Annual Groundwater Monitoring Report

Kentucky Power Company

Big Sandy Plant

Fly Ash Pond CCR Management Unit

Louisa, Kentucky

January 2021

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KENTUCKY POWER
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I. Overview

This *Annual Groundwater Monitoring Report* has been prepared to report the status of activities for the preceding year for an existing CCR unit at Kentucky Power Company's Big Sandy Power Plant. Kentucky Power Company is a wholly owned subsidiary of American Electric Power Company (AEP). 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 31.

In general, the following activities were completed:

- All monitoring wells that were installed and developed to establish a certified groundwater monitoring system around the CCR unit, in accordance with the requirements of 40 CFR 257.91 and documented in AEP's *Groundwater Monitoring Network Evaluation (Geosyntec, December 2016)* were sampled pursuant to 40 CFR 257.95(b) on March 17, 2020 and March 18, 2020, pursuant to 40 CFR 257.95(d)(1) on June 29, 2020, June 30, 2020, August 26, 2020, and August 27, 2020, and pursuant to 40 CFR 257.95(d)(1) on October 5, 2020 and August 6, 2020. All samples collected during the March 2020 sampling event were analyzed for all parameters in Appendix IV of the CCR rules. All samples collected during the June and August 2020 sampling event were analyzed for all parameters in Appendix III of the CCR rules and for those Appendix IV constituents detected during the March 2020 sampling event. All samples collected during the October 2020 sampling event were analyzed for all parameters in Appendix III of the CCR rules and for those Appendix IV constituents detected during the March 2020 sampling event. All sampling and analyses were in accordance with 40 CFR 257.94 *et seq.*, AEP's *Groundwater Sampling and Analysis Plan (AEP and EHS Support, October 2016), and AEP's Statistical Analysis Plan (Geosyntec, January 2017)*. The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance", USEPA, 2009);
- Groundwater monitoring data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Statistical analysis of the background and assessment monitoring data was conducted in accordance with *AEP's Statistical Analysis Plan (Geosyntec, January 2017)* to establish groundwater protection standards and to determine whether or not one or more Appendix IV constituents were detected at statistically significant levels (SSLs) above the corresponding groundwater protection standards in assessment monitoring samples collected during the June and August sampling event. The corresponding statistical analyses were completed on October 27, 2020;
- The statistical evaluation concluded that four Appendix IV constituents were detected at SSLs above the corresponding groundwater protection standard statistical limits at the

same well during the June and August assessment monitoring sampling event, as discussed further in Section V of this report;

- Because Appendix IV constituents were found to be detected at SSLs above the corresponding groundwater protection standard statistical limits during the October 27, 2020 statistical evaluation, an alternative source demonstration (ASD) study was conducted resulting in a January 2021 ASD report, as discussed further in Section VI of this report.

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

- A figure showing the CCR unit, all groundwater monitoring wells, and monitoring well identification numbers;
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement regarding the rationale for the installation/decommission;
- 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 required by the detection monitoring or assessment monitoring programs (attached as Appendixes 1 and 2);
- Results of the required statistical analysis of groundwater monitoring results;
- Results of alternate source demonstrations;
- A summary of any transition between monitoring programs or an alternate monitoring frequency;
- Other information required in the annual report such as an 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 depicting the PE-certified groundwater monitoring network, with the monitoring well locations and their corresponding identification numbers, is in Appendix 2.

III. Monitoring Wells Installed or Decommissioned

There were no monitoring wells installed or decommissioned in 2020. The network design, as summarized in the *Groundwater Monitoring Network Evaluation* (*Geosyntec, December 2016*) and as posted at the CCR web site for Big Sandy Plant, did not change. That report, viewable on the publicly accessible AEP CCR Rule Compliance Data and Information Internet site at the following link: http://www.aep.com/about/codeofconduct/ccrrule/, discusses the facility location, the hydrogeological setting, the hydrostratigraphic units, the uppermost aquifer, downgradient monitoring well locations, and upgradient monitoring well locations.

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

Appendix 1 contains Table 1 showing the data analyzed from the samples collected during the assessment monitoring events in 2020, including the number of samples collected per well, the sample collection dates, and the groundwater velocities for each sampling event. Table 1 also includes background data collected during the eight background sampling events and previous detection and assessment monitoring data. Static water elevation data and groundwater flow directions, in the form of potentiometric surface maps, from each monitoring event in 2020 are shown in Appendix 2.

V. Statistical Analysis of Groundwater Monitoring Data

Statistical analyses of data collected during the March and June/August 2020 sampling events for determination of SSLs detected above (or outside for pH) the corresponding groundwater protection standard statistical limits were completed and documented in the October 27, 2020 *Statistical Analysis Summary (Geosyntec, October 2020)*. The statistical analysis summary contains full statistical evaluations in Attachment B of the summary and is provided in Appendix 3 of this report. SSLs of beryllium, cobalt, lithium, and radium 226/228 were identified above the corresponding groundwater protection standard statistical limits at one monitoring well, MW-1603, in the statistical evaluation.

VI. Alternative Source Demonstration

In an attempt to demonstrate that a source other than the CCR unit caused the SSLs detected in samples collected during the March and June/August 2020 sampling events, or that the SSLs resulted from errors in sampling, analysis, statistical evaluation, or natural variations in groundwater quality, an alternative source evaluation including an assessment of site and regional geochemistry along with historical data for the CCR unit was conducted by EHS Support LLC (EHS Support). This evaluation resulted in the *Alternative Source Demonstration Addendum Report for the March and June 2020 Monitoring Data (EHS Support, January 2021).*

The alternative source demonstration report is included in Appendix 4. The report concluded that the elevated concentrations of beryllium, cobalt, lithium, and radium 226/228 in the monitoring well are "due to the oxidation of sulfide minerals present in coal seams that have been intersected by well MW-1603, including organic material within the screened interval that is identified as having 'a slight coaly texture.'"

VII. Discussion about Transition between Monitoring Requirements or Alternate Monitoring Frequency

Because the alternative source demonstration was successful in demonstrating that the Appendix IV SSLs detected in samples collected from Monitoring Well MW-1603 were not derived from the CCR constituents within the CCR unit, the assessment monitoring program was continued.

Regarding defining an alternate monitoring frequency, the groundwater velocity and monitoring well production are high enough at this facility that no modification to the semiannual assessment monitoring frequency is needed at this time.

VIII. Other Information Required

The CCR unit has progressed from detection monitoring to its current status in assessment monitoring. All required information has been included in this annual groundwater monitoring report. At the appropriate time, hydrogeological, geochemical, and statistical analyses of the groundwater assessment monitoring data will continue to attempt demonstrations of whether or not an alternative source or sources other than the CCR unit are causing the detection of SSLs above (or outside for pH) the corresponding groundwater protection standard statistical limits, or if the SSLs resulted from error in sampling, analysis, statistical evaluation or natural variation in groundwater quality. In those cases where an alternative source demonstration is made, the analyses and supporting information will be presented as well. This is likely to continue occurring at Monitoring Well MW-1603 because the well was screened across highly organic layers of rock with a coal-like texture that results in groundwater samples with a much lower pH than any other compliance well in the groundwater monitoring network. This well has not been downgradient of the CCR unit (the static water elevation in the well has been lower than the surface water elevation in the fly ash pond) since March 2020 because the unit was dewatered of all ponded surface water and closure in place neared completion in 2020. Construction of the geomembrane liner within the final cover system was completed on November 24, 2020. Since ponded surface water no longer remains within the CCR unit and the static water elevation at MW-1603 is no longer downgradient of the CCR unit, it is expected that the well will be removed from the groundwater monitoring network in 2021.

IX. Description of Any Problems Encountered in 2020 and Actions Taken

No significant problems were encountered. Through previous, proper construction of monitoring wells and use of low-flow purging and sampling methodology, samples representative of uppermost aquifer groundwater, with low turbidity, were obtained and the schedule to support preparation of this annual groundwater monitoring report was met. It is possible, however, that future necessary monitoring wells may not encounter earth materials with grain sizes coarse enough to produce low turbidity monitoring well samples no matter how carefully the monitoring wells are constructed and the groundwater samples are collected.

X. A Projection of Key Activities for the Upcoming Year

Key activities for 2021 include the following:

- Continued assessment monitoring sampling of CCR wells for all Appendix IV parameters annually pursuant to 40 CFR 257.95(b) and, pursuant to 40 CFR 257.95(d)(1), for all Appendix III parameters and those Appendix IV parameters detected during the previous sampling performed pursuant to 40 CFR 257.95(b);
- Continued establishment of groundwater protection standard statistical limits for all Appendix IV parameters and statistical comparison of Appendix IV concentrations in downgradient monitoring wells to those standards;
- If a groundwater protection standard is exceeded in a downgradient well that is not demonstrated to be due to a source other than the CCR unit or resulting from errors in sampling, analysis, statistical evaluation, or natural variations in groundwater quality by a successful alternative source demonstration, the following activities will be undertaken:
    - Prepare a notification identifying the constituents in Appendix IV that have exceeded the groundwater protection standard and place the notification in the facility's operating record;
    - Characterize the nature and extent of the potential release by installing additional monitoring wells as necessary, including at least one additional monitoring well at the facility boundary in the direction of potential contaminant migration;
    - Sample all wells in accordance with 40 CFR 257.95(d)(1) to characterize the nature and extent of the potential release.
    - Estimate the quantity of material potentially released including specific information on the Appendix IV constituents and the levels at which they are present in the material;

    - If contaminants have migrated off-site, notify all persons who own or reside on land that directly overlies any part of the plume of contamination and place the notification in the facility's operating record;
    - Initiate an assessment of corrective measures to prevent further releases, to remediate any releases, and to restore affected areas to original conditions;
- Respond to any new data received in light of CCR rule requirements;
- Prepare a fifth annual groundwater monitoring report documenting activities that were undertaken in 2021.

APPENDIX 1—Tables

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.

Table 1 - Groundwater Data Summary: MW-1011
Big Sandy - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
9/27/2016	Background	0.071	79.1	3.39	0.19	7.0	79.5	388
11/9/2016	Background	0.081	74.6	3.43	0.21	7.0	74.4	360
1/12/2017	Background	0.103	75.4	2.83	0.25	6.9	72.8	363
2/21/2017	Background	0.098	75.8	2.68	0.21	7.1	72.5	371
4/25/2017	Background	0.148	78.0	2.71	0.23	6.7	74.7	358
5/24/2017	Background	0.156	85.2	2.86	0.20	6.7	73.8	370
6/21/2017	Background	0.129	72.6	2.19	0.22	6.7	69.4	338
7/13/2017	Background	0.111	78.1	2.31	0.21	7.1	78.2	371
9/18/2017	Detection	0.146	80.1	2.85	0.18	6.9	78.0	372
4/26/2018	Assessment	0.139	105	4.71	0.20	6.3	106	456
9/20/2018	Assessment	0.165	72.7	3.43	0.28	7.0	76.3	386
3/13/2019	Assessment	0.101	80.5	5.22	0.24	6.5	84.2	411
6/27/2019	Assessment	0.119	75.3	4.20	0.27	7.0	75.2	386
8/21/2019	Assessment	0.117	86.2	4.41	0.26	7.1	76.2	385
3/17/2020	Assessment	--	--	--	0.24	7.5	--	--
6/29/2020	Assessment	0.111	82.8	5.10	0.24	6.9	82.8	--
8/26/2020	Assessment	--	--	--	--	4.3	--	443
10/5/2020	Assessment	0.105	82.7	4.86	0.26	7.2	81.5	388

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

Table 1 - Groundwater Data Summary: MW-1011
Big Sandy - FAP
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
9/27/2016	Background	1.01	17.8	52.0	< 0.005 U	0.02	0.5	2.85	2.56	0.19	0.214	0.011	< 0.002 U	1.80	0.09 J	0.229
11/9/2016	Background	0.75	9.93	48.1	< 0.005 U	0.02 J	0.744	1.12	3.56	0.21	0.297	0.017	< 0.002 U	1.51	0.07 J	0.162
1/12/2017	Background	0.36	10.5	47.7	< 0.005 U	0.01 J	0.369	1.47	5.24	0.25	0.026	0.009	< 0.002 U	1.39	0.03 J	0.160
2/21/2017	Background	0.28	11.1	49.5	< 0.005 U	0.008 J	0.189	1.09	3.43	0.21	0.024	0.016	< 0.002 U	1.21	< 0.03 U	0.153
4/25/2017	Background	0.26	11.9	53.0	< 0.004 U	0.01 J	0.223	1.23	2.65	0.23	0.035	0.003	< 0.002 U	1.23	< 0.03 U	0.102
5/24/2017	Background	0.22	9.46	54.7	< 0.004 U	0.008 J	0.318	1.15	2.566	0.20	0.020	0.005	< 0.002 U	0.99	< 0.03 U	0.134
6/21/2017	Background	0.24	5.57	45.7	< 0.004 U	0.006 J	0.294	0.413	2.576	0.22	0.01 J	0.014	0.004 J	1.34	0.05 J	0.098
7/13/2017	Background	0.24	5.92	46.0	< 0.004 U	0.01 J	0.223	0.444	2.353	0.21	0.054	0.010	< 0.002 U	1.39	0.03 J	0.091
4/26/2018	Assessment	0.16	13.5	63.1	< 0.004 U	< 0.005 U	0.207	3.25	5.69	0.20	0.095	0.010	< 0.002 U	0.82	< 0.03 U	0.121
9/20/2018	Assessment	0.18	7.25	44.8	< 0.02 U	< 0.01 U	0.588	0.683	2.56	0.28	0.08	0.009	--	0.8	< 0.03 U	< 0.1 U
10/23/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U	--	--	--
3/13/2019	Assessment	0.15	7.53	49.2	< 0.02 U	< 0.01 U	0.576	0.709	2.425	0.24	0.217	0.02 J	< 0.002 U	0.9 J	< 0.03 U	< 0.1 U
6/27/2019	Assessment	0.15	5.17	47.5	< 0.02 U	< 0.01 U	0.304	0.438	2.582	0.27	0.181	< 0.009 U	< 0.002 U	0.7 J	< 0.03 U	< 0.1 U
8/21/2019	Assessment	0.18	5.31	49.2	< 0.02 U	0.01 J	0.341	0.421	2.54	0.26	0.1 J	0.00973	< 0.002 U	0.7 J	< 0.03 U	< 0.1 U
3/17/2020	Assessment	0.14	6.96	51.5	< 0.02 U	< 0.01 U	0.253	0.724	4.44	0.24	< 0.05 U	0.00871	< 0.002 U	0.7 J	< 0.03 U	< 0.1 U
6/29/2020	Assessment	0.18	6.72	49.2	< 0.02 U	0.01 J	0.203	0.339	3.02	0.24	0.05 J	0.00993	< 0.002 U	0.8 J	0.06 J	< 0.1 U
10/5/2020	Assessment	0.18	5.31	46.3	< 0.02 U	< 0.01 U	0.09 J	0.321	2.57	0.26	< 0.05 U	0.00926	< 0.002 U	0.8 J	0.04 J	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1012
Big Sandy - FAP
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
9/27/2016	Background	0.176	1.48	1.19	0.71	8.9	35.2	547
11/9/2016	Background	0.159	1.21	1.15	0.70	9.1	35.6	535
1/12/2017	Background	0.182	1.19	1.24	0.73	9.1	40.1	553
2/22/2017	Background	0.171	1.45	1.14	0.68	9.4	36.8	554
4/26/2017	Background	0.183	1.20	1.17	0.71	8.7	37.4	546
5/24/2017	Background	0.244	1.20	1.24	0.71	8.8	36.8	540
6/22/2017	Background	0.174	1.07	1.14	0.64	8.9	38.1	547
7/13/2017	Background	0.172	1.16	1.12	0.66	9.0	38.0	558
9/19/2017	Detection	0.205	1.11	1.10	0.67	9.1	38.5	546
4/26/2018	Assessment	0.227	1.13	1.34	0.82	9.0	36.6	541
9/20/2018	Assessment	0.236	1.11	1.27	0.75	9.1	36.6	561
3/13/2019	Assessment	0.189	1.15	1.26	0.73	8.8	35.6	572
6/25/2019	Assessment	0.169	1.10	1.19	0.74	9.3	35.9	559
8/21/2019	Assessment	0.176	1.38	1.26	0.79	9.4	36.8	583
3/18/2020	Assessment	--	--	--	0.76	10.9	--	--
6/30/2020	Assessment	0.181	1.72	5.21	0.72	9.2	36.7	--
8/27/2020	Assessment	--	--	--	--	9.3	--	582
10/6/2020	Assessment	0.175	1.37	1.32	0.68	9.2	37.0	577

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

Table 1 - Groundwater Data Summary: MW-1012
Big Sandy - FAP
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
9/27/2016	Background	0.79	24.0	37.6	0.044	0.05	1.1	0.346	1.592	0.71	1.84	0.006	< 0.002 U	3.25	0.2	0.03 J
11/9/2016	Background	1.20	28.9	24.4	0.027	0.04	0.903	0.113	0.548	0.70	0.872	0.014	0.002 J	1.68	0.05 J	0.02 J
1/12/2017	Background	0.79	24.7	23.8	0.01 J	0.04	0.395	0.066	0.542	0.73	0.439	0.008	< 0.002 U	1.12	0.04 J	0.02 J
2/22/2017	Background	0.99	28.8	29.5	0.026	0.14	0.578	0.184	0.452	0.68	1.17	0.009	0.002 J	1.52	0.07 J	0.04 J
4/26/2017	Background	0.89	22.9	29.9	0.025	0.02	0.512	0.131	0.148	0.71	0.632	0.004	0.003 J	1.25	0.04 J	0.02 J
5/24/2017	Background	0.97	23.2	23.7	0.01 J	0.01 J	7.84	0.078	1.72	0.71	0.334	< 0.0002 U	0.004 J	1.41	0.07 J	0.01 J
6/22/2017	Background	0.91	21.6	21.1	0.008 J	0.007 J	0.293	0.046	0.3575	0.64	0.261	0.018	< 0.002 U	1.18	0.04 J	0.02 J
7/13/2017	Background	0.96	22.1	25.7	0.022	0.008 J	0.449	0.102	1.301	0.66	0.546	0.004	< 0.002 U	1.43	0.09 J	0.02 J
4/26/2018	Assessment	0.65	15.8	24.1	0.01 J	0.006 J	0.262	0.062	1.135	0.82	0.287	0.006	0.003 J	0.89	0.05 J	0.02 J
9/20/2018	Assessment	0.62	14.0	24.2	0.02	< 0.01 U	0.442	0.079	0.291	0.75	0.346	< 0.009 U	0.013	0.8	0.08 J	< 0.1 U
3/13/2019	Assessment	0.60	15.2	27.2	0.03 J	< 0.01 U	0.459	0.106	0.3959	0.73	0.354	0.01 J	< 0.004 U	0.9 J	0.09 J	< 0.1 U
6/25/2019	Assessment	0.67	13.4	28.0	0.03 J	< 0.01 U	0.252	0.097	0.506	0.74	0.352	< 0.009 U	< 0.002 U	0.8 J	0.08 J	< 0.1 U
8/21/2019	Assessment	0.77	19.0	41.9	0.06 J	< 0.01 U	0.625	0.260	0.354	0.79	0.924	0.00536	< 0.002 U	1 J	0.3	< 0.1 U
3/18/2020	Assessment	0.60	19.6	61.7	0.130	0.01 J	0.850	0.519	3.47	0.76	1.97	0.00588	0.002 J	1 J	0.3	< 0.1 U
6/30/2020	Assessment	0.58	19.1	68.2	0.116	0.01 J	0.912	0.527	2.62	0.72	1.86	0.00593	0.002 J	1 J	0.4	< 0.1 U
10/6/2020	Assessment	0.89	23.0	34.7	0.06 J	0.02 J	0.468	0.229	1.04	0.68	0.851	0.00531	< 0.002 U	1 J	0.2 J	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1203
Big Sandy - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
9/26/2016	Background	0.097	60.5	5.72	0.15	7.8	28.4	261
11/9/2016	Background	0.088	56.8	5.35	0.13	6.9	26.5	273
1/12/2017	Background	0.110	59.9	5.69	0.13	7.0	33.4	278
2/21/2017	Background	0.092	55.8	5.23	0.12	7.0	30.2	248
4/26/2017	Background	0.122	55.6	5.18	0.12	6.6	29.0	265
5/23/2017	Background	0.160	55.6	5.08	0.12	6.5	29.6	279
6/21/2017	Background	0.137	62.3	4.74	0.11	6.7	28.0	264
7/13/2017	Background	0.089	56.7	5.05	0.10	6.7	33.0	261
9/18/2017	Detection	0.116	57.0	4.92	0.13	6.8	29.3	255
4/26/2018	Assessment	0.147	57.4	5.66	0.14	6.0	37.5	253
9/20/2018	Assessment	0.125	53.4	5.37	0.12	6.7	32.3	253
3/14/2019	Assessment	0.09 J	54.9	5.53	0.11	6.2	38.7	259
6/27/2019	Assessment	0.1 J	54.3	5.28	0.12	6.8	39.0	273
8/21/2019	Assessment	0.097	60.8	5.14	0.13	7.0	32.4	283
3/17/2020	Assessment	--	--	--	0.12	7.4	--	--
6/30/2020	Assessment	0.104	64.9	5.17	0.12	6.7	30.6	--
8/27/2020	Assessment	--	--	--	--	6.9	--	263
10/5/2020	Assessment	0.100	64.2	5.24	0.14	7.1	30.4	266

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

Table 1 - Groundwater Data Summary: MW-1203
Big Sandy - FAP
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
9/26/2016	Background	0.02 J	0.26	95.3	0.022	< 0.004 U	0.4	1.04	1.334	0.15	0.103	0.011	< 0.002 U	0.21	0.04 J	0.01 J
11/9/2016	Background	0.03 J	0.43	110	0.126	0.009 J	1.50	1.04	1.473	0.13	1.28	0.017	< 0.002 U	0.28	0.2	0.02 J
1/12/2017	Background	0.03 J	0.42	102	0.089	< 0.004 U	0.718	1.15	1.657	0.13	0.748	0.014	< 0.002 U	0.15	0.2	0.03 J
2/21/2017	Background	0.02 J	0.39	94.8	0.077	< 0.004 U	0.365	0.989	2.509	0.12	0.509	0.017	< 0.002 U	0.20	0.1	0.063
4/26/2017	Background	0.03 J	0.45	113	0.099	< 0.005 U	0.648	1.05	1.293	0.12	0.697	0.009	< 0.002 U	0.20	0.2	0.02 J
5/23/2017	Background	0.05 J	0.61	99.9	0.149	< 0.005 U	0.960	1.07	3.44	0.12	1.22	0.020	0.002 J	0.15	0.3	0.02 J
6/21/2017	Background	0.04 J	0.63	101	0.116	< 0.005 U	0.422	0.994	3.224	0.11	0.793	0.020	< 0.002 U	0.62	0.3	0.03 J
7/13/2017	Background	0.02 J	0.44	93.8	0.062	< 0.005 U	0.377	1.16	1.707	0.10	0.312	0.011	< 0.002 U	0.59	0.05 J	0.01 J
4/26/2018	Assessment	0.03 J	0.30	89.1	0.033	< 0.005 U	0.171	0.886	2.476	0.14	0.034	0.013	< 0.002 U	0.12	< 0.03 U	0.03 J
9/20/2018	Assessment	0.03 J	0.51	90.1	0.08	< 0.01 U	0.240	0.916	1.252	0.12	0.05	0.01	--	< 0.4 U	< 0.03 U	< 0.1 U
10/22/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U	--	--	--
3/14/2019	Assessment	0.03 J	0.23	88.0	0.02 J	< 0.01 U	0.391	0.953	1.399	0.11	0.124	< 0.009 U	< 0.004 U	< 0.4 U	< 0.03 U	< 0.1 U
6/27/2019	Assessment	< 0.02 U	0.34	86.8	0.06 J	< 0.01 U	0.1 J	0.909	1.341	0.12	0.1 J	0.01 J	< 0.002 U	< 0.4 U	< 0.03 U	< 0.1 U
8/21/2019	Assessment	< 0.02 U	0.27	95.4	0.04 J	< 0.01 U	0.304	0.774	1.471	0.13	0.06 J	0.0118	< 0.002 U	< 0.4 U	< 0.03 U	< 0.1 U
3/17/2020	Assessment	0.02 J	0.35	91.0	0.06 J	< 0.01 U	0.265	0.859	7.524	0.12	0.08 J	0.0130	< 0.002 U	< 0.4 U	< 0.03 U	< 0.1 U
6/30/2020	Assessment	0.02 J	0.47	101	0.08 J	< 0.01 U	0.1 J	0.547	2.29	0.12	0.1 J	0.0121	< 0.002 U	< 0.4 U	< 0.03 U	< 0.1 U
10/5/2020	Assessment	0.02 J	0.59	94.6	0.08 J	< 0.01 U	0.2 J	0.672	1.539	0.14	0.212	0.0114	< 0.002 U	< 0.4 U	< 0.03 U	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1601
Big Sandy - FAP
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
9/27/2016	Background	0.317	63.0	25.6	0.32	7.6	122	448
11/9/2016	Background	0.263	55.7	31.2	0.33	7.3	120	438
1/12/2017	Background	0.283	63.5	25.0	0.32	7.5	128	474
2/22/2017	Background	0.241	61.0	23.9	0.29	7.4	111	430
4/26/2017	Background	0.216	50.9	23.8	0.33	6.9	97.4	372
5/24/2017	Background	0.240	55.9	21.5	0.29	7.0	91.7	370
6/22/2017	Background	0.196	47.5	21.0	0.27	7.3	90.6	367
7/13/2017	Background	0.175	51.3	17.4	0.27	7.1	84.6	364
9/18/2017	Detection	0.183	51.5	15.8	0.29	7.2	82.7	362
1/31/2018	Detection	--	--	15.4	--	7.5	84.4	--
4/25/2018	Assessment	0.177	50.4	15.2	0.36	6.9	72.6	326
9/20/2018	Assessment	0.196	68.8	16.1	0.22	7.1	167	448
3/12/2019	Assessment	0.117	54.3	9.09	0.18	6.3	88.5	316
6/25/2019	Assessment	0.1 J	50.7	8.23	0.15	7.0	86.4	312
8/21/2019	Assessment	0.097	52.1	8.43	0.15	7.1	82.9	326
3/18/2020	Assessment	--	--	--	0.17	8.3	--	--

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

Table 1 - Groundwater Data Summary: MW-1601
Big Sandy - FAP
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
9/27/2016	Background	0.13	5.03	81.7	0.026	0.009 J	0.7	1.96	1.22	0.32	0.143	0.040	< 0.002 U	27.7	0.2	0.124
11/9/2016	Background	0.08	5.49	85.4	0.01 J	0.01 J	0.863	1.46	2.335	0.33	0.321	0.035	< 0.002 U	20.5	0.2	0.02 J
1/12/2017	Background	0.05 J	5.24	79.1	0.009 J	0.01 J	0.390	1.78	1.695	0.32	0.050	0.038	< 0.002 U	37.5	0.08 J	0.03 J
2/22/2017	Background	0.08	5.15	74.0	0.009 J	0.006 J	0.380	1.54	1.603	0.29	0.044	0.037	< 0.002 U	31.5	0.1	0.02 J
4/26/2017	Background	0.17	5.48	80.4	0.009 J	0.006 J	0.411	1.23	1.3	0.33	0.034	0.025	< 0.002 U	27.3	0.2	0.02 J
5/24/2017	Background	0.09	4.30	68.1	0.007 J	0.006 J	0.807	0.941	1.317	0.29	0.037	0.026	< 0.002 U	27.0	0.09 J	0.01 J
6/22/2017	Background	0.08	4.19	60.1	< 0.004 U	< 0.005 U	0.247	0.926	0.802	0.27	0.02 J	0.037	< 0.002 U	27.1	0.07 J	0.01 J
7/13/2017	Background	0.11	5.18	64.5	0.009 J	0.008 J	0.300	1.02	1.077	0.27	0.081	0.023	< 0.002 U	28.3	0.07 J	0.01 J
4/25/2018	Assessment	0.17	4.58	56.4	0.005 J	< 0.005 U	0.245	0.794	2.783	0.36	0.024	0.033	< 0.002 U	20.6	0.1	0.02 J
9/20/2018	Assessment	0.29	3.54	75.9	< 0.02 U	< 0.01 U	0.378	1.21	0.698	0.22	0.04	0.031	--	19.6	0.2	< 0.1 U
10/23/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U	--	--	--
3/12/2019	Assessment	0.20	1.39	49.0	< 0.02 U	< 0.01 U	0.438	0.395	0.769	0.18	0.05 J	0.009 J	< 0.002 U	7.00	0.2 J	< 0.1 U
6/25/2019	Assessment	0.17	1.04	55.5	< 0.02 U	< 0.01 U	0.2 J	0.629	0.689	0.15	< 0.02 U	< 0.009 U	< 0.002 U	4.89	0.2	< 0.1 U
8/21/2019	Assessment	0.09 J	1.58	56.6	< 0.02 U	0.02 J	0.351	0.831	0.855	0.15	< 0.05 U	0.0172	< 0.002 U	5.64	0.09 J	< 0.1 U
3/18/2020	Assessment	0.59	0.63	62.9	< 0.02 U	0.01 J	0.298	0.152	1.25	0.17	0.07 J	0.0302	< 0.002 U	15.6	0.5	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1602
Big Sandy - FAP
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
9/27/2016	Background	0.054	72.5	10.6	0.19	7.7	106	400
11/9/2016	Background	0.037	63.1	8.77	0.18	7.5	86.1	360
1/12/2017	Background	0.039	65.4	7.20	0.17	7.8	81.6	362
2/22/2017	Background	0.041	69.4	8.13	0.14	7.7	96.3	399
4/26/2017	Background	0.052	73.8	7.74	0.13	6.8	83.6	382
5/24/2017	Background	0.074	74.7	9.90	0.12	6.9	103	394
6/22/2017	Background	0.062	70.4	10.7	0.11	7.5	106	416
7/13/2017	Background	0.052	81.9	12.1	0.09 J	7.0	132	484
10/19/2017	Detection	0.058	72.5	13.0	0.11	7.1	110	434
1/31/2018	Detection	--	--	15.3	--	7.5	128	--
4/26/2018	Assessment	0.143	75.2	13.9	0.14	8.0	106	416
9/20/2018	Assessment	0.070	72.1	15.2	0.11	7.0	150	492
3/13/2019	Assessment	0.07 J	79.4	12.6	0.10	6.9	133	444
6/25/2019	Assessment	0.06 J	69.8	12.2	0.11	7.5	111	436
8/20/2019	Assessment	0.04 J	74.5	13.2	0.10	7.5	117	434
3/18/2020	Assessment	--	--	--	0.09	8.8	--	--
6/30/2020	Assessment	0.05 J	79.0	17.6	0.09	7.2	--	--
8/26/2020	Assessment	--	--	--	--	4.8	121	454
10/6/2020	Assessment	0.05 J	82.5	19.2	0.10	7.7	143	479

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

Table 1 - Groundwater Data Summary: MW-1602
Big Sandy - FAP
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
9/27/2016	Background	0.16	0.50	50.7	< 0.005 U	0.005 J	0.8	0.060	1.233	0.19	0.067	0.008	0.002 J	3.41	2.0	0.02 J
11/9/2016	Background	0.13	0.42	51.1	< 0.005 U	0.01 J	0.590	0.028	1.143	0.18	0.059	0.013	0.002 J	2.63	2.2	0.01 J
1/12/2017	Background	0.10	0.45	50.2	< 0.005 U	0.01 J	0.666	0.043	1.545	0.17	0.030	0.004	< 0.002 U	2.44	2.2	0.03 J
2/22/2017	Background	0.09	0.42	48.2	< 0.005 U	0.009 J	0.547	0.020	0.712	0.14	0.02 J	0.008	< 0.002 U	2.79	2.0	0.02 J
4/26/2017	Background	0.10	0.47	59.2	< 0.004 U	0.01 J	0.692	0.024	0.534	0.13	0.026	0.006	0.002 J	1.88	2.2	0.03 J
5/24/2017	Background	0.08	0.37	54.6	< 0.004 U	0.009 J	0.703	0.01 J	1.68	0.12	0.239	0.002	0.004 J	1.51	1.5	0.02 J
6/22/2017	Background	0.07	0.50	55.0	< 0.004 U	0.01 J	0.566	0.205	0.812	0.11	0.047	0.021	0.002 J	2.12	1.3	0.02 J
7/13/2017	Background	0.07	0.71	57.6	< 0.004 U	< 0.005 U	0.482	0.850	1.138	0.09 J	0.031	0.005	0.003 J	2.29	1.0	0.01 J
4/26/2018	Assessment	0.05 J	3.15	60.9	< 0.004 U	< 0.005 U	0.290	0.552	1.754	0.14	0.049	0.008	0.003 J	1.64	0.4	0.01 J
9/20/2018	Assessment	0.03 J	3.92	55.1	< 0.02 U	< 0.01 U	0.328	0.312	1.044	0.11	0.03	< 0.009 U	< 0.004 U	1	0.4	< 0.1 U
3/13/2019	Assessment	0.06 J	1.06	52.5	< 0.02 U	< 0.01 U	1.03	0.03 J	0.504	0.10	0.122	0.009 J	< 0.002 U	2 J	1.6	< 0.1 U
6/25/2019	Assessment	0.07 J	1.06	52.5	< 0.02 U	< 0.01 U	0.632	0.02 J	0.5359	0.11	0.05 J	< 0.009 U	< 0.002 U	1 J	1.4	< 0.1 U
8/20/2019	Assessment	0.06 J	1.16	49.3	< 0.02 U	0.01 J	1.15	0.080	0.543	0.10	0.1 J	0.00637	< 0.002 U	1 J	1.1	< 0.1 U
3/18/2020	Assessment	0.06 J	1.36	55.4	< 0.02 U	< 0.01 U	0.511	0.04 J	1.517	0.09	0.08 J	0.00736	< 0.002 U	1 J	1.1	< 0.1 U
6/30/2020	Assessment	0.04 J	1.59	55.9	< 0.02 U	< 0.01 U	0.679	0.04 J	0.488	0.09	0.07 J	0.00717	< 0.002 U	1 J	1.0	< 0.1 U
10/6/2020	Assessment	0.04 J	1.53	52.4	< 0.02 U	< 0.01 U	1.05	0.04 J	2.003	0.10	< 0.05 U	0.00707	< 0.002 U	1 J	1.1	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1603
Big Sandy - FAP
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
9/26/2016	Background	0.054	105	3.37	1.24	4.3	801	1,060
11/9/2016	Background	0.053	94.7	3.22	1.10	5.6	733	1,010
1/12/2017	Background	0.037	92.7	3.45	1.11	3.6	636	948
2/21/2017	Background	0.085	91.9	2.93	0.90	4.5	720	1,020
4/26/2017	Background	0.052	90.5	3.28	1.04	3.3	678	994
5/24/2017	Background	0.096	93.9	3.34	0.98	3.3	646	936
6/22/2017	Background	0.051	90.6	3.10	0.98	3.0	873	1,040
7/13/2017	Background	0.039	90.2	3.32	0.93	3.2	694	1,000
10/19/2017	Detection	< 0.002 U	91.0	3.24	0.93	3.5	784	962
1/31/2018	Detection	--	82.2	--	0.94	3.5	714	915
4/26/2018	Assessment	0.088	83.6	4.12	1.16	2.9	661	926
9/20/2018	Assessment	0.08	97.5	3.92	1.15	3.1	747	974
3/13/2019	Assessment	0.05 J	84.6	4.42	0.92	3.2	709	896
6/27/2019	Assessment	0.05 J	83.3	4.13	0.87	3.7	658	954
8/20/2019	Assessment	< 0.1 U	95.8	3.93	0.84	3.5	704	1,010
3/17/2020	Assessment	--	--	--	0.85	3.5	--	--
6/30/2020	Assessment	0.05 J	96.6	4.18	0.71	3.4	--	--
8/26/2020	Assessment	--	--	--	--	3.3	798	1,040
10/6/2020	Assessment	0.05 J	94.5	4.10	0.47	4.1	794	1,020

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

Table 1 - Groundwater Data Summary: MW-1603
Big Sandy - FAP
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
9/26/2016	Background	0.01 J	1.51	13.4	18.6	0.84	1.1	101	6.04	1.24	9.75	0.242	< 0.002 U	0.15	5.4	1.29
11/9/2016	Background	< 0.01 U	1.19	15.4	18.3	0.93	1.12	94.4	6.6	1.10	8.18	0.237	< 0.002 U	0.17	4.8	1.55
1/12/2017	Background	< 0.01 U	1.40	11.4	17.1	0.79	0.731	89.6	5.86	1.11	6.11	0.225	< 0.002 U	0.06 J	5.6	1.39
2/21/2017	Background	< 0.01 U	1.26	10.3	18.9	0.75	0.771	93.2	4.03	0.90	6.30	0.208	< 0.002 U	0.11	4.9	1.20
4/26/2017	Background	0.01 J	1.30	12.4	16.7	0.87	0.829	97.1	5.72	1.04	6.41	0.216	0.002 J	0.18	6.1	1.41
5/24/2017	Background	< 0.01 U	1.34	11.5	16.4	0.77	0.620	85.3	6.4	0.98	4.96	0.221	< 0.002 U	0.07 J	6.3	1.35
6/22/2017	Background	< 0.01 U	1.29	11.4	16.4	0.86	0.821	92.4	6	0.98	6.47	0.263	< 0.002 U	0.32	6.1	1.43
7/13/2017	Background	< 0.01 U	0.89	11.3	18.0	0.80	0.485	92.5	6.36	0.93	3.72	0.217	< 0.002 U	0.22	2.7	1.43
4/26/2018	Assessment	0.04 J	1.60	10.5	18.7	0.74	0.771	91.1	5.09	1.16	5.27	0.187	< 0.002 U	0.03 J	8.1	1.39
9/20/2018	Assessment	< 0.02 U	1.40	11.4	19.6	0.83	0.713	93.8	6.75	1.15	4.39	0.255	--	< 0.4 U	6.3	1.70
10/23/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U	--	--	--
3/13/2019	Assessment	< 0.2 U	1.26	12.0	24.4	0.78	1 J	87.9	4.8	0.92	4.28	0.209	< 0.002 U	< 4 U	4.0	1 J
6/27/2019	Assessment	< 0.04 U	1.36	11.0	21.8	0.70	0.618	84.7	7.149	0.87	3.68	0.192	< 0.002 U	< 0.8 U	4.9	1.40
8/20/2019	Assessment	< 0.1 U	1.39	13.6	25.0	0.89	0.8 J	96.6	10.92	0.84	4.17	0.226	< 0.002 U	< 2 U	5.6	2 J
3/17/2020	Assessment	< 0.02 U	0.83	9.92	16.4	0.64	0.560	72.0	7.19	0.85	3.95	0.156	< 0.002 U	< 0.4 U	4.0	1.34
6/30/2020	Assessment	< 0.04 U	1.12	12.2	21.1	0.85	0.694	93.2	6.22	0.71	4.67	0.192	< 0.002 U	< 0.8 U	6.2	1.57
10/6/2020	Assessment	< 0.02 U	1.12	14.6	17.5	0.87	0.743	90.5	2.681	0.47	4.85	0.165	< 0.002 U	< 0.4 U	5.8	1.82

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

Table 1 - Groundwater Data Summary: MW-1604
Big Sandy - FAP
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
9/27/2016	Background	0.031	6.48	6.20	0.27	7.5	16.6	182
11/8/2016	Background	0.030	4.26	6.22	0.29	3.4	9.1	180
1/11/2017	Background	0.016	3.27	4.07	0.23	6.2	5.9	186
2/21/2017	Background	0.040	3.21	2.60	0.12	6.5	5.7	102
4/25/2017	Background	0.010	3.15	1.71	0.08	5.9	8.6	78
5/23/2017	Background	0.038	2.93	1.56	0.06	5.8	8.2	68
6/21/2017	Background	0.017	2.88	1.41	0.03 J	5.6	10.5	49
7/12/2017	Background	0.054	3.06	1.84	0.06	5.5	9.8	85
9/18/2017	Detection	0.034	2.81	2.22	0.12	6.5	4.0	124
4/25/2018	Assessment	0.052	2.96	1.58	0.06	5.4	8.4	52
9/18/2018	Assessment	0.056	2.69	1.43	0.06 J	6.1	7.8	62
3/12/2019	Assessment	0.02 J	3.55	1.34	0.04 J	5.2	10.0	46
6/25/2019	Assessment	0.02 J	2.97	1.21	0.05 J	6.0	9.5	50
8/20/2019	Assessment	< 0.02 U	3.42	1.17	0.03 J	5.4	10.5	50 J
3/17/2020	Assessment	--	--	--	0.03 J	5.8	--	--
6/29/2020	Assessment	< 0.02 U	3.56	1.03	< 0.01 U	5.2	11.1	--
8/27/2020	Assessment	--	--	--	--	5.7	--	63
10/5/2020	Assessment	< 0.02 U	3.31	1.09	0.03 J	6.8	10.3	50 J

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

Table 1 - Groundwater Data Summary: MW-1604
Big Sandy - FAP
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
9/27/2016	Background	0.05 J	2.74	67.1	0.029	0.007 J	0.6	3.47	1.105	0.27	0.154	0.004	< 0.002 U	3.48	0.2	0.01 J
11/8/2016	Background	0.04 J	3.61	59.0	0.048	0.008 J	0.583	1.55	1.277	0.29	0.265	0.005	< 0.002 U	2.34	0.1	< 0.01 U
1/11/2017	Background	0.08	4.28	54.8	0.027	0.06	0.551	2.02	0.707	0.23	0.188	0.005	< 0.002 U	2.23	0.2	0.119
2/21/2017	Background	0.02 J	3.64	52.9	0.028	0.009 J	0.427	2.78	0.927	0.12	0.103	0.009	< 0.002 U	1.51	0.1	0.175
4/25/2017	Background	0.03 J	3.54	65.1	0.034	0.006 J	0.365	5.59	0.478	0.08	0.01 J	< 0.0002 U	< 0.002 U	0.57	0.08 J	< 0.01 U
5/23/2017	Background	0.02 J	2.24	54.8	0.040	0.03	0.401	4.18	6.707	0.06	0.062	< 0.0002 U	< 0.002 U	0.51	0.2	0.01 J
6/21/2017	Background	0.03 J	1.28	66.1	0.063	0.05	0.183	5.61	16.848	0.03 J	0.049	0.002	0.003 J	0.57	0.2	0.01 J
7/12/2017	Background	0.04 J	1.73	59.8	0.041	0.02	0.322	3.67	0.636	0.06	0.097	0.004	< 0.002 U	15.9	0.1	< 0.01 U
4/25/2018	Assessment	0.08	0.74	58.9	0.053	0.09	0.285	3.75	0.1535	0.06	0.263	0.010	< 0.002 U	0.54	0.3	0.04 J
9/18/2018	Assessment	0.06	1.47	63.5	0.061	0.07	0.388	4.53	0.951	0.06 J	0.092	0.003	--	0.86	0.2	0.04 J
10/22/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U	--	--	--
3/12/2019	Assessment	0.03 J	0.16	66.8	0.06 J	0.08	0.547	0.844	0.458	0.04 J	0.04 J	< 0.009 U	< 0.002 U	< 0.4 U	0.3	< 0.1 U
6/25/2019	Assessment	0.03 J	0.12	68.3	0.07 J	0.09	0.231	0.503	0.799	0.05 J	0.03 J	< 0.009 U	< 0.002 U	< 0.4 U	0.2	< 0.1 U
8/20/2019	Assessment	< 0.02 U	0.09 J	78.3	0.117	0.08	0.612	0.246	0.641	0.03 J	< 0.05 U	0.00104	< 0.002 U	< 0.4 U	0.4	< 0.1 U
3/17/2020	Assessment	< 0.02 U	0.05 J	82.7	0.159	0.08	0.632	0.119	2.93	0.03 J	< 0.05 U	0.00113	< 0.002 U	< 0.4 U	0.4	< 0.1 U
6/29/2020	Assessment	< 0.02 U	0.05 J	90.0	0.182	0.09	0.681	0.130	1.121	< 0.01 U	< 0.05 U	0.00106	< 0.002 U	< 0.4 U	0.5	< 0.1 U
10/5/2020	Assessment	< 0.02 U	0.10	75.8	0.149	0.09	0.589	0.289	0.491	0.03 J	0.2 J	0.000964	< 0.002 U	< 0.4 U	0.4	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1605
Big Sandy - FAP
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
9/27/2016	Background	0.008	1.00	0.43	< 0.02 U	5.7	5.2	30 J
11/8/2016	Background	0.005	1.01	0.43	< 0.02 U	2.3	4.2	40
1/11/2017	Background	< 0.002 U	0.979	0.62	< 0.02 U	4.6	5.7	35
2/21/2017	Background	0.061	1.37	1.49	< 0.02 U	5.1	7.4	74
4/25/2017	Background	0.025	1.31	1.21	< 0.02 U	4.9	6.0	30 J
5/23/2017	Background	0.063	1.21	1.00	< 0.02 U	4.8	5.4	30 J
6/21/2017	Background	0.017	1.15	0.90	< 0.02 U	4.9	5.8	25
7/12/2017	Background	0.075	1.11	1.32	< 0.02 U	4.7	4.5	37
9/14/2017	Detection	0.102	1.01	1.72	< 0.02 U	4.7	4.9	20 J
4/25/2018	Assessment	0.070	1.30	0.69	< 0.02 U	4.6	6.5	37
9/18/2018	Assessment	0.036	0.930	0.62	< 0.02 U	4.0	4.3	29
3/12/2019	Assessment	0.02 J	1.27	0.53	0.02 J	4.3	7.2	33
6/25/2019	Assessment	< 0.02 U	1.20	0.43	< 0.01 U	5.2	5.7	37
8/20/2019	Assessment	< 0.02 U	1.01	0.46	0.01 J	5.5	5.5	30 J
3/17/2020	Assessment	--	--	--	0.01 J	5.0	--	--
6/29/2020	Assessment	< 0.02 U	1.24	0.43	< 0.01 U	5.0	5.3	--
8/27/2020	Assessment	--	--	--	--	5.1	--	30 J
10/5/2020	Assessment	< 0.02 U	1.04	0.39	< 0.01 U	5.6	5.3	40 J

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

Table 1 - Groundwater Data Summary: MW-1605
Big Sandy - FAP
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
9/27/2016	Background	< 0.01 U	0.04 J	30.3	0.091	0.06	2.7	0.897	0.679	< 0.02 U	0.126	0.002	< 0.002 U	0.08 J	0.2	0.01 J
11/8/2016	Background	0.01 J	0.08	30.5	0.121	0.06	2.50	0.917	1.986	< 0.02 U	0.210	0.007	< 0.002 U	0.05 J	0.2	0.01 J
1/11/2017	Background	0.01 J	0.07	32.2	0.111	0.07	2.53	1.64	0.1382	< 0.02 U	0.190	0.008	< 0.002 U	0.1 J	0.2	0.01 J
2/21/2017	Background	< 0.01 U	0.03 J	42.6	0.138	0.09	2.61	1.45	0.904	< 0.02 U	0.107	0.005	< 0.002 U	0.10	0.2	0.03 J
4/25/2017	Background	0.01 J	0.06	39.1	0.119	0.09	2.57	0.991	0.2779	< 0.02 U	0.121	< 0.0002 U	< 0.002 U	0.13	0.2	0.01 J
5/23/2017	Background	< 0.01 U	0.03 J	35.0	0.114	0.07	2.39	0.667	6.077	< 0.02 U	0.104	0.008	< 0.002 U	0.07 J	0.2	0.01 J
6/21/2017	Background	< 0.01 U	0.05 J	33.4	0.105	0.07	2.44	0.592	10.864	< 0.02 U	0.110	0.002	< 0.002 U	0.09 J	0.3	< 0.01 U
7/12/2017	Background	< 0.01 U	0.23	31.7	0.103	0.07	2.33	0.495	0.3796	< 0.02 U	0.107	0.0003 J	< 0.002 U	23.7	0.2	0.01 J
4/25/2018	Assessment	0.04 J	0.07	37.1	0.123	0.08	2.70	0.434	0.421	< 0.02 U	0.193	0.009	< 0.002 U	0.07 J	0.3	0.03 J
9/18/2018	Assessment	0.02 J	0.04 J	29.7	0.104	0.06	2.58	0.265	0.694	< 0.02 U	0.092	0.002	--	0.04 J	0.2	0.03 J
10/22/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U	--	--	--
3/12/2019	Assessment	< 0.02 U	0.17	36.6	0.131	0.08	2.91	0.483	0.2025	0.02 J	0.305	< 0.009 U	0.003 J	< 0.4 U	0.3	< 0.1 U
6/25/2019	Assessment	< 0.02 U	0.05 J	34.8	0.123	0.08	2.53	0.253	0.9023	< 0.01 U	0.164	< 0.009 U	< 0.002 U	< 0.4 U	0.2	< 0.1 U
8/20/2019	Assessment	< 0.02 U	0.03 J	29.1	0.09 J	0.06	2.41	0.215	0.268	0.01 J	0.09 J	0.000637	< 0.002 U	< 0.4 U	0.2	< 0.1 U
3/17/2020	Assessment	< 0.02 U	< 0.03 U	40.9	0.130	0.08	2.47	0.272	1.1942	0.01 J	0.1 J	0.000757	< 0.002 U	< 0.4 U	0.3	< 0.1 U
6/29/2020	Assessment	< 0.02 U	< 0.03 U	36.5	0.119	0.07	2.41	0.222	0.11	< 0.01 U	0.05 J	0.000694	< 0.002 U	< 0.4 U	0.3	< 0.1 U
10/5/2020	Assessment	< 0.02 U	0.04 J	33.7	0.113	0.07	2.55	0.219	4.041	< 0.01 U	0.1 J	0.000695	< 0.002 U	< 0.4 U	0.3	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1606
Big Sandy - FAP
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
9/27/2016	Background	1.92	78.6	31.3	0.17	7.4	54.0	362
11/8/2016	Background	1.80	75.9	31.5	0.19	7.2	54.5	400
1/12/2017	Background	1.77	75.1	31.2	0.21	7.3	58.8	396
2/22/2017	Background	1.63	76.7	30.4	0.18	7.2	53.9	358
4/26/2017	Background	1.78	73.8	31.7	0.19	6.7	56.1	380
5/23/2017	Background	1.87	78.1	31.7	0.19	6.8	56.2	360
6/21/2017	Background	1.89	78.1	31.1	0.17	6.7	55.3	369
7/12/2017	Background	1.79	75.7	31.4	0.17	6.5	57.0	382
9/18/2017	Detection	1.83	77.0	31.3	0.19	6.9	58.1	380
1/31/2018	Detection	1.63	--	32.0	--	7.2	--	--
4/25/2018	Assessment	1.81	73.7	31.3	0.26	6.6	56.0	350
9/19/2018	Assessment	1.82	71.8	31.1	0.24	6.6	56.9	380
3/13/2019	Assessment	1.93	74.2	31.7	0.22	6.9	58.8	389
6/25/2019	Assessment	1.84	74.5	30.8	0.23	7.1	58.7	384
8/20/2019	Assessment	1.74	75.1	31.4	0.21	7.0	58.3	385
3/18/2020	Assessment	--	--	--	0.20	9.1	--	--
6/30/2020	Assessment	2.04	79.7	31.8	0.18	6.8	61.2	--
8/26/2020	Assessment	--	--	--	--	6.5	--	392
10/6/2020	Assessment	2.00	78.7	32.0	0.22	6.7	62.8	363

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

Table 1 - Groundwater Data Summary: MW-1606
Big Sandy - FAP
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
9/27/2016	Background	0.03 J	0.85	1,030	0.064	0.009 J	1.7	0.814	2.76	0.17	1.19	0.006	< 0.002 U	0.68	0.2	0.04 J
11/8/2016	Background	0.04 J	1.24	994	0.114	0.01 J	2.34	1.26	4.082	0.19	1.88	0.014	< 0.002 U	0.51	0.3	0.03 J
1/12/2017	Background	0.07	1.19	883	0.058	0.06	1.52	0.919	3.35	0.21	1.02	0.010	< 0.002 U	0.67	0.2	0.110
2/22/2017	Background	< 0.01 U	0.97	875	0.025	< 0.004 U	0.747	0.381	2.289	0.18	0.330	0.008	0.002 J	0.91	0.2	0.01 J
4/26/2017	Background	0.03 J	1.40	1,080	0.053	0.007 J	1.33	0.951	2.398	0.19	0.862	0.003	< 0.002 U	0.84	0.1	0.02 J
5/23/2017	Background	0.01 J	1.03	949	0.023	< 0.005 U	0.790	0.411	3.37	0.19	0.341	0.006	0.002 J	0.54	0.09 J	< 0.01 U
6/21/2017	Background	< 0.01 U	0.98	884	0.01 J	< 0.005 U	0.385	0.209	2.79	0.17	0.159	0.004	0.003 J	0.60	0.06 J	< 0.01 U
7/12/2017	Background	0.01 J	1.14	773	0.01 J	< 0.005 U	0.353	0.153	3.37	0.17	0.103	0.008	< 0.002 U	7.56	0.06 J	< 0.01 U
4/25/2018	Assessment	0.05	0.97	767	0.008 J	< 0.005 U	0.301	0.101	3.71	0.26	0.077	0.014	< 0.002 U	0.58	0.06 J	0.01 J
9/19/2018	Assessment	0.03 J	0.97	797	0.01 J	< 0.005 U	0.366	0.155	3.28	0.24	0.126	0.001	--	0.58	0.07 J	0.03 J
10/22/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U	--	--	--
3/13/2019	Assessment	< 0.02 U	1.22	764	< 0.02 U	< 0.01 U	0.535	0.208	2.63	0.22	0.123	< 0.009 U	< 0.002 U	2.60	0.05 J	< 0.1 U
6/25/2019	Assessment	< 0.02 U	0.94	843	< 0.02 U	< 0.01 U	0.1 J	0.055	2.366	0.23	0.05 J	< 0.009 U	< 0.002 U	0.6 J	0.06 J	< 0.1 U
8/20/2019	Assessment	< 0.02 U	0.85	768	< 0.02 U	< 0.01 U	0.304	0.05 J	3.12	0.21	< 0.05 U	0.00301	< 0.002 U	0.6 J	0.05 J	< 0.1 U
3/18/2020	Assessment	< 0.02 U	1.00	828	< 0.02 U	< 0.01 U	0.343	0.196	2.49	0.20	0.1 J	0.00340	< 0.002 U	0.6 J	0.08 J	< 0.1 U
6/30/2020	Assessment	< 0.02 U	0.92	816	< 0.02 U	< 0.01 U	0.2 J	0.068	3.16	0.18	0.1 J	0.00364	< 0.002 U	0.5 J	0.07 J	< 0.1 U
10/6/2020	Assessment	< 0.02 U	1.00	750	< 0.02 U	< 0.01 U	0.1 J	0.060	2.91	0.22	< 0.05 U	0.00329	< 0.002 U	0.5 J	0.07 J	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1607
Big Sandy - FAP
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
9/27/2016	Background	0.159	97.6	3.34	0.04 J	6.9	132	406
11/8/2016	Background	0.202	76.3	15.5	0.06	6.8	88.4	368
1/11/2017	Background	0.171	99.0	5.96	0.06	6.0	171	474
2/21/2017	Background	0.195	105	3.47	0.06	6.5	150	470
4/25/2017	Background	0.273	80.8	10.2	0.07	6.3	85.3	332
5/23/2017	Background	0.186	89.4	3.24	0.06 J	6.3	114	338
6/21/2017	Background	0.164	92.5	2.42	0.05 J	6.3	119	368
7/12/2017	Background	0.167	86.0	2.28	0.05 J	5.8	105	358
9/18/2017	Detection	0.155	90.7	2.73	0.07	6.4	125	398
1/31/2018	Detection	--	110	--	--	6.6	159	--
4/25/2018	Assessment	0.234	101	3.66	0.08	6.2	137	430
9/19/2018	Assessment	0.255	95.6	7.52	0.08	6.0	144	428
3/13/2019	Assessment	0.209	93.7	5.17	0.06	6.1	135	415
6/25/2019	Assessment	0.208	91.9	5.22	0.08	6.6	120	388
8/20/2019	Assessment	0.160	101	3.84	0.07	6.5	141	419
3/18/2020	Assessment	--	--	--	0.06	8.1	--	--
6/30/2020	Assessment	0.195	85.4	8.26	0.06 J	6.3	94.1	--
8/26/2020	Assessment	--	--	--	--	6.0	--	372
10/6/2020	Assessment	0.155	99.4	4.76	0.07	6.9	129	381

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

Table 1 - Groundwater Data Summary: MW-1607
Big Sandy - FAP
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
9/27/2016	Background	0.02 J	7.36	34.3	0.01 J	< 0.004 U	0.6	1.41	1.551	0.04 J	0.156	0.003	< 0.002 U	0.52	0.1 J	0.03 J
11/8/2016	Background	0.02 J	11.6	42.3	0.025	0.007 J	0.619	1.45	1.683	0.06	0.376	0.002	< 0.002 U	0.62	0.1	0.02 J
1/11/2017	Background	0.06	12.5	53.5	0.01 J	0.05	0.456	1.31	0.577	0.06	0.129	0.007	< 0.002 U	0.83	0.1	0.119
2/21/2017	Background	0.01 J	8.71	34.3	0.01 J	< 0.004 U	0.359	1.24	1.339	0.06	0.030	0.005	< 0.002 U	0.54	0.05 J	0.055
4/25/2017	Background	0.03 J	15.4	38.1	0.028	0.006 J	0.682	1.34	1.08	0.07	0.416	0.003	< 0.002 U	0.53	0.2	0.02 J
5/23/2017	Background	0.02 J	8.87	33.9	0.01 J	0.008 J	0.350	1.30	6.76	0.06 J	0.081	0.009	0.004 J	0.42	0.1	0.02 J
6/21/2017	Background	0.02 J	9.22	27.5	0.01 J	< 0.005 U	0.324	1.39	1.274	0.05 J	0.123	0.004	< 0.002 U	0.45	0.1	0.02 J
7/12/2017	Background	0.02 J	7.59	25.0	0.01 J	< 0.005 U	0.293	1.13	0.33	0.05 J	0.070	0.004	< 0.002 U	9.02	0.1	0.02 J
4/25/2018	Assessment	0.27	68.5	37.2	0.111	< 0.005 U	0.851	1.57	3.217	0.08	0.799	0.012	< 0.002 U	0.90	0.7	0.04 J
9/19/2018	Assessment	0.04 J	23.6	42.6	0.02 J	< 0.005 U	0.423	1.59	0.611	0.08	0.159	0.001	--	0.59	0.1	0.04 J
10/22/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U	--	--	--
3/13/2019	Assessment	< 0.02 U	7.67	31.6	< 0.02 U	< 0.01 U	0.424	1.43	0.18541	0.06	0.05 J	< 0.009 U	< 0.002 U	1 J	0.08 J	< 0.1 U
6/25/2019	Assessment	0.02 J	19.3	38.1	< 0.02 U	< 0.01 U	0.250	1.39	0.501	0.08	0.09 J	< 0.009 U	< 0.002 U	0.7 J	0.1 J	< 0.1 U
8/20/2019	Assessment	< 0.02 U	14.4	29.1	< 0.02 U	< 0.01 U	0.347	1.19	0.685	0.07	< 0.05 U	0.0001 J	< 0.002 U	0.6 J	0.09 J	< 0.1 U
3/18/2020	Assessment	0.02 J	14.2	34.6	< 0.02 U	< 0.01 U	0.305	1.34	2.1757	0.06	0.1 J	0.000332	< 0.002 U	0.8 J	0.2 J	0.1 J
6/30/2020	Assessment	0.03 J	17.7	25.7	< 0.02 U	< 0.01 U	0.209	1.33	1.398	0.06 J	0.08 J	0.0001 J	< 0.002 U	0.6 J	0.1 J	< 0.1 U
10/6/2020	Assessment	0.16	24.9	30.2	< 0.02 U	< 0.01 U	0.352	1.22	1.017	0.07	0.1 J	0.0002 J	< 0.002 U	0.6 J	0.1 J	< 0.1 U

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

Table 1: Residence Time Calculation Summary
Big Sandy Fly Ash Pond

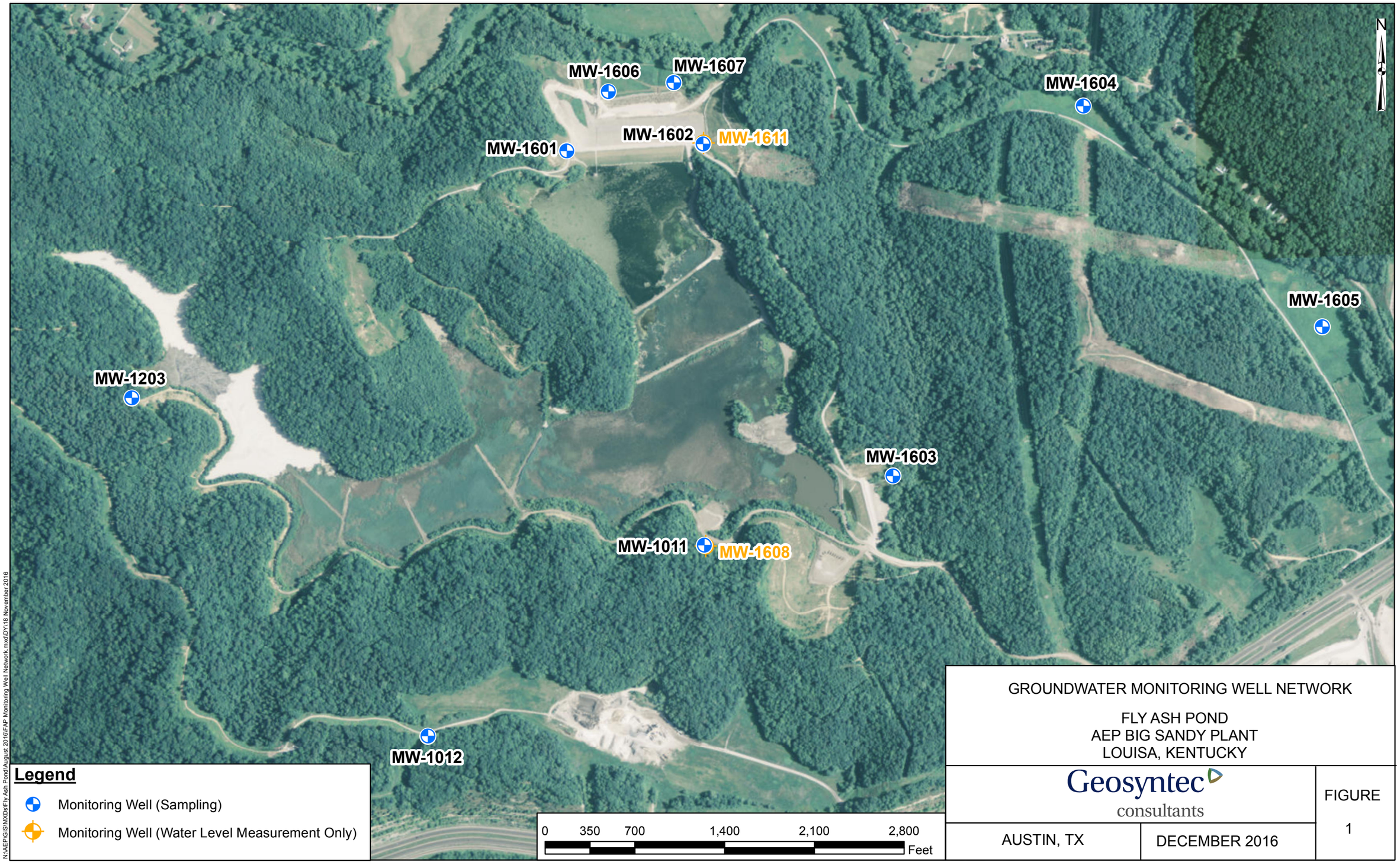
Geosyntec Consultants, Inc.

			2020-03		2020-06		2020-08		2020-10	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Fly Ash Pond	MW-1011 [1]	2.0	33.0	1.8	33.0	1.8	33.0	1.8	33.0	1.8
	MW-1012 [1]	2.0	33.0	1.8	33.0	1.8	33.0	1.8	33.0	1.8
	MW-1203 [1]	2.0	33.0	1.8	33.0	1.8	33.0	1.8	33.0	1.8
	MW-1601 [2]	4.0	33.0	3.7	33.0	3.7	33.0	3.7	33.0	3.7
	MW-1602 [2]	4.0	33.0	3.7	33.0	3.7	33.0	3.7	33.0	3.7
	MW-1603 [2]	4.0	33.0	3.7	33.0	3.7	33.0	3.7	33.0	3.7
	MW-1604 [1]	4.0	37.8	3.2	193	0.6	4.1	29.8	2.4	49.7
	MW-1605 [1]	4.0	37.8	3.2	193	0.6	4.1	29.8	2.4	49.7
	MW-1606 [2]	4.0	37.8	3.2	193	0.6	4.1	29.8	2.4	49.7
	MW-1607 [2]	4.0	37.8	3.2	193	0.6	4.1	29.8	2.4	49.7

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

APPENDIX 2—Figures

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.



Legend

- Monitoring Well (Sampling)
- Monitoring Well (Water Level Measurement Only)

GROUNDWATER MONITORING WELL NETWORK

FLY ASH POND
AEP BIG SANDY PLANT
LOUISA, KENTUCKY

Geosyntec consultants

AUSTIN, TX | DECEMBER 2016

FIGURE 1

N:\AEP\GIS\MXDs\Fly Ash Pond\August 2016\FAP Monitoring Well Network.mxd\DY\18 November 2016

Legend

- Groundwater Monitoring Well
- Inferred Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on March 17, 2020) provided by AEP.
- Site features based on information available in Groundwater Monitoring Network Evaluation - Big Sandy Fly Ash Pond (Geosyntec, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (ft amsl).
- FAP: Fly Ash Pond

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
March 2020

AEP Big Sandy Plant - Fly Ash Pond
Louisa, Kentucky

Geosyntec consultants

Columbus, Ohio | 2021/01/26

Figure **2**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Big Sandy\2020\AEP-BigSandy_FAP_GW_2020-03-March.mxd. ARevezzo. 1/26/2021. CHA8423/05/08.

Legend

- Groundwater Monitoring Well
- Inferred Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on June 29 - 30, 2020) provided by AEP.
- Site features based on information available in Groundwater Monitoring Network Evaluation - Big Sandy Fly Ash Pond (Geosyntec, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (ft amsl).
- FAP: Fly Ash Pond

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
June 2020
AEP Big Sandy Plant - Fly Ash Pond
Louisa, Kentucky

Geosyntec consultants

Columbus, Ohio | 2021/01/26

Figure **3**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Big Sandy\2020\AEP-BigSandy_FAP_GW_2020-06-June.mxd. ARevezzo. 1/26/2021. CHA8423/05/08.

Legend

- Groundwater Monitoring Well
- Inferred Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on August 26 - 27, 2020) provided by AEP.
- Site features based on information available in Groundwater Monitoring Network Evaluation - Big Sandy Fly Ash Pond (Geosyntec, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (ft amsl).
- FAP: Fly Ash Pond

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
August 2020
AEP Big Sandy Plant - Fly Ash Pond
Louisa, Kentucky

Geosyntec consultants

Columbus, Ohio | 2021/01/26

Figure **4**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Big Sandy\2020\AEP-BigSandy_FAP_GW_2020-08-August.mxd. ARevezzo. 1/26/2021. CHA8423/05/08.

Legend

- Groundwater Monitoring Well
- Inferred Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on October 5, 2020) provided by AEP.
- Site features based on information available in Groundwater Monitoring Network Evaluation - Big Sandy Fly Ash Pond (Geosyntec, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (ft amsl).
- Fly Ash Pond (FAP) water elecation not recordable on October 5, 2020 because pond cap geomembrane construction was under way. Cap geomembrane construction was completed on November 24, 2020.

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
October 2020
AEP Big Sandy Plant - Fly Ash Pond
Louisa, Kentucky

Geosyntec consultants

Columbus, Ohio | 2021/01/26

Figure **5**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Big Sandy\2020\AEP-BigSandy_FAP_GW_2020-10-October.mxd. ARevezzo. 1/26/2021. CHA8423/05/08.

APPENDIX 3—Statistical Analysis Summaries

The October 2020 statistical analysis summary concluding that SSLs were identified at the CCR unit follows.

STATISTICAL ANALYSIS SUMMARY
FLY ASH POND
Big Sandy Plant
Louisa, Kentucky

Submitted to

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

October 27, 2020

CHA8500

TABLE OF CONTENTS

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LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
FAP	Fly Ash Pond
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Fly Ash Pond (FAP), an existing CCR unit at the Big Sandy Power Plant located in Louisa, Kentucky.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron, calcium, chloride, fluoride, total dissolved solids (TDS), and sulfate at the FAP. An alternative source was not identified at the time, so the FAP initiated assessment monitoring in April 2018. Groundwater protection standards (GWPS) were set in accordance with 40 CFR 257.95(d)(2) and a statistical evaluation of the assessment monitoring data was conducted. During the most recent assessment monitoring event, statistically significant levels were observed for beryllium, cobalt, combined radium, and lithium (Geosyntec, 2019). An alternative source demonstration (ASD) was successfully completed (EHS, 2020); thus, the unit remained in assessment monitoring. Two assessment monitoring events were conducted at the FAP in March and June/August 2020 in accordance with 40 CFR 257.95. The results of these assessment events are documented in this report.

Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact data usability.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were re-established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at a statistically significant level (SSL) above the GWPS. SSLs were identified for beryllium, cobalt, combined radium, and lithium. Thus, either the unit will move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

FLY ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, two sets of samples were collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(b) (March 2020) and 257.95(d)(1) (June/ August 2020). Samples from the March 2020 event were analyzed for Appendix IV parameters only. Samples from June 2020 were analyzed for all Appendix IV and select Appendix III parameters. Where data for Appendix III parameters were not available in June 2020, additional samples were collected in August 2020. Well MW-1601 could not be sampled during the June or August 2020 sampling events due to insufficient water. A summary of data collected during these assessment monitoring events are presented in Table 1.

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

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.26 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the FAP were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained in March and June/August 2020 were screened for potential outliers. No outliers were identified for these events.

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in 40 CFR 257.95(h)(2) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from

the background wells collected during the background monitoring and assessment monitoring events. Tolerance limits were calculated parametrically with 95% coverage and 95% confidence for barium, cobalt, combined radium, lead, and lithium. Non-parametric tolerance limits were calculated for antimony, arsenic, cadmium, chromium, fluoride, molybdenum, selenium, and thallium due to apparent non-normal distributions and for mercury due to a high non-detect frequency. A non-parametric tolerance limit was calculated for beryllium due to both an apparent non-normal distribution and a high non-detect frequency. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

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

The following SSLs were identified at the Big Sandy FAP:

- The LCL for beryllium exceeded the GWPS of 0.00400 mg/L at MW-1603 (0.0173 mg/L).
- The LCL for cobalt exceeded the GWPS of 0.006 mg/L at MW-1603 (0.0867 mg/L).
- The LCL for combined radium exceeded the GWPS of 5.00 pCi/L at MW-1603 (5.34 pCi/L).
- The LCL for lithium exceeded the GWPS of 0.040 mg/L at MW-1603 (0.198 mg/L).

As a result, the Big Sandy FAP will either move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring.

2.2.3 Evaluation of Potential Appendix III SSIs

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

Data collected during the June/August 2020 assessment monitoring event from each compliance well were compared to the prediction limits to evaluate results above background values. The results from this event and the prediction limits are summarized in Table 3. The following exceedances of the upper prediction limits (UPLs) were noted:

- Boron concentrations exceeded the interwell UPL of 0.220 mg/L at MW-1606 (2.04 mg/L).

- Chloride concentrations exceeded the interwell UPL of 8.21 mg/L at MW-1602 (17.6 mg/L), MW-1606 (31.8 mg/L), and MW-1607 (8.26 mg/L).

- Sulfate concentrations exceeded the interwell UPL of 106 mg/L at MW-1602 (121 mg/L), and MW-1603 (798 mg/L).

- TDS concentrations exceeded the interwell UPL of 561 mg/L at MW-1603 (1,040 mg/L).

While the prediction limits were calculated for a one-of-two retesting procedure, SSIs were conservatively assumed if the June/August 2020 sample was above the UPL or below the LPL. Based on these results, concentrations of Appendix III constituents appear to be above background levels at compliance wells.

2.3 Conclusions

A semi-annual assessment monitoring event was conducted in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the March and June/August 2020 data. GWPSs were re-established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPS. SSLs were identified for beryllium, cobalt, combined radium, and lithium. Appendix III parameters were compared to established prediction limits, with exceedances identified for boron, chloride, sulfate, and TDS.

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

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Big Sandy Plant. January 2017.

EHS Support. 2020. Alternative Source Demonstration Addendum Report for 2019 Monitoring Data. Big Sandy Fly Ash Pond. January.

Geosyntec Consultants (Geosyntec). 2019. Statistical Analysis Summary – Fly Ash Pond, Big Sandy Plant, Louisa, Kentucky. December 6, 2019.

TABLES

Table 1 - Groundwater Data Summary
Big Sandy Plant - Fly Ash Pond

Parameter	Unit	MW-1011			MW-1012			MW-1203			MW-1601	MW-1602			MW-1603		
		3/17/2020	6/29/2020	8/26/2020	3/18/2020	6/30/2020	8/27/2020	3/17/2020	6/30/2020	8/27/2020	3/18/2020	3/18/2020	6/30/2020	8/26/2020	3/17/2020	6/30/2020	8/26/2020
Antimony	µg/L	0.14	0.18	-	0.67	0.58	-	0.1 U	0.02 J	-	0.59	0.06 J	0.04 J	-	0.1 U	0.2 U	-
Arsenic	µg/L	6.96	6.72	-	18.0	19.1	-	0.17	0.47	-	0.63	1.36	1.59	-	0.83	1.12	-
Barium	µg/L	51.5	49.2	-	20.8	68.2	-	86.9	101	-	62.9	55.4	55.9	-	9.92	12.2	-
Beryllium	µg/L	0.1 U	0.1 U	-	0.1 U	0.116	-	0.02 J	0.08 J	-	0.1 U	0.1 U	0.1 U	-	16.4	21.1	-
Boron	mg/L	-	0.111	-	-	0.181	-	-	0.104	-	-	-	0.05 J	-	-	0.05 J	-
Cadmium	µg/L	0.05 U	0.01 J	-	0.05 U	0.01 J	-	0.05 U	0.05 U	-	0.01 J	0.05 U	0.05 U	-	0.64	0.85	-
Calcium	mg/L	-	82.8	-	-	1.72	-	-	64.9	-	-	-	79.0	-	-	96.6	-
Chloride	mg/L	-	5.10	-	-	5.21	-	-	5.17	-	-	-	17.6	-	-	4.18	-
Chromium	µg/L	0.253	0.203	-	0.2 J	0.912	-	0.1 J	0.1 J	-	0.298	0.511	0.679	-	0.560	0.694	-
Cobalt	µg/L	0.724	0.339	-	0.05 U	0.527	-	0.645	0.547	-	0.152	0.04 J	0.04 J	-	72.0	93.2	-
Combined Radium	pCi/L	4.44	3.02	-	3.47	2.62	-	7.524	2.29	-	1.25	1.517	0.488	-	7.19	6.22	-
Fluoride	mg/L	0.24	0.24	-	0.74	0.72	-	0.13	0.12	-	0.17	0.09	0.09	-	0.85	0.71	-
Lead	µg/L	0.2 U	0.05 J	-	0.05 J	1.86	-	0.2 U	0.1 J	-	0.07 J	0.08 J	0.07 J	-	3.95	4.67	-
Lithium	mg/L	0.00871	0.00993	-	0.00525	0.00593	-	0.0127	0.0121	-	0.0302	0.00736	0.00717	-	0.156	0.192	-
Mercury	µg/L	0.005 U	0.005 U	-	0.005 U	0.002 J	-	0.005 U	0.005 U	-	0.005 U	0.005 U	0.005 U	-	0.005 U	0.005 U	-
Molybdenum	µg/L	0.7 J	0.8 J	-	1 J	1 J	-	2 U	2 U	-	15.6	1 J	1 J	-	2 U	4 U	-
Selenium	µg/L	0.2 U	0.06 J	-	0.2 U	0.4	-	0.2 U	0.2 U	-	0.5	1.1	1.0	-	4.0	6.2	-
Sulfate	mg/L	-	82.8	-	-	36.7	-	-	30.6	-	-	-	-	121	-	-	798
Thallium	µg/L	0.5 U	0.5 U	-	0.5 U	0.5 U	-	0.5 U	0.5 U	-	0.5 U	0.5 U	0.5 U	-	1.34	1.57	-
Total Dissolved Solids	mg/L	-	-	443	-	-	582	-	-	263	-	-	-	454	-	-	1,040
pH	SU	7.5	6.9	4.3	10.9	9.2	9.3	7.4	6.7	6.9	8.3	8.8	7.2	4.8	3.5	3.4	3.3

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. For statistical analysis, parameters which were not detected were replaced with the reporting limit.
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
Sulfate and total dissolved solids (TDS) were not analyzed for several wells in June 2020, so the wells were resampled in August 2020 and analyzed for sulfate and TDS.
MW-1601 could not be sampled in June and August 2020 due to insufficient water.

Table 1 - Groundwater Data Summary
Big Sandy Plant - Fly Ash Pond

Parameter	Unit	MW-1604			MW-1605			MW-1606			MW-1607		
		3/17/2020	6/29/2020	8/27/2020	3/17/2020	6/29/2020	8/27/2020	3/18/2020	6/30/2020	8/26/2020	3/18/2020	6/30/2020	8/26/2020
Antimony	µg/L	0.1 U	0.1 U	-	0.1 U	0.1 U	-	0.1 U	0.1 U	-	0.02 J	0.1 U	-
Arsenic	µg/L	0.04 J	0.05 J	-	0.1 U	0.1 U	-	1.00	0.92	-	10.8	12.0	-
Barium	µg/L	81.8	90.0	-	41.7	36.5	-	828	816	-	33.7	25.8	-
Beryllium	µg/L	0.149	0.182	-	0.133	0.119	-	0.1 U	0.1 U	-	0.1 U	0.1 U	-
Boron	mg/L	-	0.05 U	-	-	0.05 U	-	-	2.04	-	-	0.195	-
Cadmium	µg/L	0.08	0.09	-	0.07	0.07	-	0.05 U	0.05 U	-	0.05 U	0.05 U	-
Calcium	mg/L	-	3.56	-	-	1.24	-	-	79.7	-	-	85.1	-
Chloride	mg/L	-	1.03	-	-	0.43	-	-	31.8	-	-	8.44	-
Chromium	µg/L	0.616	0.681	-	2.54	2.41	-	0.343	0.2 J	-	0.372	0.1 J	-
Cobalt	µg/L	0.106	0.130	-	0.274	0.222	-	0.196	0.068	-	1.31	1.35	-
Combined Radium	pCi/L	2.93	1.121	-	1.1942	0.11	-	2.49	3.16	-	2.1757	1.398	-
Fluoride	mg/L	0.03 J	0.06 U	-	0.01 J	0.06 U	-	0.20	0.18	-	0.06	0.05 J	-
Lead	µg/L	0.2 U	0.2 U	-	0.08 J	0.05 J	-	0.1 J	0.1 J	-	0.2 U	0.2 U	-
Lithium	mg/L	0.00110	0.00106	-	0.000784	0.000694	-	0.00340	0.00364	-	0.000281	0.0001 J	-
Mercury	µg/L	0.005 U	0.005 U	-	0.005 U	0.005 U	-	0.005 U	0.005 U	-	0.005 U	0.005 U	-
Molybdenum	µg/L	2 U	2 U	-	2 U	2 U	-	0.6 J	0.5 J	-	0.6 J	0.6 J	-
Selenium	µg/L	0.4	0.5	-	0.3	0.3	-	0.08 J	0.07 J	-	0.09 J	0.06 J	-
Sulfate	mg/L	-	11.1	-	-	5.3	-	-	61.2	-	-	92.7	-
Thallium	µg/L	0.5 U	0.5 U	-	0.5 U	0.5 U	-	0.5 U	0.5 U	-	0.5 U	0.5 U	-
Total Dissolved Solids	mg/L	-	-	63	-	-	30 J	-	-	392	-	-	372
pH	SU	5.8	5.2	5.7	5.0	5.0	5.1	9.1	6.8	6.5	8.1	6.3	6.0

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. For statistical analysis, parameters which were not detected were replaced with the reporting limit.
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
Sulfate and total dissolved solids (TDS) were not analyzed for several wells in June 2020, so the wells were resampled in August 2020 and analyzed for sulfate and TDS.
MW-1601 could not be sampled in June and August 2020 due to insufficient water.

Table 2: Groundwater Protection Standards
Big Sandy Plant - Fly Ash Pond

Constituent Name	MCL	CCR Rule-Specified	Calculated UTL
Antimony, Total (mg/L)	0.006		0.0012
Arsenic, Total (mg/L)	0.01		0.029
Barium, Total (mg/L)	2		0.11
Beryllium, Total (mg/L)	0.004		0.00018
Cadmium, Total (mg/L)	0.005		0.00014
Chromium, Total (mg/L)	0.1		0.0029
Cobalt, Total (mg/L)	n/a	0.006	0.0060
Combined Radium, Total (pCi/L)	5		4.96
Fluoride, Total (mg/L)	4		0.82
Lead, Total (mg/L)	n/a	0.015	0.0016
Lithium, Total (mg/L)	n/a	0.04	0.03
Mercury, Total (mg/L)	0.002		0.000013
Molybdenum, Total (mg/L)	n/a	0.1	0.0035
Selenium, Total (mg/L)	0.05		0.0005
Thallium, Total (mg/L)	0.002		0.0003

Notes:
Grey cell indicates calculated UTL is higher than MCL or CCR Rule-specified value.
MCL = Maximum Contaminant Level
Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
The higher of the calculated UTL or MCL/Rule-Specified Level is used as the GWPS.

Table 3 - Appendix III Data Summary
Big Sandy Plant - Fly Ash Pond

Geosyntec Consultants, Inc.

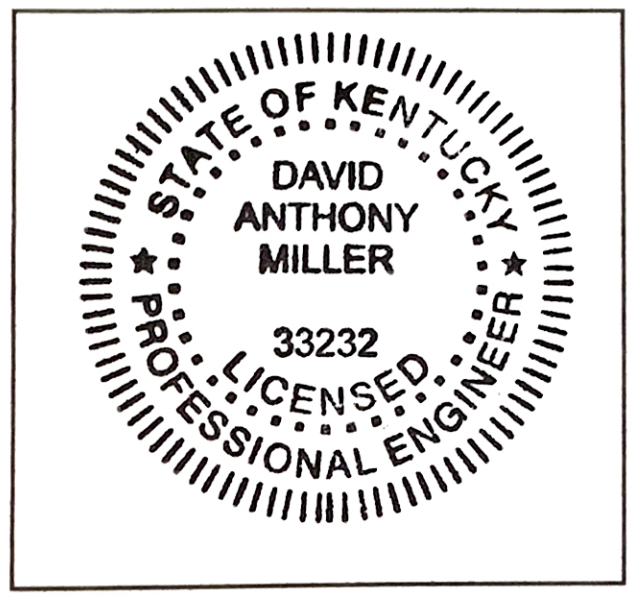
Analyte	Unit	Description	MW-1602*	MW-1603*	MW-1606[†]	MW-1607[†]
			6/30/2020	6/30/2020	6/30/2020	6/30/2020
Boron	mg/L	Interwell Background Value (UPL)	0.220			
		Analytical Result	0.05	0.05	**2.04**	0.195
Calcium	mg/L	Interwell Background Value (UPL)	105			
		Analytical Result	79.0	96.6	79.7	85.4
Chloride	mg/L	Interwell Background Value (UPL)	8.21			
		Analytical Result	**17.6**	4.18	**31.8**	**8.26**
Fluoride	mg/L	Interwell Background Value (UPL)	0.820			
		Analytical Result	0.09	0.71	0.18	0.06
pH	SU	Intrawell Background Value (UPL)	8.2	5.4	7.6	7.1
		Intrawell Background Value (LPL)	6.4	2.2	6.2	5.6
		Analytical Result	7.2	3.4	6.8	6.3
Sulfate	mg/L	Interwell Background Value (UPL)	106			
		Analytical Result	**121**	**798**	61.2	94.1
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	561			
		Analytical Result	454	**1040**	392	372

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
MW-1601 could not be sampled in June and August 2020 due to insufficient water.
*Sulfate and total dissolved solids results for the sample collected on August 26, 2020 are shown.
[†]Total dissolved solids results for the sample collected on August 26, 2020 are shown.

ATTACHMENT A
Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

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



DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

33232

License Number

KENTUCKY

Licensing State

10.28.2020

Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS CONSULTING

October 8, 2020

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

Re: Big Sandy Fly Ash Pond – Assessment Monitoring Analysis

Dear Ms. Kreinberg,

Groundwater Stats Consulting (GSC), formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the analysis of groundwater data for American Electric Power Company's Big Sandy Fly Ash Pond. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at site for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** MW-1011, MW-1012, MW-1203, MW-1604, MW-1605
- **Downgradient wells:** MW-1601, MW-1602, MW-1603, MW-1606, MW-1607.

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

The CCR Assessment Monitoring program consists of the following constituents:

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

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

Summary of Background Update Conducted in December 2019

All background data were initially screened during December 2017. Data were re-evaluated in December 2019 using Tukey's outlier test and visual screening, and the results were submitted at that time. Tukey's outlier test was used to evaluate all wells for all Appendix IV parameters. Outliers were identified by Tukey's for combined radium in well MW-1604, molybdenum in wells MW-1606 and MW-1607, and selenium in well MW-1607. These values were flagged in the database as outliers. While the test identified a few outliers for selenium in well MW-1607, only the highest value was flagged and deselected in the data base as the other measurements were similar to the other reported values within this record. Additional values were flagged as outliers for chromium in upgradient well MW-1012, combined radium in wells MW-1604 and MW-1605, as well as molybdenum in well MW-1604 and MW-1605. Although Tukey's did not identify these values as outliers, the data did not appear to represent the population for these well/constituent pairs. A summary of all flagged values follows this letter (Figure C).

Evaluation of Appendix IV Parameters

Parametric tolerance limits were used to calculate background limits from pooled upgradient well data for Appendix IV parameters with a target of 95% confidence and 95% coverage to determine the background limit (Figure D). The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and CCR-Rule specified levels in the Groundwater Protection Standards (GWPS)

table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure E).

Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters using the highest limit of either the MCL, CCR-Rule specified level or ACL as discussed above (Figure F). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. The following confidence intervals exceeded their respective GWPS: beryllium, cobalt, combined radium and lithium in well MW-1603. A summary of the confidence interval results follows this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for Big Sandy Fly Ash Pond. If you have any questions or comments, please feel free to contact me.

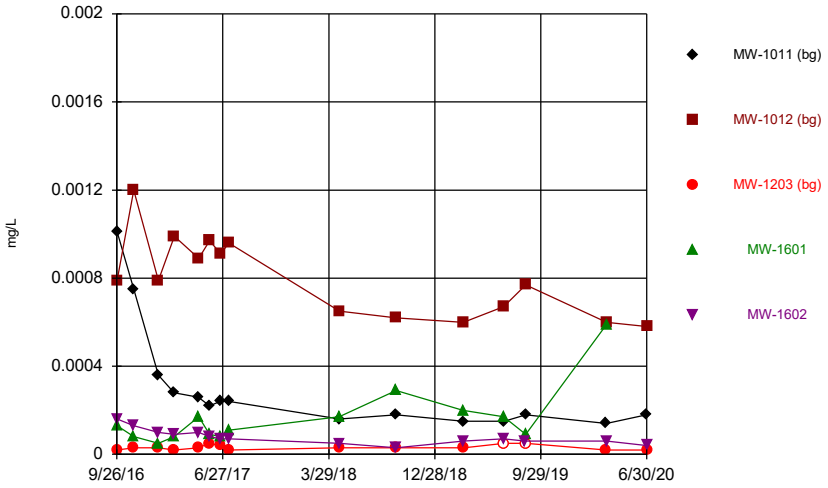
For Groundwater Stats Consulting,

Easton Rayner
Groundwater Analyst

Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.27 . UG
Hollow symbols indicate censored values.

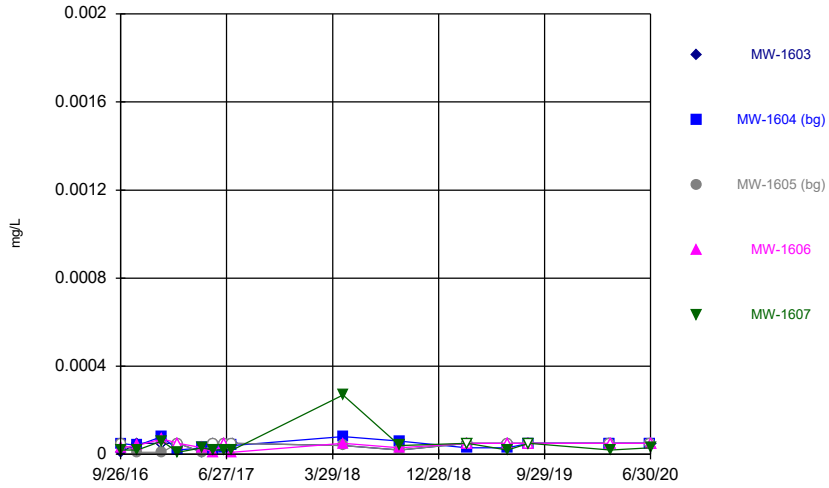
Time Series



Constituent: Antimony Analysis Run 10/8/2020 3:04 AM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG
Hollow symbols indicate censored values.

Time Series



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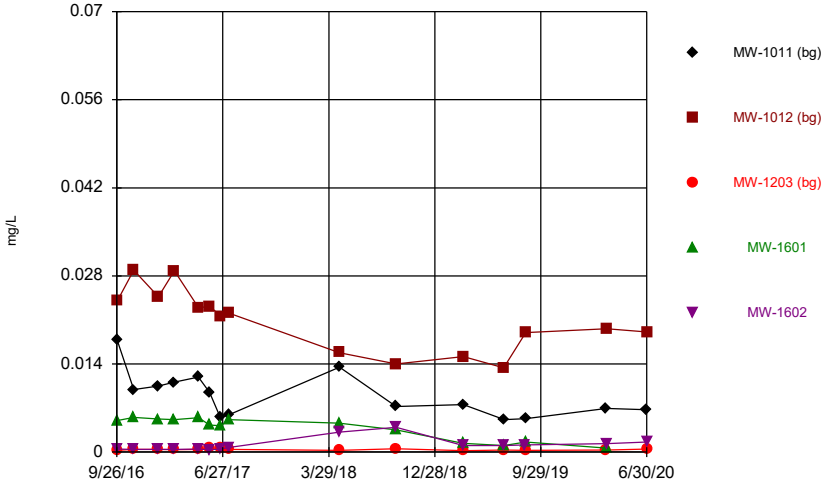
Sanitas™ v.9.6.27 . UG

Time Series



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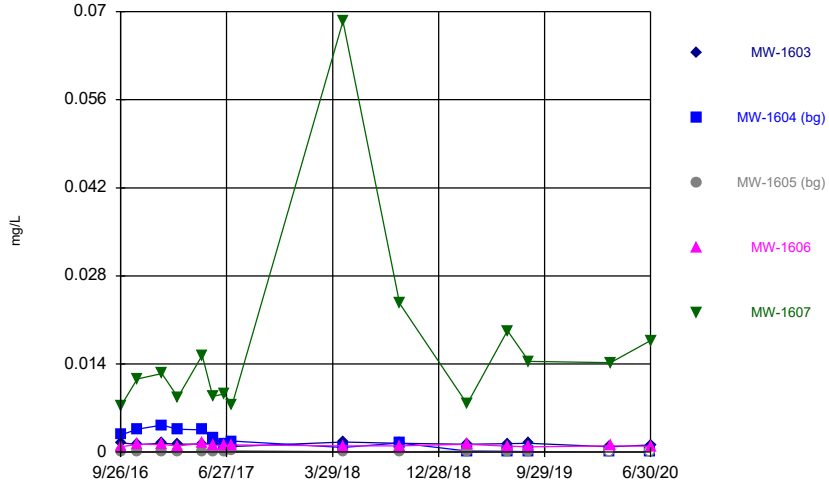

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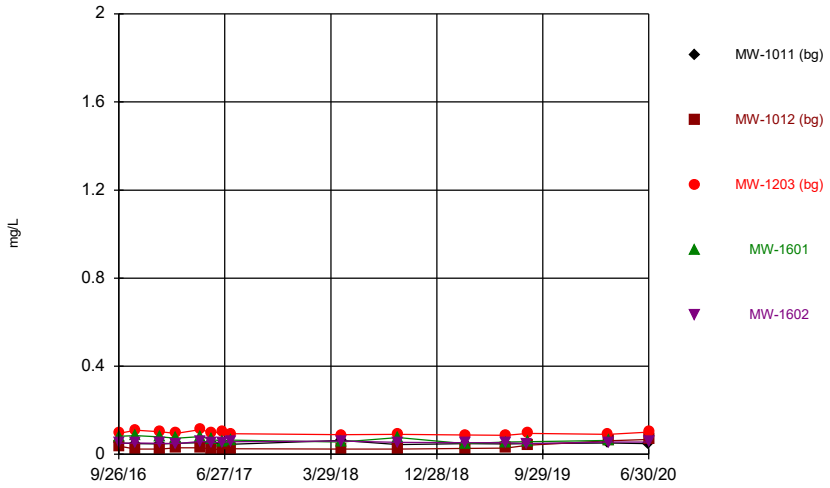
Sanitas™ v.9.6.27 . UG

Time Series



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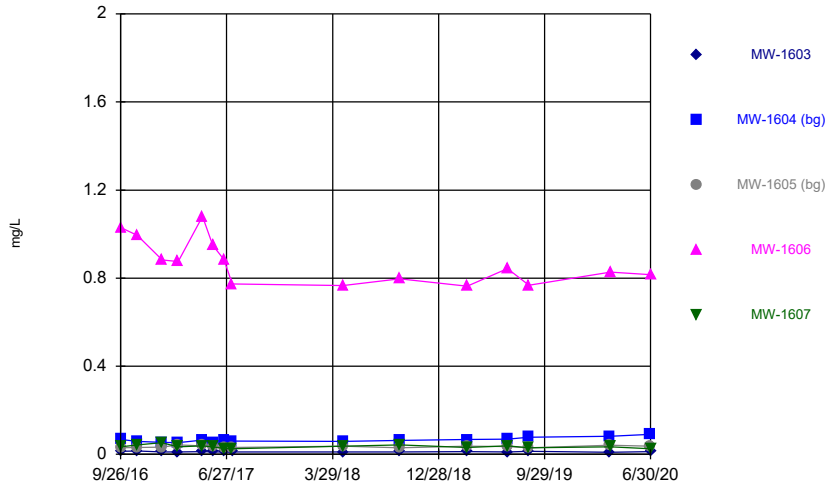
Sanitas™ v.9.6.27 . UG

Time Series



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Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG
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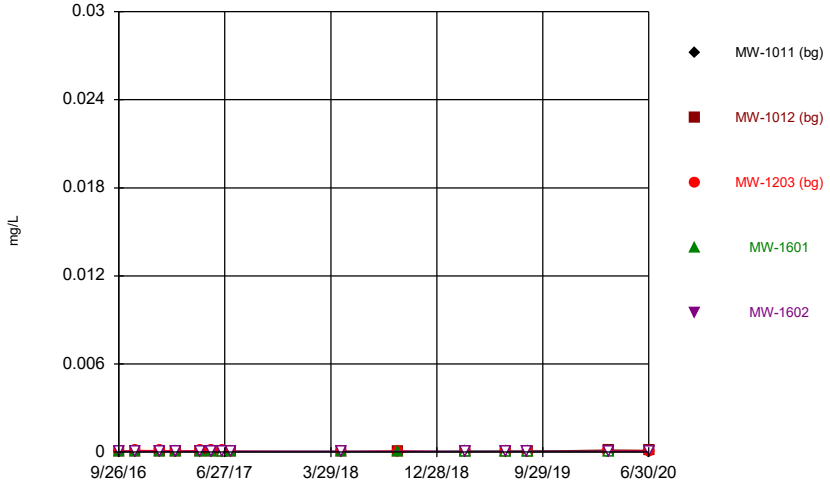
Time Series



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Sanitas™ v.9.6.27 . UG
Hollow symbols indicate censored values.

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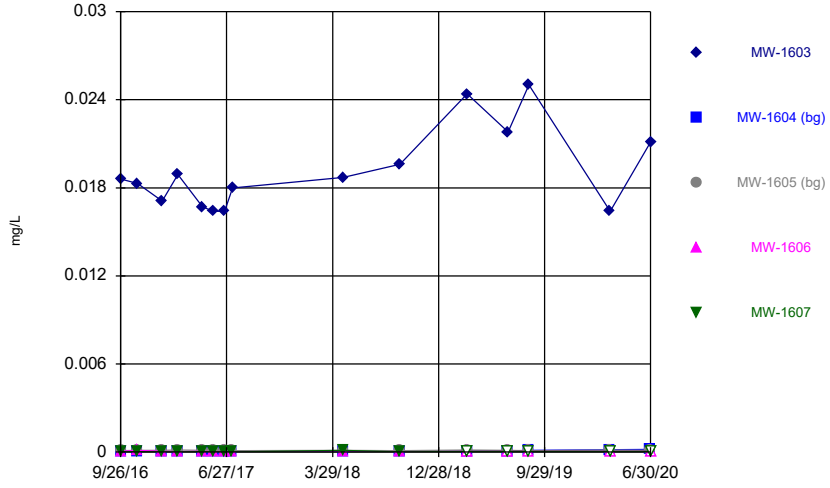

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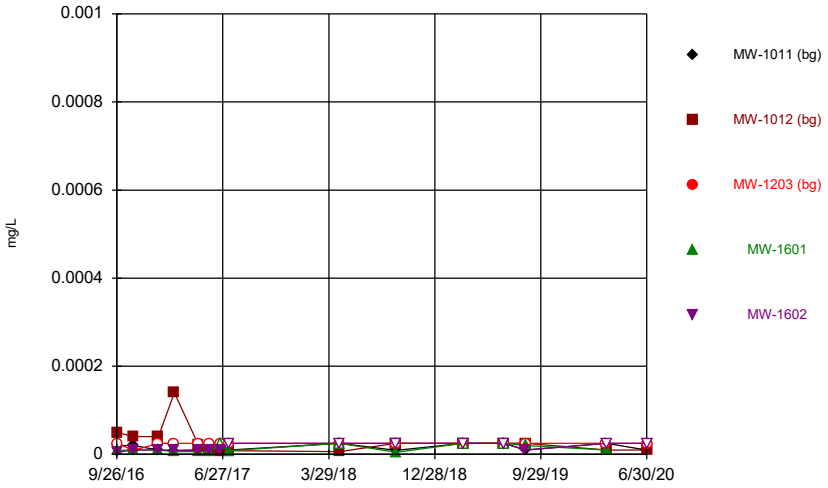
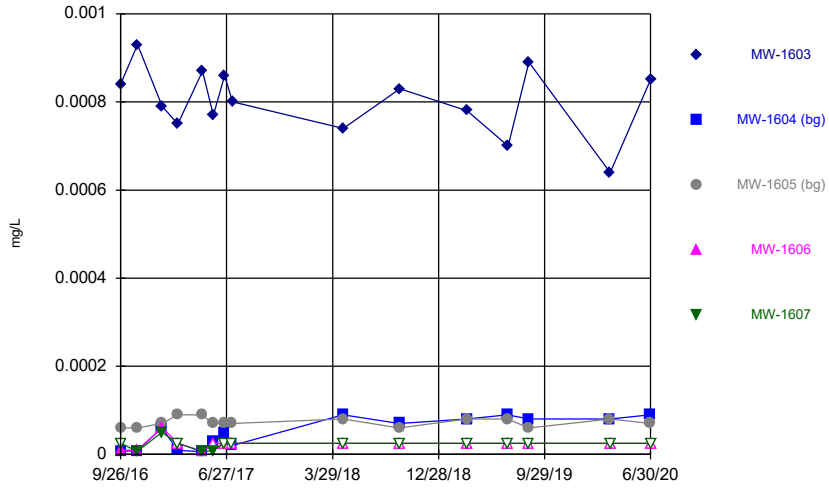


Constituent: Cadmium Analysis Run 10/8/2020 3:04 AM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG
Hollow symbols indicate censored values.

Time Series



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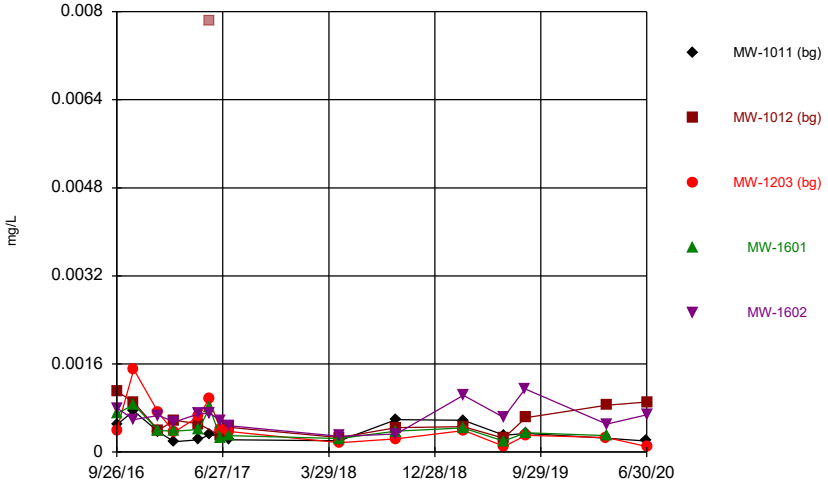
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG

Time Series



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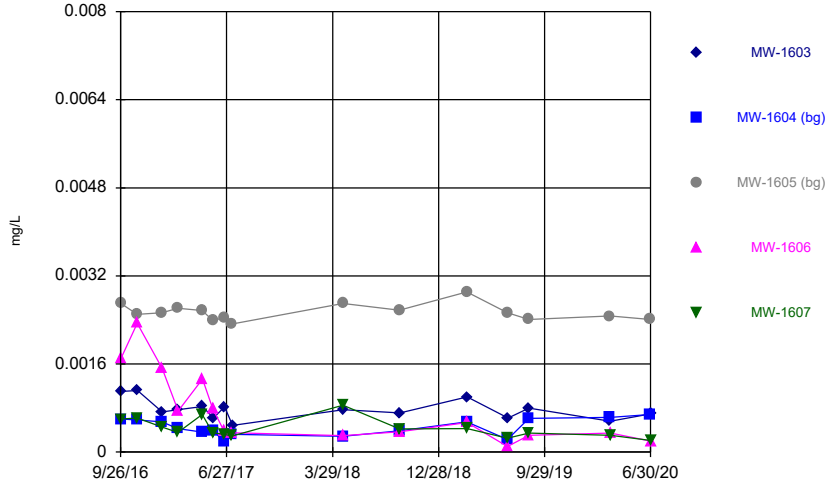
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG

Time Series



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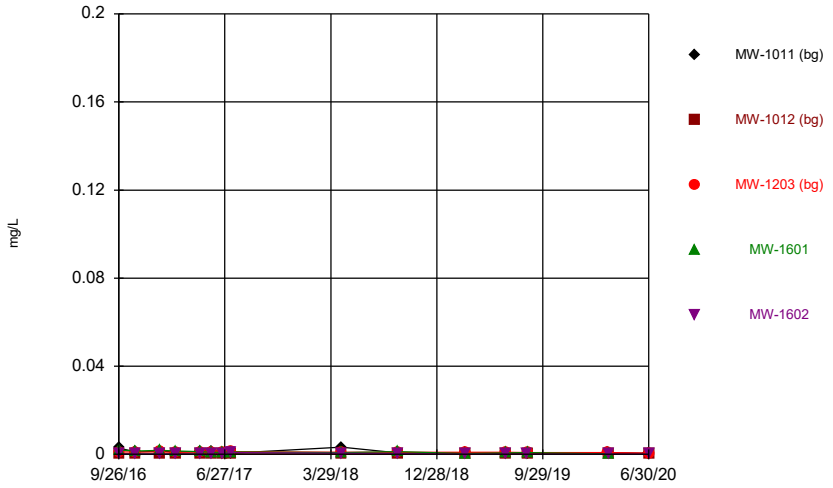
Sanitas™ v.9.6.27 . UG

Time Series



Constituent: Cobalt Analysis Run 10/8/2020 3:04 AM View: Interwell AIV
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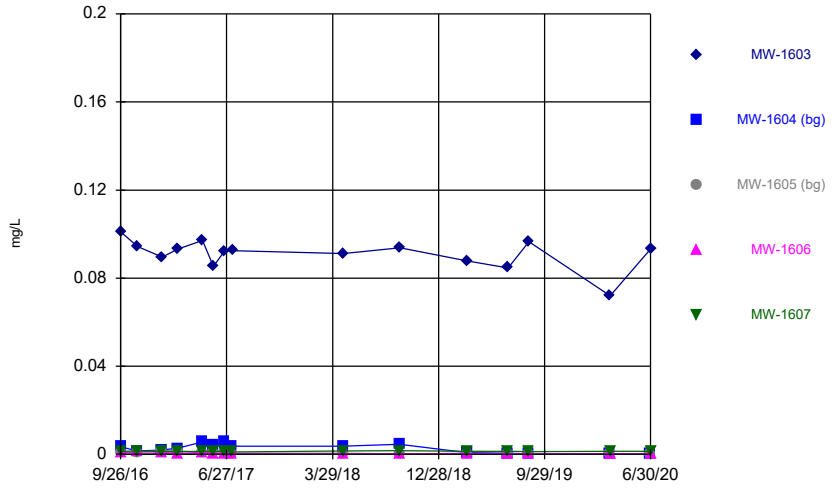
Sanitas™ v.9.6.27 . UG

Time Series



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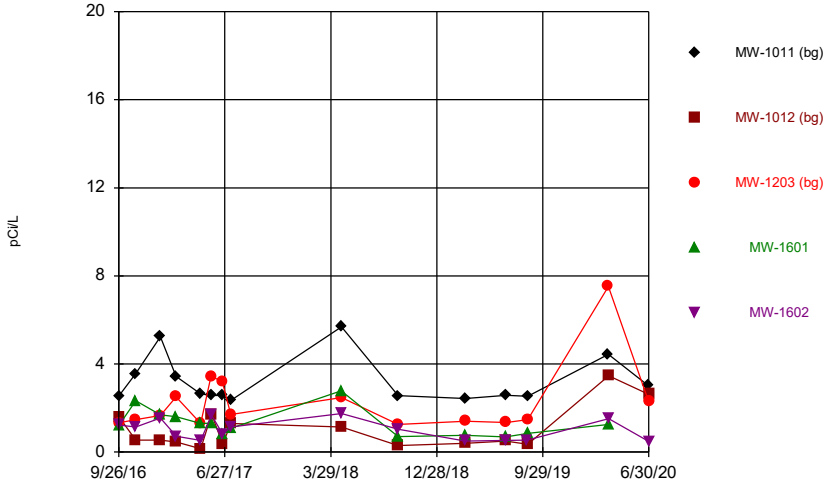
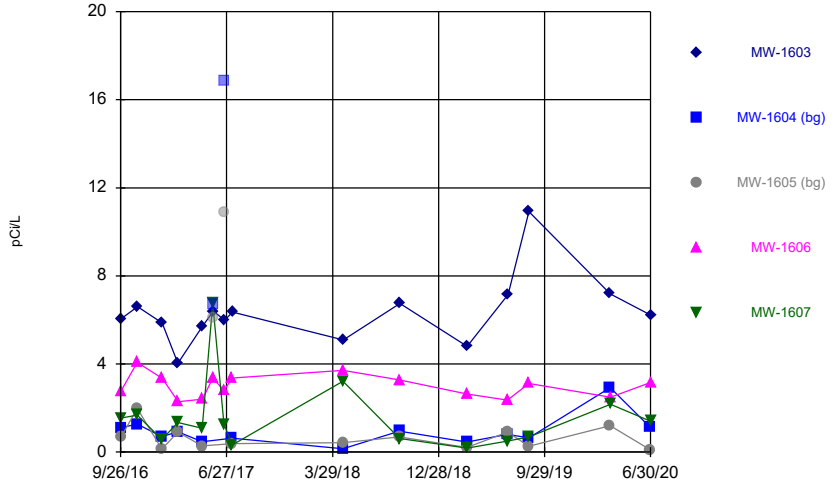


Constituent: Combined Radium 226 + 228 Analysis Run 10/8/2020 3:04 AM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG

Time Series



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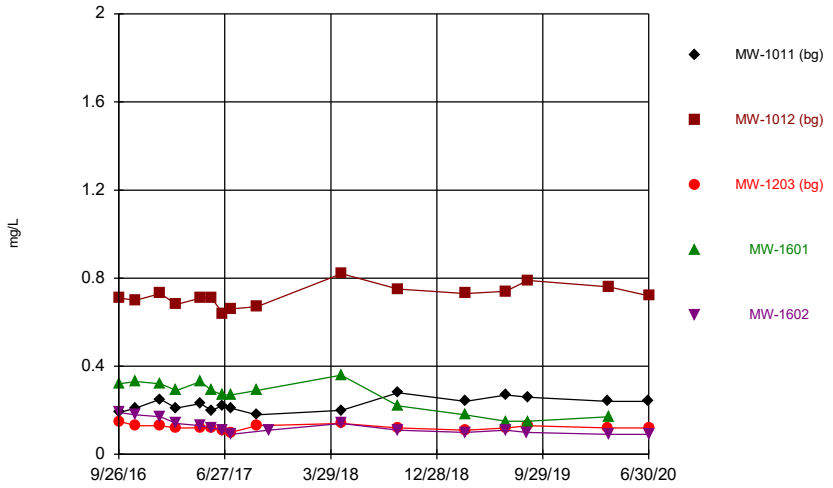
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG

Time Series



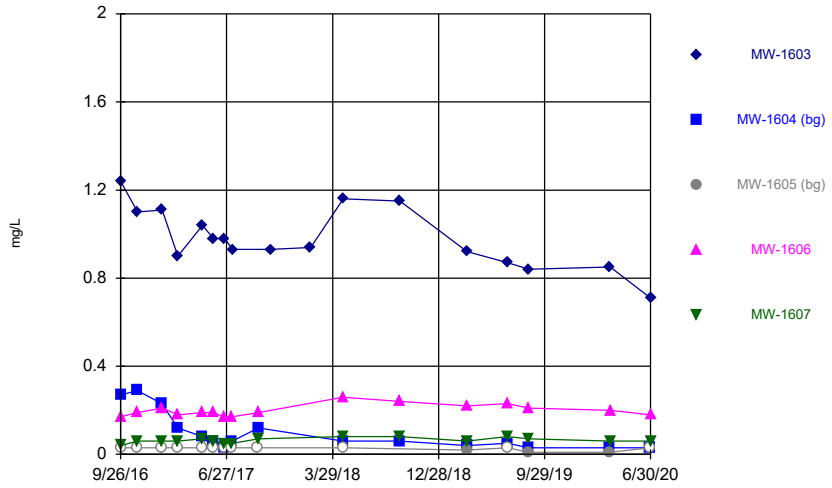
Constituent: Fluoride Analysis Run 10/8/2020 3:04 AM View: Interwell AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG

Hollow symbols indicate censored values.

Time Series



Constituent: Fluoride Analysis Run 10/8/2020 3:04 AM View: Interwell AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG

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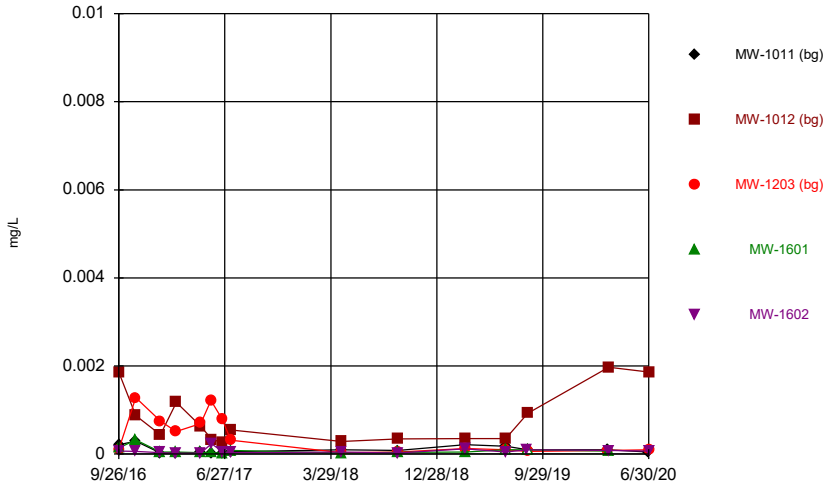

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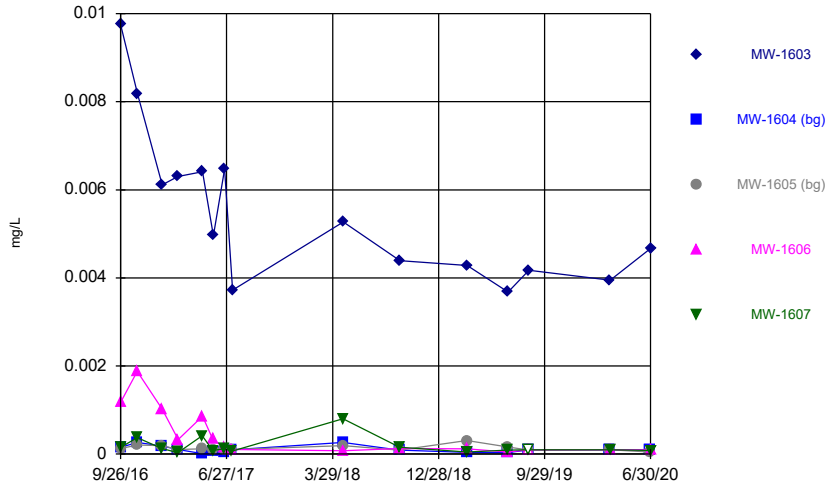

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Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG
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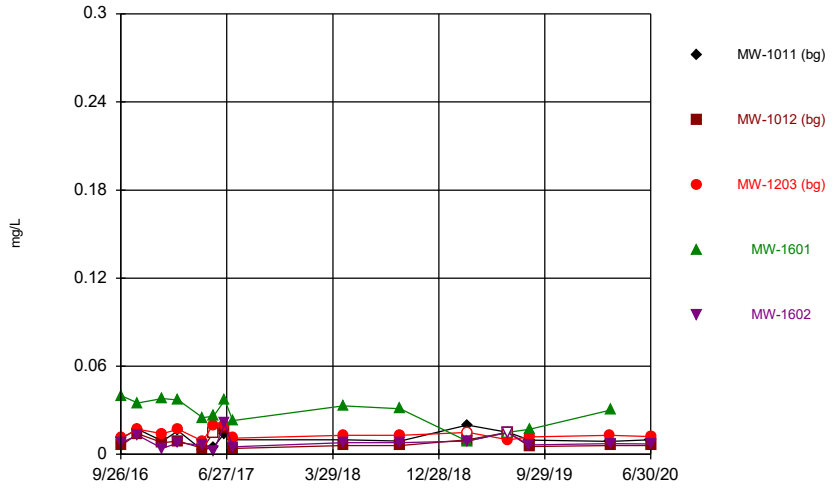
Time Series



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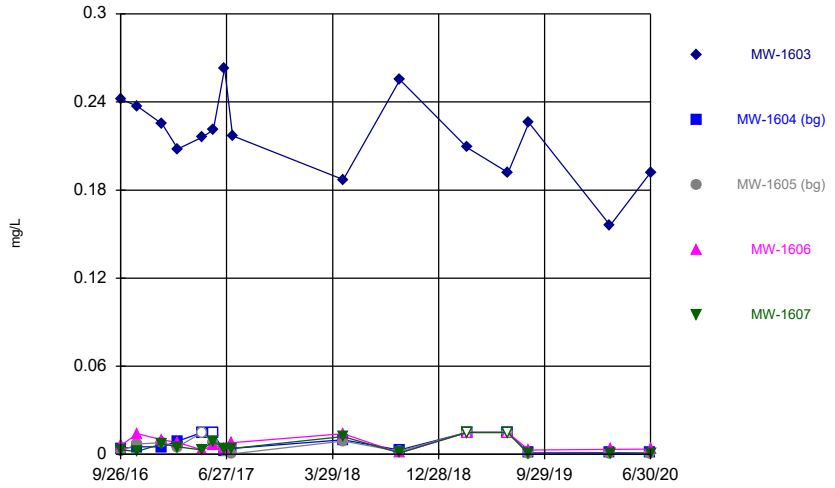

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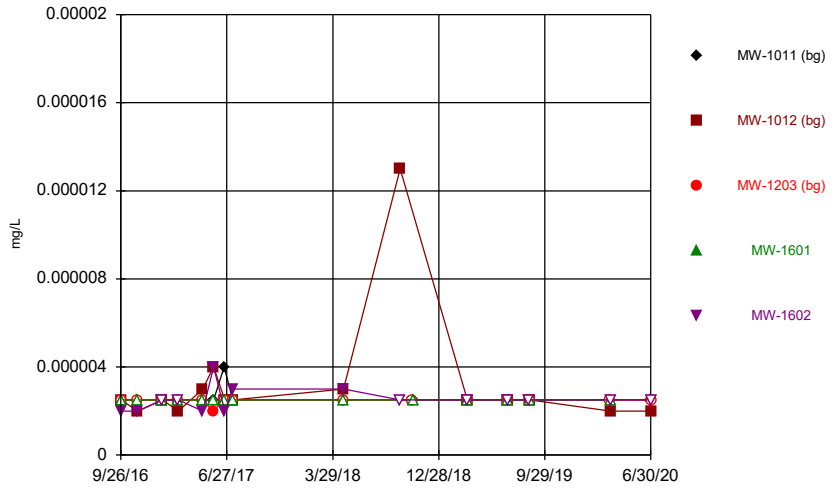
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG
Hollow symbols indicate censored values.

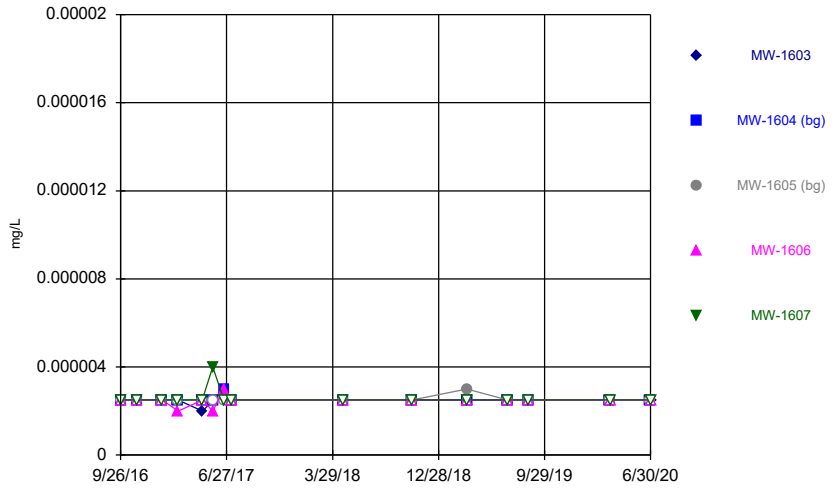
Time Series



Constituent: Mercury Analysis Run 10/8/2020 3:04 AM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG
Hollow symbols indicate censored values.

Time Series



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Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG
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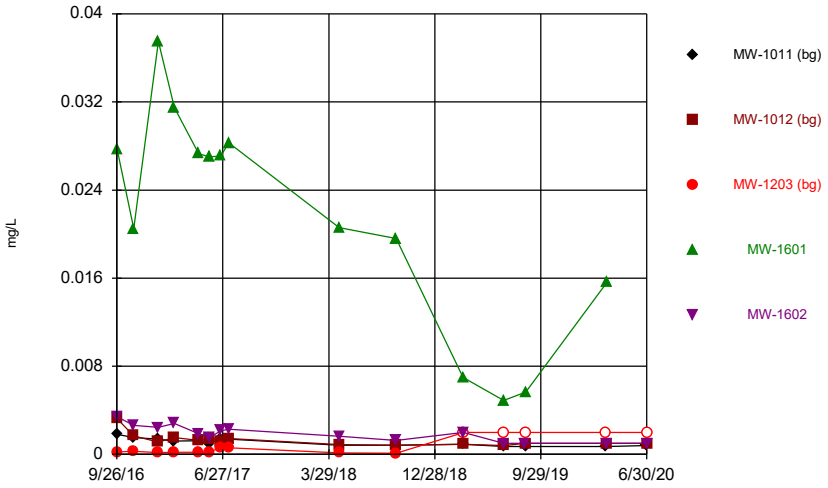
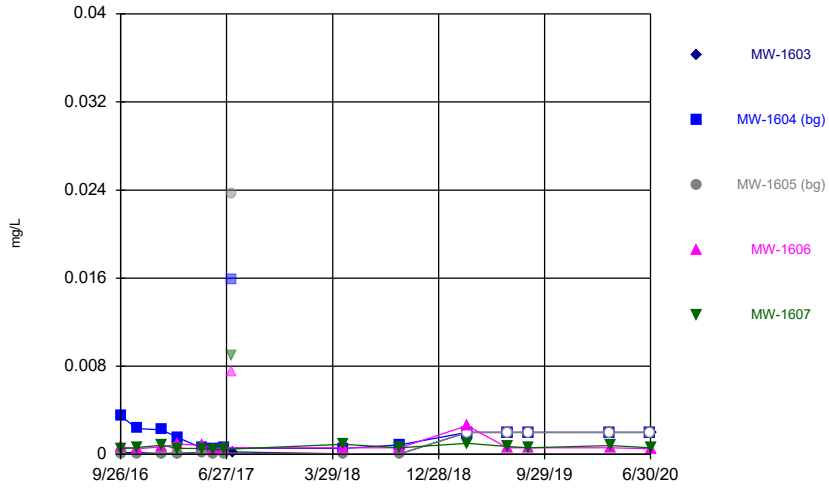
Time Series



Constituent: Molybdenum Analysis Run 10/8/2020 3:04 AM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG
Hollow symbols indicate censored values.

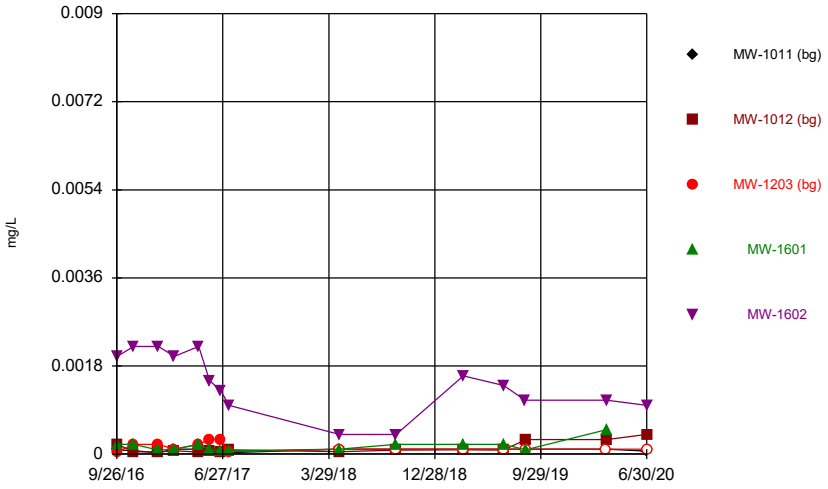
Time Series



Constituent: Molybdenum Analysis Run 10/8/2020 3:04 AM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG
Hollow symbols indicate censored values.

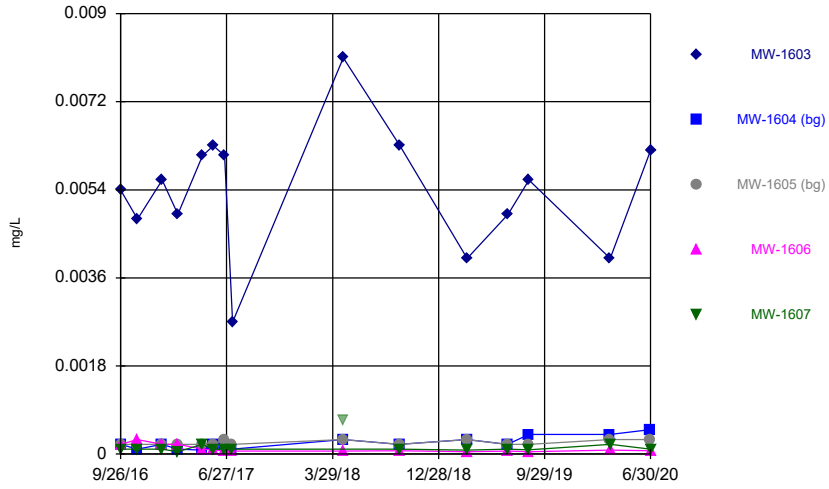
Time Series



Constituent: Selenium Analysis Run 10/8/2020 3:05 AM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG

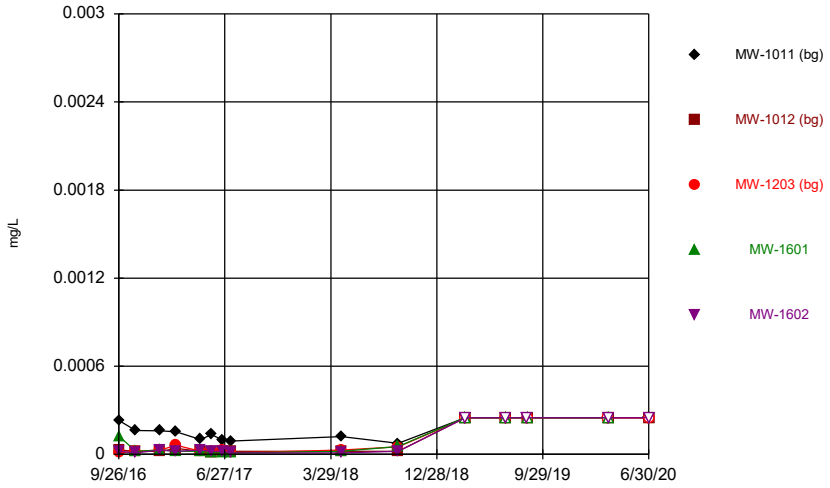
Time Series



Constituent: Selenium Analysis Run 10/8/2020 3:05 AM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG
Hollow symbols indicate censored values.

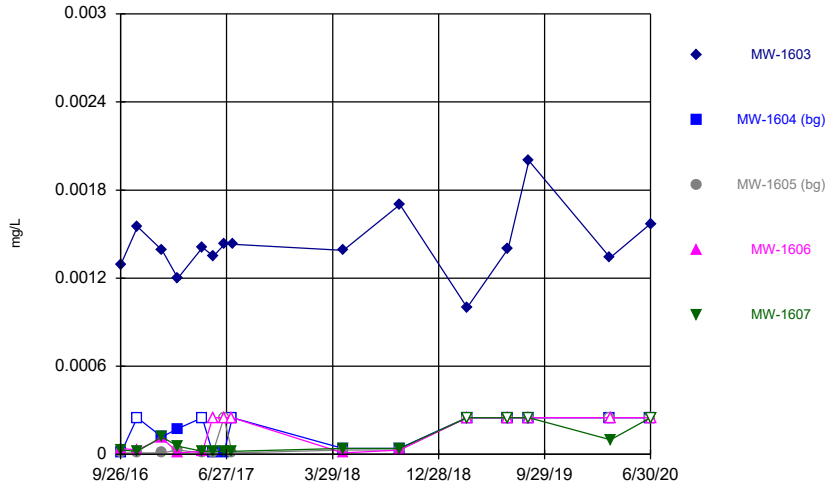
Time Series



Constituent: Thallium Analysis Run 10/8/2020 3:05 AM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.27 . UG
Hollow symbols indicate censored values.

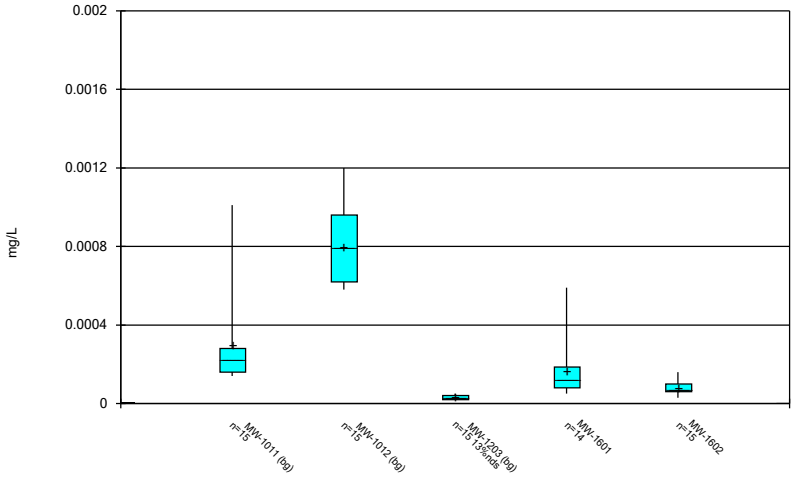
Time Series



Constituent: Thallium Analysis Run 10/8/2020 3:05 AM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

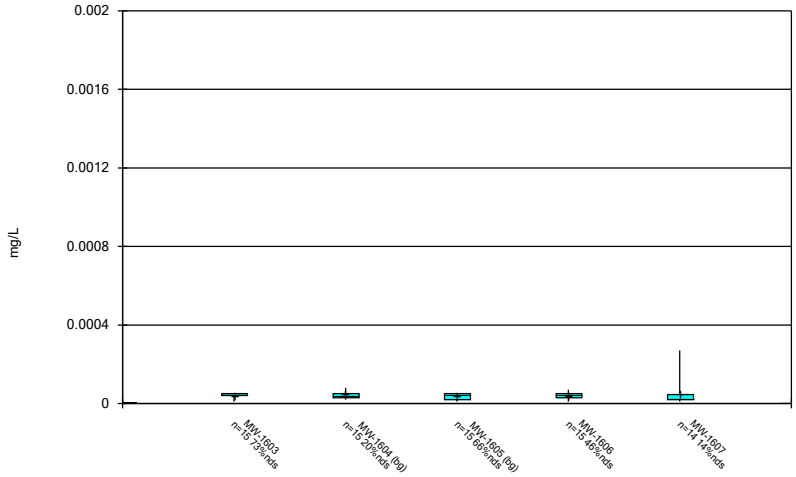
Box & Whiskers Plot



Constituent: Antimony Analysis Run 8/21/2020 2:52 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

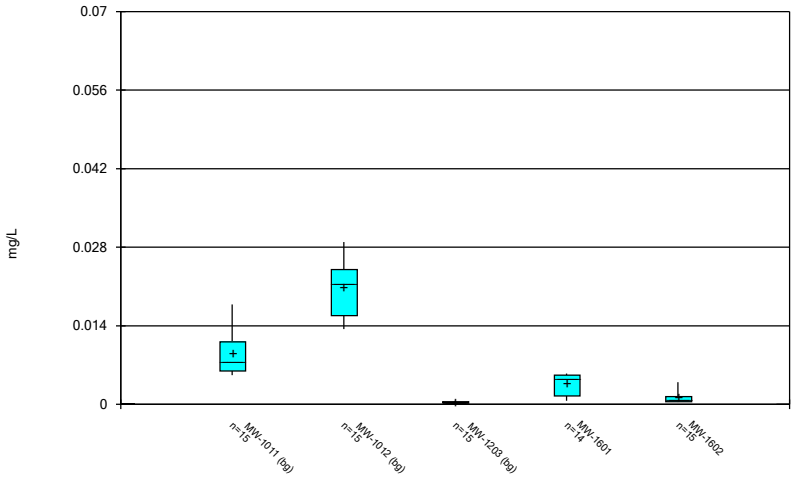
Box & Whiskers Plot



Constituent: Antimony Analysis Run 8/21/2020 2:52 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

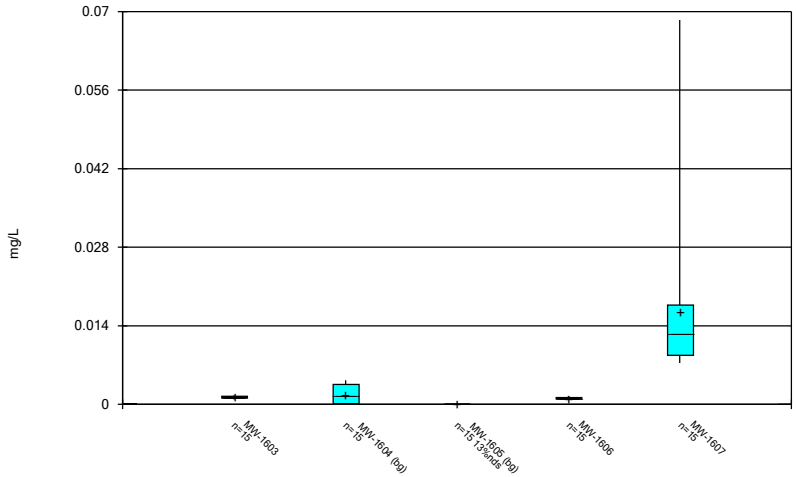
Box & Whiskers Plot



Constituent: Arsenic Analysis Run 8/21/2020 2:52 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

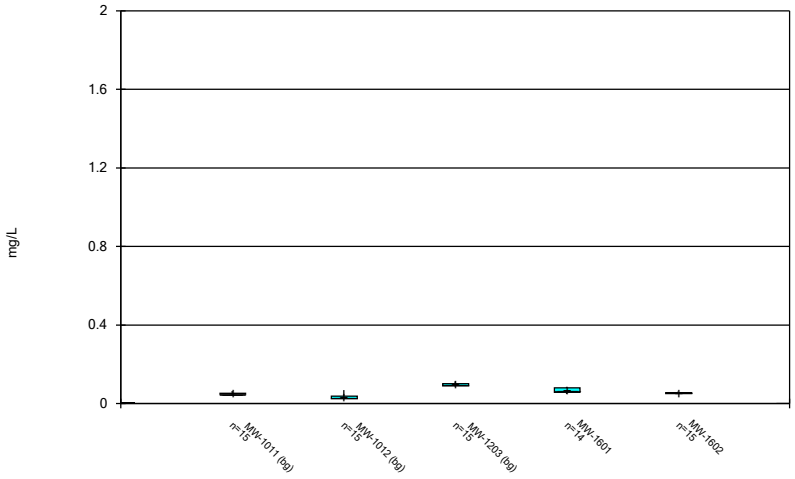
Box & Whiskers Plot



Constituent: Arsenic Analysis Run 8/21/2020 2:52 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

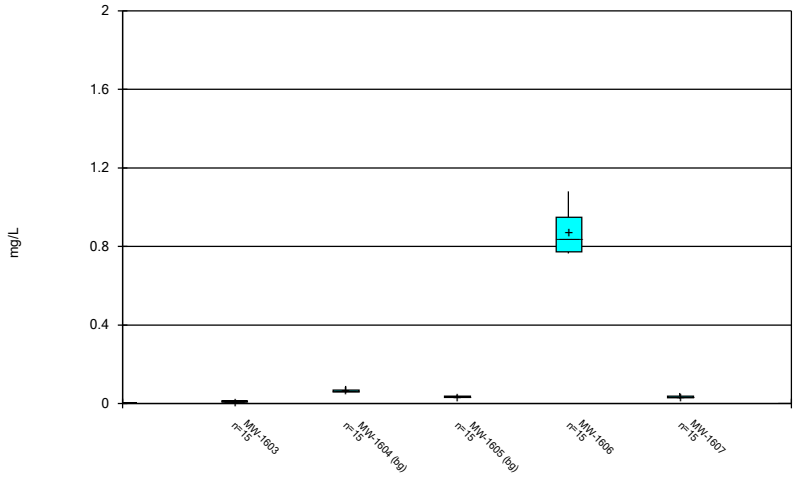
Box & Whiskers Plot



Constituent: Barium Analysis Run 8/21/2020 2:52 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

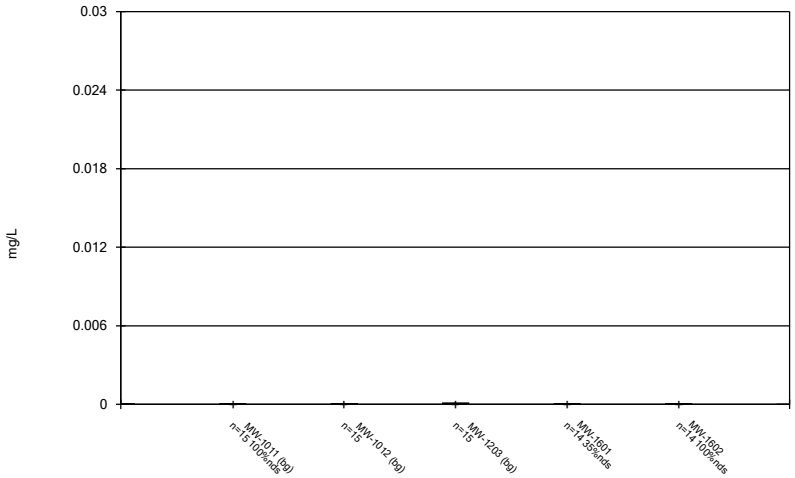
Box & Whiskers Plot



Constituent: Barium Analysis Run 8/21/2020 2:52 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

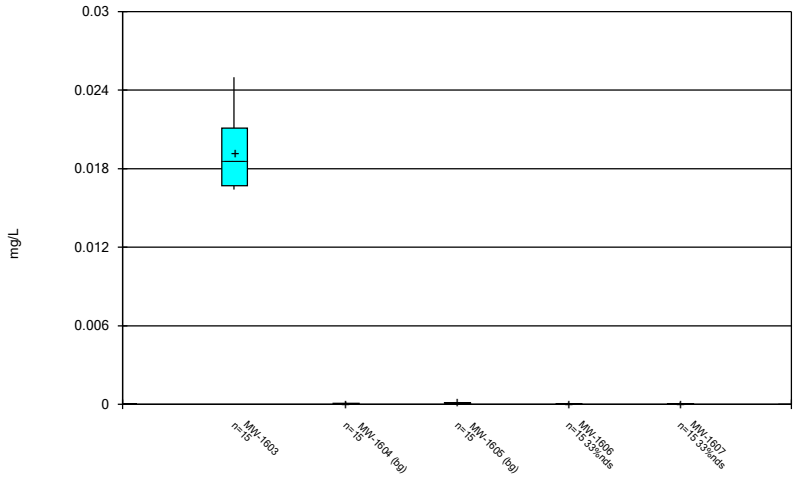
Box & Whiskers Plot



Constituent: Beryllium Analysis Run 8/21/2020 2:52 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

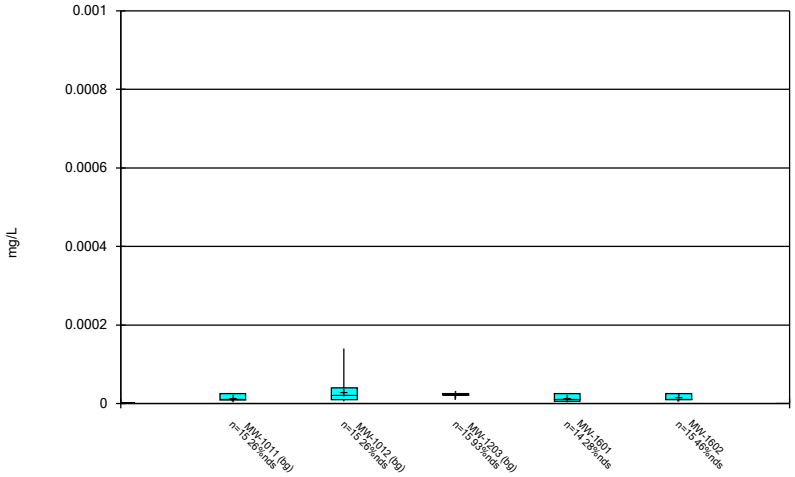
Box & Whiskers Plot



Constituent: Beryllium Analysis Run 8/21/2020 2:52 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

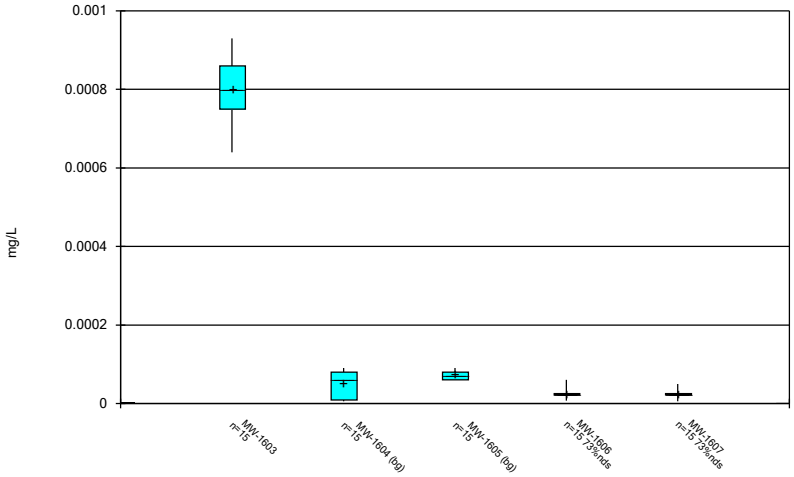
Box & Whiskers Plot



Constituent: Cadmium Analysis Run 8/21/2020 2:52 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

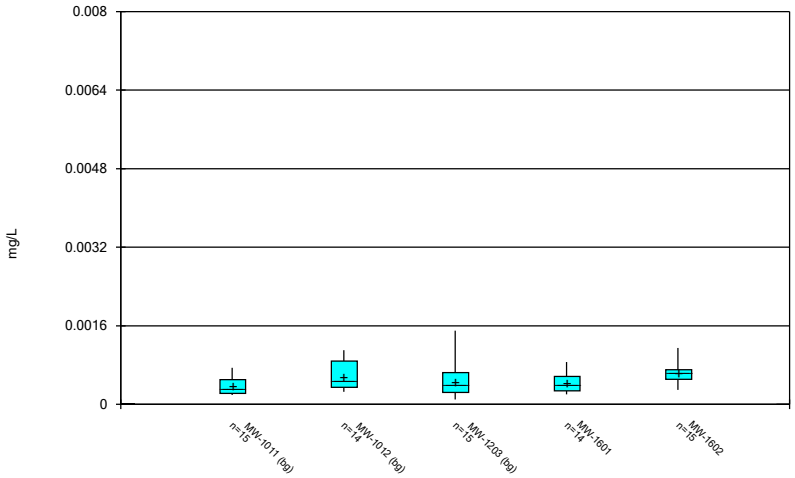
Box & Whiskers Plot



Constituent: Cadmium Analysis Run 8/21/2020 2:52 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

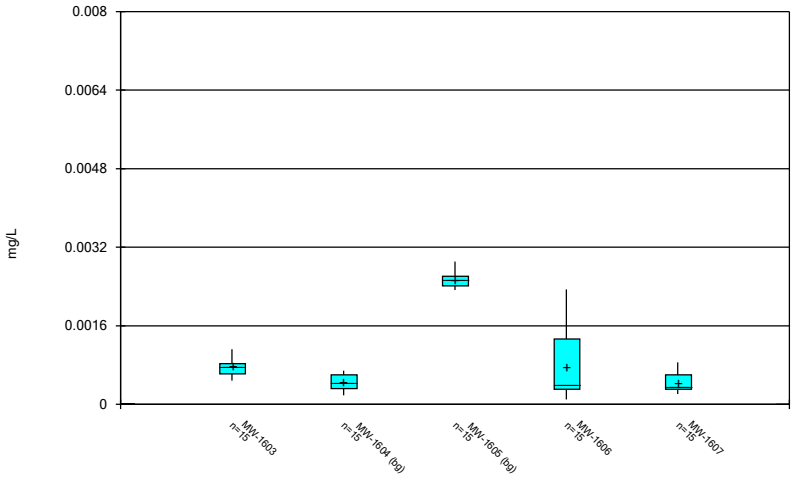
Box & Whiskers Plot



Constituent: Chromium Analysis Run 8/21/2020 2:52 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

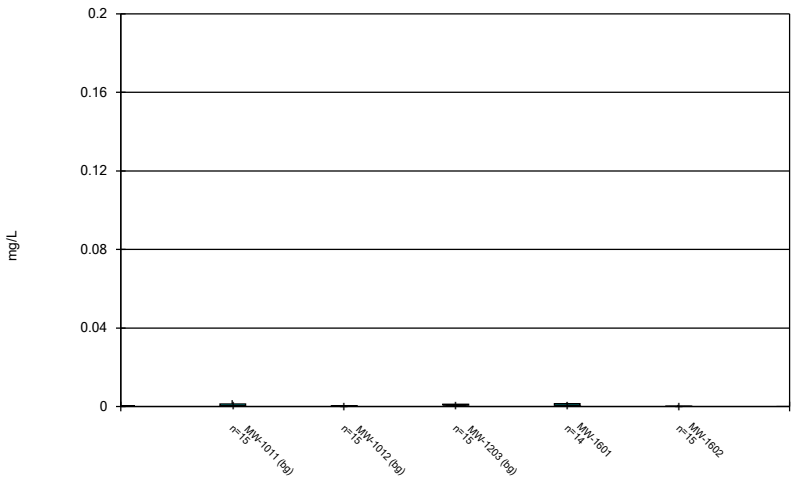
Box & Whiskers Plot



Constituent: Chromium Analysis Run 8/21/2020 2:52 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

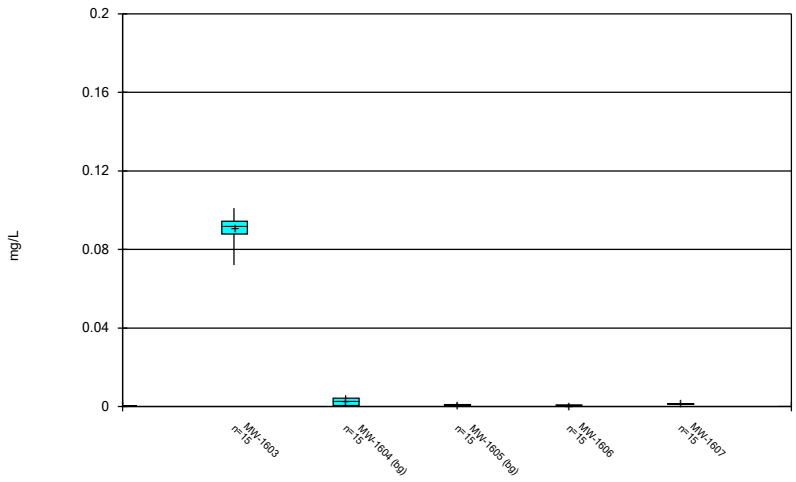
Box & Whiskers Plot



Constituent: Cobalt Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

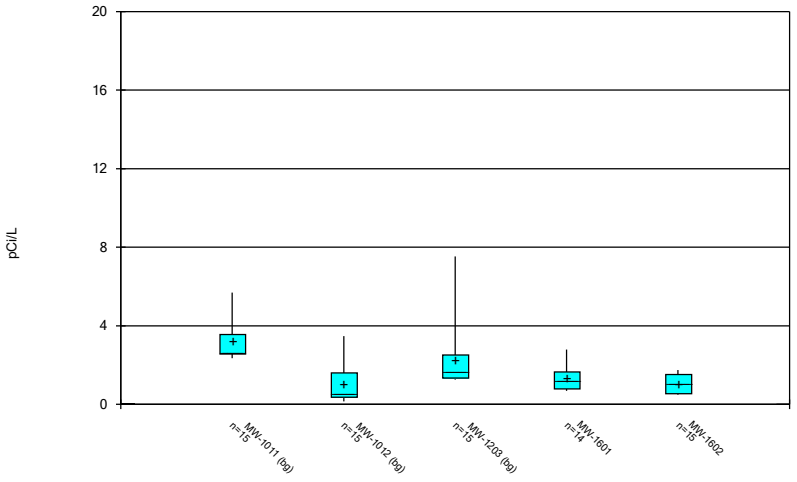
Box & Whiskers Plot



Constituent: Cobalt Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

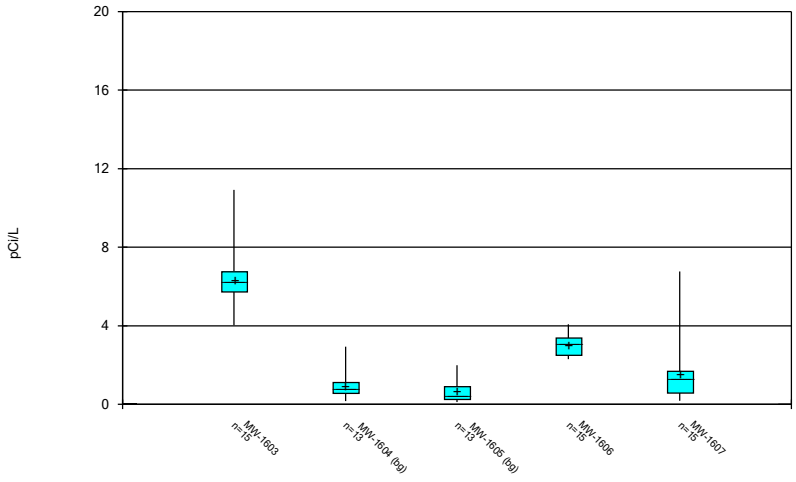
Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

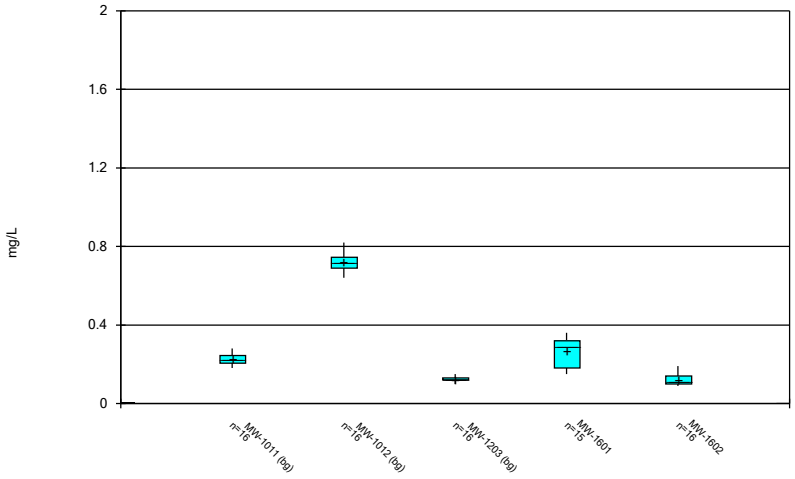
Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

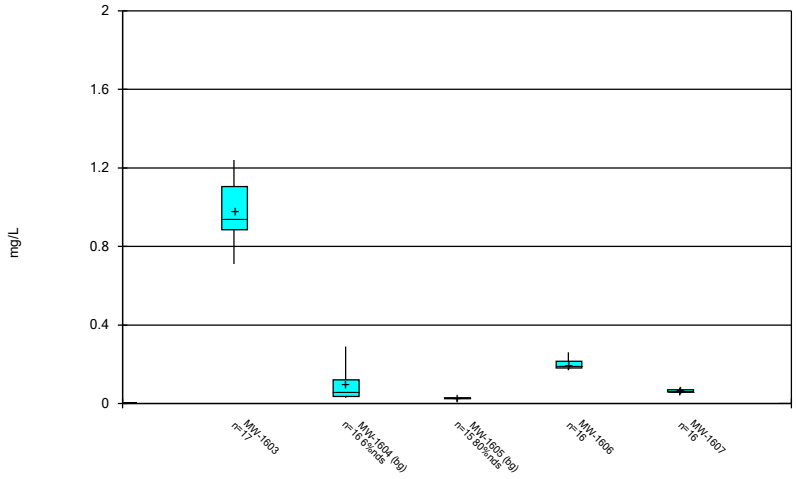
Box & Whiskers Plot



Constituent: Fluoride Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

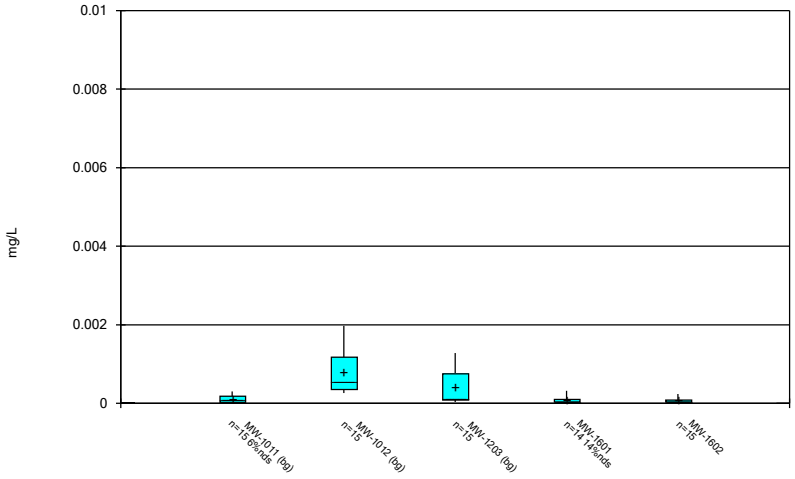
Box & Whiskers Plot



Constituent: Fluoride Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

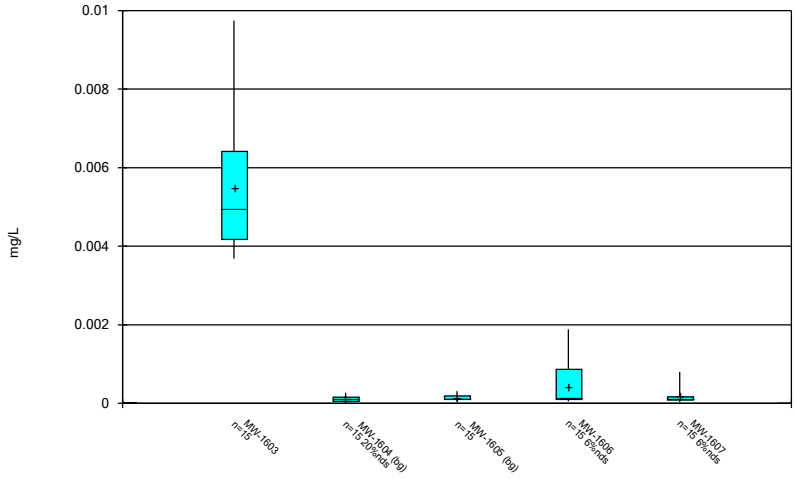
Box & Whiskers Plot



Constituent: Lead Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

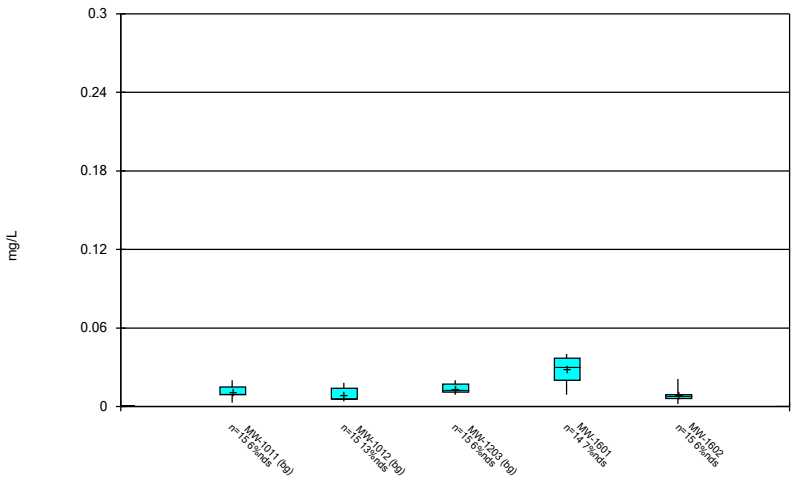
Box & Whiskers Plot



Constituent: Lead Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

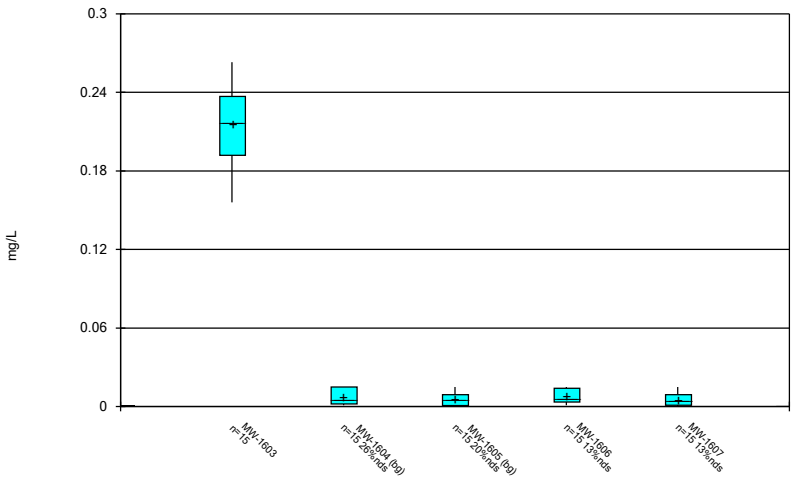
Box & Whiskers Plot



Constituent: Lithium Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

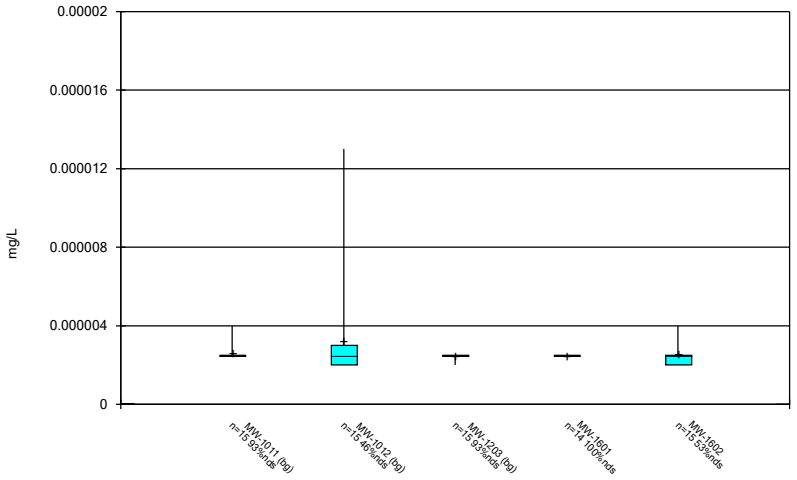
Box & Whiskers Plot



Constituent: Lithium Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

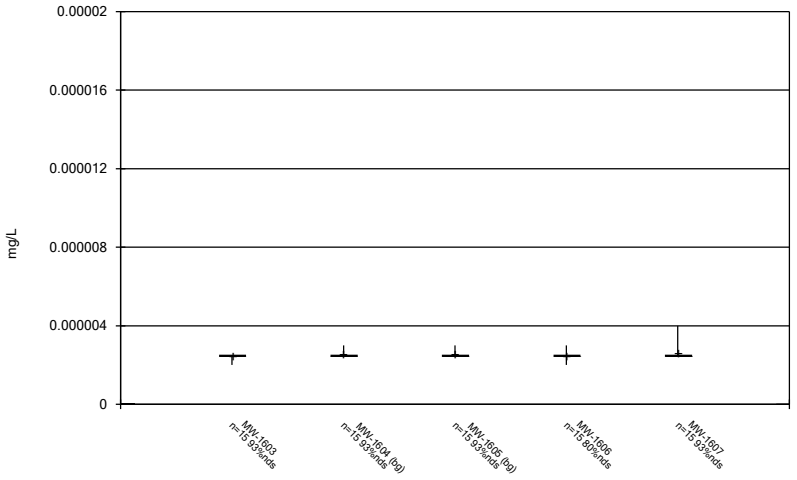
Box & Whiskers Plot



Constituent: Mercury Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

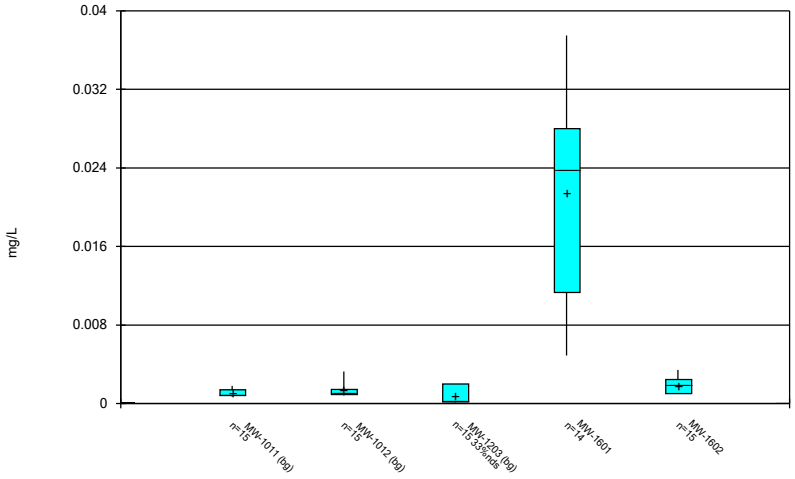
Box & Whiskers Plot



Constituent: Mercury Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

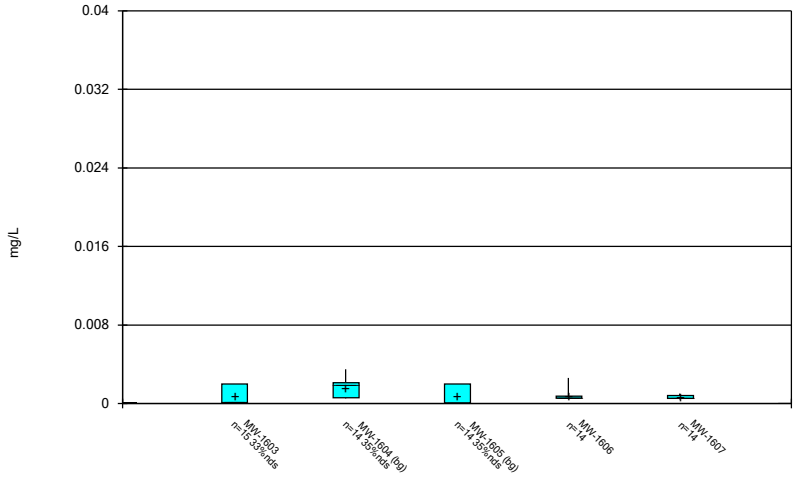
Box & Whiskers Plot



Constituent: Molybdenum Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

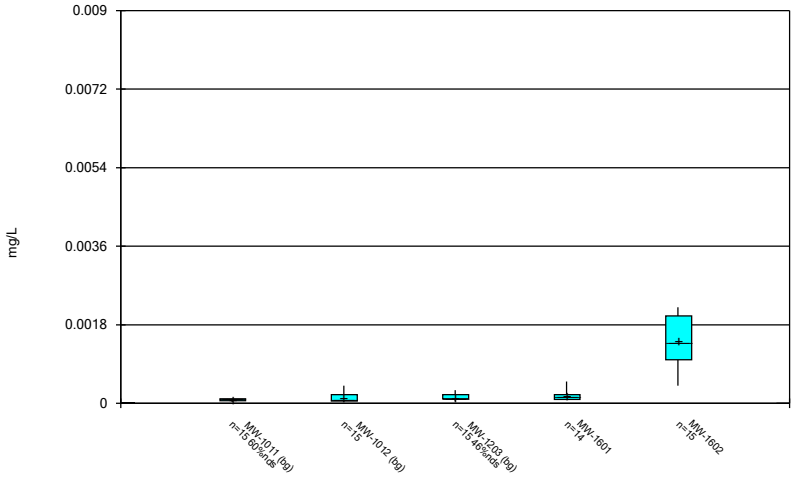
Box & Whiskers Plot



Constituent: Molybdenum Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

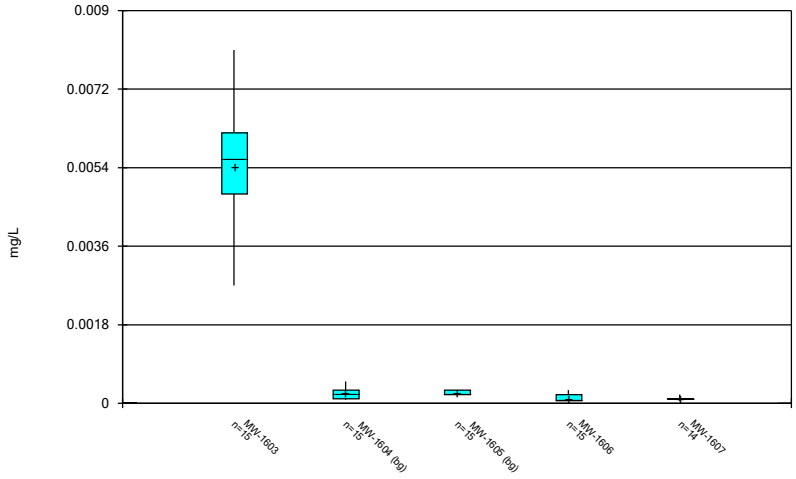
Box & Whiskers Plot



Constituent: Selenium Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

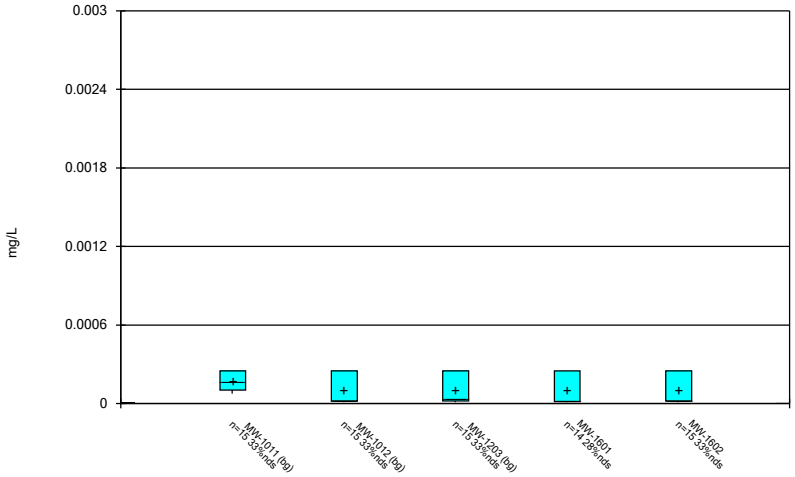
Sanitas™ v.9.6.26g . UG

Box & Whiskers Plot



Constituent: Selenium Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

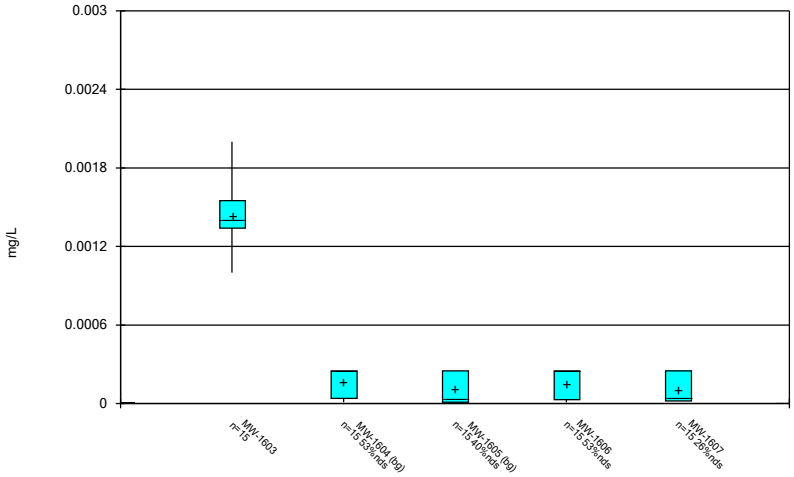
Box & Whiskers Plot



Constituent: Thallium Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Box & Whiskers Plot



Constituent: Thallium Analysis Run 8/21/2020 2:53 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Outlier Sumary

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 10/8/2020, 4:20 PM

	MW-1012 Chromium (mg/L)	MW-1604 Combined Radium 226 + 228 (pCi/L)	MW-1605 Combined Radium 226 + 228 (pCi/L)	MW-1604 Molybdenum (mg/L)	MW-1605 Molybdenum (mg/L)	MW-1606 Molybdenum (mg/L)	MW-1607 Molybdenum (mg/L)	MW-1607 Selenium (mg/L)
5/23/2017		6.707 (o)	6.077 (o)					
5/24/2017	0.00784 (o)							
6/21/2017		16.848 (o)	10.864 (o)					
7/12/2017				0.0159 (o)	0.0237 (o)	0.00756 (o)	0.00902 (o)	
4/25/2018								0.0007 (o)

Upper Tolerance Limits

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 10/8/2020, 3:03 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Bg N	Std. Dev.	%NDs	Transform	Alpha	Method
Antimony (mg/L)	n/a	0.0012	n/a	n/a	n/a	75	n/a	20	n/a	0.02134	NP Inter(normal...
Arsenic (mg/L)	n/a	0.0289	n/a	n/a	n/a	75	n/a	2.667	n/a	0.02134	NP Inter(normal...
Barium (mg/L)	n/a	0.1123	n/a	n/a	n/a	75	0.05289	0	sqrt(x)	0.05	Inter
Beryllium (mg/L)	n/a	0.000182	n/a	n/a	n/a	75	n/a	20	n/a	0.02134	NP Inter(Cohens...
Cadmium (mg/L)	n/a	0.00014	n/a	n/a	n/a	75	n/a	29.33	n/a	0.02134	NP Inter(normal...
Chromium (mg/L)	n/a	0.00291	n/a	n/a	n/a	74	n/a	0	n/a	0.02247	NP Inter(normal...
Cobalt (mg/L)	n/a	0.005968	n/a	n/a	n/a	75	1.156	0	ln(x)	0.05	Inter
Combined Radium 226 + 228 (pCi/L)	n/a	4.955	n/a	n/a	n/a	71	0.5273	0	sqrt(x)	0.05	Inter
Fluoride (mg/L)	n/a	0.82	n/a	n/a	n/a	79	n/a	16.46	n/a	0.01738	NP Inter(normal...
Lead (mg/L)	n/a	0.001638	n/a	n/a	n/a	75	1.188	5.333	ln(x)	0.05	Inter
Lithium (mg/L)	n/a	0.02011	n/a	n/a	n/a	75	0.005452	14.67	No	0.05	Inter
Mercury (mg/L)	n/a	0.000013	n/a	n/a	n/a	75	n/a	84	n/a	0.02134	NP Inter(NDs)
Molybdenum (mg/L)	n/a	0.00348	n/a	n/a	n/a	73	n/a	20.55	n/a	0.02365	NP Inter(normal...
Selenium (mg/L)	n/a	0.0005	n/a	n/a	n/a	75	n/a	21.33	n/a	0.02134	NP Inter(normal...
Thallium (mg/L)	n/a	0.00025	n/a	n/a	n/a	75	n/a	38.67	n/a	0.02134	NP Inter(normal...

BIG SANDY FAP GWPS				
Constituent Name	**MCL**	**CCR-Rule**	**Background**	**GWPS**
Antimony, Total (mg/L)	0.006		0.0012	0.006
Arsenic, Total (mg/L)	0.01		0.029	0.029
Barium, Total (mg/L)	2		0.11	2
Beryllium, Total (mg/L)	0.004		0.00018	0.004
Cadmium, Total (mg/L)	0.005		0.00014	0.005
Chromium, Total (mg/L)	0.1		0.0029	0.1
Cobalt, Total (mg/L)	n/a	0.006	0.006	0.006
Combined Radium, Total (pCi/L)	5		4.96	5
Fluoride, Total (mg/L)	4		0.82	4
Lead, Total (mg/L)	0.015		0.0016	0.015
Lithium, Total (mg/L)	n/a	0.04	0.02	0.04
Mercury, Total (mg/L)	0.002		0.000013	0.002
Molybdenum, Total (mg/L)	n/a	0.1	0.0035	0.1
Selenium, Total (mg/L)	0.05		0.0005	0.05
Thallium, Total (mg/L)	0.002		0.00025	0.002

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

**MCL = Maximum Contaminant Level*

Confidence Intervals - Significant Results

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 8/21/2020, 3:10 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Beryllium (mg/L)	**MW-1603**	**0.02091**	**0.01729**	**0.004**	**Yes**	**15**	**0**	**x^(1/3)**	**0.01**	**Param.**
Cobalt (mg/L)	**MW-1603**	**0.0955**	**0.08674**	**0.006**	**Yes**	**15**	**0**	**x^2**	**0.01**	**Param.**
Combined Radium 226 + 228 (pCi/L)	**MW-1603**	**7.243**	**5.336**	**5**	**Yes**	**15**	**0**	**x^(1/3)**	**0.01**	**Param.**
Lithium (mg/L)	**MW-1603**	**0.2352**	**0.1976**	**0.04**	**Yes**	**15**	**0**	**No**	**0.01**	**Param.**

Confidence Intervals - All Results

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 8/21/2020, 3:10 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Antimony (mg/L)	MW-1601	0.0002074	0.0000843	0.006	No	14	0	ln(x)	0.01	Param.
Antimony (mg/L)	MW-1602	0.0001011	0.00005492	0.006	No	15	0	No	0.01	Param.
Antimony (mg/L)	MW-1603	0.0001	0.00002	0.006	No	15	73.33	No	0.01	NP (normality)
Antimony (mg/L)	MW-1606	0.0001	0.00003	0.006	No	15	46.67	No	0.01	NP (normality)
Antimony (mg/L)	MW-1607	0.0001	0.00001	0.006	No	14	14.29	No	0.01	NP (normality)
Arsenic (mg/L)	MW-1601	0.005059	0.003388	0.029	No	14	0	x^3	0.01	Param.
Arsenic (mg/L)	MW-1602	0.001412	0.0005101	0.029	No	15	0	ln(x)	0.01	Param.
Arsenic (mg/L)	MW-1603	0.001416	0.001136	0.029	No	15	0	No	0.01	Param.
Arsenic (mg/L)	MW-1606	0.001152	0.0009374	0.029	No	15	0	No	0.01	Param.
Arsenic (mg/L)	MW-1607	0.0193	0.00767	0.029	No	15	0	No	0.01	NP (normality)
Barium (mg/L)	MW-1601	0.07604	0.05962	2	No	14	0	No	0.01	Param.
Barium (mg/L)	MW-1602	0.05637	0.05139	2	No	15	0	No	0.01	Param.
Barium (mg/L)	MW-1603	0.01281	0.01089	2	No	15	0	No	0.01	Param.
Barium (mg/L)	MW-1606	0.9388	0.8013	2	No	15	0	No	0.01	Param.
Barium (mg/L)	MW-1607	0.04021	0.03017	2	No	15	0	No	0.01	Param.
Beryllium (mg/L)	MW-1601	0.00005	0.000007	0.004	No	14	35.71	No	0.01	NP (normality)
Beryllium (mg/L)	MW-1602	0.00005	0.00005	0.004	No	14	100	No	0.01	NP (NDs)
Beryllium (mg/L)	**MW-1603**	**0.02091**	**0.01729**	**0.004**	**Yes**	**15**	**0**	**x^(1/3)**	**0.01**	**Param.**
Beryllium (mg/L)	MW-1606	0.000058	0.00001	0.004	No	15	33.33	No	0.01	NP (Cohens/xfrm)
Beryllium (mg/L)	MW-1607	0.00005	0.00001	0.004	No	15	33.33	No	0.01	NP (normality)
Cadmium (mg/L)	MW-1601	0.000025	0.000006	0.005	No	14	28.57	No	0.01	NP (normality)
Cadmium (mg/L)	MW-1602	0.000025	0.000009	0.005	No	15	46.67	No	0.01	NP (normality)
Cadmium (mg/L)	MW-1603	0.0008544	0.000751	0.005	No	15	0	No	0.01	Param.
Cadmium (mg/L)	MW-1606	0.00006	0.00001	0.005	No	15	73.33	No	0.01	NP (normality)
Cadmium (mg/L)	MW-1607	0.00005	0.000008	0.005	No	15	73.33	No	0.01	NP (normality)
Chromium (mg/L)	MW-1601	0.0005547	0.0002846	0.1	No	14	0	sqrt(x)	0.01	Param.
Chromium (mg/L)	MW-1602	0.0007986	0.0004902	0.1	No	15	0	No	0.01	Param.
Chromium (mg/L)	MW-1603	0.0009	0.0006511	0.1	No	15	0	No	0.01	Param.
Chromium (mg/L)	MW-1606	0.001078	0.0003115	0.1	No	15	0	sqrt(x)	0.01	Param.
Chromium (mg/L)	MW-1607	0.0005545	0.0003111	0.1	No	15	0	No	0.01	Param.
Cobalt (mg/L)	MW-1601	0.001423	0.0007008	0.006	No	14	0	No	0.01	Param.
Cobalt (mg/L)	MW-1602	0.0001515	0.0000255	0.006	No	15	0	ln(x)	0.01	Param.
Cobalt (mg/L)	**MW-1603**	**0.0955**	**0.08674**	**0.006**	**Yes**	**15**	**0**	**x^2**	**0.01**	**Param.**
Cobalt (mg/L)	MW-1606	0.0005787	0.0001285	0.006	No	15	0	sqrt(x)	0.01	Param.
Cobalt (mg/L)	MW-1607	0.001445	0.001276	0.006	No	15	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW-1601	1.689	0.8825	5	No	14	0	sqrt(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW-1602	1.323	0.7006	5	No	15	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	**MW-1603**	**7.243**	**5.336**	**5**	**Yes**	**15**	**0**	**x^(1/3)**	**0.01**	**Param.**
Combined Radium 226 + 228 (pCi/L)	MW-1606	3.371	2.651	5	No	15	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW-1607	2.25	0.5877	5	No	15	0	sqrt(x)	0.01	Param.
Fluoride (mg/L)	MW-1601	0.3106	0.2147	4	No	15	0	No	0.01	Param.
Fluoride (mg/L)	MW-1602	0.1428	0.1027	4	No	16	0	sqrt(x)	0.01	Param.
Fluoride (mg/L)	MW-1603	1.065	0.8933	4	No	17	0	No	0.01	Param.
Fluoride (mg/L)	MW-1606	0.2173	0.1827	4	No	16	0	No	0.01	Param.
Fluoride (mg/L)	MW-1607	0.07053	0.05572	4	No	16	0	No	0.01	Param.
Lead (mg/L)	MW-1601	0.0001098	0.00003456	0.015	No	14	14.29	x^(1/3)	0.01	Param.
Lead (mg/L)	MW-1602	0.00009382	0.00003377	0.015	No	15	0	sqrt(x)	0.01	Param.
Lead (mg/L)	MW-1603	0.006536	0.004321	0.015	No	15	0	sqrt(x)	0.01	Param.
Lead (mg/L)	MW-1606	0.00102	0.0001	0.015	No	15	6.667	No	0.01	NP (normality)
Lead (mg/L)	MW-1607	0.0002226	0.00007074	0.015	No	15	6.667	ln(x)	0.01	Param.
Lithium (mg/L)	MW-1601	0.03505	0.02157	0.04	No	14	7.143	No	0.01	Param.
Lithium (mg/L)	MW-1602	0.01117	0.005337	0.04	No	15	6.667	sqrt(x)	0.01	Param.
Lithium (mg/L)	**MW-1603**	**0.2352**	**0.1976**	**0.04**	**Yes**	**15**	**0**	**No**	**0.01**	**Param.**
Lithium (mg/L)	MW-1606	0.01092	0.00429	0.04	No	15	13.33	No	0.01	Param.
Lithium (mg/L)	MW-1607	0.007942	0.001454	0.04	No	15	13.33	sqrt(x)	0.01	Param.
Mercury (mg/L)	MW-1601	0.0000025	0.0000025	0.002	No	14	100	No	0.01	NP (NDs)
Mercury (mg/L)	MW-1602	0.000003	0.000002	0.002	No	15	53.33	No	0.01	NP (normality)
Mercury (mg/L)	MW-1603	0.0000025	0.000002	0.002	No	15	93.33	No	0.01	NP (NDs)
Mercury (mg/L)	MW-1606	0.000003	0.000002	0.002	No	15	80	No	0.01	NP (NDs)
Mercury (mg/L)	MW-1607	0.000004	0.0000025	0.002	No	15	93.33	No	0.01	NP (NDs)
Molybdenum (mg/L)	MW-1601	0.02857	0.01432	0.1	No	14	0	No	0.01	Param.
Molybdenum (mg/L)	MW-1602	0.002376	0.001355	0.1	No	15	0	No	0.01	Param.
Molybdenum (mg/L)	MW-1603	0.002	0.00006	0.1	No	15	33.33	No	0.01	NP (normality)
Molybdenum (mg/L)	MW-1606	0.00084	0.00054	0.1	No	14	0	No	0.01	NP (normality)
Molybdenum (mg/L)	MW-1607	0.0007724	0.0005276	0.1	No	14	0	No	0.01	Param.
Selenium (mg/L)	MW-1601	0.0005	0.00008	0.05	No	14	0	No	0.01	NP (normality)
Selenium (mg/L)	MW-1602	0.001839	0.001014	0.05	No	15	0	No	0.01	Param.
Selenium (mg/L)	MW-1603	0.006262	0.004538	0.05	No	15	0	No	0.01	Param.

Confidence Intervals - All Results

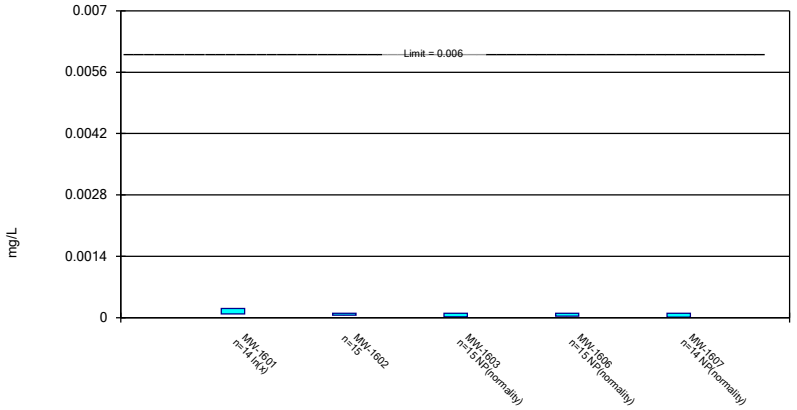
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 8/21/2020, 3:10 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Selenium (mg/L)	MW-1606	0.0002	0.00005	0.05	No	15	0	No	0.01	NP (normality)
Selenium (mg/L)	MW-1607	0.0002	0.00009	0.05	No	14	0	No	0.01	NP (normality)
Thallium (mg/L)	MW-1601	0.00025	0.00001	0.002	No	14	28.57	No	0.01	NP (normality)
Thallium (mg/L)	MW-1602	0.00025	0.00001	0.002	No	15	33.33	No	0.01	NP (normality)
Thallium (mg/L)	MW-1603	0.001582	0.001278	0.002	No	15	0	No	0.01	Param.
Thallium (mg/L)	MW-1606	0.00025	0.00002	0.002	No	15	53.33	No	0.01	NP (normality)
Thallium (mg/L)	MW-1607	0.00025	0.00002	0.002	No	15	26.67	No	0.01	NP (normality)

Sanitas™ v.9.6.26g . UG

Parametric and Non-Parametric (NP) Confidence Interval

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



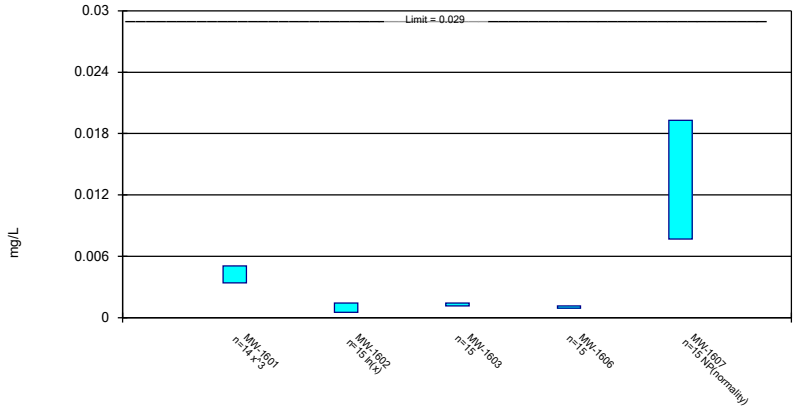
Constituent: Antimony Analysis Run 8/21/2020 3:08 PM View: Interwell AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Parametric and Non-Parametric (NP) Confidence Interval

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



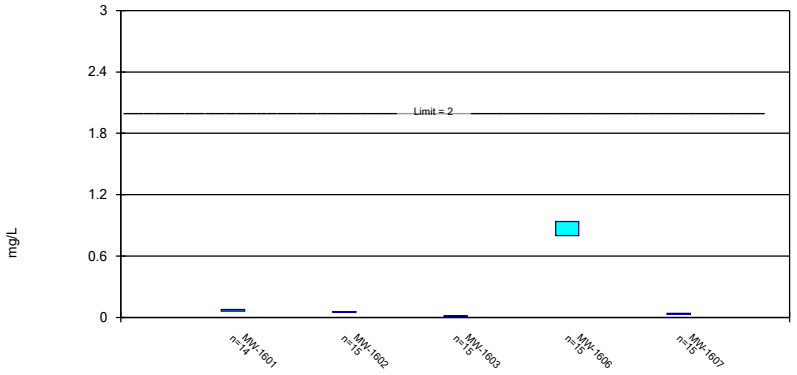
Constituent: Arsenic Analysis Run 8/21/2020 3:08 PM View: Interwell AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Parametric Confidence Interval

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



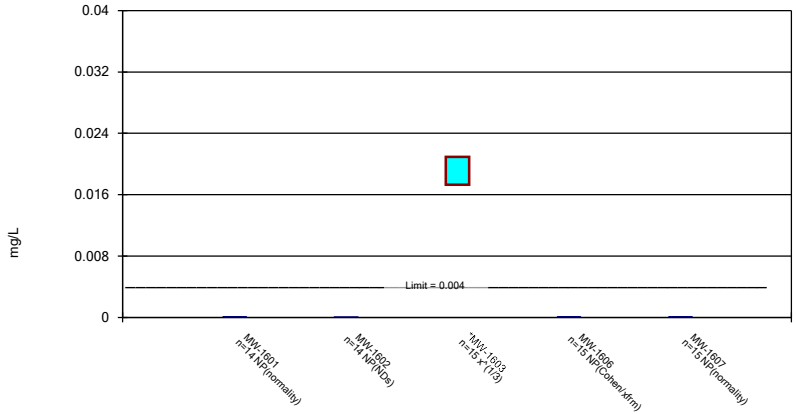
Constituent: Barium Analysis Run 8/21/2020 3:08 PM View: Interwell AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Parametric and Non-Parametric (NP) Confidence Interval

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



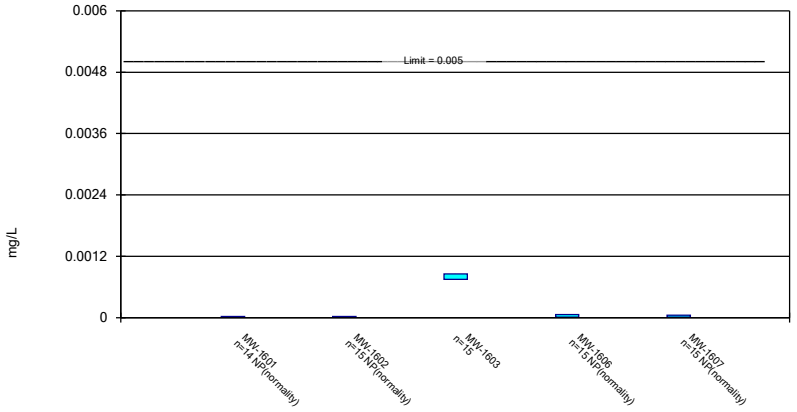
Constituent: Beryllium Analysis Run 8/21/2020 3:08 PM View: Interwell AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Parametric and Non-Parametric (NP) Confidence Interval

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

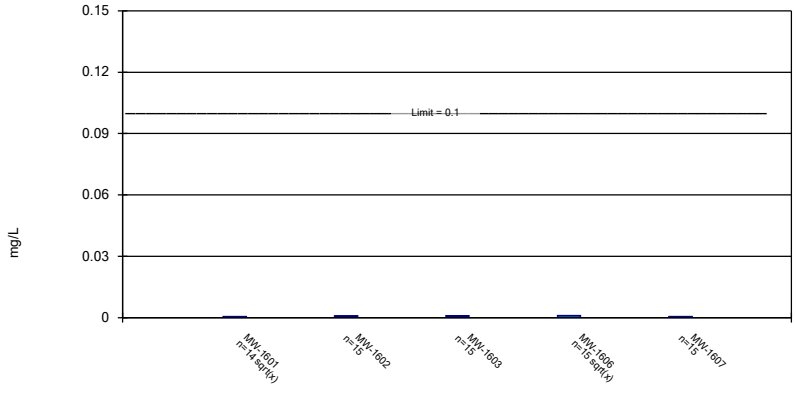


Constituent: Cadmium Analysis Run 8/21/2020 3:08 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Parametric Confidence Interval

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

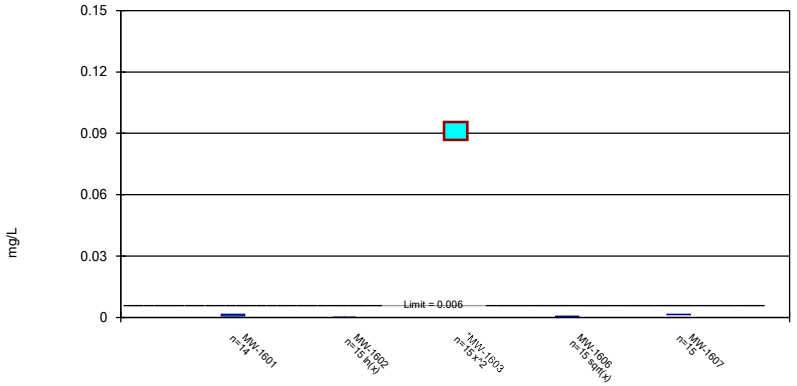


Constituent: Chromium Analysis Run 8/21/2020 3:08 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Parametric Confidence Interval

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

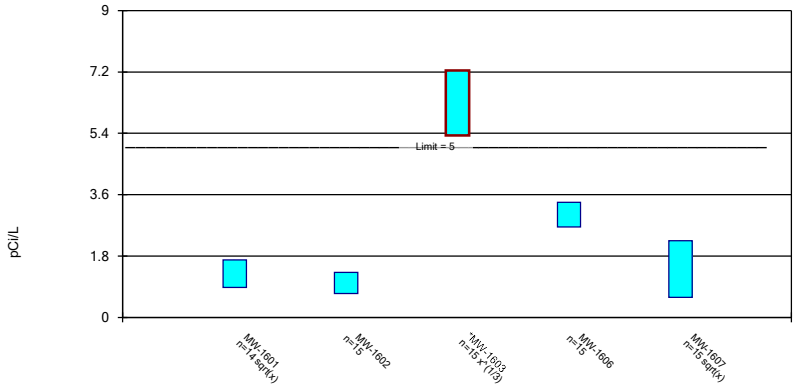


Constituent: Cobalt Analysis Run 8/21/2020 3:08 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Parametric Confidence Interval

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

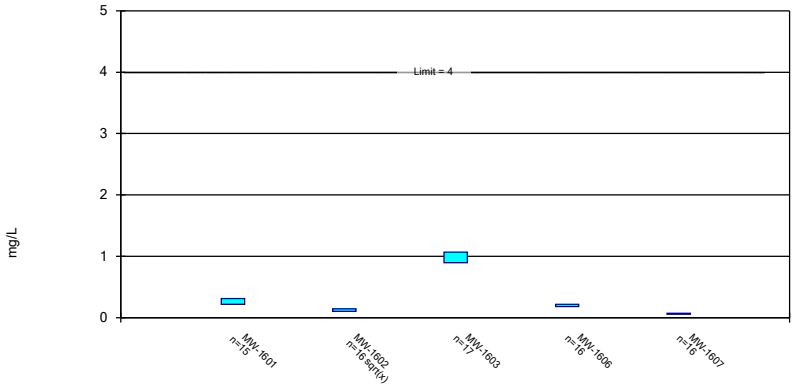


Constituent: Combined Radium 226 + 228 Analysis Run 8/21/2020 3:08 PM View: Interwell AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Parametric Confidence Interval

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



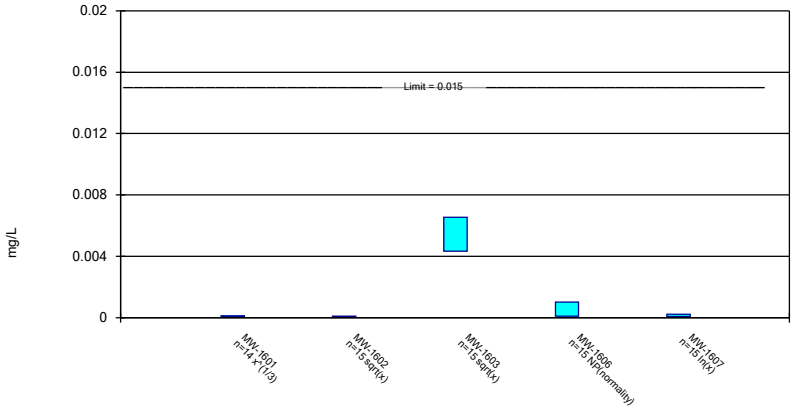
Constituent: Fluoride Analysis Run 8/21/2020 3:08 PM View: Interwell AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Parametric and Non-Parametric (NP) Confidence Interval

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



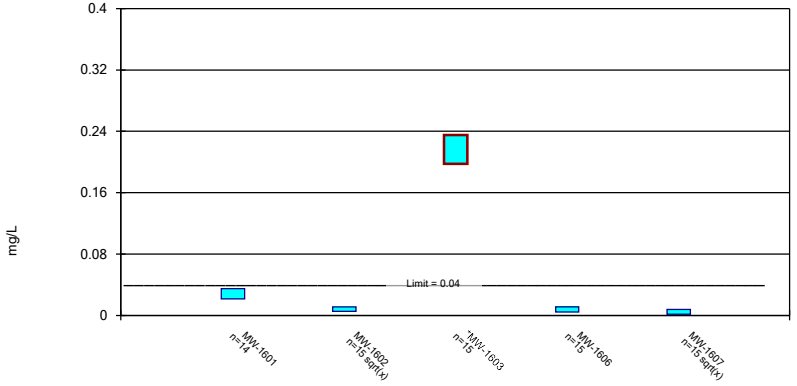
Constituent: Lead Analysis Run 8/21/2020 3:08 PM View: Interwell AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Parametric Confidence Interval

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



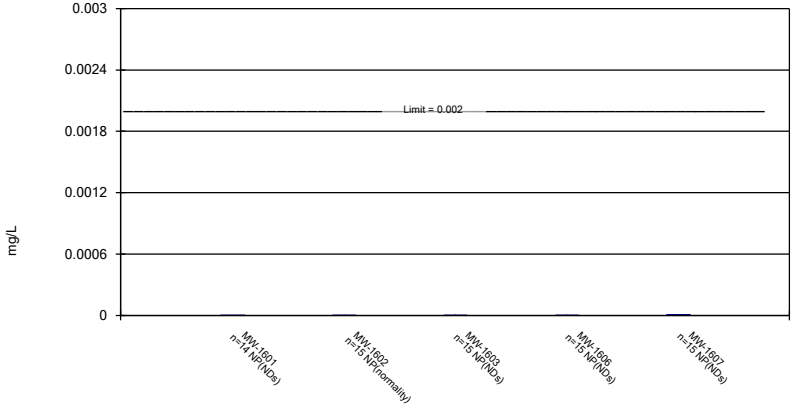
Constituent: Lithium Analysis Run 8/21/2020 3:08 PM View: Interwell AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Non-Parametric Confidence Interval

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



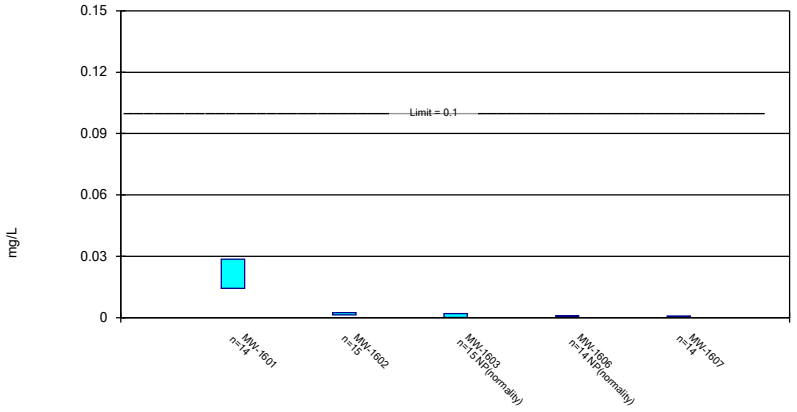
Constituent: Mercury Analysis Run 8/21/2020 3:08 PM View: Interwell AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Parametric and Non-Parametric (NP) Confidence Interval

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



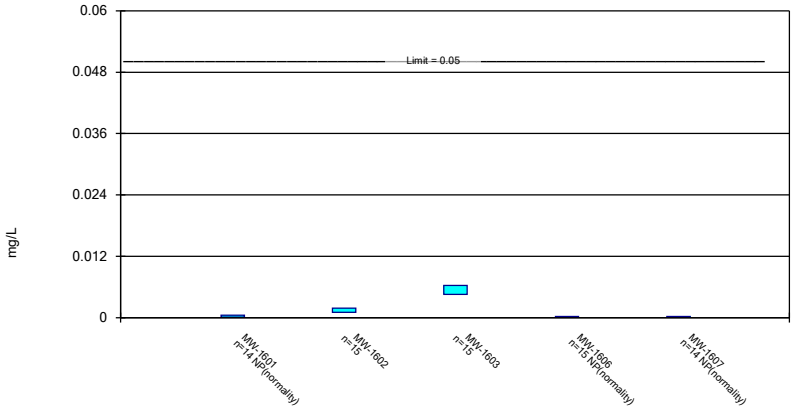
Constituent: Molybdenum Analysis Run 8/21/2020 3:08 PM View: Interwell AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Parametric and Non-Parametric (NP) Confidence Interval

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



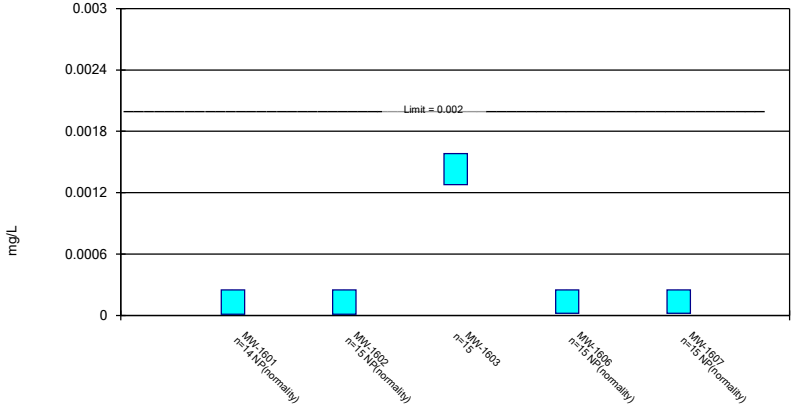
Constituent: Selenium Analysis Run 8/21/2020 3:08 PM View: Interwell AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.26g . UG

Parametric and Non-Parametric (NP) Confidence Interval

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



Constituent: Thallium Analysis Run 8/21/2020 3:08 PM View: Interwell AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

APPENDIX 4—Alternative Source Demonstration Reports

The January 2021 alternative source demonstration report concluding that an alternative source for the SSLs observed during the March and June/August 2020 assessment monitoring at the CCR unit was identified follows.

Alternative Source Demonstration Addendum Report for the March and June 2020 Monitoring Data

Big Sandy Fly Ash Pond
Louisa, Kentucky

Prepared for:

American Electric Power

Prepared by:

EHS Support

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Acronyms

<	less than
µg/L	micrograms per liter
ASD	alternative source demonstration
bgs	below ground surface
BSFAP	Big Sandy Fly Ash Pond
CCR	coal combustion residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
ft	foot/feet
GWPS	Groundwater Protection Standards
J	estimated concentration below the reporting level but greater than the method detection limit
KGS	Kentucky Geological Survey
LCL	Lower Confidence Level
mg/L	milligrams per liter
msl	mean sea level
MDL	method detection limit
NORM	naturally occurring radioactive material
ORP	oxidation reduction potential
pCi/L	picocuries per liter
ppm	parts per million
SSL	statistically significant level
S.U.	standard units (pH)
TDS	total dissolved solids
U	Below the method detection limit
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

Certification by Qualified Professional Engineer

I certify that the alternative source demonstration (ASD) conducted and presented within this report is accurate and appropriate for evaluating the groundwater monitoring data for the Big Sandy Fly Ash Pond Coal Combustion Residual (CCR) management area associated with the Big Sandy Power Plant located in Louisa, Kentucky. This ASD meets the requirements of the United States Environmental Protection Agency CCR Rule defined at 40 Code of Federal Regulations 257.95(g)(3)(ii).

Jonathan Waddell

Printed Name of Licensed Professional Engineer

Signature

31526	KY	1/22/21
License Number	Licensing State	Date

1 Introduction

EHS Support LLC ("EHS Support") was retained by American Electric Power, Kentucky Power Company ("AEP") in December 2018 to conduct an alternative source demonstration (ASD) investigation for coal combustion residual (CCR) constituents at the Big Sandy Fly Ash Pond (BSFAP) associated with the Big Sandy Power Plant located in Louisa, Kentucky (EHS Support, 2019a). The ASD determined that groundwater in the vicinity of the BSFAP was not being impacted by CCR constituents from the BSFAP. The statistically significant levels (SSLs) of beryllium, cobalt, and lithium concentrations present in excess of the Groundwater Protection Standards (GWPS), which triggered the ASD investigation, were determined to be a result of the oxidation of coal seams that were intersected by the borehole for well MW-1603.

Since the initial ASD investigation was completed (incorporating data from September 2016 to October 2018), a second ASD investigation was conducted after the March 2019 groundwater monitoring data yielded SSLs of beryllium, cobalt, and lithium exceeding the GWPS at the same groundwater monitoring location, MW-1603 (EHS Support, 2019b). The presence of these three CCR constituents at SSLs above the GWPS persisted in MW-1603 through the August 2019 sampling event, as documented in a third ASD investigation (EHS Support, 2020). In addition, the August 2019 sampling event reported an SSL of radium 226 combined with radium 228 (hereafter radium 226/228) above its GWPS for the first time in MW-1603 (EHS Support, 2020).

In March and June 2020, detections of these four constituents (beryllium, cobalt, lithium, and radium 226/228) have persisted in MW-1603, thus requiring the completion of the ASD addendum investigation presented in this report. This ASD addendum investigation has been prepared per the requirements of the United States Environmental Protection Agency (USEPA) CCR Rule (40 Code of Federal Regulations [CFR] §257.95). The detections of beryllium, cobalt, lithium, and radium 226/228 in MW-1603 groundwater were determined herein to be below levels of statistical significance. However, the results for the broader list of CCR constituents from the groundwater monitoring events have been used on plots presented within this ASD addendum report.

1.1 Objectives

The ASD investigation objective is to assess groundwater monitoring data collected in compliance with the CCR Rule, as allowed under paragraph 40 CFR §257.95(g)(3)(ii) of the CCR Rule. This part of the CCR Rule allows AEP to determine whether the source(s) for SSLs of beryllium, cobalt, lithium, and radium 226/228 exceeding the GWPSs, as reported in groundwater monitoring well MW-1603, are associated with the CCR unit; or alternatively if the SSL resulted from an error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

1.2 Lines of Evidence

This fourth ASD investigation for the BSFAP has been conducted to further evaluate potential alternate sources or reasons for the continuing SSLs of beryllium, cobalt, lithium, and radium 226/228 in groundwater samples from monitoring well MW-1603.

A potential alternate source was previously identified in the prior three ASD investigations (EHS Support, 2019a, 2019b, and 2020), based on the following lines of evidence:

- A lack of exceedances and increasing trends of primary indicators of CCR.
- Constituent concentrations in BSFAP water lower than those of the corresponding constituent observed in groundwater from MW-1603.
- Major ion chemistry was not indicative of mixing between BSFAP water and groundwater.

For the purposes of this ASD addendum investigation, constituents were identified that would serve as a primary indicator for coal ash leachate. A primary indicator must meet **both** of the following criteria:

1. Constituent typically has a high concentration in leachate, relative to background, such that it is expected to have elevated concentration in the event of a release.
2. Constituent is unreactive and has high mobility in groundwater, such that it is expected to be at the leading edge of the plume. Consequently, the constituent will have elevated concentrations relative to background across the entire area of the plume.

As boron and sulfate are primary indicators for coal ash leachate (Electric Power Research Institute [EPRI], 2012) and have previously been evaluated, they have been re-evaluated herein as primary indicators for this ASD investigation. In addition, chloride is used as a primary indicator for this ASD. Other potential indicators that were evaluated in this ASD investigation include potassium, sodium, fluoride, molybdenum, and bromide.

2 Project Background

A detailed description of site location, history, and geology was previously provided in the *Alternative Source Demonstration Report for Beryllium, Cobalt and Lithium, Big Sandy Fly Ash Pond, Louisa, Kentucky* (EHS Support, 2019a). Attached **Figure 1** and **Figure 2** show the site layout and groundwater monitoring network.

To support and provide context to this ASD addendum investigation, the following sections are included on the groundwater monitoring network and groundwater monitoring.

2.1 Groundwater Monitoring Network Evaluation

On behalf of AEP, Geosyntec Consultants, Inc. ("Geosyntec") conducted an assessment of the groundwater monitoring network in the uppermost aquifer associated with the BSFAP (Geosyntec, 2016). Geosyntec determined that the hydrostratigraphy in the vicinity of the BSFAP is characterized by an interconnected water-bearing system comprised of Pennsylvanian-aged bedrock of the Breathitt Group, Conemaugh Formation, and Quaternary alluvium. The Conemaugh Formation and Breathitt Group consists of sandstones, siltstones, shale, and coal that may grade laterally and vertically into one another. The overlying Quaternary alluvium deposits include sandy lean clay to silty sand and gravel at the bottom of the Horseford Creek valley and the floodplain of Blaine Creek. Based on these hydrogeologic conditions, Geosyntec defined the interconnected water-bearing system of the fractured bedrock and alluvium as the uppermost aquifer for the BSFAP CCR unit. This determination was based on the presence of groundwater in numerous monitoring wells screened in the water-bearing units (fractured bedrock and alluvium), the recovery of these wells during pumping and development, and a potentiometric surface generally consistent with site topography and surface water elevations.

To assess the upper water-bearing aquifer, Geosyntec defined the groundwater monitoring network as consisting of 10 groundwater monitoring wells to provide detection monitoring in the uppermost aquifer (fractured bedrock and alluvium) (Geosyntec, 2016). Of these, six monitoring wells (MW-1011, MW-1012, MW-1203, MW-1601, MW-1602, and MW-1603) are screened in fractured sandstone and shale layers of the Breathitt formation. The remaining four monitoring wells (MW-1604 through MW-1607) are screened in the alluvium. The location of each groundwater monitoring well within the uppermost aquifer is shown in **Figure 2**.

Three of the monitoring wells (MW-1011, MW-1012, and MW-1203) screened in bedrock were installed on the hillside slopes upgradient of the BSFAP to support background monitoring. The remaining three monitoring wells (MW-1601, MW-1602, and MW-1603) installed in bedrock are located downgradient of the BSFAP and used for compliance monitoring. Two monitoring wells (MW-1604 and MW-1605) screened in alluvium are used for background monitoring; while two other monitoring wells (MW-1606 and MW-1607), screened in alluvium and located below the Main Dam, are used for compliance monitoring.

As bedrock monitoring well MW-1603 is the focus of this ASD, the boring log was reviewed (EHS Support, 2019a). The boring log descriptions show alternating sequences of yellowish-brown sandstones and bluish-gray to black shales (beginning at 13 feet below ground surface [ft bgs] and extending to the bottom of the boring at 39.5 ft bgs) that are indicative of the upper portion of the Princess Formation

(uppermost formation in the Breathitt Group [Rice and Hiett, 1994]). Within the screened interval (22 to 32 ft bgs), the shale at a depth of 24 to 25 ft bgs was described as "intensely fractured, black, wet, nearly all organic matter; slight coaly texture." This depth (24 to 25 ft bgs) corresponds with the measurements by the Kentucky Geological Survey (KGS) of the elevation of the Princess Number 8 coal, which is present within the Princess Formation of the Breathitt Group (EHS Support, 2019a). Coal or "organic material" was also identified visually during soil boring logging in three other monitoring wells (MW-1608, MW-1609, and MW-1610) in the network (**Table 2-1**) at the same approximate elevation between 630 and 650 feet that matches the KGS measurements. No coal was documented in this section in three monitoring wells (MW-1601, MW-1602, and MW-1611). Four monitoring wells were installed below this coal layer in the sedimentary sequence (MW-1604, MW-1605, MW-1606, and MW-1607).

Table 2-1 Screened Interval of Monitoring Wells

Well/Boring	Surface Elevation (ft msl)	Screened Interval (ft msl)	Coal or "Organics" Description at ~632-650 ft
MW-1601	713.8	646.8-636.8	No coal logged
MW-1602	711.6	632.1-622.1	No coal logged
MW-1603	673.2	651.2-641.2	Yes, at a depth of ~25 ft (Elevation of 648 ft)
MW-1604	553.1	513.1-503.1	---
MW-1605	554.4	538.9-528.9	---
MW-1606	551	513.1-503.1	---
MW-1607	542.2	518.7-508.7	---
MW-1608	716.2	606.6-596.6	Yes, at depths of ~74 ft (Elevation of 642 ft), ~ 75.3 to 76.6 ft (Elevation of 641 to 640 ft), and ~ 83.5 to 84 ft (Elevation of 633 to 632 ft)
MW-1609	~728	---	Yes, at a depth of ~79 ft (Elevation of 649 ft)
MW-1610	~716	---	Yes, at a depth of ~81 ft (Elevation of 635 ft)
MW-1611	~711	606-596	No coal logged

--- = Boring advanced below the coal interval
~ = Approximate
ft = feet
msl = mean sea level

Geosyntec determined that the groundwater monitoring well network described above meets the requirements of 40 CFR §257.91, as it consists of a sufficient number of wells installed at the appropriate locations and depths to yield groundwater samples from the uppermost aquifer that accurately represent the quality of background groundwater and groundwater passing the waste boundary of the BSFAP.

2.2 Groundwater Monitoring

AEP has conducted groundwater monitoring of the uppermost aquifer to meet the requirements of the CCR Rules. Groundwater monitoring generally included the following activities:

- Collection of groundwater samples and analysis for Appendix III and Appendix IV constituents, as specified in 40 CFR §257.94 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan* (AEP and EHS Support, October 2016)
- Completion of validation tests for groundwater data, including tests for completeness, valid values, transcription errors, and consistent units
- Establishment of background data for each Appendix III and Appendix IV constituent
- Initiation of detection monitoring sampling and analysis
- Evaluation of the groundwater data using a statistical process in accordance with 40 CFR §257.93, which was prepared, certified, and posted to AEP's CCR website in April 2017 in AEP's *Statistical Analysis Plan* (Geosyntec, 2017); the statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance"; USEPA, 2009)
- Initiation of assessment monitoring sampling and analysis
- Completion of statistical data evaluation and determination of groundwater protection standards

Assessment monitoring for the BSFAP has been conducted on a semi-annual basis since April 2018. The groundwater data collected up until, and including the June and August 2020 monitoring events, have been used for this ASD addendum investigation. Appendix III parameters (total dissolved solids [TDS] and sulfate) were not analyzed in June 2020; thus an additional sampling event was conducted in August 2020 for these constituents. Assessment monitoring data for well MW-1603 in March through August 2020 is provided in **Table 2-2**.

Table 2-2 MW-1603 March through August 2020 Groundwater Quality

Analyte	Unit	March 2020 Value	June 2020 Value
Antimony	µg/L	<0.02	<0.04
Arsenic	µg/L	0.83	1.12
Barium	µg/L	9.92	12.2
Beryllium	µg/L	16.4	21.1
Boron	mg/L	<0.1	0.05
Cadmium	µg/L	0.64	0.85
Calcium	mg/L	NA	96.6
Chloride	mg/L	NA	4.18
Chromium	µg/L	0.56	0.694
Cobalt	µg/L	72	93.2
Fluoride	mg/L	0.85	0.71
Lead	µg/L	3.95	4.67

Analyte	Unit	March 2020 Value	June 2020 Value
Lithium	mg/L	0.156	0.192
Mercury	µg/L	<0.002	<0.002
Molybdenum	µg/L	<0.4	<0.8
pH	S.U.	3.52	3.38 / 3.27[1]
Radium 226/228	pCi/L	7.19	6.22
Residue, Filterable, TDS	mg/L	NA	1,040[1]
Selenium	µg/L	4	6.2
Sulfate	mg/L	NA	798[1]

[1] = value reported is the concentration from the August 2020 groundwater sample
< = less than
µg/L = micrograms per liter
NA = constituent not analyzed
mg/L = milligrams per liter
pCi/L = picocuries per liter
S.U. = standard units
TDS = total dissolved solids

AEP submitted the March and June 2020 monitoring data to Groundwater Stats Consulting, LLC for statistical analysis (Geosyntec, 2020). A GWPS was established for each of the Appendix IV parameters. Confidence intervals, including lower confidence levels (LCLs) and upper confidence levels (UCLs), were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at an SSL above the GWPS. Based on this statistical analysis evaluating the March and June 2020 data, the following SSLs were identified at the BSFAP in MW-1603 (no other monitoring well had constituents exceeding an SSL):

- The LCL for beryllium exceeded the GWPS of 0.004 milligrams per liter (mg/L) at MW-1603 (0.0173 mg/L).
- The LCL for cobalt exceeded the GWPS of 0.006 mg/L at MW-1603 (0.0867 mg/L).
- The LCL for combined radium 226/228 exceeded the GWPS of 5.00 picocuries per liter (pCi/L) at MW-1603 (5.34 pCi/L).
- The LCL for lithium exceeded the GWPS of 0.04 mg/L at MW-1603 (0.198 mg/L).

3 Alternative Source Demonstration Requirements

3.1 Alternative Source Demonstration

Potential causes that may support an ASD include, but are not limited to, sampling causes (ASD Type I), laboratory causes (ASD Type II), statistical evaluation causes (ASD Type III), and/or natural variation causes (ASD Type IV). This ASD for the BSFAP is focused on assessing whether Type IV natural variations in groundwater could be the cause of the SSLs of beryllium, cobalt, lithium, and radium 226/228 reported for groundwater collected from monitoring well MW-1603 during the March and June 2020 sampling.

Historical groundwater monitoring data for MW-1603 is provided in **Table 1** (attached).

3.2 Assessment of Water Monitoring Results

The following constituents will typically provide the information required for a complete ASD:

- Primary indicators (boron and sulfate) are evaluated for potential BSFAP leachate.
- Major ion concentrations (alkalinity, chloride, sulfate, calcium, magnesium, potassium, and sodium) in leachate and groundwater are used to evaluate whether downgradient groundwater chemistry remains representative of background groundwater chemistry. Major ion chemistry can also be used to evaluate natural variability due to seasonal changes or other causes.
- Field turbidity of groundwater is used as an indicator of the presence of suspended solids that may contribute to elevated concentrations of constituents monitored in unfiltered samples under the CCR Rule.
- pH of leachate and groundwater provides information on chemical reactions and potential mobility of constituents in groundwater.
- Dissolved oxygen, oxidation reduction potential (ORP), iron, and manganese in groundwater are used as indicators of redox conditions. Changes in redox can affect the chemical state and solubility of sulfate, in addition to trace elements including arsenic and selenium. For example, under strongly reduced conditions (ORP less than –200 millivolts at pH 7), sulfate can be reduced to form hydrogen sulfide or it can precipitate as iron sulfide, arsenic reduces to the more mobile arsenite species, and selenium reduces to the low-mobility selenite species.

Groundwater monitored at a CCR unit for compliance with the CCR Rule is a compilation of the history of all sources of water comingling at that particular monitoring well. Different sources may contribute to the presence and detection of some of the same constituents, making source identification challenging. The identification and use of water quality “signatures” can be used as a tool for deciphering the similarity between potential sources and the water quality at a specific monitoring point.

4 Alternative Source Demonstration Assessment

As stated within **Section 1.2**, the primary indicators for CCR (coal ash) leachate effects in groundwater are boron and sulfate. In addition to these two constituents, chloride is also used as a primary indicator for this ASD. Other potential indicators that have been evaluated include potassium, sodium, fluoride, molybdenum, and bromide.

As identified in **Section 1.1**, SSLs of beryllium, cobalt, lithium, and radium 226/228 have been reported in groundwater samples above the GWPS from monitoring well MW-1603 in March and June 2020. The water quality signatures for well MW-1603 are discussed within **Section 4.3** and compared to the water quality of the BSFAP.

EPRI (2012) defines three tiers of investigation for evaluation of water quality signatures to determine if elevated concentrations represent a release from a CCR facility:

- Tier I: Trend Analysis and Statistics
- Tier II: Advanced Geochemical Evaluation Methods
- Tier III: Isotopic Analyses

Conversely, these tools can also be used to evaluate whether or not sources other than CCR are contributing to groundwater quality degradation.

The CCR Rule requires statistical analysis under assessment monitoring for the determination of SSLs above the GWPS. Many of the primary and potential indicator constituents listed for coal ash (EPRI, 2017) are included in AEP's constituent list for the BSFAP groundwater monitoring programs, including the primary constituent's boron and sulfate. If there is an SSL without a corresponding increase in a primary indicator constituent (boron and usually sulfate for coal ash), then this is a key line of evidence for an ASD.

4.1 Groundwater Data Analysis

Temporal plots are provided in the subsections below for well MW-1603. Each of the plots use the following color-coding system:

- Red – indicates a concentration reported above the reporting limit.
- Orange – indicates a concentration reported below the reporting limit but above the method detection limit (MDL, denoted as estimated "J" values).
- Green – indicates a concentration below the MDL (denoted as "U"); results below the MDL were conservatively plotted as the MDL.

The October 19, 2017 data for the BSFAP water is presented for comparison. The BSFAP water signature is plotted as a constant concentration in **Figure 4-1** to **Figure 4-13**. As the BSFAP accepted fly ash prior to 1970, it is probable that BSFAP water quality has historically varied over time. However, since the BSFAP ceased accepting fly ash prior to 2016, the water quality is anticipated to be more stable; therefore, the October 19, 2017 data provides a reasonable representation of current BSFAP conditions.
Groundwater quality for well MW-1603 is plotted on the primary y-axis and BSFAP water quality is plotted on the secondary y-axis, due to the differences in concentration between the groundwater quality in the vicinity of MW-1603 and the BSFAP water, as labeled in **Figure 4-1** to **Figure 4-13**.

4.1.1 Primary Indicators

Temporal plots for primary indicators boron, sulfate, and chloride reported in groundwater monitoring well MW-1603 are provided in **Figure 4-1** to **Figure 4-3**, respectively.

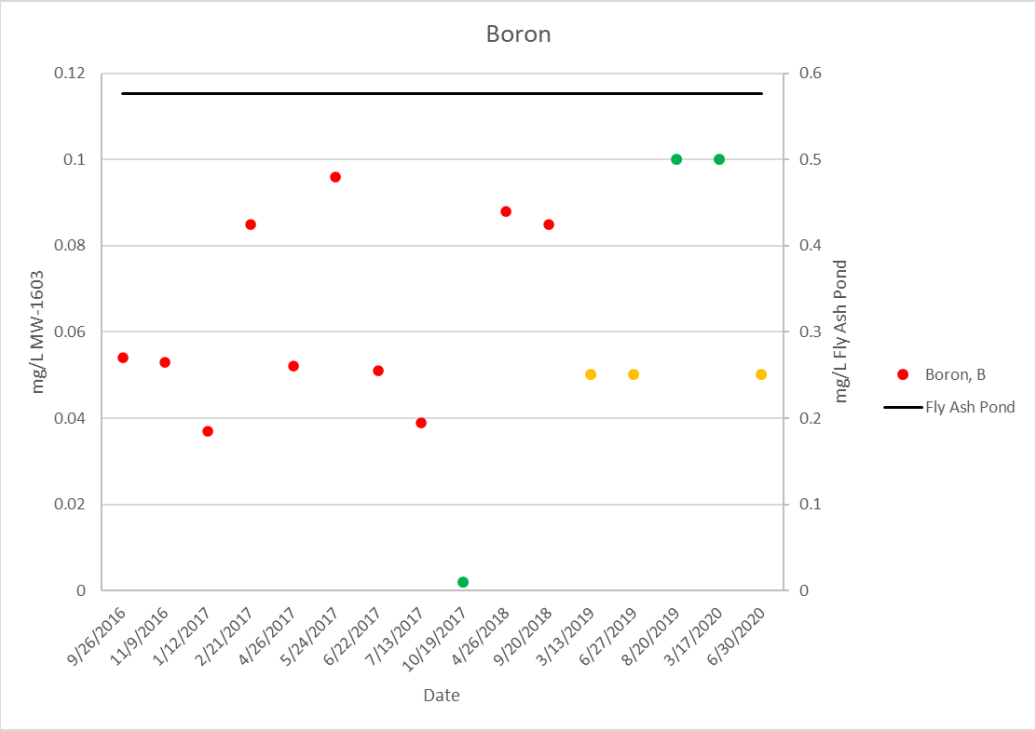

Figure 4-1 MW-1603 Boron Concentrations

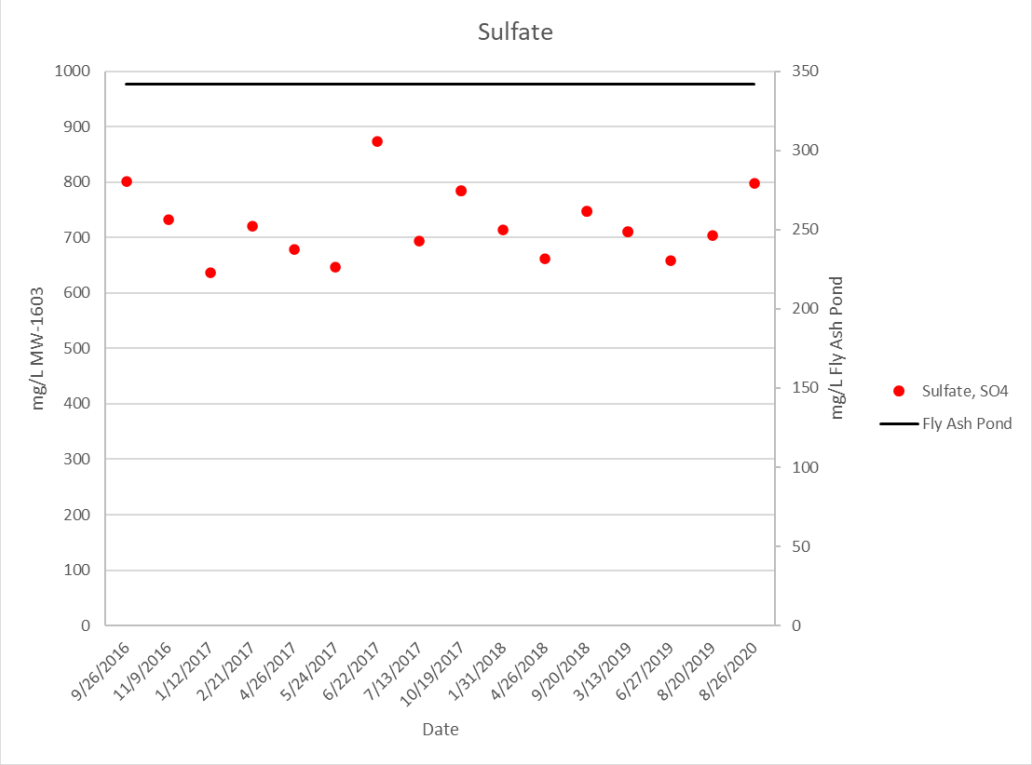

Figure 4-2 MW-1603 Sulfate Concentrations

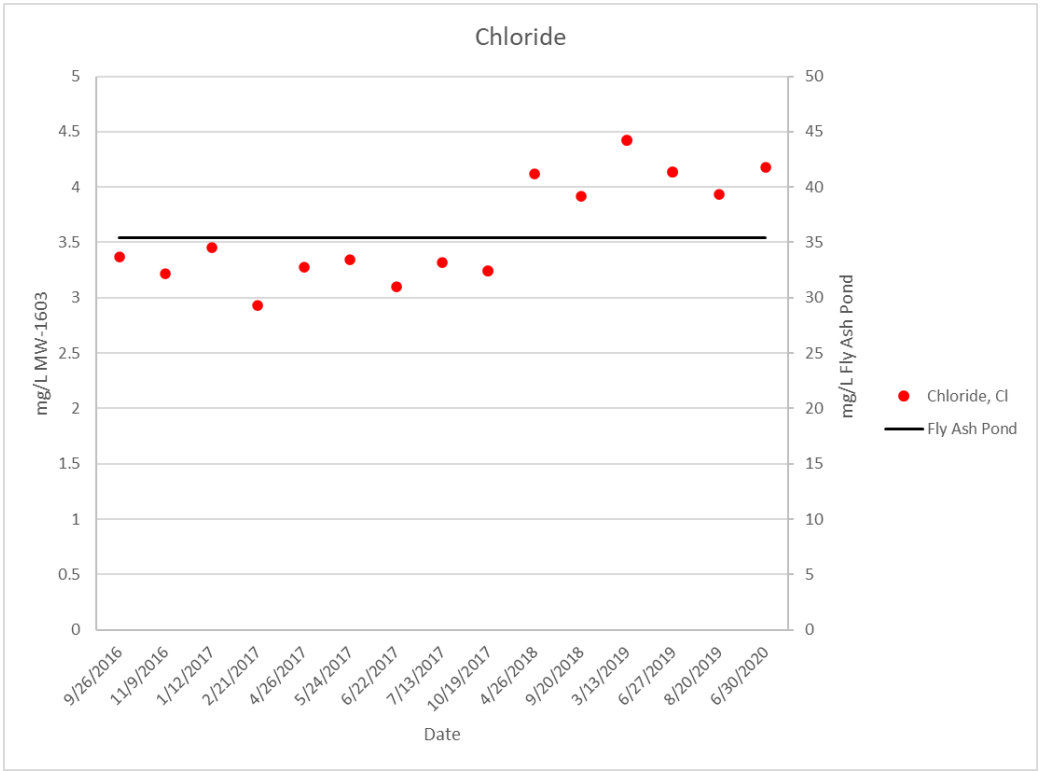

Figure 4-3 MW-1603 Chloride Concentrations

Boron and sulfate concentrations in MW-1603 have remained relatively stable within the same order of magnitude, with minor variability over the monitoring period (September 2016 through August 2020). Chloride concentrations in MW-1603 remained relatively stable between 2.93 and 3.24 mg/L until April 2018, after which a slight increase is observed that has remained stable between 3.92 and 4.42 mg/L. Boron and chloride are present at higher concentrations in water from the BSFAP than in groundwater at MW-1603, whereas sulfate is present at higher concentrations in groundwater at MW-1603 than in water from the BSFAP.

In summary, there were negligible changes in primary indicator concentrations since the last review in January 2020.

4.1.2 Potential Indicators

Temporal plots for potential indicators (bromide, fluoride, molybdenum, potassium, and sodium) reported in groundwater monitoring well MW-1603 are provided on **Figure 4-4** to **Figure 4-8**, respectively.

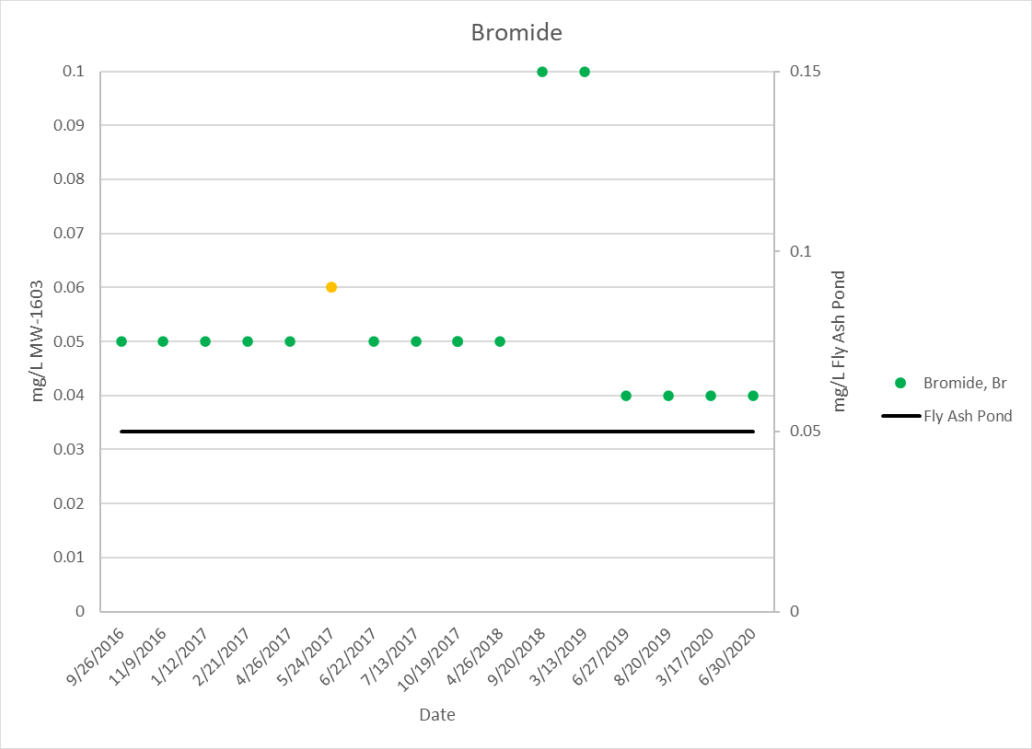

Figure 4-4 MW-1603 Bromide Concentrations[1]

[1] Bromide is below the level of reporting for the BSFAP water, with a detection level of <0.05 mg/L for this sample result.

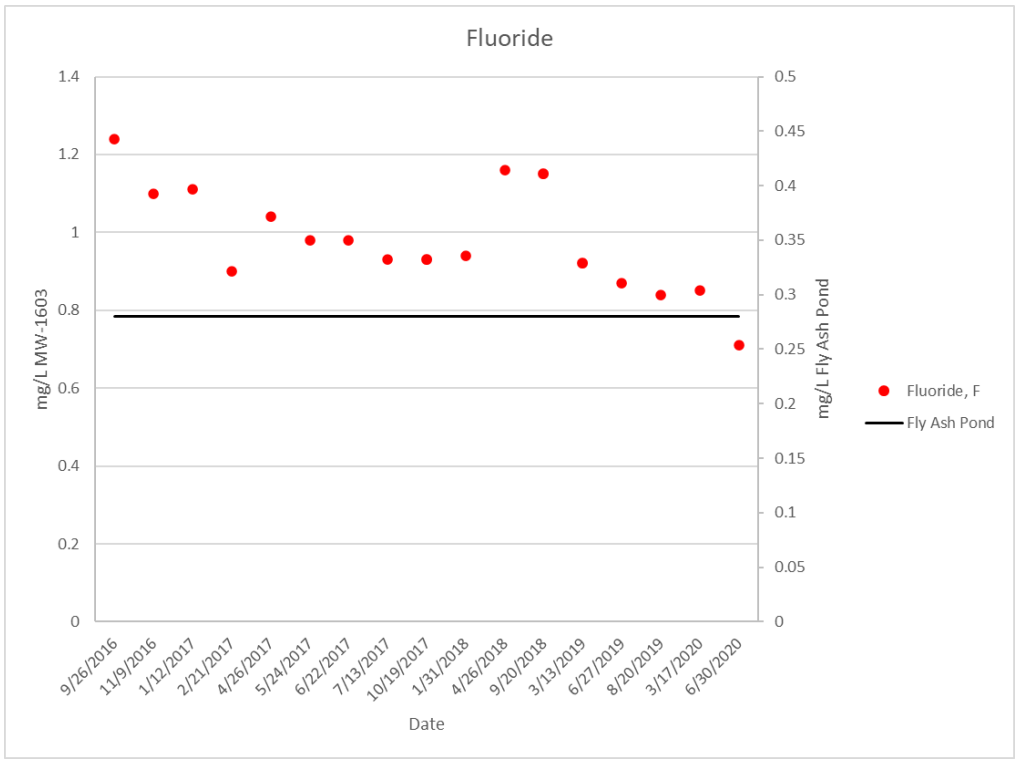

Figure 4-5 MW-1603 Fluoride Concentrations

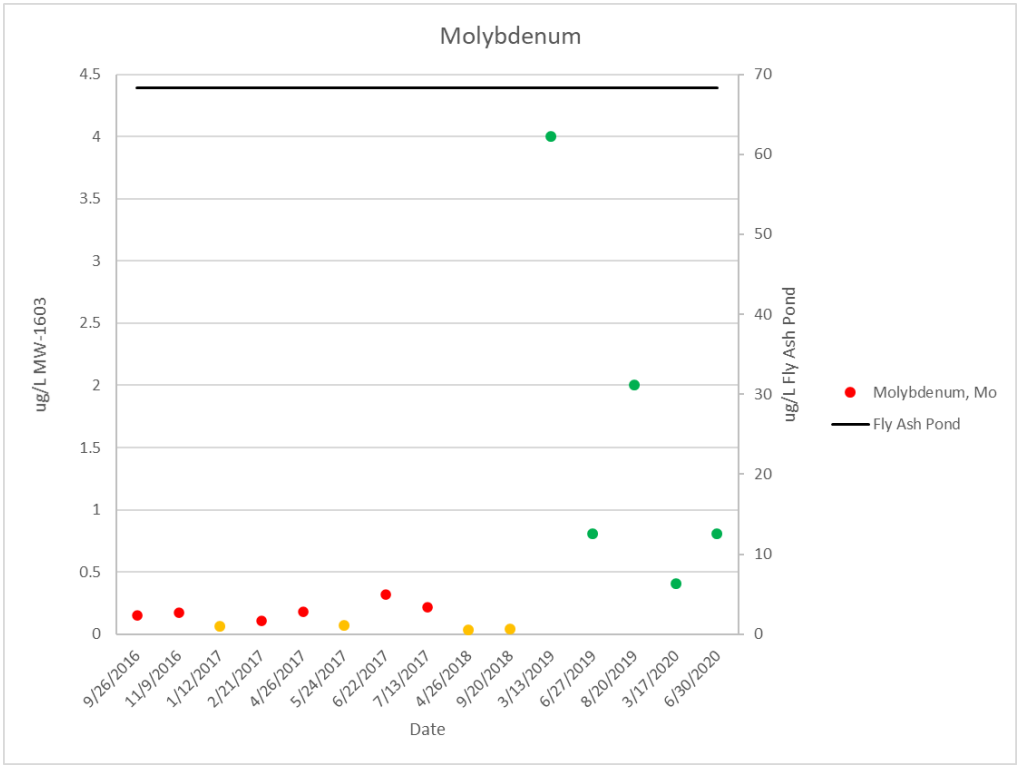

Figure 4-6 MW-1603 Molybdenum Concentrations

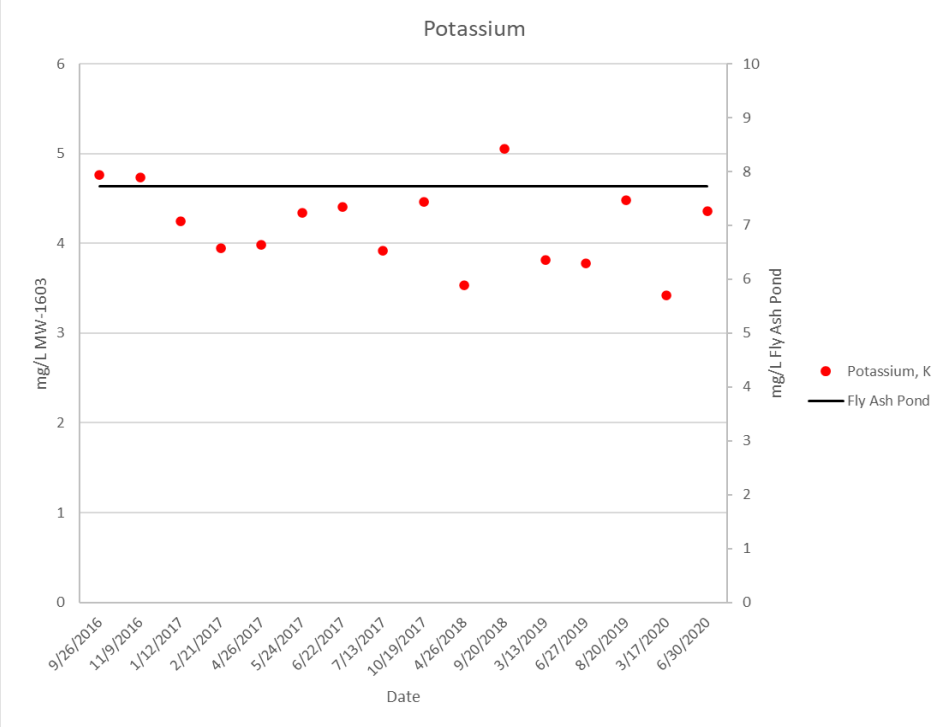

Figure 4-7 MW-1603 Potassium Concentrations

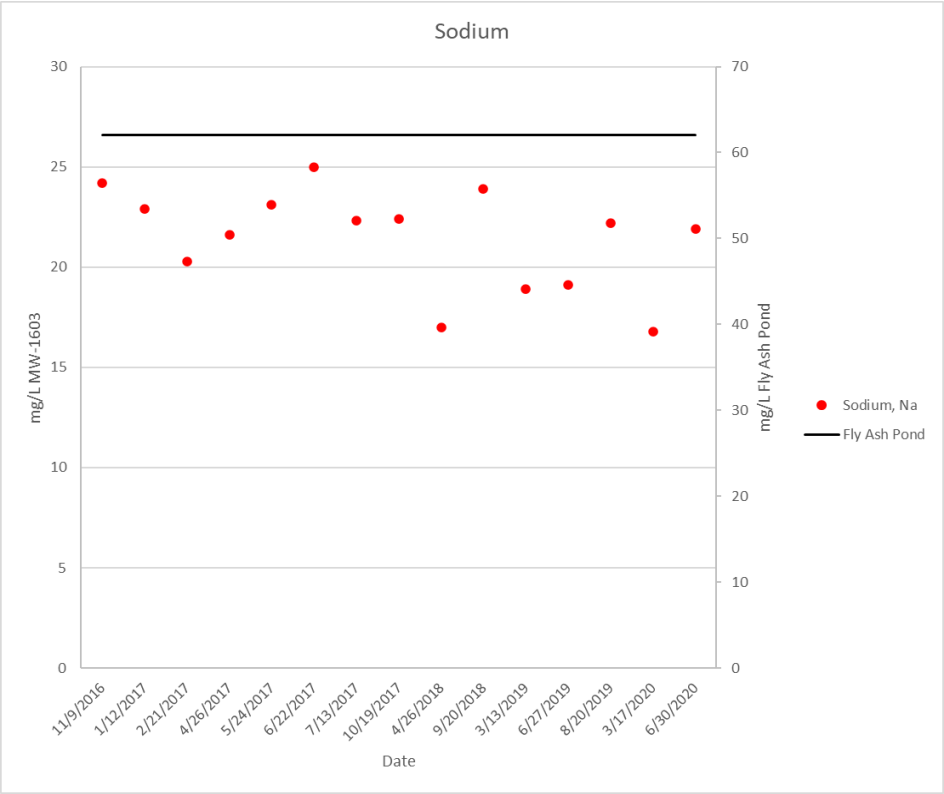

Figure 4-8 MW-1603 Sodium Concentrations

Molybdenum, potassium, and sodium concentrations in groundwater from MW-1603 have consistently been lower than water from the BSFAP. As seen in **Figure 4-6**, molybdenum was last detected above the laboratory reporting limit in MW-1603 in September 2018. Recent variation in molybdenum concentrations, as shown in green, is due to variable MDLs achieved via laboratory analysis. Fluoride concentrations in groundwater from MW-1603 have consistently been higher than for water from the BSFAP. Bromide concentrations in groundwater from MW-1603 have been mostly below the limit of detection. Bromide was detected only once since the initial background monitoring events. When bromide was detected (May 2017) it was 0.06 mg/L, or slightly above the <0.05 mg/L reported for BSFAP water in May 2017.

A comparison of the pH of BSFAP water and groundwater from MW-1603 is provided on **Figure 4-9**. The figure illustrates the substantial difference in pH between the pond water and groundwater of approximately three to five standard units. This is using the standard (logarithmic) pH scale which converts to a factor of 1,000 to 100,000 difference in the hydrogen ion concentration between the BSFAP and MW-1603.

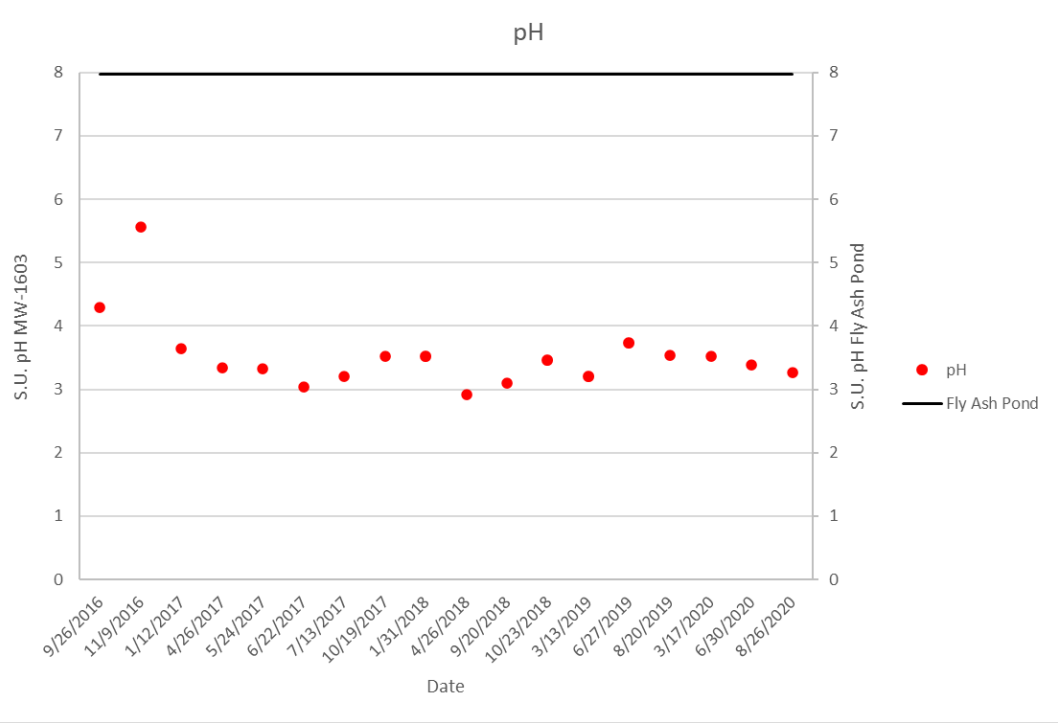

Figure 4-9 MW-1603 pH Values

In summary, there were negligible changes in potential indicator concentrations since the last review in January 2020.

4.1.3 ASD Constituent Trends

Temporal plots for the ASD constituents, beryllium, cobalt, lithium, and radium 226/228 reported in groundwater monitoring well MW-1603 are provided in **Figure 4-10** to **Figure 4-13**, respectively.

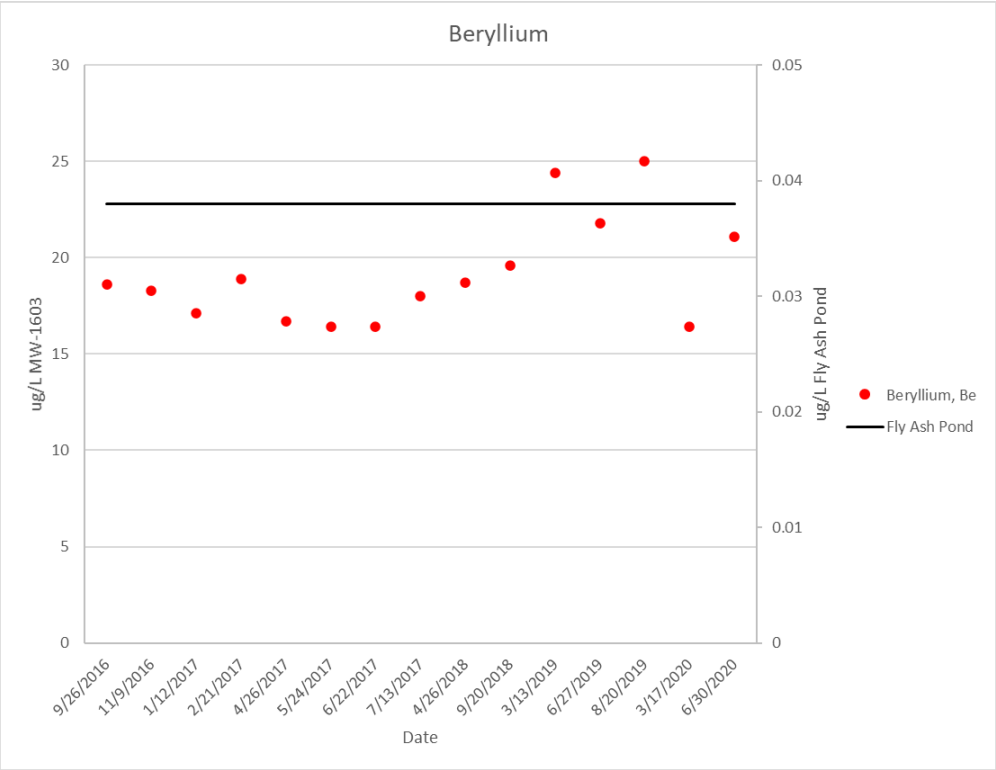

Figure 4-10 MW-1603 Beryllium Concentrations

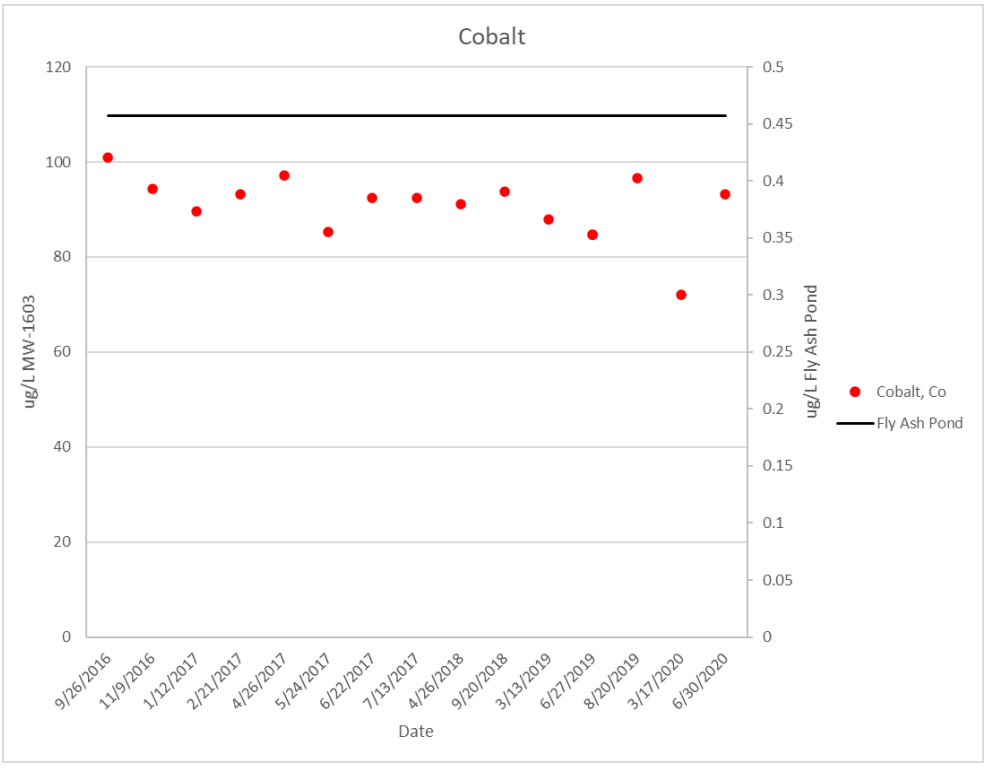

Figure 4-11 MW-1603 Cobalt Concentrations

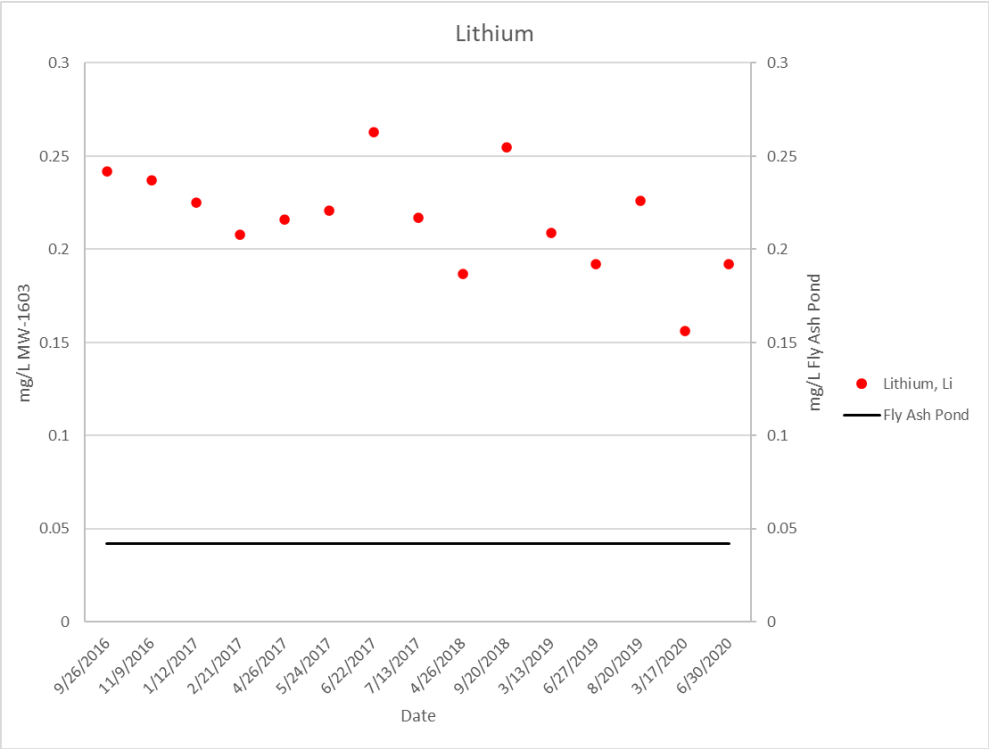

Figure 4-12 MW-1603 Lithium Concentrations

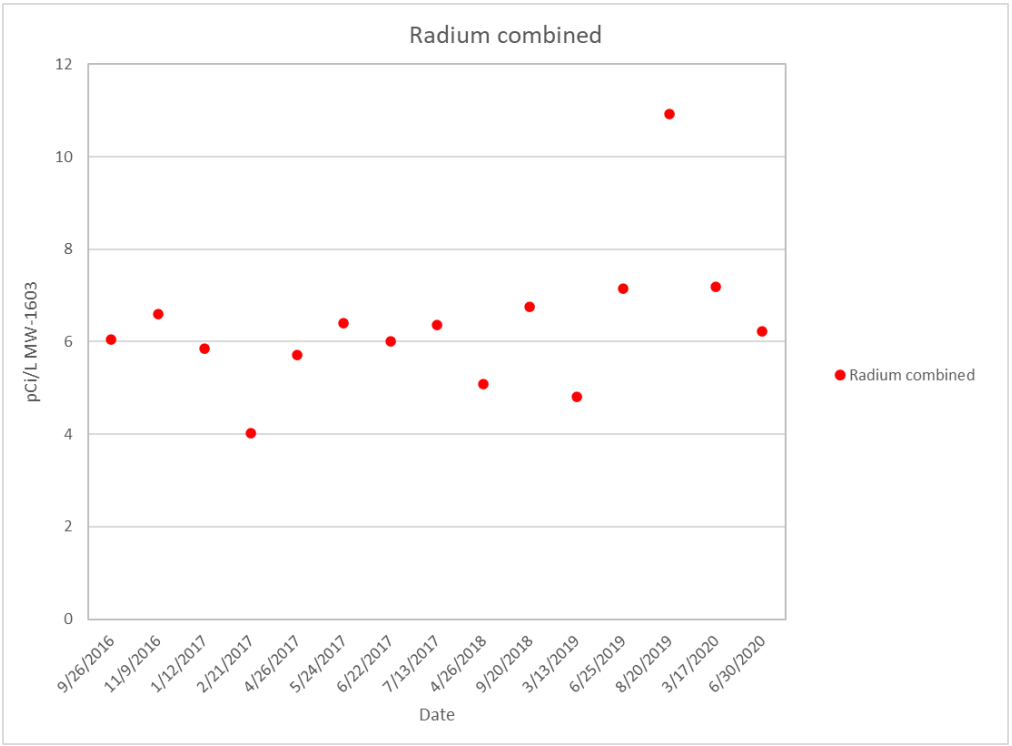

Figure 4-13 MW-1603 Radium 226/228 Concentrations

Beryllium, cobalt, and lithium concentrations are higher in groundwater from MW-1603, as compared to BSFAP water, indicating that the source of beryllium, cobalt, and lithium is not associated with the BSFAP.

Radium 226/228 concentrations in the BSFAP water are unknown, therefore, a comparison between the BSFAP water and MW-1603 groundwater cannot be made. However, radium 226/228 concentrations in MW-1603 are stable across most of the dataset, although the result from August 2019 was elevated compared to earlier and subsequent measurements and may be considered anomalous. The March and June 2020 concentrations of radium 226/228 were within the historical range of values.

4.1.4 Indicator Analysis Findings

Based on the temporal plots for primary indicators, potential indicators, and ASD constituents; it is considered unlikely that CCR constituents from the BSFAP are influencing the chemistry of surrounding groundwater. This is based on the primary indicator sulfate, potential indicators fluoride and bromide, and the ASD constituent's beryllium, cobalt, and lithium all being present at higher concentrations in surrounding groundwater in comparison to the BSFAP water (EHS Support, 2019a). As the concentrations of these constituents in surrounding groundwater are higher, it is unlikely that there is a concentration gradient extending from the BSFAP into groundwater. It is more likely that an alternate source is contributing to the higher concentrations observed in groundwater.

In summary, based on the analyses presented above, no trends within MW-1603 groundwater data suggest that CCR constituents are migrating from the BSFAP into groundwater.

4.2 Tier I Evaluation - Statistical Evaluation

A statistical evaluation of analytes has been conducted previously (EHS Support, 2019a, 2019b, and 2020). The evaluation concluded that groundwater in the vicinity of MW-1603 is statistically the same as that which the United States Geologic Survey (USGS) reported for regional background (Ruppert et al., 2000) in regard to arsenic, boron, calcium, chloride, chromium, fluoride, molybdenum, potassium, sodium, and strontium. The box plots from the earlier ASD investigations (EHS Support, 2019a, 2019b, and 2020) also show a difference between well MW-1603, BSFAP water, and/or the regional background for pH, alkalinity, barium, cobalt, lead, lithium, magnesium, selenium, and sulfate. No background values were provided by the USGS for beryllium, chromium, lead, lithium, molybdenum, and selenium.

Updated box and whisker plots for constituents reported in MW-1603 groundwater are provided in **Appendix A - Figures A-1 through A-12**. Plots for pH, cobalt, and radium 226/228 exhibit outliers which are calculated to be outside the range of distribution (refer to **Appendix A** – **Figure A-8, Figure A-10, and Figure A-12**, respectively).

It is likely that the acidic pH conditions identified at MW-1603, relative to regional background, are driving the observed SSLs. The geochemical conditions within well MW-1603, including a strongly acidic pH, low alkalinity, and high sulfate, are indicative of conditions similar to those observed at acid mine drainage sites. At MW-1603, the geochemical conditions have developed due to the presence of the sulfide-bearing Princess coal seams being intersected by the screened interval of the monitoring well (discussed in EHS Support, 2019a). The combination of the well installation and effects of well sampling

has resulted in development of aerobic and water-saturated conditions within the coal seams, which has led to a lowering of the pH through oxidation of sulfides present in the coal and subsequently led to enhanced rock dissolution. Enhanced host rock dissolution at MW-1603 is evident from the much higher TDS values at this location in comparison to groundwater samples from the other site wells, including water from the BSFAP. In addition to an abundance of sulfides, samples of host rock and coal from the Princess Formation in Kentucky have been shown to contain parts per million (ppm) levels of beryllium, cobalt, and lithium (Hood et al., 2020), thereby, providing a viable source for the observed SSLs.

For context, studies have demonstrated that the pH of groundwater in contact with fly ash is maintained alkaline (pH 7 to 10) for decades due to buffering by reactions with carbonates and amorphous aluminum silicates in the fly ash (Twardowska et al., 2003). The BSFAP water is consistent with this range, with a pH of 7.97. Consequently, the acidic pH of groundwater identified at MW-1603 is compelling evidence that groundwater at this location has not mixed with and is not representative of water from the BSFAP.

Trace amounts of uranium are also known to be present within coal deposits in general (Gabbard, 1993). Uranium (at ppm levels) has been identified in coal from the Princess Formation in which well MW-1603 is seated (Hood et al., 2020). When uranium decays it forms radium; therefore, trace amounts of uranium in the Princess coal are a potential source of the radium 226/228 present in groundwater from MW-1603.

4.3 Tier II Evaluation - Geochemical Evaluation

A simple analysis of primary and potential indicator constituents (as performed in **Section 4.1**) may not provide the lines of evidence required for a robust ASD investigation. It is recognized that naturally occurring indicator constituents and upgradient sources may have an additional influence on groundwater quality. Spatially across a site, groundwater quality may be observed to change due to chemical interactions with the aquifer matrix. EPRI (2012) recommended use of more sophisticated methods for multiple parameters over multiple locations, such as ion ratios and ternary plots.

4.3.1 Ion Ratios

Development of ion ratios involves first selecting two non-competing, non-sorbing constituents (boron and chloride). The ratios of these constituents are then compared spatially across the site and a judgment is made as to whether the hydraulically downgradient groundwater is similar to the background groundwater quality.

Calculation of ion ratios were conducted utilizing median concentrations of the indicator species. The median concentrations of boron, chloride, and sulfate over the monitoring period (September 2016 through August 2020) are provided in **Table 4-1**. These three constituents were selected based on the EPRI (2017) recommended indicator species. Whereas bromide is also a recommended indicator species, it was not included in the assessment as it was non-detect in the BSFAP water, indicating its presence in groundwater was either naturally derived or from an off-site source. The median concentrations for sulfate, boron, and chloride show minimal change since January 2019.

Table 4-1 Median Concentrations of Boron, Chloride, and Sulfate

		Median Concentrations September 2016 to August 2020		
Location	**Location ID**	**Boron (mg/L)**	**Chloride (mg/L)**	**Sulfate (mg/L)**
Source	**Fly Ash Pond**	0.58	35.4	342
Downgradient	**MW-1603**	0.052 ±0.026	3.37 ±0.47	712 ±65

mg/L = milligrams per liter

Ion ratios have been calculated using boron, chloride, and sulfate as recommended in EPRI (2017) and are provided in **Table 4-2**. The ion ratios show no change since the last evaluation in January 2020.

Table 4-2 Ion Ratios

		Median Concentrations September 2016 to August 2020		
Location	**Location ID**	**Boron/Sulfate[1] (x1000)**	**Boron/Chloride[2]**	**Chloride/Sulfate[1]**
Source	**Fly Ash Pond**	1.68	0.002	0.10
Downgradient	**MW-1603**	0.07 ±0.03	0.02 ±0.01	0.005 ±0.001

[1] Groundwater sample from MW-1603 collected for sulfate analysis in August 2020.
[2] Boron and chloride samples collected in June 2020.

Based on the previous and current ion ratio analysis, the conclusion that MW-1603 is not impacted by CCR constituents from the BSFAP is unchanged.

4.3.2 Ternary Plots

Ternary plots are used to identify changes in major or minor ion distributions over time. A ternary plot using calcium, chloride, and sulfate measured in the vicinity of MW-1603 is provided in **Figure 4-14**. The close grouping of ratios from all events on the ternary plot shows that the major ion groundwater ratios have not changed during the three-year period of groundwater quality monitoring at well MW-1603 and that the ratios are distinct from the BSFAP. Note that for the purposes of plotting, data includes calcium and chloride values from the June 30, 2020 sample, and sulfate values from the August 26, 2020 sample.

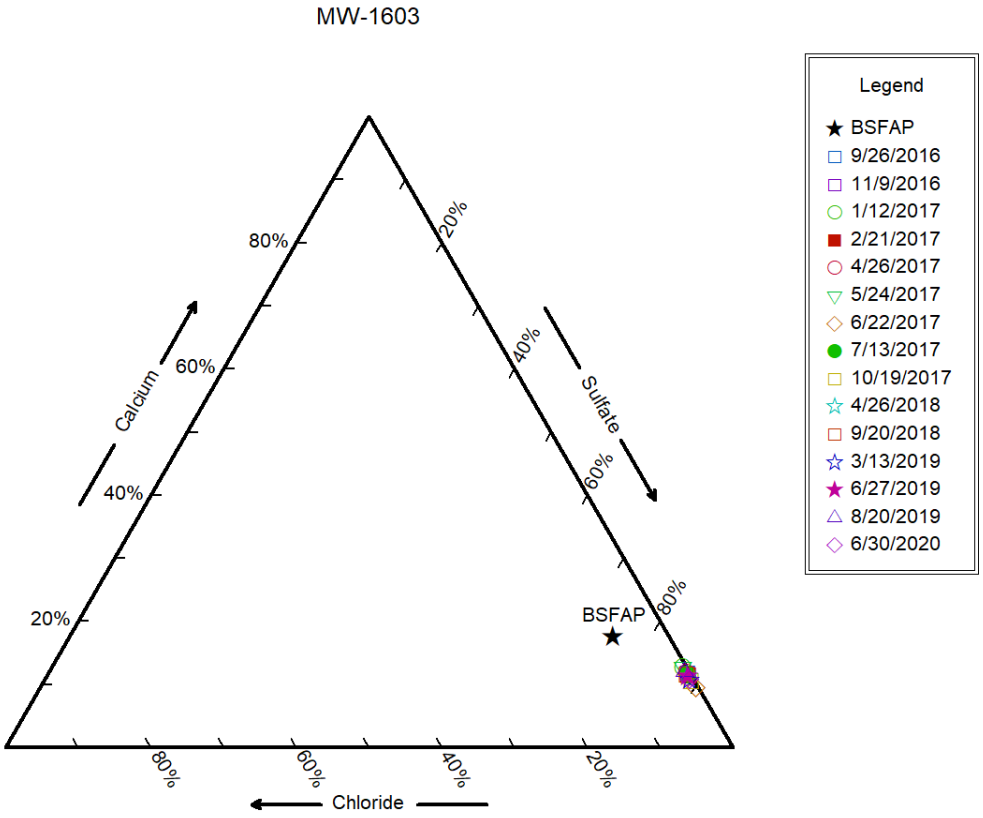

Figure 4-14 Ternary Plot MW-1603

4.3.3 Summary

In summary, based on the previous geochemical evaluation and the updated review presented in this ASD investigation, there is insufficient evidence to support the presence of CCR constituents (principally beryllium, cobalt, and lithium), as derived from the BSFAP, in groundwater sampled at MW-1603. The ternary plot does not support temporal changes of MW-1603 groundwater quality. The boron, chloride, and sulfate ion ratios remain unchanged since September 2019. Therefore, it is unlikely that beryllium, cobalt, lithium, and radium 226/228 detected within MW-1603 groundwater are sourced from the BSFAP. It is likely that beryllium, cobalt, lithium, and radium 226/228 are sourced from the lithologies in which this monitoring well is screened across, which includes the Princess coal seams.

5 Summary and Conclusions

Using the EPRI (2017) guidance for ASD investigations, the conclusions based on the lines of evidence presented and discussed within **Sections 3** and **4** indicate that groundwater in the vicinity of the BSFAP is not being impacted by CCR constituents from the BSFAP. The elevated beryllium, cobalt, and lithium concentrations that triggered the ASD investigation are due to the oxidation of sulfide minerals present in coal seams that have been intersected by well MW-1603, including organic material within the screened interval that is identified as having "a slight coaly texture." This is supported by the visual evidence recorded during the logging of the core from this location (refer to EHS Support, 2019a), the low pH reported in groundwater, and the subsequent mobilization and leaching of trace metals (beryllium, cobalt, and lithium) into groundwater by the elevated acidity.

Consistent with the August 2019 sampling event, radium 226/228 concentrations have been reported in MW-1603 as an SSL in the March 2020 and June 2020 groundwater monitoring statistics. Radium isotopes are naturally occurring radioactive materials (NORMs) found in coal, measured as decay products of uranium. Therefore, the presence of radium 226/228 is likely due to elevated uranium in the coal seams that have been intersected at well location MW-1603. As a result of the installation, screening, and extraction of groundwater from MW-1603, radium 226/228 may now be considered a technologically enhanced NORM.

The elevated pH in the BSFAP water and the corresponding lower concentrations of minor ions in the BSFAP also support the unlikely influence of the BSFAP on groundwater. Therefore, it is concluded that the elevated signatures of beryllium, cobalt, lithium, and radium 226/228 in MW-1603, as noted in the March 2020 and June 2020 groundwater monitoring data, are related to the dissolution of naturally occurring coal seam-derived constituents within the shale layers of the Breathitt Group, as supported by the discussion of local and regional geology in **Section 2.1** and EHS Support (2019a).

In conclusion, this ASD addendum for the BSFAP has determined that Type IV natural variations in groundwater are resulting in SSLs of beryllium, cobalt, lithium, and radium 226/228 at MW-1603.

6 References

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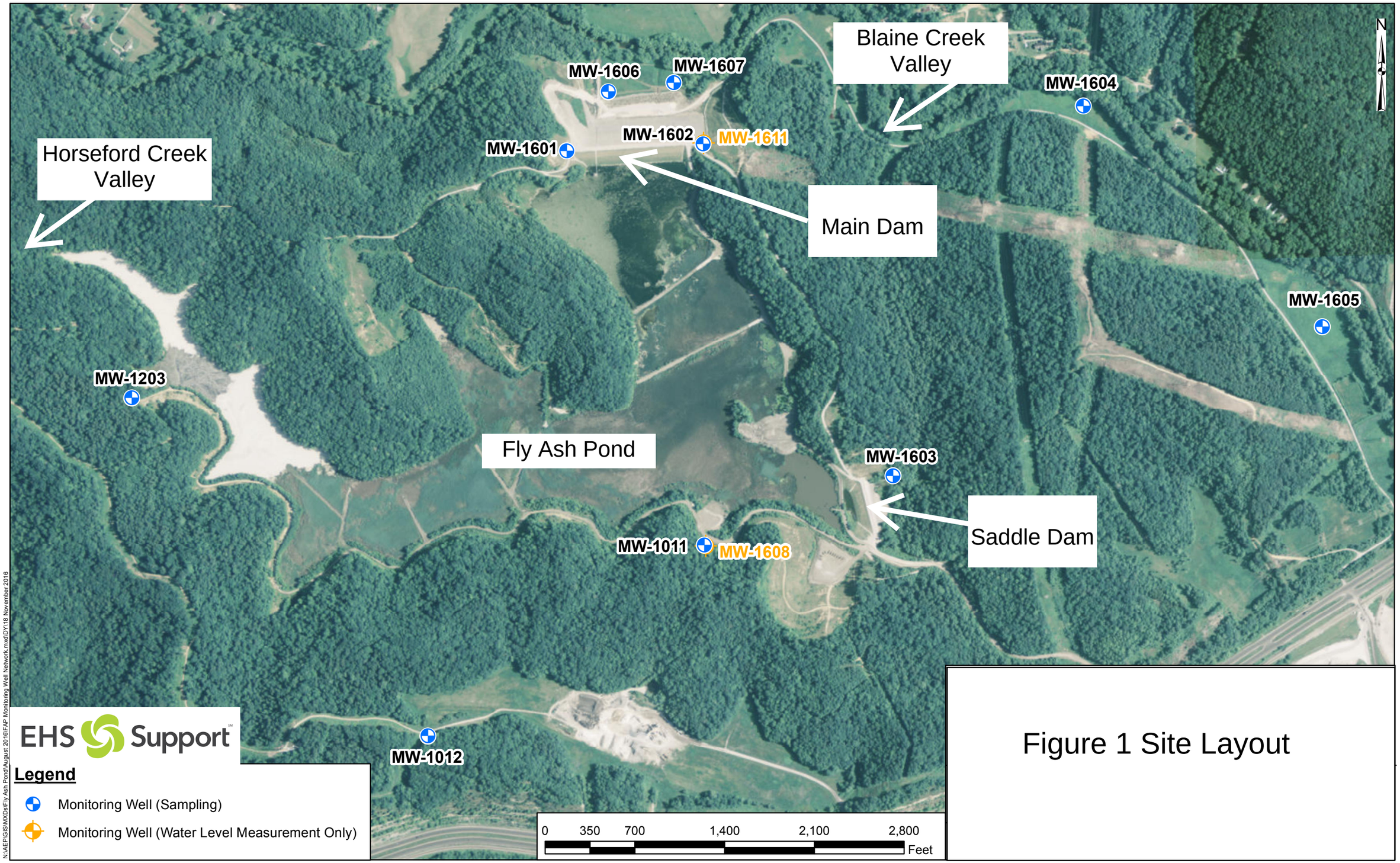
Figures



EHS Support™

Legend

- Monitoring Well (Sampling)
- Monitoring Well (Water Level Measurement Only)

Figure 1 Site Layout

N:\AEP\GIS\MXDs\Fly Ash Pond\August 2016\FAP Monitoring Well Network.mxd\DY\18 November 2016

MW-1606
MW-1607
MW-1604
MW-1602
MW-1611
MW-1601
Background Groundwater Wells
MW-1605
MW-1203
MW-1603
MW-1011
MW-1608
Background Groundwater Wells
MW-1012
N
EHS Support
Legend
Monitoring Well (Sampling)
Monitoring Well (Water Level Measurement Only)
0 350 700 1,400 2,100 2,800
Feet
N:\AEP\GIS\MXDs\Fly Ash Pond\August 2016\FAP Monitoring Well Network.mxd\DOY18 November 2016
Figure 2 Groundwater Monitoring Well Locations

Tables

Table 1
MW-1603 Historical Groundwater Data September 2016 to August 2020
Big Sandy Fly Ash Pond Groundwater Monitoring,
American Electric Power, Kentucky Power Company, Louisa, Kentucky

Analytes	Units	9/26/2016	11/9/2016	1/12/2017	2/21/2017	4/26/2017	5/24/2017	6/22/2017	7/13/2017	10/19/2017	1/31/2018	4/26/2018	9/20/2018	10/23/2018	3/13/2019	6/27/2019	8/20/2019	3/17/2020	6/30/2020	8/26/2020
Antimony, Sb	µg/L	0.01 J	< 0.01	< 0.01	< 0.01	0.01 J	< 0.01	< 0.01	< 0.01	NA	NA	0.04 J	0.02 J	NA	< 0.2	< 0.04	< 0.1	< 0.02	< 0.04	NA
Arsenic, As	µg/L	1.51	1.19	1.4	1.26	1.3	1.34	1.29	0.89	NA	NA	1.6	1.4	NA	1.26	1.36	1.39	0.83	1.12	NA
Barium, Ba	µg/L	13.4	15.4	11.4	10.3	12.4	11.5	11.4	11.3	NA	NA	10.5	11.4	NA	12	11	13.6	9.92	12.2	NA
Beryllium, Be	µg/L	18.6	18.3	17.1	18.9	16.7	16.4	16.4	18	NA	NA	18.7	19.6	NA	24.4	21.8	25	16.4	21.1	NA
Boron, B	mg/L	0.054	0.053	0.037	0.085	0.052	0.096	0.051	0.039	< 0.002	NA	0.088	0.085	NA	0.05 J	0.05 J	< 0.1	< 0.1	0.05 J	NA
Bromide	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.06 J	< 0.05	< 0.05	< 0.05	NA	< 0.05	< 0.1	NA	< 0.1	< 0.04	< 0.04	< 0.04	< 0.04	NA
Cadmium, Cd	µg/L	0.84	0.93	0.79	0.75	0.87	0.77	0.86	0.8	NA	NA	0.74	0.83	NA	0.78	0.7	0.89	0.64	0.85	NA
Calcium, Ca	mg/L	105	94.7	92.7	91.9	90.5	93.9	90.6	90.2	91	82.2	83.6	97.5	NA	84.6	83.3	95.8	NA	96.6	NA
Chloride, Cl	mg/L	3.37	3.22	3.45	2.93	3.28	3.34	3.1	3.32	3.24	NA	4.12	3.92	NA	4.42	4.13	3.93	NA	4.18	NA
Chromium, Cr	µg/L	1.1	1.12	0.731	0.771	0.829	0.62	0.821	0.485	NA	NA	0.771	0.713	NA	1 J	0.618	0.8	0.56	0.694	NA
Cobalt, Co	µg/L	101	94.4	89.6	93.2	97.1	85.3	92.4	92.5	NA	NA	91.1	93.8	NA	87.9	84.7	96.6	72	93.2	NA
Comb. Radium 226/228	pCi/L	6.04	6.6	5.86	4.03	5.72	6.4	6	6.36	NA	NA	5.09	6.75	NA	4.8	7.149	10.92	7.19	6.22	NA
Fluoride, F	mg/L	1.24	1.1	1.11	0.9	1.04	0.98	0.98	0.93	0.93	0.94	1.16	1.15	NA	0.92	0.87	0.84	0.85	0.71	NA
Lead, Pb	µg/L	9.75	8.18	6.11	6.3	6.41	4.96	6.47	3.72	NA	NA	5.27	4.39	NA	4.28	3.68	4.17	3.95	4.67	NA
Lithium, Li	mg/L	0.242	0.237	0.225	0.208	0.216	0.221	0.263	0.217	NA	NA	0.187	0.255	NA	0.209	0.192	0.226	0.156	0.192	NA
Mercury, Hg	µg/L	< 0.002	< 0.002	< 0.002	< 0.002	0.002 J	< 0.002	< 0.002	< 0.002	NA	NA	< 0.002	NA	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	NA
Molybdenum, Mo	µg/L	0.15	0.17	0.06 J	0.11	0.18	0.07 J	0.32	0.22	NA	NA	0.03 J	0.04 J	NA	< 4	< 0.8	< 2	< 0.4	< 0.8	NA
pH	S.U.	4.29	5.56	3.64	4.51	3.34	3.32	3.04	3.20	3.52	3.52	2.91	3.10	3.46	3.19	3.73	3.54	3.52	3.38	3.27
Potassium, K	mg/L	4.76	4.73	4.25	3.95	3.98	4.34	4.41	3.92	4.46	NA	3.53	5.05	NA	3.81	3.78	4.48	3.42	4.36	NA
Residue, Filterable, TDS	mg/L	1,060	1,010	948	1,020	994	936	1,040	1,000	962	915	926	974	NA	896	954	1,010	NA	NA	1,040
Selenium, Se	µg/L	5.4	4.8	5.6	4.9	6.1	6.3	6.1	2.7	NA	NA	8.1	6.3	NA	4	4.9	5.6	4	6.2	NA
Sodium, Na	mg/L	NA	24.2	22.9	20.3	21.6	23.1	25	22.3	22.4	NA	17	23.9	NA	18.9	19.1	22.2	16.8	21.9	NA
Sulfate, SO4	mg/L	801	733	636	720	678	646	873	694	784	714	661	747	NA	709	658	704	NA	NA	798
Thallium, Tl	µg/L	1.29	1.55	1.39	1.2	1.41	1.35	1.43	1.43	NA	NA	1.39	1.7	NA	1 J	1.4	2 J	1.34	1.57	NA

Notes:
< - not detected at or above the method detection limit
J - Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the method detection limit.

µg/L – Micrograms per liter
mg/L – Milligrams per liter
NA – Not analyzed
pCi/L – Picocuries per liter
S.U. – Standard Units
TDS – Total Dissolved Solids

Appendix A Box Plots

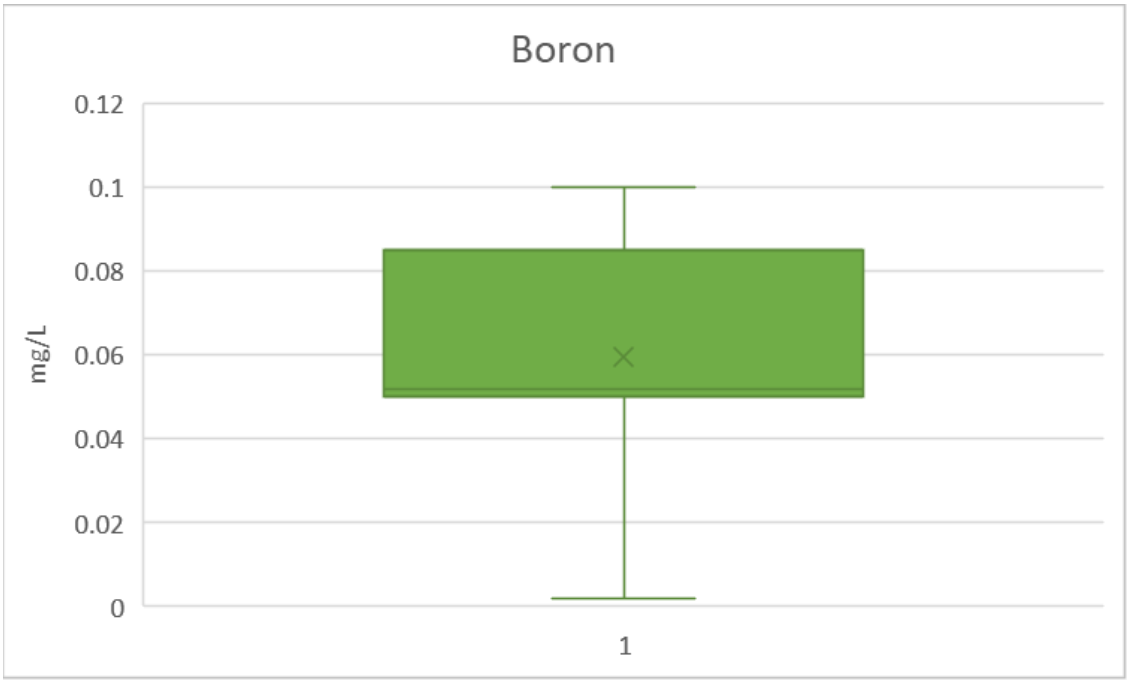


Figure A-1 Boron Box Plot

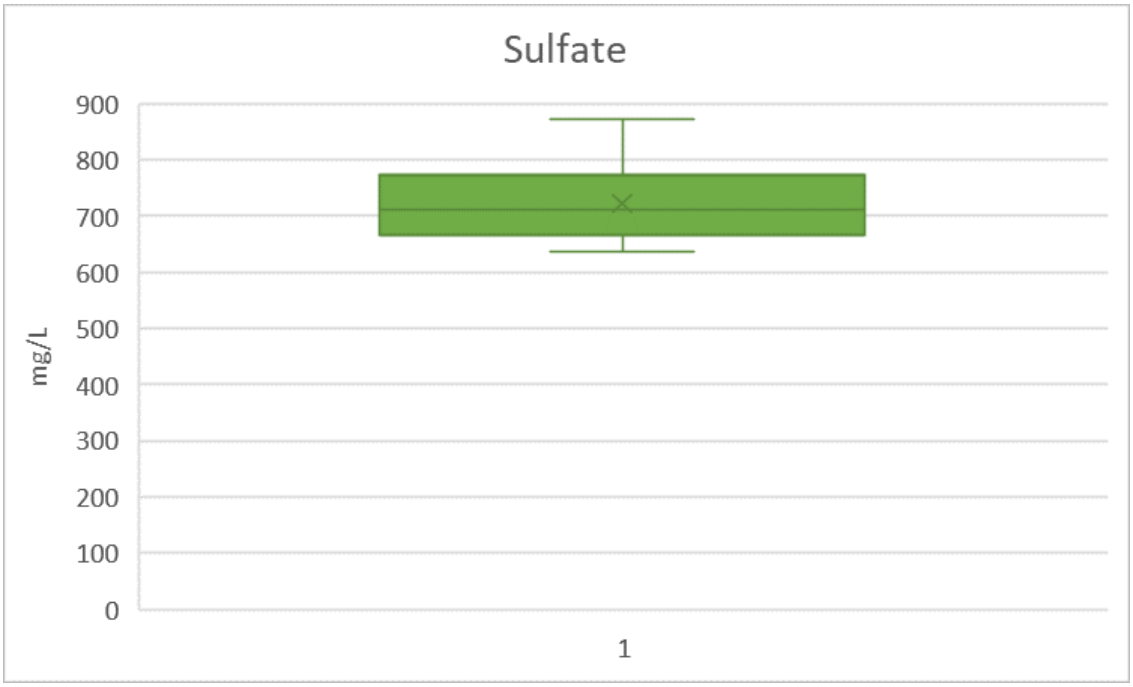


Figure A-2 Sulfate Box Plot

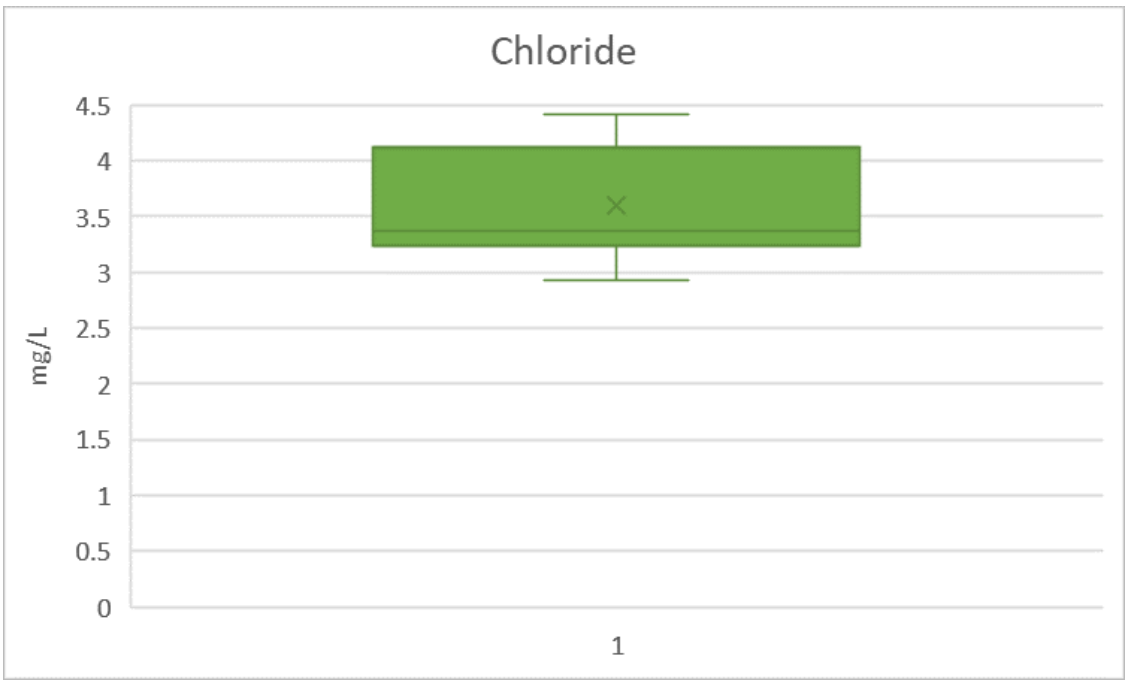


Figure A-3 Chloride Box Plot

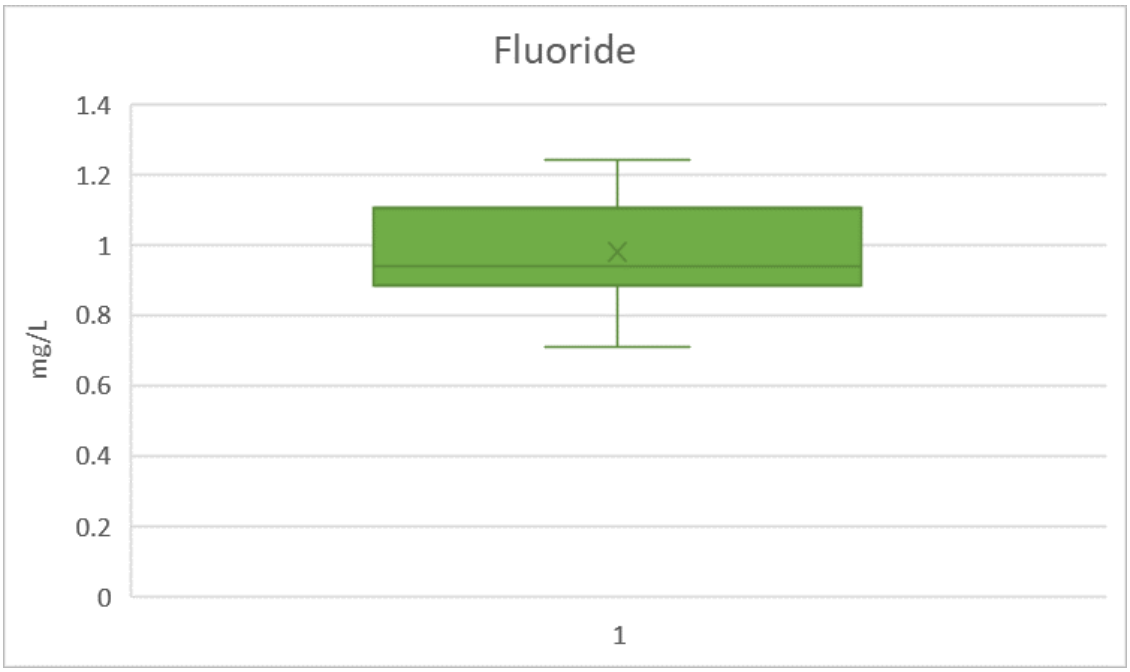


Figure A-4 Fluoride Box Plot

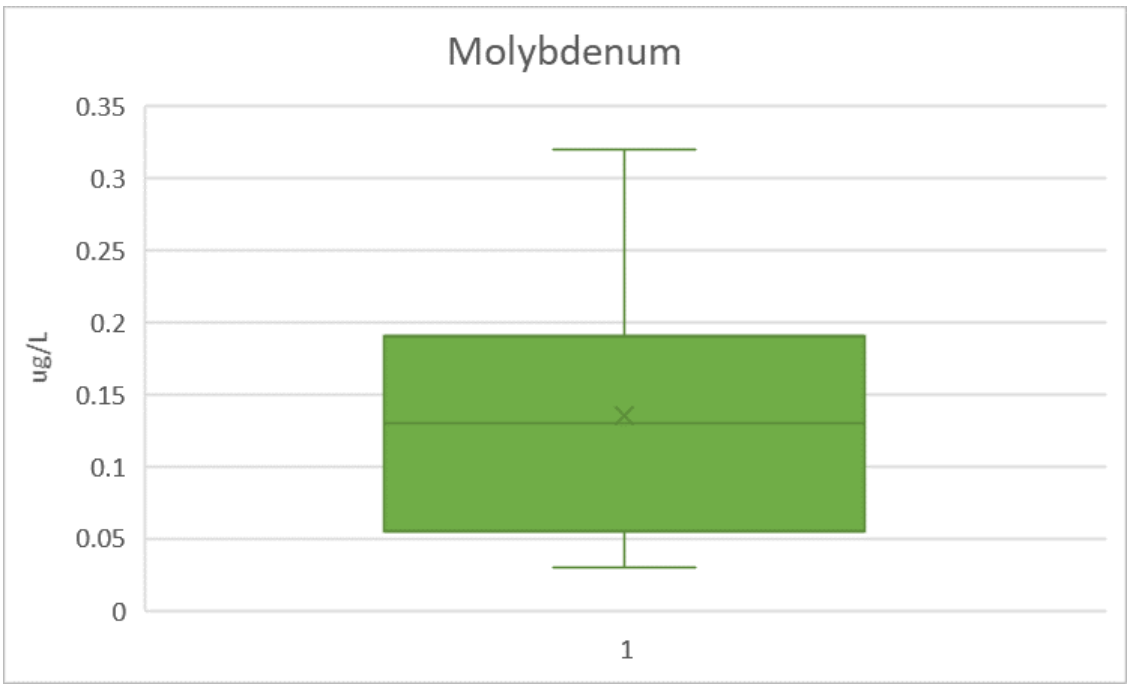


Figure A-5 Molybdenum Box Plot

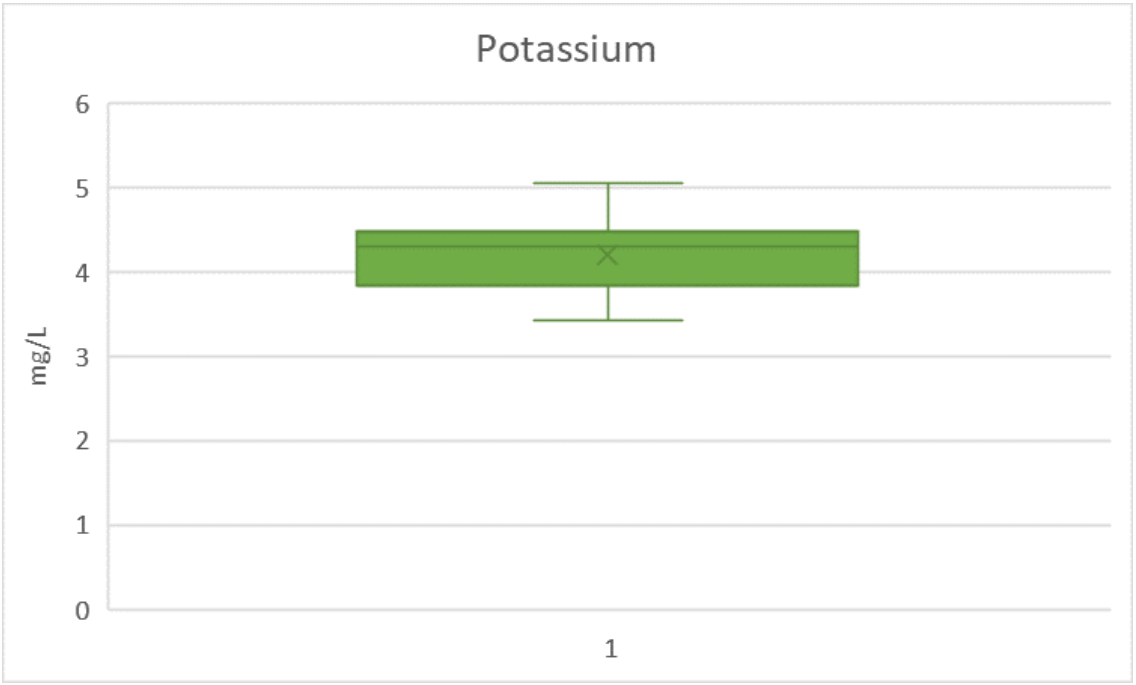


Figure A-6 Potassium Box Plot

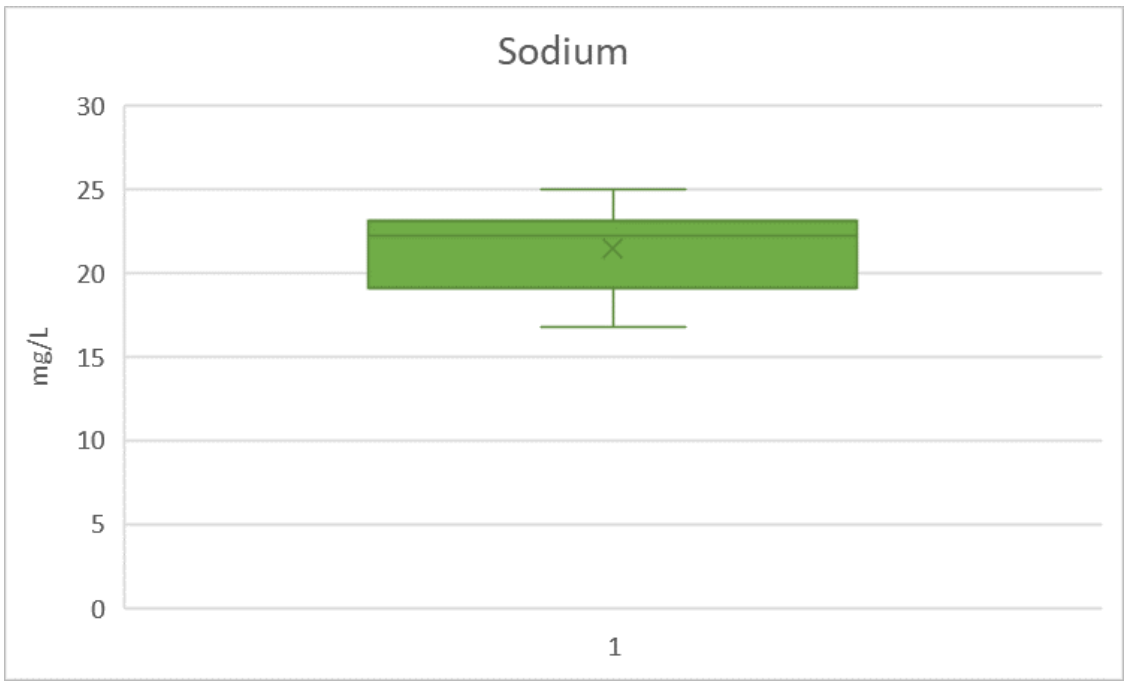


Figure A-7 Sodium Box Plot

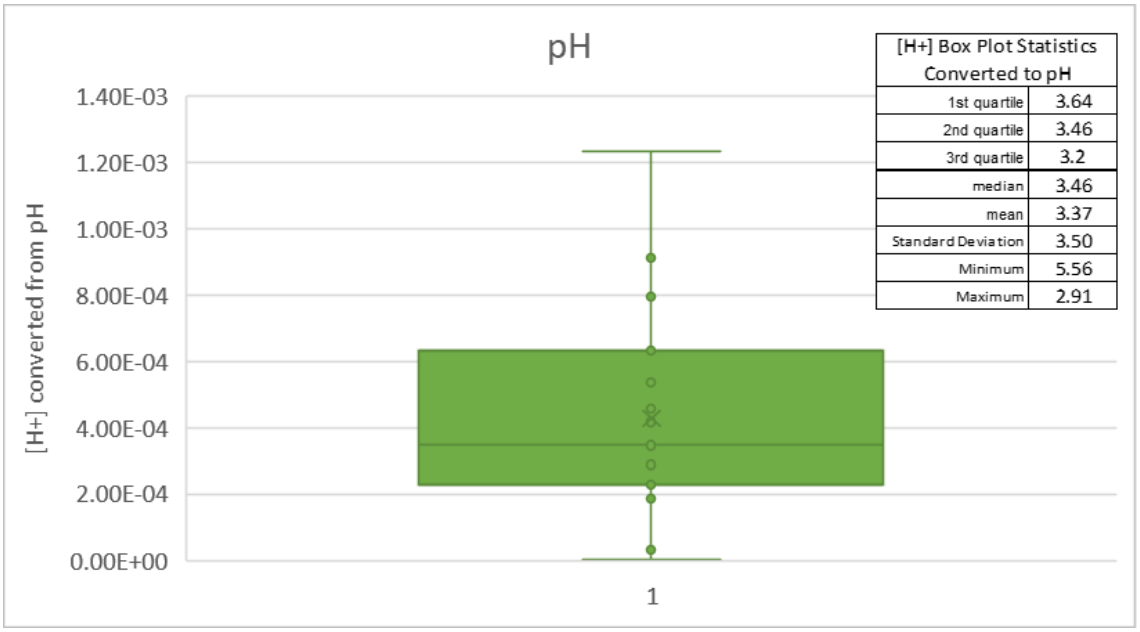


Figure A-8 pH Box Plot

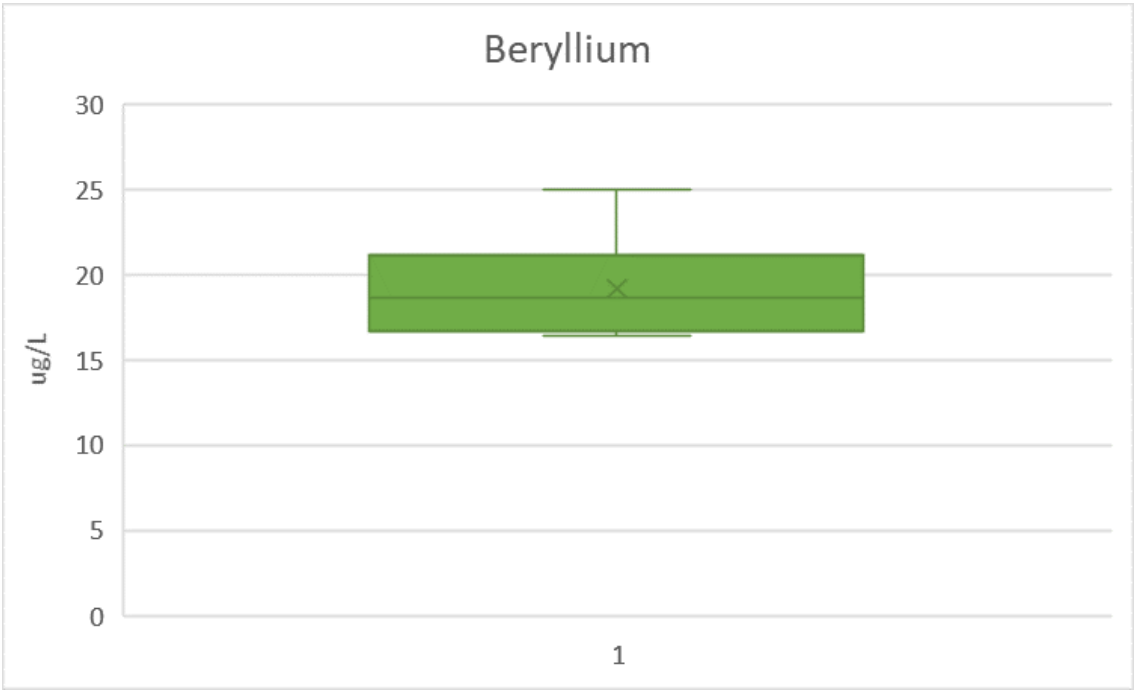


Figure A-9 Beryllium Box Plot

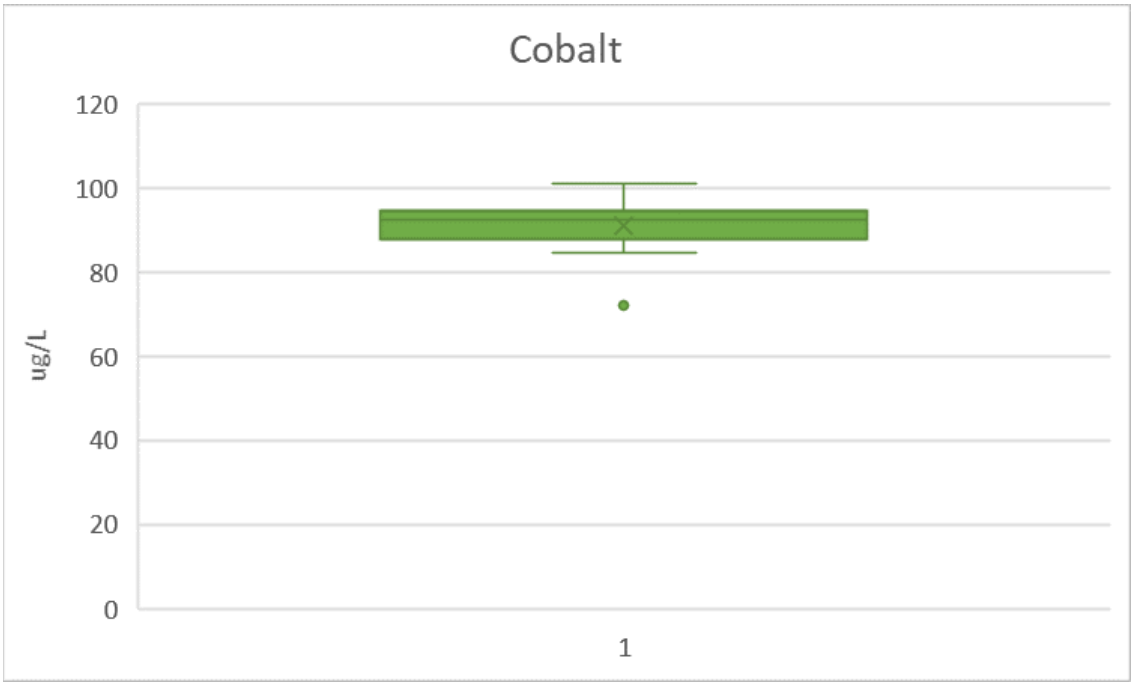


Figure A-10 Cobalt Box Plot

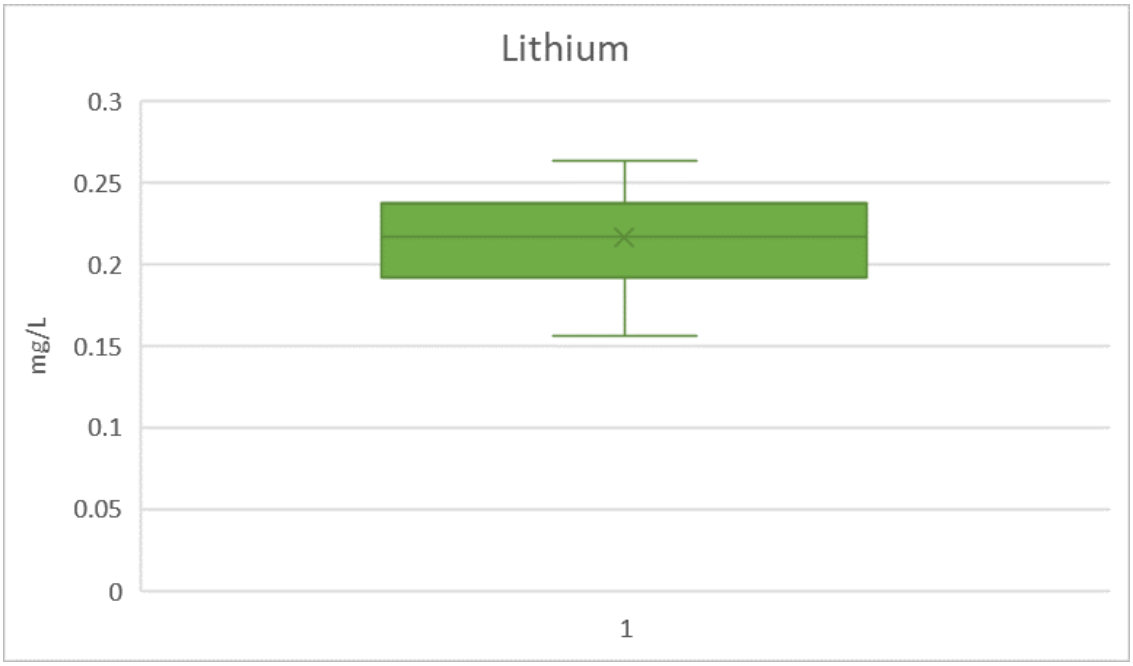


Figure A-11 Lithium Box Plot

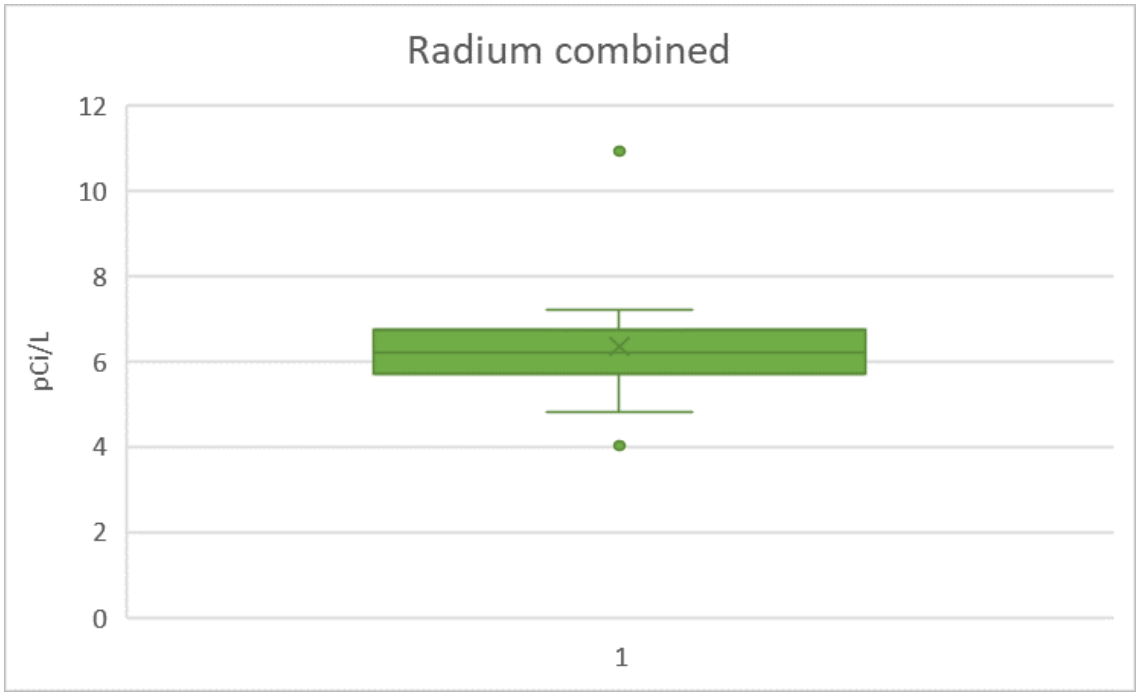


Figure A-12 Radium 226/228 Box Plot