

Annual Groundwater Monitoring Report

Appalachian Power Company
Mountaineer Plant
Landfill CCR Management Unit
Letart, WV

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



An **AEP** Company

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Abbreviations:

ASD - Alternate Source Demonstration

CCR – Coal Combustion Residual

GWPS - Groundwater protection standards

MTLF – Mountaineer Landfill

SSI - Statistically Significant Increase

SSL - Statistically Significant Level

I. Overview

This *Annual Groundwater Monitoring and Corrective Action Report* (Report) has been prepared to report the status of activities for the preceding year for the landfill CCR unit at Appalachian Power Company's, a wholly owned subsidiary of American Electric Power Company (AEP), Mountaineer Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring and Corrective Action Report be posted to the operating record for the preceding year no later than January 31st.

In general, the following activities were completed during this reporting period:

- At the start of the current annual reporting period, the Mountaineer Landfill (MTLF) was operating under the detection monitoring program in §257.94.
- At the end of the current annual reporting period, the MTLF was operating under the detection monitoring program in §257.94.
- Data and statistical analysis not available for the previous reporting period indicates that during the October 2023 semi-annual sampling event:
 - there were no confirmed statistically significant increases.
- During the May 2024 semi-annual sampling event:
 - there were no confirmed statistically significant increases.
- The October 2024 semi-annual sampling event's data are still undergoing statistical analysis and will be completed in 2025.

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

- A map, aerial photograph or a drawing showing the MTLF, all groundwater monitoring wells and monitoring well identification numbers.
- All the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs (Attached as **Appendix 1**).
- Statistical comparison of monitoring data to determine if there have been SSIs over background concentrations (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 program, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring (Notices attached as Appendix 4, where applicable).
- 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).

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

Figure 1 depicts the PE-certified groundwater monitoring network, the monitoring well locations and their corresponding identification. The groundwater quality monitoring network includes the following:

- Two upgradient wells: MW-1612 and MW-30; and
- Five downgradient wells: MW-1611, MW-26, MW-27, MW-38, and MW-39.

III. Monitoring Wells Installed or Decommissioned

There were no monitoring wells installed or decommissioned during this annual reporting period. The network design, as summarized in the *Groundwater Monitoring Network Design Report* (2016) and as posted at the CCR web site for Mountaineer Plant, did not change. That design report, viewable on the AEP CCR web site, discusses the facility location, the hydrogeological setting, the hydrostratigraphic units, the uppermost aquifer, downgradient monitoring well locations and the upgradient monitoring well locations.

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

Appendix 1 contains tables showing the groundwater quality data collected since background through data received during this annual reporting period. Static water elevation data and groundwater flow direction from each monitoring event are shown in the Figures located in **Appendix 1**, the groundwater velocity calculations are presented in a table.

V. Groundwater Quality Data Statistical Analysis

The statistical analysis reports for this reporting period are included in **Appendix 2**.

Data not available for the previous reporting period indicated that during the second semi-annual detection monitoring sampling event in October 2023:

- there were no confirmed statistically significant increases (SSIs).

During The first semi-annual detection monitoring sampling event in May 2024:

- there were no confirmed SSIs.

The 2nd semi-annual sampling event's (October 2024) data are still undergoing statistical analysis and will be completed in 2025.

The background groundwater standards were updated in January 2025, see Appendix 2.

VI. Alternative Source Demonstrations

No alternative source demonstrations were completed during this annual reporting period.

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

No transition between detection monitoring and assessment monitoring at MTLF. The sampling frequency of twice per year will be maintained for the Appendix III.

Regarding defining an alternate monitoring frequency, the groundwater velocity and monitoring well production is high enough at this facility that no modification of the twice-per-year detection monitoring effort is needed.

VIII. Other Information Required

As required by the CCR detection monitoring rules in 40 CFR §257.94, sampling all groundwater monitoring wells for the Appendix III parameters was completed during this annual reporting period. All required information that was completed during this annual reporting period has been included in this annual groundwater monitoring report.

IX. Description of Any Problems Encountered and Actions Taken

No significant problems were encountered. The low flow sampling effort went smoothly, and the schedule was met to support this first annual groundwater report preparation.

X. A Projection of Key Activities for the Upcoming Year

- Complete the statistical analysis of the data collected during the second semi-annual monitoring event that took place in during the 2H2024.
- Complete detection monitoring on a twice per year schedule.
- Evaluation of the detection monitoring results from a statistical analysis viewpoint, looking for any statistically significant increases, or decreases when pH is considered.
- Responding to any new data received considering what the CCR rule requires.
- Preparation of the next annual groundwater report.

APPENDIX 1 - Groundwater Data Tables and Figures

Tables and Figures that follow show the groundwater monitoring data collected and the rate and direction of groundwater flow. The dates that the samples were collected also is shown.

Groundwater Data Tables

**Table 1. Groundwater Data Summary: MW-26
Mountaineer - LF
Appendix III 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
9/27/2016	Background	0.097	61.5	5.57	0.12	7.5	9.6	322
11/1/2016	Background	0.117	50.5	5.17	0.13	7.4	10.6	270
12/21/2016	Background	0.074	48.6	5.21	0.13	7.6	10.2	316
2/22/2017	Background	0.145	56.2	5.35	0.13	7.4	6.5	325
3/28/2017	Background	0.222	52.9	6.25	0.13	7.4	7.3	334
4/17/2017	Background	0.169	57.1	5.73	0.13	7.3	6.7	320
5/17/2017	Background	0.161	58.6	5.87	0.13	8.1	6.5	343
6/13/2017	Background	0.121	53.7	5.00	0.12	7.4	5.3	324
10/31/2017	Detection	0.165	54.7	5.48	0.13	7.5	5.8	346
1/22/2018	Detection	--	55.7	--	--	7.3	--	--
9/20/2018	Detection	0.214	49.4	6.04	0.16	8.0	6.3	344
11/26/2018	Detection	0.182	53.6	5.97	0.14	7.4	7.2	364
4/9/2019	Detection	0.128	62.8	6.71	0.13	7.3	7.6	370
6/18/2019	Detection	--	--	7.22	--	7.2	--	387
9/9/2019	Detection	0.099	60.2	5.80	0.14	7.4	5.7	353
7/8/2020	Detection	--	--	--	--	7.4	--	366
10/8/2020	Detection	0.103	51.2	5.74	0.16	6.9	6.4	344
1/4/2021	Detection	--	--	--	--	7.5	--	--
5/13/2021	Detection	0.110	60.2	6.56	0.15	7.2	8.5	378
11/3/2021	Detection	0.091	57.5	5.50	0.14	7.1	5.20	340
3/4/2022	Detection	--	--	--	--	7.5	--	--
5/23/2022	Detection	0.099	64.8	5.97	0.13	7.5	7.90	370 L1
7/25/2022	Detection	--	61.8	--	--	7.7	--	--
11/10/2022	Detection	0.103	58.5	5.69	0.13	7.2	6.58	370
5/23/2023	Detection	0.090	57.1 M1	6.05	0.12	7.2	8.1	370
10/26/2023	Detection	0.087	57.0	5.04	0.12	7.1	6.3	350
5/20/2024	Detection	0.097	63.0 M1	5.80	0.12	7.1	6.9	370
10/2/2024	Detection	0.113	57.6	5.73	0.13	7.3	6.3	380

**Table 1. Groundwater Data Summary: MW-26
Mountaineer - LF
Appendix IV 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	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
9/27/2016	Background	0.13	3.57	917	< 0.005 U1	0.01 J1	0.4	0.214	3.25	0.12	0.165	0.010	< 0.002 U1	1.88	0.1	0.03 J1
11/1/2016	Background	0.11	4.06	871	< 0.005 U1	0.005 J1	0.3	0.220	3.57	0.13	0.043	0.006	< 0.002 U1	3.07	0.1	0.02 J1
12/21/2016	Background	0.12	4.51	872	0.01 J1	0.006 J1	1.27	0.329	3.15	0.13	0.167	0.004	< 0.002 U1	3.52	0.2	0.062
2/22/2017	Background	0.09	4.11	717	0.01 J1	0.01 J1	0.731	0.345	3.60	0.13	0.244	0.012	< 0.002 U1	2.53	0.1	0.04 J1
3/28/2017	Background	0.50	3.95	886	0.028	0.01 J1	1.43	0.532	2.88	0.13	0.517	0.014	< 0.002 U1	1.18	0.2	0.03 J1
4/17/2017	Background	0.09	3.60	802	0.007 J1	0.007 J1	0.328	0.299	1.967	0.13	0.164	0.009	< 0.002 U1	1.08	0.1 J1	0.01 J1
5/17/2017	Background	0.06	4.01	869	< 0.004 U1	0.007 J1	0.238	0.251	3.22	0.13	0.090	0.007	< 0.002 U1	3.99	0.1	0.01 J1
6/13/2017	Background	0.10	3.45	905	0.008 J1	0.008 J1	0.405	0.325	3.28	0.12	0.252	0.018	< 0.002 U1	1.23	0.1	0.01 J1

**Table 1. Groundwater Data Summary: MW-27
Mountaineer - LF
Appendix III 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
9/27/2016	Background	0.276	18.9	1.82	2.23	9.2	4.9	618
11/1/2016	Background	0.288	1.57	1.86	2.38	9.1	7.2	558
12/21/2016	Background	0.219	1.39	1.69	2.44	9.2	7.3	528
2/22/2017	Background	0.282	1.42	1.48	2.27	9.1	4.3	531
3/28/2017	Background	0.387	1.26	1.59	2.32	9.3	4.7	508
4/17/2017	Background	0.312	1.65	1.56	2.30	9.0	5.0	536
5/17/2017	Background	0.290	1.48	1.59	2.38	11.1	4.8	539
6/13/2017	Background	0.293	1.77	1.64	2.33	9.4	4.5	526
10/31/2017	Detection	0.275	1.33	1.63	2.38	9.2	4.2	544
9/20/2018	Detection	0.357	1.14	1.69	2.41	9.1	4.4	550
11/26/2018	Detection	0.292	1.20	1.52	2.37	9.0	3.6	522
4/9/2019	Detection	0.303	1.19	1.54	2.32	9.0	2.9	542
9/10/2019	Detection	0.285	1.13	1.67	2.71	9.1	3.0	530
7/8/2020	Detection	--	1.20	1.63	--	9.1	--	--
10/8/2020	Detection	0.273	1.20	1.67	2.38	8.7	3.4	541
1/4/2021	Detection	--	--	--	--	9.0	--	--
5/13/2021	Detection	0.288	1.07	1.71	2.54	8.9	3.1	541
11/3/2021	Detection	0.280	1.10	1.60	2.54	8.4	1.53	560
3/4/2022	Detection	--	--	--	--	9.3	--	--
5/23/2022	Detection	0.288	1.70	1.57	2.58	9.3	2.78	550 L1
11/10/2022	Detection	0.296	1.24	1.57	2.54	8.9	2.18	550
5/23/2023	Detection	0.272	1.18	1.48	2.58	8.8	3.0	550
10/26/2023	Detection	0.274	1.34	1.48	2.48	8.5	3.1	570
1/17/2024	Detection	--	--	--	--	9.0	--	--
5/20/2024	Detection	0.281	1.36	1.48	2.48	8.7	2.8	510
10/2/2024	Detection	0.61	1.6	1.42	2.40	9.0	2.3	530
12/9/2024	Detection	0.291	--	--	--	--	--	--
12/10/2024	Detection	--	--	--	--	8.7	--	--

**Table 1. Groundwater Data Summary: MW-27
Mountaineer - LF
Appendix IV 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	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
9/27/2016	Background	0.39	8.05	326	0.654	0.11	11.6	4.95	2.565	2.23	17.3	0.016	0.004 J1	24.2	2.2	0.1 J1
11/1/2016	Background	0.26	5.42	151	0.158	0.02	5.0	0.817	2.003	2.38	4.00	0.007	< 0.002 U1	35.6	0.4	0.03 J1
12/21/2016	Background	0.23	4.26	113	0.093	0.01 J1	2.94	0.502	1.489	2.44	8.87	0.001	< 0.002 U1	34.6	0.3	0.04 J1
2/22/2017	Background	0.06	3.76	94.8	0.054	0.009 J1	1.95	0.320	1.419	2.27	1.28	0.012	0.002 J1	32.1	0.1	0.03 J1
3/28/2017	Background	0.08	4.45	105	0.062	0.008 J1	1.69	0.319	0.888	2.32	1.06	0.016	< 0.002 U1	31.5	0.2	0.02 J1
4/17/2017	Background	0.15	4.54	108	0.085	0.01 J1	2.36	0.511	0.486	2.30	1.45	0.005	0.002 J1	32.0	0.2	0.02 J1
5/17/2017	Background	0.11	4.54	94.6	0.052	0.005 J1	1.33	0.335	0.20279	2.38	0.971	0.015	< 0.002 U1	31.6	0.2	0.01 J1
6/13/2017	Background	0.18	4.55	102	0.082	0.01 J1	2.25	0.600	0.797	2.33	1.39	0.015	< 0.002 U1	30.6	0.2	0.02 J1

**Table 1. Groundwater Data Summary: MW-30
Mountaineer - LF
Appendix III 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
10/26/2016	Background	0.239	16.6	250	3.42	8.7	31.5	--
11/2/2016	Background	0.240	10.9	257	3.41	8.6	19.6	1,350
12/28/2016	Background	0.250	9.91	250	3.43	8.0	19.1	1,280
2/22/2017	Background	0.257	2.76	246	3.18	8.6	11.5	1,220
3/29/2017	Background	0.344	2.54	242	3.31	8.7	0.1 J1	1,270
4/19/2017	Background	0.296	2.91	247	3.28	8.5	11.2	1,210
5/17/2017	Background	0.269	2.97	247	1.34	10.1	4.4	1,290
6/13/2017	Background	0.283	4.06	255	3.28	8.9	10.8	1,170
10/31/2017	Detection	0.315	3.27	257	3.30	8.5	11.4	1,210
9/20/2018	Detection	0.315	4.69	253	3.36	8.6	13.0	1,230
11/26/2018	Detection	--	--	--	--	8.4	--	--
11/27/2018	Detection	0.344	3.16	247	3.40	--	11.7	1,240
4/9/2019	Detection	0.290	2.88	245	3.32	8.4	10.6	1,260
9/10/2019	Detection	0.259	3.39	249	3.76	8.3	9.6	1,260
5/18/2020	Detection	0.271	2.95	264	3.54	8.1	10.8	1,240
10/7/2020	Detection	0.249	2.93	247	2.73	8.0	10.9	1,260
5/14/2021	Detection	0.259	2.63	259	3.38	8.3	9.9	1,250
10/28/2021	Detection	0.261	2.80	253	3.47	8.2	8.09	1,250
5/20/2022	Detection	0.289	2.94	259	3.57	8.6	10.7	1,260 L1
11/9/2022	Detection	0.279	3.37	257	3.34	8.3	8.7	1,100
5/25/2023	Detection	0.241	3.24	271	3.57	7.8	10.6	1,250
10/30/2023	Detection	0.260	4.88	288	3.46	8.0	10.9	1,320 S7
5/20/2024	Detection	0.238	3.53	254	3.46	8.1	9.6	1,250
7/18/2024	Detection	0.238	3.69	269	3.46	8.5	9.2	1,290
10/1/2024	Detection	0.280	4.61	254	3.40	8.6	9.1	1,280
10/15/2024	Detection	--	--	--	--	8.1	--	--

**Table 1. Groundwater Data Summary: MW-30
Mountaineer - LF
Appendix IV 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	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
10/26/2016	Background	0.36	7.38	567	0.692	0.10	13.1	33.8	2.588	3.42	33.2	0.034	0.054	68.7	3.8	0.724
11/2/2016	Background	0.26	7.54	576	0.630	0.09	11.7	33.3	1.404	3.41	30.9	0.026	0.016	73.7	2.7	0.654
12/28/2016	Background	0.91	6.87	360	0.502	0.08	18.1	15.9	2.725	3.43	13.8	0.024	0.026	107	2.6	0.350
2/22/2017	Background	0.52	4.65	223	0.082	0.008 J1	3.24	2.40	2.418	3.18	1.68	0.022	0.004 J1	125	0.5	0.258
3/29/2017	Background	0.66	5.45	243	0.149	0.007 J1	6.13	4.24	1.204	3.31	3.62	0.027	0.003 J1	120	0.7	0.381
4/19/2017	Background	1.55	5.80	246	0.140	0.01 J1	5.76	3.91	3.83	3.28	3.49	0.019	0.061	123	0.7	0.365
5/17/2017	Background	0.75	6.90	241	0.120	< 0.005 U1	3.99	3.63	2.395	1.34	3.41	0.027	0.004 J1	128	0.9	0.287
6/13/2017	Background	2.74	6.86	251	0.197	0.02 J1	6.83	5.35	3.45	3.28	4.80	0.027	0.005 J1	118	0.8	0.366

**Table 1. Groundwater Data Summary: MW-38
Mountaineer - LF
Appendix III 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
9/27/2016	Background	0.024	55.7	7.12	0.32	7.1	28.1	410
11/2/2016	Background	0.040	46.3	7.27	0.32	7.0	36.6	358
12/21/2016	Background	0.019	48.2	7.43	0.35	7.4	35.8	404
2/22/2017	Background	0.028	47.2	7.21	0.29	7.0	31.7	409
3/28/2017	Background	0.070	50.0	7.08	0.32	7.0	30.1	390
4/18/2017	Background	0.038	52.5	7.22	0.33	7.0	30.6	422
5/16/2017	Background	0.027	54.5	7.41	0.33	7.6	32.5	421
6/13/2017	Background	0.093	51.4	7.01	0.28	7.0	31.0	406
10/31/2017	Detection	0.045	56.1	7.59	0.38	7.0	28.7	460
1/22/2018	Detection	--	53.8	--	--	6.7	--	419
9/20/2018	Detection	0.068	51.2	7.31	0.36	7.4	31.5	441
11/26/2018	Detection	0.08 J1	48.2	7.06	0.34	7.0	35.2	415
4/9/2019	Detection	0.04 J1	52.0	7.46	0.32	6.9	27.8	427
6/18/2019	Detection	--	--	--	--	7.6	--	--
9/10/2019	Detection	0.03 J1	49.9	7.45	0.35	7.7	28.2	417
10/22/2019	Detection	--	--	--	--	6.9	--	--
5/15/2020	Detection	0.02 J1	48.3	7.59	0.38	6.7	31.4	421
10/8/2020	Detection	0.03 J1	53.4	7.68	0.47	6.8	25.5	452
5/13/2021	Detection	0.03 J1	50.9	7.51	0.43	7.1	23.2	432
10/29/2021	Detection	0.028 J1	44.6	7.26	0.37	6.9	28.7	430
5/20/2022	Detection	0.029 J1	58.8	7.51	0.39	7.2	26.7	440 L1
7/25/2022	Detection	--	53.3	--	--	7.3	--	--
11/9/2022	Detection	0.027 J1	45.4	6.85	0.33	6.9	33.4	380
5/22/2023	Detection	0.023 J1	42.2	7.30	0.36	6.9	27.5	430
10/31/2023	Detection	0.031 J1	49.5	7.25	0.38	6.9	29.5	420
5/16/2024	Detection	0.024 J1	49.3	7.34	0.39	6.8	29.7	380
10/2/2024	Detection	0.031 J1	48.4	6.88	0.31	6.9	33.5	430

**Table 1. Groundwater Data Summary: MW-38
Mountaineer - LF
Appendix IV 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	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
9/27/2016	Background	0.09	9.82	221	0.023	0.03	1.0	2.72	2.229	0.32	0.442	0.002	< 0.002 U1	2.76	0.2	0.103
11/2/2016	Background	0.07	8.15	179	< 0.005 U1	0.02 J1	0.4	0.855	1.744	0.32	0.113	0.0009 J1	< 0.002 U1	2.10	0.04 J1	0.04 J1
12/21/2016	Background	0.05	6.62	162	< 0.005 U1	0.02	1.67	0.655	2.06	0.35	0.082	< 0.0002 U1	< 0.002 U1	2.50	0.06 J1	0.082
2/22/2017	Background	0.03 J1	5.74	141	< 0.005 U1	0.02	0.526	0.949	1.000	0.29	0.039	0.004	< 0.002 U1	3.37	0.03 J1	0.04 J1
3/28/2017	Background	0.05 J1	11.5	184	< 0.005 U1	0.03	0.197	0.916	0.548	0.32	0.073	0.006	< 0.002 U1	2.47	0.06 J1	0.05 J1
4/18/2017	Background	0.04 J1	6.34	179	< 0.004 U1	0.03	0.111	2.87	0.494	0.33	0.02 J1	0.003	< 0.002 U1	2.30	< 0.03 U1	0.068
5/16/2017	Background	0.06	5.09	186	< 0.004 U1	0.03	0.093	3.66	0.536	0.33	0.01 J1	0.004	< 0.002 U1	3.76	< 0.03 U1	0.062
6/13/2017	Background	0.06	8.09	187	< 0.004 U1	0.03	0.130	2.53	1.268	0.28	0.056	0.013	< 0.002 U1	2.67	0.04 J1	0.056

**Table 1. Groundwater Data Summary: MW-39
Mountaineer - LF
Appendix III 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
9/26/2016	Background	0.143	12.4	3.00	0.77	8.4	< 0.04 U1	350
11/2/2016	Background	0.134	7.88	3.05	0.83	8.4	< 0.04 U1	344
12/21/2016	Background	0.122	10.5	3.07	0.86	8.8	< 0.04 U1	450
2/22/2017	Background	0.134	7.65	2.98	0.80	8.4	< 0.04 U1	374
3/28/2017	Background	0.202	5.95	2.95	0.78	8.4	0.1 J1	310
4/18/2017	Background	0.156	6.48	2.91	0.78	8.3	< 0.04 U1	344
5/16/2017	Background	0.139	6.74	2.98	0.79	9.5	1.5	367
6/14/2017	Background	0.179	6.15	2.92	0.78	8.5	0.1	340
10/31/2017	Detection	0.171	7.25	3.05	0.78	8.3	0.2	385
9/20/2018	Detection	0.182	6.43	2.99	0.80	8.5	0.1 J1	369
11/26/2018	Detection	0.167	6.33	2.93	0.80	8.3	0.07 J1	380
4/9/2019	Detection	0.158	6.65	2.94	0.77	8.3	< 0.06 U1	376
9/9/2019	Detection	0.144	6.78	3.07	0.84	8.1	< 0.06 U1	369
5/15/2020	Detection	0.148	6.15	3.11	0.84	7.9	0.2 J1	374
7/8/2020	Detection	--	--	--	--	8.4	--	--
10/8/2020	Detection	0.133	6.11	2.98	0.89	7.9	< 0.06 U1	404
1/4/2021	Detection	--	--	--	--	8.4	--	--
5/13/2021	Detection	0.148	5.65	3.08	0.85	8.2	0.1 J1	375
10/29/2021	Detection	0.150	6.10	3.01	0.85	8.1	< 0.06 U1	380
5/23/2022	Detection	0.140	6.46	3.02	0.86	8.6	0.18 J1	370 L1
11/9/2022	Detection	0.144	7.60	2.92	0.78	8.2	< 0.06 U1	370
5/25/2023	Detection	0.134	7.07	3.03	0.86	8.0	0.2 J1	360
10/31/2023	Detection	0.142	8.58	2.99	0.83	8.0	0.2 J1	390
5/17/2024	Detection	0.137	7.26	3.04	0.87	7.9	0.3 J1	360
7/17/2024	Detection	--	--	--	--	8.1	< 0.1 U1	--
10/2/2024	Detection	0.135	7.72	2.99	0.80	8.1	< 0.1 U1	370

**Table 1. Groundwater Data Summary: MW-39
Mountaineer - LF
Appendix IV 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	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
9/26/2016	Background	0.06	4.80	264	0.095	0.01 J1	2.2	1.43	1.142	0.77	2.21	0.016	< 0.002 U1	8.51	0.3	0.04 J1
11/2/2016	Background	0.04 J1	3.89	276	0.068	< 0.004 U1	3.2	0.615	1.941	0.83	0.532	0.011	< 0.002 U1	9.54	0.09 J1	0.03 J1
12/21/2016	Background	0.08	3.95	296	0.202	0.006 J1	6.32	2.34	1.311	0.86	1.79	0.008	< 0.002 U1	8.03	0.6	0.070
2/22/2017	Background	0.03 J1	3.91	243	0.041	0.01 J1	1.41	0.539	1.162	0.80	0.467	0.012	0.002 J1	9.23	0.1	0.03 J1
3/28/2017	Background	0.02 J1	3.58	241	0.01 J1	< 0.004 U1	0.560	0.206	0.793	0.78	0.176	0.015	< 0.002 U1	8.50	0.06 J1	0.02 J1
4/18/2017	Background	0.01 J1	3.70	244	0.007 J1	< 0.005 U1	0.243	0.188	0.1602	0.78	0.113	0.009	< 0.002 U1	8.65	0.04 J1	< 0.01 U1
5/16/2017	Background	0.01 J1	3.88	244	0.004 J1	0.02	0.221	0.174	0.611	0.79	0.073	0.017	< 0.002 U1	9.39	0.04 J1	< 0.01 U1
6/14/2017	Background	0.02 J1	3.76	247	0.008 J1	< 0.005 U1	0.203	0.209	0.470	0.78	0.092	0.028	< 0.002 U1	9.06	0.06 J1	< 0.01 U1

Table 1. Groundwater Data Summary: MW-1611

Geosyntec Consultants, Inc.

Mountaineer - LF

Appendix III 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
9/26/2016	Background	0.136	25.0	8.72	0.56	7.8	17.3	382
11/2/2016	Background	0.140	22.8	9.36	0.61	7.8	22.7	388
12/20/2016	Background	0.124	22.2	9.39	0.64	7.7	21.8	380
2/22/2017	Background	0.175	22.5	9.10	0.57	7.7	18.0	381
3/28/2017	Background	0.210	22.3	8.04	0.50	7.8	15.7	326
4/18/2017	Background	0.155	22.8	8.59	0.56	7.7	17.7	388
5/16/2017	Background	0.190	23.1	9.14	0.60	8.3	18.7	392
6/12/2017	Background	0.158	22.4	9.29	0.57	7.2	19.4	384
10/31/2017	Detection	0.152	24.0	9.80	0.61	7.8	18.9	402
1/22/2018	Detection	--	22.6	--	--	7.5	--	376
9/20/2018	Detection	0.258	23.2	9.48	0.61	7.8	19.0	416
11/26/2018	Detection	0.147	21.9	9.57	0.62	7.7	18.5	387
4/9/2019	Detection	0.139	26.2	7.96	0.46	7.6	20.7	431
6/18/2019	Detection	--	22.8	9.58	--	7.9	--	--
7/10/2019	Detection	--	--	--	--	7.6	--	402
9/9/2019	Detection	0.136	26.1	10.1	0.62	7.7	17.3	402
5/15/2020	Detection	0.135	24.0	9.35	0.61	7.3	20.8	404
10/8/2020	Detection	0.124	24.8	9.44	0.64	7.3	22.2	451
1/4/2021	Detection	--	--	--	--	7.7	--	407
5/13/2021	Detection	0.132	23.5	10.1	0.64	7.7	19.2	405
10/26/2021	Detection	0.125	24.6	9.91	0.63	7.5	20.8	400
5/20/2022	Detection	0.133	25.1	10.7	0.63	7.7	21.1	410 L1
7/25/2022	Detection	--	--	9.48	--	8.1	--	--
11/9/2022	Detection	0.134	26.1	9.89	0.58	7.6	20.8	420
5/25/2023	Detection	0.119	25.3	9.91	0.57	7.6	22.4	390
10/26/2023	Detection	0.119	23.5	10.7	0.60	7.5	20.3	400
1/17/2024	Detection	--	--	10.1	--	7.6	--	--
5/21/2024	Detection	0.124	25.2	10.6	0.59	7.3	20.1	430
10/3/2024	Detection	0.129	25.8	11.0	0.56	7.5	20.4	400
12/9/2024	Detection	--	--	--	--	7.6	--	--
12/10/2024	Detection	--	--	10.4	--	--	--	--

**Table 1. Groundwater Data Summary: MW-1611
Mountaineer - LF
Appendix IV 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	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
9/26/2016	Background	0.03 J1	1.01	165	0.046	0.02	1.4	0.370	1.258	0.56	0.482	0.004	< 0.002 U1	6.97	0.07 J1	0.088
11/2/2016	Background	0.03 J1	0.97	156	0.030	0.01 J1	0.9	0.245	2.888	0.61	0.310	0.004	< 0.002 U1	5.83	0.06 J1	0.03 J1
12/20/2016	Background	< 0.01 U1	0.74	140	< 0.005 U1	< 0.004 U1	2.10	0.092	0.772	0.64	0.023	0.002	< 0.002 U1	5.46	< 0.03 U1	< 0.01 U1
2/22/2017	Background	< 0.01 U1	0.75	135	0.007 J1	0.006 J1	0.209	0.096	0.5828	0.57	0.055	0.007	0.002 J1	5.36	0.04 J1	0.208
3/28/2017	Background	0.01 J1	0.60	166	0.01 J1	0.005 J1	0.426	0.108	0.645	0.50	0.195	0.011	< 0.002 U1	7.26	0.07 J1	0.02 J1
4/18/2017	Background	0.01 J1	0.69	155	0.01 J1	0.006 J1	0.337	0.104	0.487	0.56	0.133	0.003	< 0.002 U1	6.01	< 0.03 U1	< 0.01 U1
5/16/2017	Background	0.03 J1	0.75	145	0.008 J1	< 0.005 U1	0.661	0.101	2.534	0.60	0.119	0.006	< 0.002 U1	5.49	0.04 J1	0.02 J1
6/12/2017	Background	0.03 J1	0.76	148	0.007 J1	< 0.005 U1	0.138	0.092	0.508	0.57	0.058	0.018	< 0.002 U1	5.39	0.03 J1	< 0.01 U1

**Table 1. Groundwater Data Summary: MW-1612
Mountaineer - LF
Appendix III 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
10/26/2016	Background	0.637	9.47	38.1	3.02	8.3	272	--
11/2/2016	Background	0.629	8.48	33.4	3.23	8.3	238	850
12/21/2016	Background	0.501	8.96	36.1	3.33	8.1	271	966
2/22/2017	Background	0.473	7.90	35.6	2.95	8.4	288	1,090
3/29/2017	Background	0.673	7.10	23.7	3.50	8.7	190	1,240
4/19/2017	Background	0.589	8.61	22.4	3.26	8.4	226	1,040
5/16/2017	Background	0.565	12.5	27.8	2.88	8.8	346	1,150
6/13/2017	Background	0.532	8.09	27.4	2.98	8.2	334	1,130
10/31/2017	Detection	0.457	7.22	20.2	3.53	8.2	147	914
9/20/2018	Detection	0.543	4.50	14.6	3.78	8.4	63.9	835
11/26/2018	Detection	0.413	4.25	11.5	3.91	8.0	49.2	764
4/9/2019	Detection	0.449	3.21	10.2	4.02	8.3	54.8	725
9/10/2019	Detection	0.438	4.77	11.1	4.34	8.3	31.3	786
5/18/2020	Detection	0.388	4.18	6.75	4.39	8.2	40.5	637
10/7/2020	Detection	0.351	3.43	6.36	3.92	8.3	40.0	662
5/14/2021	Detection	0.351	4.78	6.72	4.15	8.4	36.4	688
10/26/2021	Detection	0.367	3.4	6.24	4.31	8.4	38.0	630
5/19/2022	Detection	0.394	4.40	9.29	4.17	8.6	91.5	740 L1
11/9/2022	Detection	0.407	4.94	8.81	4.09	8.4	107	780
5/22/2023	Detection	0.336	4.00	6.98	4.40	8.3	77.8	670
11/1/2023	Detection	0.365	5.95	7.72	4.14	8.3	104	730
5/22/2024	Detection	0.346	4.36	6.91	4.29	8.1	94.3	700
9/30/2024	Detection	0.45	5.3	8.79	3.94	--	167	890
10/1/2024	Detection	--	--	--	--	8.4	--	--

**Table 1. Groundwater Data Summary: MW-1612
Mountaineer - LF
Appendix IV 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	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
10/26/2016	Background	0.31	12.4	66.2	0.033	0.007 J1	1.63	0.367	2.765	3.02	0.391	0.018	< 0.002 U1	62.1	0.2	0.03 J1
11/2/2016	Background	0.35	16.8	80.4	0.009 J1	< 0.004 U1	0.6	0.197	0.973	3.23	0.168	0.014	0.002 J1	67.6	0.08 J1	0.087
12/21/2016	Background	0.13	14.9	62.1	0.007 J1	< 0.004 U1	0.913	0.111	0.947	3.33	0.121	0.011	0.002 J1	52.2	0.1	< 0.01 U1
2/22/2017	Background	0.31	14.4	72.4	0.058	< 0.004 U1	2.13	0.700	1.084	2.95	0.640	0.018	0.003 J1	38.5	0.1	0.04 J1
3/29/2017	Background	0.77	12.4	141	0.290	0.01 J1	3.19	2.60	0.860	3.50	1.37	0.020	0.014	45.9	0.5	0.03 J1
4/19/2017	Background	0.82	10.7	233	0.551	< 0.05 U1	15.5	3.94	0.425	3.26	4.10	0.019	0.004 J1	58.0	1.2	0.2 J1
5/16/2017	Background	0.15	10.4	77.1	0.02 J1	< 0.005 U1	0.445	0.231	2.744	2.88	0.210	0.022	< 0.002 U1	43.1	0.1	0.02 J1
6/13/2017	Background	0.15	10.7	59.6	0.006 J1	< 0.005 U1	0.227	0.101	0.824	2.98	0.023	0.028	< 0.002 U1	34.3	0.06 J1	< 0.01 U1

**Table 1. Groundwater Data Summary
Mountaineer - Landfill**

Geosyntec Consultants, Inc.

Notes:

Combined radium values were calculated from the sum of the reported radium-226 and radium-228 results.

Radium data quality flags were not included. Reported negative radium-226 or radium-228 results were replaced with zero.

--: Not analyzed

<: Non-detect value. Analytes which were not detected are shown as less than the method detection limit (MDL) followed by a 'U1' flag.

In analytical data prior to 5/18/2021, U1 flags were reported as U in the analytical report.

J1: Concentration estimated. Analyte was detected between the method detection limit and the reporting limit.

In analytical data prior to 5/18/2021, J1 flags were reported as J in the analytical report.

L1: The associated laboratory control sample (LCS) or laboratory control sample duplicate (LCSD) recovery was outside acceptance limits.

M1: The associated matrix spike (MS) or matrix spike duplicate (MSD) recovery was outside acceptance limits.

mg/L: milligrams per liter

pCi/L: picocuries per liter

S7: Sample did not achieve constant weight.

SU: standard unit

µg/L: micrograms per liter

Groundwater Flow Velocity Calculations

**Table 1: Residence Time Calculation Summary
Mountaineer Landfill**

CCR Management Unit	Monitoring Well	Well Diameter (inches)	2024-01 ^[3]		2024-05		2024-07 ^[3]		2024-09	
			Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	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-26 ^[2]	2.0	1.6	37.8	1.8	34.2	1.6	37.0	1.5	40.0
	MW-27 ^[2]	2.0	18.6	3.3	16.9	3.6	19.1	3.2	18.6	3.3
	MW-30 ^[1]	2.0	5.1	12.0	4.2	14.6	4.8	12.7	4.6	13.1
	MW-38 ^[2]	2.0	NC	NC	NC	NC	NC	NC	NC	NC
	MW-39 ^[2]	2.0	17.1	3.6	10.9	5.6	17.8	3.4	17.8	3.4
	MW-1611 ^[2]	2.0	10.4	5.8	9.0	6.8	9.6	6.3	12.1	5.0
	MW-1612 ^[1]	2.0	10.8	5.6	11.6	5.2	11.2	5.4	12.0	5.1

Notes:

[1] - Upgradient Well

[2] - Downgradient Well

[3] - Two-of-two verification sampling

NC - Not Calculated.

Groundwater residence time for MW-38 could not be calculated, as it is the only monitoring well for its lithologic unit (valley alluvium) within the monitoring network.

Groundwater Monitoring Network Figure

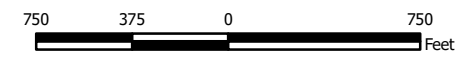


Monitoring Well Network

- ◆ Downgradient Sampling Location
- ◆ Background Sampling Location
- Landfill

Notes

- Monitoring well coordinates provided by AEP.
- Site features based on information available in Little Broad Run Landfill-CCR Groundwater Monitoring Well Network Evaluation (Arcadis, 2016) provided by AEP.



**Site Layout
CCR Landfill**

AEP Mountaineer Generating Plant
Letart, West Virginia

Geosyntec
consultants

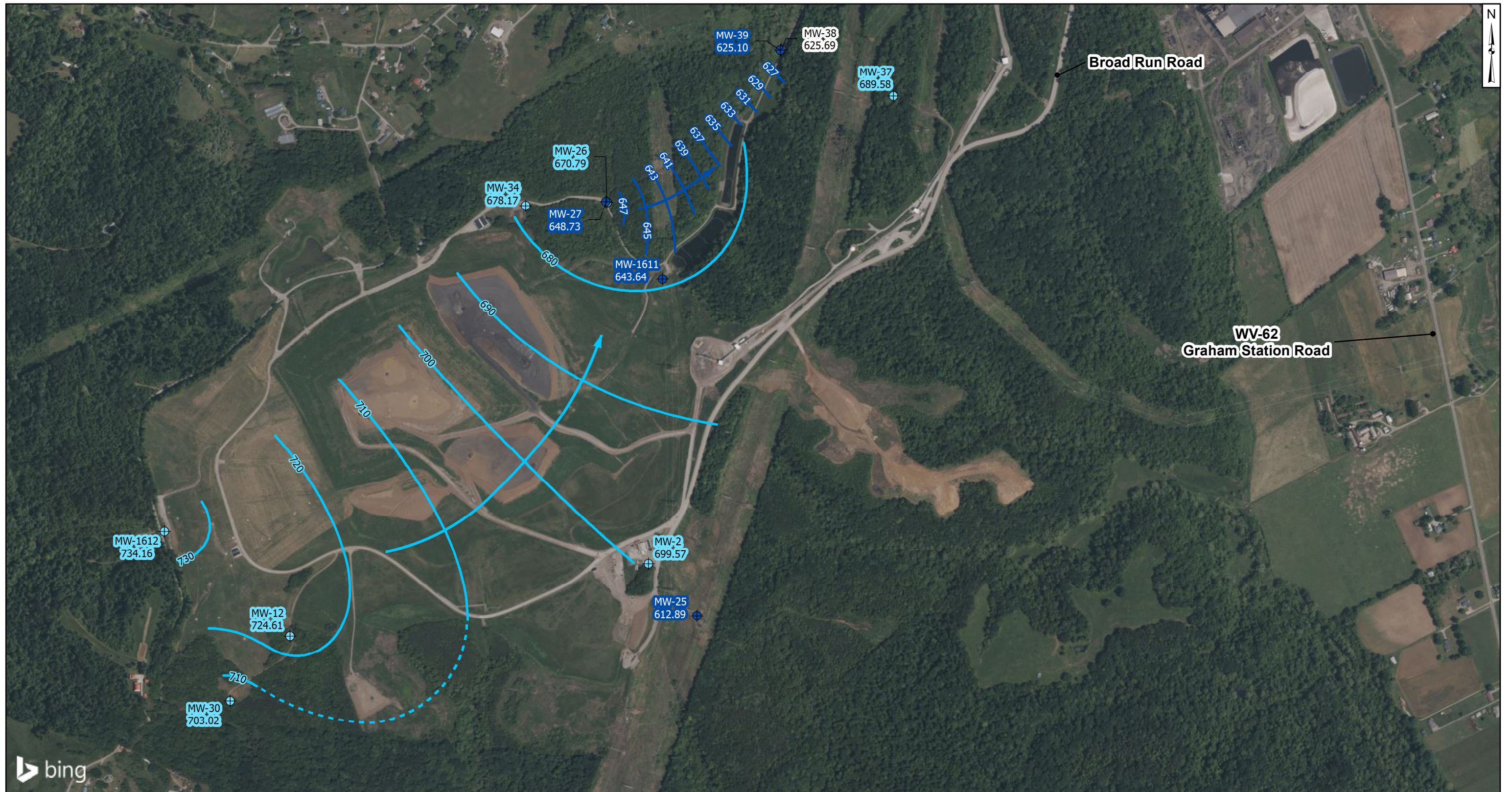
Columbus, Ohio

2018/01/26

Figure

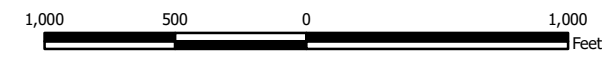
1

Groundwater Flow Direction Maps

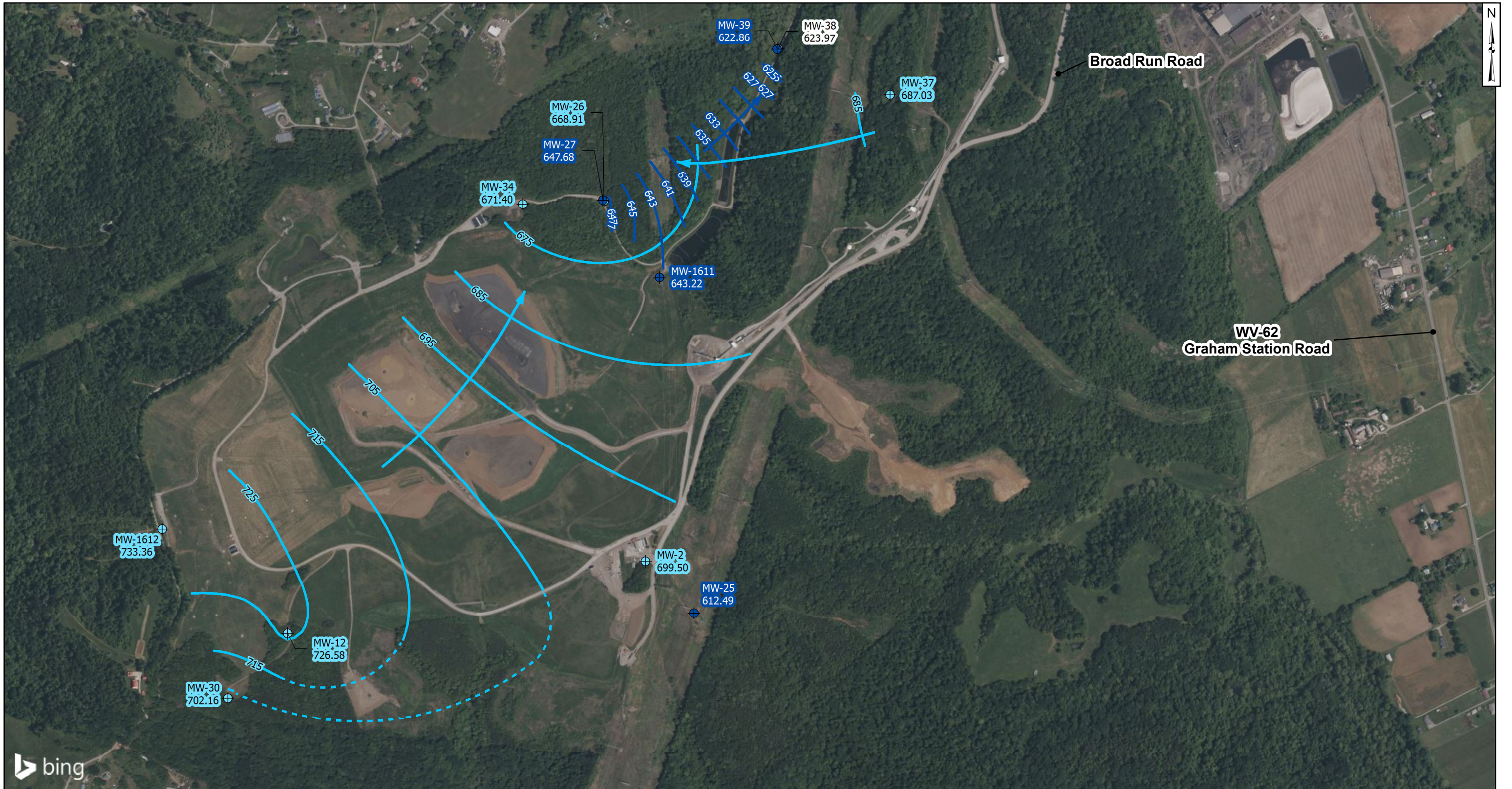


Legend	
Monitoring Wells	Groundwater Elevation Contours
⊕ Alluvium	— Hydrologic Unit 3
⊕ Hydrologic Unit 3	- - - Hydrologic Unit 3 (Inferred)
⊕ Hydrologic Unit 4	➡ Approximate Groundwater Flow Direction (Unit 3)
	— Hydrologic Unit 4
	➡ Approximate Groundwater Flow Direction (Unit 4)

- Notes**
1. Monitoring well coordinates and water level data (collected on May 16, 2024) provided by AEP.
 2. Site features based on information available in Little Broad Run Landfill-CCR Groundwater Monitoring Well Network Evaluation (Arcadis 2016) provided by AEP.
 3. Water level measurements from MW-25 (screened in shale below Unit 4) and MW-38 (screened in alluvium) were not used in ground water contouring.
 4. Groundwater elevation units are feet above mean sea level (ft amsl).
 5. Aerial imagery provided by Bing.

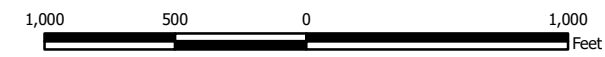


Potentiometric Surface Map - Uppermost Aquifer	
May 2024	
AEP Mountaineer Generating Plant - CCR Landfill Letart, West Virginia	
Geosyntec consultants	
Columbus, Ohio	2024/10/02
Figure 2	



Legend	
Monitoring Wells	Groundwater Elevation Contours
⊕ Alluvium	— Hydrologic Unit 3
⊕ Hydrologic Unit 3	- - - Hydrologic Unit 3 (Inferred)
⊕ Hydrologic Unit 4	→ Approximate Groundwater Flow Direction (Unit 3)
	— Hydrologic Unit 4
	→ Approximate Groundwater Flow Direction (Unit 4)

- Notes**
1. Monitoring well coordinates and water level data (collected on September 30, 2024) provided by AEP.
 2. Site features based on information available in Little Broad Run Landfill-CCR Groundwater Monitoring Well Network Evaluation (Arcadis 2016) provided by AEP.
 3. Water level measurements from MW-25 (screened in shale below Unit 4) and MW-38 (screened in alluvium) were not used in ground water contouring.
 4. Groundwater elevation units are feet above mean sea level (ft amsl).
 5. Aerial imagery provided by Bing.



**Potentiometric Surface Map - Uppermost Aquifer
September 2024**

AEP Mountaineer Generating Plant - CCR Landfill
New Haven, West Virginia

Geosyntec
consultants

Figure

3

Columbus, Ohio

2024/11/12

APPENDIX 2 – Statistical Analyses

The memorandums summarizing the statistical evaluation follow.

Memorandum

Date: February 2, 2024

To: David Miller (AEP)

Copies to: Jill Parker-Witt (AEP)

From: Allison Kreinberg (Geosyntec)

Subject: Evaluation of Detection Monitoring Data at Mountaineer Plant's Landfill (LF)

In accordance with United States Environmental Protection Agency (USEPA) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR Subpart D, "CCR rule"), the second semiannual detection monitoring event of 2023 at the Landfill, an existing CCR unit at the Mountaineer Power Plant located in Letart, West Virginia, was completed on October 26-31, 2023. Based on these results, verification sampling was completed on January 17, 2024.

Background values for the Landfill were established 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 data set 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 – Background Update Calculations* report, dated August 26, 2022.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate 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 or, in the case of pH, are below the LPL. In practice, if the initial result did not exceed the UPL and, in the case of pH, is above the LPL, 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 Mountaineer Landfill CCR unit, and as a result the Mountaineer Landfill will remain in detection monitoring.

Evaluation of Detection Monitoring Data – Mountaineer LF
February 2, 2024
Page 2

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

**Table 1. Detection Monitoring Data Comparison
Detection Summary Memorandum
Mountaineer Power Plant - Landfill**

Analyte	Unit	Description	MW-26	MW-27		MW-38	MW-39	MW-1611	
			10/26/2023	10/26/2023	1/17/2024	10/31/2023	10/31/2023	10/26/2023	1/17/2024
Boron	mg/L	Intrawell Background Value (UPL)	0.233	0.376		0.0935	0.198	0.233	
		Analytical Result	0.087	0.274	--	0.031	0.142	0.119	--
Calcium	mg/L	Intrawell Background Value (UPL)	64.7	1.77		57.6	12.4	26.2	
		Analytical Result	57.0	1.34	--	49.5	8.58	23.5	--
Chloride	mg/L	Intrawell Background Value (UPL)	7.09	1.85		7.76	3.13	10.6	
		Analytical Result	5.04	1.48	--	7.25	2.99	10.7	10.1
Fluoride	mg/L	Interwell Background Value (UPL)	4.33						
		Analytical Result	0.12	2.48	--	0.38	0.83	0.60	--
pH	SU	Intrawell Background Value (UPL)	7.8	9.5		7.6	8.8	8.0	
		Intrawell Background Value (LPL)	7.0	8.6		6.5	7.8	7.2	
		Analytical Result	7.1	8.5	9.0	6.9	8.0	7.5	--
Sulfate	mg/L	Intrawell Background Value (UPL)	10.8	7.48		37.9	0.200	23.4	
		Analytical Result	6.3	3.1	--	29.5	0.2	20.3	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	399	618		464	434	446	
		Analytical Result	350	570	--	420	390	400	--

Notes:

1. Bold values exceed the background value.

2. Background values are shaded gray.

LPL: lower prediction limit

mg/L: milligrams per liter

SU: standard units

UPL: upper prediction limit

ATTACHMENT A

Certification by a Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the August 26, 2022 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Mountaineer LF CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

David Anthony Miller

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature



22663

License Number

West Virginia

Licensing State

02.20.2024

Date

Memorandum

Date: October 11, 2024
To: David Miller (AEP)
Copies to: Jill Parker-Witt (AEP)
From: Allison Kreinberg (Geosyntec)
Subject: Evaluation of Detection Monitoring Data at Mountaineer Plant's Landfill (LF)

In accordance with United States Environmental Protection Agency (USEPA) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR Subpart D, "CCR rule"), the first semiannual detection monitoring event of 2024 at the Landfill, an existing CCR unit at the Mountaineer Power Plant located in Letart, West Virginia, was completed on May 16-21, 2024. Based on these results, verification sampling was completed on July 17, 2024.

Background values for the Landfill were originally established in January 2018. After a minimum of four additional detection monitoring events, the results of those events were compared to the existing background dataset. 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 – Background Update Calculations* report, dated August 26, 2022.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate 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 or, in the case of pH, are below the LPL. In practice, if the initial result did not exceed the UPL and, in the case of pH, is above the LPL, 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 Mountaineer Landfill CCR unit, and as a result the Mountaineer Landfill will remain in detection monitoring.

Evaluation of Detection Monitoring Data – Mountaineer LF
October 11, 2024
Page 2

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

**Table 1. Detection Monitoring Data Comparison
Detection Summary Memorandum
Mountaineer Power Plant – Landfill**

Analyte	Unit	Description	MW-26	MW-27	MW-38	MW-39		MW-1611
			5/20/2024	5/20/2024	5/16/2024	5/17/2024	7/17/2024	5/21/2024
Boron	mg/L	Intrawell Background Value (UPL)	0.233	0.376	0.0935	0.198		0.233
		Analytical Result	0.097	0.281	0.024	0.137	--	0.124
Calcium	mg/L	Intrawell Background Value (UPL)	64.7	1.77	57.6	12.4		26.2
		Analytical Result	63.0	1.36	49.3	7.26	--	25.2
Chloride	mg/L	Intrawell Background Value (UPL)	7.09	1.85	7.76	3.13		10.6
		Analytical Result	5.80	1.48	7.34	3.04	--	10.6
Fluoride	mg/L	Interwell Background Value (UPL)	4.33					
		Analytical Result	0.12	2.48	0.39	0.87	--	0.59
pH	SU	Intrawell Background Value (UPL)	7.8	9.5	7.6	8.8		8.0
		Intrawell Background Value (LPL)	7.0	8.6	6.5	7.8		7.2
		Analytical Result	7.1	8.7	6.8	7.9	--	7.3
Sulfate	mg/L	Intrawell Background Value (UPL)	10.8	7.48	37.9	0.200		23.4
		Analytical Result	6.9	2.8	29.7	0.3	<0.1	20.1
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	399	618	464	434		446
		Analytical Result	370	510	380	360	--	430

Notes:

1. **Bold values exceed the background value.**

2. Background values are shaded gray.

3. Nondetect values are shown as less than (<) the method detection limit.

LPL: lower prediction limit

mg/L: milligrams per liter

SU: standard units

UPL: upper prediction limit

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 August 26, 2022 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Mountaineer LF CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

David Anthony Miller

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature



22663

License Number

West Virginia

Licensing State

11.06.2024

Date

STATISTICAL ANALYSIS SUMMARY, BACKGROUND UPDATE CALCULATIONS

Landfill

Mountaineer Plant

Letart, West Virginia

Prepared for

American Electric Power

1 Riverside Plaza
Columbus, Ohio 43215-2372

Prepared by

Geosyntec Consultants, Inc.
500 West Wilson Bridge Road, Suite 250
Worthington, Ohio 43085

Project Number: CHA8500B

January 2025

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Table 1:	Groundwater Data Summary
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LIST OF ATTACHMENTS

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

ACRONYMS AND ABBREVIATIONS

ANOVA	analysis of variance
CCR	coal combustion residuals
CFR	code of federal regulations
LPL	lower prediction limit
QA/QC	quality assurance and quality control
TDS	total dissolved solids
UPL	upper prediction limit
USEPA	United States Environmental Protection Agency

1. INTRODUCTION

Groundwater monitoring has been conducted at the Landfill, an existing coal combustions residuals (CCR) unit at the Mountaineer Power Plant in Letart, West Virginia, in accordance with United States Environmental Protection Agency (USEPA) regulations regarding the disposal of CCR in landfills and surface impoundments (Code of Federal Regulations [CFR], Title 40, Section 257, Subpart D, “CCR rule”). It is required under the CCR rule to establish background concentrations for Appendix III parameters in groundwater. These background concentrations are used to calculate prediction limits for future detection monitoring events.

Background concentration values for Appendix III parameters were last calculated for the Landfill in August 2022. Since then, five semiannual detection monitoring events were conducted. This report details how data from these recent groundwater monitoring results were incorporated into the Landfill background dataset and provides updated prediction limits.

1.1 Previous Monitoring Events and Background Calculations

Before October 2017, at least eight monitoring events were completed to establish background concentrations and calculate prediction limits for Appendix III and Appendix IV parameters under the CCR rule. The data were reviewed for outliers and trends before upper prediction limits (UPLs) were calculated for each Appendix III parameter and lower prediction limits (LPLs) were established for pH. Intrawell prediction limits were initially selected for boron, chloride, sulfate, and total dissolved solids (TDS), and interwell prediction limits were initially selected for calcium, fluoride, and pH. The statistical analyses completed to establish background levels are detailed in the January 2018 *Statistical Analysis Summary* report (Geosyntec 2018). Tests for calcium and pH were revised to intrawell prediction limits based on an alternative source demonstration (ASD) certified on March 1, 2019 (Geosyntec 2019).

Calculated background values should be updated every four to eight measurements, as recommended in the United States Environmental Protection Agency (USEPA) *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (USEPA 2009). These updated background concentration values are used to revise the site-specific prediction limits. The prediction limits have previously been updated twice.

In August 2022, prediction limits for Appendix III parameters were updated with data collected through March 2022 (Geosyntec 2022). Intrawell testing (using a one-of-two retesting procedure) was selected as the method of analysis and these prediction limits were used for detection monitoring events completed between May 2022 and July 2024.

2. STATISTICAL ANALYSIS AND BACKGROUND DATA UPDATE

Five semiannual detection monitoring events were conducted since the last background update (Table 1). Verification sampling was completed (on an individual well or parameter basis) if the initial results for each detection monitoring event identified possible exceedances. Therefore, a minimum of five samples have been collected from each compliance well since the previous background update.

Data from the five semiannual detection monitoring events conducted at the Landfill between May 2022 and July 2024, including both initial and verification results, have been evaluated for inclusion in the background dataset.

The detection monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. The data were reviewed for outliers, and no outliers were removed from the dataset prior to analysis. The selected statistical methods have been certified by a qualified professional engineer (Attachment A).

2.1 Data Validation and QA/QC

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

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.10.0.22 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues that would impact data usability were noted.

2.2 Statistical Analysis

Statistical analyses for the Landfill were conducted in accordance with the *Statistical Analysis Plan* (Geosyntec 2020). These statistical analyses incorporated data from the five semiannual detection monitoring events and associated verification sampling events conducted between May 2022 and July 2024 (Table 1). The complete statistical analysis results are included in Attachment B.

Time series plots of Appendix III parameters 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).

2.2.1 Outlier Evaluation

Potential outliers were evaluated using Tukey's outlier test. That is, 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. No outliers were flagged in the May 2022 through July 2024 data.

2.2.2 Establishment of Updated Background Dataset

Analysis of variance (ANOVA) was conducted during the initial background screening to assist in evaluating whether intrawell testing is the most appropriate statistical approach for assessing Appendix III parameters. Intrawell tests, which compare compliance data from a single well to background data within the same well, are most appropriate 1) when 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. It is necessary to update background statistical limits (calculated prediction limits) periodically because natural systems change continuously with physical changes to the environment. For intrawell analyses, data for all wells and constituents are reevaluated when a minimum of four new data points are available. These four (or more) new data points are used to determine whether earlier concentrations are representative of present-day groundwater quality.

Mann-Whitney (Wilcoxon rank-sum) tests were used to compare the medians of historical data (September 2016–March 2022) to the new compliance samples (May 2022–July 2024). Results (Attachment B) were evaluated to determine whether 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, the data were reviewed to evaluate the cause of the difference and to assess which was most appropriate: adding newer data to the background dataset, replacing the background dataset with the newer data, or continuing to use the existing background dataset. If the differences appeared to have been caused by a release, then the previous background dataset would continue to be used.

Significant differences were found between the two groups for the following upgradient well/parameter pairs:

- A decrease was found for boron at MW-1612.
- An increase was found for chloride at MW-30.

The background dataset for chloride at MW-30 was updated because the magnitudes of the differences were minimal, and these data represent naturally occurring groundwater quality not impacted by a release. The background dataset for boron at MW-1612 was truncated because earlier results were collected more frequently and appeared to be substantially more variable than

subsequent data. While not identified via the Mann-Whitney test, chloride and sulfate results for upgradient well MW-1612 were truncated due to differences between historical and more recent values to generate background values representative of present-day groundwater quality conditions (Attachment B). The initial samples were collected shortly after well installation at MW-1612.

Statistically significant differences were found between the two groups for the following downgradient well/parameter pairs:

- A decrease was found for boron at MW-1611.
- An increase was found for chloride at MW-1611 and a decrease was found for chloride at MW-27.
- A decrease was found for sulfate at MW-27.

While statistically significant differences were identified, the background datasets for chloride and sulfate at all downgradient wells were updated because the magnitudes of the differences were minimal. The dataset for boron at MW-1611 was truncated to remove earlier concentrations due to the greater sampling frequency and variability within the dataset.

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

2.2.3 Updated Prediction Limits

Most historical data through July 2024, except as noted above, were used to update the intrawell UPLs (and intrawell LPLs, for pH) and to represent background values (Table 2).

The intrawell UPLs and LPLs were calculated for a one-of-two retesting procedure; that is, if at least one sample in a series of two has no measurement greater than the UPL and if the pH result is greater than or equal to the LPL, then it can be concluded that a statistically significant increase has not occurred. In practice, where the initial result is not greater than the UPL and where the pH result is greater than or equal to the LPL, a second sample will not be collected. The retesting procedures allow an acceptably high statistical power to detect changes at downgradient wells for constituents evaluated with intrawell prediction limits.

2.3 Conclusions

Five detection monitoring events were completed between May 2022 and July 2024 in accordance with the CCR rule. Data from these events were included in the new dataset. The laboratory and field data from these events were reviewed prior to statistical analysis, and no QA/QC issues that

impacted data usability were identified. 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 testing (using a one-of-two retesting procedure) was selected as the method of analysis, and testing data were updated for all Appendix III parameters.

3. REFERENCES

- Geosyntec. 2018. *Statistical Analysis Summary. Landfill – Mountaineer Plant*. Geosyntec Consultants, Inc. January.
- Geosyntec. 2019. *Alternative Source Demonstration – Federal CCR Rule. Mountaineer Plant. Landfill*. Geosyntec Consultants, Inc. March.
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- USEPA. 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance*. United States Environmental Protection Agency. EPA 530/R-09-007. March

TABLES

**Table 1: Groundwater Data Summary
Mountaineer Plant – Landfill**

Parameter	Unit	MW-26					
		Downgradient					
		5/23/2022	7/25/2022	11/10/2022	5/23/2023	10/26/2023	5/20/2024
		2022-D1	2022-D1-R1	2022-D2	2023-D1	2023-D2	2024-D1
Boron	mg/L	0.099	--	0.103	0.090	0.087	0.097
Calcium	mg/L	64.8	61.8	58.5	57.1 M1	57.0	63.0 M1
Chloride	mg/L	5.97	--	5.69	6.05	5.04	5.80
Fluoride	mg/L	0.13	--	0.13	0.12	0.12	0.12
Sulfate	mg/L	7.90	--	6.58	8.1	6.3	6.9
Total Dissolved Solids	mg/L	370 L1	--	370	370	350	370
pH	SU	7.5	7.7	7.2	7.2	7.1	7.1

Parameter	Unit	MW-27					
		Downgradient					
		5/23/2022	11/10/2022	5/23/2023	10/26/2023	1/17/2024	5/20/2024
		2022-D1	2022-D2	2023-D1	2023-D2	2023-D2-R1	2024-D1
Boron	mg/L	0.288	0.296	0.272	0.274	--	0.281
Calcium	mg/L	1.70	1.24	1.18	1.34	--	1.36
Chloride	mg/L	1.57	1.57	1.48	1.48	--	1.48
Fluoride	mg/L	2.58	2.54	2.58	2.48	--	2.48
Sulfate	mg/L	2.78	2.18	3.0	3.1	--	2.8
Total Dissolved Solids	mg/L	550 L1	550	550	570	--	510
pH	SU	9.3	8.9	8.8	8.5	9.0	8.7

Parameter	Unit	MW-30					
		Upgradient					
		5/20/2022	11/9/2022	5/25/2023	10/30/2023	5/20/2024	7/18/2024
		2022-D1	2022-D2	2023-D1	2023-D2	2024-D1	2024-D1-R1
Boron	mg/L	0.289	0.279	0.241	0.260	0.238	0.238
Calcium	mg/L	2.94	3.37	3.24	4.88	3.53	3.69
Chloride	mg/L	259	257	271	288	254	269
Fluoride	mg/L	3.57	3.34	3.57	3.46	3.46	3.46
Sulfate	mg/L	10.7	8.7	10.6	10.9	9.6	9.2
Total Dissolved Solids	mg/L	1,260 L1	1,100	1,250	1,320 S7	1,250	1,290
pH	SU	8.6	8.3	7.8	8.0	8.1	8.5

**Table 1: Groundwater Data Summary
Mountaineer Plant – Landfill**

Parameter	Unit	MW-38					
		Downgradient					
		5/20/2022	7/25/2022	11/9/2022	5/22/2023	10/31/2023	5/16/2024
		2022-D1	2022-D1-R1	2022-D2	2023-D1	2023-D2	2024-D1
Boron	mg/L	0.029 J1	--	0.027 J1	0.023 J1	0.031 J1	0.024 J1
Calcium	mg/L	58.8	53.3	45.4	42.2	49.5	49.3
Chloride	mg/L	7.51	--	6.85	7.30	7.25	7.34
Fluoride	mg/L	0.39	--	0.33	0.36	0.38	0.39
Sulfate	mg/L	26.7	--	33.4	27.5	29.5	29.7
Total Dissolved Solids	mg/L	440 L1	--	380	430	420	380
pH	SU	7.2	7.3	6.9	6.9	6.9	6.8

Parameter	Unit	MW-39					
		Downgradient					
		5/23/2022	11/9/2022	5/25/2023	10/31/2023	5/17/2024	7/17/2024
		2022-D1	2022-D2	2023-D1	2023-D2	2024-D1	2024-D1-R1
Boron	mg/L	0.140	0.144	0.134	0.142	0.137	--
Calcium	mg/L	6.46	7.60	7.07	8.58	7.26	--
Chloride	mg/L	3.02	2.92	3.03	2.99	3.04	--
Fluoride	mg/L	0.86	0.78	0.86	0.83	0.87	--
Sulfate	mg/L	0.18 J1	0.4 U1	0.2 J1	0.2 J1	0.3 J1	0.6 U1
Total Dissolved Solids	mg/L	370 L1	370	360	390	360	--
pH	SU	8.6	8.2	8.0	8.0	7.9	8.1

Parameter	Unit	MW-1611						
		Downgradient						
		5/20/2022	7/25/2022	11/9/2022	5/25/2023	10/26/2023	1/17/2024	5/21/2024
		2022-D1	2022-D1-R1	2022-D2	2023-D1	2023-D2	2023-D2-R1	2024-D1
Boron	mg/L	0.133	--	0.134	0.119	0.119	--	0.124
Calcium	mg/L	25.1	--	26.1	25.3	23.5	--	25.2
Chloride	mg/L	10.7	9.48	9.89	9.91	10.7	10.1	10.6
Fluoride	mg/L	0.63	--	0.58	0.57	0.60	--	0.59
Sulfate	mg/L	21.1	--	20.8	22.4	20.3	--	20.1
Total Dissolved Solids	mg/L	410 L1	--	420	390	400	--	430
pH	SU	7.7	8.1	7.6	7.6	7.5	7.6	7.3

**Table 1: Groundwater Data Summary
Mountaineer Plant – Landfill**

Parameter	Unit	MW-1612				
		Upgradient				
		5/19/2022	11/9/2022	5/22/2023	11/1/2023	5/22/2024
		2022-D1	2022-D2	2023-D1	2023-D2	2024-D1
Boron	mg/L	0.394	0.407	0.336	0.365	0.346
Calcium	mg/L	4.40	4.94	4.00	5.95	4.36
Chloride	mg/L	9.29	8.81	6.98	7.72	6.91
Fluoride	mg/L	4.17	4.09	4.40	4.14	4.29
Sulfate	mg/L	91.5	107	77.8	104	94.3
Total Dissolved Solids	mg/L	740 L1	780	670	730	700
pH	SU	8.6	8.4	8.3	8.3	8.1

Notes:

--: not measured

D1: first semi-annual detection monitoring event of the year

D2: second semi-annual detection monitoring event of the year

J1: estimated value. Parameter was detected in concentrations below the reporting limit

L1: the associated laboratory control sample (LCS) or laboratory control sample duplicate (LCSD) recovery was outside acceptance limits

M1: the associated matrix spike (MS) or matrix spike duplicate (MSD) recovery was outside acceptance limits

mg/L: milligrams per liter

R1: first verification event associated with detection monitoring round

S7: sample did not achieve constant weight

SU: standard unit

U1: parameter was not present in concentrations above the method detection limit and is reported as the reporting limit

**Table 2. Background Level Summary
Statistical Analysis Summary – Background Update Calculations
Mountaineer Plant – Landfill**

Analyte	Unit	Description	MW-26	MW-27	MW-38	MW-39	MW-1611	
Boron	mg/L	Intrawell Background Value (UPL)	0.215	0.387	0.0852	0.190	0.150	
Calcium	mg/L	Intrawell Background Value (UPL)	65.9	1.75	58.4	12.4	26.6	
Chloride	mg/L	Intrawell Background Value (UPL)	6.91	1.82	7.74	3.12	10.9	
Fluoride	mg/L	Interwell Background Value (UPL)	4.39					
pH	SU	Intrawell Background Value (UPL)	7.8	9.5	7.5	8.7	8.0	
		Intrawell Background Value (LPL)	6.9	8.5	6.5	7.8	7.2	
Sulfate	mg/L	Intrawell Background Value (UPL)	10.3	6.91	36.9	0.600	23.5	
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	400	590	463	424	445	

Notes:

LPL: lower prediction limit

mg/L: milligrams per liter

SU: standard units

UPL: upper prediction limit

ATTACHMENT A
Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Mountaineer Landfill CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

David Anthony Miller

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature



22663

License Number

West Virginia

Licensing State

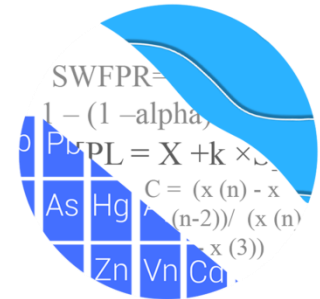
01.14.2025

Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS CONSULTING



November 20, 2024

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

RE: Background Update – May/July 2024 – Mountaineer Landfill

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the screening for the proposed background update of prediction limits with data through May/July 2024 for American Electric Power's Mountaineer Landfill. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at Mountaineer Landfill for the CCR program in 2016, and 8 background samples were initially collected at each of the groundwater monitoring wells. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** MW-1612 and MW-30
- **Downgradient wells:** MW-1611, MW-26, MW-27, MW-38, and MW-39

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis report was prepared according to the background screening conducted December 2017 that was approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting. The statistical 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 CCR Detection Monitoring constituents were evaluated:

- **Appendix III Parameters:** boron, calcium, chloride, fluoride, pH, sulfate, and TDS

Time series plots for Appendix III 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. Note that upgradient well MW-30 was sampled in July 2024 in addition to the May 2024 sample event.

Data at all wells were evaluated for the following: 1) outliers; 2) trends; 3) most appropriate statistical method for Appendix III parameters based on site characteristics of groundwater data upgradient of the facility; and 4) eligibility of downgradient wells when intrawell statistical methods are recommended.

Summary of Statistical Methods:

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

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. 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.

- 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 for parametric limits. 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 are evaluated when at least 4 new compliance values are available. In the interwell case, newer data are carefully evaluated during each event for new outliers, and prediction limits are constructed using all available data from upgradient wells.

Summary of Background Screening – December 2017

Outlier Evaluation

Time series plots are 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 III 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.

Tukey's outlier test noted a few outliers as may be seen on the Outlier Summary Table and accompanying graphs. Any values flagged as outliers are plotted in a lighter font on the time series graph. The pH values reported during the May 2017 sample event were, reportedly, due to instrumentation error. The test identified two outliers for boron in well MW-27; an outlier for calcium in well MW-1611; a low outlier for pH in well MW-1611; and an outlier for TDS in well MW-1611. However, these values were not flagged due to all concentrations being consistent over time and similar to concentrations in neighboring wells. A substitution of the most recent reporting limit was applied when varying detection limits existed in data.

Data were re-evaluated using Tukey's outlier test and visual screening with the July 2019 samples in which a low value was noted for fluoride in MW-30 and high values were noted for calcium in well MW-27 and sulfate in well MW-39. As mentioned above, flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. A summary of flagged values follows this letter (Figure C).

Seasonality

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. 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.

Trend Tests

While trends may be visual, a quantification of the trend and its 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 all data were consistent over time with no statistically significant increasing trends. A few statistically significant decreasing trends were noted; however, the magnitudes of the trends were low relative to the average concentrations. It was noted that boron, sulfate, and TDS concentrations are found to have the highest concentrations in upgradient wells. No adjustments to any data sets were required at that time

Appendix III Parameters– 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; when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter.

The ANOVA identified no variation for calcium, fluoride, or pH making these parameters eligible for interwell prediction limits. Variation was identified for boron, chloride, sulfate, and TDS suggesting an intrawell approach for these parameters. Data were further evaluated as described for the appropriateness of intrawell testing to accommodate the groundwater quality. A summary table of the ANOVA results was included with the screening.

Appendix III - Intrawell Eligibility

Prior to performing intrawell prediction limits, a demonstration is needed to show that downgradient water quality does not have existing impacts from the practices of the facility. As mentioned above, in cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to justify an intrawell approach. Such an assessment is beyond the scope of services provided by Groundwater Stats Consulting.

Parametric tolerance limits were constructed with a target of 99% confidence and 95% coverage using pooled upgradient well data for each of the Appendix III parameters. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. As more data are collected, the background population is better represented and the confidence and coverage levels increase.

Confidence intervals were constructed on downgradient wells for each of the Appendix III parameters, using the tolerance limits discussed above as background standards to determine intrawell eligibility. When the entire confidence interval is above a background standard for a given parameter, interwell methods are initially recommended as the statistical method. Therefore, only parameters with confidence intervals which did not exceed background standards are eligible for intrawell prediction limits.

No confidence interval exceedances were identified for boron, chloride, sulfate, and TDS and, therefore, these constituents are eligible for intrawell prediction limits. Interwell prediction limits were initially recommended for calcium, fluoride, and pH. However, additional studies provided by Geosyntec Consultants support natural spatial variation in groundwater for calcium and pH; therefore, interwell methods will be used for fluoride only.

Summary of Background Updates – 2024

Background data were originally screened in December 2017, and all data were re-screened during the October 2019 and March 2022 sample events. The results were submitted with each respective report. Data at all wells were re-evaluated through May/July 2024 during this analysis using time series plots and Tukey's outlier test to confirm previously identified outliers as well as identify new outliers and extreme trending patterns that would lead to artificially elevated statistical limits. Note that for the downgradient well data that are evaluated with confidence intervals, values that are marginally high relative to the rest of the data are retained unless there is particular justification for excluding them. Any flagged values, as further discussed below, may be seen on the Outlier Summary table for each formation following this letter.

Outlier Analysis

Prior to performing prediction limits, proposed background data through May/July 2024 were evaluated using Tukey's test at all wells for boron, calcium, chloride, pH, sulfate, and TDS, and at pooled upgradient wells for fluoride. During this update, both visual screening and Tukey's outlier test were used to identify potential outliers (Figure C).

Tukey's test and visual screening identified several statistical outliers and confirmed previously flagged values. High values identified by Tukey's test for sulfate and calcium at upgradient well MW-30 and a low value identified by Tukey's test for fluoride at upgradient well MW-30 were flagged as outliers and excluded from statistical limits to reduce variation and better represent present-day groundwater quality conditions. Any values identified by Tukey's test, but not flagged in the database, appeared representative of spatial variation. A list of flagged values follows this report.

Mann-Whitney Test

For constituents requiring intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through March 2022 (when available) to compliance data through May/July 2024 (Figure D). When no statistically significant difference in medians between the two groups is found at a 99% confidence level, background data may be updated with newer compliance data. Statistically significant differences (either an increase or decrease in median concentrations) were found between the two groups for the following well/constituent pairs:

Increase:

- Chloride: MW-30 (upgradient) and MW-1611

Decrease

- Boron: MW-1611 and MW-1612 (upgradient)
- Chloride: MW-27
- Sulfate: MW-27

Typically, when the test concludes that the medians of the two groups are significantly different, particularly in the downgradient wells, the background data are not updated to include the newer data but will be reconsidered in the future. During this background update, statistically significant differences in medians were identified for a few well/constituent pairs; however, the majority of the more recent compliance measurements were similar to those reported historically. Therefore, these records were updated through May/July 2024. A summary of these results follows this letter and the test results are included with the Mann Whitney test section at the end of this report.

For boron at downgradient well MW-1611 and upgradient MW-1612 earlier concentrations were sampled at higher frequencies and are substantially more variable than more recent concentrations. Therefore, as recommended by Geosyntec Consultants, earlier concentrations were truncated from the record in order to construct statistical limits that are representative of present-day groundwater quality conditions on relatively stable data. Although not identified by the Mann-Whitney test at the 99% confidence level, elevated concentrations early in the record for chloride and sulfate at upgradient well MW-1612 were similarly truncated from the record in order to construct statistical limits that are representative of present-day groundwater quality conditions on non-trending, stable data. A list of well/constituent pairs that use a truncated portion of their record for constructing statistical limits follows this letter.

Trend Tests

The Sen's Slope/Mann Kendall trend test was used to evaluate the entire record of data through May/July 2024 at upgradient wells for fluoride which utilizes interwell prediction limits (Figure E). When statistically significant increasing trends are identified in upgradient wells, the earlier portion of data may require deselection prior to construction of interwell statistical limits if the trending data would result in statistical limits that are not conservative from a regulatory perspective. A summary of the trend test results follows this report. A statistically significant increasing trend was identified for fluoride in well MW-1612. Concentrations for fluoride, however, at this well were similar to those reported in upgradient well MW-30; therefore, no adjustment was required for this record.

Statistical Limits

Intrawell prediction limits using all historical data through May/July 2024 were constructed, and a summary of the updated limits follows this letter (Figure F). Interwell prediction limits, combined with a 1-of-2 resample plan, were updated using all available data from upgradient wells for the same time period for fluoride (Figure G). Interwell prediction limits pool upgradient well data to establish a background limit for an individual constituent. A summary table of the updated limits may be found following this letter in the Prediction Limit Summary Tables.

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

For Groundwater Stats Consulting,



Andrew Collins
Project Manager



Kristina Rayner
Senior Statistician

Date Ranges

Date: 11/20/2024 11:05 AM

Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Boron, total (mg/L)

MW-1611 background:11/26/2018-5/21/2024

MW-1612 background:9/20/2018-5/22/2024

Chloride, total (mg/L)

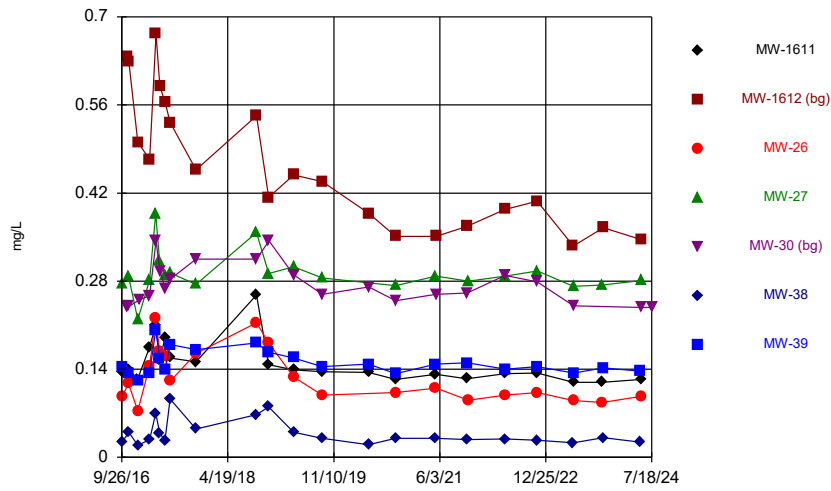
MW-1612 background:9/20/2018-5/22/2024

Sulfate, total (mg/L)

MW-1612 background:10/30/2017-5/22/2024

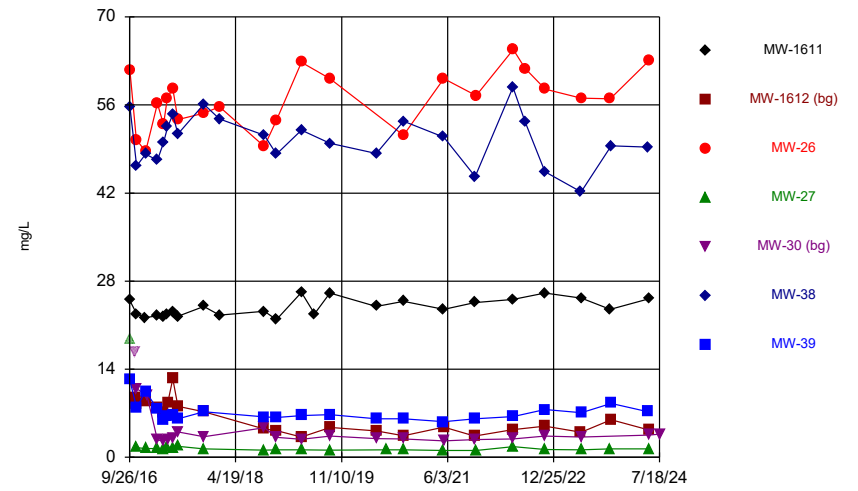
FIGURE A
Time Series

Time Series



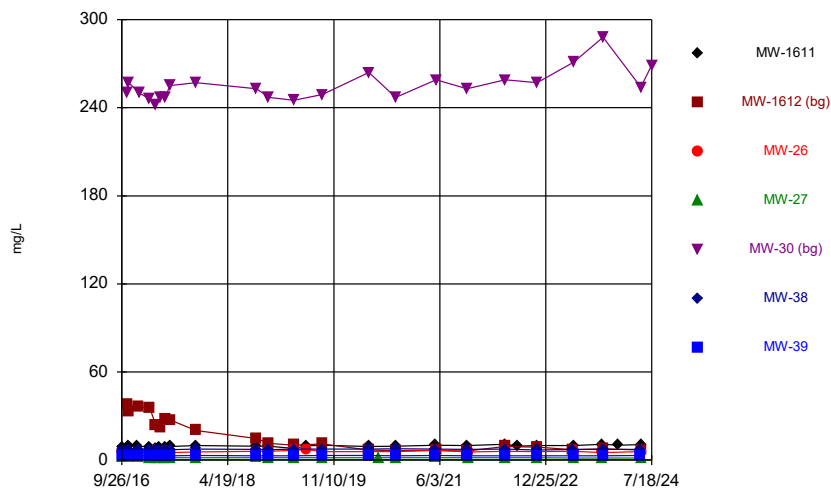
Constituent: Boron, total Analysis Run 10/17/2024 1:16 PM
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Time Series



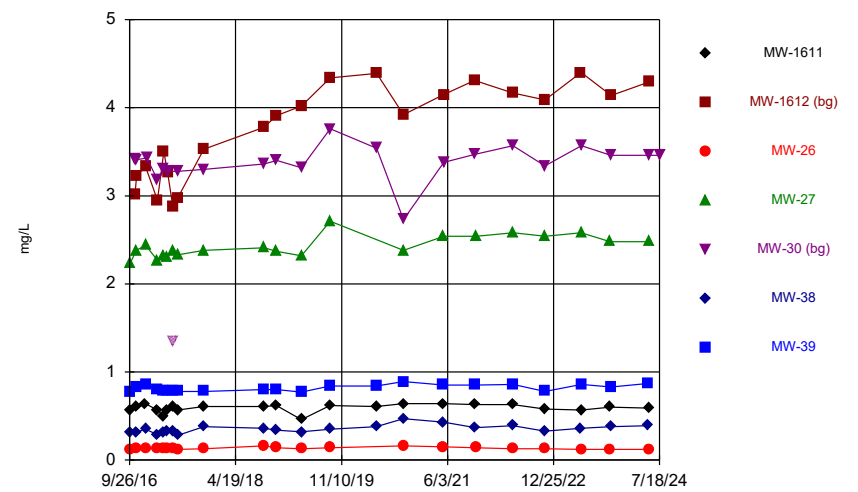
Constituent: Calcium, total Analysis Run 10/17/2024 1:16 PM
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Time Series



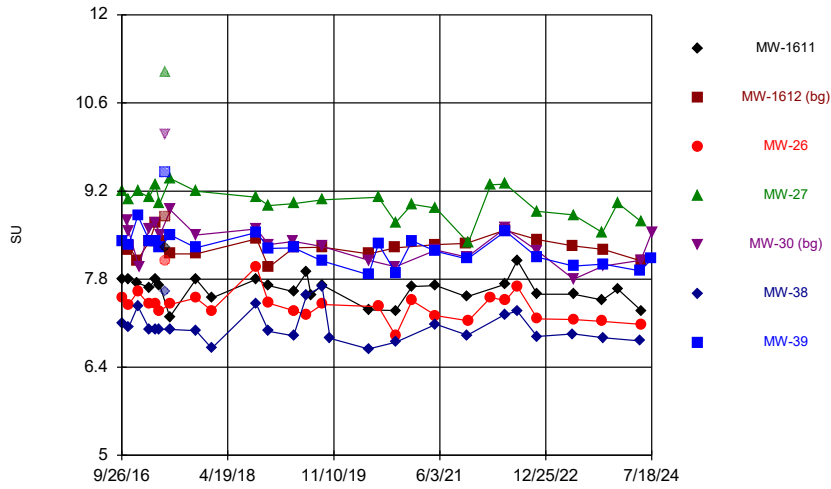
Constituent: Chloride, total Analysis Run 10/17/2024 1:16 PM
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Time Series



Constituent: Fluoride, total Analysis Run 10/17/2024 1:16 PM
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

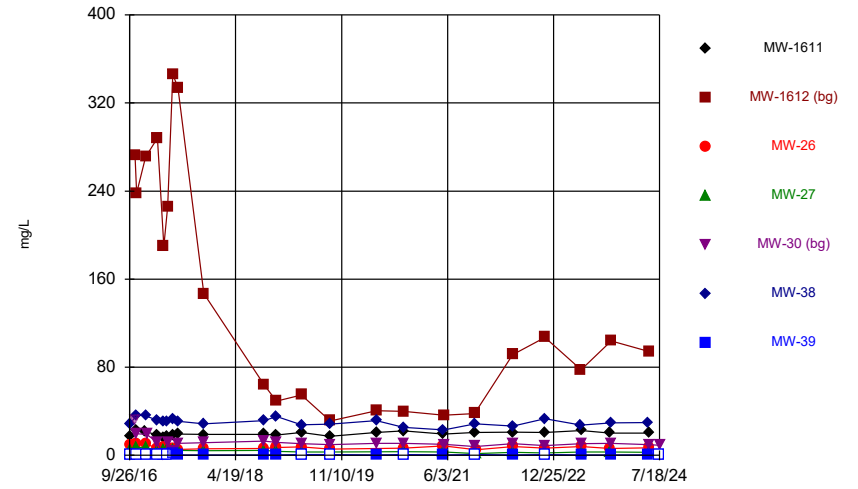
Time Series



Constituent: pH, field Analysis Run 10/17/2024 1:16 PM
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

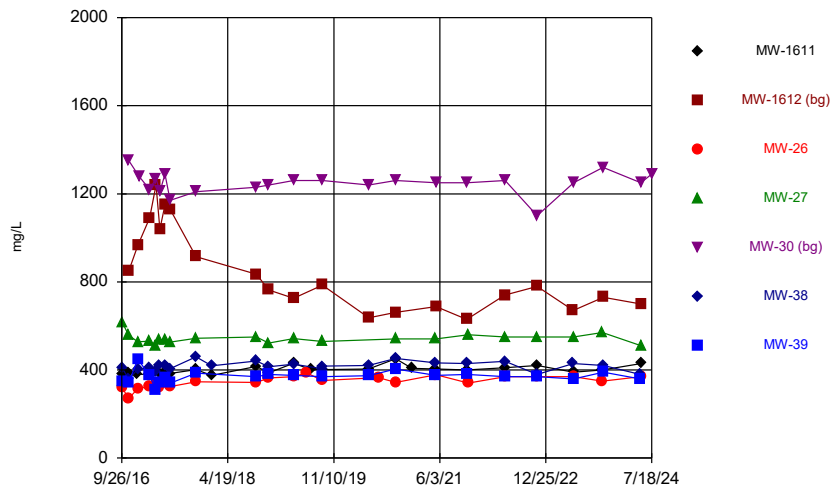
Hollow symbols indicate censored values.

Time Series



Constituent: Sulfate, total Analysis Run 10/17/2024 1:16 PM
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

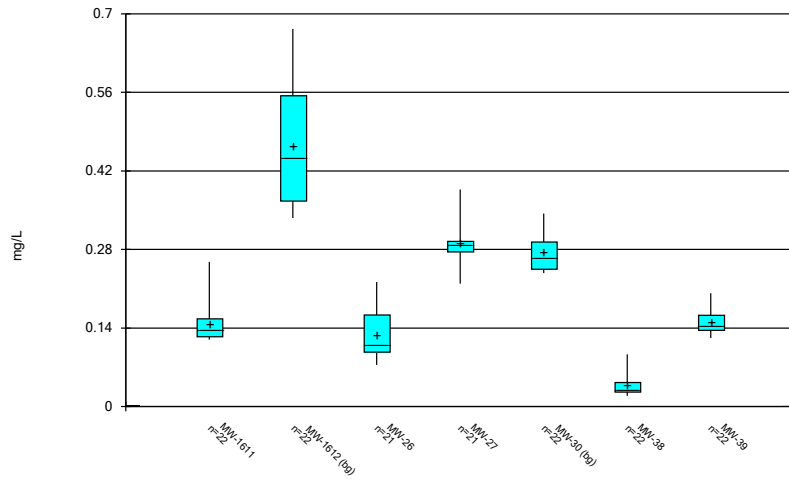
Time Series



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/17/2024 1:16 PM
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

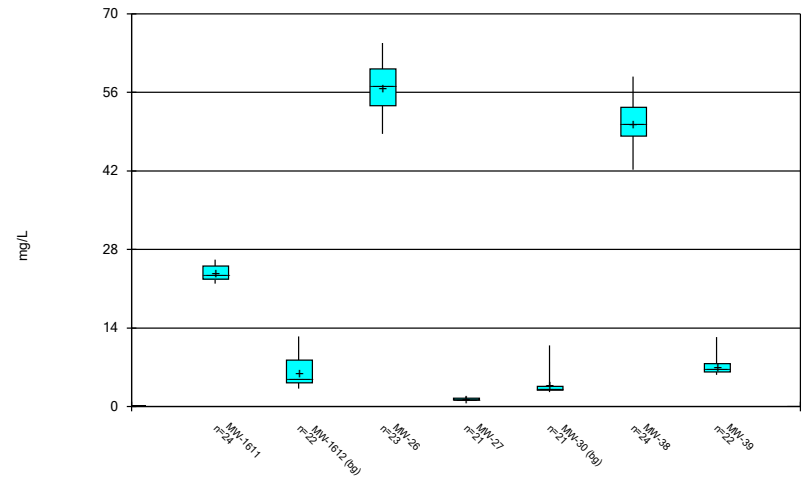
FIGURE B
Box Plots

Box & Whiskers Plot



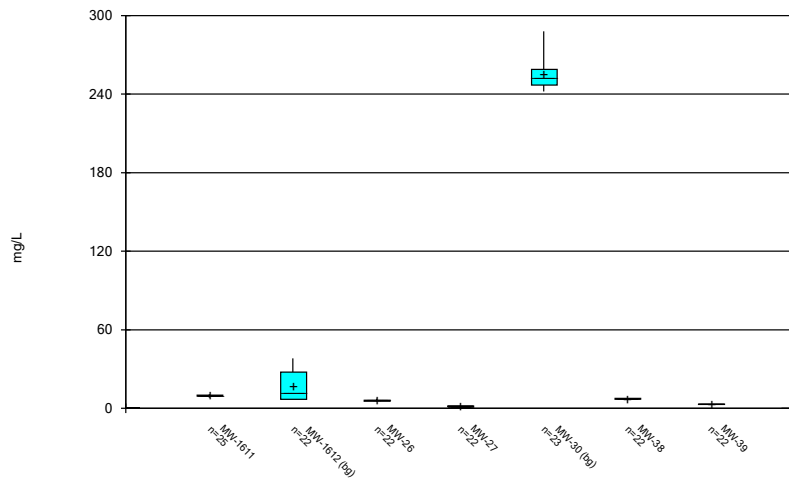
Constituent: Boron, total Analysis Run 10/17/2024 1:16 PM
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Box & Whiskers Plot



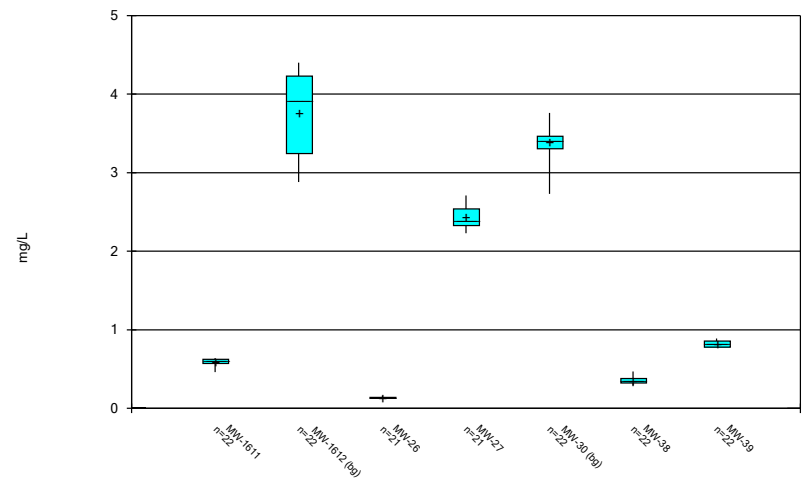
Constituent: Calcium, total Analysis Run 10/17/2024 1:16 PM
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Box & Whiskers Plot



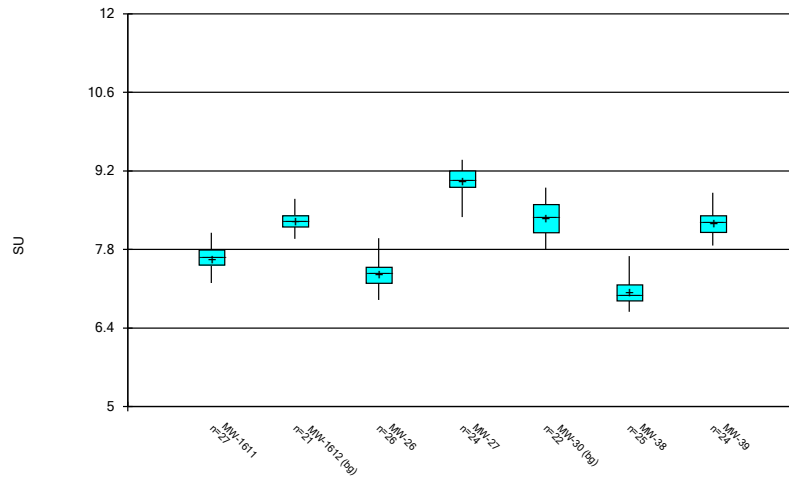
Constituent: Chloride, total Analysis Run 10/17/2024 1:16 PM
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Box & Whiskers Plot



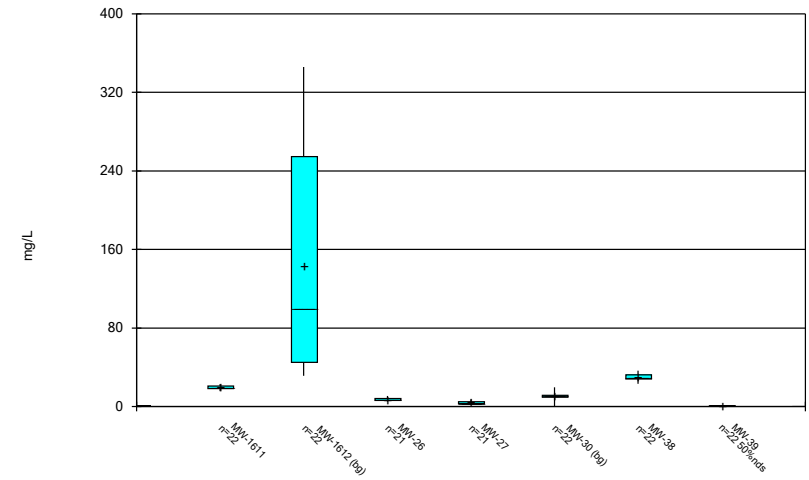
Constituent: Fluoride, total Analysis Run 10/17/2024 1:16 PM
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Box & Whiskers Plot



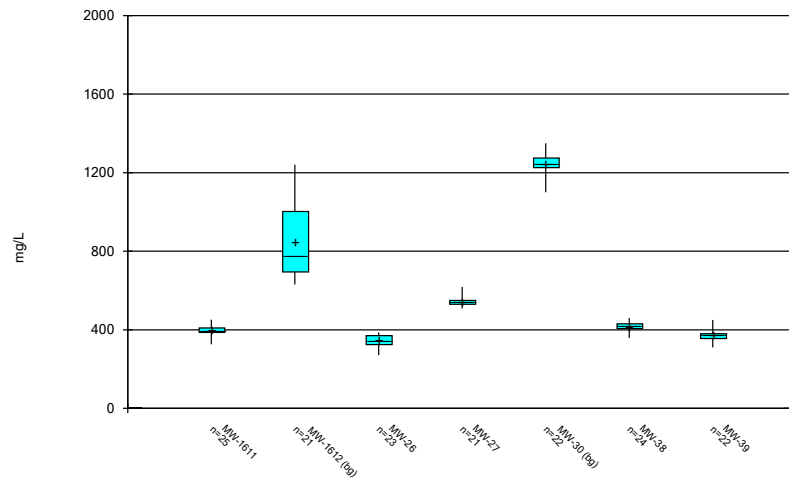
Constituent: pH, field Analysis Run 10/17/2024 1:16 PM
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Box & Whiskers Plot



Constituent: Sulfate, total Analysis Run 10/17/2024 1:16 PM
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Box & Whiskers Plot



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/17/2024 1:16 PM
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

FIGURE C

Outlier Summary and Tukey's Outlier Test

Outlier Summary

Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill Printed 10/17/2024, 1:17 PM

	MW-27 Calcium, total (mg/L)	MW-30 Calcium, total (mg/L)	MW-30 Fluoride, total (mg/L)	MW-1611 pH, field (SU)	MW-1612 pH, field (SU)	MW-26 pH, field (SU)	MW-27 pH, field (SU)	MW-30 pH, field (SU)	MW-38 pH, field (SU)	MW-39 pH, field (SU)
9/27/2016	18.9 (O)									
10/26/2016		16.6 (o)								
5/16/2017				8.3 (O)	8.8 (O)				7.6 (O)	9.5 (O)
5/17/2017			1.34 (o)			8.09 (O)	11.1 (O)	10.1 (O)		

	MW-30 Sulfate, total (mg/L)	MW-39 Sulfate, total (mg/L)
9/27/2016		
10/26/2016	31.5 (o)	
5/16/2017		1.5 (O)
5/17/2017		

Tukey's Outlier Test - Significant Results

Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill Printed 10/18/2024, 7:44 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron, total (mg/L)	MW-1611	Yes	0.258	9/20/2018	NP	NaN	22	0.1484	0.03368	normal	ShapiroWilk
Boron, total (mg/L)	MW-27	Yes	0.387,0.357	3/28/2017,9/20/2018	NP	NaN	21	0.291	0.03255	normal	ShapiroWilk
Calcium, total (mg/L)	MW-27	Yes	18.9	9/27/2016	NP	NaN	22	2.128	3.751	normal	ShapiroWilk
Calcium, total (mg/L)	MW-30 (bg)	Yes	16.6,10.9,9.91	10/26/2016,11/2/2016,12/28/2016	NP	NaN	22	4.46	3.477	normal	ShapiroWilk
Calcium, total (mg/L)	MW-39	Yes	12.4	9/26/2016	NP	NaN	22	7.19	1.579	normal	ShapiroWilk
pH, field (SU)	MW-27	Yes	11.1	5/17/2017	NP	NaN	25	9.095	0.4829	normal	ShapiroWilk
pH, field (SU)	MW-39	Yes	9.5	5/16/2017	NP	NaN	25	8.316	0.3339	normal	ShapiroWilk
Sulfate, total (mg/L)	MW-30 (bg)	Yes	31.5,19.6,19.1,0.1	10/26/2016,11/2/2016,12/28/2016,3/29/2017	NP	NaN	23	11.47	5.818	normal	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-27	Yes	618	9/27/2016	NP	NaN	21	543	23.15	normal	ShapiroWilk

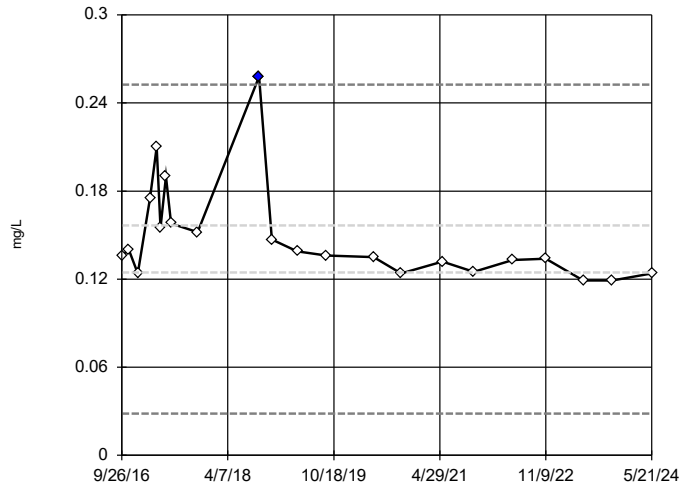
Tukey's Outlier Test - All Results

Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill Printed 10/18/2024, 7:44 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron, total (mg/L)	MW-1611	Yes	0.258	9/20/2018	NP	NaN	22	0.1484	0.03368	normal	ShapiroWilk
Boron, total (mg/L)	MW-1612 (bg)	No	n/a	n/a	NP	NaN	22	0.4638	0.105	normal	ShapiroWilk
Boron, total (mg/L)	MW-26	No	n/a	n/a	NP	NaN	21	0.1273	0.04262	normal	ShapiroWilk
Boron, total (mg/L)	MW-27	Yes	0.387,0.357	3/28/2017,9/20/2018	NP	NaN	21	0.291	0.03255	normal	ShapiroWilk
Boron, total (mg/L)	MW-30 (bg)	No	n/a	n/a	NP	NaN	22	0.2739	0.03269	normal	ShapiroWilk
Boron, total (mg/L)	MW-38	No	n/a	n/a	NP	NaN	22	0.03836	0.02051	normal	ShapiroWilk
Boron, total (mg/L)	MW-39	No	n/a	n/a	NP	NaN	22	0.1503	0.0193	normal	ShapiroWilk
Calcium, total (mg/L)	MW-1611	No	n/a	n/a	NP	NaN	24	23.83	1.366	normal	ShapiroWilk
Calcium, total (mg/L)	MW-1612 (bg)	No	n/a	n/a	NP	NaN	22	6.114	2.484	normal	ShapiroWilk
Calcium, total (mg/L)	MW-26	No	n/a	n/a	NP	NaN	23	56.81	4.521	normal	ShapiroWilk
Calcium, total (mg/L)	MW-27	Yes	18.9	9/27/2016	NP	NaN	22	2.128	3.751	normal	ShapiroWilk
Calcium, total (mg/L)	MW-30 (bg)	Yes	16.6,10.9,9.91	10/26/2016,11/2/2016,12/28/2016	NP	NaN	22	4.46	3.477	normal	ShapiroWilk
Calcium, total (mg/L)	MW-38	No	n/a	n/a	NP	NaN	24	50.53	3.928	normal	ShapiroWilk
Calcium, total (mg/L)	MW-39	Yes	12.4	9/26/2016	NP	NaN	22	7.19	1.579	normal	ShapiroWilk
Chloride, total (mg/L)	MW-1611	No	n/a	n/a	NP	NaN	25	9.532	0.709	normal	ShapiroWilk
Chloride, total (mg/L)	MW-1612 (bg)	No	n/a	n/a	NP	NaN	22	17.18	11.35	normal	ShapiroWilk
Chloride, total (mg/L)	MW-26	No	n/a	n/a	NP	NaN	22	5.805	0.545	normal	ShapiroWilk
Chloride, total (mg/L)	MW-27	No	n/a	n/a	NP	NaN	22	1.612	0.1036	normal	ShapiroWilk
Chloride, total (mg/L)	MW-30 (bg)	No	n/a	n/a	NP	NaN	23	255	10.37	normal	ShapiroWilk
Chloride, total (mg/L)	MW-38	No	n/a	n/a	NP	NaN	22	7.314	0.2093	normal	ShapiroWilk
Chloride, total (mg/L)	MW-39	No	n/a	n/a	NP	NaN	22	3.001	0.05756	normal	ShapiroWilk
pH, field (SU)	MW-1611	No	n/a	n/a	NP	NaN	28	7.658	0.2349	normal	ShapiroWilk
pH, field (SU)	MW-1612 (bg)	No	n/a	n/a	NP	NaN	22	8.335	0.1877	normal	ShapiroWilk
pH, field (SU)	MW-26	No	n/a	n/a	NP	NaN	27	7.389	0.2547	normal	ShapiroWilk
pH, field (SU)	MW-27	Yes	11.1	5/17/2017	NP	NaN	25	9.095	0.4829	normal	ShapiroWilk
pH, field (SU)	MW-30 (bg)	No	n/a	n/a	NP	NaN	23	8.438	0.4584	normal	ShapiroWilk
pH, field (SU)	MW-38	No	n/a	n/a	NP	NaN	26	7.064	0.2687	normal	ShapiroWilk
pH, field (SU)	MW-39	Yes	9.5	5/16/2017	NP	NaN	25	8.316	0.3339	normal	ShapiroWilk
Sulfate, total (mg/L)	MW-1611	No	n/a	n/a	NP	NaN	22	19.7	1.857	normal	ShapiroWilk
Sulfate, total (mg/L)	MW-1612 (bg)	No	n/a	n/a	NP	NaN	22	142.8	107.1	normal	ShapiroWilk
Sulfate, total (mg/L)	MW-26	No	n/a	n/a	NP	NaN	21	7.199	1.504	normal	ShapiroWilk
Sulfate, total (mg/L)	MW-27	No	n/a	n/a	NP	NaN	21	3.938	1.453	normal	ShapiroWilk
Sulfate, total (mg/L)	MW-30 (bg)	Yes	31.5,19.6,19.1,0.1	10/26/2016,11/2/2016,12/28/2016,3/29/2017	NP	NaN	23	11.47	5.818	normal	ShapiroWilk
Sulfate, total (mg/L)	MW-38	No	n/a	n/a	NP	NaN	22	30.15	3.302	normal	ShapiroWilk
Sulfate, total (mg/L)	MW-39	No	n/a	n/a	NP	NaN	23	0.4283	0.3247	normal	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-1611	No	n/a	n/a	NP	NaN	25	398.2	23.5	normal	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-1612 (bg)	No	n/a	n/a	NP	NaN	21	844.1	187.1	normal	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-26	No	n/a	n/a	NP	NaN	23	346.8	26.47	normal	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-27	Yes	618	9/27/2016	NP	NaN	21	543	23.15	normal	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-30 (bg)	No	n/a	n/a	NP	NaN	22	1248	50.39	normal	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-38	No	n/a	n/a	NP	NaN	24	416.3	23.2	normal	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	MW-39	No	n/a	n/a	NP	NaN	22	370	26.67	normal	ShapiroWilk

Tukey's Outlier Screening

MW-1611

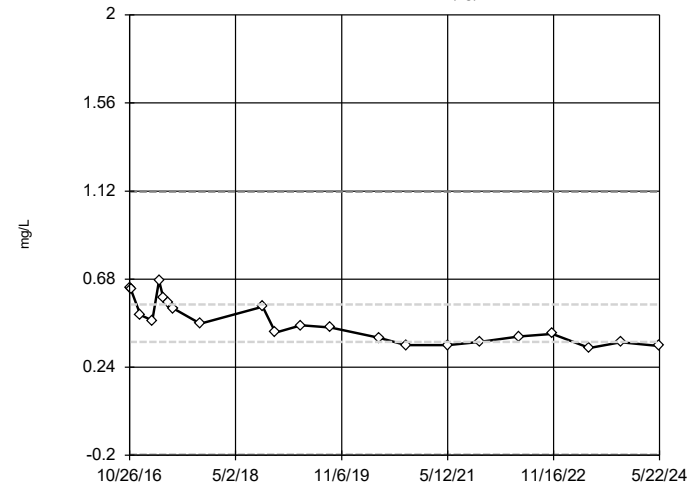


n = 22
 Outlier is drawn as solid.
 Tukey's method selected by user.
 High cutoff = 0.2525, low cutoff = 0.0285, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-1612 (bg)

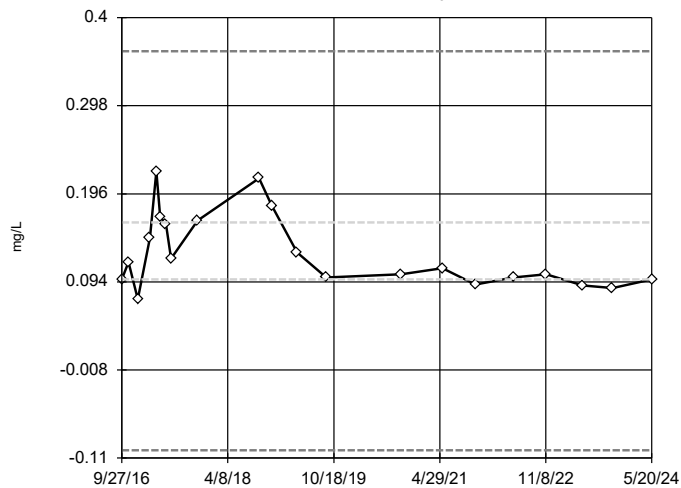


n = 22
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 1.118, low cutoff = -0.198, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

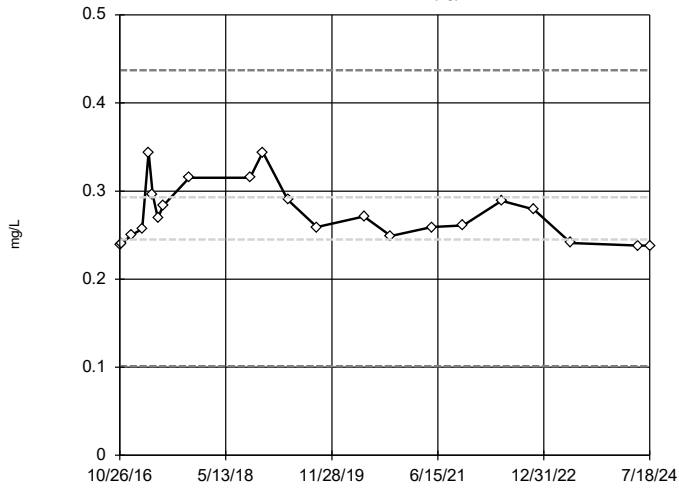
Tukey's Outlier Screening

MW-26



Tukey's Outlier Screening

MW-30 (bg)

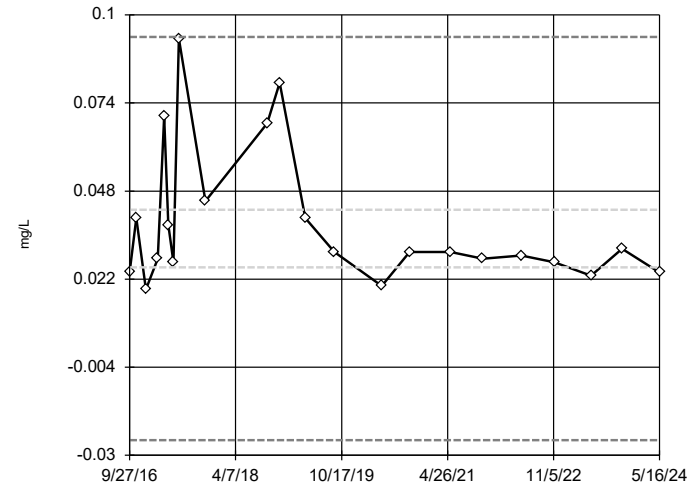


n = 22
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 0.437, low cutoff = 0.101, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-38

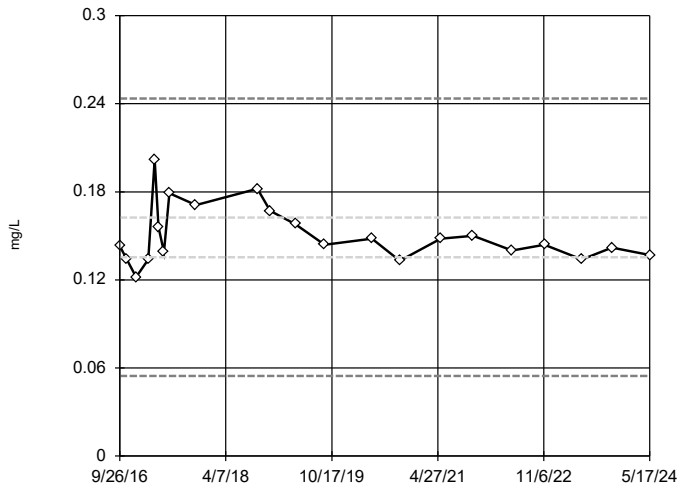


n = 22
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 0.0935, low cutoff = -0.0255, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-39

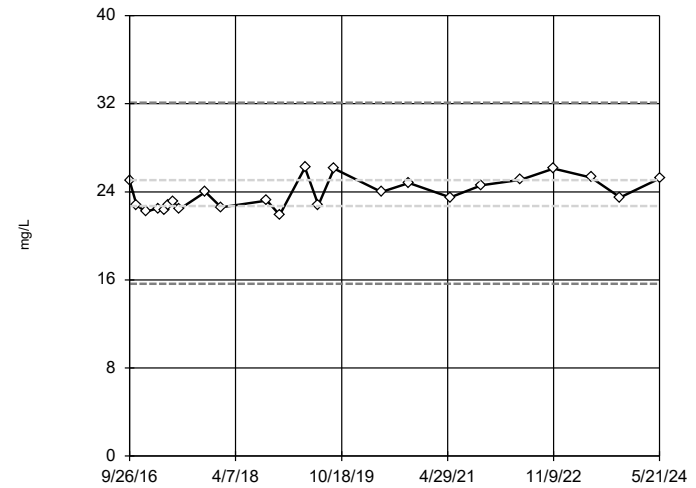


n = 22
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 0.2435, low cutoff = 0.0545, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-1611

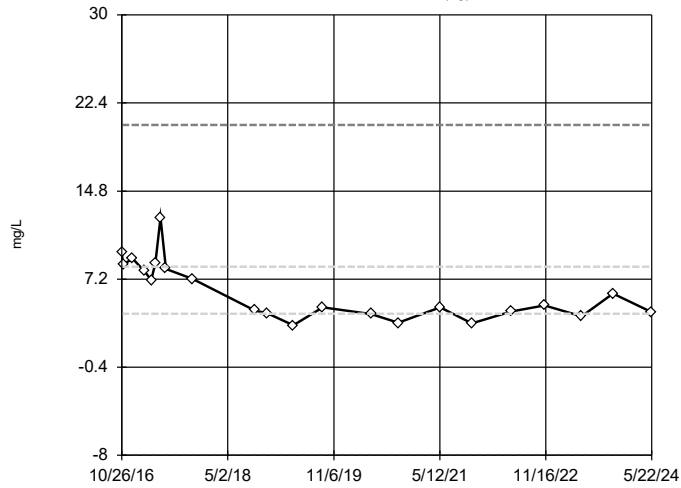


n = 24
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 32.1, low cutoff = 15.65, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-1612 (bg)

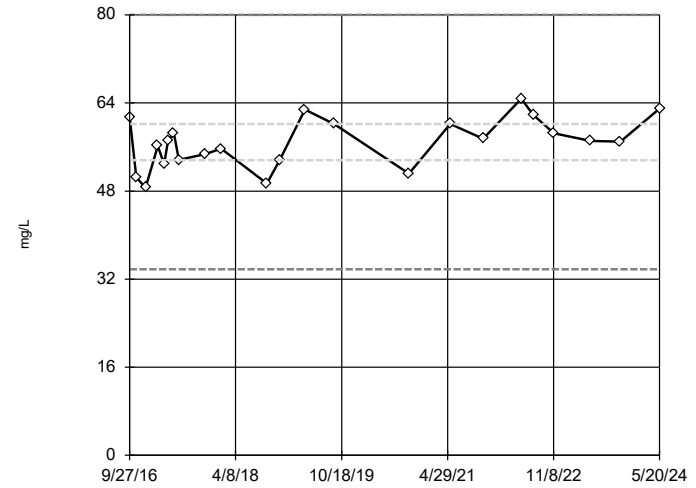


n = 22
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 20.5, low cutoff = -7.995, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-26

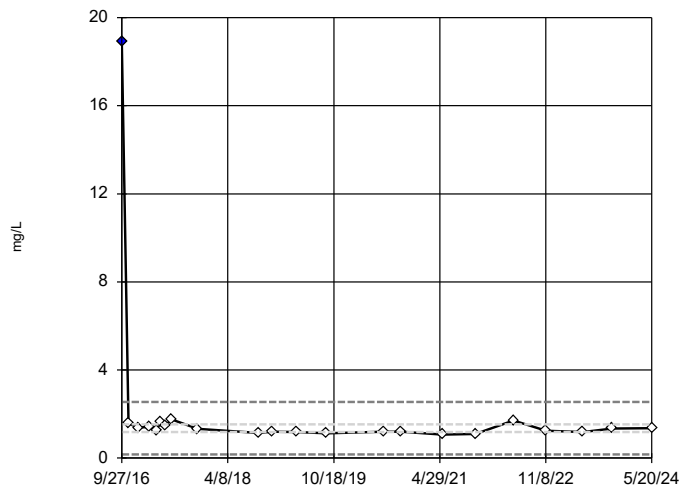


n = 23
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 80, low cutoff = 33.8, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-27

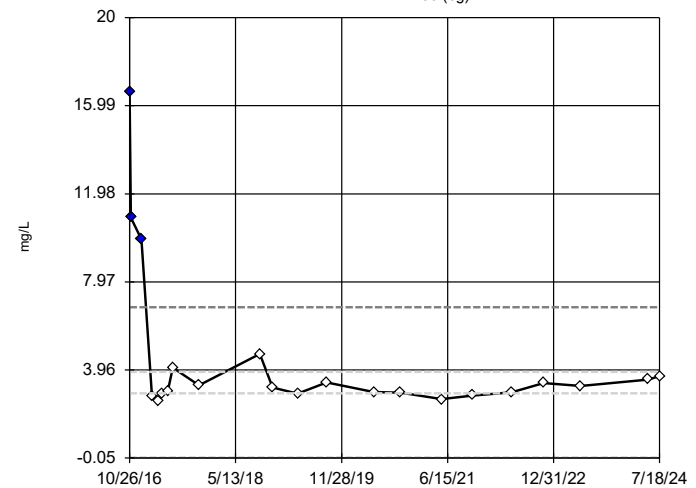


n = 22
 Outlier is drawn as solid.
 Tukey's method selected by user.
 High cutoff = 2.545, low cutoff = 0.165, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-30 (bg)

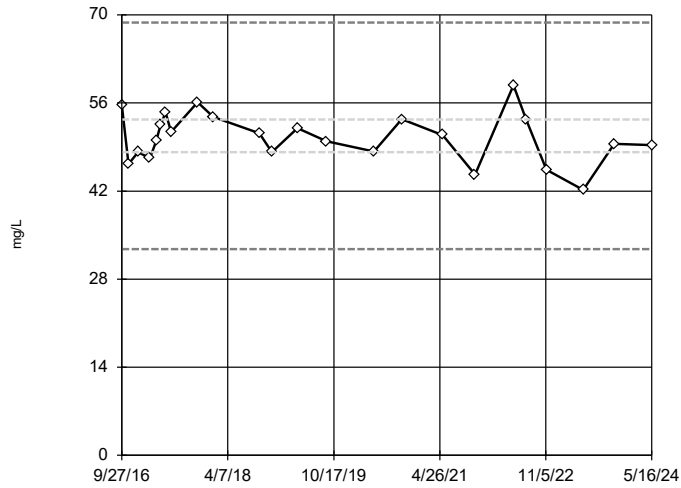


n = 22
 Outliers are drawn as solid.
 Tukey's method selected by user.
 High cutoff = 6.815, low cutoff = -0.045, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-38

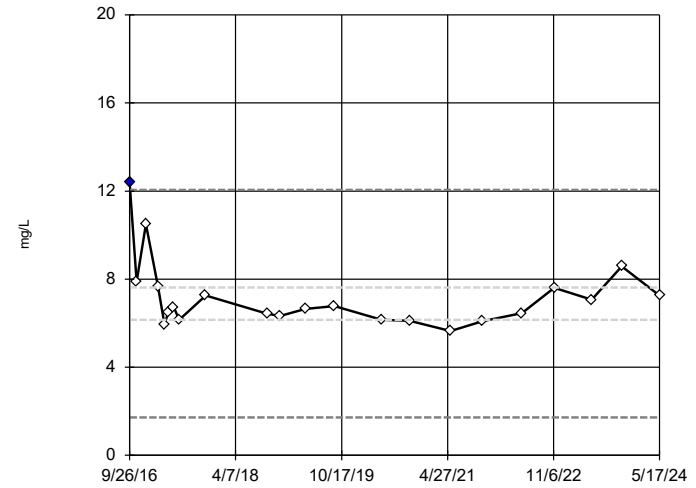


n = 24
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 68.8, low cutoff = 32.75, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-39

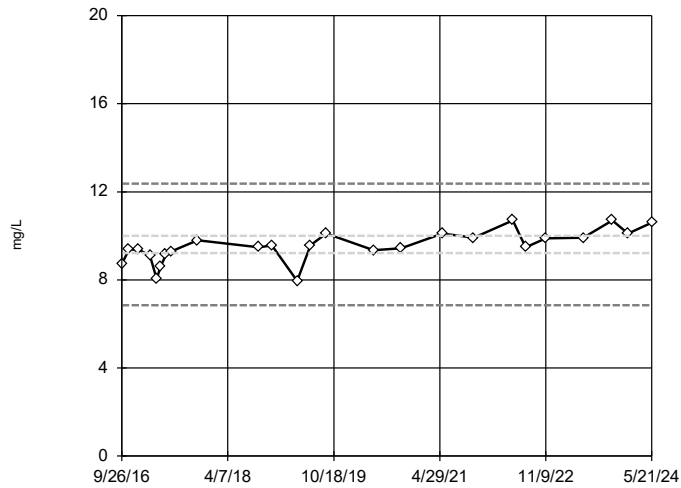


n = 22
 Outlier is drawn as solid.
 Tukey's method selected by user.
 High cutoff = 12.05, low cutoff = 1.725, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-1611

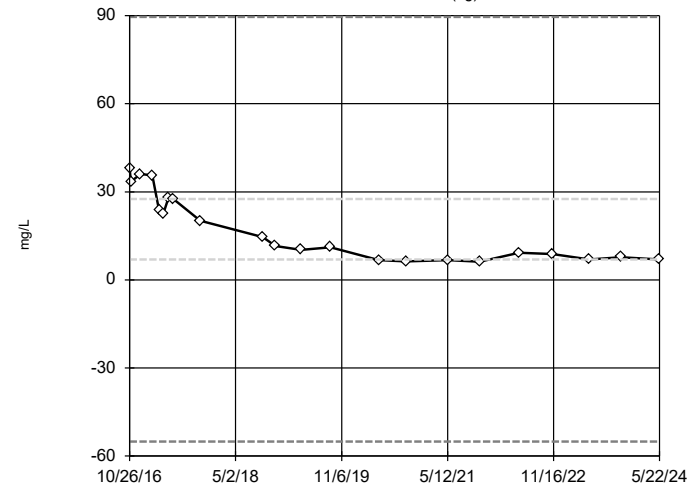


n = 25
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 12.38, low cutoff = 6.845, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-1612 (bg)

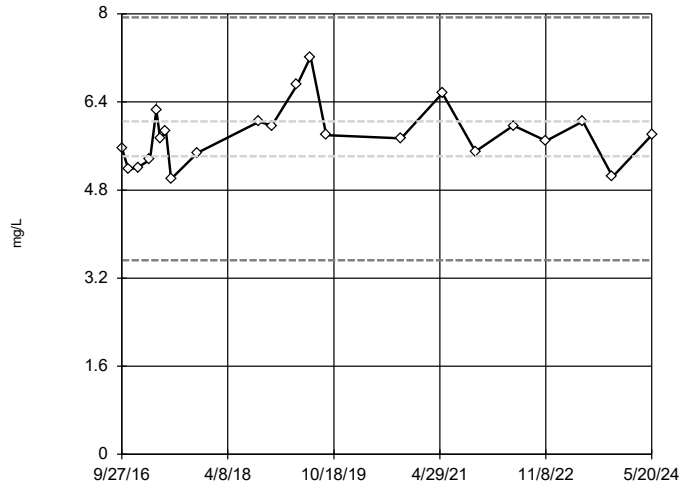


n = 22
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 89.57, low cutoff = -55.02, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-26

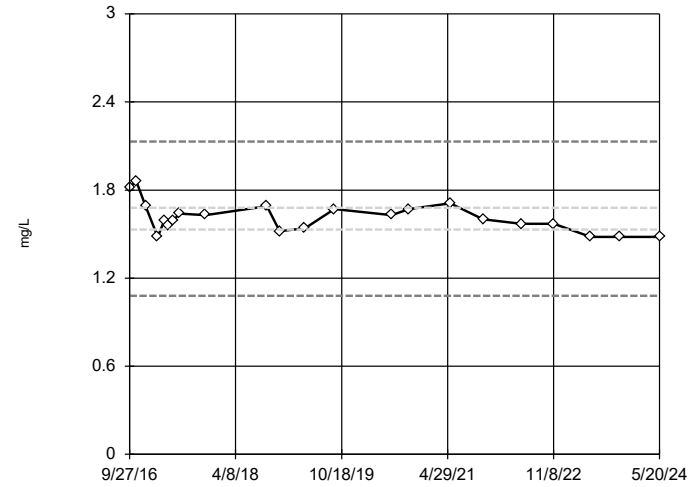


n = 22
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 7.935, low cutoff = 3.525, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-27

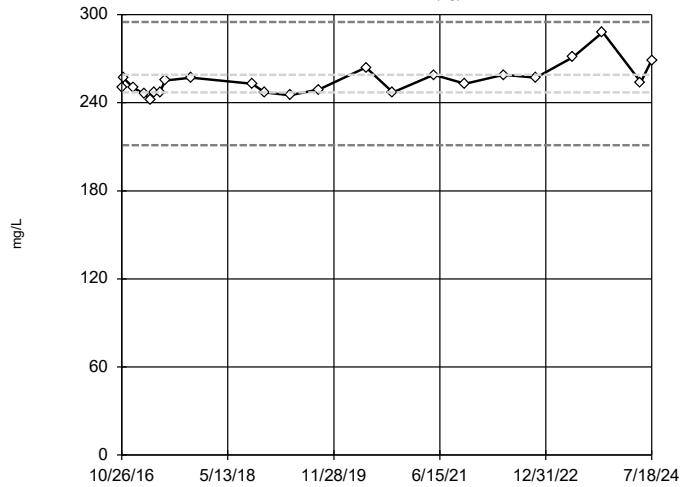


n = 22
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 2.13, low cutoff = 1.08, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-30 (bg)

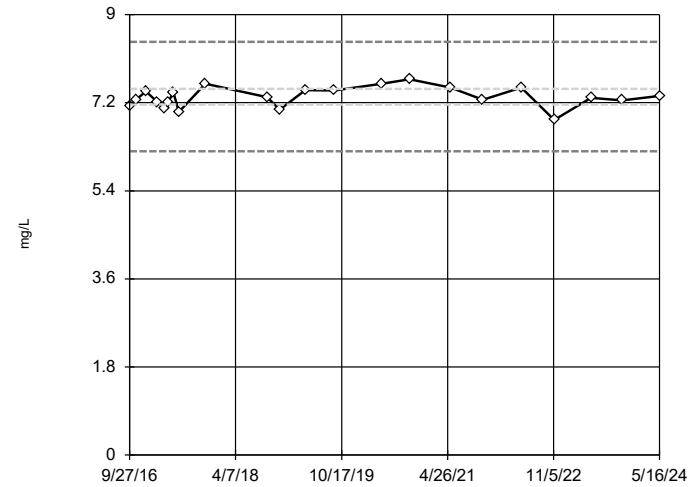


n = 23
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 295, low cutoff = 211, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-38

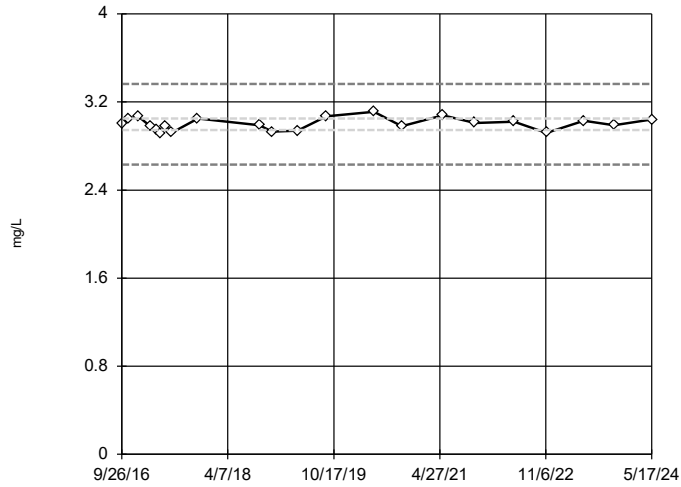


n = 22
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 8.445, low cutoff = 6.205, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-39

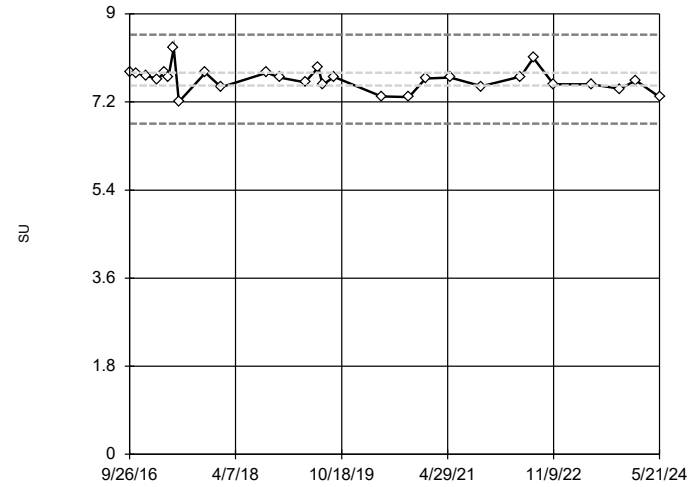


n = 22
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 3.365, low cutoff = 2.63, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-1611

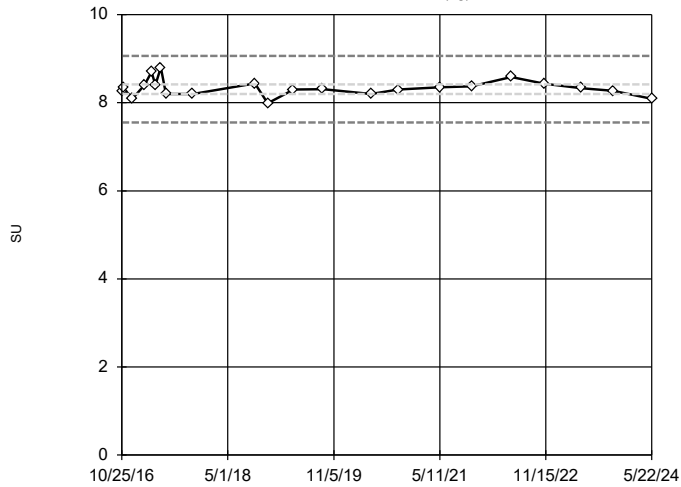


n = 28
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 8.575, low cutoff = 6.755, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-1612 (bg)

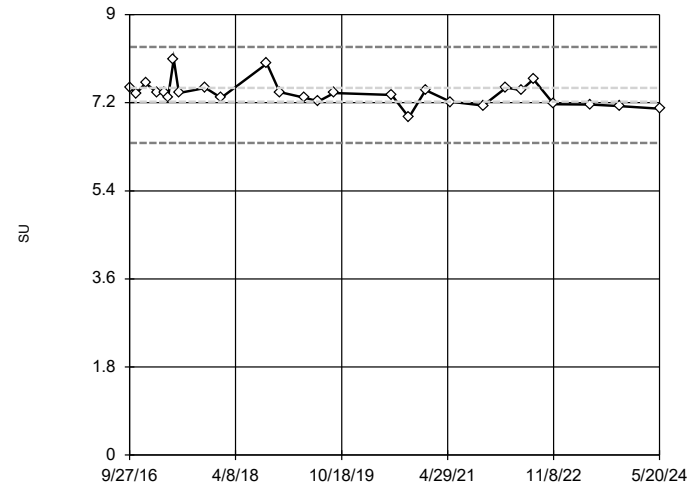


n = 22
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 9.06, low cutoff = 7.555, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-26

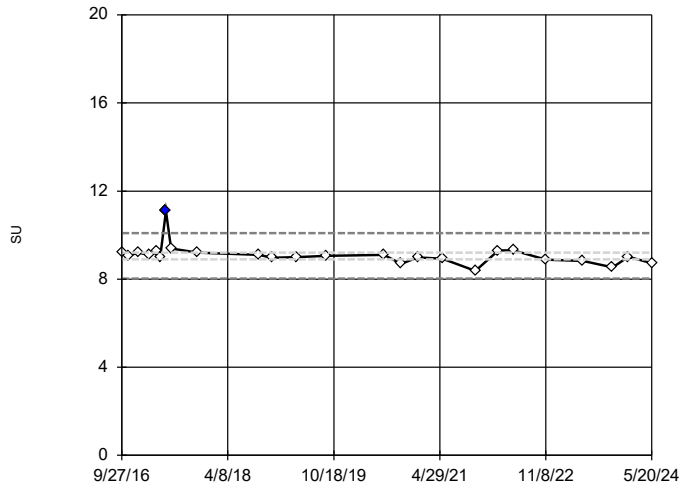


n = 27
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 8.34, low cutoff = 6.38, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-27

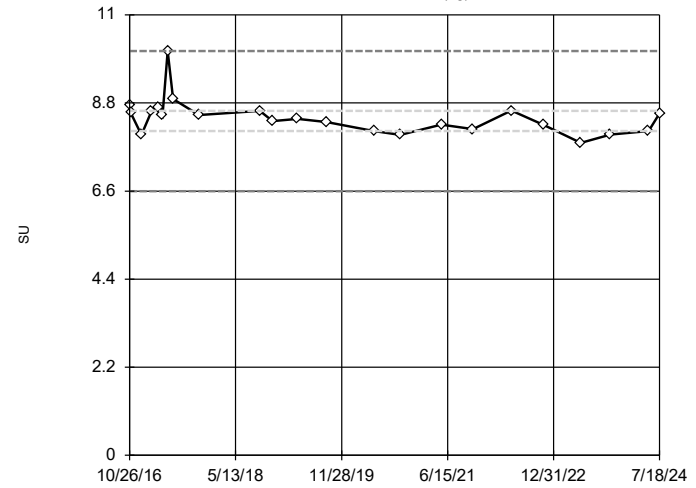


n = 25
 Outlier is drawn as solid.
 Tukey's method selected by user.
 High cutoff = 10.09, low cutoff = 8.02, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-30 (bg)

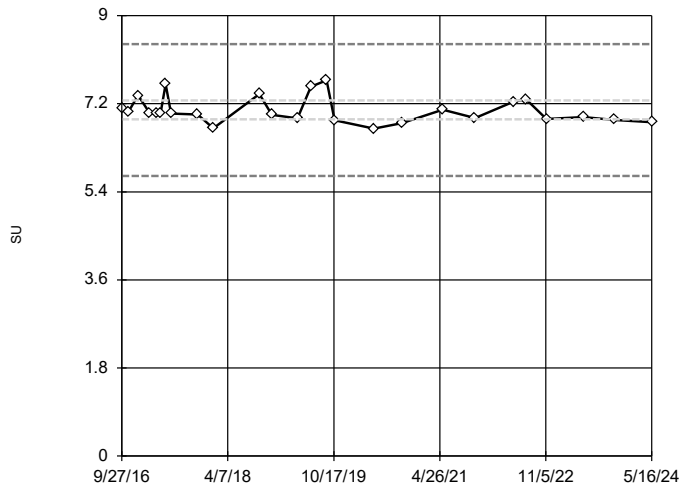


n = 23
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 10.1, low cutoff = 6.6, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-38

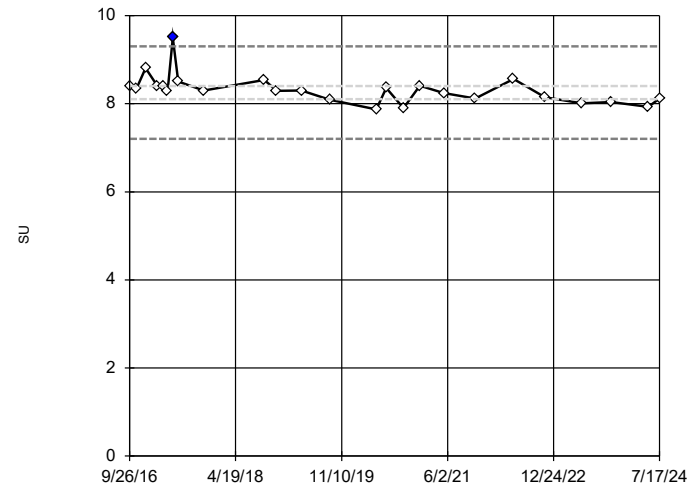


n = 26
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 8.42, low cutoff = 5.725, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

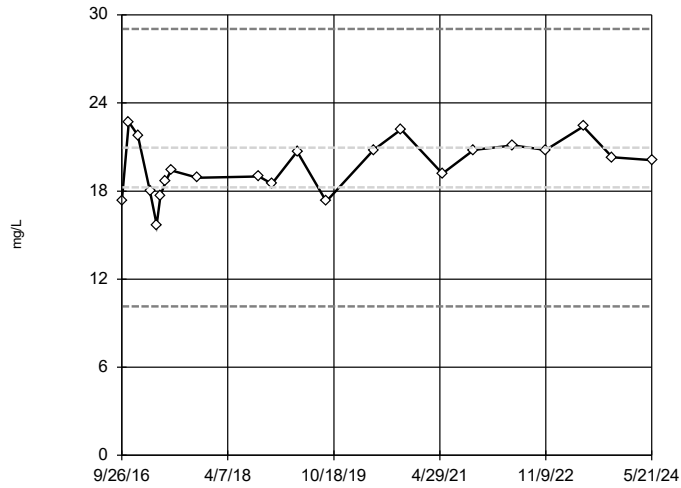
MW-39



n = 25
 Outlier is drawn as solid.
 Tukey's method selected by user.
 High cutoff = 9.305, low cutoff = 7.205, based on IQR multiplier of 3.

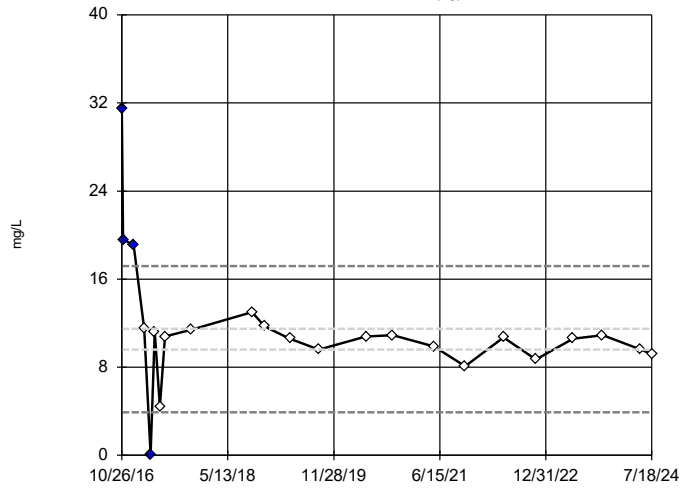
Constituent: pH, field Analysis Run 10/18/2024 7:43 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening MW-1611



Tukey's Outlier Screening

MW-30 (bg)

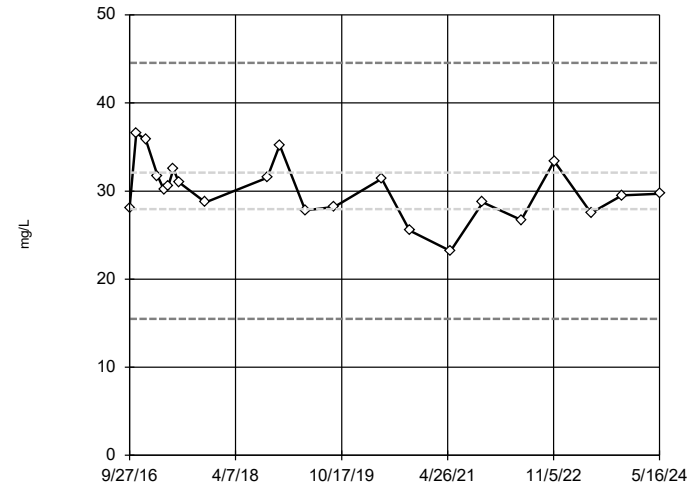


n = 23
 Outliers are drawn as solid.
 Tukey's method selected by user.
 High cutoff = 17.2, low cutoff = 3.9, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 10/18/2024 7:44 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-38

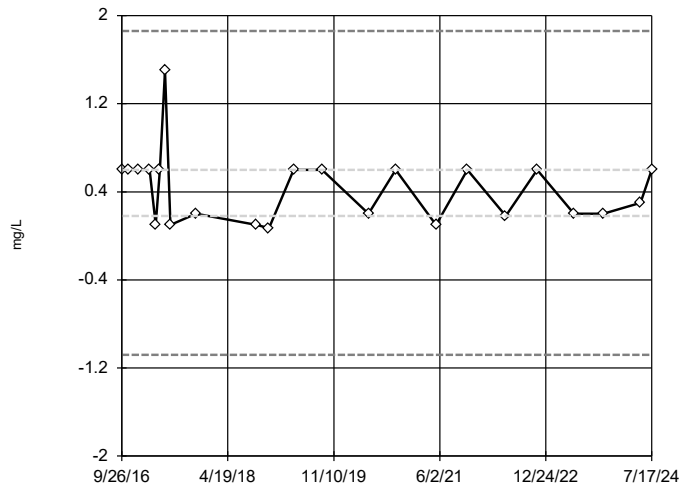


n = 22
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 44.55, low cutoff = 15.5, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 10/18/2024 7:44 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-39

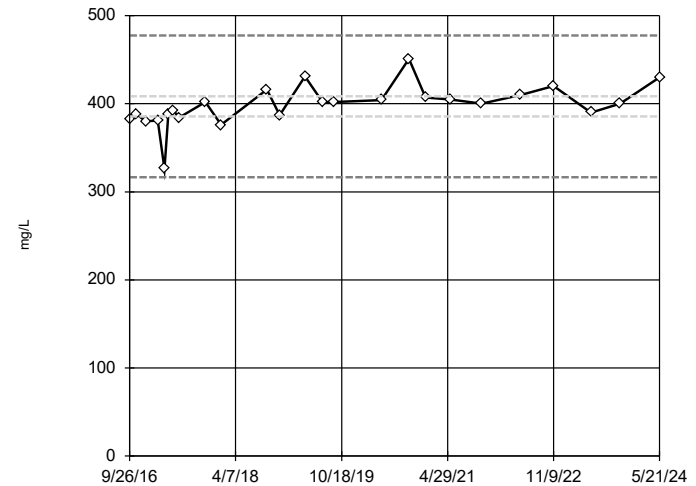


n = 23
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 1.86, low cutoff = -1.08, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 10/18/2024 7:44 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-1611

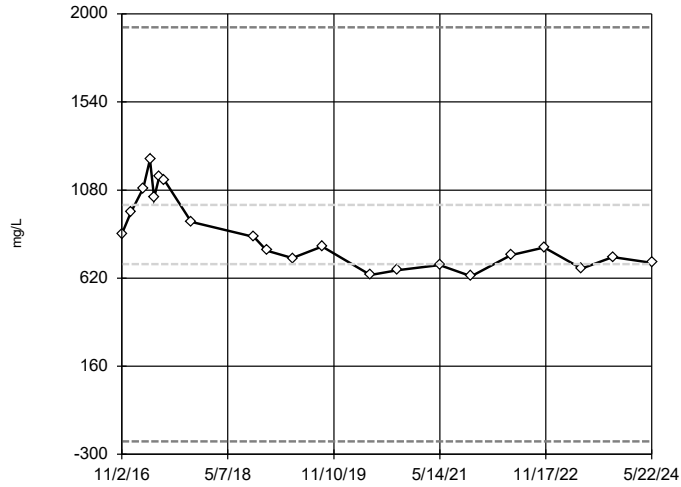


n = 25
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 477.5, low cutoff = 316.5, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/18/2024 7:44 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-1612 (bg)

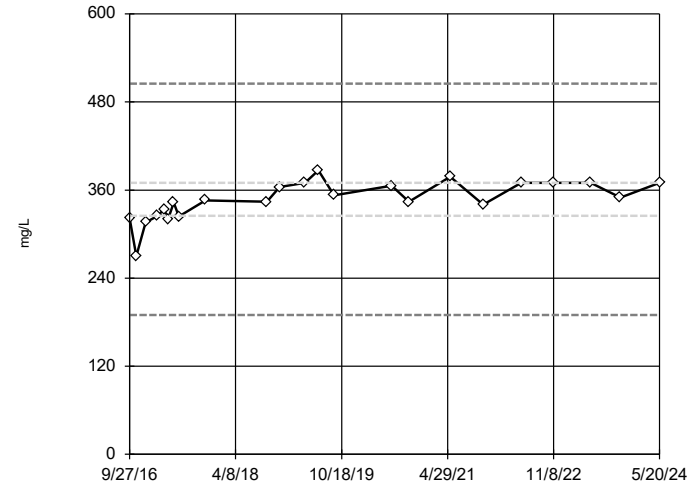


n = 21
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 1930, low cutoff = -233, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/18/2024 7:44 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-26

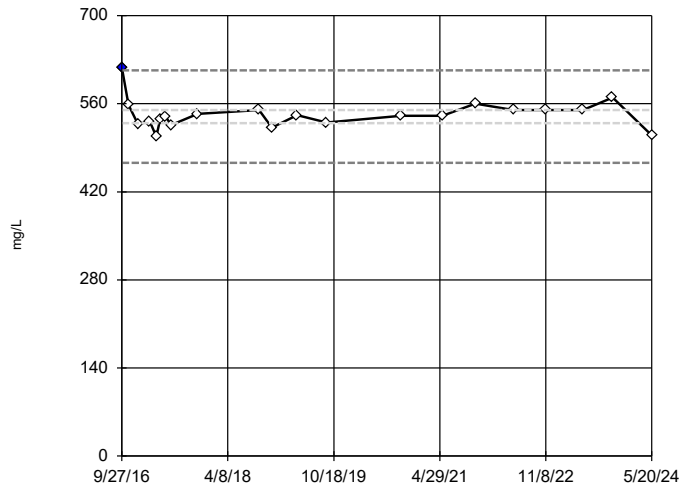


n = 23
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 505, low cutoff = 190, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/18/2024 7:44 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-27

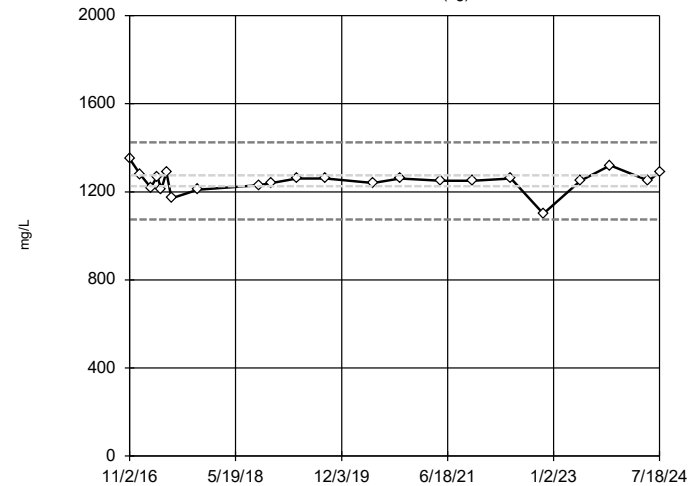


n = 21
 Outlier is drawn as solid.
 Tukey's method selected by user.
 High cutoff = 613, low cutoff = 466, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/18/2024 7:44 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-30 (bg)

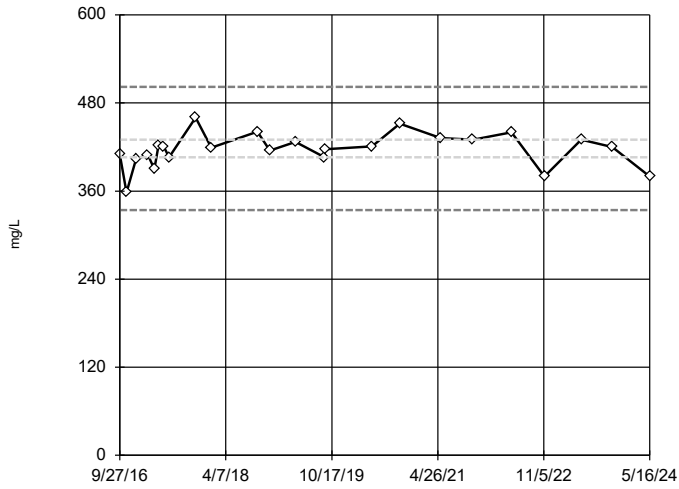


n = 22
 No outliers found.
 Tukey's method selected by user.
 High cutoff = 1425, low cutoff = 1075, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/18/2024 7:44 AM View: Outliers
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-38

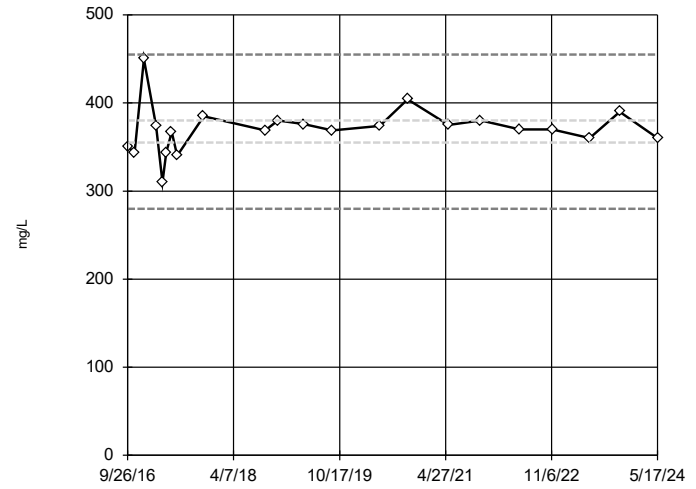


n = 24
No outliers found.
Tukey's method selected by user.
High cutoff = 502, low cutoff = 334, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/18/2024 7:44 AM View: Outliers
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Tukey's Outlier Screening

MW-39



n = 22
No outliers found.
Tukey's method selected by user.
High cutoff = 455, low cutoff = 280, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/18/2024 7:44 AM View: Outliers
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

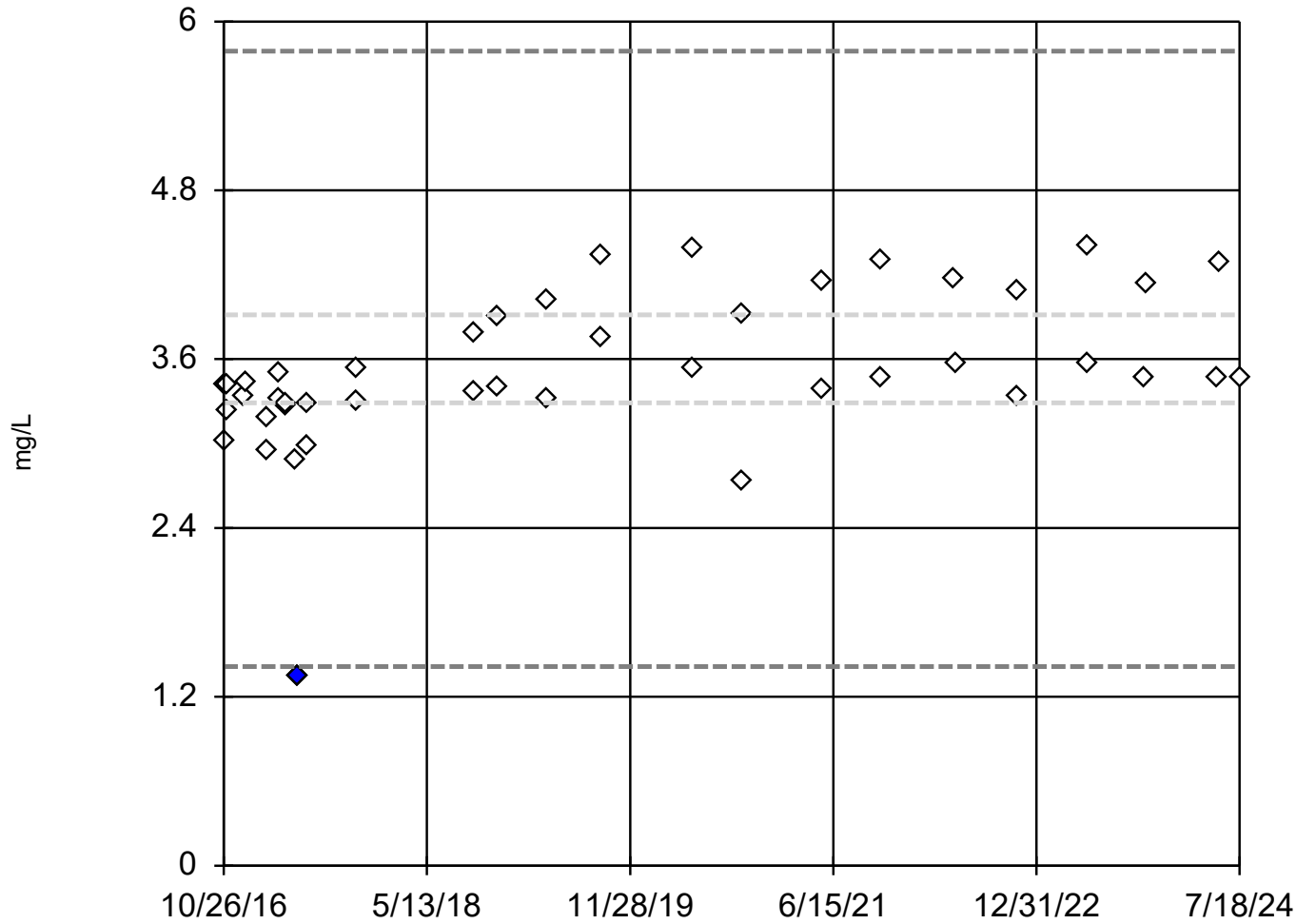
Tukey's Outlier Test - Upgradient Wells - All/Significant Results

Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill Printed 10/18/2024, 7:54 AM

<u>Constituent</u>	<u>Well</u>	<u>Outlier</u>	<u>Value(s)</u>	<u>Date(s)</u>	<u>Method</u>	<u>Alpha</u>	<u>N</u>	<u>Mean</u>	<u>Std. Dev.</u>	<u>Distribution</u>	<u>Normality Test</u>
Fluoride, total (mg/L)	MW-1612,MW-30	Yes	1.34	n/a w/combined bg	NP	NaN	45	3.519	0.5432	normal	ShapiroWilk

Tukey's Outlier Screening, Pooled Background

MW-1612,MW-30



n = 45

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

High cutoff = 5.79, low cutoff = 1.415, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 10/18/2024 7:53 AM View: Upgradient Outliers

Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

FIGURE D
Mann-Whitney

Mann-Whitney Summary - Significant Results

Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill Printed 10/17/2024, 1:21 PM

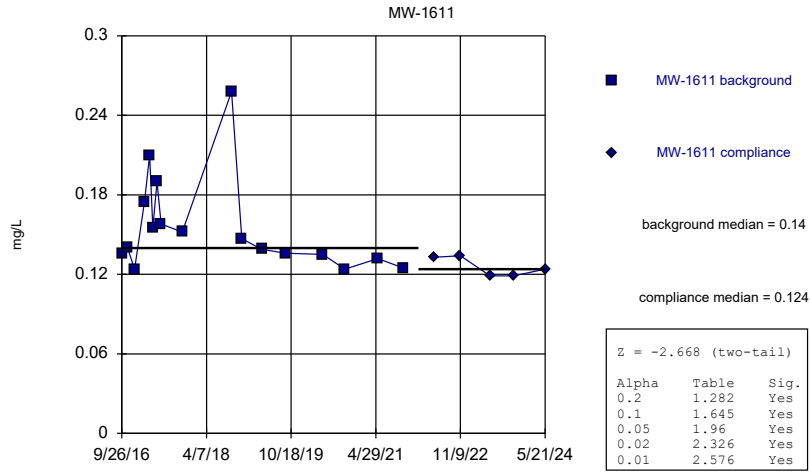
<u>Constituent</u>	<u>Well</u>	<u>Calc.</u>	<u>0.01</u>	<u>Alpha</u>	<u>Sig.</u>	<u>Method</u>
Boron, total (mg/L)	MW-1611	-2.668	Yes	0.01	Yes	Mann-W
Boron, total (mg/L)	MW-1612 (bg)	-2.586	Yes	0.01	Yes	Mann-W
Chloride, total (mg/L)	MW-1611	3	Yes	0.01	Yes	Mann-W
Chloride, total (mg/L)	MW-27	-2.636	Yes	0.01	Yes	Mann-W
Chloride, total (mg/L)	MW-30 (bg)	2.883	Yes	0.01	Yes	Mann-W
Sulfate, total (mg/L)	MW-27	-2.603	Yes	0.01	Yes	Mann-W

Mann-Whitney Summary - All Results

Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill Printed 10/17/2024, 1:21 PM

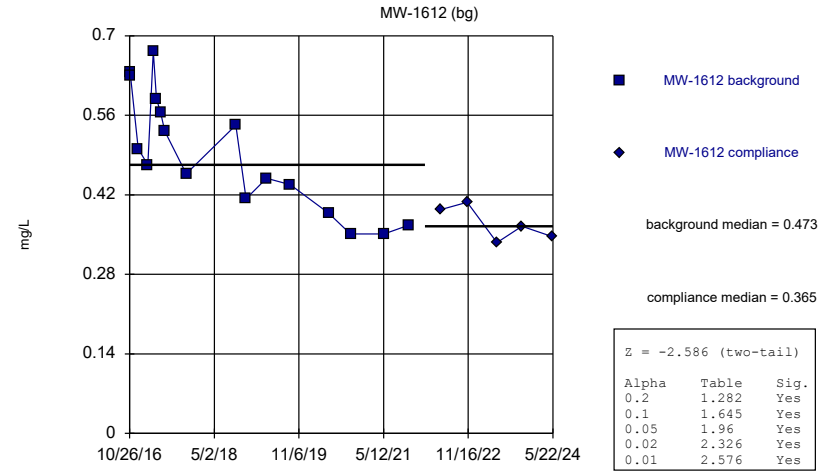
<u>Constituent</u>	<u>Well</u>	<u>Calc.</u>	<u>0.01</u>	<u>Alpha</u>	<u>Sig.</u>	<u>Method</u>
Boron, total (mg/L)	MW-1611	-2.668	Yes	0.01	Yes	Mann-W
Boron, total (mg/L)	MW-1612 (bg)	-2.586	Yes	0.01	Yes	Mann-W
Boron, total (mg/L)	MW-26	-2.314	No	0.01	No	Mann-W
Boron, total (mg/L)	MW-27	-1.033	No	0.01	No	Mann-W
Boron, total (mg/L)	MW-30 (bg)	-1.569	No	0.01	No	Mann-W
Boron, total (mg/L)	MW-38	-1.57	No	0.01	No	Mann-W
Boron, total (mg/L)	MW-39	-1.53	No	0.01	No	Mann-W
Calcium, total (mg/L)	MW-1611	2.278	No	0.01	No	Mann-W
Calcium, total (mg/L)	MW-1612 (bg)	-1.097	No	0.01	No	Mann-W
Calcium, total (mg/L)	MW-26	2.172	No	0.01	No	Mann-W
Calcium, total (mg/L)	MW-27	0.5374	No	0.01	No	Mann-W
Calcium, total (mg/L)	MW-30 (bg)	0.9496	No	0.01	No	Mann-W
Calcium, total (mg/L)	MW-38	-0.7002	No	0.01	No	Mann-W
Calcium, total (mg/L)	MW-39	1.411	No	0.01	No	Mann-W
Chloride, total (mg/L)	MW-1611	3	Yes	0.01	Yes	Mann-W
Chloride, total (mg/L)	MW-1612 (bg)	-1.802	No	0.01	No	Mann-W
Chloride, total (mg/L)	MW-26	-0.07839	No	0.01	No	Mann-W
Chloride, total (mg/L)	MW-27	-2.636	Yes	0.01	Yes	Mann-W
Chloride, total (mg/L)	MW-30 (bg)	2.883	Yes	0.01	Yes	Mann-W
Chloride, total (mg/L)	MW-38	-0.5095	No	0.01	No	Mann-W
Chloride, total (mg/L)	MW-39	0	No	0.01	No	Mann-W
pH, field (SU)	MW-1611	-0.7765	No	0.01	No	Mann-W
pH, field (SU)	MW-1612 (bg)	0.3725	No	0.01	No	Mann-W
pH, field (SU)	MW-26	-1.282	No	0.01	No	Mann-W
pH, field (SU)	MW-27	-1.57	No	0.01	No	Mann-W
pH, field (SU)	MW-30 (bg)	-1.255	No	0.01	No	Mann-W
pH, field (SU)	MW-38	-0.6694	No	0.01	No	Mann-W
pH, field (SU)	MW-39	-1.603	No	0.01	No	Mann-W
Sulfate, total (mg/L)	MW-1611	1.726	No	0.01	No	Mann-W
Sulfate, total (mg/L)	MW-1612 (bg)	-0.235	No	0.01	No	Mann-W
Sulfate, total (mg/L)	MW-26	0.4131	No	0.01	No	Mann-W
Sulfate, total (mg/L)	MW-27	-2.603	Yes	0.01	Yes	Mann-W
Sulfate, total (mg/L)	MW-30 (bg)	-1.402	No	0.01	No	Mann-W
Sulfate, total (mg/L)	MW-38	-0.8621	No	0.01	No	Mann-W
Sulfate, total (mg/L)	MW-39	-0.1189	No	0.01	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-1611	1.496	No	0.01	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-1612 (bg)	-1.445	No	0.01	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-26	2.135	No	0.01	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-27	1.077	No	0.01	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-30 (bg)	0.5565	No	0.01	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-38	-0.3913	No	0.01	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	MW-39	-0.157	No	0.01	No	Mann-W

Mann-Whitney (Wilcoxon Rank Sum)



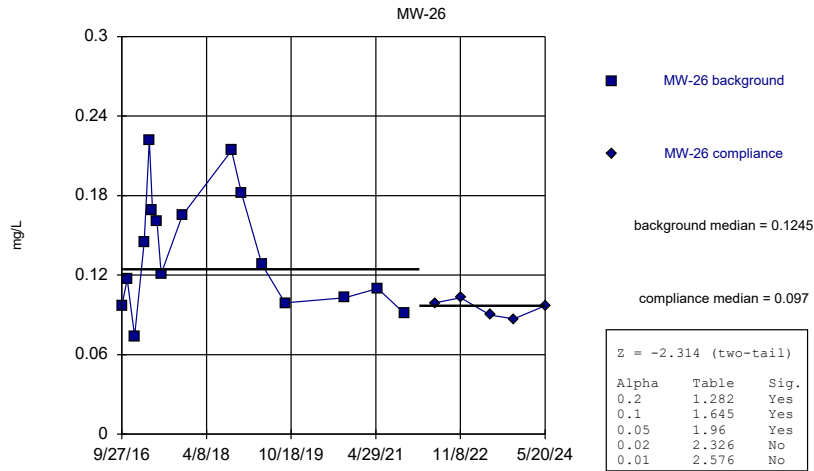
Constituent: Boron, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)



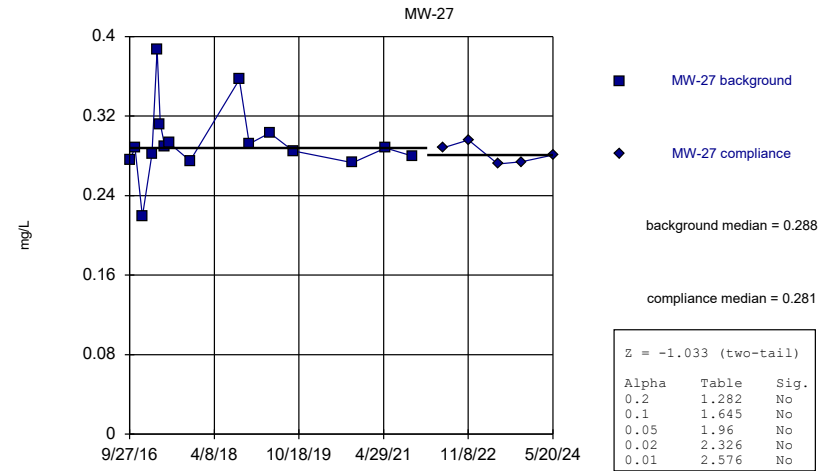
Constituent: Boron, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)



Constituent: Boron, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

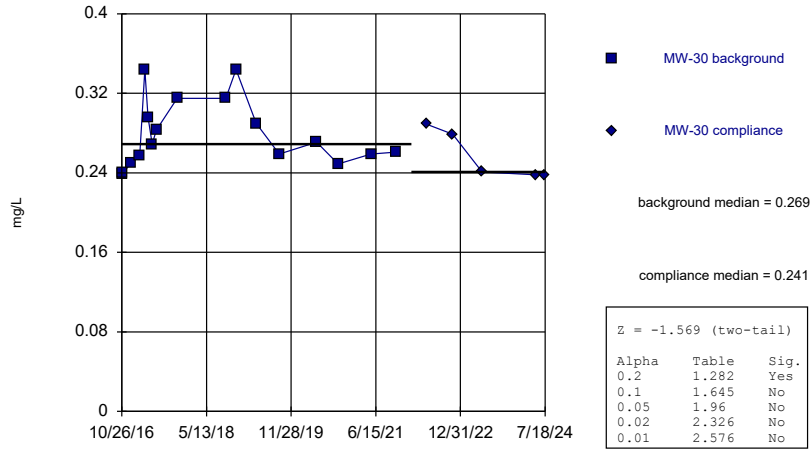
Mann-Whitney (Wilcoxon Rank Sum)



Constituent: Boron, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

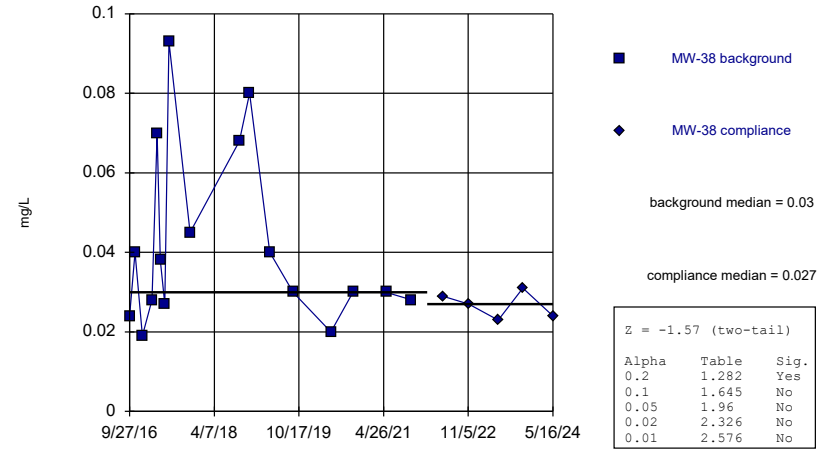
MW-30 (bg)



Constituent: Boron, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

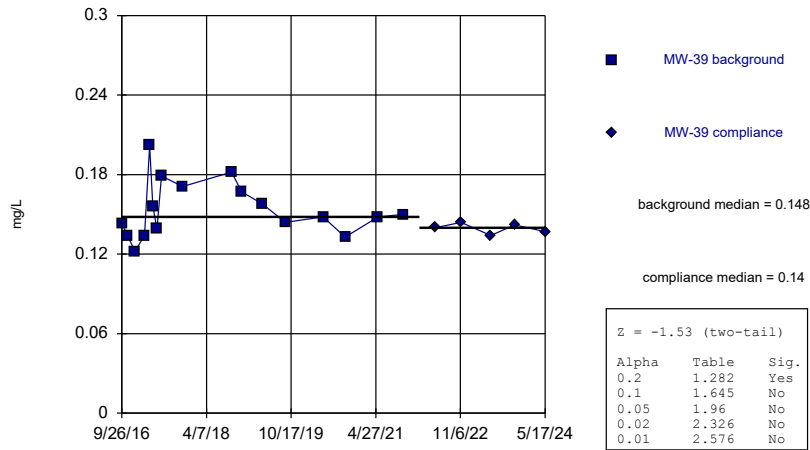
MW-38



Constituent: Boron, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

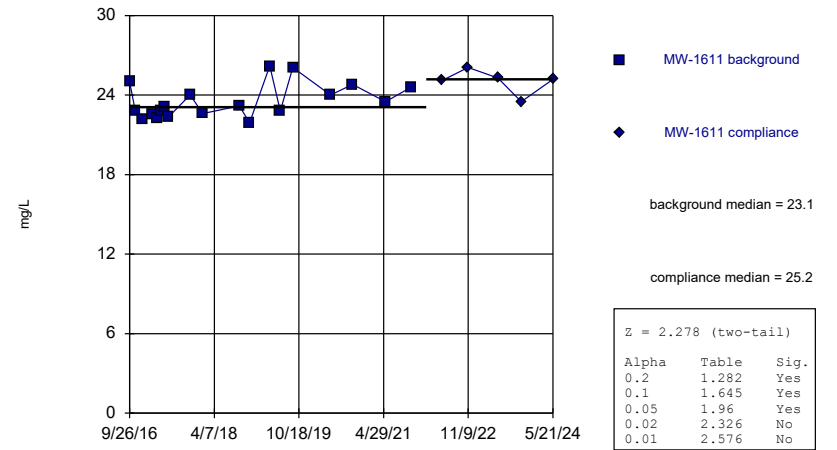
MW-39



Constituent: Boron, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

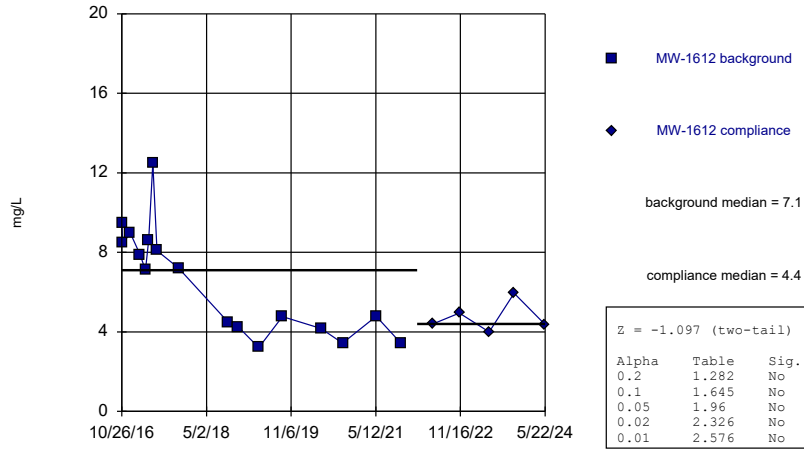
MW-1611



Constituent: Calcium, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

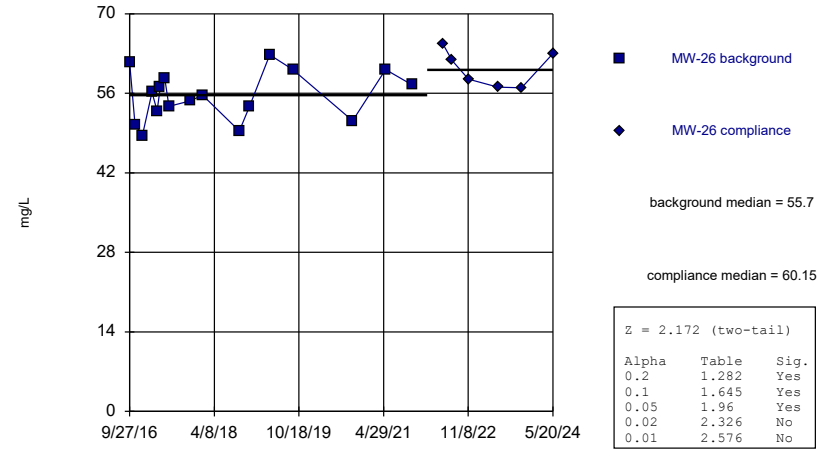
MW-1612 (bg)



Constituent: Calcium, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

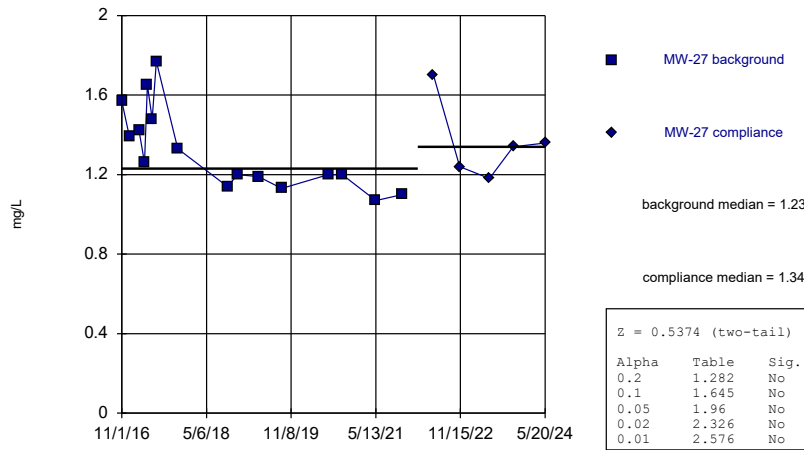
MW-26



Constituent: Calcium, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

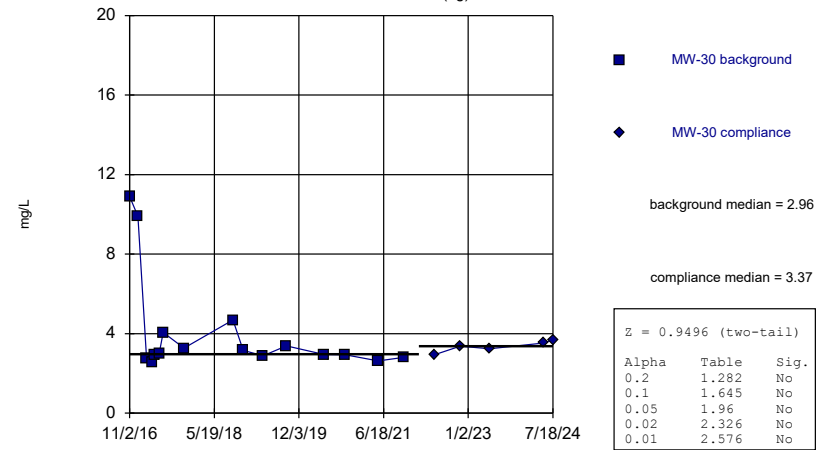
MW-27



Constituent: Calcium, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

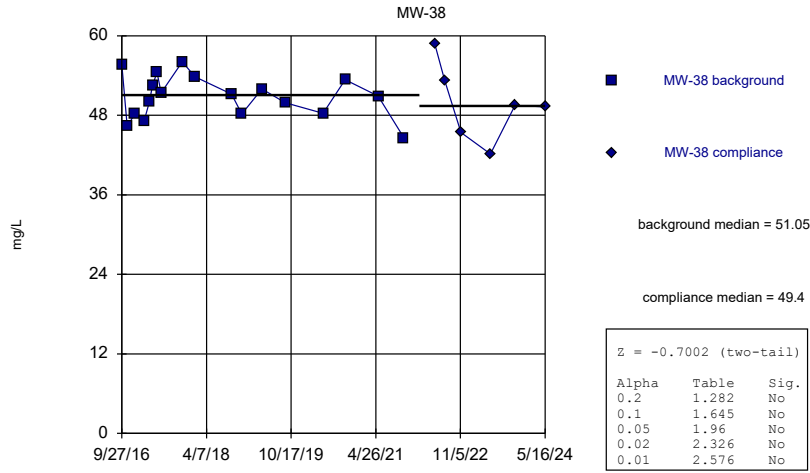
Mann-Whitney (Wilcoxon Rank Sum)

MW-30 (bg)



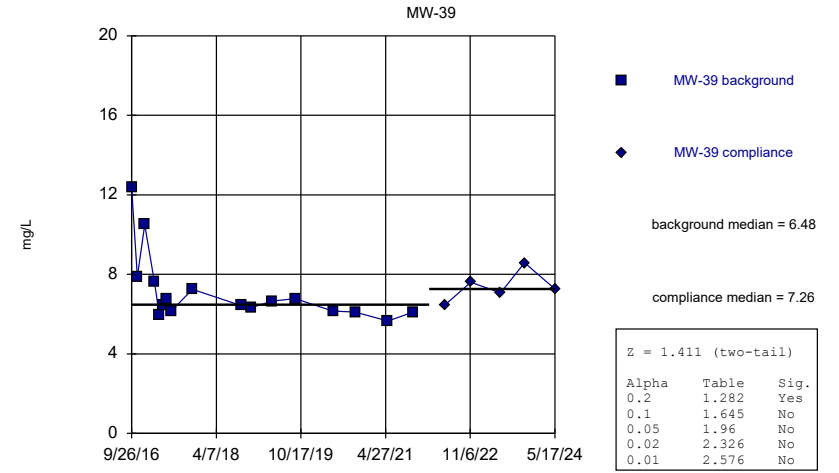
Constituent: Calcium, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)



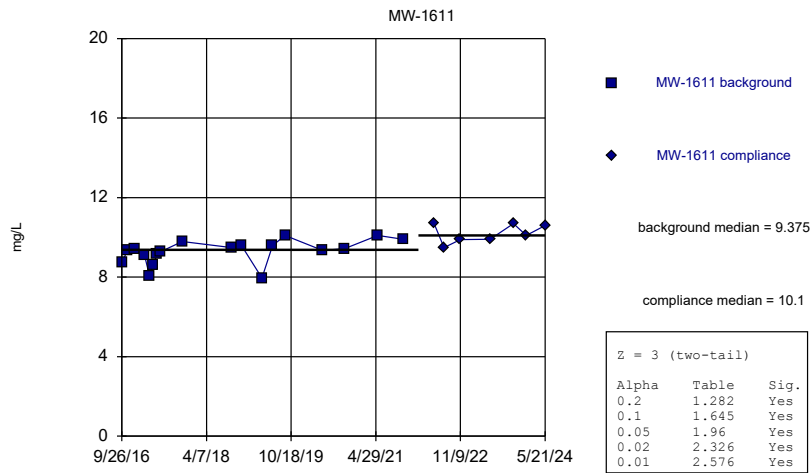
Constituent: Calcium, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)



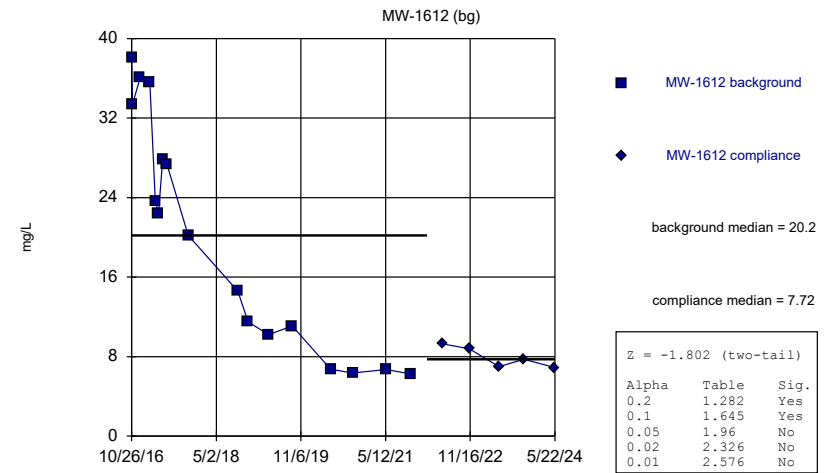
Constituent: Calcium, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)



Constituent: Chloride, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

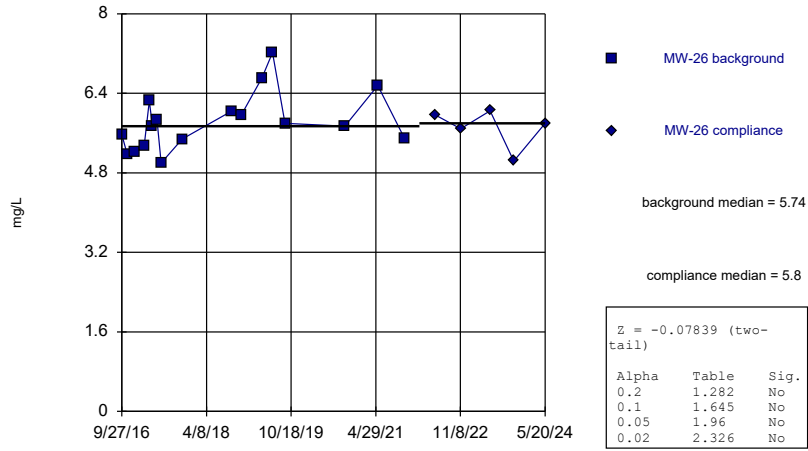
Mann-Whitney (Wilcoxon Rank Sum)



Constituent: Chloride, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

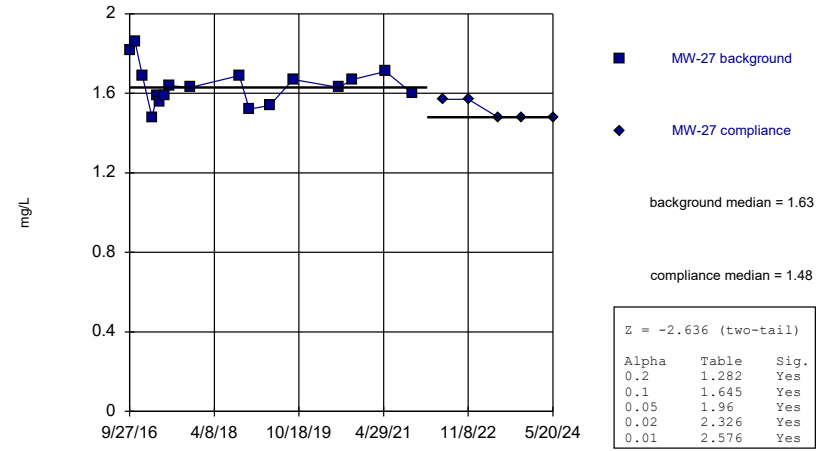
MW-26



Constituent: Chloride, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

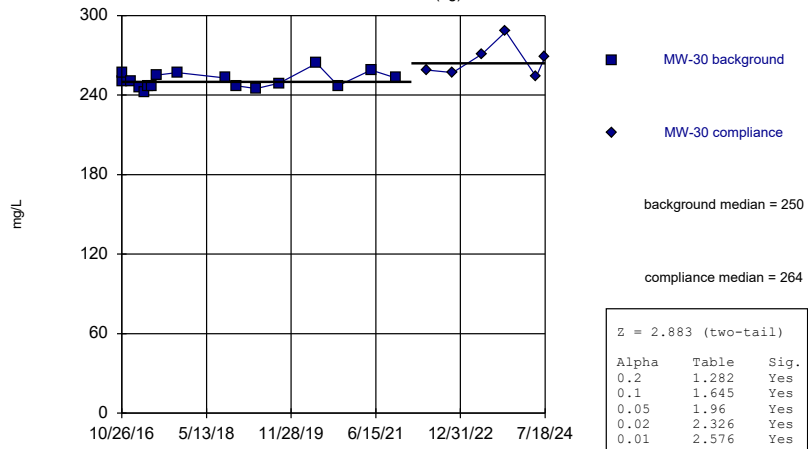
MW-27



Constituent: Chloride, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

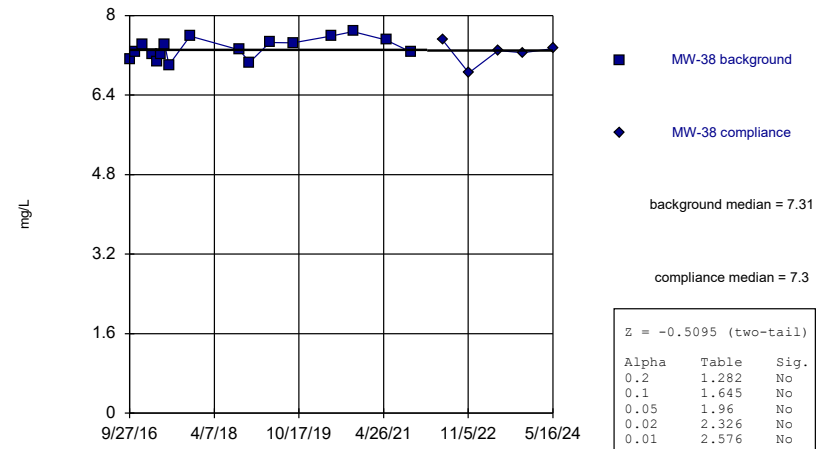
MW-30 (bg)



Constituent: Chloride, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

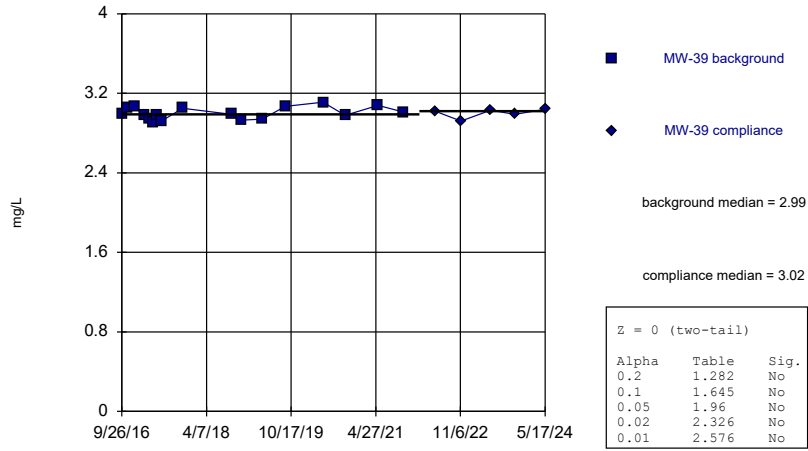
MW-38



Constituent: Chloride, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

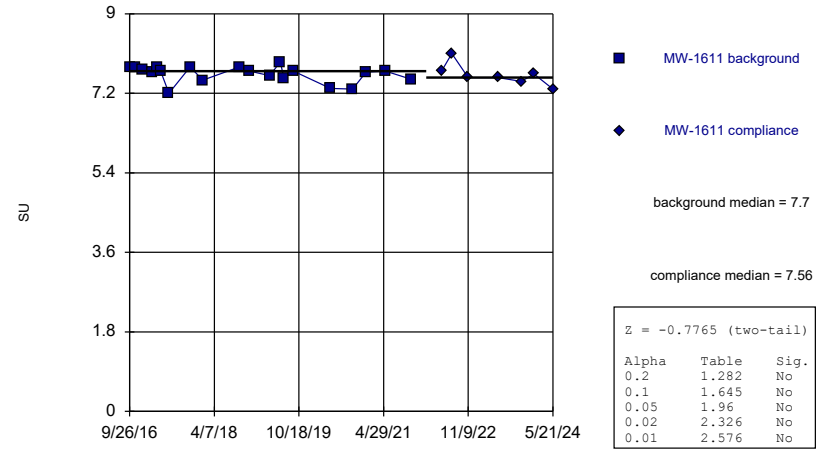
MW-39



Constituent: Chloride, total Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

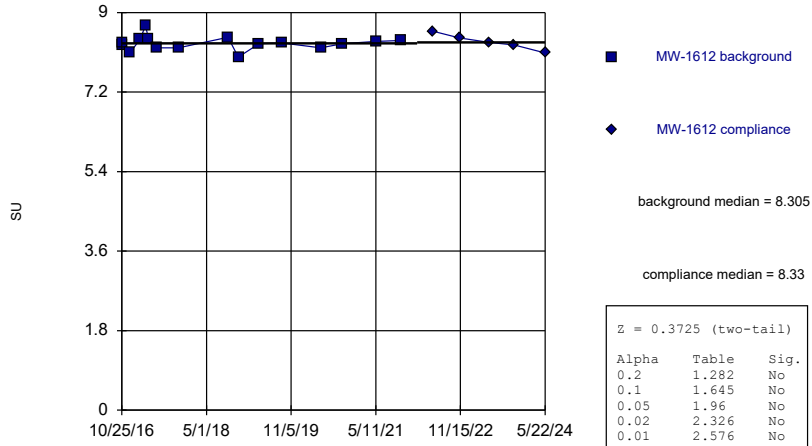
MW-1611



Constituent: pH, field Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

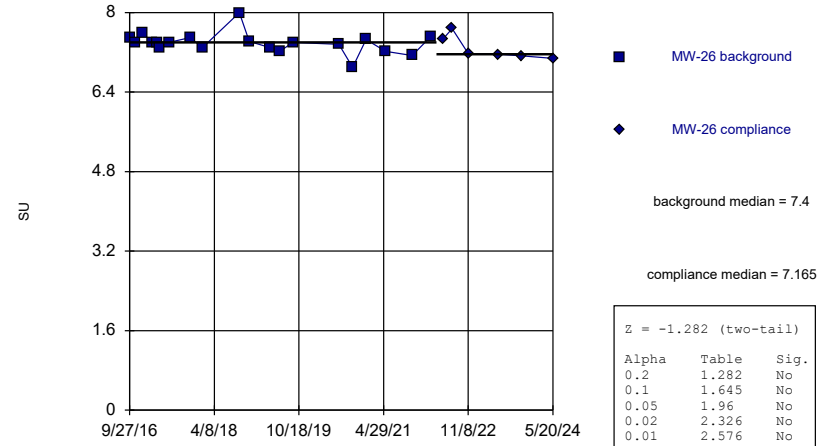
MW-1612 (bg)



Constituent: pH, field Analysis Run 10/17/2024 1:18 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

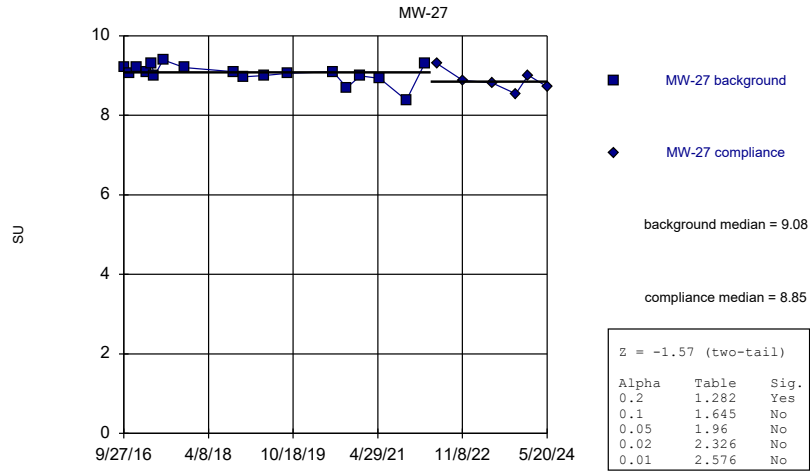
Mann-Whitney (Wilcoxon Rank Sum)

MW-26



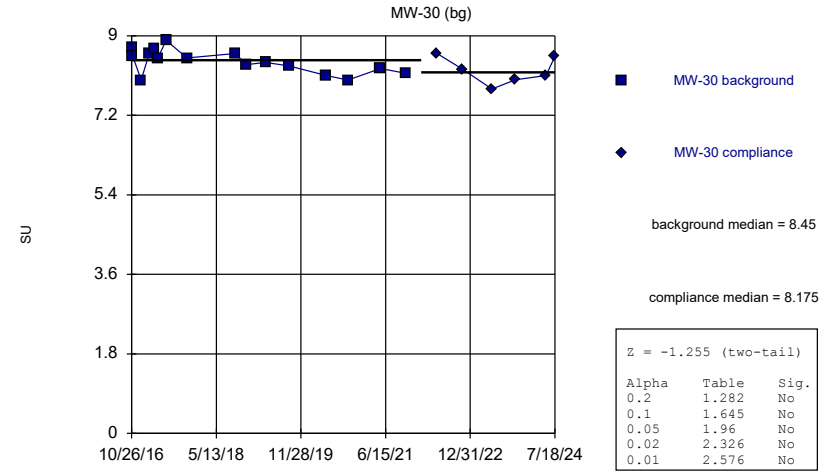
Constituent: pH, field Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)



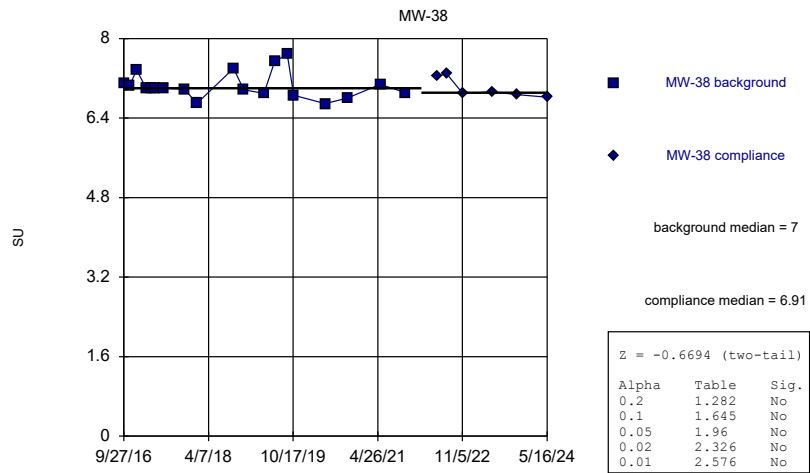
Constituent: pH, field Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)



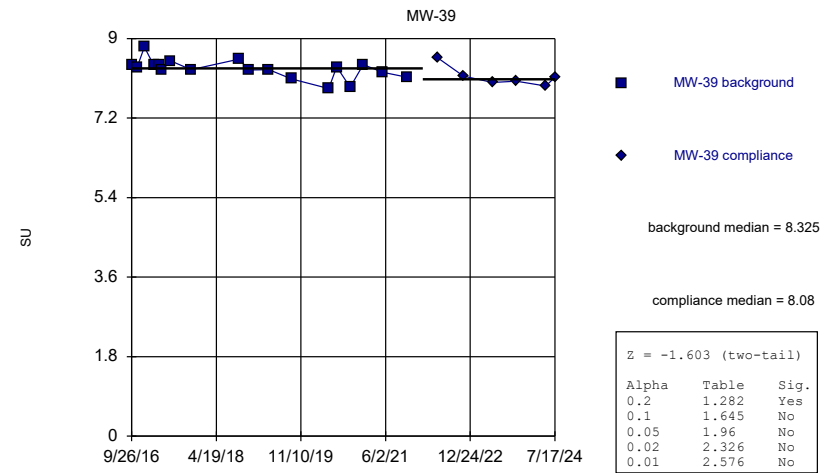
Constituent: pH, field Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)



Constituent: pH, field Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

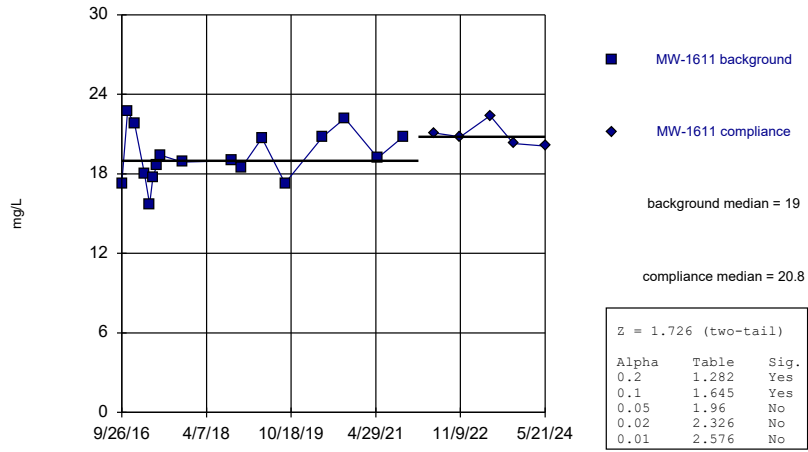
Mann-Whitney (Wilcoxon Rank Sum)



Constituent: pH, field Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

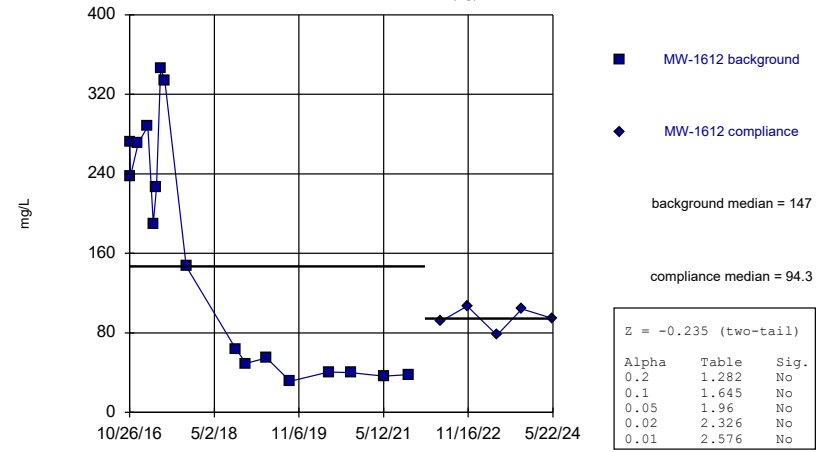
MW-1611



Constituent: Sulfate, total Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

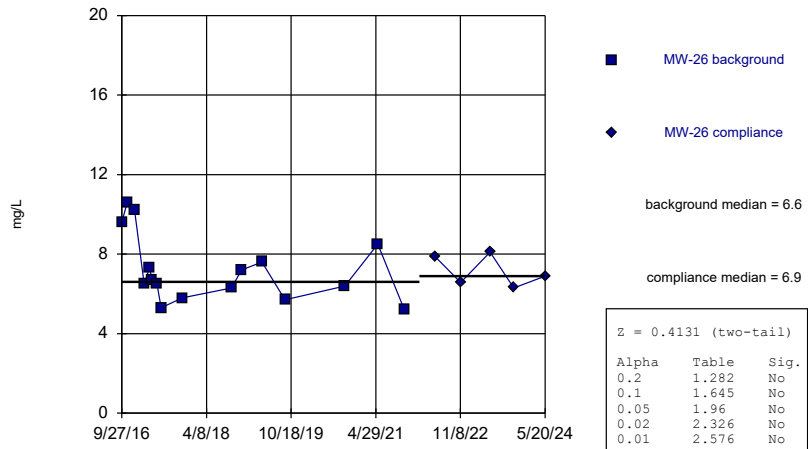
MW-1612 (bg)



Constituent: Sulfate, total Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

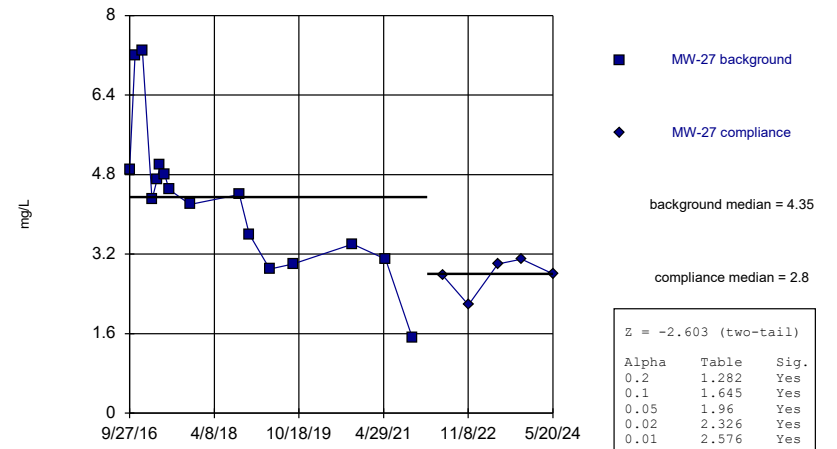
MW-26



Constituent: Sulfate, total Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

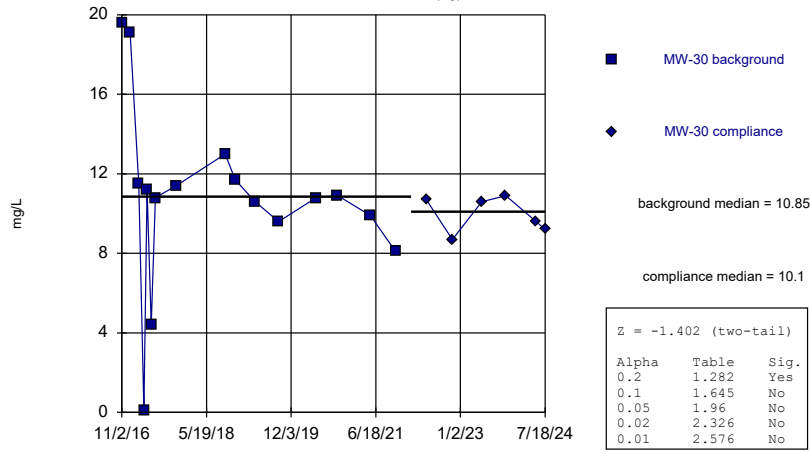
MW-27



Constituent: Sulfate, total Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

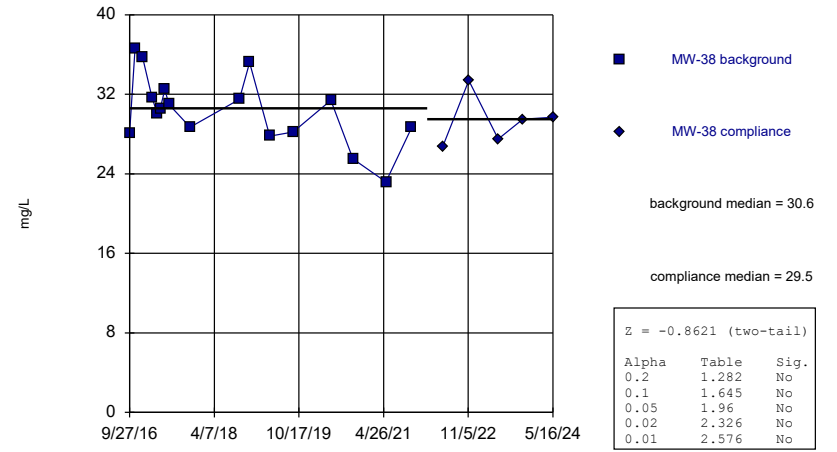
MW-30 (bg)



Constituent: Sulfate, total Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

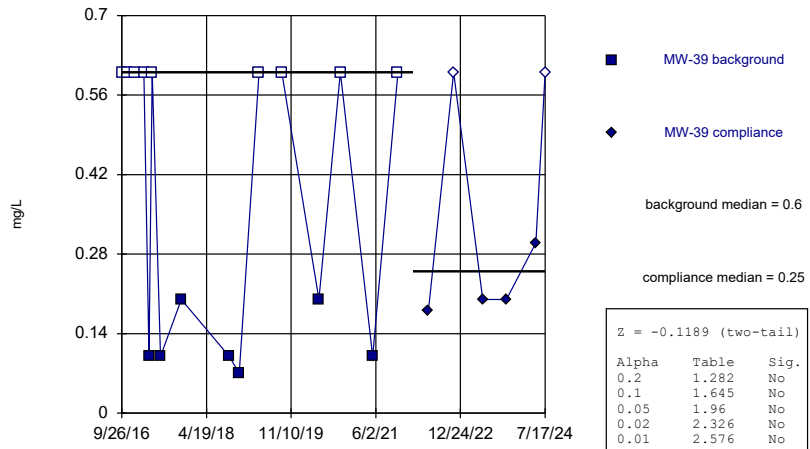
MW-38



Constituent: Sulfate, total Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

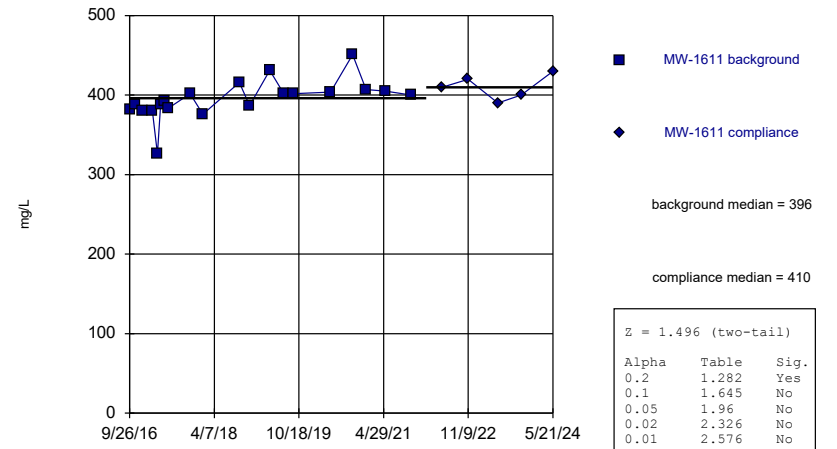
MW-39



Constituent: Sulfate, total Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

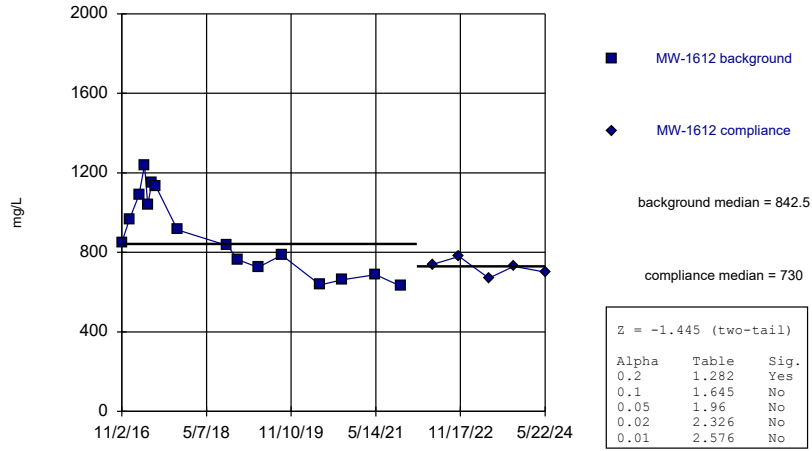
MW-1611



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

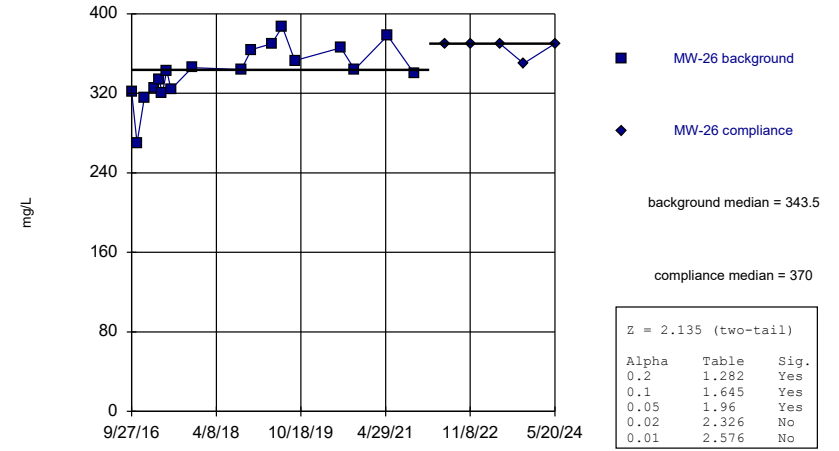
MW-1612 (bg)



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

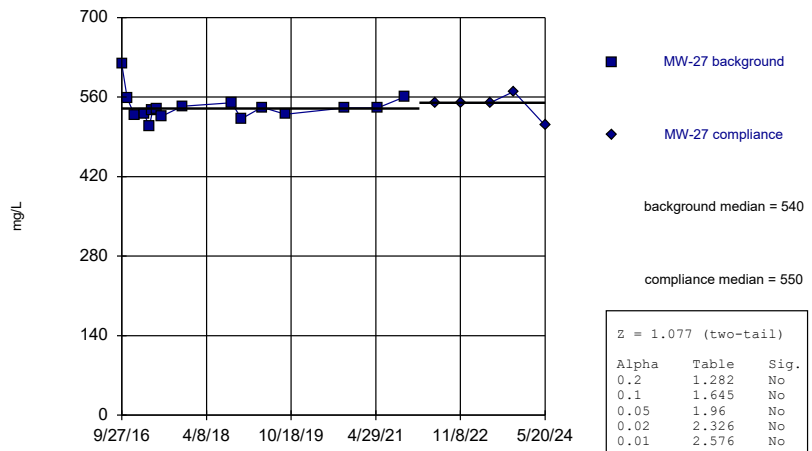
MW-26



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

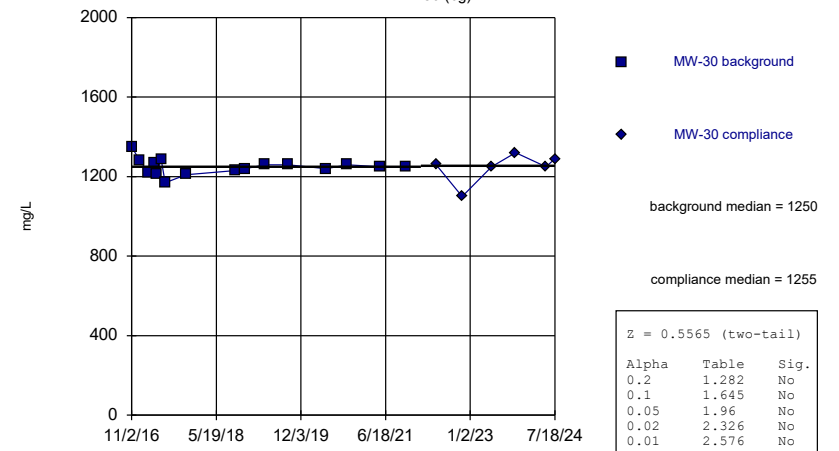
MW-27



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

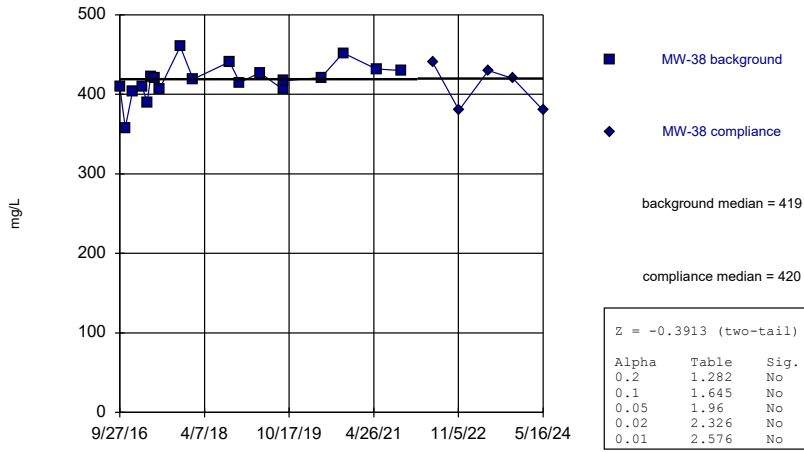
MW-30 (bg)



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

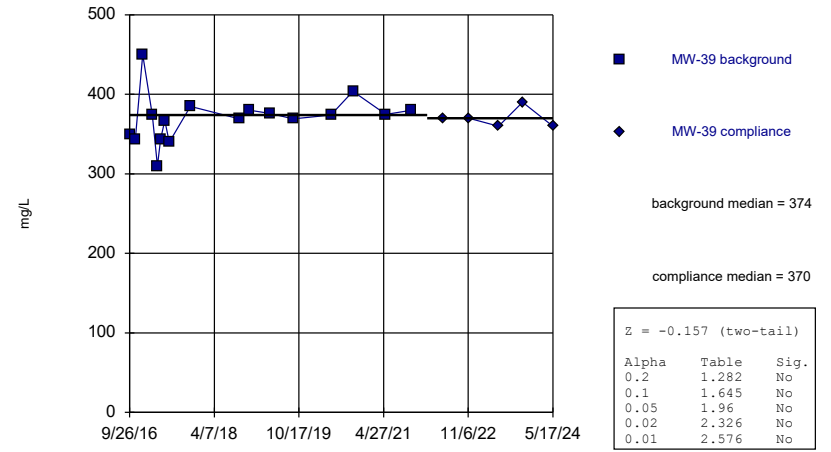
MW-38



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Mann-Whitney (Wilcoxon Rank Sum)

MW-39



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/17/2024 1:19 PM View: Mann-Whitney
 Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

FIGURE E
Upgradient Trend Tests

Upgradient Wells Trend Tests - Significant Results

Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill Printed 10/17/2024, 1:23 PM

<u>Constituent</u>	<u>Well</u>	<u>Slope</u>	<u>Calc.</u>	<u>Critical</u>	<u>Sig.</u>	<u>N</u>	<u>%NDs</u>	<u>Normality</u>	<u>Alpha</u>	<u>Method</u>
Fluoride, total (mg/L)	MW-1612 (bg)	0.179	149	92	Yes	22	0	n/a	0.01	NP

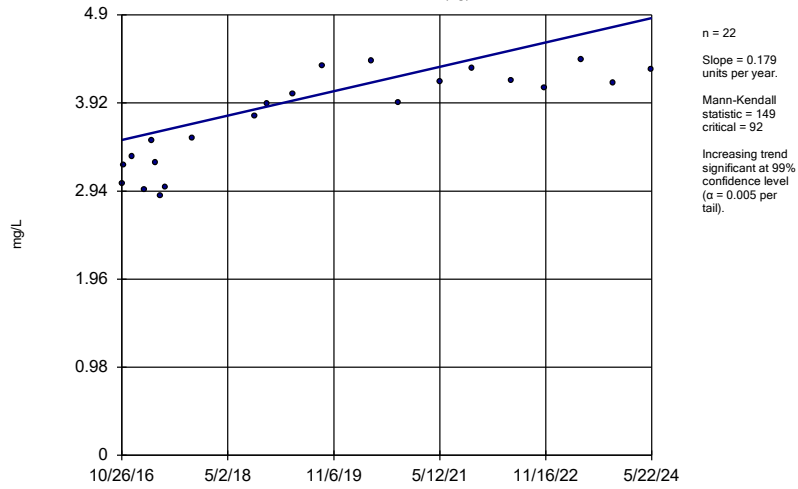
Upgradient Wells Trend Tests - All Results

Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill Printed 10/17/2024, 1:23 PM

<u>Constituent</u>	<u>Well</u>	<u>Slope</u>	<u>Calc.</u>	<u>Critical</u>	<u>Sig.</u>	<u>N</u>	<u>%NDs</u>	<u>Normality</u>	<u>Alpha</u>	<u>Method</u>
Fluoride, total (mg/L)	MW-1612 (bg)	0.179	149	92	Yes	22	0	n/a	0.01	NP
Fluoride, total (mg/L)	MW-30 (bg)	0.02099	68	92	No	22	0	n/a	0.01	NP

Sen's Slope Estimator

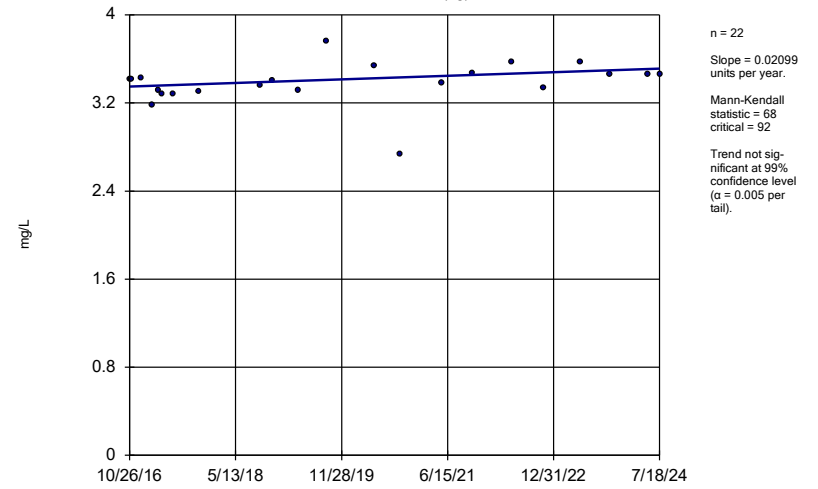
MW-1612 (bg)



Constituent: Fluoride, total Analysis Run 10/17/2024 1:22 PM View: Upgradient Well Trend Tests
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Sen's Slope Estimator

MW-30 (bg)



Constituent: Fluoride, total Analysis Run 10/17/2024 1:22 PM View: Upgradient Well Trend Tests
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

FIGURE F
Intrawell PLs

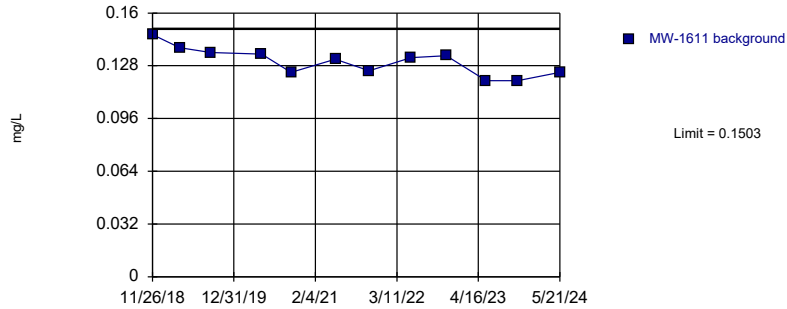
Intrawell Prediction Limits - All Results

Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill Printed 11/20/2024, 10:58 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg	NBg	Mean	Std. Dev.	%NDs	ND Adj.	TransformAlpha	Method
Boron, total (mg/L)	MW-1611	0.1503	n/a	n/a	1 future	n/a	12	0.1306	0.008501	0	None	None	No	0.001504 Param Intra 1 of 2
Boron, total (mg/L)	MW-1612	0.5283	n/a	n/a	1 future	n/a	13	0.6279	0.04341	0	None	None	sqrt(x)	0.001504 Param Intra 1 of 2
Boron, total (mg/L)	MW-26	0.2145	n/a	n/a	1 future	n/a	21	0.1273	0.04262	0	None	None	No	0.001504 Param Intra 1 of 2
Boron, total (mg/L)	MW-27	0.387	n/a	n/a	1 future	n/a	21	n/a	n/a	0	n/a	n/a	n/a	0.003999 NP Intra (normality) 1 of 2
Boron, total (mg/L)	MW-30	0.3403	n/a	n/a	1 future	n/a	22	0.2739	0.03269	0	None	None	No	0.001504 Param Intra 1 of 2
Boron, total (mg/L)	MW-38	0.08521	n/a	n/a	1 future	n/a	22	-3.367	0.4453	0	None	None	ln(x)	0.001504 Param Intra 1 of 2
Boron, total (mg/L)	MW-39	0.1895	n/a	n/a	1 future	n/a	22	0.1503	0.0193	0	None	None	No	0.001504 Param Intra 1 of 2
Calcium, total (mg/L)	MW-1611	26.57	n/a	n/a	1 future	n/a	24	23.83	1.366	0	None	None	No	0.001504 Param Intra 1 of 2
Calcium, total (mg/L)	MW-1612	11.16	n/a	n/a	1 future	n/a	22	6.114	2.484	0	None	None	No	0.001504 Param Intra 1 of 2
Calcium, total (mg/L)	MW-26	65.93	n/a	n/a	1 future	n/a	23	56.81	4.521	0	None	None	No	0.001504 Param Intra 1 of 2
Calcium, total (mg/L)	MW-27	1.746	n/a	n/a	1 future	n/a	21	1.33	0.2035	0	None	None	No	0.001504 Param Intra 1 of 2
Calcium, total (mg/L)	MW-30	10.9	n/a	n/a	1 future	n/a	21	n/a	n/a	0	n/a	n/a	n/a	0.003999 NP Intra (normality) 1 of 2
Calcium, total (mg/L)	MW-38	58.4	n/a	n/a	1 future	n/a	24	50.53	3.928	0	None	None	No	0.001504 Param Intra 1 of 2
Calcium, total (mg/L)	MW-39	12.4	n/a	n/a	1 future	n/a	22	n/a	n/a	0	n/a	n/a	n/a	0.003707 NP Intra (normality) 1 of 2
Chloride, total (mg/L)	MW-1611	10.94	n/a	n/a	1 future	n/a	25	9.532	0.709	0	None	None	No	0.001504 Param Intra 1 of 2
Chloride, total (mg/L)	MW-1612	14.49	n/a	n/a	1 future	n/a	13	8.706	2.54	0	None	None	No	0.001504 Param Intra 1 of 2
Chloride, total (mg/L)	MW-26	6.912	n/a	n/a	1 future	n/a	22	5.805	0.545	0	None	None	No	0.001504 Param Intra 1 of 2
Chloride, total (mg/L)	MW-27	1.823	n/a	n/a	1 future	n/a	22	1.612	0.1036	0	None	None	No	0.001504 Param Intra 1 of 2
Chloride, total (mg/L)	MW-30	288	n/a	n/a	1 future	n/a	23	n/a	n/a	0	n/a	n/a	n/a	0.003415 NP Intra (normality) 1 of 2
Chloride, total (mg/L)	MW-38	7.739	n/a	n/a	1 future	n/a	22	7.314	0.2093	0	None	None	No	0.001504 Param Intra 1 of 2
Chloride, total (mg/L)	MW-39	3.118	n/a	n/a	1 future	n/a	22	3.001	0.05756	0	None	None	No	0.001504 Param Intra 1 of 2
pH, field (SU)	MW-1611	8.033	7.236	n/a	1 future	n/a	27	7.634	0.2021	0	None	None	No	0.000752 Param Intra 1 of 2
pH, field (SU)	MW-1612	8.64	7.985	n/a	1 future	n/a	21	8.312	0.1602	0	None	None	No	0.000752 Param Intra 1 of 2
pH, field (SU)	MW-26	7.792	6.932	n/a	1 future	n/a	26	7.362	0.217	0	None	None	No	0.000752 Param Intra 1 of 2
pH, field (SU)	MW-27	9.507	8.516	n/a	1 future	n/a	24	9.011	0.2474	0	None	None	No	0.000752 Param Intra 1 of 2
pH, field (SU)	MW-30	8.947	7.779	n/a	1 future	n/a	22	8.363	0.2876	0	None	None	No	0.000752 Param Intra 1 of 2
pH, field (SU)	MW-38	7.541	6.544	n/a	1 future	n/a	25	7.043	0.2506	0	None	None	No	0.000752 Param Intra 1 of 2
pH, field (SU)	MW-39	8.727	7.806	n/a	1 future	n/a	24	8.266	0.2298	0	None	None	No	0.000752 Param Intra 1 of 2
Sulfate, total (mg/L)	MW-1611	23.47	n/a	n/a	1 future	n/a	22	19.7	1.857	0	None	None	No	0.001504 Param Intra 1 of 2
Sulfate, total (mg/L)	MW-1612	147.4	n/a	n/a	1 future	n/a	14	69.69	34.74	0	None	None	No	0.001504 Param Intra 1 of 2
Sulfate, total (mg/L)	MW-26	10.27	n/a	n/a	1 future	n/a	21	7.199	1.504	0	None	None	No	0.001504 Param Intra 1 of 2
Sulfate, total (mg/L)	MW-27	6.908	n/a	n/a	1 future	n/a	21	3.938	1.453	0	None	None	No	0.001504 Param Intra 1 of 2
Sulfate, total (mg/L)	MW-30	19.6	n/a	n/a	1 future	n/a	22	n/a	n/a	0	n/a	n/a	n/a	0.003707 NP Intra (normality) 1 of 2
Sulfate, total (mg/L)	MW-38	36.86	n/a	n/a	1 future	n/a	22	30.15	3.302	0	None	None	No	0.001504 Param Intra 1 of 2
Sulfate, total (mg/L)	MW-39	0.6	n/a	n/a	1 future	n/a	22	n/a	n/a	50	n/a	n/a	n/a	0.003707 NP Intra (normality) 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-1611	444.9	n/a	n/a	1 future	n/a	25	398.2	23.5	0	None	None	No	0.001504 Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-1612	1227	n/a	n/a	1 future	n/a	21	844.1	187.1	0	None	None	No	0.001504 Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-26	400.2	n/a	n/a	1 future	n/a	23	346.8	26.47	0	None	None	No	0.001504 Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-27	590.4	n/a	n/a	1 future	n/a	21	543	23.15	0	None	None	No	0.001504 Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-30	1351	n/a	n/a	1 future	n/a	22	1248	50.39	0	None	None	No	0.001504 Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-38	462.7	n/a	n/a	1 future	n/a	24	416.3	23.2	0	None	None	No	0.001504 Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-39	424.2	n/a	n/a	1 future	n/a	22	370	26.67	0	None	None	No	0.001504 Param Intra 1 of 2

Prediction Limit

Intrawell Parametric, MW-1611

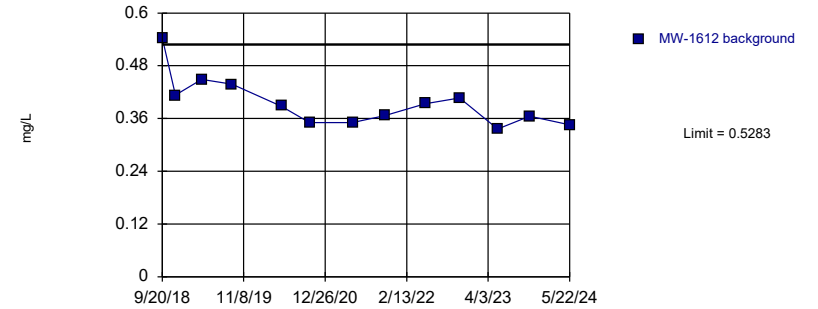


Background Data Summary: Mean=0.1306, Std. Dev.=0.008501, n=12. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9445, critical = 0.859. Kappa = 2.322 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Boron, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

Intrawell Parametric, MW-1612 (bg)

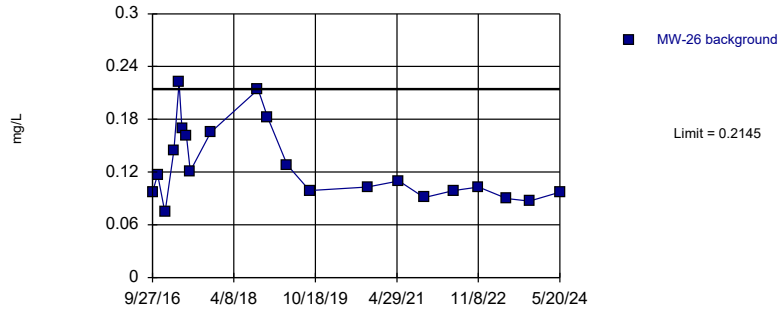


Background Data Summary (based on square root transformation): Mean=0.6279, Std. Dev.=0.04341, n=13. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.8874, critical = 0.866. Kappa = 2.279 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Boron, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

Intrawell Parametric, MW-26

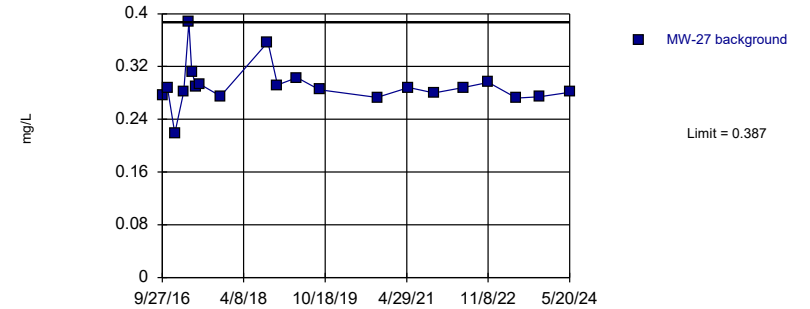


Background Data Summary: Mean=0.1273, Std. Dev.=0.04262, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8806, critical = 0.873. Kappa = 2.044 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Boron, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

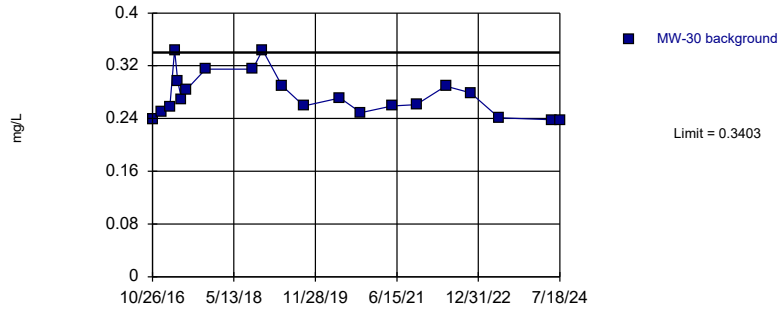
Intrawell Non-parametric, MW-27



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

Constituent: Boron, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

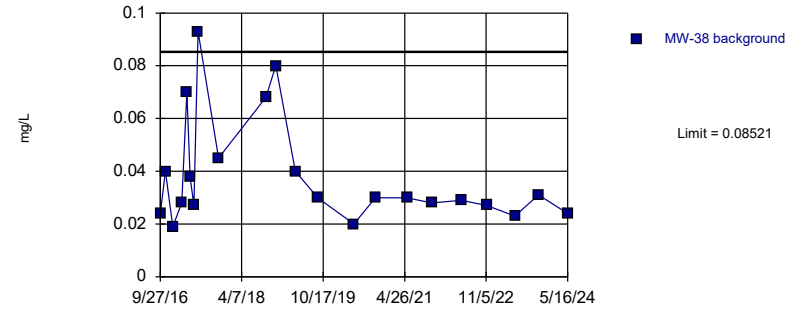
Prediction Limit
Intrawell Parametric, MW-30 (bg)



Background Data Summary: Mean=0.2739, Std. Dev.=0.03269, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.896, critical = 0.878. Kappa = 2.031 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Boron, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

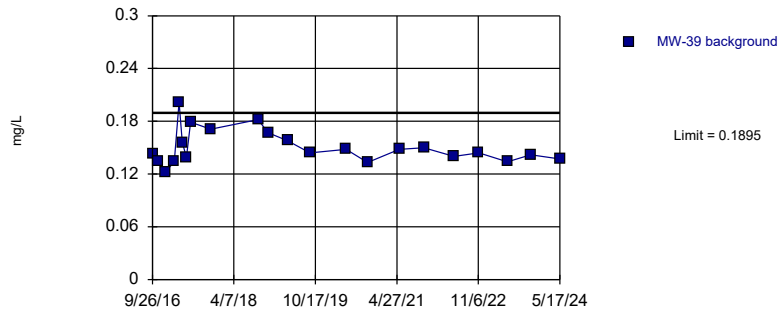
Prediction Limit
Intrawell Parametric, MW-38



Background Data Summary (based on natural log transformation): Mean=-3.367, Std. Dev.=0.4453, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8869, critical = 0.878. Kappa = 2.031 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

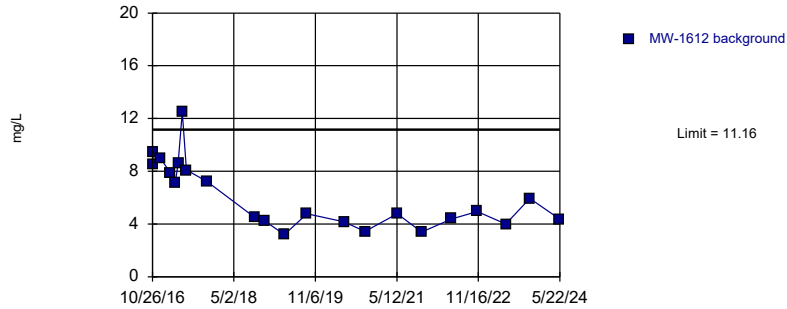
Constituent: Boron, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit
Intrawell Parametric, MW-39



Prediction Limit

Intrawell Parametric, MW-1612 (bg)

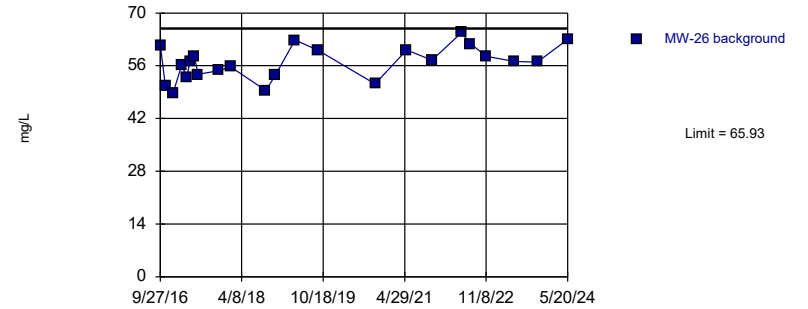


Background Data Summary: Mean=6.114, Std. Dev.=2.484, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8932, critical = 0.878. Kappa = 2.031 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

Intrawell Parametric, MW-26

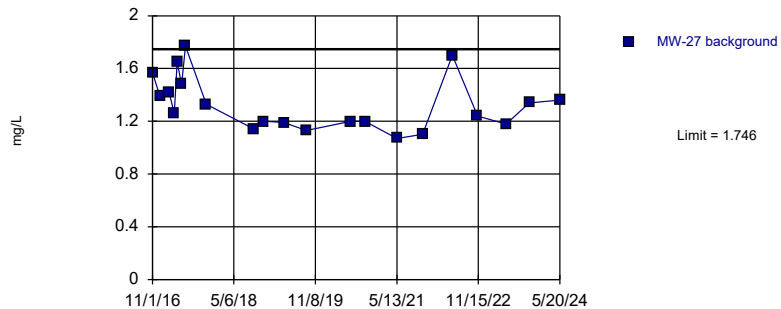


Background Data Summary: Mean=56.81, Std. Dev.=4.521, n=23. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.976, critical = 0.881. Kappa = 2.017 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

Intrawell Parametric, MW-27

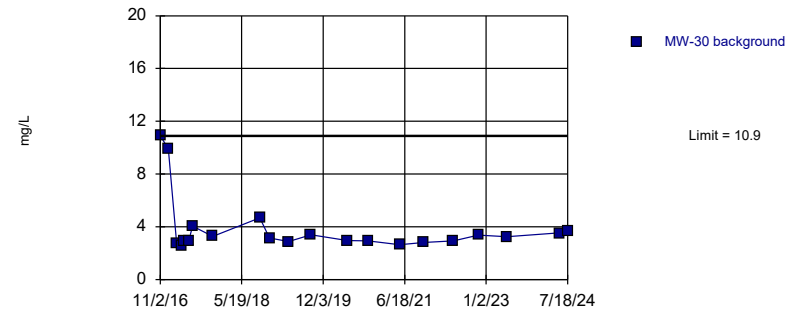


Background Data Summary: Mean=1.33, Std. Dev.=0.2035, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9118, critical = 0.873. Kappa = 2.044 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

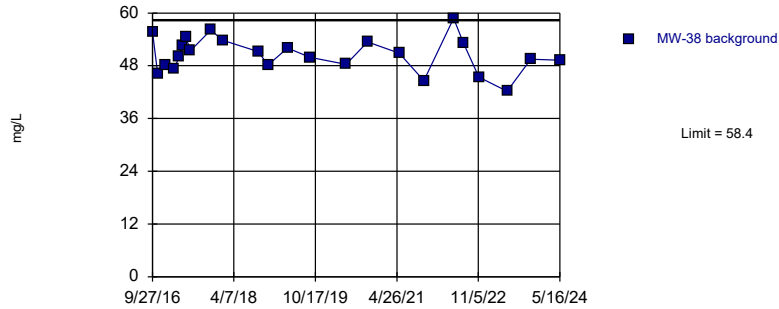
Intrawell Non-parametric, MW-30 (bg)



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

Constituent: Calcium, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

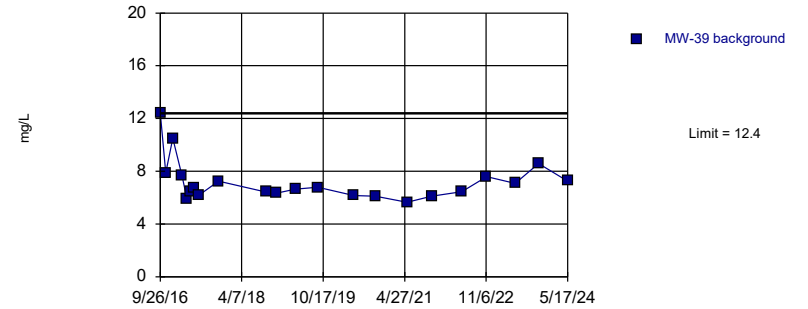
Prediction Limit
Intrawell Parametric, MW-38



Background Data Summary: Mean=50.53, Std. Dev.=3.928, n=24. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9964, critical = 0.884. Kappa = 2.004 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

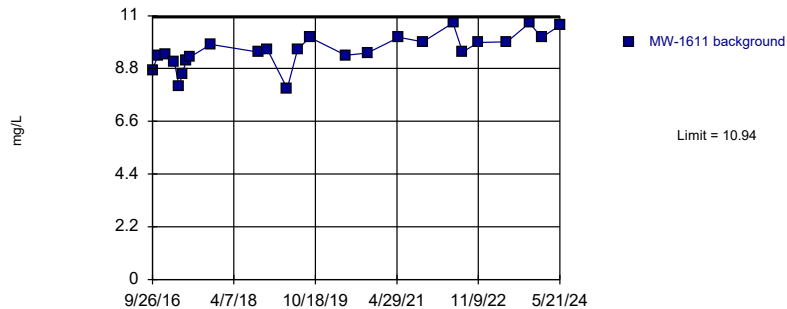
Prediction Limit
Intrawell Non-parametric, MW-39



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 22 background values. Well-constituent pair annual alpha = 0.007401. Individual comparison alpha = 0.003707 (1 of 2). Assumes 1 future value.

Constituent: Calcium, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

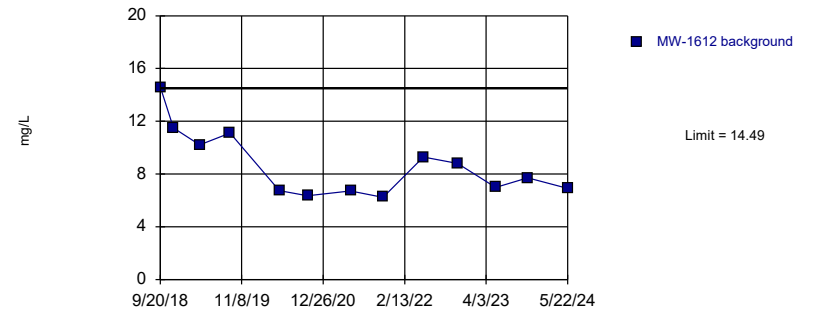
Prediction Limit
Intrawell Parametric, MW-1611



Background Data Summary: Mean=9.532, Std. Dev.=0.709, n=25. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.951, critical = 0.888. Kappa = 1.99 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

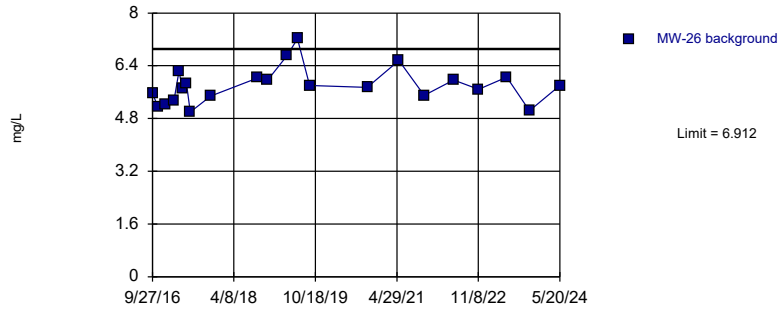
Prediction Limit
Intrawell Parametric, MW-1612 (bg)



Background Data Summary: Mean=8.706, Std. Dev.=2.54, n=13. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.8677, critical = 0.866. Kappa = 2.279 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

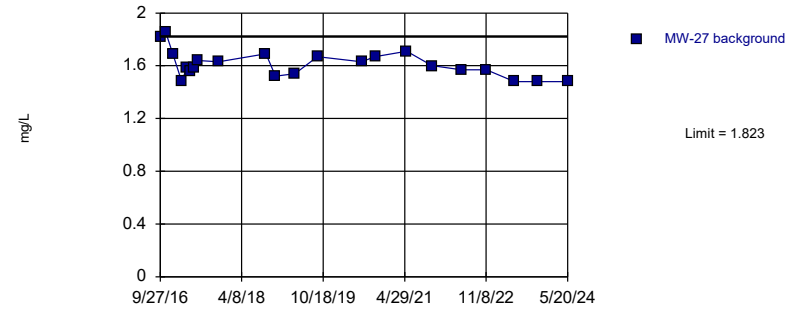
Prediction Limit
Intrawell Parametric, MW-26



Background Data Summary: Mean=5.805, Std. Dev.=0.545, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9489, critical = 0.878. Kappa = 2.031 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

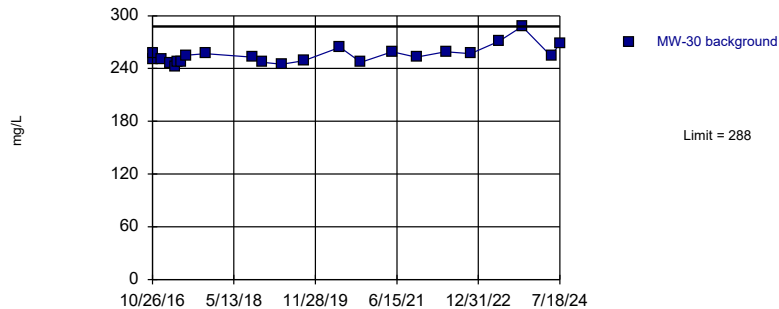
Prediction Limit
Intrawell Parametric, MW-27



Background Data Summary: Mean=1.612, Std. Dev.=0.1036, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9325, critical = 0.878. Kappa = 2.031 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

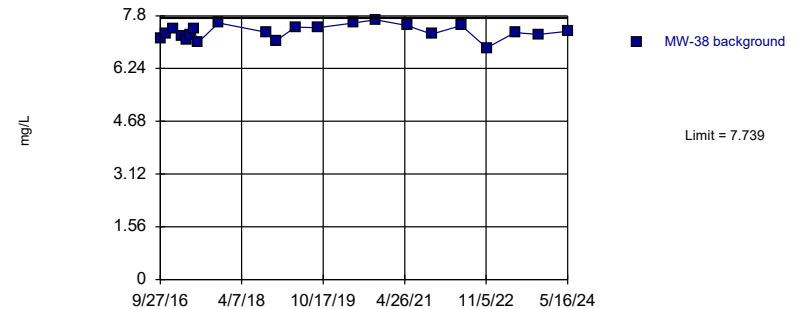
Prediction Limit
Intrawell Non-parametric, MW-30 (bg)



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 23 background values. Well-constituent pair annual alpha = 0.006819. Individual comparison alpha = 0.003415 (1 of 2). Assumes 1 future value.

Constituent: Chloride, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

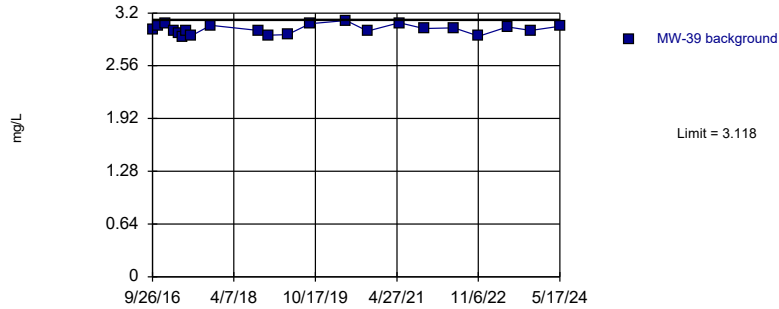
Prediction Limit
Intrawell Parametric, MW-38



Background Data Summary: Mean=7.314, Std. Dev.=0.2093, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9833, critical = 0.878. Kappa = 2.031 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

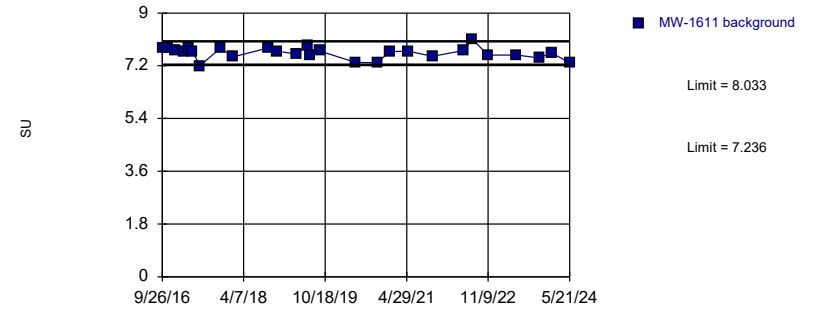
Prediction Limit
Intrawell Parametric, MW-39



Background Data Summary: Mean=3.001, Std. Dev.=0.05756, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9652, critical = 0.878. Kappa = 2.031 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

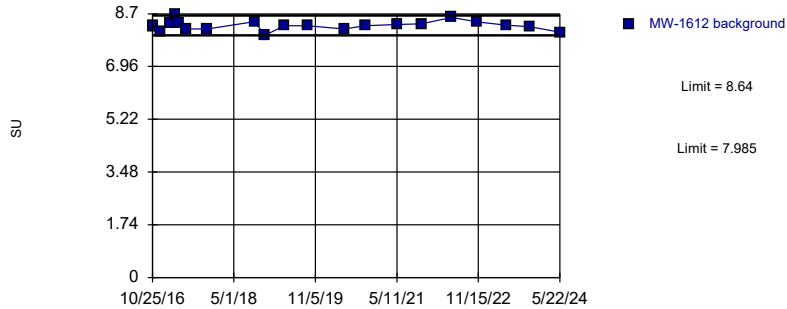
Prediction Limit
Intrawell Parametric, MW-1611



Background Data Summary: Mean=7.634, Std. Dev.=0.2021, n=27. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9577, critical = 0.894. Kappa = 1.972 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

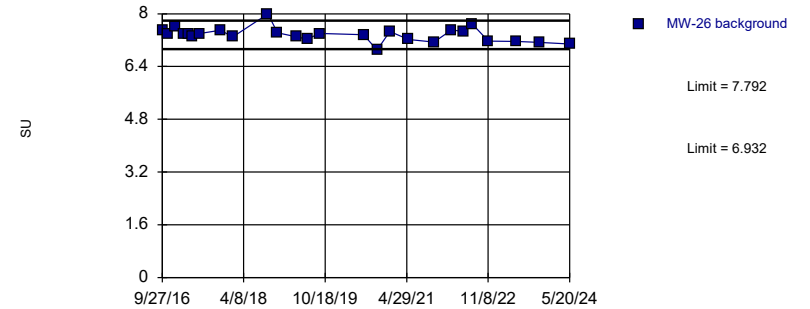
Prediction Limit
Intrawell Parametric, MW-1612 (bg)



Background Data Summary: Mean=8.312, Std. Dev.=0.1602, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9676, critical = 0.873. Kappa = 2.044 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

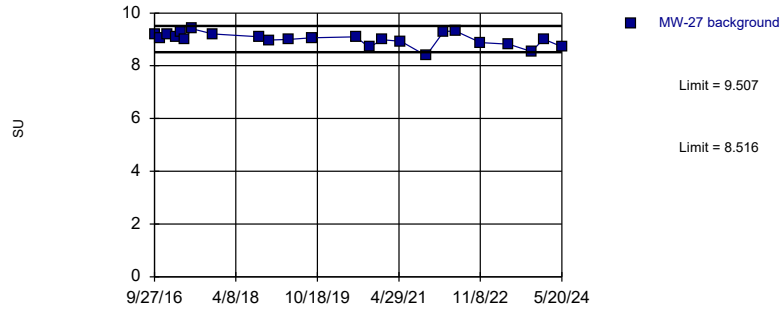
Prediction Limit
Intrawell Parametric, MW-26



Background Data Summary: Mean=7.362, Std. Dev.=0.217, n=26. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9545, critical = 0.891. Kappa = 1.981 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

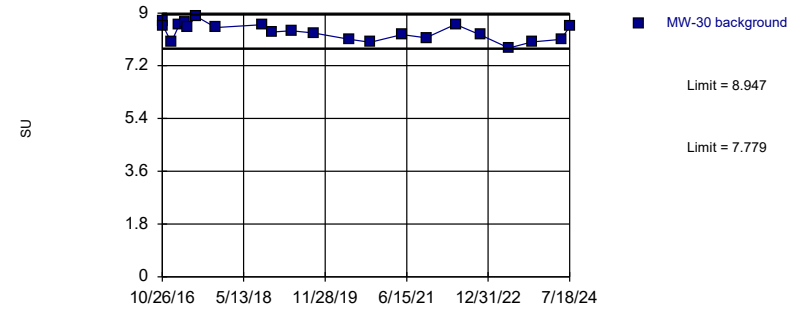
Prediction Limit
Intrawell Parametric, MW-27



Background Data Summary: Mean=9.011, Std. Dev.=0.2474, n=24. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9468, critical = 0.884. Kappa = 2.004 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

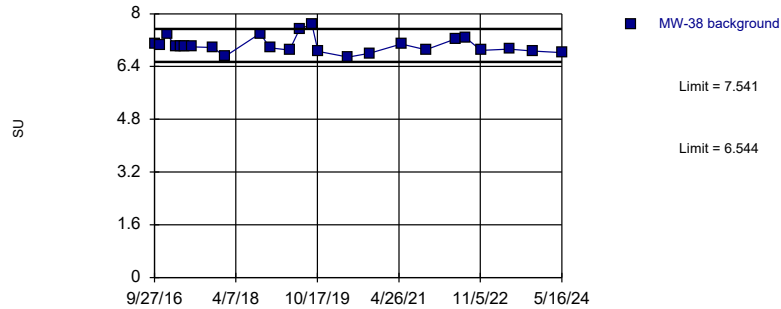
Prediction Limit
Intrawell Parametric, MW-30 (bg)



Background Data Summary: Mean=8.363, Std. Dev.=0.2876, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9733, critical = 0.878. Kappa = 2.031 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

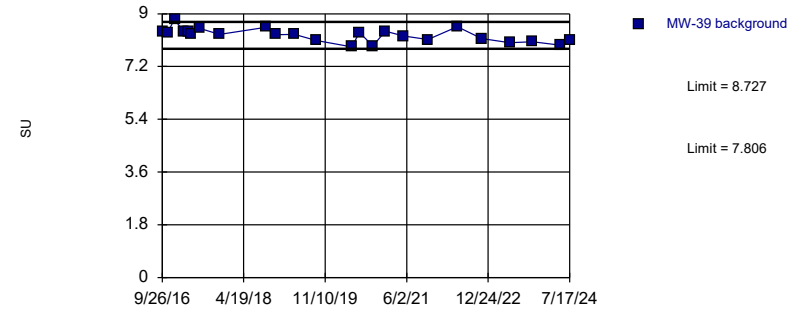
Prediction Limit
Intrawell Parametric, MW-38



Background Data Summary: Mean=7.043, Std. Dev.=0.2506, n=25. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9079, critical = 0.888. Kappa = 1.99 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit
Intrawell Parametric, MW-39

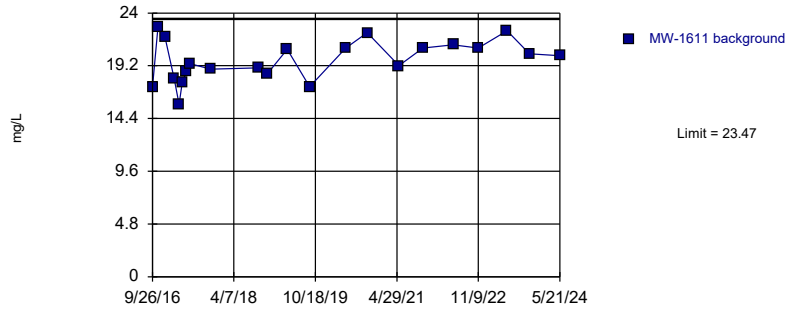


Background Data Summary: Mean=8.266, Std. Dev.=0.2298, n=24. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9718, critical = 0.884. Kappa = 2.004 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH, field Analysis Run 11/20/2024 10:48 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

Intrawell Parametric, MW-1611

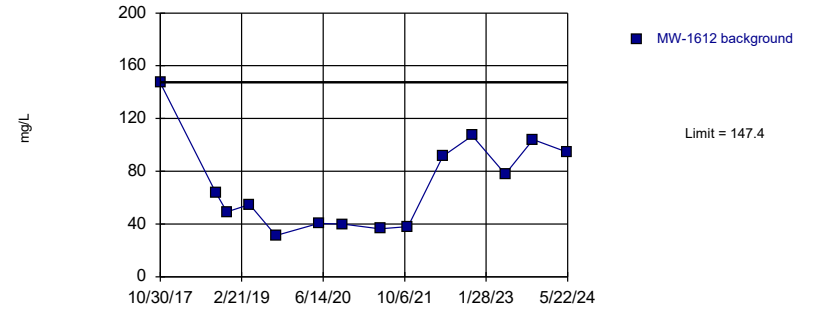


Background Data Summary: Mean=19.7, Std. Dev.=1.857, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9742, critical = 0.878. Kappa = 2.031 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 11/20/2024 10:49 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

Intrawell Parametric, MW-1612 (bg)

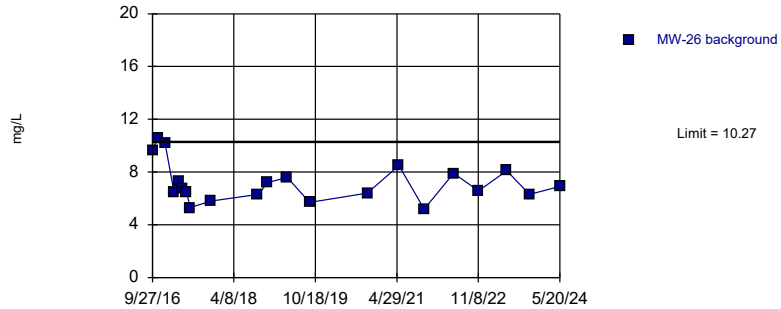


Background Data Summary: Mean=69.69, Std. Dev.=34.74, n=14. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9, critical = 0.874. Kappa = 2.236 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 11/20/2024 10:49 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

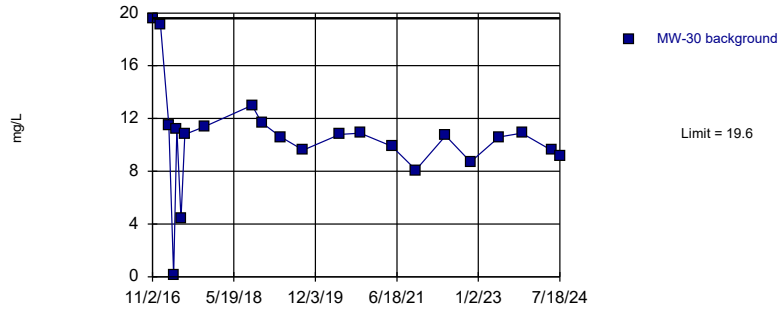
Prediction Limit

Intrawell Parametric, MW-26



Prediction Limit

Intrawell Non-parametric, MW-30 (bg)

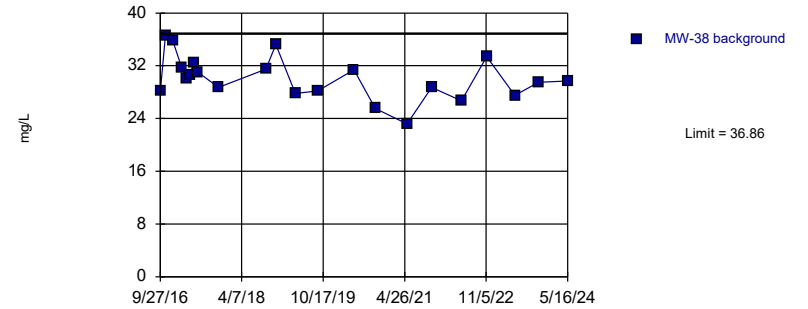


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 22 background values. Well-constituent pair annual alpha = 0.007401. Individual comparison alpha = 0.003707 (1 of 2). Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 11/20/2024 10:49 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

Intrawell Parametric, MW-38

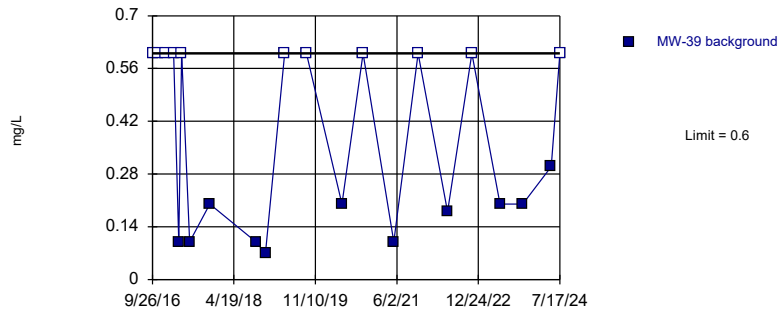


Background Data Summary: Mean=30.15, Std. Dev.=3.302, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9819, critical = 0.878. Kappa = 2.031 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 11/20/2024 10:49 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

Intrawell Non-parametric, MW-39

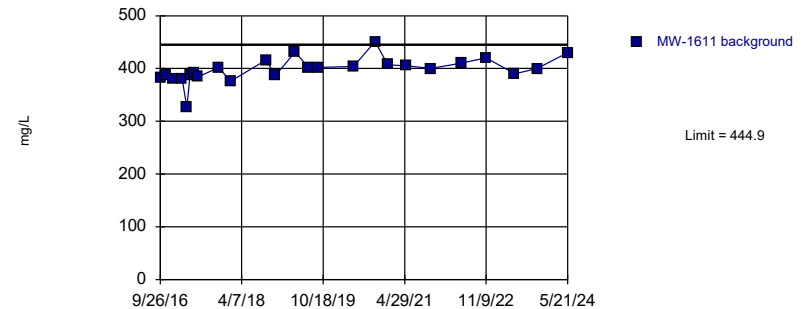


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 22 background values. 50% NDs. Well-constituent pair annual alpha = 0.007401. Individual comparison alpha = 0.003707 (1 of 2). Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 11/20/2024 10:49 AM View: Intrawell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

Intrawell Parametric, MW-1611

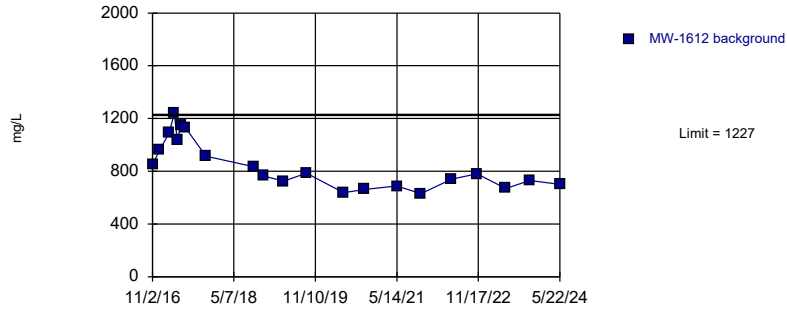


Background Data Summary: Mean=398.2, Std. Dev.=23.5, n=25. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9237, critical = 0.888. Kappa = 1.99 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/20/2024 10:49 AM View: Intrawell Prediction Li
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

Intrawell Parametric, MW-1612 (bg)

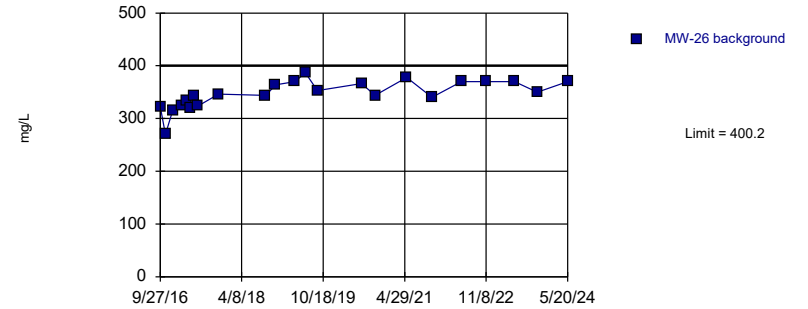


Background Data Summary: Mean=844.1, Std. Dev.=187.1, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8926, critical = 0.873. Kappa = 2.044 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/20/2024 10:49 AM View: Intrawell Prediction Li
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

Intrawell Parametric, MW-26

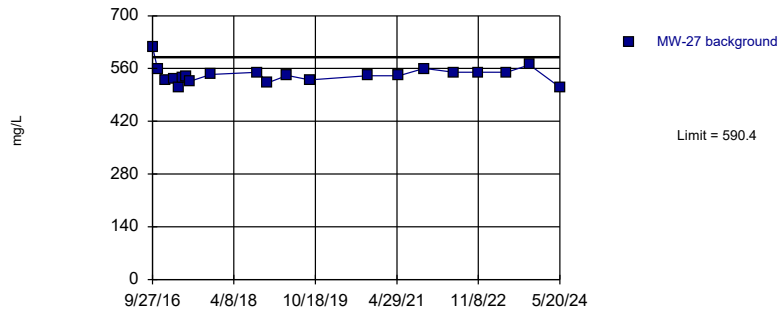


Background Data Summary: Mean=346.8, Std. Dev.=26.47, n=23. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9231, critical = 0.881. Kappa = 2.017 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/20/2024 10:49 AM View: Intrawell Prediction Li
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

Intrawell Parametric, MW-27

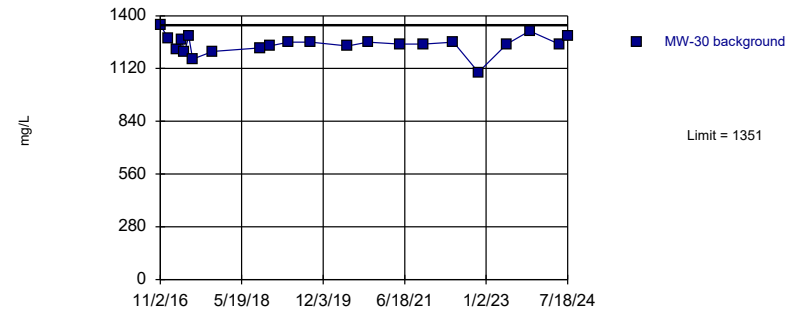


Background Data Summary: Mean=543, Std. Dev.=23.15, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8753, critical = 0.873. Kappa = 2.044 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/20/2024 10:49 AM View: Intrawell Prediction Li
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit

Intrawell Parametric, MW-30 (bg)



Background Data Summary: Mean=1248, Std. Dev.=50.39, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9167, critical = 0.878. Kappa = 2.031 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/20/2024 10:49 AM View: Intrawell Prediction Li
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit
Intrawell Parametric, MW-38

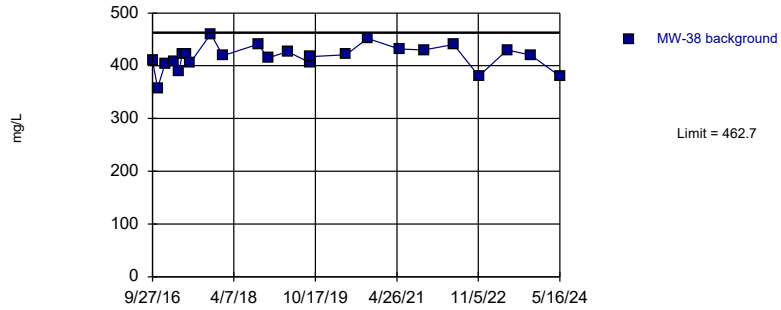


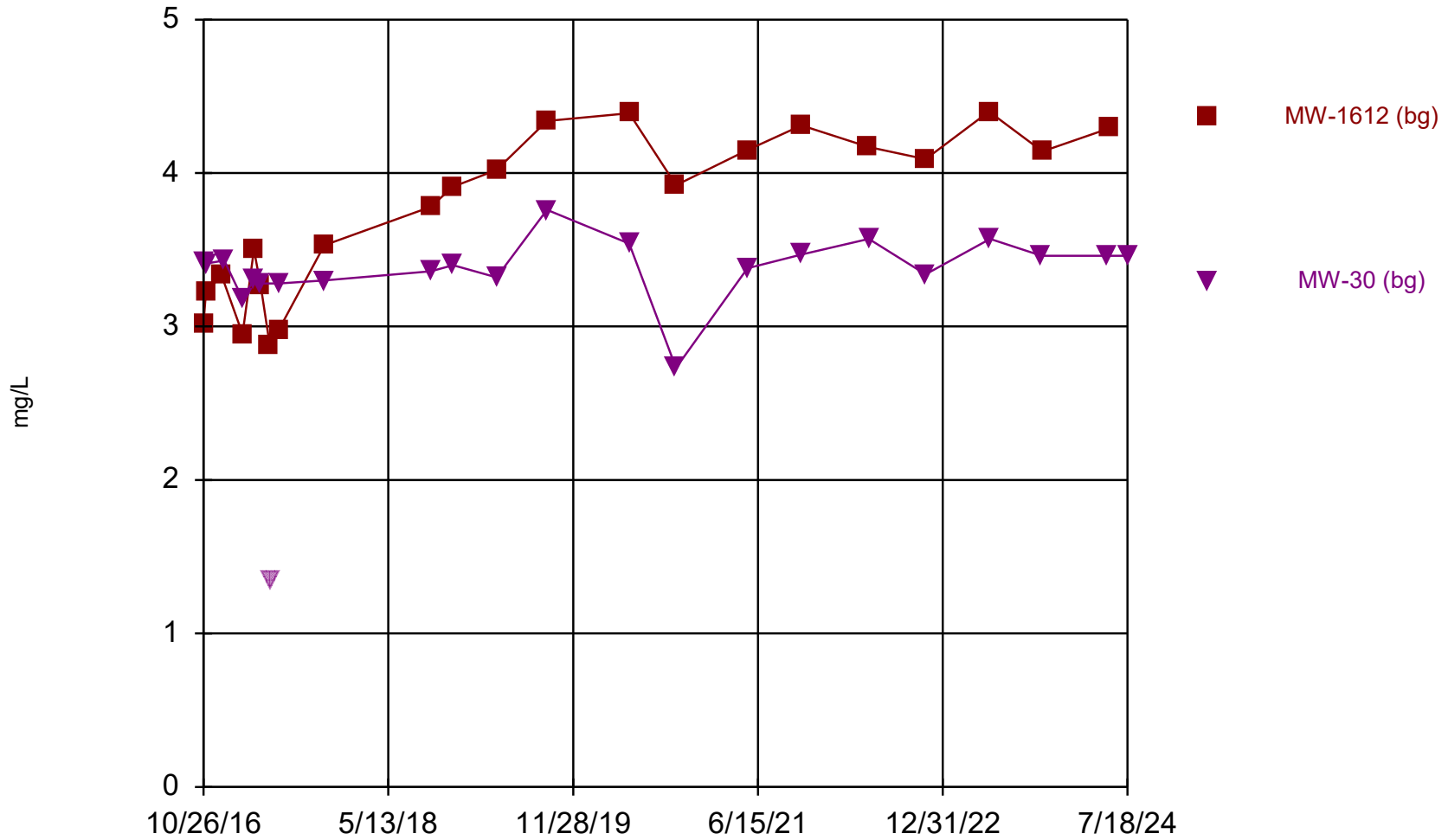
FIGURE G
Interwell PLs

Interwell Prediction Limit - All Results

Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill Printed 10/18/2024, 7:57 AM

<u>Constituent</u>	<u>Well</u>	<u>Upper Lim.</u>	<u>Lower Lim.</u>	<u>Date</u>	<u>Observ.</u>	<u>Sig.</u>	<u>Bq</u>	<u>NBq</u>	<u>Mean</u>	<u>Std. Dev.</u>	<u>%NDs</u>	<u>ND Adj.</u>	<u>TransformAlpha</u>	<u>Method</u>
Fluoride, total (mg/L)	n/a	4.386	n/a	n/a	5 future	n/a	44	3.569	0.4347	0	None	No	0.001504	Param Inter 1 of 2

Time Series



Constituent: Fluoride, total Analysis Run 10/18/2024 7:57 AM View: Interwell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

Prediction Limit Interwell Parametric



Background Data Summary: Mean=3.569, Std. Dev.=0.4347, n=44. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9263, critical = 0.924. Kappa = 1.879 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.001504. Assumes 5 future values.

Constituent: Fluoride, total Analysis Run 10/18/2024 7:57 AM View: Interwell Prediction Limits
Mountaineer Landfill Client: Geosyntec Data: Mountaineer Landfill

APPENDIX 3 – Alternative Source Demonstrations

No alternative source demonstrations were necessary during this annual reporting period.

APPENDIX 4 - Notices for Monitoring Program Transitions

Not applicable at this time.

APPENDIX 5 - Well Installation/Decommissioning Logs

Not applicable at this time.