Annual Groundwater Monitoring Report

Southwestern Electric Power Company

Flint Creek Power Plant

Primary Bottom Ash Pond CCR Management Unit

Gentry, Arkansas

Initial version – January 2019

Revision 1 - May 2019

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SOUTHWESTERN ELECTRIC POWER COMPANY℠

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I. Overview

This *Annual Groundwater Monitoring Report* (Report) has been prepared to report the status of activities for the preceding year for an existing CCR unit at Southwestern Electric Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), Flint Creek Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31, 2019.

In general, the following activities were completed:

- Groundwater samples were collected and analyzed for Appendix III constituents, as specified in 40 CFR 257.94 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan (2016)*;
- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Statistically significant increases (SSIs) were determined for boron, calcium, pH, total dissolved solids, and sulfate for the 1st half 2018 groundwater sampling and analysis event;
- A successful alternate source demonstration was prepared for the 1st half 2018 groundwater event;
- Groundwater Monitoring Statistical Evaluation Reports to evaluate groundwater data were prepared and certified in accordance with 40 CFR 257.93. The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance", USEPA, 2009).
- The 2nd half 2018 groundwater sampling event has not completed its statistical evaluation report.

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

- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers;
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened;
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs is included in Appendix I;
- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection

monitoring to assessment monitoring, in addition to identifying the constituents detected at a statistically significant increase over background concentrations (Appendix IV).

- Other information required to be included in the annual report such as alternate source demonstration or assessment of corrective measures, if applicable.

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

II. Groundwater Monitoring Well Locations and Identification Numbers

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

PBAP Monitoring Wells	
Up Gradient	Down Gradient
AP-51	AP-58
AP-53	AP-59
AP-54	AP-60

III. Monitoring Wells Installed or Decommissioned

There were no monitoring wells installed or decommissioned this year.

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

Appendix I contains tables showing the groundwater quality. Static water elevation data from each monitoring event also are shown in Appendix I, along with the groundwater velocity, groundwater flow direction and potentiometric maps developed after each sampling event.

V. Statistical Evaluation of 2018 Events

The 1st half 2018 statistical analysis report is included in Appendix II. SSIs were determined to exist in this report, however a successful alternate source demonstration was prepared that addressed all of the SSIs.

The 2nd half 2018 statistical analysis report is under development and not available in this report.

VI. Alternate Source Demonstration

An alternate source demonstration was prepared that addressed all of the SSIs found for the 1st half 2018 groundwater event. See Appendix III.

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

There were no groundwater program transitions this year. The detection monitoring program remains in effect.

Regarding defining an alternate monitoring frequency, no modification of the twice-per-year detection monitoring effort is needed.

VIII. Other Information Required

No other information applies at this time.

IX. Description of Any Problems Encountered in 2018 and Actions Taken

No problems were encountered this year.

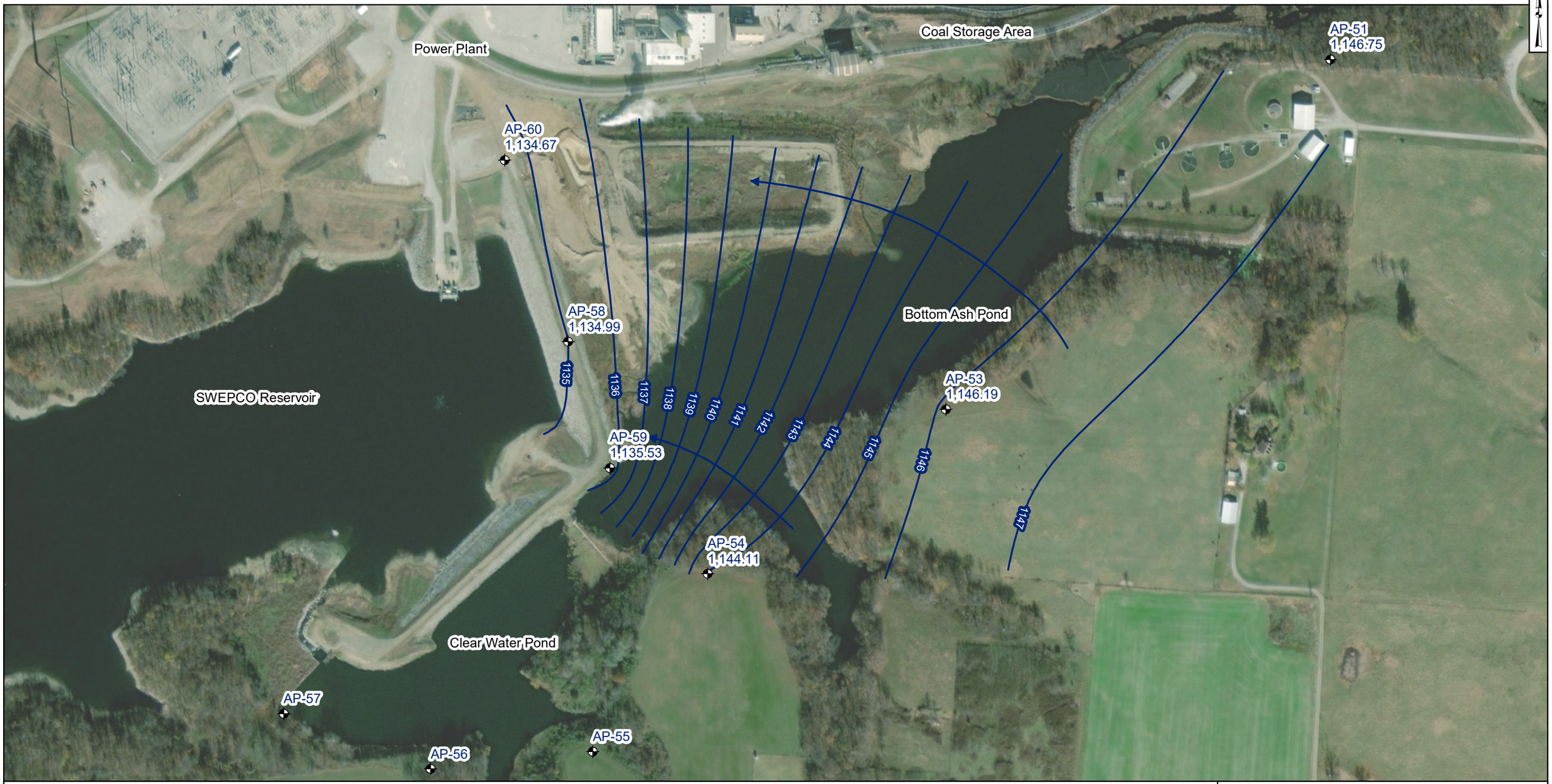
X. A Projection of Key Activities for the Upcoming Year

Key activities for 2019 include:

- Detection monitoring on a twice per year schedule;
- Evaluation of the detection monitoring results from a statistical analysis viewpoint, looking for any SSIs above background;
- Responding to any new data received in light of CCR rule requirements;
- Preparation of the third annual groundwater report.

APPENDIX I

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



Legend

- Monitoring Wells
- Groundwater Contour Elevation
- Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data were collected March 26 - 28, 2018, provided by AEP.
- AP-52 was abandoned December 6, 2016.
- AP-60 was installed January 9, 2017.
- Site features are based on information available in the Groundwater Monitoring Well Network Elevation (Terracon, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level.

200 100 0 200 Feet

Potentiometric Surface Map
Uppermost Aquifer - March 2018

AEP Flint Creek Plant - Primary Bottom Ash Pond
Gentry, Arkansas

Geosyntec consultants

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Figure **X**

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Legend

- Monitoring Wells
- Groundwater Contour Elevation
- Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data were collected August 28, 2018, provided by AEP.
- AP-52 was abandoned December 6, 2016.
- AP-60 was installed January 9, 2017.
- Site features are based on information available in the Groundwater Monitoring Well Network Elevation (Terracon, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level.

200 100 0 200 Feet

Potentiometric Surface Map
Uppermost Aquifer - August 2018

AEP Flint Creek Plant - Primary Bottom Ash Pond
Gentry, Arkansas

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Figure **X**

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Table 1: Residence Time Calculation Summary
Flint Creek Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

			2018-03		2018-08	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Primary Bottom Ash Pond	AP-51 [1]	2.0	96	0.6	62	1.0
	AP-53 [1]	2.0	231	0.3	180	0.3
	AP-54 [1]	2.0	701	0.1	429	0.1
	AP-58 [2]	2.0	240	0.3	180	0.3
	AP-59 [2]	2.0	83	0.7	430	0.1
	AP-60 [2],[3]	2.0	151	0.4	167	0.4

Notes:
[1] - Background Well
[2] - Downgradient Well
[3] - AP-52 was replaced with AP-60 in December 2016

Table 1 - Groundwater Data Summary
Flint Creek Plant - Bottom Ash Pond

Parameter	Unit	AP-51										
		5/24/2016	7/18/2016	9/13/2016	10/5/2016	11/8/2016	1/24/2017	3/7/2017	4/26/2017	5/16/2017	6/16/2017	8/29/2017
		Background										Detection
Antimony	mg/L	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	0.00129 J	<0.00093 U	0.00700	<0.00093 U	<0.00093 U	<0.00093 U	-
Arsenic	mg/L	<0.00105 U	<0.00105 U	<0.00105 U	<0.00105 U	<0.00105 U	<0.00105 U	<0.00105 U	<0.00105 U	<0.00105 U	0.00250 J	-
Barium	mg/L	0.0800	0.0860	0.128	0.0980	0.105	0.103	0.0950	0.0624	0.101	0.0889	-
Beryllium	mg/L	0.000258 J	0.000309 J	0.000374 J	0.000330 J	0.000454 J	0.000366 J	0.000355 J	0.000240 J	0.000420 J	0.000270 J	-
Boron	mg/L	0.0100	0.0100	0.0100	0.00768 J	0.0100	0.00849 J	0.0100	0.0148	0.0114	0.0186	0.0171
Cadmium	mg/L	0.0000936 J	<0.00007 U	<0.00007 U	<0.00007 U	0.000226 J	<0.00007 U	0.000128 J	<0.00007 U	0.000100 J	<0.00007 U	-
Calcium	mg/L	4.86	5.07	5.84	5.24	5.23	5.43	5.05	4.21	5.55	5.61	5.13
Chloride	mg/L	4	6	6	7	7	5	5	6	6	7	6
Chromium	mg/L	0.000258 J	0.00100	0.00600	0.00200	0.00400	0.00200	0.00200	0.00196	0.00186	0.000890 J	-
Cobalt	mg/L	0.000435 J	0.00240 J	0.0140	0.00500	0.00900	0.00446 J	0.00500	0.00408 J	0.00692	0.00526	-
Combined Radium	pCi/L	1.06	-	2.38	1.66	1.39	1.92	1.31	0.609	2.94	1.73	-
Fluoride	mg/L	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U	0.280 J	<0.083 U	<0.083 U	<0.083 U
Lead	mg/L	<0.00068 U	0.000840 J	0.00372 J	0.00149 J	0.00208 J	<0.00068 U	0.000884 J	<0.00068 U	<0.00068 U	<0.00068 U	-
Lithium	mg/L	<0.00013 U	0.00300	0.00500	0.00800	0.00400	0.00300	0.00200	0.00216	0.00315	0.00240	-
Mercury	mg/L	0.0000194 J	0.0000133 J	0.00000978 J	<0.000005 U	0.00000949 J	<0.000005 U	<0.000005 U	<0.000005 U	<0.000005 U	<0.000005 U	-
Molybdenum	mg/L	0.000922 J	<0.00029 U	<0.00029 U	<0.00029 U	<0.00029 U	<0.00029 U	0.000587 J	<0.00029 U	<0.00029 U	<0.00029 U	-
Selenium	mg/L	0.00125 J	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	-
Total Dissolved Solids	mg/L	61	80	64	80	76	80	40	96	60	68	50
Sulfate	mg/L	2	4	3	4	4	<0.14 U	0.514 J	6	3	3	3
Thallium	mg/L	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	-
pH	SU	4.64	5.29	5.27	5.00	5.19	5.09	5.02	5.21	5.12	5.12	4.83

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Flint Creek Plant - Bottom Ash Pond

Parameter	Unit	AP-53										
		5/24/2016	7/18/2016	9/13/2016	10/5/2016	11/8/2016	1/24/2017	3/7/2017	4/26/2017	5/16/2017	6/16/2017	8/29/2017
		Background										Detection
Antimony	mg/L	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	0.00137 J	0.00146 J	0.00123 J	0.00195 J	0.00115 J	-
Arsenic	mg/L	0.00600	0.00280 J	0.0240	<0.00105 U	0.00800	0.00386 J	0.00700	0.00482 J	0.00153 J	0.00310 J	-
Barium	mg/L	0.142	0.0760	0.258	0.0630	0.122	0.0970	0.110	0.102	0.0641	0.0713	-
Beryllium	mg/L	0.00100	0.000473 J	0.00300	0.000289 J	0.000980 J	0.000663 J	0.000851 J	0.000610 J	0.000330 J	0.000410 J	-
Boron	mg/L	0.110	0.109	0.155	0.121	0.138	0.158	0.137	0.124	0.118	0.122	0.114
Cadmium	mg/L	0.000586 J	0.0000914 J	0.00100	<0.00007 U	0.00300	0.0000732 J	0.000486 J	0.000220 J	<0.00007 U	<0.00007 U	-
Calcium	mg/L	4.15	3.49	5.54	3.39	3.38	3.87	3.85	3.89	3.46	3.39	2.82
Chloride	mg/L	10	12	13	13	14	14	13	15	14	14	11
Chromium	mg/L	0.0370	0.00700	0.0940	0.00200	0.0260	0.0160	0.0210	0.0154	0.00301	0.00578	-
Cobalt	mg/L	0.0120	0.00426 J	0.0270	0.00327 J	0.0130	0.00900	0.0150	0.00789	0.00290 J	0.00300 J	-
Combined Radium	pCi/L	3.55	-	5.93	0.568	2.06	2.16	1.92	1.55	1.33	2.14	-
Fluoride	mg/L	<0.083 U	<0.083 U	<0.083 U	0.205 J	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U
Lead	mg/L	0.0110	0.00107 J	0.0300	<0.00068 U	0.00800	0.00391 J	0.00800	0.00413 J	<0.00068 U	0.000870 J	-
Lithium	mg/L	0.00600	0.00400	0.0360	0.00900	0.0100	0.00600	0.00700	0.00623	0.00228	0.00357	-
Mercury	mg/L	0.000159	0.0000460	0.0000850	0.0000250	0.000118	0.000183	0.000140	<0.000005 U	0.0000400	0.0000430	-
Molybdenum	mg/L	0.00250 J	0.000344 J	0.00600	<0.00029 U	0.00109 J	0.000821 J	0.00145 J	0.000960 J	0.000310 J	<0.00029 U	-
Selenium	mg/L	<0.00099 U	0.00120 J	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	0.00214 J	<0.00099 U	<0.00099 U	-
Total Dissolved Solids	mg/L	80	104	104	110	118	132	112	200	90	136	92
Sulfate	mg/L	25	30	35	32	31	47	47	48	42	38	34
Thallium	mg/L	<0.00086 U	<0.00086 U	0.000981 J	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	-
pH	SU	4.72	4.53	4.73	4.85	4.95	4.95	4.96	5.64	4.53	4.97	4.82

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Flint Creek Plant - Bottom Ash Pond

Parameter	Unit	AP-54										
		5/24/2016	7/18/2016	9/13/2016	10/5/2016	11/8/2016	1/24/2017	3/7/2017	4/26/2017	5/16/2017	6/16/2017	8/29/2017
		Background										Detection
Antimony	mg/L	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	0.00557	-
Arsenic	mg/L	<0.00105 U	<0.00105 U	<0.00105 U	<0.00105 U	0.00183 J	0.00457 J	<0.00105 U	<0.00105 U	<0.00105 U	0.00165 J	-
Barium	mg/L	0.0350	0.0580	0.0380	0.0350	0.227	0.109	0.0960	0.0310	0.0349	0.0470	-
Beryllium	mg/L	0.000177 J	0.000294 J	0.0000362 J	0.000175 J	0.000251 J	0.000660 J	0.000165 J	0.000100 J	0.000160 J	0.000280 J	-
Boron	mg/L	0.249	0.255	0.266	0.255	0.260	0.284	0.259	0.256	0.256	0.249	0.259
Cadmium	mg/L	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	0.000164 J	0.000132 J	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	-
Calcium	mg/L	10.4	10.0	10.6	11.8	11.3	11.2	11.3	10.8	9.58	7.53	11.3
Chloride	mg/L	14	16	16	15	15	14	14	15	16	15	13
Chromium	mg/L	0.000486 J	0.00100	0.000471 J	0.00100	0.00900	0.0250	0.00400	0.000420 J	0.000440 J	0.000530 J	-
Cobalt	mg/L	0.00700	0.0130	0.00700	0.00600	0.0190	0.0240	0.0120	0.00440 J	0.00533	0.00714	-
Combined Radium	pCi/L	1.00	-	3.37	1.59	1.72	1.11	2.13	0.769	1.22	1.33	-
Fluoride	mg/L	<0.083 U	<0.083 U	<0.083 U	0.194 J	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U	<0.083 U
Lead	mg/L	<0.00068 U	<0.00068 U	<0.00068 U	<0.00068 U	0.00130 J	0.00700	<0.00068 U	<0.00068 U	<0.00068 U	<0.00068 U	-
Lithium	mg/L	0.000737 J	0.00100	0.000599 J	0.00600	0.00200	0.00600	0.00300	0.000480 J	0.000780 J	0.00127	-
Mercury	mg/L	0.0000241 J	0.0000310	0.0000122 J	0.0000250 J	0.0000490	0.0000820	0.00000568 J	0.0000170 J	0.0000200 J	0.0000180 J	-
Molybdenum	mg/L	<0.00029 U	<0.00029 U	<0.00029 U	<0.00029 U	0.00106 J	0.00335 J	0.000545 J	<0.00029 U	<0.00029 U	<0.00029 U	-
Selenium	mg/L	<0.00099 U	<0.00099 U	<0.00099 U	0.00126 J	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	-
Total Dissolved Solids	mg/L	180	178	172	164	168	164	150	154	136	192	156
Sulfate	mg/L	77	78	75	67	71	71	64	66	66	62	63
Thallium	mg/L	0.00105 J	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	-
pH	SU	5.76	5.79	5.62	5.45	5.72	5.46	5.42	6.07	5.05	5.31	5.52

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Flint Creek Plant - Bottom Ash Pond

Parameter	Unit	AP-58										
		5/24/2016	7/18/2016	9/13/2016	10/5/2016	11/7/2016	1/24/2017	3/7/2017	4/26/2017	5/16/2017	6/16/2017	8/29/2017
		Background										Detection
Antimony	mg/L	<0.00093 U	<0.00093 U	0.000971 J	0.00200 J	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	0.00216 J	-
Arsenic	mg/L	0.00500	0.0220	0.0250	0.0180	0.0140	0.0110	0.00800	0.00614	0.00432 J	0.00271 J	-
Barium	mg/L	0.0370	0.104	0.0390	0.0410	0.0410	0.0560	0.0420	0.0499	0.0431	0.0415	-
Beryllium	mg/L	0.000106 J	0.00300	0.000163 J	0.000382 J	0.000108 J	0.0000636 J	0.0000245 J	0.0000900 J	0.0000300 J	0.0000300 J	-
Boron	mg/L	1.44	1.68	1.66	1.56	1.26	1.09	0.829	0.613	0.473	0.416	0.333
Cadmium	mg/L	<0.00007 U	0.000460 J	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	-
Calcium	mg/L	24.9	27.4	17.5	18.9	30.5	34.4	48.1	59.0	69.3	70.1	75.5
Chloride	mg/L	18	21	23	27	22	16	14	14	13	12	12
Chromium	mg/L	0.000810 J	0.00800	0.00200	0.00300	0.00100	0.00200	0.00100	0.00157	0.000750 J	0.000580 J	-
Cobalt	mg/L	0.00386 J	0.00700	0.00230 J	0.00269 J	0.00129 J	0.00183 J	0.00105 J	0.00136 J	0.000870 J	0.000570 J	-
Combined Radium	pCi/L	0.548	-	1.01	0.787	1.65	1.90	0.938	1.16	0.663	2.27	-
Fluoride	mg/L	0.876 J	0.885 J	0.752 J	0.894 J	0.560 J	<0.083 U	<0.083 U	0.530 J	0.468 J	<0.083 U	<0.083 U
Lead	mg/L	<0.00068 U	0.0120	0.00220 J	0.00194 J	<0.00068 U	<0.00068 U	0.000928 J	<0.00068 U	<0.00068 U	<0.00068 U	-
Lithium	mg/L	<0.00013 U	0.0180	0.00700	0.0170	0.00800	0.00900	0.0150	0.0119	0.0119	0.0118	-
Mercury	mg/L	0.0000320	0.0000420	0.0000227 J	<0.000005 U	0.00000775 J	0.00000625 J	<0.000005 U	0.00000600 J	<0.000005 U	<0.000005 U	-
Molybdenum	mg/L	0.0620	0.0660	0.0680	0.0630	0.0440	0.0390	0.0260	0.0169	0.0141	0.0122	-
Selenium	mg/L	<0.00099 U	0.00281 J	0.00113 J	0.00255 J	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	-
Total Dissolved Solids	mg/L	602	691	644	696	562	448	420	374	344	398	344
Sulfate	mg/L	213	229	238	231	186	158	123	111	104	101	96
Thallium	mg/L	<0.00086 U	<0.00086 U	0.00102 J	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	-
pH	SU	7.10	8.38	8.25	8.75	7.83	8.08	7.01	7.08	7.50	6.04	7.75

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Flint Creek Plant - Bottom Ash Pond

Parameter	Unit	AP-59											
		5/24/2016	7/18/2016	9/13/2016	9/14/2016	10/5/2016	11/7/2016	1/24/2017	3/7/2017	4/26/2017	5/16/2017	6/16/2017	8/29/2017
		Background											Detection
Antimony	mg/L	<0.00093 U	<0.00093 U	<0.00093 U	-	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	<0.00093 U	-
Arsenic	mg/L	<0.00105 U	<0.00105 U	<0.00105 U	-	<0.00105 U	<0.00105 U	<0.00105 U	<0.00105 U	0.00158 J	<0.00105 U	0.00196 J	-
Barium	mg/L	0.0670	0.0720	0.0820	-	0.0890	0.0930	0.107	0.0960	0.104	0.0939	0.0868	-
Beryllium	mg/L	<0.00002 U	0.0000339 J	<0.00002 U	-	<0.00002 U	<0.00002 U	<0.00002 U	<0.00002 U	<0.00002 U	<0.00002 U	<0.00002 U	-
Boron	mg/L	0.250	0.339	0.380	-	0.347	0.323	0.317	0.253	0.222	0.208	0.227	0.295
Cadmium	mg/L	<0.00007 U	<0.00007 U	<0.00007 U	-	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	-
Calcium	mg/L	39.3	38.0	36.5	-	34.6	35.6	38.4	42.0	41.4	39.5	36.2	35.4
Chloride	mg/L	19	14	13	-	14	15	13	13	15	13	12	12
Chromium	mg/L	0.000583 J	0.00300	<0.00023 U	-	0.000301 J	<0.00023 U	<0.00023 U	0.000245 J	<0.00023 U	<0.00023 U	<0.00023 U	-
Cobalt	mg/L	0.00202 J	0.00254 J	0.00234 J	-	0.00273 J	0.00307 J	0.00339 J	0.00332 J	0.00336 J	0.00300 J	0.00283 J	-
Combined Radium	pCi/L	0.711	-	0.725	1.29	0.725	1.11	0.328	0.713	1.32	0.618	2.25	-
Fluoride	mg/L	0.741 J	0.652 J	0.583 J	-	0.709 J	0.583 J	<0.083 U	<0.083 U	0.610 J	0.576 J	<0.083 U	0.646 J
Lead	mg/L	<0.00068 U	0.00103 J	<0.00068 U	-	<0.00068 U	<0.00068 U	<0.00068 U	<0.00068 U	<0.00068 U	<0.00068 U	<0.00068 U	-
Lithium	mg/L	0.000379 J	0.000590 J	0.000162 J	-	0.0110	0.000392 J	0.000153 J	0.00600	0.000260 J	0.000330 J	0.000210 J	-
Mercury	mg/L	0.0000290	0.0000350	<0.000005 U	-	<0.000005 U	<0.000005 U	<0.000005 U	<0.000005 U	<0.000005 U	0.00000600 J	<0.000005 U	-
Molybdenum	mg/L	0.00700	0.00900	0.00900	-	0.00800	0.00800	0.00800	0.00700	0.00533	0.00566	0.00640	-
Selenium	mg/L	<0.00099 U	<0.00099 U	<0.00099 U	-	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	-
Total Dissolved Solids	mg/L	240	220	216	-	220	216	240	236	226	186	224	210
Sulfate	mg/L	37	27	25	-	26	32	40	43	40	38	31	21
Thallium	mg/L	0.00124 J	0.00108 J	0.00101 J	-	0.00163 J	<0.00086 U	0.00121 J	<0.00086 U	<0.00086 U	0.00109 J	<0.00086 U	-
pH	SU	7.39	6.75	7.29	-	7.13	7.15	7.03	7.91	7.16	7.05	6.73	7.10

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Flint Creek Plant - Bottom Ash Pond

Parameter	Unit	AP-60								
		12/19/2016	1/24/2017	3/7/2017	3/29/2017	4/26/2017	5/16/2017	6/16/2017	6/28/2017	8/29/2017
		Background								Detection
Antimony	mg/L	<0.00093 U	0.00135 J	<0.00093 U	<0.00093 U	<0.00093 U	0.00100 J	<0.00093 U	<0.00093 U	-
Arsenic	mg/L	0.00900	0.00362 J	0.00900	0.00700	0.0114	0.0114	0.00769	0.00932	-
Barium	mg/L	0.0170	0.0340	0.0150	0.0410	0.0240	0.0131	0.0272	0.0126	-
Beryllium	mg/L	0.0000543 J	<0.00002 U	<0.00002 U	0.0000232 J	0.000120 J	0.0000300 J	<0.00002 U	<0.00002 U	-
Boron	mg/L	1.40	1.12	1.26	1.14	1.30	1.41	1.20	1.35	1.13
Cadmium	mg/L	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	<0.00007 U	-
Calcium	mg/L	16.7	33.2	25.9	43.0	25.0	16.3	29.2	17.7	32.3
Chloride	mg/L	14	13	12	13	15	14	15	16	13
Chromium	mg/L	0.00200	0.000502 J	0.000298 J	0.00300	0.00375	0.000910 J	<0.00023 U	0.000370 J	-
Cobalt	mg/L	0.00192 J	0.000872 J	0.000459 J	0.00222 J	0.00301 J	0.000660 J	0.000420 J	0.000370 J	-
Combined Radium	pCi/L	1.18	0.771	1.12	1.16	0.429	2.08	3.70	7.17	-
Fluoride	mg/L	0.0946 J	<0.083 U	<0.083 U	<0.083 U	0.580 J	0.558 J	<0.083 U	0.552 J	0.452 J
Lead	mg/L	0.000743 J	<0.00068 U	<0.00068 U	0.00185 J	0.00291 J	<0.00068 U	<0.00068 U	<0.00068 U	-
Lithium	mg/L	0.00100	0.000638 J	0.00300	0.00200	0.00236	0.000480 J	0.000630 J	0.000310 J	-
Mercury	mg/L	<0.000005 U	<0.000005 U	<0.000005 U	0.00000961 J	0.0000100 J	0.00000900 J	<0.000005 U	0.00000600 J	-
Molybdenum	mg/L	0.0600	0.0550	0.0570	0.0530	0.0564	0.0621	0.0542	0.0638	-
Selenium	mg/L	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	<0.00099 U	-
Total Dissolved Solids	mg/L	369	356	340	368	340	302	368	368	356
Sulfate	mg/L	165	152	145	140	160	167	152	166	146
Thallium	mg/L	<0.00086 U	<0.00086 U	<0.00086 U	<0.00086 U	0.000980 J	<0.00086 U	<0.00086 U	<0.00086 U	-
pH	SU	8.86	7.84	8.11	8.36	7.62	8.56	7.79	7.50	7.65

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 3: Detection Monitoring Data Evaluation
Intrawell Prediction Limits
Flint Creek Plant - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Units	Description	AP-58		AP-59		AP-60	
			8/29/2017	12/21/2017	8/29/2017	12/21/2017	8/29/2017	12/21/2017
Boron	mg/L	Intrawell Background Value (UPL)	2.20		0.424		1.55	
	mg/L	Detection Monitoring Result	0.333	0.268	0.295	0.279	1.13	0.857
Calcium	mg/L	Intrawell Background Value (UPL)	85.1		43.6		48.7	
	mg/L	Detection Monitoring Result	75.5	73.9	35.4	46.8*	32.3	46.2
Chloride	mg/L	Intrawell Background Value (UPL)	29.3		18.5		17.2	
	mg/L	Detection Monitoring Result	12	-	12	-	13	-
Fluoride	mg/L	Intrawell Background Value (UPL)	1.09		0.774		0.95	
	mg/L	Detection Monitoring Result	0.083	-	0.6463	-	0.4518	-
pH	SU	Intrawell Background Value (UPL)	9.42		7.91		9.26	
	SU	Intrawell Background Value (LPL)	5.78		6.41		6.90	
	SU	Detection Monitoring Result	7.75	7.36	7.1	6.94	7.65	7.16
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	822		258		409	
	mg/L	Detection Monitoring Result	344	304	210	228	356	332
Sulfate	mg/L	Intrawell Background Value (UPL)	296		48.5		181	
	mg/L	Detection Monitoring Result	96	80	21	-	146	128

Notes:
*Based on 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the calculated background value.
UPL: Upper prediction limit
LPL: Lower prediction limit
-: Not Sampled
Background values are shaded gray.

Table 1 – Groundwater Data Summary
Flint Creek – Bottom Ash Pond

Parameter	Unit	AP-51			AP-53			AP-54			AP-58			AP-59			AP-60		
		3/28/2018	8/28/2018	10/22/2018	3/28/2018	8/28/2018	10/22/2018	3/28/2018	8/28/2018	10/22/2018	3/26/2018	8/28/2018	10/23/2018	3/26/2018	8/28/2018	10/23/2018	3/26/2018	8/28/2018	10/23/2018
		2018-D1	2018-D2	2018-D2	2018-D1	2018-D2	2018-D2	2018-D1	2018-D2	2018-D2	2018-D1	2018-D2	2018-D2	2018-D1	2018-D2	2018-D2	2018-D1	2018-D2	2018-D2
Boron	mg/L	0.0152	0.0110	-	0.115	0.124	-	0.223	0.240	-	0.228	0.237	-	0.218	0.277	-	0.645	1.27	-
Calcium	mg/L	11.1	6.69	-	3.51	3.37	-	5.61	15.5	-	77.2	75.9	-	43.2	42.2	-	45.5	31.1	-
Chloride	mg/L	2.00	*H1	9.71	12.0	*H1	19.2	13.0	*H1	18.3	8.00	*H1	12.5	12.0	*H1	19.0	9.00	*H1	15.7
Fluoride	mg/L	<0.083 U	*H1	<0.083 U	<0.083 U	*H1	<0.083 U	<0.083 U	*H1	<0.083 U	<0.083 U	*H1	<0.083 U	<0.083 U	*H1	0.548 J	<0.083 U	*H1	<0.083 U
Total Dissolved Solids	mg/L	96.0	74.0	-	114	120	-	130	168	-	262	300	-	180	180	-	284	276	-
Sulfate	mg/L	9.00	*H1	2.14	43.0	*H1	45.0	64.0	*H1	54.4	70.0	*H1	75.5	40.0	*H1	26.7	113	*H1	135
pH	SU	7.77	7.66	-	5.03	5.61	-	5.33	5.88	-	7.41	6.90	-	7.04	7.07	-	8.62	7.76	-

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Parameter was not present in concentrations above method detection limit and is reported as the method detection limit
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not analyzed
*H1: Sample analysis was performed past holding time. Resampling was completed in October 2018
2018-D1: First semi-annual detection monitoring event, initial sampling event
2018-D2: Second semi-annual detection monitoring event, initial sampling event

APPENDIX II

Where applicable, show in this appendix the results from statistical analyses, and a description of the statistical analysis method chosen. These statistical analyses are to be conducted separately for each constituent in each monitoring well.

Purpose of Statistical Analysis Summary Report

During the initial phase of ground water monitoring, the CCR rule requires AEP to collect at least eight independent samples from at least one up-gradient and three downgradient wells for 21 substances listed in the CCR rule. The CCR rule also requires us to select a statistical method that will be used to evaluate the samples in the later phases of the ground water monitoring program. The Statistical Plan, which has been posted to AEP's CCR website, describes the methods selected by AEP. *See* AEP's Statistical Analysis Plans.

Each **Statistical Analysis Summary Report** is based on the results of the 8 independent samples that were collected by October 17, 2017, and reported in the Annual Groundwater Monitoring Report. Using the statistical methods chosen by AEP, the samples were evaluated to eliminate outliers, determine variability and general trends in the data, and establish background values for: boron, calcium chloride, fluoride, pH, sulfate, and total dissolved solids. Appendix IV substances were evaluated for purposes of identifying outliers and understanding data trends.

A subsequent sample taken during the first detection monitoring sampling event was also compared using the proper statistical methods to the background values that were established for these seven substances from the eight independent samples. A second or third re-sampling event occurred, and the results compared using the same methods. This work is reported in the memorandum included in attachment A. If confirmed, AEP will be required to enter the next phase of monitoring. The results of future sampling will be further analyzed to target any specific substances for which ongoing monitoring or potential corrective action is required.

STATISTICAL ANALYSIS SUMMARY
PRIMARY BOTTOM ASH POND
Flint Creek Plant
Gentry, Arkansas

Submitted to

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

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January 3, 2018

CHA8423

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ANOVA	Analysis of Variance
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Value
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
NELAP	National Environmental Laboratory Accreditation Program
PBAP	Primary Bottom Ash Pond
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SWFPR	Site-Wide False-Positive Rate
TDS	Total Dissolved Solids
UPL	Upper Prediction 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 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Primary Bottom Ash Pond (BAP), an existing CCR unit at the Flint Creek Power Plant located in Gentry, Arkansas.

Ten monitoring events were completed prior to October 17, 2017, in order to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule. Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. The background data were reviewed for outliers, which were removed (when appropriate) prior to calculating upper prediction limits (UPLs) for each Appendix III parameter to represent background values. Oversight on the use of statistical calculations was provided by Dr. Kirk Cameron of MacStat Consulting, Ltd.

A groundwater sampling event occurred on August 29, 2017 at the PBAP. This sampling event obtained the first sample for the 1-of-2 prediction interval statistical test used for detection monitoring. The results of this sampling event are included in this report.

SECTION 2

PRIMARY BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the background monitoring program, ten sets of samples were collected for analysis from each background and downgradient well. A summary of data collected during background and detection monitoring sampling may be found 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 QA/QC 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.9.5.32 statistics software. The export 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

The background data used to conduct the statistical analyses and the detection monitoring data are summarized in Table 1. Statistical analyses for the PBAP were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. The complete statistical analysis results are included in Attachment A.

Time series plots of Appendix III and IV parameters are included in Attachment A. Mann-Kendall analyses ($\alpha = 0.01$) were conducted to evaluate trends in the background data. The following statistically significant trends were observed:

- Boron was found to be significantly decreasing at downgradient well AP-58.
- Calcium was found to be significantly increasing at downgradient well AP-58. If calcium concentrations at AP-58 continue to increase, a statistically significant increase (SSI) will likely be concluded.
- Cobalt was found to be significantly decreasing at downgradient well AP-58.
- Molybdenum was found to be significantly decreasing at downgradient well AP-58.

- Sulfate was found to be significantly decreasing at background well AP-54 and at downgradient well AP-58.

- Total dissolved solids (TDS) was found to be significantly decreasing at downgradient well AP-58.

No other significant increasing or decreasing trends were observed for other parameters or at other monitoring wells.

2.2.1 Background Outlier Evaluation

Potential outliers were identified using Tukey's outlier test; i.e., data points were considered potential outliers if they met one of the following criteria:

$$x_i < \tilde{x}_{0.25} - 3 \times IQR \quad (1)$$

or

$$x_i > \tilde{x}_{0.75} + 3 \times IQR \quad (2)$$

where:

$x_i =$ individual data point
$\tilde{x}_{0.25} =$ first quartile
$\tilde{x}_{0.75} =$ third quartile
$IQR =$ the interquartile range $= \tilde{x}_{0.75} - \tilde{x}_{0.25}$

Background well data were first pooled, and Tukey's outlier test was performed on the pooled dataset. For the downgradient wells, Tukey's outlier test was applied individually to each downgradient well.

Data that were evaluated as potential outliers are summarized in Attachment A. Tukey's outlier test indicated seven potential outliers, which are summarized in Table 2. Next, the data were reviewed to identify possible sources of errors or discrepancies, including data recording errors, unusual sampling conditions, laboratory quality, or inconsistent sample turbidity. The findings of this data review are summarized below.

Three arsenic values at background wells AP-53 and AP-543 were identified as potential outliers but not removed from the dataset, as they represented either estimated (J-flagged) or trace concentrations.

A fourth arsenic concentration of 0.025 mg/L and a reported lead concentration of 0.03 mg/L, both reported at background well AP-53 on September 13, 2016, were removed from the dataset. The field notes indicated very high turbidity during sampling, suggesting possible sampling error. Because these outliers were anomalously high, their removal would result in the generation of

more conservative (i.e., lower) background values should these data be used to determine background values, and removing these outliers is recommended by USEPA's *Unified Guidance* (USEPA, 2009).

The remaining two potential outliers were for reported mercury concentrations at downgradient well AP-59. The reported mercury value of 0.000006 mg/L was estimated (J-flagged) and was retained in the dataset. The other potential mercury outlier had a reported value of 0.00035 mg/L. As mercury was not detected for multiple samples collected at AP-59, this value likely represents actual concentrations in the aquifer and was retained in the dataset.

2.2.2 Establishment of Background Levels

Analysis of variance (ANOVA) was conducted to determine whether spatial variation was present among the three background wells (Attachment A). ANOVA indicated no significant variation among the three background wells for fluoride. Consequently, interwell tests were used for fluoride. Significant variation was observed for boron, calcium, chloride, pH, sulfate, and TDS. Therefore, the appropriateness of using intrawell tests was evaluated for these parameters at the Flint Creek PBAP.

Intrawell tests presume that the groundwater quality in the downgradient wells was not initially impacted by the CCR unit. To test this presumption, the data from the background wells were pooled and the data from each downgradient well were compared to a pooled background value. Tolerance limits were calculated using the pooled background data for boron, calcium, chloride, pH, sulfate, and TDS. Parametric tolerance limits with 99% confidence and 95% coverage were calculated for pH and TDS; non-parametric tolerance limits were calculated for boron, calcium, chloride, and sulfate, given the non-normal distributions observed for these four parameters. Confidence intervals were calculated for each of these six parameters at each downgradient monitoring well. If the lower confidence limit from a downgradient well exceeded the upper tolerance limit for the pooled background data, it was concluded that downgradient groundwater concentrations were above background concentrations. In these instances, intrawell tests would not be appropriate. However, these analyses indicated no significant exceedances for chloride; elevated concentrations of boron, calcium, pH, sulfate, and TDS were observed. (Non-parametric analyses also indicated elevated pH values and TDS concentrations in downgradient wells.) Therefore, intrawell tests were used to evaluate potential statistically significant increases (SSIs) for chloride. Interwell tests were used to evaluate potential SSIs for boron, calcium, fluoride, pH, sulfate, and TDS.

After equality of variance was tested and identified outliers were removed (where appropriate), 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 practical quantitation limit (PQL) – 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

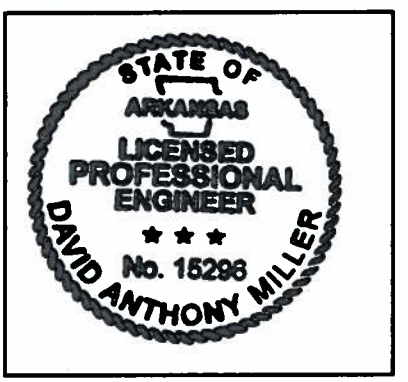
(either transformed or untransformed) that passed the Shapiro-Wilk / Shapiro-Francía test for normality. The Kaplan-Meier non-detect adjustment was applied to datasets with between 15% and 50% non-detect data. For datasets with fewer than 15% non-detect data, non-detect data were replaced with one half of the PQL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment A.

Upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. To conduct the intrawell tests for chloride, a separate UPL was calculated for each downgradient compliance well for each of these parameters. To conduct the interwell tests for boron, calcium, fluoride, pH, sulfate, and TDS, a single prediction interval was calculated for each of these parameters using pooled data from the three background wells. The background data used for the UPL calculations are summarized in Table 1; the calculated UPLs are summarized in Table 3.

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, then it can be concluded that an SSI has not occurred. In practice, where initial results did not exceed the UPL, a second sample was not collected. The one-of-two retesting procedure allowed achieving an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less. Power curves were constructed for the interwell and intrawell parametric tests and are compared with the EPA Reference Power Curve in Attachment A. The power curves associated with the statistical tests for the PBAPs exceed the EPA Reference Power Curve at 3 and 4 standard deviations; this is considered a "good" level of statistical power according to USEPA's *Unified Guidance* (USEPA, 2009).

2.2.3 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 Flint Creek Primary Bottom 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

15296	ARKANSAS	01.03.18
License Number	Licensing State	Date

2.3 Conclusions

Ten background monitoring events and one detection monitoring event were completed in accordance with the CCR Rules. 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 seven values, with two removed from the data set without replacement. Prediction intervals were constructed based on the remaining background data and a one-of-two retesting procedure. Interwell tests were selected for boron, calcium, fluoride, pH, sulfate, and TDS; intrawell tests were selected for chloride.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Flint Creek Plant. January 2017.

United States Environmental Protection Agency (USEPA). 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March 2009.

TABLES

Table 1: Groundwater Data Summary
Flint Creek Plant - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Unit	AP-51										
		5/24/2016	7/18/2016	9/13/2016	10/5/2016	11/8/2016	1/24/2017	3/7/2017	4/26/2017	5/16/2017	6/16/2017	8/29/2017
		Background										Detection
Antimony	mg/L	0.005U	0.005U	0.005U	0.005U	0.00129J	0.005U	0.007	0.005U	0.005U	0.005U	-
Arsenic	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.0025J	-
Barium	mg/L	0.08	0.086	0.128	0.098	0.105	0.103	0.095	0.06243	0.101	0.08887	-
Beryllium	mg/L	0.00026J	0.00031J	0.00037J	0.00033J	0.00045J	0.00037J	0.00036J	0.00024J	0.00042J	0.00027J	-
Boron	mg/L	0.01	0.01	0.01	0.00768J	0.01	0.00849J	0.01	0.01475	0.01135	0.0186	0.0171
Cadmium	mg/L	0.00009J	0.001U	0.001U	0.001U	0.00023J	0.001U	0.00013J	0.001U	0.0001J	0.001U	-
Calcium	mg/L	4.86	5.07	5.84	5.24	5.23	5.43	5.05	4.21	5.55	5.61	5.13
Chloride	mg/L	4	6	6	7	7	5	5	6	6	7	6
Chromium	mg/L	0.00026J	0.001	0.006	0.002	0.004	0.002	0.002	0.00196	0.00186	0.00089J	-
Cobalt	mg/L	0.00043J	0.0024J	0.014	0.005	0.009	0.00446J	0.005	0.00408J	0.00692	0.00526	-
Combined Radium	pCi/L	1.063	-	2.38	1.656	1.387	1.916	1.31	0.6089	2.935	1.728	-
Fluoride	mg/L	1U	1U	1U	1U	1U	1U	1U	0.28J	1U	1U	1U
Lead	mg/L	0.005U	0.00084J	0.00372J	0.00149J	0.00208J	0.005U	0.00088J	0.005U	0.005U	0.005U	-
Lithium	mg/L	0.001U	0.003	0.005	0.008	0.004	0.003	0.002	0.00216	0.00315	0.0024	-
Mercury	mg/L	0.00002J	0.00001J	0.00001J	0.00002U	0.00001J	0.00002U	0.00002U	0.00002U	0.00002U	0.00002U	-
Molybdenum	mg/L	0.00092J	0.005U	0.005U	0.005U	0.005U	0.005U	0.00059J	0.005U	0.005U	0.005U	-
Selenium	mg/L	0.00125J	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Total Dissolved Solids	mg/L	61	80	64	80	76	80	40	96	60	68	50
Sulfate	mg/L	2	4	3	4	4	1U	0.5139J	6	3	3	3
Thallium	mg/L	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	-
pH	SU	4.64	5.29	5.27	5	5.19	5.09	5.02	5.21	5.12	5.12	4.83

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Component was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1: Groundwater Data Summary
Flint Creek Plant - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Unit	AP-53										
		5/24/2016	7/18/2016	9/13/2016	10/5/2016	11/8/2016	1/24/2017	3/7/2017	4/26/2017	5/16/2017	6/16/2017	8/29/2017
		Background										Detection
Antimony	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.00137J	0.00146J	0.00123J	0.00195J	0.00115J	-
Arsenic	mg/L	0.006	0.0028J	0.024	0.005U	0.008	0.00386J	0.007	0.00482J	0.00153J	0.0031J	-
Barium	mg/L	0.142	0.076	0.258	0.063	0.122	0.097	0.11	0.102	0.06408	0.07132	-
Beryllium	mg/L	0.001	0.00047J	0.003	0.00029J	0.00098J	0.00066J	0.00085J	0.00061J	0.00033J	0.00041J	-
Boron	mg/L	0.11	0.109	0.155	0.121	0.138	0.158	0.137	0.124	0.118	0.122	0.114
Cadmium	mg/L	0.00059J	0.00009J	0.001	0.001U	0.003	0.00007J	0.00049J	0.00022J	0.001U	0.001U	-
Calcium	mg/L	4.15	3.49	5.54	3.39	3.38	3.87	3.85	3.89	3.46	3.39	2.82
Chloride	mg/L	10	12	13	13	14	14	13	15	14	14	11
Chromium	mg/L	0.037	0.007	0.094	0.002	0.026	0.016	0.021	0.01541	0.00301	0.00578	-
Cobalt	mg/L	0.012	0.00426J	0.027	0.00327J	0.013	0.009	0.015	0.00789	0.0029J	0.003J	-
Combined Radium	pCi/L	3.55	-	5.93	0.568	2.06	2.16	1.915	1.552	1.327	2.139	-
Fluoride	mg/L	1U	1U	1U	0.205J	1U	1U	1U	1U	1U	1U	1U
Lead	mg/L	0.011	0.00107J	0.03	0.005U	0.008	0.00391J	0.008	0.00413J	0.005U	0.00087J	-
Lithium	mg/L	0.006	0.004	0.036	0.009	0.01	0.006	0.007	0.00623	0.00228	0.00357	-
Mercury	mg/L	0.00016	0.00005	0.00008	0.00002	0.00012	0.00018	0.00014	0.00002U	0.00004	0.00004	-
Molybdenum	mg/L	0.0025J	0.00034J	0.006	0.005U	0.00109J	0.00082J	0.00145J	0.00096J	0.00031J	0.005U	-
Selenium	mg/L	0.005U	0.0012J	0.005U	0.005U	0.005U	0.005U	0.005U	0.00214J	0.005U	0.005U	-
Total Dissolved Solids	mg/L	80	104	104	110	118	132	112	200	90	136	92
Sulfate	mg/L	25	30	35	32	31	47	47	48	42	38	34
Thallium	mg/L	0.002U	0.002U	0.00098J	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	-
pH	SU	4.72	4.53	4.73	4.85	4.95	4.95	4.96	5.64	4.53	4.97	4.82

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Component was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1: Groundwater Data Summary
Flint Creek Plant - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Unit	AP-54										
		5/24/2016	7/18/2016	9/13/2016	10/5/2016	11/8/2016	1/24/2017	3/7/2017	4/26/2017	5/16/2017	6/16/2017	8/29/2017
		Background										Detection
Antimony	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.00557	-
Arsenic	mg/L	0.005U	0.005U	0.005U	0.005U	0.00183J	0.00457J	0.005U	0.005U	0.005U	0.00165J	-
Barium	mg/L	0.035	0.058	0.038	0.035	0.227	0.109	0.096	0.03104	0.03492	0.04698	-
Beryllium	mg/L	0.00018J	0.00029J	0.00004J	0.00018J	0.00025J	0.00066J	0.00016J	0.0001J	0.00016J	0.00028J	-
Boron	mg/L	0.249	0.255	0.266	0.255	0.26	0.284	0.259	0.256	0.256	0.249	0.259
Cadmium	mg/L	0.001U	0.001U	0.001U	0.001U	0.00016J	0.00013J	0.001U	0.001U	0.001U	0.001U	-
Calcium	mg/L	10.4	10	10.6	11.8	11.3	11.2	11.3	10.8	9.58	7.53	11.3
Chloride	mg/L	14	16	16	15	15	14	14	15	16	15	13
Chromium	mg/L	0.00049J	0.001	0.00047J	0.001	0.009	0.025	0.004	0.00042J	0.00044J	0.00053J	-
Cobalt	mg/L	0.007	0.013	0.007	0.006	0.019	0.024	0.012	0.0044J	0.00533	0.00714	-
Combined Radium	pCi/L	1	-	3.37	1.59	1.722	1.107	2.125	0.769	1.222	1.325	-
Fluoride	mg/L	1U	1U	1U	0.1943J	1U	1U	1U	1U	1U	1U	1U
Lead	mg/L	0.005U	0.005U	0.005U	0.005U	0.0013J	0.007	0.005U	0.005U	0.005U	0.005U	-
Lithium	mg/L	0.00074J	0.001	0.0006J	0.006	0.002	0.006	0.003	0.00048J	0.00078J	0.00127	-
Mercury	mg/L	0.00002J	0.00003	0.00001J	0.00002J	0.00005	0.00008	0.00001J	0.00002J	0.00002J	0.00002J	-
Molybdenum	mg/L	0.005U	0.005U	0.005U	0.005U	0.00106J	0.00335J	0.00055J	0.005U	0.005U	0.005U	-
Selenium	mg/L	0.005U	0.005U	0.005U	0.00126J	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Total Dissolved Solids	mg/L	180	178	172	164	168	164	150	154	136	192	156
Sulfate	mg/L	77	78	75	67	71	71	64	66	66	62	63
Thallium	mg/L	0.00105J	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	-
pH	SU	5.76	5.79	5.62	5.45	5.72	5.46	5.42	6.07	5.05	5.31	5.52

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter -
SU: standard unit
U: Component was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1: Groundwater Data Summary
Flint Creek Plant - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Unit	AP-58										
		5/24/2016	7/18/2016	9/13/2016	10/5/2016	11/7/2016	1/24/2017	3/7/2017	4/26/2017	5/16/2017	6/16/2017	8/29/2017
		Background										Detection
Antimony	mg/L	0.005U	0.005U	0.00097J	0.002J	0.005U	0.005U	0.005U	0.005U	0.005U	0.00216J	-
Arsenic	mg/L	0.005	0.022	0.025	0.018	0.014	0.011	0.008	0.00614	0.00432J	0.00271J	-
Barium	mg/L	0.037	0.104	0.039	0.041	0.041	0.056	0.042	0.04986	0.04308	0.04148	-
Beryllium	mg/L	0.00011J	0.003	0.00016J	0.00038J	0.00011J	0.00006J	0.00002J	0.00009J	0.00003J	0.00003J	-
Boron	mg/L	1.44	1.68	1.66	1.56	1.26	1.09	0.829	0.613	0.473	0.416	0.333
Cadmium	mg/L	0.001U	0.00046J	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	-
Calcium	mg/L	24.9	27.4	17.5	18.9	30.5	34.4	48.1	59	69.3	70.1	75.5
Chloride	mg/L	18	21	23	27	22	16	14	14	13	12	12
Chromium	mg/L	0.00081J	0.008	0.002	0.003	0.001	0.002	0.001	0.00157	0.00075J	0.00058J	-
Cobalt	mg/L	0.00386J	0.007	0.0023J	0.00269J	0.00129J	0.00183J	0.00105J	0.00136J	0.00087J	0.00057J	-
Combined Radium	pCi/L	0.548	-	1.007	0.787	1.65	1.896	0.938	1.163	0.663	2.268	-
Fluoride	mg/L	0.8759J	0.8849J	0.7518J	0.8942J	0.5598J	1U	1U	0.53J	0.4677J	1U	1U
Lead	mg/L	0.005U	0.012	0.0022J	0.00194J	0.005U	0.005U	0.00093J	0.005U	0.005U	0.005U	-
Lithium	mg/L	0.001U	0.018	0.007	0.017	0.008	0.009	0.015	0.01194	0.01188	0.01182	-
Mercury	mg/L	0.00003	0.00004	0.00002J	0.00002U	0.00001J	0.00001J	0.00002U	0.00001J	0.00002U	0.00002U	-
Molybdenum	mg/L	0.062	0.066	0.068	0.063	0.044	0.039	0.026	0.0169	0.01405	0.01223	-
Selenium	mg/L	0.005U	0.00281J	0.00113J	0.00255J	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Total Dissolved Solids	mg/L	602	691	644	696	562	448	420	374	344	398	344
Sulfate	mg/L	213	229	238	231	186	158	123	111	104	101	96
Thallium	mg/L	0.002U	0.002U	0.00102J	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	-
pH	SU	7.1	8.38	8.25	8.75	7.83	8.08	7.01	7.08	7.5	6.04	7.75

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Component was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1: Groundwater Data Summary
Flint Creek Plant - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Unit	AP-59											
		5/24/2016	7/18/2016	9/13/2016	9/14/2016	10/5/2016	11/7/2016	1/24/2017	3/7/2017	4/26/2017	5/16/2017	6/16/2017	8/29/2017
		Background											Detection
Antimony	mg/L	0.005U	0.005U	0.005U	-	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Arsenic	mg/L	0.005U	0.005U	0.005U	-	0.005U	0.005U	0.005U	0.005U	0.00158J	0.005U	0.00196J	-
Barium	mg/L	0.067	0.072	0.082	-	0.089	0.093	0.107	0.096	0.104	0.0939	0.08679	-
Beryllium	mg/L	0.001U	0.00003J	0.001U	-	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	-
Boron	mg/L	0.25	0.339	0.38	-	0.347	0.323	0.317	0.253	0.222	0.208	0.227	0.295
Cadmium	mg/L	0.001U	0.001U	0.001U	-	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	-
Calcium	mg/L	39.3	38	36.5	-	34.6	35.6	38.4	42	41.4	39.5	36.2	35.4
Chloride	mg/L	19	14	13	-	14	15	13	13	15	13	12	12
Chromium	mg/L	0.00058J	0.003	0.001U	-	0.0003J	0.001U	0.001U	0.00024J	0.001U	0.001U	0.001U	-
Cobalt	mg/L	0.00202J	0.00254J	0.00234J	-	0.00273J	0.00307J	0.00339J	0.00332J	0.00336J	0.003J	0.00283J	-
Combined Radium	pCi/L	0.711	-	0.725	1.288	0.725	1.109	0.3279	0.713	1.319	0.618	2.251	-
Fluoride	mg/L	0.7409J	0.6517J	0.583J	-	0.7085J	0.5832J	1U	1U	0.61J	0.5762J	1U	0.646J
Lead	mg/L	0.005U	0.00103J	0.005U	-	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Lithium	mg/L	0.00038J	0.00059J	0.00016J	-	0.011	0.00039J	0.00015J	0.006	0.00026J	0.00033J	0.00021J	-
Mercury	mg/L	0.00003	0.00003	0.00002U	-	0.00002U	0.00002U	0.00002U	0.00002U	0.00002U	0.00001J	0.00002U	-
Molybdenum	mg/L	0.007	0.009	0.009	-	0.008	0.008	0.008	0.007	0.00533	0.00566	0.0064	-
Selenium	mg/L	0.005U	0.005U	0.005U	-	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Total Dissolved Solids	mg/L	240	220	216	-	220	216	240	236	226	186	224	210
Sulfate	mg/L	37	27	25	-	26	32	40	43	40	38	31	21
Thallium	mg/L	0.00124J	0.00108J	0.00101J	-	0.00163J	0.002U	0.00121J	0.002U	0.002U	0.00109J	0.002U	-
pH	SU	7.39	6.75	7.29	-	7.13	7.15	7.03	7.91	7.16	7.05	6.73	7.1

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Component was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 1: Groundwater Data Summary
Flint Creek Plant - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Unit	AP-60								
		12/19/2016	1/24/2017	3/7/2017	3/29/2017	4/26/2017	5/16/2017	6/16/2017	6/28/2017	8/29/2017
		Background								Detection
Antimony	mg/L	0.005U	0.00135J	0.005U	0.005U	0.005U	0.001J	0.005U	0.005U	-
Arsenic	mg/L	0.009	0.00362J	0.009	0.007	0.01142	0.01139	0.00769	0.00932	-
Barium	mg/L	0.017	0.034	0.015	0.041	0.02403	0.01305	0.02723	0.01261	-
Beryllium	mg/L	0.00005J	0.001U	0.001U	0.00002J	0.00012J	0.00003J	0.001U	0.001U	-
Boron	mg/L	1.4	1.12	1.26	1.14	1.3	1.41	1.2	1.35	1.13
Cadmium	mg/L	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	-
Calcium	mg/L	16.7	33.2	25.9	43	25	16.3	29.2	17.7	32.3
Chloride	mg/L	14	13	12	13	15	14	15	16	13
Chromium	mg/L	0.002	0.0005J	0.0003J	0.003	0.00375	0.00091J	0.001U	0.00037J	-
Cobalt	mg/L	0.00192J	0.00087J	0.00046J	0.00222J	0.00301J	0.00066J	0.00042J	0.00037J	-
Combined Radium	pCi/L	1.176	0.771	1.121	1.158	0.429	2.082	3.697	7.167	-
Fluoride	mg/L	0.0946J	1U	1U	1U	0.58J	0.558J	1U	0.5516J	0.452J
Lead	mg/L	0.00074J	0.005U	0.005U	0.00185J	0.00291J	0.005U	0.005U	0.005U	-
Lithium	mg/L	0.001	0.00064J	0.003	0.002	0.00236	0.00048J	0.00063J	0.00031J	-
Mercury	mg/L	0.00002U	0.00002U	0.00002U	0.00001J	0.00001J	0.00001J	0.00002U	0.00001J	-
Molybdenum	mg/L	0.06	0.055	0.057	0.053	0.05638	0.06209	0.05418	0.06376	-
Selenium	mg/L	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	-
Total Dissolved Solids	mg/L	369	356	340	368	340	302	368	368	356
Sulfate	mg/L	165	152	145	140	160	167	152	166	146
Thallium	mg/L	0.002U	0.002U	0.002U	0.002U	0.00098J	0.002U	0.002U	0.002U	-
pH	SU	8.86	7.84	8.11	8.36	7.62	8.56	7.79	7.5	7.65

Notes:
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Component was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Component was detected in concentrations below the reporting limit
-: Not sampled

Table 2: Outlier Analysis Summary
Flint Creek - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Location	Well ID	Sample Date	Parameter	Reported Value	Units	Conclusions
Background	AP-53	9/13/2016	Arsenic	0.025	mg/L	This value was removed from the dataset. The sample had high turbidity during collection, suggesting possible sampling error.
Background	AP-53	5/19/2017	Arsenic	0.00153 J	mg/L	This value was estimated (J-flagged) and was not removed from the dataset.
Background	AP-54	11/8/2016	Arsenic	0.0018333	mg/L	This value was identified as a low outlier and was only slightly above the reporting limit. The value was retained in the dataset.
Background	AP-54	6/16/2017	Arsenic	0.00165	mg/L	This value was identified as a low outlier and was only slightly above the reporting limit. The value was retained in the dataset.
Background	AP-53	9/13/2016	Lead	0.03	mg/L	This value was removed from the dataset. The sample had high turbidity during collection, suggesting possible sampling error.
Downgradient	AP-59	7/18/2016	Mercury	0.000035	mg/L	Mercury was not detected during many of the sampling events at this location. This value likely represents actual concentrations in the aquifer and was not removed from the dataset.
Downgradient	AP-59	5/19/2017	Mercury	0.000006 J	mg/L	This value was estimated (J-flagged) and was not removed from the dataset.

Table 3: Background Level Summary
Flint Creek Plant - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Unit	Description	AP-58	AP-59	AP-60
Boron	mg/L	Interwell Background Value (UPL)	0.284		
Calcium	mg/L	Interwell Background Value (UPL)	11.8		
Chloride	mg/L	Intrawell Background Value (UPL)	29.26	18.51	17.22
Fluoride	mg/L	Interwell Background Value (UPL)	1		
pH	SU	Interwell Background Value (UPL)	5.879		
	SU	Interwell Background Value (LPL)	4.483		
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	199.8		
Sulfate	mg/L	Interwell Background Value (UPL)	78		

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit

ATTACHMENT A

Evaluation of Detection Monitoring Data

Geosyntec consultants

150 E.Wilson Bridge Road, Suite 232
Columbus, Ohio 43085
PH 614.468.0415
FAX 614.468.0416
www.geosyntec.com

Memorandum

Date:	February 26, 2018
To:	David Miller (AEP)
Copies to:	Terence Wehling (AEP)
From:	Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Flint Creek Plant's Primary Bottom Ash Pond (PBAP)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), detection monitoring events were completed on August 29, 2017 and December 21, 2017 at the Primary Bottom Ash Pond (PBAP), an existing CCR unit at the Flint Creek Power Plant located in Gentry, Arkansas.

Ten background monitoring events were conducted at the Flint Creek PBAP prior to these detection monitoring events, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 3, 2018.

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

Detection monitoring results and the relevant background values are summarized in Table 1-B.

- Boron concentrations exceeded the interwell UPL of 0.284 mg/L in both the initial (1.13 mg/L) and second (0.857 mg/L) samples collected at AP-60. Therefore, an SSI over background is concluded for boron at AP-60.

- Calcium concentrations exceeded the interwell UPL of 11.8 mg/L in both the initial (75.5 mg/L) and second (73.9 mg/L) samples collected at AP-58, in both the initial (35.4 mg/L) and second (46.8 mg/L) samples collected at AP-59, and in both the initial (32.3 mg/L) and second (46.2 mg/L) samples collected at AP-60. Therefore, an SSI over background is concluded for calcium at AP-58, AP-59, and AP-60.

- pH exceeded the interwell UPL of 5.88 SU in both the initial (7.75 SU) and second (7.36 SU) samples collected at AP-58, in both the initial (7.1 SU) and second (6.94 SU) samples collected at AP-59, and in both the initial (7.65 SU) and second (7.16 SU) samples collected at AP-60. Therefore, an SSI over background is concluded for pH at AP-58, AP-59, and AP-60.

- Total dissolved solids (TDS) concentrations exceeded the interwell UPL of 199.8 mg/L in both the initial (344 mg/L) and second (304 mg/L) samples collected at AP-58, in both the initial (210 mg/L) and second (228 mg/L) samples collected at AP-59, and in both the initial (356 mg/L) and second (332 mg/L) samples collected at AP-60. Therefore, an SSI over background is concluded for TDS at AP-58, AP-59, and AP-60.

- Sulfate concentrations exceeded the interwell UPL of 78 mg/L in both the initial (96 mg/L) and second (80 mg/L) samples collected at AP-58, and in both the initial (146 mg/L) and second (128 mg/L) samples collected at AP-60. Therefore, an SSI over background is concluded for sulfate at AP-58 and AP-60.

As a result, the Flint Creek PBAP CCR unit will conduct an alternate source demonstration. No other exceedances of UPLs were observed during these detection monitoring events.

The following modifications to Geosyntec's *Statistical Analysis Summary* report were incorporated after the certification date of January 3, 2018:

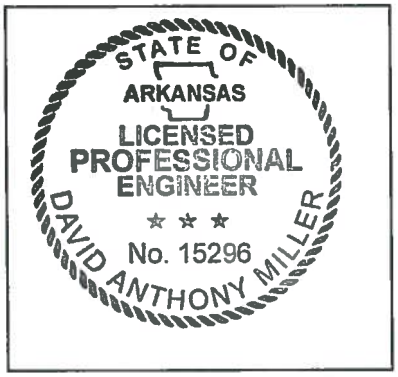
- Table 1 ("Groundwater Data Summary") was revised to reflect appropriate significant digits for estimated (J-flagged) values; and,

- Figure E ("Analysis of Variance") of Attachment A ("Statistical Analysis Output") was revised to a correct a formatting error.

* * * * *

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 3, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Flint Creek PBAP 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

15296	ARKANSAS	02.27.18
License Number	Licensing State	Date

Table 1-B: Detection Monitoring Data Evaluation
Flint Creek Plant - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Units	Description	AP-58		AP-59		AP-60	
			8/29/2017	12/21/2017	8/29/2017	12/21/2017	8/29/2017	12/21/2017
Boron	mg/L	Interwell Background Value (UPL)	0.284					
	mg/L	Detection Monitoring Result	**0.333**	0.268	**0.295**	0.279	**1.13**	**0.857**
Calcium	mg/L	Interwell Background Value (UPL)	11.8					
	mg/L	Detection Monitoring Result	**75.5**	**73.9**	**35.4**	**46.8**	**32.3**	**46.2**
Chloride	mg/L	Intrawell Background Value (UPL)	29.26		18.51		17.22	
	mg/L	Detection Monitoring Result	12	-	12	-	13	-
Fluoride	mg/L	Interwell Background Value (UPL)	1					
	mg/L	Detection Monitoring Result	0.083	-	0.6463	-	0.4518	-
pH	SU	Interwell Background Value (UPL)	5.88					
	SU	Interwell Background Value (LPL)	4.48					
	SU	Detection Monitoring Result	**7.75**	**7.36**	**7.1**	**6.94**	**7.65**	**7.16**
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	200					
	mg/L	Detection Monitoring Result	**344**	**304**	**210**	**228**	**356**	**332**
Sulfate	mg/L	Interwell Background Value (UPL)	78					
	mg/L	Detection Monitoring Result	**96**	**80**	21	-	**146**	**128**

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

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS CONSULTING

November 7, 2017

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

Dear Mr. Sass,

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

Sampling began at Flint Creek Bottom Ash Pond for the CCR program in 2016, and 8 background samples have been collected at each of the groundwater monitoring wells. The monitoring well network, as provided by Geosyntec Consultants, consists of the following: upgradient wells AP-51, AP-53, and AP-54; and downgradient wells AP-58, AP-59, and AP-60.

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis was reviewed by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting.

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

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

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

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

Summary of Statistical Method:

1) Intrawell prediction limits, combined with a 1-of-2 resample plan for chloride;
2) Interwell prediction limits combined with a 1-of-2 resample plan for boron, calcium, fluoride, pH, 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 nondetects, a nonparametric test is utilized. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

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

Background Screening

Outlier Evaluation

Time series plots are used to identify suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective, in proposed background data. Suspected outliers at all wells for Appendix III and Appendix IV parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits (Figure C).

Tukey's outlier test noted a few outliers as may be seen on the Outlier Summary Table and accompanying graphs. Any values flagged as outliers are plotted in a lighter font on the time series graph. For arsenic in upgradient wells, the highest value of 0.024 mg/L was flagged as an outlier. The other low level detections identified by the test as possible outliers were not flagged because they were just slightly above the reporting limit. No values were flagged as outliers for mercury in upgradient wells as all values are very low level detections. A substitution of the most recent reporting limit was applied when varying detection limits existed in data.

No true seasonal patterns were observed on the time series plots for any of the detected data; therefore, no deseasonalizing adjustments were made to the data. When seasonal patterns are observed, data may be

deseasonalized so that the resulting limits will correctly account for the seasonality as a predictable pattern rather than random variation or a release.

While trends may be visual, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends (Figure D). In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed several statistically significant decreasing trends, as may be seen on the Trend Test Summary Table that accompanies the trend tests. A statistically significant increasing trend was noted for calcium in well AP-58. Because interwell methods are recommended for this parameter as discussed below, no adjustments were made at this time.

Appendix III – Determination of Spatial Variation

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

The ANOVA identified no variation for fluoride, making this constituent suitable for interwell analyses. Variation was identified in groundwater upgradient of the site for all other Appendix III parameters. Therefore, these data were further evaluated as described for the appropriateness of intrawell testing to accommodate the groundwater quality. A summary table of the ANOVA results is included with the reports.

Appendix III - Statistical Limits

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

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

In cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to justify an intrawell approach. Such an assessment is beyond the scope of services provided by Groundwater Stats Consulting. When there is not an obvious explanation for observed concentration differences in downgradient wells relative to reported concentrations in upgradient wells, interwell prediction limits will initially be selected for the statistical method until further evidence shows that concentrations are due to natural variation rather than a result of the facility.

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

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

Confidence intervals for the above parameters were found to be within their respective background limit for chloride, but above background limits for all other parameters tested. Therefore, intrawell methods are recommended for chloride, and interwell methods are recommended initially for all other Appendix III parameters. As mentioned earlier, if a demonstration supports natural variation in groundwater, intrawell methods will be considered for all parameters.

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

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits will be necessary to accommodate these types of changes In the interwell case, newer data will be included in background when a minimum of 2 new samples are available. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data

points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

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

Appendix IV – Assessment Monitoring Program

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

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

Recommendations

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

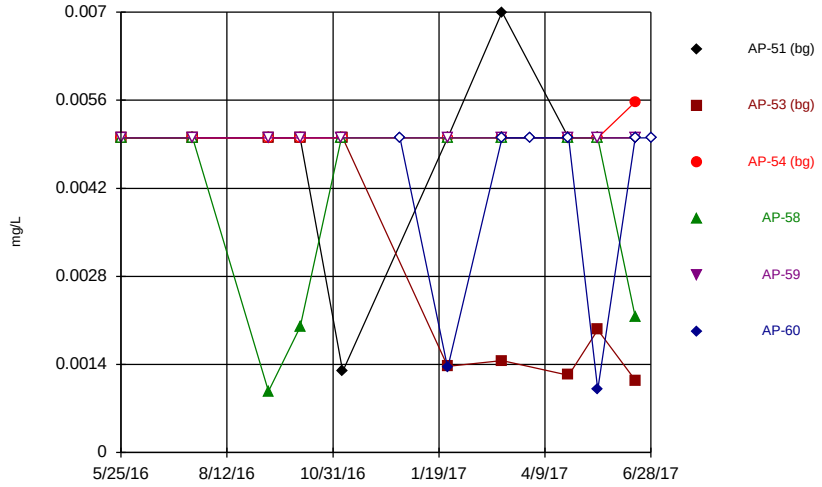
Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Flint Creek Bottom Ash Pond. If you have any questions or comments, please feel free to contact me.

For Groundwater Stats Consulting,

Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



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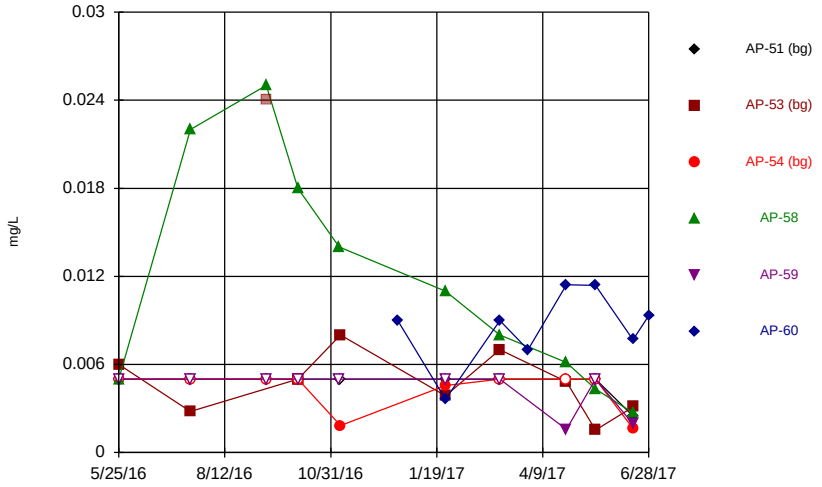
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



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Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

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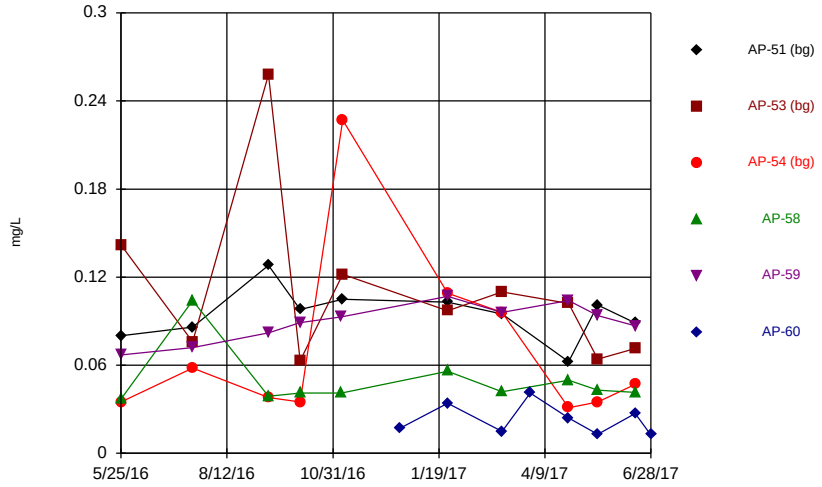

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Hollow symbols indicate censored values.

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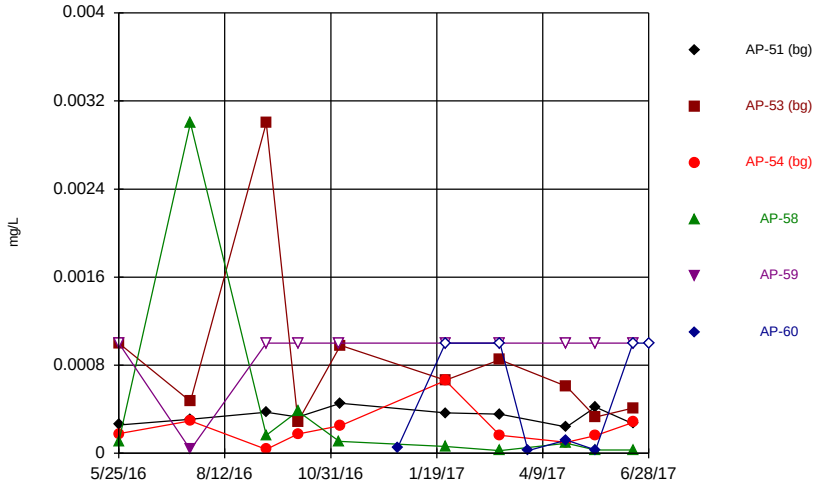

Constituent: Beryllium, total Analysis Run 11/5/2017 6:45 PM View: Time Series
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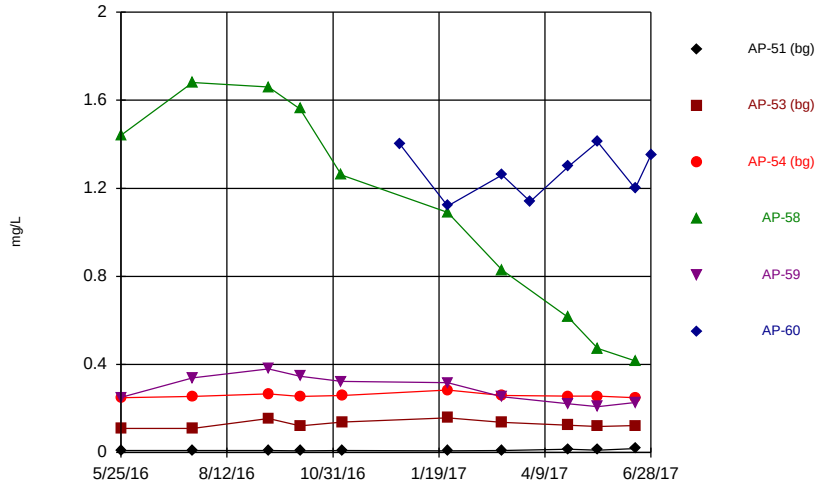
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Time Series



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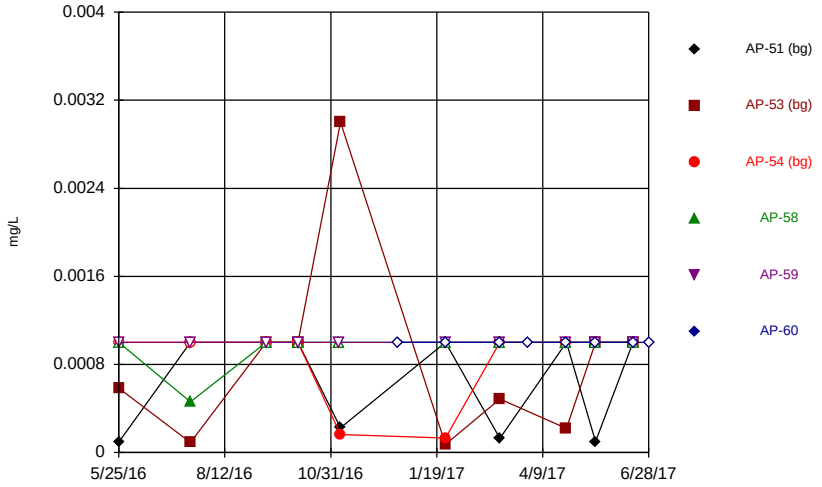
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



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Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

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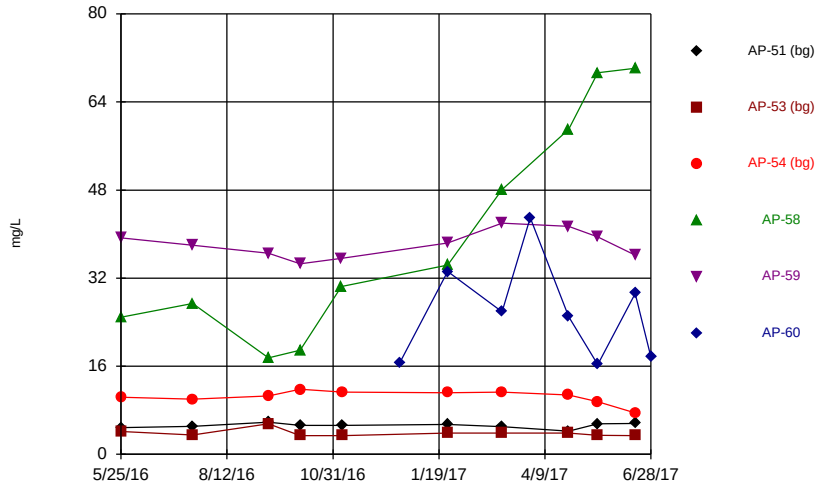

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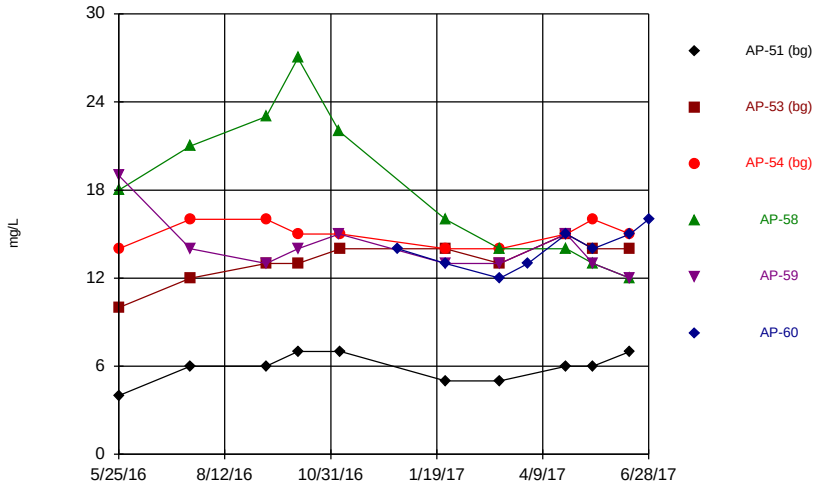
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

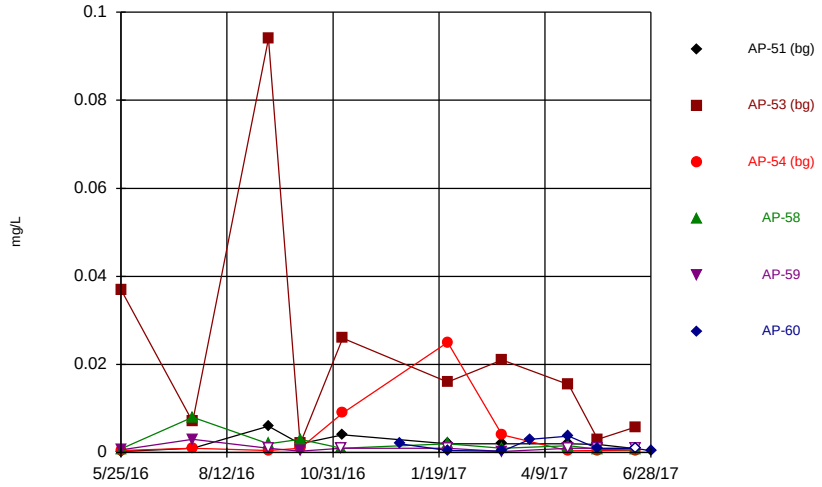
Time Series



Constituent: Chloride, total Analysis Run 11/5/2017 6:45 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



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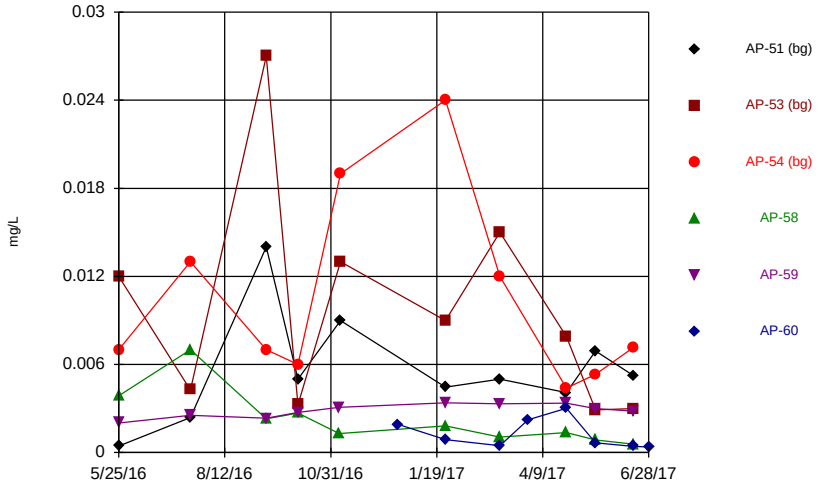
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Time Series



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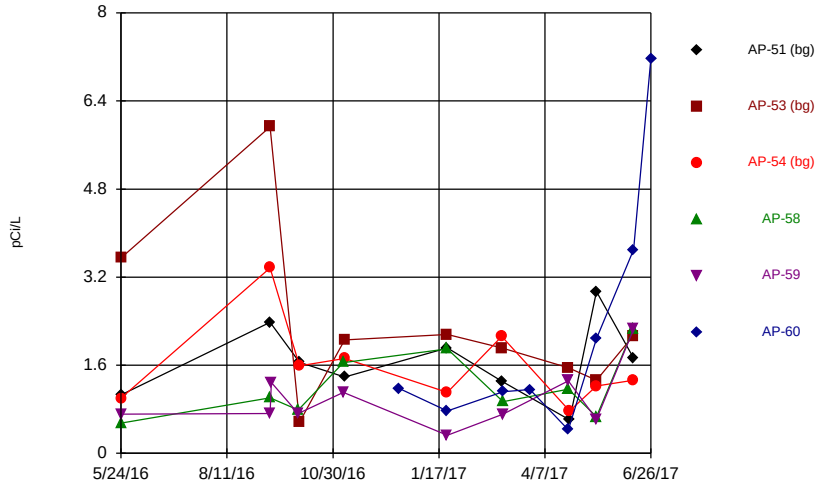
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

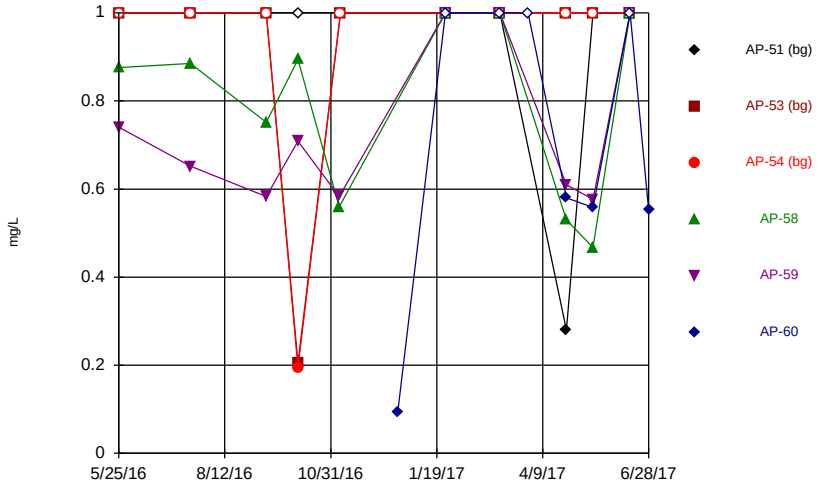
Time Series



Constituent: Combined Radium 226 + 228 Analysis Run 11/5/2017 6:45 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



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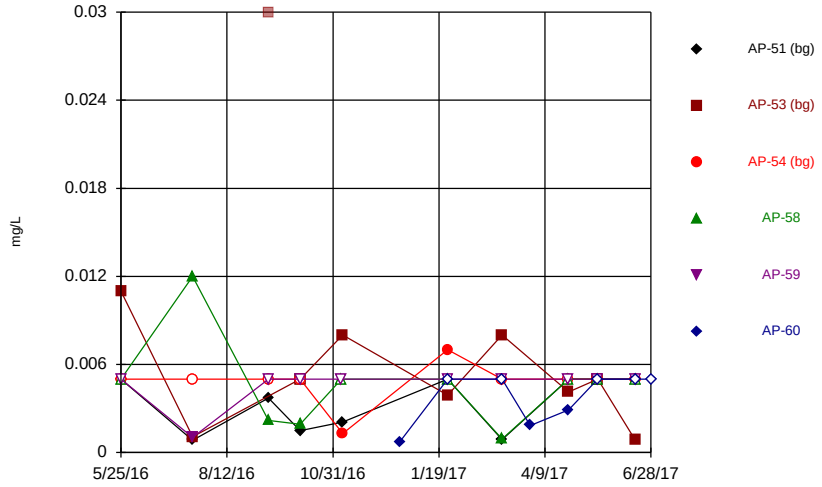
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

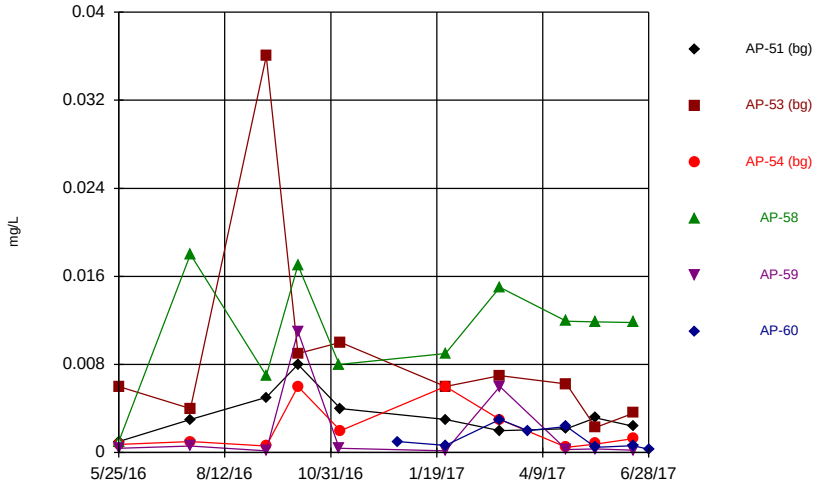
Time Series



Constituent: Lead, total Analysis Run 11/5/2017 6:45 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

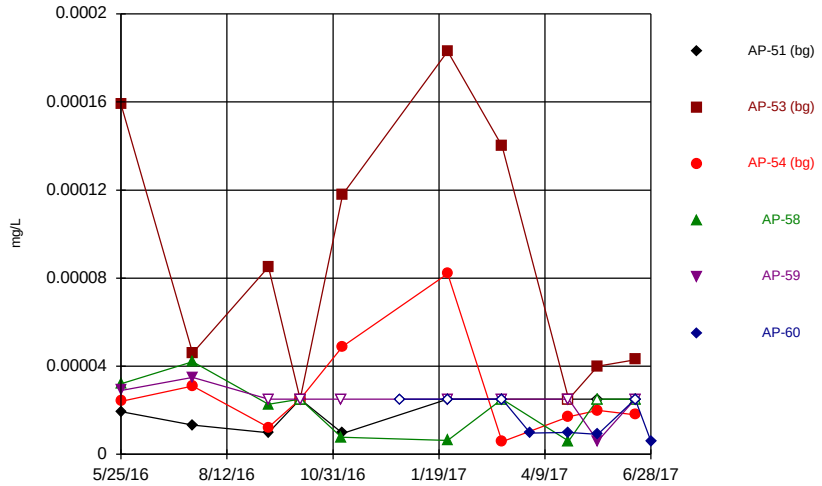
Time Series



Constituent: Lithium, total Analysis Run 11/5/2017 6:45 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

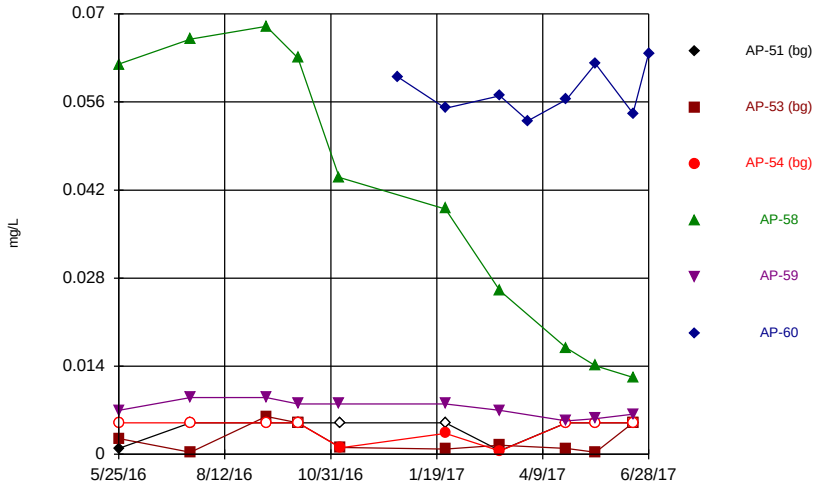
Time Series



Constituent: Mercury, total Analysis Run 11/5/2017 6:45 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

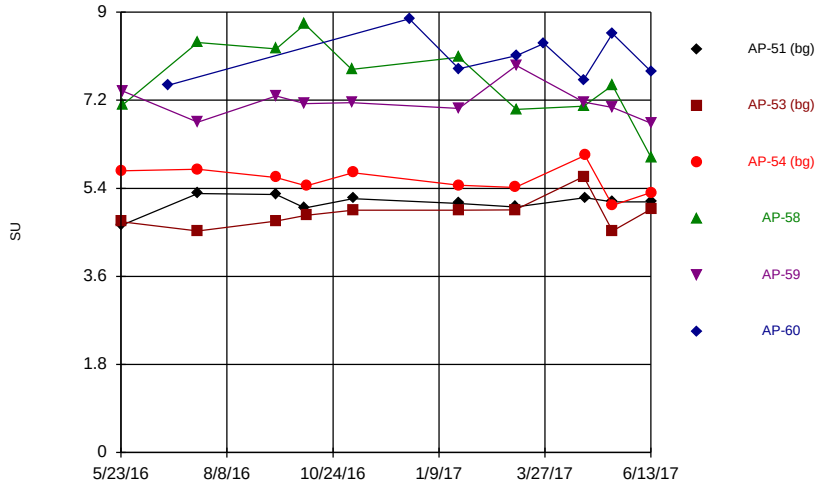
Time Series



Constituent: Molybdenum, total Analysis Run 11/5/2017 6:45 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

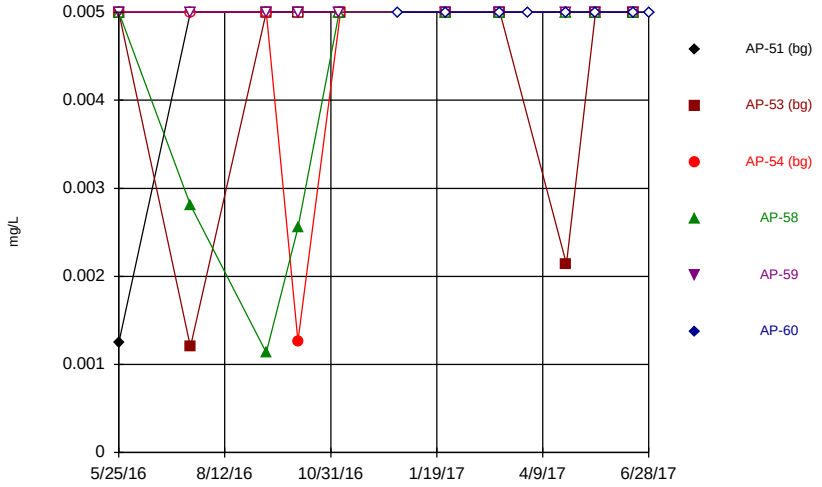
Time Series



Constituent: pH, field Analysis Run 11/5/2017 6:45 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

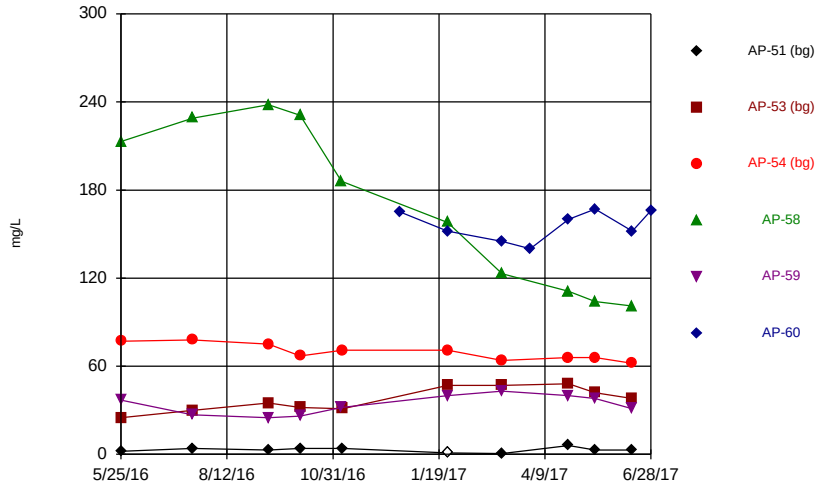
Time Series



Constituent: Selenium, total Analysis Run 11/5/2017 6:45 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

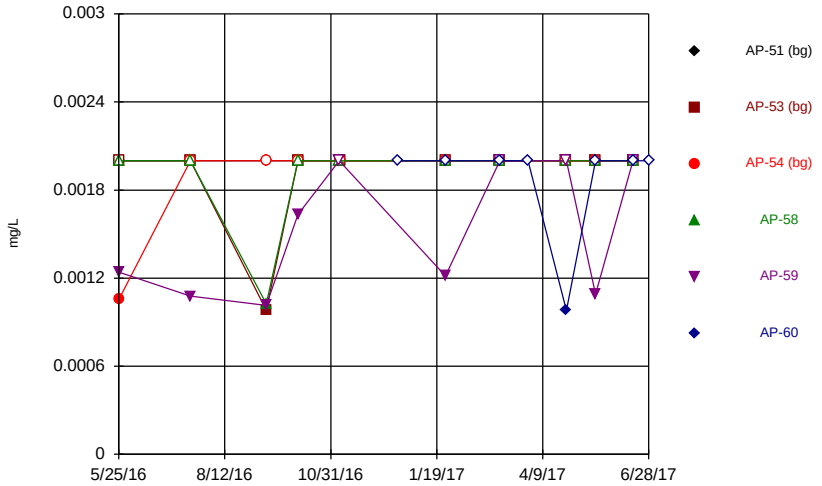
Time Series



Constituent: Sulfate, total Analysis Run 11/5/2017 6:45 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

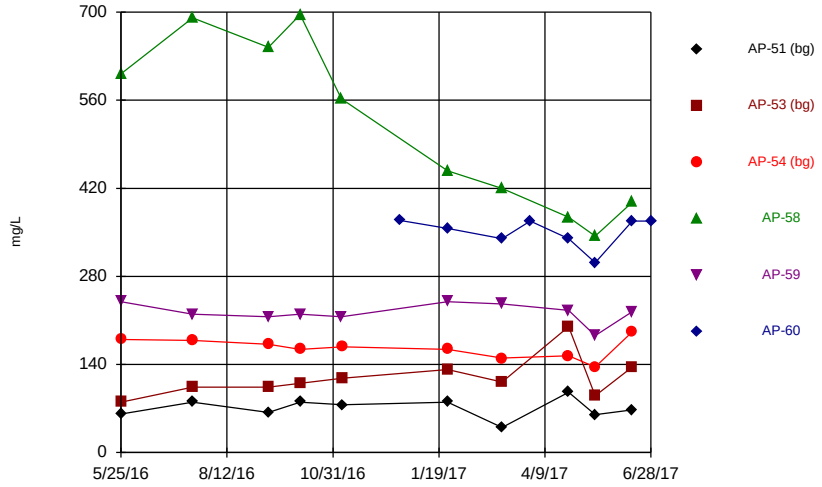
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Thallium, total Analysis Run 11/5/2017 6:45 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Time Series

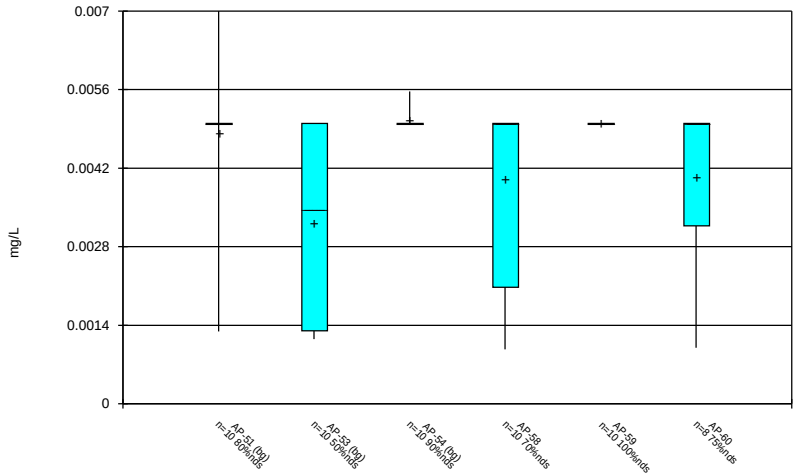


Constituent: Total Dissolved Solids [TDS] Analysis Run 11/5/2017 6:45 PM View: Time Series

Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

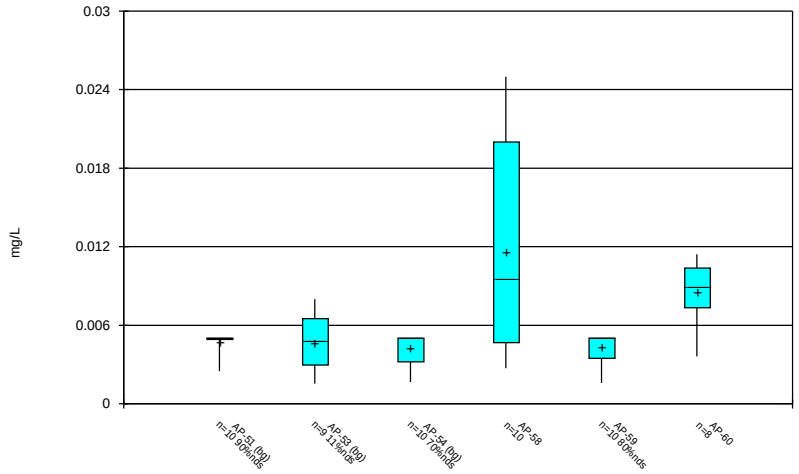
Box & Whiskers Plot



Constituent: Antimony, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

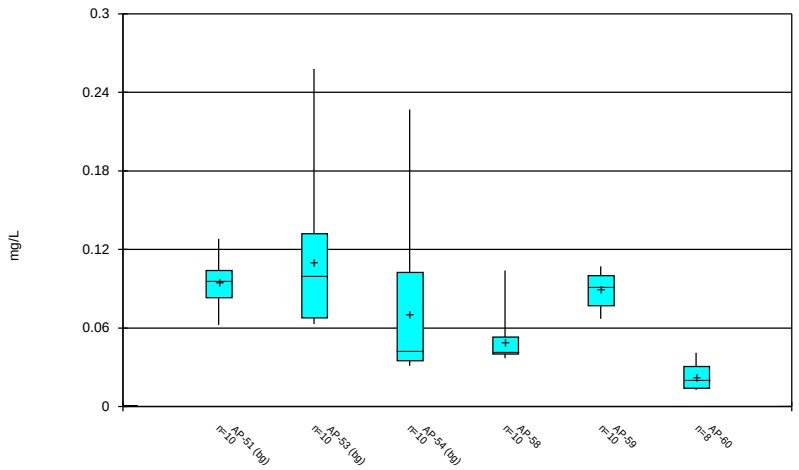
Box & Whiskers Plot



Constituent: Arsenic, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

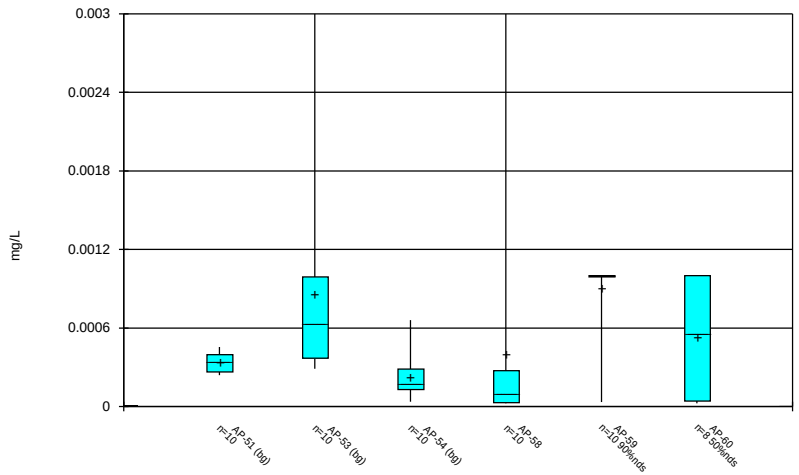
Box & Whiskers Plot



Constituent: Barium, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

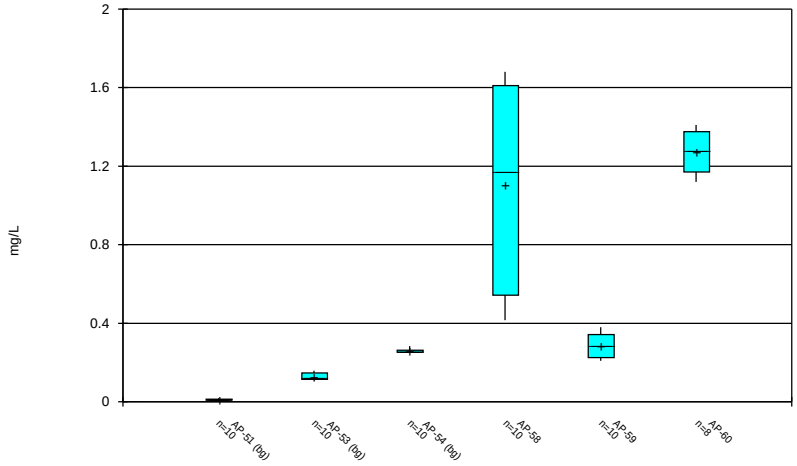
Box & Whiskers Plot



Constituent: Beryllium, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

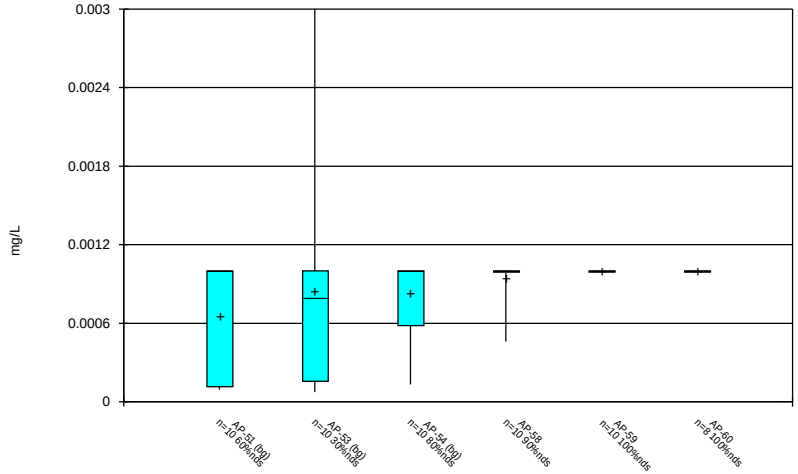
Box & Whiskers Plot



Constituent: Boron, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

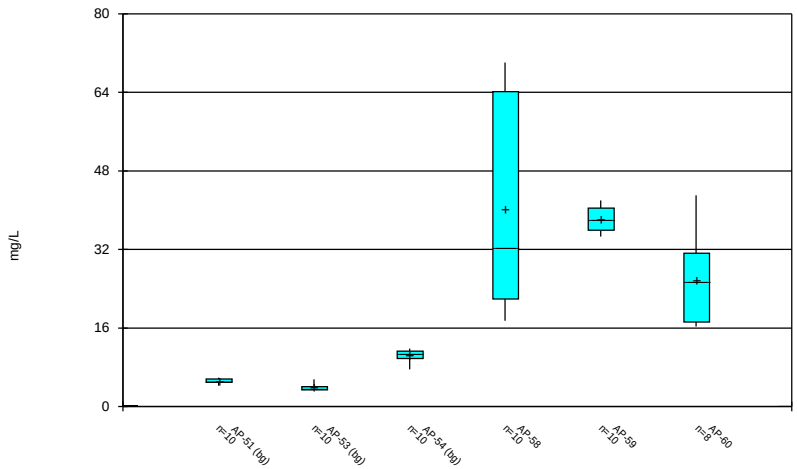
Box & Whiskers Plot



Constituent: Cadmium, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

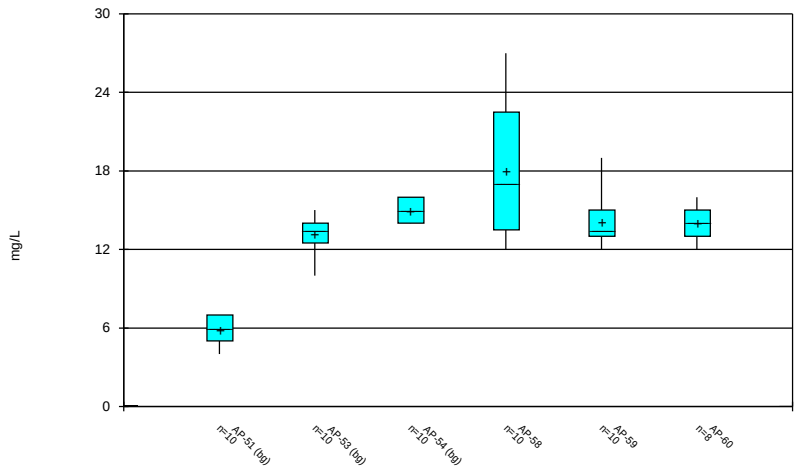
Box & Whiskers Plot



Constituent: Calcium, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

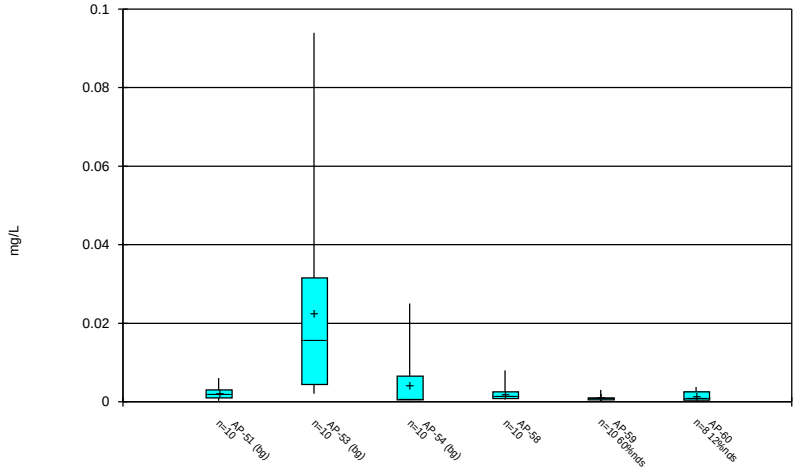
Box & Whiskers Plot



Constituent: Chloride, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

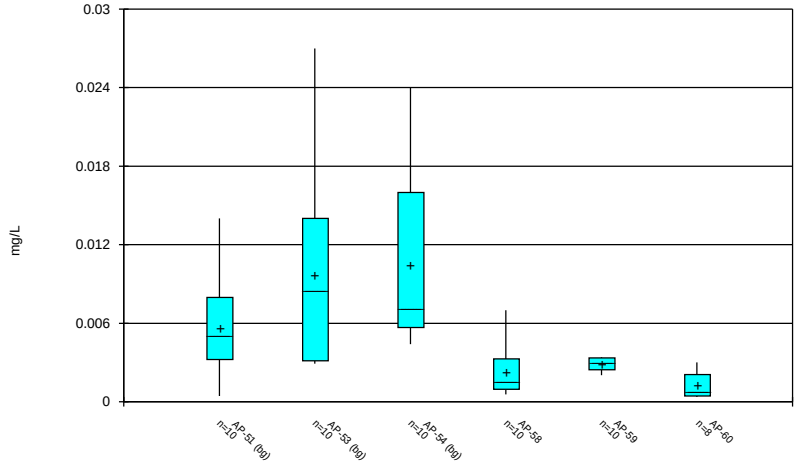
Box & Whiskers Plot



Constituent: Chromium, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

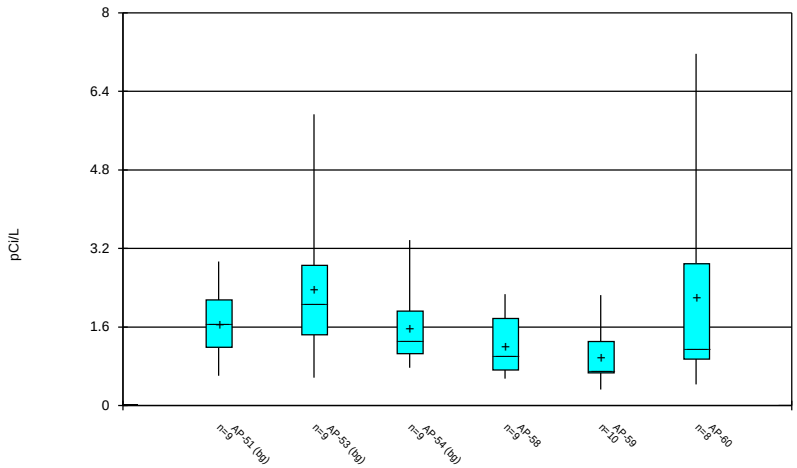
Box & Whiskers Plot



Constituent: Cobalt, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

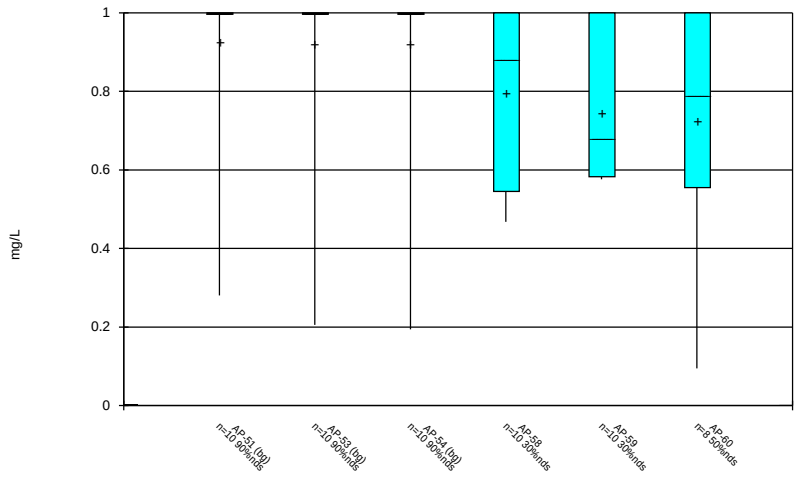
Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

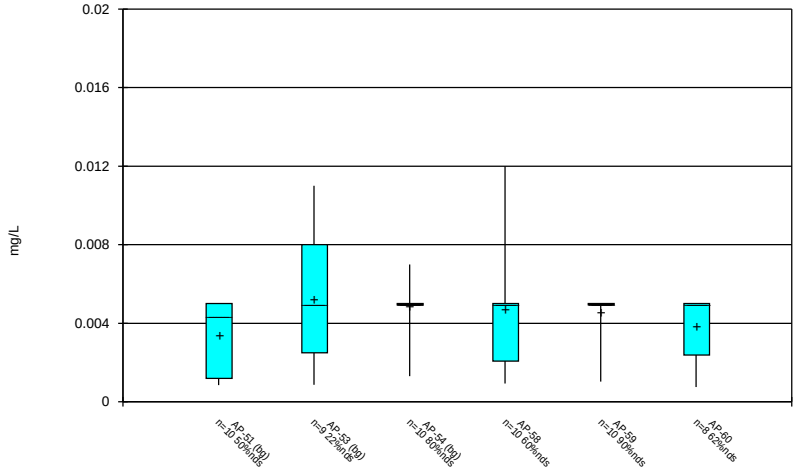
Box & Whiskers Plot



Constituent: Fluoride, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

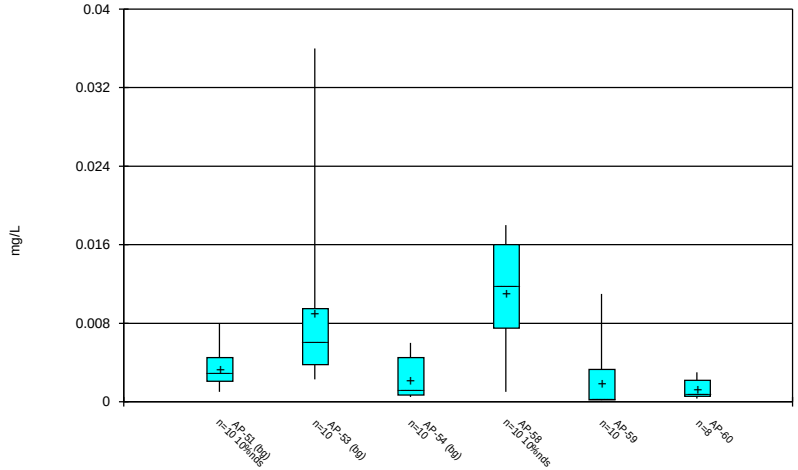
Box & Whiskers Plot



Constituent: Lead, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

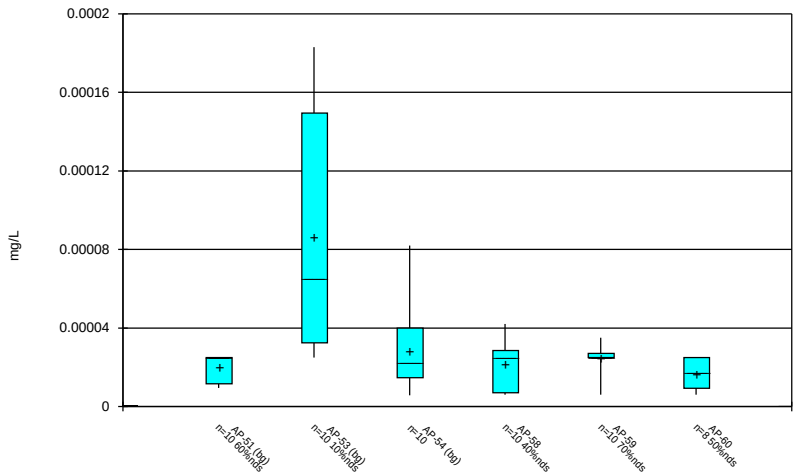
Box & Whiskers Plot



Constituent: Lithium, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

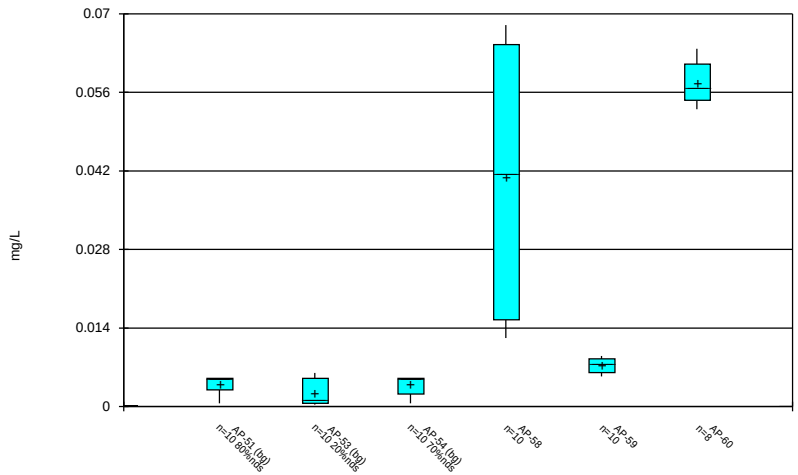
Box & Whiskers Plot



Constituent: Mercury, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

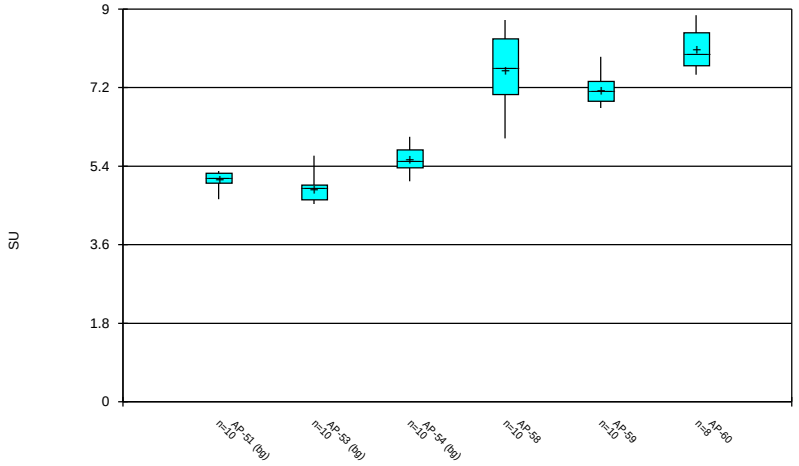
Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Box & Whiskers Plot



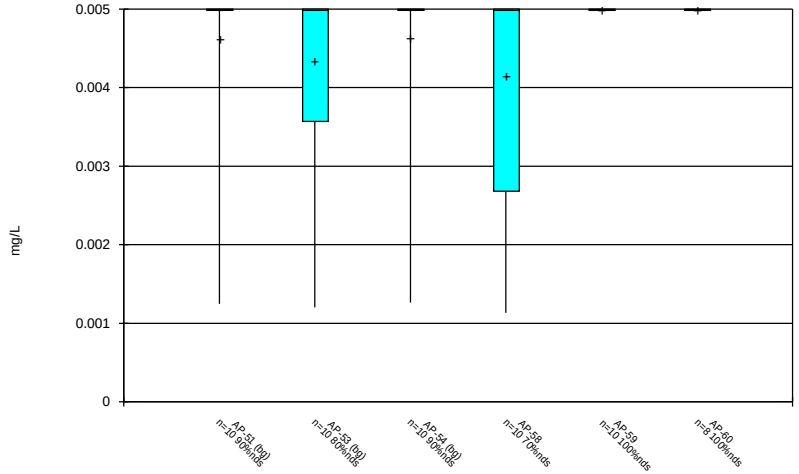
Constituent: Molybdenum, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Box & Whiskers Plot



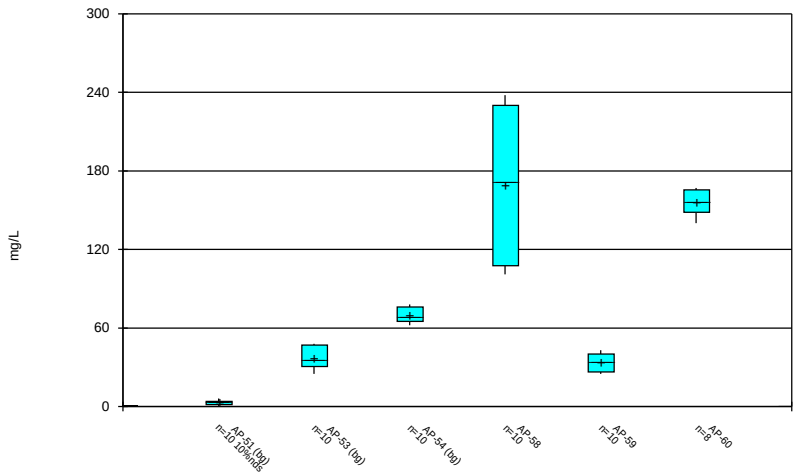
Constituent: pH, field Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Box & Whiskers Plot



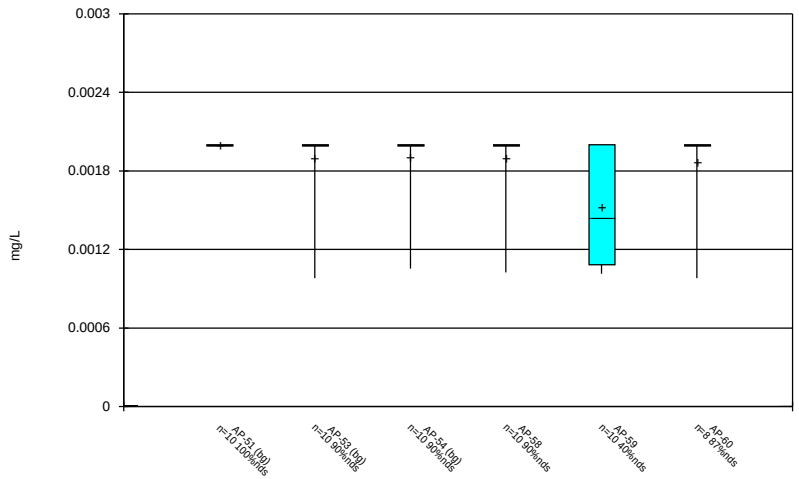
Constituent: Selenium, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Box & Whiskers Plot



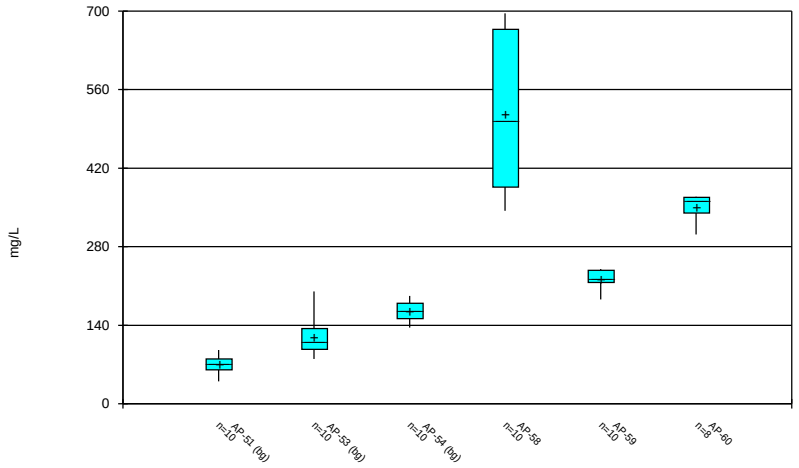
Constituent: Sulfate, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Box & Whiskers Plot



Constituent: Thallium, total Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Box & Whiskers Plot



Constituent: Total Dissolved Solids [TDS] Analysis Run 11/5/2017 6:46 PM View: Time Series
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Outlier Screening

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 11/5/2017, 6:39 PM

	AP-53 Arsenic, total (mg/L)	AP-53 Lead, total (mg/L)
9/13/2016	0.024 (o)	0.03 (o)

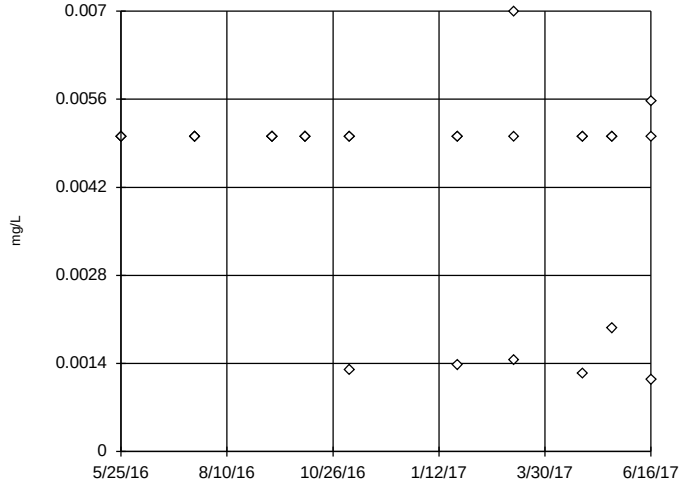
Outlier Analysis - All Upgradient Wells

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 11/5/2017, 6:25 PM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP (nrm)	30	0.004367	0.001555	unknown	ShapiroWilk
Arsenic, total (mg/L)	**AP-51,AP-53,AP-54**	**Yes**	**0.024,0.00153,0.001833,0.00165**	**NP (nrm)**	**30**	**0.005222**	**0.003819**	**unknown**	**ShapiroWilk**
Barium, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP	30	0.09212	0.05071	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP	30	0.000476	0.0005336	ln(x)	ShapiroWilk
Boron, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP (nrm)	30	0.1331	0.1036	unknown	ShapiroWilk
Cadmium, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP (nrm)	30	0.0007767	0.0005776	unknown	ShapiroWilk
Calcium, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP (nrm)	30	6.5	3.01	unknown	ShapiroWilk
Chloride, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP (nrm)	30	11.37	4.14	unknown	ShapiroWilk
Chromium, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP	30	0.009717	0.01845	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP	30	0.008625	0.006305	x^(1/3)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AP-51,AP-53,AP-54	No	n/a	NP	27	1.867	1.101	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP (nrm)	30	0.9226	0.2364	unknown	ShapiroWilk
Lead, total (mg/L)	**AP-51,AP-53,AP-54**	**Yes**	**0.03**	**NP (nrm)**	**30**	**0.00531**	**0.005203**	**unknown**	**ShapiroWilk**
Lithium, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP	30	0.004855	0.006436	ln(x)	ShapiroWilk
Mercury, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP	30	0.000045	0.00004645	ln(x)	ShapiroWilk
Molybdenum, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP (nrm)	30	0.003498	0.002026	unknown	ShapiroWilk
pH, field (SU)	AP-51,AP-53,AP-54	No	n/a	NP	30	5.181	0.3892	ln(x)	ShapiroWilk
Selenium, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP (nrm)	30	0.004528	0.001232	unknown	ShapiroWilk
Sulfate, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP (nrm)	30	36.75	28.24	unknown	ShapiroWilk
Thallium, total (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP (nrm)	30	0.001934	0.0002495	unknown	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	AP-51,AP-53,AP-54	No	n/a	NP	30	118.3	45.44	x^(1/3)	ShapiroWilk

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square transformed to achieve best W statistic (graph shown in original units).

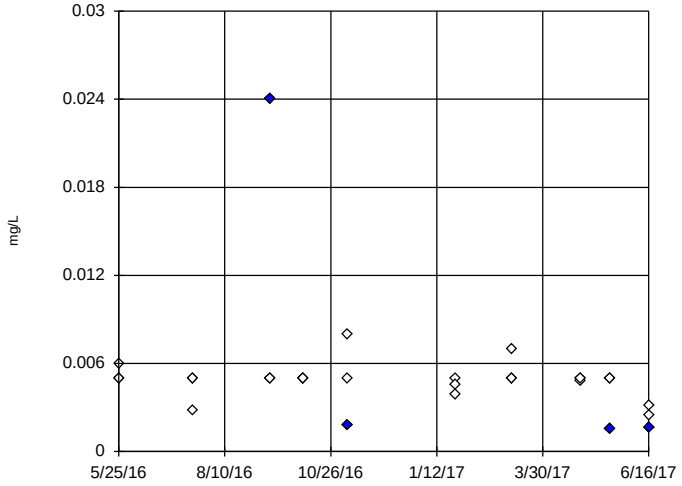
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony, total Analysis Run 11/5/2017 6:23 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

Outliers are drawn as solid.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

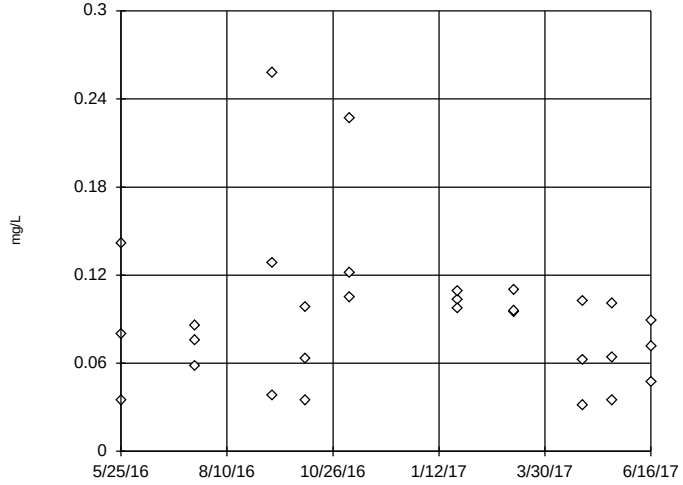
High cutoff = 0.008416, low cutoff = 0.002497, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 11/5/2017 6:23 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

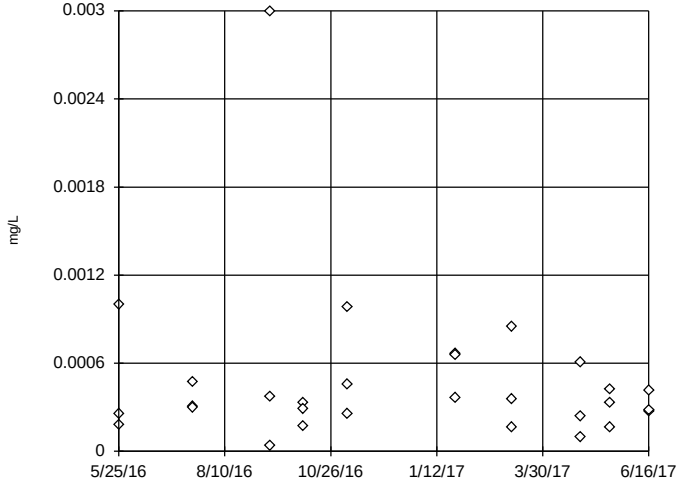
High cutoff = 0.6012, low cutoff = 0.01071, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found.
Tukey's method selected by user.

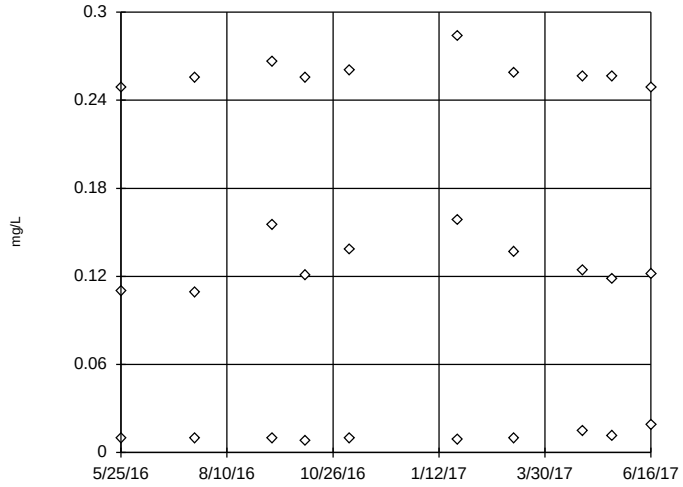
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.005644, low cutoff = 0.00002336, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

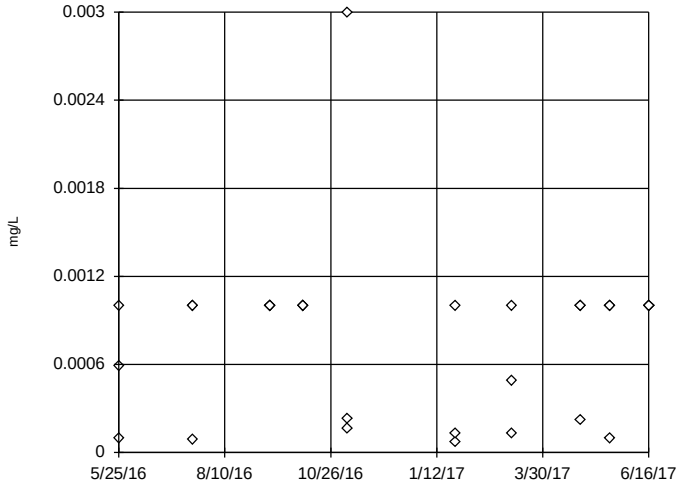
High cutoff = 0.988, low cutoff = -0.7223, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

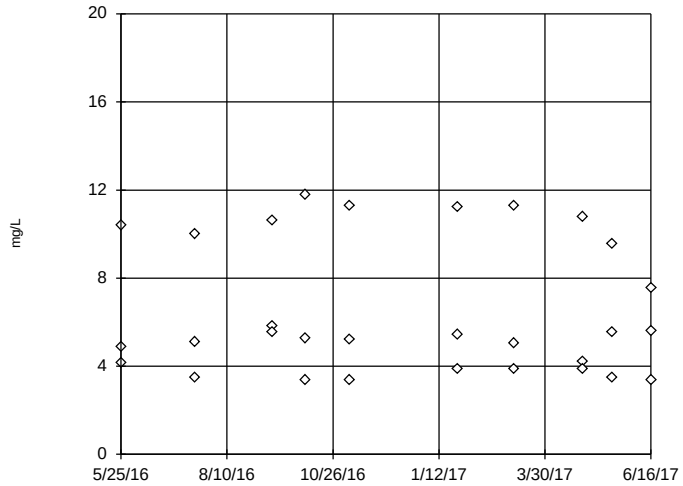
High cutoff = 0.01175, low cutoff = -0.0003398, based on IQR multiplier of 3.

Constituent: Cadmium, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

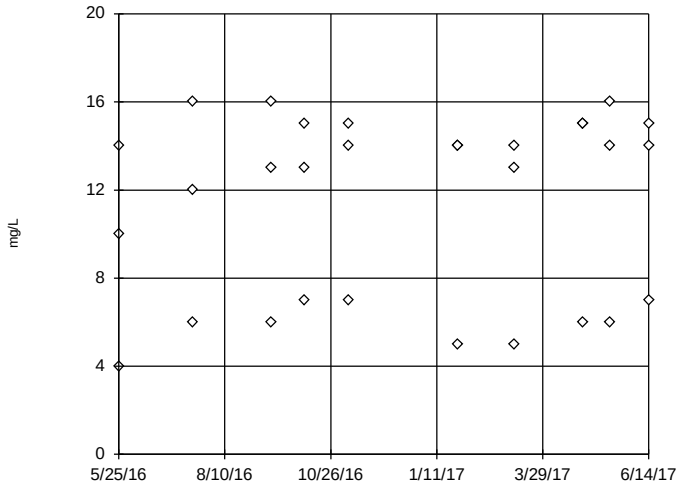
High cutoff = 185.2, low cutoff = 0.2137, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

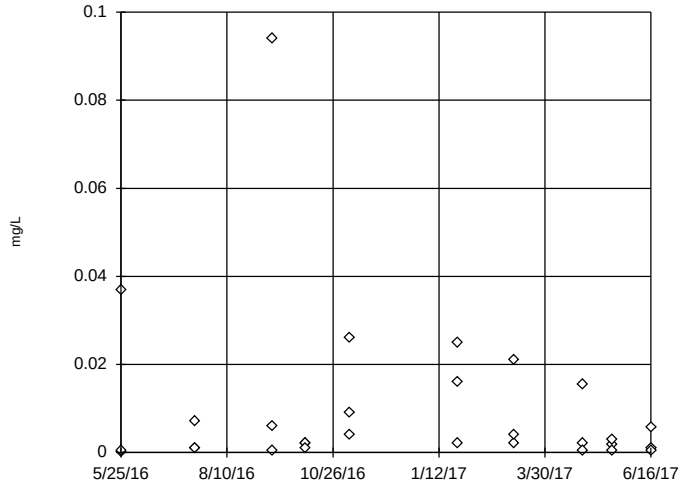
Data were x^5 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 19.74, low cutoff = -18.6, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

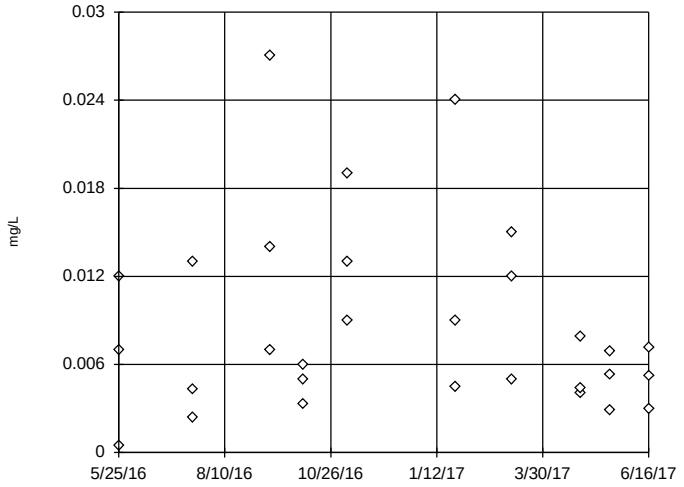
High cutoff = 22.91, low cutoff = 4.8e-7, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

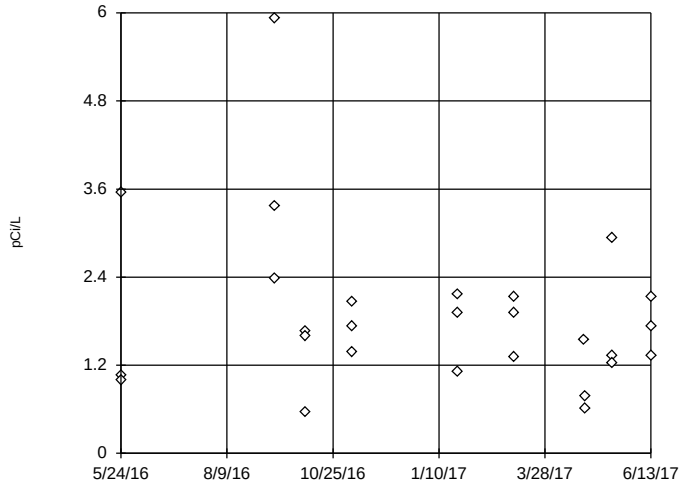
High cutoff = 0.08469, low cutoff = -0.00008578, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 27

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

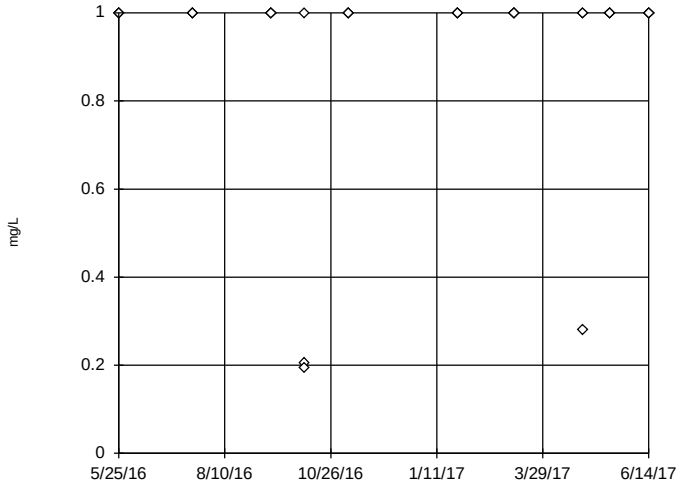
High cutoff = 11.47, low cutoff = 0.2279, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

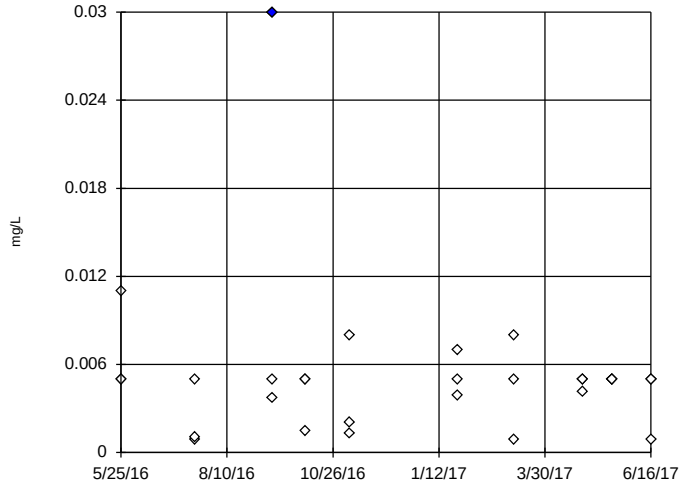
Data were natural log transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Fluoride, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

Outlier is drawn as solid. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

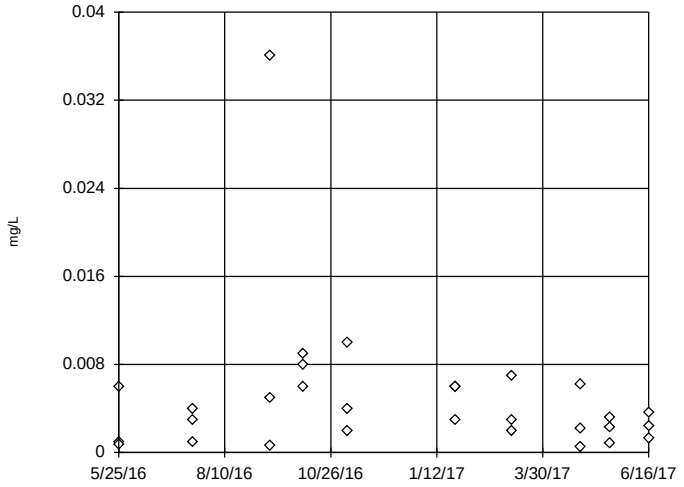
High cutoff = 0.02905, low cutoff = 0.0004787, based on IQR multiplier of 3.

Constituent: Lead, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

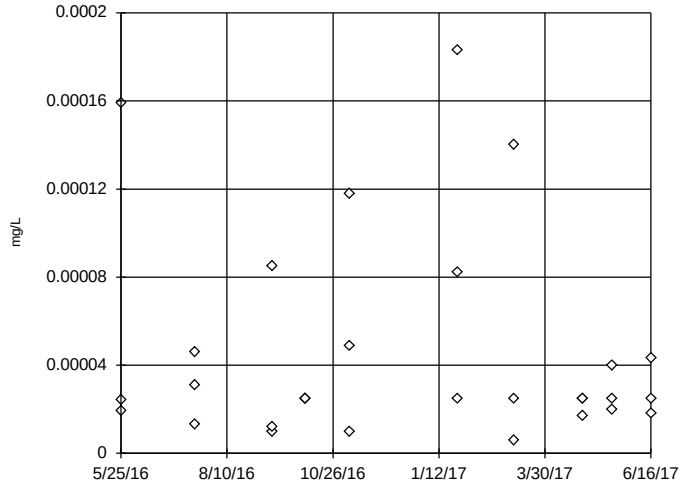
High cutoff = 0.3202, low cutoff = 0.00002987, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

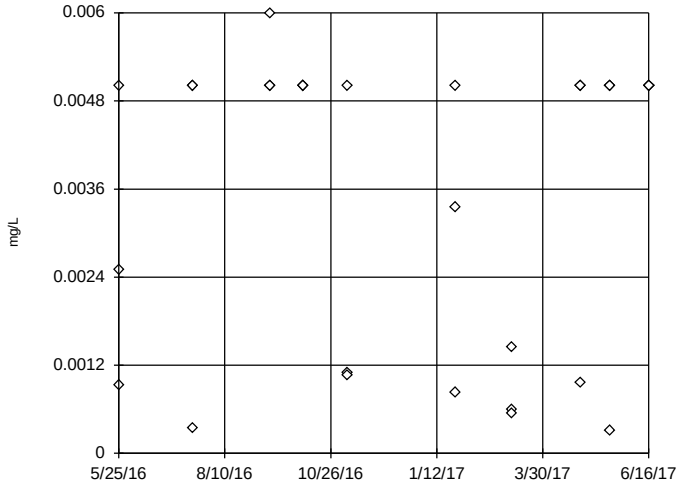
High cutoff = 0.0007798, low cutoff = 0.000001137, based on IQR multiplier of 3.

Constituent: Mercury, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

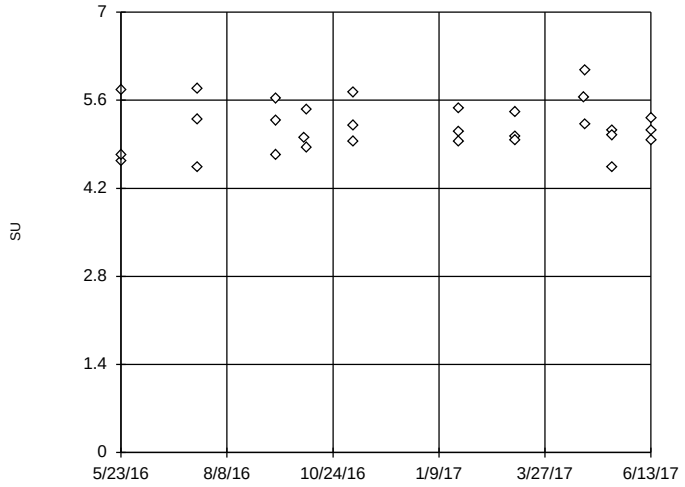
Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.0562, low cutoff = -0.001395, based on IQR multiplier of 3.

Constituent: Molybdenum, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found. Tukey's method selected by user.

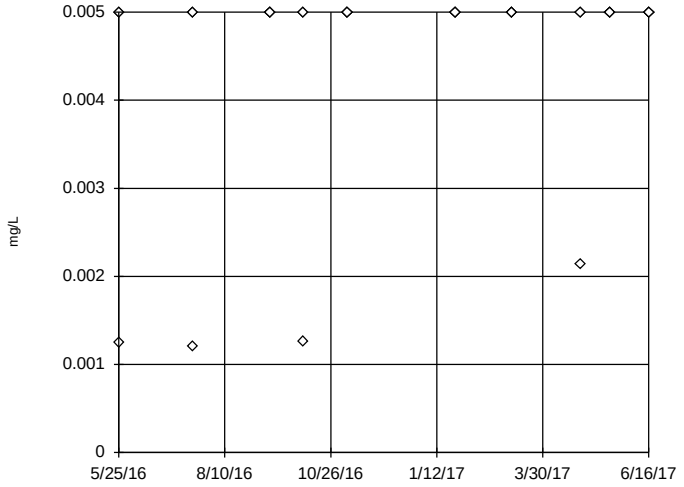
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 7.301, low cutoff = 3.699, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

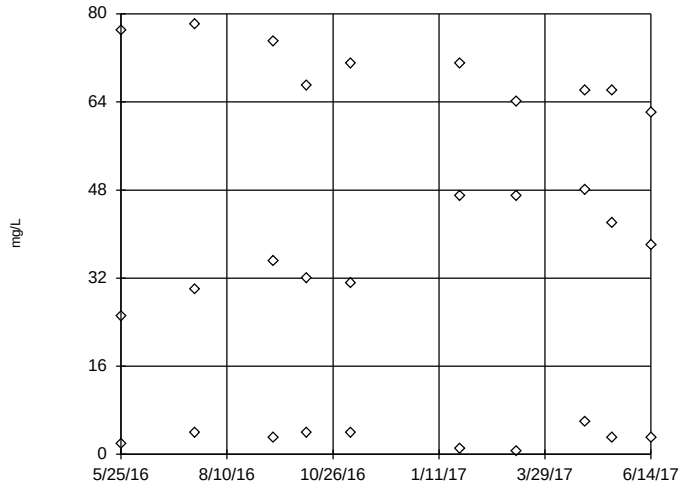
Data were cube root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Selenium, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

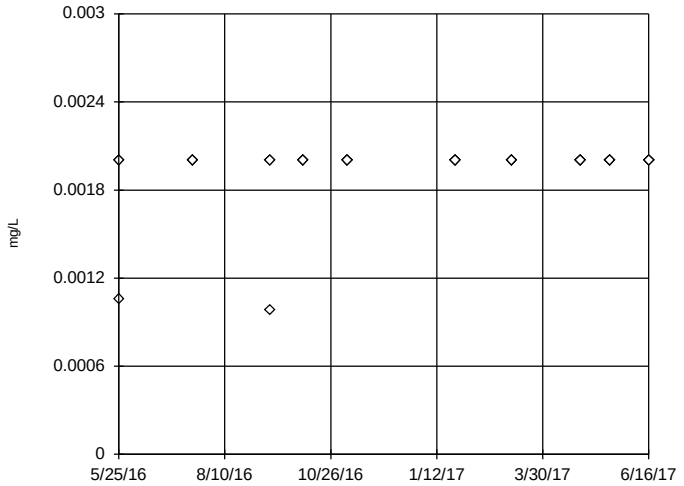
Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 252, low cutoff = -182, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

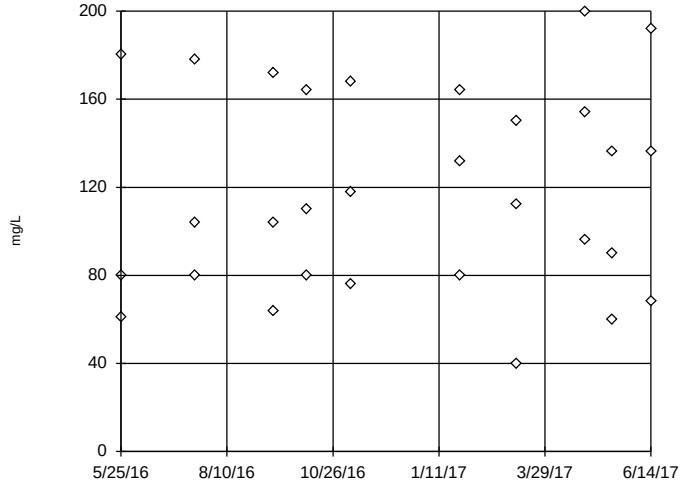
Data were natural log transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium, total Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening, Pooled Background

AP-51,AP-53,AP-54



n = 30

No outliers found. Tukey's method select-ed by user.

Data were cube root trans-formed to achieve best W statistic (graph shown in original units).

High cutoff = 721.3, low cutoff = 0.5401, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/5/2017 6:24 PM View: Tukey's Outlier

Flint BAP Client: Geosyntec Data: Flint Creek BAP

Outlier Analysis - All Downgradient Wells

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 11/5/2017, 6:32 PM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony, total (mg/L)	AP-58	No	n/a	NP (nrm)	10	0.004013	0.001618	unknown	ShapiroWilk
Antimony, total (mg/L)	AP-59	No	n/a	NP (nrm)	10	0.005	0	unknown	ShapiroWilk
Antimony, total (mg/L)	AP-60	No	n/a	NP (nrm)	8	0.004043	0.001774	unknown	ShapiroWilk
Arsenic, total (mg/L)	AP-58	No	n/a	NP	10	0.01162	0.00784	ln(x)	ShapiroWilk
Arsenic, total (mg/L)	AP-59	No	n/a	NP (nrm)	10	0.004354	0.001365	unknown	ShapiroWilk
Arsenic, total (mg/L)	AP-60	No	n/a	NP	8	0.008555	0.002529	x^2	ShapiroWilk
Barium, total (mg/L)	AP-58	No	n/a	NP	10	0.04944	0.01996	ln(x)	ShapiroWilk
Barium, total (mg/L)	AP-59	No	n/a	NP	10	0.08907	0.01276	x^3	ShapiroWilk
Barium, total (mg/L)	AP-60	No	n/a	NP	8	0.02299	0.01049	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AP-58	No	n/a	NP	10	0.0003997	0.0009197	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	AP-59	No	n/a	NP (nrm)	10	0.0009034	0.0003055	unknown	ShapiroWilk
Beryllium, total (mg/L)	AP-60	No	n/a	NP (nrm)	8	0.0005284	0.0005049	unknown	ShapiroWilk
Boron, total (mg/L)	AP-58	No	n/a	NP	10	1.102	0.4915	normal	ShapiroWilk
Boron, total (mg/L)	AP-59	No	n/a	NP	10	0.2866	0.06123	sqrt(x)	ShapiroWilk
Boron, total (mg/L)	AP-60	No	n/a	NP	8	1.273	0.1122	x^2	ShapiroWilk
Cadmium, total (mg/L)	AP-58	No	n/a	NP (nrm)	10	0.000946	0.0001708	unknown	ShapiroWilk
Cadmium, total (mg/L)	AP-59	No	n/a	NP (nrm)	10	0.001	0	unknown	ShapiroWilk
Cadmium, total (mg/L)	AP-60	No	n/a	NP (nrm)	8	0.001	0	unknown	ShapiroWilk
Calcium, total (mg/L)	AP-58	No	n/a	NP	10	40.01	20.14	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AP-59	No	n/a	NP	10	38.15	2.455	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AP-60	No	n/a	NP	8	25.88	9.269	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AP-58	No	n/a	NP	10	18	5.033	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AP-59	No	n/a	NP	10	14.1	1.969	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AP-60	No	n/a	NP	8	14	1.309	normal	ShapiroWilk
Chromium, total (mg/L)	AP-58	No	n/a	NP	10	0.002071	0.002214	ln(x)	ShapiroWilk
Chromium, total (mg/L)	AP-59	No	n/a	NP	10	0.001013	0.0007624	ln(x)	ShapiroWilk
Chromium, total (mg/L)	AP-60	No	n/a	NP	8	0.001479	0.001302	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	AP-58	No	n/a	NP	10	0.002282	0.001927	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	AP-59	No	n/a	NP	10	0.002859	0.0004611	x^2	ShapiroWilk
Cobalt, total (mg/L)	AP-60	No	n/a	NP	8	0.001242	0.001005	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AP-58	No	n/a	NP	9	1.213	0.5934	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AP-59	No	n/a	NP	10	0.9787	0.5449	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AP-60	No	n/a	NP	8	2.2	2.249	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AP-58	No	n/a	NP	10	0.7964	0.2068	x^3	ShapiroWilk
Fluoride, total (mg/L)	AP-59	No	n/a	NP (nrm)	10	0.7454	0.1839	unknown	ShapiroWilk
Fluoride, total (mg/L)	AP-60	No	n/a	NP (nrm)	8	0.723	0.3336	unknown	ShapiroWilk
Lead, total (mg/L)	AP-58	No	n/a	NP	10	0.004706	0.003018	x^(1/3)	ShapiroWilk
Lead, total (mg/L)	AP-59	No	n/a	NP (nrm)	10	0.004603	0.001255	unknown	ShapiroWilk
Lead, total (mg/L)	AP-60	No	n/a	NP (nrm)	8	0.003813	0.001738	unknown	ShapiroWilk
Lithium, total (mg/L)	AP-58	No	n/a	NP	10	0.01106	0.00508	normal	ShapiroWilk
Lithium, total (mg/L)	AP-59	No	n/a	NP (nrm)	10	0.001948	0.003651	unknown	ShapiroWilk
Lithium, total (mg/L)	AP-60	No	n/a	NP	8	0.001302	0.001009	ln(x)	ShapiroWilk
Mercury, total (mg/L)	AP-58	No	n/a	NP	10	0.00002167	0.00001175	normal	ShapiroWilk
Mercury, total (mg/L)	**AP-59**	**Yes**	**0.000035,0.000006**	**NP (nrm)**	**10**	**0.0000245**	**0.000007261**	**unknown**	**ShapiroWilk**
Mercury, total (mg/L)	AP-60	No	n/a	NP (nrm)	8	0.00001683	0.000008819	unknown	ShapiroWilk
Molybdenum, total (mg/L)	AP-58	No	n/a	NP	10	0.04112	0.02273	sqrt(x)	ShapiroWilk
Molybdenum, total (mg/L)	AP-59	No	n/a	NP	10	0.007339	0.001282	normal	ShapiroWilk
Molybdenum, total (mg/L)	AP-60	No	n/a	NP	8	0.05768	0.003878	ln(x)	ShapiroWilk
pH, field (SU)	AP-58	No	n/a	NP	10	7.602	0.813	x^3	ShapiroWilk
pH, field (SU)	AP-59	No	n/a	NP	10	7.159	0.3359	ln(x)	ShapiroWilk
pH, field (SU)	AP-60	No	n/a	NP	8	8.08	0.4793	ln(x)	ShapiroWilk
Selenium, total (mg/L)	AP-58	No	n/a	NP (nrm)	10	0.00415	0.001434	unknown	ShapiroWilk
Selenium, total (mg/L)	AP-59	No	n/a	NP (nrm)	10	0.005	0	unknown	ShapiroWilk
Selenium, total (mg/L)	AP-60	No	n/a	NP (nrm)	8	0.005	0	unknown	ShapiroWilk
Sulfate, total (mg/L)	AP-58	No	n/a	NP	10	169.4	56.65	normal	ShapiroWilk

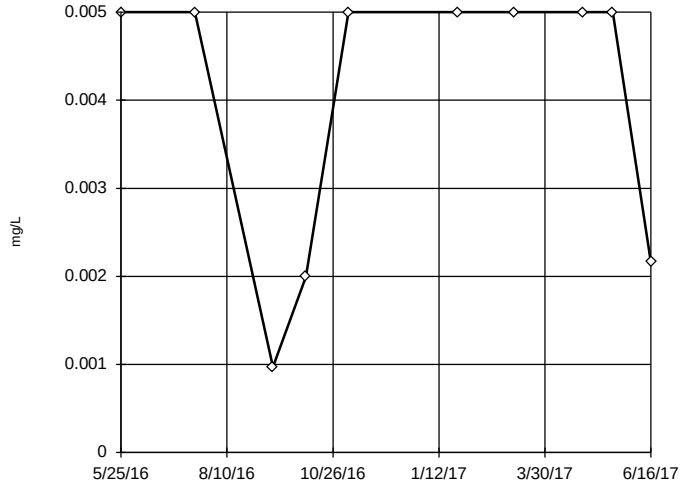
Outlier Analysis - All Downgradient Wells

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 11/5/2017, 6:32 PM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Sulfate, total (mg/L)	AP-59	No	n/a	NP	10	33.9	6.54	x^2	ShapiroWilk
Sulfate, total (mg/L)	AP-60	No	n/a	NP	8	155.9	10.19	x^3	ShapiroWilk
Thallium, total (mg/L)	AP-58	No	n/a	NP (nrm)	10	0.001902	0.0003084	unknown	ShapiroWilk
Thallium, total (mg/L)	AP-59	No	n/a	NP (nrm)	10	0.001527	0.0004399	unknown	ShapiroWilk
Thallium, total (mg/L)	AP-60	No	n/a	NP (nrm)	8	0.001873	0.0003606	unknown	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	AP-58	No	n/a	NP	10	517.9	136	ln(x)	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	AP-59	No	n/a	NP	10	222.4	15.77	x^6	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	AP-60	No	n/a	NP (nrm)	8	351.4	23.48	unknown	ShapiroWilk

Tukey's Outlier Screening

AP-58



n = 10

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

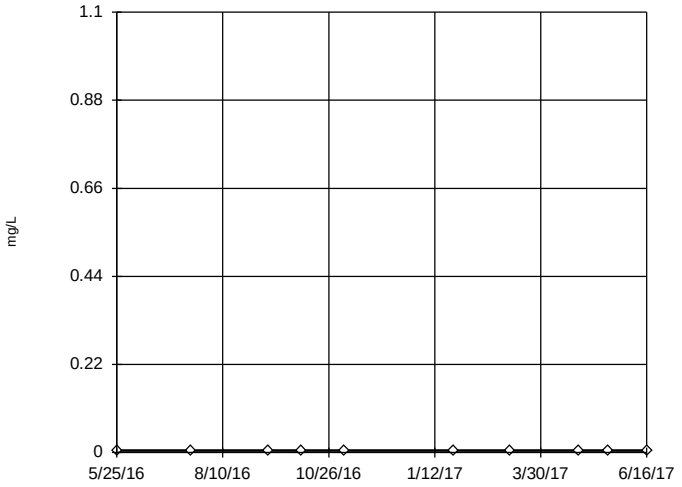
High cutoff = 0.02734, low cutoff = -1.9e-8, based on IQR multiplier of 3.

Constituent: Antimony, total Analysis Run 11/5/2017 6:28 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

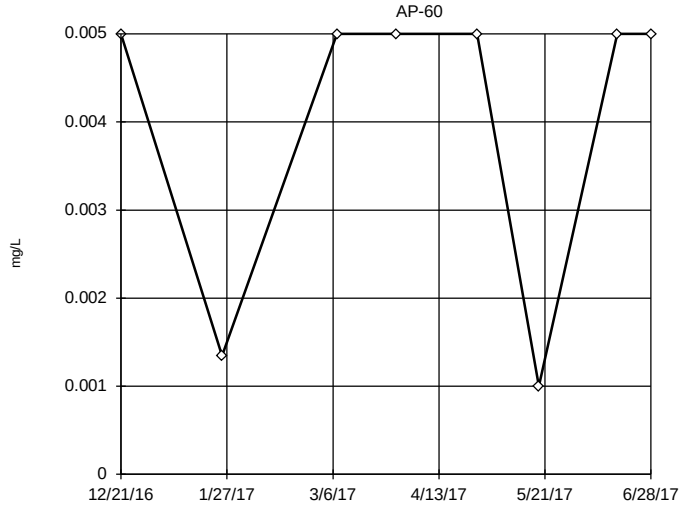
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Antimony, total Analysis Run 11/5/2017 6:28 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

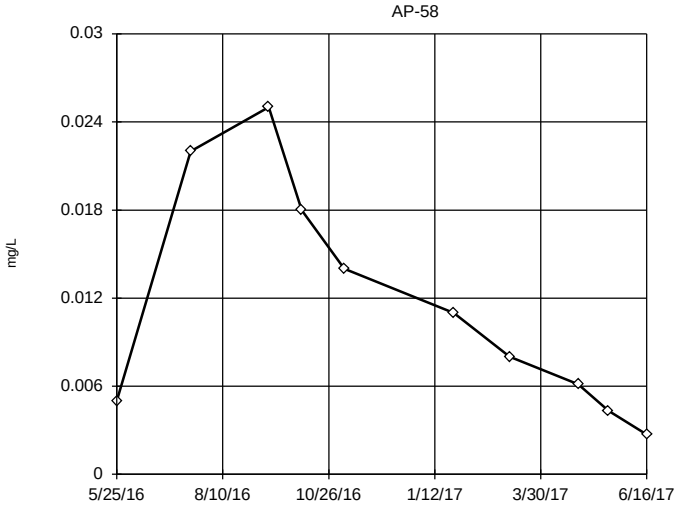
High cutoff = 0.03575, low cutoff = 0.000363, based on IQR multiplier of 3.

Constituent: Antimony, total Analysis Run 11/5/2017 6:28 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 10

No outliers found.
Tukey's method selected by user.

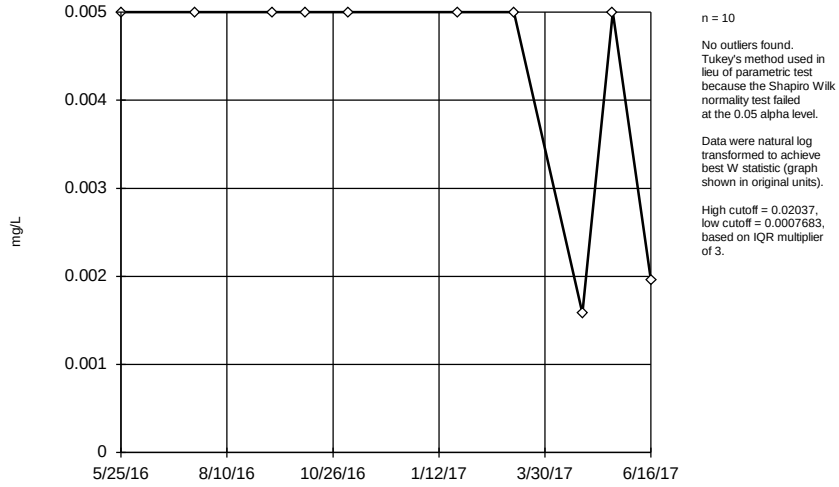
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1.562, low cutoff = 0.00005921, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 11/5/2017 6:28 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-59



n = 10

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

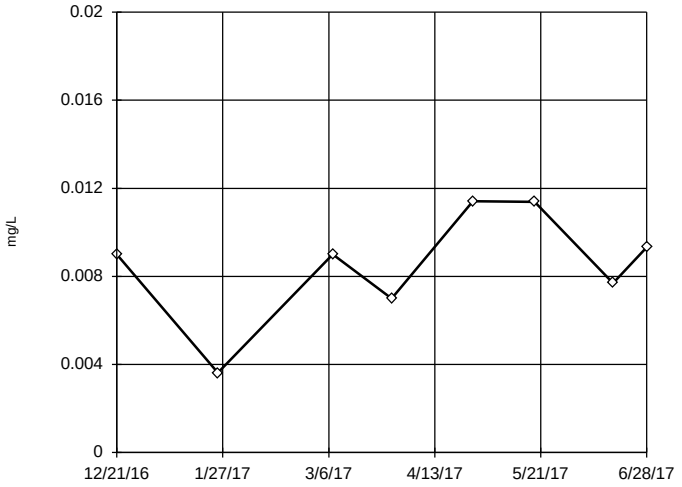
High cutoff = 0.02037, low cutoff = 0.0007683, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found.
Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

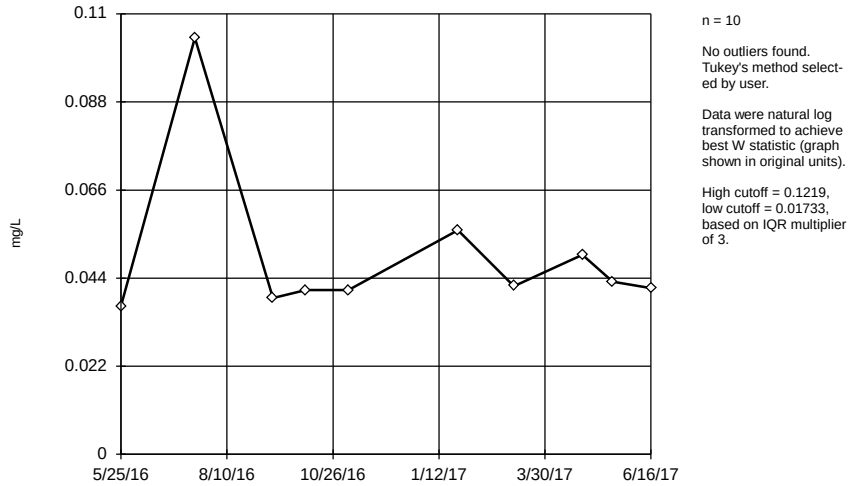
High cutoff = 0.01646, low cutoff = -0.01042, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 10

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

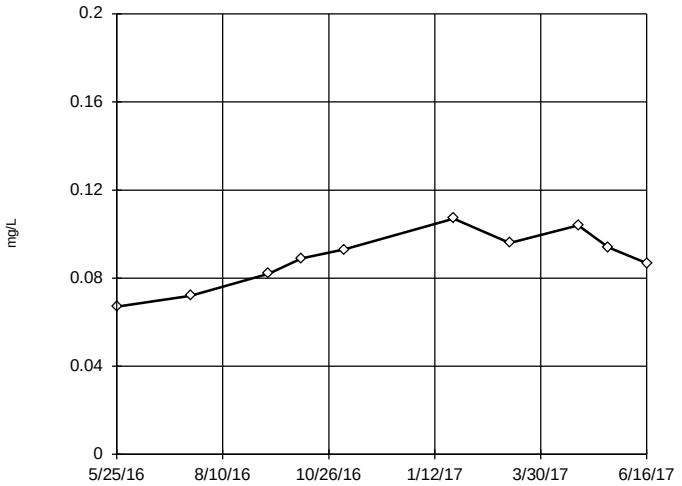
High cutoff = 0.1219, low cutoff = 0.01733, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

No outliers found.
Tukey's method selected by user.

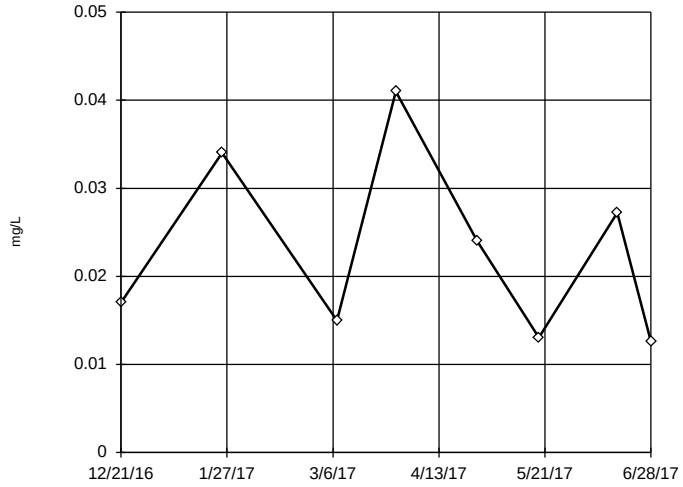
Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1381, low cutoff = -0.1052, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

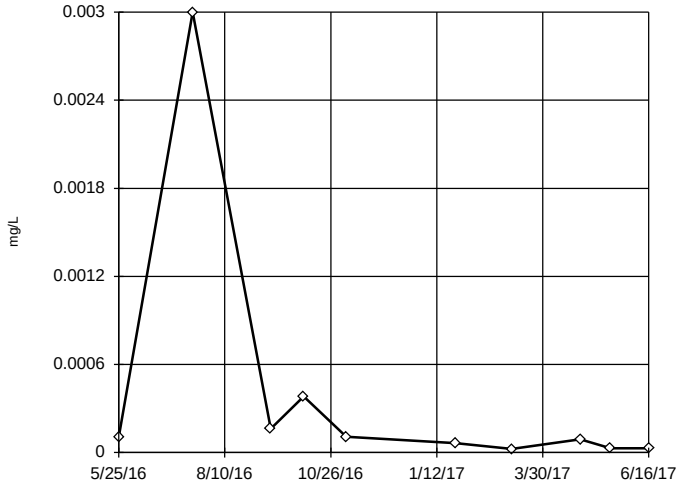
High cutoff = 0.313, low cutoff = 0.00136, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

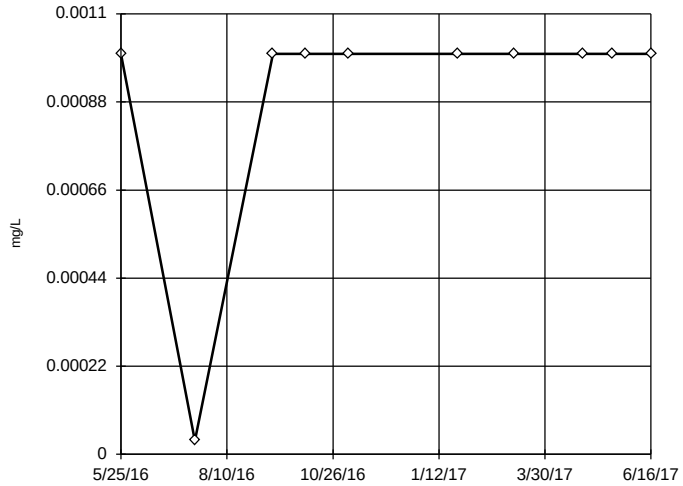
High cutoff = 0.1436, low cutoff = 5.2e-8, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were x^5 transformed to achieve best W statistic (graph shown in original units).

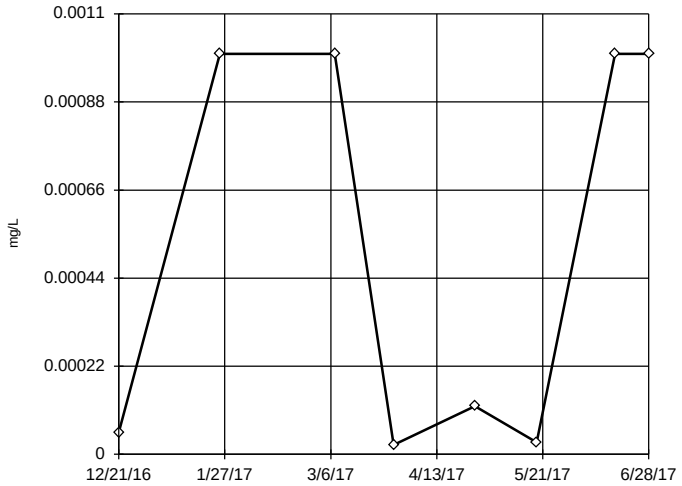
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Beryllium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

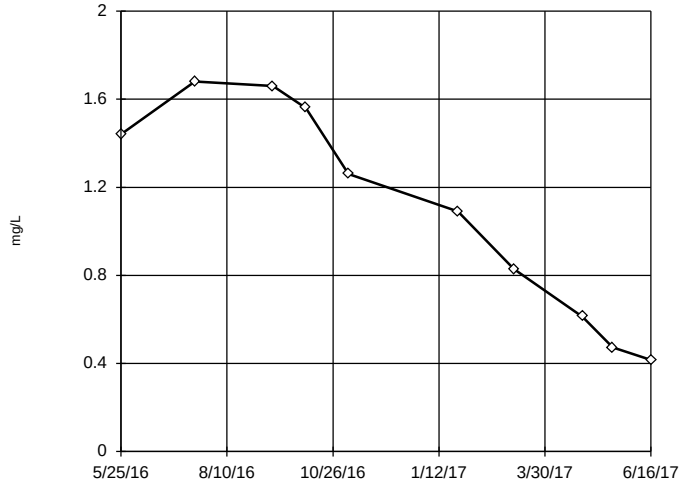
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 15.21, low cutoff = 2.7e-9, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

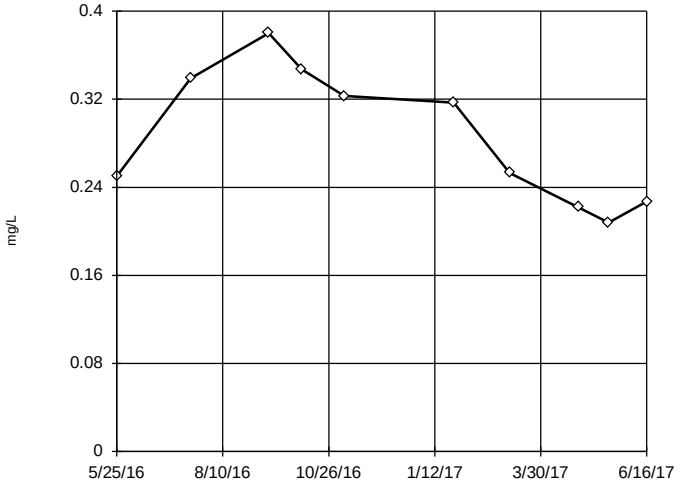
High cutoff = 4.811, low cutoff = -2.658, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

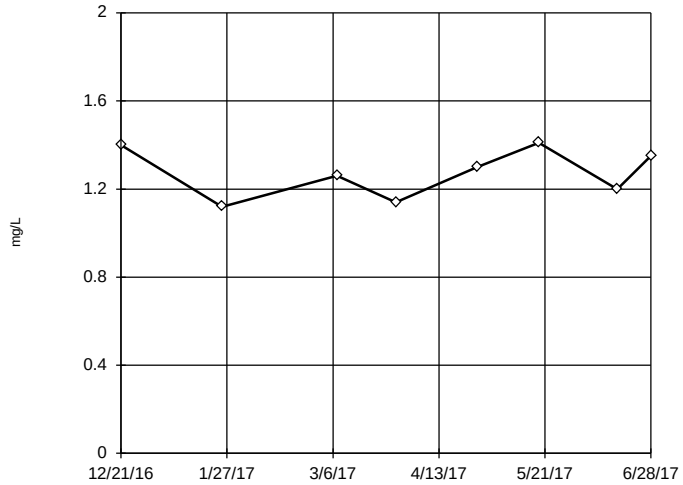
High cutoff = 0.8486, low cutoff = 0.01912, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

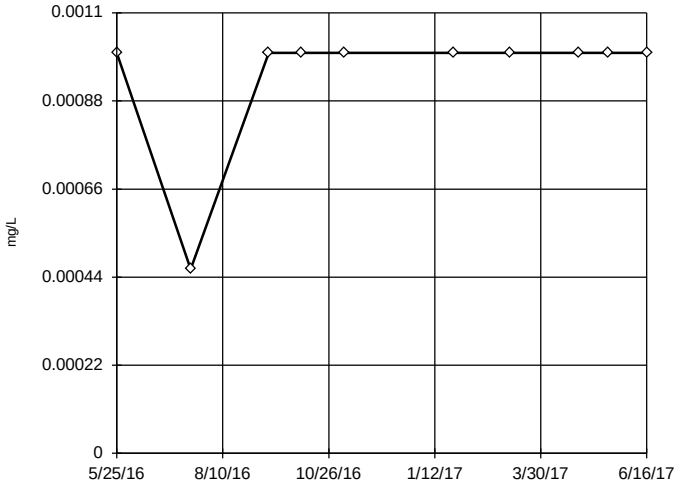
High cutoff = 1.859, low cutoff = -0.4411, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

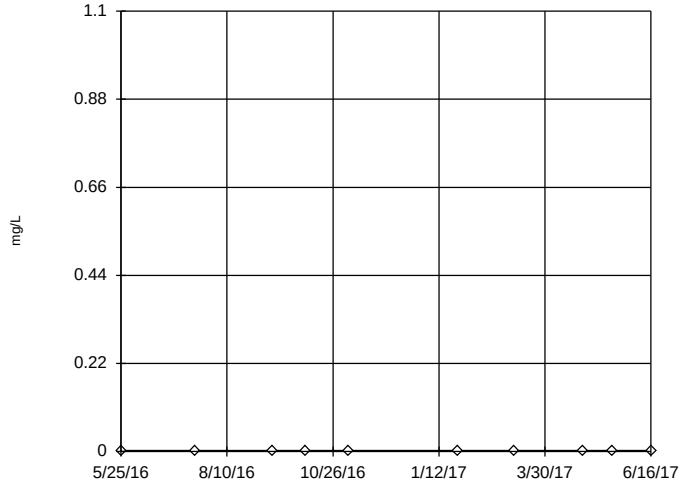
Ladder of Powers transformations did not improve normality; analysis run on raw data.

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Cadmium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-59



n = 10

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

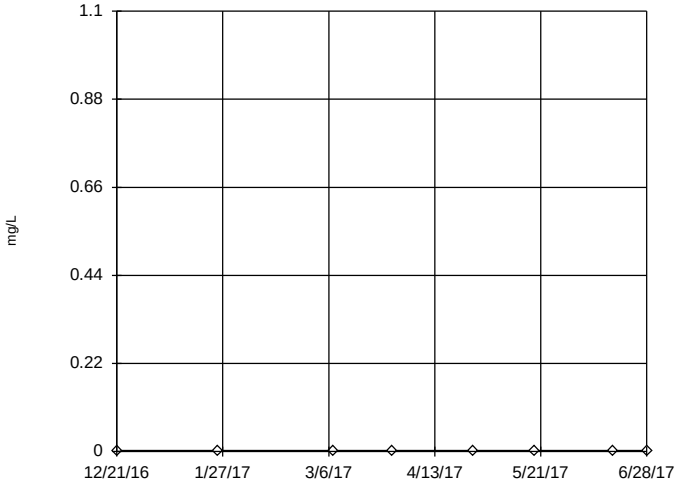
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Cadmium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

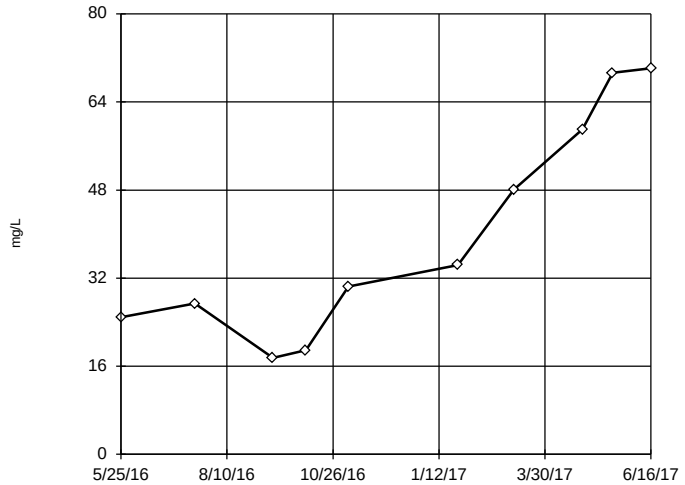
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Cadmium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 10

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

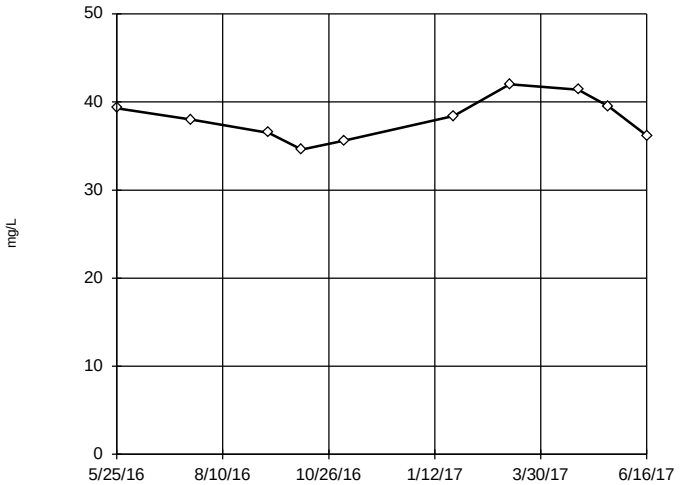
High cutoff = 1637, low cutoff = 0.8471, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

No outliers found.
Tukey's method selected by user.

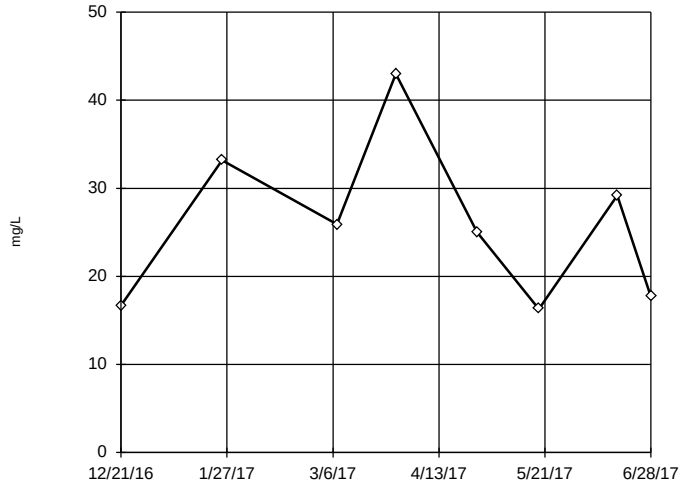
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 57.8, low cutoff = 25.11, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

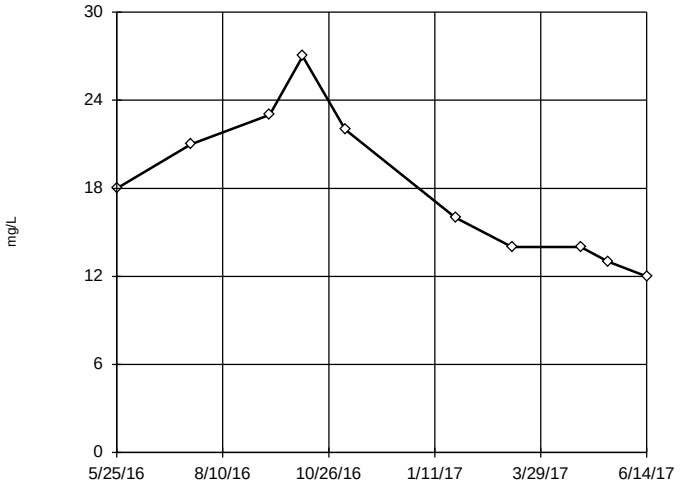
High cutoff = 184.9, low cutoff = 2.895, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

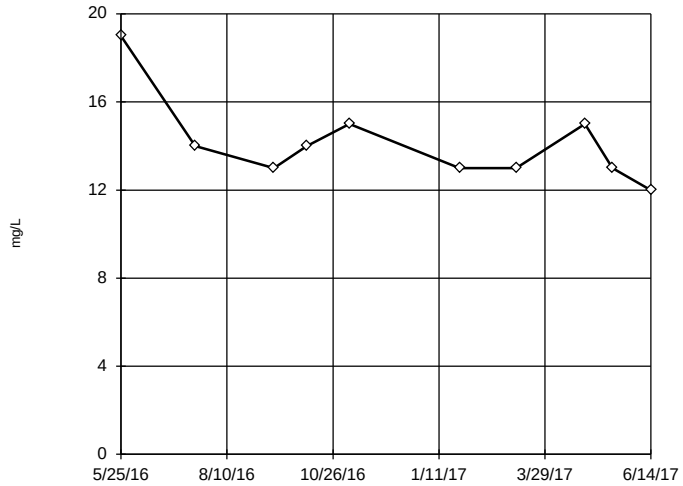
High cutoff = 104.3, low cutoff = 2.91, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

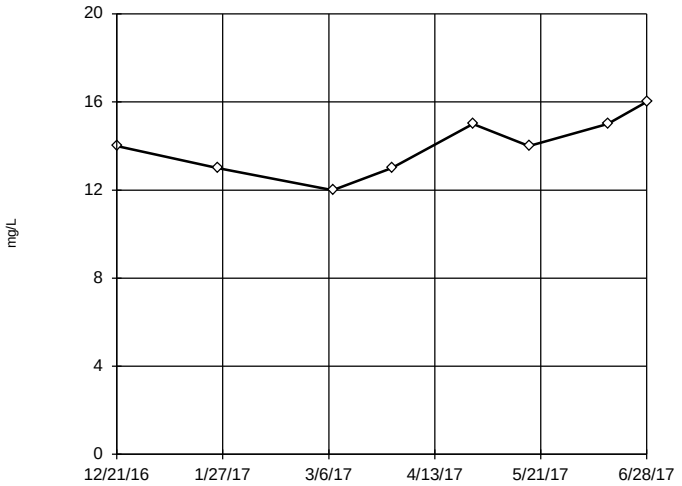
High cutoff = 23.04, low cutoff = 8.463, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method selected by user.

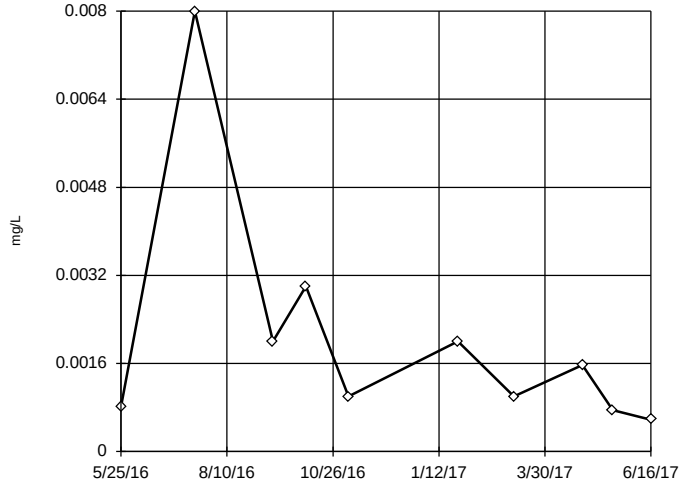
Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 21, low cutoff = 7, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

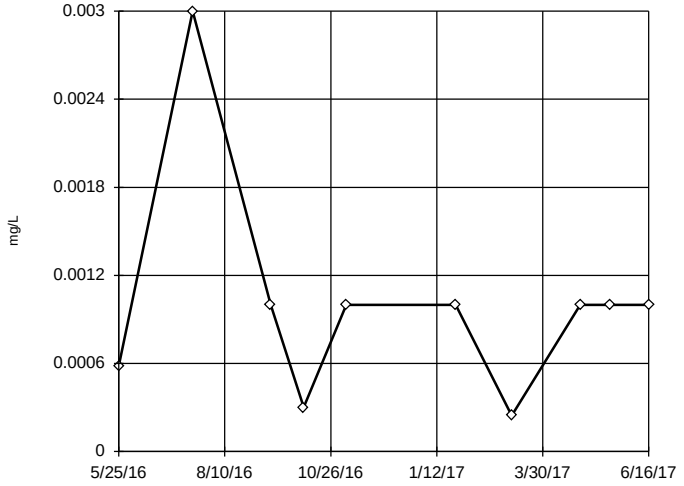
High cutoff = 0.07603, low cutoff = 0.00002511, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

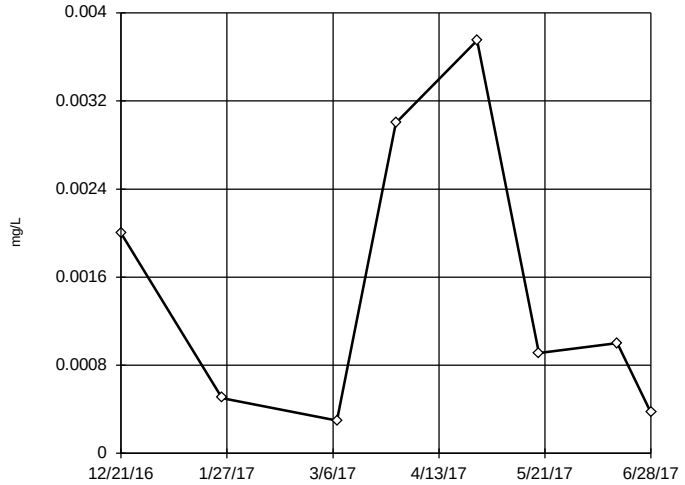
High cutoff = 0.0136, low cutoff = 0.0000308, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

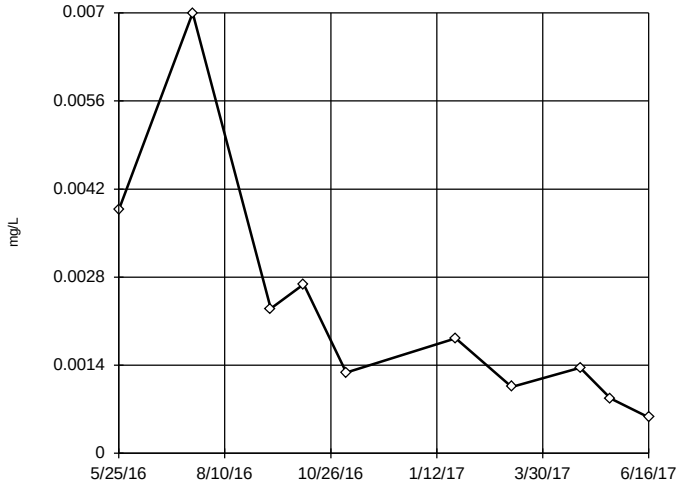
High cutoff = 0.4493, low cutoff = 0.00000235, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method selected by user.

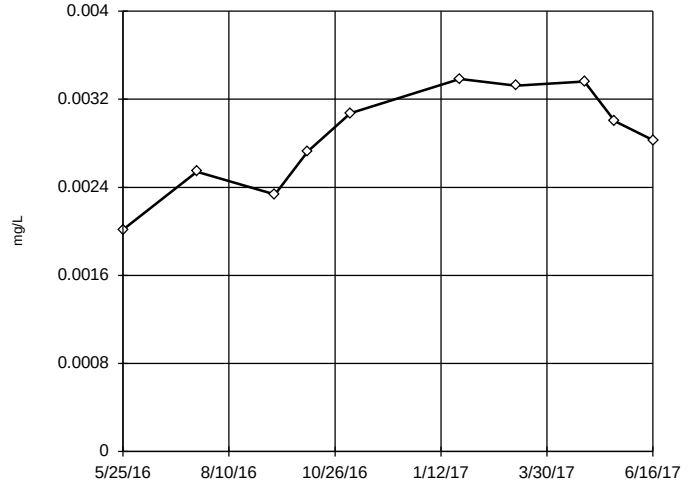
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1228, low cutoff = 0.00002513, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

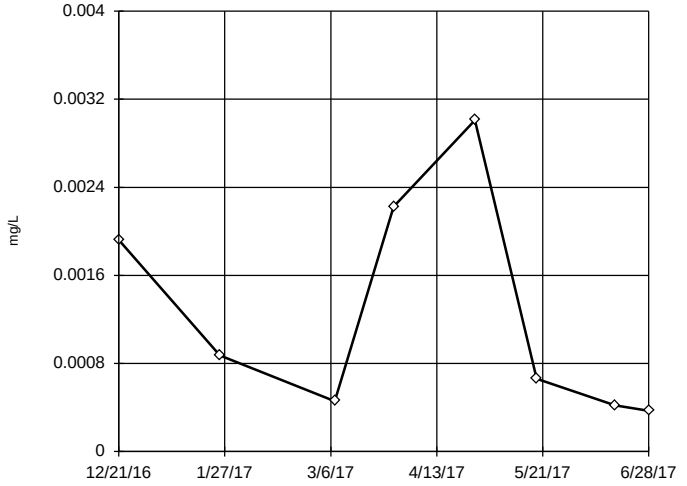
High cutoff = 0.005175, low cutoff = -0.00311, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

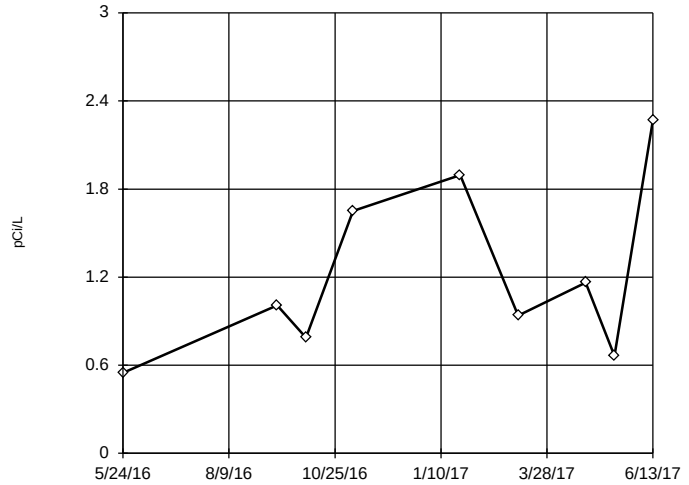
High cutoff = 0.2159, low cutoff = 0.000004202, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 9

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

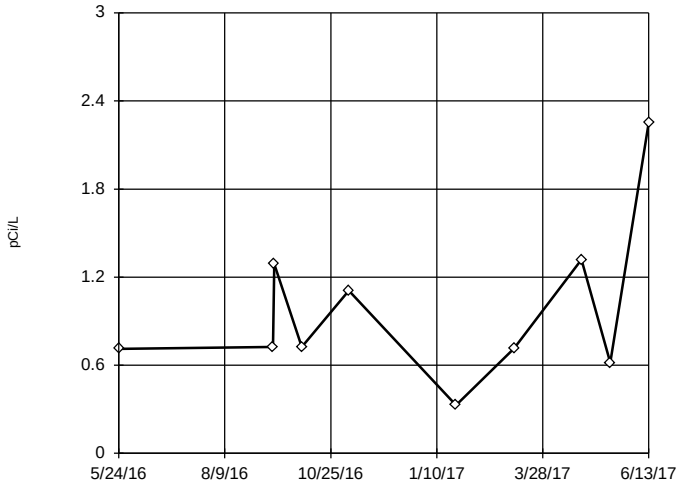
High cutoff = 25.97, low cutoff = 0.0492, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Down
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method selected by user.

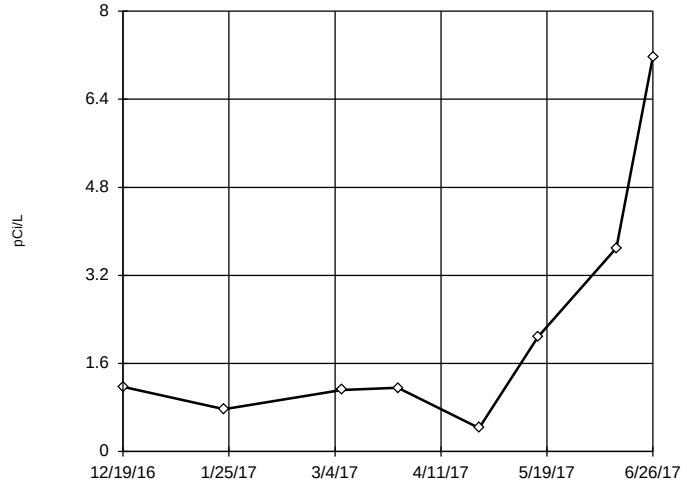
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 9.909, low cutoff = 0.08719, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Down
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

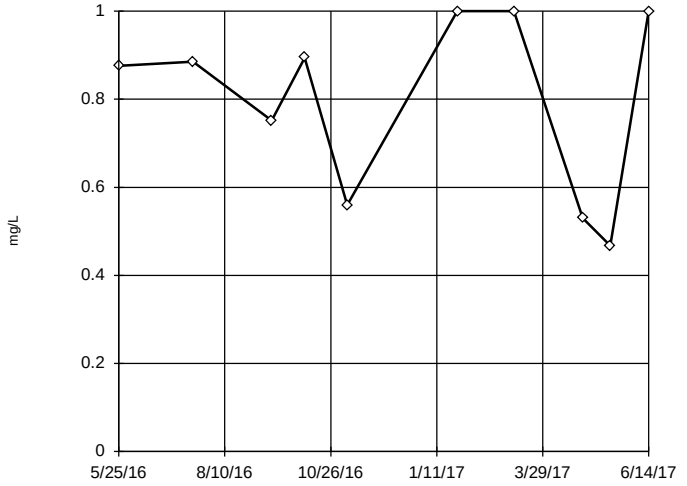
High cutoff = 73.73, low cutoff = 0.03498, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Down
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

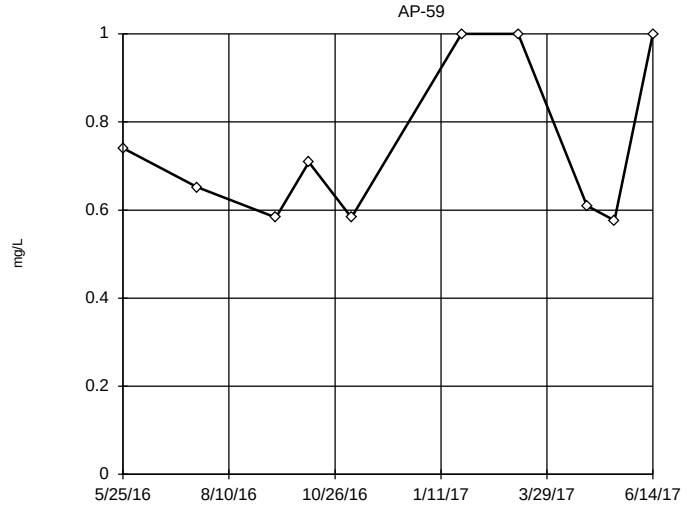
High cutoff = 1.52, low cutoff = -1.33, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

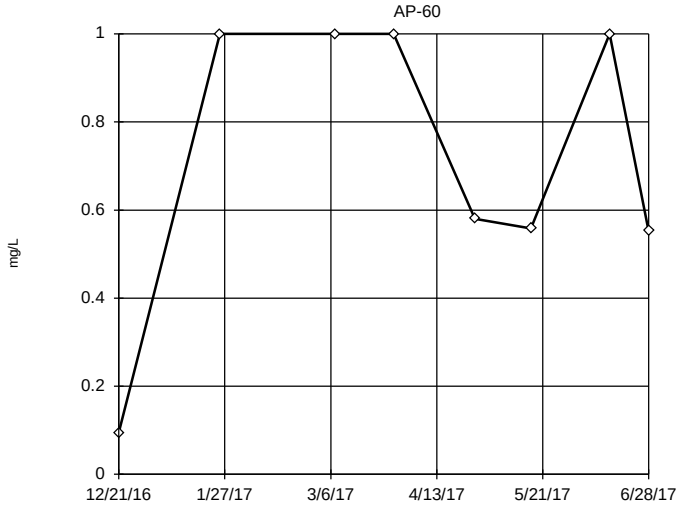
High cutoff = 5.044, low cutoff = 0.1156, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

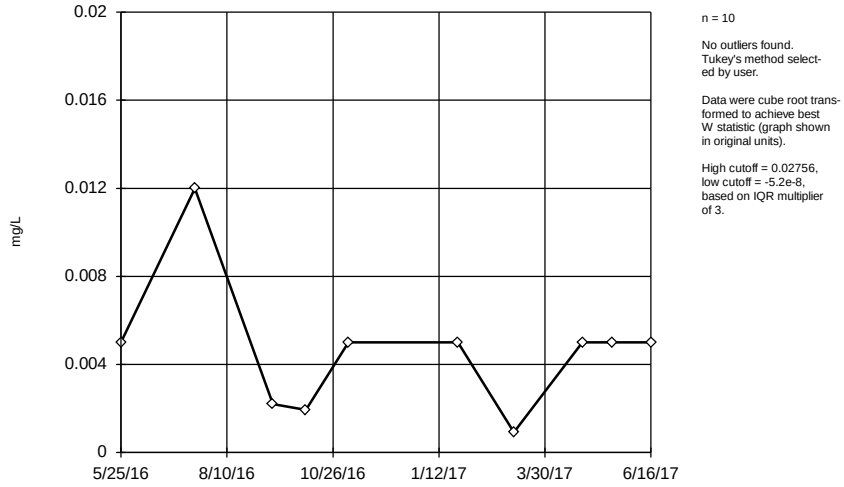
Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 2.336, low cutoff = -0.7808, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method select-ed by user.

Data were cube root trans-formed to achieve best W statistic (graph shown in original units).

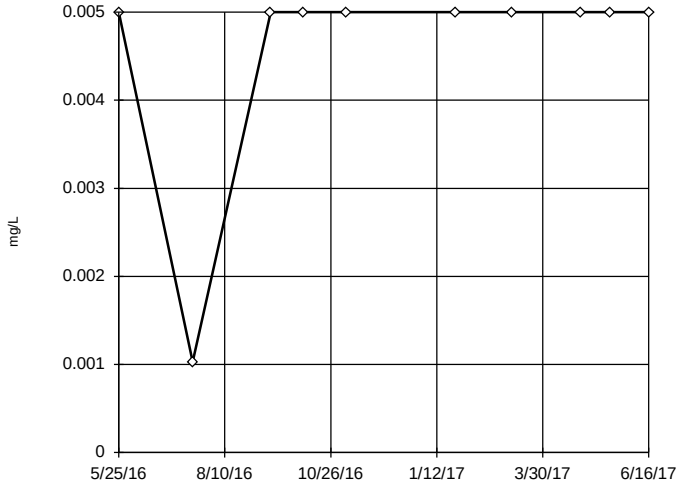
High cutoff = 0.02756, low cutoff = -5.2e-8, based on IQR multiplier of 3.

Constituent: Lead, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Ladder of Powers trans-formations did not im-prove normality; analy-sis run on raw data.

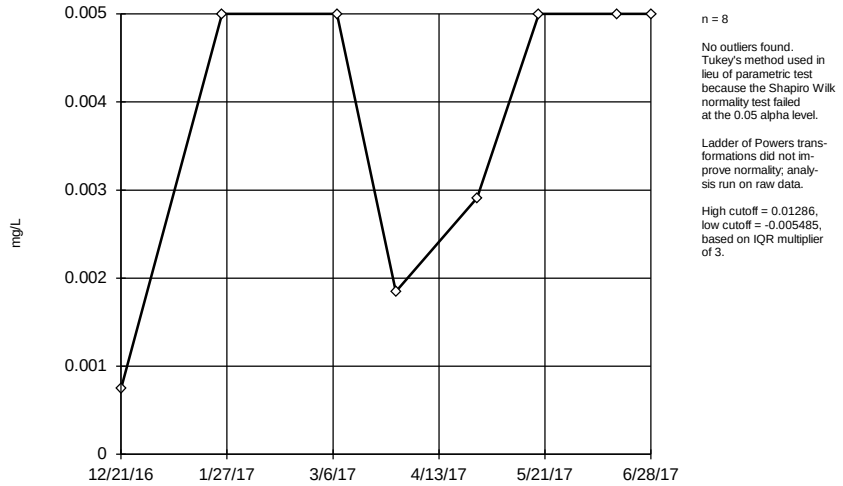
The results were invalid-ated, because the lower and upper quartiles are equal.

Constituent: Lead, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Ladder of Powers trans-formations did not im-prove normality; analy-sis run on raw data.

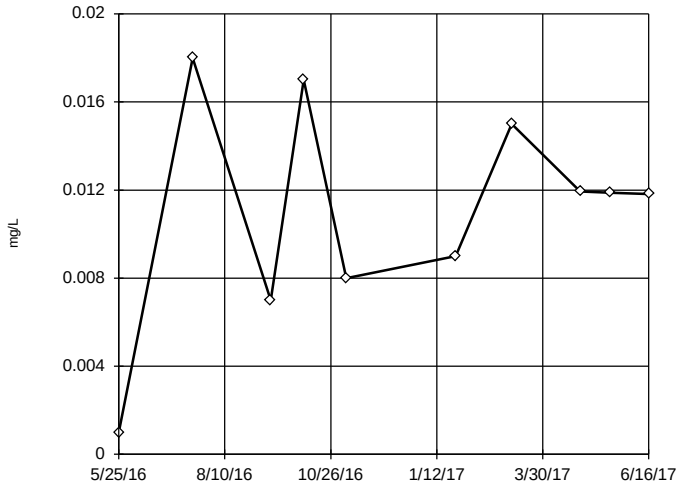
High cutoff = 0.01286, low cutoff = -0.005485, based on IQR multiplier of 3.

Constituent: Lead, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method select-ed by user.

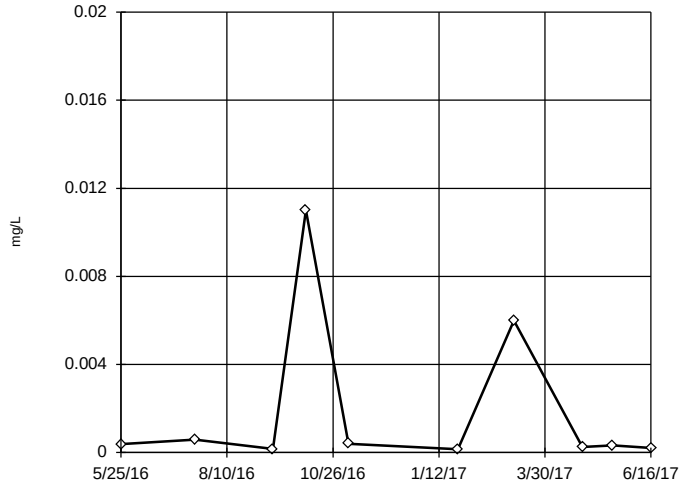
Ladder of Powers trans-formations did not im-prove normality; analy-sis run on raw data.

High cutoff = 0.0415, low cutoff = -0.018, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-59



n = 10

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

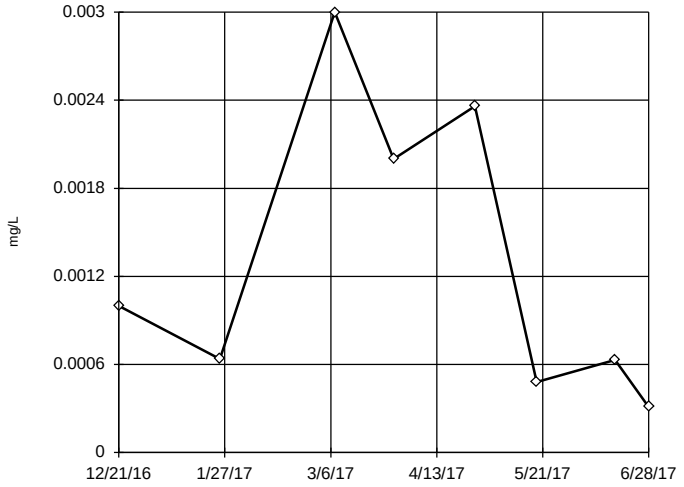
High cutoff = 1.994, low cutoff = 1.7e-7, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

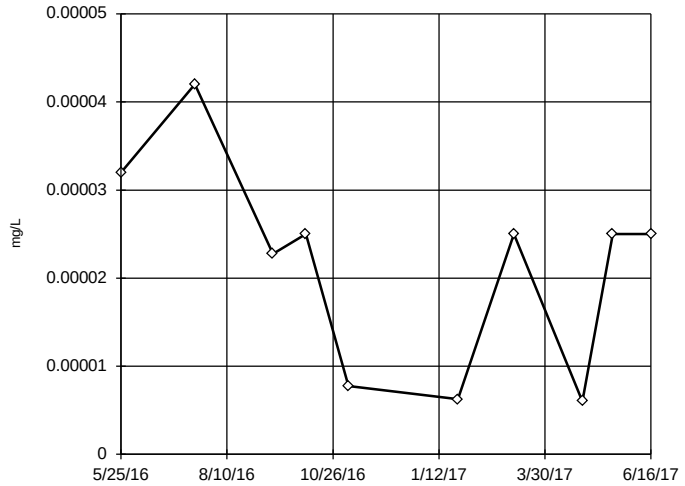
High cutoff = 0.134, low cutoff = 0.000008918, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 10

No outliers found.
Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

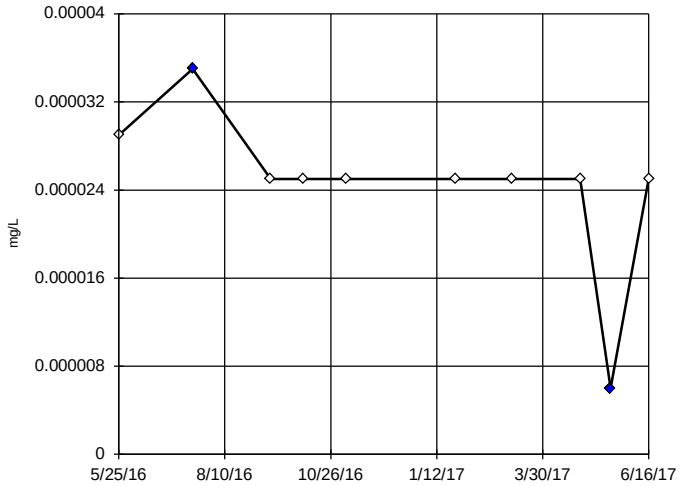
High cutoff = 0.000093, low cutoff = -0.0000575, based on IQR multiplier of 3.

Constituent: Mercury, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

Outliers are drawn as solid.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

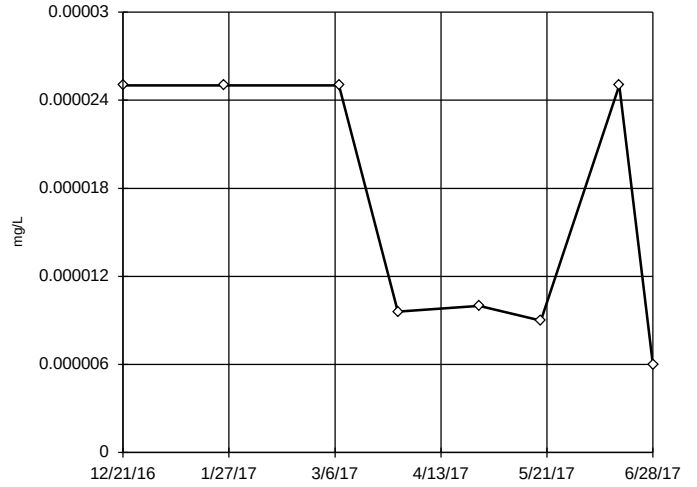
Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.00003251, low cutoff = 0.00001735, based on IQR multiplier of 3.

Constituent: Mercury, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

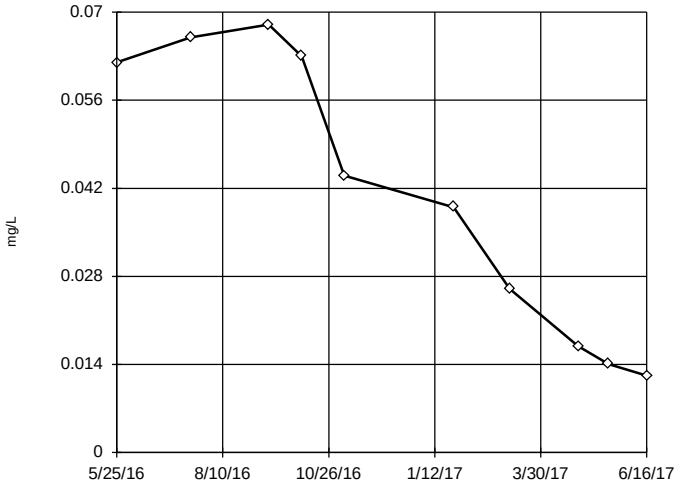
High cutoff = 0.0004856, low cutoff = 4.8e-7, based on IQR multiplier of 3.

Constituent: Mercury, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

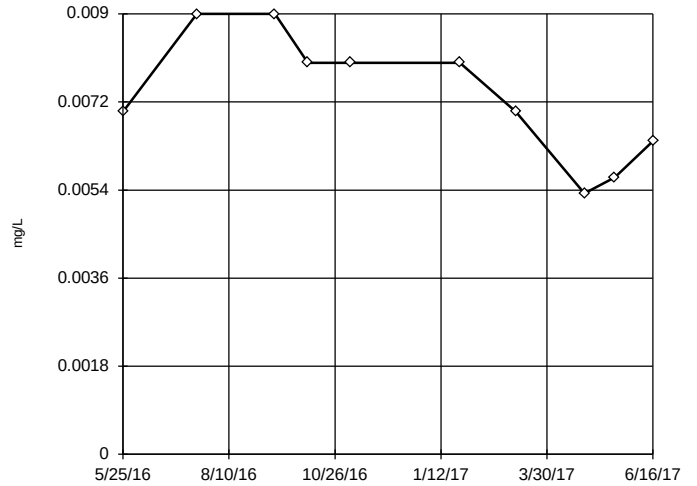
High cutoff = 0.4135, low cutoff = -0.07011, based on IQR multiplier of 3.

Constituent: Molybdenum, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

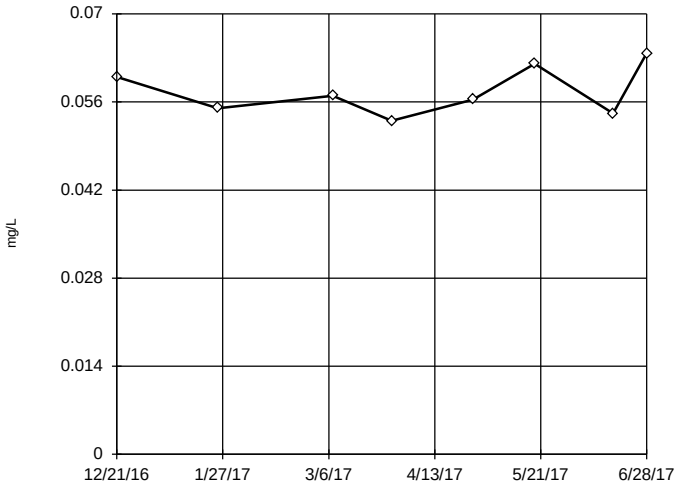
High cutoff = 0.01591, low cutoff = -0.00138, based on IQR multiplier of 3.

Constituent: Molybdenum, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method selected by user.

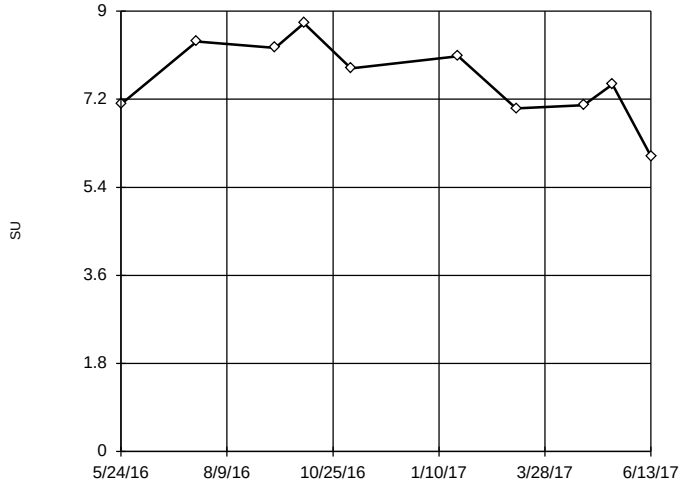
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.08532, low cutoff = 0.03905, based on IQR multiplier of 3.

Constituent: Molybdenum, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

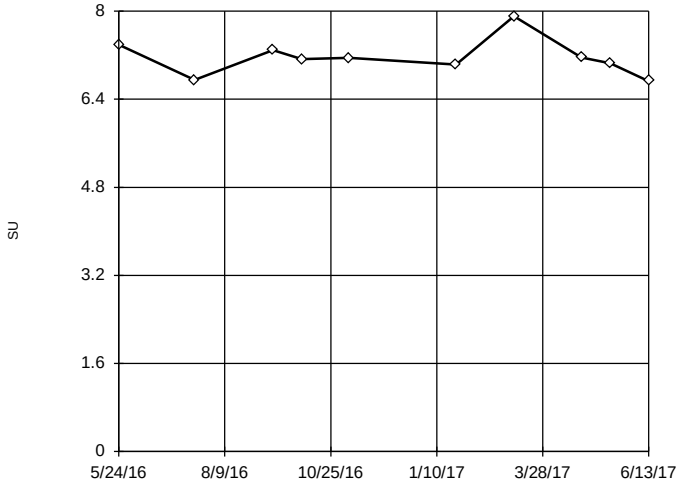
High cutoff = 10.77, low cutoff = -6.884, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

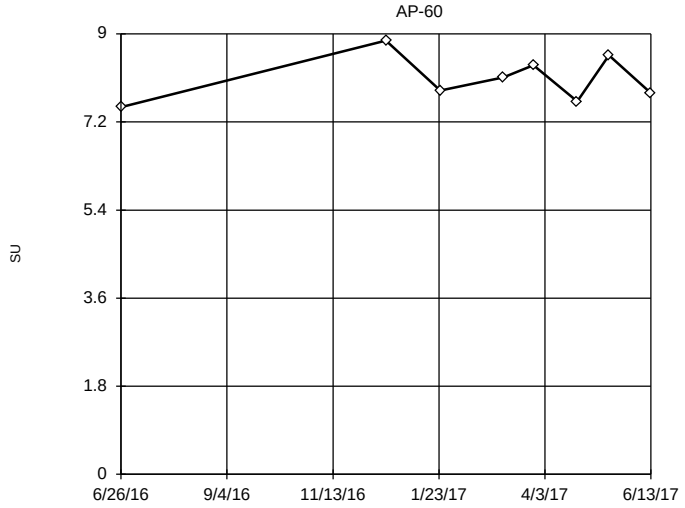
High cutoff = 8.879, low cutoff = 5.695, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

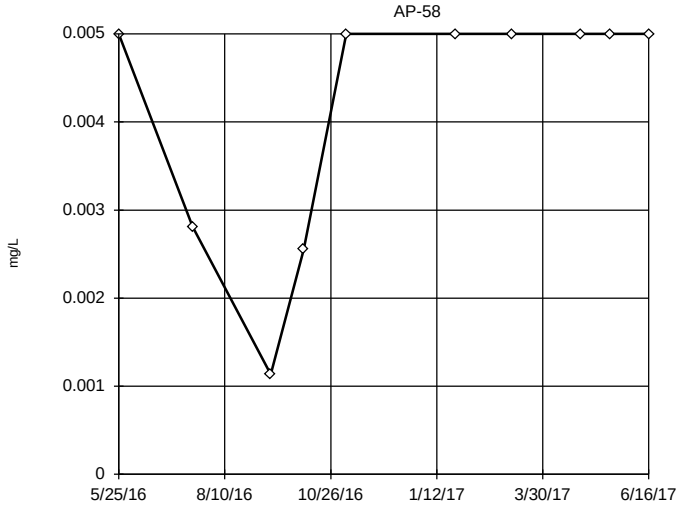
High cutoff = 11.2, low cutoff = 5.821, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

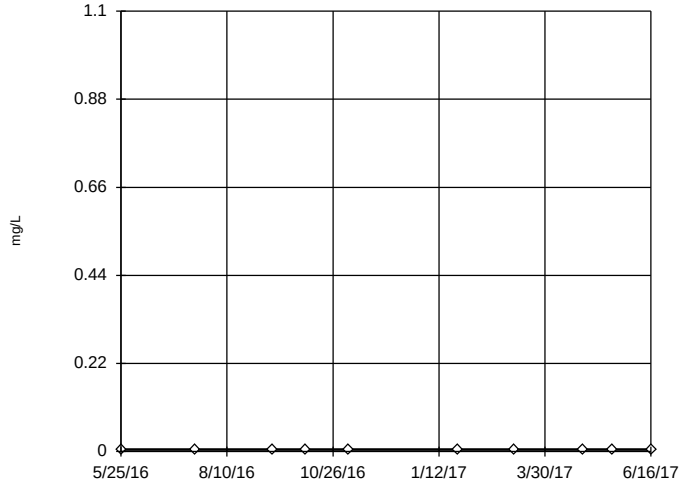
Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 0.01195, low cutoff = -0.004272, based on IQR multiplier of 3.

Constituent: Selenium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

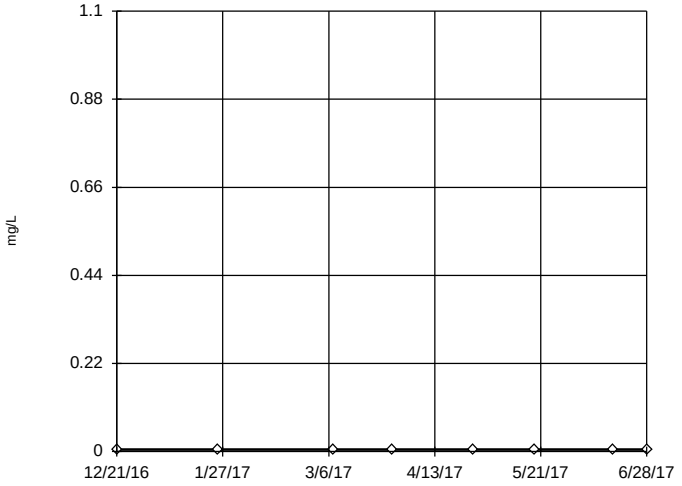
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Selenium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

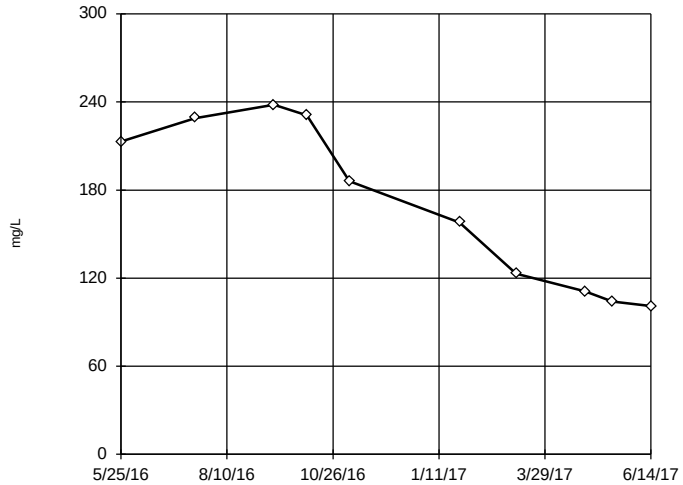
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Selenium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

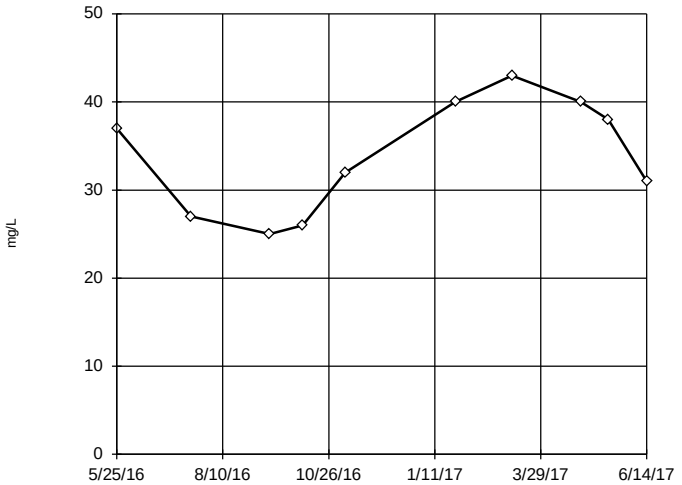
High cutoff = 597.5, low cutoff = -260, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method selected by user.

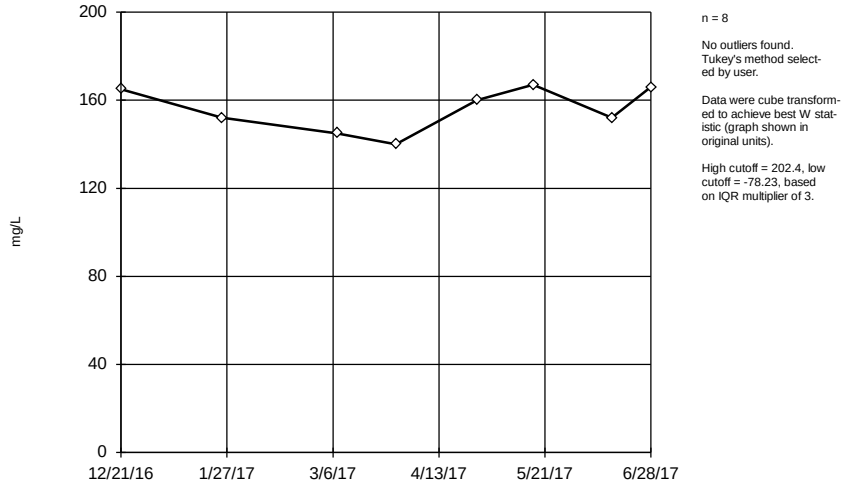
Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 65.52, low cutoff = -44.61, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method selected by user.

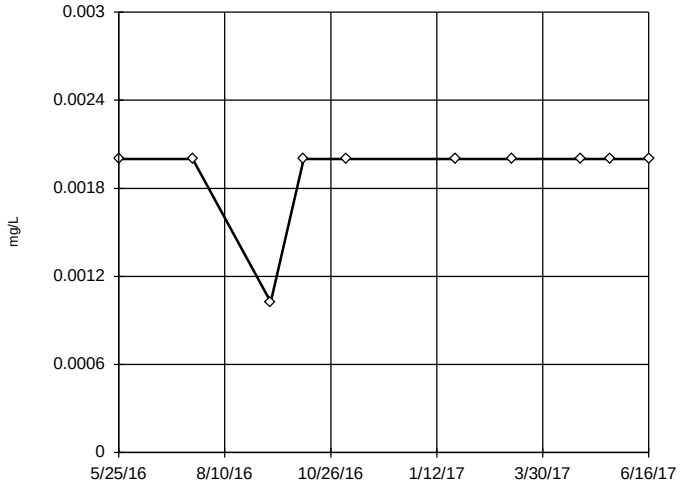
Data were cube transformed to achieve best W statistic (graph shown in original units).

High cutoff = 202.4, low cutoff = -78.23, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-58



n = 10

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

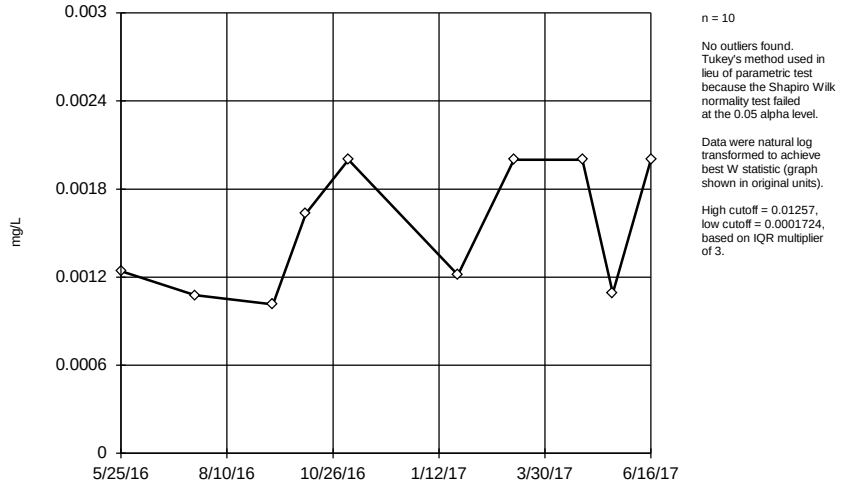
Data were square transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

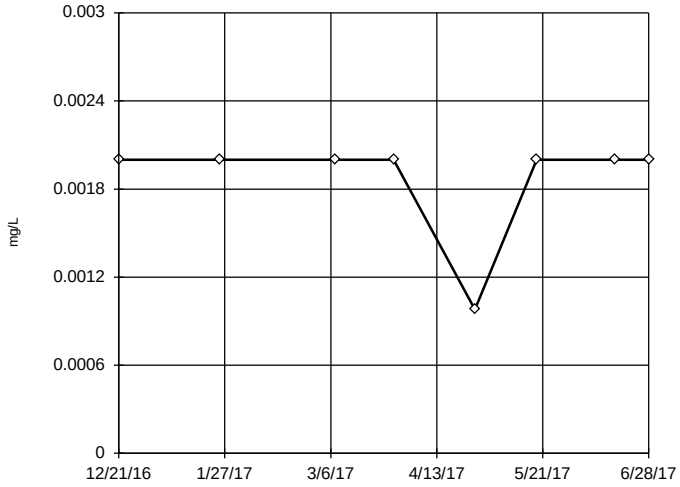
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.01257, low cutoff = 0.0001724, based on IQR multiplier of 3.

Constituent: Thallium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium, total Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downgradient
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Tukey's Outlier Screening

AP-58

n = 10

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 3448, low cutoff = 74.64, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downg
Flint BAP Client: Geosyntec Data: Flint Creek BAP

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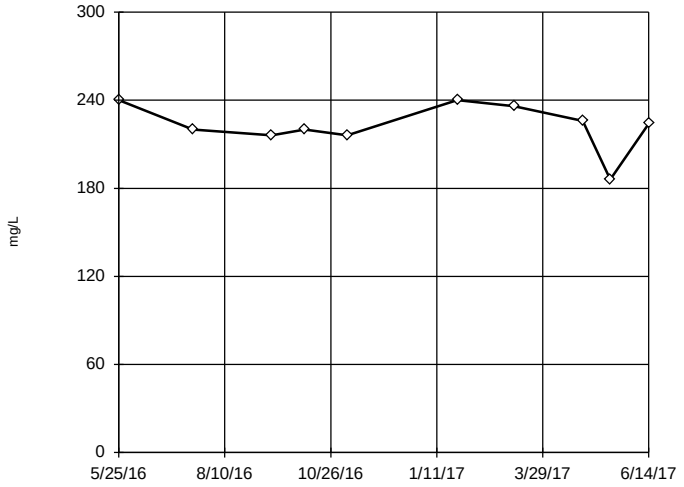
Tukey's Outlier Screening

AP-59



n = 10

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 274, low cutoff = -227.8, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downg
Flint BAP Client: Geosyntec Data: Flint Creek BAP

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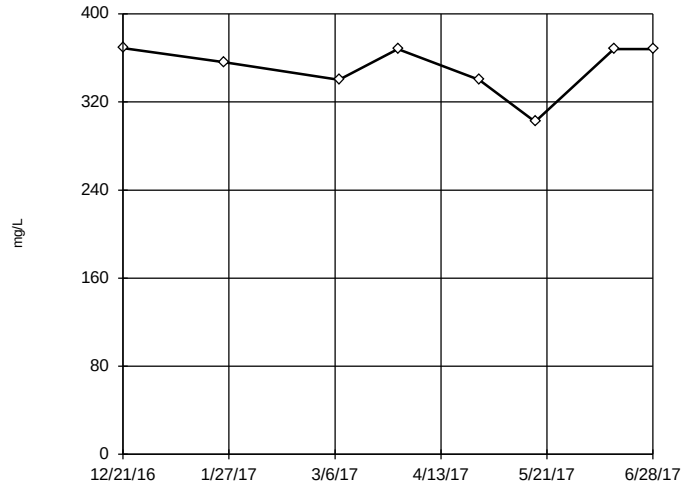
Tukey's Outlier Screening

AP-60



n = 8

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.05 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 417.6, low cutoff = -329.2, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/5/2017 6:29 PM View: Tukey's Outlier - Downg
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Trend Tests Summary Table - Significant Results

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 10/30/2017, 6:23 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	**AP-58**	**-1.444**	**-39**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Calcium, total (mg/L)	**AP-58**	**53.09**	**37**	**30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Cobalt, total (mg/L)	**AP-58**	**-0.003067**	**-35**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Molybdenum, total (mg/L)	**AP-58**	**-0.06058**	**-37**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate, total (mg/L)	**AP-54 (bg)**	**-14.22**	**-33**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate, total (mg/L)	**AP-58**	**-141.7**	**-35**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Total Dissolved Solids [TDS] (mg/L)	**AP-58**	**-342**	**-31**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**

Trend Tests Summary Table - All Results

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 10/30/2017, 6:23 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Antimony, total (mg/L)	AP-51 (bg)	0	3	30	No	10	80	n/a	n/a	0.01	NP
Antimony, total (mg/L)	AP-53 (bg)	-0.004083	-27	-30	No	10	50	n/a	n/a	0.01	NP
Antimony, total (mg/L)	AP-54 (bg)	0	9	30	No	10	90	n/a	n/a	0.01	NP
Antimony, total (mg/L)	AP-58	0	2	30	No	10	70	n/a	n/a	0.01	NP
Antimony, total (mg/L)	AP-59	0	0	30	No	10	100	n/a	n/a	0.01	NP
Antimony, total (mg/L)	AP-60	0	1	21	No	8	75	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AP-51 (bg)	0	-9	-30	No	10	90	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AP-53 (bg)	-0.002719	-10	-25	No	9	11.11	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AP-54 (bg)	0	-10	-30	No	10	70	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AP-58	-0.02099	-29	-30	No	10	0	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AP-59	0	-13	-30	No	10	80	n/a	n/a	0.01	NP
Arsenic, total (mg/L)	AP-60	0.004521	7	21	No	8	0	n/a	n/a	0.01	NP
Barium, total (mg/L)	AP-51 (bg)	-0.007204	-3	-30	No	10	0	n/a	n/a	0.01	NP
Barium, total (mg/L)	AP-53 (bg)	-0.04313	-10	-25	No	9	0	n/a	n/a	0.01	NP
Barium, total (mg/L)	AP-54 (bg)	-0.0001304	-4	-30	No	10	0	n/a	n/a	0.01	NP
Barium, total (mg/L)	AP-58	0.00574	19	25	No	9	0	n/a	n/a	0.01	NP
Barium, total (mg/L)	AP-59	0.02735	23	30	No	10	0	n/a	n/a	0.01	NP
Barium, total (mg/L)	AP-60	-0.009578	-8	-21	No	8	0	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AP-51 (bg)	0.00006139	3	30	No	10	0	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AP-53 (bg)	-0.0004078	-12	-25	No	9	0	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AP-54 (bg)	-0.00001553	-3	-30	No	10	0	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AP-58	-0.0001235	-19	-25	No	9	0	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AP-59	0	7	30	No	10	90	n/a	n/a	0.01	NP
Beryllium, total (mg/L)	AP-60	0	4	21	No	8	50	n/a	n/a	0.01	NP
Boron, total (mg/L)	AP-51 (bg)	0.002669	19	30	No	10	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AP-53 (bg)	0.005421	3	30	No	10	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AP-54 (bg)	0	0	30	No	10	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	**AP-58**	**-1.444**	**-39**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Boron, total (mg/L)	AP-59	-0.1586	-25	-30	No	10	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AP-60	0.2422	6	21	No	8	0	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AP-51 (bg)	0	0	30	No	10	60	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AP-53 (bg)	7.2e-10	5	30	No	10	30	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AP-54 (bg)	0	-1	-30	No	10	80	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AP-58	0	7	30	No	10	90	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AP-59	0	0	30	No	10	100	n/a	n/a	0.01	NP
Cadmium, total (mg/L)	AP-60	0	0	21	No	8	100	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AP-51 (bg)	0.5168	9	30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AP-53 (bg)	-0.3553	-12	-30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AP-54 (bg)	-1.074	-8	-30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	**AP-58**	**53.09**	**37**	**30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Calcium, total (mg/L)	AP-59	0.991	5	30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AP-60	-8.462	-4	-21	No	8	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AP-51 (bg)	1.103	11	30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AP-53 (bg)	3.23	28	30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AP-54 (bg)	0	-1	-30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AP-58	-9.924	-28	-30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AP-59	-2.205	-19	-30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AP-60	6.522	15	21	No	8	0	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AP-51 (bg)	-0.0001604	-8	-30	No	10	0	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AP-53 (bg)	-0.02263	-12	-25	No	9	0	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AP-54 (bg)	-0.00004514	-2	-30	No	10	0	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AP-58	-0.0014	-14	-25	No	9	0	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AP-59	0	0	30	No	10	60	n/a	n/a	0.01	NP
Chromium, total (mg/L)	AP-60	-0.001069	-2	-21	No	8	12.5	n/a	n/a	0.01	NP
Cobalt, total (mg/L)	AP-51 (bg)	0.003129	10	30	No	10	0	n/a	n/a	0.01	NP

Trend Tests Summary Table - All Results

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 10/30/2017, 6:23 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Cobalt, total (mg/L)	AP-53 (bg)	-0.004489	-15	-30	No	10	0	n/a	n/a	0.01	NP
Cobalt, total (mg/L)	AP-54 (bg)	-0.001698	-6	-30	No	10	0	n/a	n/a	0.01	NP
Cobalt, total (mg/L)	**AP-58**	**-0.003067**	**-35**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Cobalt, total (mg/L)	AP-59	0.0009786	21	30	No	10	0	n/a	n/a	0.01	NP
Cobalt, total (mg/L)	AP-60	-0.002084	-12	-21	No	8	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AP-51 (bg)	0.21	2	25	No	9	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AP-53 (bg)	-1.221	-6	-21	No	8	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AP-54 (bg)	-0.4938	-4	-25	No	9	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AP-58	0.6721	12	25	No	9	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AP-59	0.05074	8	30	No	10	0	n/a	n/a	0.01	NP
Combined Radium 226 + 228 (pCi/L)	AP-60	5.987	14	21	No	8	0	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AP-51 (bg)	0	-5	-30	No	10	90	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AP-53 (bg)	0	3	30	No	10	90	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AP-54 (bg)	0	3	30	No	10	90	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AP-58	0	0	30	No	10	30	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AP-59	0	2	30	No	10	30	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AP-60	0	-4	-21	No	8	50	n/a	n/a	0.01	NP
Lead, total (mg/L)	AP-51 (bg)	0.001689	13	30	No	10	50	n/a	n/a	0.01	NP
Lead, total (mg/L)	AP-53 (bg)	-0.004759	-10	-25	No	9	22.22	n/a	n/a	0.01	NP
Lead, total (mg/L)	AP-54 (bg)	0	1	30	No	10	80	n/a	n/a	0.01	NP
Lead, total (mg/L)	AP-58	0	-2	-30	No	10	60	n/a	n/a	0.01	NP
Lead, total (mg/L)	AP-59	0	7	30	No	10	90	n/a	n/a	0.01	NP
Lead, total (mg/L)	AP-60	0.002058	10	21	No	8	62.5	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AP-51 (bg)	-0.001083	-4	-30	No	10	10	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AP-53 (bg)	-0.004292	-9	-25	No	9	0	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AP-54 (bg)	0.00004406	2	30	No	10	0	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AP-58	0.006309	5	30	No	10	10	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AP-59	-0.0001589	-9	-30	No	10	0	n/a	n/a	0.01	NP
Lithium, total (mg/L)	AP-60	-0.001442	-12	-21	No	8	0	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AP-51 (bg)	0.000005301	16	30	No	10	60	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AP-53 (bg)	-0.00002708	-8	-30	No	10	10	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AP-54 (bg)	-0.000007657	-5	-30	No	10	0	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AP-58	-0.000006844	-13	-30	No	10	40	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AP-59	0	-20	-30	No	10	70	n/a	n/a	0.01	NP
Mercury, total (mg/L)	AP-60	-0.00002546	-14	-21	No	8	50	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AP-51 (bg)	0	5	30	No	10	80	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AP-53 (bg)	-0.001322	-8	-30	No	10	20	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AP-54 (bg)	0	-4	-30	No	10	70	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	**AP-58**	**-0.06058**	**-37**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Molybdenum, total (mg/L)	AP-59	-0.00285	-24	-30	No	10	0	n/a	n/a	0.01	NP
Molybdenum, total (mg/L)	AP-60	0.005494	4	21	No	8	0	n/a	n/a	0.01	NP
pH, field (SU)	AP-51 (bg)	0	0	30	No	10	0	n/a	n/a	0.01	NP
pH, field (SU)	AP-53 (bg)	0.3288	25	30	No	10	0	n/a	n/a	0.01	NP
pH, field (SU)	AP-54 (bg)	-0.4324	-21	-30	No	10	0	n/a	n/a	0.01	NP
pH, field (SU)	AP-58	-1.689	-21	-30	No	10	0	n/a	n/a	0.01	NP
pH, field (SU)	AP-59	-0.3259	-11	-30	No	10	0	n/a	n/a	0.01	NP
pH, field (SU)	AP-60	0.2226	2	21	No	8	0	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AP-51 (bg)	0	9	30	No	10	90	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AP-53 (bg)	0	3	30	No	10	80	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AP-54 (bg)	0	3	30	No	10	90	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AP-58	0	14	30	No	10	70	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AP-59	0	0	30	No	10	100	n/a	n/a	0.01	NP
Selenium, total (mg/L)	AP-60	0	0	21	No	8	100	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AP-51 (bg)	0	-1	-30	No	10	10	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AP-53 (bg)	14.46	24	30	No	10	0	n/a	n/a	0.01	NP

Trend Tests Summary Table - All Results

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 10/30/2017, 6:23 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Sulfate, total (mg/L)	**AP-54 (bg)**	**-14.22**	**-33**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate, total (mg/L)	**AP-58**	**-141.7**	**-35**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate, total (mg/L)	AP-59	7.631	12	30	No	10	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AP-60	15.52	5	21	No	8	0	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AP-51 (bg)	0	0	30	No	10	100	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AP-53 (bg)	0	5	30	No	10	90	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AP-54 (bg)	0	9	30	No	10	90	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AP-58	0	5	30	No	10	90	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AP-59	0.0005408	15	30	No	10	40	n/a	n/a	0.01	NP
Thallium, total (mg/L)	AP-60	0	-1	-21	No	8	87.5	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	AP-51 (bg)	0	0	30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	AP-53 (bg)	45.22	24	30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	AP-54 (bg)	-29.07	-22	-30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	**AP-58**	**-342**	**-31**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Total Dissolved Solids [TDS] (mg/L)	AP-59	-13.04	-6	-30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	AP-60	-0.9656	-4	-21	No	8	0	n/a	n/a	0.01	NP

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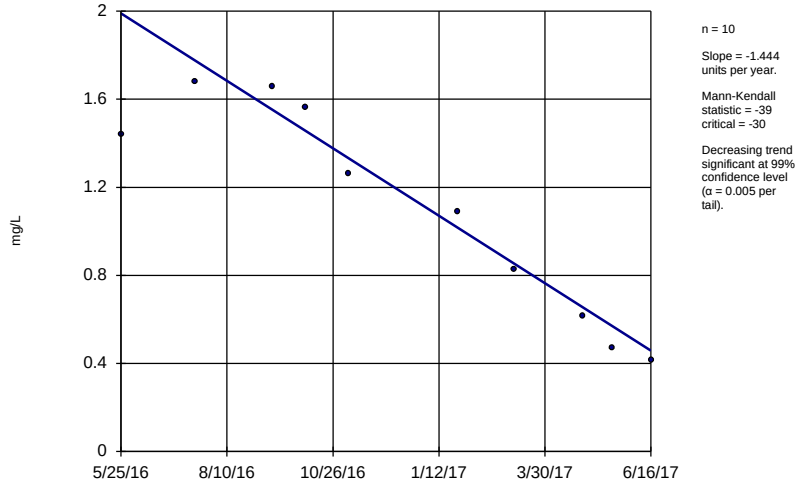
Sen's Slope Estimator

AP-58



n = 10

Slope = -1.444 units per year.

Mann-Kendall statistic = -39 critical = -30

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

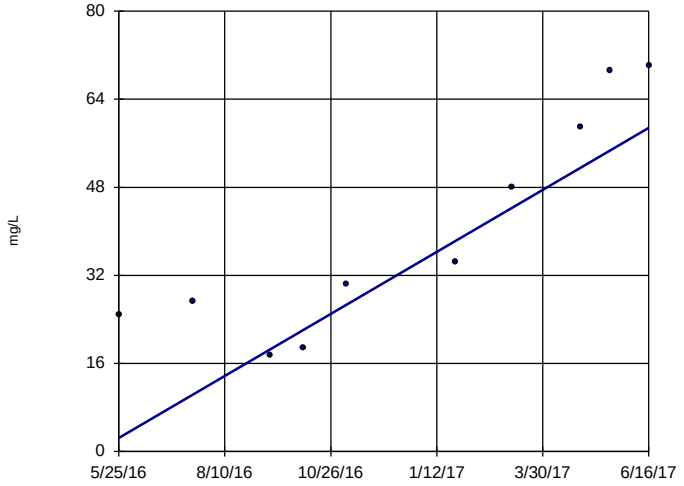
Constituent: Boron, total Analysis Run 10/30/2017 6:16 AM View: Trend Tests

Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Sen's Slope Estimator

AP-58



n = 10

Slope = 53.09 units per year.

Mann-Kendall statistic = 37 critical = 30

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

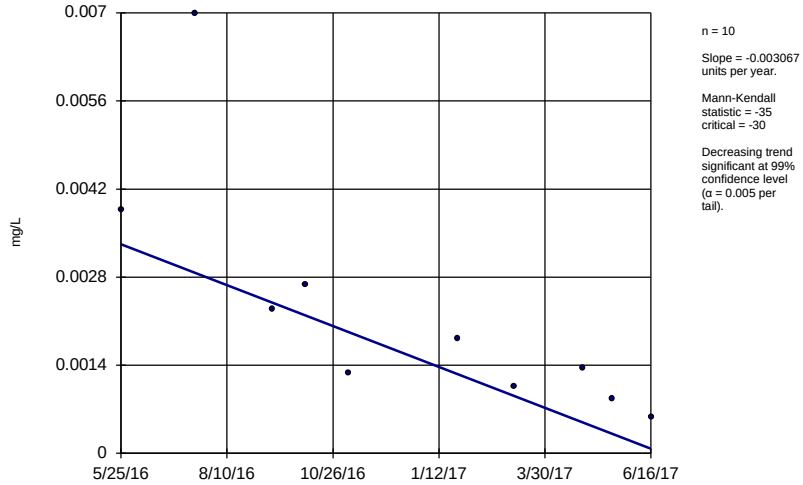
Constituent: Calcium, total Analysis Run 10/30/2017 6:16 AM View: Trend Tests

Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Sen's Slope Estimator

AP-58



n = 10

Slope = -0.003067 units per year.

Mann-Kendall statistic = -35 critical = -30

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

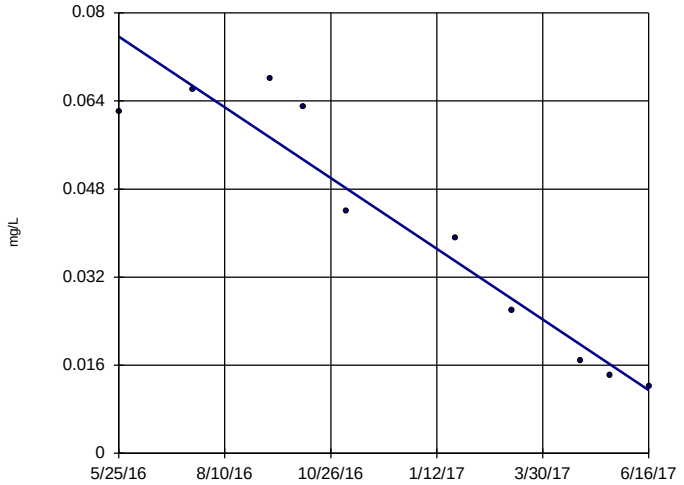
Constituent: Cobalt, total Analysis Run 10/30/2017 6:16 AM View: Trend Tests

Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Sen's Slope Estimator

AP-58



n = 10

Slope = -0.06058 units per year.

Mann-Kendall statistic = -37 critical = -30

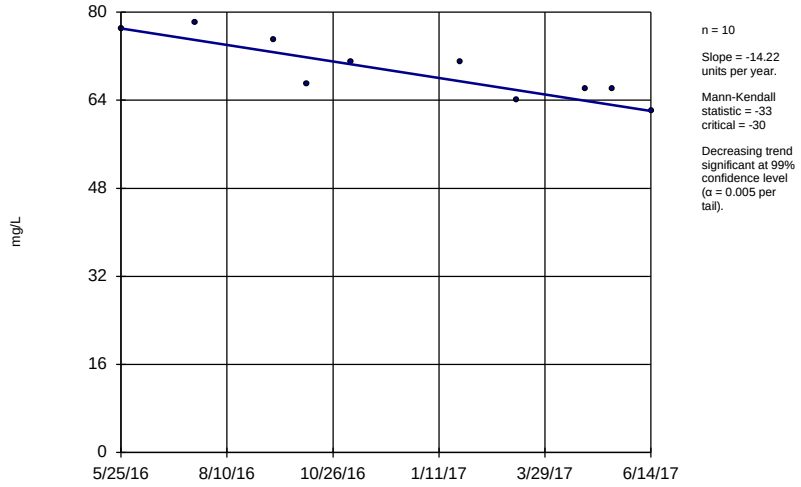
Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

Constituent: Molybdenum, total Analysis Run 10/30/2017 6:16 AM View: Trend Tests

Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sen's Slope Estimator

AP-54 (bg)



n = 10

Slope = -14.22 units per year.

Mann-Kendall statistic = -33 critical = -30

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

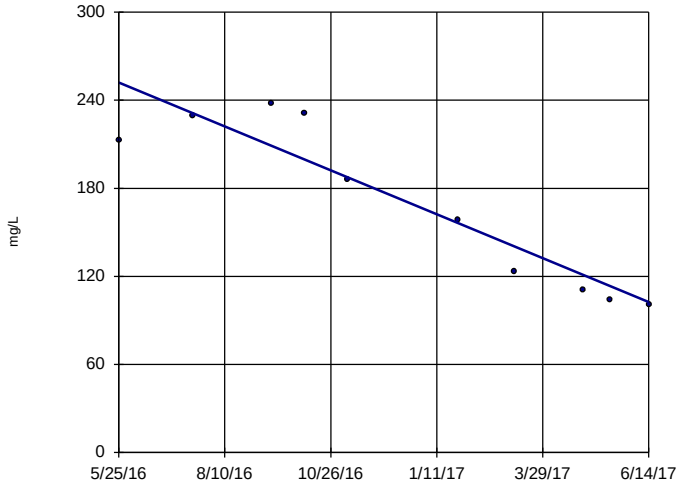
Constituent: Sulfate, total Analysis Run 10/30/2017 6:16 AM View: Trend Tests

Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Sen's Slope Estimator

AP-58



n = 10

Slope = -141.7 units per year.

Mann-Kendall statistic = -35 critical = -30

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

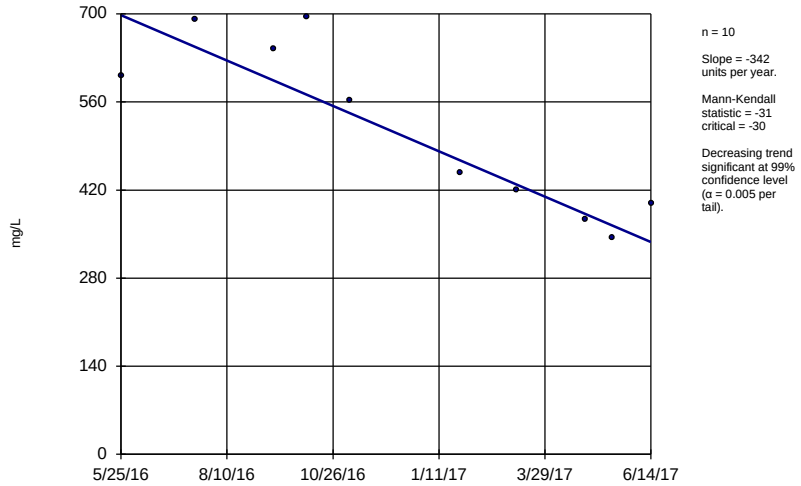
Constituent: Sulfate, total Analysis Run 10/30/2017 6:16 AM View: Trend Tests

Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Sen's Slope Estimator

AP-58



n = 10

Slope = -342 units per year.

Mann-Kendall statistic = -31 critical = -30

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

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/30/2017 6:17 AM View: Trend Tests

Flint BAP Client: Geosyntec Data: Flint Creek BAP

Analysis of Variance

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 1/15/2018, 5:25 PM

Constituent	Crit.	Sig.	Alpha	Transform	ANOVA Sig.	Calc.	Alpha	Method
Boron, total (mg/L)	n/a	n/a	n/a	No	Yes	25.94	0.05	NP (normality)
Calcium, total (mg/L)	n/a	n/a	n/a	sqrt(x)	Yes	176.3	0.05	Param.
Chloride, total (mg/L)	n/a	n/a	n/a	x^2	Yes	149.7	0.05	Param.
Fluoride, total (mg/L)	n/a	n/a	n/a	No	No	0.009516	0.05	NP (NDs)
pH, field (SU)	n/a	n/a	n/a	No	Yes	16.82	0.05	Param.
Sulfate, total (mg/L)	n/a	n/a	n/a	sqrt(x)	Yes	416.4	0.05	Param.
Total Dissolved Solids [TDS] (mg/L)	n/a	n/a	n/a	sqrt(x)	Yes	45.62	0.05	Param.

Non-Parametric ANOVA

Constituent: Boron, total Analysis Run 1/15/2018 5:23 PM View: ANOVA
Flint BAP Client: Geosyntec Data: Flint Creek BAP

For observations made between 5/25/2016 and 6/16/2017, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 25.94

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 4 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 25.81
Adjusted Kruskal-Wallis statistic (H') = 25.94

Parametric ANOVA

Constituent: Calcium, total Analysis Run 1/15/2018 5:24 PM View: ANOVA
Flint BAP Client: Geosyntec Data: Flint Creek BAP

For observations made between 5/25/2016 and 6/16/2017 the parametric analysis of variance test (after square root transformation) indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 176.3

Tabulated F statistic = 3.35 with 2 and 27 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	8.748	2	4.374	176.3
Error Within Groups	0.6698	27	0.02481	
Total	9.417	29		

The Shapiro Wilk normality test on the residuals passed after square root transformation. Alpha = 0.05, calculated = 0.9344, critical = 0.927. Levene's Equality of Variance test passed. Calculated = 0.8467, tabulated = 3.35.

Parametric ANOVA

Constituent: Chloride, total Analysis Run 1/15/2018 5:24 PM View: ANOVA
Flint BAP Client: Geosyntec Data: Flint Creek BAP

For observations made between 5/25/2016 and 6/14/2017 the parametric analysis of variance test (after square transformation) indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 149.7

Tabulated F statistic = 3.35 with 2 and 27 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	194021	2	97010	149.7
Error Within Groups	17499	27	648.1	
Total	211519	29		

The Shapiro Wilk normality test on the residuals passed after square transformation. Alpha = 0.05, calculated = 0.9446, critical = 0.927. Levene's Equality of Variance test passed. Calculated = 3.07, tabulated = 3.35.

Non-Parametric ANOVA

Constituent: Fluoride, total Analysis Run 1/15/2018 5:25 PM View: ANOVA
Flint BAP Client: Geosyntec Data: Flint Creek BAP

For observations made between 5/25/2016 and 6/14/2017, the non-parametric analysis of variance test indicates NO DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is less than or equal to the Chi-squared value, we conclude that no group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 0.009516

Tabulated Chi-Squared value = 5.991 with 2 degrees of freedom at the 5% significance level.

There were 1 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 0.002581
Adjusted Kruskal-Wallis statistic (H') = 0.009516

Parametric ANOVA

Constituent: pH, field Analysis Run 1/15/2018 5:25 PM View: ANOVA
Flint BAP Client: Geosyntec Data: Flint Creek BAP

For observations made between 5/23/2016 and 6/13/2017 the parametric analysis of variance test indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 16.82

Tabulated F statistic = 3.35 with 2 and 27 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	2.437	2	1.218	16.82
Error Within Groups	1.956	27	0.07244	
Total	4.392	29		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.9496, critical = 0.927. Levene's Equality of Variance test passed. Calculated = 0.951, tabulated = 3.35.

Parametric ANOVA

Constituent: Sulfate, total Analysis Run 1/15/2018 5:25 PM View: ANOVA
Flint BAP Client: Geosyntec Data: Flint Creek BAP

For observations made between 5/25/2016 and 6/14/2017 the parametric analysis of variance test (after square root transformation) indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 416.4

Tabulated F statistic = 3.35 with 2 and 27 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	229.9	2	114.9	416.4
Error Within Groups	7.454	27	0.2761	
Total	237.3	29		

The Shapiro Wilk normality test on the residuals passed after square root transformation. Alpha = 0.05, calculated = 0.9687, critical = 0.927. Levene's Equality of Variance test passed. Calculated = 2.829, tabulated = 3.35.

Parametric ANOVA

Constituent: Total Dissolved Solids [TDS] Analysis Run 1/15/2018 5:25 PM View: ANOVA
Flint BAP Client: Geosyntec Data: Flint Creek BAP

For observations made between 5/25/2016 and 6/14/2017 the parametric analysis of variance test (after square root transformation) indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 45.62

Tabulated F statistic = 3.35 with 2 and 27 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	102.2	2	51.09	45.62
Error Within Groups	30.24	27	1.12	
Total	132.4	29		

The Shapiro Wilk normality test on the residuals passed after square root transformation. Alpha = 0.05, calculated = 0.935, critical = 0.927. Levene's Equality of Variance test passed. Calculated = 1.354, tabulated = 3.35.

Tolerance Limits - Appendix III

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 11/5/2017, 6:54 PM

Constituent	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	0.284	n/a	30	n/a	n/a	0	n/a	n/a	0.2146	NP Inter(normality)
Calcium, total (mg/L)	11.8	n/a	30	n/a	n/a	0	n/a	n/a	0.2146	NP Inter(normality)
Chloride, total (mg/L)	16	n/a	30	n/a	n/a	0	n/a	n/a	0.2146	NP Inter(normality)
Fluoride, total (mg/L)	1	n/a	30	n/a	n/a	90	n/a	n/a	0.2146	NP Inter(NDs)
pH, field (SU)	6.287	4.075	30	5.181	0.3892	0	None	No	0.01	Inter
Sulfate, total (mg/L)	78	n/a	30	n/a	n/a	3.333	n/a	n/a	0.2146	NP Inter(normality)
Total Dissolved Solids [TDS] (mg/L)	232.6	n/a	30	118.3	45.44	0	None	No	0.01	Inter

Confidence Interval Summary Table - Significant Results Appendix III

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 11/5/2017, 6:57 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	AP-58	1.541	0.6635	0.284	Yes	10	1.102	0.4915	0	None	No	0.01	Param.
Boron, total (mg/L)	AP-60	1.391	1.154	0.284	Yes	8	1.273	0.1122	0	None	No	0.01	Param.
Calcium, total (mg/L)	AP-58	57.98	22.04	11.8	Yes	10	40.01	20.14	0	None	No	0.01	Param.
Calcium, total (mg/L)	AP-59	40.34	35.96	11.8	Yes	10	38.15	2.455	0	None	No	0.01	Param.
Calcium, total (mg/L)	AP-60	35.7	16.05	11.8	Yes	8	25.88	9.269	0	None	No	0.01	Param.
pH, field (SU)	AP-58	8.438	6.766	6.29	Yes	10	7.602	0.813	0	None	No	0.005	Param.
pH, field (SU)	AP-59	7.504	6.814	6.29	Yes	10	7.159	0.3359	0	None	No	0.005	Param.
pH, field (SU)	AP-60	8.673	7.487	6.29	Yes	8	8.08	0.4793	0	None	No	0.005	Param.
Sulfate, total (mg/L)	AP-58	219.9	118.9	78	Yes	10	169.4	56.65	0	None	No	0.01	Param.
Sulfate, total (mg/L)	AP-60	166.7	145.1	78	Yes	8	155.9	10.19	0	None	No	0.01	Param.
Total Dissolved Solids [TDS] (mg/L)	AP-58	639.2	396.6	232.6	Yes	10	517.9	136	0	None	No	0.01	Param.
Total Dissolved Solids [TDS] (mg/L)	AP-60	369	302	232.6	Yes	8	351.4	23.48	0	None	No	0.004	NP (normality)

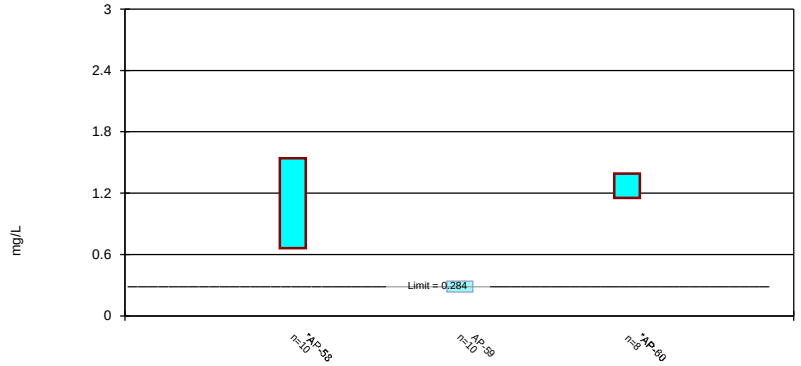
Confidence Interval Summary Table - All Results Appendix III

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 11/5/2017, 6:57 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	**AP-58**	**1.541**	**0.6635**	**0.284**	**Yes**	**10**	**1.102**	**0.4915**	**0**	**None**	**No**	**0.01**	**Param.**
Boron, total (mg/L)	AP-59	0.3412	0.232	0.284	No	10	0.2866	0.06123	0	None	No	0.01	Param.
Boron, total (mg/L)	**AP-60**	**1.391**	**1.154**	**0.284**	**Yes**	**8**	**1.273**	**0.1122**	**0**	**None**	**No**	**0.01**	**Param.**
Calcium, total (mg/L)	**AP-58**	**57.98**	**22.04**	**11.8**	**Yes**	**10**	**40.01**	**20.14**	**0**	**None**	**No**	**0.01**	**Param.**
Calcium, total (mg/L)	**AP-59**	**40.34**	**35.96**	**11.8**	**Yes**	**10**	**38.15**	**2.455**	**0**	**None**	**No**	**0.01**	**Param.**
Calcium, total (mg/L)	**AP-60**	**35.7**	**16.05**	**11.8**	**Yes**	**8**	**25.88**	**9.269**	**0**	**None**	**No**	**0.01**	**Param.**
Chloride, total (mg/L)	AP-58	22.49	13.51	16	No	10	18	5.033	0	None	No	0.01	Param.
Chloride, total (mg/L)	AP-59	15	12	16	No	10	14.1	1.969	0	None	No	0.011	NP (normality)
Chloride, total (mg/L)	AP-60	15.39	12.61	16	No	8	14	1.309	0	None	No	0.01	Param.
pH, field (SU)	**AP-58**	**8.438**	**6.766**	**6.29**	**Yes**	**10**	**7.602**	**0.813**	**0**	**None**	**No**	**0.005**	**Param.**
pH, field (SU)	**AP-59**	**7.504**	**6.814**	**6.29**	**Yes**	**10**	**7.159**	**0.3359**	**0**	**None**	**No**	**0.005**	**Param.**
pH, field (SU)	**AP-60**	**8.673**	**7.487**	**6.29**	**Yes**	**8**	**8.08**	**0.4793**	**0**	**None**	**No**	**0.005**	**Param.**
Sulfate, total (mg/L)	**AP-58**	**219.9**	**118.9**	**78**	**Yes**	**10**	**169.4**	**56.65**	**0**	**None**	**No**	**0.01**	**Param.**
Sulfate, total (mg/L)	AP-59	39.73	28.07	78	No	10	33.9	6.54	0	None	No	0.01	Param.
Sulfate, total (mg/L)	**AP-60**	**166.7**	**145.1**	**78**	**Yes**	**8**	**155.9**	**10.19**	**0**	**None**	**No**	**0.01**	**Param.**
Total Dissolved Solids [TDS] (mg/L)	**AP-58**	**639.2**	**396.6**	**232.6**	**Yes**	**10**	**517.9**	**136**	**0**	**None**	**No**	**0.01**	**Param.**
Total Dissolved Solids [TDS] (mg/L)	AP-59	236.5	208.3	232.6	No	10	222.4	15.77	0	None	No	0.01	Param.
Total Dissolved Solids [TDS] (mg/L)	**AP-60**	**369**	**302**	**232.6**	**Yes**	**8**	**351.4**	**23.48**	**0**	**None**	**No**	**0.004**	**NP (normality)**

Parametric Confidence Interval

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



Constituent: Boron, total Analysis Run 11/5/2017 6:56 PM View: Confidence Intervals - App III
Flint BAP Client: Geosyntec Data: Flint Creek BAP

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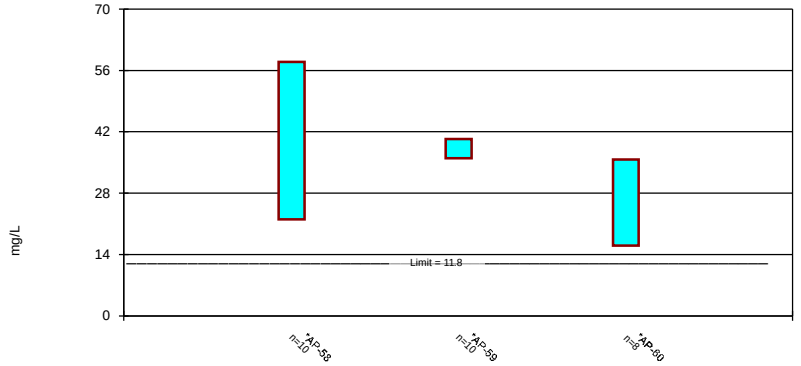
Parametric Confidence Interval

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

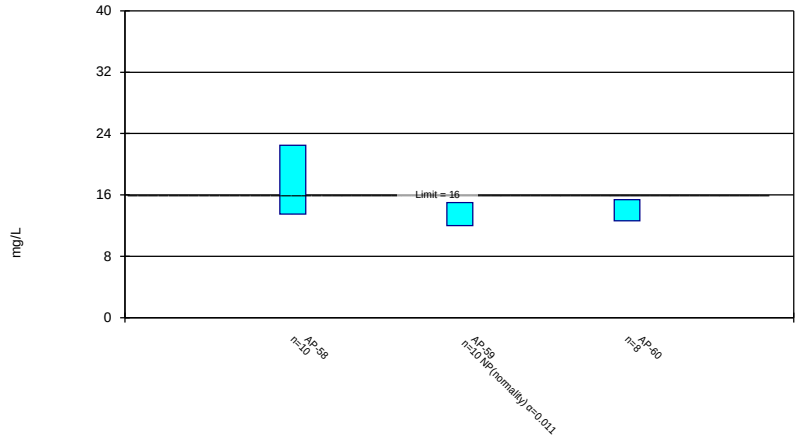


Constituent: Calcium, total Analysis Run 11/5/2017 6:56 PM View: Confidence Intervals - App III
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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

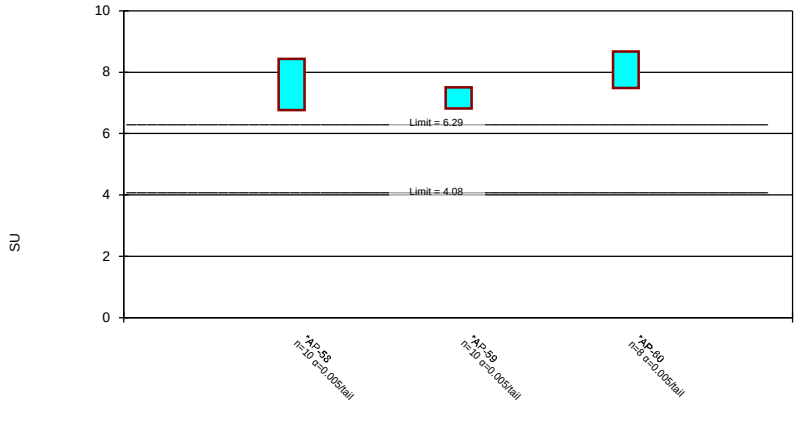


Constituent: Chloride, total Analysis Run 11/5/2017 6:56 PM View: Confidence Intervals - App III
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric Confidence Interval

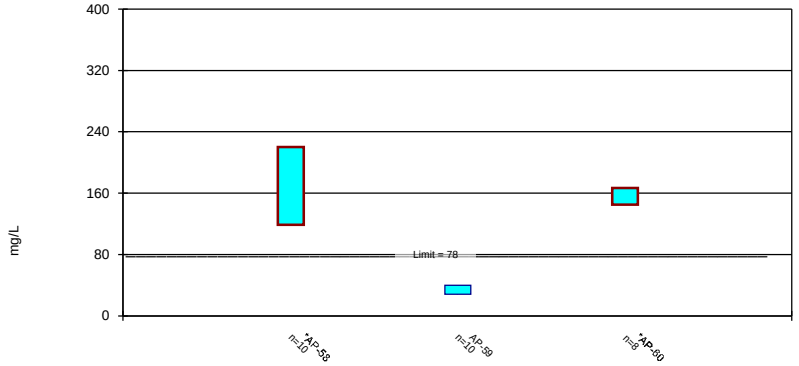
Compliance limit is exceeded.* Normality Test: Shapiro Wilk, alpha based on n.



Constituent: pH, field Analysis Run 11/5/2017 6:56 PM View: Confidence Intervals - App III
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Parametric Confidence Interval

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

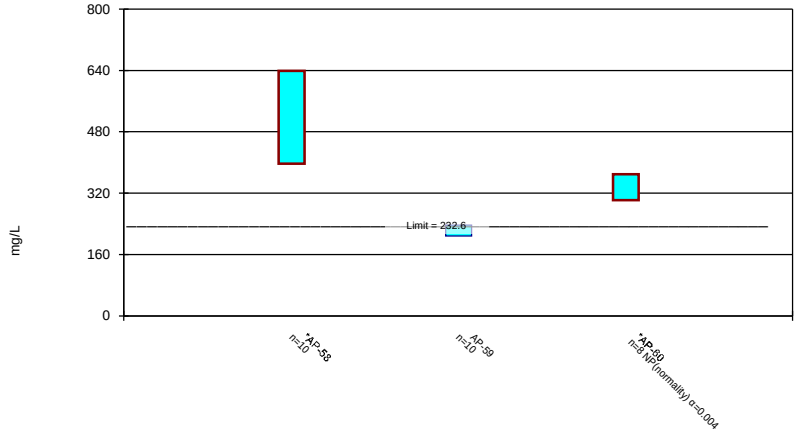


Constituent: Sulfate, total Analysis Run 11/5/2017 6:56 PM View: Confidence Intervals - App III
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Sanitas™ v.9.6.00 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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



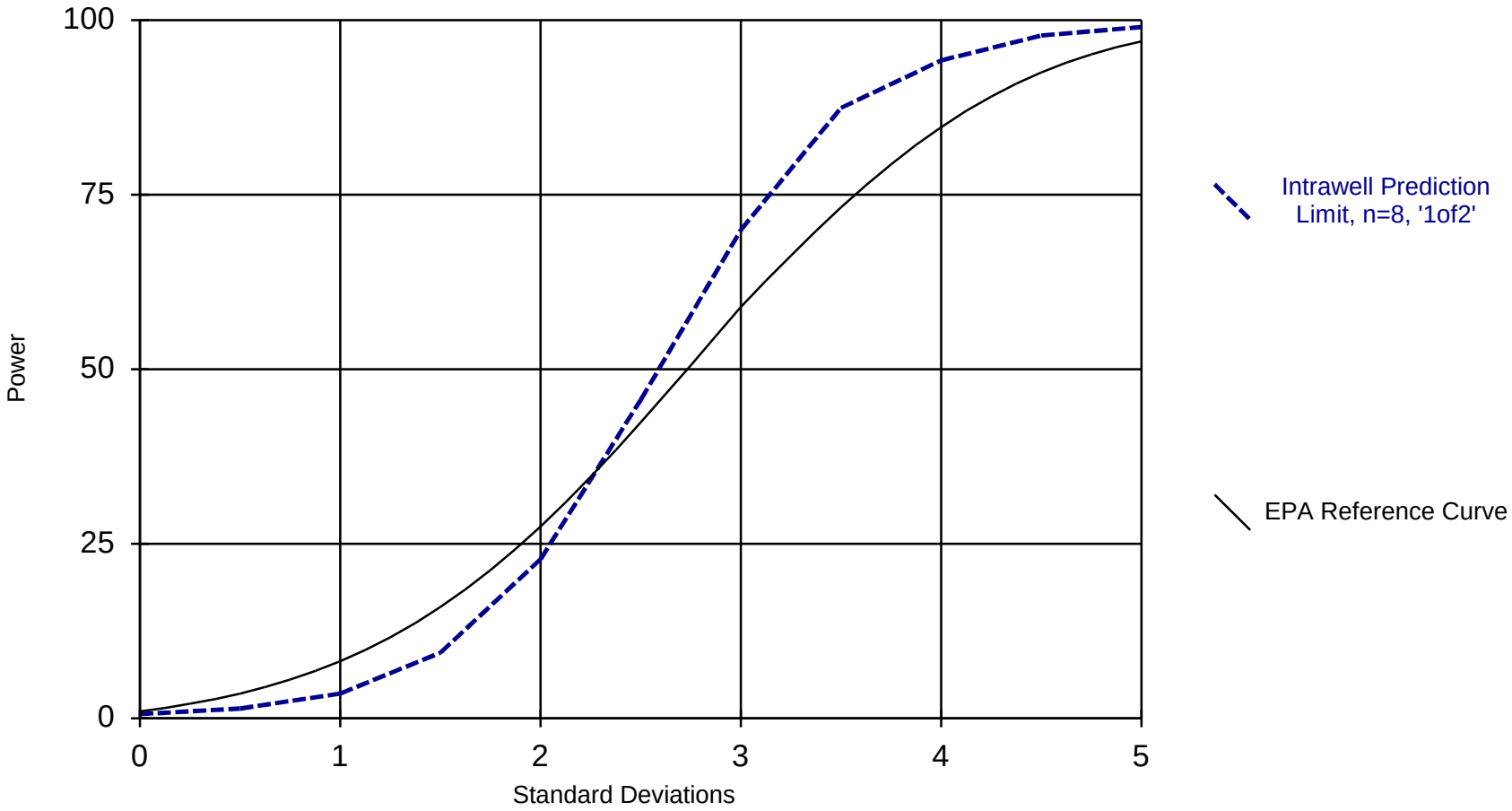
Constituent: Total Dissolved Solids [TDS] Analysis Run 11/5/2017 6:56 PM View: Confidence Intervals - A
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Intrawell Prediction Limit Summary Table

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 10/30/2017, 6:38 AM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Chloride, total (mg/L)	AP-51	8.126	n/a	10	5.9	0.9944	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AP-53	16.33	n/a	10	13.2	1.398	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AP-54	16.83	n/a	10	15	0.8165	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AP-58	29.26	n/a	10	18	5.033	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AP-59	18.51	n/a	10	14.1	1.969	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AP-60	17.22	n/a	8	14	1.309	0	None	No	0.002505	Param Intra 1 of 2

Power Curve



Kappa = 2.458, based on 3 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 10/30/2017 6:40 AM View: PLs - Interwell

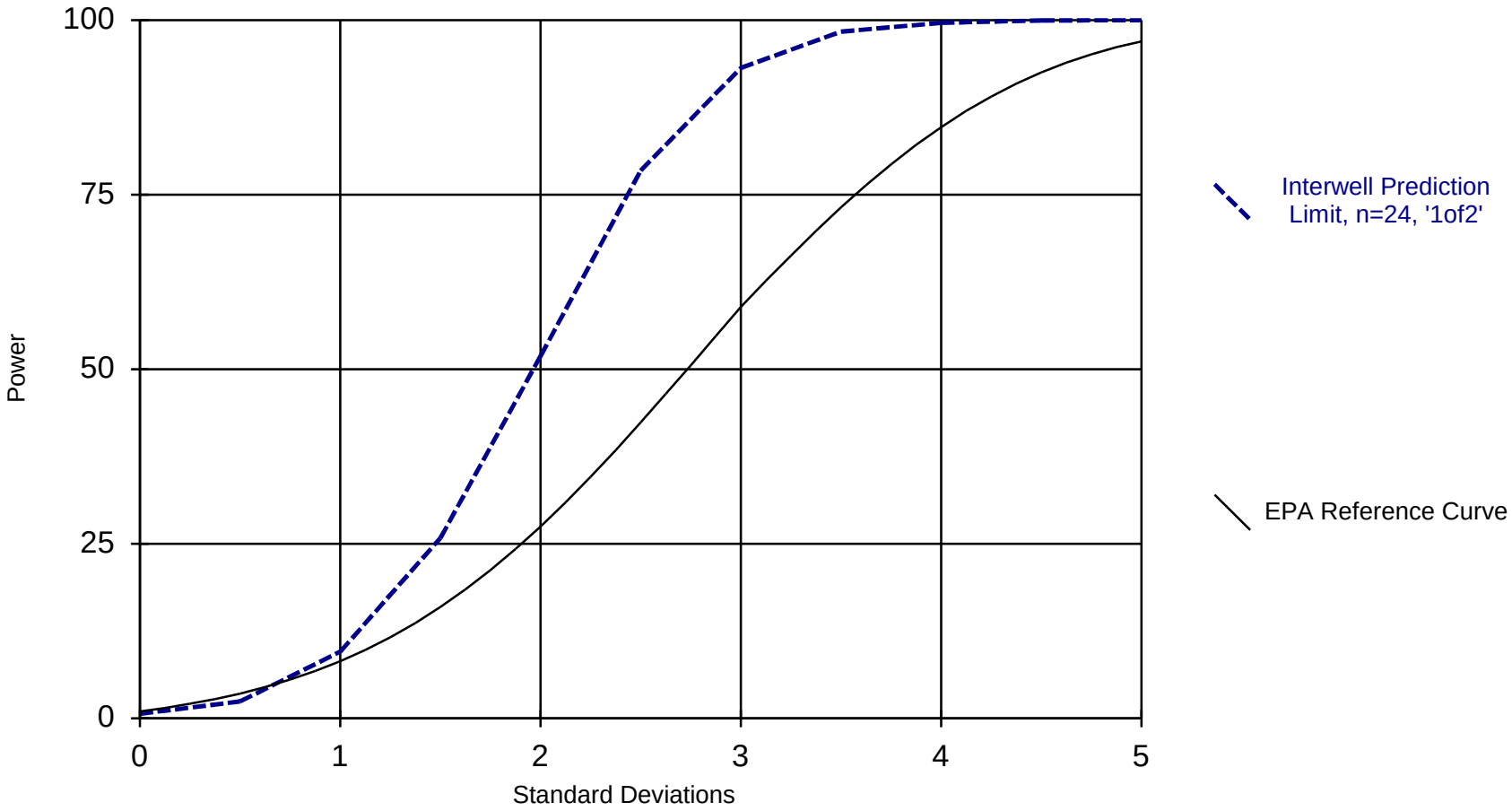
Flint BAP Client: Geosyntec Data: Flint Creek BAP

Interwell Prediction Limit Summary Table

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 10/30/2017, 6:40 AM

Constituent	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	0.284	n/a	30	n/a	n/a	0	n/a	n/a	0.00197	NP (normality) 1 of 2
Calcium, total (mg/L)	11.8	n/a	30	n/a	n/a	0	n/a	n/a	0.00197	NP (normality) 1 of 2
Fluoride, total (mg/L)	1	n/a	30	n/a	n/a	90	n/a	n/a	0.00197	NP (NDs) 1 of 2
pH, field (SU)	5.879	4.483	30	5.181	0.3892	0	None	No	0.001253	Param 1 of 2
Sulfate, total (mg/L)	78	n/a	30	n/a	n/a	3.333	n/a	n/a	0.00197	NP (normality) 1 of 2
Total Dissolved Solids [TDS] (mg/L)	199.8	n/a	30	118.3	45.44	0	None	No	0.002505	Param 1 of 2

Power Curve



Kappa = 1.845, based on 3 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 10/30/2017 6:41 AM View: PLs - Interwell

Flint BAP Client: Geosyntec Data: Flint Creek BAP

APPENDIX III

Alternate source demonstrations are included in this appendix. Alternate sources are sources or reasons that explain that statistically significant increases over background or statistically significant levels above the groundwater protection standard are not attributable to the CCR unit.

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

Flint Creek Plant
Primary Bottom Ash Pond
Gentry, Arkansas

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

150 East Wilson Bridge Road
Suite 232
Worthington, Ohio 43085

April 3, 2018

CHA8462

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LPL	Lower Prediction Limit
PBAP	Primary Bottom Ash Pond
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

Ten background monitoring events were conducted at the Flint Creek Primary Bottom Ash Pond (PBAP), and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. Prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed. Following two detection monitoring events at the PBAP, SSIs were identified for the following constituents listed in 40 CFR Part 257 Appendix III:

- Boron at AP-60 by interwell analysis;
- Calcium at AP-58, AP-59, and AP-60 by interwell analysis;
- pH at AP-58, AP-59, and AP-60 by interwell analysis;
- Total dissolved solids (TDS) at AP-58, AP-59, and AP-60 by interwell analysis; and
- Sulfate at AP-58 and AP-60 by interwell analysis.

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

1.1 CCR Rule Requirements

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

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

Pursuant to the Rule, Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report, which documents that the SSIs cited above should not be attributed to the Flint Creek PBAP.

Two detection monitoring events were conducted on August 29, 2017 and December 21, 2017 at the Flint Creek PBAP to identify SSIs over background limits. The CCR Rule allows the owner or operator 90 days from the determination of an SSI to demonstrate that the SSI resulted from a source other than the regulated CCR unit, such as an error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

1.2 Demonstration of Alternative Sources

SSIs over background limits were identified with a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

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

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

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

SECTION 2

· ALTERNATIVE SOURCE DEMONSTRATION ·

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

2.1 Proposed Alternative Source

Initial review of site geochemistry, site historical data, and laboratory QA/QC did not identify ASDs due to Type I or Type II issues. A review of the statistical analysis did not identify any errors which would relate to a Type III ASD. However, the initial review identified natural variation of groundwater quality, which is a Type IV ASD, as the likely cause of exceedances at the Flint Creek PBAP.

Boring logs provided in the Groundwater Monitoring Network Report (Terracon, 2016) reveal distinct differences in lithology between the upgradient and downgradient locations in the aquifer. The downgradient locations were characterized as consisting of massive limestone beds and clay. The downgradient limestone is typically gray and crystalline, and the clays have a silty texture. In contrast, upgradient lithology consists of thinner layers of alternating reddish-brown limestone and clay. In addition, the upgradient limestone is cherty and exhibits significantly more weathering. Also, the clays are coarser and intermixed with gravely material. Key differences between upgradient and downgradient geology are illustrated on Figure 1.

The coarser texture clays and weathered limestone in the upgradient aquifer suggest the rock offers little resistance to surface water infiltration. In-situ weathering has removed some of the limestone, leaving chert and limestone gravel mixed with clay as residual soil overburden (Terracon, 2016). Boring logs indicate that weathering is more advanced in upgradient locations. Because of their relatively inert makeup, fragments of chert (silica) and aluminosilicate clays should have little influence on Appendix III constituents. The presence of the limestone would suggest that the groundwater is in equilibrium with calcite ($CaCO_3$), which typically controls the concentrations of calcium, alkalinity (bicarbonate) and pH. However, low calcium concentrations (often <10 mg/L) and low pH (roughly 4.5 to 5.5) in upgradient groundwater suggest that the limestone has become passivated and unable to provide buffering against acidic water. A review of saturation indices (SIs) calculated using PHREEQC shows that the upgradient locations are highly undersaturated with respect to calcite (Table 2), which is a strong indication that the calcite in upgradient limestone has little effect on groundwater composition. On the contrary, downgradient groundwater tends to be very close to full saturation with calcite, suggesting that a dynamic equilibrium exists between the limestone unit and groundwater.

Fracturing in the upgradient aquifer appears to facilitate infiltration of surface water to the shallow water table. A likely scenario is that storm water collects on the ground surface upslope from the PBAP, where it picks up acidity due to decaying organic (plant) matter. Once saturated, the thin soil zone allows the surface water to migrate through fragmented and fractured rock. Acidic water, which often contains dissolved iron, manganese, aluminum and other metals, can be neutralized when contacting limestone, raising the pH of the water. However, a common side reaction includes precipitation of ferric hydroxide on reactive limestone surfaces. In addition to changing the color of the limestone from light gray to reddish brown (as was noted in the boring logs), coating the limestone surfaces further diminishes neutralization capacity and reduces the dissolution rate of the limestone (Cravotta and Trahan, 1999; Johnson and Hallberg, 2005). Limestone passivation is often known as "armoring" in the treatment of acid mine drainage. The net result is that the chemistry of the surface water reaching the water table may have changed very little compared to the surface water, and therefore is dissimilar to the downgradient groundwater.

Recharge in the downgradient aquifer may be much slower than it is upgradient, due to a thicker and more competent limestone unit. In addition, groundwater beneath the PBAP is protected from surface water infiltration by the more competent limestone and thus is more closely in equilibrium with the subsurface geology. Calculated SIs show that the downgradient groundwater is in equilibrium with respect to calcite (Table 2), which is consistent with the circumneutral pH and higher concentration of both calcium and alkalinity at downgradient monitoring locations.

Based on the observed differences between the upgradient and downgradient geology and the likely impacts on groundwater geochemistry, it was determined that interwell analysis may not be appropriate at the Flint Creek PBAP. Interwell tests had previously been used to evaluate potential SSIs for all Appendix III parameters (Geosyntec, 2018). Background values were recalculated for all Appendix III parameters using intrawell tests.

Comparing the detection monitoring results to the intrawell background values, SSIs are no longer observed for any Appendix III parameter. No new SSIs were identified as a result of changes to background values. While the second of two sampling events for calcium at AP-59 was above the revised background value, the result of the initial August 29, 2017 sampling event was below the revised calculated background value. Thus, an SSI was not identified for calcium at AP-59, as both samples in a one-of-two retesting procedure must be above the calculated background value for an SSI to be identified. The revised intrawell background values and detection monitoring results are summarized in Table 3, and the results of the revised statistical evaluation are included in Attachment A.

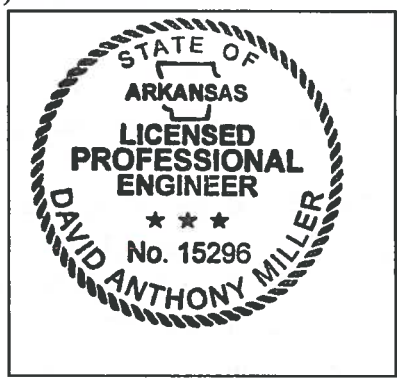
Future detection monitoring results will be compared to the applicable intrawell background values. The background values may be updated as additional data are collected, in accordance with the Statistical Analysis Plan (AEP, 2017).

2.2 Sampling Requirements

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

2.3 Certification by a Qualified Professional Engineer

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



DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

15296	ARKANSAS	04.03.18
License Number	Licensing State	Date

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding evidence serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and supports the position that the SSIs in Appendix III detection monitoring constituents are not due to a release from the Flint Creek PBAP during the August 2017 to December 2017 detection monitoring events. An investigation into differences between the upgradient and downgradient geology indicated that natural variation is the most likely source for the observed SSIs, resulting in a revision to the statistical approach utilized. Therefore, no further action is warranted and the Flint Creek PBAP will remain in the detection monitoring program.

SECTION 4

REFERENCES

AEP, 2017. Statistical Analysis Plan – Flint Creek Plant. January 2017.

Cravotta CA III, Trahan, MK. 1999. Limestone drains to increase pH and remove dissolved metals from acidic mine drainage. Appl Geochem. 14:581-606.

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Johnson DB, Hallberg KB. 2005. Acid mine drainage remediation options: a review. Sci. Tot. Environ. 338:3-14.

Terracon. 2016. Report 1 – Groundwater Monitoring Network for CCR Compliance. SWEPCO – Flint Creek Primary Bottom Ash Pond. August 2016.

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

TABLES

Table 1: Detection Monitoring Data Evaluation
Flint Creek Plant - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Units	Description	AP-58		AP-59		AP-60	
			8/29/2017	12/21/2017	8/29/2017	12/21/2017	8/29/2017	12/21/2017
Boron	mg/L	Interwell Background Value (UPL)	0.284					
	mg/L	Detection Monitoring Result	**0.333**	0.268	**0.295**	0.279	**1.13**	**0.857**
Calcium	mg/L	Interwell Background Value (UPL)	11.8					
	mg/L	Detection Monitoring Result	**75.5**	**73.9**	**35.4**	**46.8**	**32.3**	**46.2**
Chloride	mg/L	Intrawell Background Value (UPL)	29.26		18.51		17.22	
	mg/L	Detection Monitoring Result	12	-	12	-	13	-
Fluoride	mg/L	Interwell Background Value (UPL)	1					
	mg/L	Detection Monitoring Result	0.083	-	0.6463	-	0.4518	-
pH	SU	Interwell Background Value (UPL)	5.88					
	SU	Interwell Background Value (LPL)	4.48					
	SU	Detection Monitoring Result	**7.75**	**7.36**	**7.1**	**6.94**	**7.65**	**7.16**
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	200					
	mg/L	Detection Monitoring Result	**344**	**304**	**210**	**228**	**356**	**332**
Sulfate	mg/L	Interwell Background Value (UPL)	78					
	mg/L	Detection Monitoring Result	**96**	**80**	21	-	**146**	**128**

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

Table 2: Calculated Calcite Saturation Indices
Flint Creek Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Location	Well ID	Date	Calcite ($CaCO_3$)	
			SI	Average
Upgradient	AP-51	10/05/2016	-4.63	-4.84
	AP-51	01/24/2017	-4.79	
	AP-51	03/07/2017	-4.95	
	AP-51	04/26/2017	-4.09	
	AP-51	05/16/2017	-4.78	
	AP-51	06/16/2017	-4.64	
	AP-53	10/05/2016	-4.99	
	AP-53	01/24/2017	-5.06	
	AP-53	03/07/2017	-5.19	
	AP-53	04/26/2017	-4.56	
	AP-53	05/16/2017	-5.57	
	AP-53	06/16/2017	-5.27	
	AP-54	10/05/2016	-3.56	
	AP-54	01/24/2017	-3.81	
	AP-54	03/07/2017	-3.69	
	AP-54	04/26/2017	-3.01	
	AP-54	05/16/2017	-4.21	
	AP-54	06/16/2017	-4.17	
Downgradient	AP-58	10/05/2016	0.51	-0.74
	AP-58	01/24/2017	0.07	
	AP-58	03/07/2017	-0.79	
	AP-58	04/26/2017	-0.50	
	AP-58	05/16/2017	-0.04	
	AP-58	06/16/2017	-1.44	
	AP-59	10/05/2016	-0.63	
	AP-59	01/24/2017	-0.97	
	AP-59	03/07/2017	0.07	
	AP-59	04/26/2017	-0.56	
	AP-59	05/16/2017	-0.75	
	AP-59	06/16/2017	-1.09	
	AP-60	01/24/2017	-0.63	
	AP-60	03/07/2017	-0.29	
	AP-60	03/29/2017	0.26	
	AP-60	04/26/2017	-0.73	
	AP-60	05/16/2017	-0.08	
	AP-60	06/16/2017	-0.47	
	AP-60	06/28/2017	-1.06	

Notes:
SI - saturation index
Calculated SIs greater than -0.2 suggest saturation of the mineral and are shaded in red with red text.

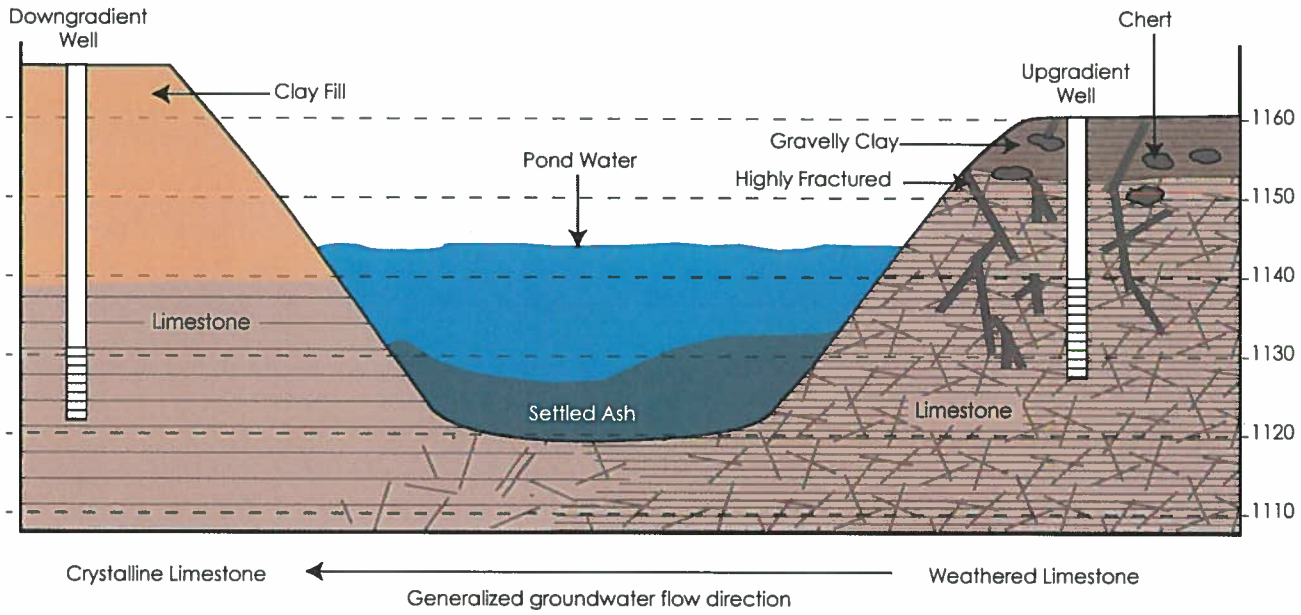
Table 3: Detection Monitoring Data Evaluation
Intrawell Prediction Limits
Flint Creek Plant - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Units	Description	AP-58		AP-59		AP-60	
			8/29/2017	12/21/2017	8/29/2017	12/21/2017	8/29/2017	12/21/2017
Boron	mg/L	Intrawell Background Value (UPL)	2.20		0.424		1.55	
	mg/L	Detection Monitoring Result	0.333	0.268	0.295	0.279	1.13	0.857
Calcium	mg/L	Intrawell Background Value (UPL)	85.1		43.6		48.7	
	mg/L	Detection Monitoring Result	75.5	73.9	35.4	46.8*	32.3	46.2
Chloride	mg/L	Intrawell Background Value (UPL)	29.3		18.5		17.2	
	mg/L	Detection Monitoring Result	12	-	12	-	13	-
Fluoride	mg/L	Intrawell Background Value (UPL)	1.09		0.774		0.95	
	mg/L	Detection Monitoring Result	0.083	-	0.6463	-	0.4518	-
pH	SU	Intrawell Background Value (UPL)	9.42		7.91		9.26	
	SU	Intrawell Background Value (LPL)	5.78		6.41		6.90	
	SU	Detection Monitoring Result	7.75	7.36	7.1	6.94	7.65	7.16
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	822		258		409	
	mg/L	Detection Monitoring Result	344	304	210	228	356	332
Sulfate	mg/L	Intrawell Background Value (UPL)	296		48.5		181	
	mg/L	Detection Monitoring Result	96	80	21	-	146	128

Notes:
*Based on 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the calculated background value.
UPL: Upper prediction limit
LPL: Lower prediction limit
-: Not Sampled
Background values are shaded gray.

FIGURES



Site Geology Illustration
AEP Flint Creek Plant - Primary Bottom Ash Pond
Gentry, Arkansas

Geosyntec consultants

Columbus, Ohio | March 2018

Figure 1

ATTACHMENT A

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

March 23, 2018

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

Dear Mr. Sass,

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

Sampling began at Flint Creek Bottom Ash Pond for the CCR program in 2016, and 8 background samples have been collected at each of the groundwater monitoring wells. The monitoring well network, as provided by Geosyntec Consultants, consists of the following: upgradient wells AP-51, AP-53, and AP-54; and downgradient wells AP-58, AP-59, and AP-60.

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis was reviewed by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting.

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

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

Data at all wells were evaluated for the following: 1) outliers; 2) trends; 3) most appropriate statistical method for Appendix III parameters based on site characteristics of groundwater data upgradient of the facility; and 4) eligibility of downgradient wells when intrawell statistical methods are recommended. Power curves are provided to demonstrate that the selected statistical methods for Appendix III parameters comply with the USEPA Unified Guidance recommendations as discussed below.

Summary of Statistical Method:

1) Intrawell prediction limits, combined with a 1-of-2 resample plan for boron, calcium, chloride, fluoride, pH, sulfate and total dissolved solids (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 nondetects, a nonparametric test is utilized. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

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

Background Screening

Outlier Evaluation

Time series plots are used to identify suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective, in proposed background data. Suspected outliers at all wells for Appendix III and Appendix IV parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits (Figure C).

Tukey's outlier test noted a few outliers as may be seen on the Outlier Summary Table and accompanying graphs. Any values flagged as outliers are plotted in a lighter font on the time series graph. For arsenic in upgradient wells, the highest value of 0.024 mg/L was flagged as an outlier. The other low level detections identified by the test as possible outliers were not flagged because they were just slightly above the reporting limit. No values were flagged as outliers for mercury in upgradient wells as all values are very low level detections. A substitution of the most recent reporting limit was applied when varying detection limits existed in data.

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

While trends may be visual, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends (Figure D). In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed several statistically significant decreasing trends, as may be seen on the Trend Test Summary Table that accompanies the trend tests. A statistically significant increasing trend was noted for calcium in well AP-58. Because interwell methods are recommended for this parameter as discussed below, no adjustments were made at this time.

Appendix III – Determination of Spatial Variation

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

The ANOVA identified no variation for fluoride. Variation was identified in groundwater upgradient of the site for all other Appendix III parameters. Data were further evaluated as described for the appropriateness of intrawell testing to accommodate the groundwater quality. A summary table of the ANOVA results is included with the reports.

Appendix III - Statistical Limits

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

Exploratory data analysis was used as a general comparison of concentrations in downgradient wells for all Appendix III parameters recommended for intrawell analyses to concentrations reported in upgradient wells. Upper tolerance limits are used in conjunction with confidence intervals to determine whether the estimated averages in

downgradient wells are higher than observed levels upgradient of the facility. The upper tolerance limits were constructed to represent the extreme upper range of possible background levels at the site.

In cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to justify an intrawell approach. Such an assessment is beyond the scope of services provided by Groundwater Stats Consulting. When there is not an obvious explanation for observed concentration differences in downgradient wells relative to reported concentrations in upgradient wells, interwell prediction limits will initially be selected for the statistical method until further evidence shows that concentrations are due to natural variation rather than a result of the facility.

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

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

Confidence intervals for the above parameters were found to be within their respective background limit for chloride, but above background limits for all other parameters tested. While typically interwell methods would be recommended for all parameters except chloride, studies conducted by Geosyntec Consultants support the use of intrawell limits for all parameters due to natural differences in lithology and the variable groundwater related to the presence of limestone.

All available data through June 2017 at each well were used to establish intrawell background limits based on a 1-of-2 resample plan that will be used for future

comparisons (Figure H). Future compliance measurements will be compared to these background limits during each subsequent semi-annual sampling event.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits will be necessary to accommodate these types of changes In the interwell case, newer data will be included in background when a minimum of 2 new samples are available. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

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

Appendix IV – Assessment Monitoring Program

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

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

Recommendations

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

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

For Groundwater Stats Consulting,

Kristina L. Rayner
Groundwater Statistician

Intrawell Prediction Limit Summary Table

Flint BAP Client: Geosyntec Data: Flint Creek BAP Printed 3/23/2018, 3:48 PM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	AP-51	0.01833	n/a	10	0.01109	0.003235	0	None	No	0.002505	Param Intra 1 of 2
Boron, total (mg/L)	AP-53	0.1678	n/a	10	0.1292	0.01726	0	None	No	0.002505	Param Intra 1 of 2
Boron, total (mg/L)	AP-54	0.2816	n/a	10	0.2589	0.01014	0	None	No	0.002505	Param Intra 1 of 2
Boron, total (mg/L)	AP-58	2.202	n/a	10	1.102	0.4915	0	None	No	0.002505	Param Intra 1 of 2
Boron, total (mg/L)	AP-59	0.4236	n/a	10	0.2866	0.06123	0	None	No	0.002505	Param Intra 1 of 2
Boron, total (mg/L)	AP-60	1.548	n/a	8	1.273	0.1122	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AP-51	6.235	n/a	10	5.209	0.4582	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AP-53	5.54	n/a	10	n/a	n/a	0	n/a	n/a	0.01476	NP Intra (normality) 1 of 2
Calcium, total (mg/L)	AP-54	13.19	n/a	10	10.45	1.223	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AP-58	85.09	n/a	10	40.01	20.14	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AP-59	43.64	n/a	10	38.15	2.455	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AP-60	48.66	n/a	8	25.88	9.269	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AP-51	8.126	n/a	10	5.9	0.9944	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AP-53	16.33	n/a	10	13.2	1.398	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AP-54	16.83	n/a	10	15	0.8165	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AP-58	29.26	n/a	10	18	5.033	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AP-59	18.51	n/a	10	14.1	1.969	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AP-60	17.22	n/a	8	14	1.309	0	None	No	0.002505	Param Intra 1 of 2
Fluoride, total (mg/L)	AP-51	1	n/a	10	n/a	n/a	90	n/a	n/a	0.01476	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	AP-53	1	n/a	10	n/a	n/a	90	n/a	n/a	0.01476	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	AP-54	1	n/a	10	n/a	n/a	90	n/a	n/a	0.01476	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	AP-58	1.094	n/a	10	0.7092	0.1722	30	Kaplan-Meier	No	0.002505	Param Intra 1 of 2
Fluoride, total (mg/L)	AP-59	0.7735	n/a	10	0.6362	0.06136	30	Kaplan-Meier	No	0.002505	Param Intra 1 of 2
Fluoride, total (mg/L)	AP-60	0.9455	n/a	8	0.4461	0.2032	50	Kaplan-Meier	No	0.002505	Param Intra 1 of 2
pH, field (SU)	AP-51	5.513	4.677	10	5.095	0.1867	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AP-53	5.589	4.177	10	4.883	0.3155	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AP-54	6.209	4.921	10	5.565	0.288	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AP-58	9.421	5.783	10	7.602	0.813	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AP-59	7.911	6.407	10	7.159	0.3359	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AP-60	9.258	6.902	8	8.08	0.4793	0	None	No	0.001253	Param Intra 1 of 2
Sulfate, total (mg/L)	AP-51	6.763	n/a	10	3.001	1.681	10	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AP-53	55.81	n/a	10	37.5	8.182	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AP-54	82.19	n/a	10	69.7	5.579	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AP-58	296.2	n/a	10	169.4	56.65	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AP-59	48.54	n/a	10	33.9	6.54	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AP-60	180.9	n/a	8	155.9	10.19	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	AP-51	104.9	n/a	10	70.5	15.39	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	AP-53	193.1	n/a	10	118.6	33.27	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	AP-54	202.1	n/a	10	165.8	16.21	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	AP-58	822.2	n/a	10	517.9	136	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	AP-59	257.7	n/a	10	222.4	15.77	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	AP-60	409.1	n/a	8	351.4	23.48	0	None	No	0.002505	Param Intra 1 of 2

APPENDIX IV

The revision history of this report is presented in the appendix.

Record of Plan Revisions		
Revision Number	Date	Revision Description
0	1/31/2019	Initial Plan
1	5/7/2019	Revision in Appendix I to update drawings and tables to current format.