Annual Groundwater Monitoring Report

Appalachian Power Company

Mountaineer Plant

Landfill CCR Management Unit

Letart, WV

January 2020

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

APPALACHIAN POWER℠

An AEP Company

BOUNDLESS ENERGY℠

Table of Contents

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 in 2019:

- Groundwater samples were collected and analyzed for Appendix III constituents, as specified in 40 CFR 257.94 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan (2016)*;
- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Appendix III constituents were compared to prediction intervals established from background data established previously;
- Statistically significant increases (SSIs) over background concentrations were observed from the September 2018 sampling event and April 2019 sampling event, however, an alternative source demonstration (ASD) was successful for each event in showing that the observed increases were due to natural variation. The statistics reports and alternative source demonstration reports were completed in 2019.

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

- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers;
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs (Attached as **Appendix 1**);
- Statistical comparison of monitoring data to determine if there have been significant increase over background concentrations (Attached as **Appendix 2**, where applicable);
- A discussion of whether any alternate source demonstration 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); and
- Other information required to be included in the annual report such as an alternate monitoring frequency, or assessment of corrective measures, if applicable.

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

II. Groundwater Monitoring Well Locations and Identification Numbers

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

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.

750 375 0 750 Feet

Site Layout
CCR Landfill

AEP Mountaineer Generating Plant
Letart, West Virginia

Geosyntec consultants

Columbus, Ohio | 2018/01/26

Figure **1**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mountaineer\AEP-Mountaineer_LF_Site_Layout.mxd. ARevezzo. 1/26/2018. CHA8423/07/08.

III. Monitoring Wells Installed or Decommissioned

There were no monitoring wells installed or decommissioned in 2019. 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 in 2019. Static water elevation data from each monitoring event also are shown in **Appendix 1**, along with the groundwater velocity calculations, groundwater flow direction and potentiometric maps developed after each sampling event.

V. Groundwater Quality Data Statistical Analysis

Statistical analysis completed in 2019 of the detection monitoring samples collected and analyzed in September 2018, November 2018, and April 2019 are included in **Appendix 2** of this report. Samples collected in September 2019 were analyzed and results received in late 2019. The statistical analysis of these results is underway and will be completed within the 90-day timeframe allowed.

The statistically significant increases (SSIs) observed from the September 2018 sampling event in the Appendix III parameters were boron, calcium, pH, and total dissolved solids; however, an alternative source demonstration was successful and detection monitoring continued on a semi-annual basis in the final sample of 2018 and all of 2019.

The statistically significant increases (SSIs) observed from the April 2019 sampling event in the Appendix III parameters were chloride and total dissolved solids; however an alternative source demonstration was successful and the detection monitoring continued in the second half of 2019.

VI. Alternative Source Demonstrations

SSIs over background for the September 2018 and April 2019 detection monitoring events were determined to be due to an alternative source per the ASD's mentioned above. The demonstrations were certified by a qualified professional engineer and are included in **Appendix 3**.

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

There has been no transition between detection monitoring and assessment monitoring at Mountaineer Plant's Landfill. Detection monitoring will continue in 2020. The sampling frequency of twice per year will be maintained for the Appendix III parameters (boron, calcium, chloride, fluoride, pH, sulfate and total dissolved solids).

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. Description of Any Problems Encountered in 2019 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.

IX. A Projection of Key Activities for the Upcoming Year

Key activities for 2020 include:

- 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 in light of what the CCR rule requires.
- Preparation of the annual groundwater report due in January 2021.

APPENDIX 1 - Groundwater Data Tables and Figures

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

Table 1 - Groundwater Data Summary: MW-26
Mountaineer - LF
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		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	322	9.6
11/1/2016	Background	0.117	50.5	5.17	0.13	7.4	270	10.6
12/21/2016	Background	0.074	48.6	5.21	0.13	7.6	316	10.2
2/22/2017	Background	0.145	56.2	5.35	0.13	7.4	325	6.5
3/28/2017	Background	0.222	52.9	6.25	0.13	7.4	334	7.3
4/17/2017	Background	0.169	57.1	5.73	0.13	7.3	320	6.7
5/17/2017	Background	0.161	58.6	5.87	0.13	8.1	343	6.5
6/13/2017	Background	0.121	53.7	5.00	0.12	7.4	324	5.3
10/31/2017	Detection	0.165	54.7	5.48	0.13	7.5	346	5.8
1/22/2018	Detection	- -	55.7	- -	- -	7.3	- -	- -
9/20/2018	Detection	0.214	49.4	6.04	0.16	8.0	344	6.3
11/26/2018	Detection	0.182	53.6	5.97	0.14	7.4	364	7.2
4/9/2019	Detection	0.128	62.8	6.71	0.13	7.3	370	7.6
6/18/2019	Detection	- -	- -	7.22	- -	7.2	387	- -
9/9/2019	Detection	0.099	60.2	5.80	0.14	7.4	353	5.7

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-26
Mountaineer - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
9/27/2016	Background	0.13	3.57	917	<0.005 U	0.01 J	0.4	0.214	3.25	0.12	0.165	0.010	<0.002 U	1.88	0.1	0.03 J
11/1/2016	Background	0.11	4.06	871	<0.005 U	0.005 J	0.3	0.2200	3.57	0.13	0.043	0.006	<0.002 U	3.07	0.1	0.02 J
12/21/2016	Background	0.12	4.51	872	0.01 J	0.006 J	1.27	0.329	3.15	0.13	0.167	0.004	<0.002 U	3.52	0.2	0.062
2/22/2017	Background	0.09	4.11	717	0.01 J	0.01 J	0.731	0.345	3.6	0.13	0.244	0.012	<0.002 U	2.53	0.1	0.04 J
3/28/2017	Background	0.50	3.95	886	0.028	0.01 J	1.43	0.532	2.88	0.13	0.517	0.014	<0.002 U	1.18	0.2	0.03 J
4/17/2017	Background	0.09	3.60	802	0.007 J	0.007 J	0.328	0.299	1.967	0.13	0.164	0.009	<0.002 U	1.08	0.1 J	0.01 J
5/17/2017	Background	0.06	4.01	869	<0.004 U	0.007 J	0.238	0.251	3.22	0.13	0.090	0.007	<0.002 U	3.99	0.1	0.01 J
6/13/2017	Background	0.10	3.45	905	0.008 J	0.008 J	0.405	0.325	3.28	0.12	0.252	0.018	<0.002 U	1.23	0.1	0.01 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-27
Mountaineer - LF
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		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	618	4.9
11/1/2016	Background	0.288	1.57	1.86	2.38	9.1	558	7.2
12/21/2016	Background	0.219	1.39	1.69	2.44	9.2	528	7.3
2/22/2017	Background	0.282	1.42	1.48	2.27	9.1	531	4.3
3/28/2017	Background	0.387	1.26	1.59	2.32	9.3	508	4.7
4/17/2017	Background	0.312	1.65	1.56	2.30	9.0	536	5.0
5/17/2017	Background	0.290	1.48	1.59	2.38	11.1	539	4.8
6/13/2017	Background	0.293	1.77	1.64	2.33	9.4	526	4.5
10/31/2017	Detection	0.275	1.33	1.63	2.38	9.2	544	4.2
9/20/2018	Detection	0.357	1.14	1.69	2.41	9.1	550	4.4
11/26/2018	Detection	0.292	1.20	1.52	2.37	9.0	522	3.6
4/9/2019	Detection	0.303	1.19	1.54	2.32	9.0	542	2.9
9/10/2019	Detection	0.285	1.13	1.67	2.71	9.1	530	3.0

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-27
Mountaineer - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
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 J	24.2	2.2	0.1 J
11/1/2016	Background	0.26	5.42	151	0.158	0.02	5.00	0.817	2.003	2.38	4.00	0.007	<0.002 U	35.6	0.4	0.03 J
12/21/2016	Background	0.23	4.26	113	0.093	0.01 J	2.94	0.502	1.489	2.44	8.87	0.001	<0.002 U	34.6	0.3	0.04 J
2/22/2017	Background	0.06	3.76	94.8	0.054	0.009 J	1.95	0.320	1.419	2.27	1.28	0.012	0.002 J	32.1	0.1	0.03 J
3/28/2017	Background	0.08	4.45	105	0.062	0.008 J	1.69	0.319	0.888	2.32	1.06	0.016	<0.002 U	31.5	0.2	0.02 J
4/17/2017	Background	0.15	4.54	108	0.085	0.01 J	2.36	0.511	0.486	2.30	1.45	0.005	0.002 J	32.0	0.2	0.02 J
5/17/2017	Background	0.11	4.54	94.6	0.052	0.005 J	1.33	0.335	0.20279	2.38	0.971	0.015	<0.002 U	31.6	0.2	0.01 J
6/13/2017	Background	0.18	4.55	102	0.082	0.01 J	2.25	0.600	0.797	2.33	1.39	0.015	<0.002 U	30.6	0.2	0.02 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-30
Mountaineer - LF
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		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	1350	19.6
12/28/2016	Background	0.250	9.91	250	3.43	8.0	1280	19.1
2/22/2017	Background	0.257	2.76	246	3.18	8.6	1220	11.5
3/29/2017	Background	0.344	2.54	242	3.31	8.7	1270	0.1 J
4/19/2017	Background	0.296	2.91	247	3.28	8.5	1210	11.2
5/17/2017	Background	0.269	2.97	247	1.34	10.1	1290	4.4
6/13/2017	Background	0.283	4.06	255	3.28	8.9	1170	10.8
10/30/2017	Detection	0.315	3.27	257	3.30	8.5	1210	11.4
9/20/2018	Detection	0.315	4.69	253	3.36	8.6	1230	13.0
11/27/2018	Detection	0.344	3.16	247	3.40	8.4	1240	11.7
4/9/2019	Detection	0.290	2.88	245	3.32	8.4	1260	10.6
9/10/2019	Detection	0.259	3.39	249	3.76	8.3	1260	9.6

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-30
Mountaineer - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
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	0.35
2/22/2017	Background	0.52	4.65	223	0.082	0.008 J	3.24	2.40	2.418	3.18	1.68	0.022	0.004 J	125	0.5	0.258
3/29/2017	Background	0.66	5.45	243	0.149	0.007 J	6.13	4.24	1.204	3.31	3.62	0.027	0.003 J	120	0.7	0.381
4/19/2017	Background	1.55	5.80	246	0.140	0.01 J	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 U	3.99	3.63	2.395	1.34	3.41	0.027	0.004 J	128	0.9	0.287
6/13/2017	Background	2.74	6.86	251	0.197	0.02 J	6.83	5.35	3.45	3.28	4.80	0.027	0.005 J	118	0.8	0.366

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-38
Mountaineer - LF
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		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	410	28.1
11/2/2016	Background	0.040	46.3	7.27	0.32	7.0	358	36.6
12/21/2016	Background	0.019	48.2	7.43	0.35	7.4	404	35.8
2/22/2017	Background	0.028	47.2	7.21	0.29	7.0	409	31.7
3/28/2017	Background	0.070	50.0	7.08	0.32	7.0	390	30.1
4/18/2017	Background	0.038	52.5	7.22	0.33	7.0	422	30.6
5/16/2017	Background	0.027	54.5	7.41	0.33	7.6	421	32.5
6/13/2017	Background	0.093	51.4	7.01	0.28	7.0	406	31.0
10/31/2017	Detection	0.045	56.1	7.59	0.38	7.0	460	28.7
1/22/2018	Detection	- -	53.8	- -	- -	6.7	419	- -
9/20/2018	Detection	0.068	51.2	7.31	0.36	7.4	441	31.5
11/26/2018	Detection	0.08 J	48.2	7.06	0.34	7.0	415	35.2
4/9/2019	Detection	0.04 J	52.0	7.46	0.32	6.9	427	27.8
6/18/2019	Detection	- -	- -	- -	- -	7.6	- -	- -
9/9/2019	Detection	0.03 J	49.9	7.45	0.35	7.7	406	28.2
10/22/2019	Detection	- -	- -	- -	- -	6.9	- -	- -

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-38
Mountaineer - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
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 U	2.76	0.2	0.103
11/2/2016	Background	0.07	8.15	179	<0.005 U	0.02 J	0.4	0.855	1.744	0.32	0.113	0.0009 J	<0.002 U	2.10	0.04 J	0.04 J
12/21/2016	Background	0.05	6.62	162	<0.005 U	0.02	1.67	0.655	2.06	0.35	0.082	<0.0002 U	<0.002 U	2.50	0.06 J	0.082
2/22/2017	Background	0.03 J	5.74	141	<0.005 U	0.02	0.526	0.949	1.000	0.29	0.039	0.004	<0.002 U	3.37	0.03 J	0.04 J
3/28/2017	Background	0.05 J	11.5	184	<0.005 U	0.03	0.197	0.916	0.548	0.32	0.073	0.006	<0.002 U	2.47	0.06 J	0.05 J
4/18/2017	Background	0.04 J	6.34	179	<0.004 U	0.03	0.111	2.87	0.494	0.33	0.02 J	0.003	<0.002 U	2.30	<0.03 U	0.068
5/16/2017	Background	0.06	5.09	186	<0.004 U	0.03	0.093	3.66	0.536	0.33	0.01 J	0.004	<0.002 U	3.76	<0.03 U	0.062
6/13/2017	Background	0.06	8.09	187	<0.004 U	0.03	0.130	2.53	1.268	0.28	0.056	0.013	<0.002 U	2.67	0.04 J	0.056

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-39
Mountaineer - LF
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		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	350	<0.04 U
11/2/2016	Background	0.134	7.88	3.05	0.83	8.4	344	<0.04 U
12/21/2016	Background	0.122	10.5	3.07	0.86	8.8	450	<0.04 U
2/22/2017	Background	0.134	7.65	2.98	0.80	8.4	374	<0.04 U
3/28/2017	Background	0.202	5.95	2.95	0.78	8.4	310	0.1 J
4/18/2017	Background	0.156	6.48	2.91	0.78	8.3	344	<0.04 U
5/16/2017	Background	0.139	6.74	2.98	0.79	9.5	367	1.5
6/14/2017	Background	0.179	6.15	2.92	0.78	8.5	340	0.1
10/31/2017	Detection	0.171	7.25	3.05	0.78	8.3	385	0.2
9/20/2018	Detection	0.182	6.43	2.99	0.8	8.5	369	0.1 J
11/26/2018	Detection	0.167	6.33	2.93	0.8	8.3	380	0.07 J
4/9/2019	Detection	0.158	6.65	2.94	0.77	8.3	376	<0.06 U
9/9/2019	Detection	0.144	6.78	3.07	0.84	8.1	369	<0.06 U

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-39
Mountaineer - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
9/26/2016	Background	0.06	4.80	264	0.095	0.01 J	2.2	1.43	1.142	0.77	2.21	0.016	<0.002 U	8.51	0.3	0.04 J
11/2/2016	Background	0.04 J	3.89	276	0.068	<0.004 U	3.2	0.615	1.941	0.83	0.532	0.011	<0.002 U	9.54	0.09 J	0.03 J
12/21/2016	Background	0.08	3.95	296	0.202	0.006 J	6.32	2.34	1.311	0.86	1.79	0.008	<0.002 U	8.03	0.6	0.070
2/22/2017	Background	0.03 J	3.91	243	0.041	0.01 J	1.41	0.539	1.162	0.80	0.467	0.012	0.002 J	9.23	0.1	0.03 J
3/28/2017	Background	0.02 J	3.58	241	0.01 J	<0.004 U	0.560	0.206	0.793	0.78	0.176	0.015	<0.002 U	8.50	0.06 J	0.02 J
4/18/2017	Background	0.01 J	3.70	244	0.007 J	<0.005 U	0.243	0.188	0.1602	0.78	0.113	0.009	<0.002 U	8.65	0.04 J	<0.01 U
5/16/2017	Background	0.01 J	3.88	244	0.004 J	0.02	0.221	0.174	0.611	0.79	0.073	0.017	<0.002 U	9.39	0.04 J	<0.01 U
6/14/2017	Background	0.02 J	3.76	247	0.008 J	<0.005 U	0.203	0.209	0.47	0.78	0.092	0.028	<0.002 U	9.06	0.06 J	<0.01 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1611
Mountaineer - LF
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		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	382	17.3
11/2/2016	Background	0.140	22.8	9.36	0.61	7.8	388	22.7
12/20/2016	Background	0.124	22.2	9.39	0.64	7.7	380	21.8
2/22/2017	Background	0.175	22.5	9.10	0.57	7.7	381	18.0
3/28/2017	Background	0.210	22.3	8.04	0.50	7.8	326	15.7
4/18/2017	Background	0.155	22.8	8.59	0.56	7.7	388	17.7
5/16/2017	Background	0.190	23.1	9.14	0.60	8.3	392	18.7
6/12/2017	Background	0.158	22.4	9.29	0.57	7.2	384	19.4
10/31/2017	Detection	0.152	24.0	9.80	0.61	7.8	402	18.9
1/22/2018	Detection	- -	22.6	- -	- -	7.5	376	- -
9/20/2018	Detection	0.258	23.2	9.48	0.61	7.8	416	19.0
11/26/2018	Detection	0.147	21.9	9.57	0.62	7.7	387	18.5
4/9/2019	Detection	0.139	26.2	7.96	0.46	7.6	431	20.7
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	402	17.3

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1611
Mountaineer - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
9/26/2016	Background	0.03 J	1.01	165	0.046	0.02	1.4	0.370	1.258	0.56	0.482	0.004	<0.002 U	6.97	0.07 J	0.088
11/2/2016	Background	0.03 J	0.97	156	0.03	0.01 J	0.9	0.245	2.888	0.61	0.310	0.004	<0.002 U	5.83	0.06 J	0.03 J
12/20/2016	Background	<0.01 U	0.74	140	<0.005 U	<0.004 U	2.10	0.092	0.772	0.64	0.023	0.002	<0.002 U	5.46	<0.03 U	<0.01 U
2/22/2017	Background	<0.01 U	0.75	135	0.007 J	0.006 J	0.209	0.096	0.5828	0.57	0.055	0.007	0.002 J	5.36	0.04 J	0.208
3/28/2017	Background	0.01 J	0.60	166	0.01 J	0.005 J	0.426	0.108	0.645	0.5	0.195	0.011	<0.002 U	7.26	0.07 J	0.02 J
4/18/2017	Background	0.01 J	0.69	155	0.01 J	0.006 J	0.337	0.104	0.487	0.56	0.133	0.003	<0.002 U	6.01	<0.03 U	<0.01 U
5/16/2017	Background	0.03 J	0.75	145	0.008 J	<0.005 U	0.661	0.101	2.534	0.6	0.119	0.006	<0.002 U	5.49	0.04 J	0.02 J
6/12/2017	Background	0.03 J	0.76	148	0.007 J	<0.005 U	0.138	0.092	0.508	0.57	0.058	0.018	<0.002 U	5.39	0.03 J	<0.01 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1612
Mountaineer - LF
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		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	850	238
12/21/2016	Background	0.501	8.96	36.1	3.33	8.1	966	271
2/22/2017	Background	0.473	7.90	35.6	2.95	8.4	1090	288
3/29/2017	Background	0.673	7.10	23.7	3.50	8.7	1240	190
4/19/2017	Background	0.589	8.61	22.4	3.26	8.4	1040	226
5/16/2017	Background	0.565	12.5	27.8	2.88	8.8	1150	346
6/13/2017	Background	0.532	8.09	27.4	2.98	8.2	1130	334
10/30/2017	Detection	0.457	7.22	20.2	3.53	8.2	914	147
9/20/2018	Detection	0.543	4.50	14.6	3.78	8.4	835	63.9
11/26/2018	Detection	0.413	4.25	11.5	3.91	8.0	764	49.2
4/9/2019	Detection	0.449	3.21	10.2	4.02	8.3	725	54.8
9/10/2019	Detection	0.438	4.77	11.1	4.34	8.3	786	31.3

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1612
Mountaineer - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
10/26/2016	Background	0.31	12.4	66.2	0.033	0.007 J	1.63	0.367	2.765	3.02	0.391	0.018	<0.002 U	62.1	0.2	0.03 J
11/2/2016	Background	0.35	16.8	80.4	0.009 J	<0.004 U	0.6	0.197	0.973	3.23	0.168	0.014	0.002 J	67.6	0.08 J	0.087
12/21/2016	Background	0.13	14.9	62.1	0.007 J	<0.004 U	0.913	0.111	0.947	3.33	0.121	0.011	0.002 J	52.2	0.1	<0.01 U
2/22/2017	Background	0.31	14.4	72.4	0.058	<0.004 U	2.13	0.700	1.084	2.95	0.640	0.018	0.003 J	38.5	0.1	0.04 J
3/29/2017	Background	0.77	12.4	141	0.290	0.01 J	3.19	2.60	0.86	3.50	1.37	0.020	0.014	45.9	0.5	0.03 J
4/19/2017	Background	0.82	10.7	233	0.551	<0.05 U	15.5	3.94	0.425	3.26	4.10	0.019	0.004 J	58.0	1.2	0.2 J
5/16/2017	Background	0.15	10.4	77.1	0.02 J	<0.005 U	0.445	0.231	2.744	2.88	0.210	0.022	<0.002 U	43.1	0.1	0.02 J
6/13/2017	Background	0.15	10.7	59.6	0.006 J	<0.005 U	0.227	0.101	0.824	2.98	0.023	0.028	<0.002 U	34.3	0.06 J	<0.01 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 2: Residence Time Calculation Summary - Landfill Mountaineer Landfill

Geosyntec Consultants, Inc.

CCR Management Unit	Monitoring Well	Well Diameter (inches)	2019-04		2019-09	
			Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	MW-26 [2]	2.0	1.8	34.0	2.2	27.4
	MW-27 [2]	2.0	19.6	3.1	19.5	3.1
	MW-30 [1]	2.0	5.3	11.5	5.3	11.6
	MW-38 [2]	2.0	NC	NC	NC	NC
	MW-39 [2]	2.0	17.6	3.5	17.4	3.5
	MW-1611 [2]	2.0	12.6	4.8	11.4	5.3
	MW-1612 [1]	2.0	15.4	4.0	15.4	3.9

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

Legend

Monitoring Wells

- Alluvium
- Hydrologic Unit 3
- Hydrologic Unit 4

Groundwater Elevation Contours

- Approximate Groundwater Flow Direction (Unit 3)
- Hydrologic Unit 3
- Hydrologic Unit 3 (Inferred)
- Approximate Groundwater Flow Direction (Unit 4)
- Hydrologic Unit 4

Notes

- Monitoring well coordinates and water level data (collected on April 8, 2019) 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.
- Groundwater elevation units are feet above mean sea level.
- Water level measurements from MW-25 (screened in shale below Unit 4), MW-37 (hydraulically disconnected from the rest of Unit 3), and MW-38 (screened in alluvium) were not used in groundwater contouring.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
April 2019

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

Geosyntec consultants

Columbus, Ohio | 2019/12/11

Figure **1**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mountaineer\2019\AEP-Mountaineer_LF_GW_2019-04.mxd. ARevezzo. 12/11/2019. CHA8423/07/08.

Legend

Monitoring Wells

- Alluvium
- Hydrologic Unit 3
- Hydrologic Unit 4

Groundwater Elevation Contours

- Approximate Groundwater Flow Direction (Unit 3)
- Hydrologic Unit 3
- Approximate Groundwater Flow Direction (Unit 4)
- Hydrologic Unit 4

Notes

- Monitoring well coordinates and water level data (collected on June 17, 2019) provided by AEP.
- MW-12 was not gauged during June sampling event.
- Site features based on information available in Little Broad Run Landfill-CCR Groundwater Monitoring Well Network Evaluation (Arcadis, 2016) provided by AEP.
- Water level measurements from MW-25 (screened in shale below Unit 4), MW-37 (hydraulically disconnected from the rest of Unit 3), and MW-38 (screened in alluvium) were not used in ground water contouring.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
June 2019

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

Geosyntec consultants

Columbus, Ohio | 2019/12/11

Figure **2**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mountaineer\2019\AEP-Mountaineer_LF_GW_2019-06.mxd. ARevezzo. 12/11/2019. CHA8423/07/08.

Legend

Monitoring Wells

- Alluvium
- Hydrologic Unit 3
- Hydrologic Unit 4

Groundwater Elevation Contours

- Approximate Groundwater Flow Direction (Unit 3)
- Hydrologic Unit 3
- Approximate Groundwater Flow Direction (Unit 4)
- Hydrologic Unit 4

Notes

- Monitoring well coordinates and water level data (collected on September 9, 2019) 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.
- Water level measurements from MW-25 (screened in shale below Unit 4), MW-37 (hydraulically disconnected from the rest of Unit 3), and MW-38 (screened in alluvium) were not used in ground water contouring.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
September 2019

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

Geosyntec consultants

Columbus, Ohio | 2019/12/31

Figure **3**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mountaineer\2019\AEP-Mountaineer_LF_GW_2019-09.mxd. ARevezzo. 12/31/2019. CHA8423/07/08.

APPENDIX 2 - Statistical Analyses

Memoranda follow summarizing the statistical analyses of Appendix III parameters.

Geosyntec consultants

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

Memorandum

Date:	February 27, 2019
To:	David Miller (AEP)
Copies to:	Justin Jent (AEP)
From:	Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Mountaineer Plant's Landfill

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), a detection monitoring event was completed on September 20, 2018 at the Landfill (LF), an existing CCR unit at the Mountaineer Power Plant located in New Haven, West Virginia.

Eight background monitoring events were conducted at the Mountaineer LF prior to these detection monitoring events, and 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 background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 15, 2018.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure for all Appendix III parameters. With this procedure, a statistically significant increase (SSI) is only concluded if all samples in a series of two exceeds the UPL or are below the LPL. However, only one sampling event was completed and so it was conservatively assumed that an SSI was identified if the initial sample exceeded the UPL or was below the LPL.

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

- The boron concentration of 0.256 mg/L at MW-1611 exceeded the intrawell UPL of 0.241 mg/L. Therefore, an SSI over background is concluded for boron at MW-1611.

- Calcium concentrations exceeded the interwell UPL of 16.2 mg/L in the samples collected at MW-1611 (23.2 mg/L), MW-26 (49.4 mg/L), and MW-38 (51.2 mg/L). Therefore, SSIs over background are concluded for calcium at MW-1611, MW-26, and MW-38.

- pH values were below the interwell LPL of 8.0 SU in the samples collected at MW-1611 (7.8 SU) and MW-38 (7.4 SU). Therefore, SSIs below background are concluded for pH at MW-1611 and MW-38.

- The total dissolved solids (TDS) concentration of 416 mg/L at MW-1611 exceeded the intrawell UPL of 392 mg/L. Therefore, an SSI over background is concluded for TDS at MW-1611.

No other exceedances of UPLs were observed during this detection monitoring event.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). Within 90 days of identification of the above-listed SSIs, a written demonstration that a source other than the Mountaineer Landfill caused the increases will be completed in accordance with 40 CFR 257.94(e)(2). If the demonstration is successful, the Mountaineer Landfill will remain in detection monitoring.

A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evaluation
Mountaineer Plant - Landfill

Geosyntec Consultants, Inc.

Parameter	Units	Description	MW-1611	MW-26	MW-27	MW-38	MW-39
			9/20/2018	9/20/2018	9/20/2018	9/20/2018	9/20/2018
Boron	mg/L	Intrawell Background Value (UPL)	0.241	0.266	0.421	0.113	0.225
		Detection Monitoring Data	**0.258**	0.214	0.357	0.068	0.182
Calcium	mg/L	Interwell Background Value (UPL)	16.2				
		Detection Monitoring Data	**23.2**	**49.4**	1.14	**51.2**	6.43
Chloride	mg/L	Intrawell Background Value (UPL)	10.24	6.66	2.01	7.63	3.14
		Detection Monitoring Data	9.48	6.04	1.69	7.31	2.99
Fluoride	mg/L	Interwell Background Value (UPL)	3.67				
		Detection Monitoring Data	0.61	0.16	2.41	0.36	0.8
pH	SU	Interwell Background Value (UPL)	10.1				
		Interwell Background Value (LPL)	8.0				
		Detection Monitoring Data	**7.8**	8.0	9.1	**7.4**	8.5
Sulfate	mg/L	Intrawell Background Value (UPL)	25.3	13.3	8.9	39.9	1.5
		Detection Monitoring Data	19	6.3	4.4	31.5	0.1
TDS	mg/L	Intrawell Background Value (UPL)	392	379	635	459	473
		Detection Monitoring Data	**416**	344	550	441	369

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

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 15, 2018 *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	WEST VIRGINIA	02.27.19
License Number	Licensing State	Date

Geosyntec consultants

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

Memorandum

Date:	March 4, 2019
To:	David Miller (AEP)
Copies to:	Justin Jent (AEP)
From:	Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Mountaineer Plant's Landfill

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR Subpart D, "CCR rule"), a detection monitoring event was completed on November 26, 2018 at the Landfill (LF), an existing CCR unit at the Mountaineer Power Plant located in New Haven, West Virginia.

Eight background monitoring events were conducted at the Mountaineer LF prior to these detection monitoring events, and 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 background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 15, 2018. An alternative source demonstration (ASD) was certified on March 1, 2019 which resulted in a revision to the calculated prediction limits for calcium and pH.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure for all Appendix III parameters. With this procedure, a statistically significant increase (SSI) is only concluded if all samples in a series of two exceeds the UPL or are below the LPL. However, only one sampling event was completed and so it was conservatively assumed that an SSI was identified if the initial sample exceeded the UPL or was below the LPL.

Detection monitoring results and the relevant background values are summarized in Table 1. No SSIs were observed at the Mountaineer LF, and as a result the Landfill will remain in detection monitoring.

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 Evaluation
Mountaineer Plant - Landfill

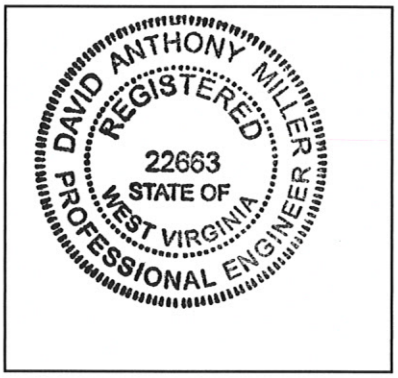
Geosyntec Consultants, Inc.

Parameter	Units	Description	MW-1611	MW-26	MW-27	MW-38	MW-39
			11/26/2018	11/26/2018	11/26/2018	11/26/2018	11/26/2018
Boron	mg/L	Intrawell Background Value (UPL)	0.241	0.266	0.421	0.113	0.225
		Detection Monitoring Result	0.147	0.182	0.292	0.08	0.167
Calcium	mg/L	Intrawell Background Value (UPL)	25.0	66.6	2.02	60.1	14.3
		Detection Monitoring Result	21.9	53.6	1.20	48.2	6.33
Chloride	mg/L	Intrawell Background Value (UPL)	10.2	6.66	2.01	7.63	3.14
		Detection Monitoring Result	9.57	5.97	1.52	7.06	2.93
Fluoride	mg/L	Interwell Background Value (UPL)	3.67				
		Detection Monitoring Result	0.62	0.14	2.37	0.34	0.80
pH	SU	Intrawell Background Value (UPL)	7.8	7.7	9.6	7.6	9.5
		Intrawell Background Value (LPL)	7.2	7.1	8.8	7.0	8.3
		Detection Monitoring Result	7.7	7.4	9.0	7.0	8.3
Sulfate	mg/L	Intrawell Background Value (UPL)	25.3	13.3	8.9	39.9	1.5
		Detection Monitoring Result	18.5	7.2	3.6	35.2	0.07
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	392	379	635	459	473
		Detection Monitoring Result	387	364	522	415	380

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

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 15, 2018 *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	WEST VIRGINIA	03.04.19
License Number	Licensing State	Date

Geosyntec consultants

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

Memorandum

Date:	September 25, 2019
To:	David Miller (AEP)
Copies to:	Justin Jent (AEP)
From:	Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Mountaineer Plant's Landfill

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR Subpart D, "CCR rule"), detection monitoring sampling events were completed on April 9, 2019, June 18, 2019, and July 10, 2019 at the Landfill (LF), an existing CCR unit at the Mountaineer Power Plant located in New Haven, West Virginia.

Eight background monitoring events were conducted at the Mountaineer LF prior to these detection monitoring events, and 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 background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 15, 2018. An alternative source demonstration (ASD) was certified on March 1, 2019 which resulted in a revision to the calculated prediction limits for calcium and pH.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure for all Appendix III parameters. With this procedure, a statistically significant increase (SSI) is only concluded if all samples in a series of two exceeds the UPL or are below the LPL.

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

- Chloride concentrations exceeded the intrawell UPL of 6.66 mg/L in both the initial (6.71 mg/L) and second (7.22 mg/L) samples collected at MW-26. Therefore, an SSI over background is concluded for chloride at MW-26.

- Total dissolved solids (TDS) concentrations exceeded the intrawell UPL of 392 mg/L in both the initial (431 mg/L) and second (402 mg/L) samples collected at MW-1611. Therefore, an SSI over background is concluded for TDS at MW-1611.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). Within 90 days of identification of the above-listed SSIs, a written demonstration that a source other than the Mountaineer LF caused the increases will be completed in accordance with 40 CFR 257.94(e)(2). If the ASD is successful, the Mountaineer LF will remain in detection monitoring.

A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evaluation
Mountaineer Plant - Landfill

Geosyntec Consultants, Inc.

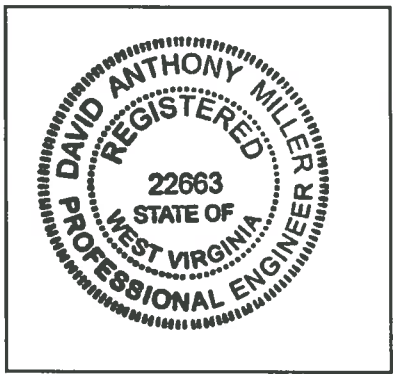
Parameter	Units	Description	MW-1611		MW-26		MW-27	MW-38		MW-39
			4/9/2019	6/18/2019	4/9/2019	6/18/2019	4/9/2019	4/9/2019	6/18/2019	4/9/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.241		0.266		0.421	0.113		0.225
		Detection Monitoring Data	0.139	--	0.128	--	0.303	0.040	--	0.158
Calcium	mg/L	Intrawell Background Value (UPL)	25.0		66.6		2.02	60.1		14.3
		Detection Monitoring Data	**26.2**	22.8	62.8	--	1.19	52.0	--	6.65
Chloride	mg/L	Intrawell Background Value (UPL)	10.2		6.66		2.01	7.63		3.14
		Detection Monitoring Data	7.96	--	**6.71**	**7.22**	1.54	7.46	--	2.94
Fluoride	mg/L	Intrawell Background Value (UPL)	3.67		3.67		3.67	3.67		3.67
		Detection Monitoring Data	0.46	--	0.13	--	2.32	0.32	--	0.77
pH	SU	Intrawell Background Value (UPL)	7.8		7.7		9.6	7.6		9.5
		Intrawell Background Value (LPL)	7.2		7.1		8.8	7.0		8.3
		Detection Monitoring Data	7.6	**--**	7.3	**--**	9.0	**6.9**	7.6	8.3
Sulfate	mg/L	Intrawell Background Value (UPL)	25.3		13.3		8.88	39.9		1.50
		Detection Monitoring Data	20.7	--	7.60	--	2.90	27.8	--	0.06
TDS	mg/L	Intrawell Background Value (UPL)	392		379		635	459		473
		Detection Monitoring Data	**431**	**402***	370	--	542	427	--	376

Notes
UPL: Upper prediction limit
LPL: Lower prediction limit
TDS: Total dissolved solids
Bold values exceed the background value.
Background values are shaded gray.
*TDS sample was collected on 7/10/2019.

ATTACHMENT A
Certification by Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 15, 2018 *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	WEST VIRGINIA	09.25.19
License Number	Licensing State	Date

APPENDIX 3 – Alternative Source Demonstrations

The certified alternative source demonstration for Appendix III parameters from the September 2018 and April 2019 detection monitoring events follow.

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

Mountaineer Plant Landfill
New Haven, West Virginia

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane, Suite 103
Columbus, Ohio 43221

March 1, 2019

CHA8462

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LPL	Lower Prediction Limit
QC	Quality Control
SSI	Statistically Significant Increase
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

Eight background monitoring events were conducted at the Mountaineer Landfill, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. The first semi-annual detection monitoring event for 2018 occurred in September. While the prediction limits were calculated assuming a 1-of-2 testing procedure, it was conservatively assumed that an SSI was identified if the initial sample exceeded either the LPL or UPL. Following the first semi-annual detection monitoring event at the Landfill, SSIs were identified for the following constituents listed in 40 CFR Part 257 Appendix III:

- Boron at MW-1611 by intrawell analysis;
- Calcium at MW-26, MW-38, and MW-1611 by interwell analysis;
- pH at MW-26, MW-38, and MW-1611 by interwell analysis; and,
- TDS at MW-1611 by intrawell analysis.

A summary of the detection monitoring analytical results and the calculated prediction limits to which they were compared is provided in Table 1.

1.1 CCR Rule Requirements

In accordance with the United States Environmental Protection Agency (USEPA) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments, Rule 40 CFR 257.94(e)(2) states the following:

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

The first semi-annual detection monitoring event for 2018 was completed on September 20 at the Mountaineer Landfill. Pursuant to 40 CFR 257.94(e)(2), Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report, which documents that the SSIs cited above should not be attributed to the Landfill.

1.2 Demonstration of Alternative Sources

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

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

A demonstration was conducted to show that the increases in constituent concentrations were based on both Type I and Type IV causes and not by a release from the Landfill.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The CCR Rule allows the owner or operator 90 days from the determination of an SSI to demonstrate that a source other than the CCR unit caused the SSI. Identified SSIs, evaluation methodology, and the proposed alternative source are described below.

2.1 Proposed Alternative Source

Initial review of sampling and laboratory data indicated that the observed boron exceedance is due to a Type I (sampling) error. A review of the laboratory and statistical analyses did not identify any Type II or III issues. An initial review of site geochemistry revealed natural variation (Type IV) as a source of the observed calcium, pH, and TDS SSIs.

2.1.1 Calcium and pH SSIs

A previous ASD generated for the Landfill attributed the observed SSIs for calcium and pH to cation exchange occurring along the groundwater flow path, which results in higher calcium concentrations and lower pH values at downgradient locations (Geosyntec, 2018). A one-dimensional (1D) reactive transport model (Model) was developed using PHREEQC to simulate the hypothesized chemical changes in groundwater as it migrates beneath the landfill. The results of the model supported the hypothesized behavior of sodium-calcium cation exchange followed by precipitation of calcite.

The results of the recent detection monitoring event are comparable to previous results, suggesting that the cation exchange process is ongoing (Figure 1). The results of this detection monitoring event were compared to the output of the Model. The Model was not revised to incorporate the most recent data. Figure 2 shows the trend lines generated from the Model overlaid onto the observed calcium and sodium concentrations and pH values. The Model results are overall in qualitative agreement with the observed changes in calcium and pH. The modeled concentration of calcium in solution increases while the concentration of sodium decreases as the modeled groundwater migrates beneath the Landfill. Additionally, a decrease in pH is observed, which is consistent with field measurements (Figure 2).

The previously generated Model supported the hypothesized behavior of sodium-calcium cation exchange followed by precipitation of calcite. The results of the September 2018 sampling event are consistent with previous results and the output of the Model. These results provide evidence that the observed SSIs for calcium and pH can be attributed to natural processes as groundwater moves downgradient beneath the Landfill.

2.1.1.1 Statistical Revision

Initial statistics developed interwell parameters for calcium, fluoride, and pH, as summarized in Table 1. However, because groundwater composition changes as it travels downgradient due to the hypothesized cation-exchange and precipitation processes, intrawell tests are considered to be the more appropriate means to evaluate calcium and pH potential SSIs. Intrawell prediction limits were not developed for fluoride, as it would tend to be unaffected by cation exchange.

The revised intrawell prediction limits and detection monitoring results are summarized in Table 2, and the results of the revised statistical evaluation are included in Attachment A. Comparing the detection monitoring results to the revised intrawell prediction limits, the original SSIs were no longer identified. However, the reported pH value of 8.0 SU at MW-26 was above the revised UPL of 7.7. The reported pH value for the next sampling event at MW-26 was 7.4, which is within the UPL and LPL. This result suggests that there is not an increasing pH trend at MW-26 and the observed SSI at MW-26 can instead be attributed to natural variation.

2.1.2 Boron at MW-1611

A review of the field quality control (QC) sample results for the September 2018 sampling event identified detected concentrations of boron in the equipment and field blanks which likely impacted the associated sample result as a high bias for boron. The field sampling technician collected an equipment blank and field blank during completion of the sampling event to evaluate both the equipment decontamination procedure and the environmental conditions surrounding the sample collection activities. Boron was detected in the equipment blank and field blank at a concentration of 0.039 milligrams per liter (mg/L) and 0.046 mg/L, respectively. QC sample concentrations greater than 10% of the concentration reported for a sample are typically considered present at a level which would affect the data quality of the sample. These values are within 10% of the reported boron concentration at MW-1611 of 0.258 mg/L, indicating that the concentration should be considered estimated with a high bias. These results are provided in the September 2018 analytical report (Attachment B).

In order to verify the occurrence of the high bias as evidenced by impacted field QC, the results of the next sampling event at MW-1611 were reviewed. The second semi-annual detection monitoring event occurred in November 2018. A field blank and equipment blank were also collected during this event. The reported boron concentration at MW-1611 was 0.147 mg/L, which is below the intrawell UPL of 0.241 mg/L. Boron was not detected in the field blank or equipment blank during this sampling event. These results are provided in the November 2018 analytical report (Attachment C). These observations suggest that the elevated reported boron concentration for the September 2018 sampling event was likely due to high bias from sampling error. Additionally, the boron concentration at MW-1611 declined below the intrawell UPL during the second semi-annual detection monitoring event and so a positive trend is not observed for boron at this well (Figure 4). These observations resulted in the conclusion that a Type I ASD was responsible for the boron SSI at MW-1611.

2.1.3 TDS at MW-1611

An SSI was also reported for TDS at MW-1611 during the September 2018 detection monitoring event, with a reported concentration of 416 mg/L. While TDS was detected in the equipment blank and field blank at 10 and 5 mg/L, respectively, these concentrations are less than 10% of the sample concentration. This suggests that the TDS value is not significantly impacted, and no bias would be applied to the results.

While the reported concentration of 416 mg/L is above the intrawell UPL of 392 mg/L, it is lower than the TDS concentrations at upgradient wells MW-30 and MW-1612 (Figure 5). As discussed in Section 2.1.1, this is due to the removal of dissolved species during the cation-exchange and precipitation processes as groundwater is transported downgradient. Additionally, the reported TDS concentration for the second semi-annual event was 387 mg/L, which is below the UPL for MW-1611. This result suggests that a positive trend is not observed for TDS at this well. Thus, the observed TDS concentration at MW-1611 is likely due to natural variation and is not considered indicative of a release from the Landfill.

2.2 Sampling Requirements

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

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and supports the position that the SSIs in Appendix III detection monitoring constituents are not due to a release from the Mountaineer Landfill during the September 2018 sampling events. The observed calcium and pH SSIs were attributed to naturally occurring cation exchange and precipitation processes as groundwater moves downgradient. Based on the observed changes in groundwater composition, intrawell statistics were developed for pH and calcium. Using the revised statistics, no SSIs were observed for pH or calcium. The observed boron SSI at MW-1611 was attributed to sampling error. The observed TDS SSI at MW-1611 was attributed to natural variation. Both boron and TDS at MW-1611 declined below their respective UPLs at the next sampling event, suggesting that positive trends for these constituents are not present. Therefore, no further action is warranted, and the Mountaineer Landfill will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in Attachment D.

SECTION 4

REFERENCES

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

Geosyntec Consultants, Inc. 2018. Alternative Source Demonstration Report – Federal CCR Rule. Mountaineer Plant Landfill. April.

U.S. EPA, 2015. Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities (Final Rule). Fed. Reg. 80 FR 21301, pp. 21301-21501, 40 CFR Parts 257 and 261, April.

TABLES

Table 1: Detection Monitoring Data Evaluation
Mountaineer Plant - Landfill

Geosyntec Consultants, Inc.

Parameter	Units	Description	MW-1611	MW-26	MW-27	MW-38	MW-39
			9/20/2018	9/20/2018	9/20/2018	9/20/2018	9/20/2018
Boron	mg/L	Intrawell Background Value (UPL)	0.241	0.266	0.421	0.113	0.225
		Detection Monitoring Data	**0.258**	0.214	0.357	0.068	0.182
Calcium	mg/L	Interwell Background Value (UPL)	16.2				
		Detection Monitoring Data	**23.2**	**49.4**	1.14	**51.2**	6.43
Chloride	mg/L	Intrawell Background Value (UPL)	10.24	6.66	2.01	7.63	3.14
		Detection Monitoring Data	9.48	6.04	1.69	7.31	2.99
Fluoride	mg/L	Interwell Background Value (UPL)	3.67				
		Detection Monitoring Data	0.61	0.16	2.41	0.36	0.8
pH	SU	Interwell Background Value (UPL)	10.1				
		Interwell Background Value (LPL)	8.0				
		Detection Monitoring Data	**7.8**	8.0	9.1	**7.4**	8.5
Sulfate	mg/L	Intrawell Background Value (UPL)	25.3	13.3	8.9	39.9	1.5
		Detection Monitoring Data	19	6.3	4.4	31.5	0.1
TDS	mg/L	Intrawell Background Value (UPL)	392	379	635	459	473
		Detection Monitoring Data	**416**	344	550	441	369

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

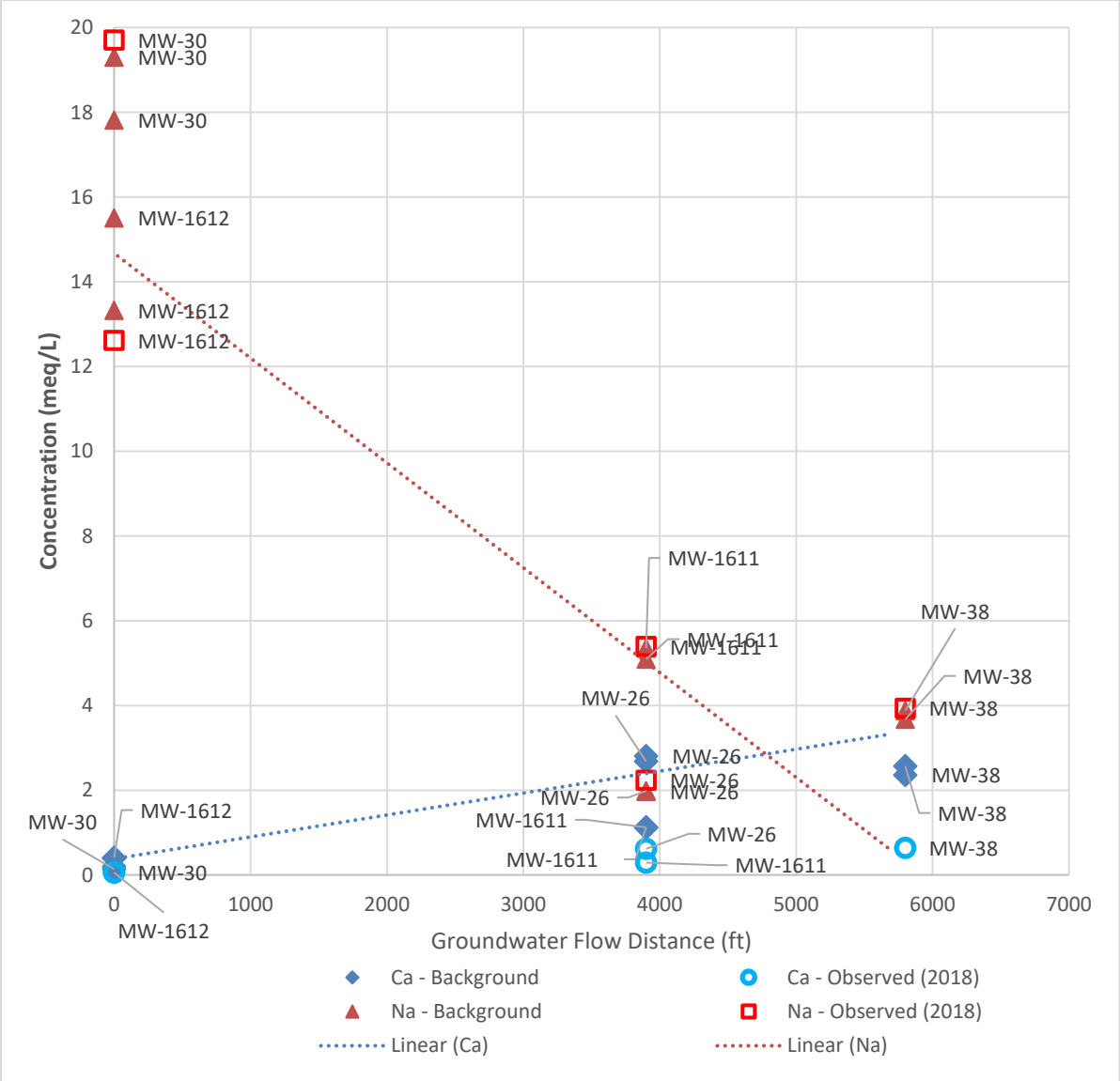
Table 2: Detection Monitoring Data Evaluation - Revised Statistics
Mountaineer Plant - Landfill

Geosyntec Consultants, Inc.

Parameter	Units	Description	MW-1611	MW-26	MW-27	MW-38	MW-39
			9/20/2018	9/20/2018	9/20/2018	9/20/2018	9/20/2018
Boron	mg/L	Intrawell Background Value (UPL)	0.241	0.266	0.421	0.113	0.225
		Detection Monitoring Data	**0.258**	0.214	0.357	0.068	0.182
Calcium	mg/L	Intrawell Background Value (UPL)	25.0	66.6	2.02	60.1	14.3
		Detection Monitoring Data	23.2	49.4	1.14	51.2	6.43
Chloride	mg/L	Intrawell Background Value (UPL)	10.24	6.66	2.01	7.63	3.14
		Detection Monitoring Data	9.48	6.04	1.69	7.31	2.99
Fluoride	mg/L	Interwell Background Value (UPL)	3.67				
		Detection Monitoring Data	0.61	0.16	2.41	0.36	0.8
pH	SU	Intrawell Background Value (UPL)	7.8	7.7	9.6	7.6	9.5
		Intrawell Background Value (LPL)	7.2	7.1	8.8	7.0	8.3
		Detection Monitoring Data	7.8	**8.0**	9.1	7.4	8.5
Sulfate	mg/L	Intrawell Background Value (UPL)	25.3	13.3	8.9	39.9	1.5
		Detection Monitoring Data	19	6.3	4.4	31.5	0.1
TDS	mg/L	Intrawell Background Value (UPL)	392	379	635	459	473
		Detection Monitoring Data	**416**	344	550	441	369

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

FIGURES



Notes: Calcium and sodium background values are from February and June 2017 sampling events and were used to generate the Model. Groundwater flow distance was estimated using approximate distance between upgradient and downgradient wells along a flow path that is consistent with observed potentiometric surfaces.

Sodium and Calcium Concentrations v. Distance

Mountaineer Landfill

Geosyntec consultants

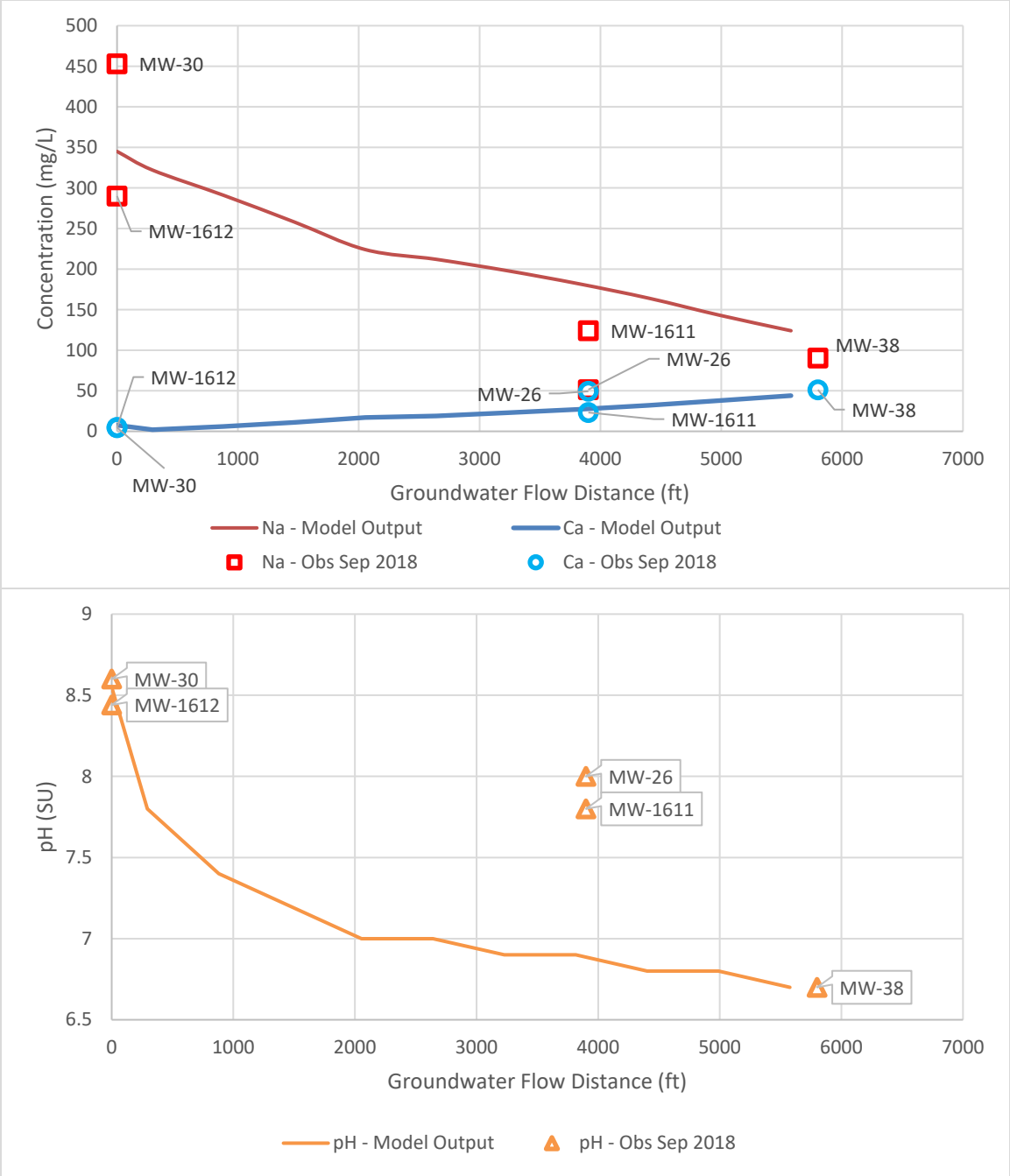
AMERICAN ELECTRIC POWER

Figure **1**

Columbus, Ohio

21-Feb-2019

internal info: path, date revised, author



Notes: The one-dimensional reactive transport model was generated using PHREEQC. The model was generated using reported February and June 2017 concentrations. Observed concentrations are shown for the September 2018 first semi-annual detection monitoring event.

Observed Concentration vs. Model Output
Mountaineer Landfill

Geosyntec consultants

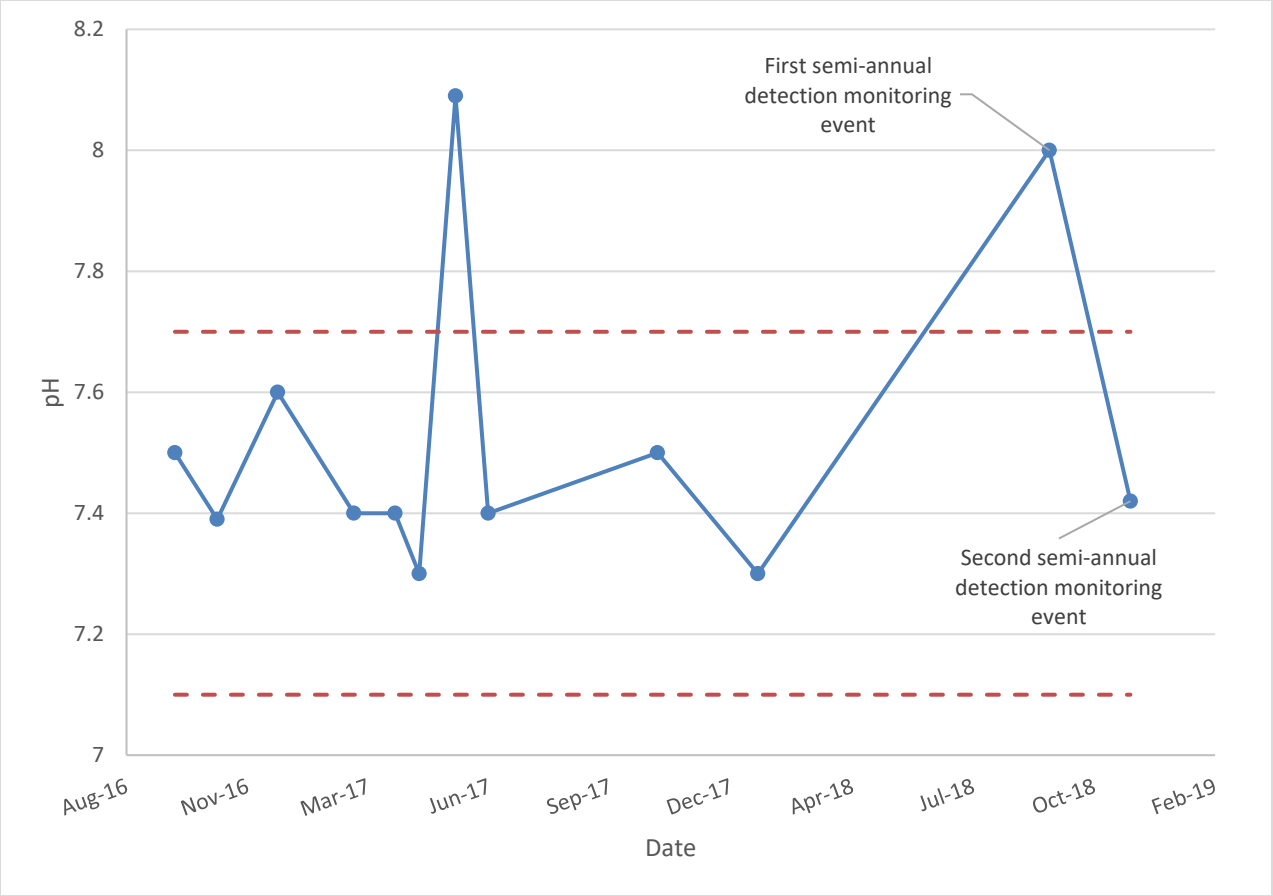
AMERICAN ELECTRIC POWER

Figure **2**

Columbus, Ohio

21-Feb-2019

internal info: path, date revised, author



Notes: pH time series for downgradient well MW-26. The dashed lines represent the calculated intrawell upper prediction limit (UPL, 7.70 SU) and lower prediction limit (LPL, 7.10 SU) for MW-26.

pH Time Series Graph
Mountaineer Landfill

Geosyntec consultants

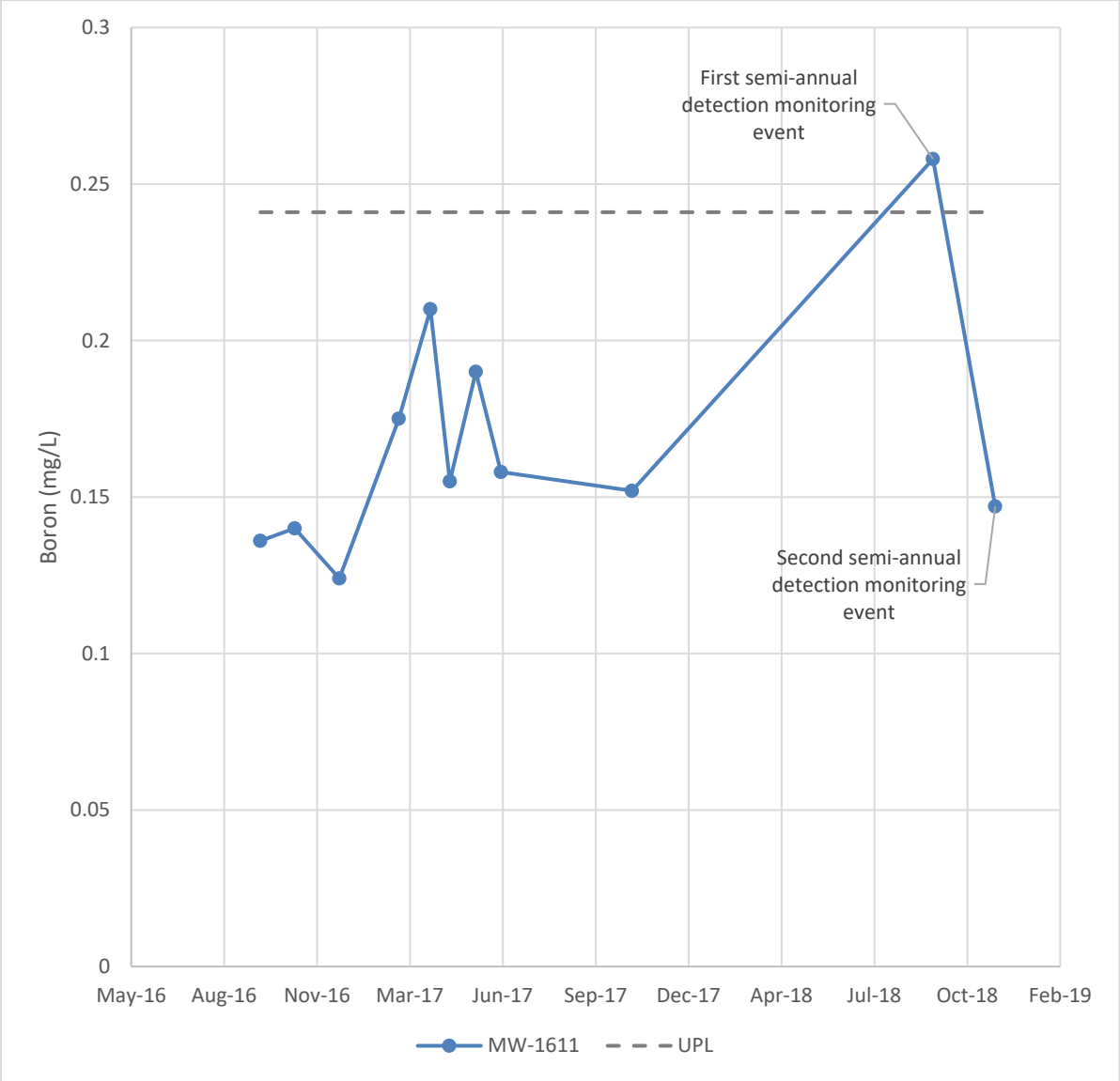
AMERICAN ELECTRIC POWER

Figure **3**

Columbus, Ohio

21-Feb-2019

internal info: path, date revised, author



Notes: The dashed line represents the calculated intrawell upper prediction limit (UPL) for MW-1611.

Boron Time Series Graph
Mountaineer Landfill

Geosyntec consultants

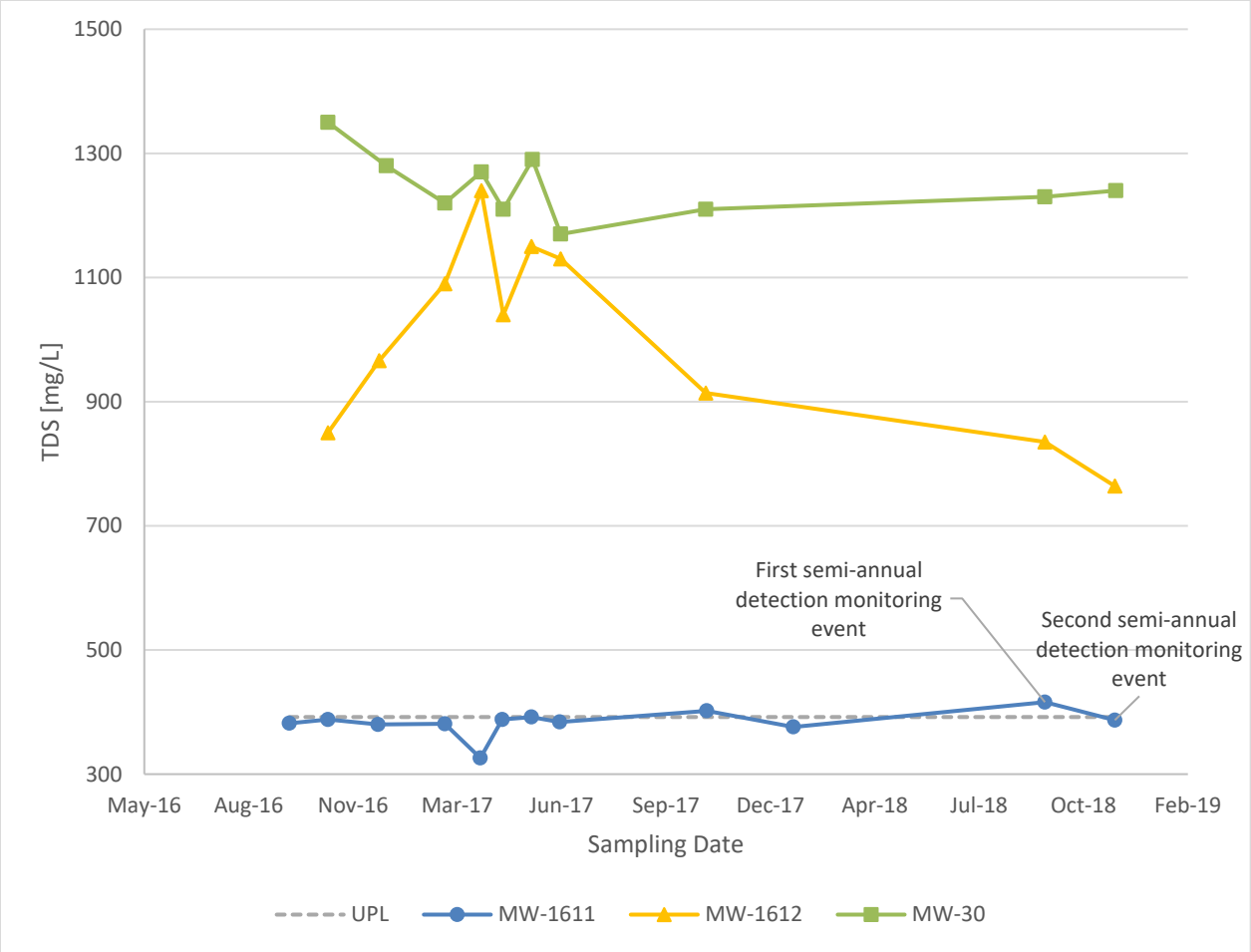
AMERICAN ELECTRIC POWER

Figure **4**

Columbus, Ohio

21-Feb-2019

internal info: path, date revised, author



Notes: Total dissolved solids (TDS) time series for downgradient well MW-1611 and upgradient wells MW-1612 and MW-30. The dashed line represents the calculated intrawell upper prediction limit (UPL) for MW-1611.

Total Dissolved Solids Time Series Graph
Mountaineer Landfill

Geosyntec consultants | AMERICAN ELECTRIC POWER | Figure 5

Columbus, Ohio | 21-Feb-2019

internal info: path, date revised, author

ATTACHMENT A

REVISED STATISTICAL OUTPUT

GROUNDWATER STATS CONSULTING

January 18, 2019

Geosyntec Consultants
Attn: Mr. Bruce Sass
150 E. Wilson Bridge Rd., #232
Worthington, OH 43085

Dear Mr. Sass,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the screening and statistical analysis of background groundwater data 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; and 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 was reviewed by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting.

The following constituents were evaluated: Appendix III parameters – boron, calcium, chloride, fluoride, pH, sulfate, and TDS; and Appendix IV parameters - antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 & 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters at all wells are provided for the purpose of screening data at these wells (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells.

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. Power curves are provided to demonstrate that the selected statistical methods for Appendix III parameters comply with the USEPA Unified Guidance recommendations as discussed below.

Summary of Statistical Method:

1) Intrawell prediction limits, combined with a 1-of-2 resample plan for boron, calcium, chloride, pH, sulfate, and TDS; and
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 nondetects, 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% nondetects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for nondetects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% nondetects.

Background Screening

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 and Appendix IV parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits (Figure C).

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.

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

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 (Figure D). 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 are 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, as may be seen on the Trend Test Summary table (Figure D). It was noted that boron, sulfate, and TDS concentrations are found to have the highest concentrations in the upgradient wells. No adjustments to any data sets were required at this time.

Appendix III – 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 (Figure E). 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 is included with the reports.

Appendix III - Statistical Limits

Intrawell limits constructed from carefully screened background data from within each well serve to provide statistical limits that are conservative (i.e. lower) from a regulatory perspective, and that will rapidly identify a change in more recent compliance data from within a given well. This statistical method removes the element of variation from across wells and eliminates the chance of mistaking natural spatial variation for a release from the facility. Prior to performing intrawell prediction limits, several steps are required to reasonably demonstrate downgradient water quality does not have existing impacts from the practices of the facility.

Exploratory data analysis was used as a general comparison of concentrations in downgradient wells for all Appendix III parameters recommended for intrawell analyses to concentrations reported in upgradient wells. Upper tolerance limits are used in conjunction with confidence intervals to determine whether the estimated averages in downgradient wells are higher than observed levels upgradient of the facility. The upper tolerance limits were constructed to represent the extreme upper range of possible background levels at the site.

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. When there is not an obvious explanation for observed concentration differences in downgradient wells relative to reported concentrations in upgradient wells, interwell prediction limits will initially be selected for the statistical method until further evidence shows that concentrations are due to natural variation rather than a result of the facility.

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 (Figure F). 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, to determine intrawell eligibility (Figure G). 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.

Confidence intervals for boron, chloride, sulfate and TDS were found were found to be within their respective background limits and are, therefore, 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 variation in groundwater for calcium and pH; therefore, interwell methods will be used for fluoride only.

All available data through June 2017, for parameters mentioned above, at each well were used to establish intrawell background limits based on a 1-of-2 resample plan that will be used for future comparisons (Figure H). Interwell prediction limits for fluoride as described above, combined with a 1-of-2 resample plan, were constructed from upgradient wells (Figure I). Downgradient measurements will be compared to these background limits during each subsequent semi-annual sampling event.

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 interwell case, newer data will be included in background when a minimum of 2 new samples are available. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of an additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered to be a false positive result and, therefore, no further action is necessary. A summary table of the background prediction limits follows this letter.

Appendix IV – Assessment Monitoring Program

During an Assessment Monitoring program confidence intervals are constructed at all wells for detected Appendix IV parameters. A minimum of 4 samples is required to construct confidence intervals; however, 8 samples are generally recommended for better representation of the true average population. Established Maximum Contaminant Levels (MCLs) are used as the GWPS comparisons, unless background limits are higher as discussed below. Parametric confidence intervals are constructed with 99% confidence when data follow a normal or transformed-normal distribution.

For all other cases, nonparametric confidence intervals are constructed, with the confidence level based on the number of samples available. The GWPS is exceeded only when the entire confidence interval exceeds its respective GWPS.

Background limits are established for the Appendix IV parameters using upper tolerance limits constructed with 95% confidence/95% coverage using pooled upgradient well data, for comparison against established MCLs. When background limits, or Alternate Contaminant Levels (ACLs), are higher than established MCLs, the CCR Rule recommends using these ACLs as the GWPS for the confidence interval comparisons. Additionally, tolerance limits are also recommended to establish ACLs for Appendix IV parameters, cobalt, lithium, and molybdenum, which do not have established MCLs. Since the scope of this project included screening and development of background limits for Appendix III Detection Monitoring statistics, comparison of the Appendix IV parameters with confidence intervals was not included in this report.

Recommendations

In summary, as a result of the background screening described in this letter, interwell prediction limits combined with a 1-of-2 resample plan are recommended for fluoride; and intrawell prediction limits combined with a 1-of-2 resample plan are recommended for boron, calcium, chloride, pH, sulfate and TDS. The statistical analyses will be constructed according to the USEPA Unified Guidance, based on seven Appendix III parameters and five downgradient wells.

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 me.

For Groundwater Stats Consulting,

Kristina L. Rayner
Groundwater Statistician

Intrawell Prediction Limit Summary

Mountaineer LF Client: Geosyntec Data: Mountaineer Landfill Printed 1/17/2019, 6:06 PM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	MW-1612	0.7669	n/a	8	0.5749	0.07009	0	None	No	0.001504	Param Intra 1 of 2
Boron, total (mg/L)	MW-30	0.3689	n/a	8	0.2723	0.03528	0	None	No	0.001504	Param Intra 1 of 2
Boron, total (mg/L)	MW-1611	0.2407	n/a	8	0.161	0.02908	0	None	No	0.001504	Param Intra 1 of 2
Boron, total (mg/L)	MW-26	0.2655	n/a	8	0.1383	0.04645	0	None	No	0.001504	Param Intra 1 of 2
Boron, total (mg/L)	MW-27	0.4207	n/a	8	0.2934	0.04647	0	None	No	0.001504	Param Intra 1 of 2
Boron, total (mg/L)	MW-38	0.1132	n/a	8	0.04238	0.02585	0	None	No	0.001504	Param Intra 1 of 2
Boron, total (mg/L)	MW-39	0.2246	n/a	8	0.1511	0.02682	0	None	No	0.001504	Param Intra 1 of 2
Calcium, total (mg/L)	MW-1612	13.34	n/a	8	8.889	1.623	0	None	No	0.001504	Param Intra 1 of 2
Calcium, total (mg/L)	MW-30	21	n/a	8	6.581	5.263	0	None	No	0.001504	Param Intra 1 of 2
Calcium, total (mg/L)	MW-1611	25	n/a	8	n/a	n/a	0	n/a	n/a	0.02144	NP Intra (normality) ...
Calcium, total (mg/L)	MW-26	66.62	n/a	8	54.89	4.281	0	None	No	0.001504	Param Intra 1 of 2
Calcium, total (mg/L)	MW-27	2.024	n/a	7	1.506	0.1715	0	None	No	0.001504	Param Intra 1 of 2
Calcium, total (mg/L)	MW-38	60.08	n/a	8	50.73	3.412	0	None	No	0.001504	Param Intra 1 of 2
Calcium, total (mg/L)	MW-39	14.29	n/a	8	7.969	2.307	0	None	No	0.001504	Param Intra 1 of 2
Chloride, total (mg/L)	MW-1612	47.01	n/a	8	30.56	6.003	0	None	No	0.001504	Param Intra 1 of 2
Chloride, total (mg/L)	MW-30	262.7	n/a	8	249.3	4.892	0	None	No	0.001504	Param Intra 1 of 2
Chloride, total (mg/L)	MW-1611	10.24	n/a	8	8.954	0.47	0	None	No	0.001504	Param Intra 1 of 2
Chloride, total (mg/L)	MW-26	6.663	n/a	8	5.519	0.4175	0	None	No	0.001504	Param Intra 1 of 2
Chloride, total (mg/L)	MW-27	2.011	n/a	8	1.654	0.1303	0	None	No	0.001504	Param Intra 1 of 2
Chloride, total (mg/L)	MW-38	7.628	n/a	8	7.219	0.1495	0	None	No	0.001504	Param Intra 1 of 2
Chloride, total (mg/L)	MW-39	3.139	n/a	8	2.983	0.05701	0	None	No	0.001504	Param Intra 1 of 2
pH, field (SU)	MW-1612	9.056	7.744	8	8.4	0.2396	0	None	No	0.000752	Param Intra 1 of 2
pH, field (SU)	MW-30	10.41	7.113	8	8.761	0.6017	0	None	No	0.000752	Param Intra 1 of 2
pH, field (SU)	MW-1611	7.8	7.2	7	n/a	n/a	0	n/a	n/a	0.05531	NP Intra (normality) ...
pH, field (SU)	MW-26	7.717	7.138	7	7.427	0.09569	0	None	No	0.000752	Param Intra 1 of 2
pH, field (SU)	MW-27	9.602	8.758	7	9.18	0.1395	0	None	No	0.000752	Param Intra 1 of 2
pH, field (SU)	MW-38	7.6	7	8	n/a	n/a	0	n/a	n/a	0.04288	NP Intra (normality) ...
pH, field (SU)	MW-39	9.5	8.3	8	n/a	n/a	0	n/a	n/a	0.04288	NP Intra (normality) ...
Sulfate, total (mg/L)	MW-1612	415.5	n/a	8	270.6	52.86	0	None	No	0.001504	Param Intra 1 of 2
Sulfate, total (mg/L)	MW-30	40.36	n/a	8	13.53	9.794	0	None	No	0.001504	Param Intra 1 of 2
Sulfate, total (mg/L)	MW-1611	25.31	n/a	8	18.91	2.336	0	None	No	0.001504	Param Intra 1 of 2
Sulfate, total (mg/L)	MW-26	13.31	n/a	8	7.838	1.997	0	None	No	0.001504	Param Intra 1 of 2
Sulfate, total (mg/L)	MW-27	8.878	n/a	8	2.299	0.2485	0	None	sqrt(x)	0.001504	Param Intra 1 of 2
Sulfate, total (mg/L)	MW-38	39.92	n/a	8	32.05	2.871	0	None	No	0.001504	Param Intra 1 of 2
Sulfate, total (mg/L)	MW-39	1.5	n/a	8	n/a	n/a	62.5	n/a	n/a	0.02144	NP Intra (NDs) 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-1612	1456	n/a	7	1067	128.7	0	None	No	0.001504	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-30	1437	n/a	7	1256	59.96	0	None	No	0.001504	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-1611	392	n/a	8	n/a	n/a	0	n/a	n/a	0.02144	NP Intra (normality) ...
Total Dissolved Solids [TDS] (mg/L)	MW-26	378.6	n/a	8	319.3	21.65	0	None	No	0.001504	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-27	634.5	n/a	8	543	33.38	0	None	No	0.001504	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-38	459	n/a	8	402.5	20.61	0	None	No	0.001504	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW-39	472.6	n/a	8	359.9	41.16	0	None	No	0.001504	Param Intra 1 of 2

Interwell Prediction Limit Summary

Mountaineer LF Client: Geosyntec Data: Mountaineer Landfill Printed 1/17/2019, 6:07 PM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Fluoride, total (mg/L)	n/a	3.671	n/a	16	104.3	36.16	0	None	x^4	0.001504	Param Inter 1 of 2

ATTACHMENT B

SEPTEMBER 2018 FIELD QUALITY CONTROL ANALYTICAL DATA

Dup-2 Dissolved

Sample Number: 183293-008A **Date Collected:** 09/20/2018 14:00 **Date Received:** 9/21/2018

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Iron, Fe	2.43	mg/L		0.005	0.002	DAM	10/03/2018 12:14	EPA 200.7-1994, Rev. 4.4
Manganese, Mn	0.741	mg/L		0.001	0.0002	DAM	10/03/2018 12:14	EPA 200.7-1994, Rev. 4.4

FB-2

Sample Number: 183293-009 **Date Collected:** 09/20/2018 09:15 **Date Received:** 9/21/2018

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.046	mg/L		0.005	0.002	DAM	10/03/2018 11:24	EPA 200.7-1994, Rev. 4.4
Calcium, Ca	0.034	mg/L		0.02	0.005	DAM	10/03/2018 11:24	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	0.005	mg/L	J	0.01	0.002	DAM	10/03/2018 11:24	EPA 200.7-1994, Rev. 4.4
Potassium, K	0.34	mg/L		0.2	0.06	DAM	10/03/2018 11:24	EPA 200.7-1994, Rev. 4.4
Sodium, Na	0.41	mg/L		0.05	0.01	DAM	10/03/2018 11:24	EPA 200.7-1994, Rev. 4.4
Strontium, Sr	< 0.0001	mg/L	U	0.0005	0.0001	DAM	10/03/2018 11:24	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	< 1	mg/L	U	5	1	GES	09/24/2018	SM 2320B-1997
Bromide, Br	< 0.02	mg/L	U	0.06	0.02	CRJ	10/01/2018 19:18	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	< 0.02	mg/L	U	0.06	0.02	CRJ	10/01/2018 19:18	EPA 300.1-1997, Rev. 1.0
Fluoride, F	< 0.02	mg/L	U	0.06	0.02	CRJ	10/01/2018 19:18	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	10	mg/L	J	20	5	SDW	09/24/2018	SM 2540C-1997
Sulfate, SO4	< 0.04	mg/L	U	0.1	0.04	CRJ	10/01/2018 19:18	EPA 300.1-1997, Rev. 1.0

EB-2

Sample Number: 183293-010 **Date Collected:** 09/20/2018 09:15 **Date Received:** 9/21/2018

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.039	mg/L		0.005	0.002	DAM	10/03/2018 11:27	EPA 200.7-1994, Rev. 4.4
Calcium, Ca	0.031	mg/L		0.02	0.005	DAM	10/03/2018 11:27	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	0.002	mg/L	J	0.01	0.002	DAM	10/03/2018 11:27	EPA 200.7-1994, Rev. 4.4
Potassium, K	0.2	mg/L	J	0.2	0.06	DAM	10/03/2018 11:27	EPA 200.7-1994, Rev. 4.4
Sodium, Na	0.43	mg/L		0.05	0.01	DAM	10/03/2018 11:27	EPA 200.7-1994, Rev. 4.4
Strontium, Sr	0.0019	mg/L		0.0005	0.0001	DAM	10/03/2018 11:27	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	< 1	mg/L	U	5	1	GES	09/24/2018	SM 2320B-1997
Bromide, Br	< 0.02	mg/L	U	0.06	0.02	CRJ	10/01/2018 18:55	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	< 0.02	mg/L	U	0.06	0.02	CRJ	10/01/2018 18:55	EPA 300.1-1997, Rev. 1.0
Fluoride, F	< 0.02	mg/L	U	0.06	0.02	CRJ	10/01/2018 18:55	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	5	mg/L	J	20	5	SDW	09/24/2018	SM 2540C-1997
Sulfate, SO4	< 0.04	mg/L	U	0.1	0.04	CRJ	10/01/2018 18:55	EPA 300.1-1997, Rev. 1.0

ATTACHMENT C

NOVEMBER 2018 FIELD QUALITY CONTROL ANALYTICAL DATA

Dup-1 Dissolved

Sample Number: 183990-008A **Date Collected:** 11/26/2018 **Date Received:** 11/27/2018

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Iron, Fe	0.058	mg/L		0.02	0.003	DAM	12/05/2018 14:59	EPA 200.7-1994, Rev. 4.4
Manganese, Mn	0.0143	mg/L		0.001	0.0002	DAM	12/05/2018 14:59	EPA 200.7-1994, Rev. 4.4

FB-1

Sample Number: 183990-009 **Date Collected:** 11/27/2018 09:25 **Date Received:** 11/27/2018

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	< 0.02	mg/L	U	0.1	0.02	DAM	12/05/2018 14:12	EPA 200.7-1994, Rev. 4.4
Calcium, Ca	0.1	mg/L	J	0.3	0.04	DAM	12/05/2018 14:12	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	< 0.01	mg/L	U	0.05	0.01	DAM	12/05/2018 14:12	EPA 200.7-1994, Rev. 4.4
Potassium, K	0.2	mg/L	J	0.5	0.2	DAM	12/05/2018 14:12	EPA 200.7-1994, Rev. 4.4
Sodium, Na	0.43	mg/L		0.2	0.06	DAM	12/05/2018 14:12	EPA 200.7-1994, Rev. 4.4
Strontium, Sr	< 0.0008	mg/L	U	0.005	0.0008	DAM	12/05/2018 14:12	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	< 3	mg/L	U	10	3	MGK	11/30/2018	SM 2320B-2011
Bromide, Br	< 0.04	mg/L	U	0.2	0.04	CRJ	11/30/2018 21:54	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	< 0.01	mg/L	U	0.04	0.01	CRJ	11/30/2018 21:54	EPA 300.1-1997, Rev. 1.0
Fluoride, F	< 0.01	mg/L	U	0.06	0.01	CRJ	11/30/2018 21:54	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	< 5	mg/L	U	20	5	KAL	11/29/2018	SM 2540C-2011
Sulfate, SO4	< 0.06	mg/L	U	0.4	0.06	CRJ	11/30/2018 21:54	EPA 300.1-1997, Rev. 1.0

EB-1

Sample Number: 183990-010 **Date Collected:** 11/27/2018 09:25 **Date Received:** 11/27/2018

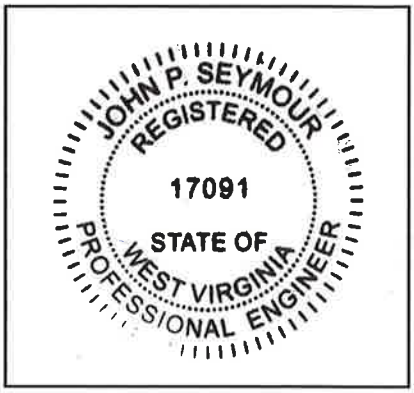
Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	< 0.02	mg/L	U	0.1	0.02	DAM	12/05/2018 14:16	EPA 200.7-1994, Rev. 4.4
Calcium, Ca	< 0.04	mg/L	U	0.3	0.04	DAM	12/05/2018 14:16	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	< 0.01	mg/L	U	0.05	0.01	DAM	12/05/2018 14:16	EPA 200.7-1994, Rev. 4.4
Potassium, K	< 0.2	mg/L	U	0.5	0.2	DAM	12/05/2018 14:16	EPA 200.7-1994, Rev. 4.4
Sodium, Na	0.24	mg/L		0.2	0.06	DAM	12/05/2018 14:16	EPA 200.7-1994, Rev. 4.4
Strontium, Sr	< 0.0008	mg/L	U	0.005	0.0008	DAM	12/05/2018 14:16	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	< 3	mg/L	U	10	3	MGK	11/30/2018	SM 2320B-2011
Bromide, Br	< 0.04	mg/L	U	0.2	0.04	CRJ	11/30/2018 22:17	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	0.02	mg/L	J	0.04	0.01	CRJ	11/30/2018 22:17	EPA 300.1-1997, Rev. 1.0
Fluoride, F	< 0.01	mg/L	U	0.06	0.01	CRJ	11/30/2018 22:17	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	< 5	mg/L	U	20	5	KAL	11/29/2018	SM 2540C-2011
Sulfate, SO4	< 0.06	mg/L	U	0.4	0.06	CRJ	11/30/2018 22:17	EPA 300.1-1997, Rev. 1.0

ATTACHMENT D

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Mountaineer Landfill CCR management area and that the requirements of 40 CFR 257.94(e)(2) have been met.



John Seymour
Printed Name of Licensed Professional Engineer

Signature

17091 — License Number

West Virginia — Licensing State

3/1/2019 — Date

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

Mountaineer Plant Landfill
New Haven, West Virginia

Submitted to

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants
engineers | scientists | innovators

941 Chatham Lane, Suite 103
Columbus, Ohio 43221

November 12, 2019

CHA8462

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LPL	Lower Prediction Limit
QC	Quality Control
SSI	Statistically Significant Increase
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

Following completion of eight background monitoring events at the Mountaineer Landfill, upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. Prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is concluded only if both samples in a series of two exceeds the UPL, or in the case of pH is above the LPL. In practice, if the initial result did not result in an exceedance, a second sample was not collected or analyzed.

The first semi-annual detection monitoring event of 2019 at the Landfill was performed in April 2019 (initial sampling event) and June 2019 (verification sampling event) and the results were compared to the calculated prediction limits. Following the first semi-annual detection monitoring event, SSIs were identified for the following constituents listed in 40 CFR Part 257 Appendix III:

- Chloride at MW-26 by intrawell analysis; and,
- TDS at MW-1611 by intrawell analysis.

A summary of the detection monitoring analytical results and the calculated prediction limits to which they were compared is provided in Table 1.

1.1 CCR Rule Requirements

In accordance with the United States Environmental Protection Agency (USEPA) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments, Rule 40 CFR 257.94(e)(2) states the following:

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

The first semi-annual detection monitoring event for 2019 was completed in April and June 2019 at the Mountaineer Landfill. Pursuant to 40 CFR 257.94(e)(2), Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report, which documents that the SSIs cited above should not be attributed to the Landfill.

1.2 Demonstration of Alternative Sources

An evaluation was completed to assess possible alternative sources to which identified SSIs could be attributed. Alternative sources were identified amongst five types:

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

A demonstration was conducted to show that the increases in constituent concentrations were based on Type IV causes and not by a release from the Landfill.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The CCR Rule allows the owner or operator 90 days from the determination of an SSI to demonstrate that a source other than the CCR unit caused the SSI. Identified SSIs, evaluation methodology, and the proposed alternative source are described below.

2.1 Proposed Alternative Source

An initial review of sampling and laboratory data did not identify any Type I (sampling) errors. A review of the laboratory and statistical analyses did not identify any Type II or III issues. An initial review of site geochemistry revealed natural variation (Type IV) as the source of the observed chloride and TDS SSIs.

2.1.1 Chloride SSI at MW-26

An SSI was identified for chloride at MW-26, which had an initial result of 6.71 mg/L, which is slightly above the calculated UPL of 6.66 mg/L. The exceedance by only 0.05 mg/L is believed to be a result of variability across the site, including the background well locations. For instance, chloride concentrations are consistently near 250 mg/L at background well MW-30 and have been as high as 38 mg/L at background well MW-1612 (Figure 1). In contrast, chloride concentrations at MW-26 are consistently below those of the background wells. Thus, changes in chloride concentrations at MW-26 likely represent natural variation in the dilution of chloride-rich groundwater as it moves through the aquifer.

Overall, concentrations of chloride at MW-26 from 2016 to present are stable. A sample was collected in September 2019 to serve as the initial sample for the second semiannual detection monitoring event of 2019 at the Mountaineer LF. The reported chloride concentration for this sample is 5.8 mg/L, which is below the calculated UPL of 6.66 mg/L (Figure 2).

2.1.2 TDS SSI at MW-1611

An SSI was also reported for TDS at MW-1611 during the first semiannual detection monitoring event of 2019. While the reported concentrations of 431 and 402 mg/L for the initial and verification sampling event, respectively, are above the intrawell UPL of 392 mg/L, they are both lower than the TDS concentrations at background wells MW-30 and MW-1612 (Figure 3). The relatively low TDS of groundwater at MW-1611 is due to the removal of dissolved species during cation-exchange and precipitation processes as groundwater is transported downgradient, as previously described (Geosyntec, 2018; Geosyntec, 2019). The net effect leads to higher concentrations of calcium and lower concentrations of sodium at downgradient locations. The increase in TDS at downgradient well MW-1611 is likely also related to natural variation in the dilution of TDS-rich groundwater.

2.2 Sampling Requirements

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

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and supports the position that the SSIs for chloride and TDS during the first semiannual sampling event of 2019 are not due to a release from the Mountaineer Landfill. The observed chloride and TDS SSIs were attributed to natural variation. Therefore, no further action is warranted, and the Mountaineer Landfill will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in Attachment A.

SECTION 4

REFERENCES

Geosyntec Consultants, Inc. 2018. Alternative Source Demonstration Report – Federal CCR Rule. Mountaineer Plant Landfill. April.

Geosyntec Consultants, Inc. 2019. Alternative Source Demonstration Report – Federal CCR Rule. Mountaineer Plant Landfill. March.

U.S. EPA, 2015. Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities (Final Rule). Fed. Reg. 80 FR 21301, pp. 21301-21501, 40 CFR Parts 257 and 261, April.

TABLES

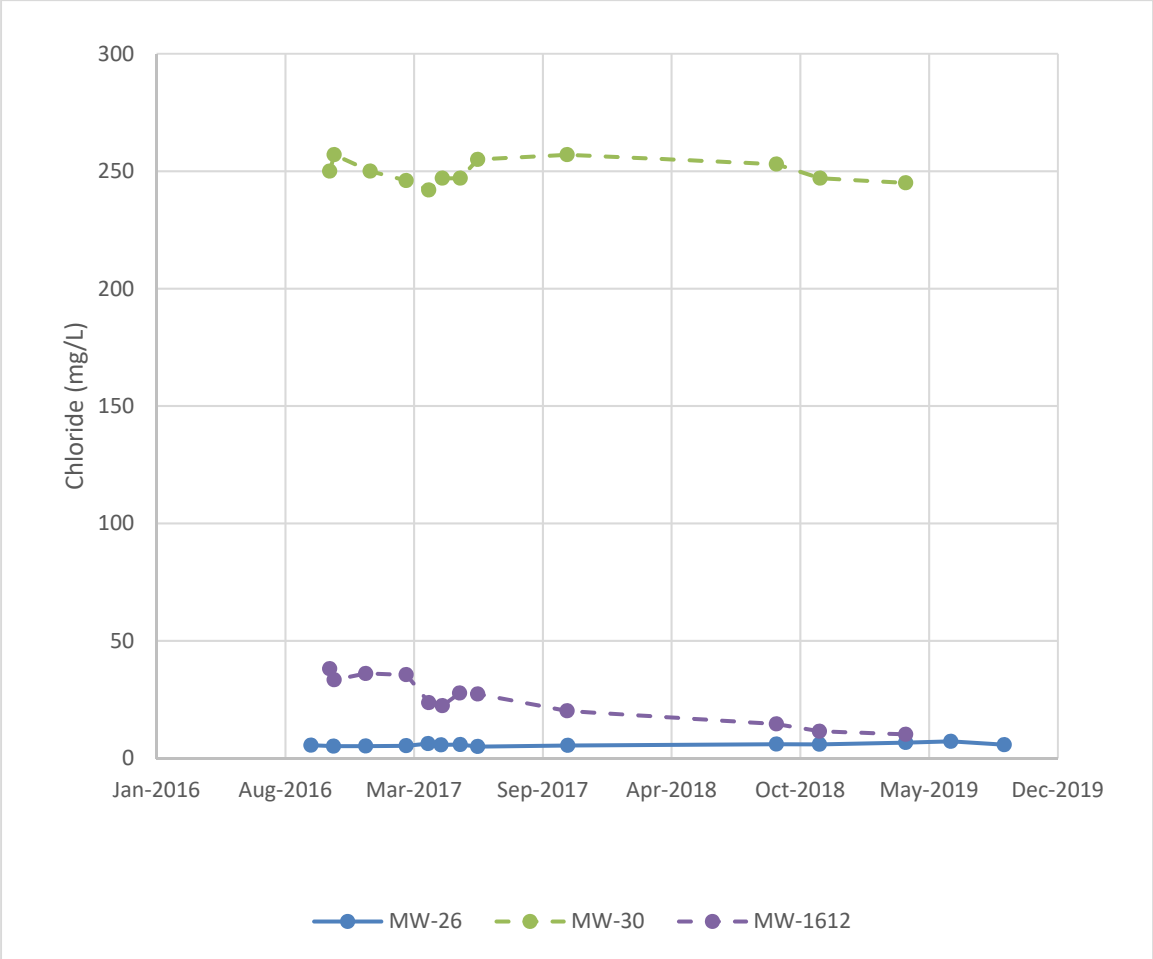
Table 1: Detection Monitoring Data Evaluation
Mountaineer Plant - Landfill

Geosyntec Consultants, Inc.

Parameter	Units	Description	MW-1611		MW-26		MW-27	MW-38		MW-39
			4/9/2019	6/18/2019	4/9/2019	6/18/2019	4/9/2019	4/9/2019	6/18/2019	4/9/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.241		0.266		0.421	0.113		0.225
		Detection Monitoring Data	0.139	--	0.128	--	0.303	0.040	--	0.158
Calcium	mg/L	Intrawell Background Value (UPL)	25.0		66.6		2.02	60.1		14.3
		Detection Monitoring Data	**26.2**	22.8	62.8	--	1.19	52.0	--	6.65
Chloride	mg/L	Intrawell Background Value (UPL)	10.2		6.66		2.01	7.63		3.14
		Detection Monitoring Data	7.96	--	**6.71**	**7.22**	1.54	7.46	--	2.94
Fluoride	mg/L	Intrawell Background Value (UPL)	3.67		3.67		3.67	3.67		3.67
		Detection Monitoring Data	0.46	--	0.13	--	2.32	0.32	--	0.77
pH	SU	Intrawell Background Value (UPL)	7.8		7.7		9.6	7.6		9.5
		Intrawell Background Value (LPL)	7.2		7.1		8.8	7.0		8.3
		Detection Monitoring Data	7.6	**--**	7.3	**--**	9.0	**6.9**	7.6	8.3
Sulfate	mg/L	Intrawell Background Value (UPL)	25.3		13.3		8.88	39.9		1.50
		Detection Monitoring Data	20.7	--	7.60	--	2.90	27.8	--	0.06
TDS	mg/L	Intrawell Background Value (UPL)	392		379		635	459		473
		Detection Monitoring Data	**431**	**402***	370	--	542	427	--	376

Notes
UPL: Upper prediction limit
LPL: Lower prediction limit
TDS: Total dissolved solids
Bold values exceed the background value.
Background values are shaded gray.
*TDS sample was collected on 7/10/2019.

FIGURES



Notes: Chloride time series for downgradient well MW-26 and background wells MW-1612 and MW-30.

Chloride Time Series Graph
Mountaineer Landfill

Geosyntec consultants

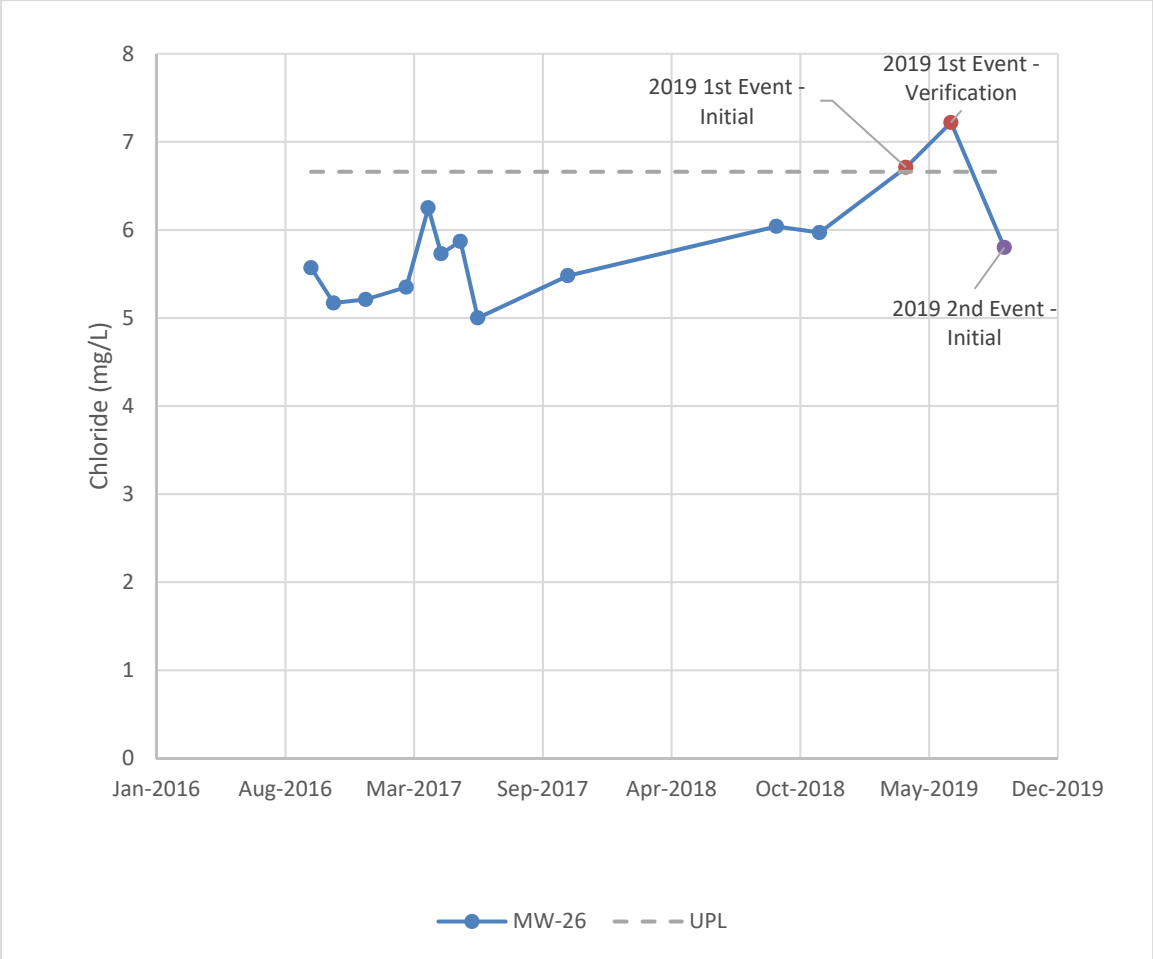
AMERICAN ELECTRIC POWER

Figure **1**

Columbus, Ohio

07-Nov-2019

internal info: path, date revised, author



Notes: Data collected from MW-26 during the background and detection monitoring period under the Federal CCR Rule are shown. Red circles represent data for the current detection monitoring event. The purple circle represents data collected for the second semiannual detection monitoring event of 2019.

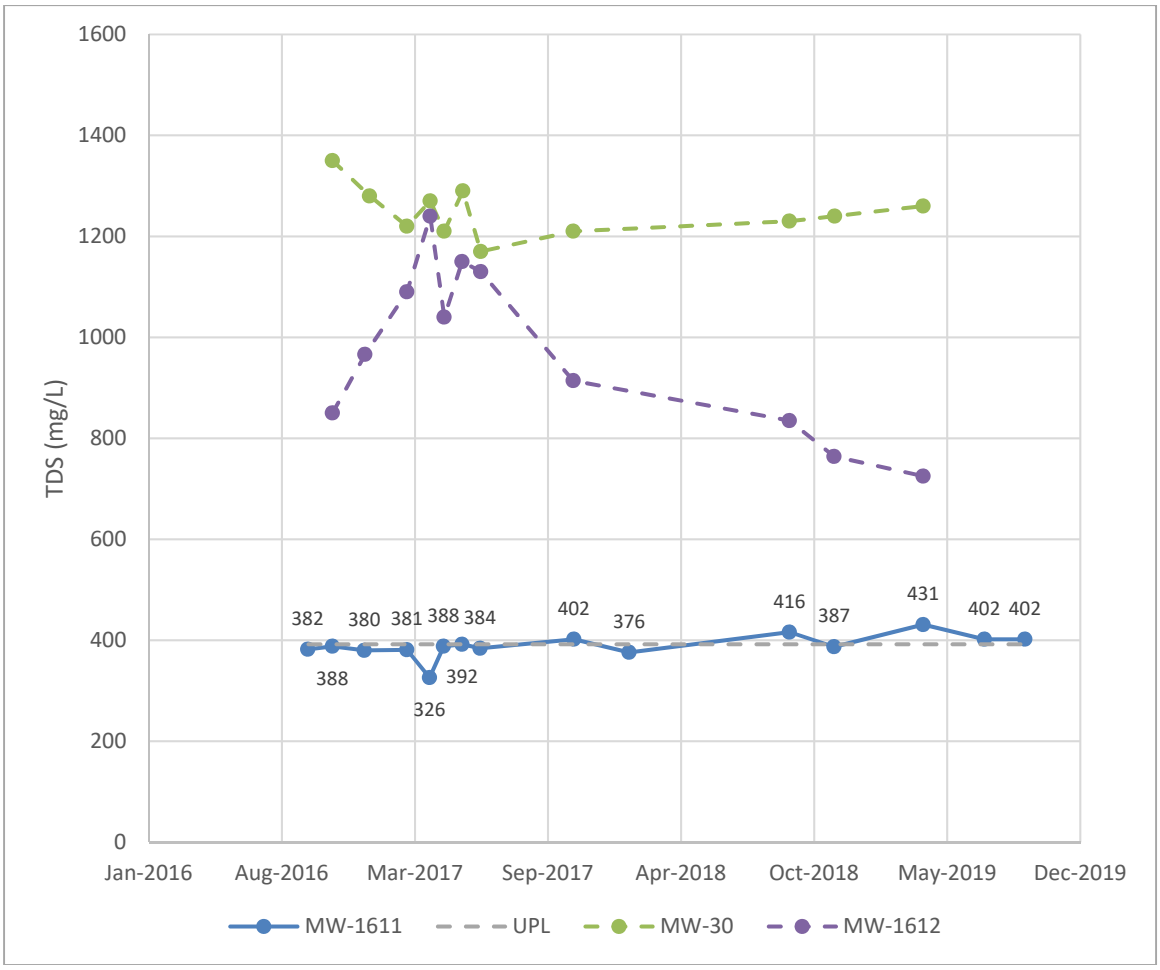
MW-26 Chloride Time Series Graph
Mountaineer Landfill

Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | 07-Nov-2019

Figure **2**

internal info: path, date revised, author



Notes: Total dissolved solids (TDS) time series for downgradient well MW-1611 and background wells MW-1612 and MW-30. The dashed line represents the calculated intrawell upper prediction limit (UPL) for MW-1611 of 392 mg/L. Data labels represent TDS concentrations at MW-1611.

Total Dissolved Solids Time Series Graph
Mountaineer Landfill

Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | 07-Nov-2019

Figure **3**

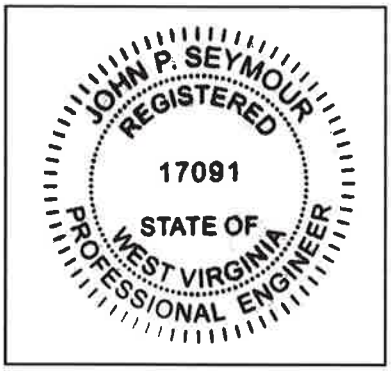
internal info: path, date revised, author

ATTACHMENT A

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Mountaineer Landfill CCR management area and that the requirements of 40 CFR 257.94(e)(2) have been met.



John Seymour
Printed Name of Licensed Professional Engineer

Signature

017091 — License Number

West Virginia — Licensing State

11/14/2019 — Date

APPENDIX 4 - Notices for Monitoring Program Transitions

Not applicable at this time.

APPENDIX 5 - Well Installation/Decommissioning Logs

Not applicable at this time.