Annual Groundwater Monitoring Report

Kentucky Power Company

Big Sandy Plant

Fly Ash Pond CCR Management Unit

Louisa, Kentucky

January 2024

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KENTUCKY POWER
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BOUNDLESS ENERGY

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:

- The CCR unit was in Assessment monitoring at the beginning and end of 2023;
- 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 13, 14, 15, and 17, 2023. Following the March 2023 sampling event, the determination was made to eliminate monitoring well MW-1603 from the groundwater monitoring network, and a revised *Groundwater Monitoring Network Evaluation (Geosyntec, October 2023)* was completed, placed in the operating record, and placed on the publicly accessible AEP CCR Rule Compliance Data and Information Internet site discussed in Section III of this report. No wells other than MW-1603 were eliminated from the groundwater monitoring network. All remaining monitoring wells were subsequently sampled pursuant to 40 CFR 257.95(d)(1) on June 12, 13, and 14, 2023, and pursuant to 40 CFR 257.95(d)(1) on October 17 and 18, 2023. All samples collected during the March 2023 sampling event were analyzed for all constituents in Appendix IV of the CCR rules. All samples collected during the June 2023 sampling event were analyzed for all constituents in Appendix III of the CCR rules and for those Appendix IV constituents detected during the March 2023 sampling event. All samples collected during the October 2023 sampling event were analyzed for all constituents in Appendix III of the CCR rules and for those Appendix IV constituents detected during the March 2023 sampling event. MW-1603 was sampled in June in case a decision was made to keep the well in the network prior to revising the December 2016 Groundwater Monitoring Network Evaluation, but that decision was not made and the 2023 data from MW-1603 was not used in any calculations. 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 October 2022 and the March and June 2023 sampling events. The corresponding statistical analyses were completed on February 6, 2023 and December 5, 2023, respectively. Statistical analyses of samples collected during the October 2023 sampling event will be completed in 2024;
- The statistical evaluation of data collected during the October 2022 sampling event concluded that four Appendix IV constituents were detected at SSLs above the corresponding groundwater protection standard at the same well (beryllium, cobalt, lithium, and combined radium 226/228 at monitoring well, MW-1603). The statistical evaluation of data collected during the March and June 2023 sampling events concluded that no Appendix IV constituents were detected at SSLs above the corresponding groundwater protection standard. These statistical evaluations are 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 2022 sampling event and corresponding February 2023 statistical evaluation, an alternative source demonstration (ASD) study was conducted resulting in a May 2023 ASD report. This ASD studies are 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:

- 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);
- A figure showing the CCR unit, all groundwater monitoring wells, and monitoring well identification numbers (attached as Appendix 2);
- Results of the required statistical analysis of groundwater monitoring results (attached as Appendix 3, where applicable);
- Results of alternate source demonstrations (attached as Appendix 4, where applicable);

- A summary of any transition between monitoring programs or an alternate monitoring frequency (notices attached as Appendix 5, where applicable);
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement regarding the rationale for the installation/decommission (attached as Appendix 6, where applicable); and
- 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 2023. One monitoring well was removed from the network design as summarized in the *Groundwater Monitoring Network Evaluation, Revision 1* (*Geosyntec, October 2023*) and as posted at the CCR web site for Big Sandy Plant. 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. Monitoring well MW-1603 is scheduled for decommission in 2024. The removal of the well from the groundwater monitoring network was due to the presence of coal within the screened interval and its hydraulic separation from the CCR unit as a result of the pond dewatering process during unit closure. The coal layer was described in the boring log as a laminated, decomposed, very soft, intensely fractured, black shale, wet, nearly all organic matter, slight coaly texture. And the resultant geochemical composition of groundwater within the well clearly resembled drainage from a coal layer, with very low pH compared to groundwater from all other compliance wells and compared to historical pond water.

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 2023, 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 2023 are shown in Appendix 2.

V. Statistical Analysis of Groundwater Monitoring Data

Statistical analyses of data collected during the October 2022 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 February 6, 2023 *Statistical Analysis Summary (Geosyntec, February 2023)*. Statistical analyses of data collected during the March and June 2023 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 December 5, 2023 *Statistical Analysis Summary (Geosyntec, December 2023)*. The statistical analysis summaries contain full statistical evaluations in Attachment B of each corresponding summary and are provided in Appendix 3 of this report. SSLs of beryllium, cobalt, lithium and combined radium 226/228 were identified above the corresponding groundwater protection standard statistical limits at one monitoring well, MW-1603, in the February 2023 statistical evaluation. No SSLs were identified in the December 2023 statistical evaluation. Appendix 3 also contains a memorandum that explains the reissuance of select analytical laboratory reports to correct laboratory equipment data quality assurance/quality control issues.

VI. Alternative Source Demonstration

To demonstrate that a source other than the CCR unit caused the SSLs detected in samples collected during the October 2022 sampling event, 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 October 2022 Monitoring Data (EHS Support, May 2023)*. The alternative source demonstration reports are included in Appendix 4. The report concluded that the elevated concentrations of beryllium, cobalt, lithium, and combined 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

No transition between monitoring requirements occurred in 2023; the CCR unit remained in assessment monitoring. A statement to this effect is provided in Appendix 5.

Because the alternative source demonstration was successful in demonstrating that the Appendix IV SSLs detected in samples collected from Monitoring Well MW-1603 in October 2022 were not derived from the CCR constituents within the CCR unit, the assessment monitoring program was continued. The fly ash pond would return to a detection monitoring program if all Appendix III and IV constituents are below background values for two consecutive monitoring events.

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, if warranted. In those cases where an alternative source demonstration is made, the analyses and supporting information will be presented as well.

The unit was dewatered of all ponded surface water prior to completion of the geomembrane liner installation within the final cover system on November 24, 2020. Ponded surface water no longer remains within the CCR unit.

IX. Description of Any Problems Encountered in 2023 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 groundwater samples collected.

X. A Projection of Key Activities for the Upcoming Year

Key activities for 2024 include the following:

- Continued assessment monitoring sampling of CCR wells for all Appendix IV constituents annually pursuant to 40 CFR 257.95(b) and, pursuant to 40 CFR 257.95(d)(1), for all Appendix III constituents and those Appendix IV constituents 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 constituents 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 seventh annual groundwater monitoring report documenting activities that were undertaken in 2024.

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

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	0.071	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
3/9/2021	Assessment	--	--	--	0.29	6.9	--	--
6/9/2021	Assessment	0.092	81.2	5.02	0.28	6.8	82.0	380
10/5/2021	Assessment	0.118	79.0	3.74	0.28	6.9	78.1	380
3/23/2022	Assessment	0.052	123 M1, P3	6.11	0.23	8.1	80.8	380
6/13/2022	Assessment	0.105	82.4	4.02	0.26	7.6	85.1	390
10/10/2022	Assessment	0.117	80.4	3.17	0.26	6.8	81.4	390
3/13/2023	Assessment	--	--	--	0.27	6.9	--	--
6/13/2023	Assessment	0.105	75.3	3.44	0.26	6.9	80.6	380 P2
10/18/2023	Assessment	0.094	75.0	5.03	0.22	7.1	77.7	400

Table 1. Groundwater Data Summary: MW-1011
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	1.01	17.8	52.0	< 0.005 U1	0.02	0.5	2.85	2.56	0.19	0.214	0.011	< 0.002 U1	1.80	0.09 J1	0.229
11/9/2016	Background	0.75	9.93	48.1	< 0.005 U1	0.02 J1	0.744	1.12	3.56	0.21	0.297	0.017	< 0.002 U1	1.51	0.07 J1	0.162
1/12/2017	Background	0.36	10.5	47.7	< 0.005 U1	0.01 J1	0.369	1.47	5.24	0.25	0.026	0.009	< 0.002 U1	1.39	0.03 J1	0.160
2/21/2017	Background	0.28	11.1	49.5	< 0.005 U1	0.008 J1	0.189	1.09	3.43	0.21	0.024	0.016	< 0.002 U1	1.21	< 0.03 U1	0.153
4/25/2017	Background	0.26	11.9	53.0	< 0.004 U1	0.01 J1	0.223	1.23	2.65	0.23	0.035	0.003	< 0.002 U1	1.23	< 0.03 U1	0.102
5/24/2017	Background	0.22	9.46	54.7	< 0.004 U1	0.008 J1	0.318	1.15	2.566	0.20	0.020	0.005	< 0.002 U1	0.99	< 0.03 U1	0.134
6/21/2017	Background	0.24	5.57	45.7	< 0.004 U1	0.006 J1	0.294	0.413	2.576	0.22	0.01 J1	0.014	0.004 J1	1.34	0.05 J1	0.098
7/13/2017	Background	0.24	5.92	46.0	< 0.004 U1	0.01 J1	0.223	0.444	2.353	0.21	0.054	0.010	< 0.002 U1	1.39	0.03 J1	0.091
4/26/2018	Assessment	0.16	13.5	63.1	< 0.004 U1	< 0.005 U1	0.207	3.25	5.69	0.20	0.095	0.010	< 0.002 U1	0.82	< 0.03 U1	0.121
9/20/2018	Assessment	0.18	7.25	44.8	< 0.02 U1	< 0.01 U1	0.588	0.683	2.56	0.28	0.08	0.009	--	0.8	< 0.03 U1	< 0.1 U1
10/23/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U1	--	--	--
3/13/2019	Assessment	0.15	7.53	49.2	< 0.02 U1	< 0.01 U1	0.576	0.709	2.425	0.24	0.217	0.02 J1	< 0.002 U1	0.9 J1	< 0.03 U1	< 0.1 U1
6/27/2019	Assessment	0.15	5.17	47.5	< 0.02 U1	< 0.01 U1	0.304	0.438	2.582	0.27	0.181	< 0.009 U1	< 0.002 U1	0.7 J1	< 0.03 U1	< 0.1 U1
8/21/2019	Assessment	0.18	5.31	49.2	< 0.02 U1	0.01 J1	0.341	0.421	2.54	0.26	0.1 J1	0.00973	< 0.002 U1	0.7 J1	< 0.03 U1	< 0.1 U1
3/17/2020	Assessment	0.14	6.96	51.5	< 0.02 U1	< 0.01 U1	0.253	0.724	4.44	0.24	< 0.05 U1	0.00871	< 0.002 U1	0.7 J1	< 0.03 U1	< 0.1 U1
6/29/2020	Assessment	0.18	6.72	49.2	< 0.02 U1	0.01 J1	0.203	0.339	3.02	0.24	0.05 J1	0.00993	< 0.002 U1	0.8 J1	0.06 J1	< 0.1 U1
10/5/2020	Assessment	0.18	5.31	46.3	< 0.02 U1	< 0.01 U1	0.09 J1	0.321	2.57	0.26	< 0.05 U1	0.00926	< 0.002 U1	0.8 J1	0.04 J1	< 0.1 U1
3/9/2021	Assessment	0.14	7.71	50.0	< 0.007 U1	< 0.004 U1	0.481	0.438	2.81	0.29	0.06 J1	0.00977	< 0.002 U1	0.7 J1	< 0.09 U1	0.06 J1
6/9/2021	Assessment	0.17	4.84	46.4	< 0.007 U1	0.012 J1	0.35	0.452	4.09	0.28	0.10 J1	0.00852	< 0.002 U1	0.8	< 0.09 U1	0.06 J1
10/5/2021	Assessment	0.19	4.42	46.1	< 0.007 U1	0.012 J1	0.22	0.305	3.19	0.28	0.10 J1	0.00987	< 0.002 U1	0.9	< 0.09 U1	0.06 J1
3/23/2022	Assessment	0.37	19.3	57.5	0.007 J1	0.007 J1	0.36	1.12	3.69	0.23	0.15 J1	0.0106	< 0.002 U1	0.7	< 0.09 U1	0.06 J1
6/13/2022	Assessment	0.16	3.55	47.2	< 0.007 U1	< 0.004 U1	0.21	0.284	3.29	0.26	< 0.05 U1	0.00948	< 0.002 U1	0.9	< 0.09 U1	0.06 J1
10/10/2022	Assessment	0.13	3.68	44.0	< 0.007 U1	< 0.004 U1	0.30	0.223	2.73	0.26	< 0.05 U1	0.0111	< 0.004 U1	0.8	< 0.09 U1	0.04 J1
3/13/2023	Assessment	0.14	3.32	41.4	< 0.007 U1	< 0.004 U1	0.29	0.229	2.67	0.27	< 0.05 U1	0.00976	< 0.002 U1	0.8	< 0.09 U1	0.05 J1
6/13/2023	Assessment	0.161	2.87	42.0	< 0.007 U1	0.008 J1	0.54	0.197	2.05 R7	0.26	0.09 J1	0.00880	< 0.002 U1	0.9	0.10 J1	0.06 J1
10/18/2023	Assessment	0.105	2.21	42.8	< 0.007 U1	< 0.004 U1	0.37	0.235	3.66	0.22	< 0.05 U1	0.00922	< 0.002 U1	1	0.07 J1	0.05 J1

Table 1. Groundwater Data Summary: MW-1012
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	0.176	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
3/10/2021	Assessment	--	--	--	0.85	9.0	--	--
6/9/2021	Assessment	0.174	1.2	1.32	0.80	9.3	35.4	550
10/6/2021	Assessment	0.192	1.2	1.40	0.80	9.2	33.5	570
3/24/2022	Assessment	--	--	--	0.82	8.7	--	--
6/15/2022	Assessment	0.237	1.46	1.41	0.77	10.3	38.6	570
10/12/2022	Assessment	0.196	1.53	1.35	0.76	8.7	38.7	550
3/15/2023	Assessment	--	--	--	0.90	9.1	--	--
6/14/2023	Assessment	0.171	1.41	2.05	0.90	9.0	49.4	580
10/18/2023	Assessment	0.194	1.58	1.66	0.85	9.1	47.4	590

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 U1	3.25	0.2	0.03 J1
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 J1	1.68	0.05 J1	0.02 J1
1/12/2017	Background	0.79	24.7	23.8	0.01 J1	0.04	0.395	0.066	0.542	0.73	0.439	0.008	< 0.002 U1	1.12	0.04 J1	0.02 J1
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 J1	1.52	0.07 J1	0.04 J1
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 J1	1.25	0.04 J1	0.02 J1
5/24/2017	Background	0.97	23.2	23.7	0.01 J1	0.01 J1	7.84	0.078	1.72	0.71	0.334	< 0.0002 U1	0.004 J1	1.41	0.07 J1	0.01 J1
6/22/2017	Background	0.91	21.6	21.1	0.008 J1	0.007 J1	0.293	0.046	0.3575	0.64	0.261	0.018	< 0.002 U1	1.18	0.04 J1	0.02 J1
7/13/2017	Background	0.96	22.1	25.7	0.022	0.008 J1	0.449	0.102	1.301	0.66	0.546	0.004	< 0.002 U1	1.43	0.09 J1	0.02 J1
4/26/2018	Assessment	0.65	15.8	24.1	0.01 J1	0.006 J1	0.262	0.062	1.135	0.82	0.287	0.006	0.003 J1	0.89	0.05 J1	0.02 J1
9/20/2018	Assessment	0.62	14.0	24.2	0.02	< 0.01 U1	0.442	0.079	0.291	0.75	0.346	< 0.009 U1	0.013	0.8	0.08 J1	< 0.1 U1
3/13/2019	Assessment	0.60	15.2	27.2	0.03 J1	< 0.01 U1	0.459	0.106	0.3959	0.73	0.354	0.01 J1	< 0.004 U1	0.9 J1	0.09 J1	< 0.1 U1
6/25/2019	Assessment	0.67	13.4	28.0	0.03 J1	< 0.01 U1	0.252	0.097	0.506	0.74	0.352	< 0.009 U1	< 0.002 U1	0.8 J1	0.08 J1	< 0.1 U1
8/21/2019	Assessment	0.77	19.0	41.9	0.06 J1	< 0.01 U1	0.625	0.260	0.354	0.79	0.924	0.00536	< 0.002 U1	1 J1	0.3	< 0.1 U1
3/18/2020	Assessment	0.60	19.6	61.7	0.130	0.01 J1	0.850	0.519	3.47	0.76	1.97	0.00588	0.002 J1	1 J1	0.3	< 0.1 U1
6/30/2020	Assessment	0.58	19.1	68.2	0.116	0.01 J1	0.912	0.527	2.62	0.72	1.86	0.00593	0.002 J1	1 J1	0.4	< 0.1 U1
10/6/2020	Assessment	0.89	23.0	34.7	0.06 J1	0.02 J1	0.468	0.229	1.04	0.68	0.851	0.00531	< 0.002 U1	1 J1	0.2 J1	< 0.1 U1
3/10/2021	Assessment	0.76	21.2	30.5	0.03 J1	0.01 J1	0.489	0.159	0.815	0.85	0.629	0.00552	0.002 J1	2.87	0.1 J1	< 0.04 U1
6/9/2021	Assessment	0.74	18.6	30.6	0.024 J1	0.014 J1	0.44	0.117	0.58	0.80	0.47	0.00540	< 0.002 U1	1.6	< 0.09 U1	< 0.04 U1
10/6/2021	Assessment	0.77	17.8	30.5	0.026 J1	0.010 J1	0.25	0.113	0.98	0.80	0.48	0.00564	< 0.002 U1	1.8	< 0.09 U1	0.05 J1
3/24/2022	Assessment	1.52	49.9	32.6	0.018 J1	0.012 J1	0.24	0.124	1.31	0.82	0.41	0.00552	< 0.002 U1	5.5	< 0.09 U1	< 0.04 U1
6/15/2022	Assessment	1.14	45.4	28.2	0.013 J1	0.012 J1	0.52	0.084	0.50	0.77	2.4	0.00493	< 0.002 U1	4.0	0.12 J1	0.05 J1
10/12/2022	Assessment	1.08	38.6	31.2	0.016 J1	0.018 J1	0.43	0.102	2.37	0.76	0.54	0.00534	< 0.002 U1	2.9	< 0.09 U1	< 0.04 U1
3/15/2023	Assessment	3.08	94.2	32.5	0.014 J1	0.008 J1	0.35	0.121	1.16	0.90	0.43	0.00637	< 0.002 U1	8.6	< 0.09 U1	< 0.04 U1
6/14/2023	Assessment	3.18	118	29.9	0.011 J1	0.008 J1	0.39	0.090	0.79 R7	0.90	0.31	0.00546	< 0.002 U1	9.1	0.07 J1	0.02 J1
10/18/2023	Assessment	3.07	107	32.1	0.013 J1	0.006 J1	0.48	0.086	0.47	0.85	0.40	0.00612	< 0.002 U1	8.4	< 0.04 U1	< 0.02 U1

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 J1	54.9	5.53	0.11	6.2	38.7	259
6/27/2019	Assessment	0.1 J1	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
3/9/2021	Assessment	--	--	--	0.15	6.7	--	--
6/9/2021	Assessment	0.096	57.8	5.32	0.15	6.6	29.4	260
10/6/2021	Assessment	0.099	59.1	5.13	0.14	6.9	27.8	270
3/23/2022	Assessment	0.098	60.2	5.40	0.12	8.9	42.9	260
6/13/2022	Assessment	0.10	59.4	4.95	0.13	7.6	28.4	290 S7
10/10/2022	Assessment	0.099	59.4	4.91	0.12	6.0	28.7	260
3/13/2023	Assessment	--	--	--	0.11	6.7	--	--
6/13/2023	Assessment	0.091	57.3	5.07	0.13	7.0	28.6	270 P2
10/18/2023	Assessment	0.103	61.0	4.86	0.14	7.0	26.6	260

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 J1	0.26	95.3	0.022	< 0.004 U1	0.4	1.04	1.334	0.15	0.103	0.011	< 0.002 U1	0.21	0.04 J1	0.01 J1
11/9/2016	Background	0.03 J1	0.43	110	0.126	0.009 J1	1.50	1.04	1.473	0.13	1.28	0.017	< 0.002 U1	0.28	0.2	0.02 J1
1/12/2017	Background	0.03 J1	0.42	102	0.089	< 0.004 U1	0.718	1.15	1.657	0.13	0.748	0.014	< 0.002 U1	0.15	0.2	0.03 J1
2/21/2017	Background	0.02 J1	0.39	94.8	0.077	< 0.004 U1	0.365	0.989	2.509	0.12	0.509	0.017	< 0.002 U1	0.20	0.1	0.063
4/26/2017	Background	0.03 J1	0.45	113	0.099	< 0.005 U1	0.648	1.05	1.293	0.12	0.697	0.009	< 0.002 U1	0.20	0.2	0.02 J1
5/23/2017	Background	0.05 J1	0.61	99.9	0.149	< 0.005 U1	0.960	1.07	3.44	0.12	1.22	0.020	0.002 J1	0.15	0.3	0.02 J1
6/21/2017	Background	0.04 J1	0.63	101	0.116	< 0.005 U1	0.422	0.994	3.224	0.11	0.793	0.020	< 0.002 U1	0.62	0.3	0.03 J1
7/13/2017	Background	0.02 J1	0.44	93.8	0.062	< 0.005 U1	0.377	1.16	1.707	0.10	0.312	0.011	< 0.002 U1	0.59	0.05 J1	0.01 J1
4/26/2018	Assessment	0.03 J1	0.30	89.1	0.033	< 0.005 U1	0.171	0.886	2.476	0.14	0.034	0.013	< 0.002 U1	0.12	< 0.03 U1	0.03 J1
9/20/2018	Assessment	0.03 J1	0.51	90.1	0.08	< 0.01 U1	0.240	0.916	1.252	0.12	0.05	0.01	--	< 0.4 U1	< 0.03 U1	< 0.1 U1
10/22/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U1	--	--	--
3/14/2019	Assessment	0.03 J1	0.23	88.0	0.02 J1	< 0.01 U1	0.391	0.953	1.399	0.11	0.124	< 0.009 U1	< 0.004 U1	< 0.4 U1	< 0.03 U1	< 0.1 U1
6/27/2019	Assessment	< 0.02 U1	0.34	86.8	0.06 J1	< 0.01 U1	0.1 J1	0.909	1.341	0.12	0.1 J1	0.01 J1	< 0.002 U1	< 0.4 U1	< 0.03 U1	< 0.1 U1
8/21/2019	Assessment	< 0.02 U1	0.27	95.4	0.04 J1	< 0.01 U1	0.304	0.774	1.471	0.13	0.06 J1	0.0118	< 0.002 U1	< 0.4 U1	< 0.03 U1	< 0.1 U1
3/17/2020	Assessment	0.02 J1	0.35	91.0	0.06 J1	< 0.01 U1	0.265	0.859	7.524	0.12	0.08 J1	0.0130	< 0.002 U1	< 0.4 U1	< 0.03 U1	< 0.1 U1
6/30/2020	Assessment	0.02 J1	0.47	101	0.08 J1	< 0.01 U1	0.1 J1	0.547	2.29	0.12	0.1 J1	0.0121	< 0.002 U1	< 0.4 U1	< 0.03 U1	< 0.1 U1
10/5/2020	Assessment	0.02 J1	0.59	94.6	0.08 J1	< 0.01 U1	0.2 J1	0.672	1.539	0.14	0.212	0.0114	< 0.002 U1	< 0.4 U1	< 0.03 U1	< 0.1 U1
3/9/2021	Assessment	< 0.02 U1	0.39	93.9	0.05 J1	< 0.004 U1	0.390	0.849	1.287	0.15	0.2 J1	0.0120	< 0.002 U1	< 0.1 U1	< 0.09 U1	< 0.04 U1
6/9/2021	Assessment	0.03 J1	0.22	89.5	0.037 J1	< 0.004 U1	0.11 J1	0.603	1.98	0.15	0.06 J1	0.0109	< 0.002 U1	< 0.1 U1	< 0.09 U1	< 0.04 U1
10/6/2021	Assessment	0.02 J1	0.23	92.7	0.041 J1	< 0.004 U1	0.11 J1	0.677	2.10	0.14	0.08 J1	0.0122	< 0.002 U1	< 0.1 U1	< 0.09 U1	< 0.04 U1
3/23/2022	Assessment	< 0.02 U1	0.24	89.4	0.041 J1	< 0.004 U1	0.13 J1	0.885	3.33	0.12	0.05 J1	0.0137	< 0.002 U1	0.1 J1	< 0.09 U1	< 0.04 U1
6/13/2022	Assessment	0.03 J1	0.32	96.8	0.090	< 0.004 U1	0.09 J1	0.577	1.63	0.13	0.11 J1	0.0132	< 0.002 U1	< 0.1 U1	< 0.09 U1	< 0.04 U1
10/10/2022	Assessment	0.04 J1	0.58	99.6	0.171	< 0.004 U1	0.31	0.651	1.27	0.12	0.09 J1	0.0127	< 0.004 U1	< 0.1 U1	< 0.09 U1	< 0.04 U1
3/13/2023	Assessment	0.03 J1	0.39	85.5	0.085	< 0.004 U1	0.25	0.838	2.35	0.11	0.16 J1	0.0112	< 0.002 U1	< 0.1 U1	< 0.09 U1	< 0.04 U1
6/13/2023	Assessment	0.023 J1	0.30	92.6	0.053	< 0.004 U1	0.29 J1	0.548	1.62 R7	0.13	0.07 J1	0.0105	< 0.002 U1	< 0.1 U1	< 0.04 U1	< 0.02 U1
10/18/2023	Assessment	0.032 J1	0.35	98.4	0.109	< 0.004 U1	0.30	0.603	1.42	0.14	0.07 J1	0.0123	< 0.002 U1	0.1 J1	< 0.04 U1	0.04 J1

Table 1. Groundwater Data Summary: MW-1601
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	0.317	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 J1	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	--	--
3/9/2021	Assessment	--	--	--	0.18	6.8	--	--
6/9/2021	Assessment	0.109	62.5	6.58	0.18	6.8	98.0	340
10/6/2021	Assessment	0.069	59.7	3.00	0.24	7.1	105	360
3/22/2022	Assessment	--	--	--	0.16	7.9	--	--
6/15/2022	Assessment	0.119	70.2	3.95	0.17	8.3	96.0	340
10/10/2022	Assessment	0.067	59.0	3.19	0.18	6.9	110	350
3/15/2023	Assessment	--	--	--	0.13	6.8	--	--
6/13/2023	Assessment	0.077	54.4	4.54	0.13	6.8	104	340 P2

Table 1. Groundwater Data Summary: MW-1601
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	0.13	5.03	81.7	0.026	0.009 J1	0.7	1.96	1.22	0.32	0.143	0.040	< 0.002 U1	27.7	0.2	0.124
11/9/2016	Background	0.08	5.49	85.4	0.01 J1	0.01 J1	0.863	1.46	2.335	0.33	0.321	0.035	< 0.002 U1	20.5	0.2	0.02 J1
1/12/2017	Background	0.05 J1	5.24	79.1	0.009 J1	0.01 J1	0.390	1.78	1.695	0.32	0.050	0.038	< 0.002 U1	37.5	0.08 J1	0.03 J1
2/22/2017	Background	0.08	5.15	74.0	0.009 J1	0.006 J1	0.380	1.54	1.603	0.29	0.044	0.037	< 0.002 U1	31.5	0.1	0.02 J1
4/26/2017	Background	0.17	5.48	80.4	0.009 J1	0.006 J1	0.411	1.23	1.3	0.33	0.034	0.025	< 0.002 U1	27.3	0.2	0.02 J1
5/24/2017	Background	0.09	4.30	68.1	0.007 J1	0.006 J1	0.807	0.941	1.317	0.29	0.037	0.026	< 0.002 U1	27.0	0.09 J1	0.01 J1
6/22/2017	Background	0.08	4.19	60.1	< 0.004 U1	< 0.005 U1	0.247	0.926	0.802	0.27	0.02 J1	0.037	< 0.002 U1	27.1	0.07 J1	0.01 J1
7/13/2017	Background	0.11	5.18	64.5	0.009 J1	0.008 J1	0.300	1.02	1.077	0.27	0.081	0.023	< 0.002 U1	28.3	0.07 J1	0.01 J1
4/25/2018	Assessment	0.17	4.58	56.4	0.005 J1	< 0.005 U1	0.245	0.794	2.783	0.36	0.024	0.033	< 0.002 U1	20.6	0.1	0.02 J1
9/20/2018	Assessment	0.29	3.54	75.9	< 0.02 U1	< 0.01 U1	0.378	1.21	0.698	0.22	0.04	0.031	--	19.6	0.2	< 0.1 U1
10/23/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U1	--	--	--
3/12/2019	Assessment	0.20	1.39	49.0	< 0.02 U1	< 0.01 U1	0.438	0.395	0.769	0.18	0.05 J1	0.009 J1	< 0.002 U1	7.00	0.2 J1	< 0.1 U1
6/25/2019	Assessment	0.17	1.04	55.5	< 0.02 U1	< 0.01 U1	0.2 J1	0.629	0.689	0.15	< 0.02 U1	< 0.009 U1	< 0.002 U1	4.89	0.2	< 0.1 U1
8/21/2019	Assessment	0.09 J1	1.58	56.6	< 0.02 U1	0.02 J1	0.351	0.831	0.855	0.15	< 0.05 U1	0.0172	< 0.002 U1	5.64	0.09 J1	< 0.1 U1
3/18/2020	Assessment	0.59	0.63	62.9	< 0.02 U1	0.01 J1	0.298	0.152	1.25	0.17	0.07 J1	0.0302	< 0.002 U1	15.6	0.5	< 0.1 U1
3/9/2021	Assessment	0.61	0.76	44.7	0.02 J1	0.02 J1	0.768	0.329	1.227	0.18	0.2 J1	0.0206	< 0.002 U1	10.0	1.0	< 0.04 U1
6/9/2021	Assessment	0.61	0.41	41.6	< 0.007 U1	0.022	0.33	0.195	0.87	0.18	0.06 J1	0.0229	< 0.002 U1	12.1	0.54	< 0.04 U1
10/6/2021	Assessment	0.92	0.53	41.4	< 0.007 U1	0.022	0.49	0.051	1.70	0.24	0.10 J1	0.0132	< 0.002 U1	4.3	0.37 J1	< 0.04 U1
3/22/2022	Assessment	0.49	0.31	39.2	< 0.007 U1	0.015 J1	0.30	0.046	2.19	0.16	< 0.05 U1	0.0205	< 0.002 U1	8.6	0.64	0.06 J1
6/15/2022	Assessment	0.54	0.40	41.3	0.01 J1	0.023	0.85	0.069	2.52	0.17	0.9 J1	0.0171	< 0.002 U1	7.7	0.52	0.04 J1
10/10/2022	Assessment	0.50	0.40	36.9	< 0.007 U1	0.009 J1	0.60	0.073	0.74	0.18	0.19 J1	0.0150	< 0.004 U1	4.3	0.21 J1	< 0.04 U1
3/15/2023	Assessment	0.47	0.30	40.2	< 0.007 U1	0.015 J1	0.33	0.067	1.00	0.13	0.06 J1	0.0197	< 0.002 U1	7.5	0.58	< 0.04 U1
6/13/2023	Assessment	0.439	0.47	35.9	0.020 J1	0.019 J1	0.60	0.272	0.46 R7	0.13	0.25	0.0165	< 0.002 U1	6.7	0.49 J1	0.03 J1

Table 1. Groundwater Data Summary: MW-1602
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	0.054	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
6/21/2017	Background	--	--	--	--	7.5	--	--
6/22/2017	Background	0.062	70.4	10.7	0.11	--	106	416
7/13/2017	Background	0.052	81.9	12.1	0.09 J1	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 J1	79.4	12.6	0.10	6.9	133	444
6/25/2019	Assessment	0.06 J1	69.8	12.2	0.11	7.5	111	436
8/20/2019	Assessment	0.04 J1	74.5	13.2	0.10	7.5	117	434
3/18/2020	Assessment	--	--	--	0.09	8.8	--	--
6/30/2020	Assessment	0.05 J1	79.0	17.6	0.09	7.2	--	--
8/26/2020	Assessment	--	--	--	--	4.8	121	454
10/6/2020	Assessment	0.05 J1	82.5	19.2	0.10	7.7	143	479
3/9/2021	Assessment	--	--	--	0.11	7.4	--	--
6/9/2021	Assessment	0.050	83.9	17.1	0.11	7.5	165	500
10/6/2021	Assessment	0.057	86.1	18.3	0.10	7.5	167	510
3/22/2022	Assessment	--	--	--	0.08	8.2	--	--
6/14/2022	Assessment	0.062	91.1	18.9	0.09	7.6	187	550 S7
10/11/2022	Assessment	0.064	82.8	20.2	0.08	7.3	181	540
3/15/2023	Assessment	--	--	--	0.08	7.4	--	--
6/13/2023	Assessment	0.078	92.3	18.3	0.08	7.2	206	610 P2
10/18/2023	Assessment	0.052	92.2	18.5	0.09	7.6	206	570

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 U1	0.005 J1	0.8	0.060	1.233	0.19	0.067	0.008	0.002 J1	3.41	2.0	0.02 J1
11/9/2016	Background	0.13	0.42	51.1	< 0.005 U1	0.01 J1	0.590	0.028	1.143	0.18	0.059	0.013	0.002 J1	2.63	2.2	0.01 J1
1/12/2017	Background	0.10	0.45	50.2	< 0.005 U1	0.01 J1	0.666	0.043	1.545	0.17	0.030	0.004	< 0.002 U1	2.44	2.2	0.03 J1
2/22/2017	Background	0.09	0.42	48.2	< 0.005 U1	0.009 J1	0.547	0.020	0.712	0.14	0.02 J1	0.008	< 0.002 U1	2.79	2.0	0.02 J1
4/26/2017	Background	0.10	0.47	59.2	< 0.004 U1	0.01 J1	0.692	0.024	0.534	0.13	0.026	0.006	0.002 J1	1.88	2.2	0.03 J1
5/24/2017	Background	0.08	0.37	54.6	< 0.004 U1	0.009 J1	0.703	0.01 J1	1.68	0.12	0.239	0.002	0.004 J1	1.51	1.5	0.02 J1
6/22/2017	Background	0.07	0.50	55.0	< 0.004 U1	0.01 J1	0.566	0.205	0.812	0.11	0.047	0.021	0.002 J1	2.12	1.3	0.02 J1
7/13/2017	Background	0.07	0.71	57.6	< 0.004 U1	< 0.005 U1	0.482	0.850	1.138	0.09 J1	0.031	0.005	0.003 J1	2.29	1.0	0.01 J1
4/26/2018	Assessment	0.05 J1	3.15	60.9	< 0.004 U1	< 0.005 U1	0.290	0.552	1.754	0.14	0.049	0.008	0.003 J1	1.64	0.4	0.01 J1
9/20/2018	Assessment	0.03 J1	3.92	55.1	< 0.02 U1	< 0.01 U1	0.328	0.312	1.044	0.11	0.03	< 0.009 U1	< 0.004 U1	1	0.4	< 0.1 U1
3/13/2019	Assessment	0.06 J1	1.06	52.5	< 0.02 U1	< 0.01 U1	1.03	0.03 J1	0.504	0.10	0.122	0.009 J1	< 0.002 U1	2 J1	1.6	< 0.1 U1
6/25/2019	Assessment	0.07 J1	1.06	52.5	< 0.02 U1	< 0.01 U1	0.632	0.02 J1	0.5359	0.11	0.05 J1	< 0.009 U1	< 0.002 U1	1 J1	1.4	< 0.1 U1
8/20/2019	Assessment	0.06 J1	1.16	49.3	< 0.02 U1	0.01 J1	1.15	0.080	0.543	0.10	0.1 J1	0.00637	< 0.002 U1	1 J1	1.1	< 0.1 U1
3/18/2020	Assessment	0.06 J1	1.36	55.4	< 0.02 U1	< 0.01 U1	0.511	0.04 J1	1.517	0.09	0.08 J1	0.00736	< 0.002 U1	1 J1	1.1	< 0.1 U1
6/30/2020	Assessment	0.04 J1	1.59	55.9	< 0.02 U1	< 0.01 U1	0.679	0.04 J1	0.488	0.09	0.07 J1	0.00717	< 0.002 U1	1 J1	1.0	< 0.1 U1
10/6/2020	Assessment	0.04 J1	1.53	52.4	< 0.02 U1	< 0.01 U1	1.05	0.04 J1	2.003	0.10	< 0.05 U1	0.00707	< 0.002 U1	1 J1	1.1	< 0.1 U1
3/9/2021	Assessment	0.06 J1	1.72	56.9	< 0.007 U1	0.006 J1	1.26	0.075	1.018	0.11	0.1 J1	0.00787	< 0.002 U1	1 J1	2.0	< 0.04 U1
6/9/2021	Assessment	0.06 J1	0.92	53.2	< 0.007 U1	< 0.004 U1	0.62	0.014 J1	2.31	0.11	< 0.05 U1	0.00629	< 0.002 U1	1.2	2.57	< 0.04 U1
10/6/2021	Assessment	0.08 J1	0.99	61.9	< 0.007 U1	< 0.004 U1	0.59	0.009 J1	0.95	0.10	0.11 J1	0.00815	< 0.002 U1	1.3	3.19	< 0.04 U1
3/22/2022	Assessment	0.15	0.66	62.0	< 0.007 U1	0.005 J1	0.53	0.014 J1	2.25	0.08	< 0.05 U1	0.0106	0.002 J1	1	1.88	< 0.04 U1
6/14/2022	Assessment	0.18	0.91	61.9	< 0.007 U1	< 0.004 U1	0.47	0.019 J1	0.82	0.09	< 0.05 U1	0.00760	< 0.002 U1	1.1	4.10	0.05 J1
10/11/2022	Assessment	0.22	0.93	64.3	< 0.007 U1	0.007 J1	0.56	0.038	1.27	0.08	0.06 J1	0.00944	< 0.004 U1	1.1	3.37	< 0.04 U1
3/15/2023	Assessment	0.14	0.88	68.4	< 0.007 U1	0.004 J1	0.65	0.026	0.78	0.08	< 0.05 U1	0.0103	< 0.002 U1	1	2.94	< 0.04 U1
6/13/2023	Assessment	0.180	1.31	66.6	< 0.007 U1	0.017 J1	0.72	0.127	0.79 R7	0.08	0.21	0.00862	< 0.002 U1	0.9	2.62	< 0.02 U1
10/18/2023	Assessment	0.085 J1	0.81	68.8	< 0.007 U1	0.005 J1	0.73	0.018 J1	0.82	0.09	< 0.05 U1	0.00910	< 0.002 U1	0.8	3.51	< 0.02 U1

Table 1. Groundwater Data Summary: MW-1603
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	0.054	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 U1	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 J1	84.6	4.42	0.92	3.2	709	896
6/27/2019	Assessment	0.05 J1	83.3	4.13	0.87	3.7	658	954
8/20/2019	Assessment	< 0.1 U1	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 J1	96.6	4.18	0.71	3.4	--	--
8/26/2020	Assessment	--	--	--	--	3.3	798	1,040
10/6/2020	Assessment	0.05 J1	94.5	4.10	0.47	4.1	794	1,020
3/9/2021	Assessment	--	--	--	0.82	3.4	--	--
6/9/2021	Assessment	0.036 J1	79.0	4.16	0.76	3.6	618	880
10/6/2021	Assessment	0.054	93.1	3.93	0.96	3.3	735	1,040
3/22/2022	Assessment	--	--	--	0.65	4.9	--	--
6/15/2022	Assessment	0.071	94.4	4.07	0.69	3.1	675	970
10/11/2022	Assessment	0.051	90.3	3.78	1.11	3.7	841	1,080
3/15/2023	Assessment	--	--	--	--	3.3	--	--
3/17/2023	Assessment	--	--	--	0.71	3.4	--	--
6/14/2023	Assessment	0.033 J1	72.8	4.30	0.71	3.2	665	880

Table 1. Groundwater Data Summary: MW-1603
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	0.01 J1	1.51	13.4	18.6	0.84	1.1	101	6.04	1.24	9.75	0.242	< 0.002 U1	0.15	5.4	1.29
11/9/2016	Background	< 0.01 U1	1.19	15.4	18.3	0.93	1.12	94.4	6.6	1.10	8.18	0.237	< 0.002 U1	0.17	4.8	1.55
1/12/2017	Background	< 0.01 U1	1.40	11.4	17.1	0.79	0.731	89.6	5.86	1.11	6.11	0.225	< 0.002 U1	0.06 J1	5.6	1.39
2/21/2017	Background	< 0.01 U1	1.26	10.3	18.9	0.75	0.771	93.2	4.03	0.90	6.30	0.208	< 0.002 U1	0.11	4.9	1.20
4/26/2017	Background	0.01 J1	1.30	12.4	16.7	0.87	0.829	97.1	5.72	1.04	6.41	0.216	0.002 J1	0.18	6.1	1.41
5/24/2017	Background	< 0.01 U1	1.34	11.5	16.4	0.77	0.620	85.3	6.4	0.98	4.96	0.221	< 0.002 U1	0.07 J1	6.3	1.35
6/22/2017	Background	< 0.01 U1	1.29	11.4	16.4	0.86	0.821	92.4	6	0.98	6.47	0.263	< 0.002 U1	0.32	6.1	1.43
7/13/2017	Background	< 0.01 U1	0.89	11.3	18.0	0.80	0.485	92.5	6.36	0.93	3.72	0.217	< 0.002 U1	0.22	2.7	1.43
4/26/2018	Assessment	0.04 J1	1.60	10.5	18.7	0.74	0.771	91.1	5.09	1.16	5.27	0.187	< 0.002 U1	0.03 J1	8.1	1.39
9/20/2018	Assessment	< 0.02 U1	1.40	11.4	19.6	0.83	0.713	93.8	6.75	1.15	4.39	0.255	--	< 0.4 U1	6.3	1.70
10/23/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U1	--	--	--
3/13/2019	Assessment	< 0.2 U1	1.26	12.0	24.4	0.78	1 J1	87.9	4.8	0.92	4.28	0.209	< 0.002 U1	< 4 U1	4.0	1 J1
6/27/2019	Assessment	< 0.04 U1	1.36	11.0	21.8	0.70	0.618	84.7	7.149	0.87	3.68	0.192	< 0.002 U1	< 0.8 U1	4.9	1.40
8/20/2019	Assessment	< 0.1 U1	1.39	13.6	25.0	0.89	0.8 J1	96.6	10.92	0.84	4.17	0.226	< 0.002 U1	< 2 U1	5.6	2 J1
3/17/2020	Assessment	< 0.02 U1	0.83	9.92	16.4	0.64	0.560	72.0	7.19	0.85	3.95	0.156	< 0.002 U1	< 0.4 U1	4.0	1.34
6/30/2020	Assessment	< 0.04 U1	1.12	12.2	21.1	0.85	0.694	93.2	6.22	0.71	4.67	0.192	< 0.002 U1	< 0.8 U1	6.2	1.57
10/6/2020	Assessment	< 0.02 U1	1.12	14.6	17.5	0.87	0.743	90.5	2.681	0.47	4.85	0.165	< 0.002 U1	< 0.4 U1	5.8	1.82
3/9/2021	Assessment	< 0.02 U1	0.84	10.1	14.0	0.62	0.659	71.4	3.73	0.82	3.37	0.125	0.002 J1	< 0.1 U1	3.9	1.39
6/9/2021	Assessment	0.04 J1	0.69	13.1	13.3	0.709	0.51	76.8	7.18	0.76	3.39	0.135	0.002 J1	< 0.1 U1	3.30	1.62
10/6/2021	Assessment	< 0.02 U1	1.01	17.1	17.4 M1	0.913	0.59	95.1 M1	10.51	0.96	6.10	0.186 M1	0.003 J1	< 0.1 U1	4.26	2.20
3/22/2022	Assessment	< 0.02 U1	0.96	13.3	14.9	0.690	0.36	79.7	17.94	0.65	3.37	0.151	< 0.002 U1	< 0.1 U1	4.01	1.66
6/15/2022	Assessment	< 0.02 U1	1.55	8.77	15.0	0.734	0.78	98.3	6.22	0.69	6.5	0.153	< 0.002 U1	0.2 J1	6.56	1.71
10/11/2022	Assessment	< 0.02 U1	1.40	15.4	19.5	0.869	0.85	95.2	7.47	1.11	6.03	0.196	< 0.004 U1	< 0.1 U1	6.25	2.02
3/15/2023	Assessment	< 0.02 U1	0.94	10.7	15.7	0.743	0.58	79.5	6.21	--	4.13	0.167	< 0.002 U1	< 0.1 U1	3.75	1.57
3/17/2023	Assessment	--	--	--	--	--	--	--	--	0.71	--	--	--	--	--	--
6/14/2023	Assessment	0.012 J1	1.12	11.9	12.9	0.714	0.66	73.4	5.74 R7	0.71	3.22	0.135	< 0.002 U1	< 0.1 U1	5.98	1.56

Table 1. Groundwater Data Summary: MW-1604
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	0.031	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 J1	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 J1	6.1	7.8	62
3/12/2019	Assessment	0.02 J1	3.55	1.34	0.04 J1	5.2	10.0	46
6/25/2019	Assessment	0.02 J1	2.97	1.21	0.05 J1	6.0	9.5	50
8/20/2019	Assessment	< 0.02 U1	3.42	1.17	0.03 J1	5.4	10.5	50 J1
3/17/2020	Assessment	--	--	--	0.03 J1	5.8	--	--
6/29/2020	Assessment	< 0.02 U1	3.56	1.03	< 0.01 U1	5.2	11.1	--
8/27/2020	Assessment	--	--	--	--	5.7	--	63
10/5/2020	Assessment	< 0.02 U1	3.31	1.09	0.03 J1	6.8	10.3	50 J1
3/10/2021	Assessment	--	--	--	0.03 J1	5.1	--	--
6/8/2021	Assessment	0.018 J1	3.4	1.15	0.03 J1	5.7	10.4	60
10/5/2021	Assessment	0.016 J1	3.2	1.11	0.03 J1	5.7	9.42	60
3/24/2022	Assessment	--	--	--	< 0.02 U1	7.0	--	--
6/14/2022	Assessment	0.017 J1	3.28	1.05	0.02 J1	5.0	10.4	50
10/11/2022	Assessment	0.012 J1	2.97	1.06	0.02 J1	5.6	10.0	60
3/14/2023	Assessment	--	--	--	0.02 J1	6.1	--	--
6/12/2023	Assessment	0.011 J1	2.44	1.30	< 0.02 U1	6.3	8.2	30 P2, J1
10/17/2023	Assessment	0.012 J1	2.03	1.33	0.03 J1	5.8	6.2	36 J1

Table 1. Groundwater Data Summary: MW-1604
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	0.05 J1	2.74	67.1	0.029	0.007 J1	0.6	3.47	1.105	0.27	0.154	0.004	< 0.002 U1	3.48	0.2	0.01 J1
11/8/2016	Background	0.04 J1	3.61	59.0	0.048	0.008 J1	0.583	1.55	1.277	0.29	0.265	0.005	< 0.002 U1	2.34	0.1	< 0.01 U1
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 U1	2.23	0.2	0.119
2/21/2017	Background	0.02 J1	3.64	52.9	0.028	0.009 J1	0.427	2.78	0.927	0.12	0.103	0.009	< 0.002 U1	1.51	0.1	0.175
4/25/2017	Background	0.03 J1	3.54	65.1	0.034	0.006 J1	0.365	5.59	0.478	0.08	0.01 J1	< 0.0002 U1	< 0.002 U1	0.57	0.08 J1	< 0.01 U1
5/23/2017	Background	0.02 J1	2.24	54.8	0.040	0.03	0.401	4.18	6.707	0.06	0.062	< 0.0002 U1	< 0.002 U1	0.51	0.2	0.01 J1
6/21/2017	Background	0.03 J1	1.28	66.1	0.063	0.05	0.183	5.61	16.848	0.03 J1	0.049	0.002	0.003 J1	0.57	0.2	0.01 J1
7/12/2017	Background	0.04 J1	1.73	59.8	0.041	0.02	0.322	3.67	0.636	0.06	0.097	0.004	< 0.002 U1	15.9	0.1	< 0.01 U1
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 U1	0.54	0.3	0.04 J1
9/18/2018	Assessment	0.06	1.47	63.5	0.061	0.07	0.388	4.53	0.951	0.06 J1	0.092	0.003	--	0.86	0.2	0.04 J1
10/22/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U1	--	--	--
3/12/2019	Assessment	0.03 J1	0.16	66.8	0.06 J1	0.08	0.547	0.844	0.458	0.04 J1	0.04 J1	< 0.009 U1	< 0.002 U1	< 0.4 U1	0.3	< 0.1 U1
6/25/2019	Assessment	0.03 J1	0.12	68.3	0.07 J1	0.09	0.231	0.503	0.799	0.05 J1	0.03 J1	< 0.009 U1	< 0.002 U1	< 0.4 U1	0.2	< 0.1 U1
8/20/2019	Assessment	< 0.02 U1	0.09 J1	78.3	0.117	0.08	0.612	0.246	0.641	0.03 J1	< 0.05 U1	0.00104	< 0.002 U1	< 0.4 U1	0.4	< 0.1 U1
3/17/2020	Assessment	< 0.02 U1	0.05 J1	82.7	0.159	0.08	0.632	0.119	2.93	0.03 J1	< 0.05 U1	0.00113	< 0.002 U1	< 0.4 U1	0.4	< 0.1 U1
6/29/2020	Assessment	< 0.02 U1	0.05 J1	90.0	0.182	0.09	0.681	0.130	1.121	< 0.01 U1	< 0.05 U1	0.00106	< 0.002 U1	< 0.4 U1	0.5	< 0.1 U1
10/5/2020	Assessment	< 0.02 U1	0.10	75.8	0.149	0.09	0.589	0.289	0.491	0.03 J1	0.2 J1	0.000964	< 0.002 U1	< 0.4 U1	0.4	< 0.1 U1
3/10/2021	Assessment	< 0.02 U1	0.07 J1	75.3	0.129	0.09	0.850	0.148	0.2279	0.03 J1	< 0.05 U1	0.000944	< 0.002 U1	< 0.1 U1	0.4	< 0.04 U1
6/8/2021	Assessment	0.02 J1	0.07 J1	82.3	0.167	0.086	0.77	0.257	1.07	0.03 J1	0.06 J1	0.00095	< 0.002 U1	< 0.1 U1	0.36 J1	< 0.04 U1
10/5/2021	Assessment	< 0.02 U1	0.06 J1	70.2	0.143	0.079	0.61	0.154	1.67	0.03 J1	0.06 J1	0.00101	< 0.002 U1	0.1 J1	0.31 J1	< 0.04 U1
3/24/2022	Assessment	< 0.02 U1	0.05 J1	78.5	0.177	0.070	0.76	0.229	1.03	< 0.02 U1	0.08 J1	0.00101	< 0.002 U1	< 0.1 U1	0.42 J1	< 0.04 U1
6/14/2022	Assessment	< 0.02 U1	< 0.03 U1	78.4	0.182	0.070	0.91	0.124	0.83	0.02 J1	< 0.05 U1	0.00100	< 0.002 U1	< 0.1 U1	0.35 J1	< 0.04 U1
10/11/2022	Assessment	< 0.02 U1	< 0.03 U1	69.7	0.148	0.060	0.87	0.096	0.96	0.02 J1	< 0.05 U1	0.00117	< 0.004 U1	< 0.1 U1	0.31 J1	< 0.04 U1
3/14/2023	Assessment	< 0.02 U1	0.04 J1	47.9	0.086	0.077	0.67	0.321	0.93	0.02 J1	< 0.05 U1	0.00071	< 0.002 U1	< 0.1 U1	0.18 J1	< 0.04 U1
6/12/2023	Assessment	0.009 J1	0.03 J1	56.4	0.123	0.049	0.93	0.130	0.67 P1, P3, R7	< 0.02 U1	< 0.05 U1	0.00080	< 0.002 U1	< 0.1 U1	0.31 J1	< 0.02 U1
10/17/2023	Assessment	0.008 J1	< 0.03 U1	44.9	0.103	0.036	0.81	0.084	0.44	0.03 J1	< 0.05 U1	0.00083	< 0.002 U1	< 0.1 U1	0.33 J1	< 0.02 U1

Table 1. Groundwater Data Summary: MW-1605
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	0.008	1.00	0.43	< 0.02 U1	5.7	5.2	30 J1
11/8/2016	Background	0.005	1.01	0.43	< 0.02 U1	2.3	4.2	40
1/11/2017	Background	< 0.002 U1	0.979	0.62	< 0.02 U1	4.6	5.7	35
2/21/2017	Background	0.061	1.37	1.49	< 0.02 U1	5.1	7.4	74
4/25/2017	Background	0.025	1.31	1.21	< 0.02 U1	4.9	6.0	30 J1
5/23/2017	Background	0.063	1.21	1.00	< 0.02 U1	4.8	5.4	30 J1
6/21/2017	Background	0.017	1.15	0.90	< 0.02 U1	4.9	5.8	25
7/12/2017	Background	0.075	1.11	1.32	< 0.02 U1	4.7	4.5	37
9/14/2017	Detection	0.102	1.01	1.72	< 0.02 U1	4.7	4.9	20 J1
4/25/2018	Assessment	0.070	1.30	0.69	< 0.02 U1	4.6	6.5	37
9/18/2018	Assessment	0.036	0.930	0.62	< 0.02 U1	4.0	4.3	29
3/12/2019	Assessment	0.02 J1	1.27	0.53	0.02 J1	4.3	7.2	33
6/25/2019	Assessment	< 0.02 U1	1.20	0.43	< 0.01 U1	5.2	5.7	37
8/20/2019	Assessment	< 0.02 U1	1.01	0.46	0.01 J1	5.5	5.5	30 J1
3/17/2020	Assessment	--	--	--	0.01 J1	5.0	--	--
6/29/2020	Assessment	< 0.02 U1	1.24	0.43	< 0.01 U1	5.0	5.3	--
8/27/2020	Assessment	--	--	--	--	5.1	--	30 J1
10/5/2020	Assessment	< 0.02 U1	1.04	0.39	< 0.01 U1	5.6	5.3	40 J1
3/10/2021	Assessment	--	--	--	0.02 J1	4.6	--	--
6/8/2021	Assessment	0.009 J1	1.2	0.59	0.01 J1	5.2	5.08	50
10/5/2021	Assessment	0.011 J1	1.2	0.41	< 0.02 U1	5.1	4.59	40 J1
3/23/2022	Assessment	0.011 J1	1.60	0.65	< 0.02 U1	6.5	9.21	30 J1
6/14/2022	Assessment	< 0.009 U1	1.18	0.56	< 0.02 U1	4.5	5.24	50
10/12/2022	Assessment	0.010 J1	1.15	0.36	< 0.02 U1	5.2	5.27	< 20 S12, U1
3/14/2023	Assessment	--	--	--	0.03 J1	6.5	--	--
6/12/2023	Assessment	0.014 J1	3.52	0.50	< 0.02 U1	6.2	7.9	64 P2
10/17/2023	Assessment	0.011 J1	1.30	0.36	< 0.02 U1	5.3	4.8	46 J1

Table 1. Groundwater Data Summary: MW-1605
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	< 0.01 U1	0.04 J1	30.3	0.091	0.06	2.7	0.897	0.679	< 0.02 U1	0.126	0.002	< 0.002 U1	0.08 J1	0.2	0.01 J1
11/8/2016	Background	0.01 J1	0.08	30.5	0.121	0.06	2.50	0.917	1.986	< 0.02 U1	0.210	0.007	< 0.002 U1	0.05 J1	0.2	0.01 J1
1/11/2017	Background	0.01 J1	0.07	32.2	0.111	0.07	2.53	1.64	0.1382	< 0.02 U1	0.190	0.008	< 0.002 U1	0.1 J1	0.2	0.01 J1
2/21/2017	Background	< 0.01 U1	0.03 J1	42.6	0.138	0.09	2.61	1.45	0.904	< 0.02 U1	0.107	0.005	< 0.002 U1	0.10	0.2	0.03 J1
4/25/2017	Background	0.01 J1	0.06	39.1	0.119	0.09	2.57	0.991	0.2779	< 0.02 U1	0.121	< 0.0002 U1	< 0.002 U1	0.13	0.2	0.01 J1
5/23/2017	Background	< 0.01 U1	0.03 J1	35.0	0.114	0.07	2.39	0.667	6.077	< 0.02 U1	0.104	0.008	< 0.002 U1	0.07 J1	0.2	0.01 J1
6/21/2017	Background	< 0.01 U1	0.05 J1	33.4	0.105	0.07	2.44	0.592	10.864	< 0.02 U1	0.110	0.002	< 0.002 U1	0.09 J1	0.3	< 0.01 U1
7/12/2017	Background	< 0.01 U1	0.23	31.7	0.103	0.07	2.33	0.495	0.3796	< 0.02 U1	0.107	0.0003 J1	< 0.002 U1	23.7	0.2	0.01 J1
4/25/2018	Assessment	0.04 J1	0.07	37.1	0.123	0.08	2.70	0.434	0.421	< 0.02 U1	0.193	0.009	< 0.002 U1	0.07 J1	0.3	0.03 J1
9/18/2018	Assessment	0.02 J1	0.04 J1	29.7	0.104	0.06	2.58	0.265	0.694	< 0.02 U1	0.092	0.002	--	0.04 J1	0.2	0.03 J1
10/22/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U1	--	--	--
3/12/2019	Assessment	< 0.02 U1	0.17	36.6	0.131	0.08	2.91	0.483	0.2025	0.02 J1	0.305	< 0.009 U1	0.003 J1	< 0.4 U1	0.3	< 0.1 U1
6/25/2019	Assessment	< 0.02 U1	0.05 J1	34.8	0.123	0.08	2.53	0.253	0.9023	< 0.01 U1	0.164	< 0.009 U1	< 0.002 U1	< 0.4 U1	0.2	< 0.1 U1
8/20/2019	Assessment	< 0.02 U1	0.03 J1	29.1	0.09 J1	0.06	2.41	0.215	0.268	0.01 J1	0.09 J1	0.000637	< 0.002 U1	< 0.4 U1	0.2	< 0.1 U1
3/17/2020	Assessment	< 0.02 U1	< 0.03 U1	40.9	0.130	0.08	2.47	0.272	1.1942	0.01 J1	0.1 J1	0.000757	< 0.002 U1	< 0.4 U1	0.3	< 0.1 U1
6/29/2020	Assessment	< 0.02 U1	< 0.03 U1	36.5	0.119	0.07	2.41	0.222	0.11	< 0.01 U1	0.05 J1	0.000694	< 0.002 U1	< 0.4 U1	0.3	< 0.1 U1
10/5/2020	Assessment	< 0.02 U1	0.04 J1	33.7	0.113	0.07	2.55	0.219	4.041	< 0.01 U1	0.1 J1	0.000695	< 0.002 U1	< 0.4 U1	0.3	< 0.1 U1
3/10/2021	Assessment	< 0.02 U1	0.06 J1	56.7	0.160	0.11	2.71	0.398	2.826	0.02 J1	0.2 J1	0.000806	0.002 J1	< 0.1 U1	0.2	< 0.04 U1
6/8/2021	Assessment	< 0.02 U1	< 0.03 U1	34.8	0.102	0.067	2.27	0.236	1.12	0.01 J1	0.08 J1	0.00063	< 0.002 U1	< 0.1 U1	0.20 J1	< 0.04 U1
10/5/2021	Assessment	< 0.02 U1	0.04 J1	36.9	0.118	0.074	2.68	0.184	0.97	< 0.02 U1	0.1 J1	0.00075	< 0.004 U1	< 0.1 U1	0.24 J1	< 0.04 U1
3/23/2022	Assessment	< 0.02 U1	0.05 J1	47.9	0.152	0.101	2.55	0.341	1.36	< 0.02 U1	0.14 J1	0.00089	< 0.002 U1	< 0.1 U1	0.22 J1	< 0.04 U1
6/14/2022	Assessment	< 0.02 U1	0.03 J1	34.5	0.111	0.071	2.41	0.242	0.41	< 0.02 U1	0.09 J1	0.00068	< 0.002 U1	< 0.1 U1	0.21 J1	< 0.04 U1
10/12/2022	Assessment	< 0.02 U1	0.04 J1	36.6	0.116	0.069	3.26	0.194	0.77	< 0.02 U1	0.08 J1	0.00071	< 0.002 U1	< 0.1 U1	0.25 J1	< 0.04 U1
3/14/2023	Assessment	0.09 J1	1.42	41.9	0.243	0.025	5.05	1.17	1.05	0.03 J1	2.16	0.00260	0.005	0.3 J1	0.56	0.07 J1
6/12/2023	Assessment	0.033 J1	0.69	30.3	0.155	0.044	2.89	0.737	0.69 R2, R7	< 0.02 U1	1.04	0.00153	0.003 J1	< 0.1 U1	0.51	0.06 J1
10/17/2023	Assessment	0.046 J1	1.00	57.2	0.349	0.082	6.60	1.91	1.10 R2	< 0.02 U1	2.55	0.00403	0.002 J1	0.1 J1	1.04	0.07 J1

Table 1. Groundwater Data Summary: MW-1606
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	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
3/10/2021	Assessment	--	--	--	0.26	6.9	--	--
6/8/2021	Assessment	1.99	74.1	31.8	0.24	7.5	61.6	370
10/5/2021	Assessment	2.04	74.5	31.4	0.22	7.0	60.7	400
3/23/2022	Assessment	2.22	81.3	32.7	0.21	7.7	63.3	370
6/14/2022	Assessment	2.08	73.6	31.7	0.21	7.3	64.9	430
10/11/2022	Assessment	2.11	75.9	32.3	0.20	6.7	64.7	390
3/14/2023	Assessment	--	--	--	0.20	7.5	--	--
6/12/2023	Assessment	1.97	73.2	32.3	0.19	7.6	65.6	380 P2
10/17/2023	Assessment	2.07	75.9	31.4	0.20	7.0	63.3	390

Table 1. Groundwater Data Summary: MW-1606
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	0.03 J1	0.85	1,030	0.064	0.009 J1	1.7	0.814	2.76	0.17	1.19	0.006	< 0.002 U1	0.68	0.2	0.04 J1
11/8/2016	Background	0.04 J1	1.24	994	0.114	0.01 J1	2.34	1.26	4.082	0.19	1.88	0.014	< 0.002 U1	0.51	0.3	0.03 J1
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 U1	0.67	0.2	0.110
2/22/2017	Background	< 0.01 U1	0.97	875	0.025	< 0.004 U1	0.747	0.381	2.289	0.18	0.330	0.008	0.002 J1	0.91	0.2	0.01 J1
4/26/2017	Background	0.03 J1	1.40	1,080	0.053	0.007 J1	1.33	0.951	2.398	0.19	0.862	0.003	< 0.002 U1	0.84	0.1	0.02 J1
5/23/2017	Background	0.01 J1	1.03	949	0.023	< 0.005 U1	0.790	0.411	3.37	0.19	0.341	0.006	0.002 J1	0.54	0.09 J1	< 0.01 U1
6/21/2017	Background	< 0.01 U1	0.98	884	0.01 J1	< 0.005 U1	0.385	0.209	2.79	0.17	0.159	0.004	0.003 J1	0.60	0.06 J1	< 0.01 U1
7/12/2017	Background	0.01 J1	1.14	773	0.01 J1	< 0.005 U1	0.353	0.153	3.37	0.17	0.103	0.008	< 0.002 U1	7.56	0.06 J1	< 0.01 U1
4/25/2018	Assessment	0.05	0.97	767	0.008 J1	< 0.005 U1	0.301	0.101	3.71	0.26	0.077	0.014	< 0.002 U1	0.58	0.06 J1	0.01 J1
9/19/2018	Assessment	0.03 J1	0.97	797	0.01 J1	< 0.005 U1	0.366	0.155	3.28	0.24	0.126	0.001	--	0.58	0.07 J1	0.03 J1
10/22/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U1	--	--	--
3/13/2019	Assessment	< 0.02 U1	1.22	764	< 0.02 U1	< 0.01 U1	0.535	0.208	2.63	0.22	0.123	< 0.009 U1	< 0.002 U1	2.60	0.05 J1	< 0.1 U1
6/25/2019	Assessment	< 0.02 U1	0.94	843	< 0.02 U1	< 0.01 U1	0.1 J1	0.055	2.366	0.23	0.05 J1	< 0.009 U1	< 0.002 U1	0.6 J1	0.06 J1	< 0.1 U1
8/20/2019	Assessment	< 0.02 U1	0.85	768	< 0.02 U1	< 0.01 U1	0.304	0.05 J1	3.12	0.21	< 0.05 U1	0.00301	< 0.002 U1	0.6 J1	0.05 J1	< 0.1 U1
3/18/2020	Assessment	< 0.02 U1	1.00	828	< 0.02 U1	< 0.01 U1	0.343	0.196	2.49	0.20	0.1 J1	0.00340	< 0.002 U1	0.6 J1	0.08 J1	< 0.1 U1
6/30/2020	Assessment	< 0.02 U1	0.92	816	< 0.02 U1	< 0.01 U1	0.2 J1	0.068	3.16	0.18	0.1 J1	0.00364	< 0.002 U1	0.5 J1	0.07 J1	< 0.1 U1
10/6/2020	Assessment	< 0.02 U1	1.00	750	< 0.02 U1	< 0.01 U1	0.1 J1	0.060	2.91	0.22	< 0.05 U1	0.00329	< 0.002 U1	0.5 J1	0.07 J1	< 0.1 U1
3/10/2021	Assessment	< 0.02 U1	1.04	739	0.009 J1	< 0.004 U1	0.433	0.100	1.92	0.26	0.08 J1	0.00306	< 0.002 U1	0.5 J1	< 0.09 U1	< 0.04 U1
6/8/2021	Assessment	< 0.02 U1	0.96	768 M1, P3	< 0.007 U1	< 0.004 U1	0.59	0.066	4.12	0.24	0.08 J1	0.00317	< 0.002 U1	0.6	< 0.09 U1	< 0.04 U1
10/5/2021	Assessment	< 0.02 U1	0.98	757 M1, P3	0.007 J1	< 0.004 U1	0.16 J1	0.086	4.15	0.22	0.08 J1	0.00354	< 0.002 U1	0.5	< 0.09 U1	< 0.04 U1
3/23/2022	Assessment	< 0.02 U1	0.80	783	< 0.007 U1	< 0.004 U1	0.09 J1	0.049	2.66	0.21	< 0.05 U1	0.00394	< 0.002 U1	0.5	< 0.09 U1	< 0.04 U1
6/14/2022	Assessment	< 0.02 U1	0.88	764	< 0.007 U1	< 0.004 U1	0.1 J1	0.047	2.75	0.21	< 0.05 U1	0.00328	< 0.002 U1	0.5	< 0.09 U1	< 0.04 U1
10/11/2022	Assessment	< 0.02 U1	0.90	730	0.009 J1	< 0.004 U1	0.91	0.079	2.96	0.20	0.05 J1	0.00378	< 0.004 U1	0.5	< 0.09 U1	< 0.04 U1
3/14/2023	Assessment	< 0.02 U1	0.95	769	0.007 J1	< 0.004 U1	0.32	0.103	3.35	0.20	0.09 J1	0.00331	< 0.002 U1	0.5	< 0.09 U1	< 0.04 U1
6/12/2023	Assessment	0.912	0.88	731	0.01 J1	0.005 J1	0.39	0.135	2.69 R7	0.19	0.23	0.00392	< 0.002 U1	0.5	0.06 J1	< 0.02 U1
10/17/2023	Assessment	< 0.008 U1	0.73	739	0.009 J1	< 0.004 U1	0.30	0.088	3.43	0.20	0.08 J1	0.00381	< 0.002 U1	0.5	< 0.04 U1	< 0.02 U1

Table 1. Groundwater Data Summary: MW-1607
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	0.159	97.6	3.34	0.04 J1	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 J1	6.3	114	338
6/21/2017	Background	0.164	92.5	2.42	0.05 J1	6.3	119	368
7/12/2017	Background	0.167	86.0	2.28	0.05 J1	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 J1	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
3/10/2021	Assessment	--	--	--	0.08	6.4	--	--
6/8/2021	Assessment	0.151	81.2	3.56	0.09	6.9	89.2	330
10/5/2021	Assessment	0.161	97.0	4.05	0.08	6.5	112	420
3/24/2022	Assessment	--	--	--	0.06	7.7	--	--
6/14/2022	Assessment	0.152	87.0	3.21	0.07	6.9	87.7	370
10/11/2022	Assessment	0.144	83.0	4.12	0.06	6.3	85.2	350
3/14/2023	Assessment	--	--	--	0.06	7.0	--	--
6/12/2023	Assessment	0.144	87.9	3.23	0.06	7.4	97.1	400 P2
10/17/2023	Assessment	0.141	89.4	3.29	0.07	6.6	99.6	370

Table 1. Groundwater Data Summary: MW-1607
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	0.02 J1	7.36	34.3	0.01 J1	< 0.004 U1	0.6	1.41	1.551	0.04 J1	0.156	0.003	< 0.002 U1	0.52	0.1 J1	0.03 J1
11/8/2016	Background	0.02 J1	11.6	42.3	0.025	0.007 J1	0.619	1.45	1.683	0.06	0.376	0.002	< 0.002 U1	0.62	0.1	0.02 J1
1/11/2017	Background	0.06	12.5	53.5	0.01 J1	0.05	0.456	1.31	0.577	0.06	0.129	0.007	< 0.002 U1	0.83	0.1	0.119
2/21/2017	Background	0.01 J1	8.71	34.3	0.01 J1	< 0.004 U1	0.359	1.24	1.339	0.06	0.030	0.005	< 0.002 U1	0.54	0.05 J1	0.055
4/25/2017	Background	0.03 J1	15.4	38.1	0.028	0.006 J1	0.682	1.34	1.08	0.07	0.416	0.003	< 0.002 U1	0.53	0.2	0.02 J1
5/23/2017	Background	0.02 J1	8.87	33.9	0.01 J1	0.008 J1	0.350	1.30	6.76	0.06 J1	0.081	0.009	0.004 J1	0.42	0.1	0.02 J1
6/21/2017	Background	0.02 J1	9.22	27.5	0.01 J1	< 0.005 U1	0.324	1.39	1.274	0.05 J1	0.123	0.004	< 0.002 U1	0.45	0.1	0.02 J1
7/12/2017	Background	0.02 J1	7.59	25.0	0.01 J1	< 0.005 U1	0.293	1.13	0.33	0.05 J1	0.070	0.004	< 0.002 U1	9.02	0.1	0.02 J1
4/25/2018	Assessment	0.27	68.5	37.2	0.111	< 0.005 U1	0.851	1.57	3.217	0.08	0.799	0.012	< 0.002 U1	0.90	0.7	0.04 J1
9/19/2018	Assessment	0.04 J1	23.6	42.6	0.02 J1	< 0.005 U1	0.423	1.59	0.611	0.08	0.159	0.001	--	0.59	0.1	0.04 J1
10/22/2018	Assessment	--	--	--	--	--	--	--	--	--	--	--	< 0.002 U1	--	--	--
3/13/2019	Assessment	< 0.02 U1	7.67	31.6	< 0.02 U1	< 0.01 U1	0.424	1.43	0.18541	0.06	0.05 J1	< 0.009 U1	< 0.002 U1	1 J1	0.08 J1	< 0.1 U1
6/25/2019	Assessment	0.02 J1	19.3	38.1	< 0.02 U1	< 0.01 U1	0.250	1.39	0.501	0.08	0.09 J1	< 0.009 U1	< 0.002 U1	0.7 J1	0.1 J1	< 0.1 U1
8/20/2019	Assessment	< 0.02 U1	14.4	29.1	< 0.02 U1	< 0.01 U1	0.347	1.19	0.685	0.07	< 0.05 U1	0.0001 J1	< 0.002 U1	0.6 J1	0.09 J1	< 0.1 U1
3/18/2020	Assessment	0.02 J1	14.2	34.6	< 0.02 U1	< 0.01 U1	0.305	1.34	2.1757	0.06	0.1 J1	0.000332	< 0.002 U1	0.8 J1	0.2 J1	0.1 J1
6/30/2020	Assessment	0.03 J1	17.7	25.7	< 0.02 U1	< 0.01 U1	0.209	1.33	1.398	0.06 J1	0.08 J1	0.0001 J1	< 0.002 U1	0.6 J1	0.1 J1	< 0.1 U1
10/6/2020	Assessment	0.16	24.9	30.2	< 0.02 U1	< 0.01 U1	0.352	1.22	1.017	0.07	0.1 J1	0.0002 J1	< 0.002 U1	0.6 J1	0.1 J1	< 0.1 U1
3/10/2021	Assessment	< 0.02 U1	12.3	54.7	0.01 J1	0.009 J1	0.276	1.75	0.2646	0.08	0.09 J1	0.000310	< 0.002 U1	0.6 J1	0.1 J1	< 0.04 U1
6/8/2021	Assessment	0.02 J1	14.3	24.3	0.009 J1	< 0.004 U1	0.23	0.946	0.88	0.09	0.05 J1	0.00012 J1	< 0.002 U1	0.6	< 0.09 U1	0.05 J1
10/5/2021	Assessment	0.03 J1	16.7	32.4	0.012 J1	0.004 J1	0.20	1.05	2.20	0.08	0.07 J1	0.00018 J1	< 0.002 U1	0.7	< 0.09 U1	< 0.04 U1
3/24/2022	Assessment	< 0.02 U1	16.7	30.2	0.012 J1	0.009 J1	0.22	1.30	0.87	0.06	0.11 J1	0.00013 J1	< 0.002 U1	0.7	0.12 J1	< 0.04 U1
6/14/2022	Assessment	0.02 J1	17.7	31.7	0.011 J1	< 0.004 U1	0.22	1.08	0.73	0.07	0.09 J1	0.00013 J1	< 0.002 U1	0.6	< 0.09 U1	< 0.04 U1
10/11/2022	Assessment	< 0.02 U1	18.7	36.7	0.008 J1	< 0.004 U1	0.33	0.913	0.49	0.06	< 0.05 U1	0.00013 J1	< 0.004 U1	0.6	< 0.09 U1	< 0.04 U1
3/14/2023	Assessment	< 0.02 U1	15.4	41.7	0.01 J1	< 0.004 U1	0.32	1.08	1.81	0.06	0.09 J1	0.00012 J1	< 0.002 U1	0.5	0.12 J1	< 0.04 U1
6/12/2023	Assessment	0.023 J1	17.8	37.6	0.013 J1	< 0.004 U1	0.40	0.916	1.38 R7	0.06	0.12 J1	0.00011 J1	< 0.002 U1	0.6	0.15 J1	0.02 J1
10/17/2023	Assessment	0.015 J1	12.2	41.7	0.012 J1	< 0.004 U1	0.30	0.739	0.82	0.07	0.06 J1	0.00013 J1	< 0.002 U1	0.4 J1	0.12 J1	0.03 J1

Notes:
- -: Not analyzed
<: Non-detect value. Analytes which were not detected are shown as less than the method detection limit (MDL) followed by a 'U1' flag.
In analytical data prior to 5/18/2021, U1 flags were reported as U in the analytical report.
J1: Concentration estimated. Analyte was detected between the method detection limit and the reporting limit.
In analytical data prior to 5/18/2021, J1 flags were reported as J in the analytical report.
L1: The associated laboratory control sample (LCS) or laboratory control sample duplicate (LCSD) recovery was outside acceptance limits.
M1: The associated matrix spike (MS) or matrix spike duplicate (MSD) recovery was outside acceptance limits.
mg/L: milligrams per liter
P1: The precision between duplicate results was above acceptance limits.
P2: The precision on the laboratory control sample duplicate (LCSD) was above acceptance limits.
P3: The precision on the matrix spike duplicate (MSD) was above acceptance limits.
pCi/L: picocuries per liter
R2: Radium-226 carrier recovery outside of acceptance limits.
R7: The MDA exceeds the critical value of 0.95 pCi/L.
S7: Sample did not achieve constant weight.
S12: Residue weight is below the method criteria but was already analyzed with 100mL.
SU: standard unit
µg/L: micrograms per liter

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

			2023-03		2023-06		2023-10	
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)
Fly Ash Pond	MW-1011 [1]	2.0	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
	MW-1203 [1]	2.0	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
	MW-1602 [2]	4.0	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
	MW-1604 [3]	4.0	61.6	2.0	51.4	2.4	68.0	1.8
	MW-1605 [3]	4.0	61.6	2.0	51.4	2.4	68.0	1.8
	MW-1606 [2]	4.0	61.6	2.0	51.4	2.4	68.0	1.8
	MW-1607 [2]	4.0	61.6	2.0	51.4	2.4	68.0	1.8

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

- Fly Ash Pond (Approximate)
- Monitoring Well
- Gauging Well

Notes

1. Monitoring well locations based on 2016 coordinates.
2. MW-1206 and MW-1207 were abandoned during construction to close the BSFAP.

- BSFAP: Big Sandy Fly Ash Pond

750 375 0 750 Feet

Revised Groundwater Monitoring Well Network of the Uppermost Aquifer

AEP Big Sandy Plant - Fly Ash Pond
Louisa, Kentucky

Geosyntec consultants

Columbus, Ohio | 2023/10/04

Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Big Sandy\2023\20230914_BigSandy_FAP_MW_Gauging Locations.mxd. hduff. 10/4/2023. CHA8423/05/08.

Legend

- Groundwater Monitoring Well
- Inferred Groundwater Flow Direction

Notes

1. Monitoring well coordinates and water level data (collected on March 13, 2023) provided by AEP.
2. Site features based on information available in Groundwater Monitoring Network Evaluation - Big Sandy Fly Ash Pond (Geosyntec 2016) provided by AEP.
3. Groundwater elevation units are feet above mean sea level (ft amsl).
4. Fly Ash Pond cap liner construction completed in November 2020.

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
March 2023
AEP Big Sandy Plant - Fly Ash Pond
Louisa, Kentucky

Geosyntec consultants

Columbus, Ohio | 2023/10/17

Figure **2**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Big Sandy\2023\AEP-BigSandy_FAP_GW_2023-03-Mar.mxd. hduff. 10/17/2023. CHA8423/05/08.

Legend

- Groundwater Monitoring Well
- Inferred Groundwater Flow Direction

Notes

1. Monitoring well coordinates and water level data (collected on June 12, 2023) provided by AEP.
2. Site features based on information available in Groundwater Monitoring Network Evaluation - Big Sandy Fly Ash Pond (Geosyntec 2016) provided by AEP.
3. Groundwater elevation units are feet above mean sea level (ft amsl).
4. Fly Ash Pond cap liner construction completed in November 2020.

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
June 2023
AEP Big Sandy Plant - Fly Ash Pond
Louisa, Kentucky

Geosyntec consultants

Columbus, Ohio | 2023/10/17

Figure **3**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Big Sandy\2023\AEP-BigSandy_FAP_GW_2023-06-June.mxd. hduff. 10/17/2023. CHA8423/05/08.

Legend

- Groundwater Monitoring Well
- Inferred Groundwater Flow Direction

Notes

1. Monitoring well coordinates and water level data (collected on October 17, 2023) provided by AEP.
2. Site features based on information available in Groundwater Monitoring Network Evaluation - Big Sandy Fly Ash Pond (Geosyntec 2016) provided by AEP.
3. Groundwater elevation units are feet above mean sea level (ft amsl).
4. Fly Ash Pond cap liner construction completed in November 2020.

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
October 2023
AEP Big Sandy Plant - Fly Ash Pond
Louisa, Kentucky

Geosyntec consultants

Columbus, Ohio | 2023/11/01

Figure **4**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Big Sandy\2023\AEP-BigSandy_FAP_GW_2023-10-Oct.mxd. ASoltero. 11/1/2023. CHA8423/05/08.

APPENDIX 3—Statistical Analysis Summaries

The February 2023 and December 2023 statistical analysis summaries follow. A memorandum that explains the reissuance of select analytical laboratory reports to correct laboratory equipment data quality assurance/quality control issues also 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

500 West Wilson Bridge Road
Suite 250
Worthington, OH 43085

February 3, 2023
CHA8500B

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

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
MDL	Method Detection Limit
NELAP	National Environmental Laboratory Accreditation Program
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
SU	Standard Units
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
UTL	Upper Tolerance Limit
USEPA	United States Environmental Protection Agency

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 Subpart D, "CCR rule"), groundwater monitoring has been conducted at the Fly Ash Pond (FAP), a closed CCR unit at the Big Sandy Plant located in Louisa, Kentucky. Recent groundwater monitoring results were compared to the site-specific groundwater protection standards (GWPS) to identify potential exceedances.

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 2022, an annual sampling event for Appendix IV parameters required by 257.95(b) was completed in March, and semiannual sampling events for both Appendix III parameters and Appendix IV parameters, as required by 257.95(d)(1), were completed in June and October. During the June 2022 assessment monitoring event, statistically significant levels (SSLs) were observed for beryllium, cobalt, combined radium, and lithium (Geosyntec, 2022). An alternative source demonstration (ASD) was successfully completed (EHS, 2022); thus, the unit remained in assessment monitoring. One assessment monitoring event was conducted at the FAP in October 2022 in accordance with 40 CFR 257.95. The results of this assessment event 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. GWPSs were re-established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether SSLs of Appendix IV parameters were present 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 October 2022 asessement monitoring event, one set of samples was collected for analysis from each upgradient and downgradient well to meet the requirements of 40 257.95(d)(1). For the October 2022 event, all samples were were analyzed for all Appendix III and Appendix IV parameters. A summary of data collected during this assessment monitoring event is 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.9.6.36 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 October 2020 *Statistical Analysis Plan* (Geosyntec, 2020). Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained in October 2022 were screened for potential outliers. One outlier was identified for arsenic at background well MW-1012. This outlier was removed from the background datset, which would result in the calculation of a more conservative (i.e., lower) arsenic background value (Attachment B).

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* (Geosyntec, 2020). 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 combined radium. Non-parametric tolerance limits were calculated for antimony, arsenic, barium, cadmium, chromium, cobalt, fluoride, lead, lithium, molybdenum, selenium, and thallium due to apparent non-normal distributions and for mercury due to a high non-detect frequency. Upper 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 (0.0165 mg/L).
- The LCL for cobalt exceeded the GWPS of 0.00600 mg/L at MW-1603 (0.0852 mg/L).
- The LCL for combined radium exceeded the GWPS of 5.00 pCi/L at MW-1603 (5.22 pCi/L).
- The LCL for lithium exceeded the GWPS of 0.0400 mg/L at MW-1603 (0.178 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 Establishment of Appendix III Prediction Limits

Upper prediction limits (UPLs) were previously established for all Appendix III parameters following the background monitoring period (Geosyntec, 2018). Intrawell tests were used to evaluate potential SSIs for pH, whereas interwell tests were used to evaluate potential SSIs for boron, calcium, chloride, fluoride, sulfate, and TDS. Interwell and intrawell prediction limits are updated periodically during the assessment monitoring period as sufficient data became available.

The intrawell prediction limits for pH were recalculated using all data collected through June 2022. Prediction limits for the interwell tests were recalculated using data collected during the 2022 assessment monitoring events. The Sen's Slope/Mann-Kendall trend test was used to evaluate data at upgradient wells for boron, calcium, chloride, fluoride, sulfate and TDS. While statistically significant increasing trends were found for fluoride at MW-1011 and MW-1012, and decreasing trends were found for chloride, fluoride, and TDS at MW-1604, the magnitudes of the trends were low compared to the average concentrations and the results were similar to those observed in other

upgradient wells; thus, no adjustments were made to the background datasets. The complete results of the interwell Sen's Slope/Mann Kendall trend test are included in Attachment B.

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

Interwell UPLs were updated for boron, calcium, chloride, fluoride, sulfate, and TDS using historical data through October 2022. Intrawell UPLs and lower prediction limits (LPLs) were updated for pH using all the historical data through June 2022 to represent background values. The updated prediction limits are summarized in Table 3. The UPLs were calculated for a one-of-two retesting procedure; i.e., if at least one sample in a series of two does not exceed the UPL, or in the case of pH, is neither less than the LPL nor greater than the UPL, then it can be concluded that an SSI has not occurred. In practice, where the initial result does not exceed the UPL, or in the case of pH, is neither less than the LPL nor greater than the UPL, a second sample will not be collected. The retesting procedures allowed achieving an acceptably high statistical power to detect changes at downgradient wells for constituents evaluated using intrawell prediction limits.

2.2.4 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 October 2022 assessment monitoring event from each compliance well were compared to the recalculated prediction limits to assess whether the results are above background values. The results from this event and the prediction limits are summarized in Table 3. The following exceedances of the UPLs were noted:

- Boron concentrations exceeded the interwell UPL of 0.244 mg/L at MW-1606 (2.11 mg/L).
- Chloride concentrations exceeded the interwell UPL of 6.22 mg/L at MW-1602 (20.2 mg/L) and MW-1606 (32.3 mg/L).
- Fluoride concentrations exceeded the interwell UPL of 0.850 mg/L at MW-1603 (1.11 mg/L).

- Sulfate concentrations exceeded the interwell UPL of 106 mg/L at MW-1601 (110 mg/L), MW-1602 (181 mg/L) and MW-1603 (841 mg/L).

- TDS concentrations exceeded the interwell UPL of 583 mg/L at MW-1603 (1,080 mg/L).

While the prediction limits were calculated for a one-of-two retesting procedure, SSIs were conservatively assumed if the October 2022 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 semiannual 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 one outlier for arsenic in the October 2022 data. 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 at MW-1603.

The Appendix III prediction limits were updated to incorporate more recent data. The Appendix III parameters were compared to the prediction limits, with exceedances identified for boron, chloride, fluoride, sulfate, and TDS at select downgradient wells.

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

EHS Support. 2022. Alternative Source Demonstration Addendum Report for the March and June 2022 Monitoring Data. Closed Big Sandy Fly Ash Pond. Louisa, Kentucky. March.

Geosyntec Consultants, Inc. (Geosyntec). 2018. Statistical Analysis Summary – Fly Ash Pond, Big Sandy Plant, Louisa, Kentucky. January 15, 2018.

Geosyntec. 2020. Statistical Analysis Plan. 2020.

Geosyntec. 2022. Statistical Analysis Summary – Fly Ash Pond, Big Sandy Plant, Louisa, Kentucky. October 13, 2022.

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	MW-1604	MW-1605	MW-1606	MW-1607
		10/10/2022	10/12/2022	10/10/2022	10/10/2022	10/11/2022	10/11/2022	10/11/2022	10/12/2022	10/11/2022	10/11/2022
Antimony	µg/L	0.13	1.08	0.04 J1	0.50	0.22	0.1 U1	0.1 U1	0.1 U1	0.1 U1	0.1 U1
Arsenic	µg/L	3.68	38.6	0.58	0.40	0.93	1.40	0.1 U1	0.04 J1	0.90	18.7
Barium	µg/L	44.0	31.2	99.6	36.9	64.3	15.4	69.7	36.6	730	36.7
Beryllium	µg/L	0.05 U1	0.016 J1	0.171	0.05 U1	0.05 U1	19.5	0.148	0.116	0.009 J1	0.008 J1
Boron	mg/L	0.117	0.196	0.099	0.067	0.064	0.051	0.012 J1	0.010 J1	2.11	0.144
Cadmium	µg/L	0.02 U1	0.018 J1	0.02 U1	0.009 J1	0.007 J1	0.869	0.060	0.069	0.02 U1	0.02 U1
Calcium	mg/L	80.4	1.53	59.4	59.0	82.8	90.3	2.97	1.15	75.9	83.0
Chloride	mg/L	3.17	1.35	4.91	3.19	20.2	3.78	1.06	0.36	32.3	4.12
Chromium	µg/L	0.30	0.43	0.31	0.60	0.56	0.85	0.87	3.26	0.91	0.33
Cobalt	µg/L	0.223	0.102	0.651	0.073	0.038	95.2	0.096	0.194	0.079	0.913
Combined Radium	pCi/L	2.73	2.37	1.27	0.74	1.27	7.47	0.96	0.77	2.96	0.49
Fluoride	mg/L	0.26	0.76	0.12	0.18	0.08	1.11	0.02 J1	0.06 U1	0.20	0.06
Lead	µg/L	0.2 U1	0.54	0.09 J1	0.19 J1	0.06 J1	6.03	0.2 U1	0.08 J1	0.05 J1	0.2 U1
Lithium	mg/L	0.0111	0.00534	0.0127	0.0150	0.00944	0.196	0.00117	0.00071	0.00378	0.00013 J1
Mercury	µg/L	0.01 U1	0.005 U1	0.01 U1	0.01 U1	0.01 U1	0.01 U1	0.01 U1	0.005 U1	0.01 U1	0.01 U1
Molybdenum	µg/L	0.8	2.9	0.5 U1	4.3	1.1	0.5 U1	0.5 U1	0.5 U1	0.5	0.6
Selenium	µg/L	0.5 U1	0.5 U1	0.5 U1	0.21 J1	3.37	6.25	0.31 J1	0.25 J1	0.5 U1	0.5 U1
Sulfate	mg/L	81.4	38.7	28.7	110	181	841	10.0	5.27	64.7	85.2
Thallium	µg/L	0.04 J1	0.2 U1	0.2 U1	0.2 U1	0.2 U1	2.02	0.2 U1	0.2 U1	0.2 U1	0.2 U1
Total Dissolved Solids	mg/L	390	550	260	350	540	1,080	60	50 S12, U1	390	350
pH	SU	6.8	8.67	6.03	6.86	7.3	3.69	5.6	5.19	6.71	6.32

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U1: Non-detect value. For statistical analysis, parameters which were not detected were replaced with the reporting limit.
J1: Concentration estimated. Analyte was detected between the method detection limit (MDL) and the reporting limit.
S12: Residue weight is below the method criteria but was already analyzed with 100 mL.

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

Geosyntec Consultants, Inc.

Constituent Name	MCL	CCR Rule Specified	Calculated UTL	GWPS
Antimony, Total (mg/L)	0.00600		0.00152	0.00600
Arsenic, Total (mg/L)	0.0100		0.0289	0.0289
Barium, Total (mg/L)	2.00		0.113	2.00
Beryllium, Total (mg/L)	0.00400		0.000182	0.00400
Cadmium, Total (mg/L)	0.00500		0.000140	0.00500
Chromium, Total (mg/L)	0.100		0.00326	0.100
Cobalt, Total (mg/L)	n/a	0.00600	0.00561	0.00600
Combined Radium, Total (pCi/L)	5.00		4.39	5.00
Fluoride, Total (mg/L)	4.00		0.850	4.00
Lead, Total (mg/L)	n/a	0.0150	0.00240	0.0150
Lithium, Total (mg/L)	n/a	0.0400	0.0200	0.0400
Mercury, Total (mg/L)	0.00200		0.0000130	0.00200
Molybdenum, Total (mg/L)	n/a	0.100	0.00550	0.100
Selenium, Total (mg/L)	0.0500		0.000500	0.0500
Thallium, Total (mg/L)	0.00200		0.000229	0.00200

Notes:
MCL = Maximum Contaminant Level
CCR = Coal Combustion Residual
GWPS = Groundwater Protection Standard
Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
Grey cells indicate the GWPS is based on the calculated UTL, which is higher than the MCL or CCR-Rule specified value.

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

Geosyntec Consultants, Inc.

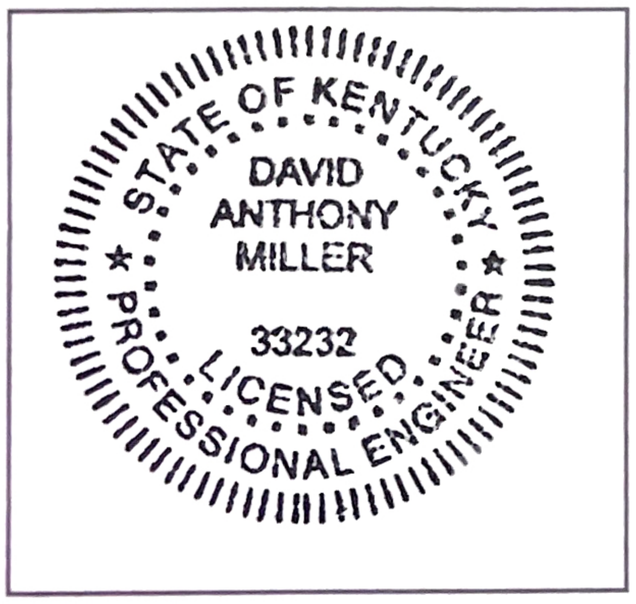
Analyte	Unit	Description	MW-1601	MW-1602	MW-1603	MW-1606	MW-1607
			10/10/2022	10/11/2022	10/11/2022	10/11/2022	10/11/2022
Boron	mg/L	Interwell Background Value (UPL)	0.244				
		Analytical Result	0.067	0.064	0.051	**2.11**	0.144
Calcium	mg/L	Interwell Background Value (UPL)	123				
		Analytical Result	59.0	82.8	90.3	75.9	83.0
Chloride	mg/L	Interwell Background Value (UPL)	6.22				
		Analytical Result	3.19	**20.2**	3.78	**32.3**	4.12
Fluoride	mg/L	Interwell Background Value (UPL)	0.850				
		Analytical Result	0.18	0.08	**1.11**	0.20	0.06
pH	SU	Intrawell Background Value (UPL)	8.3	8.5	5.6	7.6	7.6
		Intrawell Background Value (LPL)	6.2	5.9	2.9	6.3	5.5
		Analytical Result	6.9	7.3	3.7	6.7	6.3
Sulfate	mg/L	Interwell Background Value (UPL)	106				
		Analytical Result	**110**	**181**	**841**	64.7	85.2
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	583				
		Analytical Result	350	540	**1,080**	390	350

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

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

02.06.23

Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS CONSULTING

January 26, 2023

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

Re: Big Sandy Fly Ash Pond
Assessment Monitoring & Background Update – October 2022

Dear Ms. Kreinberg,

Groundwater Stats Consulting (GSC), formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the background update and analysis of 2022 groundwater data for American Electric Power Company's Big Sandy Bottom Ash Pond. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals (CCR) from Electric Utilities (CCR Rule, 2015) as well as with the United States Environmental Protection Agency (USEPA) Unified Guidance (2009).

Sampling began at 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, and MW-1605
- **Downgradient wells:** MW-1601, MW-1602, MW-1603, MW-1606, and 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 analysis was reviewed by Andrew Collins, Project Manager of Groundwater Stats Consulting.

The CCR program consists of the following constituents listed below. The terms "constituent" and "parameter" are interchangeable.

- **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS
- **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 and box plots for Appendix III and IV parameters are provided for all wells and constituents, and are used to evaluate concentrations over the entire record (Figures A & B, respectively). A summary of the values identified as outliers in this report and through previous screenings follows this letter. These values are deselected prior to the statistical analysis. All flagged values may also be seen in a lighter font and disconnected symbol on the time series graphs (Figure C).

Note that when there are no detections present in downgradient wells for a given constituent, statistical analyses are not required. A summary of well/constituent pairs with 100% non-detects follows this letter. For all constituents, a substitution of the most recent reporting limit is used for non-detect data. When calculating intrawell prediction limits, the substitution is performed for individual wells and may differ across wells. This generally gives the most conservative limit in each case.

For regulatory comparison of current observations against statistical limits for Appendix III constituents, the annual site-wide false positive rate is based on the USEPA Unified Guidance (2009) recommendation of 10% (5% for each semi-annual sample event or 2.5% for quarterly sample events). The EPA suggests the selected statistical method should provide at least 55% power at 3 standard deviations or at least 80% power at 4 standard deviations. Power curves were based on the following:

Semi-Annual Sampling
1-of-2 resample plan
Constituents: 7
Downgradient wells: 5

Data at all wells were evaluated during the initial background screening conducted in December 2017 for the following: 1) outliers; 2) trends; 3) most appropriate statistical method for Appendix III parameters based on site characteristics of groundwater data upgradient of the facility; and 4) eligibility of downgradient wells when intrawell statistical methods are recommended. Power curves were provided in the previous report and

demonstrated that the selected statistical methods for Appendix III parameters comply with the USEPA Unified Guidance recommendations as discussed below.

Summary of Statistical Methods – Appendix III Parameters

Based on the original background screening described below, the following statistical methods were selected for Appendix III parameters:

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

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are non-detects, a nonparametric test is utilized. While the annual false positive rate associated with parametric limits is fixed at 10% as recommended by the EPA Unified Guidance (2009), the false positive rate associated with nonparametric limits is not fixed and depends upon the available background sample size, number of future comparisons, and verification resample plan. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits as appropriate. Non-detects are handled as follows:

- No statistical analyses are required on wells and analytes containing 100% non-detects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% non-detects, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for non-detects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% non-detects, the Kaplan-Meier non-detect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% non-detects.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits is necessary to accommodate these types of changes.

In the intrawell case, data for all wells and constituents may be re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In the interwell case, prediction limits are updated with upgradient well data following each sampling event after careful screening for any new outliers. In some cases, deselecting the earlier portion of data may be necessary prior to construction of limits so that resulting statistical limits are conservative (lower) from a regulatory perspective and capable of rapidly detecting changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

Summary of Background Screening Conducted in December 2017

Outlier Analysis

All proposed background data were screened for outliers and trends during the background screening. The findings of those reports were submitted with that analysis. Interwell prediction limits utilize all upgradient well data for construction of statistical limits. During each sample event, upgradient well data are screened for any newly suspected outliers or obvious trending patterns using time series plots. Intrawell prediction limits utilized the background data set that was originally screened in 2017. As recommended in the EPA Unified Guidance (2009), the background data sets are evaluated for the purpose of updating statistical limits, as described below, using the Mann-Whitney two-sample test when an additional four to eight measurements are available.

Seasonality

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

Trend Test Evaluation

While trends may be visual, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends. In the absence of suspected contamination, significant trending data are typically not included as part of

the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits. No adjustments were required at the time, and results of the trend tests were included with the 2017 screening.

Appendix III – Determination of Spatial Variation

The Analysis of Variance (ANOVA) was used to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying the most appropriate statistical approach. Interwell tests, which compare downgradient well data to statistical limits constructed from pooled upgradient well data, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation; when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter.

The results of the 2017 screening demonstrated that intrawell background limits, based on a 1-of-2 resample plan, were appropriate for pH and that interwell background limits, based on a 1-of-2 resample plan, were appropriate for boron, calcium, chloride, fluoride, sulfate, and TDS. A summary of the ANOVA results was included with the 2017 screening.

Appendix III Background Update Summaries

January 2021

Outlier Analysis

Prior to updating background data for the 2020 analysis, samples were re-evaluated using Tukey's outlier test and visual screening at all wells on data through August 2020 for pH, which uses intrawell prediction limits and at upgradient wells through October 2020 for boron, calcium, chloride, fluoride, sulfate, and TDS which use interwell prediction limits. Tukey's test identified new outliers for pH in wells MW-1012 and MW-1606 and these values were appropriately flagged as outliers in the database. Tukey's outlier test on pooled upgradient well data for constituents tested using interwell prediction limits did

not identify any potential outliers; therefore, no new values were flagged in upgradient wells for Appendix III parameters requiring interwell methods.

Intrawell – Mann-Whitney Test

For constituents requiring intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through March 2019 to the new compliance samples at each well through August 2020 to evaluate whether the groups are statistically similar at the 99% confidence level, in which case background data may be updated with compliance data. No statistically significant differences were found between the two groups for pH among wells that were tested; therefore, all wells for pH with the exception of well MW-1601, which was not sampled during 2020, were updated with compliance samples to use all historical data through August 2020.

Interwell – Trend Testing

The Sen's Slope/Mann Kendall trend test was used to evaluate data at upgradient wells for boron, calcium, chloride, fluoride, sulfate and TDS to identify statistically significant increasing or decreasing trends. Statistically significant decreasing trends were noted for chloride, fluoride and TDS in upgradient well MW-1604. However, the magnitudes of the trends were low relative to average concentrations within this well and reported measurements are consistent with those reported at one or more neighboring upgradient wells. Therefore, no adjustments were made to the records at that time, and all well/constituent pairs for parameters using interwell prediction limits were updated to use all historical data through October 2020. A summary of the background update results was included with the January 2021 report.

January 2022

Outlier Analysis

Prior to updating background data, upgradient wells were re-evaluated using Tukey's outlier test and visual screening for Appendix III constituents tested with interwell prediction limits on historical data through October 2021. Tukey's outlier test was not used to evaluate pH, which is tested using intrawell prediction limits, as a minimum of 4 new compliance samples were not yet available.

For parameters which use interwell prediction limits (boron, calcium, chloride, fluoride, sulfate, and TDS), Tukey's outlier test on pooled upgradient well data did not identify any

potential outliers, and no values were flagged in upgradient wells for these Appendix III parameters. A summary of all flagged outliers follows this report (Figure C).

Intrawell – Mann-Whitney

Typically, for constituents requiring intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test is used to compare the medians of historical data through to the new compliance samples at each well to evaluate whether the groups are statistically similar at the 99% confidence level, in which case background data may be updated with compliance data. As mentioned above, pH did not have the minimum four required samples in the compliance dataset; therefore, sufficient data was not available to update background datasets.

Intrawell prediction limits using all historical data through August 2020, with the exception of well MW-1601 which utilized background data through March 2019, combined with a 1-of-2 resample plan, were constructed for pH and submitted with the report.

Interwell – Trend Test Evaluation

The Sen's Slope/Mann Kendall trend test was used to evaluate data at upgradient wells for boron, calcium, chloride, fluoride, sulfate and TDS to identify statistically significant increasing or decreasing trends. The results of the trend analyses showed one statistically significant increasing trend for fluoride in upgradient well MW-1011. Statistically significant decreasing trends were noted for chloride, fluoride and TDS in upgradient well MW-1604. However, the magnitudes of the trends were low relative to average concentrations within this well and reported measurements were consistent with those reported at one or more neighboring upgradient wells. Therefore, no adjustments were made to the records.

Interwell – Prediction Limits

Interwell prediction limits, combined with a 1-of-2 resample plan, were constructed using all pooled upgradient well data through October 2021 for boron, calcium, chloride, fluoride, sulfate and TDS and submitted with the analysis.

January 2023

Outlier Analysis

Prior to updating background data during this analysis, Tukey's outlier test was used to evaluate data through June 2022 at all wells for pH, which are tested using intrawell prediction limits, and through October 2022 at upgradient wells for boron, calcium, chloride, fluoride, sulfate, and TDS, which are tested using interwell prediction limits. (Figure C).

Tukey's outlier test identified several potential outliers and confirmed previously flagged outliers. The majority of these measurements were similar to historical data within the same well for pH, and similar to or lower than measurements in neighboring upgradient wells for constituents tested using interwell methods. Therefore, only a low value of 2.36 SU for pH at well MW-1605 was flagged in order to reduce variation. Additionally, the previously flagged measurement of 10.85 SU for pH at upgradient well MW-1012 was unflagged during the update due to a more recent and similar reported measurement which is an indication of natural variability in groundwater quality upgradient of the facility. A summary of all flagged outliers follows this report (Figure C).

Intrawell – Mann-Whitney Test

For pH which is tested using intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through August 2020 to the new compliance samples at each well through June 2022 to evaluate whether the groups are statistically similar at the 99% confidence level, in which case background data may be updated with compliance data (Figure D). No statistically significant differences were found between the two groups for pH among wells that were tested; therefore, all data sets for pH were updated with compliance samples through June 2022.

Intrawell – Prediction Limits

Intrawell prediction limits using all historical data through June 2022 combined with a 1-of-2 resample plan, were constructed for pH and a summary of the limits follows this letter (Figure E).

Interwell – Trend Test Evaluation

The Sen's Slope/Mann Kendall trend test was used to evaluate data at upgradient wells for boron, calcium, chloride, fluoride, sulfate and TDS to identify statistically significant

increasing or decreasing trends at the 99% confidence level (Figure F). The results of the trend analyses showed statistically significant increasing trends for fluoride in upgradient wells MW-1011 and MW-1012. Statistically significant decreasing trends were noted for chloride, fluoride, and TDS in upgradient well MW-1604. However, the magnitudes of the trends are low relative to average concentrations and reported measurements are consistent with those reported at one or more neighboring upgradient wells. Therefore, no adjustments were made to the records at this time. All records will be re-evaluated during the next background update and, if earlier measurements are no longer representative of present-day conditions, the historical portion of the records will be deselected prior to construction of statistical limits.

Interwell – Prediction Limits

Interwell prediction limits, combined with a 1-of-2 resample plan, were constructed using all pooled upgradient well data through October 2022 for boron, calcium, chloride, fluoride, sulfate and TDS (Figure G). Time series graphs are included with the statistical limits for graphical representation of concentrations over time at upgradient wells. A summary table of the updated limits may be found following this letter in the Prediction Limit Summary Tables.

Evaluation of Appendix IV Parameters – October 2022

Prior to evaluating Appendix IV parameters, all background data at upgradient wells are screened through visual screening and Tukey's outlier test for potential outliers (Figure C). Several outliers were identified; however, the majority of measurements were similar to remaining measurements within the respective record. Therefore, these measurements which represent naturally occurring groundwater quality upgradient of the facility were not flagged as outliers. Exceptions include the three highest reported measurements of arsenic at upgradient well MW-1012. This step results in statistical limits that are conservative (i.e., lower) from a regulatory perspective. All previously flagged measurements were confirmed during this analysis. Any flagged values may be seen on the Outlier Summary following this letter as mentioned above.

Interwell Upper Tolerance Limits

Interwell upper tolerance limits were used to calculate background limits from all available pooled upgradient well data through October 2022 (Figure H). Parametric limits use a target of 95% confidence and 95% coverage. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples.

Groundwater Protection Standards

These limits were compared to the Maximum Contaminant Levels (MCLs) and CCR-Rule specified levels, as shown in the Groundwater Protection Standards (GWPS) table following this letter (Figure I), to determine the highest limit for use as the GWPS in the confidence Interval comparisons.

Confidence Intervals

Confidence intervals were then constructed using data through October 2022 on downgradient wells for each Appendix IV constituent (Figure J). The confidence intervals were then compared against the GWPS (i.e., the highest limit of the MCL or background limit as discussed above). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. Complete results of the confidence interval analysis follow this letter. The following confidence interval exceedances were identified:

- Beryllium: MW-1603
- Cobalt: MW-1603
- Combined Radium 226 + 228: MW-1603
- Lithium: MW-1603

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 us.

For Groundwater Stats Consulting,

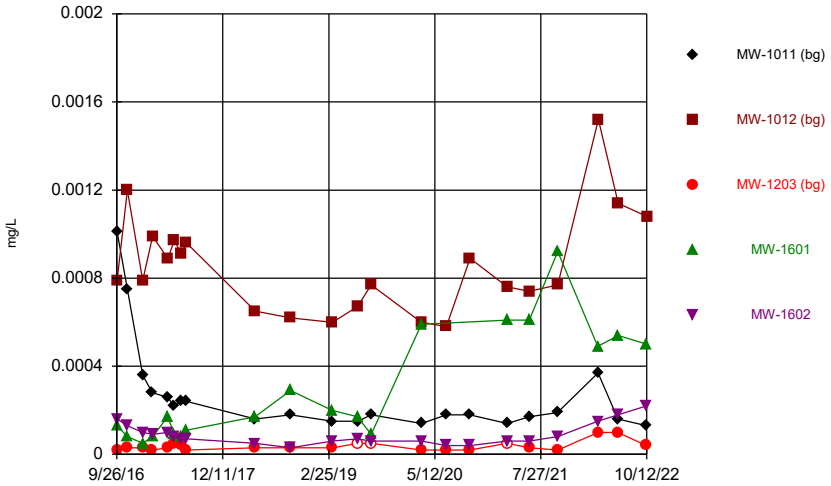
Easton Rayner
Groundwater Analyst

Andrew Collins
Project Manager

FIGURE A
Time Series

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

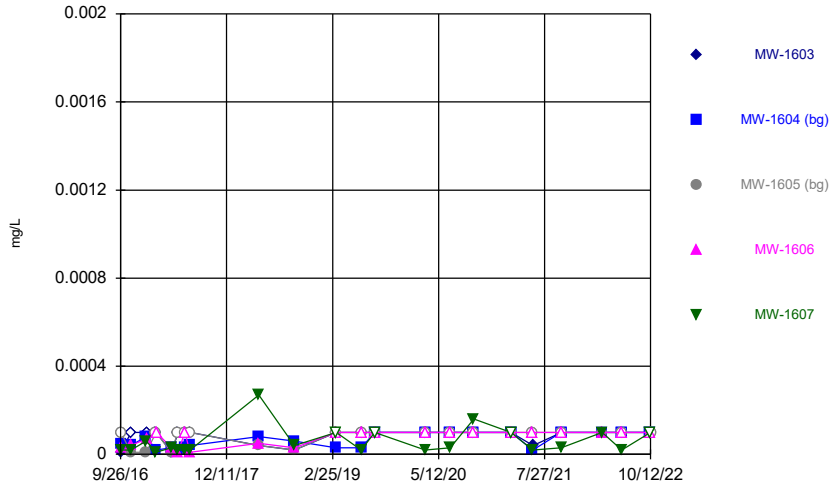
Time Series



Constituent: Antimony Analysis Run 1/12/2023 9:29 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

Time Series



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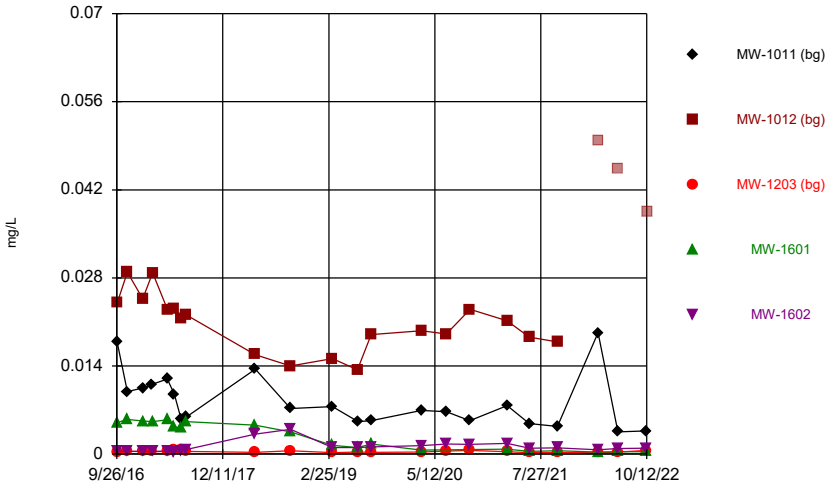
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

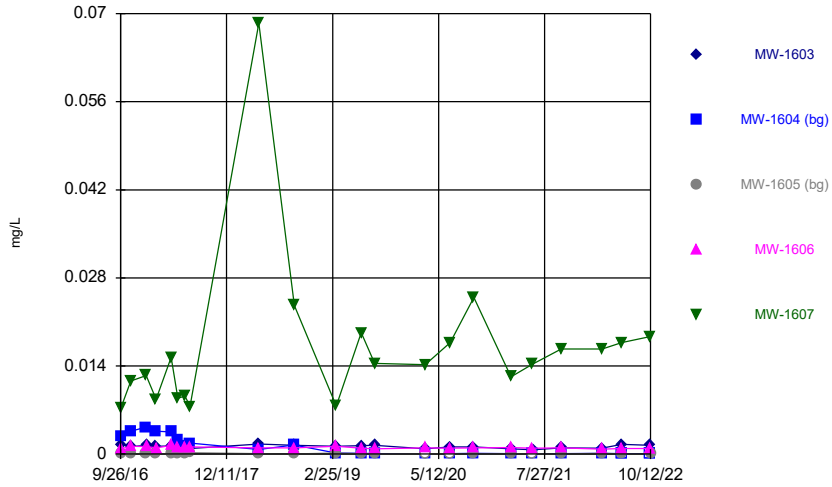
Time Series



Constituent: Arsenic Analysis Run 1/12/2023 9:29 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

Time Series



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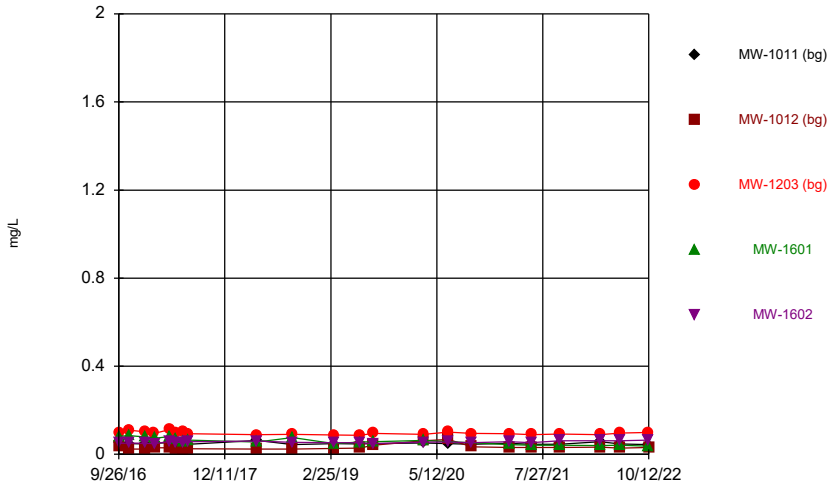
Sanitas™ v.9.6.36 . UG

Time Series



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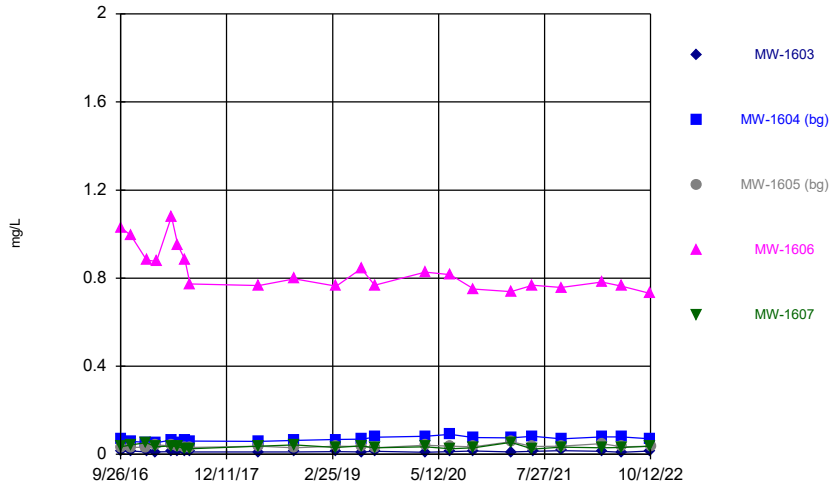
Sanitas™ v.9.6.36 . UG

Time Series



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Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
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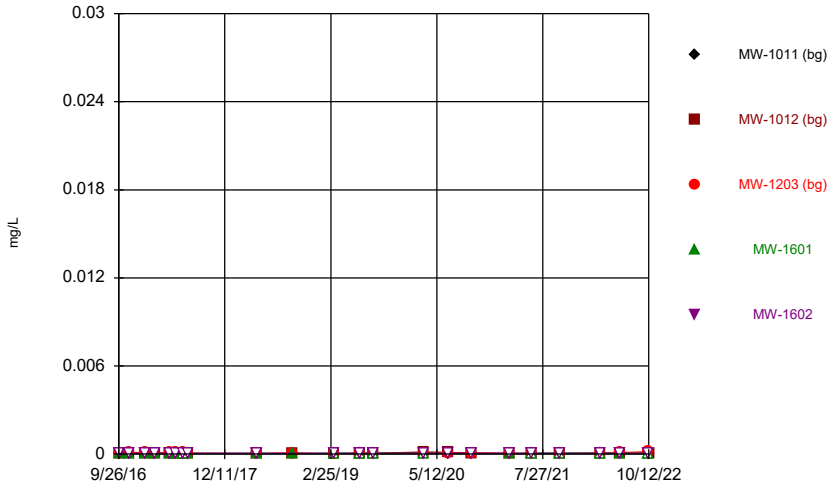

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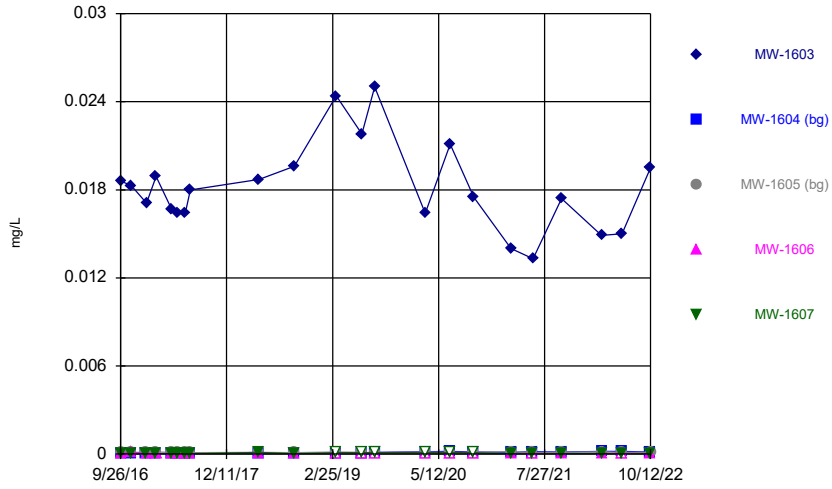
Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

Time Series



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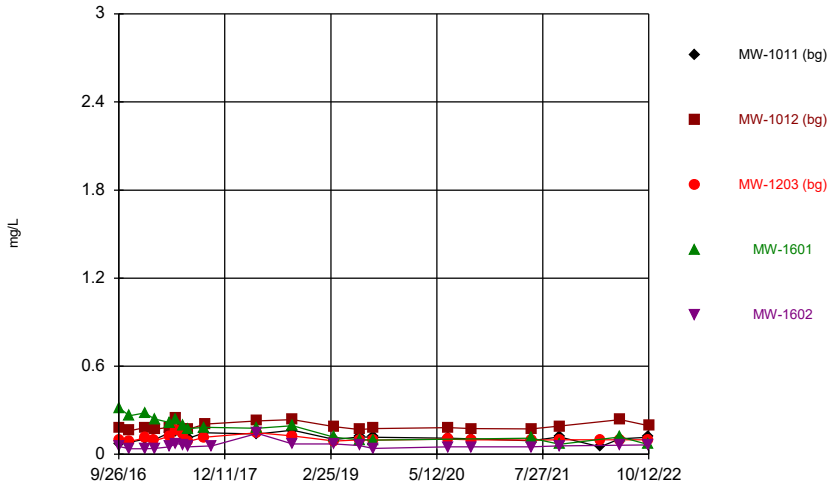
Sanitas™ v.9.6.36 . UG

Time Series



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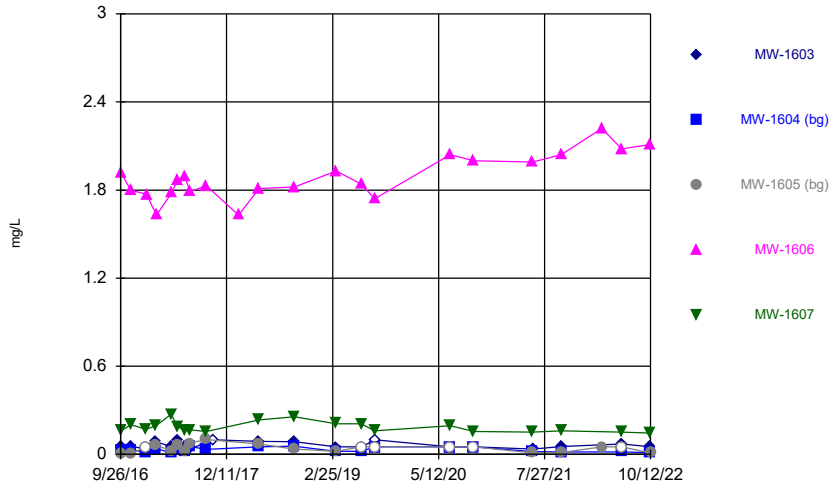

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Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

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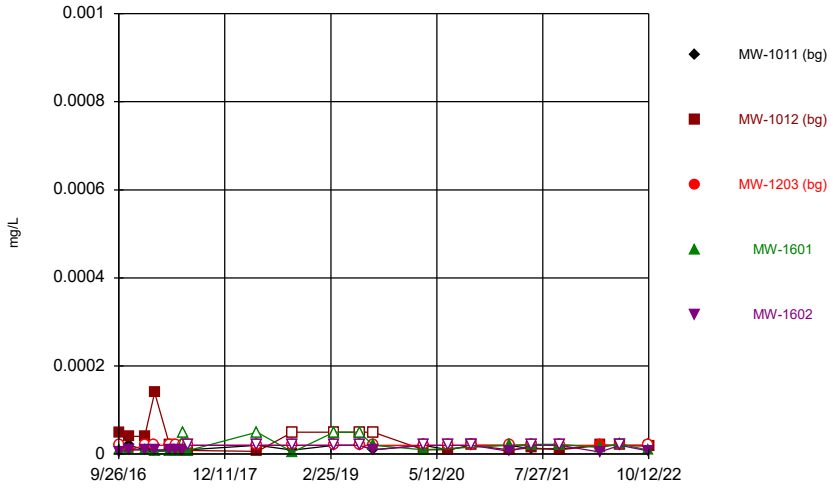

Constituent: Cadmium Analysis Run 1/12/2023 9:29 AM View: Descriptive
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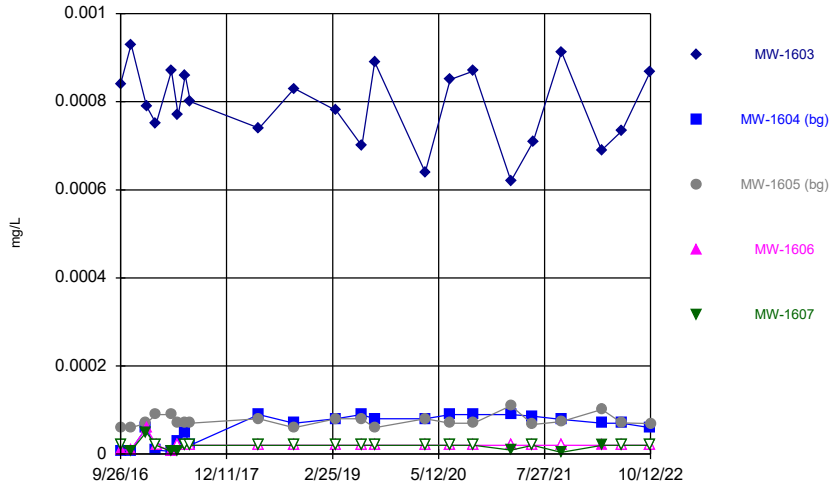
Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

Time Series



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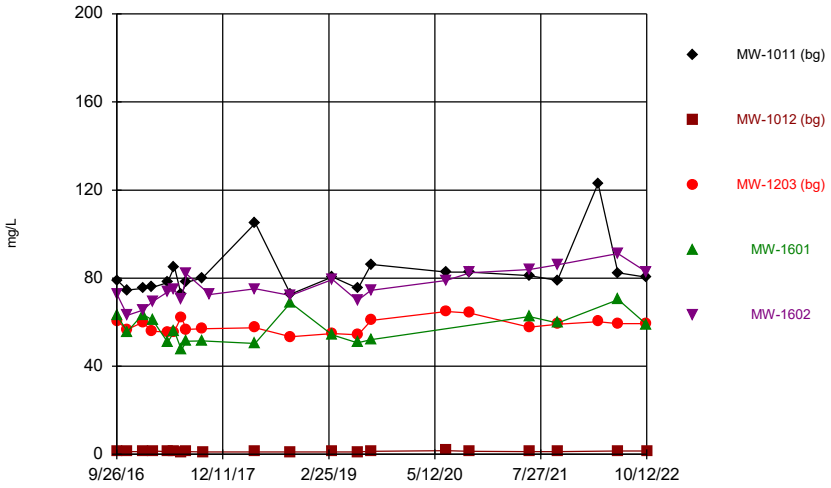
Sanitas™ v.9.6.36 . UG

Time Series



Constituent: Calcium Analysis Run 1/12/2023 9:29 AM View: Descriptive
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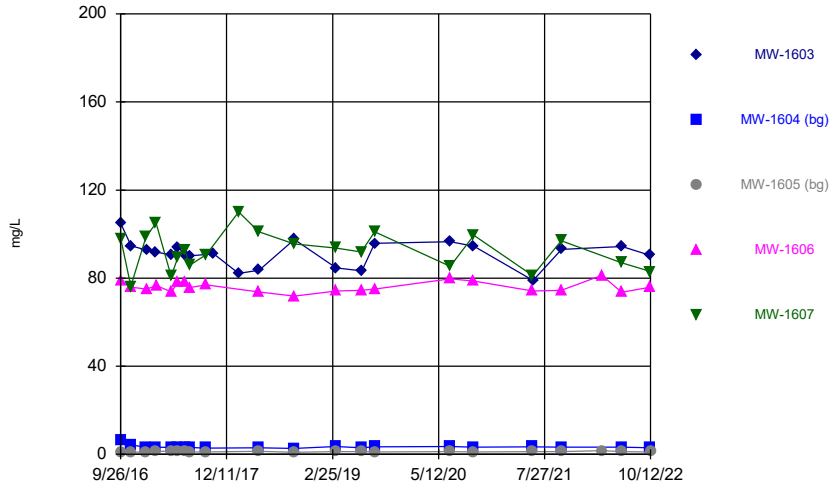
Sanitas™ v.9.6.36 . UG

Time Series



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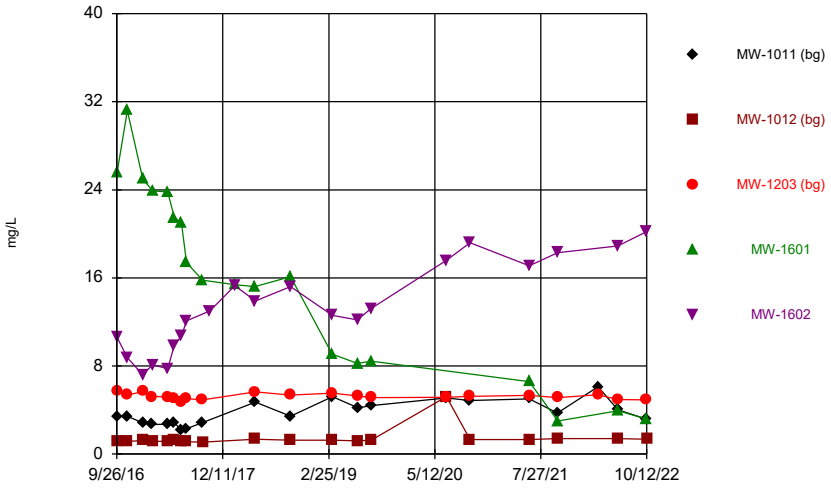
Sanitas™ v.9.6.36 . UG

Time Series



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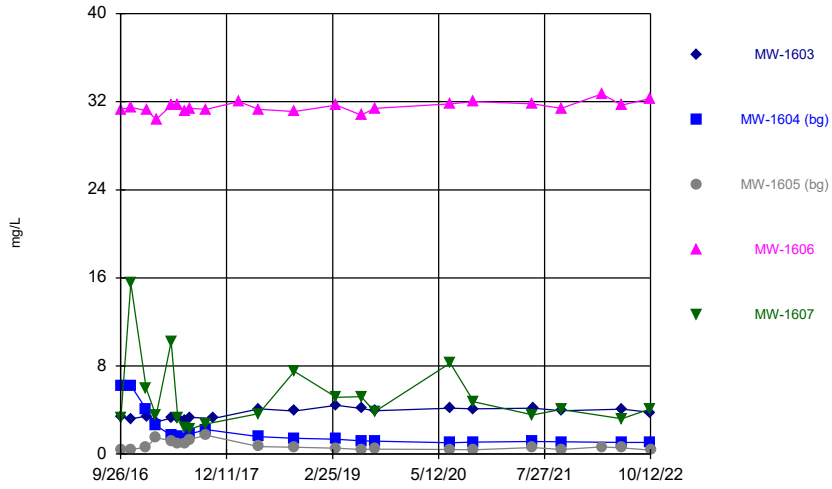
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Time Series



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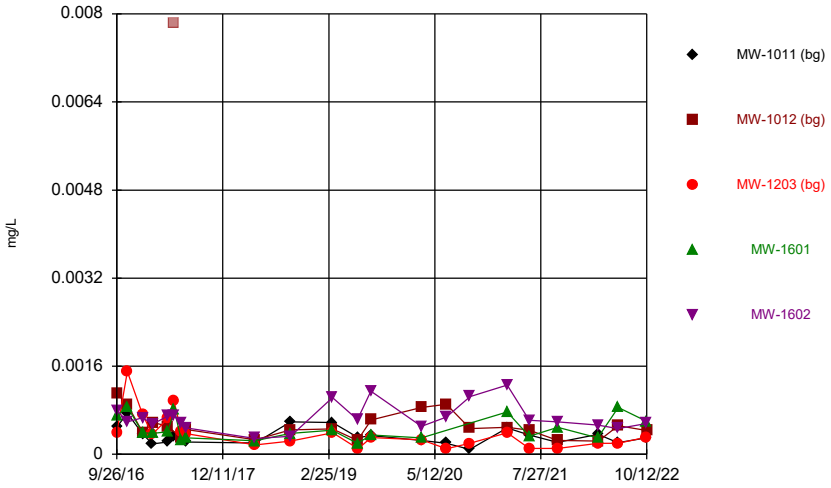
Sanitas™ v.9.6.36 . UG

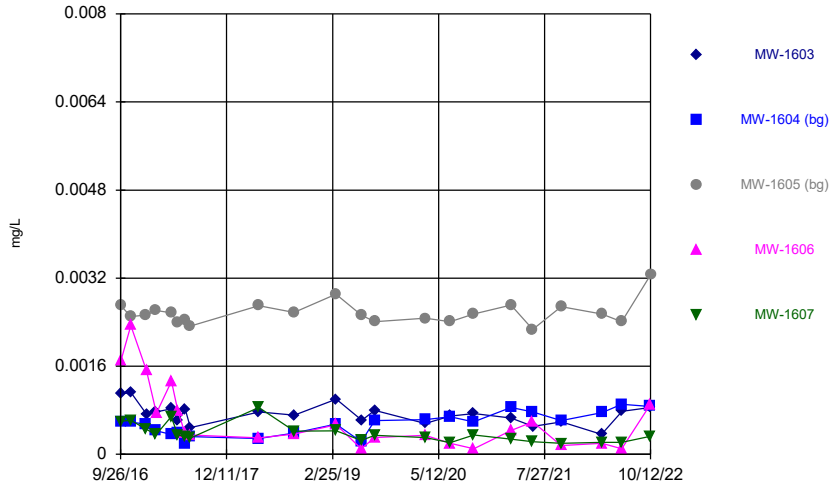
Time Series



Constituent: Chromium Analysis Run 1/12/2023 9:29 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Time Series



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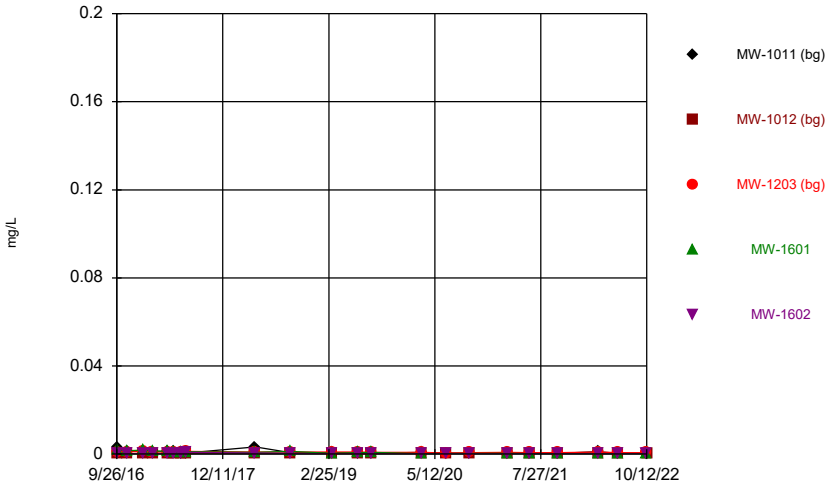
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Time Series



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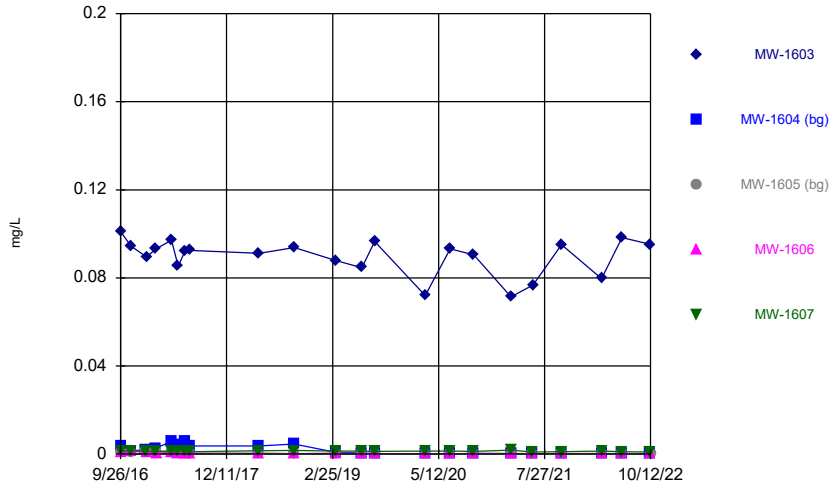
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Time Series



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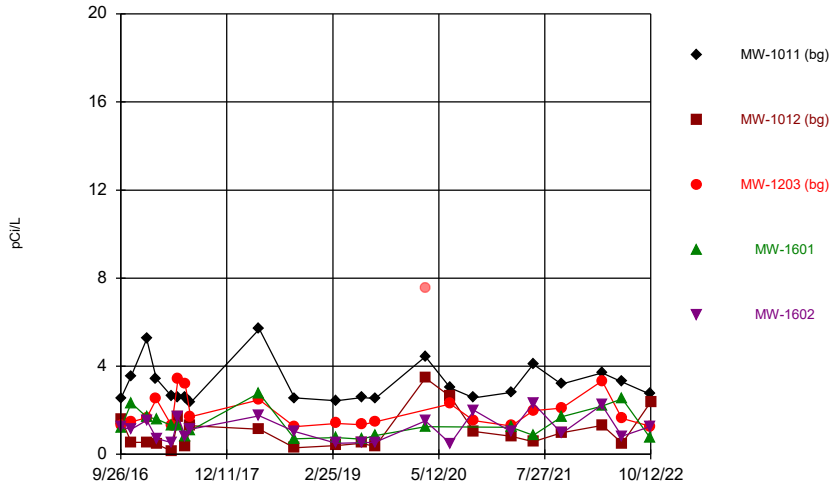
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

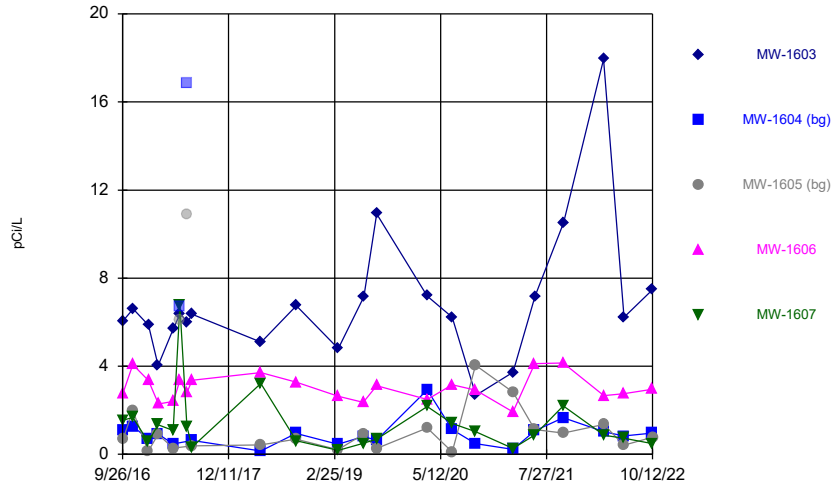
Time Series



Constituent: Combined Radium 226 + 228 Analysis Run 1/12/2023 9:29 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

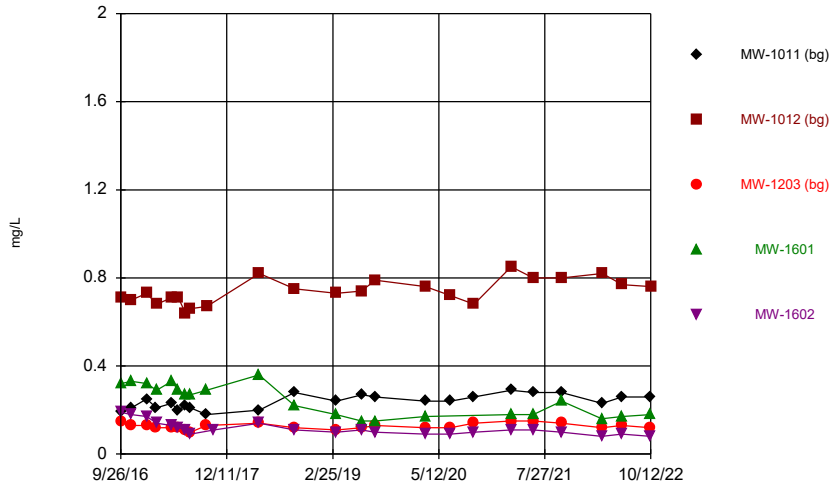
Time Series



Constituent: Combined Radium 226 + 228 Analysis Run 1/12/2023 9:29 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

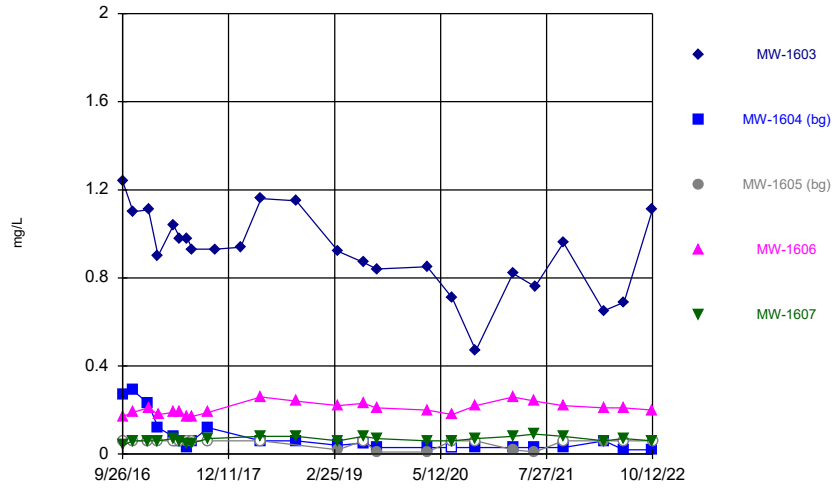
Time Series



Constituent: Fluoride Analysis Run 1/12/2023 9:29 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

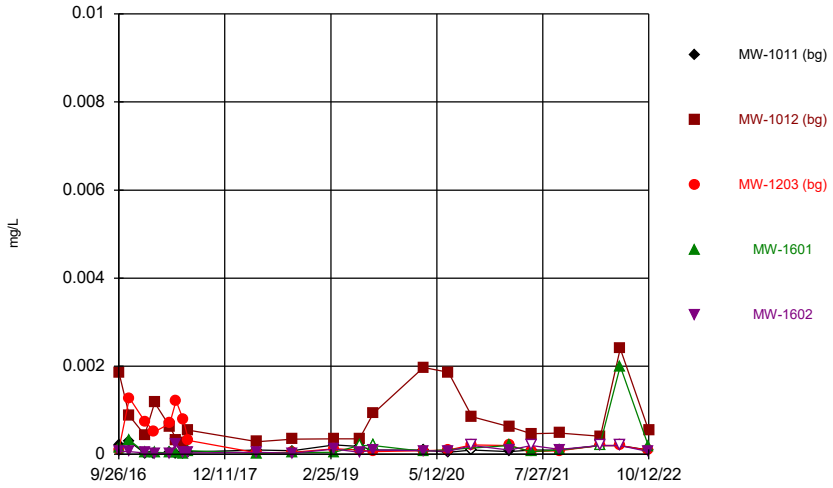
Time Series



Constituent: Fluoride Analysis Run 1/12/2023 9:29 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

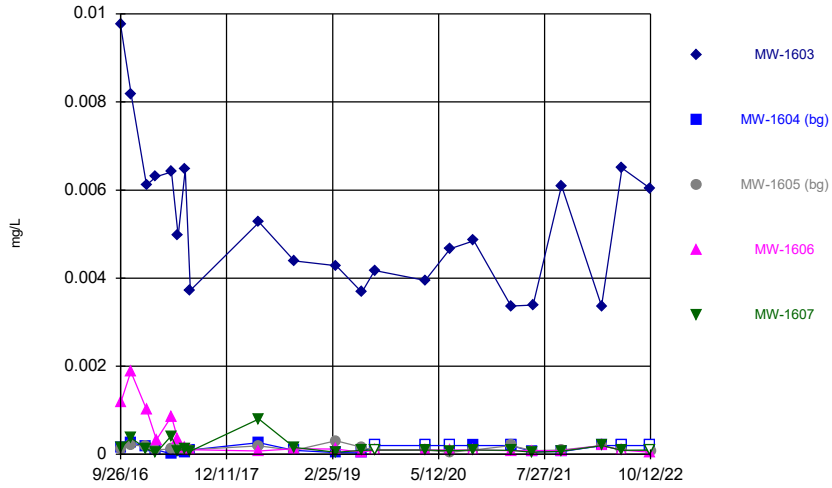
Time Series



Constituent: Lead Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

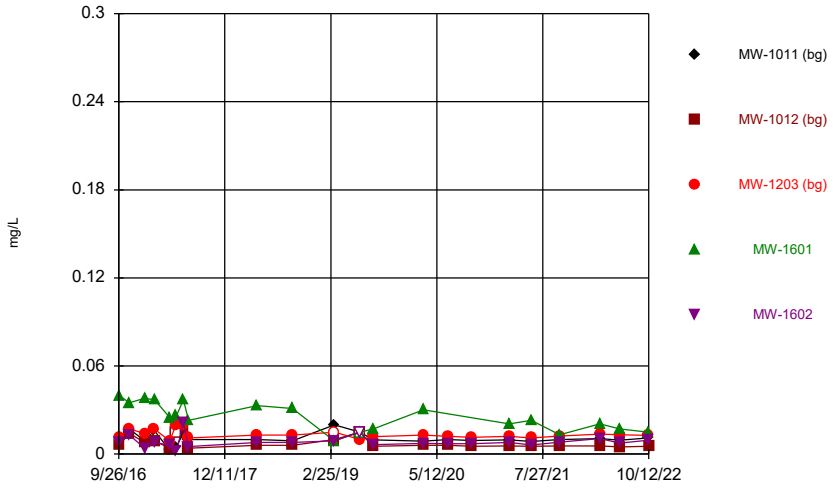
Time Series



Constituent: Lead Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

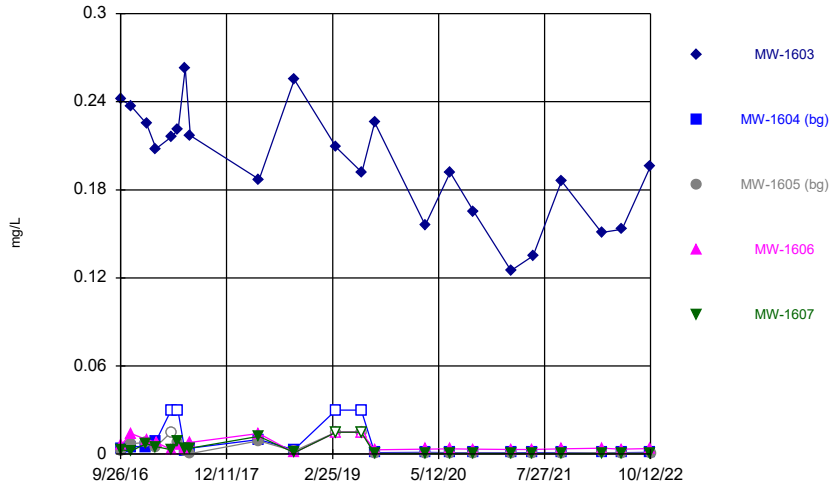
Time Series



Constituent: Lithium Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

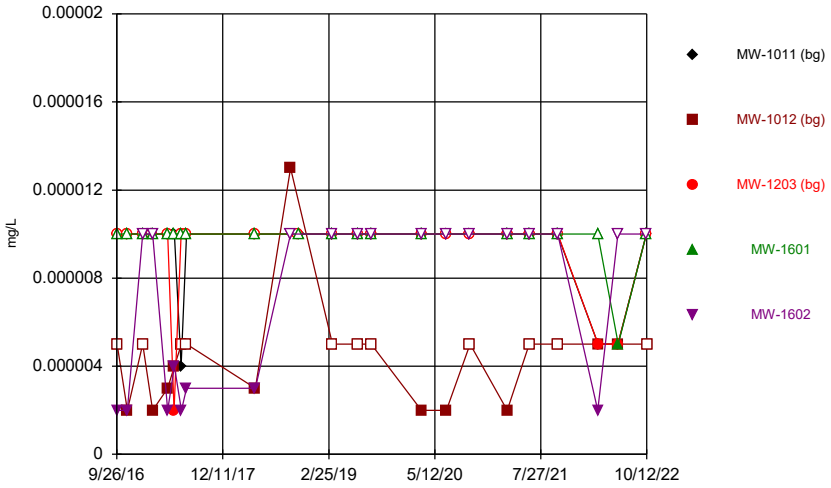
Time Series



Constituent: Lithium Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

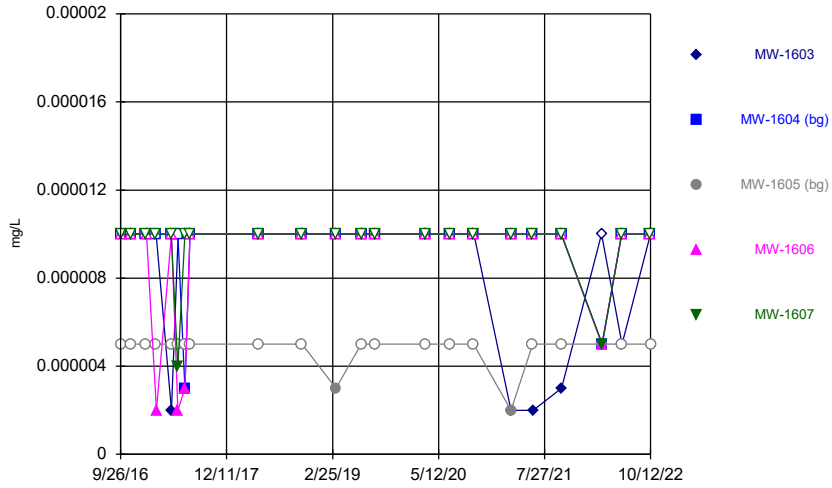
Time Series



Constituent: Mercury Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

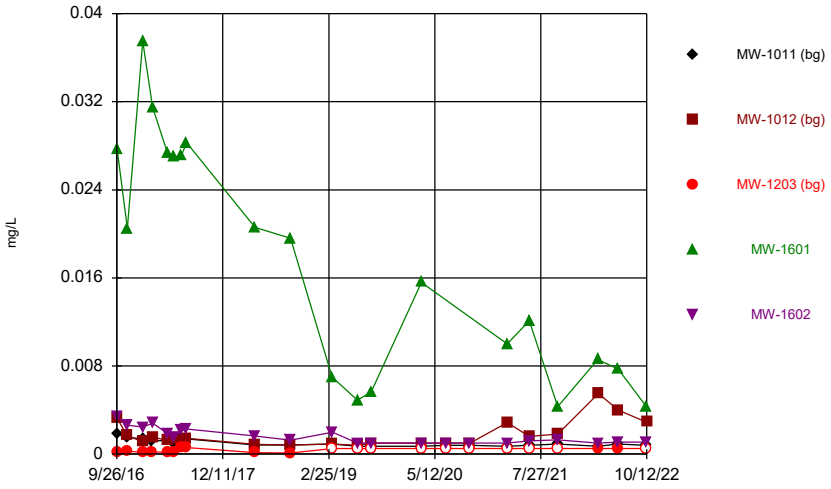
Time Series



Constituent: Mercury Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

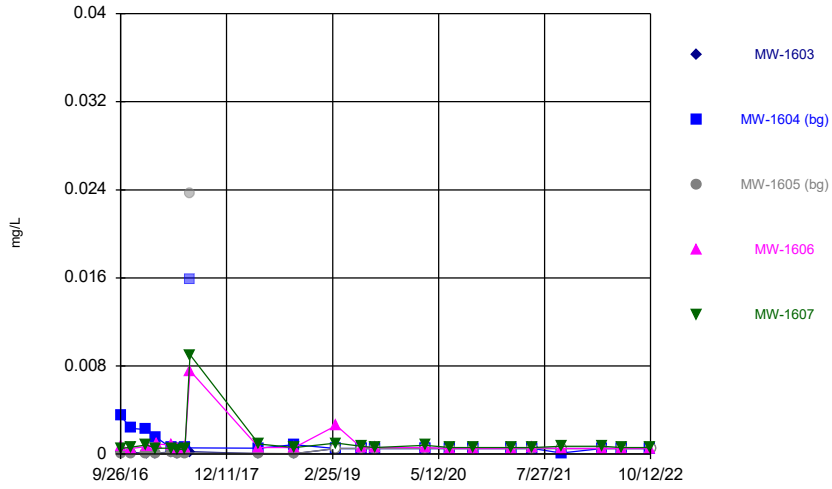
Time Series



Constituent: Molybdenum Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

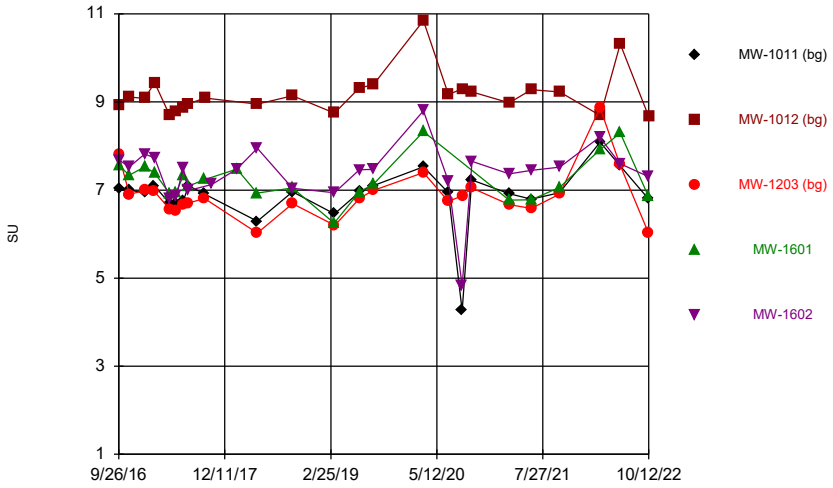
Time Series



Constituent: Molybdenum Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Time Series



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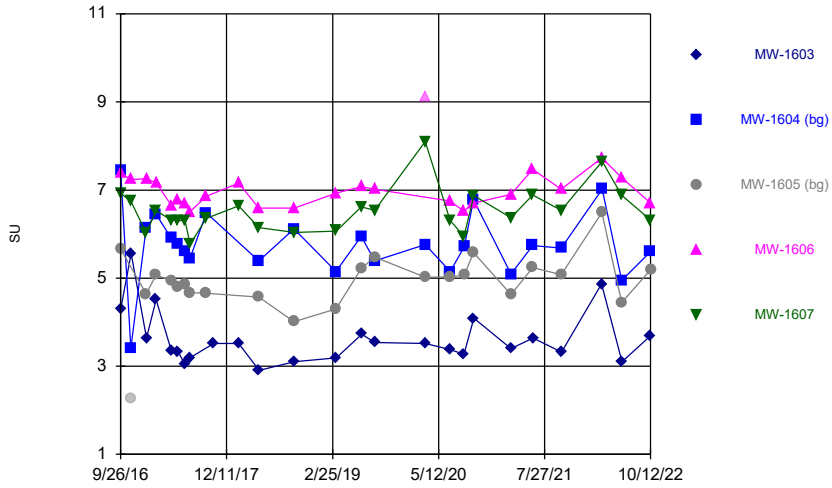
Sanitas™ v.9.6.36 . UG

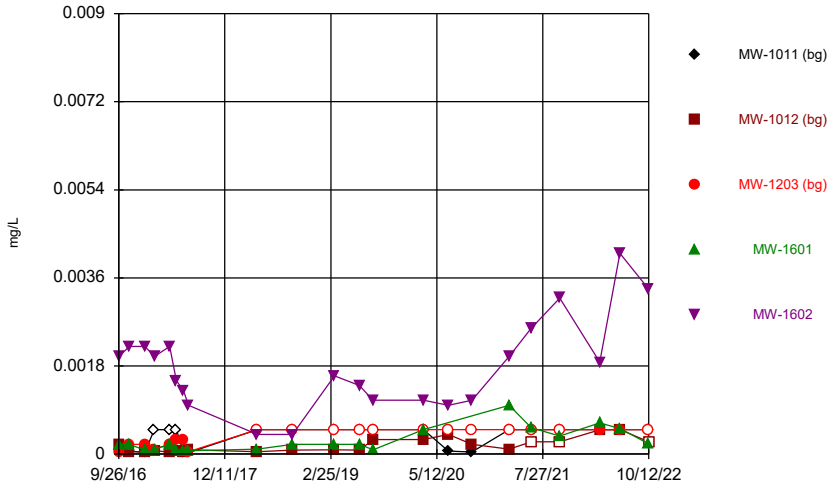
Time Series



Constituent: pH Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

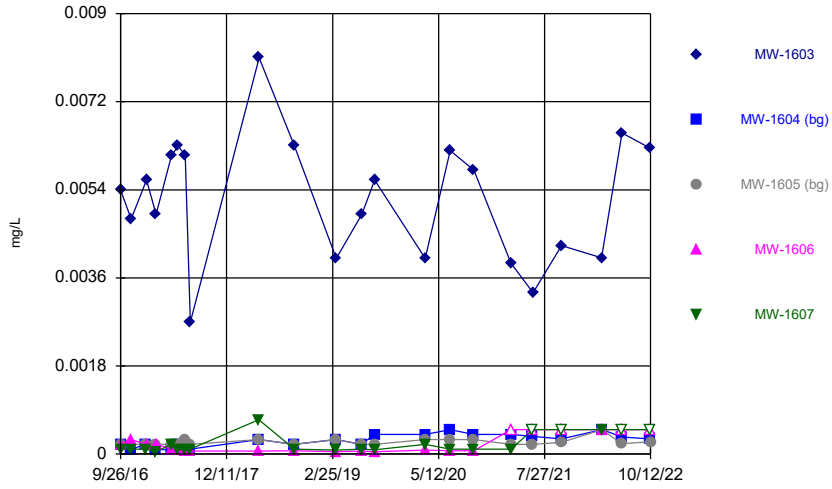
Time Series



Constituent: Selenium Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

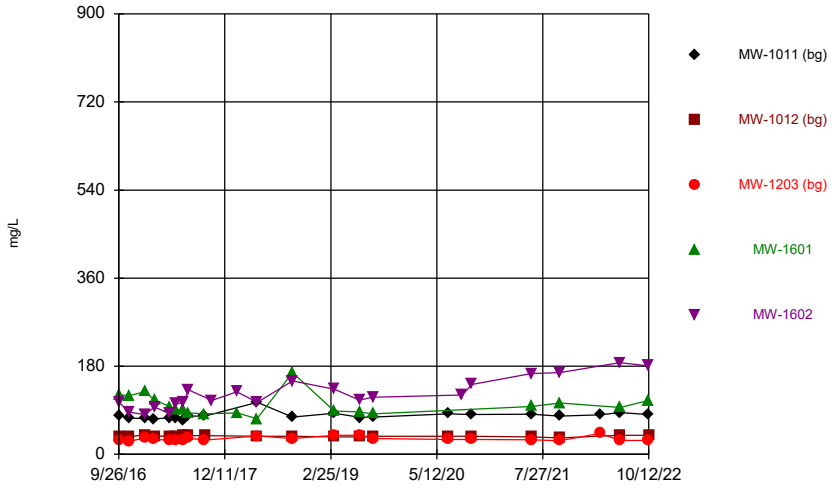
Time Series



Constituent: Selenium Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

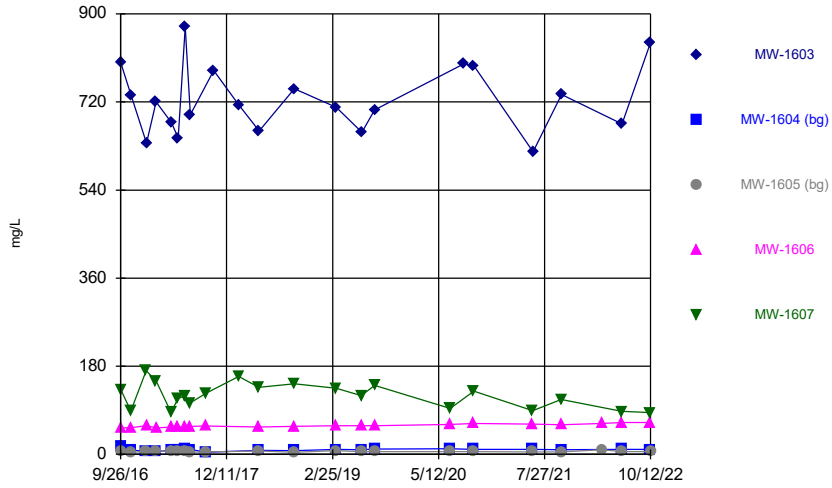
Time Series



Constituent: Sulfate Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

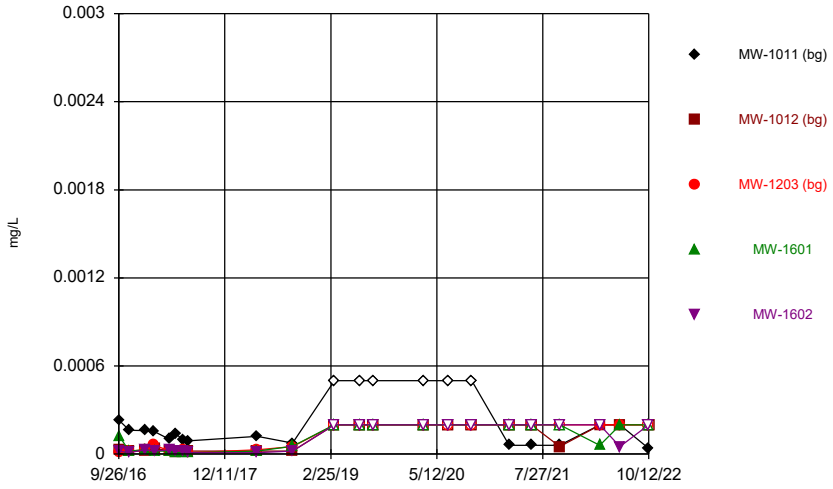
Time Series



Constituent: Sulfate Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

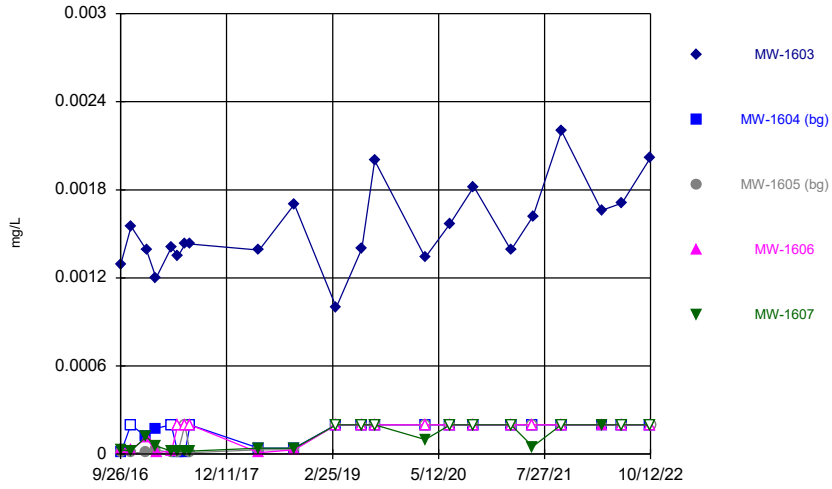
Time Series



Constituent: Thallium Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

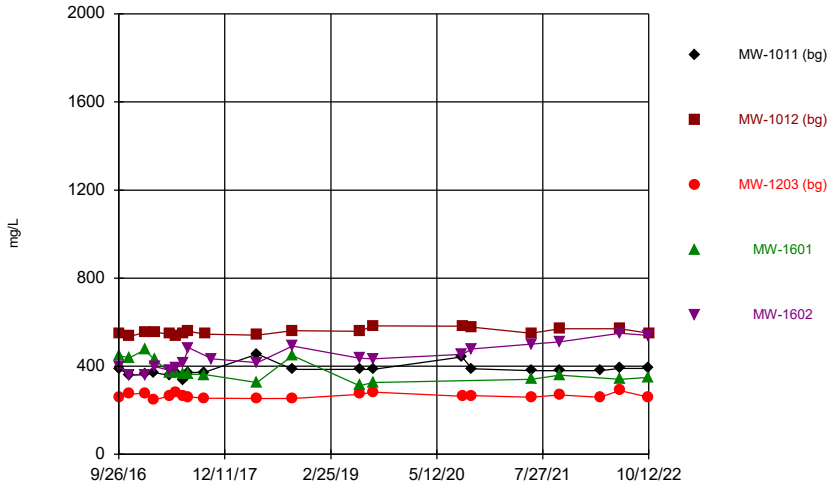
Time Series



Constituent: Thallium Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

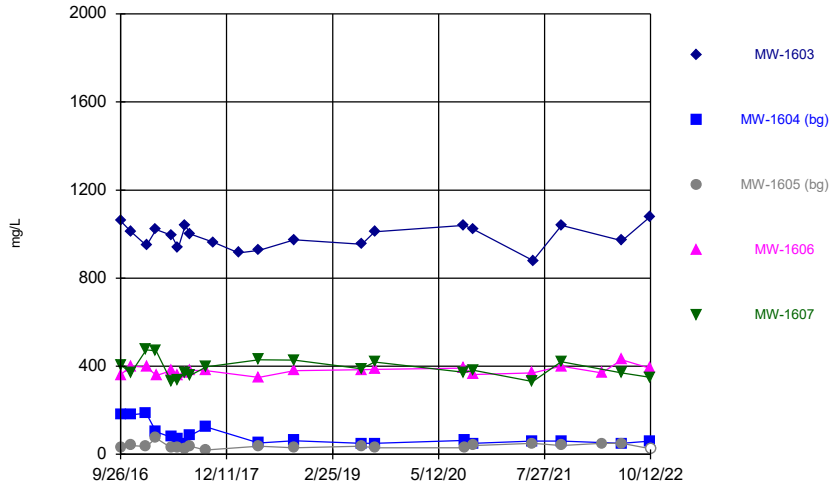
Time Series



Constituent: Total Dissolved Solids Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

Time Series

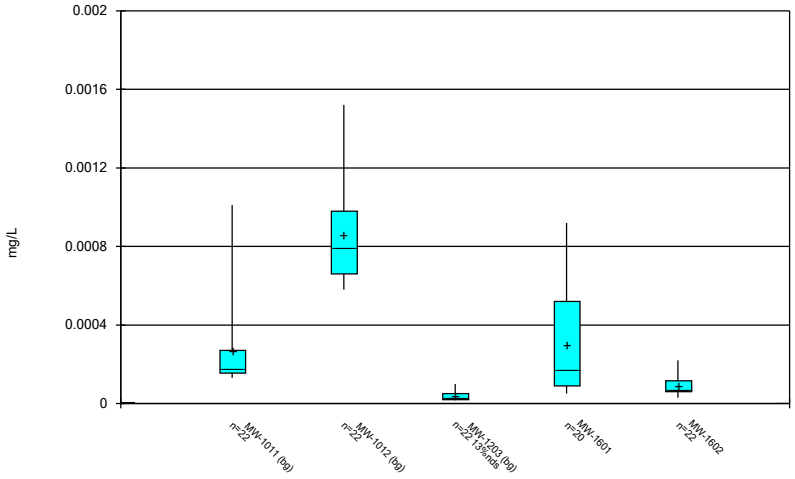


Constituent: Total Dissolved Solids Analysis Run 1/12/2023 9:30 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

FIGURE B
Box Plots

Sanitas™ v.9.6.36 . UG

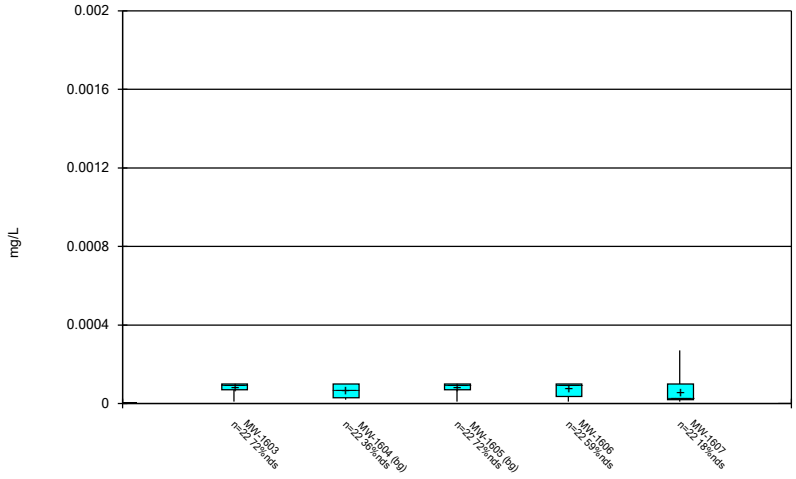
Box & Whiskers Plot



Constituent: Antimony Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

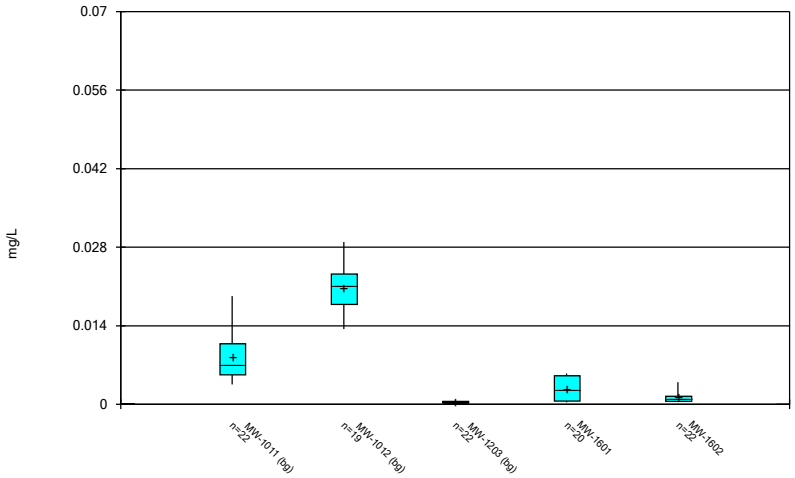
Box & Whiskers Plot



Constituent: Antimony Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

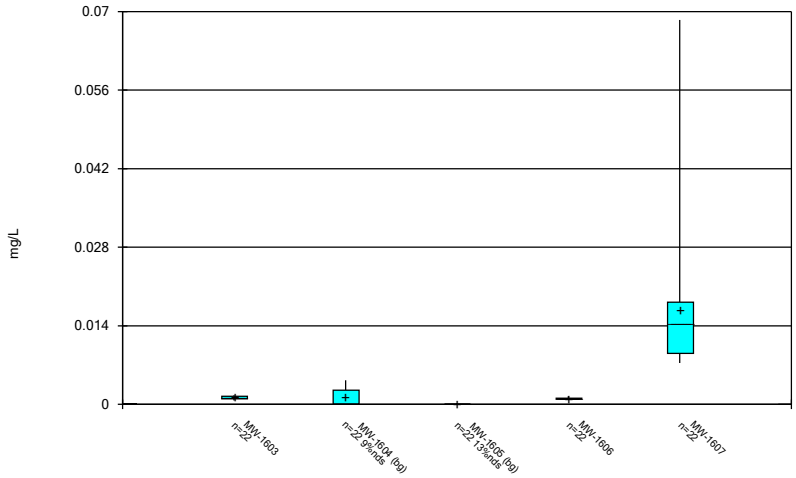
Box & Whiskers Plot



Constituent: Arsenic Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

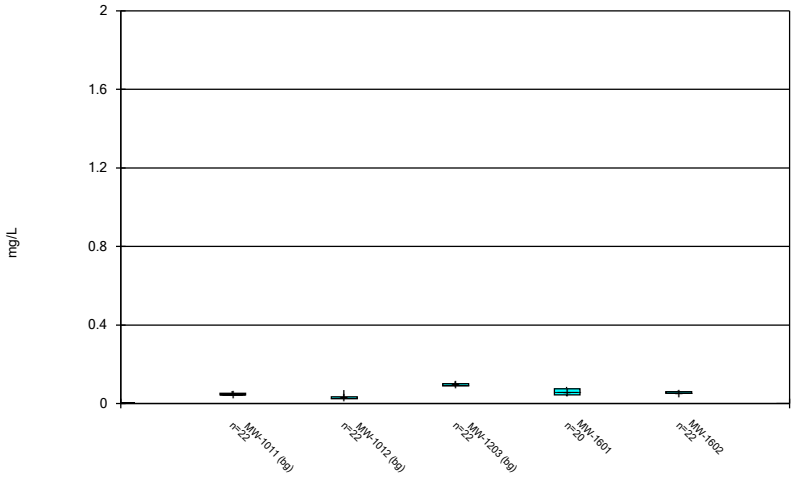
Box & Whiskers Plot



Constituent: Arsenic Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

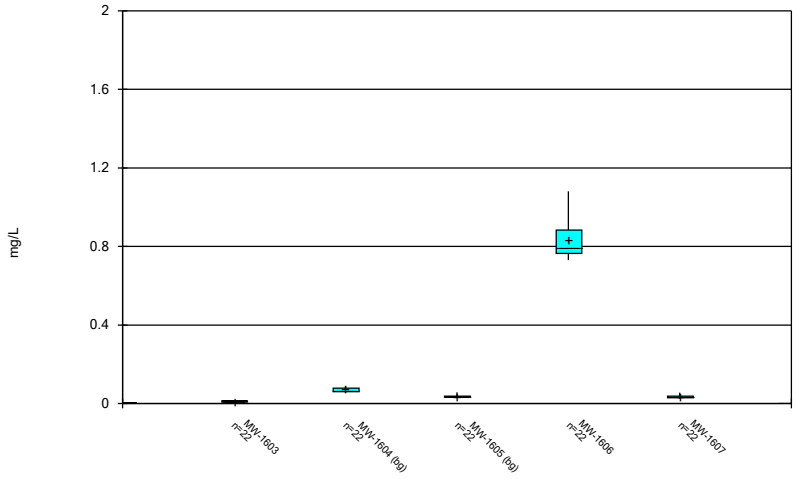
Box & Whiskers Plot



Constituent: Barium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

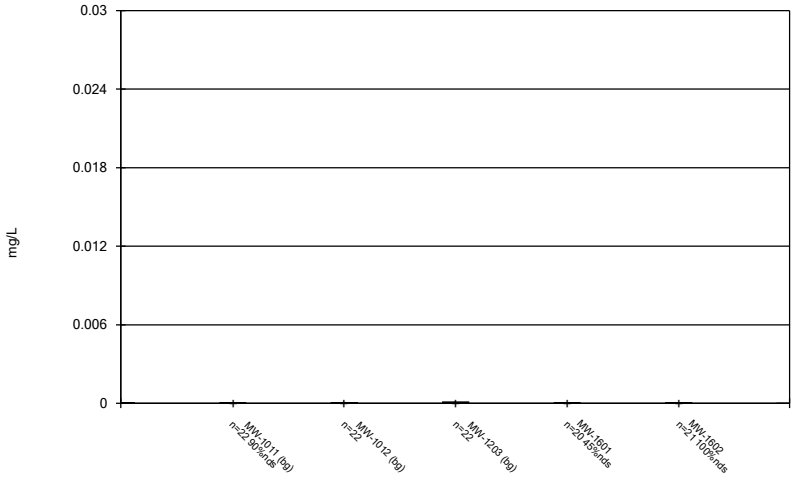
Box & Whiskers Plot



Constituent: Barium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

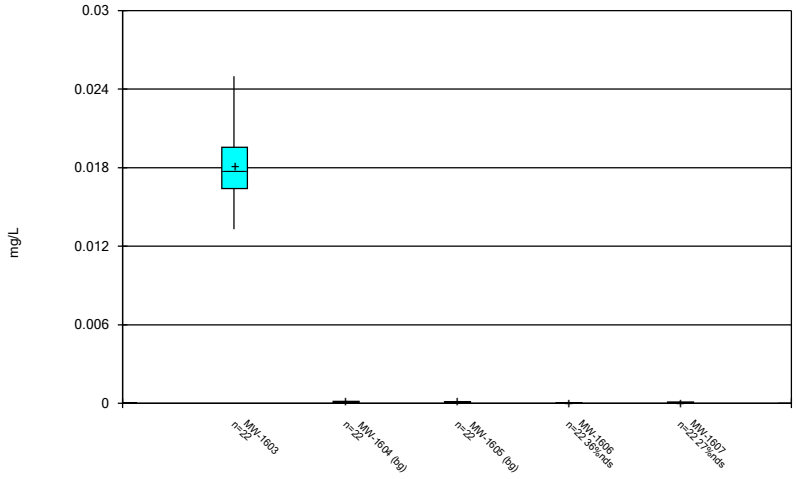
Box & Whiskers Plot



Constituent: Beryllium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

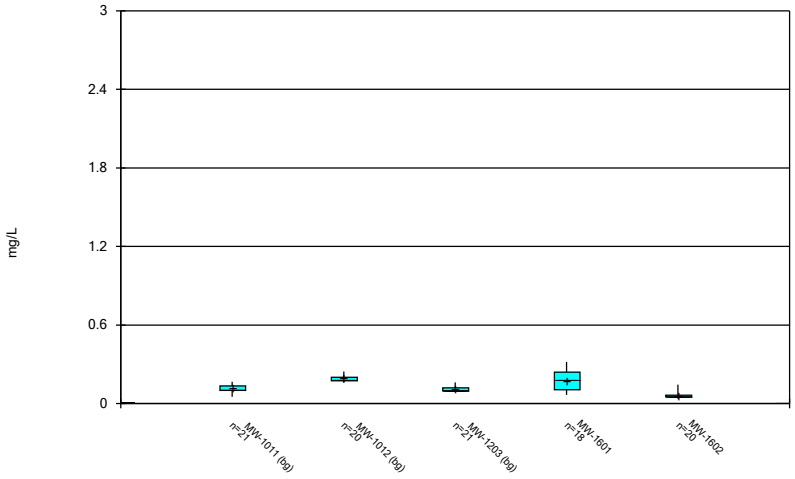
Box & Whiskers Plot



Constituent: Beryllium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

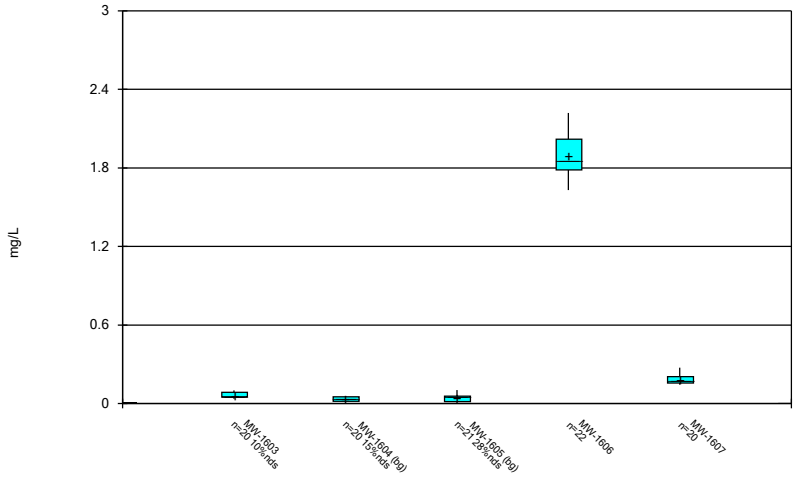
Box & Whiskers Plot



Constituent: Boron Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

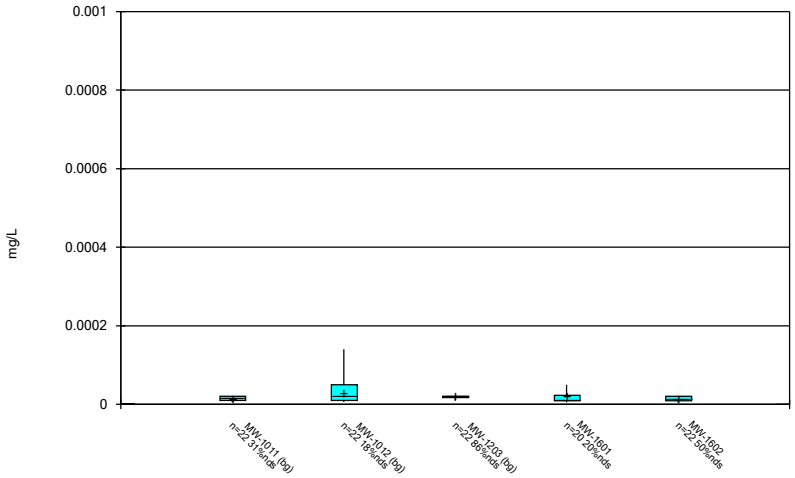
Box & Whiskers Plot



Constituent: Boron Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

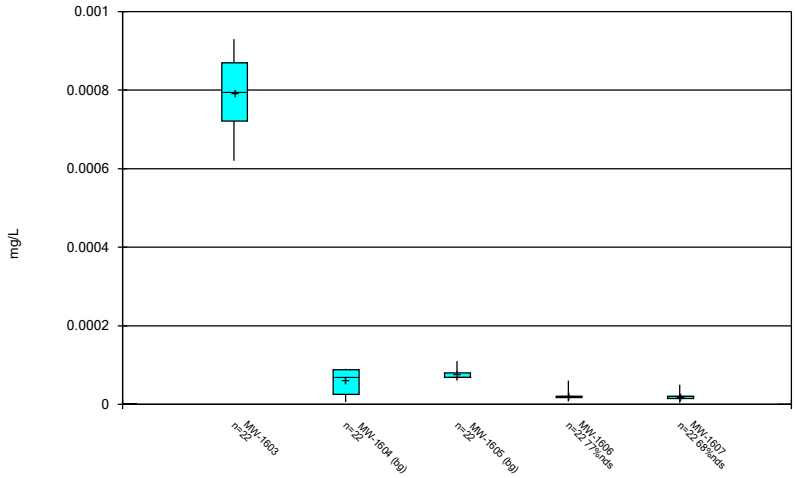
Box & Whiskers Plot



Constituent: Cadmium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

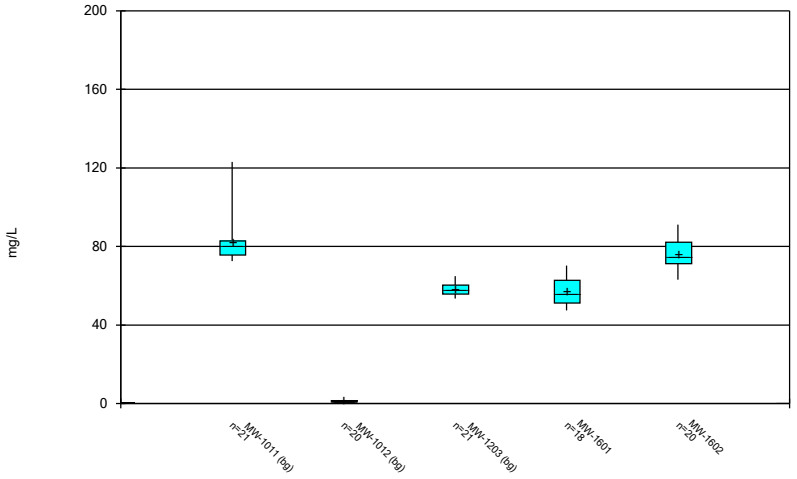
Box & Whiskers Plot



Constituent: Cadmium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

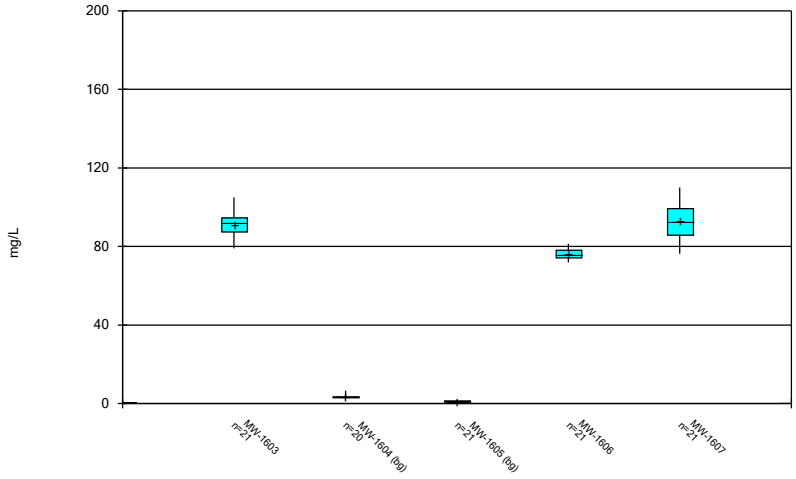
Box & Whiskers Plot



Constituent: Calcium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

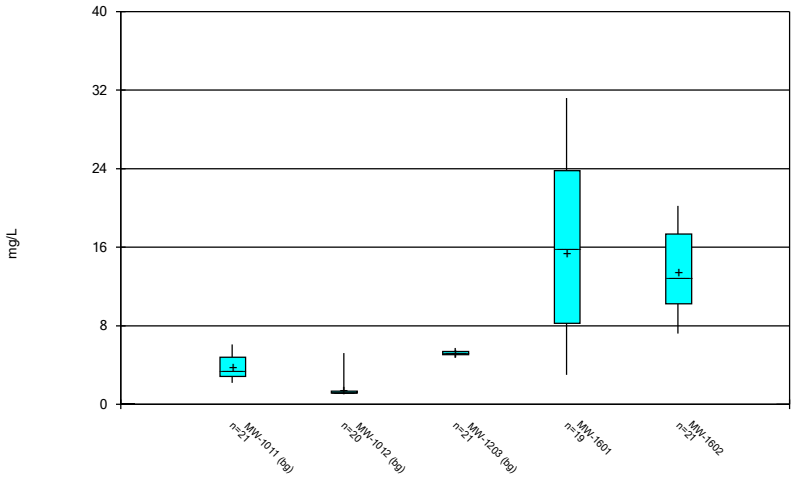
Box & Whiskers Plot



Constituent: Calcium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

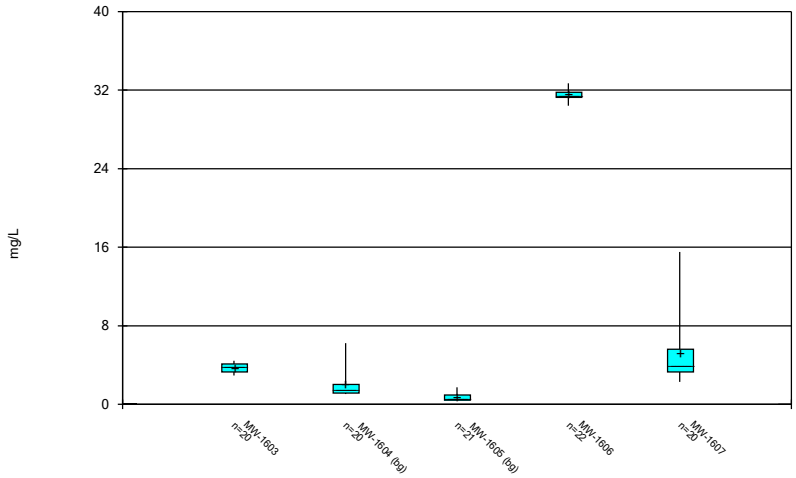
Box & Whiskers Plot



Constituent: Chloride Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

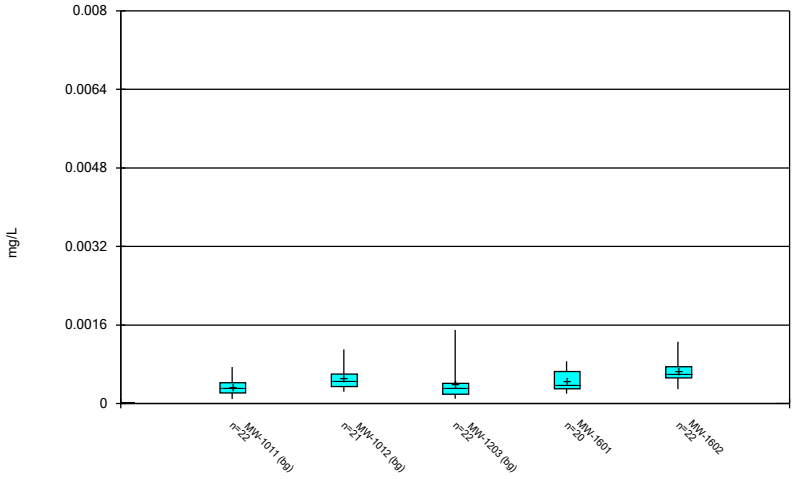
Box & Whiskers Plot



Constituent: Chloride Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

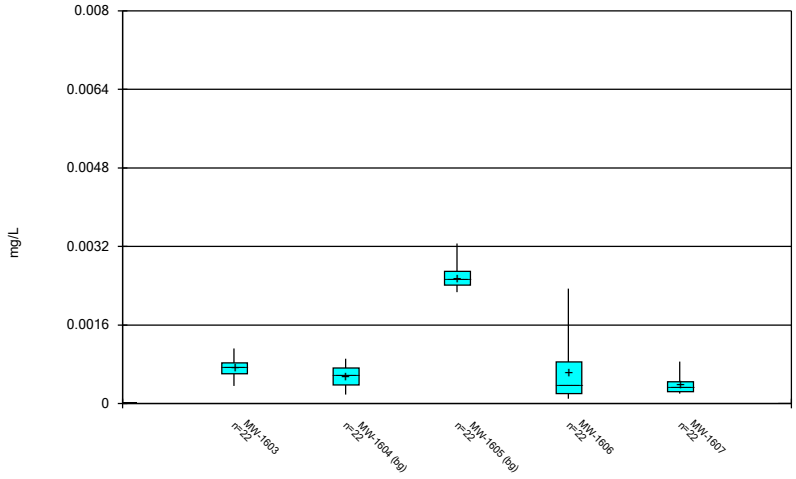
Box & Whiskers Plot



Constituent: Chromium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

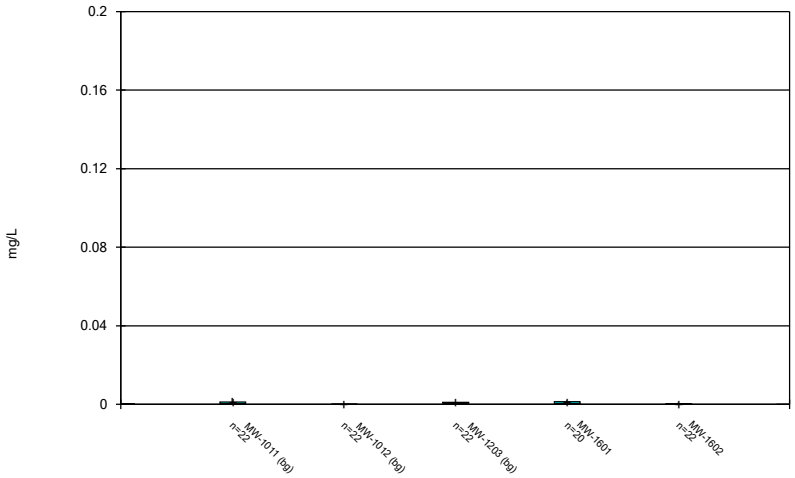
Box & Whiskers Plot



Constituent: Chromium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

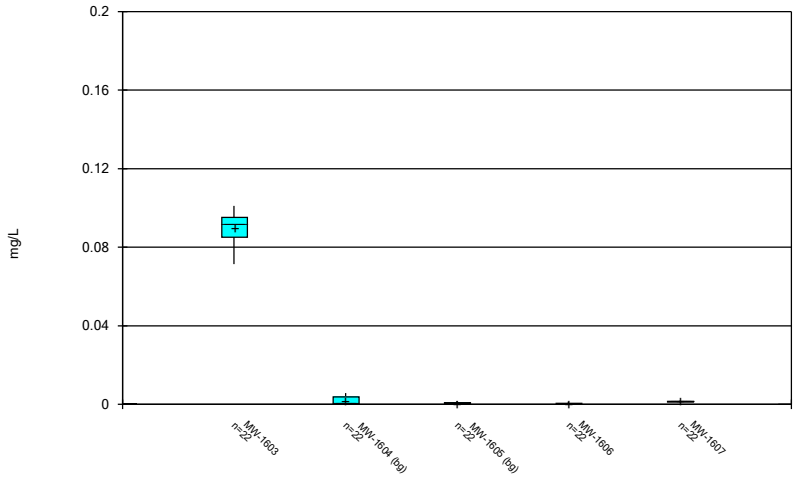
Box & Whiskers Plot



Constituent: Cobalt Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

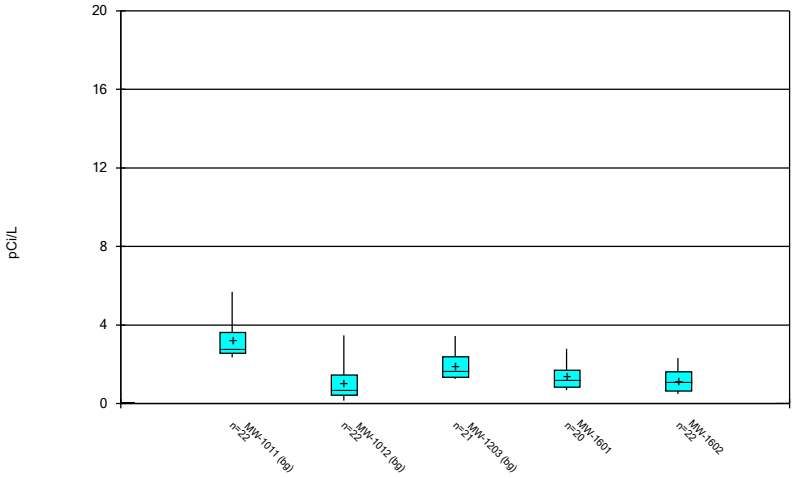
Box & Whiskers Plot



Constituent: Cobalt Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

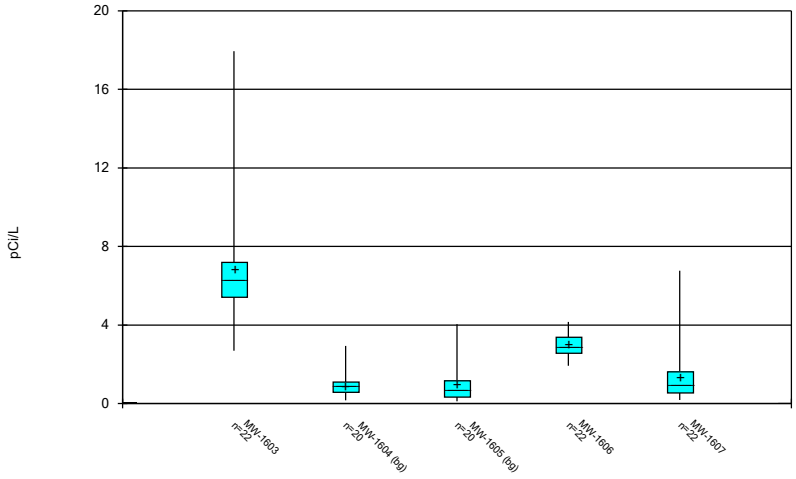
Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

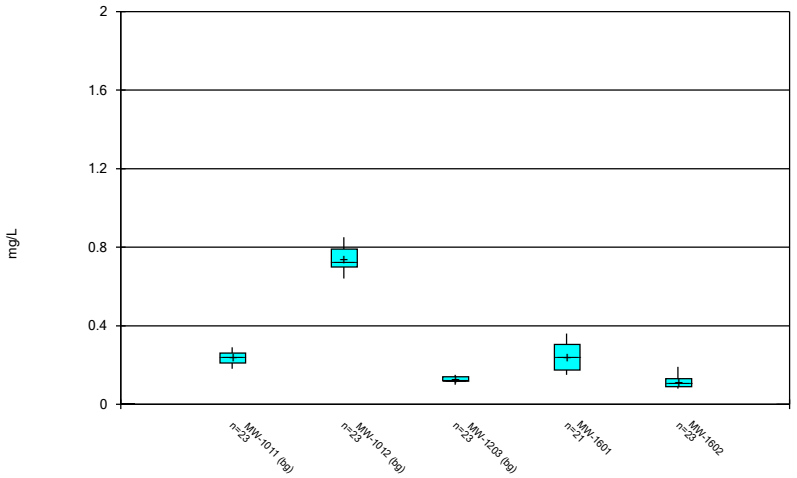
Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

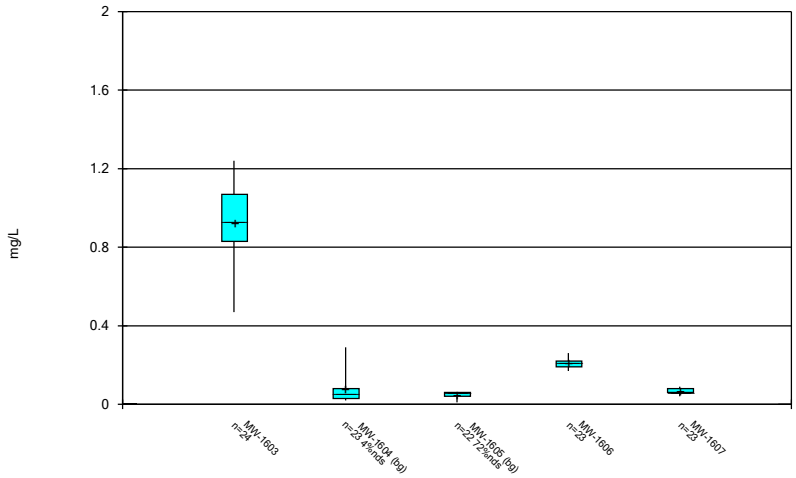
Box & Whiskers Plot



Constituent: Fluoride Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

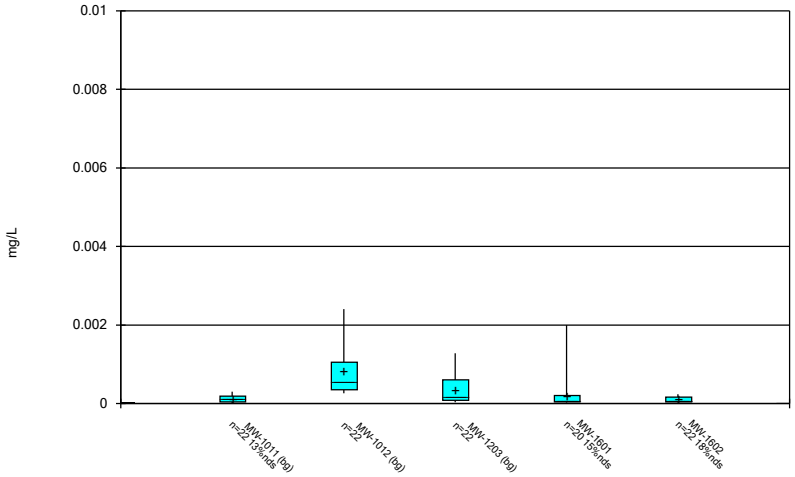
Box & Whiskers Plot



Constituent: Fluoride Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

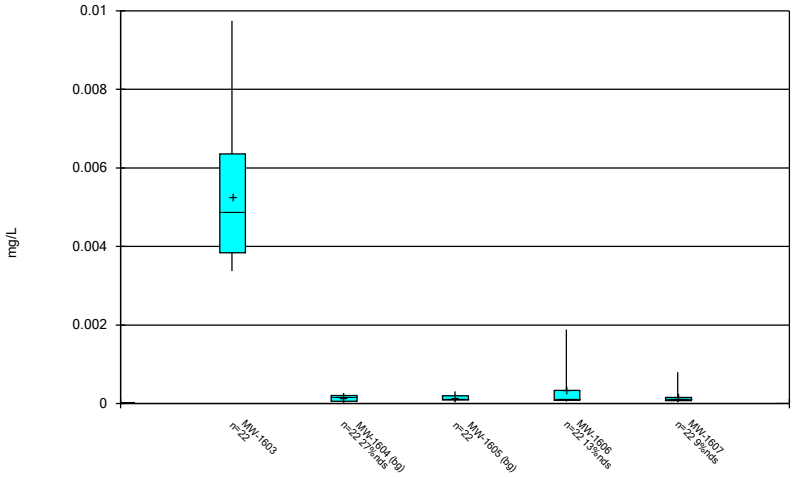
Box & Whiskers Plot



Constituent: Lead Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

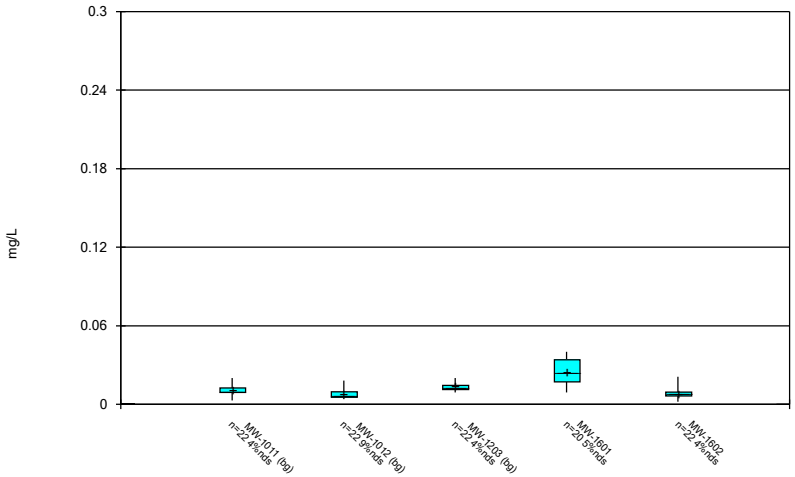
Box & Whiskers Plot



Constituent: Lead Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

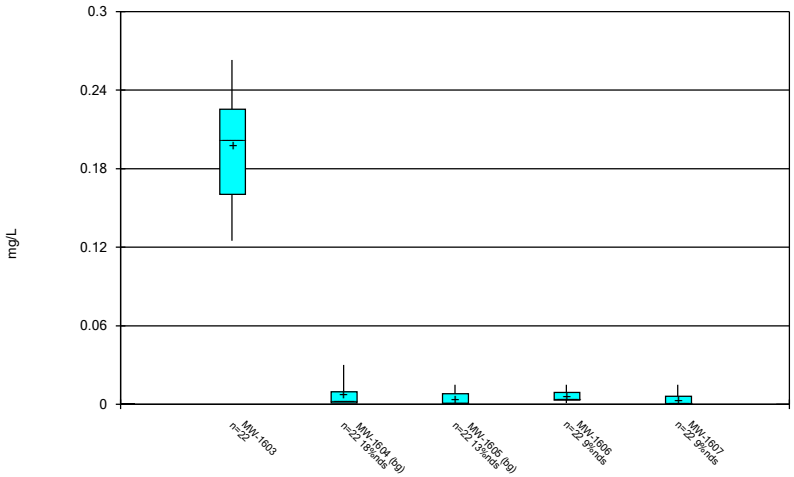
Box & Whiskers Plot



Constituent: Lithium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

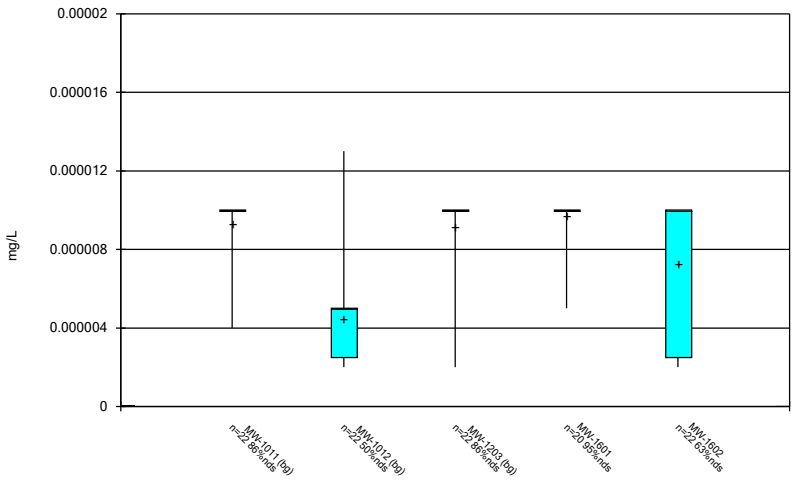
Box & Whiskers Plot



Constituent: Lithium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

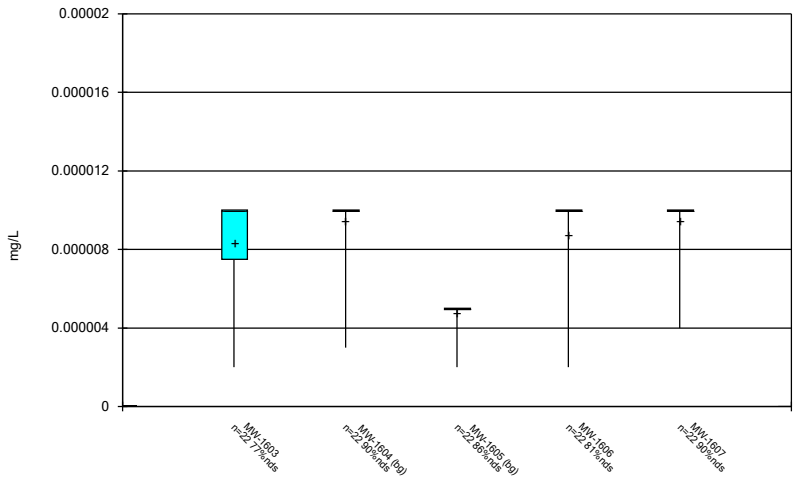
Box & Whiskers Plot



Constituent: Mercury Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

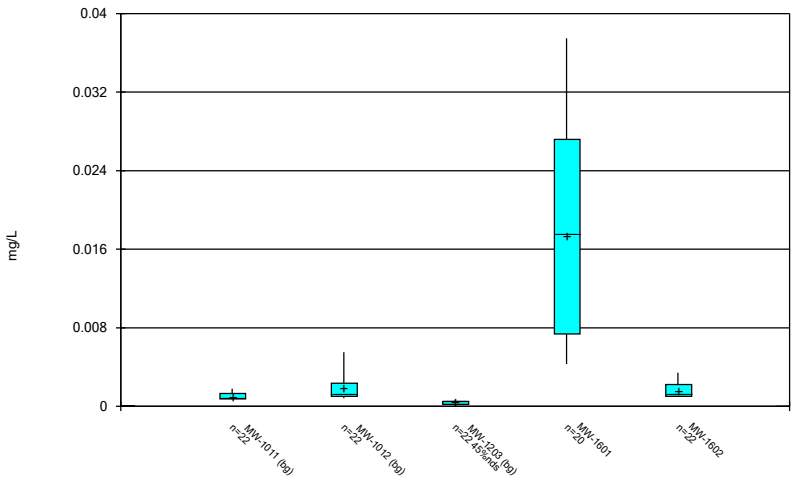
Box & Whiskers Plot



Constituent: Mercury Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

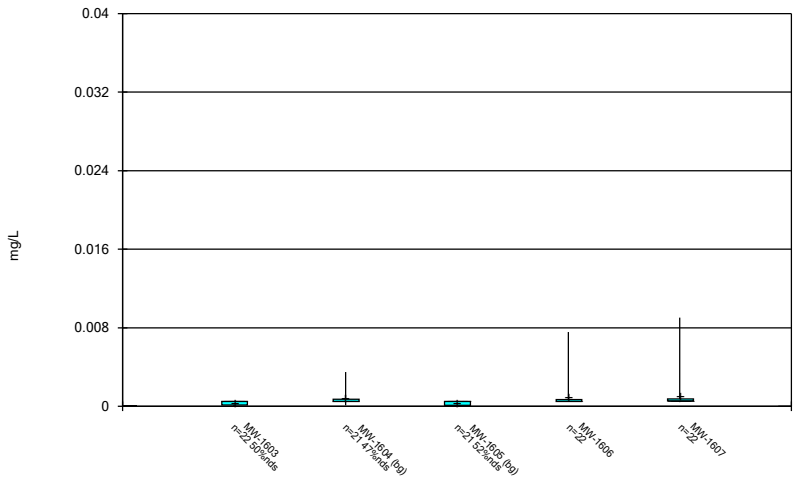
Box & Whiskers Plot



Constituent: Molybdenum Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

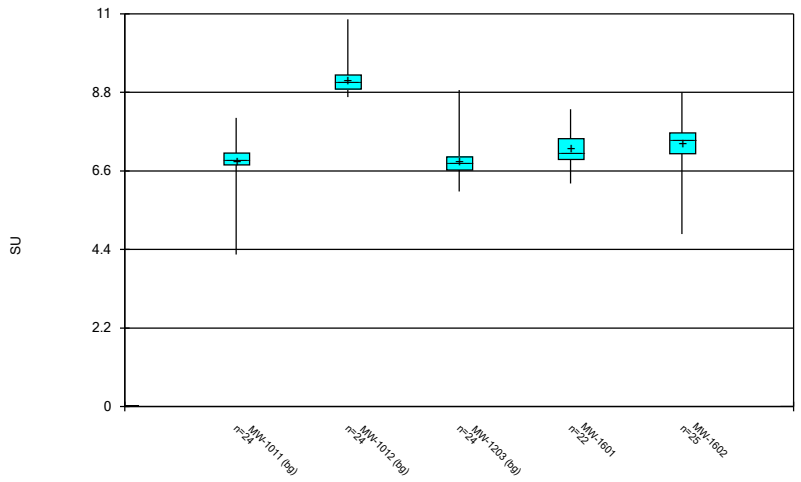
Box & Whiskers Plot



Constituent: Molybdenum Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

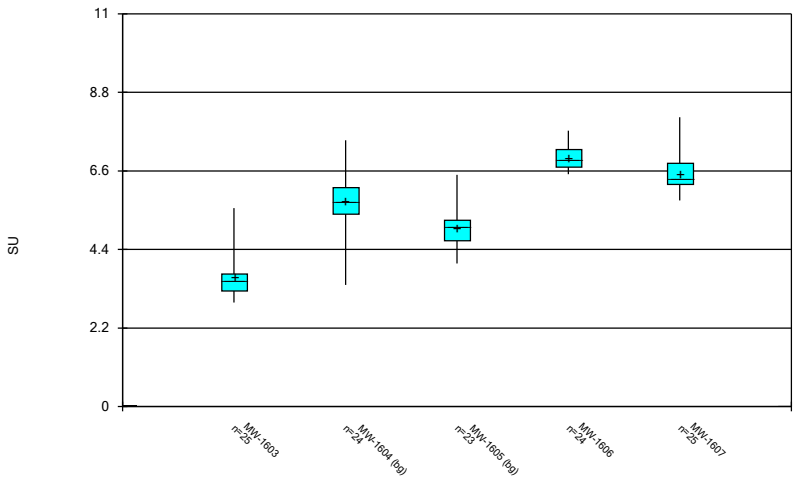
Box & Whiskers Plot



Constituent: pH Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

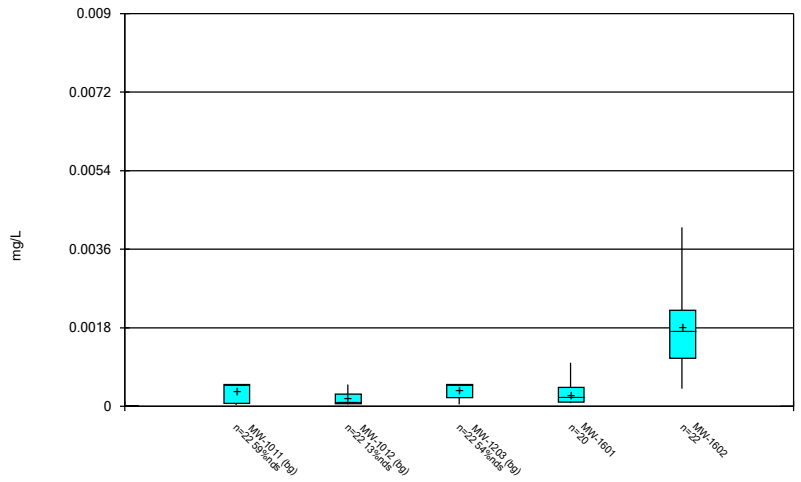
Box & Whiskers Plot



Constituent: pH Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

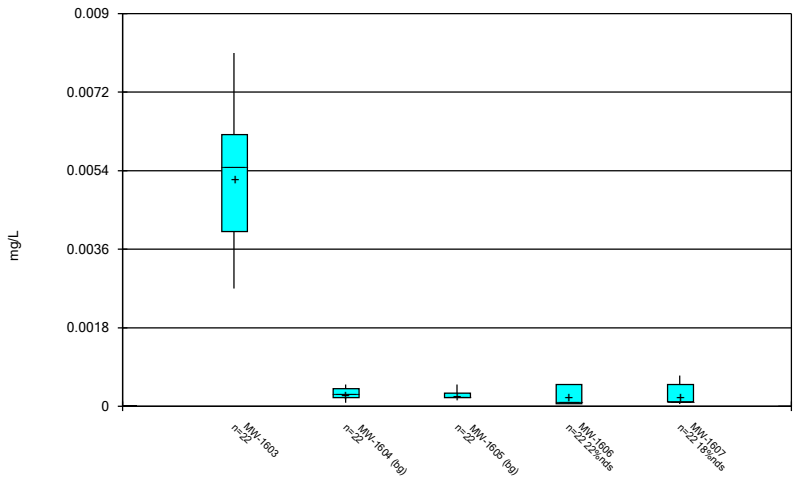
Box & Whiskers Plot



Constituent: Selenium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

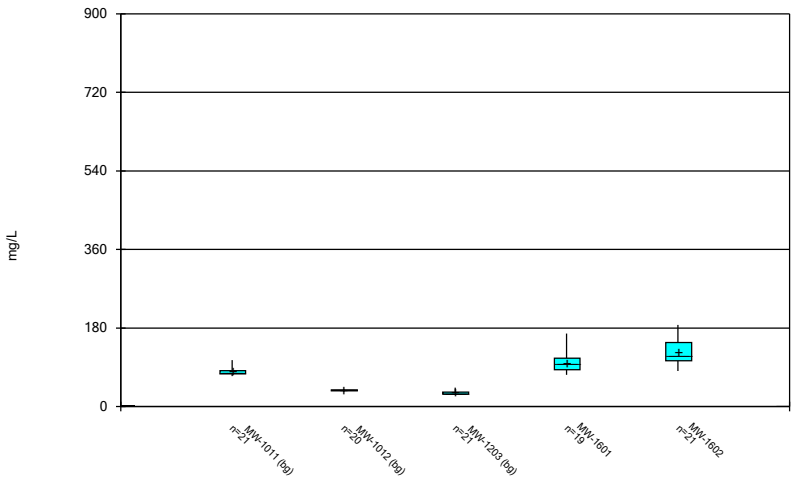
Box & Whiskers Plot



Constituent: Selenium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

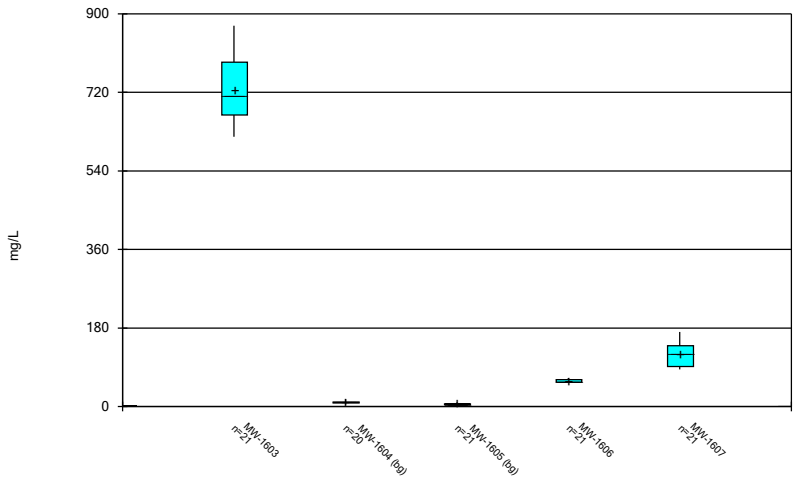
Box & Whiskers Plot



Constituent: Sulfate Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

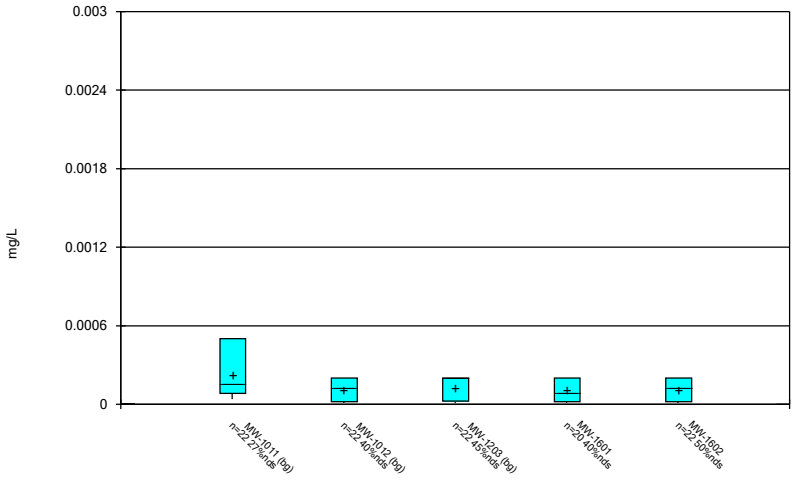
Box & Whiskers Plot



Constituent: Sulfate Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

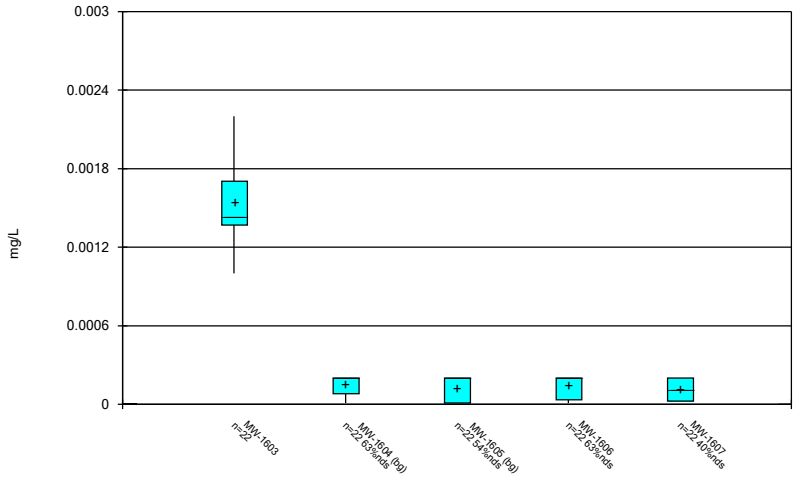
Box & Whiskers Plot



Constituent: Thallium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

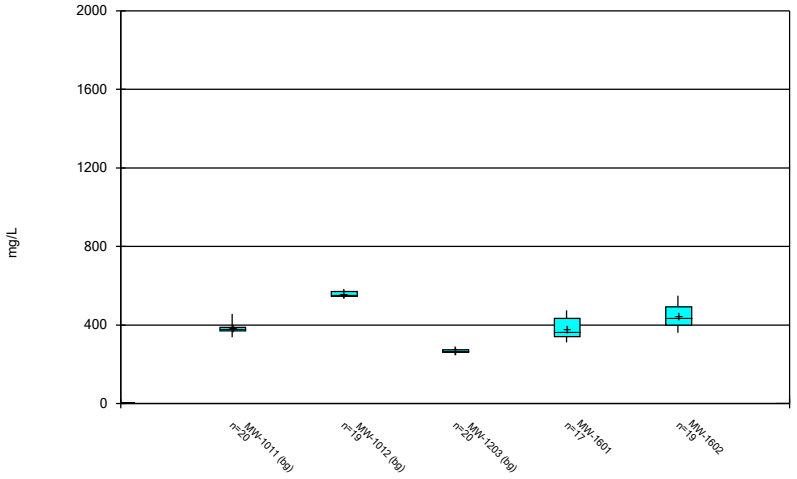
Sanitas™ v.9.6.36 . UG

Box & Whiskers Plot



Constituent: Thallium Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

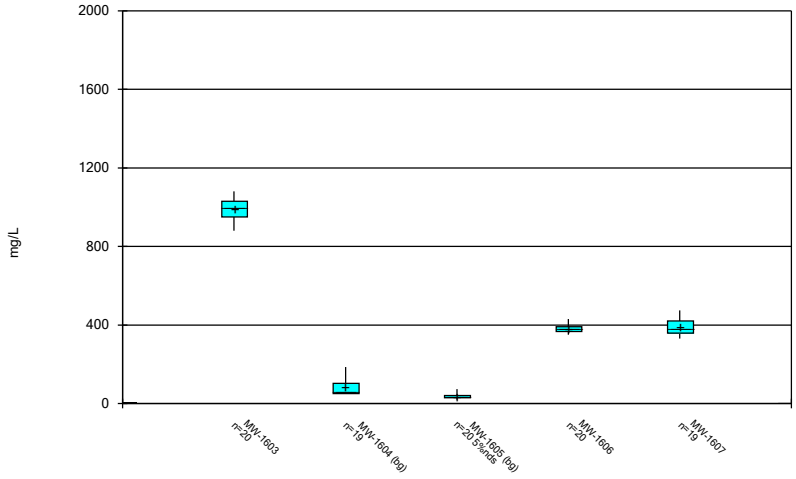
Box & Whiskers Plot



Constituent: Total Dissolved Solids Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Box & Whiskers Plot



Constituent: Total Dissolved Solids Analysis Run 1/12/2023 9:32 AM View: Descriptive
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

FIGURE C

Outlier Summary and Tukey's Outlier Test

Outlier Summary

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 1/12/2023, 9:34 AM

	MW-1012 Arsenic (mg/L)	MW-1012 Chromium (mg/L)	MW-1203 Combined Radium 226 + 228 (pCi/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-1605 pH (SU)	MW-1606 pH (SU)
11/8/2016								2.26 (o)	
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)		
3/17/2020			7.524 (o)						
3/18/2020									9.11 (o)
3/24/2022	0.0499 (o)								
6/15/2022	0.0454 (o)								
10/12/2022	0.0386 (o)								

FIGURE D

Mann-Whitney

Mann Whitney - All Results (No Significant)

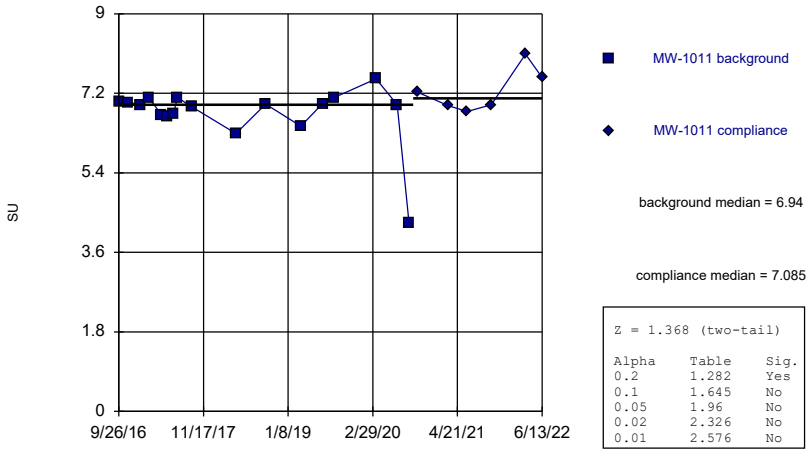
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 1/24/2023, 9:16 PM

Constituent	Well	Calc.	0.01	Sig.	Method
pH (SU)	MW-1011 (bg)	1.368	No	No	Mann-W
pH (SU)	MW-1012 (bg)	0.5252	No	No	Mann-W
pH (SU)	MW-1203 (bg)	1.156	No	No	Mann-W
pH (SU)	MW-1601	-0.2065	No	No	Mann-W
pH (SU)	MW-1602	1.1	No	No	Mann-W
pH (SU)	MW-1603	0.6009	No	No	Mann-W
pH (SU)	MW-1604 (bg)	-0.1751	No	No	Mann-W
pH (SU)	MW-1605 (bg)	1.069	No	No	Mann-W
pH (SU)	MW-1606	1.682	No	No	Mann-W
pH (SU)	MW-1607	2.268	No	No	Mann-W

Sanitas™ v.9.6.36 . UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1011 (bg)



Z = 1.368 (two-tail)

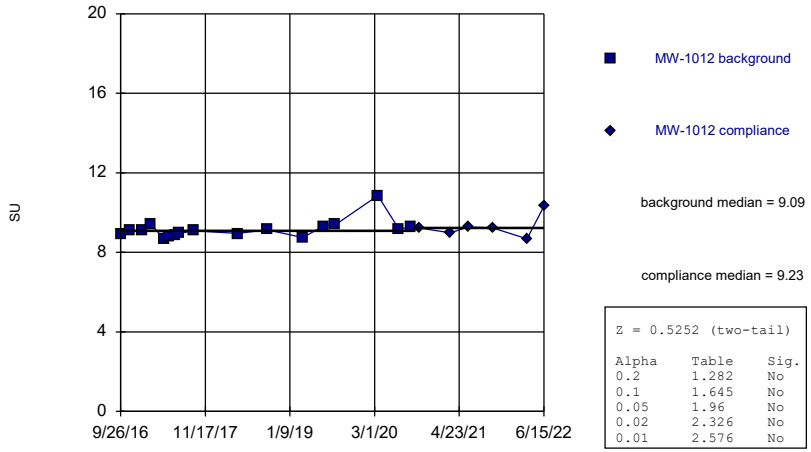
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: pH Analysis Run 1/24/2023 9:13 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1012 (bg)



Z = 0.5252 (two-tail)

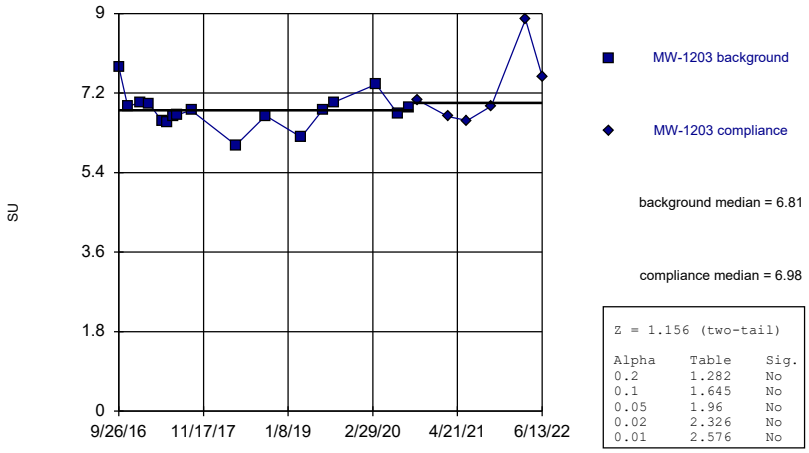
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: pH Analysis Run 1/24/2023 9:13 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1203 (bg)



Z = 1.156 (two-tail)

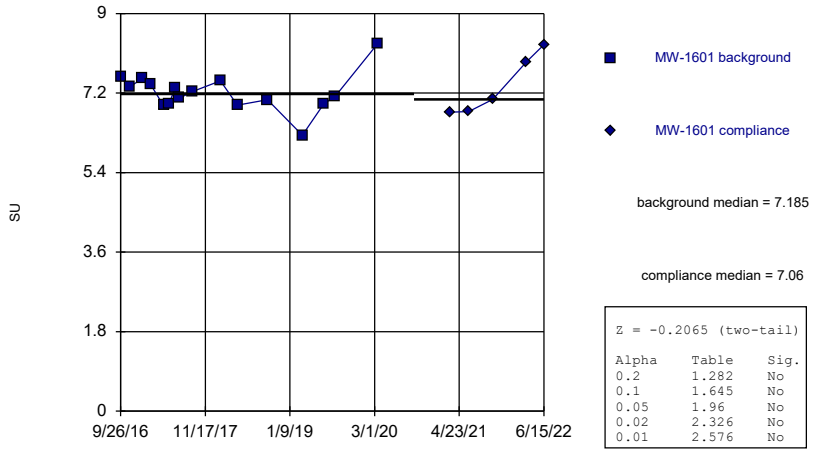
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: pH Analysis Run 1/24/2023 9:13 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1601



Z = -0.2065 (two-tail)

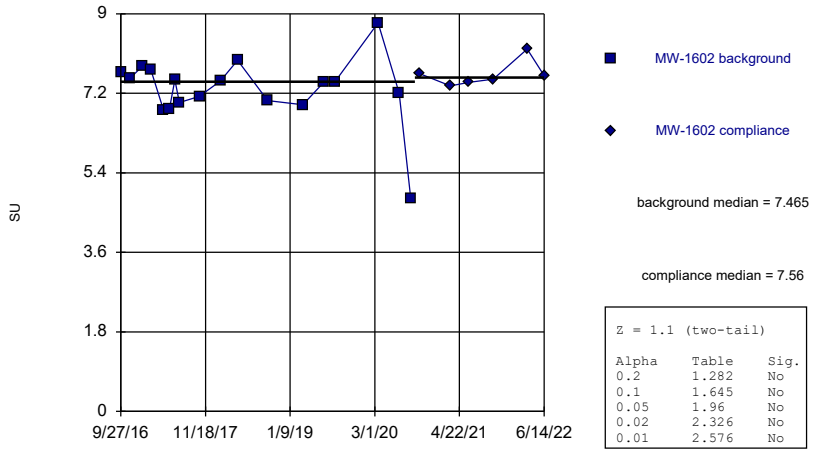
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: pH Analysis Run 1/24/2023 9:13 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1602

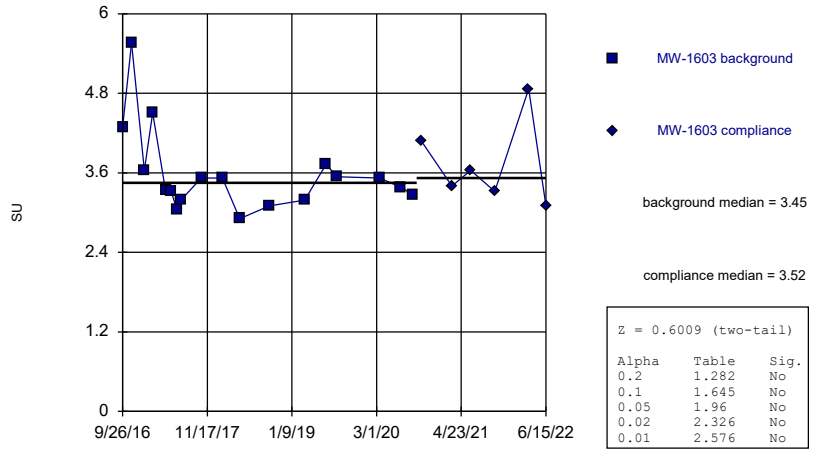


Constituent: pH Analysis Run 1/24/2023 9:13 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1603

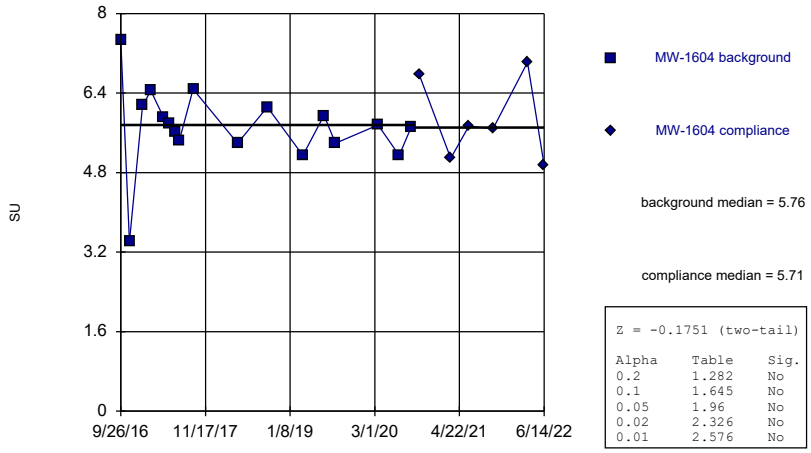


Constituent: pH Analysis Run 1/24/2023 9:13 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1604 (bg)

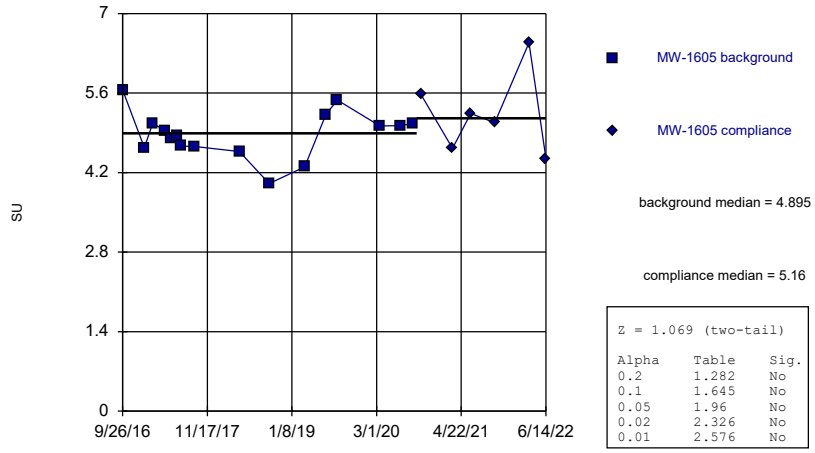


Constituent: pH Analysis Run 1/24/2023 9:13 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Mann-Whitney (Wilcoxon Rank Sum)

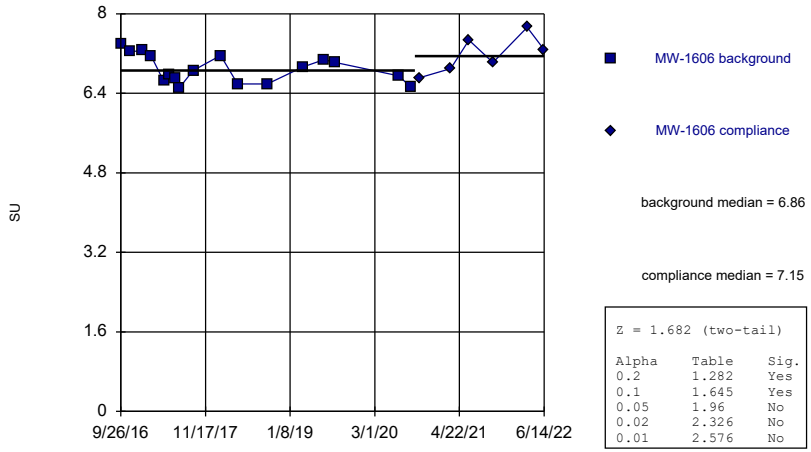
MW-1605 (bg)



Constituent: pH Analysis Run 1/24/2023 9:13 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Mann-Whitney (Wilcoxon Rank Sum)

MW-1606



Z = 1.682 (two-tail)

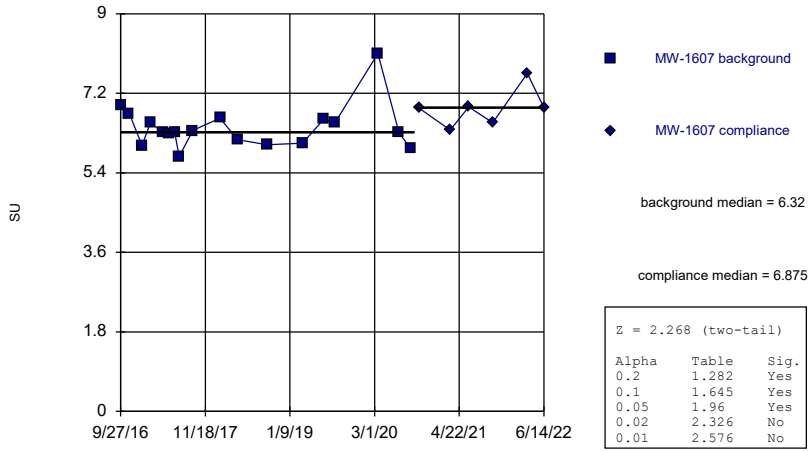
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: pH Analysis Run 1/24/2023 9:13 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1607



Z = 2.268 (two-tail)

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

Constituent: pH Analysis Run 1/24/2023 9:13 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

FIGURE E

Intrawell PL

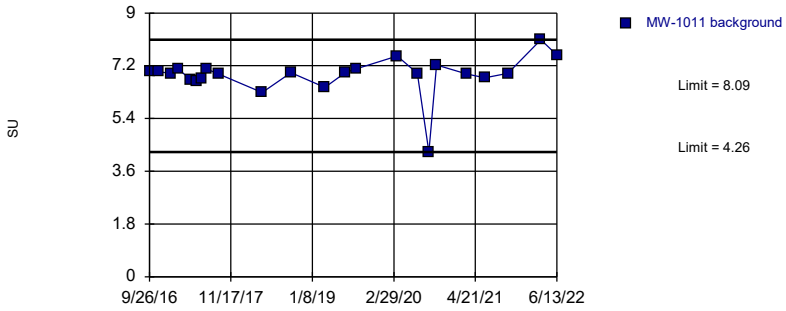
Intrawell Prediction Limits

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 1/24/2023, 9:19 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
pH (SU)	MW-1011	8.09	4.26	n/a	1 future	n/a	23	n/a	n/a	0	n/a	n/a	0.006831	NP Intra (normality) 1 of 2
pH (SU)	MW-1012	10.85	8.69	n/a	1 future	n/a	23	n/a	n/a	0	n/a	n/a	0.006831	NP Intra (normality) 1 of 2
pH (SU)	MW-1203	8.87	6.02	n/a	1 future	n/a	23	n/a	n/a	0	n/a	n/a	0.006831	NP Intra (normality) 1 of 2
pH (SU)	MW-1601	8.266	6.24	n/a	1 future	n/a	21	7.253	0.4956	0	None	No	0.000752	Param Intra 1 of 2
pH (SU)	MW-1602	8.502	5.92	n/a	1 future	n/a	24	411.1	101.6	0	None	x^3	0.000752	Param Intra 1 of 2
pH (SU)	MW-1603	5.56	2.91	n/a	1 future	n/a	24	n/a	n/a	0	n/a	n/a	0.006247	NP Intra (normality) 1 of 2
pH (SU)	MW-1604	7.409	4.12	n/a	1 future	n/a	23	5.764	0.8154	0	None	No	0.000752	Param Intra 1 of 2
pH (SU)	MW-1605	6.047	3.904	n/a	1 future	n/a	22	4.975	0.5277	0	None	No	0.000752	Param Intra 1 of 2
pH (SU)	MW-1606	7.635	6.304	n/a	1 future	n/a	23	6.97	0.33	0	None	No	0.000752	Param Intra 1 of 2
pH (SU)	MW-1607	7.588	5.488	n/a	1 future	n/a	24	6.538	0.5242	0	None	No	0.000752	Param Intra 1 of 2

Prediction Limit

Intrawell Non-parametric, MW-1011 (bg)



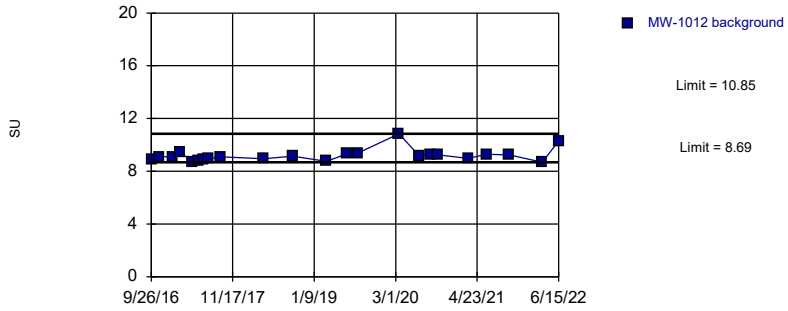
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 23 background values. Well-constituent pair annual alpha = 0.01364. Individual comparison alpha = 0.006831 (1 of 2). Assumes 1 future value.

Constituent: pH Analysis Run 1/24/2023 9:18 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Prediction Limit

Intrawell Non-parametric, MW-1012 (bg)



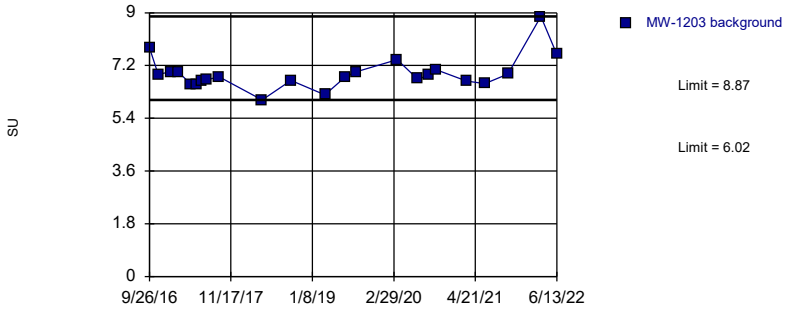
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 23 background values. Well-constituent pair annual alpha = 0.01364. Individual comparison alpha = 0.006831 (1 of 2). Assumes 1 future value.

Constituent: pH Analysis Run 1/24/2023 9:18 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Prediction Limit

Intrawell Non-parametric, MW-1203 (bg)



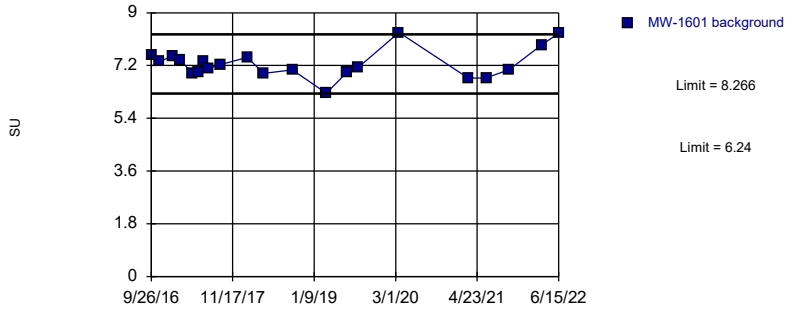
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 23 background values. Well-constituent pair annual alpha = 0.01364. Individual comparison alpha = 0.006831 (1 of 2). Assumes 1 future value.

Constituent: pH Analysis Run 1/24/2023 9:18 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Prediction Limit

Intrawell Parametric, MW-1601

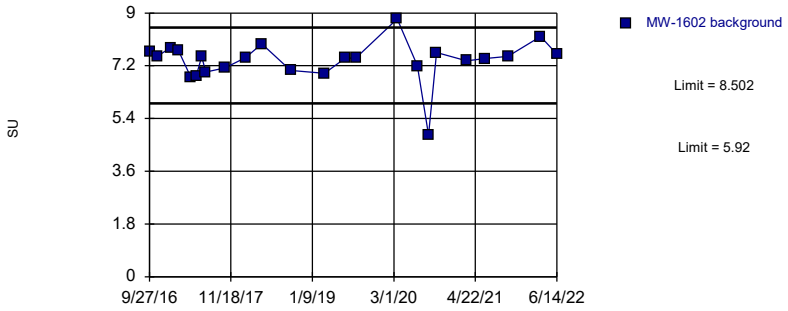


Background Data Summary: Mean=7.253, Std. Dev.=0.4956, n=21. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9369, critical = 0.873. Kappa = 2.044 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH Analysis Run 1/24/2023 9:18 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Prediction Limit

Intrawell Parametric, MW-1602



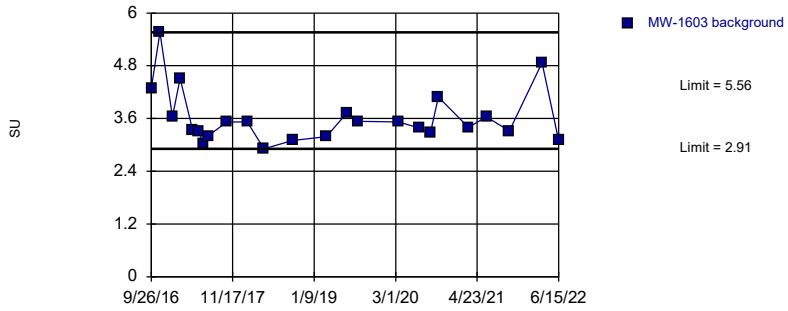
Background Data Summary (based on cube transformation): Mean=411.1, Std. Dev.=101.6, n=24. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9036, critical = 0.884. Kappa = 2.004 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH Analysis Run 1/24/2023 9:18 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Prediction Limit

Intrawell Non-parametric, MW-1603



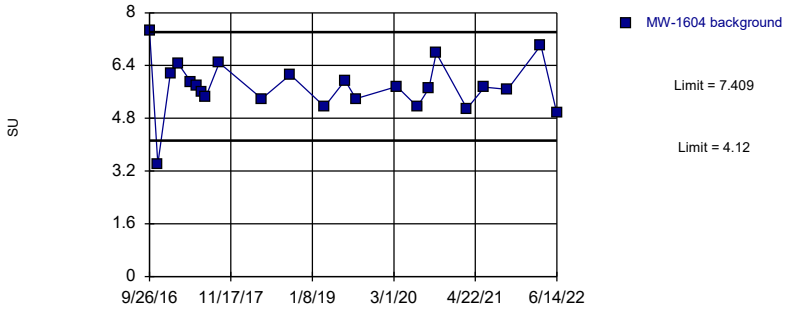
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 24 background values. Well-constituent pair annual alpha = 0.01248. Individual comparison alpha = 0.006247 (1 of 2). Assumes 1 future value.

Constituent: pH Analysis Run 1/24/2023 9:18 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Prediction Limit

Intrawell Parametric, MW-1604 (bg)



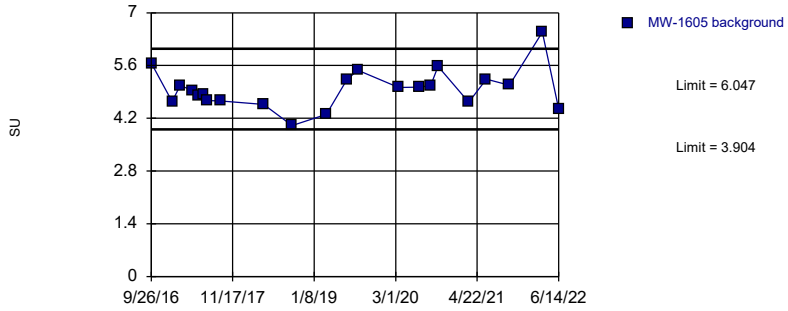
Background Data Summary: Mean=5.764, Std. Dev.=0.8154, n=23. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9412, critical = 0.881. Kappa = 2.017 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH Analysis Run 1/24/2023 9:18 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Prediction Limit

Intrawell Parametric, MW-1605 (bg)

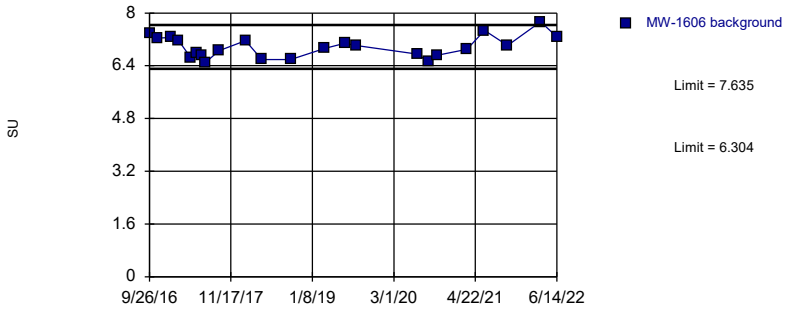


Background Data Summary: Mean=4.975, Std. Dev.=0.5277, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9452, critical = 0.878. Kappa = 2.031 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH Analysis Run 1/24/2023 9:18 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Prediction Limit

Intrawell Parametric, MW-1606



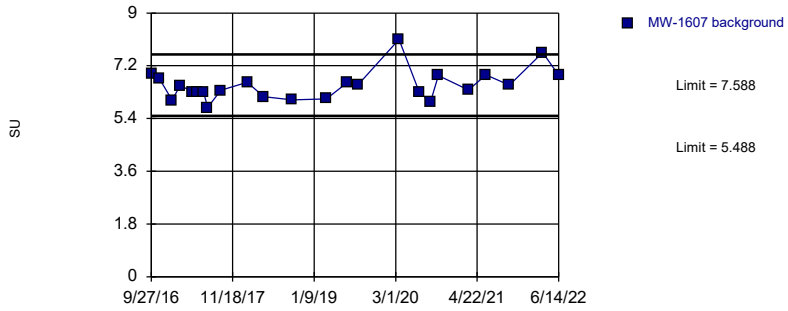
Background Data Summary: Mean=6.97, Std. Dev.=0.33, n=23. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9598, critical = 0.881. Kappa = 2.017 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH Analysis Run 1/24/2023 9:18 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Prediction Limit

Intrawell Parametric, MW-1607



Background Data Summary: Mean=6.538, Std. Dev.=0.5242, n=24. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8903, critical = 0.884. Kappa = 2.004 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH Analysis Run 1/24/2023 9:18 PM View: AIII Intrawell
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

FIGURE F

Trend Test

Trend Test - Upgradient Wells - Significant Results

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 1/9/2023, 3:49 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Chloride (mg/L)	**MW-1012 (bg)**	**0.03784**	**95**	**81**	**Yes**	**20**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride (mg/L)	**MW-1604 (bg)**	**-0.2668**	**-152**	**-81**	**Yes**	**20**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Fluoride (mg/L)	**MW-1011 (bg)**	**0.01022**	**110**	**98**	**Yes**	**23**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Fluoride (mg/L)	**MW-1012 (bg)**	**0.01751**	**107**	**98**	**Yes**	**23**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Fluoride (mg/L)	**MW-1604 (bg)**	**-0.01225**	**-171**	**-98**	**Yes**	**23**	**4.348**	**n/a**	**n/a**	**0.01**	**NP**
Total Dissolved Solids (mg/L)	**MW-1604 (bg)**	**-10.82**	**-86**	**-74**	**Yes**	**19**	**0**	**n/a**	**n/a**	**0.01**	**NP**

Trend Test - Upgradient Wells - All Results

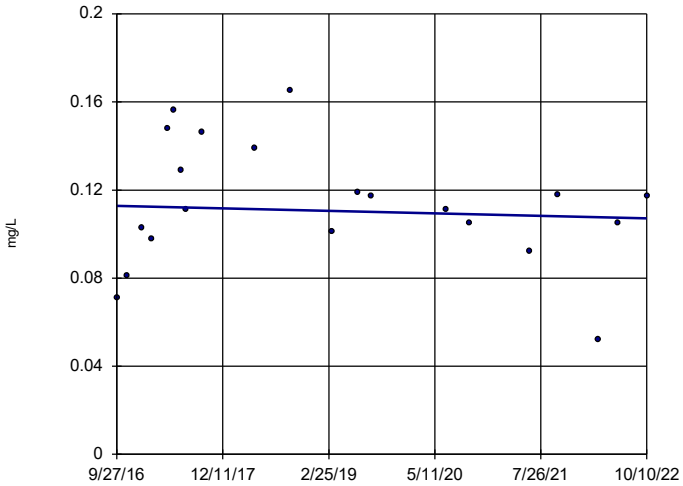
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 1/9/2023, 3:49 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron (mg/L)	MW-1011 (bg)	-0.0009553	-9	-87	No	21	0	n/a	n/a	0.01	NP
Boron (mg/L)	MW-1012 (bg)	0.002493	38	81	No	20	0	n/a	n/a	0.01	NP
Boron (mg/L)	MW-1203 (bg)	-0.0004677	-11	-87	No	21	0	n/a	n/a	0.01	NP
Boron (mg/L)	MW-1604 (bg)	-0.0009309	-18	-81	No	20	15	n/a	n/a	0.01	NP
Boron (mg/L)	MW-1605 (bg)	0	-7	-87	No	21	28.57	n/a	n/a	0.01	NP
Calcium (mg/L)	MW-1011 (bg)	1.25	70	87	No	21	0	n/a	n/a	0.01	NP
Calcium (mg/L)	MW-1012 (bg)	0.009837	17	81	No	20	0	n/a	n/a	0.01	NP
Calcium (mg/L)	MW-1203 (bg)	0.4712	34	87	No	21	0	n/a	n/a	0.01	NP
Calcium (mg/L)	MW-1604 (bg)	-0.04787	-17	-81	No	20	0	n/a	n/a	0.01	NP
Calcium (mg/L)	MW-1605 (bg)	0.01015	21	87	No	21	0	n/a	n/a	0.01	NP
Chloride (mg/L)	MW-1011 (bg)	0.3488	83	87	No	21	0	n/a	n/a	0.01	NP
Chloride (mg/L)	**MW-1012 (bg)**	**0.03784**	**95**	**81**	**Yes**	**20**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride (mg/L)	MW-1203 (bg)	-0.05428	-52	-87	No	21	0	n/a	n/a	0.01	NP
Chloride (mg/L)	**MW-1604 (bg)**	**-0.2668**	**-152**	**-81**	**Yes**	**20**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride (mg/L)	MW-1605 (bg)	-0.0618	-73	-87	No	21	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	**MW-1011 (bg)**	**0.01022**	**110**	**98**	**Yes**	**23**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Fluoride (mg/L)	**MW-1012 (bg)**	**0.01751**	**107**	**98**	**Yes**	**23**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Fluoride (mg/L)	MW-1203 (bg)	0	20	98	No	23	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	**MW-1604 (bg)**	**-0.01225**	**-171**	**-98**	**Yes**	**23**	**4.348**	**n/a**	**n/a**	**0.01**	**NP**
Fluoride (mg/L)	MW-1605 (bg)	0	-33	-92	No	22	72.73	n/a	n/a	0.01	NP
Sulfate (mg/L)	MW-1011 (bg)	1.265	84	87	No	21	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	MW-1012 (bg)	0	1	81	No	20	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	MW-1203 (bg)	0.1722	17	87	No	21	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	MW-1604 (bg)	0.2992	47	81	No	20	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	MW-1605 (bg)	-0.03014	-12	-87	No	21	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	MW-1011 (bg)	3.828	77	81	No	20	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	MW-1012 (bg)	4.443	67	74	No	19	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	MW-1203 (bg)	0	0	81	No	20	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	**MW-1604 (bg)**	**-10.82**	**-86**	**-74**	**Yes**	**19**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Total Dissolved Solids (mg/L)	MW-1605 (bg)	0.9558	30	81	No	20	5	n/a	n/a	0.01	NP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1011 (bg)



n = 21

Slope = -0.0009553 units per year.

Mann-Kendall statistic = -9
critical = -87

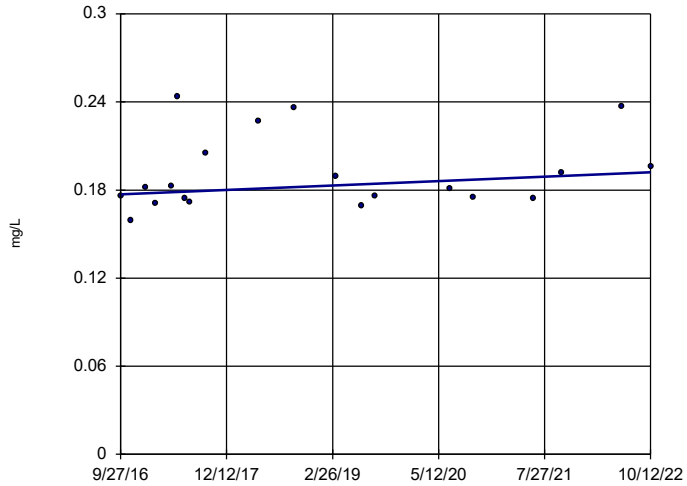
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 1/9/2023 3:46 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1012 (bg)



n = 20

Slope = 0.002493 units per year.

Mann-Kendall statistic = 38
critical = 81

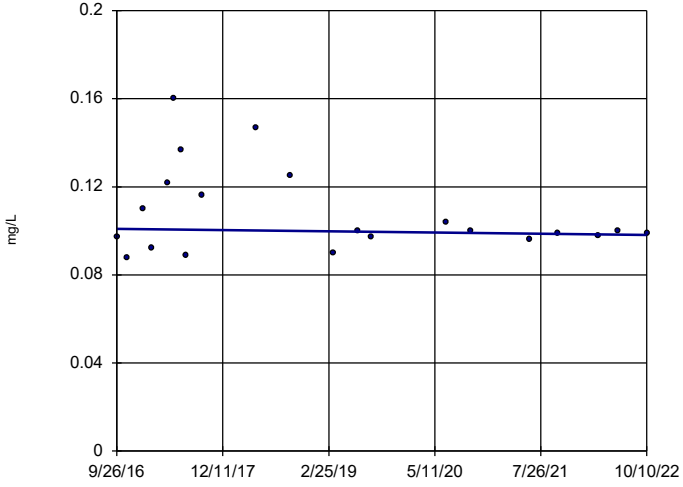
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 1/9/2023 3:46 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1203 (bg)



n = 21

Slope = -0.0004677 units per year.

Mann-Kendall statistic = -11
critical = -87

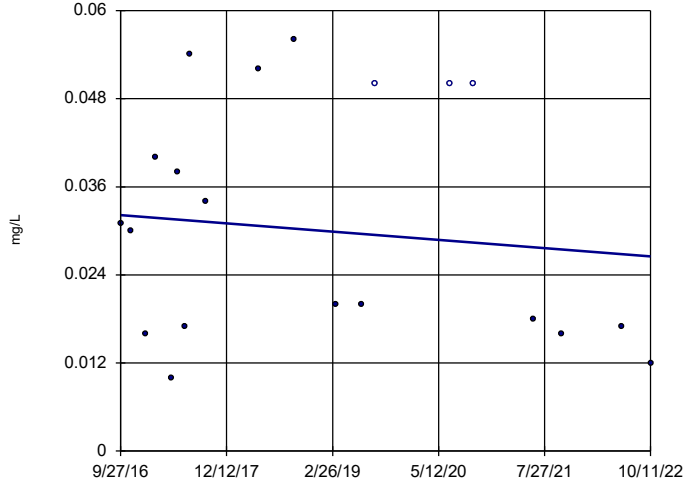
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 1/9/2023 3:46 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

MW-1604 (bg)



n = 20

Slope = -0.0009309 units per year.

Mann-Kendall statistic = -18
critical = -81

Trend not significant at 99% confidence level (α = 0.005 per tail).

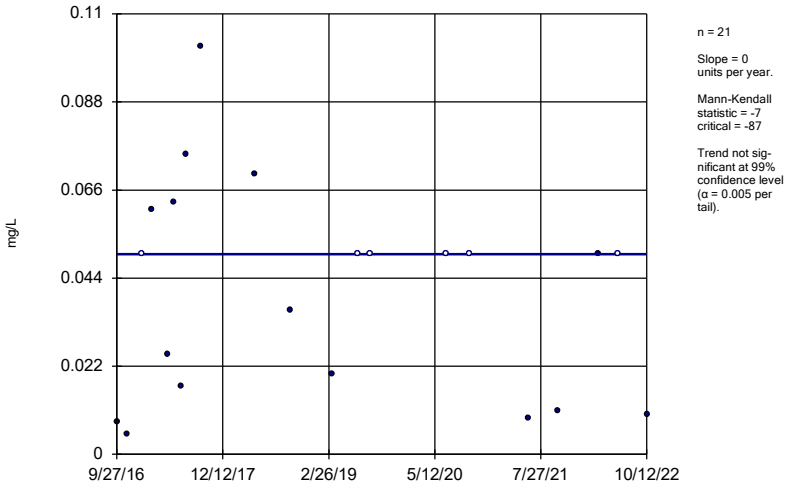
Constituent: Boron Analysis Run 1/9/2023 3:46 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Hollow symbols indicate censored values.

Sen's Slope Estimator

MW-1605 (bg)



n = 21

Slope = 0 units per year.

Mann-Kendall statistic = -7 critical = -87

Trend not significant at 99% confidence level (α = 0.005 per tail).

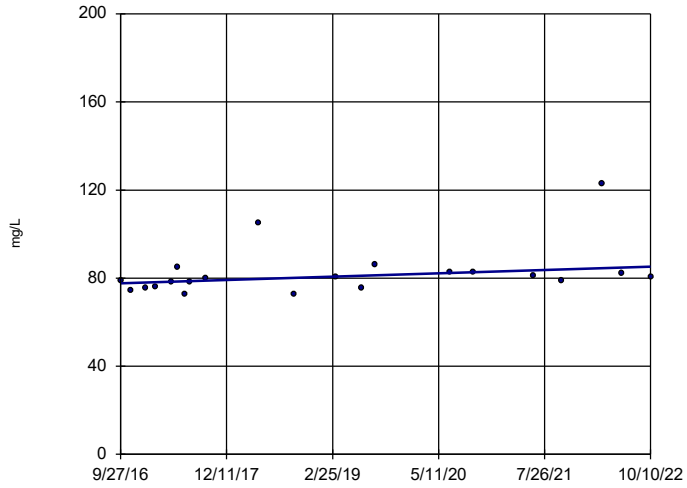
Constituent: Boron Analysis Run 1/9/2023 3:46 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1011 (bg)



n = 21

Slope = 1.25 units per year.

Mann-Kendall statistic = 70 critical = 87

Trend not significant at 99% confidence level (α = 0.005 per tail).

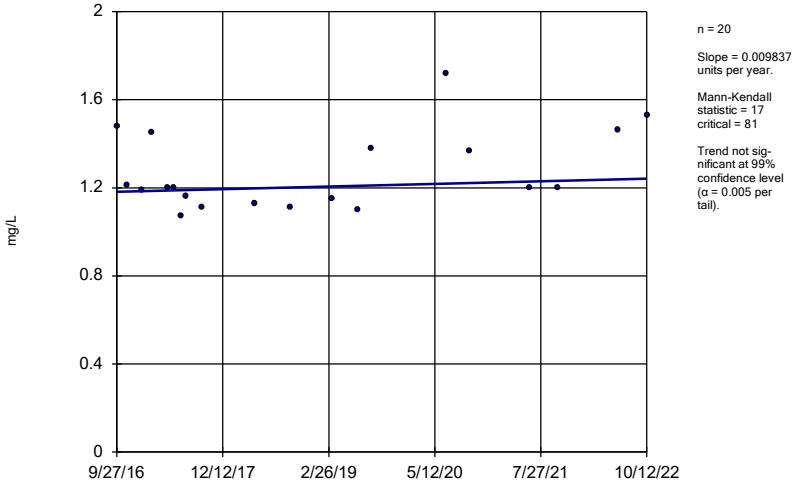
Constituent: Calcium Analysis Run 1/9/2023 3:46 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1012 (bg)



n = 20

Slope = 0.009837 units per year.

Mann-Kendall statistic = 17 critical = 81

Trend not significant at 99% confidence level (α = 0.005 per tail).

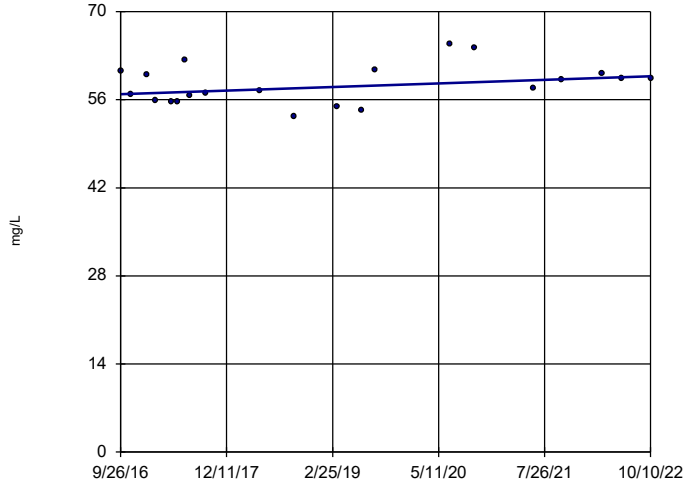
Constituent: Calcium Analysis Run 1/9/2023 3:46 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1203 (bg)



n = 21

Slope = 0.4712 units per year.

Mann-Kendall statistic = 34 critical = 87

Trend not significant at 99% confidence level (α = 0.005 per tail).

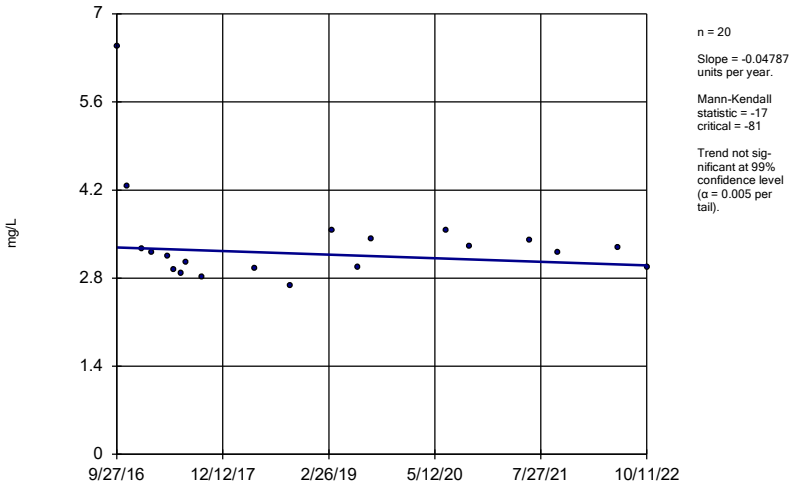
Constituent: Calcium Analysis Run 1/9/2023 3:46 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1604 (bg)



n = 20

Slope = -0.04787 units per year.

Mann-Kendall statistic = -17 critical = -81

Trend not significant at 99% confidence level (α = 0.005 per tail).

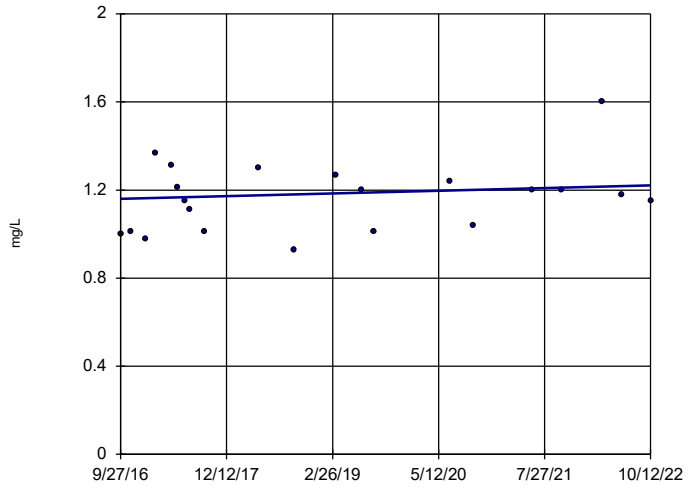
Constituent: Calcium Analysis Run 1/9/2023 3:46 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1605 (bg)



n = 21

Slope = 0.01015 units per year.

Mann-Kendall statistic = 21 critical = 87

Trend not significant at 99% confidence level (α = 0.005 per tail).

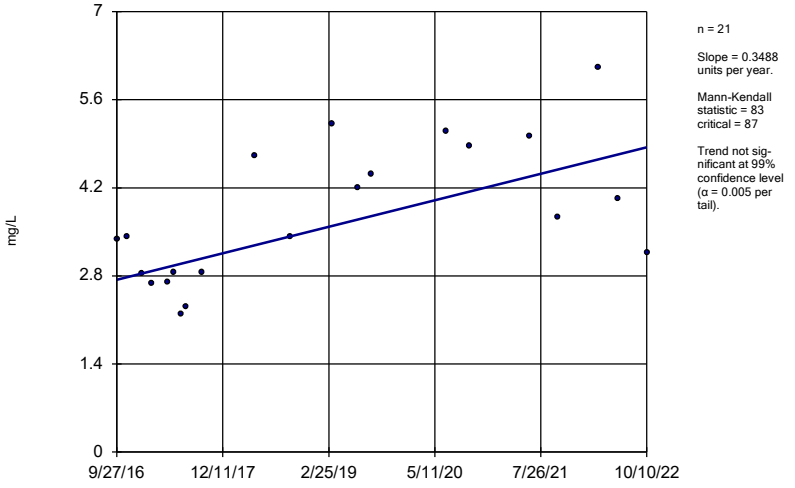
Constituent: Calcium Analysis Run 1/9/2023 3:46 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1011 (bg)



n = 21

Slope = 0.3488 units per year.

Mann-Kendall statistic = 83 critical = 87

Trend not significant at 99% confidence level (α = 0.005 per tail).

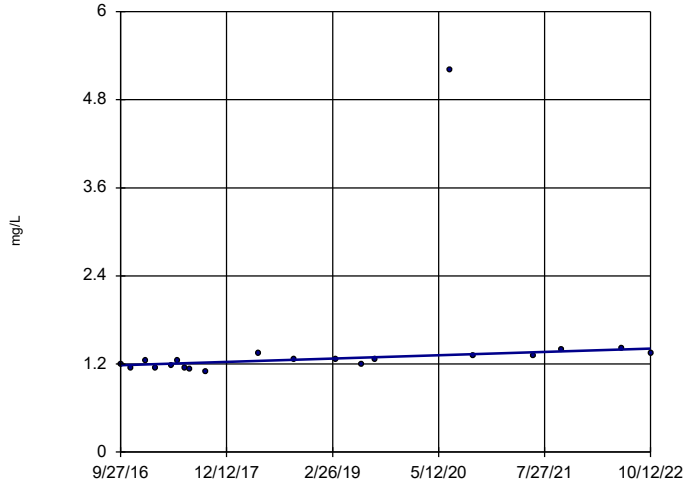
Constituent: Chloride Analysis Run 1/9/2023 3:46 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1012 (bg)



n = 20

Slope = 0.03784 units per year.

Mann-Kendall statistic = 95 critical = 81

Increasing trend significant at 99% confidence level (α = 0.005 per tail).

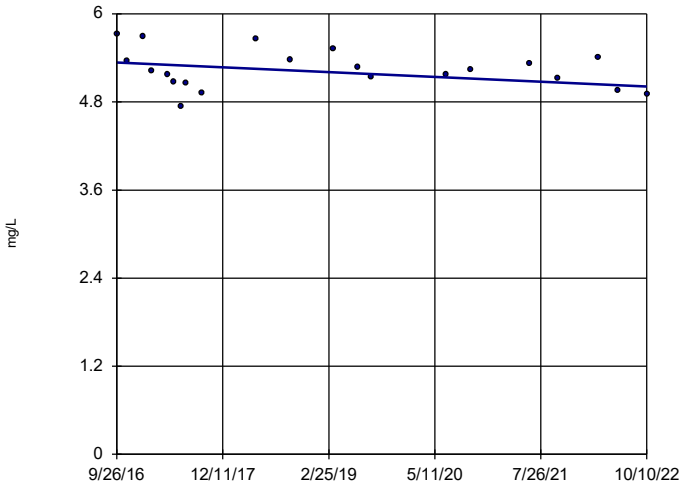
Constituent: Chloride Analysis Run 1/9/2023 3:46 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1203 (bg)



n = 21

Slope = -0.05428 units per year.

Mann-Kendall statistic = -52
critical = -87

Trend not significant at 99% confidence level (α = 0.005 per tail).

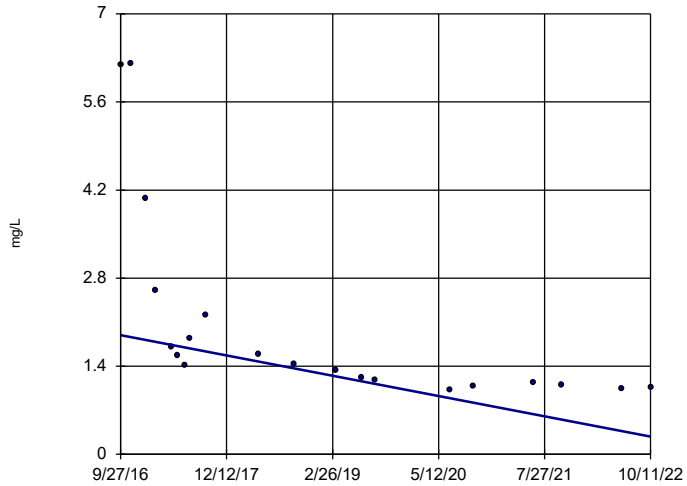
Constituent: Chloride Analysis Run 1/9/2023 3:46 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1604 (bg)



n = 20

Slope = -0.2668 units per year.

Mann-Kendall statistic = -152
critical = -81

Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

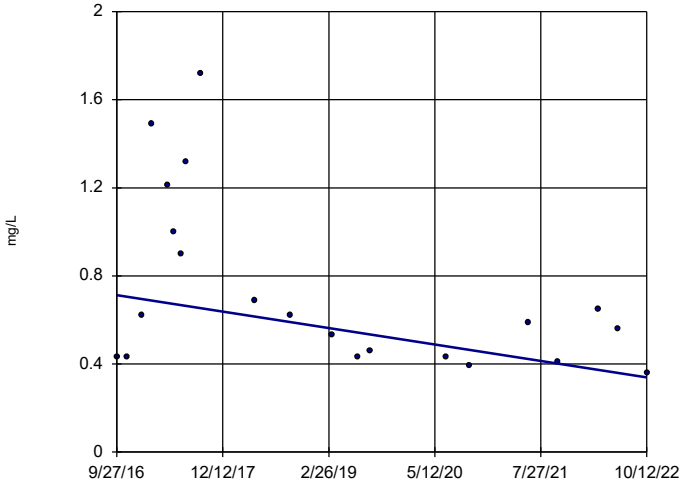
Constituent: Chloride Analysis Run 1/9/2023 3:46 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1605 (bg)



n = 21

Slope = -0.0618 units per year.

Mann-Kendall statistic = -73
critical = -87

Trend not significant at 99% confidence level (α = 0.005 per tail).

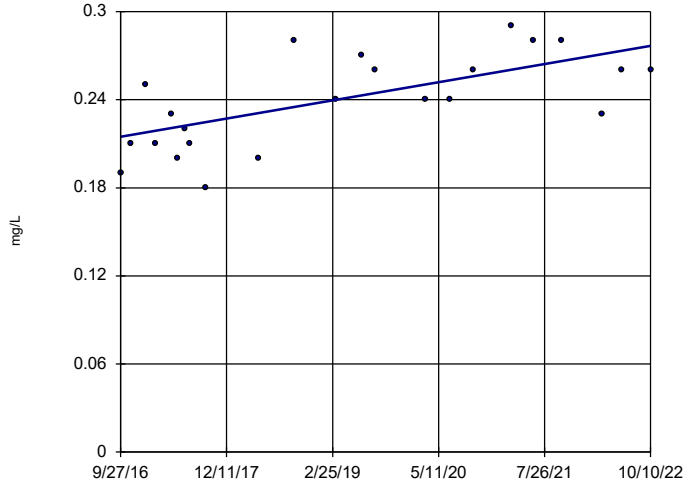
Constituent: Chloride Analysis Run 1/9/2023 3:46 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1011 (bg)



n = 23

Slope = 0.01022 units per year.

Mann-Kendall statistic = 110
critical = 98

Increasing trend significant at 99% confidence level (α = 0.005 per tail).

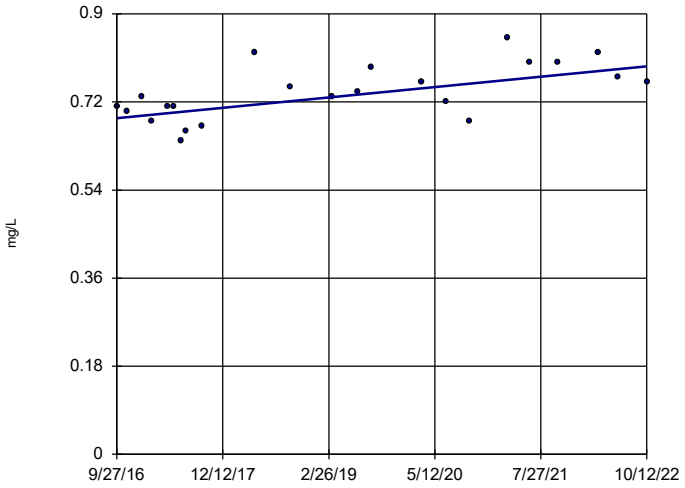
Constituent: Fluoride Analysis Run 1/9/2023 3:46 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1012 (bg)



n = 23

Slope = 0.01751 units per year.

Mann-Kendall statistic = 107
critical = 98

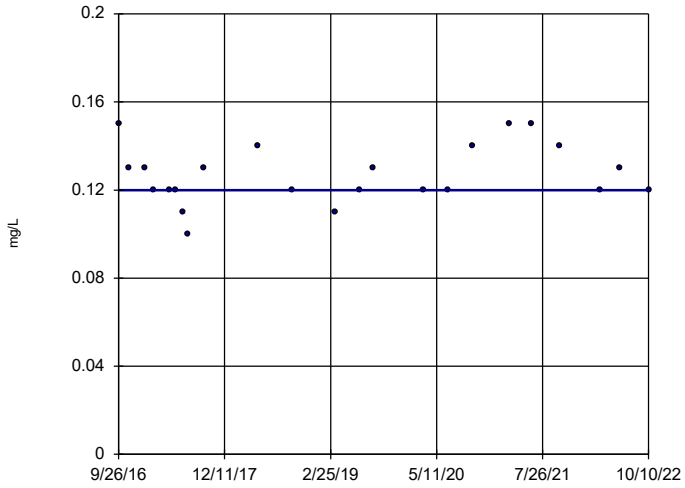
Increasing trend significant at 99% confidence level (α = 0.005 per tail).

Constituent: Fluoride Analysis Run 1/9/2023 3:46 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1203 (bg)



n = 23

Slope = 0 units per year.

Mann-Kendall statistic = 20
critical = 98

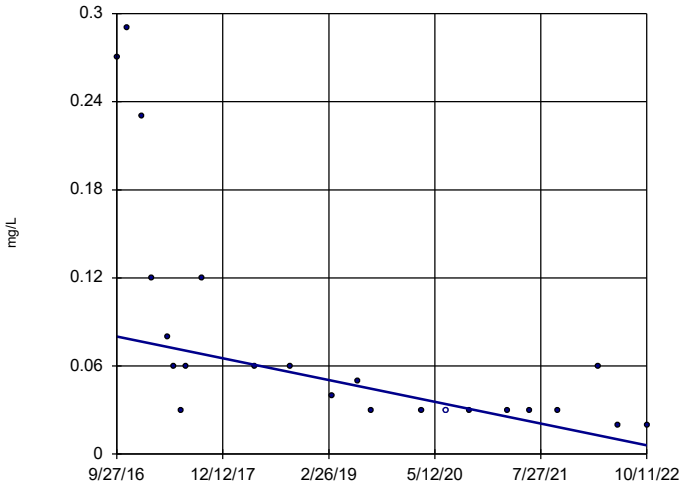
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Fluoride Analysis Run 1/9/2023 3:46 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

MW-1604 (bg)



n = 23

Slope = -0.01225 units per year.

Mann-Kendall statistic = -171
critical = -98

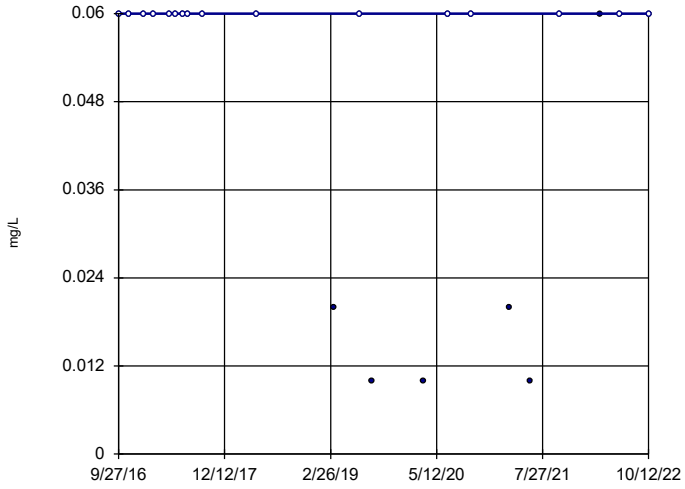
Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

Constituent: Fluoride Analysis Run 1/9/2023 3:46 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

MW-1605 (bg)



n = 22

Slope = 0 units per year.

Mann-Kendall statistic = -33
critical = -92

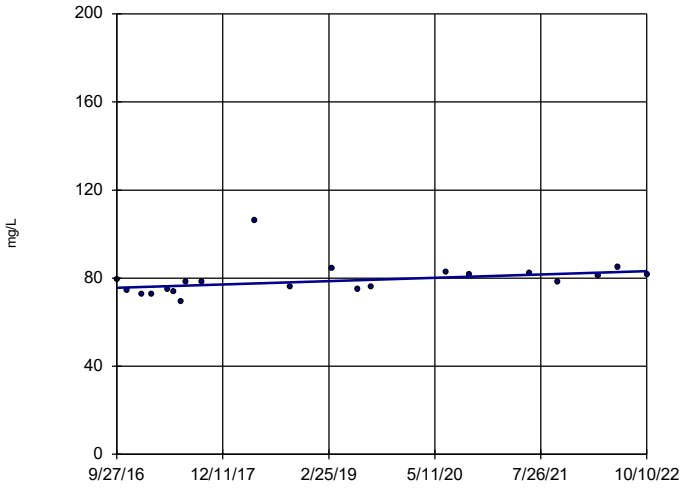
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Fluoride Analysis Run 1/9/2023 3:47 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1011 (bg)



n = 21

Slope = 1.265 units per year.

Mann-Kendall statistic = 84 critical = 87

Trend not significant at 99% confidence level (α = 0.005 per tail).

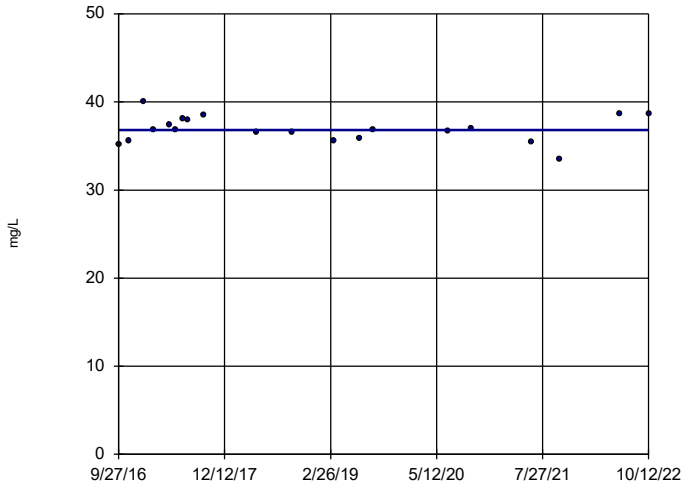
Constituent: Sulfate Analysis Run 1/9/2023 3:47 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1012 (bg)



n = 20

Slope = 0 units per year.

Mann-Kendall statistic = 1 critical = 81

Trend not significant at 99% confidence level (α = 0.005 per tail).

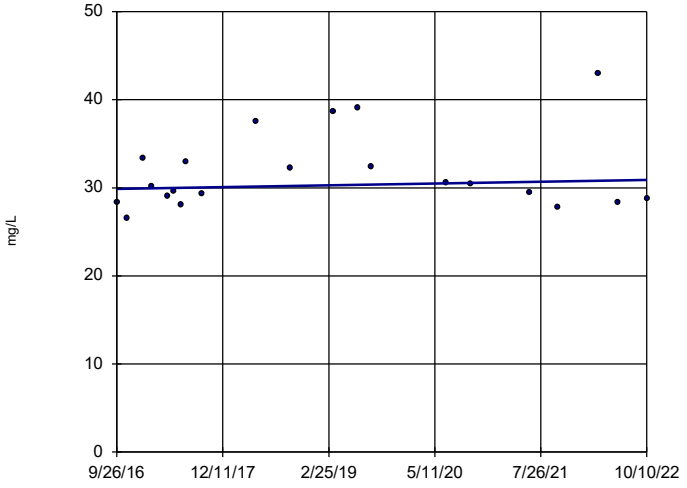
Constituent: Sulfate Analysis Run 1/9/2023 3:47 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1203 (bg)



n = 21

Slope = 0.1722 units per year.

Mann-Kendall statistic = 17 critical = 87

Trend not significant at 99% confidence level (α = 0.005 per tail).

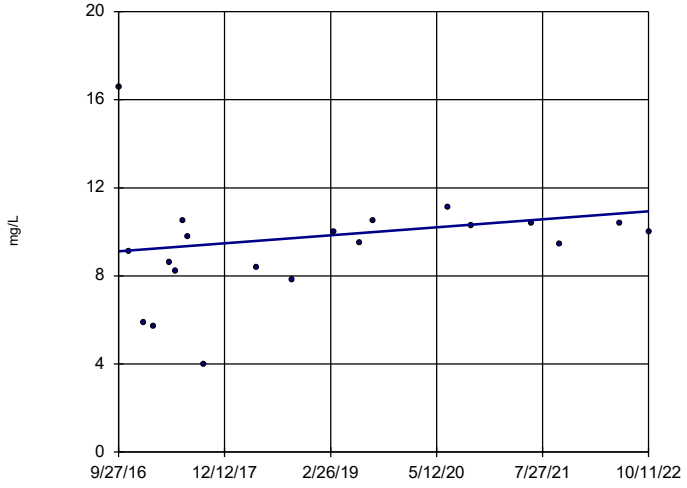
Constituent: Sulfate Analysis Run 1/9/2023 3:47 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1604 (bg)



n = 20

Slope = 0.2992 units per year.

Mann-Kendall statistic = 47 critical = 81

Trend not significant at 99% confidence level (α = 0.005 per tail).

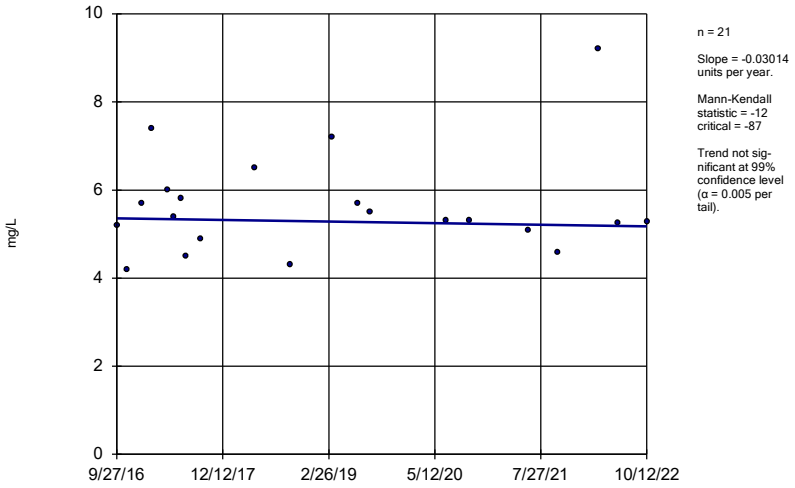
Constituent: Sulfate Analysis Run 1/9/2023 3:47 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1605 (bg)



n = 21

Slope = -0.03014 units per year.

Mann-Kendall statistic = -12
critical = -87

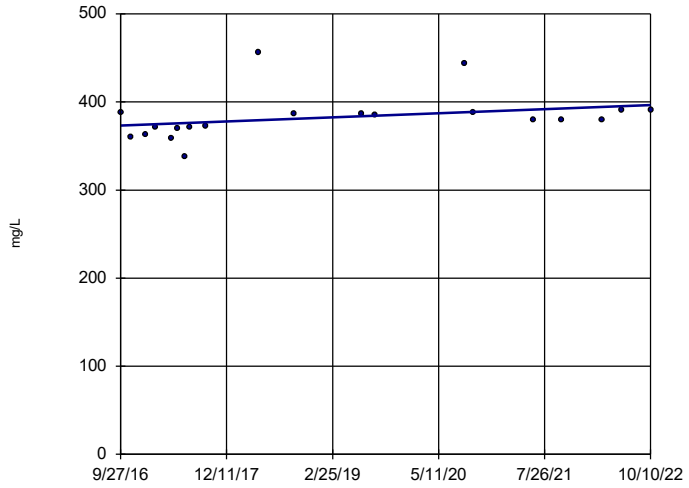
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Sulfate Analysis Run 1/9/2023 3:47 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1011 (bg)



n = 20

Slope = 3.828 units per year.

Mann-Kendall statistic = 77
critical = 81

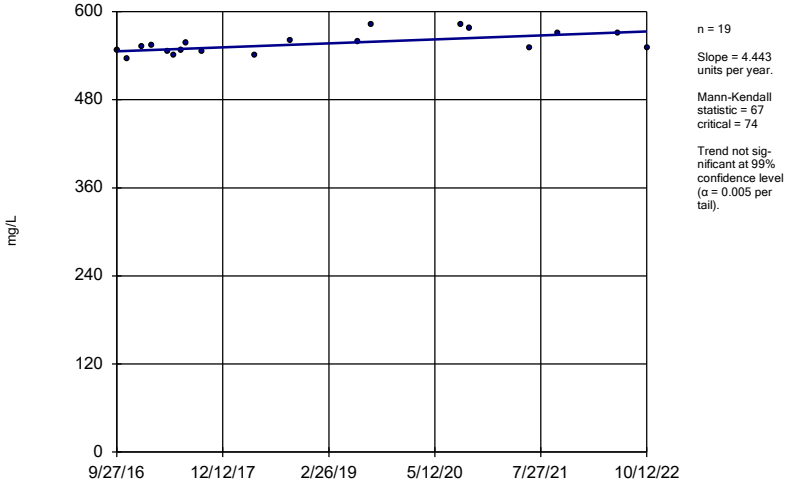
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids Analysis Run 1/9/2023 3:47 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1012 (bg)



n = 19

Slope = 4.443 units per year.

Mann-Kendall statistic = 67
critical = 74

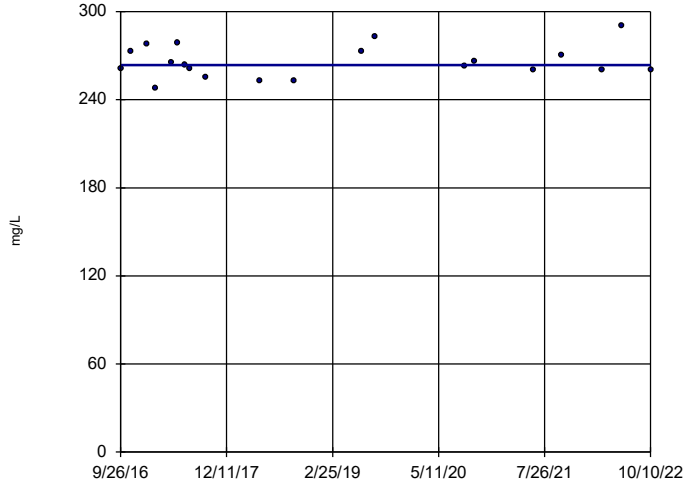
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids Analysis Run 1/9/2023 3:47 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Sen's Slope Estimator

MW-1203 (bg)



n = 20

Slope = 0 units per year.

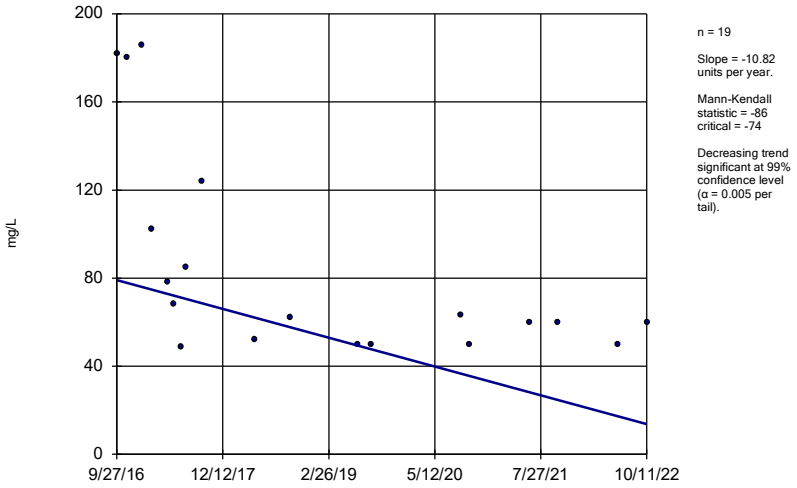
Mann-Kendall statistic = 0
critical = 81

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids Analysis Run 1/9/2023 3:47 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sen's Slope Estimator

MW-1604 (bg)



n = 19

Slope = -10.82 units per year.

Mann-Kendall statistic = -86
critical = -74

Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

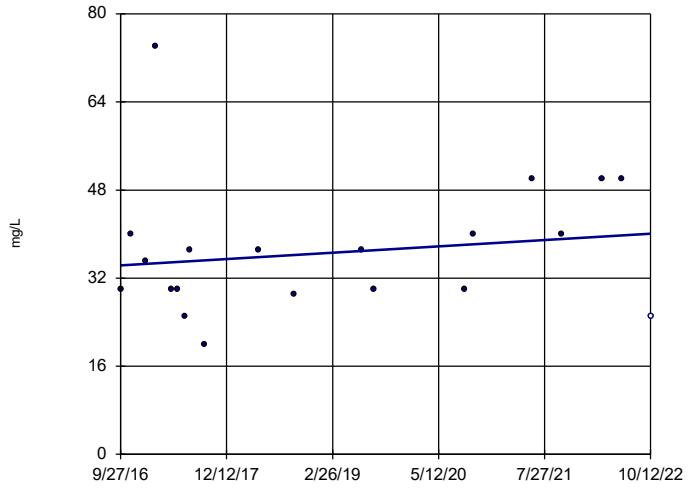
Constituent: Total Dissolved Solids Analysis Run 1/9/2023 3:47 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Hollow symbols indicate censored values.

Sen's Slope Estimator

MW-1605 (bg)



n = 20

Slope = 0.9558 units per year.

Mann-Kendall statistic = 30
critical = 81

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids Analysis Run 1/9/2023 3:47 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

FIGURE G
Interwell PL

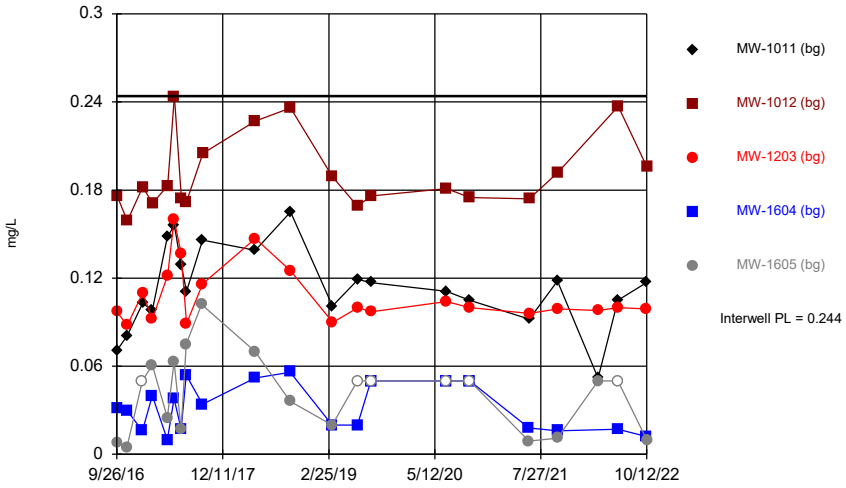
Interwell Prediction Limits

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 1/9/2023, 5:01 PM

Constituent	Well	Upper Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron (mg/L)	n/a	0.244	n/a	5 future	n/a	103	n/a	n/a	8.738	n/a	n/a	0.0001846	NP Inter (normality) 1 of 2
Calcium (mg/L)	n/a	123	n/a	5 future	n/a	103	n/a	n/a	0	n/a	n/a	0.0001846	NP Inter (normality) 1 of 2
Chloride (mg/L)	n/a	6.22	n/a	5 future	n/a	103	n/a	n/a	0	n/a	n/a	0.0001846	NP Inter (normality) 1 of 2
Fluoride (mg/L)	n/a	0.85	n/a	5 future	n/a	114	n/a	n/a	14.91	n/a	n/a	0.0001526	NP Inter (normality) 1 of 2
Sulfate (mg/L)	n/a	106	n/a	5 future	n/a	103	n/a	n/a	0	n/a	n/a	0.0001846	NP Inter (normality) 1 of 2
Total Dissolved Solids (mg/L)	n/a	583	n/a	5 future	n/a	98	n/a	n/a	1.02	n/a	n/a	0.0002022	NP Inter (normality) 1 of 2

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

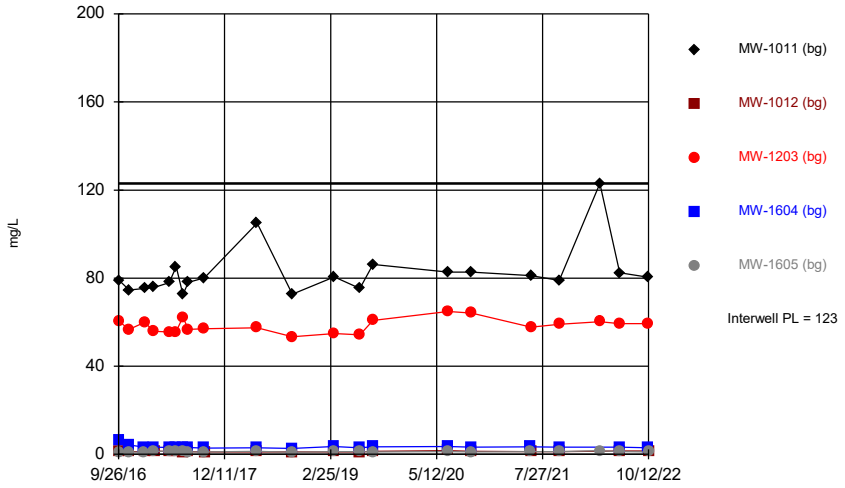
Time Series



Constituent: Boron Analysis Run 1/9/2023 5:10 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

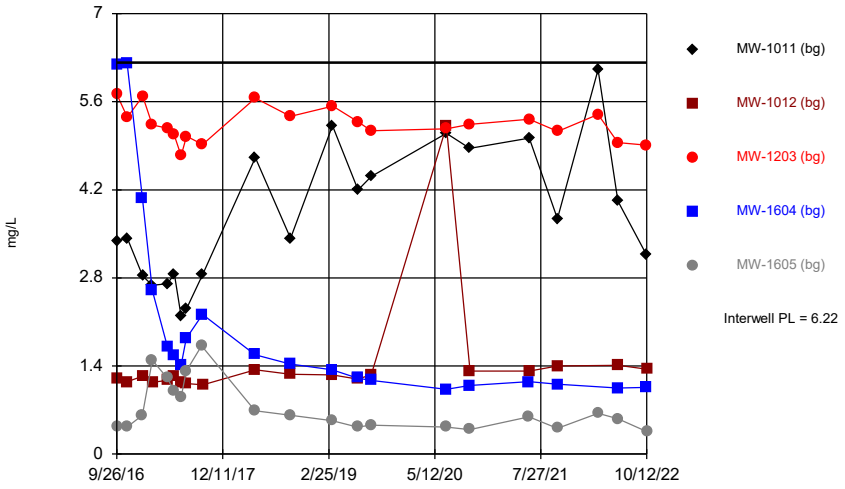
Time Series



Constituent: Calcium Analysis Run 1/9/2023 5:10 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

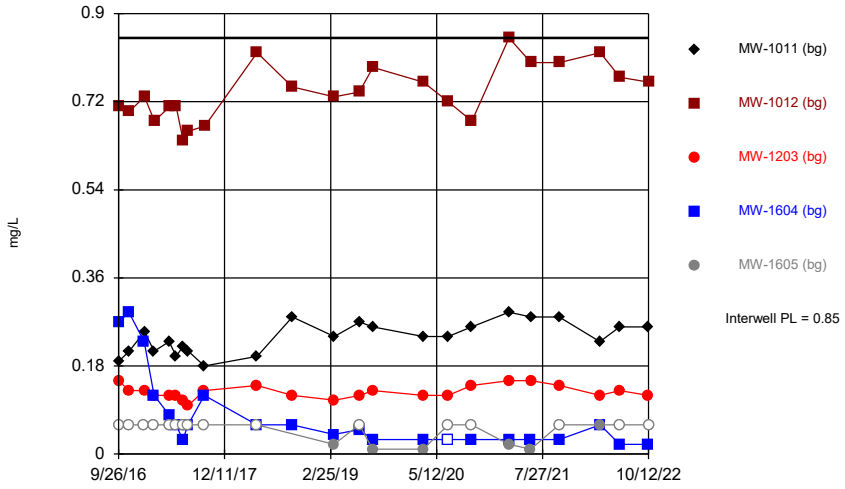
Time Series



Constituent: Chloride Analysis Run 1/9/2023 5:10 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG
Hollow symbols indicate censored values.

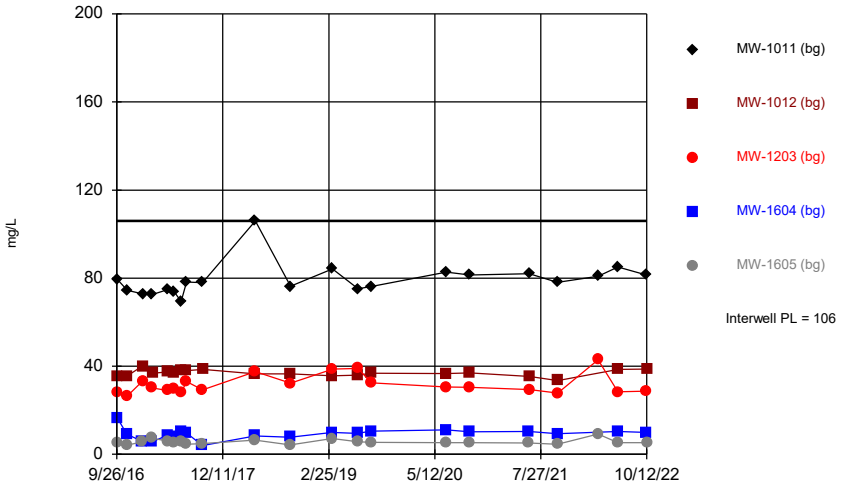
Time Series



Constituent: Fluoride Analysis Run 1/9/2023 5:10 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Time Series



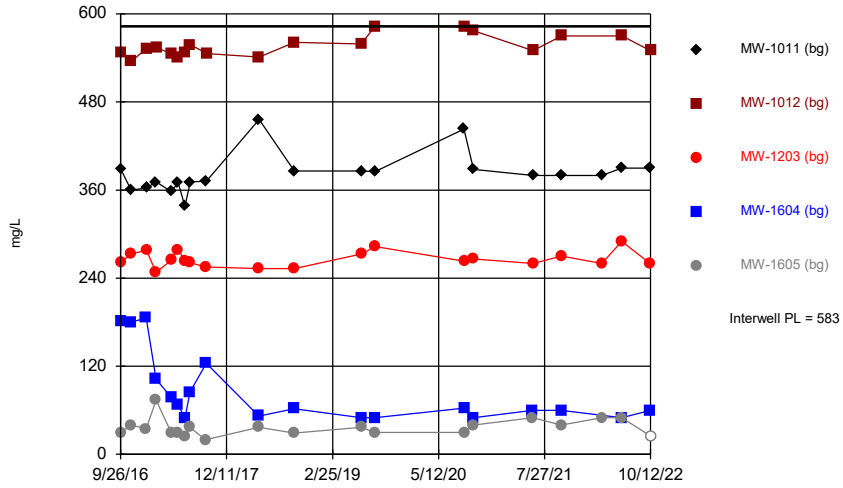
Constituent: Sulfate Analysis Run 1/9/2023 5:10 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Hollow symbols indicate censored values.

Time Series



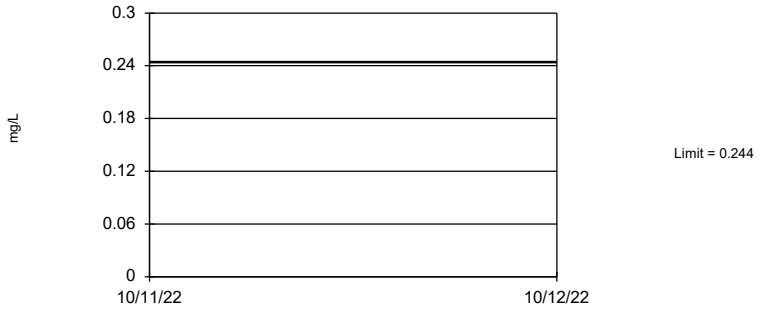
Constituent: Total Dissolved Solids Analysis Run 1/9/2023 5:10 PM View: AIII

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Chi Squared normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 103 background values. 8.738% NDs. Annual per-constituent alpha = 0.001845. Individual comparison alpha = 0.0001846 (1 of 2). Assumes 5 future values.

Constituent: Boron Analysis Run 1/9/2023 5:00 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Prediction Limit

Interwell Non-parametric

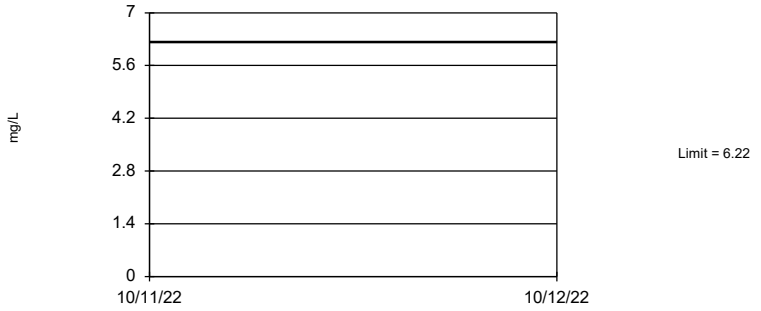
Non-parametric test used in lieu of parametric prediction limit because the Chi Squared normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 103 background values. Annual per-constituent alpha = 0.001845. Individual comparison alpha = 0.0001846 (1 of 2). Assumes 5 future values.

Constituent: Calcium Analysis Run 1/9/2023 5:00 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Prediction Limit

Interwell Non-parametric



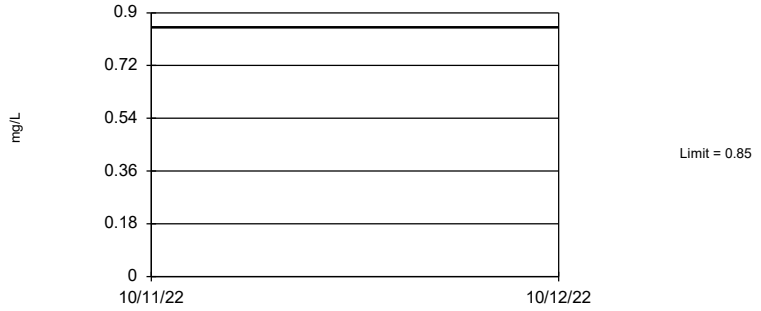
Non-parametric test used in lieu of parametric prediction limit because the Chi Squared normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 103 background values. Annual per-constituent alpha = 0.001845. Individual comparison alpha = 0.0001846 (1 of 2). Assumes 5 future values.

Constituent: Chloride Analysis Run 1/9/2023 5:00 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Prediction Limit

Interwell Non-parametric

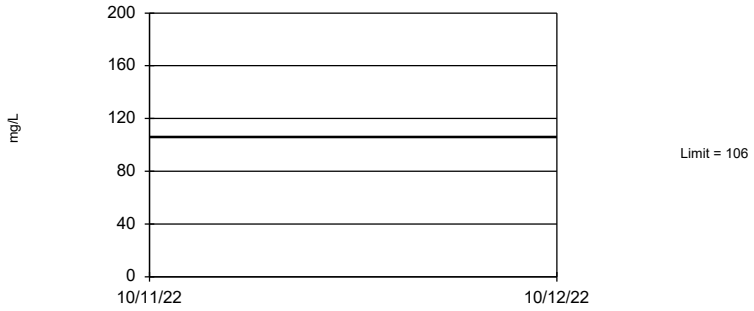


Non-parametric test used in lieu of parametric prediction limit because the Chi Squared normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 114 background values. 14.91% NDs. Annual per-constituent alpha = 0.001525. Individual comparison alpha = 0.0001526 (1 of 2). Assumes 5 future values.

Constituent: Fluoride Analysis Run 1/9/2023 5:00 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Prediction Limit

Interwell Non-parametric



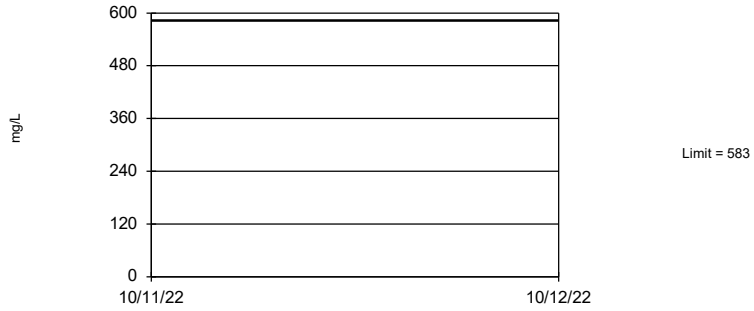
Non-parametric test used in lieu of parametric prediction limit because the Chi Squared normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 103 background values. Annual per-constituent alpha = 0.001845. Individual comparison alpha = 0.0001846 (1 of 2). Assumes 5 future values.

Constituent: Sulfate Analysis Run 1/9/2023 5:00 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Francia normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 98 background values. 1.02% NDs. Annual per-constituent alpha = 0.00202. Individual comparison alpha = 0.0002022 (1 of 2). Assumes 5 future values.

Constituent: Total Dissolved Solids Analysis Run 1/9/2023 5:00 PM View: AIII
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

FIGURE H
UTL

Upper Tolerance Limits

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 1/9/2023, 5:12 PM

Constituent	Upper Lim.	Bg N	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony (mg/L)	0.00152	110	n/a	24.55	n/a	n/a	0.003545	NP Inter(normality)
Arsenic (mg/L)	0.0289	107	n/a	4.673	n/a	n/a	0.004135	NP Inter(normality)
Barium (mg/L)	0.113	110	n/a	0	n/a	n/a	0.003545	NP Inter(normality)
Beryllium (mg/L)	0.000182	110	n/a	18.18	n/a	n/a	0.003545	NP Inter(normality)
Cadmium (mg/L)	0.00014	110	n/a	27.27	n/a	n/a	0.003545	NP Inter(normality)
Chromium (mg/L)	0.00326	109	n/a	0	n/a	n/a	0.003731	NP Inter(normality)
Cobalt (mg/L)	0.00561	110	n/a	0	n/a	n/a	0.003545	NP Inter(normality)
Combined Radium 226 + 228 (pCi/L)	4.388	105	0.4722	0	None	sqrt(x)	0.05	Inter
Fluoride (mg/L)	0.85	114	n/a	14.91	n/a	n/a	0.002887	NP Inter(normality)
Lead (mg/L)	0.0024	110	n/a	8.182	n/a	n/a	0.003545	NP Inter(normality)
Lithium (mg/L)	0.02	110	n/a	10	n/a	n/a	0.003545	NP Inter(normality)
Mercury (mg/L)	0.000013	110	n/a	80	n/a	n/a	0.003545	NP Inter(NDs)
Molybdenum (mg/L)	0.0055	108	n/a	28.7	n/a	n/a	0.003928	NP Inter(normality)
Selenium (mg/L)	0.0005	110	n/a	25.45	n/a	n/a	0.003545	NP Inter(normality)
Thallium (mg/L)	0.000229	110	n/a	46.36	n/a	n/a	0.003545	NP Inter(normality)

FIGURE I

GWPS

BIG SANDY FAP GWPS				
Constituent Name	**MCL**	**CCR-Rule Specified**	**Background Limit**	**GWPS**
Antimony, Total (mg/L)	0.006		0.0015	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		0.0033	0.1
Cobalt, Total (mg/L)	n/a	0.006	0.0056	0.006
Combined Radium, Total (pCi/L)	5		4.39	5
Fluoride, Total (mg/L)	4		0.85	4
Lead, Total (mg/L)	0.015		0.0024	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	0.0055	0.1
Selenium, Total (mg/L)	0.05		0.0005	0.05
Thallium, Total (mg/L)	0.002		0.00023	0.002

**Grey cell indicates Background is higher than MCL or CCR-Rule Specified Level*

**GWPS = Groundwater Protection Standard*

**MCL = Maximum Contaminant Level*

**CCR = Coal Combustion Residual*

FIGURE J
Confidence Intervals

Confidence Interval Summary Table - Significant Results

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 1/9/2023, 5:19 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	ND Adj.	Transform	Alpha	Method
Beryllium (mg/L)	**MW-1603**	**0.01974**	**0.01653**	**0.004**	**Yes**	**22**	**0**	**None**	**No**	**0.01**	**Param.**
Cobalt (mg/L)	**MW-1603**	**0.09402**	**0.08523**	**0.006**	**Yes**	**22**	**0**	**None**	**No**	**0.01**	**Param.**
Combined Radium 226 + 228 (pCi/L)	**MW-1603**	**8.006**	**5.221**	**5**	**Yes**	**22**	**0**	**None**	**x^(1/3)**	**0.01**	**Param.**
Lithium (mg/L)	**MW-1603**	**0.2185**	**0.1776**	**0.04**	**Yes**	**22**	**0**	**None**	**No**	**0.01**	**Param.**

Confidence Interval Summary Table - All Results

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 1/9/2023, 5:19 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	ND Adj.	Transform	Alpha	Method
Antimony (mg/L)	MW-1601	0.0003944	0.0001397	0.006	No	20	0	None	sqrt(x)	0.01	Param.
Antimony (mg/L)	MW-1602	0.000109	0.00006126	0.006	No	22	0	None	sqrt(x)	0.01	Param.
Antimony (mg/L)	MW-1603	0.0001	0.00004	0.006	No	22	72.73	None	No	0.01	NP (NDs)
Antimony (mg/L)	MW-1606	0.0001	0.00004	0.006	No	22	59.09	None	No	0.01	NP (NDs)
Antimony (mg/L)	MW-1607	0.0001	0.00002	0.006	No	22	18.18	None	No	0.01	NP (normality)
Arsenic (mg/L)	MW-1601	0.00515	0.00053	0.029	No	20	0	None	No	0.01	NP (normality)
Arsenic (mg/L)	MW-1602	0.001374	0.000655	0.029	No	22	0	None	x^(1/3)	0.01	Param.
Arsenic (mg/L)	MW-1603	0.001349	0.001079	0.029	No	22	0	None	No	0.01	Param.
Arsenic (mg/L)	MW-1606	0.001089	0.0009322	0.029	No	22	0	None	No	0.01	Param.
Arsenic (mg/L)	MW-1607	0.01887	0.01101	0.029	No	22	0	None	ln(x)	0.01	Param.
Barium (mg/L)	MW-1601	0.0688	0.05067	2	No	20	0	None	No	0.01	Param.
Barium (mg/L)	MW-1602	0.05797	0.05301	2	No	22	0	None	No	0.01	Param.
Barium (mg/L)	MW-1603	0.01338	0.01118	2	No	22	0	None	No	0.01	Param.
Barium (mg/L)	MW-1606	0.883	0.764	2	No	22	0	None	No	0.01	NP (normality)
Barium (mg/L)	MW-1607	0.03919	0.03062	2	No	22	0	None	No	0.01	Param.
Beryllium (mg/L)	MW-1601	0.00005	0.000009	0.004	No	20	45	None	No	0.01	NP (normality)
Beryllium (mg/L)	**MW-1603**	**0.01974**	**0.01653**	**0.004**	**Yes**	**22**	**0**	**None**	**No**	**0.01**	**Param.**
Beryllium (mg/L)	MW-1606	0.00005	0.00001	0.004	No	22	36.36	None	No	0.01	NP (normality)
Beryllium (mg/L)	MW-1607	0.0001	0.00001	0.004	No	22	27.27	None	No	0.01	NP (normality)
Cadmium (mg/L)	MW-1601	0.00001045	0.000005932	0.005	No	20	20	Kaplan-Meier	ln(x)	0.01	Param.
Cadmium (mg/L)	MW-1602	0.00002	0.000009	0.005	No	22	50	None	No	0.01	NP (normality)
Cadmium (mg/L)	MW-1603	0.0008398	0.0007461	0.005	No	22	0	None	No	0.01	Param.
Cadmium (mg/L)	MW-1606	0.00002	0.00001	0.005	No	22	77.27	None	No	0.01	NP (NDs)
Cadmium (mg/L)	MW-1607	0.00002	0.000009	0.005	No	22	68.18	None	No	0.01	NP (NDs)
Chromium (mg/L)	MW-1601	0.0005904	0.0003442	0.1	No	20	0	None	No	0.01	Param.
Chromium (mg/L)	MW-1602	0.0008042	0.0005363	0.1	No	22	0	None	No	0.01	Param.
Chromium (mg/L)	MW-1603	0.000833	0.0006329	0.1	No	22	0	None	No	0.01	Param.
Chromium (mg/L)	MW-1606	0.0008129	0.0002892	0.1	No	22	0	None	sqrt(x)	0.01	Param.
Chromium (mg/L)	MW-1607	0.0004502	0.0002841	0.1	No	22	0	None	sqrt(x)	0.01	Param.
Cobalt (mg/L)	MW-1601	0.001129	0.0004341	0.006	No	20	0	None	No	0.01	Param.
Cobalt (mg/L)	MW-1602	0.00008846	0.00002344	0.006	No	22	0	None	ln(x)	0.01	Param.
Cobalt (mg/L)	**MW-1603**	**0.09402**	**0.08523**	**0.006**	**Yes**	**22**	**0**	**None**	**No**	**0.01**	**Param.**
Cobalt (mg/L)	MW-1606	0.0002854	0.00009026	0.006	No	22	0	None	ln(x)	0.01	Param.
Cobalt (mg/L)	MW-1607	0.001412	0.001194	0.006	No	22	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW-1601	1.747	1.017	5	No	20	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW-1602	1.476	0.8696	5	No	22	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	**MW-1603**	**8.006**	**5.221**	**5**	**Yes**	**22**	**0**	**None**	**x^(1/3)**	**0.01**	**Param.**
Combined Radium 226 + 228 (pCi/L)	MW-1606	3.357	2.7	5	No	22	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW-1607	1.751	0.6509	5	No	22	0	None	sqrt(x)	0.01	Param.
Fluoride (mg/L)	MW-1601	0.2795	0.2015	4	No	21	0	None	No	0.01	Param.
Fluoride (mg/L)	MW-1602	0.129	0.09901	4	No	23	0	None	sqrt(x)	0.01	Param.
Fluoride (mg/L)	MW-1603	1.014	0.8283	4	No	24	0	None	No	0.01	Param.
Fluoride (mg/L)	MW-1606	0.2209	0.193	4	No	23	0	None	No	0.01	Param.
Fluoride (mg/L)	MW-1607	0.07234	0.05983	4	No	23	0	None	No	0.01	Param.
Lead (mg/L)	MW-1601	0.000173	0.00005049	0.015	No	20	15	None	ln(x)	0.01	Param.
Lead (mg/L)	MW-1602	0.00008314	0.00004104	0.015	No	22	18.18	Kaplan-Meier	sqrt(x)	0.01	Param.
Lead (mg/L)	MW-1603	0.006152	0.004386	0.015	No	22	0	None	No	0.01	Param.
Lead (mg/L)	MW-1606	0.00033	0.00008	0.015	No	22	13.64	None	No	0.01	NP (normality)
Lead (mg/L)	MW-1607	0.0001693	0.00007643	0.015	No	22	9.091	None	ln(x)	0.01	Param.
Lithium (mg/L)	MW-1601	0.03062	0.01995	0.04	No	20	5	None	No	0.01	Param.
Lithium (mg/L)	MW-1602	0.01007	0.006203	0.04	No	22	4.545	None	sqrt(x)	0.01	Param.
Lithium (mg/L)	**MW-1603**	**0.2185**	**0.1776**	**0.04**	**Yes**	**22**	**0**	**None**	**No**	**0.01**	**Param.**
Lithium (mg/L)	MW-1606	0.007256	0.003461	0.04	No	22	9.091	None	ln(x)	0.01	Param.
Lithium (mg/L)	MW-1607	0.005	0.00018	0.04	No	22	9.091	None	No	0.01	NP (normality)
Mercury (mg/L)	MW-1601	0.00001	0.000005	0.002	No	20	95	None	No	0.01	NP (NDs)
Mercury (mg/L)	MW-1602	0.00001	0.000003	0.002	No	22	63.64	None	No	0.01	NP (NDs)
Mercury (mg/L)	MW-1603	0.00001	0.000005	0.002	No	22	77.27	None	No	0.01	NP (NDs)
Mercury (mg/L)	MW-1606	0.00001	0.000005	0.002	No	22	81.82	None	No	0.01	NP (NDs)
Mercury (mg/L)	MW-1607	0.00001	0.000005	0.002	No	22	90.91	None	No	0.01	NP (NDs)
Molybdenum (mg/L)	MW-1601	0.02339	0.01133	0.1	No	20	0	None	No	0.01	Param.
Molybdenum (mg/L)	MW-1602	0.00212	0.001	0.1	No	22	0	None	No	0.01	NP (normality)
Molybdenum (mg/L)	MW-1603	0.0005	0.00015	0.1	No	22	50	None	No	0.01	NP (normality)
Molybdenum (mg/L)	MW-1606	0.00067	0.0005	0.1	No	22	0	None	No	0.01	NP (normality)
Molybdenum (mg/L)	MW-1607	0.0008	0.00059	0.1	No	22	0	None	No	0.01	NP (normality)
Selenium (mg/L)	MW-1601	0.000367	0.0001368	0.05	No	20	0	None	sqrt(x)	0.01	Param.
Selenium (mg/L)	MW-1602	0.002299	0.001302	0.05	No	22	0	None	No	0.01	Param.
Selenium (mg/L)	MW-1603	0.005916	0.004546	0.05	No	22	0	None	No	0.01	Param.
Selenium (mg/L)	MW-1606	0.0005	0.00006	0.05	No	22	22.73	None	No	0.01	NP (normality)

Confidence Interval Summary Table - All Results

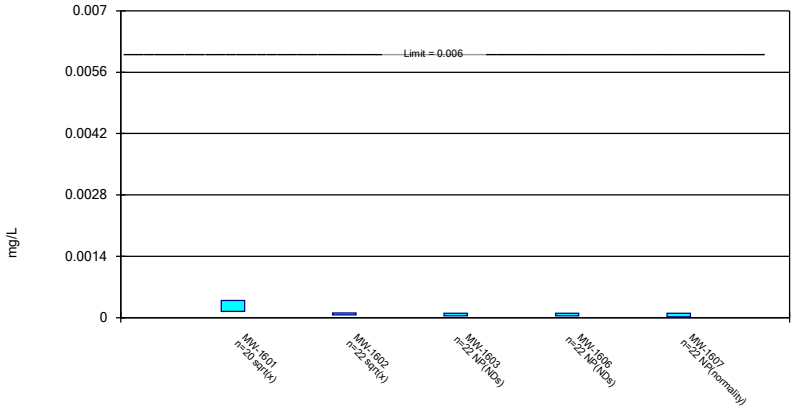
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 1/9/2023, 5:19 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	ND Adj.	Transform	Alpha	Method
Selenium (mg/L)	MW-1607	0.0005	0.00009	0.05	No	22	18.18	None	No	0.01	NP (normality)
Thallium (mg/L)	MW-1601	0.0002	0.00002	0.002	No	20	40	None	No	0.01	NP (normality)
Thallium (mg/L)	MW-1602	0.0002	0.00002	0.002	No	22	50	None	No	0.01	NP (normality)
Thallium (mg/L)	MW-1603	0.001693	0.001387	0.002	No	22	0	None	No	0.01	Param.
Thallium (mg/L)	MW-1606	0.0002	0.00004	0.002	No	22	63.64	None	No	0.01	NP (NDs)
Thallium (mg/L)	MW-1607	0.0002	0.00003	0.002	No	22	40.91	None	No	0.01	NP (normality)

Sanitas™ v.9.6.36 . 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.



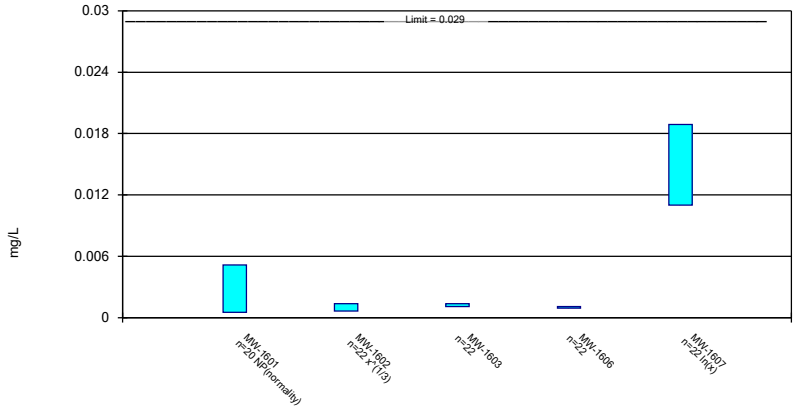
Constituent: Antimony Analysis Run 1/9/2023 5:17 PM View: AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . 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.



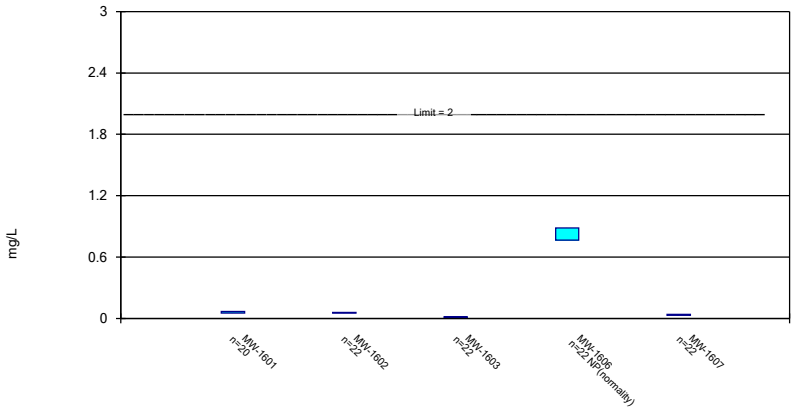
Constituent: Arsenic Analysis Run 1/9/2023 5:17 PM View: AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . 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.



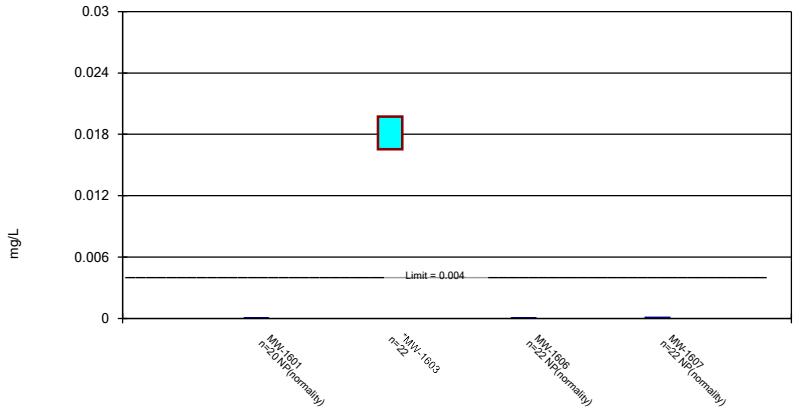
Constituent: Barium Analysis Run 1/9/2023 5:17 PM View: AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . 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.



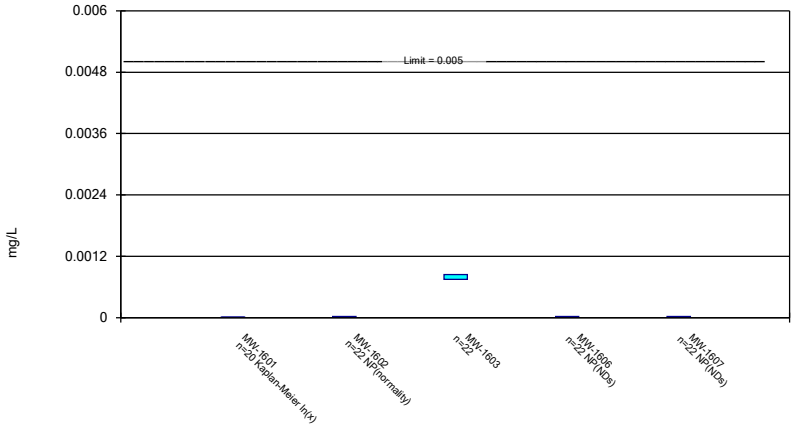
Constituent: Beryllium Analysis Run 1/9/2023 5:17 PM View: AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . 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.

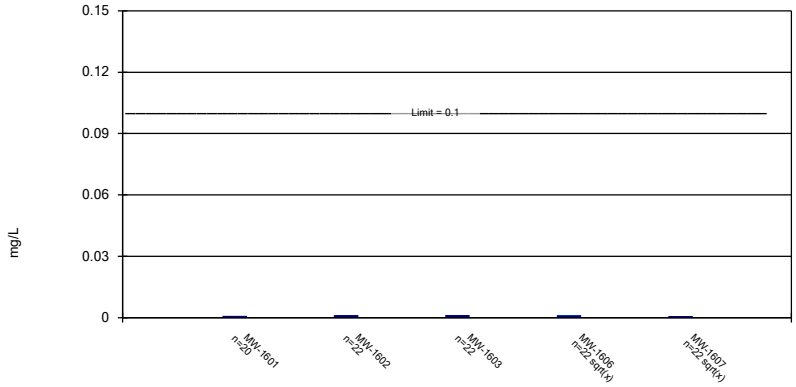


Constituent: Cadmium Analysis Run 1/9/2023 5:17 PM View: AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Parametric Confidence Interval

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

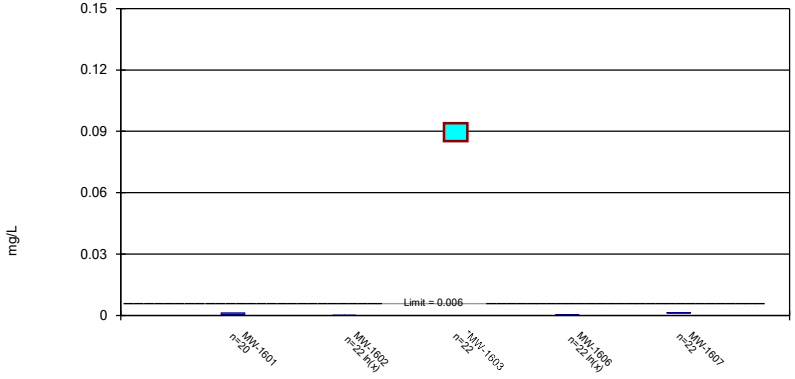


Constituent: Chromium Analysis Run 1/9/2023 5:17 PM View: AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Parametric Confidence Interval

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

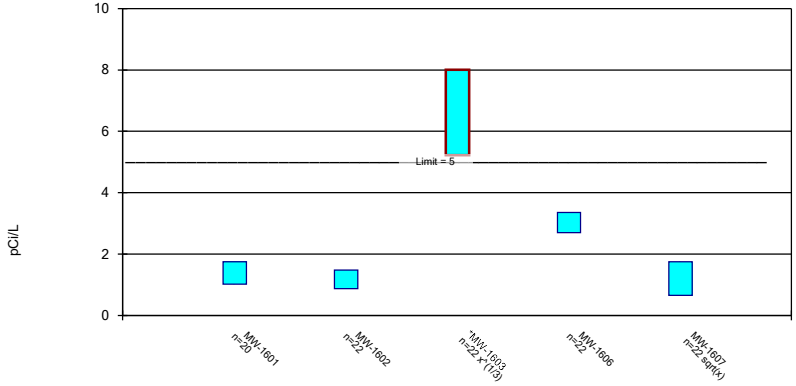


Constituent: Cobalt Analysis Run 1/9/2023 5:17 PM View: AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Parametric Confidence Interval

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

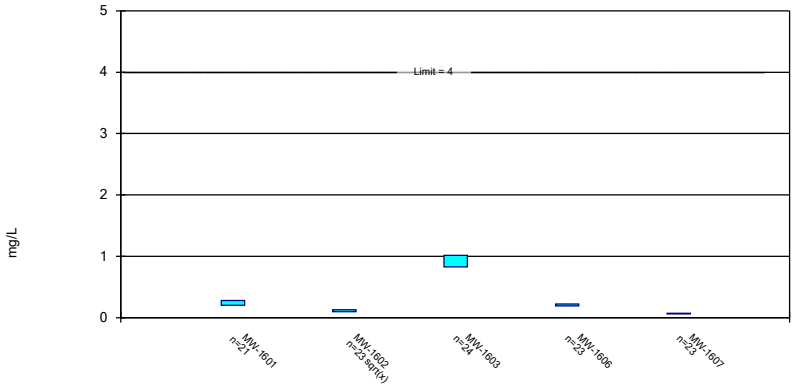


Constituent: Combined Radium 226 + 228 Analysis Run 1/9/2023 5:17 PM View: AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Parametric Confidence Interval

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

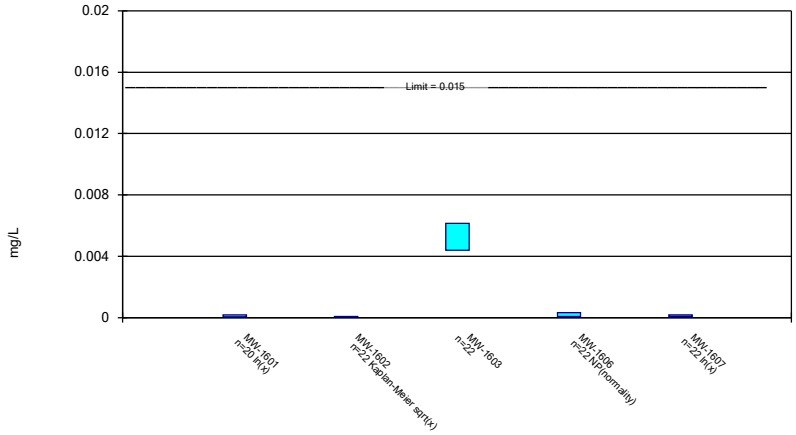


Constituent: Fluoride Analysis Run 1/9/2023 5:17 PM View: AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . 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.

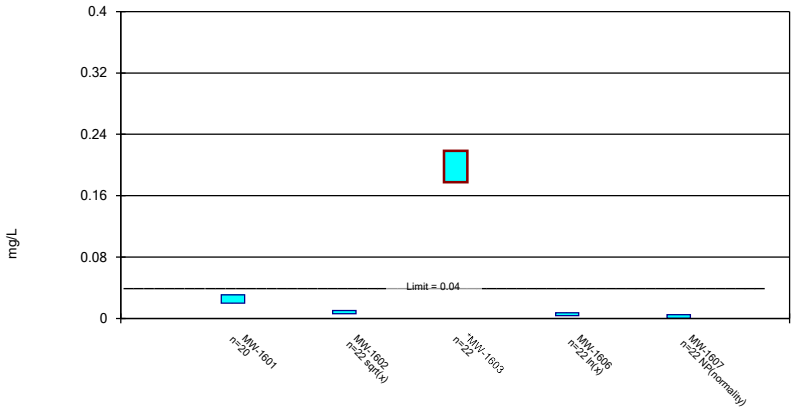


Constituent: Lead Analysis Run 1/9/2023 5:17 PM View: AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . 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.

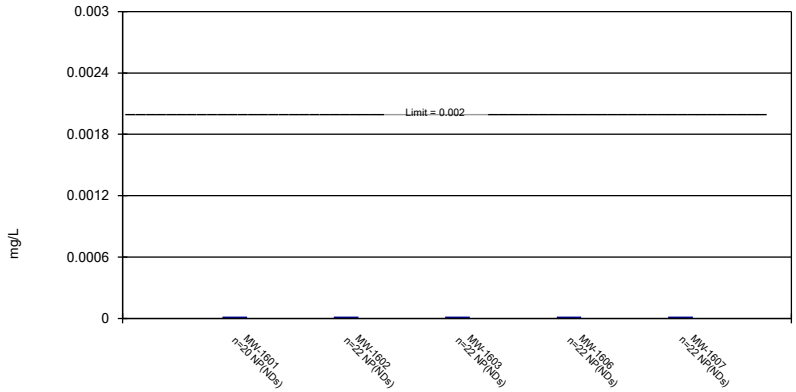


Constituent: Lithium Analysis Run 1/9/2023 5:17 PM View: AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . UG

Non-Parametric Confidence Interval

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

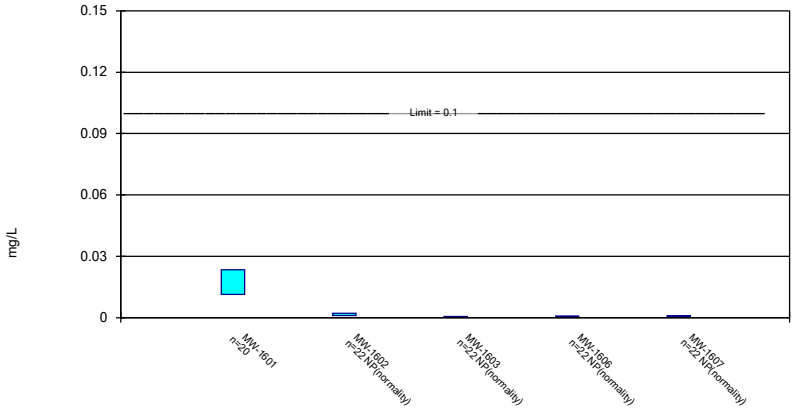


Constituent: Mercury Analysis Run 1/9/2023 5:18 PM View: AIV
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . 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.



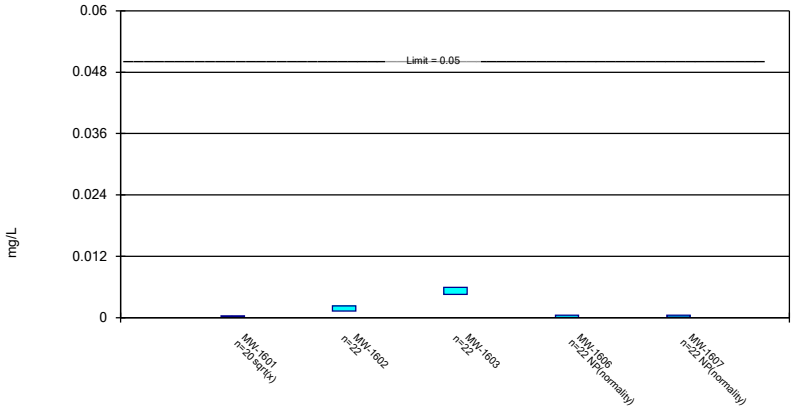
Constituent: Molybdenum Analysis Run 1/9/2023 5:18 PM View: AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . 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.



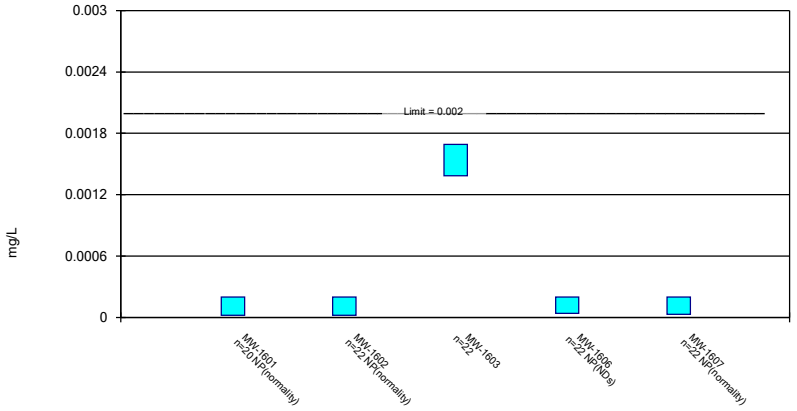
Constituent: Selenium Analysis Run 1/9/2023 5:18 PM View: AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.9.6.36 . 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 1/9/2023 5:18 PM View: AIV

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Geosyntec consultants

engineers | scientists | innovators

STATISTICAL ANALYSIS SUMMARY FLY ASH POND

Big Sandy Plant

Louisa, Kentucky

Prepared for

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1 Riverside Plaza
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Prepared by

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Project Number: CHA8500B

December 4, 2023

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LIST OF ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

ASD	alternative source demonstration
CCR	coal combustion residuals
CFR	code of federal regulations
FAP	Fly Ash Pond
GWPS	groundwater protection standard
LCL	lower confidence limit
QA/QC	quality assurance and quality control
SSI	statistically significant increase
SSL	statistically significant level
SU	standard units
TDS	total dissolved solids
UPL	upper prediction limit
USEPA	United States Environmental Protection Agency

1. INTRODUCTION

In accordance with the United States Environmental Protection Agency (USEPA) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (Code of Federal Regulations [CFR] Title 40, Section 257, Subpart D), groundwater monitoring has been conducted at the Fly Ash Pond (FAP), an existing CCR unit at the Big Sandy Power Plant in Louisa, Kentucky. Recent groundwater monitoring results were used to identify concentrations of Appendix IV constituents that are above site-specific groundwater protection standards (GWPSs).

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 (SSLs) were observed for beryllium, cobalt, combined radium, and lithium (Geosyntec 2023a). An alternative source demonstration (ASD) was successfully completed (EHS 2023); therefore, the unit remained in assessment monitoring. Since the previous round of assessment monitoring, the groundwater monitoring network was revised to remove downgradient well MW-1603 from the certified network (Geosyntec 2023b).

An annual sampling event at the BAP for the Appendix IV parameters required by 40 CFR 257.95(b) was completed in March 2023, and a semiannual sampling event for the Appendix III and Appendix IV parameters required by 40 CFR 257.95(d)(1) was completed in June 2023. The results of these annual and semiannual assessment monitoring 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 that would impact data usability were identified.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether SSLs of Appendix IV parameters were present above the GWPS. No SSLs were identified; however, concentrations of Appendix III parameters remained above background Therefore, the unit will remain in assessment monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

2. FLY ASH POND EVALUATION

2.1 Data Validation and QA/QC

During the 2023 assessment monitoring program through June, two sets of samples were collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95b (March 2023) and 257.95(d)(1) (June 2023). For the March 2023 event, all samples were analyzed for all Appendix IV parameters. All samples from the June 2023 sample event were analyzed for all Appendix III and Appendix IV parameters. A summary of data collected during these assessment monitoring events is presented in Table 1.

Chemical analysis was completed by a National Environmental Laboratory Accreditation Program–certified analytical laboratory. The laboratory completed analysis of quality assurance and quality control (QA/QC) samples such as laboratory reagent blanks, continuing calibration verification samples, and laboratory fortified blanks.

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.36 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues that would impact data usability were noted.

2.2 Statistical Analysis

Statistical analyses for the FAP were conducted in accordance with the October 2020 *Statistical Analysis Plan* (Geosyntec 2020). Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained in March and June 2022 were screened for potential outliers; however, no outliers were identified in either set of data (Attachment B).

2.2.1 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, nonparametric confidence limits were calculated in some cases (e.g., when the data were not normally distributed or when the nondetect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) was above the GWPS (i.e., if the entire confidence interval was above the GWPS). The calculated confidence limits (Attachment B) were compared to the GWPSs provided in Table 2. The GWPSs were established during a previous statistical analysis as either (a) the background concentration or (b) the maximum contaminant level (MCL) and risk-based levels specified in 40 CFR 257.95(h)(2), whichever was greater (Geosyntec 2023a).

No SSLs were identified at the Big Sandy FAP.

2.2.2 Evaluation of Potential Appendix III SSIs

The Appendix III results were also analyzed to assess whether concentrations of Appendix III parameters at the compliance wells were above background concentrations. Data collected during

the June 2023 assessment monitoring event from each compliance well were compared to previously established prediction limits to assess whether the results are above background values (Table 3). The following concentrations were above the upper prediction limits (UPLs):

- Boron concentrations were above the interwell UPL of 0.244 mg/L at MW-1606 (1.97 mg/L).
- Chloride concentrations were above the interwell UPL of 6.22 mg/L at MW-1602 (18.3 mg/L) and MW-1606 (32.3 mg/L).
- Sulfate concentrations were above the interwell UPL of 106 mg/L at MW-1602 (206 mg/L).
- TDS concentrations were above the interwell UPL of 583 mg/L at MW-1602 (610 mg/L).

While the prediction limits were calculated for a one-of-two retesting procedure, SSIs were conservatively assumed if the June 2023 sample was above the UPL or below the lower prediction limit in the case of pH. Based on these results, concentrations of Appendix III constituents appear to be above background levels at compliance wells.

2.3 Conclusions

An annual and a semiannual assessment monitoring event were conducted in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, and no QA/QC issues that impacted data usability were identified. A review of outliers identified no potential outliers in the March 2023 and June 2023 data. 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. No SSLs were identified. Appendix III parameters were compared to established prediction limits with exceedances identified for boron, chloride, sulfate, and TDS at select downgradient wells.

Based on this evaluation, the Big Sandy FAP CCR unit will remain in assessment monitoring.

3. REFERENCES

EHS Support. 2023. *Alternative Source Demonstration Addendum Report for the October 2022 Monitoring Data. Closed Big Sandy Fly Ash Pond*. May.

Geosyntec. 2020. *Statistical Analysis Plan – Amos Plant*. Geosyntec Consultants, Inc. October.

Geosyntec. 2023a. *Statistical Analysis Summary – Fly Ash Pond, Big Sandy Plant, Louisa, Kentucky*. Geosyntec Consultants, Inc. February.

Geosyntec. 2023b. *Groundwater Monitoring Network Evaluation – Big Sandy Fly Ash Pond. Louisa, Kentucky. Revision 1.* Geosyntec Consultants, Inc. October.

TABLES

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

Parameter	Unit	MW-1011		MW-1012		MW-1203		MW-1601		MW-1602	
		3/13/2023	6/13/2023	3/15/2023	6/14/2023	3/13/2023	6/13/2023	3/15/2023	6/13/2023	3/15/2023	6/13/2023
Antimony	µg/L	0.14	0.161	3.08	3.18	0.03 J1	0.023 J1	0.47	0.439	0.14	0.180
Arsenic	µg/L	3.32	2.87	94.2	118	0.39	0.30	0.30	0.47	0.88	1.31
Barium	µg/L	41.4	42.0	32.5	29.9	85.5	92.6	40.2	35.9	68.4	66.6
Beryllium	µg/L	0.050 U1	0.050 U1	0.014 J1	0.011 J1	0.085	0.053	0.050 U1	0.020 J1	0.050 U1	0.050 U1
Boron	mg/L	--	0.105	--	0.171	--	0.091	--	0.077	--	0.078
Cadmium	µg/L	0.020 U1	0.008 J1	0.008 J1	0.008 J1	0.020 U1	0.020 U1	0.015 J1	0.019 J1	0.004 J1	0.017 J1
Calcium	mg/L	--	75.3	--	1.41	--	57.3	--	54.4	--	92.3
Chloride	mg/L	--	3.44	--	2.05	--	5.07	--	4.54	--	18.3
Chromium	µg/L	0.29	0.54	0.35	0.39	0.25	0.29 J1	0.33	0.60	0.65	0.72
Cobalt	µg/L	0.229	0.197	0.121	0.090	0.838	0.548	0.067	0.272	0.026	0.127
Combined Radium	pCi/L	2.67	2.05	1.16	0.79	2.35	1.62	1.00	0.46	0.78	0.79
Fluoride	mg/L	0.27	0.26	0.90	0.90	0.11	0.13	0.13	0.13	0.08	0.08
Lead	µg/L	0.20 U1	0.09 J1	0.43	0.31	0.16 J1	0.07 J1	0.06 J1	0.25	0.20 U1	0.21
Lithium	mg/L	0.00976	0.0088	0.00637	0.0055	0.0112	0.0105	0.0197	0.0165	0.0103	0.0086
Mercury	µg/L	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1
Molybdenum	µg/L	0.8	0.9	8.6	9.1	0.5 U1	0.5 U1	7.5	6.7	1	0.9
Selenium	µg/L	0.50 U1	0.10 J1	0.50 U1	0.07 J1	0.50 U1	0.50 U1	0.58	0.49 J1	2.94	2.62
Sulfate	mg/L	--	80.6	--	49.4	--	28.6	--	104	--	206
Thallium	µg/L	0.05 J1	0.06 J1	0.20 U1	0.02 J1	0.20 U1	0.20 U1	0.20 U1	0.03 J1	0.20 U1	0.20 U1
Total Dissolved Solids	mg/L	--	380 P2	--	580	--	270 P2	--	340 P2	--	610 P2
pH	SU	6.85	6.91	9.09	9.00	6.65	6.96	6.82	6.83	7.43	7.21

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U1: Non-detect value. For statistical analysis, parameters that were not detected were replaced with the reporting limit.
J1: Estimated value. Parameter was detected in concentrations below the reporting limit.
P2: The precision on the laboratory control sample duplicate (LCSD) was above acceptance limits.
-: Not sampled

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

Parameter	Unit	MW-1603			MW-1604		MW-1605		MW-1606		MW-1607	
		3/15/2023	3/17/2023	6/14/2023	3/14/2023	6/12/2023	3/14/2023	6/12/2023	3/14/2023	6/12/2023	3/14/2023	6/12/2023
Antimony	µg/L	0.10 U1	--	0.012 J1	0.10 U1	0.009 J1	0.09 J1	0.019 J1	0.10 U1	0.912	0.10 U1	0.023 J1
Arsenic	µg/L	0.94	--	1.12	0.04 J1	0.03 J1	1.42	0.27	0.95	0.88	15.4	17.8
Barium	µg/L	10.7	--	11.9	47.9	56.4	41.9	20.8	769	731	41.7	37.6
Beryllium	µg/L	15.7	--	12.9	0.086	0.123	0.243	0.046 J1	0.007 J1	0.01 J1	0.01 J1	0.013 J1
Boron	mg/L	--	--	0.033 J1	--	0.011 J1	--	0.01 J1	--	1.97	--	0.144
Cadmium	µg/L	0.743	--	0.714	0.077	0.049	0.025	0.036	0.020 U1	0.005 J1	0.020 U1	0.020 U1
Calcium	mg/L	--	--	72.8	--	2.44	--	3.32	--	73.2	--	87.9
Chloride	mg/L	--	--	4.30	--	1.30	--	0.50	--	32.3	--	3.23
Chromium	µg/L	0.58	--	0.66	0.67	0.93	5.05	1.14	0.32	0.39	0.32	0.40
Cobalt	µg/L	79.5	--	73.4	0.321	0.130	1.17	0.141	0.103	0.135	1.08	0.916
Combined Radium	pCi/L	6.21	--	5.74	0.93	0.67	1.05	1.44	3.35	2.69	1.81	1.38
Fluoride	mg/L	--	0.71	0.71	0.02 J1	0.06 U1	0.03 J1	0.06 U1	0.20	0.19	0.06	0.06
Lead	µg/L	4.13	--	3.22	0.20 U1	0.20 U1	2.16	0.20 U1	0.09 J1	0.23	0.09 J1	0.12 J1
Lithium	mg/L	0.167	--	0.135	0.00071	0.0008	0.00260	0.0006	0.00331	0.0039	0.00012 J1	0.0003 U1
Mercury	µg/L	0.005 U1	--	0.005 U1	0.005 U1	0.005 U1	0.005	0.005 U1	0.005 U1	0.005 U1	0.005 U1	0.005 U1
Molybdenum	µg/L	0.5 U1	--	0.5 U1	0.5 U1	0.5 U1	0.3 J1	0.5 U1	0.5	0.5	0.5	0.6
Selenium	µg/L	3.75	--	5.98	0.18 J1	0.31 J1	0.56	0.19 J1	0.5 U1	0.06 J1	0.12 J1	0.15 J1
Sulfate	mg/L	--	--	665	--	8.2	--	7.9	--	65.6	--	97.1
Thallium	µg/L	1.57	--	1.56	0.20 U1	0.20 U1	0.07 J1	0.20 U1	0.20 U1	0.20 U1	0.20 U1	0.02 J1
Total Dissolved Solids	mg/L	--	--	880	--	30 P2, J1	--	38 P2, J1	--	380 P2	--	400 P2
pH	SU	3.30	3.41	3.21	6.07	6.31	6.47	6.23	7.45	7.63	6.99	7.36

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U1: Non-detect value. For statistical analysis, parameters that were not detected were replaced with the reporting limit.
J1: Estimated value. Parameter was detected in concentrations below the reporting limit.
P2: The precision on the laboratory control sample duplicate (LCSD) was above acceptance limits.
-: Not sampled

Table 2. Appendix IV Groundwater Protection Standards
Statistical Analysis Summary
Big Sandy Plant - Fly Ash Pond

Constituent Name	MCL	CCR Rule-Specified	Calculated UTL	GWPS
Antimony, Total (mg/L)	0.00600		0.00152	0.00600
Arsenic, Total (mg/L)	0.0100		0.0289	0.0289
Barium, Total (mg/L)	2.00		0.113	2.00
Beryllium, Total (mg/L)	0.00400		0.000182	0.00400
Cadmium, Total (mg/L)	0.00500		0.000140	0.00500
Chromium, Total (mg/L)	0.100		0.00326	0.100
Cobalt, Total (mg/L)	n/a	0.00600	0.00561	0.00600
Combined Radium, Total (pCi/L)	5.00		4.39	5.00
Fluoride, Total (mg/L)	4.00		0.850	4.00
Lead, Total (mg/L)	n/a	0.0150	0.00240	0.0150
Lithium, Total (mg/L)	n/a	0.0400	0.0200	0.0400
Mercury, Total (mg/L)	0.00200		0.0000130	0.00200
Molybdenum, Total (mg/L)	n/a	0.100	0.00550	0.100
Selenium, Total (mg/L)	0.0500		0.000500	0.0500
Thallium, Total (mg/L)	0.00200		0.000229	0.00200

Notes:
Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
Grey cells indicate the GWPS is based on the calculated UTL, which is higher than the MCL or CCR Rule-specified value.
CCR: Coal Combustion Residuals
GWPS: Groundwater Protection Standard
MCL: Maximum Contaminant Level
mg/L: milligrams per liter
pCI/L: picocuries per liter

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

Geosyntec Consultants, Inc.

Analyte	Unit	Description	MW-1601	MW-1602	MW-1606	MW-1607
			6/13/2023	6/13/2023	6/12/2023	6/12/2023
Boron	mg/L	Interwell Background Value (UPL)	0.244			
		Analytical Result	0.077	0.078	**1.97**	0.144
Calcium	mg/L	Interwell Background Value (UPL)	123			
		Analytical Result	54.4	92.3	73.2	87.9
Chloride	mg/L	Interwell Background Value (UPL)	6.22			
		Analytical Result	4.54	**18.3**	**32.3**	3.23
Fluoride	mg/L	Interwell Background Value (UPL)	0.850			
		Analytical Result	0.13	0.08	0.19	0.06
pH	SU	Intrawell Background Value (UPL)	8.3	8.5	7.6	7.6
		Intrawell Background Value (LPL)	6.2	5.9	6.3	5.5
		Analytical Result	6.8	7.2	7.6	7.4
Sulfate	mg/L	Interwell Background Value (UPL)	106			
		Analytical Result	104	**206**	65.6	97.1
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	583			
		Analytical Result	340	**610**	380	400

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

ATTACHMENT A
Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the 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	Kentucky	12.05.2023
License Number	Licensing State	Date

ATTACHMENT B
Statistical Analysis Output

GROUNDWATER STATS CONSULTING

November 14, 2023

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

Re: Big Sandy Fly Ash Pond
Assessment Monitoring Summary – March & June 2023

Dear Ms. Kreinberg,

Groundwater Stats Consulting (GSC), formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the statistical analysis of groundwater data for the March and June 2023 Assessment Monitoring sample events at American Electric Power Company's Big Sandy Fly Ash Pond. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals (CCR) from Electric Utilities (CCR Rule, 2015) as well as with the United States Environmental Protection Agency (USEPA) Unified Guidance (2009).

Sampling began at the 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, and MW-1605
- **Downgradient wells:** MW-1601, MW-1602, MW-1606, and MW-1607

Downgradient well MW-1603 was historically sampled; however, the groundwater monitoring well network was revised in October 2023 to remove MW-1603 from the network due to the presence of coal in the screened interval and its hydrogeologic separation from the Fly Ash Pond as a result of the pond dewatering process.

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 analysis was reviewed by Andrew Collins, Project Manager for Groundwater Stats Consulting.

The CCR 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 and box plots for Appendix IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record (Figures A and B, respectively). Values in background which have previously been flagged as outliers may be seen in a lighter font and disconnected symbol on the graphs. Additionally, a summary of flagged values follows this letter (Figure C).

Although Groundwater Protection Standards were not updated during this analysis, the March and June 2023 observations for arsenic at upgradient well MW-1012 were elevated and flagged as outliers in anticipation of maintaining statistical limits that are conservative from a regulatory perspective.

Summary of Statistical Methods – Appendix IV Parameters

Parametric tolerance limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are non-detects, a nonparametric test is utilized. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (USEPA, 2009), data are analyzed using either parametric or non-parametric tolerance limits as appropriate.

- No statistical analyses are required on wells and analytes containing 100% non-detects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% non-detects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for non-detects is the most recent practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% non-detects, the Kaplan-Meier non-detect adjustment is applied to the background data for parametric limits. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.

- Nonparametric tolerance limits are used on data containing greater than 50% non-detects.

Summary of Background Update – Conducted in January 2023

Outlier Analysis

Prior to constructing tolerance limits, background data were screened through visual screening and Tukey's outlier test for potential outliers and extreme trending patterns that would lead to artificially elevated statistical limits. A discussion of those findings is provided below.

Tukey's outlier test on pooled upgradient well data through October 2022 identified several outliers; however, the majority of measurements were similar to remaining measurements within the respective record. Therefore, these measurements were not flagged as outliers. Exceptions include the three highest reported measurements at the time of arsenic at upgradient well MW-1012 which were flagged to construct statistical limits that are conservative (i.e., lower) from a regulatory perspective. All previously flagged measurements were confirmed.

Additionally, downgradient well data through October 2022 were screened through visual screening using time series graphs. Since the downgradient well data are used to construct confidence intervals, a regulatory conservative approach is taken in that values that are marginally high relative to the rest of the data are retained unless there is particular justification for excluding them. No outliers were flagged among downgradient wells for Appendix IV parameters.

In previous reports, such as the original screening in 2017 and the February 2021 screening, several high values not identified by Tukey's were flagged as outliers in order to construct limits that are conservative (i.e., lower) from a regulatory perspective. Tukey's outlier test results and a discussion for Appendix IV parameters were included with the background update conducted in January 2023. As mentioned above, a list of flagged values follows this report (Figure C).

Interwell Upper Tolerance Limits

Interwell upper tolerance limits were used to calculate background limits from all available pooled upgradient well data for each Appendix IV parameter through October 2022 (Figure D). These limits are updated on an annual basis and will be updated again during the Fall 2023 sample event. Parametric tolerance limits are calculated, with a target of 95%

confidence and 95% coverage, when data follow a normal or transformed-normal distribution. When data contained greater than 50% non-detects or did not follow a normal or transformed-normal distribution, non-parametric tolerance limits were constructed using the highest background measurement. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples.

Groundwater Protection Standards

The upper tolerance limits were compared to the Maximum Contaminant Levels (MCLs) and CCR-Rule specified levels in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure E).

Evaluation of Appendix IV Parameters – March & June 2023

Time series plots were used to visually identify potential outliers in downgradient wells through the March and June 2023 sample events. When suspected outliers are identified, Tukey's outlier test may be used to formally test whether measurements are statistically significant. As mentioned above, high outliers are 'cautiously' flagged in the downgradient wells when measurements are clearly much different from remaining data within a given well. This is intended to be a regulatory conservative approach in that it will reduce the variance and thus reduce the width of parametric confidence intervals; although it will also reduce the mean and thus lower the entire interval. The intent is to better represent the actual downgradient mean. No additional suspected outliers were identified.

Confidence intervals were then constructed with data through June 2023 on downgradient wells for each of the Appendix IV parameters using the highest limit of the MCL, CCR-Rule specified levels, or background limit as the GWPS as discussed above (Figure F). When data followed a normal or transformed-normal distribution, parametric confidence intervals were used for Appendix IV parameters. Nonparametric confidence intervals, which use the largest and smallest order statistics depending on the sample size as interval limits, were constructed when data did not follow a normal or transformed-normal distribution or when there were greater than 50% non-detects. The lower confidence limit, which is constructed with 99% confidence for parametric confidence intervals, is compared to the GWPS prepared as described above. The confidence level associated with nonparametric confidence intervals is dependent upon the number samples available.

Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. A summary of the confidence interval results follows this letter. No exceedances were identified.

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

For Groundwater Stats Consulting,

Tristan Clark
Groundwater Analyst

Andrew Collins
Project Manager

100% Non-Detects: Appendix IV Downgradient

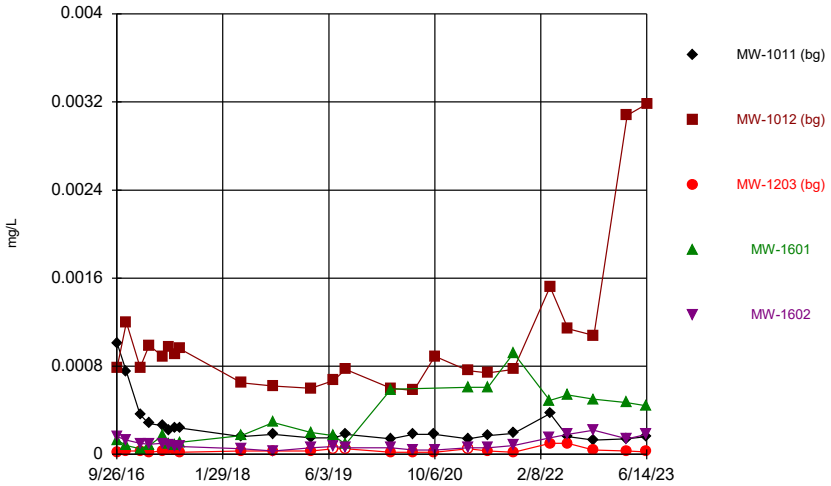
Analysis Run 10/5/2023 2:45 PM View: Appendix IV Time Series & Box Plot
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Beryllium (mg/L)
MW-1602

FIGURE A
Time Series

Sanitas™ v.10.0.13b Software licensed to . UG
Hollow symbols indicate censored values.

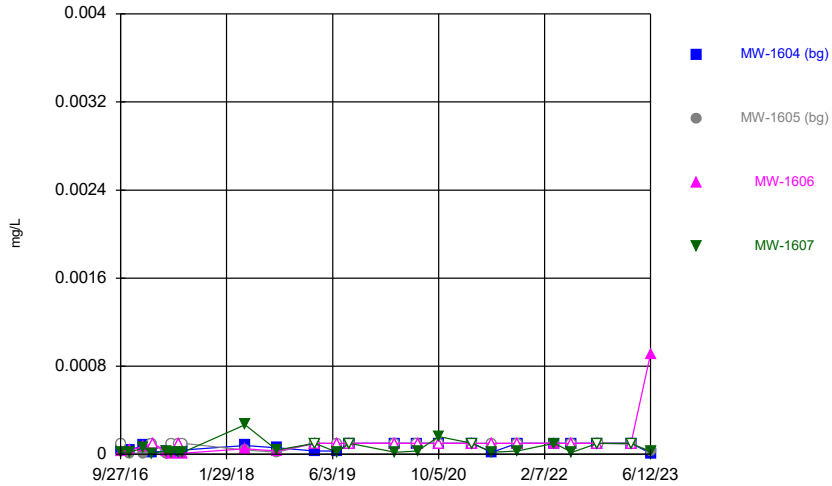
Time Series



Constituent: Antimony Analysis Run 11/13/2023 9:42 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG
Hollow symbols indicate censored values.

Time Series



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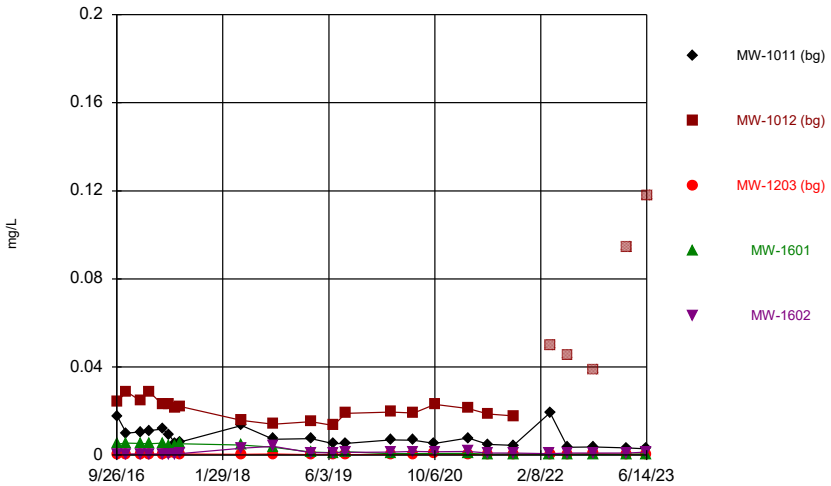
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

Time Series



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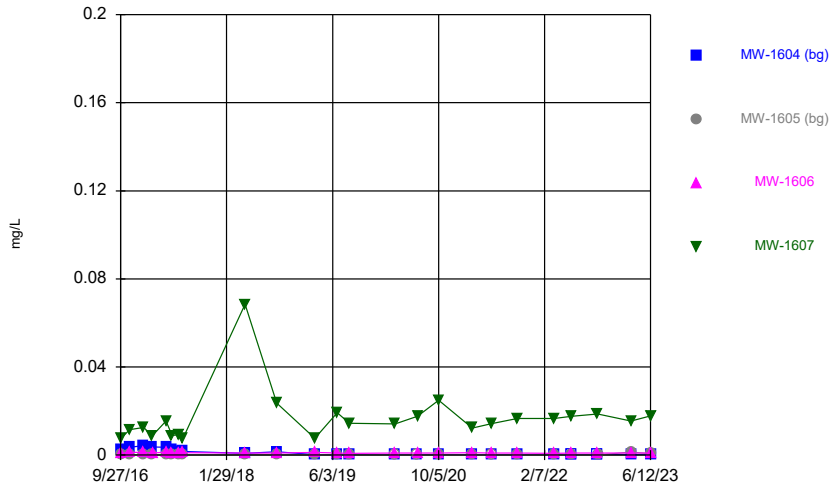
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG
Hollow symbols indicate censored values.

Time Series



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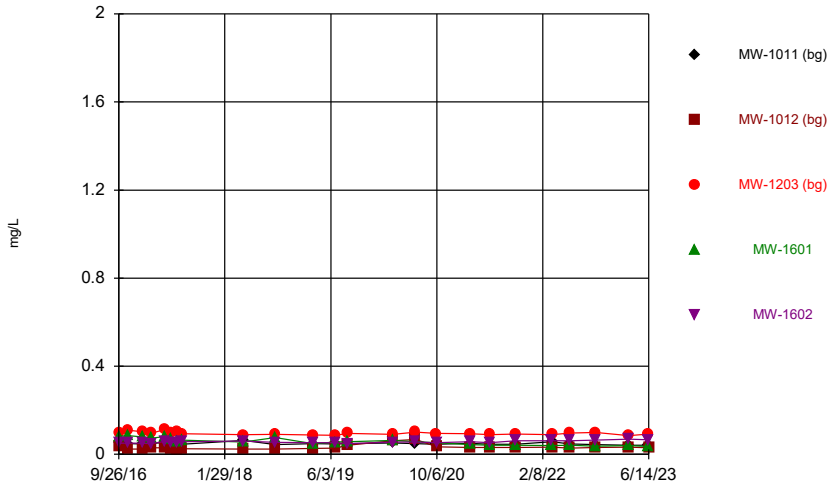
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

Time Series



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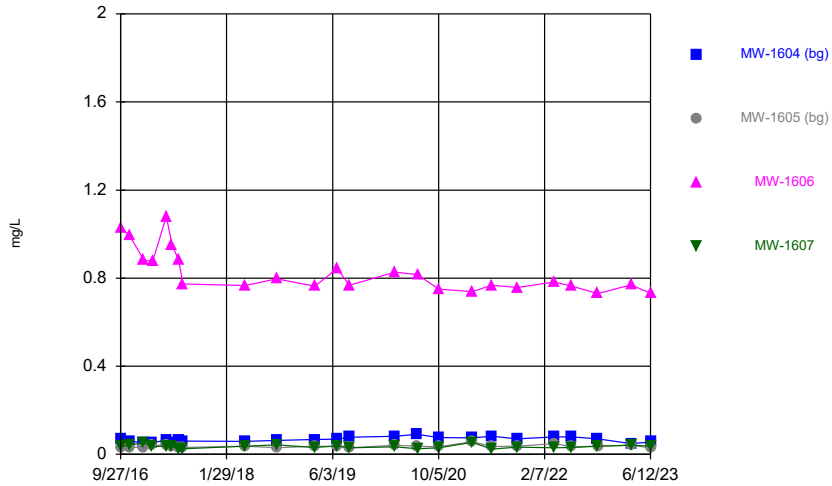
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

Time Series



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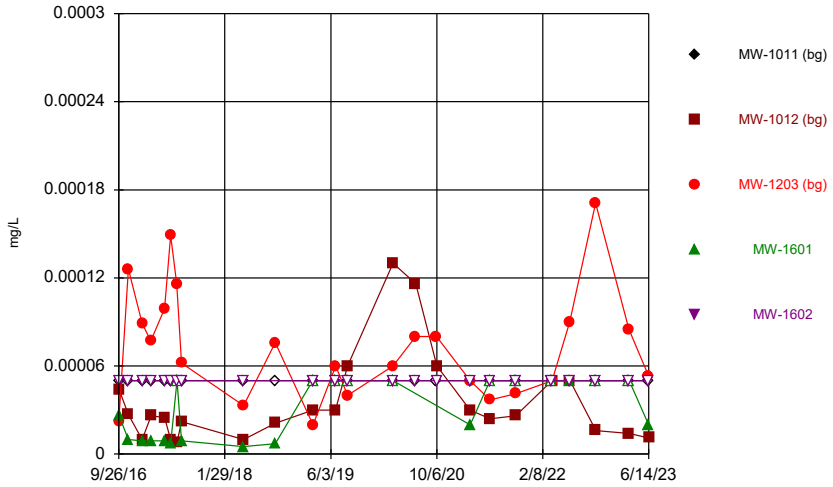
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

Hollow symbols indicate censored values.

Time Series



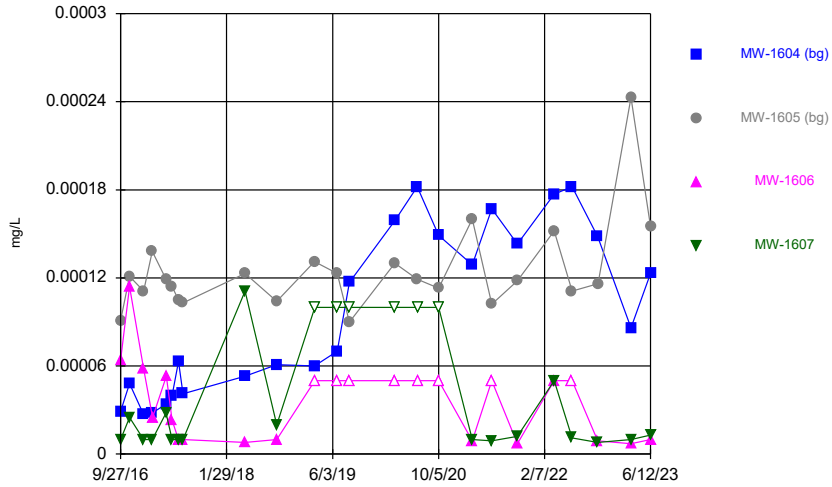
Constituent: Beryllium Analysis Run 11/13/2023 9:42 AM

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

Hollow symbols indicate censored values.

Time Series

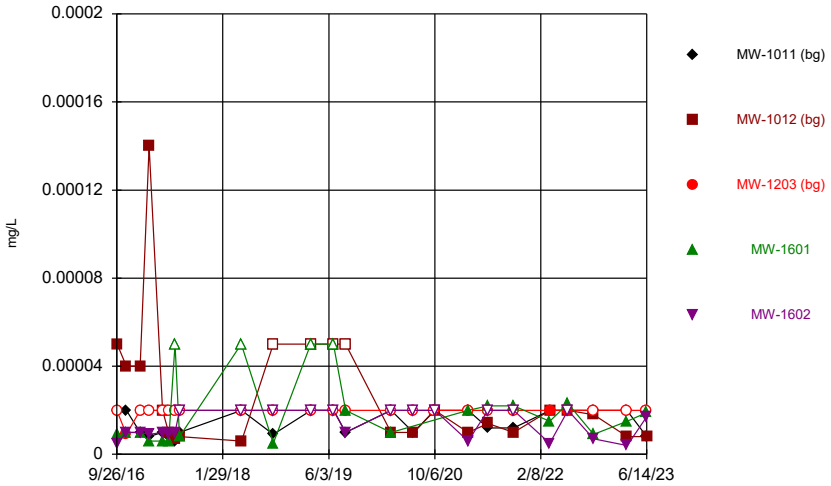


Constituent: Beryllium Analysis Run 11/13/2023 9:42 AM

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG
Hollow symbols indicate censored values.

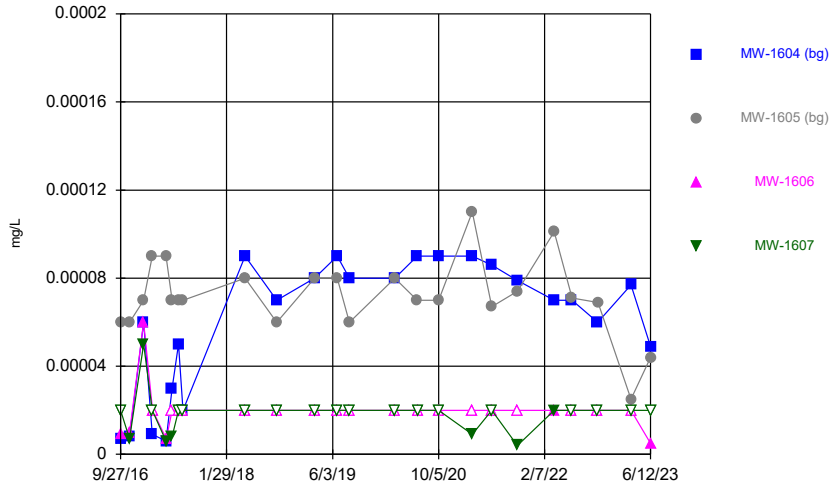
Time Series



Constituent: Cadmium Analysis Run 11/13/2023 9:42 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG
Hollow symbols indicate censored values.

Time Series



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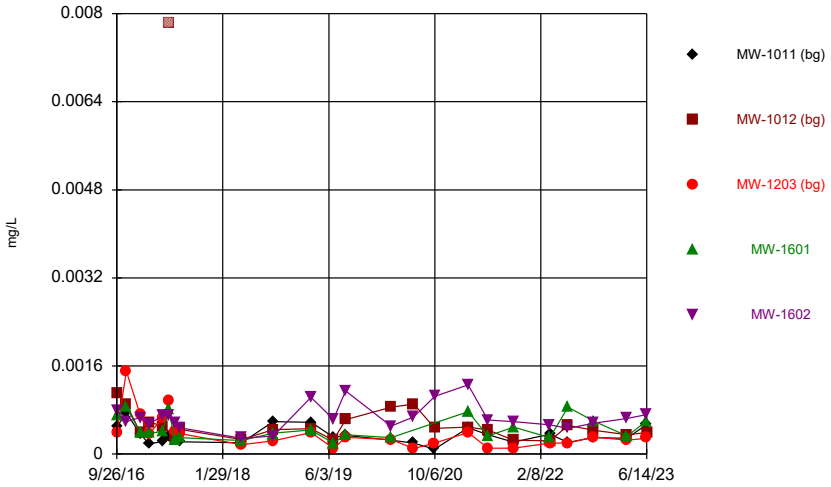
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

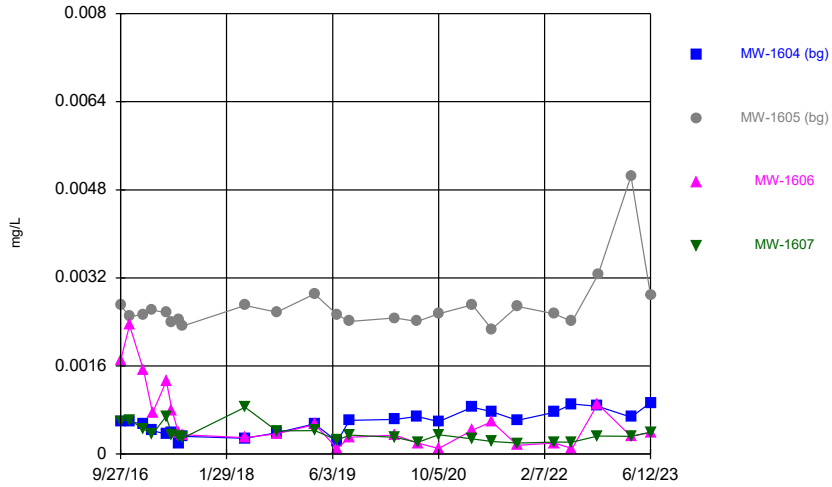
Time Series



Constituent: Chromium Analysis Run 11/13/2023 9:42 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

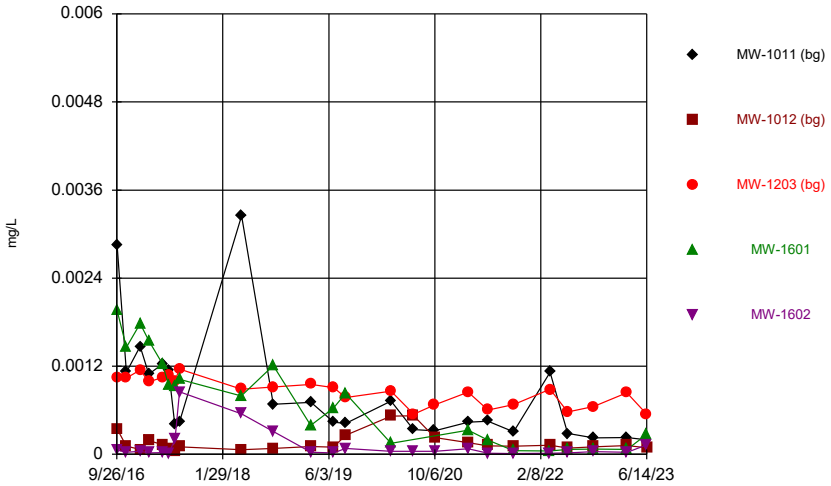
Sanitas™ v.10.0.13b Software licensed to . UG

Time Series



Constituent: Chromium Analysis Run 11/13/2023 9:42 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Time Series



Constituent: Cobalt Analysis Run 11/13/2023 9:42 AM

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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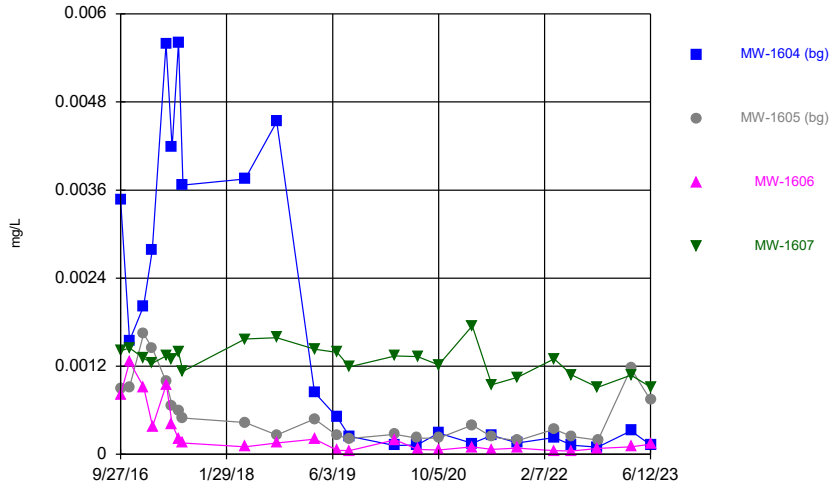
Time Series

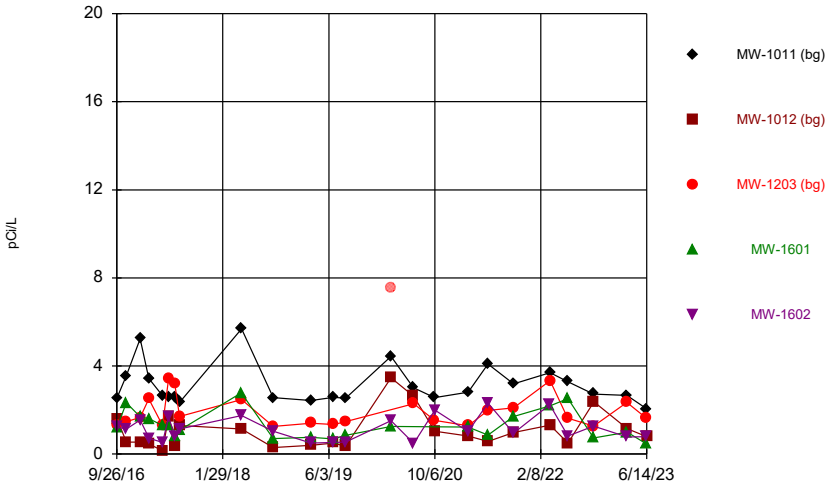


Constituent: Cobalt Analysis Run 11/13/2023 9:42 AM

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

Time Series

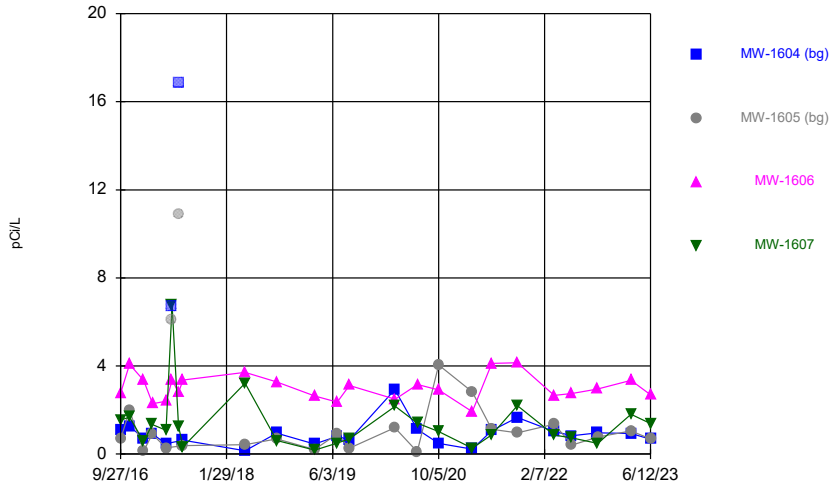


Constituent: Combined Radium 226 + 228 Analysis Run 11/13/2023 9:42 AM

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

Time Series

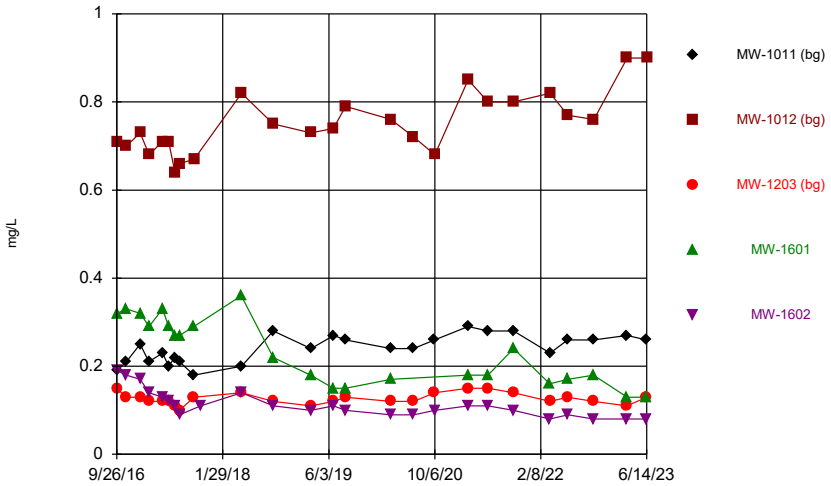


Constituent: Combined Radium 226 + 228 Analysis Run 11/13/2023 9:42 AM

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

Time Series



Constituent: Fluoride Analysis Run 11/13/2023 9:42 AM

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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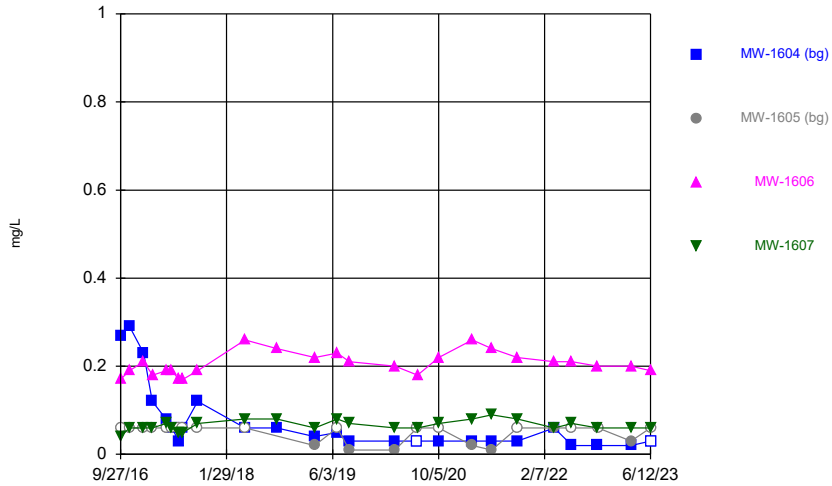
Hollow symbols indicate censored values.

Time Series



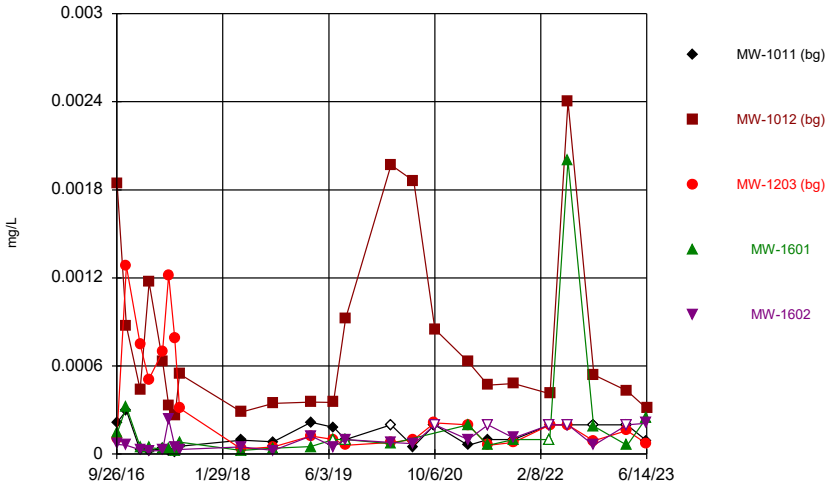
Constituent: Fluoride Analysis Run 11/13/2023 9:43 AM

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

Hollow symbols indicate censored values.

Time Series



Constituent: Lead Analysis Run 11/13/2023 9:43 AM

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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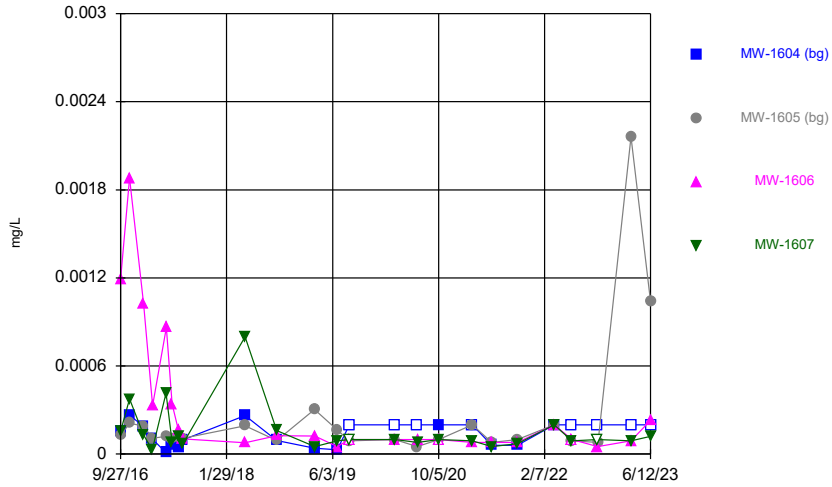
Hollow symbols indicate censored values.

Time Series



Constituent: Lead Analysis Run 11/13/2023 9:43 AM

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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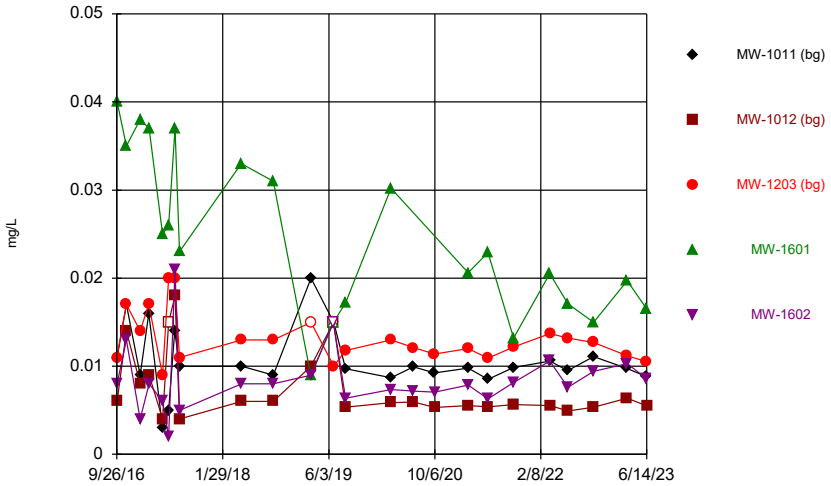
Hollow symbols indicate censored values.

Time Series



Constituent: Lithium Analysis Run 11/13/2023 9:43 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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Hollow symbols indicate censored values.

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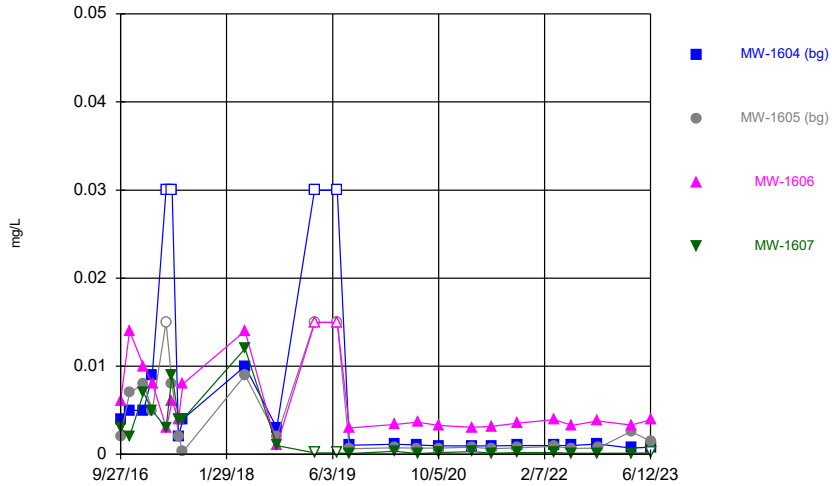

Constituent: Lithium Analysis Run 11/13/2023 9:43 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG
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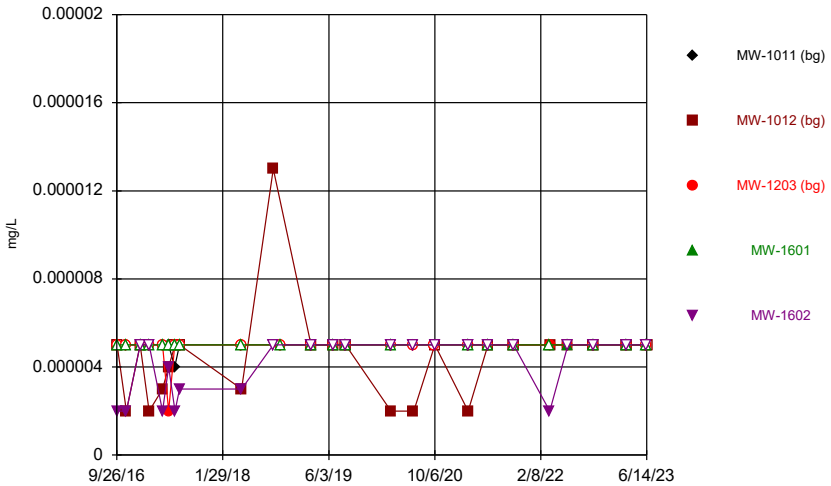
Time Series



Constituent: Mercury Analysis Run 11/13/2023 9:43 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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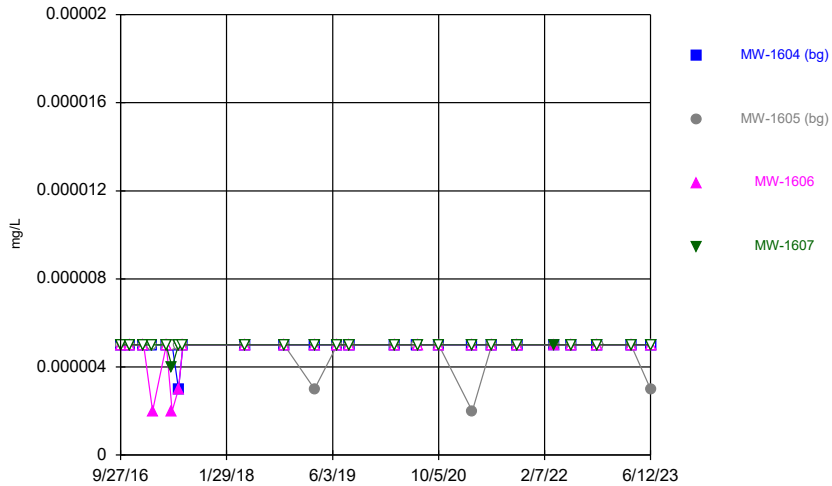
Hollow symbols indicate censored values.

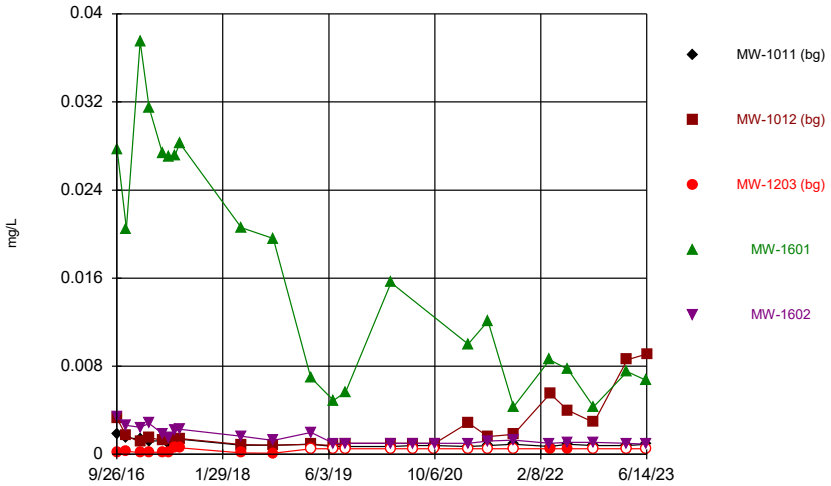
Time Series



Constituent: Mercury Analysis Run 11/13/2023 9:43 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG
Hollow symbols indicate censored values.

Time Series



Constituent: Molybdenum Analysis Run 11/13/2023 9:43 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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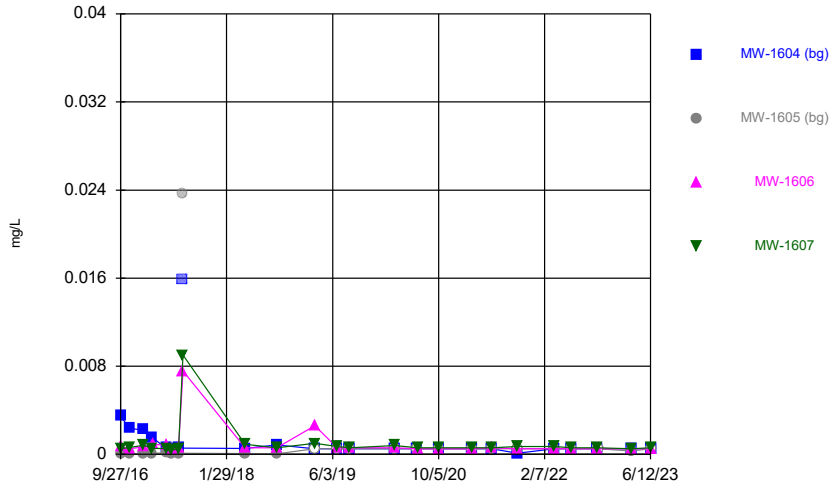
Hollow symbols indicate censored values.

Time Series



Constituent: Molybdenum Analysis Run 11/13/2023 9:43 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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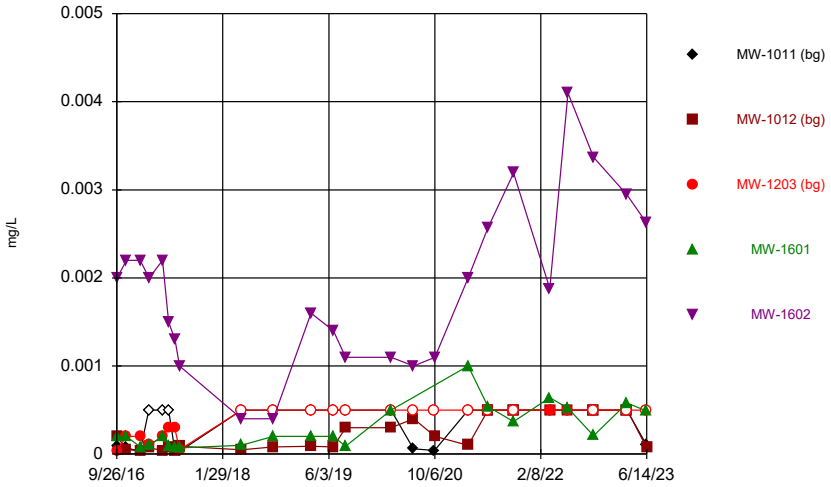
Hollow symbols indicate censored values.

Time Series



Constituent: Selenium Analysis Run 11/13/2023 9:43 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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Hollow symbols indicate censored values.

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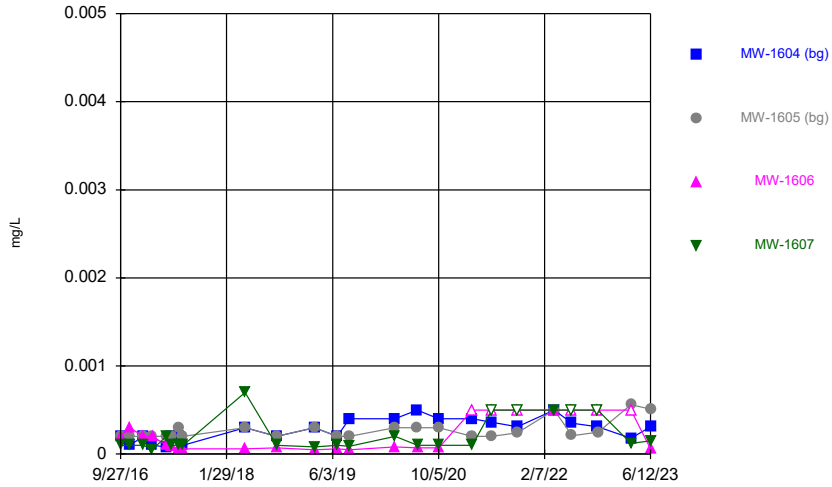

Constituent: Selenium Analysis Run 11/13/2023 9:43 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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Hollow symbols indicate censored values.

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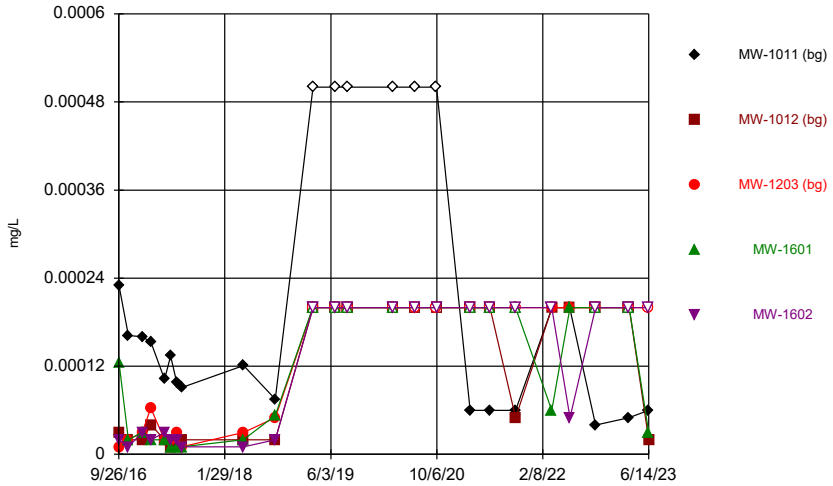

Constituent: Thallium Analysis Run 11/13/2023 9:43 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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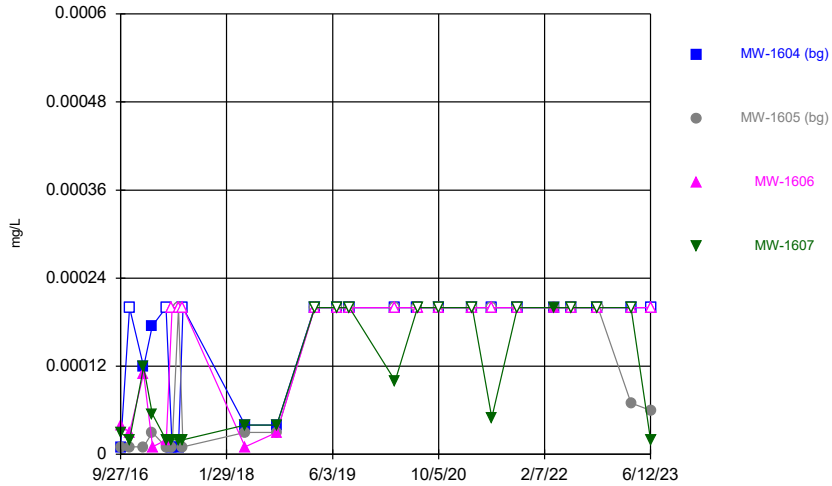
Hollow symbols indicate censored values.

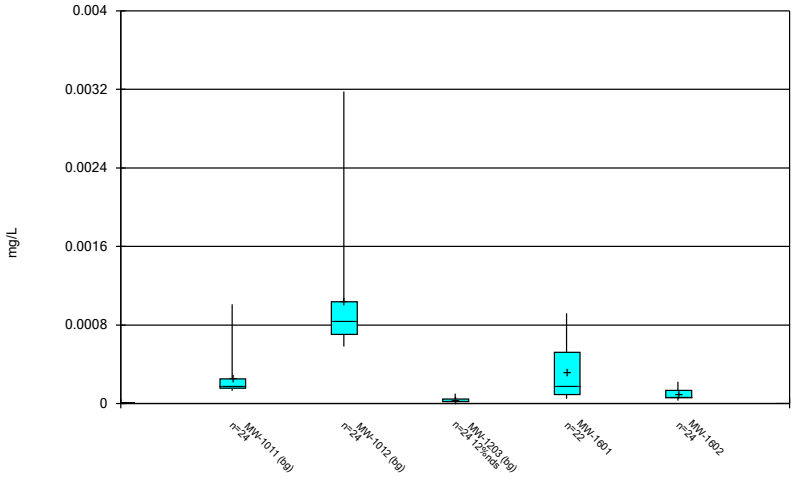
Time Series



Constituent: Thallium Analysis Run 11/13/2023 9:43 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

FIGURE B
Box Plots

Box & Whiskers Plot



Constituent: Antimony Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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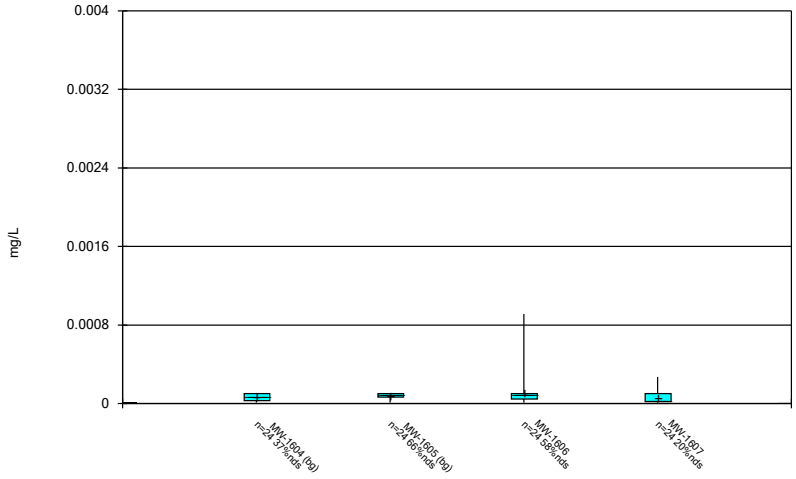
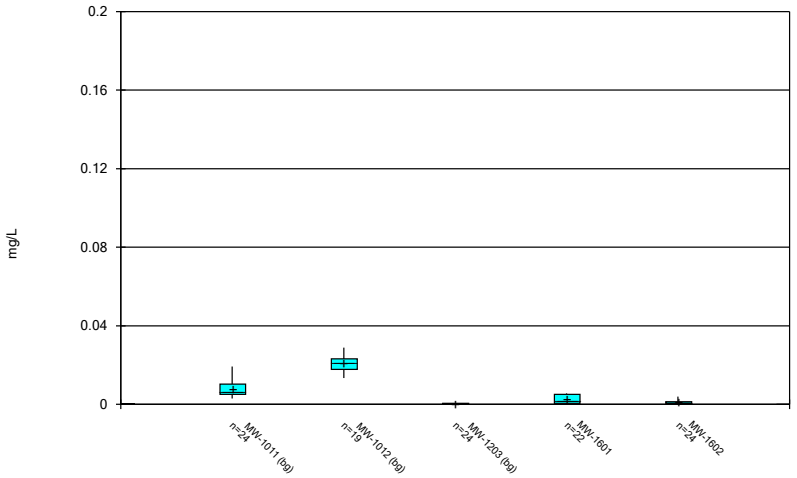
Box & Whiskers Plot



Constituent: Antimony Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

Box & Whiskers Plot



Constituent: Arsenic Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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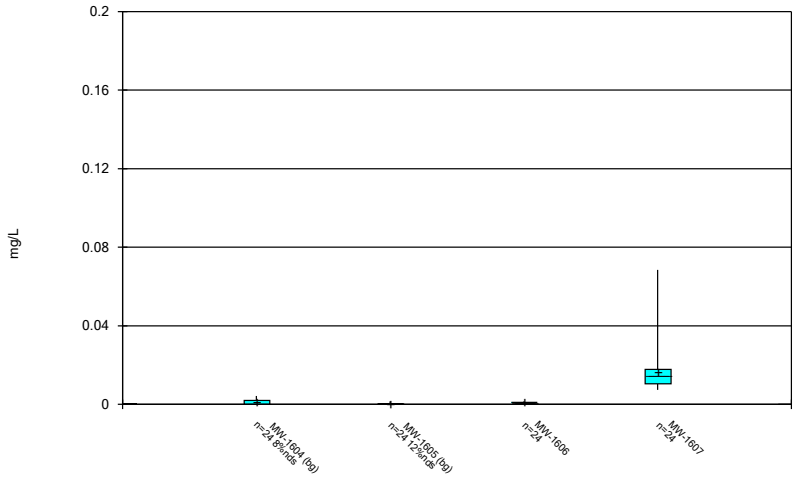
Box & Whiskers Plot



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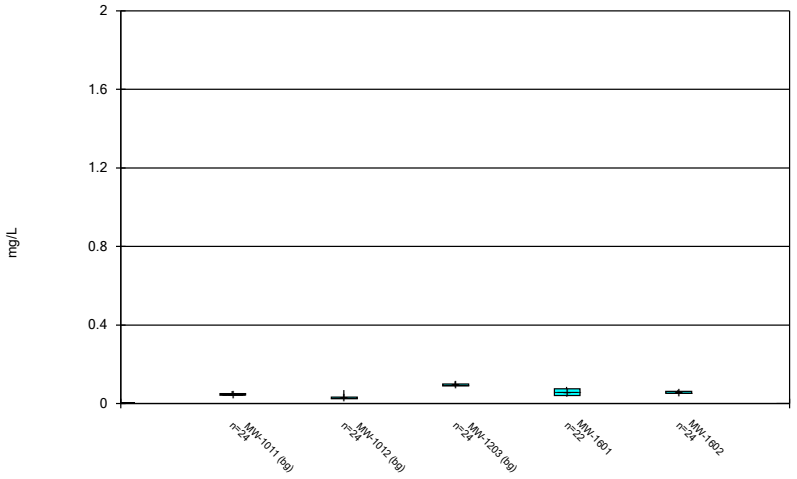
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Box & Whiskers Plot



Constituent: Barium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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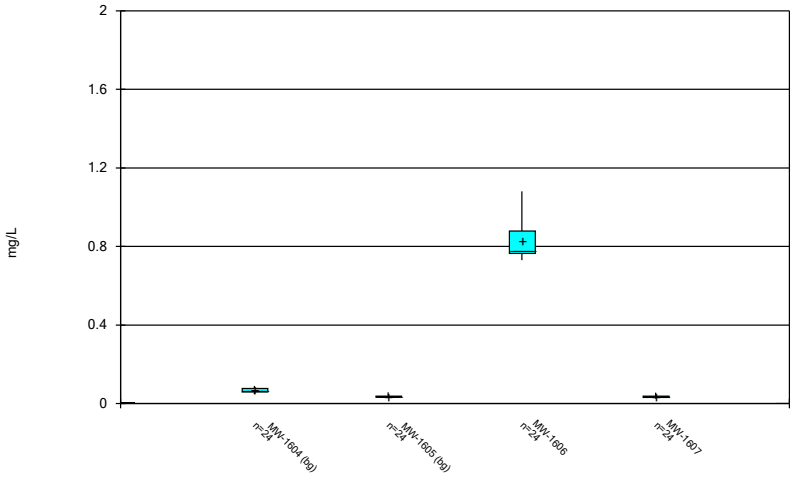
Box & Whiskers Plot



Constituent: Barium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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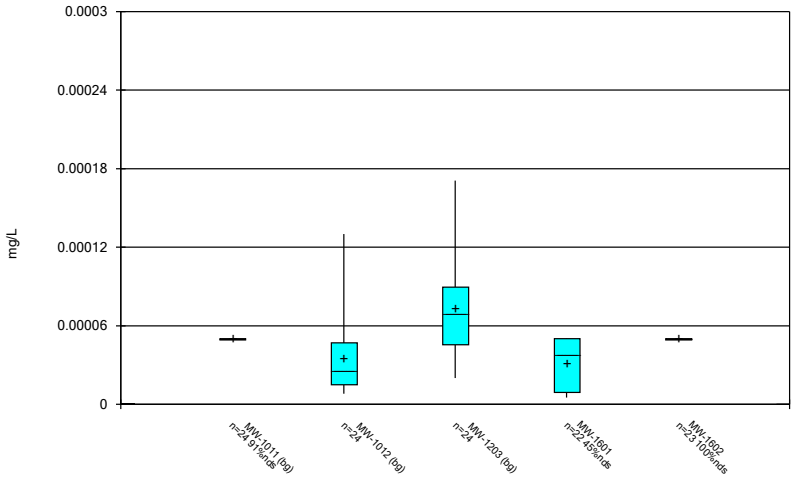
Box & Whiskers Plot



Constituent: Beryllium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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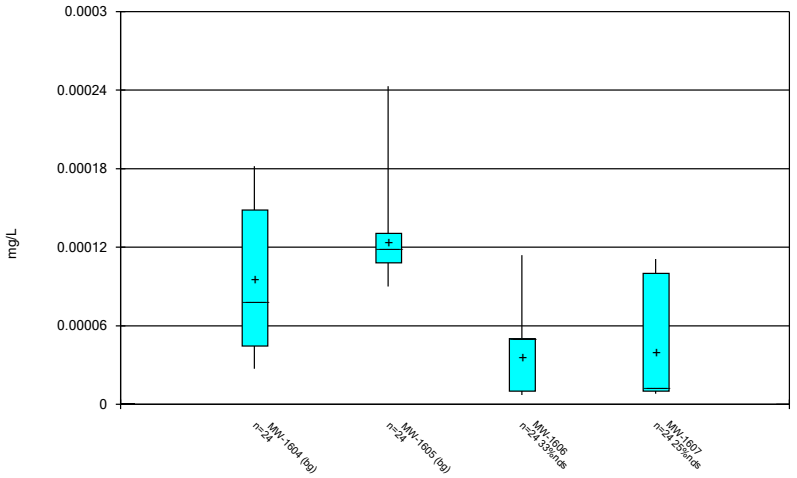
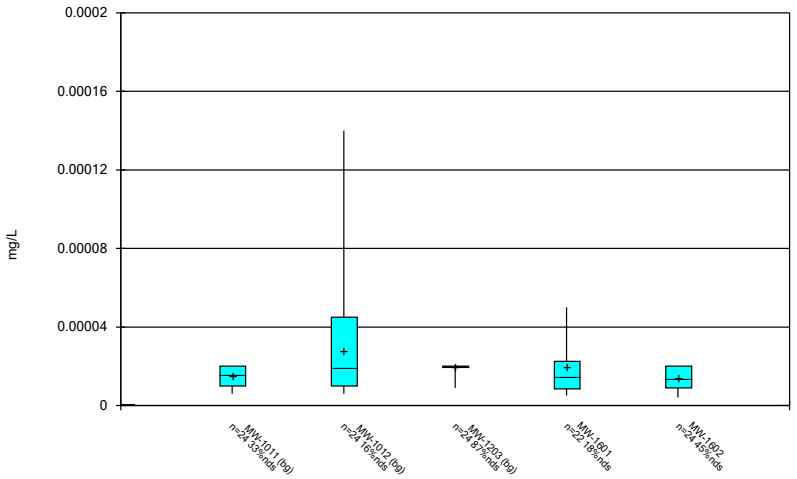
Box & Whiskers Plot



Constituent: Beryllium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Box & Whiskers Plot



Constituent: Cadmium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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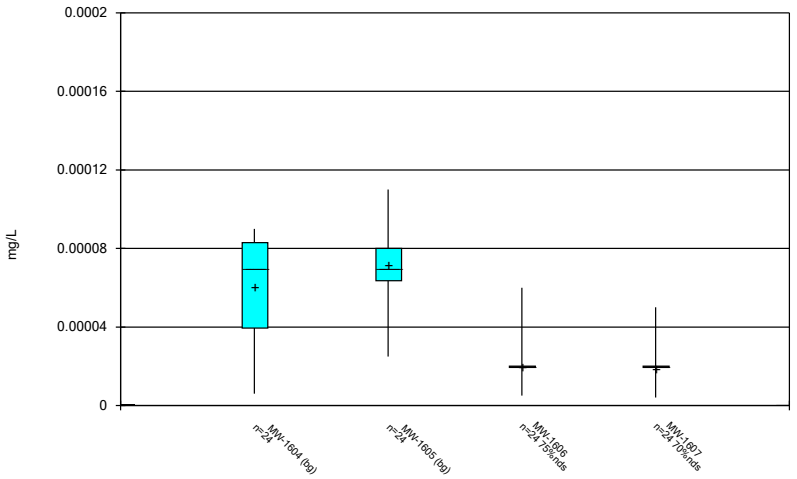
Box & Whiskers Plot



Constituent: Cadmium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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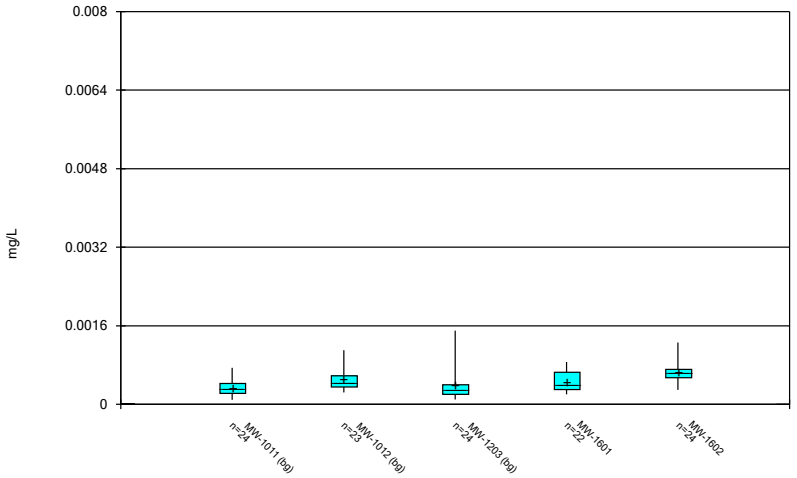
Box & Whiskers Plot



Constituent: Chromium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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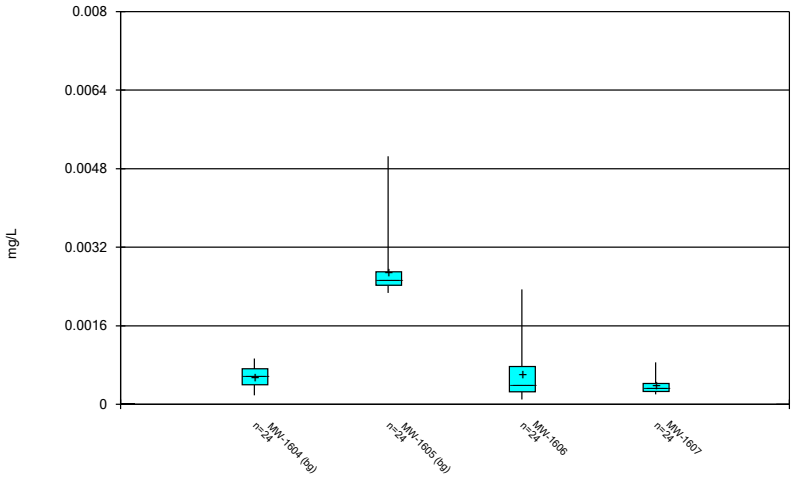
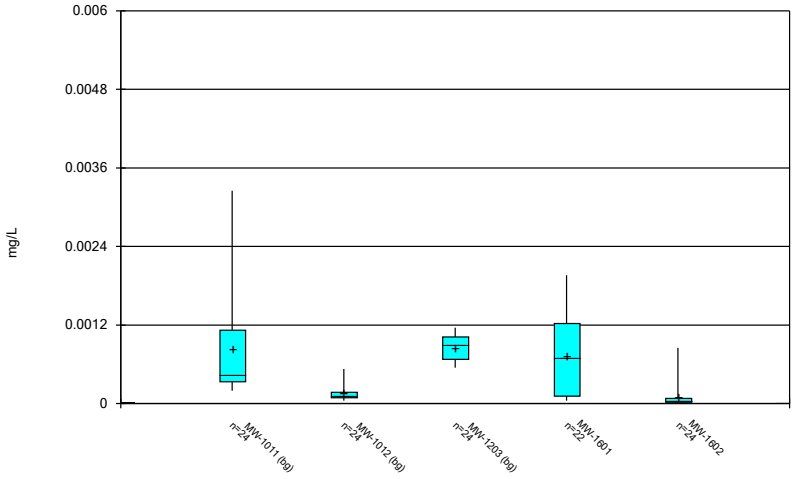
Box & Whiskers Plot



Constituent: Chromium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Box & Whiskers Plot



Constituent: Cobalt Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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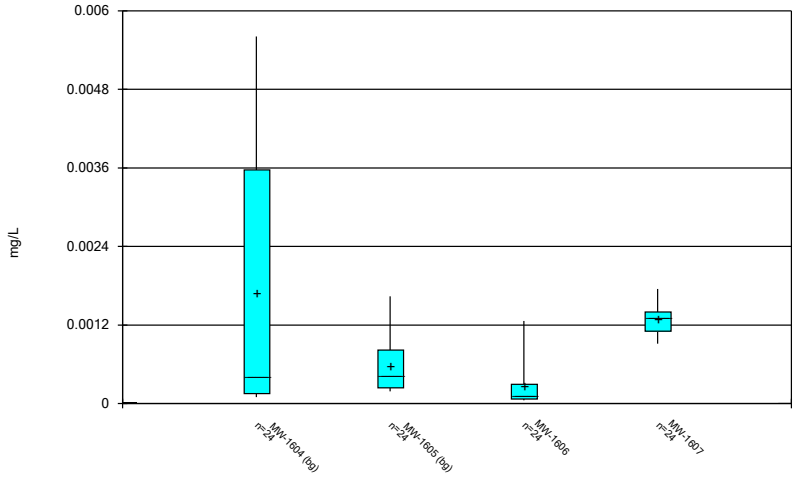
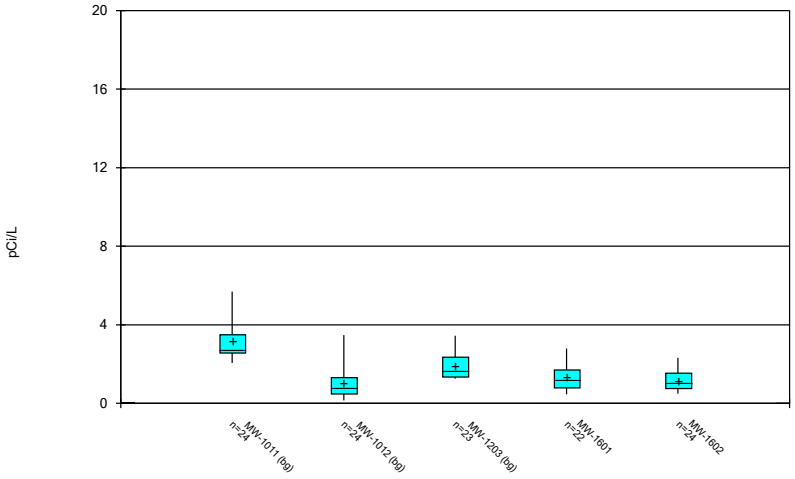
Box & Whiskers Plot



Constituent: Cobalt Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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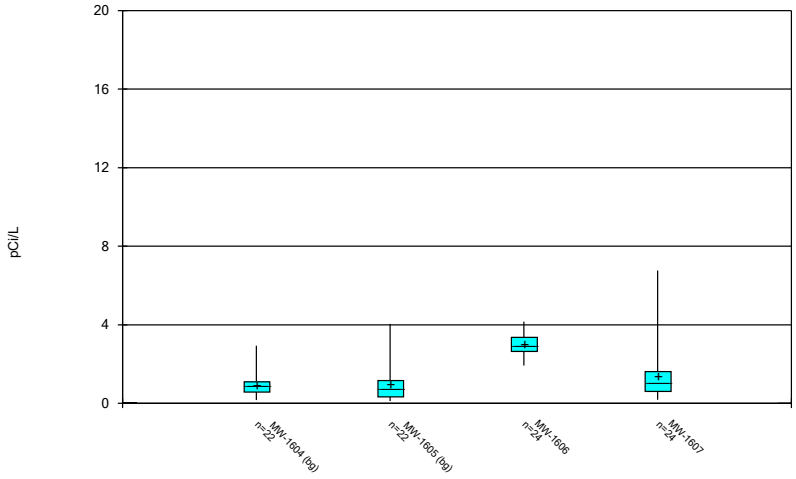
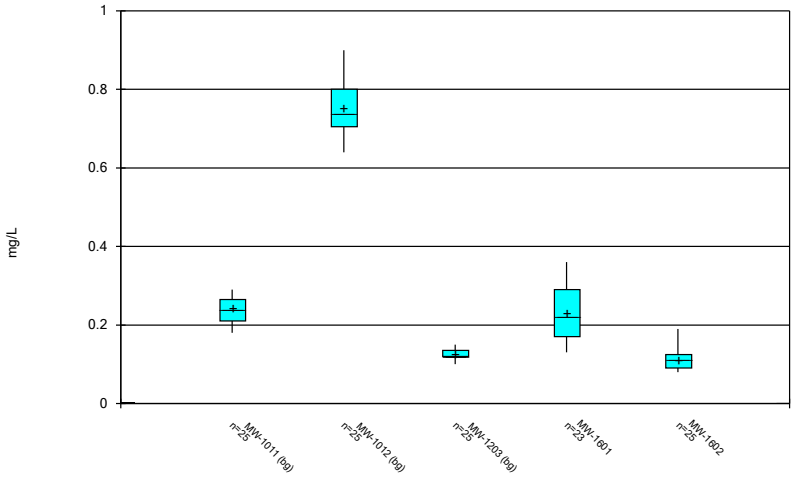
Box & Whiskers Plot



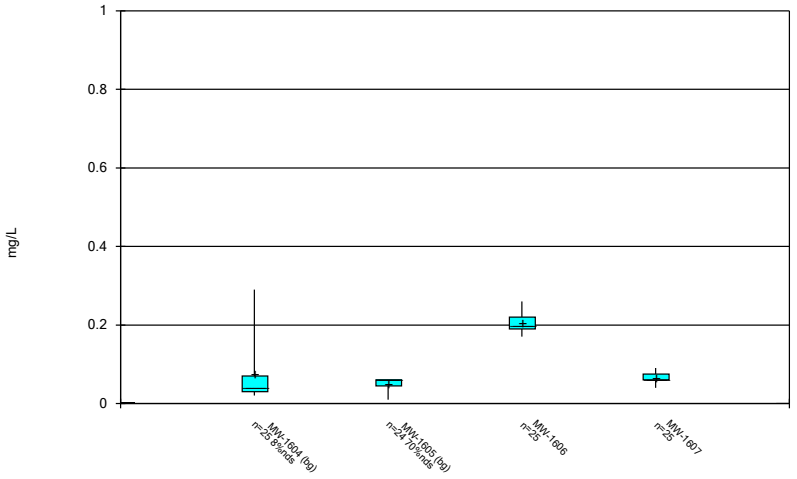
Constituent: Combined Radium 226 + 228 Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Box & Whiskers Plot



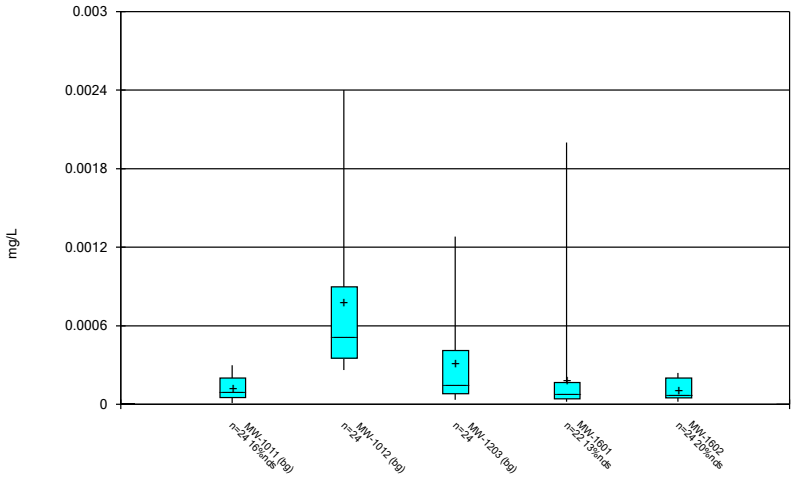
Constituent: Fluoride Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Box & Whiskers Plot



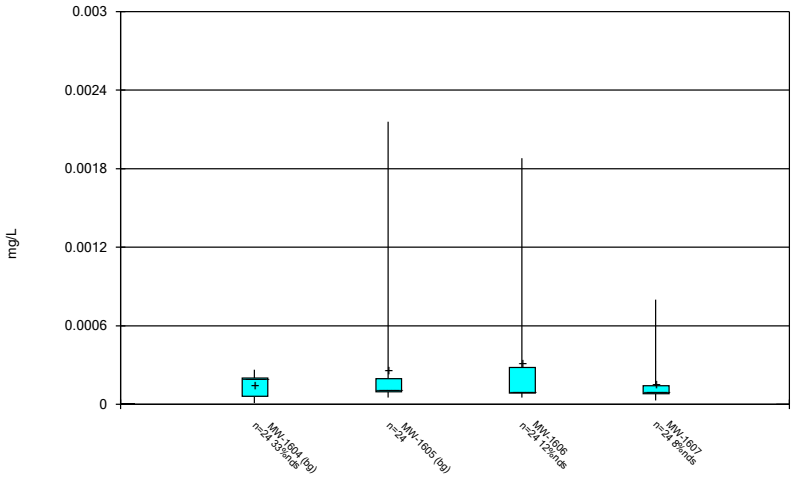
Constituent: Fluoride Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Box & Whiskers Plot



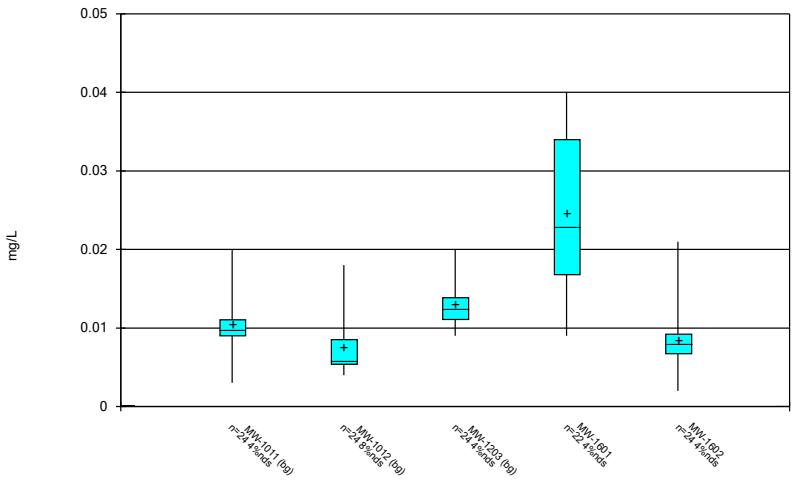
Constituent: Lead Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Box & Whiskers Plot



Constituent: Lead Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Box & Whiskers Plot



Constituent: Lithium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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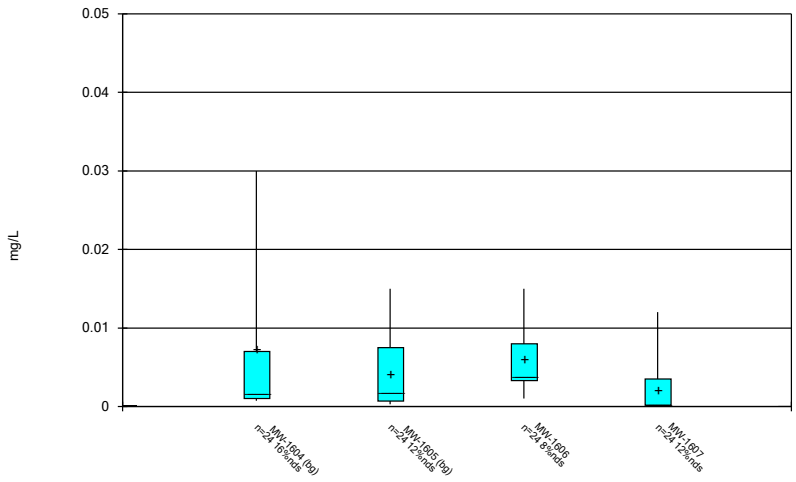
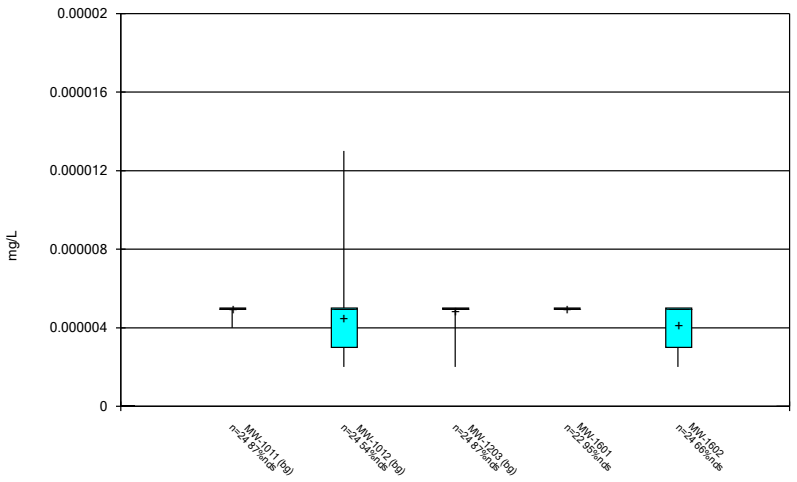
Box & Whiskers Plot



Constituent: Lithium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

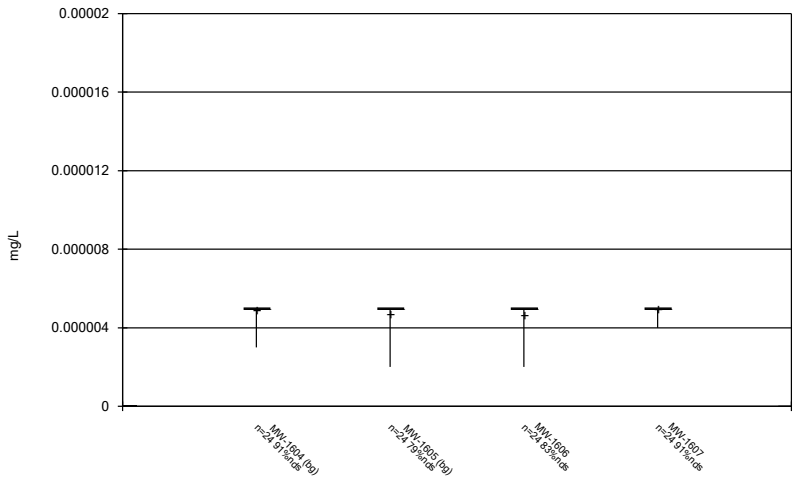
Box & Whiskers Plot



Constituent: Mercury Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

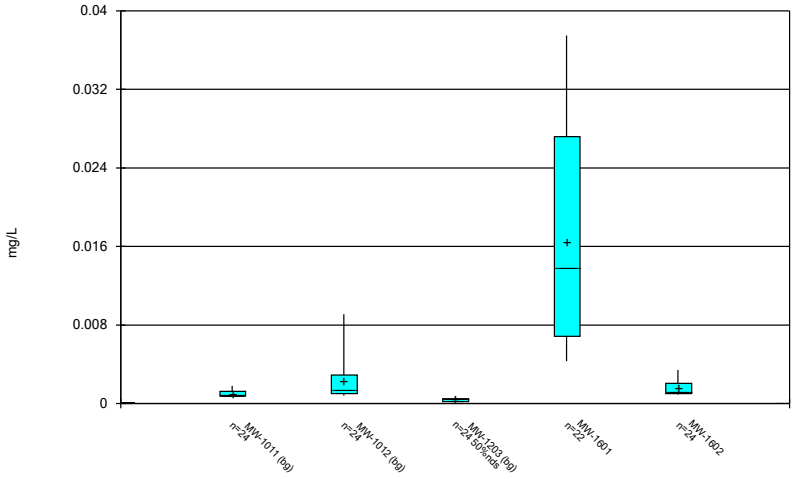
Sanitas™ v.10.0.13b Software licensed to . UG

Box & Whiskers Plot



Constituent: Mercury Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Box & Whiskers Plot



Constituent: Molybdenum Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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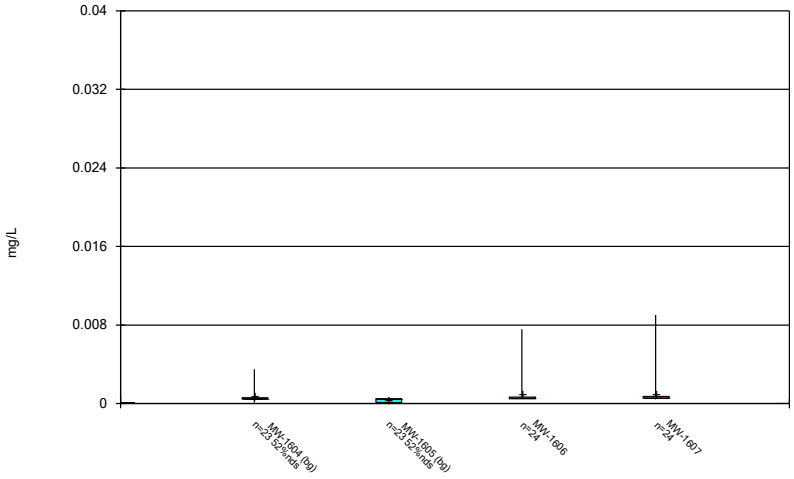
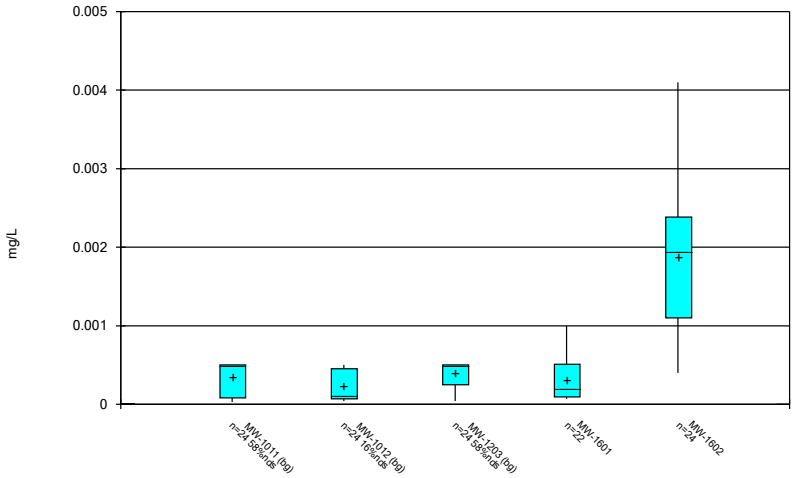
Box & Whiskers Plot



Constituent: Molybdenum Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.13b Software licensed to . UG

Box & Whiskers Plot



Constituent: Selenium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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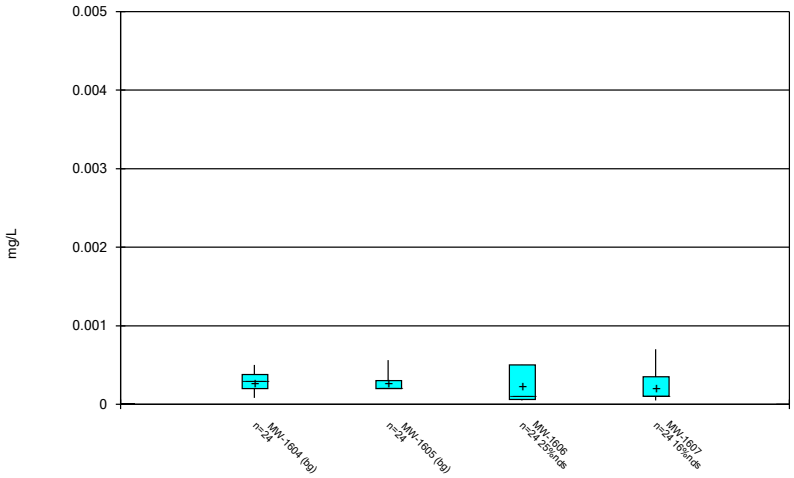
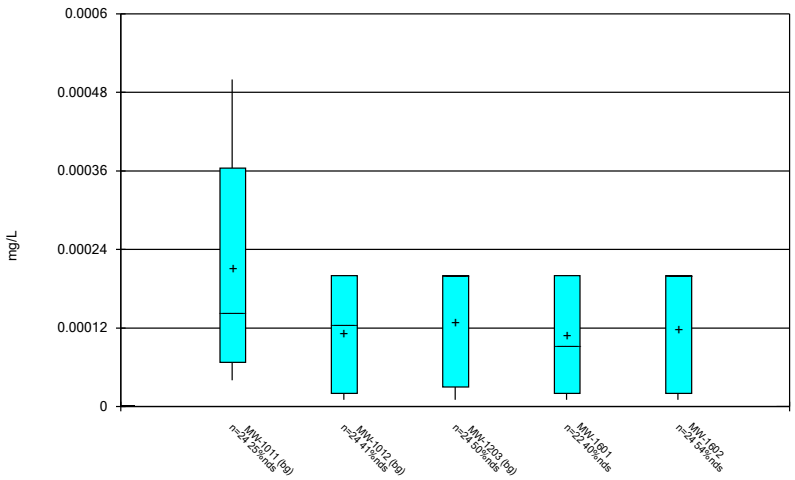
Box & Whiskers Plot



Constituent: Selenium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Box & Whiskers Plot



Constituent: Thallium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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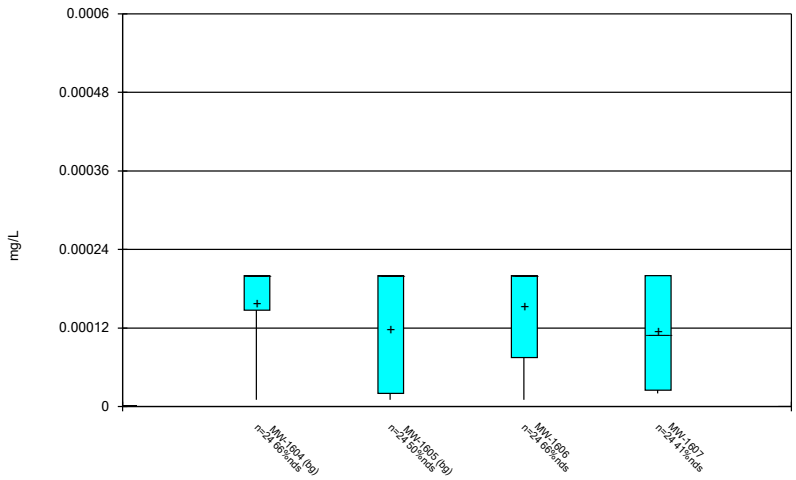
Box & Whiskers Plot



Constituent: Thallium Analysis Run 11/13/2023 9:46 AM
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

FIGURE C
Outlier Summary

Outlier Summary

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 11/13/2023, 9:48 AM

	MW-1012 Arsenic (mg/L)	MW-1012 Chromium (mg/L)	MW-1203 Combined Radium 226 + 228 (pCi/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)
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)
3/17/2020			7.524 (o)				
3/24/2022	0.0499 (o)						
6/15/2022	0.0454 (o)						
10/12/2022	0.0386 (o)						
3/15/2023	0.0942 (o)						
6/14/2023	0.118 (o)						

FIGURE D

UTLs

Upper Tolerance Limits

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 1/9/2023, 5:12 PM

Constituent	Upper Lim.	Bg N	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony (mg/L)	0.00152	110	n/a	24.55	n/a	n/a	0.003545	NP Inter(normality)
Arsenic (mg/L)	0.0289	107	n/a	4.673	n/a	n/a	0.004135	NP Inter(normality)
Barium (mg/L)	0.113	110	n/a	0	n/a	n/a	0.003545	NP Inter(normality)
Beryllium (mg/L)	0.000182	110	n/a	18.18	n/a	n/a	0.003545	NP Inter(normality)
Cadmium (mg/L)	0.00014	110	n/a	27.27	n/a	n/a	0.003545	NP Inter(normality)
Chromium (mg/L)	0.00326	109	n/a	0	n/a	n/a	0.003731	NP Inter(normality)
Cobalt (mg/L)	0.00561	110	n/a	0	n/a	n/a	0.003545	NP Inter(normality)
Combined Radium 226 + 228 (pCi/L)	4.388	105	0.4722	0	None	sqrt(x)	0.05	Inter
Fluoride (mg/L)	0.85	114	n/a	14.91	n/a	n/a	0.002887	NP Inter(normality)
Lead (mg/L)	0.0024	110	n/a	8.182	n/a	n/a	0.003545	NP Inter(normality)
Lithium (mg/L)	0.02	110	n/a	10	n/a	n/a	0.003545	NP Inter(normality)
Mercury (mg/L)	0.000013	110	n/a	80	n/a	n/a	0.003545	NP Inter(NDs)
Molybdenum (mg/L)	0.0055	108	n/a	28.7	n/a	n/a	0.003928	NP Inter(normality)
Selenium (mg/L)	0.0005	110	n/a	25.45	n/a	n/a	0.003545	NP Inter(normality)
Thallium (mg/L)	0.000229	110	n/a	46.36	n/a	n/a	0.003545	NP Inter(normality)

FIGURE E

GWPS

BIG SANDY FAP GWPS				
Constituent Name	**MCL**	**CCR-Rule Specified**	**Background Limit**	**GWPS**
Antimony, Total (mg/L)	0.006		0.0015	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		0.0033	0.1
Cobalt, Total (mg/L)	n/a	0.006	0.0056	0.006
Combined Radium, Total (pCi/L)	5		4.39	5
Fluoride, Total (mg/L)	4		0.85	4
Lead, Total (mg/L)	0.015		0.0024	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	0.0055	0.1
Selenium, Total (mg/L)	0.05		0.0005	0.05
Thallium, Total (mg/L)	0.002		0.00023	0.002

**Grey cell indicates Background is higher than MCL or CCR-Rule Specified Level*

**GWPS = Groundwater Protection Standard*

**MCL = Maximum Contaminant Level*

**CCR = Coal Combustion Residual*

FIGURE F

Confidence Interval

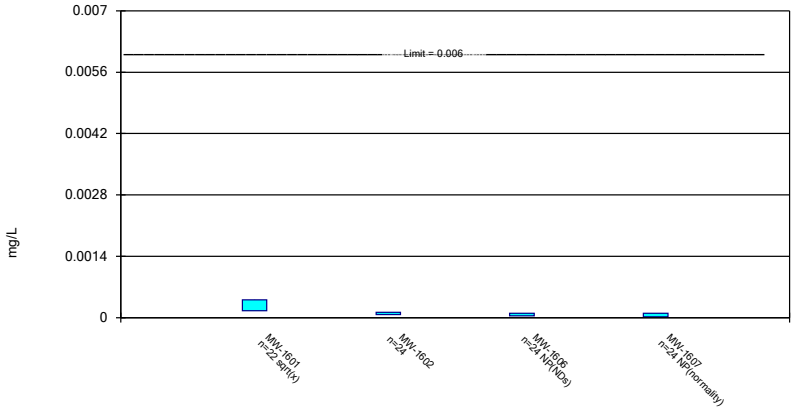
Appendix IV Confidence Intervals - All Results (No Significant)

Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP Printed 10/8/2023, 7:13 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	ND Adj.	Transform	Alpha	Method
Antimony (mg/L)	MW-1601	0.0004022	0.0001593	0.006	No	22	0	None	sqrt(x)	0.01	Param.
Antimony (mg/L)	MW-1602	0.0001214	0.00006863	0.006	No	24	0	None	No	0.01	Param.
Antimony (mg/L)	MW-1606	0.0001	0.00004	0.006	No	24	58.33	None	No	0.01	NP (NDs)
Antimony (mg/L)	MW-1607	0.0001	0.00002	0.006	No	24	20.83	None	No	0.01	NP (normality)
Arsenic (mg/L)	MW-1601	0.00503	0.00047	0.029	No	22	0	None	No	0.01	NP (normality)
Arsenic (mg/L)	MW-1602	0.001346	0.0006862	0.029	No	24	0	None	x^(1/3)	0.01	Param.
Arsenic (mg/L)	MW-1606	0.001075	0.0009299	0.029	No	24	0	None	No	0.01	Param.
Arsenic (mg/L)	MW-1607	0.01865	0.0114	0.029	No	24	0	None	ln(x)	0.01	Param.
Barium (mg/L)	MW-1601	0.06661	0.04892	2	No	22	0	None	No	0.01	Param.
Barium (mg/L)	MW-1602	0.05933	0.05365	2	No	24	0	None	No	0.01	Param.
Barium (mg/L)	MW-1606	0.883	0.764	2	No	24	0	None	No	0.01	NP (normality)
Barium (mg/L)	MW-1607	0.03927	0.03134	2	No	24	0	None	No	0.01	Param.
Beryllium (mg/L)	MW-1601	0.00005	0.000009	0.004	No	22	45.45	None	No	0.01	NP (normality)
Beryllium (mg/L)	MW-1606	0.00005	0.00001	0.004	No	24	33.33	None	No	0.01	NP (normality)
Beryllium (mg/L)	MW-1607	0.00005	0.00001	0.004	No	24	25	None	No	0.01	NP (normality)
Cadmium (mg/L)	MW-1601	0.00001158	0.000006344	0.005	No	22	18.18	Kaplan-Meier	x^(1/3)	0.01	Param.
Cadmium (mg/L)	MW-1602	0.00002	0.000009	0.005	No	24	45.83	None	No	0.01	NP (normality)
Cadmium (mg/L)	MW-1606	0.00002	0.00001	0.005	No	24	75	None	No	0.01	NP (NDs)
Cadmium (mg/L)	MW-1607	0.00002	0.000009	0.005	No	24	70.83	None	No	0.01	NP (NDs)
Chromium (mg/L)	MW-1601	0.00058	0.0003542	0.1	No	22	0	None	No	0.01	Param.
Chromium (mg/L)	MW-1602	0.0007933	0.0005497	0.1	No	24	0	None	No	0.01	Param.
Chromium (mg/L)	MW-1606	0.0007667	0.0002948	0.1	No	24	0	None	sqrt(x)	0.01	Param.
Chromium (mg/L)	MW-1607	0.0004417	0.0002904	0.1	No	24	0	None	sqrt(x)	0.01	Param.
Cobalt (mg/L)	MW-1601	0.001053	0.0003984	0.006	No	22	0	None	No	0.01	Param.
Cobalt (mg/L)	MW-1602	0.00008595	0.00002508	0.006	No	24	0	None	ln(x)	0.01	Param.
Cobalt (mg/L)	MW-1606	0.0002645	0.00009252	0.006	No	24	0	None	ln(x)	0.01	Param.
Cobalt (mg/L)	MW-1607	0.001387	0.001169	0.006	No	24	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW-1601	1.669	0.9759	5	No	22	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW-1602	1.421	0.8594	5	No	24	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW-1606	3.331	2.726	5	No	24	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW-1607	1.737	0.7135	5	No	24	0	None	sqrt(x)	0.01	Param.
Fluoride (mg/L)	MW-1601	0.2698	0.1919	4	No	23	0	None	No	0.01	Param.
Fluoride (mg/L)	MW-1602	0.1247	0.09655	4	No	25	0	None	x^(1/3)	0.01	Param.
Fluoride (mg/L)	MW-1606	0.2189	0.1931	4	No	25	0	None	No	0.01	Param.
Fluoride (mg/L)	MW-1607	0.07137	0.05983	4	No	25	0	None	No	0.01	Param.
Lead (mg/L)	MW-1601	0.0001504	0.00005051	0.015	No	22	13.64	None	ln(x)	0.01	Param.
Lead (mg/L)	MW-1602	0.0000894	0.00004356	0.015	No	24	20.83	Kaplan-Meier	sqrt(x)	0.01	Param.
Lead (mg/L)	MW-1606	0.00033	0.00009	0.015	No	24	12.5	None	No	0.01	NP (normality)
Lead (mg/L)	MW-1607	0.0001622	0.0000786	0.015	No	24	8.333	None	ln(x)	0.01	Param.
Lithium (mg/L)	MW-1601	0.02957	0.0197	0.04	No	22	4.545	None	No	0.01	Param.
Lithium (mg/L)	MW-1602	0.01001	0.006447	0.04	No	24	4.167	None	sqrt(x)	0.01	Param.
Lithium (mg/L)	MW-1606	0.008	0.00328	0.04	No	24	8.333	None	No	0.01	NP (normality)
Lithium (mg/L)	MW-1607	0.004	0.00013	0.04	No	24	12.5	None	No	0.01	NP (normality)
Mercury (mg/L)	MW-1601	0.000005	0.000005	0.002	No	22	95.45	None	No	0.01	NP (NDs)
Mercury (mg/L)	MW-1602	0.000005	0.000003	0.002	No	24	66.67	None	No	0.01	NP (NDs)
Mercury (mg/L)	MW-1606	0.000005	0.000003	0.002	No	24	83.33	None	No	0.01	NP (NDs)
Mercury (mg/L)	MW-1607	0.000005	0.000004	0.002	No	24	91.67	None	No	0.01	NP (NDs)
Molybdenum (mg/L)	MW-1601	0.02209	0.01077	0.1	No	22	0	None	No	0.01	Param.
Molybdenum (mg/L)	MW-1602	0.00212	0.001	0.1	No	24	0	None	No	0.01	NP (normality)
Molybdenum (mg/L)	MW-1606	0.00067	0.0005	0.1	No	24	0	None	No	0.01	NP (normality)
Molybdenum (mg/L)	MW-1607	0.0007	0.00054	0.1	No	24	0	None	No	0.01	NP (normality)
Selenium (mg/L)	MW-1601	0.0003879	0.0001577	0.05	No	22	0	None	sqrt(x)	0.01	Param.
Selenium (mg/L)	MW-1602	0.002357	0.001407	0.05	No	24	0	None	No	0.01	Param.
Selenium (mg/L)	MW-1606	0.0005	0.00006	0.05	No	24	25	None	No	0.01	NP (normality)
Selenium (mg/L)	MW-1607	0.0005	0.0001	0.05	No	24	16.67	None	No	0.01	NP (normality)
Thallium (mg/L)	MW-1601	0.0002	0.00002	0.002	No	22	40.91	None	No	0.01	NP (normality)
Thallium (mg/L)	MW-1602	0.0002	0.00002	0.002	No	24	54.17	None	No	0.01	NP (NDs)
Thallium (mg/L)	MW-1606	0.0002	0.00004	0.002	No	24	66.67	None	No	0.01	NP (NDs)
Thallium (mg/L)	MW-1607	0.0002	0.00003	0.002	No	24	41.67	None	No	0.01	NP (normality)

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 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Parametric and Non-Parametric (NP) Confidence Interval

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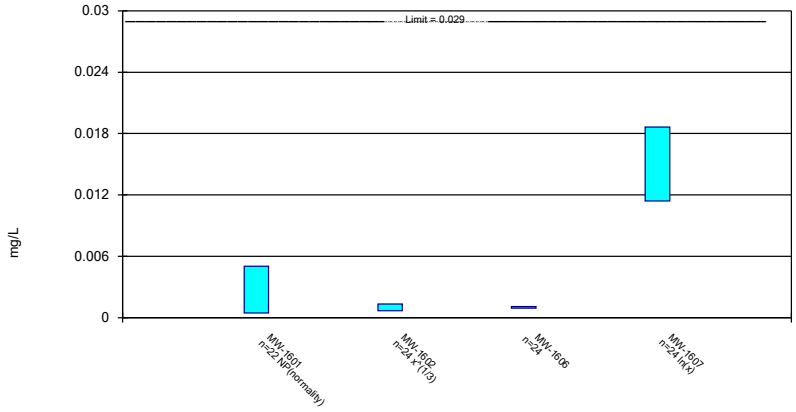

Constituent: Arsenic Analysis Run 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Parametric and Non-Parametric (NP) Confidence Interval

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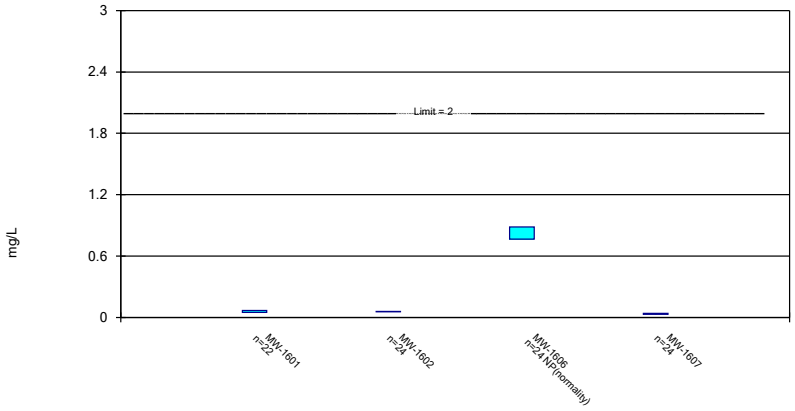

Constituent: Barium Analysis Run 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Non-Parametric Confidence Interval

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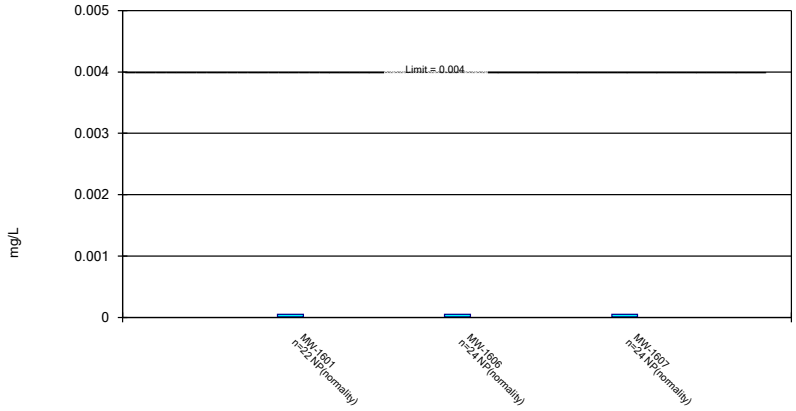

Constituent: Beryllium Analysis Run 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Parametric and Non-Parametric (NP) Confidence Interval

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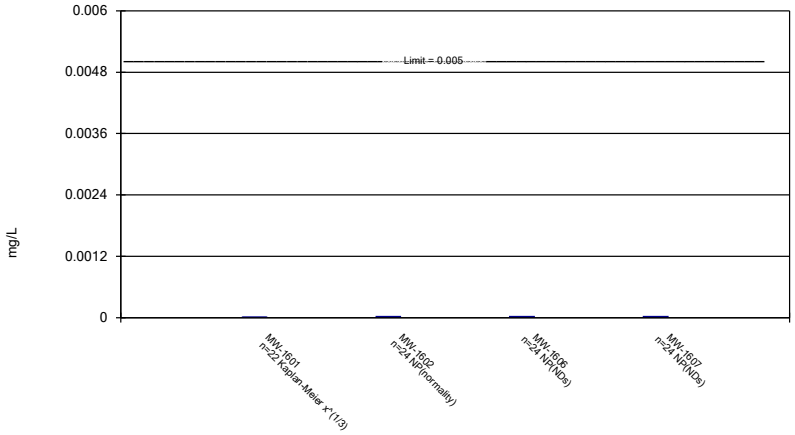

Constituent: Cadmium Analysis Run 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Parametric Confidence Interval

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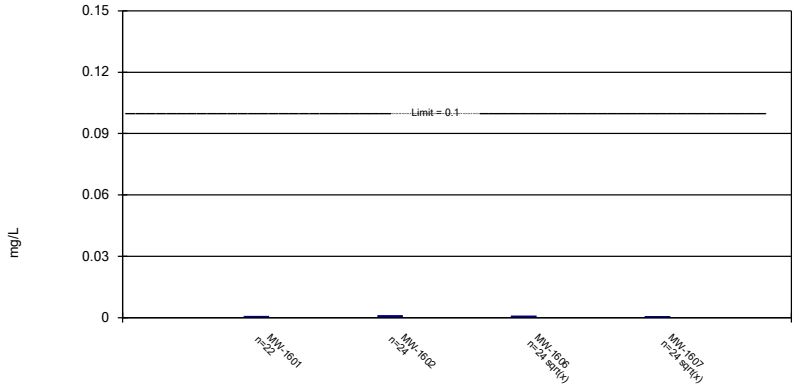

Constituent: Chromium Analysis Run 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Parametric Confidence Interval

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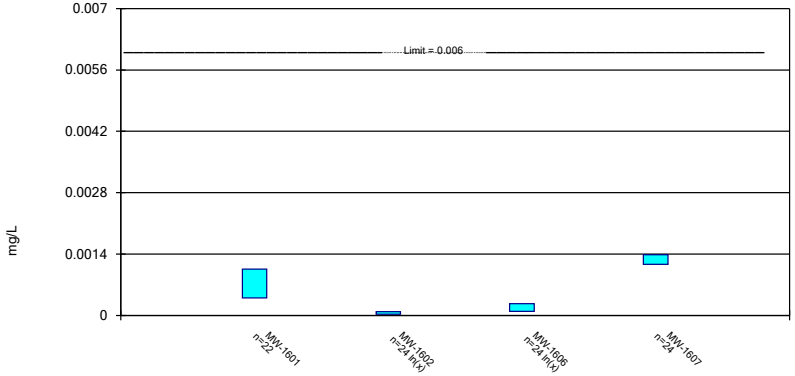

Constituent: Cobalt Analysis Run 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Parametric Confidence Interval

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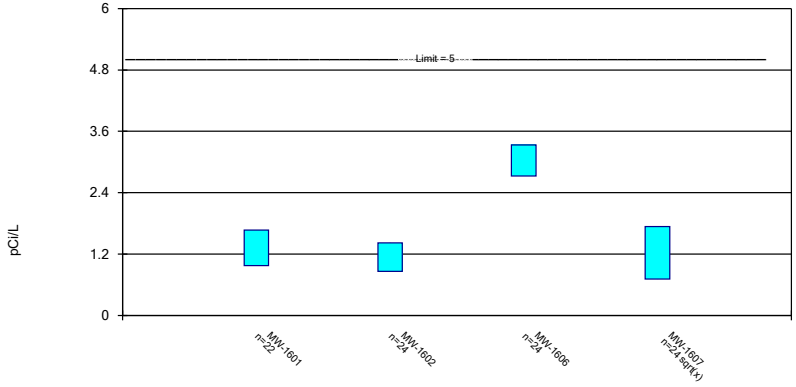

Constituent: Combined Radium 226 + 228 Analysis Run 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Parametric Confidence Interval

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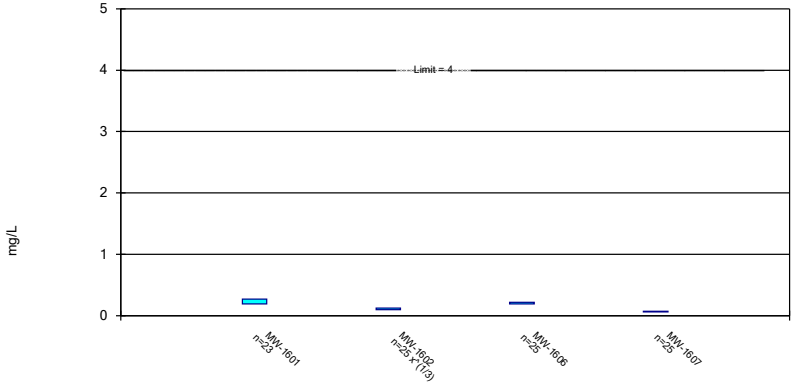

Constituent: Fluoride Analysis Run 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Parametric and Non-Parametric (NP) Confidence Interval

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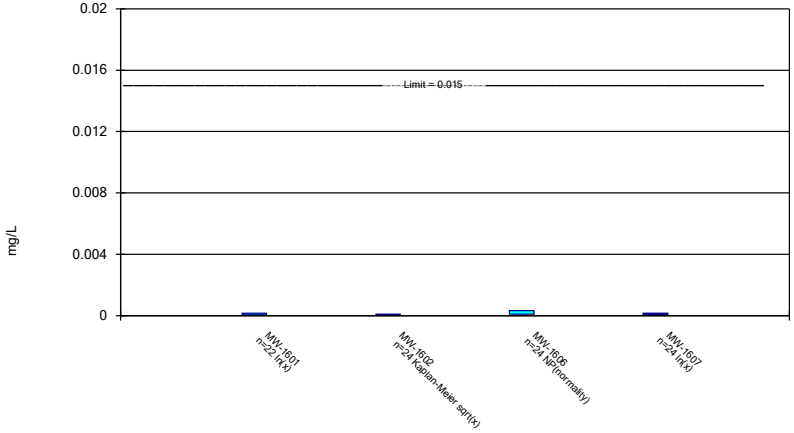

Constituent: Lead Analysis Run 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Parametric and Non-Parametric (NP) Confidence Interval

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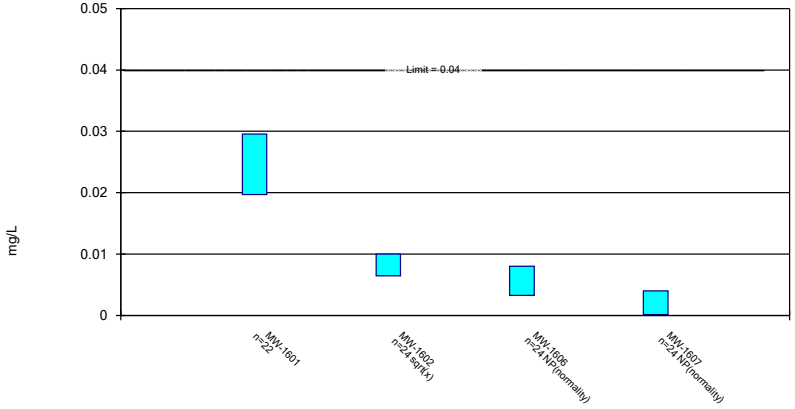
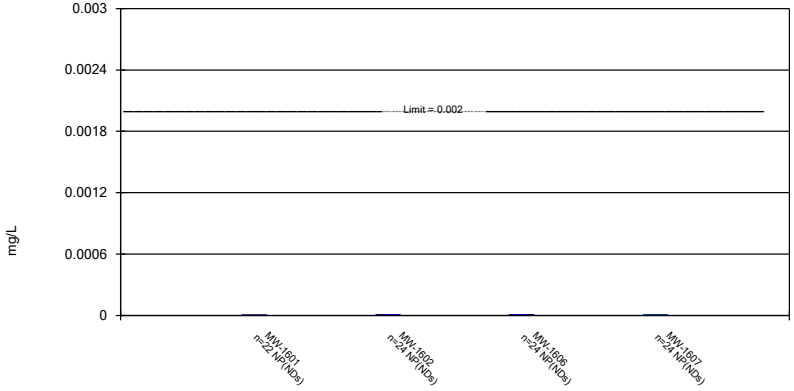


Constituent: Lithium Analysis Run 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Non-Parametric Confidence Interval

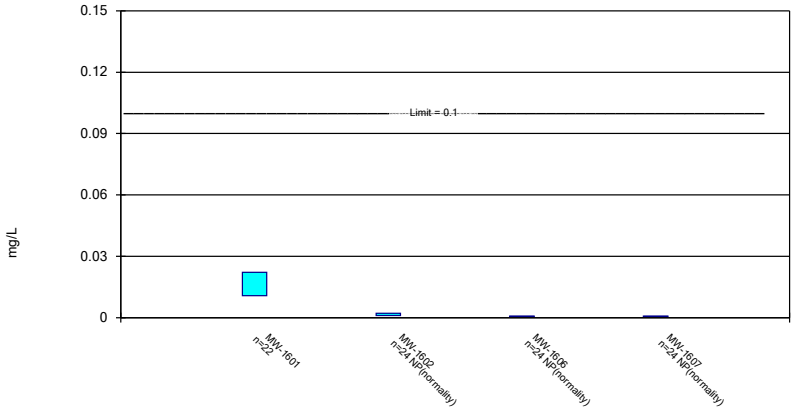
Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Mercury Analysis Run 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

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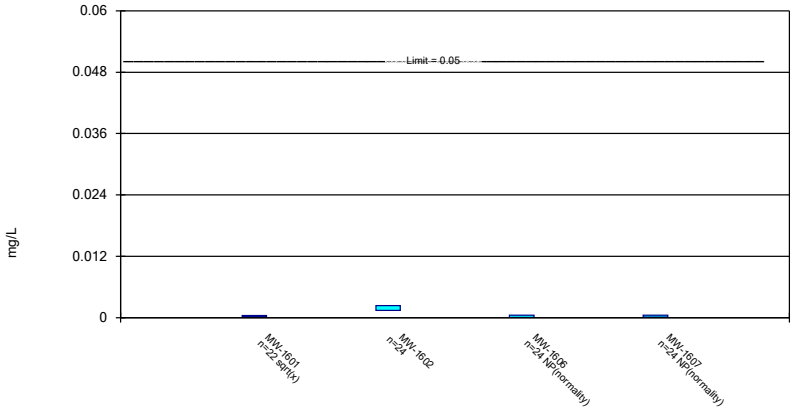
Parametric and Non-Parametric (NP) Confidence Interval

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

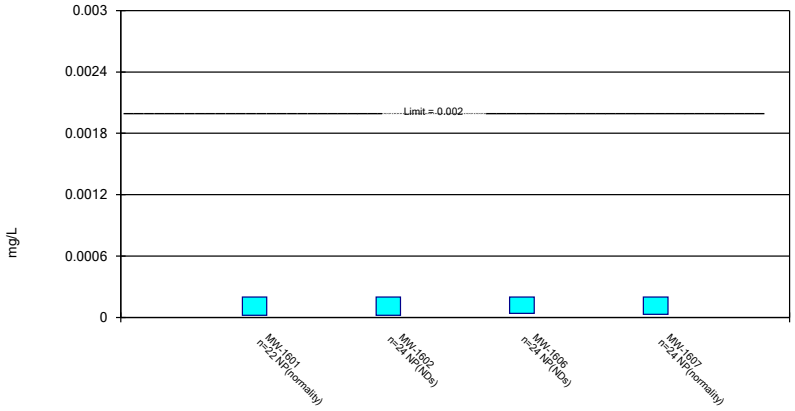


Constituent: Selenium Analysis Run 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Sanitas™ v.10.0.12 Software licensed to . UG

Non-Parametric Confidence Interval

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



Constituent: Thallium Analysis Run 10/8/2023 7:12 PM View: Confidence Intervals
Big Sandy FAP Client: Geosyntec Data: Big Sandy FAP

Geosyntec consultants

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Memorandum

Date:	January 14, 2024
To:	Bill Smith (AEP)
Copies to:	Brian Newton (AEP)
From:	Allison Kreinberg (Geosyntec)
Subject:	Evaluation of 2023 Reissued Analytical Laboratory Data for Big Sandy Plant's Fly Ash Pond

In accordance with United States Environmental Protection Agency (USEPA) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (CCR Rule; Code of Federal Regulations Title 40, Part 257, Subpart D) groundwater sampling was completed in 2023 to support assessment monitoring at the Fly Ash Pond, an existing CCR unit at the Big Sandy Power Plant in Louisa, Kentucky. After the statistical evaluation was completed using data from the first semiannual assessment monitoring event,[1] select analytical laboratory reports were reissued to correct laboratory equipment data quality assurance/quality control issues.

A review of the reissued analytical laboratory reports identified several reported lithium results that had changed (Table 1). The site-specific background value for lithium was not updated as part of the first semiannual assessment monitoring event; therefore, the lithium results at background locations were not used in the statistical evaluation before the reissued analytical laboratory reports were reviewed. Both the initial reported lithium values and the revised lithium values at downgradient locations were below the site-specific groundwater protection standard of 0.0400 milligrams per liter, and no statistically significant levels of lithium were identified during the first semiannual assessment monitoring event.[1] Therefore, no changes to the statistical outcome of the first semiannual assessment monitoring event would occur.

The revised lithium values in the reissued laboratory analytical reports will be used in future reporting and statistical evaluations.

[1] Geosyntec. 2023. *Statistical Analysis Summary – Fly Ash Pond. Big Sandy Plant, Louisa, Kentucky*. Geosyntec Consultants, Inc. December.

Table 1. 2023 Revised Analytical Results
Big Sandy - Fly Ash Pond

Geosyntec Consultants, Inc.

Sample Date	Well ID	CCR Unit	Well Location	Constituent	Units	Initial Reported Value	Revised Value
6/14/2023	MW-1012	FAP	Upgradient	Lithium	mg/L	0.0055	0.00546
6/13/2023	MW-1602	FAP	Downgradient	Lithium	mg/L	0.0086	0.00862
6/12/2023	MW-1605	FAP	Upgradient	Lithium	mg/L	0.0015	0.00153
6/12/2023	MW-1606	FAP	Downgradient	Lithium	mg/L	0.0039	0.00392
6/12/2023	MW-1607	FAP	Downgradient	Lithium	mg/L	<0.0006 U1	0.00011 J1

Notes:
1. All lithium results are shown in milligrams per liter (mg/L).
2. Non-detect values are shown as less than the method detection limit with a 'U1' flag.
FAP: Fly Ash Pond
J1: Concentration estimated. Analyte was detected between the method detection limit and the reporting limit.

APPENDIX 4—Alternative Source Demonstration Reports

The May 2023 alternative source demonstration report concluding that an alternative source was identified for the SSLs associated with the October 2022 assessment monitoring sampling event at the CCR unit follows.

Alternative Source Demonstration Addendum Report for the October 2022 Monitoring Data

Closed Big Sandy Fly Ash Pond
Louisa, Kentucky

Prepared for:

American Electric Power

Prepared by:

EHS Support

May 2023

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Acronyms

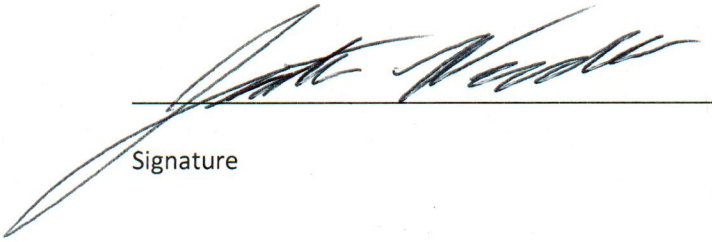
µg/L	micrograms per liter
AEP	American Electric Power
ASD	alternative source demonstration
bgs	below ground surface
BSFAP	Big Sandy Fly Ash Pond
CCR	coal combustion residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
ft	foot/feet
GWPS	Groundwater Protection Standards
KGS	Kentucky Geological Survey
LCL	lower confidence limit
MDL	method detection limit
mg/L	milligrams per liter
msl	mean sea level
NORM	naturally occurring radioactive materials
ORP	oxidation-reduction potential
pCi/L	picocuries per liter
ppm	parts per million
S.U.	standard units (pH)
SSL	statistically significant level
TDS	total dissolved solids
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

Certification by Qualified Professional Engineer

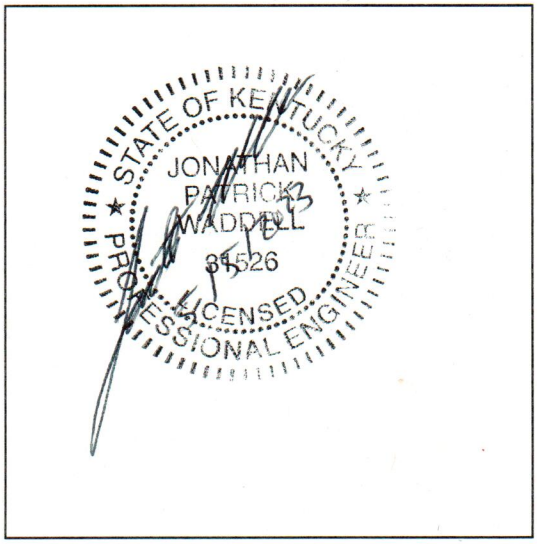
I certify that the alternative source demonstration (ASD) conducted and presented within this report is accurate and appropriate for evaluating the groundwater monitoring data for the Closed Big Sandy Fly Ash Pond Coal Combustion Residual (CCR) management area associated with the Big Sandy Power Plant 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 Patrick Waddell

Printed Name of Licensed Professional Engineer



Signature



31526	KY	5/5/2023
License Number	Licensing State	Date

1 Introduction

EHS Support LLC ("EHS Support") was retained by the American Electric Power (AEP) – Kentucky Power Company in December 2018 to conduct an alternative source demonstration (ASD) investigation for coal combustion residual (CCR) constituents in groundwater near the closed Big Sandy Fly Ash Pond (BSFAP or "Site"). The BSFAP is associated with the Big Sandy Power Plant located in Louisa, Kentucky (EHS Support, 2019a). The BSFAP was closed between September 2015 and November 2020 (**Section 4.1**).

The initial ASD investigation determined that groundwater in the vicinity of the Site was not being impacted by CCR constituents from the BSFAP (EHS Support, 2019a). The statistically significant levels (SSLs) of beryllium, cobalt, lithium, 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 and well screen for well MW-1603. Since the initial ASD investigation was completed (incorporating data from September 2016 to October 2018), the following ASD investigations have been conducted:

- An ASD investigation was conducted after the March 2019 groundwater monitoring data indicated continued SSLs of beryllium, cobalt, and lithium exceeding the GWPS at MW-1603 (EHS Support, 2019b).
- An ASD investigation was conducted following continued detections of beryllium, cobalt, and lithium at SSLs above the GWPS in MW-1603 during the August 2019 sampling event (EHS Support, 2020). In addition, an SSL of radium 226 combined with radium 228 (hereafter radium 226/228) was measured above its GWPS for the first time in MW-1603 groundwater during the August 2019 sampling event (EHS Support, 2020).
- An ASD investigation was conducted following continued detections of four constituents (beryllium, cobalt, lithium, and radium 226/228) at SSLs above the GWPS in MW-1603 in March and June 2020 (EHS Support, 2021a).
- An ASD investigation was conducted following continued detections of three constituents (beryllium, cobalt, and lithium) at SSLs above the GWPS in MW-1603 in October 2020 (EHS Support, 2021b).
- An ASD investigation was conducted following continued detections of three constituents (beryllium, cobalt, and lithium) at SSLs above the GWPS in MW-1603 in March and June 2021 (EHS Support, 2021c).
- An ASD investigation was conducted following continued detections of three constituents (beryllium, cobalt, and lithium) and the fourth constituent radium 226/228 at SSLs above the GWPS in MW-1603 in October 2021 (EHS Support, 2022a).
- An ASD investigation was conducted following continued detections of four constituents (beryllium, cobalt, lithium, and radium 226/228) at SSLs above the GWPS in MW-1603 in March and June 2022 (EHS Support, 2022b).

In October 2022, four constituents (beryllium, cobalt, lithium, and radium 226/228) were detected at SSLs above the GWPS in MW-1603, thus requiring the ASD investigation presented in this report. This ASD 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 beryllium, cobalt, lithium, and radium 226/228 concentrations in MW-1603 groundwater, were determined to result from Type IV natural variations in groundwater.

ASD types are discussed in **Section 3**. This conclusion was reached by examining analytical results for compounds detected at SSLs in the context of the broader list of CCR constituents analyzed at the Site.

1.1 Objective

The objective of this ASD investigation is to assess groundwater monitoring data collected in compliance with the CCR Rule, as allowed under paragraph 40 CFR §257.95(g)(3)(ii). 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 GWPS, 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 ASD investigation for the BSFAP has been conducted to further evaluate potential alternate sources or reasons for the continued detection of 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 prior ASD investigations[1] based on the following lines of evidence:

- A lack of exceedances and increasing trends of primary indicators of CCR.
- Constituent concentrations in BSFAP water are 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.
- Acidic groundwater in MW-1603 (pH ranging from 3.0 to 5.5 standard units [S.U.]) is not indicative of BSFAP water (pH 7.97).

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

1. The constituent typically has a high concentration in CCR leachate, relative to background, such that it is expected to have an elevated concentration in the event of a release; and
2. The 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 CCR (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 bromide, fluoride, molybdenum, potassium, and sodium.

[1]EHS Support, 2019a; EHS Support, 2019b; EHS Support, 2020; EHS Support, 2021a; EHS Support, 2021b; EHS Support, 2021c; EHS Support, 2022a; EHS Support, 2022b

2 Project Background

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

To support and provide context to this ASD, **Section 2.1** and **Section 2.2** describe the groundwater monitoring network and groundwater monitoring activities.

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 consist of sandstones, siltstones, shale, and coal that may grade laterally and vertically into one another. The overlying Quaternary alluvial 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 system (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.

Geosyntec defined the groundwater detection monitoring network as consisting of ten monitoring wells used to assess the upper water-bearing aquifer (fractured bedrock and alluvium) (Geosyntec, 2016). Of these monitoring wells, six locations (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. Three monitoring wells (MW-1601, MW-1602, and MW-1603) were installed in bedrock located downgradient of the BSFAP and are used for compliance monitoring. Two monitoring wells (MW-1604 and MW-1605) side gradient of the BSFAP are screened in alluvium and are used for background monitoring. The remaining two monitoring wells (MW-1606 and MW-1607) are located south of the Main Dam (**Figure 1**) and are screened in the alluvium downgradient of the BSFAP and are used for compliance monitoring.

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. Thus, the current groundwater monitoring network accurately represents the quality of background groundwater and groundwater passing the waste boundary of the BSFAP.

As bedrock monitoring well MW-1603 is the focus of this ASD, the boring log was reviewed to assess the lithology that could impact groundwater chemistry (EHS Support, 2019a). The boring log descriptions show alternating sequences of yellowish-brown sandstones and bluish gray to black shales beginning at 13 feet (ft) below ground surface (bgs) and extending to the total depth of the boring at 39.5 ft bgs. This lithologic description is indicative of the upper portion of the Princess Formation (uppermost formation in the Breathitt Group [Rice and Hiett, 1994]). Within the MW-1603 screened interval (22 to 32 ft bgs), the shale encountered at a depth of 24 to 25 ft bgs was described on the boring log 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 visually identified on the MW-1608, MW-1609, and MW-1610 boring logs at the same approximate elevation, between 630 and 650 ft, and align with the KGS measurements (**Table 2-1**). No coal was documented in this section in three monitoring wells (MW-1601, MW-1602, and MW-1611). Four monitoring wells (MW-1604, MW-1605, MW-1606, and MW-1607) were installed stratigraphically below this coal layer.

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	551.0	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

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

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, 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 per 40 CFR §257.93, which was prepared, certified, and originally posted to AEP's CCR website in April 2017 in AEP's Statistical Analysis Plan (Geosyntec, 2017) and updated as Revision 1 in January 2021 (Geosyntec, 2021); the statistical process was guided by USEPA's Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance (USEPA, 2009)
- Initiation of assessment monitoring sampling and analysis
- Completion of statistical data evaluation and determination of GWPS

Assessment monitoring for the BSFAP has been conducted on a semi-annual basis since April 2018. The groundwater data collected through the October 2022 monitoring event have been used for this ASD addendum investigation. Historical groundwater monitoring data for MW-1603 is provided in **Table 1**. The October 2022 groundwater data was evaluated, and no data usability issues were found (Geosyntec, 2023). Assessment monitoring data for well MW-1603 in October 2022 is provided in **Table 2-2**.

Table 2-2 MW-1603 October 2022 Groundwater Quality

Analyte	Unit	October 2022 Value
Antimony	µg/L	<0.02
Arsenic	µg/L	1.40
Barium	µg/L	15.4
Beryllium	µg/L	19.5
Boron	mg/L	0.051
Bromide	mg/L	0.03 J
Cadmium	µg/L	0.869
Calcium	mg/L	90.3
Chloride	mg/L	3.78

Analyte	Unit	October 2022 Value
Chromium	µg/L	0.85
Cobalt	µg/L	95.2
Fluoride	mg/L	1.11
Lead	µg/L	6.03
Lithium	mg/L	0.196
Mercury	µg/L	<0.004
Molybdenum	µg/L	<0.1
pH	S.U.	3.69
Potassium	mg/L	4.47
Radium 226/228	pCi/L	7.47
Residue, Filterable, TDS	mg/L	1,080
Selenium	µg/L	6.25
Sodium	mg/L	23.2
Sulfate	mg/L	841
Thallium	µg/L	2.02

Notes:
< = non detect at method detection limit (MDL)
µg/L = micrograms per liter
J = Concentration estimated. Analyte was detected between the method detection limit and the reporting limit.
mg/L = milligrams per liter
NA = constituent not analyzed
pCi/L = picocuries per liter
S.U. = standard units
TDS = total dissolved solids

AEP submitted the October 2022 monitoring data to Groundwater Stats Consulting, LLC for statistical analysis. A GWPS was established for each of the Appendix IV parameters. Confidence intervals, including lower confidence limits (LCLs) and upper confidence limits (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 of the October 2022 data, the following SSLs were identified at the BSFAP in MW-1603 (no other monitoring well had constituents exceeding a GWPS):

- The LCL for beryllium exceeded the GWPS of 0.004 milligrams per liter (mg/L) at MW-1603 (0.0165 mg/L).
- The LCL for cobalt exceeded the GWPS of 0.006 mg/L at MW-1603 (0.0852 mg/L).
- The LCL for lithium exceeded the GWPS of 0.04 mg/L at MW-1603 (0.178 mg/L).
- The LCL for radium 226/228 exceeded the GWPS of 5.00 picocuries per liter (pCi/L) at MW-1603 (5.22 pCi/L).

3 Alternative Source Demonstration Requirements

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).

3.1 Alternative Source Demonstration

This ASD investigation 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 October 2022 sampling event.

Historical groundwater monitoring data for MW-1603 from September 2016 to October 2022 is provided in **Table 1**.

3.2 Assessment of Groundwater Monitoring Results

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

- Primary indicators (boron and sulfate) are evaluated to indicate 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.
- The 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. Redox changes can affect the chemical state and solubility of sulfate, in addition to trace elements including arsenic and selenium. For example, under strongly reducing conditions (ORP less than -200 millivolts at pH 7 S.U.), sulfate can be reduced to form hydrogen sulfide, or it can precipitate as iron sulfide; arsenic reduces to 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 co-mingling at that particular monitoring well. Different sources may contribute to the presence and detection 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 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 October 2022. The water quality signatures for well MW-1603 are discussed in **Section 4.3** and compared to the water quality of the BSFAP.

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

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 CCR (EPRI, 2022) are included in AEP's constituent list for the BSFAP groundwater monitoring programs, including primary constituents boron and sulfate. If there is an SSL without a corresponding increase in a primary indicator constituent (boron and usually sulfate for CCR), then this is a key line of evidence for an ASD.

4.1 Groundwater Data Analysis

Temporal plots are provided in **Section 4.1.1** through **Section 4.1.3** for monitoring well MW-1603 (**Figure 4-1** through **Figure 4-13**). Each of the plots uses the following color-coding system:

- Red indicates a concentration reported above the reporting limit.
- Orange indicates a concentration reported below the reporting limit but greater than the method detection limit (MDL) (denoted as estimated "J" values).
- Green indicates a concentration not detected at or above the MDL (denoted as "U"); results were conservatively plotted as the MDL.

The BSFAP surface water signature from October 2017 is plotted as a constant concentration in **Figure 4-1** through **Figure 4-12** as a proxy for BSFAP pore water for comparison to downgradient groundwater concentrations. It is probable that BSFAP water quality historically varied over time since the BSFAP accepted fly ash before 1970; however, the BSFAP ceased accepting fly ash in November 2015 and the surface water quality is anticipated to be more stable following this termination of relatively constant fly ash addition. As a result, the October 19, 2017 data provides a reasonable representation of the BSFAP surface water conditions. Shortly after the October 2017 sample collection, BSFAP closure work, including contouring of CCR in preparation for geomembrane cover installation, began near the surface water collection area and samples were no longer representative of porewater conditions after this

time. Geomembrane installation was completed over the entire BSFAP in November 2020 and the BSFAP is now closed.

Groundwater constituents for well MW-1603 are plotted on the primary y-axis and BSFAP water constituents are plotted on the secondary y-axis due to the differences in concentration (**Figure 4-1** through **Figure 4-12**).

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 (note the y-axis scales associated with the BSFAP water data).

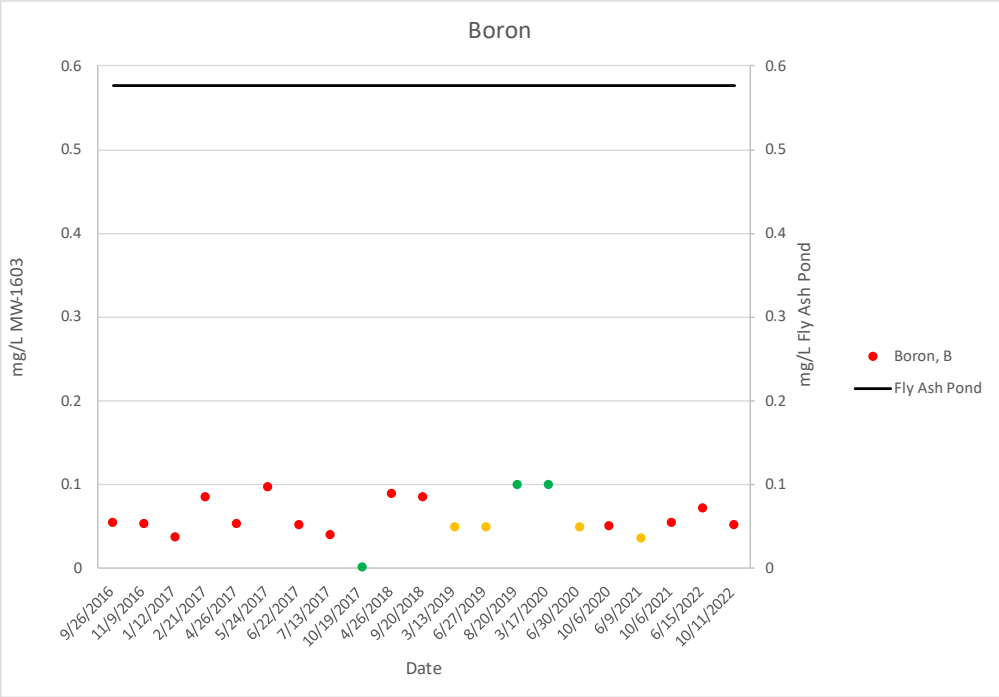


Figure 4-1 MW-1603 Boron Concentrations

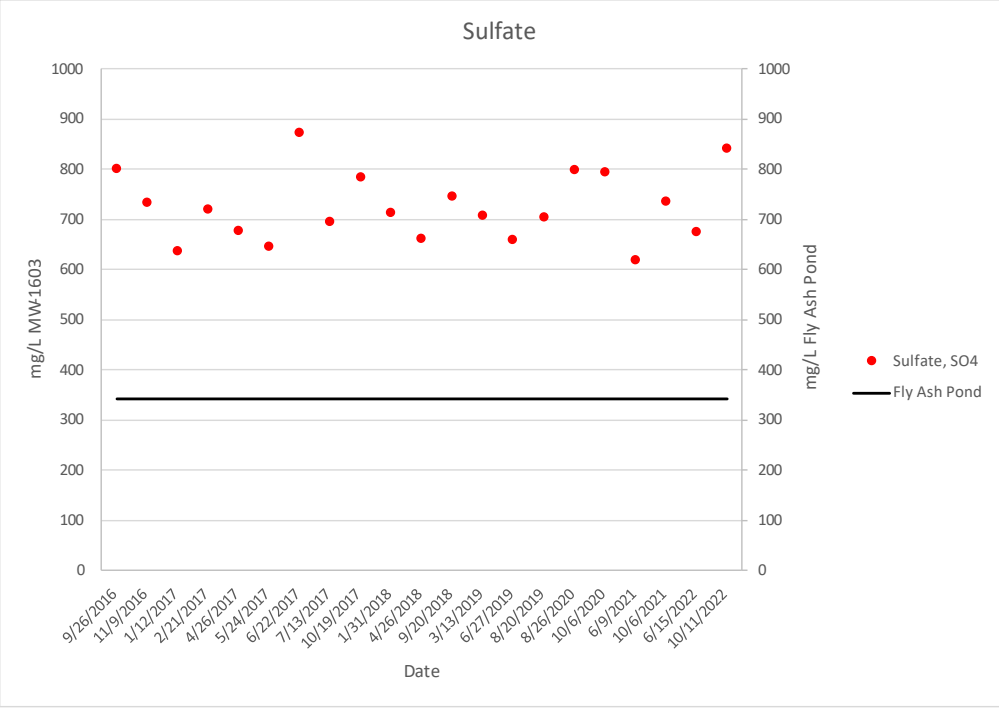


Figure 4-2 MW-1603 Sulfate Concentrations

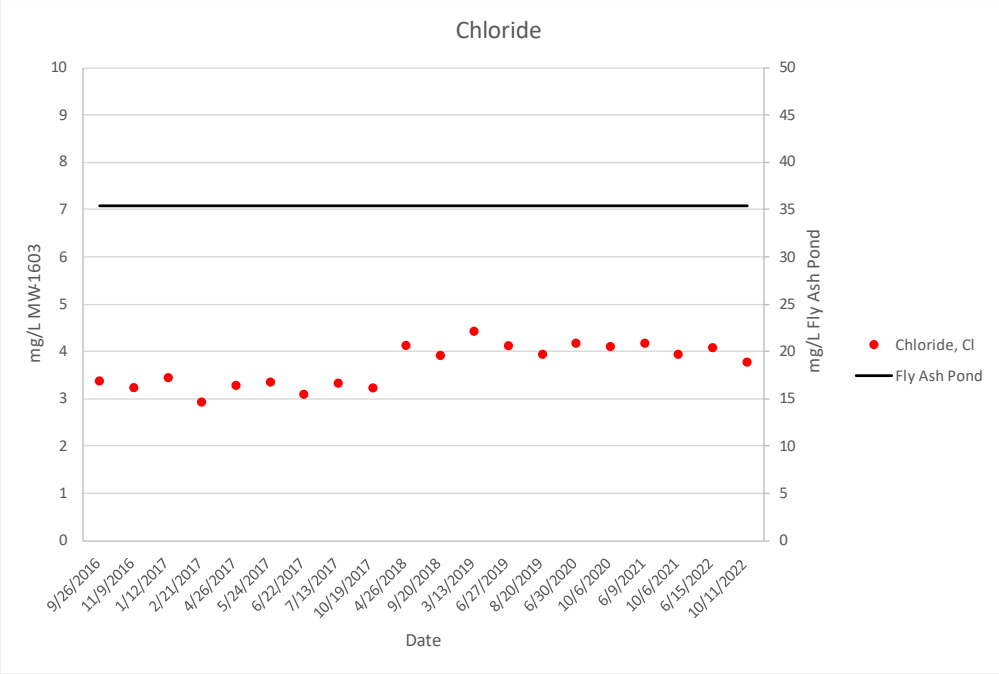


Figure 4-3 MW-1603 Chloride Concentrations

Concentrations of boron (up to 0.1 mg/L) and sulfate (between 600 and 900 mg/L) in MW-1603 have remained graphically stable, within the same order of magnitude, with minor variability over the monitoring period (September 2016 through October 2022). Chloride concentrations (generally between 3.0 to 3.5 mg/L) in MW-1603 remained relatively stable until April 2018, after which a slight increase was observed followed by stable concentrations (around 4 mg/L). Given the overall very low chloride concentrations at MW-1603 (an order of magnitude lower than in the BSFAP), this slight apparent increase in chloride of approximately 1 mg/L is minimal and most likely reflects a change in sampling or analytical procedure. Boron and chloride in water from the BSFAP are present at higher concentrations 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 of the March and June 2022 monitoring data (EHS Support, 2022b).

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 in **Figure 4-4** to **Figure 4-8**, respectively.

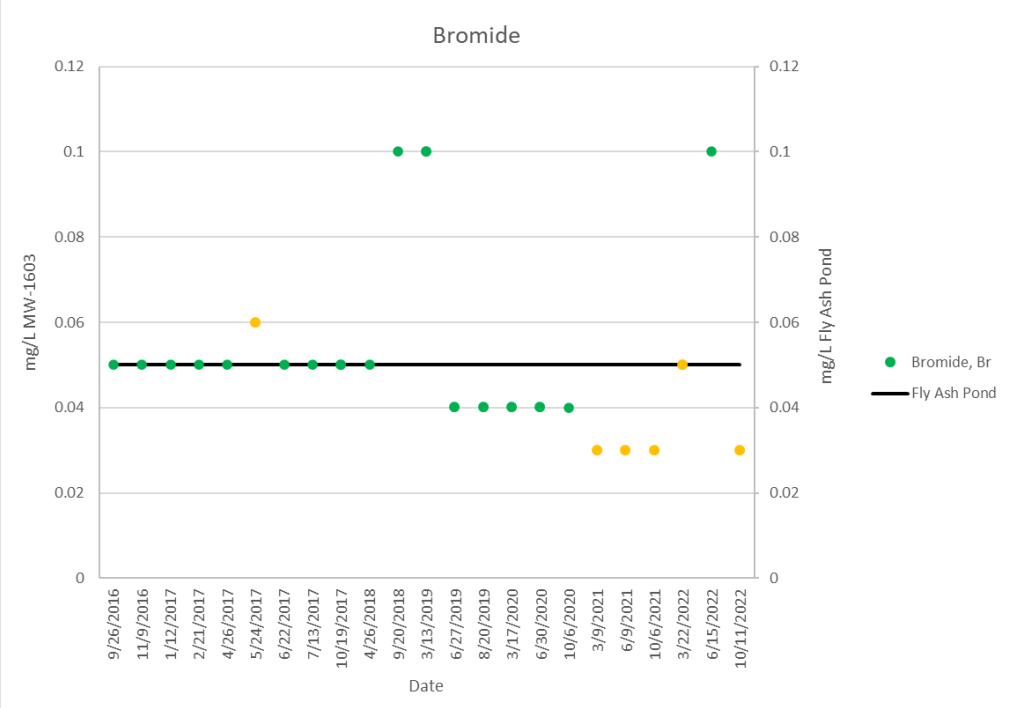


Figure 4-4 MW-1603 Bromide Concentrations[2]

[2] Bromide is below the reporting limit for BSFAP water; therefore, it is plotted at the method detection limit of 0.05 mg/L.

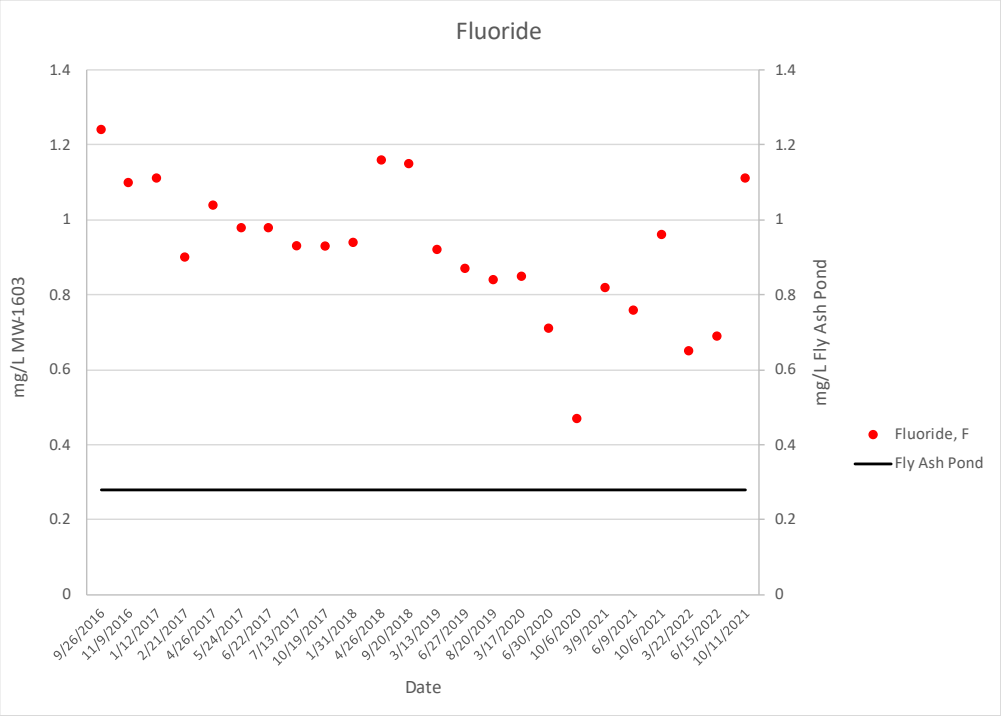


Figure 4-5 MW-1603 Fluoride Concentrations

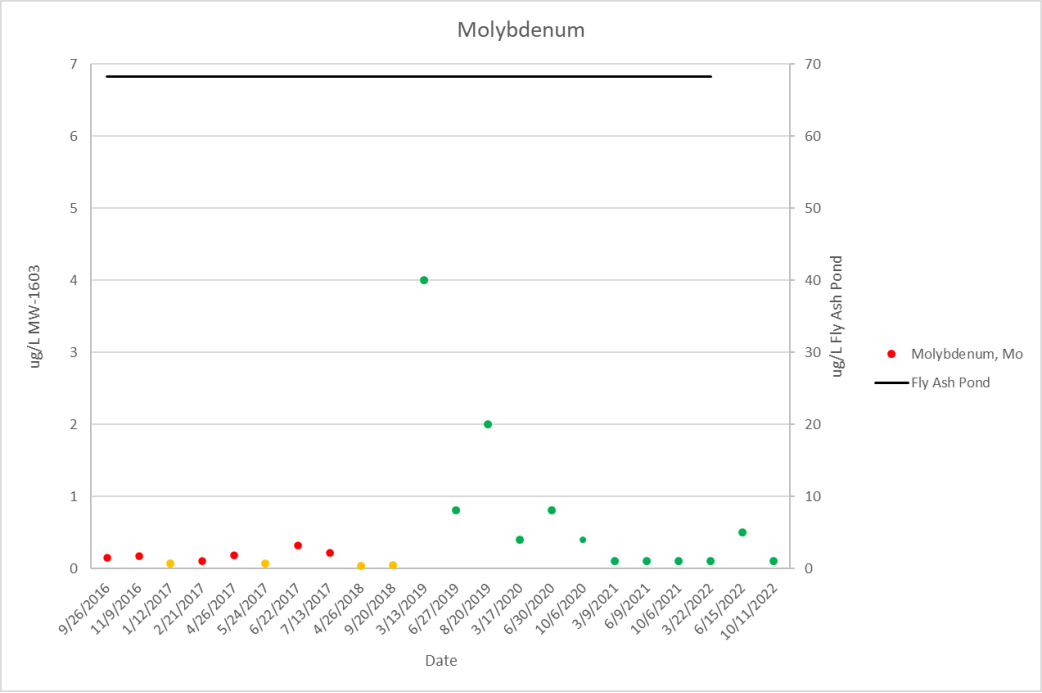


Figure 4-6 MW-1603 Molybdenum Concentrations

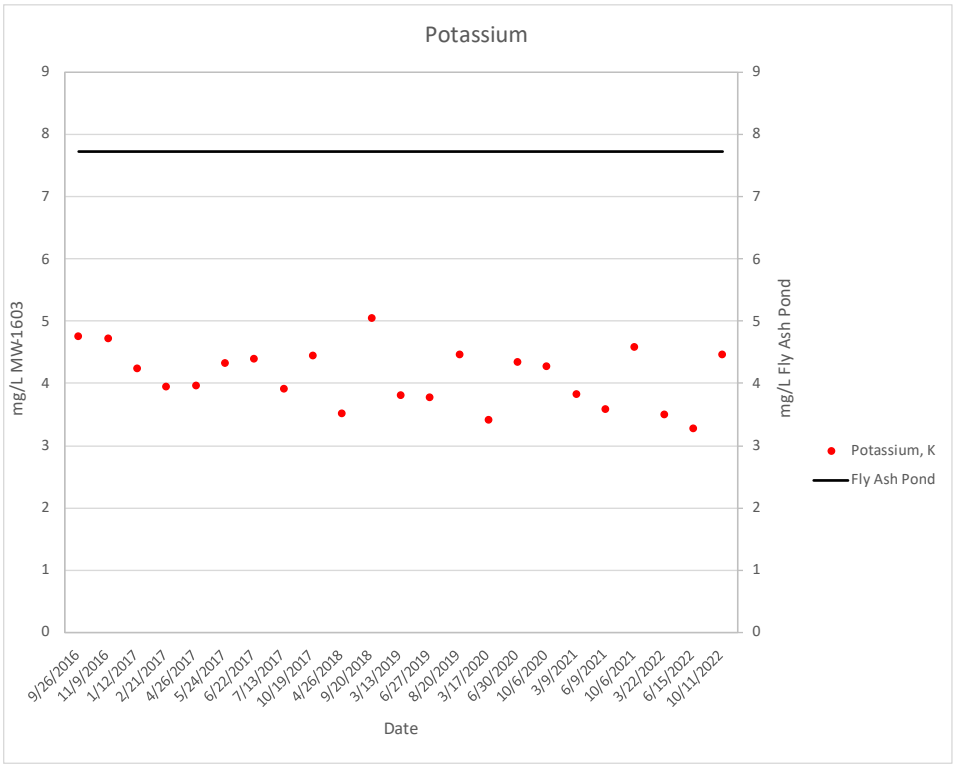


Figure 4-7 MW-1603 Potassium Concentrations

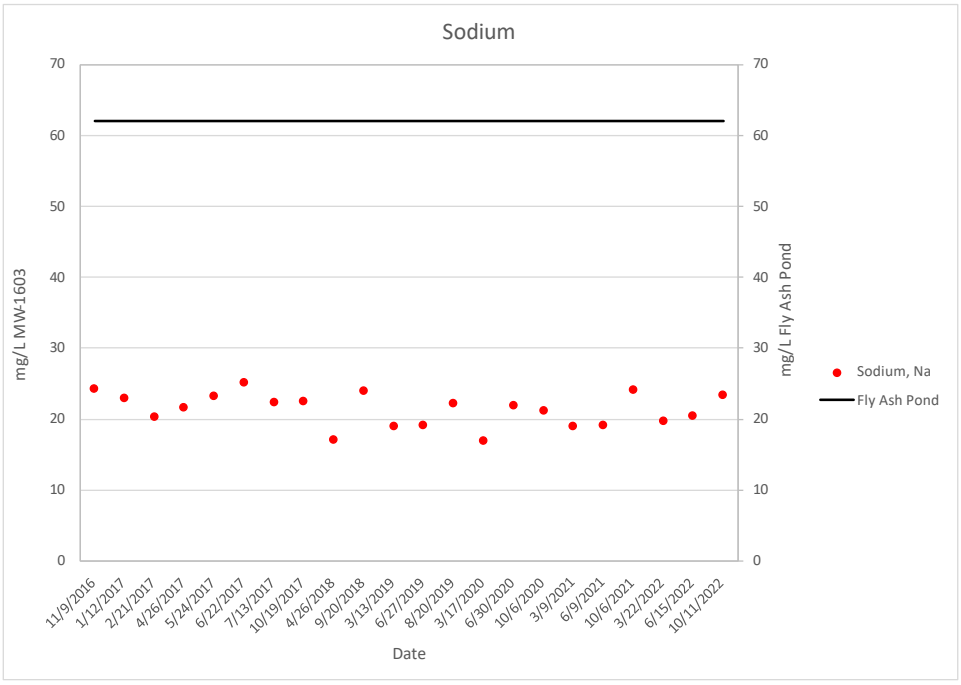


Figure 4-8 MW-1603 Sodium Concentrations

The following summarizes the data presented in **Figure 4-4** through **Figure 4-8**.

- Bromide concentrations in groundwater from MW-1603 have historically been non-detect below the MDL of 0.5 mg/L, except for an estimated "J" value detection of 0.06 mg/L in May 2017. Estimated "J" value detections of 0.03 mg/L have been reported for bromide during four out of the last six sampling events (March, June, and October 2021, and October 2022) due to the laboratory lowering the MDL (**Figure 4-4**).
- Fluoride concentrations in groundwater from MW-1603 have consistently been higher than water from the BSFAP but have exhibited an overall graphically decreasing concentration trend with time (**Figure 4-5**).
- Molybdenum, potassium, and sodium concentrations in groundwater from MW-1603 have consistently been lower than water from the BSFAP (**Figure 4-6**, **Figure 4-7**, and **Figure 4-8**, respectively).
- Molybdenum was last detected above the MDL in MW-1603 in September 2018 (**Figure 4-6**). The recent variation in molybdenum concentrations, as shown in green, is due to variable MDLs achieved in the laboratory analyses.

A comparison of the pH of BSFAP water and groundwater from MW-1603 is provided in **Figure 4-9**. The figure illustrates the substantial difference in pH between the BSFAP water and groundwater. 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. The pH in MW-1603 is acidic with values generally between 3.0 and 4.0 S.U., whereas the BSFAP water is alkaline at a pH of approximately 8.0 S.U.

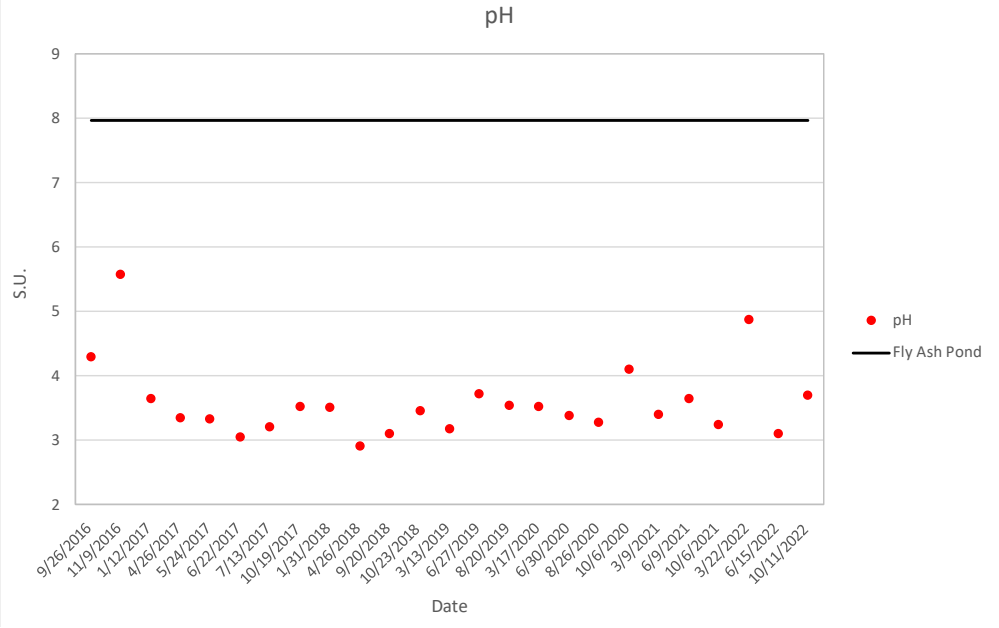


Figure 4-9 MW-1603 pH Values

In summary, there were negligible changes in potential indicator concentrations since the review of the March and June 2022 monitoring data (EHS Support, 2022b).

4.1.3 ASD Constituent Trends

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

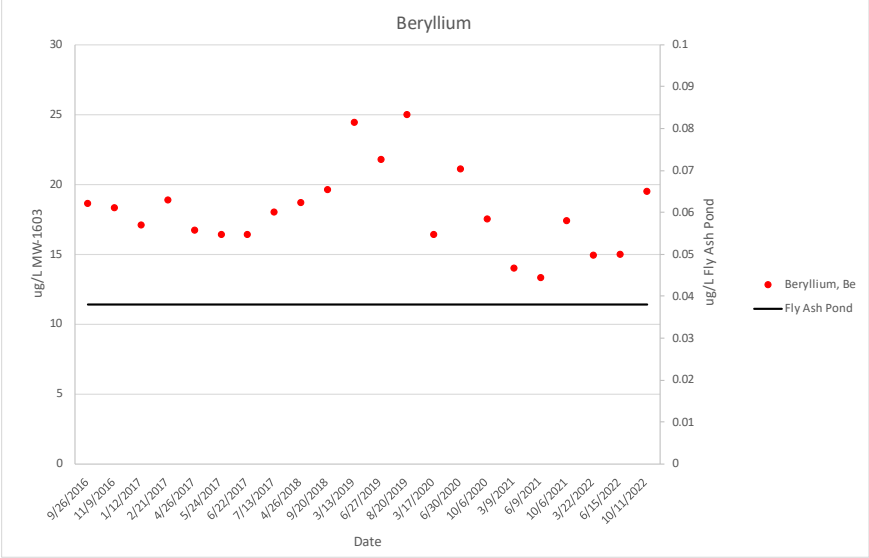


Figure 4-10 MW-1603 Beryllium Concentrations

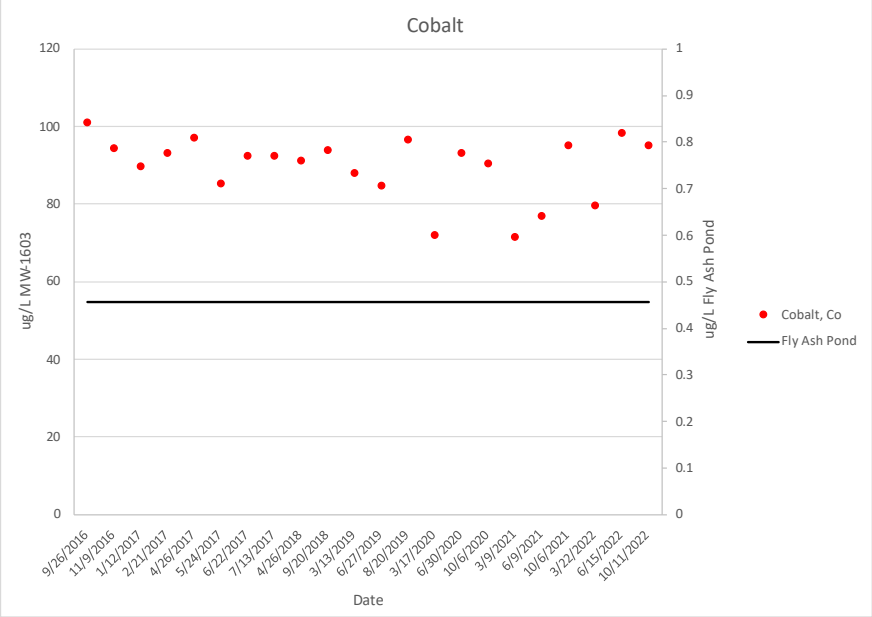


Figure 4-11 MW-1603 Cobalt Concentrations

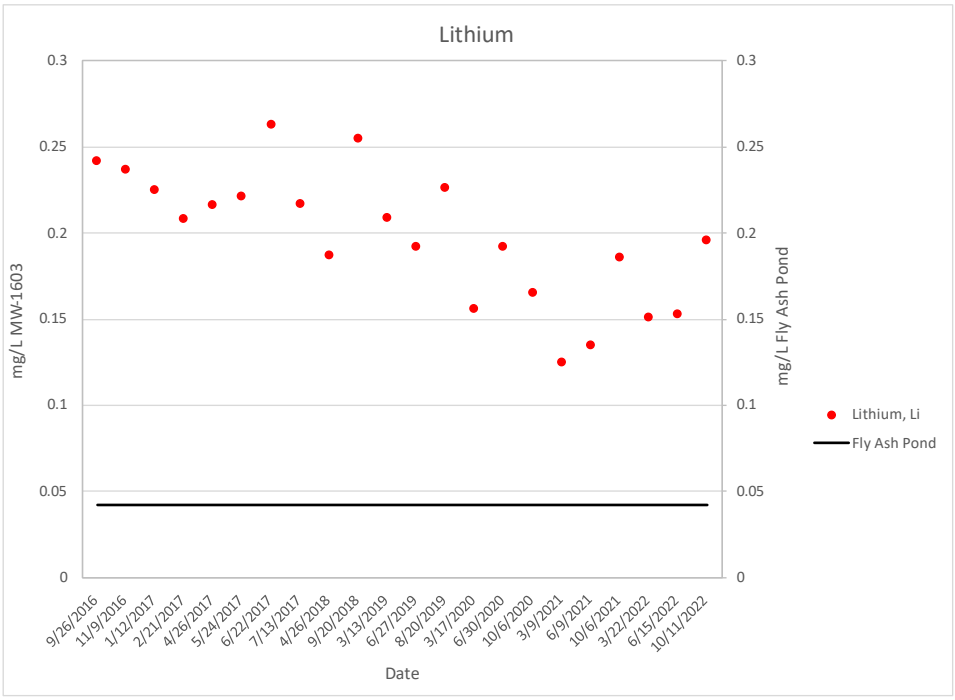


Figure 4-12 MW-1603 Lithium Concentrations

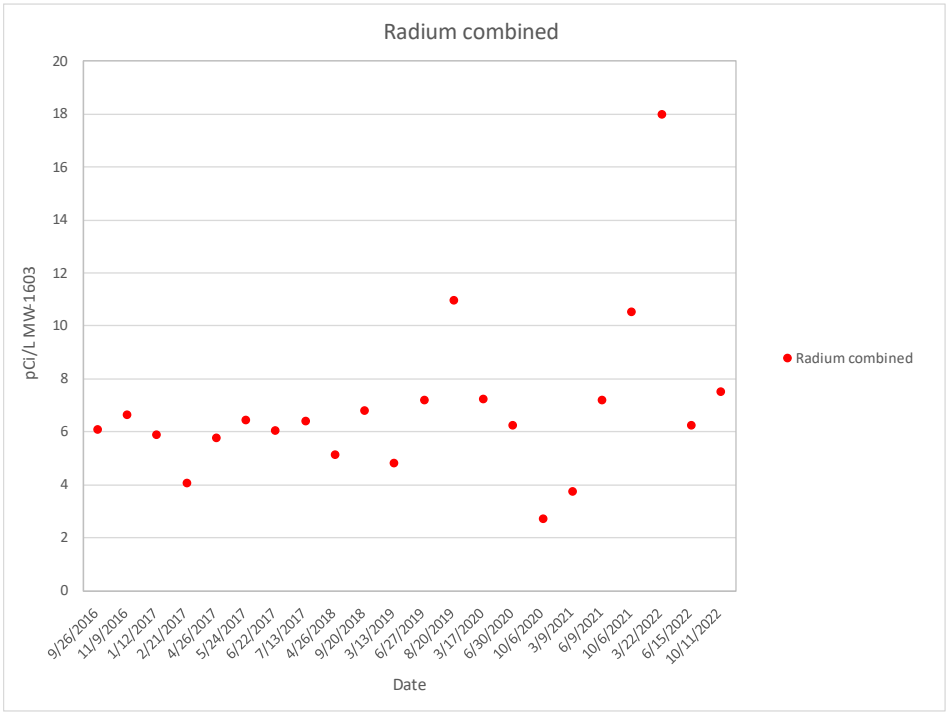


Figure 4-13 MW-1603 Radium 226/228 Concentrations

Beryllium, cobalt, and lithium concentrations are higher in groundwater from MW-1603 compared to BSFAP water (note the y-axis scales associated with **Figure 4-10** and **Figure 4-11**). This data indicates that the source of beryllium, cobalt, and lithium in groundwater at MW-1603 is different from and 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, generally at concentrations between 4 to 8 pCi/L, except for the results from August 2019, October 2020, October 2021, and March 2022. These concentrations are considered anomalies which is supported by the outliers on the box and whisker plot of radium 226/228 on Figure A-12 of **Appendix A**.

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 groundwater at MW-1603. This is based on the primary indicator sulfate, potential indicator fluoride, and the ASD constituent's beryllium, cobalt, and lithium all being present at higher concentrations in MW-1603 groundwater in comparison to the BSFAP water (EHS Support, 2019a). As the concentrations of these constituents in MW-1603 groundwater are higher, it is unlikely that there is a concentration gradient extending from the BSFAP to groundwater at that location. A key line of evidence that CCR constituents are not affecting groundwater at MW-1603 is the vastly different pH values between the locations. 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, trends in the MW-1603 groundwater dataset indicate that CCR constituents are not migrating from the BSFAP into groundwater.

4.2 Tier I Evaluation - Statistical Evaluation

Statistical evaluations of analytes in groundwater at MW-1603 were conducted as part of prior ASD investigations[3]. The evaluations concluded that groundwater in the vicinity of MW-1603 is statistically the same as that which the United States Geological Survey (USGS) reported for regional background (Ruppert et al., 2000) for arsenic, boron, calcium, chloride, chromium, fluoride, molybdenum, potassium, sodium, and strontium.

The box plots from the earlier ASD investigation (EHS Support, 2019a) also show a difference between monitoring 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.

[3] EHS Support, 2019a; EHS Support, 2019b; EHS Support, 2020; EHS Support, 2021a; EHS Support, 2021b; EHS Support, 2021c; EHS Support, 2022a; EHS Support, 2022b

Updated box and whisker plots for constituents reported in MW-1603 groundwater are provided in **Appendix A**. Plots for boron, molybdenum, pH, beryllium, and radium 226/228 exhibit outliers which are calculated to be outside the range of distribution (Figure A-1, Figure A-5, Figure A-8, Figure A-9, and Figure A-12of **Appendix A**, respectively).

It is likely that the acidic groundwater 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 the development of aerobic and water-saturated conditions within the coal seams. These conditions have led to a lowering of the pH through oxidation of sulfides present in the coal which has subsequently enhanced rock dissolution. Enhanced host rock dissolution at MW-1603 is evident from the much higher total dissolved solids (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, rock and coal samples 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. Ppm concentrations of the radioactive elements thorium and uranium are also reported for the Princess coal (Gabbard, 1993; Hood et al., 2020), and radium is a typical decay product of thorium and uranium that is often detected at elevated levels in coal deposits (Zielinski and Finkelman, 1997).

Conditions that are associated with the highest radium concentrations in groundwater include 1) oxygen poor water, 2) acidic conditions (low pH), and 3) high concentrations of dissolved solids (Szabo et al, 2012). Radium is removed from groundwater under shifts to oxidizing conditions by co-precipitation with barite and adsorption onto iron/manganese oxide precipitates. Radium is mobilized into groundwater following shifts to more reducing conditions where it is desorbed following reduction of iron and manganese (McMahon et al., 2019).

For context, studies have demonstrated that the pH of groundwater in contact with fly ash is maintained alkaline (pH 7 to 10 S.U.) 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 S.U.; therefore, the acidic pH of groundwater identified at MW-1603 is compelling evidence that groundwater at this location is different from, has not mixed with, and is not representative of, water from the BSFAP.

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 the use of more sophisticated methods for multiple parameters over multiple locations, such as ion ratios and ternary plots.

4.3.1 Ion Ratios

The 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.

The calculation of ion ratios was conducted using median concentrations of the indicator species. The median concentrations of boron, chloride, and sulfate over the monitoring period (September 2016 through October 2022) 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

Location	Location ID	Median Concentrations September 2016 to October 2022		
		Boron (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
Source	Fly Ash Pond	0.58	35.4	342
Downgradient	MW-1603	0.052 ± 0.025	3.85 ± 0.45	714± 69

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 little to no change since the last evaluation of the March and June 2022 monitoring data (EHS Support, 2022b).

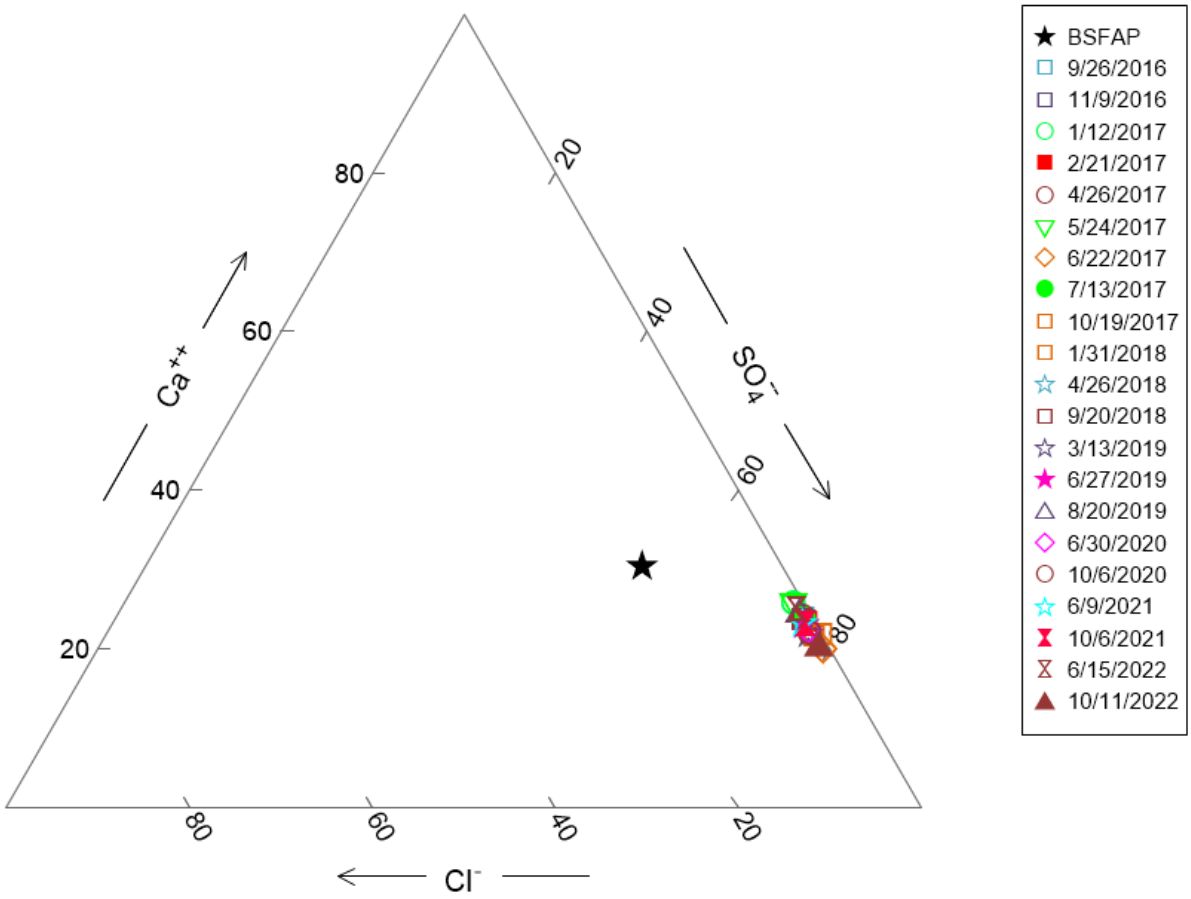
Table 4-2 Ion Ratios

Location	Location ID	Median Concentrations September 2016 to October 2022		
		Boron/Sulfate (x1000)	Boron/Chloride	Chloride/Sulfate
Source	Fly Ash Pond	1.68	0.002	0.10
Downgradient	MW-1603	0.069 ± 0.038	0.015 ± 0.007	0.0052 ± 0.001

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

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 events on the ternary plot shows that the major ion groundwater ratios have not changed during the five-year period of groundwater quality monitoring at well MW-1603, from September 2016 to October 2022, and that the ratios are distinct from the BSFAP.



Notes:
Ca^{++} = calcium
SO_4^{--} = sulfate
Cl^- = chloride

Figure 4-14 Ternary Plot MW-1603

4.3.3 Summary

Based on the previous geochemical evaluations[4] and the updated review presented in this ASD investigation, there is insufficient evidence to support the presence of CCR constituents (beryllium, cobalt, and lithium, and radium 226/228 concentrations), 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 relatively unchanged since September 2019; therefore, it is apparent that beryllium, cobalt, lithium, and radium 226/228 detected within MW-1603 groundwater are sourced from an alternate source than the BSFAP. It is likely that beryllium, cobalt, lithium, and radium 226/228 are sourced from the localized lithologies in which MW-1603 is screened across, primarily the Princess coal.

[4] EHS Support, 2019a; EHS Support, 2019b; EHS Support, 2020; EHS Support, 2021a; EHS Support, 2021b; EHS Support, 2021c; EHS Support, 2022a; EHS Support, 2022b

5 Summary and Conclusions

Using the EPRI (2017) guidance for ASD investigations, the conclusions based on the lines of evidence discussed in **Section 3** and **Section 4** indicate that groundwater in the vicinity of the Site is not being impacted by CCR constituents from the BSFAP. The elevated concentrations of beryllium, cobalt, lithium, and radium 226/228 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 (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, March 2020, June 2020, October 2021, March 2022 and June 2022 sampling events, radium 226/228 detections have been reported for MW-1603 as an SSL in the October 2022 groundwater monitoring statistics. Radium is sourced from radioactive decay of naturally occurring radioactive materials (NORM), including uranium and thorium, which are present in the Princess coal at ppm levels. Therefore, the presence of radium 226/228 is likely due to naturally occurring elevated uranium and thorium concentrations in the coal seams that have been intersected at well location MW-1603. Natural variations in redox conditions likely cause sorption and desorption of radium to iron/manganese oxides that leads to fluctuation in the detections in groundwater. 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 higher 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 October 2022 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).

6 Recommendation

Consistent with the previous ASD investigations[5], conducted from 2019 to 2022, this ASD for the BSFAP has determined that Type IV natural variations in groundwater resulted in the SSLs of beryllium, cobalt, lithium, and radium 226/228 detected at MW-1603. Based on the natural variation in MW-1603 groundwater attributable to the bedrock composition in the screened interval, it is recommended that this monitoring point be removed from the assessment monitoring program and properly abandoned in accordance with Kentucky regulations. MW-1603 does not provide compliance data sufficient to remain in assessment monitoring, as evidenced by the data measured and presented in the ASD investigations over seven years (September 2016 through October 2022).

[5] EHS Support, 2019a; EHS Support, 2019b; EHS Support, 2020; EHS Support, 2021a; EHS Support, 2021b; EHS Support, 2021c; EHS Support, 2022a; EHS Support, 2022b

7 References

AEP and EHS Support. (2016). Groundwater Sampling and Analysis Plan. October.

EHS Support. (2019a). Alternative Source Demonstration Report for Beryllium, Cobalt and Lithium, Big Sandy Fly Ash Pond, Louisa, Kentucky. February.

EHS Support. (2019b). Alternative Source Demonstration Addendum Report for Beryllium, Cobalt and Lithium, Big Sandy Fly Ash Pond, Louisa, Kentucky. September.

EHS Support. (2020). Alternative Source Demonstration Addendum Report for 2019 Monitoring Data, Big Sandy Fly Ash Pond, Louisa, Kentucky. January.

EHS Support. (2021a). Alternative Source Demonstration Addendum Report for the March and June 2020 Monitoring Data, Big Sandy Fly Ash Pond, Louisa, Kentucky. January.

EHS Support. (2021b). Alternative Source Demonstration Addendum Report for the October 2020 Monitoring Data, Big Sandy Fly Ash Pond, Louisa, Kentucky. April.

EHS Support. (2021c). Alternative Source Demonstration Addendum Report for the March and June 2021 Monitoring Data, Big Sandy Fly Ash Pond, Louisa, Kentucky. November.

EHS Support. (2022a). Alternative Source Demonstration Addendum Report for the October 2021 Monitoring Data, Big Sandy Fly Ash Pond, Louisa, Kentucky. March.

EHS Support. (2022b). Alternative Source Demonstration Addendum Report for the March and June 2022 Monitoring Data, Closed Big Sandy Fly Ash Pond, Louisa, Kentucky. December.

EPRI. (2012). Groundwater Quality Signatures for Assessing Potential Impacts from Coal Combustion Product Leachate. EPRI, Palo Alto, CA. 1017923.

EPRI. (2017). Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites. EPRI, Palo Alto, CA. 3002010920.

EPRI. (2022). Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites. EPRI, Palo Alto, CA. 3002010920.

Gabbard, A. (1993) Coal Combustion: Nuclear Resource or Danger. Oak Ridge National Laboratory Review v.26, no. 3&4.

Geosyntec Consultants, Inc. (2016). Groundwater Monitoring Well Installation Report – Fly Ash Pond. October.

Geosyntec Consultants, Inc. (2017). Statistical Analysis Plan, Revision 0. January.

Geosyntec Consultants, Inc. (2021). Statistical Analysis Plan, Revision 1. January.

Geosyntec Consultants, Inc. (2023). Statistical Analysis Summary. February.

Hood, M.M., Eble, C.F., Hower, J.C. and Dai, S. (2020). Geochemistry, petrology, and palynology of the Princess No. 3 coal, Greenup County, Kentucky. International Journal of Coal Science & Technology, pp.1-19.

McMahon, P.B., Vengosh, A., Davis, T.A., Landon, M.K., Tyne, R.L., Wright, M.T., Kulongoski, J.T., Hunt, A.G., Barry, P.H., Kondash, A.J. and Wang, Z., 2019. Occurrence and sources of radium in groundwater associated with oil fields in the southern San Joaquin Valley, California. Environmental Science & Technology, 53(16), pp.9398-9406.

Rice, C. and Hiett, J. (1994). Revised Correlation Chart of the Coal Beds, Coal Zones, and Key Stratigraphic Units in the Pennsylvanian Rocks of Eastern Kentucky, USGS Miscellaneous Field Studies Map MF-2275.

Ruppert, L., Tewalt, S., Wallack, R., Bragg, L., Brezinski, D., Carlton, R., Butler, D., and Calef, F. (2000). A Digital Resource Model of the Middle Pennsylvanian Upper Freeport Coal Bed Allegheny Group, Northern Appalachian Basin Coal Region. USGS Professional Paper 1625-C. 101 pages.

Szabo, Z., Fischer, J.M. and Hancock, T.C., 2012. Principal aquifers can contribute radium to sources of drinking water under certain geochemical conditions. US Department of the Interior, US Geological Survey.

Twardowska, I., Szczepanska, J. and Stefaniak, S. (2003). Occurrence and mobilization potential of trace elements from disposed coal combustion fly ash. In Chemistry of Trace Elements in Fly Ash (pp. 13-24). Springer, Boston, MA.

USEPA. (2009). Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance. March.

Zielinski, R.A. and Finkelman, R.B. (1997). Radioactive elements in coal and fly ash: abundance, forms, and environmental significance (No. 163-97). US Geological Survey.

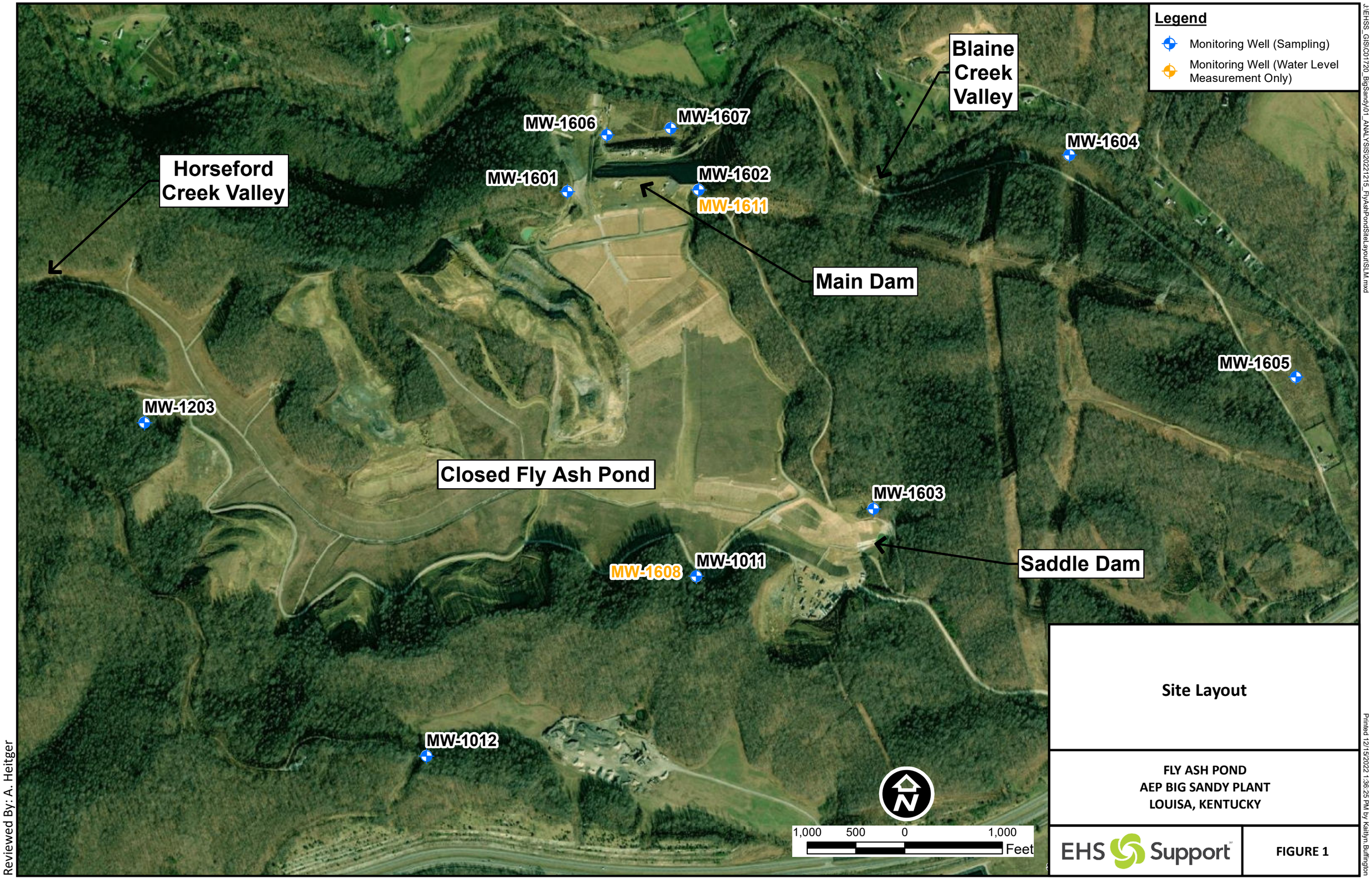
Tables

Table 1
MW-1603 Historical Groundwater Data September 2016 to October 2022
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	10/6/2020	3/9/2021	6/9/2021	10/6/2021	3/22/2022	6/15/2022	10/11/2022
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	< 0.02	< 0.02	0.04 J	< 0.02	<0.02	<0.10	<0.02
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	1.12	0.84	0.69	1.01	0.96	1.55	1.4
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	14.6	10.1	13.1	17.1	13.3	8.77	15.4
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	17.5	14	13.3	17.4 M	14.9	15	19.5
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	0.05	NA	0.036 J	0.054	NA	0.071	0.051
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	< 0.04	0.03 J	0.03 J	0.03 J	0.05 J	<0.10	0.03 J
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	0.87	0.62	0.709	0.0931	0.69	0.734	0.869
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	94.5	NA	79	93.1	NA	94.4	90.3
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	4.1	NA	4.16	3.93	NA	4.07	3.78
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	0.743	0.659	0.51	0.59	0.36	0.78	0.85
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	90.5	71.4	76.8	95.1 M	79.7	98.3	95.2
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	2.681	3.73	7.18	10.51 B	17.94	6.22	7.47
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	0.47	0.82	0.76	0.96	0.65	0.69	1.11
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	4.85	3.37	3.39	6.1	3.37	6.5	6.03
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	0.165	0.125	0.135	0.186 M	0.151	0.153	0.196
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	< 0.002	0.002 J	0.002 J	0.003 J	< 0.002	<0.005	<0.004
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	< 0.4	< 0.1	< 0.1	<0.1	<0.1	<0.5	<0.1
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	4.09	3.4	3.64	3.23	3.1	4.87	3.69
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	4.29	3.83	3.6	4.6	3.51	3.28	4.47
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	1,020	NA	880	1,040	NA	970	1,080
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	5.8	3.9	3.3	4.26	4.01	6.56	6.25
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	21.1	18.9	19	24	19.7	20.4	23.2
Sulfate, SO_4	mg/L	801	733	636	720	678	646	873	694	784	714	661	747	NA	709	658	704	NA	NA	794	NA	618	735	NA	675	841
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	1.82	1.39	1.62	2.2	1.66	1.71	2.02

Notes:
< = not detected at or above the method detection limit
µg/L = Micrograms per liter
B = Analyte detected in a blank sample
J = Estimated value. Analyte detected at a level less than the reporting limit but greater than the method detection limit.
M = the associated MS or MSD recovery was outside acceptance limits.
mg/L = Milligrams per liter
MS = Matrix spike
MSD = Matrix spike duplicate
NA = Not analyzed
pCi/L = Picocuries per liter
S.U. = Standard Units
TDS = Total Dissolved Solids

Figures



Site Layout

FLY ASH POND
AEP BIG SANDY PLANT
LOUISA, KENTUCKY

EHS Support

FIGURE 1

Reviewed By: A. Heitger

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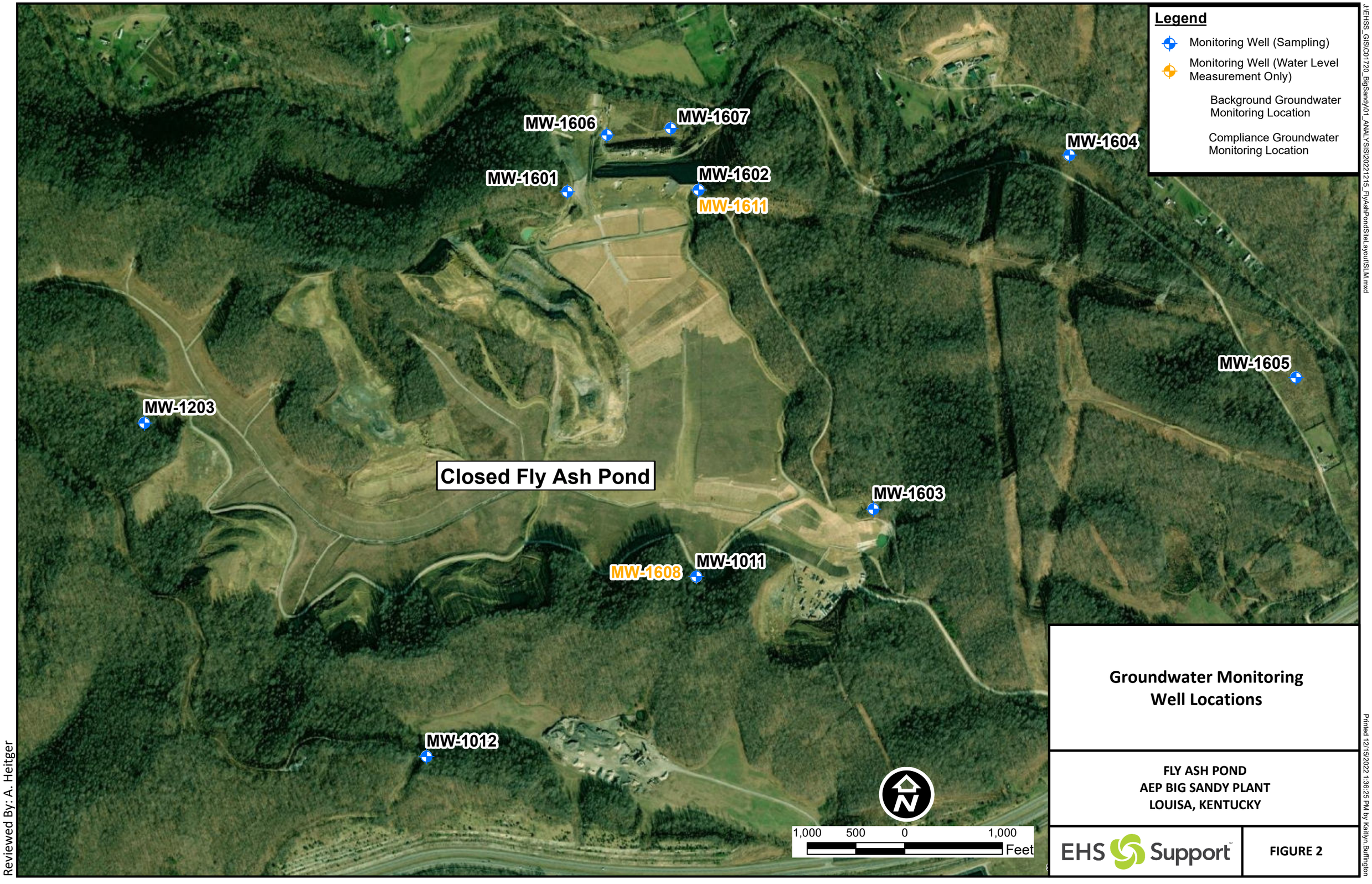

Legend

- Monitoring Well (Sampling)
- Monitoring Well (Water Level Measurement Only)
- Background Groundwater Monitoring Location
- Compliance Groundwater Monitoring Location

Groundwater Monitoring Well Locations

FLY ASH POND
AEP BIG SANDY PLANT
LOUISA, KENTUCKY

EHS Support

FIGURE 2

Reviewed By: A. Heitger

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Appendix A MW-1603 Box Plots

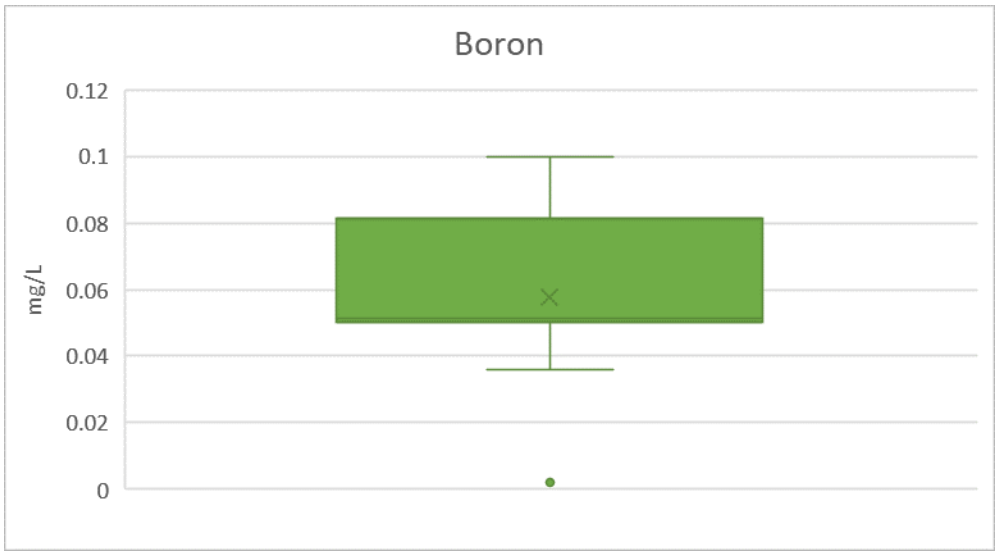

Figure A-1 Boron Box Plot

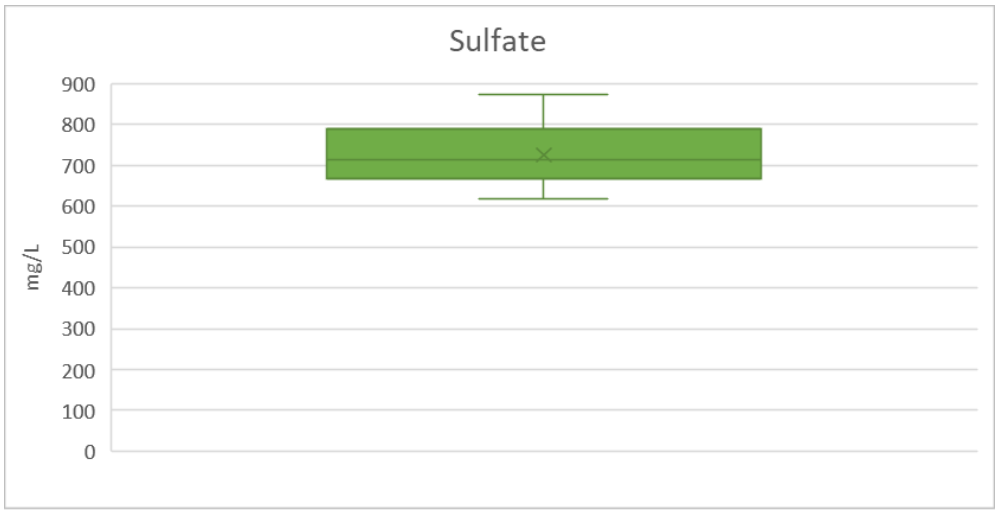

Figure A-2 Sulfate Box Plot

Figure A-3 Chloride Box Plot

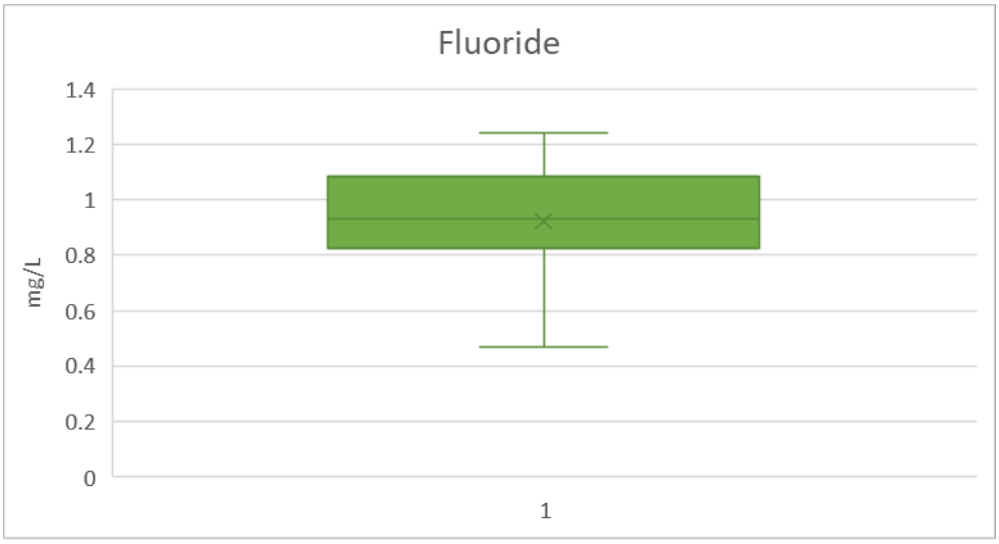

Figure A-4 Fluoride Box Plot

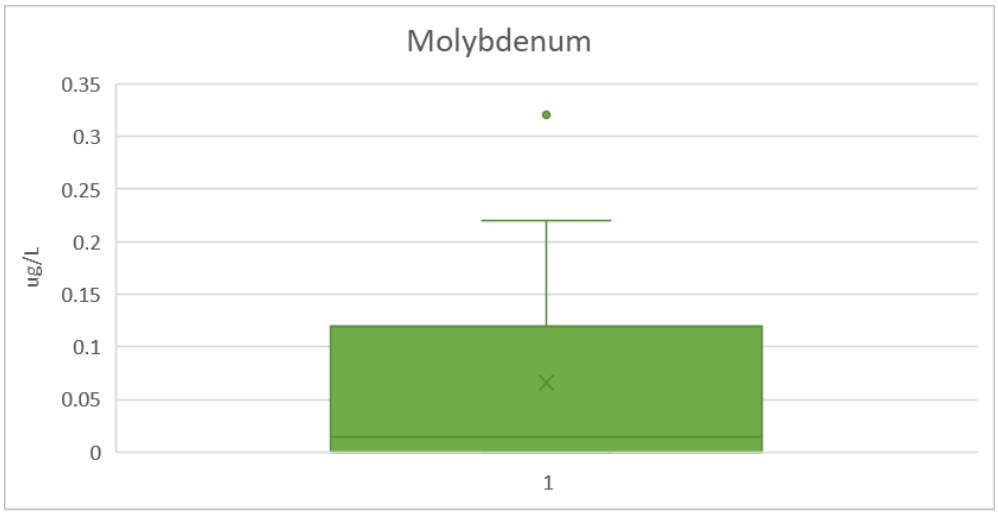

Figure A-5 Molybdenum Box Plot

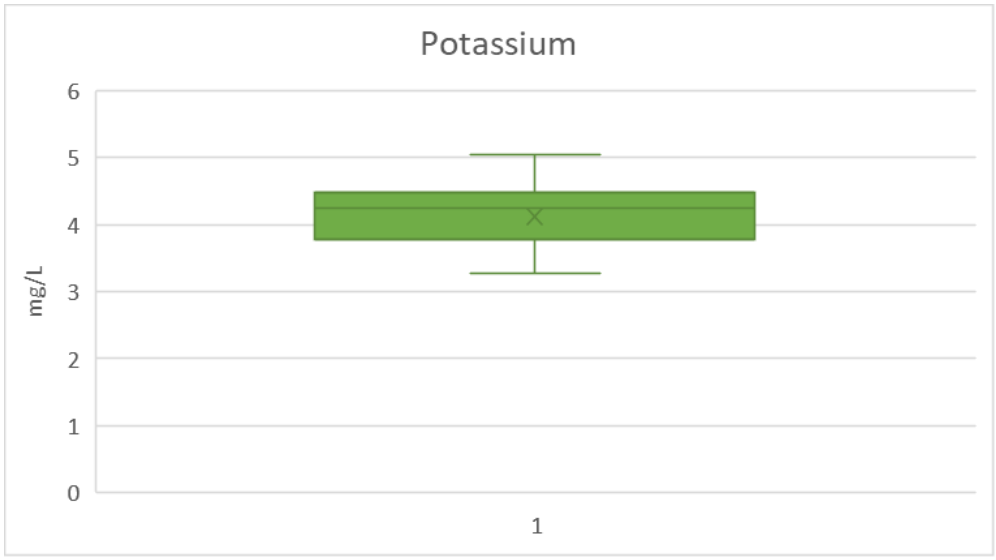

Figure A-6 Potassium Box Plot

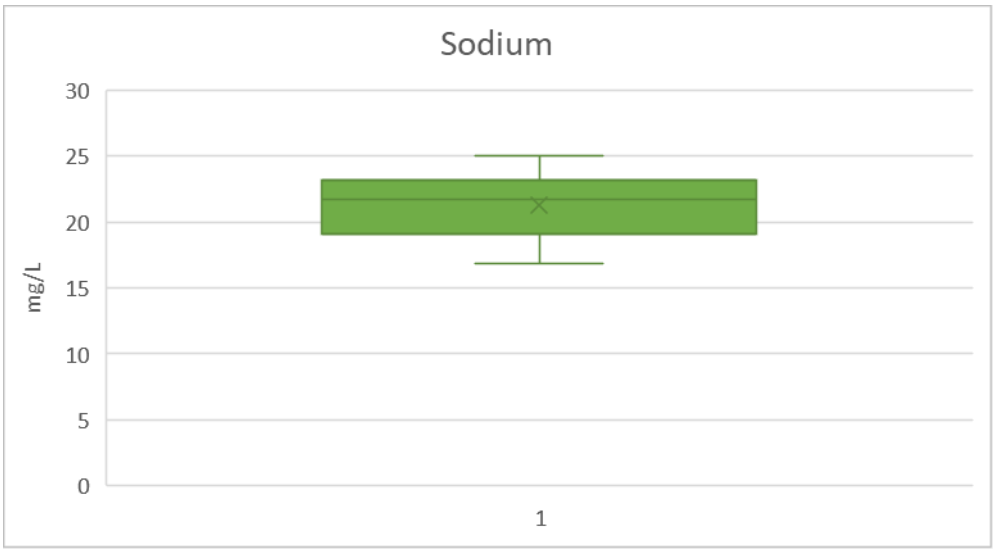

Figure A-7 Sodium Box Plot

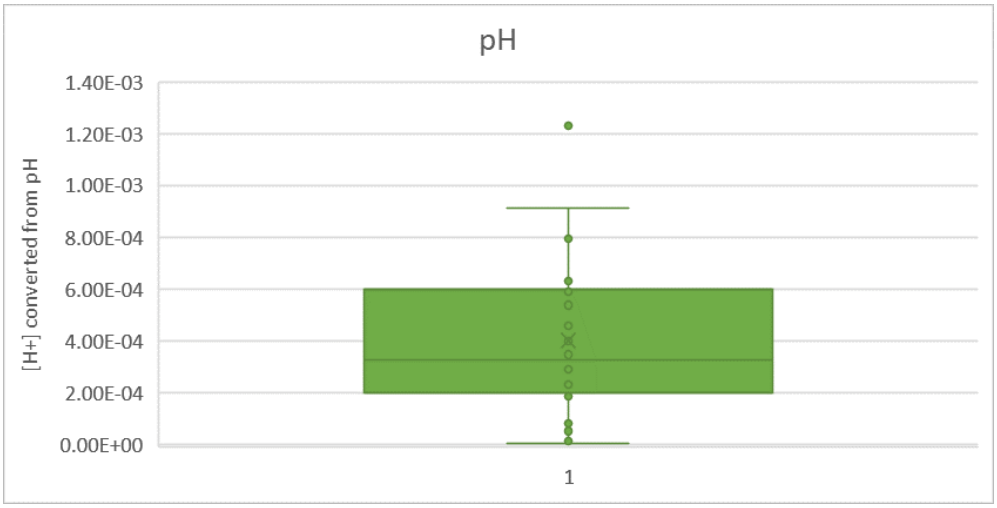

Figure A-8 pH Box Plot

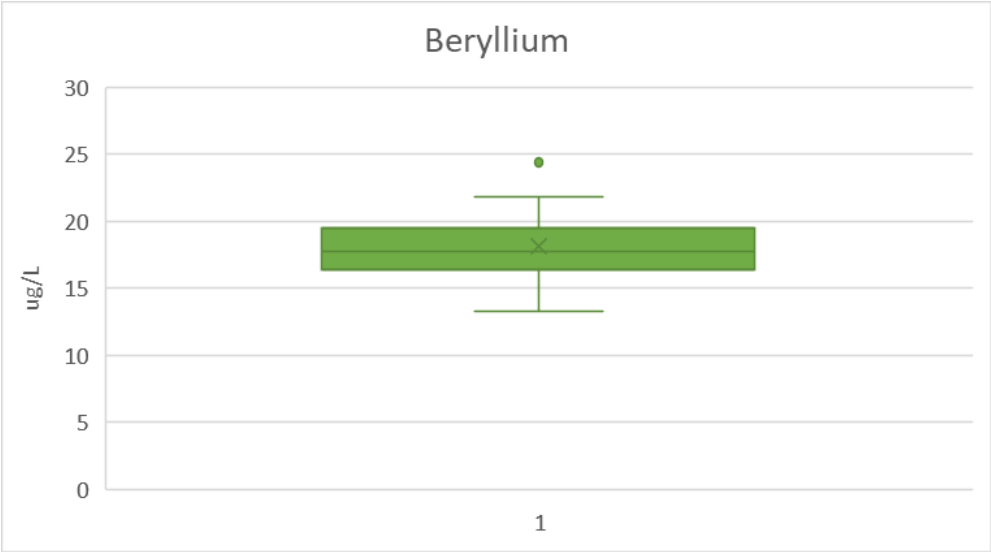

Figure A-9 Beryllium Box Plot

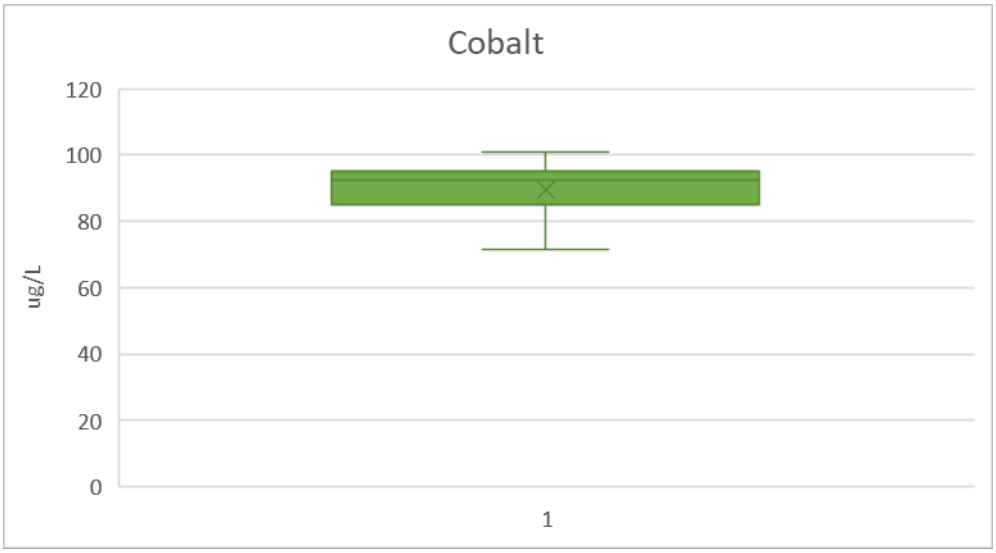

Figure A-10 Cobalt Box Plot

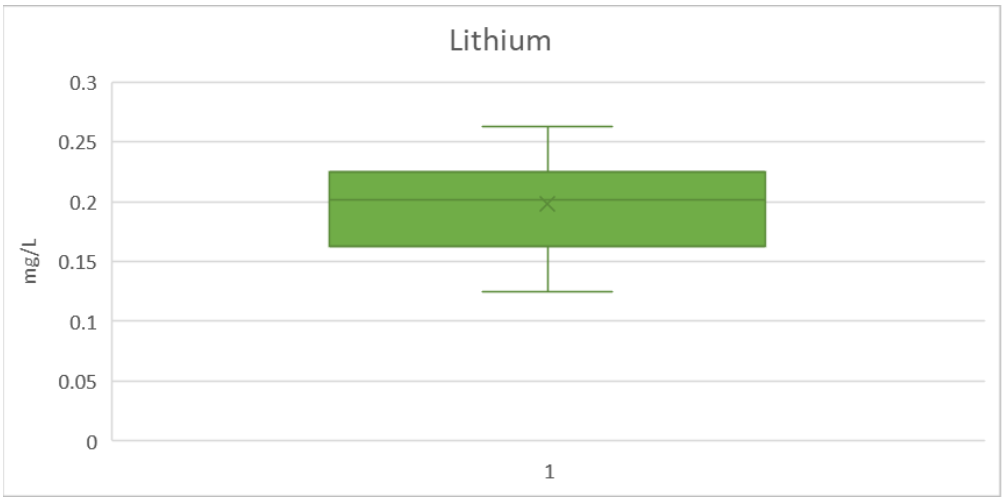

Figure A-11 Lithium Box Plot

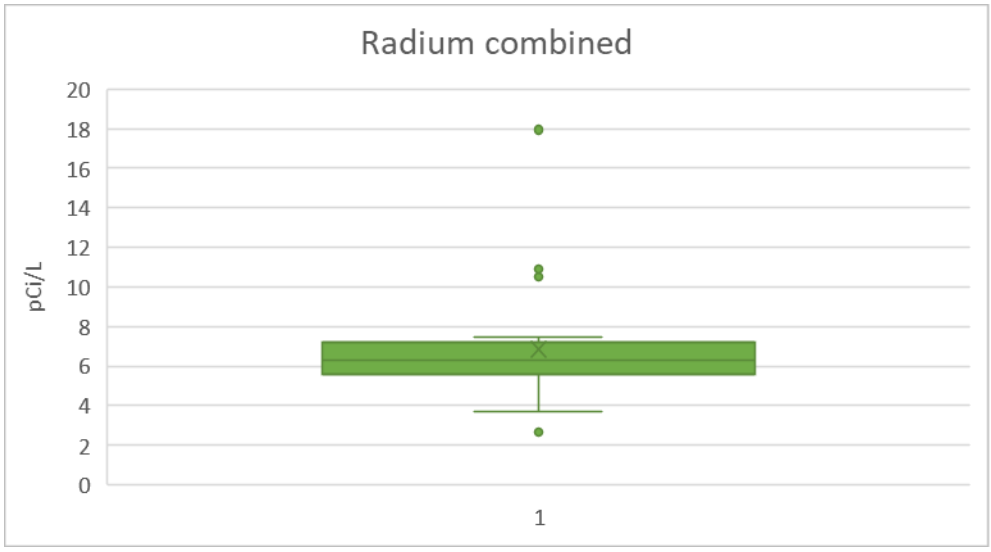

Figure A-12 Radium 226/228 Box Plot

APPENDIX 5 - Notices for Monitoring Program Transitions

No transition between monitoring requirements occurred in 2023; the CCR unit remained in assessment monitoring. Notices for monitoring program transitions are not applicable at this time.

APPENDIX 6 - Well Installation/Decommissioning Logs

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