium (mg/L)	MW-6D	-1.847	No	Mann-W
Calcium (mg/L)	**MW-9D**	**-2.807**	**Yes**	**Mann-W**
Chloride (mg/L)	MW-12D	-1.741	No	Mann-W
Chloride (mg/L)	MW-15	-1.941	No	Mann-W
Chloride (mg/L)	MW-3D	-0.4323	No	Mann-W
Chloride (mg/L)	MW-4D	-0.6754	No	Mann-W
Chloride (mg/L)	MW-5D	-0.2027	No	Mann-W
Chloride (mg/L)	MW-6D	-2.336	No	Mann-W
Chloride (mg/L)	**MW-9D**	**-2.938**	**Yes**	**Mann-W**
Fluoride (mg/L)	MW-12D	-2.207	No	Mann-W
Fluoride (mg/L)	MW-15	-2.287	No	Mann-W
Fluoride (mg/L)	MW-3D	0.996	No	Mann-W
Fluoride (mg/L)	**MW-4D**	**-3.295**	**Yes**	**Mann-W**
Fluoride (mg/L)	MW-5D	-1.733	No	Mann-W
Fluoride (mg/L)	MW-6D	-0.3003	No	Mann-W
Fluoride (mg/L)	MW-9D	1.111	No	Mann-W
pH, field (SU)	MW-12D	0.5511	No	Mann-W
pH, field (SU)	MW-15	1.438	No	Mann-W
pH, field (SU)	MW-3D	2.373	No	Mann-W
pH, field (SU)	MW-4D	0.705	No	Mann-W
pH, field (SU)	MW-5D	1.611	No	Mann-W
pH, field (SU)	**MW-6D**	**2.821**	**Yes**	**Mann-W**
pH, field (SU)	**MW-9D**	**3.171**	**Yes**	**Mann-W**
Sulfate (mg/L)	MW-12D	0.5511	No	Mann-W
Sulfate (mg/L)	**MW-15**	**2.684**	**Yes**	**Mann-W**
Sulfate (mg/L)	MW-3D	-1.882	No	Mann-W
Sulfate (mg/L)	MW-4D	1.805	No	Mann-W
Sulfate (mg/L)	**MW-5D**	**2.588**	**Yes**	**Mann-W**
Sulfate (mg/L)	MW-6D	-1.063	No	Mann-W
Sulfate (mg/L)	MW-9D	-2.154	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-12D	-2.469	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-15	0.8517	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-3D	-1.927	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-4D	-1.6	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-5D	0.367	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-6D	0.592	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-9D	-2.546	No	Mann-W

Mann-Whitney (Wilcoxon Rank Sum)

MW-12D



Z = -1.733 (two-tail)

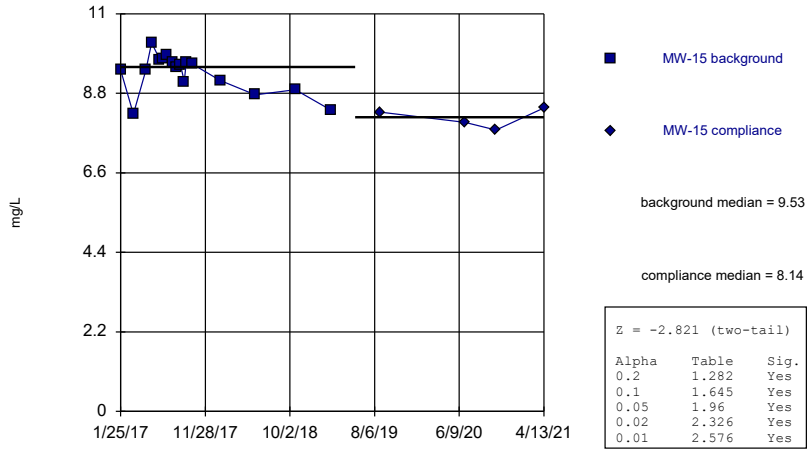
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Boron Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-15



Z = -2.821 (two-tail)

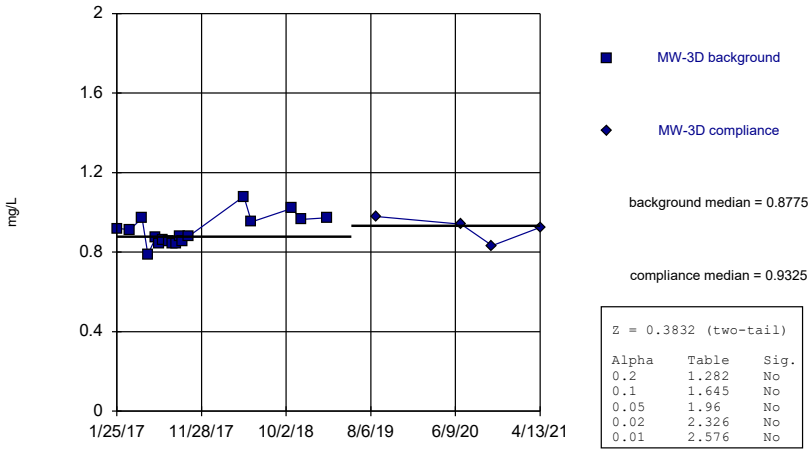
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: Boron Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-3D



Z = 0.3832 (two-tail)

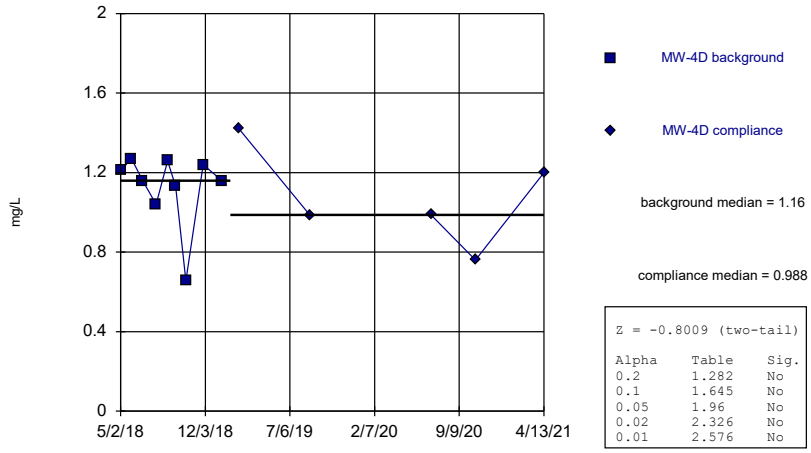
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Boron Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-4D



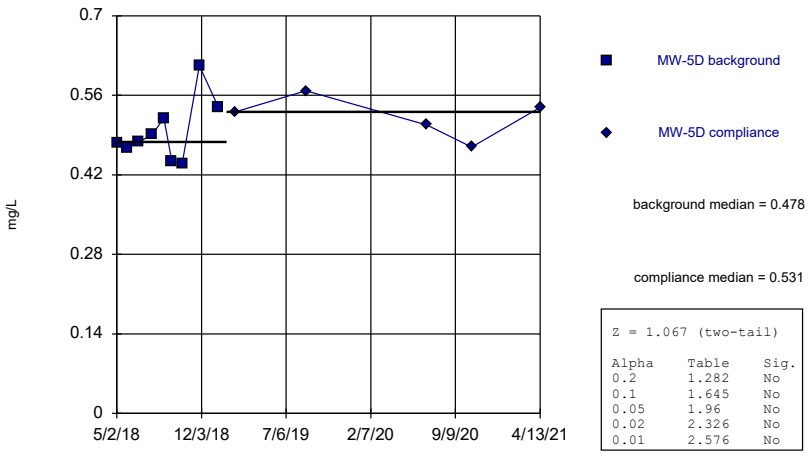
Z = -0.8009 (two-tail)

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: Boron Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-5D



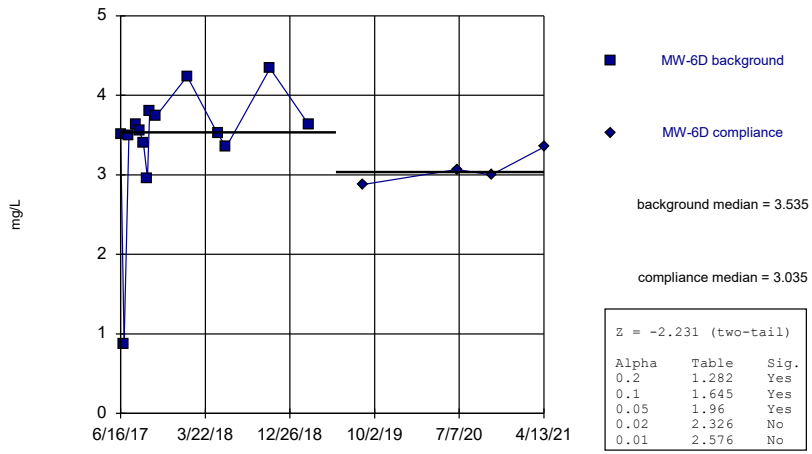
Z = 1.067 (two-tail)

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: Boron Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-6D



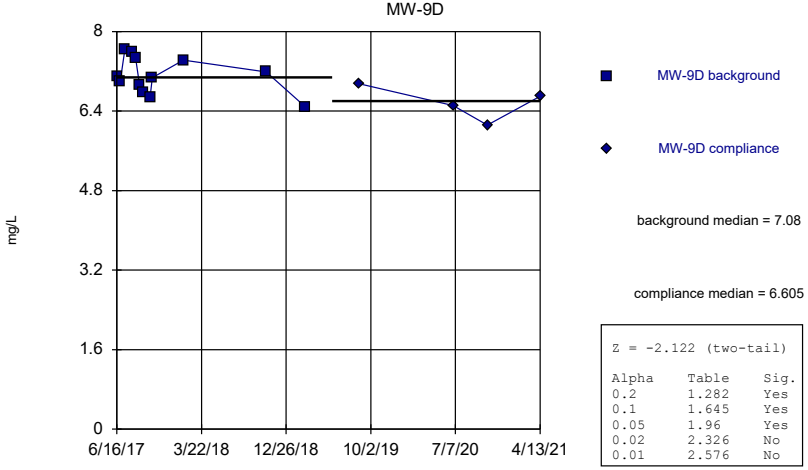
Z = -2.231 (two-tail)

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

Constituent: Boron Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-9D



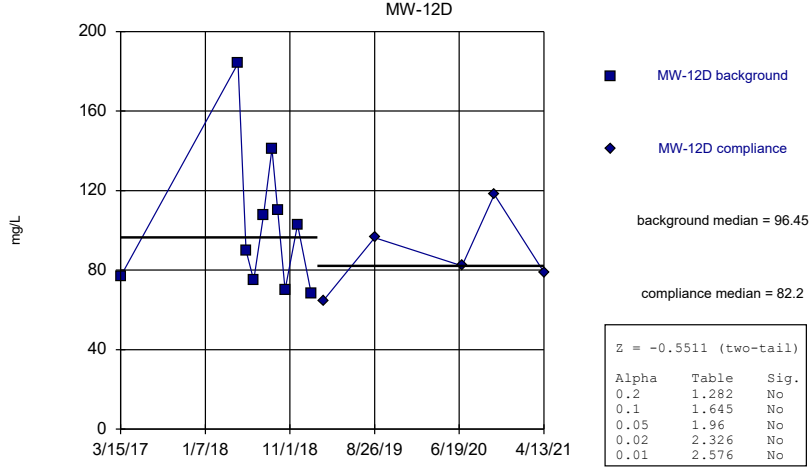
Z = -2.122 (two-tail)

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

Constituent: Boron Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-12D



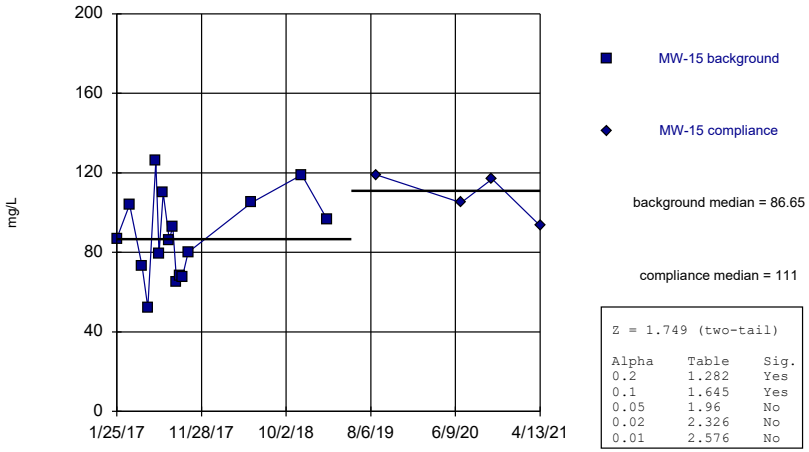
Z = -0.5511 (two-tail)

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 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-15



Z = 1.749 (two-tail)

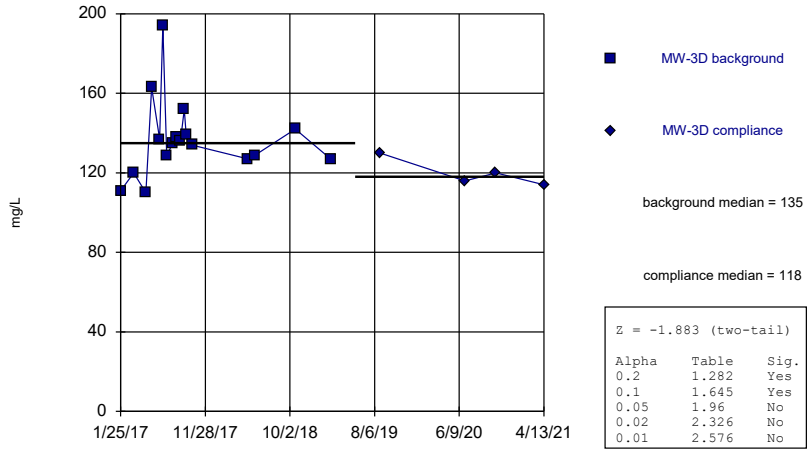
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-3D



Z = -1.883 (two-tail)

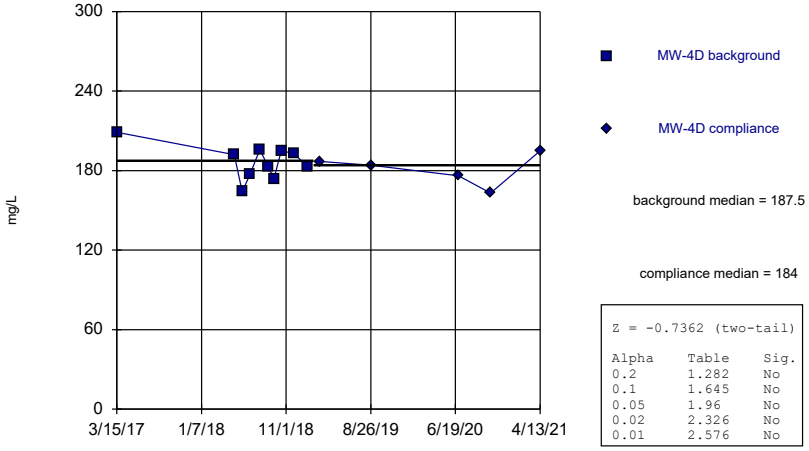
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-4D



Z = -0.7362 (two-tail)

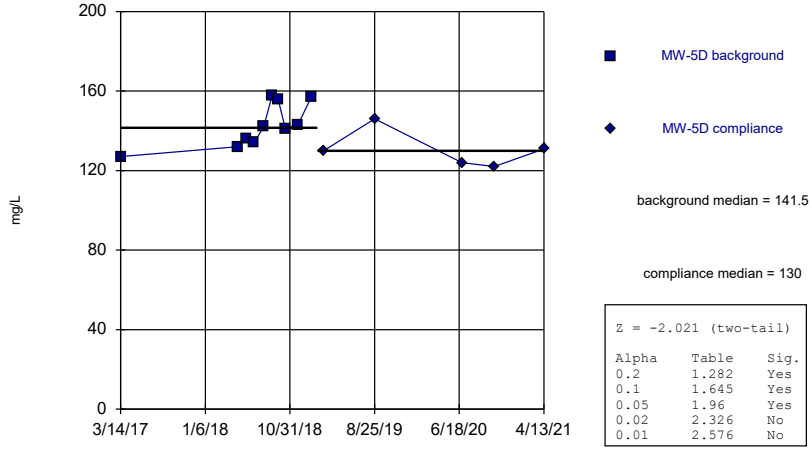
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-5D



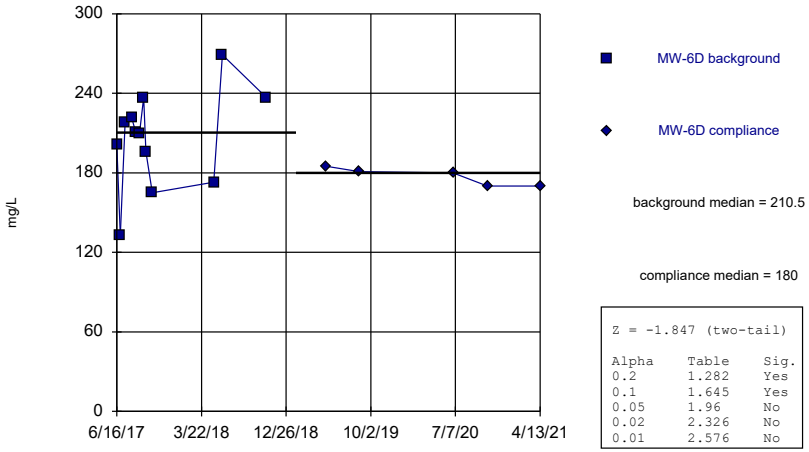
Z = -2.021 (two-tail)

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

Constituent: Calcium Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-6D



Z = -1.847 (two-tail)

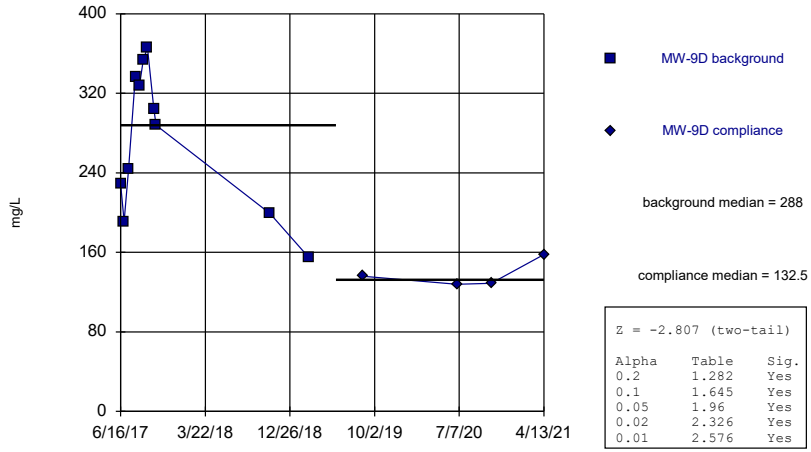
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-9D



Z = -2.807 (two-tail)

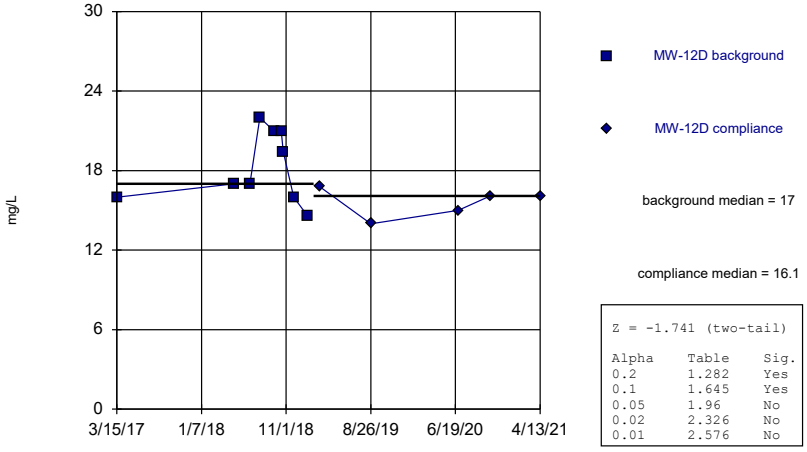
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: Calcium Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-12D



Z = -1.741 (two-tail)

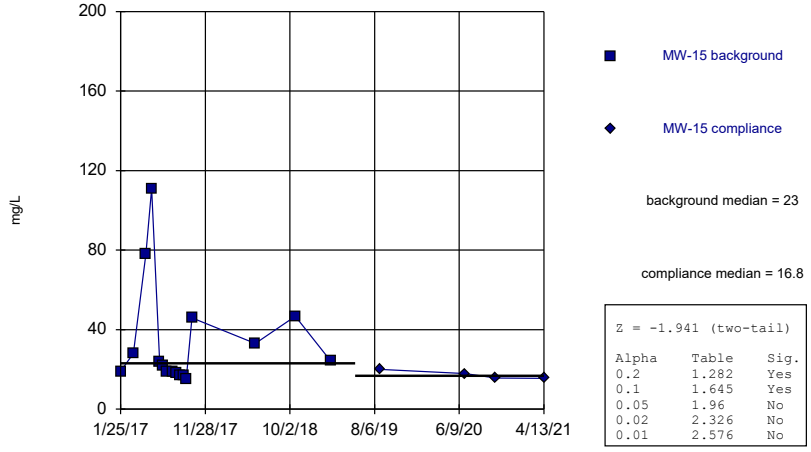
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Chloride Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-15



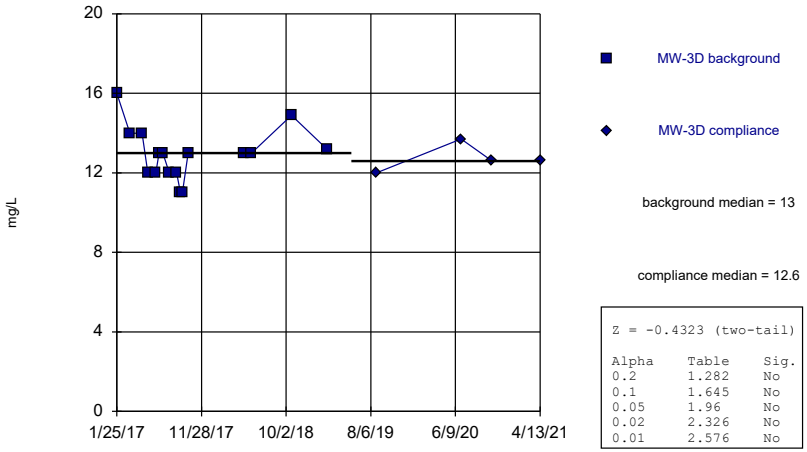
Z = -1.941 (two-tail)

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

Constituent: Chloride Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-3D



Z = -0.4323 (two-tail)

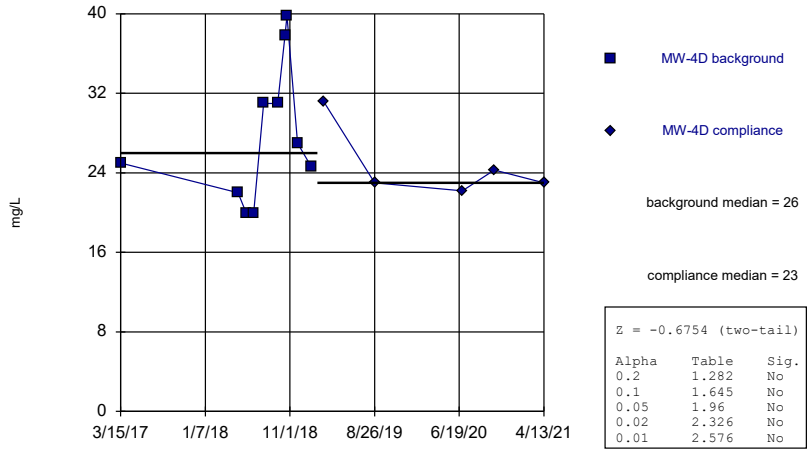
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Chloride Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-4D



Z = -0.6754 (two-tail)

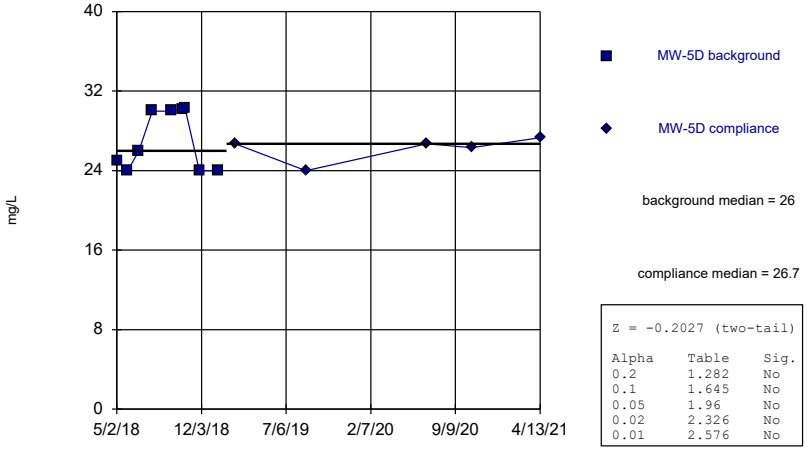
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Chloride Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-5D



Z = -0.2027 (two-tail)

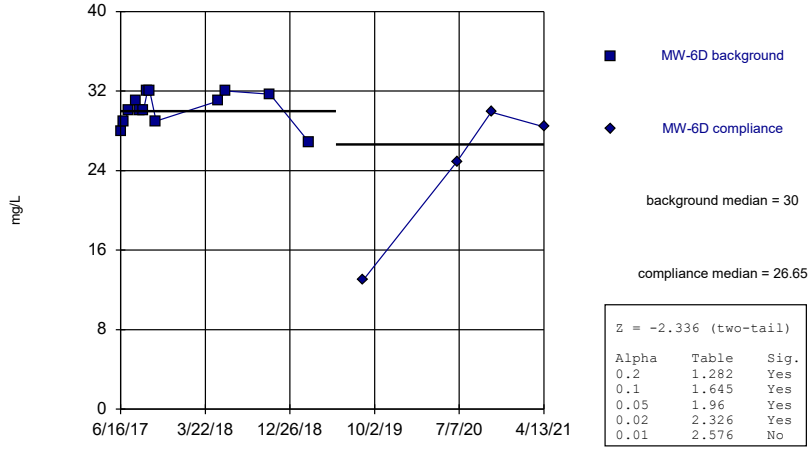
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Chloride Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-6D



Z = -2.336 (two-tail)

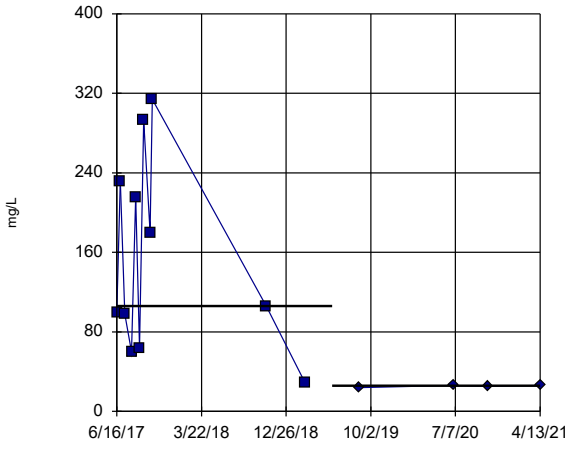
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	No

Constituent: Chloride Analysis Run 10/28/2021 2:53 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-9D



MW-9D background

MW-9D compliance

background median = 106

compliance median = 25.7

Z = -2.938 (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

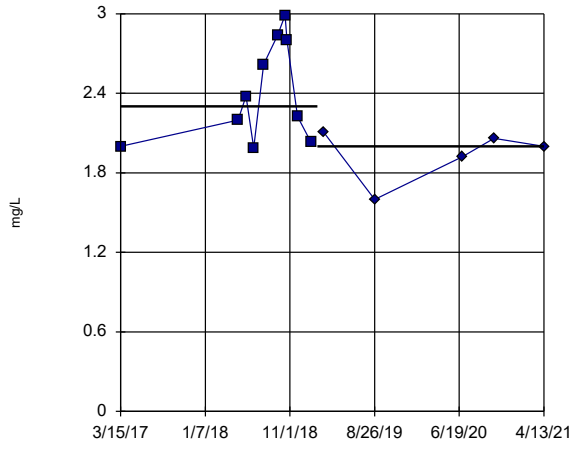
Constituent: Chloride Analysis Run 10/28/2021 2:53 PM View: Prediction Limits

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-12D



MW-12D background

MW-12D compliance

background median = 2.301

compliance median = 2

Z = -2.207 (two-tail)

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

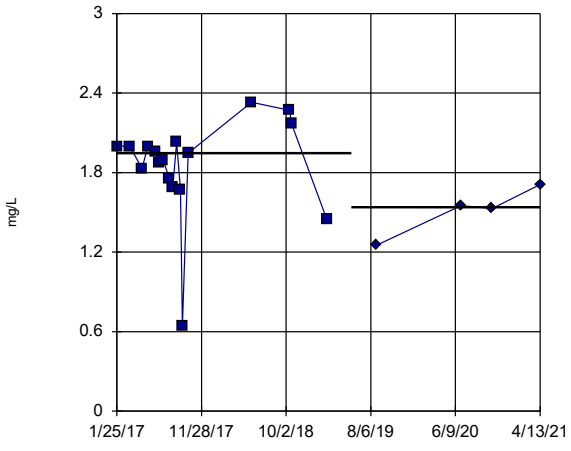
Constituent: Fluoride Analysis Run 10/28/2021 2:53 PM View: Prediction Limits

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-15



MW-15 background

MW-15 compliance

background median = 1.947

compliance median = 1.54

Z = -2.287 (two-tail)

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

Constituent: Fluoride Analysis Run 10/28/2021 2:53 PM View: Prediction Limits

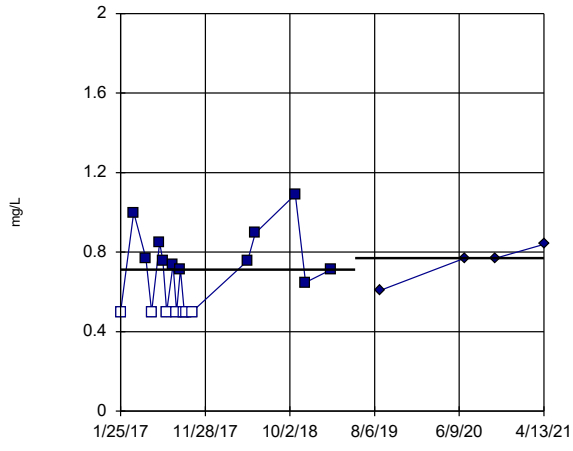
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-3D



MW-3D background

MW-3D compliance

background median = 0.7122

compliance median = 0.77

Z = 0.996 (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

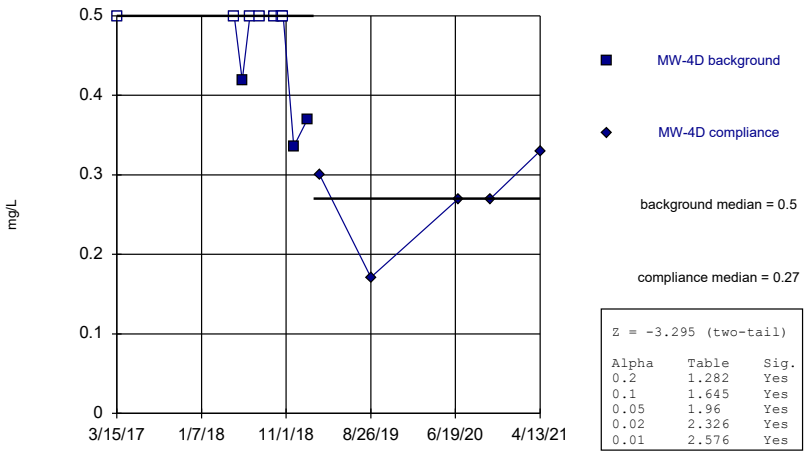
Constituent: Fluoride Analysis Run 10/28/2021 2:54 PM View: Prediction Limits

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-4D



Z = -3.295 (two-tail)

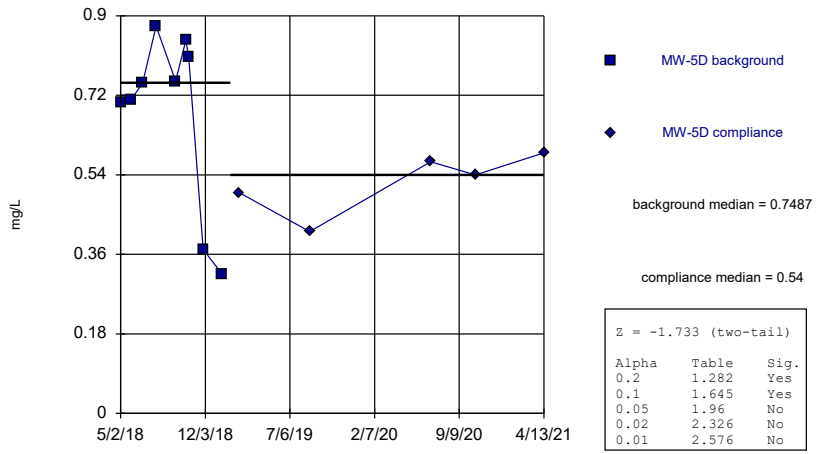
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: Fluoride Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-5D



Z = -1.733 (two-tail)

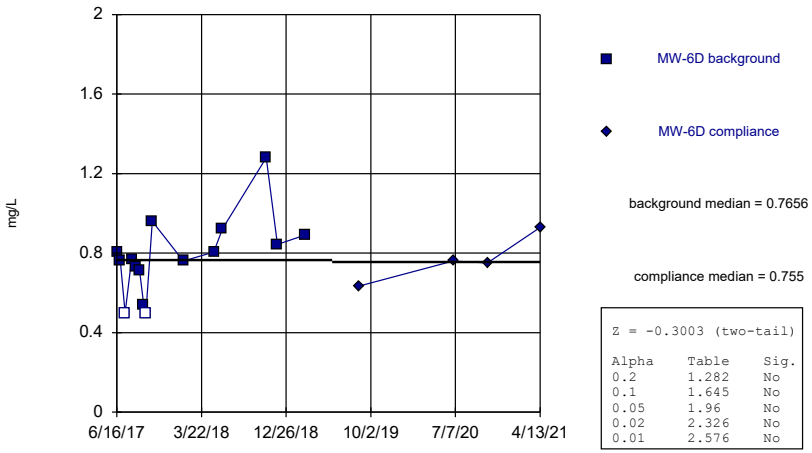
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Fluoride Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-6D



Z = -0.3003 (two-tail)

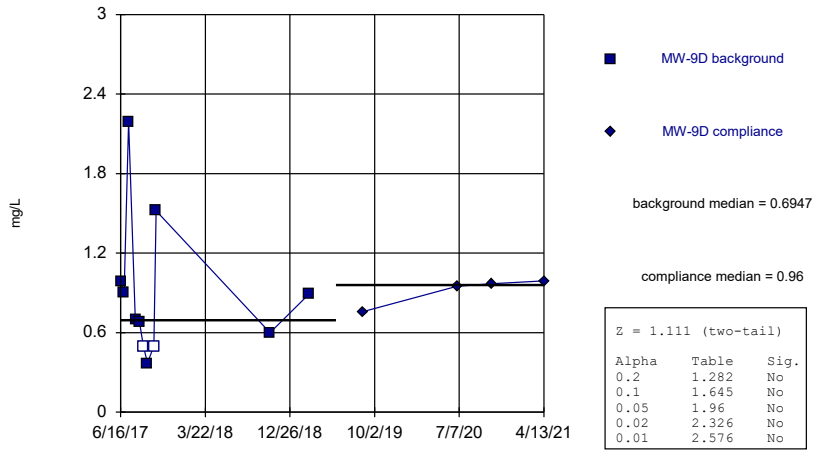
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Fluoride Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

MW-9D



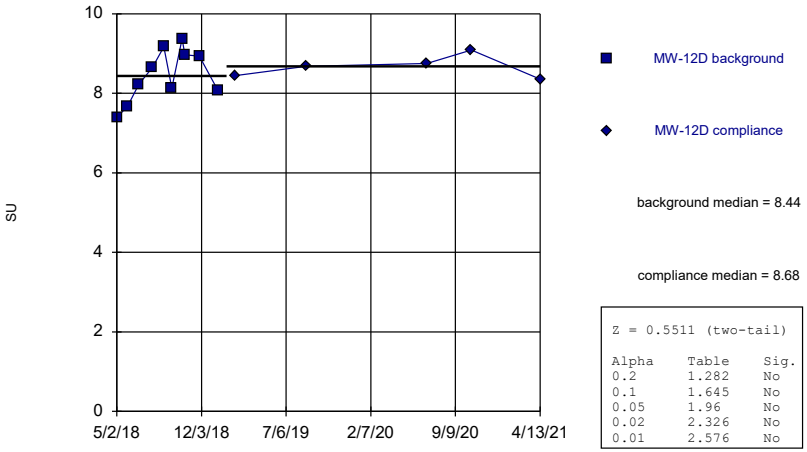
Z = 1.111 (two-tail)

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: Fluoride Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-12D



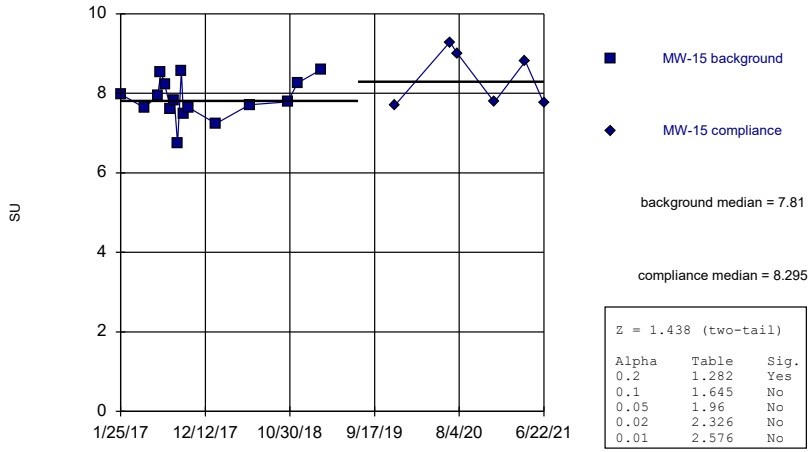
Z = 0.5511 (two-tail)

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: pH, field Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-15



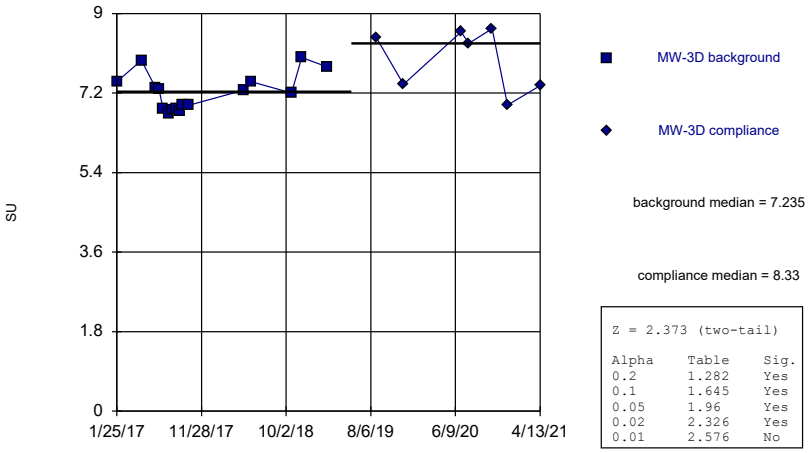
Z = 1.438 (two-tail)

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: pH, field Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-3D



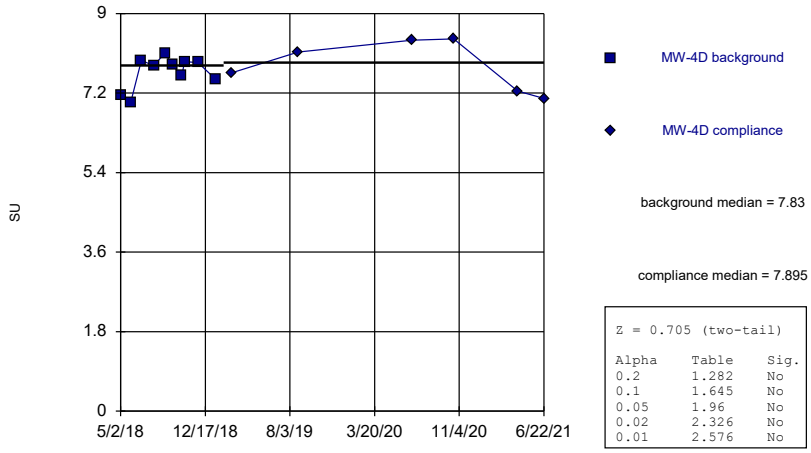
Z = 2.373 (two-tail)

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	No

Constituent: pH, field Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-4D



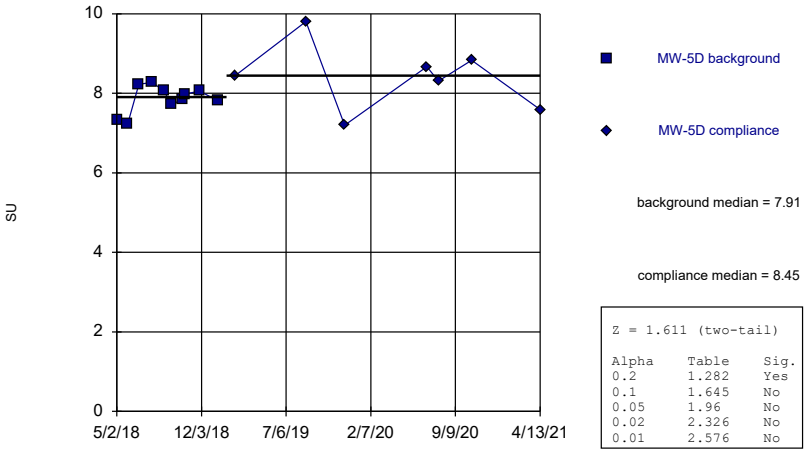
Z = 0.705 (two-tail)

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: pH, field Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-5D



Z = 1.611 (two-tail)

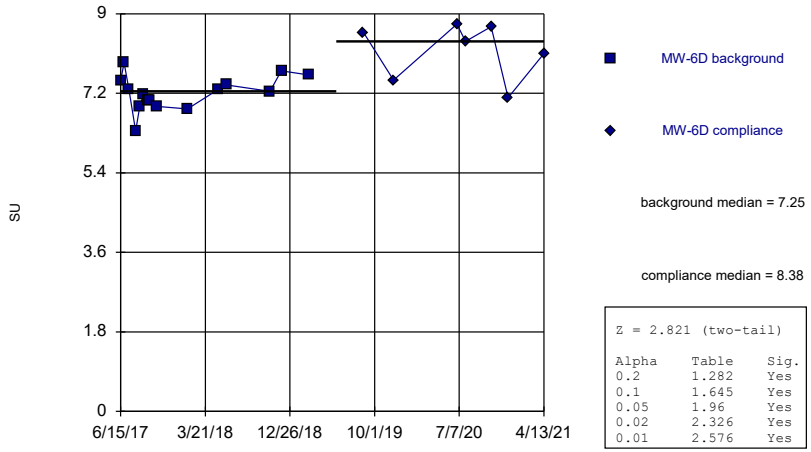
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: pH, field Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-6D



Z = 2.821 (two-tail)

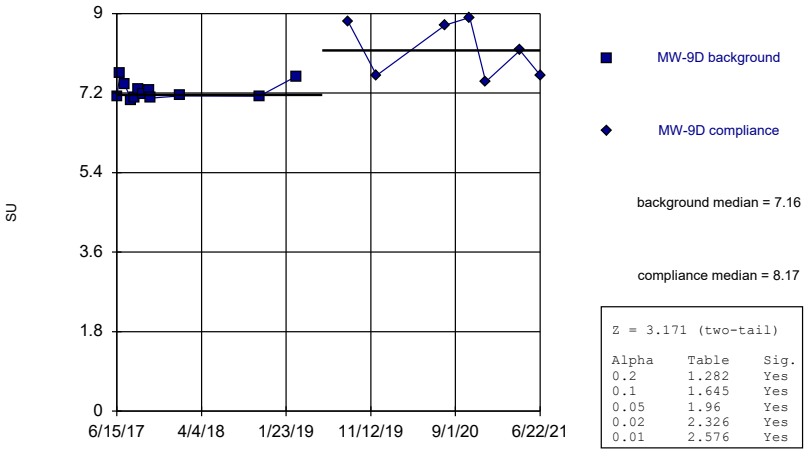
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: pH, field Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-9D



Z = 3.171 (two-tail)

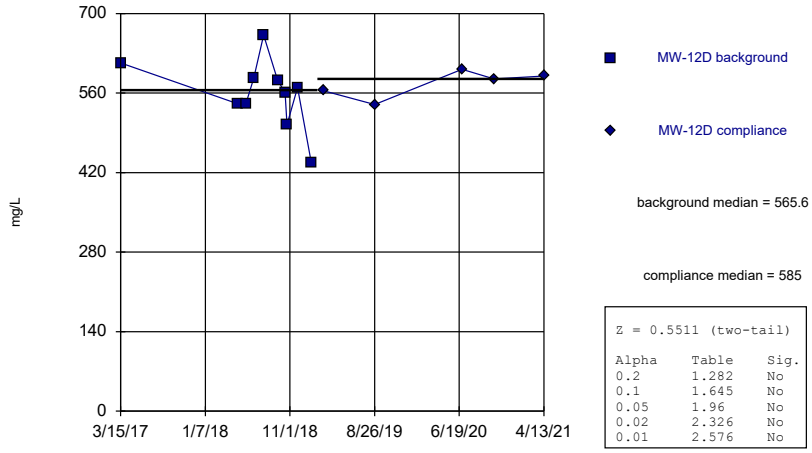
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: pH, field Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-12D



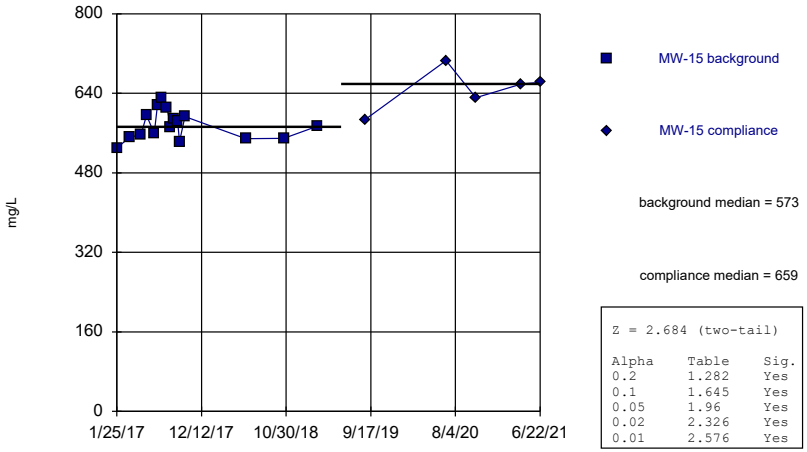
Z = 0.5511 (two-tail)

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: Sulfate Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-15



background median = 573

compliance median = 659

Z = 2.684 (two-tail)

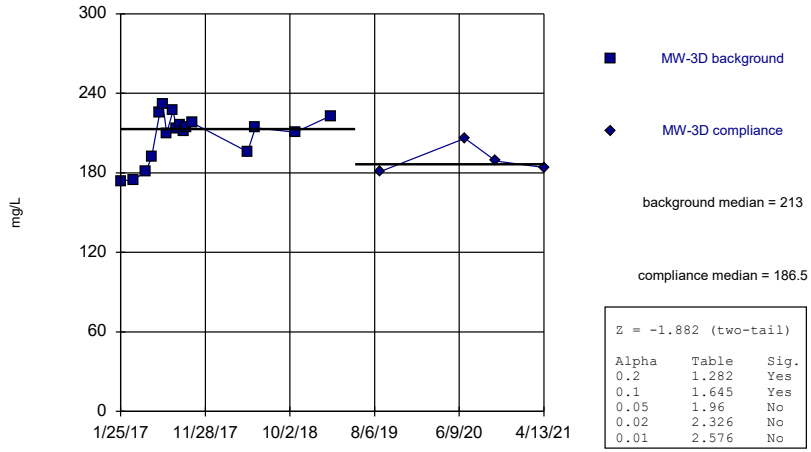
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: Sulfate Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-3D



background median = 213

compliance median = 186.5

Z = -1.882 (two-tail)

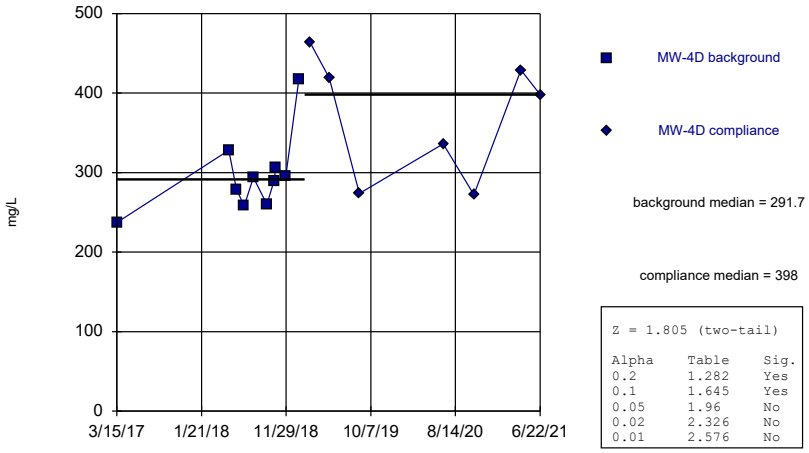
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Sulfate Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-4D



background median = 291.7

compliance median = 398

Z = 1.805 (two-tail)

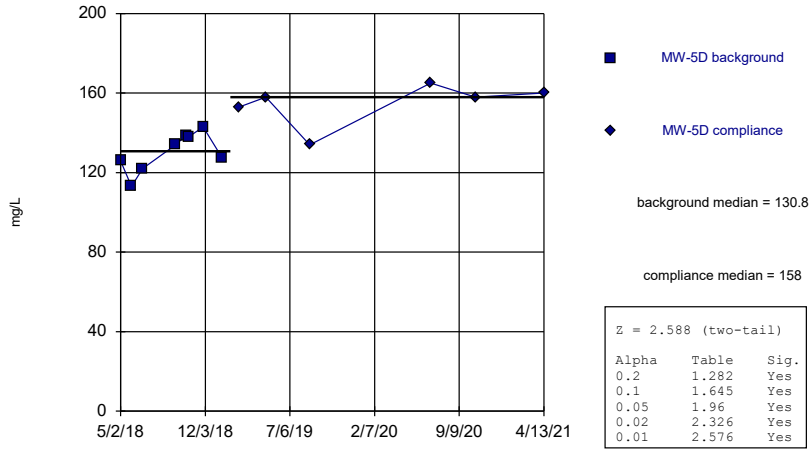
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Sulfate Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-5D



background median = 130.8

compliance median = 158

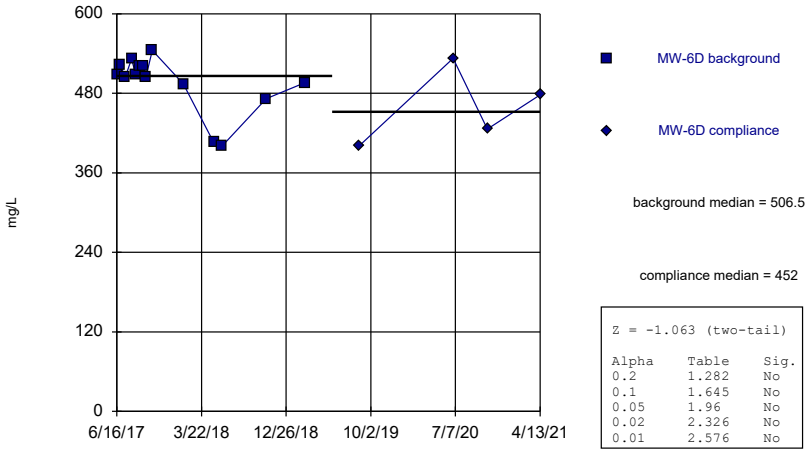
Z = 2.588 (two-tail)

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: Sulfate Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-6D



Z = -1.063 (two-tail)

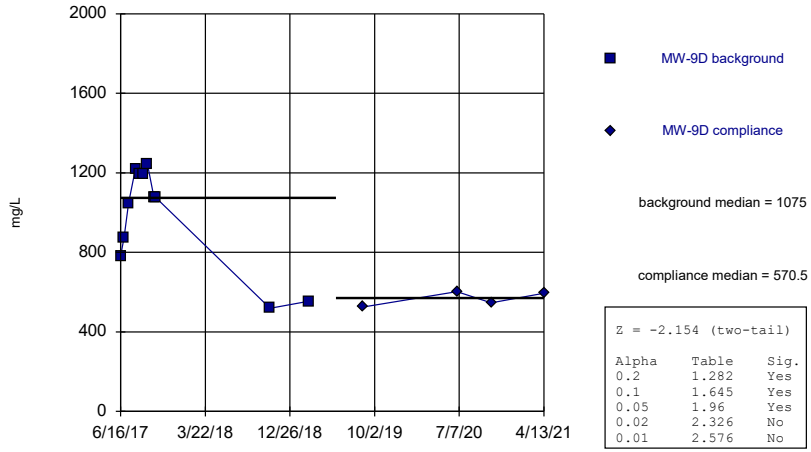
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Sulfate Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-9D



Z = -2.154 (two-tail)

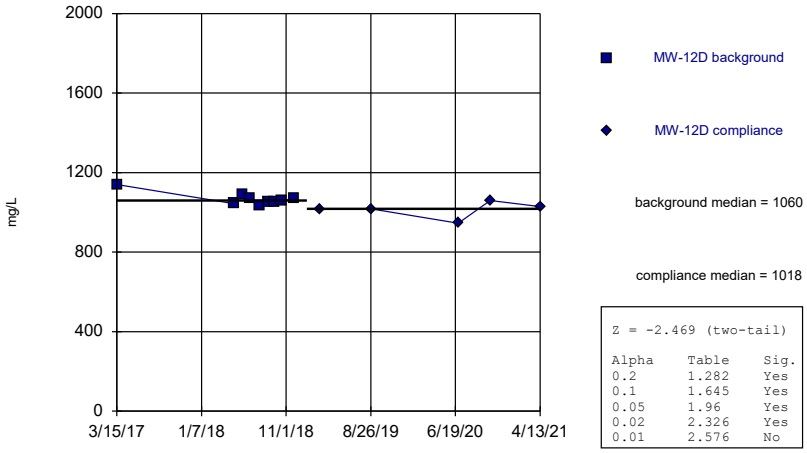
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	No
0.01	2.576	No

Constituent: Sulfate Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-12D



Z = -2.469 (two-tail)

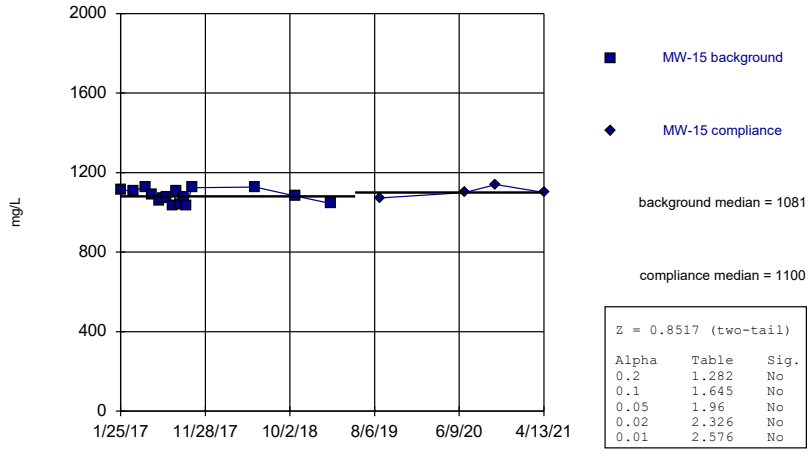
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	No

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-15



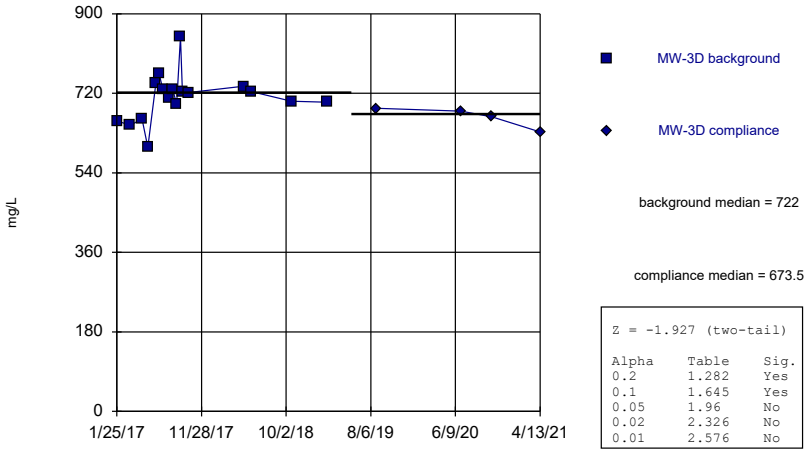
Z = 0.8517 (two-tail)

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: Total Dissolved Solids [TDS] Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Mann-Whitney (Wilcoxon Rank Sum)

MW-3D



Z = -1.927 (two-tail)

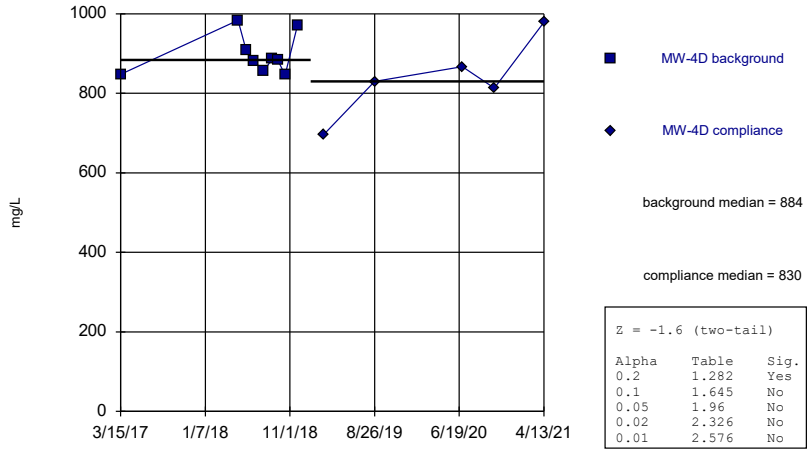
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-4D



Z = -1.6 (two-tail)

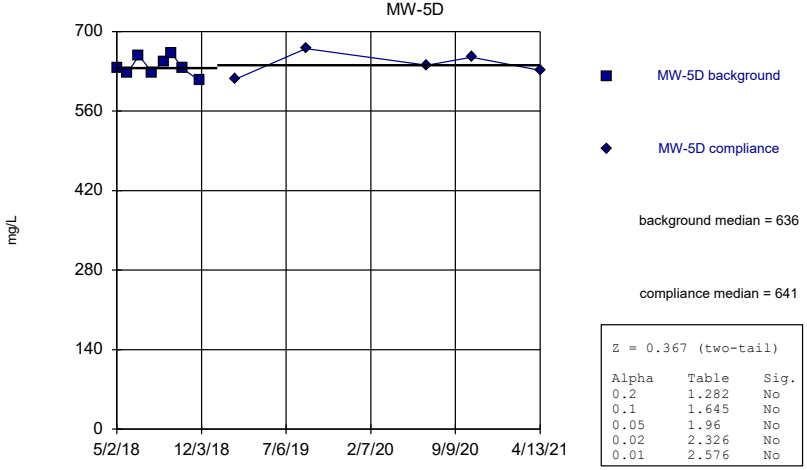
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-5D



Z = 0.367 (two-tail)

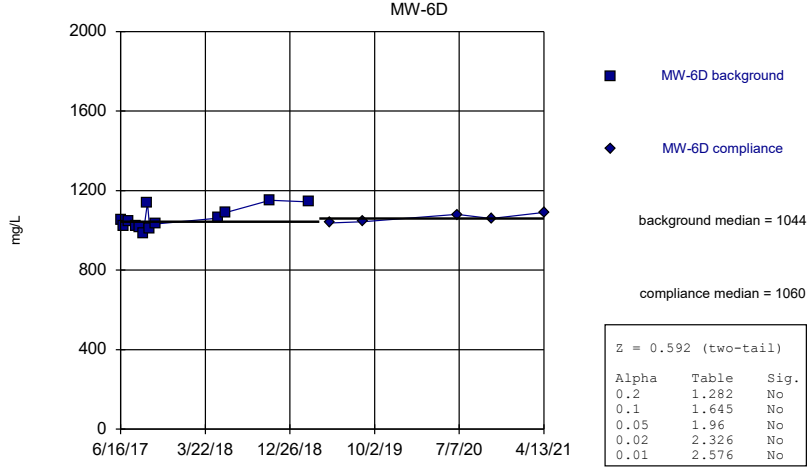
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

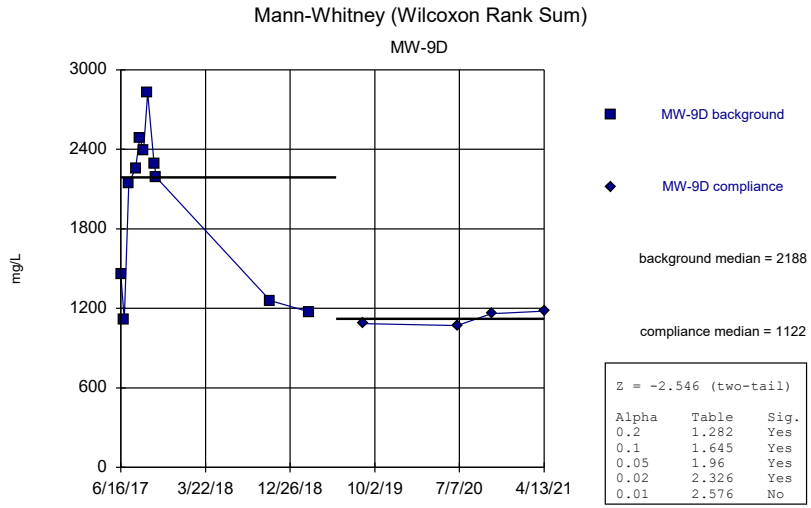
MW-6D



Z = 0.592 (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: Total Dissolved Solids [TDS] Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/28/2021 2:54 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

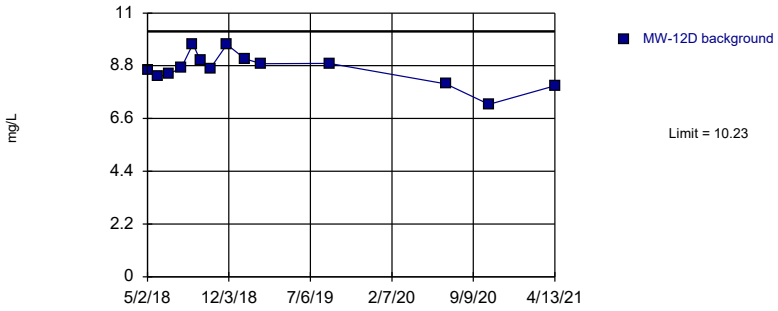
Intrawell Prediction Limits - All Results

Northeastern Landfill Client: Geosyntec Data: Northeastern LF Printed 10/29/2021, 3:18 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)	MW-12D	10.23	n/a	n/a	1 future	n/a	14	8.664	0.6654	0	None	No	0.001075	Param Intra 1 of 2
Boron (mg/L)	MW-15	10.62	n/a	n/a	1 future	n/a	21	9.119	0.6986	0	None	No	0.001075	Param Intra 1 of 2
Boron (mg/L)	MW-3D	1.06	n/a	n/a	1 future	n/a	22	0.9082	0.07116	0	None	No	0.001075	Param Intra 1 of 2
Boron (mg/L)	MW-4D	1.589	n/a	n/a	1 future	n/a	14	1.106	0.2052	0	None	No	0.001075	Param Intra 1 of 2
Boron (mg/L)	MW-5D	0.6213	n/a	n/a	1 future	n/a	14	0.5059	0.04899	0	None	No	0.001075	Param Intra 1 of 2
Boron (mg/L)	MW-6D	4.521	n/a	n/a	1 future	n/a	18	11.75	3.93	0	None	x^2	0.001075	Param Intra 1 of 2
Boron (mg/L)	MW-9D	7.937	n/a	n/a	1 future	n/a	16	6.977	0.4247	0	None	No	0.001075	Param Intra 1 of 2
Calcium (mg/L)	MW-12D	171.6	n/a	n/a	1 future	n/a	15	97.73	32.03	0	None	No	0.001075	Param Intra 1 of 2
Calcium (mg/L)	MW-15	137.4	n/a	n/a	1 future	n/a	20	92.35	20.88	0	None	No	0.001075	Param Intra 1 of 2
Calcium (mg/L)	MW-3D	174.8	n/a	n/a	1 future	n/a	21	11.53	0.7904	0	None	sqrt(x)	0.001075	Param Intra 1 of 2
Calcium (mg/L)	MW-4D	213.7	n/a	n/a	1 future	n/a	15	184.7	12.57	0	None	No	0.001075	Param Intra 1 of 2
Calcium (mg/L)	MW-5D	165.7	n/a	n/a	1 future	n/a	15	138.6	11.76	0	None	No	0.001075	Param Intra 1 of 2
Calcium (mg/L)	MW-6D	271.8	n/a	n/a	1 future	n/a	17	197.5	33.23	0	None	No	0.001075	Param Intra 1 of 2
Calcium (mg/L)	MW-9D	294.5	n/a	n/a	1 future	n/a	9	174.3	43.36	0	None	No	0.001075	Param Intra 1 of 2
Chloride (mg/L)	MW-12D	23.28	n/a	n/a	1 future	n/a	14	17.29	2.545	0	None	No	0.001075	Param Intra 1 of 2
Chloride (mg/L)	MW-15	111	n/a	n/a	1 future	n/a	20	n/a	n/a	0	n/a	n/a	0.004291	NP Intra (normality) 1 of 2
Chloride (mg/L)	MW-3D	15.53	n/a	n/a	1 future	n/a	20	12.9	1.219	0	None	No	0.001075	Param Intra 1 of 2
Chloride (mg/L)	MW-4D	40.96	n/a	n/a	1 future	n/a	15	26.8	6.134	0	None	No	0.001075	Param Intra 1 of 2
Chloride (mg/L)	MW-5D	32.59	n/a	n/a	1 future	n/a	14	26.75	2.481	0	None	No	0.001075	Param Intra 1 of 2
Chloride (mg/L)	MW-6D	34.11	n/a	n/a	1 future	n/a	17	755625	267368	0	None	x^4	0.001075	Param Intra 1 of 2
Chloride (mg/L)	MW-9D	146.5	n/a	n/a	1 future	n/a	10	55.85	34.58	0	None	No	0.001075	Param Intra 1 of 2
Fluoride (mg/L)	MW-12D	3.162	n/a	n/a	1 future	n/a	15	2.25	0.3951	0	None	No	0.001075	Param Intra 1 of 2
Fluoride (mg/L)	MW-15	2.592	n/a	n/a	1 future	n/a	21	1.789	0.3748	0	None	No	0.001075	Param Intra 1 of 2
Fluoride (mg/L)	MW-3D	1.022	n/a	n/a	1 future	n/a	22	0.7744	0.1164	31.82	Kaplan-Meier	No	0.001075	Param Intra 1 of 2
Fluoride (mg/L)	MW-4D	0.5	n/a	n/a	1 future	n/a	15	n/a	n/a	46.67	n/a	n/a	0.007533	NP Intra (normality) 1 of 2
Fluoride (mg/L)	MW-5D	1.049	n/a	n/a	1 future	n/a	14	0.6244	0.1802	0	None	No	0.001075	Param Intra 1 of 2
Fluoride (mg/L)	MW-6D	1.176	n/a	n/a	1 future	n/a	19	0.7817	0.1806	10.53	None	No	0.001075	Param Intra 1 of 2
Fluoride (mg/L)	MW-9D	2.032	n/a	n/a	1 future	n/a	15	0.9252	0.2169	13.33	None	sqrt(x)	0.001075	Param Intra 1 of 2
pH, field (SU)	MW-12D	9.822	7.234	n/a	1 future	n/a	15	8.528	0.5609	0	None	No	0.0005373	Param Intra 1 of 2
pH, field (SU)	MW-15	9.293	6.717	n/a	1 future	n/a	22	8.005	0.6052	0	None	No	0.0005373	Param Intra 1 of 2
pH, field (SU)	MW-3D	8.176	6.283	n/a	1 future	n/a	16	7.229	0.4188	0	None	No	0.0005373	Param Intra 1 of 2
pH, field (SU)	MW-4D	8.738	6.725	n/a	1 future	n/a	16	7.731	0.4451	0	None	No	0.0005373	Param Intra 1 of 2
pH, field (SU)	MW-5D	9.532	6.631	n/a	1 future	n/a	17	8.082	0.6491	0	None	No	0.0005373	Param Intra 1 of 2
pH, field (SU)	MW-6D	8.11	6.321	n/a	1 future	n/a	15	7.215	0.3877	0	None	No	0.0005373	Param Intra 1 of 2
pH, field (SU)	MW-9D	7.735	6.763	n/a	1 future	n/a	12	7.249	0.1985	0	None	No	0.0005373	Param Intra 1 of 2
Sulfate (mg/L)	MW-12D	683.3	n/a	n/a	1 future	n/a	15	565.3	51.11	0	None	No	0.001075	Param Intra 1 of 2
Sulfate (mg/L)	MW-15	690.2	n/a	n/a	1 future	n/a	21	593	45.35	0	None	No	0.001075	Param Intra 1 of 2
Sulfate (mg/L)	MW-3D	243.1	n/a	n/a	1 future	n/a	21	204.4	18.04	0	None	No	0.001075	Param Intra 1 of 2
Sulfate (mg/L)	MW-4D	485	n/a	n/a	1 future	n/a	17	326.8	70.78	0	None	No	0.001075	Param Intra 1 of 2
Sulfate (mg/L)	MW-5D	178.4	n/a	n/a	1 future	n/a	14	140.7	15.99	0	None	No	0.001075	Param Intra 1 of 2
Sulfate (mg/L)	MW-6D	581.3	n/a	n/a	1 future	n/a	18	239882	44395	0	None	x^2	0.001075	Param Intra 1 of 2
Sulfate (mg/L)	MW-9D	1009	n/a	n/a	1 future	n/a	8	625.1	131.3	0	None	No	0.001075	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-12D	1150	n/a	n/a	1 future	n/a	14	1048	43.37	0	None	No	0.001075	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-15	1158	n/a	n/a	1 future	n/a	20	1087	32.98	0	None	No	0.001075	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-3D	815.1	n/a	n/a	1 future	n/a	21	702.8	52.43	0	None	No	0.001075	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-4D	1052	n/a	n/a	1 future	n/a	14	875.2	75.19	0	None	No	0.001075	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-5D	682.1	n/a	n/a	1 future	n/a	13	640.3	17.4	0	None	No	0.001075	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-6D	1166	n/a	n/a	1 future	n/a	18	1060	47.77	0	None	No	0.001075	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-9D	1552	n/a	n/a	1 future	n/a	8	1187	124.8	0	None	No	0.001075	Param Intra 1 of 2

Prediction Limit

Intrawell Parametric, MW-12D



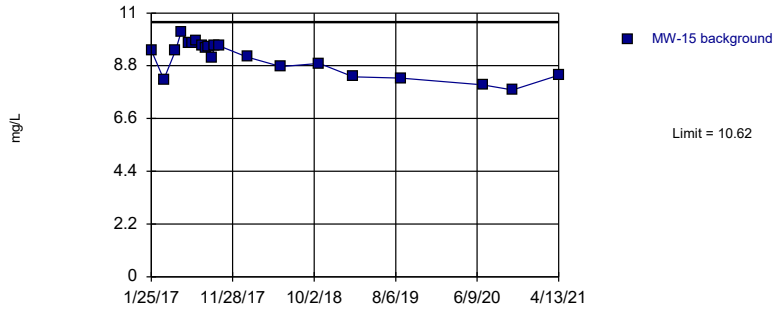
Background Data Summary: Mean=8.664, Std. Dev.=0.6654, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9585, critical = 0.825. Kappa = 2.355 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Boron Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-15



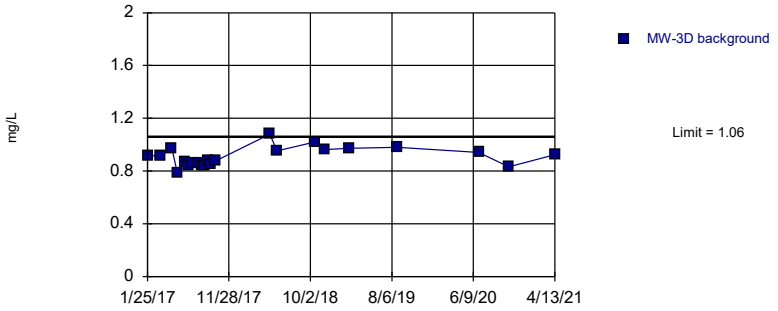
Background Data Summary: Mean=9.119, Std. Dev.=0.6986, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9209, critical = 0.873. Kappa = 2.143 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Boron Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-3D



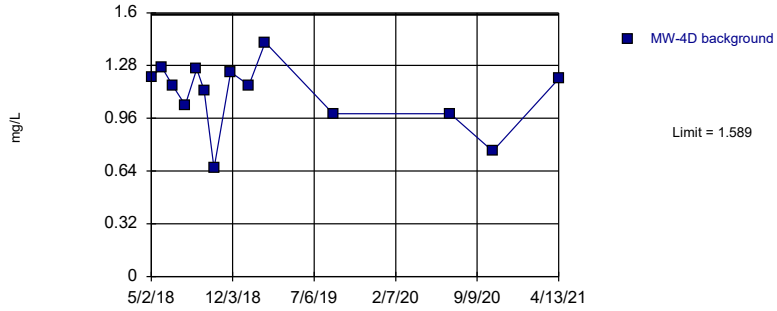
Background Data Summary: Mean=0.9082, Std. Dev.=0.07116, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9554, critical = 0.878. Kappa = 2.128 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Boron Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-4D

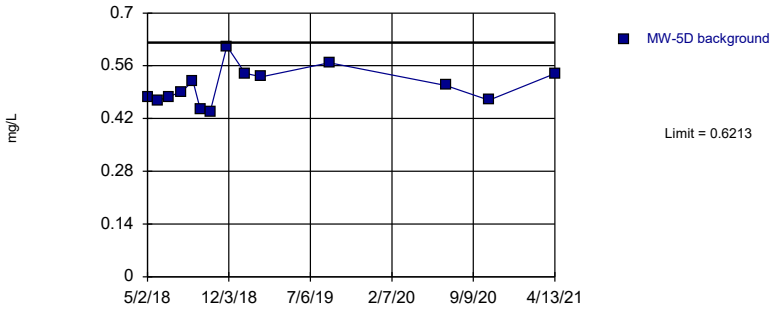


Background Data Summary: Mean=1.106, Std. Dev.=0.2052, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9181, critical = 0.825. Kappa = 2.355 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Boron Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-5D



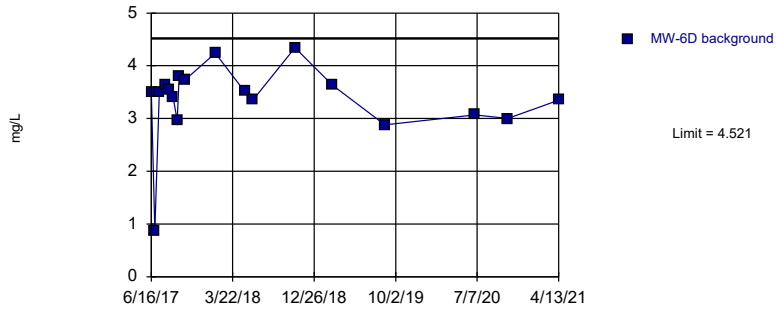
Background Data Summary: Mean=0.5059, Std. Dev.=0.04899, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9546, critical = 0.825. Kappa = 2.355 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Boron Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-6D



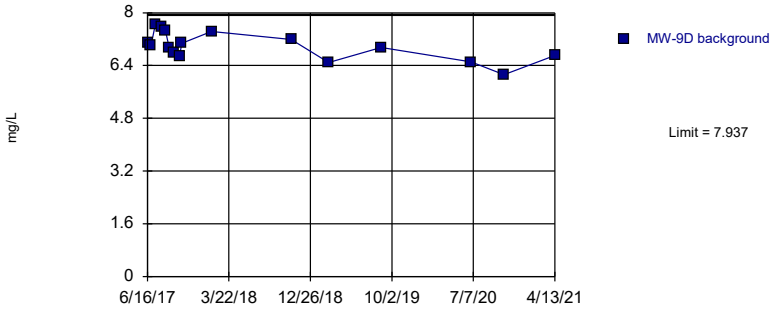
Background Data Summary (based on square transformation): Mean=11.75, Std. Dev.=3.93, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9096, critical = 0.858. Kappa = 2.209 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Boron Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-9D



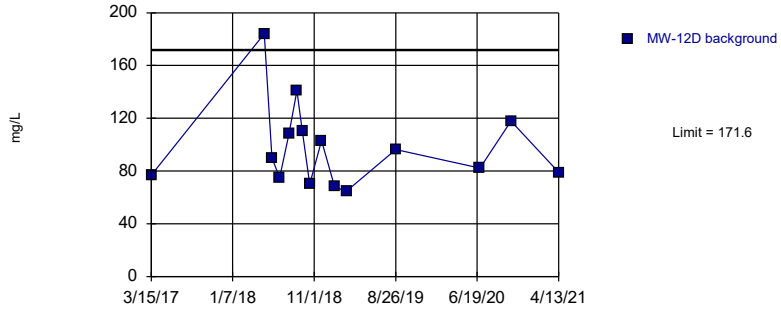
Background Data Summary: Mean=6.977, Std. Dev.=0.4247, n=16. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9724, critical = 0.844. Kappa = 2.261 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Boron Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-12D

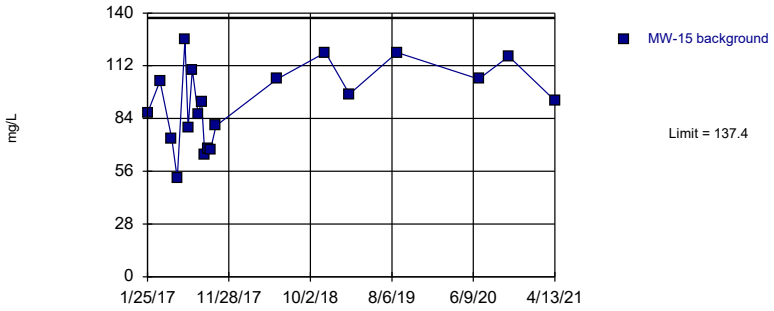


Background Data Summary: Mean=97.73, Std. Dev.=32.03, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8589, critical = 0.835. Kappa = 2.308 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Calcium Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-15



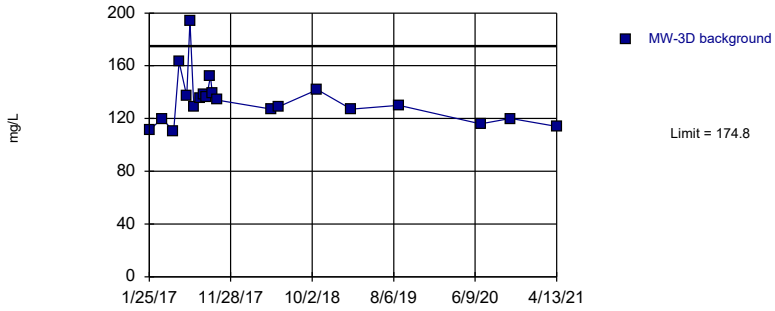
Background Data Summary: Mean=92.35, Std. Dev.=20.88, n=20. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9691, critical = 0.868. Kappa = 2.158 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Calcium Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-3D



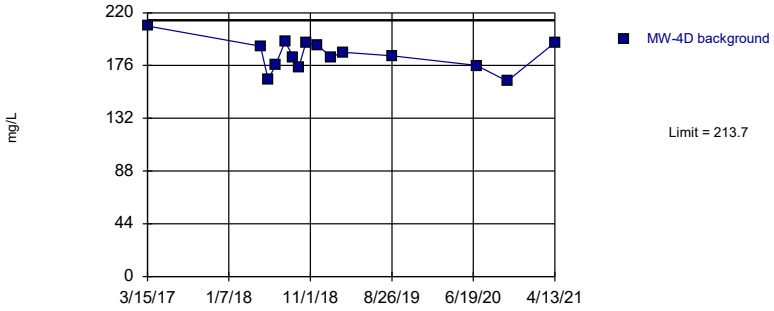
Background Data Summary (based on square root transformation): Mean=11.53, Std. Dev.=0.7904, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8881, critical = 0.873. Kappa = 2.143 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Calcium Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-4D



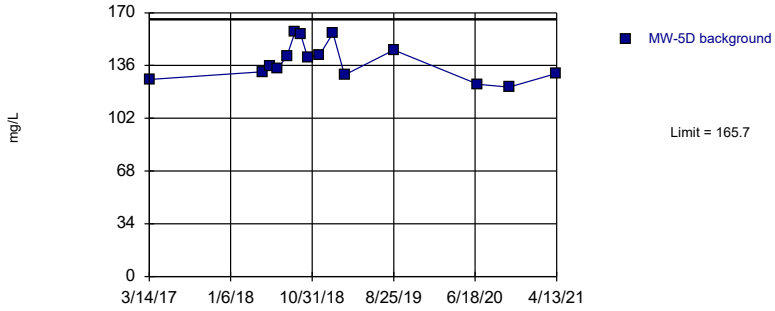
Background Data Summary: Mean=184.7, Std. Dev.=12.57, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9648, critical = 0.835. Kappa = 2.308 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Calcium Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-5D

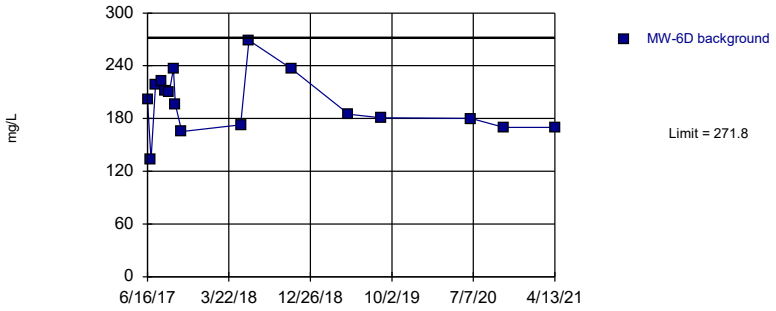


Background Data Summary: Mean=138.6, Std. Dev.=11.76, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.933, critical = 0.835. Kappa = 2.308 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Calcium Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-6D



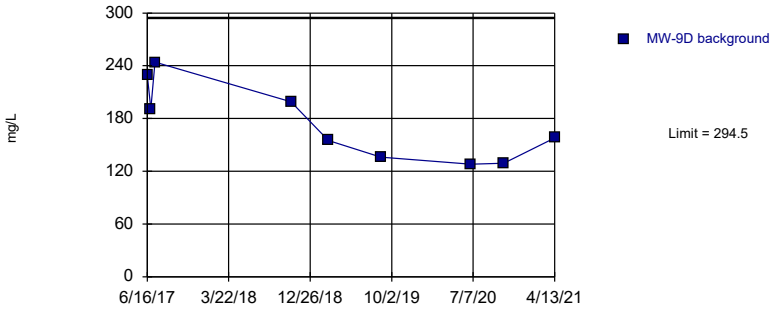
Background Data Summary: Mean=197.5, Std. Dev.=33.23, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.978, critical = 0.851. Kappa = 2.235 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Calcium Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-9D



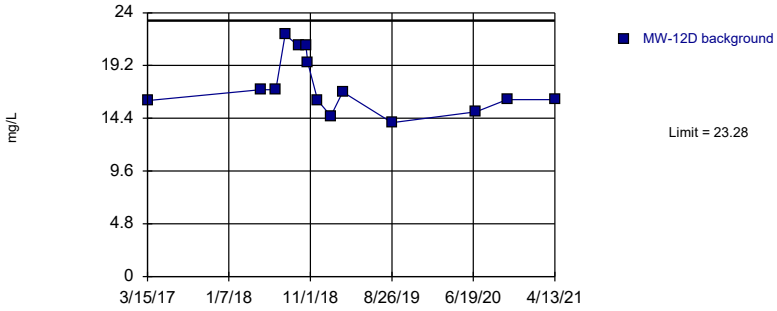
Background Data Summary: Mean=174.3, Std. Dev.=43.36, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9039, critical = 0.764. Kappa = 2.772 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Calcium Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-12D



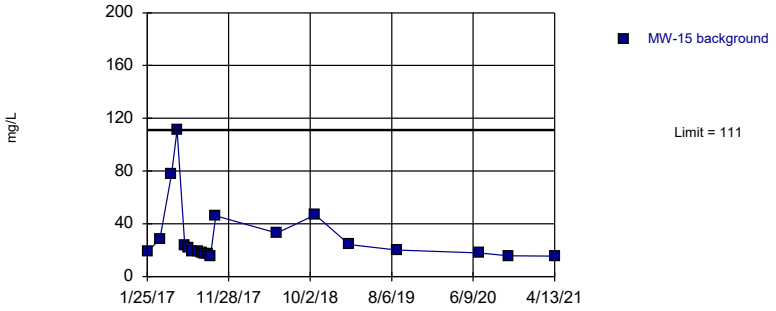
Background Data Summary: Mean=17.29, Std. Dev.=2.545, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8837, critical = 0.825. Kappa = 2.355 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Chloride Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, MW-15

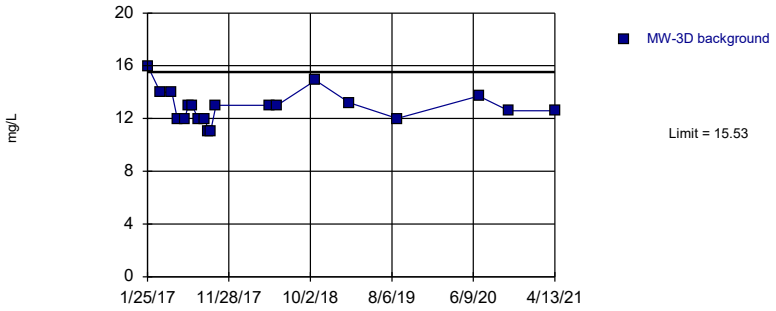


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 20 background values. Well-constituent pair annual alpha = 0.008564. Individual comparison alpha = 0.004291 (1 of 2). Assumes 1 future value.

Constituent: Chloride Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-3D



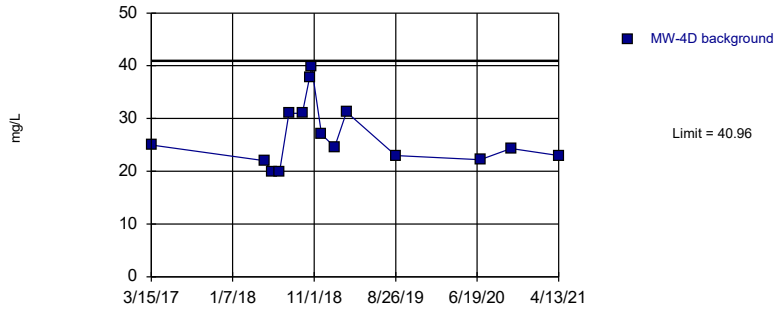
Background Data Summary: Mean=12.9, Std. Dev.=1.219, n=20. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.936, critical = 0.868. Kappa = 2.158 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Chloride Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-4D



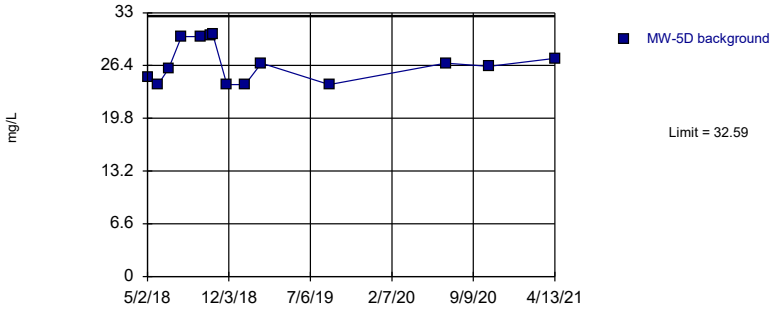
Background Data Summary: Mean=26.8, Std. Dev.=6.134, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8797, critical = 0.835. Kappa = 2.308 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Chloride Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-5D



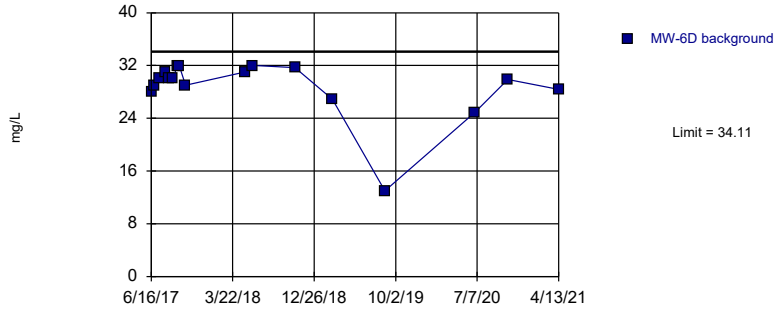
Background Data Summary: Mean=26.75, Std. Dev.=2.481, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8544, critical = 0.825. Kappa = 2.355 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Chloride Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-6D

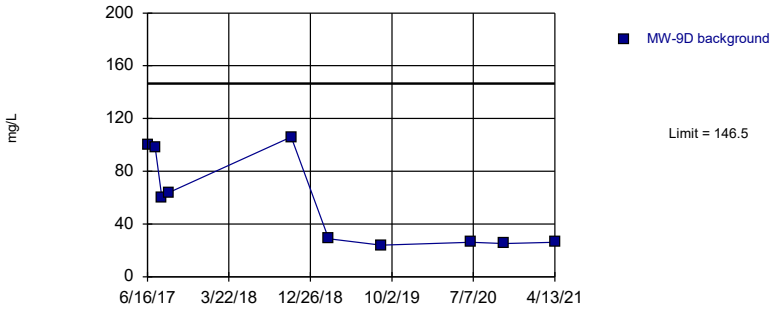


Background Data Summary (based on x^4 transformation): Mean=755625, Std. Dev.=267368, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.89, critical = 0.851. Kappa = 2.235 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Chloride Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-9D

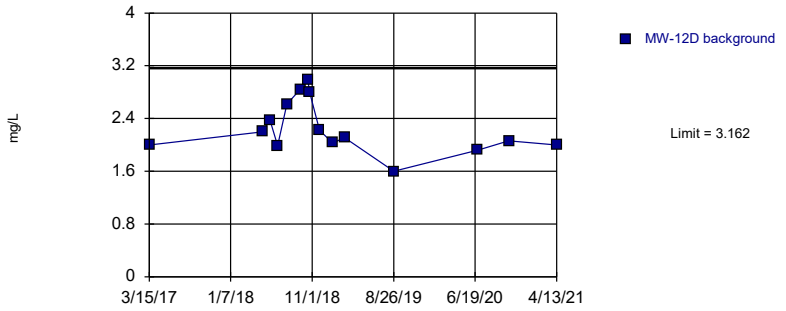


Background Data Summary: Mean=55.85, Std. Dev.=34.58, n=10. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.802, critical = 0.781. Kappa = 2.621 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Chloride Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-12D

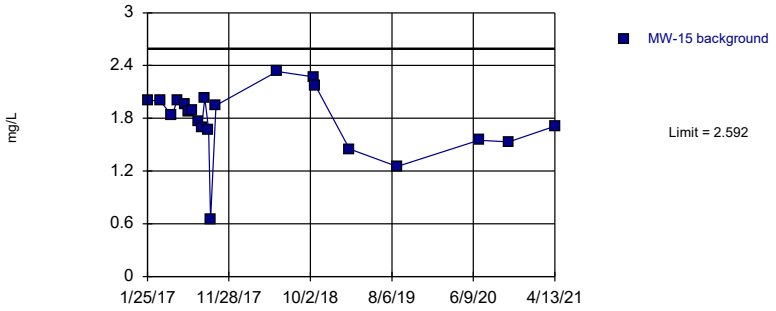


Background Data Summary: Mean=2.25, Std. Dev.=0.3951, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9145, critical = 0.835. Kappa = 2.308 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Fluoride Analysis Run 10/29/2021 3:15 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-15

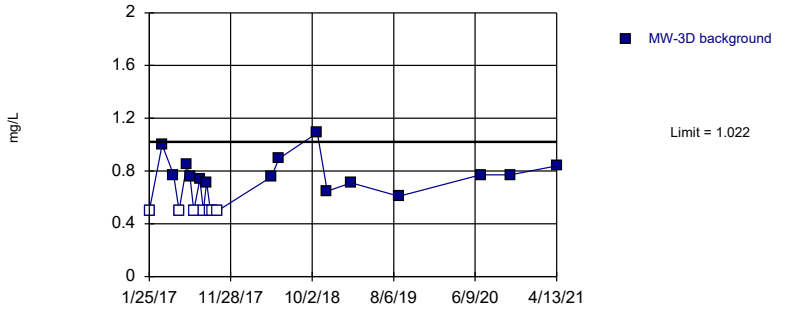


Background Data Summary: Mean=1.789, Std. Dev.=0.3748, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8992, critical = 0.873. Kappa = 2.143 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Fluoride Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-3D

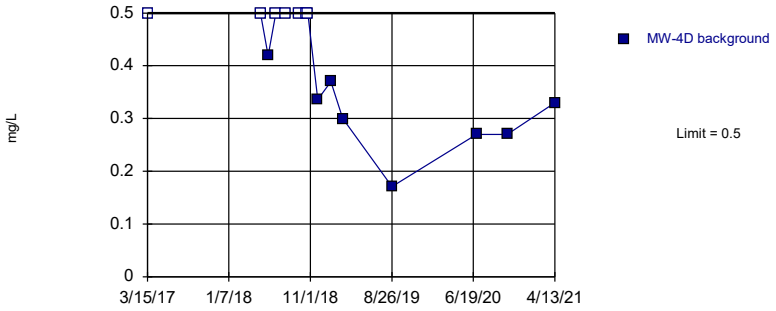


Background Data Summary (after Kaplan-Meier Adjustment): Mean=0.7744, Std. Dev.=0.1164, n=22, 31.82% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.902, critical = 0.878. Kappa = 2.128 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Fluoride Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Non-parametric, MW-4D

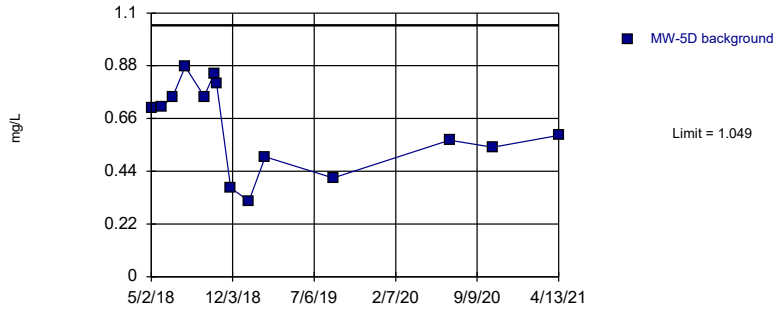


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 15 background values. 46.67% NDs. Well-constituent pair annual alpha = 0.01501. Individual comparison alpha = 0.007533 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-5D

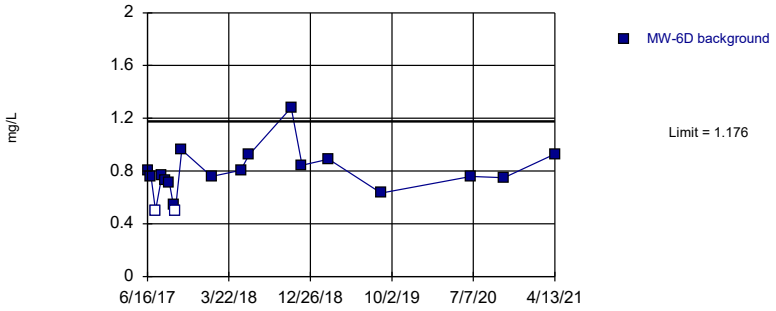


Background Data Summary: Mean=0.6244, Std. Dev.=0.1802, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9495, critical = 0.825. Kappa = 2.355 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Fluoride Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-6D

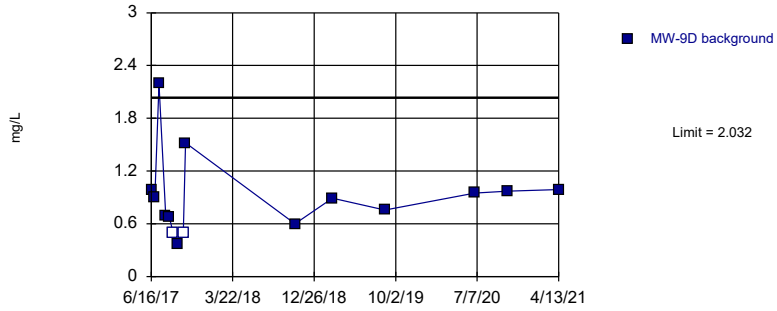


Background Data Summary: Mean=0.7817, Std. Dev.=0.1806, n=19, 10.53% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.918, critical = 0.863. Kappa = 2.184 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Fluoride Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-9D

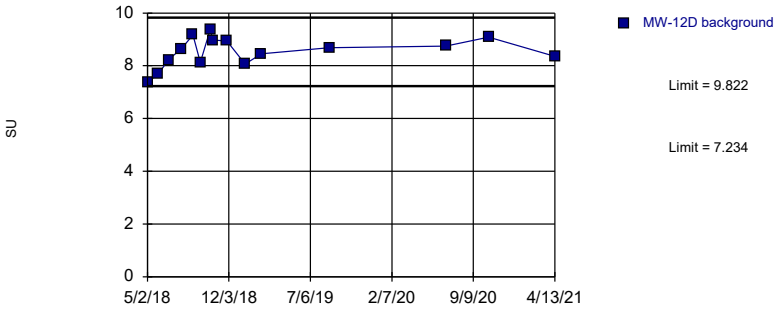


Background Data Summary (based on square root transformation): Mean=0.9252, Std. Dev.=0.2169, n=15, 13.33% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9074, critical = 0.835. Kappa = 2.308 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Fluoride Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-12D



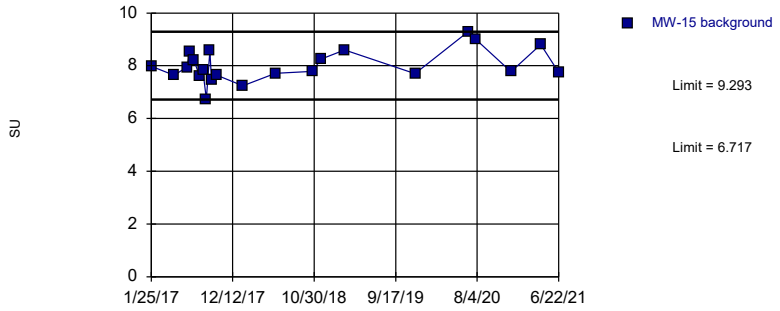
Background Data Summary: Mean=8.528, Std. Dev.=0.5609, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9705, critical = 0.835. Kappa = 2.308 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-15



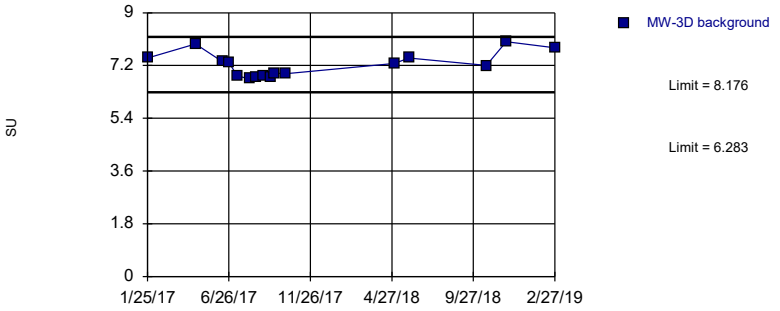
Background Data Summary: Mean=8.005, Std. Dev.=0.6052, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9589, critical = 0.878. Kappa = 2.128 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-3D



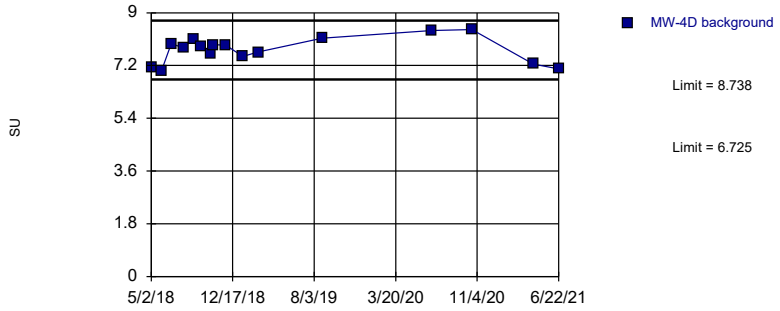
Background Data Summary: Mean=7.229, Std. Dev.=0.4188, n=16. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8997, critical = 0.844. Kappa = 2.261 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-4D

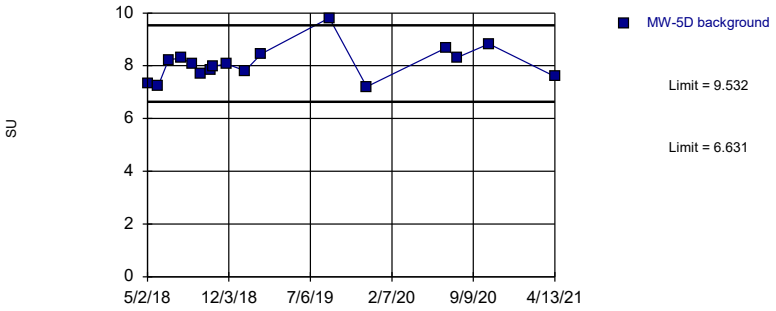


Background Data Summary: Mean=7.731, Std. Dev.=0.4451, n=16. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9518, critical = 0.844. Kappa = 2.261 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-5D



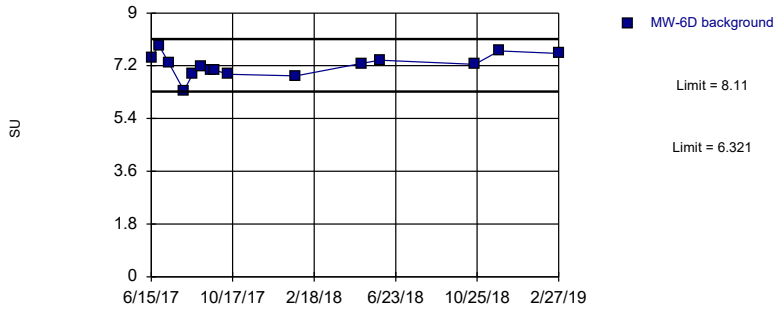
Background Data Summary: Mean=8.082, Std. Dev.=0.6491, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9326, critical = 0.851. Kappa = 2.235 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-6D



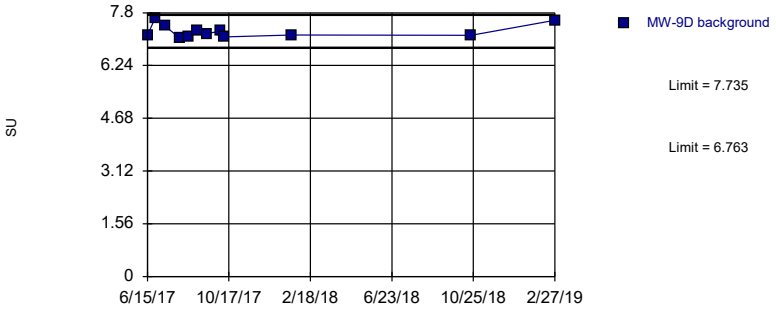
Background Data Summary: Mean=7.215, Std. Dev.=0.3877, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9778, critical = 0.835. Kappa = 2.308 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-9D



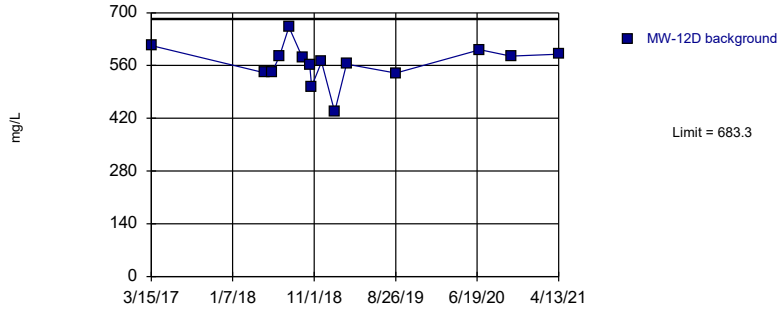
Background Data Summary: Mean=7.249, Std. Dev.=0.1985, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.849, critical = 0.805. Kappa = 2.449 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-12D

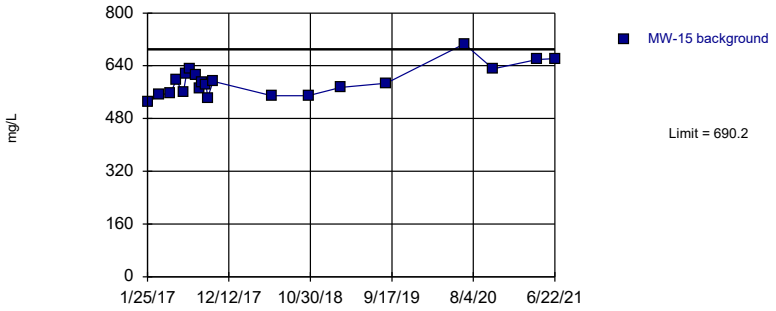


Background Data Summary: Mean=565.3, Std. Dev.=51.11, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9369, critical = 0.835. Kappa = 2.308 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Sulfate Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-15

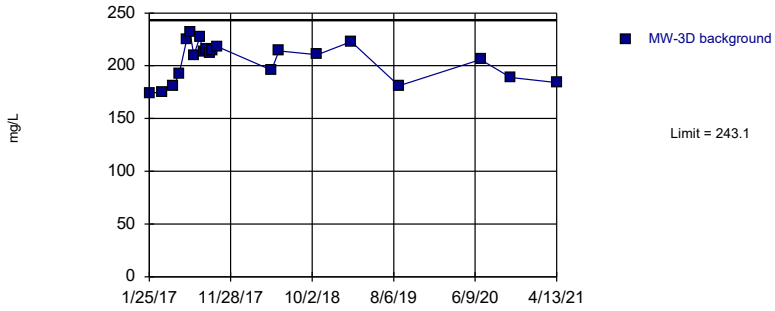


Background Data Summary: Mean=593, Std. Dev.=45.35, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9375, critical = 0.873. Kappa = 2.143 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Sulfate Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-3D

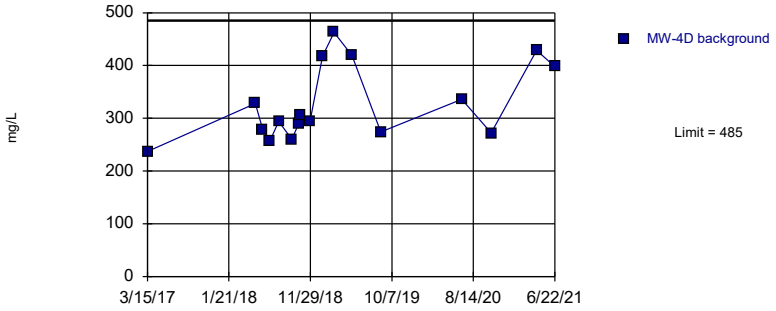


Background Data Summary: Mean=204.4, Std. Dev.=18.04, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9268, critical = 0.873. Kappa = 2.143 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Sulfate Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-4D

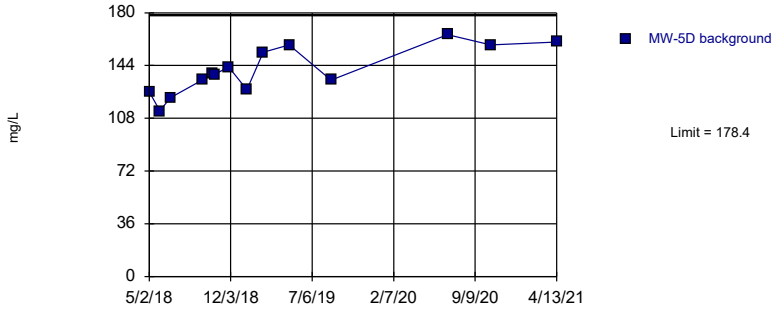


Background Data Summary: Mean=326.8, Std. Dev.=70.78, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8829, critical = 0.851. Kappa = 2.235 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Sulfate Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-5D

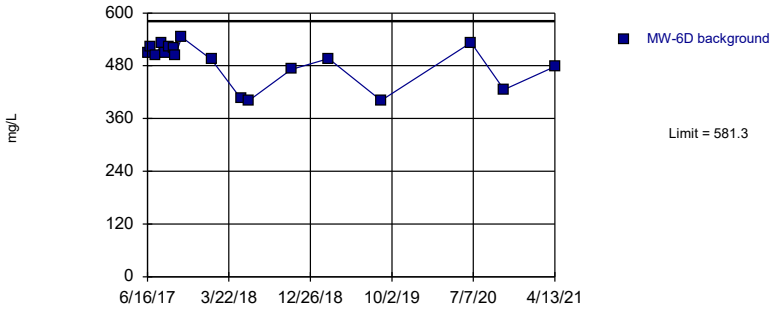


Background Data Summary: Mean=140.7, Std. Dev.=15.99, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9533, critical = 0.825. Kappa = 2.355 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Sulfate Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-6D

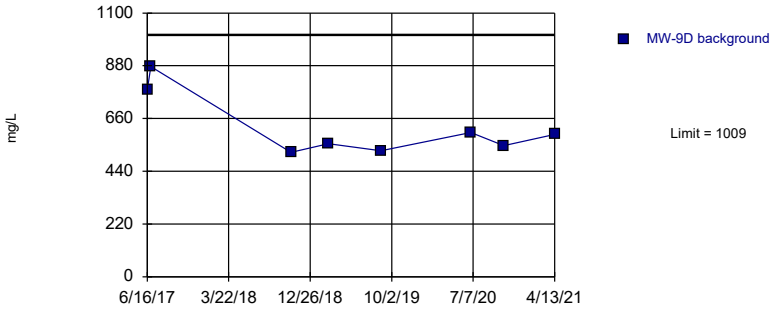


Background Data Summary (based on square transformation): Mean=239882, Std. Dev.=44395, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8691, critical = 0.858. Kappa = 2.209 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Sulfate Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-9D

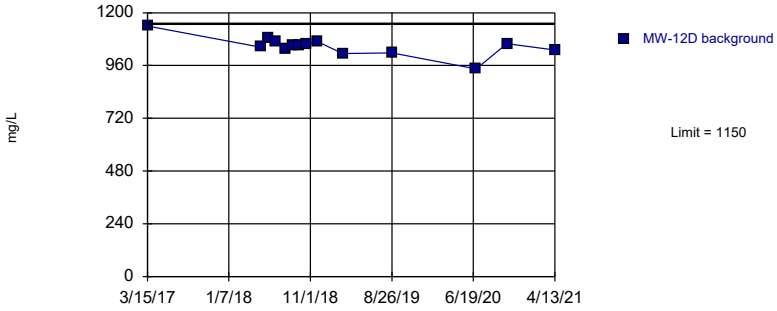


Background Data Summary: Mean=625.1, Std. Dev.=131.3, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7869, critical = 0.749. Kappa = 2.923 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Sulfate Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-12D

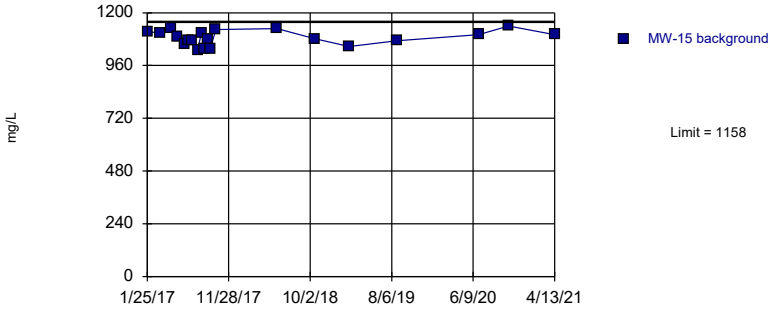


Background Data Summary: Mean=1048, Std. Dev.=43.37, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9326, critical = 0.825. Kappa = 2.355 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-15

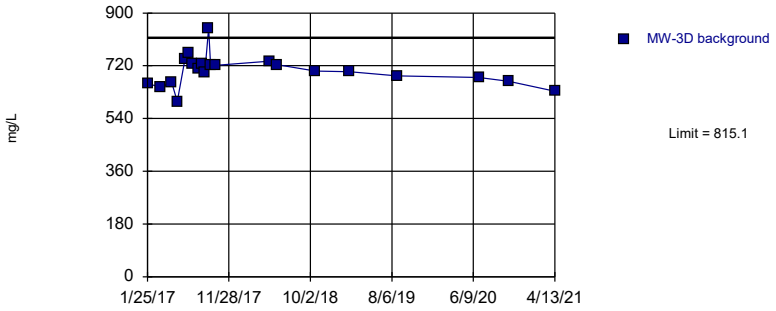


Background Data Summary: Mean=1087, Std. Dev.=32.98, n=20. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9537, critical = 0.868. Kappa = 2.158 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2021 3:16 PM View: Prediction Limits
Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-3D



Background Data Summary: Mean=702.8, Std. Dev.=52.43, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9513, critical = 0.873. Kappa = 2.143 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

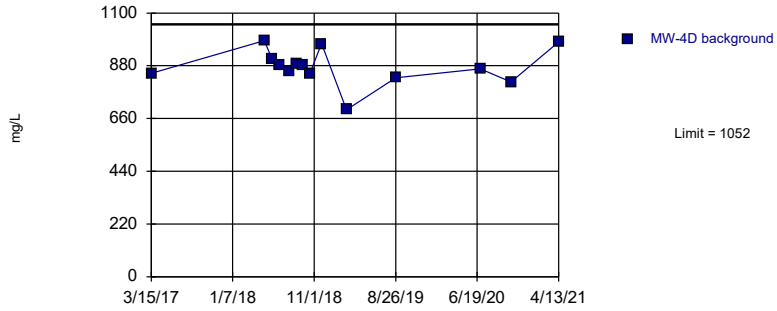
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2021 3:16 PM View: Prediction Limits

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-4D



Background Data Summary: Mean=875.2, Std. Dev.=75.19, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.919, critical = 0.825. Kappa = 2.355 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

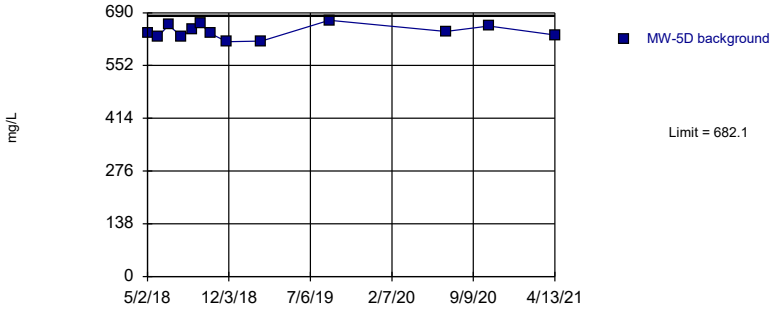
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2021 3:16 PM View: Prediction Limits

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-5D



Background Data Summary: Mean=640.3, Std. Dev.=17.4, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.964, critical = 0.814. Kappa = 2.402 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

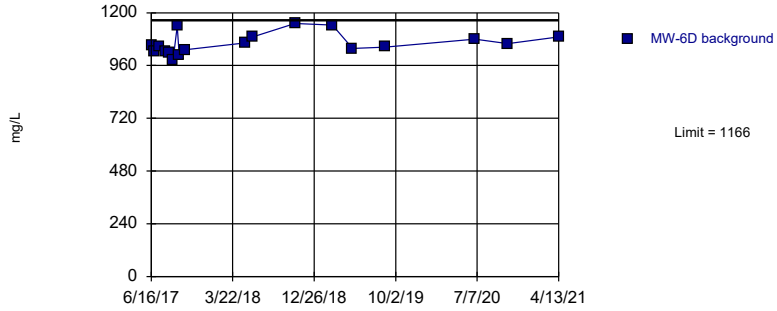
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2021 3:16 PM View: Prediction Limits

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Sanitas™ v.9.6.31 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-6D



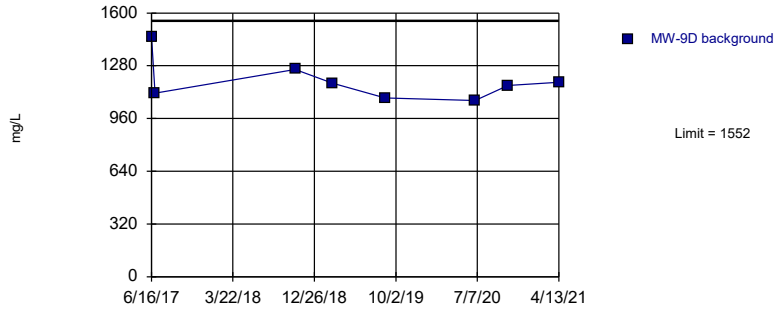
Background Data Summary: Mean=1060, Std. Dev.=47.77, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9303, critical = 0.858. Kappa = 2.209 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2021 3:16 PM View: Prediction Limits

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

Prediction Limit

Intrawell Parametric, MW-9D



Background Data Summary: Mean=1187, Std. Dev.=124.8, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8372, critical = 0.749. Kappa = 2.923 (c=7, w=7, 1 of 2, event alpha = 0.05132). Report alpha = 0.001075. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2021 3:16 PM View: Prediction Limits

Northeastern Landfill Client: Geosyntec Data: Northeastern LF

APPENDIX 3

Alternative Source Demonstrations

ALTERNATIVE SOURCE DEMONSTRATION REPORT STATE CCR RULE

Northeastern Plant Landfill
Oologah, Oklahoma

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, OH 43221

February 2021

CHA8495

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
EPRI	Electric Power Research Institute
LPL	Lower Prediction Limit
OAC	Oklahoma Administrative Code
ODEQ	Oklahoma Department of Environmental Quality
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SU	Standard Units
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

The Northeastern Plant Landfill (Northeastern Landfill) is a regulated coal combustion residual (CCR) management unit at the Northeastern Power Station in Oogolah, Oklahoma. Prediction limits were recalculated in 2020 to include data from recent sampling events. The recalculated prediction limits used intrawell statistics to reflect natural variability between wells (Geosyntec, 2020). Upper prediction limits (UPLs) were calculated for each Appendix A parameter to represent background values. In addition, a lower prediction limit (LPL) was also calculated for pH. A one-of-two retesting procedure was employed for all wells at the Northeastern Landfill. Using this procedure, a statistically significant increase (SSI) is concluded only if both samples in a series of two exceed the UPL and, for pH, are lower than the LPL. If the initial result did not exceed a prediction limit, a second sample was not collected.

The first semi-annual detection monitoring event of 2020 was performed on 30 June 2020 (initial sampling event) and 8 September 2020 (verification sampling event), and the results were compared to the calculated prediction limits. SSIs were identified for pH at MW-9D and sulfate at MW-5D and MW-15 using intrawell comparisons. A summary of the detection monitoring analytical results and the calculated prediction limits to which they were compared is presented in **Table 1**.

1.1 CCR Rule Requirements

Oklahoma Department of Environmental Quality (ODEQ) regulations regarding detection monitoring programs for coal combustion residuals (CCR) landfills and surface impoundments allow the following evaluation process when an SSI has been identified (OAC 252:517-9-5(e)(2)):

> *The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report.*

Pursuant to OAC 252:517-9-5(e)(2), Geosyntec Consultants, Inc. (Geosyntec) has prepared this ASD report, which documents that the SSIs identified for pH and sulfate should not be attributed to the Northeastern Landfill.

1.2 Demonstration of Alternative Sources

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

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

A demonstration was conducted to assess whether the increases in constituent concentrations were based on a Type I cause for pH at monitoring well MW-9D and Type II and Type IV causes for sulfate at monitoring wells MW-5D and MW-15 and not by a release from the Northeastern Landfill.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The methods used to assess possible alternative sources of the SSIs for pH at MW-9D and sulfate at MW-5S and MW-15 and the proposed alternative sources are described below.

2.1 Proposed Alternative Source

Initial review of site geochemistry, site historical data, and groundwater sampling field forms identified an ASD due to a Type I issue (sampling causes) for pH at well MW-9D. As described below, the SSIs observed at wells MW-5D and MW-15 for sulfate are attributed to natural variation in the aquifer and laboratory causes, which are Type IV and Type II issues, respectively.

2.1.1 pH

The initial and verification sampling for the first semi-annual detection monitoring event of 2020 were completed in June and September 2020, respectively. The reported pH for the June sample from well MW-9D was 10.9 standard units (SU) and the reported pH value for the September event was 8.6 SU, both of which are above the calculated UPL of 7.7 SU. Subsequent groundwater sampling events were completed in October and December 2020. Key data are provided in **Table 2**. While the next event (21 October 2020) remained above the UPL, the reported pH values for the two subsequent sampling events were both within the acceptable range (**Figure 1**). Based on the recorded values for these events, the pH values at MW-9D do not remain above the UPL.

Well purge logs from the sampling events completed in June through December 2020 indicate that well MW-9D was purged dry during each event. The well logs for the June and September 2020 events at MW-9D are provided in **Attachment A**. This suggests that the well does not reliably produce water which is representative of the aquifer using the current sampling technique. USEPA sampling guidance recommends purging either via “low stress” or “well volume” approaches until key parameters, including pH, have stabilized in order to collect a sample which is representative of the aquifer. Unrepresentative samples “can lead to mis-representations of groundwater quality” (USEPA, 2002). Furthermore, well MW-9S, which was sampled immediately prior to MW-9D during the June event, had a recorded pH value of 14.0. This suggests possible instrumentation errors, as 14.0 is not a feasible value to observe in groundwater conditions. Thus, the observed pH during the first semi-annual event of 2020 is not considered indicative of a release from the Northeastern Landfill and is instead likely due to sampling causes.

2.1.2 Sulfate

SSIs were identified for sulfate at MW-5D and MW-15 using intrawell comparisons during the 30 June and 8 September 2020 sampling events (**Table 1**). The reported sulfate concentration for the October 2020 sample from well MW-15 was 631 mg/L, which is below the calculated UPL of 642 mg/L (**Figure 2, Table 2**). The analytical laboratory reports for all three events are provided in

Attachment B. Thus, the concentrations of sulfate at MW-15 as of October 2020 do not remain above the UPL. Additionally, no other Appendix A exceedances were observed for MW-15 during the first semi-annual event, with concentrations of these constituents appearing to be relatively stable during recent sampling events. This is illustrated in the time series graphs for calcium, chloride, and TDS which are provided in **Figure 3**, **Figure 4**, and **Figure 5**, respectively. Thus, the observed sulfate concentrations in MW-15 during the first semi-annual event are not considered indicative of a release from the Landfill and are instead likely due to natural variability in the aquifer.

The reported sulfate concentration for the October 2020 sample from well MW-5D was 158 mg/L, which is below the calculated UPL of 160 mg/L (**Figure 2, Table 2**). The analytical laboratory reports for all three events are provided as **Attachment B**. Thus, as of October 2020, the concentrations of sulfate at MW-5D do not remain above the UPL. Additionally, no other Appendix A exceedances were observed for MW-5D during the first semi-annual event, with concentrations of these constituents appearing to be relatively stable during recent sampling events. This is illustrated in the time series graphs for calcium, chloride, and TDS which are provided in **Figure 3**, **Figure 4**, and **Figure 5**, respectively. Thus, the observed sulfate concentrations in MW-5D during the first semi-annual event are not considered indicative of a release from the Landfill and are instead likely due to natural variability (Type IV ASD) in the aquifer.

The sulfate samples were analyzed using USEPA Method 300.0, which prescribes ±10% variation as the daily calibration verification standard acceptance criteria (USEPA, 1993). Because both reported concentrations at MW-5D are within 10% (3.1% and 9.5% respectively) of the calculated intrawell UPL, the variations observed, although above the UPL, may also be due to the anticipated variation in the analytical procedure (Type II ASD).

2.2 Sampling Requirements

As the ASD described above supports the position that the identified SSIs are not due to a release from the Northeastern Landfill, the unit will remain in the detection monitoring program. Groundwater at the unit will continue to be sampled for Appendix A parameters on a semi-annual basis.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with OAC 252:517-9-5(e)(2) and supports the position that the SSIs in pH for MW-9D and sulfate for MW-5D and MW-15 observed during the first semi-annual sampling event in 2020 are not due to a release from the Northeastern Landfill. The observed SSIs were, instead, attributed to sampling causes, natural variation in the aquifer, and variation in the laboratory procedure. Therefore, no further action is warranted, and the Northeastern Landfill will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in **Attachment C**.

SECTION 4

REFERENCES

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

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

Geosyntec Consultants, 2020. Statistical Analysis Summary – Background Update Calculations. Stations 3 and 4 Landfill. Northeastern Plant Station. January.

USEPA, 1993. Method 300.0 – Determination of Inorganic Anions by Ion Chromatography. Revision 2.1.

USEPA, 2002. Groundwater Sampling Guidelines for Superfund RCRA Project Managers. EPA 542-S-02-001. May.

TABLES

Table 1: Detection Monitoring Data Summary
Northeastern Plant - Landfill

Geosyntec Consultants, Inc.

Analyte	Unit	Description	MW-3D		MW-4D	MW-5D		MW-6D		MW-9D		MW-12D	MW-15	
			6/30/2020	9/8/2020	6/30/2020	6/29/2020	9/8/2020	6/30/2020	9/8/2020	6/30/2020	9/8/2020	6/29/2020	6/30/2020	9/8/2020
Boron	mg/L	Intrawell Background Value (UPL)	1.07		1.52	0.647		4.73		8.00		10.3	10.6	
		Analytical Result	0.941	--	0.966	0.508	--	3.07	--	6.51	--	8.04	8.00	--
Calcium	mg/L	Intrawell Background Value (UPL)	181		221	172		342		456		198	196	
		Analytical Result	116	--	176	124	--	180	--	128	--	82.2	105	--
Chloride	mg/L	Intrawell Background Value (UPL)	16.0		46.2	35.3		34.1		403		25.6	104	
		Analytical Result	13.7	--	22.3	26.7	--	24.9	--	26.2	--	15.0	17.9	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1.09		1.00	1.24		1.24		2.18		3.40	2.49	
		Analytical Result	0.77	--	0.25	0.57	--	0.76	--	0.95	--	1.92	1.55	--
pH	SU	Intrawell Background Value (UPL)	8.2		8.6	8.8		8.1		7.7		10.2	9.0	
		Intrawell Background Value (LPL)	6.3		6.7	6.9		6.3		6.8		6.7	6.7	
		Analytical Result	**8.6**	7.8	8.4	8.7	--	**8.8**	8.0	**10.9**	**8.6**	8.8	**9.3**	8.9
Sulfate	mg/L	Intrawell Background Value (UPL)	248		428	160		585		1,640		720	642	
		Analytical Result	206	--	361	**165**	**176**	533	--	602	--	602	**706**	**730**
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	832		1,040	686		1,180		3,480		1,160	1,160	
		Analytical Result	680	--	884	641	--	1,080	--	1,070	--	945	1,100	--

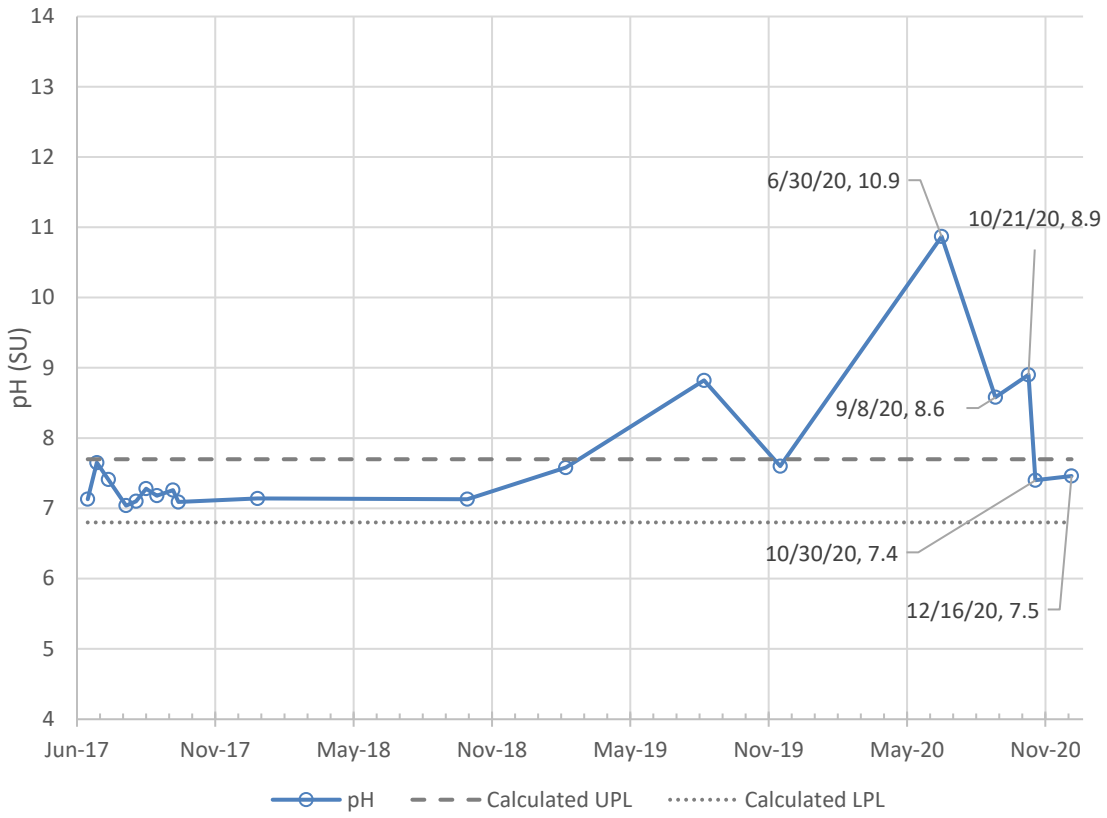
Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
SU: standard units
mg/L: milligrams per liter

Table 2: Summary of Key Data
Northeastern Plant - Landfill

Well ID	Parameter	UPL	Sample Result	Sample Date	Sample Type
MW-9D	pH	7.7	**10.9**	6/30/2020	2020-1st Event Initial
			8.6	9/8/2020	2020-1st Event Verification
			8.9	10/21/2020	2020-2nd Event Initial
			7.4	10/30/2020	Non-CCR Event
			7.5	12/16/2020	2020-2nd Event Verification
MW-5D	Sulfate	160	**165**	6/30/2020	2020-1st Event Initial
			176	9/8/2020	2020-1st Event Verification
			158	10/21/2020	2020-2nd Event Initial
MW-15D	Sulfate	642	**706**	6/29/2020	2020-1st Event Initial
			730	9/8/2020	2020-1st Event Verification
			631	10/21/2020	2020-2nd Event Initial

Notes:
Bolded sample results exceed the upper prediction limit (UPL).

FIGURES



Notes: Initial sampling for the first semi-annual detection monitoring event occurred on 06/30/2020. Verification sampling for the first semi-annual event occurred on 07/28/2020. The upper prediction limit (UPL) was calculated using intrawell analyses.

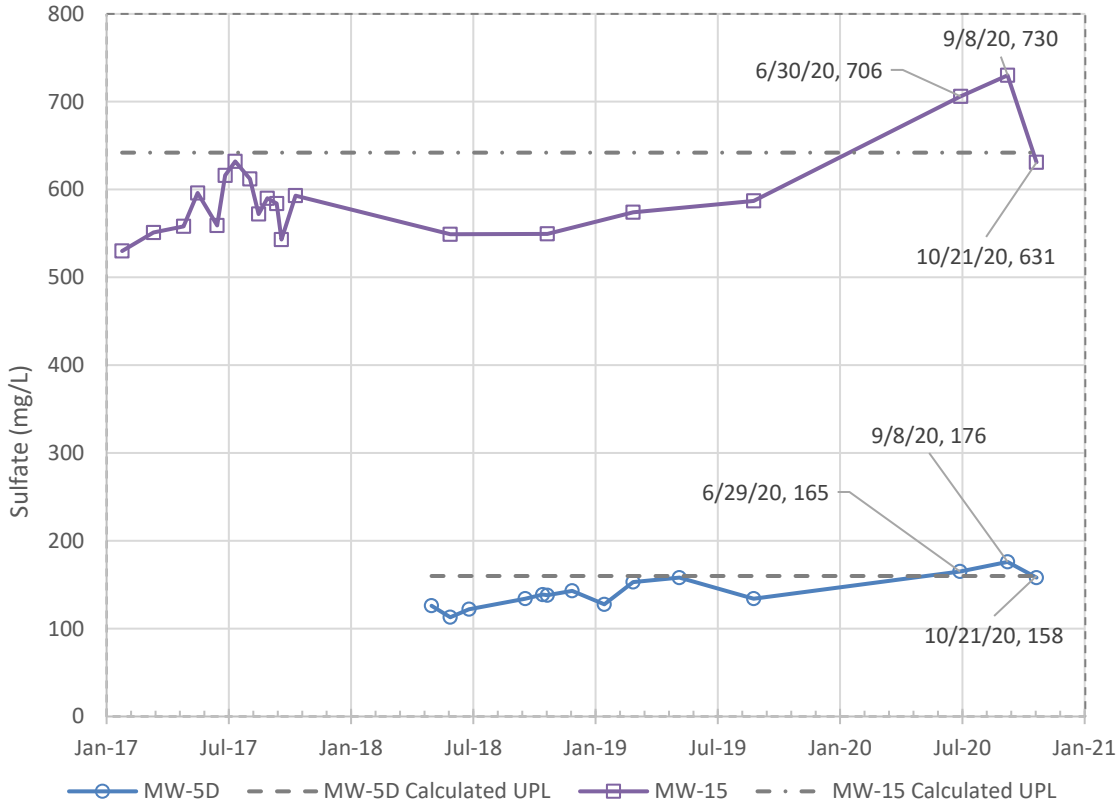
pH Time Series Graph at MW-9D
Northeastern Landfill

Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | 18-Feb-2021

Figure **1**

2020-CHA846-AEP Northeastern ASD, CIC



Notes: Initial sampling for the first semi-annual detection monitoring event occurred in June 2020. Verification sampling for the first semi-annual event occurred in September 2020. Initial sampling for the second semi-annual event occurred in October 2020. Separate upper prediction limits (UPLs) were calculated using intrawell analyses for both MW-5D and MW-15.

Sulfate Time Series Graph

Northeastern Landfill

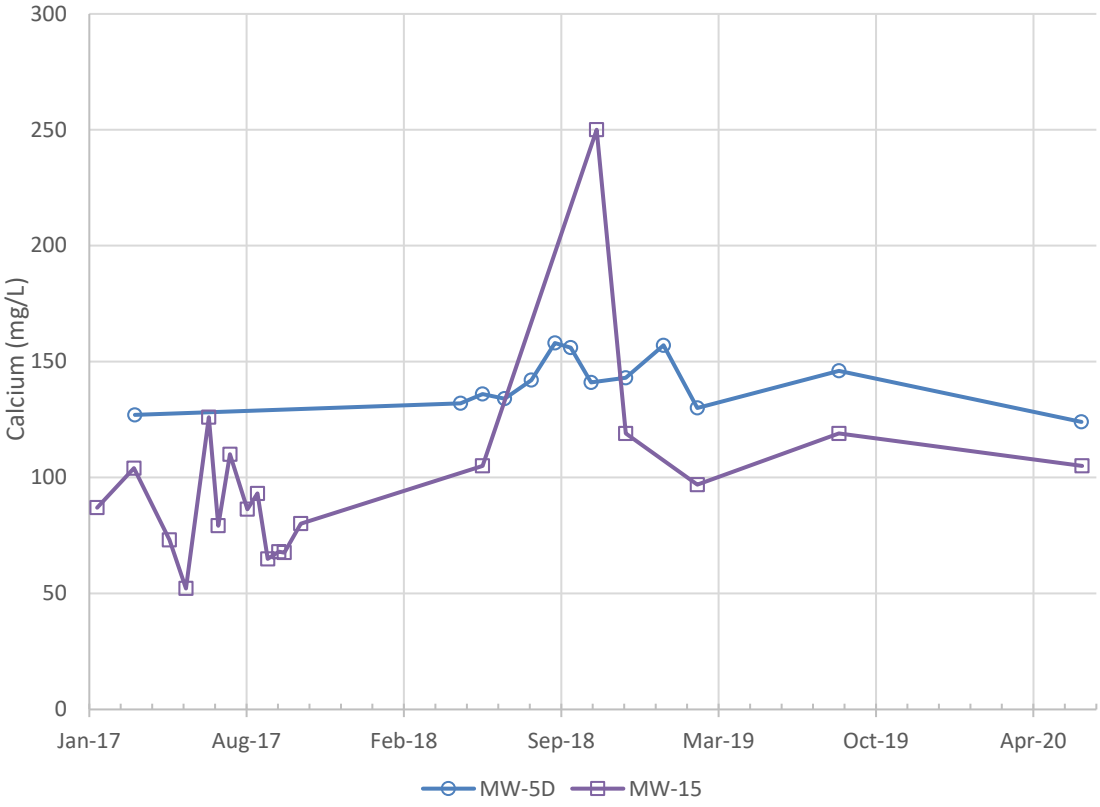
Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure **2**

Columbus, Ohio

14-Feb-2021



Notes: Calcium results are shown in milligrams per liter (mg/L).

Calcium Time Series Graph
Northeastern Landfill

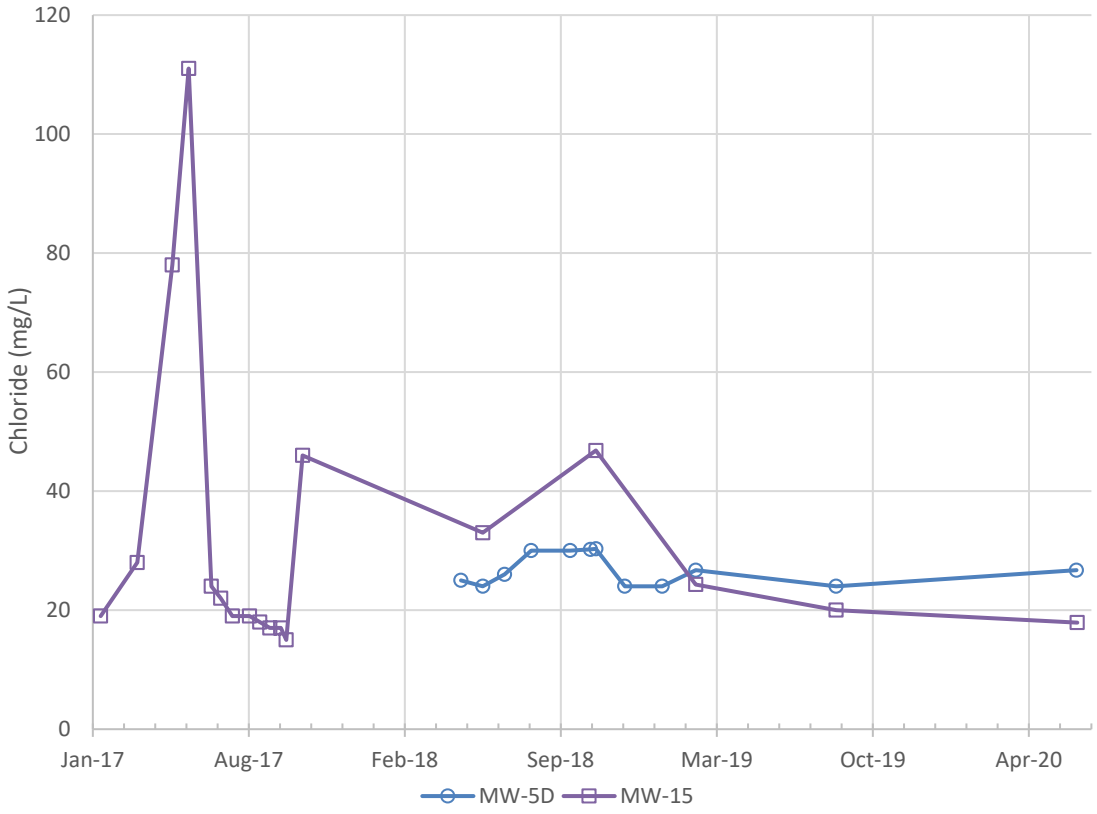
Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure **3**

Columbus, Ohio

18-Feb-2021



Notes: Chloride results are shown in milligrams per liter (mg/L).

Chloride Time Series Graph

Northeastern Landfill

Geosyntec consultants

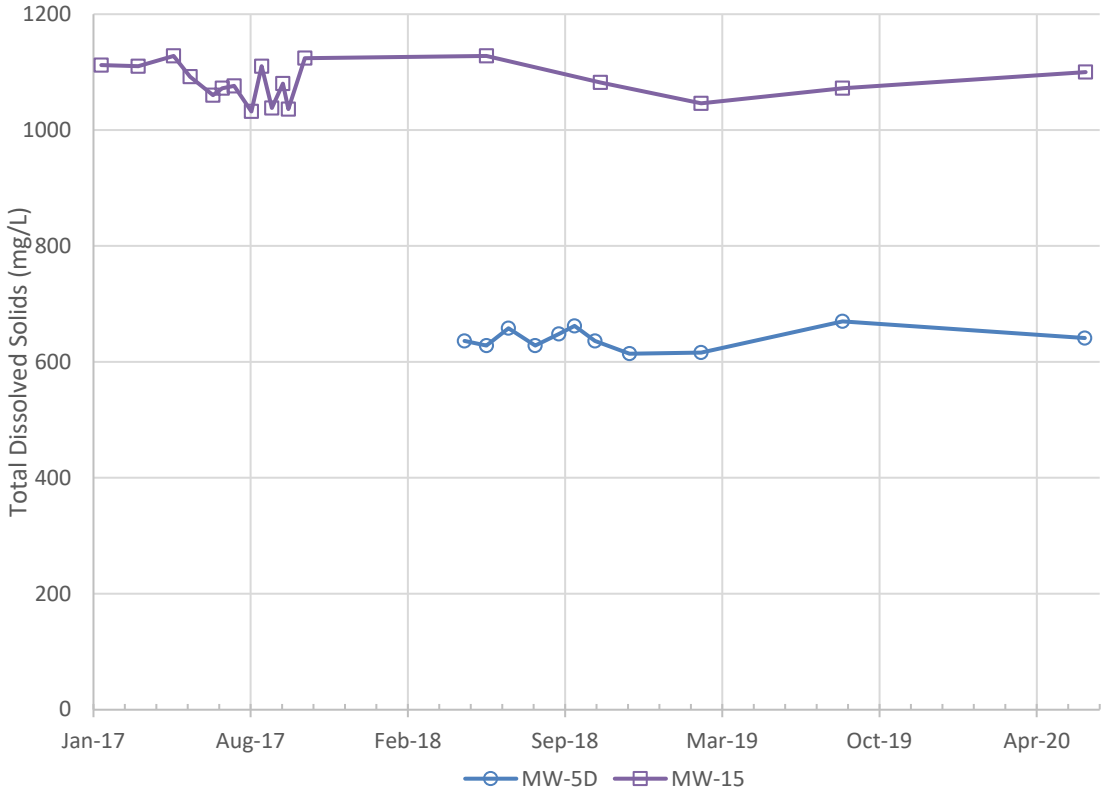
AMERICAN ELECTRIC POWER

Figure **4**

Columbus, Ohio

18-Feb-2021

2020-CHA846-AEP Northeastern ASD, CIC



Notes: Total dissolved solids results are shown in milligrams per liter (mg/L).

Total Dissolved Solids Time Series Graph
Northeastern Landfill

Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | 18-Feb-2021

Figure **5**

2020-CHA846-AEP Northeastern ASD, CIC

ATTACHMENT A
MW-9D Purge Logs

NORTHEASTERN POWER PLANT
GROUNDWATER SAMPLING DATA FORM

SAMPLED BY: KENNY McDONALD. **DATE:** 06/29-30/20.

Well Identification Number	MW-7D	MW-7S	MW-8D	MW-8S	MW-9D	MW-9S
Activities	Gauge	Gauge	Gauge	Gauge	Gauge	Gauge
Samples	NA	NA	NA	NA	Appendix III	Listed Metals
Depth to Water (ft)	10.24	10.72	25.14	8.89	47.34	26.23
Water Level Elevation (ft. NGVD)						
Measured Depth Total Depth of Well (ft.)	58.70	33.54	64.50	43.30	63.10	36.71
Height of Water Column (ft.)	48.46	22.82	39.36	34.41	15.76	10.48
Well Size (I.D.) (inches)	2	2	2	2	2	2
Volume of Water in Well (gallons)	7.90	3.72	6.42	5.61	2.57	1.71
Water Removed From Well (gallons)	—	—	—	—	4.25	2.75
Method of Removal	—	—	—	—	Pump	Pump
Was Well Purged Dry?	—	—	—	—	YES	YES
pH (standard units)	—	—	—	—	10.87	14.00
Temperature (°C)	—	—	—	—	22.10	22.17
Conductivity (µmhos/cc)	—	—	—	—	1570	4240
Turbidity (NTU)	—	—	—	—	69.4	133
Appearance	—	—	—	—	CLEAR	CLEAR
Odor	—	—	—	—	NONE	NONE
Containers	—	—	—	—	250 mL HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL
Sample Time	—	—	—	—	0954	0946
Sample Date	—	—	—	—	06/30/20	06/30/20

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 . **DATE:** 09/08/20 .

Well Identification Number	MW-3D	MW-5D	MW-6D	MW-9D	MW-15	
Activities	Gauge	Gauge	Gauge	Gauge	Gauge	
Samples	pH	Sulfate	pH	pH	pH Sulfate	
Depth to Water (ft)	37.16	29.81	33.51	55.43	60.55	
Water Level Elevation (ft. NGVD)						
Measured Depth Total Depth of Well (ft.)	62.95	58.42	58.51	63.10	74.21	
Height of Water Column (ft.)	25.79	28.61	25.00	7.67	13.66	
Well Size (I.D.) (inches)	2	2	2	2	2	
Volume of Water in Well (gallons)	4.20	4.66	4.08	1.25	2.23	
Water Removed From Well (gallons)	14.00	12.50	9.00	2.00	5.50	
Method of Removal	Pump	Pump	Pump	Pump	Pump	
Was Well Purged Dry?	No	Yes	Yes	Yes	Yes	
pH (standard units)	7.76	8.16	8.00	8.58	8.86	
Temperature (°C)	19.62	19.31	19.74	20.74	20.13	
Conductivity (µmhos/cc)	997	946	1410	1460	1460	
Turbidity (NTU)	4.4	13.4	109	247	81.2	
Appearance	Clear	Clear	Slightly Turbid	Clear	Slightly Turbid	
Odor	None	None	None	None	Slight Sulphur	
Containers	NA	500 mL Cool 0-6C	NA	NA	500 mL Cool 0-6C	
Sample Time	1247	1413	1307	1324	1351	
Sample Date	9/8/2020	9/8/2020	9/8/2020	9/8/2020	9/8/2020	

For 2" well multiply by	0.163
For 4" well multiply by	0.653

ATTACHMENT B
Analytical Laboratory Reports

Form REP-703
Rev. 1, 11/2013

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

Water Analysis

Location: Northeastern Station ***Report Date: 7/14/2020***

MW-2D LF

Sample Number: 202052-001 **Date Collected: 06/29/2020 16:08** **Date Received: 7/2/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	251	mg/L		20	5	MGK	07/07/2020 13:50	SM 2320B-2011
Bromide, Br	0.3	mg/L	J	0.5	0.1	CRJ	07/10/2020 01:27	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	11.5	mg/L		0.1	0.03	CRJ	07/10/2020 01:27	EPA 300.1-1997, Rev. 1.0
Fluoride, F	1.91	mg/L		0.2	0.04	CRJ	07/10/2020 01:27	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1310	mg/L		50	20	HRF	07/02/2020	SM 2540C-2011
The RPD between the LFB and LFBD exceeds 5%. The LFB is outside of the acceptable lmit of 92.24-105.69%. Hrf07102020								
Sulfate, SO4	732	mg/L		10	2	CRJ	07/09/2020 18:23	EPA 300.1-1997, Rev. 1.0

MW-3D LF

Sample Number: 202052-002 **Date Collected: 06/30/2020 10:48** **Date Received: 7/2/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	362	mg/L		20	5	MGK	07/07/2020 13:50	SM 2320B-2011
Bromide, Br	0.288	mg/L		0.2	0.04	CRJ	07/10/2020 06:51	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	13.7	mg/L		0.04	0.01	CRJ	07/10/2020 06:51	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.77	mg/L		0.06	0.01	CRJ	07/10/2020 06:51	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	680	mg/L		50	20	HRF	07/02/2020	SM 2540C-2011
The RPD between the LFB and LFBD exceeds 5%. The LFB is outside of the acceptable lmit of 92.24-105.69%. Hrf07102020								
Sulfate, SO4	206	mg/L		2	0.3	CRJ	07/09/2020 23:22	EPA 300.1-1997, Rev. 1.0

MW-4D LF

Sample Number: 202052-003 **Date Collected: 06/30/2020 08:47** **Date Received: 7/2/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	329	mg/L		20	5	MGK	07/07/2020 13:50	SM 2320B-2011
Bromide, Br	0.601	mg/L		0.2	0.04	CRJ	07/09/2020 17:33	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	22.2	mg/L		0.04	0.01	CRJ	07/09/2020 17:33	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.27	mg/L		0.06	0.01	CRJ	07/09/2020 17:33	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	867	mg/L		50	20	HRF	07/02/2020	SM 2540C-2011
The RPD between the LFB and LFBD exceeds 5%. The LFB is outside of the acceptable lmit of 92.24-105.69%. Hrf07102020								
Sulfate, SO4	336	mg/L		5	0.8	CRJ	07/09/2020 17:08	EPA 300.1-1997, Rev. 1.0

MW-5D LF

Sample Number: 202052-004 **Date Collected: 06/29/2020 15:31** **Date Received: 7/2/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	370	mg/L		20	5	MGK	07/07/2020 13:50	SM 2320B-2011
Bromide, Br	0.1	mg/L	J	0.2	0.04	CRJ	07/10/2020 07:16	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	26.7	mg/L		0.04	0.01	CRJ	07/10/2020 07:16	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.57	mg/L		0.06	0.01	CRJ	07/10/2020 07:16	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	641	mg/L		50	20	HRF	07/02/2020	SM 2540C-2011
The RPD between the LFB and LFBD exceeds 5%. The LFB is outside of the acceptable lmit of 92.24-105.69%. Hrf07102020								
Sulfate, SO4	165	mg/L		2	0.3	CRJ	07/09/2020 23:47	EPA 300.1-1997, Rev. 1.0

MW-6D LF

Sample Number: 202052-005 **Date Collected: 06/30/2020 10:01** **Date Received: 7/2/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	351	mg/L		20	5	MGK	07/07/2020 13:50	SM 2320B-2011
Bromide, Br	0.3	mg/L	J	0.5	0.1	CRJ	07/10/2020 01:52	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	24.9	mg/L		0.1	0.03	CRJ	07/10/2020 01:52	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.76	mg/L		0.2	0.04	CRJ	07/10/2020 01:52	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1080	mg/L		50	20	HRF	07/02/2020	SM 2540C-2011
The RPD between the LFB and LFBD exceeds 5%. The LFB is outside of the acceptable lmit of 92.24-105.69%. Hrf07102020								
Sulfate, SO4	533	mg/L		10	2	CRJ	07/09/2020 18:48	EPA 300.1-1997, Rev. 1.0

MW-9D LF

Sample Number: 202052-006 **Date Collected: 06/30/2020 09:54** **Date Received: 7/2/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	265	mg/L		20	5	MGK	07/07/2020 13:50	SM 2320B-2011
Bromide, Br	0.3	mg/L	J	0.5	0.1	CRJ	07/10/2020 02:17	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	26.2	mg/L		0.1	0.03	CRJ	07/10/2020 02:17	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.95	mg/L		0.2	0.04	CRJ	07/10/2020 02:17	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1070	mg/L		50	20	HRF	07/02/2020	SM 2540C-2011
The RPD between the LFB and LFBD exceeds 5%. The LFB is outside of the acceptable lmit of 92.24-105.69%. Hrf07102020								
Sulfate, SO4	602	mg/L		10	2	CRJ	07/09/2020 19:13	EPA 300.1-1997, Rev. 1.0

MW-12D LF

Sample Number: 202052-007 **Date Collected: 06/29/2020 14:51** **Date Received: 7/2/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	120	mg/L		20	5	MGK	07/07/2020 13:50	SM 2320B-2011
Bromide, Br	0.3	mg/L	J	0.5	0.1	CRJ	07/10/2020 03:06	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	15.0	mg/L		0.1	0.03	CRJ	07/10/2020 03:06	EPA 300.1-1997, Rev. 1.0
Fluoride, F	1.92	mg/L		0.2	0.04	CRJ	07/10/2020 03:06	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	945	mg/L		50	20	HRF	07/02/2020	SM 2540C-2011
The RPD between the LFB and LFBD exceeds 5%. The LFB is outside of the acceptable lmit of 92.24-105.69%. Hrf07102020								
Sulfate, SO4	602	mg/L		10	2	CRJ	07/09/2020 19:38	EPA 300.1-1997, Rev. 1.0

MW-13D LF

Sample Number: 202052-008 **Date Collected: 06/29/2020 14:33** **Date Received: 7/2/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	503	mg/L		20	5	MGK	07/07/2020 13:50	SM 2320B-2011
Bromide, Br	< 0.1	mg/L	U	0.5	0.1	CRJ	07/10/2020 05:36	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	4.68	mg/L		0.1	0.03	CRJ	07/10/2020 05:36	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.32	mg/L		0.2	0.04	CRJ	07/10/2020 05:36	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1100	mg/L		50	20	HRF	07/02/2020	SM 2540C-2011
The RPD between the LFB and LFBD exceeds 5%. The LFB is outside of the acceptable lmit of 92.24-105.69%. Hrf07102020								
Sulfate, SO4	476	mg/L		10	2	CRJ	07/09/2020 20:28	EPA 300.1-1997, Rev. 1.0

MW-14 LF

Sample Number: 202052-009 **Date Collected: 06/30/2020 09:04** **Date Received: 7/2/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	893	mg/L		20	5	MGK	07/07/2020 13:50	SM 2320B-2011
Bromide, Br	8.42	mg/L		5	1	CRJ	07/09/2020 20:53	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	2980	mg/L		10	3	CRJ	07/10/2020 12:46	EPA 300.1-1997, Rev. 1.0
Fluoride, F	3.97	mg/L		2	0.4	CRJ	07/09/2020 20:53	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	5370	mg/L		100	40	HRF	07/02/2020	SM 2540C-2011
Sample was reanalyzed on 7-8-2020 to confirm the results. Reanalysis occurred after the hold time was expired. Sdw70920 The RPD between the LFB and LFBD exceeds 5%. The LFB is outside of the acceptable lmit of 92.24-105.69%. Hrf07102020								
Sulfate, SO4	189	mg/L		10	2	CRJ	07/09/2020 20:53	EPA 300.1-1997, Rev. 1.0

MW-15 LF

Sample Number: 202052-010 **Date Collected: 06/30/2020 09:33** **Date Received: 7/2/2020**

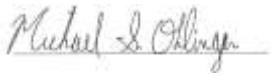
Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	129	mg/L		20	5	MGK	07/07/2020 13:50	SM 2320B-2011
Bromide, Br	0.3	mg/L	J	0.5	0.1	CRJ	07/10/2020 03:31	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	17.9	mg/L		0.1	0.03	CRJ	07/10/2020 03:31	EPA 300.1-1997, Rev. 1.0
Fluoride, F	1.55	mg/L		0.2	0.04	CRJ	07/10/2020 03:31	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1100	mg/L		50	20	HRF	07/02/2020	SM 2540C-2011
The RPD between the LFB and LFBD exceeds 5%. The LFB is outside of the acceptable lmit of 92.24-105.69%. Hrf07102020								
Sulfate, SO4	706	mg/L		10	2	CRJ	07/09/2020 21:17	EPA 300.1-1997, Rev. 1.0

Landfill Duplicate LF

Sample Number: 202052-011 **Date Collected: 06/30/2020 08:51** **Date Received: 7/2/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	328	mg/L		20	5	MGK	07/07/2020 13:50	SM 2320B-2011
Bromide, Br	0.546	mg/L		0.5	0.1	CRJ	07/10/2020 03:56	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	22.3	mg/L		0.1	0.03	CRJ	07/10/2020 03:56	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.25	mg/L		0.2	0.04	CRJ	07/10/2020 03:56	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	884	mg/L		50	20	HRF	07/02/2020	SM 2540C-2011
The RPD between the LFB and LFBD exceeds 5%. The LFB is outside of the acceptable lmit of 92.24-105.69%. Hrf07102020								
Sulfate, SO4	361	mg/L		10	2	CRJ	07/09/2020 21:42	EPA 300.1-1997, Rev. 1.0

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



Michael Ohlinger, Chemist

Email msohlinger@aep.com *Tel.*

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

Form REP-703
Rev. 1, 11/2013

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

Water Analysis

Location: Northeastern Station ***Report Date: 9/11/2020***

MW-5D

Sample Number: 202684-001 **Date Collected: 09/08/2020 14:13** **Date Received: 9/9/2020**

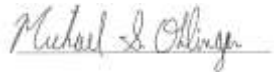
Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Sulfate, SO4	176	mg/L		10	2	CRJ	09/09/2020 17:09	EPA 300.1-1997, Rev. 1.0

MW-15

Sample Number: 202684-002 **Date Collected: 09/08/2020 13:51** **Date Received: 9/9/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Sulfate, SO4	730	mg/L		10	2	CRJ	09/09/2020 17:34	EPA 300.1-1997, Rev. 1.0

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



Michael Ohlinger, Chemist
Email msohlinger@aep.com *Tel.*
Fax 614-836-4168 *Audinet 8-210-*

Form REP-703
Rev. 1, 11/2013

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

Water Analysis

Location: Northeastern Station ***Report Date: 11/4/2020***

MW-3D

Sample Number: 203053-001 **Date Collected: 10/21/2020 09:38** **Date Received: 10/23/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	392	mg/L		20	5	MGK	10/28/2020 15:14	SM 2320B-2011
Bromide, Br	0.264	mg/L		0.2	0.04	CRJ	10/30/2020 18:17	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	12.6	mg/L		0.04	0.01	CRJ	10/30/2020 18:17	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.77	mg/L		0.06	0.01	CRJ	10/30/2020 18:17	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	667	mg/L		50	20	HRF	11/27/2020	SM 2540C-2011
Sulfate, SO4	189	mg/L		2	0.3	CRJ	10/30/2020 17:51	EPA 300.1-1997, Rev. 1.0

MW-4D

Sample Number: 203053-002 **Date Collected: 10/21/2020 08:46** **Date Received: 10/23/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	353	mg/L		20	5	MGK	10/28/2020 15:14	SM 2320B-2011
Bromide, Br	0.494	mg/L		0.2	0.04	CRJ	10/30/2020 21:40	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	24.3	mg/L		0.04	0.01	CRJ	10/30/2020 21:40	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.27	mg/L		0.06	0.01	CRJ	10/30/2020 21:40	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	813	mg/L		50	20	HRF	11/27/2020	SM 2540C-2011
Sulfate, SO4	272	mg/L		2	0.3	CRJ	10/30/2020 19:08	EPA 300.1-1997, Rev. 1.0

MW-5D

Sample Number: 203053-003 **Date Collected: 10/21/2020 09:20** **Date Received: 10/23/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	380	mg/L		20	5	MGK	10/28/2020 15:14	SM 2320B-2011
Bromide, Br	0.1	mg/L	J	0.2	0.04	CRJ	10/30/2020 22:06	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	26.3	mg/L		0.04	0.01	CRJ	10/30/2020 22:06	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.54	mg/L		0.06	0.01	CRJ	10/30/2020 22:06	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	655	mg/L		50	20	HRF	11/27/2020	SM 2540C-2011
Sulfate, SO4	158	mg/L		2	0.3	CRJ	10/30/2020 19:33	EPA 300.1-1997, Rev. 1.0

MW-6D

Sample Number: 203053-004 **Date Collected: 10/21/2020 09:51** **Date Received: 10/23/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	356	mg/L		20	5	MGK	10/28/2020 15:14	SM 2320B-2011
Bromide, Br	0.482	mg/L		0.2	0.04	CRJ	10/31/2020 04:02	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	29.9	mg/L		0.04	0.01	CRJ	10/31/2020 04:02	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.75	mg/L		0.06	0.01	CRJ	10/31/2020 04:02	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1060	mg/L		50	20	HRF	11/27/2020	SM 2540C-2011
Sulfate, SO4	426	mg/L		5	0.8	CRJ	10/30/2020 21:15	EPA 300.1-1997, Rev. 1.0

MW-9D

Sample Number: 203053-005 **Date Collected: 10/21/2020 10:04** **Date Received: 10/23/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	294	mg/L		20	5	MGK	10/28/2020 15:14	SM 2320B-2011
Bromide, Br	0.295	mg/L		0.2	0.04	CRJ	10/31/2020 04:53	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	25.3	mg/L		0.04	0.01	CRJ	10/31/2020 04:53	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.97	mg/L		0.06	0.01	CRJ	10/31/2020 04:53	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1160	mg/L		50	20	HRF	11/27/2020	SM 2540C-2011
Sulfate, SO4	547	mg/L		5	0.8	CRJ	10/31/2020 01:04	EPA 300.1-1997, Rev. 1.0

MW-12D

Sample Number: 203053-006 **Date Collected: 10/20/2020 14:00** **Date Received: 10/23/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	127	mg/L		20	5	MGK	10/28/2020 15:14	SM 2320B-2011
Bromide, Br	0.366	mg/L		0.2	0.04	CRJ	10/31/2020 05:18	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	16.1	mg/L		0.04	0.01	CRJ	10/31/2020 05:18	EPA 300.1-1997, Rev. 1.0
Fluoride, F	2.06	mg/L		0.06	0.01	CRJ	10/31/2020 05:18	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1060	mg/L		50	20	HRF	11/27/2020	SM 2540C-2011
Sulfate, SO4	585	mg/L		5	0.8	CRJ	10/31/2020 01:29	EPA 300.1-1997, Rev. 1.0

MW-14

Sample Number: 203053-007 **Date Collected: 10/21/2020 09:06** **Date Received: 10/23/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	835	mg/L		20	5	MGK	10/28/2020 15:14	SM 2320B-2011
Bromide, Br	8.78	mg/L		2	0.5	CRJ	10/31/2020 06:09	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	2830	mg/L		5	2	CRJ	10/31/2020 01:55	EPA 300.1-1997, Rev. 1.0
Fluoride, F	4.22	mg/L		0.8	0.2	CRJ	10/31/2020 06:09	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	11900	mg/L		200	80	HRF	10/28/2020	SM 2540C-2011
Sample 203053-007-B exceeded 0.2g at 2x and was reran at 4x dilution for verification results: 6048mg/L, but was past the hold time. The 2x was reported. Hrf10292020.								
Sulfate, SO4	226	mg/L		5	0.8	CRJ	10/31/2020 06:09	EPA 300.1-1997, Rev. 1.0

MW-15

Sample Number: 203053-008 **Date Collected: 10/21/2020 10:23** **Date Received: 10/23/2020**

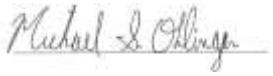
Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	143	mg/L		20	5	MGK	10/28/2020 15:14	SM 2320B-2011
Bromide, Br	0.305	mg/L		0.2	0.04	CRJ	10/31/2020 06:34	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	15.7	mg/L		0.04	0.01	CRJ	10/31/2020 06:34	EPA 300.1-1997, Rev. 1.0
Fluoride, F	1.53	mg/L		0.06	0.01	CRJ	10/31/2020 06:34	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1140	mg/L		50	20	HRF	11/27/2020	SM 2540C-2011
Sulfate, SO4	631	mg/L		5	0.8	CRJ	10/31/2020 02:45	EPA 300.1-1997, Rev. 1.0

Landfill Duplicate

Sample Number: 203053-009 **Date Collected: 10/21/2020 08:56** **Date Received: 10/23/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Alkalinity, as CaCO3	349	mg/L		20	5	MGK	10/28/2020 15:14	SM 2320B-2011
Bromide, Br	0.5	mg/L	J	0.5	0.1	CRJ	10/30/2020 17:01	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	24.0	mg/L		0.1	0.03	CRJ	10/30/2020 17:01	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.25	mg/L		0.2	0.04	CRJ	10/30/2020 17:01	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	808	mg/L		100	40	HRF	11/27/2020	SM 2540C-2011
Sulfate, SO4	243	mg/L		10	2	CRJ	10/30/2020 16:35	EPA 300.1-1997, Rev. 1.0

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

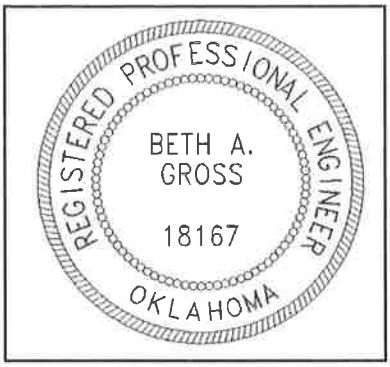


Michael Ohlinger, Chemist
Email msohlinger@aep.com *Tel.*
Fax 614-836-4168 *Audinet 8-210-*

ATTACHMENT C
Certification by Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Northeastern Landfill CCR management area and that the requirements of OAC 252:517-9-5(e)(2) 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. 6/30/2022

18167	Oklahoma	February 26, 2021
License Number	Licensing State	Date

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

October 19, 2021

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)
Landfill (LF)
Public Service Company of Oklahoma (PSO) - Northeastern Power Station (NPS)
Roger County
Solid Waste Permit No. 3566010

Dear Ms. Young,

PSO received ODEQ's correspondence dated June 22, 2021 in which ODEQ accepted the ASD for the Sulfate detected in MW-15 during the June 2020 sampling event. ODEQ agreed that the statistically significant increase (SSI) for Sulfate in MW-15 may be attributed to natural variation in the aquifer and accepted the ASD. For future sulfate SSIs, a new ASD in accordance with OAC 252:517-9-5(e)(2) is required.

On July 22, 2021, the statistical evaluation of the first semi-annual 2021 assessment monitoring event conducted April 12, 2021 for the LF was certified. In that statistical evaluation report, it was determined that Sulfate concentrations exceeded the intrawell UPL of 642 mg/L in both the initial (659 mg/L) and second (662 mg/L) samples collected at MW-15. Therefore, an SSI over background is concluded for sulfate at MW-15.

Attached is an ASD for your review outlining the lines of evidence that these exceedances are the result of natural variations occurring in the groundwater surrounding the LF.

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

ALTERNATIVE SOURCE DEMONSTRATION REPORT STATE CCR RULE

Northeastern Plant Landfill
Oologah, Oklahoma

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, OH 43221

October 2021

CHA8495

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
EPRI	Electric Power Research Institute
LPL	Lower Prediction Limit
OAC	Oklahoma Administrative Code
ODEQ	Oklahoma Department of Environmental Quality
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SU	Standard Units
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

The Northeastern Plant Landfill (Northeastern Landfill) is a regulated coal combustion residual (CCR) management unit at the Northeastern Power Station in Oogolah, Oklahoma. Prediction limits were recalculated in 2020 to include data from recent sampling events. The recalculated prediction limits used intrawell statistics to reflect natural variability between wells (Geosyntec, 2020). Upper prediction limits (UPLs) were calculated for each Appendix A parameter to represent background values. In addition, a lower prediction limit (LPL) was also calculated for pH. A one-of-two retesting procedure was employed for all wells at the Northeastern Landfill. Using this procedure, a statistically significant increase (SSI) is concluded only if both samples in a series of two exceed the UPL and, for pH, are lower than the LPL. If the initial result did not exceed a prediction limit, a second sample was not collected.

The first semi-annual detection monitoring event of 2021 was performed on 13 April 2021 (initial sampling event) and 22 June 2021 (verification sampling event), and the results were compared to the calculated prediction limits. One SSI was identified for sulfate at MW-15 using an intrawell comparison. A summary of the detection monitoring analytical results and the calculated prediction limits to which they were compared is presented in **Table 1**.

1.1 CCR Rule Requirements

Oklahoma Department of Environmental Quality (ODEQ) regulations regarding detection monitoring programs for coal combustion residuals (CCR) landfills and surface impoundments allow the following evaluation process when an SSI has been identified (OAC 252:517-9-5(e)(2)):

> *The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report.*

Pursuant to OAC 252:517-9-5(e)(2), Geosyntec Consultants, Inc. (Geosyntec) has prepared this ASD report, which documents that the SSI identified for sulfate should not be attributed to the Northeastern Landfill.

1.2 Demonstration of Alternative Sources

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

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

A demonstration was conducted to assess whether the increases in constituent concentrations were based on Type II and Type IV causes for sulfate at monitoring well MW-15 and not by a release from the Northeastern Landfill.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The methods used to assess possible alternative sources of the SSI for sulfate at MW-15 and the proposed alternative sources are described below.

2.1 Proposed Alternative Source

As described below, the SSI observed at well MW-15 for sulfate is attributed to natural variation in the aquifer or laboratory causes, which are Type IV and Type II issues, respectively.

An SSI was identified for sulfate at MW-15 using intrawell comparisons during the 13 April and 22 June 2021 sampling events (**Table 1**). The reported sulfate concentrations for the April (659 mg/L) and June (662 mg/L) 2021 samples from well MW-15 were above the calculated UPL of 642 mg/L (**Figure 1**). The analytical laboratory reports for both events are provided in **Attachment A**. No other Appendix A exceedances were observed for MW-15 during the first semi-annual event, with concentrations of these constituents appearing to be relatively stable during recent sampling events. This is illustrated in the time series graphs for calcium and chloride, which are provided in **Figure 2** and **Figure 3**, respectively.

Additionally, a piper diagram was created to illustrate changes in MW-15 groundwater geochemistry over time (**Figure 4**). This diagram shows that there is very little historical variation in the geochemistry of groundwater sampled at MW-15 from background (2017) to present. Thus, the observed sulfate concentrations in MW-15 during the first semi-annual event are not considered indicative of a release from the Landfill and are instead likely due to natural variability (Type IV ASD) in the aquifer.

The sulfate samples were analyzed using USEPA Method 300.1, which prescribes ±15% variation as the daily calibration verification standard acceptance criteria (USEPA, 1999). Because both reported concentrations at MW-15 are within 15% (2.6% and 3.1% for the April and June 2021 sampling events, respectively) of the calculated intrawell UPL, the variations observed, although above the UPL, may also be due to the anticipated variation in the analytical procedure (Type II ASD).

2.2 Sampling Requirements

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

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with OAC 252:517-9-5(e)(2) and supports the position that the SSI in MW-15 observed during the first semi-annual sampling event in 2021 is not due to a release from the Northeastern Landfill. The observed SSI was, instead, attributed to a combination of natural variation in the aquifer and variation in the laboratory procedure. Therefore, no further action is warranted, and the Northeastern Landfill will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in **Attachment B**.

SECTION 4

REFERENCES

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

Geosyntec Consultants, 2020. Statistical Analysis Summary – Background Update Calculations. Stations 3 and 4 Landfill. Northeastern Plant Station. January.

USEPA, 1999. Method 300.1 – Determination of Inorganic Anions in Drinking Water by Ion Chromatography. Revision 1.0

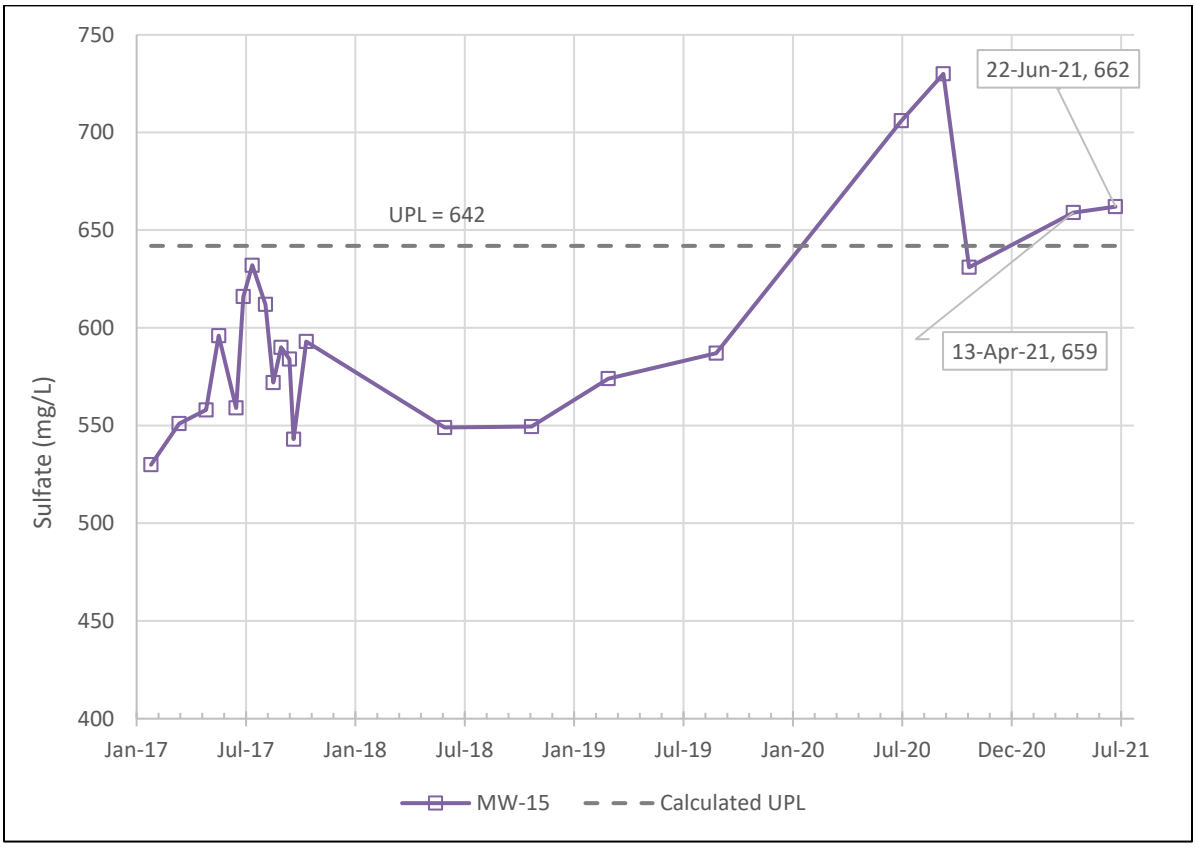
TABLES

Table 1: Detection Monitoring Data Summary
Northeastern Plant - Landfill

Analyte	Unit	Description	MW-3D	MW-4D		MW-5D	MW-6D	MW-9D		MW-12D	MW-15	
			4/13/2021	4/13/2021	6/22/2021	4/13/2021	4/13/2021	4/13/2021	6/22/2021	4/13/2021	4/13/2021	6/22/2021
Boron	mg/L	Intrawell Background Value (UPL)	1.07	1.52		0.647	4.73	8.00		10.3	10.6	
		Analytical Result	0.924	1.20	--	0.539	3.35	6.70	--	7.96	8.40	--
Calcium	mg/L	Intrawell Background Value (UPL)	181	221		172	342	456		198	196	
		Analytical Result	114	195	--	131	170	158	--	79.0	93.5	--
Chloride	mg/L	Intrawell Background Value (UPL)	16.0	46.2		35.3	34.1	403		25.6	104	
		Analytical Result	12.6	23.0	--	27.3	28.4	26.1	--	16.1	15.5	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1.09	1.00		1.24	1.24	2.18		3.40	2.49	
		Analytical Result	0.84	0.33	--	0.59	0.93	0.99	--	2.00	1.71	--
pH	SU	Intrawell Background Value (UPL)	8.2	8.6		8.8	8.1	7.7		10.2	9.0	
		Intrawell Background Value (LPL)	6.3	6.7		6.9	6.3	6.8		6.7	6.7	
		Analytical Result	7.4	7.3	7.1	7.6	8.1	**8.2**	7.6	8.4	8.8	7.8
Sulfate	mg/L	Intrawell Background Value (UPL)	248	428		160	585	1,640		720	642	
		Analytical Result	184	**429**	398	160	478	594	--	590	**659**	**662**
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	832	1,040		686	1,180	3,480		1,160	1,160	
		Analytical Result	633	979	--	632	1,090	1,180	--	1,030	1,100	--

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
--: Not Analyzed

FIGURES



Notes: Initial sampling for the first semi-annual detection monitoring event occurred in April 2021. Verification sampling for the first semi-annual event occurred in June 2021. The upper prediction limit (UPL) was calculated using intrawell analyses for MW-15.

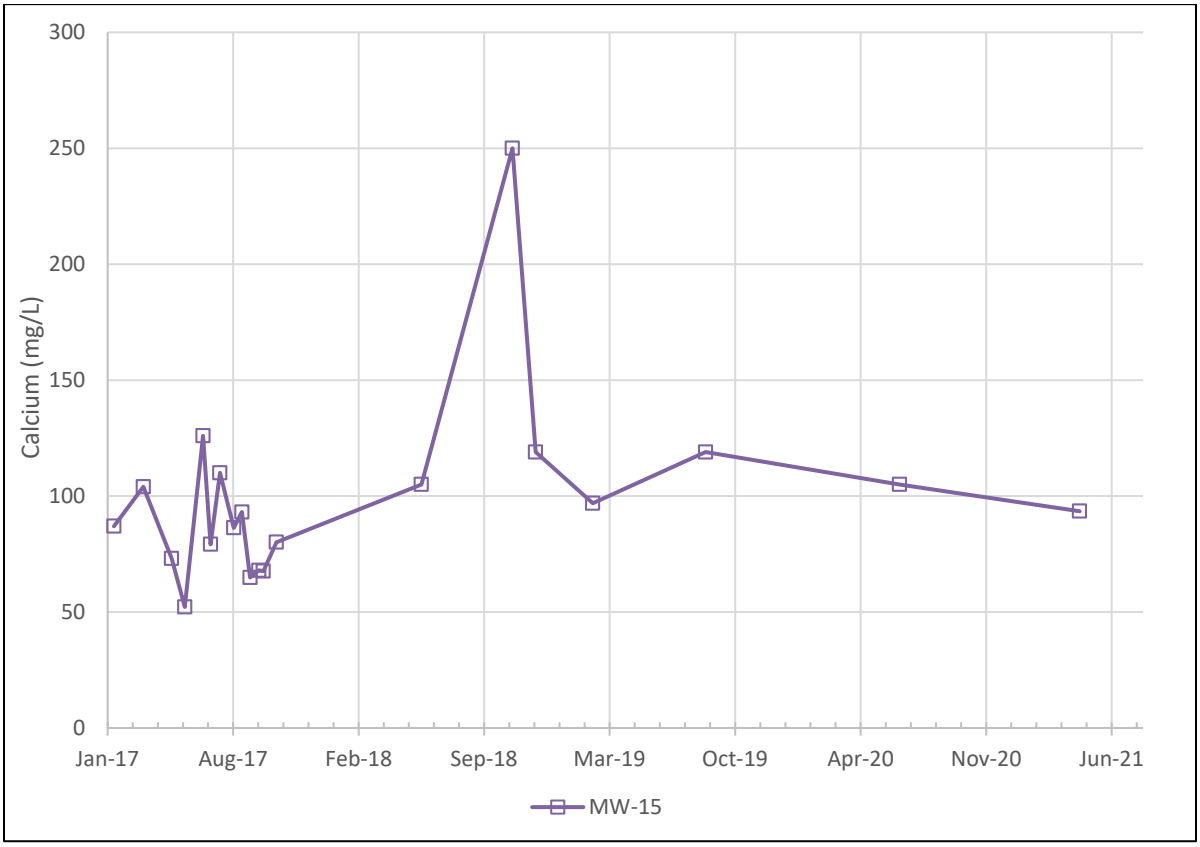
Sulfate Time Series Graph
Northeastern Landfill

Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | 17-Sep-21

Figure **1**

2020-CHA846-AEP Northeastern ASD, CIC



Notes: Calcium results are shown in milligrams per liter (mg/L).

Calcium Time Series Graph
Northeastern Landfill

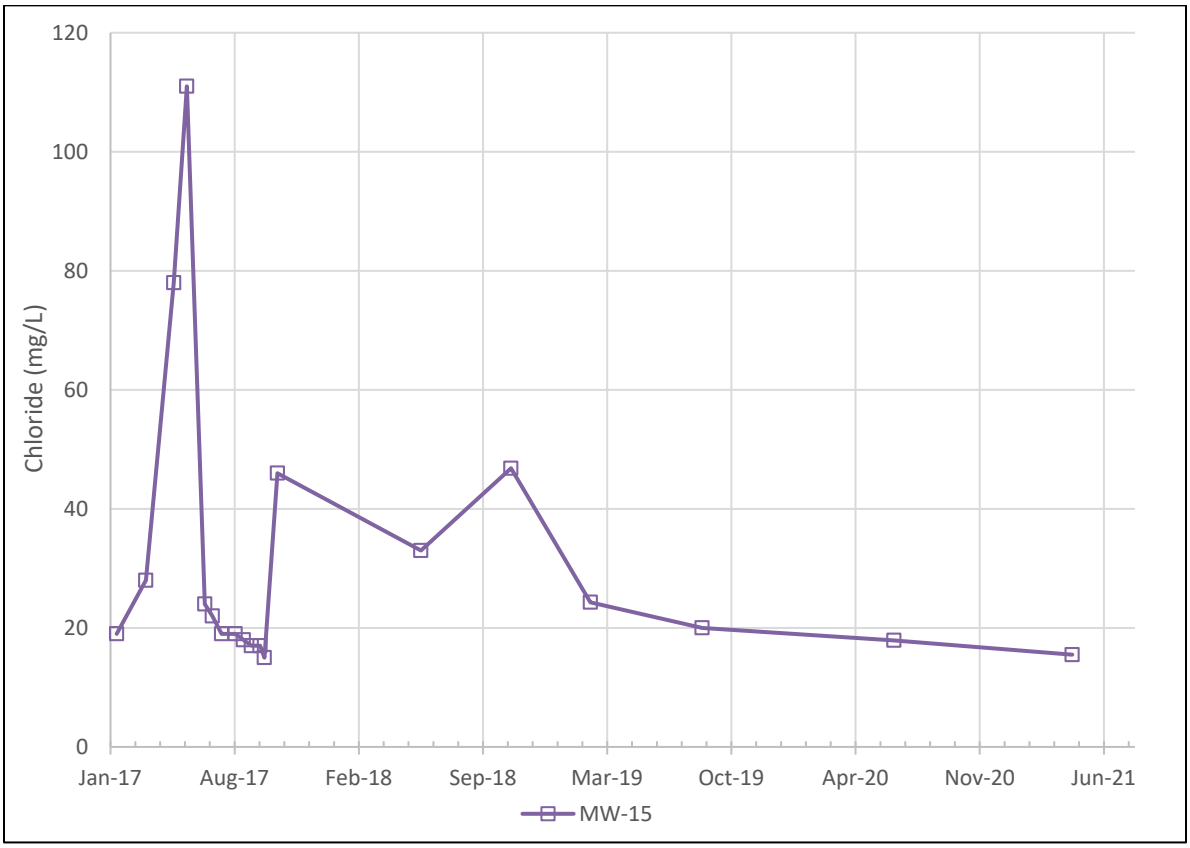
Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure **2**

Columbus, Ohio

17-Sep-21



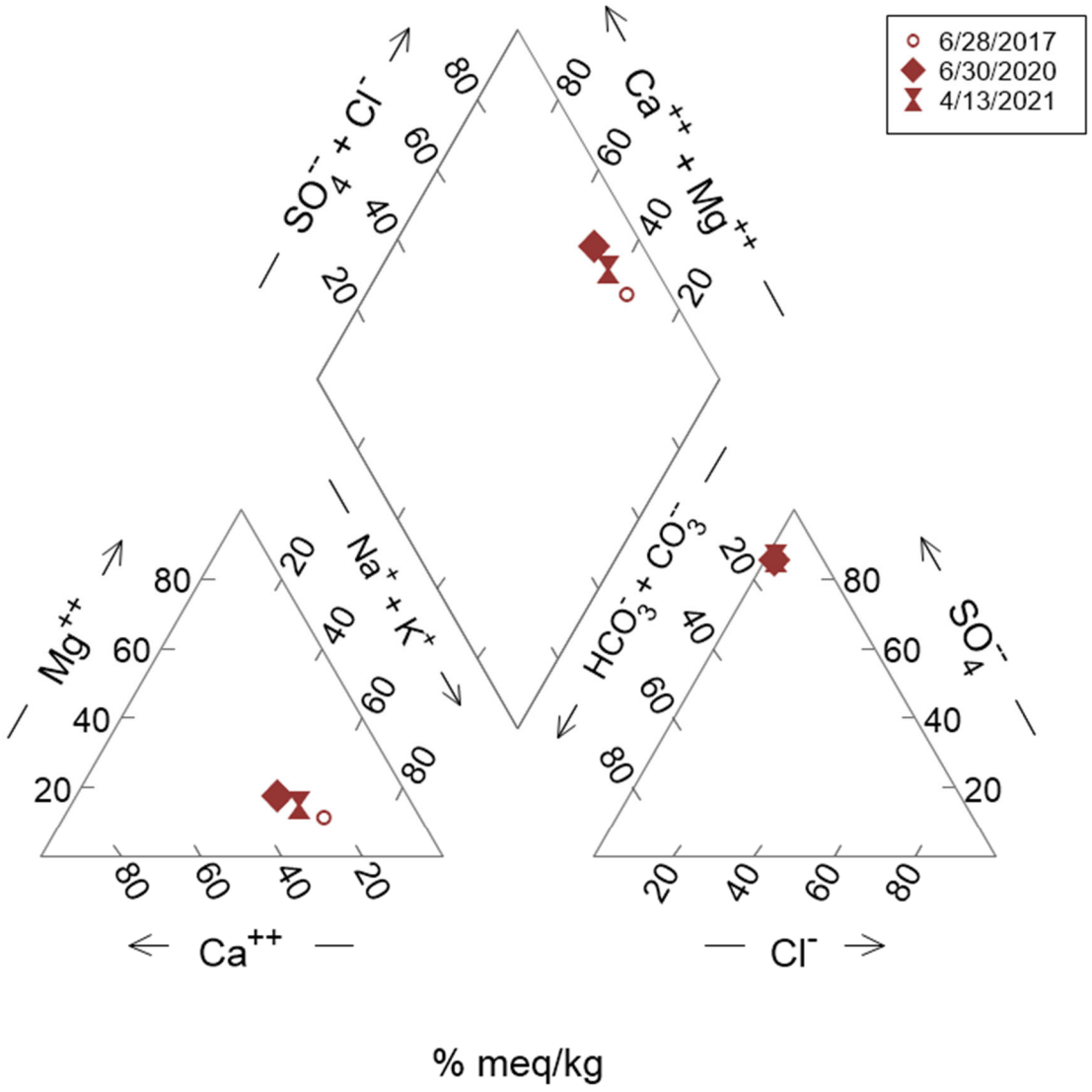
Notes: Chloride results are shown in milligrams per liter (mg/L).

Chloride Time Series Graph
Northeastern Landfill

Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | 17-Sep-21

Figure **3**



Notes: Data shown are for sampling events at MW-15 at the dates listed. Results are shown in the relative percentage of milliequivalents per kilogram (meq/kg).

MW-15 Piper Diagram
Northeastern Landfill

Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | 17-Sep-21

Figure **4**

2020-CHA846-AEP Northeastern ASD, CIC

ATTACHMENT A
Analytical Laboratory Reports

Form REP-703
Rev. 1, 11/2013

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

Water Analysis

Location: Northeastern Station ***Report Date: 4/30/2021***

MW-2D

Sample Number: 210878-001 **Date Collected: 04/13/2021 09:58** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	10.6	mg/L		0.05	0.009	GES	04/20/2021 02:13	EPA 200.8-1994, Rev. 5.4
•The MSD is outside the acceptable limit of 75-125%.•The RPD between the MS/MSD exceeds 20%.								
Calcium, Ca	12.5	mg/L		0.3	0.1	DAM	04/19/2021 17:21	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	0.157	mg/L		0.1	0.02	DAM	04/19/2021 17:21	EPA 200.7-1994, Rev. 4.4
Potassium, K	4.68	mg/L		1	0.2	DAM	04/19/2021 17:21	EPA 200.7-1994, Rev. 4.4
Sodium, Na	384	mg/L		0.5	0.2	DAM	04/19/2021 17:21	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	216	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.380	mg/L		0.1	0.02	CRJ	04/21/2021 21:48	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	12.1	mg/L		0.04	0.01	CRJ	04/21/2021 21:48	EPA 300.1-1997, Rev. 1.0
Fluoride, F	1.81	mg/L		0.06	0.01	CRJ	04/21/2021 21:48	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1250	mg/L		100	40	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	654	mg/L		5	0.8	CRJ	04/21/2021 13:45	EPA 300.1-1997, Rev. 1.0

MW-3D

Sample Number: 210878-002 **Date Collected: 04/13/2021 12:16** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.924	mg/L		0.05	0.009	GES	04/20/2021 02:18	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	114	mg/L		0.3	0.1	DAM	04/19/2021 17:02	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	44.9	mg/L		0.1	0.02	DAM	04/19/2021 17:02	EPA 200.7-1994, Rev. 4.4
Potassium, K	2.04	mg/L		1	0.2	DAM	04/19/2021 17:02	EPA 200.7-1994, Rev. 4.4
Sodium, Na	63.7	mg/L		0.5	0.2	DAM	04/19/2021 17:02	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	370	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.368	mg/L		0.1	0.02	CRJ	04/21/2021 20:57	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	12.6	mg/L		0.04	0.01	CRJ	04/21/2021 20:57	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.84	mg/L		0.06	0.01	CRJ	04/21/2021 20:57	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	633	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	184	mg/L		2	0.3	CRJ	04/21/2021 14:10	EPA 300.1-1997, Rev. 1.0

MW-4D

Sample Number: 210878-003 **Date Collected: 04/13/2021 15:32** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	1.20	mg/L		0.05	0.009	GES	04/20/2021 02:23	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	195	mg/L		0.3	0.1	DAM	04/19/2021 17:26	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	25.2	mg/L		0.1	0.02	DAM	04/19/2021 17:26	EPA 200.7-1994, Rev. 4.4
Potassium, K	1.79	mg/L		1	0.2	DAM	04/19/2021 17:26	EPA 200.7-1994, Rev. 4.4
Sodium, Na	116	mg/L		0.5	0.2	DAM	04/19/2021 17:26	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	336	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	1.05	mg/L		0.1	0.02	CRJ	04/21/2021 21:22	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	23.0	mg/L		0.04	0.01	CRJ	04/21/2021 21:22	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.33	mg/L		0.06	0.01	CRJ	04/21/2021 21:22	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	979	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	429	mg/L		5	0.8	CRJ	04/21/2021 14:36	EPA 300.1-1997, Rev. 1.0

MW-5D

Sample Number: 210878-004 **Date Collected: 04/13/2021 09:25** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.539	mg/L		0.05	0.009	GES	04/20/2021 02:28	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	131	mg/L		0.3	0.1	DAM	04/19/2021 17:30	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	49.1	mg/L		0.1	0.02	DAM	04/19/2021 17:30	EPA 200.7-1994, Rev. 4.4
Potassium, K	1.09	mg/L		1	0.2	DAM	04/19/2021 17:30	EPA 200.7-1994, Rev. 4.4
Sodium, Na	37.5	mg/L		0.5	0.2	DAM	04/19/2021 17:30	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	391	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.173	mg/L		0.1	0.02	CRJ	04/21/2021 22:39	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	27.3	mg/L		0.04	0.01	CRJ	04/21/2021 22:39	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.59	mg/L		0.06	0.01	CRJ	04/21/2021 22:39	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	632	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	160	mg/L		2	0.3	CRJ	04/21/2021 15:01	EPA 300.1-1997, Rev. 1.0

MW-6D

Sample Number: 210878-005 **Date Collected: 04/13/2021 11:40** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	3.35	mg/L		0.05	0.009	GES	04/20/2021 02:33	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	170	mg/L		0.3	0.1	DAM	04/19/2021 17:34	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	36.0	mg/L		0.1	0.02	DAM	04/19/2021 17:34	EPA 200.7-1994, Rev. 4.4
Potassium, K	3.29	mg/L		1	0.2	DAM	04/19/2021 17:34	EPA 200.7-1994, Rev. 4.4
Sodium, Na	154	mg/L		0.5	0.2	DAM	04/19/2021 17:34	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	362	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.484	mg/L		0.1	0.02	CRJ	04/21/2021 23:04	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	28.4	mg/L		0.04	0.01	CRJ	04/21/2021 23:04	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.93	mg/L		0.06	0.01	CRJ	04/21/2021 23:04	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1090	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	478	mg/L		5	0.8	CRJ	04/21/2021 15:52	EPA 300.1-1997, Rev. 1.0

MW-9D

Sample Number: 210878-006 **Date Collected: 04/13/2021 10:46** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	6.70	mg/L		0.05	0.009	GES	04/20/2021 02:38	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	158	mg/L		0.3	0.1	DAM	04/19/2021 17:38	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	71.6	mg/L		0.1	0.02	DAM	04/19/2021 17:38	EPA 200.7-1994, Rev. 4.4
Potassium, K	4.41	mg/L		1	0.2	DAM	04/19/2021 17:38	EPA 200.7-1994, Rev. 4.4
Sodium, Na	163	mg/L		0.5	0.2	DAM	04/19/2021 17:38	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	307	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.367	mg/L		0.1	0.02	CRJ	04/21/2021 23:30	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	26.1	mg/L		0.04	0.01	CRJ	04/21/2021 23:30	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.99	mg/L		0.06	0.01	CRJ	04/21/2021 23:30	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1180	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	594	mg/L		5	0.8	CRJ	04/21/2021 16:17	EPA 300.1-1997, Rev. 1.0

MW-12D

Sample Number: 210878-007 **Date Collected: 04/13/2021 08:41** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	7.96	mg/L		0.05	0.009	GES	04/20/2021 02:43	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	79.0	mg/L		0.3	0.1	DAM	04/19/2021 17:42	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	9.69	mg/L		0.1	0.02	DAM	04/19/2021 17:42	EPA 200.7-1994, Rev. 4.4
Potassium, K	2.22	mg/L		1	0.2	DAM	04/19/2021 17:42	EPA 200.7-1994, Rev. 4.4
Sodium, Na	240	mg/L		0.5	0.2	DAM	04/19/2021 17:42	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	124	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.429	mg/L		0.1	0.02	CRJ	04/22/2021 00:20	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	16.1	mg/L		0.04	0.01	CRJ	04/22/2021 00:20	EPA 300.1-1997, Rev. 1.0
Fluoride, F	2.00	mg/L		0.06	0.01	CRJ	04/22/2021 00:20	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1030	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	590	mg/L		5	0.8	CRJ	04/21/2021 16:43	EPA 300.1-1997, Rev. 1.0

MW-13D

Sample Number: 210878-008 **Date Collected: 04/13/2021 08:24** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	1.39	mg/L		0.05	0.009	GES	04/20/2021 02:49	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	192	mg/L		0.3	0.1	DAM	04/19/2021 17:47	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	88.3	mg/L		0.1	0.02	DAM	04/19/2021 17:47	EPA 200.7-1994, Rev. 4.4
Potassium, K	1.94	mg/L		1	0.2	DAM	04/19/2021 17:47	EPA 200.7-1994, Rev. 4.4
Sodium, Na	82.3	mg/L		0.5	0.2	DAM	04/19/2021 17:47	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	456	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.1	mg/L	J	0.1	0.02	CRJ	04/22/2021 00:46	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	5.83	mg/L		0.04	0.01	CRJ	04/22/2021 00:46	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.46	mg/L		0.06	0.01	CRJ	04/22/2021 00:46	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1170	mg/L		100	40	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	519	mg/L		5	0.8	CRJ	04/21/2021 17:08	EPA 300.1-1997, Rev. 1.0

MW-15

Sample Number: 210878-009 **Date Collected: 04/13/2021 10:28** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	8.40	mg/L		0.05	0.009	GES	04/20/2021 02:54	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	93.5	mg/L		0.3	0.1	DAM	04/19/2021 17:52	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	29.7	mg/L		0.1	0.02	DAM	04/19/2021 17:52	EPA 200.7-1994, Rev. 4.4
Potassium, K	2.17	mg/L		1	0.2	DAM	04/19/2021 17:52	EPA 200.7-1994, Rev. 4.4
Sodium, Na	216	mg/L		0.5	0.2	DAM	04/19/2021 17:52	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	115	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.361	mg/L		0.1	0.02	CRJ	04/22/2021 01:37	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	15.5	mg/L		0.04	0.01	CRJ	04/22/2021 01:37	EPA 300.1-1997, Rev. 1.0
Fluoride, F	1.71	mg/L		0.06	0.01	CRJ	04/22/2021 01:37	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1100	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	659	mg/L		5	0.8	CRJ	04/21/2021 17:59	EPA 300.1-1997, Rev. 1.0

Landfill Duplicate

Sample Number: 210878-010 **Date Collected: 04/13/2021 18:00** **Date Received: 4/15/2021**

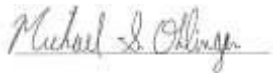
Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	1.17	mg/L		0.05	0.009	GES	04/20/2021 02:59	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	189	mg/L		0.3	0.1	DAM	04/19/2021 18:29	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	24.4	mg/L		0.1	0.02	DAM	04/19/2021 18:29	EPA 200.7-1994, Rev. 4.4
Potassium, K	1.62	mg/L		1	0.2	DAM	04/19/2021 18:29	EPA 200.7-1994, Rev. 4.4
Sodium, Na	113	mg/L		0.5	0.2	DAM	04/19/2021 18:29	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	358	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.991	mg/L		0.1	0.02	CRJ	04/22/2021 02:02	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	22.9	mg/L		0.04	0.01	CRJ	04/22/2021 02:02	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.32	mg/L		0.06	0.01	CRJ	04/22/2021 02:02	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	992	mg/L		100	40	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	427	mg/L		5	0.8	CRJ	04/21/2021 18:25	EPA 300.1-1997, Rev. 1.0

Equipment Blank

Sample Number: 210878-011 **Date Collected: 04/13/2021 09:00** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	< 0.009	mg/L	U	0.05	0.009	GES	04/20/2021 05:53	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	< 0.1	mg/L	U	0.3	0.1	DAM	04/19/2021 17:57	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	< 0.02	mg/L	U	0.1	0.02	DAM	04/19/2021 17:57	EPA 200.7-1994, Rev. 4.4
Potassium, K	< 0.2	mg/L	U	1	0.2	DAM	04/19/2021 17:57	EPA 200.7-1994, Rev. 4.4
Sodium, Na	< 0.2	mg/L	U	0.5	0.2	DAM	04/19/2021 17:57	EPA 200.7-1994, Rev. 4.4

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



Michael Ohlinger, Chemist

Email msohlinger@aep.com *Tel.*

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

Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 215210 **Customer: Northeastern 3&4 Power Station** **Date Reported: 07/09/2021**

Customer Sample ID: MW-4D
Customer Description:
Lab Number: 215210-001
Sampling Point:
Date Collected: 06/22/2021 16:17
Date Received: 06/23/2021 11:29
Preparation:

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Sulfate	398	mg/L	25	5.0	0.8		CRJ	06/24/2021 14:50	EPA 300.1 -1997, Rev. 1.0

Customer Sample ID: MW-15
Customer Description:
Lab Number: 215210-002
Sampling Point:
Date Collected: 06/22/2021 15:38
Date Received: 06/23/2021 11:29
Preparation:

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Sulfate	662	mg/L	25	5.0	0.8		CRJ	06/24/2021 15:15	EPA 300.1 -1997, Rev. 1.0

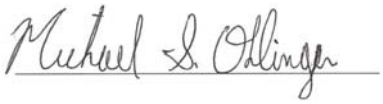
Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 215210 **Customer: Northeastern 3&4 Power Station** **Date Reported: 07/09/2021**

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

ATTACHMENT B
Certification by Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Northeastern Landfill CCR management area and that the requirements of OAC 252:517-9-5(e)(2) 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. 6/30/2022

18167	Oklahoma	10/18/2021
License Number	Licensing State	Date

APPENDIX 6

Groundwater monitoring Field and Laboratory Reports

NORTHEASTERN POWER PLANT
GROUNDWATER SAMPLING DATA FORM

SAMPLED BY: Kenny McDonald . **DATE:** 04/12-13/21 .

Well Identification Number	MW-1D	MW-1S	MW-2D	MW-2S	MW-3D	MW-3S
Activities	Gauge	Gauge	Gauge	Gauge	Gauge	Gauge
Samples	Appendix III	NA	Appendix III	WQ & Metals/Filtered	Appendix III	WQ & Metals/Filtered
Depth to Water (ft)	53.42	22.01	54.87	30.24	37.19	20.47
Water Level Elevation (ft. NGVD)						
Measured Depth Total Depth of Well (ft.)	58.25	37.76	61.80	36.75	62.95	27.21
Height of Water Column (ft.)	4.83	15.75	6.93	6.51	25.76	6.74
Well Size (I.D.) (inches)	2	2	2	2	2	2
Volume of Water in Well (gallons)	0.79	2.57	1.13	1.06	4.20	1.10
Water Removed From Well (gallons)	-----	-----	1.25	2.25	13.00	2.00
Method of Removal	-----	-----	Pump	Pump	Pump	Pump
Was Well Purged Dry?	-----	-----	Yes	Yes	No	Yes
pH (standard units)	-----	-----	10.95	8.35	7.37	7.56
Temperature (°C)	-----	-----	17.97	16.96	19.35	18.29
Conductivity (µmhos/cc)	-----	-----	1900	2900	974	2940
Turbidity (NTU)	-----	-----	25.2	108	50.6	57.5
Appearance	-----	-----	Brownish Tint	Slightly Turbid	Clear	Slightly Turbid
Odor	-----	-----	None	None	None	None
Containers	250 mL HNO3 1 L Cool 0-6C	-----	250 mL HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 1 L Cool 0-6C Filtered Metals	250 mL HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 1 L Cool 0-6C Filtered Metals
Sample Time	-----	-----	958	1008	1216	1238
Sample Date	-----	-----	4/13/2021	4/13/2021	4/13/2021	4/13/2021

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 . **DATE:** 04/12-13/21 .

Well Identification Number	MW-4D	MW-4S	MW-5D	MW-5S	MW-6D	MW-6S
Activities	Gauge	Gauge	Gauge	Gauge	Gauge	Gauge
Samples	Appendix III	NA	Appendix III	NA	Appendix III	WQ & Metals/Filtered
Depth to Water (ft)	43.44	Dry	21.75	20.51	33.95	28.18 (Dry)
Water Level Elevation (ft. NGVD)						
Measured Depth Total Depth of Well (ft.)	53.86	32.94	58.42	33.15	58.51	28.20
Height of Water Column (ft.)	10.42	----	36.67	12.64	24.56	----
Well Size (I.D.) (inches)	2	2	2	2	2	2
Volume of Water in Well (gallons)	1.70	----	5.98	2.06	4.00	----
Water Removed From Well (gallons)	7.00	----	15.50	----	8.75	----
Method of Removal	Pump	----	Pump	----	Pump	----
Was Well Purged Dry?	No	----	Yes	----	Yes	----
pH (standard units)	7.25	----	7.59	----	8.10	----
Temperature (°C)	18.97	----	18.19	----	19.51	----
Conductivity (µmhos/cc)	1350	----	976	----	1450	----
Turbidity (NTU)	13.2	----	17.2	----	83.3	----
Appearance	Clear	----	Clear	----	Clear	----
Odor	None	----	None	----	None	----
Containers	250 mL HNO3 1 L Cool 0-6C	----	250 mL HNO3 1 L Cool 0-6C	----	250 mL HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 1 L Cool 0-6C Filtered Metals
Sample Time	1532	----	925	----	1140	----
Sample Date	4/12/2021	----	4/13/2021	----	4/13/2021	----

Landfill Dup 1800

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 . **DATE:** 04/12-13/21 .

Well Identification Number	MW-7D	MW-7S	MW-8D	MW-8S	MW-9D	MW-9S
Activities	Gauge	Gauge	Gauge	Gauge	Gauge	Gauge
Samples	NA	NA	NA	NA	Appendix III	WQ & Metals/Filtered
Depth to Water (ft)	10.84	11.09	34.12	7.42	50.87	25.61
Water Level Elevation (ft. NGVD)						
Measured Depth Total Depth of Well (ft.)	58.70	33.54	64.50	43.30	63.10	36.71
Height of Water Column (ft.)	47.86	22.45	30.38	35.88	12.23	11.10
Well Size (I.D.) (inches)	2	2	2	2	2	2
Volume of Water in Well (gallons)	7.80	3.66	4.95	5.85	1.99	1.81
Water Removed From Well (gallons)	----	----	----	----	3.25	2.50
Method of Removal	----	----	----	----	Pump	Pump
Was Well Purged Dry?	----	----	----	----	Yes	Yes
pH (standard units)	----	----	----	----	8.17	12.12 - Field 11.99 - Lab
Temperature (°C)	----	----	----	----	18.38	19.28
Conductivity (µmhos/cc)	----	----	----	----	1550	3790
Turbidity (NTU)	----	----	----	----	87.7	118
Appearance	----	----	----	----	Slightly Turbid	Brownish Color
Odor	----	----	----	----	None	None
Containers	------	------	------	------	250 mL HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 1 L Cool 0-6C Filtered Metals
Sample Time	----	----	----	----	1046	1110
Sample Date	----	----	----	----	4/13/2021	4/13/2021

Slurry 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 . **DATE:** 04/12-13/21 .

Well Identification Number	MW-10D	MW-10S	MW-11D	MW-11S	MW-12D	MW-12S
Activities	Gauge	Gauge	Gauge	Gauge	Gauge	Gauge
Samples	Appendix III	NA	Appendix III	NA	Appendix III	WQ & Metals/Filtered
Depth to Water (ft)	69.83	22.04	47.50	12.31	15.08	12.13
Water Level Elevation (ft. NGVD)						
Measured Depth Total Depth of Well (ft.)	71.33	36.22	50.34	31.02	44.92	22.94
Height of Water Column (ft.)	1.50	14.18	2.84	18.71	29.84	10.81
Well Size (I.D.) (inches)	2	2	2	2	2	2
Volume of Water in Well (gallons)	0.24	2.31	0.46	3.05	4.86	1.76
Water Removed From Well (gallons)	----	----	----	----	15.00	3.25
Method of Removal	----	----	----	----	Pump	Pump
Was Well Purged Dry?	----	----	----	----	No	Yes
pH (standard units)	----	----	----	----	8.36	7.09
Temperature (°C)	----	----	----	----	15.87	15.71
Conductivity (µmhos/cc)	----	----	----	----	1410	990
Turbidity (NTU)	----	----	----	----	144	58.8
Appearance	----	----	----	----	Slightly Turbid	Blackish Color
Odor	----	----	----	----	None	None
Containers	250 mL HNO3 1 L Cool 0-6C	------	250 mL HNO3 1 L Cool 0-6C	------	250 mL HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 1 L Cool 0-6C Filtered Metals
Sample Time	----	----	----	----	841	901
Sample Date	----	----	----	----	4/13/2021	4/13/2021

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 . **DATE:** 04/12-13/21 .

Well Identification Number	MW-13D	MW-13S	MW-14	MW-15	MW-16	MW-17
Activities	Gauge	Gauge	Gauge	Gauge	Gauge	Gauge
Samples	Appendix III	WQ & Metals/Filtered	Appendix III	Appendix III	Appendix III	Appendix III
Depth to Water (ft)	32.53	15.24	74.51	55.74	62.69	43.76
Water Level Elevation (ft. NGVD)						
Measured Depth Total Depth of Well (ft.)	47.56	18.12	78.96	74.21	64.15	58.41
Height of Water Column (ft.)	15.03	2.88	4.45	18.47	1.46	14.65
Well Size (I.D.) (inches)	2	2	2	2	2	2
Volume of Water in Well (gallons)	2.45	0.47	0.73	3.01	0.24	2.39
Water Removed From Well (gallons)	7.50	0.25	0.50	7.25	----	1.50
Method of Removal	Pump	Bailer	Pump	Pump	----	Pump
Was Well Purged Dry?	No	Yes	Yes	Yes	----	Yes
pH (standard units)	7.65	----	----	8.81	----	----
Temperature (°C)	17.10	----	----	18.57	----	----
Conductivity (µmhos/cc)	1580	----	----	1480	----	----
Turbidity (NTU)	33.6	----	----	36.3	----	----
Appearance	Clear	----	----	Clear	----	----
Odor	None	----	----	None	----	----
Containers	250 mL HNO3 1 L Cool 0-6C	250 mL HNO3 125 mL HCL 1 L Cool 0-6C Filtered Metals	250 mL HNO3 1 L Cool 0-6C	250 mL HNO3 1 L Cool 0-6C	250 mL HNO3 1 L Cool 0-6C	250 mL HNO3 1 L Cool 0-6C
Sample Time	824	----	----	1028	----	----
Sample Date	4/13/2021	----	----	4/13/2021	----	----

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 . **DATE:** 06/22/21 .

Well Identification Number	MW-4D	MW-9D	MW-15			
Activities	Gauge	Gauge	Gauge			
Samples	Sulfate	pH	Sulfate			
Depth to Water (ft)	43.62	55.91	58.06			
Water Level Elevation (ft. NGVD)						
Measured Depth Total Depth of Well (ft.)	53.86	63.10	74.21			
Height of Water Column (ft.)	10.24	7.19	16.15			
Well Size (I.D.) (inches)	2	2	2			
Volume of Water in Well (gallons)	1.67	1.17	2.63			
Water Removed From Well (gallons)	8.00	2.75	6.75			
Method of Removal	Pump	Pump	Pump			
Was Well Purged Dry?	No	Yes	Yes			
pH (standard units)	7.08	7.61	7.75			
Temperature (°C)	19.07	20.18	20.02			
Conductivity (µmhos/cc)	1320	1440	1440			
Turbidity (NTU)	11.8	62.9	43.5			
Appearance	Clear	Slightly Turbid	Clear			
Odor	None	None	None			
Containers	250 mL Cool 0-6C	NA	250 mL Cool 0-6C			
Sample Time	1617	1551	1538			
Sample Date	6/22/2021	6/22/2021	6/22/2021			

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 . **DATE:** 06/22/21 .

Well Identification Number	MW-5D	MW-5S	MW-13D	MW-13S		
Activities	Gauge	Gauge	Gauge	Gauge		
Samples	NA	NA	NA	NA		
Depth to Water (ft)	23.25	21.33	34.53	15.81		
Water Level Elevation (ft. NGVD)						
Measured Depth Total Depth of Well (ft.)	58.42	33.15	47.56	18.12		
Height of Water Column (ft.)	35.17	11.82	13.03	2.31		
Well Size (I.D.) (inches)	2	2	2	2		
Volume of Water in Well (gallons)	5.73	1.93	2.12	0.38		
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						

Landfill Dup 1800

For 2" well multiply by	0.163
For 4" well multiply by	0.653

Form REP-703
Rev. 1, 11/2013

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

Water Analysis

Location: Northeastern Station ***Report Date: 4/30/2021***

MW-2D

Sample Number: 210878-001 **Date Collected: 04/13/2021 09:58** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	10.6	mg/L		0.05	0.009	GES	04/20/2021 02:13	EPA 200.8-1994, Rev. 5.4
•The MSD is outside the acceptable limit of 75-125%.•The RPD between the MS/MSD exceeds 20%.								
Calcium, Ca	12.5	mg/L		0.3	0.1	DAM	04/19/2021 17:21	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	0.157	mg/L		0.1	0.02	DAM	04/19/2021 17:21	EPA 200.7-1994, Rev. 4.4
Potassium, K	4.68	mg/L		1	0.2	DAM	04/19/2021 17:21	EPA 200.7-1994, Rev. 4.4
Sodium, Na	384	mg/L		0.5	0.2	DAM	04/19/2021 17:21	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	216	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.380	mg/L		0.1	0.02	CRJ	04/21/2021 21:48	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	12.1	mg/L		0.04	0.01	CRJ	04/21/2021 21:48	EPA 300.1-1997, Rev. 1.0
Fluoride, F	1.81	mg/L		0.06	0.01	CRJ	04/21/2021 21:48	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1250	mg/L		100	40	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	654	mg/L		5	0.8	CRJ	04/21/2021 13:45	EPA 300.1-1997, Rev. 1.0

MW-3D

Sample Number: 210878-002 **Date Collected: 04/13/2021 12:16** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.924	mg/L		0.05	0.009	GES	04/20/2021 02:18	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	114	mg/L		0.3	0.1	DAM	04/19/2021 17:02	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	44.9	mg/L		0.1	0.02	DAM	04/19/2021 17:02	EPA 200.7-1994, Rev. 4.4
Potassium, K	2.04	mg/L		1	0.2	DAM	04/19/2021 17:02	EPA 200.7-1994, Rev. 4.4
Sodium, Na	63.7	mg/L		0.5	0.2	DAM	04/19/2021 17:02	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	370	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.368	mg/L		0.1	0.02	CRJ	04/21/2021 20:57	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	12.6	mg/L		0.04	0.01	CRJ	04/21/2021 20:57	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.84	mg/L		0.06	0.01	CRJ	04/21/2021 20:57	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	633	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	184	mg/L		2	0.3	CRJ	04/21/2021 14:10	EPA 300.1-1997, Rev. 1.0

MW-4D

Sample Number: 210878-003 **Date Collected: 04/13/2021 15:32** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	1.20	mg/L		0.05	0.009	GES	04/20/2021 02:23	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	195	mg/L		0.3	0.1	DAM	04/19/2021 17:26	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	25.2	mg/L		0.1	0.02	DAM	04/19/2021 17:26	EPA 200.7-1994, Rev. 4.4
Potassium, K	1.79	mg/L		1	0.2	DAM	04/19/2021 17:26	EPA 200.7-1994, Rev. 4.4
Sodium, Na	116	mg/L		0.5	0.2	DAM	04/19/2021 17:26	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	336	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	1.05	mg/L		0.1	0.02	CRJ	04/21/2021 21:22	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	23.0	mg/L		0.04	0.01	CRJ	04/21/2021 21:22	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.33	mg/L		0.06	0.01	CRJ	04/21/2021 21:22	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	979	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	429	mg/L		5	0.8	CRJ	04/21/2021 14:36	EPA 300.1-1997, Rev. 1.0

MW-5D

Sample Number: 210878-004 **Date Collected: 04/13/2021 09:25** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.539	mg/L		0.05	0.009	GES	04/20/2021 02:28	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	131	mg/L		0.3	0.1	DAM	04/19/2021 17:30	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	49.1	mg/L		0.1	0.02	DAM	04/19/2021 17:30	EPA 200.7-1994, Rev. 4.4
Potassium, K	1.09	mg/L		1	0.2	DAM	04/19/2021 17:30	EPA 200.7-1994, Rev. 4.4
Sodium, Na	37.5	mg/L		0.5	0.2	DAM	04/19/2021 17:30	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	391	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.173	mg/L		0.1	0.02	CRJ	04/21/2021 22:39	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	27.3	mg/L		0.04	0.01	CRJ	04/21/2021 22:39	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.59	mg/L		0.06	0.01	CRJ	04/21/2021 22:39	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	632	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	160	mg/L		2	0.3	CRJ	04/21/2021 15:01	EPA 300.1-1997, Rev. 1.0

MW-6D

Sample Number: 210878-005 **Date Collected: 04/13/2021 11:40** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	3.35	mg/L		0.05	0.009	GES	04/20/2021 02:33	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	170	mg/L		0.3	0.1	DAM	04/19/2021 17:34	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	36.0	mg/L		0.1	0.02	DAM	04/19/2021 17:34	EPA 200.7-1994, Rev. 4.4
Potassium, K	3.29	mg/L		1	0.2	DAM	04/19/2021 17:34	EPA 200.7-1994, Rev. 4.4
Sodium, Na	154	mg/L		0.5	0.2	DAM	04/19/2021 17:34	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	362	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.484	mg/L		0.1	0.02	CRJ	04/21/2021 23:04	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	28.4	mg/L		0.04	0.01	CRJ	04/21/2021 23:04	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.93	mg/L		0.06	0.01	CRJ	04/21/2021 23:04	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1090	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	478	mg/L		5	0.8	CRJ	04/21/2021 15:52	EPA 300.1-1997, Rev. 1.0

MW-9D

Sample Number: 210878-006 **Date Collected: 04/13/2021 10:46** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	6.70	mg/L		0.05	0.009	GES	04/20/2021 02:38	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	158	mg/L		0.3	0.1	DAM	04/19/2021 17:38	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	71.6	mg/L		0.1	0.02	DAM	04/19/2021 17:38	EPA 200.7-1994, Rev. 4.4
Potassium, K	4.41	mg/L		1	0.2	DAM	04/19/2021 17:38	EPA 200.7-1994, Rev. 4.4
Sodium, Na	163	mg/L		0.5	0.2	DAM	04/19/2021 17:38	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	307	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.367	mg/L		0.1	0.02	CRJ	04/21/2021 23:30	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	26.1	mg/L		0.04	0.01	CRJ	04/21/2021 23:30	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.99	mg/L		0.06	0.01	CRJ	04/21/2021 23:30	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1180	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	594	mg/L		5	0.8	CRJ	04/21/2021 16:17	EPA 300.1-1997, Rev. 1.0

MW-12D

Sample Number: 210878-007 **Date Collected: 04/13/2021 08:41** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	7.96	mg/L		0.05	0.009	GES	04/20/2021 02:43	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	79.0	mg/L		0.3	0.1	DAM	04/19/2021 17:42	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	9.69	mg/L		0.1	0.02	DAM	04/19/2021 17:42	EPA 200.7-1994, Rev. 4.4
Potassium, K	2.22	mg/L		1	0.2	DAM	04/19/2021 17:42	EPA 200.7-1994, Rev. 4.4
Sodium, Na	240	mg/L		0.5	0.2	DAM	04/19/2021 17:42	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	124	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.429	mg/L		0.1	0.02	CRJ	04/22/2021 00:20	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	16.1	mg/L		0.04	0.01	CRJ	04/22/2021 00:20	EPA 300.1-1997, Rev. 1.0
Fluoride, F	2.00	mg/L		0.06	0.01	CRJ	04/22/2021 00:20	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1030	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	590	mg/L		5	0.8	CRJ	04/21/2021 16:43	EPA 300.1-1997, Rev. 1.0

MW-13D

Sample Number: 210878-008 **Date Collected: 04/13/2021 08:24** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	1.39	mg/L		0.05	0.009	GES	04/20/2021 02:49	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	192	mg/L		0.3	0.1	DAM	04/19/2021 17:47	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	88.3	mg/L		0.1	0.02	DAM	04/19/2021 17:47	EPA 200.7-1994, Rev. 4.4
Potassium, K	1.94	mg/L		1	0.2	DAM	04/19/2021 17:47	EPA 200.7-1994, Rev. 4.4
Sodium, Na	82.3	mg/L		0.5	0.2	DAM	04/19/2021 17:47	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	456	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.1	mg/L	J	0.1	0.02	CRJ	04/22/2021 00:46	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	5.83	mg/L		0.04	0.01	CRJ	04/22/2021 00:46	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.46	mg/L		0.06	0.01	CRJ	04/22/2021 00:46	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1170	mg/L		100	40	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	519	mg/L		5	0.8	CRJ	04/21/2021 17:08	EPA 300.1-1997, Rev. 1.0

MW-15

Sample Number: 210878-009 **Date Collected: 04/13/2021 10:28** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	8.40	mg/L		0.05	0.009	GES	04/20/2021 02:54	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	93.5	mg/L		0.3	0.1	DAM	04/19/2021 17:52	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	29.7	mg/L		0.1	0.02	DAM	04/19/2021 17:52	EPA 200.7-1994, Rev. 4.4
Potassium, K	2.17	mg/L		1	0.2	DAM	04/19/2021 17:52	EPA 200.7-1994, Rev. 4.4
Sodium, Na	216	mg/L		0.5	0.2	DAM	04/19/2021 17:52	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	115	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.361	mg/L		0.1	0.02	CRJ	04/22/2021 01:37	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	15.5	mg/L		0.04	0.01	CRJ	04/22/2021 01:37	EPA 300.1-1997, Rev. 1.0
Fluoride, F	1.71	mg/L		0.06	0.01	CRJ	04/22/2021 01:37	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	1100	mg/L		50	20	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	659	mg/L		5	0.8	CRJ	04/21/2021 17:59	EPA 300.1-1997, Rev. 1.0

Landfill Duplicate

Sample Number: 210878-010 **Date Collected: 04/13/2021 18:00** **Date Received: 4/15/2021**

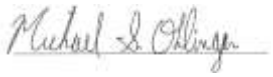
Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	1.17	mg/L		0.05	0.009	GES	04/20/2021 02:59	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	189	mg/L		0.3	0.1	DAM	04/19/2021 18:29	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	24.4	mg/L		0.1	0.02	DAM	04/19/2021 18:29	EPA 200.7-1994, Rev. 4.4
Potassium, K	1.62	mg/L		1	0.2	DAM	04/19/2021 18:29	EPA 200.7-1994, Rev. 4.4
Sodium, Na	113	mg/L		0.5	0.2	DAM	04/19/2021 18:29	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	358	mg/L		20	5	MGK	04/15/2021 16:05	SM 2320B-2011
Bromide, Br	0.991	mg/L		0.1	0.02	CRJ	04/22/2021 02:02	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	22.9	mg/L		0.04	0.01	CRJ	04/22/2021 02:02	EPA 300.1-1997, Rev. 1.0
Fluoride, F	0.32	mg/L		0.06	0.01	CRJ	04/22/2021 02:02	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	992	mg/L		100	40	SDW	04/19/2021	SM 2540C-2011
Sulfate, SO4	427	mg/L		5	0.8	CRJ	04/21/2021 18:25	EPA 300.1-1997, Rev. 1.0

Equipment Blank

Sample Number: 210878-011 **Date Collected: 04/13/2021 09:00** **Date Received: 4/15/2021**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	< 0.009	mg/L	U	0.05	0.009	GES	04/20/2021 05:53	EPA 200.8-1994, Rev. 5.4
Calcium, Ca	< 0.1	mg/L	U	0.3	0.1	DAM	04/19/2021 17:57	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	< 0.02	mg/L	U	0.1	0.02	DAM	04/19/2021 17:57	EPA 200.7-1994, Rev. 4.4
Potassium, K	< 0.2	mg/L	U	1	0.2	DAM	04/19/2021 17:57	EPA 200.7-1994, Rev. 4.4
Sodium, Na	< 0.2	mg/L	U	0.5	0.2	DAM	04/19/2021 17:57	EPA 200.7-1994, Rev. 4.4

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



Michael Ohlinger, Chemist

Email msohlinger@aep.com *Tel.*

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

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 LF Semi-Annual CCR sampling
Contact Name: Jill Parker-Witt
Contact Phone: 318.673.3816
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 #: 210878

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 B, Ca, Na, K, Mg	Field-filter 500 mL bottle, then pH<2, HNO_3 dissolved Fe and Mn	1 L bottle, Cool, 0-6°C TDS, F, Cl, SO_4, and Br, Alkalinity	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		Sample Specific Notes:
MW-2D	4/13/2021	958		GW	2		X		X				
MW-3D	4/13/2021	1216		GW	2		X		X				
MW-4D	4/12/2021	1532		GW	2		X		X				
MW-5D	4/13/2021	925		GW	2		X		X				
MW-6D	4/13/2021	1140		GW	2		X		X				
MW-9D	4/13/2021	1046		GW	2		X		X				
MW-12D	4/13/2021	841		GW	2		X		X				
MW-13D	4/13/2021	824		GW	2		X		X				
MW-15	4/13/2021	1028		GW	2		X		X				
LANDFILL DUPLICATE	4/13/2021	1800		GW	2		X		X				
LANDFILL EQUIPMENT BLANK	4/13/2021	900		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	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	04/14/21 1500		
Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Date/Time:
			[signature]	4/15/21 10:00 Am

WATER & WASTE SAMPLE RECEIPT FORM

Package Type	Delivery Type
(Cooler) Box Bag Envelope	PONY UPS (FedEX) USPS
	Other _____

Plant/Customer 210878 Number of Plastic Containers: 21

Opened By MGK / SH Number of Glass Containers: -

Date/Time 4/15/21 10:00AM Number of Mercury Containers: -

Were all temperatures within 0-6°C? (Y) / N or N/A Initial: SH (on ice) / no ice

1(IR Gun Ser# 200700311, *Expir.* 11/06/22) - 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:** SH / MGK 4/15/21

pH paper (circle one): MQuant,PN1.09535.0001,LOT# HC904495 [OR] Lab Rat,PN4801,LOT# (X000RWDG21)

- 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# 210878

Comments: _____

Logged by MGK

Reviewed by SM

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: 215210 **Customer: Northeastern 3&4 Power Station** **Date Reported: 07/09/2021**

Customer Sample ID: MW-4D
Customer Description:
Lab Number: 215210-001
Sampling Point:
Date Collected: 06/22/2021 16:17
Date Received: 06/23/2021 11:29
Preparation:

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Sulfate	398	mg/L	25	5.0	0.8		CRJ	06/24/2021 14:50	EPA 300.1 -1997, Rev. 1.0

Customer Sample ID: MW-15
Customer Description:
Lab Number: 215210-002
Sampling Point:
Date Collected: 06/22/2021 15:38
Date Received: 06/23/2021 11:29
Preparation:

Ion Chromatography

Parameter	Result	Units	Dilution	RL	MDL	Data Qualifiers	Analyst	Analysis Date	Method
Sulfate	662	mg/L	25	5.0	0.8		CRJ	06/24/2021 15:15	EPA 300.1 -1997, Rev. 1.0

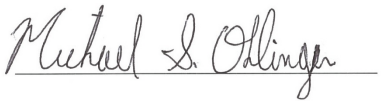
Water Analysis Report

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
Phone: 614-836-4221
Audinet: 210-4221

Job ID: 215210 **Customer: Northeastern 3&4 Power Station** **Date Reported: 07/09/2021**

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: 2 of 2

6/15/21

Dolan Chemical Laboratory (DCL)
4001 Bixby Road
Groveport, Ohio 43125
Contacts: Jonathan Barnhill (318-673-3803)
Michael Ohlinger (614-836-4184)

Project Name: NPS LF 2 of 2 Sampling

Contact Name: Jill Parker-Witt

Contact Phone: 318-673-3816

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 #:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Sampler(s) Initials	250 mL bottle, pH<2, HNO3 B, Ca, Na, K, Mg	Field-filter 250 mL bottle, then pH<2, HNO3 dissolved Fe and Mn	250 mL bottle, Cool, 0-6°C SO_4	Three (six every 10th*) 1 L bottles, pH<2, HNO3 Ra-226, Ra-228	125 mL PTFE lined bottle, pH <2, HCl HG			Sample Specific Notes:
MW-4D	06/22/21	1617	Grab	GW	1				X					
MW-15	06/22/21	1538	Grab	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: EAGLE	Date/Time: 06/22/21 1700	Received by:	Date/Time: 06/23/21 11:20
Relinquished by:	Company:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Date/Time:

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:** 2

Opened By Misgina **Number of Glass Containers:** _____

Date/Time 06-23-21 11:_ **Number of Mercury Containers:** _____

Were all temperatures within 0-6°C? (Y) / N or N/A **Initial:** mgk (on ice) / no ice

1(IR Gun Ser# 200700311, *Expir.* 06-11-22) - 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 06-23-21

pH paper (circle one): MQuant,PN1.09535.0001,LOT# HC904495 [OR] Lab Rat,PN4801,LOT# X000RWDG21

- 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# 215210 Initial & Date & Time : _____

Comments: _____

Logged by mgk _____

_____

Reviewed by SM _____

_____

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.