Annual Groundwater Monitoring Report

Kentucky Power Company

Mitchell Plant

Landfill

Moundsville, WV

January 2024

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KENTUCKY POWER

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BOUNDLESS ENERGY

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I. **Overview**

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

In general, the following activities were completed in 2023:

- The unit was in detection monitoring at the beginning and end of 2023;
- Groundwater samples were collected on May 17, 2023 and on October 11, 2023, and analyzed for Appendix III constituents, as specified in 40 CFR 257.94 and AEP's *Groundwater Sampling and Analysis Plan (2016)*. A detection monitoring resample corresponding to the October 5, 2022 initial sampling was collected on March 22, 2023;
- Groundwater monitoring data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Appendix III constituents were compared to prediction limits (intervals for pH) established from background data established previously. Statistical comparisons to background were made for samples collected on October 5, 2022;
- The statistical evaluation of the October 5, 2022 sampling, completed on July 7, 2023, concluded that there was one potential statistically significant increase (SSI) over background at one well (chloride at monitoring well MW-1102F). Statistical evaluations of data collected during the May 17, 2023 and October 11, 2023 sampling events will be completed in 2024;
- Because a potential SSI over background of an Appendix III constituent was detected at Mitchell Plant's landfill during the May 12, 2022 initial sampling, the corresponding August 31, 2022 resampling, and the corresponding statistical analysis completed on December 5, 2022, an alternative source demonstration (ASD) study was conducted resulting in a March 2, 2023 ASD report. Because a potential SSI over background of an Appendix III constituent was detected at Mitchell Plant's landfill during the October 5, 2022 initial sampling, the corresponding March 23, 2023 resampling, and the corresponding statistical analysis completed on July 7, 2023, an ASD study was conducted resulting in a September 27, 2023 ASD report;

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 one or more SSIs over background levels (Attached as Appendix 2, where applicable);
- A discussion of whether any alternate source demonstrations were performed, and the conclusions (Attached as Appendix 3, where applicable);
- A summary of any transition between monitoring programs, 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 regarding the rationale for the installation/decommission (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

A figure that depicts the PE-certified groundwater monitoring network, the monitoring well locations, and their corresponding identification is provided in Appendix 1.

III. Monitoring Wells Installed or Decommissioned

There were no monitoring wells installed or decommissioned in 2023. The network design, as summarized in the *Groundwater Monitoring Network Design Report* (2016) and as posted at the CCR web site for Mitchell 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

In response to initially significant increases in concentrations of calcium and chloride detected at monitoring well MW-1101R, chloride detected at monitoring well MW1102F, and pH detected at MW-1502R during the October 5, 2022 sampling event, resamples for these constituents were collected at the three wells on March 22, 2023. Appendix 1 contains tables showing the groundwater quality data collected during the establishment of background quality and detection monitoring. Static water elevation data from each monitoring event also are shown in Appendix 1, along with the groundwater velocities, groundwater flow direction, and potentiometric maps developed after each sampling event.

V. Groundwater Quality Data Statistical Analysis

The statistical evaluation of the October 5, 2022 sampling, completed on July 7, 2023, concluded that a potential SSI of chloride over background was detected at MW-1102F. Statistical analysis of the detection monitoring samples collected on May 17, 2023 and October 11, 2023, will be completed in 2024. A memorandum with the results of the statistical evaluation completed on July 7, 2023 is provided in Appendix 2.

As required by 40 CFR 257.94, groundwater samples were collected and analyzed for all Appendix III constituents during semiannual sampling events on May 17, 2023 and on October 11, 2023. Statistical evaluations of data collected during these sampling events will be completed in 2024.

VI. Alternative Source Demonstrations

Because a potential SSI over background of an Appendix III constituent was detected at Mitchell Plant's landfill during the May 12, 2022 initial sampling, the corresponding August 31, 2022 resampling, and the corresponding statistical analysis completed on December 5, 2022, an ASD study was conducted resulting in a March 2, 2023 ASD report. The report concluded that the SSI was not due to a release from the Mitchell Landfill, but was instead attributed to natural variation in groundwater quality. Because a potential SSI over background of an Appendix III constituent was detected at Mitchell Plant's landfill during the October 5, 2022 initial sampling, the corresponding March 23, 2023 resampling, and the corresponding statistical analysis completed on July 7, 2023, an ASD study was conducted resulting in a September 27, 2023 ASD report. The report concluded that the SSI was not due to a release from the Mitchell Landfill, but was instead attributed to natural variation in groundwater quality. Both reports are provided in Appendix 3.

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

No transition between monitoring requirements occurred in 2023; the CCR unit was in detection monitoring at the beginning and at the end of the year. A statement to this effect is provided in Appendix 4. The sampling frequency of twice per year will be maintained for the Appendix III constituents (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 semiannual detection monitoring schedule is necessary.

VIII. Other Information Required

The Mitchell landfill has remained in its current status of detection monitoring. All required information has been included in this annual groundwater monitoring report.

IX. Description of Any Problems Encountered in 2023 and Actions Taken

No significant problems were encountered. Through the use of low-flow purging and sampling methodology, samples representative of uppermost aquifer groundwater were obtained and the schedule was met to support this annual groundwater report preparation. There were, however, dry wells encountered during sampling, but this did not affect the statistical evaluation or monitoring network at the landfill. The minimum requirement of one upgradient and three downgradient wells was still met.

X. A Projection of Key Activities for the Upcoming Year

Key activities for 2024 include the following:

- Detection monitoring on a semiannual schedule;
- Statistical evaluation of the detection monitoring results to determine any SSIs (or decreases with respect to pH);
- Responding to any new data received in light of CCR rule requirements;
- Preparation of the next annual groundwater report.

APPENDIX 1 - Groundwater Data Tables and Figures

Tables follow showing the groundwater monitoring data collected, the rate of groundwater flow each time groundwater was sampled, the number of samples collected per monitoring well, dates that the samples were collected, and whether each sample was collected as part of a detection monitoring or an assessment monitoring program. Figures follow showing the PE-certified groundwater monitoring network with the corresponding well identifications along with static water elevation data and groundwater flow directions each time groundwater was sampled in the form of annotated satellite images.

Table 1. Groundwater Data Summary: MW-1101F
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/15/2016	Background	0.042	88.3	3.87	0.22	7.4	64.3	395
8/3/2016	Background	0.380	91.0	3.30	0.21	7.4	62.1	425
9/28/2016	Background	0.054	88.6	3.73	0.26	8.7	58.1	466

Table 1. Groundwater Data Summary: MW-1101F
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/15/2016	Background	0.21	1.64	159	0.023	0.08	0.6	0.294	0.304	0.22	0.525	0.012	< 0.002 U1	3.87	0.2	0.02 J1
8/3/2016	Background	0.14	1.46	155	0.033	0.08	0.6	0.244	1.494	0.21	0.673	0.017	< 0.002 U1	4.04	0.2	< 0.01 U1
9/28/2016	Background	0.18	1.79	142	0.029	0.12	0.8	0.231	1.561	0.26	0.511	0.016	< 0.002 U1	3.39	0.3	0.02 J1

Table 1. Groundwater Data Summary: MW-1101R
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/15/2016	Background	0.287	6.91	8.41	1.20	8.2	76.4	741
8/3/2016	Background	0.518	5.00	10.3	1.56	8.4	76.4	750
9/28/2016	Background	0.382	6.12	13.3	1.83	8.5	43.5	43
11/16/2016	Background	1.80	19.4	15.2	2.29	8.6	32.2	801
2/14/2017	Background	0.501	2.23	15.4	2.40	8.6	32.0	806
4/12/2017	Background	0.360	4.02	14.4	2.17	8.7	39.2	798
5/24/2017	Background	0.380	1.91	15.1	2.41	8.7	28.6	793
7/25/2017	Background	0.415	1.76	15.8	2.61	8.7	28.7	788
10/11/2017	Detection	0.394	1.87	16.9	2.59	8.7	29.1	784
1/11/2018	Detection	--	1.75	--	--	7.9	28.8	--
4/10/2018	Detection	0.344	1.75	16.5	2.62	8.5	29.0	790
8/29/2018	Detection	0.371	2.42	16.3	2.45	9.0	29.7	783
5/1/2019	Detection	0.376	1.90	16.9	2.62	10.5	28.7	809
6/12/2019	Detection	0.371	2.03	16.2	2.38	8.8	27.4	822
10/23/2019	Detection	0.389	1.81	17.2	2.70	8.7	28.4	820
5/6/2020	Detection	0.364	2.17	15.1	2.46	8.2	23.9	828
10/21/2020	Detection	0.409	2.42	16.6	2.57	9.1	28.5	845
5/12/2021	Detection	0.349	2.46	16.8	2.47	8.3	27.5	856
10/20/2021	Detection	0.359	2.6	16.9	2.60	8.6	24.6	850
5/12/2022	Detection	0.373	2.52	17.5	2.67	9.0	29.1	840
10/5/2022	Detection	0.394	2.79	18.3	2.81	8.3	29.3	840
3/22/2023	Detection	--	2.54	17.3	--	8.4	--	--
5/17/2023	Detection	0.361	2.61	17.4	2.73	8.4	28.7	850
10/11/2023	Detection	0.365	3.23	17.1	2.56	8.6	29.4	830

Table 1. Groundwater Data Summary: MW-1101R
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/15/2016	Background	0.82	8.11	185	0.031	0.03	1.1	0.650	0.493	1.20	1.22	0.002	0.003 J1	31.8	0.5	0.05 J1
8/3/2016	Background	1.10	10.8	149	0.023	0.03	1.0	0.363	0.4776	1.56	0.674	0.012	< 0.002 U1	32.9	0.5	0.02 J1
9/28/2016	Background	0.92	11.1	149	0.01 J1	0.02	0.7	0.301	0.565	1.83	0.550	0.009	< 0.002 U1	26.2	0.5	0.01 J1
11/16/2016	Background	0.67	14.2	125	0.01 J1	0.02 J1	0.595	0.143	1.808	2.29	0.292	0.026	< 0.002 U1	20.6	0.4	< 0.01 U1
2/14/2017	Background	0.69	15.3	102	0.01 J1	0.02 J1	0.512	0.160	1.661	2.40	0.327	0.012	< 0.002 U1	34.0	0.4	0.02 J1
4/12/2017	Background	0.84	12.4	117	0.02 J1	0.02 J1	0.824	0.333	0.19	2.17	0.634	0.010	0.002 J1	16.7	0.5	< 0.01 U1
5/24/2017	Background	0.66	15.7	102	0.01 J1	0.01 J1	0.526	0.299	0.759	2.41	0.298	< 0.0002 U1	< 0.002 U1	14.8	0.3	< 0.01 U1
7/25/2017	Background	0.62	14.5	91.3	0.01 J1	0.01 J1	0.377	0.126	0.977	2.61	0.235	0.009	< 0.002 U1	18.3	0.3	0.02 J1

Table 1. Groundwater Data Summary: MW-1102F
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/15/2016	Background	0.109	4.34	12.4	0.56	8.0	37.2	523
8/3/2016	Background	0.280	5.48	11.9	0.58	8.2	35.9	535
10/3/2016	Background	0.160	5.45	11.8	0.60	8.1	29.5	519
11/15/2016	Background	0.117	4.87	11.7	0.56	8.1	27.4	551
2/14/2017	Background	0.109	5.04	11.3	0.53	8.2	29.9	521
4/12/2017	Background	0.109	4.67	11.3	0.53	8.3	30.6	530
5/24/2017	Background	0.118	5.31	13.7	0.56	8.3	31.8	521
7/26/2017	Background	0.202	5.41	11.4	0.57	8.3	31.5	519
10/10/2017	Detection	0.278	4.79	12.4	0.57	8.4	32.3	526
1/11/2018	Detection	--	4.47	--	--	7.9	32.1	--
4/10/2018	Detection	0.109	4.40	13.4	0.63	8.2	33.2	539
8/28/2018	Detection	0.247	4.48	14.1	0.64	8.6	33.8	549
5/1/2019	Detection	0.126	4.69	15.2	0.66	9.5	37.6	577
6/12/2019	Detection	0.110	4.36	14.9	0.74	8.2	38.0	574
10/23/2019	Detection	0.114	4.46	16.3	0.68	8.3	38.8	564
1/31/2020	Detection	--	--	16.3	--	8.2	--	--
5/6/2020	Detection	0.129	4.33	16.0	0.69	8.8	33.8	574
7/15/2020	Detection	--	--	16.0	--	8.4	--	--
10/21/2020	Detection	0.147	3.81	17.3	0.76	9.0	39.2	580
3/17/2021	Detection	0.113	4.10	18.2	0.84	9.6	38.8	585
5/12/2021	Detection	0.114	4.08	18.2	0.79	8.9	38.4	584
10/12/2021	Detection	--	--	18.3	0.79	8.3	--	610
10/20/2021	Detection	0.121	4.3	18.5	0.82	8.3	35.9	590
5/12/2022	Detection	0.126	4.37	20.0	0.85	8.8	40.8	600
8/31/2022	Detection	--	--	19.9	--	8.2	--	--
10/5/2022	Detection	0.124	4.34	21.5	0.86	7.9	41.3	590
3/22/2023	Detection	--	--	21.1	--	8.1	--	--
5/17/2023	Detection	0.112	3.82	21.3	0.85	8.2	40.8	600
10/10/2023	Detection	--	--	21.0	--	8.2	--	--
10/11/2023	Detection	0.116	4.17	21.3	0.84	8.4	40.1	600

Table 1. Groundwater Data Summary: MW-1102F
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/15/2016	Background	0.71	9.37	214	< 0.005 U1	0.04	0.4	0.096	0.352	0.56	0.335	0.003	< 0.002 U1	28.1	0.3	< 0.01 U1
8/3/2016	Background	0.69	8.16	212	< 0.005 U1	0.02 J1	0.4	0.090	0.881	0.58	0.183	0.006	< 0.002 U1	25.8	0.3	0.01 J1
10/3/2016	Background	0.64	8.45	194	0.005 J1	0.01 J1	0.5	0.286	0.972	0.60	0.298	0.002	< 0.002 U1	23.9	0.3	< 0.01 U1
11/15/2016	Background	0.63	8.49	212	0.005 J1	0.008 J1	0.435	0.074	1.859	0.56	0.141	0.003	< 0.002 U1	22.9	0.3	< 0.01 U1
2/14/2017	Background	0.62	8.66	197	0.006 J1	0.006 J1	0.411	0.049	1.015	0.53	0.131	0.004	< 0.002 U1	21.4	0.3	0.02 J1
4/12/2017	Background	0.56	7.68	191	0.005 J1	0.01 J1	0.399	0.079	0.1825	0.53	0.135	0.005	< 0.002 U1	19.3	0.3	0.01 J1
5/24/2017	Background	0.60	8.76	229	0.01 J1	0.02	0.807	0.203	0.3252	0.56	0.335	< 0.0002 U1	< 0.002 U1	20.0	0.4	0.01 J1
7/26/2017	Background	0.54	7.58	205	< 0.004 U1	0.01 J1	0.323	0.072	0.942	0.57	0.121	0.007	< 0.002 U1	34.7	0.3	0.03 J1

Table 1. Groundwater Data Summary: MW-1102R
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/15/2016	Background	0.339	3.49	219	2.97	8.2	47.8	1,470
8/3/2016	Background	0.467	4.05	217	2.98	8.3	44.9	1,450
10/3/2016	Background	0.332	5.33	213	2.96	8.3	35.1	1,530

Table 1. Groundwater Data Summary: MW-1102R
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
6/15/2016	Background	2.01	2.64	292	0.02 J1	0.35	0.5	0.799	0.710	2.97	0.558	0.015	< 0.002 U1	68.7	0.9	0.01 J1
8/3/2016	Background	1.71	3.57	356	0.128	0.14	3.0	1.75	1.217	2.98	2.82	0.021	0.007 J1	66.0	1.2	0.03 J1
10/3/2016	Background	1.73	3.37	441	0.307	0.17	3.9	3.01	2.828	2.96	7.24	0.028	0.007	51.4	1.9	0.03 J1

Geosyntec Consultants, Inc.

Table 1. Groundwater Data Summary: MW-1103F
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/15/2016	Background	0.355	3.01	243	3.11	8.3	0.5	1,390
8/2/2016	Background	0.402	2.99	247	3.20	8.3	0.3	1,420
10/3/2016	Background	0.321	3.12	242	3.34	8.4	< 0.04 U1	1,380
11/16/2016	Background	0.323	2.97	240	2.96	8.4	0.2	1,370
2/15/2017	Background	0.303	2.82	240	3.07	8.5	0.2	1,400
4/11/2017	Background	0.304	2.57	234	3.05	8.6	0.4	1,400
5/23/2017	Background	0.346	2.88	237	3.23	8.5	0.4	1,370
7/26/2017	Background	0.343	2.76	240	3.24	8.5	0.3	1,370
10/11/2017	Detection	0.328	3.09	247	3.17	8.6	0.5	1,390
4/11/2018	Detection	0.286	2.58	239	3.16	8.3	0.5	1,390
8/29/2018	Detection	0.332	2.76	244	3.03	8.6	0.4	1,380
5/2/2019	Detection	0.342	2.95	245	3.13	9.1	0.8	1,360
6/12/2019	Detection	0.329	2.96	233	3.55	8.3	0.9	1,410
10/23/2019	Detection	0.336	3.44	242	3.25	8.5	0.8	1,440
5/6/2020	Detection	0.358	3.48	235	2.96	8.9	0.8	1,420
10/21/2020	Detection	0.332	3.05	237	3.07	8.8	0.8	1,440
5/12/2021	Detection	0.294	3.50	247	2.96	9.1	1.2	1,440
10/20/2021	Detection	0.299	3.3	241	3.08	8.5	0.77	1,450
5/12/2022	Detection	0.333	4.04	244	3.07	8.7	1.5	1,430
10/5/2022	Detection	0.335	4.12	290	3.21	8.1	1.0	1,590
5/17/2023	Detection	0.314	3.95	243	3.18	8.1	1.4	1,440
10/11/2023	Detection	0.302	4.64	238	2.94	8.3	2.2	1,380

Table 1. Groundwater Data Summary: MW-1103F
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/15/2016	Background	0.16	8.03	639	0.029	0.02	1.0	0.351	1.100	3.11	0.674	0.012	< 0.002 U1	10.1	0.2	0.01 J1
8/2/2016	Background	0.14	7.01	704	0.026	0.01 J1	0.9	0.299	0.899	3.20	0.479	0.016	< 0.002 U1	2.61	0.2	< 0.01 U1
10/3/2016	Background	0.04 J1	5.80	558	0.01 J1	0.03	0.4	0.180	1.026	3.34	0.313	0.016	< 0.004 U1	2.66	0.1 J1	0.01 J1
11/16/2016	Background	0.10	7.71	723	0.01 J1	0.009 J1	0.471	0.159	1.570	2.96	0.218	0.015	< 0.002 U1	2.57	0.1	< 0.01 U1
2/15/2017	Background	0.03 J1	7.67	631	0.009 J1	0.008 J1	0.336	0.147	1.416	3.07	0.213	0.016	< 0.002 U1	2.81	0.09 J1	0.03 J1
4/11/2017	Background	0.07	8.46	618	0.006 J1	0.006 J1	0.262	0.102	2.183	3.05	0.088	0.015	< 0.002 U1	3.19	0.1	< 0.01 U1
5/23/2017	Background	0.03 J1	7.85	688	0.006 J1	0.007 J1	0.260	0.149	1.214	3.23	0.194	0.006	< 0.002 U1	2.80	0.06 J1	< 0.01 U1
7/26/2017	Background	0.02 J1	6.81	562	< 0.004 U1	0.007 J1	0.112	0.136	1.798	3.24	0.103	0.015	< 0.002 U1	5.46	0.07 J1	0.02 J1

Table 1. Groundwater Data Summary: MW-1104R
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/21/2016	Background	0.431	39.4	485	1.18	7.9	162	2,390

Table 1. Groundwater Data Summary: MW-1104R
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/21/2016	Background	0.66	4.35	182	0.570	0.18	3.4	4.36	0.153	1.18	9.41	0.014	< 0.09 U1	42.3	2.3	0.133

Table 1. Groundwater Data Summary: MW-1502R
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/20/2016	Background	0.268	71.5	33.4	0.18	7.3	155	474
8/9/2016	Background	0.160	95.4	34.0	0.17	7.3	187	547
9/27/2016	Background	0.376	103	39.7	0.1 J1	7.4	183	560
11/9/2016	Background	0.214	87.3	25.4	0.1 J1	7.4	186	551
2/15/2017	Background	0.069	90.0	167	0.16	7.5	90.1	564
4/12/2017	Background	0.075	72.2	79.5	0.16	7.6	102	507
5/23/2017	Background	0.100	73.9	52.4	0.17	7.6	118	466
7/25/2017	Background	0.158	61.7	18.8	0.20	7.3	88.6	358
10/11/2017	Detection	0.132	91.0	24.5	0.1 J1	7.3	159	535
1/11/2018	Detection	--	240	--	--	7.0	149	--
4/10/2018	Detection	0.051	78.3	196	0.19	7.4	87.6	616
8/29/2018	Detection	0.150	95.7	99.3	0.17	7.7	167	650
5/2/2019	Detection	0.1 J1	93.6	245	0.17	8.5	105	702
6/12/2019	Detection	0.127	80.7	155	0.23	7.3	114	661
10/23/2019	Detection	0.194	104	102	0.18	7.2	252	758
1/31/2020	Detection	--	--	--	--	7.4	120	474
5/6/2020	Detection	0.081	64.8	74.6	0.18	7.8	93.0	471
9/1/2020	Detection	--	--	--	--	7.2	--	--
10/21/2020	Detection	0.267	92.5	56.6	0.18	7.7	249	679
3/17/2021	Detection	0.083	94.9	274	0.24	7.9	117	759
5/12/2021	Detection	0.121	73.0	113	0.24	8.3	118	540
10/12/2021	Detection	--	--	--	--	7.4	--	--
10/20/2021	Detection	0.194	91.0	91.8	0.21	7.5	176	650
5/12/2022	Detection	0.084	84.0 M1	102	0.21	8.3	105	520
10/5/2022	Detection	0.135	89.5 M1, P3	69.4	0.21	6.9	131	540
3/22/2023	Detection	--	--	--	--	7.4	--	--
5/17/2023	Detection	0.091	69.4 M1	76.7	0.19	7.4	98	470

Table 1. Groundwater Data Summary: MW-1502R
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/20/2016	Background	0.22	0.28	30.6	< 0.005 U1	0.005 J1	0.3	0.082	0.143	0.18	0.064	0.002	< 0.09 U1	3.48	8.2	0.01 J1
8/9/2016	Background	0.20	0.26	34.1	< 0.005 U1	0.006 J1	0.3	0.068	1.029	0.17	0.089	0.010	< 0.002 U1	8.71	7.4	< 0.01 U1
9/27/2016	Background	0.16	0.27	38.2	< 0.005 U1	0.004 J1	0.4	0.076	0.429	0.1 J1	0.064	0.012	< 0.002 U1	8.40	8.8	< 0.01 U1
11/9/2016	Background	0.20	0.84	44.2	0.062	0.009 J1	1.44	0.507	2.497	0.1 J1	0.764	0.006	< 0.002 U1	3.19	5.3	0.03 J1
2/15/2017	Background	0.13	0.24	27.7	0.006 J1	< 0.004 U1	1.90	0.069	2.61	0.16	0.061	0.009	< 0.002 U1	1.84	4.3	0.03 J1
4/12/2017	Background	0.13	0.69	29.2	0.053	0.008 J1	1.20	0.426	0.613	0.16	0.630	0.015	0.002 J1	1.91	4.8	0.02 J1
5/23/2017	Background	0.15	0.53	32.2	0.033	< 0.005 U1	0.918	0.238	0.647	0.17	0.364	0.002	< 0.002 U1	2.46	4.7	0.01 J1
7/25/2017	Background	0.21	0.30	19.0	0.008 J1	< 0.005 U1	0.196	0.082	0.6323	0.20	0.088	0.009	< 0.002 U1	2.47	3.2	0.03 J1

Notes:
- -: Not analyzed
<: Non-detect value. Analytes which were not detected are shown as less than the method detection limit (MDL) followed by a 'U1' flag.
In analytical data prior to 5/18/2021, U1 flags were reported as U in the analytical report.
J1: Concentration estimated. Analyte was detected between the method detection limit and the reporting limit.
M1: The associated matrix spike (MS) or matrix spike duplicate (MSD) recovery was outside acceptance limits.
P3: The precision on the matrix spike duplicate (MSD) was above acceptance limits.
In analytical data prior to 5/18/2021, J1 flags were reported as J in the analytical report.
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
µg/L: micrograms per liter

Table 1: Residence Time Calculation Summary
Mitchell Landfill

			2023-03		2023-05		2023-10	
CCR Management Unit	Monitoring Well Pair	Well Diameter (inches)	Vertical Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Vertical Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Vertical Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	MW1101F/R [1]	2.0	3.1	20	3.1	20	3.0	20
	MW1102F/R [1]	2.0	0.5	118	0.5	122	0.5	135
	MW1103F/R [2]	2.0	1.6	37	1.6	37	1.6	37
	MW1104F/R [2]	2.0	1.1	57	1.1	56	1.2	51
	MW1501F/R [3]	4.0	2.4	51	2.4	51	2.4	51
	MW1502R [3]	4.0	NC	NC	NC	NC	NC	NC
	MW1503F/R [3]	4.0	1.3	93	1.3	95	1.4	88

Notes:
[1] - Sidegradient Well
[2] - Background Well
[3] - Downgradient Well
NC - No calculation can be generated

Legend

Compliance Sampling Location

Upgradient Sampling Location

CCR Landfill (Approximate Limits of Waste)

Notes

- Monitoring well coordinates provided by AEP.

-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.

500 250 0 500 Feet

Site Layout
Landfill - Fish Creek Aquifer

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2018/01/26

Figure **1a**

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Legend
- Compliance Sampling Location
- Upgradient Sampling Location
- CCR Landfill (Approximate Limits of Waste)

Notes
- Monitoring well coordinates provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.

Site Layout
Landfill - Rush Run Aquifer

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2018/01/26

Figure **1b**

Legend

- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on May 16, 2023) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

Potentiometric Surface Map - Fish Creek
May 2023

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2023/09/20

Figure **2**

\\annarbor-01\Data\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2023\AEP-Mitchell_Landfill-FC_GW_May2023.mxd. ASoltero. 9/20/2023. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on May 16, 2023) provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Rush Run May 2023

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2023/11/16

Figure 3

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Legend
- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Groundwater Flow Direction

Notes
- Monitoring well coordinates and water level data (collected on October 10, 2023) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Fish Creek October 2023

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2023/10/27

Figure 4

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Legend
- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Groundwater Flow Direction

Notes
- Monitoring well coordinates and water level data (collected on October 10, 2023) provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Rush Run
October 2023

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2023/10/27

Figure 5

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APPENDIX 2 - Statistical Analyses

The July 7, 2023 statistical memorandum summarizing the October 5, 2022 detection monitoring sampling event follows.

Geosyntec consultants

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Worthington, Ohio 43085
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Memorandum

Date:	July 5, 2023
To:	David Miller (AEP)
Copies to:	Bill Smith (AEP)
From:	Allison Kreinberg (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Mitchell Plant's Landfill (LF)

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 Subpart D, "CCR rule"), the second semiannual detection monitoring event of 2022 at the Mitchell Landfill (LF), an existing CCR unit at the Mitchell Power Plant located in Moundsville, West Virginia was completed on October 5, 2022. Based on the results, verification sampling was completed on March 22, 2023.

Background values for the LF were originally calculated in January 2018 and were revised in February 2020. After a minimum of four detection monitoring events, the results of those events were compared to the existing background and the dataset was updated as appropriate. Revised upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these revised background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 17, 2022.

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

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

- Chloride concentrations exceeded the intrawell UPL of 19.6 mg/L in both the initial (21.5 mg/L) and second (21.1 mg/L) samples collected at MW-1102F. Therefore, an SSI over background is concluded for chloride at MW-1102F.

In response to the exceedances noted above, the Mitchell LF CCR unit will either transition to assessment monitoring or an alternative source demonstration (ASD) for chloride at MW-1102F will be conducted in accordance with 40 CFR 257.94(e)(2). If the ASD is successful, the Mitchell LF 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 Comparison
Detection Summary Memorandum
Mitchell Plant, Landfill

Analyte	Unit	Description	MW-1101R		MW-1102F		MW-1502R	
			10/5/2022	3/22/2023	10/5/2022	3/22/2023	10/5/2022	3/22/2023
Boron	mg/L	Intrawell Background Value (UPL)	0.498		0.280		0.267	
		Analytical Result	0.394	--	0.124	--	0.135	--
Calcium	mg/L	Intrawell Background Value (UPL)	2.61		5.60		110	
		Analytical Result	**2.79**	2.54	4.34	--	89.5	--
Chloride	mg/L	Intrawell Background Value (UPL)	18.1		19.6		250	
		Analytical Result	**18.3**	17.3	**21.5**	**21.1**	69.4	--
Fluoride	mg/L	Intrawell Background Value (UPL)	3.09		0.875		0.254	
		Analytical Result	2.81	--	0.86	--	0.21	--
pH	SU	Intrawell Background Value (UPL)	9.1		9.6		8.5	
		Intrawell Background Value (LPL)	7.9		7.6		7.2	
		Analytical Result	8.3	--	7.9	--	**6.9**	7.4
Sulfate	mg/L	Intrawell Background Value (UPL)	37.8		44.6		236	
		Analytical Result	29.3	--	41.3	--	131	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	930		614		778	
		Analytical Result	840	--	590	--	540	--

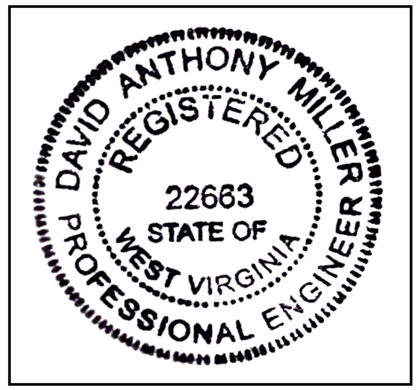
Notes:
Bold values exceed the background value.
Background values are shaded gray.
LPL: Lower prediction limit
mg/L: milligrams per liter
SU: standard units
UPL: Upper prediction limit

ATTACHMENT A

Certification by a Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 17, 2022 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Mitchell 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

Signature

22663	West Virginia	07.07.2023
License Number	Licensing State	Date

APPENDIX 3 – Alternative Source Demonstrations

The March 2, 2023 and September 27, 2023 ASD reports follow.

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

Mitchell Plant Landfill
Marshall County, West Virginia

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

500 West Wilson Bridge Rd, Suite 250
Columbus, Ohio 43085

March 2, 2023

CHA8495

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
LF	Landfill
LPL	Lower Prediction Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

SECTION 1

INTRODUCTION AND SUMMARY

1.1 Introduction

This Alternative Source Demonstration (ASD) report has been prepared to address a statistically significant increase (SSI) for chloride at the Mitchell Plant Landfill (LF) following the first semiannual detection monitoring event of 2022.

Following completion of four detection monitoring events, the previously calculated upper prediction limits (UPLs) for the Landfill were recalculated for each Appendix III parameter to represent background values (Geosyntec, 2020a). A lower prediction limit (LPL) was also recalculated for pH. The revised prediction limits were calculated based on a one-of-two retesting procedure in accordance with the Unified Guidance (United States Environmental Protection Agency [USEPA], 2009) and the statistical analysis plan developed for the site (Geosyntec, 2020b). With this procedure, an SSI is concluded only if both samples in a series of two (the initial sample and the resample) exceed the UPL, or in the case of pH are both below the LPL or above the UPL.

The first semiannual detection monitoring event of 2022 was performed in May 2022 (initial sampling event) and August 2022 (verification sampling event), and the results were compared to the recalculated prediction limits. During this detection monitoring event, an SSI was identified for chloride at monitoring well MW-1102F. A summary of the detection monitoring analytical results for all constituents listed in 40 CFR Part 257 Appendix III and the calculated prediction limits for comparison is provided in **Table 1**.

1.2 CCR Rule Requirements

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 semiannual detection monitoring event for 2022 was completed in May and a resampling event was completed in August 2022 to identify SSIs over background limits. Pursuant to 40 CFR 257.94(e)(2), Geosyntec Consultants, Inc. (Geosyntec) has prepared this ASD report to identify whether the SSI identified for chloride at MW-1102F is from a source other than the LF.

1.3 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 assess whether the increase in chloride at MW-1102F could be attributed to an alternative source and not a release from the LF.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

This section provides a brief description of the site geology, ASD evaluation methodology, and the proposed alternative source.

2.1 LF Construction and Site Geology Summary

The LF was designed and constructed in accordance with West Virginia Department of Environmental Protection Class F Industrial Landfill requirements. The LF design includes several engineering controls, including a composite liner, groundwater interceptor drainage system, and a leachate collection system (CEC, 2016). The LF is being constructed in phases; CCR materials are currently being placed in Phase 3. Phases 1 and 2, which previously received CCR materials, were covered with a 6-inch thick layer of temporary cover (American Electric Power [AEP], 2022).

The local geology consists of Pennsylvanian/Permian-age clastic units separated by sharp contacts with shale or coal seams (CEC, 2016). These units are components of the Dunkard and Monongahela Groups. From top to bottom, the named sandstone units underlying the LF include: the Burton Sandstone, the Fish Creek Sandstone, the Rush Run Sandstone, the Jollytown Sandstone, and the Hundred Sandstone. A cross-section of the geology underlying the LF which was included in the groundwater monitoring network report (CEC, 2016) is provided as **Attachment A**.

2.2 Groundwater Monitoring History and Flow Characteristics

The LF monitoring well network was installed, and groundwater has been monitored under the West Virginia Solid Waste Management Rule (33CSR1) since 2012, which is prior to construction of the LF in 2013 and the initial waste placement in 2014 (CEC, 2016). Background monitoring under the Federal CCR Rule began in 2016. Wells set within either the Fish Creek Sandstone or Rush Run Sandstone are both included in the monitoring network for the Federal program (CEC, 2016). The well of concern (MW-1102F) is set within the Fish Creek Sandstone.

The cross-section of the geology shown in **Attachment A** indicates the presence of the Fish Creek Sandstone spanning the entire length of the cross-section as a continuous layer. Boring logs indicate that this unit is a clastic aquifer consisting of siltstone and sandstone, with the sandstone described as "micaceous, very fine to medium grained sand" (CEC, 2016). The cross-section transect fully encompasses the LF; therefore, it is reasonable to assume that the Fish Creek Sandstone constitutes an uninterrupted groundwater flow pathway permitting hydraulic connectivity between (at a minimum) upgradient well MW-1103F to downgradient well MW-1503F. The continuous nature of the Fish Creek Sandstone within the cross-section indicates that the unit extends laterally outside of the identified transect up to where incision occurs.

A potentiometric site map showing the location of Fish Creek Sandstone monitoring wells and groundwater flow directions during May 2022 is provided as **Figure 1**. Groundwater flow at and around the Landfill does not display noticeable seasonal variation. Potentiometric maps for the Fish Creek monitoring well network using groundwater elevations from events completed between October 2020 and October 2022 are provided as **Attachment B**.

2.3 Proposed Alternative Source

Our analysis will demonstrate that the SSI for chloride has been attributed to natural variation associated with the underlying geology, which is a Type IV (natural variation) cause. Other potential types of ASDs were evaluated but were not determined to be influential in triggering the chloride SSI. Initial review of site geochemistry, site historical data, and laboratory quality assurance and quality controls (QA/QC) did not identify alternative sources of chloride due to Type I (sampling) or Type II (laboratory) causes. A review of the statistical methods used did not identify any Type III (statistical) causes. A preliminary review did not identify any Type V (anthropogenic) causes.

2.3.1 Comparison to Background Concentrations

Chloride in groundwater at the LF is monitored using intrawell prediction limits. A comparison of the reported concentration for chloride between MW-1102F and nearest upgradient background well (MW-1103F) shows that chloride concentrations at the background location have consistently been more than an order of magnitude greater, including before waste was placed in the unit in 2014 (**Figure 2**). While chloride concentrations are consistently around 250 mg/L at background well MW-1103F, concentrations at downgradient well MW-1102F have not exceeded 25 mg/L (**Figure 2)**.

Background wells set within the Fish Creek formation were installed prior to the construction of the LF at upgradient locations in a groundwater flow system containing little seasonal variation. These background wells provide data points characterizing groundwater chemistry at locations that are not susceptible to LF impacts. The range of chemical concentrations observed between wells that are upgradient and downgradient of the LF establishes that significant natural variation exists within the aquifer unit. Fluctuations of chemical concentrations within this range may result from groundwater flow through the aquifer. Additional support for this conclusion is seen in the observable increase in chloride concentrations at MW-1102F which started prior to initiation of waste placement in the LF in 2014.

Therefore, the changes in chloride concentrations at MW-1102F appear to represent natural variation in the dilution of higher chloride concentration groundwater from within the Fish Creek Sandstone as it migrates through the aquifer. This conclusion was also reported in previous ASDs completed for chloride at MW-1102F (Geosyntec, 2019; Geosyntec, 2020c; Geosyntec, 2020d; Geosyntec, 2021; Geosyntec, 2022).

2.3.2 Comparison of Groundwater Boron Concentrations to Landfill Leachate

A comparison of boron, which is sourced from LF leachate, and chloride concentrations was conducted to determine if these parameter's trends were similar or divergent. Boron is a geochemically conservative parameter that is not significantly attenuated during advective flow. Concentrations of boron in groundwater are unlikely to be modified as a result of geochemical processes common in clastic aquifers such as mineral precipitation/dissolution, ion exchange, or oxidation-reduction (redox) variations due to the chemically inert nature of the minerals comprising these types of aquifers. If chloride and boron concentrations at compliance wells were both observed to be increasing, it could indicate the LF leachate was the source of the chloride at MW-1102F.

Figure 3 displays boron concentrations at MW-1102F, upgradient well MW-1103F, and within the LF leachate over time, including reported concentrations in groundwater prior to waste placement that began in 2014. The LF leachate samples presented in **Figure 3** are representative of composite leachate generated in the leachate collection system. Boron concentrations in LF leachate are approximately two orders of magnitude greater than those reported at either monitoring well. If a release from the LF had occurred, the effect of physical mixing is likely to be observed in downgradient groundwater boron concentrations due to the multiple orders of magnitude difference in concentrations between the leachate and the groundwater.

Figure 3 indicates that boron concentrations in groundwater at upgradient and downgradient monitoring locations are stable since monitoring began in 2012. This stability in boron concentrations at MW-1102F provides additional support that the chloride SSI observed at this well is not attributable to LF leachate, as both chloride and boron would be expected to increase if a release had occurred. Rather, these data suggest that chloride is sourced from within the aquifer.

2.3.3 Regional Groundwater Chloride Concentrations

The Fish Creek Sandstone is considered a component of the Pennsylvanian/Permian-age Dunkard Group (Fedorko and Skema, 2013). Groundwater quality data from wells screened within these geologic periods in West Virginia are presented in United States Geological Survey (USGS) Scientific Investigations Report 2012-5186 (USGS, 2012). This study collected groundwater samples from 300 wells across West Virginia, 142 of which were collected from Pennsylvanian-age wells and 19 from Permian-age wells. Multiple wells sampled for this study are located in Marshall County as indicated on the map of sampling locations (**Attachment C**).

These data were put into a box and whisker plot showing chloride concentrations for these samples for each geologic period in **Attachment C**. The median chloride concentration for samples from both Pennsylvanian and Permian groundwater samples appears to be approximately 20 mg/L, with the 75th percentile appearing to be approximately 40 mg/L. Select samples reported chloride concentrations up to 736 mg/L in Pennsylvanian-age wells. Results of this USGS study demonstrate the degree of variability in chloride concentrations from groundwater wells in West

Virginia and support the conclusion that chloride concentrations observed at monitoring well MW-1102F are within the expected range for Pennsylvanian/Permian-age groundwater.

2.4 Sampling Requirements

The conclusions of this ASD support the determination that the identified chloride SSI is from natural variation and not due to a release from the LF. Therefore, the unit will remain in the detection monitoring program. Groundwater at the unit will be sampled for Appendix III parameters on a semiannual basis.

SECTION 3

CONCLUSIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and supports the conclusion that the SSI for chloride observed during the first semiannual sampling event of 2022 is not due to a release from the LF. The observed chloride SSI is instead attributed to natural variation.

The alternative source at MW-1102F is the natural chemical concentration variation of the native water of the Fish Creek Sandstone, which has been shown to contain a range of concentrations for chloride. The Fish Creek Sandstone is documented in **Attachment A** to be a continuous unit of porous sandstone/siltstone spanning from upgradient of the LF to downgradient of the LF without interruption. Boring logs and cross-sections included with the Groundwater Monitoring System Demonstration (CEC, 2016) suggest that the Fish Creek Sandstone is hydrologically continuous and comprised of very fine to medium grained sandstone.

Given the hydrogeology of the unit and geochemistry at upgradient and downgradient monitoring points relative to the LF leachate, the concentrations of chloride at MW-1102F are attributed to the alternative natural source rather than a release from the LF.

This demonstration meets the requirements in both 40 C.F.R. § 257.95(3)(ii) and the Technical Manual for the Municipal Solid Waste Landfill regulatory program at 40 C.F.R. § 258.54(c)(iii) that an SSI may result from natural variation in the groundwater quality. Therefore, no further action is warranted, and the Mitchell Landfill will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in **Attachment D**.

SECTION 4

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TABLES

Table 1 - Detection Monitoring Data Comparison
Mitchell - Landfill

Analyte	Unit	Description	MW-1101R	MW-1102F		MW-1502R
			5/12/2022	5/12/2022	8/31/2022	5/12/2022
Boron	mg/L	Intrawell Background Value (UPL)	0.498	0.280		0.267
		Analytical Result	0.373	0.126	--	0.084
Calcium	mg/L	Intrawell Background Value (UPL)	2.61	5.60		110
		Analytical Result	2.52	4.37	--	84.0
Chloride	mg/L	Intrawell Background Value (UPL)	18.1	19.6		250
		Analytical Result	17.5	**20.0**	**19.9**	102
Fluoride	mg/L	Intrawell Background Value (UPL)	3.09	0.875		0.254
		Analytical Result	2.67	0.85	--	0.21
pH	SU	Intrawell Background Value (UPL)	9.1	9.6		8.5
		Intrawell Background Value (LPL)	7.9	7.6		7.2
		Analytical Result	9.0	8.8	--	8.3
Sulfate	mg/L	Intrawell Background Value (UPL)	37.8	44.6		236
		Analytical Result	29.1	40.8	--	105
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	930	614		778
		Analytical Result	840	600	--	520

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

FIGURES

Legend

- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on May 10, 2022) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

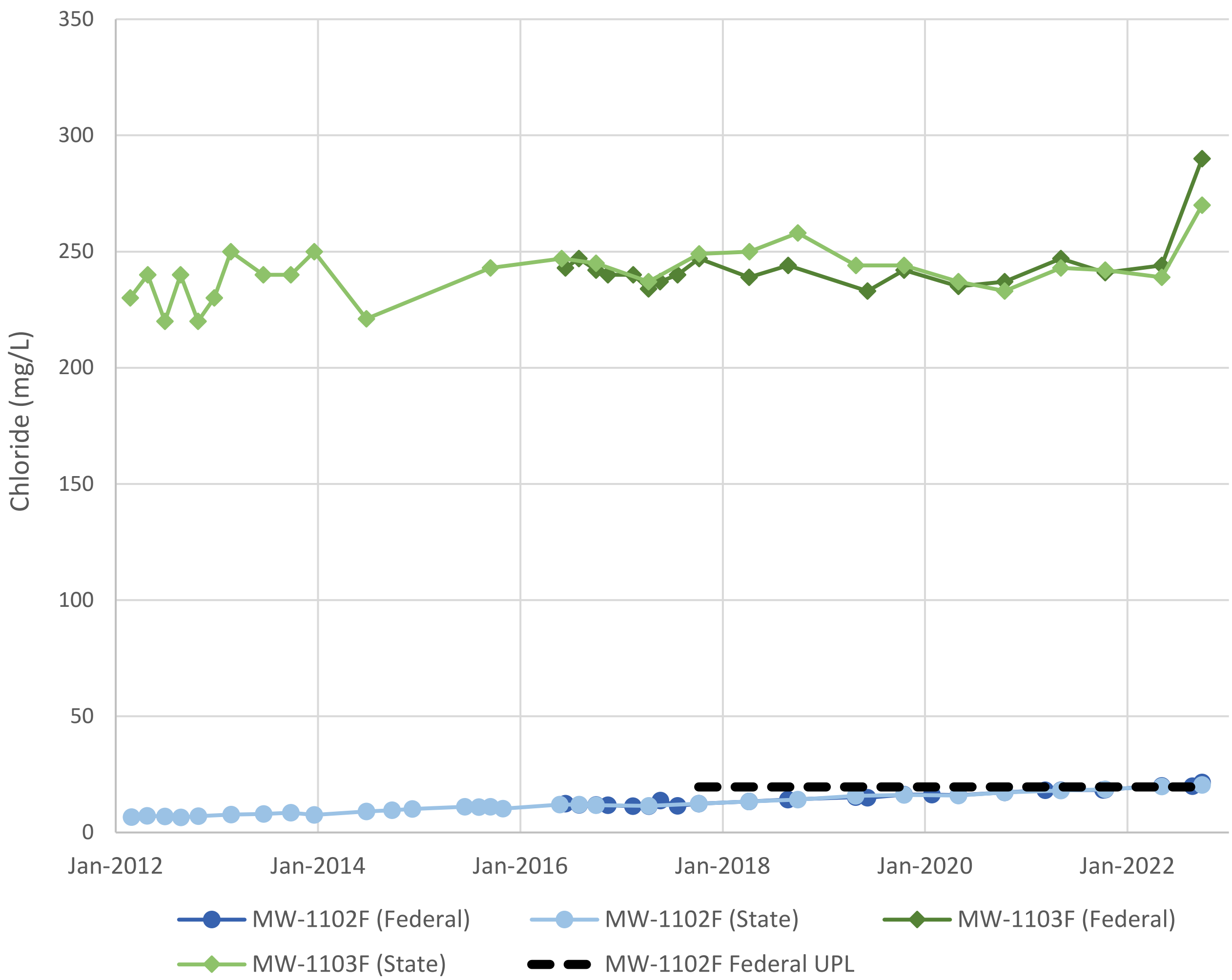
Potentiometric Surface Map - Fish Creek May 2022

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio	2022/11/22	Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2022\AEP-Mitchell_Landfill-FC_GW_May2022.mxd. ASoltero. 11/22/2022. Project/Phase/Task.



Notes: Data are shown for both the federal and state monitoring programs. MW-1103F is a background monitoring location for the Fish Creek Formation. Downgradient location MW-1102F is also screened in the Fish Creek Formation. Samples for chloride analysis were not filtered for the federal or state programs.

Chloride Time Series Graph

Mitchell Landfill

Geosyntec consultants

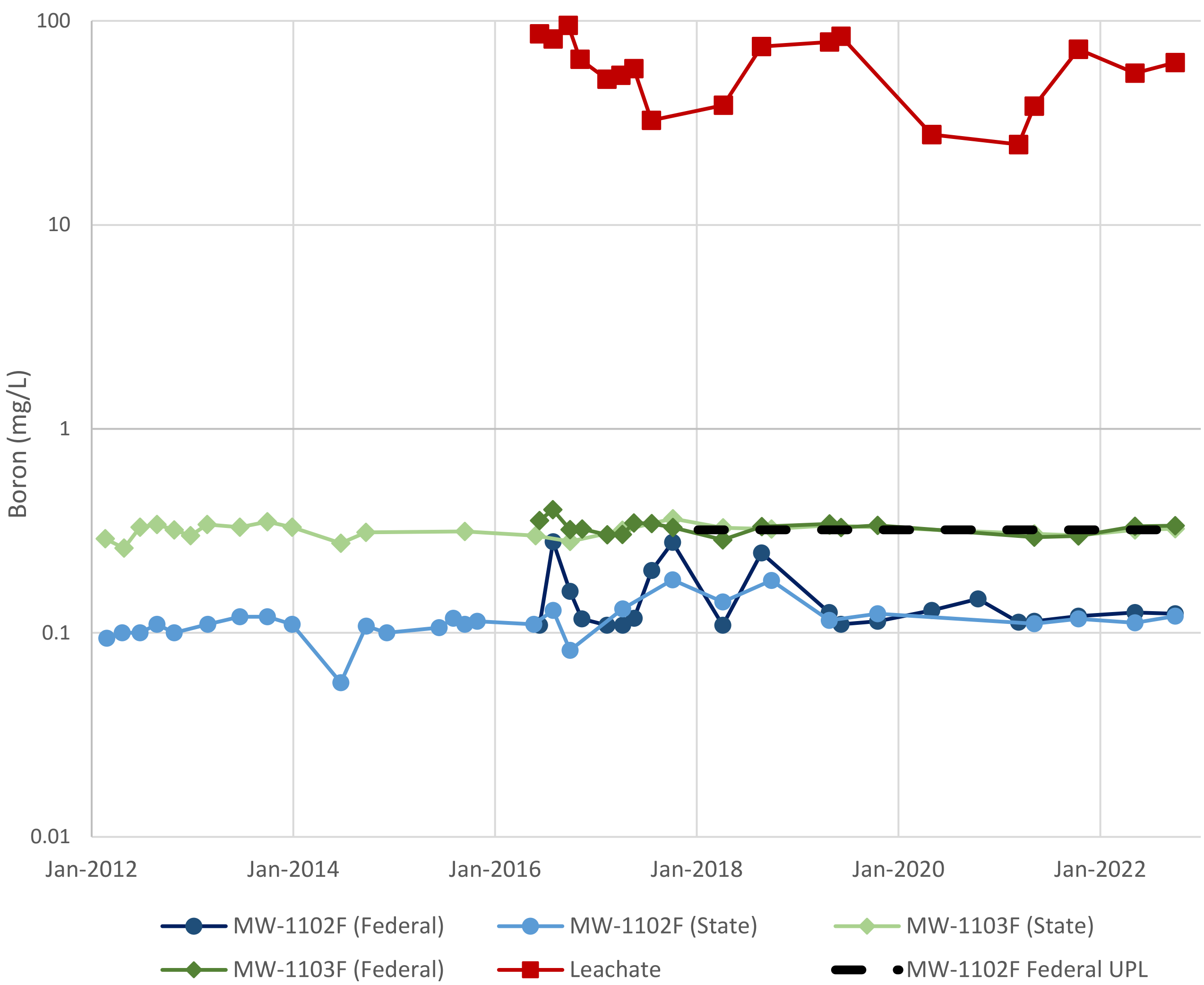
AMERICAN ELECTRIC POWER

Figure 2

Columbus, Ohio

February 2023

\\annarbor-01\data\Projects\AEP\Legal Department - ASD Review\Mitchell\LF_2022_01 ASD_1st2021\Figures



Notes: Data are shown for both the federal and state monitoring programs. MW-1103F is a background monitoring location for the Fish Creek Formation. Downgradient location MW-1102F is also screened in the Fish Creek Formation. Samples for boron analysis were filtered for the state monitoring program, and were not filtered for the federal monitoring program.

Boron Time Series Graph

Mitchell Landfill

Geosyntec consultants

AMERICAN ELECTRIC POWER

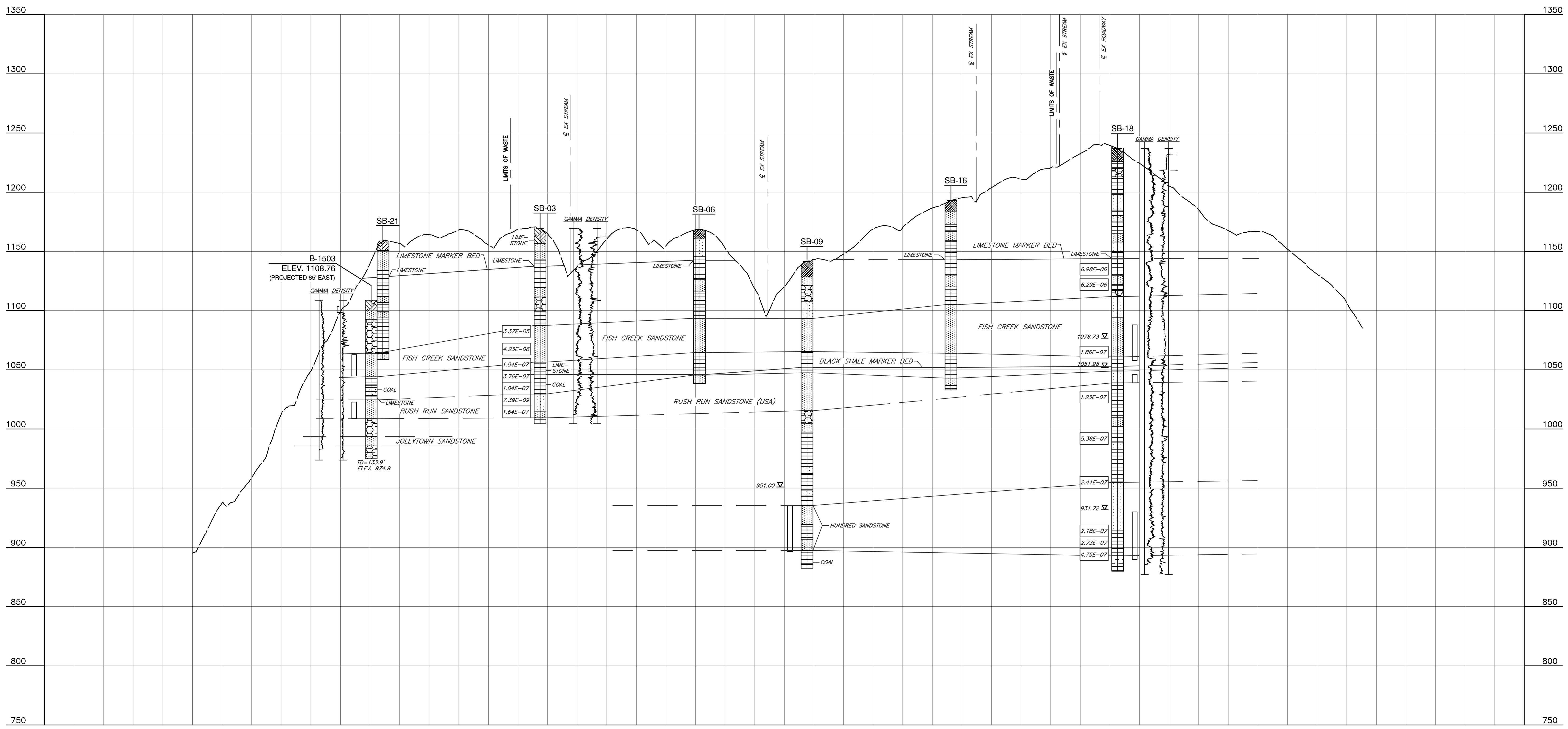
Figure **3**

Columbus, Ohio

February 2023

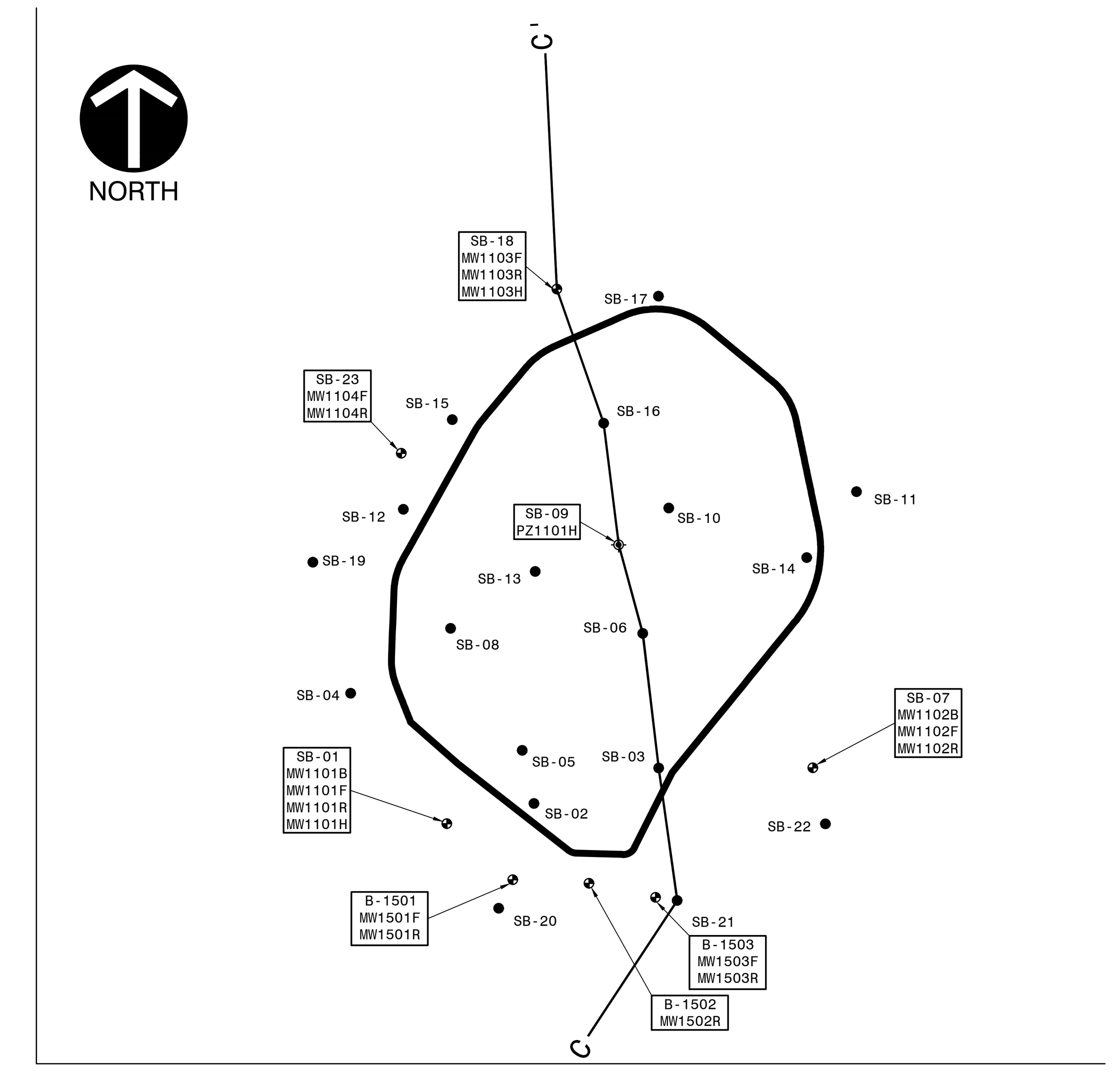
ATTACHMENT A

Geologic Cross Section



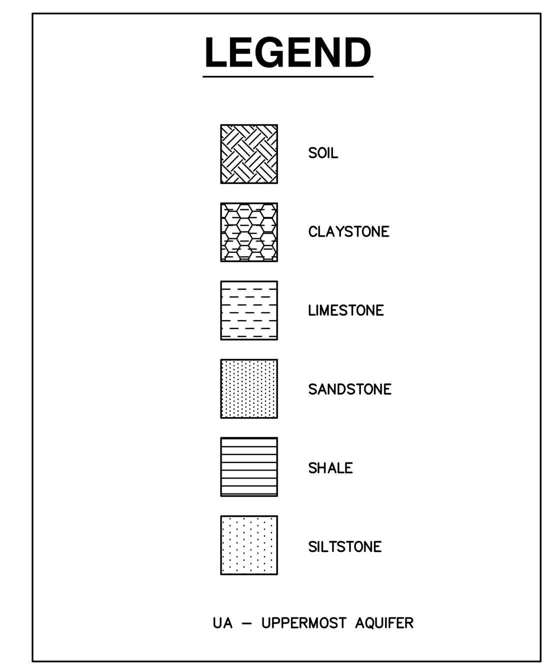
GEOLOGIC CROSS SECTION C - C'

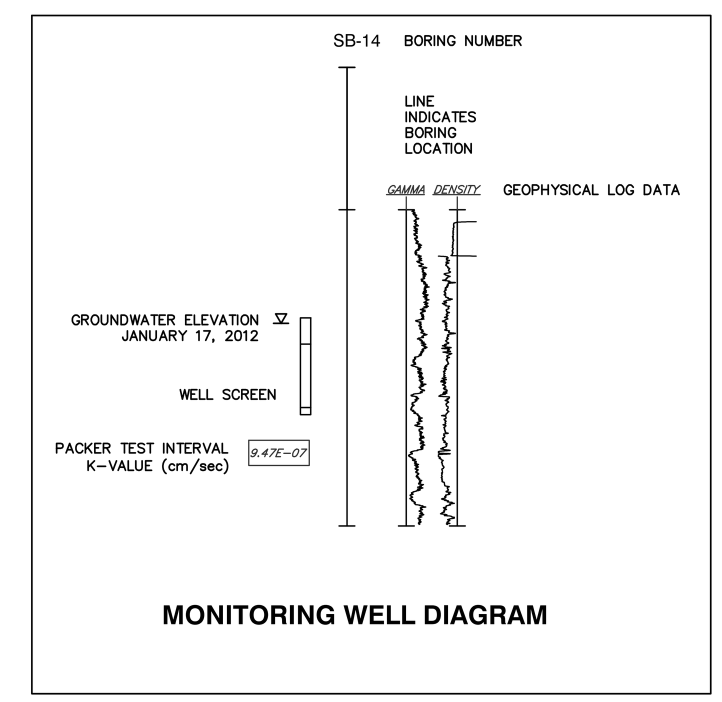
SCALE H:1"=200'; V:1"=50'



KEY PLAN

N.T.S.





NOTE:

1. THE BORING LOGS AND RELATED INFORMATION PRESENTED HEREIN DEPICT SUBSURFACE CONDITIONS AT THE TEST BORING LOCATIONS AND AT THE TIME OF DRILLING. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER.
2. GEOLOGIC CORRELATIONS SHOWN BETWEEN TEST BORINGS GENERALLY ARE BASED ON A STRAIGHT–LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN TEST BORINGS MAY DIFFER.

HORZ. SCALE: 1"=200'
VERT. SCALE: 1"=50'

REVISION RECORD

NO	DATE	DESCRIPTION

Civil & Environmental Consultants, Inc.
5899 Montclair Blvd. · Cincinnati, OH 45150
513-985-0226 · 800-759-5614
www.cecinc.com

AMERICAN ELECTRIC POWER
MITCHELL LANDFILL
MITCHELL POWER GENERATION PLANT
MARSHALL COUNTY, WEST VIRGINIA

GROUNDWATER MONITORING SYSTEM DEMONSTRATION

GEOLOGIC CROSS SECTION C-C'

DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7601		
APPROVED BY:	APA		

FIGURE NO.: 6

P:\2011\110-416\-CADD\DWG\ML GMM Evaluation Report Task 7601\110416-7601 Figure 6_Geologic Cross Section C-C.dwg{CCR FIGURE 6} LS:(30/12/2015 - drudy) - LP: 12/30/2015 3:14 PM

ATTACHMENT B

Potentiometric Maps

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on October 20, 2020) provided by AEP.

-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.

- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Fish Creek
October 2020

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2020/12/29

Figure **B1**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2020\AEP-Mitchell_Landfill-FC_GW_Oct2020.mxd. HDuff. 12/29/2020. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on March 16, 2021) provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Fish Creek March 2021

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2021/06/11

Figure **B2**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2021\AEP-Mitchell_Landfill-FC_GW_March2021.mxd. ASoltero. 6/11/2021. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on May 11, 2021) provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Fish Creek May 2021

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2021/09/07

Figure **B3**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2021\AEP-Mitchell_Landfill-FC_GW_May2021.mxd. ASoltero. 9/7/2021. Project/Phase/Task.

Legend
- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes
- Monitoring well coordinates and water level data (collected on October 19, 2021) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Fish Creek October 2021

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2022/01/11

Figure **B4**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2021\AEP-Mitchell_Landfill-FC_GW_Oct2021.mxd. ASoltero. 1/11/2022. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on May 10, 2022) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

Potentiometric Surface Map - Fish Creek
May 2022

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2022/11/22

Figure **B5**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2022\AEP-Mitchell_Landfill-FC_GW_May2022.mxd. ASoltero. 11/22/2022. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on October 5, 2022) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Fish Creek October 2022

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2023/01/23

Figure **B6**

M:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2022\AEP-Mitchell_Landfill-FC_GW_Oct2022.mxd. HDuff. 1/23/2023. Project/Phase/Task.

ATTACHMENT C
Sampling Locations and Chloride Results for West Virginia Groundwater

organic compounds, volatile organic compounds, and dissolved gases. A summary of dissolved gas data collected as part of this study can be found in McCoy and Kozar (2007).

Study Area, Design, and Methods

West Virginia lies entirely within the Appalachian Mountains with parts of the State in three physiographic provinces (Fenneman and Johnson, 1946), regions with similar rock types and groundwater characteristics. The western and central parts of the State lie within the Appalachian Plateaus Physiographic Province. The Appalachian Plateaus consist of sub-horizontal consolidated sedimentary rocks of Devonian to Permian age (fig. 1). These rocks have been highly dissected by stream erosion resulting in steep hills and deeply incised valleys. Valleys are filled in part with unconsolidated sediments of Quaternary age.

The eastern part of the State lies primarily in the Valley and Ridge Physiographic Province, named for the series of northeast-southwest trending valleys and ridges formed from Cambrian to Silurian aquifers. These strata are consolidated sedimentary rocks that are extensively faulted and sharply folded. The Blue Ridge Physiographic Province includes only the very easternmost edge of the Eastern Panhandle of West Virginia. In contrast to the sedimentary rocks of the Appalachian Plateaus and Valley and Ridge Physiographic Provinces, the Blue Ridge Physiographic Province is underlain by crystalline rock.

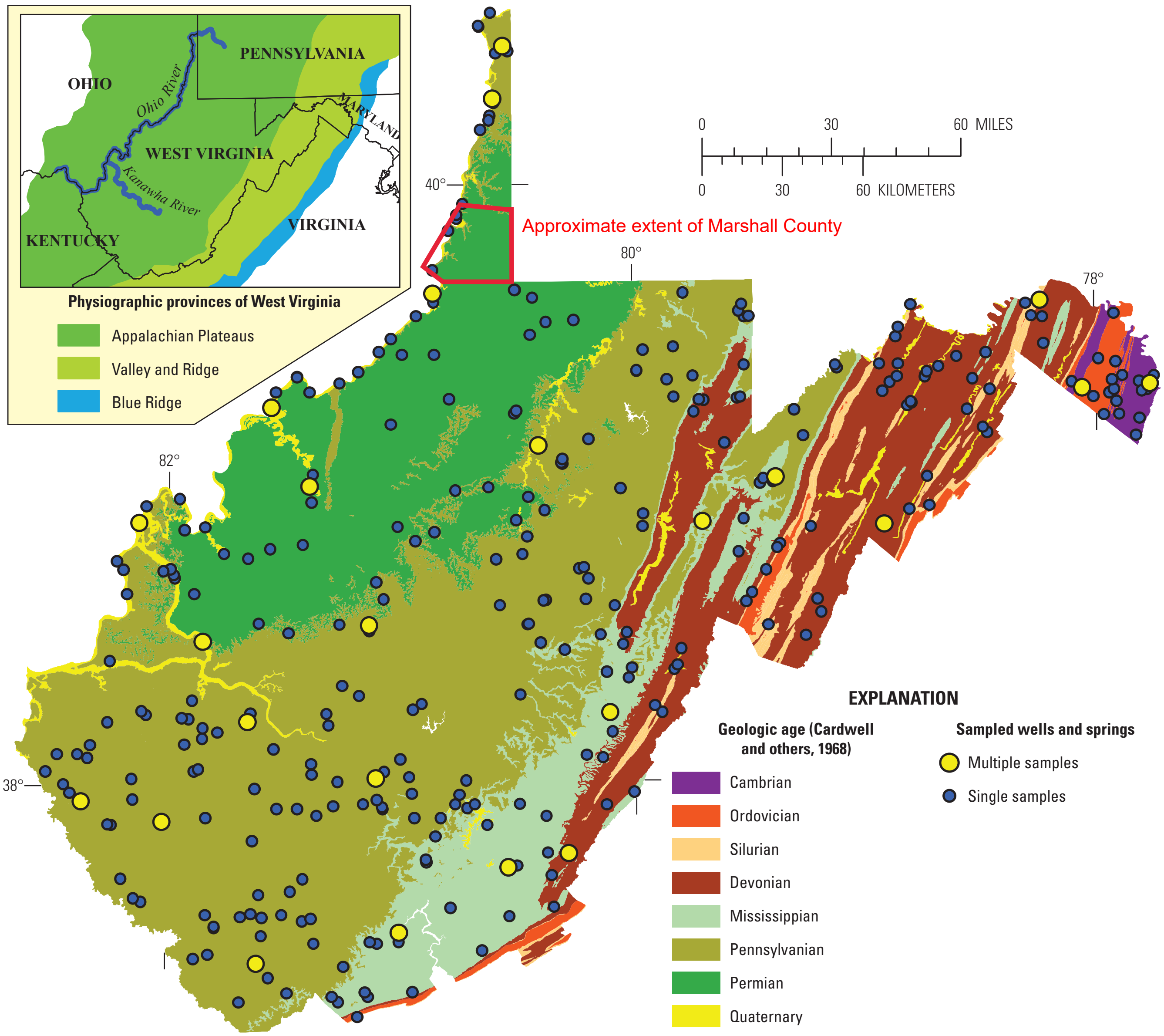


Figure 1. The geology of West Virginia and locations of groundwater-quality sampling sites, wells, and springs in the West Virginia ambient monitoring network, 1993–2008.

Chloride

Chloride, the most abundant halide (Hem, 1985), ranged in concentration from less than the 0.2 mg/L minimum reporting level to 736 mg/L with a median value of 16.6 mg/L (table 4). Most wells, 80 percent, had chloride values from 1.8 mg/L to 77 mg/L. Median values, by geologic ages of aquifers, ranged from 6.6 mg/L for wells in Devonian aquifers to 28 mg/L for wells in Quaternary aquifers (fig. 10).

The SMCL for chloride is 250 mg/L (U.S. Environmental Protection Agency, 2009b). Samples from four wells exceeded this concentration. All four were from areas of Pennsylvanian aquifers.

Sulfate

In West Virginia pyrite-bearing rock formations are a major source of sulfate in groundwater. MacAuley and Kozar (2006) found groundwater sulfate concentrations to be increased in mined areas of West Virginia's Northern Appalachian Coal Basin.

Although sulfate concentrations ranged from less than a reporting level of 0.07 mg/L to 767 mg/L with a median value of 14.7 mg/L for all samples, most wells (80 percent) had sulfate concentrations of 0.3 mg/L to 86 mg/L. Median sulfate concentrations varied widely by geologic age of the aquifers, from a low of 6.7 mg/L for wells in Pennsylvanian aquifers to 58.6 mg/L for wells in Quaternary aquifers (fig. 11). Sulfate concentrations exceeding the SMCL of 250 mg/L (U.S. Environmental Protection Agency, 2009b) were found in samples from nine wells (table 4).

Water Types

Natural waters can be classified by "water type" on the basis of major-ion composition. Water samples with a specific cation or anion constituting more than one-half the total cations or anions can be classified by water type, calcium carbonate type water, for example (Hem, 1985). However, waters in which no single cation or anion constitutes greater than one-half of the total cations or anions are classed as mixed-type waters (Hem, 1985). Samples from aquifers classified by geologic age typically reflect a signature characteristic of the rock type, although the rock-type signatures may overlap broadly. Calcium was the dominant cation in most samples from wells in Quaternary aquifers (fig. 12*A*); the dominant anion in most samples from Quaternary aquifers was bicarbonate with some samples having a sulfate or chloride

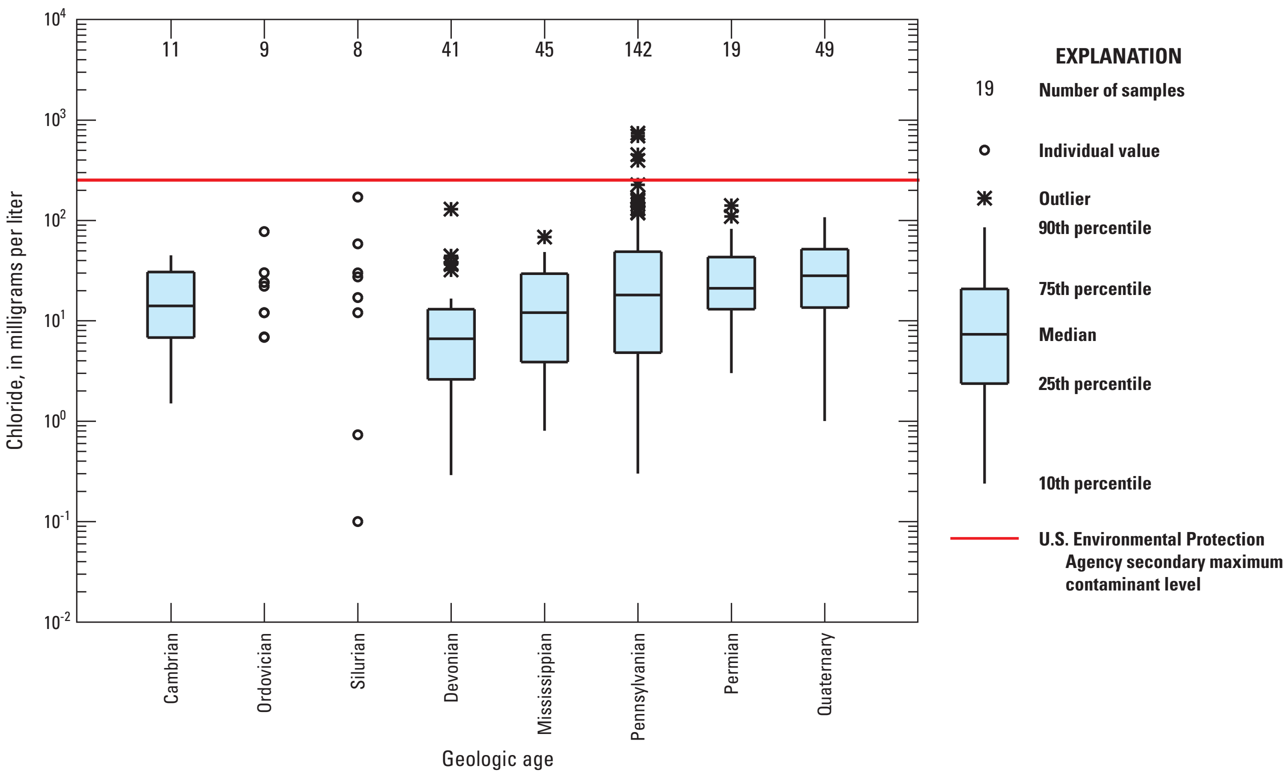


Figure 10. Distribution of chloride concentrations in groundwater samples from the West Virginia ambient monitoring network, grouped by geologic age of the aquifers, 1993–2008. U.S. Environmental Protection Agency (2009b) secondary maximum contaminant level of 250 milligrams per liter for finished drinking water is shown.

ATTACHMENT D

Certification by a Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

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

JOHN P. SEYMOUR
REGISTERED
17091
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

John Seymour
Printed Name of Licensed Professional Engineer

Signature

017091
License Number

West Virginia
Licensing State

3/2/2023
Date

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

Mitchell Plant Landfill

Marshall County, West Virginia

Prepared for

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

Prepared by

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

Project CHA8495

September 2023

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ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	alternative source demonstration
CCR	coal combustion residuals
CEC	Civil & Environmental Consultants, Inc.
CFR	Code of Federal Regulations
LPL	lower prediction limit
mg/L	milligrams per liter
QA/QC	quality assurance and quality control
SSI	statistically significant increase
UPL	upper prediction limit
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

1. INTRODUCTION AND SUMMARY

This alternative source demonstration (ASD) report has been prepared to address a statistically significant increase (SSI) for chloride at the Mitchell Plant Landfill (Landfill) following the second semiannual detection monitoring event of 2022.

Following completion of four additional detection monitoring events, the previously calculated upper prediction limits (UPLs) for the Landfill were recalculated for each Appendix III parameter to represent background values (Geosyntec 2020a). A lower prediction limit (LPL) was also recalculated for pH. The revised prediction limits were calculated based on a one-of-two retesting procedure in accordance with the *Unified Guidance* (United States Environmental Protection Agency [USEPA] 2009) and the statistical analysis plan developed for the site (Geosyntec 2020b). With this procedure, an SSI is concluded only if concentrations in both samples in a series of two (the initial sample and the resample) are above the UPL or, in the case of pH, are either below the LPL or above the UPL.

The second semiannual detection monitoring event of 2022 at the Landfill was completed in October 2022 (initial sampling event) and March 2023 (verification sampling event), and the results were compared to the recalculated prediction limits. During this detection monitoring event, an SSI was identified for chloride at monitoring well MW-1102F. A summary of the detection monitoring analytical results for all constituents listed in the Code of Federal Regulations (CFR) Title 40, Part 257, Appendix III and the calculated prediction limits for comparison are provided in **Table 1**.

1.1 CCR Rule Requirements

USEPA regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments state 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. (40 CFR 257.94[e][2])

The second semiannual detection monitoring event for 2022 was completed in October 2022 and a resampling event was completed in March 2023 to identify SSIs over background limits. Pursuant to 40 CFR 257.94(e)(2), Geosyntec Consultants, Inc. (Geosyntec) has prepared this ASD report to identify whether the SSI identified for chloride at MW-1102F is from a source other than 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 from among five types:

- ASD Type I: Sampling Causes

- ASD Type II: Laboratory Causes
- ASD Type III: Statistical Evaluation Causes
- ASD Type IV: Natural Variation
- ASD Type V: Alternative Sources

A demonstration was conducted to assess whether the increase in chloride at MW-1102F could be attributed to an alternative source and not a release from the Landfill.

2. ALTERNATIVE SOURCE DEMONSTRATION

This section provides a brief description of the site geology, ASD evaluation methods, and the proposed alternative source.

2.1 Landfill Construction and Site Geology Summary

The Landfill was designed and constructed in accordance with West Virginia Department of Environmental Protection Class F Industrial Landfill requirements. The Landfill design includes several engineering controls, including a composite liner, groundwater interceptor drainage system, and a leachate collection system (Civil & Environmental Consultants, Inc. [CEC] 2016). The Landfill is being constructed in phases; CCR materials are currently being placed in Phase 3. Phases 1 and 2, which previously received CCR materials, were covered with a 6-inch-thick layer of temporary cover (American Electric Power [AEP] 2022).

The local geology consists of Pennsylvanian/Permian-age clastic units separated by sharp contacts with shale or coal seams (CEC 2016). These units are components of the Dunkard and Monongahela Groups. From top to bottom, the named sandstone units underlying the Landfill include the Burton Sandstone, the Fish Creek Sandstone, the Rush Run Sandstone, the Jollytown Sandstone, and the Hundred Sandstone. A cross section of the geology underlying the Landfill, which was included in the groundwater monitoring network report (CEC 2016), is provided as **Attachment A**.

2.2 Groundwater Monitoring History and Flow Characteristics

Groundwater at the Landfill has been monitored under the West Virginia Solid Waste Management Rule (33CSR1) since 2012, before the Landfill was constructed in 2013 and before the initial waste placement in 2014 (CEC 2016). Background monitoring under the Federal CCR Rule began in 2016. Wells set within either the Fish Creek Sandstone or Rush Run Sandstone are both included in the monitoring network for the federal program (CEC 2016). The well of concern (MW-1102F) is set within the Fish Creek Sandstone.

The cross section of the geology shown in **Attachment A** indicates the presence of the Fish Creek Sandstone spanning the entire length of the cross section as a continuous layer. Boring logs indicate that this unit is a clastic aquifer consisting of siltstone and sandstone, with the sandstone described as "micaceous, very fine to medium grained sand" (CEC 2016). The cross-section transect fully encompasses the Landfill; therefore, it is reasonable to assume that the Fish Creek Sandstone constitutes an uninterrupted groundwater flow pathway permitting hydraulic connectivity between (at a minimum) upgradient well MW-1103F and downgradient well MW-1503F. The continuous nature of the Fish Creek Sandstone within the cross section indicates that the unit extends laterally outside of the identified transect up to where incision occurs.

A potentiometric site map showing the location of Fish Creek Sandstone monitoring wells and groundwater flow directions during October 2022 is provided as **Figure 1**. Groundwater flow at and around the Landfill does not display noticeable seasonal variation. Potentiometric maps for the Fish Creek monitoring well network using groundwater elevations from events completed between October 2020 and October 2022 are provided as **Attachment B**.

2.3 Examined Alternative Source

The analysis will examine whether the SSI for chloride can be attributed to natural variation associated with the underlying geology, which is a Type IV (natural variation) cause. Other potential types of alternative sources were evaluated but were determined not to be influential in triggering the chloride SSI. Initial review of site geochemistry, site historical data, and laboratory quality assurance and quality controls (QA/QC) did not identify alternative sources of chloride due to Type I (sampling) or Type II (laboratory) causes. A review of the statistical methods used did not identify any Type III (statistical) causes. A preliminary review did not identify any Type V (anthropogenic) causes.

2.3.1 Comparison to Background Concentrations

Chloride in groundwater at the Landfill is monitored using intrawell prediction limits. A comparison of the reported concentration for chloride between MW-1102F and nearest upgradient background well (MW-1103F) shows that chloride concentrations at the background location have consistently been more than 10 times greater, including the period before waste was placed in the unit in 2014 (**Figure 2**). While chloride concentrations have consistently been detected around 250 mg/L at background well MW-1103F, the October 2022 samples were found to have the highest chloride concentrations to date (290 mg/L). However, the concentrations at downgradient well MW-1102F have not exceeded 25 mg/L (**Figure 2)**.

Background wells set within the Fish Creek formation were installed prior to the construction of the Landfill at upgradient locations in a groundwater flow system containing little seasonal variation. These background wells provide data points characterizing groundwater chemistry at locations that are not susceptible to Landfill impacts. The range of chemical concentrations observed between wells that are upgradient and downgradient of the Landfill establishes that significant natural variation exists within the aquifer unit. Fluctuations of chemical concentrations within this range could result from groundwater flow through the aquifer. Additional support for this conclusion is seen in the observable increase in chloride concentrations at MW-1102F, which started before the initial waste placement in the Landfill in 2014.

Therefore, the changes in chloride concentrations at MW-1102F appear to represent natural variation in the dilution of higher-chloride-concentration groundwater from within the Fish Creek Sandstone as it migrates through the aquifer. This conclusion was also reported in previous ASDs completed for chloride at MW-1102F (Geosyntec 2019; Geosyntec 2020c; Geosyntec 2020d; Geosyntec 2021; Geosyntec 2022; Geosyntec 2023).

2.3.2 Comparison of Groundwater Boron Concentrations to Landfill Leachate

A comparison of concentrations of boron, obtained from Landfill leachate analysis, and chloride, was conducted to assess whether these parameter's trends were similar or divergent. Boron is a geochemically conservative parameter that is not significantly attenuated during advective flow. Concentrations of boron in groundwater are unlikely to be modified as a result of geochemical processes common in clastic aquifers, such as mineral precipitation/dissolution, ion exchange, or oxidation-reduction (redox) variations, because the minerals that make up these types of aquifers are chemically inert. If chloride and boron concentrations at compliance wells were both observed to be increasing, it could indicate that the Landfill leachate was the source of the chloride at MW-1102F.

Boron concentrations in Landfill leachate are approximately 100 times greater than those reported at MW-1102F and MW-1103F (**Figure 3**). If a release from the Landfill had occurred, the effect of physical mixing is likely to be observed in downgradient groundwater boron concentrations due to the multiple orders of magnitude difference in concentrations between the leachate and the groundwater. Boron concentrations in groundwater at upgradient and downgradient monitoring locations appear stable since monitoring began in 2012 (**Figure 3**). This stability in boron concentrations at MW-1102F provides additional support that the chloride SSI observed at this well is not attributable to Landfill leachate, as both chloride and boron would be expected to increase if a release had occurred. Rather, these data suggest that chloride is sourced from within the aquifer.

2.3.3 Regional Groundwater Chloride Concentrations

The Fish Creek Sandstone is considered a component of the Pennsylvanian/Permian-age Dunkard Group (Fedorko and Skema 2013). Groundwater quality data from wells screened within these geologic periods in West Virginia are presented in United States Geological Survey (USGS) Scientific Investigations Report 2012-5186 (USGS 2012). This study collected groundwater samples from 300 wells across West Virginia, 142 of which were collected from Pennsylvanian-age wells and 19 from Permian-age wells. Multiple wells sampled for this study are in Marshall County, as indicated on the map of sampling locations (**Attachment C**).

These data were put into a box-and-whisker plot showing chloride concentrations for these samples for each geologic period in **Attachment C**. The median chloride concentration for samples from both Pennsylvanian and Permian groundwater samples is approximately 20 mg/L, and the 75th percentile is approximately 40 mg/L. Select samples reported chloride concentrations up to 736 mg/L in Pennsylvanian-age wells. Results of this USGS study demonstrate the degree of variability in chloride concentrations from groundwater wells in West Virginia and support the conclusion that chloride concentrations observed at monitoring well MW-1102F are within the expected range for Pennsylvanian/Permian-age groundwater.

2.4 Sampling Requirements

The conclusions of this ASD support the determination that the identified chloride SSI is due to natural variation and not a release from the Landfill. Therefore, the unit will remain in the detection monitoring program. Groundwater at the unit will be sampled for Appendix III parameters on a semiannual basis.

3. CONCLUSIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and supports the conclusion that the SSI for chloride observed during the first semiannual sampling event of 2022 is not due to a release from the Landfill. The observed chloride SSI is instead attributed to natural variation.

The alternative source at MW-1102F is the natural chemical concentration variation of the native water of the Fish Creek Sandstone, which has been shown to contain a range of concentrations for chloride. The Fish Creek Sandstone is documented (**Attachment A**) to be a continuous unit of porous sandstone/siltstone spanning without interruption from upgradient of the Landfill to downgradient of the Landfill. Boring logs and cross sections included with the *Groundwater Monitoring System Demonstration* (CEC 2016) suggest that the Fish Creek Sandstone is hydrologically continuous and consists of very-fine- to medium-grained sandstone.

Given the hydrogeology of the unit and geochemistry at upgradient and downgradient monitoring points relative to the Landfill leachate, the concentrations of chloride at MW-1102F are attributed to the alternative natural source rather than a release from the Landfill.

This demonstration meets the requirements in both 40 CFR 257.95(3)(ii) and the Technical Manual for the Municipal Solid Waste Landfill regulatory program at 40 CFR 258.54(c)(iii) and supports the position that the chloride SSI is likely a result from natural variation in the groundwater quality. Therefore, no further action is warranted, and the Mitchell Landfill will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in **Attachment D**.

4. REFERENCES

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TABLES

Table 1. Detection Monitoring Data Comparison
Mitchell Plant, Landfill

Analyte	Unit	Description	MW-1101R		MW-1102F		MW-1502R	
			10/5/2022	3/22/2023	10/5/2022	3/22/2023	10/5/2022	3/22/2023
Boron	mg/L	Intrawell Background Value (UPL)	0.498		0.280		0.267	
		Analytical Result	0.394	--	0.124	--	0.135	--
Calcium	mg/L	Intrawell Background Value (UPL)	2.61		5.60		110	
		Analytical Result	**2.79**	2.54	4.34	--	89.5	--
Chloride	mg/L	Intrawell Background Value (UPL)	18.1		19.6		250	
		Analytical Result	**18.3**	17.3	**21.5**	**21.1**	69.4	--
Fluoride	mg/L	Intrawell Background Value (UPL)	3.09		0.875		0.254	
		Analytical Result	2.81	--	0.86	--	0.21	--
pH	SU	Intrawell Background Value (UPL)	9.1		9.6		8.5	
		Intrawell Background Value (LPL)	7.9		7.6		7.2	
		Analytical Result	8.3	--	7.9	--	**6.9**	7.4
Sulfate	mg/L	Intrawell Background Value (UPL)	37.8		44.6		236	
		Analytical Result	29.3	--	41.3	--	131	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	930		614		778	
		Analytical Result	840	--	590	--	540	--

Notes:
Bold values exceed the background value.
Background values are shaded gray.
LPL: lower prediction limit
mg/L: milligrams per liter
SU: standard units
UPL: upper prediction limit
--: not measured

FIGURES

Legend

- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on October 5, 2022) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Fish Creek October 2022

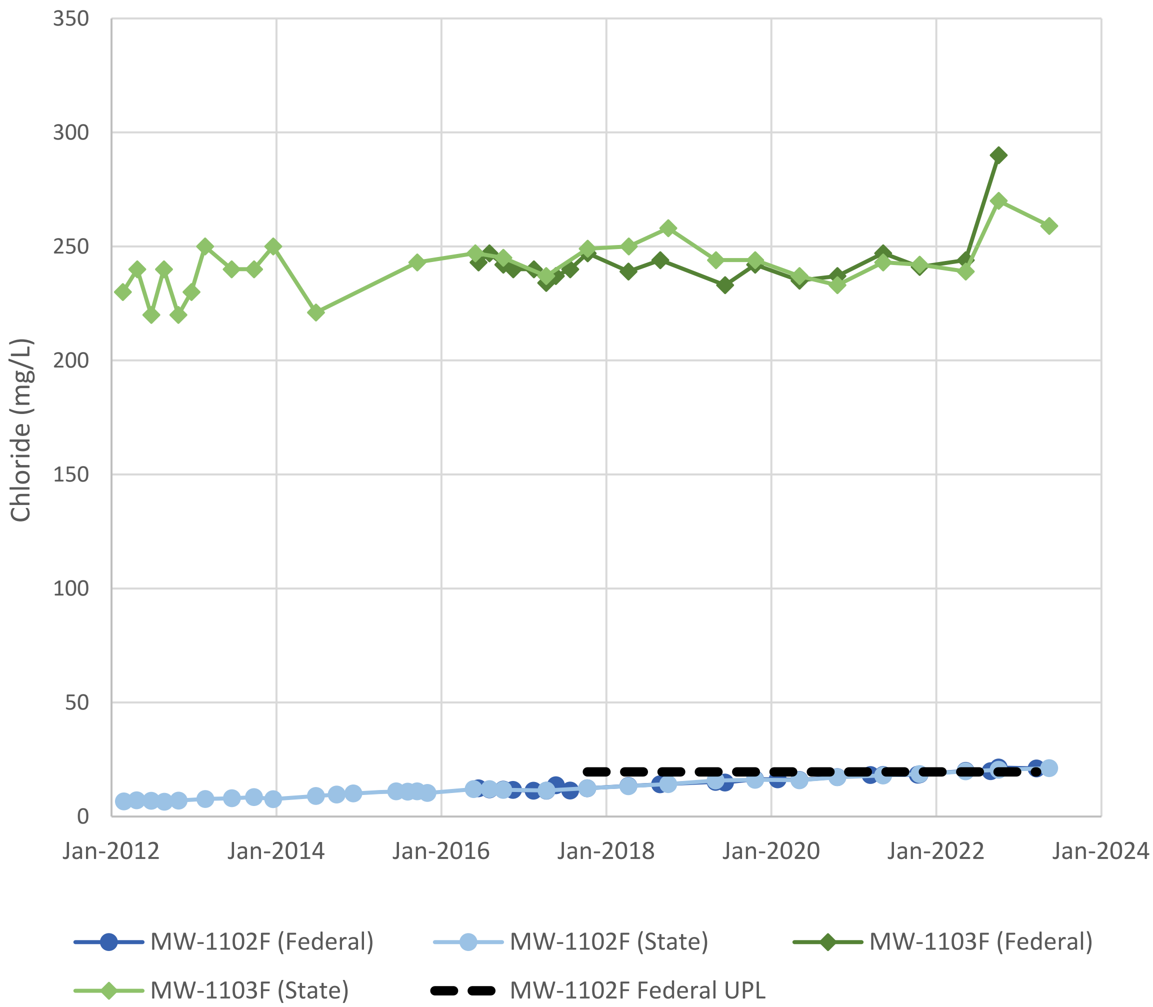
Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | September 2023

Figure 1

M:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2022\AEP-Mitchell_Landfill-FC_GW_Oct2022.mxd. HDuff. 1/23/2023. Project/Phase/Task.



Notes: Data are shown for both the federal and state monitoring programs. MW-1103F is a background monitoring location for the Fish Creek Formation. Downgradient location MW-1102F is also screened in the Fish Creek Formation. Samples for chloride analysis were not filtered for the federal or state programs.
mg/L: milligrams per liter
UPL: upper prediction limit

Chloride Time Series Graph

Mitchell Landfill

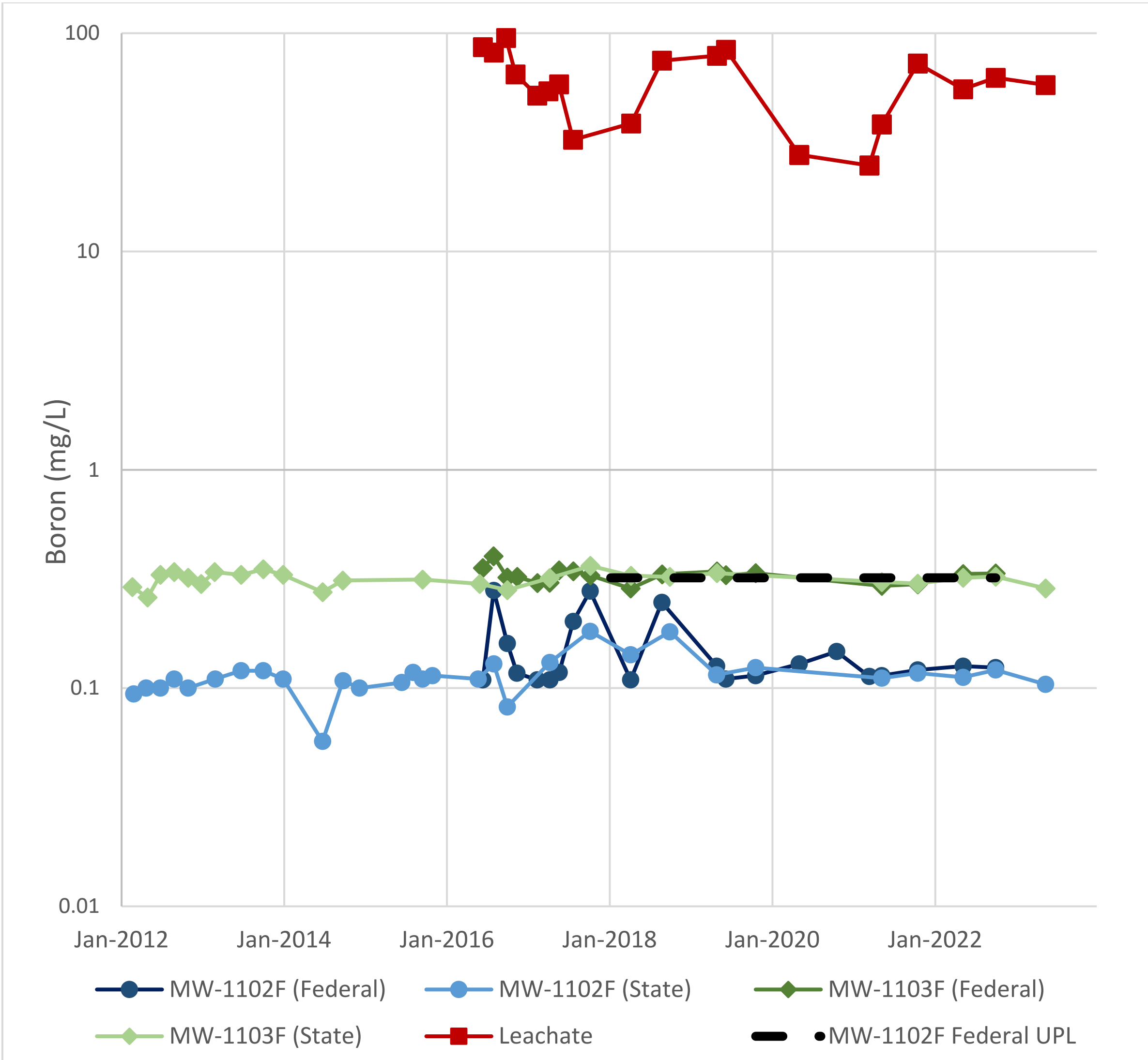
Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure 2

Columbus, Ohio

September 2023



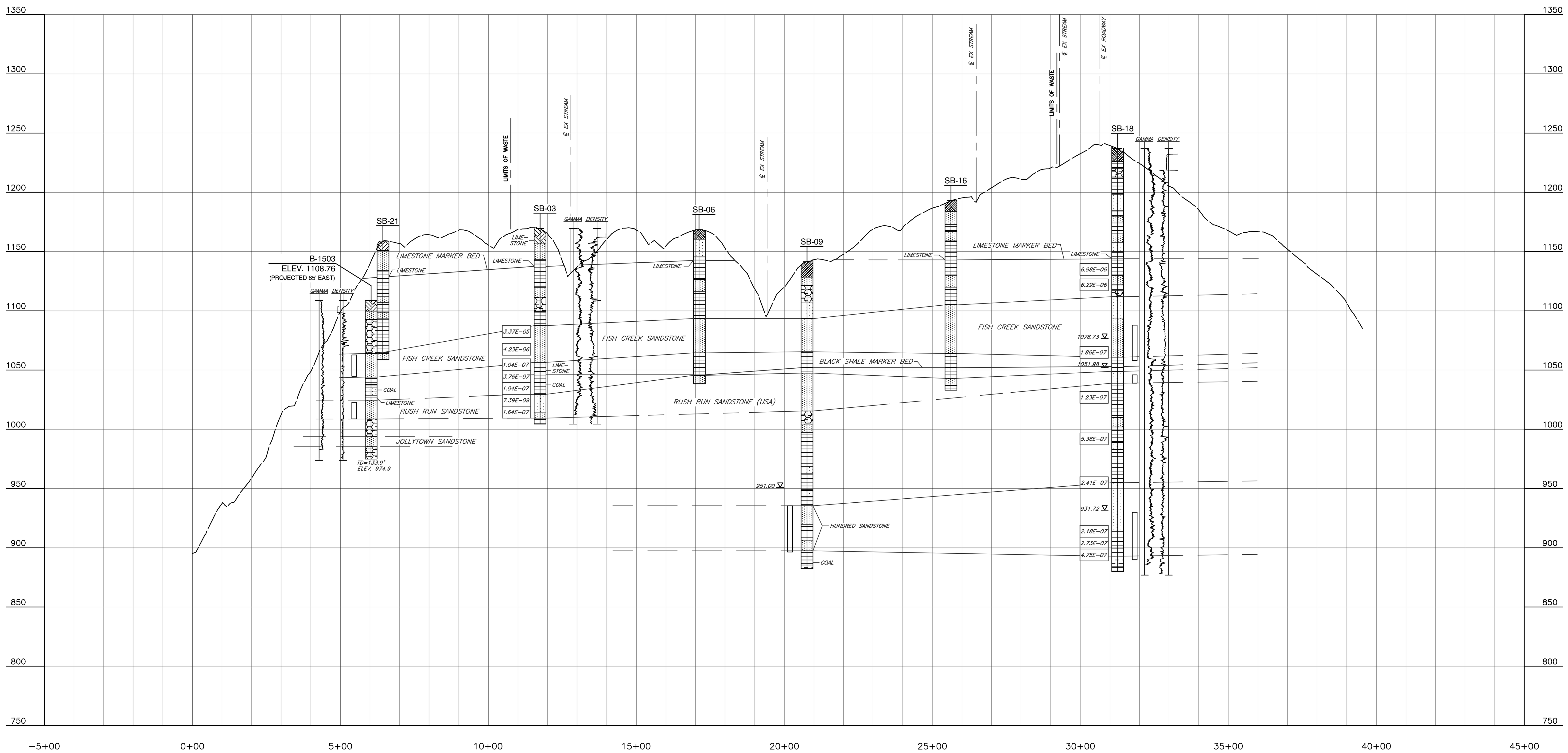
Notes: Data are shown for both the federal and state monitoring programs. MW-1103F is a background monitoring location for the Fish Creek Formation. Downgradient location MW-1102F is also screened in the Fish Creek Formation. Samples for boron analysis were filtered for the state monitoring program, and were not filtered for the federal monitoring program.
mg/L: milligrams per liter
UPL: upper prediction limit

Boron Time Series Graph
Mitchell Landfill

Geosyntec consultants | American Electric Power | Figure 3

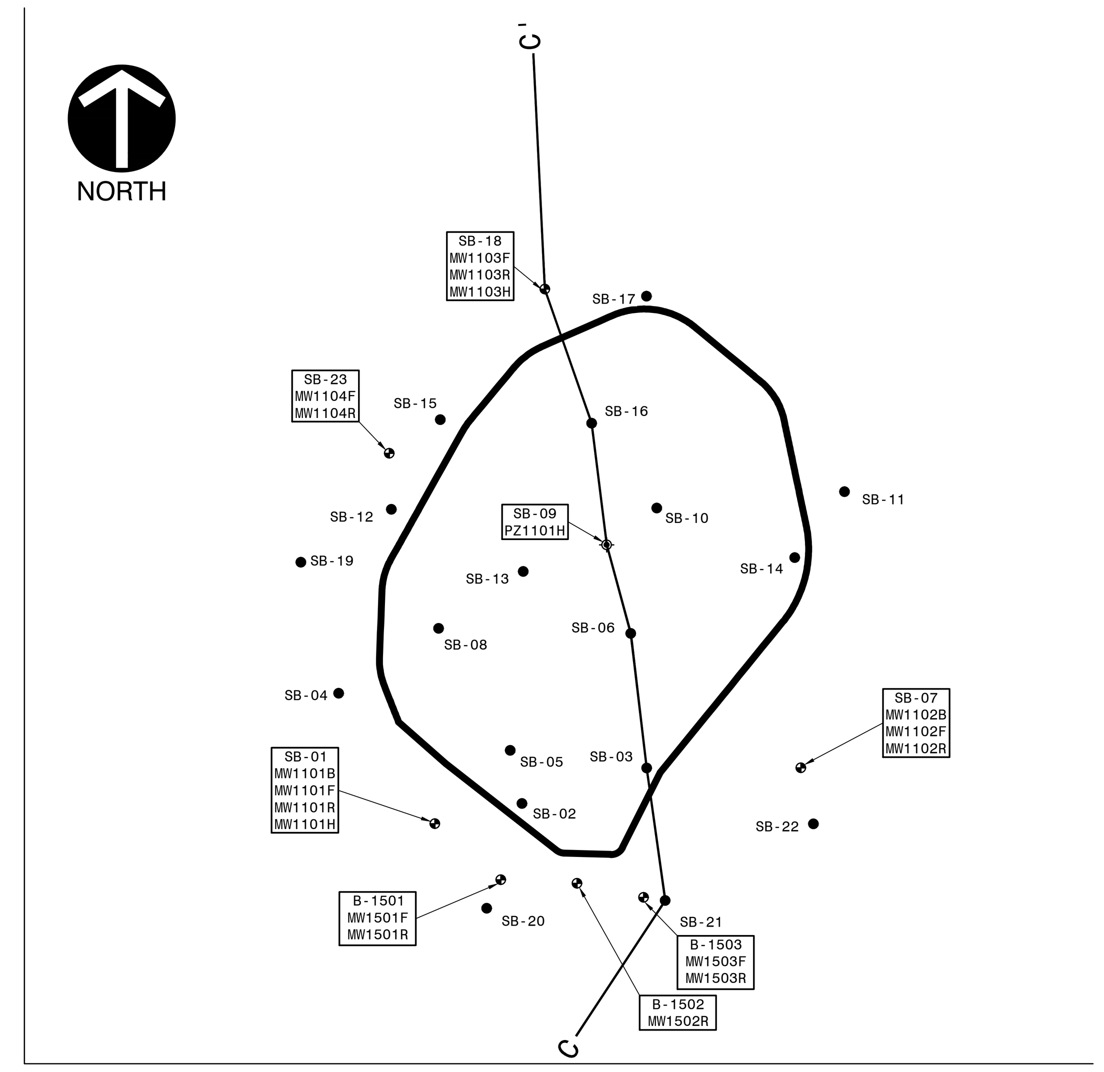
Columbus, Ohio | September 2023

ATTACHMENT A
Geologic Cross Section



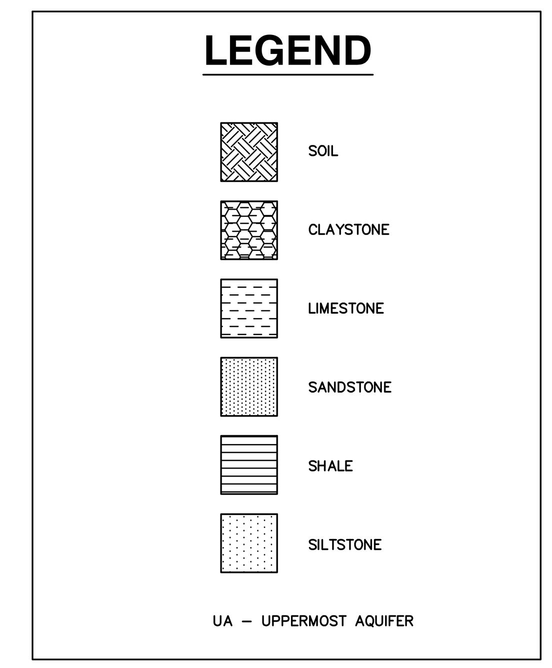
GEOLOGIC CROSS SECTION C - C'

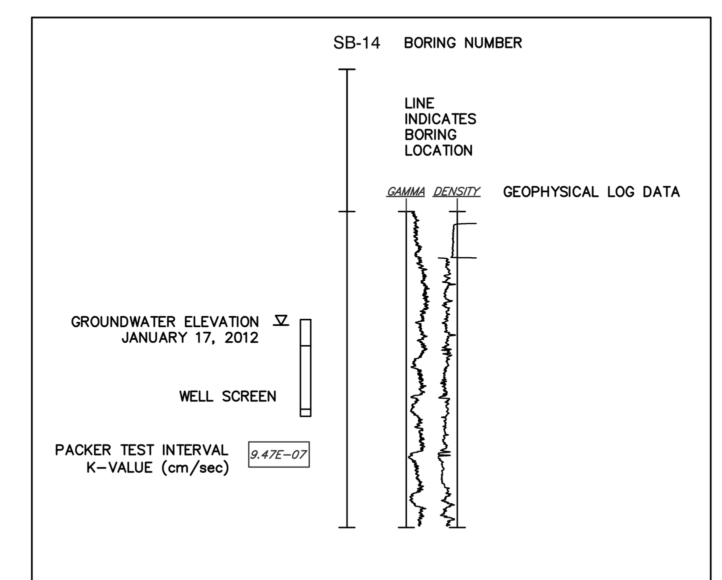
SCALE H:1"=200'; V:1"=50'



KEY PLAN

N.T.S.





MONITORING WELL DIAGRAM

NOTE:

1. THE BORING LOGS AND RELATED INFORMATION PRESENTED HEREIN DEPICT SUBSURFACE CONDITIONS AT THE TEST BORING LOCATIONS AND AT THE TIME OF DRILLING. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER.
2. GEOLOGIC CORRELATIONS SHOWN BETWEEN TEST BORINGS GENERALLY ARE BASED ON A STRAIGHT-LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN TEST BORINGS MAY DIFFER.

HORZ. SCALE: 1"=200'

VERT. SCALE: 1"=50'

REVISION RECORD

NO	DATE	DESCRIPTION

Civil & Environmental Consultants, Inc.
5899 Montclair Blvd. · Cincinnati, OH 45150
513-985-0226 · 800-759-5614
www.cecinc.com

AMERICAN ELECTRIC POWER
MITCHELL LANDFILL
MITCHELL POWER GENERATION PLANT
MARSHALL COUNTY, WEST VIRGINIA

GROUNDWATER MONITORING SYSTEM DEMONSTRATION

GEOLOGIC CROSS SECTION C-C'

DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7601	APPROVED BY:	APA

FIGURE NO.: **6**

ATTACHMENT B
Potentiometric Maps

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on October 20, 2020) provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Fish Creek
October 2020

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2020/12/29

Figure **B1**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2020\AEP-Mitchell_Landfill-FC_GW_Oct2020.mxd. HDuff. 12/29/2020. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on March 16, 2021) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

Potentiometric Surface Map - Fish Creek
March 2021

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2021/06/11

Figure **B2**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2021\AEP-Mitchell_Landfill-FC_GW_March2021.mxd. ASoltero. 6/11/2021. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on May 11, 2021) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

Potentiometric Surface Map - Fish Creek
May 2021

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2021/09/07

Figure **B3**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2021\AEP-Mitchell_Landfill-FC_GW_May2021.mxd. ASoltero. 9/7/2021. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on October 19, 2021) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

Potentiometric Surface Map - Fish Creek
October 2021

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2022/01/11

Figure **B4**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2021\AEP-Mitchell_Landfill-FC_GW_Oct2021.mxd. ASoltero. 1/11/2022. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on May 10, 2022) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Fish Creek May 2022

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2022/11/22

Figure **B5**

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Legend

- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on October 5, 2022) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

Potentiometric Surface Map - Fish Creek
October 2022

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2023/01/23

Figure
B6

M:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2022\AEP-Mitchell_Landfill-FC_GW_Oct2022.mxd. HDuff. 1/23/2023. Project/Phase/Task.

ATTACHMENT C
Sampling Locations and Chloride Results for West Virginia Groundwater

Modified by Geosyntec (2023) from Fedorko and Skema (2013)

organic compounds, volatile organic compounds, and dissolved gases. A summary of dissolved gas data collected as part of this study can be found in McCoy and Kozar (2007).

Study Area, Design, and Methods

West Virginia lies entirely within the Appalachian Mountains with parts of the State in three physiographic provinces (Fenneman and Johnson, 1946), regions with similar rock types and groundwater characteristics. The western and central parts of the State lie within the Appalachian Plateaus Physiographic Province. The Appalachian Plateaus consist of sub-horizontal consolidated sedimentary rocks of Devonian to Permian age (fig. 1). These rocks have been highly dissected by stream erosion resulting in steep hills and deeply incised valleys. Valleys are filled in part with unconsolidated sediments of Quaternary age.

The eastern part of the State lies primarily in the Valley and Ridge Physiographic Province, named for the series of northeast-southwest trending valleys and ridges formed from Cambrian to Silurian aquifers. These strata are consolidated sedimentary rocks that are extensively faulted and sharply folded. The Blue Ridge Physiographic Province includes only the very easternmost edge of the Eastern Panhandle of West Virginia. In contrast to the sedimentary rocks of the Appalachian Plateaus and Valley and Ridge Physiographic Provinces, the Blue Ridge Physiographic Province is underlain by crystalline rock.

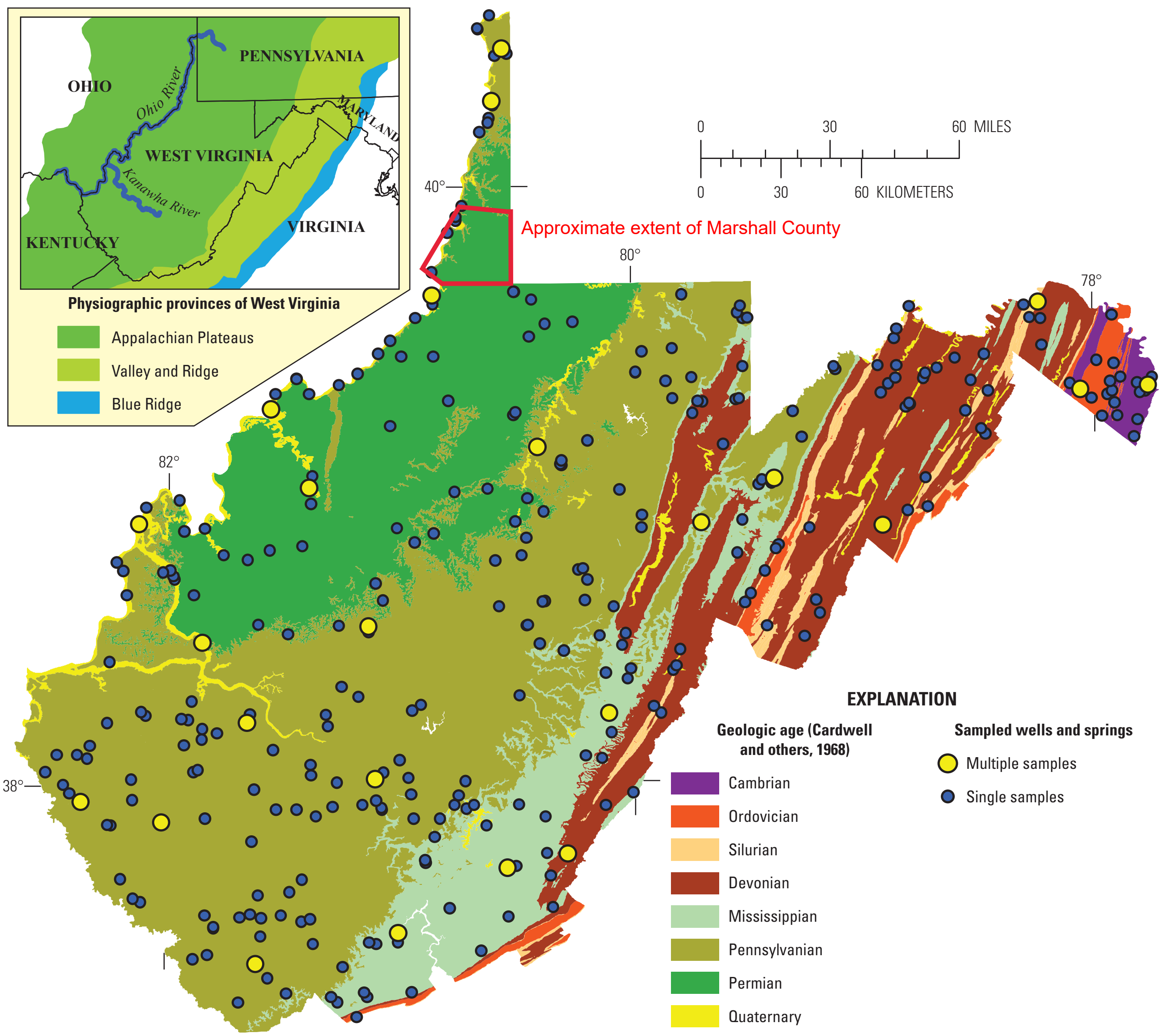

Figure 1. The geology of West Virginia and locations of groundwater-quality sampling sites, wells, and springs in the West Virginia ambient monitoring network, 1993–2008.

Chloride

Chloride, the most abundant halide (Hem, 1985), ranged in concentration from less than the 0.2 mg/L minimum reporting level to 736 mg/L with a median value of 16.6 mg/L (table 4). Most wells, 80 percent, had chloride values from 1.8 mg/L to 77 mg/L. Median values, by geologic ages of aquifers, ranged from 6.6 mg/L for wells in Devonian aquifers to 28 mg/L for wells in Quaternary aquifers (fig. 10).

The SMCL for chloride is 250 mg/L (U.S. Environmental Protection Agency, 2009b). Samples from four wells exceeded this concentration. All four were from areas of Pennsylvanian aquifers.

Sulfate

In West Virginia pyrite-bearing rock formations are a major source of sulfate in groundwater. MacAuley and Kozar (2006) found groundwater sulfate concentrations to be increased in mined areas of West Virginia's Northern Appalachian Coal Basin.

Although sulfate concentrations ranged from less than a reporting level of 0.07 mg/L to 767 mg/L with a median value of 14.7 mg/L for all samples, most wells (80 percent) had sulfate concentrations of 0.3 mg/L to 86 mg/L. Median sulfate concentrations varied widely by geologic age of the aquifers, from a low of 6.7 mg/L for wells in Pennsylvanian aquifers to 58.6 mg/L for wells in Quaternary aquifers (fig. 11). Sulfate concentrations exceeding the SMCL of 250 mg/L (U.S. Environmental Protection Agency, 2009b) were found in samples from nine wells (table 4).

Water Types

Natural waters can be classified by "water type" on the basis of major-ion composition. Water samples with a specific cation or anion constituting more than one-half the total cations or anions can be classified by water type, calcium carbonate type water, for example (Hem, 1985). However, waters in which no single cation or anion constitutes greater than one-half of the total cations or anions are classed as mixed-type waters (Hem, 1985). Samples from aquifers classified by geologic age typically reflect a signature characteristic of the rock type, although the rock-type signatures may overlap broadly. Calcium was the dominant cation in most samples from wells in Quaternary aquifers (fig. 12*A*); the dominant anion in most samples from Quaternary aquifers was bicarbonate with some samples having a sulfate or chloride

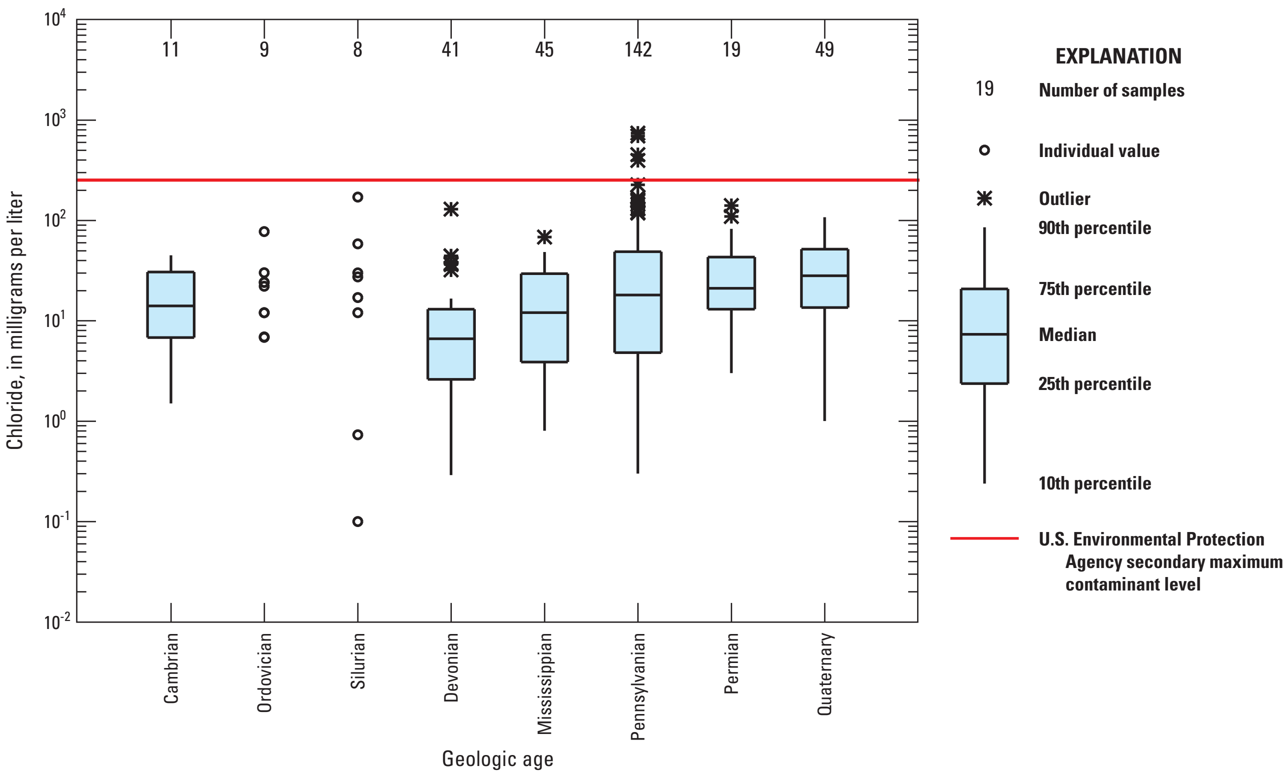

Figure 10. Distribution of chloride concentrations in groundwater samples from the West Virginia ambient monitoring network, grouped by geologic age of the aquifers, 1993–2008. U.S. Environmental Protection Agency (2009b) secondary maximum contaminant level of 250 milligrams per liter for finished drinking water is shown.

ATTACHMENT D

Certification by a Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

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

JOHN P. SEYMOUR
REGISTERED
17091
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

John Seymour
Printed Name of Licensed Professional Engineer

Signature

017091
License Number

West Virginia
Licensing State

9/27/2023
Date

APPENDIX 4 - Notices for Monitoring Program Transitions

No transition between monitoring requirements occurred in 2023; the CCR unit was in detection monitoring at the beginning and at the end of the year. Notices for monitoring program transitions are not applicable at this time.

APPENDIX 5 - Well Installation/Decommissioning Logs

No monitoring wells installed or decommissioned in 2023. Well installation/decommissioning logs are not applicable at this time.